## BRAKING SYSTEM

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GENERAL LAYOUT

(Also refer to sub-section JJ.18 for additional components used if vehicle is fitted with a Bosch ESP8 module)
JJ 1 - GENERAL DESCRIPTION

From Start of Production at '04MY to '11MY VIN BH_10390 fitted with Kelsey-Hayes ABS module.

*Please see section JJ.18 for information on Bosch ABS module fitted from '11MY VIN BH_10391 (Non-Federal vehicles).*

The Braking system of the Lotus Elise/Exige comprises ventilated discs all round with AP Racing 2-piston fixed callipers on the front and Brembo single piston sliding callipers on the rear. A tandem master cylinder, with vacuum servo assistance, operates the callipers via a front/rear split hydraulic circuit with anti-lock control by a Kelsey-Hayes microprocessor based system. The centrally mounted parking brake lever, operates the rear calliper pistons by control cables.

The AP Racing front callipers, have lightweight alloy bodies housing two opposed pistons, and are mounted via two bolts directly to the rear of the forged steel hub carriers. The rear brakes use Brembo cast iron, single piston callipers, sliding on pins mounted directly to the forged steel hub carriers. A ventilated cast iron brake disc with curved internal vanes and cross drilling is common to all four wheels, and is sandwiched between the road wheels and hubs, retained for convenience by a single countersunk screw.

The tandem master cylinder is made by FTE, and incorporates a front section to supply both front brakes, and a rear section to supply the rear brakes. A translucent fluid reservoir is mounted on a bracket above the master cylinder, and has separate compartments connected to the front and rear cylinder sections by flexible hose. A third hose connects the rear reservoir compartment with the clutch master cylinder to supply that system's needs. A fluid level sensor in the filler cap will light a fascia tell tale lamp if the level becomes dangerously low.

The parking brake ratchet lever is mounted between the seats and uses a short primary cable and balancing yoke to actuate a single control cable linked to each rear calliper. Adjustment of the calliper mechanism to compensate for brake pad wear is automatic. The parking brake should be applied by pulling up the lever with high effort, and engaging the highest ratchet setting attainable. 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 as the discs cool.

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, and the braking efficiency will increase significantly as new discs or pads become 'bedded in'. After fitting new brake components, 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.

A Kelsey-Hayes Antilock Brake System (ABS) is used to optimise brake performance in extreme conditions and reduce the tendency of any wheel to lock up. Under most conditions, the maximum braking force is provided by a wheel which is rotating at about 90% of road speed. Apart from the likelihood of increasing the stopping distance, a locked wheel provides no steering force, such that with both front wheels locked, movement of the steering wheel has no effect on vehicle direction. With the antilock system, even panic braking results in controlled deceleration and the retention of steering response and is especially advantageous when braking on slippery road surfaces and in bad driving conditions. The ABS control system is self monitoring and has the capability of switching itself off if a fault is detected, allowing the base brake system to operate without anti-lock control.

Under normal circumstances, the hydraulic power brake system of the vehicle operates without input from the ABS, with brake pressures governed by the force applied to the brake pedal. The ABS microprocessor receives signals from wheel speed sensors at each of the four wheel hubs, and interprets this data to determine if any wheel is tending to lock up. If imminent lock up is determined, the microprocessor commands solenoid valves in an electro-hydraulic unit to reduce the pressure in that particular brake circuit in order to restore wheel speed to that providing the maximum braking force consistent with continued wheel rotation.
When the ABS is operating, indication to the driver is provided by a ‘pulsing’ sensation felt at the brake pedal as fluid is pumped between the master cylinder and hydraulic control unit, and also by audible clicking of the relays and switches. These signals indicate to the driver that maximum retardation is being approached, and that driving style should be modified to suit the conditions. The minimum stopping distance is achieved by applying the brakes firmly and steadily, and allowing the ABS to modulate hydraulic pressure. The driver should not attempt to emulate this process by ‘pumping’ the brake pedal, as modulation at the pedal will treat all four wheels similarly, rather than the individual wheel control allowed by the electronics.

During ABS operation, the wheels may appear to lock momentarily as the wheel speed changes rapidly, and some tyre noise (intermittent screeching) may be heard. This noise is normal and will vary with road and tyre conditions. However, a wheel that completely locks and stays locked for more than one or two seconds is not normal, and indicates that the vehicle should be serviced as soon as possible. The ABS cannot operate properly if the base brake system is faulty, and will also be affected by dragging brakes, faulty wheel bearings or other related faults.

The ABS controller constantly monitors the anti-lock system for faults, and lights a fascia tell tale if a problem is detected. Information stored in the computer's memory may be accessed via a hand held electronic scanner, in order to facilitate diagnosis of system faults (see later).
JJ 2 - TELL TALE LAMPS

Brake Tell Tale Lamps
Two tell tale lamps are provided in the instrument cluster to warn of problems in the brake system.

<table>
<thead>
<tr>
<th>USA spec.</th>
<th>Euro spec.</th>
</tr>
</thead>
<tbody>
<tr>
<td>'Brakes' tell tale</td>
<td>'ABS' tell tale</td>
</tr>
</tbody>
</table>

As a bulb check function, this tell tale will glow red for about 3 seconds after ignition switch on, and then go out unless one of the following conditions applies:

i) The parking brake is applied.
ii) The brake fluid level in the master cylinder reservoir is low.

Under normal circumstances, the tell tale should light when the ignition is switched on, and go out when the parking brake is released. If the lamp stays on, or comes on whilst driving, the car should be stopped immediately, as this may be an indication of low brake fluid level caused by a hydraulic leak. A button on the reservoir cap allows the tell tale circuit to be tested.

ABS Tell Tale
The ABS tell tale warns the driver of problems in the anti-lock system. The lamp should light for about 3 seconds following ignition switch on, and then go out. If the lamp remains lit, or comes on whilst driving, a fault in the ABS is indicated. The base brake system will continue to operate normally, but without ABS regulation. The car can be driven but should be checked and repaired at the earliest opportunity.

Lotus Dynamic Performance Management (Lotus DPM) Tell Tales
Also refer to sub-section JJ.21 and service notes section MP.13 for further information on Lotus Dynamic Performance Management tell-tales.
JJ.3 - BRAKE FLUID CHECK & CHANGE

Before checking the brake fluid level, ensure that the car is parked on a level surface, and open the front body access panel. The level of fluid in the reservoir may be inspected without disturbing the filler cap, and should be level with the top of the ‘MAX’ mark 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 tell tale lamp in the instrument cluster if the level drops significantly.

Use only a fresh supply of DOT 4 non-mineral type fluid, identified by a yellow and black symbol (see left hand illustration). 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.

As a bulb check, the tell tale should light for about 3 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.

The reservoir is mounted on a bracket fixed to the wiper spindle support, and is connected to the master cylinder by flexible hoses. An internal baffle divides the reservoir into two compartments, with one section supplying the front brake circuit, and a second section supplying the rear brakes in addition to, via another flexible 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 4 non-mineral type fluid, identified by a yellow and black symbol. 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 syringe.

Renewal of Brake Fluid
Brake fluid absorbs water from the atmosphere over a period of time (i.e. is 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 24 months (including clutch release system).
Brake Bleeding
Note: if bleeding the braking system is required due to the renewal of the BOSCH ESP 8.1 ABS modulator, please refer to sub-section JJ.18 ABS module renewal, before carrying out this procedure.

Brake Bleeding Procedure:
If the brake fluid is to be renewed, or an hydraulic component replaced, the system should be bled of air using the following procedure:

1. Using conventional manual techniques, or low air pressure applied to the reservoir, bleed the system from each calliper bleed nipple in turn until no air bubbles can be seen.

2. '04 - '07MY Vehicles: Carefully pull the one-way valve off of the brake vacuum servo unit*, then connect the Lotus Techcentre to the data link connector (refer to sub-section JJ.15), select ABS and follow the brake bleeding instructions. Whilst this automatic process is taking place (with all 4 calliper nipples open), gently cycle the brake pedal up and down whilst keeping the reservoir topped up, to move any air bubbles displaced from the ABS unit down the hydraulic lines. Finish by closing each nipple with the pedal down.

2. '08 MY Vehicles onwards: Carefully pull the one-way valve off of the brake vacuum servo unit*, then connect the Lotus Techcentre to the diagnostic link, select ABS and follow the brake bleeding instructions. Whilst this automatic process is taking place (with all 4 calliper nipples open), gently cycle the brake pedal up and down whilst keeping the reservoir topped up, to move any air bubbles displaced from the ABS unit down the hydraulic lines. Finish by closing each nipple with the pedal down.

3. Repeat step (1) to purge each calliper feed line in turn.

*Whilst performing a brake fluid bleeding procedure, it is possible that the brake pedal may not fully return to its released/uppermost position (when being fully actuated as part of the manual bleeding routine) due to vacuum stored within the brake servo unit.

Although this will not affect the brake bleeding process, it may be incorrectly assumed that this has occurred because of a fault within the braking circuit and that the brake bleeding procedure is being compromised.

Preventing the build-up of vacuum within the brake servo unit will ensure that the brake pedal will always return to its fully released position whilst performing a brake fluid bleeding/flush procedure.

Therefore it is recommended that PRIOR to performing a brake fluid flush or bleeding procedure as described above, that the one-way/non-return valve of the vacuum servo unit is removed from the servo unit.

IMPORTANT: Ensure that the one-way/non-return valve is refitted to the servo unit as soon as the brake bleeding procedure is completed.
JJ.4 - FRONT BRAKE PAD REPLACEMENT

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

Standard pad thickness (excluding backplate): 9.0 mm
Minimum pad thickness (excluding backplate): 2.5 mm

If the thickness of any pad is below the specified minimum, the axle set of pads should be renewed. Note that the pad backplates are factory fitted with anti-squeal overlays, and are identified with T 4139 on the backplate. For cars used on track, where sustained hard use and extreme brake temperatures are likely to occur, 'Motor-sport' pads made by Pagid may be fitted in complete vehicle sets under part number A111J0150S (front) and A111J0151S (rear).

1. To remove the brake pads: Remove the 'R' clip from the lower of the two pad retaining pins, and withdraw the lower of the pin taking care to restrain the anti-rattle spring. Remove the second retaining pin together with the anti-rattle spring plate. Withdraw the pads from the calliper. 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 calliper for any signs of fluid leakage from a piston seal or joint, and replace the calliper if any such signs are evident. Clean the pad recess in the calliper 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 calliper 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 calliper, 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 calliper, 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 top of 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.
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JJ.5 - REAR BRAKE PAD REPLACEMENT

Pad thickness may be checked after removing the road wheel, without disturbing the calliper.
Standard pad thickness (excluding backplate): 6.5 mm
Minimum pad thickness (excluding backplate): 2.5 mm

If the thickness of any pad is below the specified minimum, the axle set of pads should be renewed. Note that the pad backplates are marked T4139 and are factory fitted with anti-squeal overlays.

Tools Required:
Piston Retraction Tool T000T1242F

1. Remove the rear road wheels.

2. At each rear corner: using a suitable pin punch, knock the pad retaining pin out of the calliper 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 calliper. Measure the thickness of the lining material, and renew the axle set of pads if any are below 2.5 mm.

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 calliper should be replaced as Brembo do not recommend that this calliper 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 calliper piston must be screwed back into the calliper 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 T000T1242F into the holes in the calliper piston (also see sub-section JJ.16), and screw the piston back down the parking brake mechanism screw thread until fully bottomed.
   - Refit the brake disc, and tighten the countersunk retaining screw to 12 Nm.

