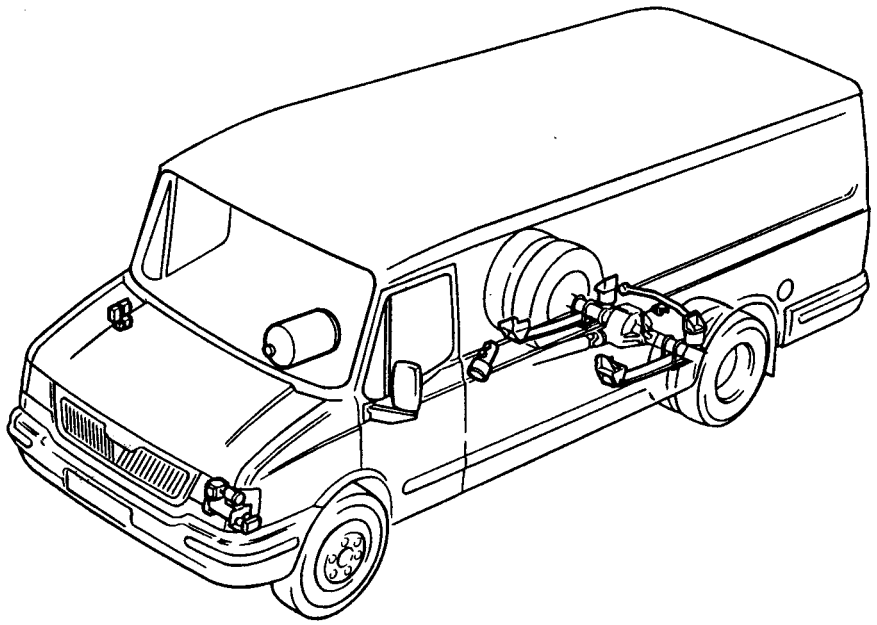
WORKBOOK SUPPLEMENT

Air Suspension ECAS 1B

(2nd edition)



CONTENTS

This supplement should be used in conjunction with Service Workbook 'Air Suspension' (Part No. DW 03906008)

Supplement Part No. DW03965102

INTRODUCTION

A revised and improved air suspension system (ECAS 1B) has been introduced on Convoy vehicles from VIN 23669.

The system can be most easily identified by the new compressor and valve block assembly located underbonnet, and the larger diameter air pipes elsewhere.

Features of the new system are:

- Larger diameter air pipes giving faster response times.
- Separate air harness, having formed pipe-ends to prevent seal damage, and indication to show that pipes are properly connected.
- Non-adjustable height sensor of advanced design.
- Handbrake cover, giving protection to the switch wiring.
- Improved sealing of electrical connections.
- More sophisticated Electronic Control Unit.
- Built-in safety protection to prevent compressor 'burn-out'.
- In-built diagnostics with blink light codes for faults.
- Preset ride height in the ECU, with self-calibration on the vehicle.

NOTE: None of the ECAS 1B components can be used on earlier systems, or vice versa.

IMPORTANT !

CAUTION: When jacking a vehicle fitted with air suspension, it is imperative that the rear axle is supported and NOT allowed to hang free.

WARNING: Depressurisation of the air tank does NOT depressurise the air system.

