FORD ESCORT

rally preparation

Ford

Written by: **Charles Reynolds**

Information: **Mick Jones**

Research and Group I: **Henry Inurrieta**

Produced by: Paul English

FOREWORD

The Ford Escort ranks as the most successful rally car in the sport's long history. To write a book spanning ten years of development would require a volume four times the length of this book.

As the idea of this book came from the Rallye Sport Club Technical leaflets, they have been used as the foundation of the 13 Chapters. Wherever possible, information has been updated, although development offshoots, and in particular tarmac suspension derivations are not covered.

Another area deliberately omitted is engine preparation. There are so many engine variations available that we cover only outline descriptions. Specialist tuners are the best people to consult.

In many Chapters, Mk I & Mk II Escorts are covered, appreciating that not everyone can afford to run the latest model, especially in Club rallying.

Whether you rally professionally or for enjoyment, we hope this book will help you.

Charles Reynolds. Ford Competitions Co-ordinator.

CONTENTS

BODY SHELL

If you look carefully through the current FIA Year Book, you'll see that now "Any kind of reinforcement is authorised" for Gp 2 and 4 (Art 261 - v), so what has been written before about not doing 'this and that' for Gp 2 no longer applies. Strengthening for Gp 1 is still not permitted, however.

If you intend building a Gp 2 car it is important that you read the FIA rules correctly as, for example, although body shell strengthening is free, you are not able to use turret kits and slipper type rear springs as you can on a Gp 4 car.

This is mentioned at the start of this chapter because it does clarify that body strengthening, essential if you're going stage rallying in an Escort, is now legal. Assuming you're starting with a basic Escort shell, what are the first things to do?

1.1. FIRST PRIORITY

Number one essential is to bring the car up to heavy duty (h/d) specification, as standard on RS produced vehicles. This beefs-up the front end and eliminates any weak spots on the strut mounts.

Part numbers and welding instructions are as follows:

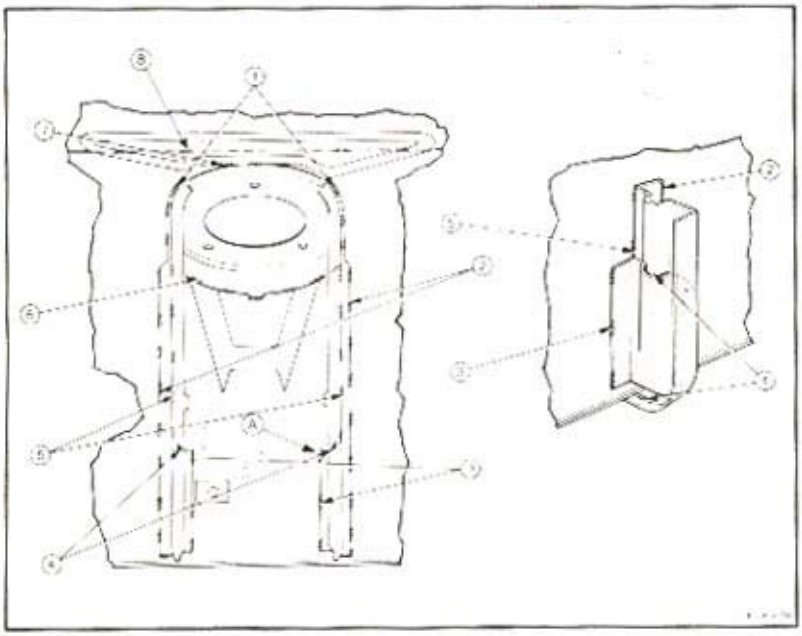
The parts, with finis code numbers for the Mk I Escort are:

Front Apron Reinforcement	R 1421040
" " "	L 1421041
Front Unit Stay "	R 1421038 (2 off)
" " " "	L 1421039 (2 off)
Upper Suspension "	R 1421044
" " "	L 1421045

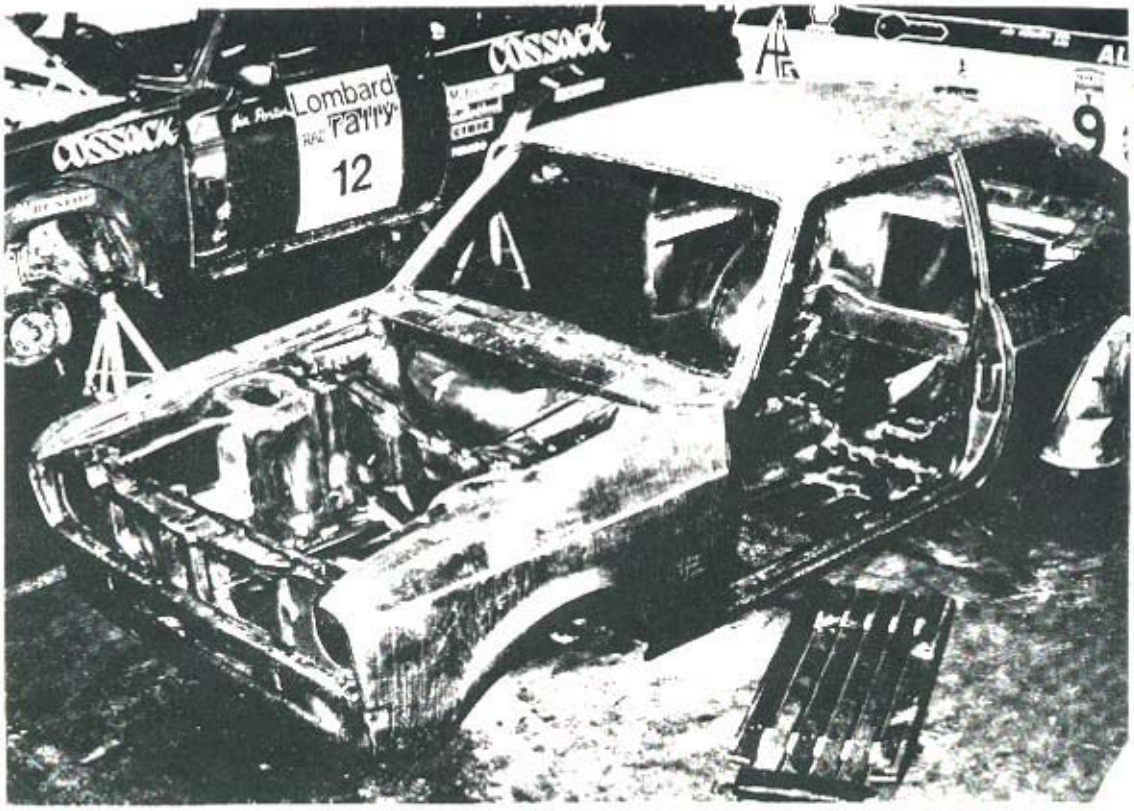
In the case of the Mk II Escort, reinforcements are not as such specifically available, however, you can use the Mk I reinforcement panels as listed above, although this will only be necessary in the case of Standard Popular, 1100 or 1300cc body shells, since all Mk II Sport/Mexico and RS2000 shells have these reinforcements fitted as standard.

Below is a sketch with fitting and welding details:

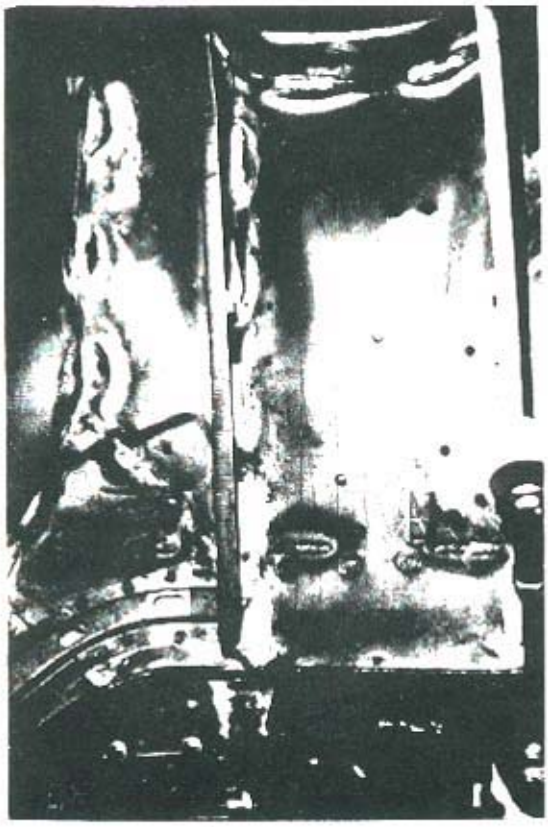
1. Six tack welds on suspension mounting plate supports to inner fender panel.
2. Tack welds.
3. Six tack welds on reinforcement angle to inner fender panel.
4. Four tack welds on reinforcement angles to support.
5. Ten tack welds on supports to inner fender panel.
6. Five tack welds on suspension mounting plate to fender stiffener panel.
7. Three tack welds on suspension mounting plate to fender stiffener panel to inner fender panel.



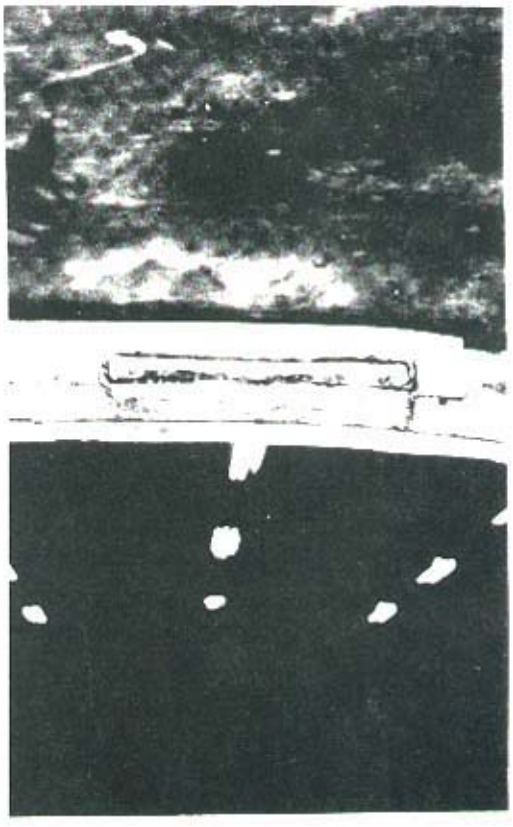
The h/d front end will take a great deal of the strain of rally use, but for stage driving and to extend shell life, you've got to go quite a bit further. A shell, prepared to works rally standard, will take quite a few hours work purely on strengthening. Here's what is involved: either nickel bronze or braze all the seams on the body with $\frac{1}{2}$" long tacks at $1\frac{1}{2}$" intervals. Remember the regular intervals though: there must be some flex left otherwise the body will shake itself silly. Next the glass opening seams - especially around the windscreen - again $\frac{1}{2}$" tacks all round. Fill in all the paint drain holes on the floor: either braizing a small plate, or stick down alloy washers with a good quality adhesive (Evostick or Bostick will do). The dashboard belt rail also needs attention from the brass where the corners meet the screen pillars, and along its length where it joins the bulkhead. Here regular $\frac{1}{2}$" long welds should be made and the bulkhead rolled over to ensure freedom at the back of the cam cover when ohc engines are used.



Works shell at Boreham awaiting painting.

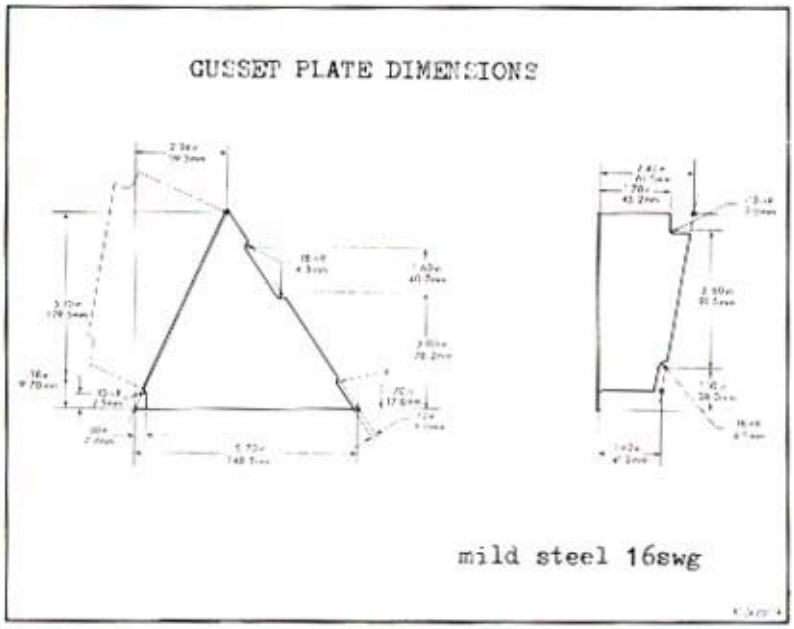


Outer wheel arch, front, on works car. Note extra welds where wheel arch meets inner wing panel, and sumpguard mounting bracket.



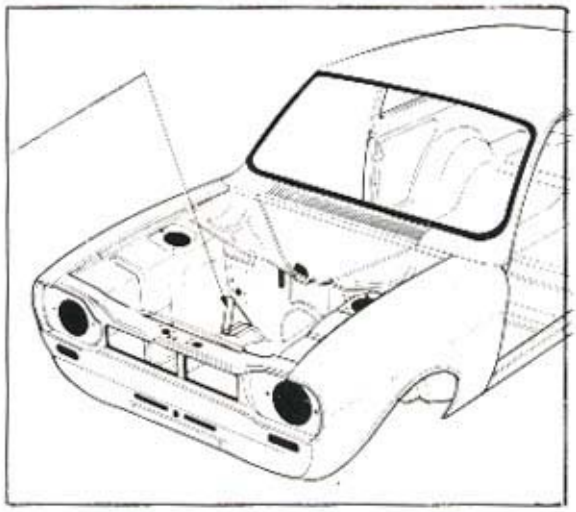
Body welding for grab handle bracket (see end of this chapter).

In addition, because everything is now so solid on the shell, a gusset plate for strengthening a known weak spot - where the side rails and base of bulk-head meet - can be made up. Exact size and measurements are shown below:



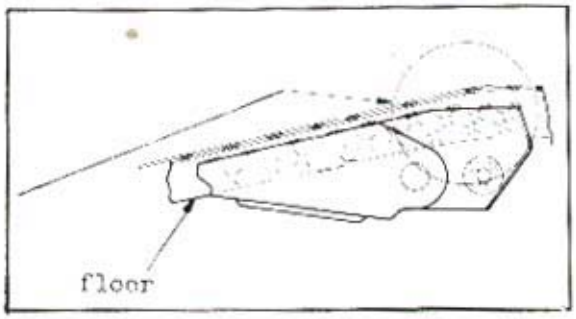
Gusset Plate fixing position

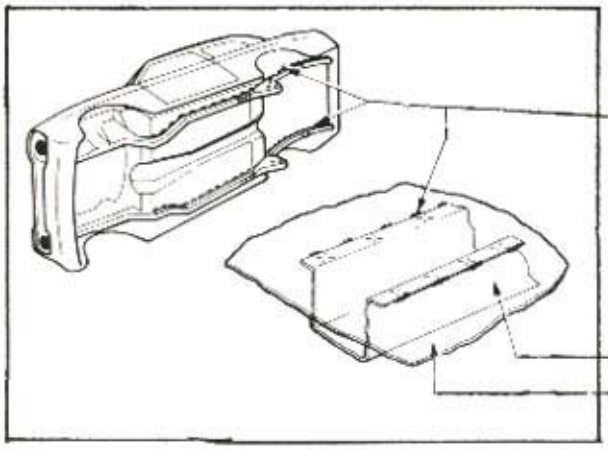
½" tack welds as shown fixing gusset plate to body shell, both sides of shell



Front Spring Hanger Bracket

welds in circle on outboard side of stiffener only

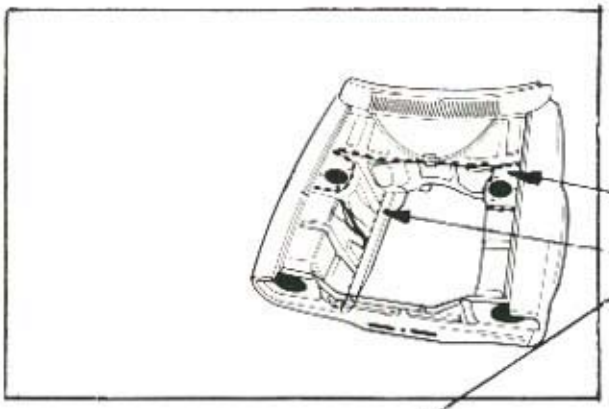




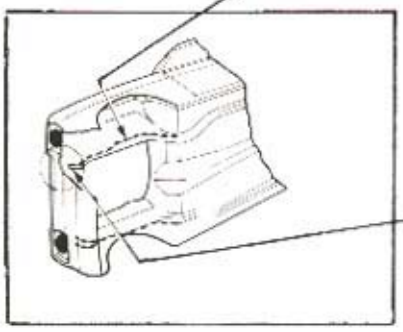
½" tack welds, 1½" apart on both flanges of the longitudinal stiffeners

longitudinal stiffener (chassis rail)

floor pan



½" welds extending along this area, also on strut mounts and belt rail



welds in circle as above for long. stiffener - also weld to body lower front panel and inner face of stiffener.

At the back of the car, testing has shown that after rough road use, the rear arches have a nasty tendency of revealing The Queen's Highway from the inside compartment. For serious work, a rear turret kit must be fitted. This both strengthens the rear end and improves the handling.

The standard Escort I, with rear sub-frame, mounts the dampers at 45°. The so called 'pull-ahead' rear dampers, as fitted to all Mk II Escorts, but also on the late (post Nov '73) Mk I's, were at 15°, without a sub-frame. Although the 15° inclination is a great improvement, a turret kit is still necessary for serious work and with engines giving more than 180 bhp you won't get all the power down unless you have upright dampers. The inside of the wheel arch must be cut away, so the job is really for a skilled cutter/welder. The kit is available through RS Dealers (finis code 905 1643) and, of course, longer dampers have to be fitted. For more details on this kit, see rear suspension chapter.

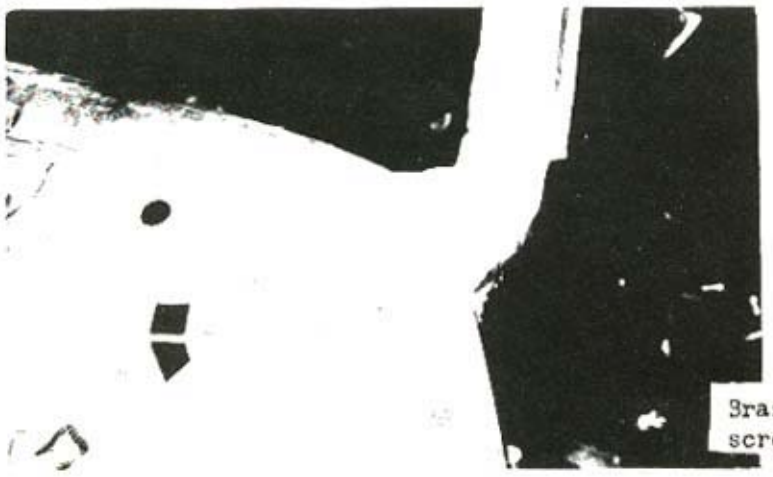
1.2. SEAM WELDING

With the freedom of new Gp 4 regs, there's quite a bit you can do to the basic Mk II shell. The same jobs as on the Mk I should be carried out to bring the shell up to h/d spec unless it's a new Mexico, RS1800 or RS2000 shell.

After a lot of stage pounding, one of the places on the shell that starts to go is the base of screen pillars. First of all the paint will start to break up, and then a slight kink will appear - mind you, there are many who say that a shell hasn't settled until these points are visible!

On the Mk II's, the top of the screen pillars also tend to kink (probably more than Mk I's).

One way to get over this is to beef up the whole area by either braze filling the gap between outer wing and screen base panel, or it has been known for club cars to have the area double skinned with the whole lot smoothed over with some body filler and painted. At the top an extra careful bit of welding where pillar meets the roof panel is called for. From the photo, you should be able to see some of the tack welding around the windscreen opening.



Braze filling of the screen base/wing joint

Another area on the Mk II's worth a tack weld is on the front wheel arch where the foot well meets the inside wing.

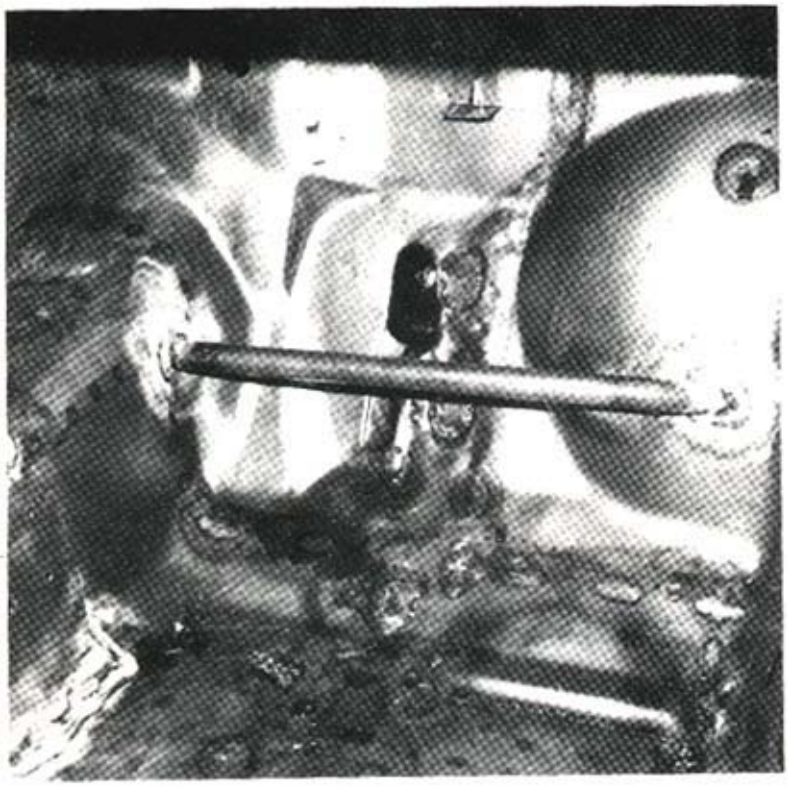
1.3. INSIDE ROOF

If you're being really serious there are one or two tips to pass on about what can be done if the car headlining is removed: At the back, the through-flow vent holes inside the top of the rear screen pillars can be blanked off with a circular plate brazed in place. At the base of these pillars, the other vent slots can also be blanked off. The central bracing across the roof should be brazed to the inside roof perimeter panel, but not necessarily to the roof itself. As another tweak, a strip of $2\frac{1}{2}$" wide 16 swg can be bent into roughly an 'L' shape and brazed to the inside length above the door openings from central brace to screen pillars with the 'foot' of the 'L' just touching the roof. The tack welds should be along the inner roof perimeter panel at approx $1\frac{1}{2}$" intervals. It's also a good idea to weld up all the overlapping joints on this perimeter panel for even more strength.

Brazing on inside 'C' pillar

1.4. NAVIGATOR'S FOOT REST

As well as being a neat extra for the comfort of the other side of your rallying partnership, a good foot brace, properly welded to the floor can add strength to the shell. The photo shows a typical Boreham rest, made from 1/16th mild steel tube. Diameter is not critical, $1\frac{1}{2}$"-$2\frac{1}{2}$" is ideal though. Note from the photograph that the wheel arch end of the tube lies almost flush with the arch face.



Positioning of navigators footrest tube - LHD

1.5. WHEELARCH EXTENSIONS - MK I

Now a topic where you can see the results of your toils actually make the car look different, and many people do fit arches purely for looks. If you want to run with anything wider than 6" rims, arches are essential to clear the bodywork, and if you do use 6" rims with standard arches, you will have to go to low profile tyres. Even then it may be necessary to squash back the inside flange of the rear arches, as factory tolerances usually mean the axle is slightly off-set from centre from new, and the tyres will just foul, especially if rear seat passengers are carried.

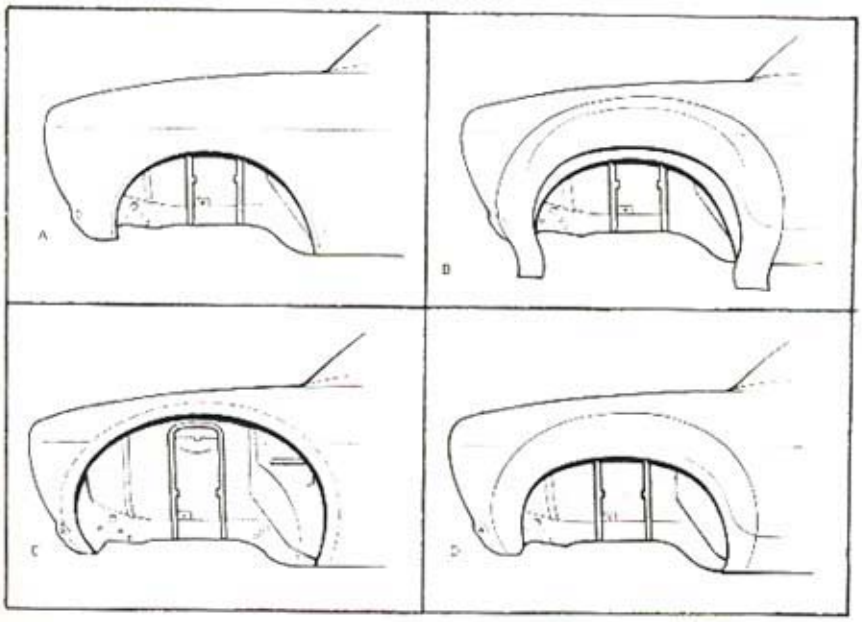
Arches are also necessary to house the h/d 'Atlas' axle, (although not the RS2000 GP I 'Narrow Atlas')

The Mk I arches are made in steel, finis code no 905 1699, and are designed to mate up with Mk I existing body lines. Borcham did use alloy arches which, although weight saving, were not offered as an RS Part. Arches can be attached either inside or outside the shell, and should be trimmed to leave a smooth $1\frac{1}{2}$" lip for shell fixing.

a) Front Fixings

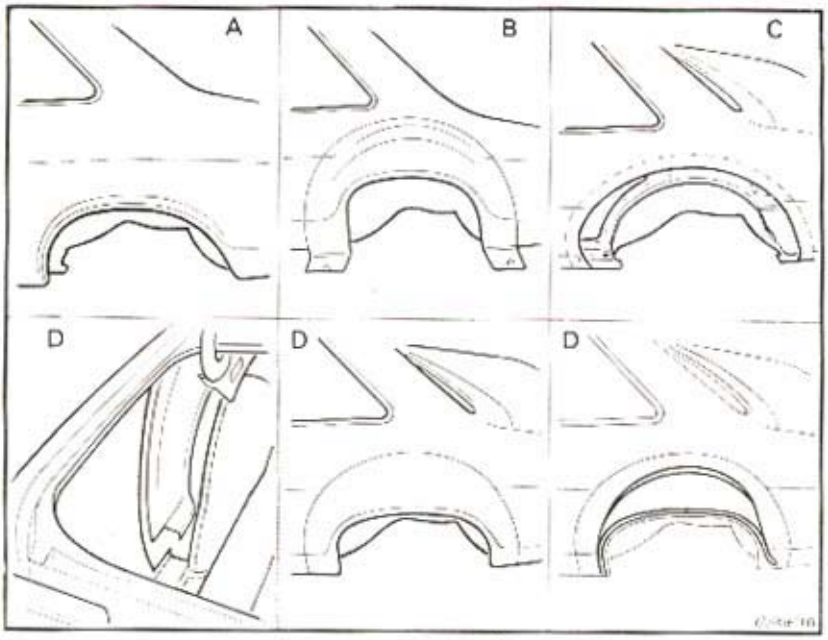
When you have trimmed the new arch, offer it up to the body, marking on the body around the extreme edge. Make sure it is spot on; there's no going back after the next stage. At the front the standard wing should be cut away $1\frac{1}{2}$" below the mark you've made. If you're using steel arches, they can then be spot welded, brazed or gas welded with $\frac{1}{2}$" tacks. Alloy arches should be pop-riveted and glued - remember to use plenty of rivets.

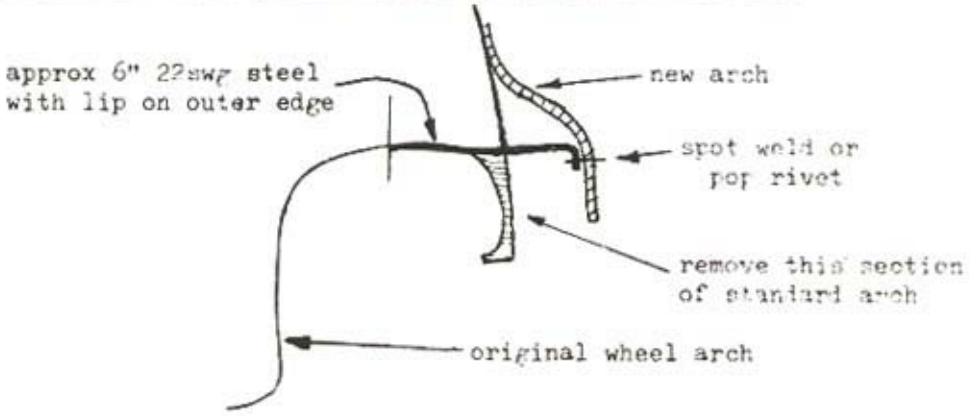
After cutting, clean off all the ragged edges and blend the arch into the bodywork with filler. This is a longer job than you think but do it properly, and you won't detect the join at all.



b) Rear Fixings

The rear arches are a bit more aggro'. This time, the inner arch has to be cut, as well as the outside of the shell, and then extended out at 90^{o} to the body for about 6". A piece of 22 gauge sheet steel should be used for this, and remember it tapers at front and rear the nearer it gets to the vertical. Once you've made this, which comes as part of the RS Parts kit, the arch can be offered up in the same way as the front ($1\frac{1}{2}$" clearance) and cut the body away. Your new inside arch should be lipped and riveted/ welded to the new outer arch. Again, clean off, fill and paint.





1.6. WHEEL ARCH EXTENSIONS - MK II

Mk II arches provide more simple attachment than Mk I's, being manufactured in glass fibre and simply bolted to the body. You still have to cut away to within $1\frac{1}{2}$" of a scribed fixing line of the arches, and the rear arch still requires a distance piece inserted - just as the Mk I's. RS Parts produce a kit of 4 arches, under finis code no 905 2880. Fixing bolts will have to be obtained separately. To preserve the life of the rear arches, a rubber protection gaiter can be bolted to the lower leading edge on each side. Any thick rubber will do.

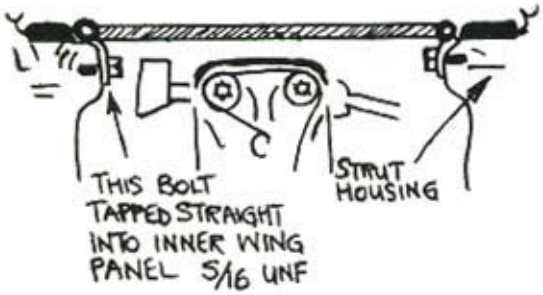
Aluminium arches and front spoilers are being used on the works cars.

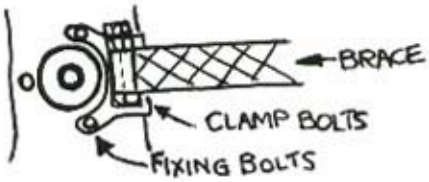
Rubber type wheel arch extensions will soon be available from Ford Performance Parts, which will cure the stone damage problem on the existing rear wheel arches.

1.7. STRUT BRACE

This is a very useful piece of chassis strengthening as it adds support to the inner wing panels and spreads the shock loads from the front suspension. It is, of course, only suitable for use with engines which have side mounted carbs or a side mounted air cleaner.

The brace literally sits between the two turret housings. Its mounts use the two side locating bolts for the top of the strut with an additional 5/16" bolt mounted into the side of the inner wing.





The bar itself is obtained as a complete kit (Code No 905 0562) or can be made up. If you decide to make one, use 12/14 gauge tube x 1" seamless cold drawn steel. Make sure it is under NO tension when you fit it, and don't use any rubber bushes; these will allow the bar to move and do virtually nothing. One useful effect of fitting the bar is that you can even hang the engine from it, should the cross member have to come out.

To give you an idea of the extra strength a turret brace will give the front end, Competitions Department don't usually bother to fit one for UK forest or tarmac events - they make the car unnecessarily stiff.

Incidentally, if you use the RS bar on a Mk II shell, it is advisable to weld two mounting tubes at the ends of the bar underneath the existing tubes, to effectively increase clearance between engine and brace bar, alternatively, you can make your own brackets as shown in the photo'.

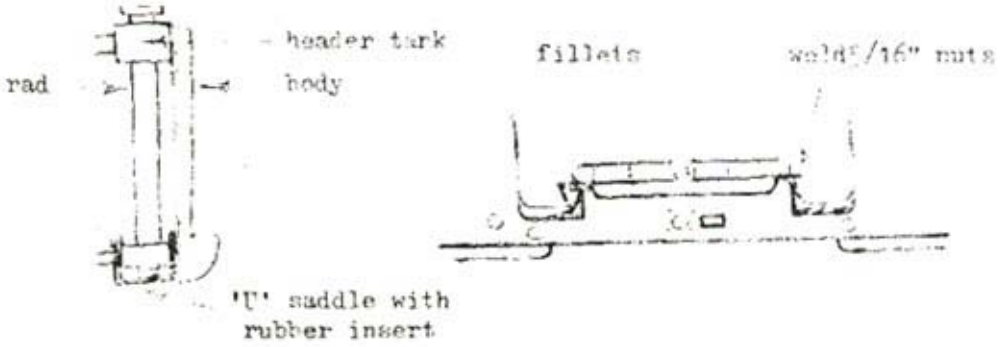
Strut brace fitt to works shell. Note simplicity, with mounting bracket in fron of strut mount.

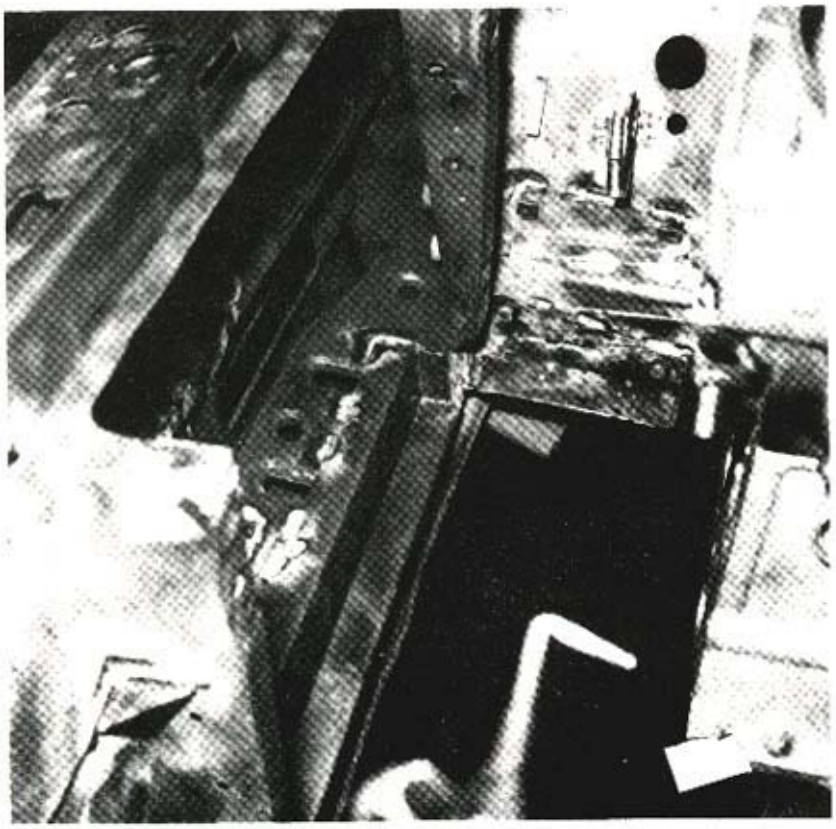
1.8. STRENGTHENED RADIATOR MOUNTS

At the front end, the radiator supports take a hell of a bashing on rough events - so here are a few tips.

At the top of the rad, brazing 2 small fillets, one either side, will triangulate the top support and add a great deal of strength. A 'U' section support underneath lined with soft rubber can be brazed or welded across the body to give even more support - remember not to try and weld with the rubber insert in position!

Another tweak is to sling out the 4 self tapping bolts which actually locate the rad and replace them with 5/16 UNC bolts with the nuts welded onto the back of the mounts - the self tapping ones will usually work their way loose.





Sub-rung of inside front apron forming cradle to accept large rod. Note roll bar mounting welded and bolted in position. Fillet for rad. support is visible in bottom left of picture.

1.9. SEAT MOUNTS

It can happen to the best co-drivers: That means break your seat mountings. Seriously, remember to thoroughly check both of your seat frames, runners and mountings before each event. Most of you will know that even for Gp 2 Internationals, a rear seat is not needed and this space can do very well for all sorts of things, but not heavy spares such as wheels.

There are too many types of seat to go into details of runners, etc - and as you are usually the only person to drive, why bother with runners at all? So, to quickly talk about Boreham floor mounts.

SAFETY

2.1. INTRODUCTION

Over the years Rallying has become an incredibly competitive sport, with a handful of seconds separating drivers over several miles of very demanding roads. The advent of racing tyres, compression strut and rose-jointed suspensions, fuel injection, and the like highlight the fact that drivers are scratching for the last few seconds of ultimate performance. In a word, present day rallying is a risky sport, and none of us wish to have to bemoan the injuries of fellow competitors. Besides, a driver will feel much more confident in his machine if he knows that everything has been done to protect him and his co-driver to the utmost. In this chapter, the legal safety requirements and, more specifically, the fitting of roll cages to works standard will be covered.

2.2. ROLL CAGES

The ultimate roll cage will, unfortunately, turn your four passenger touring car into strictly a two-seater with an interior boot, but it's worth the trouble and inconvenience. The full FIA cage consists of a hoop behind the driver, braced down to the inner rear wheel arches. All works drivers are in favour of the additional forward braces (now compulsory on International and many other events) which go from the transverse hoop forwards, and down the screen pillars to the floor, where they are mounted to the floor. Ironically enough, full roll cages are not compulsory on FIA run events for Group 1 cars, but those who saw photographs of Tony Fowkes' Mk II Escort after his accident on the 1977 Virgo Galaxy will realise that even an Escort with a full roll cage can end up looking like a 'bowl of porridge'! Besides, a proper roll cage will actually stiffen a unit constructed bodyshell by something like ten percent.

Making a roll bar is a very tricky job. It has to be a certain thickness (see table below), correctly measured up and designed to a stringent FIA pattern. In fact, we would discourage anyone from attempting to make their own - it's far easier to buy one from a reputable firm. Like a fire extinguisher, you hope you will never need to use it, but if you do, it pays to have the best.

FIA Minimum Thickness of Material Used in Bar Construction

	Closed Cars	
Groups 1-4	Up to 1200 kg	Over 1200 kg
Cold drawn seamless Carbon steel	38mm 2.6mm 33.7mm	48.3mm outside dia. 2.6mm thickness
Alloy steel	2.3mm	42.4mm outside dia. 2.6mm thickness

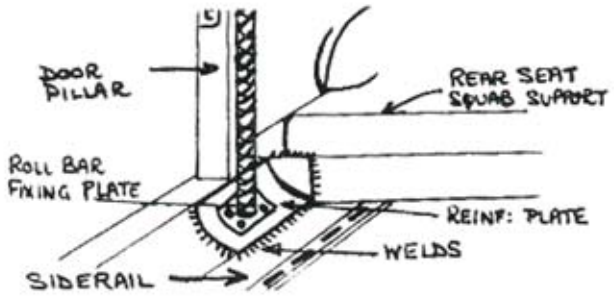
2. 3. MK I ROLL CAGE

a) Even if you're working to a limited budget with a Clubbie car, it's worth spending a little more to have a complete cage - both for safety and strength. The F.A.V.O. Mk I marketed cage comes as either a rally (without diagonal, 9052295), race (with diagonal, 9052296) for the rear legs and hoop, and a complete front cage and top screen bar (9052297) including compulsory mounting plates and hardware.

Always assemble the complete cage inside the car before drilling all the bolt holes. The attachment points to the chassis are very important and these should be reinforced with steel plate of at least 2mm /1 /8" thick and have a total surface area of at least 35 sq. cm. This is the smallest plate area permitted under the FIA regulations as in the FIA yellow book, but of course you can have more.

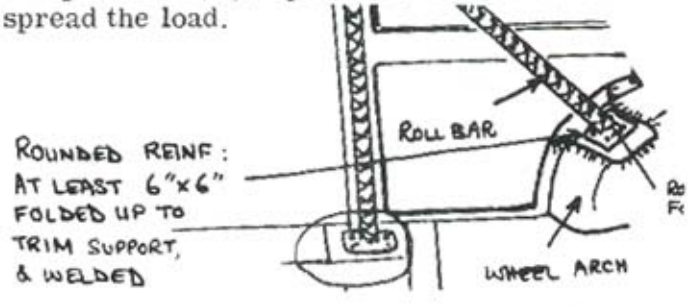
With the help of the following sketches, we will describe how Boreham attach the roll cage to the car.

The main hoop must have at least three bolts of a minimum 8mm. Four bolts is a better bet.



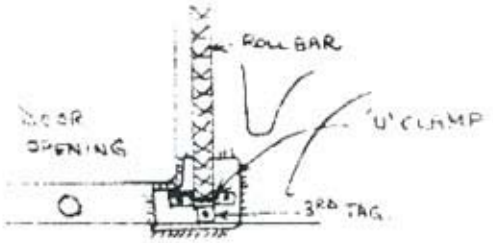
b) Rear Leg Fixing

Where the rear support bars run onto the wheel arch, the material is very thin (20 gauge) so a reinforcing plate should be very carefully cut and fitted as per the diagram. Again 2mm /1 /8" plate should be welded to the wheel arch, which will spread the load.



c) Screen Pillar Fixing

A screen tweak is to attach the front legs of the roll cage to the screen pillars to give even more support. Weld a 1" tag to the roll cage hoop at a convenient spot between the top and the base of the screen pillars. Opposite this weld is a 5/16" UNC nut to a 1" x 2" x 1/8" plate, invited inside the pillar and the bar is then bolted direct to the pillar.



d) Front Leg Fixing

The attachment of the front legs of the cage is really an extension of the main hoop theme. The base of the front leg should be attached to a stiffening plate of the same area dimensions as the main hoop plate. Again, three bolts are used.

2.4. MK II ROLL CAGE

There's little difference in the safety preparation of the Escort II over the Escort I, except for the availability of a very special roll cage, which mounts via 14 attachment points.

The standard Mk II roll cage is a Safety Devices item, with a removable diagonal, available through RS dealers, under finis code No's:

9052788 (rear)

9052787 (front)

9052652 (cage sleeving kit)

The 14 point roll cage is available directly from Safety Devices in either Group I or Group II - Group IV form, the difference being in the rear wheel arch mounting points.

This roll cage should be fitted by Safety Devices themselves, and carries its own integral navigator's foot rest which bolts onto the side of the transmission tunnel. Incidentally, the Group I cage comes with its own Group I homologation certificate.

Boreham fit the bars as follows:

The standard main hoop floor mounts, using 3 bolts and backing foot plate properly welded to the floor take the main loads. Remember to mount the bar direct to floor - don't run the carpet, if fitted, between them.

The rear arms are fed directly into the top of the rear arches and turret top. A special 'L' bracket laid across the arch and drilled through the foot sits adjacent to a triangulation plate, also drilled, welded along the arch top. The bar sits neatly between the two with solid bolt mounting through the two holes. This means that in the event of a roll, all the stresses are fed into a very strong part of the shell.

With the exception of the front feet, which mount, via a metal plate, welded to the floor (as the main hoop) and bolted down, the remaining mounts involve tags being welded to the cage and bolted to the body sides. In order to accept the bolts there obviously has to be a threaded plate or captive nut arrangement attached to the shell. What Boreham do is to weld 1"x2"x3/16" ready threaded plates to the body in the following places:

1. On inside roof perimeter panel 3" behind 'B' pillar above rear side window.
2. On 'B' pillar adjacent to bottom front corner of rear side window (to take main hoop).
3. On inside roof panel, 6" behind screen opening, above doors.
4. On front corner of dash board (to take front hoop).

These points will give 14 mounts in all, and will give you a good strong shell, as well as making it as safe as possible.

Base plate for main hoop, roll bar.

Mount for rear arm of roll bar on big tank Safari car.

2.5 FINISHING OFF

A navigator's grab handle can be fixed to the front roll cage, and for this a standard Capri plastic handle is quite adequate and readily obtainable from any Ford dealer.

2.6. ROLL BAR PADDING

You might note that there is a proper 'works' thick rubber padding kit for the Escort II roll cage. Finis code no is 9052652. It looks neat, and could save some angry utterances, alternatively, cover the roll cage with plumbers' central heating pipe lagging foam tube, which is the cheapest and neatest material you can get. It is also available in a variety of sizes; if you obtain a piece that is one size under the roll cage tube, it will fit tightly. Don't forget that the inspection holes for the scrutineers, one in each section of tube, must be visible, as must the makers specification labe

The end of the road for Inurietta's Mk.1 Escort in 1976. Note how roll cage has helped keep the crew compartment in tact.

2.7. BACK BULKHEAD FIREPROOFING

Regulations for any stage event demand the fitting of a fireproof bulkhead. As well as being a sensible requirement, the bulkhead also adds strength to the back of the bodyshell.

The easy and cheap way out is to retain the existing sheet metal panel, covering all holes with 18 gauge aluminium or sheet steel, sealing the whole bulkhead with glass-fibre and fire-proof resin. If you do this, remember to fill the gap between the outside of the wheel arch and the outer wings with glass-fibre.

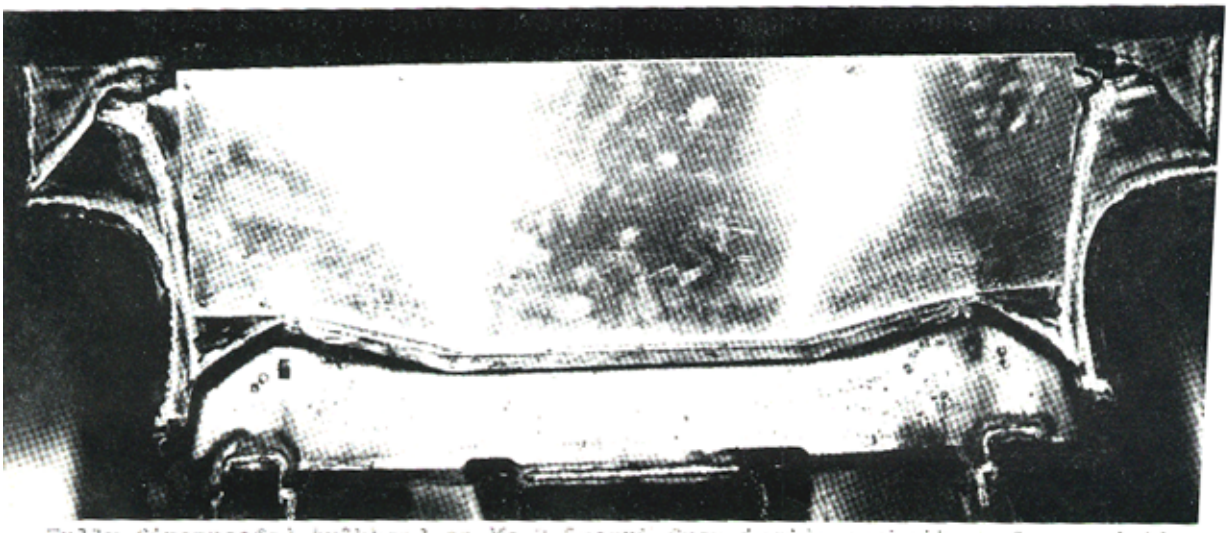
In the case of a full house Escort with 4 link axle and turrets, it is best to redesign the bulkhead, especially if you are fitting an alloy fuel tank.

