Section C

Heating, Ventilation and Air Conditioning

(HVAC)

This Section Refers to Cars from

Chassis (VIN) SCAZSOOOOACH01001
to Chassis 16930.

1980 to September 1986

Discrete Component Controlled Climate Control

Issue record sheet 1

March 1984

The dates quoted below refer to the issue date of individual pages within this chapter.

Sections	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Page No.										
Contents						Mar 84				
1	Jan 81	Jan 81	Jan 81			Jan 81	Apr 81	Apr 81	Apr 81	
2		——	Jan 81			Jan 81				
3		Jan 81	Jan 81			Jan 81	Apr 81			
4		Jan 81				Jan 81	Apr 81			
5		Jan 81				Jan 81	Apr 81			
6		——				Jan 81	Apr 81			
7						Jan 81	Apr 81			
8						——	Apr 81			
9						Jan 81	Apr 81			
10						——	Apr 81			
11						Mar 84	Apr 81			
12						——	Apr 81			
13						Mar 84	Apr 81			
14						——	Apr 81			
15							Apr 81			
16							Apr 81			
17							Apr 81			
18							Apr 81			
19							Apr 81			
20										
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										
31										
32										
33										
34										
35										
36										
37										
38										
39										
40										
41										
42										
43										
44										
45										
46										
47										
48										

Printed in England

Air conditioning system

Printed in England

Printed in England

Chapter C

Issue record sheet 2

March 1984

The dates quoted below refer to the issue date of individual pages within this chapter.

Section	C1	C2	C3	C4	C5	C6	C7					
Page No.												
49							Sept 78					
50							Sept 78					
51							Sept 78					
52							Sept 78					
53							Dec 78					
54							Dec 78					
55							Sept 82					
56							Sept 82					
57							Dec 78					
58							Dec 78					
59							Mar 84					
60							Mar 84					
61							Dec 78					
62							Dec 78					
63							Dec 78					
64							Dec 78					
65							Dec 78					
66							Dec 78					
67							Dec 78					
68							Dec 78					
69							Dec 78					
70							Dec 78					
71							Dec 78					
72							Dec 78					
73							Dec 78					
74												
75												
76												
77												
78												
79												
80												
81												
82												
83												
84												
85												
86												
87												
88												
89												
90												
91												
92												
93												
94												
95												
96												

Precautions

Danger – Exhaust gases

Sitting in a car that is in a confined space with the engine running is dangerous. Operating the air conditioning unit will increase this danger.

First aid – Refrigerant burns

If the skin is injured by refrigerant it should be bathed with clean cold water and medical attention sought immediately. Do not apply any localised heat or hot dressings, etc.

An eye injured by refrigerant must be immediately washed with clean cold water. The eye must not be rubbed as this will aggravate the injury.

A doctor should be consulted as soon as possible after administering emergency treatment.

General precautions

Before commencing work on the electrical system or components it is recommended that the battery master switch (situated in the luggage compartment) be turned off.

If the battery has to be left connected for any reason the gear range selector lever must be placed in the Park position and the gearchange isolator and ignition key removed.

The battery master switch must not be operated whilst the engine is running.

Short circuiting or reverse polarity will cause immediate and permanent damage to the electronic components.

It is important that no 'live' connections or disconnections are made where fuel vapour or other inflammable materials are present.

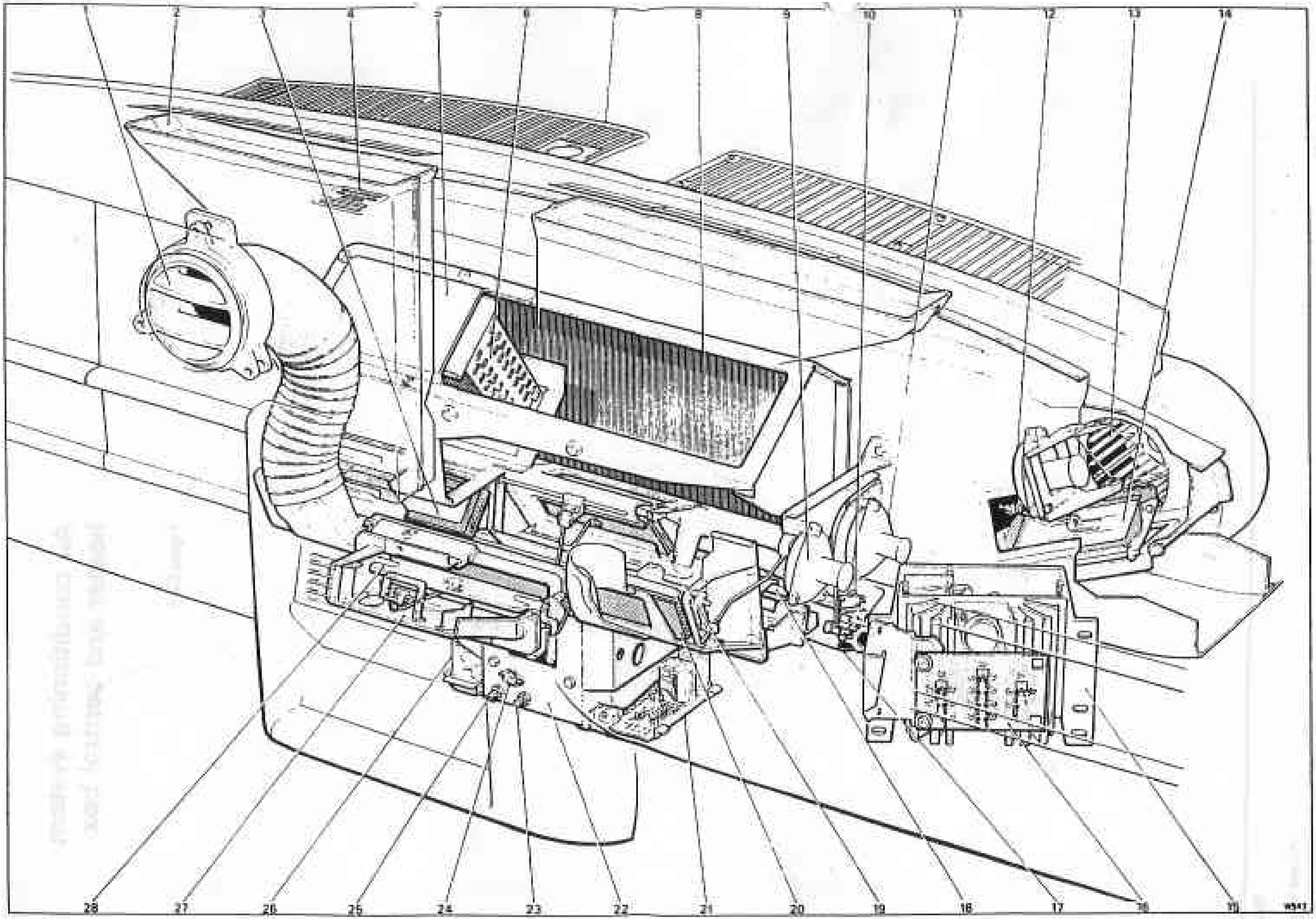
Where reference is made in this Chapter to the use of voltmeters or continuity testers never use generator type meters.

Section C2

Refrigeration unit
Contents

Air conditioning system heater and control box

Figure C2-1


2
3
4
5
6
7
8
9
10
11
12
13
14
28
27
26
25
24
23
22
21
20
19
18
17
16
15
W541

Introduction and basic operation

Introduction
The basic function of the air conditioning system is to automatically maintain selected temperatures of the upper and lower levels of the car interior, regardless of climatic conditions.

Basic operation (see fig. C2-3)
One of the features of the air conditioning system is that all air entering the system is dehumidified and cooled. This is done by passing the air through the refrigeration evaporator matrix before it enters the heater and control box assembly.

The upper and lower systems operate independently, each system having its own air temperature sensor chain, temperature selector, servo mechanism, blend flap and electronic circuitry.

The heater and control box supplies hot and cold air to the two independent ducting systems. The upper system delivers air to the windscreen demister outlets, circular facia outlets and the rectangular facia outlet. The lower system delivers air to the lower outlets in both the front and rear compartments of the car.

Fig. C2-1 Air conditioning system heater and control box
1 Circular facia outlet (1 of 2)
2 Windscreen demister outlet
3 Upper system air blend flap (1 of 2)
4 Solar sensor
5 Heater box
6 Heater matrix
7 Ambient air intake
8 Refrigeration matrix
9 Windscreen/facia mode change actuator
10 Lower quantity flap micro-switch
11 Lower quantity flap actuator
12 Recirculation actuator (1 of 2)
13 Fan motor (1 of 2)
14 Recirculation flap (1 of 2)
15 Fan speed module and voltage stabilizer
16 Air conditioning diode board
17 Lower quantity footwell outlet
18 Lower quantity flap
19 Lower system air blend flap
20 Windscreen/facia mode change flap
21 Upper system servo module
22 Servo assembly
23 Upper servo trimming potentiometer
24 Servo assembly test socket
25 Lower servo trimming potentiometer
26 Lower system servo module
27 Rectangular facia outlet
28 Rectangular facia outlet control flap

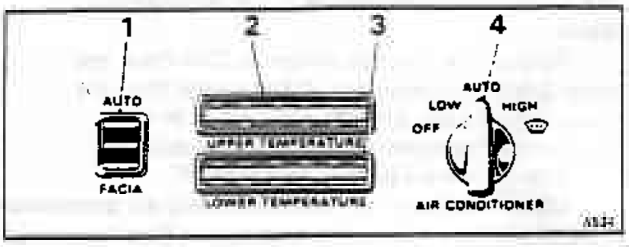


Fig. C2-2 Air conditioning control panel
1 Upper system override (AUTO/FACIA) switch
2 Upper temperature selector (optimum setting)
3 Lower temperature selector (optimum setting)
4 Air conditioner control (function) switch

Contained in each ducting system is an air temperature blend flap. The position of which determines the ratio of hot and cold air required to achieve the pre-selected temperatures. The blend flaps form the basis of the air conditioning system, each flap being operated by an electro-mechanical servo controlled by its servo module (see fig. C2-1).

Each servo module collects information in the form of temperature related current signals provided by temperature sensors from various parts of the car. The module then compares actual in-car air temperature with the pre-selected required temperature and then operates the servo to position the air temperature blend flap. This achieves the required In-car temperature.

The air conditioning system also includes a coolant tap (mechanically operated in conjunction with the lower servo mechanism), two air recirculation flaps, a windscreen/facia mode change flap and a lower air quantity flap. These are operated by electrical actuators upon signals related to servo positions.

A rear window demister is incorporated into the system. The demister element is automatically switched on whenever the car is being heated, this being the only time that misting or ice formation is likely to occur.

Two fans, controlled by an electronic fan speed control unit, are used to boost the input of air to the system.

Driver's controls

The driver's controls comprise four switches situated on the air conditioning control panel (see fig. C2-2). Also three manually operated air flow controls situated on the facia.

The function and operation of these controls is as follows.

Printed in England

Air conditioner (function) control (see fig. C2-2)
The air conditioner (function) control is a five position rotary switch marked OFF, LOW, AUTO (automatic), HIGH and (defrost).

The function of the air conditioning system in each switch position is as follows.

OFF The air conditioning system is switched off and ambient air is prevented from entering the car as the recirculation flaps will be in the recirculation position.

Turning the function switch to OFF from any other position immobilises all flaps other than the recirculation flaps, which if not already in the recirculation position will move to that position.

The fan motors are also switched off.

LOW The system provides automatic air temperature control with the fan motors running at a fixed low speed.

AUTO The system provides automatic air temperature control. The fan speed automatically varies in relation to servo position. Maximum fan speed is not attainable in this position.

HIGH The system provides automatic air temperature control. The fan speed automatically varies in relation to servo position. Maximum fan speed is attainable

(defrost). The system shuts off the supply of air to the lower outlets and all available heat is directed to the windscreen outlets.

The fan motors operate at maximum speed even if the engine coolant is cold and heated air is not available.

Temperature selector controls (see fig. C2-2)
Any in-car air temperature between 17°C and 33°C can be independently selected for the upper and lower levels of the car interior using the UPPER TEMPERATURE and LOWER TEMPERATURE selectors respectively. The selected temperatures will then be automatically maintained within the limitations of the system.

Upper system override (AUTO/FACIA) switch (see fig. C2-2)
When the air conditioning system is functioning automatically and air is being directed to the windscreen demister outlets the driver may, if he prefers, direct the air to the facia outlets by momentarily pressing the override switch to the FACIA position.

To cancel the override facility and return the system to automatic control, press the switch to the AUTO position.

The override facility will also be cancelled when the ignition is switched off.

Manually operated flap controls (see fig. C2-1)
Three manually operated controls are provided to direct and regulate the flow of air from the upper system facia outlets.

When the system is providing air to the facia outlets the two circular outlets can be swivelled to direct the flow of air as required. The rectangular facia outlet admits air into the car when the flap control lever is pressed down.

Fig. C2-3 Airflow and system control

1 Solar sensor
2 Cantrail sensor
3 Upper system ambient sensor
4 Servo assembly
5 Air conditioning control panel
6 Lower system ambient sensor
7 Knee roll sensor
8 Fan speed module and voltage stabilizer
9 Windscreen demister outlets
10 Windscreen/facia mode change flap
11 Circular facia outlets
12 Rectangular facia outlet
13 Lower system footwell outlets
14 Lower quantity flap
15 Coolant tap
16 Recirculation flaps
17 Fan motors
18 Ambient air intakes
19 Refrigeration matrix
20 Heater matrix
21 Upper system air blend flap
22 Lower system air blend flap

A Lower sensor chain
B Upper sensor chain
C Ambient air
D Recirculated air
E Refrigerated air
F Heated air
G Warm air

Section C2

Refrigeration unit

Description (see Fig C2)
The refrigerant (Refrigerant 12) is circulated by a compressor which is driven from the engine crankshaft by twin 'vee' belts. An electro-magnetic clutch is incorporated in the compressor that is energised in the engaged position at all times when the engine is running except when the ambient temperature is below 0°C.

High pressure vapour is pumped from the compressor to the condenser matrix where it condenses from vapour at the top of the matrix to a liquid at the bottom of the matrix. The liquid passes to a receiver/drier which absorbs any traces of moisture that may be present and it also ensures that the refrigerant passes to the expansion valve in liquid form.

A sight glass on the drier enables the refrigerant to be inspected whilst the system is operating when a steady flow of liquid should be observed. If bubbles or foam can be seen it usually indicates incorrect operation of the system or insufficient refrigerant, however it is normal for some foaming to show when the ambient air temperature is below 21 °C. The refrigerant is pumped to the expansion valve which controls the flow of refrigerant to the evaporator. To achieve this, the temperature in the evaporator outlet pipe is sensed by a phial attached to the outside of the pipe and the pressure in the pipe is sensed by an equaliser line connected to the suction throttling valve.

When the refrigerant enters the evaporator, heat is transferred from the air passing through the evaporator to the refrigerant causing the refrigerant to evaporate, thereby cooling the air.

From the evaporator, the refrigerant (which is now a low pressure vapour) passes to the suction throttling valve which 'throttles' the refrigerant flow to maintain a constant pressure within the evaporator regardless of the compressor speed or evaporator loading. The refrigerant then passes to the compressor as a low pressure vapour.

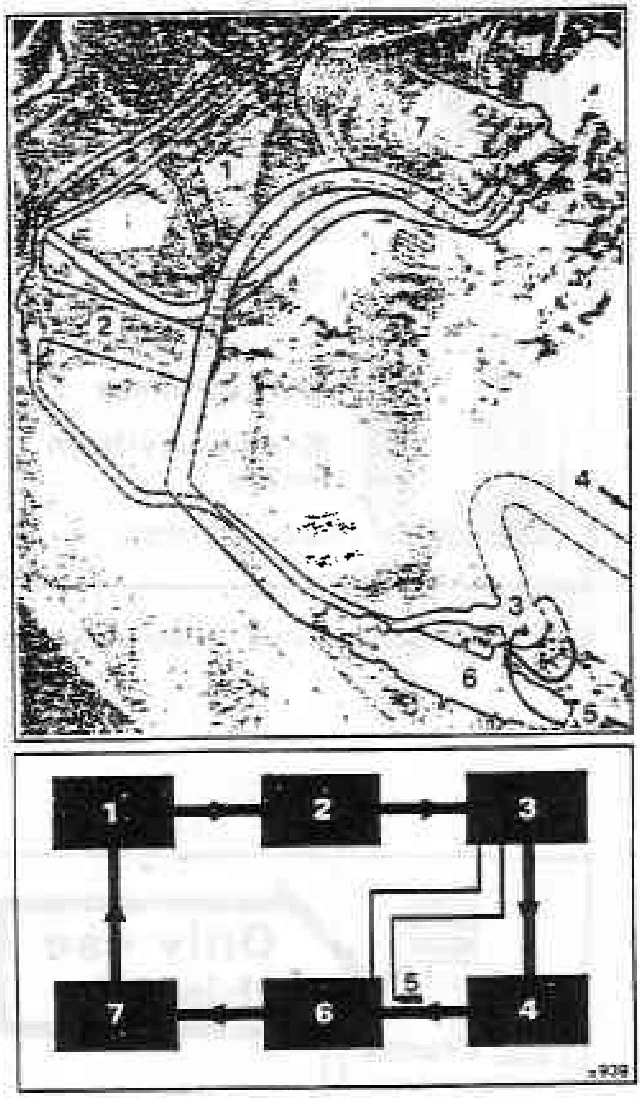


Fig. C2 **Refrigeration component layout**
1 Condenser matrix
2 Receiver/drier
3 Expansion valve
4 Evaporator matrix
5 Sensor
6 Suction throttling valve
7 Compressor

Refrigeration special precautions & accident damage

Handling the refrigerant

The refrigerant used in the air conditioning system is dichlorodifluoromethane (internationally known as Refrigerant 12) and is usually supplied to the Service network as a liquid under pressure in either disposable containers or metal drums, dependent upon the quantity ordered.

If it is correctly handled the refrigerant is perfectly safe, however if incorrectly handled it can cause serious injury or damage. In particular, smoking in the region of exposed refrigerant can be a health hazard. The following elementary safety precautions should be adopted when handling refrigerant:

1. If the drum has a metal cap, always ensure that the cap is fitted when not in use.

2. Do not carry refrigerant in the passenger compartment of a car, always place the drum in the luggage compartment.

3. If a drum is to be transported or stored,always shield it from the direct rays of the sun. (The sun's heat could increase the pressure within the drum sufficiently to activate the safety valve causing the refrigerant to escape.)

4. A drum must not be overfilled because the increased pressure can cause the drum to explode before the temperature rises to a point where the temperature safety valve is activated.

5. Do not subject the drum to high temperatures when charging the system. The drum must not be placed on a radiator or stove, neither must a blow-lamp be used for heating the drum.

To heat the drum when charging, the drum should be immersed in warm water which must not exceed 51°C.

6. Do not discharge the refrigerant where there is an exposed flame or where it can be drawn into the engine air intake. Concentrations of this refrigerant in contact with a flame can produce a poisonous gas.

7. Do not discharge the refrigerant in a confined space because it will displace the air which could result in suffocation.

8. Always wear goggles when carrying out work which involves the use of refrigerant or when opening any of the lines. If an accident occurred and refrigerant struck the face, goggles would protect the eyes and therefore reduce the risk of serious injury.

9. Excessive heat applied to any section of the refrigerant lines will create excessively high pressures, therefore welding should not be carried out on any part of the car adjacent to the refrigerant units or lines.

Accident damage (refrigerant)

It is essential that the air conditioning system is inspected as soon as possible if the car has been involved in an accident.

If the system has been 'opened' as a result of an accident, air, moisture and dirt could have entered the system causing internal damage to the components. The extent of the damage and the length of time since the damage occurred will govern the amount of work required to correct the system. A definite repair procedure cannot be recommended to cover all cases of accident damage therefore the following guidelines should be followed:

1. Ensure that the compressor clutch is disengaged if the car is to be driven before repair work is carried out. This can be achieved by disconnecting the blue/yellow cable from the compressor ambient

Fig. C3 Refrigerant handling - safety precautions

Fig. C4 Approved refrigerant oil

switch located on the engine compartment face of the evaporator box (Fig. C19)

2. Inspect all refrigeration components and lines.
3. If the condenser has been damaged it MUST be replaced; soldering, brazing or welding etc. must not be attempted.
4. Fit a new receiver/drier if damage has occurred or if the system has been 'open' for more than one day.
5. Check the compressor and clutch pulley for cracks, if the clutch plate is bright yellow it should be replaced.
6. If the compressor does not show signs of external damage it may be used again.

Chemical stability of the refrigerant

The efficient operation of the air conditioning system depends upon the pressure/saturation temperature relationship of the refrigerant.

Provided that the system contains pure refrigerant, plus a certain amount of refrigerant oil which mixes with the refrigerant, it is considered to be chemically stable.

However, when foreign materials such as dirt, air or moisture enters the system, the chemical stability is affected which results in a change in the pressure/saturation temperature relationship of the refrigerant. The system will then no longer operate at the correct pressures and temperatures which decreases the efficiency of the system.

The following general rules should be observed to ensure chemical stability in the system.

1. Before disconnecting a refrigeration connection, wipe away all dirt or oil from the connection to prevent foreign matter entering the system.
2. All tools should be kept clean and dry.
3. Before adding oil, ensure that the container and tube (if any) is clean and dry in order to keep the refrigerant oil as free of moisture as possible.
4. Before 'opening' the refrigeration system, ensure that all tools etc. are close at hand to reduce the operation time to a minimum. Do not leave the system 'open' longer than necessary.
5. If the system has been 'opened' and sealed again, it must be correctly evacuated.

Servicing the refrigeration system

Refrigeration system - To discharge, purge or drain

1. The refrigerant must be discharged from the system before 'opening' any joint. Always wear goggles when carrying out work which involves 'opening' refrigerant lines.
2. Refrigerant must not be discharged near an open flame otherwise a poisonous gas will be formed. This also applies to discharging when smoking a cigarette or near a car engine air intake.
3. Remove the caps from the compressor discharge valve and the service connection of the suction throttling valve and attach to the manifold gauge set (with depressors fitted), after ensuring that the valves are closed. Attach a pipe to the centre connection of the gauge set.

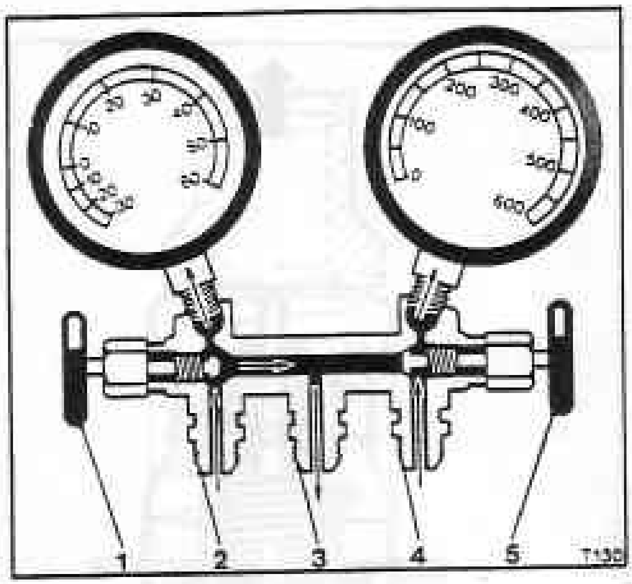


Fig. C5 Manifold gauge set

The illustration shows the manifold hand valve with the suction side cracked, while high side remains closed. Pressure is recorded on both gauges even though one hand valve is cracked.

1 'Low' side hand valve
2 Connection to suction throttling valve
3 Charging or evacuating connection
4 Connection to compressor
5 'High' side hand valve

4. Crack both hand valves and open further as the system discharges.
5. Do not release the refrigerant too quickly as this can result in oil being drawn from the system. If any trace of oil is noticed, loosen the adapter. The operation should require at least 15 minutes to ensure complete discharge.

Note

Any oil which has discharged into the container should be measured and a corresponding amount added to the system.

6. When all the refrigeration appears to have escaped, slacken the adapter to close the valve and allow approximately two minutes for any build-up of pressure in the system to develop, then repeat the discharge procedure.

This operation should be repeated until all the refrigerant has been discharged.

Refrigeration system - To evacuate

1. Ensure that the system is fully discharged.
2. Connect the centre pipe of the manifold set to the vacuum pump. The vacuum pump should have a 20-0 torr vacuum gauge fitted (1mm Hg = 1torr).
3. Open both valves on the manifold set and switch on the vacuum pump. When a reading of 5 torr or less has been obtained, allow the pump to operate for a further 15 minutes.

Note

The vacuum of 5 torr is related to sea level only.

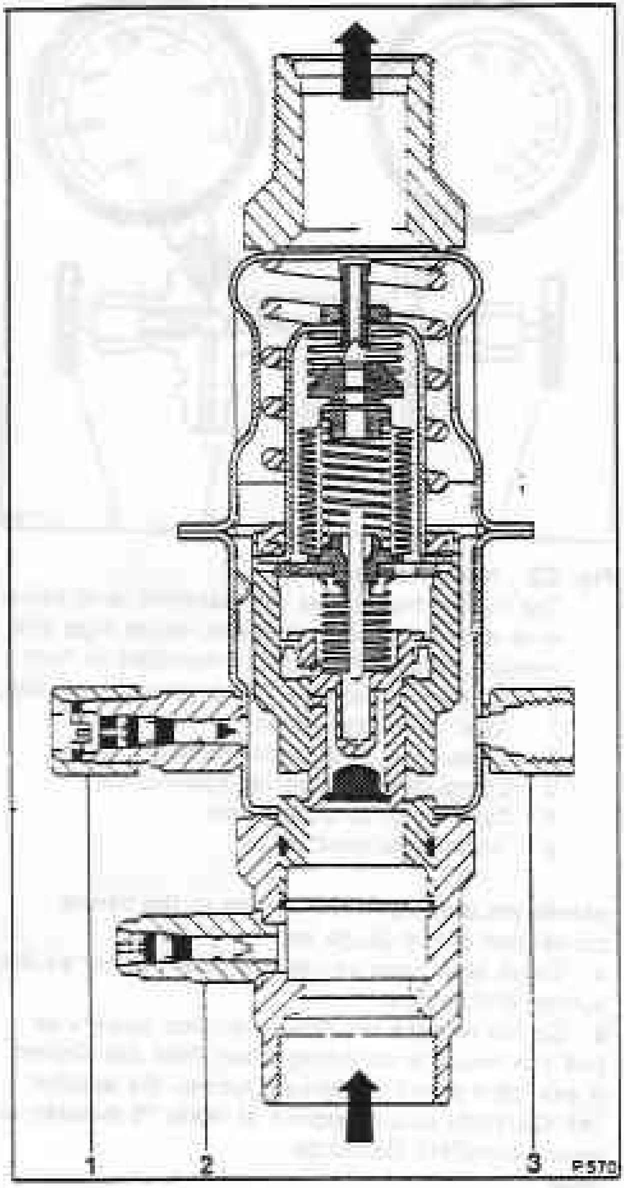


Fig. C6 Suction throttling valve
1 Oil bleed line
2 Service valve connection
3 Equaliser line connection

4. Switch off the vacuum pump, if the vacuum falls quickly investigate for a leak.

5. If the system loses vacuum very slowly, a leak is possible but it is advisable to evacuate for a further 45 minutes to eliminate the possibility of residual liquid refrigerant in the compressor oil vaporising and causing the pressure to rise.

6. The final vacuum reading obtained should be held for 30 minutes to ensure that there are no leaks in the system.

Refrigeration system - To sweep

1. Evacuate the system

2. Connect the refrigerant bottle to the centre connection of the manifold set, close the low side valve (to suction throttling valve) and open the valve on the bottle.

3. Ensure that the low pressure gauge comes out of vacuum, close the high side valve (to compressor) and open the low side valve.

4. Charge the system with 0,45 kg (1lb) of Refrigerant 12. If the ambient temperature is low it may be necessary to start the engine and switch on the system in order to draw in the refrigerant. Run the engine for a further 10 minutes with ACU switch set to HIGH.

5. Switch the system off and stop the engine.

6. Allow 5 to 10 minutes for the refrigerant pressure to equalise.

7. Leak test the system using an electrical leak detector. If a leak is detected, it must be rectified and the discharge and evacuation operations repeated.

8. If the system maintains its pressure, discharge and evacuate the system prior to charging.

Refrigeration system - To charge

Before charging the system, it is necessary to evacuate and sweep the system.

1. Attach a cylinder of Refrigerant 12 to the appropriate connection on the vacuum pump apparatus.

2. Open the cylinder valve and purge the line between the cylinder and the vacuum pump apparatus.

3. Suspend the cylinder on a spring balance and note the weight.

Note

If a 'charging station' or other refrigeration system servicing equipment is used, follow the manufacturers instructions.

4. Open the tap on the vacuum pump apparatus to enable the refrigerant to flow into the system.

5. Ensure that the parking brake is applied and that the gear selector is in either 'Park' or 'Neutral'.

6. Start the engine and run it at 1000 to 1250 rpm.

7. Move both temperature selector dials to the 'Full cold' position. Open the circular facia outlets and the rectangular outlets: move the air conditioning function switch to HIGH.

8. Allow 0,45 kg (1 lb) of refrigerant to flow into the system, close the tap on the vacuum pump apparatus and switch off the engine.

9. Test for leaks in the system with an electrical leak detector. If the system is free of leaks, continue the charging operation and increase the weight of refrigerant in the system by 1,02 kg (2.25 lb) to make the total weight of refrigerant added equal to 1,47 kg (3.25 lb).

10. If a leak is detected it must be rectified and the evacuation and charging operation repeated.

Note

The presence of bubbles or foam passing through the receiver drier sight glass is not a reliable indication of refrigerant deficiency if the ambient temperature is below 24°C (75°F).

11. Close the tap on the vacuum apparatus and unscrew the connection to the valve of the service connection on the suction throttling valve and fit the valve cap.

12. Check the system for leaks.

Airflow and system control

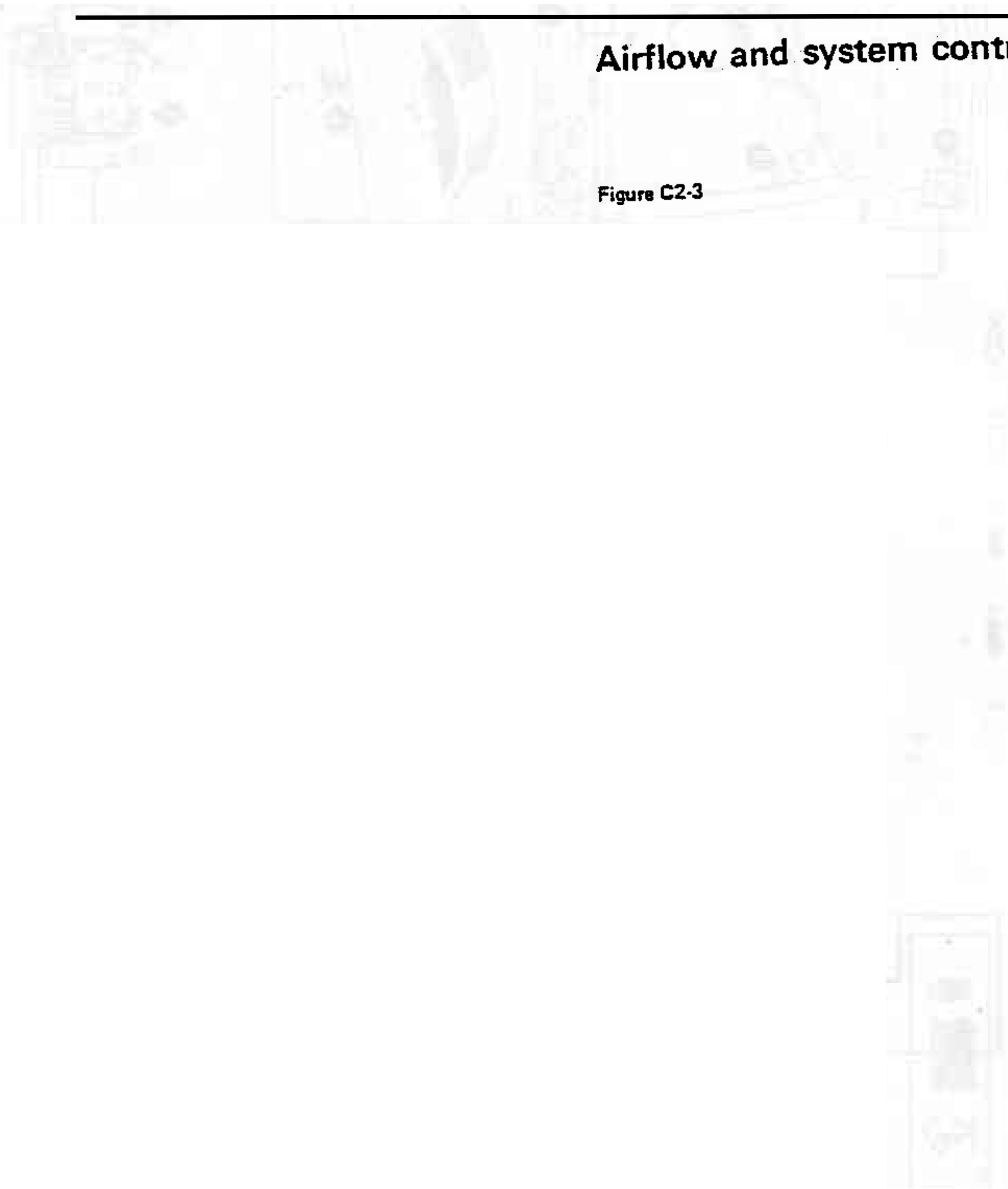
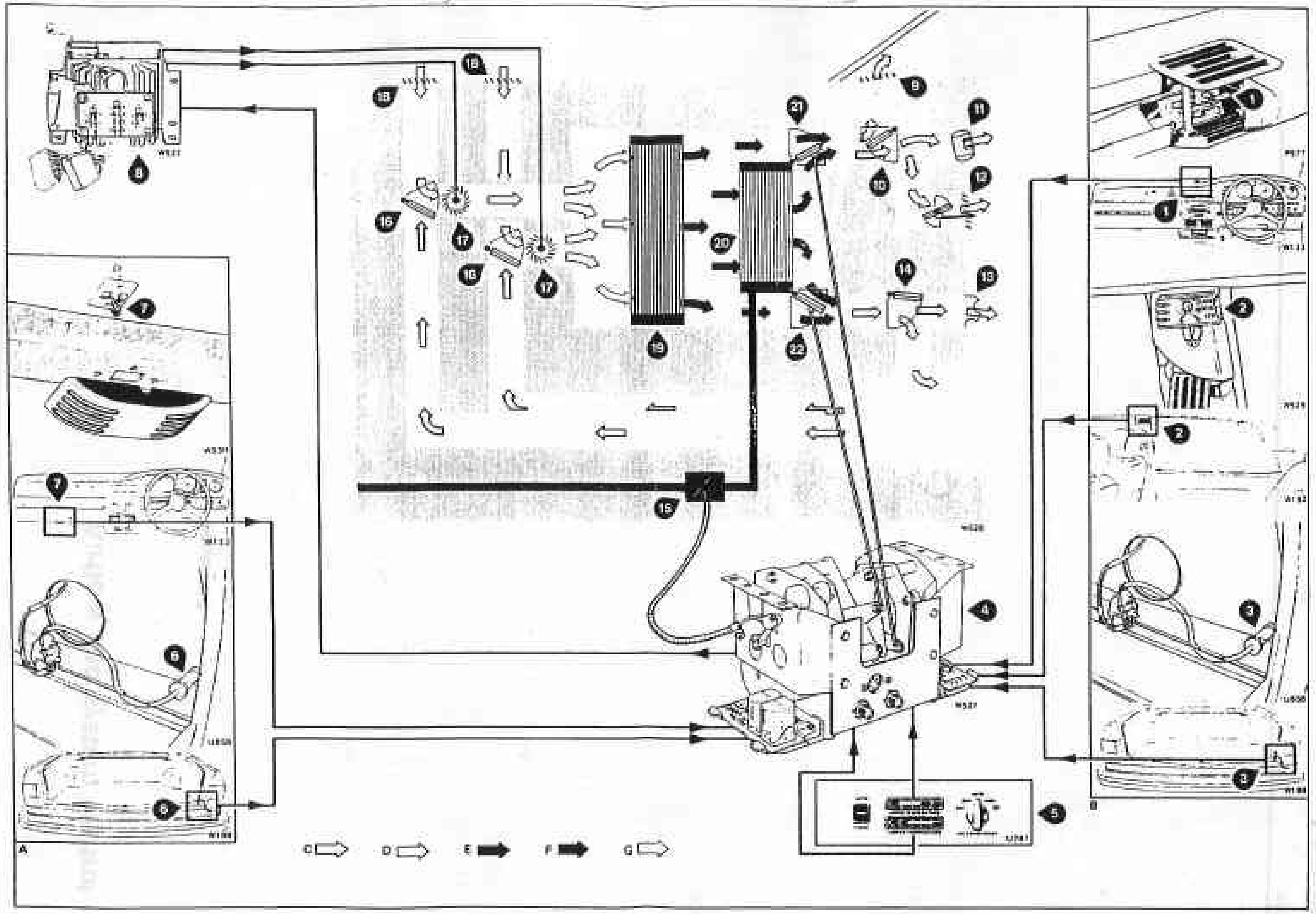


Figure C2-3


W533
8
18
18
16
17
16
17
19
20
21
22
9
10
11
12
13
14
15
7
W531
W132
6
U658
6
W188
A
4
W527
5
U787
1
P677
W133
2
W526
W528
W142
3
U658
3
W188
B
C
D
E
F
G

Oil level - refrigeration system
The refrigeration pump is originally filled with 310ml (10.5 ounces US of 'Frigidaire' 525 viscosity refrigeration oil and servicing is not normally required. However, during normal operation, a small amount of oil combines with the refrigerant and circulates round the system.

If any oil escapes from the system due to leakage, discharge of the refrigerant or replacement of a component, it must be replaced because it is important that the amount of oil in the system is always correct.

Insufficient oil in the system will result in inadequate lubrication of the compressor and too much oil circulating with refrigerant will reduce the cooling capacity of the system.

The procedure for correcting the oil level is as follows:

1. Ensure that the parking brake is firmly applied and the transmission is in either 'neutral' or 'Park'.
2. Run the engine at 1000 to 1500 rpm for ten minutes with the ACU temperature selector dials turned to the 'maximum cold' position and set to AUTO, this will allow the oil to be distributed throughout the system.
3. Stop the engine, discharge the refrigerant and remove the compressor.
4. Position the compressor horizontally with the drain plug pointing downwards.
5. Remove the drain plug and allow the oil to drain into a clean measuring container; measure and discard the oil.
6. If the oil drained from the compressor is more than 125 ml (4 ozs US.) top-up the compressor with an equivalent amount of new compressor oil.
7. If the oil drained from the compressor is less than 125 ml (4 ozs US) and a major oil loss has occurred, fill the compressor with 185 ml (6 ozs US) of compressor oil.
8. If the compressor has been overhauled, increase the quantities given in the two previous paragraphs by 30 ml (1.0 oz US).
9. If a new compressor is to be fitted, the oil contained in it should be drained into a clean measuring cylinder and the quantity adjusted until the amount is equivalent to that drained from the old compressor.

This amount should then be poured into the new compressor, plus any oil lost during rapid discharge of the refrigerant.

Replacing components
Whenever a refrigeration system component is replaced, measured quantities of approved refrigerant oil must be added to the component to ensure that the total amount of oil in the system is maintained.

