



TRANSMISSION

SECTION FI - ELISE 2001 M.Y. Onwards

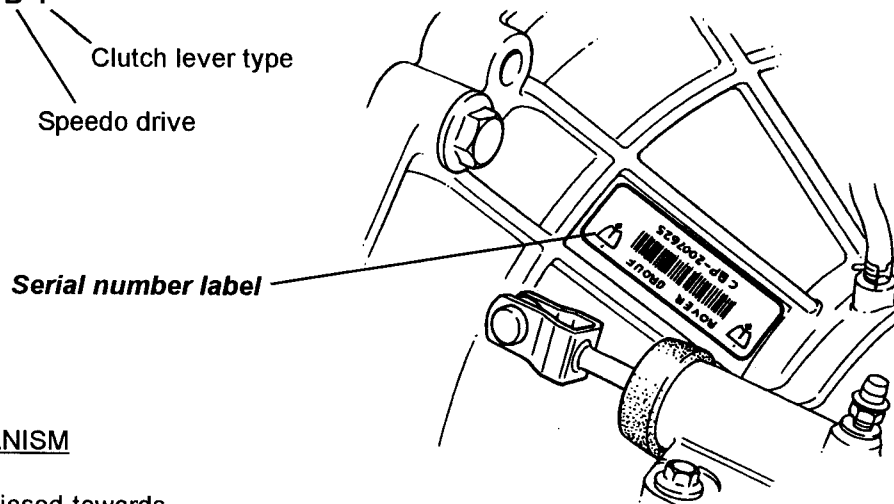
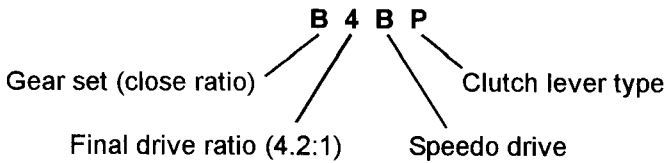
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FI.1 - INTRODUCTION

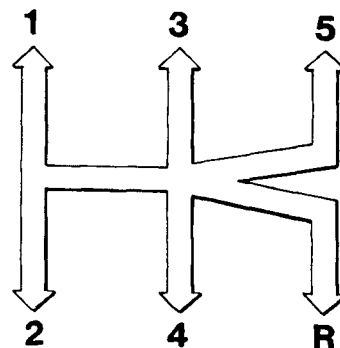
The transmission assembly is an 'end on' type, mounted on the left hand end of the engine unit, and comprises of the clutch housing, five speed gearbox, final drive gears, and differential. The unit is supplied by Rover, and is designated 'PG1', with Rover publication RCL 0124ENG covering the description and overhaul of this transmission. A conventional bevel gear differential is fitted for the Elise application. The gearchange mechanism is different to that used by Rover, with the two cables running beneath the power unit (see sub-section FI.2).

The transmission serial number is printed on a bar code label fixed to the top of the clutch housing, and is prefixed by a specification code. In the case of the Elise 2001 M.Y. the code is:



FI.2 - GEARCHANGE MECHANISM

The gearlever is spring biased towards the 3rd/4th gear plane such that it must be moved against light spring pressure to the left before selecting first or second gear, and against similar pressure to the right before selecting 5th or reverse gear. An inhibitor device within the transmission selector mechanism prevents the selection of reverse gear directly from 5th, by requiring that the lever first be moved across the gate to release an interlock. A reverse selector 'brake' mechanism utilises the 4th gear synchroniser to halt the input gear train, and assist the engagement of reverse gear.



