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Colin Chapman's innovation brought to life in historic racing



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Fax +44 (0)20 8446 2191

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Masters

HISTORIC RACING



2017 EVENT CALENDAR

APRIL	08 – 09	Barcelona, Spain	Espiritu de Montjuic
MAY	19 – 21	Mazda Raceway Laguna Seca, USA	The Spring Classic
	27 – 28	Brands Hatch GP Circuit, UK	Masters Historic Festival
JUNE	09 – 11	Montreal, Canada	Formula 1 Grand Prix du Canada*
	16 – 18	Mosport, Toronto, Canada	VARAC Vintage Grand Prix
	18	Silverstone GP Circuit, UK	MGLive!
JUNE/JULY	30 – 02	Magny Cours, France	Grand Prix de France Historique
JULY	21 – 23	Road America, USA	The WeatherTech® International Challenge presented by HAWK
	28 – 30	Silverstone GP Circuit, UK	Silverstone Classic
	11 – 13	Nürburgring, Germany	Oldtimer Grand Prix
SEPTEMBER	01 – 03	Zandvoort, Holland	Historic Grand Prix
OCTOBER	15 – 17	Spa-Francorchamps, Belgium	Spa Six Hours
	20 – 22	Austin, Texas, USA	Formula 1 United States Grand Prix*
	21 – 22	Estoril, Portugal	Estoril Classic
	27 – 29	Mexico City, Mexico	Formula 1 Gran Premio de Mexico*



Masters Historic Racing
The Bunker, Lower End Road
Wavendon, Milton Keynes MK17 8DA

T +44 (0)1908 587545 F +44 (0)1908 587009

US Office: T +1 347 343 5898

Email team@mastershistoricracing.com

 Masters Historic Racing  @MastersHistoric

www.mastershistoricracing.com

EDITOR

William Kimberley

CONTRIBUTORS

Chris Pickering

Andy Swift

Hal Ridge

CONSULTANT EDITOR

Mark Skewis

HEAD OF DIGITAL CONTENT

Sara Kimberley

ART EDITOR

Paul Bullock

**ADMINISTRATION/
SUBSCRIPTIONS**

Adem Ataturk

SALES MANAGER

Mike Norman

COMMERCIAL DIRECTOR

Maryam Lamond

MANAGING DIRECTOR

Adrian Goodsell

PUBLISHING DIRECTOR

Soheila Kimberley



@historicrace

facebook.com/
HistoricRaceTechnology

841 High Road, Finchley
London N12 8PT
Tel: +44 (0) 208 446 2100
Fax: +44 (0) 208 446 2191

www.kimberleymediagroup.com

Coming to fruition

AT last we have reached the time of year when racing is firmly back on the menu with so many meetings around the world taking place. It means that all the work that has been going on behind the scenes is now coming to fruition and on display.

What is particularly encouraging to see is the increasing number of specialist engineering companies that are now becoming involved in the historic segment. For example, DC Electronics is a well known company in the modern motorsport world for its high-end harnesses and other products. Based in Maldon, Essex in recent years it even opened a facility in North Carolina to cater for its North American customers in NASCAR and in other series. Notwithstanding that, though, it believes it has plenty to offer the historic racing market which is also pushing technology boundaries albeit in a very different way to modern motorsport.

In a way, it's even more complicated because while a component has to look the part it was designed even 60 years ago, underneath the skin, it is a very different thing. I am thinking here of the Jenvey Dynamics Heritage throttle body that boasts all the plus points associated with Individual Throttle Bodies, yet manages to marry these with the subtle, understated looks of a period carburettor, ensuring that it won't look out of place in the engine bays of any classic and retro vehicles. The engineering that goes into that is quite sublime.

However, one has to be careful. As has been highlighted in a news story, it can go wrong. Corbeau USA, the seat and harness manufacturer, has come across a design fault in one of its 5-point camlock harness belts manufactured between April last year and May this year which it has recalled. If you are about to go racing it will be a real bugbear as it may mean that you can't do so now.

To seasoned and experienced racers, buying safety equipment from a supplier or brand you trust is a given. The danger with newcomers in the sport is that they may be tempted to buy the cheapest option on the internet, but that can be fraught with danger. Cheap is not the benchmark when you are buying a safety critical item. As we know, there are also pirate goods for sale that may tell you that it's a well known brand but which has been manufactured in China, for example, and simply fails under duress. It's not good that Corbeau USA has had to recall some of its products, but at least it saw a fault and has addressed it. If that was an unscrupulous brand, it would not have done so. **HRT**

William Kimberley
Editor



Brooklands celebrates 110 year anniversary and re-opening of the Finishing Straight



ABOVE SCH 'Sammy' Davis and Lord 'Freddie' March celebrate winning the 1930 BRDC 500 in an Austin 7

Courtesy Brooklands Museum

William Kimberley

THIS summer will see the grand re-opening at the famous Brooklands circuit of the newly restored Finishing Straight which has not seen motoring action since 1940. The event will take place on 17 June, 110 years to the day since the track was originally opened, marking the completion of the first stage of the £8.1million Heritage Lottery-funded Brooklands Aircraft Factory and Race Track Revival Project. Highlights of the re-opening will include a re-enactment of the original opening parade of 17 June 1907 with scores of cars and motorcycles which competed on that hallowed concrete.

The opening ceremony will be performed by The Earl of March, whose

grandfather, 'Freddie' March, was an apprentice to Bentley Motors and won the 1930 Brooklands 500 in an Austin 7 and the Brooklands Double Twelve in 1931 in an MG Midget. He also achieved fame as the designer of March Special bodies for sporting cars such as Rileys and ACs. After World War Two he opened the perimeter track of Westhampnett Airfield on his Goodwood Estate, which became a spiritual successor to the by-then defunct Brooklands race track until 1966. The present Earl of March followed in his grandfather's footsteps by starting the Goodwood Festival of Speed in 1991 and the Goodwood Revival in 1995.

This historic celebration takes place during the Double Twelve Motorsport Festival at Brooklands that is organised in association with the Vintage Sports-

Car Club. The two-day extravaganza features Speed Trials, a Sprint on the track at neighbouring Mercedes-Benz World, driving tests, the prestigious Double Twelve Concours and Test Hill ascents, alongside family-friendly entertainment and activities.

Some of the rarest and most exotic cars in the world will converge in what is hotly anticipated as a never-to-be-repeated line-up. They include the 1927 Delages which took the top three places in the second British Grand Prix, held at Brooklands 90 years ago this year; the 1911 Fiat S76 known affectionately as The Beast of Turin; the John Parry-Thomas Land Speed Record car 'Babs' and the Museum's own 24 litre multi-world record holder Napier-Railton Special.

Joining them in an unprecedented gathering of other rare vehicles for this most historic weekend includes a 1912 Sunbeam Coupe de L'Auto from the permanent collection at the National Motor Museum, an MG 'R' Type that first appeared at the Weybridge track in 1935 and a 4½ litre Bentley driven in the first ever Bentley Handicap at the track in 1936. A 1934 MG PA 'cream cracker', winner of race 8 in an MCC Scratch Race event on 8 September that same year, joins an MG L2 Magna factory team car from 1933 with a list of at least 12 appearances at the track through to 1935. Also appearing, with their own impressive sets of Brooklands credentials will be an Austin 7 EA Sports which competed in the 1931 'Double Twelve' and 10 other events and a 1932 Morgan Racing Super Aero hailed as 'the fastest ever Brooklands Morgan' achieving a lap speed of over 103 mph amongst its many appearances at the circuit.

Motorcycles will also be given prominence at the event with owners and organisations lining up to be part of the spectacle. A rare 1911 Humber TT from the Sammy Miller collection will be joined by a host of historic machines including a 1927 500 cc Norton once belonging to Brooklands racer Pat Driscoll, himself a competitor in the 1930 JCC 'Double Twelve' driving a blown 1½ litre Hyper Lea-Francis. Alongside them will be a 1935 250 cc New Imperial ridden in period by Les Arthur and from the Museum's own collection, a 1928 172 cc Francis Barnett. **HRT**

Courtesy Masters Historic Racing



ABOVE Masters will be organising a demonstration run of 10 historic F1 cars at Suzuka in Japan in mid November and is inviting entries for consideration

Masters goes to Japan

William Kimberley

MASTERS Historic Racing is organising a demonstration of 10 historic Formula 1 cars on behalf of Suzuka Circuit as part of its Richard Mille Sound of Engine event, taking place over the weekend of 18/19 November. The 10 cars, all running in period colour schemes, will be offered plenty of track time during the weekend in front of a wildly enthusiastic crowd.

The main element of the weekend will form a pseudo-qualifying session as the cars will run one at a time in a Time Attack format on the Saturday

afternoon before two more 20 minute practice sessions. Sunday will see a 40 minute demonstration beginning from a rolling start, which will complete a busy weekend's activity for the teams.

Masters will be selecting 10 cars for the event which should illustrate different cars from the 1966-1985 eligibility era. Interest is sought from Masters drivers in the US and Europe who are interested in being part of this event, with priority being given to drivers who regularly support Masters. There will be a full transport and travel package available to those selected.

"We are very proud to have been asked to put together this grid of cars and it further highlights the reputation Masters has with organisers worldwide coming to us," said Ron Maydon, Masters Historic Racing founder and president. "On the back of providing grids for Formula 1 Grand Prix support races, we now have the chance to show the knowledgeable and enthusiastic Japanese fans some of the cars that have played such an important part in the history of Formula 1. It is a major compliment to us and we will repay that by taking the best selection of cars, and histories, that we can." **HRT**



ABOVE In a difficult season, Will Gollop's best result of the '93 campaign in his Peugeot 309 Supercar was a single podium at Mondello Park

Restoration of an historic stopgap

Hal Ridge

The Peugeot 309 Supercar that 1992 FIA European Rallycross Champion Will Gollop used to defend his crown is being restored. The car was only used by him for the 1993 season as a stopgap before it was superseded by a newly homologated 306, which became one of the most successful cars in rallycross history.

The 309 has not been used in rallycross since it was replaced by Gollop, which achieved a sole podium at Mondello Park in Ireland. Since, components of the car have been split up and the bodyshell significantly adapted. Its new owner, Adam Keeler, who also owns the ex-Gollop MG Metro 6R4 featured in HRT11, has acquired the car and is setting about restoring it to near original specification, with the addition of some modern refinements.

"It took months of negotiating to buy the car, but I'm really happy to have got it. This is an absolute piece of rallycross history, it's the original bodyshell with all the original panels," said Keeler. The shell had been altered to fit a Honda S2000 running gear and

suspension, but Keeler has sourced an additional 309 bodyshell to use as a donor, and some original Peugeot 205 T16 suspension.

"Will (Gollop) used the original inner wings to a certain extent, but when I got the car it had all been spaceframed, so we've bought another shell to get the inner wings out of it and the local bodyshop is going to put them back on, using a jig. A lot of people have said to me that I'm mad to do this because of the amount of work involved, but it's because I'm passionate about doing it and I want to do it as best I can."

Keeler has been aided in the restoration of the car by acquiring

original photographs, and has also sourced the original Quaife transmission. "I've got hold of some original suspension and the rear cradle off a Peugeot 205 T16 that I've refurbished – it looks like brand new. I'm trying to do this as close as I can to how it was, but I want it to work well too. We're going to use as much modern technology as we can while keeping it as period as possible. I think we'll go down the M16 steel block engine route rather than the T16. We're aiming for between 400 and 500 horsepower, so we will use a more modern management system, to make it more reliable. Things have moved on since 1993." **HRT**



ABOVE Owner Adam Keeler, who also owns the ex-Gollop MG Metro 6R4, is restoring the Peugeot to near original specification

Corbeau harness recall

CORBEAU USA has recently discovered a potential safety issue with its 5-point camlock harness belts. It has announced that it has reason to believe that on a small percentage of belts, the right lap insert tab had the hole drilled off centre by a 1/16th of an inch, causing the lock pin inside the camlock dial not to lock

properly. This could potentially cause the right lap belt to come unlocked from the camlock dial under minimal stress. The problem was found during testing with the SFI Foundation.

Corbeau USA is therefore voluntarily recalling these 5-point camlock harness belts with part numbers 53001B,

53007B, and 53009B that have purchased between 1 April, 2016 and 24 April, 2017. These would have SFI stamp dates from May 2016 to June 2017 are being recalled. This does not include any belts purchased after 24 April, 2017.

The company is certain it only applies to a very small percentage of these belts, but at the same time it also wants to be certain that all belts in the field are free from this defect. **HRT**



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ABOVE David Nordgard is restoring Martin Schanche's '96 Ford Escort Supercar

Martin Schanche Ford Escort being brought back to life

Hal Ridge

THE last Ford Escort rallycross car built by six-time European Rallycross Champion Martin Schanche is being restored by rallycross Touring Car racer David Nordgard. The Escort Supercar was introduced in 1996 and although it didn't win a European crown, scored multiple event victories.

Like the Gollop 309, the car has been acquired as a bodyshell. "We, me and my

sponsor, Steinsholt Entreprenør, knew of the car for a couple of years. The complete bodyshell was in very good condition, in Denmark," said Nordgard. "It hadn't raced since Dutchman Jos Kuypers stopped using it, after he bought it from Martin. We got a few parts with it, but not many."

The Norwegian has sourced two 2.0-litre engines for the car and an original Xtrac gearbox. "The gearbox and rear differential are from a Ford

Focus that was also built by MSR (Martin Schanche Racing). Some vital parts were missing, like the big recognisable rear wing, but we got that made from the original moulds."

The project was given a significant leg up when Kuypers offered up original parts that had been kept in storage. "All of a sudden Jos gave us a call and said that he had all the remaining parts. The biggest challenge is to try and build it as close as possible to how it was originally. We don't want to improve it, if we wanted to build a better car, then it would be a completely new car. However, the engine management system is being upgraded and the car will be a little bit more driveable. One engine has been built with the (FIA regulation) 45 mm restrictor, and one without it. We are not sure which one to use yet."

The restoration is set to be completed later this year, with the interior of the car and engine plumbing next on the to-do list. MSR will rebuild and check the gearbox before it is used. **HRT**

Classic car maintenance courses

William Kimberley

BANBURY and Bicester College is set to offer classic car maintenance courses to owners and enthusiasts from its workshops in the former RAF engine test house at Bicester Heritage.

The historic motoring community in the very heart of Oxfordshire is home to over 30 specialist businesses covering everything from vehicle storage to specialist dealers, upholsterers, vintage car radiator manufacturers, fabricators, classic car service centre, grand prix car preparation and more.

Bicester Heritage and Banbury and Bicester College's classic car future-proofing courses will give the opportunity for those entering the world of historic vehicles or more experienced owners and drivers expert advice and tips for making the most of their machine.

Owning and running a classic car requires a basic mechanical knowledge,

and Bicester Heritage and Banbury and Bicester College are looking to ease buyers' initial fear of not being able to keep their pride and joy running in tip-top condition all year round. Two and five day courses are available, with the former offering the basics to beginners looking to understand the fundamentals of running a classic car.

Key components will be covered, including oil and filter servicing, replacing and setting spark plugs, replacing contact breakers (points),



ABOVE Banbury and Bicester College is to offer classic car owners the chance to learn the best ways to maintain their pride and joy for the future

checking brakes, and checking transmission oil and coolant.

The five day 'intermediate' course builds on everything from the two day programme and takes the students' knowledge to the next level. They will gain an understanding of how to assess large structural issues and be taught how to carry out a major vehicle assessment.

On top of this, they will undertake several tasks that will prepare them for classic car issues in the future, including removing, assessing and refitting a petrol pump, checking and adjusting valve clearances and clutch operation.

Bicester Heritage – heralded the home of the classic car – is delighted to be the location for these ground-breaking courses which sit alongside the hugely popular Classic Car Restoration Apprenticeship Scheme run by Banbury and Bicester College and the vast amount of knowledge residing within the 34 industry specialist businesses on the rest of the campus. **HRT**



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SINCE 1887



ABOVE Goodwood to celebrate Ferrari's 70th anniversary

Ferrari celebrated at Goodwood

William Kimberley

A highlight of this summer's Goodwood Festival of Speed Presented by Mastercard is a celebration of Ferrari's 70th anniversary since being

established by Enzo Ferrari in 1947.

From Ferrari's long, continuous and hugely successful history in motorsport, a number of the most celebrated of Maranello's racers will be in action up Goodwood's famous

1.16-mile hill. It will include around 25 iconic single-seater Ferraris, covering each of the key post-war Grand Prix eras, powered by four, six, eight and 12-cylinder engines, with normal aspiration, superchargers and turbos.

Sports cars in action will chart Ferrari's landmark successes in all the great endurance races, from the late 1940s right through to the present day. A mouth-watering line-up of current production cars will grace the Michelin Supercar Paddock, as well as running on the hill.

One of the classes in the popular Cartier 'Style et Luxe' concours d'elegance will be dedicated to Ferrari's legendary 250 models – named after the 3-litre V12 which propelled the Scuderia to countless victories on-track, as well as powering some of its most iconic road cars. **HRT**

Ferrari Museum celebrates creative and engineering development over the years

William Kimberley

ONE of the two exhibitions that have recently opened at the Ferrari Museum in Maranello, Italy is called "Under the Skin" which has been created in partnership with the London Design Museum.

The theme is exploring the creative and engineering development of Ferrari down the years through a series of exceptional cars beginning with the 125 S, the marque's first car. Some technical drawings from the historical archive of the Prancing Horse and the engines on display reveal the design process of cars of all eras, casting an unprecedented eye over the engineering work hidden behind their exterior beauty. Design models and the Wind Gallery also show the evolution of styles and technologies down the years, recalling how Enzo Ferrari was at the forefront of experimenting with new scientific techniques. The exhibition will move to the London Design Museum from November.

The other exhibition is called "Infinite Red" which celebrates the 70 year history of the Prancing Horse with some of Maranello's most exclusive creations for track and road. The Formula 1

cars on display have a long series of victories to their name from the 500 F2, with which Alberto Ascari won for Ferrari the first world drivers' title in 1952, to the F2004, the Ferrari that won the most grands prix in history (15, like the F2002) and concluded Michael Schumacher's epic run of world titles, and finally the F2008, which won the World Constructors' Championship.

Among the GT cars, visitors can admire various models from the 250 family, such as the 250 GT Berlinetta "Tdf", which dominated races in the second half of the 1950s, its evolution the 250 GT Berlinetta SWB and the 250 GTO, a collectors' favourite. Then

down to the present, the exhibition features a number of limited special series such as the F50, the Enzo and the latest, the LaFerrari, also present in the non-homologated FXX K version for exclusive use on track.

To accommodate visitor growth, the museum has been expanded by more than 600 square metres to a total of 4,100 square metres, creating a new wing that connects to the existing structure by means of a great continuous glass facade, and a new museum itinerary. In addition, a multifunctional space of about 300 square metres has been built, which can host up to 250 people for events, conventions and educational activities. The refreshments area and the Ferrari Store are also completely new. **HRT**



ABOVE The Ferrari Museum is hosting two new exhibitions at its recently expanded site in Maranello

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Pushing boundaries

Seemingly traditional to the core, vintage Bentley specialist William Medcalf is anything but as **William Kimberley** discovers

To many the vintage Bentley is the epitome of the pre-war car, its distinctive radiator, long bonnet with leather straps and open four-seater body, along with its racing heritage, embodying everything great about that era's motoring. While more modern classics come into and fall out of fashion, the vintage Bentley is a constant, a constant

that is probably unreachable for most.

Over the years there have been a good number of companies that have specialised in the marque, catering for a discerning clientele who knows what it wants. One such company is run by William Medcalf.

Actually, it is not surprising when one delves into the person after whom the

company is named. There was probably little escape from the Bentley world for him as his father Bill was also a Bentley nut, taking his family, including young William, on various expeditions overseas in his own vintage Bentley. Bill also had a very successful MOT garage in Edmonton, North London. William started his Bentley business tucked away behind some secure gates which grew into an Aladdin's cave of pre- and post-war Bentleys, not for sale but being worked on by craftsmen, including William, who were giving their charges special loving care. I should know: I used to take my own 1938 4¼ Derby Bentley there.

"I started working on vintage Bentleys professionally 22 years ago," says William Medcalf. "I traded through one of my father's dormant companies, Enfield Auto Electrical Limited. Finally I established William Medcalf Limited, which reflected who I was but again not what I did. Since moving to Liss I have established a sales



ABOVE The company initially carved out a niche with the restoration of vintage Bentleys, specialising in rally preparation

“Standard practice in modern cars but revolutionary in the pre-war car world”

company, The Medcalf Collection and our manufacturing business, Benchmark Precision Engineering. However, we are just about to rebrand and bring all three companies under one umbrella hopefully to be called – but yet to be confirmed – simply Vintage Bentley.”

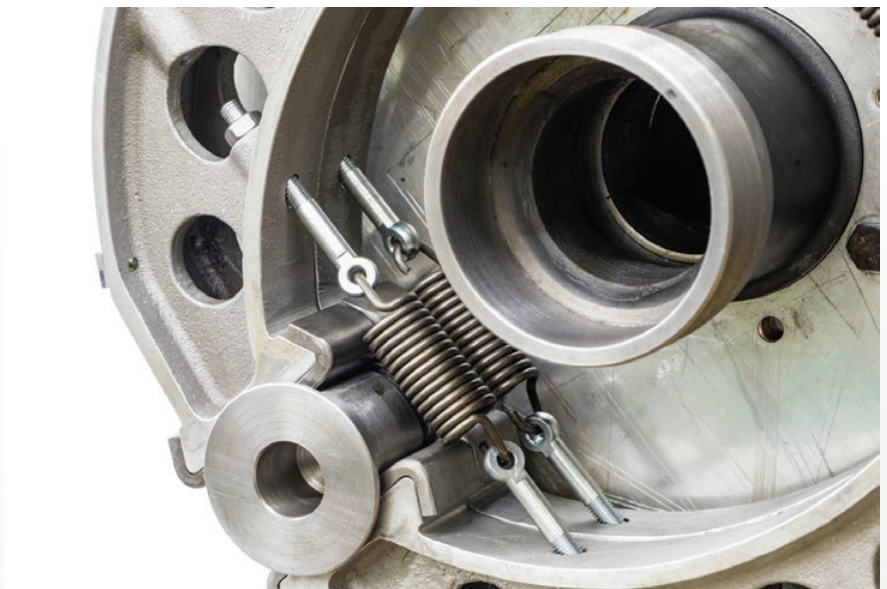
Space was always at a premium. The thought of moving was becoming more imperative but the Tottenham riots, in August 2010, were the trigger. For those who don't know the geography of North London, Tottenham is a close neighbour of Edmonton.