Oil should be added in the following quantities plus any lost through rapid discharge of the system:
Evaporator - 90 ml (3 ozs US)
Condenser - 30 ml (1 oz US)
Receiver/Drier - 30 ml (1 oz US)

Low refrigerant charge protector system

System description
The low refrigerant charge protector system consists of a superheat shutoff switch located in the rear head of the compressor, connected in series by an electrical lead to the thermal fuse which is basically a temperature sensitive fuse link between the air conditioning system ambient switch and the clutch coil connection.

During normal air conditioning system operating conditions, current flows through the air conditioner switch, the ambient switch, and through the thermal fuse to the clutch coil to actuate the compressor clutch. Should a partial or total loss of refrigerant in the system cause the superheat switch to sense low system pressure and a high suction gas temperature, the superheat switch contacts will close. When the contacts close, current flows to energize the resistance type heater in the thermal fuse. The resultant heat warms the fuse link to its specific melt temperature, thus opening the circuit to the compressor clutch coil. Compressor operation ceases and compressor damage due to a loss of refrigerant charge is prevented. The cause of the refrigerant loss must be corrected and the system charged prior to replacing the thermal fuse.

Component description

Temperature sensors
The temperature sensors used in the air conditioning system are thermistors. These are devices that vary in resistance as temperature changes. As the temperature changes the amount of current flowing through the sensors varies proportionately.

The current signals emitted by the sensors are used to help determine the positions of the temperature blend flaps.

There are two sets of sensors in the air conditioning system, one set comprising three sensors is referred to as the upper sensor chain. The other set of two sensors is known as the lower sensor chain.

The function of the sensors in each chain is as follows.

Upper sensor chain
1. The solar sensor (see fig. C2-3) measures the effect of heat radiated by the sun into the car.
2. The cantrail sensor (see fig. C2-3) measures the upper level in-car temperatures.
3. The upper air ambient sensor (see fig. C2-3) measures the outside air temperature.

Lower sensor chain
1. The knee roll sensor (see fig. C2-3) measures lower level in-car temperatures.
2. The lower air ambient sensor (see fig. C2-3) measures the outside air temperature.

Servo assembly (see figs. C3-1 and C2-1)
The servos drive the air temperature blend flaps and also provide signals to activate other automatic functions within the system.

There are two servos contained within the assembly, one for the upper system and one for the lower system.

The upper servo controls the temperature and quantity of air from the windscreen and facia outlets. The lower servo controls the temperature and quantity of the air from the lower outlets.

The systems controlled by the upper servo are the recirculation actuators, lower quantity actuator, windscreen/facia mode change actuator, upper temperature blend flap, fan speed and rear window demister.

The systems controlled by the lower servo are the lower temperature blend flap, coolant tap and fan speed.

Upper and lower system servo modules (see fig. C3-1)
The movement of each servo is controlled by its servo module. Acting upon information computed from its sensor chain and temperature selector the module controls servo position.

The two servo modules are identical and therefore interchangeable. However, the servos must be recalibrated if the modules are interchanged.

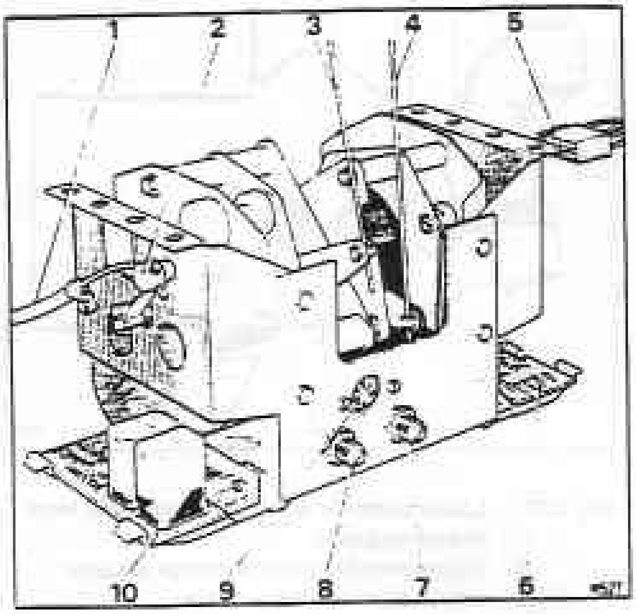


Fig. C3-1 Servo assembly
1 Coolant tap Bowden cable
2 Coolant tap lower servo connection
3 Lower servo blend flap connecting rod
4 Upper servo blend flap connecting rod
5 Sensor chain socket
6 Upper servo module
7 Upper servo trimming potentiometer
8 Lower servo trimming potentiometer
9 Servo test socket
10 Lower servo module

Fan speed module and voltage stabiliser (see fig. C2-3)
The fan speed module and voltage stabiliser are independent components assembled to form one unit.

The fan speed module provides variable fan speeds automatically controlled by servo positions. With both servos in the mid-position the fans run at minimum speed but as either or both servos move towards their 'full hot' or 'full cold' positions the fan speed increases progressively.

The voltage stabiliser provides two 7.0 volt supplies to the servo motors and a 9.1 volt supply to the servo modules. These render the servos insensitive to car system voltage variations.

Coolant tap (see fig. C6-4)
The coolant tap incorporated in the cooling system is connected to a cranked lever on the lower servo output

Printed in England

shaft. The tap is connected by a bowden cable. The tap opens progressively as the lower servo moves towards the hot position.

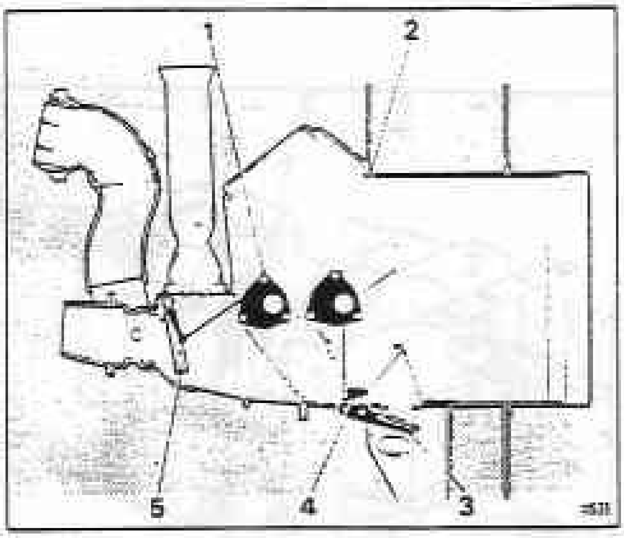


Fig. C3-2 Lower quantity and windscreen/facia mode change actuators

1 Windscreen/facia mode change actuator
2 Lower quantity flap actuator
3 Lower quantity flap
4 Lower quantity flap micro-switch
5 Windscreen/facia mode change flap

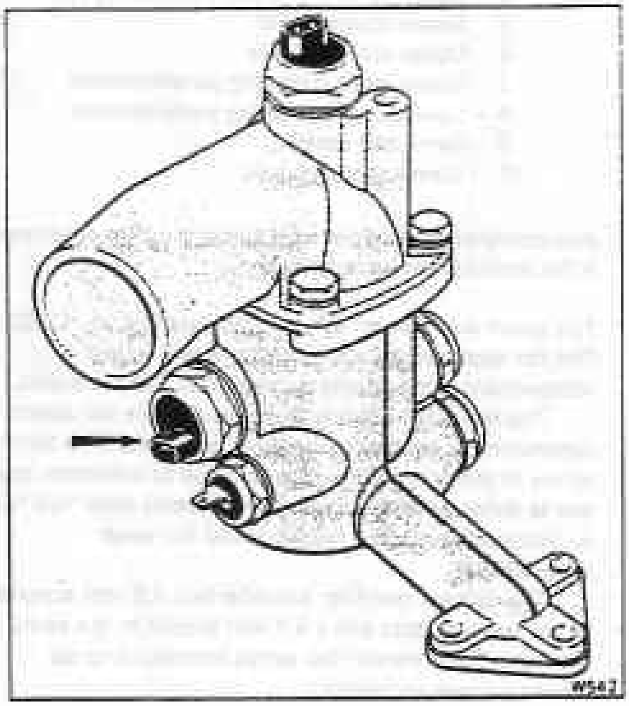


Fig. C3-3 **Fan delay thermostat (applicable to cars conforming to a Japanese or North American specification)**

Recirculation actuators and flaps (see fig. C2-1)
There are two recirculation actuator and flap assemblies incorporated into the system. The actuators operate simultaneously and each has two positions, one of which directs fresh air from outside the car into the air conditioning system; the other position recirculates air from within the car.

The actuators are activated by a micro-switch in the upper servo. This signals full recirculation when the servo is at the 'full cold' position or when the air conditioning is switched off. When the servo is at any other position than 'full cold' fresh air is signalled.

Mode change actuator and flap (see figs. C3-2 and C2-1)
The actuator operates the mode change flap to direct air to either the windscreen demister outlets or to the facia outlets.

When the upper servo is below 25% of its travel from 'full cold' towards 'full hot' the mode flap directs air to the facia outlets. Above 25% of its travel air is directed to the windscreen demister outlets. However, the upper system override (AUTO/FACIA) switch may be used to direct air to the facia outlets when the servo is above 25% of its travel.

Lower quantity actuator and flap (see figs. C3-2 and C2-1)
The lower quantity actuator operates the lower quantity flap. The flap is closed when the upper servo is below 10% of its travel from 'full cold' towards 'full hot'.

If defrost position has been selected on the air conditioning function switch the system overrides to close the lower quantity flap. This enables all available air to be directed to the upper system.

The lower quantity flap is also closed whenever the engine coolant temperature is below 44°C.

The micro-switch incorporated into the lower quantity flap linkage holds off the fan motors until the flap is fully open. This prevents a large quantity of air being suddenly directed from the windscreen area.

Fan delay thermostat (see figs. C3-3 and C3-4)
The fan delay thermostat is closed when the engine coolant temperature is below 44°C. This prevents the

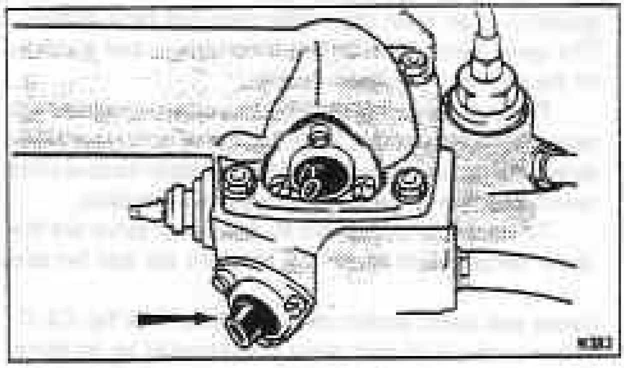


Fig. C3-4 **Fan delay thermostat (applicable to cars other than those conforming to a Japanese or North American specification)** fans operating and also closes the lower quantity flap.

When the engine coolant temperature reaches 44°C the thermostat opens to operate the lower quantity flap. Only when the flap is fully open does the lower quantity flap micro-switch open to allow the fans to operate.

Relays (see fig. C3-9)

The relays associated with the air conditioning system are all of the Bosch 12 volt 20/30 amp type.

With the exception of the starter relay all relays are interchangeable.

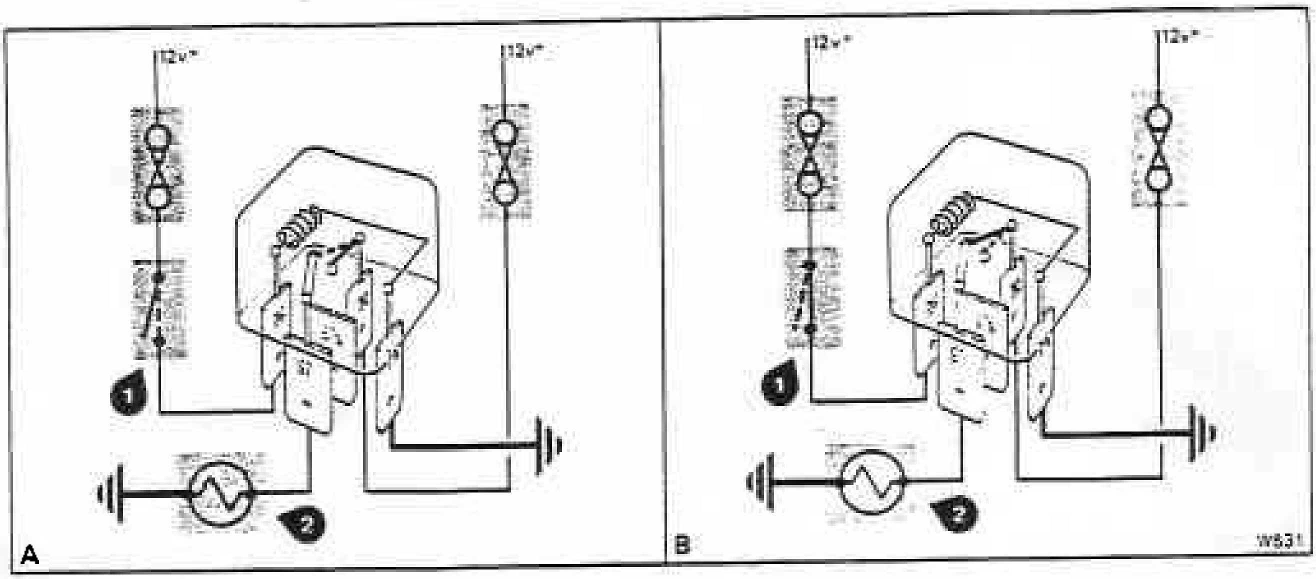


Fig. C3-5 Switching relay
A Not energised
1 Switch open
2 Bulb not illuminated

B Energised
1 Switch closed
2 Bulb illuminated

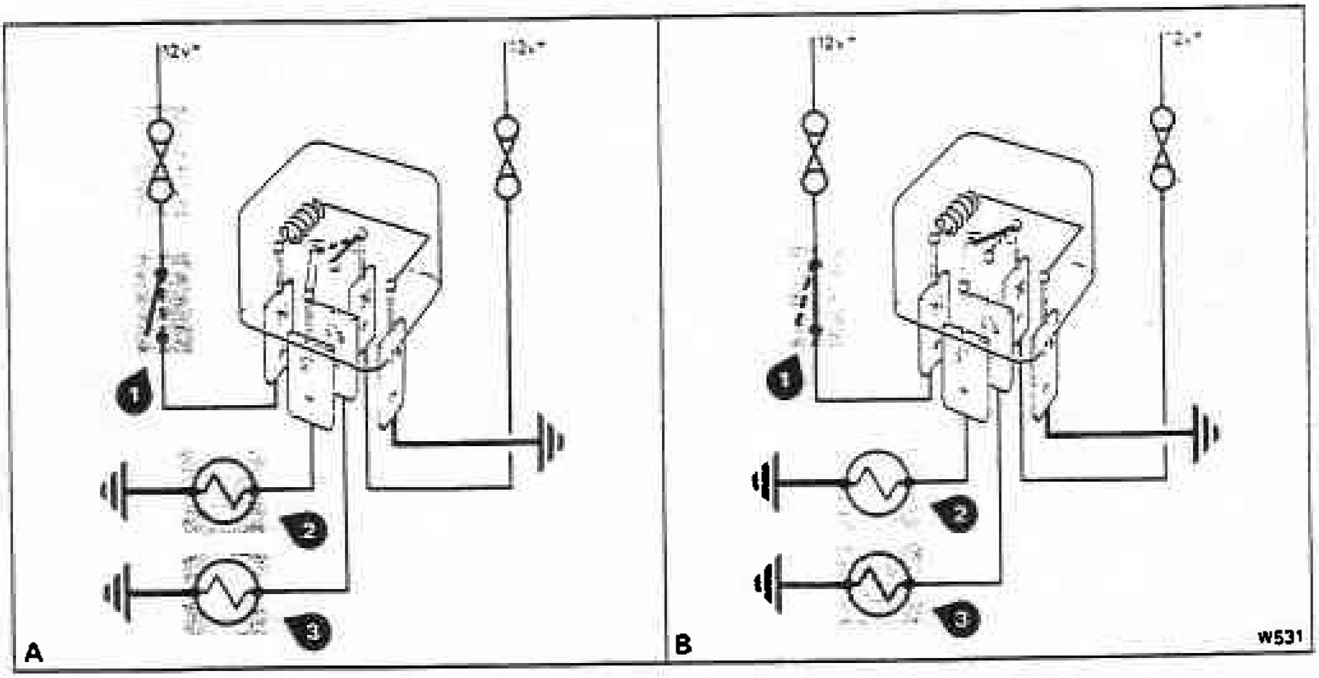


Fig. C3-6 Changeover relay
A Not energised
1 Switch open
2 Bulb not illuminated
3 Bulb illuminated through the normally closed contacts of the relay

B Energised
1 Switch closed
2 Bulb illuminated
3 Bulb not illuminated

Printed in England

Section C4

Interlock and Inhibit systems

Interlock (see Fig. C22)
The interlock circuit prevents the ACU from operating until the car engine is running to allow all battery power to be available to start the car during engine cranking.
Sequence of operations

1. The fan and compressor fuse supplies voltage to contact C2 of the fan and compressor relay at all times.
2. When the ignition is switched on and the ACU function switch is set to LOW, AUTO, HIGH or DEFROST, the coil of the fan and compressor relay is energised, the earth path being provided by the low resistance winding of the starter motor.
3. Contact C2 and C1 are 'made' which connects the live feed from fan and compressor relay to contact C2 of the servo isolation relay and the fan speed module.
4. The servo isolation relay coil is also energised because the oil pressure switch is closed (no oil pressure). Contact C2 is connected to C1 thereby isolating the live feed from the servos and voltage stabiliser.
5. When the starter motor is operated it effectively de-energises the coil of the fan and compressor relay, contact C1 and C2 are broken which disconnect the feed from the fan and compressor fuse. This allows all available battery power to start the car.
6. When the engine has started and the oil pressure has built up, the coil of the fan and compressor relay is again energised, remaking C1/C2 and the coil of the servo isolation relay is de-energised which connects the live feed from C2 to C3 which completes the circuit for the servos and voltage stabiliser.

Note
The fans will not operate until the fan inhibit cycle is completed.

Inhibit (see Fig. C23)
The inhibit circuit prevents the compressor and fans from operating under the following circumstances:

1. The compressor is disconnected when the ambient temperature is below 1°C.
2. The compressor and fans are inhibited when the ACU is operating in the 'screen' mode (except when DEFROST has been selected), until the engine coolant is above 44°C and the lower quantity flap is fully open. This prevents cold air from being blown into the car when hot air is required and also prevents a sudden surge of air to the screen causing considerable noise which, as well as being undesirable, would also be unexpected.
3. The fans are inhibited for 13 seconds after the starter motor has operated to allow the compressor to freeze any condensed water vapour in the system and so prevent moist air from misting the windscreen in the screen mode.

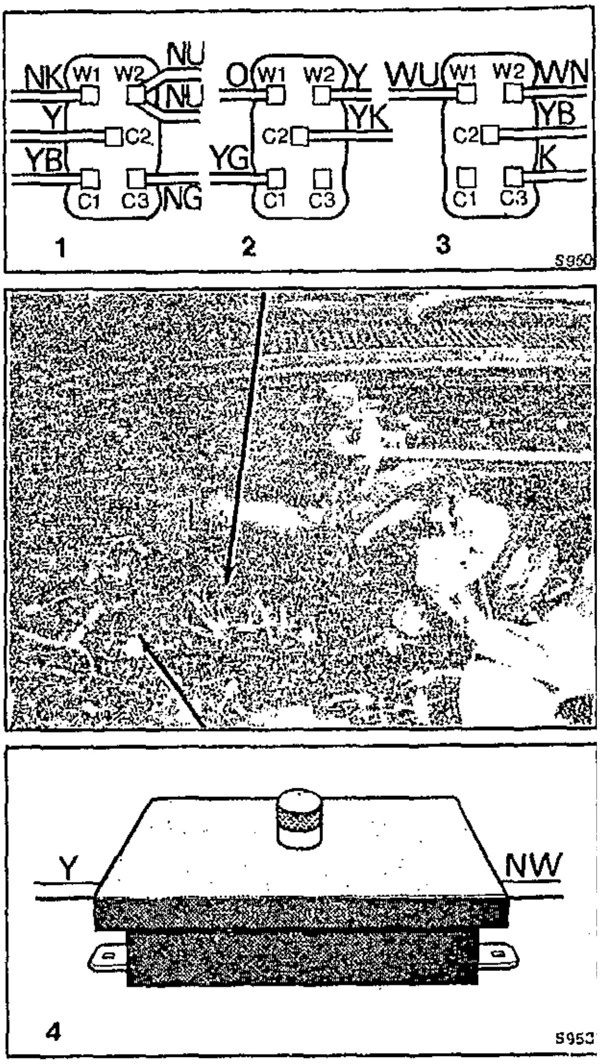


Fig. C17 1. Fan and compressor relay
2. Fan delay relay
3. Servo isolation relay
4. Fan and compressor fuse

In (1), the compressor thermostat, which is situated in the evaporator box, 'breaks' below 1 °C and disconnects the live feed from the compressor clutch thereby disconnecting the compressor.

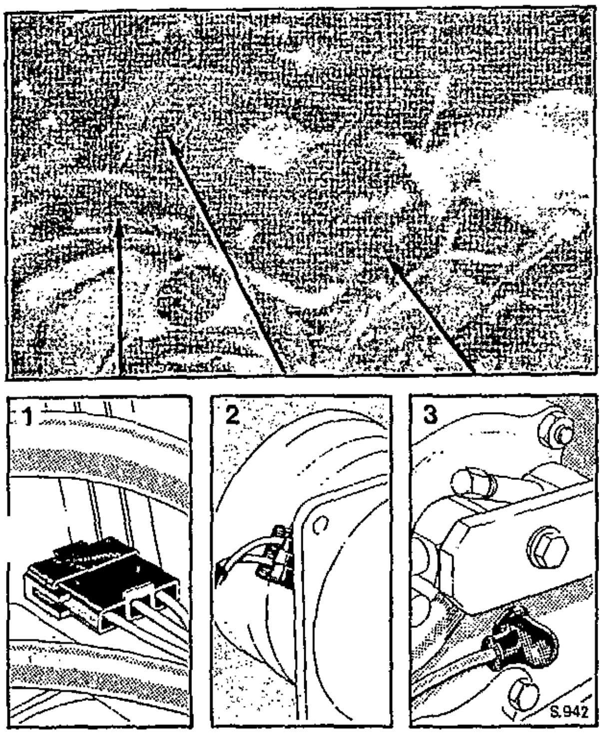


Fig. C18 Compressor protection device
1 Compressor safety fuse
2 Compressor clutch thermostat
3 Compressor temperature sensor

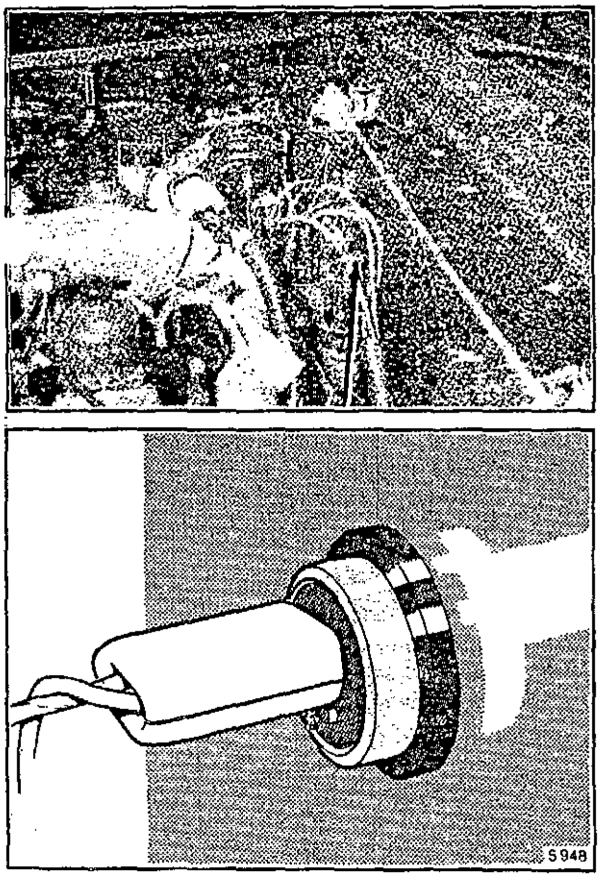


Fig. C19 Compressor ambient thermostat

In (2), the fan speed module and compressor are inoperative whenever the coil of the fan switch-off relay is energised. This is achieved by having the common contact (C2) of the relay connected to earth, when the coil is energised it removes the earth path from the compressor and effectively puts an earth path on the fan speed power circuit therefore preventing the fans from operating. When the relay coil is de-energised the earth path is removed and the compressor earth path is restored.

The coil of the fan switch-off relay has two earth paths, one when the oil pressure switch is closed (ie. no oil pressure) and also when the coil of the fan delay relay is energised with either the fan delay thermostat closed (below 44°C) or the lower quantity flap miscroswitch closed. This second earth path (via the contacts of the fan delay relay) provides the necessary signal to hold off the fans and compressor when the coolant is below 44°C and the mode is to 'screen' and the lower quantity flap is not fully open. It also prevents the fans from being inhibited when DEFROST has been selected.The live feed to energise the coil of the fan delay relay is switched by the 25% mode change microswitch in the upper servo. When the mode is to 'screen' the orange/purple cable from the upper servo is 'live' which feeds the fan delay relay coil via the diode block and yellow cable via toeboard socket D to W2. The earth path for the relay coil is through the ACU switch to the left-hand 'A' post earth (except when DEFROST has been selected).

In addition, the lower quantity flap microswitch initiates a fixed sequence of events when the fan delay thermostat opens. When the coolant tempe-

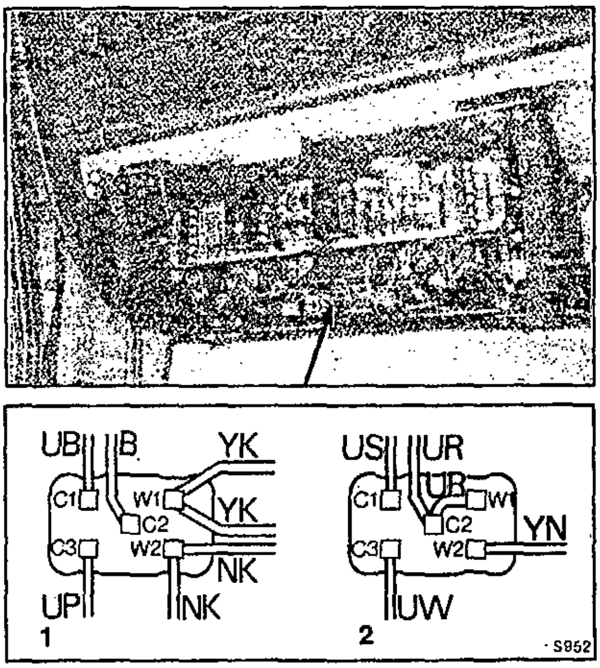


Fig. C20 1. Fan switch-off relay
2. Lower quantity relay
Right-hand drive cars

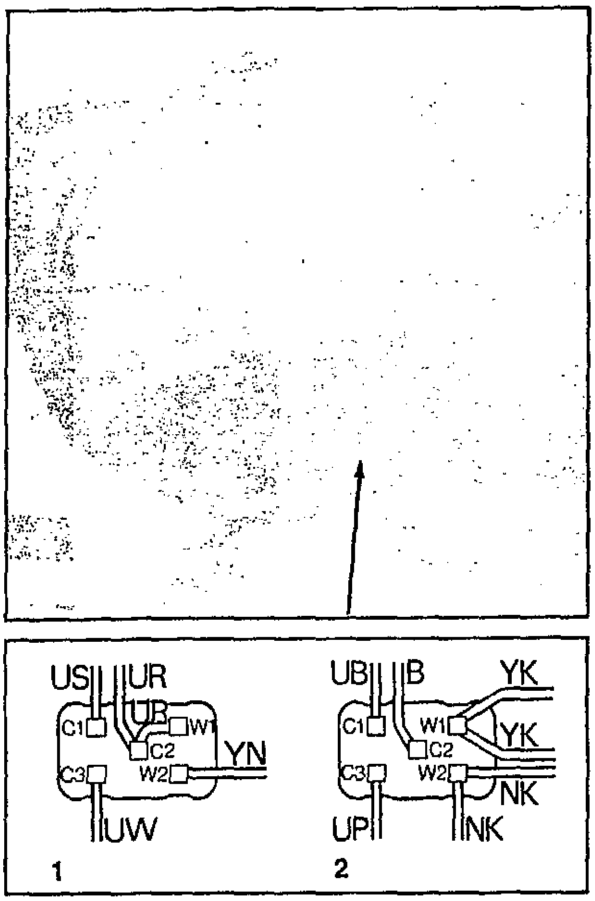


Fig. C21 1. Lower quantity relay
2. Fan switch-off relay
Left-hand drive cars

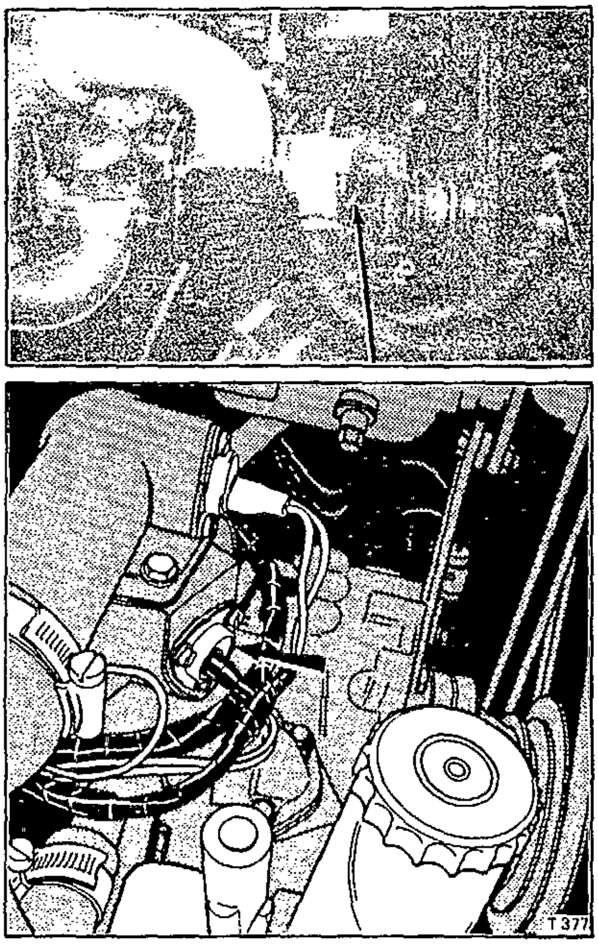


Fig. C22 Fan delay thermostat

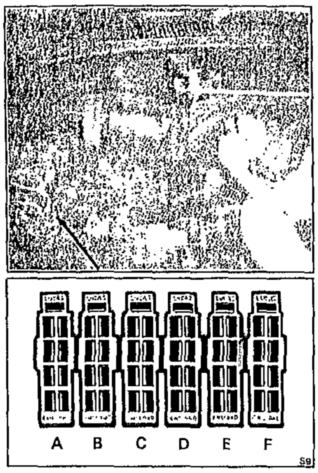
rature is below 44 °C, the fan delay thermostat not only inhibits the fans and compressor but also energises the coil of the lower quantity relay which keeps the lower quantity flap closed. As soon as the coolant exceeds 44 °C the thermostat opens which disconnects the earth from the lower quantity relay and allows the lower quantity flap to open, when fully open it opens the lower quantity flap microswitch thereby allowing the fans and compressor to operate. Therefore, the fans do not operate until the lower quantity flap is fully open.

In (3), to prevent the fans operating when the car is started with a 'hot' engine which could cause misting of the windscreen, a 13 second delay is initiated by connecting the fan speed module to the starter motor (brown-blue cable) which activates a 13 second delay circuit in the module each time the starter motor is used. This allows the compressor to freeze any condensed water vapour in the system so preventing any misting of the windscreen.

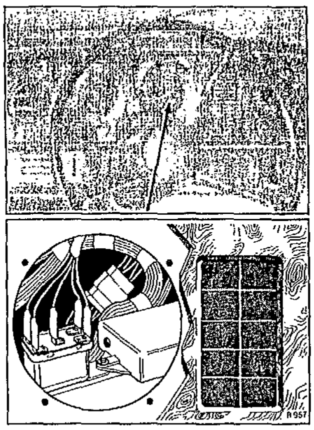
Note
The diode between the fan switch-off relay coil and oil pressure switch prevents the warning lamp from finding an earth path through the fan switch-off relay coil, fan and compressor relay coil and starter motor. If this diode fails short circuit, the oil pressure warning light would glow dimly with the ACU switched off.

Interlock circuit

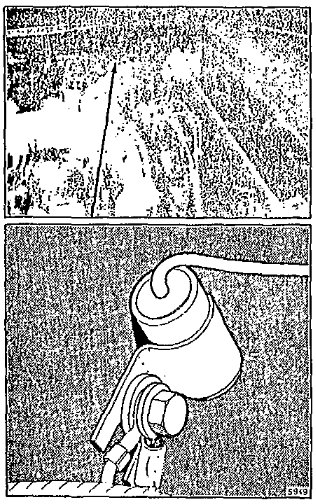
Schematic wiring diagram
Fig. C22



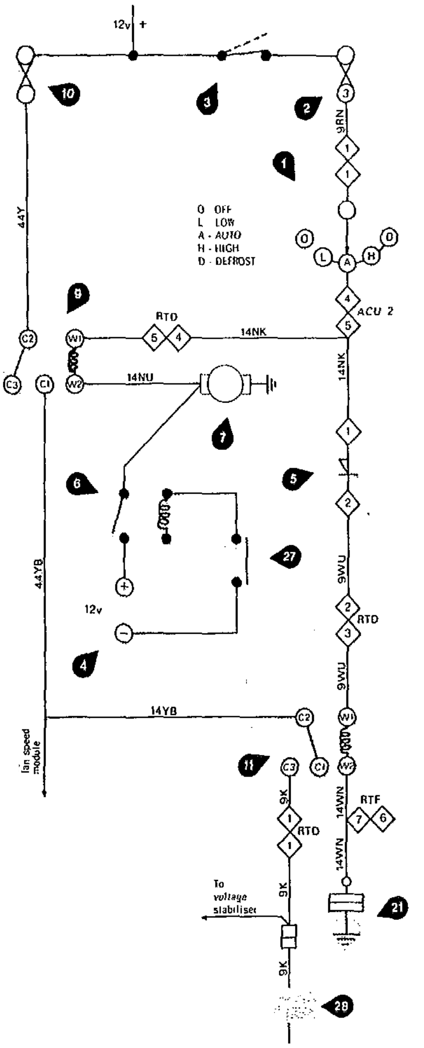
Toeboard sockets



Location of main distribution loom plug (MD)



Right-hand valance earth



Components

1	ACU function switch
2	Fuse number 3
3	Ignition switch
4	Battery
5	ACU diode board
6	Starter relay
7	Starter motor
8	Fan speed module
9	Fan and compressor relay
10	*Fan and compressor fuse*
11	Servo isolation relay
12	Upper servo microswitches
13	Compressor clutch thermostat
14	Compressor protection unit
15	*Compressor clutch*
16	Compressor protection sensor
17	Lower quantity actuator
18	Lower quantity flap microswitcl
19	Fan switch-off relay
20	Fan delay relay
21	Oil pressure switch
22	Left-hand 'A' post earth
23	Fan delay thermostat
24	Right-hand valance earth
25	Lower quantity relay
26	*Right-hand 'A' post earth*
27	Starter switch
28	Servos

Inhibit circuit

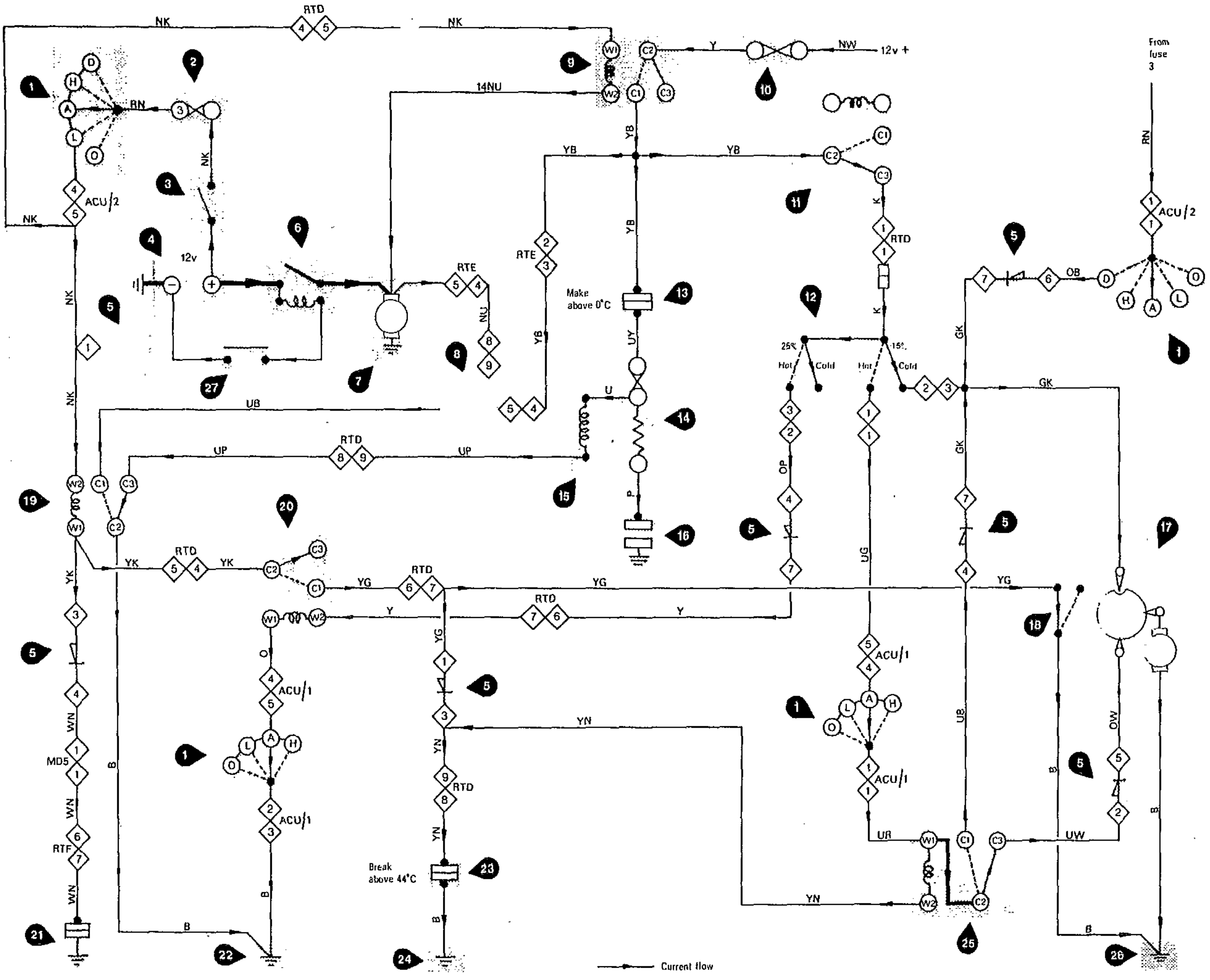
Schematic wiring diagram
Fig. C23

T134

C4-8

Printed in England

© Rolls-Royce Motors Limited



Section C5

System test and fault diagnosis Contents

Section C5

A.C.U. test box

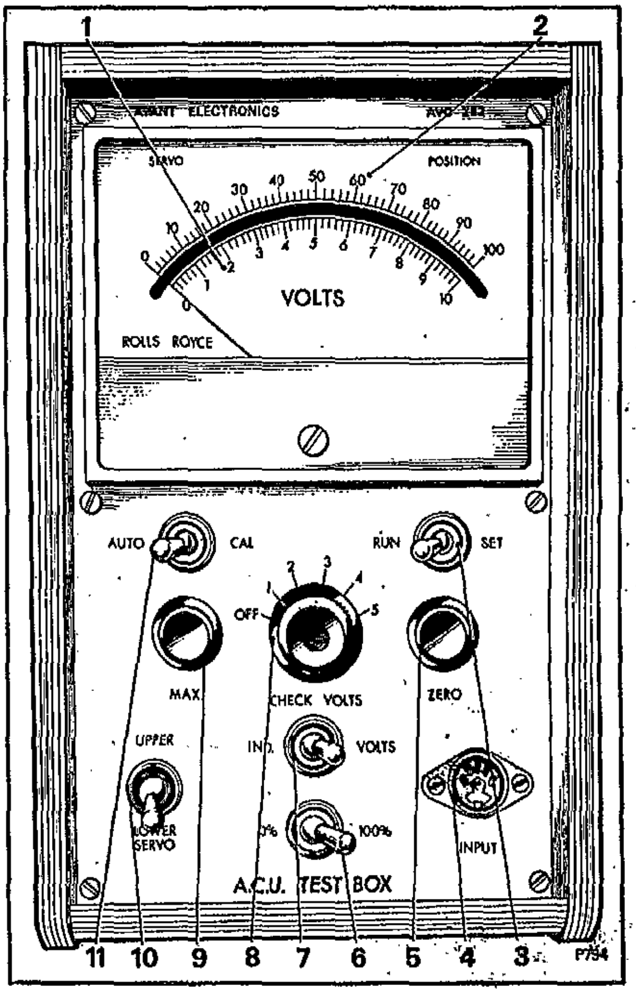


Fig. C33 Test box details

1	Volts scale
2	Servo position scale
3	RUN/SET switch
4	Input plug
5	ZERO control
6	0%/100% switch
7	IND/VOLT switch
8	CHECK VOLTS control
9	MAX control
10	UPPER/LOWER servo switch
11	AUTO/CAL switch

Description

The automatic air conditioning system test box (RH 8851) enables the air conditioning system to be tested whilst the components are fitted to the car. The function of the controls on the box are as follows:

1. AUTO/CAL switch.
When AUTO is selected and the ACU is in 'automatic' mode, the test box functions as a servo position indicator. When CAL is selected, the test box can be calibrated.