7. In order to minimise brake squeal from new pads during the bedding-in period, a copper based (PBC) paste (e.g Renolit) should be used on the pad contact surfaces of the rear callipers in the areas shown:

   [Diagram showing Pad retaining pin, Retaining pin snap ring, Anti-rattle spring, Contact face of piston, Calliper outboard fingers]
8. Slide the brake pads into the calliper. Position the pad anti-rattle spring in the calliper 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 calliper 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 calliper.

9. Refit the road wheels 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.

10. 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.
JJ.6 - PARKING BRAKE MECHANISM

Operation of the parking brake 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 callipers. At each calliper, the cable connects to a lever which operates the hydraulic piston by mechanical means:

Movement of the calliper 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 apart, and in so doing, apply an axial force to the piston via a screwthread and nut. The nut is restrained in the piston by a one way clutch which grips the nut when the parking brake is applied, but allows it to turn when the mechanism relaxes, or when the piston is operated hydraulically by the footbrake. In this way, the mechanical mechanism is adjusted automatically to compensate for pad wear.

For the auto adjustment system to function correctly, it is essential that each calliper parking brake lever is allowed to return fully when the brake is released, and is not prevented from doing so by maladjustment of the parking brake cable. To check that the calliper levers are fully returned; with the parking brake ‘off’, measure the distance between the cable abutment and calliper lever as shown.
After verifying this dimension, any slack in the rear cable may be adjusted out at the left hand outer cable abutment, which is integral with the pivot bracket for the front leg of the lower wishbone. Remove the engine bay undertray for access. After adjustment, re-check the calliper lever ‘off’ dimension.

The parking brake lever is mounted in a steel bracket which also houses the gearchange lever, and is bolted to the seat mounting crossmember at the front, and to the floor rear crossmember. The parking brake lever is secured by two bolts fixing the ratchet quadrant to the bracket. Access to the lever is available after removing the cockpit centre trim panel:

- Unscrew the gear lever knob.
- Release the fixing screw at either side of the gear lever shroud base.
- Remove the single screw retaining the rear bulkhead centre pocket, and then the two screws securing the rear shroud. Disconnect the auxiliary power socket.
- Lift the centre trim panel, label and disconnect the CDL switch and (if fitted) hazard switch, and release the gear lever gaiter.

Note that the parking brake/gearchange lever mounting bracket is not drive handed, but is offset, via alternative fixing holes in the chassis, towards the passenger side. The ratchet pawl operates a micro switch to light the ‘brakes’ tell tale lamp in the instrument panel whenever the ignition is switched on and the parking brake is applied. The short front cable is connected to the lever assembly by a clevis pin with spring retaining clip. When carrying out any work in this area, take care not to damage or misroute the electrical main harness.
JJ 7 - BRAKE DISCS

The same disc is used at each corner of the car, and features cast iron construction with internal curved vane cooling and cross-drilling. The opposite direction of rotation of the curved vanes on each side of the car does not significantly affect the cooling performance of the disc. A countersunk screw is used to retain the discs for convenience when servicing.

The condition of the brake disc friction surface is a major factor in brake performance and feel, with a good surface quality and minimal run-out and thickness variation being required. After an extended lay up, some surface corrosion may develop on the discs which will cause a degradation in braking quality until the surfaces are cleaned up by normal brake action.

Excessive run-out or thickness variation as a result of overheating or extended wear, may cause brake judder and/or extended pedal travel due to pad 'knock off'. Scoring and ridging of the braking surfaces will be exacerbated by operation in dusty or unmetalled road environments, and will reduce braking performance.

No skimming or re-surfacing of the brake discs is recommended. If the disc becomes badly scored, or is out of specification in any way, it should be renewed. NOTE: Ensure that there is no discernible free play in the wheel bearings before attempting to measure brake disc run-out. If disc run-out exceeds the service maximum, check the hub run-out before replacing the disc.

<table>
<thead>
<tr>
<th>Brake disc thickness:</th>
<th>New</th>
<th>26.0 mm (1.02 in)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Service minimum</td>
<td>24.0 mm (0.98 in)</td>
</tr>
<tr>
<td>Runout:</td>
<td>New maximum</td>
<td>0.03 mm (0.001 in)</td>
</tr>
<tr>
<td></td>
<td>Service maximum</td>
<td>0.10 mm (0.004 in)</td>
</tr>
<tr>
<td>Hub:</td>
<td>Disc mounting face run-out max</td>
<td>0.04 mm (0.0015 in)</td>
</tr>
</tbody>
</table>

**Front Disc**

*Removal:*
1. Remove the road wheel; refer to service notes section GH.2 for further information.

2. Remove the two bolts securing the brake calliper to the hub carrier, and withdraw the calliper from the disc. Secure clear without straining the flexible hose; refer to sub-section JJ.8 for further information.

3. Remove the single countersunk screw retaining the disc to the hub flange and withdraw the disc from the hub.

*Refitment:*
- Before re-fitting a disc, ensure that the mating face between disc and hub is scrupulously clean. Mount the disc onto the hub and align the wheel bolt holes and refit.

- Refit the countersunk screw and tighten to 9Nm.

- Refit the brake calliper; refer to sub-section JJ.8 for further information for specific refitment procedure.

- Refit the road wheel and operate the brakes before driving the car to set the brake pad position.

**Rear Disc**

*Replacement:*
Replacement of the rear discs is similar to that for the front discs, except that if the brake pads are removed, it is not necessary to remove the brake calliper to enable the disc to be withdrawn from the hub; refer to sub-section JJ.5 for further information.
JJ.8 - BRAKE CALLIPERS

Front Callipers
The front brake callipers are manufactured by AP Racing and is a 2-piston fixed callipers design. Replacement seals or pistons are not available from the Lotus Cars Aftersales Department and so are considered non-serviceable.

The callipers are secured to the hub carrier by two bolts disposed in a plane perpendicular to the disc axis, mounted behind the axle line.

Removal:
Note: If an uprated front brake kit, comprising 4-piston front callipers has been fitted, also refer to sub-section JJ.8 for additional procedural information and revised torque figures before commencing with calliper removal or refitment.

1. Remove the road wheel; refer to service notes section GH.2 for further information.

2. Remove the M10 x 65 bolts (2) securing the brake calliper to the hub carrier and withdraw the calliper complete with pads from the disc. Secure clear without straining the flexible hose.

Refitment:
Reverse procedure of removal except:
- Apply Permabond A130 (Blue - part number A912E7033V) to the threads of the calliper fixing bolts. Fit the calliper with pads over the disc and secure to the hub carrier with the two bolts. Tighten to 45Nm.
- Refit the road wheel and when all brakes are assembled, pump the brake pedal to restore brake pad position before driving the car.

Calliper replacement:

Preparation:
Note: In the event that the remaining brake fluid lines are not being disrupted for any reason, then it may be advantageous to limit brake fluid loss to the individual fluid circuit to the calliper being removed rather than draining the complete braking system. This will reduce the possibility of accidentally introducing air into the braking system which may be difficult to remove causing a 'spongy' brake pedal and ineffective braking system.

Place a suitable disposable towel around the lower wishbone/balljoint area as well as a container beneath the wishbone area directly below the front calliper/brake hose assembly to prevent the accidental spillage of brake fluid onto the floor.

Removal:
1. Remove the road wheel; refer to service notes section GH.2 for further information.

2. Clamp the brake hose using a suitable hose clamp* before loosening the brake hose from the calliper by rotating it approximately 1/2 a turn in the calliper thread using a suitable open ended/brake spanner or crows foot adaptor on the machined ‘flats’ located at the end of the brake hose.

3. Remove the two bolts securing the brake calliper to the hub carrier (as described in step 2 of calliper removal).

4. Once the calliper has been withdrawn from the disc, rotate the calliper to fully release it from the brake hose.
Note: "If a steel braided brake hose is fitted, it cannot be clamped to prevent brake fluid loss. Therefore it is recommended to ensure that the new calliper is already prepared for fitment to receive the brake hose as soon as possible.

Renewal:
- Fit the new brake calliper onto the thread of the brake hose and hand tighten only this should stop any further brake fluid loss.

- Apply Permabond A130 Blue (part number A912E7033V) to the threads of the calliper fixing bolts. Fit the calliper with pads over the disc and secure to the hub carrier, torque to 45Nm.

- Ensure the brake hose route is unhindered, cannot rub on any other components and is free of kinks before torque tightening to 22Nm using a suitable crows foot adaptor.

- Bleed the brake assembly as required; refer to sub-section JJ.3 for further information.

- Refit the road wheel and when all brakes are assembled, pump the brake pedal to restore brake pad position before driving the car.

**Rear Brake Calliper**
The single piston sliding type rear brake callipers are manufactured by Brembo. For information on brake pad renewal please refer to sub-section JJ.5.

**Removal:**
1. Remove the road wheel; refer to service notes section GH.2 for further information.

2. Remove the upper M10 x 80mm bolt/washer and lower M8 x 60mm bolt securing the brake calliper to the hub carrier.

3. Withdraw the calliper complete with pads from the disc. Secure clear without straining the flexible hose or handbrake cable (if still attached to the parking brake lever).

**Refitment:**
Reverse procedure of removal except:

- Apply Permabond A130 (Blue - part number A912E7033V) to the first 10mm of the threads of the calliper fixing bolts.

- Fit the calliper with pads over the disc and secure to the hub carrier with the two bolts.

- Refit and tighten the upper M10 x 80mm bolt/washer to 45 - 50 Nm and the lower M8 x 60mm bolt to 26 - 30Nm.

- Refit the road wheel and when all brakes are assembled, pump the brake pedal and operate the parking brake lever to restore brake pad position before driving the car.
Calliper replacement:

Preparation:
Note: In the event that the remaining brake fluid lines are not being disrupted for any reason, then it may be advantageous to limit brake fluid loss to the individual fluid circuit to the calliper being removed rather than draining the complete braking system. This will reduce the possibility of accidentally introducing air into the braking system which may be difficult to remove causing a ‘spongy’ brake pedal and ineffective braking system.

Place a suitable disposable towel around the lower wishbone/balljoint area as well as a container beneath the wishbone area directly below the front calliper/brake hose assembly to prevent the accidental spillage of brake fluid onto the floor.

Removal:
1. Remove the road wheel; refer to service notes section GH.2 for further information.

2. Clamp the brake hose using a suitable hose clamp* before loosening the brake hose from the calliper by rotating it approximately 1/2 a turn in the calliper thread using a suitable open ended/brake spanner or crows foot adaptor on the machined ‘flats’ located at the end of the brake hose.

3. Disconnect the parking brake cable from the calliper park brake lever (it may be necessary to slacken the handbrake cable to perform this operation; refer to sub-section JJ.6 for further information.

4. Remove the two bolts securing the brake caliper to the hub carrier (as described in step 2 of calliper removal).

5. Once the calliper has been withdrawn from the disc, rotate the calliper to fully release it from the brake hose.

Note: *If a steel braided brake hose is fitted, it cannot be clamped to prevent brake fluid loss. Therefore it is recommended to ensure that the new calliper is already prepared for fitment to receive the brake hose as soon as possible.

Renewal:
- Fit the new brake calliper onto the thread of the brake hose and hand tighten only this should stop any further brake fluid loss.

- Apply Permabond A130 (Blue - part number A912E7033V) to the first 10mm of the threads of the calliper fixing bolts.

- Refit and tighten the upper M10 x 80mm bolt/washer to 45 - 50 Nm and the lower M8 x 60mm bolt to 26 - 30Nm.

- Ensure the brake hose route is unhindered, cannot rub on any other components and is free of kinks before torque tightening to 22Nm using a suitable crows foot adaptor.

- Attach the parking brake cable onto the calliper park brake lever.

- Check the operation of the calliper lever ensuring that it is in the fully returned position (with the parking
handbrake lever 'off'), adjust the parking brake cable as necessary; refer to sub-section JJ.6 for further information.