INTERNATIONAL CLIENTELE

The chosen site was Liss. With a stretch of imagination, Liss lies on the Goodwood to Brooklands road. Perhaps more importantly, it is midway between Heathrow and Gatwick airports, ideal for William Medcalf's international clientele.

What started out as just one company, though, which was the restoration of vintage Bentleys, specialising in rally preparation, has grown into two more complementary businesses. The William Medcalf Collection, which looks after and maintains customers' cars while also providing a bespoke service to find cars for customers, and Benchmark Precision Engineering.

This is the latest addition to the group,



ABOVE & BELOW Tending pre-war cars doesn't have to mean pre-war technology or practices



only formed in late 2014, but it is already proving to be the driving force in the business. “The growth of Benchmark is an important milestone for the business overall, because along with William Medcalf Ltd and The Medcalf Collection, the closed loop of sales, restoration, preservation, development and parts becomes completely self-

supporting,” says Medcalf.

It would be too easy to assume that servicing pre-war cars means having pre-war work practices, but this is very far from the case with Benchmark. Under William Medcalf's careful guidance, it is at the cutting edge of best practices in terms of manufacturing and production techniques where viable. 3D printing, ▶



HRT

for example, has been embraced as it offers a quick and economic solution without denting quality, which must reign supreme. As Medcalf explains, “The 3D printing world has really opened our eyes and it’s amazing what can be achieved in the level of consistency. We 3D print all the chassis brackets, which is not a safety-critical part, for the rev counters and speedometers as the originals were made of a Mazak material that corrodes. The cost price is around £2 whereas if we hand-crafted it out of the original material it would be uneconomical.”

Scanning, though, is a different matter: “I’m always cautious in investing in modern technologies because as we all know, software moves on in six months and after a huge upfront outlay, within two years it can be out of date and not worth a penny. It means, for example, that we currently outsource the scanning because those guys have got the knowledge and they probably have three



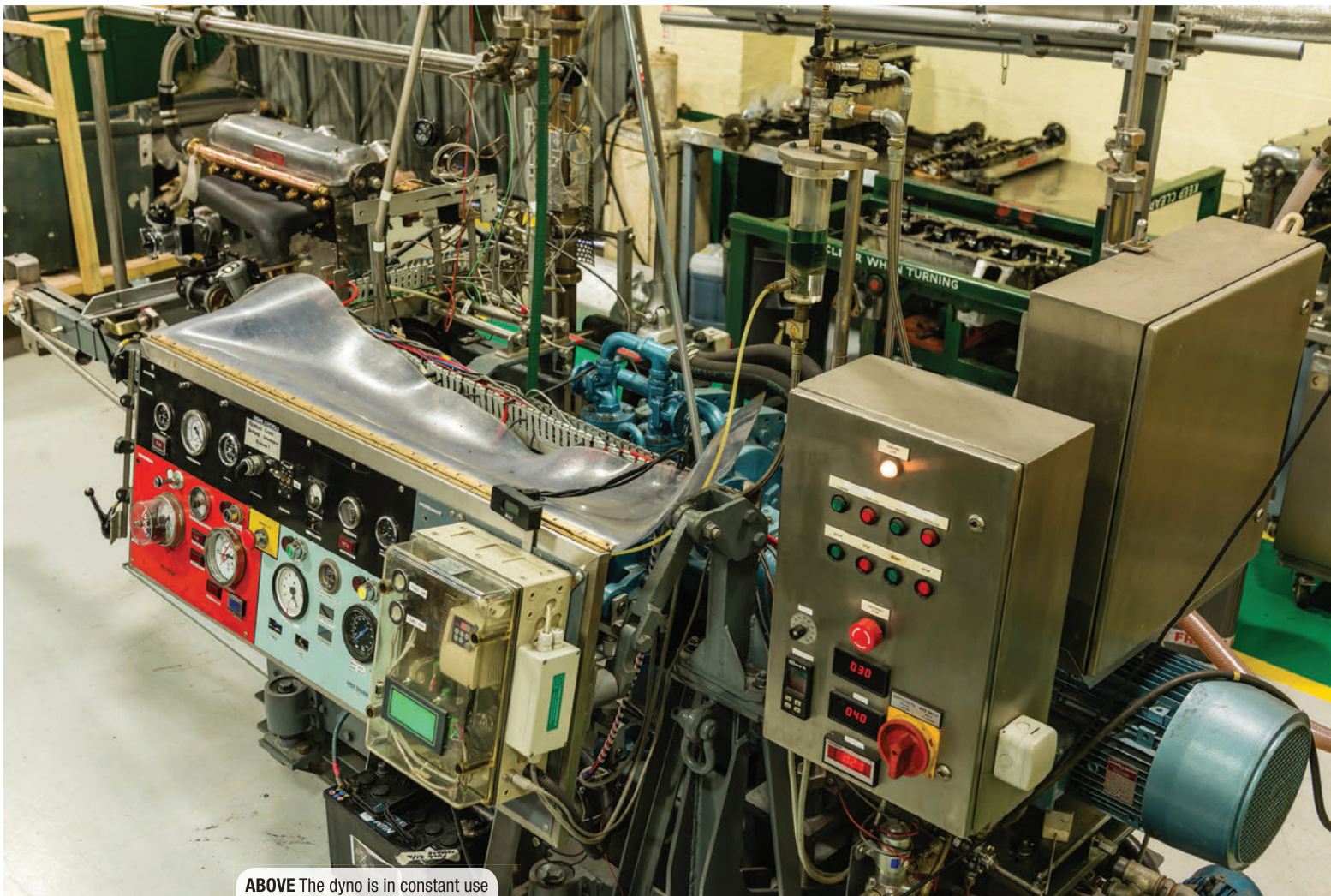
ABOVE The team of skilled craftsmen take pride in their work

different types of scanner anyway.

“These boys will make anything,” he says proudly when talking about the Benchmark business. “The range of skills, from hand-crafted trimming to computer stress analysis, and range of machinery here spans 90 years like the cars themselves. We have all the CNC milling machines necessary to do the job. However, all the assemblies are still fitted

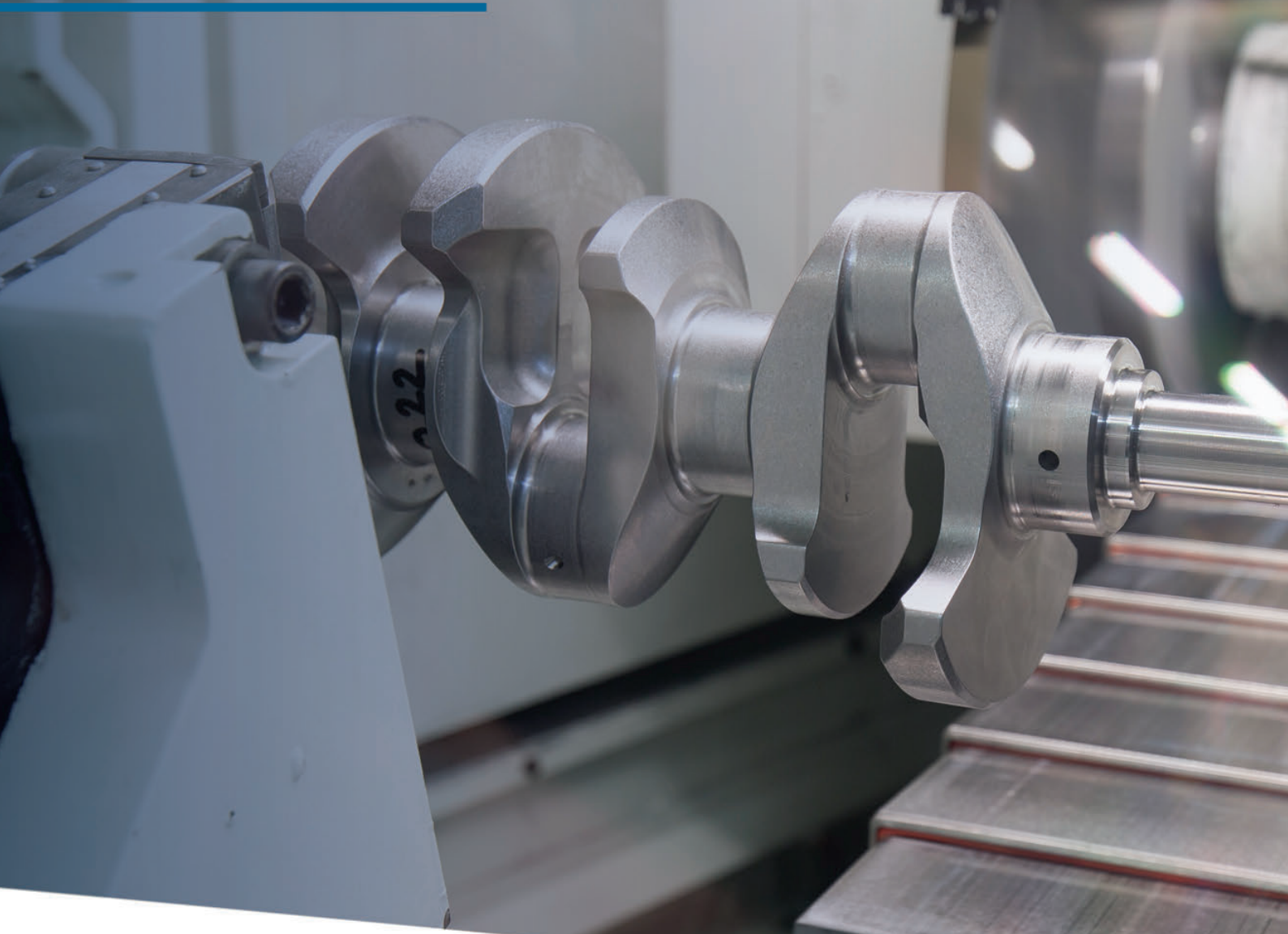
by hand and then checked, which gives us the quality assurance we need.

“We have a CNC milling centre and are codifying a lot of what we are doing. If it’s a repeat job, more than one or two, we’ll write a programme for it. We’re moving over to being able to keep up with demand and future-proof the business by CAD modelling everything and CNC as much as we can. By keeping as much ▶



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ABOVE William Medcalf Vintage Bentley has tended the Bentley Motors 3-litre team car – the first works Le Mans entry in 1925 – for the last 14 years. It was given a complete and historically sympathetic restoration in 2001, and fully rebuilt again recently

in-house as possible it means we have greater control, that word being the key one around here.”

Another example of embracing modern technology is the vintage Bentley water pump that has been sand cast for the last 70 years. “We’ve got an investment programme going on in making lost wax proper moulds that are aesthetically pleasing and have all the detail of the original components that have been watered down and lost over the last 70 years. Functionality is a given, it’s the look and the feel we are trying to enhance,” says Medcalf.

“We are also the only people in the world with the forging equipment to stamp stub axles and front axle beams. The tooling was huge, the only people ever to have it being Mr Bentley – but it was scrapped when Rolls-Royce took over – and a company we bought two years ago. We also invested in all the tooling for gaskets because for years they’d been made on the proverbial kitchen table. Actually I always thought they were made of cork, but on investigation that wasn’t the case, it was a 1950s/60s trait that’s come all the way through. They were originally paper.”

BEST GENERATION

While Benchmark doesn’t make the crankshaft, it supplies a design to renowned company Arrow Precision to manufacture the part. However, Medcalf believes that there is room for improvement on the original design that goes back over 30 years when it was modified into a fully counter balanced or semi-counter balanced modern billet crank, “What we now have is the best generation of crank on the market but I’m not happy with it to the extent that it will be superseded by what’s coming next.”

On site is an engine dyno, built by a vintage Bentley owner for his own engine, which Medcalf managed to acquire. It is in constant use, an engine typically spending eight to 10 hours on it at different loads and speeds. “You plug a laptop in, get a graph and see what it does,” says Medcalf. “We can ▶

Supersports favourite

WHILE the Blower Bentley remains the schoolboy’s impression of what a vintage Bentley should look like, for those that know, it is the 100 mph 3-litre Supersports model built between 1925-27 that is the one to have. Only 18 examples were built, of which 17 were on the short, 9-foot wheelbase, the other on the Standard Speed model 9-foot, 9½-inch wheelbase. It was the only model to be adorned with a green label.

It is this model that is Medcalf’s personal favourite and he is lucky enough to own chassis number 1. “Out of the 18 cars built, only nine we think were built with the tapered radiator with a tapered bulkhead,” he says. “With a chassis that weighs 1140 kg, 15:53 rear axle ratio and the A-type gearbox as standard, it was a very purposeful car.

“They were seriously successful and probably the first supercar of its day and arguably the first production car to exceed 100 mph. What I have learnt after 10 years of rallying one is that it has the best power-to-weight ratio and is the best handling car by far out of every Bentley model.”

Such is the demand for this rare model that Medcalf has done something about it. “As there are only 18 cars, the prices have gone through the roof,” he says, “so we build a Supersports Continuation model. We left number 19 out in case one does exist and started with SSC20 and we are now up to 24. We make them to order and the customer can choose the colour and trim and from the back of the seats rearward they can choose the design of the body, but everything else is standardised.

“We start with an original 3-litre Bentley that’s usually the most unloved, uncherished, completely neglected, derelict car that’s been butchered, which is brilliant for us as we are going to re-engineer most of it. The chassis frame sizes are slightly different so we shorten it, alter the crossmembers and tweak it up and make it a full 9-foot specification and build it up from there.

“For safety reasons we add hydraulic brakes and it comes with a complete re-fit. We also bullet-proof the diff, gearbox and engine so it’s a car that can be rallied anywhere in the world. They come in at just under 1500 kg, which for a pre-war car isn’t bad, and produce 200 bhp.” **HRT**



ABOVE For many enthusiasts the Supersports is the car to have



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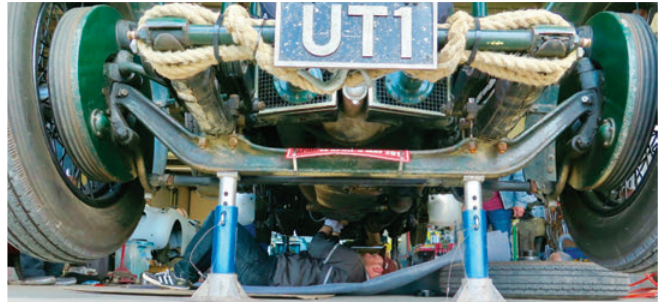
actually deal with data which sharpens everyone up because when we've got the data sheet for a client, who tells us that his car is underperforming, we have something to measure it by. It is standard practice in modern cars but revolutionary in the pre-war car world."

The trim shop is manned by Mark Hopkins, who has been trimming Bentleys for 40 years, and Scott Weymouth, a cabinet maker by trade. "We don't build bodies yet but again that control of having woodworking skills in-house is absolutely crucial because deadlines don't move," says Medcalf.

What is an eye-opener is the stock. In a world where lean means everything, the less on your shelf, the better, Medcalf takes the opposite view: "We own 1100 different lines and manufacture just about everything from brake shoes and front brake assemblies to a complete, beautifully produced, shock absorber; even a square section copper washer that we had to make the tooling for to make them.

"Our latest product is a copper hammer that can either be bought as new or one that's weathered for a month in the works. Our financial director is slowly getting the idea that money in the bank isn't as good as parts on the shelf. Actually it is nuts having this amount of stock on the shelf but it does buy us flexibility for both our clients and ourselves."

Not one to rest on his laurels, Medcalf has entered a new chapter in the business' life. The Knowledge Transfer Partnerships is a UK-wide programme that has been helping businesses for the past 40 years to improve their competitiveness and productivity through the better use of knowledge, technology and skills that reside within the UK Knowledge Base. Its purpose ►



ABOVE & BELOW William Medcalf to the rescue: he flew 14,000 miles to help out a stricken Peking to Paris rally client, whose failed halfshaft had damaged a diff. The vintage Bentley part he delivered was worth just £87



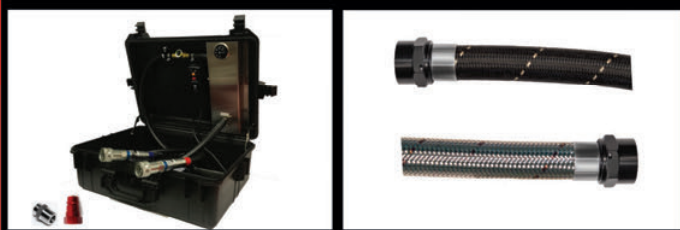
ABOVE The preparation specialists are passionate not just about preserving vintage Bentleys, but ensuring they can survive running in harsh environments



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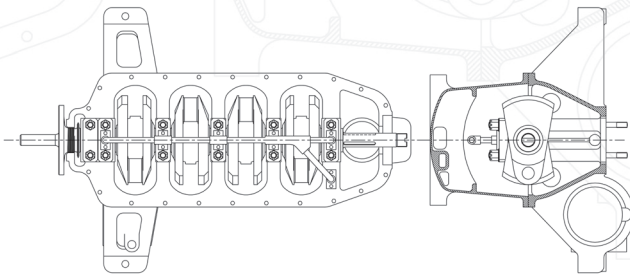
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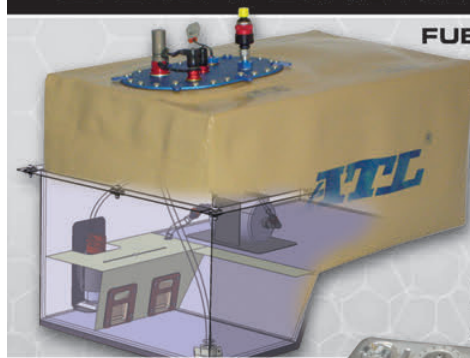
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EXP4 experimental car

ONE of the cars in the trim shop was EXP4, one of the five experimental cars.

“It was retained by Frank Burgess, the designer at Bentley Motors, who kept it until his death in 1929,” says Medcalf. “He took it from a 3-litre that was the prototype car for many things, including the front braking system, and built it into a 4½-litre. It had a prototype 4½ bulkhead, radiator and engine, so it evolved from being one of the first 3 litres to being the first 4½, the first with front wheel brakes and so was the first short chassis 4½ because it’s on a 9’ 9½” wheelbase. He then re-bodied it several times but then as a saloon so it’s the only short chassis 4½ saloon ever to be built. It doesn’t appear in the records but there are photographs of it.

“The company retained the car after Burgess’ death and continued to use it and when the company was bought in 1932, it was sold into private hands, bought by Margaret Allan who raced it at Brooklands, so it has Brooklands history as well. The body that’s on it now is the one that it raced at Brooklands with and we are going to restore it back to as it raced. It’s been in a collection for 50 years that was bought specifically for this car.” **HRT**

is to meet a core strategic need and to identify innovative solutions to help that business grow. The William Medcalf Group has entered such an arrangement with the University of Surrey that has seen the arrival of Dongni Pan, KTP Associate at the university.

Six years studying at the Beijing Foreign Language School at Xicheng, she got her mechanical engineering degree at the Troyes Universite de Technologie in France before coming to Cranfield University for her Master of Science degree and automotive engineering.

“When at Cranfield I learnt a lot about diesels and electric cars but I never saw anything like the parts I have seen here at William Medcalf,” she says. “It’s very interesting to discover how designers and engineers from the past went about things without the benefit of any type of modern technology and it’s amazing to find out how they made things.”

Describing her secondment to William Medcalf, she says: “This project is all about optimisation of the vintage Bentley, the supply chain and the production process, which is divided into five stages with three more automotive technical stages. The first stage is engine optimisation.”

One of her principal tools is Ricardo WAVE, a simulation software package for 1D engine and gas dynamics



ABOVE William Medcalf’s whole life has revolved around vintage Bentleys. He is seen here in the foreground



ABOVE There are always over 30 vintage Bentleys at the works



ABOVE William Medcalf Vintage Bentley prepared 52 cars for competition throughout 2016



ABOVE & BELOW The manufacturing arm, Benchmark Precision Engineering, has quickly proven to be the driving force of the business

analysis. It enables performance and acoustic simulations to be carried out based on virtually any intake, combustion and exhaust system configuration, and includes a drivetrain model to allow complete vehicle simulation.

“Once the preliminary model has been built we are going to collaborate with the University of Surrey to do a real engine

dyno test,” she says. “After that we will be able to implement some optimisation inside the simulation software and see where we can make any performance improvements on the engine.”

The second stage focuses on engine component redesign, followed by the third stage on vehicle dynamics. “Once you have the engine up and running and now

more powerful, it has a knock-on effect on the drivetrain and chassis,” she notes. “So I will be looking at the suspension and chassis tuning, mostly using MathWorks MATLAB and IPG Carmaker simulation software to build a model of the vintage Bentley’s chassis, brakes and suspension.

“There’s also the supply chain process. We have received help from a supply chain expert from the University of Surrey’s business school who will identify areas that need improvement and specifically best practice. Then the fifth phase focuses on marketing.”

“What’s really interesting is that soon the tail will wag the dog,” says Medcalf. “Dongni will be analysing what skillsets we actually have, our capabilities and capacity as well as the machinery itself. Only through the supply chain analysis will it become apparent what we should have and how we should be doing it and that will lead the business forward.