2. UPPER/LOWER switch.
Selects the appropriate circuit under test.

3. MAX control
With the AUTO/CAL switch set to CAL and the 0% 100% switch set to 100%, the meter can be adjusted to 100%.

4. CHECK VOLTS switch
Measures the following:
Position 1. Supply voltage to the servo modules (9.1 volts)
Position 2. Output voltage from lower servo position potentiometer.
Position 3. Output voltage from lower sensor chain.
Position 4. Output voltage from upper servo position potentiometer.
Position 5. Output voltage from upper sensor chain.

5. IND/VOLTS switch
Determines whether the meter is to be used as a voltmeter or a servo position indicator.

6. 0%/100% switch.
Enables the test box to be calibrated to the servo under test.

7. ZERO control
With the AUTO/CAL switch set to CAL and the 0%/100% switch set to 0%, the meter can be adjusted to 0%.

8. RUN/SET switch
In the RUN position, the switch enables a servo to be operated in the automatic mode or calibrated. In the SET position, the temperature selector dials can be calibrated to a specific servo position.

Using the test box as a voltmeter

1. Set AUTO/CAL switch to AUTO and the RUN/SET switch to RUN.
2. Set IND/VOLTS switch to VOLTS.
3. Select the appropriate switch position as follows:

Position 1. Supply voltage to the servo modules (9.1 volts)
Position 2. Output voltage from lower servo position potentiometer.
Position 3. Output voltage from lower sensor chain.
Position 4. Output voltage from upper servo position potentiometer.
Position 5. Output voltage from upper sensor chain.

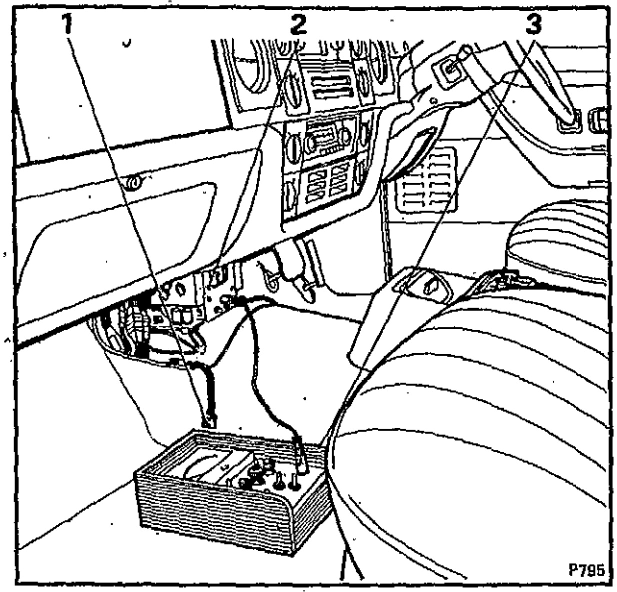


Fig. C34 Test box in position
1 Servo trim cover 5 way socket
2 Servo assembly
3 Test box RH 8851

Calibrating the test box as a servo position indicator.

1. Connect the test box to the test socket.
2. Select the required servo on the UPPER/LOWER SERVO switch.
3. Set IND, CAL and RUN on the appropriate switches.
4. Disconnect the socket situated under the servo trim cover, start the car engine and select LOW on the ACU function switch.
5. Set the 0%/100% switch to 0% and wait for the servo to stop.
6. Adjust the ZERO control to set the meter to 0%.
7. Set the 0%/100% switch to 100% and wait for the servo to stop.
8. Adjust the MAX control to set the meter to 100%.
9. Repeat operations 5 to 8 until both readings are correct.

Important
A servo may appear to have travelled to the limit switch (operations 5 and 7) and the test box adjusted accordingly but, in fact, the servo has stalled. If a stall condition is suspected the supply voltage to the servo motor should be measured at the servo socket where a voltmeter probe can be inserted. The upper servo supply is at the pink/blue cable and the lower servo supply is at the pink/light green cable. If a stall condition exists the voltage between the servo supply and earth will be less than 8 volts, otherwise the voltage should be greater than 12 volts.

Servo position indicator with ACU operating automatically

1. Select the required servo on the UPPER/LOWER SERVO switch and calibrate the test box.
2. Set the AUTO/CAL switch to AUTO.
3. Set the RUN/SET switch to RUN.
4. Ensure that the servo trim cover socket is connected.

Servo position indicator with manual control of ACU.

To observe the operation of the actuators and water tap, set up the test box as follows:
1. Select the required servo on the UPPER/LOWER SERVO switch and calibrate the test box.
2. Set the AUTO/CAL switch to CAL.
3. Set the RUN/SET switch to SET.
4. The servo may now be set to any required position using the temperature selectors on the facia but to achieve the extremes of servo position the servo trim potentiometers will have to be used.

Calibrating the temperature selectors

Correct servo position is related to selector position, in-car temperature and outside air temperature, therefore, to calibrate the temperature selectors, the servo positions are adjusted with the temperature sensors substituted by known fixed resistances. To obtain the correct temperature settings, the upper servo must be set to 51% and the lower servo set to 48% with the temperature selectors set to mid-range. *The temperature selector calibration procedure is as follows:*
1. Select the appropriate servo and calibrate the test box.
2. Set the AUTO/CAL switch to CAL.
3. Set the RUN/SET switch to SET
4. Disconnect the servo trim cover socket.
5. Set both temperature selectors to their **mid-position.**
6. Adjust the servo trim potentiometer until the meter reads 51% for the upper servo and 48% for the lower servo. **Approach the setting from 0%.**

ACU QUICK CHECK

1. Remove servo trim cover. Do not disconnect 5 way socket.

2. Connect test box into the servo test socket.

3. On the test box:-

   Switch ind/volts switch to volts position
   run/set switch to run position
   auto/cal switch to auto position
   0% 100% switch to 100% position

4. On the car:-

   turn upper and lower temperature selector knobs to mid-position (i.e. 12 o'clock)
   turn ACU switch to low

5. Disconnect oil pressure switch. White, brown wire, switch is on front, left hand side of engine.

6. Switch on ignition. A number of actuators will now run, but should stop within a few seconds. The fans will blow at minimum speed.

7. On the test box:-

   switch check volts switch to position:-

   1. Reading 91 ± 5
   2. Reading between 10 and 40
   3. " " " " " "
   4. " " " " " "
   5. " " " " " "

   Return switch to position 1.

   If readings are incorrect see below.

   If readings 1, 2, or 4 are incorrect there is a fault in the servo, stabilisers or looms and this must be rectified before proceeding. Refer to fault diagnosis. If readings 3 or 5 are not as specified there is a fault in the temperature sensor networks. However, one can proceed with the setting instructions and the fault can be rectified after instruction 25.

8. Switch off ignition.

9. Disconnect 5 way servo trim cover socket.

d. Switch 0%/100% switch to 100%, wait or servo to stop. Throughout items 15A to 15E the ACU actuators will run randomly and the fans will be switched off and on, this is normal.
e. Adjust max control to make meter read 100.
f. Repeat items 15C to 15E until both readings are correct. Meter is now calibrated as a servo position indicator for the upper servo.

Switch run/set switch to set. Wait for servo to stop. The reading should be 51% ± 3%.

Disconnect fan delay thermostat (yellow/brown wire, right-hand front of engine), lower quantity flap will open, when fully open fans should start and airflow will be to screen.

Turn temperature selector fully let, the reading should be between 0% and 20% preferably 0%. Assuming a reading of 0%, turn selector slowly to the right. At 5% the recirculatory actuator should run, at 10% ± 3% the lower quantity flap. Fully right the reading should be between 80% and 100%. If a reading of 0% is not obtained, this check can be done using the trim screw. Remember to reset at 51% with selector in mid-position.

21. Adjust upper servo trim pot clockwise to move sergvo until meter reading is 51 approaching this from 0 hot 100. If servo overshoots approach reading from 0 once more.

This has set up the upper servo to calibrate the upper temperature selector knob. Thus the reading of 51 must be set up very carefully.

22. Switch air conditioner to 'off'

Check:-

1. Recirc actuators have opened.
2. Fans have stopped.

23. Switch air conditioner switch to 'low'.

Check:-

1. Recirc actuators have closed.
2. Fans have re-started.

24. Switch off ignition

a. Re-connect 5 way trip cover socket
b. Switch test box 'off'
c. Remove test box

10. On the test box, switch:-

    Auto/cal switch to 'Cal'
    Ind/volts switch to 'Ind'

    Adjust 'Max' control fully anti-clockwise.

11. Switch on ignition. Both servos will run to full hot, number of actuators will now run but will stop within few seconds. The fans will not be running.

    IF THE SERVO FAILS T OMOVE THIS MUST BE REPAIRED BEFORE PROCEEDING

12. On the test box, switch:-

    a. Upper/lower switch to 'lower'
       0%/100% switch to 0% lower servo will run to full cold and close the wtaer tap

    b. Adjust 'zero' control to make read 0

    c. Switch 0% 100% switch to 100%. Wait for servo to stop. Lower servo will run to full hot, opening the water tap as it moves.

    d. Adjust 'max' control to make meter read 100.

    e. Repeat 12A to 12D until both readings are correct. Finish this procedure with the 0%/100% switch in the 0% position.

    Item 12 has now calibrated the meter as a servo position indicator, 0 being full cold and 100 full hot. The meter has a linear response, i.e. 50 is mid-servo-position.

13. On the test box:-

    Switch run/set switch to 'set'. Servo may now run and then stop, this is irrelevant. Meter reading should be 43% ± 3%, if not adjust approaching 43 from zero.

14. Turn temperature selector fully left, reading should be between 0% and 5% turn fully right, reading should be 80% to 100%.

15. On the test box:-

    a. Switch run/set switch to 'run'. Lower servo will run to full cold.
    b. Switch upper/lower switch to 'upper'. Lower servo will run to full hot, upper servo will run to full cold. Fans will start to run at minimum speed, all the ACU actuators will run and then stop. Positions of these will be checked later.
    c. With 0%/100% switch in the 0% position, adjust zero control until meter reads 0.

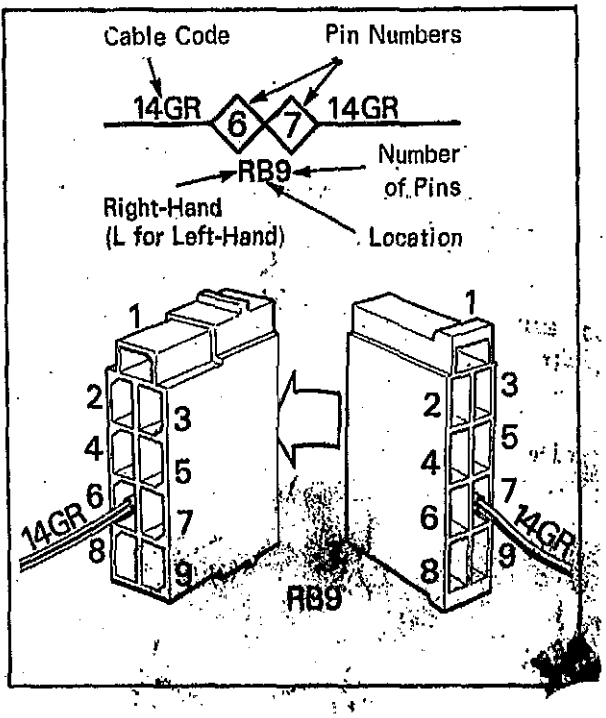
Section C5

System test and fault diagnosis

Introduction

This section describes the complete system test procedure and includes fault-finding charts that can be used to quickly diagnose a fault when time is not available to complete the test procedure. However, when time is available, the test procedure should be carried out.

To use the fault-finding charts, first complete the road test described in this section noting each malfunction. A guide, indicating the appropriate chart to use, is given at the completion of the road test.



Connector and cable colour codes

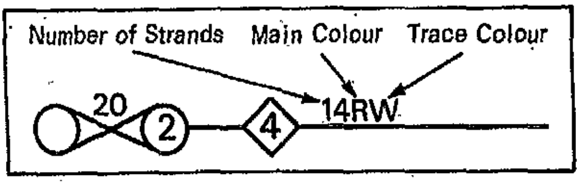
Connector code

The wiring diagrams are basically theoretical circuits showing all plug and socket connectors, which can be identified using the following code. The pin numbers referred to are viewed with the plug inserted and do not necessarily correspond with the numbers moulded on the plug and socket.

Code	Location
ACU	ACU switch sockets
B	Body socket
C	Console
D	Door socket
FA	Fuseboard 'A'
FB	Fuseboard 'B'
V	Valance
MD	Main distribution
TA	Toeboard socket 'A'
TM	Toeboard socket M
SCS	Sensor connector socket

Cable colour code

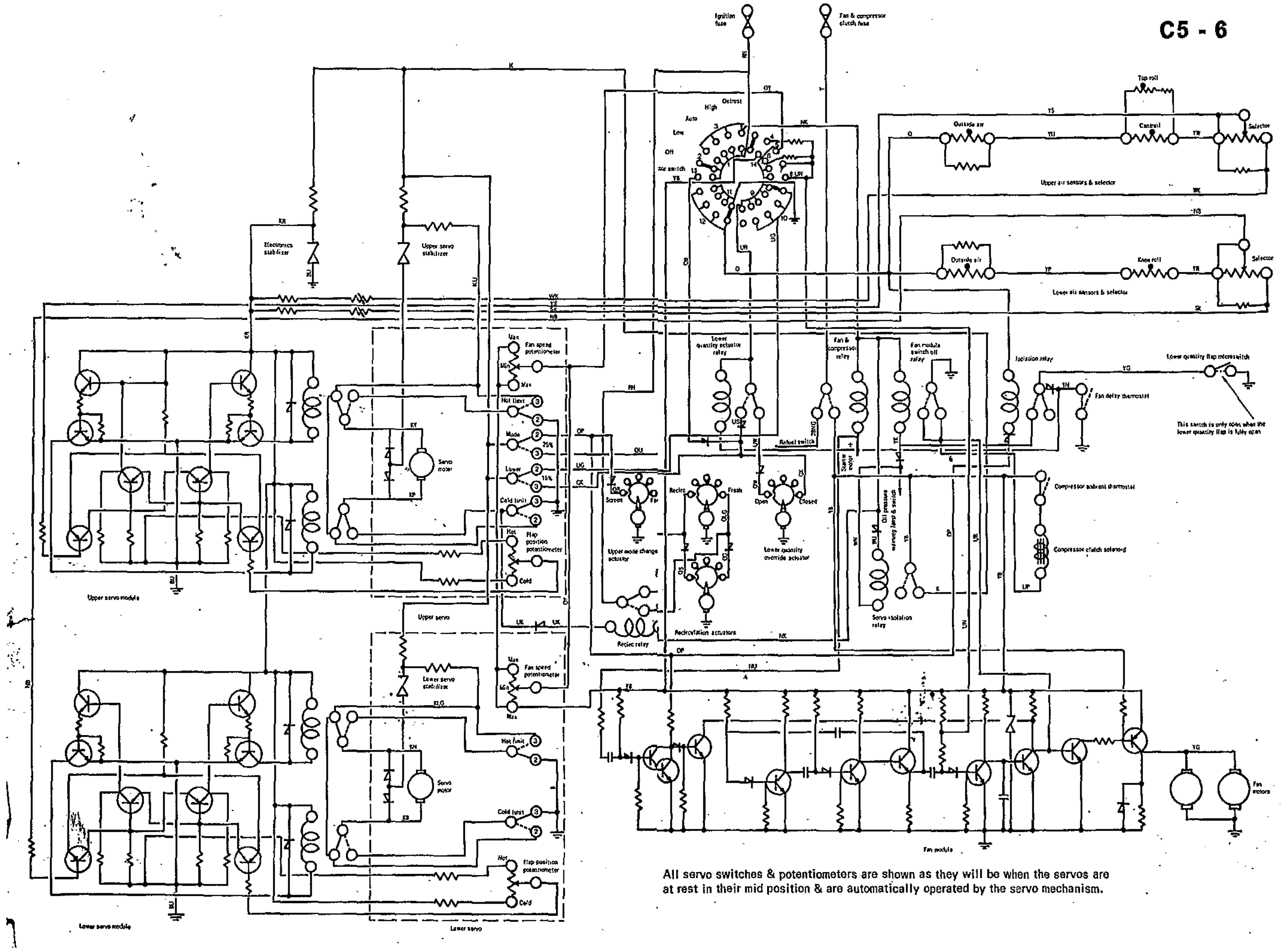
B	Black	LG	Light green
N	Brown	U	Blue
R	Red	S	Slate
O	Orange	P	Purple
Y	Yellow	W	White
G	Green	K	Pink



Section C5

System test and fault diagnosis

Theoretical wiring diagram
Automatic air conditioning unit
Fig. C35



All servo switches & potentiometers are shown as they will be when the servos are at rest in their mid position & are automatically operated by the servo mechanism.

System test and fault diagnosis

Initial tests

Introduction
These initial tests describe the sequence of events that should occur when the ACU is switched on, one test applies to a car with a 'cold' engine, the other test applies to a car with a 'hot' engine i.e. when the coolant is above 44 °C.

The right-hand column indicates which fault diagnosis chart to use or which part of the system is probably faulty. However, the test should be completed fully before attempting any rectification to enable a complete picture of the malfunction to be given.

'Cold' engine

1. Turn ACU switch to AUTO and both temperature selectors to maximum temperature position. Start engine. **The fans should not operate**	Interlock or Inhibit circuits faulty.
2. **The lower quantity flap should be closed**	Lower quantity flap fault diagnosis.
3. **The recirculation flaps should be in the 'Fresh Air' position.**	Recirculation flap fault diagnosis ACU switch faulty.
4. As the engine coolant warms up, **the lower quantity flap should open**	Lower quantity flap fault diagnosis.
5. **The fans should start operating ONLY when the lower quantity flap is fully open**	Lower quantity flap fault diagnosis.
6. **Warm air will flow from the windscreen outlets**	No airflow - Fans inoperative fault diagnosis Airflow from facia - Mode flap fault diagnosis Incorrect air temperature - Water tap incorrect. Upper servo fault diagnosis. Sensor chain fault diagnosis.
7. **Warm air will also flow from the front and rear footwells.**	Lower quantity flap fault diagnosis
8. Turn the ACU switch to DEFROST ***Verify that the lower quantity flap has closed.***	ACU switch fault Lower quantity flap fault diagnosis
9. **The fans should run at a fixed fast speed**	Fan speed module
10. **Air should only flow from the screen outlets**	Mode flap fault diagnosis . ACU switch faulty. Upper servo fault diagnosis

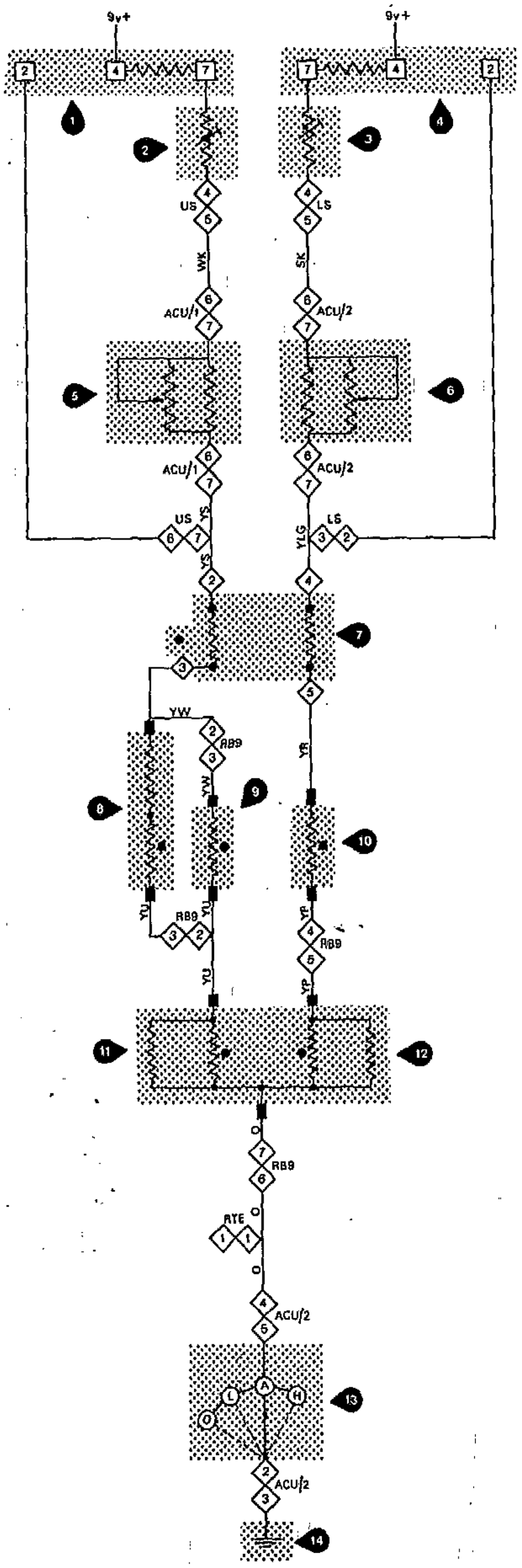
11. Set the Mode Change switch to FACIA **The airflow should now flow from the facia outlets**	Mode change switch faulty. Mode change relay faulty
12. Set the Mode Change switch to AUTO **The airflow should now be from the windscreen outlets**	Mode change switch or mode change relay faulty
13. Set the Mode Change switch to FACIA **Airflow should be from facia outlets**	Mode change switch or mode change relay faulty
14. Switch off the ignition and immediately restart the engine **The fans should not operate for approximately 13 seconds**	Inhibit circuit faulty
15. Airflow should now only be from the windscreen outlets	Mode change switch or Mode change relay faulty
16. Let the 'In-car' temperature rise to an uncomfortable level to enable the mode, lower quantity and recirculation flaps to be tested.	
17. Set the ACU switch to AUTO and both temperature selectors to the minimum temperature position. **The airflow should only be from the facia outlets**	Mode flap fault diagnosis
[illegible] The lower quantity flap should be closed	Lower quantity flap fault diagnosis
19. The recirculation flaps should be in the 'Recirculation' position Note. This can only be achieved with a combination of high 'in-car' temperature and an outside temperature above 5 C	Recirculation flap fault diagnosis
20. Slowly rotate the upper temperature selector away from the minimum temperature position **The recirculation flaps should move to the 'Fresh air' position**	Recirculation flaps fault diagnosis
21. The lower quantity flap should open	Lower quantity flap fault diagnosis
22. Stop rotating the temperature selector **Airflow should only be from the facia outlets and front and rear footwells**	Mode flap fault diagnosis
23. Switch off ignition & restart engine **The fans should start immediately**	Fans inoperative fault diagnosis

24. Continue rotating the upper temperature selector away from the minimum temperature position until the Mode flap operates **Airflow should be from the windscreen outlets and the front & rear footwells**	Mode flap fault diagnosis
25. Set both temperature selectors to the 'preferred' temperature position. Set the ACU switch to HIGH **The fan speed should increase**	Fan speed does not vary fault diagnosis
26. Set the ACU switch to LOW **The fan speed should decrease**	Fan speed does not vary fault diagnosis
27. Set the ACU switch to AUTO & drive the car on the road. Ensure that the system stabilises, giving a comfortable in-car temperature. Stabilisation is achieved when the fan speed decreases & becomes constant although this may not occur if the outside temperature is extremely high or low.	
28. When the road test is completed and with the engine still running, raise the car bonnet and inspect the condition of the refrigerant through the sight glass of the receiver/drier. **There should not be any bubbles or foaming**	Refrigeration system faulty

'Hot' engine

1. Disconnect the yellow/brown cable and the black cable from the 44 C fan delay thermostat and connect them together. Set the ACU switch to AUTO and both temperature selectors to the maximum temperature position. Start the engine **The fans should not operate**	Interlock or Inhibit circuits faulty
2. **The lower quantity flap should be closed**	Lower quantity flap fault diagnosis
3. **The recirculation flaps should be in the 'Fresh air' position**	Recirculation flap fault diagnosis
4. Switch off the engine & reconnect the yellow/brown and black cables to the fan delay thermostat. Start the engine. **The lower quantity flap should be open**	Lower quantity flap fault diagnosis
5. **The fans should not operate for approximately 13 seconds**	Inhibit circuit

For the remainder of this test, refer to paragraphs 6 to 28 of 'Initial test - cold engine'.



Section C5

System test and fault diagnosis

Upper and lower sensor chains

Fig. C36

Components

1	Upper servo module
2	Upper servo
3	Lower servo
4	Lower servo module
5	Upper temperature selector
6	Lower temperature selector
7	Sensor connection socket
8	Solar sensor
9	Cantrail sensor
10	Knee roll sensor
11	Outside air temperature sensor (upper system)
12	Outside air temperature sensor (lower system)
13	ACU switch
14	RH 'A' post earth

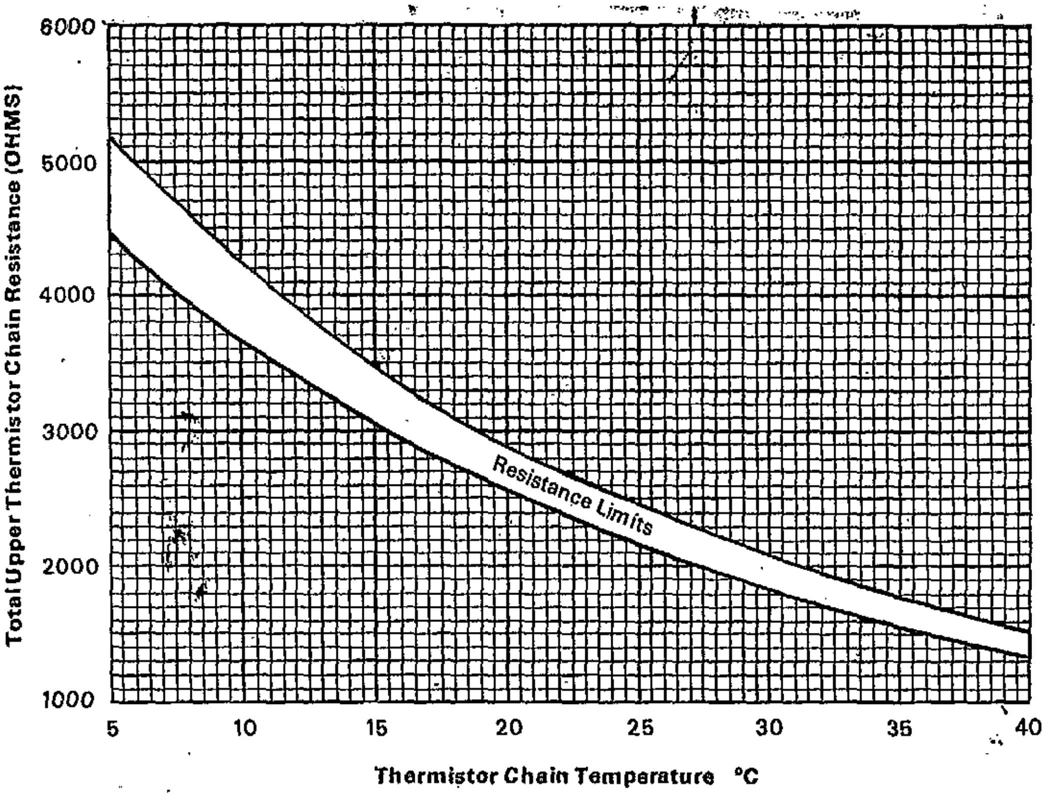
LS	Lower servo
US	Upper servo
RB9	Right-hand body socket 9 way
RTE	Right-hand toeboard socket E

Section C5

System test and fault diagnosis

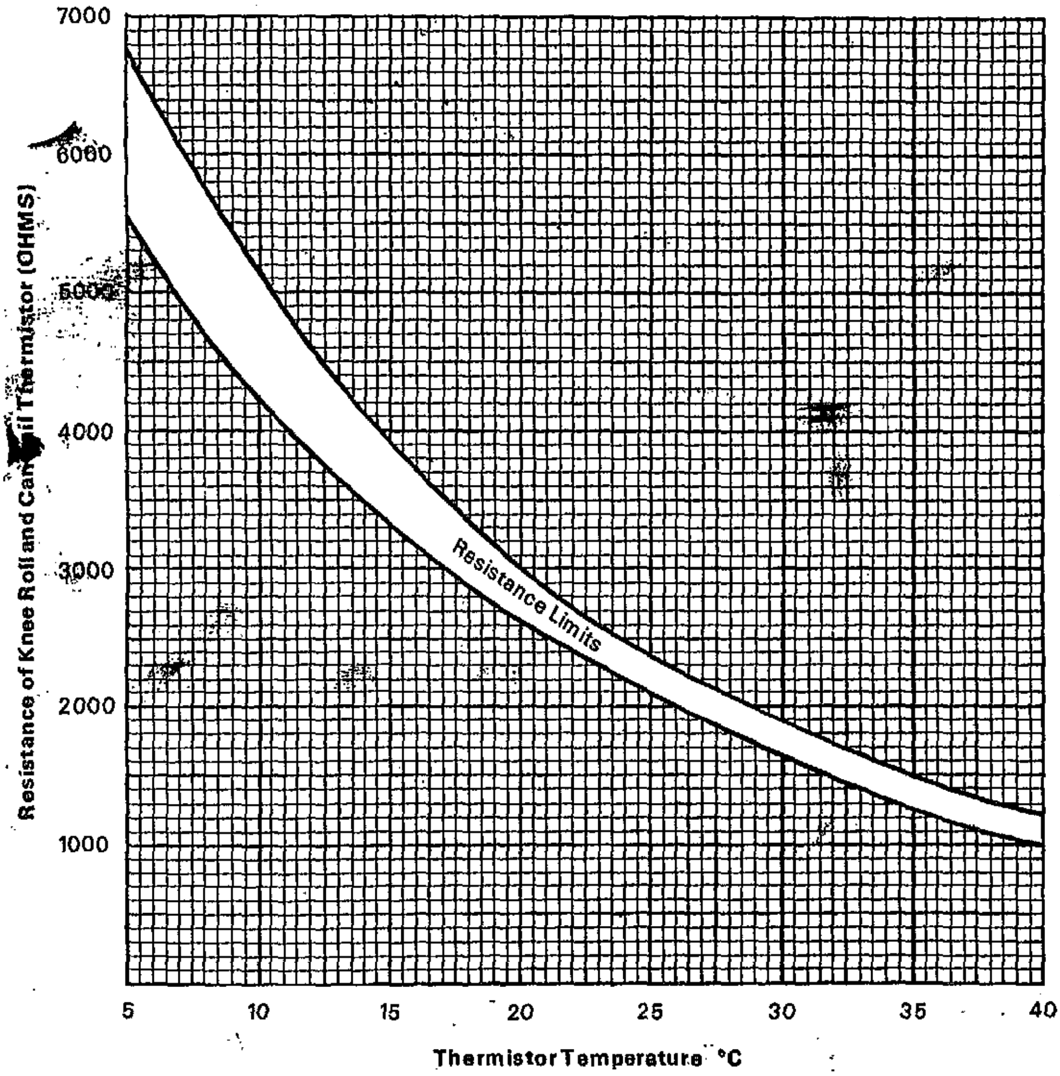
Sensor chain resistance/temperature graphs

