DRIVE LINE: TRANSMISSION, FINAL DRIVE and DRIVE SHAFTS

Note: preparation and modification of the **Clutch** is covered in a separate section.

For Group N cars, the only changes allowed to the entire drive line are that the stiffness of the gearbox and final drive mountings may be increased and that transmission fluids may be changed, if required, in routine maintenance and repair.

For Group A cars, alternative gearboxes, propeller shafts, final drives and drive shafts are all authorised. These have all been developed and are available from the Motorsport Parts Division.

Group N cars: if the car has been used significantly before rally preparation begins, we recommend that the viscous coupling limited-slip differentials (rear on the SIERRA RS COSWORTH, rear **and** centre on the SIERRA XR4 × 4) should be removed and sent for rectification, rebuild and optimisation, to:

FF Developments Ltd.,
Wolston Business Park,
Main Street,
Wolston,
COVENTRY CV3 4FJ (Tel: 0203 544048)

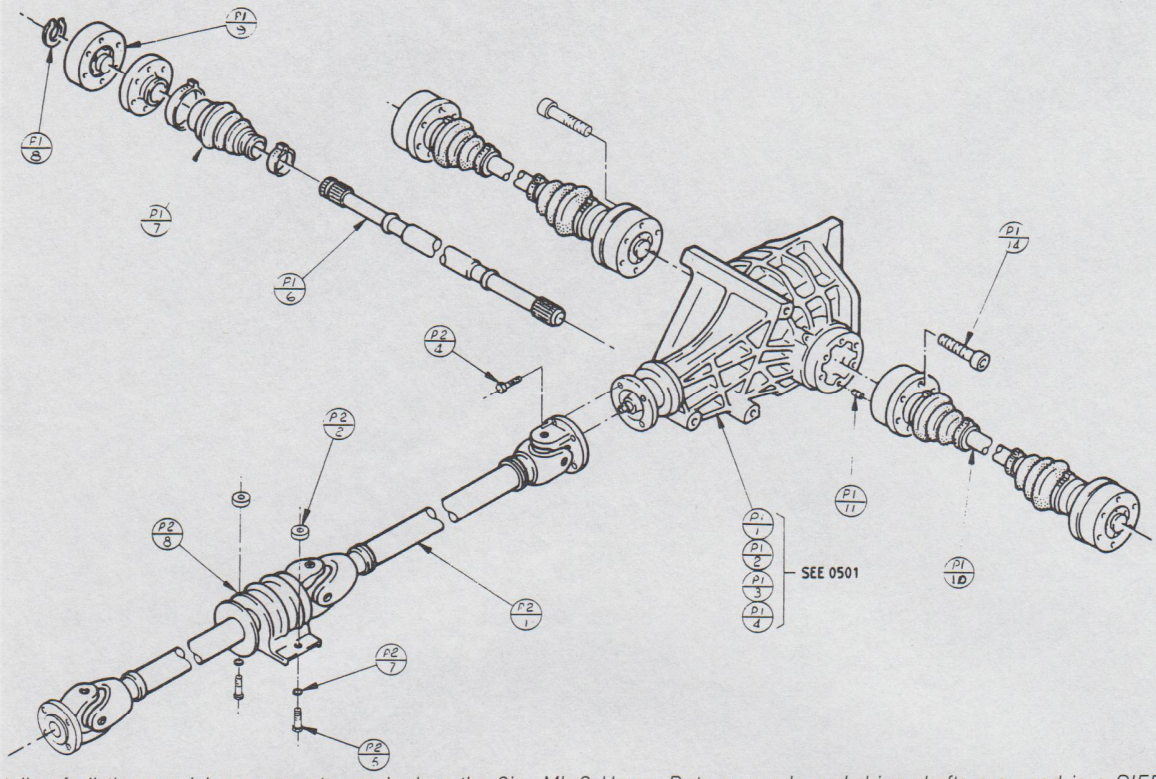
— this work involves checking out and, if necessary, re-setting the alignment of the VC plates, and renewing the viscous fluid which stiffens up the differential when it is under load. The work cannot be tackled by the private owner and Ford dealers are not usually equipped to do more than supply complete new units.

Although the standard gearbox assembly and final drive assembly must be retained, along with the same ratios, we strongly recommend that you should have the differential bevel gears shot-peened. This significantly increases their endurance and resistance to shock loading, especially where the cars are to be used on loose-surface rally stages which have rapidly changing levels of wheel grip.

In the case of the SIERRA RS COSWORTH model, we recommend that these bevel gears should be renewed after every major rally, or in any case if the final drive has been used for more than a very brief period in conjunction with a broken drive shaft, with a punctured tyre, or with misaligned rear suspension.

Group A cars: For a SIERRA RS COSWORTH, and the SIERRA RS500 COSWORTH, alternative Getrag gearboxes, heavy-duty final drives, alternative final drive ratios for the standard **or** the heavy-duty final drive unit and specially-developed rear drive shafts have all been developed and are available.

The homologated internal ratios for the Getrag gearbox differ slighty between the RS COSWORTH and the RS500 COSWORTH - it is important to make clear which model is involved when parts are being ordered.



Details of all the special components used when the 9in. Mk 2 Heavy Duty rear axle and drive-shafts are used in a SIERRA.

Driveline - 9in. axle (Mark 2)

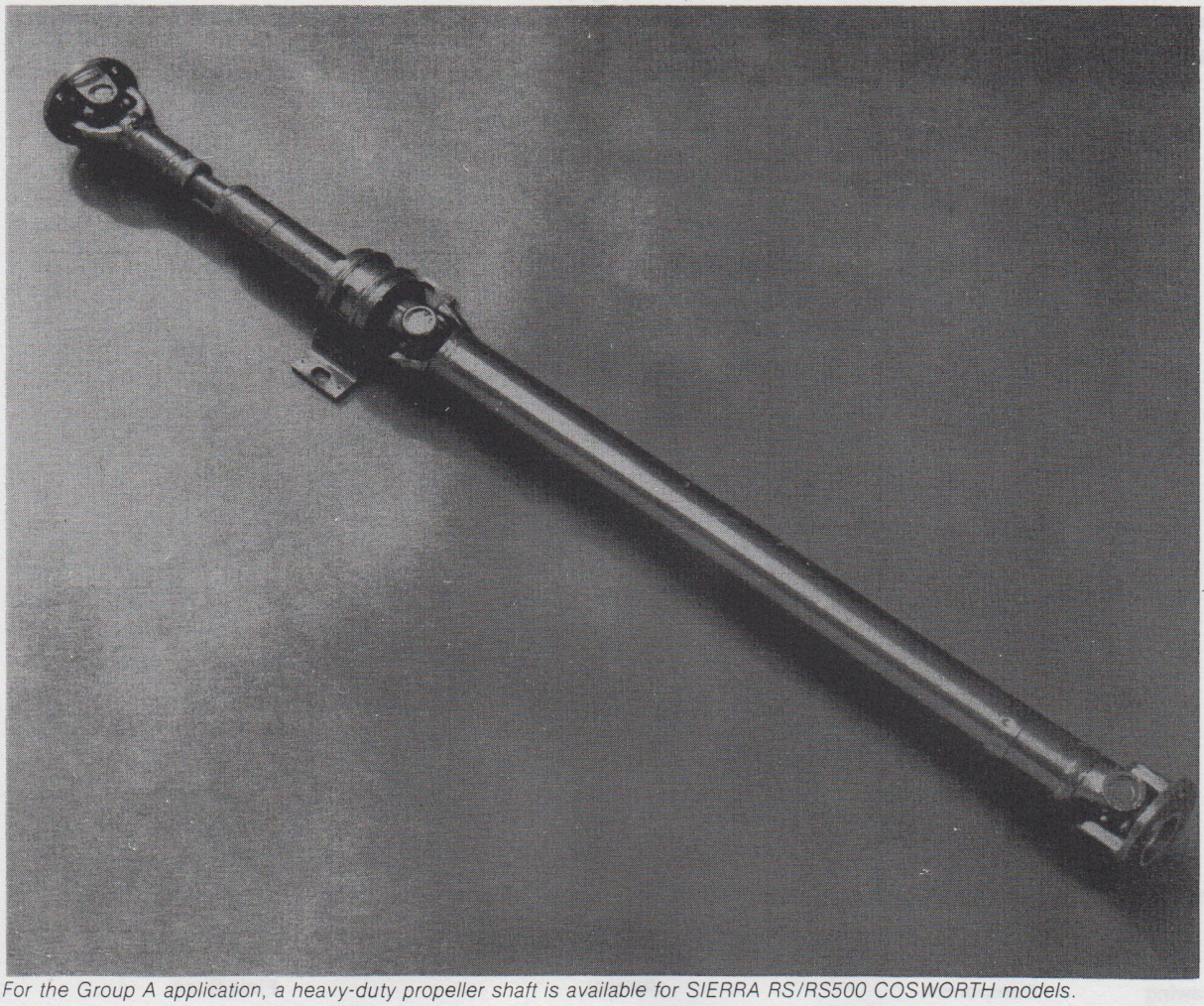
Drawing Reference	Component	Part No.	Finis Code
P1/1 P1/2 P1/3 P1/4	Rear axle assembly, various ratios	—	—
P1/10	Drive shaft assembly, rear	Comprises	
P1/6	Drive shaft	MS87BB4235BB	9093234
P1/7	Gaiter, rear drive shaft	MS88BB4K258AA	9093236
P1/8	Circlip, rear drive shaft	MS88BB4480AA	9093237
P1/9	Constant velocity joint	MS85PB4635AA	9093233
P1/11	Dowel stud	MS86PB4003AE	9090650
P1/14	Bolt	MS86BB4636AA	—
P2/1	Propeller shaft assembly	MS87BB4602FB	9092618
P2/2	Spacer - propeller shaft brkt/body	MS87BB4607AA	9092619
P2/4	Bolt	E8003595200	6118344
P2/5	Bolt	E602353S72	1461203
P2/7	Washer	E630029S71	1465378
P2/8*	Collar, prop shaft centre bearing	MS87BB4830AA	9092621

* Included in item P2/1

Two different Getrag gearboxes are used for the RS COSWORTH and the RS500 COSWORTH models. For use in the SIERRA RS COSWORTH model, the correct Getrag gearbox carries the Finis Code 9092727. For use in the SIERRA RS500 COSWORTH, the correct Getrag box carries the Finis Code 9092669. This gearbox is stronger and is intended to deal with the increased power and torque of the SIERRA RS500 COSWORTH engine; in particular is has a stronger fourth gear.

For homologation purposes it is important that these gearboxes should not be confused, or misused.

Note that the standard Borg Warner gearbox is an 'over-drive' unit, with a 0.804:1 fifth gear ratio and a direct fourth gear ratio whilst the Getrag gearbox used in either RS or RS500 models has a direct fifth gear. This will therefore affect your choice of final drive ratio to be used in each case.

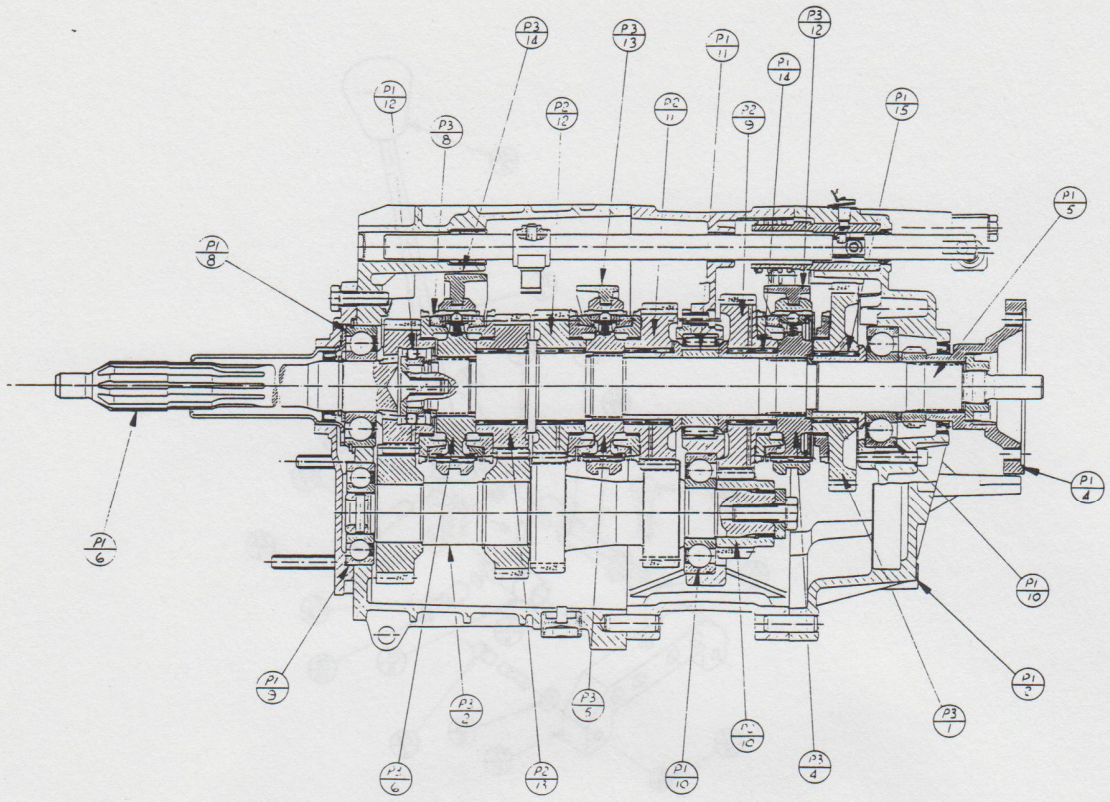


For the Group A application, a heavy-duty propeller shaft is available for SIERRA RS/RS500 COSWORTH models.

For the SIERRA XR4 × 4 model, an alternative gearbox, alternative transfer gear ratios, heavy duty final drive (rear) and alternative final drive ratios for the standard **or** the heavy-duty final drive unit, and specially-developed drive shafts have all been developed.

On the SIERRA RS/RS500 COSWORTH models, because it is strongly recommended that the alternative Getrag gearbox should be used for all Group A motor sport applications (and especially in motor racing), no competition parts or modifications have been developed for the standard Borg Warner gearbox. Many private customers, however, continue to use the unmodified Borg Warner gearbox in their Group A rally cars, with success and reliability. It was used, without problem, in the 1987 Safari rally.

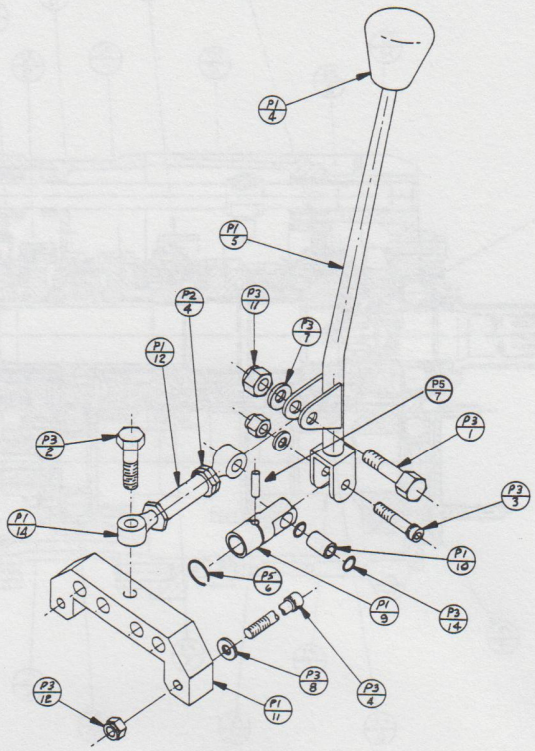
Because of the permanent four-wheel-drive layout of the SIERRA XR4 × 4 model, any change made to the rear final-drive ratio must always be matched by an equivalent change to the front final drive ratio. Alternative front differential ratios are in short supply, but the change may nevertheless be achieved by altering the transfer ('step-off') gear ratios behind the main gearbox, by the use of different chain drive gears. Depending on the gears chosen, this may involve minor re-machining operations on the inside of the transfer gear casing, to provide sufficient clearance for the enlarged gear wheel.



The Getrag gearbox assembly as homologated for use in the Group A SIERRA RS COSWORTH. The SIERRA RS500 COSWORTH uses slightly different fourth and third gear ratios.

Getrag Gearbox - Sierra RS Cosworth

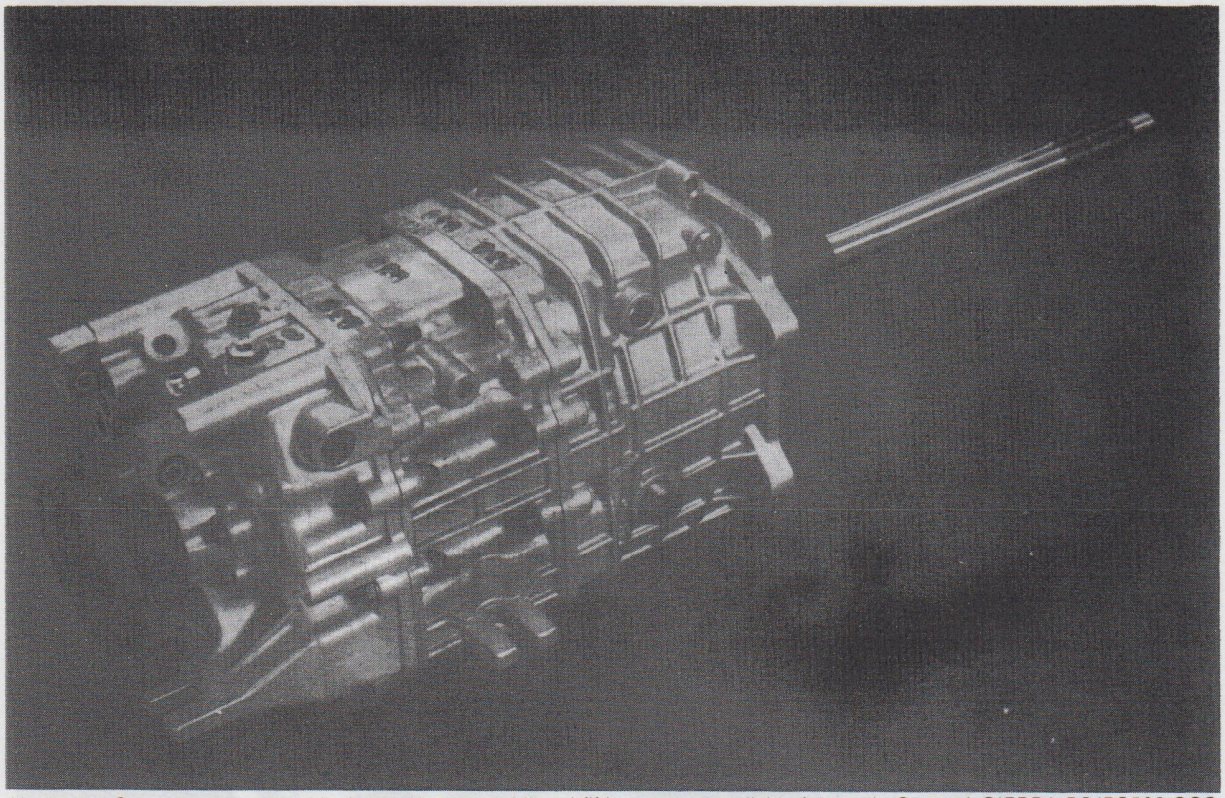
Drawing Reference	Component	Part No.	Finis Code
P1/1	Getrag gearbox, comprising:	MS87BB7003AA	9092727
P1/2	Gearbox casing	MS87BB7006AA	9092999
P1/3	Kit - bushes and plugs	MS87BB7K041AA	9092977
P1/4	Drive flange	MS87BB7021BA	9092976
P1/5	Main shaft - output	MS87BB7061AA	9092986
P1/6	Main shaft - input	MS87BB7017AA	9092987
P1/8	Bearing - input shaft	MS87BB7025AA	9092658
P1/9	Bearing - counter shaft	MS87BB7025BA	9092660
P1/10	Bearing - output shaft	MS87BB7065AA	9092663
P1/11	Bearing - main shaft	MS87BB7065BA	9092664
P1/12	Bearing - main shaft	MS87BB7120AA	9092665
P1/13	Needle roller bearing	MS87BB7143AA	9092666
P1/14	Needle roller bearing	MS87BB7B369AA	9092661
P1/15	Needle roller bearing	MS87BB7B369BA	9092717
P2/4	Kit - circlips and spacers	MS87BB7109AA	9092651
P2/5	Kit - bearing shims	MS87BB7L172AA	9092654
P2/6	Kit - gaskets and seals	MS87BB7223AA	9092653
P2/9	Gear - 1st speed	MS87BB7100BA	9092984
P2/10	Gear, 1st speed, countershaft	MS87BB7N100AA	9092979
P2/11	Gear - 2nd speed	MS87BB7102AA	9092983
P2/12	Gear - 3rd speed	MS87BB7B340DA	9092982
P2/13	Gear - 4th speed	MS87BB7110AA	9092981
P2/15	Reverse gear idler shaft	MS87BB7141AA	9092980
P3/1	Gear - reverse	MS87BB7K316AA	9092985
P3/2	Gear cluster assembly	MS87BB7113AA	9092978
P3/4	Synchroniser - 1st/Reverse	MS87BB7124AA	9092991
P3/5	Synchroniser - 2nd/3rd	MS87BB7B280AA	9092989
P3/6	Synchroniser - 4th/5th	MS87BB7L053AA	9092988
P3/8	Synchro. ring	MS87BB7107AA	9092667
P3/12	Transmission selector fork, 1st/reverse	MS87BB7C114DA	9092998
P3/13	Transmission selector fork, 2nd/3rd	MS87BB7230AA	9092997
P3/14	Transmission selector fork, 4th/5th	MS87BB7B297AA	9092992