“We will probably end up with her being quite instrumental in reorganising the machine shop and investment going forward, so that we have the right equipment and the right people in place to bring a lot of this in-house if that’s economically viable. My job will be to facilitate that and allow it to grow.” **HRT**

Breaking 5,000 rpm

THE Knowledge Transfer Partnerships (KTP) programme represents a step change in the business, with the professionalism, processes and systems that are going to come in, says Medcalf.

“There are lovely indicators in history,” he notes, “one being Syd Lawrence, a former Bentley engineer before setting up his own business converting and racing Bentleys. His nickname was 5 thou Syd. When he used to race in the 1950s and ‘60s his engine would rev to 5,000 rpm and at that time he was still using original cranks and rods so 5 thou Syd often blew the block off his engine. So we know there are indications that these engines would rev to 5,000 rpm, because he’s already proved it with standard kit.

“Today you can rev to 3,750 rpm with the power dropping off from 3,500 rpm, so the question I’m asking the University of Surrey is why won’t it safely and reliably rev to 5,000 rpm and beyond? Equally, why is the power output at around 180 hp for a 4½ and not 200 or more? It’s great to have these questions to ask and have such a network to address them.

“If we end up with a reliable 4½-litre engine that will rev to 5,000 rpm, for example, and produce another 30 per cent brake horsepower, as a company we will have the best engine that there is and finish WO’s work for him. We will work on other engines but the 4½-litre is the most common one we deal with.” **HRT**

BELOW Trofeo Nastro Rosso cup success underlined the car's credentials



Bizzarrini - The Dark Horse

An underachiever in its day, the Bizzarrini has finally come of age through an active historic racing scene. **Glen Smale** reports

THE Bizzarrini burst onto the scene in the 1960s at a time when the motor industry was peppered with exotic, interesting and exciting new names.

It was a period when design houses dipped their toes into the deep and enticing waters of motorsport with creations that were not only fast and powerful, but were also beautiful to look at. Ferrari boasted such iconic racers as the 250 GT SWB and the 250 GTO, Jaguar offered the Lightweight E-Type, Shelby shook the world with the Cobra Daytona, and there were many others beside.

The creator of our feature car, a 5300 GT Strada, was Giotto Bizzarrini. Engineer and test driver, Bizzarrini could have written the words to Frank Sinatra's *My Way*. Never one to be beaten by a problem, he blazed his own trail in finding solutions to engineering challenges.

After three years at Alfa Romeo, Bizzarrini attracted the attentions of none other than Enzo Ferrari himself, and in 1957 he found himself working within the hallowed gates of Ferrari.

Here he would climb his way up the ladder to head up experimental sports and GT car development, not something that would have happened at Ferrari without showing extraordinary skill and promise.

Bizzarrini spent four years working in this department, and under his watchful eye, some of Ferrari's most notable sports racers took shape. These included the 250 Testa Rossa (TR) in 1957, the 250 GT SWB, and the iconic 250 GTO of 1962. Bizzarrini only had a hand in starting the 250 GTO, but what an important part that was, as history would show us.

Unfortunately, due to ructions within the walls of the Ferrari headquarters, four key engineers and management were ousted in the infamous 'Palace Revolt' of November 1961. Nothing binds like-minded souls together like a good revolt, so the now unemployed, yet highly talented, ex-Ferrari personnel united to form Automobili Truismo e Sport (ATS) with the generous financial aid of Count Giovanni Volpi.

The ATS venture was short-lived, and soon Bizzarrini found himself working

for Renzo Rivolta, but he was always looking to develop projects of his own. Disagreements and problematic relationships followed him and despite continuing to develop models for Rivolta, he also created Societa Autostar in 1962 to handle his other freelance work. This small company morphed into Societa Prototipi Bizzarrini in 1964, eventually becoming Bizzarrini SpA in 1966.

AMERICAN MUSCLE

It was, though, while working for Rivolta that the idea of developing a Corvette-engined model was conceived. Bizzarrini saw the benefits of dropping some American muscle into a beautifully crafted Italian-designed body. The problem was that his employer wanted to apply the concept to roadgoing production cars, while Bizzarrini was instead motivated by the idea of creating a more motorsport-orientated product. Further disagreements followed, but eventually Bizzarrini got his way and he was given a rolling chassis to work with.

Already with the successful Iso Grifo to his name, Bizzarrini turned his attention to the new Grifo model, the Bertone-designed A3/C, where 'C' stood for 'Corsa' or Competition. Rivolta in the meantime was developing the A3/L. The 'L' denoted 'Lusso' or Luxury, but with Bizzarrini off developing his competition version in his own workshop, tensions once again began to build.

When the development of the A3/C was complete, Piero Drogo's Sports Cars of Modena was commissioned by Bizzarrini to produce it, a total of 22 cars being the result of this collaboration.

Under the bonnet lurked a Chevrolet Corvette small-block 5.3-litre (327 cubic inch) V8 engine producing around 365 bhp in street form, and up to 400 bhp in the competition version. A further revision of the A3/C by Bertone led to the Bizzarrini 5300 Strada (Street) and the 5300 Corsa. Around 150 of both the Strada and Corsa models were produced before Bizzarrini went bankrupt in 1969.

Our feature car, chassis IA30245, was built in 1965 as a Bizzarrini 5300 GT Strada and delivered to Elio Mazzetti of Bologna. Mazzetti paid 3.8-million Lira

(approx £2,200.00) for the car, which started life in the same red colour that it is today and was used on the road for around a decade. It passed through another pair of hands in 1976, also in Bologna, but was quickly sold on to its first American owner, Carlo Frosini of California. Within a year Frosini sold it to Edgar Downs. The car stayed in America with Downs, and during his ownership he had Silverstone Restorations of Wisconsin refurbish the interior, fitting air-conditioning, electric windows and a Blaupunkt stereo system. Chassis 0245 had three more American owners and it appeared in a number of top motoring journals of the day, before being sold back to Europe in 1995.

RACING HEART

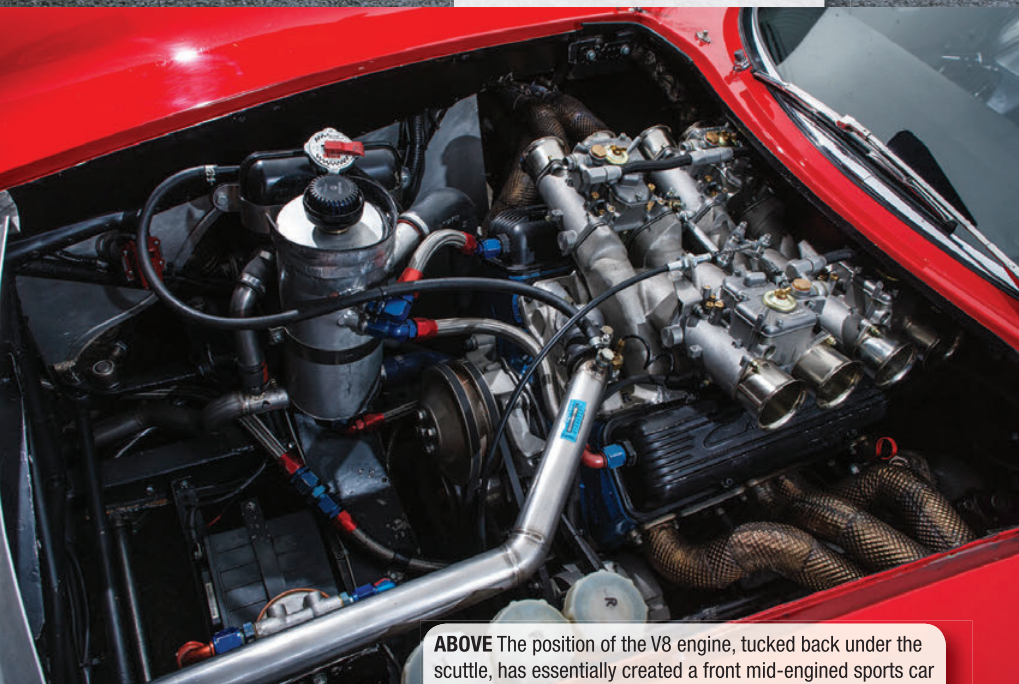
The Bizzarrini's new owner, Paul Koppenwallner of Salzburg in Austria, had other ideas for his acquisition, and he duly prepared the car for racing. Koppenwallner was a regular entrant in historic events and campaigned it around Europe. It was while competing at Spa with his Alfa Romeo GTA in May 2001, that Michael Erlich of Berne in Switzerland found himself alongside the Bizzarrini in the paddock. Erlich recalls, "I was quite impressed by the shape and the wonderful lines, and of course the powerful, strong-sounding Chevy engine. I told Paul Koppenwallner that if by any chance he would like to sell his car, he should get in touch with me. That is what he did in 2005, and I was able to purchase the car from him."

It might have taken four years, but Erlich got his car, and it was with eager anticipation that he arranged a test session with it at a local Swiss airfield. After 10 years of racing under its previous owner, the car was, as Erlich puts it, "a little bit worn out". Within just 15 minutes the engine blew, leaving him with a rebuild which must have been rather deflating, to say the least, after such a long wait.

"I had to cope with the efforts of many workshops in Switzerland, and it took me a long time until I found a mechanic who had the right *feeling* for the car," he admits. "But finally, I found the right ▶



ABOVE Racing at Le Mans highlighted the difference between the braking capabilities of the Strada and Corsa models



ABOVE The position of the V8 engine, tucked back under the scuttle, has essentially created a front mid-engine sports car



ABOVE & BELOW Fifty years on, the mystique of the Bizzarrini is now married to impressive performance and reliability



Technical specifications

1965 Bizzarrini 5300 GT Strada

ENGINE	Make	Chevrolet
	Type	V8
	Capacity	327 cubic inch (5.3-litre)
	Bore	4-inch (101.6 mm)
	Stroke	3.25-inch (82.55 mm)
	Spark plugs	8
LUBRICATION	Type	Wet sump
IGNITION	Type	Magnetic pulse type, Coil
	Ignition	Transistor controlled breakerless ignition system
FUEL FEED	Carburettor	Weber 48 DCOE (4x)
	Fuel system type	Electric
	Fuel tank	FIA FT3
GEARBOX	Type	T10 D.N.
	Gears	4+1
DRIVE	Driven wheels	Rear wheel drive
	Type	Shaft
	Ratio	1:3.23 (alternatives: 2.88; 3.07; 3.31)
	Differential	Salisbury, Hypoid
BRAKES	Operation	Hydraulic
	Disc diameter & width	Front: 298.5 mm x 31.8 mm Rear: 298.5 mm x 31.8 mm
	Disc type	Ventilated
	Calliper	Front: 4-pot; rear: 4-pot
STEERING	Type	Worm & peg by Burman
CHASSIS		Tubular
SUSPENSION	Front	Independent with unequal length A-arms
	Springs	Coil
	Shock absorbers	Adjustable telescopic
	Anti-roll bar	Yes
	Rear	De Dion with radius arms
	Springs	Coil
	Shock absorbers	Adjustable telescopic
	Anti-roll bar	Yes
WHEELS	Type	Front: cast; rear: cast
	Diameter	Front: 15-inch; rear: 15-inch
	Rim width	Front: 7-inch; rear: 9-inch
TYRES	Front:	5-50 M 15
	Rear:	6-50 M 15
DIMENSIONS	Wheelbase	2450 mm
	Track	Front: 1445 mm; rear: 1480 mm
	Weight	1140 kg

guy and the engine was rebuilt, and after about one and a half years I was able to enter my first race with the car, the Le Mans Legends support race in June 2007."

When asked how he found finally getting to race the car, Erlich replies, "Well it was hard work, because it was very hot inside. There was very little air that came into the cockpit and the temperature would rise extremely high because the exhaust pipes ran just over your knees. Steering and braking was also very hard but at the end of its development, the car handled very well, oversteering just slightly. It was fun and really good to drive in races, but this car is definitely not suitable for touring because it is really too hot inside. Without air-conditioning, it was just like being in a sauna."

Despite the car's proportions, the front/rear weight distribution is 52/48. This favourable balance is made possible by the position of the engine. Twisting the two chrome, spring-loaded catches on the trailing edge of the bonnet allows it to be tilted forward, revealing a truly cavernous space. This is in contrast to the 3-litre V12 engine bay of the Ferrari 250 GTO, where access is extremely tight. In ▶



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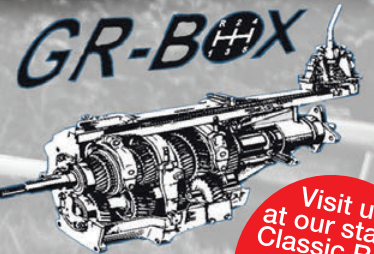
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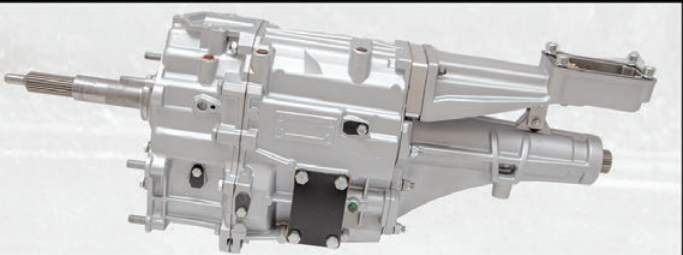
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Impressions of a Bizzarrini

HAVING seen several Bizzarrinis racing, and comparing them to other cars of the same period, my first impressions were that it was a relatively large car. But this perception is based on the car's design, with its flat bonnet, relatively flat sides, and a low and flat roofline that incorporates an expansive rear window.

The large rear window lies at an extraordinarily near-horizontal angle. Combined with the car's generous width, this gives it the overall impression of being quite large.

Having just sung the car's praises as regards size and proportions, climbing aboard is actually rather a challenge. The low roofline and roll cage combine to narrow the aperture through which you must climb. The seating position is best described as a lying position, as your feet are really on the same level as your hips, which also gives you a somewhat restricted view of the road ahead.

Located in the centre of the dashboard, and more easily read by the passenger than the driver, is the 320 km/h speedometer and rev counter. If their position is a surprise, then the fuel gauge – which is placed straight in front of the passenger – is an even greater mystery. Straight in front of the driver are two large dials with a third nestled between them and slightly above. The dial on the left gives the oil temperature while the one on the right monitors water temperature, with the smaller central dial giving oil pressure. With the driver's right elbow resting conveniently on the gearbox tunnel, the stubby and slightly crooked gear lever falls neatly to hand.

Despite the challenge of getting in and out of the Bizzarrini, and the staggered layout of dials, it is a car that I can imagine you would get to know quickly, and grow to like immensely. Its design is oh-so typically Italian, and here Bertone has excelled at giving this classic racer the Coke-bottle treatment with stylish humps over the wheels, creating a really muscular appearance.

As a result of underachieving in period, the Bizzarrini lacked the high-profile recognition its Italian contemporaries received. Perhaps carrying an inferiority complex from the 1960s, it was a much-underrated car, but is today the dark horse of the historic racing scene. The Bizzarrini is blisteringly fast thanks to a lightweight body, and very reliable thanks to its use of off-the-shelf componentry. Today though, thankfully, the Bizzarrinis are receiving more attention because in historic racing, with a small number of well-restored and maintained cars, they are achieving the results they deserved, more than 50 years after they burst onto the scene. **HRT**



ABOVE The positioning of some of the gauges is a mystery

the Bizzarrini, the engine seems to be tucked so far back under the scuttle that in order to access the distributor, a panel on the top of the dashboard inside the car must be removed.

Bizzarrini originally wanted a V12 powerplant under the bonnet, which would explain the large amount of available space. But this engine position has essentially created a front mid-engined sports car, giving excellent handling and performance. "The layout of the car allowed you to drive it with a slightly oversteering attitude, which is always better for taking corners. It was easy to control, and I found it very predictable," Erlich adds.

BRAKE ISSUE

It was at that first outing at Le Mans, in 2007, that Erlich realised that he had a problem with the brakes, which obviously had not been adequately modified for racing. It highlighted an important difference between the Strada and Corsa models. "The brakes were rather poor and we had problems with the rear brakes especially, which overheated and lost fluid. We had to go home and do a lot of work on the car once again," he points out.

A solution had to be found, but the problem was that the Bizzarrini's inboard discs sat right next to the differential. Cooling of the diff and the rear brakes on the Strada (street version) was perhaps adequate, but when subjected to the rigours of racing, this issue was exacerbated. It was eventually solved by the fitment of ducting with pick-up points under the vehicle, but also with efficient venting to allow the hot air to escape.

The Bizzarrini was fitted with either Dunlop Mk IX or Campagnolo brakes, both being standard items in period. Erlich expands, "The Campagnolo brakes are very hard to find now and while there are some replica Campagnolo units in existence, I doubt if these are legal [for some events]. But the Dunlop Mk IX brakes work well. You just need to have the most efficient cooling possible for the brakes, and then they will work.



ABOVE The mating of American muscle to Italian curves is a fabulous combination

“ Nothing binds like-minded souls together like a good revolt”

“On Avon CR6ZZ tyres, the car is easy to control. In some series, we had to run on Dunlop CR 65 L section tyres, but with these tyres the car was much less lively and more difficult to control. You had to be very precise with your braking, down-shifting and turning in. The Avon tyres, on the other hand, allowed you to make a few little mistakes because they were more forgiving thanks to the more modern tyre patterns.”

All maintenance on the car is carried out by a fulltime professional mechanic. As with every racecar, the Bizzarrini has to be cared for and checked after each event. That is normal, but how easy is it to source parts for a low production, exotic mid-’60s Italian sports car?

This is perhaps easier than one might imagine, as the engine is a Chevrolet Corvette unit, and the gearbox is a 4-speed Borg Warner T10 as used in the AC/Shelby Cobra and similar cars of the day. The differential is a Salisbury unit, as fitted to the E-Type Jaguar and Cobra, and even the Dunlop Mk IX brakes are relatively easy to find replacement parts for.


This is confirmed by Erlich: “The mechanical parts are easy to get and to maintain because it is all Chevrolet, and the gearbox is Borg Warner or Muncie, so that you can get off-the-shelf. The problem is the bodywork. If you have to repair the body, it is very costly because it is hand-made. The body is all aluminium, and if something happens or if you have an accident, that can set you back a lot in both time and money. There are a few specialists who are able to do the bodywork. For instance, in Turin there is a chap who has all the jigs and spare parts to rebuild the body.”

While in his possession, Erlich raced the car extensively around Europe but one of his most memorable experiences was at Paul Ricard in 2012. “I stayed in front of Carlos Monteverdi’s 250 LM Ferrari, which is a prototype, for more than an hour,” he recalls with a smile. “He should have been quicker than me, but I enjoyed that race victory in the Bizzarrini very much.”

But motor racing does not always go as smoothly as you might want. When asked if he could recall a really scary

moment, the reply was immediate and firm. “Yes!” Erlich starts laughing: “It was at Paul Ricard in 2012 as well, at the start of one of the races. After the start, I still had poorly performing brakes at the rear and I was a little bit too quick for the first corner, so I had to brake hard. The rear locked and I spun in front of the whole field. It was very scary. Fortunately, I didn’t hit anything and I stayed on track and I could carry on going forward. But I was quite shattered!”

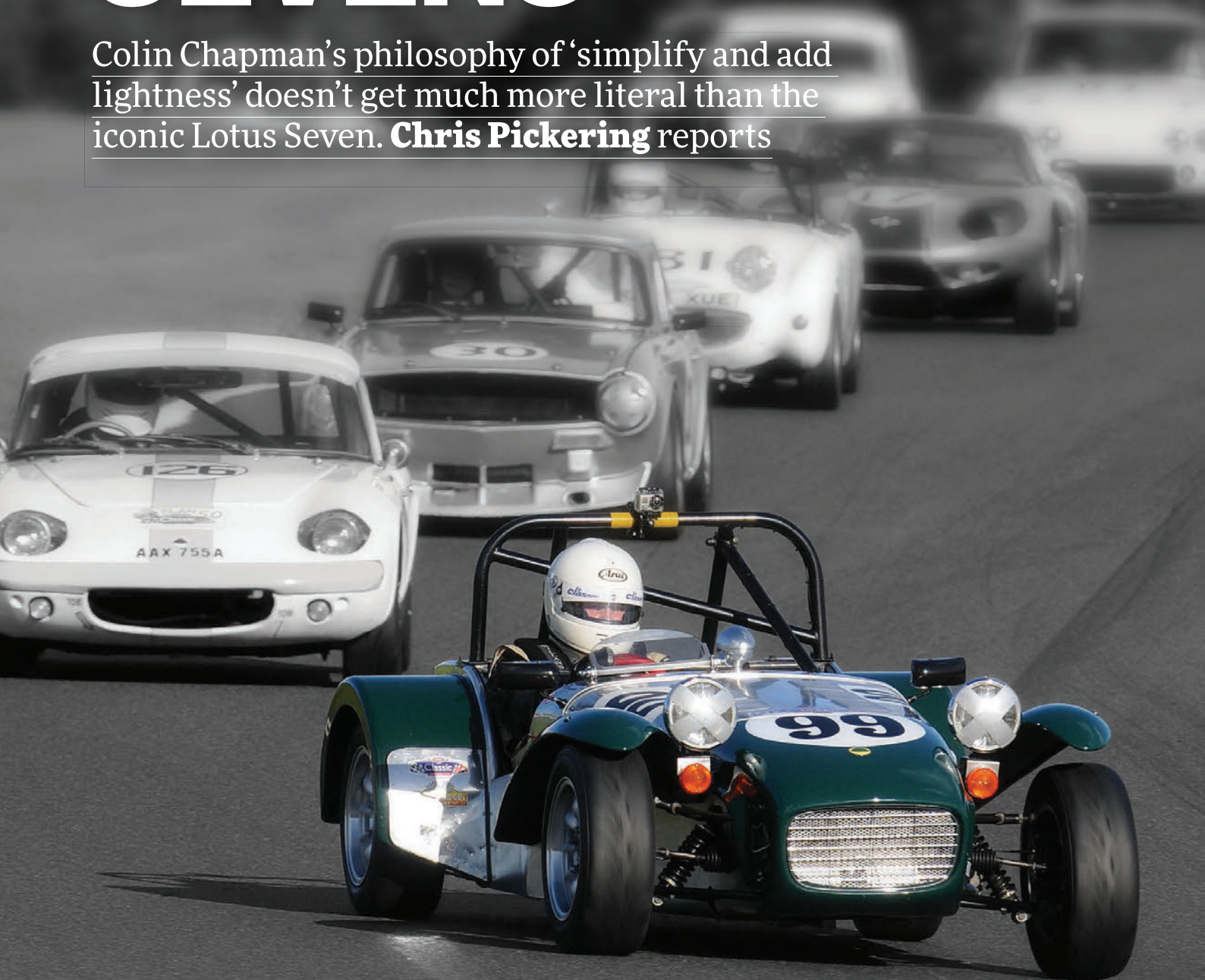
Between 2012 and 2014, Erlich participated in the Patrick Peter events which included races at Paul Ricard and Dijon in France, and at Spa Francorchamps amongst others. His efforts were rewarded when at the end of the 2014 season he won the Trofeo Nastro Rosso cup.

