

82 - AIR CONDITIONING

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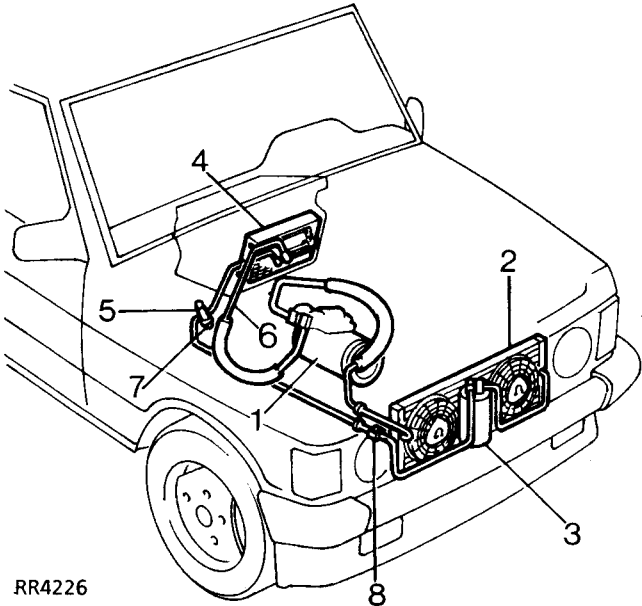
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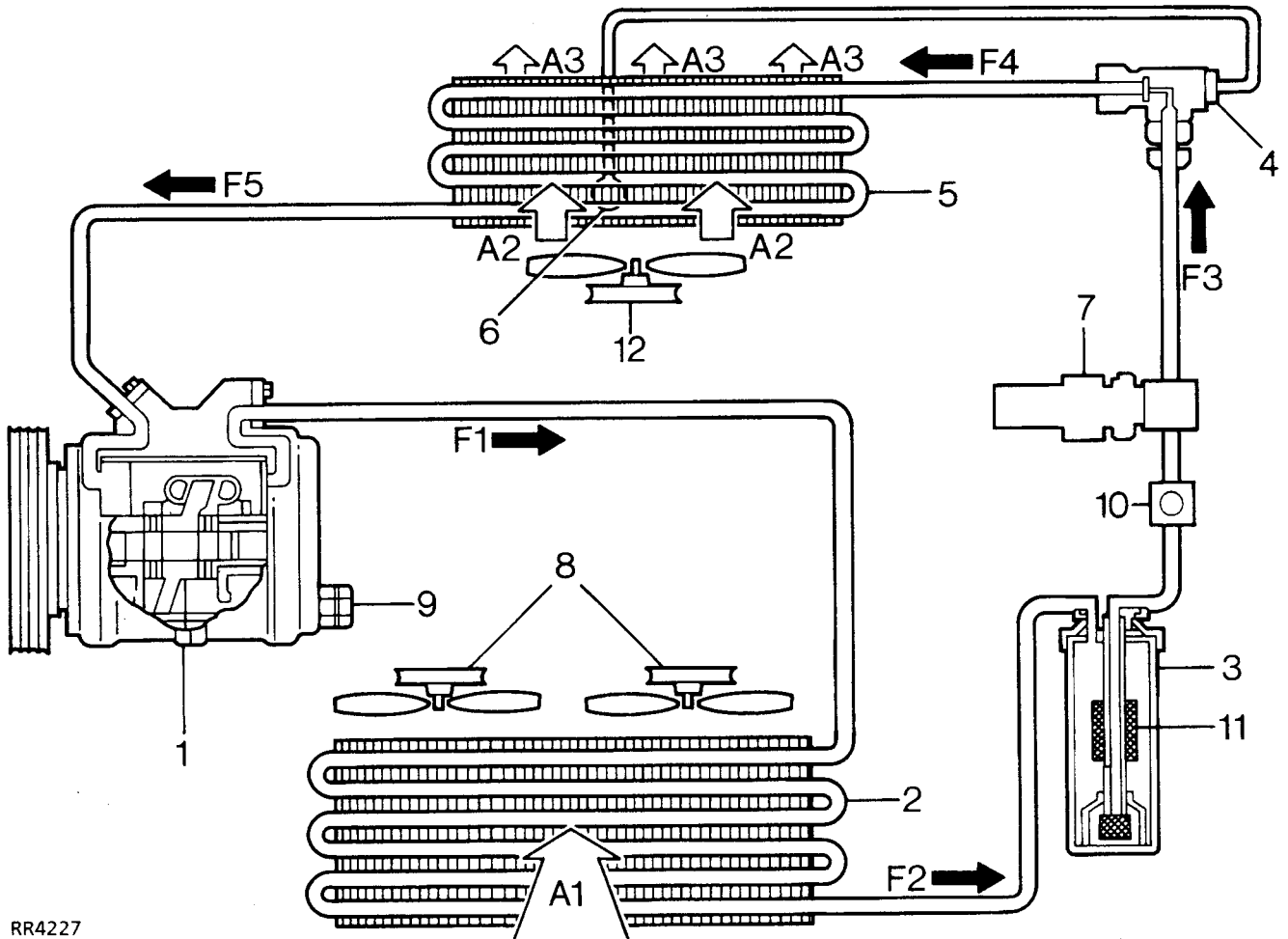


AIR CONDITIONING SYSTEM COMPONENTS



- 1. Compressor
- 2. Condenser
- 3. Receiver/drier
- 4. Evaporator
- 5. High pressure servicing connection
- 6. Low pressure servicing connection
- 7. Dual pressure switch
- 8. Sight glass

SCHEMATIC LAYOUT OF THE AIR CONDITIONING SYSTEM



RR4227

- | | |
|--|---|
| 1. Compressor | A1 Ambient air flow through condenser |
| 2. Condenser | A2 Ambient air flow through fan and evaporator |
| 3. Receiver/drier | A3 Cooled air flow to vehicle interior |
| 4. Thermostatic expansion valve | F1 High pressure high temperature refrigerant vapour |
| 5. Evaporator | F2 High pressure slightly subcooled refrigerant liquid |
| 6. Capillary tube | F3 High pressure slightly subcooled refrigerant liquid with moisture, vapour bubbles and foreign matter removed |
| 7. Dual pressure switch | F4 Low pressure low temperature mixed liquid and vapour |
| 8. Cooling fans to maintain air flow | F5 Low pressure slightly superheated refrigerant vapour |
| 9. Compressor high pressure relief valve | |
| 10. Sight glass - refrigerant | |
| 11. Drying agent - receiver/drier | |
| 12. Blower motor | |



AIR CONDITIONING SYSTEM OPERATION

The air conditioning system provides the means of supplying cooled and dehumidified, fresh or recirculated air to the interior of the vehicle. The cooling effect is obtained by blowing air through the matrix of an evaporator unit and when required, mixing that air with heated air by means of the heater distribution and blend unit, to provide the conditions required inside the vehicle. The volume of conditioned air being supplied is controlled by a variable speed blower.

A sealed system, charged with Refrigerant R134a, together with a blower unit, blend unit and control system combine to achieve the cooled air condition.

For air conditioning air distribution system. **See HEATING AND VENTILATION, Description and operation, Heating and Ventilation Unit**

The air conditioning system comprises five major units:

1. An engine-mounted compressor.
2. A condenser mounted in front of the radiator.
3. A receiver/drier unit located in front of the condenser.
4. Thermostatic expansion valve mounted above the evaporator.
5. An evaporator unit mounted in front of the heater matrix.

These units are interconnected by hoses and pipes carrying Refrigerant R134a, the evaporator is linked into the vehicle ventilation system.

Refrigeration cycle

1. Compressor

The compressor (1), belt driven from the crankshaft pulley, pressurises and circulates the refrigerant through the system. Mounted on the compressor, an electro-mechanical clutch maintains the correct temperature and pressure by engaging or disengaging to support the system's requirements. The clutch action is normally controlled by a thermostat located at the evaporator (5). The compressor is of the swashplate type having fixed displacement.

Should the temperature at the evaporator (5) fall low enough for ice to begin to form on the fins, the thermostat disengages the clutch and also isolates the cooling fans relays. When the temperature at the evaporator (5) rises to the control temperature, the clutch is re-engaged.

Should the system pressure become excessive or drop sufficiently to cause damage to the compressor (1) a dual pressure switch (7), located in the high pressure line, signals the relay unit to disengage the clutch. The compressor also has an emergency high pressure relief valve (9) fitted.

The cooling fans are controlled by engine temperature when the air conditioning is not switched on.

2. Condenser

From the compressor, hot high pressure vaporised refrigerant (F1) passes to the condenser (2), which is mounted in front of the engine coolant radiator. Ram air(A1) passing through the condenser (2), supplemented by 2 cooling fans (8) mounted in front of the condenser, cools the refrigerant vapour sufficiently to form a high pressure slightly subcooled liquid (F2).

3. Receiver/drier

This liquid then passes to a receiver/drier (3) which fulfils two functions. It acts as a reservoir and moisture extractor (11).

