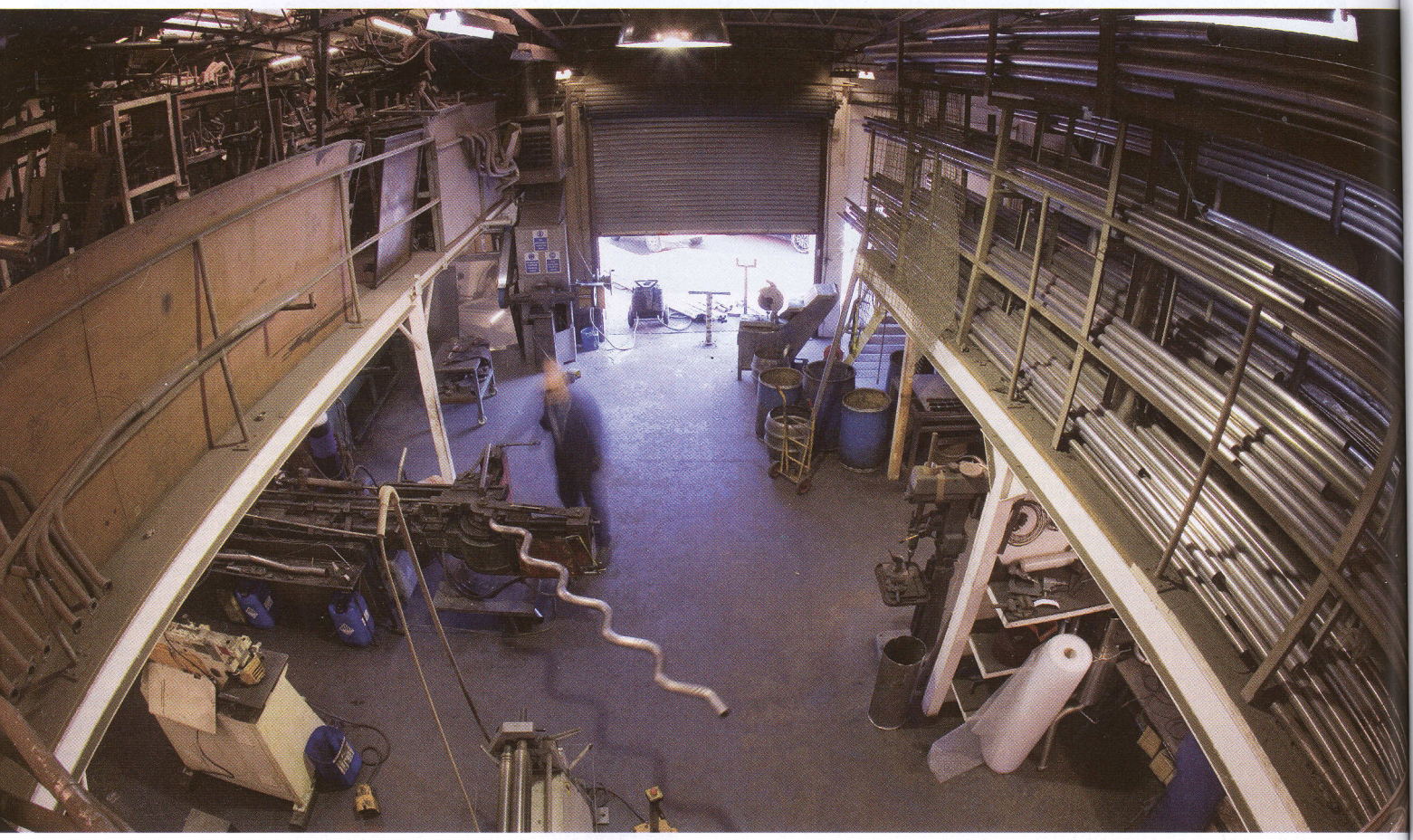


Hayward & Scott

Masters of the black art

Words: Paul Davies Photography: Matt Howell

You know the signs. The nice burble that reminds you of one of the many reasons why you bought a Porsche begins to get just a little louder. All too soon you know what's happening: the exhaust system is on the way out.

