Section C2

Refrigeration unit Contents

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Refrigeration unit

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

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

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

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

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

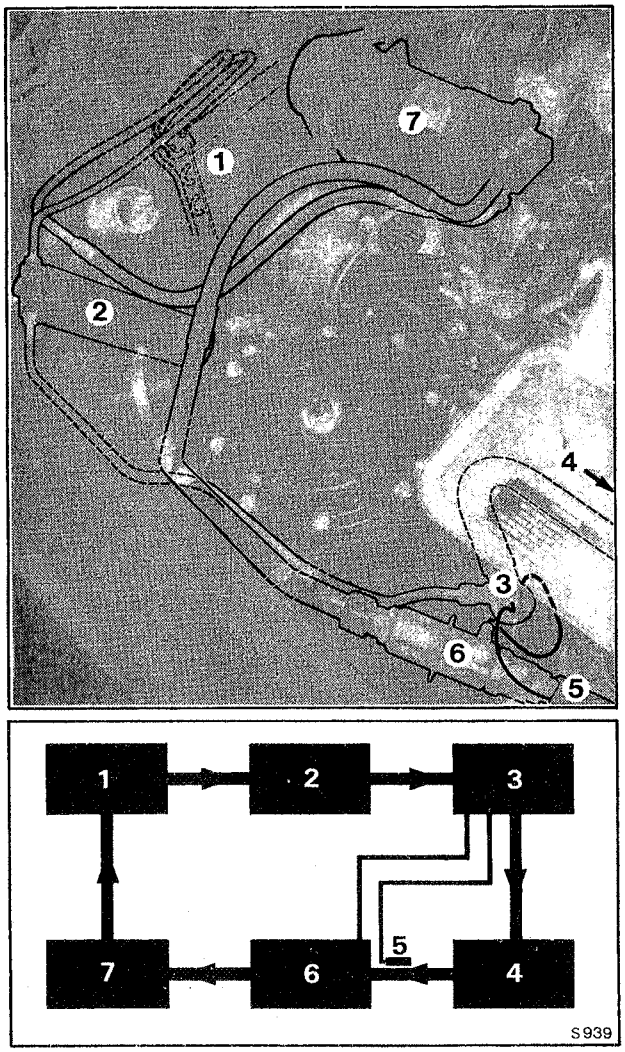

Fig. C2 Refrigeration component layout
1 Condenser matrix
2 Receiver/drier
3 Expansion valve
4 Evaporator matrix
5 Sensor
6 Suction throttling valve
7 Compressor

Refrigeration special precautions & accident damage

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

If it is correctly handled the refrigerant is perfectly safe, however if incorrectly handled it can cause serious injury or damage. In particular, smoking in the region of exposed refrigerant can be