Fig. C37



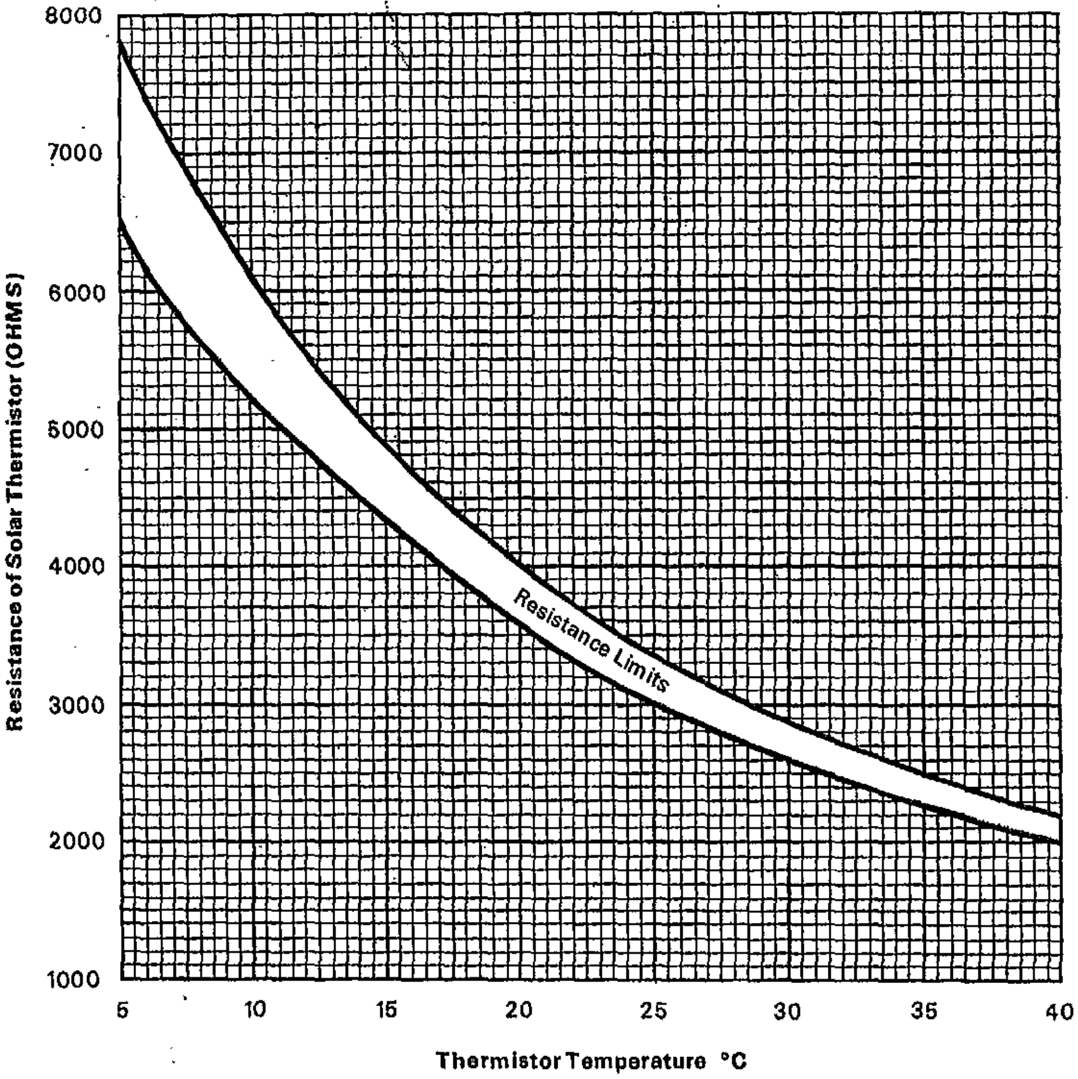
Graph 1

S 965



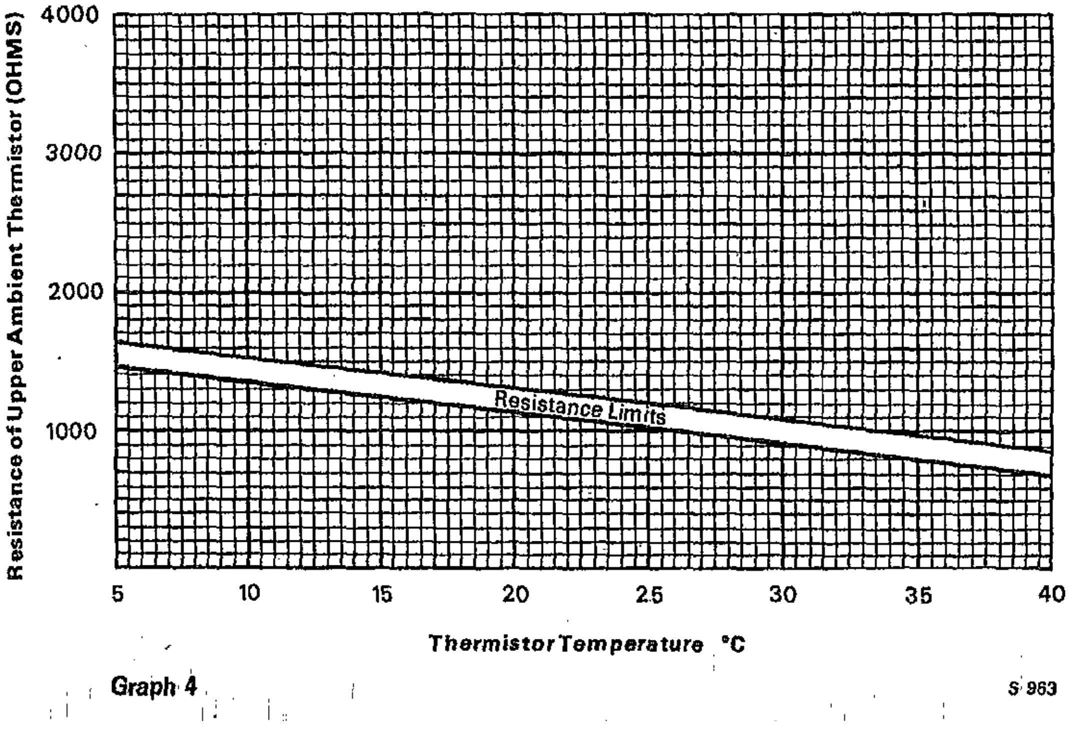
Graph 2

S 967



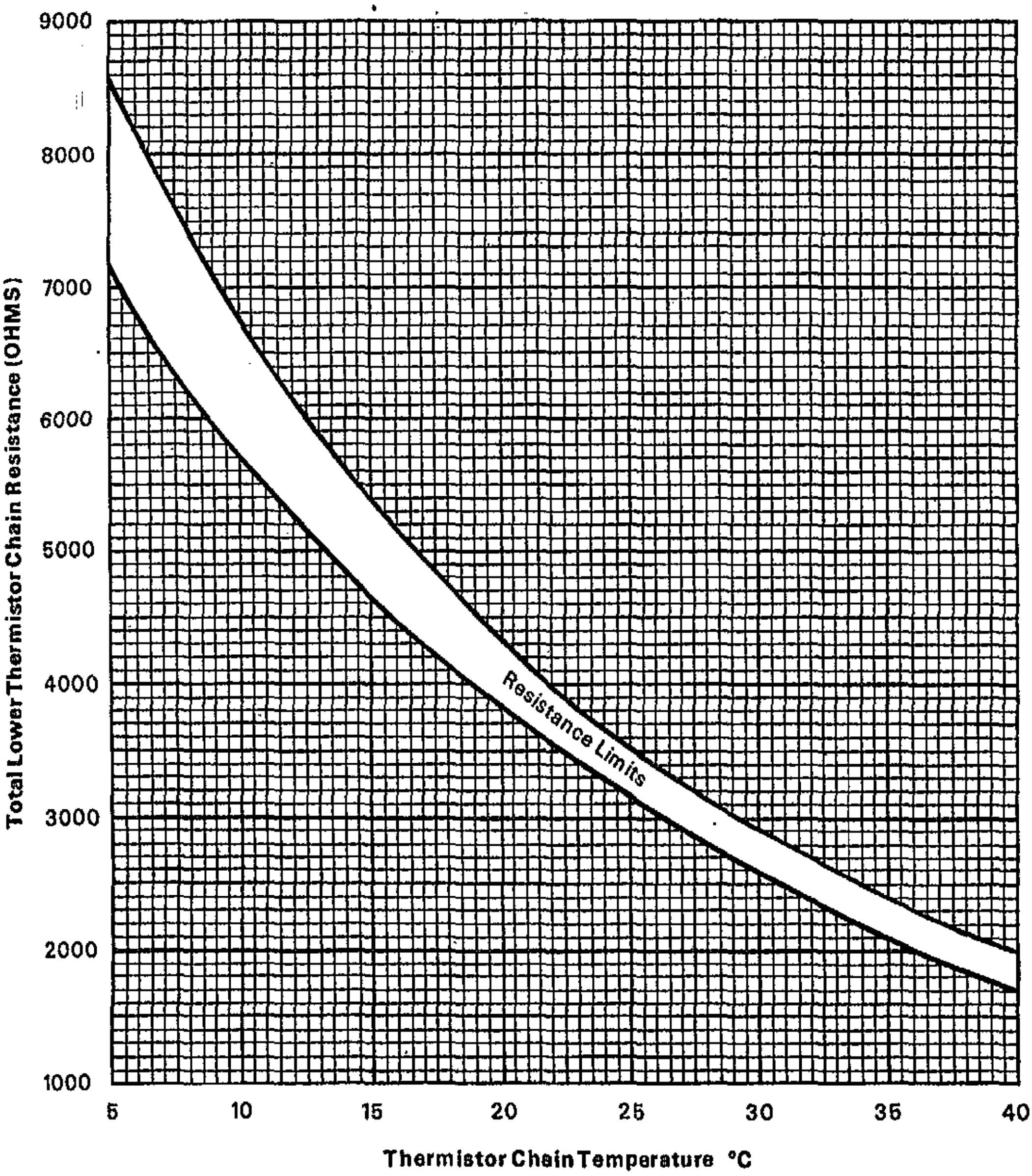
Graph 3

S 966



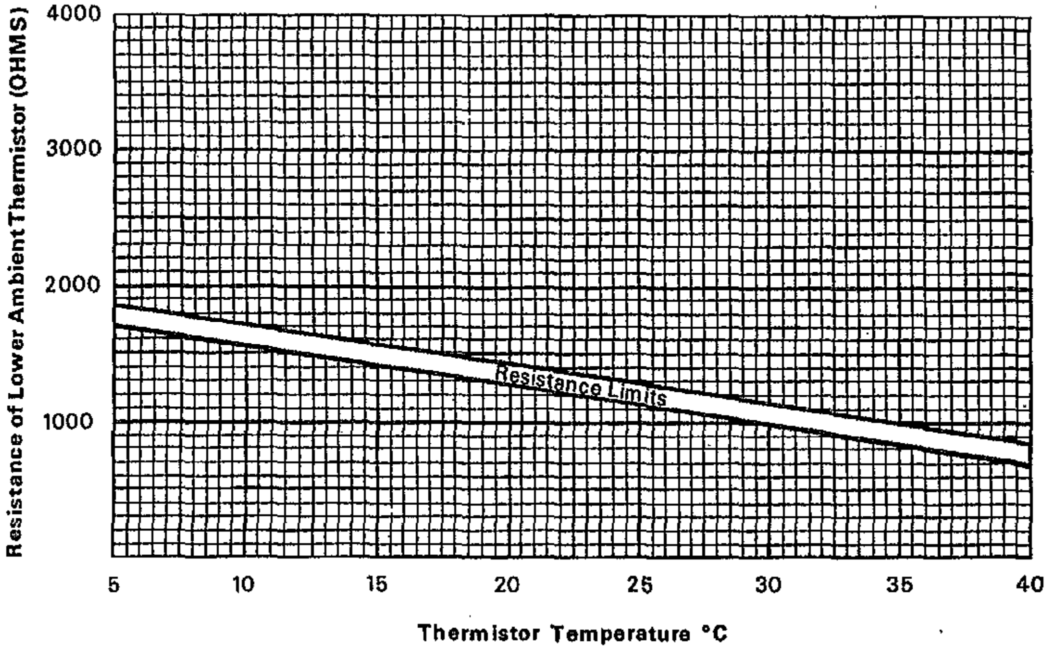
Graph 4

S 963



Graph 5

S 968



Graph 6

S 964

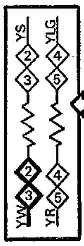
Section C5

System test and fault diagnosis

Upper sensor chain fault diagnosis
Fig. C38

If a cable fault is indicated when using this chart, refer to next page to isolate the fault.

Start



Upper sensor chain check.
Set ACU switch to AUTO. Disconnect plug & measure resistance between yellow/white cable & a good earth. Referring to graph 1, is the resistance correct?

YES → **Upper sensor chain correct. If temperature fault still exists check servo settings, water tap and lower sensor chain.**

NO ↓

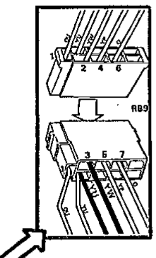
Set ACU switch to DEF. Does the resistance meter read more than 20 000Ω ?

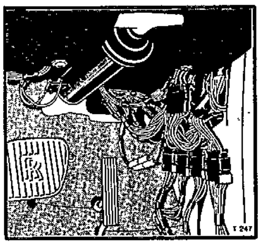
NO ↓

There is an earth fault in the sensor chain. Disconnect the right-hand body socket and isolate fault. When fault is found go back to START to check for other faults.

YES →

Cantrail sensor check
Disconnect the right-hand body socket. Measure the resistance between yellow/white cable in pin 3 and yellow/blue cable in pin 2. Referring to graph 2, is resistance correct?





Location of right-hand body sockets

NO →

Remove the cantral sensor cover. Disconnect the cantrail sensor and measure the resistance of the sensor at the sensor connector. Referring to graph2, is the resistance correct?

YES → **Cantrail sensor is correct**
Fault is in cables or connectors. After finding fault, reconnect body socket & go back to START to check for other faults.

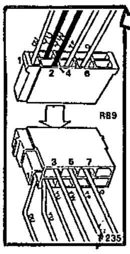
NO ↓

Fit new sensor, reconnect body socket. Go back to START to check for other faults.

YES ↓

The cantrail sensor is correct, now check solar sensor.

Solar sensor check
Measure resistance between yellow/white cable in pin 2 and yellow/blue cable in pin 3. Referring to graph 3, is the resistance correct?



NO ↓

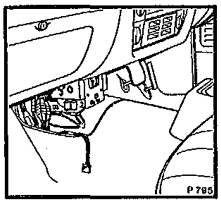
Remove top roll & disconnect sensor. Measure resistance of sensors at sensor leads. Referring to graph 3, is the resistance correct?

YES → **Solar sensor is correct.**
Fault is in cables or connector. After finding fault, reconnect body socket & go back to START to check for other faults.

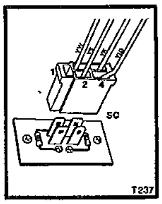
NO ↓

Fit new sensor, reconnect body socket. Go back to START to check for other faults.

YES → **Solar sensor is correct, now check ambient sensor.**

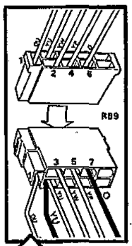


Location of sensor chain socket



Sensor chain socket

Ambient sensor check
Measure resistance between yellow/blue cable in pin 2 and orange cable in pin 7. Referring to graph 4, is the resistance correct?

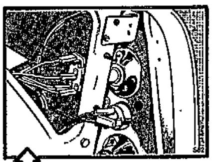


YES ↓

Ambient sensor is correct

Intermittent fault in cables or connectors in sensor chain. Ensure that all connectors are mated correctly then go back to START.

NO →



Location of ambient sensor connections

Remove trim on right-hand side of boot. Disconnect yellow/blue & orange lucar connectors. Measure resistance of cables to sensors. Referring to graph 4, is the resistance correct?

YES → **Ambient sensor is correct.**
Fault is in cables or connectors from body socket. After finding fault, reconnect Lucar & body sockets, go back to START to check for other faults.

NO ↓

Fit new sensors (upper & lower) & reconnect 'Lucar' connectors and body socket. Go back to START to check for other faults.

These are landmarks. They show which part of the system has been proved correct.

Section C5

System test and fault diagnosis

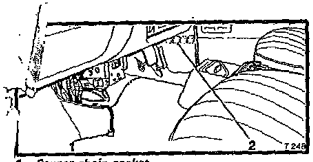
Upper sensor chain cable faults

Fig. C39

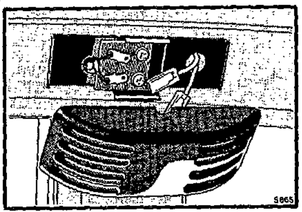
This chart enables the user to isolate a cable fault in the sensor chain by separately testing each cable for open circuit (broken cable) or short circuit (earth fault).

When a cable fault is suspected, disconnect the first cable as shown at the top of the chart, test it with the resistance meter and if it is satisfactory, reconnect it and test the next cable in the circuit. If a faulty cable is found, rectify the fault and measure the total sensor chain resistance to ensure that another fault does not exist.

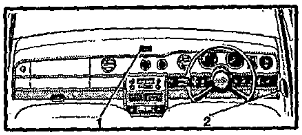
If the fault is a short circuit, the simplest remedy is to sever the cable at each end by cutting it or disconnecting it and insulating the ends with tape, then insert a new length of cable.



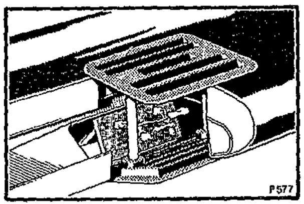
1. Sensor chain socket
2. Right-hand body sockets



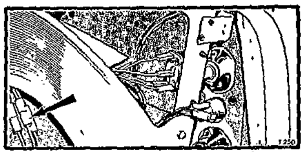
Cantrail sensor



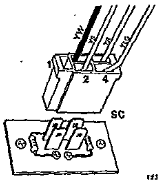
1. Solar sensor
2. Cantrail sensor



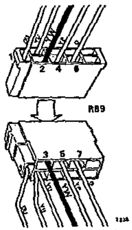
Solar sensor



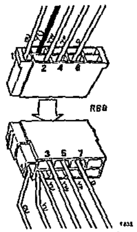
Outside temperature connectors



Sensor chain socket

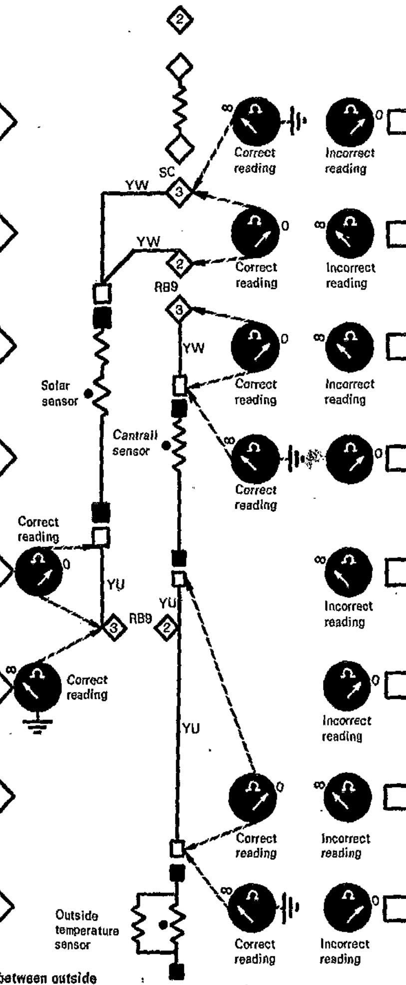


Right-hand body socket



Right-hand body socket

Resistance meter connection	Fault location
Connect meter between pin 3 of sensor chain socket (yellow/white cable) and 'A' post earth.	Earth fault on yellow/white cable.
Connect meter between pin 3 of sensor chain socket and pin 2 of right-hand body socket (yellow/white cable).	Open circuit on yellow/white cable or poor connection at solar sensor.
Connect meter between pin 3 of right-hand body socket and yellow/white cable at cantrail sensor.	Open circuit on yellow/white cable.
Connect meter between yellow/white cable at cantrail sensor and a good earth.	Earth fault on yellow/white cable.
Connect meter between yellow/blue connection at solar sensor and pin 3 at right-hand body socket.	Open circuit on yellow/blue cable.
Connect meter between pin 3 at right-hand body socket and 'A' post earth.	Earth fault on yellow/blue cable.
Connect meter between yellow/blue cable at cantrail sensor and yellow/blue cable at outside temperature sensor.	Open circuit on yellow/blue cable.
Connect meter between yellow/blue cable at outside temperature sensor and boot earth.	Earth fault on yellow/blue cable.



For cable faults on the orange cable between outside temperature sensor and ECU switch, refer to chart for lower

∞ = Meter reading over 100

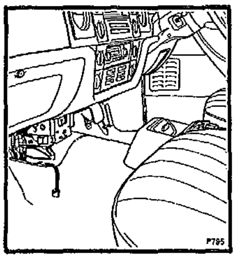
Section C5

System test and fault diagnosis

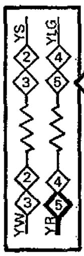
Lower sensor chain fault diagnosis

Fig. C40

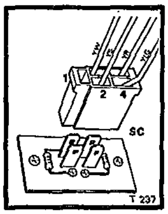
If a cable fault is indicated when using this chart, refer to next page to isolate the fault.



Location of sensor chain socket



Sensor chain socket schematic diagram



Sensor chain socket

Start

Lower sensor chain check. Set ACU switch to AUTO. Disconnect servo trim cover plug & measure resistance between yellow/red wire & a good earth. Referring to graph 5, is the resistance correct?

YES

Lower sensor chain is correct
If temperatre fault still exists, check serv settings, water tap and upper ensor chain.

NO

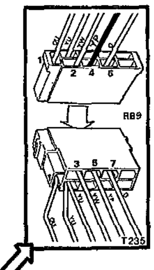
Set ACU switch to DEF. Does the resistance meter read more than 20 000Ω ?

NO

There is an earth fault in the sensor chain. Disconnect the right-hand body socket and isolate fault. When fault is found, go back to START to check for other faults.

YES

Knee roll snsor check
Disconnecthe right-hand body socket & masure the resistance between th yellow/purple cable in pin 4 anl the yellow/red cable at servo plg. Referring to graph 2, is the reistance correct?



NO

Unfasten the fuseboard cover. Disconnect the Lucar connector from the knee roll sensor and measure the resistance across the sensor. Referring to graph 2, is the resistance correct?

YES

Knee roll sensor is correct
Fault is in cables or connectors. After finding the fault, reconnect body socket, go back to START to check for other faults.

NO

Fit new sensor, reconnect body socket. Go back to START to check for other faults.

YES

The knee rll sensor is correct, now checkambient sensor.

Ambient sasor check
Measure reistance between yellow/purle in pin 5 and orange cab in pin 7. Referring to graph 6,is resistance correct?

NO

Remove trim on right-hand side of boot. Disconnect orange and yellow/purple Lucar connectors. Measure the resistance of cables to sensors. Referring to graph 6, is the resistance correct?

YES

Ambient sensor is correct
Fault is in cables or connectors from body socket. After finding fault, reconnect Lucar and body sockets, go back to START to check for other faults.

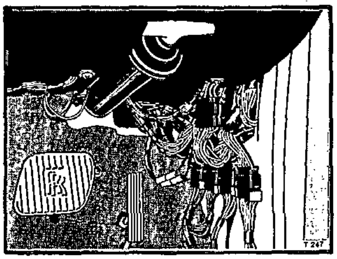
NO

Fit new sensors (upper & lower), reconnect Lucar connectors and body socket. Go back to START to check for other faults.

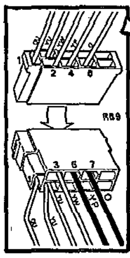
YES

Ambientsensor is correct

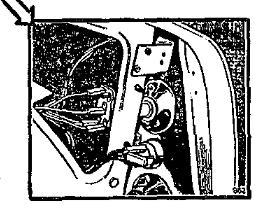
Go back t START to check for other faul.



Location of right-hand body sockets



Right-hand body socket



Location of ambient sensor connection

These are landmarks. They show which part of the system has been proved correct.

Section C5

System test and fault diagnosis

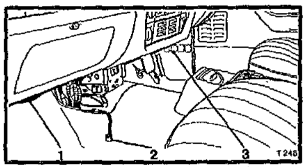
Lower sensor chain cable faults

Fig. C41

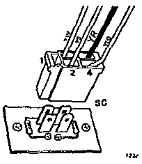
This chart enables the user to isolate a cable fault in the sensor chain by separately testing each cable for open circuit (broken cable) or short circuit (earth fault).

When a cable fault is suspected, disconnect the first cable as shown at the top of the chart, test it with the resistance meter and if it is satisfactory, reconnect it and test the next cable in the circuit. If a faulty cable is found, rectify the fault and measure the total sensor chain resistance to ensure that another fault does not exist.

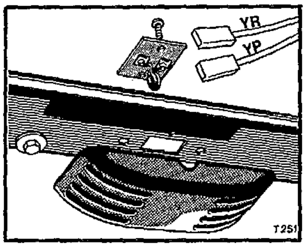
If the fault is a short circuit, the simplest remedy is to sever the cable at each end by cutting it or disconnecting it and insulating the ends with tape, then insert a new length of cable.



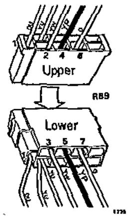
1. Knee roll sensor 2. Sensor chain socket
3. Right-hand body sockets



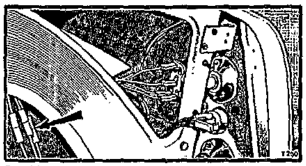
Sensor chain socket



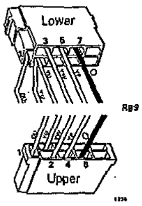
Knee roll sensor



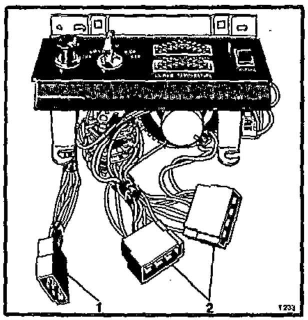
Right-hand body socket



Outside temperature connectors



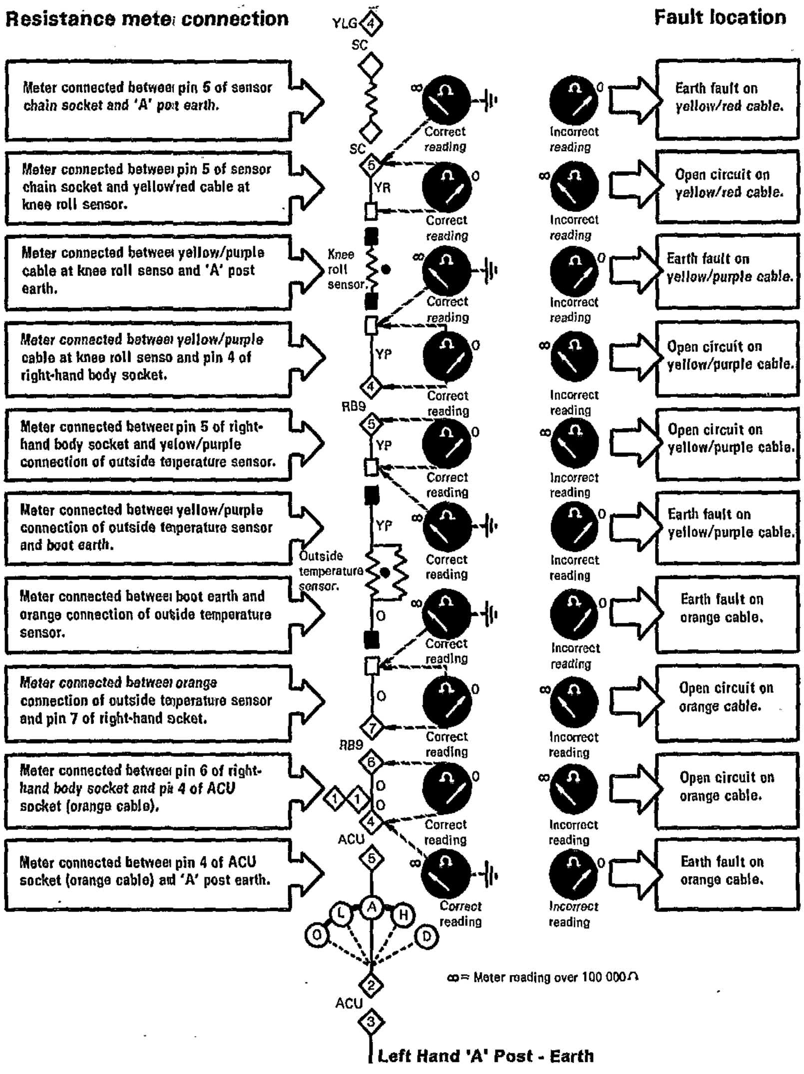
Right-hand body socket



1. Hazard switch socket
2. A.C.U. sockets

Resistance meter connection

Fault location



Resistance meter connection	Fault location
Meter connected between pin 5 of sensor chain socket and 'A' post earth.	Earth fault on yellow/red cable.
Meter connected between pin 5 of sensor chain socket and yellow/red cable at knee roll sensor.	Open circuit on yellow/red cable.
Meter connected between yellow/purple cable at knee roll senso and 'A' post earth.	Earth fault on yellow/purple cable.
Meter connected between yellow/purple cable at knee roll senso and pin 4 of right-hand body socket.	Open circuit on yellow/purple cable.
Meter connected between pin 5 of right-hand body socket and yelow/purple connection of outside temperature sensor.	Open circuit on yellow/purple cable.
Meter connected between yellow/purple connection of outside temperature sensor and boot earth.	Earth fault on yellow/purple cable.
Meter connected between boot earth and orange connection of outside temperature sensor.	Earth fault on orange cable.
Meter connected between orange connection of outside temperature sensor and pin 7 of right-hand socket.	Open circuit on orange cable.
Meter connected between pin 6 of right-hand body socket and pin 4 of ACU socket (orange cable).	Open circuit on orange cable.
Meter connected between pin 4 of ACU socket (orange cable) and 'A' post earth.	Earth fault on orange cable.

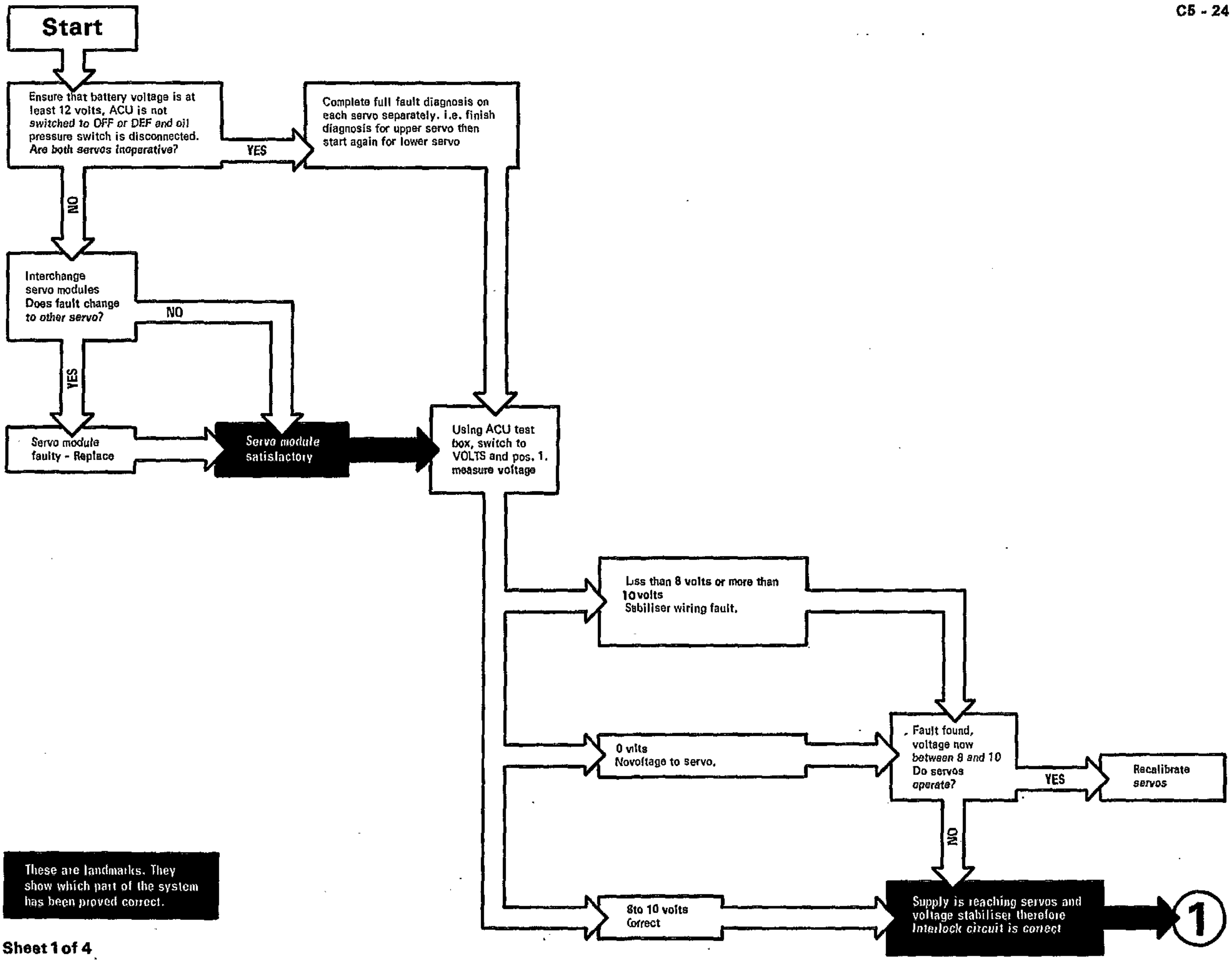
∞ = Meter reading over 100 000Ω

Left Hand 'A' Post - Earth

Section C5

System test and fault diagnosis

Servo fault diagnosis Sheet 1 of 4
Fig. C42



These are landmarks. They show which part of the system has been proved correct.

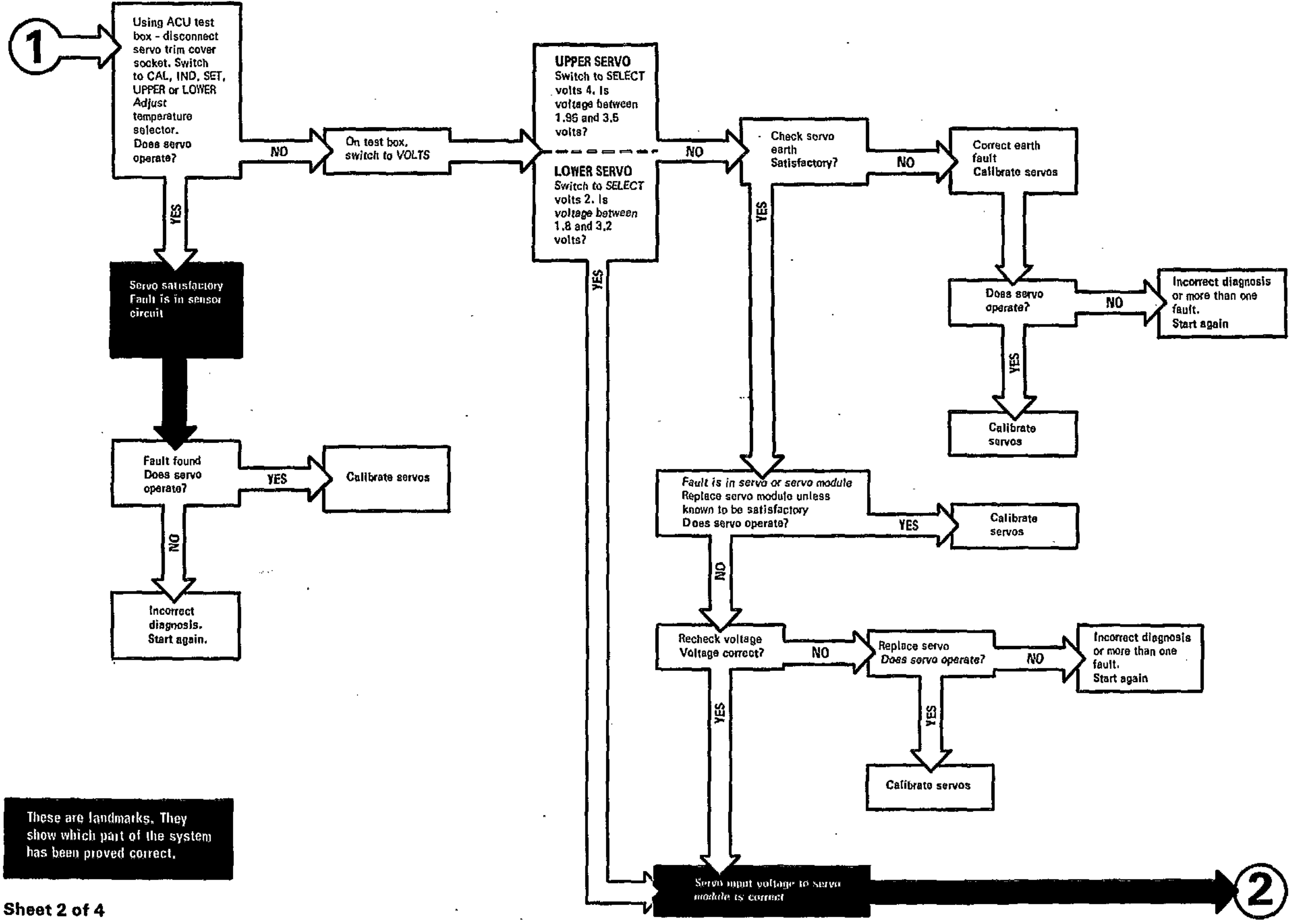
Sheet 1 of 4

Section C5

System test and fault diagnosis

Servo fault diagnosis Sheet 2 of 4

Fig. C42 continued



These are landmarks. They show which part of the system has been proved correct.

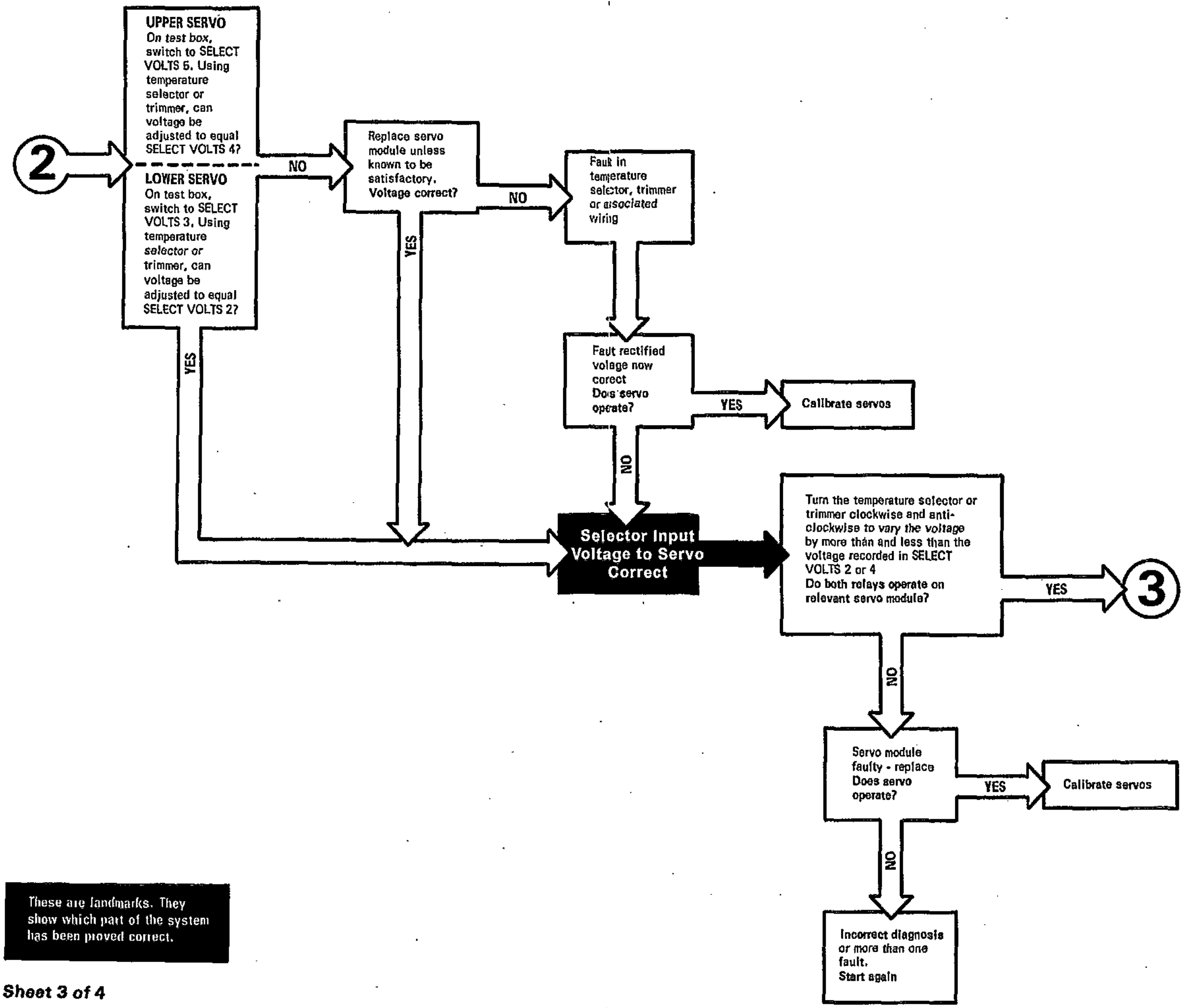
Sheet 2 of 4

Section C5

System test and fault diagnosis

Servo fault diagnosis Sheet 3 of 4

Fig. C42 continued



These are landmarks. They show which part of the system has been proved correct.

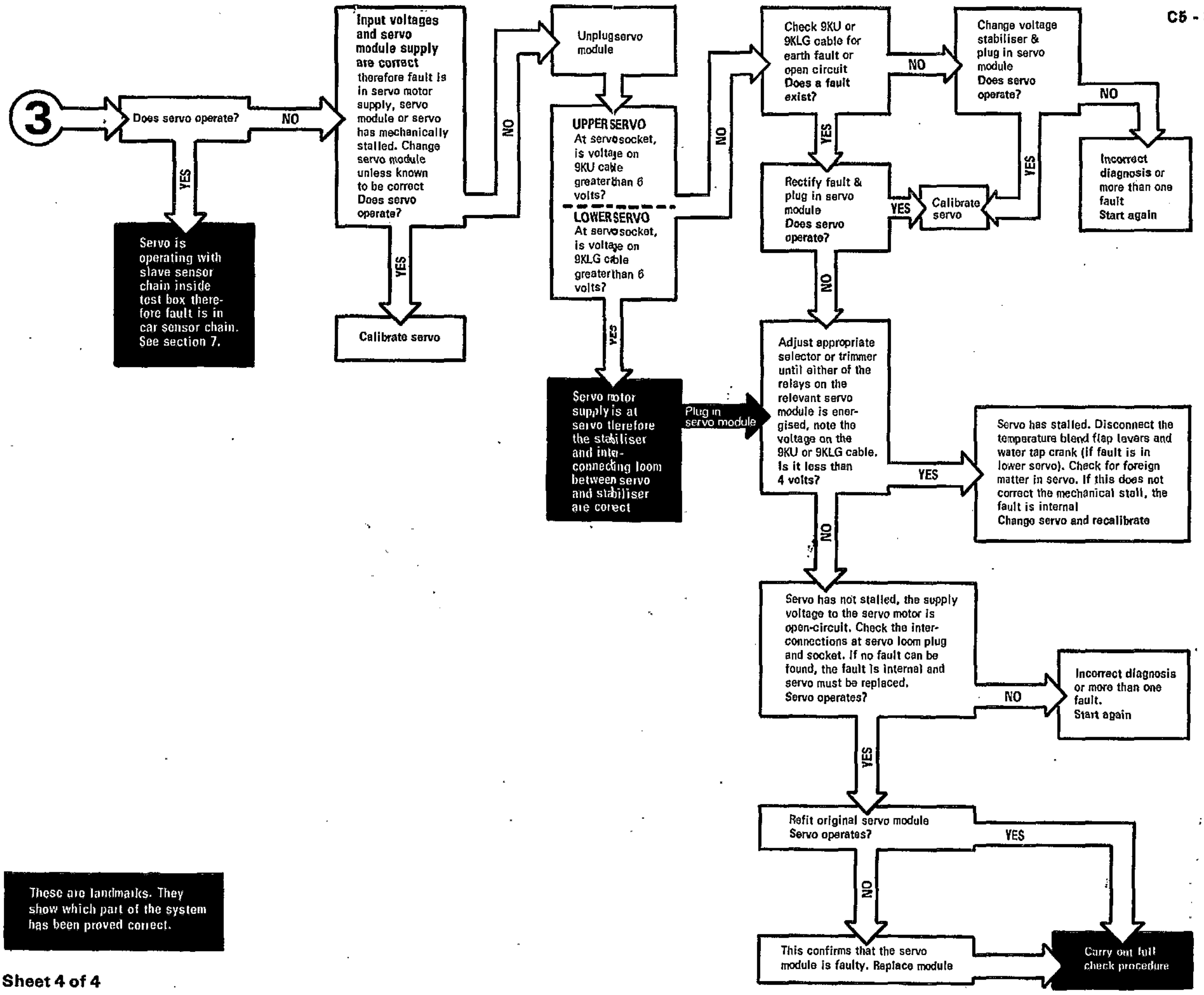
Sheet 3 of 4

Section C 5

System test and fault diagnosis

Servo fault diagnosis Sheet 4 of 4

Fig. C42 continued

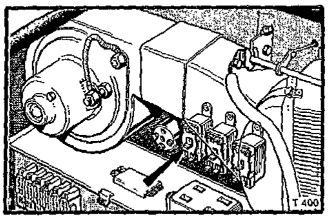


These are landmarks. They show which part of the system has been proved correct.

