

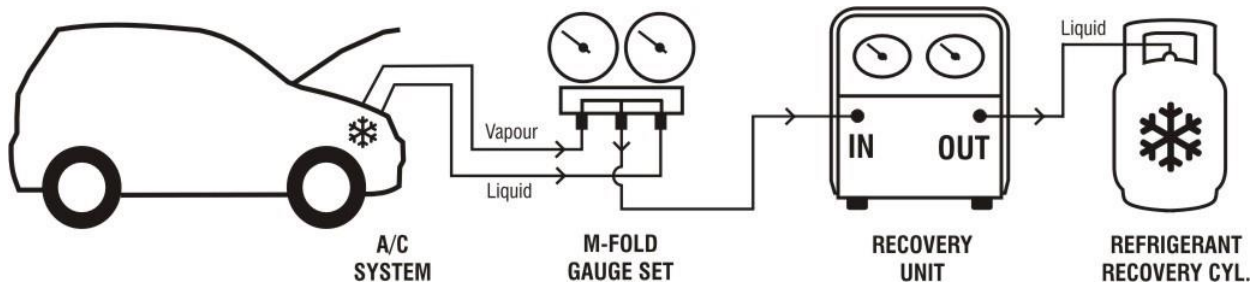
# UNIT -4 Servicing of vehicle air-conditioning systems

## A/C Service Equipment

All automotive A/C systems eventually require service. A typical A/C system needs recharging every three or four years as contamination in the system (water, incorrect oil, dirt, metal fragments, acids) can cause a wide variety of problems.

### Refrigerant Recovery & Recycling Equipment

The purpose of the Recovery & Recycling is to recover refrigerant from the air conditioning system, which will condense, purify and store the liquid refrigerant in the unit cylinder ready for re-use.



All refrigerant must be recovered from the vehicle's A/C system prior to opening the system for repairs. The refrigerant then **must be recycled** to meet certain purity standards.

The fact that R134a adds to the Global Warming Potential (also from a cost point), it is still mandatory that it be recovered and recycled.

#### What's Important:

- Use only approved Recovery and Recycling equipment (recovery units, cylinders and hoses).
- Change device filters when suggested by equipment manufacturer.
- A scale must be used to avoid overfilling the storage tank. Tank is full at 80% volume.
- Ensure oil collected during recovery is replaced into the A/C system with new oil.

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### Ariazone 601HD – Refrigerant Recovery & Recycling Unit

The Ariazone 601HD is lightweight **all in one** refrigerant **recovery & recycling** system for the on site mobile technician or small workshop operator. This system has been designed to be very user friendly and efficient for every user. Simply connect the Ariazone to the air conditioning system switch on and walk away. The 601 will take care to the rest.



The unit is designed to be:

- User friendly (fully automatically operation)
- Safe (built in high pressure and liquid control protection)
- Durable (compressor with thermal protection)
- Universal (recovers vapour or liquid)
- Simple maintenance (easy accessible filter)

Specifications:

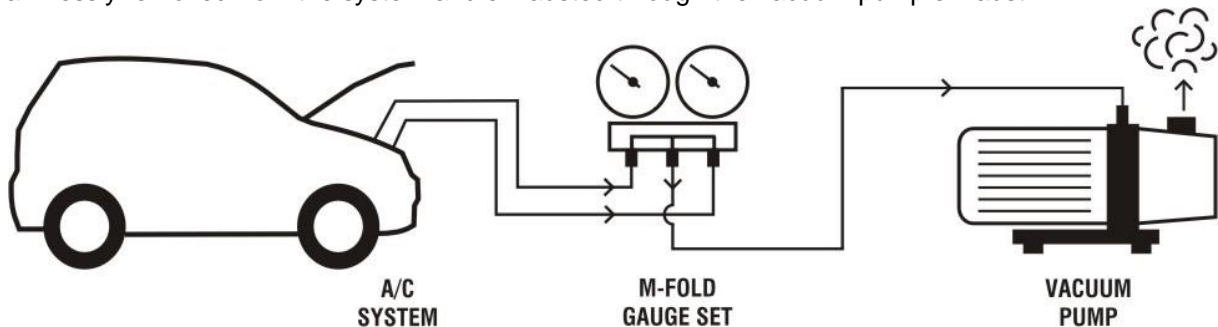
- Recovery Rate: 0.2kg/min (liquid state)
- Dimensions: 230mm x 380mm x 220mm; 18kg
- LP&HP gauges - AI-D 68-L mm kl.1.0
- High pressure protection 24bar
- Large filter dryer - AI FD162-1/4"
- Oil separator OS-100/76
- Easy start compressor against high block-pressure
- Chassis - Sturdy all steel construction powder coated.
- Supply voltage - 230V/50(60)Hz

## Evacuation Equipment

A single drop of water may look harmless, but to a refrigerant system, it is the number one enemy of the service technicians because moisture enters a system easily and is hard to remove.

- Moisture forms ice crystals at the expansion valve which retard or stop the flow of the refrigerant, causing loss of cooling. As the expansion valve warms, due to lack of refrigerant, the ice melts and passes through the expansion valve. The refrigerant will then start again until the moisture returns to the expansion valve and once more builds ice crystals. The result is intermittent cooling.
- Moisture mixed with refrigerant creates corrosion trouble.
- Some refrigerant oil attracts moisture and will absorb it rapidly if left open to the atmosphere. Water-formed acid mixes with refrigerant oil, forming a closely bonded mixture of fine globules. The effect is called "sludging" and greatly reduces the oil's lubrication ability.

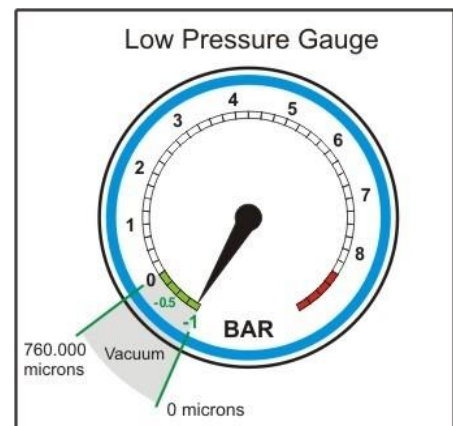
The most effective way to eliminate moisture from a system is with a good vacuum pump. The purpose of a vacuum pump is to remove moisture and air from an A/C system. Vacuum pump actually does not "suck out" the liquid moisture, but causes it to boil in to a vapour state which can be harmlessly removed from the system and exhausted through the vacuum pump exhaust.



Modern systems are built tighter and charges are more critical. That means these systems have a greater sensitivity to moisture and other contaminants, making thorough evacuation more important than ever before.

### What's Important:

- Use 2 (dual) stages vacuum pump only.
- Use 3/8" connection hoses between the pump and m-fold.
- Minimum capacity 2.5cfm (70lit/min)
- Change the vacuum pump oil every 30-40 working hours. Use only high quality vacuum pump oil.
- The lower number in microns, the better the pump.
- Dehumidification starts properly at levels of 1,000 microns (or less). The use of an electronic vacuum gauge clearly indicates whether the level is reached and whether it is maintained as well.