- Bleed the brake assembly as required; refer to sub-section JJ.3 for further information.

- Refit the road wheel and when all brakes are assembled, pump the brake pedal and operate the parking brake lever to restore brake pad position before driving the car.

The Brembo rear brake callipers 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 Calliper Sliding Pins**
The sliding bushes and sleeves of the Brembo rear callipers may be replaced without disturbing the hydraulic connection:

![Diagram of rear calliper sliding pins](image)

*Replacement procedure:*
1. Disconnect the parking brake cable from the calliper park brake lever (it may be necessary to slacken the handbrake cable to perform this operation; refer to sub-section JJ.6 for further information.

2. Remove the lower M8 x 60mm bolt securing the bottom guide bush to the hub carrier.

3. Remove the upper M10 x 80mm bolt/washer securing the top guide bush to the hub carrier, and withdraw the calliper from the car with the brake hose still connected.

4. Slide out the lower steel guide sleeve and withdraw the bush/boot from the calliper. Pull the boots off the top steel guide bush and slide out the bush from the calliper.

5. Clean the guide bores in the calliper body with brake cleaner. Lubricate the new bushes and boots with silicone grease provided in the repair kit, and reassemble into the calliper in reverse order to disassembly; refer to calliper refitment procedure as shown on previous pages for further information.
**JJ.8A - '08 MODEL YEAR UPGRADE OPTION**

**Big Brake Kit**

Introduced as an option for some '08 models, is an uprated front brake kit, comprising:

A. 4-piston front callipers

B. Calliper to hub adaptor brackets

C. Larger diameter front discs with adaptor bells

D. Steel braided hoses & banjo fittings.

E. Pagid RS14B 16.5mm thick front brake pads

---

**Big brake kit (early option with 2-piece disc with adaptor)**

**Front Callipers**

At each front corner, the A.P. Racing, alloy, 4-piston front calliper is radially mounted to the front hub carrier via an alloy adaptor bracket. Two reduced head capscrews secure the adaptor bracket to the hub carrier, with two capscrews with washers securing the calliper to the adaptor. Two retaining pins are used to locate the Pagid RS14 brake pads, and also secure an anti-rattle spring plate which incorporates a direction of rotation arrow.

**Torque figures**

Adaptor to hub carrier: 58 Nm.
Calliper to adaptor: 58 Nm.
Caliper bleed screw: 17 Nm.

**Front Discs**

The front discs are increased in diameter from 288mm to 308mm, and are cooled by internal curved vanes which trail the normal direction of rotation, to result in distinct RH and LH components. Each disc is mounted to its hub via an adaptor 'bell' from which it should not be separated under normal circumstances.

Torque of disc to bell mounting bolts; 14 Nm. Note that these discs are fitted only on the front, with standard discs on the rear. New thickness of the front discs is 26.00mm; minimum service thickness 25.00mm

**Wheel bolts**

In order to provide sufficient clearance between the 4-piston brake callipers and all road wheel options, the thickness of the disc mounting bell at the hub face is increased from the standard 7mm disc thickness to 11mm. This requires the use of 2mm longer wheel bolts (C117G6000F) to maintain sufficient thread engagement.

To reduce the possibility of incorrect fitment, both front and rear wheels are secured with the longer bolts, with no coded security bolts fitted. Note that these bolts use the standard spline type socket heads, but have a reduced outside diameter of the head.

*Standard bolt:* B117G6000F 26mm thread length Head outside diameter: 22mm
*Long bolt:* C117G6000F 28mm thread length Head outside diameter: 19mm

**Braided hoses**

The steel braided front hoses are connected to the front callipers using a banjo fitting tightened to 25 Nm.
Retrofit Big Brake Kit: 'Fast Road' Specification

Introduced in June 2008, at approx. '08 M.Y. VIN serial number 1742, the ‘big brake’ kit fitted to all 4 cylinder Exige S models with the Performance Pack option, has been revised to a 'Fast Road' specification.

The differences may be summarised as follows:

A. Bespoke single piece front callipers replace callipers with separate adaptor brackets.

B. Standard wheel bolts (incl. security coding) replace longer versions without security bolt.

C. Single piece iron front brake discs replace separate iron discs and alloy mounting bells.

D. Revised braided hoses front and rear.

E. Brake pad material change, front and rear (Ferodo DS25HP brake pads14.5mm thick).

Retrofit Big Brake Kit: 'Sport' Specification

For Cup 260 cars, a new Sport brake specification combines the Fast Road front callipers with 2-piece front discs for marginally better disc cooling, in conjunction with Pagid pad material.

A. The Sport brakes, have marginally better disc cooling via the alloy mounting bells.

B. The new calliper requires a new reduced thickness version of the Pagid pad (A128J0003S).

The Fast Road callipers do not require the thicker disc bells formerly used to provide wheel/calliper clearance, or the corresponding increased length wheelbolts.

Consequently, a new version of the two piece disc assembly uses the standard 8 mm flange thickness and standard wheelbolts.

Trade offs include a greater susceptibility to noise generation, and reduced response when the brakes are cold.

Be aware that erroneously fitting a new 2-piece disc on an original ‘Big Brake’ car will result in the road wheel fouling the brake calliper.
### Comparison chart:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Standard (reference)</th>
<th>‘Big Brake’ (discontinued)</th>
<th>Fast Road</th>
<th>Sport</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Front calliper pistons</strong></td>
<td>2</td>
<td>4</td>
<td>Leading 31.75</td>
<td>4</td>
</tr>
<tr>
<td><strong>Piston diameter (mm)</strong></td>
<td>44.45</td>
<td>Leading 31.75</td>
<td>Trailing 36.00</td>
<td>Leading 31.75</td>
</tr>
<tr>
<td><strong>Pad material</strong></td>
<td>Textar T4139</td>
<td>Pagid RS14B</td>
<td>Ferodo DS25HP</td>
<td>Pagid RS14B</td>
</tr>
<tr>
<td><strong>New pad thickness</strong></td>
<td>14.5</td>
<td>16.5</td>
<td>14.5</td>
<td>14.5</td>
</tr>
<tr>
<td><strong>Front disc size</strong></td>
<td>288 x 26</td>
<td>308 x 26</td>
<td>308 x 26</td>
<td>308 x 26</td>
</tr>
<tr>
<td><strong>Front disc features</strong></td>
<td>Curved internal vanes, cross drilled.</td>
<td>Curved internal vanes, cross drilled.</td>
<td>Handed RH LH</td>
<td>Handed RH LH</td>
</tr>
<tr>
<td></td>
<td>Common RH LH</td>
<td>Separate 11mm thick alloy mounting bell.</td>
<td>Single piece.</td>
<td>Separate 8mm thick alloy mounting bell.</td>
</tr>
<tr>
<td><strong>Wheelbolts</strong></td>
<td>26mm long + coded bolt</td>
<td>26mm long + coded bolt</td>
<td>26mm long + coded bolt</td>
<td>26mm long + coded bolt</td>
</tr>
</tbody>
</table>

### Brake pad bedding-in

Fast Road brakes should be bedded-in according to standard handbook advice; avoid needless heavy braking for the first 100 miles (160 km). Thereafter, the first time the brakes are used aggressively, some loss of brake feel may be evident as the brake pads undergo a final conditioning phase. After the brakes have cooled, full brake performance will be restored.

For cars built with Sport Brakes, and any car fitted with ‘big brakes’ using Pagid RS14B pads, an extended bedding-in procedure is required, detailed in LSL534b (see Technical Service Bulletin TSB 2008/05).

Whichever brake equipment is fitted, it is vital that the brake pad material is matched at all four wheels - do not mix front and rear pad materials.

The braided brake hoses have been revised on introduction of the Fast Road brakes to optimise hose length and improve ‘P’ clip security. These hoses may be used as service replacement on all cars.
JJ 9 - BRAKE MASTER CYLINDER

Brake master cylinder
The tandem master cylinder incorporates a rear section to supply both front brakes, and a front section to supply the rear brakes.

A translucent fluid reservoir is mounted on a bracket above the master cylinder and brake servo, and is divided into front and rear chambers separated by a baffle.

The two chambers are connected to the front and rear master cylinder sections by flexible hoses, with a third hose connecting the rear brake reservoir chamber to the clutch master cylinder to supply that system’s needs.

A fluid level sensor in the filler cap will light a fascia tell tale lamp if the level becomes dangerously low.

The tandem brake master cylinder is mounted in the drivers side of the front compartment and is secured to the brake servo by two studs with M8 nuts. The cylinder uses two pistons to supply the independent front and rear brake circuits. The cross-section below is provided for information, but the master cylinder manufacturer does not recommend any dismantling of the unit, and supplies no replacement parts or internal components. If the cylinder is faulty it should be renewed as a complete assembly.

Key to Cross-Section
1. Body
2. Passage to rear cylinder
3. Rear cylinder inlet port
4. Guide bush
5. Rear piston
6. Lip seal
7. Stop washer
8. Primary seal
9. Washer
10. Spring plate
11. Retaining screw
12. Stop sleeve
13. Rear piston spring
14. Front piston
15. Secondary seal
16. Transfer passage
17. Front piston stop
18. Front piston spring

Updated 27th September 2016
Master cylinder removal:
1. On all Exige models or 2011MY onwards Elise, remove the front clamshell (see sub-section BR.6).

2. Place suitable absorbent towelling underneath the brake master cylinder to prevent any brake fluid that may spill out of the master cylinder during removal causing damage or contamination to any surrounding ancillary components or painted surfaces.

3. To protect the radiator from accidental damage or brake fluid contamination whilst working in this area, place a suitable cover (such as a piece of cardboard) on the top of the radiator assembly.

4. To reduce brake fluid spillage, clamp the hoses connecting the fluid reservoir to the master cylinder using a suitable hose clamps.

5. With the fluid reservoir to master cylinder hoses still attached to the plastic port adaptor connectors, use a gentle levering/rocking action and pull the adaptor connectors off of the master cylinders front and rear brake fluid inlet ports.

Tip: To reduce the potential for airlocks within the fluid line and reduce the time required to bleed the new cylinder it is recommended to place the new master cylinder near the servo assembly area at this stage (with the brake pipe caps still fitted), ensuring it is positioned as low as possible, then transfer the fluid reservoir hoses over to the new master cylinder. This will allow the new master an opportunity to self bleed whilst performing the remaining procedure.
6. Release the two brake pipes from the master cylinder, and plug the pipes and ports.

7. Release the two nuts securing the master cylinder to the brake servo and discard.

8. Pull the master cylinder forward until it has cleared the brake servo retaining studs and withdraw from the vehicle.

Note: This brake master cylinder and servo assembly is also used on other automotive applications where an application of silicone sealant between the contact areas of the brake master cylinder and servo assembly is specified. Dependant on the build date of the Elise, silicone sealant may have also been applied.

If silicone has been applied then resistance may be encountered when trying to separate the master cylinder from the brake servo assembly. To release the master cylinder apply a gentle up and down and side to side rocking motion to the end of the cylinder to break the silicone bead. Only use a utility knife as a last resort to carefully cut the bead around the brake servo area.

Prior to fitment:
If silicone sealant was originally applied to the master cylinder brake servo assembly, then inspect the front of the brake servo assembly and ensure that there is no silicone residue on the master cylinder contact area which may result in the new master cylinder body not seating properly on the front of the brake servo assembly.

Note: A small residue of silicone sealant around the periphery of the master cylinder contact area is acceptable which does not require removal.

Ensure the square profiled rubber sealing ring is located correctly in position into the corresponding groove in the rear of the master cylinder body prior to fitment.