The sides of the bulkhead, between the fuel tank and the inner wheel arches, should be made into a box section encircling the turrets, and thereby giving that area of the body shell some welcome extra strength, particularly in the case of the Mk II body shells.

You should then make up a sheet of 18 gauge soft dural, and fix it to the box sections and the parcel shelf with either Advel rivets (Aircraft), or an aircraft quality pop rivet at least 1/8" diameter. Again, once it's in place, remember the gap between the inner and outer wheel arches. The bulkhead is designed to prevent fuel entering the cockpit at all costs. Then the lot: wheel arches, diaphragm and ventilation system must be sealed around with petrol proof substance, usually fibre glass.

Ford RS Parts can supply a cut to size bulkhead kit complete. Finis code numbers are:

Mk I		Mk II	
Rear parcel shelf	9051812	Rear bulkhead	9052811
Rear seat bulkhead	9051811	Rear wing RH	9052812
		" " LH	9052813



Fully fireproofed bulkhead on Mk 2 Escort from inside cockpit, before painting.

SUSPENSION

1. GENERAL

We are now, perhaps, coming to the single most important point in the preparation of a car for rallying. To get the best out of a car, whatever its power, it is essential that it handles properly. Few people can afford to build the optimum Gp 4 car straight off, so here's an approximate list of priorities for those of you who aren't quite so well off.

1. Matched springs and gas damper combination.
2. High ratio steering rack.
3. Balance bar pedal box.
4. 5 link rear suspension.

But before getting into the technicalities of all the different systems, it's a good idea to explain some of the terms used.

Camber	is the angle the front wheels point in or out from the vertical, viewed from the front. It is another compromise setting to maximise tyre contact under all conditions.
Castor	is a product of the inclination of the front struts fore and aft, and directly affects the self-centring and consequently the feel of the road through the steering.
Toe In/Out	is the angle that the front tyres point in or out when viewed from the top and is evolved from practice rather than theory. It ensures wheel stability under all conditions, braking, cornering, etc.
Bump Steer	is found at extremes of suspension movement. The toe in/out set static can vary at those positions and affect handling. This is not important for forest rally conditions, but can be significant on tarmac cars with slick tyres.
Zero Steer	is a term applied to the four link trailing arm set-ups, and is rarely strictly true. Consider a normally sprung car - if one rear wheel is deflected upwards, the car would tend to turn into a curve. 4 link arrangements minimise this effect, but cannot completely cure it.
Roll Centre	is the instantaneous point about which a car moves. Dramatic changes in a car's optimum cornering potential can be affected by moving suspension pick-up points. However, this is not a subject to be undertaken lightly - get everything else 100% first!

3.2. GAS FILLED DAMPERS

If a car is to be used for high performance work, the usual procedure adopted for dampers is to 'uprate' them. That is the valving is adjusted so making the damper stiffer.

This works well, but over a period of time the oil becomes aerated and thus causes it to fade. The only way to offset this problem is to make the initial setting harder, so allowing for fade. Unfortunately, this means that the initial setting is too hard for optimum handling and comfort, and it is not until the damper has begun to fade that the car really begins to handle. This also means that all the mounting points, and the damper itself, are subject to strain until fade occurs.

So, the gas filled (Bilstein) damper was evolved which completely fulfilled all the requirements. The reason for the gas in a gas filled damper is that it keeps the oil pressurised at all times so it is impossible for any oil to become aerated; a secondary advantage is that due to the oil being pressurised, it can operate extremely efficiently with a very short suspension travel.

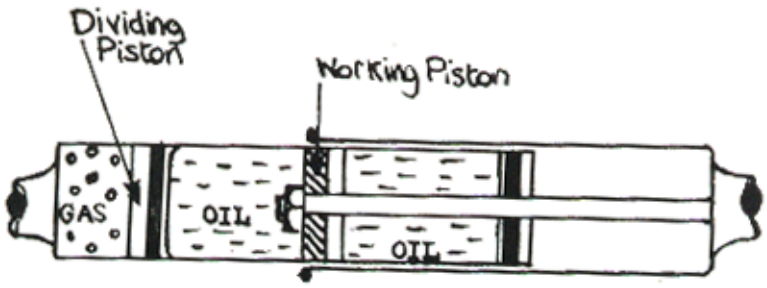


Diagram showing working principles of a gas filled damper

Suspension-FRONT

4.1. FRONT STRUTS

The strut suitable for 90% of British Stage rallies is the one based on the original World Cup Strut, marketed by RS Parts (RH 9053062, LH 9053063).

The bump/rebound settings are 260/60 and its wedged stub axle is welded right at the bottom of the strut tube, which will allow you to drive your Halda from the front wheels, (rather than the speedo cable) by getting the stub axle drilled along its axis. We will cover this point in finer detail later.

Incidentally, adjustable front struts (spring height only) are now available, although the only advantage lies in the instant change of ride height, as the settings are identical.

Dealing with the struts as fully assembled units, the steering arms to use are the standard RS/Mexico arms (finis code RH 1443547, LH 1443548). These want to be bolted with the production bolts (finis code 1443784) using a nylock followed by a half nut.

Note that there are two problems in transferring Mk I World Cup struts to a Mk II shell, if you're building up a new car. Firstly, the Mk II strut has a spring seat $1\frac{1}{2}$" lower as standard than the Mk I. This means that front ride height is going to be $1\frac{1}{2}$" lower if you do a straight swap. This can be counteracted by either cutting and rewelding the seat higher - but watch you don't get full spring compression before the inbuilt damper bump-stop comes into play - or fitting a longer spring. Point two concerns steering racks. Escort II struts, excluding those on RS spec. cars have cast in steering arms, which means they must mate-up to a Mk II rack, with standard Mk II track-rod ends. On RS model Mk II's, Mk I type struts with bolt on UNF tapers for the steering arms are fitted. However, RS Mk II's do have a metric thread on the rack steering arms which necessitates steering rod ends having a metric thread and UNF taper.

To summarise:

- Mk I struts have bolt on steering arms to take UNF tapers.
- Mk II struts (except RS) have cast in steering arms (metric).
- Mk II struts RS have bolt-on steering arms with UNF tapers.
- Mk I racks have UNF tapered track-rod ends.
- Mk II racks have metric thread for metric cast steering arms.
- Mk II RS racks have metric thread with special UNF tapered track-rod ends.

NB: Standard Mk II track rod ends are colour coded BLACK. RS track rod ends are colour coded GREEN (Pt No 1564468).

Application Chart - RS Front Struts

RS Models Mk I and II

Rally - Gp 4	-	905 4031*	RH front
		905 4032*	LH front
		905 3385	rear
Rally - Gp 1/2/4	-	905 3062*	RH front
		905 3063*	LH front
		905 3385	rear (turreted) Gp 4
		905 2890	rear Gp 1/2
'World Cup' - General all purpose rally	-	905 1219*	RH front
		905 1228*	LH front
		905 1492	rear (turreted)

RS2000 Mk I - Gp 1

Rally	-	905 2655	RH front
		905 2656	LH front
		905 2130	rear to 11/75
		905 2889	rear 11/75 on

Escort II - Sport, Ghia

Rally	-	905 2885	RH front
		905 2886	LH front
		905 3159	rear

Escort I - 1.3L, GT, Sport

Rally	-	905 1870	RH front
		905 1871	LH front
		905 2130	rear to 11/75
		905 2889	rear 11/75 on

When fitting struts marked * a heavy duty top mounting kit (905 4002) must be fitted.

4.2. FRONT SPRINGS

Overall, the best all round spring to use is the Green/White (finis 905 2707) which is rated at 145 lb/ft, though you'll see from the table below that there is a wide range from 100 lb rating up to the 190 lb/in spring currently being used by the works.

When building a car from scratch, choice of springs can be a major headache, with everyone suggesting different ratings as if an expert. So, until you've got the rest of the car working properly, stick to proven set-ups.

4.3. FITTING HINTS

Before you assemble the spring, check the three peenings which locate the ball bearing on to the top mount and ensure that the three captive nuts on the top mounts line up with the holes on the inner wing.

After compressing the spring, locate it on to the strut spring cup. Position the top spring cup, followed by one washer (supplied with 905 2278), the top mount and the lock nut. Should the nut not lock onto the last threads of the piston rod, you will have to cut it down by the required amount for it to lock on. Note to tape the dust cap to the top mount to prevent dust getting to the bearings which will prolong top mount life.

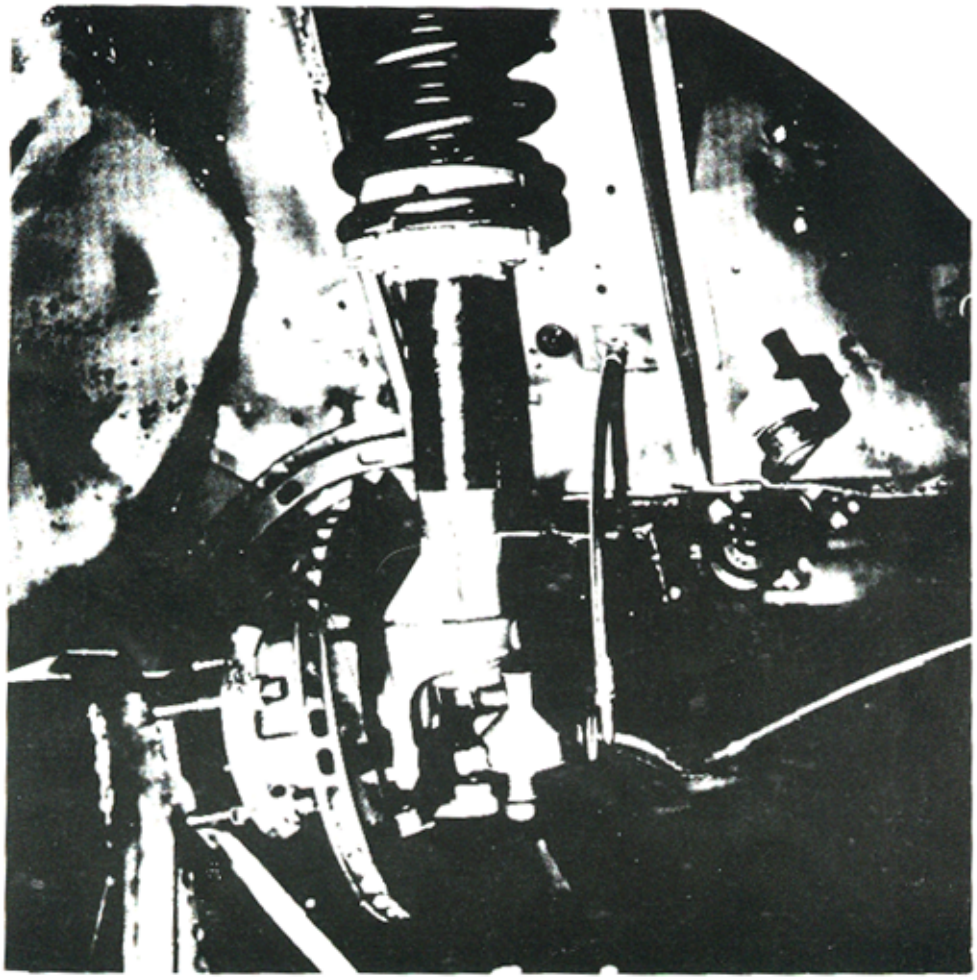
Front Spring Chart

Front Suspension Unit	Spring	Rate lbs/in	Ride Height (ins)	Application	
World Cup	World Cup	100	+1	Rally - club level - general	905 1296
	Green/white	145	+1	Rally - club level - forest	905 2707
	Blue/white	145	standard	Rally - club level - tarmac	905 2706
Gp 2/Gp 1	Green/white	145	+1	Rally - forest + RS2000 Gp 1 international	905 2707
	Blue/white	145	standard	Rally - tarmac + RS2000 Gp 1 race	905 2706
	Green/yellow	190	+1	Rally - international - Gp 2, Gp 4	905 3387
Gp 1	Blue/white	145	+1	Rally - RS2000 Gp 1 - general	905 2706
	-	160	standard	Escort II Sport, Ghia	905 2870

4. 4. FRONT HUBS

At the stub axle end, you should use the Gp 4 RS Parts Aluminium hub which accommodates standard wheel bearings and oil seals, together with the early Gp 4 studs also available from RS Parts; at the time of writing the current large stud arrangement as used on works cars is not generally available, although RS Parts will be marketing the set up.

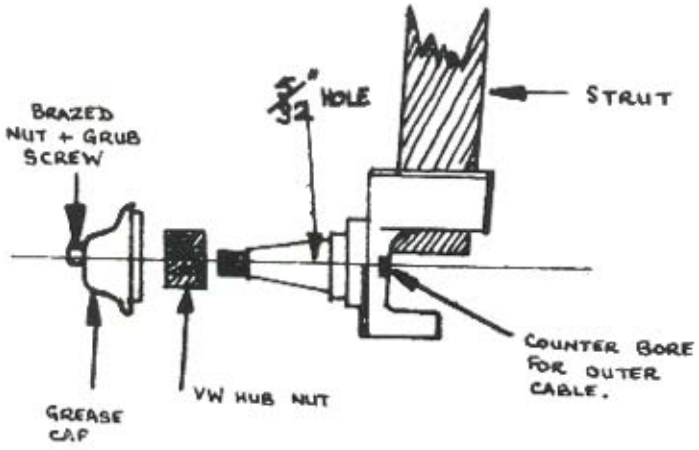
Having obtained the large 10" + vented discs and bells from A P Racing, pack the hub and inner wheel bearing with Castrol FCB grease, fit the inner bearing and tap the oil seal home. Bolt the bell to the disc, then bolt the assembly to the hub with standard disc to hub bolts. On the ventilated discs, no backplates are used, so push the lot on the stub axle, then locate the outer wheel bearing.



Works adjustable front strut. Note double nuts on the steering arms.

4. 5. HALDA DRIVE

If you wish to run your Halda via the front wheels, get the stub axles drilled out from one end to the other with a 5/32" drill. You will also require two right hand thread Volkswagen hub nuts. Fit the production washer next to the outer bearing onto the stub axle, followed by the Volkswagen hub nut and the dust cap suitably modified with a brazed nut and grub screw to pinch the Halda cable. Your struts are now complete and ready to be bolted onto the inner wings. Of course, with this drive, the Halda system is very accurate since there is no loss through wheel spin.



Remember, though, that only the latest struts (905 3062 RH, 905 3063 LH) are suitable for this modification.

(Note: The works cars now rarely use the Halda for outright accuracy, using one of a number of electronic distance recording devices available on the market. In 1976/77 the works cars used 'Holtrip' recorders.)

4. 6. CROSSMEMBER

For stage events, you will have to use the only crossmember man enough for the job, the so-called 'World Cup' crossmember.

Finis code 905 1874 (Mk I and II) crossmember.

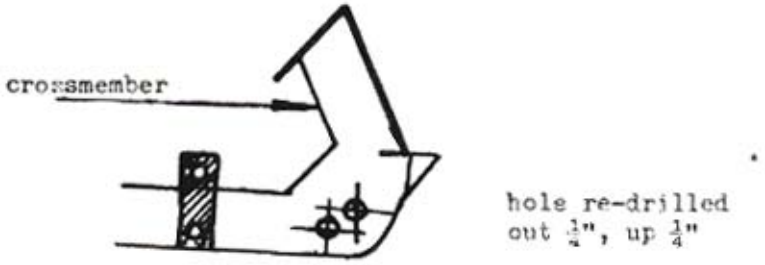
X Flow/BDA	(905 1565 RH eng mounting bracket) (905 1566 LH " " ")
S O H C	(905 2738 RH " " ") (905 2737 LH " " ")

905 3070 replacement bush

905 1748 spacer for X-flow/BDA engines prior to 8/70

Before installing the crossmember, it's a good idea to elongate the mounting holes onto the chassis rails, so that when you come to the fine tuning of your front suspension, you can even out the camber angles on both front wheels by repositioning the crossmember. Mounting bolts to use are the production items.

Another inexpensive and easy mod is to increase the camber angle of the front wheels. This is a bit more time-consuming, and of course, cannot be attempted within the Group 1 regs. The reason for this mod is, that if tall springs are used for stage rallying, the nose of the car is raised and the standard negative camber settings return to virtually zero in the static position. So, to counteract this the inner (crossmember) locating hole for the TCA is moved out $\frac{1}{4}$", and up $\frac{1}{4}$". The repositioned angle of the TCA moves the bottom of the wheel out and the top in, and gives you the 1-1$\frac{1}{2}^{o}$ camber of the standard car. The TCA, incidentally, is not modified, and is the standard forged Mex/RS1600/RS2000 part.



4.7 FRONT SUSPENSION GEOMETRY (an ideal standard setting)

Castor	3^{o}
Camber	1^{o} 30' neg
Toe in	1/8" max ride height $6\frac{1}{4}$" - forest (under side rail)
	1/16" to 0, ride height $5\frac{1}{4}$" - tarmac

4.8. T.C.A.'s

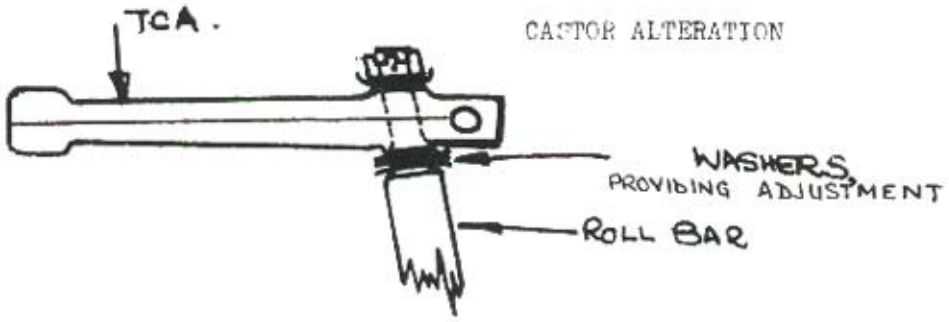
Now onto the Track control arms and anti-roll bars, which are the most easily bendable items of the suspension, so remember to carry a full quota of spares. If you convert a TCA into a boomerang, you will have almost certainly bent at least a roll bar clamp and the anti-roll bar to TCA washers, so carry plenty of these as well.

The TCA to use (it's the only one around anyway) is the standard Escort I/II item, which you want to equip with the hard bushes available from RS Parts.

On Mk II's it is desirable to increase the castor action of the front wheels which will also increase the steering self centering. This leads to greater stability, as the car will not tend to dart off the road on the opposite side at the exist of a corner.

This is simply done by moving the anti-roll bar clamp forward, or more accurately, the weld nuts on the standard bracket. Before you weld the nuts on to the bracket it's best to have a dummy run to check the setting. (This can be done with the struts and anti-roll bar on the chassis, but no road springs. With the car level the strut can be easily moved up 50% of its free travel - the point it just touches the internal bump stops - this will be the approx ride height of the finished car. The desired castor angle can be set and the anti-roll bar clamp welded in position.)

For fine adjustment, the parallel section of the roll bar that passes through the TCA can be machined back to allow four standard washers to be fitted. These can be fitted in any combination either side of the TCA - see sketch.



4.9. DOUBLE ANTI-ROLL BAR MOUNTS

To stop those expensive McPherson units flapping in the breeze, a production Mk I Mexico/RS2000 anti-roll bar, finis code 905 2549 (this is a mainstream part, not an RS part, ie, you can ask any Ford Dealer to order you one) should be clamped to the body via the RS Parts twin roll bar mounting kit, finis code 905 1304. These really do need to be beefed up because they provide the fore and aft location of the front struts as well as acting as the anti-roll bar mount. If the standard brackets are used, you'll find the constant pounding and dropping wheels into holes on the inside of corners will squash out the standard rubber. The bracket then bends with the resulting loads, and the tracking changes at will.

The complete kit comprises 2 foot brackets, 2 rubber mounts, 2 securing clamps and a new set of screws with lock tabs. It mounts via the existing holes in the chassis rails so no extra drilling is required but if you want a top class belt and braces job, tack weld the foot plate onto the side rails after you've bolted it into place. If you're using a magnesium alloy sump guard, you may have to file away a corner of the side rail foot to clear the wider mount.

4.10. FITTING ANTI-ROLL BARS

Firstly, buy a spare rubber, finis code 905 1302, which you should place on the middle of your roll bar. If you have an 'off', and bend or shear the clamp, you will almost certainly have destroyed the rubber, so you can slide the spare one into position. Of course, there is the theory that if you have done that much damage, 10 to 1 you will have bent the roll bar as well; but you may not have enough time to change the roll bar, in which case, a shove with a bottle jack and a new clamp will keep you going until more service time is available.

Next, you will find when bolting the roll bar up, that the two outer clamp bolts on each clamp (those directly below the chassis rails) will bottom on the actual chassis rails. So before permanent fitment, position the anti-roll bar brackets. Mark up the two outer holes, and drill out two $\frac{1}{2}$" holes on each rail to allow the bolts to screw fully home.

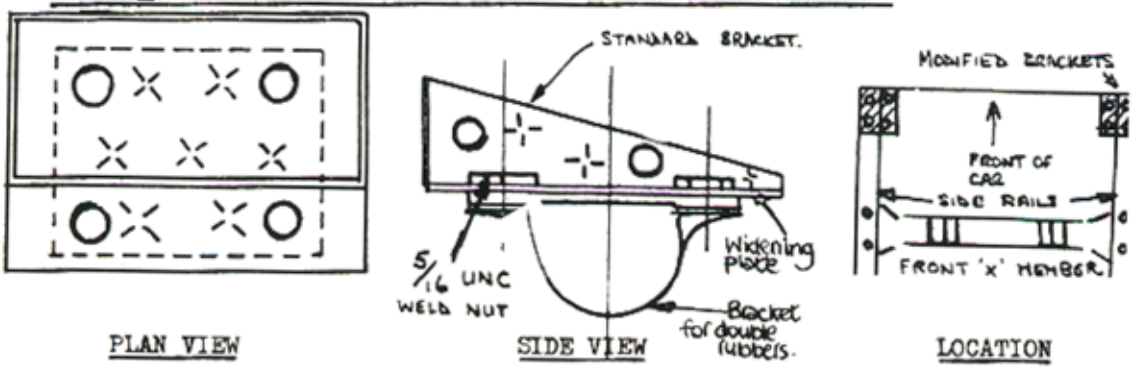
Thirdly, a bit of washing-up liquid will do wonders to help the rubbers slide onto the anti-roll bar.

4.11. ANTI-ROLL BAR BUSHES

Heavy duty front suspension bushes are available from RS Parts, as follows:

Anti-roll bar mounting (double)	905 1302
TCA - inner	905 3166
- outer	905 3168
Steering rack mounting LH	905 3172
" " " RH	905 3171

Double width anti-roll bar mounting drawings (not to scale)



PLAN VIEW SIDE VIEW LOCATION

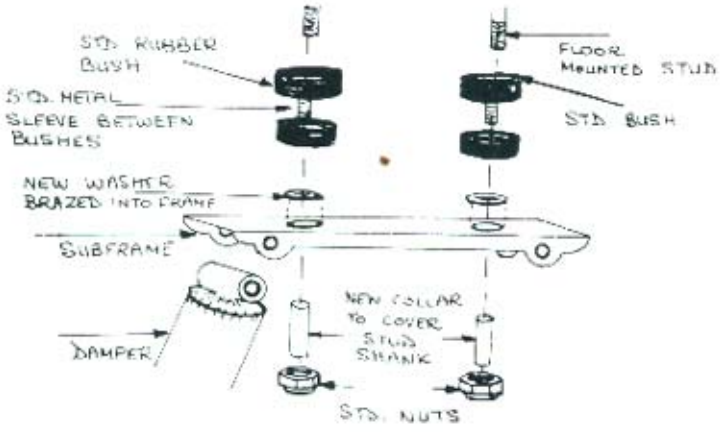
Suspension - REAR

5.1. POSITIVE AXLE LOCATION

The first consideration when doing anything to the rear suspension is to stop unwanted movement, and get the axle travelling as much as possible in a straight up and down plane. Because of the way most live axles are located on production cars, the axle does, in fact, move in an arc.

5.2. MODS FOR EARLY ESCORTS

To stop the axle moving from left to right on corners, a lot of the rubber must be thrown away. On Escorts with the rear cross-brace (ie 45° inclination) damper mounting, this means throwing out the rubber spacers between the damper mounts and floor pan. The brace then mounts directly onto the floor. A flat washer, filed to size, should then be brazed or welded into the cross member to provide positive location using the standard body welded bolts. A spacer must then be placed over the shank of the projecting bolt, between the cross brace and securing nut. This ensures the cross member is securely pressed against the body, and production damper travel is retained.

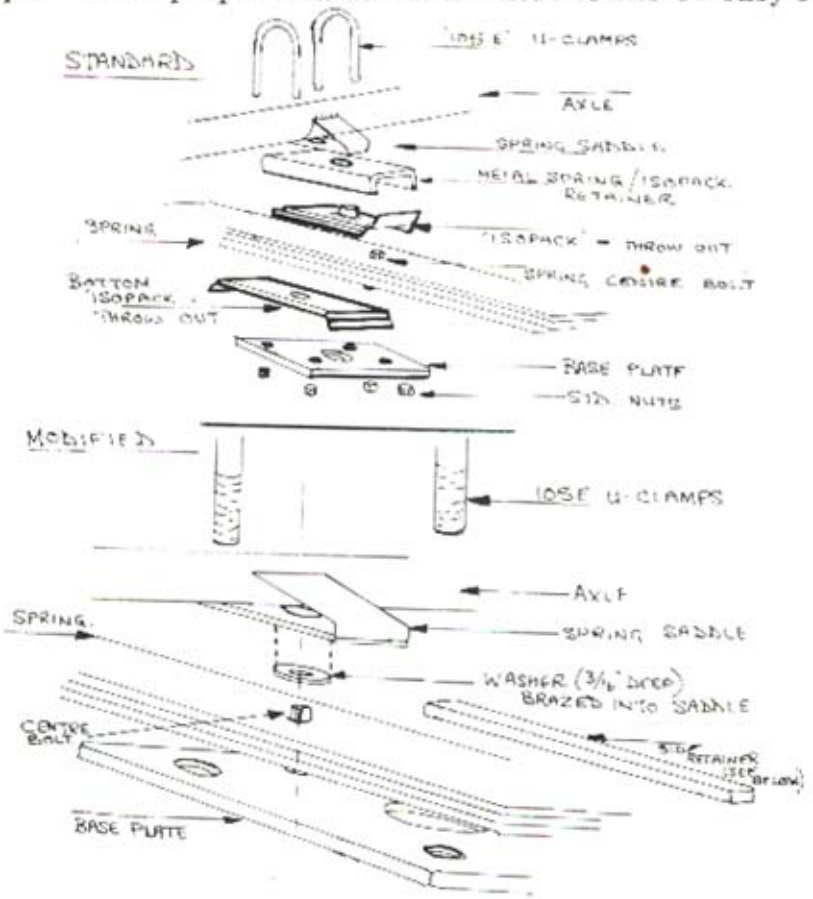


This modification will transmit more rear axle noise and vibration through the body, but don't worry. For anyone running an Escort with this older suspension, and has not converted to turrets, the cross member, which is prone to bending if the car is used on stages, can be strengthened by either double skinning it, or boxing in the open fourth side. The latter course is strictly not Gp 1, and still allows the weakest area, directly where the dampers bolt through, to bend a bit.

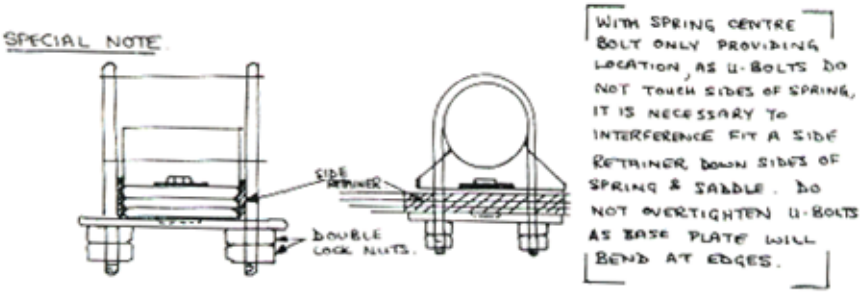
RS Parts did produce a kit, with a modified section of floor pan, to update this earlier set-up to Mk II spec of 15° inclination, but this is no longer available.

The next move, no matter what rear damper arrangement there is on your car, is to positively locate the axle on the spring and stop unwanted sideways axle movement. This lateral movement is inbuilt in the standard car for comfort and is caused by a rubber 'Isopack' block between axle and spring. This has to come out, and can be hurled in the nearest dustbin. To do this, undo the 'U' bolts on both sides, remove the actual 'U' clamps and jack up the axle a few inches. This will enable you to just lift out the 'Isopack' blocks. From the 'Isopack' shape you will see it incorporates a central, circular inbuilt metal protrusion, which locates in the axle saddle, and removal of the block means that the spring can move inside the oversize saddle hole.

To prevent this, a large 3/16" deep washer, (finis code 905 1310) with central hole large enough to accommodate the bolt on the spring top, should be brazed into the axle saddle. See sketch. The spring and axle can now be brought directly together. Because of the space vacated by the 'Isopack' the standard 'U' clamps will be too long, and should be replaced by 105E 'U' clamps and plates for retaining 'U' clamps. Don't attempt to increase the thread on the 'U' clamps, it's not worth the bother and can weaken them. Remember to cut off any unnecessary length on the 'U' clamps that projects down and can catch on rocks, etc, and bend the clamps. Some people fit a double nut here to ensure easy removal.



The end result of this exercise will be a positive gain in handling and an increase in rear ground clearance of approx $\frac{3}{4}$".



5.3. AXLE RADIUS ARMS

With the axle positively located, the next essential is to attach it to the body by radius arms. These - sometimes called anti-tramp bars - prevent the springs winding up under acceleration and help the springs just get on with being a suspension medium.

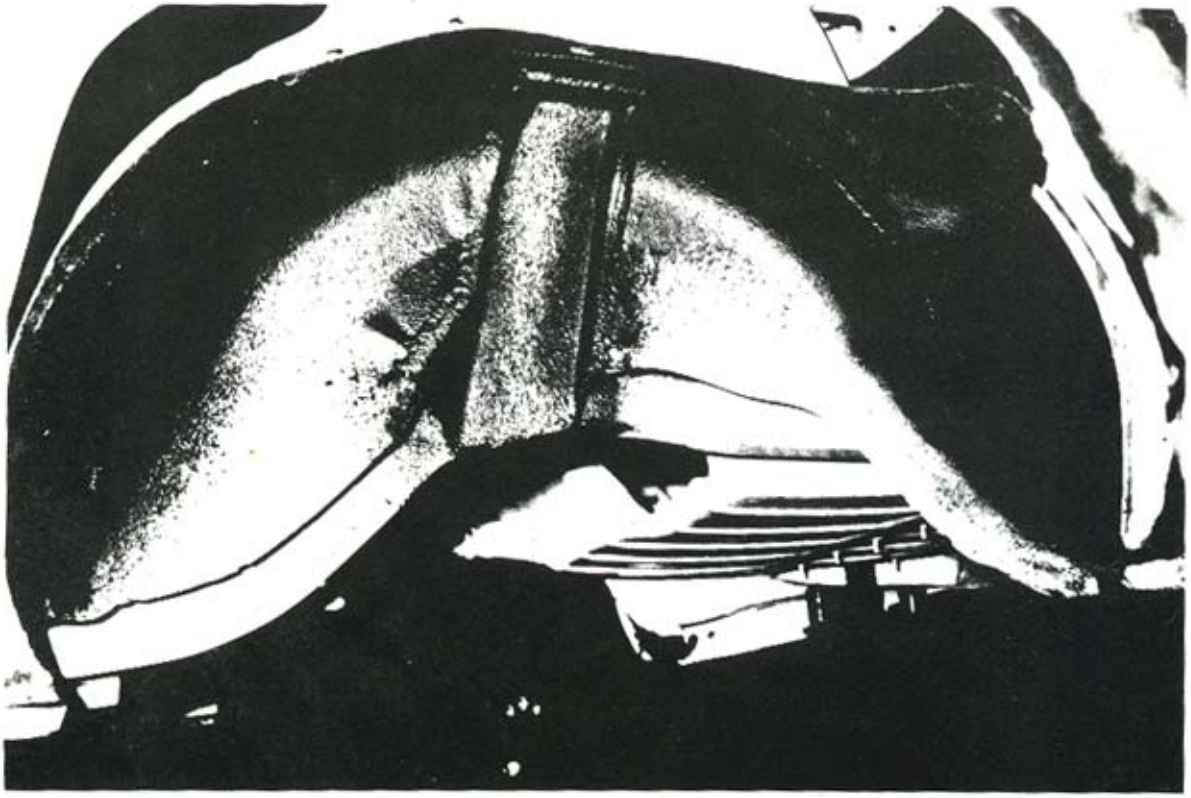
Radius arms are fitted as standard to all RS Escort models, but not Mk I 1300GT, nor Mk I/Mk II Sport models. If going Group 1 with a Sport derivative, radius arms cannot be fitted, but would be essential for Gp 2 or 4. RS Parts market a radius arm kit (905 2143) comprising arms, body mounts, axle mounts, bushes and eye bolts. In the case of Post 11/73 Escorts (ie upright or pull ahead dampers as they are called), you will have to purchase some different radius arms (finis code 905 2566 RH, 905 2567 LH). For competition use it's worth fitting h/d bushes to the radius arms for more positive location - front 905 3167, rear 905 3168.

5.4. TURRET KIT

To have the rear suspension working efficiently, the dampers really have to be mounted in an upright position.

The simple way out is to fit an AVO turret kit, available under finis code 905 1643. This gives a box section mounted vertically in the rear inner wing, with the damper passing through to its top mount. Fitting the actual turret is a precise job, and it's worth taking the car to an RS dealer or specialist; they have a special tool (jig no P5522) which mounts in the front spring eye on the body, and arcs up into the shell so that the cutting marks can be accurately scribed on the inner wing. This kit is designed for use with the AVO shockers finis code 905 1492, although accurate positioning of the axle bracket is essential to avoid bottoming of the dampers.

At Boreham a special turret derived from the standard Capri unit is used, which although giving near ultimate damping, is a more complex job. Again, Safety Devices and Gartrac are set-up to graft these on.



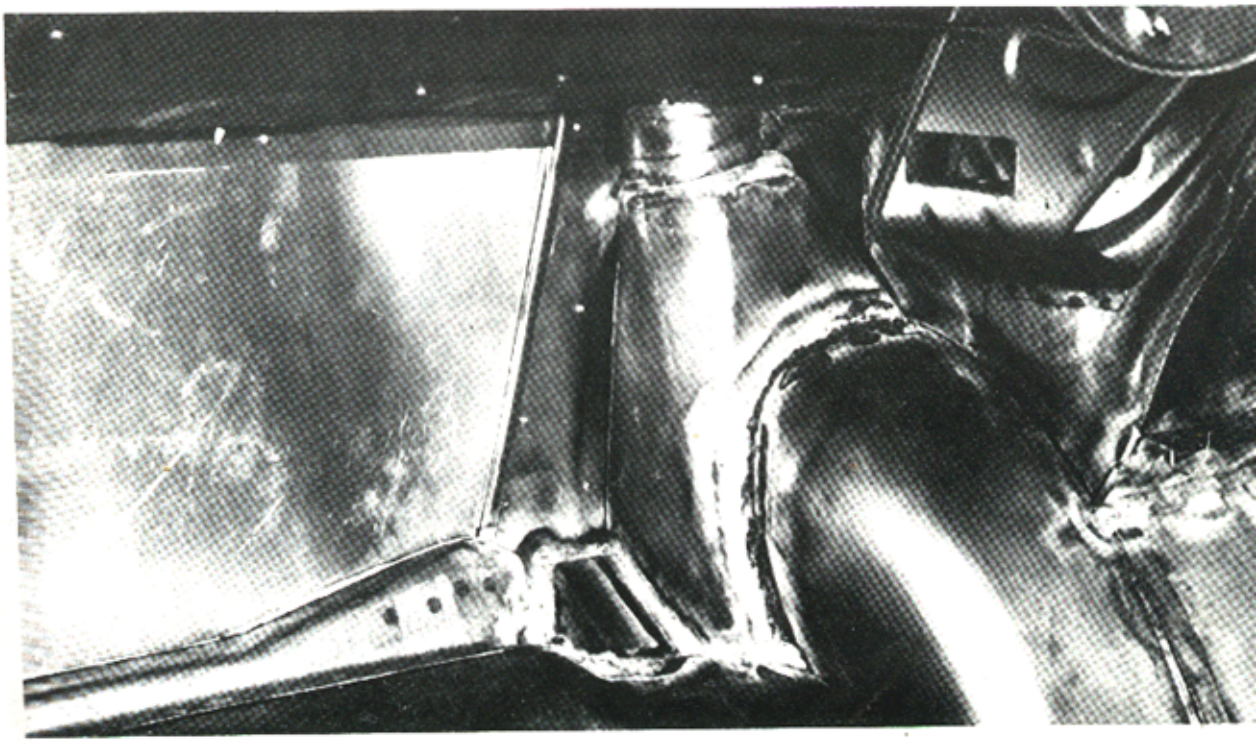
Turret kit 9051643, here fitted to a Mk 1 Escort. View into wheelarch.

5. 5. WORKS DAMPER POSITIONING

The RS Parts turret kit, when fitted to either Mk I or Mk II Escorts, with damper 905 3385, gives you a turret above and just behind the axle vertical line viewed from the side. This is an easy location, as only the inner wheel arch behind the bulkhead has to be cut, making fitting simpler. The damper is mounted in front of the axle, which gives the damper a rearward tilt at the top, when viewed from the side.

On the works cars, the damper is mounted directly on top of the axle, giving direct downward pressure, and keeping it out of the way of boulders thrown up from the front wheels. In doing this though, the turret must be exactly above the damper/axle mount in the standard ride height position, which means locating the turret in the bulkhead plane, as shown. The axle mount has to be very carefully fabricated, since the outer 'U' bolt must pass through its base, when located correctly.

As a half-way between the RS Parts and current works spec set-up, there was an additional complication when Boreham used two damper settings. Measured from the top seat to a line extending along the side rails, these were either $10\frac{1}{2}$" or $12\frac{1}{2}$", with the difference arrived at by a longer damper and welding in the turret at a different height.



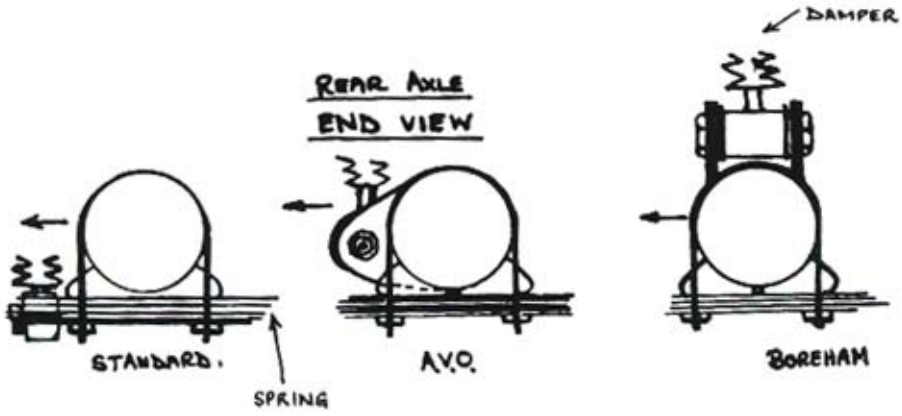
Works turret viewed from inside boot. Damper top nut access is from inside cockpit.

It's a good idea to use a 105E bump stop located as normal under the axle 'U' bolts. If you cut about $\frac{3}{4}$" off the domed top, which is quite soft, the remaining part will allow that extra bit of travel before the stop comes into action. Check, of course, that your dampers are not fully compressing before the rubber stop hits the chassis rail.

5.6. WORKS DAMPER TO AXLE MOUNTING

Boreham used to locate the bottom shock absorber mount in front of the axle casing to help prevent axle wind-up under acceleration, but when the length of the radius arms was increased, thereby restricting wind-up, they were able to alter the turreting arrangement for optimum damping.

The dampers are now mounted on top of the rear axle, giving them a greater inclination outwards of the damper. To do this, the turret must either be made longer or placed a corresponding distance higher in the wheel arch than previously, and the top cut off and re-welded so that the damper sits with an inclination from the vertical of 8^{o}, not 4^{o} as before, the base of the damper being nearer each wheel vertical line, than the top. Another advantage with the new position is to prevent occasional damage to the bottom bush and to stop it from getting knocked out of its housing.



5.7. REAR SPRINGS

Model	Unit	Finis Code	Rate (lb/in)	Front Bush	Rear Bush	Ride Ht in ins	Application
Mk I	CD6	9051305	85	9051311	1710123	Std	All round 4 leaf spring. Bush for pre '68 Escorts.
	"		"	9051890	"	"	Bush for post '68 Escorts
Mk I	CD8	9051307	115	9051564	9051311	+1"	Only for post '68 Escorts as speci bushes needed. Very hard spring designed for full load in boot (big tank etc)
Mk I	RS3100	9051947	112	9051564	9051564	-1"	Single leaf. Idea
Mk II	"	"	"	9053169	"		for Gp 1. Use 105E shackles
Mk I/II		9053604	145	none	1710123	-	Slipper spring a used on 4 link G 4 rear axle (5 le

5.8. NOTES ON REAR SPRINGS

The prefix CD is derived from Competitions Developed, ie, it originated from Boreham testing.

All the ride height figures quoted have taken into account the removal of the rubber sandwich plates beforehand. All springs, except the RS3100, and the slipper springs, are four leaf - standard on Escorts is 3 leaf.

When changing rear springs, especially when converting a non original RS h/d shell, watch for different size rear bushes. In some cases, depending on shell age, 105E rear spring hangers will have to be fitted. For most special stage events, stick with the CD6 as the best all rounder.

If fitting the RS3100 single leaf spring take special care to check homologation within event regs.

Standard Mk II springs are $\frac{1}{4}$" wider than Mk I.

5.9. WORKS 5 LINK REAR SUSPENSION

To make the most of power outputs of 200 bhp plus, one needs a highly effective rear axle set up. In the Escort, this is satisfied by the use of a fully floating rear axle located by a 5 link zero steer rear system, which involves extensive modifications to both axle and bodyshell, (the 5th link being the transverse panhard rod).

The axle itself is based on the Capri 3-litre unit, and should be built up from scratch, starting with a bare differential housing, available from RS Parts (finis code 905 3330) and assembled using all the relevant fully floating components, which we shall list further on.

This is no mean job, and the experts to contact are Safety Devices (Cambridge), Gartrac (Godalming) or Gomm Metal Developments (Old Woking) - although the latter are reluctant to work on one-off jobs.

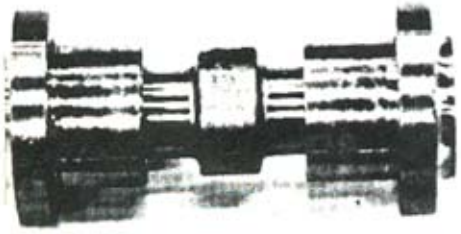
To return to the rear suspension: Basically, it consists of an outboard turret assembly based on the standard Capri turrets, sliding roller (commonly called "slipper") rear springs and Bilstein rear shock absorbers.

To achieve zero steer rear suspension, there must be no interference with the straight up and down movement of the axle, so both spring ends must be free moving. This is achieved by using a slipper arrangement at the front of the spring, instead of the usuall bush. Using the standard bracket widths, a hardened steel roller for the spring to sit on is inserted, and a phosphor-bronze bush above the spring, on another roller, to keep it seated on the lower one.

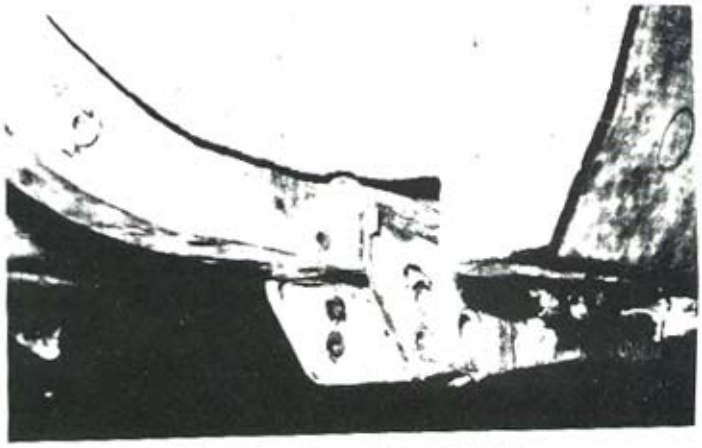
This kit is available from RS Parts, the relevant finis codes being as follows:

Roller - upper (2 off)	905 3602
- lower (2 off)	905 3601
Bush - bronze - spring roller (4 off)	905 3603
Grease nipple (2 off)	176 1997

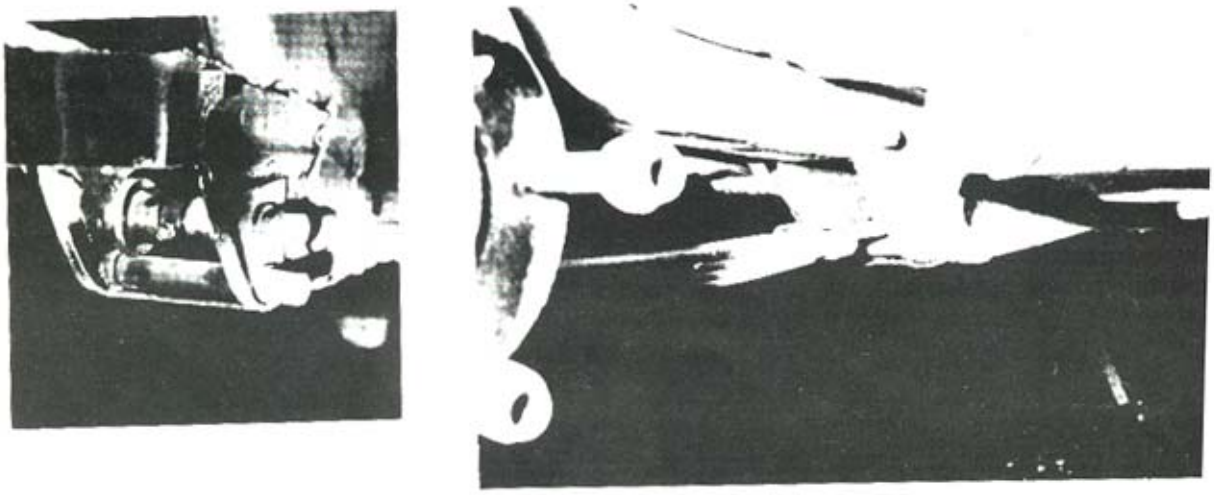
Components of slipper-roller kit.



Roller built up.



Modified front spring hanger.



Spring hanger without and with spring.

The rear springs themselves are standard units of whatever specification, with the front eye cut off. When sawing off the eye, cut as far forward on the flat of the spring as possible, to give the maximum feed between rollers. Grease liberally with graphite grease.

