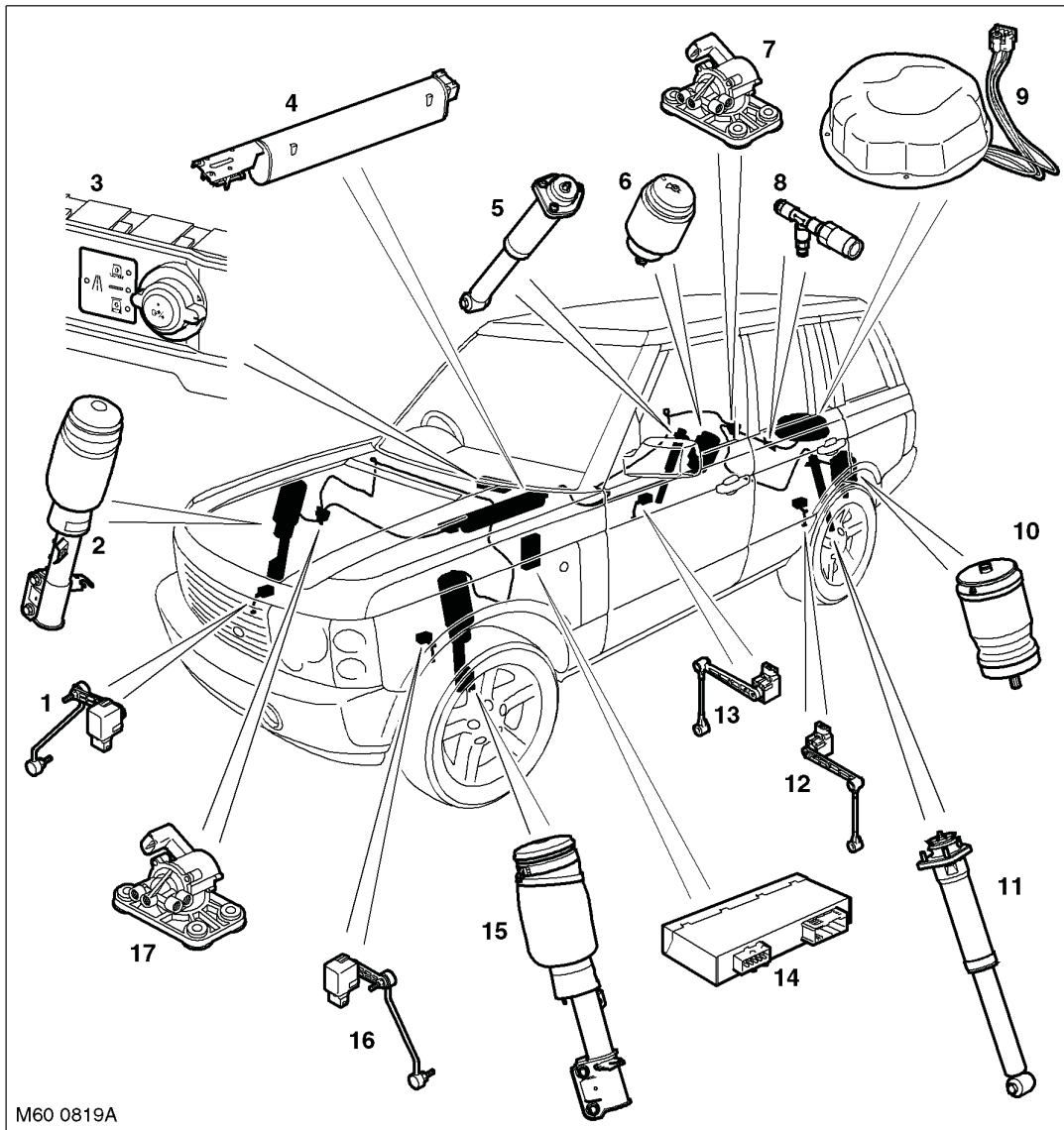




**Suspension Component Location**

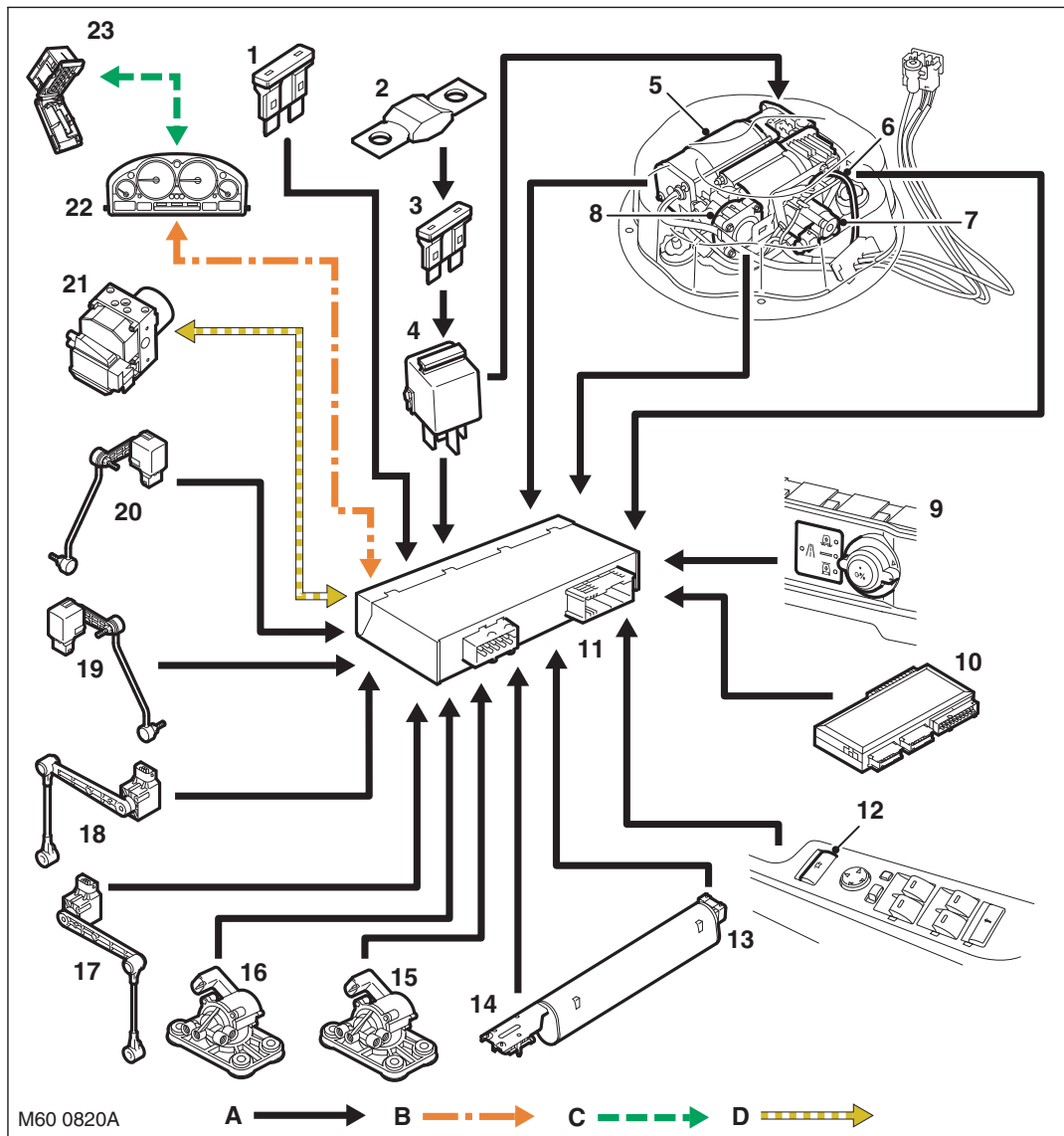


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- |   |                            |
|---|----------------------------|
| 1 Front RH height sensor                        | 10 Rear LH air spring      |
| 2 Front RH strut assembly                       | 11 Rear LH damper          |
| 3 Air suspension control switch                 | 12 Rear LH height sensor   |
| 4 Reservoir and valve block                     | 13 Rear RH height sensor   |
| 5 Rear RH damper                                | 14 Air suspension ECU      |
| 6 Rear RH air spring                            | 15 Front LH strut assembly |
| 7 Rear cross link valve                         | 16 Front LH height sensor  |
| 8 External pressure relief valve (where fitted) | 17 Front cross link valve  |
| 9 Compressor assembly                           |                            |

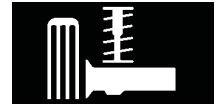
# SUSPENSION

## Suspension Control Diagram



A = Hardwired connections; B = K bus; C = Diagnostic DS2 bus; D = CAN bus

- |  |                              |
|--|------------------------------|
| 1 Fuse 15A – Permanent feed                | 13 Reservoir pressure sensor |
| 2 Fusible link 100A                        | 14 Valve block               |
| 3 Fuse 50A                                 | 15 Front cross link valve    |
| 4 Air suspension relay                     | 16 Rear cross link valve     |
| 5 Compressor and motor                     | 17 LH rear height sensor     |
| 6 Temperature sensor                       | 18 RH rear height sensor     |
| 7 HP exhaust valve                         | 19 LH front height sensor    |
| 8 Exhaust valve                            | 20 RH front height sensor    |
| 9 Control switch                           | 21 ABS ECU                   |
| 10 Body control Unit (BCU)                 | 22 Instrument pack           |
| 11 Air suspension ECU                      | 23 Diagnostic socket         |
| 12 Driver door module (Access mode switch) |                              |



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## Description

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### General

The main function of the four corner air suspension system is to maintain the vehicle at the correct ride height, irrespective of load. Additionally, the system allows the driver to request ride height changes to improve off-road performance or ease of access or loading. The system automatically adjusts the ride height to improve the vehicle handling and dynamics when speed increases or decreases.

The system will temporarily inhibit height adjustments when the vehicle is subject to cornering, heavy acceleration or heavy braking. The inhibit function prevents unsettling of the vehicle by reducing the effective spring rates.

Height changes are also inhibited for safety reasons, when a door is opened and the vehicle is stationary for example.

The air suspension system fitted to Range Rover is controlled by an ECU located behind the passenger side of the fascia. The ECU monitors the height of each corner of the vehicle via four height sensors, which are mounted in-board of each road wheel. The ECU also performs an 'on-board diagnostic' function to perform 'health checks' on the system. If faults are detected, codes are stored in the ECU and can be retrieved using TestBook/T4.

The independent front and rear suspension offers many design and performance advantages over the conventional beam axle design.

### Front Suspension

The independent front suspension offers a reduction of un-sprung mass over the conventional beam axle design. The suspension geometry features positive ground level off-set for improved control under braking. The suspension arms have been designed for maximum ground clearance. Suspension geometry can be adjusted via the strut top mount for camber and on the steering rack track rod ends for toe-in.

Front suspension features a 6mm positive off-set.

The following wheel travels are shown for on road and off-road vehicle operation. The difference between the two operating conditions is a result of operation of the front cross-link valve. When the cross-link valve is opened the suspension travel is as given for off-road wheel travel. When the cross-link valve is closed the suspension travel given for on road applies.

The off road mode wheel travel is:

- 175 mm bump
- 95 mm rebound
- This gives a total of 270 mm off road suspension travel.