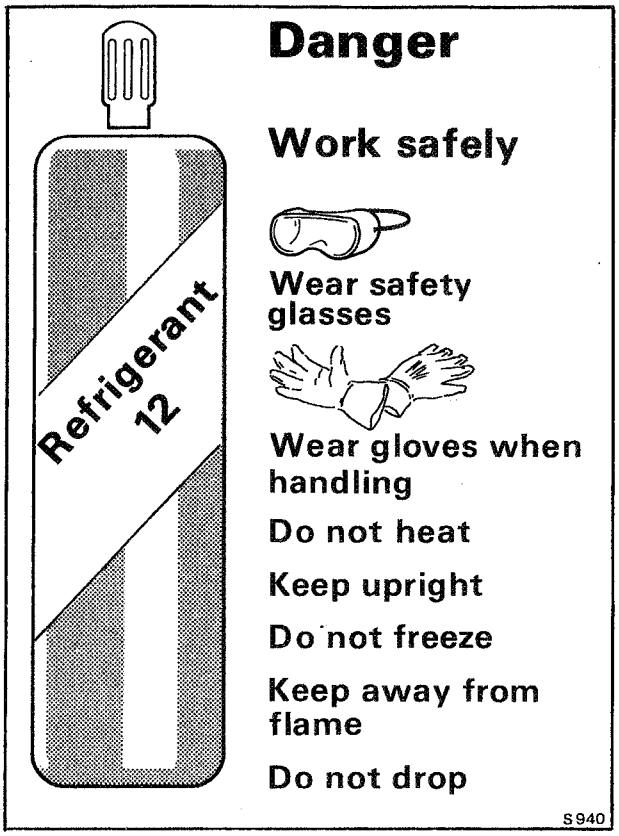

Fig. C3 Refrigerant handling - safety precautions

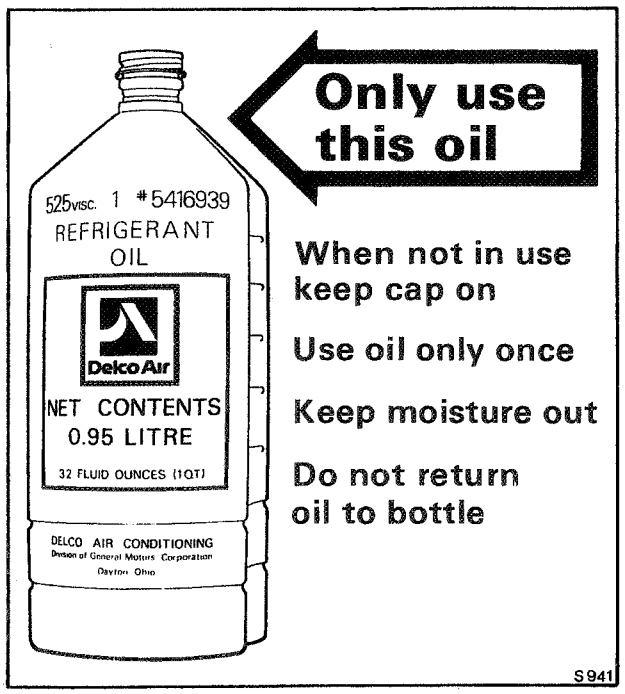

Fig. C4 Approved refrigerant oil

a health hazard. The following elementary safety precautions should be adopted when handling refrigerant:

1. If the drum has a metal cap, always ensure that the cap is fitted when not in use.
2. Do not carry refrigerant in the passenger compartment of a car, always place the drum in the luggage compartment.
3. If a drum is to be transported or stored,always shield it from the direct rays of the sun. (The sun's heat could increase the pressure within the drum sufficiently to activate the safety valve causing the refrigerant to escape.)
4. A drum must not be overfilled because the increased pressure can cause the drum to explode before the temperature rises to a point where the temperature safety valve is activated.
5. Do not subject the drum to high temperatures when charging the system. The drum must not be placed on a radiator or stove, neither must a blow-lamp be used for heating the drum.

   To heat the drum when charging, the drum should be immersed in warm water which must not exceed 51°C.
6. Do not discharge the refrigerant where there is an exposed flame or where it can be drawn into the engine air intake. Concentrations of this refrigerant in contact with a flame can produce a poisonous gas.
7. Do not discharge the refrigerant in a confined space because it will displace the air which could result in suffocation.
8. **Always wear goggles** when carrying out work which involves the use of refrigerant or when opening any of the lines. If an accident occurred and refrigerant struck the face, goggles would protect the eyes and therefore reduce the risk of serious injury.
9. Excessive heat applied to any section of the refrigerant lines will create excessively high pressures, therefore welding should not be carried out on any part of the car adjacent to the refrigerant units or lines.

Accident damage (refrigerant)

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

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

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

switch located on the engine compartment face of the evaporator box (Fig. C19)
2. Inspect all refrigeration components and lines.
3. If the condenser has been damaged it MUST be replaced; soldering, brazing or welding etc. must not be attempted.
4. Fit a new receiver/drier if damage has occurred or if the system has been 'open' for more than one day.
5. Check the compressor and clutch pulley for cracks, if the clutch plate is bright yellow it should be replaced.
6. If the compressor does not show signs of external damage it may be used again.

Chemical stability of the refrigerant
The efficient operation of the air conditioning system depends upon the pressure/saturation temperature relationship of the refrigerant. Provided that the system contains pure refrigerant, plus a certain amount of refrigerant oil which mixes with the refrigerant, it is considered to be chemically stable.