Incidentally, many privateers and semi-professional teams fit a similar kit which uses PTFE bushes and is marketed by F English's Ltd in Bournemouth. It is a simple affair, as it bolts on to the existing spring mounting holes, when using 905 3604 rear springs. If you happen to obtain some twin leaf rear springs, you will have to relocate the fixing holes, slightly further back, as these springs are shorter than the 5 leaf type.

5.10. REAR HANGERS

At the back of the spring, short 105E shackles are used (142 8295), with small bushes top and bottom. These have their pivot pins welded onto the shackles, as they do occasionally come apart.

Finally, the springs are retained on to the axle via 105E bottom spring plates and 105E 'U' bolts, using double nuts on the threads to prevent these from being damaged.

The 5-leaf. 145 lb/ft slipper springs are available from RS Parts as are the rear shock absorbers, set at 220/110, under finis codes:

Rear spring	905 3604
Rear shock absorber	905 3385

Particularly in the case of tarmac events, it is more desirable to use twin-leaf slipper rear springs, rated at 175 lb/ft, normally used in conjunction with 260/60 rear shock absorbers.

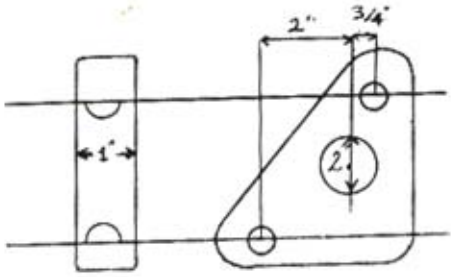
5.11. FOUR LINK DESIGN & BODY ATTACHMENT (to be read in conjunction with rear axle chapter)

The axle is attached directly by four radius arms, to the body thus:

In 1974 a 'short arm' was used, but from 1975 onwards, the 'long arm' has been employed, giving the axle greater travel, and proving to have lost no strength.

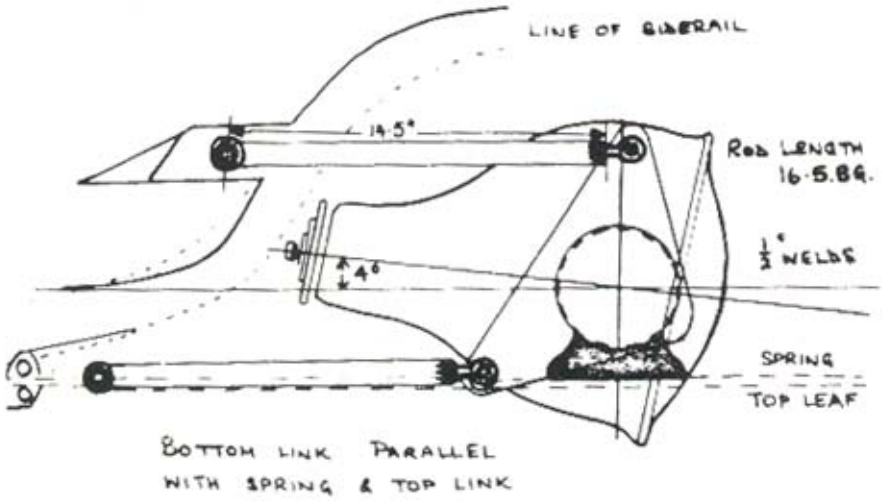
Firstly, a brief description of the older $14\frac{1}{2}$" system.

The bracket for axle mounting the arms meant that the bottom arm was considerably forward of the top arm to prevent axle wind-up. The mount, made from 12 gauge mild steel, and fully boxed for Rose-joint protection and strength, looked like this:



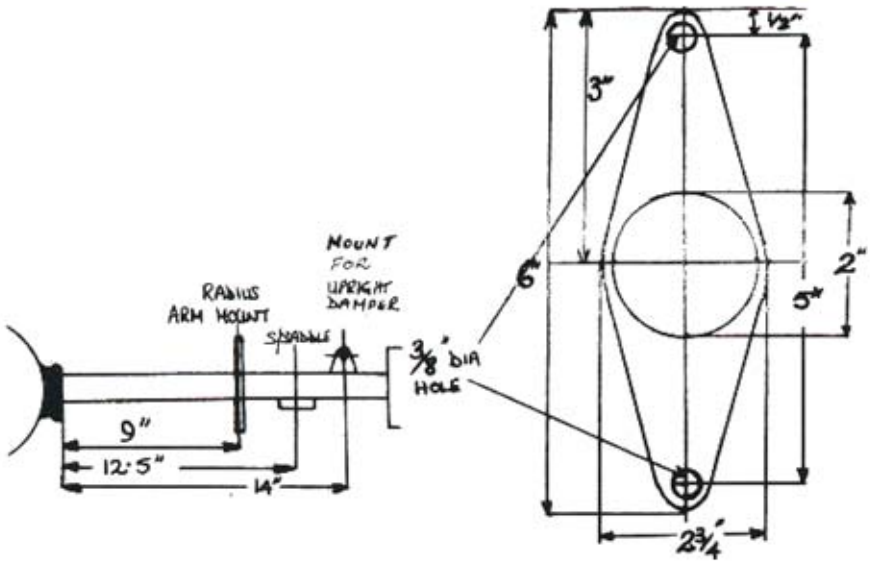
The linkage was, and remains, a means of providing positive location, stronger than the standard 2 arm set up, even with h/d rubber mounts, for the rear axle, so letting the springs just provide the springing. As such, the arms, attached to the body, must travel forward in a line exactly parallel with the side rails, whilst, when viewed from the side, also be parallel with the line of the top spring with the vehicle in the static position. From the next drawing, it can be seen that the shorter arms meant location of the lower one to the body was adjacent to the spring rollers, with the upper having a floor mounted box section just inside the cockpit.

The slipper spring was fitted between a lower hardened steel roller and an upper phospor-bronze bush at the front, using the standard bracket widths, and short 105E shackles at the backs.



Onto the latest spec now, using the 23" arm system.

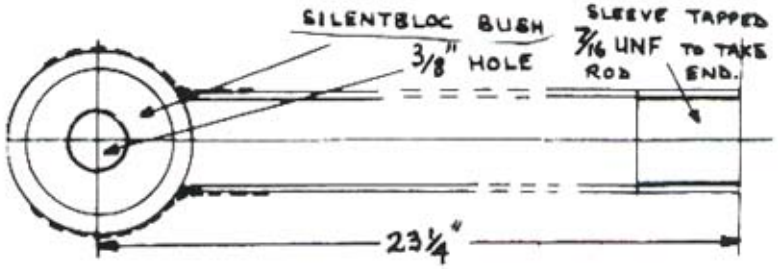
The bracket accepting the four arms on the axle measures as follows:



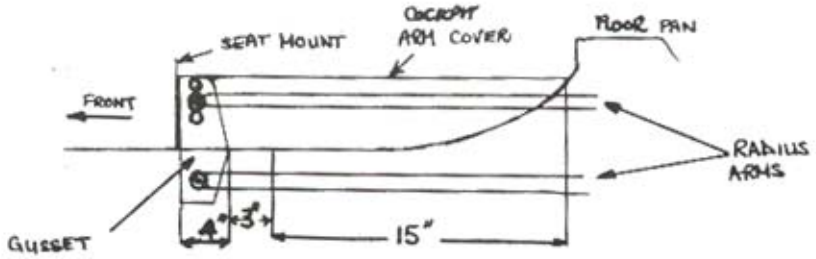
Unlike the earlier short arm system, the pick-up is at exactly 90° to the spring saddle horizontal line.

The centre line of the radius arm pick-up to the edge of the diff casing is exactly 9". Corresponding distances to the spring saddle centre line being an additional $3\frac{1}{2}$" and the damper mount a further $1\frac{1}{2}$".

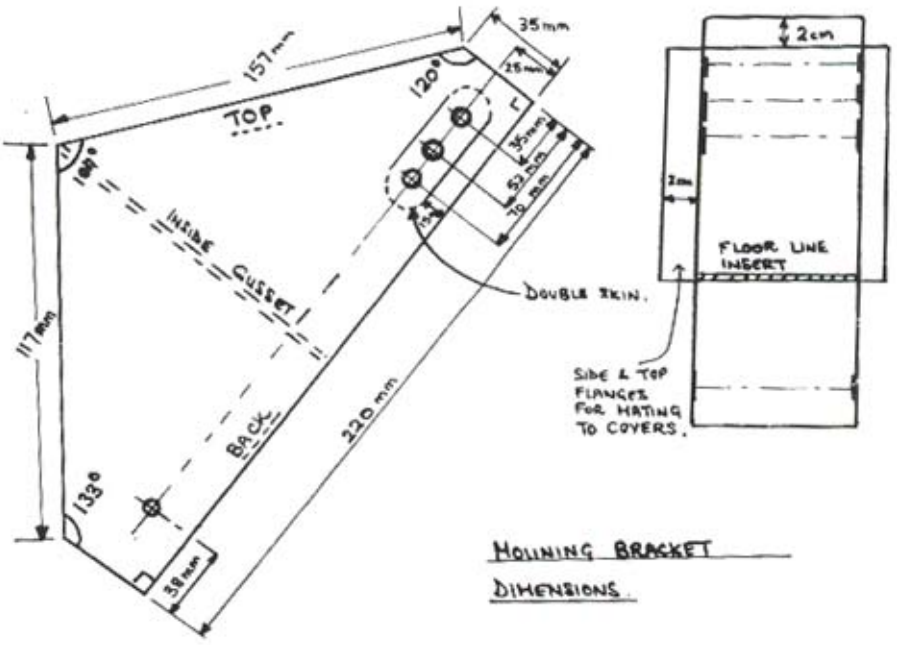
The major difference remains in the radius arm length. Now the arm is $23\frac{1}{4}$" long, with an ideal total length between eye centres of $25\frac{1}{2}$". The arm is made from 1" x 10 gauge cold drawn seamless tube. The foreward end of the arm should be welded to a 1" length of 1" dia tube at 90° to the arm. This should house a standard inner TCA rubber bush, accepting a 11/16" x $2\frac{1}{2}$" bolt. The rearward end is tapped with a 7/16 UNF thread to take an RC8H Rose joint, so that axle skew is adjustable.



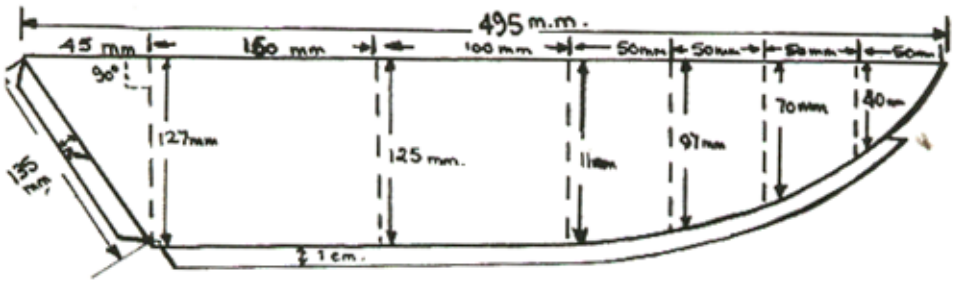
The length of the radius arms means that the front mounts are inside the cockpit on a bracket forming part of the transverse floor support for the rear seat were it in position. The radius arms therefore have to pass through the floor pan, and to achieve this a 15" slot sited $\frac{1}{4}$" inside each chassis rail, from the commencement of floor curvature in front of the axle recess should be cut. The slot should be 2" wide. Working forward on the shell floor, there should then be a 3" standard floor section before another slot 4" long to house the projection of the forward radius arm mount, directly in line with the long slot, and again, 2" wide.

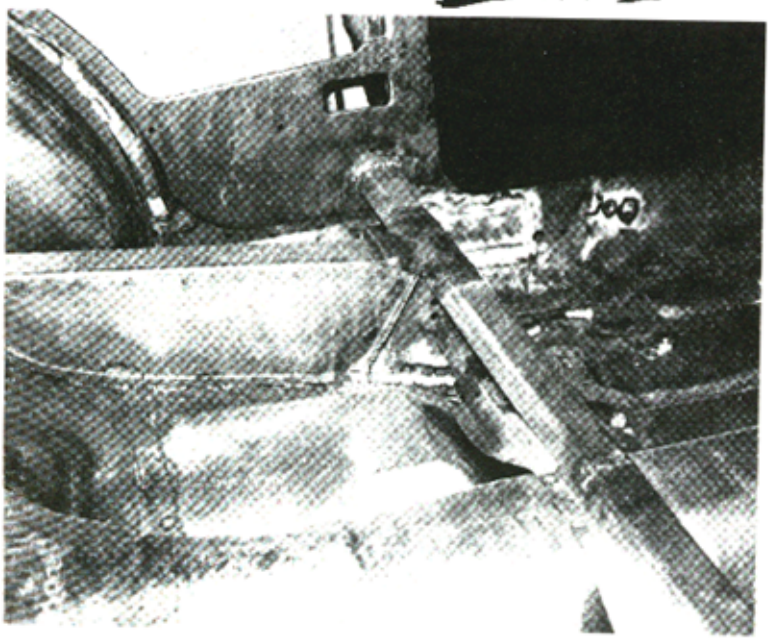


Full dimentions of the front radius arm mount, and the cover over the upper arm for cockpit mounting (both fabricated from 16 s.w.g.) are thus:



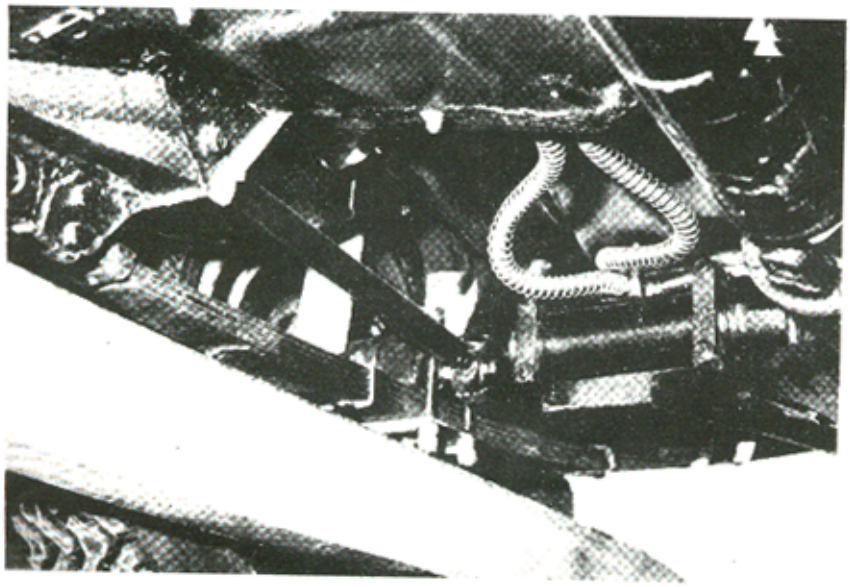
RADIUS ARM INSIDE COVERS





Top arm front mount running forward to rear seat crossmember. Note three pick-up points for arm adjustment.

Below. View of four link system. Note position of bump stop over U bolt.



5. 12. ALIGNMENT OF 4 LINK REAR SUSPENSION

With the four link rear suspension, it becomes possible to set up the axle skew.

This exercise is really to make sure that all four wheels are running parallel. A more simple alignment, using the same principles, can be made with the standard rear end, but, in this case, only the front 'axle' can be moved relative to the rear. This is achieved by moving the engine X member forward or back on one side, by elongating the slots in the X member.

First off, get the car on 4 level axle stands, and draw a chalk line down the centre line of the car, on the garage floor, to act as a check. This done, with either string, or preferably, a steel bar (it doesn't stretch!) measure the distance from front to rear wheel hub centre on either side. From this, you will be able to tell whether you have any correcting to do - and if you've just built up and installed a 4 link system, you can bet that you'll be out somewhere. Having found that there is a difference between either wheelbase, you've now got to find out which 'axle' to move to correct it, as either front or rear could be out.

So, the next move is to drop a plumb-line from each inner t.c.a. bush up front, to the floor, and chalk the point where the bob falls. On the rear do the same, taking the centre point at the rear of the bottom axle link as your plumb-line drop position, again chalking a mark on the floor.

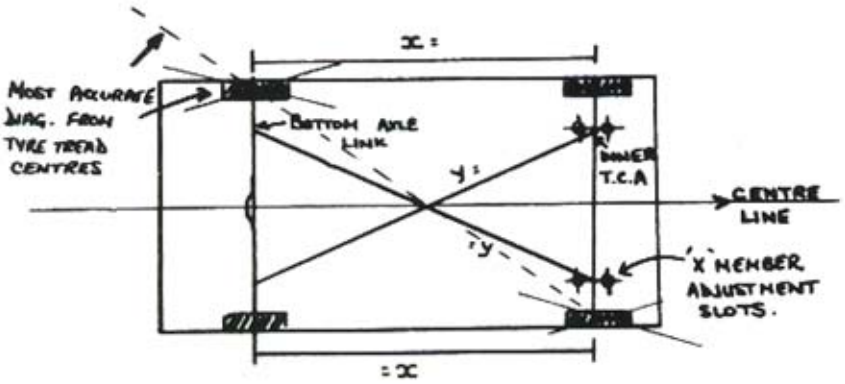
After this, chalk-up a piece of string and join the diagonals, front to rear, by two more chalk lines on the ground, and measure.

Your task is now to get your 2 pairs of measurements the same - ie, diagonals and wheelbase equal.

Adjustment on the rear can easily be carried out by lengthening or shortening the radius arm lengths, remembering to adjust both arms on each side by the same amount.

At the front, adjustments can also be made by elongating the slots in the X member in a fore/aft plane as well as the standard east/west direction, although adjustment here is obviously not as easy as at the rear.

When your diagonal and wheelbase measurements are paired equally, you should have a correctly set up car. Incidentally, although we don't bother for rally machinery, in racing, to be really accurate, you can take measurements from each tyre tread pattern when resting on the ground, and do your calculations from there. It's also advisable to carry out the above procedure with the correct geometry settings already made to the front end.



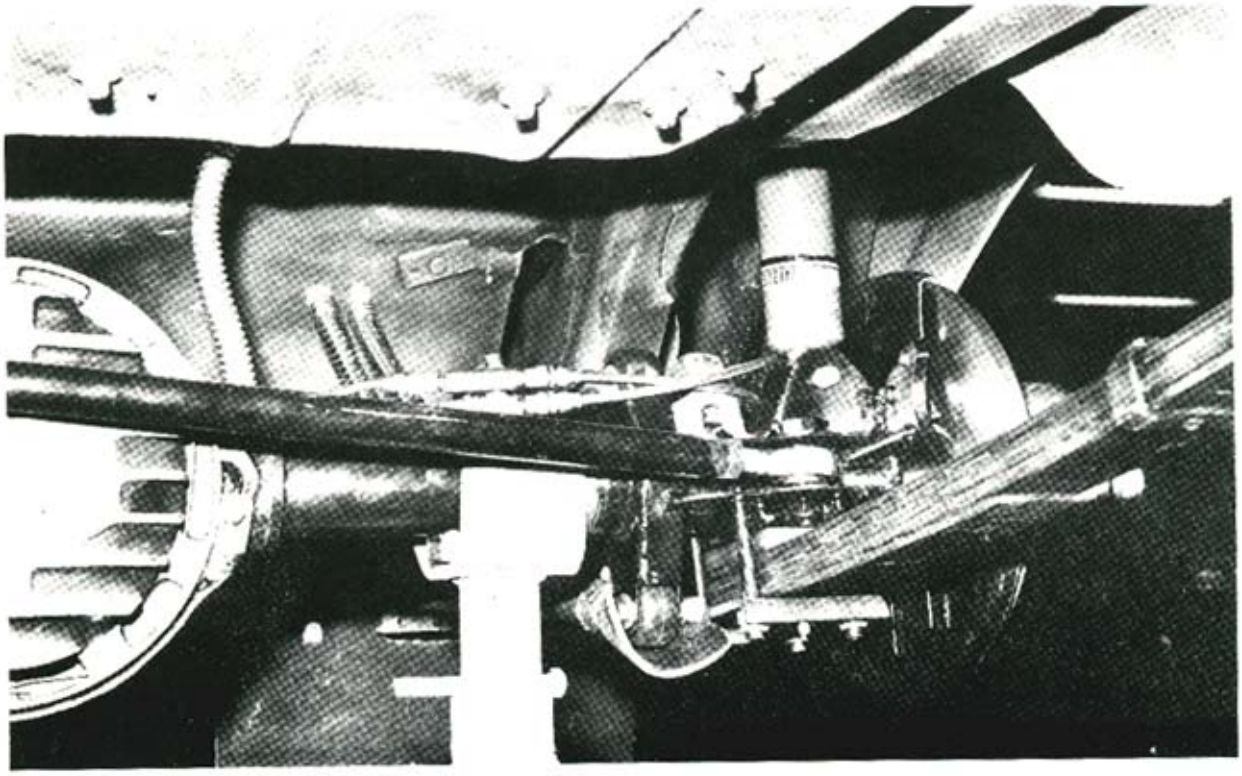
5.13. PANHARD RODS

When Boreham began rallying Mk II Escorts, it was decided to incorporate a Panhard rod on the rear suspension. It is now a permanent feature on all works cars, as well as most competitive Gp 4 cars.

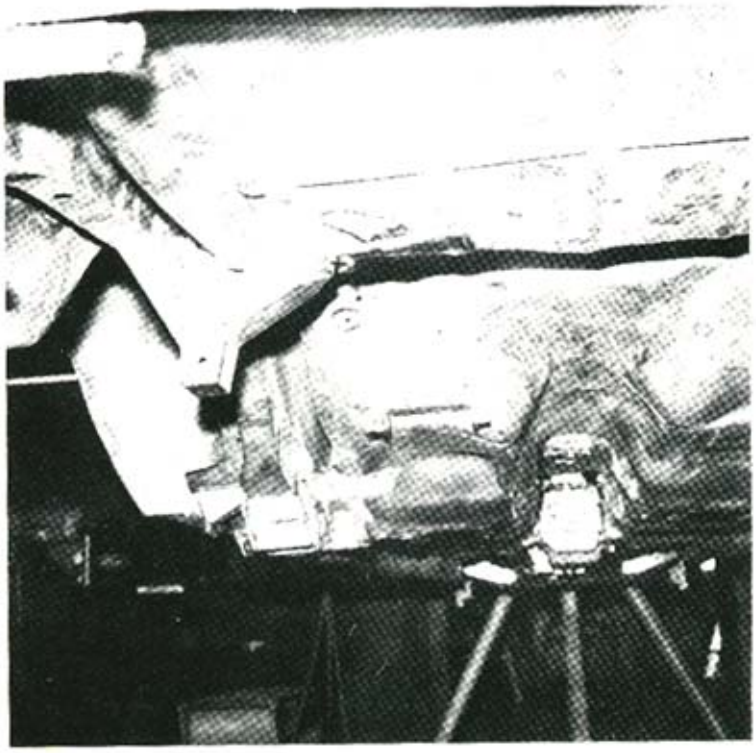
The Panhard rod is made out of 1" steel tubing and measures in at $36\frac{1}{2}$" long, from the centre of the body end bush to the axle end of the tube.

At the axle end, a bracket is welded on the axle casing (see photograph) and an AGS 3084 Rose joint is used.

At the body end, a special bracket (available from Bracey Price, Gartrac, etc) is welded to the floor pan. The Panhard rod is terminated by a tube welded on to the end of the rod, and carries an inner Track control arm bush.



General suspension seen from below. Note starboard roll coupling.



Starboard roll bolt mount.

REAR AXLE

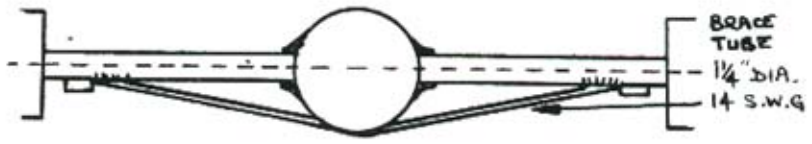
6.1. INTRODUCTION

There are three alternatives when thinking of axles:

1)	'English axle'	-	Standard production axle on all Escorts including RS products. Reliable but prone to bending in very rough events.
2)	'Narrow Atlas' (905 3540-3546) Depending on f/d ratio.	-	Produced as homologated axle for RS2000 in Gp 1. Wheel arch extensions not necessary, but also excellent choice for cheap Gp II car.
3)	Gp 4 axle	-	The Capri derived Atlas axle is no longer available as a new part. Gp 4 axles with their bracketry for Gp 4 suspension can be made up or are available from Rallye Sport Dealers.

6.2. STRENGTHENING ENGLISH AXLES

A simple mod to the English axle is to put a strip of 'U' section, or round tube, from one side of the axle to the other, remembering to get it as near the spring seats as possible. $1\frac{1}{4}$" dia or $1\frac{1}{2}$"x1" channel tube, 14 s.w.g. is ideal and underneath the diff tuck it in front of the flange running round the back of the axle casting to prevent reducing ground clearance more than necessary. Bend this strengthener so that it is under tension when welded up - that way it will be stronger. Use good quality welds.

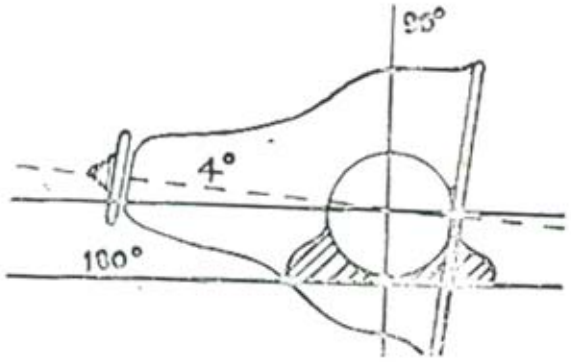


The standard English axle is adequate enough for competition use if used with a Gp 1 stage of engine tune, or medium power - say up to 150 bhp. Fitted with a Salisbury limited-slip diff and matched to the correct ratio, this is a reliable enough unit.

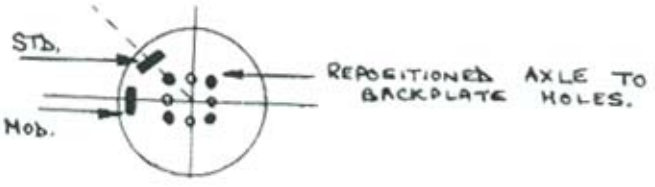
On English axles, half-shafts are retained by a bearing interference fit. The bearings can slacken, resulting in shaft and wheel sliding out of the axle casing. A good idea, therefore, is to tack-weld, in two spots, the bearing collar to shaft. Bearing replacement can be achieved by a tap with a cold chisel on the weld. Also, keep on eye on spline distortion on half-shaft ends.

6.3. MAKING THE ATLAS AXLE

The Atlas is an adapted version of the 3 litre Capri axle, and is 1" wider than the English unit. On this basis, it is possible to convert a Capri unit found second-hand. For this, RS Parts produce a useful fitting kit, Pt No 905 1629, comprising radius arm mounts, adapted mounts for the handbrake mechanism and new u/j flange bolts. If you are going to adapt a Capri axle, the spring saddle and radius arm brackets will have to be de-welded and relocated $6\frac{3}{4}$" and $10\frac{1}{4}$" respectively from the end flange of the axle, as shown, and, a more precise operation, the tilt angle of the diff has to be altered as the drive line angle on the Escort is not the same as Capri. The Capri spring saddle, should be tilted down 4^{o} at the front, which raises the nose of the diff a corresponding 4^{o} when in situ.



Another job you will have to carry out is turn the backplates through 45^{o} to get the handbrake linkage slot in a horizontal plane with the axle. This means redrilling the four backplate retaining holes. Note here that the Capri brakes and drums will also mount (suitably modified) on the English axle: for those who cannot run to a pedal box with balance bar assembly, this is useful, as the wider drums and larger slave cylinder will give a helpful bias to the rear brakes.



6.4. FULLY FLOATING BACK AXLE

This modification is probably the most prohibitive expense for the clubman. To make it cheaper, once having modified the axle and rear suspension to take the 4 link system, with the slipper rear springs, you can obtain all the relevant fully floating half shaft components and still retain drum rear brakes, using the Mk I Capri 3 litre rear brakes with VG 95 shoes and 7/8" wheel cylinders.

The drum brake fully floating half shaft kit is now only available from F English Ltd, of Bournemouth, complete with halfshafts, etc.

Now on to the big time stuff. If you are lucky enough to have a decent budget, you ought to have the best (apart from the fact that you no longer have excuses for not winning).

We shall now go through the details of the original (1975) rear disc brake set-up (or small stud, single bearing arrangement, as it is called). All the relevant components, except the discs and calipers, are available from RS Parts. It used to be possible to bolt these straight on to the Atlas axle (the modified Capri axle), but this is no longer available. The new Gp 1 Atlas replaces it and it is too narrow for the length of halfshafts available, so, as was said earlier, axles now have to be built from a bare diff housing.

To build a fully floating axle, the first job is to bore out the ZF limiting slip diff (finis code 905 0438) to 1.2" to accept the splined end of the half shaft, which incidentally, is $29\frac{3}{4}$" long. This will also mean fitting larger planet gears either side of the diff, again for the male halfshaft to go through.

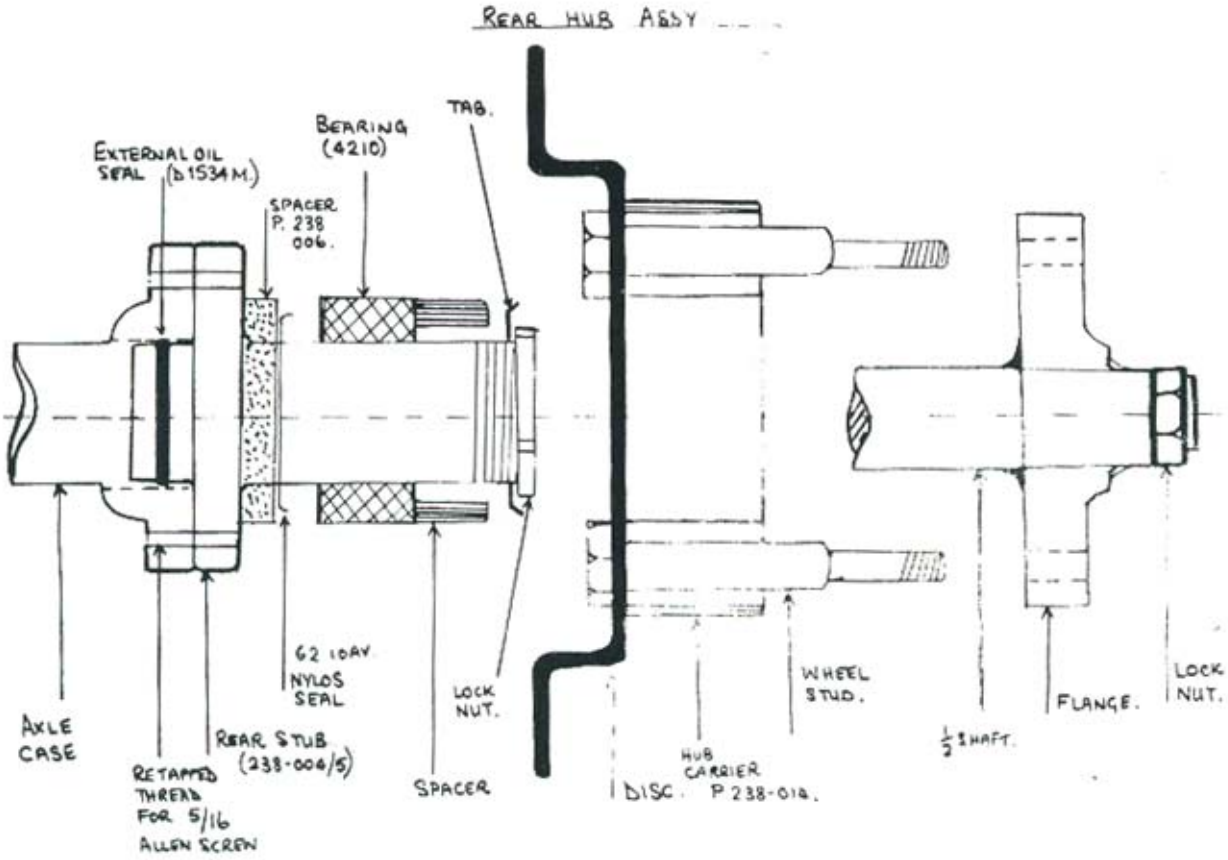
At the outer ends of your axle tube, whoever you have chosen to do the axle build for you will have welded some flanges on the ends of the axle tube suitably drilled and tapped to accept 5/16" UNF Allen screws, $\frac{3}{4}$" long. This will enable a new stub axle to be attached directly to the axle.

As the stub axle acts as an oil stop, you will have to fit seals inside, and just in case any oil wants to get out between the stub axle and axle flange, an 'O' ring fits in a groove around the outside of the stub.

Before sliding on the bearing, an alloy spacer slides over the stub axle to prevent the back of the wheel studs on the hub carrier rubbing against the new axle flange.

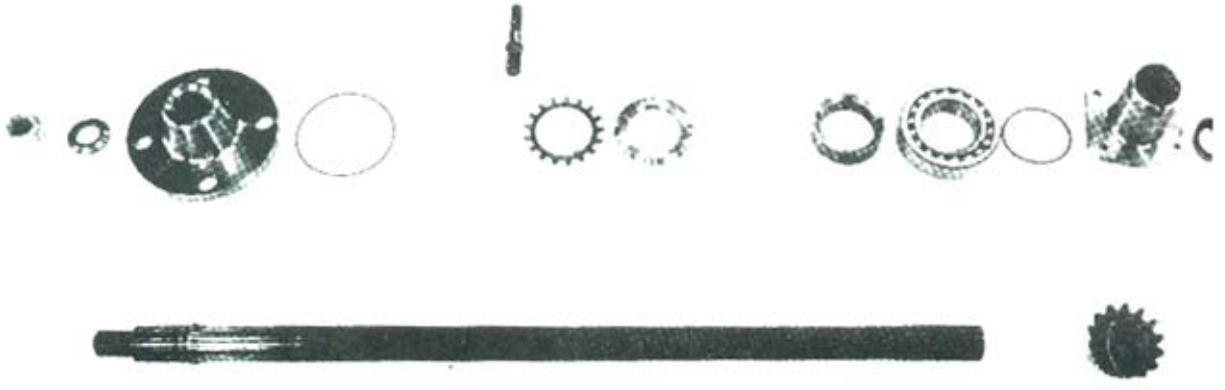
After the spacer comes a 'nylos' seal which looks like a moulded top from a tin can. This seats behind the bearing to prevent all the grease flying out, and its sharp lip digs into the carrier making its own seal through use.

Next job is to bolt the disc assembly direct to the carrier using the standard front hub to disc mounting bolts. Place this assembly over the stub axle, and then, after liberally packing the bearing with Castrol FCB grease, press the bearing right home between stub and carrier. When right home, there will be a distance between the outer edge of the carrier and bearing front surface.



A spacer fits in here to complete the bearing seal. The wheel studs can then be screwed into the carrier. After checking for free rotation slide the tab lock washer over the remaining stub showing, and tighten down with the lock nut, first using Loctite on the threads.

Then all you have to do is hammer the half shaft on to its flange, position the tapering washer, screw the end nut in (careful, as they can be r. and l. handed), and tighten really tight. Finally, arc weld the nut onto the flange, and push the assembled shaft home, locating it on the carrier studs.



Loctite laid out for early design of fully floating axle.

Here is the list of the various components needed for the fully floating set-up:

ZF differential side gear	2 off	905 3605
Carrier LH	1	905 3606
Carrier RH	1	905 3607
Bearing carrier -(rear stub)	LH	905 3606
	RH	905 2606
Locknut	RH	905 3608
	LH	905 3609
Lock tab		905 3610
Spacer		905 3612
Spacer		905 3613
Nylos ring		905 3614
'O' ring		905 3615
'O' ring		905 3616
Seal - internal - halfshaft		905 3611
Halfshaft		905 4035
Flange		905 4041
Lock nut - halfshaft		146 4492
Washer - cone - halfshaft		905 4067
Stud - rear wheel		905 3619
Hub Carrier (alloy)		905 3634
Bearing		905 3637

6.5. 1976 SPEC: FLOATING AXLE

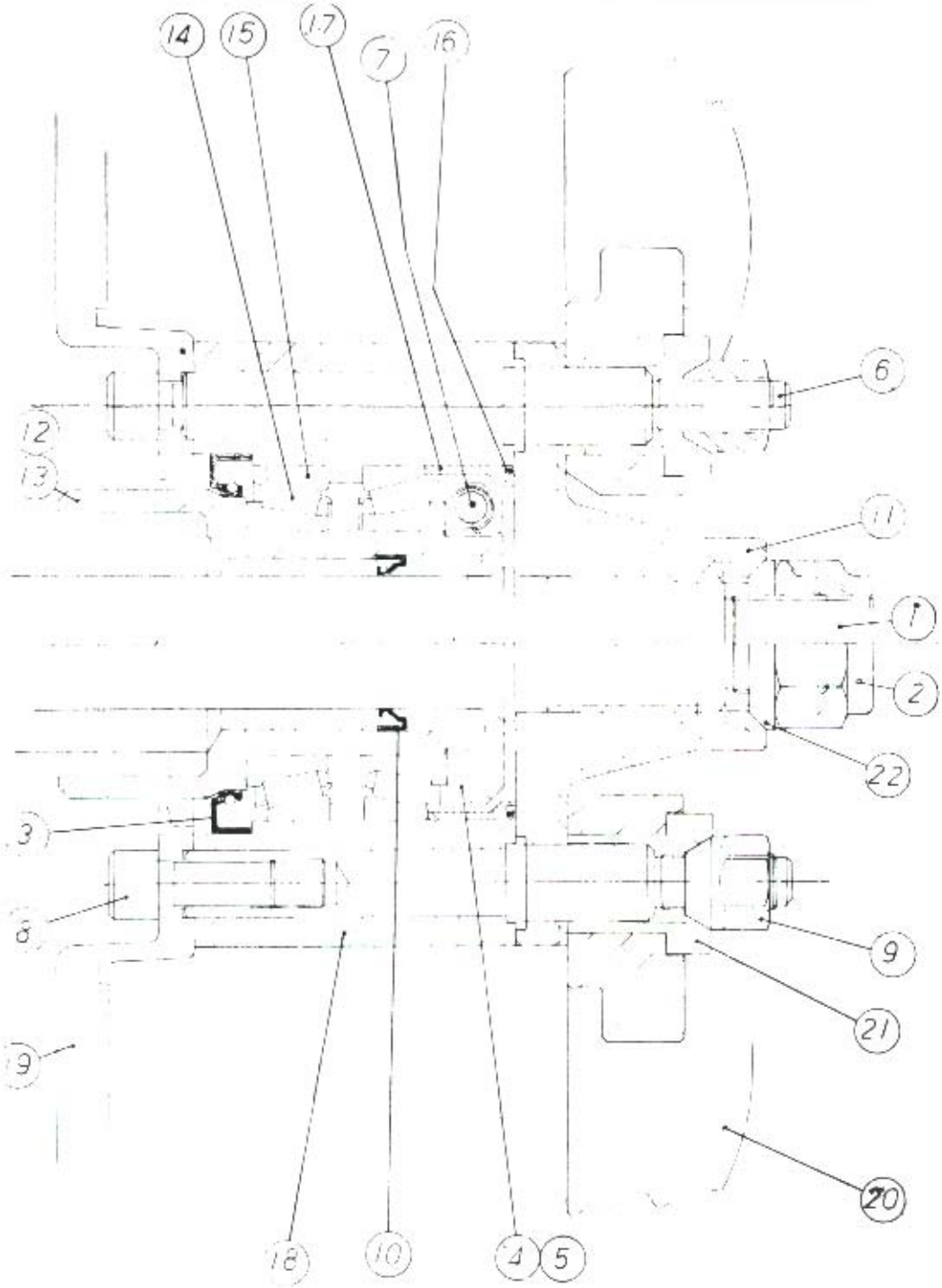
Boreham have now gone to a twin taper roller bearing halfshaft set-up, incorporating larger wheel studs and thicker rear brake discs, as well as a different combination of brake calipers.

To digress slightly, they have at the same time modified the front stud arrangement, the studs being of a larger diameter, and splined as opposed to the earlier stud which was threaded (see front suspension).

By increasing the size of the stud, the size of the road wheel insert has changed, which is now made in steel. The hub is basically the same as the one available from RS Parts, except for the stud holes, which are plain as opposed to being threaded to take the earlier studs. The studs now have a splined section which locates into the hole in the hub and a thread in the back of the stud which is locked onto the hub from the back of the flange, using Loctite 35. Wheel nuts should be torqued to 55-60 lb. ft., and checked at regular intervals.

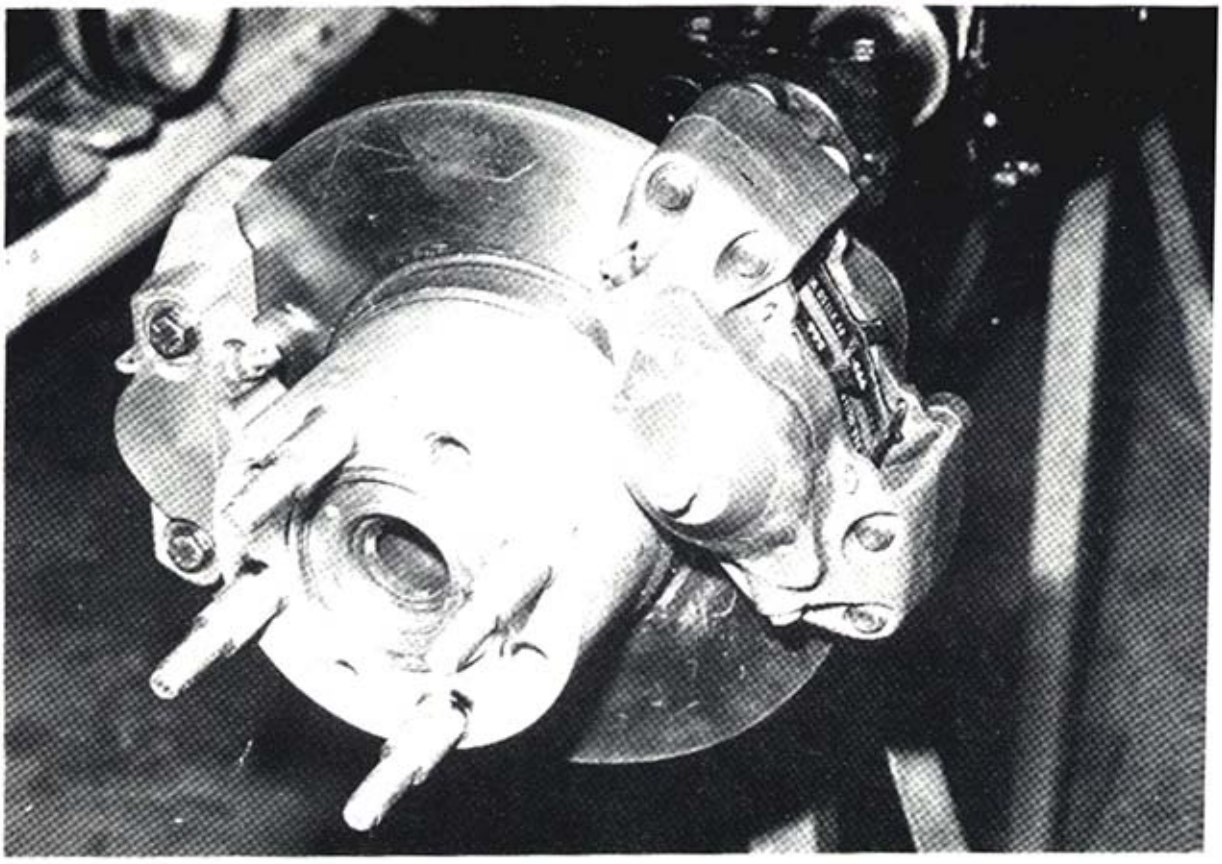
The necessary rear suspension and rear axle parts are listed below, together with a drawing of the set-up:

Half shaft	905 4035
Nut - halfshaft	146 4492
Seal - hub	150 1216
Lock nut - bearing adjust RH	905 4036
LH	905 4037
Stud - rear wheel	905 4038
Allen bolt	150 2826
Bolt - disc to stud	142 3398
Wheel nut	905 4039
Seal - halfshaft	905 4052
Flange - halfshaft	905 4041
Hub - bearing carrier RH	905 4042
LH	905 4043
Bearing - inner	905 4044
Bearing - outer	905 4045
'O' ring	905 4053
Carrier - 'O' ring	905 4046
Stud ring	905 4047
Disc - rear brake	905 4070
Magnesium wheel 6x13	905 0260
7x13	905 1205
Insert - wheel stud	905 4055
Washer - cone - halfshaft	905 4067
Casing - thick tube - less hub carrier	905 4040
Gasket - differential cover - h.d.	905 4080
Wheel nut $\frac{1}{2}$" UNF	905 4039
Caliper RH	905 4048
LH	905 4049

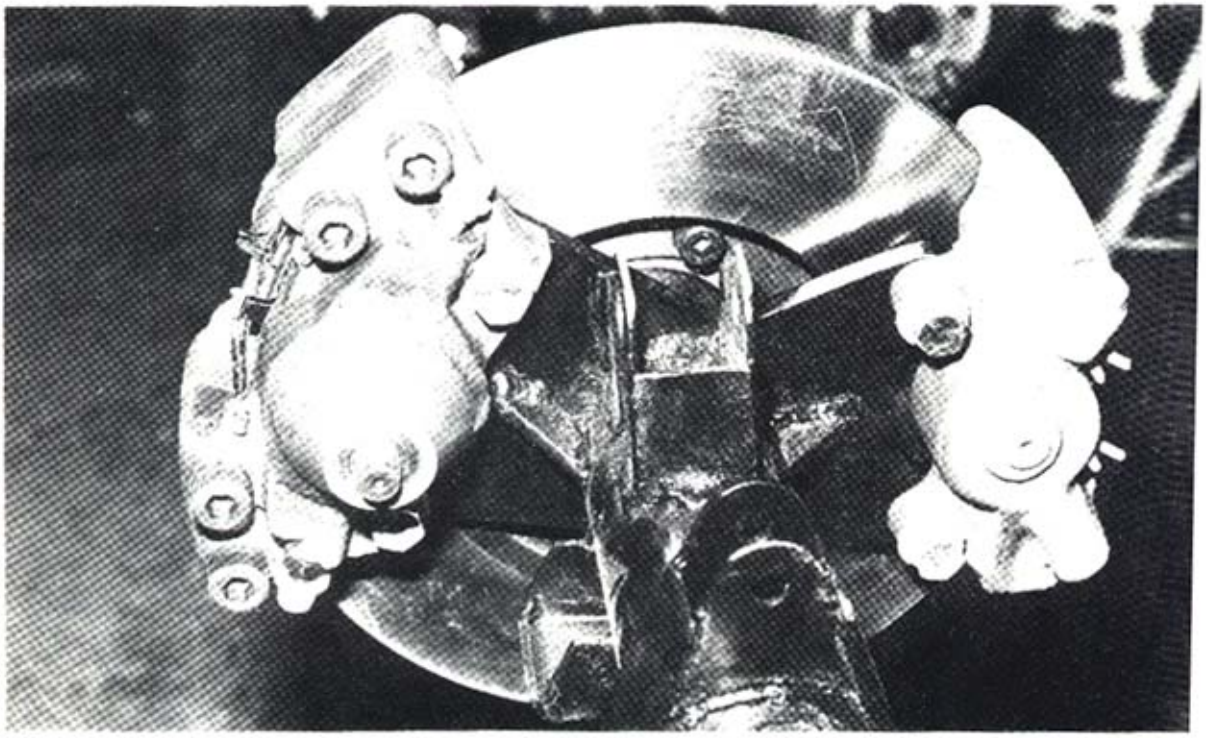


Sectioned diagram of parts listed on previous page.