*Microns can be measured with special digital vacuum gauge only.*

## Ariazone Vacuum Pump (with solenoid valve and vacuum gauge)



Dual stage vacuum pump with solenoid valve and vacuum gauge, easy to carry due low weight. Very low noise levels make it a pleasure to operate.

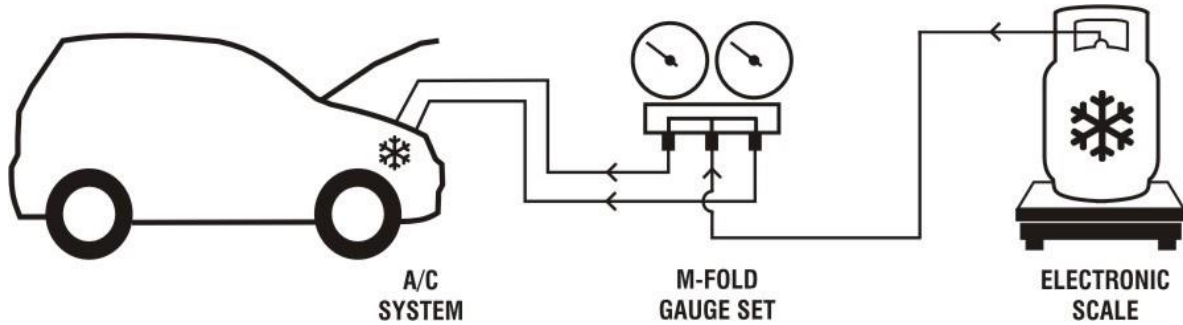
- Two stages
- Vacuum gauge D80mm with adjustable pointer
- Large solenoid valve
- 3x10Pa (25 microns) ultimate Vacuum
- 3.5 CFM (100 l/min)
- Finned alum. housing for lower operating temperature
- Motor 190 W (1/4 HP), Capacitor start,
- Intake fitting 3/8" & 1/4" SAE flare
- Oil capacity 300 ml
- Power supply - 230V / 50-60Hz

## Charging Equipment

The purpose of the refrigerant charge equipment is to batch a user-defined weight amount of refrigerant into the air-conditioning system. Charging correct amount of refrigerant will ensure the proper capacity and efficiency from air-conditioning system.

**Important:** Before start refrigerant charge A/C system MUST be properly evacuated and leak tested.

Charging by weight by using the digital refrigerant scales is the most accurate and fastest methods of charging a system that has a known refrigerant charge (manufacturer recommendation).

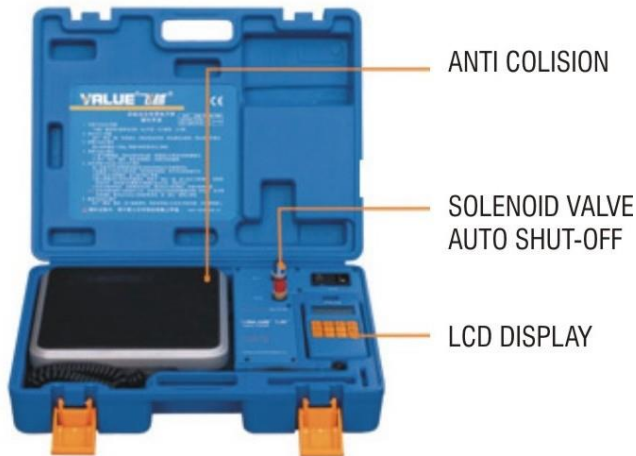


*What's Important:*

- Use only precise charging stations equipped with solenoid valve for automatic charge shut-off.
- 50kg minimum weight

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### Electronic scale with automatic charge shut-off



#### Specifications:

Weighing range: 50kg(110lb)  
Resolution: 2g/0.01lb/0.1oz  
Accuracy: 0.05%  
Display: LCD (7 segment)  
Power: 220V or 110V AC P  
Platform Size: 237x237mm  
Weight: 5kg

## All in One Unit – Automatic A/C Service Station

Rather than have a machine that only recovers refrigerant and then a vacuum pump and charging scale to complete the task of servicing an A/C system, there are all in one machines that incorporate all the necessary functions required to start and complete a full air conditioning system diagnosis and service, which can operate manual (step by step) or in fully automatic mode.

Basic functions of all in one unit include:

- A/C system test by reading the gauges
- Refrigerant Recovery & Recycling
- Recovered Oil Drain
- Evacuation of the system
- Oil & UV Dye Injection
- Refrigerant Charge by weight

Above basic, Full Automatic machines features:

- Automatic Oil Reintegration
- Vehicle Database
- Integrated Thermal Printer
- Refrigerant Management
- USB connection to PC

Last generation advanced machines also features:

- Flushing the A/C system with refrigerant
- Oil injection for electric compressors
- Diagnostic of a/c system failures
- Refrigerant analyzer
- Wireless temperature probes
- Wireless Bluetooth connection with PC
- Touch Screen



**1988**

**Ariazone 2002** was the first all in one machine, which was capable of carrying out all the necessary functions, for servicing automotive A/C systems, such as recovery, recycling, evacuation, oil injection and charging.

**1993**

**Ariazone 4001** was the first electronic fully automatic refrigerant processor worldwide, incorporating digital display, remote control and electronic oil injection.

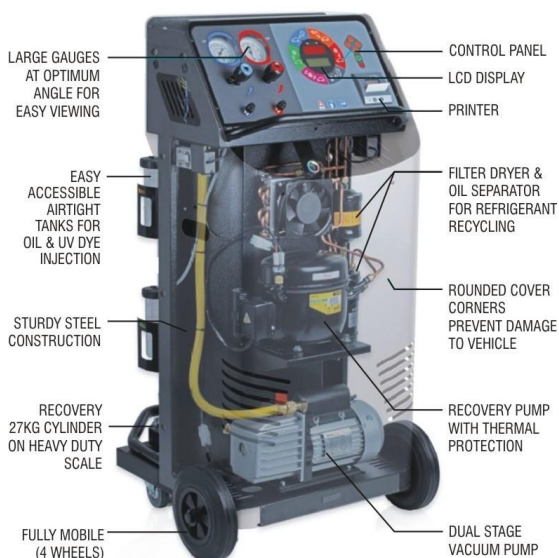


*What's Important:*

- The unit must be able to recover 95% of the refrigerant contained in the air con within 30 minutes.
- Refrigerant must be charged with an accuracy of +/- 15 g.
- Refrigerant recovery must be made and displayed with an accuracy of +/- 30 g.
- Dual stage vacuum pump minimum 2.5cfm (70lit/min) or larger.
- High efficiency filtration and oil separation system
- Regular maintenance of the unit (calibration, filter and vacuum pump oil change).

### Ariazone 5001 FAHD

*Full Automatic A/C Service station*



### Ariazone 6001

*Advanced Refrigerant Processor*



## A/C Flushing Equipment

When a compressor fails, a lot of metallic debris is often thrown into the system. Most of this debris collects in the condenser where it can cause blockages that reduce cooling performance. Debris can plug the orifice tube or expansion valve. This can block the flow of refrigerant and lubricating oil causing a loss of cooling and possible compressor damage. Flushing the system is the best way of removing residual oil and contaminants, when performing a compressor replacement.

