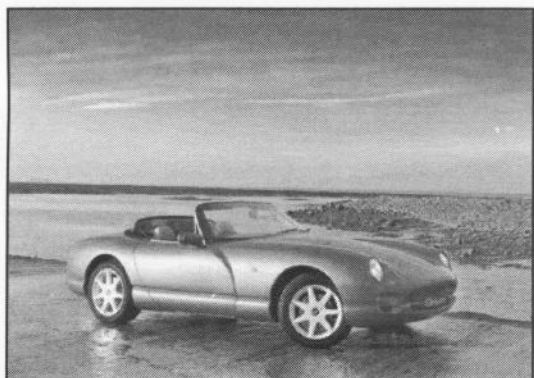
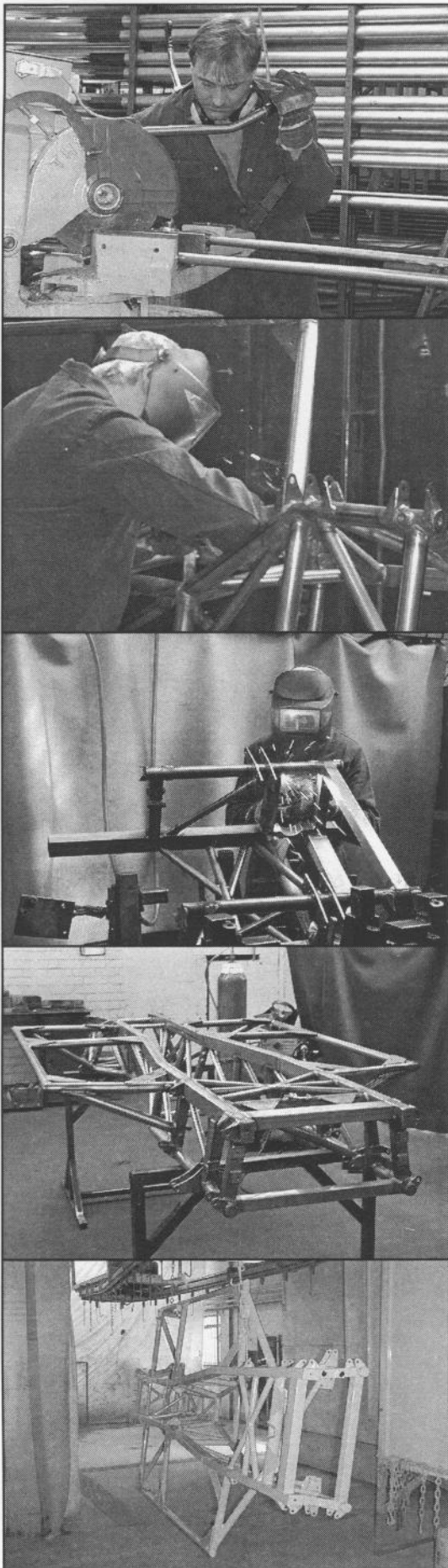