Refitment:
Is the reverse procedure of removal except:

- **IMPORTANT:** Check that the master cylinders hollow piston rod is aligned centrally once the cylinder is fitted back onto the retaining studs to ensure that the piston rod slides over the brake servo push rod.

The brake master cylinder will still fit onto the brake servo even if the piston rod is misaligned **BUT** the vehicles braking performance will be **SEVERELY** affected!

- Using NEW locknuts (supplied with a new cylinder), tighten to the following torques:
  - Master cylinder fixing nuts; 25 Nm
  - Brake pipes to cylinder; 17.5 Nm

- Upon refitment, ensure the two brake master cylinder to ABS/ESP module brake fluid pipes are routed correctly so that they are not touching each other or any other ancillary components.

- Fill the reservoir with DOT 4 non-mineral type brake fluid, and bleed the complete brake system of air using standard vacuum assisted, pressure assisted or manual techniques; refer to sub-section JJ.3 for further information.

Updated 28th September 2016
Servo unit removal:
1. Remove the brake master cylinder; refer to sub-section for further information.

2. From within the footwell, remove the clevis pin connecting the servo pushrod to the brake pedal; refer to sub-section JJ.11 for further information.

3. Disconnect the brake servo vacuum hose,

4. Disconnect the single hose connecting reservoir to the clutch master cylinder and plug the hose.

5. Disconnect the electrical tell tale connector from the reservoir cap.

6. Cut the tie wrap securing the reservoir to the mounting bracket and remove the reservoir assembly.

7. Release the four nuts securing the servo's retaining studs to the pedal box extension plinth and withdraw the servo assembly.

Refitment:
Is the reverse of removal.

- Tightening the servo mounting nuts to 25 Nm, and the new master cylinder fixing nuts to 25 Nm.

- Check pushrod adjustment as it is essential that the brake pedal, servo piston (and master cylinder piston) are allowed to return fully when the brakes are released, and is not pre-loaded by mal-adjustment of the input pushrod; refer to sub-section JJ.11 for further information.

- bleed the brake hydraulic system; refer to sub-section JJ.3 for further information.
JJ 11 - PEDAL BOX

Prior to '06MY.
The extruded and welded aluminium alloy pedal box is bonded and rivetted to an aperture in the chassis scuttle. A hollow steel pivot shaft serving all three pedals is bolted to a steel mounting plate, itself bolted to the inside of the pedal box.

Each pedal is machined from a common alloy extrusion, with the throttle pedal being of a narrower section than that used for the brake and clutch. An extruded footpad is keyed, bonded and rivetted to the clutch and brake pedals, and is bolted to the throttle pedal. All the pedals use synthetic bushes for maintenance free articulation on the steel pivot shaft, and the clutch pedal uses a cylindrical steel trunnion supported in synthetic bearing rings to actuate the master cylinder pushrod.

In order for the required pedal spacing to be achieved within the packaging constraints of the vehicle, the brake pedal uses a relay lever to move the output plane inboard of the pedal line. A steel relay lever pivots on the common pedal shaft, and is equipped with two legs, one of which is used to connect to the brake pedal via an integral trunnion, whilst the other leg is connected to the brake servo pushrod by a clevis pin.

The throttle pedal actuates the throttle cable directly, which is routed along the cockpit centre, beneath the gear lever and parking brake lever trim panels, beneath the fuel tank bay and up to the front of the engine bay to the throttle body.

Adjustment

Throttle cable:
- The pedal is pulled against a rubber buffer on a steel upstop bracket by an extension spring.
- Adjust the cable outer length at the engine end abutment bracket to allow 2 - 3mm of pedal movement before the throttle is actuated.
- Set the downstop in the pedal footpad such that vigorous full depression of the pedal achieves full opening of the throttle butterfly without allowing the cable to be strained.
- An alternative pedal position which may be preferred for 'heel and toeing' may be achieved by replacing the rubber upstop buffer with a M5x15 hex. head setscrew, with three flat washers beneath the head for a total thickness of around 7mm. The cable must then be re-adjusted at the engine abutment as above. The footpad downstop bolt should then be replaced by an M8x20 setscrew and reset as above.

Brake pedal:
- The pedal is pulled 'off' by an extension spring anchored to a bracket rivetted to the scuttle beam.
- There is normally a gap of approximately 3mm between the brake pedal and the pedal box upstop flange with the pedal released. If preferred, the brake pedal can be raised slightly by adjusting the effective length of the pushrod at its connection to the clevis, but the master cylinder must never be preloaded, i.e. there must always be a small clearance between the pedal and upstop bracket to ensure that the master cylinder piston is allowed fully to return and open the reservoir port.
- After any adjustment, tighten the clevis locknut and check operation of the brake light switch.

Clutch pedal:
- The pushrod, which is captive in the master cylinder, is screwed fully into the pedal trunnion, and controls the pedal height. Rubber buffers are provided to cushion the pedal at full travel.

Pedal Removal
To remove a pedal from the pivot shaft, the pedal shaft mounting plate must be removed from the pedal box complete with all three pedals:
1. Remove the intermediate steering column (see Section HG).
2. Disconnect the brake servo clevis pin from the pedal relay lever, and release the throttle cable from the pedal.
3. Remove the two bolts securing the clutch master cylinder assembly to the pedal box and unscrew the pushrod from the pedal trunnion.

Updated 28th January 2014
4. Remove the two bolts securing the brake servo mounting plinth to the pedal box and provide alternative support for the servo/brake master cylinder assembly.

5. Release the pedal return springs and remove the stop lamp switch.

6. From above, release the six M6 screws securing the pedal shaft mounting bracket to the top of the pedal box, and the single screw in the front face of the pedal box. Withdraw the pedal shaft assembly from inside the pedal box.

7. Remove the three M5 screws securing the pedal shaft to its mounting bracket, and disassemble the pedals from the shaft taking careful note of spacers and washers.

8. On re-assembly, note that the pivot bushes of the brake pedal and relay lever should be lubricated with Syntheso GLK1, or equivalent. Check pedal pushrod and stop switch operation as detailed above.
From '06MY
Introduced for the 2006 model year, was electronic throttle control (ETC), which dispensed with the mecha-
nical throttle cable linking the accelerator pedal to the throttle body. The ‘drive by wire’ throttle actuation uses a
throttle pedal fabricated from steel rod which is pivotted in a plastic housing bolted to the pedal box.

The plastic housing incorporates two pedal position potentiometers operated by rotation of the pedal pivot,
and provide signals to the engine ECU, which then interprets driver commands allied to emission and engine
management requirements, and drives the throttle butterfly stepper motor to the appropriate position, or rate
of change of position.

Other changes to the pedal box include fabricated steel, silver painted brake and clutch pedals fitted with alloy
pedal pads. Some markets, principally Canada, are fitted with a pedal actuated ‘clutch down’ switch to inhibit
engine cranking unless the clutch pedal is fully depressed.

Clutch potentiometer switch
‘11MY onwards Elise vehicles fitted with a T6 ECU also had the option for cruise control, therefore a clutch
pedal potentiometer is also fitted in order to provide data for cruise control as well as Lotus DPM (Dynamic
Performance Management) Control operations.

The throttle pedal assembly may be removed by disconnecting the harness plug from the module and releasing
the three M8 bolts and nuts securing the unit to the pedal box.

- The throttle pedal upstop is set internally within the electronic housing, with a downstop moulded into the
  housing itself.
- The brake pedal is pulled ‘off’ by an extension spring anchored to a bracket rivetted to the scuttle beam.
- There is normally a gap of approximately 3mm between the brake pedal and the pedal box upstop flange
  with the pedal released. If preferred, the brake pedal can be raised slightly by adjusting the effective length of
  the pushrod at its connection to the clevis, but the master cylinder must never be preloaded, i.e. there must
  always be a small clearance between the pedal and upstop bracket to ensure that the master cylinder piston
  is allowed fully to return and open the reservoir port.
- After any adjustment, tighten the clevis locknut and check operation of the brake light switch.
- The clutch pushrod uses an integral plastic clevis to connect to the pedal and control the pedal up position
  as the master cylinder tops out. A downstop buffer is provided on the pedal box flange.

Updated 19th April 2012
Electronic throttle assembly

Due to the limited access within the driver’s footwell area, it may be necessary to remove the driver’s seat and steering wheel assembly to gain access to the electronic throttle assembly and its fixings.

Removal:
1. Release the cable tie securing the brake master cylinder reservoir from its mounting bracket and move aside to access throttle assembly bolts.
2. Disconnect main harness connector from throttle assembly.
3. With an assistant holding the bolt heads, remove M8 flanged nuts (3), securing the throttle assembly to pedal box (torque 12 Nm).
4. Remove throttle assembly mounting M8 x 40 bolts (3) from the pedal box.
5. Remove the throttle assembly.

Refitment:
Reverse procedure of removal.

Brake and clutch pedal
To remove a brake or clutch pedal from the pivot shaft, the pedal shaft mounting plate must be removed from the pedal box complete with the brake and clutch pedals:

1. Unplug and remove the throttle pedal assembly complete with mounting bracket by releasing the three screws securing the bracket to the pedal box - refer to procedure on previous page.
2. Disconnect the brake and clutch pedals from their pushrods, and unhook the brake pedal return spring.
3. Unplug and remove the clutch pedal potentiometer switch by releasing the M4 x 10 screw securing it to its bracket (torque 4 Nm).
4. Release the clutch pedal assistor spring anchor bracket from the pedal box side (3 bolts).
5. Remove the two bolts securing the clutch master cylinder assembly to the pedal box and support the cylinder aside.
6. Remove the 4 remaining fixings securing the pedal shaft bracket to the pedal box, and manoeuvre the pedal assembly from the car.
7. Release the three Torx head screws securing the pedal shaft and withdraw the shaft and pedals.
8. Refit the pedals in reverse order to removal, noting that the pivot bushes of the brake and clutch pedals should be lubricated with Syntheso GLK1 or equivalent.

<table>
<thead>
<tr>
<th>Torque Settings</th>
<th>Nm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brake servo to alloy spacer</td>
<td>25</td>
</tr>
<tr>
<td>Pedal shaft bracket to pedal box</td>
<td>16</td>
</tr>
<tr>
<td>Throttle pedal mounting bracket to pedal box</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>25</td>
</tr>
</tbody>
</table>
**Brake light switch setting** *(Critical for ‘11MY vehicles onwards fitted with Bosch ABS model)*

The switch has 3 settings (as shown below), the correct setting of the brake light switch plunger results in the switches internal contacts closing at the correct time in relation to the brake pedal travel exerted by the driver.

<table>
<thead>
<tr>
<th>Pedal effort/travel position</th>
<th>Switch Stage</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>No pedal effort - no pedal travel</td>
<td>Off</td>
<td>Cruise control available (if required).</td>
</tr>
<tr>
<td>Initial/light pedal effort - minor pedal travel</td>
<td>1st Stage</td>
<td>Cruise control cancelled (if activated).</td>
</tr>
<tr>
<td>Light/moderate pedal effort - increased pedal travel</td>
<td>2nd Stage</td>
<td>Brake lights illuminated coinciding with an ABS module brake fluid line pressure reading of between 2 - 6 Bar.</td>
</tr>
</tbody>
</table>

The brake light switch is mounted in a right angle bracket fixed to the underside of the scuttle, and abuts directly against the master cylinder pedal pushrod quadrant. The switch is retained in the bracket by a quarter turn mechanism, with no adjustment provided or required.

**Removal:**
1. Rotate the switch 90° counter-clockwise within its mounting bracket and release.
2. Disconnect from the harness connector and remove the switch.

