TECHNICAL SERVICE INFORMATION

Subject	**R-134a Refrigerant Circuit Evacuation - Guidelines for Valeo Small Bus Applications**	Bulletin #2 Revision #0
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IMPORTANT NOTE!

This document describes the recommended procedures for evacuating a refrigerant circuit prior to adding refrigerant or refrigerant oil to Valeo **AC products using R-134a refrigerant**. Some of the information provided herein may not be suitable for evacuating refrigerant circuits within Large products like Valeo Rear Mount and some Rooftop products.

These guidelines may differ from those guidelines for Large bus products because of refrigerant type, compressor construction and service application. **Please read and follow carefully.** Questions should be directed to the Valeo Service team by telephoning 1-800-462-6322

Recent Valeo research has revealed that refrigerant compressors often fail because of improper refrigerant circuit evacuation. In fact, 100 percent of returned compressors showed signs of moisture within the circuit. This objective evidence alone highlights the fact that refrigerant circuit evacuation is poorly understood and poorly practiced in bus applications. Every refrigerant circuit should be evacuated with a vacuum pump after system installation and after any service activity that requires the circuit to be opened. Whether the service activity is large or small, completed quickly or takes hours to finish, an evacuation should be done before charging the system and returning the bus to operation.

It should be noted that the Valeo **31000001F Operation and Service Manual** already published and distributed by Valeo contain full installation and service information for Split System applications. These documents can be viewed by registered Valeo Dealers. Skilled AC Technicians are aware of the contents of these publications and consistently practice the proper procedures at all times.

The whole idea behind refrigerant circuit evacuation is two fold. First, a proper evacuation will identify the presence of leaks, both large and small, in the refrigerant circuit. If a leak is present, a properly administered evacuation process will detect it. Second, a proper evacuation removes gases and moisture from the circuit so that, when charged with refrigerant, only refrigerant and oil are present within the system. Any water or air remaining within the circuit compromises cooling efficiency and reduces system reliability.

Water vapor is everywhere in the air around us, and so it is easy to realize that moisture will enter open, uncapped refrigerant hoses and components right along with the air. Even the best AC Technician cannot prevent air and moisture from entering. And it only takes a second to happen. The problem is that this same moisture, even in tiny amounts, can corrode refrigerant components to the point of failure,

particularly components experiencing high temperatures and pressures. But since air and moisture are everywhere around us and are bound to get into hoses, compressors, coils and valves no matter how good we are, the only defense is to thoroughly remove it from the circuit before charging with refrigerant.

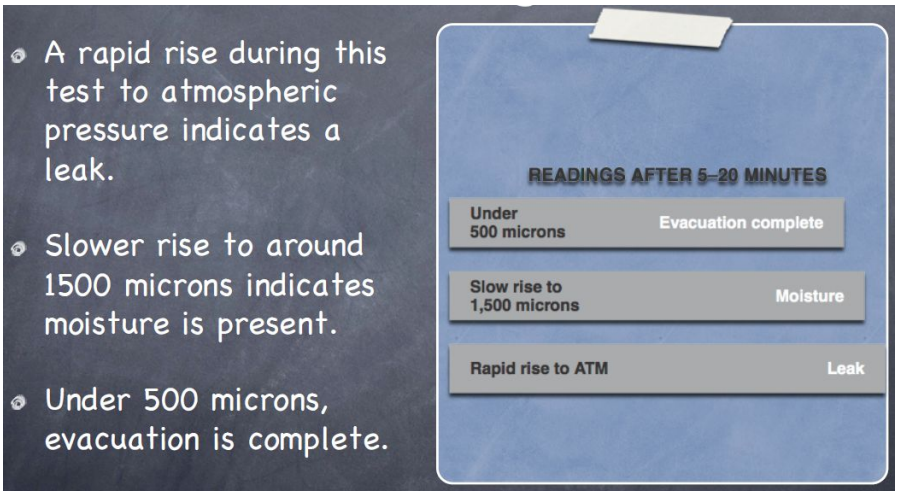
For small bus refrigerant circuits employing an automotive-style compressor (i.e. Seltec, Zexel, Valeo TM15, TM16, TM21, TM31, TM43, TM55, TM65, Sanden SD-7, Electrical Scroll, QUE QP16/21, Emerson Scroll, Panasonic Scroll or Valeo EDC electrical Scroll) the evacuation process can be summarized:

1. Evacuate the circuit to **500 microns**
2. Isolate the vacuum pump from the refrigerant circuit and **wait 5 minutes**
3. Read the micron gauge again to verify that the pressure did **not rise more than 500 microns** within that 5-minute timeframe

If the micron gauge rises more than 500 microns (to exceed a gauge reading of 500 + 500 = 1000 microns) at the end of the 5 minutes, either a leak is present or an unacceptable level of moisture remains in the circuit and **the bus should NOT be released for operation**. If the gauge reads a gain of less than 500 microns during the 5-minute wait, the circuit is acceptably tight and dry.