## Factory Guide





## Introduction

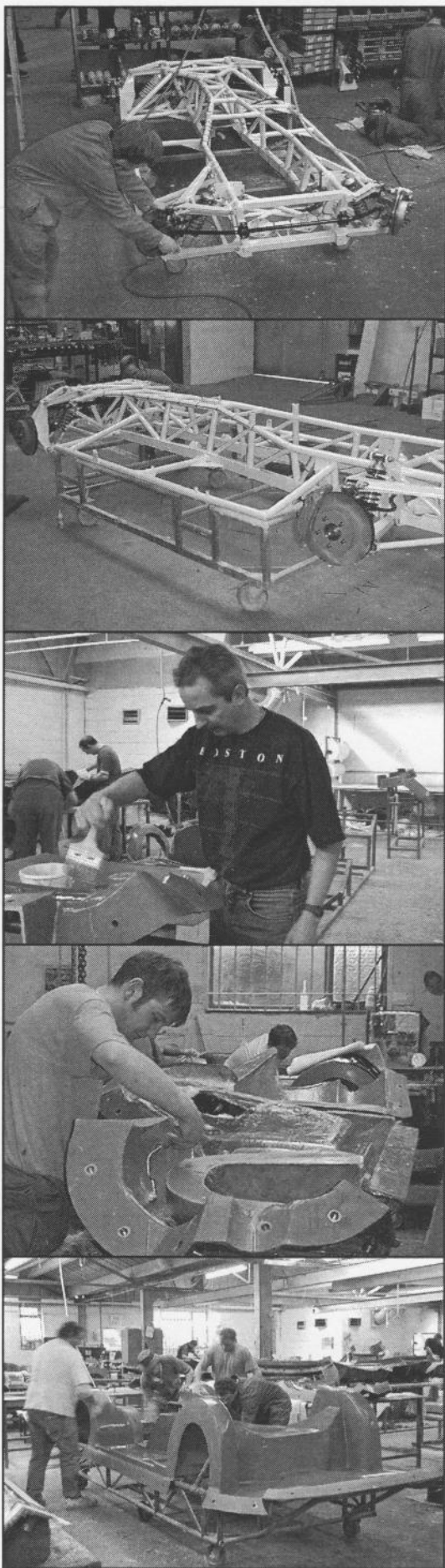
The year 2000 will see TVR's production reach the 2,000 mark, now building four different models. The factory itself has grown to 200,000 square feet in recent years and the workforce to 750.

None of this would have been possible without the talent of TVR's engineers and craftsmen, which is often obscured by people's perceptions of TVR. Every car is hand-built to the customer's own specification and every engine has the engine builder's initials on it. Nowhere else could you buy a car of such sophistication which is all hand-made, to your own order, for a price even remotely comparable. In the case of the Tuscan Speed Six, this has been taken even further and everything, from body to chassis to engine and in this case even the switchgear and instrumentation, is designed and crafted in house. Indeed, TVR is irrationally proud of the fact that there are probably more employees per car produced here than there is anywhere else.

Yet despite all this talk of craftsmanship, it would have been impossible for TVR to have engineered such a car ten or fifteen years ago. The very latest high technology has been used, not in the styling but in the design engineering, to enable the largest British car manufacturer to produce simple and elegant solutions to problems of how to hand-manufacture such sophisticated cars in such small volumes. It is only at the stage that a design has to be compromised in order to mass produce it where TVR parts company from high tech. If TVR ever had accountants in a position of authority, they would make sure that, just because of the cost of the switchgear a car like the new Tuscan would never make it off the drawing board. Fortunately, TVR Chairman Peter Wheeler is an engineer whom, in his own words, "just likes designing and building things..."

## Chassis Fabrication

The first process is to cut the mild steel lengths of tubing to size, before being jig formed for complete accuracy, followed by spot and seam welding. Six welders work on any one chassis, on three separate jigs. It takes 16 man hours to completely weld a chassis. As much of the welding as possible takes place while the chassis is in the jig in order to minimise distortion in the final frame. Chassis for Chimaera and Griffiths are identical and prepared on the same jig. The Cerbera and Tuscan are prepared on separate jigs. These share a similar chassis, the Tuscan being a shorter version of the Cerbera chassis. The completed chassis is then inspected and date coded before being taken over to the powder coating plant. The chassis are also numbered to correspond to the final customer even at this early stage.



The next stage involves a shot blasting process which, once again takes place on site.

After de-greasing, the chassis is etch primed, then sprayed with a polyester and epoxy hybrid powder. The chassis hang on a conveyor which is electrostatically charged. The powder particles leave the gun oppositely charged. The result is that the particles are attracted to the steel which greatly reduces the time needed to perform the job and completely cover all the metal. The chassis then travels along an oven at a constant temperature of 200 degrees Celsius. During the twenty minutes this takes, the plastic particles fuse together to form a protective skin over the chassis.

The completed chassis and suspension components are then assembled along with all the running gear. Wishbones, uprights, steering racks, springs, dampers, fuel and brake lines are fitted at this stage. The engine and gearbox are left to a much later stage to add to the chassis so as to reduce the amount of capital tied up in work in progress. Even at this early stage we can identify customers cars by the individual specification.