However, when foreign materials such as dirt, air or moisture enters the system, the chemical stability is affected which results in a change in the pressure/saturation temperature relationship of the refrigerant. The system will then no longer operate at the correct pressures and temperatures which decreases the efficiency of the system. The following general rules should be observed to ensure chemical stability in the system.
1. Before disconnecting a refrigeration connection, wipe away all dirt or oil from the connection to prevent foreign matter entering the system.
2. All tools should be kept clean and dry.
3. Before adding oil, ensure that the container and tube (if any) is clean and dry in order to keep the refrigerant oil as free of moisture as possible.
4. Before 'opening' the refrigeration system, ensure that all tools etc. are close at hand to reduce the operation time to a minimum. Do not leave the system 'open' longer than necessary.
5. If the system has been 'opened' and sealed again, it must be correctly evacuated.

Servicing the refrigeration system

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

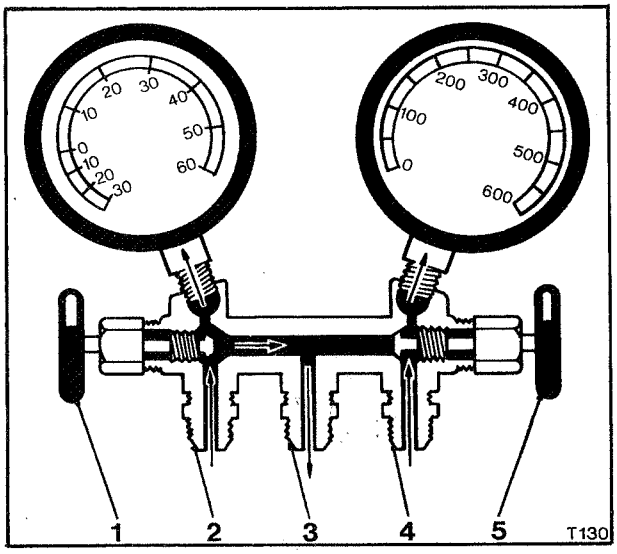

Fig. C5 Manifold gauge set
The illustration shows the manifold hand valve with the suction side cracked, while high side remains closed. Pressure is recorded on both gauges even though one hand valve is cracked.
1 'Low' side hand valve
2 Connection to suction throttling valve
3 Charging or evacuating connection
4 Connection to compressor
5 'High' side hand valve

valves are closed. Attach a pipe to the centre connection of the gauge set.
4. Crack both hand valves and open further as the system discharges.
5. Do not release the refrigerant too quickly as this can result in oil being drawn from the system. If any trace of oil is noticed, loosen the adapter. The operation should require at least 15 minutes to ensure complete discharge.
Note
Any oil which has discharged into the container should be measured and a corresponding amount added to the system.
6. When all the refrigeration appears to have escaped, slacken the adapter to close the valve and allow approximately two minutes for any build-up of pressure in the system to develop, then repeat the discharge procedure.