CAUTION!

Do NOT evacuate a circuit employing an open drive compressor like: Carrier / Carlyle 05G or 05K, Bitzer, Bock or any lower than 500 microns as described in Step 1 above or shaft seal damage may result. This Service Bulletin describes the evacuation process for circuits employing automotive-style compressors installed in Bus applications only.



Interpreting the reading

What is a "micron"?

The "micron" is a metric unit of measure for distance. It equals 1/1,000,000 of a meter. Technicians have historically measured pressures within an AC circuit in "inches of Hg" and it follows that the metric unit of meters could also be used. Unfortunately, the pressures needed to properly remove moisture from an AC system are so low that these units of inches and meters are simply too large for practical use. An experienced AC technician would not measure the length of a bolt in miles just as, for bus AC evacuation, the technician would not measure negative pressure in inches of Hg.

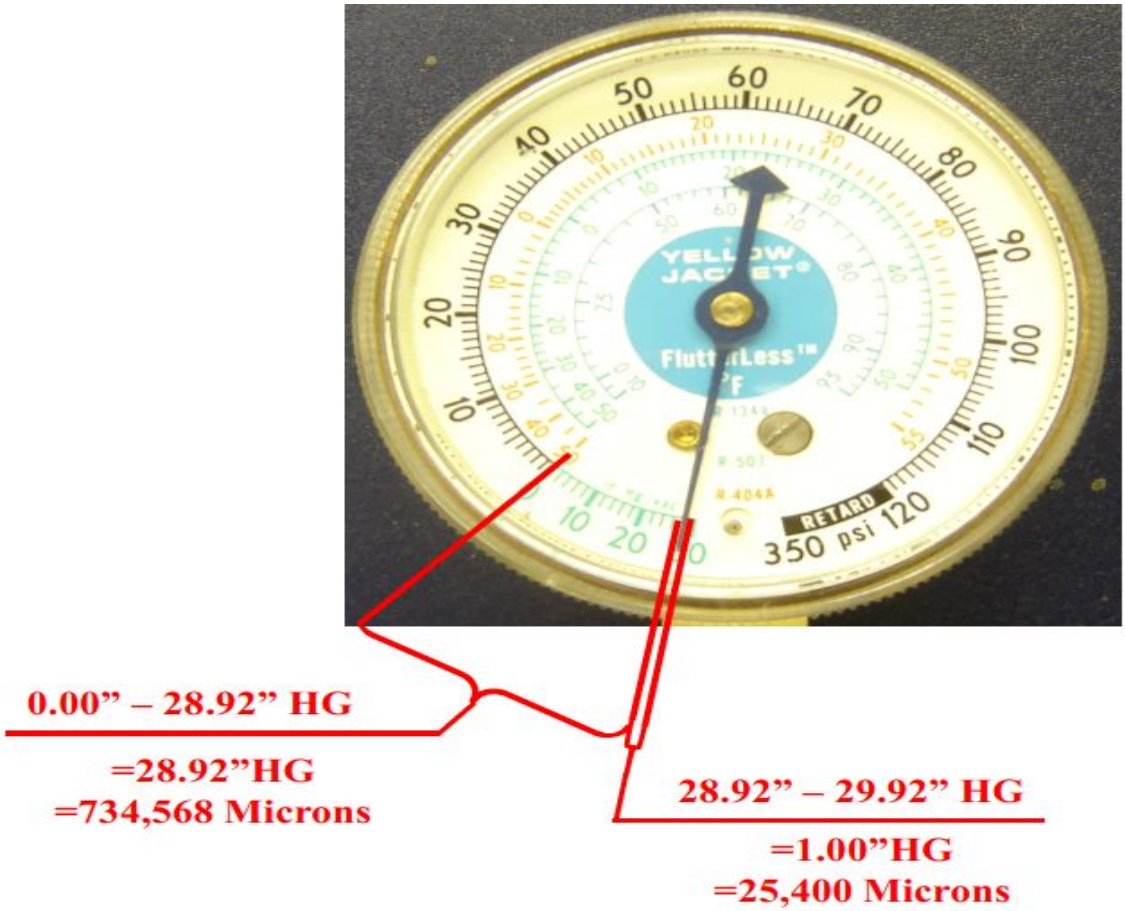
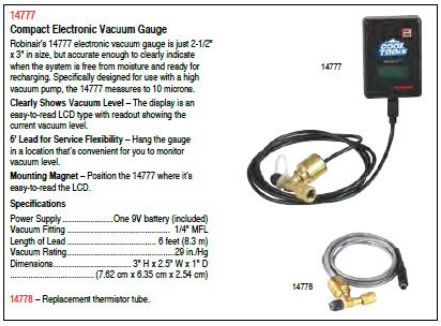