### **Body Construction**

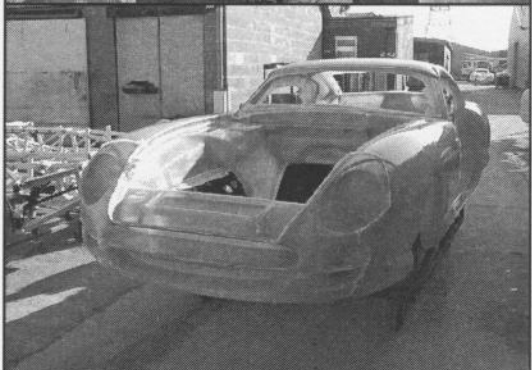
Meanwhile, a parallel process is taking place in the body shop. All TVR bodies are hand layed. All the bodies are made using random chopped strand glass matting for the most part. Areas of high stress such as seat belt mountings use bi-axial woven glass fibres. Generally, the bodysell is layed up to a thickness of 1200 g/m squared. In large flat areas liable to resonate, the laminate is further stiffened by the additional layer of "coremat".

The removable roof panels for the convertible cars are layed up using woven carbon fibre cloth so as to keep the weight to a minimum to allow easy removal and storage by one person while still maintaining the necessary stiffness.

The moulds themselves are made from an epoxy rather than polyester resin and a traxial stitched matting rather than woven mat. This is partly because of the increased strength and partly because of the better release properties of the epoxy.

After waxing the mould, the gel coat is applied and left to partly cure. The glass fibre matting is cut to a shape that will fit into that particular mould and "painted" with the resin.





The glass fibre matting is then laid into the mould and stippled with the brush to force the fibres to follow the contours of the mould surface and ensure good adhesion to the gelcoat.

The final stage is to roll the wet mat to make sure that all the air trapped between any of the layers is excluded. The component is then left to partly cure. When the resin is sufficiently rigid the matting overhanging the edge of the mould is cut away with a knife.

A black gelcoat pigment is used on the floor pan mould only for aesthetic reasons. Each of the body moulds are split into about eight pieces to allow the body to be removed when cured.

The sides, front, rear and top of the mould are then bolted together and the joints between separate parts of the mould are joined together with strips of chopped strand matting. The top half of the mould is then turned the right way up and bolted to the floorpan. The shell is then left for 8 hours in the mould to cure enough to be released the following morning.

Once broken out of the mould, the flash left round all the seams is removed by hand grinding. This is the single most time consuming part of producing a TVR taking about 160 man hours per car.

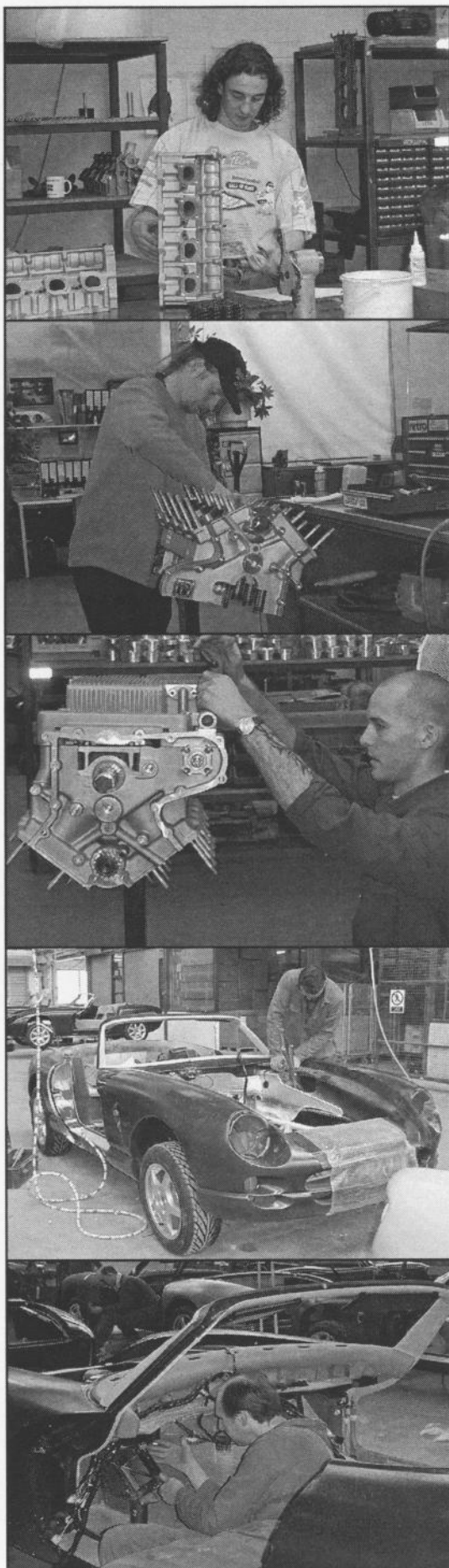
The shell is then bolted to the chassis and cured in an oven for a further eight hours. Once out of the oven, the flattening process continues until the car is ready for paint. Bonnet, boot lid and doors are all trial fitted and adjusted at this stage and removed for paint.