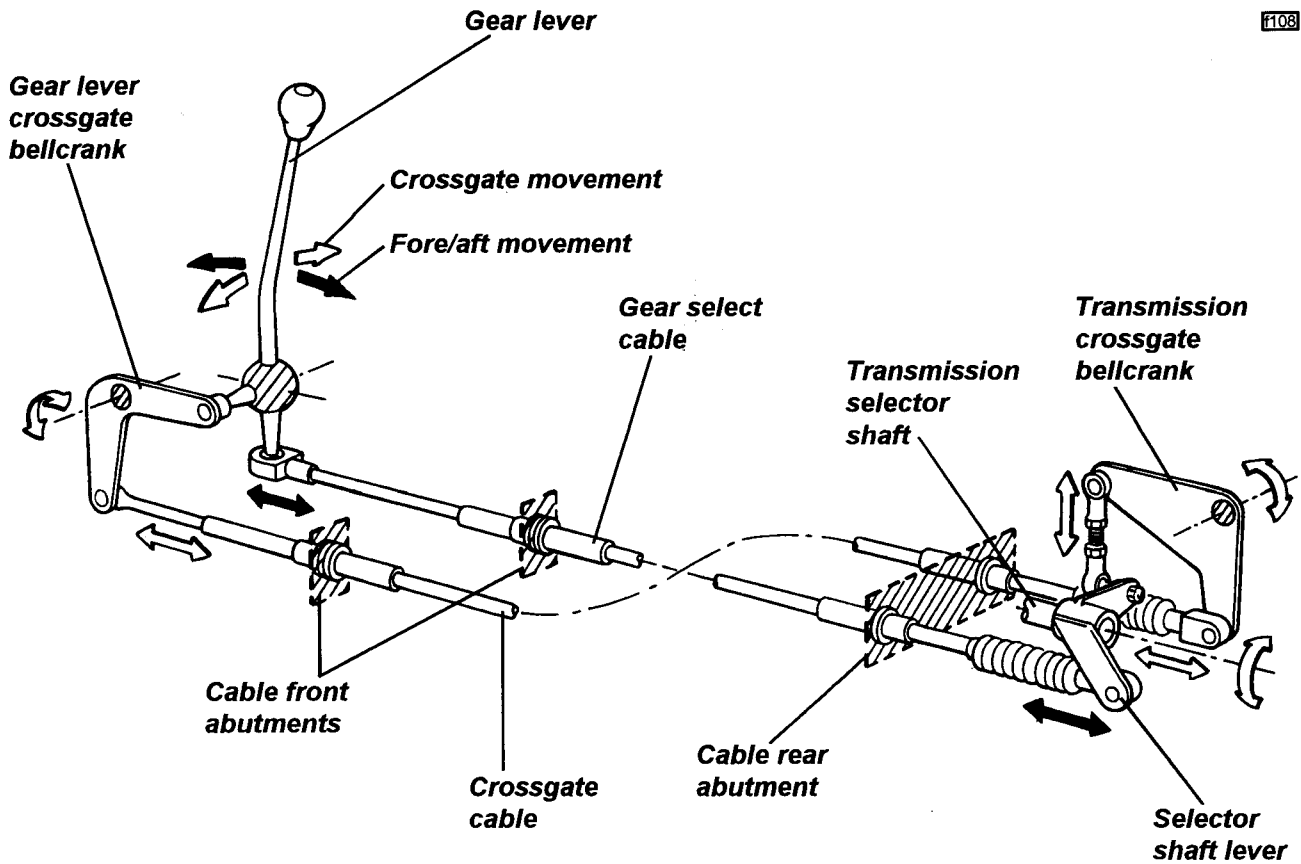
A two cable mechanism is used to connect the gearchange lever with the transmission, one cable ('shift') to transmit the fore/aft movement of the lever, and a second ('crossgate') for the sideways movement. The steel gearchange lever incorporates an integral pivot ball which pivots in a two piece nylon socket in an alloy housing. The housing is mounted on a fabricated steel bracket which incorporates abutments for the two cables, and is fixed to the cabin floor crossmembers. Both gearchange cables run down the centre of the cabin floor, beneath the fuel tank bay, and under the engine to connect with the transmission selector shaft at the bottom rear of the power unit.

A vertical extension to the gearchange lever, below the pivot ball, connects via a ball joint to the shift cable. Fore/aft movement of the lever is thus transmitted directly to the cable, the rear end of which is connected directly to the transmission selector shaft via a short leg.

Crossgate movement of the gear lever is transmitted to a second cable via a short horizontal leg protruding from the left side of the gear lever pivot ball. Vertical movement of this leg is translated into a fore/aft motion by a forward mounted bellcrank lever, the other end of which connects with the crossgate cable. The rear end of this cable links via another bellcrank lever, and a ball jointed link, to a lever on the transmission selector shaft, to which is imparted a rotational movement.



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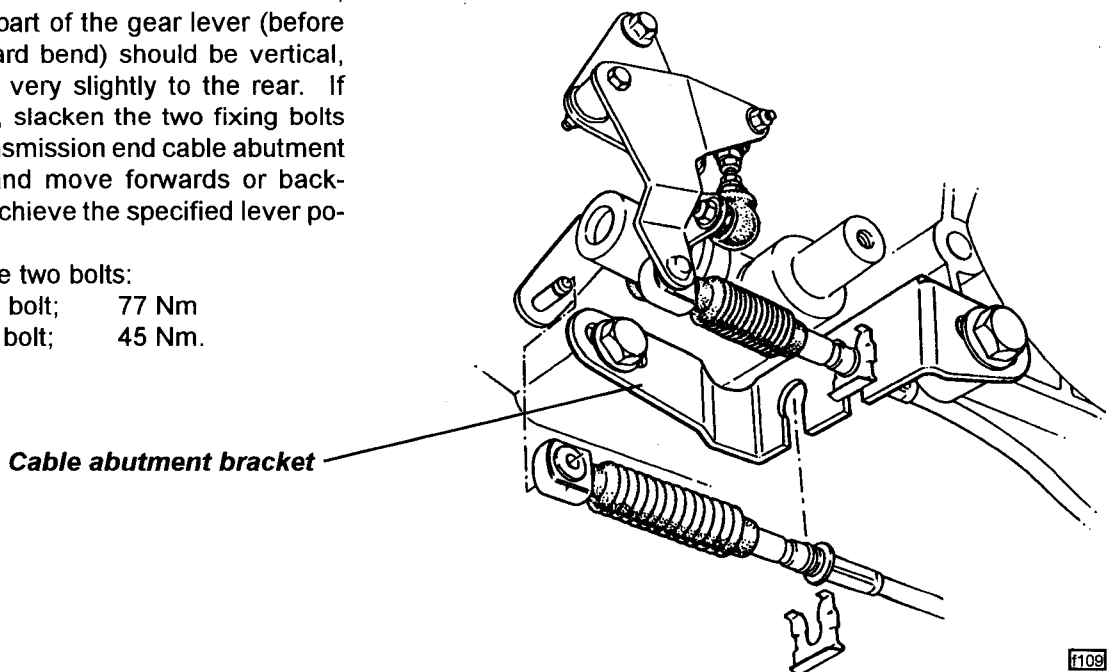
**Gearchange Cable Adjustment**

