

6.0 Rear Axle

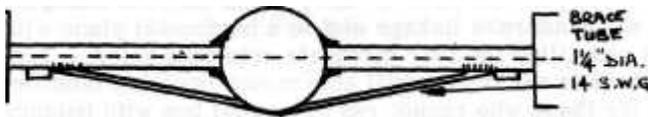
6.1. INTRODUCTION

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' - Produced as homologated axle for RS2000 (905 3540-3546) in Gp 1. Wheel arch extensions not depending on f/d necessary, but also excellent choice for ratio. 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 1/4" dia or 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.

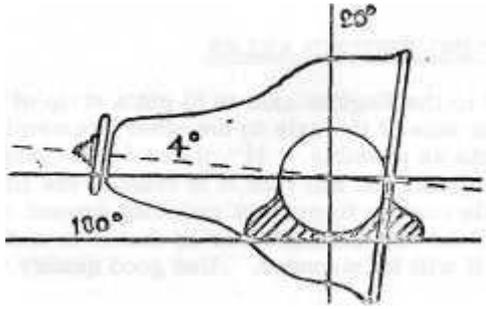


The standard English axle is adequate enough for competition use if used with a Gp 1 stage of engine tune, or medium power - say up to 150 bhp. Fitted with a Salisbury limited-slip diff and matched to the correct ratio, this is a reliable enough unit.

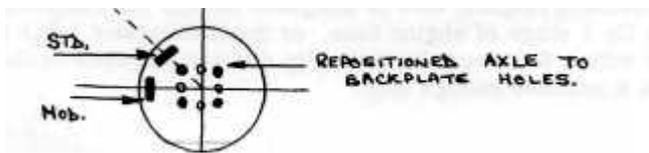
On English axles, half-shafts are retained by a bearing interference fit. The bearings can slacken, resulting in shaft and wheel sliding out of the axle casing. A good idea, therefore, is to tack-weld, in two spots, the bearing collar to shaft. Bearing replacement can be achieved by a tap with a cold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

5. 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 3/4" and 10 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 at the front, which raises the nose of the diff a corresponding 4 when in situ.



Another job you will have to carry out is turn the backplates through 45 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 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, 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.

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
Bearing carrier -(rear stub) RH	905 2606
Locknut RH	905 3608
Locknut 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 - half shaft	146 4492
Washer - cone - halfshaft	905 4067
Stud - rear wheel	905 3619
Hub Carrier (alloy)	905 3634
Bearing	905 3637