A sight glass (10), in the high pressure line, provides a method of determining the state of the refrigerant without breaking into the system.

4. Expansion valve

From the receiver/drier (3) the moisture free high pressure liquid refrigerant (F3) passes through a thermostatic expansion valve (4). A severe pressure drop occurs across the valve and as the refrigerant enters the evaporator space at a temperature of approximately -5°C it boils and vaporises.

5. Evaporator

As this change of state occurs, a large amount of latent heat is absorbed. The evaporator is therefore cooled and as a result heat is extracted from the air flowing across the evaporator. The air flow is controlled by the ventilation fan which can be operated at any one of four speeds.

To prevent liquid passing through to the compressor, a capillary tube (6), attached to the outlet pipe of the evaporator (5) and connected to the thermostatic expansion valve (4), controls the amount that the valve opens and closes in relation to the temperature of the low pressure high temperature refrigerant vapour (F4) at the outlet. The atomised refrigerant then passes through the evaporator (5). Fan blown air (A2) passes through the matrix (A3) of the evaporator and is cooled by absorption due to the low temperature refrigerant passing through the evaporator.

A thermostat is fitted in the airflow out of the evaporator to sense the temperature of the exterior fins. Should ice begin to form, due to a too cold condition, it will signal to disengage the electro-mechanical clutch on the compressor (1).

From the evaporator, low pressure slightly superheated refrigerant (F5) passes to the compressor to complete the cycle.

AIR CONDITIONING CONTROL SYSTEM

The air conditioning control system comprises relays, thermostat, pressure switches, and a control panel. Inputs from outside the air conditioning system comprise temperature information from the engine cooling system. Together these controls, in conjunction with the cooling fans, compressor clutch, blower and heater distribution and blend unit enable minimal input to maintain the required environment inside the vehicle.

When air conditioning is not selected, air is supplied by ram effect or blower to the areas selected by the controls. The air mix flap on the blend unit controls the temperature of the air being supplied. No cooled air is available.

Selecting air conditioning provides the added facility of cooled air available to be mixed as before. When required a fully cold condition can be selected by turning the temperature controls to cold, which automatically closes the heated coolant access to the heater matrix. Mixtures of cooled, fresh, and hot air can be selected to give required interior environmental conditions by selection at the control panel.

Dual pressure switch

This switch, located in the high pressure line between the receiver drier and the expansion valve, monitors refrigerant pressure and by means of the relay module controls the following system functions:

1. Refrigerant pressure drops below 2.0 bar, 29 lbf/in² (due to possible leakage), the compressor's electro-mechanical clutch is dis-engaged.
When pressure rises above 2.0 bar, 29 lbf/in² the compressor's clutch is re-engaged.
2. Refrigerant pressure rises above 32 bar, 455 lbf/in² (due to possible blockage), even with cooling fan operation, the compressor's electro-mechanical clutch is dis-engaged.
When the pressure drops below 26 bar, 375 lbf/in² the compressor clutch is re-engaged.

**Condenser cooling fans**

The condenser cooling fans operate automatically whenever the air conditioning system is switched on.

Fan timer unit

The thermostatically controlled timer will continue to operate the cooling fans after the air conditioning or ignition is switched off. When the system temperature is excessive, the fans will operate for 10 minutes to reduce condenser and underbonnet temperature.

Blower control

The blower can be operated at any one of four speeds by sliding the blower switch to the required position. When the blower is switched off the air conditioning system will not operate.

The fresh air/recirculation flaps can move between two positions. One position covers the outside air inlet, leaving open an inlet from the inside of the vehicle clear, when recirculated air is required. In the other position they will cover the inlet from the inside of the vehicle leaving open the outside air inlet, when fresh air is required.

Heater distribution and blend unit control

Blower unit air flow, having passed through the evaporator passes into the heater blend unit to be heated, if required. It is then directed into the vehicle interior in accordance with the flap positions designated by the air distribution control. Heater flaps control the amount of air flowing through the heater matrix. These flaps are controlled individually by the driver's and passenger's temperature controls.

When the temperature control is in the cold position, a micro switch actuates a vacuum control to close the coolant valve on the engine. As the temperature control is moved away from cold, the coolant valve is opened allowing heated engine coolant to flow through the heater matrix. The temperature of the heated air flow into the vehicle interior is controlled by the blend flaps.

The distribution control moves the flaps which control the direction of the air flow into the interior of the vehicle.



AIR CONDITIONING - ELECTRICAL - MECHANICAL FAULTS

FAULT	CAUSE	REMEDY
<p>A. BLOWER MOTOR INOPERATIVE OR SLOW RUNNING</p>	<ol style="list-style-type: none"> 1. Incorrect voltage. 2. Open or defective fuse or relay. 3. Loose wire connection including ground. 4. Switch open or defective. 5. Tight, worn, or burnt motor bearings. 6. Open rotor windings. 7. Worn motor brushes. 8. Shaft binding-blade misaligned. 9. Defective resistors 	<ol style="list-style-type: none"> 1. Check voltage. 2. Check and replace as necessary. 3. Check system wires; tighten all connections. 4. Replace switch. 5. Replace motor. 6. Replace motor. 7. Replace motor. 8. Check alignment. Repair or replace as necessary. 9. Rectify or replace.
<p>B. COMPRESSOR CLUTCH INOPERATIVE</p>	<ol style="list-style-type: none"> 1. Incorrect voltage. 2. Open or defective fuse or relay. 3. Defective thermostat control or pressure switch. 4. Shorted or open field coil. 5. Bearing seized (clutch will not disengage). 6. Refrigeration circuit problem causing heavy load and excessive drive torque. 	<ol style="list-style-type: none"> 1. Check voltage. 2. Check and replace as necessary. 3. Replace thermostat or pressure switch. 4. Replace coil. 5. Replace clutch pulley assembly. 6. Check and rectify.
<p>C. COMPRESSOR CLUTCH NOISY</p>	<ol style="list-style-type: none"> 1. Incorrect alignment. 2. Loose belt. 3. Compressor not mounted securely. 4. Bearing in clutch-pulley assembly not pressed in. 5. Low voltage to clutch. 6. Clutch will not spin freely. 7. Oil on clutch face. 8. Slipping clutch. 9. Overloaded or locked compressor. 10. Icing. 	<ol style="list-style-type: none"> 1. Check alignment; repair as necessary. 2. Adjust to proper tension. 3. Repair as necessary. 4. Remove clutch and replace clutch pulley assembly. 5. Check connections and voltage. 6. Refer to B5 above. 7. Check compressor seals for leaks. 8. Refer to C5 above. Then check air gap. 9. Repair or replace compressor. 10. Check for suction line frosting. Replace expansion valve if necessary. Replace receiver/drier if necessary.
<p>D. CONDENSER VIBRATION</p>	<ol style="list-style-type: none"> 1. Motor and/or blades improperly mounted. 2. Foreign matter build-up on blades. 3. Excessive wear of motor bearings. 	<ol style="list-style-type: none"> 1. Check mountings, adjust as necessary. 2. Clean blades with a suitable non-flammable cleaner. 3. Replace motor.

REFRIGERATION SYSTEM FAULTS

For any refrigeration system to function properly all components must be in good working order. The unit cooling cycle and the relationship between air discharge temperature and ambient temperature and the pressures at the compressor can help to determine proper operation of the system.

The length of any cooling cycle is determined by such factors as ambient temperature and humidity, thermostat setting, compressor speed and air leakage into the cooled area, etc. With these factors constant, any sudden increase in the length of the cooling cycle would be indicative of abnormal operation of the air conditioner.

The low and high side pressures at the compressor will vary with changing ambient temperature, humidity, in-car temperature and altitude.

The following items should be checked before operating the system:

1. Compressor drive belt tension.
2. Compressor magnetic clutch operation.
3. Condenser fan operation.
4. Condenser fins, dirt will cause poor cooling and higher operating temperatures.

The following conditions should be checked after operating the system for several minutes:

1. All high pressure lines and components should be hot to the touch.
2. All low pressure lines should be cool to the touch.
3. Inlet and outlet temperatures at the receiver/drier should be at the same temperature (warm). Any very noticeable temperature difference indicates a blocked receiver/drier.
4. Heavy frost on the inlet to the expansion valve may indicate a defective valve or moisture in the system.
5. Evaporation air temperature will vary with ambient temperature and humidity. As humidity increases the outlet temperature will be higher.



