



## JH.1 - GENERAL DESCRIPTION

The braking system of the Lotus M111 comprises of ventilated discs all round with AP Racing 2-piston fixed calipers on the front and Brembo single piston sliding calipers on the rear. A tandem master cylinder, without servo assistance, operates the calipers via a front/rear split hydraulic circuit. The centrally mounted parking brake lever, operates the rear caliper pistons by control cables.

The AP Racing front calipers, have lightweight alloy bodies housing two opposed pistons, and are mounted via two bolts directly to the rear of the extruded aluminium alloy front hub carriers. The Brembo rear brakes use single piston sliding calipers, with cast iron bodies, mounted via an adaptor plate to the rear of each hub carrier. The rear calipers are also used on some versions of the Lotus Esprit. A common ventilated brake disc is used on all four wheels, with cars built prior to June '98 (approx. VIN W 3714) using discs constructed from a silicon carbide reinforced aluminium metal matrix. Later cars use cast iron discs, with a corresponding change in brake pad material. The discs are sandwiched between the road wheels and hubs and use no additional fixings.

The tandem master cylinder is made by ITT, and incorporates a front section to supply both front brakes, and a rear section to supply the rear brakes. A translucent fluid reservoir surmounting the cylinder, services both front and rear circuits, and also, via a linking hose, the clutch master cylinder. A fluid level sensor is incorporated into the filler cap, and lights a fascia tell tale lamp if the level becomes dangerously low.

The parking brake ratchet lever is mounted between the seats and uses a balancing linkage to actuate individual control cables to each rear caliper. Adjustment of the caliper mechanism to compensate for brake pad wear is automatic. The brake should be applied by pulling upwards firmly and fully to engage the maximum number of ratchet 'clicks'. When parking the car on a slope, the additional precaution should be taken of leaving the transmission in first or reverse gear and steering the wheels towards the kerb. If the parking brake is applied when the brakes are hot (e.g. after prolonged or vigorous braking), special care should be taken to ensure that the parking brake is securely engaged in order to allow for any potential affect on brake performance due to temperature change.

The braking system is designed to enhance brake performance during high speed driving, with good fade and pad wear characteristics, and have a higher friction level when heated to normal working temperature than when cold. Required pedal effort will reduce as cold brakes become heated to normal working temperature. After fitting new brake discs or pads, the braking efficiency will increase significantly as the brakes 'bed-in', and for cars with aluminium discs, as a deposit of the brake pad material builds on the part ceramic discs, characterised by a dull grey band around the rubbing surface. Maximum braking efficiency will be achieved if, for the first few hundred miles, needless heavy braking is avoided, and the brake pads are allowed to 'bed in' fully before being used to their full potential.

## JH.2 - BRAKE FLUID CHECK & CHANGE

Before checking the brake fluid level, ensure that the car is parked on a level surface, and remove the front bonnet. The level of fluid in the reservoir may be inspected without disturbing the filler cap, and should lie between the 'MIN' and 'MAX' marks moulded on the translucent reservoir body. The level will fall progressively as the brake pads wear in service, and should be checked at each service interval. A sensor incorporated into the filler cap will light a fascia mounted tell tale lamp if the level becomes dangerously low. As a bulb check, the tell tale should light for about six seconds when the ignition is first turned on, but may also be tested by pressing the button on the filler cap, which action should light the tell tale with the ignition switched on.

An internal baffle divides the reservoir into two compartments, with the front section supplying the front brake circuit, and the rear section the rear brakes in addition to, via a short linking hose, the clutch master cylinder. Service wear of the clutch friction plate will cause fluid to be displaced from the self adjusting clutch slave cylinder, back to the reservoir, and will counteract to some extent the dropping of the level due to brake pad wear.

If the reservoir needs topping up, first clean around the cap to reduce the possibility of contamination before unscrewing the cap; it is not necessary to disconnect the level sensor cables. Take suitable precautions to guard against damage to paintwork caused by brake fluid dripping from the level sensor.

Use only a fresh supply of DOT 3 or DOT 4 *non-mineral* type fluid, identified by a yellow and black symbol.



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Do NOT use DOT 5 silicone fluid, or any fluid which has been exposed to the atmosphere for more than a brief period, or any fluid suspected of being wet, dirty or contaminated. Do not overfill. Replace the filler cap securely.

