System pressure testing and diagnosis

System temperature checks

A simple but effective initial test is to check the temperature of the refrigerant system components and lines by touching them while the system is operating.

With the engine at operating temperature and the air conditioning system switched ON, the touch test should reveal the following:

- A hot compressor.
- A hot high pressure refrigerant line from the compressor outlet to the condenser.
- A hot condenser on the inlet side.
- A warm condenser on the outlet side.
- A warm liquid line from the condenser to the evaporator (before the expansion valve or fixed orifice tube).
- A cold evaporator outlet line.
- A cold low pressure refrigerant line to compressor inlet.

If the results from the touch test deviate from the above list, suspect a restriction in the line or the component whose temperature is abnormal.

Confirm this by carrying out a pressure test.

System pressure testing

Measuring the pressures in the high and low pressure circuits is the best way to test an air conditioning system.

- ALWAYS wear appropriate protective clothing, including gloves made of fluoroelastomer (leather or fabric gloves are not suitable when servicing any part of a refrigerant system).
- ALWAYS wear eye protection, a leak of refrigerant can result in serious blistering (frostbite) of any unprotected skin and especially the eyes.
- Identify which type of refrigerant is in the system.

NOTE: DO NOT presume that it has been charged with the correct refrigerant. The pressure-temperature relationship of other gasses will be different and may result in incorrect diagnosis. Refer to the chart at the end of this section.

- Connect a manifold gauge set to the low and high pressure service connectors.
- Carry out a pressure test without the engine running.

NOTE: The shaded area on the gauges denotes normal system pressures at an ambient air temperatures of 20-25℃.

- Refer to the vehicle chapter for model specific data (where available).

Compressor clutch cycling time

To control the temperature of the evaporator the compressor clutch switches ON and OFF (cycles).

The rate of the cycle and the time that the compressor is operating is dependent on the pressure in the low pressure refrigerant line between the evaporator and the accumulator/drier.

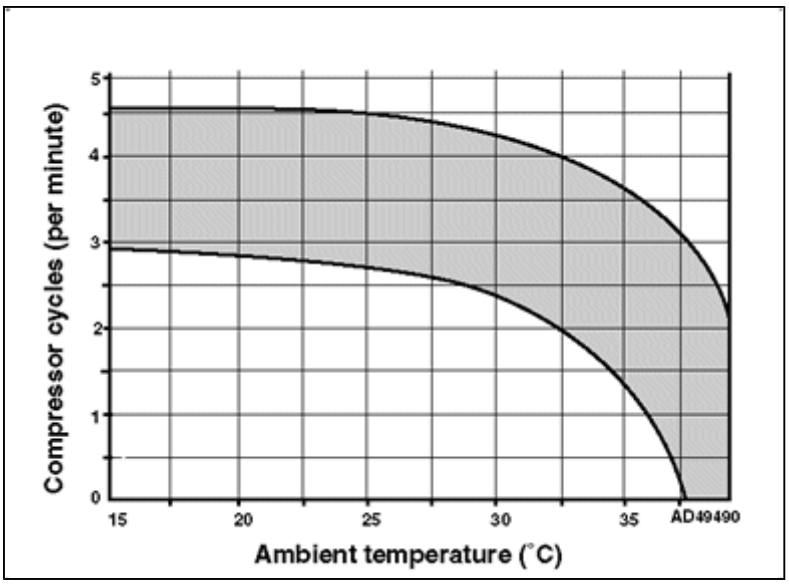
As the evaporator temperature falls, the refrigerant starts to freeze and the flow through the evaporator is restricted.

This restriction results in a decrease in pressure at the evaporator outlet and the low pressure refrigerant (cycling) switch breaks the compressor circuit.

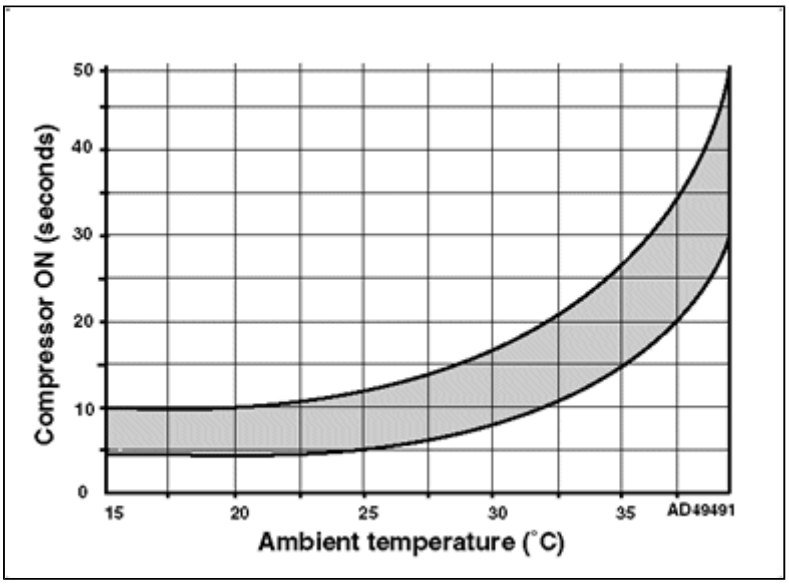
When the restriction thaws, the pressure increases and the cycling switch reconnects the compressor circuit.