Both gearchange cables, crossgate and select, are of fixed length. Fore/aft adjustment is provided via slotted fixing holes in the transmission end abutment bracket, with crossgate adjustment catered for by an adjustable length tie rod between transmission end bellcrank lever and selector shaft.

With the gearchange mechanism assembled, and the transmission in neutral:

1. Fore/aft position: Viewed from the side, the lower part of the gear lever (before the rearward bend) should be vertical, or leaning very slightly to the rear. If necessary, slacken the two fixing bolts on the transmission end cable abutment bracket, and move forwards or backwards to achieve the specified lever position.

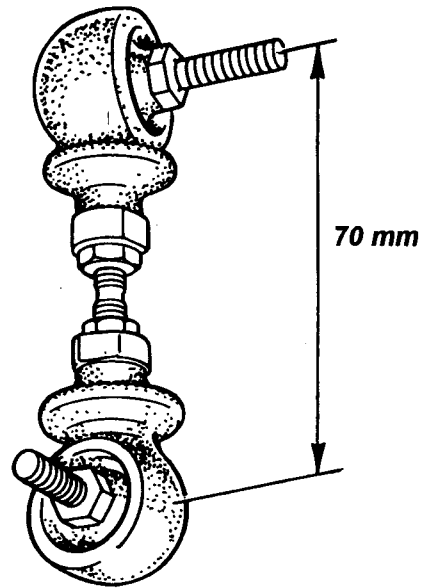
Tighten the two bolts:  
 Front M12 bolt; 77 Nm  
 Rear M10 bolt; 45 Nm.



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2. Crossgate position: Viewed from behind, the gear lever should be vertical. If necessary, adjust the length of the transmission end bellcrank tie rod. The nominal length between ball joint centres is 70 mm. The tie rod is RH threaded at both ends, so that before an adjustment can be made, the lower ball joint must be released from the selector shaft lever. Adjustments to the tie rod length can be made only in increments of one thread pitch:



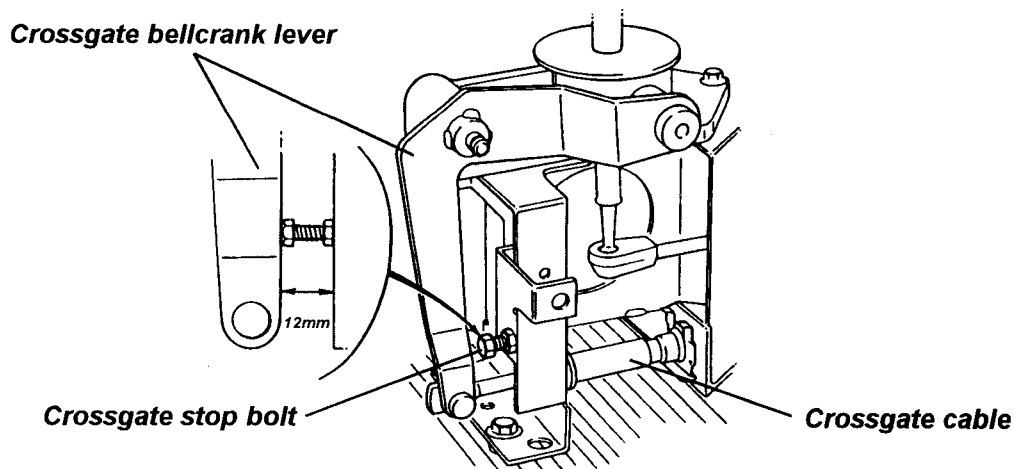
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- Lengthen the rod to move the lever position to the left;
- Shorten to move the lever to the right.

Ensure that there is similar thread engagement into each of the two ball joints. Refit the ball joint to the lever and tighten to 4.7 Nm.

3. 5th & reverse crossgate stop: An adjustable stop bolt is provided to limit the gear lever crossgate movement to the right (5th and reverse plane). If any adjustment to the crossgate cable is made, the stop bolt adjustment should be checked. For access to the lever mechanism, the gear lever knob and shroud must first be removed - unscrew the knob, remove the screw each side of the shroud, and lift the shroud over the lever.

The nominal stop bolt setting of 12 mm should be adjusted as necessary to provide minimal clearance when the lever is operated in the 5th/reverse gear plane, as is consistent with satisfactory gear selection.