FAULT	CAUSE	REMEDY
<p>A. HIGH HEAD PRESSURE</p>	<ol style="list-style-type: none"> 1. Overcharge of refrigerant. 2. Air in system. 3. Condenser air passage clogged with dirt or other foreign matter. 4. Condenser fan motor defective. 5. Incorrect voltage to fan motor. 	<ol style="list-style-type: none"> 1. Discharge, evacuate and charge system. 2. Discharge system, fit new drier, evacuate and charge system. 3. Clean condenser of debris. 4. Replace motor. 5. Check voltage.
<p>B. LOW HEAD PRESSURE</p>	<ol style="list-style-type: none"> 1. Undercharge of refrigerant; evident by bubbles in sight glass while system is operating 2. Split compressor gasket or leaking valves. 3. Defective compressor. 	<ol style="list-style-type: none"> 1. Evacuate and charge system. Check for leakage. 2. Replace gasket and/or reed valve. Fit new drier, evacuate and charge system. 3. Repair or replace compressor.
<p>C. HIGH SUCTION PRESSURE</p>	<ol style="list-style-type: none"> 1. Loose drive belt 2. Refrigerant flooding through evaporator into suction line; evident by ice on suction line and suction service valve. 3. Expansion valve stuck open. 4. Leaking compressor valves, valve gaskets and/or service valves. 5. Receiver/drier blocked; evident by temperature difference between input and output lines. 	<ol style="list-style-type: none"> 1. Check belt tension. 2. Check thermobulb. Bulb should be securely clamped to clean horizontal section of copper suction pipe. 3. Replace expansion valve. 4. Replace valves and/or gaskets. Fit new drier evacuate and charge system. 5. Fit new drier, evacuate and charge system.
<p>D. LOW SUCTION</p>	<ol style="list-style-type: none"> 1. Expansion valve thermobulb not operating. 2. Expansion valve sticking closed. 3. Moisture freezing in expansion valve orifice. Valve outlet tube will frost while inlet hose tube will have little or no frost. System operates periodically. 4. Dust, paper scraps, or other debris restricting evaporator blower grille 5. Defective evaporator blower motor, wiring, or blower switch. 	<ol style="list-style-type: none"> 1. Warm thermobulb with hand. Suction should rise rapidly to 1.4 bar 20 lb/in² or more. If not replace expansion valve. 2. Check inlet side screen. Clean if clogged. Refer to C-2 and C-3. 3. Fit new drier, evacuate and charge system. 4. Clean grilles as required. 5. Refer to Fault Diagnosis Chart for blower motor.

FAULT	CAUSE	REMEDY
E. NOISY EXPANSION VALVE (steady hissing)	1. Low refrigerant charge; evident by bubbles in sight glass.	1. Leak test. Repair or replace components as required.
F. INSUFFICIENT COOLING	1. Expansion valve not operating properly. 2. Low refrigerant charge-evident by bubbles in sight glass. 3. Compressor not pumping.	1. Refer to C-2, C-3, D-1 and E. 2. Refer to B-1 and E. 3. Refer to B-2 and B-3
G. COMPRESSOR BELT SLIPPING	1. Belt tension. 2. Excessive head pressure. 3. Incorrect alignment of pulleys or worn belt not riding properly. 4. Nicked or broken pulley. 5. Seized compressor.	1. Adjust belt tension. 2. Refer to A-1 through A-4 and C-6. 3. Repair as needed. 4. Replace as needed. 5. Replace compressor.
H. ENGINE NOISE AND/OR VIBRATION	1. Loose or missing mounting bolts. 2. Broken mounting bracket. 3. Loose flywheel or clutch retaining bolt. 4. Rough idler pulley bearing. 5. Bent, loose, or improperly mounted engine drive pulley. 6. Defective compressor bearing. 7. Insecure mountings of accessories; generator, power steering, air filter, etc. 8. Excessive head pressure. 9. Incorrect compressor oil level.	1. Repair as necessary. 2. Replace bracket. 3. Repair as necessary. 4. Replace bearing. 5. Repair as necessary. 6. Replace bearing. 7. Repair as necessary. 8. Refer to A-1, A-2, A-3 A-4 and C-6. 9. Refer to compressor Oil Level Check.

HEATER AND AIR CONDITIONING - CIRCUIT DIAGRAMS

1. For details of heating and air conditioning electrics. *See Electrical Trouble Shooting Manual.*



GENERAL PRECAUTIONS

The refrigerant used in the air conditioning system is HFC (Hydrofluorocarbon) R134a.



WARNING: R134a is a hazardous liquid and when handled incorrectly can cause serious injury. Suitable protective clothing must be worn when carrying out servicing operations on the air conditioning system.



WARNING: R134a is odourless and colourless. Do not handle or discharge in an enclosed area, or in any area where the vapour or liquid can come in contact with naked flame or hot metal. R134a is not flammable but can form a highly toxic gas.



WARNING: Do not smoke or weld in areas where R134a is in use. Inhalation of concentrations of the vapour can cause dizziness, disorientation, uncoordination, narcosis, nausea or vomiting.



WARNING: Do not allow fluids other than R134a or compressor lubricant to enter the air conditioning system. Spontaneous combustion may occur.



WARNING: R134a splashed on any part of the body will cause immediate freezing of that area. Also refrigerant cylinders and replenishment trolleys when discharging will freeze skin to them if contact is made.



WARNING: The refrigerant used in an air conditioning system must be reclaimed in accordance with the recommendations given with a Refrigerant Recovery Recycling Recharging Station.



NOTE: Suitable protective clothing comprises: Wrap around safety glasses or helmet, heatproof gloves, rubber apron or waterproof overalls and rubber boots.

REMEDIAL ACTIONS

1. If liquid R134a strikes the eye, do not rub it. Gently run large quantities of eyewash over the eye to raise the temperature. If eyewash is not available cool, clean water may be used. Cover eye with clean pad and seek immediate medical attention.
2. If liquid R134a is splashed on the skin run large quantities of water over the area as soon as possible to raise the temperature. Carry out the same actions if skin comes into contact with discharging cylinders. Wrap affected parts in blankets or similar material and seek immediate medical attention.
3. If suspected of being overcome by inhalation of R134a vapour seek fresh air. If unconscious remove to fresh air. Apply artificial respiration and/or oxygen and seek immediate medical attention.



NOTE: Due to its low evaporating temperature of -30°C , R134a should be handled with care.



WARNING: Do not allow a refrigerant container to be heated by a direct flame or to be placed near any heating appliance. A refrigerant container must not be heated above 50°C .



WARNING: Do not leave a container of refrigerant without its cap fitted. Do not transport a container of refrigerant that is unrestrained, especially in the boot of a car.

SERVICING PRECAUTIONS

Care must be taken when handling refrigeration system components. Units must not be lifted by their hoses, pipes or capillary lines. Hoses and lines must not be subjected to any twist or stress. Ensure that hoses are positioned in their correct run before fully tightening the couplings, and ensure that all clips and supports are used. Torque wrenches of the correct type must be used when tightening refrigerant connections to the stated value. An additional spanner must be used to hold the union to prevent twisting of the pipe.

Before connecting any hose or pipe ensure that refrigerant oil is applied to the seat of the new 'O' ring but not to the threads.

Check the oil trap for the amount of oil lost.

All protective plugs on components must be left in place until immediately prior to connection.

The receiver/drier contains desiccant which absorbs moisture. It must be positively sealed at all times.



CAUTION: Whenever the refrigerant system is opened, the receiver/drier must be renewed immediately before evacuating and recharging the system.

Use alcohol and a clean cloth to clean dirty connections.

Ensure that all new parts fitted are marked for use with **R134a**.

Refrigerant oil

Use the approved refrigerant lubricating oil:
Nippon Denso ND-OIL 8
Unipart R134a ND-OIL8



CAUTION: Do not use any other type of refrigerant oil.

Refrigerant oil easily absorbs water and must not be stored for long periods. Do not pour unused oil back into the container.

When renewing system components, add the following quantities of refrigerant oil:

Condenser	40 ml
Evaporator	80 ml
Pipe or hose	20 ml
Receiver/drier	20 ml

Total quantity of refrigerant oil in system = **180 ml = 6.3 Fl oz**

A new compressor is sealed and pressurised with Nitrogen gas, slowly release the sealing cap, gas pressure should be heard to release as the seal is broken.



NOTE: A new compressor should always have its sealing caps in place and must not be removed until immediately prior to fitting.

Fitting a new compressor

A new compressor is supplied with an oil fill (X) of: 180 ml

A calculated quantity of oil must be drained from a new compressor before fitting.

To calculate the quantity of oil to be drained:

1. Remove sealing plugs from the OLD compressor
2. Invert compressor and gravity drain oil into measuring cylinder. Rotating the compressor clutch plate will assist complete draining.
3. Note the quantity of oil drained (Y).
4. Calculate the quantity (Q) of oil to be drained from the NEW compressor using the following formula:

$$X - (Y + 20 \text{ ml}) = Q$$

Rapid refrigerant discharge

When the air conditioning system is involved in accident damage and the circuit is punctured, the refrigerant is discharged rapidly. The rapid discharge of refrigerant will also result in the loss of most of the oil from the system. The compressor must be removed and all the remaining oil in the compressor drained and refilled as follows:

1. Gravity drain all the oil, assist by rotating the clutch plate (not the pulley).
2. Refill the compressor with the following amount of new refrigerant oil:

130 ml

3. Plug the inlet and outlet ports.



SERVICING EQUIPMENT

The following equipment is required for full servicing of the air conditioning system.

