**AIR CONDITIONING, HEATING & VENTILATION**

**SECTION PM**

<table>
<thead>
<tr>
<th>Sub-Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Description</td>
<td>PM.1 3</td>
</tr>
<tr>
<td>Controls Operation &amp; Airflow Distribution</td>
<td>PM.2 5</td>
</tr>
<tr>
<td>Cooling Fans &amp; Re-circulation Pump</td>
<td>PM.3 11</td>
</tr>
<tr>
<td>Refrigerant Handling</td>
<td>PM.4 13</td>
</tr>
<tr>
<td>Refrigerant Pipework Precautions</td>
<td>PM.5 13</td>
</tr>
<tr>
<td>Refrigerant Oil</td>
<td>PM.6 15</td>
</tr>
<tr>
<td>Compressor</td>
<td>PM.7 16</td>
</tr>
<tr>
<td>Condenser</td>
<td>PM.8 18</td>
</tr>
<tr>
<td>Receiver-Drier</td>
<td>PM.9 20</td>
</tr>
<tr>
<td>Expansion Valve</td>
<td>PM.10 21</td>
</tr>
<tr>
<td>Heater/Evaporator/Fan Unit</td>
<td>PM.11 22</td>
</tr>
<tr>
<td>Air Distribution Unit</td>
<td>PM.12 22</td>
</tr>
<tr>
<td>Refrigerant Pipes</td>
<td>PM.13 23</td>
</tr>
<tr>
<td>Air Blender &amp; Re-circ. Flap Actuators</td>
<td>PM.14 23</td>
</tr>
</tbody>
</table>
Heater Circuit

Water feed pipe along outside of RH chassis siderail

Heater matrix

Water return pipe along outside of LH chassis siderail

Return to engine water pump

Coolant re-circulation pump

Refrigerant Circuit

Receiver-drier

Feed & return pipes along outside of RH chassis siderail

Condenser

Expansion valve

Evaporator housing

Compressor
PM 1 - GENERAL DESCRIPTION

Heater System
The heater system uses engine coolant to provide a heat source transferred to the interior airstream via a heat exchanger matrix mounted in an 'air blend' unit housed within the chassis well, ahead of the cabin footwell. The heater circuit is fed from the right hand rear of the head via a re-circulation electric pump mounted behind the engine, to a hose running across the back of the engine bay to join an aluminium pipe routed along the outside of the right hand chassis siderail, within the composite sill member. The front end of this pipe rises over the end of the scuttle, penetrates the plenum/scuttle baffle panel, and connects to the heater matrix mounted in the chassis front climate chamber. The heater return circuit is similarly routed along the left hand side of the chassis to the left hand front corner of the engine bay, where a moulded hose including an air bleed screw, joins this pipe to the oil/water heat exchanger inlet connection.

In conditions of 'heat soak', after stopping a hot engine, the electric re-circulation pump is energised under engine ECU control to pump coolant through the heater circuit and limit the potential for localised boiling within the cylinder head.

Air Conditioning - Basic Principles
The air conditioning unit uses a cycling clutch system with a thermostatic expansion valve to provide refrigerated air to the vehicle interior. The system comprises:
- a closed circuit containing refrigerant R134a;
- a compressor mounted on the front side of the engine, driven by multi-vee belt from the front end of the crankshaft via an electromagnetic clutch;
- a condenser mounted horizontally at the front of the car, beneath the engine cooling radiator;
- an evaporator unit (cooler) fitted in the chassis well ahead of the cabin footwell;
- a thermostatic expansion valve fitted at the inlet connection to the evaporator;
- a receiver-drier unit mounted above the heater/a.c. unit.

Closed Circuit
The closed refrigerant circuit should not be opened unless absolutely necessary, and only then using appropriate refrigerant recovery equipment. Never allow the refrigerant to vent to atmosphere. Refer to sub-section PM 5. Failure to observe these precautions may result in personal injury.
Compressor
When the engine is running, and the refrigeration controls demand it, the electromagnetic clutch incorporated in the compressor pulley is energised, which then locks the pulley to the shaft and drives the compressor. The variable displacement type compressor operates to discharge refrigerant vapour at high pressure and temperature into the condenser. The compressor is lubricated by a quantity of special refrigerant oil, most of which is retained in the compressor, with the remainder being circulated with the refrigerant. A control valve in the rear of the compressor senses evaporator load and automatically changes compressor displacement to match that load. In order to avoid engine stalling and to maintain idle speed when the compressor driving load is placed on the engine, the a.c. request and compressor command signals are processed by the engine management ECU, which amends the idle air control valve position as necessary.