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

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

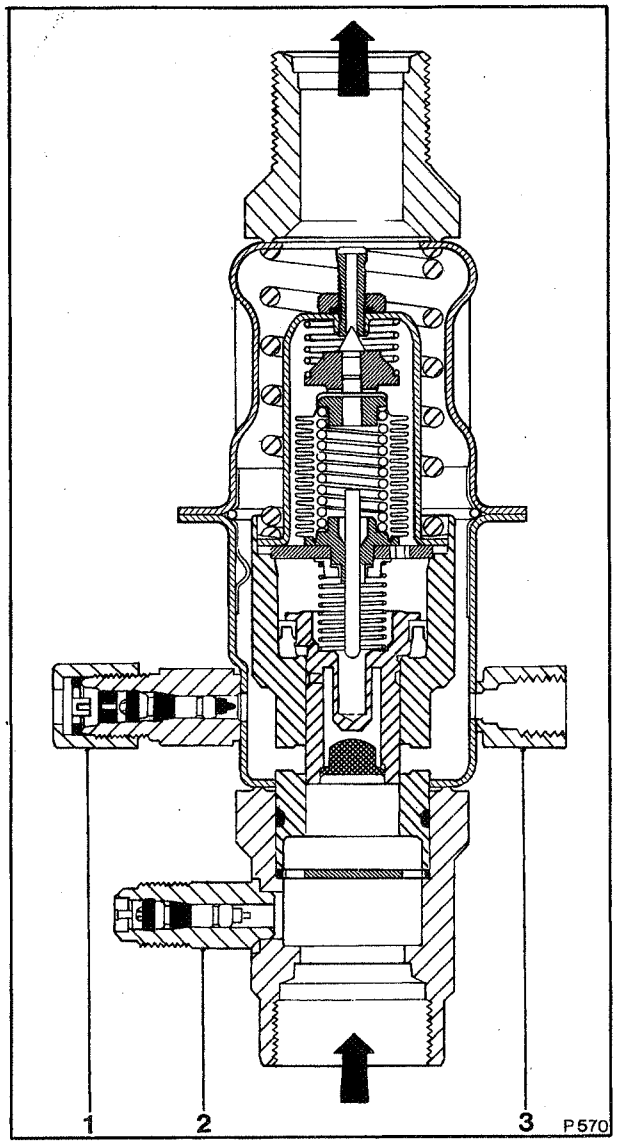

Fig. C6 Suction throttling valve
1 Oil bleed line
2 Service valve connection
3 Equaliser line connection

4. Switch off the vacuum pump, if the vacuum falls quickly investigate for a leak.
5. If the system loses vacuum very slowly, a leak is possible but it is advisable to evacuate for a further 45 minutes to eliminate the possibility of residual liquid refrigerant in the compressor oil vaporising and causing the pressure to rise.
6. The final vacuum reading obtained should be held for 30 minutes to ensure that there are no leaks in the system.

Refrigeration system - To sweep
1. Evacuate the system
2. Connect the refrigerant bottle to the centre connection of the manifold set, close the low side valve (to suction throttling valve) and open the valve on the bottle.
3. Ensure that the low pressure gauge comes out of vacuum, close the high side valve (to compressor) and open the low side valve.
4. Charge the system with 0,45 kg (1lb) of Refrigerant 12. If the ambient temperature is low it may be necessary to start the engine and switch on the system in order to draw in the refrigerant. Run the engine for a further 10 minutes with ACU switch set to HIGH.
5. Switch the system off and stop the engine.
6. Allow 5 to 10 minutes for the refrigerant pressure to equalise.
7. Leak test the system using an electrical leak detector. If a leak is detected, it must be rectified and the discharge and evacuation operations repeated.
8. If the system maintains its pressure, discharge and evacuate the system prior to charging.

Refrigeration system - To charge
Before charging the system, it is necessary to evacuate and sweep the system.
1. Attach a cylinder of Refrigerant 12 to the appropriate connection on the vacuum pump apparatus.
2. Open the cylinder valve and purge the line between the cylinder and the vacuum pump apparatus.
3. Suspend the cylinder on a spring balance and note the weight.

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

4. Open the tap on the vacuum pump apparatus to enable the refrigerant to flow into the system.
5. Ensure that the parking brake is applied and that the gear selector is in either 'Park' or 'Neutral'.
6. Start the engine and run it at 1000 to 1250 rpm.
7. Move both temperature selector dials to the 'Full cold' position. Open the circular facia outlets and the rectangular outlets: move the air conditioning function switch to HIGH.
8. Allow 0,45 kg (1 lb) of refrigerant to flow into the system, close the tap on the vacuum pump apparatus and switch off the engine.
9. Test for leaks in the system with an electrical leak detector. If the system is free of leaks, continue the charging operation and increase the weight of refrigerant in the system by 1,02 kg (2.25 lb) to make the total weight of refrigerant added equal to 1,47 kg (3.25 lb).
10. If a leak is detected it must be rectified and the evacuation and charging operation repeated.

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

11. Close the tap on the vacuum apparatus and unscrew the connection to the valve of the service connection on the suction throttling valve and fit the valve cap.
12. Check the system for leaks.

Oil level - refrigeration system

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

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

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

The procedure for correcting the oil level is as follows:

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

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

Replacing components

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

Oil should be added in the following quantities plus any lost through rapid discharge of the system:

Evaporator - 90 ml (3 ozs US)
Condenser - 30 ml (1 oz US)
Receiver/Drier - 30 ml (1 oz US)

Low refrigerant charge protector system

System description

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

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