Recovery, recycling and charging station
 Leak detector
 Thermometer +20° C to -60° C
 Safety goggles and gloves

REFRIGERANT RECOVERY RECYCLING RECHARGING



WARNING: The air conditioning system is charged with a high pressure, potentially toxic refrigerant. Repairs or servicing must only be carried out by an operator familiar with both the vehicle system and the charging and testing equipment.

All operations must be carried out in a well-ventilated area away from open flame and heat sources.

Always wear safety goggles and gloves when opening refrigerant connections.



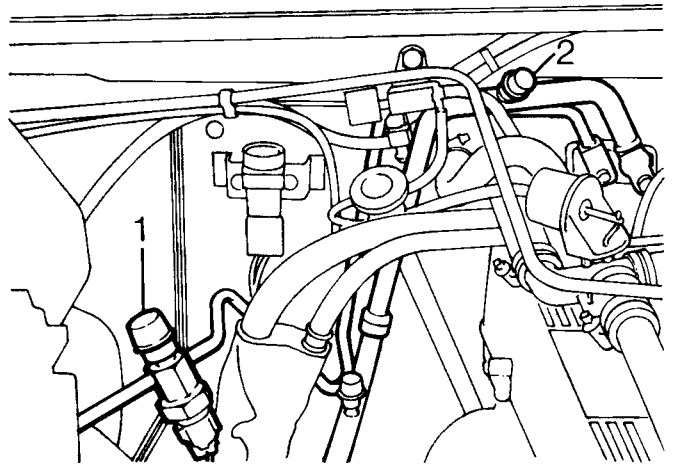
WARNING: Wear eye and hand safety protection. Open connections slowly in case liquid or pressure is present. Allow to bleed off slowly.



CAUTION: Overcharging air conditioning system will cause excessive head pressure.

An air conditioning portable Refrigerant Recovery Recycling Recharging Station for use with R134a refrigerant incorporates all the features necessary to recover refrigerant R134a from the air conditioning system, to filter and remove moisture, to evacuate and recharge with the reclaimed refrigerant. The unit can also be used for performance testing and air conditioning system analysis. The operator must adhere to the equipment manufacturer's instructions.

Recovery and recycling



RR3963M

1. High pressure servicing connection
2. Low pressure servicing connection

1. Connect a Refrigerant Station to the high and low pressure servicing connections.
2. Operate the refrigerant recovery system according to the manufacturer's instructions.
3. Measure the amount of oil discharged from the system. Add an equal amount of new refrigerant oil to compressor before evacuation sequence.



WARNING: Refrigerant must always be recycled before reuse, to ensure that the purity of the refrigerant is high enough for safe use in the air conditioning system. Recycling should always be carried out with equipment which is design certified by Underwriter Laboratory Inc. for compliance with SAE-J1991. Other equipment may not recycle refrigerant to the required level of purity.

A R134a Refrigerant Recovery Recycling Recharging Station must not be used with any other type of refrigerant.

Refrigerant R134a from domestic and commercial sources must not be used in motor vehicle air conditioning systems.

Evacuation and recharging

1. Add refrigerant oil to compressor if necessary.
2. Renew the receiver/drier.



CAUTION: When a major repair has been carried out, a leak test should be carried out using inert gas.

3. Connect a Refrigerant Station to the high and low pressure servicing connections.



CAUTION: Whenever the refrigerant system is opened, the receiver/drier must be renewed immediately before evacuating and recharging the system.

4. Operate the refrigerant evacuation system according to the manufacturer's instructions.



NOTE: If the vacuum reading is below 700mmHg after 15 minutes, suspect a leak in the system. Partially recharge the system and check for leaks using an electronic leak tester. Check suction lines first, then run the compressor for 5 minutes and then check the high pressure lines.



CAUTION: The system must be Evacuated immediately before recharging commences. Delay between Evacuation and Recharging is not permitted.

5. Operate the refrigerant recharging system according to the manufacturer's instructions.

Refrigerant to charge system is 0.90kg

6. If the full charge has not been accepted by the system, start the engine and run it at 1500 rev/min for a minimum of 2 minutes. Switch on the air conditioning system, open the car windows, set the temperature control to cold and switch the blower to maximum speed.
7. Consult Refrigerant Station Manual for correct procedure to complete the charge.
8. Carry out the air conditioning system performance test.

LEAK TEST SYSTEM

The following instructions refer to an electronic type Refrigerant Leak Detector for use with R134a, which are the safest and most sensitive.



CAUTION: When a major repair has been carried out, a leak test should be carried out using an inert gas (see below).

1. Place the vehicle in a well ventilated area but free from draughts, as leakage from the system could be dissipated without detection.
2. Follow the instructions issued by the manufacturer of the particular leak detector being used.
3. Commence searching for leaks by passing the detector probe around all joints and components, refrigerant gas is heavier than air.
4. Insert the probe into an air outlet of the evaporator or into the evaporator drain tube. Switch the air conditioning blower on and off at intervals of ten seconds. Any leaking refrigerant will be gathered in by the blower and detected.
5. Insert the probe between the magnetic clutch and compressor to check the shaft seal for leaks.
6. Check all service valve connections, valve plate, head and base plate joints and back seal plate.
7. Check the condenser for leaks at the pipe unions.
8. If any leaks are found, the system must be discharged before rectification.
9. Rectify any leaks and recheck for leaks during evacuation prior to charging.

Leak test using inert gas

Use Nitrogen or Helium gas.

1. Connect gas line to recharging station.
2. Pressurise system to 3 bar.
3. Carry out leak test as above.



AIR CONDITIONING SYSTEM - PERFORMANCE TEST



WARNING: R134a is hazardous, refer to the GENERAL PRECAUTIONS given at the beginning of this section.

Carry out this test with bonnet and doors or windows open, air conditioning switched on, temperature control set to cold and blower at maximum speed. Set the air supply control to supply fresh air.

1. Close low pressure valve on refrigerant station.
2. Close high pressure valve on refrigerant station.
3. Connect a Refrigerant Station to the high and low pressure servicing connections.

4. Insert dry bulb thermometer into cold air outlet and position dry and wet bulb thermometer close to outside air inlet.
Do not spill water from the wet thermometer (psychrometer).
5. Start engine and run it at 1500 rev/min for 10 minutes with air conditioning switched on.
6. Check that sight glass is free of bubbles.
7. Read both pressure gauges and thermometers. Check readings against table below with humidity between 60% and 80%. If readings are incorrect. **See Fault diagnosis, Refrigeration System Faults**
8. Switch off air conditioning, stop engine, disconnect test equipment.

Performance range

Intake temperature	Outlet temperature	Low pressure	High pressure
20 - 24° C	4 - 10° C	18 - 28 lbf/in ² 1.2 - 1.9 bar	213 - 299 lbf/in ² 14.7 - 20.6 bar
25 - 29° C	9 - 19° C	27 - 37 lbf/in ² 1.9 - 2.6 bar	256 - 341 lbf/in ² 17.6 - 23.5 bar
30 - 35° C	20 - 27° C	33 - 47 lbf/in ² 2.3 - 3.2 bar	299 - 384 lbf/in ² 20.6 - 26.5 bar

Table 1

Ambient Temperature		Compound Gauge Readings		High Pressure Gauge Readings	
° C	° F	bar	lbf/in ²	bar	lbf/in ²
16	60	1,03-1,4	15-20	6,9-10,3	100-150
26,7	80	1,4-1,72	20-25	9,6-13,1	140-190
38	100	1,72-2,1	25-30	12,4-15,5	180-225
43,5	110	2,1-2,4	30-35	14,8-17,2	215-250

SYSTEM TEST

1. Place the vehicle in a ventilated, shaded area free from excessive draught, with the doors and windows open.
2. Check that the surface of the condenser is not restricted with dirt, leaves, flies, etc. Do not neglect to check the surface between the condenser and the radiator. Clean as necessary.
3. Switch on the ignition and the air conditioner air flow control. Check that the blower is operating efficiently at low, medium and high speeds. Switch off the blower and the ignition.
4. Check that the evaporator condensate drain tubes are open and clear.
5. Check the tension of the compressor driving belt, and adjust if necessary.
6. Inspect all connections for the presence of refrigerant oil. If oil is evident, check for leaks, and repair as necessary.



NOTE: The compressor oil is soluble in Refrigerant R134a and is deposited when the refrigerant evaporates from a leak.

7. Start the engine.
8. Set the temperature controls to cold and switch the air conditioner blower control on and off several times, checking that the magnetic clutch on the compressor engages and releases each time.

9. With the temperature control at maximum cooling and the blower control at high speed, warm up the engine and fast idle at 1000 rev/min. Check the sight glass for bubbles or foam. The sight glass should be generally clear after five minutes running, occasional bubbles being acceptable. Continuous bubbles may appear in a serviceable system on a cool day, or if there is insufficient air flow over the condenser at a high ambient temperature.
10. Repeat at 1800 rev/min.
11. Gradually increase the engine speed to the high range, and check the sight glass at intervals.
12. Check for frosting on the service valves.
13. Check the high pressure hoses and connections by hand for varying temperature. Low temperature indicates a restriction or blockage at that point.
14. Switch off the air conditioning blower and stop the engine.
15. If the air conditioning equipment is still not satisfactory, carry out a pressure test as previously described in this section.