Some service operations, such as replacing brake pads, will result in the displacement of fluid from the hydraulic circuit back into the reservoir. In order to prevent fluid overflowing from the reservoir, it may be necessary to remove some fluid using a 'squeeze bulb' type tool.

### Renewal of Brake Fluid

Brake fluid absorbs water from the atmosphere over a period of time (hygroscopic), resulting in a lowering of the boiling point of the fluid, and corrosion of the hydraulic system. For optimum safety and brake performance, the brake fluid should be renewed every twelve months.

The fluid may be changed and bled of air using pressure or vacuum assisted equipment, or standard manual techniques. Each brake caliper is provided with a bleed nipple for this purpose. The clutch release system hydraulic fluid should be changed at the same time.

### JH.3 - FRONT BRAKE PAD REPLACEMENT

Pad thickness may be checked with the wheel removed without disturbing the caliper.

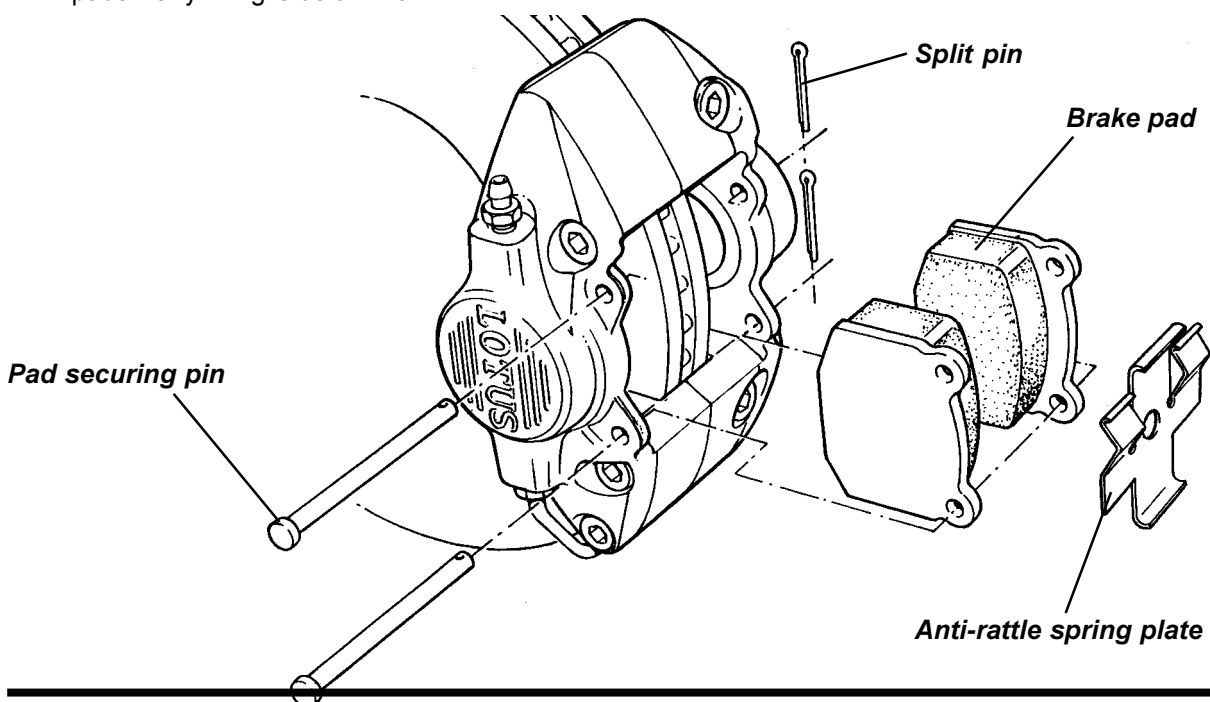
	<i>Alloy discs</i>	<i>Iron discs</i>
Standard pad thickness (excluding backplate);	10.0 mm	9.0 mm
Minimum pad thickness (excluding backplate);	2.5 mm	2.5 mm

If the thickness of any pad is below the specified minimum, the axle set of pads should be renewed. Note that different brake pads are used for aluminium and iron discs.

*Aluminium discs:* These pads are identified by a stencilled number on the backplate commencing with 'BXD'. If desired, self adhesive anti-squeal overlays (A111J0122F) may be fitted to the pads after approx. 0.75mm of wear has taken place, but some loss of pedal 'feel' will be incurred.