With such fond memories of racing the Bizzarrini, and having sold it at the end of 2014, would Erlich buy another one? “I must say I had a wonderful time with that car. It was the right car for me at the right time,” he adds fondly. “This was a good period for racing this type of car, but maybe I will get back to my long-term racer, the Alfa Romeo GTA.” 

• *With special thanks to Simon Blake of Historic Automobiles*

MAGNIFICENT SEVENS

Colin Chapman's philosophy of 'simplify and add lightness' doesn't get much more literal than the iconic Lotus Seven. **Chris Pickering** reports



ABOVE Too fast to race! Lotus Sevens were once banned for their performance and even today they still excel through the corners. This is John Muirhead's S3, which runs with the original (hideously un-aerodynamic) teardrop wings



Steve Jones

IT'S hard to believe that the Lotus Seven turns 60 this year. So familiar is its silhouette – perhaps the most recognisable and certainly the most widely imitated in the motor industry – that it seems to have taken on a timeless quality. Nowhere else will you find a car from 1957 that still has direct descendants rolling out of a factory today.

In reality, though, the Lotus Seven's story stretches back even further. It was a relatively mild evolution of the brand's first production car, the Mk VI, which debuted in 1952. Both were designed with racing very much in mind, and in particular the 750 Motor Club's 1172 Formula. One heavily modified Seven even found its way into a non-championship Formula 1 race in 1962, beating a handful of contemporary grand prix cars in the process.

Despite such giant-slaying performance – or perhaps more accurately, because of it – original Sevens are a relatively rare sight in historic racing. They were famously banned from several different categories in-period, which led to Caterham gleefully adopting the slogan 'too fast to race' after it bought the design from Lotus in 1973.

Then as now, the more extreme Seven variants tend to find themselves trapped between heavier, slower GT cars and faster, more exotic open-wheelers. There are still plenty of opportunities to compete with one of these machines, though, particularly if it's a lower-powered Seven or a Mk VI.

BACK TO THE START

The chassis from the Lotus Mk VI forms the basis of all subsequent Seven-type cars, with a bloodline that stretches right up to the current Caterhams. Its base is a set of 1-7/8" round section tubes that run down both sides of the engine bay and the cockpit. The sides, the scuttle and the curve of the rear haunches, meanwhile, are comprised of a mixture of square and round section 1" tubes, with extensive triangulation.

At the front, the Mk VI chassis uses independent suspension, formed from a

Ford 10 beam axle that's split to create two swing axles. At the back, most Mk VIs use a conventional live axle – taken from a number of donors, but often from the Ford 10 – with a transverse Panhard rod. Quite impressively for its time, coil-over spring damper units are used front and rear.

"No two Lotuses of this era are quite the same," explains Eddie Hopkins, owner of Riversdale Restorations. "People used to put all sorts of things in them to get different drive ratios or track widths. I've got a Mk VI here with a TR3 back axle and a Series 1 Seven with a complete Lotus XI rear end on it!"

Generally, 10-inch Ford drum brakes were used all-round, operated by cables onto Girling actuators. Anyone who's ever experienced cable brakes will appreciate why hydraulic conversions have since become a popular modification. A handful did actually leave the factory with a de Dion back axle, fitted with the Lotus Mk IX's hydraulic brake system, including 11-inch elektron finned drums.

The Ford 10 also provided the source for the Mk VI's worm-and-nut steering box. This isn't generally considered to be the last word in precision, so various cars have been converted to rack and pinion steering over the years. Lotus specialist Mike Brotherhood currently offers a conversion requiring minimal modifications to the chassis.

All of the 100-or-so Mk VI customer cars were kit built, with owners left to choose their own running gear. A ready supply of cheap parts and its eligibility for the 750 Motor Club's 1172 Formula ensured that the 1,172 cc sidevalve engine from the Ford Popular and its 3-speed gearbox were a common choice. Other options included the MG XPAG series and the 1,100 cc Coventry Climax FWA.

EVOLUTION

The Seven is very much an evolution of the Mk VI. It features a revised chassis with smaller main tubes and a more intricate construction. As with the previous car, a variety of different fabrication firms were used for the ►



ABOVE Chassis cracks are not unknown, particularly when using modern tyres

chassis, including Arch Motors, which remains one of the foremost sources for chassis repairs and restorations to this day.

The biggest departure for the Seven was the adoption of what is – at first glance – a conventional double wishbone front suspension system. In a typically Chapman move, however, the

anti-roll bar actually forms the front half of the top wishbones on most Sevens. The exception is the Series 4, which uses pressed steel wishbones with separate anti-roll bars.

“Chapman, as usual, looked to make things lighter with the Seven, but the early examples were still very much built to order,” comments Hopkins.

“ In a typically Chapman move, the anti-roll bar forms the front half of the top wishbones on most Sevens ”

“We’ve got a Series 1 Seven here with strengthening plates all around the front suspension that were part of the original build. It’s a one-owner car that was ordered in 1958 for racing. Next to it there’s the chassis of a similar car built for road use and it doesn’t have any of the additional bracing.”

Although fundamentally live axle in most cases, the rear suspension also evolved over time. Generally, the Series 1 uses a Nash Metropolitan axle with twin trailing arms on both sides and a diagonal link to provide lateral location, although a few of the early cars have a de Dion tube. ▶



ABOVE Most Sevens use the anti-roll bar as the front half of the upper wishbone



Juan Fangio raced so hard at the 1957 German GP that he couldn't sleep for days afterwards.

He won.

He was on Ferodo.

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Series 2 cars typically use a Standard 10 axle with a similar trailing arm setup, except this time located by an A-frame that picks up on the bottom of the axle casing. A variety of Ford live axles were used for the remainder of production, which are generally considered to be stronger, albeit somewhat heavier.

As with the Mk VI, the floor and the transmission tunnel are fully-stressed members of the chassis, riveted to the spaceframe in 18 gauge. Two different grades were used originally on the ▶



BELOW Eddie Hopkins and his son Thomas demonstrating their Lotus Mk VI at Castle Combe

Andy Shepherd: Series 2 Seven

ANDY SHEPHERD races a 1962 Series 2 Seven in the Historic Sports Car Club's Road Sports Championship. It uses modern Yokohama tyres, but in most other respects it's period-spec, complete with a 1500 cc Ford pre-Crossflow engine built by Rob Morley at Protune Racing Services.

"When I first entered the championship I was running a 1600 Crossflow and I was given a year's grace to reduce it to a 1500," comments Shepherd. "The outright power difference isn't that big. We got 148 bhp from the Crossflow

with the same carburettor chokes and exhaust size and we're now on 138 bhp with the 1500. The main difference is the torque. You do feel at a disadvantage somewhere like the long hill up to Druids at Oulton Park, where the pre-Crossflow just doesn't have the same grunt."

The big plus of a well set-up Seven is the sheer cornering speed it can generate, he explains: "That comes into its own at places like Castle Combe. In a Seven it actually pays to drop back from the car in front going into the final corner so you can maximise your exit

speed and try and carry that advantage the whole way up to Quarry. You know all the other cars with much less drag, and usually much more power, will be gaining on you, but it's great fun."

Like all owners, he says keeping the weight down and getting it as low in the car as possible is key. A recent programme of weight reduction on his Series 2 included the fitting of an aluminium bellhousing and a new aluminium radiator.

"Racing radiators aren't cheap, so I had a look online and discovered that the Toyota Yaris radiator would just about fit and had its inlet and outlet in the right locations," he recalls. "It weighs an absolute fraction of the old radiator and it's much more efficient. Plus, a brand new radiator costs about half as much as repairing a stone chip in the old one."

Due to their light weight, Sevens are also particularly sensitive to unsprung mass, he explains. A set of new magnesium 'wobbly wheels' from Tony Thompson Racing is said to have helped, particularly when taking kerbs.

Despite running on dainty 5.5-inch wide wheels and an all-up weight of just 479 kg, the grip of the modern tyres appears to be taking its toll, Shepherd explains: "The Yokohamas are dramatically stickier than the tyres the car was originally designed to use. You quite often hear of chassis cracking around the rear mounts for the lower wishbone, where the braking loads go in. It can also be an issue for the drivetrain; I've just had a set of uprated halfshafts made after snapping four or five of the originals." **HRT**



ABOVE & BELOW A Toyota Yaris radiator (below) is part of the weight reduction programme on Andy Shepherd's Series 2 Seven



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John Muirhead: Series 3 Super Seven

JOHN MUIRHEAD has a trio of Lotus Sevens, including a 1968 Series 3 Super Seven, which he currently races in the Classic Sports Car Club's (CSCC) Swinging Sixties series.

The CSCC regulations still require a high degree of period authenticity, but they are somewhat more relaxed than the HSCC. Muirhead's car now runs rose jointed suspension all-round with single-adjustable Avo dampers on the front and Spax on the rear, plus uprated front brakes.

"The rose jointed suspension feels a bit clunky on the road, but it's a lot more precise on the track," he notes.

Power comes from a 1.6-litre Lotus Twincam, prepared by Craig Beck Racing, which is good for around 180 bhp with a big valve head and twin 45 DCOE Weber carburettors. One concession to modernity is the use of an off-the-shelf Caterham exhaust system, which helps it to meet modern noise requirements.

"There are a lot of later Caterham parts that can be used on the Lotus Sevens, but I've chosen to keep mine fairly original. It still has the flared clamshell wings, for instance, which add to the drag and generate a lot of lift at speed," he says.

"When they're well sorted they are very quick little cars, but they're still not especially fast in a straight line. On the more open circuits like Silverstone or Thruxton you can say goodbye to the Astons and the E-Types; they just disappear off under power, but under braking and through the corners there's not a lot that will keep up."

Other mods include a Quaife straight cut gear set inside the original four-speed gearbox and a period-spec limited slip differential.

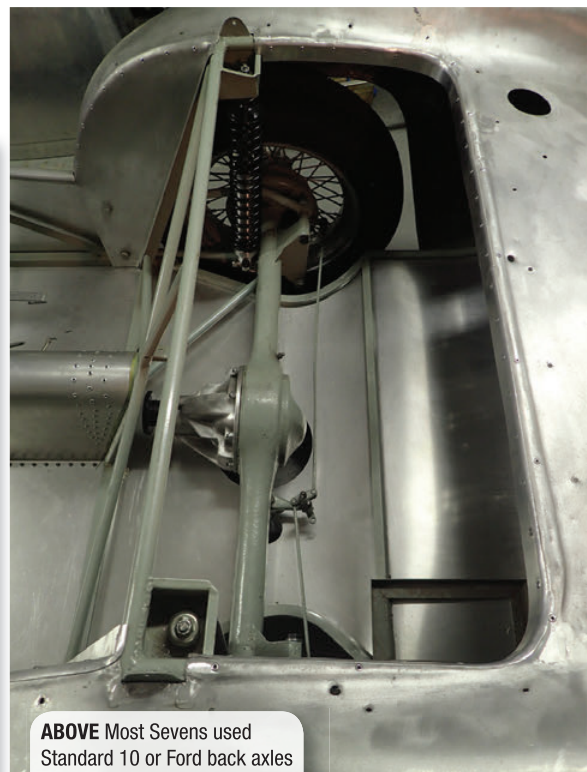
Muirhead emphasises the need to keep an eye on the geometry. "Sevens are quite sensitive to setup changes," he notes. "I try to get a flat floor setup done a couple of times a season."

Overall, he says his Sevens have proved incredibly reliable – not just in competition, but also as road transport: "I bought my Series 3 in 1970; it was my everyday transport until about 1980 and I started racing it in 1994. It's competed every season since then with very few issues." **HRT**

BELOW John Muirhead's Lotus Seven S3



John Luke Muirhead



ABOVE Most Sevens used Standard 10 or Ford back axles

Seven, with NS4 underneath the engine bay and then a harder LS7 aircraft-grade material from the bulkhead back.

Following aircraft industry practice, Lotus used rivets made from Monel – a nickel alloy that's highly corrosion resistant and stronger than stainless steel. "It's important to get the right rivets when you're joining an aluminium skin to a steel frame," notes Hopkins. "We also use an anti-corrosive jointing compound called Duralac between the different metals to prevent galvanic corrosion."

Rotten chassis tubes are not uncommon, he explains: "You often see corrosion around the rivet holes. If that's the case you can't just pick up the old holes, so we weld them up and re-rivet everything."

Bent or twisted chassis are also a risk, particularly if the car has led a hard life in competition. To check everything is correct Hopkins uses a chassis jig, which clamps onto the lower rails, with a set of reference plates to check the suspension positions. In some instances the tubes are then cut to release the twist and then gas welded back to the correct shape.

"People like to keep their original chassis. It's very easy to put a replacement chassis on these cars, but that's not really what it's about," says Hopkins. "One of the cars we did recently had about a quarter of an inch of twist and we were able to take that out." ▶



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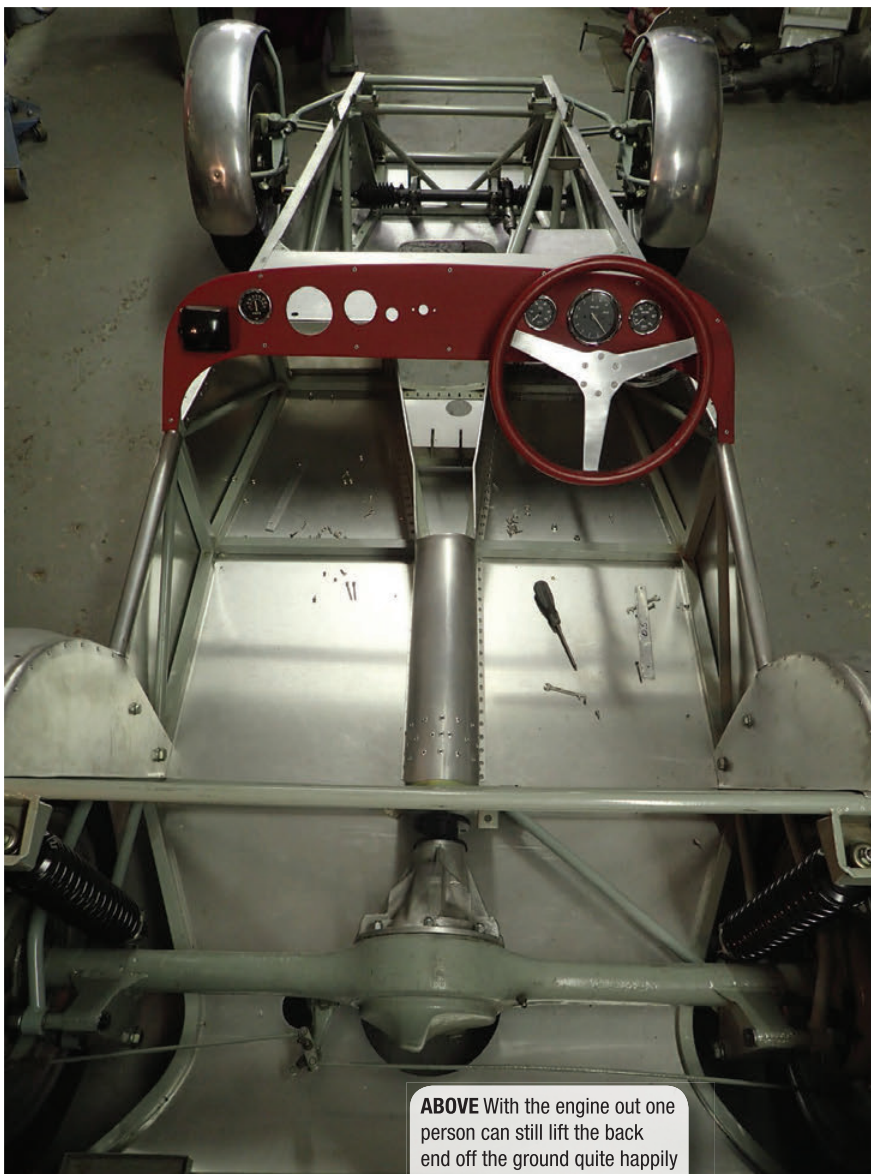
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ENGINES

Much like the Mk VI, the fastest Series 1 Sevens came with a Coventry Climax FWA. This was by no means a cheap option, though. It cost almost three times as much as the Ford 1172, which remained a popular choice, alongside the BMC A-Series. Both soldiered on into the Series 2 era, when the overhead valve Ford Kent engine (also known as the pre-Crossflow) was introduced in a variety of forms.

For the Series 2, Cosworth effectively replaced Coventry Climax as the preferred supplier for high-end engines, beginning with the 1,340 cc Mk V engine. This produced a heady 85 bhp in Super Seven form, but it was relatively short-lived due to problems with the crankshaft. In late 1962 it was replaced by the five-bearing 116E engine, which was available in various states of tune, including fast-road and full-race Cosworth 1500 variants.

“A lot of people favour the BMC engine for the Series 1, because you can get a reasonable amount of power quite cheaply. If you go down the Coventry Climax route it’s a much more expensive option to rebuild and to run,” says



ABOVE With the engine out one person can still lift the back end off the ground quite happily

BELOW Hopkins owns a unique Lotus 7 S1 with XI-type rear end





ABOVE & BELOW Beneath the skin of the S1 restored by Eddie Hopkins, owner of Riversdale Restorations



Hopkins. “The 1500 Cosworth in the Series 2 Super Seven is a really nice package and that’s broadly what a lot of people run in historic racing today.”

The tail end of the Series 2 era saw the first appearance of the Ford 1600 Crossflow, which was to dominate for the remainder of production. A Holbay tuned version of this engine, producing 120 bhp, was available in the Series 3, which also saw the venerable Lotus Twincam become a factory option for the first time.

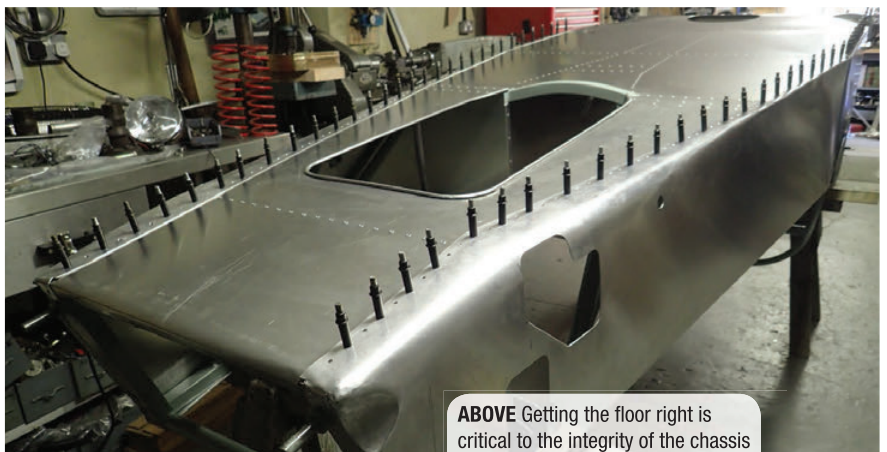
ON TRACK

There’s a race series to suit virtually all original Lotus Sevens, not to mention a multitude of sprint and hill climb events. You do need to think carefully, though. Everyone in the Lotus Seven racing community seems to know someone who has either been refused entry to a series or asked to reduce their engine size.

In many cases the Sevens are also required to run full-width windscreens and clamshell wings. This substantially increases what is already believed to be the worst coefficient of drag on any production car. If anything, it reinforces the Seven’s unorthodox performance characteristics; resulting in a car that’s generally faster than the competition through the corners, yet at risk of being

left behind on the straights.

The drivers will tell you this is all part of the fun, however. One owner we spoke to recalled swapping position 13 times with the same car as the Seven’s brick-like aerodynamics and modest power output took hold. Being a Lotus, though, it won in the end. And being a Seven it will probably still be competing in another 60 years. **HRT**



ABOVE Getting the floor right is critical to the integrity of the chassis

SNAKE BITE!

Given its brick-like aerodynamics, the AC/Shelby Cobra should never have been successful. **Glen Smale** looks into how this Anglo-American sports car became one of the world's most respected racers

THE AC/Shelby Cobra is, beyond doubt, the most copied sports car of all time.

This Anglo-American race car was created in the mind of Carroll Shelby after the irrepressible Texan had been told to discontinue racing himself due to a serious heart condition. Shelby was no slouch behind the wheel, having won the 1959 Le Mans 24 Hours with Englishman Roy Salvadori in an Aston Martin DBR1, so sitting in the grandstands was not an option for the American.

Shelby, though, was tired of seeing the Ferraris winning across America in the

late 1950s and early 1960s, and decided that if he could not match them from the driver's seat, he was going to build a car that could beat the Ferraris. But despite knowing what was needed, the problem was that such an American car did not exist at that time.