Parts for 'taper bearing' floating rear axle.

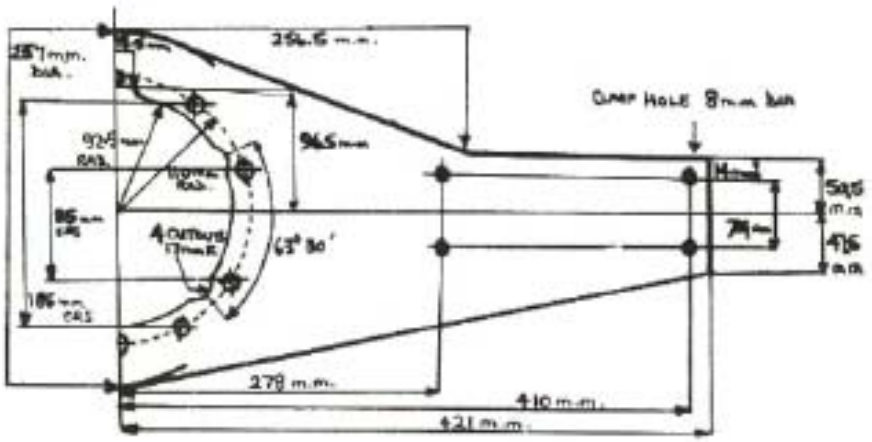


Above: Complete rear hub assembly.
Below: Axle tube, spring saddle, bumper mount, top link mount and calipers on completed rear axle.



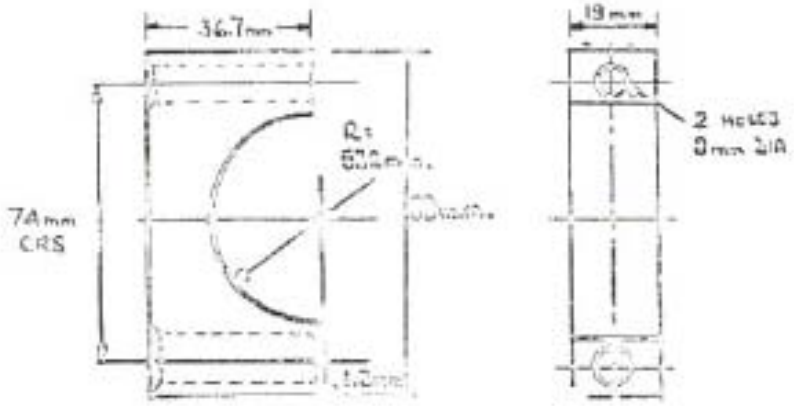
6.6. DIFF-GUARD PLATE

To protect the underside of the diff casing, a plate, cut to shape, is mounted over the nose of the diff by a 'U' clamp, and at the back by a dural plate which also helps to strengthen the axle. The plate, to be made from 5/16" dural can be cut as follows:



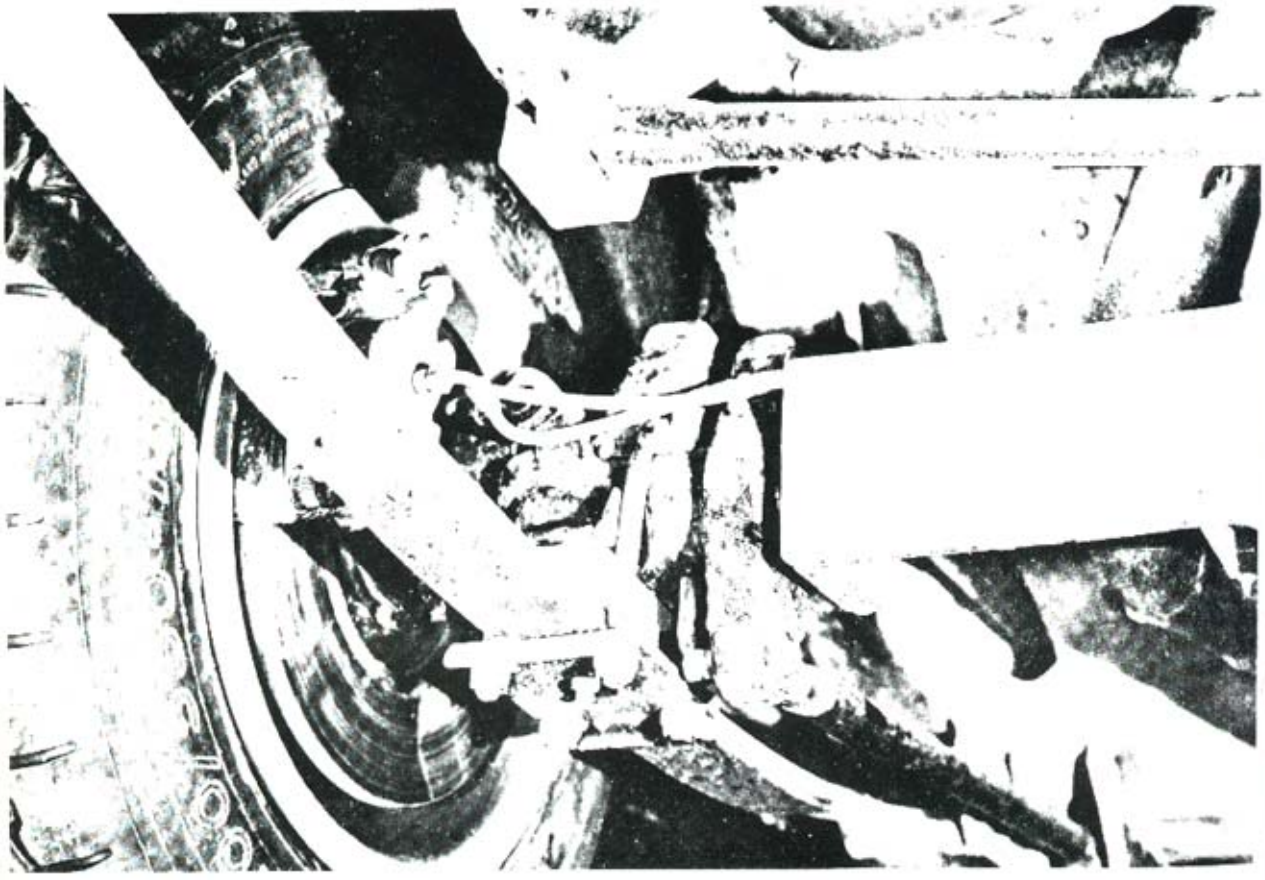
This plate is clamped to the axle by two clamps either side of the diff. These can be made up from alloy plate 1" thick drilled with a 2 1/8" cutter and then cut in half as shown. Two sides should then be drilled through the clamp's length to accept 2 x 5/16" bolts.

With your plate lined up, and your four clamps lined up, two equally either side of the diff, drill the back plate to accept the 5/16" bolts - see illustration again for location distances. The outermost clamps should be as near the extreme edge of the plate as possible.

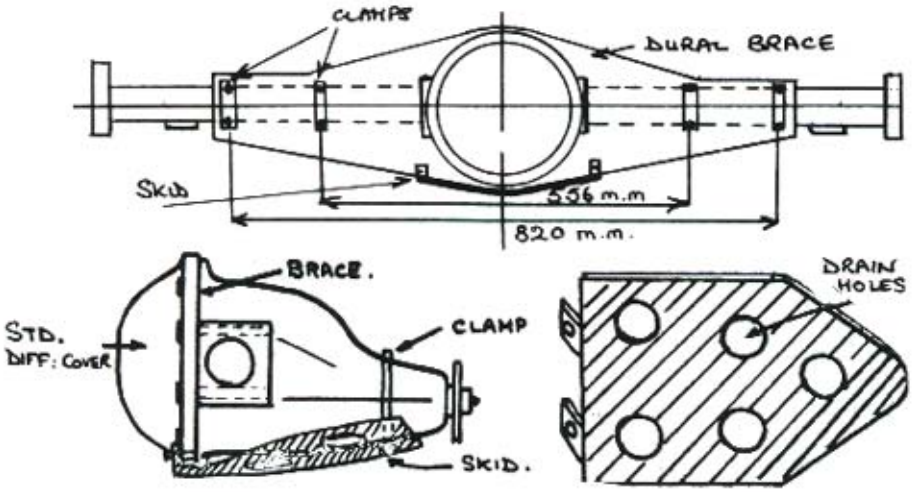


The back-plate now receives its final hole - a great big one in the middle around the diff housing, which must accept the rear oil pan, and allow easy access to the C.W.P. and removal of diff. The standard rear cover retaining bolts with 10mm cap screws should be replaced by ones 5/16" longer to counteract the plate's thickness. Gaskets should be placed on either side of the plate, and cap screws drilled and wired to prevent coming loose. During events, keep an eye on the gaskets, sometimes axle movement and vibration can squeeze them out at the bottom.

So, now you have a smart back mounting plate, what about the diff skid itself? This can be a 'home-brew' affair made from 10 gauge mild steel. At the back it is mounted via two flanges onto the backplate. At the front, you can either make up a rear axle 'U' bolt type arrangement to clamp the plate up to the diff nose, or, you will find that there are a couple of cast webs running the length of the diff which can be drilled, and the guard bolted up direct. Remember when making up a plate to drill drain and clearing holes large enough to make sure no stones get wedged up there.



Diff guard plate outer location on tarmac spec: car.



6.7. AXLE RATIOS

The selection of the ideal ratio is directly related to the horsepower available, vehicle weight and specific driving condition. Production axle ratios are generally chosen for average driving condition, allowing for near maximum speeds at relatively low revs and, consequently, good fuel economy.

It is possible, by changing the axle ratio, to utilise fully the available engine power for a specific purpose. For example, on a special stage rally where the top speed is never likely to exceed 100mph, even a 240 bhp Escort can be geared down so that it is reaching maximum engine revs in top gear at that speed. In doing this the rate of acceleration from a standstill and in all the gears is increased.

High ratios give less acceleration but greater top speed and economy. Low gear ratios give greater acceleration but a lower top speed. Generally, ratios below 4.4:1 are not practical for daily use on the road.

The selection of suitable gearing for any given task or event is usually governed by the point in the rev range at which maximum horsepower is reached in relation to the maximum speed of the chassis and tyre size or diameter. In many cases, the choice is one that requires a little experimentation.

To use as a general guide, in selecting the ideal ratio, a graph can be drawn which relates road speed to engine rpm in any gear. The following formula should be employed to establish road speed at, say, 600rpm in any gear ratio. A straight line graph can then be drawn, originating from the axis and passing through that point.

Formula:

$$\frac{60 \times \text{engine rpm}}{\text{wheel revs / mile} \times \text{axle ratio} \times \text{gearbox ratio}}$$

The above applies to a normal 1:1.0 top gear, and obviously tyre size. Below is a list of some of the more common tyre size revs per mile figures:

DUNLOP

SP68 13x165 = 892

SP44 13x165 = 884

SP44 13x175 = 862

MSII 13x175 & 195/70 = 865

Rally Super 13x205/60 = 934

UNIROYAL

Rallye 'T' & Rallye 180 13x165 = 890

MICHELIN

XM & S 13x165 = 880

GOODYEAR

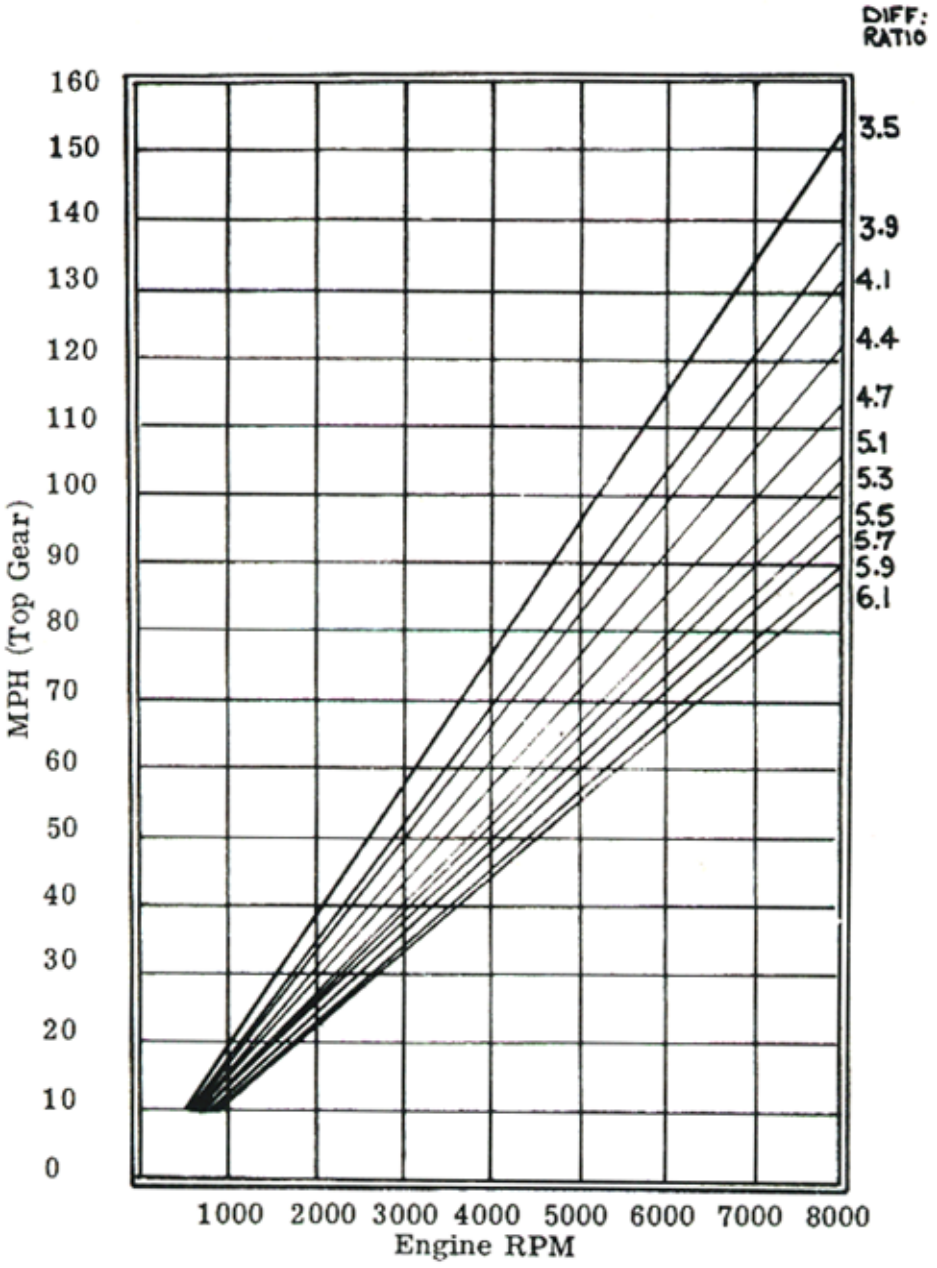
Rally Special G800 13x175 = 890

Rally Special U/Grip 13x175 = 890

Rally Special U/Grip 13x180/330SR = 863

G800 13x185 = 842

G800 (GP70) 13x175 = 926



6.8. SPEEDOMETER RECALIBRATION

Remember, when an axle ratio is changed, the speedometer reading will be incorrect, and it will then be necessary to change the speedometer drive gears.

Since the drive gears can be 6 or 7 tooth only, then the drive gear

either $\frac{6 \times \text{axle ratio} \times \text{wheel revs/mile}}{1000}$

or $\frac{7 \times \text{axle ratio} \times \text{wheel revs/mils}}{1000}$

Since the driven gear must be an exact number of teeth, then the nearest whole number should be taken.

Wheel revs/mile may be obtained from the tyre manufacturers for any tyre available, or calculated from the rolling radius.

Example: An Escort on low profile 175 x 13 in having a rolling radius of 68.4" with a back axle ratio 3.9:1:

$$\text{Wheel revs/mile} = \frac{63360}{68.4}$$
$$= 926$$

Speedo driver gear =

$$\frac{6 \times 3.9 \times 926}{1000} \text{ (using 6 tooth drive gear)}$$
$$= 21.7 \text{ or } 22 \text{ teeth}$$

6.9. DIFFERENTIAL C.W.P. RATIOS

The following rear axle ratios are available from RS Parts:

Crown wheel and pinions for all 'Atlas' axles

4.11:1	905 2095	4.63:1	905 2097
4.37:1	905 2096	5.14:1	905 2098

Crown wheel and pinions for all British Escorts

4.7:1	905 1259	5.5:1	905 1263
4.9:1	905 0906	5.7:1	905 1264
5.1:1	905 1261	5.9:1	905 1265
5.3:1	905 1262	6.1:1	905 1266

H/D replacement halfshaft with bearing

For all 'Atlas' axles	905 1887

Kit-fitting parts for 'Atlas' axle

For all Escorts	905 1629

Limited slip differential

For all British Escorts (Salisbury)	905 0828
For 'Atlas' axles (ZF)	905 0438

6.10. LIMITED SLIP DIFFS

A conventional differential provides an equal torque division between the road wheels with the ability to allow the driving wheels to turn at different rates when cornering. It is this ability which allows a wheel to spin when it loses adhesion causing no drive to be transmitted to the gripping wheel. When a driving wheel begins to lose adhesion and spins, the limited slip differential effectively locks the axle and therefore the torque available will always be transmitted to the wheel with the greater adhesion. These units come into their own on loose or slippery surfaces and are essential for any serious competition. Due to the method of operation, these assemblies are inherently noisy, and this characteristic is particularly noticeable at low speeds.

When fitting, the following differential/crown wheel bolts should be used:

Limited Slip Diff	Bolt	Quantity
9050 828	120 669	6
9050 438	905 2727	8

The threads of the bolts should be meticulously cleaned, dried and fitted using Loctite.

6.11. LIMITED SLIP DIFF OILS

Limited slip differentials require special axle oil, and below are listed recommended oils:

Limited slip diff No 905 0828 (Salisbury)

Castrol-Hypoy LS
Shell - 8096
BP limslip 90/1
Texaco 3450

Limited slip diff No 905 0438

Castrol-Hypoy LS
Shell-8096
Agip-F1 Rotra MP/S90
Aral-P3216
Ecubsol-Sperr differential gear oil ESQ M2C104A
Esso-Hypoid gear oil LSA 90
Fuchs-Hypoid LSA90
Kendal-Special limited slip gear lube 90
Quaker State - High performance gear oi
Valvolene-Hypoid X-18 MD LSAE 90
Veedol-Multigear-limited slip SAE 90

6.12. SERVICE PARTS AVAILABLE FOR L.S. DIFFS

The range of service parts for the Salisbury limited slip differential has been increased to include the side gears, planet gears and cross pins (available from RS Parts).

Service parts for limited slip diff - (finis 905 0828)

Side gear	-	905 3058	-	qty required	- 2
Planet gear	-	905 3059	-	" "	- 4
Cross pins	-	905 3060	-	" "	- 2
Concave friction plate	-	905 1277	-	" "	- 2
Flat friction plate	-	905 1278	-	" "	- 2
Clutch disc	-	905 1280	-	" "	- 4

Limited slip No	905 0438(ZF)
Kit-gear repair	905 1880
Kit-clutch repair	905 1878

6.13. FITTING INSTRUCTIONS - SALISBURY MK II UNITS

1. Remove the complete differential and carrier assembly from the vehicle and separate the crown-wheel and differential unit from the carrier assembly; using standard procedures as covered in the Escort Workshop Manual.

2. Remove the six bolts securing the crown-wheel to the differential case. Suitably support the crownwheel in the bed of a press, and press out the differential case.

3. Examine the mating faces of the crown-wheel and limited slip differential case, removing any burrs by light stoning. Locate the crown-wheel on the case and enter three suitable long bolts through the case into the crown-wheel to ensure correct alignment.

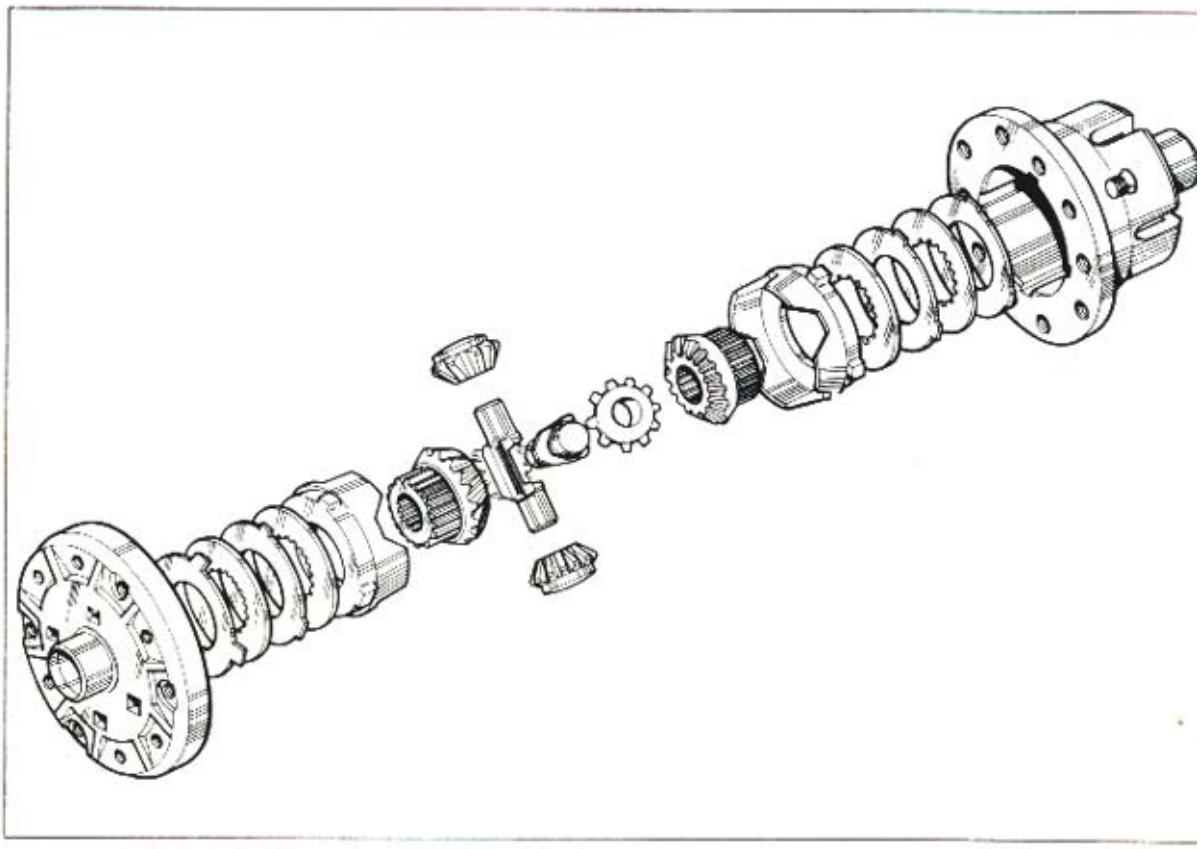
4. Place the crown-wheel, teeth downwards, on wooden blocks in the bed of a press. Using a thrust button on the case, bring the ram down to press the case onto the crown-wheel.

5. Remove the pilot bolts and fix the crown-wheel to the differential case using bihexagonal headed bolts (part no 142779) coated with Loctite, torque to 6.9 to 7.6 kg.m (50 to 55 lb.ft.).

6. Locate the crown-wheel and differential assembly in position in the differential case and check for any possibly foul condition between the differential unit and differential carrier casting. Should foul condition be evident, light relief at the affected area on the carrier casting is necessary.

7. Using standard procedures, replace the crown-wheel and limited slip differential assembly in the carrier unit and replace the complete assembly in the vehicle.

8. The rear axle unit should be filled with Limited Slip gear oil.



Exploded drawing of multiple disc type differential, consisting of a conventional bevel gear differential with two friction plate clutches placed between the bevel gears and the diff: case.

6.14. PROP SHAFTS AVAILABLE

For Escort Twin Cam /RS1600 /Mexico:

Rocket gearbox with standard axle	905 1559
Rocket gearbox with 'Atlas' axle	905 1560
Standard gearbox with 'Atlas' axle	905 1628

GEARBOXES

7.1. INTRODUCTION

Many competitors are guilty of inconsistent preparation as regards the specification of the car they build. To go out and buy a gleaming 1800cc BDA with 45 DCOE Webers, BD3 cams, etc, and they try to bolt it all together with a 2000E gearbox obtained from the local scrapyard, is not uncommon. Net result, a boxful of neutrals on the first event which may not only blow the engine apart, but could alternatively give the driver a heart-stopping moment, as the back wheels lock on solid.

As an approximate guide-line, English axles and 2000E gearboxes are OK up to 150-160 bhp. Thereafter, transmission failures are likely to be a major problem.

7.2. ROCKET BOX

The next step is to use a rocket gearbox, which is homologated on Gp 1 RS2000's, but can also make a good basis for a Group II RS 1800, the limit here being 170-180 bhp approximately.

Listed below are the gear ratios of the above gearboxes:

	2000E	RS2000	Rocket
1st	2.972:1	3.65:1	2.54:1
2nd	1.97:1	1.97:1	1.66:1
3rd	1.4:1	1.37:1	1.255:1
4th	1:1	1:1	1:1

'Rocket' gearbox for all Escorts: 905 2507
an ultra close ratio gearbox - requires some floor pan modification to fit.

Gear kit - close ratio: 905 1637
A complete gear kit to bring the standard Cortina 2000 or Escort RS2000 gearbox to 'Rocket' specification.

To fit the 'Rocket' gearbox into an Escort Mexico, Twin Cam, RS1600, the following parts are required:

Rallye Sport:

Clutch housing - Alloy	905 1203
Clutch release lever	905 1928
Hub - clutch release bearing	905 3075
Kit spacer - gearbox mounting to body	905 2867
Propshaft	see 'Rear Axles'
Short-shift kit	905 2908

Standard Parts:

Bearing - clutch release	150 1250
Pivot pin - clutch release	602 2530
Spacer - clutch release	905 2486
Plate - reinforcement - transmission tunnel	905 2502
Gasket	148 1202
Speedo cable	601 1863
Cap	142 5662
Seal	145 1589
Bolt - 4 off	341 4943
Bolt - 4 off	171 5883
Bolt - 4 off	175 7038
Washer - 4 off	341 5308
Circlip	341 6354
Bolt	142 0737
Speedo gear - 22T	147 3921
23T	143 8509
24T	143 8507
25T	147 3922

Over and above 180 bhp, you have two alternatives: The ZF gearbox (not eligible for Gp 2 cars though), and the Escort Gp 2 gear kits. These gear kits are designed to fit in the standard RS1800 gearbox, and each gear is individually machined and can be interchanged, thereby giving a wide range of ratios. This set-up is good for 240 bhp+, and should ultimately be cheaper than the ZF assembly.

Although the RS2000 and RS1800 gearboxes are different internally, they are fully interchangeable as complete units.

That is to say that a Gp 2 gearbox based on the RS1800 assembly, will also fit into a Gp II RS2000 (OHC engine) without any exterior modifications.

If you intend running an hydraulic clutch system on an RS1800, then you will have to purchase the parts listed below:

RS Parts:	Clutch housing alloy	905 1203
	Clutch release lever	905 1928
	Hub	905 3075
	Pedal box - kit - hydraulic clutch	905 2599
Standard Parts:	Bearing - clutch release	150 1250
	Pivot pin " "	602 2530
	Spacer " "	905 2486

Remember, though, that your car is no longer eligible for Gp 2, as the original bellhousing has to be retained.

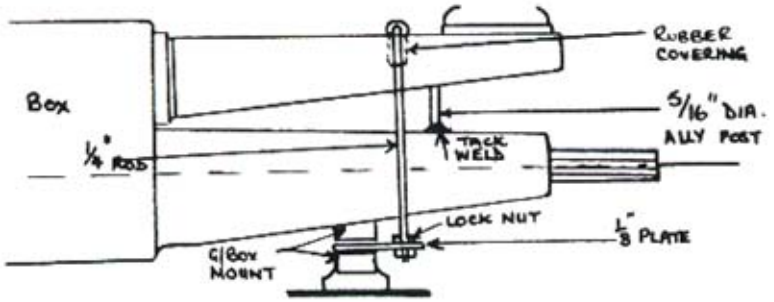
The following gear kits are available from RS Parts:

Gear kits - Escort Group Two	
Rally - ratios 2.30, 1.58, 1.27, 1.00:1	905 3375
Rally/Race - 2.30, 1.51, 1.16, 1.00:1	905 3372
Race - 2.05, 1.51, 1.21, 1.00:1	905 3377
Kit - gearbox build	905 3376

ZF GEARBOXES

7.3. ZF SELECTOR TIE

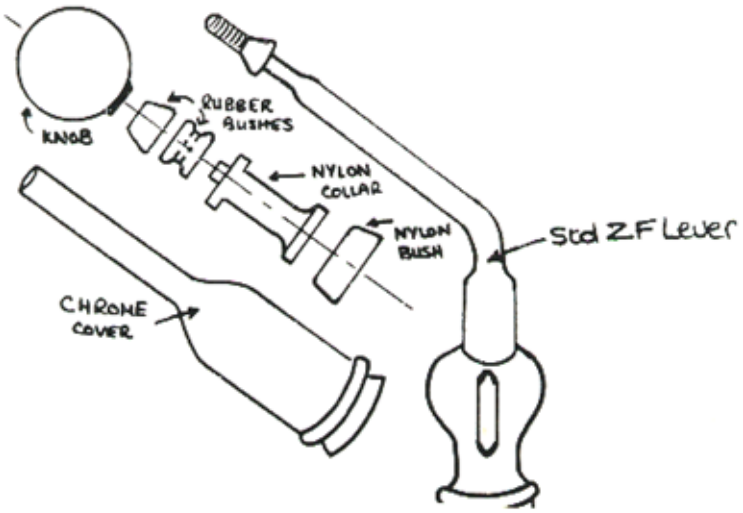
While talking about ZF boxes, we shall quickly describe a mod to stop the selector housing moving about too much. Most people using ZF boxes know about this, but the idea is to prevent the selectors shaking about on rough roads and consequently jumping out of gear.



An 1/8" plate is sandwiched between the underneath of the gear-box, and the rear mount block, as above. This plate is drilled to accept $\frac{1}{4}$" dia. rod on either side of the box, in fact, you can use a battery tie rod which has a threaded end. The rod forms a hoop over the top of the lever housing, and is effectively pulled down by a nut on the underside of the plate. Note that there is a lock nut above the plate to ensure that it doesn't work loose, and a rubber sleeve - a piece of strong plastic tube will do as well - over the housing to absorb vibration. To ensure that undue strain is not placed on the housing to gearbox casing bolts, by being pulled down too much, an ally post of 5/16" dia. is tack welded to the output shaft housing so that it fits neatly under the lever extension.

7.4. ZF GEARBOX LEVER ADAPTION

Those of you who have ZF boxes will know that, even after you've paid a lot of bread for one, they are delivered without a pukka gear-lever. What can be done, therefore, is to use a series of standard FIAT parts to provide something that looks smart and doesn't rattle itself off every 200 miles. The parts can be obtained from most Fiat dealers and come from any of their 5 speed box models (125S, 124C, 124ST, 132S). Bits needed are (1) Knob - even has 5 speeds marked on the drop for drivers! (2) Rubber cushion. (3) Rubber spacer. (4) Nylon collar. (5) Nylon bush. (6) Chrome outer lever. All the bits go together as shown and simply push or screw on.

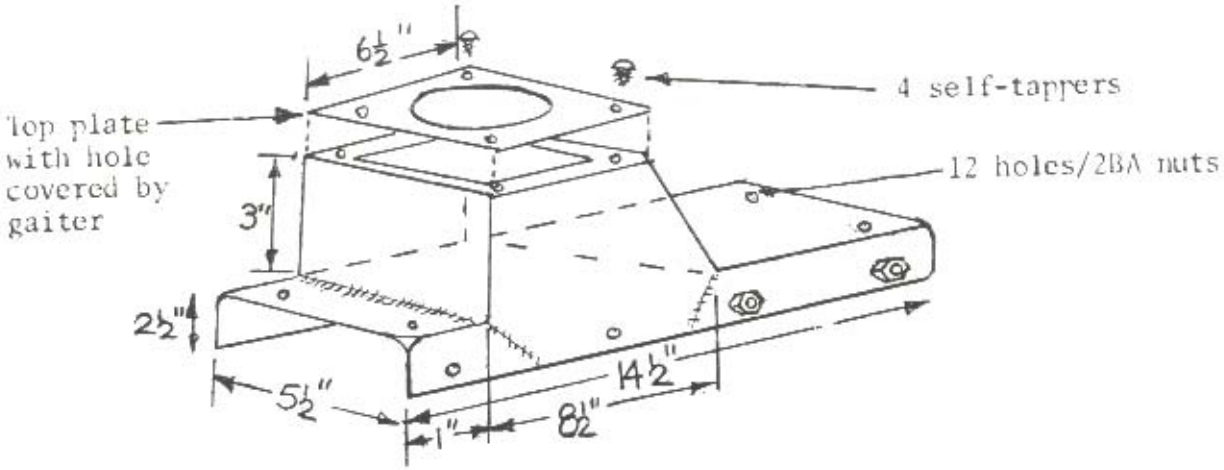


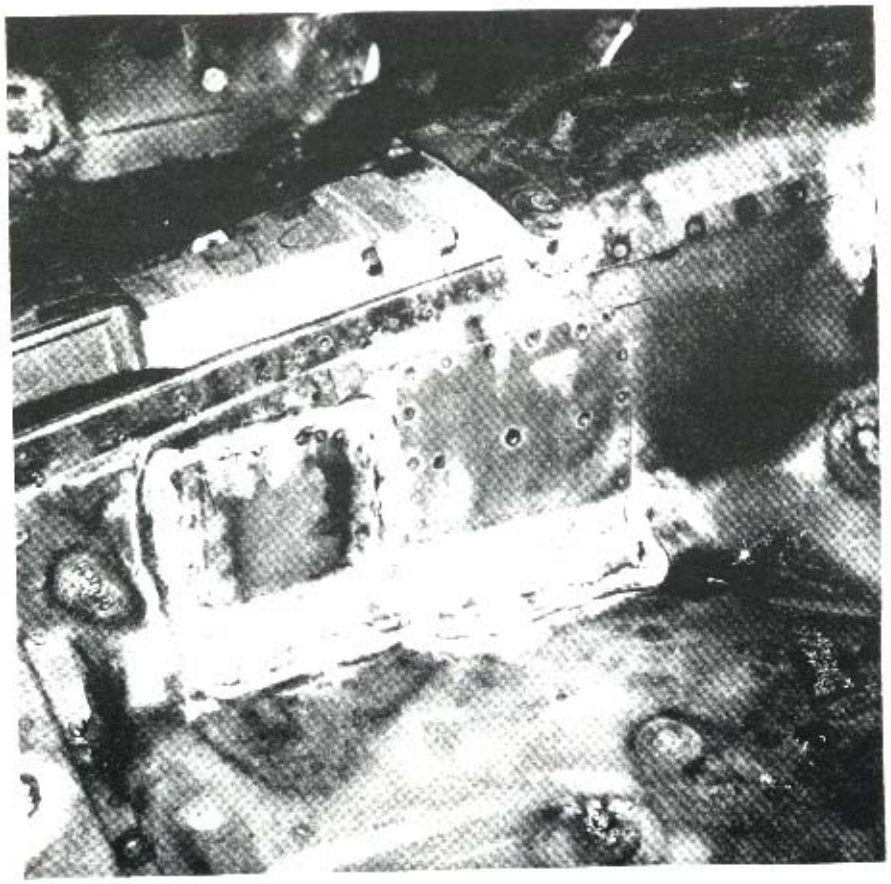
7.5. ZF GEARBOX FITTING

If you are going to use the ZF 5 speed gearbox, the rear mounts on either side of the transmission tunnel will have to be repositioned further back.

Standard mounts are used here. You can either fit new ones, standard Ford Finis Code No: 143 4773, or if cut off neatly from their original, spot welded positions, the same mounts can be re-used. Mounts should be relocated $5\frac{3}{4}$" back (centre to centre vertical). To double support the mount, a 16 gauge steel plate measuring $4\frac{3}{4}$"x5" can be mounted inside the cockpit against the tunnel before repositioning the mounts. As a fool-proof way of repositioning the mounts, it's best to tack-weld them against the tunnel sides with the engine, gearbox and prop-shaft in position to check adequate clearance around the ZF and bell housing, because it is a very close fit.

To fit a ZF, you're going to have to chop a lump out of the top of the tunnel for the gear lever. This removable panel will also give you a good access area to the top of the box for servicing and box removal on an event. The panel measures $14\frac{1}{2}$"x$5\frac{1}{2}$" and is formed as the top of the tunnel - it can be carpet covered to look smart. There are 12 easily removable captive 2 BA nuts around the panel. The lever box at the back measures $6\frac{1}{2}$"x$5\frac{1}{2}$"x3" as per the drawing. The sides of the original tunnel are turned in, to obviate sharp edges, after the captive nuts have been brazed in.





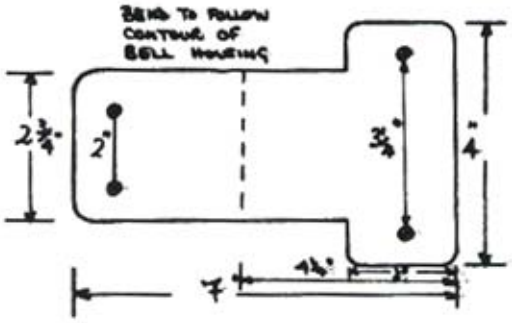
Revised gearbox mounting support viewed from inside the cockpit. The cut-away for the ZF box on the tunnel top is clearly visible.

7.6. ZF BOX QUICK RELEASE BELL HOUSING

A worthwhile adaption for the ZF box, especially if considering entering an International, where service time is at a premium, is to make the box easy to remove and replace to facilitate clutch replacement.

First of all, the bell housing release bolts, usually accessible only from inside have to be made external. The lower four bolt locating lugs on the box are drilled through to 3/8" dia. so that the bolt can pass straight through to thread in the bell housing, from the outside. The bell housing itself normally does not have a thread in of course, so it must be reamed to accept a 3/8 UNC Helicoil. The two top box/bell housing studs are cut right back and act as locating dowels only, their place being taken by an external plate, made up and mounted as follows:

On top of the box are three bolts, forming a triangle, which are part of the casing. The foremost two of these should be drilled and tapped to accept 3/8" UNC bolts. Then from a sheet of $\frac{1}{4}$" dural, make up a plate as shown.

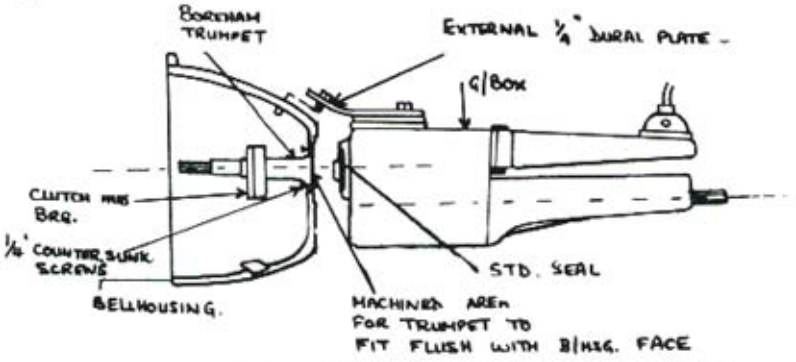


The plate should now be attached to the gearbox via the two 3/8" bolts, and the position of the two foreward holes marked on the bell housing top. The housing can now be drilled to accept two $\frac{1}{4}$" bolts which are secured from inside the bell housing as a permanent attachment.

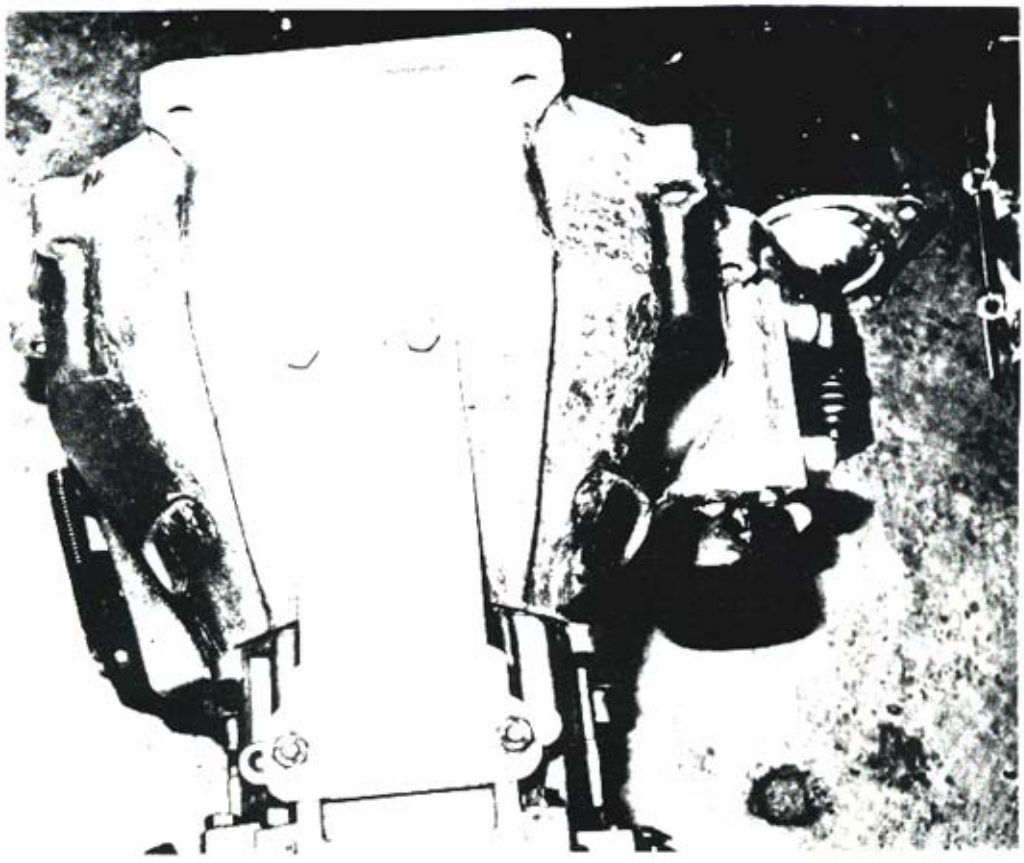
So, now, by undoing only external bolts on the gearbox, it can be pulled back without having to drop the engine at all. But it doesn't finish here, because if you think about it, withdrawing the gearbox would result in the clutch release mechanism falling out of position and there would be problems replacing it.

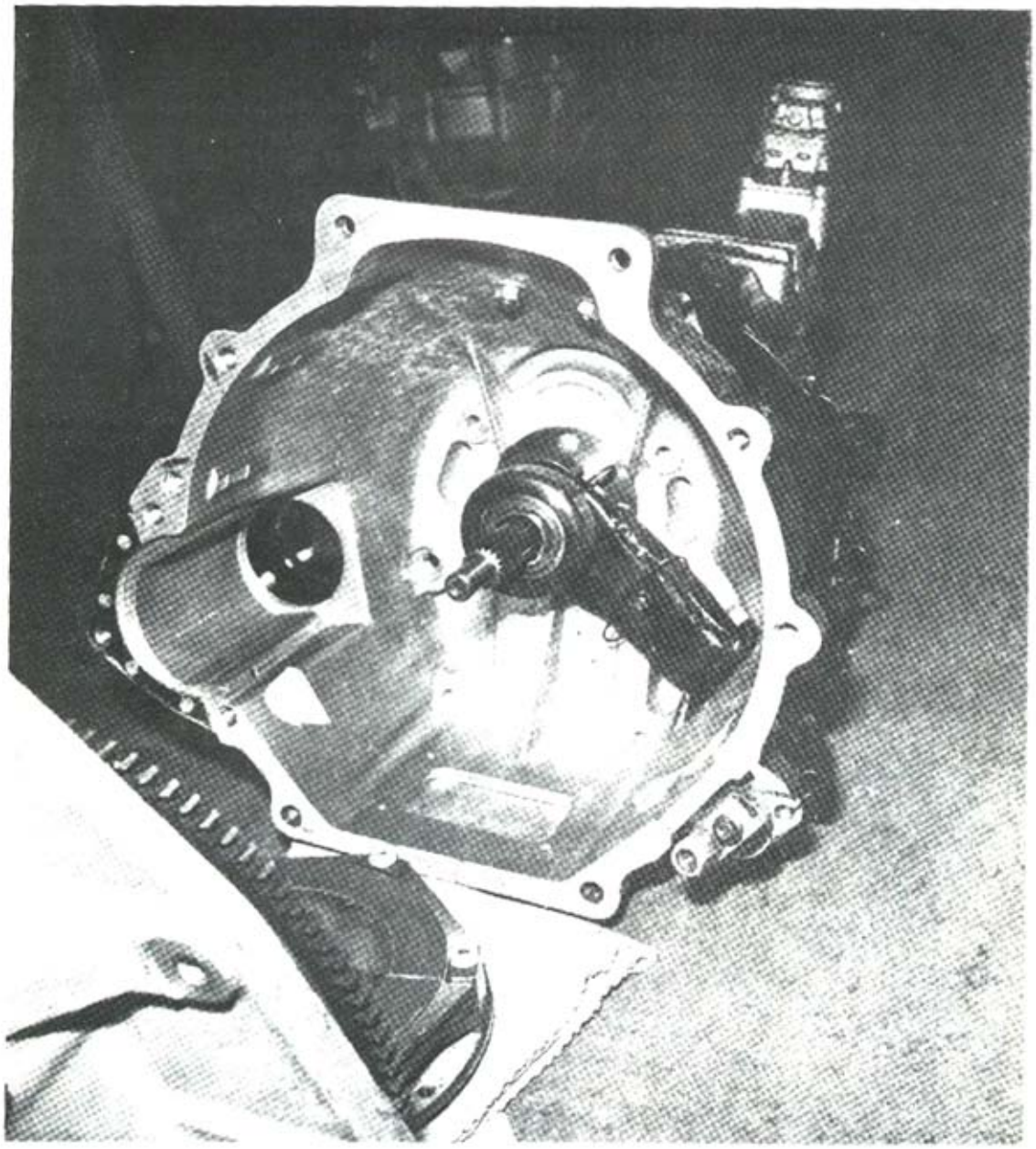
So then, what the works do is to build in a mechanism that attaches all the clutch release mechanism to the inside of the bell housing, as follows:

The 'trumpet' on the ZF box that surrounds the mainshaft, and along which the clutch release bearing travels, is cut off at its neck, and just acts as a simple locator in the bell housing. It is replaced, however, by a similar arrangement inside the bell housing which is available from RS Parts. This replacement 'trumpet' has a broad flange on it, so the inside of the bell housing has to be machined to accept it. The 'trumpet' is located in the housing by four countersunk $\frac{1}{4}$" screws, for which threaded drillings have to be tapped. Note that the standard seal of the ZF box remains, and a useful tip is to slide a couple of rubber 'O' rings over the neck of the 'trumpet' to prevent dirt getting onto the area swept by the clutch release bearing.



Below: Bell housing mounting plate.





Inside the quick release bell housing, showing release mechanism with built-in trumpet.