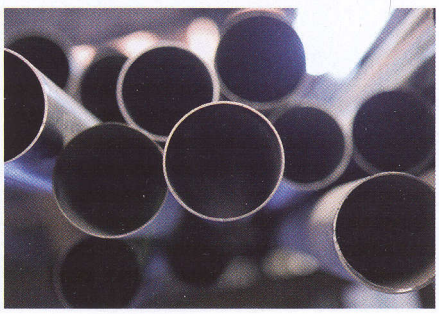
Initial despair turns to a sly grin as you contemplate the up-side of this situation. Could this be a chance to nudge just a little more power from the engine, improve the torque a tad, make that exhaust note even sweeter, and maybe swap a rusty bit of piping for a shiny new work of art?

Of course, Porsche, and one of several aftermarket suppliers, will sell you a replacement system, offering a like-for-like version of the manufacturer's original. But taking this road could be a lost opportunity. There are people out there who can offer so much more that just something that will get you back on the road in legal trim, no longer a source of nuisance to the neighbours. It's about this time that your thoughts could well turn to Hayward & Scott.

On a trading estate in Basildon, Essex, the small team at Hayward & Scott has been mastering what is undoubtedly the black art of manufacturing exhaust systems for nearly a quarter of a century. They've built a reputation for delivering a product that not only works, but lasts for almost as long as the car itself.

Stainless steel is the key. Most production exhaust manifolds (headers, if you're in the USA) and systems are made from mild steel, partly because of ease of manufacture but mainly because of cost. Stainless is stronger (and so, importantly in some situations, can be used to make a lighter exhaust system), does not rust, and is less affected by extreme variations in temperature. All of which is why – with only a very few special exceptions – this particular subject of our Specialist series manufactures systems, off-the-shelf or bespoke, only in stainless steel.

Gordon Scott's company has been making Porsche exhaust systems almost as long as it's been in existence. He's a fan himself – currently



driving a 993 that has a 100-cell high-flow catalytic converter linked to a pair of his company's sports boxes. Workshop manager Ian Reeve is also a Stuttgart man. His Carrera 3.2 Supersport – previously owned by Gordon – has a 3.6-litre engine transplant, complete with a full H&S system, of course.

The two Porsches at the Basildon factory are not just nice cars. Hayward & Scott practises what it preaches, or in this case manufactures. The cars are test beds for the latest ideas, and make regular visits to the rolling road – all-important, as Porsche systems make up about 20 per cent of the company's production.

But it started with a Jaguar. Apprenticed as a coachbuilder in the mid-1950s, and then working (like many automotive specialists who live in Essex) for Ford in the press shop, Gordon learnt the importance of making and working to accurate drawings. Then he emigrated to Canada where, in a three-year stay, he worked for the Pratt and Whitney aero engine company, and recognised the qualities of stainless steel that were to become all-important in the scheme of things.

Strangely, he took a Jaguar XK cylinder head with him over the Atlantic, and brought it back when he returned to the UK. 'I decided I'd build a Jaguar special and, because I had the head, started by making the exhaust manifold,' he explains.

The manifold, crafted from stainless steel, of course, was seen by Jaguar dealers Swallow Engineering, and Gordon was asked if he could make an XK120 petrol tank in the same material. The resulting work produced an order for ten more, and then some exhaust systems. Ferrari owners, as well as Jaguar-philes, took notice – and the XK special project was sidelined as Gordon and partner Mark Hayward (who had studied sheet metal work at evening classes) built up a business, working evenings in a rented garage while they both continued their day jobs.

Hayward & Scott came into being in 1983, in small premises at the rear of the quaintly-named Blinking Owl Café in Rayleigh, Essex, the move to Basildon taking place in 1986. Breakthrough came at about the same time, when engineer Terry Hoyle asked if H&S could manufacture manifolds and systems for the RS200 Group B rally car that he was developing for Ford. It wasn't long before the company was also fabricating components for the Mitsubishi Ralliart concern.

Gordon's first Porsche came along when, tired of losing money on mainstream performance cars, he bought a 911SC. The exhaust he made worked – and so did the one for the 930 Turbo that followed. He admits that the Porsche side of the stainless business took a bit of time to get going. 'We made three Turbo systems and they were stuck on the wall for so long that, in the end, I swapped them for an engine.'