An system safeguard is provided in the form of a high pressure relief valve incorporated into the compressor which opens at 40 bar.

Condenser
The aluminium condenser is horizontally mounted beneath the engine cooling radiator, and is of parallel flow construction. The hot vapour received by the condenser from the compressor, releases heat to the surrounding air via the condenser finning, with airflow boosted by two electric fans mounted on top of the engine radiator, and ram air flow caused by vehicle movement.

Evaporator
The serpentine type evaporator is a heat exchanger mounted in a plastic housing fitted into the chassis well ahead of the passenger compartment footwell. All incoming airflow is directed through the evaporator, before being directed through or past the heater matrix, and then into the air distribution chamber.

The low pressure liquid refrigerant flowing into the evaporator via the expansion valve, begins to boil (evaporate) and in so doing, draws the necessary heat for this process from the airstream passing through the evaporator. This airstream is consequently cooled, and is directed through the various outlet vents to the passenger compartment.

When the a.c. switch is pressed by the driver, and other parameters allow it (i.e. ignition on, blower fan speed selected, a.c. system pressurised, ambient temperature above 3°C), the a.c. circuit is activated and the compressor clutch is engaged.

A thermostat, using a sensor positioned against the outlet side of the evaporator finning, monitors the temperature of the refrigerated air and switches off the compressor if the likelihood of evaporator icing becomes too great.

The inlet and outlet pipes connect to the evaporator via the expansion valve block, into which they are sealed using ‘O’ rings and a clamp plate. The inlet is supplied from the receiver-drier, and the outlet feeds the compressor.

Expansion Valve
The expansion valve block is fitted into the high and low pressure lines at the evaporator, and provides a restriction to the flow of high pressure liquid into the evaporator, such that the consequent pressure drop causes a change of state from a high temperature, high pressure liquid, to a low pressure, low temperature atomised liquid.

By sensing the temperature and pressure of refrigerant leaving the evaporator, the expansion valve is able to modulate the flow of refrigerant into the unit to optimise the cooling performance.

Receiver-Drier
The receiver-drier unit is fitted into the refrigerant line between the condenser and evaporator expansion valve, and houses a screen sack filled with desiccant to absorb traces of moisture and other contaminants from the refrigerant. The unit is mounted in the chassis well above the heater/a.c. unit. A sight glass built into the top of the receiver-drier allows a visual assessment of refrigerant charge to be made - a clear sight glass may indicate that the system is correctly charged, or completely empty, although the latter situation is usually accompanied by oil streaks. If refrigerant charge is low, a stream of bubbles will be visible at the sight glass.

A sensor fitted into the pipe between the receiver-drier and expansion valve supplies an analogue pressure signal to the engine ECU, which then allows system operation only within a pressure range of 2 to 32 bar in order to prevent system damage from too high a pressure, or from compressor oil starvation damage caused by too low a pressure. This data is also used by the ECU to engage the two condenser fans at half speed at pressures over 17.5 bar (see also sub-section KI.5).
PM 2 - HEATER/A.C. AIRFLOW OVERVIEW

The major units of the Heating Ventilation and Air Conditioning (HVAC) system comprise a dual intake blower fan, an evaporator housing, a heater housing and an airflow distribution unit. The fan blower unit and the combined evaporator/heater unit are mounted in the chassis climate chamber ahead of the cabin footwells, with the airflow distribution unit mounted on the top of the chassis scuttle area. Ambient air is collected from the radiator air intake duct via two ports in the radiator ducting, which mate to apertures in the chassis front crossmember. Moulded ducting on the rear side of the chassis front face directs this air, via a shut off butterfly flap valve (to provide a recirc. function), to the blower fan front intake. The rear intake of the double sided fan housing is connected to perforated ports in the front wall of each footwell.

The fan blower unit directs all airflow through the a.c. evaporator, after which an air blender flap controls the proportion of air which flows through the heater matrix, the flap being driven by a stepper motor as dictated by the cockpit temperature selector. After leaving the HVAC chamber, air is ducted to a distribution chamber mounted on the top of the chassis scuttle which distributes air to screen, face level vents and footwell vents. The distribution chamber contains a horizontal, three vane, rotary flap, driven by a stepper motor, and controlling outlets to the screen and face level vents. A link rod connects this flap to a second flap controlling airflow to the footwells. Ducting for the windscreen vents is incorporated into the underside of the fascia top panel.

Schematic Airflow
Airflow through a.c./heater unit

Cold air

Ambient or re-circulated air inlet

Fan blower

Trunking to distribution unit

Temperature flap in fully cold position

a.c. evaporator

Heater matrix

Warm air

Flap in full warm position
Interior Climate Controls
The interior climate controls consist of two push switches (if fitted) for air conditioning and air re-circulation, and three rotary controls for heater temperature, fan speed, and air distribution.