The charts below show typical compressor clutch cycling times.

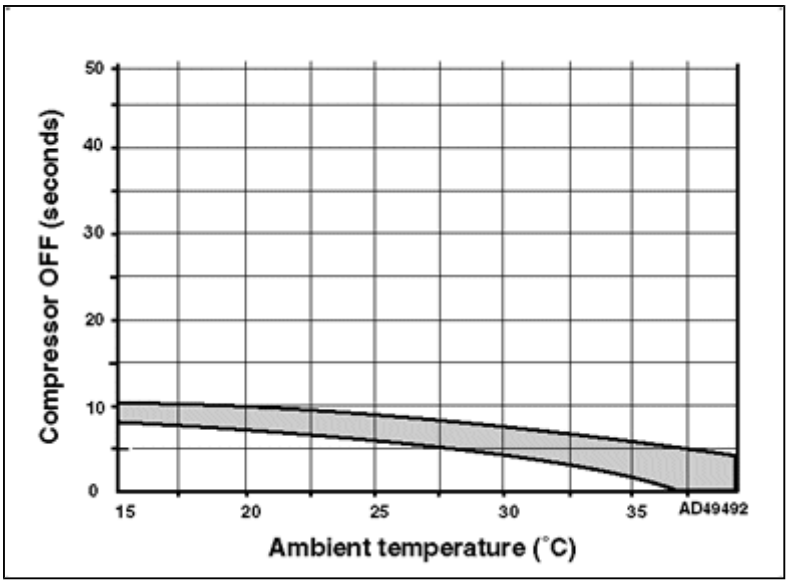
Compressor clutch cycling rate



Compressor clutch ON time



Compressor clutch OFF time



Refrigerant pressure-temperature relationship

The following chart shows the relationship between pressure and temperature for both R12 and R134a.

This information can be used to identify which refrigerant is in the system.

Pressure-temperature relationship

Temperature	R12	R134a
-9℃	1,27 bar	1,06 bar
0℃	2,07 bar	1,88 bar
10℃	3,22 bar	3,1 bar
21℃	4,84 bar	4,87 bar
30℃	6,33 bar	6,55 bar
40℃	8,59 bar	9,17 bar

- Connect a manifold gauge set to the low and high pressure service connectors.
- Carry out the pressure test without the engine running.
- Ensure that the high and low pressure gauges have equalised.
- Insert an accurate thermometer into the lower fins of the condenser.
- Check the temperature and low pressure gauge readings.
- Compare the results with the chart.

Refrigerant circuit leak testing

Introduction

Many leaks are caused simply by vibration which causes refrigerant line connections to come loose, but refrigerant gas can also escape through the walls of the rubber hoses or at the drive shaft oil seal of the compressor.

NOTE: A leakage rate of between 50 and 100g of refrigerant per annum is normal.

In systems using R12 refrigerant, leaks can appear as an oily residue at the leakage point. The oily residue soon picks up

dust and dirt particles from the surrounding air and appears greasy. Through time, this will build up and appear to be a heavy dirty grease deposit.

In systems using R134a refrigerant, the leaks can be more difficult to pinpoint as the synthetic refrigerant oil does not appear as an oily residue at the leakage point.

If an air conditioning system requires frequent charging, a leak test should be carried out. If the source of the refrigerant leak cannot be found through visual inspection, there are various other methods available.

Preparation for leak testing

The refrigerant circuit must be under pressure when performing a leak test.

If the air conditioning system is still operational there should be sufficient pressure in the circuit (at least 3,5 bar), to carry out an effective leak test. If the system charge is too low, the refrigerant will need to be recovered.

NOTE: If the system is empty, DO NOT charge it with refrigerant, carry out leak testing with oxygen free nitrogen (OFN).