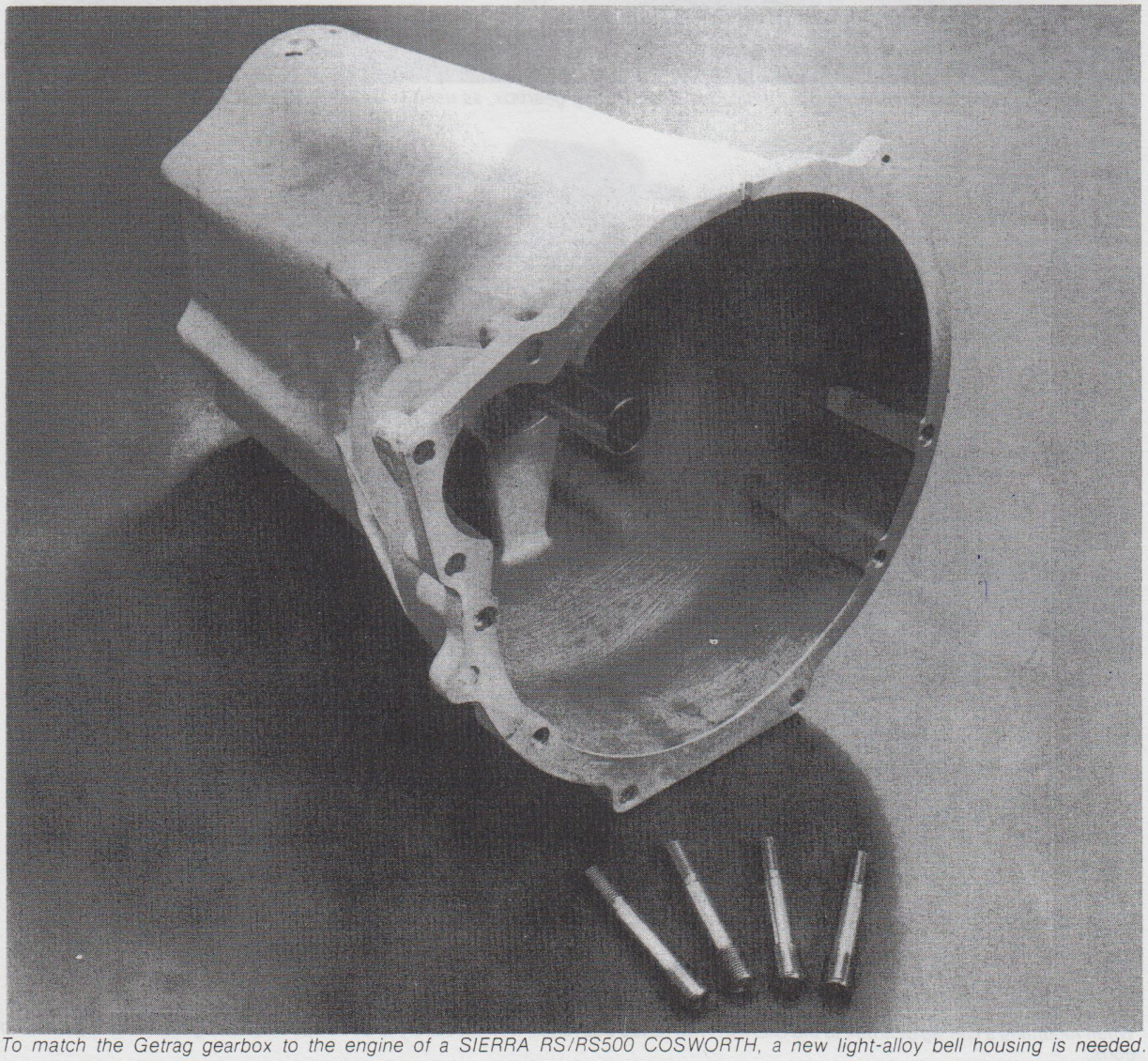
Gearshift components used along with the Getrag gearbox in SIERRA models.

Getrag Gearbox - detail of gearchange assembly

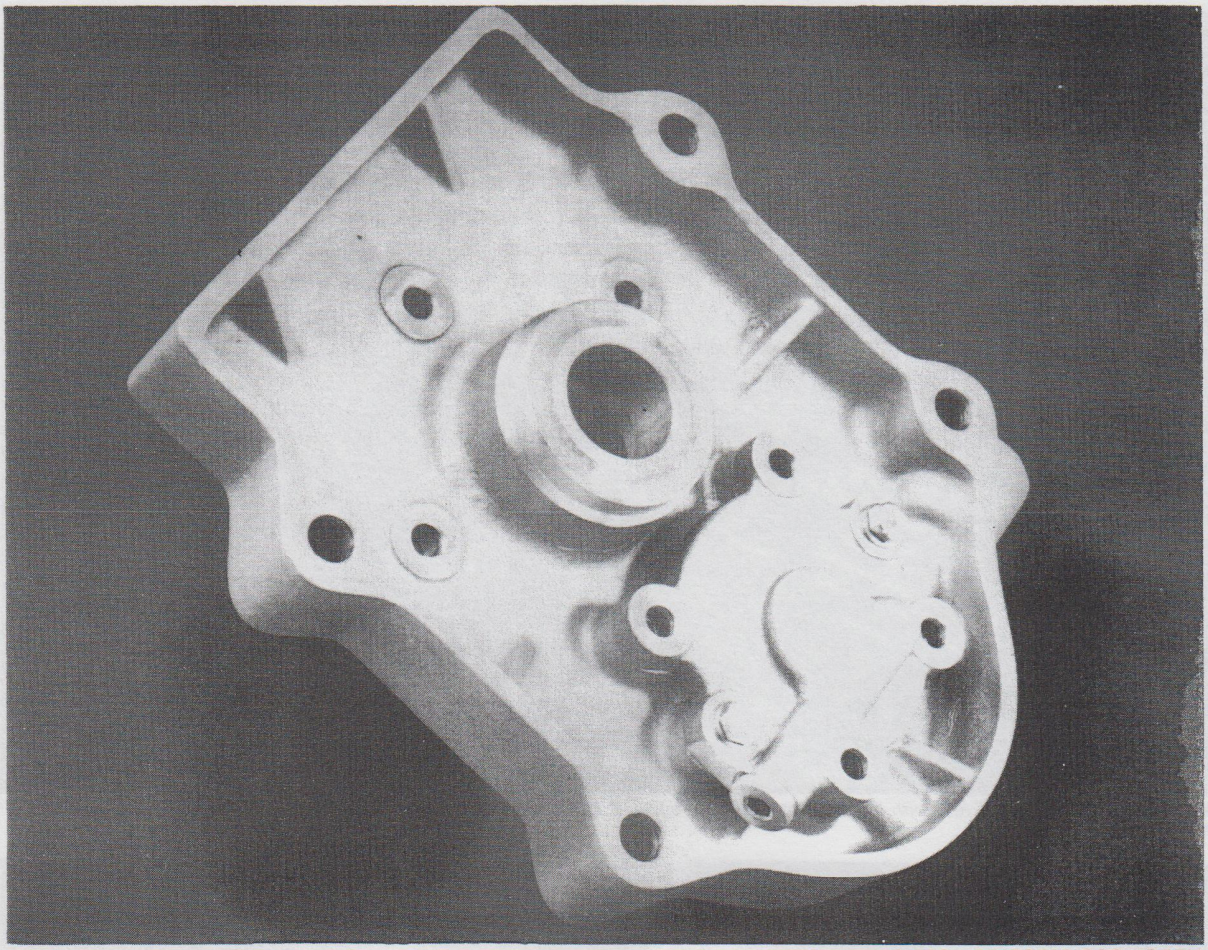
Drawing Reference	Component	Part No.	Finis Code
P1/4	Gear lever knob	H85PB7217BA3J	9092361
P1/5	Gear lever	MS87BB7008CB	9092804
P1/9	Rod end, gearchange	MS87BB7322CB	9093494
P1/10	Bush, rod end, gear change	MS87BB7323BC	9092799
P1/11	Tie rod, retaining plate, gear lever	MS87BB7324AA	9092801
P1/12	Tie rod, gear lever	MS87BB7325AA	9092798
P1/14	Rod end bearing, tie rod	MS87BB7330AA	9092797
P2/2	Kit - gearshift gate spring	MS87BB7331AA	9092807
P2/4	Locknut	E620334S72	1596460
P3/1	Bolt	E602069S72	1548435
P3/2	Bolt	E600312S72	0242519
P3/3	Bolt	E6012111S72	1478951
P3/4	Bolt M8 × 160		
P3/7	Washer, plain	E830085S71	1490514
P3/8	Washer, plain	E830111S82	1477027
P3/11	Nut, nyloc	E822025S72	1505594
P3/12	Nut, nyloc	E822018S72	1474529
P5/6	Circlip - rod end	MS88BB7412AA	9093483
P5/7	Pin - rod end	MS88BB7C141AA	9093493



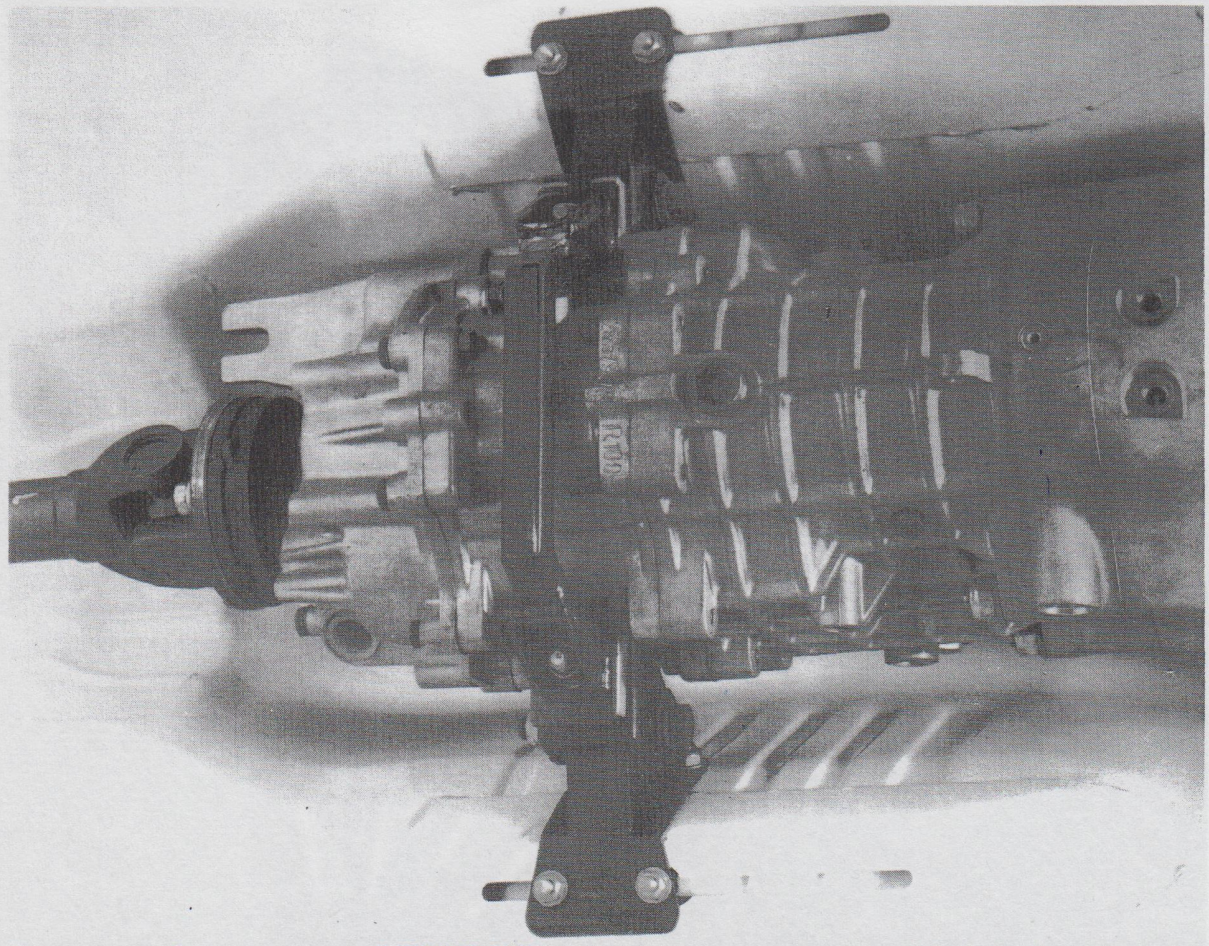
Alternative Getrag gearboxes, with close ratios and a 'direct' fifth gear, are available for use in Group A SIERRA RS/RS500 COSWORTH models.



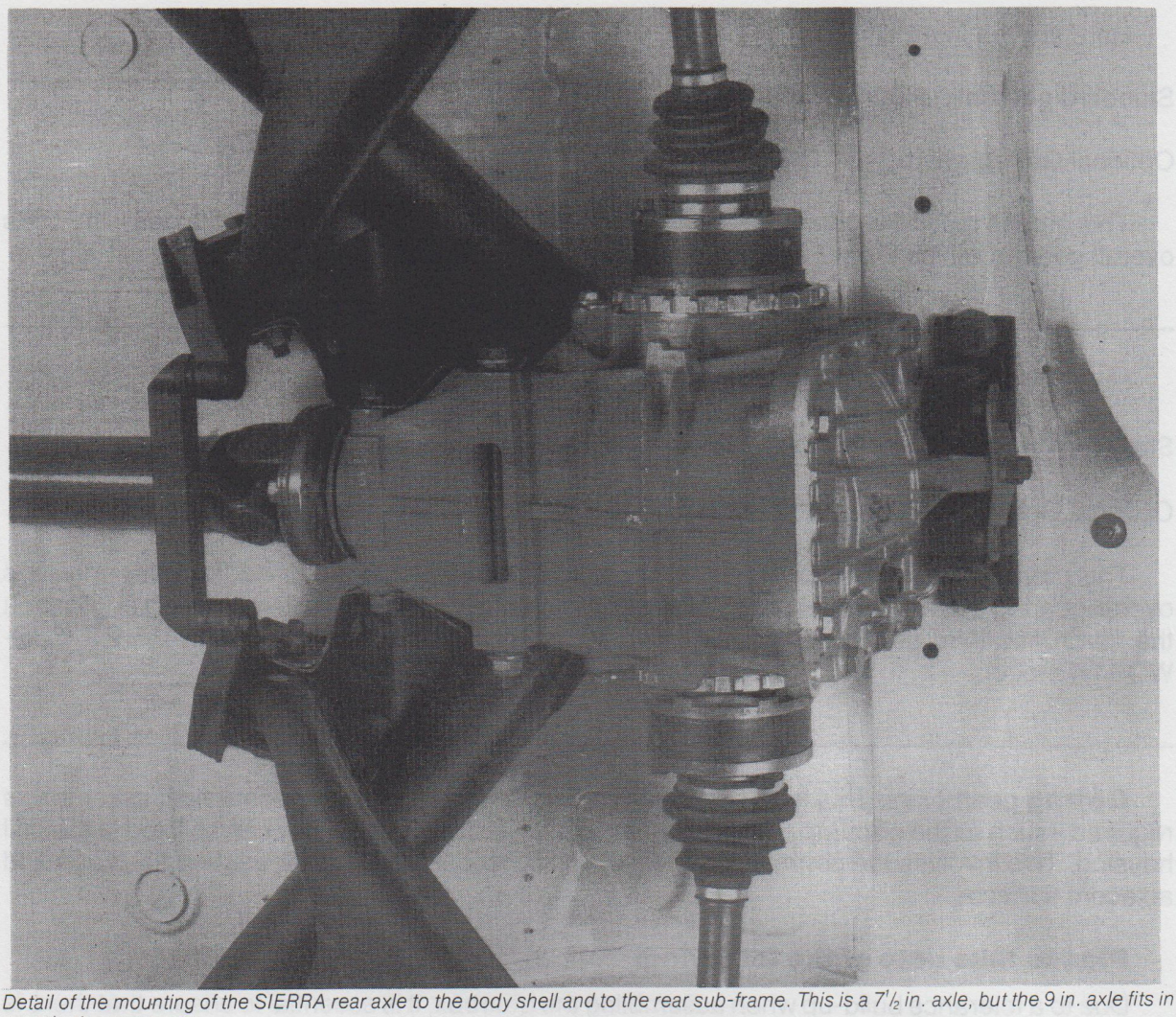
To match the Getrag gearbox to the engine of a SIERRA RS/RS500 COSWORTH, a new light-alloy bell housing is needed.



There is a very compact oil pump in the front cover of the Getrag gearbox, as used in Group A SIERRA RS/RS500 COSWORTHs.



When mounting a Getrag gearbox to the SIERRA RS/RS500 bodyshell, it is necessary to use a specially-designed mounting and supports.



Detail of the mounting of the SIERRA rear axle to the body shell and to the rear sub-frame. This is a 7 ½ in. axle, but the 9 in. axle fits in exactly the same way.

It is recommended that the 7 ½ inch crown wheel final drive and differential casing of the standard SIERRA RS COSWORTH should be used in a Group A SIERRA XR4 × 4; no changes are needed to body fixings. It is strongly recommended that the alternative Heavy Duty (9 inch crown wheel) final drive and differential casing should be fitted to all SIERRA RS/RS500 COSWORTH cars whose engine has been tuned to the limit of the Group A regulations.

For more lightly-tuned applications (for Clubman use), if the standard 7 ½ inch crown wheel final drive and differential casing is to be retained, it is recommended that the alternative ZF plate-type limited slip differential be used. If the standard car's viscous coupling is retained, it is important that shot-peened differential bevel gears should be used - as already descibed in the Group N section.

If the standard axle's viscous coupling limited slip differentials are to be retained, these should be returned to FF Developments for modification and calibration to Group A settings.

Gearboxes:

Here are the internal ratios for the SIERRA XR4 × 4 model:

Standard gearbox: 0.82, 1.00, 1.26, 1.81, 3.36, reverse 3.37:1.

Optional gearbox, using the same gearbox casing, but without synchromesh and with a different gearbox top cover:

1.000, 1.227, 1.515, 1.909, 2.649, reverse 2.961:1.

The optional gearbox uses the standard bellhousing and clutch connections and the same connection to the standard propeller shaft, plus the same gearbox mountings and gear lever position as the standard car.

Here are the internal ratios for the SIERRA RS COSWORTH:

Standard gearbox: 0.804, 1.000, 1.336, 1.937, 2.952, reverse 2.755:1.