The on road standard wheel travel is:

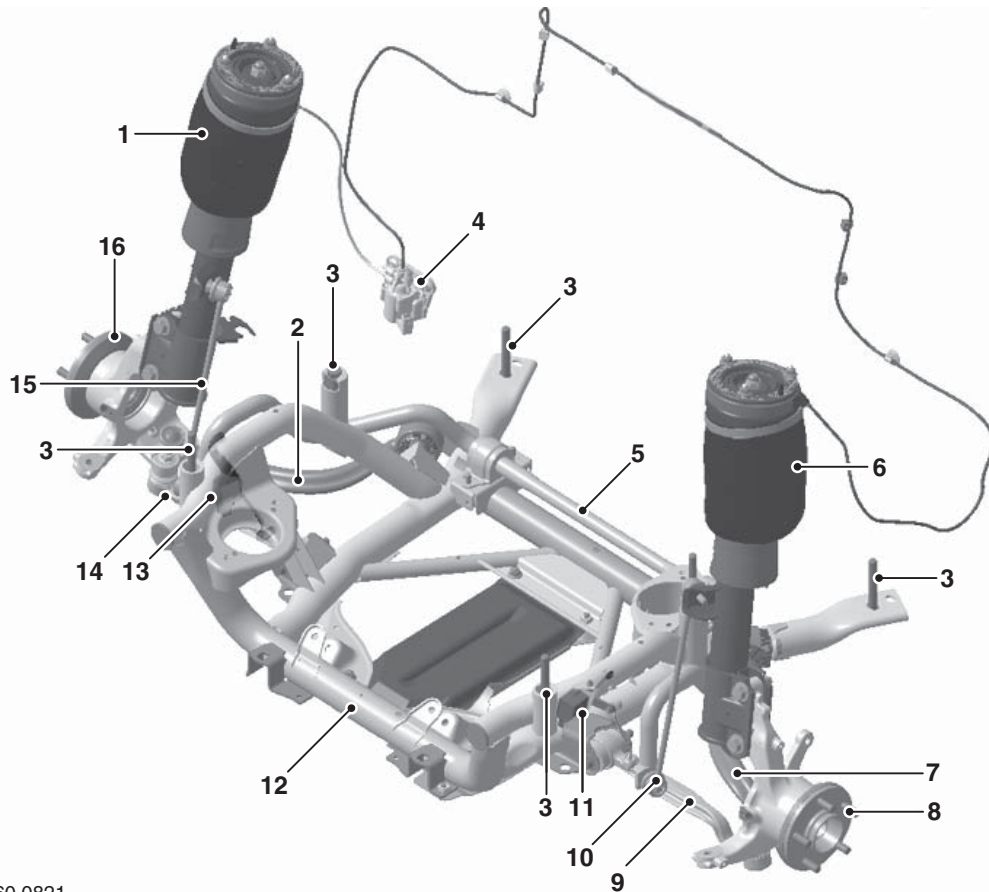
- 115 mm bump
- 155 mm rebound
- This gives a total of 270 mm on road suspension travel.

The front suspension comprises:

- Two air spring damping struts
- Subframe
- Anti-roll bar
- Anti-roll bar links
- Suspension arms
- Two hub assemblies.

# SUSPENSION

## Front Suspension Components



M60 0821

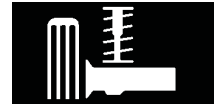
- |                           |                                    |
|---------------------------|------------------------------------|
| 1 RH front strut assembly | 9 LH lower arm                     |
| 2 RH tie rod              | 10 LH anti-roll bar link           |
| 3 Subframe body mounts    | 11 LH front height sensor          |
| 4 Front cross link valve  | 12 Front subframe                  |
| 5 Anti-roll bar           | 13 RH front height sensor (hidden) |
| 6 LH front strut assembly | 14 RH lower arm                    |
| 7 LH tie rod              | 15 RH anti-roll bar link           |
| 8 LH front hub assembly   | 16 RH front hub assembly           |

### Struts

The front suspension struts are a MacPherson twin tube design with the conventional coil spring replaced by an air spring. The lower end of the strut is connected to the front hub assembly with two bolts. The upper top mount is attached to the inner wing with three studs and nuts.

The top mount has a bearing installed which reduces the force required on the steering when the strut rotates. A paper gasket is fitted on the underside of the inner wing, between the inner wing and the top mount. The gasket prevents the ingress of dirt and moisture into the bearing. When the strut is removed, this gasket must be replaced with a new item to maintain the performance of the bearing and care must be taken to ensure that the gasket is correctly positioned.

The damper functions by restricting the flow of hydraulic fluid through internal galleries within the damper. A damper rod moves axially within the damper. As the rod moves, its movement is limited by the flow of fluid through the galleries thus providing damping of undulations in the terrain. The damper rod is sealed at its exit point from the damper body to maintain fluid within the unit and to prevent the ingress of dirt and moisture. The seal also acts as a wiper to keep the rod outer diameter clean.



The air spring is fitted on the upper part of the strut. Within the strut module the air spring elements comprise a top plate assembly, an air bag and a base piston. The air bag is attached to the top plate and the piston with a crimped ring. The air bag is made from a flexible rubber material which allows the bag to expand with air pressure and deform under load. On the side of the top cap is a connector which allows for the attachment of the air hose from the cross-link valve. The piston is made from plastic and is shaped to allow the air bag to roll over its outer diameter.

### **Subframe**

The subframe is fabricated from steel tubing to provide a robust platform for the mounting of the suspension and engine. The subframe is attached to the vehicle body via six mountings.

The subframe fabrication provides accurate location for the suspension components and the steering rack. Additional brackets allow for the attachment of the height sensors and the engine mountings. The anti-roll bar is attached across the rear of the subframe and is mounted in flexible bushes which are secured with 'D' shaped clamp plates.

### **Anti-Roll Bar and Links**

The anti-roll bar is fabricated from 30mm diameter, solid spring steel bar. The anti-roll bar operates, via a pair of links, from a bracket mounted on each strut.

The anti-roll bar is attached to the rear of the subframe with two bushes which are bonded to the bar and cannot be removed. Clamp plates are pressed onto the bushes and must not be removed. The anti-roll bar is secured to the subframe with the clamp plates which are located on studs on the subframe and secured with nuts.

The ends of the anti-roll bar are attached to each strut spring seat via an anti-roll bar link. This arrangement allows the anti-roll bar to act on a 1:1 ratio with the wheel travel providing maximum roll bar effectiveness. A hardened washer is fitted between the ball joint and the strut mounting plate. The hardened washer prevents the ball joint damaging the bracket, which could lead to loosening of the torque on the nut. When the link is removed from the strut, it is important to ensure that the correct hardened washer is replaced in the correct position.

Each anti-roll bar link has a ball joint fitting at each end which improves response and efficiency. The top ball joint is mounted at 90° to the axis of the link and attaches directly to the strut and is secured with a locknut. The lower ball joint is mounted at 90° to the axis of the link. The ball joint attaches to the anti-roll bar and is secured with a locknut. The link must be attached to the anti-roll bar with the ball joint on the outside of the bar and the locknut facing inwards. The ball joints on the anti-roll bar links are not serviceable and if replacement of either is necessary, a new anti-roll bar link will be required.

### **Suspension Links**

The front suspension hub assembly is secured to the subframe via two suspension links:

#### *Lower Arm*

Each lower arm is fitted with a bush which is secured with a bolt between two brackets on the subframe. The opposite end of the lower arm is fitted with a ball joint which attaches to the hub assembly.

#### *Tie Rod*

The tie rod is located rearward of the lower arm. The tie rod is fitted with a compliance bush which is secured with a bolt between two brackets on the subframe. The opposite end of the tie rod has a tapered hole which locates on a ball joint which is bolted to the hub assembly.

### **Hub Assembly**

The hub assembly comprises a swivel hub, drive flange and bearing. A seal and bearing are fitted in the swivel hub and are secured with a circlip. The drive flange has the wheel studs attached to it and locates on the splined drive shaft and is secured with a stake nut.

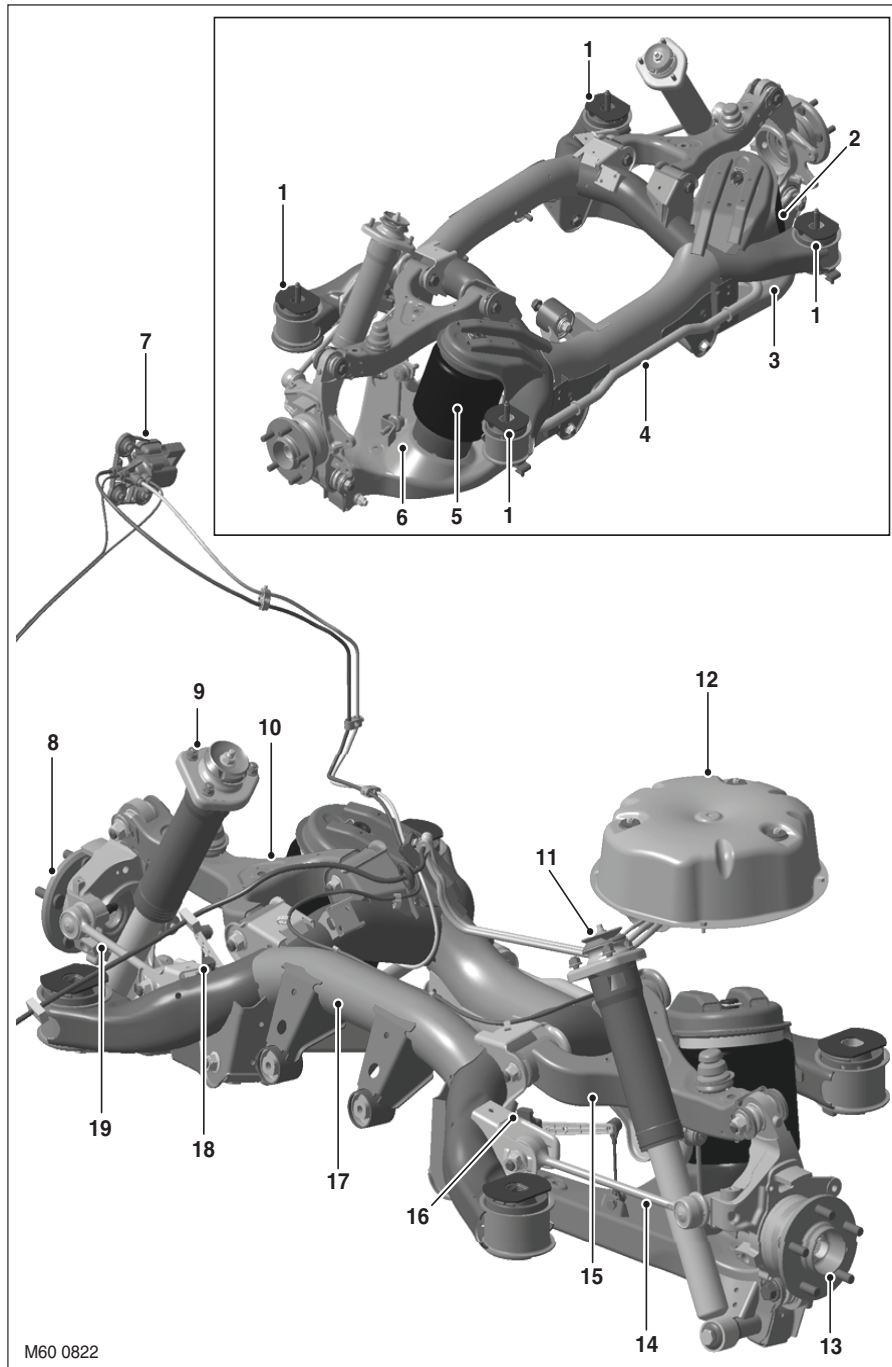
The forged swivel hub has a vertical boss with two cross holes. This provides location for the strut assembly which is secured with bolts and nuts to the swivel hub. Two additional bosses provide location for the brake calliper.

The lower part of the swivel hub has two threaded holes which allow for the attachment of the ball joint which locates the outer end of the tie rod. A further tapered hole allows for the attachment of the lower arm ball joint.