Areas to check

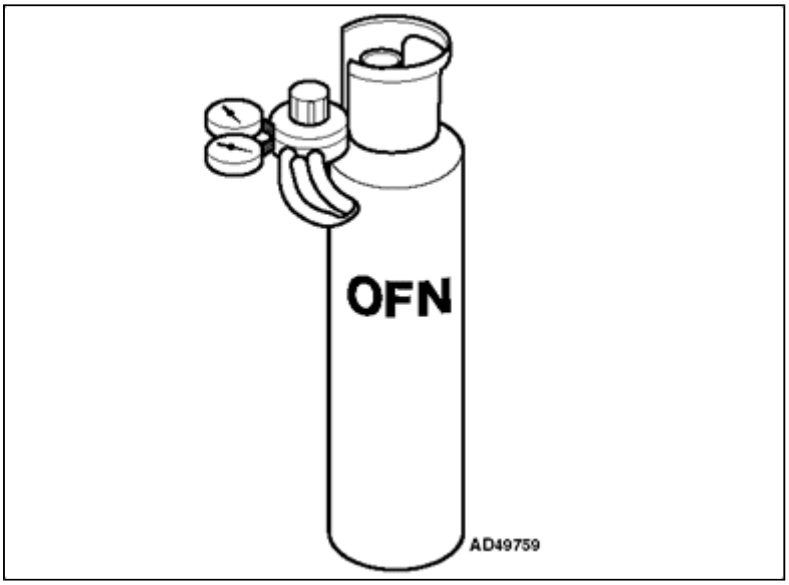
- All connections and pipes.
- Compressor drive shaft.
- Compressor service valves and sealing gaskets.
- Condenser and evaporator matrix tube ends.
- Receiver/drier or accumulator/drier connections.
- Pressure switches.
- Spring lock coupling connections.
- Hoses.

Leak testing using oxygen free nitrogen (OFN)

Nitrogen has a molecular structure which makes it suitable to find most leaks, and in addition it is reasonably priced.

IMPORTANT:

- DO NOT exceed the recommended pressures (use a pressure regulator).
- DO NOT operate the air conditioning system with oxygen free nitrogen (OFN) in the refrigerant circuit.



Testing

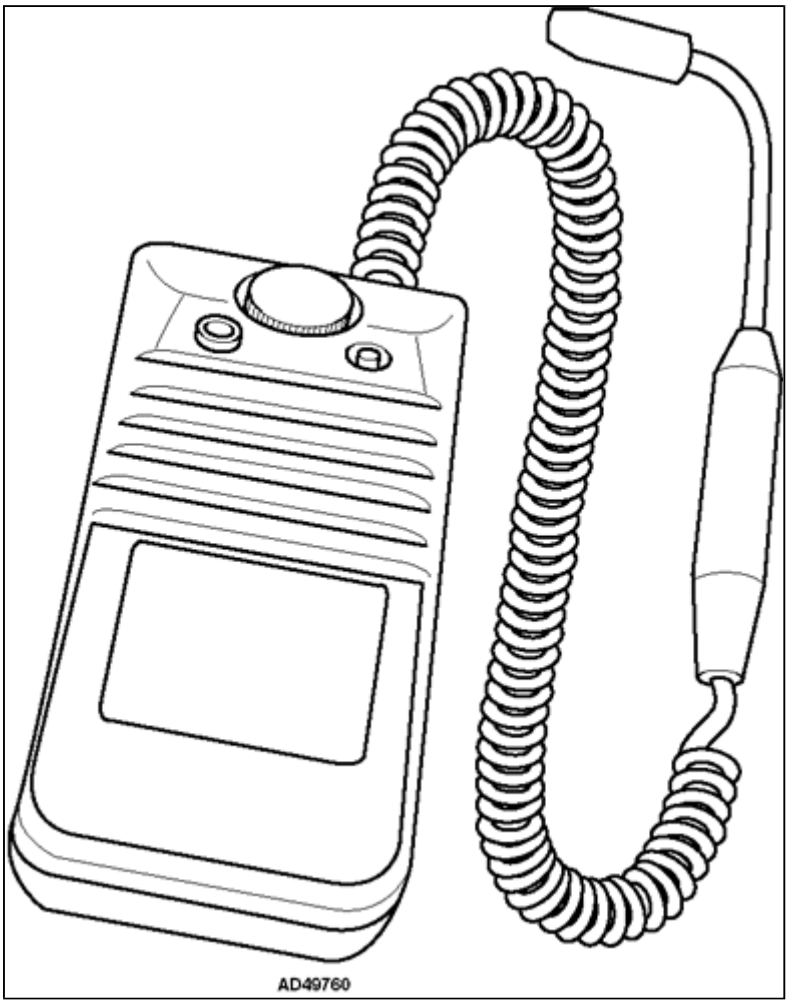
- If the air conditioning system is still operational, recover the refrigerant.
- Connect the cylinder of OFN to a service connector, component or line, using a suitable adapter.
- Open the cylinder valve to pressurise the circuit to approx. 10 to 15 bar (sufficient for leak testing purposes), and close the valve.
- Using a commercially available bubble dye solution, spray the suspect areas to locate the leak.
- Release the OFN from the circuit before attempting any repairs.