Gearlever Replacement

For access to the gear lever assembly, unscrew the gear knob, remove the single screw each side of the gear lever shroud, and lift the shroud over the lever. To remove the gear lever:

- Remove the 'E' clip from the bellcrank lever pivot.
- Unsnap the select cable socket from the gear lever ball.
- Remove the three screws securing the gear lever housing to the mounting bracket, disengage the bellcrank

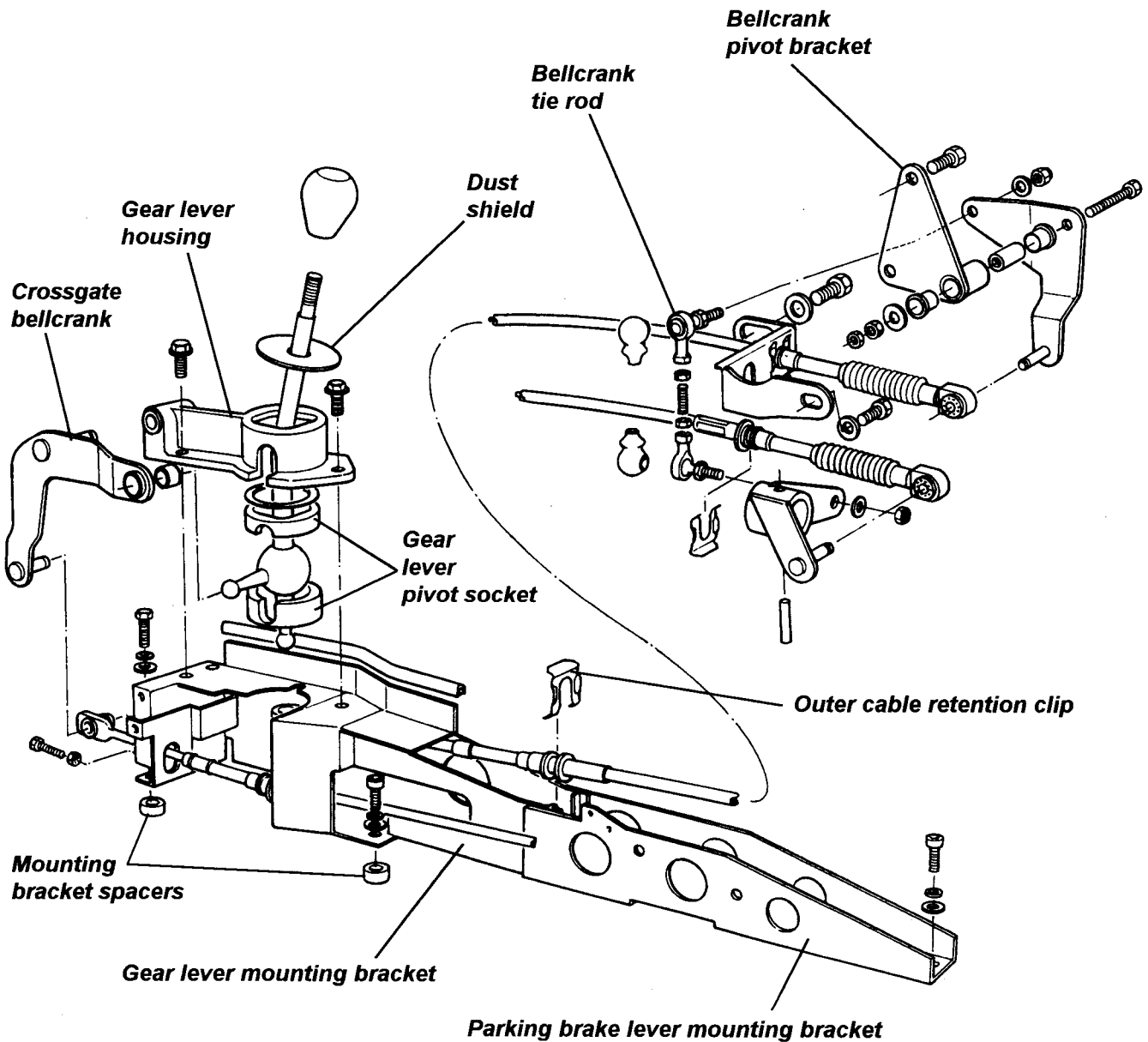


lever pivot and crossgate spigot bush, and withdraw the housing and gear lever assembly.

To re-assemble:

- Fit the pivot socket gasket into the gear lever housing, followed by the top (smaller) section of the pivot socket.
- Apply Dow Corning Molykote 33 Medium silicone grease (A111F6016) to the gear lever pivot ball and to the crossgate spigot ball before fitting the lever into the housing followed by the lower section of the socket. Snap the plastic bush onto the lever crossgate spigot ball.
- Locate the bellcrank lever pivot into the gear lever housing, and retain with the 'E' clip. Fit the crossgate spigot into the bellcrank lever and locate the gear lever housing onto the mounting bracket.
- Fit and tighten the three gear lever housing screws, and snap the select cable socket onto the bottom of the gear lever.
- Check gear linkage operation and adjustments before fitting the pivot ball dust shield over the lever, and refitting the shroud.