The following relevant components are available from RS Parts:

7.7. ZF - PARTS NEEDED (RS)

To fit the ZF-5 speed gearbox to an Escort the following parts are required:

Rallye Sport:

Gearbox - ratios 2.3, 1.6, 1.36, 1.14, 1.00:1	905 3635
Bellhousing ZF/BDA - crossflow	905 2595
Propshaft ZF/Atlas	905 2598
Multi-plate clutch	905 2594
Pivot pin - clutch release	905 3625
Hub - clutch release bearing	905 3623
'O' ring - clutch release - 2 off	905 3616
Seal - oil	905 3624

Standard Parts:

Qty Req	Description	
1	Fork	171 1392
1	Cap	174 5654
1	Spring	171 1461
2	Spring	171 1487
1	Slave Cylinder	143 2754
1	Push rod	173 0981
1	Nut	173 0982
1	Spring	171 1421
1	Bearing	150 1250
1	Gaiter	170 7553
1	Plate	141 9265
2	Support	143 4773
1	Link	170 7552

STEERING

8.1. HIGH RATIO RACKS

There are several types of steering rack for the Escort range, starting with the standard rack giving $3\frac{1}{2}$ turns lock to lock. This rack (like its high ratio counterpart) has three different specifications - and here some history is needed. When the Twin Cam was introduced, it was decided to fit the 2000E gearbox, necessitating use of the old 105E bellhousing and hydraulic clutch. With this bellhousing, the starter motor is positioned on the right of the engine, viewed from the driver's seat. Unfortunately, this meant that the steering column knuckle fouled on the starter motor, so for all rhd cars, a "long post" rack had to be introduced. This raised the height of the steering knuckle above the starter motor, and gave rise to the long post rack. On lhd cars there was, of course, no problem. Finis code numbers for these standard racks (geared to give $3\frac{1}{2}$ turns lock to lock) are: (1) Rhd - standard, 151 2342, for use on all Escort with non hydraulic clutches. (2) Rhd - long post, 150 3807, for use with 105E bellhousing (Mexico, RS1600). (3) Lhd - standard only, 151 1343.

Obviously, the problem of the starter motor position doesn't change when you swap over to the higher geared competition rack, which gives $2\frac{1}{2}$ turns lock to lock, and is essential for competitions. Remember, though, that you will also have to hold the steering wheel tighter, as the kick back when bitting bolders or hidden holes is greatly increased.

The various high ratio steering racks available from RS Parts are as follows:

Escort I

LHD		905 2056
RHD	- long pinion TC/RS1600/Mexico	905 2057
	- short pinion GT/Sport/RS2000	905 2871*

Escort II

LHD		905 2872
RHD		905 2871
*Use	- track rod ends	156 4468) Mainstream supply
	- lock nuts	147 2933)

When buying a new rack there's one other point to note. The shaft coming out of the rack to link to the steering column via the knuckle coupling has changed design over the years, so make a note of the one you remove to get a similar replacement. The difference is in the spline arrangement and earlier racks having a complete flat on one side for the knuckle pinch-bolt, whereas later racks have one groove running round the shaft.

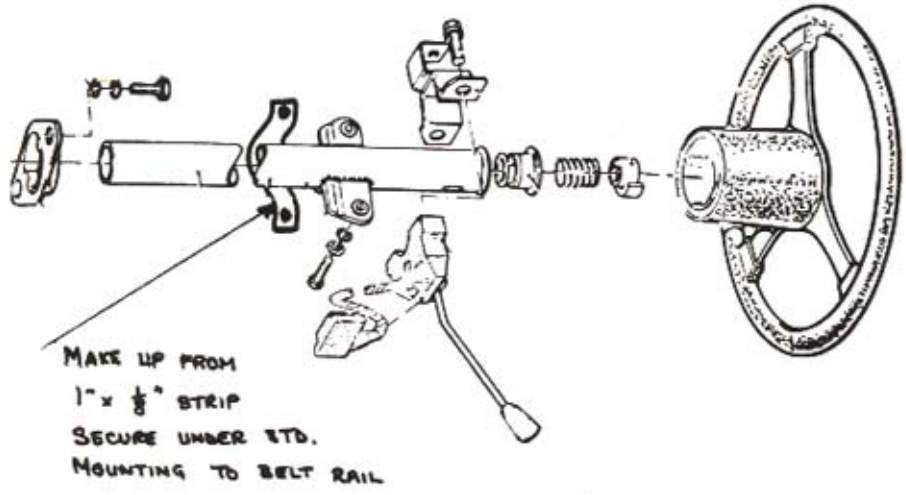
For anyone converting their car from cable to hydraulic clutch, there is a small tweek that will prevent you from having to buy a new steering rack as well as all the other bits. By fitting a steering knuckle from the Triumph Toledo (and therefore the Herald) you can retain the short pinion with just enough clearance against the side of the starter motor. Boreham currently use a very solid steering joint, which is, in fact, a sturdy U/J and is available from Rallye Sport Dealers under finis code No 905 4084.

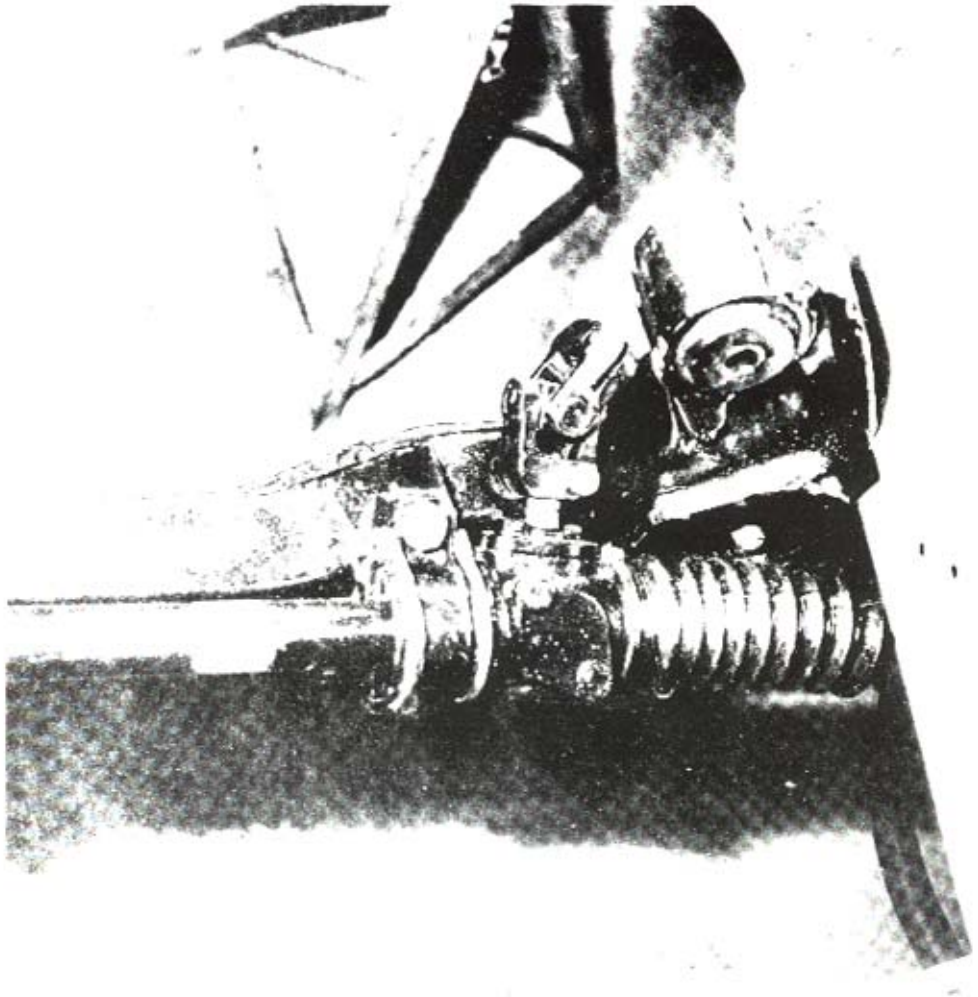
8.2. STEERING COLUMNS

One of the more sensible rules of stage rallying is that steering lock mechanisms should be removed, or made inoperative for cases have been known of locks jamming. Ideally for this, you should get hold of an early Mk I shaft, but, if you can't get hold of the earlier column, the plunger hole can be filled with weld, or an insert welded in place and filed to fit. The best way of doing this is to simply remove the steering lock and saw off the plunger. There is then no way that the steering can become locked.

Because the Rallye Sport joint is longer than the standard Escort item, cut off the last 3/8" of the steering shaft (which, incidentally, is a Mk I shaft) around the groove located at the bottom of the splined section. Use a Mk II outer steering column, which does not require any alterations, together with a Mk I bottom bush. The trick here is not to put on the circlip normally located directly under the bottom bush, and to machine off the raised portion on the shaft around the steering lock slot. This enables you to loosen the bottom steering joint pinch bolt and pull the steering shaft up, allowing easy removal of the steering rack.

The only other deviation from the standard steering system is something that anyone who is stage rallying should carry out. Where the outer steering column joins the dashboard underside, two mounts stick out from the column through which $\frac{1}{4}$ UNC bolts pass to thread into captive nuts on a sliding bar arrangement on the inside lip of the dash panel. Now these mounts have been known to break off after hard use, so as a safety measure, make up a strip of 1" x 1/8" steel to shape and run it under the column from the existing bolts. This is well worth the effort - trying to steer with the column on your lap won't produce outstanding stage times.





Steering rack on works car. Note wire locking on rack retaining bolts.

BRAKES

9.1. INTRODUCTION

You've all heard how the stars alter their brake balance - this is simply the ratio of front wheel braking effort (pressure) to rear.

On road cars this balance is not adjustable; because the car is designed only for tarmac use, far more effort is put onto the front system than the rear, which is fine for road events. On the loose though, you want to balance the car under braking without locking up at the front and slithering off into the pine trees, so more effort is required at the back which helps get the tail out as well.

Unfortunately, whilst every modern single seater racing car incorporates an adjustable balance bar, it's not so easy on a production car, and the only efficient way found is using the compete works axle incorporating rear disc brakes. In most cases a drum system will literally burn itself out if too much effort is put through it.

We shall now try to cover a selection of braking systems which should include all or most of the suitable components which you can then permutate according to the spec of your car and, above all, your budget. Gp 1 brakes will be covered at a later point.

If you are the proud owner of a late Mk I Mexico with direct servo, or a Mk II Sport, Mexico, RS1800 or RS2000, the first thing to do is to chuck away that awful push-rod operated system, which only makes for insensitive brakes, and lack of accessibility in the engine compartment.

From here on, things start to become complicated. First of all, if you are running a Mk II Sport, it is advisable to discard your front suspension assemblies completely; the reason being that Mk II Sport struts have integral steering arms.

Then, go for Mexico/RS2000 type Bilstein struts, be it Group 1 struts, World Cup type struts or Group 4 struts, again according to your pocket. This will enable you to use, as a first step, the production Mk I/II Mexico/RS2000 9.6" discs, together with type .16 Girling calipers and DS11 pads. Remember that there are two types of pads according to whether you have P16 or M (for metric) 16 calipers.

Front brake disc finis code	601 0149	(Mainstream)
Front hub (metric studs)	604 1132	
" " (A/F studs)	151 9138	
DS11 pads P16 caliper finis code	905 0571	
" " M16 " " "	905 2124	

The next step up is to use the Group 1 RS2000 ventilated disc kit. The discs (9.6") bolt on to the above mentioned hubs.

This conversion, incidentally, is OK for Group 2, since you are not increasing the area of the friction surface.

Ventilated disc brake kit finis code	905 1676
Backplate kit " "	905 1556

The backplate kit is optional (but compulsory in Group 1), since Group 2 and Group 4 regs allow their removal.

The next and ultimate step is to use the Boreham set-up which consists of $10\frac{1}{2}$" vented discs and Formula 2 calipers, although these must be homologated for your vehicle if you intend running in Group 2 (more details later).

9.2. PEDAL BOX AND MASTER CYLINDERS

Let's turn now to pedal boxes and master cylinders.

RS Parts were, until recently, selling a triple master cylinder pedal box with adjustable balance bar as used on the works cars. Unfortunately, it was a rather expensive item, and has since been discarded in favour of a complete pedal box kit, available under finis codes:

Hydraulic clutch	905 2599
Cable clutch	905 3064

The kit comes complete with a fully modified bare pedal box, master cylinders, all relevant pedals (less throttle pedal) and balance bar assembly. The pedal box is basically a Mk II Escort box, and fits both Mk I and Mk II bodies. The beauty of it all? It will cost you half as much as the old pedal box.

A very important point here is that unless you are running full house brakes (ie, $10\frac{1}{2}$" vented fronts, four pot front calipers and rear discs) there is no necessity to use any servos at all (which again makes things cheaper, right?). As a point of interest, all competitive Mk II Group 1 RS2000's run the Group 1 vented disc kit, a 905 3064 pedal box, and production Mk II RS2000 rear brakes with DS11 pads and VG95 linings, without servo! An added bonus here is increased brake sensitivity on snow and ice.

9.3. REAR WHEEL SLAVE CYLINDERS

You have a choice here. Either Mk I Capri 3 litre 9" rear brakes or the production Mk II Sport/Mexico/RS2000 assemblies which also carry 9" rear drums. Mk I RS2000's used 8" drums in production, but Mk I RS1600's and Mexicos had 9" drums.

One easy way of helping rear braking using drum rear brakes, is to use 9" drums and larger rear wheel cylinders. It's not nearly as efficient as the rear discs but costs little by comparison. Change the back plate and drums if necessary, and replace the wheel cylinders with the 7/8" units from the 3 litre Capri Mk I. Standard Mexico and RS1600 cylinder is 0.7" diameter. Standard rear linings should be retained but DS11, or equivalent, front pads with standard disc (P16) Calipers should be used, or go for complete 3 litre brakes.

The advantage of the Capri 3 litre units is that the linings are very wide (again watch out in Group 2 as it is forbidden to increase the width of the linings), but you will have to modify the handbrake linkage and redrill the backplates (see rear axle chapter).

The Mk II rear brake assemblies have a fairly good self adjusting mechanism and a selection of rear wheel cylinders, as follows:

Standard wheel cylinder	finis code	
$\frac{3}{4}$" (19.05mm)	" "	602 3398
13/16" (20.64mm)	" "	602 5668

VG95 shoes - finis code

905 2876	Mk II braking system
905 1630	Capri 3 litre

9.4. MAKING AN ADJUSTABLE PEDAL BOX

As briefly mentioned earlier, the works system can be described as follow:

Dual master cylinder pedal box

$10\frac{1}{2}$" ventilated front discs

Formula 2, 4 pot front calipers

10" solid rear discs with separate footbrake and handbrake calipers

Two Lockheed 2.5:1 servos.

Competitions Department still use the old type pedal box, based on the Mk I unit, as was available from RS Parts, although eventually going onto the Mk II type pedal box. Master cylinder sizes are: .700" for brakes and clu

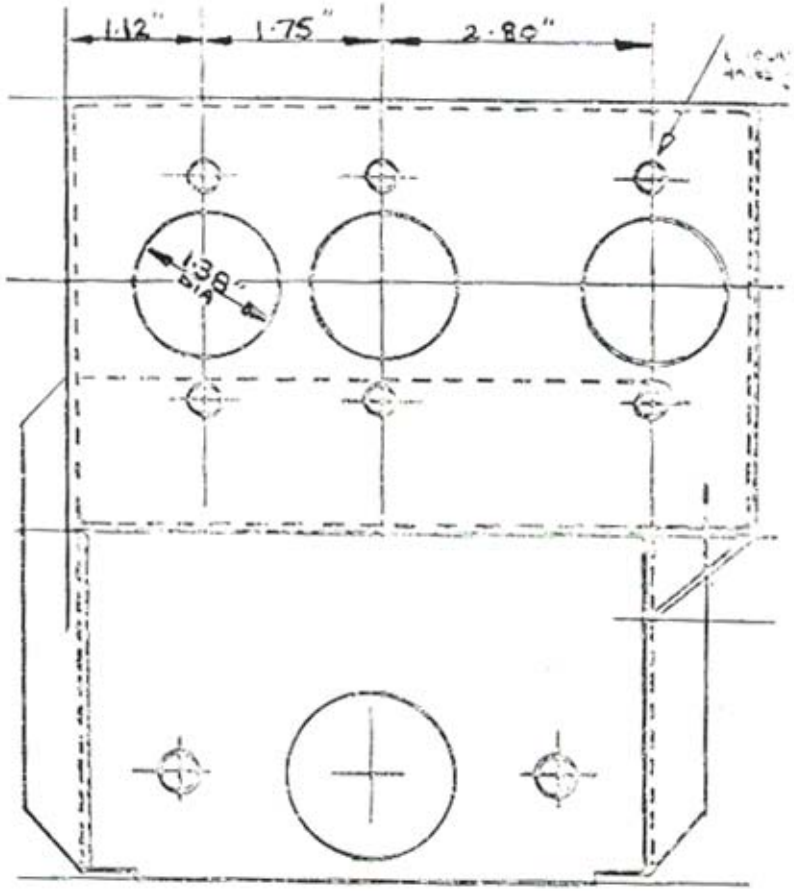
As the Mk I Pedal box bolts onto the vertical bulkhead panel via 4 studs, our shells have a strengthening plate welded on the engine side of the bulkhead to prevent the pedal box from flexing. The Mk II type box, incidentally, bolts on via 2 studs through the bulkhead, and two bolts onto the top cowl panel.

You can use Transit reservoirs to feed the master cylinders.

Another tip here is to use flexible hoses between master cylinders and bulkhead unions. This will allow you to unbolt the pedal box and work on it, if the need arises, without having to disconnect any unions.

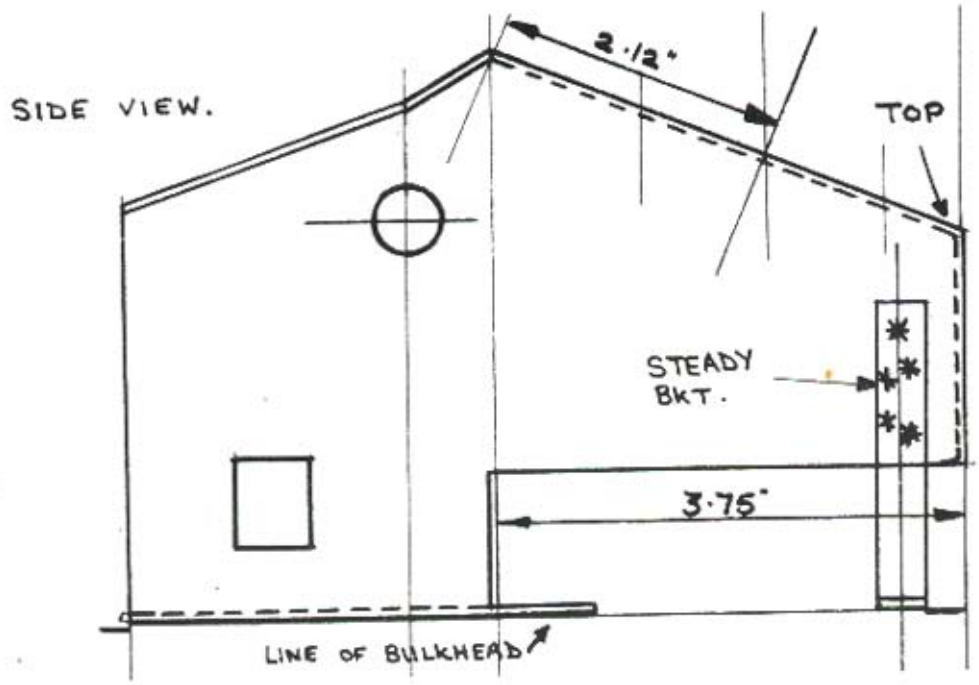
A word of warning first: the basic Mk I hydraulic pedal box, is no longer available, so you will have to find a second-hand one, as this is the basis of the 'works' pedal box.

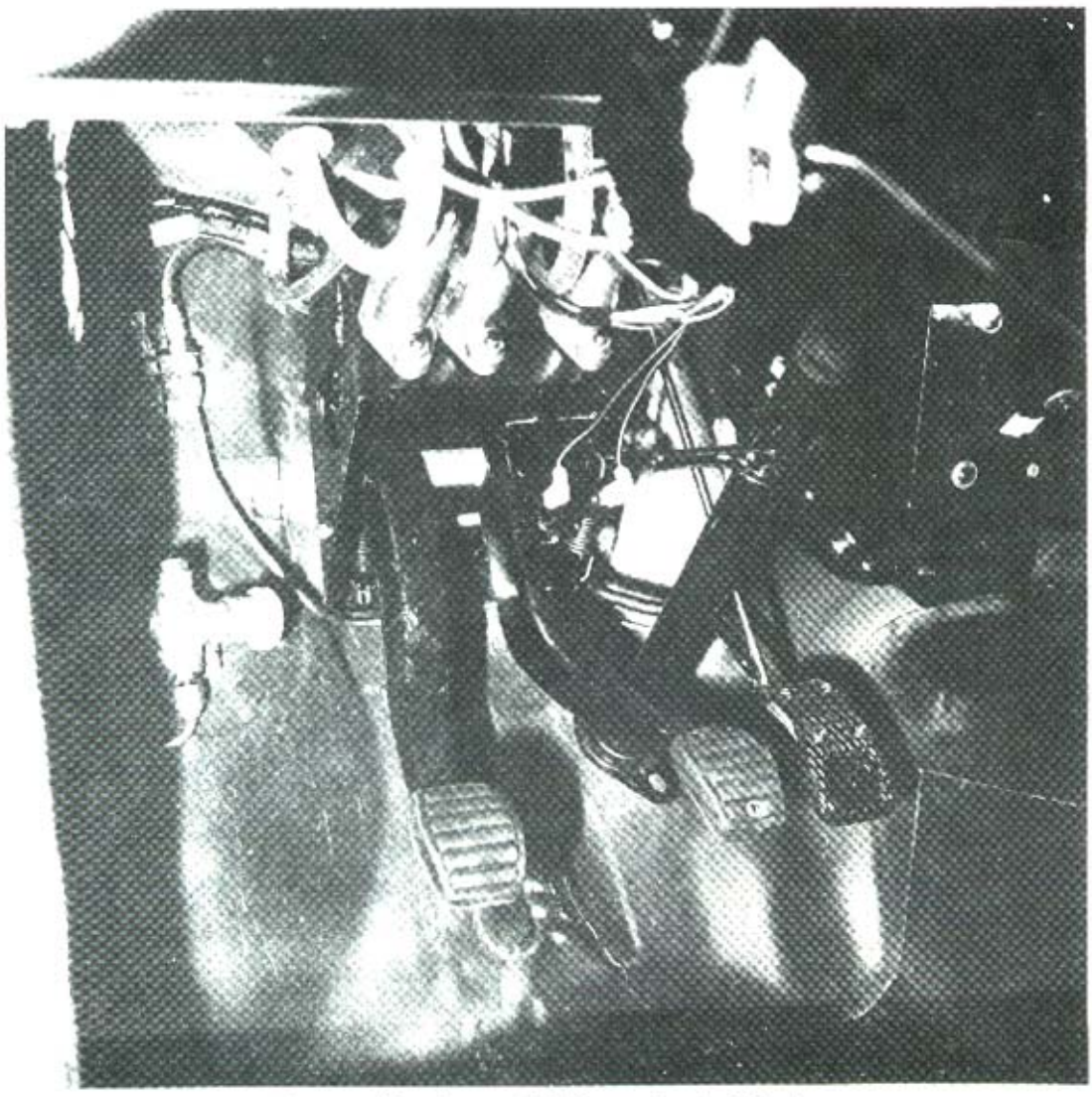
Starting with the pedal box from RS1600/Mexico. As each circuit (front and rear) will have its own master cylinder operated directly from the pedal, the box has to be extended to accommodate an extra cylinder. The clutch m/cylinder remains in position, with the first brake cylinder 1.75" to its right, viewed from the driving seat. The mounting surface for the cylinders, welded on at the same angle as the existing face, must then extend a further 2.8" to the vertical centre line of the 3rd cylinder and then another $1\frac{1}{2}$" to its edge. The pedal box is 'boxed' for strength and accepts the 3rd standard 7" Girling cylinder, as already employed by clutch and brake.



PEDAL BOX
FABRICATED FROM
3024E-2468D
14 G. M/STEEL PLATE

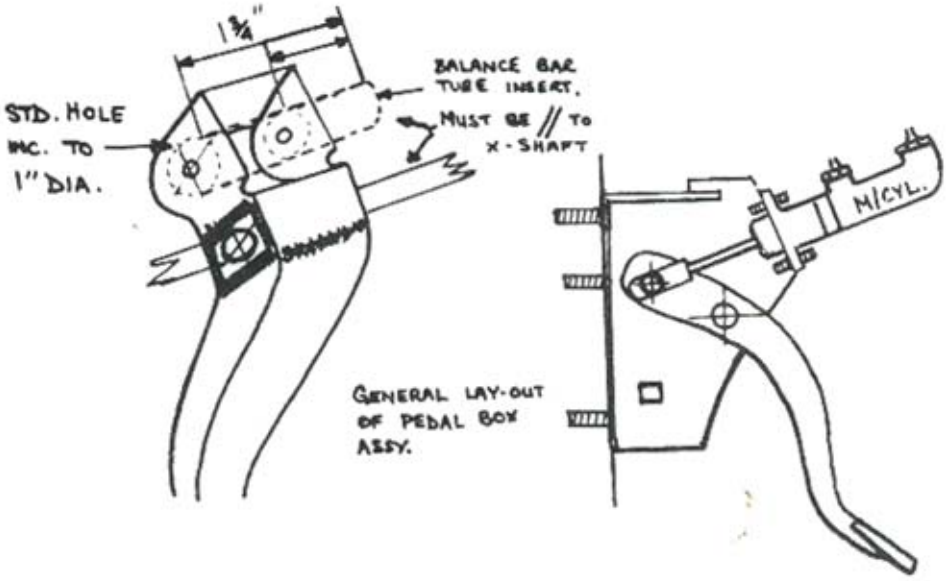
(BRAKE LIGHT SW. BRACKET TO BE RELOCATED OVER BRAKE PEDAL).



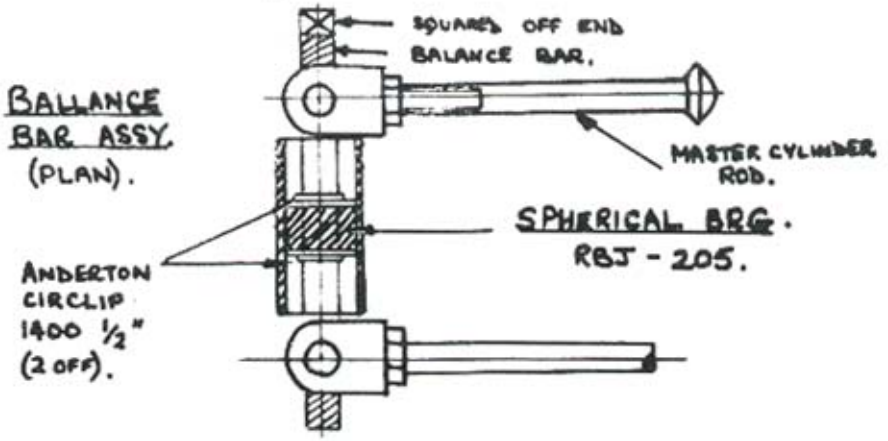


Above: Works pedal box installed.

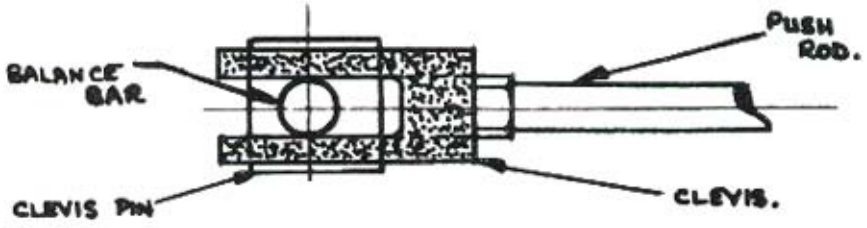
Modifications to the actual brake pedal are small. Its length remains unaltered, but the hole connecting the standard m /cylinder push rod is enlarged to take a 1" diameter straight tube of $1\frac{3}{4}$" length, flush fitting with the pedal on the clutch side. This tube is then brazed into position in the hole, exactly parallel with the cross shaft holding the pedal in the box. box. As the brake pedal must now sit exactly between the two m /cylinders, a $1\frac{1}{4}$" 10 gauge straight tube spacer, with the standard nylon bushes, slides over the locating cross shaft between clutch and brake pedal. The cross shaft remains standard, as the base of the assembly box remains unaltered.



Having set up the pedal box for the balance bar, this now has to be made up and fitted. The tube brazed to the pedal houses the adjustable mechanism which is a solid $\frac{1}{2}$" threaded bar approx 4" long with a RBJ -20S Rose bearing circlipped to its centre. The left to right movement of this bar, having been connected to the m /cylinder push rods alters the pivot point and hence the braking ratio. To facilitate adjustment when the box is in situ, the end of the balance bar should be squared off.



The yoke and trunion which forms a u/joint type link between bar and m/cylinder push rods can be made up as the diagram. Although there is no set part no. for this, most racing car manufacturers will be able to supply a mechanism for you, which is far easier than trying to make one yourself.



Now the box is almost complete, the throttle pedal will have to be bent to clear the outside extension of the pedal box, and extended upwards to meet the throttle cable. Lastly, the sensor for the brake light switch will have to be remounted above the pedal.

9.5. WORKS BRAKES

As we said earlier, Competitions Department use $10\frac{1}{2}$" vented front discs and Formula 2, 4 pot calipers, available from A.P. Racing, the basic part no. for the caliper being CP 2361.

The discs, bells and calipers will be available from RS Parts, although finis codes for these have not been allocated.

The rear end set-up has changed several times over the years, but basically Boreham started off with what were called thin rear solid discs, and two separate calipers for footbrakes and handbrake.

At approximately the time of changing to large studs, the back brakes were converted, using thicker discs and different calipers, although the change of studs and brakes were not connected.

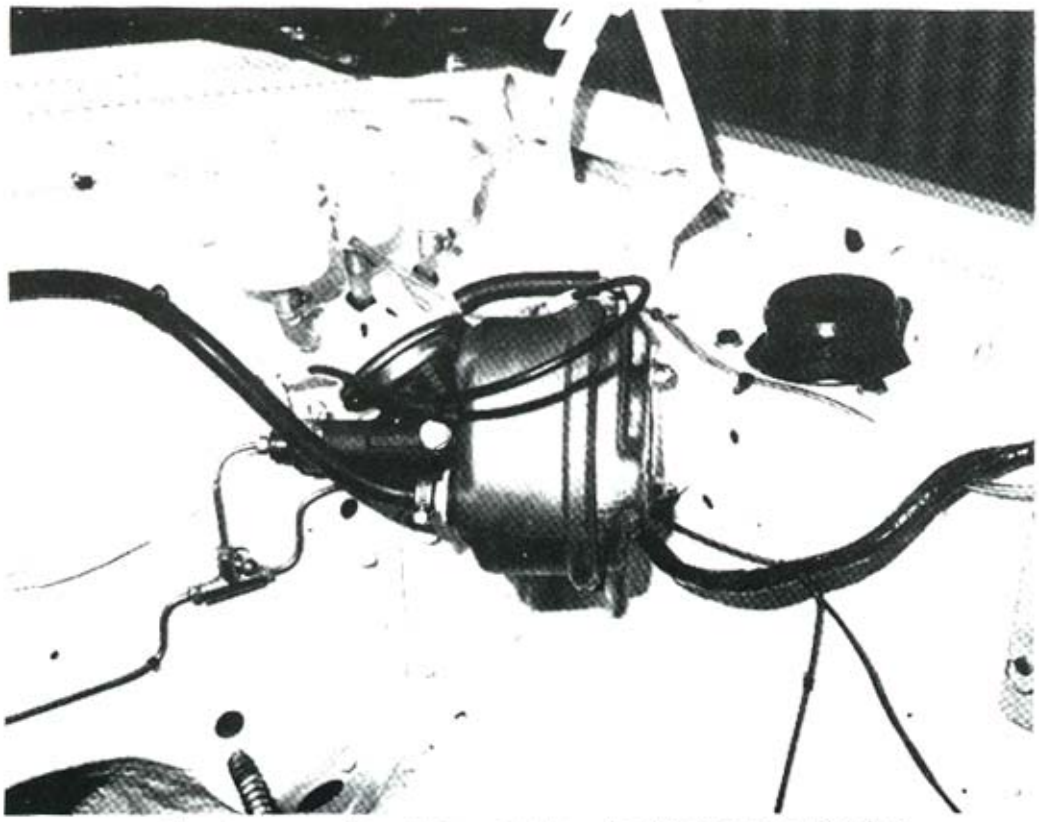
'Thin disc' twin caliper system:		'Thick disc' twin caliper system:	
Footbrake caliper	CP 2213	Footbrake caliper	CP 2383
Handbrake "	CP 2195	Handbrake "	CP 2213

9.6. SERVOS

The servos used were basically Mini Cooper S units fitted with a different valve by AP racing (giving 2:1 ratio), but now the units are available with current spec 2.5:1 ratio, direct from AP.

Yet again, the late type rear brakes and servos will be available from RS Parts.

As you can see, all very complex and expensive, but by golly, they do stop a car quickly.



Front servo location. Note master cylinder reservoirs.

Rear brakes servo. Pay special attention to even regulations: the interpretation of FIA rules differs according to scrutineers about having servos inside the car. Servos will not be allowed inside the car from 1978 onwards for international Group 2 and 4 events.

NB: It is illegal to run a motor car on the roads in the UK with only an hydraulic handbrake. An MOT efficient mechanical handbrake must be in working order on the car at all times.

9.7. BEDDING IN PADS

Lastly, a word of advice on using handbrake pads.

When using high efficiency braking material, a lining which has a long life will of necessity take longer to 'bed-in' than linings of the more normal type. To obtain the maximum efficiency, it is essential to condition the surface of the material and this, once established, will remain throughout its life. The following procedure is therefore recommended during the initial 'bedding-in' period.

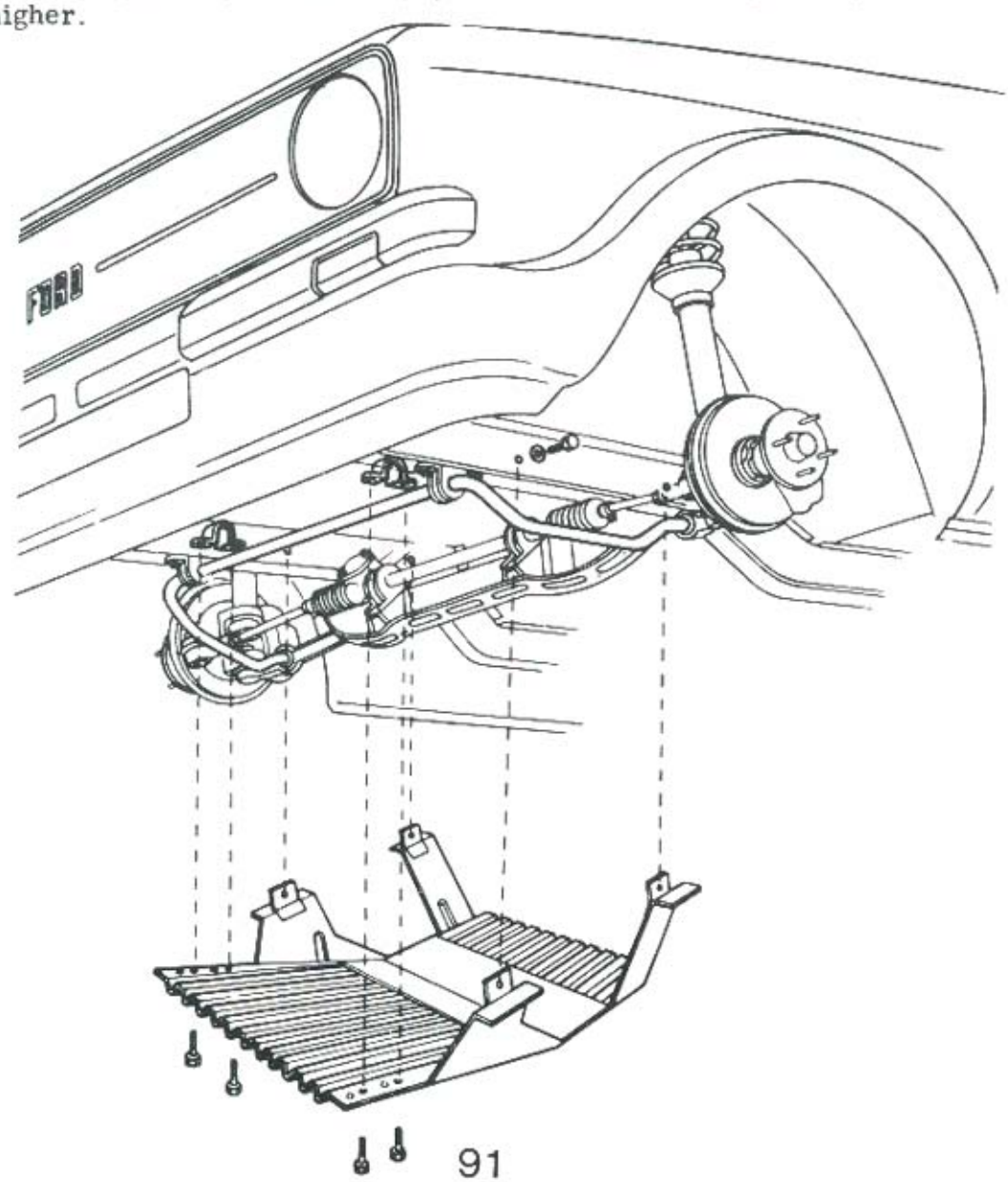
1. Driving the car normally the brakes should be used lightly but frequently for the first 150-200 miles.
2. The brakes should be used hard, giving several heavy applications, preferably from the medium range speeds until some falling off in efficiency is noted. (This is the surface conditioning process and is accompanied by slight fade and a rather pungent smell of hot brake lining.)
3. Allow the brakes to cool. Braking should then be continued for several further applications until stabilized conditions are reached, no further increase in pedal pressure being required for a given deceleration.

UNDER PROTECTION

10.1. THE RS PARTS SUMP GUARD

A magnesium alloy sump guard was always standard wear for any self-respecting Escort rally machine in the past, but supply problems and soaring costs resulted in RS Parts producing a light, thoroughly proven and engineered guard made of steel.

Latitudinal swages and strategic reinforcements give the guard exceptional strength without any sacrifice in weight. Weighing in at under 24 lbs gives the new steel guard a 6 lb advantage over other magnesium alloy guards. The material used is a special high carbon spring steel which was chosen because of its high impact, strength and resilience, and of course, there are none of the corrosion problems which plague magnesium alloys, therefore the life expectancy is much higher.



Four sturdy mountings bolt onto the chassis side rails and add to the overall strength of the body shell, while two additional mounting points clamp onto the stabilizer bar giving the bar better location and doing away with the necessity of fitting double width stabilizer bar mountings (a great advantage in Group 1). Initial fitting of the new guard is much simpler, and access to steering and engine components is just a matter of undoing 4 bolts and swinging the guard forward. Another advantage lies in the fact that it does not bolt under the crossmember, which otherwise tends to bend under the pounding of forests.

The new RS sump guard is designed for all derivatives of Escort I and II. You can use it on a Gp 4 car to better effect by cutting off its first two inches, thereby clearing your twin roll bar brackets and anti-roll bar, which will make for easier access when you bend one. Also, if you are using one of these guards, and are having your bodyshell prepared by someone like Safety Devices, make sure you take your guard along with you, as the positioning of the support brackets varies slightly; they will be able to insert and weld the mounting tubes inside the chassis rails to fit your guard exactly.

RS sump guard:	Finis Code No	905 2879
Fitting kit:	" " "	905 2780

10.2. WORKS GUARD

Although the RS guard is strong enough, the works make their own for really rough events, where quick engine access is a premium. The following description is of a 'rough road' guard; for tarmac events a thin short skid is used.

The main undertray is made from a rectangular sheet of 3/8" dural measuring $22\frac{1}{2}$"x$24\frac{1}{2}$" - see fig. 1. Arcing a 6" radius $\frac{1}{4}$ circle from each rear corner, and cutting away will give your exhaust freedom to move. From the front of the guard scribe a line $11\frac{1}{2}$" back across the plate and have the tray bent along this line to an angle of 8^{O}

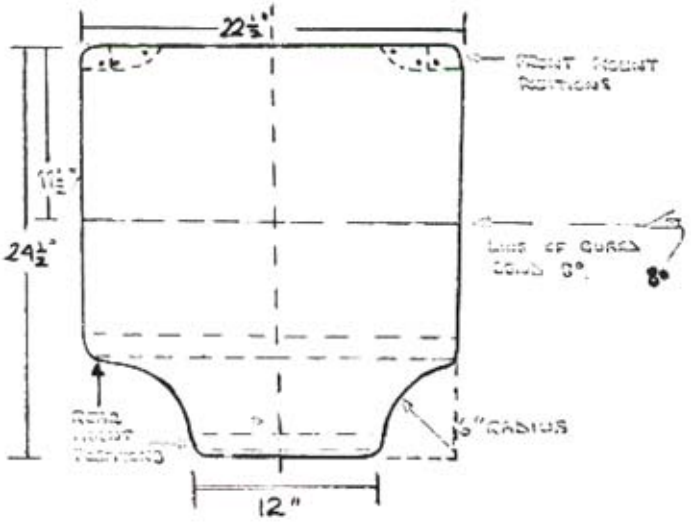
The Boreham guard then uses two complete transverse mounts, with one 'ear' at each front corner, without ever coming in contact with the crossmember - at least at the start of an event! You might care to note that on Safari strength guards, we use three transverse mounts, a single one replacing the two front 'ears' on the European spec. These mounts use the front bumper iron location holes with extended bolts, and you'll note that the 'ears' themselves have two mounting holes, $3\frac{1}{4}$" apart, to spread the load. A good idea here is to braze onto the ear a captive nut so that you don't have to use two spanners when removing the guard.

The middle mount does not bolt at all to the chassis rails, but with the insert of a hard rubber pad 'Araldited' to the mount, merely sits against them. This middle transverse mount is bolted to the guard just before it narrows down, and when dropping the guard comes down with it.

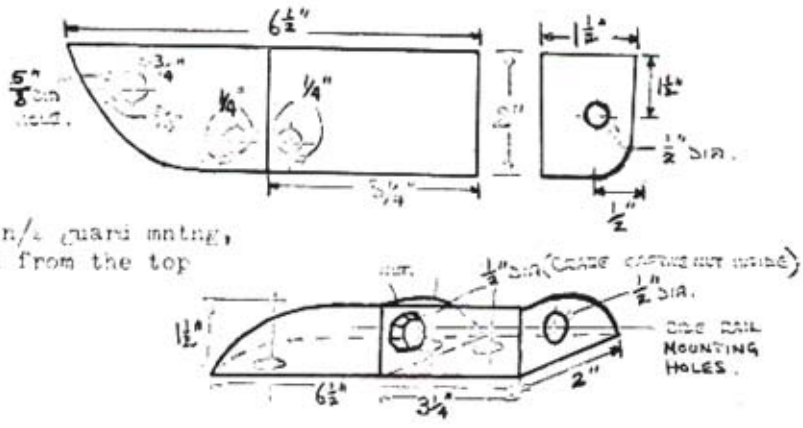
The rearmost mount is again bolted to the guard, and positioned approx 1" from the very back of the dural sheet. The chassis mounting of this is not through the chassis rails, but by a lug welded to the rails. From the drawing (not to scale) you will see the dimensions of the mount, and all Boreham do is duplicate the outer flange and weld one to either chassis rail, and, by one bolt only on either side, (for ease of removal) mount the rearmost mount to the chassis.

So, there you have it, a works sump guard - simple and easy to remove, and, using a front transverse mount, you could make the dural sheet whatever width and thickness you wanted. Incidentally, it's a good idea to glue some rubber padding under the X member to absorb thumps.