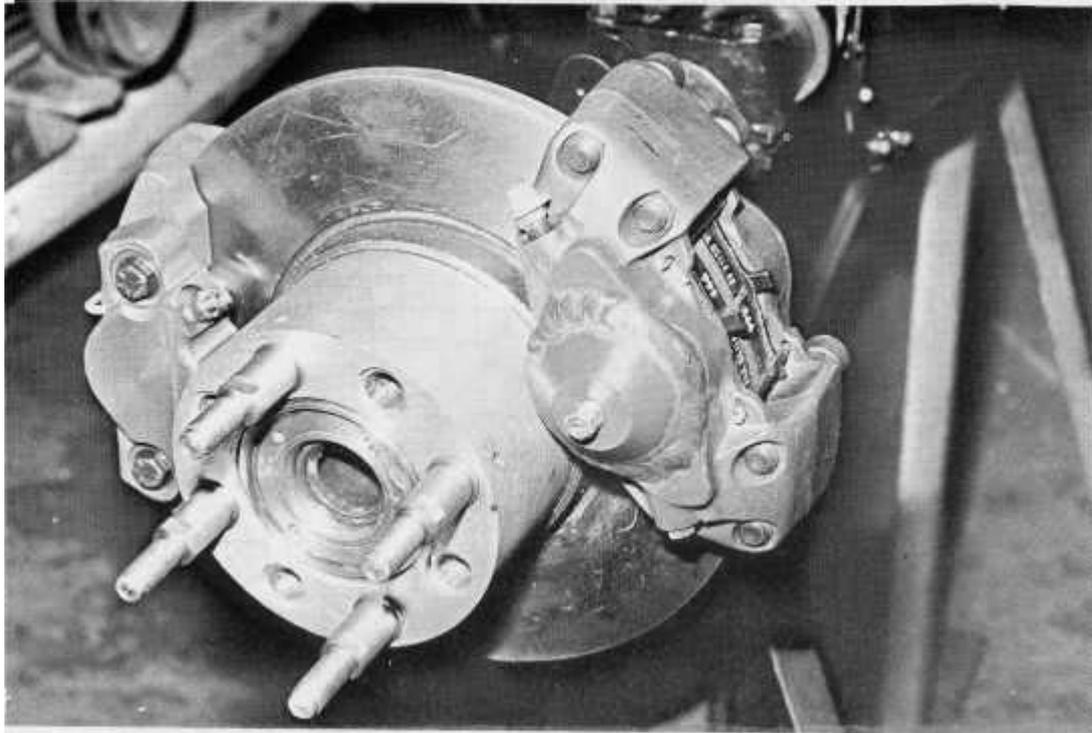
1976 SPEC: FLOATING AXLE

Boreham have now gone to a twin taper roller bearing half shaft 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:

Halfshaft	905 4035
Nut - halfshaft	146 4492
Seal - hub	150 1216
Lock nut - bearing adjust RH	905 4036
Lock nut - bearing adjust 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
Hub - bearing carrierLH	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 ½" UNF	905 4039
Caliper RH	905 4048
Caliper LH	905 4049



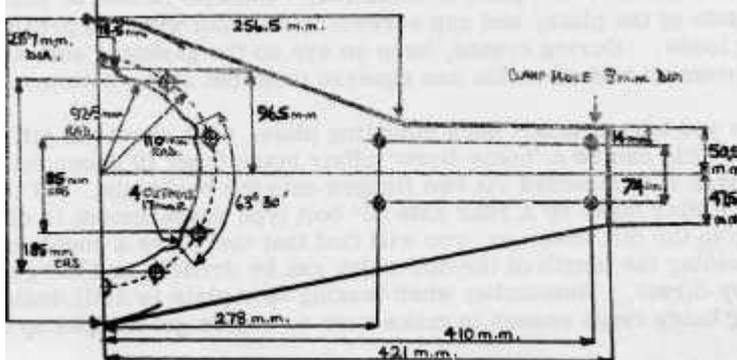
Above: Complete rear hub assembly

Below: Axle tube, spring saddle, damper mount, top link mount and calipers on completed rear axle.



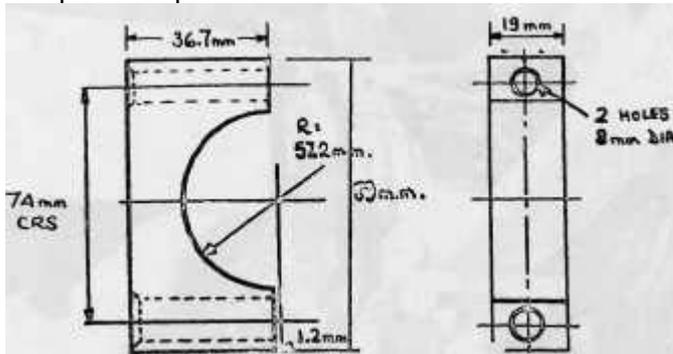
6.6. DIFF-GUARD PLATE

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:



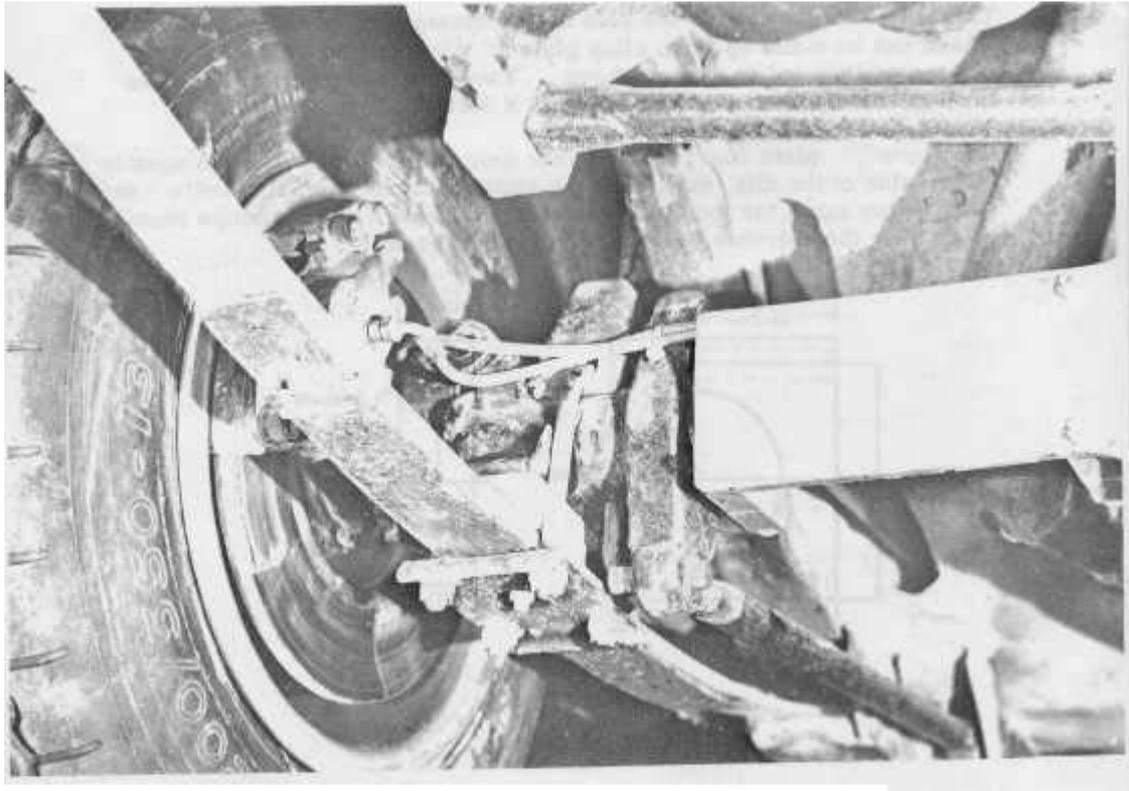
This plate is clamped to the axle by two clamps either side of the diff. These can be made up from alloy plate 1" thick drilled with a 2 1/8" cutter and then cut in half as shown. Two sides should then be drilled through the clamp's length to accept 2 x 5/16" bolts.

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.

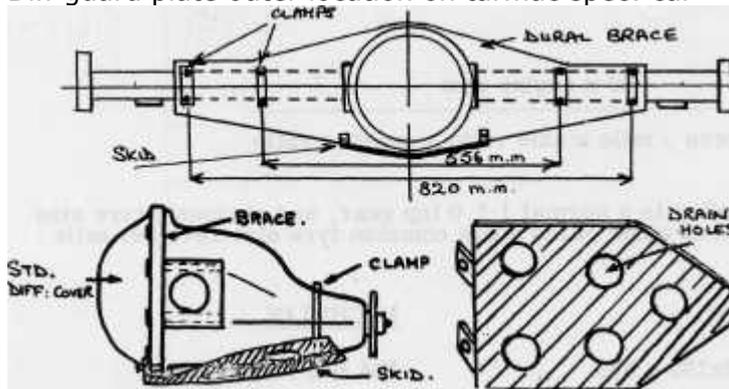


The back-plate now receives its final hole - a great big one in the middle around the diff housing, which must accept the rear oil pan, and allow easy access to the C . W . P . and removal of diff. The standard rear cover retaining bolts with 10mm cap screws should be replaced by ones 5/16" longer to 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:

$60 \times \text{engine rpm}$

wheel revs /mile \times axle ratio \times 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 G800 (GP70) 13x175 = 926