An opportune meeting with the Ford suits included one Lee Iacocca, who was himself not averse to taking the odd calculated risk. Iacocca was willing to fund Shelby's bold plan to build a Ferrari-beater, as long as it was powered by a Ford engine of course. Ford could not be seen to go racing in a corporate sense in

America, so Shelby's plan offered it the best way of achieving this goal.

Clearly, the Cobra had no predecessor. It was instead a tantalising dream, but Shelby needed to find a way of turning that vision into reality. At that time, England was the sports car capital of the world, so a trip to the UK was arranged, specifically a visit to AC Cars. This small manufacturer located in Thames Ditton, Surrey, England, produced a range of quality saloons and sports cars such as the AC Ace and AC Aceca. What appealed to Shelby about a potential partnership with AC Cars, was that the AC



BELOW Not all Cobras went racing. This car, COB6029, belongs to the Haynes Motor Museum, and still wears its chrome wire wheels





ABOVE Cobra chassis CS2130 speeds around Chapel at Silverstone. This vehicle was prepared by John Willment and driven in period by South African Bobby Olthoff

All photos: Virtual Motorpix

chassis was a proven component which in his mind, could be adapted to take the Ford engine he had up his sleeve, without too much modification.

You could argue that the Cobra was a sports racing car that should never have happened. But the early 1960s was an era when you could take an engine from one manufacturer, install it in the body/chassis of another, and call the end product your own creation. So the Cobra was the product of convenient timing, two willing parties and a ready market. This was not an unusual way of doing things back then, and as a result many 'specials' were created. Most of them have disappeared in the mists of time. The Cobra, though, was different.

Shelby had cut his teeth in motorsport during the formative years of the southern Californian hot rod scene, so he knew how to lighten a car and extract every last bit of power from its engine. In 1961, Ford had just produced its latest small-block V8 engine. It was this that Ford's lacocca wanted to push, and so the new 4.2-litre unit was dropped into the AC chassis. Less than a year after Shelby had started the ball rolling on his dream, he found himself behind the wheel of the first prototype bearing his name.

The AC Ace chassis consisted of two longitudinal three-inch tubes with three cross-members as well as the suspension towers at the front and rear. An extra cross-member was added just ahead of the differential which provided added strength

for the increased torque generated by the more powerful engine. A Salisbury diff was fitted, similar to that used in the Jaguars of the day, but this required a redesign of the rear suspension tower as the diff was suspended from, rather than built into, the suspension.

The first 75 Cobra cars were fitted with Ford's 4.2-litre or 260 cubic inch HiPo engine, a unit that had been developed for the Ford Fairlane production model. Being a low-revving unit, Ford provided Shelby with engines in a higher state of tune, which meant that the standard hydraulic tappets were replaced by solid

“ With a front-mounted V8 engine the Cobra appears front-end heavy. In fact, it has excellent balance and a favourable centre of gravity”

tappets, sportier cams, increased porting and high-compression pistons. With an output of 260 bhp, this was around double that of the AC Ace, and so the AC chassis had to work hard to keep all that power under control.

In period, the Cobra was powered by three different engines: the initial 260 cubic inch unit, followed by the 289 and then the 427. Ask any Cobra enthusiast which of these was the best-loved, and the reply is almost always the 289, largely because it had plenty of power for the chassis and weight of the car. The larger 427 unit was, in the opinion of many, a bit

of a handful and was only really successful in the hands of the professionals.

The front/rear weight distribution on the 289 Cobra was 48:52. This might surprise many, with the car's front-mounted V8 engine, as it appears more front-end heavy. In fact, the engine is located well back in the chassis and behind the front wheels, and when combined with the driver's weight and the heavy Salisbury differential, much of the car's weight was focused towards the centre of the car. As such, being a front mid-engined car, this gave the Cobra excellent balance and a favourable centre of gravity.

The larger 289 cubic inch, or 4.7-litre engine, was easier to tune for racing as it came with sturdier main end bearings, a crankshaft that was cast from higher-quality steel, and the conrods had thicker securing bolts. This meant the engine could handle the rigours of racing and, with power increased to 271 bhp, it was the preferred unit.

Apart from a small number of early 260 Cobras which had the Ford gearbox (iron casing), the rest of the cars produced were fitted with the Borg-Warner T-10 4-speed gearbox (aluminium casing). Although the gears could be changed ▶

internally, the preferred 'M' gear set was as follows: first 2.36:1; second 1.62:1; third 1.20:1; fourth 1:1.

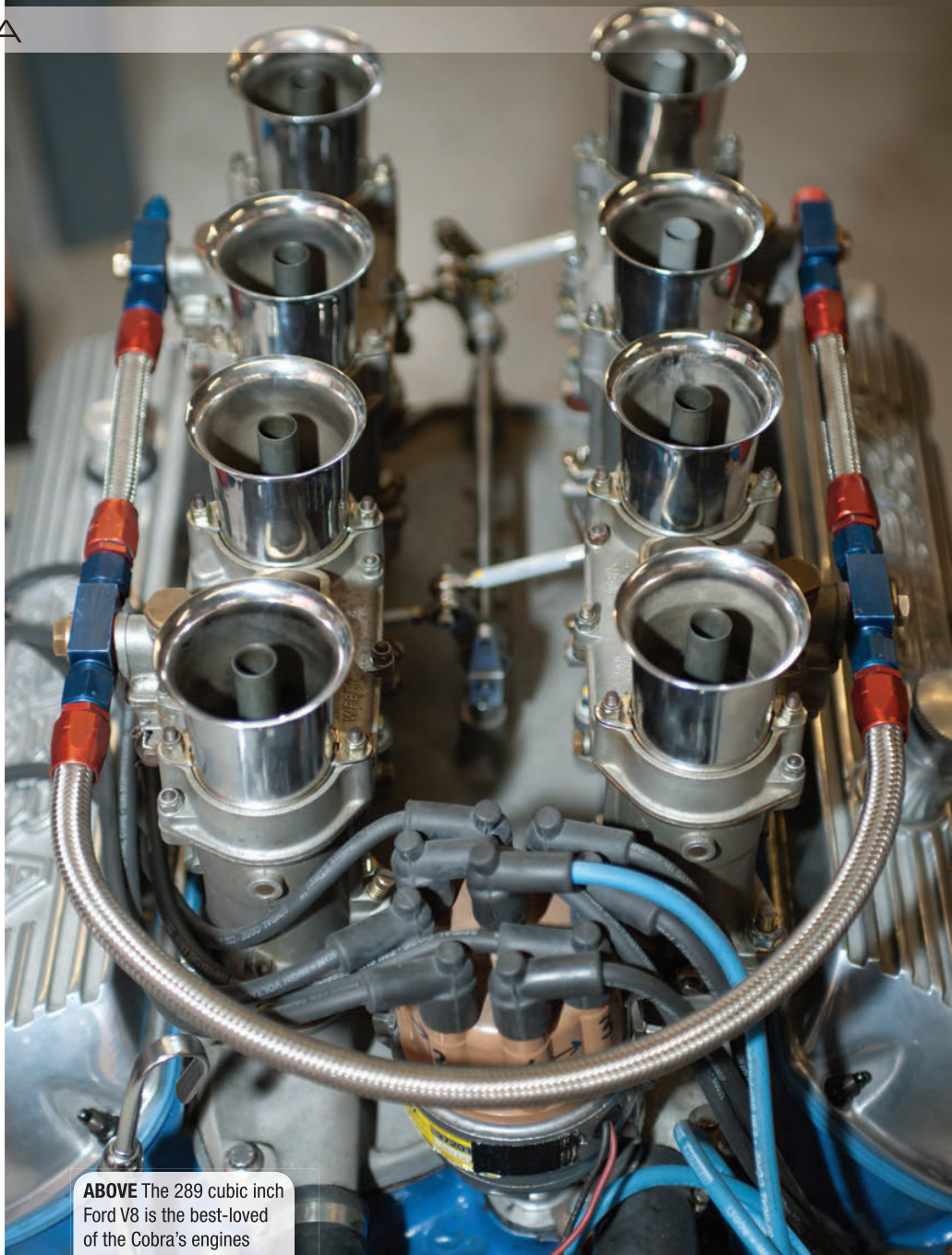
The first 126 Cobras featured a worm and peg steering system, but from 1963 on all Cobras were fitted with rack and pinion steering which was the same system used on many British sports cars in the 1960s. The suspension layout of the Cobra on both 260 and 289 models was the same as that of the AC Ace, the identical set-up having been used by AC Cars for the past decade.

The front suspension comprised a transverse leaf-spring 39¼ inches in length, made up of 10 leaves and mounted to forged steel uprights at each end. This set-up remained the same for the first 126 cars with the worm and peg steering. When the rack and pinion steering system was introduced as from the 127th car, the transverse leaf-spring set-up remained the same but the uprights were fabricated from forged steel.

By contrast, the rear suspension in the Cobra was quite different from the Ace right from the very first car due to the fitment of the Salisbury diff. Additional bracing was required to secure the diff, which would transfer far higher forces through the driveshafts. The transverse leaf-spring set-up was the same as the AC Ace and despite the Cobra's 51-inch rear track being an inch wider than the Ace, the leaves were the same at 41 inches. However, an additional leaf was added to the set-up, making eight leaves in total. Original equipment shock absorbers were Koni Special D with 82G 1359 at the front, while the slightly shorter rear shocks were 82J 1360.

Cobras ran with Girling disc brakes on all four wheels. The front discs were 296 mm (11 11/16 inches) while the rear discs were 273 mm (10 3/4 inches). Shelby's early plans to have inboard discs at the rear were dropped prior to production commencing as the outboard set-up allowed for the fitment of stronger rear suspension towers. The front discs carried two-piston iron callipers but this was later changed to three-piston callipers. Brake pedal effort was comparatively hard as the system was not servo-assisted.

Although most Cobras are known for the familiar Halibrand magnesium wheels, ▶



ABOVE The 289 cubic inch Ford V8 is the best-loved of the Cobra's engines



ABOVE As can be seen from this shot of Gavin Henderson's car, the Cobra is actually a mid front-engined machine that features a surprisingly equal weight distribution front to rear

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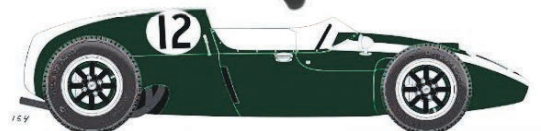
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ABOVE What a Cobra looks like when it sheds its skin: the car owned by Robin Stainer



ABOVE The scuttle panel can just be seen over the top of the dash



ABOVE The Hurst shifter was a period modification



ABOVE Detail of the brake and clutch pedals. The former can become rather long after an hour of hard-charging around Goodwood!

every one left the Thames Ditton factory fitted with traditional spoke wheels. The Halibrand wheels were preferred by those racing Cobras in the day because they were less prone to break.

RUNNING A COBRA TODAY

Running a racing Cobra today is easier than one might expect, due mainly to the availability of replacement parts and expertise. In the 1960s, Ford was probably the most prolific producer of manufacturer 'go-fast' accessories, due largely to the company being committed to many different categories of motorsport. From single-seater formula cars to the mighty Can-Am beasts, from touring and GT cars to rallying, Ford was involved in most race arenas globally. As a result, a plethora of components were produced in period, many of which are still reproduced today by companies set up specially to satisfy this market.

On the maintenance and repair side of things, there are today a large number of

garages and workshops that specialise in keeping important historic race cars running. This service sector has over time grown as the historic racing world has evolved, to meet the seemingly ever-increasing number of top tier races catering for these cars.

There will always be those owner/drivers who like to do their own maintenance and repairs, simply because they enjoy the challenge. On the other hand, there will also be those owners who feel happier letting someone else do the maintenance on their race car because they don't have the time to do it themselves, or because they feel that a professional workshop is better equipped to carry out this work. In this latter instance, there is also the safety net, that a workshop that deals with such issues day in and day out can offer.

Simon Blake and his team at Historic Automobiles in Hampshire have maintained Gavin Henderson's car for around seven years. Blake explains how it works: "The owner buys the car, he gives it to us and it stays here 365 days of the

year. He will tell us the race programme he wants to do that year and we have to make sure that the car is compliant for that race, because different events have different rules such as minimum weight, different tyres, different engine specs, silenced or non-silenced, so we have to have the car prepared for each particular set of race regulations.

"We transport the car to the circuit and the owner just turns up and drives. Sometimes they break them, and so we bring them back to the workshop and fix them again in time for the next outing."

When the car comes back from a race, the team will check the engine, ignition timing and balance the carbs, then they remove the rocker covers to set the tappets and look at the valves. The brakes are examined to ensure there is sufficient pad material and they are then bled. The gearbox level is monitored and a complete spanner check of every nut and bolt carried out from bumper to bumper.

"We have to do a complete spanner check because on a race car, a lot of it ►

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“ The Cobra is putting out a lot more power than it did in its day”

ABOVE Bill Bridges' 'Hairy Canary', chassis number CSX 2151, is one of the most famous Cobras on the historic racing scene. The roof pods were common to give the driver more headroom and evacuate air from the cockpit



ABOVE Of all the original Cobras, this is the only known example to have the long air scoop stretching the length of the bonnet



ABOVE The Salisbury diff seen in place on the rear suspension

is solid-mounted, and with it vibrating throughout the race, you just have to check every nut and bolt,” Blake adds. “The engine oil is changed every other race, and we do a good visual inspection over the whole car.”

The Henderson Cobra has competed at the Goodwood Revival on numerous occasions. For this event, Blake and two mechanics will take the car down to the circuit on the Thursday for sign-on and scrutineering. The car would have had its pre-race inspection at the workshop, where the data records would be consulted to ensure that the correct suspension settings are dialled-in. Because the team knows the regulations covering each event, scrutineering should be plain sailing which leaves just the fuel level to be checked prior to practice or qualifying. Blake points out, “Ninety per cent of what happens as regards the car’s reliability, is done in the workshop. At the track, we check it over as there are some known parts on the car that tend to come loose. We check fluid levels again, and then prepare it for the race.”

The Cobra’s engine and gearbox are both strong units, and the Blake team would expect to get around 30 hours of racing out of both, which equates to more than a season. While the car’s engine specs cannot be altered, as this would rule it ineligible for the main historic races, some improvements are permitted. Today it is common to find a period engine running with reprofiled cams, oil coolers and lighter internals where these are permitted. With

improved oils, the engine is able to run more freely up to its maximum limits, which are greater today than in period, but these higher performance limits require a strong gearbox and brakes capable of hauling a relatively heavy race car down to sensible cornering speeds.

If there is a slight chink in the Cobra's armour, it is the brakes; it's not that they aren't effective, but after an hour of hard racing around Goodwood the brake pedal tends to go a bit long. Tyres also play an important part in the car's improved performance as technology in this area has come forward in leaps and bounds.

Blake explains, "Although it is still the same basic 289 engine, the Cobra today is obviously putting out a lot more power than it did in its day. The cams are the same, but the lift is different. We have to use solid rockers because we are not allowed to use roller rockers, so we still have to run to the '65 spec motors. We run JE pistons but some people use Cosworth pistons, and the conrods are Carrillo, that was original equipment. The crankshaft is standard but the webs are smaller and they are shaped to cut through the oil, so it's a normal design crank but it has been made a lot nicer: it is a work of art. The gearbox is the standard Borg-Warner T10 aluminium four-speed synchro 'box, and the differential is all exactly the same as in period."

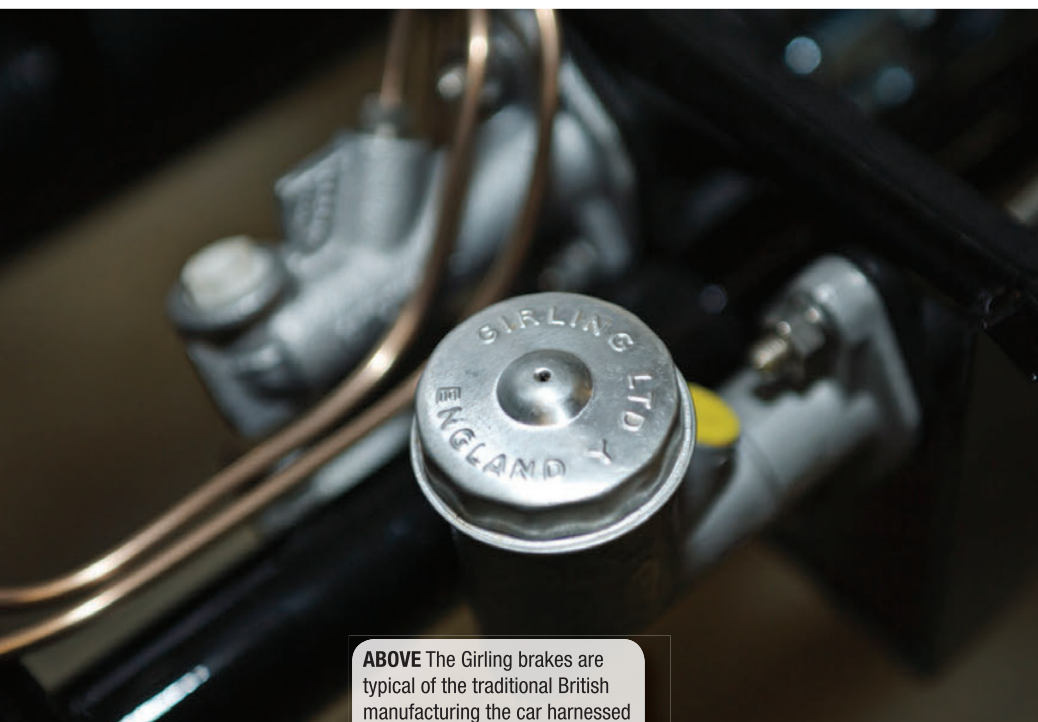


ABOVE When the cars were exported to Shelby, he removed the AC badging but also the wire wheels fitted at the factory (left). His preference for the Hallbrand magnesium wheels (right) was dictated by their reduced weight and need for less maintenance

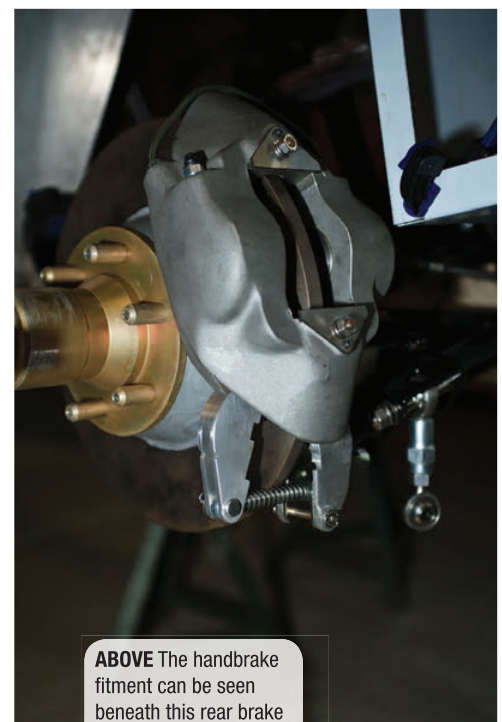
Racing a historic car requires a different approach from the way a modern one is driven. While the latter needs to be handled very precisely in order to get the best out of it, an older car is more flexible and offers a wider margin for the driver. Darren Turner, an Aston Martin works pilot, has driven the Henderson Cobra around Goodwood on a number of occasions. He explains how it is done: "The Cobra wants to be set up at an angle to the corner and it likes to be driven through on a bit of throttle; once you can straighten the car out, and you know it is in a straight line, then you can really apply the gas to get the speed back up."

It should be remembered that, in

general, race cars are built to last a season or two at most before being replaced by the next iteration of that car. So, for us as spectators, to be watching a race car from the 1960s still being put through its paces 50-plus years later, is nothing short of miraculous. It stands to reason then, in enduring forces way beyond those envisaged in period, that these historic race cars need to be suitably prepared to cope with the stresses of modern-day historic racing. In this way, we need to accept sympathetic improvements and upgrades, in order to continue watching these magnificent racing machines performing at the limit. Long may it continue! **HRT**



ABOVE The Girling brakes are typical of the traditional British manufacturing the car harnessed



ABOVE The handbrake fitment can be seen beneath this rear brake

HRT

Hot internet date with a difference

Hal Ridge discovers how an internet forum led to Nissan returning its innovative diesel Dakar project to the Sahara desert – 30 years on from it being discarded



ABOVE The Patrol Fanta Limon returns to the Sahara desert three decades on

IT'S impossible to forecast the future, but those in the know can often make educated predictions. However, three decades ago, when a diesel-powered car finished just inside the top 10 on the Paris-Dakar Rally, even the most established engineers wouldn't have foreseen that the endurance aspect of motor racing would one day be dominated at the highest echelons by diesels.

In 1987, as Nissan's Patrol Fanta Limon finished ninth overall in that January's event, off-road motor racing was in the middle of a game-changing period. The legendary Group B era of world rallying had just ended, the monstrous machines banished from the stages for being too powerful and too fast. One of those beasts deemed surplus to requirements, Peugeot's 205 T16, was then used by Ari Vatanen, one of the French marque's star drivers, to win the '87 Paris-Dakar, which back then was a 22-day 13,000-kilometre endurance challenge.

Nissan's top-ten result, though it garnered fewer headlines, was also a game-changer in its own way. These days in cross-country motorsport, everything at the top of the order is diesel-powered. Before the introduction of hybrid technology, Le Mans too was dominated by TDi engines. Thirty years ago, however, performance diesels were in their infancy.

Following its impressive result in the French-African event, Nissan's Patrol was decommissioned. It wasn't until very recently that it was found nestled away in a small Spanish museum, in Girona, covered in dust, having been acquired by the Salvador Claret private car collection.