*Iron discs:* These pads are factory fitted with anti-squeal overlays and marked 'Brembo 07.5505.30/40'. The overlay is assymetric and is marked with a directional arrow - ensure the arrow on all four pads points in the direction of forward disc rotation.

1. To remove the brake pads; Remove the securing split pin and withdraw the lower of the two pad retaining pins, taking precautions to restrain the anti-rattle spring. Remove the second retaining pin and the anti-rattle spring plate. Withdraw the pads from the caliper. Measure the lining thickness and renew the axle set of pads if any lining is below 2.5 mm.





2. Before replacing the pads, inspect the caliper for any signs of fluid leakage from a piston seal or joint, and replace the caliper if any such signs are evident. Clean the pad recess in the caliper taking suitable precautions to protect from dust inhalation.
3. If refitting the existing brake pads, refit each pad in the same position as originally fitted.
4. If fitting new pads, the pistons must be pushed back into the caliper to provide the necessary clearance. This action will return fluid to the master cylinder such that some fluid may need to be removed in order to prevent overflowing. Take care to avoid damaging the brake disc surface, or distorting the disc.
5. Position the pads in the caliper, and insert the upper pad retaining pin from the outboard side. Secure with the split pin.
6. Fit the anti-rattle spring into position with the side tangs pressing against the top end of the pad backplates, and the centre tang beneath the retaining pin. Insert the second pad retaining pin into the caliper, passing over the lower central anti-rattle spring tongue.
7. Before driving the car, press the brake pedal several times to bring the pads to their correct running position. Top up the master cylinder reservoir if necessary to bring the level to the 'MAX' mark.
8. Ensure the customer is made aware that maximum braking efficiency will be achieved if, for the first few hundred miles, needless heavy braking is avoided, and the brake pads are allowed to 'bed in' fully before being used to their full potential.

## JH.4 - REAR BRAKE PAD REPLACEMENT

Pad thickness may be checked after removing the road wheel, without disturbing the caliper.

	<i>Alloy discs</i>	<i>Iron discs</i>
Standard pad thickness (excluding backplate);	7.8 mm	6.5 mm
Minimum pad thickness (excluding backplate);	2.5 mm	2.5 mm

If the thickness of any pad is below the specified minimum, the axle set of pads should be renewed. Note that different brake pads are used for aluminium and iron discs.

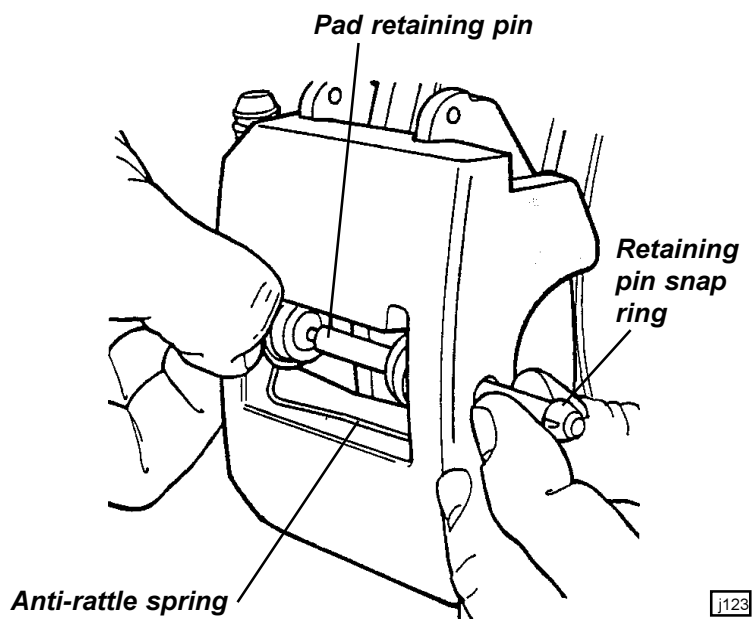
*Aluminium discs:* These pads are identified by a stencilled number on the backplate commencing with 'BXD'. If desired, self adhesive anti-squeal overlays (A111J0122F) may be fitted to the pads after approx. 0.75mm of wear has taken place, but some loss of pedal 'feel' will be incurred.

*Iron discs:* These pads are factory fitted with anti-squeal overlays and marked 'Brembo 07.7236.20'.