### Paint

Each TVR receives four coats of primer, after each coat the body is baked for 30 minutes at 62 degrees Celsius. A team of people will then set about flattening and sanding the body smooth with a fine grain wet and dry paper. They will also fill any tiny imperfections in the shell such as pin holes. This is the stage where the bodywork has to be smoothed to perfection ready for the paint spraying of the customer's chosen colour.

TVR mixes its own two pack paint using a mixing station. A huge range of about 12 000 colours are therefore on offer to each customer, with each car made to order. Part of the attraction of a hand built car is the tailoring process. In this respect, a wide choice of colour is essential. We have even matched a customer's car to a lipstick or a pair of ski boots.

### Engine Build



The Griffith 500 and Chimaera are powered by TVR modified Rover based V8 engines. Work on these engines is carried out at the sister company, TVR Power in Coventry. The completed units in 4.5 and 5.0 litre form are transported to Blackpool ready to be fitted to the cars on the assembly line.

Over recent years TVR has become involved in design and development of completely new engines. The first was the Speed 8 which is now produced in 4.2 and 4.5 litre V8 form and more recently the new Speed 6.

This straight six, 4.0 litre engine has proved to be a high performance unit producing 360bhp and 310ft.lbs of torque. This all aluminium alloy engine has a number of new features. It is the first of TVR's own engines to feature four valves per cylinder, giving volumetric efficiency at high rpm, which also helps to give a sporty nature. Furthermore it has finger followers which allow higher valve accelerations to improve the engines torque. It also has chain driven overhead camshafts for a reliable drive. The Speed 6 is now available in the Cerbera and Tuscan Speed Six

The Speed 8 and Speed 6 engines are hand built at the TVR factory taking around 40 hours to assemble. Once completed the engines are taken over to the assembly line to be fitted into the appropriate cars.

### Assembly

The painted body then moves on to the assembly area, where it spends about 6 days. There are seven separate lines in this area, each line being named after UK racing circuits. The objective of this is to closely monitor quality control and also to provide job satisfaction to our team members.

The following processes then takes place:-

Stage 1 - The cars are firstly fitted with wheels so they can be pushed from stage to stage.

Stage 2 - This is where the car will receive the engine and radiator. The gearbox, gear linkage and gear lever arm are also added.

Stage 3 - The doors and boot lid are fitted along with door wiring loom and wing mirrors. The side windows are also fitted.



Stage 4 - The trim shop prepares all carpets, trim and dashboard prior to installation. This involves cutting and sewing carpets, leathers, vinyls and mohair (for the convertible's hoods) to exacting standards. These are then fitted to the car. Because of the uniqueness of each car, this work is done to order rather than for stock.



Stage 5 - The steering column is fitted, together with the seat belts, door seals and windscreen.

Stage 6 - The folding hood and removable targa panel are trimmed and fitted at this stage.



Stage 7 - The fitting of the battery, cables, alarm, door electrics and dash occurs here. The headlamp unit is also built up and fitted.

Stage 8 - The car is then moved on to the ramp where the propshaft and exhaust are fitted along with the airflow meter. All the suspension bushes are tightened. Everything is then checked over, fluids added and the geometry of the wheels corrected.

### Final Completion

The car is then taken off the ramp and started up for the first time. The engine settings are checked, before leaving the factory on a 30 - 40 mile test run. The car is thoroughly checked over in the quality control area before being returned to the paint shop for the final paint inspection.