Figure 1: A <u>refrigeration manifold</u> or refrigerant reclaim machine <u>gauge is not suitable for measuring fine evacuation pressures</u> as a single tick mark on the "inches of Hg" vacuum scale represents 1 inches of Hg, or 25,400 microns. Given that kind of resolution, a rise of <u>500 microns will never be detected!</u>

What tool should be used to measure vacuum pressure for Bus AC service activities?

Every evacuation performed on a Bus AC system should employ a micron gauge to measure negative pressure. These gauges come in various configurations and price ranges. Most have digital displays today. For Bus AC evacuation, the gauge should measure vacuum down to at least 250 microns and display that measurement in increments of 200 or 250 microns on the face of the gauge. For example, many of the inexpensive gauges may only measure as low as 1000 or 1500 microns. Those gauges are unsuitable for use in measuring a vacuum on a Bus AC system because they do not measure low enough; Other gauges might measure down to 250 microns but the digital display jumps from 250 to 1000 microns with no resolution, or readouts, between those two values. Don't waste your money purchasing ineffective gauges! Lastly, good micron gauges display the pressure in numbers rather than green and red LED's. Good Technicians should know what the pressure is inside the circuit rather than relying on the Micron gauge or Vacuum gauge to interpret the pressure at a predetermined level and signal acceptability with a light. Who knows what the trip point for the LED is? Pass on those models, too.

The micron / vacuum gauge illustrated in **Figure 2** is a relatively inexpensive but acceptable micron gauge for Bus AC evacuation. This gauge can be obtained through Robin Air by internet


14777

Compact Electronic Vacuum Gauge

Robinair's 14777 electronic vacuum gauge is just 2-1/2" x 3" in size, but accurate enough to clearly indicate when the system is free from moisture and ready for recharging. Specifically designed for use with a high vacuum pump, the 14777 measures to 10 microns.

Clearly Shows Vacuum Level – The display is an easy-to-read LCD type with readout showing the current vacuum level.

6' Lead for Service Flexibility – Hang the gauge in a location that's convenient for you to monitor vacuum level.

Mounting Magnet – Position the 14777 where it's easy-to-read the LCD.

Specifications

Power Supply .....One 9V battery (included)
Vacuum Fitting ..... 1/4" MFL
Length of Lead ..... 6 feet (8.3 m)
Vacuum Rating.....29 in./Hg
Dimensions..... 3" H x 2.5" W x 1" D
.....(7.62 cm x 6.35 cm x 2.54 cm)

14778 – Replacement thermistor tube.

Figure 2: An example of a digital output vacuum gauge. The technician should select a micron gauge sensitive enough to respond in unit increments necessary to do the job properly.

Figure 3: Other excellent micron / vacuum gauges for use in Bus AC evacuations. Note: It is important that the Vacuum hose can be of ⅝" diameter**.**

IMPORTANT!

Always replace the discharge screen filter, Suction accumulator and filter drier (if it is present) after opening the refrigerant circuit for service!

Always Add a filter drier with sight-glass in the liquid hose (preferently it is suggested to install it closest to the condenser liquid outlet). If the compressor was replaced or after an AC flushing process. The Suction accumulator Must be replaced too just prior to closing the circuit for evacuation and charging.

Proper vacuum pump selection

A vacuum pump does not have to be large to do a good job. In fact, a small vacuum pump is less likely than a large vacuum pump to overshoot the 500-micron evacuation target. **A 6 or 8 CFM (cubic feet per minute) pump is/are an ideal size for drawing an evacuation on a Bus AC system**. A smaller pump will simply take a little more time to perform the task while a larger pump will do it a little quicker but be more difficult to control. The pump available within a refrigerant reclaim system is typically of a 6 or 8 CFM size **(Figure 4)** so that works great, too. A suitable pump can be purchased through Robin Air, Yellow Jacket, etc internet