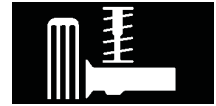
A hole is machined at 90° to the hub bearing. This hole allows for the fitment of the ABS speed sensor which is secured with a screw into an adjacent threaded hole. The speed sensor reads off a target which is part of the drive shaft assembly.

# SUSPENSION

## Rear Suspension



- |                         |                          |
|-------------------------|--------------------------|
| 1 Subframe mounts       | 11 LH damper             |
| 2 RH air spring         | 12 Compressor assembly   |
| 3 RH lower wishbone     | 13 LH rear hub assembly  |
| 4 Anti-roll bar         | 14 LH toe control arm    |
| 5 LH air spring         | 15 LH upper wishbone     |
| 6 LH lower wishbone     | 16 LH rear height sensor |
| 7 Rear cross link valve | 17 Rear subframe         |
| 8 RH rear hub assembly  | 18 RH rear height sensor |
| 9 RH damper             | 19 RH toe control arm    |
| 10 RH upper wishbone    |                          |



The independent rear suspension offers a reduction of un-sprung mass over the conventional beam axle design. The suspension arms have been designed for maximum ground clearance. Wheel alignment can be adjusted for camber and toe-in using eccentric bolts.

The following wheel travels are shown for on road and off-road vehicle operation. The difference between the two operating conditions is a result of operation of the rear cross-link valve. When the cross-link valve is opened the suspension travel is as given for off-road wheel travel. When the cross-link valve is closed the suspension travel given for on road applies.

The off road mode wheel travel is:

- 190 mm bump
- 140 mm rebound
- This gives a total of 330 mm off road suspension travel.

The on road standard height wheel travel is:

- 140 mm bump
- 190 mm rebound
- This gives a total of 330 mm on road suspension travel.

The rear suspension comprises:

- Two dampers
- Two air springs
- Subframe
- Two upper wishbones
- Two lower wishbones
- Two toe control arms
- Anti-roll bar
- Anti-roll bar links
- Two hub assemblies.

### **Dampers**

The rear dampers are unique to New Range Rover and are of a mono-tube design manufactured by Bilstein. The mono-tube design gives the following advantages over conventional twin tube dampers:

- Lightweight construction
- Excellent high frequency response
- Consistent performance – mono-tube design eliminates fluid aeration and emulsification
- Larger diameter piston produces increased fluid displacement for a given damper stroke resulting in more accurate damping control.

The damper comprises a single tube which forms the operating cylinder. The lower end of the cylinder has an eye which accepts the bush for mounting to the lower wishbone. A piston and rod slides inside the cylinder. The rod emerges from the top of the cylinder which is fitted with a rod guide and a seal.

A dust cover is fitted to the top of the rod and protects the rod from damage. A bump stop is fitted to the top of the piston rod, under the dust cover, and protects the damper from full travel impacts. A top mount is fitted at the top of the piston rod and is secured with a flanged nut. A hardened washer is fitted between the shoulder on the piston rod and the bump washer which is fitted inside the dust cover. When the damper is removed and replaced, care must be taken to ensure that the correct hardened washer is refitted in the correct position. The washer prevents the piston rod shoulder causing damage to the bump washer.

The piston is fitted with reed valves which cover a series of holes, through which oil can pass. A chamber at the base of the damper is sealed by a free floating piston. The chamber is filled with inert gas. When the damper is assembled and filled with oil, the gas is in a compressed condition below the piston. On the bump stroke, the downward movement of the piston displaces oil from the full area (bottom) of the cylinder to the cylinder annulus (top). The energy required to pump the oil through the piston drillings and reed valves creates the damping action.

As the piston moves downwards, the volume available on the annulus side of the piston is less than required by the displaced oil from the full area side. When this occurs, the free floating piston moves downwards, further compressing the gas and providing the additional volume for the displaced oil and further enhancing the damping process.

## SUSPENSION

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The dampers are located between the lower wishbone and the vehicle body. The lower mounting is fitted with a bush which provides for the attachment to the wishbone with a bolt and nut. The damper top mounting is located in a turret in the body and secured to the body with three nuts. A paper gasket is located between the damper top mounting and the body and prevents the ingress of dirt and moisture into the mounting studs and corresponding holes in the body. It is important that this gasket is discarded and replaced with a new item when the damper is removed.

### ***Air Springs***

Each air spring comprises a top plate assembly, an air bag and a base piston. The air bag is attached to the top plate and the piston with a crimped ring. The air bag is made from a flexible rubber material which allows the bag to expand with air pressure and deform under load. The top plate assembly comprises the plastic top plate with a spigot which protrudes through a hole in the subframe. On the side of the top cap is a connector which allows for the attachment of the air hose from the cross-link valve. The piston is made from plastic and is shaped to allow the air bag to roll over its outer diameter. The base of the piston has a splined stud in the centre and an offset timing peg for correct orientation of the air spring into the lower wishbone.

The air springs are located rearward of the dampers and are retained between the subframe and the lower wishbone. The air spring is attached to the lower wishbone with a screw which is fitted from the underside of the wishbone into the splined stud on the base of the piston. The air spring top plate is attached to the subframe via an integral 'D' shaped spigot which is secured with a retaining clip.

### ***Subframe***

The subframe is fabricated from steel tubing to provide a robust platform for the mounting of the suspension and the rear differential. The subframe is attached to the vehicle body via four, voided rubber mounts.

The subframe provides location for the suspension components and the rear differential. Two bushes at the front of the subframe and one at the rear allow for the attachment of the rear differential. Additional brackets, bolted to the subframe, allow for the attachment of the height sensors. The anti-roll bar is attached across the rear of the subframe and is mounted in flexible bushes which are secured with 'D' shaped clamps.

### ***Upper and Lower Wishbones***

#### ***Upper Wishbone***

The steel fabricated upper wishbone has two bushes pressed into housings which provide for the attachment to the subframe. The bushes are located between brackets on the subframe and are secured with bolts and nuts. The outer end of the upper wishbone has two brackets with slotted holes. A boss on the hub is fitted with a ball joint which locates between the brackets and is secured with an eccentric bolt, washer and nut. This allows for the adjustment of the rear wheel camber. Rotation of the bolt moves the eccentric head against a recessed slot in the bracket, moving the location of the hub in the upper wishbone slots, allowing the camber to be adjusted to within the set limits. A rubber bump stop is fitted centrally on the upper wishbone to cushion the wishbone movement when the suspension is at the extremes of its travel.

#### ***Lower Wishbone***

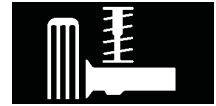
The lower wishbone is larger than the upper wishbone and is a steel fabrication. Two bushes are pressed into the wishbone and provide for the attachment to the subframe. The bushes are located between brackets on the subframe and secured with bolts and nuts. The lower wishbone has a platform which provides for the attachment of the air spring. A welded bracket allows for the attachment of the anti-roll bar link. A boss on the hub is fitted with a ball joint which locates between brackets on the lower wishbone. The hub is secured to the lower wishbone with a bolt and nut. A bracket with a tubular extension provides for the attachment of the damper lower mounting.

### ***Toe Control Arms***

The toe control arm is a forged steel component. One end is fitted with a taper ball joint and the opposite end has a bush pressed into an integral housing.

The bush locates between brackets on the subframe and is secured with a special eccentric bolt, washer and nut. This allows for the adjustment of the rear wheel toe in. Rotation of the bolt moves the eccentric head within a recessed slot in the bracket, allowing the toe-in to be adjusted within the set limits.

The taper ball joint locates in a tapered hole in the hub and is secured with a nut.



### **Anti-Roll Bar and Links**

The anti-roll bar is fabricated from 23 mm diameter, solid spring steel. The anti-roll bar operates, via a pair of links, from a bracket on the upper face of each lower arm.

The anti-roll bar is attached to the rear of the subframe with two bushes which are bonded to the bar and cannot be removed. Clamp plates are pressed onto the bushes and must not be removed. The anti-roll bar is secured to the subframe with the clamp plates which are secured with bolts. The ends of the anti-roll bar are attached to the lower arms via anti-roll bar links. This arrangement allows the anti-roll bar to act on a 1:1 ratio with the wheel travel providing maximum effectiveness. A hardened steel washer is fitted between the ball joint and the lower wish bone bracket. The hardened washer prevents the ball joint damaging the bracket which could lead to loosening of the torque nut. When the link is removed it is important to ensure that the correct hardened washer is replaced in the correct position.

Each anti-roll bar link has a ball joint fitting at each end which improves response and efficiency. The top ball joint is mounted at 90° to the axis of the link and attaches to the anti-roll bar and is secured with a nut. The lower ball joint is also mounted at 90° to the axis of the link. The ball joint attaches to the lower arm and is secured with a nut. The ball joints on the anti-roll bar links are not serviceable and if replacement of either is necessary, a new anti-roll bar link will be required.

### **Hub Assembly**

The hub assembly comprises a wheel hub, drive flange and bearing. A seal and bearing are fitted in the wheel hub and are secured with a circlip. The drive flange has wheel studs attached to it and locates on the splined drive shaft and is secured with a stake nut.

The cast wheel hub has a vertical boss with a cross hole. A ball joint is pressed in the hole and provides the attachment point for the upper wishbone. The upper wishbone is secured to the wheel hub with a bolt and nut. An additional boss with two cross holes provide location for the brake calliper.

A second vertical boss with a cross hole at the bottom of the wheel hub provides for the attachment of the lower wishbone. A ball joint is pressed in the hole and the lower wishbone is secured with a bolt and nut. A further tapered hole in the wheel hub allows for the attachment of the toe control arm ball joint.

A hole is machined in the wheel hub at 90° to the hub bearing. This hole allows for the fitment of the ABS speed sensor which is secured with a screw into an adjacent threaded hole. The speed sensor reads off a target which is part of the drive shaft assembly.

### **Air Suspension**

The air suspension comprises the following:

- Two front struts incorporating air springs
- Two rear air springs
- Two cross link valves
- An air reservoir, pressure sensor and valve block
- Four height sensors
- Air supply unit
- Air suspension ECU
- Air supply pipes
- External pressure relief valve (only on systems with a lower maximum operating pressure)
- Air suspension fascia control switch.

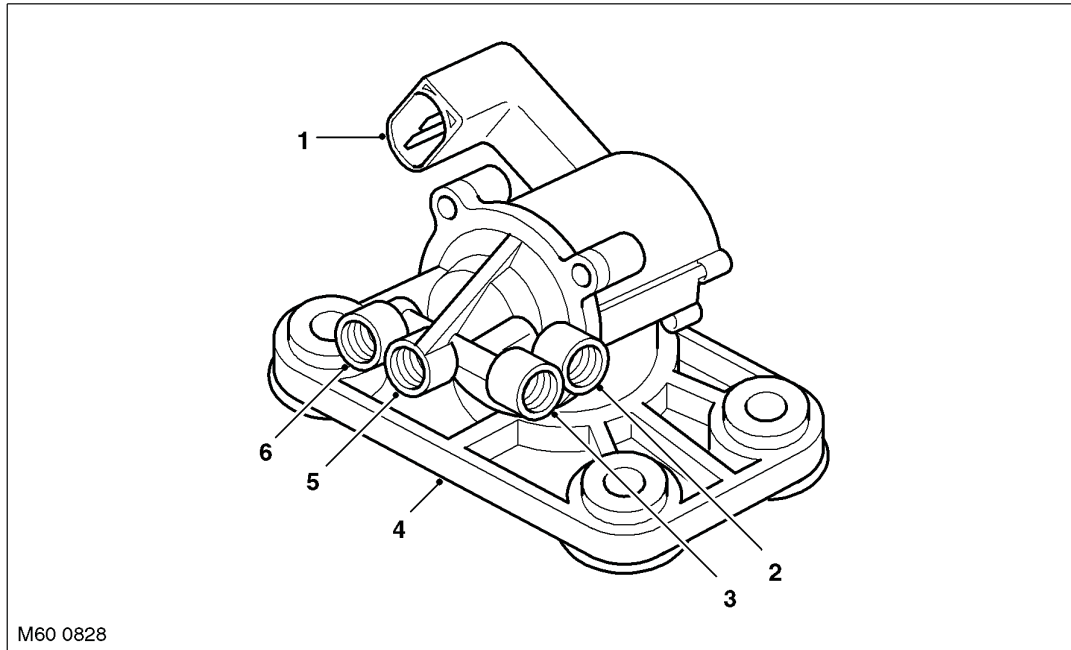
The air suspension system is controlled by the air suspension ECU which is located adjacent to the passenger compartment fusebox, behind the fascia. The ECU is located in a white coloured plastic bracket for identification.