**Refitment:**
Installation procedure is reverse of removal except that the switch plunger must be adjusted to suit the brake pedal travel characteristics of the specific vehicle it is being fitted to. **PLEASE ALSO REFER TO SWITCH PLUNGER LUBRICATION AS DESCRIBED IN TECHNICAL SERVICE BULLETIN TSB 2015/03 - BRIEF SUMMARY ALSO SHOWN ON FOLLOWING PAGE.**

The switch plunger uses an internal ratchet mechanism which can be adjusted to suit the vehicle allowing for any brake pedal travel tolerance thus ensuring the correct phasing of the internal switch contacts in relation to the switch plunger position and brake pedal position.

**Refitment Procedure**

1. With TechCentre connected to the vehicle and the ignition on, select ABS brakes>Live Data:

2. From the ‘Available Items’ table, select:
   - Brake light switch (03).
   - Brake switch.
   - Pressure sensor

3. With the switch still removed from the pedal box (but harness connected), push the plunger fully inwards towards the switch housing (light resistance will be felt until the plunger overcomes its ratchet mechanism).

4. Pull the plunger outwards to its mid point setting *(approximately half way out from the switch housing, 5 audible clicks should be heard as it is being pulled)*. Note: the plunger is on a stiff ratchet mechanism which may take some effort to extend.

5. Using your hand to push down on the brake pedal, refit the brake switch back into the pedal box bracket.
6. Gently release the brake pedal back to its normal position against its bump-stop.

7. Select the ‘play’ option on the live data screen and gently depress and release the brake pedal to simulate normal braking operations and examine the value readings displayed on ABS live data in relation to:
   - ‘Brake Switch’ (1st stage)
   - ‘Brake Light Switch (03)’ (2nd stage)
   - ‘Pressure Sensor’ (ABS brake line pressure).

### Normal Values Proportional To Brake Pedal Depression

<table>
<thead>
<tr>
<th>No pedal effort - no pedal travel</th>
<th>No Actuation</th>
</tr>
</thead>
<tbody>
<tr>
<td>'Brake Switch' (1st stage)</td>
<td>No Actuation</td>
</tr>
<tr>
<td>'Brake Light Switch (03)' (2nd stage)</td>
<td>No Actuation</td>
</tr>
<tr>
<td>'Pressure Sensor' (ABS brake line pressure)</td>
<td>+ or - 0.5 Bar</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Initial/light pedal effort - minor pedal travel</th>
<th>Actuated</th>
</tr>
</thead>
<tbody>
<tr>
<td>'Brake Switch' (1st stage)</td>
<td>Actuated</td>
</tr>
<tr>
<td>'Brake Light Switch (03)' (2nd stage)</td>
<td>No Actuation</td>
</tr>
<tr>
<td>'Pressure Sensor' (ABS brake line pressure)</td>
<td>+/- 0.5 Bar</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Light/moderate pedal effort - increased pedal travel</th>
<th>Actuated</th>
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<tbody>
<tr>
<td>'Brake Switch' (1st stage)</td>
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</tr>
<tr>
<td>'Brake Light Switch (03)' (2nd stage)</td>
<td>Actuated</td>
</tr>
<tr>
<td>'Pressure Sensor' (ABS brake line pressure)</td>
<td>+ 2 - 6 Bar</td>
</tr>
</tbody>
</table>

8. If the readings are not within range then remove the brake light switch again repeating step 2 of the adjustment procedure but adjusting the plunger inwards or outwards against its ratched mechanism as necessary until the correct readings are achieved.

**Note:** Incorrect switch plunger adjustment may result in fault codes relating to ABS, Lotus DPM (Dynamic Performance Management) and cruise control being generated also illuminating the relevant tell tale lamp.

### Brake Switch Plunger Lubrication

Conditions within the pedal box environment could over time cause the brake light switch plunger to stick, which under certain conditions could cause the ABS brake light warning tell tale to illuminate. To prevent this a small quantity of RS 494-124 silicone grease should be applied to the switch plunger as shown in the RH illustrations and procedure listed below:

A. Apply the equivalent of a ‘pin head’ amount of silicone grease to either side of the plunger at the base of the switch body and evenly distribute along the complete length of the shaft.

B. Fully actuate the plunger so that it travels inwards into the switch body so that the silicone grease lubricates the internals of the switch mechanism.

Silicone grease should be applied if fitting a new service replacement brake light switch, but if carrying out this procedure to the existing switch in-situ, ensure the plunger is fully extended by depressing the brake pedal and use the application nozzle supplied to accurately apply the grease*.

**Care point:** Ensure that silicone grease has not split onto any of the pedal pads, as a precaution cover the pedal pads prior to carrying out this procedure. Check and clean the pedal pads as necessary after completing this procedure.

*Only RS 494-124 silicone grease should be used for this procedure, other silicone greases may cause damage to the internal electrical components of the switch. RS 494-124 silicone grease is readily available in 100g tubes and can be sourced locally.
JJ 12 - ABS THEORY OF OPERATION

('04 - '11MY Elise & all MY Exige)

The Kelsey-Hayes antilock brake system is an 'add on' type used to supplement the dual circuit, tandem master cylinder, vacuum servo assisted brakes fitted to the Elise. A single electro-hydraulic unit comprising a hydraulic modulator, hydraulic pump, microprocessor and solenoid valve bank, is mounted in the front services compartment and plumbed into the front and rear brake circuit lines from the tandem master cylinder.

The microprocessor (ECM) receives signals from magnetic wheel speed sensors integrated into each of the four road wheel hubs, and interprets the individual wheel acceleration, deceleration, and comparative wheel speeds. From this data, the ECM is able to determine if any wheel is tending to lock up, and if imminent lock up is sensed, the microprocessor commands the relevant solenoid valves firstly to reduce pressure in that particular brake circuit in order to restore wheel speed, and then to modulate pressure to that providing the maximum braking force consistent with continued wheel rotation. The system is able to monitor and independently control each of the four wheel brakes, and is referred to a 4-channel system.

In order to achieve the required pressure modulation, three basic modes are used:
- Pressure hold;
- Pressure reduction;
- Pressure increase;

In order to maintain the safety provision of two entirely independent hydraulic circuits, one for the front brakes, and one for the rear, the hydraulic elements of the control unit are doubled up, with no part of the system shared between the two circuits. For the pressure hold function, four isolation solenoid valves are used, one in the hydraulic circuit for each wheel brake. The pressure reduction function is achieved by a separate dump solenoid valve in each of the four wheel brake circuits, and the pressure increase provided for by a single electric motor operating two hydraulic pumps, one serving the front, and on the rear brake circuit. Separate low pressure accumulators are used for the front and rear circuits.

Electro-Hydraulic Control Unit

The electro-hydraulic control unit comprises an alloy valve block containing the four isolation valves, four dump valves, two hydraulic pumps and two accumulators, with the single pump motor screwed to the housing, and with a solenoid block and ECM unit attached to the topside.

The complete assembly is flexibly mounted via three rubber isolator bushes to a steel cradle, which is itself mounted on three rubber bobbins to the passenger side front chassis. The eight solenoid valves are grouped in two rows, with the valve plungers protruding in sealed canisters from the topside of the unit where each one is surrounded by a solenoid coil. The isolation and dump valves share a similar construction, but the spring loaded isolation valves are normally open, and the dump valves normally closed.
JJ.13 - ABS ELECTRO-HYDRAULIC UNIT

(Please refer to sub-section JJ.18 For ‘11MY onwards vehicles fitted with Bosch ESP8 modules)

The ABS electro-hydraulic unit is located on the driver’s side in the front services compartment, and is flexibly mounted in a support frame via three isolator rubber bushes. The support frame itself is fixed to the front suspension damper top mounting bracket and windscreen frame butress via another three rubber bobbins. A single 27 pin electrical connector plug is provided with a sliding retainer to aid its mating with the vehicle harness.

CAUTION: Do not disconnect or connect the main connector plug with the ignition switched on. Switch off the ignition and disconnect the main connector plug before carrying out any electrical welding operations on the car.

Hydraulic pipe connections to the unit comprise two input pipes from the master cylinder (one for the front circuit, one for the rear) and four output pipes, one for each of the wheel brakes. Note that all hydraulic connections are identified by engraved markings on the unit, with further protection against incorrect connection provided by the use of two different brake pipe union sizes: M10 x 1.0 and M12 x 1.0.

Removal:

Preparation: When removing the unit, beware of dripping brake fluid and take appropriate precautions to prevent damage to paintwork.

1. Remove the front clamshell; refer to service notes section BR.6 for further information.

2. Switch off the ignition before drawing out the retainer slide from the connector plug to release the harness from the unit.

3. Label each of the hydraulic pipes before disconnecting from the unit and immediately capping the pipes and plugging the ports to reduce the spillage of brake fluid, and to prevent the ingress of dirt.

4. Release the three fixings securing the controller mounting bracket to the damper bracket and windscreen frame butress, and withdraw the unit and mounting cradle.

5. To remove the controller from the cradle, unscrew the two socket head pins supporting the sides of the unit, and withdraw the unit from the third grommet at the end of the motor casing.
Refitment:

Is the reverse the removal procedure.

- Tightening the two socket head mounting pins to 9 Nm, and the brake pipe unions (both sizes) to 16 Nm, taking care to connect the brake pipes to the correct ports on the hydraulic block - see diagram below.

- Press in the retainer slide to connect the harness plug.

- Bleed the unit using the procedure detailed in sub-section JJ.3.

- Verify correct connection by using the 'Lotus Scan' tool or Lotus TechCentre in actuator tests with the car on a wheel free lift. Check that operation of each solenoid valve affects the appropriate wheel.

Service Breakdown of Electro-Hydraulic Unit

Service parts for this unit are limited to; the hydraulic modulator with pump motor; and the coil integrated module which comprises the ECM and solenoid pack.

To separate the module from the hydraulic block, release the 'Torx' screws and withdraw the module from the solenoid valve spigots. When refitting, check that the gasket is correctly located around the solenoid coil cluster, before mating with the hydraulic block and fitting the screws.

Note that component parts are calibrated specifically for the Lotus Elise. Do not use parts from other sources.
JJ.14 - WHEEL SPEED SENSORS

A WSS (Wheel Speed Sensor) is integrated into each of the four hub bearing assemblies and supplies a signal to the ABS control module. The module outputs a road speed signal to the engine ECM, and also to the instrument pack for speedometer operation.

If there is found to be any discernible free play in the hub bearing, roughness or tight spots can be felt or a fault within the WSS, or any signs of lubricant expulsion are evident, the hub assembly should be replaced - there is no provision for adjustment.

Output from each wheelspeed sensor can be checked using Lotus Scan tool and Lotus TechCentre, and if found to be faulty or absent, the complete hub assembly should be renewed; refer to sub-section CI.5 (front) or DH.4 (rear) for further information.
JL 15 - DATA LINK CONNECTOR (DLC)

The Data Link Connector (DLC) is a 16 terminal electrical connector plug, complying with SAE J 1962, which provides a means of communication with the ABS and engine management electronic control units. The connector is used in service to connect electronic diagnostic equipment such as the Lotus scanner tools which allows system interrogation including the reading of trouble codes.

The DLC is either tied to the main harness at the front of the passenger footwell, or secured to the centre underside of the scuttle beam.
JJ.16 - SPECIAL TOOLS

Piston Retraction Tool T000T1418F

The majority of routine servicing, removal and refitment of brake callipers and pads can be carried out using standard good quality workshop tools.

The only additional specialist tool required is a calliper piston retraction tool (Lotus part number T000T1242F) which is used to rotate the rear calliper pistons, screwing them back down into the calliper body to facilitate brake pad fitment without causing damage to the piston/seal surface. Also see sub-section JJ.5 for further information.