COMPRESSOR DRIVE BELT

Service repair no - 82.10.01

See ENGINE, Repair, Drive Belt -Tdi

See ENGINE, Repair, Compressor Drive Belt - V8i



PRECAUTIONS IN HANDLING REFRIGERANT LINES



WARNING: Wear eye and hand protection when disconnecting components containing refrigerant. Plug all exposed connections immediately.

1. When disconnecting any hose or pipe connection the system must be discharged of all pressure. Proceed cautiously, regardless of gauge readings. Open connections slowly, keeping hands and face well clear, so that no injury occurs if there is liquid in the line. If pressure is noticed, allow it to bleed off slowly.
2. Lines, flexible end connections and components must be capped immediately they are opened to prevent the entrance of moisture and dirt.
3. Any dirt or grease on fittings must be wiped off with a clean alcohol dampened cloth. Do not use chlorinated solvents such as trichloroethylene. If dirt, grease or moisture cannot be removed from inside the hoses, they must be replaced with new hoses.
4. All replacement components and flexible end connections must be sealed, and only opened immediately prior to making the connection.
5. Ensure the components are at room temperature before uncapping, to prevent condensation of moisture from the air that enters.
6. Components must not remain uncapped for longer than fifteen minutes. In the event of delay, the caps must be fitted.
7. Receiver/driers must never be left uncapped as they contain Silica Gel crystals which will absorb moisture from the atmosphere. A receiver/ drier left uncapped must not be used, fit a new unit.
8. The compressor shaft must not be rotated until the system is entirely assembled and contains a charge of refrigerant.
9. A new compressor contains an initial charge of refrigerant oil. The compressor also contains a holding charge of gas when received which should be retained by leaving the seals in place until the pipes are re-connected.
10. The receiver/drier should be the last component connected to the system to ensure optimum dehydration and maximum moisture protection of the system.
11. All precautions must be taken to prevent damage to fittings and connections. Slight damage could cause a leak with the high pressures used in the system.
12. Always use two wrenches of the correct size, one on each fitting when releasing and tightening refrigeration unions.
13. Joints and 'O' rings should be coated with refrigeration oil to aid correct seating. Fittings which are not lubricated with refrigerant oil are almost certain to leak.
14. All lines must be free of kinks. The efficiency of the system is reduced by a single kink or restriction.
15. Flexible hoses should not be bent to a radius less than 90mm.
16. Flexible hoses should not be within 100mm of the exhaust manifold.
17. Completed assemblies must be checked for refrigeration lines touching metal panels. Any direct contact of lines and panels transmits noise and must be eliminated.

PERIODIC MAINTENANCE

Routine servicing, apart from visual checks, is not necessary. The visual inspections are as follows:

Condenser

With a water hose or air line, clean the fins of the condenser to remove flies, leaves, etc. Check the pipe connections for signs of oil leakage.

Compressor

Check pipe connections for signs of oil leakage. Check flexible hoses for swelling. Examine the compressor belt for tightness and condition.

Sight glass and Receiver/Drier

Examine the sight glass for bubbles with the system operating. Check connections for leakage.

Evaporator

Examine the refrigeration connections at the unit. If the system should develop a fault, or if erratic operation is noticed. **See *Fault diagnosis, Refrigeration System Faults***

RECEIVER DRIER

Service repair no - 82.17.01

Remove

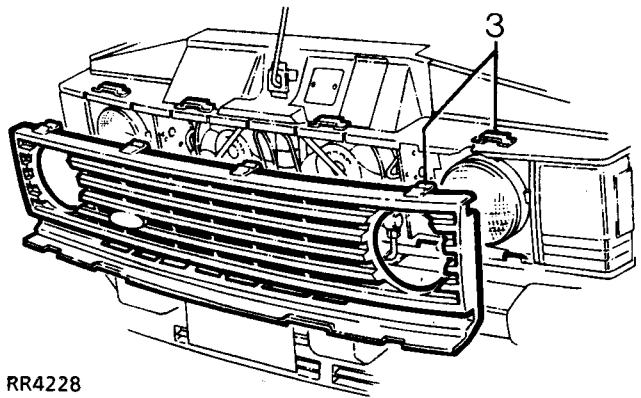


CAUTION: If receiver/drier is to be refitted, the ports must be blanked off immediately on disconnection. Exposed life of unit is only 15 minutes.

1. Disconnect battery negative lead.
2. Recover refrigerant from system. **See *Adjustment, Refrigerant Recovery Recycling Recharging***

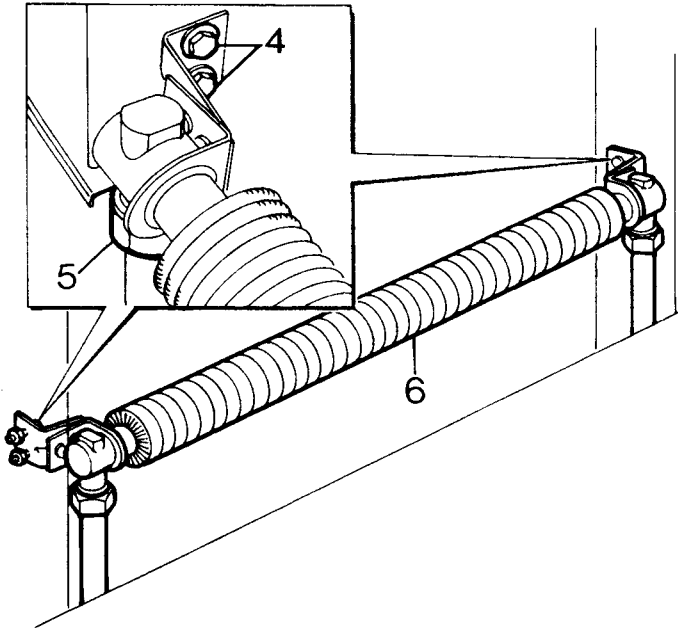


WARNING: Wear eye and hand protection when disconnecting components containing refrigerant. Plug all exposed connections immediately.



RR4228

3. Release 4 clips from brackets on bonnet locking platform and remove radiator grille.

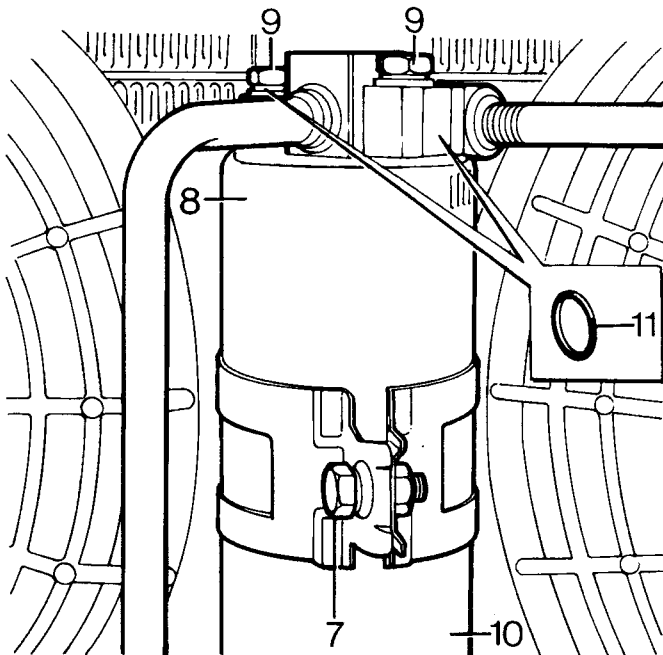


RR3964M

Automatic gearbox

4. Remove 4 bolts securing transmission oil cooler to body.
5. Disconnect 2 pipe unions from oil cooler. Use a second spanner to support hose adapter.
6. Remove transmission oil cooler. Seal connections.

All models



RR3965M

7. Remove bolt securing receiver/drier clamp.



WARNING: Wear eye and hand protection when disconnecting components containing refrigerant. Plug all exposed connections immediately.

8. Move receiver/drier just sufficiently to gain access to pipe flange bolts without distorting the pipes.
9. Remove bolt securing each pipe flange to receiver/drier.
10. Disengage pipe flanges and withdraw receiver/drier from mounting bracket.
11. Remove 'O' ring from each pipe flange.

Refit

12. Fit new 'O' ring to each pipe flange, lubricate with refrigerant oil.
13. Position receiver/drier in mounting bracket with inlet and outlet connections correctly aligned.
14. Engage pipe flanges, fit bolts in turn and tighten.
15. Fit clamp bolt.

Automatic gearbox

16. Refit transmission oil cooler. Use a second spanner to support pipe unions.
17. Check gearbox fluid level, top-up if necessary.