The car is then cleaned, polished and prepared for despatch.

Finally the car is loaded on to the transporter and delivered to the TVR dealership either in the UK or overseas. At the dealership each car undergoes a pre-delivery inspection before being handed over to the expectant customer.

The Blackpool factory also fulfils a number of other interesting functions such as design, development and testing of new models. The preparation of the works team Tuscan race cars and preparation of the Speed 12 GT race and road car also take place on site.







### TVR Tuscan Speed Six

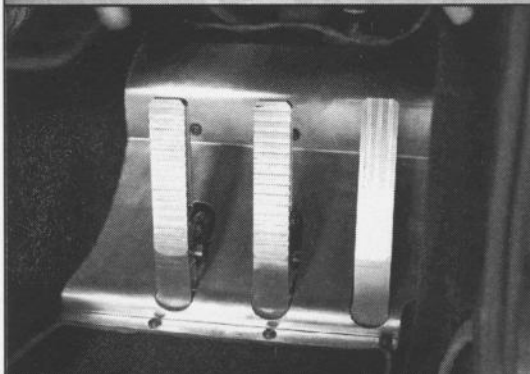
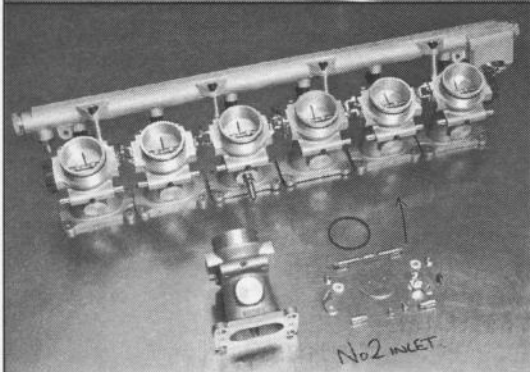
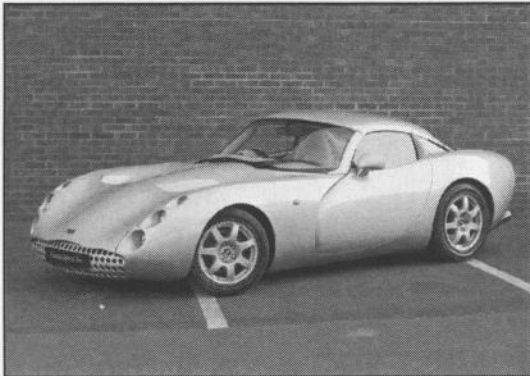
It was four years ago that TVR exhibited the Tuscan Speed Six for the first time. Since then, over 1300 deposits have been taken for the car in an unprecedented rush of demand. While many of the orders have been from TVR's existing customers, a far larger proportion than ever before have been from people who have decided to transfer their allegiance away from mass manufacturers.

Much has happened since then as the car has undergone an intensive development programme. As well as subtle changes to the interior and external styling of the car, hundreds of thousands of man hours have gone into its development and homologation.

The TVR Tuscan Speed Six is probably TVR's most significant new model since the Chimaera was introduced seven years ago. To sum it up, it is a convertible in which two people and their luggage could go on holiday for a month with creature comforts like air conditioning and power steering but without the car weighing much more than 1000kg. It has TVR's own straight six engine which pumps out 360 bhp and has a novel roof design whereby, despite looking like a fixed head coupé, it is able to stow its roof and rear window in the boot, while still leaving room for luggage. No computers have been used in the styling of the car and TVR's team of stylists, led by Damien McTaggart but with the close involvement of Chairman Peter Wheeler, has taken two years sculpting the shape of this future classic.

There are a number of advantages in designing a car in the manner that TVR does. Sculpting and developing the shape solely by hand is an inordinately time-consuming business. Just as one only truly appreciates the lines of a car when one washes it, so it is TVR's belief that one can only really get to grips with the design of a car over a long period of time. Furthermore, it is impossible to control a surface as subtly on a computer screen as when sculpting the car by hand.