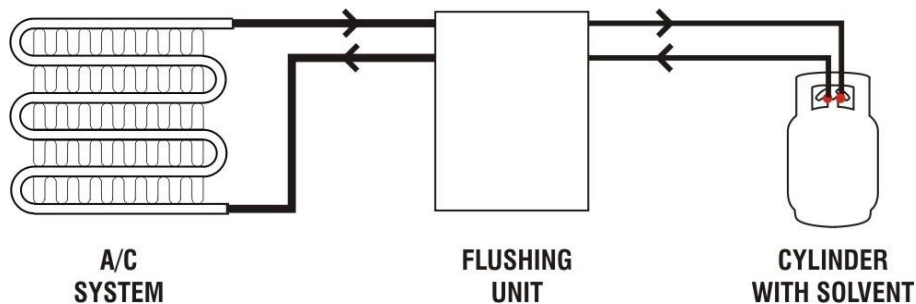
Flushing can help prevent repeat compressor failures and system blockages by dislodging and cleaning out sludge and debris. Replacing badly contaminated parts such as the condenser, accumulator or receiver-drier and orifice tube or expansion valve is another way to get rid of these contaminants, but flushing is usually more economical choice. Regardless of which approach you use, the orifice tube or expansion valve should always be replaced when contamination is found.

Sludge is usually the result of moisture-contamination. The blackish goo that results can damage the compressor and plug the orifice tube or expansion valve. The moisture-absorbing "desiccant" in the accumulator or receiver-drier is supposed to prevent this from happening. But the desiccant can only hold so much moisture. Once saturated, sludge begins to form

Another reason for flushing is to remove residual lubricating oil from the system.

The basic concept behind any flush job is to remove the oil and contaminants from the A/C system. In most cases, contaminants and debris will 'stick' to the oil. If you can remove all the oil, you will remove all the contamination.

Regardless of the type of A/C system you are flushing, never attempt to flush the compressor, accumulator or receiver drier. Orifice tube, filter drier and accumulator must be replaced.



Flushing unit works on the principle of pulsing operation during the cleaning process. The solvent is recovered within the machine and the purified solvent returned to the cylinder. This flushing procedure ensures effective and fast cleaning out of difficult contamination.

Using high-pressure, up to 8 bar, particles and soot are forcefully flushed out. A special pulsing operation applies additional abrasive degreasing action to remove soot and dirt from crevices and corners. Due to its low boiling point the solvent can easily be recovered from the equipment and leaves it dry and clean.



### Eko-Flush K570

Workshop units for use in larger service and repair shops, and automotive garages

This unit can conveniently be used for systems up to 20 L volume.

#### Specifications:

Connection with the flushed device 3/8" SAE (5/8" UNF)

Power supply: 230V/50Hz

Maximum power input: 1350W

Dimensions: 570x605x950mm

Weight: 54kg

## Leak Test & Detection Equipment

Leakage of refrigerant from a/c system affects the performance of a sealed system. Both suction as well as discharge pressures reduce due to loss of refrigerant. Due to lower suction pressures, the lubricating oil return becomes difficult. In addition to this possibility of oil leaking with refrigerant may lead to the damage of the compressor. If the suction pressure due to refrigerant leakage falls below atmospheric pressure, then there is a possibility of air leaking into the system. This will bring moisture into the system and cause internal components to corrode.

There are 2 main methods for leak test the a/c system:

**Leak Test under Vacuum.** When a vacuum is drawn (minimum 1000 microns or lower) on the system and the vacuum pump is then turned off, it is a good practice to allow the system to sit for about 20-30min with the gauges connected to monitor. If vacuum is lost during this time, it indicates a leak is present. Note that the vacuum test is not conclusive. System may have leaks under vacuum that do not appear under normal system pressure, and vice-versa. Still, it's not a good sign.

**Pressure Hold Leak Test.** The most reliable method for leak testing the automotive A/C system is using nitrogen. For a complete A/C system test, the system should be pressurized to 15bar (200 psi) with nitrogen. Allow the system to sit for at least 20-30 minutes. If there is no degradation in the pressures, the A/C system is free of leaks. Nitrogen MUST be used with care and caution, because it is packaged under extreme pressures as a bottled gas. Nitrogen regulator is required in order to regulate and control the pressures of nitrogen that you put into the A/C system. For best results, it is suggested that the nitrogen be connected to the A/C system through a set of manifold pressure gauges.

Nitrogen can also be used for purging excess moisture from A/C systems and for flushing. Nitrogen is known to be a very dry and inert gas. What's best is that nitrogen will not cause any other problems with components nor will it react with any oils or other contaminants that may be found in the A/C system.



Nitrogen Pressure Test Kit

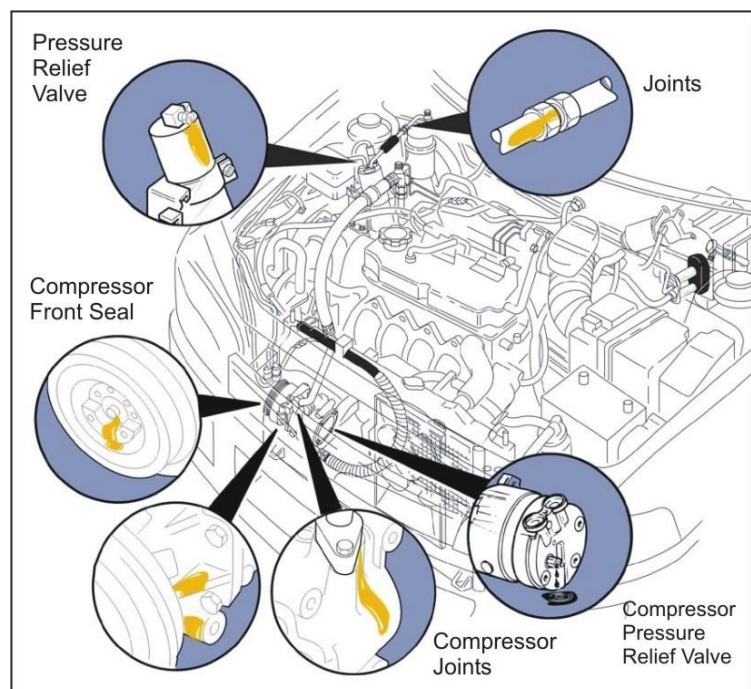
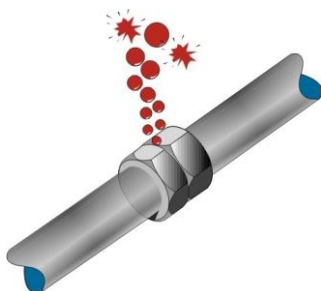
Both tests (under vacuum or pressure hold) will not show exactly where the leak is located. This type of check is only useful to verify whether the system has a leak or not.

## Leak Detection Methods Visual

### Leak Detection

When a refrigerant leak occurs, it is common in some cases for the lubricant oil to escape with the refrigerant. The presence of oil and encrusted dust around hose fittings, joints and components will indicate a leakage point.

A mixture of dishwashing liquid and water applied around the pressurised A/C system pipes and fittings will form bubbles at the leakage points.