COMPONENT FUNCTION

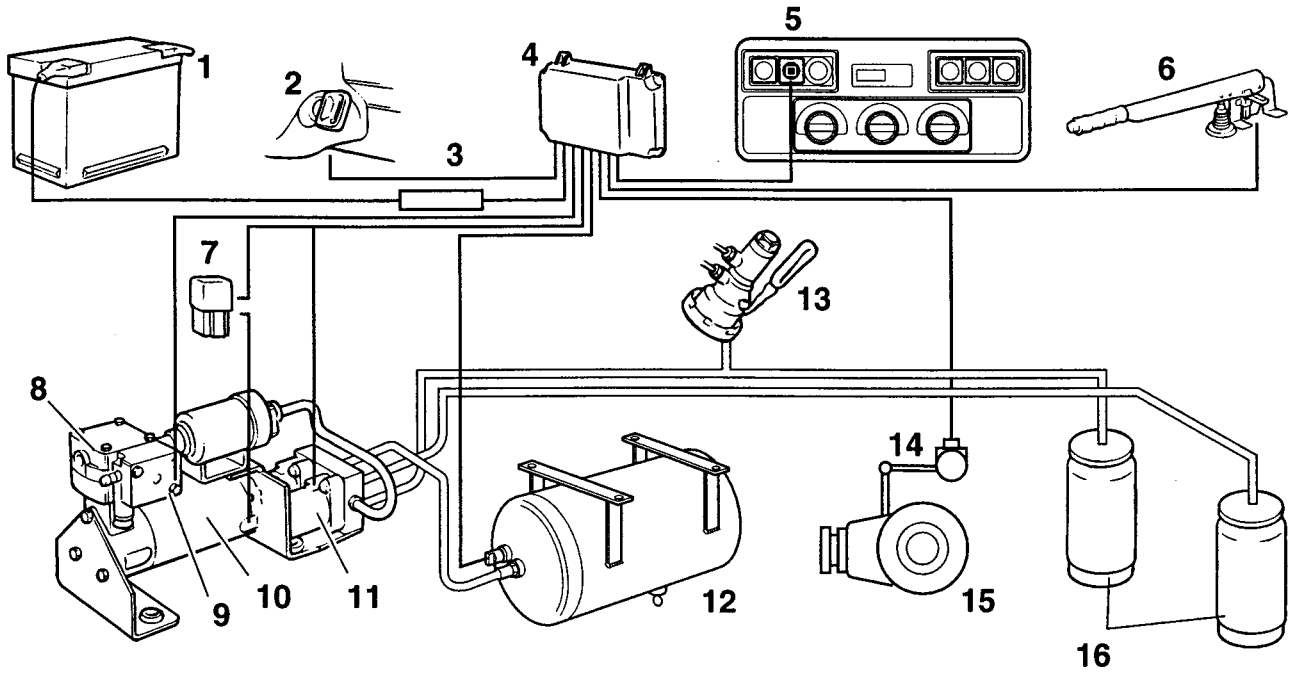


Fig.1 Air suspension system

1. Battery
2. Ignition switch
3. Fuse (Diesel)
   Circuit breaker (V8)
4. Electronic control unit (ECU)
5. Kneel switch
6. Handbrake
7. Compressor relay
8. Compressor
9. Down solenoid valve
10. Motor
11. Solenoid valve block
12. Air tank
13. Brake valve
14. Height sensor
15. Rear axle
16. Air springs

For the air suspension system to function, the individual components of the system must interact together. The components and their functions are described as follows.

Air Tank

A storage vessel for compressed air supply to the system. Located behind the right hand front door step, it connects to the air system by one pipe through which it can receive air for storage under pressure, and supply this stored air when required by the system.

The air tank also has a connection into the electrical system via its pressure switch.

A drain valve is fitted to the bottom of the tank to enable the air to be released when required for servicing of the system.

A threaded plug at the forward end of the tank can be removed to enable a pressure gauge to be fitted for fault diagnosis.

Compressor and Drier

A powerful electric motor drives a connecting rod and compressor piston via a crank. Air is drawn into the compressor, is compressed, passes through a drier and then into the solenoid valve block. When the vehicle is knelt, or the load removed, air is exhausted through the drier, and then to atmosphere via the down solenoid valve. Thus any water originally deposited in the drier is removed.

Solenoid Valve Block

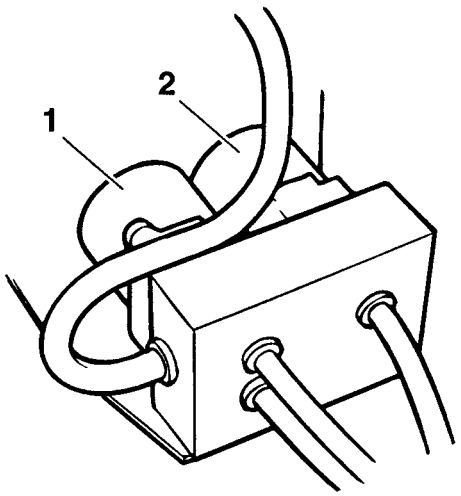


Fig. 2

1. Air spring solenoid valve
2. Air tank solenoid valve

The Solenoid Valve Block contains the Air Spring Solenoid Valve and the Air Tank Solenoid Valve, both under the control of the Electronic Control Unit (ECU).

The Air Tank Solenoid Valve is opened to allow air into the tank from the compressor, or out of the tank to the air springs.

The Air Spring Solenoid Valve is opened to allow air into the springs from the air tank (in conjunction with the tank solenoid) to raise the body. It is also opened (in conjunction with the 'down' solenoid) to exhaust air out of the springs, and lower the body.

Down Solenoid Valve

The Down Solenoid Valve is part of the compressor cylinder head. When operated, it releases air from the air springs to lower the vehicle's ride height in conjunction with the air spring solenoid valve.

The down solenoid valve can operate when the ignition is on or off.

Air Springs

The Air Springs are mounted immediately rearward of the rear axle, and secured to the suspension flexi-links and chassis frame. They support the vehicle, provided sufficient air pressure is available to them.

Height Sensor
The Height Sensor is a sealed electrical potentiometer which returns a voltage signal to the air suspension system Electronic Control Unit (ECU). The voltage varies relative to the vehicle's ride height; as the ride height increases, so does the voltage, and vice versa.

Electronic Control Unit (ECU)
The ECU monitors information from various points around the electrical system, and operates the Up and Down solenoids as required to keep the vehicle at its pre-determined ride height or 'kneel' height.

The ECU also determines when the air tank requires recharging, and controls the running of the compressor and operation of the solenoid valves to achieve this.

To prevent the system using large quantities of air to react to minor ride height changes when the vehicle is being driven, a delay of 12 seconds is built into the ECU before it will take action to correct any change in ride height.

Brake Valve
Because the vehicle ride height is always constant, a mechanical brake proportioning valve cannot be used. Therefore the brake valve is connected into the air spring circuit.