Suspension geometry changes when moving from off-road to access heights. See the following table for data:

	<b>Front</b>	<b>Rear</b>
Toe change	30 mins	10 mins
Camber change	90 mins	90 mins

# SUSPENSION

## Cross Link Valves



- |  |  |
|--|--|
| 1 Electrical connector                         | 4 Cross link valve body                        |
| 2 RH air spring supply/return                  | 5 LH air spring supply/return                  |
| 3 RH air spring supply/return from valve block | 6 LH air spring supply/return from valve block |

The cross-link valves are located at the rear of the front RH wheel arch, behind the liner for the front valve and at the top of the rear RH wheel arch, behind the liner for the rear valve. The valves are attached to the body by three fixing and are rubber mounted to isolate solenoid noise.

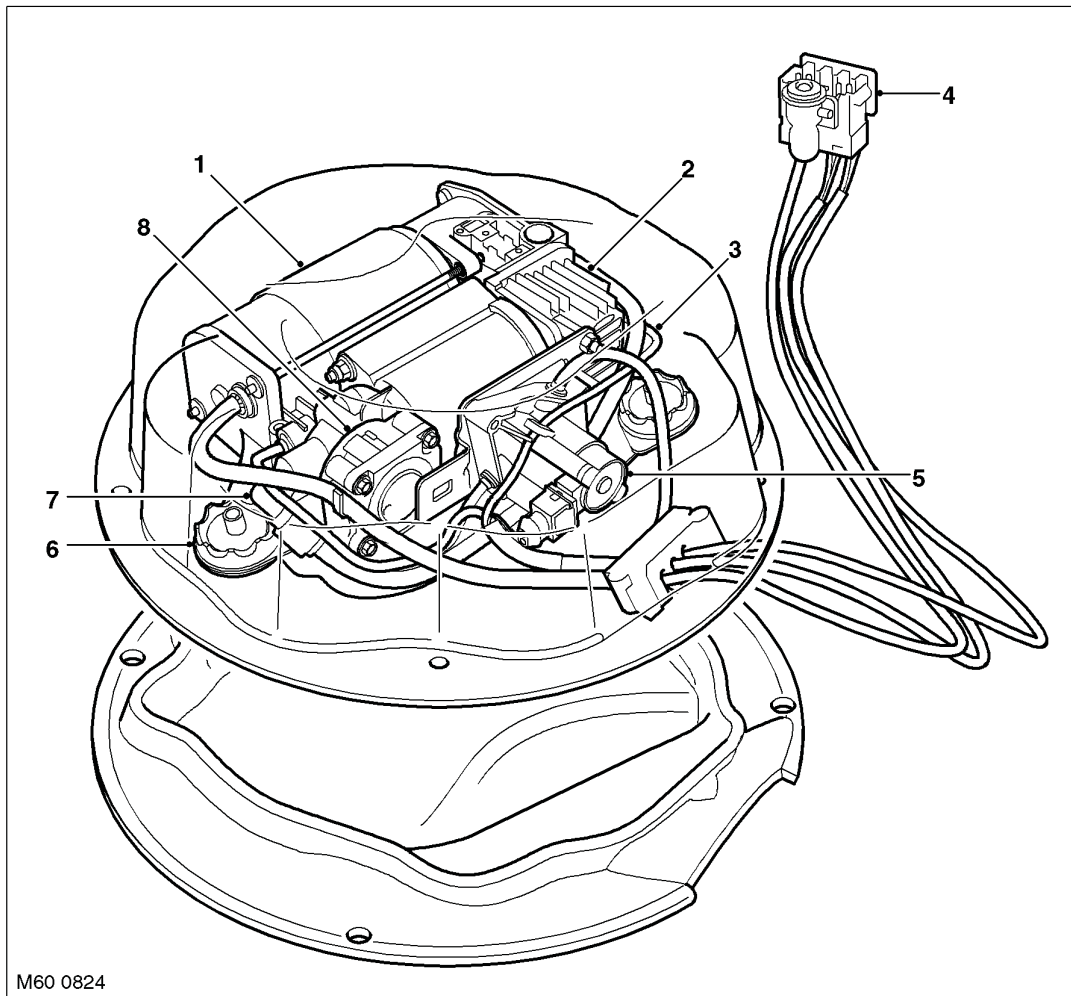
The cross-link valves comprise a single large solenoid valve with connections to the LH and RH air springs and also connections for each air spring from the reservoir mounted valve block. The solenoid operated valve is controlled by the air suspension ECU. When the solenoid is energised, the cross-link valve connects the two air springs together, allowing air to flow between them if required. This provides additional articulation of the suspension improving the off-road capabilities of the vehicle and an improvement in low speed ride comfort.

The air suspension ECU senses that the vehicle is off-road by comparing rapid changes in signals from the height sensors. The operation of the cross-link valves is fully automatic, requiring no driver intervention.

The cross link valves are only operated at vehicle speeds of 12.5 mph (20 km/h) and below. At vehicle speeds above 12.5 mph (20 km/h), the cross link valves remain closed.



### Air Supply Unit



M60 0824

- |  |                               |
|--|-------------------------------|
| 1 Electric motor                       | 5 High pressure exhaust valve |
| 2 Compressor                           | 6 Rubber mounting (3 off)     |
| 3 Compressor temperature sensor        | 7 Exhaust hose                |
| 4 Electrical and air supply connectors | 8 Exhaust pilot valve         |

The air supply unit is located in a sealed housing which is mounted in the spare wheel well. The unit is secured with four bolts into threaded inserts in the vehicle floorpan. The unit is connected to the system via a single air pipe and harness wiring and multiplug. The air pipe from the unit passes through a grommet in the wheel well. It is important to ensure that this grommet is not disturbed and correctly installed. Incorrect fitment will allow water to enter the wheel well leading to possible damage to and failure of the air supply unit.

The unit comprises a piston compressor, a 12V electric motor, a solenoid operated exhaust pilot valve, a pressure relief valve and an air dryer unit.

The electric motor, compressor, air dryer and pressure limiting and exhaust valve are mounted on a frame which in turn is mounted on flexible rubber mountings to reduce operating noise.

Removal of the air supply unit does not require depressurisation of the air suspension system. The corner and the reservoir valves close, retaining the air in the system.

# SUSPENSION

The electric motor drives a crank with an eccentric pin to which a connecting rod is attached. The connecting rod has a piston which fits in the bore of the compressor. Operation of the motor rotates the crank, moving the piston in the bore of the compressor. The compressor is attached with special bolts to the motor housing and sealed with an O-ring. The compressor has a temperature sensor located in its housing. The sensor measures the compressor temperature which is measured by the air suspension ECU.

Attached to the compressor is the air dryer which contains a silicate box for removing moisture from the compressed air. Air supplied to inflate the air springs passes through the air dryer. When the air springs are deflated, the exhaust air also passes through the air dryer, removing the moisture from the unit.

Attached to the end of the air dryer unit is a solenoid operated exhaust pilot valve. This valve is opened when the air springs are to be deflated.

Located in the same housing as the exhaust pilot valve is a pressure limiting valve which, on systems without an external pressure relief valve, protects the air springs from over inflation. The valve is pneumatically operated, responding to air pressure applied to it to overcome pressure from a spring located behind the valve. The pressure limiting valve also operates when the exhaust pilot valve is opened, allowing air returning from the air springs to be exhausted.

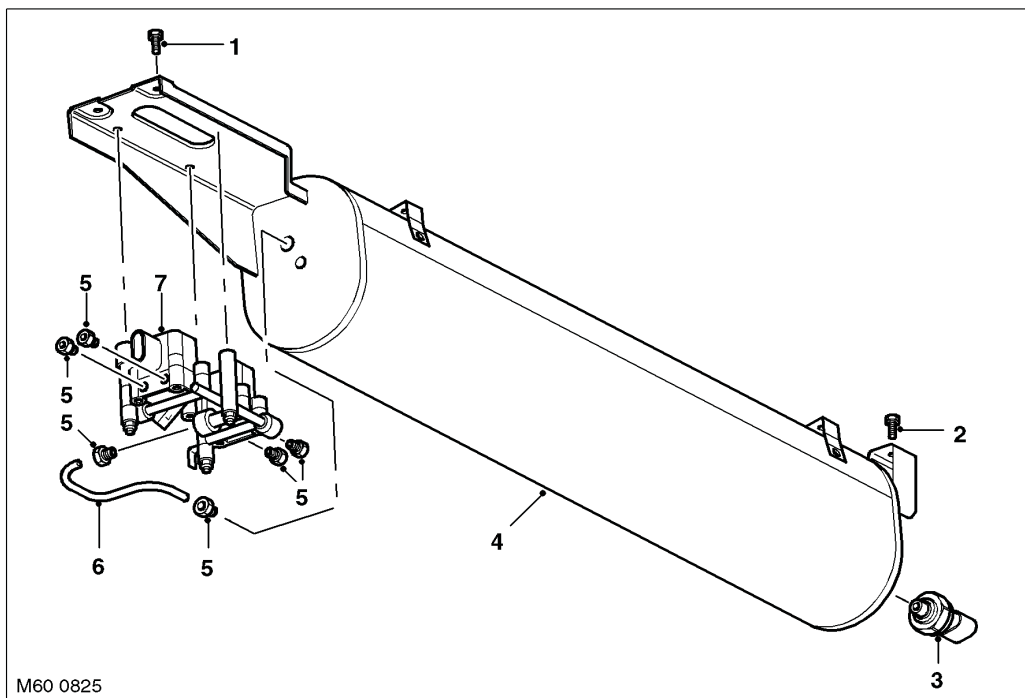
The compressor is used to supply air pressure to the air suspension reservoir. The ECU monitors the pressure within the reservoir and, when the engine is running, maintains a pressure of:

- 13.7 bar (199 lbf/in<sup>2</sup>), in systems without an external pressure relief valve
- 11.8 bar (171 lbf/in<sup>2</sup>), in systems with an external pressure relief valve

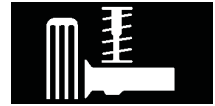
There are a number of conditions that will inhibit operation of the air suspension compressor. It is vitally important that these inhibits are not confused with a system malfunction. A full list of compressor inhibits is contained in the Air Suspension Control section.

A temperature sensor is located within the compressor. If the compressor temperature rises above set limits, the ECU will inhibit compressor operation.

## Reservoir



- |                                    |  |
|------------------------------------|--|
| 1 Reservoir mounting screw – front | 5 Air hose connectors                      |
| 2 Reservoir mounting screw – rear  | 6 Hose – reservoir pressure to valve block |
| 3 Air pressure sensor              | 7 Valve block                              |
| 4 Reservoir                        |  |



The air suspension reservoir is fabricated from aluminium and is located under the RH sill of the vehicle. The reservoir is secured with four bolts to the underside of the vehicle. The reservoir has an additional bracket on the forward facing end which provides the mounting for the valve block. A pressure sensor is screwed into the rear face of the reservoir. The sensor is connected to the air suspension ECU and measures the pressure within the reservoir. The pressure sensor cannot be replaced. If failure of the sensor occurs, the reservoir, complete with the sensor must be replaced.