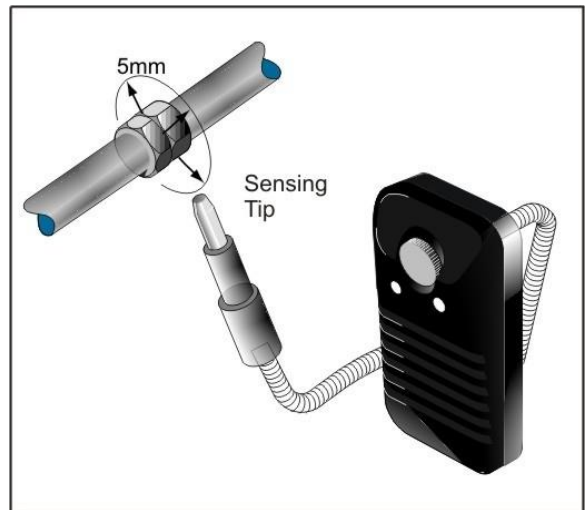
## Electronic Leak Detector

These leak detectors operate in various ways. The most common being that when the unit is turned on, a low ticking sound can be heard and once the probe locates a leak, the ticking sound increases to a high pitched noise. This can be achieved by moving the sensing tip slowly around the underside of components and fittings at a distance of approximately 5-10 mm.



Sensing Tip

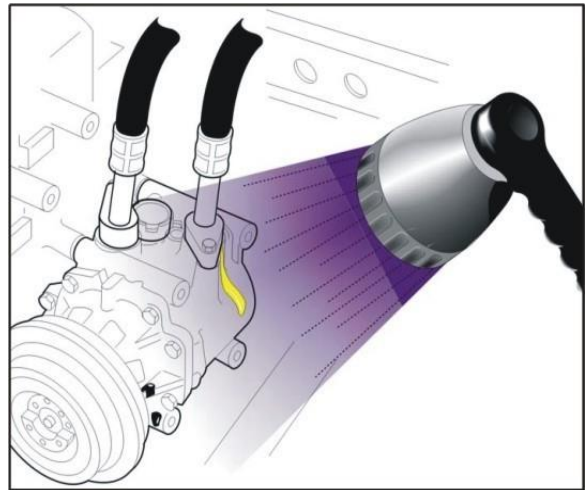
**Important:** DO NOT allow the sensing tip to contact components or fittings as false readings and tip damage will occur.



## Ultraviolet Fluorescent System

A fluorescent coloured dye is injected into the A/C system and allowed to circulate with refrigerant. Then a specially designed ultraviolet lamp is passed over each component in the A/C system. If a leak is evident, the coloured dye glows yellow bright. This method is exceptionally good for pin pointing a small leak.

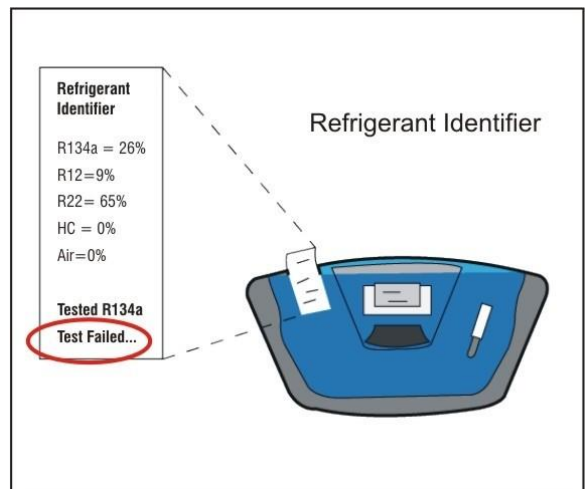
It is advisable to ask the customer to return in approximately one week time as the dye could take longer to emerge if the A/C system has a small leak.



## Refrigerant Identifier

The best defence against unknown refrigerant, and the risks associated with unknown refrigerant, is a refrigerant identifier. Use a refrigerant identifier any time a refrigerant mixture is suspected.

The main function of the refrigerant identifier is to assist the servicing technicians to check the purity of refrigerants in storage cylinders or directly in vehicle air conditioning systems. These devices typically detect R12, R134a, R22, air, and hydrocarbons. It also determines and controls the purging of ambient air-based Non Condensable gases (NCG) from refrigerant storage vessels or vehicle air conditioning systems.



## Other Measuring Instruments



### Mini R134a Identifier

Economy identifier for verifying the quality of R-134a refrigerants in automotive a/c systems. It checks and verifies with a “GO” or “NO GO” signal.



Digital Thermometer with probe



### Digital IR Thermometer

This can be used for measuring the temperature of registers and grills as well as ambient temperatures



### Electronic vacuum gauge

The instrument reads from vacuum levels of 12,000 micron to ... “0”, and may be used in ambient temperatures from 0°C to 50°C.



### Variable Displacement Compressor Tester

It controls the clutch-less variable compressors. By controlling the displacement (independent from the onboard computer) a more precise diagnosis can be made on the system.



### Pressure Switches Tester

Tester for checking gas pressure switches. Includes adapters for the most common gas pressure switch thread sizes.



### Digital refrigerant pressure/temperature chart

This instrument offers fast and accurate temperature references on a large and LCD display.



### Sound Level Meter

To quantify sound level.



### Electronic Scale

For weighing refrigerant cylinders



### Nitrogen / Hydrogen Tracer Gas Leak Detector

It utilizes a solid-state heated sensor designed to be highly sensitive to Nitrogen/Hydrogen tracer Gas. The tracer gas mixture complies with Article 6, Paragraph 3 of EU Directive 2006/40/EC.



## Universal Automotive A/C Tools



Universal Orifice tube remover kit

This set of tools makes it a snap to remove orifice tubes found in automotive air conditioning systems. Select the correct jaw, attach it to the handle and remove the tube by simply locking it onto the tool and pulling it out.



Fin Straightener

For alignment of condenser or evaporator fins.



Valve core remover

Valve core remover for standard & JRA valves.



Hose cutter

For cutting all common sizes of A/C hoses.



Sight glass a/c diagnose

Convenient instrument to make the refrigerant flow visible. This gives an indication about: Presence of leak "stop" substances, Compressor damage caused by metal particles and shavings, Quality of the refrigerant oil...



Compressor seal service set

Special tools are required when replacing seals on the compressor.



Clutch tool kit

Universal tool kit for assembly & disassembly of clutches on most used compressors.



Spring-lock tool kit

Spring-lock coupling disconnect tool for Ford, Hyundai, Volvo, Peugeot and Citroen.



Hose Crimping Equipment

Covers all 4 standard hose dimensions.



Thread chaser kit

To re-align damaged threads on A/C specific fittings. Thread chaser kit with various chaser sizes for making female and male thread like new again.

## Universal A/C Assortments



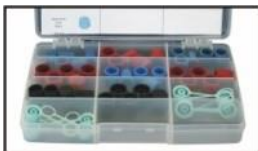
O-ring assortment  
Universal HNBR O-ring kit for a/c systems.



Valve core set  
7 different valve core and 1 small valve core remover.