MICHELIN

XM & S 13x165 = 880

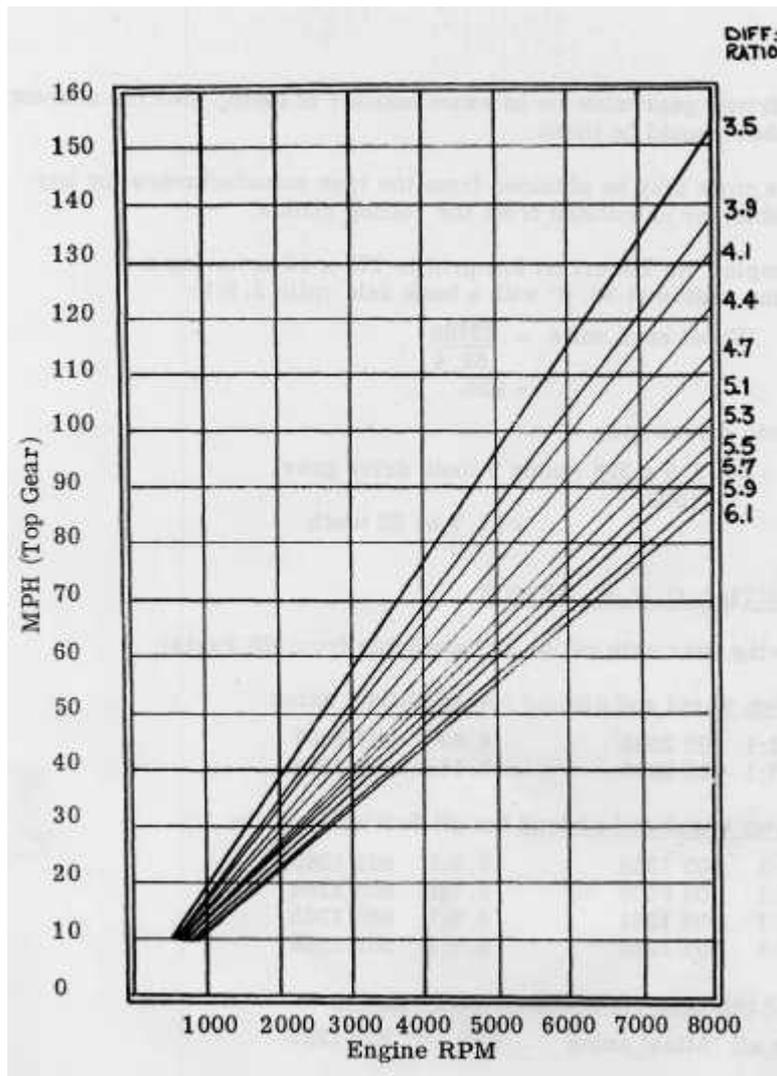
GOODYEAR

Rally Special G800 13x175 = 890

Rally Special U/Grip 13x175 = 890

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

G800 13x185=842



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

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

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:

$$\begin{aligned}\text{Wheel revs/mile} &= \frac{63360}{68.4} \\ &= 926\end{aligned}$$

$$\begin{aligned}\text{Speedo driver gear} &= \frac{6 \times 3.9 \times 926}{1000} \quad (\text{using 6 tooth drive gear}) \\ &= 21.7 \text{ or } 22 \text{ teeth}\end{aligned}$$

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 half shaft 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 905 0828

(Salisbury)

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	BP limslip 90/1
Shell - 8096	Texaco 3450

Limited slip diff No 905 0438

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

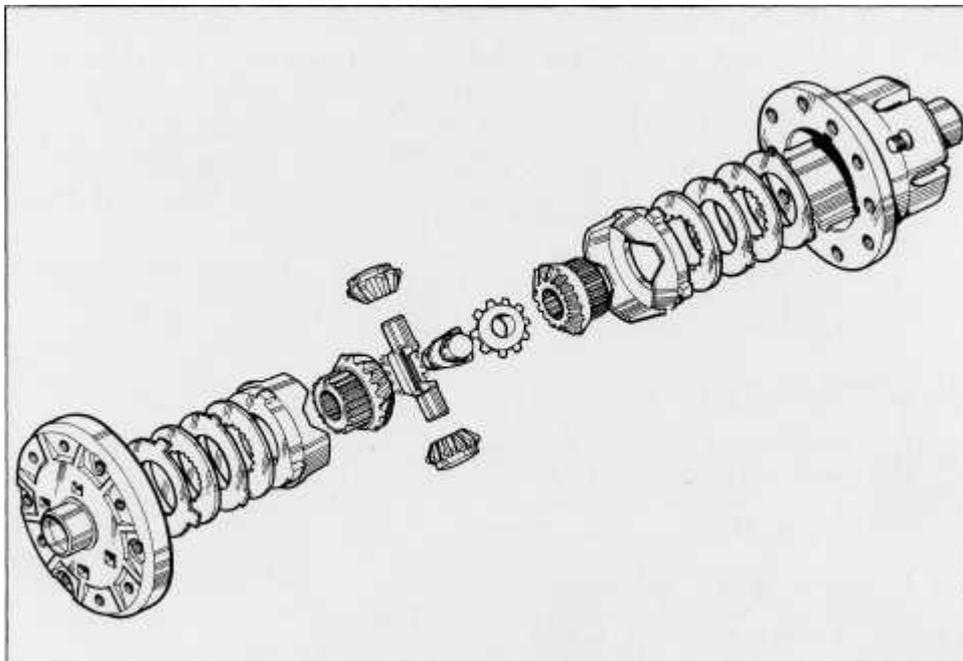
Service parts for limited slip diff - (finis 905 0828)

Item	Code	Qty
Side gear	905 3058	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/RS 1600/Mexico:

Rocket gearbox with standard axle

Rocket gearbox with 'Atlas' axle

Standard gearbox with 'Atlas' axle

Please be aware that these articles were written in the 70s and some of the regulations may have changed. Please consult the MSA Blue Book before preparing your car