NOTE: To avoid the requirement to replace the retaining clip/bush, do not disconnect the crossgate cable from the bellcrank lever unless necessary.



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## Gearchange Cable Replacement

For access to the gear cables, the gear lever shroud and parking brake lever trim must be removed: Unscrew the gear lever knob, remove the single screw each side of the shroud, and withdraw the shroud. Remove the single screw securing the parking brake trim to the rear bulkhead and ease the panel over the lever.

Unclip the crossgate cable from the bellcrank lever, or unsnap the select cable from the lever ball. Pull off the spring clip retaining the cable outer to the abutment bracket, and release the cable from the bracket. At the rear end, prise the cable off the lever, pull off the outer cable spring clip, and release from the abutment bracket. Release cable ties and clips as necessary to allow the cable to be withdrawn, noting the routing past the park brake lever.

Refit in reverse order to removal, paying particular attention to the routing through or alongside the park lever and gear lever mounting brackets. Check the cable adjustments as detailed above.

## Gearlever Mounting Bracket

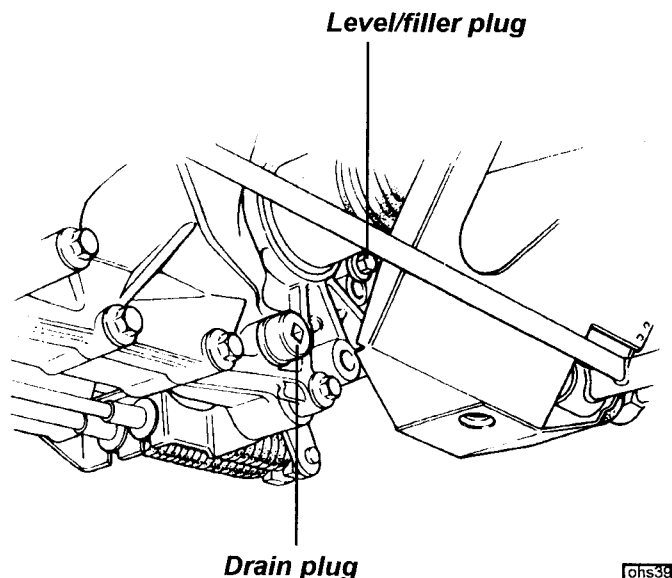
The gear lever mounting bracket is secured to the cabin floor by four M8 bolts, the rearmost of which also fixes the front of the parking brake lever bracket. Note that alloy spacers are used on the front three fixing points between bracket and floor. The whole assembly is offset towards the passenger side of the car, with alternative fixing holes provided either in the mounting bracket, or in the cabin floor.

## FI.3 - LUBRICATION

The PG1 transmission is 'filled for life' with Texaco MTF94 fully synthetic lubricant, and requires no periodic renewal. No other transmission oil is approved. If there are any signs of leakage, the source should be identified and appropriate action taken to rectify the fault.

A filler/level plug is provided on the left hand side of the the final drive housing, and with the car parked on a level surface, the oil level should be up to the level of this hole. A drain plug in the underside of the casing (square socket plug) permits the oil to be drained prior to transmission removal or repair.

Dry fill capacity = 2.4 litres. Refill = 2.1 litres.



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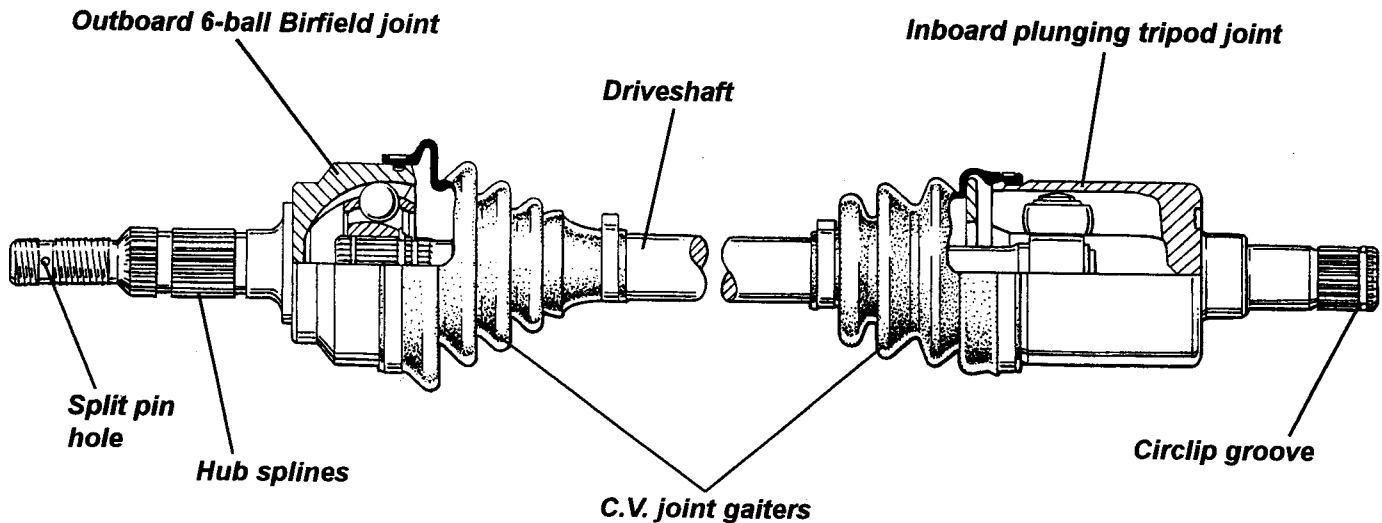
## FI.4 - DRIVE SHAFTS