Optional Getrag gearbox: 1.000, 1.150, 1.358, 1.681, 2.337, reverse 2.661:1.

This means that if the optional Getrag gearbox is fitted, which has a direct fifth gear, the car's overall gearing will be lower ('shorter') than with the standard gearbox.

Here are the internal ratios for the SIERRA RS500 COSWORTH:

Standard gearbox: 0.804, 1.000, 1.336, 1.937, 2.952, reverse 2.755:1.

Optional Getrag gearbox: 1.000, 1.163, 1.355, 1.681, 2.337, reverse 2.661:1.

This means that if the optional Getrag gearbox is fitted, which has a direct fifth gear, the car's overall gearing will be lower ('shorter') than with the standard gearbox. Note that in this application the fourth and third gear ratios are slightly different from those used in the SIERRA RS COSWORTH model.

Getrag gearboxes: This kit is supplied with some parts loose, and some final assembly is required - such as the oil pump, shims and front cover - before the gearbox can be fixed to the bell housing. This involves the correct shimming of clearances between roller bearing housings and adjacent surfaces.

Please take note of the following:

Due to a tolerance build-up when assembling the gearbox, it is essential to ensure that there is sufficient clearance for the drive shaft of the oil pump to locate into the slotted oil pump drive. In some instances the depth of the slot in the oil pump drive may have to be ground, or spark eroded, by approximately 1 mm/0.039 in. in order to obtain optimum fit.

Please ensure that the necessary thickness of shim is established before final assembly takes place and that the main and layshaft assemblies rotate freely when this job has been completed.

The change quality of the Getrag gearbox was greatly improved in the latter half of the 1987 season by specifying stiffer self-centring springs in the selector mechanism: the box needs to be partially stripped for stronger springs to be inserted in early-specification Getrag gearboxes.

The use of a gearbox oil cooler and external pump is recommended for long events held in hot weather. This can be achieved by mounting a standard Cosworth type oil/water heat exchanger (Modine) under the dashboard and tapping off engine water from the heater circuitry.

Borg Warner gearboxes: Note that these gearboxes were used successfully by the 'works' rally team in the 1987 Safari rally. This application requires a low first gear ratio for pulling the car through mud and a high fifth gear ratio to give a high top speed on fast sections. The Borg Warner gearbox worked well in this event.

Propeller Shafts:

On the SIERRA XR4 × 4, use the standard two-piece propeller shaft but with an up-rated centre bearing.

On the SIERRA RS/RS500 COSWORTH, use a two-piece propeller shaft with the standard centre bearing, but with an extra nylon ring to stiffen it up. Note: Experience shows that propeller shaft balance weights tend to fly off, especially if they have been struck by a stone on a loose-surface event. The result is that vibration sets in, which could damage other parts of the transmission; inspect the propeller shaft regularly and have it re-balanced if this occurs.

We do not recommend the use of one-piece propeller shafts on the SIERRA RS/RS500 COSWORTH Model. Experience by the 'works' team in rallies shows that these are subject to vibration problems.

Final Drives and Final Drive Ratios:

In all cases, we recommend that newly-fitted final drive assemblies should be carefully run-in over at least 100 miles/160 km without imposing high shock loads. At this point the oil should be changed and all the settings should be re-checked.

For the SIERRA XR4 × 4, the 7 ½ inch crown wheel final drive used in the SIERRA RS/RS500 COSWORTH road cars (which is a slightly modified version of that also used in the Granada/Scorpio range of cars introduced in 1985) should be used. Its casing should be modified to allow it to be fitted to the XR4 × 4's rear suspension cross beam. This is sufficiently strong to deal with the power and torque of a fully-prepared V6 engine in Group A tune. The viscous coupling fitted to this rear axle, and that fitted to the centre differential, should both be returned to FF Developments for optimisation, rebuilding and to be uprated. Shot-peened differential gears should be used; ideally these should be changed after every long event.

The torque developed by the V6 engine is not sufficient to make fitment of the optional ZF plate-type differential essential, though this is available.

It is recommended that the light-alloy differential closing plate (9091949) should be fitted; this is useful for locating stiffer support mountings behind the final drive.

For the SIERRA RS COSWORTH, the 7 ½ in. crown wheel final drive may be used for what are called 'Clubman' applications where the engines are not fully tuned to Group A limits, or for circuit racing where there are fewer shock reversals compared with loose-surface rallying, though it is strongly recommended that the optional ZF plate-type differential, which has four bevel gears compared with the two gears fitted to the VC, should always be fitted. Differential bevel gears should be shot-peened. The ZF limited-slip differential requires special output flanges to be used; these are available from the Motorsport Parts Division.

Where a viscous coupling is, however, retained, it should be returned to FF Developments for rebuilding and recalibration. Standard VCs have settings of 80 Nm. For Group A use only, in tarmac and gravel rallying, a normal competition setting is 400/500 Nm, but for very slippery conditions, 300 Nm is sufficient.

Note that if the internal oil temperature of a VC exceeds approximately 150 deg C, it may cause the VC to 'hump' and effectively go solid, this temperature can be reached after a drive shaft has broken and the VC is working to its limits, but it allows the car to be driven - 'limped' - out of a stage or to the pits, for attention. Under normal circumstances the temperatures should be kept within the 80 - 100 deg C range. For hot-weather events, it is recommended that an oil cooler and electric pump should be used; naturally the cooler should be placed where it cannot be damaged by flying debris, or clogged by mud or road filth.

The 'works' cars use Texaco Synthetic 75W140 EP SYNSTAR transmission fluid, though any high-quality premium oil is acceptable for these differentials. The same lubricant is used in the gearboxes, where they cause no damage to the synchromesh mechanisms.

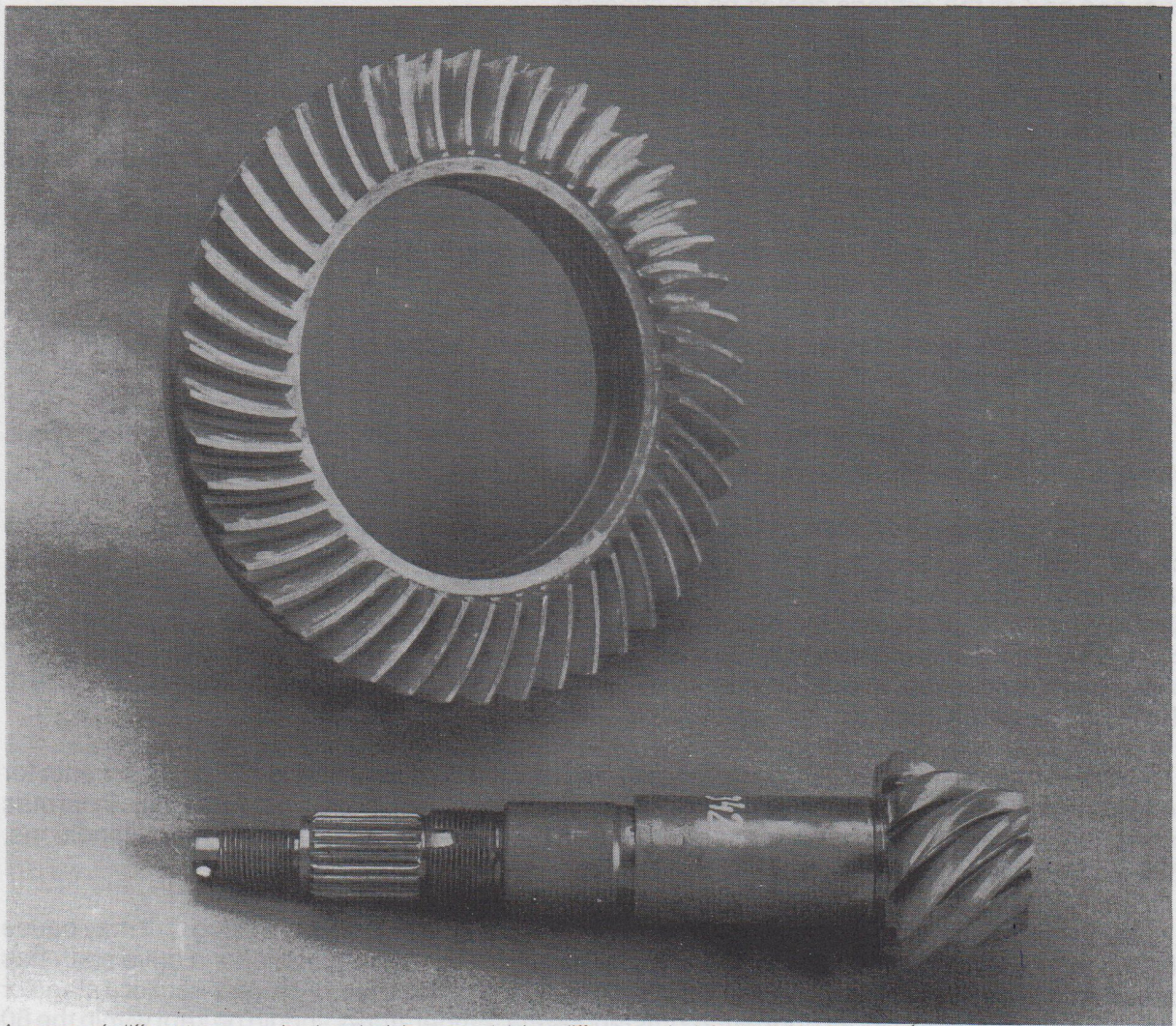
For a fully-tuned SIERRA RS COSWORTH and for tuned SIERRA RS500 COSWORTH cars used in circuit racing, it is recommended that the heavy-duty 9 in. final drive assembly should be used. This is sold complete with a viscous coupling limited-slip differential which has already been set-up for motorsport. As with the 7 ½ in. axles, use an oil cooler in hot-weather events, along with the same type of oil.

The 9 in. rear axle must be mated to the appropriate propeller shafts, output flanges and drive shafts, all of which are available from the Motorsport Parts Division.

Because the SIERRA RS COSWORTH and RS500 COSWORTH models are potentially very powerful cars, the life of final drives in these competition cars is greatly enhanced if they are carefully and correctly built up and adjusted, before being used. The correct back-lash and bearing preload settings must always be achieved and maintained. A separate section gives the correct procedure to follow in every case.

A note regarding Rear Axles and Final Drive Ratios:

A number of differential final drive ratios are available, and others are homologated, for the SIERRA models. These may be used in any of the rear axle casings homologated for the cars:



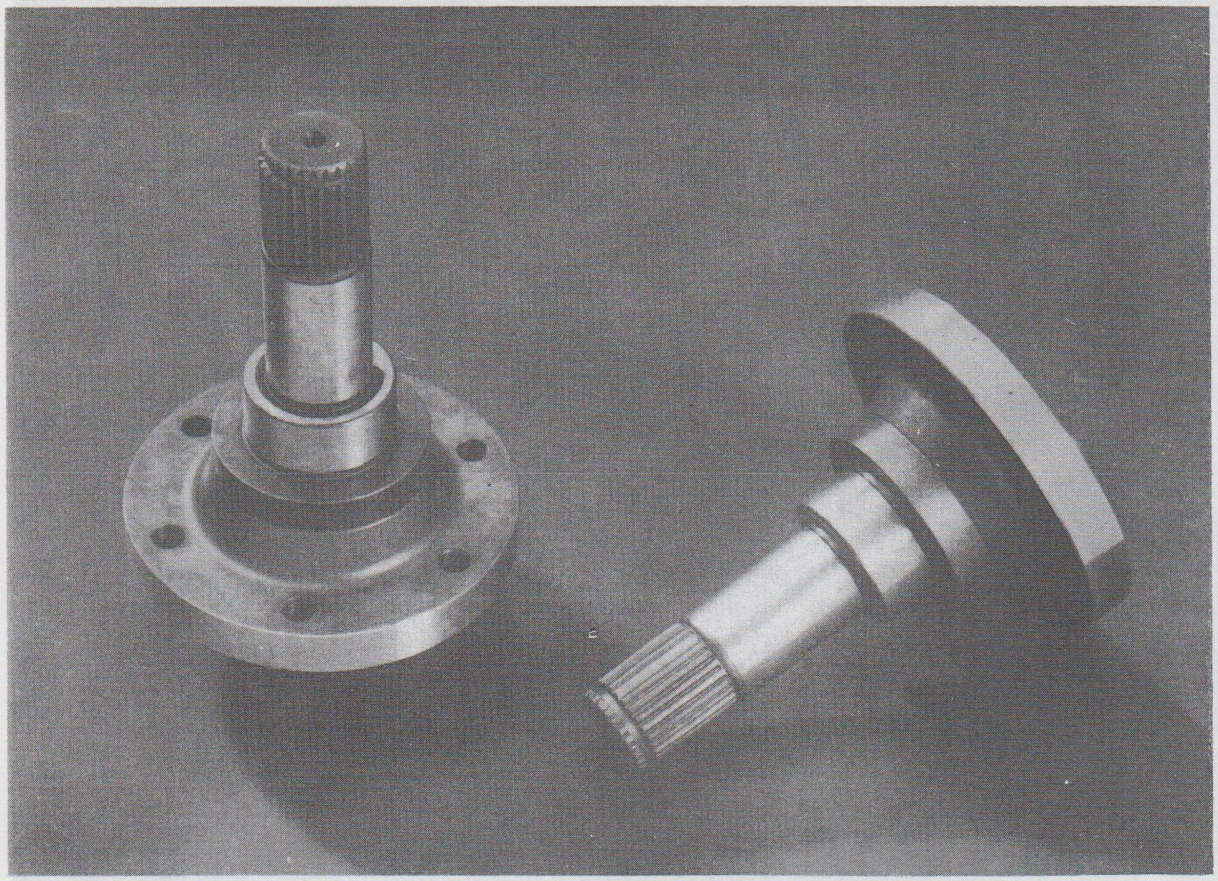
A range of different crown wheel and pinion sets (giving different ratios) is available for the 7½ in. or the 9 in. rear axle.

For the SIERRA XR4 × 4 the following ratios are homologated:

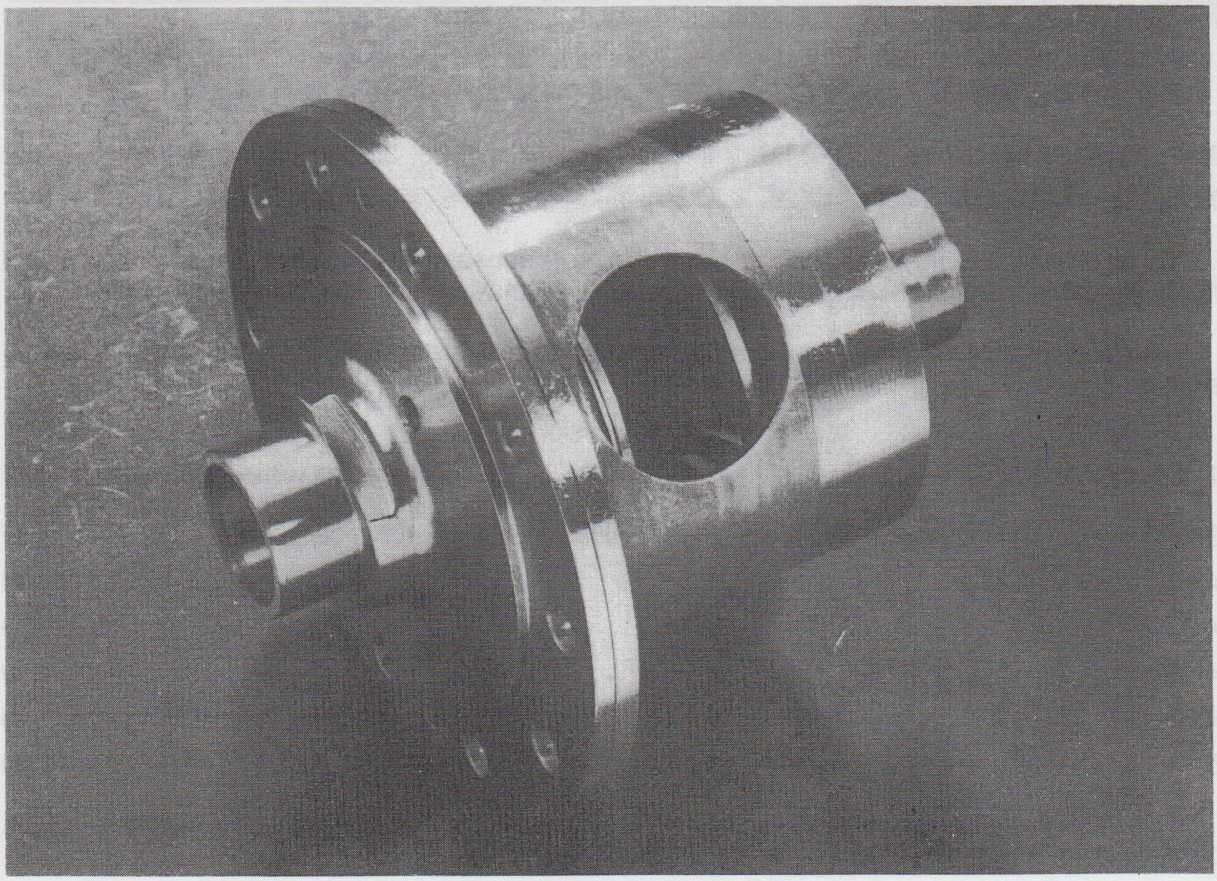
3.083, 3.25, 3.417, 3.62, 3.636, 3.818, 3.92, 4.091, 4.273, 4.33, 5.125:1

— and apart from the standard car's 1:1 transfer gear ratio the following combinations are also homologated:

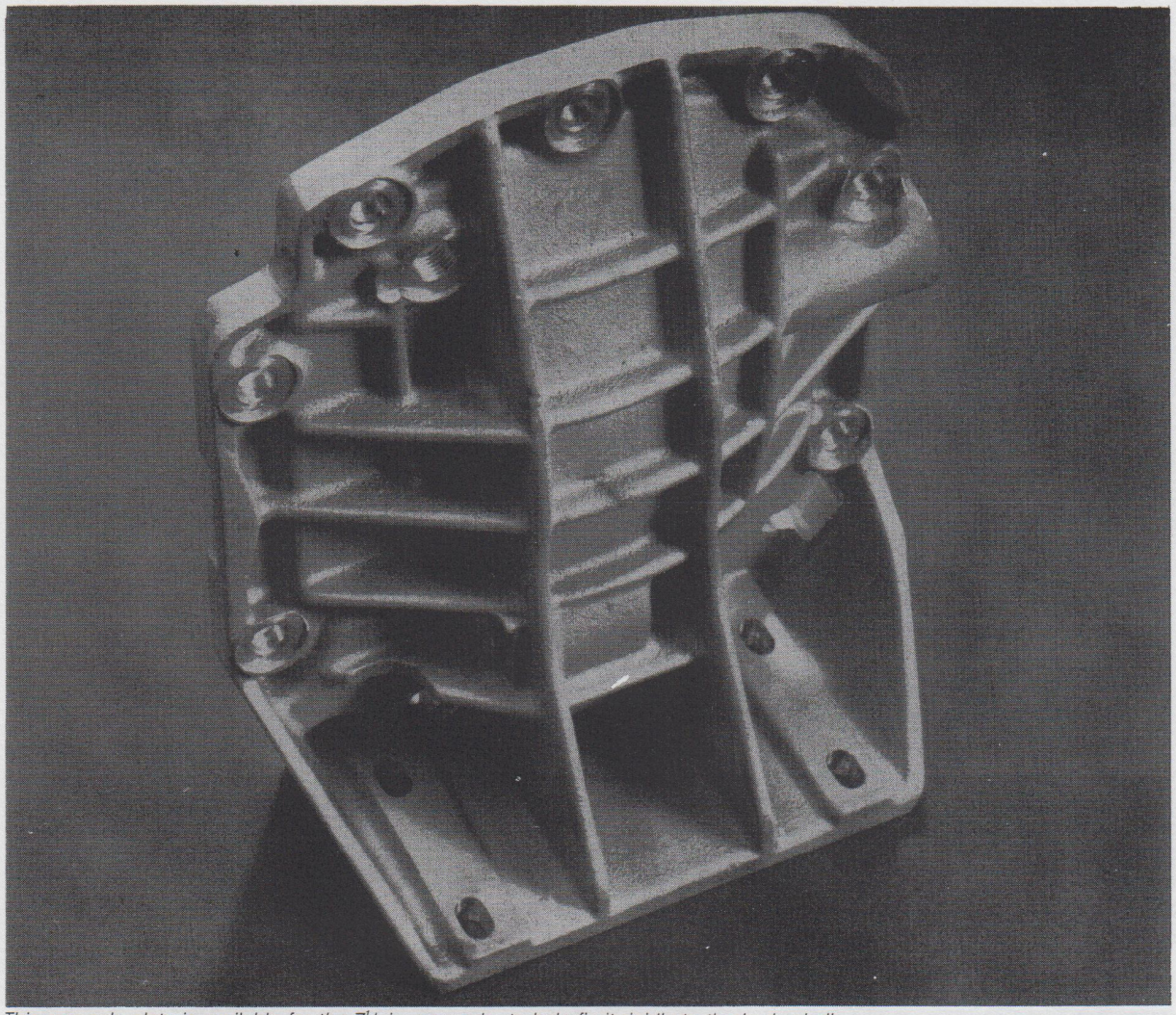
34/24 = 1.4166	When multiplied by the front	5.128:1
34/25 = 1.36	final drive ratio of 3.62:1, these	4.923
31/24 = 1.2917	give equivalent front ratios of:	4.676
32/26 = 1.2308		4.455



Special rear output shafts (sometimes known as 'quarter shafts') are used to link the differentials to the drive shafts of Group A SIERRAs.