Lotus Scan 3 Tool T000T1418F (Pre-2008 MY Vehicles)

In order to provide for communication with the engine management system electronic control module, a hand held electronic scanner 'Lotus Scan' (part number T000T1418F), is plugged into the Data Link Connector (DLC), located at the front of the passenger footwell; refer to sub-section JJ.15 for further information.

Note that this tool may also be used on previous Elise models (excluding Exige '00 M.Y, 340R and 160 models).

Amongst the operations available using the 'Lotus Scan' tool are:
- Clear fault codes
- View fault codes/wheel speeds/valve activities
- Generate valve/motor activities
- Read EEPROM contents
- Read ECU identification

Operating instructions are provided with the tool.

Important Note: The power supply transformer is used for overnight charging of the printer, and also for powering the Lotus Scan tool during software downloading from a PC (personal computer). For the software download operation, the Scan tool requires a power supply from the mains via the transformer and an inverter. Two types of inverter have been used; early kits used an adaptor lead to plug into the bottom end of the Scanner tool.

Later kits use an adaptor plug fitting into the top end of the scanner. When charging the printer, it is most important that the inverter is NOT used, or damage to the transformer may be caused. Incorrect connection is possible only with the early type adaptor lead, with which extra care should be exercised.
Downloading software from P.C.

**With early type adaptor lead**

1. Connect to COM port on P.C.
2. Adaptor lead used to connect to transformer

**With later type adaptor**

1. Connect to COM port on P.C.
2. Power supply to adapter

Charging printer

Do NOT use adaptor lead for this application
Lotus TechCentre (2008 MY Vehicles Onwards)

All USA market cars from '08 model year onwards, are required by legislation to use a CAN compliant onboard diagnostic system. This has been commonised for all Elise/Exige models. The Lotus Scan 3 tool is replaced by a ‘stand alone’ lap top PC loaded with ‘Lotus TechCentre’ software to allow the CAN based serial data to be read.

Controller Area Network (CAN) is an electronic standard to allow high speed communication between modules and controllers, via a serial data bus. The bus is a circuit linking the modules to the controller, consisting of a pair of cables, twisted together to reduce electromagnetic interference, and carrying a square wave voltage signal corresponding to ‘0’s and ‘1’s, coded in such a way as to identify and prioritise the individual messages.

On the Elise/Exige, CAN based systems for 2008 onwards include; engine management, anti-lock braking and related features, tyre pressure monitoring and onboard diagnostics.

A Vehicle Communication Device (T000T1472F) introduced for the Europa model is used to connect the vehicle to the laptop Lotus TechCentre. All system interrogation and diagnosis are carried out via the Lotus TechCentre.

The minimum specification of the laptop computer for installation of the Lotus TechCentre is as follows:
- Processor 1.70 Ghz;
- 1 GB RAM;
- 40 GB HDD;
- CDRW DVD ROM;
- WIN XP PRO or VISTA;
- USB interface;
- Ethernet or Wireless LAN

Note that this laptop should be dedicated solely to the Lotus TechCentre, with no other software installed. This diagnostic software is designed primarily for use by trained Lotus technicians, and is available as a CD under part number T000T1510F (version 4) or later supercessions. A monthly (Lotus Dealers) or annual (non- Lotus dealers) licence and support fee will also be levied, providing access to Lotus TechCentre Technical Support phoneline on 0870 9493 668, and e-mail on lotus.support.uk@omitec.com

Also required is a unique 18 character licence/registration key without which Techcentre will not function. This key is non transferable to other PC’s.
Scope of Lotus TechCentre

<table>
<thead>
<tr>
<th>MODEL/PWRTRAIN/MODELYEAR</th>
<th>ELECTRONIC CONTROL UNIT</th>
<th>ENGINE ECU TYPE</th>
<th>ENGINE ECU PROGRAMMABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>COMMUNICATIONS COMPATIBLE</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>EMS</td>
<td>ABS</td>
<td>SRS</td>
</tr>
<tr>
<td>ELISE 2ZZ '04 - '05MY</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>ELISE 2ZZ '06 - '11MY</td>
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<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>ELISE 1ZZ '07 - '10MY</td>
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<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>EXIGE 2ZZ '04 - '05MY</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>EXIGE 2ZZ '06 - '11MY</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>EUROPA Z20 LER '06 - '09MY</td>
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<td>Y</td>
<td>Y</td>
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<tr>
<td>2-11 2ZZ '07 - '11MY</td>
<td>Y</td>
<td>Y</td>
<td>N/A</td>
</tr>
<tr>
<td>EVORA 2GR-FE '09MY ONWARDS</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>ESPRIT V8 918</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>ELISE 1ZR '11MY ONWARDS</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>ELISE 2ZR '12MY ONWARDS</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>EXIGE S 2GR-FE '12MY ONWARDS</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

* If fitted with a Bosch ABS module. † Also see notes on below for special requirements with regards reprogramming the EMS on any '04 - '07MY vehicles.

TechCentre will automatically update the VCD and display a message to confirm. The VCD, under part number T000T1472F is supplied in a black plastic carry case containing the following:

- VCD
- 16 Pin Yellow connector lead (VCD to Vehicle)*
- USB lead (VCD to PC)
- USB extension lead (VCD to PC) not illustrated

Notes

*This lead can be used on all '04MY onwards Toyota power trained models to interrogate the engine management system, read DTC (diagnostic Trouble Codes) or for resetting the MIL (Misfire Indication Light) but will only allow the download of standard EMS programs into vehicles from '08MY onwards.

A Green connector lead part number T000T1522F is also available separately which can be used to download EMS programs into '04 - '07MY vehicles also using Lotus TechCentre instead of the Lotus Scan 3 tool. Please refer to TSB 2011/05 for additional information.

Use of TechCentre

Instructions for using the TechCentre are available in the ‘Technical Information’ section displayed on programme start up.

An additional Lotus TechCentre guide is available to view/download from the Lotus Dealer Portal within the ‘Aftersales’ > TechCentre and Production ECM program information category.
JJ.17 - LOTUS SCANNER TOOL CHECKING PROCEDURES

1. Trouble Codes
When the ABS controller detects a fault in the system, the following events occur;
   i) The ABS tell tale is lit;
   ii) The anti-lock system is switched out;
   iii) A trouble code is stored in the non volatile random access memory i.e. memory which is retained when the
       power supply is interrupted, or the battery disconnected.

Trouble codes may be either Condition Latched, or Ignition Latched:

Condition Latched; With this type of fault, which is generally low or high voltage, the ABS tell tale will light, and
the anti-lock system switch out, until such time as conditions return to normal, at which point the light will be
extinguished, and the anti-lock be reinstated. The trouble code will be stored only whilst the fault is present.

Ignition Latched; This type of fault, of which are most categories, will cause the tell tale to be lit and the antilock
to be inhibited until such time as the fault is no longer detected at the moment of a subsequent switching on
of the ignition. At this point, the lamp will be extinguished, and the ABS restored, but the trouble code will be
retained in the memory for the next 20 drive cycles i.e. ignition switched on and a minimum road speed of 5
mph attained.

Access to the diagnostic codes is available only by using the 'Lotus Scan 3' tool or Lotus TechCentre connected
to the DLC; refer to sub-section JJ.16 for further information. When connected the diagnostic tool will display
any stored trouble codes and sensor readings as well as allowing manual operation of actuators.

The facilities available include:
- View fault codes/wheel speeds/valve activities
- Clear fault codes
- Generate valve/motor activities
- Read EEPROM contents
- Read ECU identification

Important Notes
- Whenever the Lotus Scan tool is connected, the ABS tell tale is lit and the anti-lock function is inoperative.
- Never connect or disconnect the DLC to/from the control unit with the ignition switched on.
- Before charging or quickcharging, disconnect the battery from the vehicle electrical system.
- Never disconnect the battery from the vehicle electrical system with the engine running.
- Never use a quick-charger for starting.
- Take care when touching energised parts of the ignition system.
- ECMs must be removed prior to welding operations, or subjecting to oven temperatures above 80°C.
- When voltage testing, use only a high-resistance type meter.
- During test steps which involve the connection of contacts from harness plugs or control units with ground or
  battery voltage (+12V), exercise great care as incorrect contact can cause permanent damage to the ECM
  internal circuits.
- When measuring resistance from ground bearing wires to vehicle ground, the nominal value of 'less than 2
  ohms' sometimes cannot be achieved. In this case, disconnect the negative (ground) post of the battery and
  measure the resistance to the vehicle earth lead.
- Always erase trouble codes from any control unit after a test is done.
2. Abbreviations & Definitions

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>BATTERY VOLTAGE</td>
<td>System voltage</td>
</tr>
<tr>
<td>BRAKE LIGHT SW.</td>
<td>Brake light switch</td>
</tr>
<tr>
<td>FL WHEEL SPEED</td>
<td>Front left wheel speed</td>
</tr>
<tr>
<td>FR WHEEL SPEED</td>
<td>Front right wheel speed</td>
</tr>
<tr>
<td>RL WHEEL SPEED</td>
<td>Rear right wheel speed</td>
</tr>
<tr>
<td>RR WHEEL SPEED</td>
<td>Rear right wheel speed</td>
</tr>
<tr>
<td>FRONT WHL SPEEDS</td>
<td>Front wheel speed</td>
</tr>
<tr>
<td>REAR WHL SPEEDS</td>
<td>Rear wheel speed</td>
</tr>
<tr>
<td>VALVE RELAY CMD</td>
<td>Valve relay command</td>
</tr>
<tr>
<td>VALVE RELAY FDBK</td>
<td>Valve relay feedback</td>
</tr>
<tr>
<td>RETURN PUMP CMD</td>
<td>Return pump command</td>
</tr>
<tr>
<td>RETURN PUMP FDBK</td>
<td>Return pump feedback</td>
</tr>
<tr>
<td>FL HOLD SOL. CMD</td>
<td>Front left solenoid hold command</td>
</tr>
<tr>
<td>FL HOLD SOL. FDBK</td>
<td>Front left solenoid hold feedback</td>
</tr>
<tr>
<td>FL REL. SOL. CMD</td>
<td>Front left solenoid release command</td>
</tr>
<tr>
<td>FL REL. SOL. FDBK</td>
<td>Front left solenoid release feedback</td>
</tr>
<tr>
<td>FR HOLD SOL. CMD</td>
<td>Front right solenoid hold command</td>
</tr>
<tr>
<td>FR HOLD SOL. FDBK</td>
<td>Front right solenoid hold feedback</td>
</tr>
<tr>
<td>FR REL. SOL. CMD</td>
<td>Front right solenoid release command</td>
</tr>
<tr>
<td>FR REL. SOL. FDBK</td>
<td>Front right solenoid release feedback</td>
</tr>
<tr>
<td>RL HOLD SOL. CMD</td>
<td>Rear left solenoid hold command</td>
</tr>
<tr>
<td>RL HOLD SOL. FDBK</td>
<td>Rear left solenoid hold feedback</td>
</tr>
<tr>
<td>RL REL. SOL. CMD</td>
<td>Rear left solenoid release command</td>
</tr>
<tr>
<td>RL REL. SOL. FDBK</td>
<td>Rear left solenoid release feedback</td>
</tr>
<tr>
<td>RR HOLD SOL. CMD</td>
<td>Rear right solenoid hold command</td>
</tr>
<tr>
<td>RR HOLD SOL. FDBK</td>
<td>Rear right solenoid hold feedback</td>
</tr>
<tr>
<td>RR REL. SOL. CMD</td>
<td>Rear right solenoid release command</td>
</tr>
<tr>
<td>RR REL. SOL. FDBK</td>
<td>Rear right solenoid release feedback</td>
</tr>
</tbody>
</table>

3. ECU Identification

(Applicable to 2ZZ, 1ZZ & 1ZR models up to '11MY fitted with Kelsey Hayes ABS module; refer to sub-section JJ.18 for Bosch ABS ESP8 module identification)

The ECU identification number for the Elise/Exige is: A120J6000F
Supplier ECU Hardware Number: EBC 430
Supplier ECU Software Number: LCFWDQ04K2K

4. Circuit Diagrams

Circuit diagrams are an essential aid in trouble shooting ABS system faults as they display information such as wiring harness connections and pin out information to ABS module components.