Technicians at Nissan's European Technology Centre in Barcelona were first alerted to images of the machine on an internet forum in February 2014. They quickly hatched a bold plan: to return the car to working condition ahead of the 30th anniversary of its Dakar achievement.

The car was returned to the NTCE in May 2014, having been originally conceived at the same base on behalf of Nissan Motorsport for its competition debut in 1986. Assisted by internal funding from Nissan's 'Performance Innovation' fund (a pot of money set aside each year for 'projects that bring to life the company's

brand promise, Innovation that Excites'), a group of eight Nissan employees spent their own time, evenings and weekends, working on the car with the target of returning it to the Saharan desert.

"The first step was to find out what the vehicle's condition was like. The main worries were regarding the engine, drivetrain and chassis condition because they are the areas that would have suffered the most during the competition," says Juan Villegas, an NTCE technician. "After the first analysis, we discovered that the most damaged area was the engine. It needed to be fully restored due to some big degradation, mainly caused by the cooling water. The engine (in period) used fresh water, and as a result it was completely rusty inside."

Starting with the largest components, the body and chassis were disassembled, until the team were left with a kit of 30-year-old parts desperate

“The rat-eaten wiring loom was the single biggest headache”

for some TLC. The repairs and restoration wasn't as easy as just cleaning and restoring what was in front of them however, as Fernando Villatoro explains: "For some reason, some modifications were done to the vehicle many years ago but they were not concluded, and these modifications affected the wiring loom [post its Dakar success]. When the vehicle arrived at NTCE, there was a lot of short-circuiting in the loom, so it had to be checked really thoroughly and it was a lot of work to return it to original condition."

“HUGE DAMAGE”

Villatoro was also involved with the rebuild of the Patrol's 2.8-litre four-cylinder transverse engine with around 145 horsepower as part of the resurrection project. "We had to fully overhaul the engine," he confirms. "There was huge damage caused by rust. Some components, like the crankshaft, block and cylinder head, were carefully cleaned and machined, but a lot of parts were changed for new ones, like the liners, pistons and rings, main bearings, water pump and of course gaskets. The engine and ▶



HRT

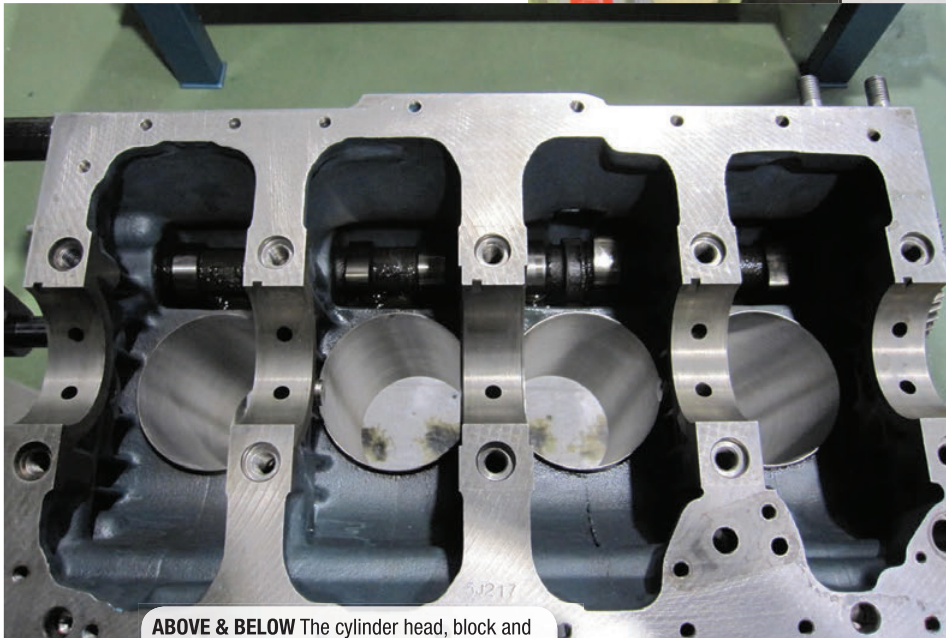
the wiring loom were the biggest tasks with the project; we spent many hours working with them.”

The Patrol Dakar machine had originally been fitted with a modified turbocharger and intercooler, but those items were missing when the vehicle was discovered. “Back in the day, the Patrol used a TGV turbo with custom intercooler system, but because they were missing we decided to use a standard turbo specification,” says José Luis Fernández López.

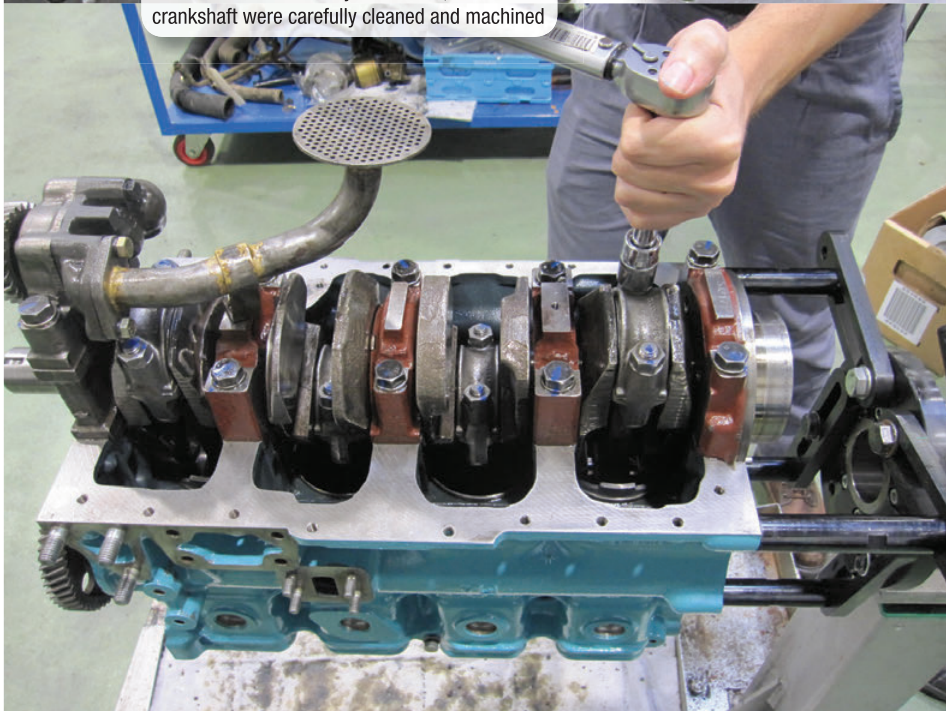
In part, the decision to use standard parts was made due to the inherent



ABOVE The engine was corroded inside as a result of using fresh water for cooling in period



ABOVE & BELOW The cylinder head, block and crankshaft were carefully cleaned and machined



issues with sourcing replacements for a car that went out of production in 2002. Some components were able to be restored, including the enlarged water radiator and some of the cast pipes which were welded to repair extensive rust corrosion. “Many of the parts of this Patrol are a carry-over from the standard car and therefore we were able to get some spare parts from Nissan dealers,” explains Villatoro. “For the Dakar-specific parts that would have been much harder, but luckily we were able to restore the original ones mostly.”

Aside from the engine overhaul, the rat-eaten wiring loom was the single biggest headache for the team of enthusiasts, but luckily for them, the original wiring diagrams for the Dakar machine were nestled in Nissan’s archive. Not on computer, but hand-drawn by the original team who created the first diesel to complete the gruelling event. And with that level of enthusiasm, it’s easy to see why they succeeded at the time.

NEW-FANGLED TECHNOLOGIES

“All the electrical circuit diagrams are still available, hand-made on several A4 pages,” says Pedro Diaz Illan, the only member of the original 1987 team still working at the plant. “They were created by Nissan engineers with a big portion of enthusiasm in order to understand and fulfil the very special requirements [of competing on the Dakar]. We had never worked with a project like this, so it was it was a great challenge. ▶



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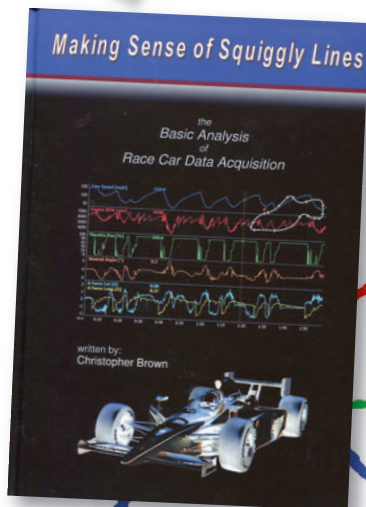
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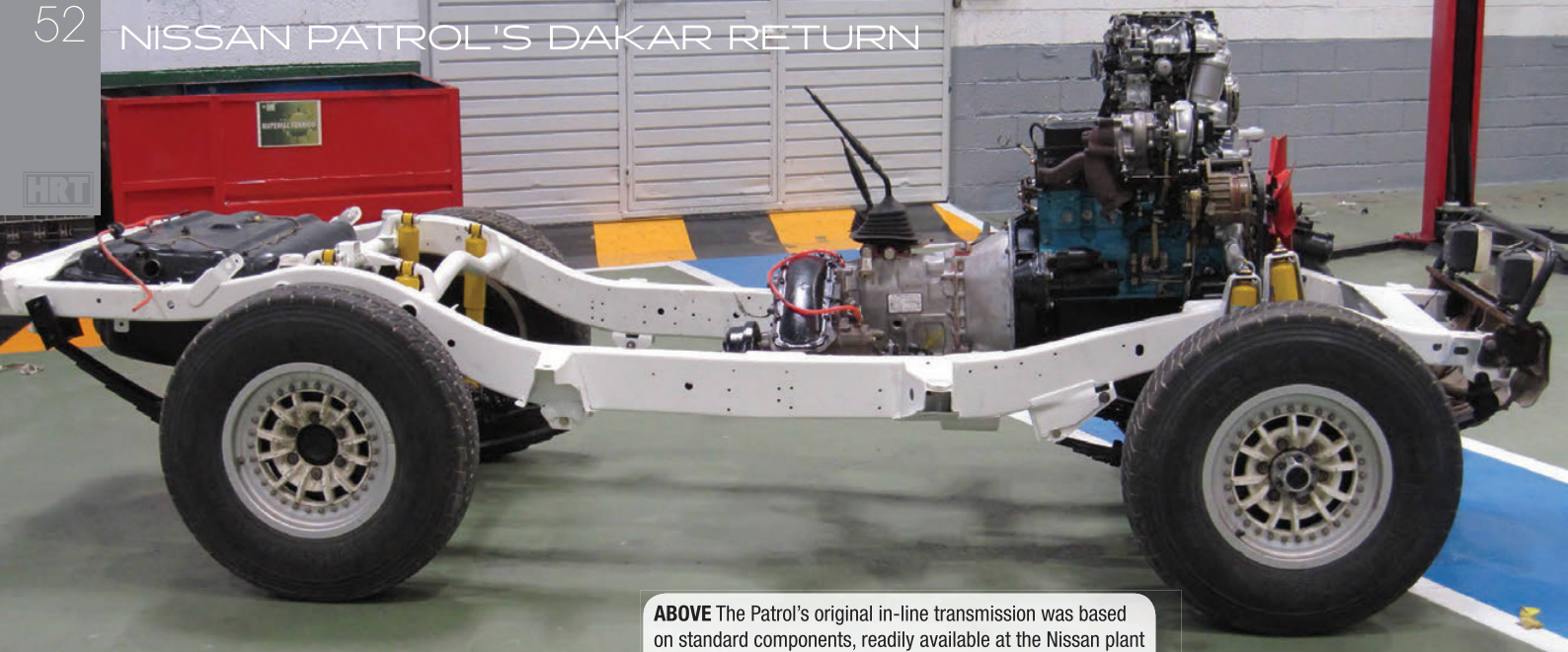
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ABOVE The Patrol's original in-line transmission was based on standard components, readily available at the Nissan plant

"The wiring harness and some of the components were made by hand; others were thanks to collaboration with special suppliers. We had a double fuel pump with electronic control system that automatically changed from one to another in the event of a failure, and a system that monitored all of the electrical signals to quickly inform the driver if there was a problem – to avoid any risk or damage."

The Patrol Dakar was heavily based on the production vehicle in a lot of respects, but the wiring was certainly not one of those. "All of the electrical parts were replaced in order to adapt to the needs and requirements from the Paris-Dakar regulations," continues Diaz. "Some double [piggy-back] electronic control systems were designed to ensure no failures in the rally. Gauges, relays and fuses were located to be able to be replaced quickly and easily, but the headlamps and those things were original equipment."

SHORT ON SPARES

In a nice parallel to the team that restored the machine most recently, it was a squad of young employees from Nissan Motor Iberica in Zona Franca's factory in Barcelona who had built the car in period. Those employees, who worked on agricultural vehicles and trucks, enthusiastically volunteered their time to the project, but had to learn on their feet about 'new-fangled' technologies in the vehicle that they were not used to working with. "The terratrip [navigational aid], compass, different suspension, cooling and big fuel tank in a high stress ▶

The full works

WHILE Nissan-based vehicles began competing on the Dakar Rally in a variety of guises with varying degrees of support from 1982, it wasn't until 2003 that the Japanese marque sent a works team to the event for the first time.

Based on a development of the Nissan South Africa-built super production pickup campaigned in 2002 by now Dakar legend Stephane Peterhansel, three cars were entered into the 2003 event. They were driven by the Dakar's first Japanese winner, Kenjiro Shinozuka, world rally legend Ari Vatanen and Giniel de Villiers. Both Shinozuka and Vatanen claimed stage wins, but Shinozuka would retire as De Villiers completed the event fifth and Vatanen seventh.

For 2004, Britain's first World Rally Champion Colin McRae joined the team and claimed two stage wins as the squad won five tests overall, including a one-two-three on the 13th stage. However, despite undeniable pace, the team faced a number of problems and de Villiers was the highest finisher in seventh.

The 2005 version pickup was again a substantial upgrade from its predecessor, moving from a 3.5-litre to an all-aluminium 4.0-litre V6 petrol engine. The engine position was also moved in the 1825 kilogram rear-engined, tubular spaceframe chassis to allow for easier maintenance. A six-speed Sadev sequential transmission, along with front and rear differentials, were also part of the redesign, while the suspension geometry was revised with new pick-up points and components for the double wishbone, double damper setup.

McRae and co-driver Tina Thorner won the Baja Portalegre in Portugal – the Scottish driver's first and only rally-raid win – in preparation for what would be the squad's final Dakar outing. McRae was fastest on two of the first five stages, fighting for the lead with Robby Gordon, but in Morocco on stage six crashed heavily, putting him out of the event. De Villiers finished fourth – the works outfit never finishing on the podium in the programme. **HRT**



ABOVE Nissan's works project showed flashes of real pace



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vehicle for a dusty environment were a big novelty for us, but we achieved all of our targets," says Diaz.

Despite the punishing nature of the Dakar environment, the Patrol's steel ladder frame chassis was in remarkably good condition, with little serious corrosion or damage. Regardless, it was cleaned and refreshed. "We just cleaned and painted it," says Villatoro. "Although the Paris-Dakar competition is very hard on the car, we didn't find any cracks." In preparation for the Dakar, an additional 100-litre fuel tank was added to the standard 85-litre tank mounted in the chassis.

Another period Dakar upgrade was made to the Patrol's leaf sprung suspension, which was adapted to accommodate two shock absorbers at each corner, attached to brakes in 16" Braid wheels, fitted with 7.50 R 16 C Pirelli tyres. The rubber that the car finished the event on is still fitted today.

The Patrol's in-line transmission was

based on standard components, readily available at the Nissan plant, but was adapted for purpose. "Almost the entire driveline was made from in-house parts produced in the same plant in Barcelona where the Patrol was born," says Jose Luis López. "It uses the standard five-speed M5-25 manual transmission for synchros and ratios, but reinforced for strength. During the events it did use a few spare gearboxes, but it did pretty well for being a standard part running in the Paris-Dakar. During the restoration, the gearbox was stripped down to be checked. It was in really good shape, but we changed the seals as a precautionary measure." The differentials were also from the same factory originally, while the propshaft and driveshafts were produced by GKN.

Two cars were built to compete in the Dakar, but neither was free of drama in the 1987 event. Car number 212 was forced out after rolling down a sand dune – its whereabouts is since

unknown. The chances of the Patrol featured in this article, number 211, making it to the finish took a hit when the team's support truck broke down on the second stage. Thereafter, it had to manage without the backup of additional spares, making it even more astonishing that it finished at all.

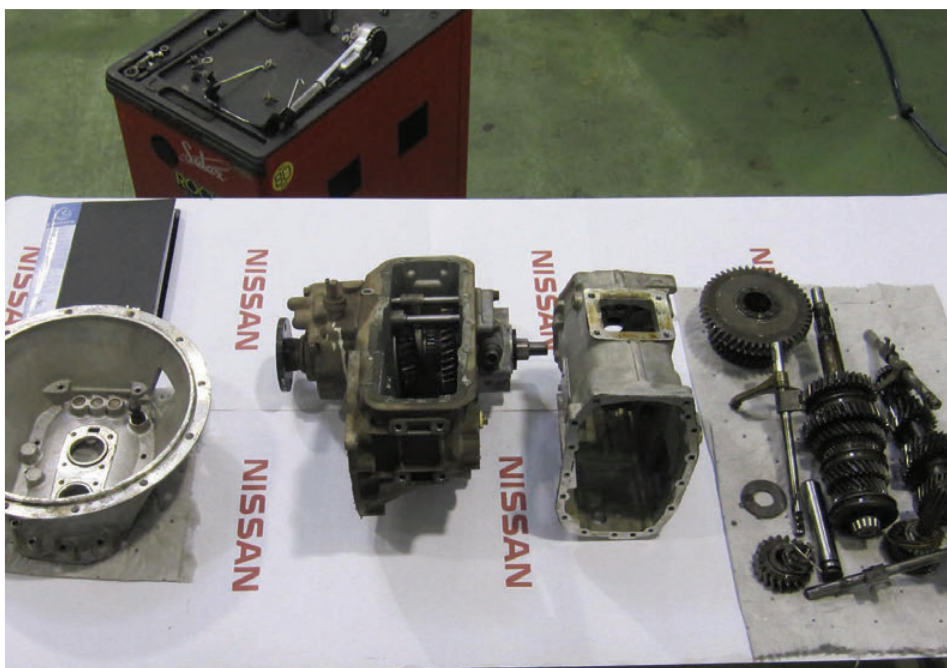
RELIABILITY ISSUES

"In all of the different races the cars did, there were no reliability issues," says Villegas. "The spare parts in the car were an alternator, engine belts, steering arms and ball joints. The car didn't have a winch, only a tow rope, and two spare wheels."

Those spare wheels were mounted through the rear of the modified rear cover, made of fibreglass. The original team had worked on reducing the weight of the vehicle as much as possible to bring it down to 1600 kg, with doors and bonnet joining the rear cover in being moulded

and made in fibreglass. But, unlike the restoration work required under the skin, the Patrol's bodywork remains as original, with the livery from the '87 encounter intact. Weight was further lost by use of polycarbonate windows, that opened to assist ventilation.

Unlike the machines that finish in the top 10 on the Dakar these days, the Patrol didn't have the luxury of air conditioning, and there was no additional internal heating either, other than that produced by the engine and transmission. Water wasn't offered up to the crew via an electric pump; instead a camelback was behind each of the seats for them to drink from. As an ingenious precaution, all of the water in the engine system was also fresh when it was put in,



ABOVE The team were left with a kit of 30-year-old parts desperate for some TLC



ABOVE The team's hard work was rewarded by a return to the desert



ABOVE The rudimentary nature of the controls is striking compared to today's sophisticated raid racers

so that it could be drunk if required.

"Apart from the wiring, the interior was in good condition when we found the car," explains Villatoro, who also makes reference to the rudimentary nature of the controls, a far cry from the machines of today, which bear more resemblance to a flight deck: "The interior is very basic, and we were able to clean most of it, which was enough. The dials and controls the driver has to look at are just the speedometer and engine RPM, fuel and oil pressure [gauges]. He also has switches for the lights, a stopcock to switch between the extra fuel tank mounted internally or the standard tank, and brake bias valve. The co-driver only had the terratrip."

The intention of this restoration wasn't just for the car to be a working showpiece, but to return it to the desert it last left 30 years ago. In November 2016, the team transported the Patrol Fanta Limon back to the Sahara and completed over 300 kilometres of running.