Needless to say, since those early days, the company (Mark Hayward, in fact, left after five years to concentrate on bodywork) has established itself as a leading manufacturer of stainless systems for a variety of performance cars, including the Porsche range. Some products are available off-the-shelf, working from established patterns; anything else can be fabricated as a one-off if the customer is happy to leave his car in the workshop.

Stainless steel is a mild steel alloy with chrome content, plus nickel and zinc. H&S uses mainly BS304 or BS316 tubing, which contains 18 per cent chrome, with a wall thickness of 1.2 or 1.6mm

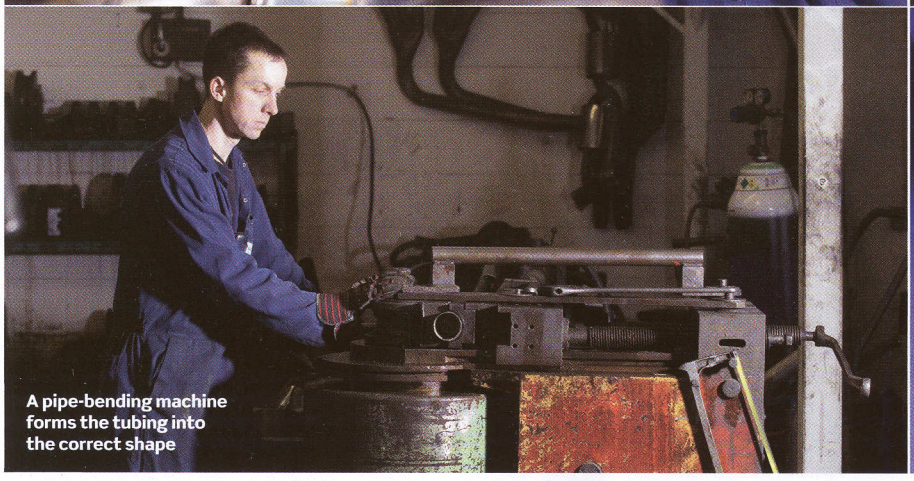
Set of Carrera 3.2 pipes bolted to a jig to check overall shape. The post on the right shows the close proximity of a shock absorber

Each system has a set of patterns to determine the correct shape and length of each pipe

Workshop manager Ian Reeve started with H&S in 1984, when he was 17. He was left to remove an engine and gearbox from a Jaguar on his first day!

Stainless steel is TIG (Tungsten Inert Gas) welded because the process is more controllable

964 engine transplant into a Carrera 3.2 means a one-off system is required



A pipe-bending machine forms the tubing into the correct shape

Most free-flow silencer boxes have a central perforated pipe covered in stainless steel wool to absorb heat. Long-strand glassfibre filling is used between the wool and the outer casing

WHY BLACK ART?

Talk exhaust systems and you really are entering a mystical world. Yes, there are formulae to tell you how big and how long pipes should be, but when it comes down to the practical side of things it's really a matter of a) what fits, and b) how the engine performs on the dynamometer or on the road. More than anything else, a good exhaust manifold is down to experience.

The manifold is just as vital for achieving maximum usable power as the induction system, cylinder head and camshaft(s). These three ensure that the maximum possible amount of fuel/air mixture is burnt in the combustion chamber. The exhaust then has the job of quickly and efficiently extracting the gases produced.

But an exhaust manifold is more than just a pipe, or series of pipes, that carries the gases away from the engine. Properly designed and manufactured, it should improve combustion – and therefore increase power. Here's why.

As the spark plug fires and the compressed fuel/air charge is burnt rapidly in the combustion chamber, the exhaust valve opens and a pulse – in the form of a continuous pressure wave – is sent through the port into the manifold and through the exhaust system. This pulse has the effect of extracting, or sucking, gases from the combustion chamber.

But the pulse does more than just pull out the burnt gases. Because most engines have camshafts that have overlap – the period when the exhaust valve has started to open but the inlet valve has not yet fully closed – the process helps to suck fresh mixture into the combustion chamber. It also helps to take hot gases away from the combustion chamber and lowers the temperature of the charge, and so makes it denser. It's generally reckoned that the correct use of the pulses in the exhaust manifold can improve the volumetric efficiency of the engine by up to 10 per cent.