It is with this in mind that one should view the new Tuscan. When a vehicle is mass-produced the tooling takes longer to develop than the styling but that is categorically not the case here. The whole philosophy at TVR is that the shape of the car comes first so the constraints of conventional industry thinking have not been an issue.



As such, the philosophy behind the styling of the car has been that function and form have been combined and the result has been left on show. Many of the features that make this car extraordinary are there for sound engineering reasons but the simplicity and elegance of their form enhances the overall look of the car. For instance, the unusual bonnet arrangement, whereby the main piece of the bonnet is bolted into the car, is there for the reasons that it is in most racing cars. It is actually lightly stressed and means that one is able to duct the airflow very precisely. Furthermore, it is bolted into place and therefore can be manufactured lighter.

One of the notable features of the car is the way that the shutlines run along the top of the car so that if you draw them, you draw the shape of the car. This shows its lines off to the best advantage but also gives a far bigger boot opening to make the roof much easier to stow in the boot. While it might be possible to say that the exterior design of the car is relatively extravagant in concept, TVR has taken a minimalist approach to the interior. The very highest quality components have been used and once again, function has determined form. The curved aluminium top to the dash, for example, actually acts as one of the transverse strengthening beams for the car. The pedal box, again hand made from extremely high quality components, is left on show as it would be a shame to hide craftsmanship like it and it also serves to make individual fittings for customers that much easier.

The original thinking of TVR's team of engineers and designers has also manifested itself in the instrument binnacle, again manufactured in house by TVR. The advantage of this is that it enables one to link it to the engine management system which, combined with a number of other sensors, results in an extremely comprehensive range of instrumentation being available. Most immediately noticeable is the use of aluminium and brass which is a combination not seen in a car for many decades and which gives a sensation of warmth in the car without using walnut. It is also notable that a revcounter is not among the analogue gauges. This goes against the long-standing trend that in sports cars the revcounter should be to the forefront. However, with today's engine management systems and the far wider rev ranges of modern powerplants, it is no longer necessary to monitor the engine speed all the time. Indeed, nowadays, even in racing applications, road speed is far more important. Yet for those who wish it, the graphical LCD display in the middle of the binnacle displays engine speed with just the two salient digits clearly visible, Formula One style.





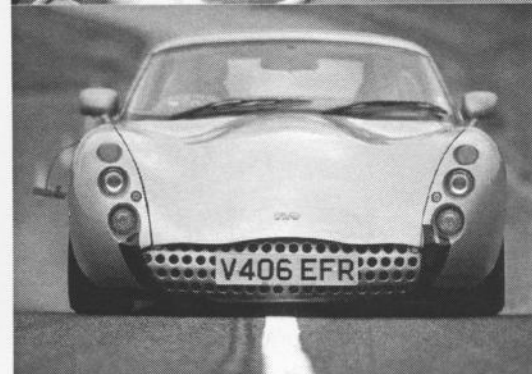
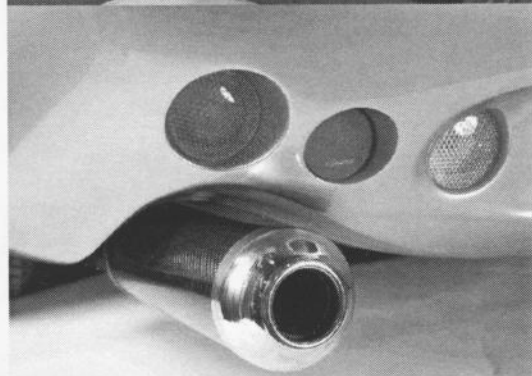
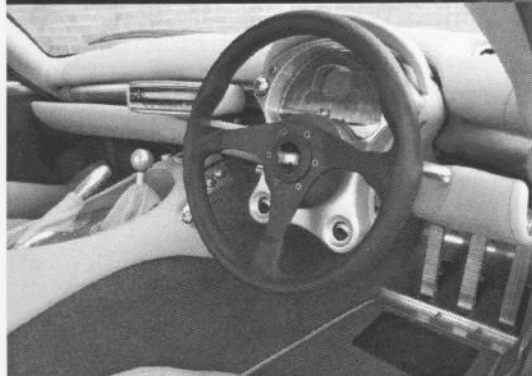
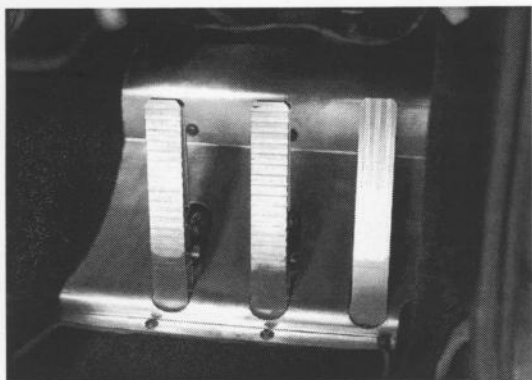
Alternatively, a myriad of further readouts is easily selectable via a rotary knob and so, while the binnacle is extremely sophisticated, its appearance and operation is simplicity itself. These readouts include road speed, engine speed, fuel level, oil level, water temperature, oil temperature, ambient air temperature, oil pressure, fuel pressure and battery voltage. Minimum and maximum readings are recorded. In the future a track option will be available which includes a lap time recorder and memory. Furthermore, on the top of the instrument binnacle is a graduated shift light which again takes its inspiration from Formula One racing cars. This whole binnacle adjusts up and down with the steering wheel so all the gauges are always visible.

