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Introduction

The purpose of this publication is to allow the automotive air-conditioning trainee or student to gain a better-than-basic working knowledge of the system and its components plus a diagnostic ability. The student should be able to apply this knowledge so as to competently repair and/or modify an air-conditioning system in order to return it to its full working capacity.

Refrigeration and air conditioning are not discoveries of the past century. Simple forms of refrigeration and air conditioning have been in use for thousands of years.

Within the past 70 years many aspects of modern life have been made possible through the development of sophisticated air-conditioning systems. Many components associated with the worldwide space program could not have been possible without the use of air conditioning. These components were manufactured in a temperature and humidity-controlled environment. Also, modern medicine and delicate machine components are perfected in scientifically controlled air-conditioned environments.

Computer centres are only able to function properly because they are kept within a specific temperature and humidity range, which depends on complex air-conditioning systems.

Automotive air conditioning became available in 1940, but did not start to become popular in Australia until the late 1960s. At this time the air-conditioning system was an add-on under-the-dash unit, of which the most popular was the Mark 4 system (see Figure 1.1).

Since then the number of vehicles fitted with air conditioning has greatly increased. During the early 1970s, OEM (original equipment manufacturer)-fitted integrated air-conditioning systems were introduced by each of the big three Australian car manufacturers.

Air conditioning is now the most popular accessory fitted to new vehicles. Some 95 per cent of new vehicles are now fitted with air conditioning.

What is air conditioning?

Air conditioning is the process by which the air is cooled and cleaned, the humidity lowered and the air circulated. The quantity and quality of the air is also controlled. Under ideal conditions the air-conditioning system can be expected to accomplish all these tasks at the same time. The air-conditioning system in modern vehicles is designed to lower the temperature to
therefore assess the system’s performance. The manifold and hand valves allow the system to be purged of refrigerant, evacuated of air and moisture, and recharged with new refrigerant.

Most modern gauge sets use two gauges, but some air-conditioning systems that use a pressure control regulator for the evaporator may require a second **low-pressure gauge**.

The normal manifold and gauge set has two gauges (refer to Figure 8.5):

› low-pressure gauge (combination pressure and vacuum)  
  
› high-pressure gauge (pressure only).

Each of the gauges is connected to the system via the manifold, hand taps and hoses. Each hand tap, when opened, allows the refrigerant to flow out of the system into the manifold and into the centre yellow service hose.

The hand valves and yellow hose are used to purge, evacuate and charge the system. The hand valves must remain closed at all times so that it is possible to read the system pressures. They should only be opened to service the system.

**The low-side gauge**

The gauge used on the low-pressure side of the system is called a **compound gauge** (refer to Figure 8.5). It gives both pressure and vacuum readings. It connects to the blue hose through the manifold.

The metric scale starts at –100 kPa and has a maximum pressure accuracy reading of 800 kPa (–1 to 8 bar), but the gauge can read up to 2400 kPa or 24 bar.

The imperial scale reads vacuum pressures between 30 and 0 inches of mercury (in/Hg), and pressure from 0 to 300 psi.
SECTION 2: SYSTEM DIAGNOSIS

2.3 System-diagnostics problem sheets

Note: The ambient temperature for all diagnosis sheets is 30°C and all pressures relate to a cycling clutch system.

System-diagnostics problem sheet 1

Low-gauge reading: Low
High-gauge reading: Slightly low
Complaint: Little or no cooling, especially on warmer days
System conditions:
1. Low-side gauge reading low – should read 100–180 kPa
2. High-side gauge reading slightly low – should read 1400–1600 kPa
3. Compressor cycling on time extended
4. Evaporator air cool but not cold
5. Low-pressure suction line temperature high (5 to 8°C)

Diagnosis: Low refrigerant charge – possible leak
Corrective steps:
1. Leak test the system
2. Purge and recover the refrigerant
3. Repair leak
4. Check the compressor oil level
5. Replace the receiver dryer
6. Evacuate the system and make sure the system holds a vacuum as per legislation
7. Recharge the system to specifications and retest for leaks
8. Performance test the system