"We are very proud of the car's history and success. It happened with very few resources but a lot of willpower (in period), and that was the key to achieving the goal," concludes Villatoro. "It was an amazing experience to go back to the desert to see it driving again 30 years later, and a great part of the story to experience a bit of what they did in the race. It wasn't easy, but fantastic to be part of." **HRT**

Method, not magic

There is something of an art to setting up carburettors, but it's not as mysterious as you might think, **Chris Pickering** discovers

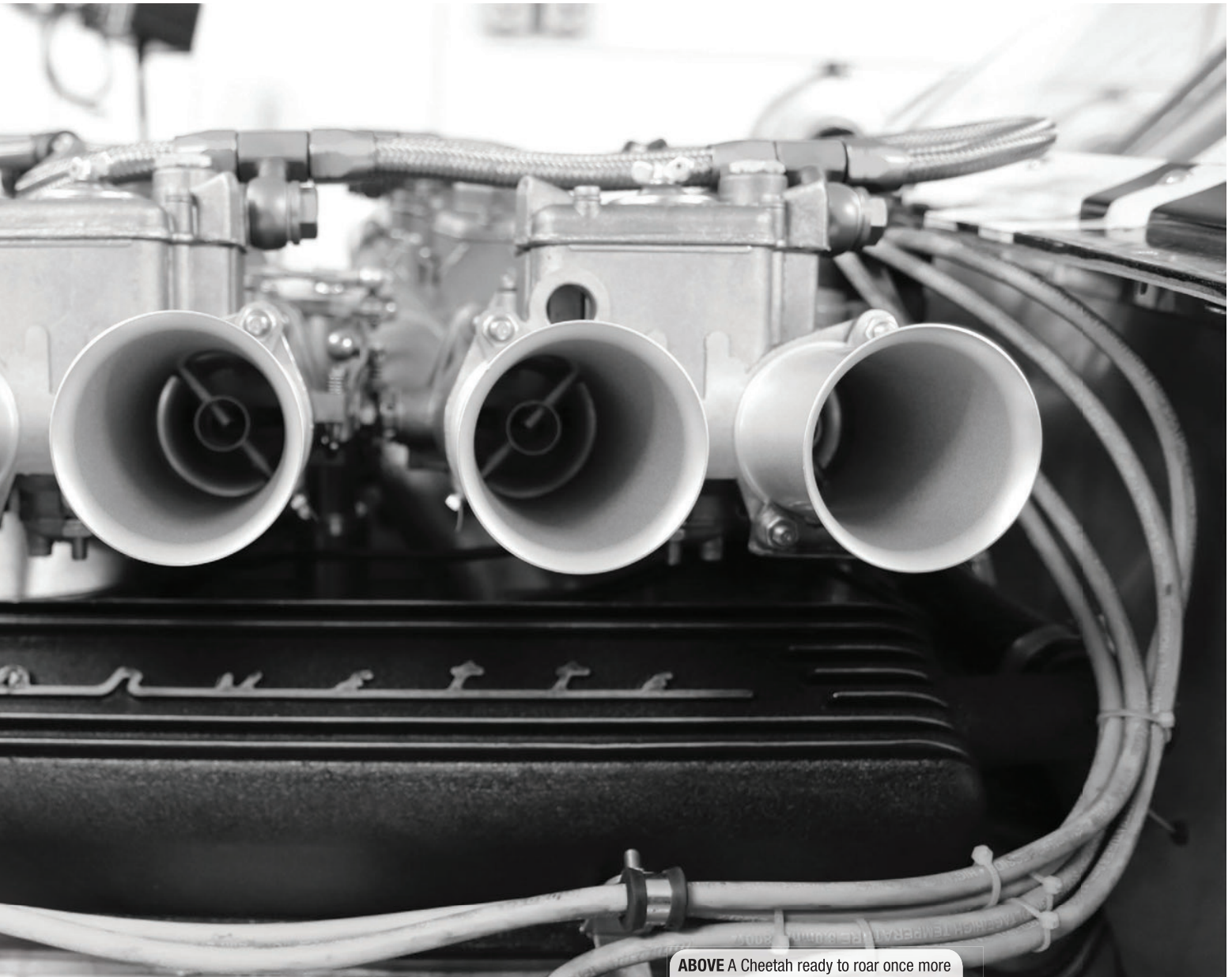
MOST people with cars of a certain age are broadly familiar with the workings of a carburettor. The principle is simple enough: Air is drawn into the engine through a Venturi, causing an area of low pressure, which sucks the fuel in through a jet. In theory, that's about all there is to it, but getting the best out of

carburettors in the real-world isn't trivial. Nonetheless, it is still a logical process, rather than the shadowy form of black magic that's sometimes portrayed.

To demystify things we've come to CCK Historic, an Aladdin's cave of old racing cars hidden away in the Sussex countryside. Don't let the quaint setting deceive you, though, because inside



ABOVE Swapping the main jet assemblies on a set of Webers



ABOVE A Cheetah ready to roar once more

lies a thoroughly modern computerised rolling road facility, which is the key to CCK's tuning approach.

"You need to put an engine under load to really set up the carburetors," points out CCK technician Graham Smeeton. "Revvng it to 6,000 rpm in neutral will barely open the throttle, but with the rolling road we can sweep through all the different speed and load points."

The exact approach depends on the type of carburetor you're looking at. There are dozens of designs out there, but most historic competition cars fall into one of two types.

Perhaps the most common in high-performance applications is the fixed-jet carburetor, typified by the Italian manufacturer Weber. This also covers brands like Dellorto and Solex, plus (broadly speaking) the American Holleys. The other type is the variable-

jet carburetor, which covers SUs, Zeniths and Strombergs.

FIXED JETS

A typical twin-barrel Weber-type design has a plinth in the float chamber with four holes. For each cylinder there is the main jet, found in one of the larger holes, and the slow running jet (commonly known as the idle jet), found in one of the smaller holes. Both have a reservoir of fuel at the base, fed from the float chamber.

At low engine speeds and light throttle, the fuel is principally drawn from the slow-running jet. Further up the rev range, or under greater load, it's the main jet assembly that dominates.

This consists of a hollow tube with a series of holes drilled into it known as an emulsion tube. Fuel is sucked into the tube through the main jet that sits

at the bottom, while a small amount of air is sucked in from the top via an interchangeable orifice known as the air corrector. Inside the tube the two mix to form an emulsion, which is then sucked down a drilling and through the Venturi, where it mixes with the main airflow through the carburetor barrel.

There is also a third element, which effectively operates in the speed and load range between that of the slow running jet and the main jet. This is a set of progression holes, drilled into the barrel just downstream of the butterfly valve, which tap into the slow running fuel circuit.

As the butterfly tilts open it exposes each hole in turn, creating an additional source of fuel. This feature is designed into the body of the carburetor, however, so it's not usually modified or adjusted. Incidentally, it also means that two outwardly identical carburetors ►



BELOW A stripped Weber. The larger holes are for the main jets, while the smaller holes are for the slow running jets. You can also see the top of the accelerator, the idle adjuster and caps for the progression holes

can actually be designed for specific engines, such as an Alfa Romeo fitment and a BMW fitment.

A range of different main jets, emulsion tubes and air correctors are available to fine tune the strength of the mixture, Smeeton explains: "The various elements interact, so you can't always say definitively what you will need to adjust to change the fuelling at a certain speed and load point. Generally, though, the slow running jet does very little on a competition engine; the main jet tends to have more of an effect on the mixture strength in the middle of the rpm range, while the air corrector tends to dominate at the top end. For instance, if the engine was running lean at high rpm you might put a smaller air corrector in to restrict the amount of air going into the emulsion and richen the mixture."

Weber-type carburetors also use what's known as an accelerator pump. This is essentially a plunger, driven by a cam on the throttle linkage. When the accelerator is pressed, it squirts fuel out through an additional jet downstream of the Venturi.

Fuel is denser than air, so this extra

shot of fuel is needed to overcome the momentary weakness that would otherwise occur when the airflow increases but the flow through the jets has yet to catch up.

One of the key things to bear in mind about a fixed-jet carburettor is that almost every function is controlled by its own set of hardware. So, despite the outwardly bewildering array of different adjustments, most things can be

accomplished by physically substituting one part for another.

The intricacy of all the drillings and passageways can lead to its own complications, however. These all have to be free of dirt or debris – usually achieved by blowing compressed air through. Smeeton warns against sandblasting or shotblasting carburetors, though, as it can be virtually impossible to remove all the particles. ▶



ABOVE The plunger mechanism from a Weber lift pump



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VARIABLE JETS

In a variable-jet carburettor, the airflow is still controlled by a butterfly valve, but the fuel delivery is metered by a tapered needle that slides in and out of the jet.

Carburettors of this type have a characteristic domed chamber, inside which sits a piston. A pair of drillings connect this chamber to the downstream side of the carburettor barrel, so as the vacuum builds in the intake it sucks the air out of the chamber and pulls the piston up. This causes the needle to slide out of the jet, progressively increasing the fuelling.

In order to raise the needle, the suction has to overcome a spring on the back of the piston. Using a softer spring will make the jet open further for a given vacuum, which allows you to tune the fuel delivery for different speed and load conditions. Generally, higher performance engines require stronger springs to hold the piston down, otherwise they will overfuel.

“In theory, the SU is a much simpler device than the Weber,” says Smeeton.



ABOVE Graham Smeeton from CCK watches the gas analyser as he performs a rolling road test on a Chevy Small Block fitted with Webers

“In reality, there’s a bit of an art to tuning them. Some 700 different needle profiles were originally offered and you can also develop your own if you wish, so there’s a huge range of adjustment. It can also be quite counterintuitive. You might assume that you need a thinner needle if the engine is running lean at a particular point, but it could be that you’re better off keeping the same profile and using a softer spring.”

Running up the centre of the piston is an oil-filled damper. This controls the speed at which the piston will rise, without affecting its outright displacement. And much like the dampers found in the suspension system, you can change the valving or the viscosity of the fluid to alter its characteristics.

“Ordinarily in a road engine you’d run SU carburettor oil or 20w50 engine oil,” ▶



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ABOVE Stripping down an SU. Note the characteristic domed vacuum chamber, the spring and the damper piston (in Graham's hand)

says Smeeton. "In high-performance engines we sometimes use automatic transmission fluid, because it's a bit thinner and it allows the piston to rise that little bit quicker."

At a fixed speed and load this damper doesn't do anything, so it can be removed during steady-state runs on the dyno, Smeeton explains: "If I can see the top of the carburettors from the driver's seat I take the dampers out and put flags on the top of the pistons. That way I can see the position of the pistons in each carburettor at a given speed and load."

ON THE DYNO

When a car comes in for a rolling road session, the first thing CCK does is

carry out a few basic checks, such as ensuring that it has oil and water. Next they check the ignition, Smeeton explains: "If the timing is a bit retarded I'll leave it alone initially, but if it's a bit advanced I'll adjust it back to the recommended settings. That's largely done as a safety measure. If the ignition is heavily advanced and it turns out to be running lean then you risk melting a piston on the dyno, so we tend to do the fuelling first and then come back to the timing."

If the engine's performance has deteriorated it's best to rule out other potential issues, such as tappet clearances, plug gaps and ignition timing before adjusting the carburettors, he points out: "Sometimes you get something that throws you a curveball.

We had a Lotus Elan that felt like it was running into fuel starvation at about 5,000 rpm. Our initial thoughts were that maybe the float valve in the carburettor wasn't big enough to get the fuel through. In practice, it turned out there was a centrifugal rev limiter on the rotor arm and the springs had gone weak, causing the spark to drop out."

Another issue he's encountered in the past is fuel cavitation. Most carburettors are mounted on anti-vibration washers, but if they're done up too tight the vibration from the engine can cause the fuel to froth at high revs, upsetting the mixture control.

Once everything else is sorted attention finally turns to the fuelling. The first thing is to ensure all the carburettors are pulling the same

vacuum, which can be done with an air flow meter or even a medical stethoscope. Smeeton, however, says he finds a finely-tuned ear does the best job when it comes to balancing.

The next step is to do a few sweeps on the dyno looking at the diagnostics from the gas analyser. Lambda probes, which are the standard means of measuring the air-to-fuel ratio on modern road cars, can't be used with leaded fuel. Instead, CCK uses a carbon monoxide probe linked to a self-calibrating MAHA gas analyser. This can infer things like lambda readings and air-to-fuel ratios.

"We do a series of runs up to a specified engine speed and then hold it there at full throttle, see what the mixture is doing, then back off to half throttle and see what the mixture is doing again," says Smeeton. "We then repeat that at various points throughout the rev range. That gives you an idea where an issue is occurring and hence what you might need to change to address it.

"Generally speaking, you want a consistent CO value right across the range. Some cars do like to run richer than others, though. The Volvo B18 and B20 engines, for example, run



ABOVE The vacuum piston and needle valve that control the jet opening on an SU – see the bronze jet in the body of the carb

best at about 7.5 per cent due to the design of the porting."

Perhaps the most important thing to bear in mind is that the carburettor's function is to match the fuel delivery to the airflow. Although it is possible to tune the air-to-fuel ratio to different levels across the rev range using a variety of jets and emulsion tubes, that's not necessarily beneficial.

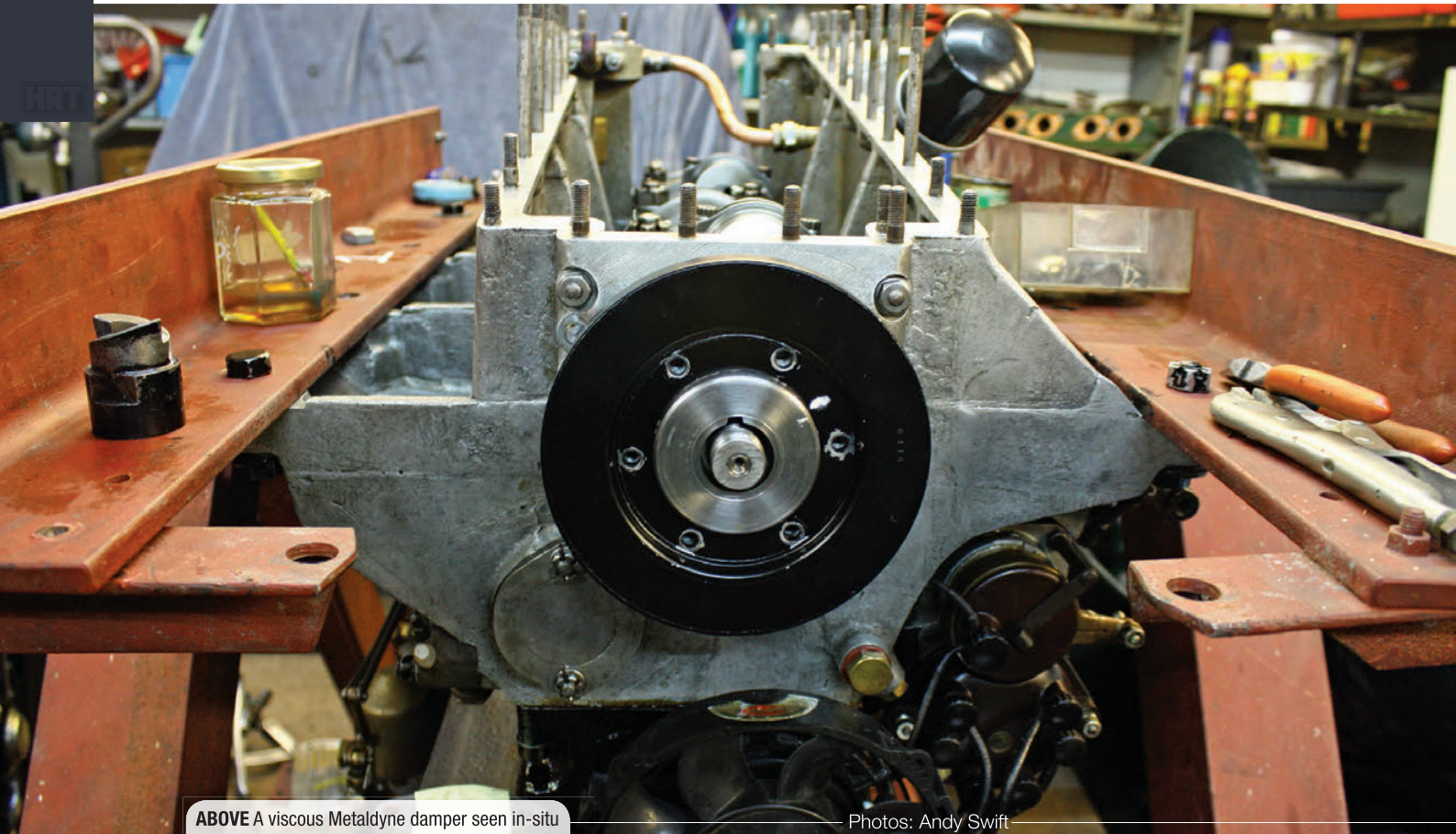
"People often say 'I don't want my car to be too peaky' when they come to us, but that has very little to do with the carburettor if it's been properly set up," explains Smeeton. "Carb tuning is

about delivering the best air-to-fuel ratio across the board. You have to work with the valve sizes, the camshaft profile and the tuned lengths that determine the airflow. Those are the factors that really define the shape of the torque curve."

Ultimately, though, the fuelling plays a massive part in realising the full potential of an engine. This is particularly true of historic race engines that may now rev substantially higher than they did in-period. Setting these up can be a lengthy process, and one that takes years of practice to perfect, but it's not voodoo. At least, not quite. **HIT**



BELOW An SU carb with the vacuum chamber and piston removed. Note the bronze jet, which the needle slides in and out of



ABOVE A viscous Metaldyne damper seen in-situ

Photos: Andy Swift

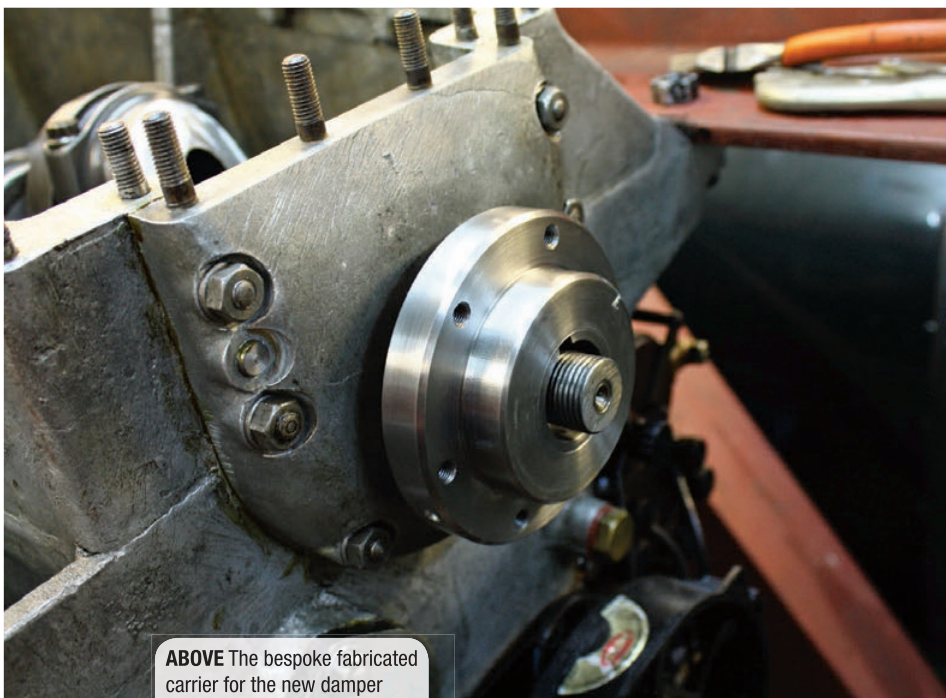
DAMPING EXPECTATIONS

Andy Swift examines a modern alternative to the traditional Lanchester-type crankshaft damper

SMOOTH crankshaft rotation is critical for every internal combustion engine and the crankshaft damper is an area which can offer real benefit for those running high-performance historic racing engines. Pre-war motor engineer James Baxter believes that their impact on performance is generally underestimated and has found a modern alternative to the traditional fitment.

The fundamental purpose of the crankshaft damper (also known as crankshaft balancer, or even a harmonic damper) is to absorb the shock imposed on the crank by cylinder combustion. Each 'bang' forces a torsional load upon the crank; in a traditional four-stroke cycle that means three shocks for every revolution on a six-cylinder engine.

This creates a third order vibration along the crank, something specific to six-cylinder engines which requires them all to have a crankshaft damper but as Baxter points out, four-cylinder engines can also benefit – for example the BMC A-series engine utilises one. The balancer acts to absorb, or damp, those torsional shocks to allow smooth rotation of the crank and reduce potential damage to the shaft itself, as well as its bearings. ▶



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This is particularly relevant with historic racing cars as they tend to operate at relatively low engine speeds, but generate vast torque. That means each bang puts proportionately greater shock into the crank than is the case in a modern engine.

The principle of any automotive crankshaft damper is the same: there is a section which is bolted rigidly to the crank and another section capable of moving relative to it under torsional vibration – the shock absorber itself, known as an inertia ring. That relative movement is tiny but just sufficient to serve its purpose. The weight of the inertia ring is determined by the torsional vibration imposed upon it: the greater the vibration, the heavier the inertia ring is required to be.

LANCHESTER COMPLEXITY

The original fitment to most historic racing cars is the Lanchester-type unit. Baxter, who is head of Tip Top Engineering, disassembles one he has recently removed from an Alvis to illustrate its operation. The carrier is located on the fore end of the crank using a parallel diameter shaft and parallel key, rather than a taper, to ensure perfectly true running. The carrier is a two-part unit which clamps around the inertia ring, held in place with springs. The slip between the inertia ring and the carrier is controlled by Ferodo-type brake lining material.

The unit possesses a number of variables which might affect performance and operation over time, the most critical being the thickness of the lining. The unit on the Alvis has been adapted, with a couple of thin steel shims having been inserted to compensate for the wear on the linings. Baxter reckons this is a good fix, but ultimately the number of different parts, and the level of tolerance required, means that a damper will eventually require replacement. While the damper may have been perfect on a freshly-balanced crankshaft when first installed, even run-out of ten thou can be damaging.

The solution is a modern viscous substitute. Baxter is a distributor for Metaldyne, a West Yorkshire-based company which specialises in torsional vibration dampers for all types of

engines – not just automotive but also industrial and marine applications.

“The viscous damper is a sealed unit,” explains Baxter. “The inertia ring floats in a viscous fluid, located by nylon bearings. The outer casing is steel and requires a bespoke adapter for each application. The damper is an off-the-shelf unit but there’s no set pattern for the carrier – I simply drop the old and new dampers off at a local fabricators as he knows exactly what I want.”

Under normal conditions, the casing and inertia ring move at a constant velocity. However, when torsional vibration occurs, the inertia ring continues to move, shearing the film of the silicone fluid, absorbing the vibration energy, with the resultant heat energy being dissipated through the surface of the casing. The damper is balanced by Metaldyne prior to shipment and the casing features a couple of subtle scallops where material has been shed for the purpose.

The viscous damper is lighter, simpler and requires less maintenance than the old Lanchester-type unit. It seems that the change would be an obvious decision to make during an engine rebuild – in fact Baxter cites authenticity as the sole reason not to move to a viscous damper. The alternative to the viscous or Lanchester-type damper is a metalastic, a bonded rubber system, which was OEM fitment in Jaguar XK engines, among others. This is a cheap and cost-effective solution but the rubber is prone to deterioration over time and the anticipated lifespan is no more than perhaps 10 years.