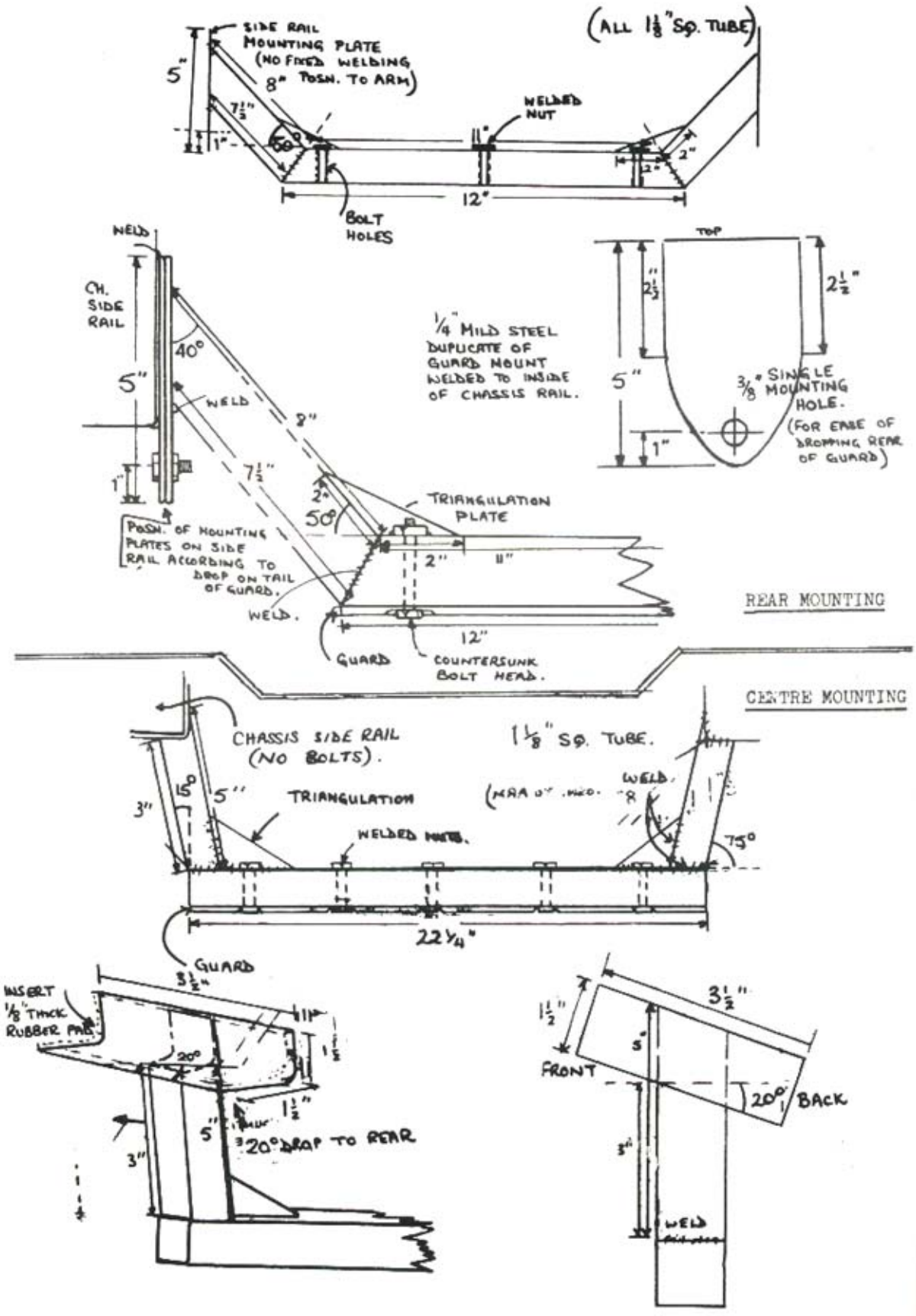
Sump Guard

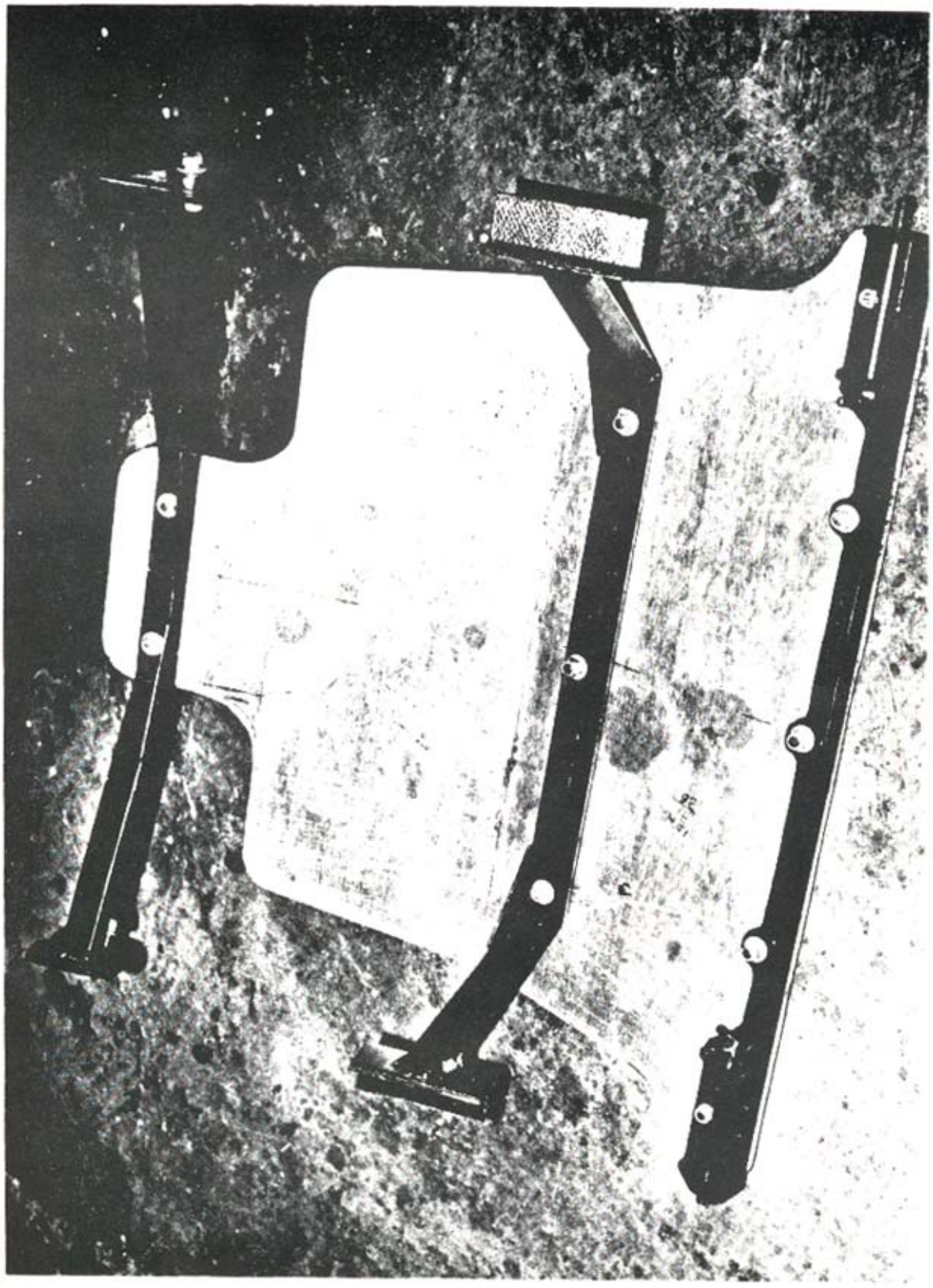


Front Mounting



Front n/s guard mnting, viewed from the top


(ALL 1⅛" SQ. TUBE)
SIDE RAIL MOUNTING PLATE (NO FIXED WELDING 8" POSN. TO ARM)
5"
7⅓"
1"
60°
WELDED NUT
11"
2"
12"
BOLT HOLES
WELD
CH. SIDE RAIL
40°
5"
WELD
8"
7⅓"
1"
2"
50°
TRIANGULATION PLATE
2"
11"
POSN. OF MOUNTING PLATES ON SIDE RAIL ACCORDING TO DROP ON TAIL OF GUARD.
WELD.
12"
GUARD
COUNTERSUNK BOLT HEAD.
¼" MILD STEEL DUPLICATE OF GUARD MOUNT WELDED TO INSIDE OF CHASSIS RAIL.
TOP
2⅓"
2½"
5"
1"
⅜" SINGLE MOUNTING HOLE. (FOR EASE OF DROPPING REAR OF GUARD)
REAR MOUNTING
CENTRE MOUNTING
CHASSIS SIDE RAIL (NO BOLTS).
1⅛" SQ. TUBE.
15°
5"
3"
TRIANGULATION
WELDED NUTS.
WELD
75°
22¼"
GUARD
3½"
INSERT ⅛" THICK RUBBER PAD
20°
1½"
5"
3"
20° DROP TO REAR
1½"
3½"
5"
FRONT
20°
BACK
3"
WELD



Boreham Dumpguard Complete

UNDER THE CHASSIS

Under the car, pay attention to the leading edge of the chassis rails, since where these reach their lowest point is the most vulnerable area on the floor pan. The constant pounding from rough roads, rocks and dips can severely effect the strength of a body shell at that point. It is therefore advisable that you should make up a skid from 16 swg sheet steel and weld it from the inner edge of the chassis rail to the edge of the bottom sill panel, flush with the front edge of the doors.

Safety Devices, incidentally, make some very effective skids for both Mk I and Mk II's, which they automatically fit when they prepare a Gp 2/4 body shell.

The brake and fuel pipes should be disconnected and fed inside the passenger compartment by rerouting and bending where necessary. Use grommets where 'bundy' pipes pass through sheet metal. Also pay special attention to the safety rules from the RAC 'Blue Book' and ensure petrol pipes are double covered when inside the passenger area.

Brake pipe shields, particularly around the back axle, are a must, and a few hours spent making these up will pay real dividends in terms of reliability. Besides, losing the use of rear brakes on a forest will make a driver age very rapidly. While we're on the subject, always use flexible hose coil protectors, and always run the piping behind the axle, rather than above or in front.

Differential guards are described in the chapter on axles, which leaves the rear valence. This tends to get destroyed very rapidly, as it gets regularly ripped off when the rear suspension is on full bump. One idea is to cut off the valence area directly below the rear floor pan, which will also help keep the car light. A good alternative (very necessary on Gp 1 cars) is to fit a valence skid. This is fitted in production on most export models, and you should order one from your local Ford Dealer. This is a mainstream (ie not RS Parts) part, and comes under finis code 144 4450, both for Mk I and Mk II models.

10. 4. EXHAUST SYSTEMS

The first thing to remember when fitting exhaust systems, is that even the best and most expensive system will not be a straightforward fit on to your car. You have to be prepared to spend quite a few hours making it fit, tailoring it to the shape of your floor pan, and most important, fitting it as snugly to the body as possible.

Golden rules are to skid all silencers both on the front and rear edges and to doubly secure mounting rubbers by loosely fixing a loop of wire to prevent the exhaust falling on the track, should the rubber 'O' rings split or come off the mounting hooks.

Equally so, it is inadvisable to clamp the joints between manifold and centre pipe, as well as that between centre pipe and tail pipe, as all the vibrations created by an excessively rigid system, tend to fatigue exhaust manifolds which end up cracking. The best idea here is to weld two 5/16" nuts on both sides of the exhaust, with each of the two nuts on either side of the joint, and to loop these together with wire. This will hold the two pipes together, allowing them to move within each other, thereby reducing the ill effects of vibration.

The following exhaust systems are available from RS Parts:

Escort RS Mk I RHD Only		Escort Mexico Mk I RHD Only	
Manifold	905 1876	Manifold (W/Cup)	905 1427
Connecting Pipe	905 1292	Connecting Pipe	905 1292
Tail Pipe	905 2064	Tail Pipe	905 2064

Group 4 Escort RS 1600/RS1800 Mk I and Mk II

Manifold	905 4006
Connecting Pipe	905 4007
Tail Pipe	905 4008

The first system listed (Mk I RS1600) is only really suitable in the case of 1600cc or 1800cc BDA engines. For any Escort SOHC derivatives, you can obtain suitable systems from Janspeed.

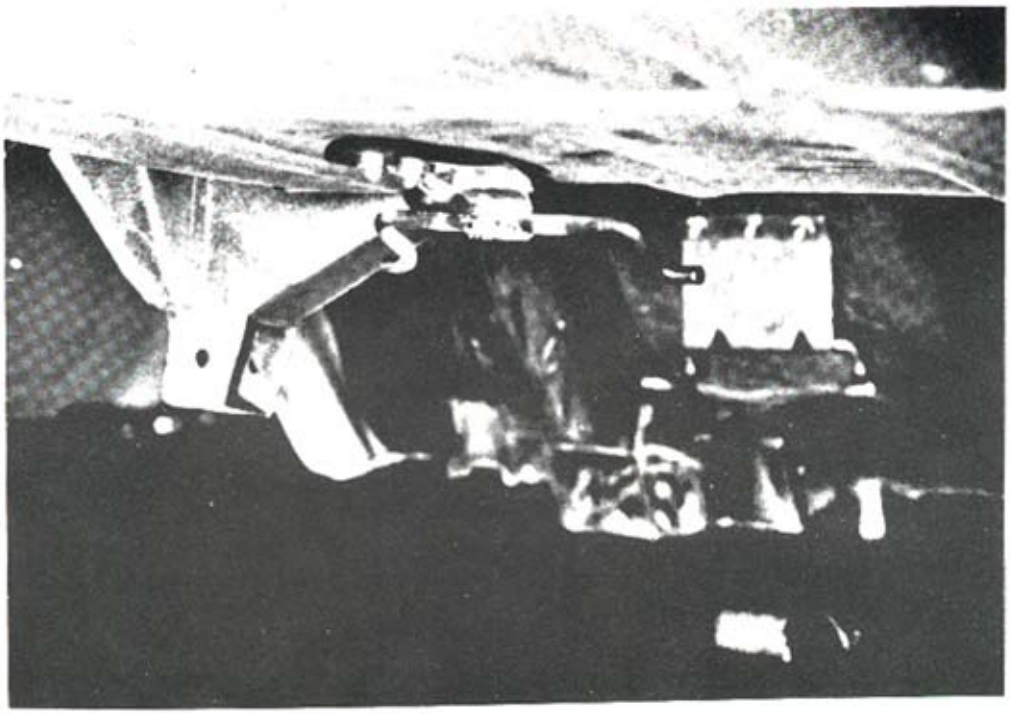
On the central downpipe, try to get this as near the prop-shaft tunnel as possible, and, if you can, make a recess the length of the car just on the corner of the tunnel in which the pipe can sit.

10.5. EXHAUST MOUNTINGS TO BODY

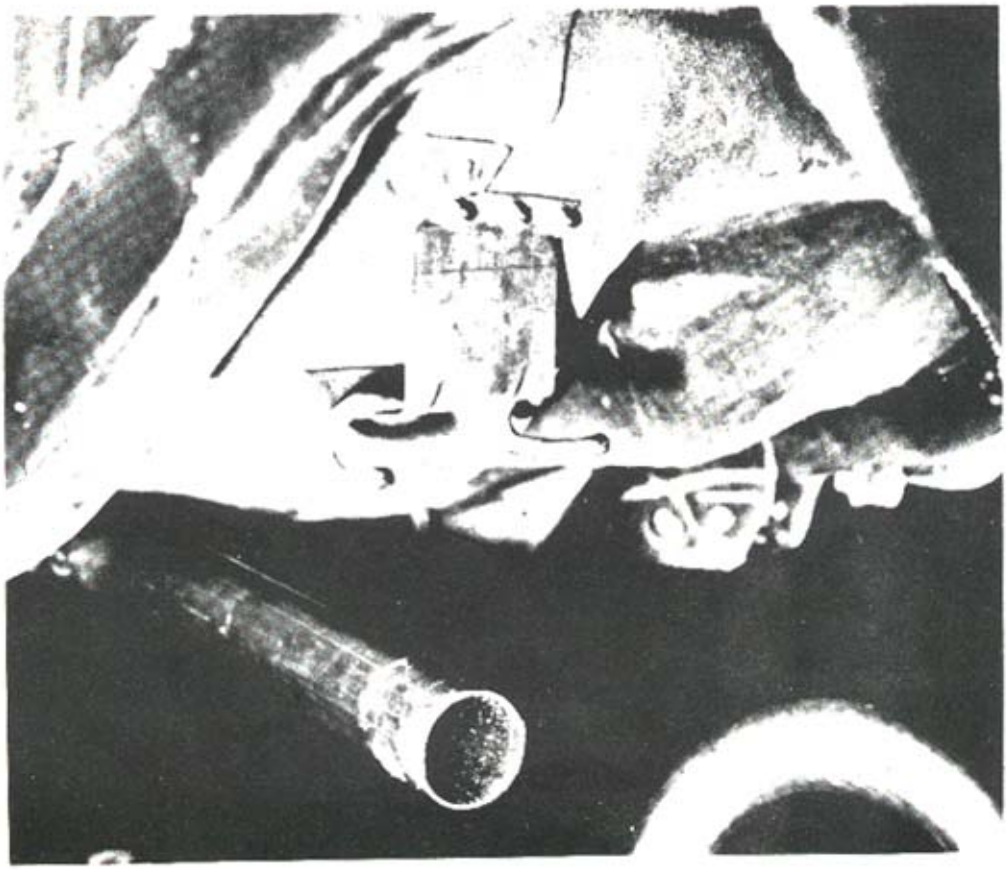
The works put one mounting in front of the rear axle, one behind the rear axle, one on the extreme rear of the silencer, and one at the base of the downpipe; this means that the system is free to move about in the middle section. About one inch of upward movement is left before the system starts to hit the car floor. The actual mountings used are standard Ford rubber 'O' rings.

For additional protection, mount skid plates on the manifold, centre section, and rear section. These are basically simply steel strips tacked on.

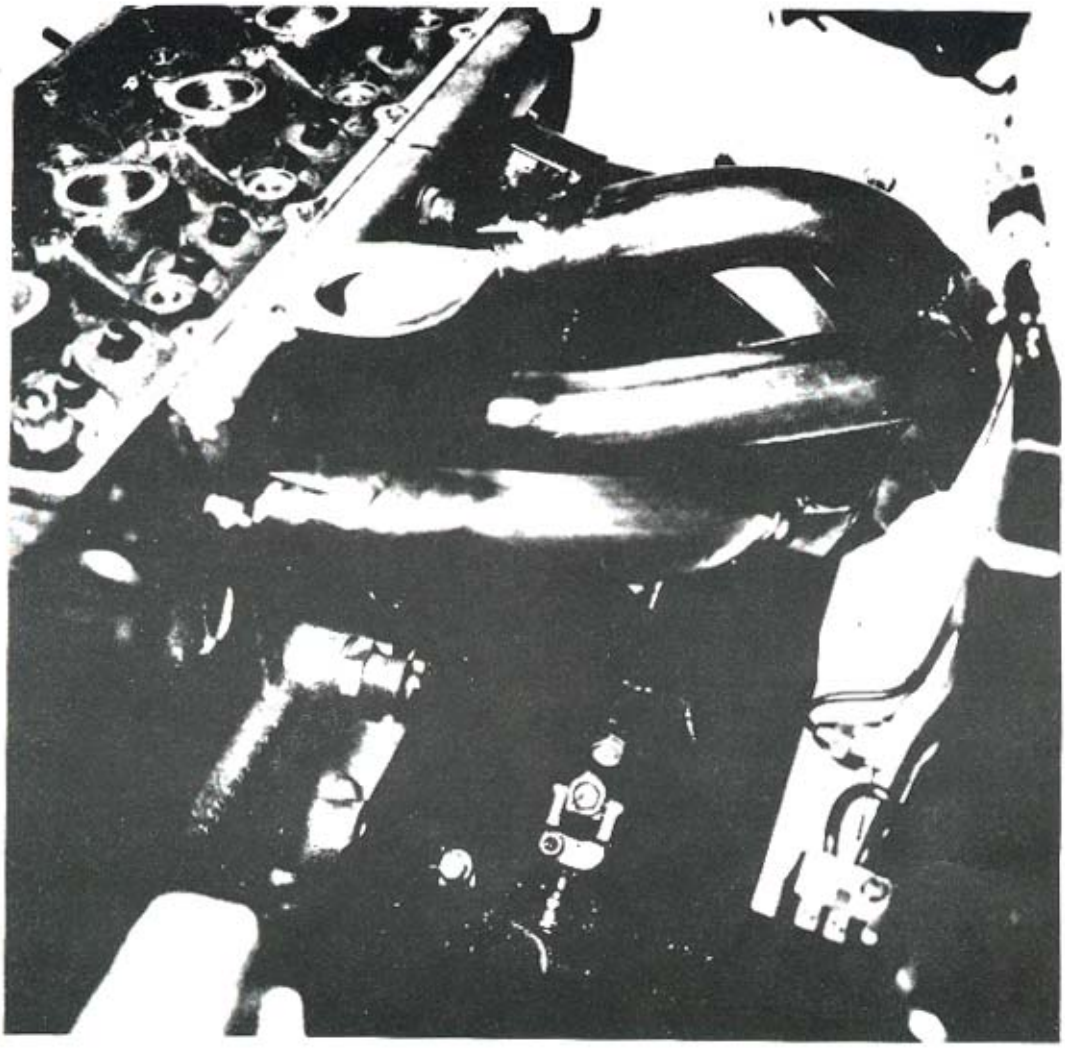
On the works cars, no exhaust clamps are used at all.



Rearmost silencer mount with Lanhard rod mount in background.



Front silencer mount.



Tight exhaust manifold fit on l.h.d. car.

ELECTRICS

INTRODUCTION

WHAT WITH OHMS, volts, amps, relays, polarities, and a host of other electric jargon, it's not surprising that electrics baffle so many people, including, at times, those who pronounce themselves experts. There are so many factors involved when an electrical fault occurs that we should really go back to basics first of all.

About 90% of electrical problems are due to faulty connections, particularly on batteries, alternators, lights, pumps and switches. Always ensure that connections are grease free and tight fitting, especially snap connectors. The exception to this rule is the battery terminals which should be clean and smeared with light grease or vaseline to protect from corrosion.

Looms or wires passing through a bulkhead or bracket must not be allowed to chafe as this is a prime cause of dead shorts, and can lead to an electrical fire. Always use grommets, tape or even rubber tubing around the hole in question. Looms should be clipped where they hang free; the best clip to use here is an insulated 'B' type. If a standard loom is used, incorporating the standard fuse box, always use the correct amperage fuse. Do not be tempted to use an oversize fuse to overcome an overloading problem - this is defeating the object of having a fuse anyway.

Fuses should be easy to see whether they have blown, and also easy to replace. Obviously, the box should be away from sources of intense heat, ie exhaust pipes. One point, Boreham never fuse the headlights. This is not a 'must', but if headlights are fused, make sure they are NOT both on the same fuse!

When adding a loom for auxiliaries, try and obtain a different colour wire for each item. Believe me, ten red wires through a hole in the bulkhead is a real headache to trace when only one or two auxiliaries have a fault. Also, do not paint over the wires should you decide the 'banger' needs an under bonnet respray. A neat and tidy wiring job is worth the extra bit of time it takes to prepare and looks good.

Now on to lights themselves. Headlights, spots and fogs are an individual choice, and is down to you. If in doubt, have a look at what everyone else is using.

There are legal requirements for auxiliary lighting and the fittings in the diagram should be strictly adhered to, but take in one further point. For road events run under RAC rules, you should not have more than FOUR forward pointing lights at any one time, whilst on the public highway. This is to try and cut down the annoyance of some of the solar systems charging around the lanes that we used to have. On stages though you can, of course, use all six lights.

11.2. LIGHTS

When fitting spot or fog lights, it's a good idea to make up a separate loom from the cockpit to the lamps. Have a junction in the loom about 4" from the lamp, which makes removal and changing much easier. Individual earths for each lamp are a must.

Lights should be set up to personal preference, but don't forget club rallying in this country is not on closed roads, so don't annoy other road users. Remember six lamps is the legal maximum (in practice you don't need more anyway).

To keep your lights at their best, the source of power, the alternator, and battery must be good and reliable. Remember to tightly secure the battery - something that scrutineers nearly always check. The 3" pulley on the alternator is the recommended size to use because it has the advantage of a low speed charge. The theory here is the bigger the pulley, the better as far as the battery is concerned.

With all the lamps and extras on a rally car, you need a good 'storage space' so a good battery is vital. The Ford heavy duty 57 amp/hr is adequate for most people.

To help decide which charging system would be necessary when extra lights, and all the extras are fitted on a rally car, the calculation should be as follows:

Headlights	110W
Spot Lights	110W
Side Rear No Plate	30W
Dash	4W
Brake Lights	48W
Fuel Pump	20W
Flashers	48W

The lighting total is 254 Watts. This converted into amps (that is divided by 12) gives 21 amps. Usually, the standard fittings, such as ignition, takes 3 amps, heater 4 amps and wipers 3 amps, giving a total of 33 amps, so you need at least 40 amps output.

One final point, whenever the charging system is changed, or alternator swapped, always have the control box or regulator checked and adjusted to suit power and battery. Over charging can cause just as much trouble as under charging. It will give you blown bulbs and eventually a useless battery.

11. 3. WATERPROOFING

Water on the ignition side of the eletrical system is one of the best-known ways of immobilising a rally car, as anyone who has found himself stationary with his Ford stuck motionless in a ford (sorry) will know only too well.

The main cause of getting the engine drowned is via the cooling fan. This sucks water through the radiator in the same way that it sucks through air: the water hits the fan, gets itself blown about in a very fine mist and you have an instant dead engine. In other words, it's this fine mist of water, which is incredibly penetrating, that has to be kept off the ignition connections, leads and distributor cap. Boreham have tried most of the known spray-on goodies, which work very well indeed up to a point, but for deep fords you need a bit extra.

The biggest, and most important job is the distributor. One idea is to obtain one of the waterproof covers they use for BMC Minis, which has to be used with a side-entry distributor cap. Then make sure that all the plug leads are in really good condition and check that they are secure in the distributor after you've fitted the waterproof cover. All the leads into the distributor should be sealed at their entry into the distributor cap with a waterproof sealant, such as Bostik or Salastic.

The next thing you need is a bit of motorcycle inner tube which will provide a really tight fit over the whole unit at the point where the cap joins the body. A piece about four inches long will have to be rolled onto the cap underneath the waterproof cover, which you also roll up out of the way while you're doing it. The distributor cap is then slipped onto the body, the rubber rolled back into place over both the joint and the clips. Then you pull the Mini cover down over the whole assembly and tape it into place. One thing you will have to watch is that the vents in the base of the distributor do not become obstructed, otherwise it won't breathe, it'll get dry, and it might then seize up solid.

You must use spark plug covers, preferably rubber ones, at the other end of the leads to protect the plug insulator: if they get damp you'll get arcing, misfiring and all sorts of aggravation.

The bits that supply the eletric power to the distributor - the coil or transistor pack - need just the same amount of careful sealing. The high-tension or "king" lead should be covered by a rubber sleeve and then sealed as one, and so should all connections on this side of the ignition system. Then you get your little aerosol (one of the silicone mixtures that are on the market) and spray all over the leads and connectors of the entire system - and don't skimp any part that might be affected by water, however well you think it is protected.

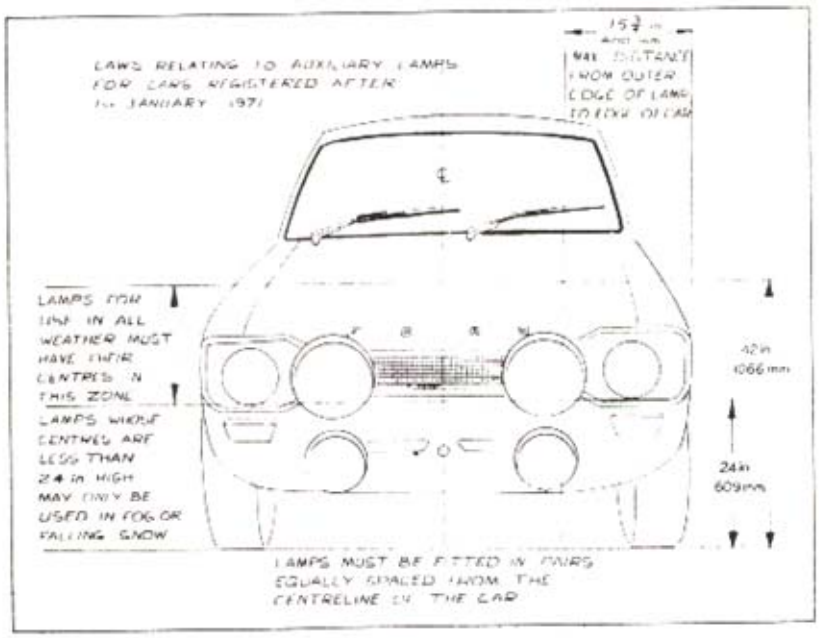
This silicone spray should also be applied to the spot and fog lamps connections exposed to the elements, and if you've got children pinch some of their plasticine, which is excellent stuff for sealing spot-lamp rims or where wiring passes through rubber grommets in body panels. A dose of plasticine can also be applied where the headlamp loom enters the body of the headlamps - in fact, you can use it on any hole that might let in water or even damp. If you haven't got kids or small brothers or sisters, you'll have to buy your own, in which case you can get it coloured to match your car. It costs no more and looks a lot smarter.

There are one or two extra things, when talking about electrics, which, as far as competition cars are concerned, are necessary to comply with regulations or law.

Battery earth leads must be either painted yellow or covered in yellow tape. The battery master switch, identified by "flash and triangle" sticker, must be capable of cutting out not only the battery, but also the ignition: on a car equipped with an alternator, cutting out the battery won't stop the engine.

11.4. LIGHTING REGULATIONS

The dip-switch, when operated to put the headlights onto dip, must cut out all the other main lights, leaving only the dipped beam in use. And the reverse light must be operated only be engaging reverse gear.



Broadly, there are two sets of regs, both are interlinked, just to complicate things.

On cars registered before 31 December, 1970, a pair of auxiliaries have to be no less than 13.8 inches apart (measured to the inner lit edges). After that date, the distance of each outer lit edge to the outer extremity of the car (note that this means what it says - it could be your flared arch, or your doorhandle) must be less than 15.8 inches.

To cap that lot, any light mounted less than 24 inches from the ground (to its centre) can only be used legally on the public roads in fog or falling snow. Above that height, the lights may be used in any weather conditions, but must be extinguishable with the standard dipswitch.

Note; that no mention is made of types of lamps - if you put a driving lamp six inches from the ground, the law thinks of it as a fog lamp. Barmy, but we have to live with it.

11.5. SPOT LIGHT RELAYS

It's best when dealing with a complex system such as electricity to start from the first principles: Your car depends entirely on what happens in that bundle of coloured wires behind the dash, and how and where the wires go; but it all starts at the battery. Like most other things inside a car, successful performance is a result of keeping it happy. Like women, batteries need attention: in the long run, simple, cheap maintenance will be rewarded by way of lack of aggro and expense. It's not necessary for me to go into battery theory. Suffice it is to say that the battery functions as an electrical reservoir as a result of a chemical reaction between lead plates and sulphuric acid. The best place for this acid - which is highly corrosive - is inside the battery. If it spills or seeps out it will commence its devilish work on your terminals. The posts and clamps will start to look white and fluffy - at worst they will later disintegrate, at best a layer of highly resistive deposit will form at the electrical connection. Voltage in the system will thus be low, resulting in poor starting, dim lights and perhaps misfiring. The moral is: keep your battery clean and the connections tight, and it won't let you down.

The battery is kept charged by the alternator or dynamo. These are generally trouble free if kept clean and protected from clumsy spanners. Any charging troubles can usually be traced to a 'nasty' inside the little box of tricks known as the Regulator. Unfortunately, if this goes on the blink there's very little you can do about it - replacement is the only answer. However, make sure the terminals are clean and tight. Should you have to remove it, please ensure the cables go back on the correct terminals - you can check on this with the wiring diagram in the car's handbook - otherwise you will damage it irrepairably.

The next "component" is the wiring loom. All you need do as far as the standard loom is concerned is to keep the connections clean and tight, and the looms well protected from chafing. Where they pass through a hole in the bodywork - for example the bulkhead - there should always be a rubber grommet to prevent the cables running on the sharp metal edge. Rubber does, in time, perish, so preventative maintenance is again the answer to prevent disaster. Naturally this goes for any extra wiring you carry out - for example, remounting fuses within the passenger compartment, or fitting auxiliary lights. Having mentioned D-I-Y wiring, the cable you use must be able to cope with the current it is going to be asked to carry: failure to make allowances on this score can result in voltage drop (of which more later) or the cable over-heating and perhaps burning. This can spell real disaster, for obvious reasons.

A good cable gauge to choose for most installations is 28/030 (metric) - which means that the cable has 28 strands each 0.030 mm in diameter. Beware of using this gauge as an alternator charging cable - it cannot take that sort of current.

Next, fuses: their job is protection of the circuit from a current that will damage the circuit or component. The necessary fuse value can be worked out by the simple formula:

$$\text{Rating (continuous)} = \frac{\text{Wattage of component}}{12}$$

Note that this is a threshold value: the chosen fuse should be rated about 25% higher than this. For example, two Halogen lights at 55 watts each:

$$\text{Rating} = \frac{110}{12} = 9.2 \text{ amps}$$

Choose a fuse of about 12 or 15 amps continuous rating. On a competition car it's a good idea to fuse all important circuits independently, mounting the box of tricks within the passenger compartment. The advantage of this is that they're all easily accessible for the co-driver to deal with if necessary; and make sure appropriate spares are always carried.

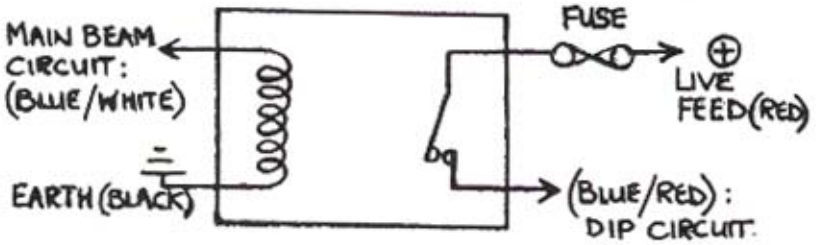
One hang-up that all circuits suffer from, to a greater or lesser extent, is voltage drop. Any cable has a certain resistance, and therefore the voltage available at the component will be less than 12V. It's impossible to completely avoid voltage drop, but it can be minimised. To give an example of its effect; an Oscar run at 11V instead of 12V will produce 25-30% less light. Points to watch are (again!) cable gauges and connections. Also, it is likely that switches, especially if they have been in use for some time, have slightly burnt contacts. The deposit thus formed is resistive and will cause voltage drop. So if you have a low voltage problem, investigate the switchgear - the answer might be to replace it.

Another way of avoiding low voltage is to use relays. These are simply remotely-operated heavy duty switches, capable of handling 15-18 amps. Mount the relay so that the run of cable from the battery to the component is at the minimum, thus lessening the resistance of the circuit. Actual switching of the relayed circuit is completely independent, whereby the relay is "fired" by providing a live feed through the relay coil, via a dash-board switch, to an earth point; this also means that each dashboard switch only requires one cable passing through the bulkhead.

Below are three commonly used relay circuits. Obviously, the method can be applied to almost any other circuit within the car, with beneficial results.

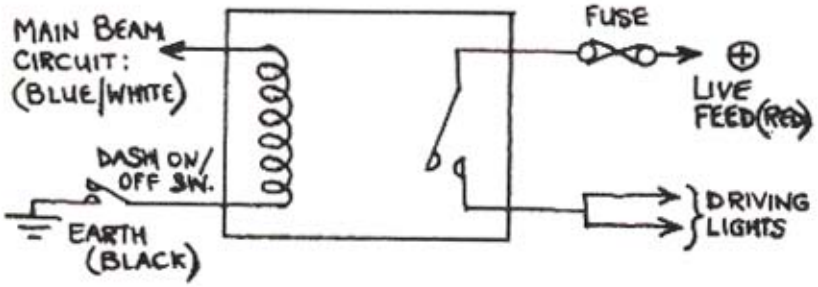
1. It is often advantageous to have both main and dip filaments alight on main beam: the dipswitch then effectively becomes an on/off switch for the main beam.

Circuit:

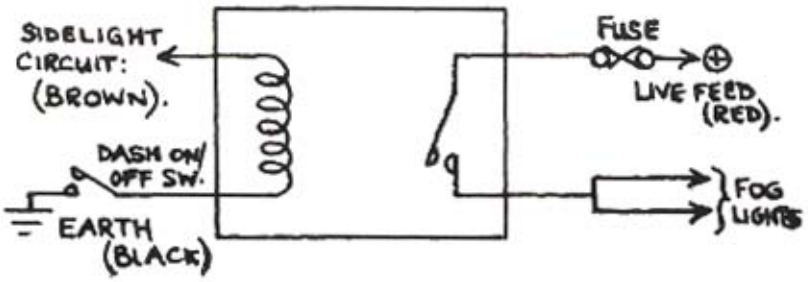


2. To operate legally, driving or spot lights must be wired to extinguish when dip beam is selected.

Circuit:

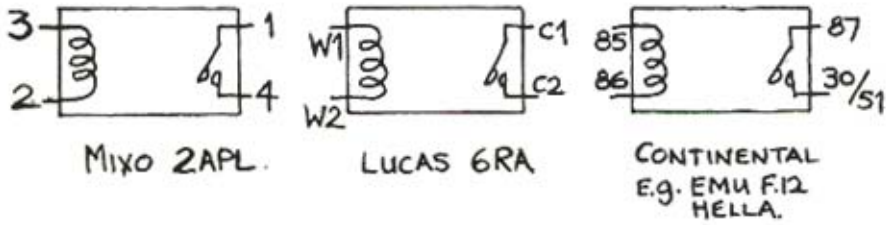


3. Fog lights should operate independently of headlights; preferably switched through the sidelamp circuit.



Any make of relay is suitable, assuming the current capacity is great enough; however, the terminals of different relays are not, surprisingly, coded differently.

The following diagrams give you some common equivalents:



MIXO 2APL. LUCAS 6RA CONTINENTAL E.g. EMU F.12 HELLA.

One last word about relays, they are very sensitive to heat and water. They should therefore be fitted away from direct heat, and in a place where they are protected from water.

11.6. CIBIE LIGHTS

A) Long Range ("Spot") Lamps

These can be recognised by the almost completely clear lens - Note: not glass, but lens - it is in fact itself a complex form of prism. The beam produced by this type is what used to be known as a spot lamp beam. It is highly intense, and thus has the greatest possible range in absolute terms. However, because sheer power has been the design requirement, very little lateral illumination or spread has been provided, hence the term Long Range lamp.

B) Driving Lamps

A development on the above theme. Here, though, the lens is provided with a larger number of separate prisms - each individually designed - in order to give adequate lateral illumination. Whereas the long range lamp has a much greater spot intensity, the driving lamp is, in fact, much better as a road illuminator, although it has not got the range capability of a long range model. Shape of the beam is roughly eliptical, to be contrasted with the round spot of the long range lamp.

C) Fog Lamps

The most specialised light available. Here the designer has been faced not with giving as much light as possible on the road, but to make possible adequate vision in poor conditions. The beam is therefore very wide (about 80°) and sharply cut off at its upper limit. The reason for this is to avoid, as far as possible, the back-scatter of light - that effect which precludes the use of main beam in fog. The lensing to give this beam is distinctive, and is composed completely of vertically aligned prisms. Some small element of scatter is allowed for above the cut off so that the position of the light can be seen by other road users. The light should, of course, be mounted as low as legally allowed.

There is another type of lamp that is not supplied by Cibie as such, but is a derivative of the Fog lamp. The modification is very simple, and the lamp is then known as:

D) "The Virage"
If the fog lens of your fog light unit is dismantled (by levering the bulb holder from the reflector) you will see that the bulb is shielded by a black metal pressing, which is attached to the holder by three rivets. Drill these out, throw the black thing away, reassemble, and you are the proud owner of a Virage. You may now ask what good is all that? The answer is that it improves intensity of the wide beam, at the expense of the sharpness of the cut-off.

So, what is the best to use? For the first pair we would recommend a pair of driving lights without hesitation, as the best all-round performers. For sheer power go to the Super Oscar. Better 'cos it's bigger'. The other pair (you aren't really allowed more than two pairs by the Road Traffic Act or RAC regs) is up to you to choose, but make sure they are suitable for the type of event you are going to do. If the event is in the forests, have a pair of Fog or Virage - beam width is very useful for corners. If you are doing a very fast, mostly straight event, try a pair of long range lamps. The range is the important thing, and if they are supplemented by driving lights as suggested, you should have enough lateral illumination.

You'll probably see some cars with the lower pair of lights aimed so that they diverge or even cross. Some folk like one pointing up, the other down. This is again to your own preference: up/down divergence is useful for yumpy stages, where you need to see over a brow or up a hill, before you get to it. Lateral divergence helps vision around corners - but only very slightly.

E) Reversing Lights
Most of the time, you will be driving forwards. However, even the best can wrong-slot, and you have to use that other position on your box and go into reverse. Again, it's nice to see where you're going, so what about reversing lights. The law limits these to 21 watts each, but we would recommend a Halogen Foglight for off-road use. The Cibie type 40 is ideal. Wire them into the existing circuit, using a gearbox-switched system if possible. We must stress that the use of Halogen 55W lamps, in this case, is technically illegal - but that's your decision.

F) Headlights
Lastly, headlamps: The make is a matter of personal preferance, but one thing you can do, assuming you are using quartz halogen units, is to wire up both filaments on the double filament bulbs. This will shorten the bulb life very little, but gives you a good spread of light without much effort. In other words, the dip beam remains on all the time once the headlamps are on, and is supplemented by the main beam. This will give you the advantage of the Cibie Biode system, but without the slight problem of that particular light in adjusting the main beam relative to the dip beam.

11.7. WIRING UP HEADLIGHTS

To make sure that the dip switch does not become overloaded, the headlight system, using double filament bulbs, as well as the auxilliary lighting, is run through relays. We use the Bosch 30 amp relay.

The best way to attack this problem of wiring is to mount the fuse box and all lighting relays (and there are four of them) on one panel. This panel is made up from sheet ally, and is located above the parcel tray on the inside of the quarter panel by three Dzus fasteners. The panel mounts, in which the fasteners seat, are raised from the car structure so that the mounts for the relays and fuse box do not rub against the vehicle bodywork. There are multi connectors for all wiring leading to and from the panel for ease of removal. The main reason for putting all these items on one panel is to facilitate removal, and also to do a neat job ..... if you think about it, it's almost impossible to attach four relays and a fuse box direct to the car under the dash and make a good job of it; one relay is bad enough!

Without going into the wiring of the fuse box now (because it needs a complete article in itself) let us simply say that it is a standard Ford fuse panel cut short. The incoming power is direct from the shunt, and in the case of the headlights, power is taken on the incoming, ie non-fused side of the box, to the relevant relays, one for dip and one for main beam. Stopping here for one moment, you'll note that the headlight system is not fused at all. This is really driver preference, no more, because there are two schools of thought on this one. The main point against having headlights fused is that if both fuses go (which is not very likely) you <u>can</u> be plunged into instant darkness. On the other hand, you should consider the more likely case of a possible electric fire being caused by the obliteration of one headlight in a minor incident, with a tree for example, that can be caused by non fusing headlights. Anyway, it's the driver's choice, and Boreham doesn't fuse the headlight system.

On the Bosch relay, the power is taken to the terminal marked 30/51. The offtake to the lights is from the terminal marked 87. You will note that this terminal is divided, and the power to each light is taken separately to each headlight, (and indeed spotlight) by its own wire. Terminal 86 goes to earth, and the remaining 85 to the dash dip and light on/off switch.

11.8. QUARTZ BULBS

To finish, some information about the Halogen bulb. This has been known by many names, ie Iodine , Iodine Vapour, IVB, Quartz, Quartz Iodine , Quartz Halogen, etc, etc. They all mean the same thing: that is, the "glass" is quartz, and the gas inside is a Halogen vapour. You'll notice one main difference btween this and the conventional Tungsten bulb (by the way, QI bulbs also have a tungsten filament), and that is that they are smaller. The reason for this is to promote a higher operating temperature of about 2000°C. This is the reason for the considerable gain of brightness. It is the Halogen gas inside that stops the filament deteriorating rapidly as it would do under such extreme heat, and gives it a longer life.

11.9. AMMETER/SHUNT

Let's have a bit of background first, with the Gp 4 cars, for which we make up our own looms, and later go on to Gp I adaptations and the Escort II.

Our own loom for Roger Clark's car made up especially?

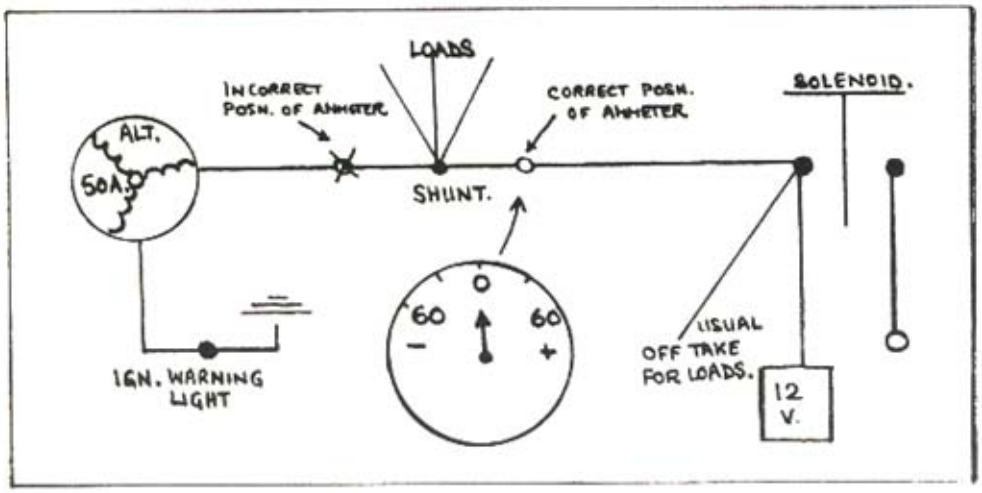
That's right. As the Gp 4 cars developed and became more sophisticated, various items were moved around and we started to land up with a right hotch-potch of wires that were lengthened and thickened chasing the components around the car. The real crisis came when the fuse box was moved (more of that later), and from then complete looms for each shell were made as it arrived at Boreham. Later on, when this became a standard job and all the wire lengths etc were known, we got the looms made up outside.

A typical example of one problem we faced was the use of a larger alternator to keep up with output demands. This meant the wire cable size going up, from the alternator output cable to the shunt, to 97/012, added to which the cable in the headlight circuits, ignition and fuel pump circuits was increased from 14 to 28/012 (012 is standard thickness of one strand of wire at .012").

One of the first things to realize when talking car electrics is that the generator, be it dynamo or alternator, must be able to take all the loads put on it without having to 'lean' on the battery reserve. To be able to check this accurately then, the first thing you must do on any serious rally car is fit an ammeter, and an accurate one at that. You'll find that the standard gauge fitted, for example to the 1300GT, 1300E, Mexico, RS1600, RS2000, etc is described as a voltage charge indicator, which is not the same thing as an ammeter. The voltage gauge tells you approximately the state of battery reserve, but not the state of balance in the eletrical system.

If an ammeter is not fitted, you are dependant upon the ignition warning light to tell you when anything is wrong. This might be fine for a shopping car, but by the time this light appears on a rally, it's usually too late to do much about it. An example - if one of the three phases in our rally alternator burns out, the ignition light won't come on, but eventually the whole system will drain the battery, and the middle of Kielder is not the most convenient place to come to a halt.

Now you know why to fit an ammeter, the $60,000 question is how to fit it. At Boreham, a standard Lucas 60-0-60 ammeter is fitted (Pt No 36408), but that's only part of the story, with this ammeter we also have to fit what is known as a REMOTE SHUNT in the system. To explain ..... to get an accurate reading from the ammeter, it MUST be fitted between the power source, the battery, and the point where all the loads (lights, wipers, horn, etc) are taken off. If all the loads are taken from the system after the ammeter you might as well not bother fitting one in the first place.



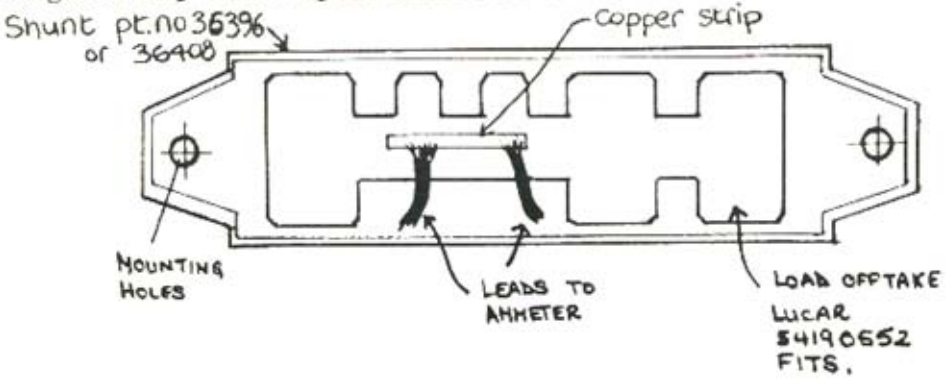
From the drawing, you can see that normally these loads are taken direct from the battery side of starter solenoid, which of course links straight to the battery. The answer is then to move the offtake for the loads. Now this can be done on certain ammeters by having a vast bunch of wires going to the fusebox linked directly to the gauge. In practice though, with any dashboard mounting this is very difficult and untidy, so the remote shunt is put in the system and all the wires linked to that; in other words, it is also a remote junction box.

The shunt has a calibrated strip of copper which records the mili-volts drop between either end, and this is recorded on the ammeter. There are two types of shunt box made by Lucas, both look just the same, but one has longer leads with the spade connectors to run to the ammeter than the other. The length of these leads is related to the calibrated strip, so they MUST NOT be cut or lengthened.

Lucas pt Nos are: 36396 - short leads (with short calibrated strip)

36378 - long leads (with long calibrated strip)

On the works cars, the position of the shunt is on the back of the heater box under the dash. Up here, it is out of harm's way and wires cannot be pulled off accidentally. The box looks as below and you might care to note the large 60 amp Lucar spade connector Pt No is: 54190552.



Having told you how to fit your ammeter in the system, it's up to you where you put the gauge. In an ideal situation, the gauge needle should be nicely balanced on 0 - this means everything is working normally, other than when starting. Here, with a fully charged battery, which, incidentally, is around 14.2 volts (although described as a 12v unit - it's 2.35v per cell) from the voltage regulator incorporated in the back of a standard alternator, but separate on our rally alternator (which we'll talk about at a later date), you should get a + reading on the gauge for a few miles only. After this the needle should swing back to 0 pretty quickly. A plus reading is therefore indicative of a charge being restored to the battery from the alternator. A negative reading is power being drained by the system from the battery.

Works Mk11 Escort dashboard. Note centrally positioned ammeter as only extra gauge.

11.10. ALTERNATOR

Firstly then, the following simple formula will help you decide the output needed from the alternator:

Total Watts ÷ 12 = Amps

Therefore, add up the total wattage of your lights, flashers, heater, wiper motor, etc, devide by 12 and that will give you the minimum size of alternator needed.