The greater the weight supported by the springs, the higher the air pressure in them, and vice versa. This variation in air pressure is applied to the brake valve, and is used to control the fluid pressure to the rear brakes and balance the front and rear brakes under varying load conditions.

Kneel Switch
The kneel switch is used in conjunction with the handbrake 'on' to kneel the vehicle. A light in the switch flashes to indicate height changes when the ignition is on.
The light is also used to signal a blink code, which indicates a fault in the system (see section 'Fault Blink Codes').

Kneel switch light – Flash 

– Blink 

The above is a brief description of the function of the main components in the air suspension system. The following describes how those and other components interact to operate the system.

SYSTEM OPERATION

To pressurise the system

Ignition 'ON'.

Signals to ECU are:

- Low air tank pressure (air tank pressure switch closed).
- Ride height low (information from height sensor).

Action taken by ECU:

- Switch on compressor.
- Open air tank solenoid valve.
- Open air spring solenoid valve.

Pressure will rise in the air springs and the air tank until the pressure in the springs is sufficient to start supporting the weight of the vehicle. The vehicle will rise. When the correct ride height is reached, the height sensor will signal the ECU accordingly. The ECU will then close the air spring solenoid valve.

The compressor will continue to pressurise the air tank via the air tank solenoid valve until sufficient pressure is built up to open the air tank pressure switch. This action signals the ECU to close the air tank solenoid valve and switch off the compressor.

If the air tank pressure drops below approximately 8 bar, the tank pressure switch will close, signalling the ECU to start the compressor.

To ensure that the compressor cannot overheat, it is switched off by the ECU after it has been running continuously for approximately 8 minutes. To re-start the compressor, switch the ignition off and back on; the compressor can now run for up to a further 8 minutes, or until air tank pressure reaches 10.5 bar +/- 0.5 bar.

NOTE: A thermal switch is fitted in the compressor motor to prevent overheating and possible burn-out. If the switch opens, this is sensed by the ECU which will stop the compressor automatically. The compressor will not re-start until it has fully cooled down.

When a load is added

The extra weight will compress the springs and lower the ride height; this lower height will be signalled to the ECU by the height sensor. If the ignition is off, the 'up' function will not operate.

If the ignition is on, after approximately 12 seconds the air tank solenoid valve and the air spring solenoid valve will be opened by the ECU. Air will pass from the tank to the springs to increase the volume of air in them, and the body will rise until the correct ride height is reached. The height sensor will signal this information to the ECU which will close the air tank and air spring solenoid valves.

When a load is removed

The reduced weight will cause the air springs to extend, and this higher ride height will be signalled to the ECU.

The ECU will open the air spring solenoid valve and the 'down' solenoid valve, to allow air to exhaust from the springs and lower the ride height. When the correct ride height is reached, the height sensor will signal the ECU to close the spring and 'down' solenoid valves.

NOTE: The 'down' function will operate whether the ignition is on or off.

To kneel the vehicle

- Apply the handbrake
- Press the kneel switch.

These two signals are sent to the ECU as follows:
- Applying the handbrake earths a cable from the ECU through the handbrake switch.
- Pressing the kneel switch earths a cable from the ECU through the kneel switch.

On receipt of these two signals, the ECU opens the air spring solenoid valve and the 'down' solenoid valve. The vehicle lowers until the height sensor signals the ECU that the kneel position has been reached; the ECU then closes the solenoid valves.

To raise the vehicle from the kneel position

- Apply the footbrake (if considered necessary)
- Turn the ignition to position 'II'.
- Fully release the handbrake.

These two signals are sent to the ECU as follows:
- Turning the ignition switch to position 'II' gives the ECU an ignition 'on' signal.
- Releasing the handbrake removes the earth from the cable between the ECU and the handbrake switch.

On receipt of these two signals, the ECU opens the air tank solenoid valve and the air spring solenoid valve; the vehicle then rises until the correct ride height is reached. This position is signalled by the height sensor to the ECU which closes the two solenoid valves.

The kneel switch light will flash while the vehicle is rising.

OPERATIONAL CHARACTERISTICS

The operational characteristics of the new system are the same as those listed in Service Workbook 'Air Suspension', page 12, except the entry 'Kneel feature; the ECAS1B system will 'kneel' whether the ignition is on or off.
NOTE: The kneel switch will not illuminate if the ignition is off.

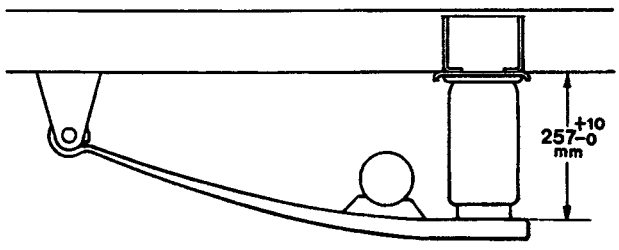
RIDE HEIGHT CALIBRATION

Kneel and standard ride height datums are programmed into the Electronic Control Unit (ECU) during manufacture, and the height sensor link rod is therefore no longer adjustable for length.