The reservoir supplies pressurised air to the four air springs, via the valve block, to enable the air suspension system to carry out ride height changes.

#### ***Valve Block***

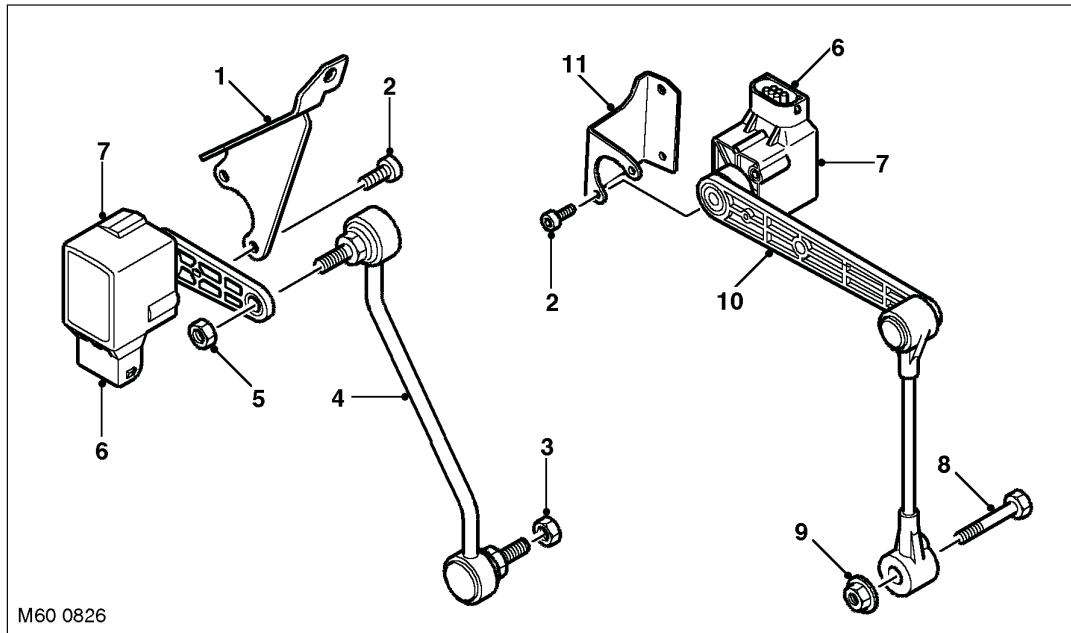
The five way air suspension valve block is located under the RH sill of the vehicle, and is mounted forward of the air reservoir. The valve block is held in place on the air reservoir support bracket by 3 studs and secured by nuts. The studs are bonded into rubber mounts which isolates solenoid operation from the vehicle.

The valve block contains five solenoid operated valves which are controlled by the air suspension ECU. Four of the valves, known as corner valves, control the air flow to and from air springs, via the cross-link valves. The fifth valve, known as the reservoir valve, controls the air pressure supply from the reservoir to the air springs, via the corner valves and cross-link valves and also from the compressor to the reservoir.

Removal of the valve block will require full depressurisation of the air suspension system. The valve block is a non-serviceable item and should not be disassembled.

# SUSPENSION

## Height Sensors



- |                          |                          |
|--------------------------|--------------------------|
| 1 Bracket – front sensor | 7 Sensor                 |
| 2 Screw                  | 8 Bolt                   |
| 3 Nut                    | 9 Nut                    |
| 4 Connecting link        | 10 Connecting link       |
| 5 Nut                    | 11 Bracket – rear sensor |
| 6 Electrical connector   |                          |

A height sensor is fitted in each corner of the vehicle to monitor the ride height of the vehicle. The sensors are mounted on the front and rear subframes, with a mechanical link to the suspension lower arms. There are six different types of sensor fitted to Range Rover:

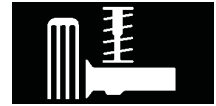
- LH front height sensor – All vehicles
- RH front height sensor – Halogen headlamps fitted
- RH front height sensor – Xenon headlamps fitted
- LH rear height sensor – All vehicles.
- RH rear height sensor – Halogen headlamps fitted
- RH rear height sensor – Xenon headlamps fitted.

*NOTE: RH front and RH rear height sensors fitted to vehicles with Xenon headlamps have a white stripe across the back face of the sensor housing for identification.*

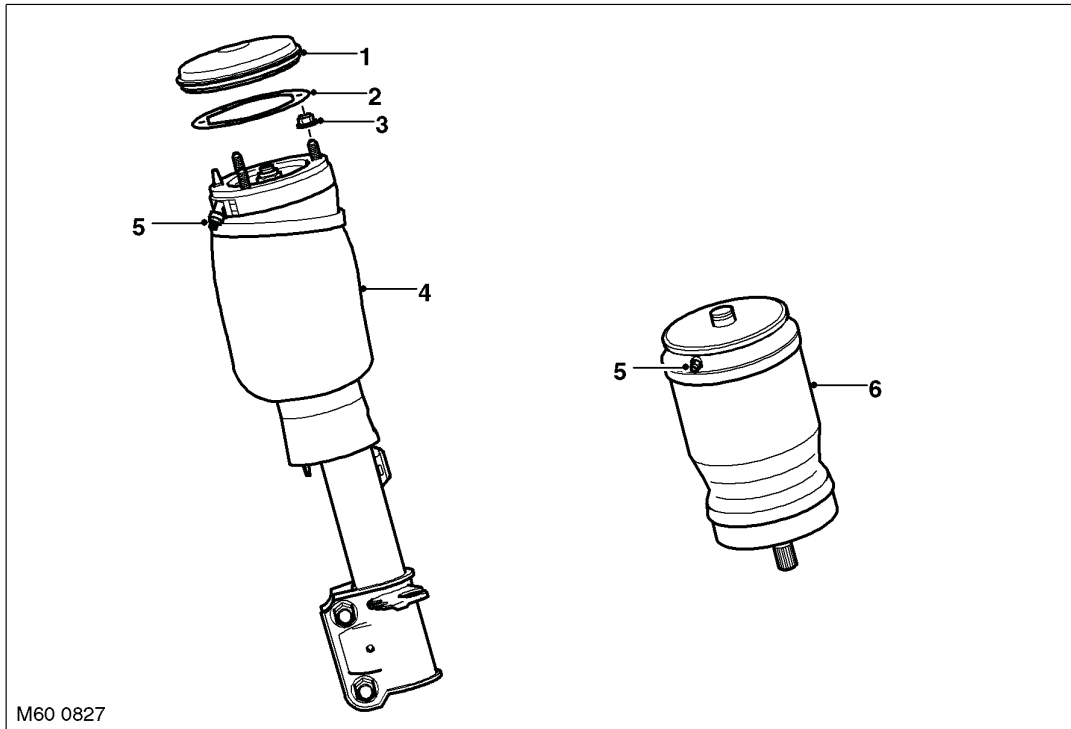
The height sensors are attached to brackets on the subframes and are connected to the lower arms by links. The links allow articulation of the arm to allow for suspension travel. Each sensor is connected by a six pin multiplug. Standard height sensors use three of the six pins and height sensors for vehicles fitted with xenon headlamps use all six.

The height sensors contain a circuit board with a Hall effect sensor. The sensor is supplied with a reference voltage from the air suspension ECU which measures the returned voltage to determine the sensor arm position. The sensors used on vehicles with xenon headlamps use a sensor with a second circuit. This second circuit is used by the xenon headlamp levelling ECU.

The front sensor ball jointed linkage is a serviceable item. The rear sensor linkage cannot be serviced and must be changed as a complete assembly.



## Air Springs



- 1 Cover
- 2 Seal plate
- 3 Nut

- 4 Front air spring
- 5 Air hose connector
- 6 Rear air spring

The air springs on the front and rear suspension are similar in construction. The air springs are manufactured from a flexible rubber. Each air spring forms an air tight cavity which provides the required spring rate for each corner of the vehicle.

As the air spring is compressed, the rubber material compresses and rolls down the side of the vertical housing below the spring. An air connection port is located on the top of each spring and allows air to be added or removed from each spring. The port is connected via a Voss connector and a plastic tube to the valve block on the reservoir.

Replacement of an individual air spring does not require a full depressurisation of the air suspension system. Only the corner concerned need be depressurised.

When servicing of an air spring or a full system depressurisation is required, the weight of the vehicle must be supported before the system is depressurised. On reassembly, the air spring must be fully pressurised before the weight of the vehicle is applied to it.

### Air Pipes

The system is interconnected via yellow and black nylon pipes. The yellow pipes denote RH side and the black pipes denote LH side. The pipes are attached to the subframes and vehicle body with clips. To ensure that the correct routing is maintained, the pipes have timing marks which align with various clip positions. The timing marks are in the form of a white band around the pipe, indicating the clip position. If the correct routing is not achieved, unnecessary tension at the pipe joints will occur resulting in possible early failure.

# SUSPENSION

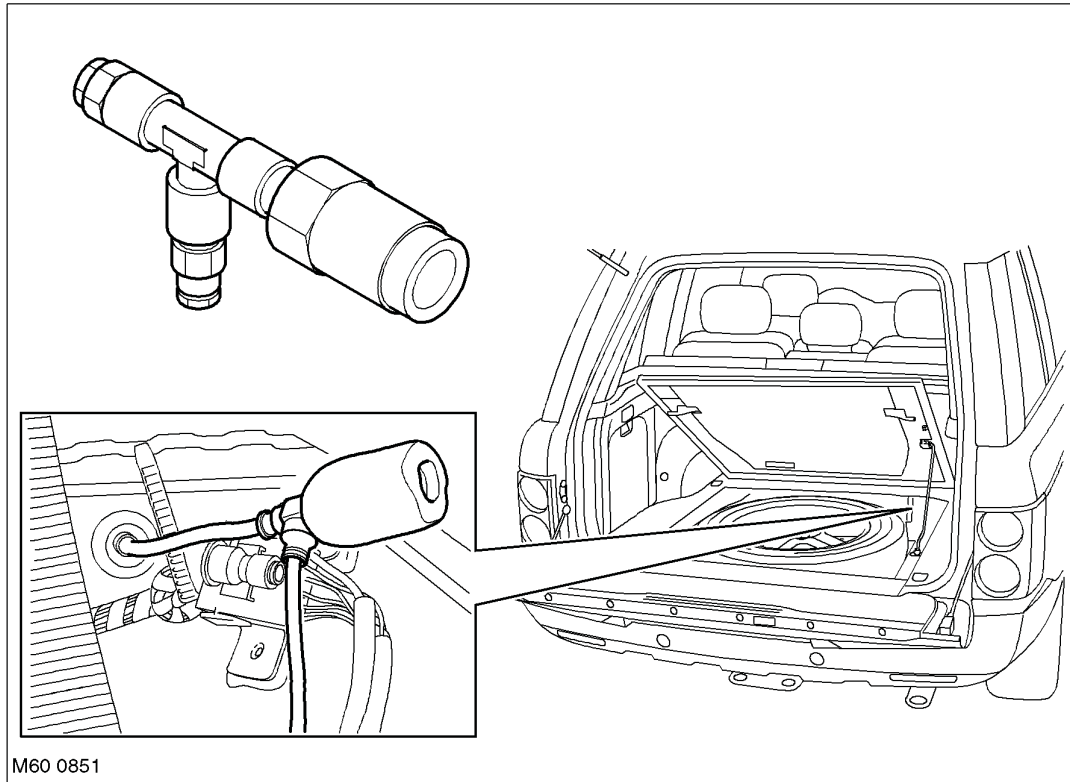
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## External Pressure Relief Valve

On vehicles from VIN 106310 onwards, the maximum system pressure was reduced from 13.7 to 11.8 bar (199 to 171 lbf/in<sup>2</sup>) with the introduction of a new level of software for the air suspension ECU. For systems running with the higher operating pressure, a relief valve in the air supply unit protects the subsequent components in the circuit. The relief valve in the air supply unit became redundant with the introduction of the lower maximum system pressure, so an external pressure relief valve was introduced to maintain protection.