Air Conditioning
The left hand push button switch requests air conditioning, but the engine must be running and a fan speed selected before the system will operate. The a.c. switch supplies a request signal to the engine ECM via the switch pack module and a.c. thermostat. When the correct conditions apply, (e.g. not wide open throttle, not excessive coolant temperature), the ECM will open the IAC valve before supplying a ground signal to the compressor relay in the a.c. control module. Note also that ambient air temperature must be above 3°C.

With a fully cold temperature setting, refrigerated air will be supplied. For de-humidified air, select air conditioning in conjunction with a warm temperature setting.
The tell tale in the switch button lights up blue when the circuit is active.

Air Re-circulation
Air supply for the interior climate system is normally drawn from both the intake duct ahead of the engine cooling radiator, and the vehicle interior. When the re-circulation button is pressed, a stepper motor is activated to close a butterfly flap in the fresh air intake, in order to provide a 90% recirculation supply to the blower fan. The re-circulation facility should be used when maximum refrigeration is desired. The tell tale in the switch button lights up blue when the circuit is active.

Heater Temperature
With the left hand rotary electrical control turned fully counterclockwise, the air blender flaps are positioned to direct all the airflow to by-pass the heater chamber so that no air heating is provided. If air cooling is required, use this temperature position in conjunction with air conditioning. Turning the control progressively clockwise operates the stepper motor attached to the upper flap spindle, and via toothed belt to the lower flap, to direct airflow through the heater matrix and provide an increasing level of air heating until at the fully clockwise position, maximum heat is supplied.

Fan Speed
The centre rotary switch provides three fan speeds to boost air circulation. Turned fully counterclockwise, the fan is off; Turning the switch progressively clockwise operates the blower fan at increasing speed in three steps. Note that the fan operates only with the ignition switched on. The fan speed resistors are mounted in the top of the evaporator housing.

Air Distribution
The right hand electrical rotary control operates a stepper motor on the air distribution unit to direct airflow to the windscreen, face level and footwell vents. The following diagrams indicate airflow for the different control positions:
Face Level:

Turned fully counterclockwise, the stepper motor on the air distribution unit (ADU) operates the rotary flap to close off the windscreen vents, and direct all airflow to the four face level vents, each of which may be manipulated to adjust volume and direction. The footwell flap is closed.
Footwell:

As the control is turned clockwise from the face level vents symbol towards the footwell symbol, the stepper motor turns the rotary flap to progressively close off the face level vents. A rod connecting the rotary flap to the footwell flap is arranged to open the footwell vents in opposite proportion, until at the footwell symbol, all airflow is directed to the footwells.
Demist:  
As the control is turned clockwise from the footwell symbol towards the windscreen symbol, the stepper motor turns the rotary flap to progressively open the windscreen vents. The rod connecting the rotary flap to the footwell flap is arranged to close the footwell vents in opposite proportion, until at the screen symbol, all airflow is directed to the windscreen. Select a warm temperature setting and a suitable fan speed.

Full Defrost Performance
For maximum defrost performance, turn the distribution knob fully clockwise and select maximum temperature and fan speed. For optimum de-misting in ambient temperatures above 3°C, switching on the a.c. will help de-humidify the air directed to the screen.

Ventilation Shut-Off
To close off the ventilation, which may be desirable in heavy traffic to reduce the induction of fumes into the car, turn off the fan, turn the distribution control fully counterclockwise to the face level vent position, and manually shut off each of the face level vents.
PM 3 - COOLING FANS & RE-CIRCULATION PUMP

The two cooling fans are fitted on the top side of the radiator/condenser package, and the coolant re-circulation pump is mounted behind the engine. Both the fans and pump are controlled by the engine management ECU using data provided by the engine coolant temperature sensor and a.c. pressure sensor.

Cooling Fans
The cooling fans are switched as a pair, and will operate at half speed (connected in series) when coolant temperature reaches 98°C on rise (94°C with a.c. on), and switch off at 96°C on fall (92°C with a.c. on). If coolant temperature rises to 105°C (96°C with a.c. on), the fans will switch to full speed (connected in parallel), reverting to half speed on fall at 98°C (94°C with a.c. on).

Note that the temperatures displayed on the instrument panel may differ from the programmed values described above due to damping lag.

The fans are also activated by signals received from the air conditioning pressure sensor; the fans will run at low speed for pressures between 13 - 18 bar, and at high speed for pressures over 18 bar.