In the majority of cases, this is going to mean using a higher output alternator, since the standard 17 ACR Lucas unit (or equivalent) produces a maximum 35 amps under ideal conditions. Staying on the Lucas range for a moment, within the same casing as the 17 ACR unit is the 45 amp output 18 ACR, and there is a possibility of Lucas manufacturing a 55 amp output 20 ACR type. As said, all these are in the same machine casing (? Gp I adaptations). Two bodily larger alternators are the 23 ACR, giving 55 amps, and the 25 ACR, giving 70 amps output. The suffix 'R' here means that the regulator is incorporated in the alternator.

11.11. REMOTE REGULATORS

Now, many of you will have heard about remote regulators being needed on rally cars, and to fit a sound reliable system, this is indeed necessary. An advantage of the Bosch alternator here has always been that it is supplied with a remote regulator unit. The reason for the separation of alternator and regulator is principally engine vibration, and thumping that rally cars take adds even more strain. For instance, Boreham fit a nylon top support arm to the alternator and a couple of metalastic bushes on each base bolt, to further stop vibration, plus, of course, remotely mounting the voltage regulator and rectifier, which I'll talk about in more detail shortly.

What can happen is that the main output lucar connector on the back of the alternator can loosen under vibration, resulting in overheating and eventually an open circuit. When this happens, the battery sensing lead (B+) can no longer sense the voltage, and the alternator becomes free to generate its full open circuit voltage of over 150 volts. For this reason then, Boreham use the Lucas AC11 alternator, with remote regulator and rectifier. This unit is available in two types, a 50 amp output (Lucas Pt No 54021271) and a 60 amp output (Lucas Pt No 54021243). Because of its greater output Boreham use the 60 amp one on the works cars.

As a point of interest, if you do overload an alternator, you will just end up flattening the battery until you stop and try to restart the engine, when there will be that familiar click of a dead battery when the key is turned. A dynamo, however, will eventually overheat and melt the solder on the end of the commutator bars if it is overloaded, and the vehicle will eventually grind to a halt.

Having decided on the big alternator with remote regulator, let me just advise you that you'll really have to fit the works type 'Polly Vee' drive belt arrangement for reliability. This is a broad drive belt for which you will have to fit special pulleys on both crankshaft and alternator. The works found that with the estimated 6/7 bhp absorbed in driving the higher output alternators, the standard design belt could not take the strain.

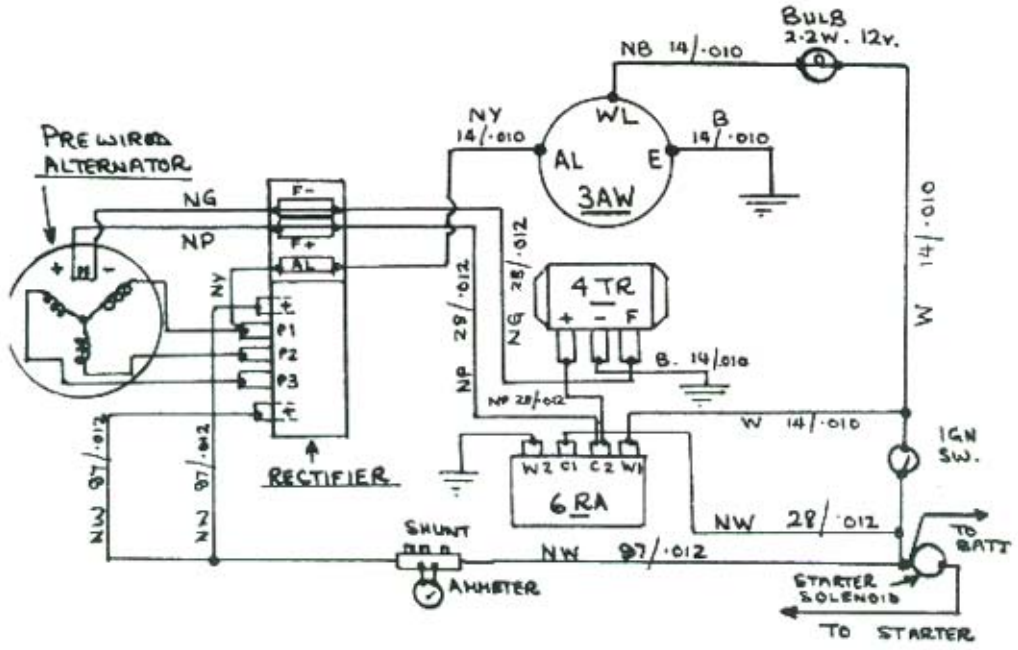
11.12. RECTIFIERS

Remembering that we are still only talking about the main charging circuit, not any of the auxiliaries, and that the regulator, which does just what it says in regulating the alternator's AC current to DC, are not housed in the alternator itself, these two items have to go somewhere. The works mount the 4TR control box (Lucas Pt No 37585) on a neat sheet of ally with its 6RA relay and warning light control relay (Type 3AW Pt No 38706) alongside and wired up via one multi-plug. This complete panel is then mounted inside the car under the dashboard above the usual parcel shelf. It is held in position with four Dzus fasteners - the idea being that if a fault develops, the whole panel is changed rather than wasting time fault finding. But, why are there three items, the regulator, relay and warning light control?

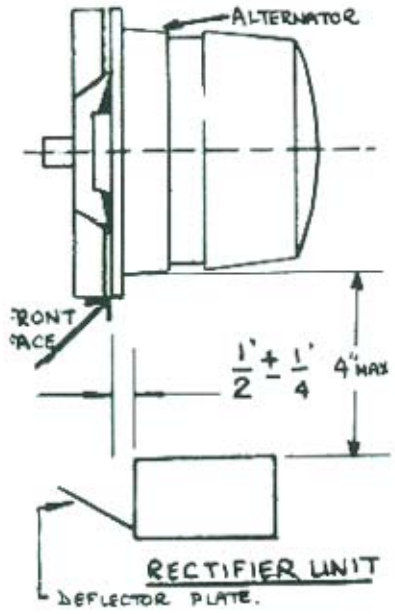
The regulator we know about. The constantly rated relay is controlled by the ignition switch, which, in the off position de-energises the relay by open circuiting both C1 and C2 contacts. This switches off the battery sensing supply (NW 28/.012 in diagram) from the battery side of the starter solenoid to + on the 4TR regulator, and at the same time open circuiting the + supply to the alternator field windings. This stops both an unwanted drain on the battery and overheating of the field windings with the engine switched off, acting in the same way as a cut out with a generator.

You will note that the alternator has three phases, or output windings, so what stops this overheating with the ignition on and the alternator stationary? Here the rectifier comes in, which, in converting AC to DC current, will not allow a reverse flow with the alternator stationary.

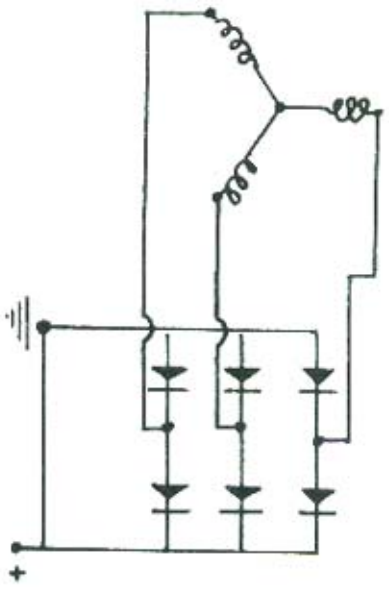
MAIN CIRCUIT



RECTIFIER POSITION



RECTIFIER UNIT



The warning light control, which picks up from the P1 terminal on the rectifier unit, merely reverses the warning light current so that the ignition light does the normal thing of remaining off when running, and coming on when the engine is not turning over.

Lastly, onto the rectifier unit (Pucas Pt No 47220A). This piece of equipment converts the alternator's AC current to a useful DC supply. Now, although its strong metal case looks pretty robust, the actual unit is very fragile and doesn't like heat at all. Being mounted in the engine bay is therefore perhaps not the best place, except that it has to be directly linked to the alternator, with as short wires as possible. Because of the heat problem, we in fact link two rectifiers in parallel in the same box, which means each does half as much work and is less likely to overheat. The two rectifier offtakes are then wired together to give one feed to the loads supply via the shunt and then battery. Continuing on the heat problem, the rectifier, usually cooled by the alternator's own fan, must still receive a good draught of cool air. Ram effect is no good when the car is still and ticking over, so we mount it on the inner wing next to the alternator complying with the following:

1. The distance between the edge of the rectifier case to the front face of the alternator must be $\frac{1}{2}$", plus or minus $\frac{1}{4}$".
2. With the belt in position, the rectifier unit must be no more than 4" from the body of the alternator and preferably with the air deflector plate next to the alternator fan blades.
3. The rectifier to be fitted away from any area subjected to direct water splash.
4. A good earth contact must be made between the body of the car and the rectifier.
5. Cooling air passage through the rectifier must remain unobstructed.
6. Leads from the alternator to rectifier must be secured to the car body.

We underline the requirement in No 4 because it is most important that a good earth always be maintained. Clean off any paint around the mounting holes on the body, and add a smear of silicone grease to prevent rust forming.

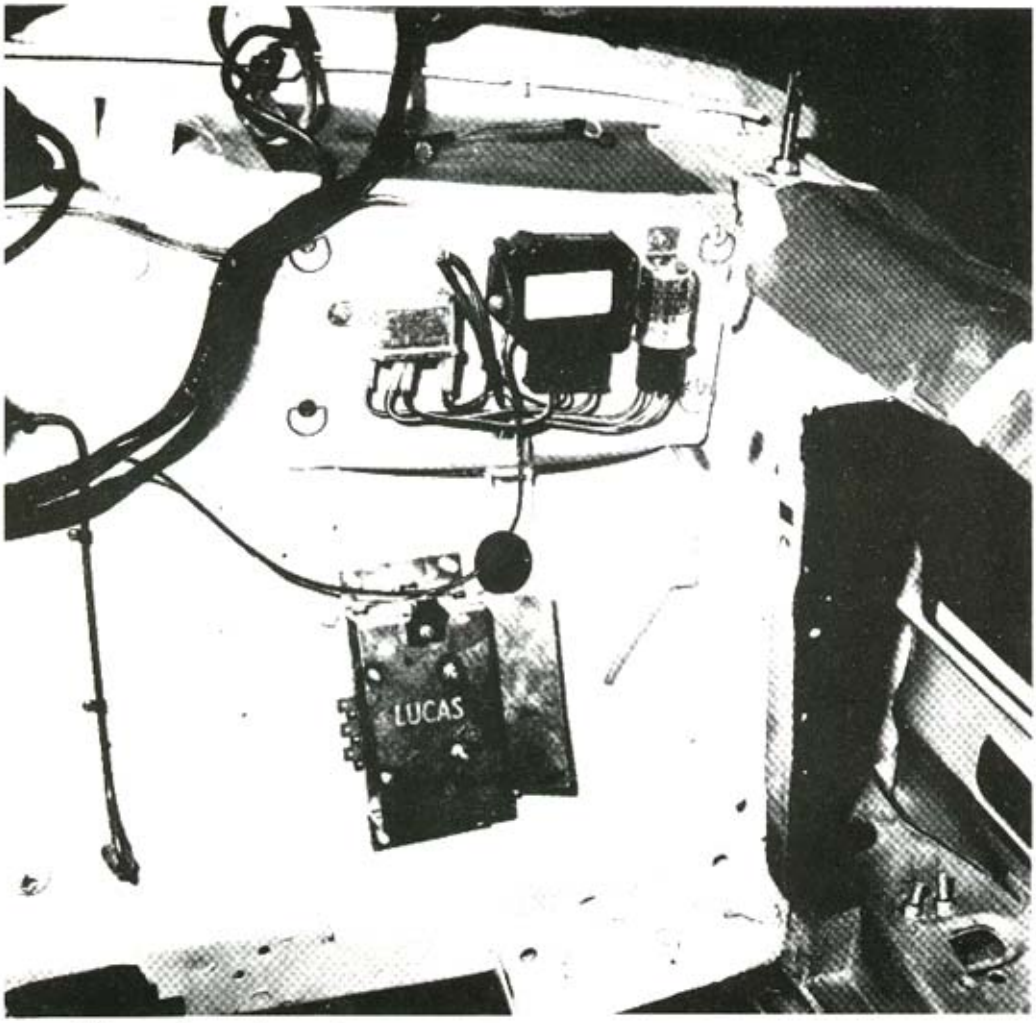
That's it on the works main supply system then. Remember to keep the battery terminals really clean all the time, both for good starting and, on the subject above, to enable the alternator to sense the correct voltage all the time.

RS ELECTRICAL PARTS

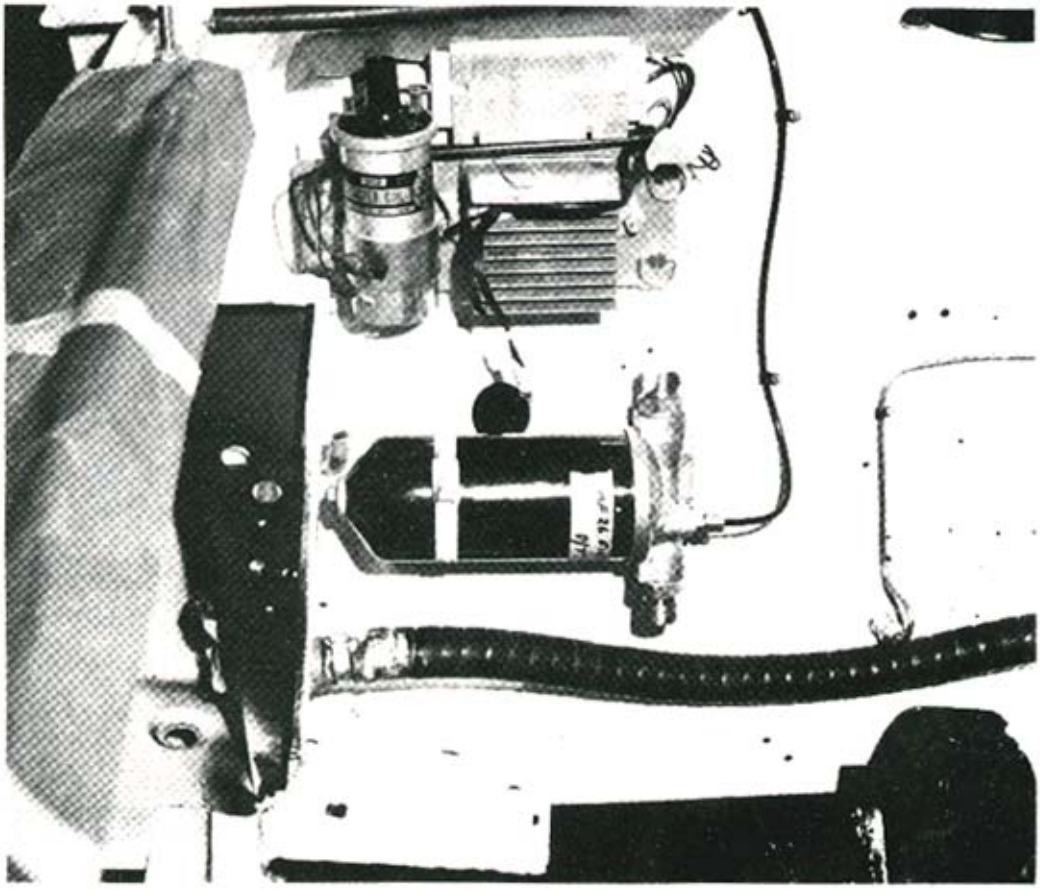
RS Parts Dept have now made available the following Boreham spec eletrical components.

Poly V alternator /waterpump drive:

Kit - Poly V	9054022
Pulley - Crankshaft	9054019
- Waterpump	9054018
- Alternator	9054017
Bracket - alternator mounting	9054020
Belt - drive	9054021
Strap - alternator adjust	9054082



Rectifier unit and regulator panel



Transistorised ignition and coil pack.

11.14. WIRING LOOM - ESCORT I

When wiring anything, be it a flexilight, spotlight or whatever, I cannot overstress the need to stick to some form of colour code. On a competition vehicle this is doubly important - tracing ever-changing wire colours in the middle of the night can make the difference between finishing and not finishing an event. Boreham base their loom on the old Lucas system, although there are added problems now for the later Escort I's and Escort II conform to the standard European code which is very different. Although there are mixed feelings on this new code, at least one good thing has come out of it - all live wires are red.

Anyway, here is the code used on Mk I cars, and if you're building it from scratch or just adding the bear necessary extras, say wires to sportlights via a relay, I suggest you use this as your reference:

Brown	All live supply feeds from alternator side of shunt.
Brown/Blue	Live feed to spot light switch.
Brown/Purple	Alternator Field to + on 4TR regulator via 6RA relay.

Brown /Green	Alternator Field to F on 4TR regulator.
Brown /Light Green	Screen wiper motor to switch - slow speed.
Brown /White	Alternator + to ampmeter shunt 97 /012. Alternator sensing cable 28 /012.
Brown /Yellow	Ampmeter shunt to battery master switch 97 /012. Alternator control panel to alternator AL 14 /012.
Brown /Black	Alternator control panel to warning light 14 /012.
Blue	Headlight switch to dip switch.
Blue /Red	Dip switch to dip beam.
Blue /Light Green	Screen wiper motor to switch - fast speed.
Blue /White	Dip switch to main beam.
Blue /Yellow	Spot lights.
Red	Side and tail lights.
Red /Brown	Tachometer illumination (unswitched).
Red /Purple	Map reading light.
Red /White	Panel light switch to panel lights (instruments).
Red /Yellow	Fog lights.
White	Ignition switch controlled circuits.
White /Brown	Oil warning.
White /Red	Starter solenoid from ignition switch.
White /Purple	Feed to fuel pumps.
White /Green	Link to second fuel pump.
White /Light Green	Feed to heater motor (fused).
White /Black	Coil Neg to distributor LT.
White /Pink	Cigar lighter and radiator fan warning light from Aux Post, on ignition switch.
White /Orange	Feed to wiper motor (fused).
Black	All earth connections.
Black /Yellow	Override manual switch to radiator fan relay.
Black /Green	Thermal switch to radiator fan relay.

Purple	Clock and Halda lights.
Purple /Brown	Horn supply.
Purple /Black	Horn buttons to relay.
Purple /Red	Boot and bonnet lights.
Purple /White	Interior light switches.
Purple /Yellow	Horn to horn relay.
Green /Brown	Reverse light.
Green /Blue	Water temperature.
Green /Red	Left hand flashers.
Green /Purple	Stop lights.
Green /White	Right hand flashers.
Green /Yellow	Slow speed heater motor.
Green /Black	Fuel gauge.
Green /Slate	Fast speed on heater motor.
Light Green	Instrument voltage stabiliser to instruments.
Light Green /Brown	Flasher switch to flasher unit.
Light Green /Black	Screen washer.

11.15. WIRING LOOM - ESCORT II (EUROPEAN STANDARDISED)

Brown	Earth (negative).
Black	Coil in line resistance to give 6 volts. (Ballast resist for starting) Fuse 6 & 7 - see below - to: 1) Back up lights 2) Heated rear window (control of relay) 3) Brake lights.
Blue	Ignition switch from alternator.
Black/Yellow	Ignition controlled feeds.
Black /Red	1) Ignition switch to starter solenoid 2) Brake light switch.
Black /Blue	Windscreen washer motor.
Black /White	Left hand indicators.
Black /Green	Right hand indicators.
Blue /Black	Fuel gauge.
Blue /Light Green	Oil warning light.
Blue /White	Main beam warning light.

Black/White/Green	Flasher relay.
Black/Purple	Ignition controlled supply to wiper.
Black/Red/Yellow	Ignition controlled supply to heater blower.
Black/White	Supply from No 4 fuse to r.h. headlamp main beam.
White	1) Loop from r.h. to l.h. headlamp main beam 2) Main beam feed to No 4 fuse from column lighting switch.
Yellow	1) Dip beam feed to No 4 fuse from column lighting switch. 2) Loop from r.h. to l.h. headlamp dip beam.
Yellow/White	Supply from No 5 fuse to r.h. headlamp dip beam.
Grey/Black	Left hand front side and tail light.
Grey/Red	Right hand front side and tail light.
Grey/Yellow	Instrument panel illumination.
Red	1) Interior light 2) Ignition switch feed 3) Heated rear window 4) Alternator output 5) Feed from battery. (Most reds should be common (unswitched and unfused) live supplies through soldered connection
Purple	Brake fluid warning light level switch - to 2 pin plug, then to brown and brown/yellow.

11.16. FUSE BOXES

Using the Escort II wiring as above, the fuse box, mounted on the dash panel top in the engine bay, can be wired in as follows:

No 1 fuse 8A To:	Interior lamp	red
	Cigar lighter	red
	Emergency flasher	red
Supply:	Red/Blue 28/012	
	Soldering connection to alternator and battery (red) in engine compartment.	
No 2 fuse 8A To:	Side light l.h.	grey/black
	Tail light l.h.	grey/black
	Number plate light	
Supply:	Grey 14/012	
	To fuse from 9 pin socket into column switch.	
	Common supply (link) No 3 fuse.	

No 3 fuse 8A To:	Side light r.h.	grey/red
	Tail light r.h.	grey/red (via 8 pin rear plug)
	Instrument panel illumination	grey/yellow (looped from 8 pin rear plug)
Supply:	Common Grey 14/012 with No 2 fuse.	

NB: Also looped from above via soldered connection is:
1) Grey cigar lighter illumination
2) Grey/yellow heater control panel illumination.

No 4 fuse 8A To:	R.h. headlamp (main)	Black/white (36/012)
	White 14/012 loop from r.h. headlamp plug to l.h. headlamp plug.	
Supply:	White 36/012 from 4 pin socket in column switch.	

NB: Blue/White 14/012 loops from this white in 4 pin plug to Main Beam warning light on instrument panel.

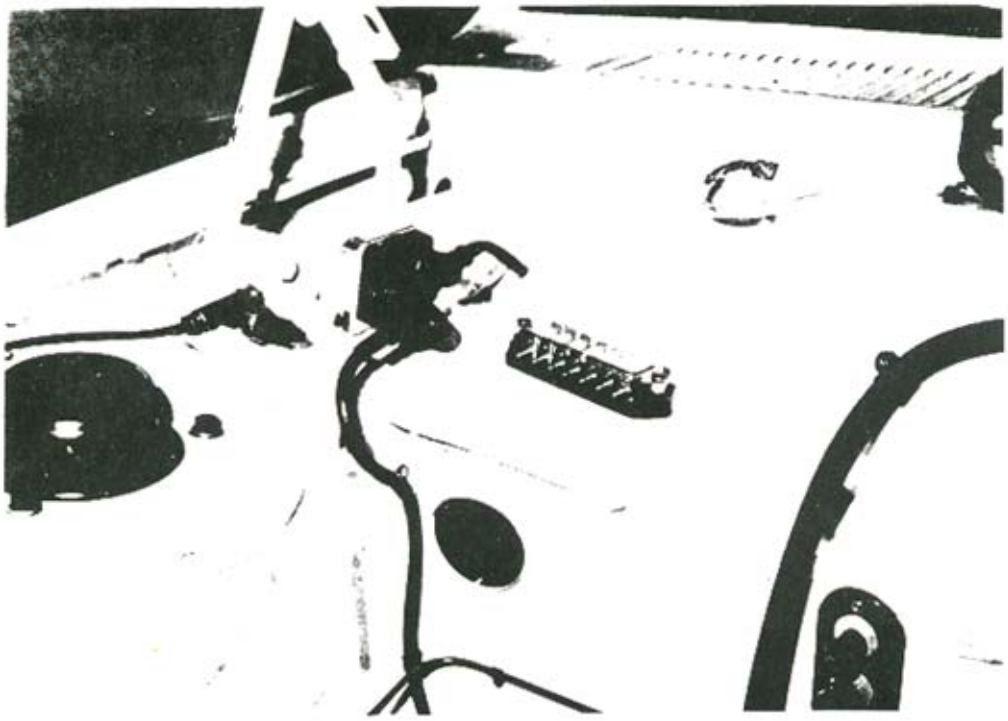
No 5 fuse 8A To:	R.h. headlamp (dip)	Yellow/White (36/012)
	Yellow 14/012 loop from r.h. headlamp plug to l.h. headlamp plug.	
Supply:	Yellow 36/012 from 4 pin socket in column switch.	

No 6 fuse 8A To:	Back-up lights From soldered connection via 8 pin socket. *Connection near column.	Black (28/012)
	Heater motor *Solder connection	Black/Red/Yellow via 2 pin plug
	Brake lights To right angle Lucar on foot brake pedal.	Black/Red (14/012)
	Emergency flasher *From soldered connection to flasher switch.	Black (14/012)
	Heated rear window *From soldered connection, via 4 pin socket to h.r.w. Mixo relay (coil)	Black/Red (14/012)

*= Black/Yellow supply has soldered connection half way to supply black (2 approx) resistance cable to feed black/yellow ignition feed to 6 volt coil through soldered connection in engine compartment.

Supply: Black/Yellow (28/012) ignition switch controlled direct from switch.
ALSO FEEDS No 7 FUSE BY DIRECT LINK.

No 7 fuse 8A To:	Windscreen washer motor	Black/Blue
	4 pin column switch	Black/Purple (28/012)
	(via soldered connection and then 14/012 to switch)	
	Windscreen wiper motor	Black/Purple
	From soldered connetion to 3 pin socket in wiper motor.	
	Tacho	Black/Yellow (14/012)
	From Black/Purple soldered connection on Fuse 7	
	10 pin column socket	Black/Yellow (14/012)
	From Black/Purple soldered connection	
	Instrument Panel	Black/Yellow (14/012)
	From Black/Purple soldered connection to black socket in instrument panel.	
Fuse No 8	NO CONNECTED INTO LOOM - SPARE	



Fuse box and starter solenoid location.

11.17. PETROL PUMPS

It is essential, when building a Group 4 car to use twin eletric fuel pumps in conjunction with either a bag tank or an alloy fuel tank, preferably incorporating a reserve tank.

The best pumps to use are undoubtedly Bendix pumps. As all Escorts are wired to a negative earth system, make sure though, that you purchase a negative earth pump.

Bendix have three pumps available:

- Silver top (25 gallons/hour)
- Blue " (35 " ")
- Red " (45 " ")

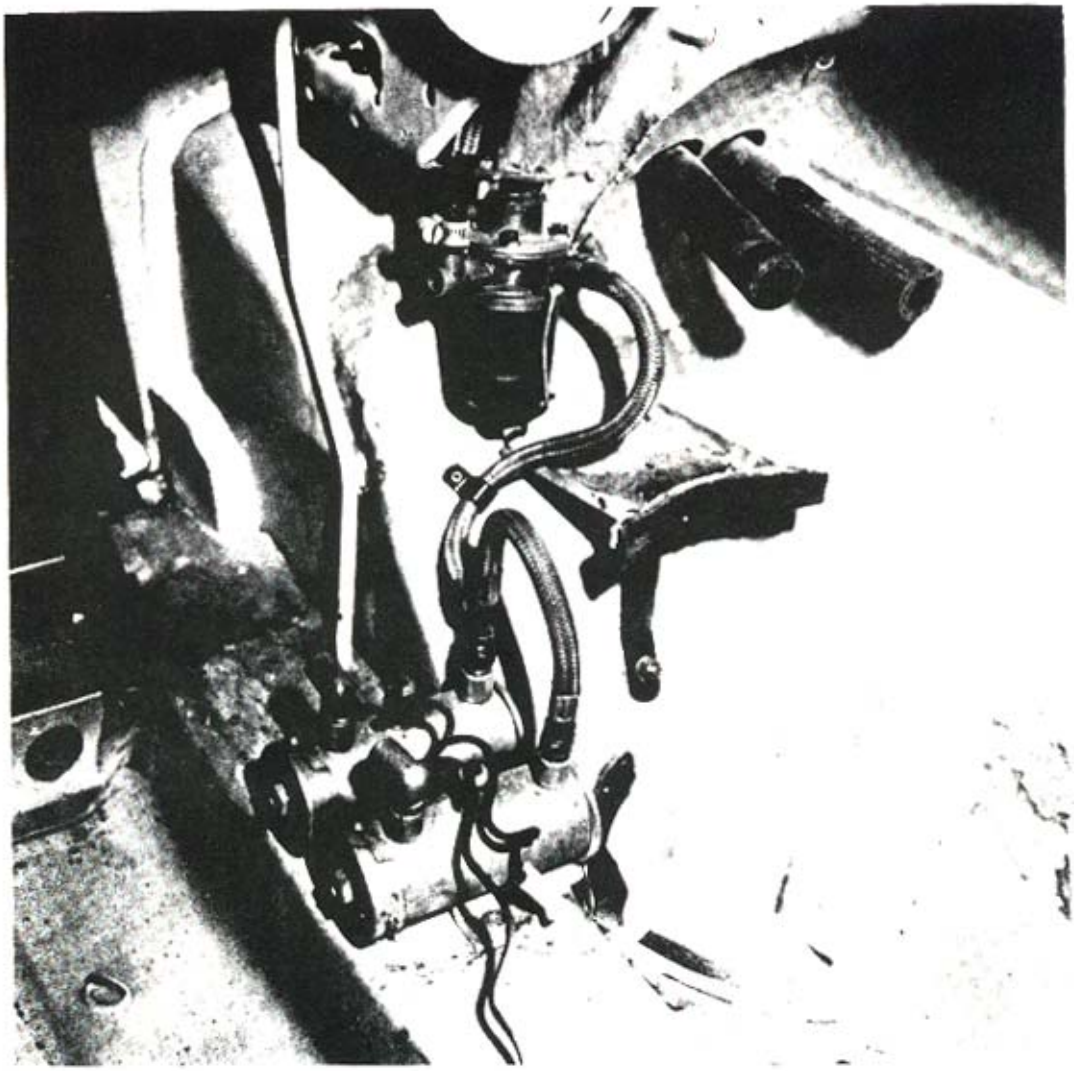
The one to go for is the Blue top, which incidentally is now made under licence by Facet, so don't let the different make bother you.

The pumps should be mounted horizontally in the boot, with one pump connected to the main tank and the second pump to the reserve tank. The pumps should be activated by a three position switch (Off, Pump 1, Pump 2) mounted to the dashboard and connected to the ignition.

It is also advisable to use a fuel filter (Filter King etc) to reduce the fuel pressure, as Bendix pumps deliver at about 7 psi, which is liable to blow the needle valves on your carburettors. Weber recommend a maximum fuel pressure of 4.5 psi, but in practice about 4.5 to 5 psi is needed as any less is likely to cause fuel starvation.

11.18. WIRING PETROL PUMPS

A 28/012 cable (in our case coded white) is taken from the fuel box, to a dash mounted switch. From the switch, two wires are taken, again both 28/012, one white/green, the other white/purple, and each running via a cartridge fuse each to their own fuel pumps in the boot. Number 1 pump has its offtake in the tank some three inches higher than Number 2. This means that, in the event of pump failure, the driver can simply switch over to the Number 2 pump before the car comes to a halt. It also acts as a reserve, having a lower offtake than the Number 1 pump. So, whatever the fuel problem, the driver just flicks the switch in the appropriate direction.



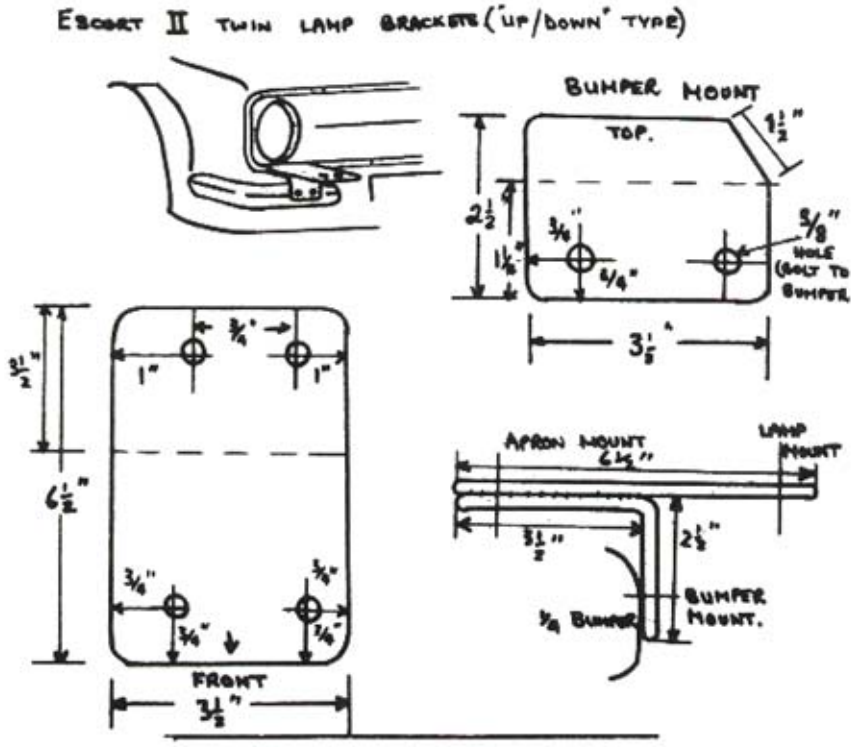
Location of two petrol pumps in boot, next to oil tank, with connecting filter.

11.19. LAMP BRACKETS

On the Mk II Escorts, as on the Mk I's, the works make their own auxilliary mounting brackets that are light, strong and most important, do not vibrate at all. On Escort II, the front $\frac{1}{4}$ bumpers are used as mounting points, whereas on the older car, although the principle and design was similar, the 1 up/1 down light system brackets were direct body mounted.

For those of you building up Escort II's, here are the dimensions:

The bracket itself is made in two parts, an L bracket and flat top. The material is 3/8" dural for strength and lightness, with the L bracket 3/16" thickness. For the Mk I, the rearward projection is cut by 2" This is because the whole bracket mounts to the front apron, not the bumper.



12.1. SERVICE CARS AND EQUIPMENT

DON'T get carried away by the business of rally servicing. A properly-built and prepared rally car should be capable of lasting the length of a 200-mile rally in Britain without having to be rebuilt by the side of the road, and the only function of a service-crew should be to keep the thing supplied with fuel (if no allowance is made for the rally crew to do it themselves) and to give them a hand with wheel-changing if need be.

Of course, accidents can happen, and if the rally regulations permit the use of service vehicles (and they don't always do so) it can be a very handy thing to have a couple of mates nearby to bend a wing off a wheel, or replace a front strut.

But if you are going to have a service crew, you might as well do it properly. Almost any car will do, as long as it's strong enough to carry all the tools and bits, and reliable enough to get to its service points on time. This is the first point that needs to be made; bear in mind that the service car, if it's going to be any use at all, will be relied on by the rally crew to be in the right place at the right time, so the car needs to have as much attention paid to its preparation as the rally car.

It's no good having the thing stuck with a burst water hose at the side of the road when the rally is fifty miles away. If you plan the service schedule intelligently, the service car shouldn't have to be very fast, but it must be reliable.

The ideal vehicle, of course, is an estate car, and if you can afford to run one just as a service car, you can strip it out and equip it as a mobile workshop - which is what it might need to be.

Keep everything neatly stowed and always in the same place so that you can find it quickly. Remember to replace items that get used up, like spark plugs, hoses, fuses, lamp bulbs and so on, and if the service car has a crew of two, make sure you both know where to find everything. If you can't find something, bad-mouthing each other in loud voices won't help, and it isn't appreciated by onlookers, either.

In the same way, make sure the service car is kept neat and tidy, like the rally car should be; don't play boy-racers all round the country at night. While a roof-rack and some extra lights will probably be handy to have, try not to make the service car too obtrusive. Remember a good deal of unpopularity rallying may suffer is undoubtedly due to noisy service cars and spectators.

One other point about the interior of the service car: remember the service crew might be in it for a long time, so try and get some comfortable seats, a map-reading light and plenty of interior light.

Once you're on the rally, pick your service points carefully, preferably not on the road but in a lay-by, a field entrance or even, provided you can get permission, on a filling station forecourt. Put a service board well down the road so as to give the rally crew plenty of warning, make sure the rally crew can recognise it and finally, don't pack up and leave the thing behind when you go - it's easily done!

When the car arrives, find out exactly what needs to be done, how long you have to do it and then get on with it - quietly. When you leave, your schedule should allow you time to pack the service car properly, including securing any heavy objects, such as a jack, which could do a lot of damage in the event of a swift stop. Take your rubbish with you - when you've left the service point it should be impossible to tell you've ever been there. No-one should leave a litter of empty oil tins and so on all over the place; keep it with you until you find a proper place to throw it - don't just chuck it out of the window on the way down the A6!

Of course, many people expect, and the work's team has, some of the best equipment there is available. However, it's a strange fact of life that the larger the car you have to provide service facilities, the more unnecessary junk one carries around.

As a guide, here are some of the equipment we carry around in the works Granada Estate cars. The back seat on these cars is completely removed and the main occupier of space once this has been done are the two gas bottles for welding equipment, which are strapped in with both metal and canvas retainers.

Standard Essentials

Water

Petrol

Oil

Grease

Crow-Bar

Trolley-Jack

Jumper-Leads

Wire

Spark Plugs

Hoses

Tape

Nuts and Bolts

Brake Fluid

Brake Pads and Liners

In addition, we carry the following 'extras':

A complete welding equipment.

Twelve-volt drill, which can be wired in the car's electrical circuit.

Spare battery, which again is wired into the car's electrical circuit so that it is constantly kept charged.

Fire extinguisher.

Complement of spare spot lights.

Halda parts with speedo drive cable.

Chest of small drawers, correctly labelled for holding miscellaneous items - including nuts and bolts!

Two windscreen wiper arms with blades.

Also, depending upon the event, but usually because present international rallies incorporate stage work, we carry the following bits:

Differential.

Exhaust system.

Complete set of front struts.

Rear springs and dampers.

Spare prop shaft.

Gasket set.

Spare master cylinder.

Spare oil filter.

One other item that is absolutely essential is food and drink (non-alcoholic!) for the rally crew. The time saved in doing this can be invaluable as, instead of queueing for food at the next control, they can be catching a few moments of sleep.

Other points about servicing?

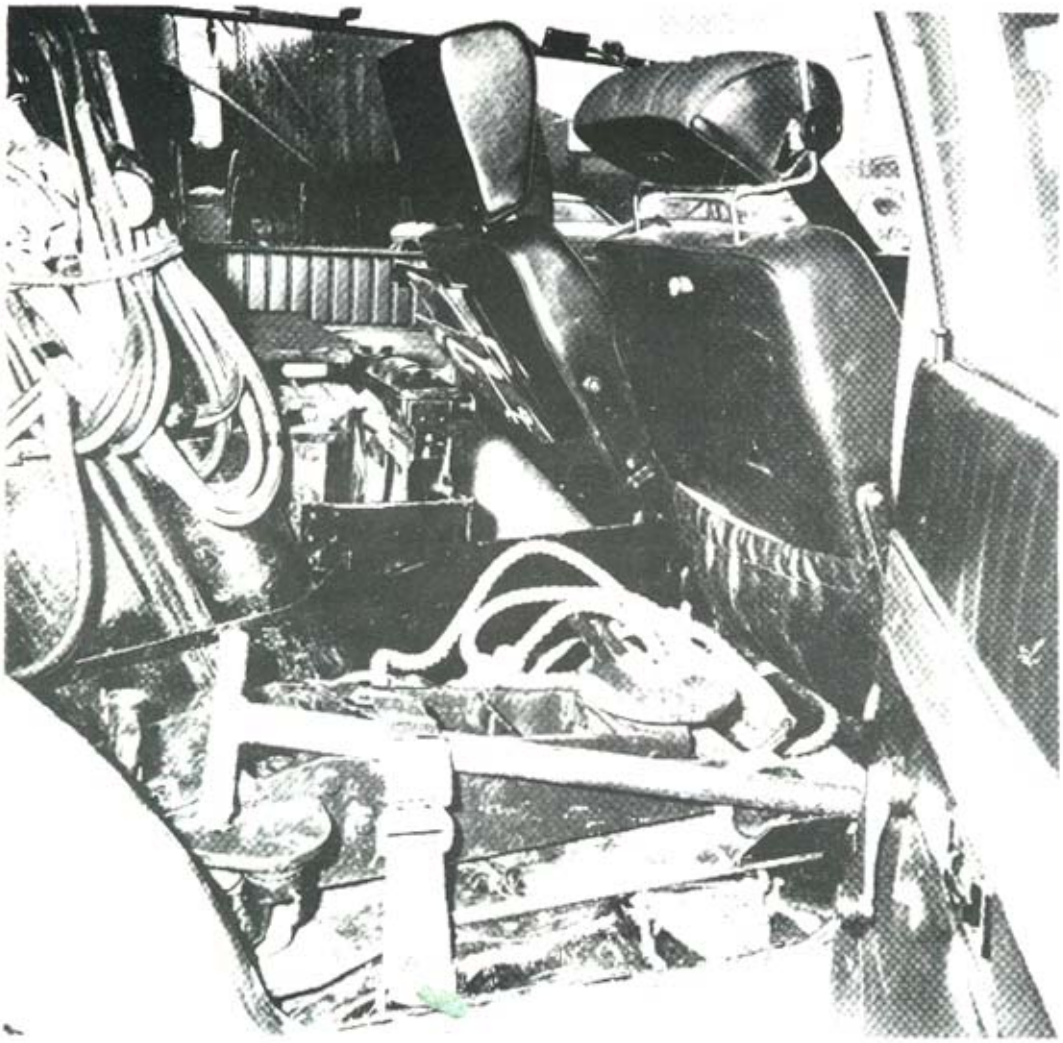
Make sure your service is well away from rally controls, remembering that the control extends to the yellow boards and isn't simply centred round the man sitting at the table.

Don't obstruct marshals or policemen, neither of whom will like it.

Be very careful of fires. In many cases regulations prohibit smoking in forests, and at all times make sure that your rally car can't be excluded from the event because of rules that the service crew has broken.

Winter and summer, make sure that the service car is carrying the right tyres both on the road and on its roof.

Take care about driving when you're tired. Stop and change over frequently, so that each man does short stints at the wheel, and don't set too tight a schedule; accidents with service cars are expensive, they can be very dangerous if the occupants get clobbered on the back of the neck by an hydraulic jack.



Inside Boreham Service Granada. Rear seats are removed; note accessibility of jack and jack handle.

Back of Granada Service car. Spare wheel recess is used for quick access parts. Wheel goes on the roof.

12.2. WHEELS

The trouble with wheels is that they can come off, and whenever they do it's bound to be embarrassing - it can also be dangerous. Obviously, if they're put on right they won't come off until you want to take them off, and it might surprise some of you to know that there's more to putting wheels on properly than you might think.

Wheels - standard steel wheels - normally come off when you don't want them to because they've been overtightened, stretching the threads or because the wheels themselves are old and there are cracks in the tapered seats for the wheel nuts. Another reason is rusty threads inside the nuts: chrome sports nuts in particular are prone to rust half-way down, which can deceive you into thinking that the nut is right home when in fact it isn't. So the first thing to make sure of is that the threads inside the nuts are completely free of rust, paint and so on, and before you fit them, give the threads and the back face of the wheels a fair smearing of oil.

Extra care must be taken with Minilite, magnesium and alloy wheels, which are more subject to gunge problems than steel ones: the nuts used for these are normally "blind" nuts, and you can't see how far up the thread you've got. The worst enemies of these wheels are salt and corrosion, and they must be regularly washed and cleaned. When you're tightening the wheel nuts the correct torque is 55 lb ft for both aluminium and steel wheels, and surprisingly enough the normal wheel-brace supplied with the car should give you this torque provided you use it normally without putting your foot on it, or calling on the local muscleman for help.

When you change a wheel, never put the car back on the deck until all four wheel nuts have been registered on the seat of the wheel. Better still, get someone to put his foot on the brake pedal and tighten the nuts right home with the wheel still in the air - but still check them when it's down on the ground.

If a wheel does come off, the car will usually land on the brake back plate, and this could leave you brakeless. Get the car jacked up - the standard jack is made to fit under the car even when it is sitting on the hub - and have a look. If you've lost the wheel because the nuts have come off it is practically certain that the studs are damaged, so just in case they are try the nuts on the threads before you put the new wheel on. Clean the studs as best you can first. If there is damage, all you can do is hope that you've got two opposite studs in good enough condition to accept the nuts properly, and provided you keep the speed down a wheel secured by two opposite nuts will be safe enough to get you to your service crew. While you're inspecting the damage, don't forget the possible loss of brakes: if that has happened, close up the pipe leading to the affected wheel - a good belt with a hammer is the most effective way of doing this, and then watch it because you'll now have brakes on only three corners of the car where the good Lord meant you to have four.

12.3. JACKS AND JACKING POINTS

If you've had a puncture on a stage at one time or another, and have had to work away at the standard Ford 'winder jack', you'll know how much time it takes to go up and then wind it down again. For a long time now Borcham have used an adaptation of the VW Beetle type jack. This has a pump type lift, and an instant down action to save time, and in fact, is made by Bilstein

Not much work is needed to convert the jack itself, although our mounts on the car are fairly intricate, and considering you can often find these jacks at scrap dealers, to purchase one and work out your own chassis mounts is not too difficult.

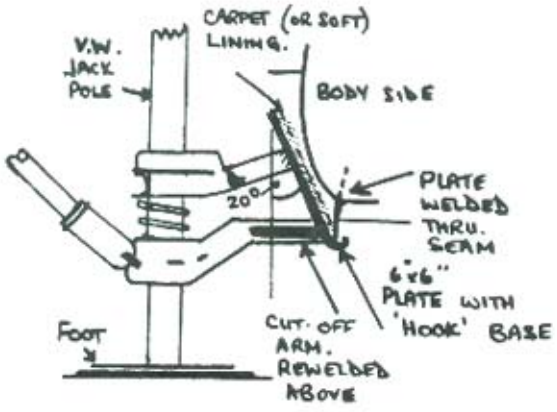
The jack is a single pole type with round foot and climbing mechanism. From the side of the jack protrudes an 'H' section arm, which, on the VW, slots into a square tube under the side of the car. An easy solution, therefore, is to leave the jack as standard and weld to the underside of your machine 4 lengths of $1\frac{1}{2}$" sq tube suitably skidded to accept the standard Bilstein jacking arm. The only problem with this is that the tube tends to get full of muck and all sorts of other unmentionables, so don't blank off the inner end of the tube, and watch for the 'square tube' becoming an 'oval tube', as it can easily get bent under the car.

Having told you how it works, this is what you do:

The jacking arm is cut off roughly half way along its length. The sawn--off lump is then rewelded onto the jacking mechanism, above the arm, to act as a top mount for a slightly curved 6" x 6" 1/8" plate which has its base rolled through approx 120^{o} to form a hook along its length. This plate is welded to the two arms of the jack at an angle of 20^{o} from vertical.

On the vehicle, all that is now needed to make a simple swift jacking system are some 6" wide steel plates hanging vertically from under the car onto which the hooked bottom plate of the jack can mount. We use two such plates either side, one just behind the front wheel and one just in front of the rear wheel. The mounts are 1/8" plate, of 5" (approx) x 6" wide. The seams of the side body pressings are slightly opened up and the mounting plates pushed through to the inside of the shell, just leaving 1" hanging underneath for the jack. Being in the direction of travel, these plates do not get knocked around, are easy to locate, and cannot get filled with mud. The plates are welded inside the car and around the seam.

With the jack plate against the side of the car and the bottom hook lifting, you now have an A1 jack.



12.4. F.I.A. GROUP 2 REGULATIONS

To be classified as a Group II car, a minimum production of 1000 units in 12 consecutive months has to be achieved, as opposed to 5000 units as per pre-1976 regulations. Thus, all variants of Escort (Sport, Mexico, RS1800 and RS2000) are OK for Group II.

