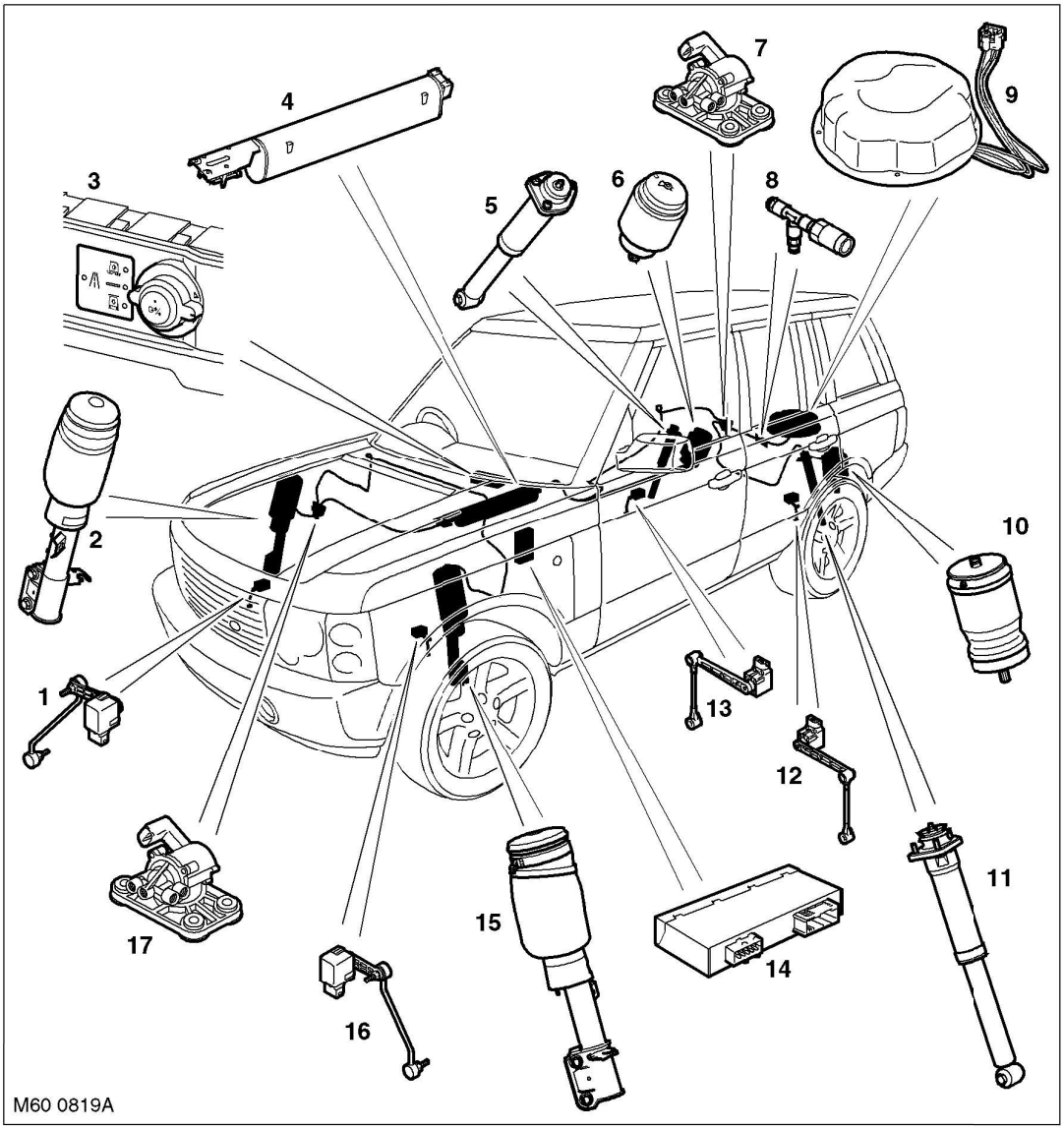