All models

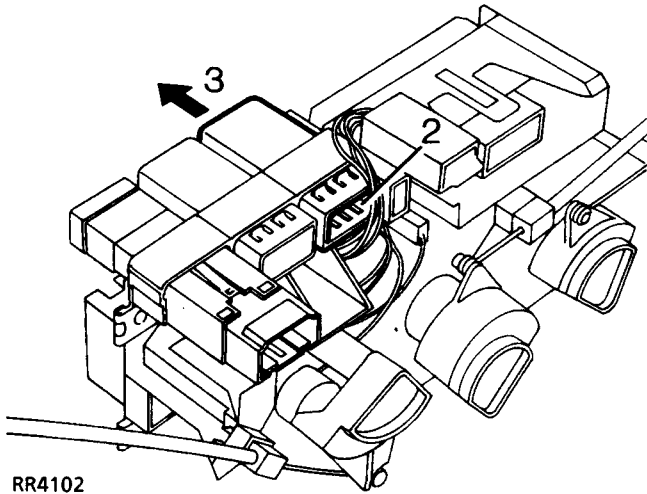
18. Evacuate and recharge air conditioning system. **See Adjustment, Refrigerant Recovery Recycling Recharging**
19. Perform a leak test on disturbed joints.
20. Carry out a functional check.

AIR CONDITIONING SWITCH

Service repair no - 82.20.29

Remove

1. Remove fascia centre louvre vent panel. **See CHASSIS AND BODY, Repair, Dash Panel Central Louvre Panel**



2. Disconnect multiplug from switch
3. From the rear, push switch out of panel.

Refit

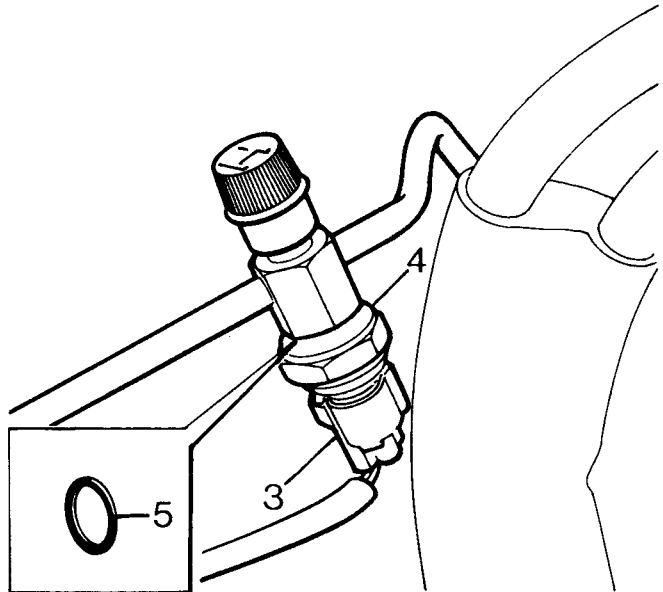
4. Reverse removal procedure.

DUAL PRESSURE SWITCH

Service repair no - 82.20.20

Remove

1. Disconnect battery negative lead.
2. Recover refrigerant from system. **See Adjustment, Refrigerant Recovery Recycling Recharging**



RR3966M

3. Disconnect multiplug from switch.
4. Unscrew switch from adapter. Use a second spanner to support adapter.



WARNING: Wear eye and hand protection when disconnecting components containing refrigerant. Plug all exposed connections immediately.

5. Remove 'O' ring from switch.

Refit

6. Reverse removal procedure. Lubricate new 'O' ring with refrigerant oil and fit to switch.
7. Screw switch into adapter and tighten to **11 Nm**.
8. Evacuate and recharge air conditioning system. **See Adjustment, Refrigerant Recovery Recycling Recharging**

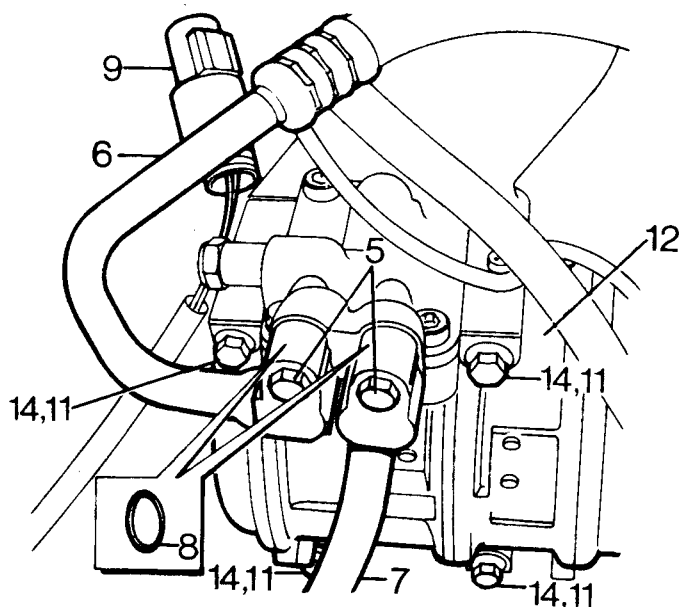


COMPRESSOR

Service repair no - 82.10.20

Remove

1. Disconnect battery negative lead.
2. Recover refrigerant from air conditioning system.
See Adjustment, Refrigerant Recovery Recycling Recharging
3. Remove screws retaining centre panel to fan cowl
4. Remove centre panel.



RR3967M

6. Disconnect high pressure hose from compressor.
7. Disconnect low pressure hose from compressor.
8. Remove 'O' ring from each flange.
9. Disconnect electrical lead from compressor clutch.
10. Release drive belt from compressor pulley. **See ENGINE, Repair, Drive Belt**
11. Remove 4 bolts securing compressor to mounting bracket.
12. Remove compressor from mounting bracket.

Refit

13. New compressor to be fitted: Drain oil from new compressor outlet port. Drain and measure oil from old compressor. Measure new oil equal to amount drained from old compressor, add 30 ml extra to this amount and refill new compressor through outlet port.
14. Locate compressor in mounting bracket, fit bolts. Tighten to **25 Nm**.
15. Connect electrical lead to compressor clutch.
16. Fit new 'O' rings to high and low pressure hose flanges, lubricate with refrigerant oil.
17. Engage hose flanges, fit bolts. Tighten to **10 Nm**.
18. Fit compressor drive belt. **See ENGINE, Repair, Drive Belt**
19. Fit centre panel to fan cowl.
20. Evacuate and recharge air conditioning system.
See Adjustment, Refrigerant Recovery Recycling Recharging
21. Perform a leak test on disturbed joints.
22. Carry out a functional check.

V8i Engine Illustrated

5. Remove 2 bolts securing hose flanges to compressor.



WARNING: Wear eye and hand protection when disconnecting components containing refrigerant. Plug all exposed connections immediately.

CONDENSER

Service repair no - 82.15.07

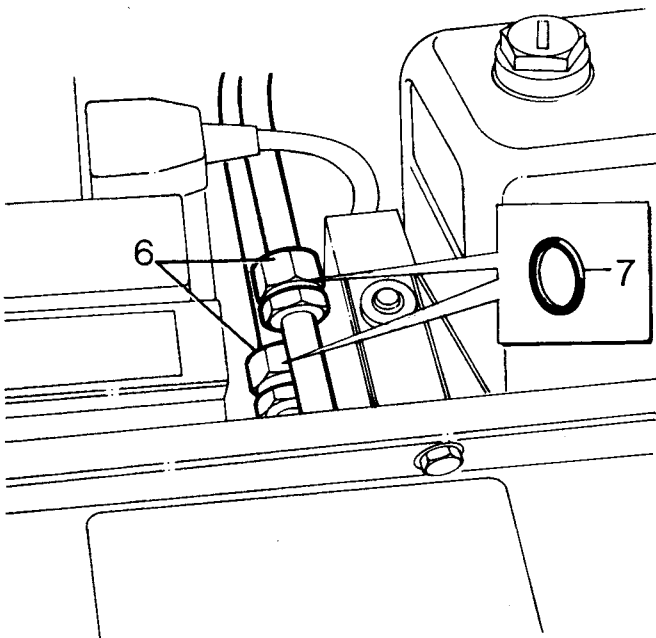
Remove

1. Disconnect battery negative lead.



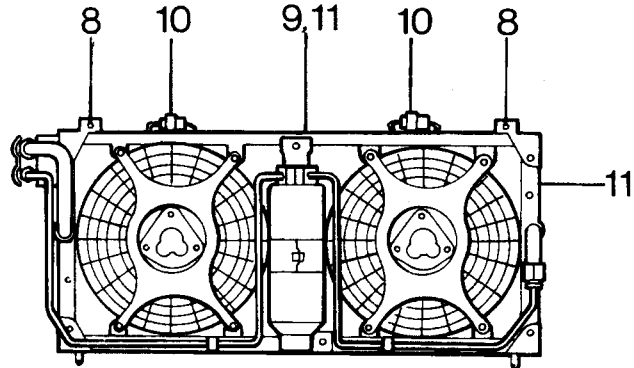
WARNING: Wear eye and hand protection when disconnecting components containing refrigerant. Plug all exposed connections immediately.