However, if a new ECU or height sensor is fitted, it will be necessary to carry out a calibration procedure to re-programme the system.
NOTE: If the battery should ever be disconnected when the ignition is not switched off, it will be necessary to re-calibrate the system. **(Always** lower the suspension to the kneel position **before** depressurising and / or disconnecting the electrics.)

Calibration procedure is as follows:

1. Apply handbrake.
2. Switch off ignition.
3. Remove system fuse (A7).
4. Press kneel switch and hold pressed.
5. Keeping kneel switch pressed, replace fuse A7.
6. Wait for vehicle to lower to bump stops.
7. Release kneel switch.
8. Turn ignition switch to position 'II'.
9. Vehicle will rise its calibrated ride height. The air spring height should be 257 mm (+10/-0 mm) as illustrated.
   NOTE: Before measuring ride height the vehicle must always be operated twice through the kneel cycle to overcome resistances in the system.



NOTE: During the above procedure, the kneel switch light will illuminate while the vehicle is lowering and rising when the ignition is in position 'II'. After completion:–

If calibration was successful – Light will extinguish.
If calibration was unsuccessful – Light will signal a blink code (see 'Blink Code' chart.)

FAULT BLINK CODES

A feature of the new air suspension system is in-built blink coding, signalled by the light in the kneel switch on the centre console (see note below). The number of blinks signalled will indicate the problem area (see blink code chart).

Priority: If more than one fault is present, only one fault can be signalled, as indicated by the priority numbers in the left hand column of the chart. Once that fault has been rectified, the light will then blink the next priority code.

Kneel switch light: When the ignition is switched on, the light will illuminate for 3 seconds; then:–

- If no fault present, light will go out.
- If fault(s) exist(s), light will blink the priority code. This will continue until the ignition is turned off and the fault rectified.

NOTE: The light in the kneel switch has two types of illumination as follows:

Flash – 

A regular on / off illumination to indicate height changes when the ignition is on.

Blink –  (Code 3 illustrated)

Light illumination which is faster and of a shorter duration than a flash. Used to signal fault codes when the ignition is on.

Blink Code Chart

NOTE: To assist rectification, use this chart in conjunction with the ECU Voltage chart in the section 'Fault Diagnosis'.

Priority	No. of blinks	Problem / Action
1	TWO	ECU. NOTE: The ECU may have failed as a result of a defect within the electrical circuit external to the ECU itself. It is essential therefore that the cause of failure is established prior to fitting a replacement ECU.
2	THREE	EEPROM (ECU). This indicates a problem within the memory of the ECU. Prior to fitting a replacement ECU, check all electrical circuits external to the ECU.
3	FOUR	HEIGHT SENSOR Check continuity of the wiring between the ECU and the height sensor connector. If OK, disconnect the height sensor and use an ohmeter to check the height sensor for continuity whilst moving its arm through the full arc.
4	SEVEN	SUPPLY VOLTAGE IS OUT OF LIMITS Check continuity of wiring between: – Battery and ECU via fuse A7. – Battery and ECU via fuse C2 and ignition switch. – ECU and battery negative (earth return).
5	FIVE	INCORRECT HEIGHT DUE TO A SOLENOID FAULT Check continuity of wiring and solenoids at each of the following: – Air tank solenoid valve. – Air spring solenoid valve. – Down solenoid valve. – Air leaks.
6	SIX	COMPRESSOR HAS RUN FOR 8 MINUTES Under normal operation the ECU will run the compressor for up to 8 minutes, after which it will switch off the compressor and signal this action using the blink code. To reset, switch the ignition off and back on. The compressor can now run for a further 8 minutes or until the system is fully pressurised. If frequent resetting is required, check the system for air leaks.
7.	ONE	CALIBRATION FAULT Re-calibrate (see section 'Self Calibration'). If the fault persists, check the system to establish its inability to calibrate.

FAULT DIAGNOSIS

If a fault develops, first check whether a blink code is displayed and, if so, refer to section 'Fault Blink Codes'. If there is no blink code, the Fault Diagnosis Chart (opposite) and the ECU Voltage Chart will be of assistance.

The Fault Diagnosis Chart assumes that the following items have been checked and are satisfactory:

- That an operational fault exists, by comparing performance against the Operational Characteristics listed in Service Workbook 'Air Suspension' page 12.
  NOTE: Ref. entry 'Kneel feature' on that page, the ECAS1B system will 'kneel' whether the ignition is on or off. (The kneel switch will not illuminate if the ignition is off.)
- Battery fully charged.
- No obvious damage to, and/or leaks from air pipes / connectors.
- Electrical wiring / connectors sound.
- No obvious damage to, and/or correct installation of components.

ECU Voltages

To aid diagnosis, voltages at the ECU can be established using a suitable digital voltmeter connected between a good body earth and the appropriate connector at the ECU plug. Make the tests with the ignition in position 'II'; and compare the readings with the values listed in the ECU Voltage Chart.

Reference to the Wiring Diagram will assist in establishing where a fault in the electrical system may be.