Figure 4: Example of Vacuum Pump 6 & 8 CFM

The vacuum pump oil itself serves not only to lubricate the pump but also to create a seal between pump components so that a deep vacuum can be drawn. Experienced AC Technicians recognize that vacuum pump oil naturally becomes contaminated with moisture through normal and proper use of the pump. Oil contamination is unavoidable. Vacuum pump oil that becomes contaminated with moisture or other gases and liquids can no longer provide the seal necessary to draw a vacuum into the 500-micron range so it becomes necessary to replace the oil within the pump frequently. Experience tells us that moisture accumulates within the pump oil rather quickly so **Valeo recommends changing the pump oil every 15 to 17 coaches serviced.** If the circuits being serviced contain significant moisture accumulated during a previous installation or service activity, the pump oil may have to be changed even more frequently! If the pump cannot draw a vacuum to 500 microns, change the pump oil and try again.

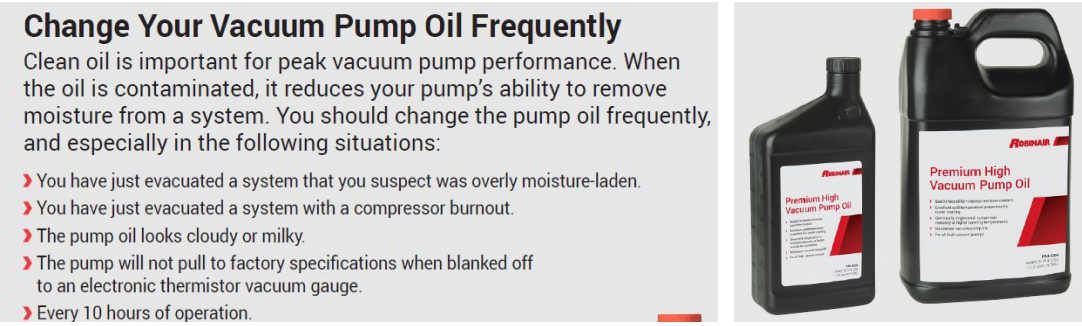


Figure 5: Examples of Vacuum Oil

Some vacuum pumps are outfitted with a "gas ballast" valve (**Figure 6)**. The gas ballast feature is intended to reduce the accumulation of moisture within the pump oil, however, use of this feature may compromise the pumps ability to draw as deep of a vacuum than if the valve is turned "OFF". A little experimentation will reveal how a specific pump operates with this feature and, if you still have questions, contact the pump manufacturer for clarification.

Figure 6: "gas ballast" valve

How should the pump and micro gauge be connected to conduct an effective evacuation?

A detailed of effective evacuation process can be found in the Valeo publication entitled **"31000001F Operation and Service Manual"** Pages 4-12. (& See Figure 7 and Figure 8) and ordered in electronic format on the manual can be obtained thru Valeo Service team by telephoning 1-800-462-6322

Figure 7 - With Orifice Tube System

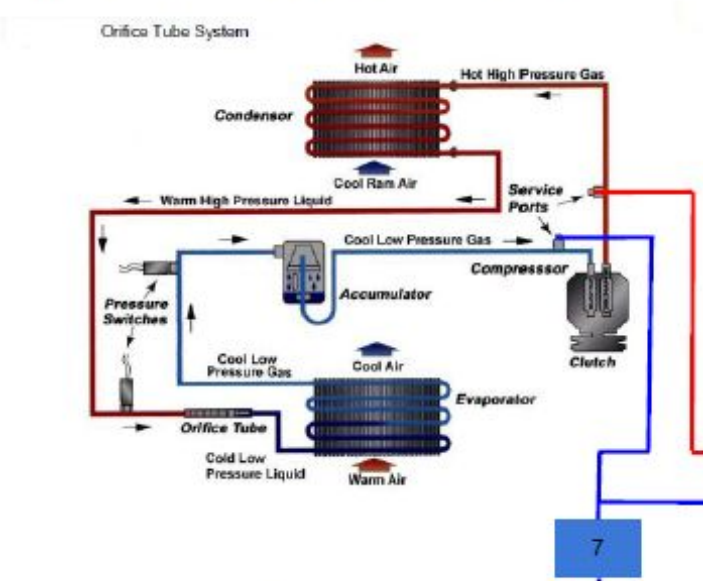
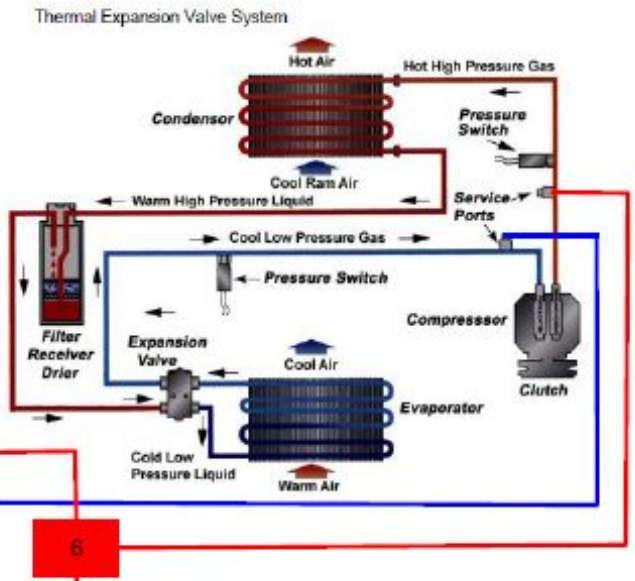
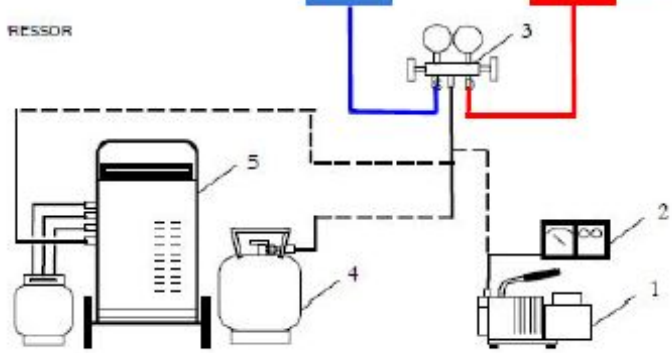