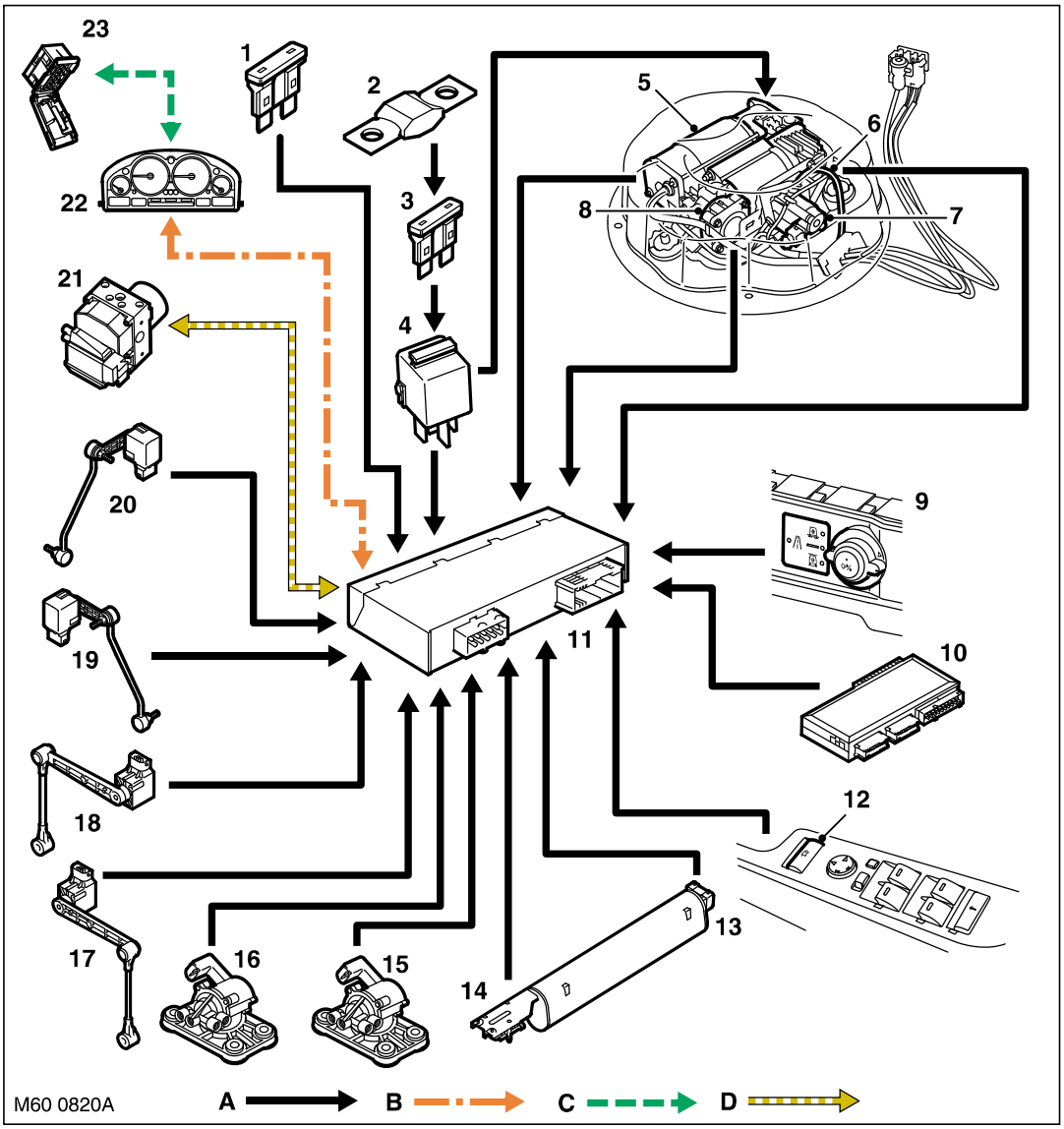
Suspension Component Location