For the 7'/2 in. rear axle, a ZF plate-type limited-slip differential is available.



This rear axle plate is available for the 7 ½ in. rear axle, to help fix it rigidly to the body shell.

For the SIERRA RS/RS500 COSWORTH, the following ratios are homologated:

2.92, 3.083, 3.14, 3.250, 3.33, 3.36, 3.375, 3.417, 3.50, 3.625, 3.636, 3.64, 3.70, 3.818, 3.85, 3.86, 3.89, 4.08, 4.091, 4.11, 4.125, 4.273, 4.33, 4.444, 4.56, 4.63 4.667, 4.889, 5.11, 5.125:1.

By no means all of the crown-wheel and pinion sets necessary to produce these ratios are currently available from the Motorsport Parts Division. All may be obtained by special order.

The following crown-wheel-and-pinion sets are normally stocked by the Motorsport Parts Division:

7 ½ Rear Axle:		**(Crown wheel: pinion teeth)**
3.64:1	This is the SIERRA RS/RS500 COSWORTH road-car ratio	(51:14)
4.44:1		(40: 9)
4.63:1		(51:11)
4.667:1		(42: 9)
4.889:1		(44: 9)
5.11:1		(46: 9)

Note that there are two closely-similar '4.6:1' ratios for the 7 ½ in. rear axle which are, in fact, completely different designs:

The 4.63:1 ratio (with 51 crown wheel teeth and 11 pinion teeth) is not recommended for use with the fully-tuned Group A SIERRA RS/RS500 COSWORTH.

The 4.667:1 ratio (with 42 crown-wheel teeth and nine pinion teeth) is stronger and more suitable for use with any fully tuned SIERRA RS COSWORTH, though not recommended for a fully-tuned SIERRA RS500 COSWORTH.

9 in. Rear Axle:

3.083:1	(37:12)	3.250:1	(39:12)
3.417:1	(41:12)	3.636:1	(40:11)
3.818:1	(42:11)	4.091:1	(45:11)
4.273:1	(47:11)	4.444:1	(40: 9)
4.667:1	(42: 9)	4.889:1	(44: 9)
5.111:1	(46: 9)		

All ratios produced for the 9 in. rear axle are suitable for use with a fully-tuned RS/RS500 COSWORTH model.

What ratios give what Top Speeds?

The following simple chart, prepared with particular reference to rally cars, should allow you to work out the theoretical top speed of your own car in fifth gear:

In each case, the calculation has assumed the use of a Getrag gearbox, with a direct fifth gear ratio.

At an engine speed of 7,500 rpm:

Rear Axle Ratio	640 mm Diameter Tyres kph/mph	670 mm Diameter Off-Road Tyres kph/mph
4.444:1	204/127	214/133
4.667:1	194/121	203/126
4.889:1	185/115	194/121
5.11:1	177/110	185/115

At an engine speed of 7,000 rpm;

Rear Axle Ratio	640 mm Diameter Tyres kph/mph	670 mm Diameter Off-Road Tyres kph/mph
4.444:1	190/118	199/124
4.667:1	181/112	189/117
4.889:1	173/108	181/113
5.11:1	165/103	173/108

SIERRA RS COSWORTH REAR AXLES

Whether you use the standard (7 ½ in) rear axle casing, or the optional (9 in) rear axle, it is essential for motorsport purposes that the assembly should be properly and carefully built up and adjusted.

The following sections cover:—

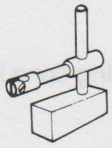
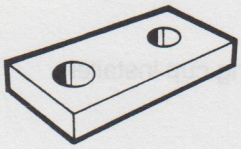
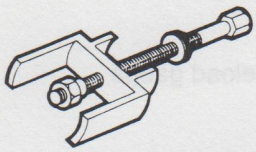
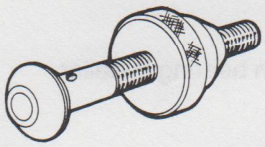
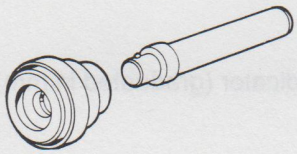
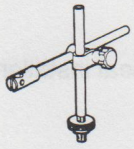
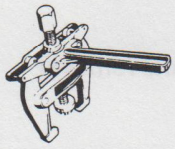
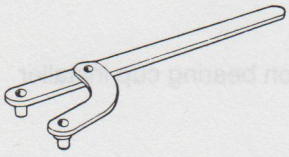
Overhaul of the 7 ½ in rear axle assembly. This information is a re-print of that already available on Microfiche at any Ford dealer. It is not, however, available in printed form to the private customer.

Assembly and setting up of the optional 9 in rear axle assembly. This is the heavy-duty rear axle, which became available during 1987-1988 for use in Group A (**not** Group N) SIERRAs.

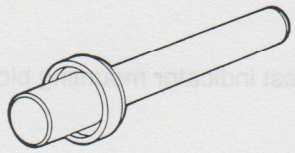
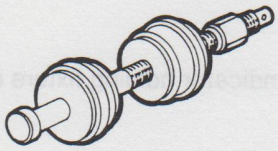
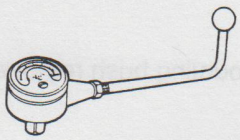
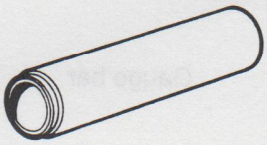
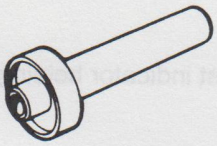
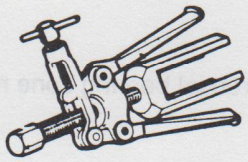
Please note that special tools are required to do these jobs correctly. The list of tools provided is that recommended by Ford dealers.

Note: Even though no material changes are allowed (by regulation) to Group N rear axles, it is strongly recommended that they should be stripped, carefully inspected, then re-assembled to the optimum settings, before the car is used in motorsport.

Special Service Tool Recognition

 15-008	Dial test indicator mounting block
 15-008-01	Dial test indicator holding fixture adaptor
 15-014	Suspension mounting bush remover and installer
 15-019	Gauge bar
 14-019	Oil seal and bearing cup installer
 15-022-A	Dial test indicator holding fixture
 15-026-A	Differential bearing cone remover
 15-030	Universal flange holding wrench

Special Service Tool Recognition

 15-032	Differential bearing cone installer
 15-033	Bearing cup installer
 15-041	Preload gauge
 15-042	Pinion bearing installer
 15-046	Dial test indicator (graduated in mm)
 15-047	Pinion oil seal installer
 15-048	Oil seal remover
 15-068	Pinion bearing cup installer

To Dismantle

1. Secure mounting bracket 15-070 to the rear axle casing and mount the rear axle assembly on a stand, Fig. 27.

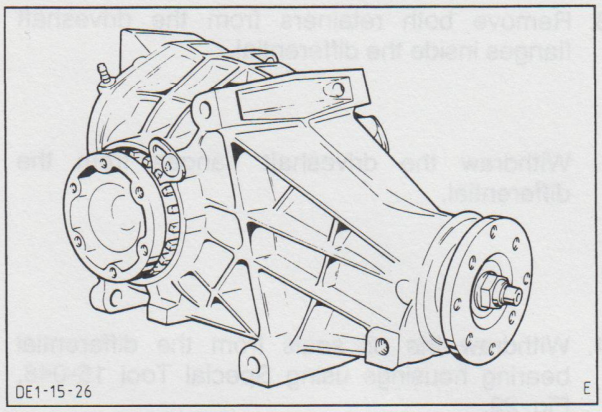


Fig. 26. Rear axle assembly.

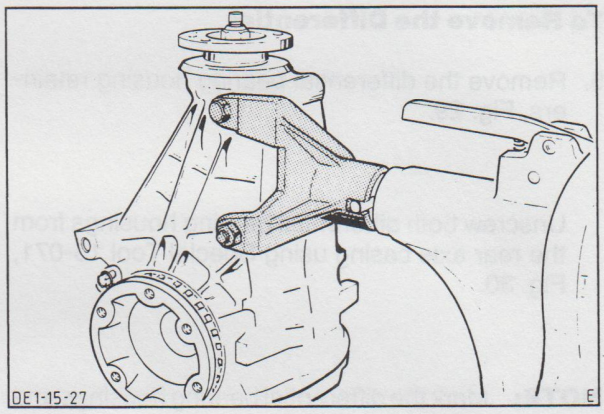


Fig. 27. Rear axle casing secured to assembly stand using mounting bracket 15-070.

2. Remove the cover from the rear axle casing (9 Tor bolts) and drain the oil, Fig. 28.

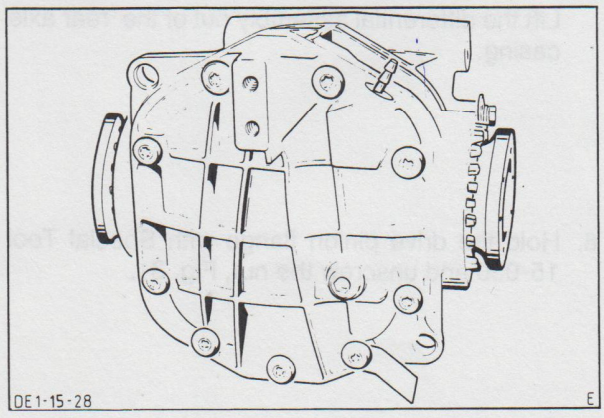


Fig. 28. Cover of rear axle casing.

3. Remove both retainers from the driveshaft flanges inside the differential.

   Withdraw the driveshaft flanges from the differential.

4. Withdraw the oil seals from the differential bearing housings using Special Tool 15-048, Fig. 29.

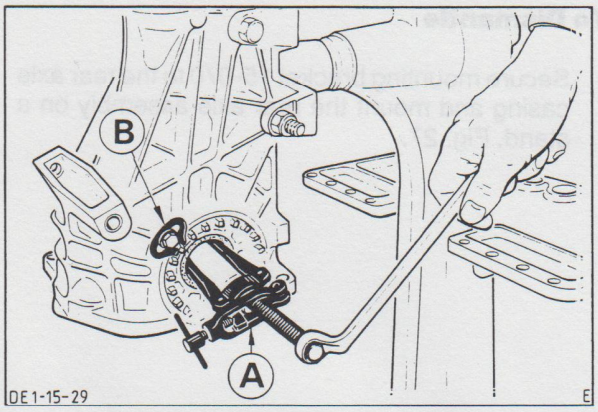


Fig. 29. A - Remove bearing housing oil seal
B - Bearing housing retainer

To Remove the Differential

5. Remove the differential bearing housing retainers, Fig. 29.

   Unscrew both differential bearing housings from the rear axle casing using Special Tool 15-071, Fig. 30.

NOTE: Mark the differential bearing housings and axle casing for reassembly.

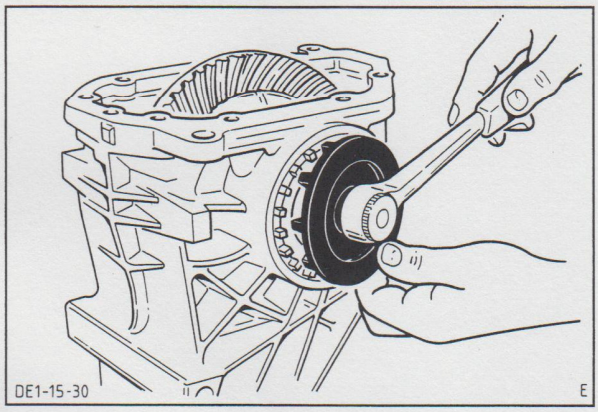


Fig. 30. Unscrew differential bearing housing.

   Lift the differential assembly out of the rear axle casing.

6. Hold the drive pinion flange with Special Tool 15-030 and unscrew the nut, Fig. 31.

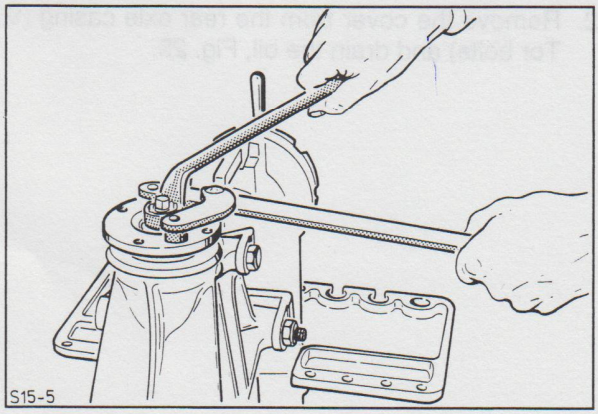


Fig. 31. Remove flange nut, holding flange with Special Tool 15-030.

7. Using a suitable puller, remove the drive flange from the pinion, Fig. 32.

   Remove the pinion oil seal from the rear axle casing using Special Tool 15-072.

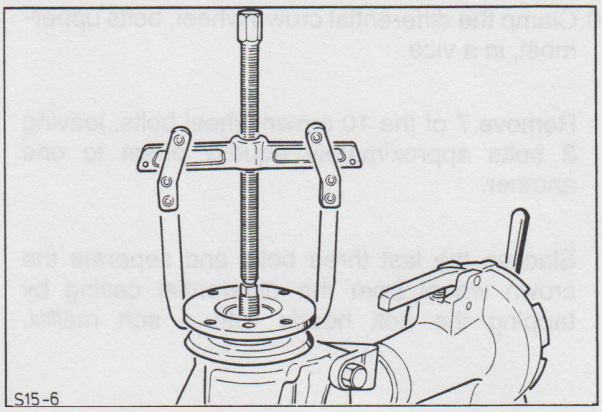


Fig. 32. Pull off drive flange.

To Remove the Drive Pinion

8. Fit Holding Tool GV-1504 on the drive pinion nut and bolt it to the casing, Fig. 33.

   Fit Special Socket 15-073 on the drive splines and unscrew the nut by rotating the pinion anti-clockwise.

   Drive out the pinion using a copper mallet.

   Remove the outer taper roller bearing.

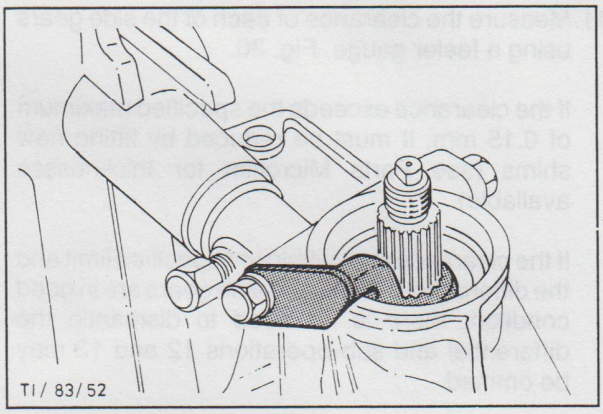


Fig. 33. Holding tool GV-1504 in use.

To Dismantle the Differential

NOTE: Do **not** dismantle limited slip differentials. They are only replaced as complete units.

9. Fit Special Tool 15-026 A over the differential taper roller bearing. Clamp one leg of the tool in the vice and pull off the bearing.

   Repeat the operation for the other bearing.

   Mark the taper roller bearings if they are to be used for reassembly.

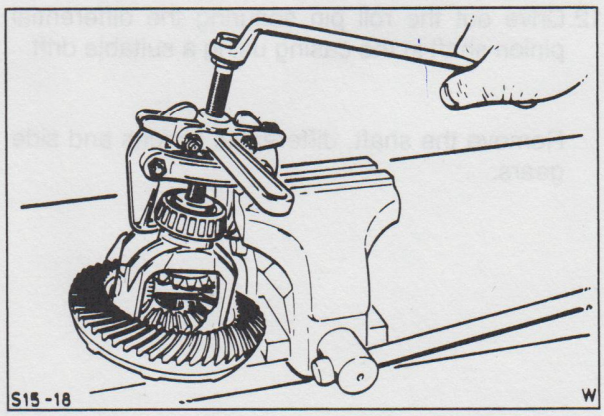


Fig. 34. Remove differential taper roller bearing.

10. Clamp the differential crown wheel, bolts uppermost, in a vice.

    Remove 7 of the 10 crown wheel bolts, leaving 3 bolts approximately equally offset to one another.

    Slacken the last three bolts and separate the crown wheel from the differential casing by tapping the bolt heads with a soft mallet.

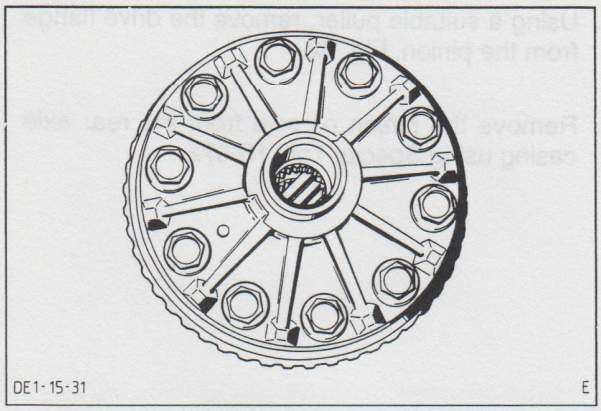


Fig. 35. Attachment of crown wheel to differential casing.

11. Measure the clearance of each of the side gears using a feeler gauge, Fig. 36.

    If the clearance exceeds the specified maximum of 0.15 mm, it must be reduced by fitting new shims (see Parts Microfilm for thicknesses available).

    If the clearances are within the specified limit and the differential pinions and side gears are in good condtion, there is no need to dismantle the differential and sub-operations 12 and 13 may be omitted.

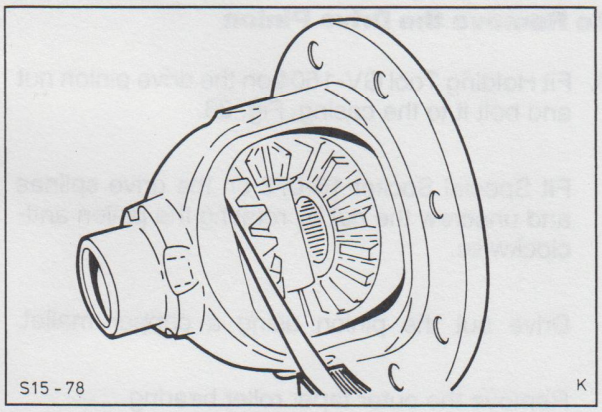


Fig. 36. Measure clearance of side gears.

12. Drive out the roll pin securing the differential pinion shaft in the casing using a suitable drift.

    Remove the shaft, differential pinions and side gears.