### *Tools Required:*

Piston Retraction Tool T000T1242

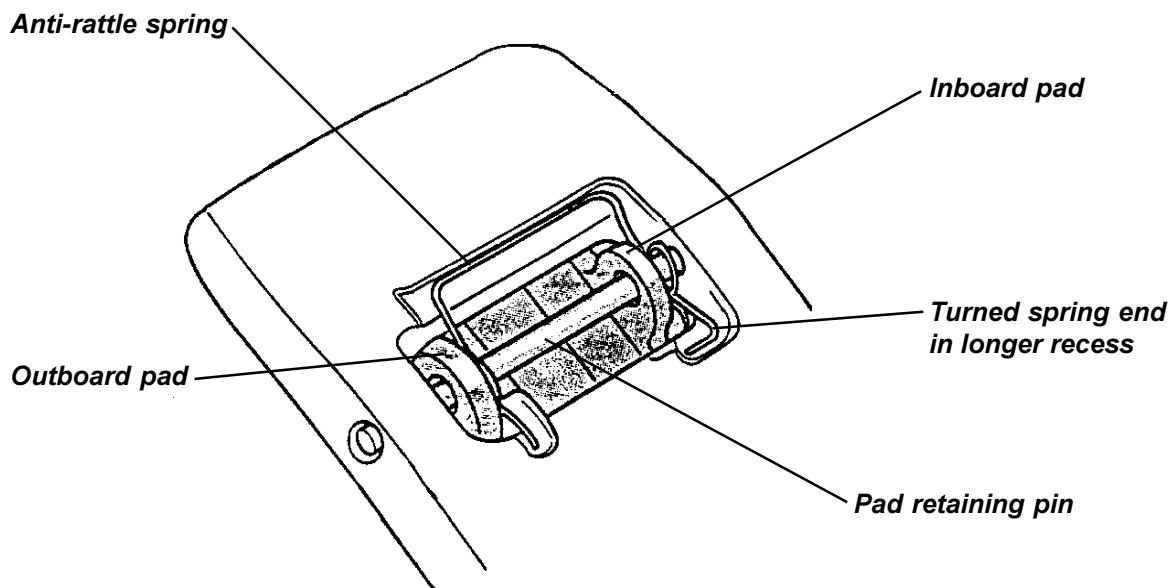
1. Remove the rear road wheels.
2. At each rear corner: using a suitable pin punch, knock the pad retaining pin out of the caliper towards the outside, taking precautions as necessary to restrain the anti-rattle spring from flying off as the pin is withdrawn.
3. Remove the anti-rattle spring, and withdraw both brake pads from the caliper. Measure the thickness of the lining material, and renew the axle set of pads if any are below 2.5 mm.



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4. Before refitting the pads, inspect the piston boot for splits, cracks or other damage, and for any signs of fluid leakage or wetness. If any such signs are apparent, the complete caliper should be replaced as Brembo do not recommend that this caliper be dismantled.
5. If refitting the existing brake pads, refit each pad in the same position as originally fitted.
6. Before fitting new rear pads, the caliper piston must be screwed back into the caliper down the parking brake actuation mechanism. This operation requires the use of special tool T000T1242 and the removal of the brake disc:
  - Remove the single socket head screw retaining the brake disc, and remove the disc.
  - Fit special tool T000T1242 into the holes in the caliper piston, and screw the piston back down the parking brake mechanism screwthread until fully bottomed.
  - Refit the brake disc, and tighten the countersunk retaining screw to 12 Nm.
7. Slide the brake pads into the caliper. Position the pad anti-rattle spring in the caliper aperture, with the spring ends located in the recesses provided. Ensure that the spring is fitted the correct way up, with the turned spring end in the longer recess. Press the spring eyes into alignment whilst the pad retaining pin is inserted through the caliper from the outside. Ensure that the pin passes through both eyes of the anti-rattle spring, and both brake pads, and that the pin is fully installed with the snap ring seated in the outboard side of the caliper.