Orifice tube assortment



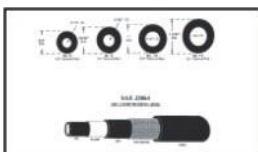
**Valve cap assortment**  
10 different valve caps.



GM seal & gasket assortment  
An assortment of hose gaskets for GM com-pressors. Six different types, four of each type.



Hose Ferrule set  
Assortment of replacement crimp sockets in the standard hose sizes 6, 8, 10, and 12.



Standard A/C Hose  
Hose size 6, 8, 10, 12 per meter.



Compressor Guard Assortment  
New or reconditioned compressors are regularly damaged by metal shavings or dirt particles left in an air conditioning system. A simple screen in the suction line of the new compressor can prevent this from happening. Easy to install without cutting lines.



Foam Tape  
Used for the protection and insulation of various air conditioning parts.

## Compressor Oil





The purpose of compressor oil is to provide lubrication for the compressor. It helps compressors to last longer by providing enough grease that inhibits friction between the bearings, vanes, and rotor. Manufacturer of the vehicles or compressors determines the viscosity and lubricant type. Use of the correct lubricants is critical for proper system performance, durability, and longevity.

There are four major a/c compressor oils in the market today and these are:

- **Mineral oil** used in old R12 systems only.
- **PAG oil (Poly-alkaline-glycol)** used in original equipment passenger car and light truck HFC-134a systems.
- **POE oil (Poly-ol-ester or Ester for short)** is synthetic lubricant specified by few vehicle manufacturers.
- **PAO oil (Poly-alpha-olefin)** is synthetic oil. It is new in the market and slowly becoming popular. Its trademark is "one size fits all", because its viscosity level is compatible with almost all types of a/c system oils and additives, as well as with most compressors.

There are few viscosities or thicknesses of compressor oil: ISO 46, ISO 68, ISO 100, ISO 150. The smaller number indicates less viscous oil.

***Important:*** Most A/C compressors used in Hybrid or Electrical vehicles are driven by a high voltage electric motor. Only the non-conductive lubricating oil (POE or PAO) can be used as the windings in these electric motors are exposed to the A/C system lubricating oil. Even a small amount of PAG oil can damage the high voltage insulation in an electric compressor.

MINERAL oil	PAG oil (Poly-alkaline-glycol)	POE oil (Poly-ol-ester or ester)	PAO oil (Poly-alpha-olefin)
			
R12 - Compatible R134 - NON Compatible	R12 – NON Compatible R134 - Compatible	R12 - Compatible R134 - Compatible	R12 - Compatible R134 - Compatible
Hygroscopic	Hygroscopic	Hygroscopic	NON Hygroscopic
NON COMPATIBLE with other lubricants	NON COMPATIBLE with other lubricants	NON COMPATIBLE with other lubricants	COMPATIBLE with other lubricants
MISCIBLE May not prevent oil logging	MISCIBLE May not prevent oil logging	MISCIBLE May not prevent oil logging	LOW MISCIBILITY Prevents oil logging
POOR High Temperature Viscosity Properties	FAIR High Temperature Viscosity Properties	FAIR High Temperature Viscosity Properties	SUPERIOR High Temperature Viscosity Properties
NON AGGRESSIVE	AGGRESIVE	AGGRESIVE	NON AGGRESSIVE
Electric Compressors NON Compatible	Electric Compressors NON Compatible	Electric Compressors Compatible	Electric Compressors Compatible

## Component replacement

When replacing components, check the manufacturers recommendations on the quantity of oil to be added to the new components before installation. This is normally found in the particular vehicle workshop manual.

EXAMPLES of approximate quantities:

Evaporator – 40ml  
Filter drier – 20ml  
Condenser – 30ml  
Accumulator – 40ml  
Hoses – 20 ml  
Tubes – 20ml

Insufficient oil in the system will damage the compressor due to lack of lubrication, but excess oil will collect in the condenser and prevent proper cooling performance.

If the compressor sounds as though it needs lubricating, it probably does. Check the system for debris, and replace the compressor if needed.

If cooling performance is poor despite several recent repairs, the system may contain excess lubricant, especially if oil was added to the system without draining and measuring all the oil.

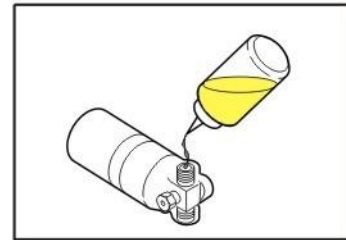
## Compressor (new replacement)

Drain and measure the lubricating oil from removed compressor. Likewise, remove the oil from the new compressor, refill this new compressor with the same quantity of oil drained from the old compressor.

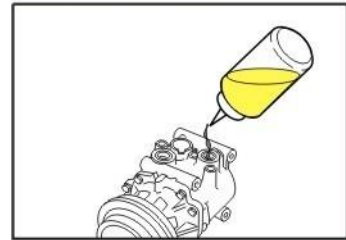
On compressors without inspection plugs, add oil to compressor through the discharge and suction ports, **turn the compressor hub several times by hand to make sure no oil is trapped in the compressor chambers.**

Use the new clean oil removed from the new compressor plus 10cc to allow for any internal oil.

**Receiver Drier -20ml**



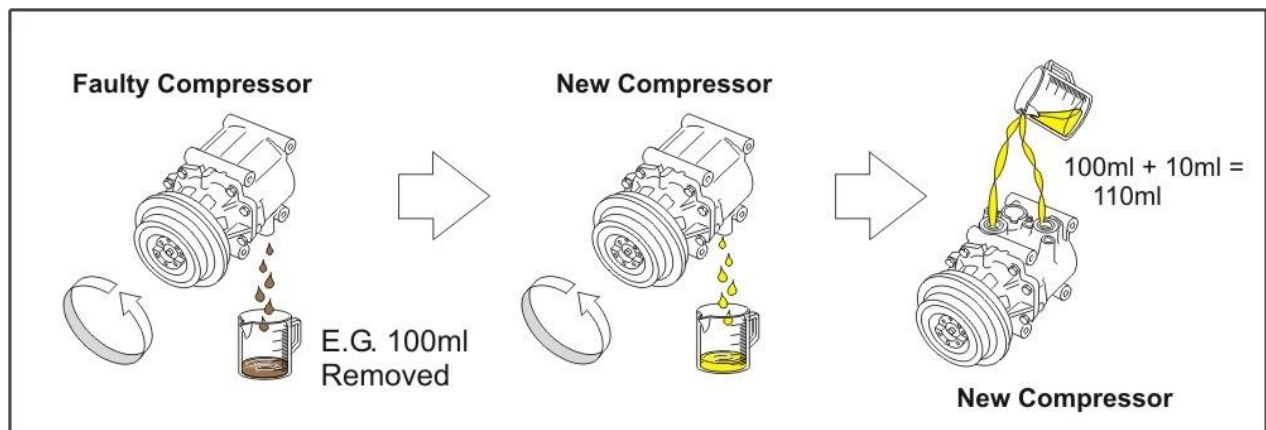
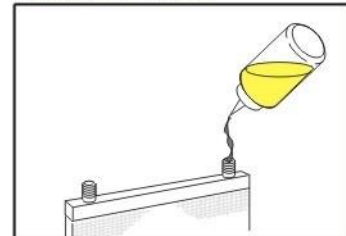
**Compressor - 10ml**



**Hoses - 30ml**



**Condenser - 30ml**



## Refrigerant Safety

As R134a has a very low boiling point, care must be taken when it is been handled. The following safety precautions must be followed:

- Always wear eye protection.