A driveshaft assembly comprising a steel shaft with a constant velocity joint at each end, is used to transmit the drive from each differential output gear to the rear wheel hub. The two shafts are of unequal length due to the offset transmission housing, with the longer shaft on the right hand side. Both driveshaft assemblies use plunging tripod type inboard C.V. joints, and six ball Birfield type outboard C.V. joints. The outboard joint is available as a service part, as is the inboard joint complete with shaft. Replacement gaiter kits are available for both joints. The joints themselves are packed with grease on initial assembly, and are maintenance free. It is however vitally important that the protective gaiters are carefully inspected at service intervals, to check for splits, tears or punctures, since the joint will deteriorate very quickly once contaminated with dirt or water. Damaged gaiters should be renewed immediately, once the servicibility of the joint has been established.

Clicking noises, torque reversal 'clonks', or shudder and vibration when accelerating are all possible symptoms of worn C.V. joints. It should not be possible to discern any free play in a joint, but care must be taken not to confuse this with transmission backlash, which may be considerable. Any symptoms that could be due to worn driveshaft joint assemblies, should be investigated and rectified without delay, since safety considerations are always of paramount importance.



The inboard C.V. joint is equipped with a male splined spigot shaft which engages with the female splines of the differential output sun gear, and is retained by a round section spring circlip on its end. Each of the two transmission output oil seals runs on a stepped shoulder on the C.V. joint spigot shaft. The outboard end of each driveshaft carries a second C.V. joint whose spigot shaft is used to clamp the hub and wheel bearing into the hub carrier via a thread on the end of the shaft.



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### Driveshaft Replacement

Removing a driveshaft from the transmission will result in some loss of transmission lubricant. It may be preferred to drain off some oil via the transmission drain plug beforehand.

1. Remove the transmission drain plug and drain off approximately 1 litre of oil into a clean container for re-use.
2. Remove the rear road wheel.
3. Before attempting to release the driveshaft hub nut, first use a punch to knock the distorted end of the nut clear of the driveshaft slot. Apply the parking brake and release the driveshaft hub nut.
4. Remove the wheel speed sensor from its plinth to prevent damage during driveshaft removal.
5. To allow the hub carrier to be leant outwards and provide room for the driveshaft to be withdrawn from the transmission and hub, remove the bolt securing the toe link to the hub carrier and remove the two bolts securing the top ball joint plinth to the hub carrier, taking note of the shim pack fitted between plinth and carrier.
6. The inboard C.V. joint is retained in the transmission by a rounded section circlip, and may be removed by applying a shock pull to the C.V. joint body using a slide hammer with a forked end, or on the RH side, by using a special wedge tool T000T1276.

**CAUTION:** Do NOT attempt to remove the inboard C.V. joint from the transmission by pulling on the driveshaft. This action will cause the joint to become disassembled and may entail replacement of the joint. The components of the inboard plunging joint are held in position, for transit purposes only, by a collar within the boot which will be overridden if excessive axial force is used. Apply pressure only to the 'tulip' or outer body of the joint.

Withdraw the inboard C.V. joint from the transmission, taking great care not to damage the output seal, and fit blanking plug T000T1385 into the transmission to limit the amount of transmission oil loss.

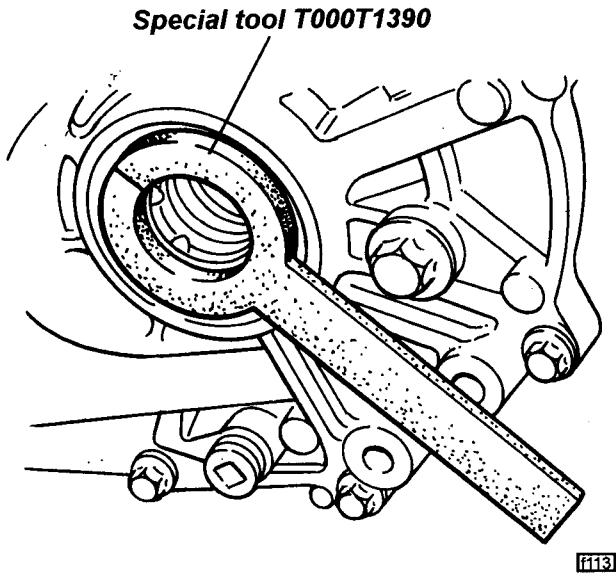
7. Withdraw the driveshaft from the hub using a puller if necessary, and remove the driveshaft assembly from the car.