Please refer to the relevant Service Notes 'MP' section applicable to the vehicles model by year/build specification etc to obtain the correct circuit diagrams for any Lotus vehicle required.
5. Diagnostic Trouble Codes

(Applicable to 2ZZ, 1ZZ & 1ZR models up to ‘11MY fitted with Kelsey Hayes ABS module; refer to sub-section JJ.18 for Bosch ABS ESP8 module identification)

<table>
<thead>
<tr>
<th>DTC</th>
<th>Diagnostic Trouble Code Storage Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>C0035</td>
<td>Front left wheel speed sensor: Short circuit or circuit open;</td>
</tr>
<tr>
<td></td>
<td>... No signal;</td>
</tr>
<tr>
<td></td>
<td>... Incorrect signal;</td>
</tr>
<tr>
<td>C0040</td>
<td>Front right wheel speed sensor: Short circuit or circuit open;</td>
</tr>
<tr>
<td></td>
<td>... No signal;</td>
</tr>
<tr>
<td></td>
<td>... Incorrect signal;</td>
</tr>
<tr>
<td>C0045</td>
<td>Rear left wheel speed sensor: Short circuit or circuit open;</td>
</tr>
<tr>
<td></td>
<td>... No signal;</td>
</tr>
<tr>
<td></td>
<td>... Incorrect signal;</td>
</tr>
<tr>
<td>C0050</td>
<td>Rear right wheel speed sensor: Short circuit or circuit open;</td>
</tr>
<tr>
<td></td>
<td>... No signal;</td>
</tr>
<tr>
<td></td>
<td>... Incorrect signal;</td>
</tr>
<tr>
<td>C0060</td>
<td>Front left outlet solenoid valve circuit malfunction;</td>
</tr>
<tr>
<td>C0065</td>
<td>Front left inlet solenoid valve circuit malfunction;</td>
</tr>
<tr>
<td>C0070</td>
<td>Front right outlet solenoid valve circuit malfunction;</td>
</tr>
<tr>
<td>C0075</td>
<td>Front right inlet solenoid valve circuit malfunction;</td>
</tr>
<tr>
<td>C0080</td>
<td>Rear left outlet solenoid valve circuit malfunction;</td>
</tr>
<tr>
<td>C0085</td>
<td>Rear left inlet solenoid valve circuit malfunction;</td>
</tr>
<tr>
<td>C0090</td>
<td>Rear right outlet solenoid valve circuit malfunction;</td>
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<tr>
<td>C0095</td>
<td>Rear right inlet solenoid valve circuit malfunction;</td>
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<tr>
<td>C0110</td>
<td>Return pump: circuit open or shorted; locked or shorted;</td>
</tr>
<tr>
<td>C0121</td>
<td>Valve relay circuit malfunction;</td>
</tr>
<tr>
<td>C0161</td>
<td>Brake light switch fault;</td>
</tr>
<tr>
<td>C0232</td>
<td>Brake system telltale voltage: high or open circuit;</td>
</tr>
<tr>
<td></td>
<td>... low;</td>
</tr>
<tr>
<td>C0245</td>
<td>Wheel speed: sensor erratic signal;</td>
</tr>
<tr>
<td></td>
<td>... error;</td>
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<tr>
<td>C0252</td>
<td>Replace electronic control unit;</td>
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<tr>
<td>C0550</td>
<td>Replace electronic control unit;</td>
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<td>C0550</td>
<td>Brake system or electronic control unit malfunction;</td>
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<td>C0556</td>
<td>Replace electronic control unit;</td>
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<td>C0561</td>
<td>Replace electronic control unit;</td>
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<tr>
<td>C0563</td>
<td>Replace electronic control unit;</td>
</tr>
<tr>
<td>C0564</td>
<td>Replace electronic control unit;</td>
</tr>
<tr>
<td>C0800</td>
<td>Switched battery voltage: high (valve relay)</td>
</tr>
<tr>
<td></td>
<td>... low (valve relay)</td>
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JJ.18 - INTRODUCTION OF BOSCH ABS/ESP® BRAKE SYSTEM MODULATOR

A Bosch ABS/ESP8 modulator replaces the Kelsey Hayes ABS unit as a production running change on all Elise 1ZR powertrain vehicles built from September 2010 onwards and was fitted from the start of production on all Elise 2ZR powertrain vehicles introduced at ’12MY.

The Bosch unit was first fitted to the Elise 1ZR powertrain at VIN: BH_10931. The powertrain can be identified by the letter ‘X’ as the 7th digit of the vehicle VIN.

Note: the Bosch unit was not fitted to the remaining ’11MY 1.8 litre 2ZZ Elise or Exige range which retained the Kelsey Hayes module.

The Bosch 8.1 ABS/ESP® brake system modulator fitted to the Elise is an integral component to both the braking and engine management control systems. The ABS/ESP® modulator consists of a single electro-hydraulic unit, hydraulic modulator, hydraulic pump, microprocessor and solenoid valve bank. The complete assembly is flexibly mounted via three rubber isolator bushes to a steel cradle, which is itself mounted on three rubber bobbins to the passenger side front chassis and upper damper mounting bracket. The modulator is plumbed into the front and rear brake circuit lines from the tandem master cylinder.

The module is equipped with software providing:

- Anti-lock Braking System (ABS)
- Hydraulic Brake Assist (HBA)
- Traction Control System (TCS)
- Electronic Stability Program (ESP)
- Electronic Brake Distribution (EBD)
- Electronic Differential Lock (EDL)
- Corner Brake Control (CBC)
- Drag Torque Control (DTC)
The collective name for this functionality is ‘Lotus Dynamic Performance Management’ (Lotus DPM).

These systems utilise input information from the Yaw Rate Sensor, Steering Angle Sensor (SAS), Wheel Speed Sensors (WSS) and Engine Control Unit (ECU) to determine if any excessive degree of wheelspin is occurring or if the vehicle's stability is at risk activating the anti-lock braking system (ABS) to apply a measured braking force to individual wheels as necessary or reduce or increase engine torque in order to help the driver maintain control of the vehicle.

The ABS/ESP® module receives signals from the wheel speed sensors, and interprets the individual wheel acceleration, deceleration, and comparative wheel speeds. From this data, the processor is able to determine if any wheel is tending to lock up, and if imminent lock up is sensed, the unit commands the relevant solenoid valves firstly to reduce pressure in that particular brake circuit in order to restore wheel speed, and then to modulate pressure to that providing the maximum braking force consistent with continued wheel rotation. The system is able to monitor and independently control each of the four wheel brakes, and is referred to as a 4-channel system.

In order to achieve the required pressure modulation, three basic modes are used:
- Pressure hold;
- Pressure reduction;
- Pressure increase;

In order to maintain the safety provision of two entirely independent hydraulic circuits, one for the front brakes, and one for the rear, the hydraulic elements of the control unit are doubled up, with no part of the system shared between the two circuits.

Functionality of ABS/ESP® software (also referred to as Lotus Dynamic Performance Management)

**Anti-Lock Braking (ABS)**

Maximum braking force is provided from a tyre when there is around 15% slippage, dependent on road surface conditions and tyre characteristics. The function of the ABS is to limit tyre slippage when braking to around this figure in order to provide optimum grip, and also, by preventing wheel lock, to ensure that steering control of the vehicle is retained.

**ABS Tell Tale**

The ABS tell tale warns the driver of problems in the anti-lock system. The lamp should light for about 3 seconds following ignition switch on, and then go out. If the lamp remains lit, or comes on whilst driving, a fault in the ABS is indicated. The base brake system will continue to operate normally, but without ABS regulation. The car can be driven but should be checked and repaired at the earliest opportunity.

**Hydraulic Brake Assist (HBA)**

Hydraulic Brake Assist detects an emergency situation by the driver’s determination to rapidly stop the vehicle by measuring the gradient of brake pressure build-up. In case of insufficient brake pressure the (HBA) system increases pressure up to ABS activation threshold to ensure the shortest stopping distance possible. These features enhance vehicle stability in extreme manoeuvres typified by accident avoidance attempts or misjudged cornering demands. Current vehicle behaviour is constantly monitored, and compared with a determination of the driver intent as indicated by data gathered from the driving controls.

**Traction Control System (TCS)**

To prevent a wheel spin when starting off or accelerating, particularly on a slippery or wet road surface, the drive torque at each driven wheel is monitored and reduced correspondingly when necessary to improve the traction of the vehicle. TCS supplements the ABS function. If one of the driven wheels begins to spin, TCS is activated. The traction control system reduces the drive torque supplied by the engine and, if necessary, brakes individual wheels in order to regulate the slip of the driven wheels as quickly as possible to the optimum level.

**Electronic Stability Program (ESP®)**

The ABS/ESP module monitors the signals from the Yaw Rate and the Steering Angle Sensor sensors and checks 25 times a second, whether the driver's steering input corresponds to the actual direction in which the
vehicle is moving. If the vehicle moves in a different direction the ESP® detects the critical situation and reacts immediately – independently of the driver. It uses the vehicle's braking system to "steer" the vehicle back on track. With these selective braking interventions ESP® generates the desired counteracting force, so that the car reacts as the driver intends. ESP® initiates braking intervention, but can also intervene on the engine side to accelerate the driven wheels.

**Electronic Brake Distribution (EBD)**
This feature addresses the instability that could be caused under heavy braking due to the tendency of the lightly loaded rear wheels to lock prematurely. Electronic Brake Distribution is incorporated into the ABS to limit the rear brake system hydraulic pressure prior to any anti-lock intervention.

**Electronic Differential Lock (EDL)**
If hard acceleration is demanded in conditions of variable surface grip, or when cornering forces result in a lightly loaded inside rear wheel, there will be a tendency for drive torque to overcome the grip available, resulting in spinning of the lightly loaded wheel. When this situation is detected by the ABS controller, brake pressure is applied to the spinning wheel in order to transfer drive torque to the opposite wheel, thus maintaining drive and aiding vehicle stability.

**Corner Brake Control (CBC)**
If the driver applies the brake whilst performing a heavy cornering manoeuvre, there is a possibility that the vehicle may oversteer. Corner Brake Control (CBC) reduces the brake pressure to the inside rear brake calliper in an attempt to maintain vehicle stability.

**Drag Torque Control (DTC)**
The braking effect of the engine can cause the driven wheels to skid as they temporarily lose traction. This can be caused by the driven wheels locking on slippery surfaces during sudden/rapid deceleration which can be caused by the quick release of the accelerator pedal or fast down shifting through the gears.

Drag Torque Control (DTC) system attempts where possible to maintain directional stability. The ABS/ESP® control module receives information from the rear wheel-speed sensors as well as the Engine Control Unit (ECU) via the CAN data bus. If wheel slip is detected under these circumstances, it sends a signal to the ECU to increase engine torque, until the driven wheels are turning at a rate appropriate to the vehicles speed.
ABS/ESP Module

The electro-hydraulic ABS/ESP8 unit is fitted onto a mounting bracket located at the left side front of the services compartment.

It is initially positioned in place onto the support bracket by an integral locating pin fitted to the lower housing of the unit which slides into a grommet located at the base of the bracket.