The external pressure relief valve is installed in the air pipe between the compressor and the reservoir, in the front right corner of the spare wheel well. If the pressure of the air from the compressor increases to 12.3 bar (178 lbf/in<sup>2</sup>), the pressure relief valve opens and releases excess pressure to atmosphere.

### External Pressure Relief Valve Location



## Leak Detection

Leak detection can be carried out using a Land Rover approved leak detection spray.

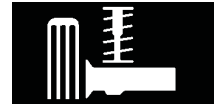
If the vehicle appears to be leaking, perform a leak check on all aspects of the system, i.e.; air spring hose fittings and the associated connections on the valve block and cross-link valve, air springs, reservoir. Failure to correctly diagnose leakage will result in unnecessary exchange of serviceable components and recurrence of original problem.

## Air Suspension ECU

The air suspension ECU monitors vehicle ride height via four height sensors. The ECU has three modes of operation:

- Normal
- Periodic Wake-Up
- Transportation.

When a new air suspension ECU is fitted, the air suspension system will not function until configured with TestBook/T4.

**Normal Mode**

The air suspension ECU will enter normal mode when it receives a 'wake up' signal from the Body Control Unit (BCU). The BCU will provide the 'wake up' signal when the following occurs:

- A door is opened.
- The vehicle is unlocked using the remote handset.
- The ignition is switched on.

The BCU will continue to supply the 'wake up' signal for 15 minutes after the ignition is switched off. The air suspension ECU will then remain active for a further 10–15 seconds to enable any new data to be written to its Electronic Erasable Programmable Read Only Memory (EEPROM).

If the BCU has supplied a 'wake up' signal, but the ignition is off, the air suspension ECU will enter an Inactive Mode. Under these circumstances, air suspension functionality is reduced. Although the air suspension ECU will continue to monitor vehicle ride height and make any necessary adjustments, to keep the vehicle at the correct height, all ride height selections made via the rotary switch will be ignored. The ECU will not illuminate the LED's or allow the compressor to fill the reservoir. If a height increase is necessary and the pressure in the air reservoir is below 9 bar (130 lbf/in<sup>2</sup>), the ECU will power the compressor to raise the vehicle back to the correct height.

If the ignition is switched on but the engine is not running, the air suspension ECU will continue to monitor vehicle ride height and make any necessary adjustments. Downwards ride height selections made via the rotary switch will be accepted, and the LED's will illuminate as normal. Upward ride height selections made via the rotary control switch will be rejected. However, if the vehicle height decreases (e.g. if a load is added to the car), the ECU will return the vehicle to the current ride height. These height changes are made using the air suspension reservoir providing the available air pressure is more than 9 bar (130 lbf/in<sup>2</sup>). If the air pressure is less than 9 bar (130 lbf/in<sup>2</sup>), the compressor is used for the height changes. Filling of the reservoir remains inhibited.

**Periodic Wake-Up Mode**

When the 'wake up' signal is removed by the BCU, the air suspension ECU powers down. After it powers down, the air suspension ECU will wake up approximately every six hours and level the vehicle ride height. The air suspension ECU will determine which corner of the vehicle is lowest, and adjust the remaining corners to the same level. This action takes approximately 6–10 seconds to perform. The air suspension ECU will then remain active for a further 10–15 seconds to enable any new data to be written to its EEPROM.

If the air suspension ECU fails to level the vehicle (if there is an obstruction beneath the vehicle for instance), periodic wake-up mode will be suspended until the air suspension ECU receives a wake-up signal from the BCU.

*NOTE: The air suspension ECU will not raise the vehicle in this mode.*

**Transportation Mode**

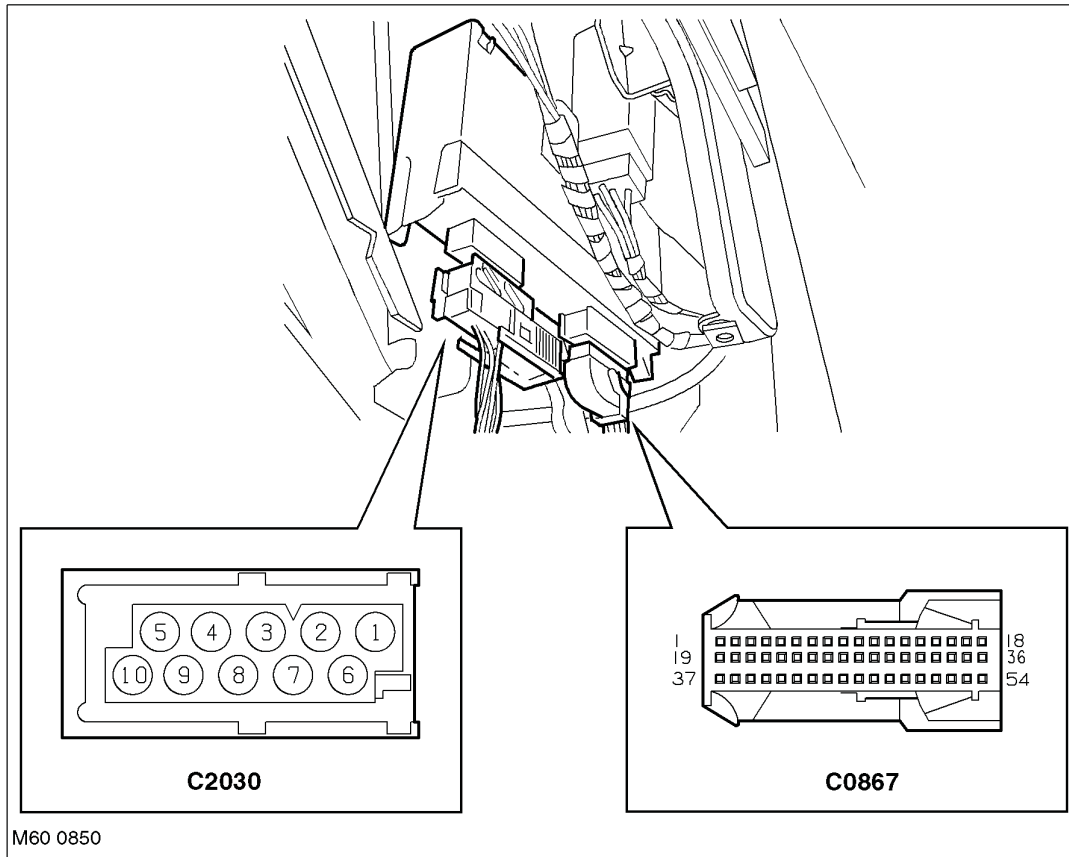
To enable the vehicle to be delivered safely from the factory to the dealership, the air suspension system is set in transportation mode. When the engine is running, the ride height will be set at 'Transportation High', which is 20 mm below standard ride height. All four LED's will remain illuminated.

When the engine is not running, the air suspension ECU will drop the ride height by 50 mm (Transportation Low). All four LED's will flash.

When the ride height is at 'Transportation Low' the vehicle can be lashed to a transporter, without the risk of loosening due to the suspension ride height lowering.

# SUSPENSION

## Air Suspension ECU Harness Connectors



### Air Suspension ECU Harness Connector C0867 Pin Details

Pin No.	Description	Input/Output
1	Not used	–
2	CAN bus high	Input/Output
3	Control switch up selection	Input
4	Control switch hold selection	Input
5	Control switch motorway ride height LED	Input
6	Front RH corner valve control	Input
7	Front LH and RH corner valves power supply	Output
8	Front LH corner valve control	Input
9	Rear RH corner valves control	Input
10	Rear LH and RH corner valves power supply	Output
11	Rear LH corner valve control	Input
12	Reservoir valve control	Input
13	Reservoir valve power supply	Output
14	Exhaust pilot valve power supply	Output
15	Exhaust pilot valve control	
16	Air suspension relay control	Input
17	High pressure exhaust valve power supply	Output
18 and 19	Not used	–
20	CAN bus low	Input/Output
21	Control switch down selection	Input
22	Control switch off-road ride height LED	Output
23	Control switch access ride height LED	Output



Pin No.	Description	Input/Output
24	Front RH height sensor signal	Input
25	Front LH height sensor signal	Input
26	Rear RH height sensor signal	Input
27	Rear LH height sensor signal	Input
28	Air pressure sensor signal	Input
29 and 30	Not used	–
31	Temperature sensor	Output
32	Front LH height sensor power supply	Output
33	Front RH height sensor power supply	Output
34	Air pressure sensor power supply	Output
35	High pressure exhaust valve control	Input
36	Not used	–
37	K bus	Input/Output
38	Wake up signal	Input
39	Ride height switch (on driver's door module)	Input
40	Control switch standard ride height LED	Output
41	Control switch hold switch LED	Output
42	Front RH height sensor ground	–
43	Front LH height sensor ground	–
44	Rear RH height sensor ground	–
45	Rear LH height sensor ground	–
46	Air pressure sensor ground	–
47 and 48	Not used	–
49	Temperature sensor ground	–
50	Rear RH height sensor power supply	Output
51	Rear LH height sensor power supply	Output
52 to 54	Not used	–

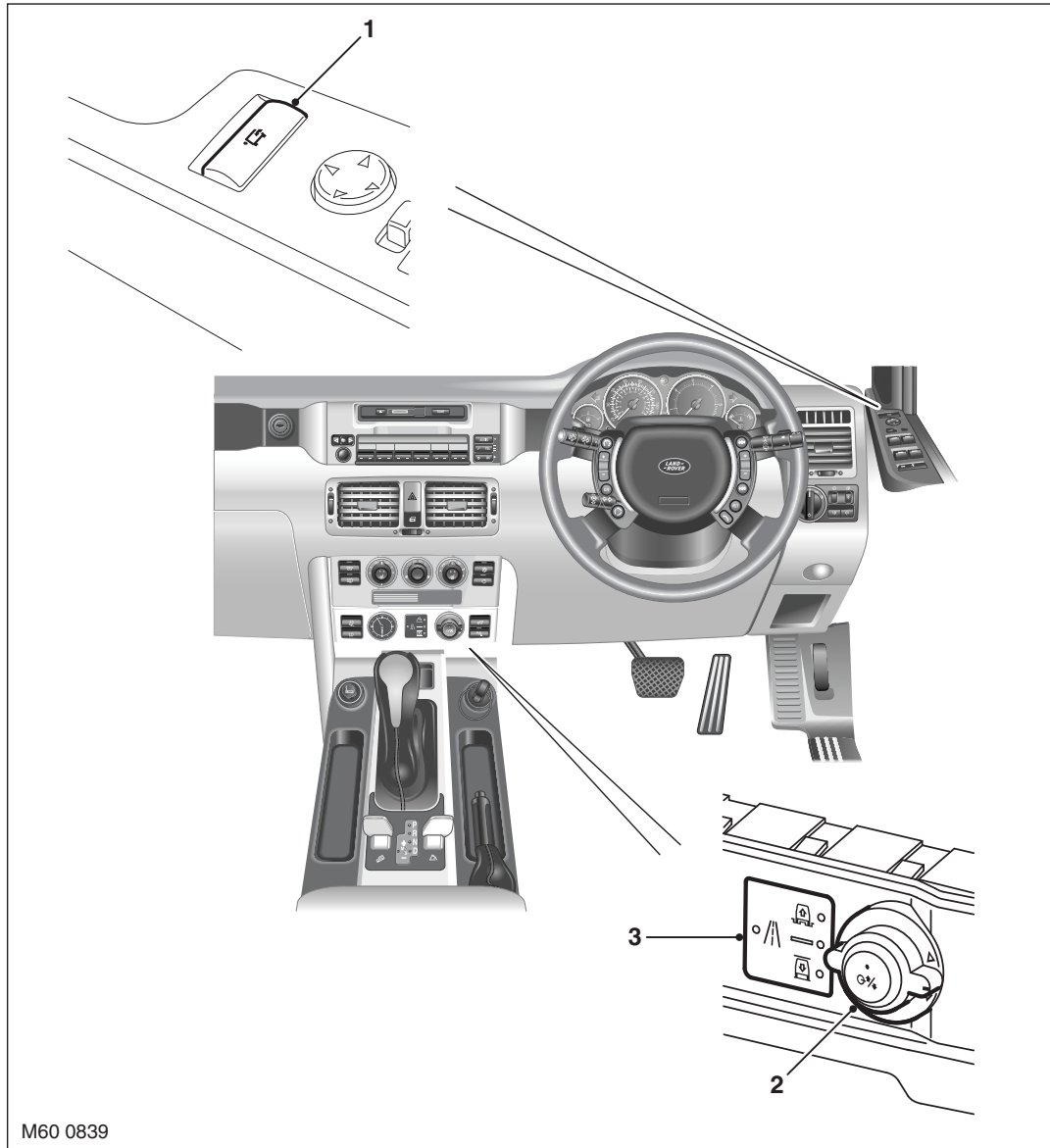
**Air Suspension ECU Harness Connector C2030 Pin Details**