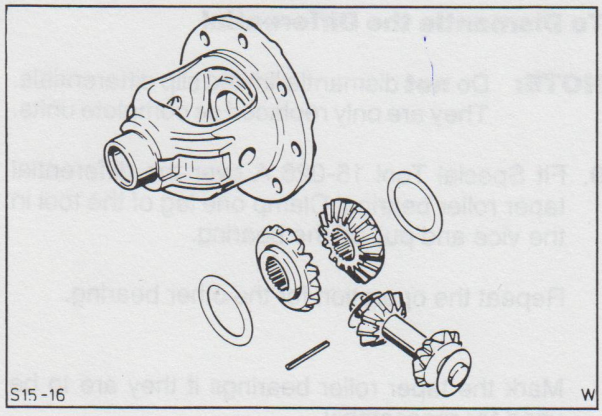


Fig. 37. Differential - exploded view.

To Reassemble the Differential

13. Insert the side gears with new shims into the differential casing.

    Position the two differential pinions and new thrust washers in between the side gears. Rotate the gears to align with the shaft holes, Fig. 38. Insert the shaft making sure to align the drilling for the roll pin.

    Recheck the clearance of the side gears (max. 0.15 mm) using a feeler gauge. If necessary, dismantle the differential again and fit thicker shims.

    Secure the differential shaft with a roll pin, Fig. 39.

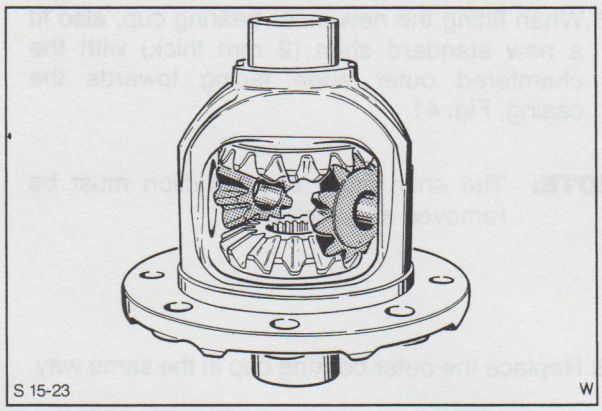


Fig. 38. Rotate differential pinions into the differential casing.

14. Immerse the crown wheel in boiling water for about 10 minutes or heat it on a hot plate. The crown wheel is an interference fit on the casing and should not be assembled cold.

    Draw the crown wheel uniformly onto the differential casing using four of the original bolts.

    Remove the old bolts, insert new bolts and tighten to the specified torque (see Technical Data).

    Do not fit the taper roller bearings at this stage.

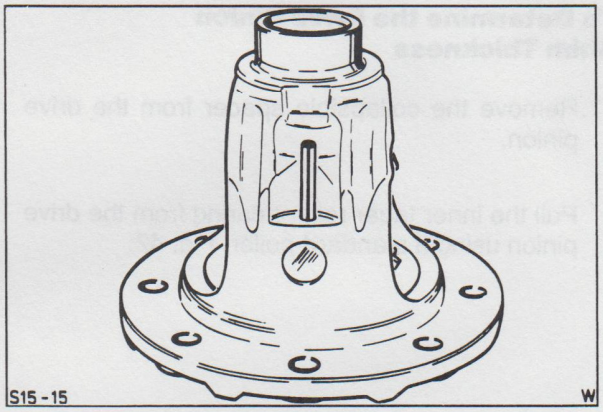


Fig. 39. Roll pin securing differential pinion shaft.

To Replace the Pinion Bearing Cups

NOTE: Because the casing is aluminium, the two bearing cups must only be removed one at a time and never simultaneously, so that the other bearing cup can act as a guide.

Therefore, the appropriate stepped washer, part of installer 15-003, must also be used to guide remover 15-074 as shown in Fig. 40.

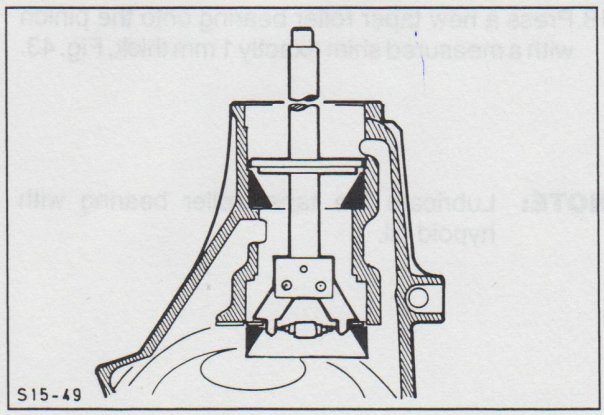


Fig. 40. Remove inner bearing cup using special tools.

15. When fitting the new inner bearing cup, also fit a new standard shim (2 mm thick) with the chamfered outer edge facing towards the casing, Fig. 41.

NOTE: The shim fitted in production must be removed and scrapped.

16. Replace the outer bearing cup in the same way.

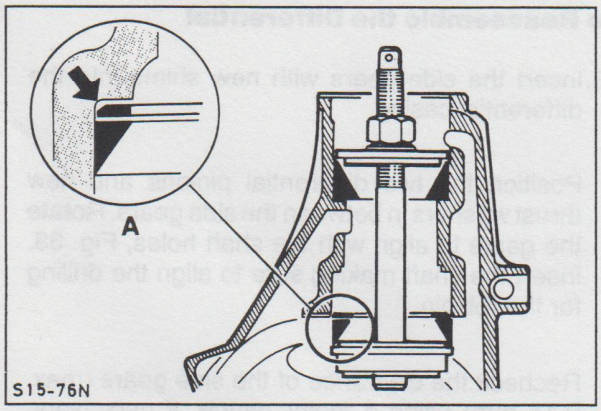


Fig. 41. Fit inner bearing cup using special tools.
A - Standard shim.

To Determine the Drive Pinion Shim Thickness

17. Remove the collapsible spacer from the drive pinion.

Pull the inner taper roller bearing from the drive pinion using a standard puller, Fig. 42.

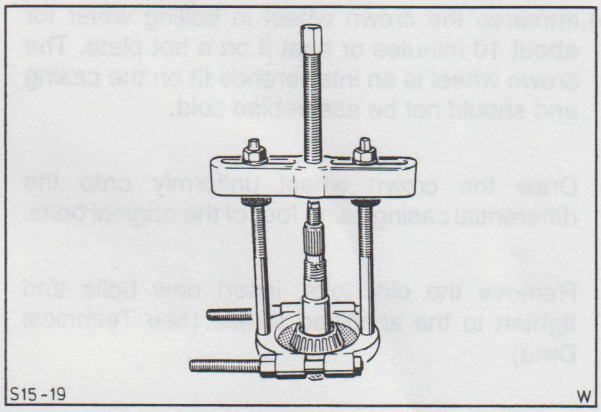


Fig. 42. Pull taper roller bearing off drive pinion.

18. Press a new taper roller bearing onto the pinion with a measured shim exactly 1 mm thick, Fig. 43.

NOTE: Lubricate the taper roller bearing with hypoid oil.

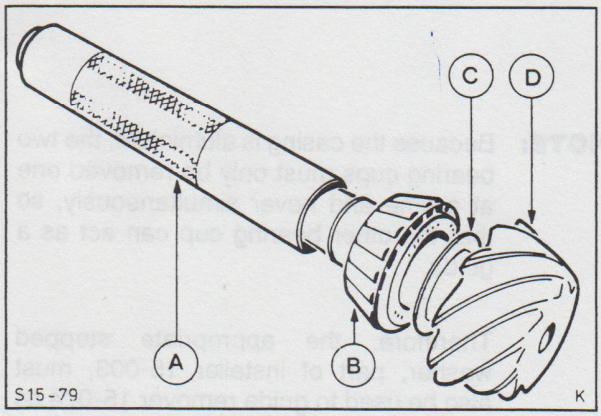


Fig. 43. A - Installer 15-042
B - Taper roller bearing
C - Measured shim
D - Drive pinion

19. Insert the drive pinion in the rear axle casing and fit the outer taper roller bearing. Fit the pinion nut and hold it using Holding Tool GV-1504, Fig. 44.

    Fit Special Socket 15-073 onto the pinion splines and progressively tighten the nut by turning the drive pinion clockwise.

    Continuously check the turning torque of the drive pinion as the nut is tightened using preload gauge 15-041, Fig. 45.

    Gradually tighten the pinion nut until the reading matches the specified turning torque (see Technical Data).

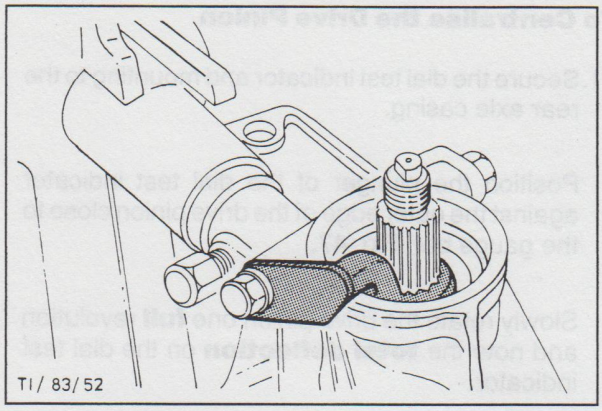


Fig. 44. Holding Tool GV-1504 in use.

To Install the Gauge Bar

20. Install the right and left hand differential bearing housings, without the O-ring seals, as a pair, with the bearings and the gauge bar into the rear axle casing.

    Lubricate the bearings with hypoid oil. Screw in the differential bearing housings uniformly finger tight until they abut the bearing cups.

    Hold gauge bar with a suitable drift, Fig. 46, and unscrew the gauge bar adjusting nut until the gauge bar can just be turned by the adjusting nut by hand (having removed the drift).

    Rotate the gauge bar a number of turns to settle the bearings.

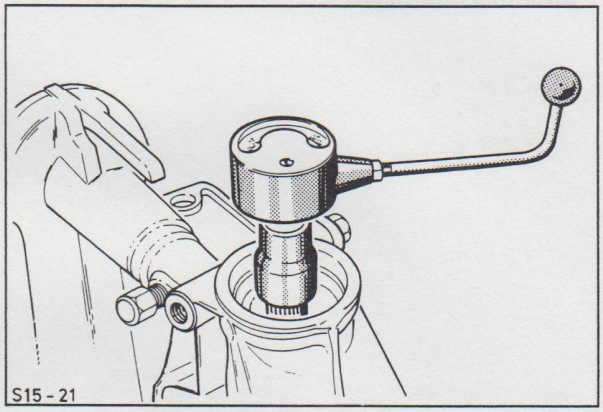


Fig. 45. Check turning torque of drive pinion.

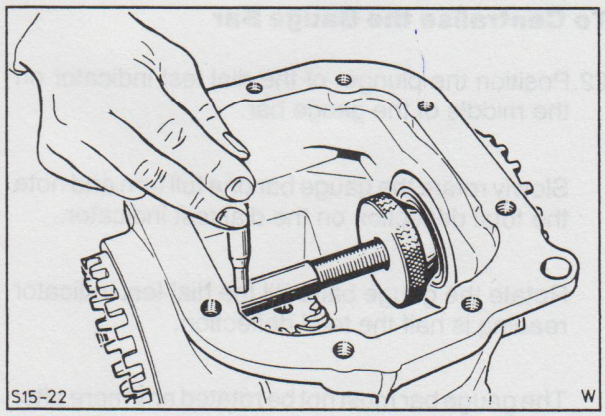


Fig. 46. Setting up gauge bar.

To Centralise the Drive Pinion

21. Secure the dial test indicator and mounting to the rear axle casing.

    Position the plunger of the dial test indicator against the outer edge of the drive pinion close to the gauge bar, Fig. 47.

    Slowly rotate the drive pinion one **full** revolution and note the **total deflection** on the dial test indicator.

    Then rotate the drive pinion until the dial test indicator reading is **half** the value of the **total deflection.**

    The drive pinion must not be rotated any more after this operation.

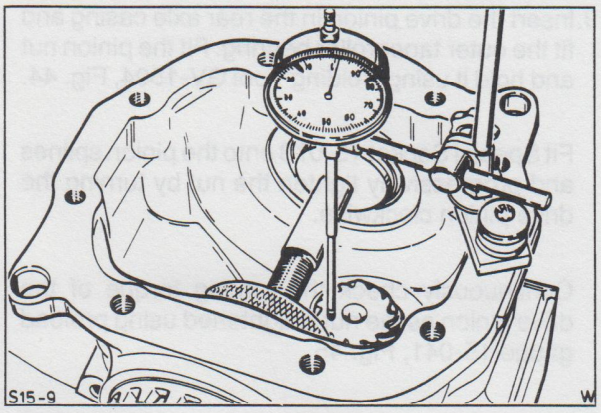


Fig. 47. Centralise drive pinion.

To Centralise the Gauge Bar

22. Position the plunger of the dial test indicator on the middle of the gauge bar.

    Slowly rotate the gauge bar one full turn and note the total deflection on the dial test indicator.

    Rotate the gauge bar until the dial test indicator reading is half the total deflection.

    The gauge bar must not be rotated any more after this, Fig. 48.

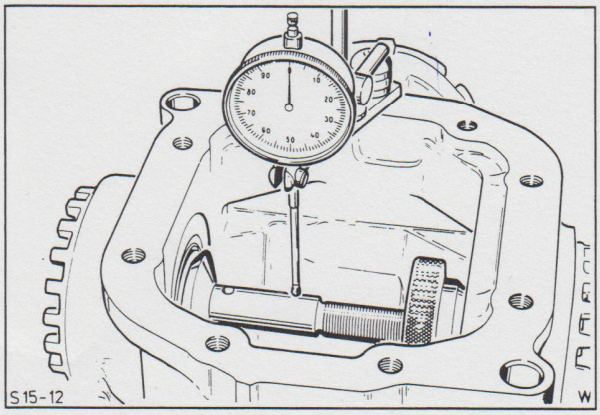


Fig. 48. Centralise gauge bar.

23. Remove the dial test indicator from the fixture and fit it in the mounting block 15-008.

    Place the mounting block and dial test indicator on a surface plate and set the dial test indicator to '0' using step gauge 15-075, Fig. 49.

NOTE: A dial test indicator with a pointer which rotates clockwise when the plunger is pressed in must be used for this operation.

NOTE: The millimetre scale of the dial test indicator must be set to 1 and the large pointer of the dial test indicator to '0', Fig. 49, in order to obtain a reading when measuring the depth of the drive pinion.

    7" axle: Set the dial test indicator to '0' on the upper step.

    7.5" axle: Set the dial test indicator to '0' on the lower step.

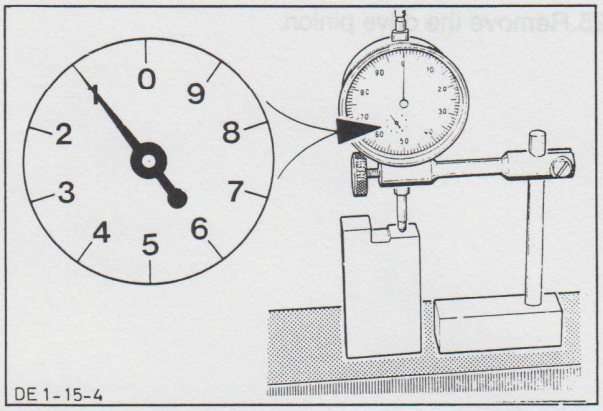


Fig. 49. Zero dial test indicator using step gauge.

24. Position the mounting block and dial test indicator on the centre of the drive pinion end face and slowly move the plunger of the dial test indicator transversely across the gauge bar, Fig. 50.

    Observe the dial test indicator and note the measurement at the precise position at which the pointer changes direction.

    Repeat this process a number of times as accurately as possible.

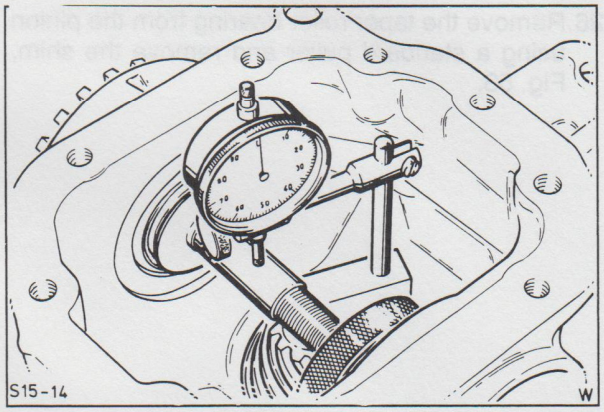


Fig. 50. Dial test indicator reading at '0' position.

NOTE: Add the value to the **right** of the '0' to the 1 mm shim under the pinion head, Fig. 52.

    Subtract the value to the left of the '0' from the shim thickness, Fig. 51.

Example

Thickness of the shim under the drive pinion:	1.00 mm
Dial test indicator reading to the left of the '0' e.g. 95	− 0.05 mm
	= 0.95 mm

    This value is thickness of the shim required between the large taper roller bearing and the pinion head.

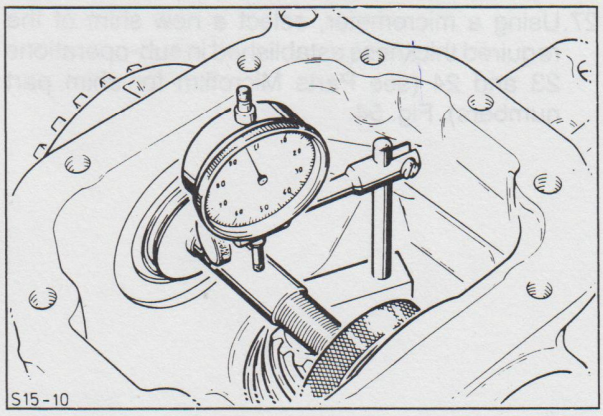


Fig. 51. Dial test indicator reading to the left of the '0'. Shim under pinion is too thick.

25. Remove the drive pinion.

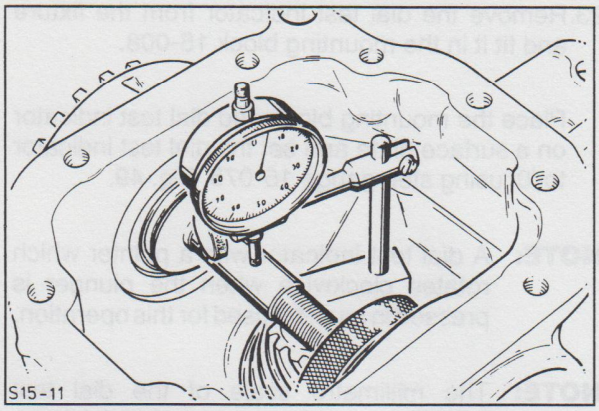


Fig. 52. Dial test indicator to the right of the '0'. Shim under pinion is too thin.

26. Remove the taper roller bearing from the pinion using a standard puller and remove the shim, Fig. 53.

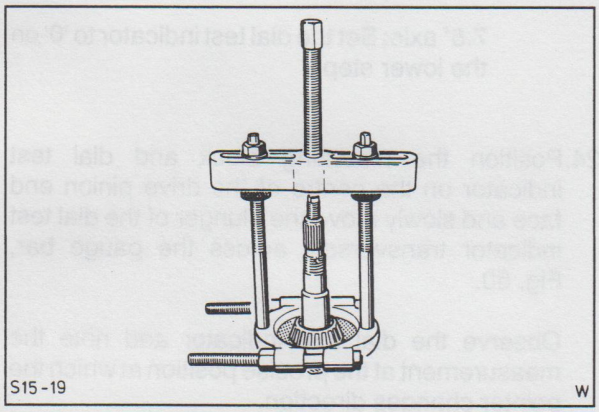


Fig. 53. Pull taper roller bearing off drive pinion.

27. Using a micrometer, select a new shim of the required thickness established in sub-operations 23 and 24 (see Parts Microfilm for shim part numbers), Fig. 54.