The jewellers' quality of the exterior is matched by an extremely high tech interior with mapped stepper motors operating the water temperature and fuel gauges which learn as they go along and an aircraft grade stepper motor controlling the speedometer so that the instrument can keep up with the performance of the car.

All the rest of the switchgear will be in the driver's line of sight and once again will be simple and elegant. With the exception of the heater and window controls, all these extremely expensive switches, as well as the radio, are mounted high up on the dashboard.

A lot of thinking has also gone into the design of the seats which have the seatbelts built into the backrest so that the buckle always falls easily to hand. Furthermore, it is impossible to build a seat height adjuster into such a low car so the squab is removable. This is primarily so that the many TVR owners who take their cars on track days can more easily get into the car with a crash helmet on.

The styling of the car has been very much influenced by the fact that it has a straight six mounted between the front wheels and it is this engine which is the heart of the car. Straight sixes have somewhat gone out of fashion because they cannot be mounted transversely, be it in the front, middle or back of the car. However, TVR's adherence to the true course of sportscar manufacture, i.e. mounting the engines in the front to drive the rear wheels, makes it possible to use this most classic of sportscar engines.



However, while one eye has been on the past in terms of the tradition of the layout, the other has been resolutely forward as the engine is very much up to date. Gruelling tests over the last four years have shown its performance and reliability in Tuscan prototypes as well as the Cerbera Speed Six. Furthermore, in its doubled up, twelve cylinder form, the engine has seen competition in the mighty Speed Twelve.

One of the inherent characteristics of a straight six is that it can be perfectly balanced and this particular one has a capacity of four litres and a power output of 360 bhp.

It also features a grade of high quality components and a level of high technology design on a parallel with its eight and twelve cylinder sisters. Like the Speed Twelve and racing variants of the Speed Eight engine, it has a dry sump which means it can sit very low in the chassis and that it doesn't suffer from oil surge which can be a problem with the long sump required for this configuration of engine. In addition, the engine is canted over 15 degrees to enable the bonnet line to be even lower. It also features forged steel conrods, slipper style lightweight pistons, thin wall cylinder liners and a fully counterweighted nodular iron crankshaft.

The chassis is based on that of the Cerbera but in this case is 8" shorter. This means that it has improved interior room over the Griffith and Chimaera but as the overall thinking behind it, and indeed the dimensions, stem from the Tuscan Challenge racing car, the balance of the chassis between ride and handling is as well honed as ever. The other advantage of basing the chassis on that of TVR's one make race series car is that there is probably no chassis anywhere in the world that has been so often and so comprehensively crash tested. Safety has been uppermost in the designers thoughts throughout the process and the roll cage, door beams and transverse aluminium tube are evidence of that. The brakes are 294mm at the front with superb four pot aluminium callipers and are 273mm at the rear.

The dealer demonstrator Tuscons were first released in January of this year and there are now over 100 Tuscons on the road.