Pin No.	Description	Input/Output
1	Not used	–
2	Front cross link valve ground	–
3	Rear cross link valve ground	–
4	Not used	–
5	Ground	–
6	Not used	–
7	Rear cross link valve power supply	Output
8	Front cross link valve power supply	Output
9	Not used	–
10	Battery power supply	Input

# SUSPENSION

## Air Suspension Control

### Air Suspension Control Switch



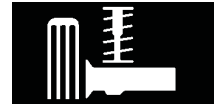
- 1 Driver's door module access switch
- 2 Air suspension rotary control switch

- 3 Air suspension LED display

The air suspension ECU is able to provide four different ride heights:

- Standard
- Off-road
- Motorway
- Access.

The ride heights are selected via the rotary control switch mounted on the centre console. Rotating the switch upwards or downwards selects a different ride height (providing all the criteria outlined below are met). The centre of the rotary switch contains the 'Hold' switch. The 'Hold' switch prevents the air suspension ECU from automatically changing from the currently selected ride height, and prevents the user selecting a new ride height.



Next to the rotary control switch are mounted a series of four LED's. An illuminated LED indicates which ride height is active. If a new ride height is selected using the rotary control switch, the 'current' height LED remains illuminated and the 'requested' height LED flashes until the vehicle achieves the new ride height. If a new ride height is selected using the rotary control switch and the 'current' height LED flashes briefly, this indicates that the ride height selection is invalid and will not be performed. When the operating parameters are correct for the new ride height, the height change request must be repeated.

### ***Standard Ride Height***

Standard ride height is used during most driving conditions. This setting is used as a datum for the remaining ride heights, and is defined as 0 mm. All other ride height settings are described as above or below this setting. The standard ride height can be active at any vehicle speed.

Access or off-road ride height can be selected from standard ride height using the rotary control or the drivers door access switch.

When the vehicle is in standard ride height, the 'Hold' switch can be selected. This prevents automatic height changes from taking place and disables manual height changes until the 'Hold' switch is deselected. If a height change is selected with the hold function active, the standard height LED will flash.

When towing, the electrical connection of the trailer socket will cause the vehicle to set the air suspension to standard height. No other height setting is available whilst towing.

### ***Off-Road Ride Height***

Off-road ride height is the highest of the four settings, and raises the front of the vehicle by 60 mm, and the rear of the vehicle by 50 mm. Off-road ride height is selected by turning the rotary switch upwards when the vehicle is travelling at less than 31 mph (50 km/h). The suspension will return to the standard ride height setting if the rotary control switch is turned downwards, or vehicle speed rises above 31 mph (50 km/h).

If the vehicle is travelling too fast when off-road ride height is selected, the standard road height LED will flash, and the request will not be carried out. The driver must repeat the off-road ride height request once the vehicle speed is reduced.

When the vehicle is in the off-road ride height setting, the 'Hold' switch will not be operational. Similarly, if the vehicle is in the standard ride height setting with 'Hold' selected, the vehicle will not move into the off-road ride height setting until 'Hold' is deselected.

### ***Motorway Ride Height***

Motorway ride height lowers the vehicle by 20 mm, and improves the high speed handling of the vehicle. Motorway ride height is only active when the vehicle is travelling at more than 62 mph (100 km/h) for more than 30 seconds, and is not selectable by the driver.

If the vehicle speed falls to below 43 mph (70 km/h) for more than 60 seconds, the ECU automatically returns the vehicle to the standard ride height setting. If the vehicle stops while the motorway ride height is active, the timer is paused, stopping the vehicle rising unnecessarily.

Although motorway ride height isn't selectable by the driver, the 'Hold' switch can be used to keep the motorway ride height active, and prevent the automatic return to the standard ride height. The vehicle will return to the standard ride height once the 'Hold' switch is deselected (and vehicle speed is less than 43 mph (70 km/h)).

Motorway ride height may be deselected by the driver at any speed by turning the rotary control switch upwards. The vehicle may return to motorway ride height if the vehicle speed remains greater than 62 mph (100 km/h) and the driver does not select 'Hold' when the vehicle has returned to standard ride height.

If the vehicle speed is within the required parameters, the driver can select access ride height by turning the rotary control switch downwards or pressing the access switch on the drivers door.

# SUSPENSION

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## **Access Ride Height**

Access ride height lowers the vehicle by 40 mm when the vehicle is stationary or moving at very low speeds in order to improve ease of access to the vehicle. Access ride height can be selected by operating the access switch on the drivers door module when the vehicle is in standard, off-road or motorway ride heights or by turning the rotary control switch downwards when the vehicle is in standard or motorway ride heights.

Access ride height has three different modes of operation:

- Access Height
- Access Pre-Select
- Crawl Mode.

### *Access Height*

If the vehicle is stationary or travelling at less than 15 mph (25 km/h) 'Access Height' mode can be selected. If vehicle speed increases to more than 18 mph (30 km/h) the vehicle automatically returns to the standard ride height.

### *Access Pre-Select*

If the vehicle is travelling below 49 mph (80 km/h) and access ride height is selected, the vehicle enters the 'Access Pre-Select' mode. The ECU acknowledges this request by flashing the 'Access' LED, but the height of the vehicle does not change immediately. If the vehicle is travelling above 49 mph (80 km/h) and access ride height is selected, the 'Standard' LED will flash and the request will be denied.

When access pre-select mode is active, the vehicle will automatically lower to Access ride height if the speed drops below 15 mph (25 km/h) within 65 seconds of the request being made. If the vehicle speed rises above 49 mph (80 km/h) after 'Access Pre-Select' mode is selected, or if it takes longer than 65 seconds to come to rest, access ride height will not be activated and the vehicle will remain at its current height.

### *Crawl Mode*

Crawl mode does not change the vehicle height, but inhibits manual height changes and allows the vehicle to be driven at a higher speed than in normal access mode.

Crawl mode is activated when the vehicle is at the access ride height and 'Hold' is selected. If 'Access Height' has been selected, but the air suspension ECU has not lowered the vehicle because the road speed is too high, when 'hold' is selected the 'Access Height' request is cancelled and the vehicle remains at standard ride height. The 'Hold' button remains active so that all automatic and manual height changes are disabled.

Crawl mode allows the vehicle to be driven at speeds up to 25 mph (40 km/h) without returning to the standard ride height. If the vehicle speed reaches 22 mph (35 km/h), a chime will sound from the instrument pack sounder and the message centre will display a 'SLOW DOWN' warning message. If the vehicle speed exceeds 25 mph (40 km/h), crawl mode is cancelled and standard ride height will become active automatically.

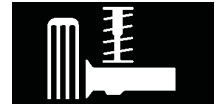
## **System Inhibits**

A number of conditions exist where a change in ride height is undesirable. To counter this, the air suspension ECU is programmed with a number of system inhibits. If any of the conditions detailed below exist, the air suspension ECU will suspend height changes and height corrections.

## **Compressor**

The temperature sensor located within the compressor protects the compressor from overheating. If the compressor temperature rises above set limits, the ECU will inhibit compressor operation. These limits are shown in the table below:

	<b>Filling Reservoir</b>	<b>Height Regulation</b>
<b>Stop</b>	100 °C (212 °F)	110 °C (230 °F)
<b>Start</b>	80 °C (176 °F)	105 °C (221 °F)



### **Compressor Timeout**

Compressor operation will be halted after 180 seconds of continuous operation. If the compressor was attempting to regulate vehicle height, it remains inhibited for 20 seconds. If the compressor was attempting to fill the air suspension reservoir, it remains inhibited for 180 seconds. These time out functions act as a further safe guard against over heating.

### **Cornering**

If the air suspension ECU registers a cornering force greater than 0.2g it will inhibit all height changes and corrections. The system will remain inhibited until the cornering force falls to less than 0.15g for 0.5 seconds. The air suspension ECU receives a message from the ABS sensor on the CAN Bus for the cornering force.

### **Rapid Acceleration**

If the air suspension ECU registers a rapid acceleration greater than 0.2g it will inhibit all height changes and corrections. The system will remain inhibited until the rapid acceleration falls to less than 0.2g for 1 second. Acceleration is calculated by the ECU from a vehicle speed signal received via the CAN bus.

### **Rapid Deceleration**

If the air suspension ECU registers a rapid deceleration smaller than  $-0.2g$  it will inhibit all height changes and corrections. The system will remain inhibited until the rapid deceleration rises above  $-0.2g$  for 1 second. Deceleration is calculated by the ECU from a vehicle speed signal received via the CAN bus.

### **Axle Articulation**

To avoid excess pressure differentials between different air springs, the air suspension ECU will inhibit all height changes and corrections if axle articulation is greater than 350 mm. The system will remain inhibited until axle articulation falls below 350 mm.

### **Vehicle Lift**

The air suspension ECU will inhibit all height changes and corrections if it detects all four corner heights are greater than 90 mm. This is interpreted as the vehicle being on a wheels free car lift with all wheels hanging freely. In this situation, the corner heights will not change when air is released from the air springs. The system will remain inhibited until any of the following conditions exist:

- All four corner heights fall below 90 mm
- The rotary switch is moved to the 'UP' or 'DOWN' position.
- Vehicle speed rises to greater than 25 mph (40 km/h) for longer than 3 seconds.

### **Vehicle Jack**

The air suspension ECU will inhibit all height changes and corrections if it detects a corner lowering too slowly for more than 3 seconds. This is interpreted as the corner identified as moving too slowly being supported on a jack. In this situation, the corner height will not change when air is released from the air spring because the jack acts as a mechanical prop. The system will remain inhibited until any of the following conditions exist:

- The height of the wheel identified as lowering too slowly, returns to the height where jacking was detected.
- The rotary switch is moved to the 'UP' or 'DOWN' position.
- Vehicle speed rises to greater than 25 mph (40 km/h) for longer than 3 seconds.

### **Door Open**

The air suspension ECU will stop all height change requests while any of the doors are open. Vehicle levelling is also inhibited with a door open.

### **Trailer Mode**

Using the electrical trailer connection will cause the air suspension to be set to standard height. If the vehicle is at any other height when the trailer is connected the air suspension will adjust to standard height and stay in that mode until the trailer is disconnected.