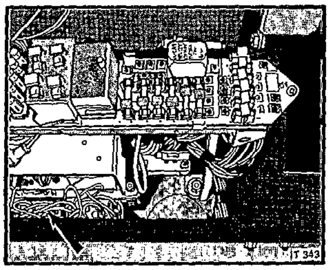
Section C5

System test and fault diagnosis

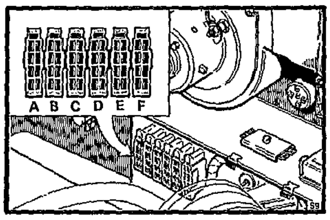
Fans inoperative in all situations
Fig. C43



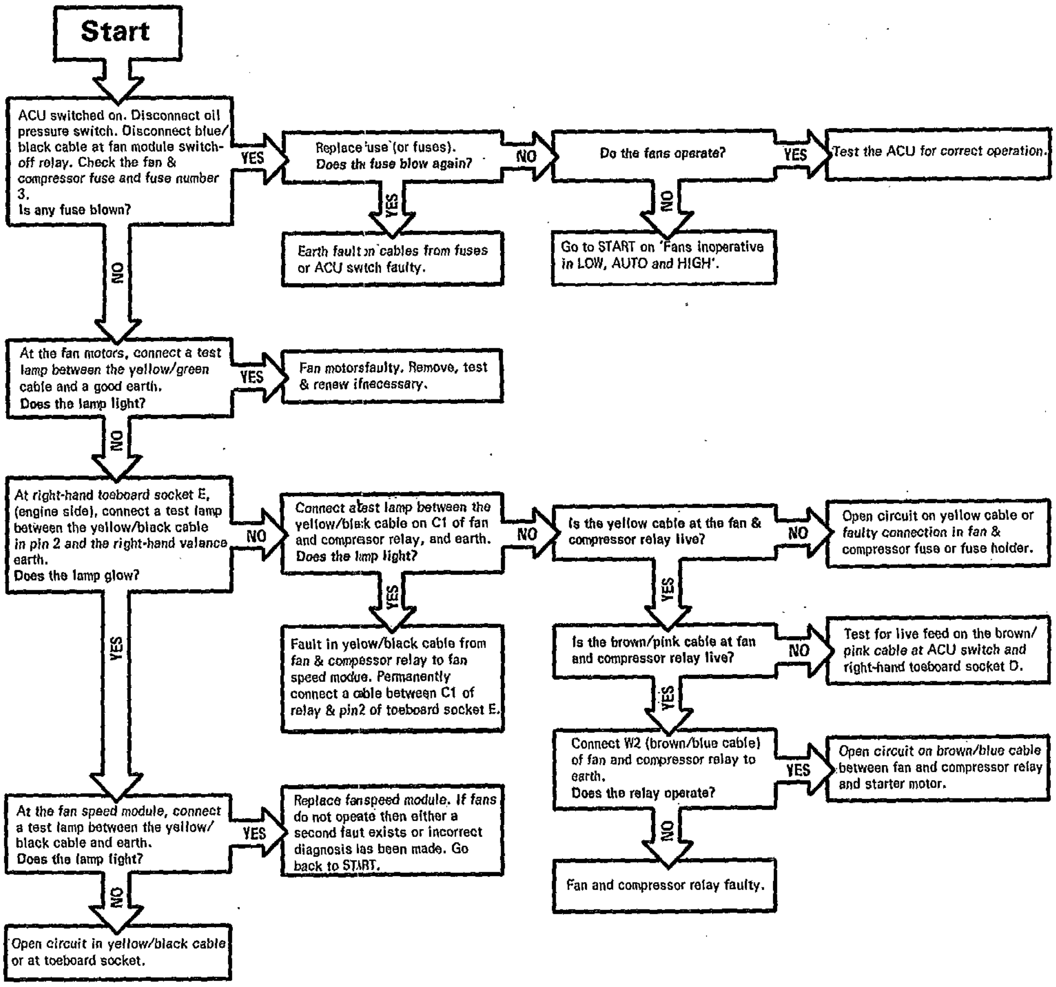
Fan and compressor relay



Fan switch-off relay right-hand drive cars. For left-hand drive cars, see Section C4.



Toeboard socket (engine side)



Start

ACU switched on. Disconnect oil pressure switch. Disconnect blue/black cable at fan module switch-off relay. Check the fan & compressor fuse and fuse number 3.
Is any fuse blown?

Replace fuse (or fuses).
Does the fuse blow again?

Earth fault in cables from fuses or ACU swtch faulty.

Do the fans operate?

Test the ACU for correct operation.

Go to START on 'Fans inoperative in LOW, AUTO and HIGH'.

At the fan motors, connect a test lamp between the yellow/green cable and a good earth.
Does the lamp light?

Fan motorsfaulty. Remove, test & renew ifnecessary.

At right-hand toeboard socket E, (engine side), connect a test lamp between the yellow/black cable in pin 2 and the right-hand valance earth.
Does the lamp glow?

Connect a test lamp between the yellow/black cable on C1 of fan and compresor relay, and earth.
Does the lamp light?

Fault in yelow/black cable from fan & compessor relay to fan speed modue. Permanently connect a cable between C1 of relay & pin2 of toeboard socket E.

Is the yellow cable at the fan & compressor relay live?

Open circuit on yellow cable or faulty connection in fan & compressor fuse or fuse holder.

Is the brown/pink cable at fan and compressor relay live?

Test for live feed on the brown/pink cable at ACU switch and right-hand toeboard socket D.

Connect W2 (brown/blue cable) of fan and compressor relay to earth.
Does the relay operate?

Open circuit on brown/blue cable between fan and compressor relay and starter motor.

Fan and compressor relay faulty.

At the fan speed module, connect a test lamp between the yellow/black cable and earth.
Does the lamp light?

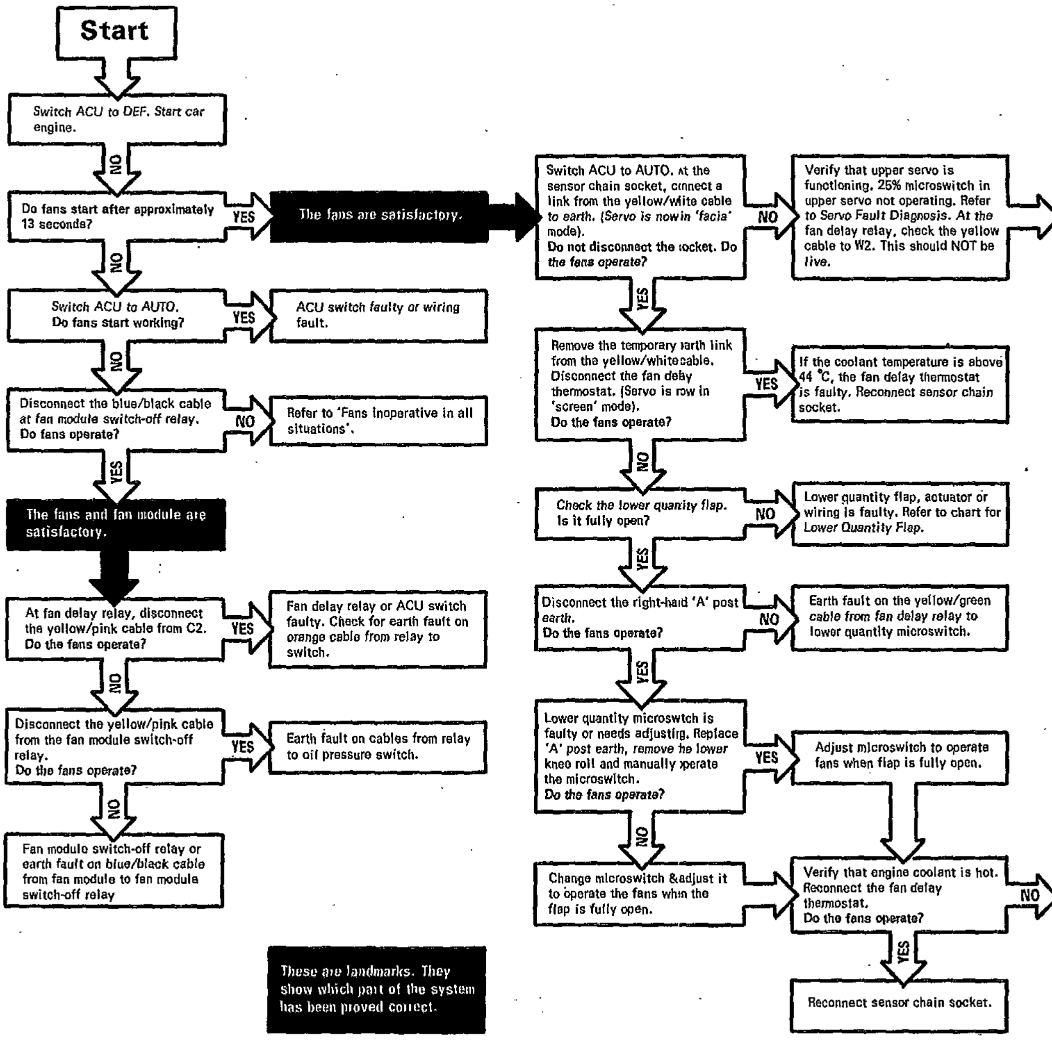
Replace fanspeed module. If fans do not opeate then either a second faut exists or incorrect diagnosis las been made. Go back to START.

Open circuit in yellow/black cable or at toeboard socket.

Section C5

System test and fault diagnosis

Fans inoperative in LOW AUTO and HIGH
Fig. C44



Start

Switch ACU to DEF. Start car engine.

Do fans start after approximately 13 seconds?

The fans are satisfactory.

Switch ACU to AUTO.
Do fans start working?

ACU switch faulty or wiring fault.

Disconnect the blue/black cable at fan module switch-off relay.
Do fans operate?

Refer to 'Fans inoperative in all situations'.

The fans and fan module are satisfactory.

At fan delay relay, disconnect the yellow/pink cable from C2.
Do the fans operate?

Fan delay relay or ACU switch faulty. Check for earth fault on orange cable from relay to switch.

Disconnect the yellow/pink cable from the fan module switch-off relay.
Do the fans operate?

Earth fault on cables from relay to oil pressure switch.

Fan module switch-off relay or earth fault on blue/black cable from fan module to fan module switch-off relay

These are landmarks. They show which part of the system has been proved correct.

Switch ACU to AUTO. At the sensor chain socket, connect a link from the yellow/white cable *to earth. (Servo is nowin 'facia'* mode).
Do not disconnect the socket. Do *the fans operate?*

Verify that upper servo is functioning. 25% microswitch in upper servo not operating. Refer *to Servo Fault Diagnosis. At the* fan delay relay, check the yellow cable to W2. This should NOT be *live.*

If the yellow cable is live and the servo is operating correctly, there is a fault on the cables from *servo to fan delay relay.*

Remove the temporary earth link from the yellow/white cable. Disconnect the fan delay thermostat. (Servo is now in 'screen' mode).
Do the fans operate?

If the coolant temperature is above 44 °C, the fan delay thermostat is faulty. Reconnect sensor chain socket.

Check the lower quanity flap.
Is it fully open?

Lower quantity flap, actuator or wiring is faulty. Refer to chart for *Lower Quantity Flap.*

Disconnect the right-hand 'A' post *earth.*
Do the fans operate?

Earth fault on the yellow/green *cable from fan delay relay to* lower quantity microswitch.

Lower quantity microswtch is faulty or needs adjusting. Replace 'A' *post* earth, *remove the lower* knee roll and manually operate the microswitch.
Do the fans operate?

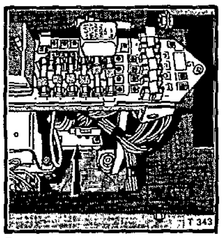
Adjust microswitch to operate fans when flap is fully open.

Change microswitch &adjust it to operate the fans when the flap is fully open.

Verify that engine coolant is hot. Reconnect the fan delay thermostat.
Do the fans operate?

Earth fault on the yellow/brown cable from diode to thermostat or from diode to lower quantity relay.

Reconnect sensor chain socket.



Diode board right-hand drive cars

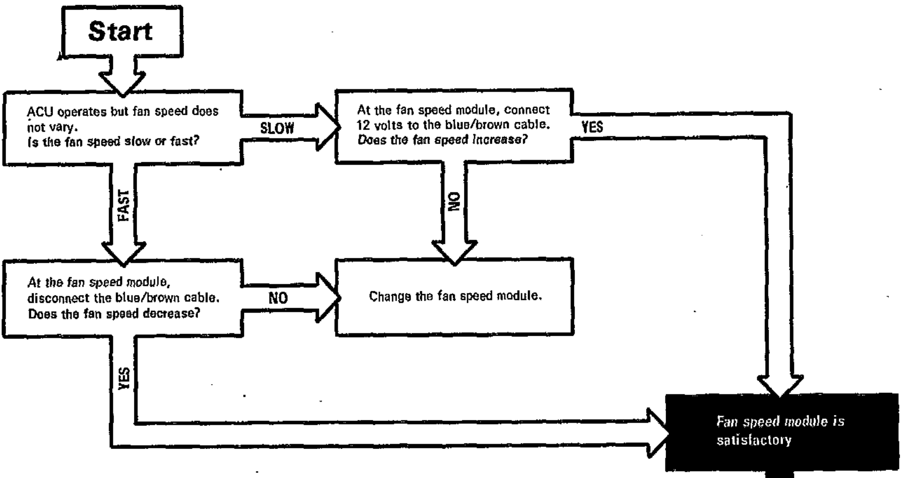
Diode board left-hand drive cars viewed with top roll removed

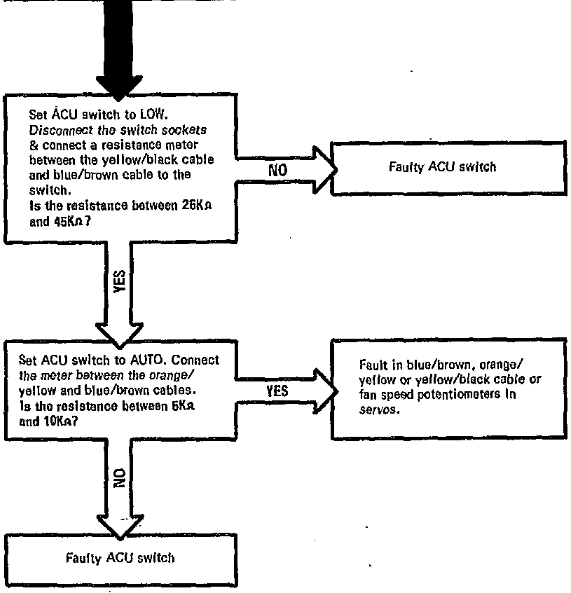
Section C5

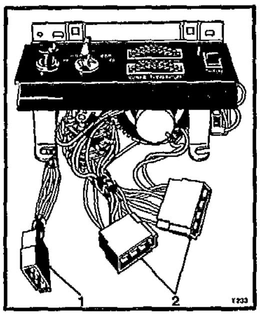
System test and fault diagnosis

Fan speed does not vary

Fig. C45







1. Hazard switch socket
2. A.C.U. sockets

These are landmarks. They show which part of the system has been proved correct.

Section C5

System test and fault diagnosis

Recirculation flaps inoperative

Fig. C47

Start

Are both actuators inoperative?

NO: Using a test lamp, test for 12 volts at the faulty actuator that is faulty, also test for 12 volts on the orange/slate or orange/green cables as appropriate at the diode board. Check the earth connections at the 'A' post.

YES

At the recirculation relay, connect a test lamp between the red/brown cable on C2 and a good earth.
Is the lamp lit?

NO: Test for a live feed on the red/brown cable at the ACU switch socket and the fuseboard.

YES

Set the ACU switch to OFF. At the recirculation relay, connect the test lamp between earth and the orange/brown cable. At the servo, disconnect the blue/pink 'flying lead'.
Is the test lamp lit?

NO: The recirculation relay is faulty.

YES

Set ACU switch to LOW. At the recirculation relay, connect a test lamp between earth and the orange/light green cable. Connect the blue/pink flying lead from the relay to earth.
Is the test lamp lit?

YES: The recirculation relay and the voltage supply to it are satisfactory.

NO

Connect the test lamp between earth and the brown/pink cable at the relay.
Is the lamp lit?

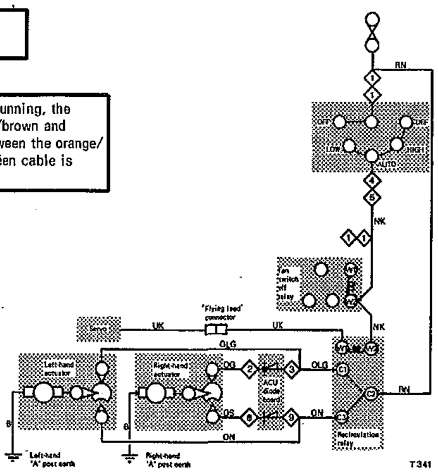
NO: Referring to the actuator wiring diagram, test for 12 volts on the brown/pink cable at the ACU switch (in the LOW position) and the fan switch-off relay.

YES

The recirculation relay is faulty.

Note

If the actuators continue running, the diode between the orange/brown and orange/slate cable or between the orange/light green and orange/green cable is short circuit.



Have the actuators moved from the 'Recirculation' to the 'Fresh' position?

NO: Check the continuity of the orange/light green cable between the relay and diode block.

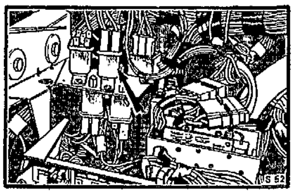
YES

Remove the earth link from the blue/pink 'flying lead' but do not connect the leads. Have the actuators moved to the 'Recirculation' position?

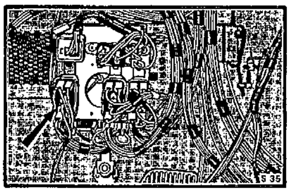
YES: The recirculation circuit is satisfactory. The fault is probably in the servo, refer to servo fault diagnosis.

NO

Check the continuity of the orange/brown cable between the relay and the diode block.

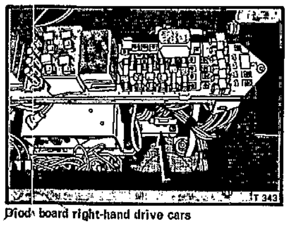


Recirculation relay right-hand drive cars

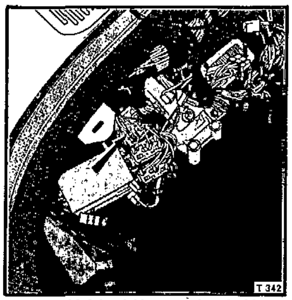


Recirculation relay left-hand drive cars

These are landmarks. They show which part of the system has been proved correct.



Diode board right-hand drive cars

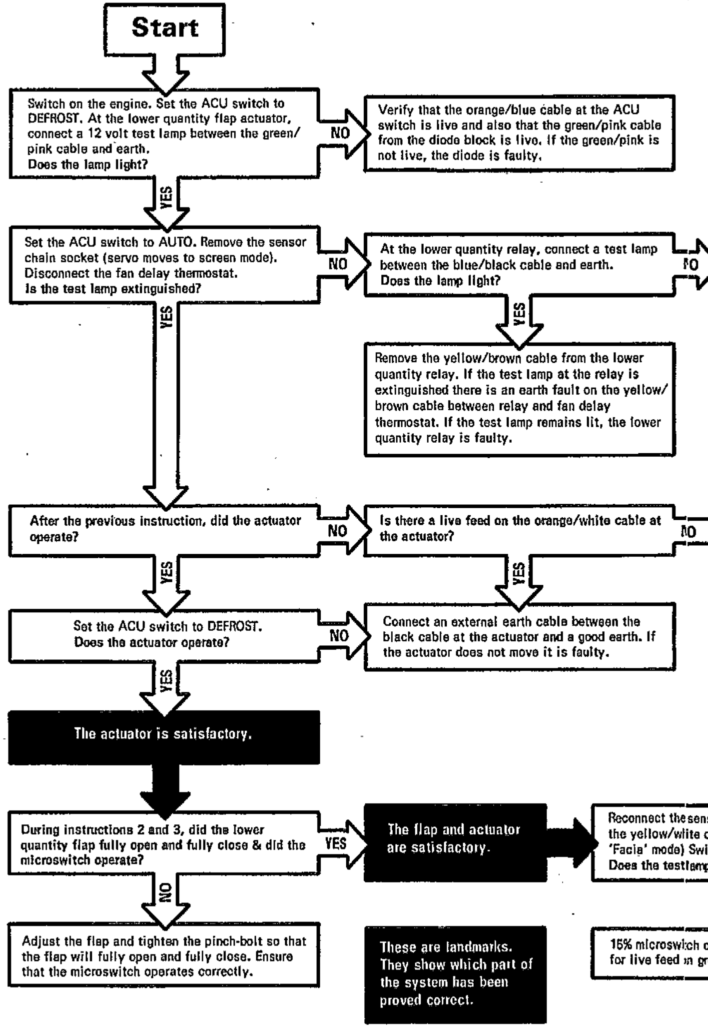


Diode board left-hand drive cars viewed with top roll removed

Section C5

System test and fault diagnosis

Lower quantity flap inoperative
Sheet 1 of 2
Fig. C48



Switch on the engine. Set the ACU switch to DEFROST. At the lower quantity flap actuator, connect a 12 volt test lamp between the green/pink cable and earth.
Does the lamp light?

Verify that the orange/blue cable at the ACU switch is live and also that the green/pink cable from the diode block is live. If the green/pink is not live, the diode is faulty.

Set the ACU switch to AUTO. Remove the sensor chain socket (servo moves to screen mode).
Disconnect the fan delay thermostat.
Is the test lamp extinguished?

At the lower quantity relay, connect a test lamp between the blue/black cable and earth.
Does the lamp light?

An incorrect live feed to the actuator is being supplied from the orange/black cable at ACU switch or the green/pink cable at upper servo plug. Replace the appropriate faulty component. (ACU switch or servo).

Remove the yellow/brown cable from the lower quantity relay. If the test lamp at the relay is extinguished there is an earth fault on the yellow/brown cable between relay and fan delay thermostat. If the test lamp remains lit, the lower quantity relay is faulty.

After the previous instruction, did the actuator operate?

Is there a live feed on the orange/white cable at the actuator?

Go to sheet 2

Set the ACU switch to DEFROST.
Does the actuator operate?

Connect an external earth cable between the black cable at the actuator and a good earth. If the actuator does not move it is faulty.

The actuator is satisfactory.

During instructions 2 and 3, did the lower quantity flap fully open and fully close & did the microswitch operate?

The flap and actuator are satisfactory.

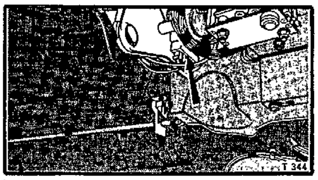
Reconnect thesensor chain socket & connect the yellow/wite cable to earth. (Servo moves to 'Facia' mode) Switch to AUTO.
Does the testlamp light?

2 faults or incorrect diagnosis.

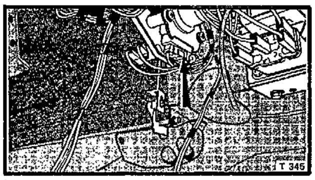
Adjust the flap and tighten the pinch-bolt so that the flap will fully open and fully close. Ensure that the microswitch operates correctly.

These are landmarks. They show which part of the system has been proved correct.

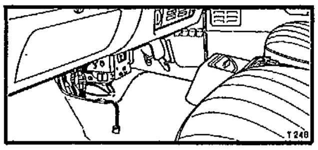
15% microswitch on upper servo faulty, check for live feed in green/pink cable at servo plug.



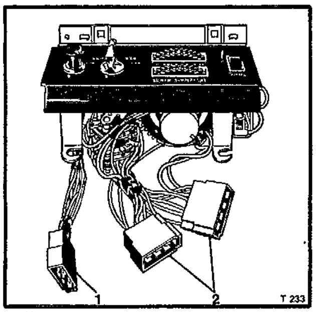
Lower quantity flap actuator right-hand drive cars.



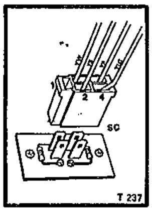
Lower quantity flap actuator left-hand drive cars.



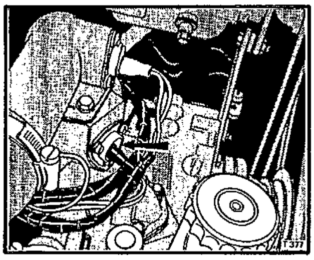
Location of sensor chain socket.



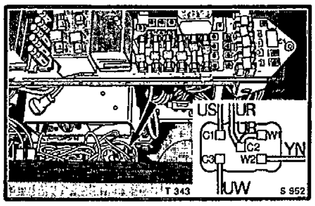
1. Hazard switch socket
2. A.C.U. sockets



Sensor chain socket.



Fan delay thermostat.

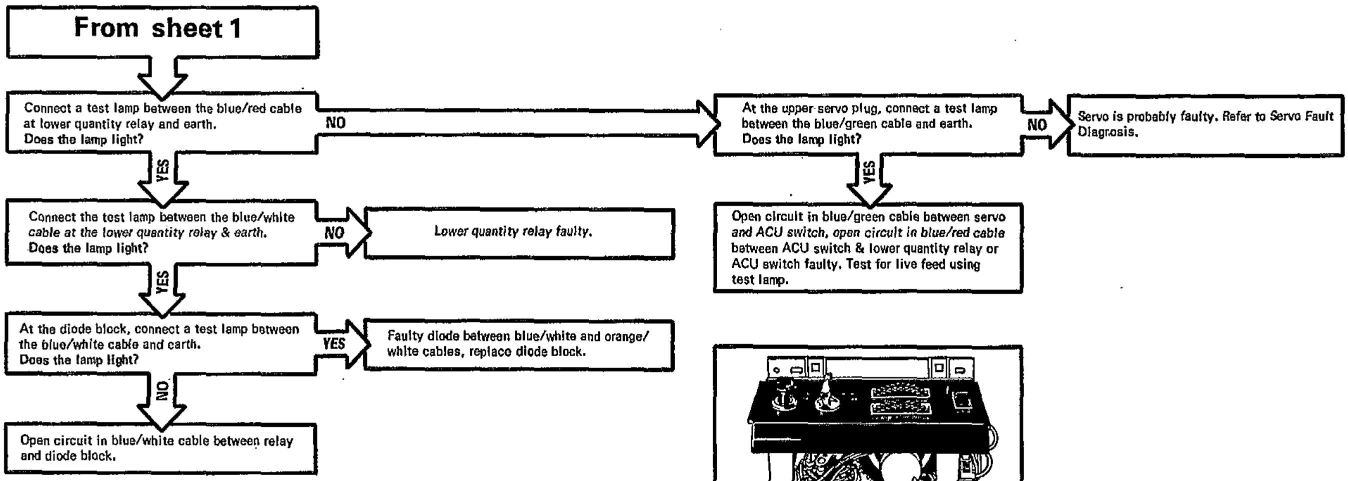


Lower quantity relay.

Section C5

System test and fault diagnosis

Lower quantity flap inoperative
Sheet 2 of 2
Fig. C48 continued



Connect a test lamp between the blue/red cable at lower quantity relay and earth. Does the lamp light?

At the upper servo plug, connect a test lamp between the blue/green cable and earth. Does the lamp light?

Servo is probably faulty. Refer to Servo Fault Diagnosis.

Open circuit in blue/green cable between servo and ACU switch, open circuit in blue/red cable between ACU switch & lower quantity relay or ACU switch faulty. Test for live feed using test lamp.

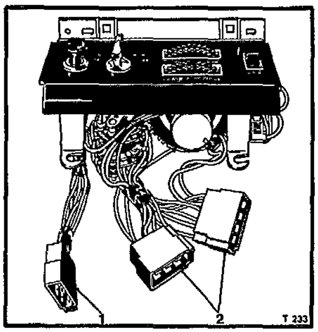
Connect the test lamp between the blue/white cable at the lower quantity relay & earth. Does the lamp light?

Lower quantity relay faulty.

At the diode block, connect a test lamp between the blue/white cable and earth. Does the lamp light?

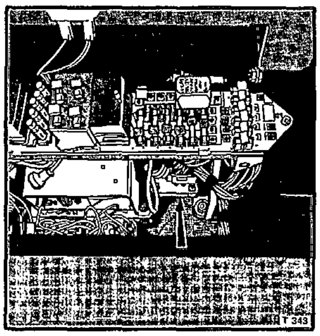
Faulty diode between blue/white and orange/white cables, replace diode block.

Open circuit in blue/white cable between relay and diode block.



1. Hazard switch socket
2. A.C.U. sockets

Diode board,left-hand drive cars,viewed with top roll removed.

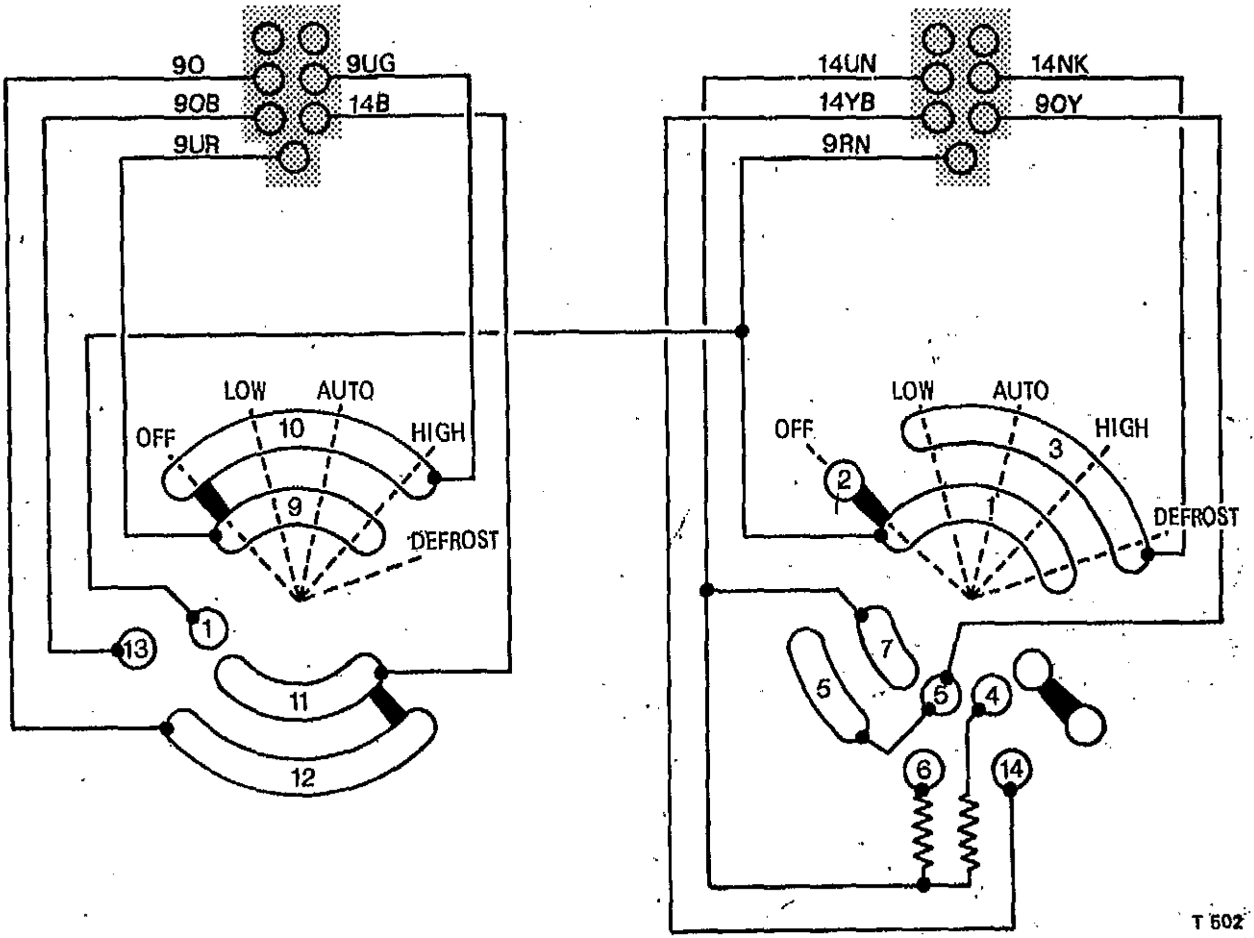


Diode board,right-hand drive cars.

Section C5

System test and fault diagnosis

ACU switch wiring diagram and testing
Fig. C49



Resistance meter connection:

	Blue/green & blue/red	Orange/black & red/brown	Black & orange	Red/brown & brown/pink	Yellow/black & blue/brown	Orange/yellow & blue/brown
OFF	Short circuit	Open circuit	Short circuit	Open circuit	Open circuit	Open circuit
LOW	Short circuit	Open circuit	Short circuit	Short circuit	36 K	Open circuit
AUTO	Short circuit	Open circuit	Short circuit	Short circuit	Open circuit	6.8 K
HIGH	Short circuit	Open circuit	Short circuit	Short circuit	C ~~Open~~ circuit	Open circuit
DEF	Open circuit	Short circuit	Open circuit	Short circuit	C ~~Open~~ circuit	Open circuit

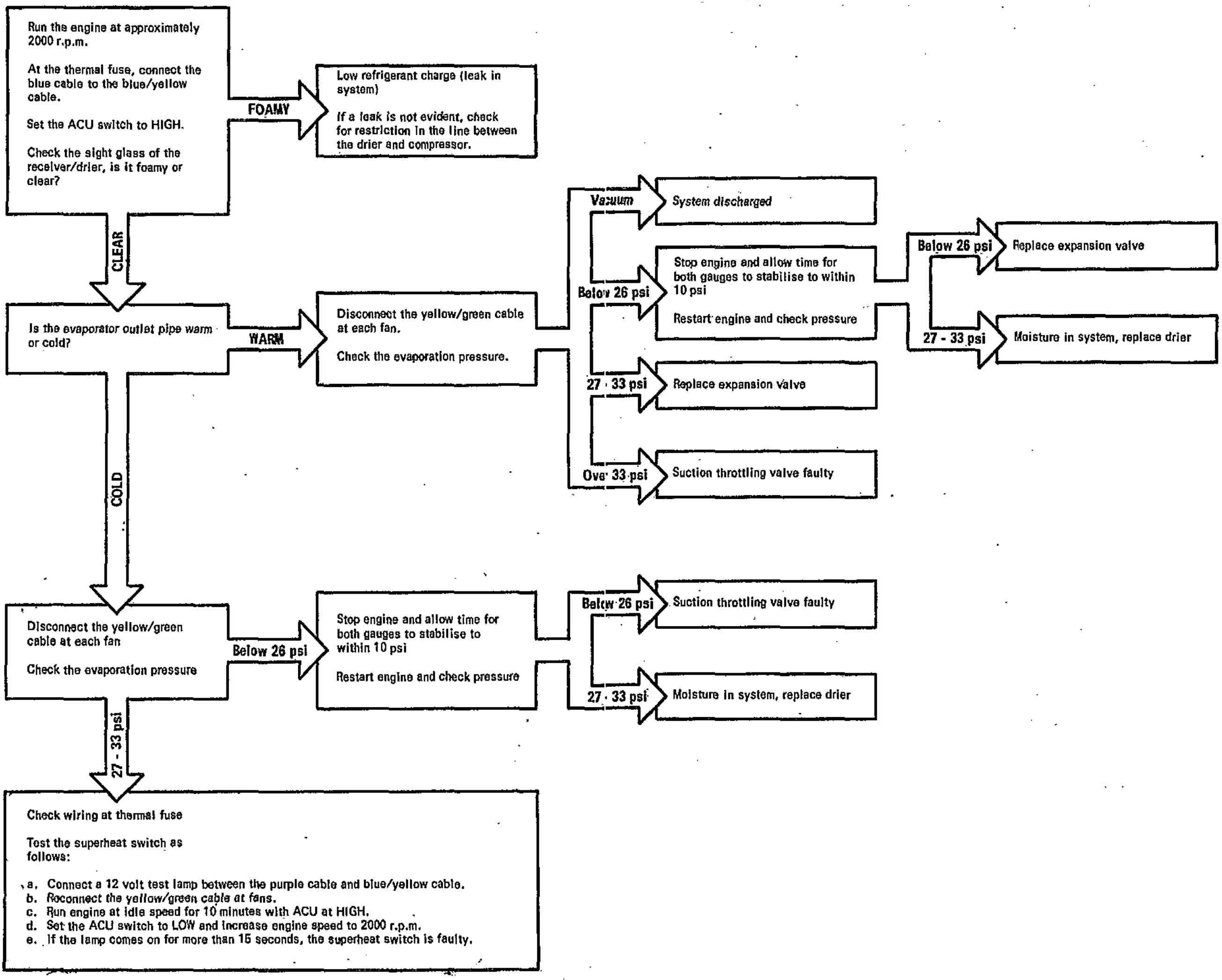
Section C5

System test and fault diagnosis

Compressor thermal fuse fault diagnosis Fig. C50

This chart should be used to locate the cause of a thermal fuse 'blowing' in the compressor protection unit.

The air temperature surrounding the car must be above 24 °C before this diagnosis can be carried out.



Run the engine at approximately 2000 r.p.m.

At the thermal fuse, connect the blue cable to the blue/yellow cable.

Set the ACU switch to HIGH.

Check the sight glass of the receiver/drier, is it foamy or clear?

Low refrigerant charge (leak in system)

If a leak is not evident, check for restriction in the line between the drier and compressor.

Is the evaporator outlet pipe warm or cold?

Disconnect the yellow/green cable at each fan.

Check the evaporation pressure.

System discharged

Stop engine and allow time for both gauges to stabilise to within 10 psi

Restart engine and check pressure

Replace expansion valve

Moisture in system, replace drier

Replace expansion valve

Suction throttling valve faulty

Disconnect the yellow/green cable at each fan

Check the evaporation pressure

Stop engine and allow time for both gauges to stabilise to within 10 psi

Restart engine and check pressure

Suction throttling valve faulty

Moisture in system, replace drier

Check wiring at thermal fuse

Test the superheat switch as follows:

a. Connect a 12 volt test lamp between the purple cable and blue/yellow cable.
b. Reconnect the yellow/green cable at fans.
c. Run engine at idle speed for 10 minutes with ACU at HIGH.
d. Set the ACU switch to LOW and increase engine speed to 2000 r.p.m.
e. If the lamp comes on for more than 15 seconds, the superheat switch is faulty.

Section C5

System test and fault diagnosis

Voltage stabiliser
Sheet 1 of 2
Fig. C51

Start

Have you checked the battery voltage?

Ensure that the battery voltage is at least 12 volts.
Disconnect the oil pressure switch. Set the A.C.U. to Auto. Measure the voltage on the 9K wire at the voltage stabiliser plug.
Is it at least 12 volts?

NO

Go to sheet 2

YES

Measure the voltage on the 9KR wire at the voltage stabiliser plug.
Is it between 8.6 & 9.6 volts?