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

Suspension Control Diagram



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

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

Description

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.

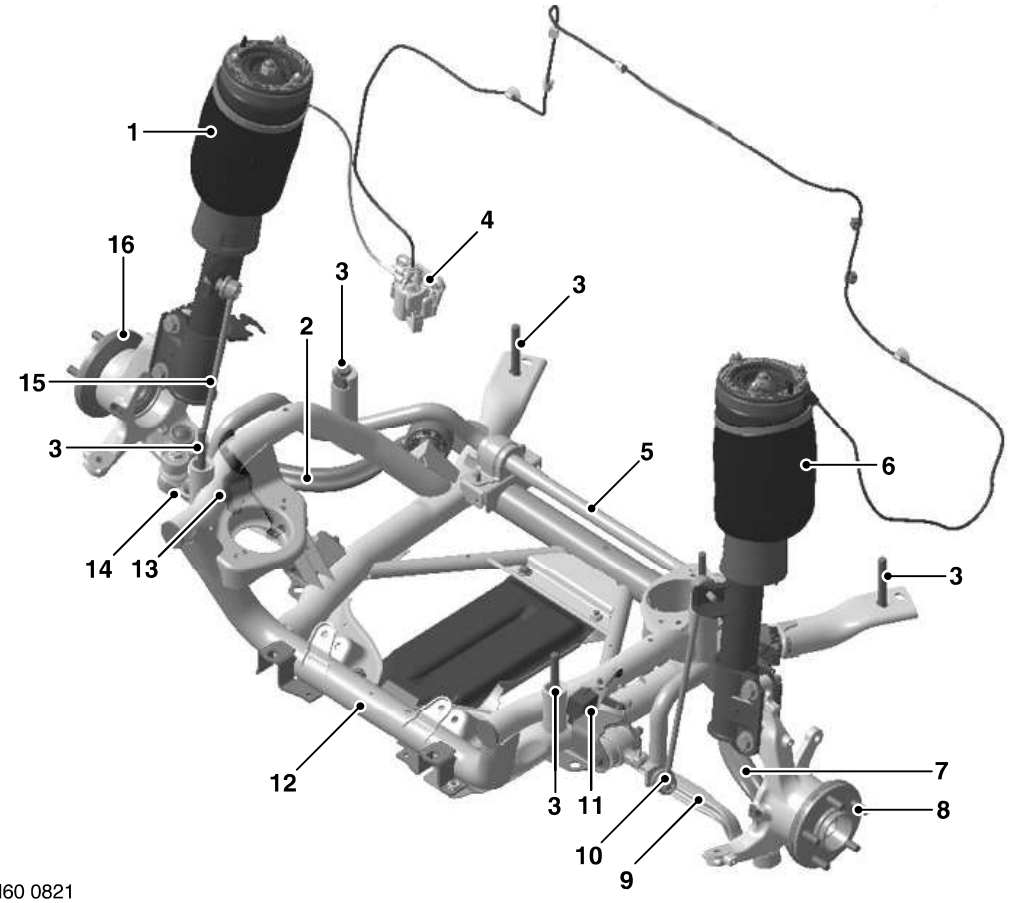
The following wheel travels are shown for on road and off-road vehicle operation. The difference between the two operating conditions is a result of operation of the front cross-link valve. When the cross-link valve is opened the suspension travel is as given for off-road wheel travel. When the cross-link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

Front Suspension Components



M60 0821

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

Transverse Link

The front suspension hub assembly is secured to the subframe via two suspension links. Each transverse link is fitted with a bush which is secured with a bolt between two brackets on the subframe. The opposite end of the transverse link is fitted with a ball joint which attaches to the hub assembly.

Compression Link

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

Hub Assembly

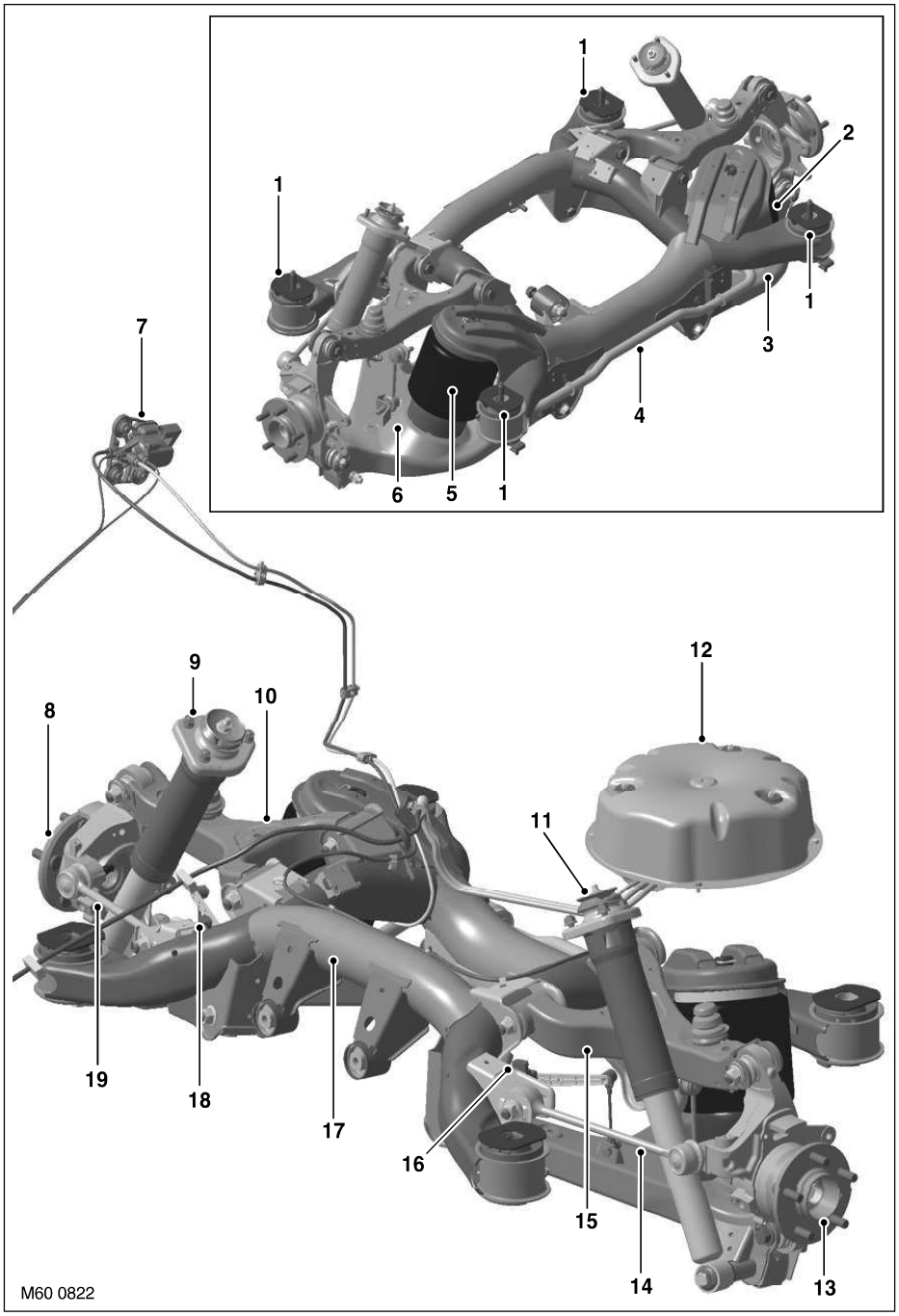
The hub assembly comprises a swivel hub, drive flange and bearing. A seal and bearing are fitted in the swivel hub and are secured with a circlip. The drive flange has the wheel studs attached to it and locates on the splined drive shaft and is secured with a stake nut.