# SUSPENSION

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## **Diagnostics**

The air suspension ECM can store fault codes which can be retrieved using TestBook/T4. The diagnostics information is obtained via the diagnostic socket which is located in the fascia, in the drivers stowage tray. The socket is secured in the fascia panel and protected by a hinged cover.

The diagnostic socket allows the exchange of information between the various ECU's on the bus systems and TestBook/T4 or a diagnostic tool. This allows the fast retrieval of diagnostic information and programming of certain functions using TestBook/T4 or a suitable diagnostic tool.

## **Fault Detection**

The air suspension ECU performs fault detection and plausibility checks. Fault detection is limited to faults that the ECU can directly measure, as follows:

- Sensor hardware faults
- Valve hardware faults
- Sensor and actuator supply faults
- Bus failures
- ECU hardware errors.

Plausibility checks are checks on signal behaviour, as follows:

- Average height does not change correctly
  - Height changes too slowly
  - Suspension moves in the wrong direction.
- Reservoir pressure
  - Does not increase when reservoir filling requested
  - Does not decrease when reservoir used to lift vehicle
  - Does not decrease when reservoir is vented
  - Pressure varies too much when inactive.
- Compressor temperature
  - Increases when compressor inactive
  - Does not increase when compressor active.
- 'Energy' used to change height of corner
  - Too much 'energy' used – height change takes too long or long term filtered height does not reach target.
- Sensor activity
  - Signal floating
  - Inconsistent signal characteristics – signal on one side of axle is varying but other side remains static
  - Constant articulation when moving.

When a fault is detected, the ECU will attempt to maintain a comfortable ride quality with restricted functionality of the air suspension system.

The system functionality depends on the severity of the fault. The faults are defined as minor or major faults.

Minor faults are:

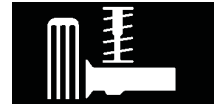
- Most sensor faults (hardware faults and plausibility faults)
- Cross link valve failure
- Reservoir valve failure.

For most minor faults, height changes are inhibited except for a return to standard height. If the suspension is not in standard height, the ECU will respond to a request for manual or automatic height change to return the vehicle to standard height. The ECU will continue to level the vehicle at the 'current' ride height.

Major faults are:

- Compressor faults
- Plausibility errors – for example:
  - Average height does not increase when lifting and the vehicle is moving. This could be caused by a compressor fault or a fault in the reservoir valve.
  - Reservoir pressure decreases when filling requested. This could be caused by a leak in the common gallery in the valve block or connecting pipe.

For major faults the ECU will not level the vehicle at the 'current' ride height. The ECU freezes height changes until it receives a manual or automatic request for height change. The ECU will return to standard height and freezes once standard height is achieved.



If the air suspension ECU loses information regarding vehicle speed, the ECU cannot determine if the current ride height is suitable for the vehicle speed. The ECU immediately returns to the 'default' height, which is 20 mm below the standard height. Once at the default height, the ECU will continue to level the vehicle at this height. A loss of the speed signal could be due to a fault in the CAN Bus or a fault in the ABS ECU. It is unlikely to be a fault in the air suspension ECU. It may, for example, be caused if the battery is disconnected and the steering sensor is not recalibrated immediately after reconnection. In this case a CAN Bus fault is recorded in the error memory. If this fault is seen, other ECU's using the CAN Bus should be also be checked for faults. When the fault is repaired, the air suspension ECU will resume full functionality but the CAN error remains in the memory.

If the suspension is above the standard height and the air suspension ECU cannot lower the suspension or cannot determine the vehicle height, all height changes will be frozen. The ECU will issue a message on the CAN Bus which is received by the instrument pack which displays a maximum advisable speed in the message centre of '35MPH'. an immediate 'freeze' of the vehicle height is caused by the following:

- Failure of more than one height sensor
- Implausible articulation symptoms detected
- Valve or solenoid failure (does not include reservoir valve)
- Stuck corner or whole vehicle (diagnosed using plausibility of the sensor inputs).

If the air suspension ECU has a hardware fault, the ECU will disable all air suspension functions. Detectable hardware errors include memory error, ECU failure, calibrations errors.

### ***Fault Messages***

The air suspension has two methods which it can use to inform the driver of a fault in the air suspension system; the air suspension control switch LED's and the instrument pack message centre.

When minor faults occur and the air suspension ECU is able to level the vehicle to the 'current' ride height, the control switch LED's will display the current ride height. When the vehicle returns to the standard ride height and further height changes are disabled, the 'HOLD' LED in the control switch will be permanently illuminated.

The air suspension ECU suffers a major failure and there is no air suspension control, all the control switch LED's will remain unlit.

If a fault occurs and the ECU can determine the ride height and the vehicle is not above standard ride height, the driver will be notified via a 'AIR SUSP. INACTIVE' message in the message centre. If the ECU cannot determine the height of the vehicle, or the vehicle is above standard ride height and cannot be lowered, the 'AIR SUSP. INACTIVE' message is accompanied with an alternating 'MAX 35MPH' message.

# SUSPENSION

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## Operation

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### General

Under normal operating conditions, the air suspension ECU keeps the vehicle level at the 'current' ride height. The incoming height signals from the sensors are passed through filters to remove irregular signals produced by road noise or other irregularities. When the vehicle is stationary or a height change is in progress, the signals are passed through a 'fast' filter, which tracks the true rate of change of height. When the vehicle is moving, the signals are passed through a 'slow' filter. The 'slow' filtered signals remove almost all road noise from the signals and output a true long term average for each corner height. The 'slow' filtered signals cannot be used to respond quickly during height changes.

The air suspension ECU monitors each corner height signal using the fast filtered signals if the vehicle is stationary or the slow filtered signals if the vehicle is moving. If the height remains in a 'dead band' which is  $\pm 10$  mm from the target height, the ECU does not implement any height adjustment changes. When the ECU detects that a corner has moved outside of the 'dead band', the ECU operates the compressor and/or the valves to raise or lower the corresponding corner(s) back into the target height.

When the engine is not running, the 'dead band' target height tolerance is increased to +20 mm and -25 mm. During 'wake-up', the tolerance band is  $\pm 20$  mm. In all cases, the ECU will bring the corner height as close as possible to the target height. The ECU monitors the rate of change of height of the corner signals to predict when to close the valve so that the target height is not overshoot.

### Reservoir

The reservoir supplies pressurised air to the four air springs, via the valve block, to enable the air suspension system to carry out ride height changes.

If an upwards height change request is made when the engine is not running, air pressure within the reservoir is used to lift the vehicle. If the pressure within the reservoir has dropped below 9 bar (130 lbf/in<sup>2</sup>) when an upwards height change request is made, the lift procedure is performed by the compressor. When the engine is started, the ECU runs the compressor to increase reservoir pressure to:

- 13.7 bar (199 lbf/in<sup>2</sup>), in systems without an external pressure relief valve
- 12 bar (174 lbf/in<sup>2</sup>), in systems with an external pressure relief valve



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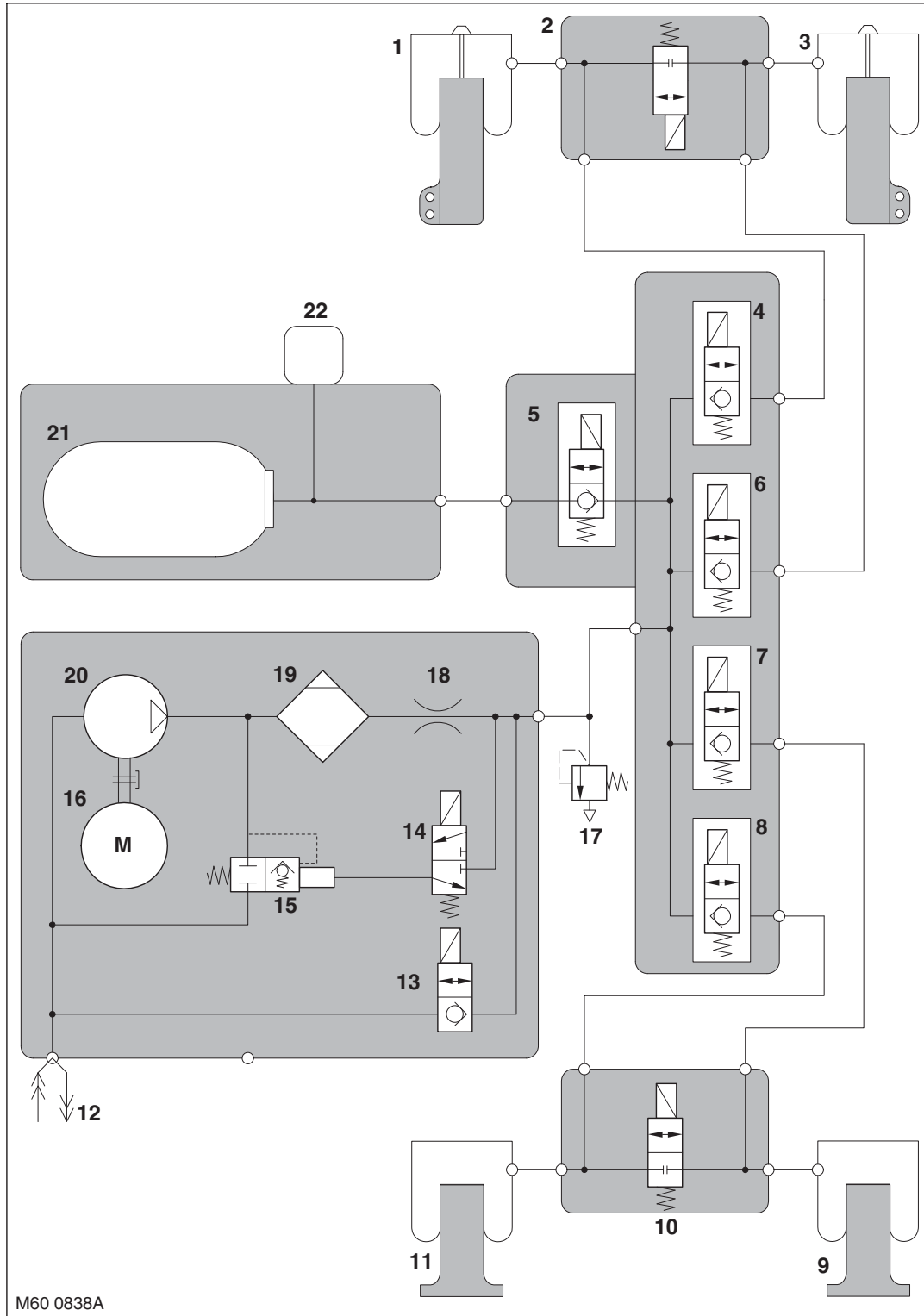
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# SUSPENSION

## System Pneumatic Circuit

The following schematic diagram shows the connection relationship between the air supply unit, the reservoir, the reservoir valve block, the cross-link valves and the air springs.

System Schematic Circuit Diagram





- 1 Front LH damper air spring
- 2 Front cross link valve
- 3 Front RH damper air spring
- 4 Front LH corner valve
- 5 Reservoir valve
- 6 Front RH corner valve
- 7 Rear RH corner valve
- 8 Rear LH corner valve
- 9 Rear RH air spring
- 10 Rear cross link valve
- 11 Rear LH air spring
- 12 Compressor inlet/exhaust port
- 13 HP pressure exhaust valve
- 14 Exhaust pilot valve
- 15 Pressure limiting valve
- 16 Electric motor
- 17 External pressure relief valve (where fitted)
- 18 Restrictor
- 19 Drier
- 20 Compressor
- 21 Reservoir
- 22 Pressure sensor

# SUSPENSION

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