2. Recover refrigerant from system. See *Adjustment, Refrigerant Recovery Recycling Recharging*
3. Remove front grille panel.
4. Remove battery. See *ELECTRICAL, Repair, Battery*
5. Remove radiator and oil coolers assembly. See *COOLING SYSTEM, Repair, Radiator/Oil Coolers*



RR3988M

6. Disconnect high and low pressure pipes at condenser unions.
7. Discard 'O' ring seal from each union.



RR3989M

8. Remove 2 bolts securing condenser to body.
 9. Pull condenser into radiator area.
 10. Disconnect multiplug from each fan lead.
 11. Remove condenser assembly.
- Do not carry out further dismantling if component is removed for access only.** Blank off inlet and outlet ports.

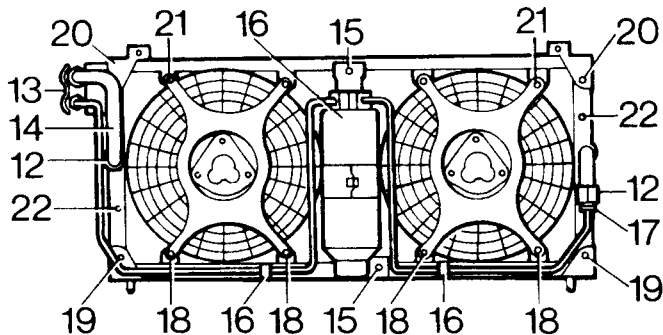


CONDENSER FANS AND MOTORS

Service repair no - 82.15.01 - Motor
 Service repair no - 82.15.03 - Fan

Remove

1. Remove condenser assembly. *See Condenser*

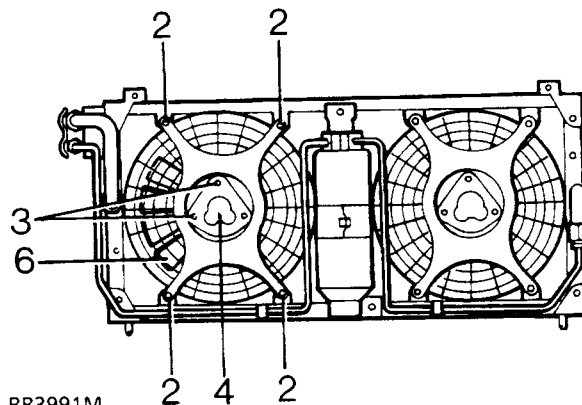


RR3990M

12. Disconnect receiver/drier pipes at condenser unions.
13. Remove retaining bracket from side pipe.
14. Remove LH pipe from condenser and discard 'O' ring.
15. Remove 2 screws securing receiver/drier bracket.
16. Release pipes from lower clips and remove receiver/drier assembly.
17. Remove 'O' ring from RH pipe.
18. Remove 2 screws securing lower end of each fan motor.
19. Remove 2 bolts and remove condenser lower mounting bracket.
20. Remove 2 bolts and securing condenser upper mounting bracket.
21. Remove upper mounting bracket and fan motor assembly.
22. Remove 2 screws securing each side mounting bracket and remove the brackets.
23. Transfer parts removed to new condenser.
24. Add 40 ml of refrigerant oil to new compressor to compensate for oil loss.

Refit

25. Reverse removal procedure. 3 to 11.
26. Evacuate and recharge air conditioning system. *See Adjustment, Refrigerant Recovery Recycling Recharging*
27. Carry out leak test on disturbed joints. *See Adjustment, Leak Test System*
28. Check air conditioning operation by carrying out a System Test. *See Adjustment, System Test*



RR3991M

2. Remove 4 bolts securing fan cowl to condenser.
3. Remove 3 bolts securing fan motor to cowl.
4. Remove fan motor assembly.
5. Remove 3 screws securing fan blades to motor.
6. Remove fan blades.

Refit

7. Reverse removal procedure. Ensuring that wiring is clipped and no fouling of fan blade can occur.

HEATER AND COOLER UNIT

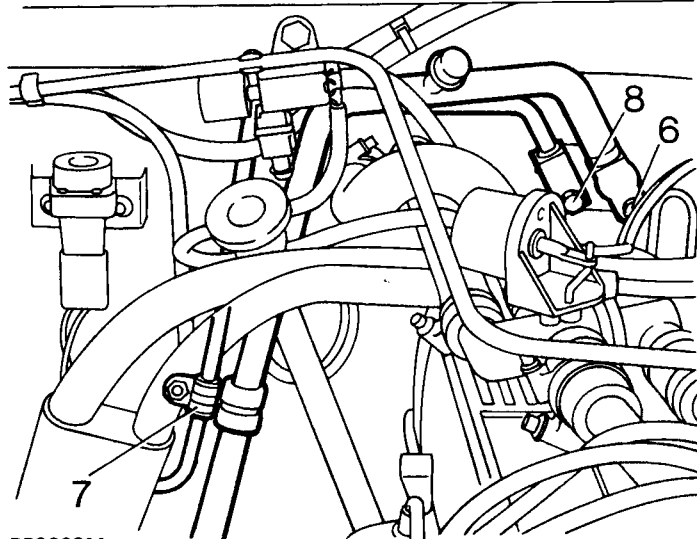
Service repair no - 86.25.21



WARNING: All work involving the service and maintenance of air conditioning requires special equipment, knowledge, experience and a full awareness and adherence to safety precautions.

Remove

1. Disconnect battery negative lead.
2. Drain engine coolant. *See COOLING SYSTEM, Adjustment, Coolant*
3. Recover refrigerant from air conditioning system. *See Adjustment, Refrigerant Recovery Recycling Recharging*
4. Remove fascia panel assembly. *See CHASSIS AND BODY, Repair, Dash Panel Assembly*



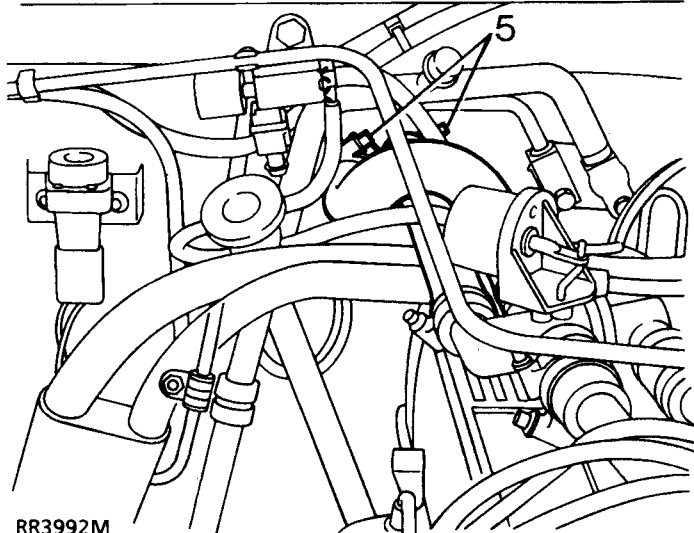
RR3993M

6. Remove securing bolt and disconnect low pressure pipe from evaporator.



WARNING: Wear eye and hand protection when disconnecting components containing refrigerant. Plug all exposed connections immediately.

7. Release 'P' clip retaining high and low pressure pipes.
8. Remove securing bolt and disconnect high pressure pipe from evaporator.
9. Discard 'O' ring seals.



RR3992M

5. Release clips and disconnect coolant hoses from heater pipes.



EVAPORATOR AND EXPANSION VALVE

Service repair no - 86.25.20 - Evaporator

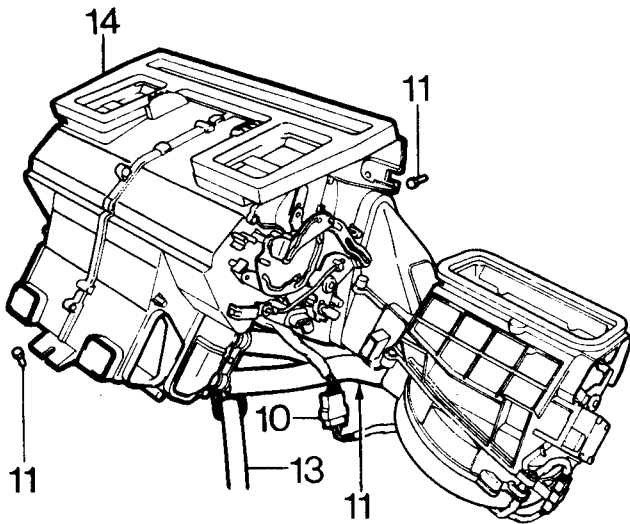
Service repair no - 86.25.01 - Expansion valve

Remove



WARNING: Wear eye and hand protection when disconnecting components containing refrigerant. Plug all exposed connections immediately.