8. Before re-fitting a driveshaft, first renew the round section circlip (A100R6001F) on the end of the inboard joint spigot shaft, and lubricate the circlip with grease. Also, check the condition of the transmission output seal, and renew if necessary. Lubricate the lip of the seal with transmission oil, and grease the corresponding shoulder on the driveshaft (C.V. joint) spigot, to reduce the danger of damaging the seal on assembly.
9. A special tool T000T1390 is available to protect the seal during driveshaft fitment, and should always be used with the more vulnerable early type seal (see above).

To use the tool:

- Check first that the tool is clean and undamaged before fully inserting into the oil seal. Check that the split joint in the tool is butted correctly.
- Carefully insert the driveshaft through the seal protector until it engages in the splines of the differential output gear.
- Remove the protector tool by pulling over the shaft.
- Press the C.V. joint into the differential gear splines until a 'click' indicates that the circlip has engaged in its location. Pull on the body of the joint to check security.



10. Fit the outer end of the shaft into the hub, and retain with the nut.
11. Refit the top ball joint plinth to the hub carrier with the camber adjustment shim pack in position, and tighten the two socket head bolts to 45 Nm. Apply the parking brake and tighten the driveshaft nut to 220 Nm. Tighten the toe link to hub carrier pivot bolt to 45 Nm. Refit the wheel speed sensor to its plinth.
12. With the car on a level surface, top up the transmission oil to the filler/level plug hole.

#### Driveshaft C.V. Joint and/or Gaiter Replacement

The outboard joint is available as a separate part, whilst the inboard joint is supplied complete with the driveshaft. Gaiter kits are separately available for both joints.

1. Remove the driveshaft assembly from the car (see above).
2. Cut off the gaiter retaining clips from both joints, and slide the gaiters along the shaft.
3. The outboard joint is retained by a round section circlip on the end of the shaft. To remove the joint, hold the drive shaft in a vice, and use a soft mallet to tap the joint over the circlip and off the shaft. If the joint is reluctant to move, use a brass drift on the front face of the inner race.

**CAUTION:** Do not attempt to remove an outboard joint without first removing the shaft assembly from the car. Unless the shaft is securely retained (e.g. in a vise) attempts to remove the outboard joint may result in the inboard joint becoming disassembled.

4. Slide both C.V. joint gaiters off the driveshaft.
5. Cleaning & Inspection: Complete disassembly of either joint is NOT recommended. The separate components are a precision fit and develop their own individual wear patterns, such that any interchanging or re-orientation of parts is likely to result in premature failure.





If the grease in the joint is contaminated with dirt or water, it is likely that the joint is damaged, and should be replaced. If the grease is not contaminated, the joint should be degreased by soaking in a suitable solvent (NOT petrol), and then carefully inspected.

On the outboard ball type joint, tilt the inner race to one side to expose each ball. Severe pitting, galling, play between ball and its cage window, any cracking or damage to the cage, or pitting, galling or chips in raceways, call for joint replacement.

On the inboard, tripod type joint, examine the fit between the rollers and the housing. Excessive free play, roughness on either roller or track surfaces, damage to the bearings or trunnion, call for joint replacement. If the joint is found to be serviceable, it must be repacked with special grease as follows:

Outboard joint; 1 sachet A100R6009 (52 ml) - boot kit contains 2 sachets

Inboard joint; 2 sachet A100R6010 (62 ml) - boot kit contains 3 sachets

6. Replace the circlips securing the inboard joint to the transmission and the outboard joint to the shaft. New circlips should always be used to ensure security of joint retention. Note that the circlip for the outboard joint is supplied in the boot kit for either joint, but that the inboard joint circlip should be ordered separately.
7. Tape over the shaft outboard splines to prevent damage to the new gaiters, and slide the inboard gaiter and small retaining clip onto the shaft, followed by the outboard gaiter small clip and gaiter. Remove the tape.
8. Outboard Joint: New joints are pre-packed with grease, but if re-fitting a cleaned out joint, lubricate the joint with one sachet of the special grease provided in the boot kit. Fill the ball tracks with grease both behind and in front of the balls, pack around the balls, and the inside of the splines, so that grease is pushed behind the joint when the shaft is inserted. Use the second grease sachet from the boot kit to fill the inside of the new boot.  
NOTE: The grease provided in the kits is specially formulated for wear resistance and durability. DO NOT use substitutes or mix with other lubricants.
9. Inboard Joint: If re-fitting a cleaned out joint, pack the joint with two of the grease sachets from the gaiter kit. Use the third grease sachet from the gaiter kit to fill the inside of the new gaiter.
10. Slide the outer joint onto the shaft splines, and tap the joint into position until the circlip 'clicks' into its groove. Pull on the joint to ensure it is fully located.
11. Pull each gaiter over its C.V. joint and locate the lips of the gaiter in the grooves on the joint and shaft. Before fitting the gaiter clamps, ensure that the gaiter is ventilated so that it is not dimpled or collapsed. Position the plunging joint with 80 mm between the boot clip grooves before ventilating by inserting a smooth rod (take care not to damage the boot) between the large end of the boot and the joint, and fitting the retaining clips. Tighten the clips using suitable pliers.
12. Refit the driveshaft assemblies to the car (see above).