Certain types of ECU detected engine fault will also cause the fans to be activated as an engine protection measure. If the ECU receives a coolant temperature sensor signal voltage outside of the acceptable range, a default setting equating to 60°C will be substituted, and the cooling fans will run at half speed.

Re-circulation Pump
A coolant re-circulation electric pump is mounted on a bracket secured by a clutch housing bolt at the right hand side of the block, and is plumbed into the heater supply line. When energised, the pump circulates coolant through the heater system, drawing coolant from the back of the cylinder head, and pumping it through the heater matrix and back to the engine.

Heat Soak
After ignition switch off, the ECU remains live for a minimum period of 1 minute for coolant temperatures below 75°C (at time of switch off), extending progressively to a maximum period of 10 minutes for temperatures over 90°C. If, during this period, the coolant temperature exceeds 110°C, the re-circ. pump will be activated and will run for a maximum period of 6 minutes, or until the coolant temperature falls to 50°C.

If, during the ECU live period the coolant temperature rises to 120°C, the cooling fans will run at slow speed in addition to the re-circ. pump, for a maximum period of 2 minutes, or until the temperature falls to 70°C.

Defrost Enhancement
In order to speed windscreen defrosting/demisting, when coolant temperature is between 2°C and 60°C, the re-circ. pump will be activated to boost coolant circulation through the heater matrix, commencing 10 seconds after engine start up. The pump will continue to run until 30 seconds after either 1400 rpm is exceeded, or the coolant reaches 60°C.

Fan Control Module
The cooling fans, re-circ. pump and a.c. compressor are controlled by a relay module mounted on the protective cover for the wiper motor, and accessible via the front services compartment.

Important Note: The a.c. relay module is identical in appearance to the engine relay module, but the function of the two modules is different and they must not be transposed. The a.c. relay module A117M0038F has a brown label marked YWB100800 and a blue connector moulding; The engine relay module A111E6024F has a brown label marked YWB100970 and a black connector moulding.
Location of re-circulation pump

To cylinder head

Recirculation pump

To sill heater pipe

Location of relay module

Fans/compressor relay module

Fusebox
PM 4 - REFRIGERANT HANDLING

The system is charged with 0.75 kg of refrigerant HFC R134a, and the following precautions MUST ALWAYS BE OBSERVED.

1. On no account should refrigerant ever be discharged to atmosphere - use a refrigerant recovery/recycling station in accordance with the manufacturer's instructions.

2. Standard R134a 'quick fit' connectors are provided in the compressor suction and discharge pipes at the right hand front of the engine bay;
   - the low pressure vapour line port is fitted in the pipe between the evaporator and compressor.
   - the high pressure liquid line port is fitted in the pipe between the compressor and condenser.

3. Heavy concentrations of refrigerant vapour can produce toxic gas if exposed to a naked flame. The gas can also attack metal.

4. Refrigerant drums must never be left open - always ensure the caps are securely fitted.

5. Never transport drums of refrigerant in the passenger compartment of a car.

6. Never expose refrigerant drums to high temperature.

7. Never weld or use a steam cleaner in close proximity to any part of the air conditioning system.

8. Never expose the eyes to vapourised or liquid refrigerant - ALWAYS wear safety goggles and gloves when handling refrigerant.

PM 5 - REFRIGERANT PIPEWORK PRECAUTIONS

The following precautions must be observed when carrying out any work on the refrigerant pipework:
Before disconnecting any refrigerant pipework, the refrigerant must first be recovered using suitable equipment connected to the service valves at the right hand front of the engine bay. Ensure that the equipment is suitable for R134a.

1. All replacement components and flexible end connections are sealed when new, and should only be opened IMMEDIATELY PRIOR TO FITTING, AND AT ROOM TEMPERATURE, to prevent condensation of any moisture which may enter when the sealing is removed.

2. Pipes, flexible end connections and components, must be capped immediately they are opened to prevent the ingress of moisture and/or dirt.

3. The receiver-drier should be the LAST component to be connected, to ensure optimum dehydration and maximum moisture protection of the system.

4. All joints should be coated with refrigeration oil before making any connections, to aid seating.

5. Great care must be taken to prevent damage to the pipe fittings and connections, since due to the high pressures involved, a leak can be caused by the slightest imperfection. Always use two spanners of the correct size when releasing or tightening any pipe joint so that the fixed part of the union may be prevented from twisting and damaging the component. This is especially important with the aluminium condenser.