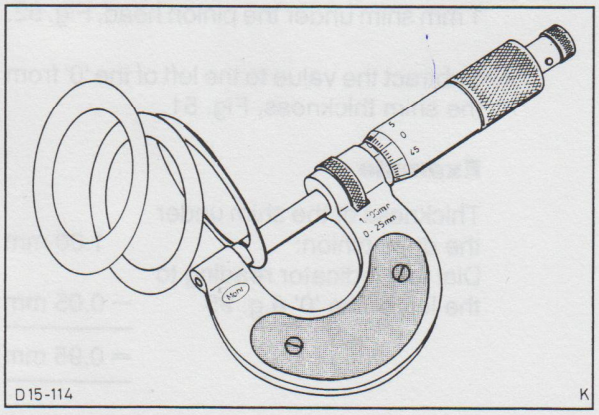


Fig. 54. Measure new shims with micrometer.

28. Fit the shim onto the drive pinion and press on the taper roller bearing using Special Tool 15-042, Fig. 55.

Fig. 55. Press taper roller bearing and shims onto drive pinion.
A - Installer
B - Taper roller bearing
C - Shim
D - Drive pinion

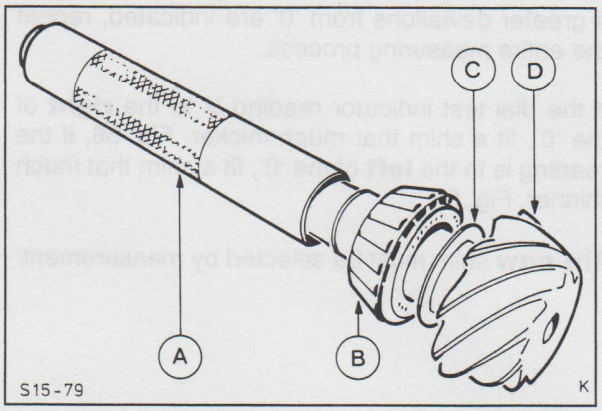


Fig. 55. Press taper roller bearing and shim onto drive pinion.

29. Refit the drive pinion as described in sub-operation 19.

30. Centralise the drive pinion as described in sub-operation 21, Fig. 56.

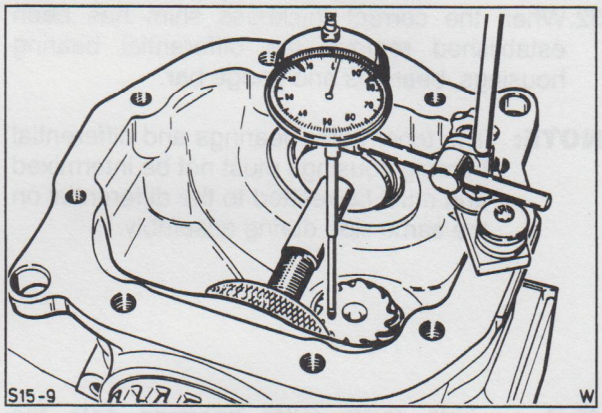


Fig. 56. Centre drive pinion using dial indicator.

31. Check that the dial test indicator on the mounting block is still at '0' using the step gauge on a ground surface.

Place the mounting block and dial test indicator on the end of the drive pinion and move the plunger of the dial test indicator transversely across the gauge bar.

The dial test indicator must read '0' if the preceding measurements have been carried out accurately.

A maximum deviation of ± 0.01 mm from '0' is permissable, Fig. 27.

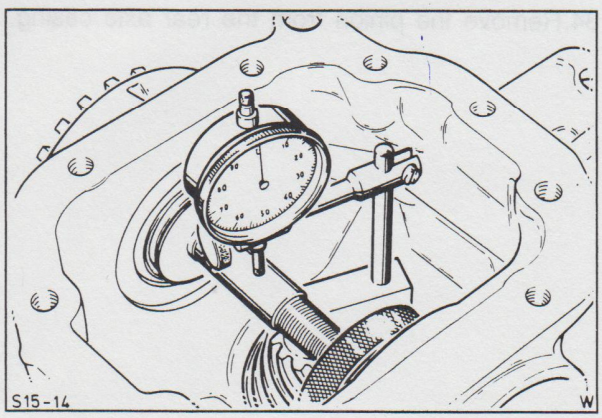


Fig. 57. Dial test indicator in '0' position (maximum deviation 0.01 mm).

If greater deviations from '0' are indicated, repeat the entire measuring process.

If the dial test indicator reading is to the **right** of the '0', fit a shim that much thicker, Fig. 58, if the reading is to the **left** of the '0', fit a shim that much thinner, Fig. 59.

The **new** shim must be selected by measurement.

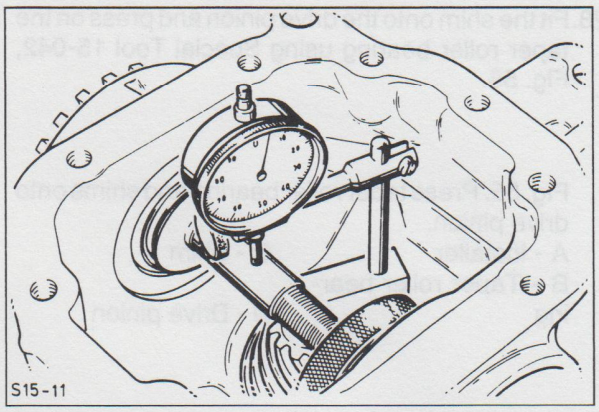


Fig. 58. Dial test indicator reading to the right of the '0'. Shim under pinion is too thin.

32. When the correct thickness shim has been established remove the differential bearing housings, bearings and gauge bar.

NOTE: The taper roller bearings and differential bearing housings must not be intermixed and must be refitted to the differential on the same side during assembly.

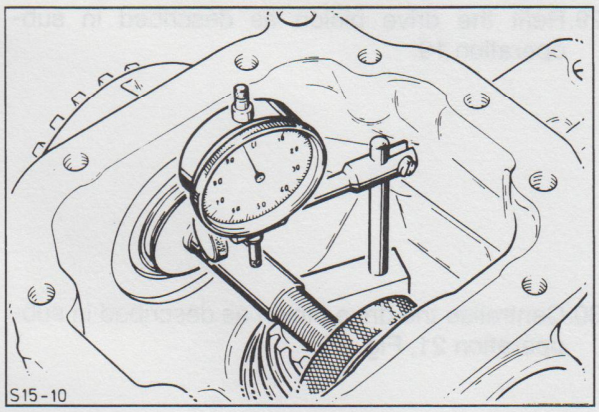


Fig. 59. Dial test indicator reading to the left of the '0'. Shim under pinion is too thick.

33. Press both taper roller bearings onto the differential using Special Tool 15-032, Fig. 60.

34. Remove the pinion from the rear axle casing.

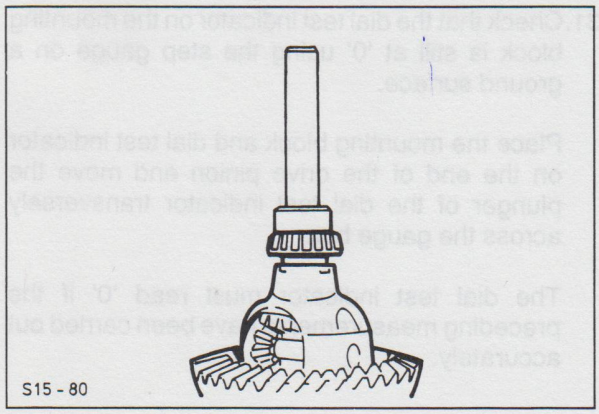


Fig. 60. Press taper roller bearing onto differential using Special Tool 15-032.

To Install the Drive Pinion

35. Insert the drive pinion in the rear axle casing with a new collapsible spacer and outer taper roller bearing, lubricate the bearings with the specified hypoid oil, Fig. 61.

NOTE: The drive pinion nut has a left hand thread.

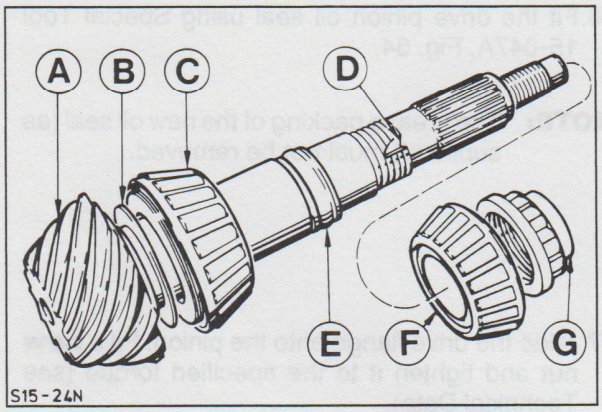


Fig. 61. Parts of drive pinion assembly.

Fig. 61. Parts of drive pinion assembly.

A - Drive pinion
B - Shim
C - Inner taper roller bearing
D - Circlip groove
E - Collapsible spacer
F - Outer taper roller bearing
G - Drive pinion nut

Screw on a new drive pinion nut, hold it with-holding tool GV-1504 and tighten using Special Tool 15-073, Fig. 62.

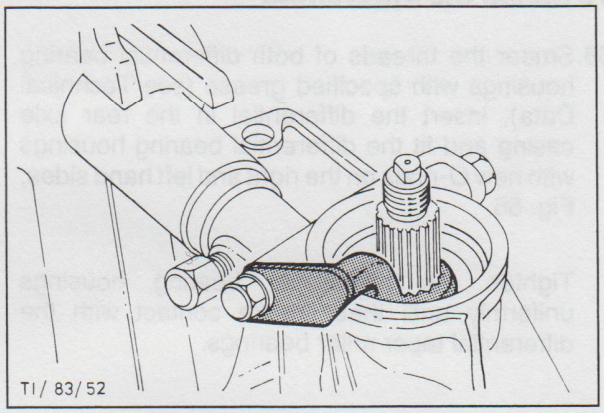


Fig. 62. Holding tool GV-1504 in use.

As the nut is tightened continuously check the turning torque of the drive pinion using torque gauge 15-041, Fig. 63.

NOTE: If the specified turning torque is exceeded, the drive pinion must be removed and the process repeated with a new collapsible spacer. The turning torque must **not** be corrected by slackening the pinion nut.

Tighten the pinion nut until the specified turning torque is obtained (see Technical Data).

Lock the pinion nut by staking the collar of the nut into the two grooves in the drive pinion.

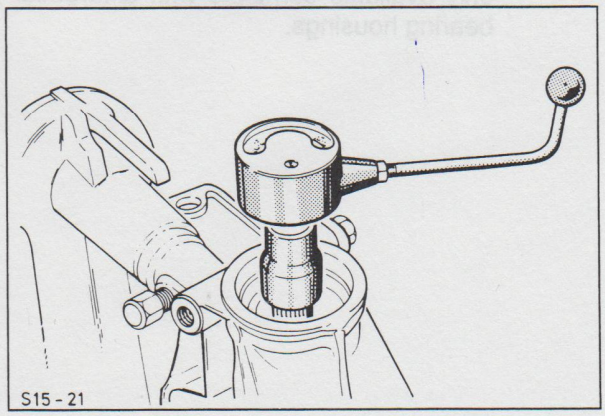


Fig. 63. Check turning torque of drive pinion (preload gauge 15-041).

36. Fit the drive pinion oil seal using Special Tool 15-047A, Fig. 64.

NOTE: The grease packing of the new oil seal (as supplied) must not be removed.

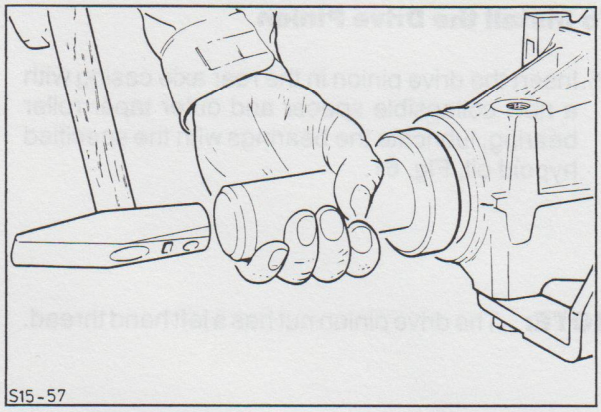


Fig. 64. Replacing drive pinion oil seal using Special Tool 15-047-A.

37. Slide the drive flange onto the pinion. Fit a **new** nut and tighten it to the specified torque (see Technical Data).

Hold the driveshaft flange with Special Tool 15-030, Fig. 65.

To Install the Differential

38. Smear the threads of both differential bearing housings with specified grease (see Technical Data), insert the differential in the rear axle casing and fit the differential bearing housings with new O-rings on the right and left hand sides, Fig. 66.

Tighten the differential bearing housings uniformly until these make contact with the differential taper roller bearings.

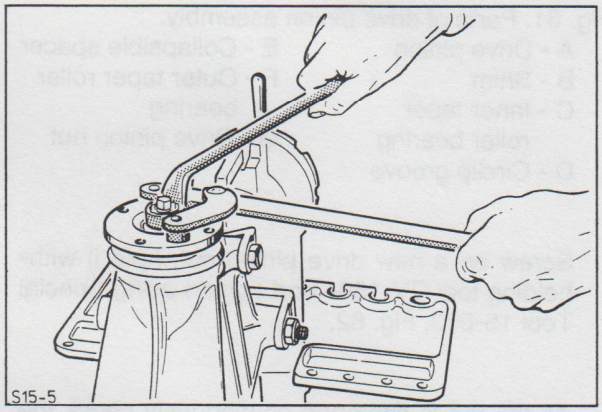


Fig. 65. Hold drive flange with Special Tool 15-030.

Rotate the drive pinion a number of turns to settle the bearings. There must be appreciable backlash between the pinion and crown wheel.

NOTE: New differential taper roller bearings are only available complete with differential bearing housings.

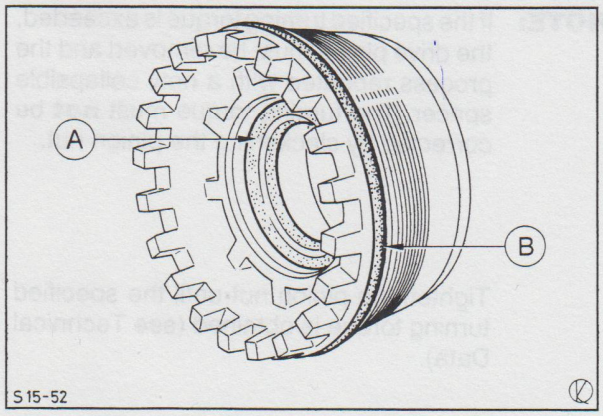


Fig. 66. Differential bearing housing.
A - Oil seal B - O-ring

To Adjust the Backlash

39. Secure a dial test indicator to the axle casing using a holding fixture and position the dial test indicator plunger on one of the crown wheel teeth at right angles to the tooth flank, Fig. 67.

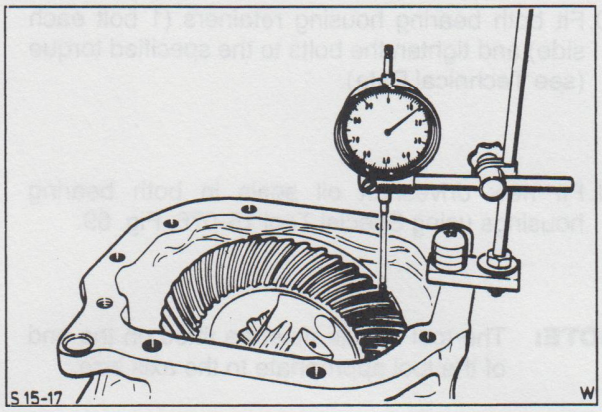


Fig. 67. Position plunger of dial test indicator at right angles to crown wheel tooth.

Screw in the differential bearing housing on the crown wheel side using Special Tool 15-071 (loosen the bearing on the opposite side by the same amount) until a backlash of 0.01 mm is obtained.

Tighten the differential bearing housing on the differential side a further 4 or 5 teeth, Fig. 68.

The backlash should be as specified (see Technical Data) if the preceding operations have been carried out correctly.

Rotate the pinion and crown wheel a number of turns and recheck the backlash mesurement at three points.

Maximum backlash variation 0.03 mm.

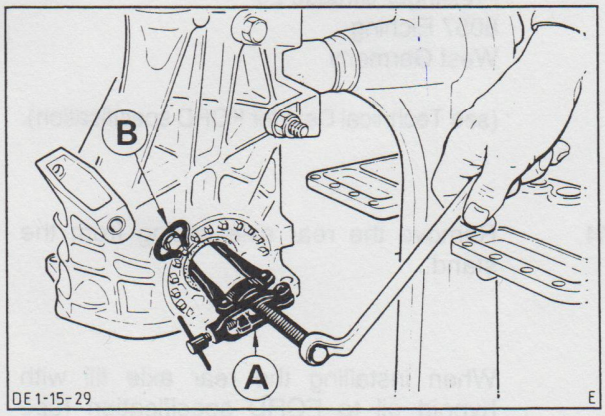


Fig. 68. Tighten differential bearing housing 4 or 5 teeth.

40. Fit both bearing housing retainers (1 bolt each side) and tighten the bolts to the specified torque (see Technical Data).

41. Fit new driveshaft oil seals in both bearing housings using Special Tool 15-076, Fig. 69.

NOTE: The tool handle must be fitted on the end of the tool appropriate to the axis size.

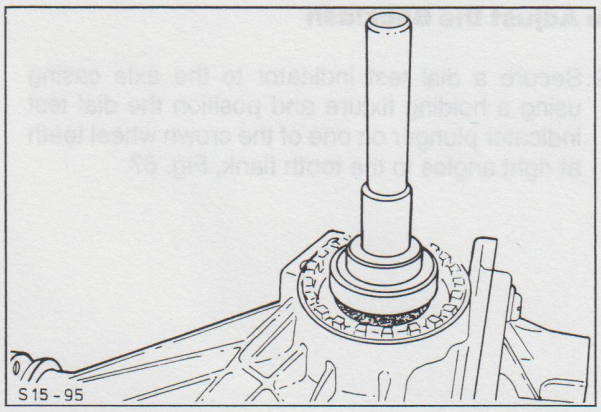


Fig. 69. Fit oil seal in bearing housing.

42. Guide the driveshaft flanges into the differential and secure with the circlips.

NOTE: Select the thickness of the circlips (see Parts Microfilm) so that the driveshaft flange end float does not exceed 0.3 mm after assembly.

43. Fit the rear axle casing cover using liquid sealer 1110 B and secure the nine Torx bolts to the specified torque (see Technical Data), Fig. 70.

Use a standard T 50 Torx key.

Type 110 B liquid sealer can be obtained from the following firm:

Drie Bond GmbH
Chemische Verbindungstechnik
Freisinger Strasse 25
8057 Eiching
West Germany

(see Technical Data for FORD specification).

44. Remove the rear axle casing from the stand.

When installing the rear axle fill with hypoid oil to FORD specification (see Technical Data).

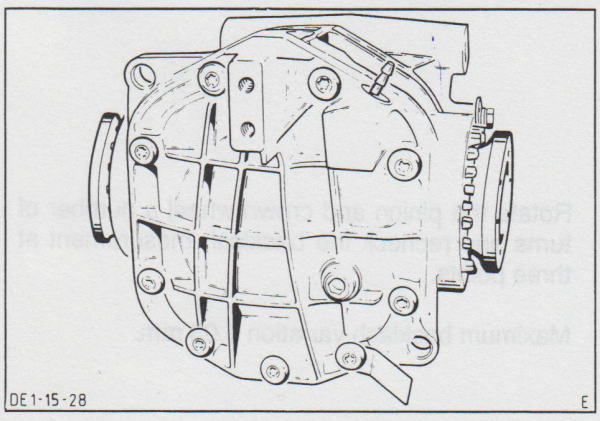


Fig. 70. Attachment of rear axle casing cover.