As with anything when rebuilding an old race engine, the crankshaft damper presents a multitude of options; the ultimate decision will be dependent upon budget and maintenance requirements. The effect upon engine performance and longevity, though, cannot be underestimated. **ERT**

“ The inertia ring floats in a viscous fluid, located by nylon bearings”



ABOVE The old-style Lanchester damper reduced to its component parts to illustrate its complexity

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ABOVE Managing demand for races such as the Le Mans Classic is an essential part of Dunlop's programme

COMPOUND INTEREST

Tyres are often the distress purchase, unloved and misunderstood, but as **William Kimberley** finds out, there is a great deal more to them than meets the eye

THE increase in historic motor racing has brought with it the demand for racing tyres. What was, until recently, more or less a cottage industry has grown exponentially over the last few years and along with it not just the quality of the product, but the suppliers themselves.

One of the biggest names in classic racing tyres is Dunlop, a brand that stretches back to the creation of the pneumatic tyre, so it is natural that it is a major player in the historic racing world. However, rather than deal direct with customers and retailers, it has devolved that responsibility to HP Tyres.

As a family that is now into the second generation running it, it provides all Dunlop Motorsport circuit products from its 15,000 sq ft facility at more than 60 race meetings throughout the year, at events as diverse as the Britcar 24-hour GT race and the Goodwood Revival. It also has a healthy European customer base.

"One of the challenges of servicing the historic racing market is managing demand," says John Pearson, a director at HP Tyres, and son of the founder.

"We've been doing it a long time and we know that if it's a Monaco year and Le Mans Classic year then we need to ramp up on certain sizes.

"In modern industry we do now need to do a 12-month forecast and then a quarterly one and then constantly reviewing things on a monthly basis. However, there will always be occasions when a surge in demand can catch you off guard with an event that's crept under the radar. For example, there might be a special MG celebration that leads to massive demand for a certain type and size of tyre where we should have made 250 of them rather than the 150. However, compared to former days, our increased warehouse space means that we are able to carry a much larger stock than we have ever done before.

"We also regularly go to FIA technical

meetings and tyre workshops, which really help us plan as well. We also work very closely with the Masters Historic Racing team and have an annual review of where we are going and what we are doing and we'll service all those events all the way across Europe. It means that there's a link from the governing body to the championship organisers as well as with the end user, the customer who fits our tyres to their cars."

With more and more professional race teams coming into historic racing, Pearson notes that they bring with them their own procedures and demands. "The rigours of how they engineer a car are quite different to how an individual in a VSCC event, for example, would go about things," he says. "Overall, though, it's meant that they have upped the game in this branch of motorsport. We now even have teams that go tyre testing, not just in Britain but around Europe.

"This level of professionalism that's

coming into historic racing some would see as a blessing, but others as a potential curse because it is making historic racing more difficult financially to continue to do if the goalposts keep moving in terms of performance levels. I can understand the frustration of someone who has been doing it on the back of a trailer and has been enjoying themselves and how the sport is changing for them. However, it must be good for the industry overall as the performance level gets better year on year.”

SURGEON'S TOUCH

Michelin and Pirelli also take a slightly hands-off approach when it comes to historic racing, South Yorkshire specialist Longstone benefitting from this policy. In fact, it could have been quite different had it not been for an A4 piece of paper floating around the Silverstone paddock at a VSCC event.

“I was attending a VSCC race meeting when I spotted this note that said ‘business for sale’, says Dougal Cawley. “At the time I read it I was a tree surgeon but was considering a career change before I chopped my leg off. I made enquiries and ended up by working the rest of the year with Mike Hurst, the person selling the business, taking over in the down period in October 1999. Mike continued to work with me at the end of the phone as I learnt the trade, which is how I ended up taking over. Mike’s business was only pre-war car tyres and while my core interest was initially them as well, it has evolved over the years to post-war ones as well.”

Longstone has a good relationship with a number of companies including Pirelli and Borrani, but the longest one is with Michelin. “I’ve almost got the Monsieur Bibendum tattooed on my arse,” he says. “I’m a big advocate. The quality is exceptional and its history is fantastic.”

For the racing world it does a small range of 1960s and ‘70s Michelin XAS FF (for Formula France), a period asymmetric tyre and, critically, an asymmetric carcass as well as the tread patterns that were developed to enhance cars of that period. It was constructed taking into account the different kinds of work done



ABOVE Dunlop's technology makes for a classic look but modern performance

by the shoulders, which are rounded on this tyre, sidewalls and different parts of the crown, depending on whether they are on the inside or outside relative to the car. Just as a person’s foot is asymmetrical, the inside and outside of a tyre work differently to give the car good balance and sure handling.

“People think that a modern tyre is better and in some ways that’s true but not quite so when you think about putting them on an historic car,” he points out. “A more modern tyre with a square shoulder doesn’t work very well on a classic car: as it heels you don’t have built-in adverse camber in the suspension, so it climbs up

on the shoulder when cornering; period tyres have more rounded shoulders so that there isn’t some dramatic loss of grip. It means that the car doesn’t go round the corner like a 50 pence piece, but progressively.

“A modern tyre will improve straightline braking and it will cut down wheelspin in the wet in a straight line, but the handling isn’t as good. A modern tyre is designed to be used in a completely different environment, so it doesn’t handle as well. However, build quality, materials and compounds of modern tyres are better.

“All the historic tyres we currently have from Michelin and Pirelli are built with ►



ABOVE Longstone enjoys a good relationship with many of the tyre companies



ABOVE The Longstone name is a growing force in historic racing

modern compounds with a modern carcass design and with the demands of the classic car in mind, they build high quality modern products that suit the chassis, suspension and steering while also looking nice. The tyres we have now for historic racing are top quality and built with the classic racer in mind. It means that we've got the best of both worlds.

"People may think it's not a proper Michelin X because it hasn't got the right compounds, but that's no longer an option. When you drive your car you are effectively grating that rubber tread into a fine powder and putting it into our water systems, which isn't really ideal. You might say it is ozone-angry. The material they used to make tyres with is no longer legal, so we have to change and the modern compounds used on the tyres are greener."

After winning the Michelin contract, the business took off for Longstone, which led to the next chapter in its life: the contract with wheel maker Borrani. "Because we are now able to supply various restorers with the tyres they needed, it put us in a situation where the Borrani wheel builders became aware of what we were doing so we landed a deal with them to become the UK agent," Cawley explains. "It means that we can now get a Borrani wheel rebuilt in Milan at the factory

really quickly."

The next big thing for Longstone was the relationship with Pirelli, which had made some historic tyres that hadn't found their way to market. "I had been nagging them as I wanted some Cinturatos for Ferraris and Maseratis and ended up becoming an agent," he says. "The range has expanded now and Pirelli is bringing out some top quality products. It has done a small range of '50 and '60s radials and then moved into producing later ones as well, including the CN36 Cinturato that was introduced in 1969 as Pirelli's 70 profile high-performance range of tyres, and is well known for its fitment to the Ford Escort Mexico while the CN36 N4 was specially homologated for the Porsche 911.

"Pirelli also does a CN72 205 15 which is a quite important tyre that came out in 1964 as it was capable of maintaining the speeds that the supercars of the day were reaching. Pretty well most of the road Ferraris, Maseratis and Lamborghinis between then and 1972 were fitted with the 205 VR15s but hadn't been for years as there hasn't been a proper period V-rated tyre in that size. Instead, people have had to fit 70 profile tyres or others that are inappropriate for those cars.

"I am also taking delivery of a 175 HR 400 Cinturato which was original

equipment to the Lancia Flaminia and the Alfa Romeo 2600SV and a few 250 GT Ferraris. It's a pretty good thing for Pirelli to have stepped into the market because it's only a low volume of car that needs that tyre, but it will again be good to supply the tyres that are the correct size and have the correct tread pattern.

"In the future Pirelli intends to make a proper Morris Minor tyre, as there isn't one. We are going to get a Pirelli Cinturato made which would have been in period and to the correct dimensions. We are going to make the right tyre with the right tread pattern with a decent compound and good build quality that will satisfy what the Morris Minor brigade need."

The next item on the menu, says Cawley, is to make some Pirelli P7 Lamborghini Countach tyres, including some competition rubber: "We do all the competition tyres, including Dunlop Racing, Avon and Michelin's TB range, which is a road-legal intermediate, fully treaded tyre and the TB5 semi-slick, which is also road-legal."

Were it not for the tyre companies, along with the specialist dealers supplying their products, the historic racing scene would not be what it is today. They may be black, round and not easily understood, but without tyres, racing would come to a halt. **HRT**

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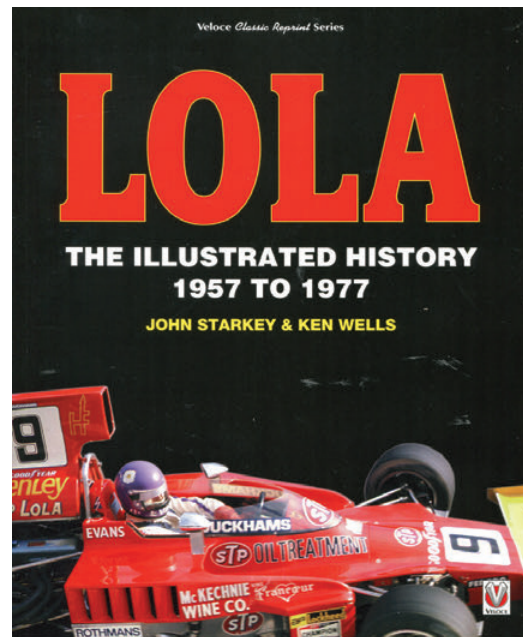
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I HAVE to confess that I almost dropped this book when I took it out of its wrapping because the first thing I saw was that it was co-written by Ken Wells. This was the chap I brought into motor racing journalism over 30 years ago but who sadly passed away 20 years ago. Then I saw it was one in the Veloce Classic Reprint series.

From the first page you can tell that this is a reprint. In the Introduction, co-author John Starkey states that as he was writing it Lola was trying to get over the debacle of its Formula 1 entry in 1997 and that he wished Eric Broadley and everyone at Lola a good future...

Apart from the demise of Ken Wells, this is rather a sad book for me. Lola was a fantastic company producing some great racing cars. For a while it was king of the customer car racing world, but it all got blown away. Thumbing through this book, though, brings it all back.

Illustrated with mainly monochrome pictures, it is a comprehensive story of this manufacturer from the start. The early marks are covered in the first few chapters before the authors get into their stride with cars that the company produced from the mid '60s on. There are some wonderfully evocative pictures throughout – Graham Hill winning the 1966 Indy 500 in a Lola T90, John Surtees in the Honda-powered T180 in the 1968 Monaco Grand Prix and Mario Andretti in the uber-successful T332 in 1974. Then there are the oddities such as the T150, the four-wheel drive Indianapolis car built for Roger Penske in 1969 and the T270 Indycar in which Patrick Head had a hand working with Bob Marston and Eric Broadley. Great stuff and a good read.

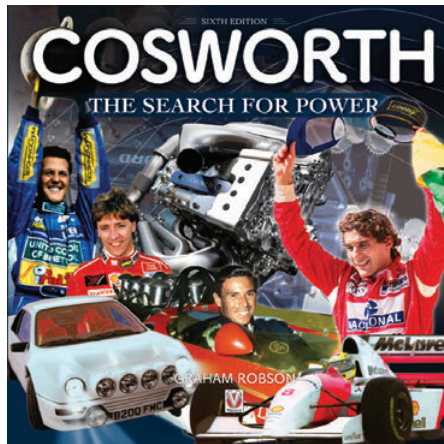
At £37.50 the book is not cheap, but for those who missed it first time round, it will be worth it. **HRT**

Cosworth

The Search for Power
Sixth Edition

Graham Robson

Published by Veloce
ISBN 978-1-845848-95-8
312 pages
£55.00/\$90.00



COSWORTH is such an icon in British motorsport engineering that it is not surprising that book after book are published on its activities and achievements. However, this one has to be taken very seriously as it is written by doyen of all motoring historians Graham Robson and it is the sixth edition, and so has been updated since the fifth edition that was published as long ago as 2003.


Since that time a great deal has happened, the principal one being the takeover of the company by Jerry Forsythe and Kevin Kalkhoven, the latter having written the Foreword. The publication of this edition has been timed to coincide with the 50th anniversary of the birth of the DFV.

Even if you know the Cosworth story inside out, this is a great read. While it may look like a coffee table book with its fine illustrations, including a number of cutaway drawings, it is a very serious read indeed.

For me personally, the section I found most interesting was the more modern history. The story behind the unsuccessful and unhappy foray in Formula 1 with Jaguar is fascinating and the now-forgotten agreement with the Jordan team, which was going through a tough time financially with the collapse of a huge sponsorship deal. Then there was the entry onto the scene of Red Bull, which had taken over from the Ford-owned Jaguar, followed by the deal with Williams which ran a Cosworth engine in Formula 1 in 2006. Williams then deserted the Northampton team, lured by the Japanese yen of Toyota which, as Robson points out in the book, was at least 25 bhp down on the Cosworth CA.

As he writes: "In almost every way, therefore – technically, financially and in marketing terms – this was a sporting tragedy for Cosworth, as the new V8 was demonstrably competitive, and would have been more so if development cash had been there to back it."

The final chapter covers the Forsythe/Kalkhoven ownership when Cosworth got out of Formula 1 and successfully diversified into other industries. That is why there is a picture of a hulking great diesel train that the company undertook to rescue, remanufacture and reverse engineer major parts of the engine.

Appendix 1 is a very comprehensive list of every single Cosworth engine from the beginning that includes notes, line drawings and pictures. 

• **First Principles, the Official Biography of Keith Duckworth OBE by Norman Burr**, the book we reviewed in the summer 2015 issue of *Historic Racing Technology*, has just been republished as a paperback by Veloce for £32.50/52.50.

Formula 1: Car by Car 1960-69

By Peter Higham


Published by Evro Publishing
ISBN 978-1-910505-18-2
300 pages
£50.00



AT first glance you might think not another book on 1960s Formula 1 cars, but you would be mistaken for dismissing it. To start with, Peter Higham comes with a huge amount of pedigree as he was the publishing director of Haymarket Consumer Media's motor racing publications for a good number of years, and his knowledge is immense. He also has a good turn of phrase.

The book is incredibly well illustrated with 630 photographs, a good chunk all in colour that bring this decade of motor racing alive. It was a time when the independent team had as much chance of winning a Formula 1 race as the works outfits, unlike today's scenario. Nor was it a business dominated by the huge mega-buck sponsors or visiting some strange places in the world where no-one really cares about motor racing. In other words, it was an era of the purist, not that we knew it at the time.

The sections that drew me into the book were the items on the teams or cars I did not know about or had forgotten. Gilby Engineering, for example, which was a bit of a half-cock entry in 1962, but hats off to the people who tried to make it work. Then there is Equipe Galloise, which despite the name, was a British entry, Jack Lewis, the owner and entrant, having backing from Cardiff's Western Sporting Press and his father's H&L Motors. Some would protest that for the self-proclaimed pinnacle of motorsport, such things shouldn't be allowed, and there's an argument to be had there, but it was so much more characterful. The list of such entries goes on and on, thanks to Higham's masterful research.

In fact, the more I got into this book, the more I couldn't put it down and while it isn't cheap, it's highly recommended. 

Blurred Lines

The use of re-engineered performance parts has raised the issue of originality. But with historics needing new parts, which category does this leave them in – original or replica?

Sophie Williamson-Stohtert brainstorms...

THERE appears to be an ever-growing fine line between what is, or isn't, deemed "fit to compete" in historic motorsport. But, with so many (arguably hazy) rules and regulations to abide by, how are we to determine the answer?

Entry rules are becoming increasingly strict. An unnamed source suggests that in order to compete at one particular circuit in the UK, owners will soon be required to present scrutineers with an Historical Technical Passport (HTP) – documentation only usually required to compete in international events.

International historic motorsport competition is governed by Appendix K of the FIA's International Sporting Code (ISC). This means that the car in question must be in possession of a valid FIA HTP, as mandatory – a sporting document which confirms that the car's specification is that of the particular model it purports to be. The HTP's purpose, as it has been since it was introduced in 2004, is to ensure that all cars accord with the authentic specification and can, therefore, compete with one another fairly.

According to the MSA, the HTP must refer to a historic period in the life of the car, but this is not necessarily the point of original manufacture. "Period Specification" is defined as corresponding to the configuration of the model, proven to the satisfaction of the FIA, to have existed in the period in which it is classified. Whether the

car is wholly original, partly original, assembled wholly or partly out of period components, or is a replica, is not relevant to the issuing of an HTP. The prime criteria to be granted an HTP is that "the car represents a provable specification and type that competed internationally in period".

So, you ask, with at least one circuit requesting that all competitor vehicles now be equipped with a said HTP – which can cost up to £1,000 to fund – could this be the beginning of the end of historic motorsport, or a way of renewing and re-establishing its

presence on the competition calendar? Well, according to said circuit, it's the latter – protecting the future and integrity of historic racing while ensuring an equal playing field.

However, come to mention it, there are a few dangers facing historic competition. Spares and repairs, for example, arguably remain the biggest threats, simply because vintage cars run vintage parts, which (let's face it) won't last forever. That's why a number of companies specialise in restoring original, or reproducing bespoke, historic performance car parts, including Vintage Parts Supply, Aurora Bearings, Jenvey Dynamics and WOSPerformance.

The thing is, in the eyes of the purist, if a part isn't wholly original – as in, if it hasn't been tampered with in any way other than with an oily rag and some copper slip grease – then the car isn't either. I can see their point. But, let's look at it from the revolutionist's point of view: if you can't rebuild the parts, how can you run the cars? This confirms, then, that the innovative engineering could be the only answer to keeping historic motorsport alive.

Sometimes it's a case of "make do and mend"; other times it's a case of embracing change. **HRT**

“ If you can't rebuild the parts, how can you run the cars? ”

BELOW Saloons of the 1970s and early '80s racing hard. When new parts are required, the thorny issue of originality rears its head





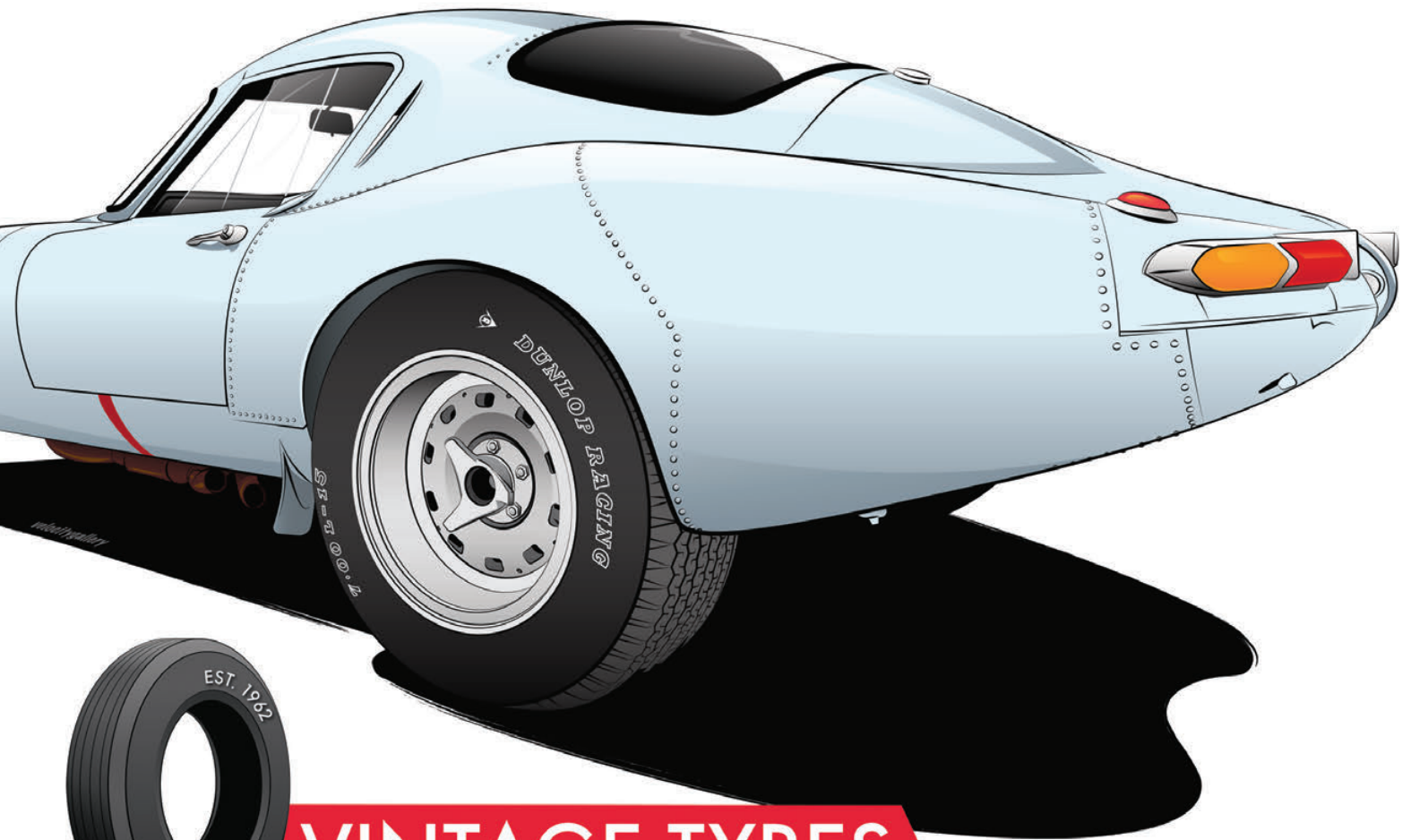
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