6. All pipes and hoses must be free from any kinking. The efficiency of the system can be impaired by a single kink, or restriction. Flexible hoses should not be bent to a radius which is less than ten times the diameter of the hose.
Refrigerant Pipework Fixing Torques

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
<th>Qty</th>
<th>Thread</th>
<th>Pitch</th>
<th>Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Compressor to engine</td>
<td>3</td>
<td>M8</td>
<td>35 Nm</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>A.C. hoses to compressor</td>
<td>2</td>
<td>M6</td>
<td>10 Nm</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Bulkhead connector, high pressure</td>
<td>2</td>
<td>3/4 - 16 UNF</td>
<td>1.6</td>
<td>25-30 Nm</td>
</tr>
<tr>
<td>4</td>
<td>Bulkhead connector, low pressure</td>
<td>2</td>
<td>1 1/16 - 14 UNS</td>
<td>1.8</td>
<td>35-40 Nm</td>
</tr>
<tr>
<td>5</td>
<td>High pressure pipe to condenser</td>
<td>1</td>
<td>3/4 - 16 UNF</td>
<td>1.6</td>
<td>25-30 Nm</td>
</tr>
<tr>
<td>6</td>
<td>Liquid line to condenser</td>
<td>1</td>
<td>5/8 - 18 UNF</td>
<td>1.4</td>
<td>20-25 Nm</td>
</tr>
<tr>
<td>7</td>
<td>Receiver-drier inlet/outlet pipes</td>
<td>2</td>
<td>5/8 - 18 UNF</td>
<td>1.4</td>
<td>20-25 Nm</td>
</tr>
<tr>
<td>8</td>
<td>Trinary switch to pipe</td>
<td>1</td>
<td>7/16 - 20 UNF</td>
<td>1.27</td>
<td>15-20 Nm</td>
</tr>
<tr>
<td>9</td>
<td>Clamp plate, pipes to expansion valve</td>
<td>1</td>
<td>M6</td>
<td>1</td>
<td>7-9 Nm</td>
</tr>
<tr>
<td>10</td>
<td>Clamp plate, expansion valve to evap</td>
<td>2</td>
<td>M5</td>
<td>0.8</td>
<td>5-6 Nm</td>
</tr>
</tbody>
</table>

# Use refrigeration oil only, smear on “O” rings and threads prior to assembly

(Gloves should be worn when handling refrigeration oil - see data sheet)

Refrigerant Pipework ‘O’ Rings

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
<th>Size</th>
<th>Part Number</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>Suction line to compressor</td>
<td>18mm o.d.</td>
<td>A120P6002H</td>
</tr>
<tr>
<td>B</td>
<td>High pressure line to compressor</td>
<td>15 mm o.d.</td>
<td>A120P6001H</td>
</tr>
<tr>
<td>C</td>
<td>Suction line bulkhead connectors and expansion valve to suction line</td>
<td>17mm i.d.</td>
<td>A082P6081F</td>
</tr>
<tr>
<td>D</td>
<td>High press. line bulkhead connectors, cond. inlet, exp. valve to evaporator</td>
<td>11mm i.d.</td>
<td>A082P6079F</td>
</tr>
<tr>
<td>E</td>
<td>Condenser outlet, rec. drier, inlet pipe to exp. valve</td>
<td>7.5mm i.d.</td>
<td>A082P6078F</td>
</tr>
<tr>
<td>F</td>
<td>Evaporator to expansion valve</td>
<td>13.5mm i.d.</td>
<td>A082P6080F</td>
</tr>
</tbody>
</table>
PM.6 - REFRIGERANT OIL

The internal working parts of the compressor are lubricated by refrigerant oil. This is a special type of oil which has an affinity with the refrigerant, such that a proportion of the oil circulates with the refrigerant, around the whole system. Under normal operating conditions, the oil never needs changing or replenishing, and if the correct procedure for system depressurisation and re-charging is followed, minimal oil will be lost from the system during these operations. If, however, the system suffers a major leak or sudden de-pressurisation, most of the oil held in suspension will be lost as the refrigerant escapes, necessitating the addition of a specified quantity of oil to the compressor on re-assembly (see section PM.7).

If a refrigeration component is to be replaced, the removed item will contain a certain amount of oil, and a corresponding amount of new oil must be added to the system on re-assembly:

- Condenser; 30 cm³
- Evaporator; 30 cm³
- Any major pipe or hose; 10 cm³
- Receiver-drier; 30 cm³

Approved Oils
Use only Denso ND-OIL 8 low viscosity (ISO46) PAG oil or equivalent (Sanden SP10; Four Seasons 59007).

Refrigerant oil absorbs water and should not be exposed to the atmosphere for any longer than is strictly necessary to perform the operation. Never return decanted oil back into the storage container.
PM 7 - COMPRESSOR

The a.c. compressor is mounted on the left hand side of the cylinder block, and is driven from the crankshaft, together with the alternator, by a multi-rib serpentine synthetic belt. A maintenance free belt tensioner takes the form of an idler pulley mounted on a sprung eccentric hub, which mechanism applies pressure to the smooth back side of the belt between alternator and crankshaft, and also provides routing to allow a generous belt wrap around the crankshaft pulley.