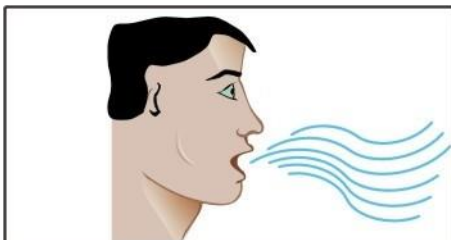
- Wear gloves for Hand/Skin Protection. Don't allow R134a to contact bare skin as this causes frostbites.



- Do not expose refrigerant containers to open flames, red hot surfaces, or temperature above of 50°C.



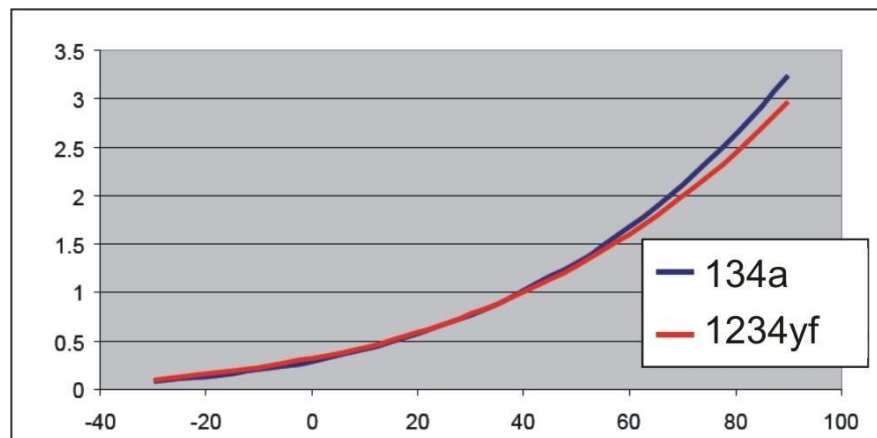
- Provide adequate ventilation when charging or recovering refrigerant as it is heavier than air. Avoid breathing R134a vapour.



- Use care when hot water steam cleaning the engine. Hot water on the air conditioning pipes and tubes could create thermal expansion of the refrigerant contained in the system.
- Do not transfer refrigerant from cylinder to cylinder using a pump without knowing when the bottle being filled has reached 80% of its capacity, as a remaining 20% is used for thermal expansion.
- Do not transport refrigerant containers in the passenger compartment of a vehicle.
- Do not puncture or incinerate refrigerant containers.

## R134a – HFO 1234yf Handling and Service Differences

Starting in 2012 vehicles with air conditioning systems running on the new 1234yf refrigerant will enter the European market. However, the great majority of vehicles on the roads will still be using the older R-134a refrigerant – and these will continue to require servicing for the next 15 years or so.



*HFO-1234yf has vapour pressure, toxicity class A, similar to R-134a, but has mild flammability*

HFO1234yf is mildly flammable. Precautions used with other flammables (gasoline, oil) are applicable to 1234yf. In general, low lying areas, (such as workshop pits, shafts or cellar exits), may cause released refrigerant to pool as it is heavier than air. Current regulations require work areas to be adequately ventilated and extraction units switched on if available.

Service technicians should not smoke or have any open flame present while working on refrigerant containing systems



**R134a**  
**Light blue cylinder**

Both disposable and returnable containers available.



**HFO 1234yf**  
**White cylinder with red band**

Both disposable and returnable containers available.

*Refrigerants should always be stored in a cool, dry location, out of direct sun light.*

To prepare for HFO1234yf service technicians will need:

- New 1234yf recovery/recycle/recharge equipment
- New refrigerant identifier to allow the workshop to monitor the type, quality and purity of a given refrigerant.
- New leak detection equipment capable of identifying leaks of the new refrigerant in the vehicle's air con system.
- Assure adequate ventilation and follow flammable storage practices.
- Appropriate technician training

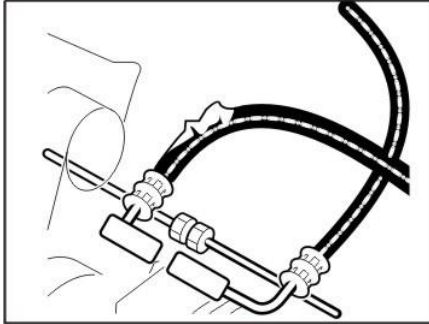
HFO1234yf refrigerant system components should not be replaced with ones removed from a system that uses another type of refrigerant, or from a salvaged vehicle.

Lubricants used with HFO1234yf systems may be different than those currently used. hybrid compressors, driven by high voltage electric motors, or equipped with hermetic mobile A/C systems, use different oils. Necessary to check oil requirements.

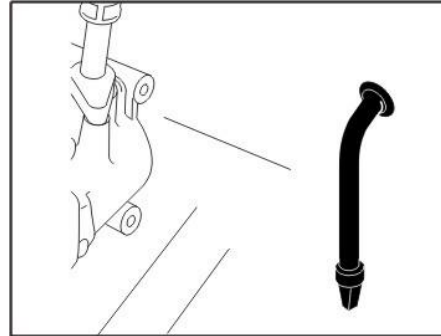
## Air Conditioning Performance Testing (General)

This procedure describes methods for testing and inspecting air conditioning systems. Before servicing or diagnosing an A/C system there are preliminary checks that should take place.

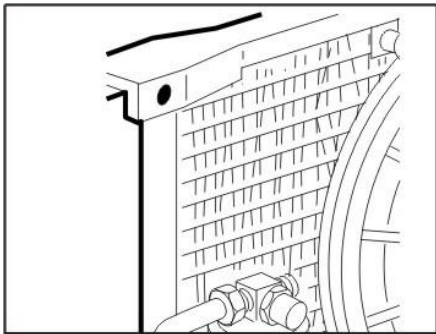
**STEP 1.** Park the vehicle in a shaded area. Open the vehicle doors or windows to vent the interior. Record the ambient temperature and relative humidity.



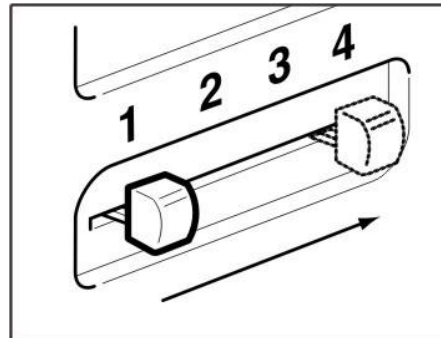
**STEP 2.** Visual checking for hose damage. Inspect all connectors for signs of leakage or oil. Look for kinks, bends, or weather cracking.



**STEP 3.** Visual checking for damage on compressor housing. Inspect drive belts for correct tension and damage. Evaporator drain hose not blocked.



**STEP 4.** Ensure the condenser cooling fins are not blocked with obstructions such as insects, leaves or grass. Condenser fan operates and runs in correct direction.



