# Chapter 1 – Basic Cooling and Air Conditioning Systems

## *EXPERIMENT 1.7 – MAINTENANCE METHODS AND EQUIPMENT REQUIRED FOR SERVICING*

| Name | Class/Period | Date |
|---|---|---|
| | | |

### 1. Objectives:

The Gains at the end of this experiment session are to:

- Use the pressure gauges and manifold set.
- Use the high pressure gauge.
- Use the refrigerant recycling station.
- Evacuation the refrigerant from the air-conditioning system.
- Refrigerant's charge to the system.

### 2. Equipment Required:

- Main Platform Unit
- Professional Air Conditioning Panel
- Pressure gauges and manifold set
- Digital thermometer
- Refrigerant recycling device

## 3. Discussion: **The pressure gauges and manifold set**

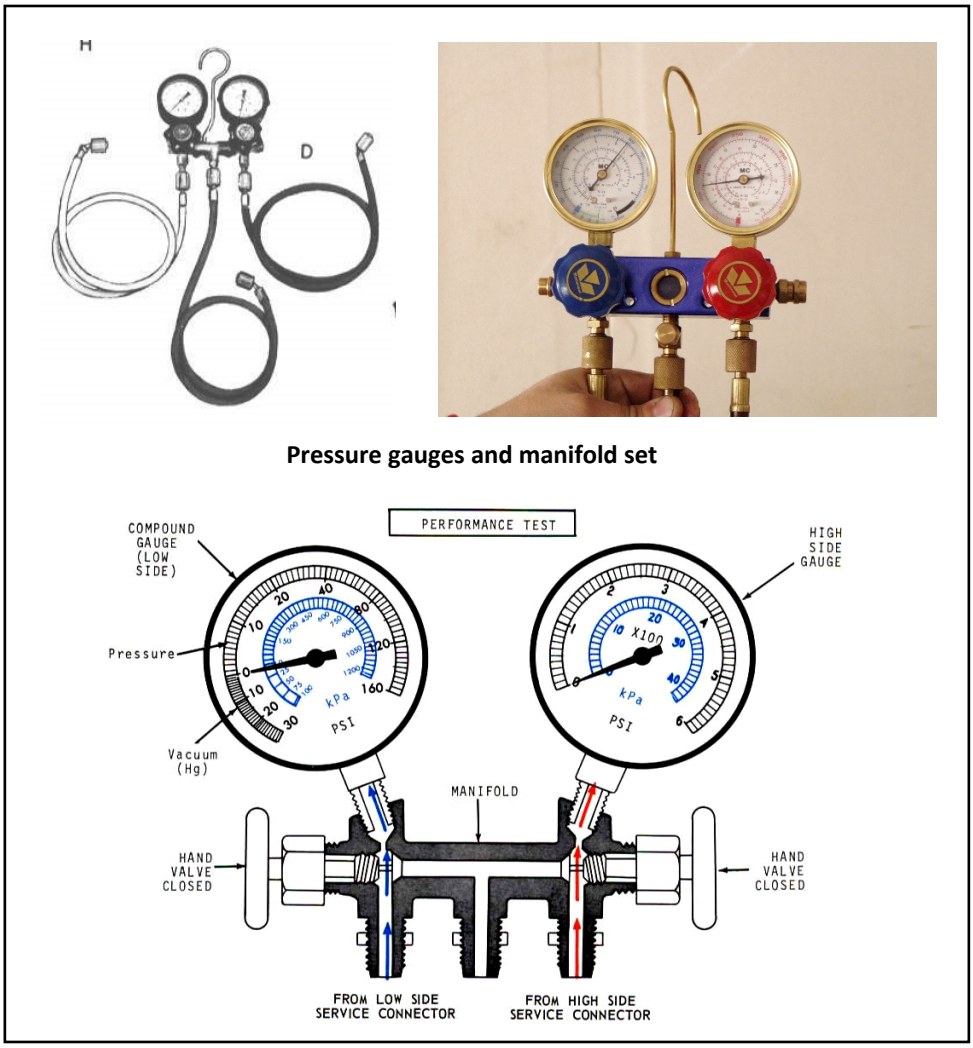


**Figure 1-35**

## 4. Discussion: **Pressure gauge (low side)**

The pressure gauge registers both pressure and vacuum. All air-conditioning systems can, under certain conditions, drop from a pressure into a vacuum on the low side. It is necessary that a gauge be used that will show either pressure (psi and/or Bar) or inches/mm. of mercury vacuum (Hg.).

The vacuum side of the gauge must be calibrated to show 0 to 30 inches Hg (0-760 mm. Hg). The pressure side of the gauge must be calibrated to register accurately from 0 pressure to a minimum of 20 psi (~1.8 bar).

The maximum reading of the pressure should not exceed 150 psi (~10 bar). Practically all readings of the

low side of the system will be less than 60 psi (~4 bar) with the system in operation.

The scale reading preferred by an individual serviceman is left to their own choice. To accurately convert pressures to temperatures in the system, the gauge should be calibrated to a low enough scale that it will not be difficult to obtain an accurate reading. The higher the pressure scale, the more difficult it becomes to get an accurate pressure-temperature conversion.

Filling gas in the air-conditioning system may be done only with a gas container and with a single pressure gauge and the manifold connected to the suction side of the compressor.

### 5. Discussion: **High pressure gauge (high side)**

The high pressure gauge is used to determine pressures in the high side of the system. The gauge is calibrated to register accurately from zero pressure to a minimum of 300 psi (~20 bar). A few systems operate under high head pressure during normal operation conditions. This is why the high pressure gauge should have a reading of at least 600 psi (~40 bar).