The belt itself should be inspected for condition at each service interval, and if it exhibits any evidence of physical damage, cracking, fraying, perishing, abrasion, contamination or any other deterioration, it should be replaced. In the case of oil or coolant contamination, the cause must be identified and rectified, and each of the pulleys must be thoroughly degreased before the new belt is fitted.

Compressor Removal

1. Recover the refrigerant using equipment connected to the service ports at the right hand front of the engine bay.

2. From beneath the car, remove the fuel tank bay undertray.

3. From beneath the car, release the clamp plate securing the suction and discharge pipes to the compressor and immediately cap the pipes and compressor ports to prevent ingress of dirt and moisture.

4. Disconnect the compressor clutch harness.

5. Using a suitable socket spanner, rotate the auxiliary belt tensioner assembly clockwise and insert a suitable locking pin in the hole provided to lock the tensioner in the 'unloaded' position. Remove the belt from the compressor pulley.

6. Release the three compressor fixing bolts, and remove the compressor from the engine. Retain the compressor for oil quantity measurement if a new unit is to be fitted.

![Diagram of a.c. compressor components](image-url)
Oil Quantity Adjustment Prior to Compressor Refitment

Refitting Existing Compressor
i) If the existing compressor is to be refitted after normal refrigerant recovery has been performed, a quantity of oil equivalent to that recovered must be added to that already held in the compressor.
ii) If the system has suffered a rapid discharge, caused for example by accident damage, most of the refrigerant oil will have been lost. Drain the remaining oil from the compressor by removing the drain plug and rotating the clutch plate. Add 150 cm³ of new refrigerant oil (see above) to the compressor before refitment.

Fitting New Compressor
New compressors are sealed and pressurised with nitrogen gas. The sealing caps should be removed only immediately prior to compressor fitment, at which time the gas pressure should be heard to escape as a cap is slowly released. New compressors are supplied with an oil fill of 150 cm³.

iii) If normal refrigerant recovery has been performed, the new compressor oil should be drained off, and the required oil quantity in the new compressor calculated and added:
   - Drain and measure the oil quantity in the OLD compressor by removing the drain plug and rotating the clutch plate. Quantity = X cm³
   - Oil quantity to be added to new compressor = X + 10 cm³

iv) If the system has suffered a rapid discharge, caused for example by accident damage, most of the refrigerant oil will have been lost. In this case, fit the new compressor as supplied with its 150 cm³ oil charge.

Compressor Fitment
1. Fit the compressor to the engine and secure with the three M8 bolts; Tighten to 25 Nm (18 lbf.ft).
2. Using new 'O' rings lubricated with mineral refrigerant oil, fit the two refrigerant pipes to the compressor and tighten the clamp plate screw to 20 Nm (15 lbf.ft).
3. Connect the compressor clutch harness.
4. Fit the auxiliary belt around the pulleys ensuring correct engagement of the ribs. Apply a counterclockwise torque to the auxiliary belt tensioner and remove the locking pin.
5. Recharge the system with R134a refrigerant.
PM 8 - CONDENSER

The engine cooling radiator, a.c. condenser and cooling fans are secured together as a package and are mounted horizontally on top of the crash structure, condenser lowermost, radiator above and the two cooling fans on the top side of the radiator. Bonded to the front and rear of the condenser are steel channels which incorporate mounting brackets to attach the unit to the lower flanges of the engine cooling radiator. This package is then fixed to the composite radiator mounting panel by two rear brackets attaching to the condenser/radiator flange, and two front brackets attaching to the top flange of the radiator.

The all aluminium condenser is of parallel flow construction, with tanks at each side which direct the refrigerant flow from the front inlet connection successively through 10, 7, 5 and 4 rows, before it emerges from the rear outlet union. Bonded to the front and rear of the condenser are steel channels which incorporate mounting brackets to attach the unit to the lower flanges of the engine cooling radiator, and also to provide mountings for the two cooling fans.

Radiator Fans

For access to the radiator fans, the front clamshell must be removed (see sub-section BT.4). Each fan is secured to right angle brackets bolted to the front and rear of the radiator top flange, via a single fixing bolt. The rear fixing is readily accessible, but the front fixing is restricted by the outlet ducting of the radiator mounting panel. In order to avoid removing the complete mounting panel and cooling pack, it is recommended to cut an access hole in the ducting and blank off the hole on completion.