YES

Measure the voltage on the 9KR wire at the upper servo plug.
Is it between 8.6 & 9.6 volts?

NO

Fault on 9KR cable between stabiliser plug & servo plug.

YES

Refer to Servo fault diagnosis.

NO

Is the voltage less than 8.6 volts?

NO

Check the 44B cable between the voltage stabiliser plug and left-hand 'A' post earth.
Are the cable & earth point satisfactory?

NO

Correct the earth fault.
Is the voltage on the 9KR wire between 8.6 & 9.6 volts?

YES

If a fault still exists, *refer to Servo fault* diagnosis.

NO

YES

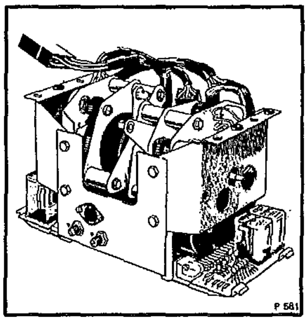
Disconnect the plug containing the 9KR wire at the servo and the voltage stabiliser.
Is the voltage on the 9KR wire at the voltage stabiliser between 8.6 & 9.6 volts?

NO

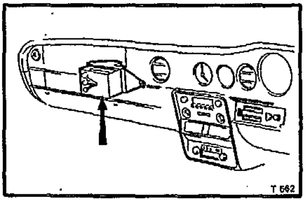
Change the voltage stabiliser assembly.

YES

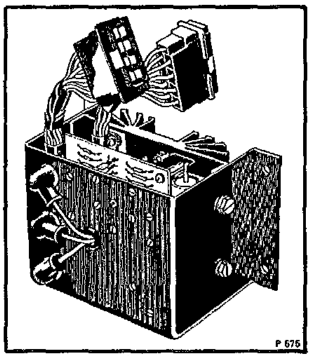
There is an earth fault on the 9KR wire, correct the fault. If the voltage is still not between 8.6 & 9.6 volts, change the voltage stabiliser assembly.



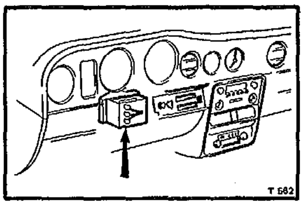
Servo assembly



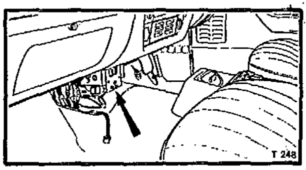
Location of fan speed module and voltage stabiliser right-hand drive cars



Fan speed module and voltage stabiliser



Location of fan speed module and voltage stabiliser left-hand drive cars



Location of servo assembly

Section C5

System test and fault diagnosis

Voltage stabiliser

Sheet 2 of 2

Fig. C51 continued

Sheet 2 of 2

From page 1

Have you checked the battery voltage?

Measure the voltage on the pink wire at the servo isolation relay.
Is it at least 12 volts?

YES

Check the continuity of the pink wire between the servo isolation relay & voltage stabiliser assembly.

NO

Test for 12 volts on the yellow/black cable at the servo isolation relay.
Is 12 volts available?

NO

Test for 12 volts on the yellow/black cable at the fans compressor relay.
Is 12 volts available?

YES

Check interconnecting cables and connections between servo isolation relay and fan & compressor relay.

NO

Refer to 'Fans inoperative in all situations' chart.

YES

Is there 12 volts at the spare contact (C1) of the servo isolation relay?

NO

Relay faulty.

YES

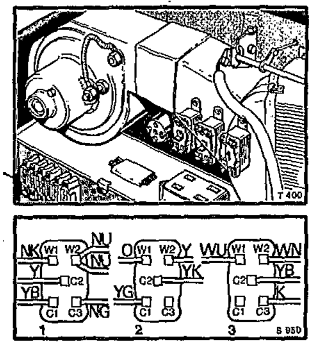
The servo isolation relay is energised which is incorrect. Disconnect the white/brown cable at the relay.
Is there 12 volts on the pink cable?

NO

Relay faulty.

YES

Check the white/brown cable between the servo isolation relay and oil pressure switch for earth fault.



1. Fan and compressor relay
2. Fan delay relay
3. Servo isolation relay

Section C5

System test and fault diagnosis

Upper servo test and calibration procedure
Sheet 1 of 2
Fig. C52

Start

Disconnect the white/brown cable from the oil pressure switch.
Disconnect the sensor chain socket and connect the test box into the socket. On the test box set the following:
IND/VOLTS to VOLTS RUN/SET to RUN
AUTO/CAL to CAL. UPPER/LOWER SERVO to UPPER
CHECK VOLTS to Position 1.
On the car, set the upper temperature selector to the mid-position, the A.C.U. switch to LOW and switch on the ignition.
Is a voltage reading between 8 and 10 volts shown on the test box?

NO → Refer to VOLTAGE STABILISER FLOW CHART.

YES ↓

The voltage supply to the servo is satisfactory.

On the test box, set IND/VOLTS to IND and 0%/100% to 0%.
Adjust ZERO control until meter reads 0%. Set 0%/100% to 100%.
Adjust MAX control until meter reads 100%.
Can both readings be obtained?

NO ↓ If upper servo does not move and calibration cannot be achieved, refer to SERVO FAULT DIAGNOSIS FLOW CHARTS.

YES → **The test box is now calibrated and the lower servo operates.**

*

On the test box, set the 0%/100% switch to 0% and wait for servo to stop at 0%. Switch the RUN/SET switch to SET.
Does the servo run from 0% and stop at a servo position reading of 51% ± 2%?

NO ↓ Turn the upper servo trim potentiometer anti-clockwise to a meter reading of 0%. Turn theupper servo trim potentiometer clockwise until a meter reading of 51% ± 2% is obtained.
This setting MUST be approached from the 0% position.

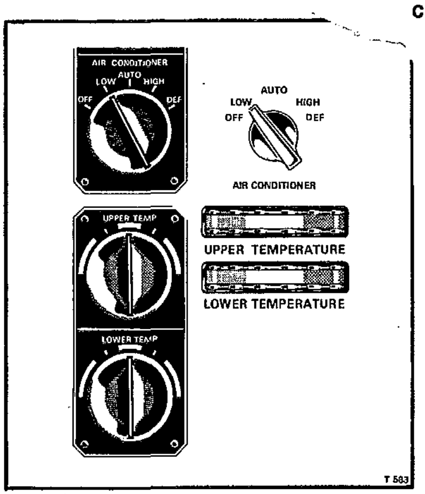
YES →

The upper servo is now correctly calibrated.

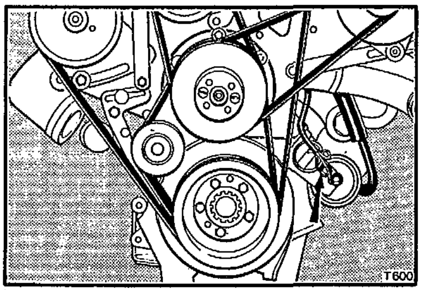
Go to sheet 2

Sheet 1 of 2

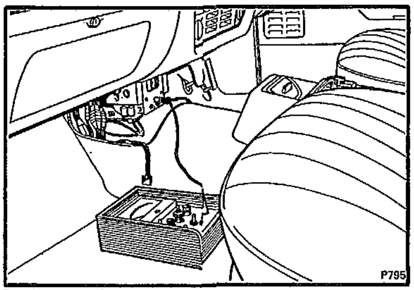
Ensure that the battery is fully charged



ACU Switch settings



Oil pressure switch



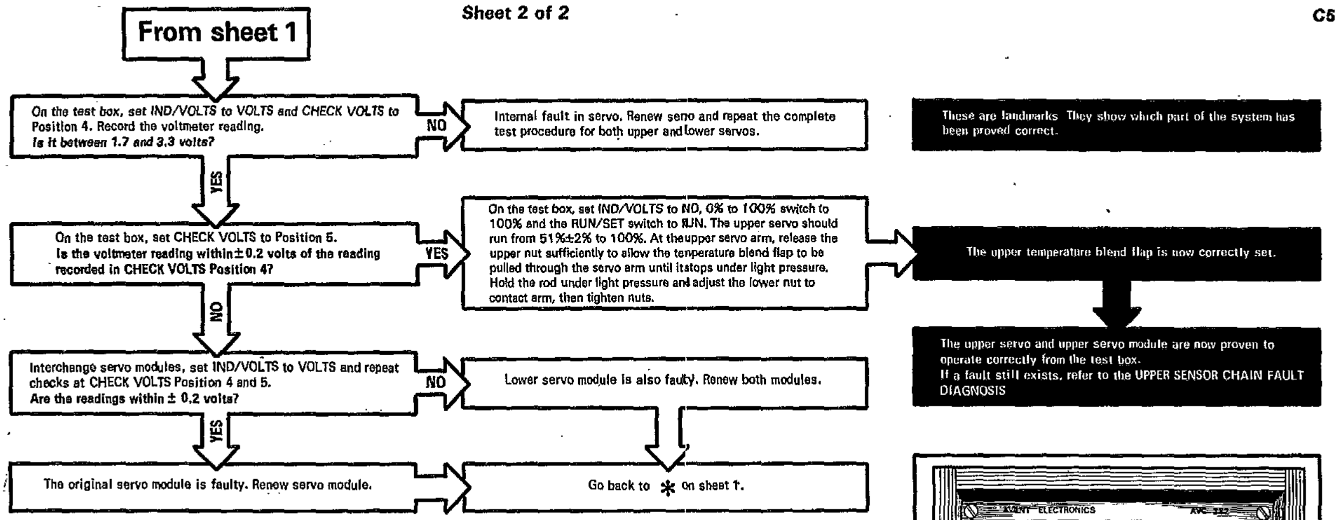
Test box connection

These are landmarks. They show which part of the system has been proved correct

Section C5

System test and fault diagnosis

Upper servo test and calibration procedure
Sheet 2 of 2
Fig. C52 continued



On the test box, set IND/VOLTS to VOLTS and CHECK VOLTS to Position 4. Record the voltmeter reading.
Is it between 1.7 and 3.3 volts?

Internal fault in servo. Renew servo and repeat the complete test procedure for both upper and lower servos.

These are landmarks They show which part of the system has been proved correct.

On the test box, set CHECK VOLTS to Position 5.
Is the voltmeter reading within ± 0.2 volts of the reading recorded in CHECK VOLTS Position 4?

On the test box, set IND/VOLTS to IND, 0% to 100% switch to 100% and the RUN/SET switch to RUN. The upper servo should run from 51%±2% to 100%. At the upper servo arm, release the upper nut sufficiently to allow the temperature blend flap to be pulled through the servo arm until it stops under light pressure. Hold the rod under light pressure and adjust the lower nut to contact arm, then tighten nuts.

The upper temperature blend flap is now correctly set.

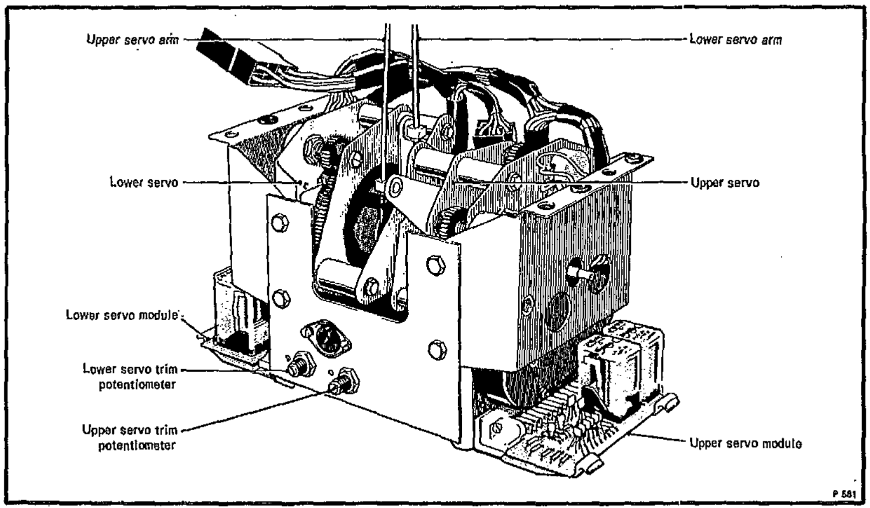
The upper servo and upper servo module are now proven to operate correctly from the test box.
If a fault still exists, refer to the UPPER SENSOR CHAIN FAULT DIAGNOSIS

Interchange servo modules, set IND/VOLTS to VOLTS and repeat checks at CHECK VOLTS Position 4 and 5.
Are the readings within ± 0.2 volts?

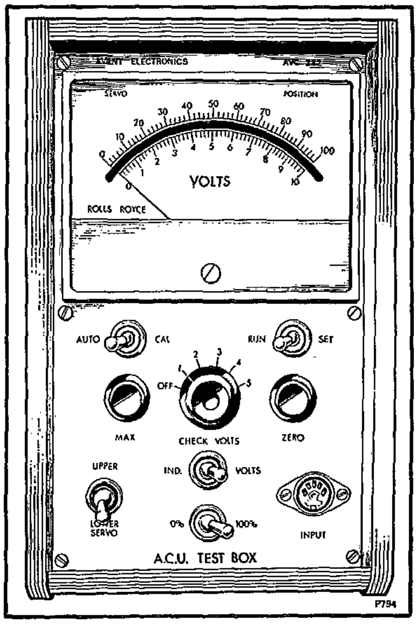
Lower servo module is also faulty. Renew both modules.

The original servo module is faulty. Renew servo module.

Go back to ✻ on sheet 1.



Servo assembly



Section C5

System test and fault diagnosis

Lower servo test and calibration procedure
Sheet 1 of 2
Fig. C53

Start

Sheet 1 of 2

Ensure that the battery is fully charged

Disconnect the white/brown cable from the oil pressure switch. Disconnect the sensor chain socket and connect the test box into the socket. On the test box set the following:
IND/VOLTS to VOLTS. RUN/SET to RUN
AUTO/CAL to CAL. UPPER/LOWER SERVO to LOWER
CHECK VOLTS to Position 1.
On the car, set the lower temperature selector to the mid-position, the A.C.U. switch to LOW and switch on the ignition.
Is the voltage reading between 8 and 10 volts?

NO

Refer to VOLTAGE STABILISER FLOW CHART

YES

The voltage supply to the servo is satisfactory.

On the test box, set IND/VOLTS to IND and 0%/100% to 0%. Adjust ZERO control until meter reads 0%. Set 0%/100% to 100% Adjust MAX control until meter reads 100%.
Can both readings be obtained?

NO

If the lower servo does not move and calibration cannot be achieved, refer to *SERVO FAULT DIAGNOSIS FLOW CHARTS.*

YES

The test box is now calibrated and the upper servo operates

*

On the test box, set the 0%/100% switch to 0% and wait for the servo to stop at 0%. Switch the RUN/SET switch to SET.
Does the servo run from 0% and stop at a servo position reading of 43% ± 2%?

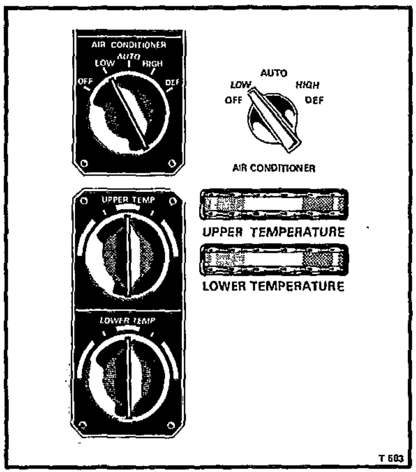
YES

NO

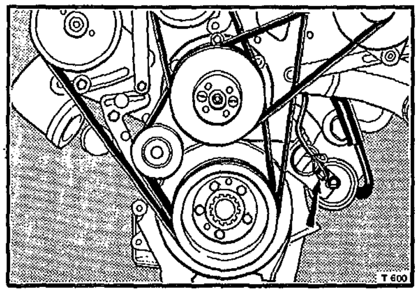
Turn the lower servo trim paentiometer anti-clockwise to a meter reading of 0%. Turn the lower servo trim potentiometer *clockwise until a meter readng of 43%±2% is obtained. This* setting MUST be approachedfrom the 0% position.

The lower servo is now correctly calibrated.

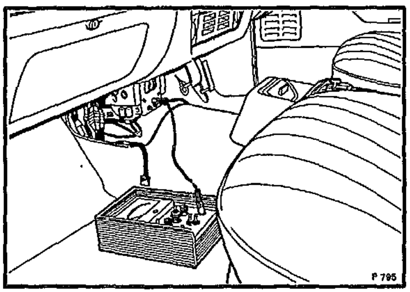
Go to sheet 2



ACU switch settings



Oil pressure switch



Test box connection

These are landmarks. They show which part of the system has been proved correct.

Section C5

System test and fault diagnosis

Lower servo test and calibration procedure
Sheet 2 of 2
Fig. C53 continued

Sheet 2 of 2

From sheet 1

On the test box, set the IND/VOLTS to VOLTS and CHECK VOLTS to Position 2. Record the voltmeter reading.
Is it between 1.7 and 3.3 volts?

NO

Internal fault in servo. Renew servo and repeat the complete test procedure for both upper and lower servos.

YES

On the test box, set CHECK VOLTS to Position 3.
Is the voltmeter reading within ± 0.2 volts of the reading recorded in CHECK VOLTS Position 2?

YES

On the test box, set the IND/VOLTS to IND and the RUN/SET switch to RUN. The lower servo should run from 43% ± 2% to 0%. At the lower servo arm, release the upper nut sufficiently to allow the temperature blend flap rod to be pulled through the servo arm until it stops under light pressure. Hold the rodunder light pressure and adjust the lower nut to contact the servoarm, then tighten nuts.

These are landmarks. They show which part of the system has been proved correct.

The lower temperature blend flap is now correctly set

The lower servo and lower servo module are now proven to operate correctly from the test box. If a fault still exists, refer to the LOWER SENSOR CHAIN FAULT DIAGNOSIS

NO

Interchange servo modules and repeat checks at CHECK VOLTS Position 2 and 3.
Are the readings within ± 0.2 volts?

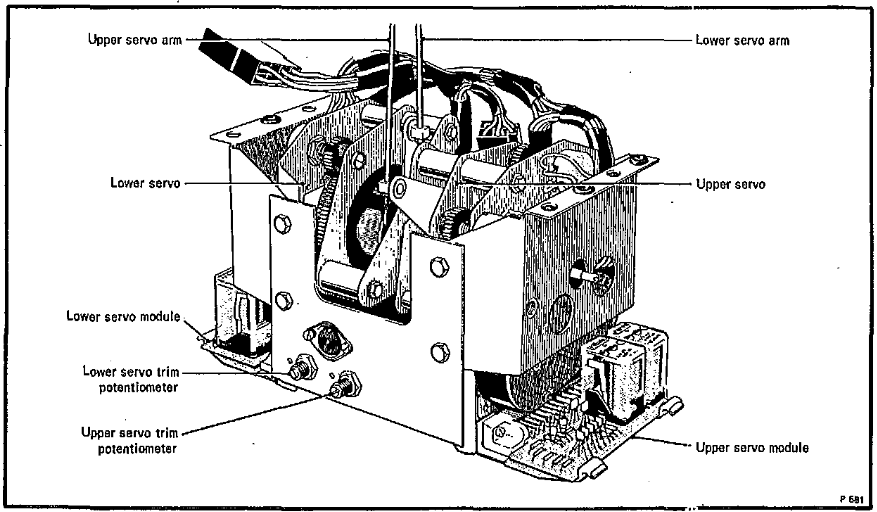
NO

Upper servo module is also faulty. Renew both modules.

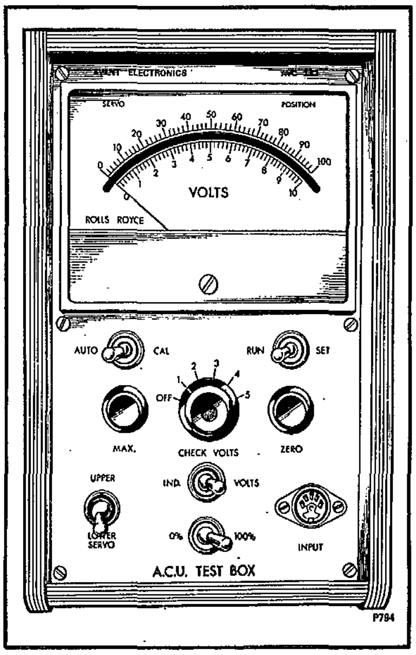
YES

The original servo module is faulty. Renew servo module.

Go back to ✻ or sheet 1



Servo assembly



Section C5

System test and fault diagnosis

Test procedure for recirculation,
lower quantity, mode change,
fan inhibit and rear window demist circuits.
Sheet 1 of 7
Fig. C54

Sheet 1 of 7

Start

Disconnect the white/brown cable from the oil pressure switch.
Disconnect the sensor chain socket.
Connect the test box into the servo test socket.

On the test box set the following:
IND/VOLTS to IND. RUN/SET to RUN.
AUTO/CAL to CAL. UPPER/LOWER SERVO to UPPER.
CHECK VOLTS to Position 1.

On the car, set the upper temperature switch to the mid-position and the ACU switch to LOW. Switch on the ignition.

On the test box, set the 0%/100% switch to 0% and adjust ZERO control until meter indicates 0%. Set the 0%/100% switch to 100% and adjust MAX control until meter indicates 100%. Repeat both operations until both readings are correct.

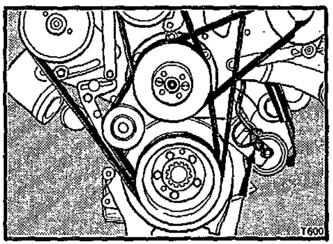
On the test box, set the RUN/SET switch to SETand the 0%/100% switch to 0%. Turn the upper servo trim potentiometer fully anti-clockwise and waitfor the servo to stop. If the meter reading is not 0%, turn the upper temperature selector towards the minimum temperature position until 0% is obtaind.

Checking the Recirculation Actuators — **Go to sheet 2**

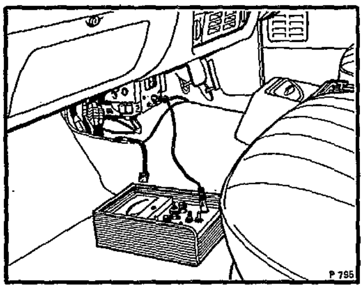
Checking the Lower Quantity Actuator — **Go to sheet 3**

Checking the Mode Flap Actuator and Rear *Window Demist* — **Go to sheet 4**

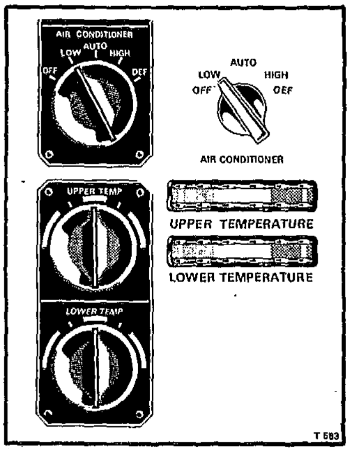
Checking the Fans Inhibit Circuit. — **Go to sheet 6**



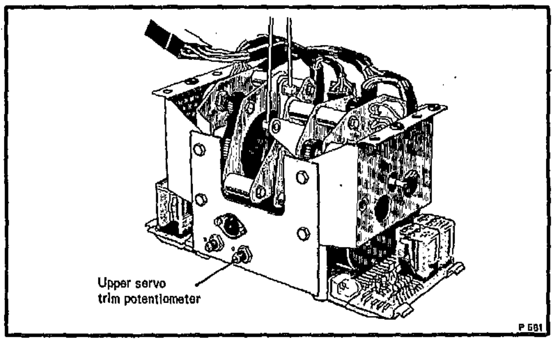
Oil pressure switch



Test box connection



ACU switch settings



Servo assembly

Section C5

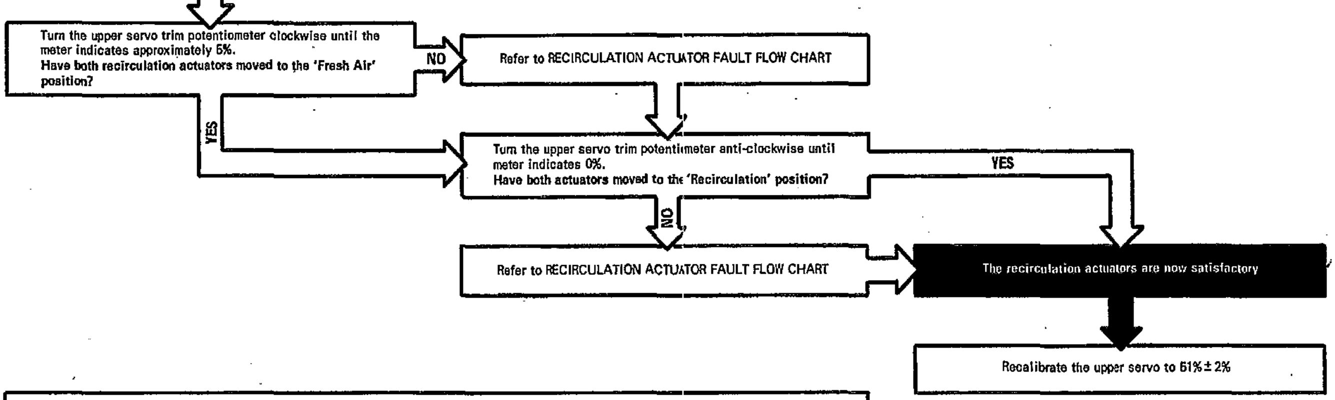
System test and fault diagnosis

Test procedure for recirculation,
lower quantity, mode change,
fan inhibit and rear window demist circuits.
Sheet 2 of 7
Fig. C54 continued

From sheet 1
Recirculation actuators

Sheet 2 of 7

These are landmarks. They show which part of the system has been proved correct.



Turn the upper servo trim potentiometer clockwise until the meter indicates approximately 5%.
Have both recirculation actuators moved to the 'Fresh Air' position?

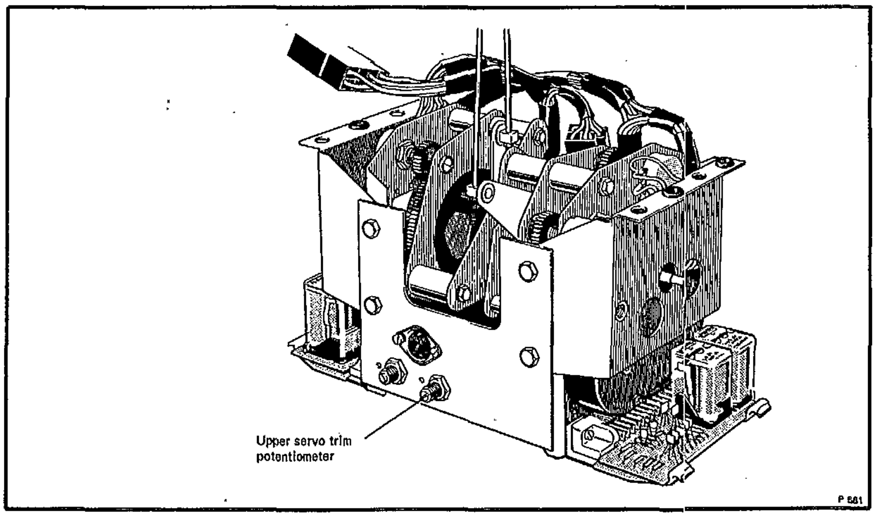
Refer to RECIRCULATION ACTUATOR FAULT FLOW CHART

Turn the upper servo trim potentiometer anti-clockwise until meter indicates 0%.
Have both actuators moved to the 'Recirculation' position?

Refer to RECIRCULATION ACTUATOR FAULT FLOW CHART

The recirculation actuators are now satisfactory

Recalibrate the upper servo to 51%±2%



Servo assembly

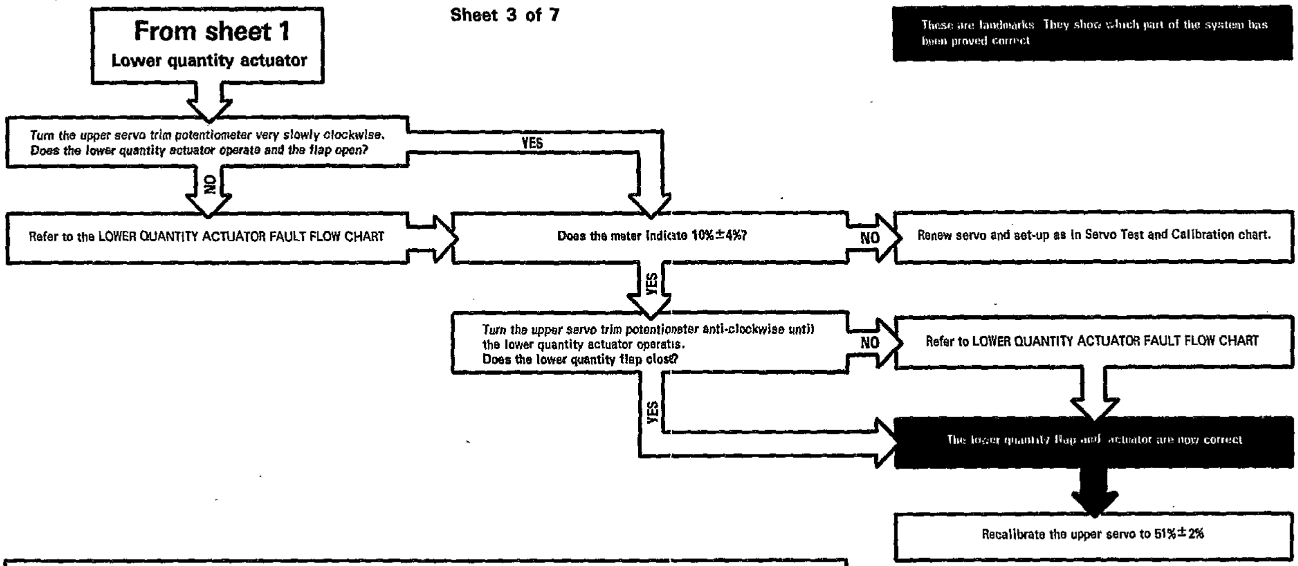
Section C5

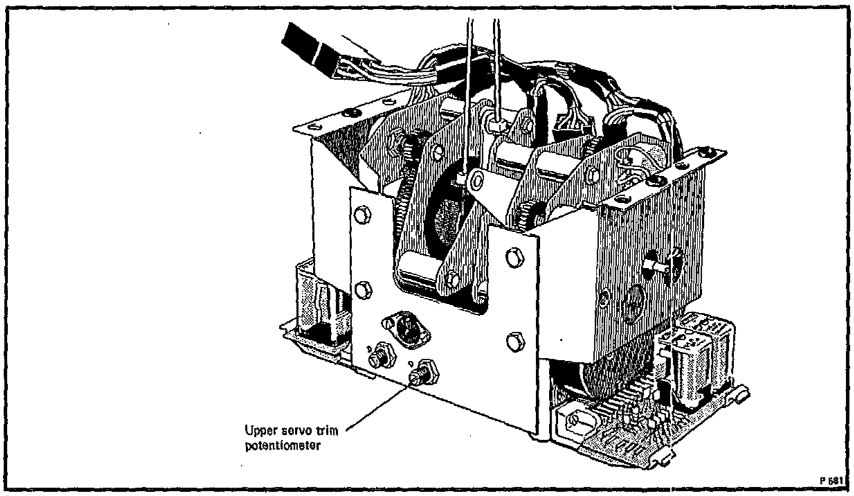
System test and fault diagnosis

Test procedure for recirculation,
lower quantity, mode change,
fan inhibit and rear window demist circuits.
Sheet 3 of 7
Fig. C54 continued

Sheet 3 of 7

These are landmarks They show which part of the system has been proved correct





Servo assembly

Section C5

System test and fault diagnosis

Test procedure for recirculation,
lower quantity, mode change,
fan inhibit and rear window demist circuits.
Sheet 4 of 7

Fig. C54 continued

Sheet 4 of 7

From sheet 1

Turn the upper servo trim potentiometer slowly clockwise.
Does the mode flap actuator operate and is the mode flap in the 'Screen' position?

NO → Refer to MODE FLAP and ACTUATOR FAULT DIAGNOSIS

YES

Does the meter indicate 26% ± 4%?

NO → Renew servo and set-up as in Servo test and calibration chart.

YES

Turn the upper servo trim potentiometer anti-clockwise.
Does the mode flap actuator operate and is the mode flap in the 'Facia' position?

NO → Refer to MODE FLAP and ACTUATOR FAULT DIAGNOSIS

YES

The mode flap actuator is satisfactory.

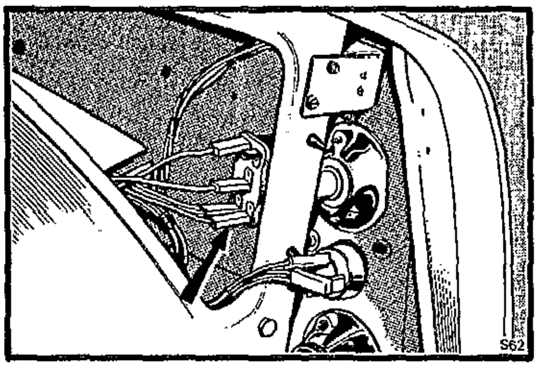
Turn the upper servo trim potentiometer slowly clockwise until the mode flap operates into the 'Screen' mode. With the engine running, disconnect the blue/slate wire from terminal C2 of the rear window demist relay and connect a suitable ammeter between the blue/slate wire and terminal C2.
Does the ammeter indicate between 8.5 and 13.5 amps?

NO → **Go to sheet 5**

YES

The rear window demister is satisfactory.

Recalibrate the upper servo to 51% 2%.



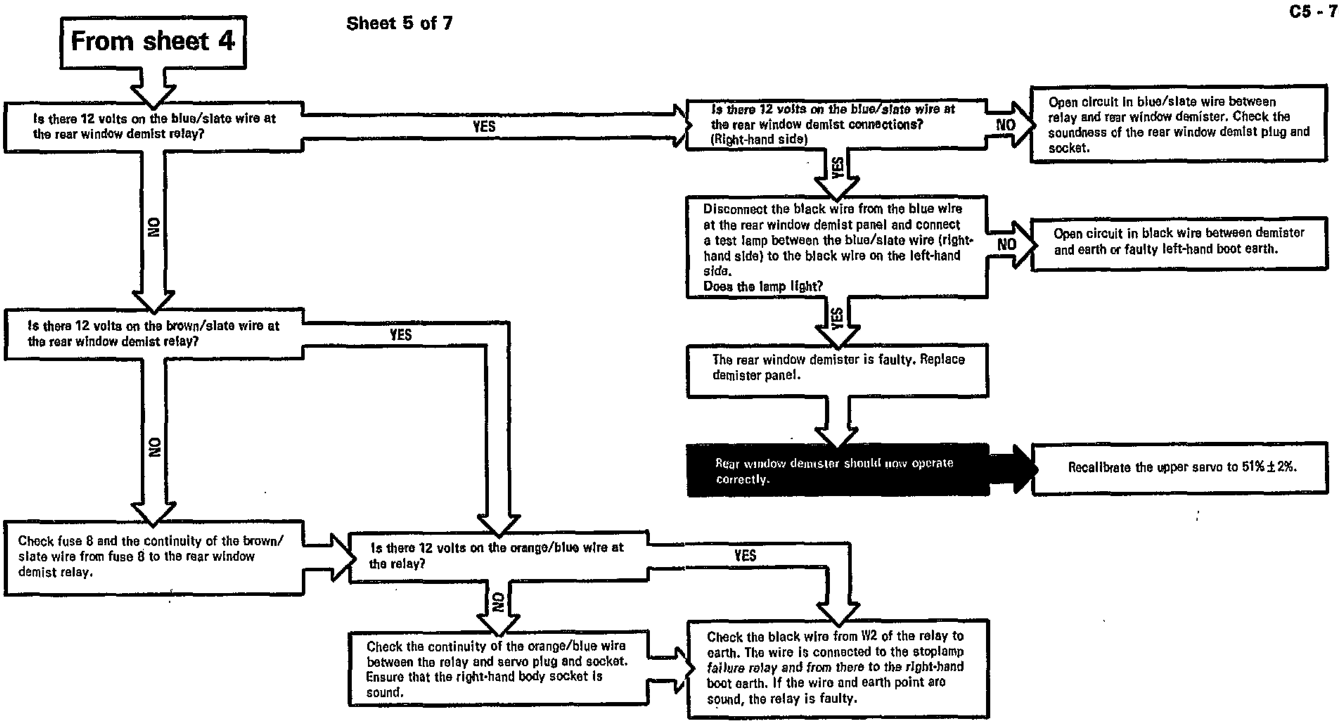
Window demist relay

These are landmarks. They show which part of the system has been proved correct.

Section C5

System test and fault diagnosis

Test procedure for recirculation,
lower quantity, mode change,
fan inhibit and rear window demist circuits.
Sheet 5 of 7
Fig. C54 continued



Is there 12 volts on the blue/slate wire at the rear window demist relay?

Is there 12 volts on the blue/slate wire at the rear window demist connections? (Right-hand side)

Open circuit in blue/slate wire between relay and rear window demister. Check the soundness of the rear window demist plug and socket.

Disconnect the black wire from the blue wire at the rear window demist panel and connect a test lamp between the blue/slate wire (right-hand side) to the black wire on the left-hand side.
Does the lamp light?

Open circuit in black wire between demister and earth or faulty left-hand boot earth.

The rear window demister is faulty. Replace demister panel.

Rear window demister should now operate correctly.

Recalibrate the upper servo to 51% ± 2%.

Is there 12 volts on the brown/slate wire at the rear window demist relay?

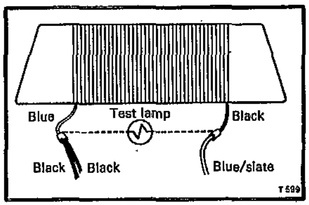
Check fuse 8 and the continuity of the brown/slate wire from fuse 8 to the rear window demist relay.

Is there 12 volts on the orange/blue wire at the relay?

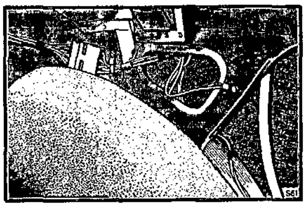
Check the continuity of the orange/blue wire between the relay and servo plug and socket. Ensure that the right-hand body socket is sound.

Check the black wire from W2 of the relay to earth. The wire is connected to the stoplamp *failure relay and from there to the right-hand* boot earth. If the wire and earth point are sound, the relay is faulty.

Right-hand body sockets



Rear window demist



Rear window demist socket & Right-hand boot earth

These are landmarks. They show which part of the system has been proved correct.

Section C5

System test and fault diagnosis

Test procedure for recirculation,
lower quantity, mode change,
fan inhibit and rear window demist circuits.
Sheet 6 of 7
Fig. C54 continued

From sheet 1
Fans inhibit circuit

Sheet 6 of 7

Disconnect the fan delay thermostat.
Do the fans operate?

NO

Refer to FANS INOPERATIVE IN ALL SITUATIONS *fault diagnosis.*

YES

Turn the upper servo trim potentiometer clockwise until the *mode flap operate* to the *'Screen' position.*
Do the fans continue to operate?

NO

Refer to FANS INOPERATIVE IN LOW, AUTO *and* HIGH *fault diagnosis.*

YES

Switch off the ignition and immediately restart the engine.
Are the fans inoperative for approximately 13 seconds?

YES

Go to sheet 7

NO

At the fan speed module plug is there 12 volts on the brown/blue wire when the engine is *cranking?*

NO

Open circuit on brown/blue wire between fan speed module plug and starter motor. Correct the fault and restart the engine.
Are the fans inoperative for 13 seconds?