### 6. Discussion: **The refrigerant recycling device – emptying the cooling system**

**Note: For operation instructions, connection of the servicing and recycling device to the system, filling refrigerant into the system and recycling the refrigerant. Please refer to the Refrigerant servicing and recycling device manufacturers' instruction manual. Additionally, emptying the system may only be done with the gas recycling device. The gas must not be released into the atmosphere.**

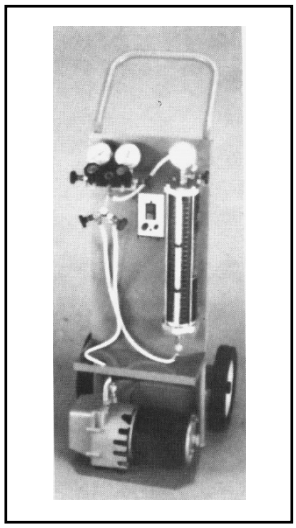

**Figure 1-36 Refrigerant Servicing and Recycling Station**

## 7. Discussion: Servicing and maintaining the air-conditioning system

**Note: Emptying the refrigerant from the cooling circuit and refilling it anew is always done through the low-pressure side.**

### Performing vacuum of the cooling system:

Step 1: Emptying the air-conditioning system is done before repairing it or for exercise.

It is not necessary to vacuum the system when we only want to add refrigerant.

Step 2: Connect the bottom hose of the manifold (blue) to the compressor service connection.

Step 3: Connect the left hose of the manifold (yellow) to the vacuum pump.

Step 4: Open the hand valve of the manifold gauge.

Step 5: Check the oil level of the vacuum pump through the sight glass, and add oil if necessary.

Step 6: Turn ON the vacuum pump and let it operate for about 15 minutes even after the low-pressure gauge indicates 30 mm of mercury.

Step 7: Close the manifold tap and turn the vacuum pump OFF.

Step 8: Continue to the next procedure immediately in order to prevent air penetration into the system.

### Refrigerant filling:

Step 9: Connect the bottom hose of the manifold (blue) to the compressor service connection.

Step 10: Connect the left hose of the manifold (yellow) to the refrigerant container.

Step 11: Open the refrigerant container valve one and a half turns, and open the yellow hose at its connection to the manifold a little, until you hear the gas release (for two seconds), and close it again. Open the left tap.

Step 12: Allow the refrigerant to charge the system until a pressure of about 3.0 bars is reached.

Step 13: Turn ON the trainer main switch.

Step 14: Activate the compressor in order to circulate the refrigerant through the system. Operating the system in STATE 20 (turns the system to TEV mode in order to rapidly remove the

bubbles from the sight glass. Let the system work while filling gas by opening the container tap until getting a full sight glass.

Step 15: Now close the refrigerant container valve and turn OFF the filling unit.

Step 16: Disconnect the hose from the compressor and block the service connection plug by the cork.

Step 17: The refrigerant filling procedure is now complete.

### 7.1. Maintaining the air-conditioning compressor:

Normally the air-conditioning compressor does not need special maintenance. In case a compressor produces unusual mechanical noises, it should be replaced.

**Please note: The compressor (as well the other components) on the trainer is not meant as removing or dismantling training. In case of a fault, please refer to the instructor.**

### 7.2. Cooling chamber maintenance:

Periodic preventive maintenance should be done on cooling systems. The following sub-systems should be checked:

- **Evaporator** – It is necessary to check if ice is forming on the evaporator, which will cause poor cooling in the cooling chamber. The possible factors for ice forming on the evaporator are inadequate seals such as dry rubber bands of the refrigerator's door, which do not seal completely. In systems with automatic defrost, this ice formation can indicate that the automatic defrost system is not functioning properly. In many refrigerators the freezer has its own door. The doorpost has a heater, which prevents moisture and/or ice from forming on it, which causes a poor seal of the door. If this heater does not work, moisture entry can cause ice forming on the evaporator.

- **Moisture or ice on the cooling chamber insulation** – The presence of moisture or ice inside the cooling chamber indicates hot air leakage from outside the cooling chamber coming in. When hot air enters the cooling chamber and comes in to contact with the cold air inside the cooling chamber, moisture is manifested in the cooling chamber side. This phenomenon causes the condensing unit to work longer than usual. An additional clue that shows a problem of this type is if the external surface of the cooling chamber is cooler to the touch than usual.

- **Noises** – Most noises are rattles. The noise source can come from:
  - Parts of the system which are not secured properly.
  - Piping which touches another part while vibrating.
  - The condensing unit tilts to one side because the cooling system was installed in an unbalanced way.
  - The motor or fan is vibrating.
  - The cooling unit's door is not secured properly.

In addition, the following systems and their function should be checked:

- Is there a cooling liquid leakage?
- Are there blockages in the capillary tube or in the filter's drier? It can be checked by looking through the eyepiece and making sure that there are no bubbles, which indicate shortage of cooling material or a blocked filter in the filter's drier.
- Is the compressor working properly?
- Oil leakage can be caused by cooling material leakage, which can cause oil leakage through it.

### 7.3. Adjustment of the thermostatic expansion valve:

Usually the thermostatic expansion valve comes already adjusted and there is no need to adjust it. The valve setting is determined by the amount of superheat in the refrigerant gas. Superheat is the temperature of the refrigerant gas, which is above the temperature given by the pressure and temperature chart for specific pressure. Most valves are set to 10°F superheat. The superheat determines the amount of liquid refrigerant mixed in the returned gas. Too little superheat will cause the liquid refrigerant to damage the compressor. Too much superheat will cause poor evaporator coil performance and compressor overheating.

An experiment or procedure to test for such adjustment is not included.