#### F1.5 - TRANSMISSION REPLACEMENT

With the car supported on a 'wheel free' lift, the transmission can be removed from below, leaving the engine 'in situ':

1. Remove the LH rear lower wishbone:
  - Release the bolt securing the spring/damper unit to the lower wishbone;
  - Release the wishbone to chassis pivot bolts;
  - Release the parking brake cable clip and swing the wishbone out of the way.
2. Release the RH rear suspension toe control link from the hub carrier, and release the top ball joint plinth from the hub carrier taking note of the camber adjustment shimplates. in order to allow withdrawal of the driveshaft from the transmission.



- 3. Remove both inboard C.V. joints by applying a shock pull to the joint body using a slide hammer with a forked end, or on the RH side, by using a special wedge tool T000T1276. Fit blanking plug T000T1385 into the transmission to limit the amount of transmission oil loss.

**CAUTION:** Do NOT attempt to remove an inboard C.V. joint from the transmission by pulling on the driveshaft. This action will cause the joint to become disassembled and may entail replacement of the joint. The components of the inboard plunging joint are held in position, for transit purposes only, by a collar within the boot which will be overridden if excessive axial force is used. Apply pressure only to the 'tulip' or outer body of the joint.

- 4. Remove the 'R' clip and clevis pin connecting the clutch slave cylinder to the release arm. Remove the four bolts fixing the slave cylinder bracket to the transmission, and support aside.
- 5. Release the two bolts securing the starter motor and dirt shield to the clutch housing. Remove the shield, and withdraw and support the starter motor, taking care to protect the live starter motor lead from grounding.
- 6. Remove the dirt shield from the top front of the clutch housing.
- 7. Disconnect the reverse light switch.
- 8. Disconnect the two gearchange cables from their transmission levers, and release the cables from the abutment bracket.
- 9. Remove the air cleaner housing and mounting plate from the roll over bar brace.
- 10. Support the weight of the transmission assembly before removing the LH engine (transmission) mounting and bracket.
- 11. Remove the six bolts securing the clutch housing to the engine:
  - 2 bolts to the sump;
  - 1 bolt each side through the block lower 'wings';
  - 2 bolts securing the top of the clutch housing to the engine.
- 12. Pushing the engine to the right and downwards at the flywheel end, withdraw the transmission from the engine.
- 13. Refit the transmission in the reverse order to removal with the following notes:
  - Check that the type of output shaft seals fitted are compatible with the driveshaft inboard C.V. joints - see Sub-Section FI.4.
  - Use new circlips on the spigots of the inboard C.V. joints, and follow the procedure in Sub-Section FI.4 to refit.

**FI.6 - TRANSMISSION OVERHAUL**

The overhauling of the Rover supplied type PG1 transmission, is detailed in Rover publication RCL 0124ENG. Note that a conventional bevel gear differential is used for the Elise application. Special tools are available through Lotus under the following part numbers:

Transmission Special Tools

<b>Description</b>	<b>Lotus Part No.</b>	<b>Churchill Part No. (ref.)</b>
Driveshaft Removal Wedge (RH)	T000T1276	18G1578
Adaptor Plate, bearing puller	T000T1291	18G 2-3
Replacer Dolly, input shaft oil seal	T000T1293	18G 134-4

Continued .....

Transmission Special Tools (continued)

<b>Description</b>	<b>Lotus Part No.</b>	<b>Churchill Part No.(ref.)</b>
Slide Hammer, output shaft bearing remover	T000T1294	18G 284
Adaptor, output shaft bearing remover	T000T1295	18G 284-14
Driver Handle, bearing dolly	T000T1296	18G 1354
Replacer Dolly, output shaft bearing	T000T1297	18G 1354-5
Circlip Pliers, bearing access plug	T000T1298	18G 1392
Thrust Pad, bearing puller	T000T1299	18G 1397
Hex. Socket, M14, access plug	T000T1300	18G 1472
Anti-Spread Plate, input/output shafts	T000T1301	18G 1473
Replacer Dolly, differential bearings	T000T1302	18G 1675
Replacer, clutch release shaft inner bush	T000T1303	18G 1723-1
Replacer, clutch release shaft outer bush	T000T1304	18G 1723-2
Clutch Alignment Mandrel	T000T1277	18G1483
Blanking Plug, driveshaft output	T000T1385	-
Replacer Dolly, output seal, RH	T000T1388	18G1354-16
Replacer Dolly, output seal, LH	T000T1389	18G1354-21
Seal Protector, output shaft seals	T000T1390	-