Fault Diagnosis Chart

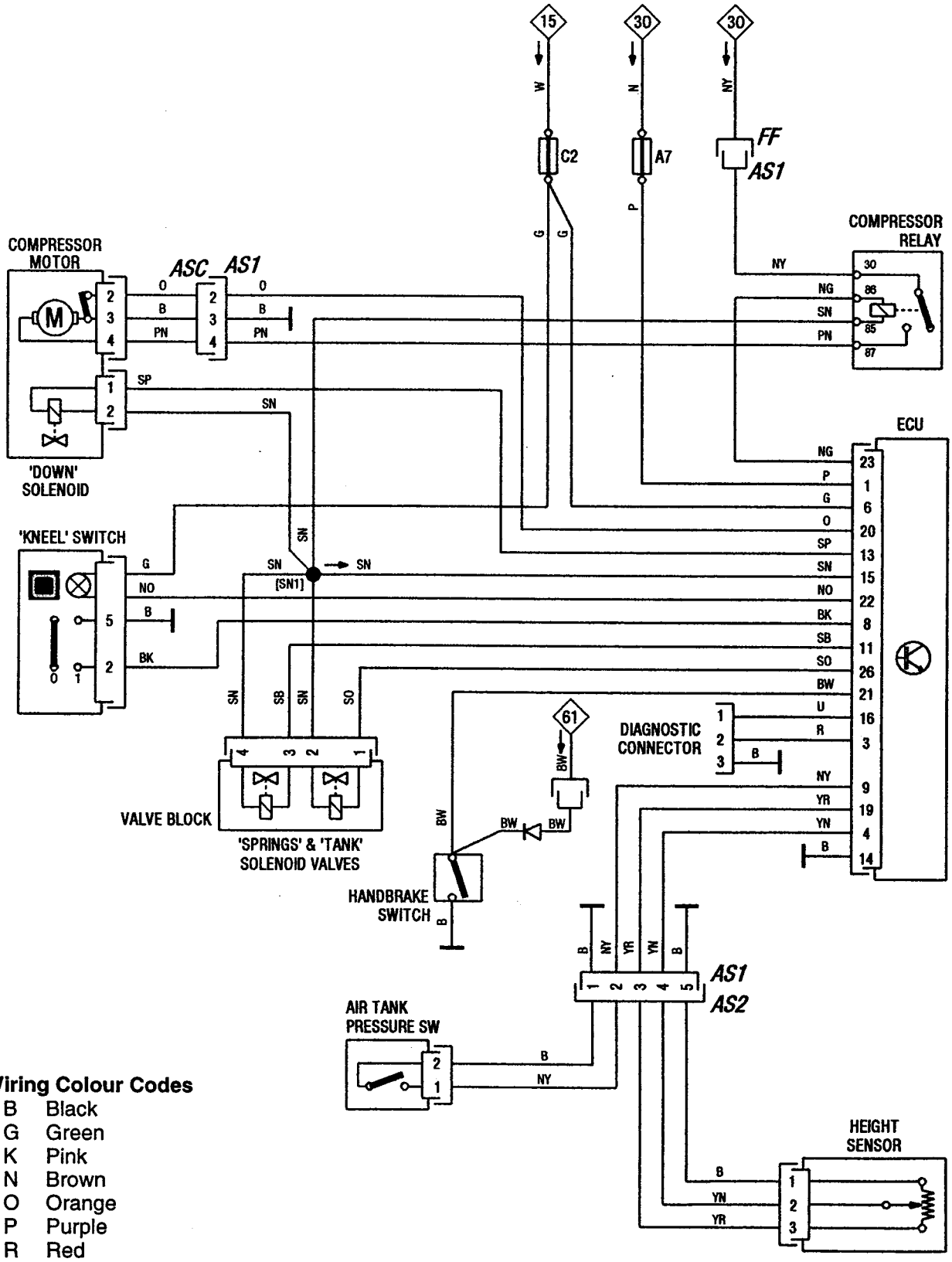
SYMPTOM														POSSIBLE CAUSES	DIAGNOSTIC ACTION		
Blink code	Unequal ride height side to side	Vehicle loses ride height while standing	Compressor will not run	Compressor will not stop (8 mins. max. run time)	Low ride height	High ride height	Vehicle will not kneel	Vehicle will not raise from kneel	Ride height fluctuates	Vehicle will not resume normal ride height (kneel not operated) when payload added	Vehicle will not resume normal ride height (kneel not operated) when payload removed	Vehicle will not resume kneel height with kneel operated and payload removed			Check electrical system	Check air system	Refer to section 'Fault Flash Codes'
			●		●		●	●	●	●			Ignition switch not in 'II' position				
			●										System already at operating pressure				
●			●										ECU has switched off compressor after 8 min.				●
							●						Suspension already in kneel position				
							●						Handbrake not applied				
								●		●			Handbrake not released				
	●			●	●	●	●	●	●				Mixed air pipes at valve block			●	
				●	●			●		●			Air tank pressure low			●	
●		●		●	●			●	●	●			Air leak(s)			●	●
●			●	●	●			●		●			Faulty air tank pressure switch	●	●	●	●
					●	●		●		●			Faulty air tank solenoid / wiring	●	●		
●			●		●			●		●			Faulty compressor (8 min. max. run time)	●	●	●	●
●			●		●	●	●	●	●	●	●	●	Battery(s) discharged / isolated	●			●
●			●		●	●	●	●		●	●	●	Failed fuse(s)	●			●
			●		●			●		●			Compressor circuit breaker tripped (V8) Compresr. power supply fuse failed (Diesel)	●			
●			●	●	●			●		●			Faulty compressor relay / wiring	●			●
●					●	●	●	●		●	●	●	Faulty air springs solenoid / wiring	●			●
●				●	●	●	●	●		●	●	●	Faulty down solenoid / wiring	●			●
●		●	●		●	●	●	●	●	●	●	●	Faulty height sensor / wiring	●			●
					●		●	●			●	●	Faulty kneel switch / wiring	●			
					●		●	●		●			Faulty handbrake switch / wiring	●			
●		●	●	●	●	●	●	●	●	●	●	●	Faulty ECU	●			●
●													System fault identified by ECU				●
●			●		●	●	●	●	●	●	●	●	Calibration fault				●