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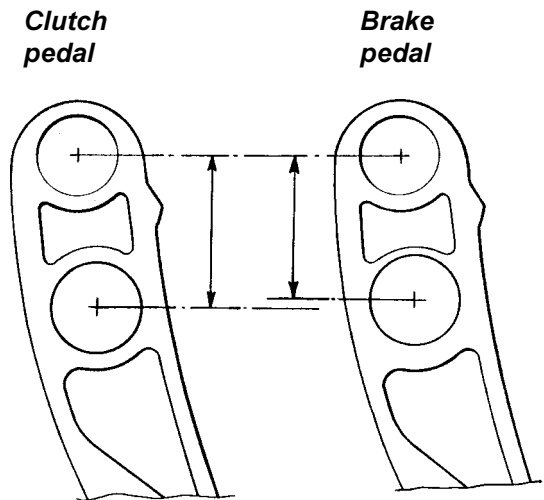
8. Refit the roadwheels and press the brake pedal several times to set the brake pad position. Before switching on the ignition, check the fluid level in the reservoir and top up if necessary.
9. Ensure the customer is made aware that maximum braking efficiency will be achieved if, for the first few hundred miles, needless heavy braking is avoided, and the brake pads are allowed to 'bed in' fully before being used to their full potential.

#### JH.5 - PARKING BRAKE MECHANISM

Operation of the handbrake lever applies a pull to a short link cable which connects via a horseshoe compensator to the centre of a single cable linking the two rear calipers. At each caliper, the cable connects to a lever which operates the hydraulic piston by mechanical means:

Movement of the caliper lever causes rotation of one of a pair of steel discs, rotation of the other being restrained by a stop bolt in the cylinder. Hardened balls housed in ramps machined in the discs, force the discs

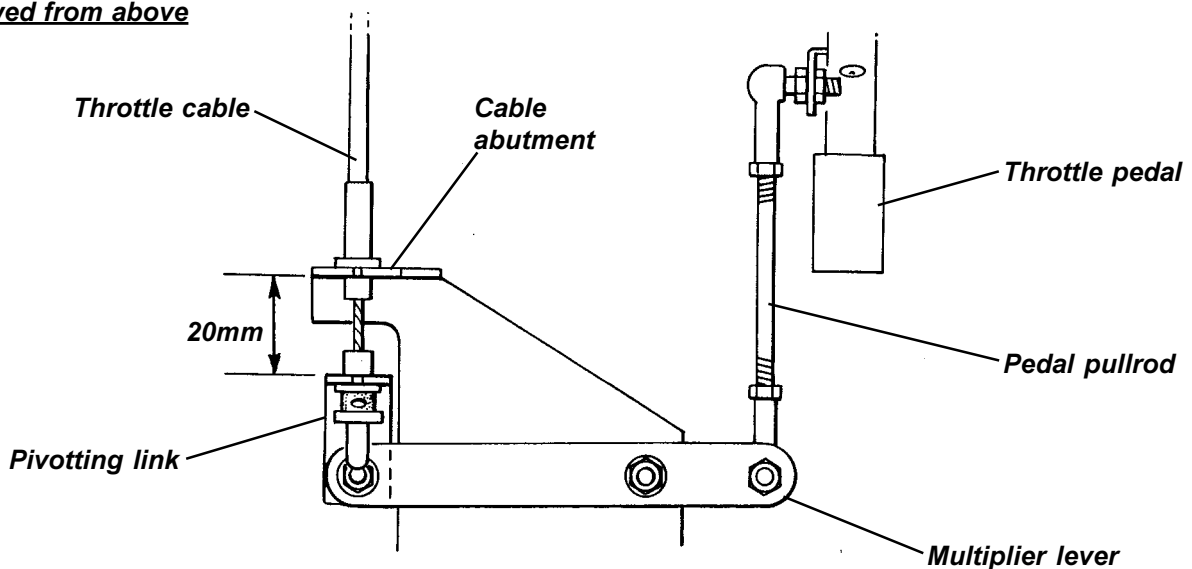
8. On re-assembly, note that no lubricants are used in conjunction with plastic bushes, but that a special Dow Corning DC33 Medium grease (A111F6016) is used on the brake and clutch pedal trunnions. Take care to correctly identify the brake and clutch pedals: The bore for the pushrod trunnion is offset on the brake pedal towards the pivot.



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7. Refit in reverse order to removal, adjusting the brake pedal pushrod as detailed in sub-section JH.7 and the clutch pedal in a similar manner. The throttle pedal upstop should be adjusted as follows:
- Adjust the pedal upstop for a throttle pedal height approximately 30mm lower than the clutch and brake pedals.
  - Adjust the length of the ball jointed pull rod to achieve a gap of 20mm between the outer cable abutment and the inner cable pivoting link on the multiplier lever.
  - Adjust the cable slack at the engine end abutment as detailed in section EMN (or 'Lotus Check' operating instructions).
  - Adjust the pedal downstop so that full travel of the throttle butterfly can just be achieved without allowing the cable to be strained.