15 308 0 Seal - Drive Pinion - Replace

Special Service Tools Required:

Universal flange holding wrench 15-030
Pinion oil seal installer ..... 15-047 A
Pinion oil seal remover 15-072

To Remove

1. Raise the vehicle on a lift.

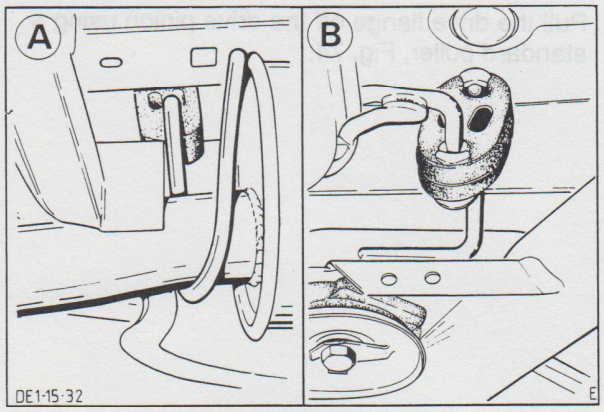


Fig. 71. A - Rear exhaust insulator
B - Middle exhaust insulator

2. Unhook the rear part of the exhaust system from the insulators, Fig. 71.

   Support the exhaust system from the floor panel with wire at a suitable point.

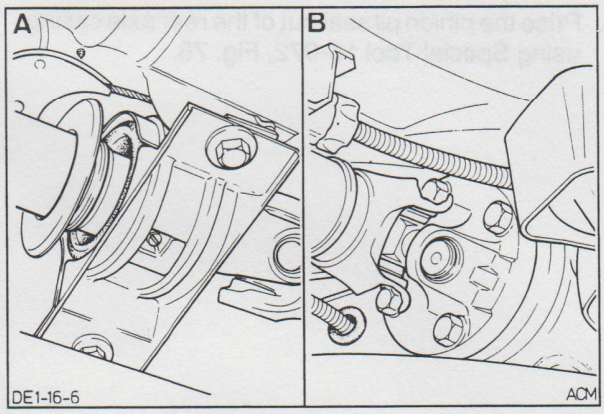


Fig. 72. A - Driveshaft centre bearing
B - Driveshaft rear flange

3. Disconnect the driveshaft from the drive flange and the centre bearing from the floor assembly, Fig. 72. Retain the spacer washers.

   Remove the driveshaft and plug the transmission with a plastic sleeve, Fig. 73.

4. Hold the drive flange with Special Tool 15-030 and unscrew the retaining nut.

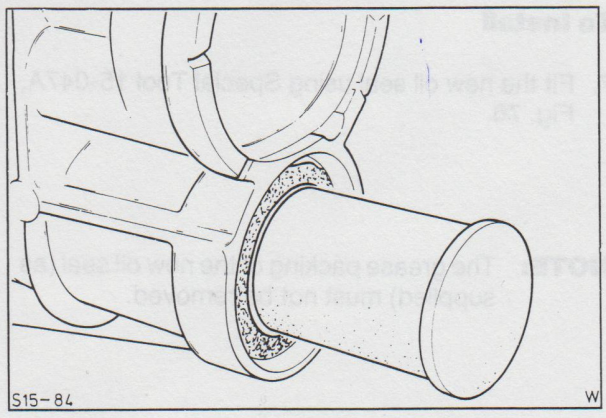


Fig. 73. Plug transmission with a plastic sleeve.

5. Pull the drive flange off the drive pinion using a standard puller, Fig. 74.

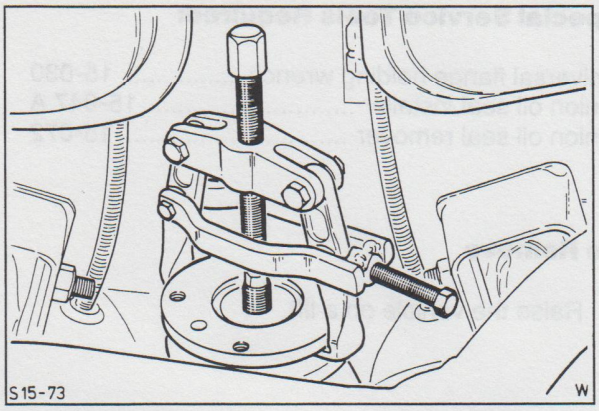


Fig. 74. Remove drive flange.

6. Prise the pinion oil seal out of the rear axle casing using Special Tool 15-072, Fig. 75.

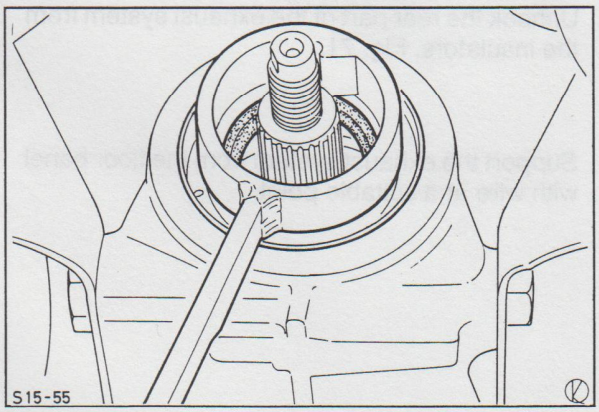


Fig. 75. Remove pinion oil seal.

To Install

7. Fit the new oil seal using Special Tool 15-047A, Fig. 76.

NOTE: The grease packing of the new oil seal (as supplied) must not be removed.

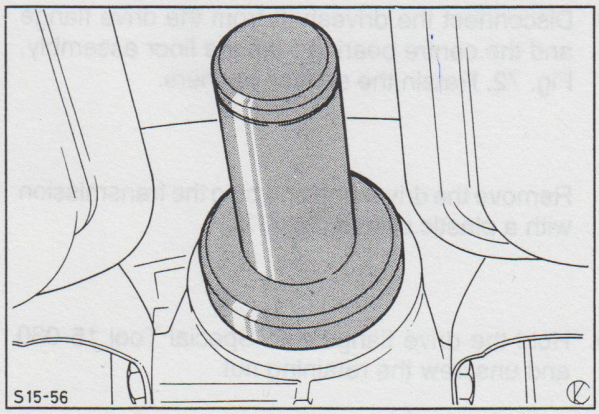


Fig. 76. Fit pinion oil seal.

8. Fit the flange onto the drive pinion, hold it using Special Tool 15-030 and tighten the self-locking nut to the specified torque (see Technical Data), Fig. 77.

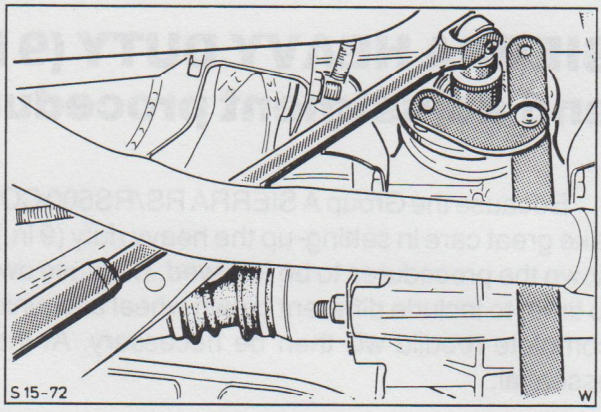


Fig. 77. Hold drive flange with special tool and tighten flange nut.

9. Remove the plastic sleeve from the extension housing and guide the splined end of the driveshaft into the extension housing Fig. 78.

Loosely mount the centre bearing housing on the floor assembly. Remember the spacer washers.

Secure the driveshaft to the drive flange, tighten the bolts to the specified torque (see Technical Data), Fig. 79.

Tighten the centre bearing housing bolts to the specified torque (see Technical Data), Fig. 79.

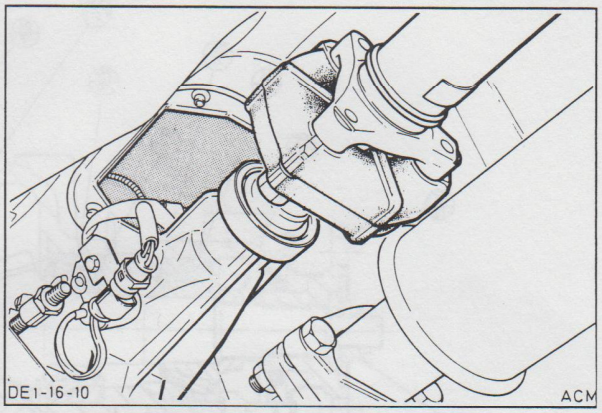


Fig. 78. Guide splined end of driveshaft into extension housing.

10. Attach the exhaust system into the insulators.

11. Check the rear axle and transmission oil levels and top up as necessary (see Technical Data for oil capacity and specification).

12. Lower the vehicle to the ground.

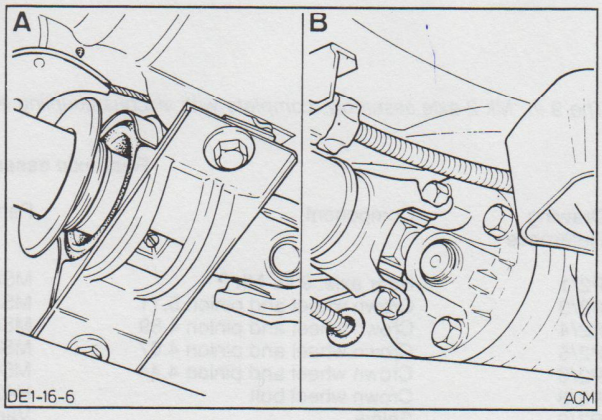
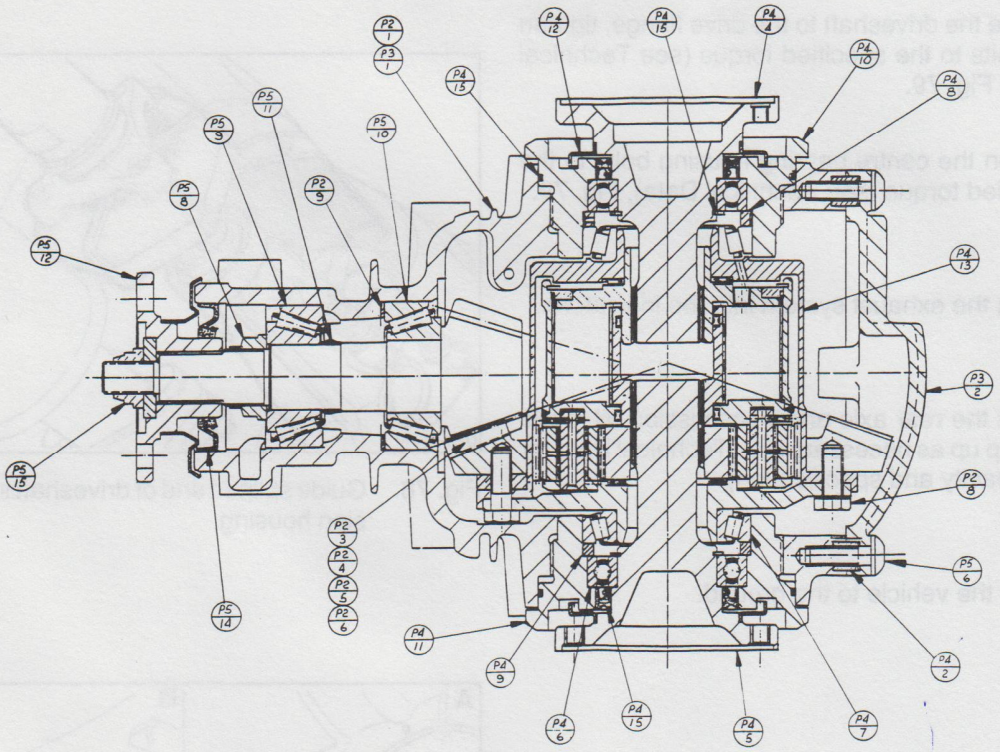


Fig. 79. A - Driveshaft centre bearing
B - Driveshaft rear flange

SIERRA HEAVY DUTY (9 in.) Rear Axle: Setting-up and adjustment procedures

Because the Group A SIERRA RS/RS500 COSWORTH is such a powerful car, it is advisable to take great care in setting-up the heavy duty (9 in.) rear axle for use in motorsport. This section lays down the procedures to be followed. Because owners will invariably modify the rear axle from time to time, to include different crown wheel and pinion ratios, and modified limited slip differentials, a complete rebuild will then be necessary. At that stage, accurate assembly and adjustment is essential.

Please note that the rear axle used in the standard SIERRA RS/RS500 COSWORTH is basically the same as that used in the GRANADA/SCORPIO. Special tools necessary for the rebuilding of that axle may also be used in re-building, or adjusting, the heavy duty axle.



The 9 in. Mk 2 axle assembly, complete with viscous coupling limited slip differential.

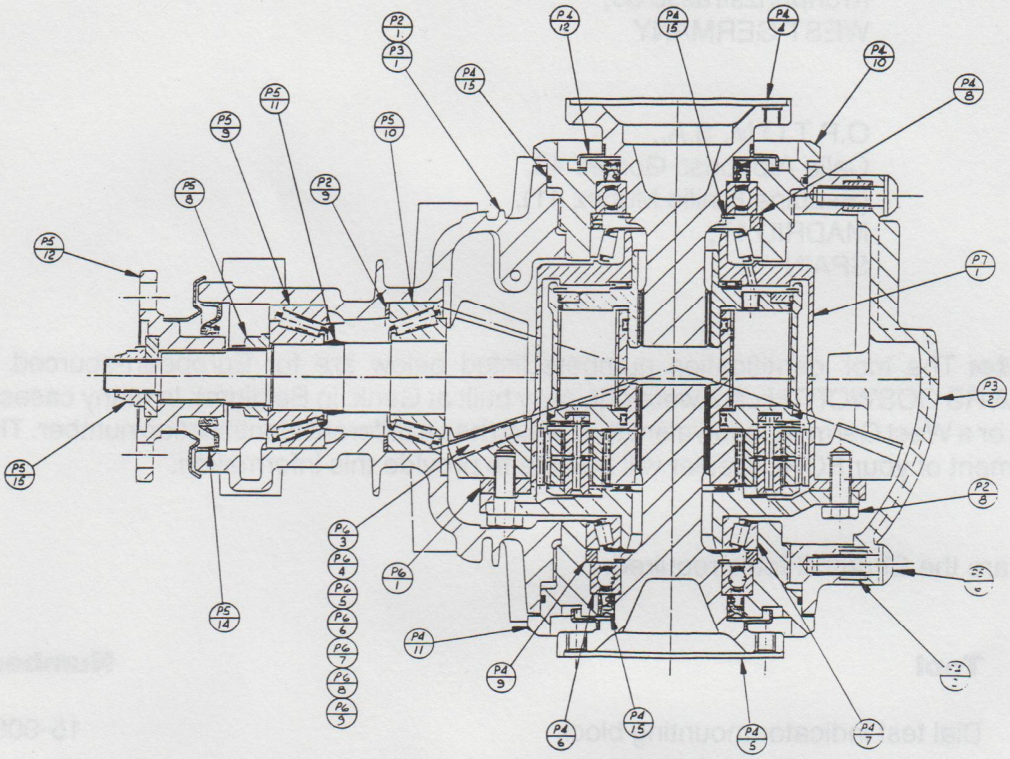
Rear axle assembly - 9 in. Mk 2

Drawing Reference	Component	Part No	Finis Code
P2/1	Rear axle, 9 in. Mk 2	MS88BB4A007AA	9092970
P2/3	Crown wheel and pinion 5.11	MS87BB4209AA	9092446
P2/4	Crown wheel and pinion 4.89	MS87BB4209BA	9092447
P2/5	Crown wheel and pinion 4.67	MS87BB4209CA	9092445
P2/6	Crown wheel and pinion 4.44	MS87BB4209DA	9092448
P2/8	Crown wheel bolt	H437F085S	9092508
P2/9	Shims	Various	Various
P3/1	Case assembly	MS88BB4025AA	9093242
P3/2	Cover assembly	MS87BB4033BB	9093322
P4/2	Dowel	MS88BB4003AA	9093240
P4/4	Output flange, RH	MS88BB4K033AA	9093251
P4/5	Output flange, LH	MS88BB4K185AA	9093250
P4/6	Bearing assembly - Outer	MS88BB4220AA	9093245

Continued from page 101

Rear axle assembly - 9 in. Mk 2

Drawing Reference	Component	Part No	Finis Code
P4/7	Bearing assembly - Inner	MS88BB4220BA	9093246
P4/8	Spacer - RH	MS88BB4548AA	9093247
P4/9	Spacer - LH	MS88BB4548BA	9093248
P4/10	Bearing housing - RH	MS88BB4K334AA	9093252
P4/11	Bearing housing - LH	MS88BB4K334BA	9093253
P4/12	Dust shield	MS88BB4676AA	9093254
P4/13	Limited slip differential (VC 400Nm)	MS88BB4K343AA	9093244
P4/15	Kit - bearing housing seals	MS87BB3K169AA	9092512
P5/6	Screw	E8043305201	6132498
P5/8	Nut, pinion bearing	E822122S82	6136522
P5/9	Bearing - front	11440378	0440378
P5/10	Bearing - rear	11440375	0440375
P5/11	Collapsible spacer	72GG4662AA	1498537
P5/14	Oil seal	83BG4676AK	6099522
P5/15	Nut	E822120S76	6122453



For racing, with much higher gearing (— numerically lower crown wheel/pinion axle ratios) the 9 in. Mk 2 rear axle has slight internal differences and a higher rating to the viscous coupling.

Rear axle assembly - 9 in. Mk 2 - race version

Drawing Reference	Component	Part No	Finis Code
P2/1	Rear axle, 9 in. Mk 2	MS88BB4A007AA	9092970
P6/3	Crown wheel and pinion 4.27	MS88BB4209EA	9092955
P6/4	Crown wheel and pinion 4.09	MS88BB4209FA	9092956
P6/5	Crown wheel and pinion 3.82	MS88BB4209GA	9092957
P6/6	Crown wheel and pinion 3.64	MS88BB4209HA	9092958
P6/7	Crown wheel and pinion 3.42	MS88BB4209IA	9092959
P6/8	Crown wheel and pinion 3.25	MS88BB4209JA	9092960
P6/9	Crown wheel and pinion 3.08	MS88BB4209KA	9092961
P6/1	Conversion kit - rally to race axle	MS88BB4K344AA	9092962
P7/1	Limited slip differential (VC 600Nm)	MS88BB4K343BA	9093276
	For other details, see the adjoining rear axle assembly drawing.		

Special Service Tools required for Rebuilds

A series of special tools are required for the work listed below. Those customers familiar with the 'Atlas' axles used in Escort RS, or Capri models may already have most of these tools in their possession. These tools may be obtained from:

V. L. Churchill & Co. Ltd.,
P.O. Box No. 3,
London Road,
Daventry,
NORTHANTS NN11 4NF (UK)

V. Loewener,
D-4018 Langefeld,
Kronprinzstrasse 35,
WEST GERMANY

O.P.T.O.M. S.A.,
Calle Alphonso Gomez 42,
(Esquina Emilio Munez 41),
MADRID 17,
SPAIN

Note: The tool identification numbers listed below are for European-sourced cars (the SIERRA RS COSWORTH cars were originally built at Genk, in Belgium). In many cases there is a British, or a West German, equivalent tool, which has a different identification number. The service department of your FORD Dealer will be able to provide this information.

These are the Churchill tools required:

Tool	Number
Dial test indicator mounting block	15-008
Dial test indicator holding fixture adaptor	15-008-01
Gauge bar	15-019
Oil seal and bearing cup installer	14-019
Master pinion	15-020
Dial test indicator holding fixture	15-022-A
Preload sleeve	15-023
Universal flange holding wrench	15-030
Bearing cup installer	15-033

Tools continued from page 103

Tool	Number
Preload gauge	15-041
Pinion bearing installer	15-042
Dial test indicator (graduated in mm)	15-046
Pinion oil seal installer	15-047
Pinion bearing cup installer	15-068
Rear axle mounting bracket	15-070
Pinion oil seal remover	15-072
Pinion preload socket	15-073
Pinion bearing cup remover	15-074

Use proprietary Installers and Removers to:

i) Remove oil seals from differential bearing housings
ii) Remove both the bearings from the housings

At this point, please note that the spacers between the ball bearing and the differential bearing cups, in the bearing housings, are of different thicknesses on each side. When rebuilding an axle, do **not** interchange these spacers from side to side.