Figure 8 - With EXV Block Valve





1.- Vacuum Pump 6 or 8 CFM
2.- Vacuum / Micron Gauge
3.- Manifold Gauge Set (R134a)
4.- Refrigerant Cylinder
5.- Recovery / Recycle Machine
6.- R134a High (Discharge) Side Service Port.
7.- R134a Low (Suction) Side Service Port.

Why must the circuit be evacuated down to 500 microns?

As discussed above, evacuation serves to remove damaging moisture from the circuit. An evacuation causes moisture remaining within the circuit to evaporate from a liquid form to a gas form and get pulled out through the vacuum pump. A deep vacuum vigorously boils that remaining moisture and assists the water vapor to travel through the relatively long hose network of the Bus AC systems. Experienced AC Technicians understand that long lengths of refrigerant hose dramatically influence the dynamics of the evacuation process. For instance, we have all sipped a beverage through a straw and recognize that a very long straw requires more effort to draw the liquid from the glass, as does a very narrow straw. The same goes for the refrigerant circuit in the bus. Some buses employ upwards of 100+ feet of relatively narrow hose to connect all of the AC components. It follows that an aggressive evacuation is necessary to successfully draw moisture out of the system prior to refrigerant charging. AC Technicians should not be fooled into thinking that evacuation standards applied to passenger automobiles are sufficient for larger bus systems – they are not!

What can be done to assure the success of the evacuation process?

AC circuits that have been poorly installed or previously serviced may contain a significant quantity of moisture and make the evacuation process seem difficult or tedious. Excessive moisture will extend the time required for the evacuation to reach the 500-micron level and will cause the micron gauge to rise more than 500 microns during the 5-minute wait. A skilled AC Technician will react by conducting a "nitrogen sweep" of the circuit to assist in the removal of moisture. The general idea is to 1) evacuate the system as close to the 500-micron target as possible, then 2) fill the circuit for 2 to 3 minutes with no more than 200 psig of dry nitrogen out of a pressurized gas cylinder, 3) release the high-pressure nitrogen into the air (nitrogen is not toxic or hazardous and can legally be vented to the atmosphere), and then 4) repeating the evacuation process with the vacuum pump. This process may have to be repeated for circuits containing excessive moisture.

What else can be done if the 500-micron target cannot be reached?

Contrary to what many may think, a 500-micron target is not difficult to reach provided that the vacuum pump is not in need of repair or replacement. The following should be checked to assist the AC Technician in successfully reaching the 500-micron mark:

a) Review the refrigerant installation for leaks;
b) Ensure that all hose connections from the vacuum pump are tight and in good repair;
c) Verify that the gas ballast valve on the vacuum pump is closed, and
d) Change the vacuum pump oil.

Additional information is available within the Valeo **"31000001F Operation and Service Manual"** for your particular product. the manual can be obtained thru Valeo Service team by telephoning 1-800-462-6322