1. Remove heater and cooler unit. *See Heater and Cooler Unit*

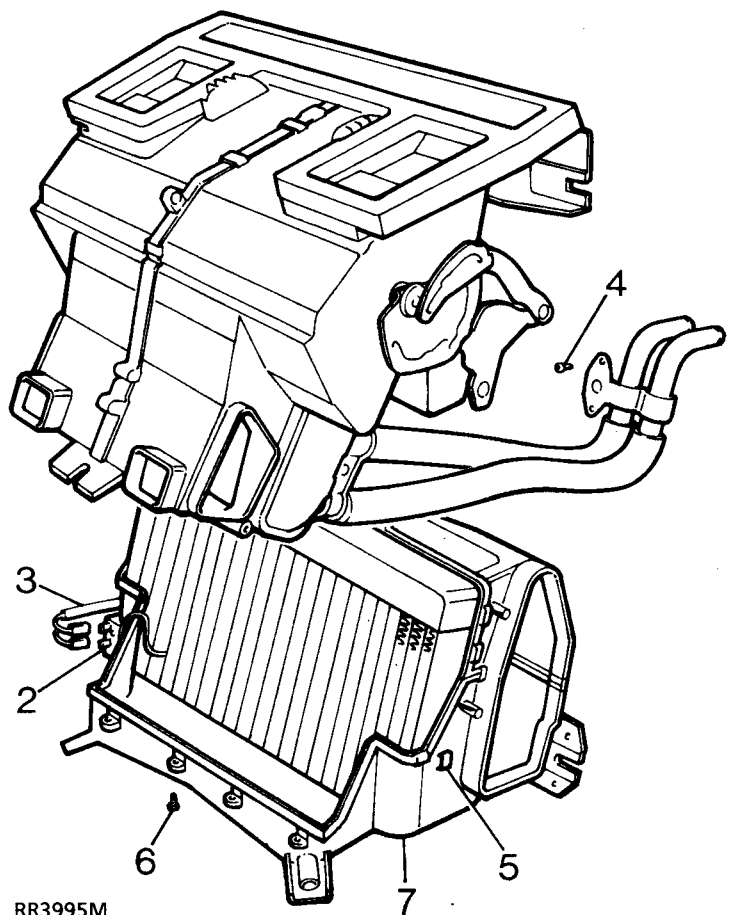


RR3994M

10. Disconnect multiplug connecting heater to blower unit, remove 3 screws and remove blower unit.
11. Remove 5 screws securing casing to bulkhead and tunnel.
12. Remove 2 securing bolts and remove centre console front mounting bracket.
13. Disconnect 2 drain tubes..
14. Ease heater and cooler unit from its location and remove from vehicle.

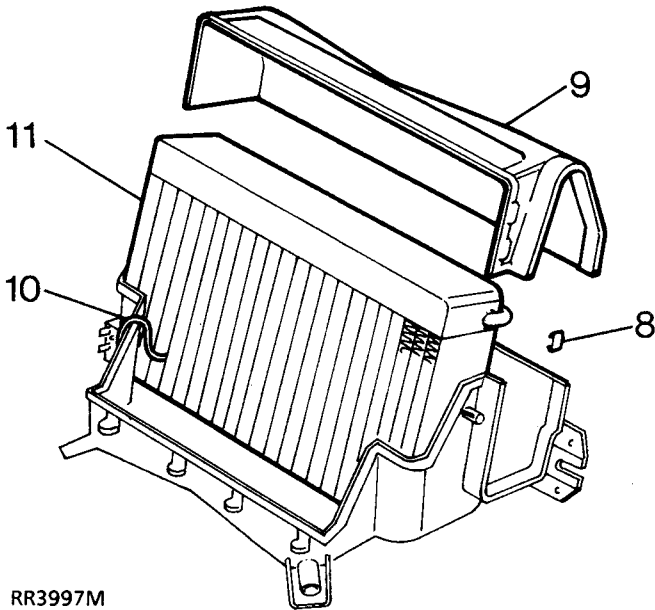
Refit

15. Ease heater and cooler unit into position.
16. Fit retaining bolts finger tight. Tighten in sequence, centre and top bolts and then the bottom bolt.
17. Reverse removal procedure.
18. Use new 'O' rings and lubricate with refrigerant oil.
19. Evacuate and recharge system. *See Adjustment, Refrigerant Recovery Recycling Recharging*
20. Leak test any disturbed joints. *See Adjustment, Leak Test System*
21. Perform a functional check.



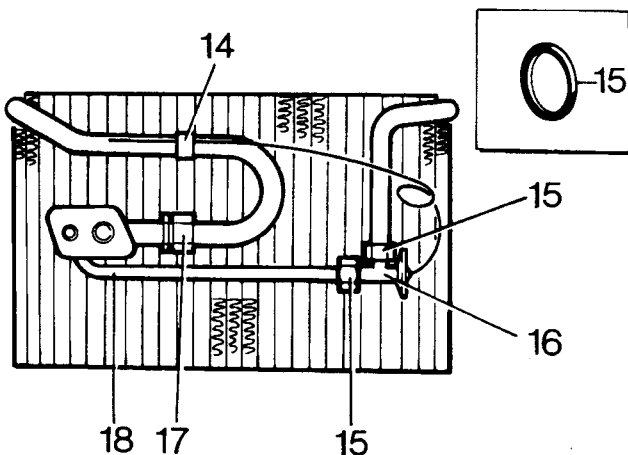
RR3995M

2. Disconnect 2 Lucar connectors from thermostat.
3. Position wiring aside.
4. Remove 2 screws securing heater pipe bracket and position pipes aside.
5. Remove 10 clips retaining upper and lower casings.
6. Remove 5 screws retaining upper casing.
7. Remove lower casing and evaporator.



RR3997M

8. Remove 4 clips securing evaporator top cover.
9. Remove evaporator top cover.
10. Remove thermostat sensor from evaporator matrix.
11. Remove evaporator assembly from lower casing.
12. Remove bulkhead seal from case.



RR3996M

Expansion valve

13. Remove insulation from evaporator and expansion valve connections.
14. Remove expansion valve sensor retaining clip.
15. Unscrew 2 pipe unions. Discard 'O' ring seals.



CAUTION: Use a second wrench to support pipe adapters and plug connections.

16. Remove expansion valve.
17. Unscrew pipe union. Discard 'O' ring seal.
18. Remove evaporator pipe.

Refit

19. Reverse removal procedure. Use new 'O' rings, insulation and bulkhead seal.



NOTE: Use refrigerant oil on all 'O' rings and mating surfaces. Tighten connection. See Specifications, torque, Torque Values

20. Wrap all exposed metal at hose connections with prestite tape.
21. Evacuate and recharge system. *See Adjustment, Refrigerant Recovery Recycling Recharging*
22. Leak test any disturbed joints. *See Adjustment, Leak Test System*
23. Perform a functional check.
24. Disconnect service unit.

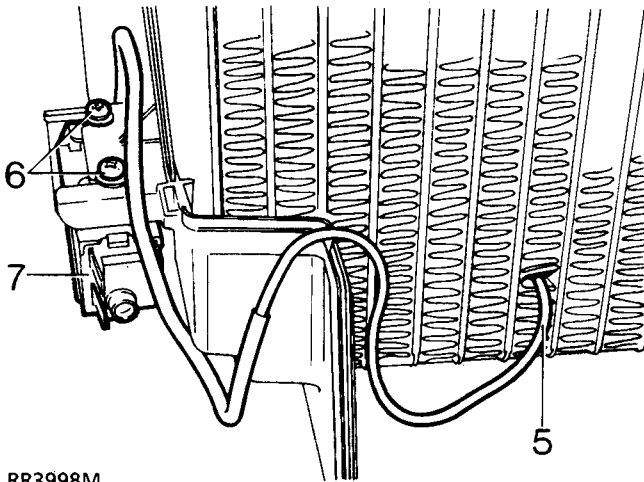


THERMOSTAT

Service repair no - 86.25.50

Remove

1. Remove heater and cooler unit. *See Heater and Cooler Unit.*
2. Remove lower cover and evaporator. *See Evaporator and Expansion Valve*
3. Remove 5 clips and screw securing evaporator top cover.
4. Remove evaporator top cover.



RR3998M

5. Remove thermostat sensor from evaporator matrix.
6. Remove 2 screws securing sensor unit.
7. Remove thermostat and insulation.

Refit

8. Reverse removal procedure.



CAUTION: The thermostat insulation must be installed in the ORIGINAL POSITION in the evaporator.



TORQUE VALUES



NOTE: Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
AIR CONDITIONING	
Compressor flange bolts	10
Receiver drier union bolts	6
Dual pressure switch	11
Pressure pipe union nuts - M16	14
Discharge pipe union nuts - M22	22
Suction pipe union nuts - M24	33

AIR CONDITIONING CHARGE DATA

Total oil in system	180ml - 6.3 Fl oz
Total refrigerant in system	0.90kg - 32 Fl oz