YES

Go to sheet 7

NO

YES

Check for an earth fault on the blue/black wire between the fan speed module and fan switch-off relay. Restart the engine.
Are the fans inoperative for 13 seconds?

YE;

Go to sheet 7

NO

At the fan speed module plug is there 12 volts on the orange/purple wire?

NC

Open circuit on orange/purple wire between *fan speed module and servo.* Correct the fault and restart the engine.
Are the fans inoperative for approximately 13 *seconds?*

YES

Go to sheet 7

NO

YES

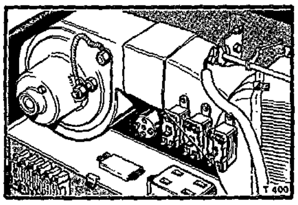
Renew fan speed module. Restart the engine.
Are the fans inoperative for approximately 13 seconds?

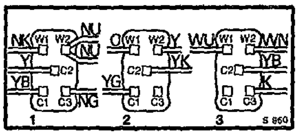
YES

Go to sheet 7

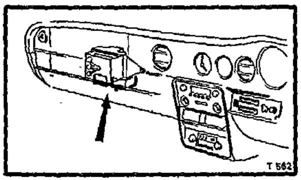
NO

Two faults or incorrect diagnosis

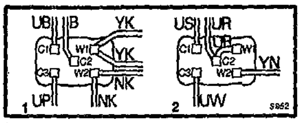




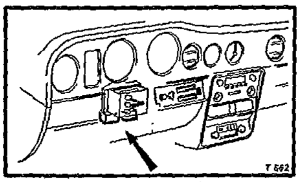
1. Fan and compressor relay
2. Fan delay relay
3. Servo isolation relay



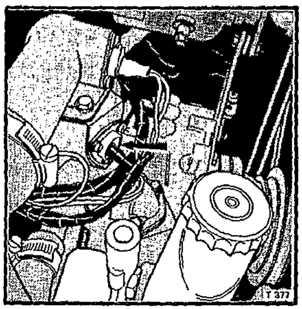
Location of fan switch-off relay and lower quantity relay right-hand drive cars



1. Fan switch-off relay
2. Lower quantity relay



Location of fan switch-off relay and lower quantity relay left-hand drive cars



Fan delay thermostat

Section C5

System test and fault diagnosis

Test procedure for recirculation,
lower quantity, mode change,
fan inhibit and rear window demist circuits.
Sheet 7 of 7
Fig. C54 continued

From sheet 6

Sheet 7 of 7

These are landmarks. They show which part of the system has been proved correct.

Short circuit the yellow/brown wire of the fan delay thermostat to earth.
Do the fans stop and has the lower quantity flap closed?

NO

Check the yellow/brown wire for continuity and also the fan delay relay and lower quantity micro-switch for correct operation.

YES

Disconnect the yellow/brown wire from earth.
Do the fans only restart when the lower quantity flap is fully open?

YES

NO

Refer to LOWER QUANTITY ACTUATOR FLOW CHART.

Turn the upper servo trim potentiometer anti-clockwise until the mode flap operates to the 'Facia' position.
Do the fans restart?

NO

Refer to FANS INOPERATIVE IN LOW, AUTO and HIGH fault diagnosis

YES

Switch off the ignition and immediately restart the engine.
Do the fans start immediately?
(i.e. no 13 second delay)

NO

Check the diodes between the orange/purple and orange/red wires and also between the orange/purple and yellow wires at the ACU diode board.

YES

The 13 second delay circuit is satisfactory

Pull gently downwards on the lower quantity flap microswitch operating rod.
Do the fans continue to operate?

YES

NO

Readjust microswitch setting
Do the fans operate?

YES

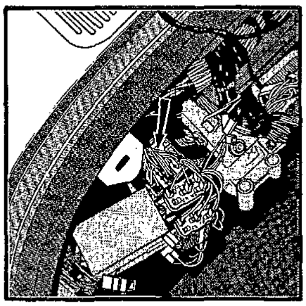
Remove the yellow/brown wire from earth and reconnect the fan delay thermostat. Turn the upper servo trim potentiometer clockwise until the mode flap operates to the 'Screen' position. Verify that the fans stop.

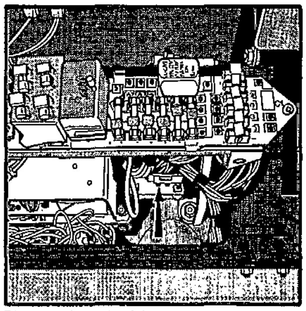
NO

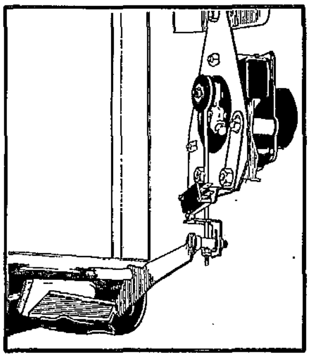
Two or more faults or incorrect diagnosis

The fans inhibit circuit is satisfactory.

Recalibrate the upper servo to 51%± 2%.


Diode board left-hand drive cars


Diode board right-hand drive cars


Lower quantity flap microswitch operating rod

Refrigeration system

Contents	Pages Silver Spirit Mulsanne	Silver Spur	Mulsanne Turbo	Corniche
Basic operation	C6-1	C6-1	C6-1	C6-1
Servicing the refrigeration system	C6-2	C6-2	C6-2	C6-2
Fault diagnosis	C6-4	C6-4	C6-4	C6-4
Rear compartment air conditioning system	—	C6-11	—	—

Printed in England

Refrigeration system

Basic operation (see figs. C6-1 and C6-4)

The refrigerant (Refrigerant 12) is circulated by a compressor driven from the engine crankshaft. An electro-magnetic clutch, incorporated in the compressor, is energised in the engaged position when the engine is running, except when the ambient temperature is below 0°C.

The refrigerant is pumped from the compressor as a high pressure vapour to the top of the condenser matrix, where it condenses from a vapour into a high pressure liquid at the bottom of the matrix.

From the condenser matrix the liquid is passed to the EE model valves-in-receiver (EEVIR) unit where any moisutre present is absorbed by a dessicant bag. Within the EEVIR unit, the amount of liquid passed to the evaporator matrix is controlled by a pressure and temperature sensitive valve (TX valve).

The evaporator matrix absorbs heat from the air passing through it, evaporating the refrigerant and thereby cooling the air.

From the evaporator matrix the refrigerant, (now a low pressure vapour) is passed to the pressure operated absolute suction throttling valve (POAST valve) situated adjacent to the TX valve in the EEVIR unit. The POAST valve controls the flow of refrigerant from the evaporator matrix to maintain a constant pressure within the evaporator.

From the POAST valve the refrigerant is returned to the compressor as a low pressure vapour.

Special precautions

The refrigerant used in the air conditioning system is dichlorodifluoromethane (Refrigerant 12). It is supplied to the service network in disposable containers or metal drums.

When correctly handled the refrigerant is perfectly safe, however incorrect handling could result in injury or accident.

The following precautions must always be observed.

1. Do not smoke in the vicinity of refrigerant or a refrigeration system.
2. Always wear safety glasses when working on a refrigeration system.
3. Store refrigerant containers upright and away from direct sunlight.
4. When transporting refrigerant ensure that the containers are secured, remain upright and away from direct sunlight.
5. Ensure that caps are fitted to drums when not in use.
6. Refrigerant containers must not be overfilled, increased pressure could cause an explosion.
7. To heat the drum when charging a system, immerse in warm water with a maximum temperature of 51°C.

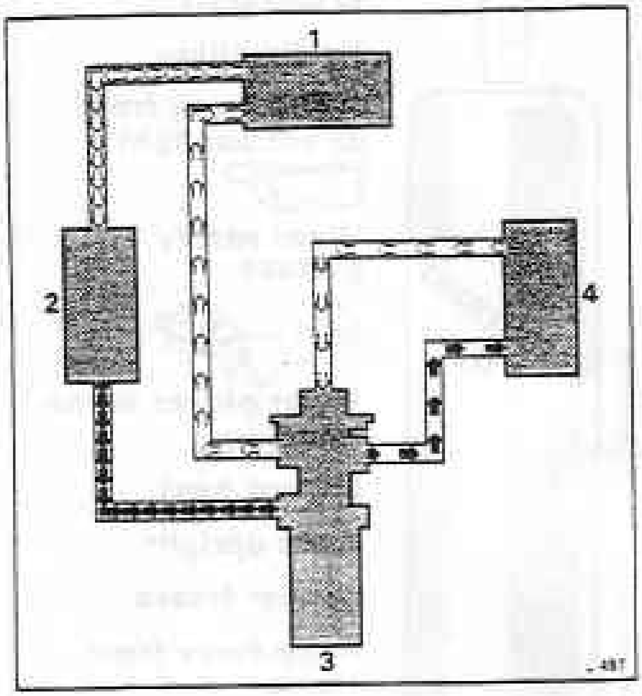


Fig. C6-1 Refrigerant flow

1. Compressor	3. EEVIR unit
2. Condenser matrix	4. Evaporator matrix

⇨⇨⇨ High pressure vapour

➡➡➡ High pressure liquid

⇨ ⇨ Low pressure vapour

➡ ➡ Low pressure liquid

Never place the drum on a hot surface or attempt to heat the drum by means of a blowlamp, etc.

8. Do not discharge refrigerant in confined spaces or near to exposed flames. Contact with exposed flames can produce a toxic gas.

   Always keep refrigerant clear of engine air intakes.
9. Excessive heat applied to any part of the refrigeration system will create high pressures within the system. Therefore welding, soldering or brazing should not be carried out on the system, or to any adjacent part of the car.

Accident damage

The following guidelines should be observed when carrying out repairs.

1. If the car is to be driven before repair work is carried out ensure that the compressor clutch is disengaged. This can be achieved by disconnecting the blue/yellow cable from the compressor ambient switch (see fig. C6-4).
2. Inspect all refrigeration components and lines to ascertain the extent of the damage.

Printed in England

3. If the condenser has been damaged it must be renewed. Welding, soldering or brazing must not be attempted.

4. If damage has occured to the system or if it has been 'open' for more than a day, fit a new dessicant bag.

Fig. C6-2 Refrigerant handling – safety precautions

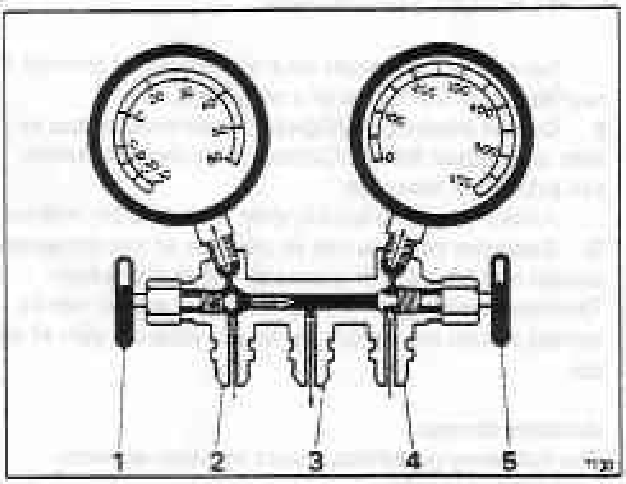


Fig. C6-3 Manifold gauge set
1 Low side hand valve
2 Connection to EEVIR unit
3 Charging or evacuating connection
4 Connection to compressor
5 High side hand valve

5. Inspect the compressor and clutch pulley for cracks. If cracks are apparent replace components as necessary.

6. If the clutch plate is discoloured it must be replaced. Discolouration indicates that the clutch plate has burnt out.

7. If the compressor does not show signs of damage it may be used again.

Chemical stability

The following general rules should be observed to ensure that the chemical stability of the refrigerant is maintained.

1. Before releasing a refrigerant connection, wipe away all dirt or oil from the connection to prevent foreign matter entering the system.

2. All tools and containers should be kept clean and dry to prevent moisture from entering the system.

3. Ensure that the system is not left 'open' any longer than necessary.

4. If the system has been opened and then sealed again, it must be correctly evacuated.

Servicing the refrigeration system

To discharge

The refrigerant must be discharged from the system before opening a connection. Ensure that the special precautions described on page C6-1 are always observed.

1. Remove the caps from the compressor discharge valve and from the service connection of the EEVIR unit. Attach the manifold gauge set (with depressors fitted and valves closed). Attach a pipe to the centre connection of the gauge set and direct this pipe into a clean container to collect any refrigerant oil discharged with the refrigerant.

2. Do not release the refrigerant too quickly as this will result in more oil than is necessary being drawn from the system.

3. Fractionally open both hand valves. Open further as the system discharges. The operation requires at least 15 minutes to ensure complete discharge.

4. When all the refrigerant appears to have discharged, slacken the adapter to close the valve and allow approximately two minutes for any build up of pressure to develop. Then, repeat the discharge procedure until all refrigerant has been discharged.

5. Measure any oil which has discharged into the container and add a corresponding amount of new refrigerant oil to the system.

To evacuate

1. Ensure that the system is fully discharged.

2. Connect the centre pipe of the manifold gauge set to the vacuum pump. The vacuum pump must be capable of producing a minimum vacuum of 250 microns (0.250 torr, 0.250 mm Hg).

3. Open both valves on the manifold gauge set and switch on the vacuum pump.

4. Carry out evacuation until a minimum vacuum of 300 microns (0.300 torr, 0.300 mm Hg) is achieved.

5. Switch off the vacuum pump. If the vacuum level decreases steadily over a period of approximately three

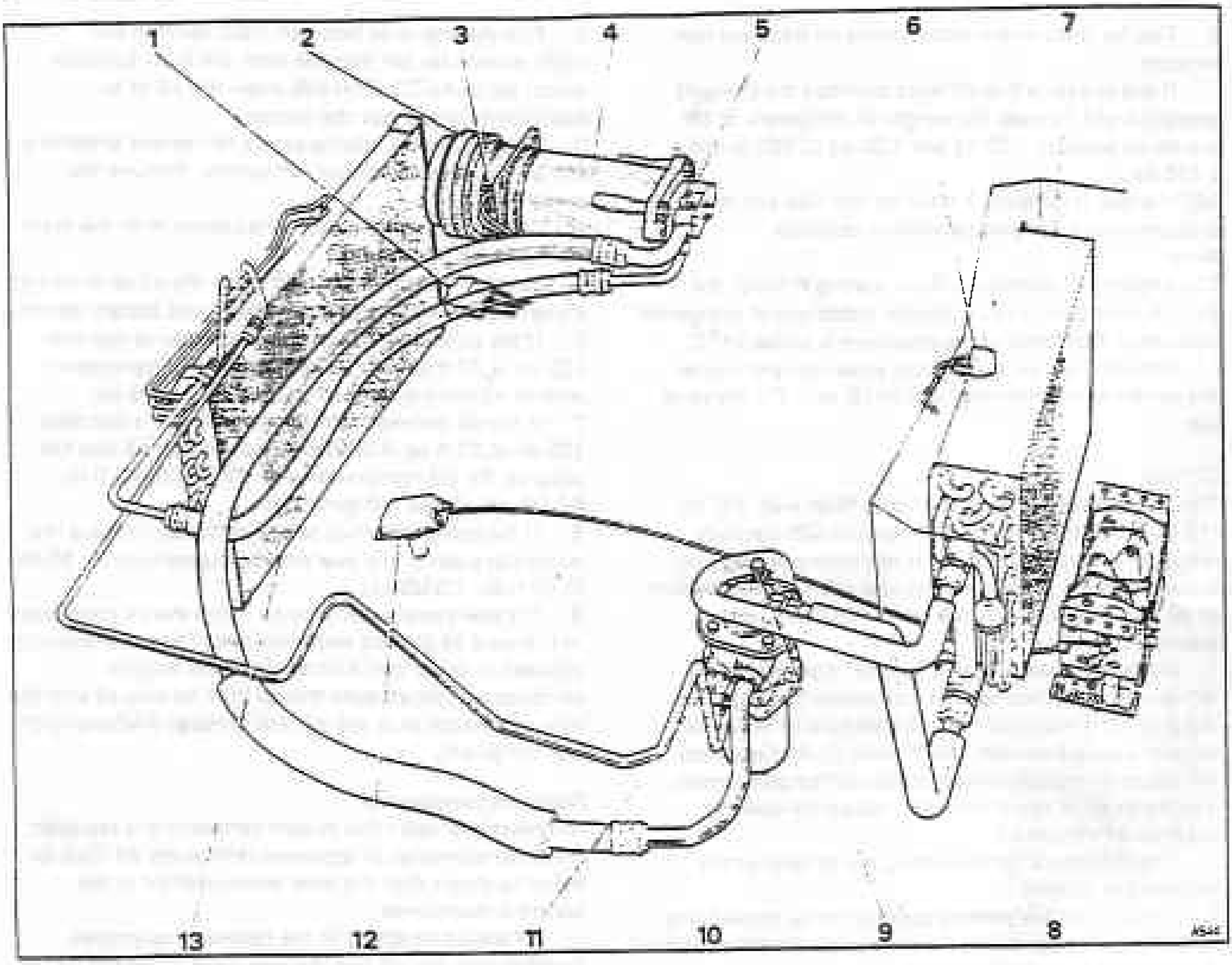


Fig. C6-4 Refrigeration system component lay-out
1 Compressor thermal fuse
2 Compressor clutch
3 Compressor clutch coil connections
4 Compressor
5 Compressor discharge valve
6 Compressor ambient thermostat
7 Evaporator matrix
8 Servo assembly
9 EEVIR service connection
10 EEVIR unit
11 EEVIR sight glass
12 Coolant tap
13 Condenser matrix

minutes there is a leak in the system which must be rectified.

6. A slow leak in the level of vacuum indicates that there is moisture present in the system. Carry out evacuation for a further 45 minutes to eliminate the possibility of residual liquid refrigerant in the compressor oil vapourising and causing the pressure to rise.

7. The final vacuum reading obtained should be held for thirty minutes to ensure that there are no leaks in the system.

To sweep and charge

1. Evacuate the system.
2. Attach a cylinder of Refrigerant 12 to the appropriate connection on the vacuum pump apparatus.
3. Suspend the cylinder on a spring balance and record the weight.

Note
If a charging station or other type of refrigeration system servicing equipment is to be used, follow the manufacturers' instructions.

4. Open the tap on the vacuum pump apparatus to allow the refrigerant to flow into the system.
5. Ensure that the parking brake is applied, the gear range selector lever is in the Park position and that the gearchange isolator is removed.
6. Start the engine and run at between 1000 rev/min and 1250 rev/min.
7. Move both temperature selectors to the full cold position. Open the rectangular facia outlet and turn the air conditioning unit (ACU) function switch to HIGH.
8. Allow between 0,45 kg and 0,57 kg (1 lb and 1.250 lb) of refrigerant to flow into the system. Close the tap on the vacuum pump apparatus and switch off the engine.

Printed in England

9. Test for leaks in the system using an electrical leak detector.

If the system is free of leaks continue the charging operation and increase the weight of refrigerant in the system to between 1,20 kg and 1,30 kg (2.650 lb and 2.850 lb).

10. If a leak is detected it must be rectified and the evacuation and charging operations repeated.

Note
The presence of bubbles or foam passing through the EEVIR sight glass is not a reliable indication of refrigerant deficiency if the ambient temperature is below 24°C.

11. Close the tap on the vacuum apparatus and release the service connection on the EEVIR unit. Fit the valve cap.

Oil level

The refrigeration pump is originally filled with 310 ml. (10.85 fl oz., 10.3 US oz) of Frigidaire 525 viscosity refrigeration oil and servicing is not normally required. However during normal system operation a small amount of oil combines with the refrigerant and circulates around the system.

If any oil escapes due to leakage, discharge of the refrigerant or replacement of a component, it must be replaced. It is important that the amount of oil in the system is always correct. Insufficient oil in the system will result in inadequate lubrication of the compressor. Too much oil in the system will reduce the cooling capacity of the system.

The procedure for correcting the oil level in the system is as follows.

1. Ensure that the parking brake is firmly applied and that the gear range selector lever is in the PARK position. Remove the gearchange isolator.

Fig. C6-5 Approved refrigerant oil

2. Run the engine at between 1000 rev/min and 1500 rev/min for ten minutes with the ACU function switch set to AUTO. This will allow the oil to be distributed throughout the system.

3. Stop the engine, discharge the refrigerant preserving any oil discharged with the refrigerant. Remove the compressor.

4. Position the compressor horizontally with the drain plug pointing downwards.

5. Remove the drain plug and allow the oil to drain into a clean measuring container; measure and discard the oil.

6. If the oil drained from the compressor is less than 125 ml (4.37 fl oz, 4.0 US oz) top-up the compressor with an equivalent amount of new refrigerant oil.

7. If the oil drained from the compressor is less than 125 ml (4.37 fl oz, 4.0 US oz) and a major oil loss has occured, fill the compressor with 185 ml (6.48 fl oz, 6.0 US oz) of new refrigerant oil.

8. If the compressor has been overhauled increase the quantities given in the two previous operations by 30 ml (1.05 fl oz, 1.0 US oz).

9. If a new compressor is to be fitted the oil contained in it should be drained and measured. Then, the quantity adjusted to equal that drained from the original compressor. This amount should then be poured into the new compressor plus any oil lost through discharging of the refrigerant.

Replacing components

Whenever a refrigeration system component is replaced, measured quantities of approved refrigerant oil must be added to ensure that the total amount of oil in the system is maintained.

Oil should be added in the following quantities together with any oil lost through discharging the system.

Evaporator	90 ml	(3.15 fl oz , 3.0 US oz)
Condenser	30 ml	(1.05 fl oz, 1.0 US oz)
EEVIR unit	30 ml	(1.05 fl oz, 1.0 US oz)

Fault diagnosis

EE model valves-in-receiver (EEVIR) unit (see fig. C6-6)

At a temperature of 24°C and above the condition of the refrigerant can be visually inspected in the sight glass of the EEVIR unit.

After approximately five minutes of compressor operation a shortage of liquid refrigerant is indicated by the appearance of slow moving bubbles or by a broken column of refrigerant under the glass. Continuous bubbles may appear in a fully charged system on a cool day, however this is a normal condition. If the sight glass is generally clear and the system is functioning normally occasional bubbles do not indicate a shortage of refrigerant.

If the sight glass consistently shows foaming or a broken column of liquid, partially block the air flowing through the condenser matrix using a sheet of cardboard.

If this action clears the sight glass and the performance of the system is satisfactory, the refrigerant charge is considered adequate.

The sight glass also enables the colour of the TX valve in the casting to be observed. The valve must be the same gold allodine colour as the ring around the sight glass.

Expansion (TX) valve
Expansion valve failures will normally be indicated by low suction pressure, low discharge pressure and insufficient evaporator cooling.

Pressure operated absolute suction throttling (POAST) valve
A fault occurring in the POAST valve may cause evaporator pressure (and therefore air temperature) to be either too high or too low. No adjustment of the valve is possible, therefore if the valve is diagnosed as faulty it must be renewed.

Operating the car at higher altitudes will affect the performance of the POAST valve. To evaluate the performance refer to the following altitude corrected table.

Altitude of car		Gauge pressure	
metres	feet	Bar	lbf/in^2
0 (sea level)	0 (sea level)	1,96	28.50
300	1000	2,00	29.00
600	2000	2,03	29.50
900	3000	2,07	30.00
1200	4000	2,10	30.50
1500	5000	2,14	31.00
1800	6000	2,16	31.40
2100	7000	2,19	31.80
2400	8000	2,23	32.30
2700	9000	2,25	32.70
3000	10000	2,29	33.20

Condenser (see fig. C6-4)
A condenser fault can appear in two ways; it can either leak or become restricted. A restriction will result in excessive compressor discharge pressure. Ice or frost will form immediately after the restriction as the refrigerant expands after passing the restriction. Restriction of the airflow through the condenser or radiator will result in high discharge pressures.

During normal condenser operation the outlet pipe will be slightly cooler than the inlet pipe.

Condenser leakage will result in insufficient system cooling. If the condenser is leaking it must be renewed. Welding, soldering or brazing must not be attempted.

Compressor (see fig. C6-4)
Compressor malfunctions can be caused by electrical failure, low discharge pressure, noise or seizure.

Electrical failure
Using the wiring diagram for the refrigerant charge – protection system ensure that current is being supplied to the compressor clutch terminals before removing the compressor for service.

Low discharge pressure
Low compressor discharge pressure may be caused by a fault within the compressor. However, it is recommended that the refrigeration system is checked to ensure that the refrigerant charge is adequate and that there are no leaks or restrictions in the system before removing the compressor for service.

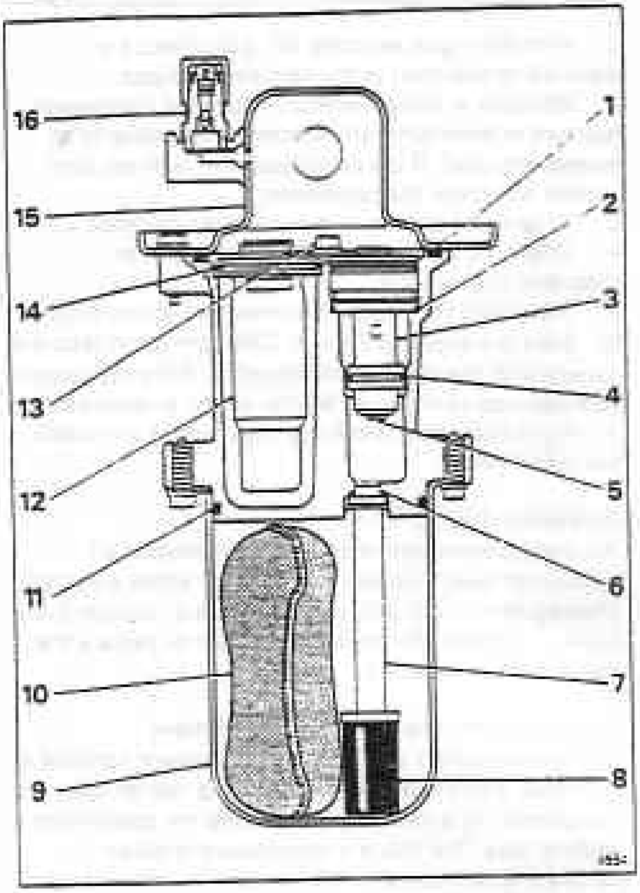


Fig. C6-6 EE model valves-in-receiver (EEVIR) unit
1 Inlet connector shell to housing 'O' ring
2 Expansion valve 'O' ring
3 Expansion valve capsule
4 Expansion valve lower 'O' ring
5 Expansion valve inlet
6 Liquid pick-up tube 'O' ring
7 Liquid pick-up tube
8 Pick-up tube filter
9 Receiver shell
10 Dessicant (drier) bag
11 Valve housing to receiver 'O' rings
12 POAST valve capsule
13 Valve capsule retainer screw and washer
14 POAST valve 'O' ring
15 Inlet connector shell assembly
16 Evaporator gauge connector (low pressure)

Noise or seizure
Resonant compressor noise can be ignored but an irregular noise or rattle may indicate damaged components or excessive wear. In these cases the compressor should be removed and repaired.

If the car has been stored for a long period or the air conditioning system not used, the oil drains away from the compressor pistons and axial plate. The resulting increased friction causes belt slip and noise. To overcome this condition (ensuring that there are no obvious signs of overheating or mechanical damage) adopt the following procedure.

1. With the engine switched off, disconnect the electrical connections at the compressor clutch.
2. Manually or using a wrench, rotate the compressor hub two or three turns anti-clockwise (opposite to its normal rotation). If the compressor hub will not turn remove and repair the compressor.
3. Reverse the procedure described in Operation 2.
4. Check the compressor drive belt tension as described in Chapter E.
5. Reconnect the electrical connections at the clutch.
6. Start the engine and run at 2000 rpm for at least one minute with the compressor operating. If the compressor now operates normally no further action is required.
7. If the noise level is still too high remove and repair the compressor.

Evaporator (see fig. C6-4)
An inadequate supply of cool air may indicate an evaporator fault. This will be caused by either a partially blocked core due to dirt, a cracked case or leakage from a seal. Therefore, if a fault exists rectify or replace the component as necessary.

Low refrigerant charge — Protection system
The low refrigerant charge protection system contains a superheat shut-off switch located in the rear of the compressor. It is connected in series to the compressor thermal fuse. The fuse is a temperature sensitive fusible link between the ACU ambient switch and the clutch coil connection.

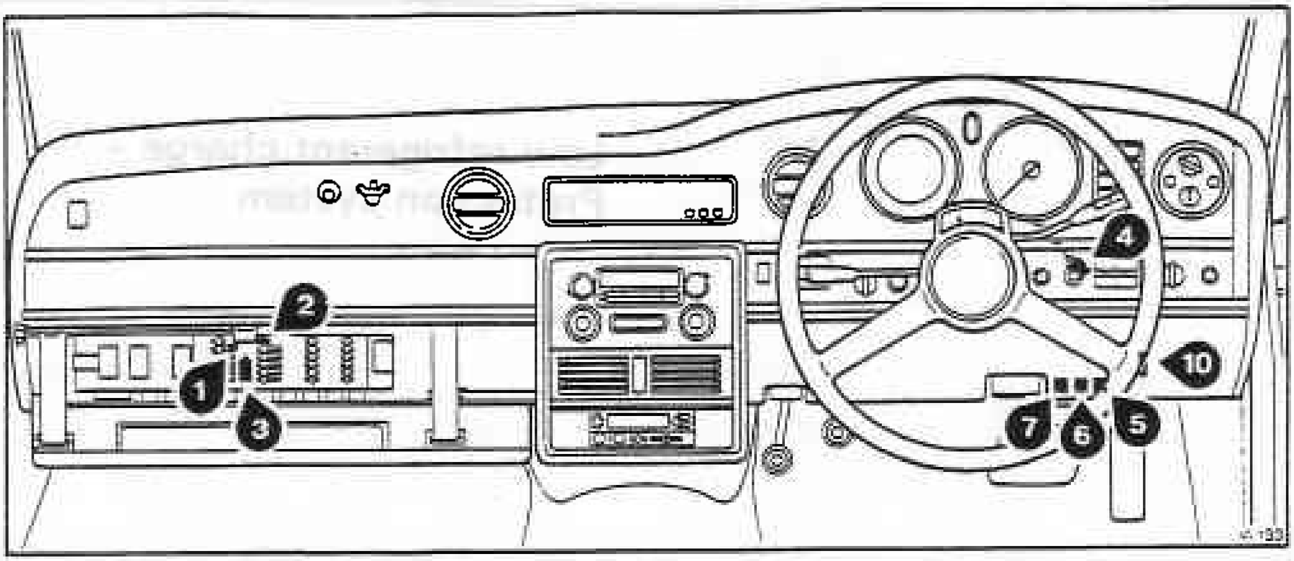
During normal ACU operation current flows through the ambient switch and thermal fuse to the clutch coil, thereby actuating the compressor clutch. Partial or total loss of refrigerant causes the superheat switch to sense low system pressure and high suction gas temperature, thereby closing the switch contacts and melting the thermal fuse. This action prevents damage being caused to the compressor due to a low refrigerant charge.

The cause of lost refrigerant must be established and rectified. The system must then be evacuated and recharged before the thermal fuse is replaced.

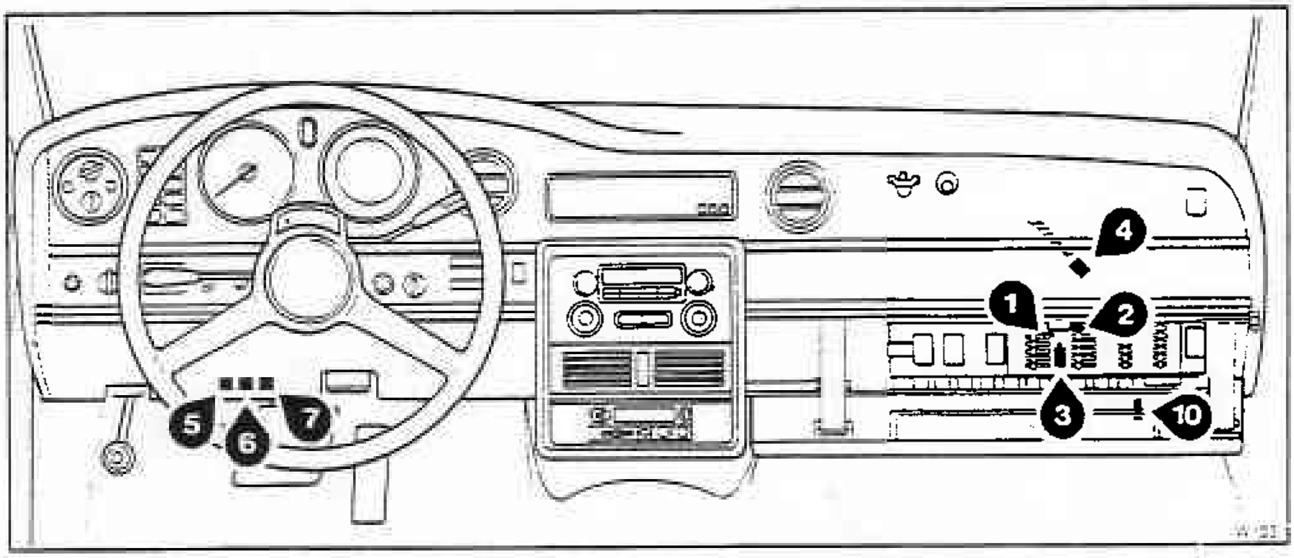
Low refrigerant charge - Protection system

Wiring diagram and component location

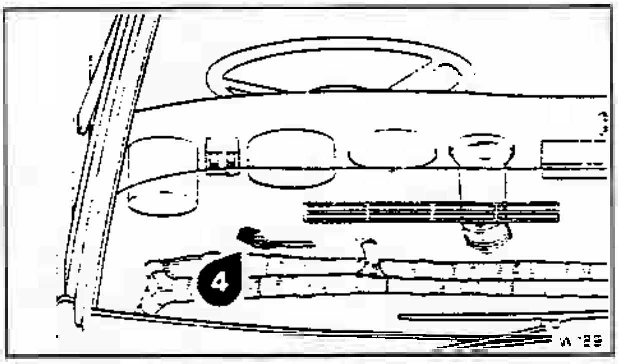
Printed in England



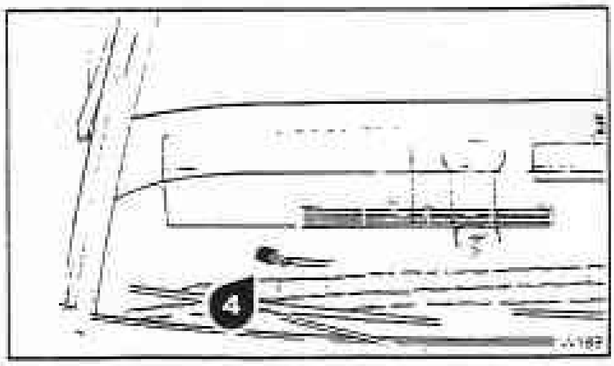
4
2
10
1
3
7
6
5
W 193



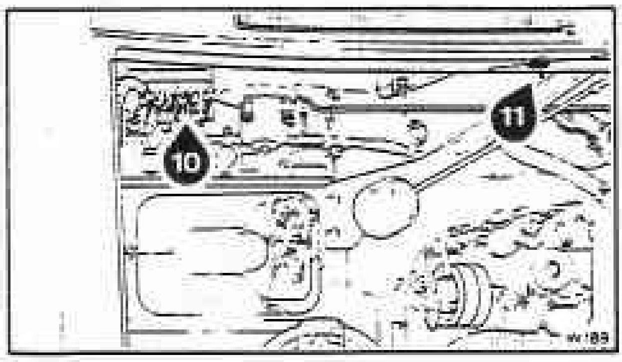
4
1
2
3
10
5
6
7
W 192



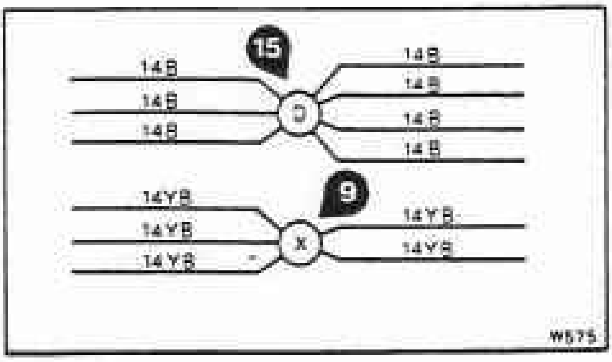
4
W 129



4
W 187



11
10
W 189

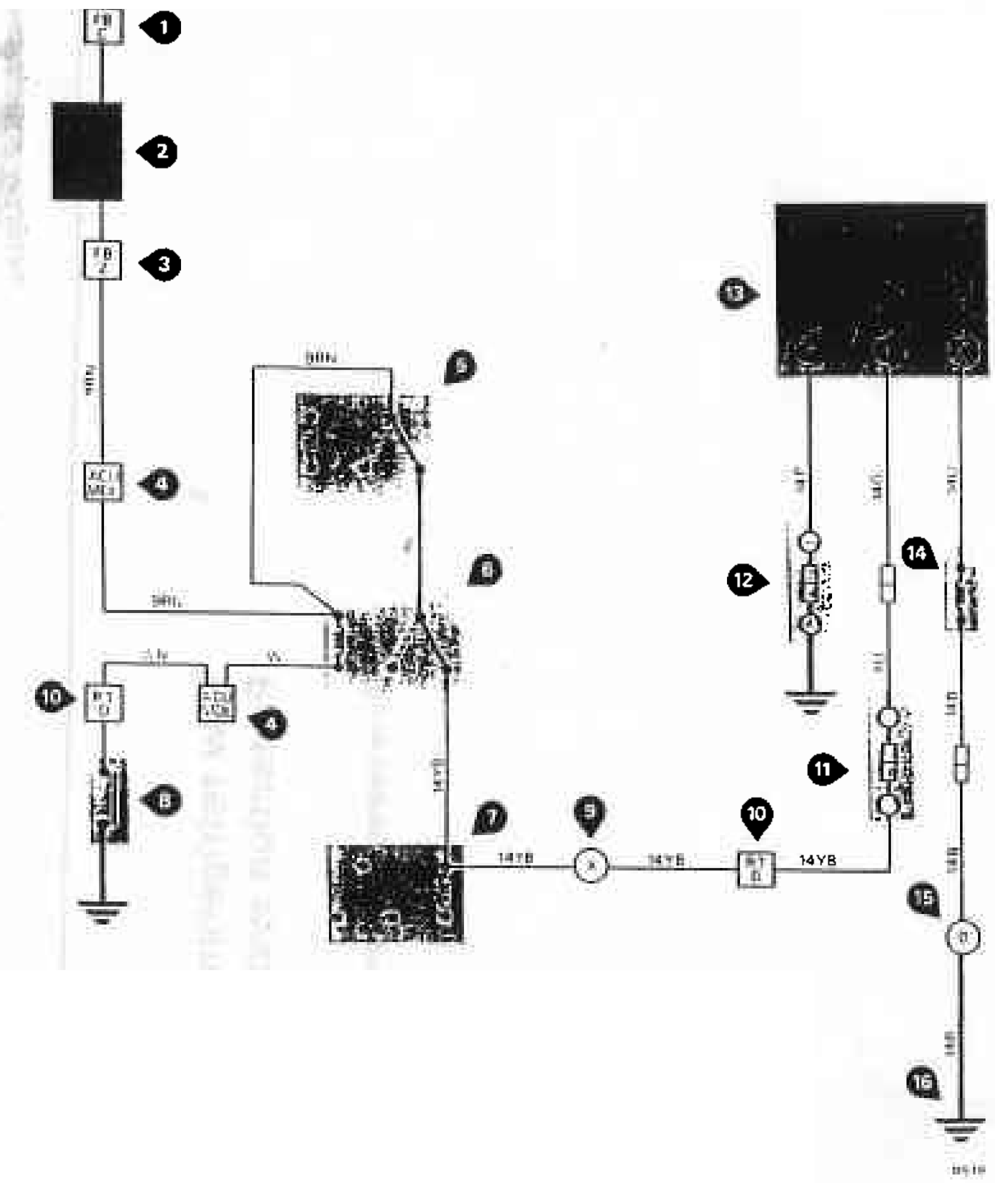


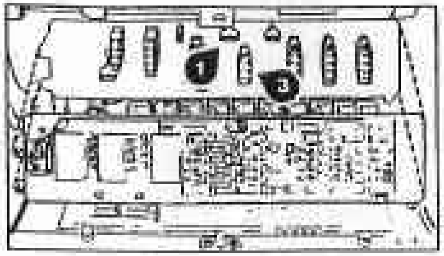
15
14 B
14 B
14 B
14 B
14 B
14 B
14 B
9
14 YB
14 YB
14 YB
14 YB
14 YB
W575