**STEP 5.** Set the controls to:  
Fresh air position;  
Maximum cooling;  
Highest blower speed;

**STEP 6.** Place a thermometer in the air outlet nearest the center of the dash for record of discharge air temperature.

**STEP 7.** Connect both high and low pressure service hose coupling valves of service unit to the system filling ports.

**STEP 8.** Set the transmission in neutral and start engine. Turn the A/C on and bring engine speed to 1500 RPM then allow pressure gauge needles to stabilize.

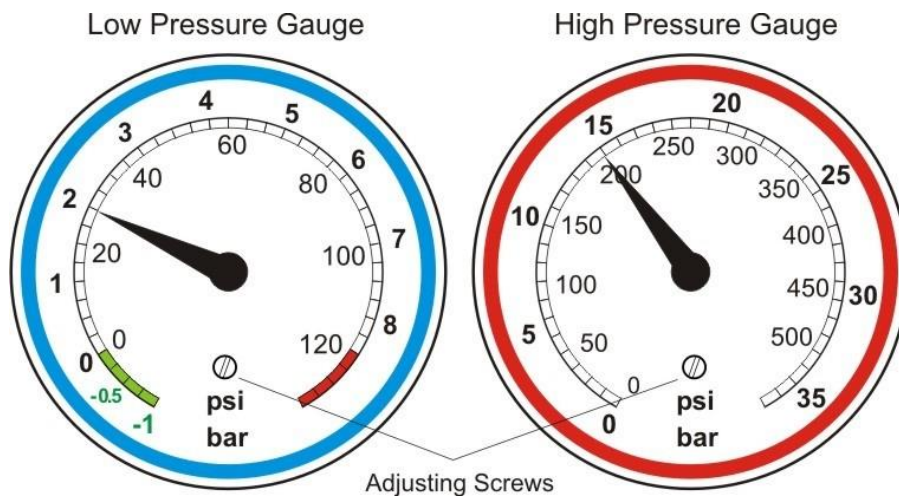
**STEP 9.** Record the pressure and temperature readings. Compare this to the performance charts. Note: Take pressure and temperature readings when the compressor is engaged.

Ambient temperature (°C)	Discharge air temperature °C	Low Side Pressure (bar)	High Side Pressure (bar)
20	4-10	1.6 – 2.2	10 – 13
25	5-12	1.7 – 2.4	11 – 15
30	6-13	1.8 – 2.6	12 – 17
35	8-14	1.9 - 2.8	13 – 19

If the system performance is less than described on the performance chart, make necessary repairs, perform the leak test.

## Pressure gauges

An accurate diagnosis and determination of air conditioning system function and more importantly, malfunction, depend largely upon the ability of the technician to interpret gauge pressure reading. The importance of a gauge set is often compared to that of a doctor's stethoscope.



An improper gauge reading will relate to a specific problem. More than one problem may be associated with particular gauge reading, however. A system operating normally will have a low-side gauge pressure reading that corresponds with the temperature of the liquid refrigerant as it becomes a vapor while removing heat from the air flowing over the evaporator coil surface. The high-side gauge readings should correspond with the temperature of the vapor as it becomes a liquid while giving up its heat to the ambient air flowing through the condenser.

Any deviation from ambient dependant normal gauge readings, other than slight, indicates a malfunction. This malfunction, if within the system, may be caused by a faulty control device, a restriction, or defective component. It should be noted that improper mounting or location of components in a newly installed system may affect system performance. The vehicle engine may also affect system performance and will be note as abnormal gauge readings.

### Pressure gauge pre check

Always inspect pressure gauges to ensure the needles rest as zero on both low and high sides on atmospheric pressure. If the needle(s) do not rest on zero, remove the hoses, open both taps, detach the dial face and gently turn the adjustable screw until the needle(s) rest on zero. Reconnect hoses and close taps.

### Pressure gauge readings in normal condition



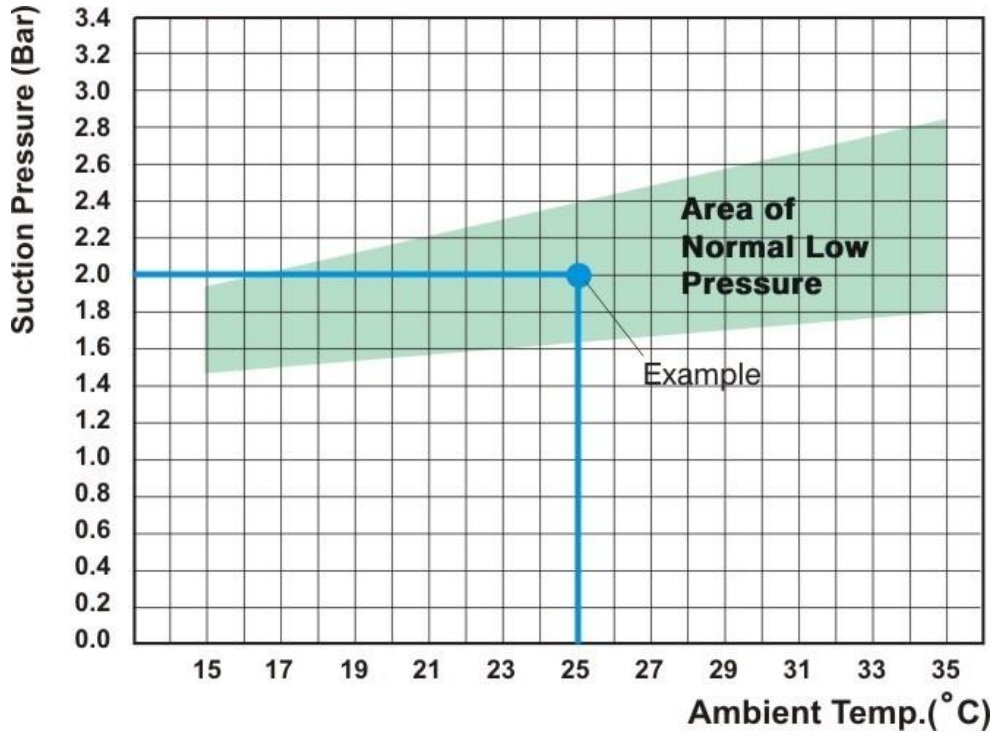
Gauges show normal operation of A/C system.

If the pressure readings to the ambient temperatures are different to these, then the system is probably defective.