NOTE: The above fault diagnosis chart is not exhaustive and is for guidance only

ECU Voltage chart

ECU pin No.	Colour code	Function	Expected reading (with ignition in position 'II')
1	Purple	Battery power supply (fused)	Battery voltage
2	Not used		
3	Red	Diagnostic data output from ECU	5 V
4	Yellow/Brown	Height signal from height sensor	2.5 V approx. at normal ride height
5	Not used		
6	Green	Ignition switch power supply (fused)	Battery voltage
7	Not used		
8	Black/Pink	Regulated power supply to kneel switch	5 V (0 V if switch pressed)
9	Brown/Yellow	Pressure switch supply	5 V if air tank pressure switch contacts are open. 0 V if pressure in tank is below 8 bar approx.
10	Not used		
11	Slate/Black	Supply to air springs valve solenoid	0 V (battery voltage if solenoid operating)
12	Not used		
13	Slate/Purple	Power supply to down valve solenoid	0 V (battery voltage if solenoid operating)
14	Black	ECU earth return	0 V
15	Slate/Brown	Earth return paths for: - Air tank valve solenoid - Air springs valve solenoid - Down valve solenoid - Compressor relay windings	Approximately 0 V
16	Blue	Diagnostic data input to ECU	5 – 13 V
17	Not used		
18	Not used		
19	Yellow/Red	Regulated power supply to height sensor	5 V
20	Orange	Supply to compressor overload circuit	0 V (battery voltage if overload circuit operating)
21	Black/White	Supply to handbrake switch	0 V if handbrake applied Battery voltage if handbrake released
22	Brown/Orange	Supply from ignition switch via kneel switch lamp	Battery voltage (0 V if bulb lit)
23	Brown/Green	Supply to compressor relay	0 V (Battery voltage if compressor relay windings energised)
24	Not used		
25	Not used		
26	Slate/Orange	Supply to air tank valve solenoid	0 V (Battery voltage if solenoid is operating)

Wiring Diagram



Wiring Colour Codes

B	Black
G	Green
K	Pink
N	Brown
O	Orange
P	Purple
R	Red
S	Slate
U	Blue
W	White

AIR PRESSURE TESTS

Equipment required: Pressure indicator 0 - 12 Bar (minimum) (0 - 175 psi) from test kit 1237469 and suitable adaptor.

Test procedure

1. Kneel the vehicle.
   Switch off the ignition.

2. ⚠ **WARNING: Wear protective ear muffs, goggles and gloves.**
   Depressurise air tank by pulling ring on drain valve until all air is exhausted.

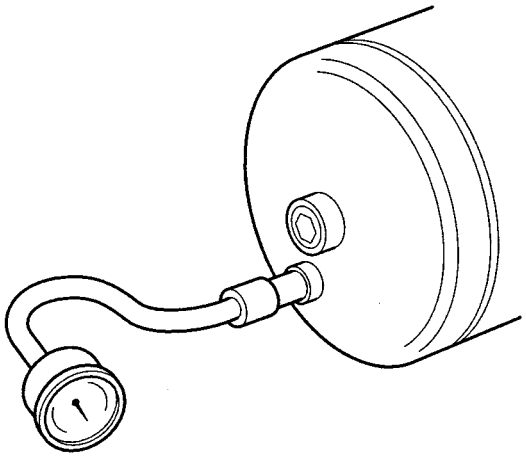


Fig.1 Connecting pressure indicator

3. Remove smaller plug at forward end of air tank and connect pressure gauge.

4. Chock road wheels, release handbrake and, if engine is to be run, select neutral gear.

5. If battery is in poor condition engine may be started, otherwise switch ignition to position 'II'.
   Check that the compressor operates. If not, check the electrical system.

6. While compressor is operating, observe pressure in air tank which should increase until compressor cuts out.
   NOTE: ECU will switch off compressor after 8 minutes. As the system can take longer than 8 minutes to charge from empty, when the compressor cuts out: – switch the ignition off and then on again. The compressor will restart if air tank pressure is still low.