Recommended Tightening Torques:

Operation	Torque - Nm	lb. ft.
Drive pinion turning torque when adjusting with special tool 5-041 (Aim for lower torque value of 1.6 Nm/1.2 lb. ft. when re-using old bearings)	2.5 to 3.0	1.8 to 2.2
Crown wheel to differential housing	85 to 90	63 to 66
Pinion bearing nut (minimum)	140	103
Pinion flange (drive pinion flange) self-locking nut	110 to 130	81 to 96
Bearing housing retainer	19 to 25	14 to 18
Rear axle casing to rear axle cross member mounting	70 to 90	52 to 66
Axle casing cover	45 to 60	33 to 44
Oil filler plug	35 to 45	26 to 33

Recommended sealants and grease:

Liquid sealant - rear axle case.	Use FORD Specification SQM 4G 9523 A
Grease - bearing housings.	Use FORD Specification ESEAM 1C 1014 A — or Texaco 75W 120 EP

Build Procedure:

Fit Pinion bearing cups. At the same time, fit a new standard shim (2mm thick) with the chamfered outer edge facing towards the casing.

NOTE: The shim originally fitted to the production car must be removed and scrapped. Replace the outer bearing cup in the same way.

To determine the Drive Pinion Shim Thickness:

Pull the inner taper roller bearing from the drive pinion using a standard puller.

Install the bearings on a Master Pinion, Tool No. 15-020. Install this in the housing using Pre-load Sleeve 15-023, tightening it to:

i) The **lower** line, for new bearings.
ii) The **upper** line, for used bearings.

NOTE: Lubricate the taper-roller bearing with hypoid oil.

To install Gauge Bar:

Install the right and left-hand bearing housings without the O-ring seals, as a pair with the bearings and the gauge bar into the rear axles.

Lubricate the bearings with hypoid oil. Screw in the bearing housings uniformly, finger tight, until they abut against the bearing cups.

Hold the gauge bar with a suitable drift and unscrew the gauge bar adjusting nut by hand (having removed the drift).

Rotate the gauge bar a number of turns to settle the bearings.

To centralise the Drive Pinion:

Secure the dial test indicator and mounting to the rear axle casing.

Position the plunger of the dial test indicator against the outer edge of the Master pinion close to the gauge bar.

Slowly rotate the Master pinion one full revolution and note the **total deflection** on the dial test indicator.

Then rotate the Master pinion until the dial test indicator reading is **half** the value of the **total deflection.**

The Master pinion must not be rotated any more after this operation.

To Centralise the Gauge Bar

Position the plunger of the dial test indicator on the middle of the gauge bar.

Slowly rotate the gauge bar one full turn and note the total deflection on the dial test indicator.

Rotate the gauge bar until the dial test indicator reading is half the total deflection.

The gauge bar must not be rotated any more after this.

Remove the dial test indicator from the fixture and fit it to the mounting block 15-008.

Place the mounting block and dial test indicator on to a surface plate and set the dial test indicator at '0' using a block precisely 32.9 mm high.

NOTE: A dial test indicator with a pointer which rotates clockwise when the plunger is pressed must be used for this operation.

NOTE: The millimetre scale of the dial test indicator must be set to '2' and the large pointer of the dial test indicator to '0'.

Position the mounting block and dial test indicator on the centre of the Master pinion end face and slowly move the plunger of the dial test indicator transversely across the gauge bar.

Observe the dial test indicator and note the measurement at the precise position at which the pointer changes direction.

Repeat this process a number of times as accurately as possible.

NOTE: Add the value to the **right** of the '0' to the 1 mm shim under the pinion head.

Subtract the value to the **left** of the '0' from the shim thickness.

Example:

Thickness of shim	1.00 mm
Dial test indicator reading to the left of the '0' (eg 95)	− 0.05 mm
	= 0.95 mm

This value is the thickness of shim required between the large taper roller bearing and the pinion head.

Remove the Master pinion.

Remove the taper roller bearing from the Master pinion.

Using a micrometer, select a new shim of the required thickness established by the above procedure.

Fit the shim onto the Master pinion.

Refit the Master pinion as described above.

Centralise the Master pinion as described above.

Check that the dial test indicator on the mounting block is still at '0' using the step gauge on the ground surface plate.

Place the mounting block and dial test indicator on the end of the Master pinion and move the plunger of the dial test indicator transversely across the gauge bar.

The dial test indicator must read '0' if the preceding measurements have been carried out accurately.

A maximum deviation of +/— 0.01 mm from '0' is permissible. However, if great deviations are indicated, repeat the entire measuring process.

NOTE: If the indicator reading is to the **right** of '0', fit a thicker shim; if the reading is to the **left** fit a thinner shim. The new shim **must** be selected by measurement.

When the correct thickness shim has been established, remove the Master pinion from the rear axle housing and remove the bearing housings, bearings and gauge bar.

NOTE: The taper roller bearings and bearing housings must **not** be inter-mixed. They must be refitted to the differential on the same side during assembly.

Press both taper roller bearings onto the differential, using a suitable tool.

Remove the pinion from the rear axle housing.

To install the Drive Pinion:

Remove the bearing and spacer from the Master pinion and instal them on to the drive pinion, using Special Tool 15-042.

Insert the drive pinion into the rear axle casing with a new collapsible spacer and outer taper roller bearing and lubricate the bearings with the specified hypoid oil.

NOTE: The drive pinion nut has a left-hand thread.

Screw on a new drive pinion nut, holding it with tool GV-1504, and tighten using special tool 15-073.

As the nut is tightened, continuously check the turning torque of the drive pinion, using torque gauge 15-041.

NOTE: If the specified torque is exceeded, the drive pinion must be removed and the process repeated with a new collapsible spacer. The turning torque must **not** be corrected by slackening the pinion nut.

Tighten the pinion nut (don't forget the left-hand thread) until the specified turning torque is obtained.

Lock the pinion nut by staking the collar of the nut into the two grooves in the drive pinion.

Fit the drive pinion oil seal using special tool 15-047A.

NOTE: The grease packing of the new oil seal (as supplied) must not be removed.

Slide the drive flange on to the pinion. Fit a **new** nut and tighten it to the specified torque (See **Tightening Torques,** above).

Hold the drive shaft flange with special tool 15-030.

To install the Differential

The following procedure has been evolved by the 'works' Motorsport Dept:

1) Smear the threads of both bearing housings, with specified grease (See 'Recommended Sealants and Greases', above), insert the differential in the rear axle casing and fit the bearing housings with new O-rings on the right and left-hand sides.

[A special tool is required to engage in the adjusting teeth. It is **not** recommended that a C-spanner be used for adjustment, as single teeth may easily be broken off.]

2) Tighten up the bearing adjusters uniformly until they make contact with the taper roller bearings and give excessive preload, ensuring that there is backlash between the crown wheel and pinion.

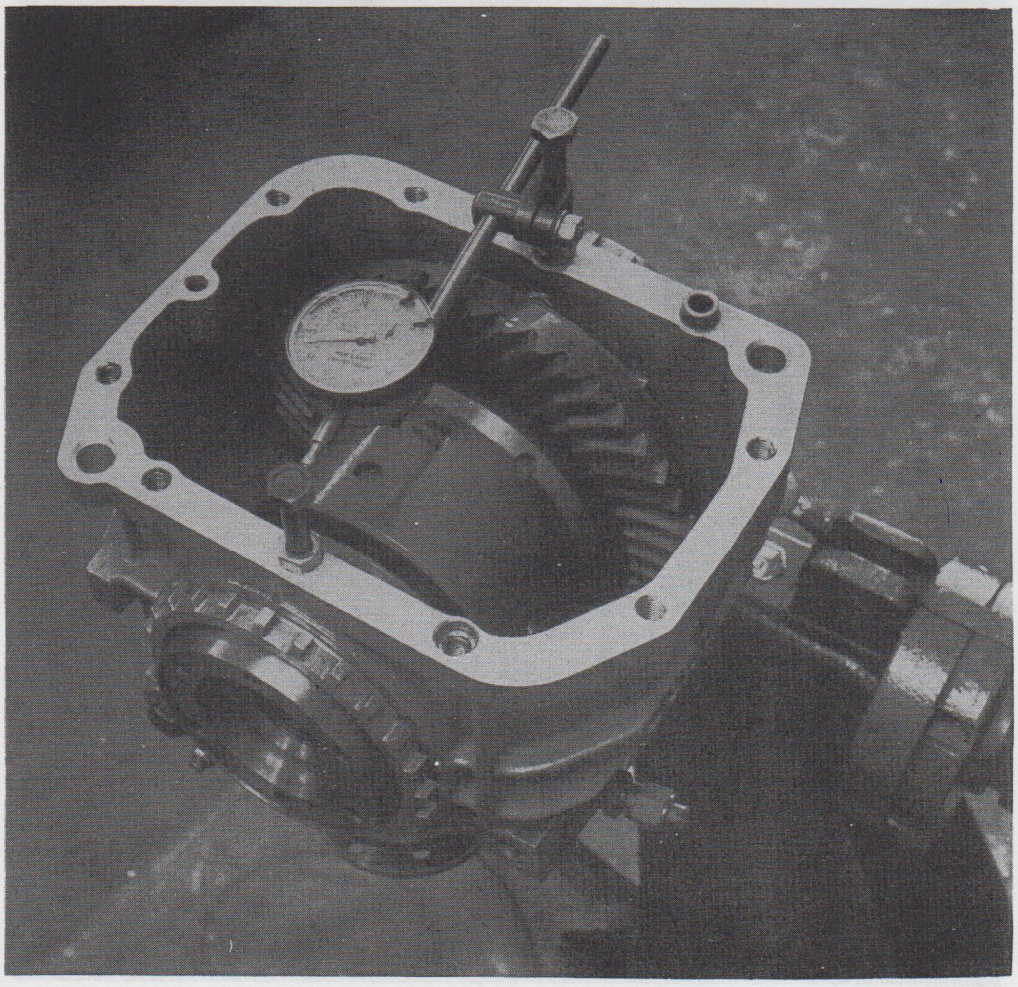
3) Strike the casing in several places, near to the bearing on each side, with a soft hammer, to settle the bearings.

4) Rotate the drive pinion a number of turns to settle the bearings. There must be appreciable backlash between the pinion and crown wheel.

5) Slacken off both adjusters.

6) Tighten both adjusters equally until bearing play is taken up, making sure that excessive Crown Wheel/Pinion backlash is maintained.

7) Attach a dial indicator from one side of the case to the other, to indicate the point at which preloading of the bearings begins. Find the zero preload position by this method.



Zeroing the 'spread' on the axle casing, before setting the backlash, to eliminate end float.

8) Rotate the pinion several times.

9) Reduce the backlash almost to zero (0.01 mm) by gradual equal adjustments of adjusters. Mark the flange and corresponding case position, so that it indicates the lowest backlash position.

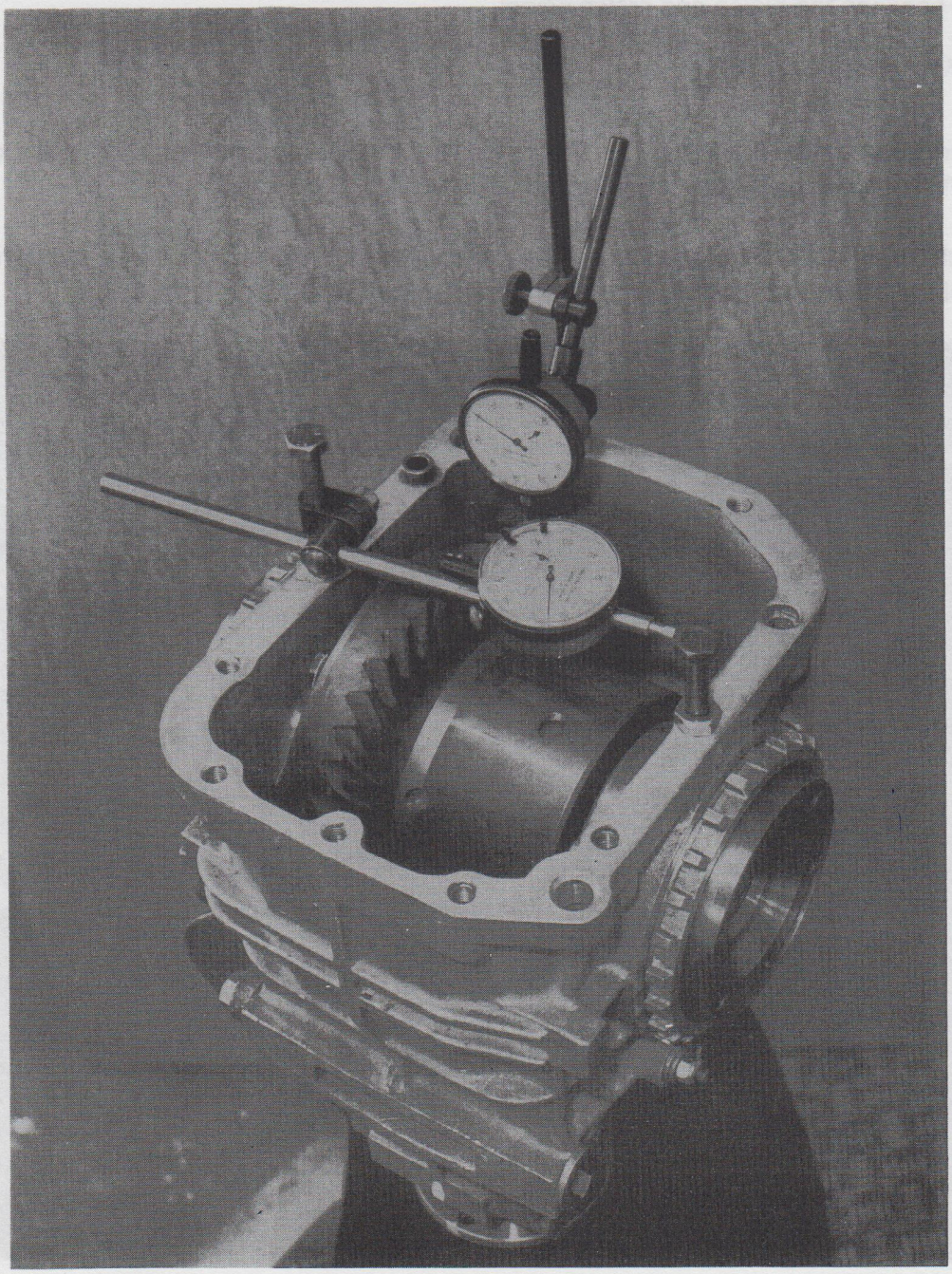
10) Completely rotate the pinion at least six (6) times, to competely rotate the crown wheel and check that there are no tight spots. Adjust the backlash, if necessary, to eliminate tight spots.

11) Preload the differential bearings by tightening the adjuster on the differential side by six (6) teeth (¼ turn).

12) Observe the deflection of the casing during adjustment (the expected deflection is 0.25 mm). [Refer back to Item 7 in this procedure]

13) Strike the casing several times to settle the bearings.

14) Check the backlash, in the marked positions on the flange.



Checking the backlash by adding a dial test indicator gauge.

15) Slacken the differential side adjuster again and check the zero preload position.

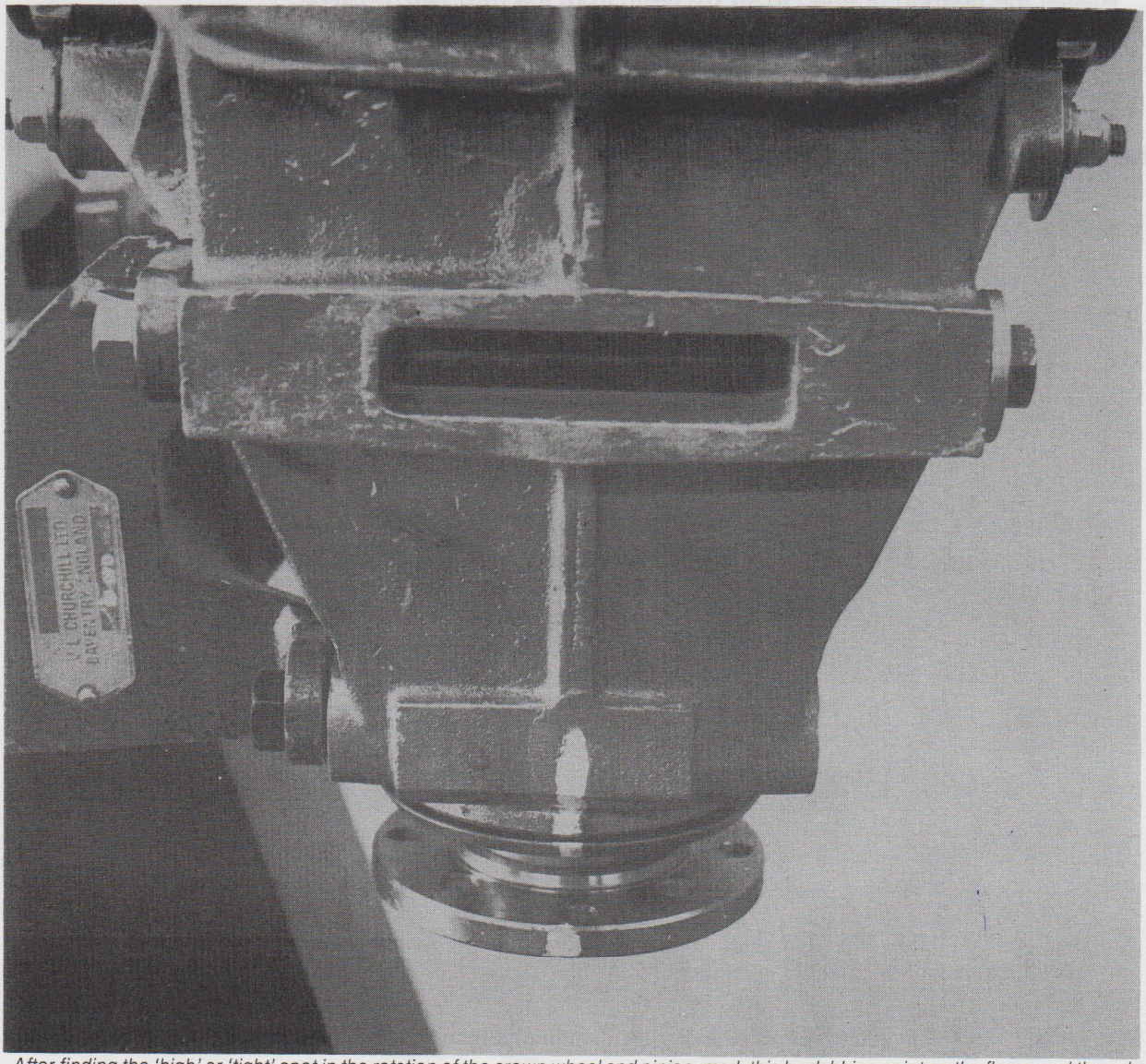
16) Preload again, by six (6) teeth, using the new Zero position.

17) Strike the case, once again to settle the bearings.

18) Rotate the pinion several times.

19) Check the backlash in the marked positions on the flange.

20) Adjust the backlash to 0.08 mm by equal adjustments to left and right adjusters. Do not go below 0.08 mm even if inconsistency in the mating of the gears puts the backlash greater than 0.15 mm in some positions. If the variation is greater than 0.08 - 0.30 mm, then the gears should be rejected.



After finding the 'high' or 'tight' spot in the rotation of the crown wheel and pinion, mark this by dabbing paint on the flange and the axle casing itself. This then becomes a reference point when checking the backlash.

21) Fit the lock plates to the bearing adjusters and fit the axle cover, using 11 cap screws. Use liquid sealer 1110B.

22) When fitting the axle to the car, fill with hypoid oil to FORD (or equivalent) standards - see **Recommended Sealants and Greases.**

Running In the Assembly:

After fitting the axle to the car, run the car gently for 60 miles/100 km. Use no more than 3,800 rpm in fifth gear.

Then return the car to the workshop and remove the rear cover.

Check the backlash.

Fit a dial indicator to the rear of the case.

Check the zero bearing preload position.

Re-set the bearing preload to six (6) teeth from the new zero position.

Re-set the backlash and re-assemble as before.

The axle is now ready for competition use. **NEVER use a new axle in competition until the above procedure has been followed.**