The actual Group II details:

First off, there is a complete series of weights at which the cars will run, not according to details on the homologation form, but by engine capacity. The weights apply to vehicles as they cross the finishing line, but without fuel. In theory, at least, this new rule should stop some of the weight fiddles that people got up to when it appeared on the homologation form.

Of interest are these:

From 850cc to 1000cc = 655 kgs
From 1150cc to 1300cc = 720 kgs
From 1300cc to 1600cc = 775 kgs
From 1600cc to 2000cc = 845 kgs
From 2500cc to 3000cc = 990 kgs

Reading on, there is still a fair amount of freedom left in the section on modifications permitted to original parts. With the express exception of brake calipers, it is still allowed to polish, modify, lighten, balance or machine production parts. However, 'Any adjunction of material in a homogenous way (defined as welding, glueing, electrolysis, etc), is forbidden on the following: engine, gearbox, transmission, suspension parts'.

Now then, getting down to the engine, don't go out and buy a full house 2 litre BDA engine. You are only allowed to overbore the standard engine by 0.6 mm which will bring it to 1866cc, although no overlapping of cylinder capacities is allowed, which means that if you run a 1600 cross-flow, a 1600 or 2000 OHC, you must run standard size pistons, as the first overbore will automatically bring these over their capacity limit. Dry sumping is now permitted, which it was not at inception of Gp II regulations.

The cylinder head casting must remain standard, as must the number of camshafts and valves. The method of cam drive must also remain standard, although cams as such are free. Crank and rods must also be standard (an interesting point here is that the RS1800 is now equipped in production with a steel crank).

Valves, guides and valve springs are free, as are pistons and gaskets. Bearings are free as such, although their type must remain standard.

The induction method is free (which means that fuel injection is OK), as are fuel pumps which allows you to use electric fuel pumps.

Exhaust systems are free, as are the engine mounts, so World Cup X-members are OK, since the difference between standard X-members and the W/C X-member is in the engine mount brackets. Starter motor and alternator are also free.

Clutch and Gearbox

The clutch is free on condition that it has the same number of discs as the series production clutch and that the original bellhousing and flywheel are retained.

The clutch operating method is free, which means that you can convert to hydraulic operation providing that no addition of material is needed to modify the bellhousing. As an exception to the rule, the release arm can be beefed up.

The gearbox must retain the original casing as well as the original number of gears, which means that the faithful ZF is out. Two other sets of gearbox ratios are allowed, but these must be mentioned in the homologation form.

Gearbox mountings and gear lever are free.

Rear Axle

Final drive ratios are free providing that these are specified in the homologation form. Halfshafts are also free, so 'fully floaters' are OK, as are rear discs.

Suspension

Adjustable struts and anti-dive kits are OK, but standard pick-up points must be retained, which rules out turrets plus the existing 4-link set up, sliding roller rear springs and compression struts.

Otherwise, springs are free, as are radius arms (again their pick-up points must remain standard).

Coachwork

'Any kind of reinforcement is authorized', says the yellow book, so, gussets, brace bars, chassis rail skids, etc are OK.

Unfortunately, the original fibreglass RS arches are too wide (max of 5 cms). However, the new polyurethene arches meet Group II regs.

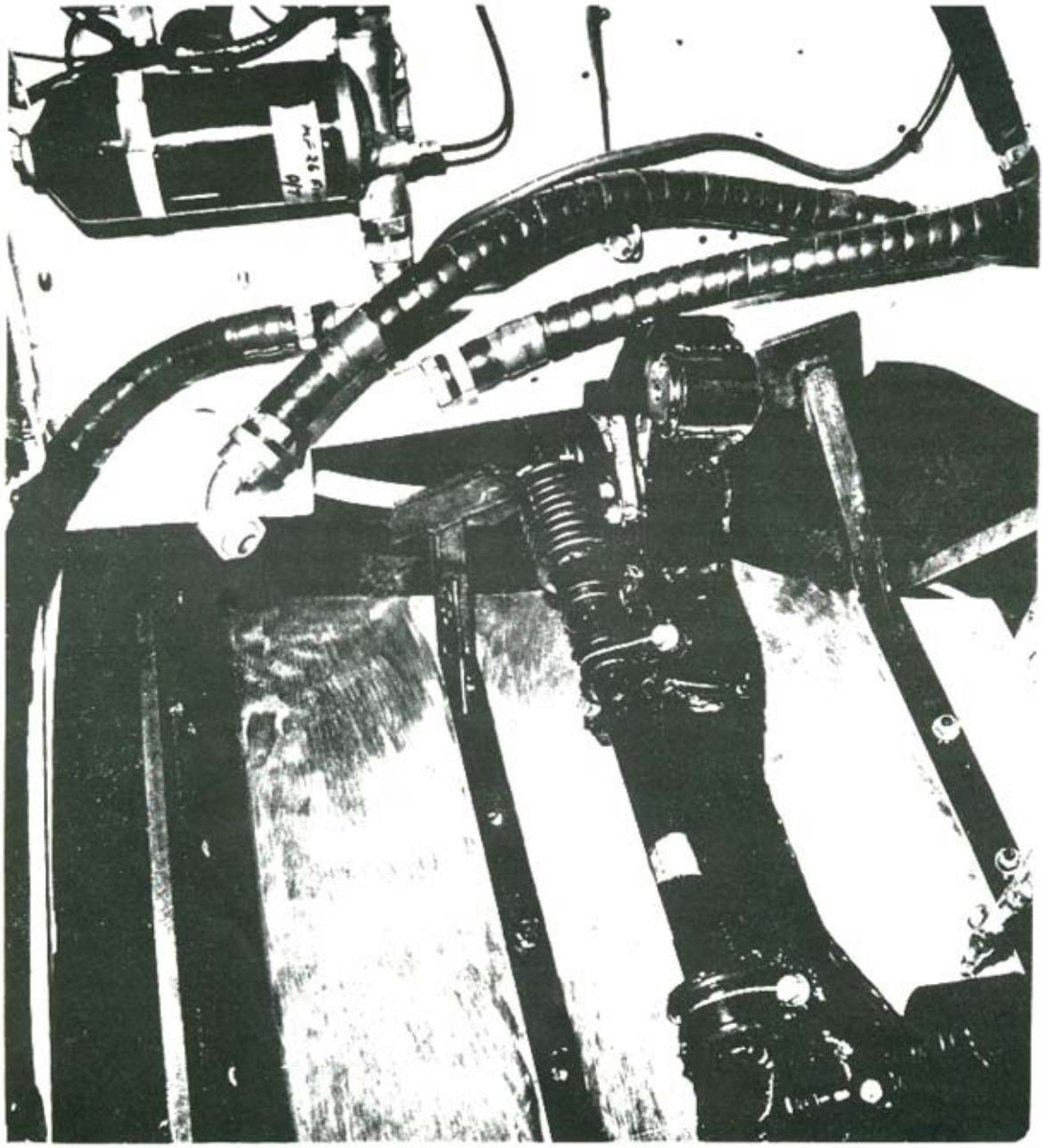
Seats may be changed, rear seats may be removed.

Roll cages can be welded in, dashboard and fuel tanks may be replaced by alternatives providing they are specified in the recognition form.

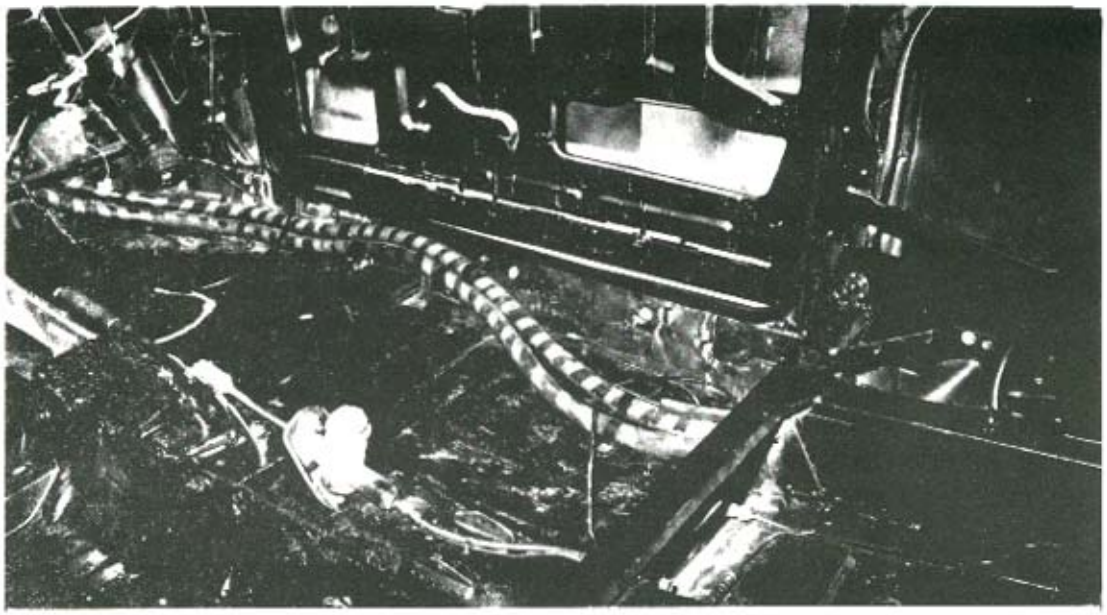
Brakes

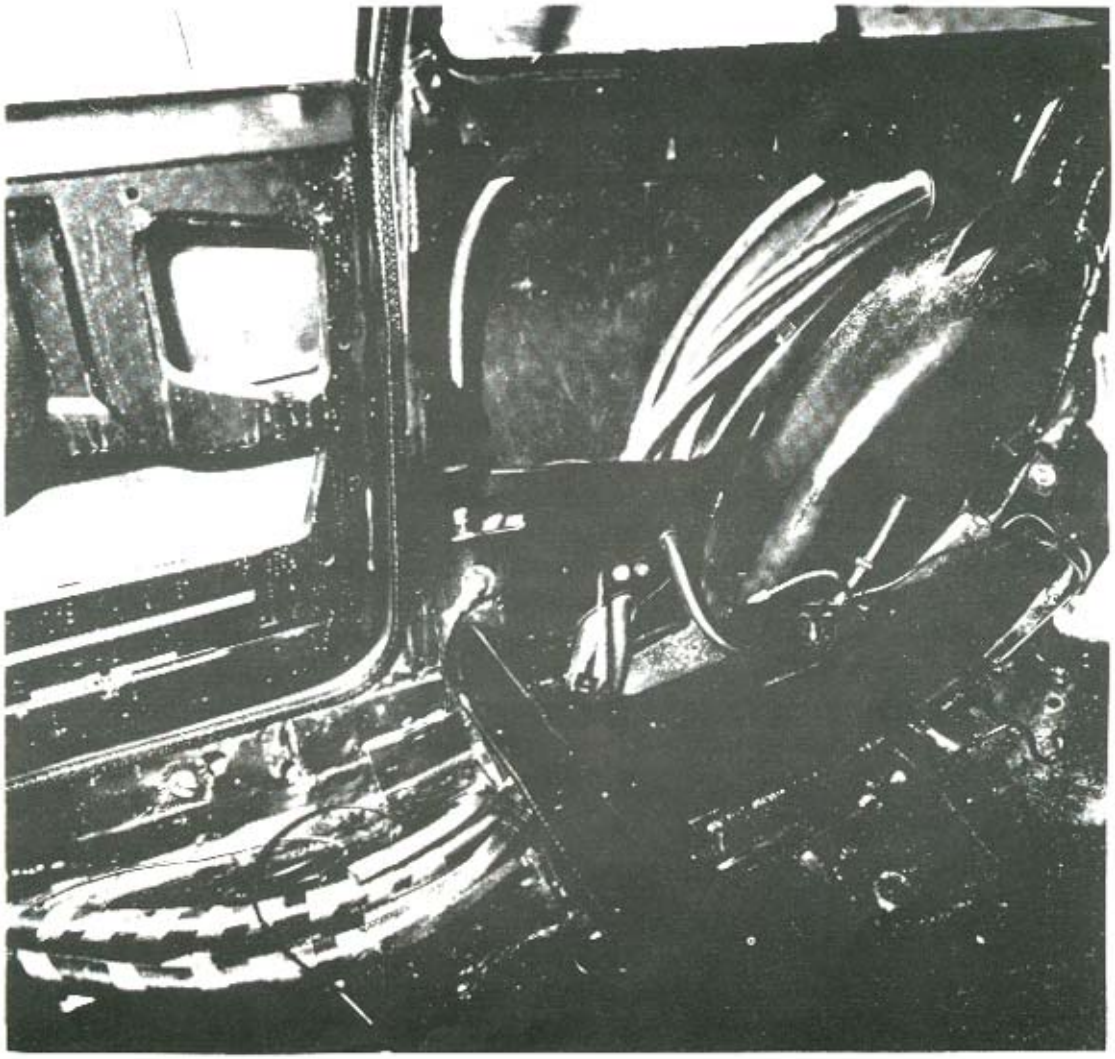
As said earlier, rear discs are OK. Discs are free as are calipers, so the current $10\frac{1}{2}$" front vented discs and 4 pot calipers are in. The same applies to balance bar pedal boxes and twin servos, although these must not be in the passenger compartment.

12.5. GENERAL BUILD PHOTOS

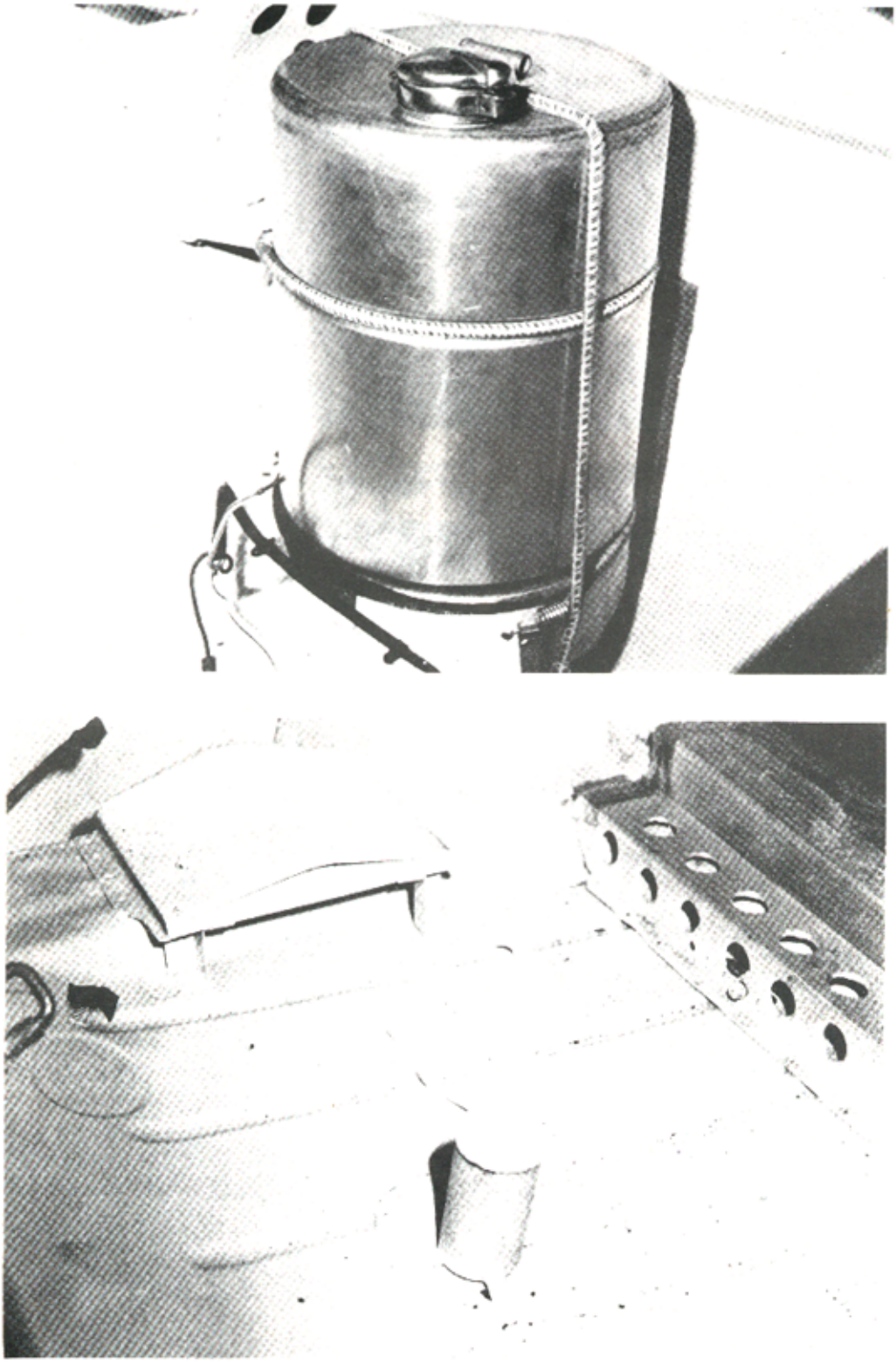


Engine bay. Sump guard is resting on floor at front. Note wire locking on rack bolts. Engine bay is painted white irrespective of exterior colour.



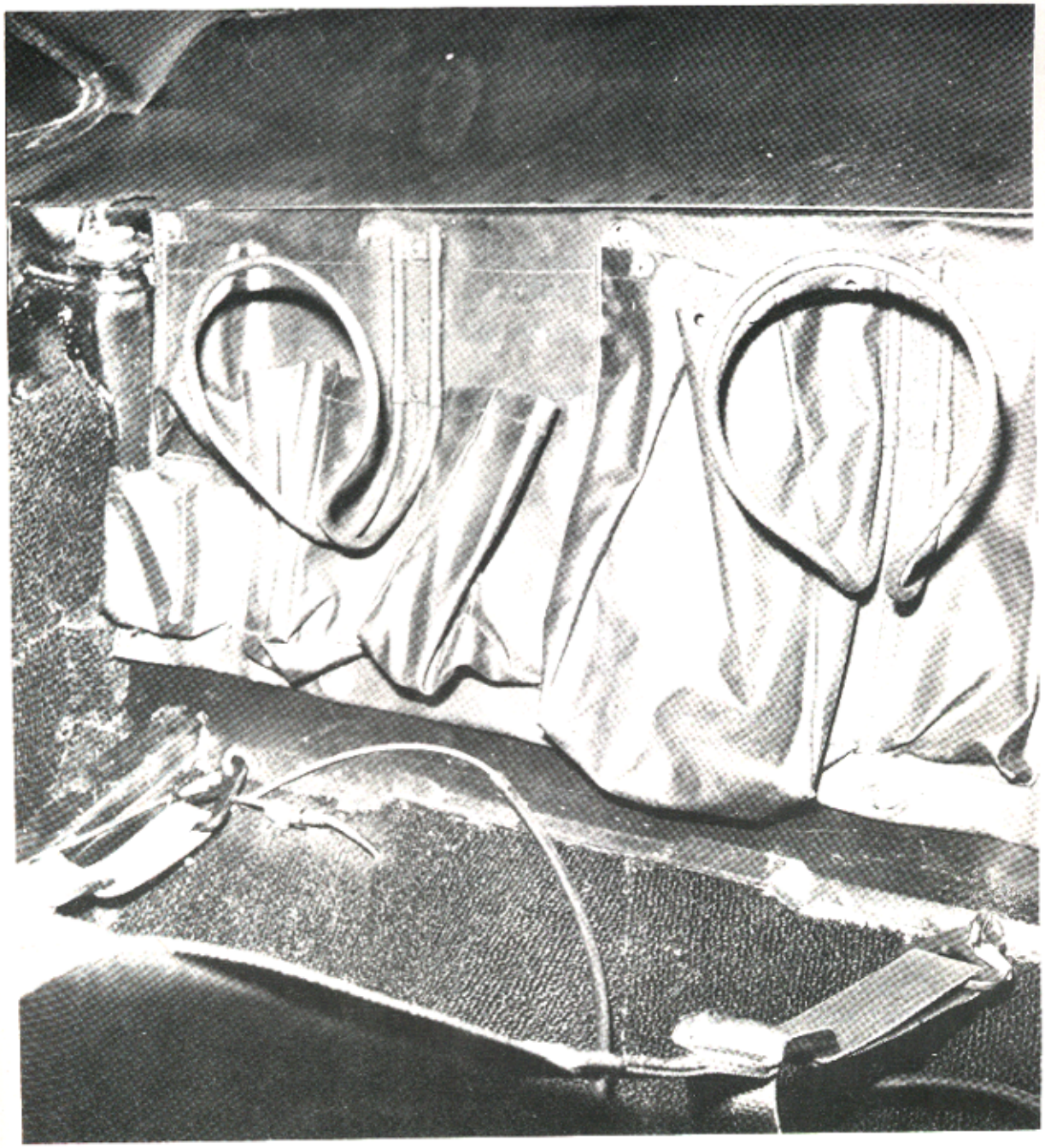


Top. Oil pipes passing through cockpit.
Below.Oil pipes passing through rear bulkhead.



Top. Oil Tank mounting in boot of works cars.

Bottom. Battery tray, bag tank support and simple post fixing for spare wheel (held down by 2 'bungees').



ear seat tool pou . Seat quick fastening tool and emergencies pouch
n rear bulkhead. Helmet clips have now been replaced by simple aluminium
oxes on floor lined with foam.

12.6. TECHNICAL DETAILS

a) MEXICO (KENT ENGINE)

	lb. ft.
Wheels and Suspension	
Wheel nuts	50 to 55
Brake calliper to front suspension unit	45 to 50
Front brake disc to hub	30 to 34
Front wheel bearing adjusting nut	See text
Axle shaft bearing retainer bolts	15 to 18
Brake System	
Brake calliper to front suspension unit	45 to 50
Brake disc to hub	30 to 34
Rear brake plate to axle housing	15 to 18
Hydraulic unions	5 to 7
Bleed valves	5 to 7
Steering Linkage	
Steering arm to suspension unit	30 to 34
Steering gear to crossmember	15 to 18
Track rod end to steering arm	18 to 22
Coupling to pinion spline	12 to 15
Universal joint to steering shaft spline	12 to 15
Steering wheel to steering shaft	20 to 25
Rear Axle and C.W.P	
Crown wheel to differential case bolts	50 to 55
Differential carrier to axle housing nuts	25 to 30
Differential bearing locking plate bolts	12 to 15
Differential bearing cap bolts	45 to 50
Axle shaft bearing retainer bolts	15 to 18
Universal joint flange to pinion flange	15 to 18
Rear axle filler plug	25 to 30
Axle shaft bearing assembly pressure (minimum)	1, 200 lb
Axle shaft bearing retainer pressure (minimum)	2, 400 lb
Front Suspension Assembly (note * markings)	
Suspension unit upper mounting bolts	15 to 18
**Spindles to top mount assembly	28 to 34
Track control arm ball stud nut	30 to 34
*Stabiliser bar attachment clamps	15 to 18
*Stabiliser bar to track control arm nut	25 to 30
*Track control arm inner bushing	22 to 28
Front suspension crossmember to body sidemember	25 to 30

*These to be tightened with the weight of the car resting on its wheels.

**These to be tightened with wheels in straight-ahead position.

Rear Suspension Assembly (note * markings)

*Radius arm to axle	25 to 30
*Radius arm to body	25 to 30
Shock absorber to body	15 to 20
Shock absorber to axle	40 to 45
*Rear spring plate 'U' bolts	18 to 26
**Rear spring front hanger	25 to 30
*Rear spring axle shackle nuts	8 to 10

*These items to be tightened with the vehicle resting on its wheels.

**This torque to be applied to the bolt head.

Engine 1600 GT

Cylinder head	7/16" - 14 UNC	65 to 70
Main bearing cap	7/16" - 14 UNC	65 to 70
Connecting rod big end	3/8" - 24 UNF	30 to 35
Flywheel (Bi-hexagonal only)	3/8" - 24 UNF	50 to 55
Flywheel (Hexagonal only)	3/8" - 24 UNF	50 to 54
Oil filter centre bolt	3/8" - 24 UNF	12 to 15
Rocker shaft	3/8" - 16 UNC	17 to 22
Manifolds - bolts	5/16" - 18 UNC	15 to 18
- nuts	5/16" - 24 UNC	15 to 18
Front cover	1/4" - 20 UNC	5 to 7
Sump	1/4" - 20 UNC	6 to 8
Rear oil seal retainer	5/16" - 18 UNC	12 to 15
Crankshaft pulley	7/16" - 20 UNF	24 to 28
Oil pump	5/16" - 18 UNC	12 to 15
Camshaft thrust plate	1/4" - 20 UNC	2.5 to 3.5
Camshaft sprocket	5/16" - 18 UNC	12 to 15
Rocker cover	1/4" - 20 UNC	2.5 to 3.5
Chain tensioner to cylinder block	1/4" - 20 UNF	5 to 7
Sump drain plug	1/2" - 20 UNF	20 to 25
Tappet adjusting screw locknut	5/16" - 24 UNF	8 to 12

Engine Accessories

Water pump	1/4" - 20 UNC	5 to 7
Thermostat housing	5/16" - 18 UNC	12 to 15
Fan blade	1/4" - 20 UNC	5 to 7
Fuel pump	5/16" - 18 UNC	12 to 15
Manifold - nuts	5/16" - 24 UNF	15 to 18
- bolts	5/16" - 18 UNC	15 to 18
Air cleaner (except GT)	1/4" - 20 UNC	3 to 5
Air cleaner (GT only)	5mm x 0.8mm	2.5 to 3
Air cleaner cover (GT only)	5/16" - 24 UNF	5 to 7
Spark plug	14 x 1.25mm	24 to 28
Starter motor retaining bolts	3/8" - 16 UNC	20 to 25
Generator pulley	7/16" - 20 UNF	14 to 17
Generator mounting bolts	5/16" - 24 UNF	15 to 18
Generator mounting bracket	3/8" - 16 UNC	20 to 25

Transmission

Clutch pressure plate to flywheel	12 to 15
Clutch housing to transmission case	40 to 45
Transmission case drain and filler plugs	25 to 30
Transmission extension to transmission case	30 to 35

b) RS 2000 (PINTO ENGINE)

Tightening Torques (lb/ft)

Main bearing caps	(64.5-74.5)
Connecting rod big end	30-35 lbs/ft
Crankshaft sprocket	
Camshaft sprocket	
Flywheel	(46.5-50.9)
Oil pump	(12-15)
Oil pump cover	(1) (0.7-1.4)
	(2) (4.3-5.7)
after 20 mins running re-tighten	(3) (4.3-5.7)
Oil drain plug	(15-20)
Cylinder head	(1) (28.5-39.5)
	(2) (39.5-50)
after 20 mins running re-tighten	(3) (64.5-79)
Rocker cover	(1) (1st to 6th bolt) (3.5-5.0)
	(2) (7th & 8th bolt) (14.3-17.9)
	(3) (9th & 10th bolt)(35.8-50)
	(4) (7th & 8th bolt) (35.8-50)
Inlet pipe	
Spark plugs	(14.3-20)

Brake System

Front brakes	244.6mm	244.6mm
Disc diameter	0.05mm TIR	0.05mm TIR
Disc run-out (maximum)	Ferodo 2441F	Don 227
Pad material		
Rear brakes		
Drum diameter and width	229x44.5mm	203x37.1mm
Shoe material	Don 242	Mintex M79
Shoe swept area (total)	639 sq.cm.	639 sq.cm.
Wheel cylinder diameter	17.8mm	19.0mm
Braking ratio	67.9% front - 32.1% rear	72.5% front - 24.5% rear
Brake fluid	ESEA-M6C-1001-A	ESEA-M6C-1001-A

Steering Gear and Linkage

Wheel alignment (unladen)	
Castor	2°18' positive
Camber	0°50' negative
King pin inclination	8°50'
Toe-in	1.00 to 3.00mm
Type	Rack and pinion
Lubricant capacity	0.13 litre
Lubricant type	SAE 90E P

Rear Axle

Axle ratio (Standard)	3.54:1
Crown wheel & pinion backlash	0.13 to 0.17mm
*Pinion bearing pre-load	0.23 to 0.29 kg.m. excluding oil seal drag
*Differential carrier spread	0.20 to 0.25mm
Differential pinion thrust washer thickness	0.762 to 0.813mm
Differential pinion inside diameter	15.953 to 16.004mm
Oil capacity	1.1 litres
Grade of oil	SAE 90 Hypoid
'Initial fill' lubricant	SQM-2C-9003-A
Service topping up lubricant	SQM-2C-9002-A

*These specifications apply when fitting new bearings. When rebuilding differential assemblies with the original bearings the pre-loads should be set to 0.14 to 0.21 kg.m.

Front Suspension

Springs	Coil
Type	255kg
Load (Mean)	255kg
Rate (Mean)	23.1kg/cm
Wire diameter	11.9mm

Rear Suspension

Spring length (between eye centres)	1144mm
Width of leaves	51mm
Rate	14.25 to 15.00 kg/cm

Engine Details

Cylinder block	2.0 litre HC
Cast identification markes	20
Number of main bearings	5

Cylinder bore dia mm grades	
Standard grade	
1	90.800-90.810
2	90.810-90.820
3	90.820-90.830
4	90.830-90.840
Oversize Amm	91.310-91.320
Oversize Bmm	91.320-91.380
Oversize Cmm	91.330-91.340
Spigot bearing length mm	27.22-27.17
Main bearing liners fitted	
Inner diameter	
Standard REDmm	57.014-57.038
BLUEmm	57.004-57.028
Crankshaft	
Undersize 0.25 REDmm	56.764-56.788
BLUE mm	56.754-56.778
0.50mm	56.514-56.548
0.75mm	56.264-56.298
1.00mm	56.014-56.048
Main bearing parent bore dia	
REDmm	60.620-60.630
BLUEmm	60.630-60.640
Crankshaft	
End float mm	0.08-0.28
Main bearing journal dias	
Standard REDmm	57.000-56.990
BLUEmm	56.990-56,980
Undersize 0.25mm	56.740-56.730
0.50mm	56.500-56.490
0.75mm	56.250-56.240
1.00mm	56.000-55.990
Thrust washer thickness	
Standard mm	2.3-2.35
Undersize mm	2.5-2.55
Main bearing clearance mm	0.014-0.048
Crankpin journal diameter	
Standard RED mm	52.000-51.990
BLUE mm	51.990-51.980
Undersize 0.25 RED mm	51.750-51.740
BLUE mm	51.740-51.730
0.50mm	51.500-51.490
0.75mm	51.250-51.240

Connecting Rod

Big end bore RED mm	55.00-55.01
BLUE mm	55.01-55.02
Small end bush diameter mm	23.964-23.976
Inside diameter	
Standard RED mm	52.014-52.038
BLUE mm	52.004-52.028

Undersize 0.25 RED mm	51.764-51.788	
BLUE mm	51.754-51.778	
0.50 mm	51.514-51.548	
0.75 mm	51.264-51.298	
1.00 mm	51.014-51.048	
Crankpin to bearing liner clearance		
Standard mm	0.014-0.048	
Undersize mm	0.014-0.058	

Camshaft

Drive	toothed belt	
Thrust plate thickness		
Type 1 mm	4.01	
Type 2 mm	3.98	
Width of camshaft groove mm	4.064 $^{+0.070}_{-0.000}$	
Cam lift mm	5.938	6.397
Cam heel to toe dimensions mm	36.01-35.87	36.46-36.32
Journal diameter		
front mm	42.01-41.99	
centre mm	44.72-44.52	
rear mm	45.01-44.99	
Bearing - inside dia		
front mm	42.055-42.035	
centre mm	44.675-44.655	
rear mm	45.055-45.035	
Camshaft and float mm	0.05-0.09	
Identification colour	white	yellow

Pistons

Piston diameter	
Standard Grade 1 mm	90.755-90.765
2 mm	90.765-90.775
3 mm	90.775-90.785
4 mm	90.785-90.795
Standard supple in service mm	90.780-90.805
Oversize in suppl in service	
0.5mm	91.280-91.305
1.0mm (in)	91.780-91.805 (3.6134-3.6144)
Piston clearance in cylinder bore mm	0.025-0.060 (0.001-0.0024)
Ring gap	
Top mm	0.38-0.58
Centre mm	0.38-0.58
Bottom mm	0.4-1.4

12.7. ENGINES

Whilst comprehensively covering the other areas of rally Escort preparation, it seems a good idea to quickly explain the different engines you might find lurking under the bonnet.

There are three basic types of engine which you could come across:

1.	The 'Kent' engine	-	4 cylinder pushrod unit ranging from 1100cc to 1600cc in standard form.
2.	The 'Pinto' engine	-	this term is no longer strictly true, but in this country refer to the 4 cylinder SOHC units in 1600cc and 2000cc form.
3a.	The Twin Cam	-	now obsolete, Lotus developed 4 cylinder, 8 valve engine.
b.	The BDA	-	Cosworth developed, 4 cylinder, 16 valve engine.

Kent Engine

A mainstream production engine which over the years has been developed from an original 997cc, 3 bearing crank form found in 105E Anglias, to the final 1600cc, 5 bearing form found in Cortinas and Escorts. Competition successes for this engine are many and varied from early 1000cc Formula 3 race engines through to the highly successful World Cup and London to Sydney Rally cars - so there is a wealth of information and parts available.

The standard bore size for the Kent block is 80.96mm, and the largest overbore you can make is 83.5mm, which gives a capacity of 1700cc using the standard 77.62 crank. The old square, or siameses, bore blocks which allowed overboring to 85 and even 86mm are no longer available. Turning to crankshafts, it is possible to run 80mm and even 81mm throw crankshafts, but care must be taken to ensure the con rods do not foul the bores, and cap bolts foul the camshaft.

With 2 45 DCOE Webers and a World Cup type big bore exhaust system, it is quite possible to obtain a reliable 140bhp DIN (DIN means as installed in the car, with fan, air-cleaner and exhaust fitted) in Rally tune - indeed, it's possible to extract considerably more, but it's best to contact a reputed engine builder for advice before going too far.

SOHC Engine

The 1600cc unit is found in the current production Mexico, but in this form the Kent is a better bet - having a lighter unit weight for the same power. In 2 litre form, this engine is very attractive to the Gp 1 competitors, as with the high performance valves and twin downdraught Weber carb kit it is possible to obtain 150bhp DIN.

For those of you who want the biggest possible engine,it is possible to bore selected blocks to 93.6mm with care, fitted with an 80mm crankshaft this gives 2.2 litres.

These engines are very strong and reliable if treated with reasonable respect. In particular, you must not rev the engine until the valves float as this quickly causes cam failure. In the gears 6500 and 7000 in top is the successful formula applied to the works Gp 1 cars.

In Gp 2 form, over 160bhp is possible using sidedraught Webers and free flow exhaust - this represents an excellent set-up for the majority of club drivers for forest stages.

Twin Cam

This engine has not been fitted to the production Escort since 1970, so first of all it's out of homologation. But the engine has become a favourite with clubmen due to its reliability and good power to weight ratio. Basically 1580cc, many engines were taken out to 1700 and even 1800cc using the old siamesed blocks. Spare parts for this engine are still available from the Daventry Parts Centre through your local Ford Dealer.

BDA

BDA means Belt Drive 'A' series and represents the design of engine which Ford commissioned Cosworth to design. This came about as a result of the never ending quest for power, when the faithful Twin Cam engine hit a ceiling around the 180bhp mark. So, the 16 valve BDA series was conceived - in fact, BDA was the original 1601cc version, Cosworth now manufacture kits for BDC - 1800cc, BDG - 2 litre, and BDH - 1300cc. Original BDA engines were built onto 1600cc Kent blocks, but later production units used purpose made aluminium blocks - though you can't use this block for the push rod engine as there is no provision for push rods, etc.

Current Boreham rally engines have stretched the standard bore from 81mm to 90.4mm, which with the standard 77.62mm stroke gives a capacity just under 2 litres. When built up with Cosworth steel crank, rods, forged pistons, BD3 exhaust and LI inlet cams the engine can give a genuine, reliable 240bhp at 9000rpm.

These engines are now very specialised and expensive to build, so it's really best to leave this job to one of the established experts in the field who have all the experience of getting things right first time.

RS 2000-GROUP 1

Having campaigned Group 1 RS2000's for the last three years, I have probably come across most failures that could occur (I hope) and found a remedy for it. To cover the full preparation of Gp 1 cars would take as long as this book: As much as I would like to do this, space is limited and I shall cover the main points and add the most important tweeks as I go along.

But first of all, a brief description of how Gp 1 works. The formula was conceived to bring a section of the sport back down to ground - rally cars like the ones from your dealer showroom.

For cars to be approved in this Class of competition their manufacturers have to supply evidence to the sport's governing body (FIA) to prove that sufficient quantities of a particular model have been made, that is, 5,000 in any 12 consecutive months. Suspension and engine kits, and anything else come to that, must also meet this quantity requirement. This process of approval is known as homologation, and homologation forms for cars in this country are issued by the RAC, Belgrave Square, London, SW1. There is a separate form for each car and it contains lists of all homologated parts for that model. At the time of writing, these cost £3.50 each.

13.1. SUSPENSION

The Gp 1 owner really scores here as the works-type Gp 4 Bilstein struts are legal (albeit without adjustable spring seats); with these you need to use the ball bearing top mounts and spring cup kit. As far as springs go, you have a choice of two - both rated at 145 lb/in; the green/white for forest and general rally (finis 905 2707) and the blue/white for tarmac (finis 905 2706), which gives a 1" lower ride height.

Anti-roll bars can get confusing if you're not careful, but here's the fact :

There are three types of anti-roll bar fitted to the Escort II, one at 20mm diameter (finis 147 2919), a heavy duty 22mm bar (601 0163), and the Mk II RS bar measures in at 21.3mm (157 1182), but due to different geometry needs, special mountings (RH - 157 1184; LH - 157 1185) to give improved castor characteristics. However, the bar which most people tend to use is the original Mk I RS (905 2549) which measures 20.5mm - to use this though, you need to use the standard Mk I RS anti-roll bar mounting (RH - 146 7796; LH - 146 7800).

This leads us neatly onto anti-dive kits which basically lower the point of action of the anti-roll bar. The use of these anti-dive kits is a matter for personal preference, but they are certainly at their best on tarmac. There are two kits marketed, a tarmac version (905 2989) using your standard Mk II RS 21.3mm roll bar; and rally (905 3384) which comes complete with the thinner, Mk 1 anti-roll bar - this promotes the desired oversteer for forest use.

At the back, things are far easier. Single leaf springs are the name of the game (available from RS Parts, of course) and Group 1 Race rear shock absorbers, are ideal for both forest and tarmac use.

I shall bring in sumpguards at this stage, as the RS Parts steel guard plays a vital part in the location of the roll bar. It's probably the best sumpguard to use anyway, but it also has an extra pair of mounts for the roll bar, which means that you effectively have the equivalent of the Group 4 twin-roll bar clamp kit, and is very effective.

If you do decide to use an anti-dive kit (which has three double mounts on to the roll bar) you can still use the sumpguard after cutting a strip off at the front wide enough to clear the anti-dive kit.

Remember that all the above are only homologated for Mk II RS2000's.

Listed below are the relevant finis codes:

Front Suspension		
1st stage	Struts	905 2655 RH 905 2656 LH
	Springs	905 2707
	Rubber top mounts	600 5147 (include metric studs)
2nd stage	Struts	905 3062 RH 905 3063 LH
	Top mount kit	905 4002
	Springs	905 2707
	Anti-dive kit	905 3384
Rear Suspension		
	Rear springs	905 1947
	Rear shock absorbers	905 2890
Sumpguard		905 2879
Fitting kit		905 2780
H/D Bushes		
Stabiliser bar mounting		905 1301 (without a-dive kit) 905 1302 (with a-dive kit)
Track control arm outer		905 3166
" " " inner		905 3168
Radius arm front		905 3167
" " rear		905 3168
Rear spring Std front		905 3169
" " " rear		905 3170
Rear spring single leaf* front		905 3169
" " " " rear		905 1564

*Use 105E shackles

A point about non-roller top mount struts is that if you need to tighten up the top mount nut on your strut, make sure to do so with the wheels in the straight ahead position. The rubber can get 'wound up' as the steering tries to centre itself if you've tightened up with lock applied. A foolproof check is to slacken the top nuts, drive down the road, and retighten. This should cure any pulling.

13.2. BRAKES

The stopping power of a Mk II RS2000 is now unbelievably good. A ventilated disc brake kit (finis code 905 1676) which fits onto the standard hubs is homologated in Group 1 and cures any possibilities of fade, which was a problem in the Mk I days. You must also use a back plate kit, listed under finis code 905 1556. Brake pads to use are type P16 DS11's finis code 905 2124.

At the rear, a larger wheel cylinder ($\frac{3}{4}$") has been homologated and VG95 brake shoes (finis code 905 2876) should be used.

The ultimate in braking consists in a Balance bar pedal box kit, which allow adjustment of brake bias, and does away with the existing servo and turret assembly in the engine compartment. No servos are used at all, which means a lighter car, extra accessibility in the engine compartment and something less to go wrong. The pedal box is available from RS Parts in kit form under finis code 905 3064.

Ferodo DS11 pads are the best all rounders in my experience, with preference going to the P16 type rather than the M16 - they wear more evenly. The lock tabs from the bolts holding the calipers onto the struts can effectively be thrown away; and remember to use coil protection around the front brake hoses. Remember when you fit new pads, to carry out a pre-fade test to bed them in properly. After a bit of normal use, give the brakes a series of hard applications until they start to fade (there will be a pungent smell of hot linings, but don't worry). Then let the brakes cool and give the pedal several more medium /high speed applications until stabilised braking conditions are reached and there is no increase in pedal pressure. After this, you may note a thin film of copper on disc and pad, but this is perfectly normal and does not impair braking efficiency.

At the rear, if you are a "handbrake merchant", and use the middle lever a lot, AM8's are a bit softer and therefore easier on the old arm muscles. For cars equipped with the Gp 1 exhaust system, you must reroute the rear brake pipe because the downpipe comes very close to it and overheats the brake fluid.

It is essential to watch the half shaft bearings as the seals often pack up. The results in grease getting onto the rear linings, and the already small effort from the Mk I 8" drums becomes virtually zero! The Mk II Escort RS2000 incidentally, and thankfully, has 9" drums fitted.

13. 3. BRAKE WARNING LIGHT

Originally fitted to comply with European requirements, a dashboard brake-failure warning light is fitted to all RS2000's. This is a simple pendulum type valve affair, but often it can play up - the mode of operation is that the system pressure should be equal on both sides of the pendulum valve for front and rear.

If the warning light does come on, slowly bleed the front system until the light goes off. If that doesn't work, bleed the rear system in the same way. If the light still stays on, you can flick the pendulum in the valve on earlier RS2000's by jiggling with a small screwdriver under the valve, returning the pendulum to a central position. If you can't get a screwdriver in the 'ole, it's a later fitting and sometimes a hard stab on the brakes will cure the problem. After that, either disconnect the wire (!) or place a pinch-bolt on the warning switch on the valve to stop pendulum movement.

Lastly, rear brake pipe skids are a good idea. They are standard fitment on some export markets, or are obtainable through RS dealers on special order.

STEERING RACKS

A high ratio rack is also homologated (RH, 905 2871; LH, 905 2872), and fits without further modification.

As on Group 4 cars, it is advisable to revert to a Mk I steering shaft and a heavy duty steering coupling (905 4084). Remember though, that you will have to get a Mk I RS steering wheel (splines are different). When bolting the rack to the cross member, don't bother with the time consuming standard tab washers; use a flat washer, then a spring washer and plenty of 'Loctite'.

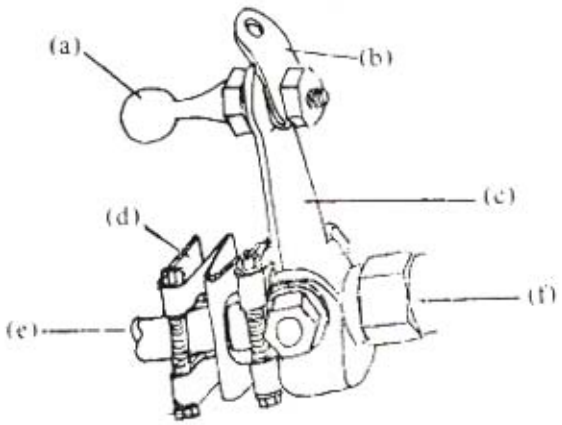
It's an idea to replace the standard castellated nuts and split pin on the track rod ends with a nylock - replacement is so much easier. On most stage events, it's all too easy to upset the steering geometry by bending steering arms, so as a precaution, slit a length of small bore heater hosing onto the track rods which will protect them to a certain degree, but most important, helps to keep the threads on the rod clean and therefore easy to adjust. Simple preparation like this can pay real dividends against time.

13. 5. CARBURATION

The twin downdraught Solex carburettor kit has been replaced by a twin Weber (finis code 905 3032). The Weber kit gives more power, better fuel economy, improved tractibility, and has been homologated in Group 1 for both Escort RS2000 Mk I and Mk II.

The complete Solex Kits will no longer be available, but the details will continue to be serviced.

Aircleaner assembly	905 2791
Replacement element	905 3042
Ram pipes	905 2792
Carburettor	905 2793
Inlet manifold assembly	905 2794
Throttle bracket	905 3044
Return spring bracket	905 3045



		Previous Pt No
(a) Ball joint	905 3036	PP 0251
(b) attachment - throttle return	905 3037	PP 0459
(c) Lever	905 3038	AVE 202
(d) Coupling	905 3039	AVE 75
(e) Spindle extension - long	905 3040	FCO 544A
- short	905 3041	FCO 544

The twin downdraught Weber carburettor kit, gives approx 7-10b.h.p. more than previous Solex kit. Kit comprises: carburettors, inlet manifold, air cleaner, camshafts, valves, etc.

Kit	905 3032

13.6. EXHAUSTS

Anyone wishing to fit a complete exhaust system to an Escort RS2000 Mk I can fit the high efficiency system, currently fitted in production to RS2000 Mk II. The following parts can then be ordered from any Ford dealer (not just RS).

Manifold	156 8147
Gasket	156 5558
Downpipe	156 4770
Centre pipe	156 5562
Rear pipe	156 5563
Front pipe	156 5556

13.7. TRANSMISSION

Ideally, you want to use the competition clutch cover assembly, available from AP Racing (CP 2511/1) together with the Heavy Duty clutch disc 905 1404. I strongly recommend the self centering release bearing (mainstream Finis Code 155 5006), as the standard early type tends to be short lived.

Gearbox wise, a 905 1637 Rocket gear kit will fit straight into your gearbox (if you have an RS2000, that is) or if you are building from scratch, a 905 2507 Rocket gearbox will save you buying a standard box and having to strip it.

ALWAYS carry a spare gearlever (they can break, and they can also come loose), and a clutch cable in the car. Also, you should drill and rivet the gear lever at the sound-deadening rubber joint, otherwise the vulcanising can let go at the most embarrassing times, leaving you with a 3" stub!!

13.8. REAR AXLES

As far as back axles are concerned, if you can't afford a Group 1 Atlas axle, a 905 0828 LSD in your axle (using 142 7779 crown wheel bolts) is all you need do, as well as change the diff ratio to either a 4.124 or a 4.7, as both are homologated.

The Atlas axle is infinitely stronger, and the half shaft bearings are much bigger.

Group 1 Atlas axle:	905 3540	3.5:1
	905 3541	3.75:1
	905 3546	4.11:1
	905 3545	4.63:1

these four being the homologated ratios.

Seats

Don't get caught out by seats - they also have to be homologated, but don't despair, there is a whole range of seats listed in the homologation form to suit most shapes.

13.9. WORLD CUP CROSS MEMBER

Also recently added to the list of allowable extras is the old faithful heavy duty World Cup cross member (905 1874) which is much stronger than the standard item, and recommended for all rough use.