7. Continue until compressor cuts out.
   To check that system has reached full pressure, switch ignition off and on again, and check that compressor does not restart.
   NOTE: A thermal switch is fitted in the compressor motor to prevent overheating and possible burn-out. If the switch opens, this is sensed by the ECU which will stop the compressor automatically. The compressor will not re-start until it has fully cooled down.

8. Switch off ignition.
   Leave ignition turned off.

9. Record pressure reading on gauge.
   Pressure in air tank should read 10.5 ± 0.5 bar.
   If satisfactory, proceed to operation 10.

9a If pressure is much above 11 bar, check for faulty pressure switch or associated wiring.

9b If pressure is low and compressor has cut out, check for:
   - A faulty pressure switch.
   - Incorrect down solenoid valve operation.

10. Apply handbrake and remove fuse A7.

11. Measure and record ride height 'X on both sides of vehicle (see fig 2).

12. Leave vehicle for at least 30 minutes, or until ride height or air pressure is seen to drop

13. If ride height or pressure decreases, then suspect an air leak.
Carefully check for signs of damage or abuse to any component (see fig.3), especially the air harness and the connections.

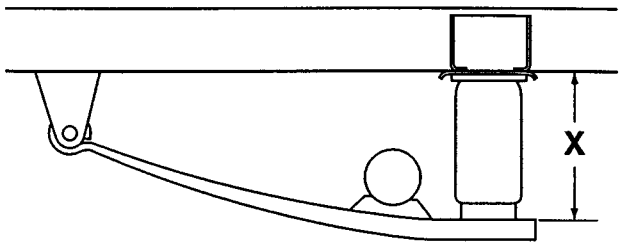


Fig.2 Checking ride height

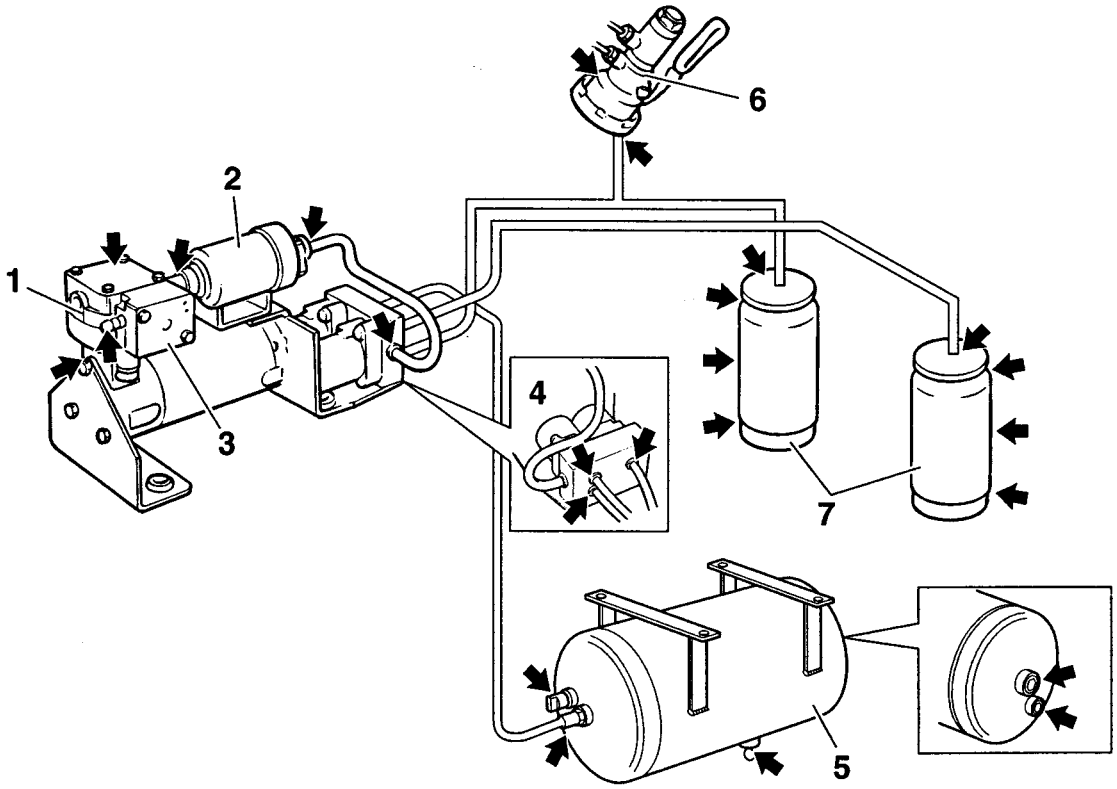


Fig.3 Air system potential leak points (arrowed)

1. Compressor
2. Air drier
3. Down solenoid valve
4. Solenoid valve block
5. Air tank
6. Brake valve
7. Air springs

14. Air leaks can be detected by liberal application of soapy water at suspected point, but it should be noted that air bubbles sometimes cannot be detected if pressure is high. If so, reduce the system pressure and re-check.

(continued....)