The manifold designer's aim is to arrive at a length for each pipe that coincides with a peak in the pulse, which encourages maximum extraction. If this is not achieved, back pressure will restrict the flow in the pipe, reduce the sucking effect on the inlet charge, and cause an increase in temperature.

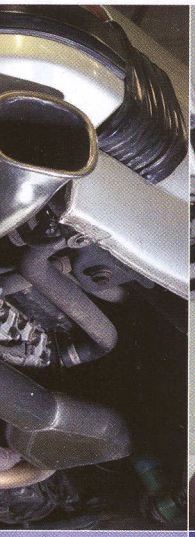
The simplest exhaust would have a separate pipe from each exhaust port on the head, but this is usually not practical. It can also be very noisy and not really all that efficient. Most likely, the manifold has primary pipes that join together at some point, either into secondary pipes or direct to an exhaust system with a silencer and tail pipe.

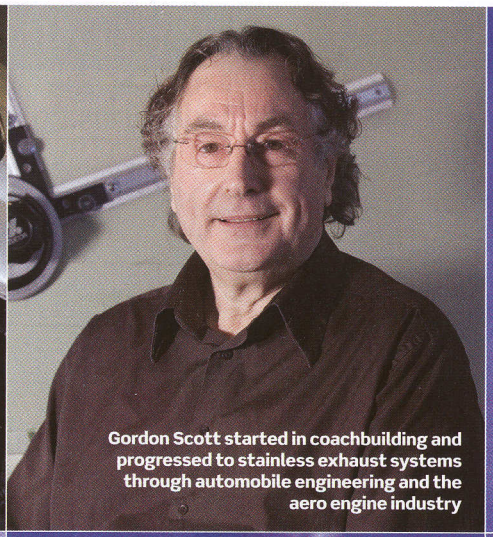
While the length of the entire system can be important, the most critical part is the length from the exhaust valve to the first join in the primary pipes. If this is at the correct point, then the pulse creates a venturi effect that makes one primary pipe have a sucking effect on another, assisting gas flow from the engine even further. Ideally, primary pipes should be of equal length and linked with alternate-firing cylinders to achieve maximum venturi effect.

Size is also important. Ideally, the internal diameter of a manifold pipe should be the same as the exhaust port on the cylinder head – if there is a 'step' at the join (ie, the manifold pipe is smaller than the port) then back pressure will be created. But primary pipes should not be too large – if they are, the speed of the exhausting gases will be slowed down.

All this is fine in theory. Practice, of course, may not be the same. Four-cylinder in-line engines (such as the 924, 944 and 968) can benefit from a 4-2-1 manifold, where separate primary pipes join into two secondaries before coming together at the exhaust pipe. The same could also be said of V8-powered cars. But when it comes to the flat six, theory has to take a back seat to practicality. It's mighty tight down there in a 911 tail – and with air-cooled engines there's also the little matter of allowing room for the heating system.

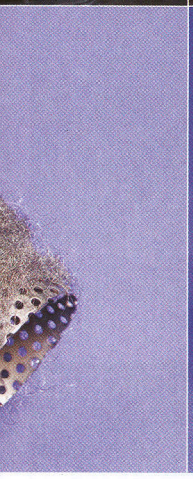
Perhaps you can see why it's a black art. In the end, designing and manufacturing an exhaust system, especially one for the 911, is really down to two things: testing and loads of experience.



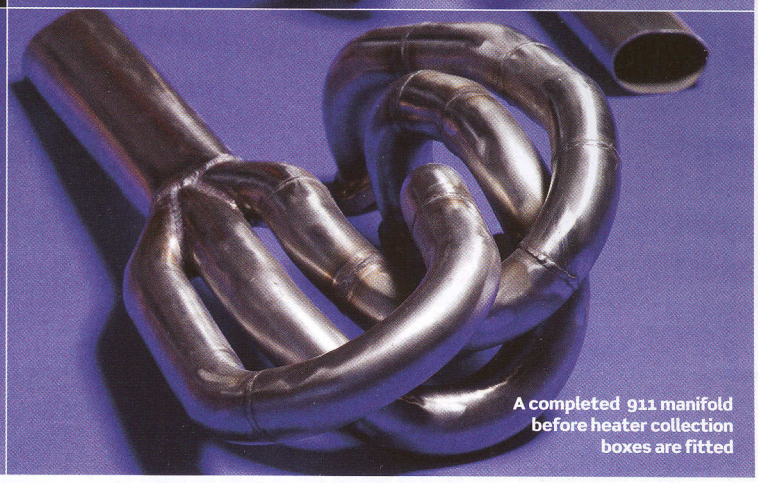


Gordon Scott started in coachbuilding and progressed to stainless exhaust systems through automobile engineering and the aero engine industry