**Important: Pressure gauge readings (low & high) depends on ambient temperature.**



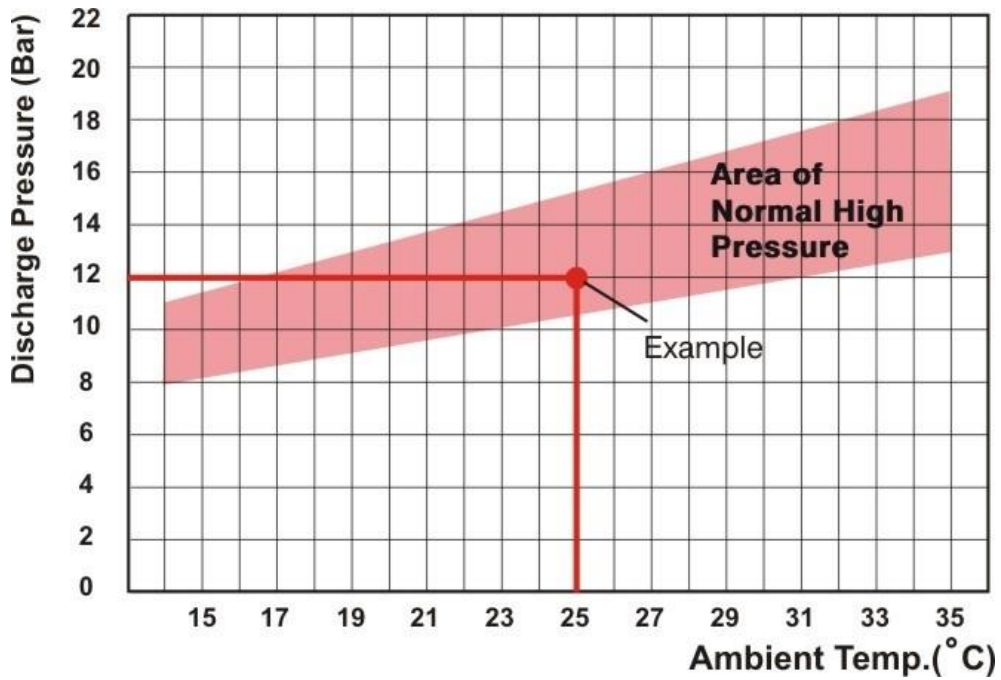
### 1. Low Pressure (Suction) vs. Ambient Temperature



Example:

The outside temperature is 25 °C. The suction pressure we have measured is 2 Bar (30psi). The graph shows that the point is in the area of normal pressure.

### 2. High Pressure (Discharge) vs. Ambient Temperature



Example:

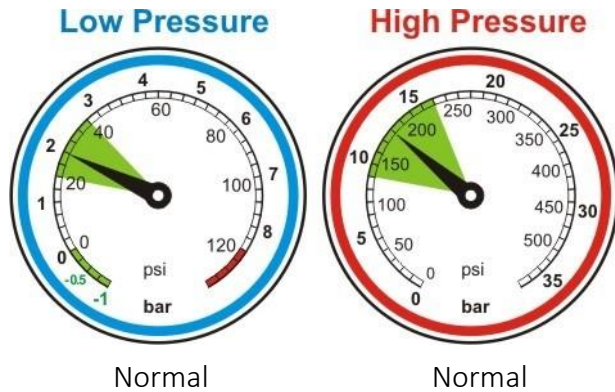
The outside temperature is 25 °C. The discharge pressure we have measured is 12 Bar (170psi). The graph shows that the point is in the area of normal pressure.

## Faulty performance of A/C system

As we have mentioned before, correct pressure gauges reading may show particular problem or associate to a possible problems.

Note: (F) fixed displacement compressor, (V) variable displacement compressor

### Pressure readings are normal, A/C system is not cooling.



#### Probable Causes

- Warm air infiltrated into the evaporating unit or passenger compartment.
- Warm water infiltrated in the heater.
- Ice on evaporator core.

An A/C system that blows cold air for awhile then warm air is probably freezing up. This can be caused by air and moisture in the system that allows ice to form and block the orifice tube.

### Low Pressure - Low, High Pressure - low



#### Probable Causes

- Normal situation if ambient temp. is very low.
- Too little refrigerant quantity. Check for leaks.
- Expansion valve (or orifice tube) stuck partially closed or blocked.
- Blockage between filter and evaporator.
- Blockage in the H.P. branch between compressor and condenser-filter hose, but before the H.P. reading point.

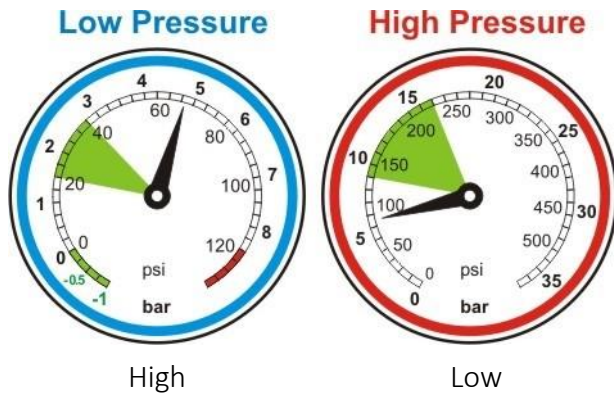
### Low Pressure - High, High Pressure - High



#### Probable Causes

- Normal situation if ambient temp. is very high.
- Excess refrigerant charge, 30% more.
- Condenser overheated. Faulty condenser fan (slow or no rotation).
- Air present in the A/C system. More than 6% air can cause a big drop in cooling performance.
- (V) Compressor displacement regulator valve defective.
- Blockage in the H.P. branch between compressor and condenser filter hose, but after the H.P. reading point.

**Low Pressure - High, High Pressure – Low (Low Press. approximately equal to High Press)**



**Probable Causes**

- Electric clutch of the compressor not engaged. If the voltage to the clutch is low, or the clutch coils have too much resistance, the clutch may not engage to drive the compressor. Also check to see if the clutch relay is receiving voltage when the A/C is turned on.
- Compressor belt jumped. Probably caused by misalignment of the pulleys.
- Compressor damaged.
- (V) Compressor displacement regulator valve defective.

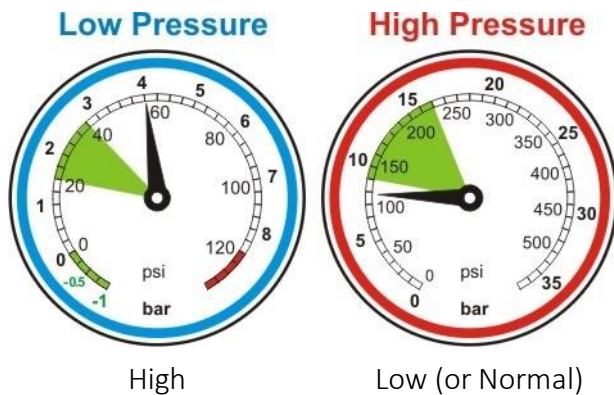
Manual A/C systems.

- Faulty low pressure cut-out switch. This switch prevents the compressor from running if the refrigerant level is low.

Automatic A/C systems.

- Problem in the control module, or bad sensor (an ambient air temperature sensor, interior air temperature sensor, evaporator temperature sensor, or sun-load sensor).

**Low Pressure - High, High Pressure – Low or Normal**



**Probable Causes**

- Suction and drainage hoses reversed on compressor.
- Electric clutch of the compressor not engaged.
- Expansion valve stuck open. If the compressor is “variable displacement type”, the low pressure has small but fast oscillations.
- (V) Compressor displacement regulator valve incorrectly set or defective
- Compressor damaged

**Low Pressure - Low, High Pressure – High or Normal**



**Probable Causes**

- Filter saturated with moisture
- (V) Compressor displacement regulator valve stuck at maximum displacement.
- (F) Blockage in H.P. or L.P. branch between filter and evaporator.