Condenser

For access to the condenser, the front clamshell must be removed followed by the radiator mounting panel with the complete cooling pack.

1. Remove the front bumper and clamshell (see sub-sections BT.3 & BT.4).

2. Recover the refrigerant (see section PM), and release the condenser connections using two spanners at each joint to prevent damage to the condenser. Immediately cap all ports.

3. Drain the coolant and disconnect the radiator hoses.

4. Unplug the fan harness connector at each front corner of the radiator mounting panel. Disconnect the horn (RH side) and alarm siren (LH side) and feed the harnesses through the crash structure. Release the front harness from the radiator panel along the rear edge, RH side and front edge.
Radiator & Condenser Mounting

- Radiator inlet hose
- Radiator mounting panel
- Radiator rear mounting bracket
- Radiator outlet hose
- Air bleed plug
- Radiator fan rear mounting bracket
- Engine cooling radiator
- Radiator fan
- Condenser rear fixing screw
- Condenser front fixing stud
- A.C. condenser
- Radiator fan front mounting bracket
- Radiator front mounting bracket

FRONT
5. Release the 3 fixings securing the RH downward extension of the panel from the side of the crash structure. At the LH side, release the 4 similar fixings, two of which secure the alarm siren.

6. Remove the 3 screws securing the radiator panel to the crash structure along the top rear edge, and the 3 along the front edge, and withdraw the panel and cooling pack assembly.

7. To remove the cooling pack from the mounting panel, release the four setscrews along the front of the panel, and the four screws along the rear top edge, and slide the pack from the panel.

8. Unbolt the condenser and fan assemblies from the radiator as necessary. CAUTION: When handling the radiator and condenser, take care not to damage or distort the delicate finning, and impair efficiency.

9. Refit components in reverse order to disassembly, ensuring that the foam seals are correctly refitted to protect from vibration and optimise airflow through the matrices. Refill with coolant and bleed as detailed in sub-section KI.3. Re-charge refrigerant system.

10. - If a new condenser is fitted, add 30 cm³ of approved refrigerant oil to the system.
    - Use new 'O' rings on the pipe connections, and lubricate with refrigerant oil.
    - Using two spanners, tighten the condenser inlet connection to 25 - 30 Nm.
    - Using two spanners, tighten the condenser outlet connection to 20 - 25 Nm.
    - Recharge the system with 0.75 kg of R134a.
    - Refill the cooling system (see sub-section KI.3).

PM.9 - RECEIVER-DRIER

If the system has been open to atmosphere for any length of time, e.g. following accident damage or a burst hose or damaged component, the receiver-drier unit must be renewed, and should be the last component to be fitted, and uncapped only immediately prior to connection and recharging.

The receiver-drier is clamped to a mounting bracket at the front of the climate chamber. If the receiver-drier is to be replaced, the refrigerant must first be recovered using suitable equipment connected to the service ports at the right hand front of the engine bay.
- Cap all pipes and ports immediately after disconnection to prevent the ingress of dirt and moisture.
- When reconnecting the pipes, use new 'O' rings coated in an approved refrigerant oil, and tighten to 20 - 25 Nm.
**PM.10 - EXPANSION VALVE**

The expansion valve is fitted onto the evaporator inlet and outlet pipes above the climate chamber, and is accessible from within the front services compartment. To replace the valve:

1. Recover the refrigerant using suitable equipment connected to the service ports at the right hand front of the engine bay.

2. Release the single M6 screw securing the clamp plate to the top of the expansion valve, and withdraw the plate and both pipes from the valve. Immediately cap the pipes and ports to prevent the ingress of dirt and moisture.

3. Release the two M5 screws from the counterbored holes in the top of the valve, securing the valve to the evaporator pipes, and withdraw the valve from the pipes. Immediately cap the pipes and ports to prevent the ingress of dirt and moisture.

4. Before refitting, renew all the connector ‘O’ rings, and coat with an approved refrigerant oil.

5. Fit the threaded clamp plate around the evaporator pipes, and secure the expansion valve onto the pipes with the two M5 screws tightened to 5 - 6 Nm.

6. Use the second clamp plate to secure the two pipes to the expansion valve, tightening the single M6 screw to 7 - 9 Nm.

7. Recharge the system with 0.75 kg of R134a.
PM.11 - HEATER/EVAPORATOR/FAN UNIT

The heater matrix and a.c. evaporator are contained within a single housing together with the air blender temperature control flap. The housing is mounted in the chassis climate chamber where it is clipped to the fan blower unit, and retained by a simple clamp bracket. The blower fan is positioned on the driver's side, with the heater/a.c. housing on the passenger side, and the air blend flap actuator on the front of RHD cars and the rear of LHD.