**Viewed from above**



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<u>Torque Settings</u>	<u>Nm</u>
Pedal box to chassis	9
Brake master cylinder to pedal box	28
Clutch master cylinder to pedal box	28
Brake pipes to master cylinder	15

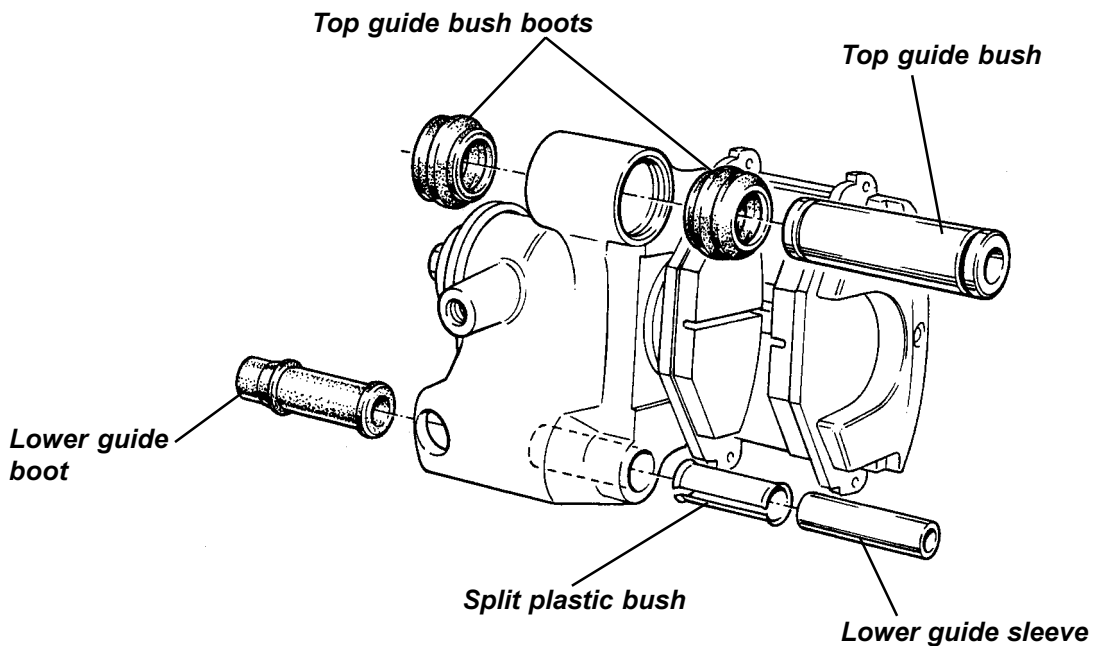
**JH.9 - CALIPER OVERHAUL**

The front brake calipers are manufactured by A.P. Racing, and are to be dismantled or overhauled only by their factory at Wheeler Road, Seven Stars Industrial Estate, Coventry, CV3 4LB.

The Brembo rear brake calipers may have the sliding pins overhauled as detailed below, but any signs of hydraulic leakage from the cylinder indicate that the unit should be replaced.

#### Rear Caliper Sliding Pins

The sliding bushes and sleeves of the Brembo rear calipers may be replaced without disturbing the hydraulic connection:



- a) Disconnect the parking brake cable from the caliper.
- b) Remove the cap head bolt securing the bottom guide bush to the caliper adaptor plate.
- c) Remove the hex. head bolt securing the top guide bush to the caliper adaptor plate, and withdraw the caliper from the car with the brake hose still connected.
- d) Slide out the lower steel guide sleeve and withdraw the bush/boot from the caliper. Pull the boots off the top steel guide bush and slide out the bush from the caliper.
- e) Clean the guide bores in the caliper body with brake cleaner. Lubricate the new bushes and boots with silicone grease provided in the repair kit, and reassemble into the caliper in reverse order to disassembly.
- f) Refit the caliper to the adaptor plate using Permatbond A134 on the threads of both bolts, torque tightening the two fixings to:

Upper M10 bolt;	45 - 50 Nm (33 - 37 lbf.ft)
Lower M8 caphead;	26 - 30 Nm (19 - 22 lbf.ft)
- g) Reconnect the parking brake cable and operate the footbrake to reposition the pads before driving the car.