Leak testing using an electronic tester

Electronic leak detectors can be particularly useful in finding very small leaks. Different types of detectors are available for air conditioning, and most leak detectors can be used for both R12 and R134a.

Electronic leak testing can be difficult in drafty conditions. It may be necessary therefore to shelter the suspected leak area in order to prevent any draft blowing the refrigerant gas away.

If the surrounding air is contaminated with refrigerant gas, the leak tester will indicate gas all the time. It may therefore be necessary to ventilate an area to be leak tested.



- Ensure that the air conditioning system is charged, a partial charge, approximately 225g is sufficient.
- Pass the probe under the suspected leak area starting at the highest point in the circuit (refrigerant gas is heavier than air).
- When a refrigerant leak is detected, the tester will emit an acoustic signal. The signal and intensity will change as the concentration of refrigerant gas increases or decreases.
- If the leak cannot be detected with the air conditioning system switched off, start the engine and operate the system to build up system pressure.

NOTE: With a partially charged system it is advisable to run the air conditioning system for only a short period and not to

exceed engine idle speed, as there may be insufficient oil to sustain lubrication of the compressor.

Leak testing with bubble dye solution

For basic leak detection, for instance in the area of connections, a bottle of commercially available bubble dye solution can be used. The bubble test method is a cheap form of leak testing and can assist in finding a variety of leaks, but it is not as reliable as other leak testing methods.

- Ensure the refrigerant circuit is fully charged.
- Swab the suspected area with the solution.
- Check for bubbles which would indicate a leak.
- If the leak cannot be detected with the air conditioning system switched off, start the engine and operate the system to build up system pressure.

NOTE: With a partially charged system it is advisable to run the air conditioning system for only a short period and not to exceed engine idle speed, as there may be insufficient oil to sustain lubrication of the compressor.

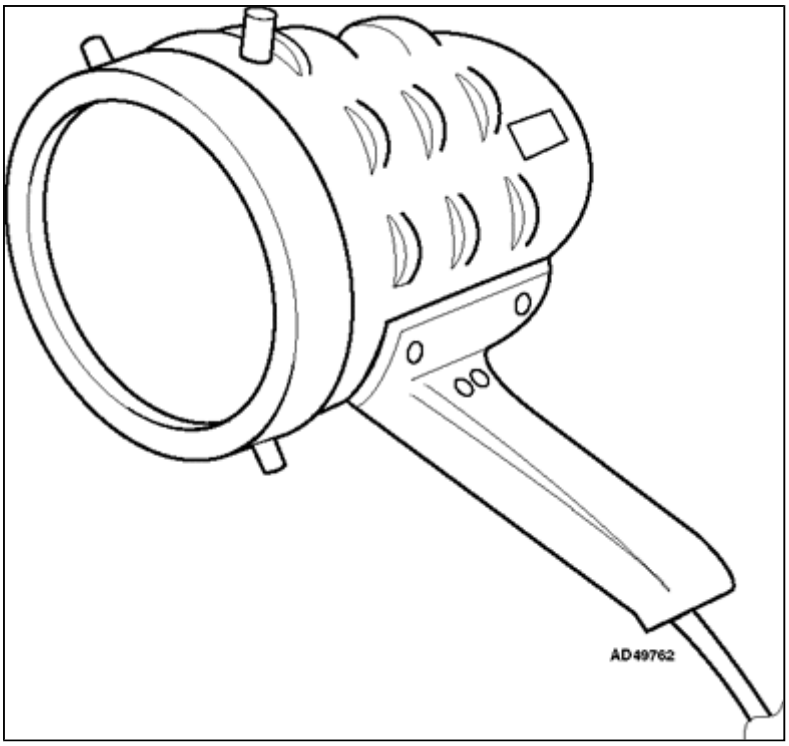
Leak testing with an ultraviolet lamp

To make leaking refrigerant visible under ultraviolet light, the refrigerant gas is mixed with a special dye which is added to the refrigerant. The highlighting effect produced by exposure to the light of an ultraviolet lamp makes it easy to locate refrigerant system leaks.

NOTE: Leak testing dye may have already been added to the system by the vehicle manufacturer.

The dye can be added to the refrigerant system during repair, or during the evacuation process, depending on the equipment available. Using an injector, dye can also be added to the low pressure (suction) side when the system is being charged.

The dye attaches itself to the refrigerant oil and even if the refrigerant is removed and the system is re-charged, the dye will still remain in the system.



- Following the manufacturer's instructions add the amount of dye stated to the refrigerant system.
- Start the engine and operate the air conditioning system.
- Shine the ultraviolet lamp around the suspected areas.
- The leak will be visible when the dye is exposed to the ultraviolet lamp.

CAUTION: Excessive ultraviolet light can damage eyesight. When using ultraviolet light always wear suitable safety goggles that screen out ultraviolet light.