15. Refit fuse A7.
If an air leak has been detected, proceed as follows:

Air leak rectification

WARNING: Do not attempt to disconnect any air pipe or unit while the system is pressurised.

16. Kneel vehicle and depressurise system (see 'Depressurising the Air System').

17a. If leakage occurs at junction of a pipe and its connector:

- Disconnect air pipe (see 'Disconnection / Refit of Air Pipes').
- Remove connector sleeve and 'O' rings.
- Thoroughly clean pipe end and connector components, and carefully inspect for damage or distortion. Renew as necessary. **NOTE:** If pipe is damaged, it must be replaced as a complete harness.
- Lubricate connector seals with silicone type grease and reassemble connector.
- Lubricate pipe end with silicone type grease and refit correctly to connector (see 'Disconnection / Refit of Air Pipes').
- Recharge the system.
- Check that fault has been rectified.

17b. If leakage occurs from solenoid valve block, complete valve block must be replaced as an assembly.

DEPRESSURISING / PRESSURISING THE AIR SYSTEM

Depressurising

1. Chock road wheels.

2. To kneel vehicle:
   - apply handbrake,
   - press kneel switch.

3. **WARNING: Wear protective ear muffs, goggles and gloves.**
Pull ring on air tank drain valve until all pressurised air in tank is exhausted.

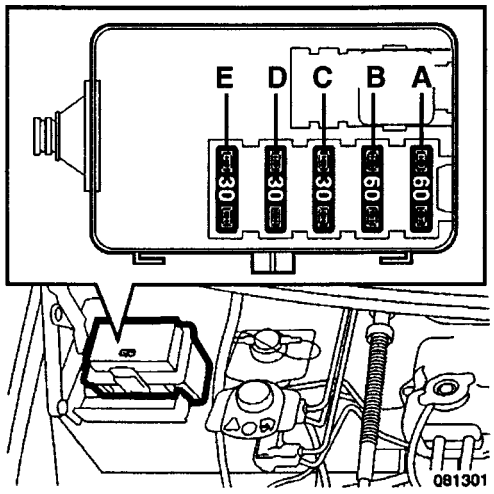


Fig.1 Supplementary fuse box
A. Main power supply
B. Main power supply
C. Electric cooling fan (if fitted)
D. Optional auxiliaries (if fitted)
E. Air suspension compressor

4. Remove compressor power supply fuse (V8 engine: trip power supply circuit breaker – alongside fuse box).

5. **WARNING: Ensure fingers etc. cannot be trapped.**
Pressure still remains in air springs, depressurise them as follows:
   - switch ignition to position 'II',
   - release handbrake,
   - pull ring on air tank drain valve until body settles on bump stops .

Pressurising

6. Switch off ignition and refit power supply fuse (V8 engine: reset circuit breaker).

7. Switch on ignition. Compressor will run to pressurise the system.
   NOTE:
   1: ECU will switch off compressor after 8 minutes. As the system can take longer than 8 minutes to charge from empty, when the compressor cuts out switch the ignition off and then on again. The compressor will re-start if air tank pressure is still low.

   2: A thermal switch is fitted to the compressor motor to prevent overheating and burn-out. If the switch opens, the compressor will be turned off automatically for 3 minutes.

   However the switch can be re-set manually before this time limit by switching the ignition off, and back on again.

DISCONNECTION / REFIT OF AIR PIPES

1. ⚠ **WARNING: Depressurisation of the air tank does not depressurise the total air system.**
   Depressurise the system (see 'Depressurising the Air System).

2. **CAUTION: Never grip pipes with pliers or any handtool as this will damage the finish and cause a leak.**
   To disconnect a pipe, press brass clutch ring inwards (towards body of connector), and at the same time pull gently on the pipe.

3. To refit:
   a. Ensure pipe end is clean.
   b. Lubricate external diameter of pipe end with silicone type grease.
   c. Carefully push pipe end squarely into connector, ensuring it is fully home to the indicator.

VALVE BLOCK CONNECTIONS

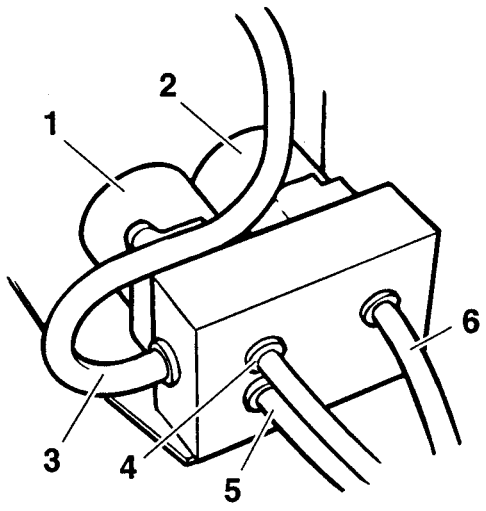


Fig.1 Valve block
Valve Solenoids:
1. Air spring valve solenoid
2. Air tank valve solenoid

Air Pipe Connections:
3. Compressor
4. Right hand air spring (red)
5. Left hand air spring (blue)
6. Air tank