996 silencer box



993 silencer box



A completed 911 manifold before heater collection boxes are fitted

While some Porsche owners buy from the parts list and make their own fitting arrangements, many take advantage of H&S's reasonable labour rate and have the system installed at Basildon – people in the know realise it's no fun prising a rusty exhaust from a 911 engine bay!

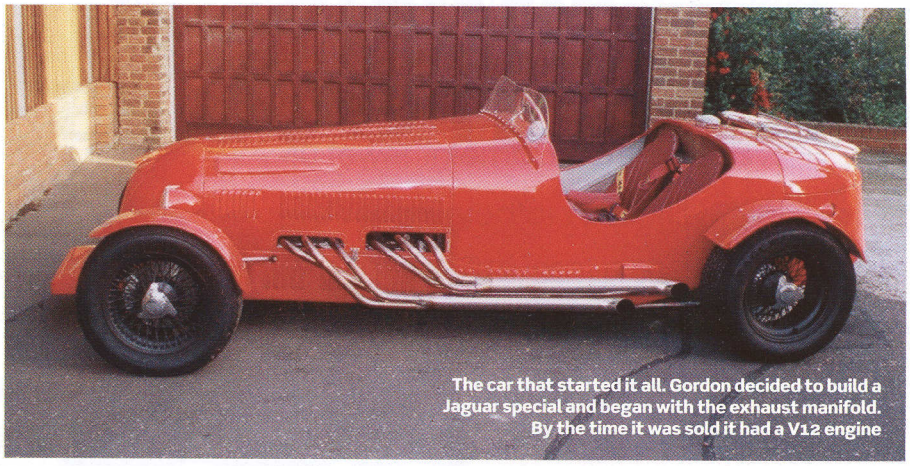
The H&S range of manifolds and exhaust systems has grown over the years, with new products being added as Porsche increased and developed the model range. The 911 system, more than any, is somewhat of a compromise. 'Space within the engine bay, the need for heat exchangers on a road car and ground clearance dictate the overall design,' says Gordon.

In fact, the starting point for the 911 system was the equal-length manifolding designed some years ago at the Porsche factory. H&S has further developed the design as the car itself has evolved and – in addition to its own dyno testing – it has relied heavily on customer feed-back to get it right.

Gordon quotes the example of the 930 Turbo system that at first did not seem to perform. The customer brought it back, they cut it up, located the problem (two pipes facing each other in the back box were causing back pressure), and found an extra 22hp. Now they're experimenting with slightly smaller diameter pipes in an effort to increase gas speeds.

Getting it right and leaving a customer well and truly happy is all-important. 'I'd rather take a system off if someone's not satisfied,' Gordon says.

Prices? Stainless steel is an expensive material, and so a system is likely to be more costly than anything manufactured in mild steel. But it lasts much, much longer, and has a quality look that cannot be bettered. For example: a typical complete 911 system – manifolds, heat exchangers and exhaust – costs £1600, a Turbo back box £600, and an exhaust system including sports cat for a 968 is £850. If you want H&S to carry out fitting, the labour rate is £50 per hour – and workshop manager Ian Reeves reckons five hours will usually be sufficient to fit a 911 system. All these figures exclude VAT.



The car that started it all. Gordon decided to build a Jaguar special and began with the exhaust manifold. By the time it was sold it had a V12 engine

Of course, cars manufactured after 1993 require catalysts to be fitted, so H&S buys in appropriate 100-cell sports versions to mate with its exhausts.

As they say, the choice is yours. Do you want to fit an exhaust that will slowly, relentlessly rot, or how about a shiny work of art that will last for ever, give you that little extra performance, and sound right? Go on, do it.

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