The unit is then positively fixed by 2 threaded pins fitted within isolator bushes which are screwed to the side of the ABS housing; the isolator bushes then slot into recesses located to the side of the bracket and retained by 2 M6 nyloc nuts (torque 9Nm).

The mounting bracket itself is fixed to the front suspension damper top mounting bracket and windscreen frame buttress via another three rubber bobbins. An electrical connector plug is provided with a sliding retainer to aid its mating with the vehicle harness. The connector is protected from water ingress by an ABS cover which is retained by an M6 screw to the upper damper mounting bracket.
CAUTION: Do not disconnect or connect the main connector plug with the ignition switched on. Switch off the ignition and disconnect the main connector plug before carrying out any electrical welding operations on the car. Hydraulic pipe connections to the unit comprise two input pipes from the master cylinder (one for the front circuit, one for the rear) and four output pipes, one for each of the wheel brakes. Note that all hydraulic connections are identified by engraved markings on the unit:

Output: Input:
FL Front left MC1 From master cylinder rear port (front brake circuit)
FR Front right MC2 From master cylinder front port (rear brake circuit)
RR Rear right
RL Rear left

Removal:
Carepoint: When removing the unit, beware of dripping brake fluid and take appropriate precautions to prevent damage to paintwork.

1. Remove the front clamshell and ABS module connector cover; refer to service notes section BR.6 for additional information.
2. Switch off the ignition before drawing out the retainer slide from the connector plug to release the harness from the unit.
3. Label each of the hydraulic pipes before disconnecting (torque 16Nm) from the unit and immediately capping the pipes and plugging the ports to reduce the spillage of brake fluid, and to prevent the ingress of dirt.
4. Release the M6 x 10 setscrew (2) securing the controller mounting bracket to the damper bracket and M6 nyloc nut (1) to the windscreen frame buttress (all fixings torqued to 9Nm), and withdraw the unit and mounting cradle.
5. Remove the unit from the cradle by unscrew the two socket head pins supporting the sides of the unit, and withdraw the unit from the third grommet at the end of the motor casing.

Refitment:
Is the reverse the removal procedure, taking care to connect the brake pipes correctly.

Carepoint: The ABS module harness connector M6 screw torqued to 6Nm only
- Bleed the unit of air; refer to sub-section JJ.3 for further information.
- Verify correct connection by using the ‘Lotus Techcentre’ tool in actuator tests with the car on a wheel free lift.
- Check that operation of each solenoid valve affects the appropriate wheel.

Module renewal:
To ensure the best possible brake bleeding operation using the generic bleed/fill equipment normally available within a vehicle workshop, service replacement ABS modules are supplied ‘Wet filled’ i.e. pre-filled with brake fluid.

Preparation of New ABS/ESP Module Prior to Perform Brake Bleed Procedure
Once the new ABS/ESP module is fitted it will be necessary to connect the vehicle to the Lotus Techcentre (see sub-section JJ.15) to perform the 3 operations listed below before carrying out the brake bleed procedure shown in sub-section JJ.3:

1. Installation of the correct module program relevant to the vehicle into the new ABS/ESP module.
2. Configuration of the ABS/ESP module to the vehicles specific type, powertrain (such as Naturally Aspirated or Supercharged, Elise/Exige or Evora etc).
3. Recalibration of the SAS (Steering Angle Sensor) after the successful completion of steps 1 & 2.

The following 4 pages describe how to perform operations 1 & 2 using Lotus TechCentre. For further information see the ‘Lotus TechCentre User Guide’, which can be downloaded from the Lotus Dealer Portal at: http://dealers.lotuscars.com

Step1. Installation of the correct module program relevant to the vehicle into the ABS/ESP module.

From the TechCentre home page, enter the actual full 17 digit VIN and click on the magnifying glass icon. (Sample VIN shown, ensure to enter actual vehicle VIN).

To ensure the correct specific vehicle details are found - DO NOT select the vehicle type from the drop down box options.

VIN relevant details and readable control units will be displayed - Select ABS (Brakes).

Select the ‘ECU Reprogramming’ tab.
Click on the 'Start Program Download' icon and follow the on screen instructions.

IMPORTANT: BEFORE BEGINING ANY PROGRAM DOWNLOAD ENSURE THE VEHICLES BATTERY IS FULLY CHARGED, OR IF UNSURE CONNECT THE BATTERY TO AN EXTERNAL CHARGER.

Follow the on screen instructions.

2. Configuration of the ABS/ESP module to the vehicles specific type, powertrain

With ABS/ESP module programmed it now has to be configured to the vehicle by selecting specific options available.

Select the 'Vehicle Configuration' tab.
Select the options relevant to the vehicle (such as engine, gearbox & model etc).

Note: Although there are several options available, in all instances the 'Variant' and 'Process Byte' options must be selected as shown.

Selecting the 'Bosch deliver state' option from the Process Byte drop down box will result in an error message as shown.

Once all the relevant correct vehicle options have been chosen, select the 'Pen' icon.

If all the options selected are compatible to the vehicle a 'Configuration successful' message will be displayed.

3. Recalibration of the SAS (Steering Angle Sensor)

Once the ABS/ESP module is programmed and configured select guided routines to recalibrate the SAS.

Once successfully recalibrated the ASP/ESP module can be bleed as described in sub-section JJ.3.
JJ.19 - YAW RATE SENSOR

The yaw rate sensor measures the rotation of the vehicle around its vertical axis. The data from the sensor is compared to data from the Steering Angle Sensor (SAS) to determine if intervention from the ABS/ESP module is required to apply a braking force as well as the vehicles Engine Control Unit (ECU) is to adjust engine torque to assist understeer and oversteer control.

Located behind the rear bulkhead trim the sensor is mounted to the bulkhead floor on a bracket and is retained with M6 x 20 bolts (2) and M6 nyloc nuts (2) (torque 9Nm).

The sensor is connected to the vehicles main harness to provide information to both the ABS/ESP module and Engine Control Unit (ECU).

Removal:
1. Remove rear bulkhead panel trim; refer to service notes section BR for further information.
2. Release nuts and bolts retaining sensor to its bulkhead bracket.
3. Disconnect main harness multi-plug from sensor and withdraw sensor.

Refitment:
Is the reverse procedure of removal.

Front Wheel Speed Sensor (WSS)
Both front hub assemblies are common and incorporate a Wheel Speed Sensor (WSS) in the bearing unit, with a flying lead terminating in an electrical connector plug secured by a camber shim plate bracket.

If there is found to be any discernible free play in the hub bearing, roughness or tight spots can be felt or a fault within the WSS, or any signs of lubricant expulsion are evident, the hub assembly should be replaced - there is no provision for adjustment.

Removal:
For further information; refer to sub-section JJ.14 as well as service notes sections DH.4 for rear wheel hub assembly removal and CI.5 for front hub assembly removal.
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**JJ.20 - STEERING ANGLE SENSOR**

The Lotus DPM system requires information on the overall steering wheel angle. This is measured by the steering angle sensor.

The sensor assembly consists of a housing with a built in circular switch/drive which is free to rotate within the housing. The drive has an aperture allowing the lower steering column assembly to pass through it. A two piece collar is clamped around the intermediate column shaft. The internal aperture of the switch drive has 2 machined recesses, external pins fitted to the collar fit into these recesses allowing the switch drive to rotate with the steering column.

The steering angle sensor is attached to an angled bracket via 3 fixings and the whole assembly is fixed behind the dash cross beam with rivets. An electrical connector on the back of the unit connects the unit to the vehicle main harness so that output signals can be sent to the ABS and engine management ECM's.

When the inner steering column rotates the sensor, information on the driver’s steering input and direction is fed back to the ECM's of the ABS module and Engine Management System.

The information received from the sensor is compared to signals sent from the yaw rate and wheel speed sensors to determine if the steering intent of the driver matches that of the actual course and direction of the vehicle.

If the Lotus DPM system considers the vehicle's stability is at risk, the ABS module will apply a measured braking force to individual wheels and/or the Engine Management Controller will reduce vehicle torque as necessary in order to help the driver maintain control of the vehicle.

**Removal:**
1. Remove the upper steering column assembly and intermediate shaft; refer to service notes section HG.3 for further information
2. From inside the driver’s footwell remove the 3 x panhead screws securing steering angle sensor to the mounting bracket.
3. Disconnect main harness multi-plug from sensor and withdraw sensor.

**Refitment:**
Is the reverse of removal except:
Ensure that the steering angle sensor collar peg is located within the narrow slot of the sensor switch.

Once the steering column is refitted it is essential to recalibrate the steering angle sensor using Lotus Techcentre.

Once the correct vehicle by model type, year and market has been identified, select ABS > Guided Routines > Steering Angle Sensor Calibration.

**Failure to calibrate the sensor could result in impaired Traction Control/ Dynamic Performance Management functionality and will illuminate the tell-tale light.**
JJ.21 - LOTUS DPM TELL TALES & SWITCHES

Lotus Dynamic Performance Management (Lotus DPM) / (TC)

Initially, to perform a bulb check, the tell tale located within the instrument pack will glow amber for approximately 3 seconds following ignition switch on. This indicates the system is working correctly.

Whilst driving the tell tale may flicker amber, which is an indication that the Lotus Dynamic Performance Management (Lotus DPM) / (TC) has been triggered and electronic intervention is taking place; the tractive limit has been reached and driving style should be modified accordingly.

If however the warning lamp illuminates constantly, a fault has been detected, and although the mechanical/hydraulic braking system should not be affected the Lotus DPM will be disabled and the fault should be identified and rectified immediately.

Lotus DPM ‘Off’

This tell tale will glow amber if the (Lotus DPM) has been manually switched off.

If the driver demands, this feature can be de-activated by pressing the Lotus DPM 'Off' button provided in the centre console.

This may be temporarily desirable in certain unusual circumstances, such as loose surfaces, deep snow or when ‘rocking’ the vehicle free from mud.

Refer to service notes section MP.13 for further information.
JJ.22 - BOSCH ABS/ESP8 MODULE TROUBLE CODES

(Applicable to 1ZR & 2ZR models fitted with Bosch ABS ESP8 module, for vehicles fitted with a Kelsey Hayes ABS module refer to sub-section JJ.17)

**DTC  Diagnostic Trouble Code Storage Condition**

C0200  Wheel Speed Sensor line failure front right
C0201  Wheel Speed Sensor failure front right
C0205  Wheel Speed Sensor line failure front left
C0206  Wheel Speed Sensor failure front left
C0210  Wheel Speed Sensor line failure rear right
C0211  Wheel Speed Sensor failure rear right
C0215  Wheel Speed Sensor line failure rear left
C0216  Wheel Speed Sensor failure rear left
C0222  Wheel Speed monitoring
C0250  Valve deactivation due to overheat protection at EOL
C0256  ABS valve failure
C0266  Reflow pump failure
C0276  Valve relay
C0281  Brake-fluid level
C0286  Cut Valve
C0296  Suction Valve
C0340  Brake light switch - Refer to Technical Service Bulletin TSB 2015/03
C0431  Sensor cluster failure (yaw-rate or lateral acceleration)
C0440  SAS Steering Angle Sensor fault
C0443  SAS not calibrated
C0460  Pressure sensor failure
C0607  Internal ECU failure
C0802  ECU voltage failure
C0E03  Emergency braking, VDC Control
C0E07  ECU ASW error
C1281  Failure variant coding
U0101  CAN Bus failure: no sending on CAN possible
U0111  CAN Bus failure: CAN-BUS off
U0150  Absent CAN-Message EMS
U0151  Absent CAN-Message TCU (only for automatic gearbox)
U0153  Absent CAN-Message SAS
U0160  Absent CAN-Message Sensor cluster (yaw-rate or lateral acceleration)
U0200  Error in CAN-Message EMS