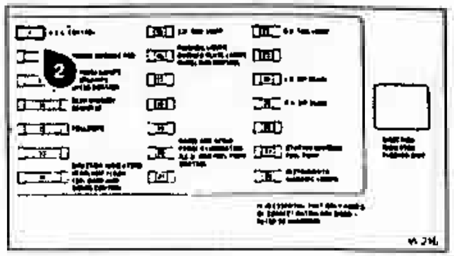
Low refrigerant charge - Protection system

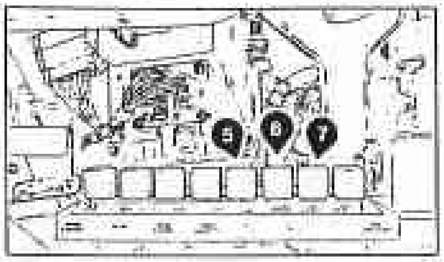
Wiring diagram and component location

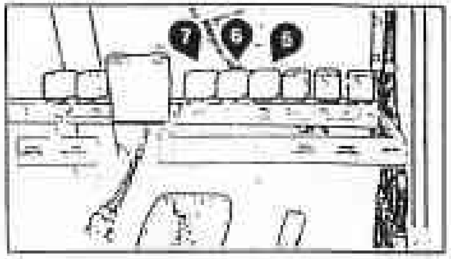
Printed in England

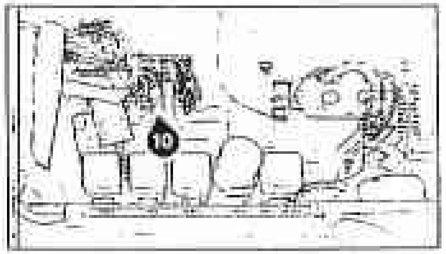

1
2
FB 2
3
4
BRN
5
6
4
10
8
7
14YB
9
14YB
10
14YB
13
12
14
11
15
16

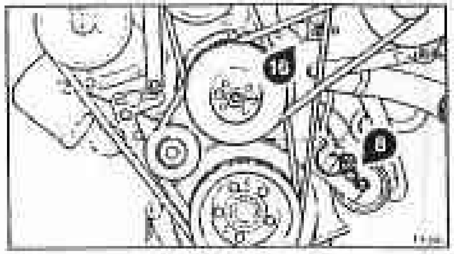

1
3

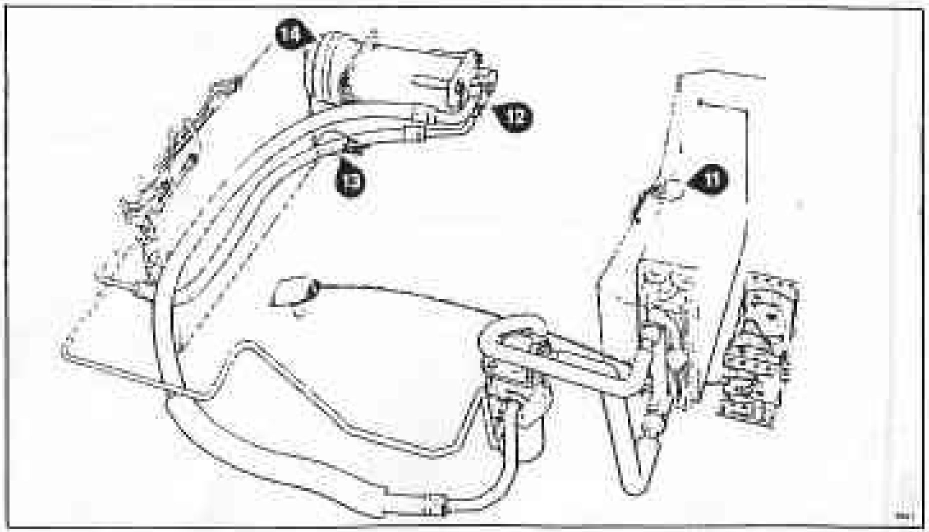

2


5
6
7


7
6
5


10


16
8

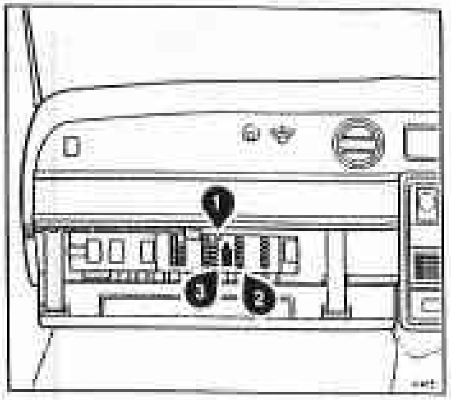

14
12
13
11

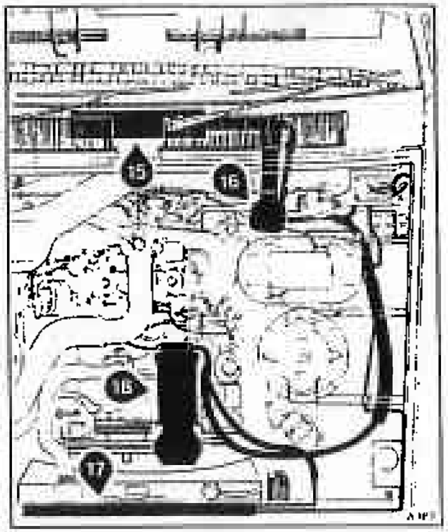
Rear compartment air conditioning system

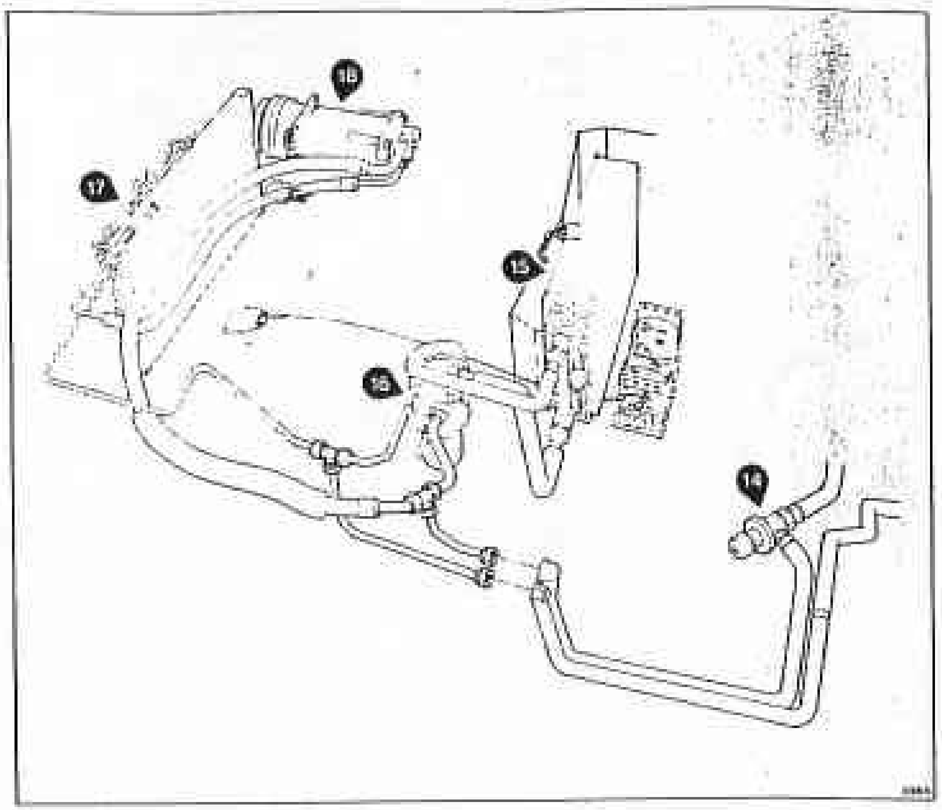
Silver Spur cars with a Centre Division

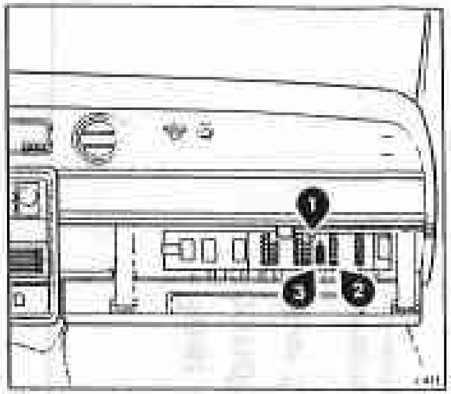
Component location, refrigerant flow, air flow, and wiring diagrams

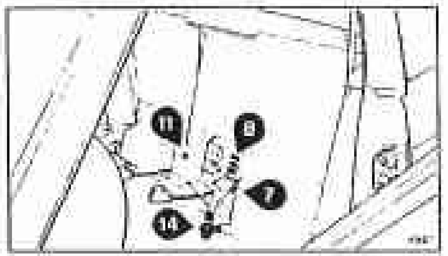
Printed in England

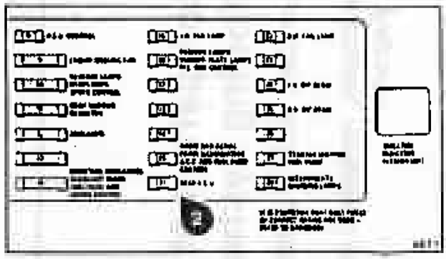

1
3
2

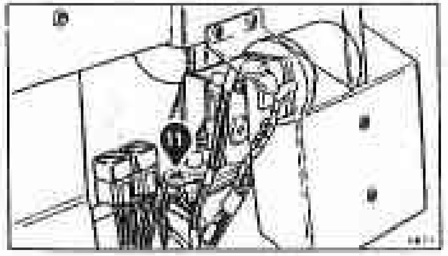

15
16
16
17

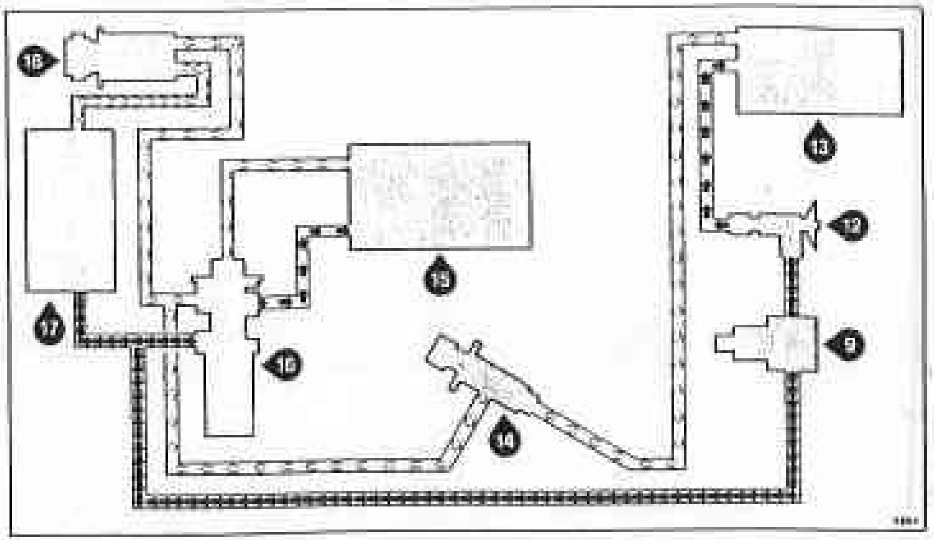

18
17
15
15
14

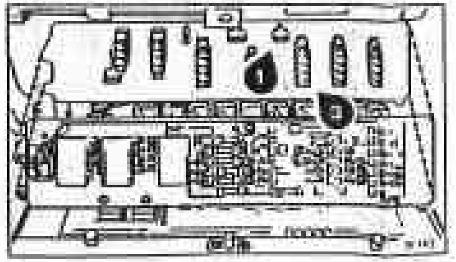

1
3
2

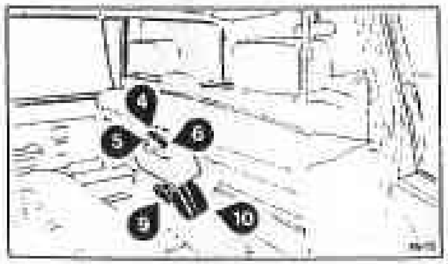

11
8
7
14


2


11


18
13
12
17
15
16
9
14


1
3

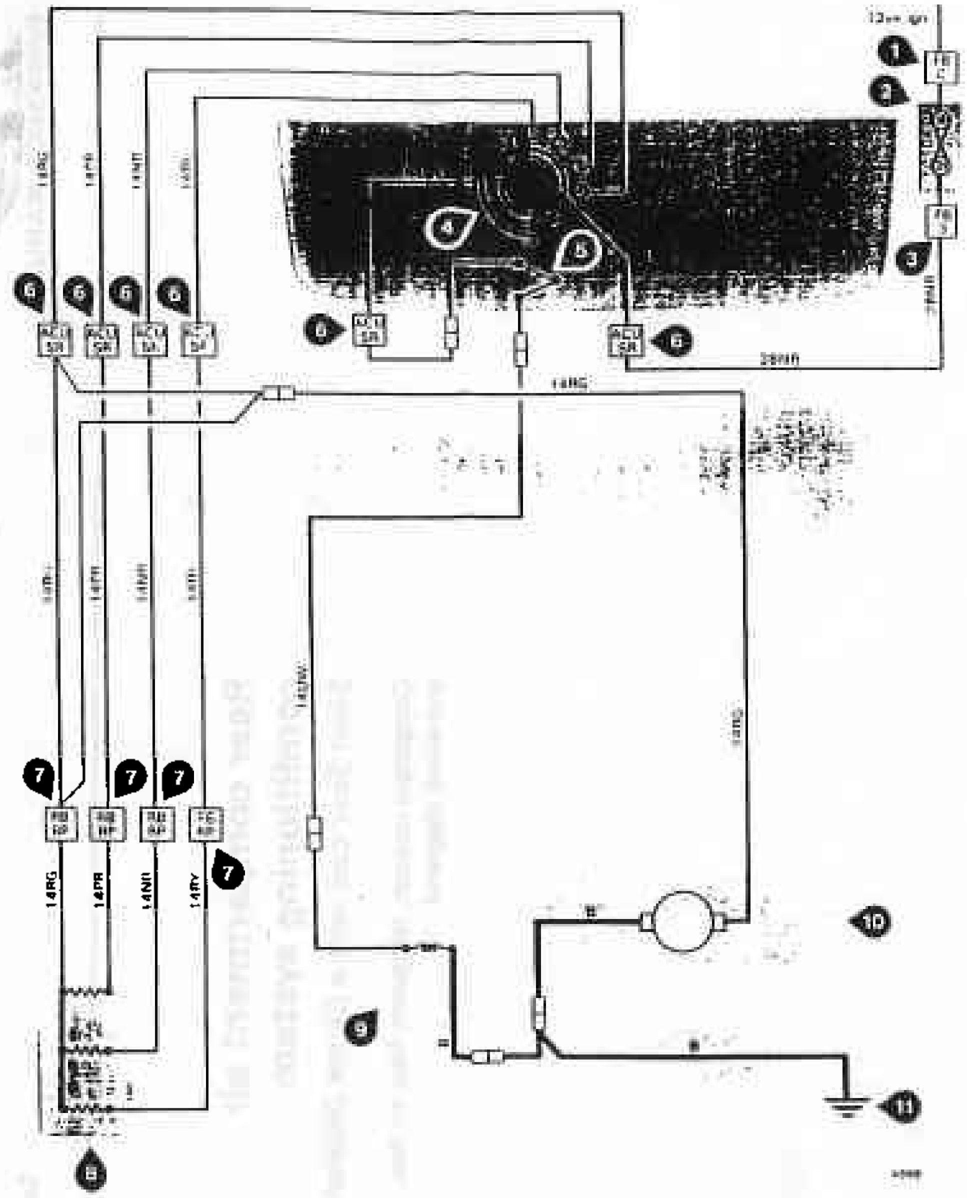

4
5
6
9
10

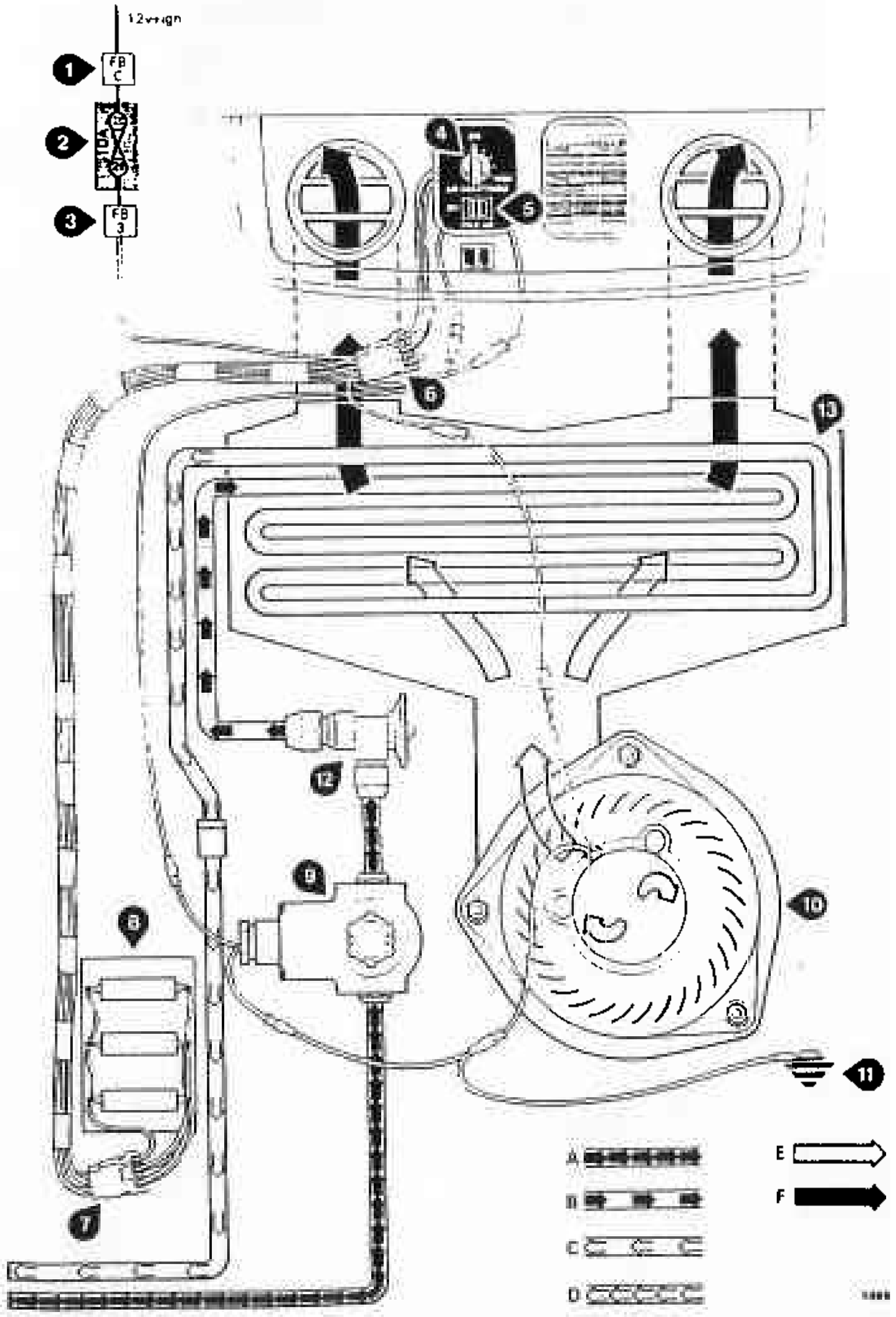
Rear compartment air conditioning system

Silver Spur cars with a Centre Division

Component location, refrigerant flow, air flow, and wiring diagrams

Printed in England


12v+ ign
1
FB C
2
3
FB 3
4
5
6
14RG
14PR
14NR
14PY
28NR
14SW
RB RP
FC RP
7
8
9
10
11
B


12v+ign
1
FB C
2
10A
3
FB 3
4
5
6
7
8
9
10
11
12
13
A
B
C
D
E
F

Section C7

System test and fault diagnosis

Lower quantity flap inoperative
Sheet 1 of 2
Fig. C48

Start

Switch on the engine. Set the ACU switch to DEFROST. At the lower quantity flap actuator, connect a 12 volt test lamp between the green/pink cable and earth.
Does the lamp light?

NO → Verify that the orange/blue cable at the ACU switch is live and also that the green/pink cable from the diode block is live. If the green/pink is not live, the diode is faulty.

YES ↓

Set the ACU switch to AUTO. Remove the sensor chain socket (servo moves to screen mode). Disconnect the fan delay thermostat.
Is the test lamp extinguished?

NO → At the lower quantity relay, connect a test lamp between the blue/black cable and earth.
Does the lamp light?

NO → An incorrect live feed to the actuator is being supplied from the orange/black cable at ACU switch or the green/pink cable at upper servo plug. Replace the appropriate faulty component. (ACU switch or servo).

YES ↓ Remove the yellow/brown cable from the lower quantity relay. If the test lamp at the relay is extinguished there is an earth fault on the yellow/brown cable between relay and fan delay thermostat. If the test lamp remains lit, the lower quantity relay is faulty.

YES ↓

After the previous instruction, did the actuator operate?

NO → Is there a live feed on the orange/white cable at the actuator?

NO → **Go to sheet 2**

YES ↓ Connect an external earth cable between the black cable at the actuator and a good earth. If the actuator does not move it is faulty.

YES ↓

Set the ACU switch to DEFROST.
Does the actuator operate?

NO → Connect an external earth cable between the black cable at the actuator and a good earth. If the actuator does not move it is faulty.

YES ↓

The actuator is satisfactory.

↓

During instructions 2 and 3, did the lower quantity flap fully open and fully close & did the microswitch operate?

YES → **The flap and actuator are satisfactory.**

→ Reconnect the sensor chain socket & connect the yellow/white cable to earth. (Servo moves to 'Facia' mode). Switch to AUTO.
Does the test lamp light?

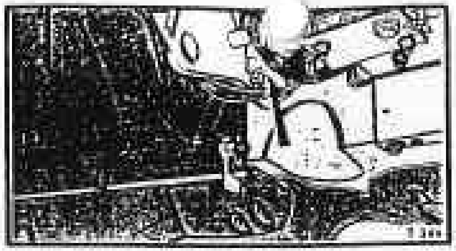
YES → 2 faults or incorrect diagnosis.

NO ↓ 15% microswitch on upper servo faulty, check for live feed on green/pink cable at servo plug.

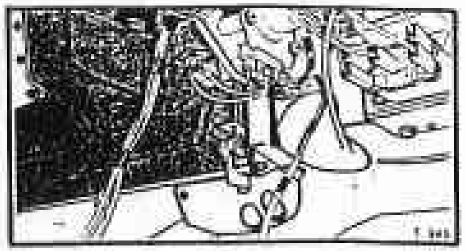
NO ↓

Adjust the flap and tighten the pinch-bolt so that the flap will fully open and fully close. Ensure that the microswitch operates correctly.

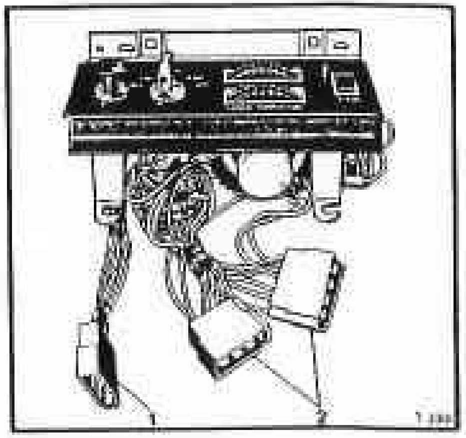
These are landmarks. They show which part of the system has been proved correct.



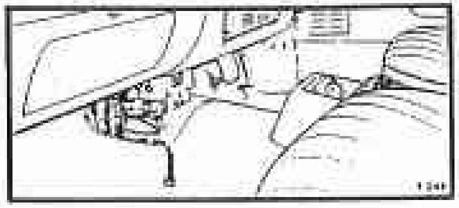
Lower quantity flap actuator right-hand drive cars



Lower quantity flap actuator left-hand drive cars.

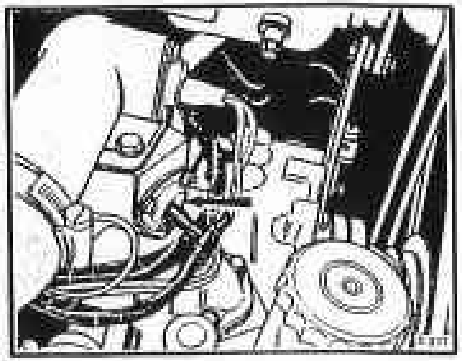


1. Hazard switch socket
2. A.C.U. sockets

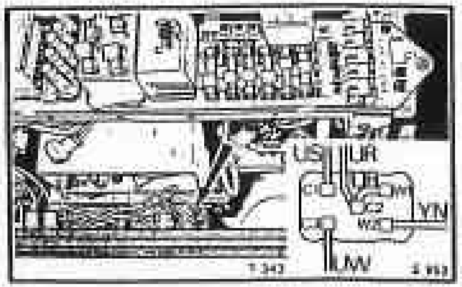


Location of sensor chain socket.

Sensor chain socket.



Fan delay thermostat.

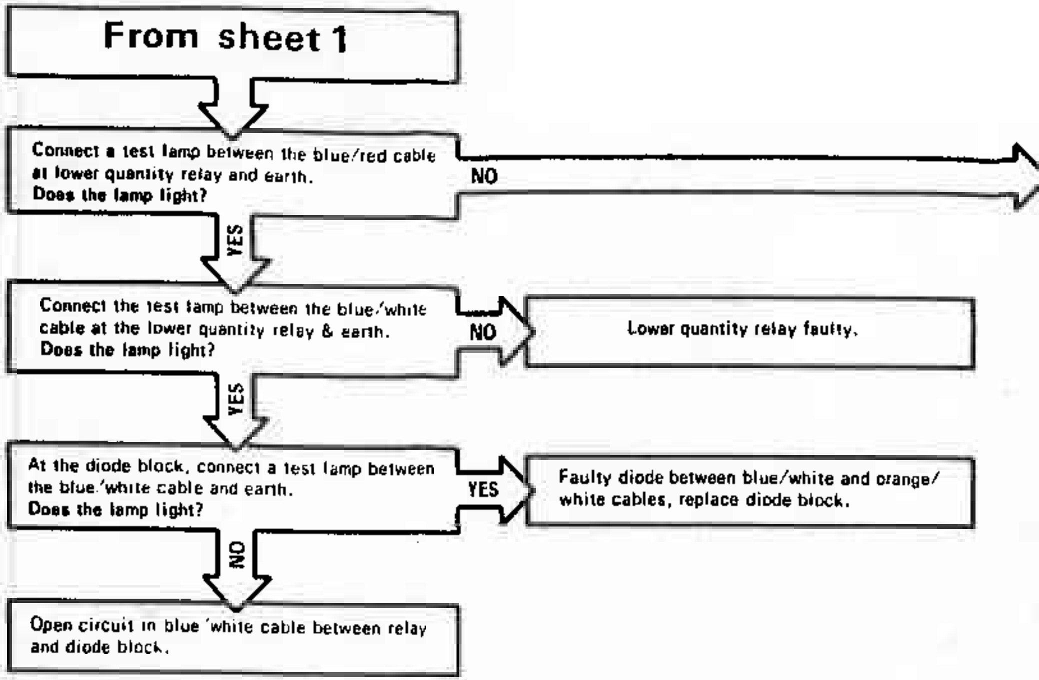


Printed in England
© Rolls-Royce Motors Limited 1976

Section C7

System test and fault diagnosis

Lower quantity flap inoperative
Sheet 2 of 2
Fig. C48 continued



From sheet 1

Connect a test lamp between the blue/red cable at lower quantity relay and earth.
Does the lamp light?

NO → At the upper servo plug, connect a test lamp between the blue/green cable and earth.
Does the lamp light?

NO → Servo is probably faulty. Refer to Servo Fault Diagnosis.

YES → Open circuit in blue/green cable between servo and ACU switch, open circuit in blue/red cable between ACU switch & lower quantity relay or ACU switch faulty. Test for live feed using test lamp.

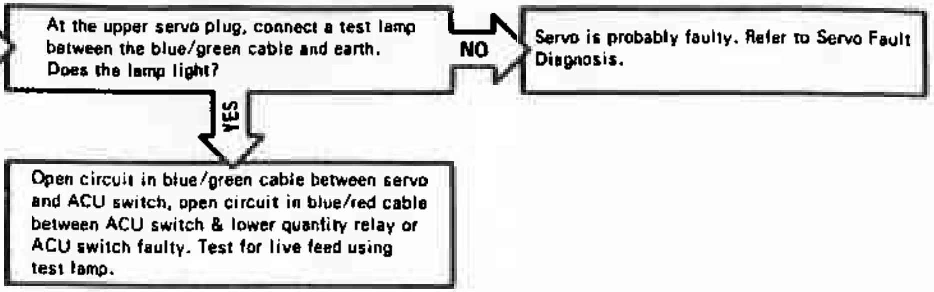
YES → Connect the test lamp between the blue/white cable at the lower quantity relay & earth.
Does the lamp light?

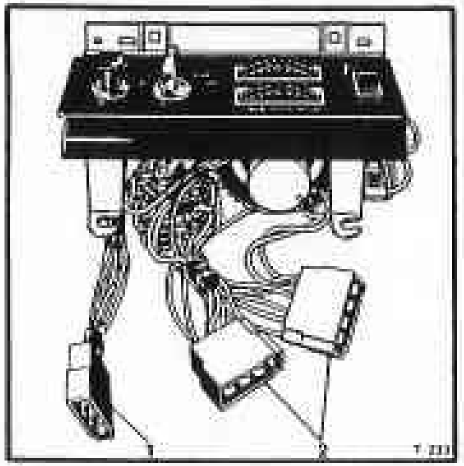
NO → Lower quantity relay faulty.

YES → At the diode block, connect a test lamp between the blue/white cable and earth.
Does the lamp light?

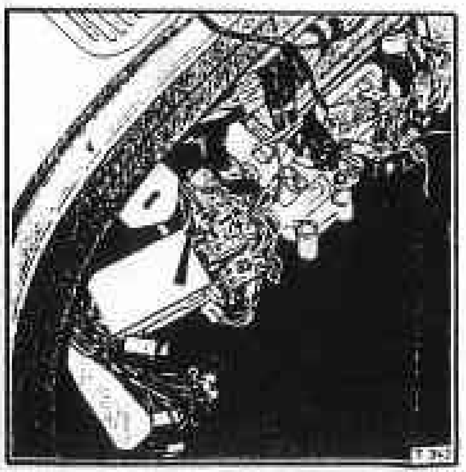
YES → Faulty diode between blue/white and orange/white cables, replace diode block.

NO → Open circuit in blue/white cable between relay and diode block.

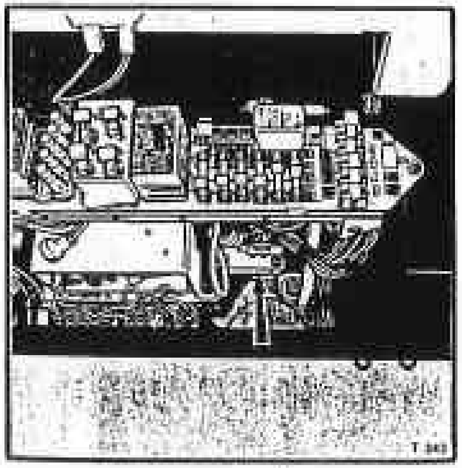




1. Hazard switch socket
2. A.C.U. sockets



Diode board, left-hand drive cars, viewed with top roll removed.



Diode board, right-hand drive cars.

Section C7

System test and fault diagnosis

Lower servo test and calibration procedure
Sheet 2 of 2
Fig. C53 continued

From sheet 1

On the test box, set the IND/VOLTS to VOLTS and CHECK VOLTS to Position 2. Record the voltmeter reading. **Is it between 1.7 and 3.3 volts?**

NO → Internal fault in servo. Renew servo and repeat the complete test procedure for both upper and lower servos.

YES ↓

On the test box, set CHECK VOLTS to Position 3. **Is the voltmeter reading within ± 0.2 volts of the reading recorded in CHECK VOLTS Position 2?**

YES → On the test box, set the IND/VOLTS to IND and the RUN/SET switch to RUN. The lower servo should run from 43% ± 2% to 0%. At the lower servo arm, release the upper nut sufficiently to allow the temperature blend flap rod to be pulled through the servo arm until it stops under light pressure. Hold the rod under light pressure and adjust the lower nut to contact the servo arm, then tighten nuts.

→ The lower temperature blend flap is now correctly set

↓ The lower servo and lower servo module are now proven to operate correctly from the test box. If a fault still exists, refer to the LOWER SENSOR CHAIN FAULT DIAGNOSIS

NO ↓

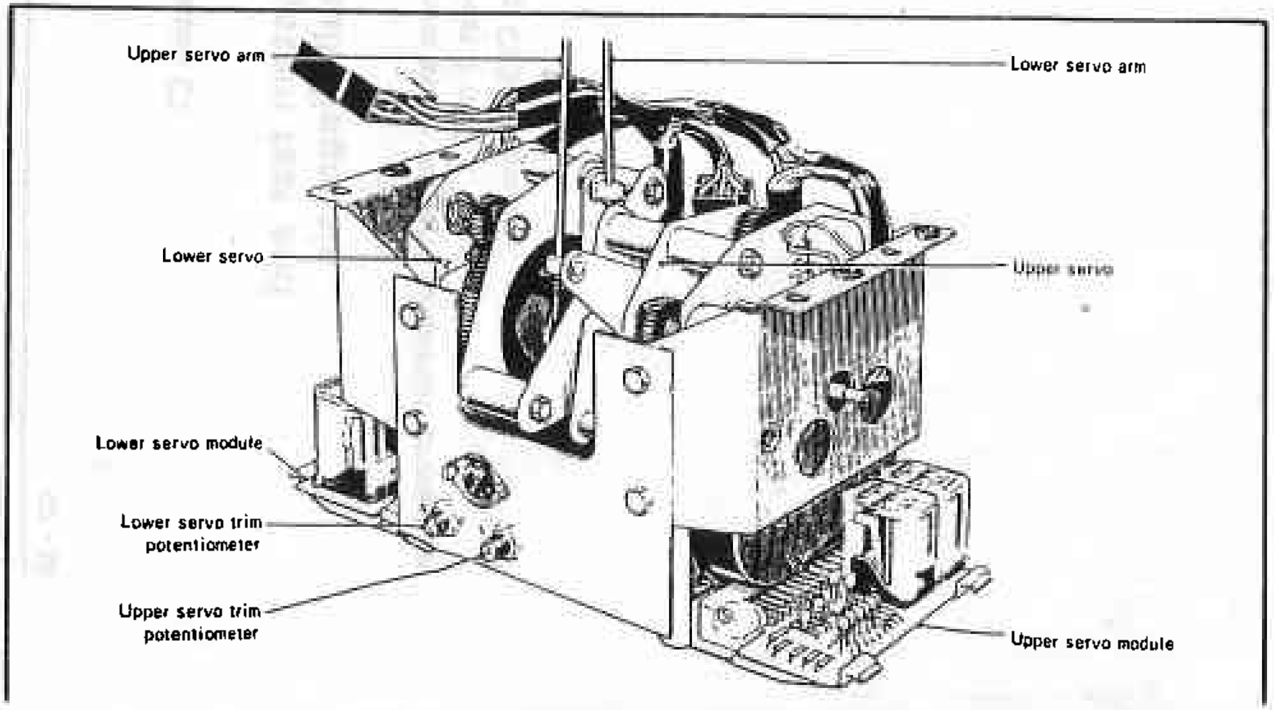
Interchange servo modules and repeat checks at CHECK VOLTS Position 2 and 3. **Are the readings within ± 0.2 volts?**

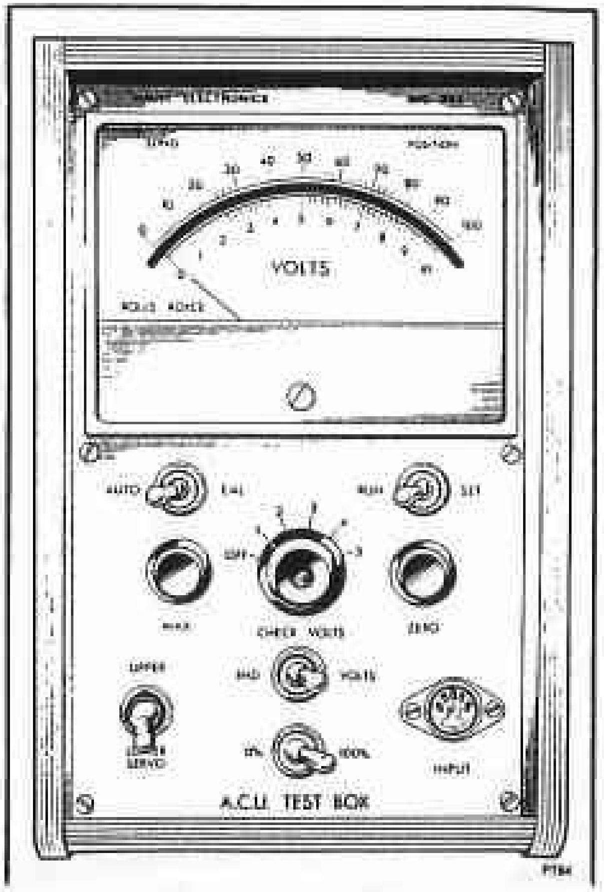
NO → Upper servo module is also faulty. Renew both modules. → Go back to ✱ on sheet 1

YES ↓

The original servo module is faulty. Renew servo module. → Go back to ✱ on sheet 1

These are landmarks. They show which part of the system has been proved correct.





T.S.D. 4200 March 1984

Printed in England

Workshop tools

RH 7792	Extractor pilot – Compressor pulley
RH 7794	Handle
RH 7796	Installing tool – Compressor pulley and bearing
RH 7798	Holding tool – Compressor clutch hub
RH 7799	Fitting tool – Compressor hub and drive plate
RH 7937	Adaptor – Schrader valve
RH 8741	Extractor – Compressor pulley
RH 8851	Test box – Automatic air conditioning system
RH 8948	Removal tool – EEVIR unit valve capsules

Printed in England