To remove heater/evaporator/fan unit:
1. Remove the front clamshell (see sub-section BT.4).
2. Remove the radiator outlet air deflector/water shield, windscreen washer reservoir and ducting between heater/a.c. unit and air distribution unit.
3. Recover the refrigerant using suitable equipment connected to the service ports at the right hand front of the engine bay.
4. Disconnect the refrigerant pipes as necessary and remove the receiver-drier unit and mounting bracket. Disconnect the outlet pipe from the expansion valve. Cap all pipes and ports immediately to prevent the ingress of dirt and moisture.
5. Disconnect the hoses from the heater matrix and collect escaping coolant.
6. Unplug the wiring harness from the temperature flap motor, a.c. thermostat and fan motor.
7. Remove the clamping bridge retaining the unit into the chassis and release the overcentre clips securing the unit to the fan blower housing. Withdraw the unit from the chassis together with the drain tube.

To refit heater/evaporator/fan unit:
Before refitting the unit, first ensure that the following components are fitted in the chassis:
- Fresh air intake ducting/re-circulation valve assembly, retained in channel at front of chamber by single clamp bracket. Check that re-circ. flap stepper motor harness is connected, and that the moulded plastic water shield is fitted over the actuator.
- Recirc. ducting is fitted in rear of chassis climate chamber
- Earth cables are connected to chassis negative post at the left hand side of the chamber.
- Rear circuit brake pipe is fitted between master cylinder and bulkhead connector.

Position the fan housing into the passenger side of the chassis chamber. Fit the drain tube into the base of the heater/evap. unit and use a guide wire or similar to aid routing of the tube through the chassis crossmember via the central aperture at the back of the chamber, as the unit is fitted into the chamber. Engage the lower edges of the fan unit and heater/evap. unit before clamping together with the two overcentre latches. Retain the assembly by fitting the bridging clamp bracket.
Continue re-assembly in reverse order to removal.

PM.12 - AIR DISTRIBUTION UNIT

The airflow distribution unit is mounted on top of the chassis scuttle, sandwiched between the underside of the fascia top/demist duct and the chassis. The unit comprises several plastic mouldings bonded and riveted together to contain the rotary flap for windscreen/face level vents, and also the footwell flap. The stepper motor for the rotary flap is mounted on the side of the unit.

To Remove
1. Remove the front clamshell (see sub-section BT.4) and washer bottle and wiper mechanism (see sub-section MP.8).
2. Remove the air trunking between the heater/a.c. unit and the distribution unit.
3. Release the fixings securing the heater water pipe to the chassis scuttle.

4. Drill out the rivets securing the distribution unit retaining bracket to the chassis scuttle.

5. Withdraw the unit from beneath the scuttle baffle panel, disconnecting the stepper motor harness plug when access allows.

6. Refit in reverse order to removal, ensuring that the sealing foam between the unit and baffle panel and on the chassis scuttle is present and in good condition. Secure by re-rivetting the retaining bracket.

PM.13 - REFRIGERANT PIPES

The main feed and return (high pressure liquid and low pressure suction) lines to the compressor take the form of aluminium pipes routed along the outside of the RH chassis rail, such that removal of the body sill panel is required for access to the pipes. Replacement of the pipes is unlikely to be necessary other than as a result of accident damage, in which case the body sill will be replaced in accordance with Service Notes sub-section BS.9.

If the sill pipe does require replacement without having incurred accident damage, it is recommended to remove the pipe by withdrawing from the rear and cutting the pipe as required. A proprietary service repair a.c. hose and suitable end fittings should then be used to replace the pipe, ensuring that the side impact foam block is retained.

PM.14 - AIR BLENDER & RE-CIRC. FLAP ACTUATORS

The stepper motor (actuator) for the air temperature blender flap is mounted on the side of the heater/a.c. casing and is secured by two screws. A moulded plastic cover is hooked over the actuator to provide protection from direct water contamination. On LHD installations where the actuator is on the rear of the unit, access to the actuator requires the unit to be removed from the chassis (see sub-section PM.12).

With the heater/a.c. unit removed, pull off the moulded water shield and release the two fixings securing the actuator to the casing. The nuts are accessible inside the casing via the air outlet aperture, but the air blender flap may need to be moved to allow access to both nuts. In order to allow flap movement, the flap must be mechanically disconnected from the motor by unclipping the actuator outer cover and sliding a drive gear off its shaft.

The re-circulation flap actuator on both RHD and LHD cars is accessible only with the heater/a.c. unit removed. Note that the actuator lead should be looped downwards to prevent water tracking along the lead and into the actuator.