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 compression link. A further tapered hole allows for the attachment of the transverse link 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.

Rear Suspension



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

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 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.

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:

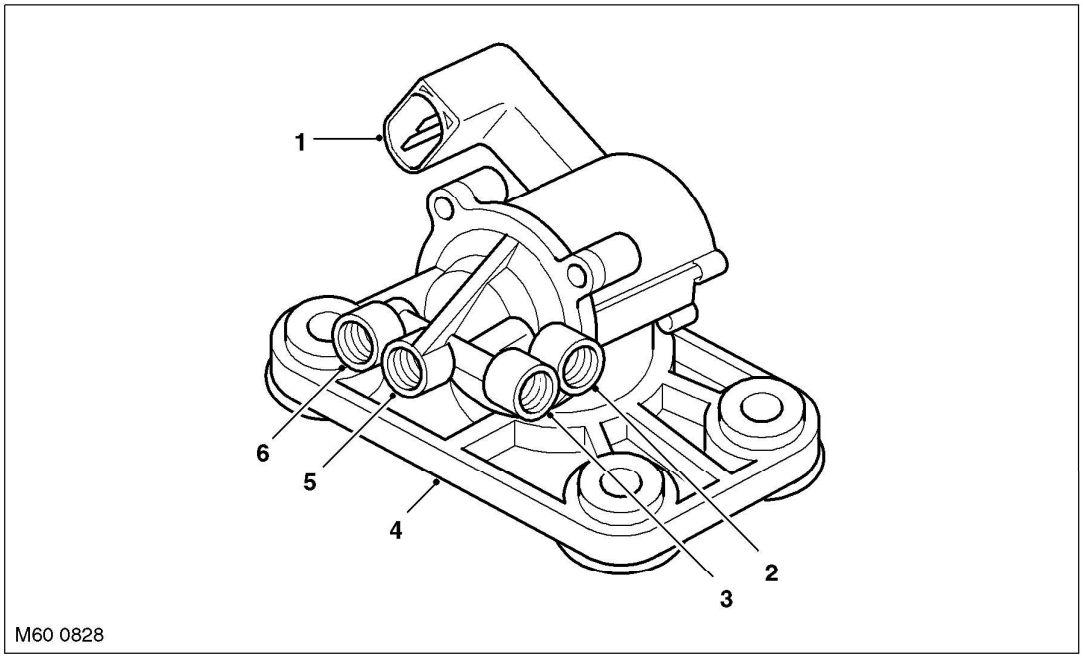
- Two front struts incorporating air springs
- Two rear air springs
- Two cross link valves
- An air reservoir, pressure sensor and valve block
- Four height sensors
- Air supply unit
- Air suspension ECU
- Air supply pipes
- External pressure relief valve (only on systems with a lower maximum operating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

	Front	Rear
Toe change	30 mins	10 mins
Camber change	90 mins	90 mins

Cross Link Valves



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