For a vapor compression refrigeration system to operate properly, the only fluids that should be inside the system are refrigerant and oil. This means that service technicians must be trained to apply best practices to ensure a proper vacuum is pulled on any system left open to atmosphere before charging. As stated in the first article, changing the oil in the vacuum pump after every use is only the starting point of an effective deep vacuum evacuation. Monitoring oil condition and changing it as-needed is critical to performing a proper deep vacuum quickly and efficiently.

As one begins to pull into a vacuum, the pump is degassing the system, removing moisture and air that tends to cling to the walls of the tubing along with oil. As these contaminants are removed, the vacuum pump oil tends to rapidly collect unwanted material. These contaminants cause the vapor pressure of the oil to rise. As a result, the pump cannot pull down below the combined vapor pressure of the oil used to seal it and the contaminants that it holds which were pulled from the system. If the pump is capable of pulling down to 20 microns with fresh oil and the vapor pressure of the oil increases to 450 microns when contaminated, your pump will only be able to pull down to 450 microns. That pump will have to run long and hard to get the system down to 500, and time is money. Remember, there is no need to use a refrigerant manifold to pull a proper vacuum.

The tools

Tools needed to pull a deep vacuum on most residential systems:

1. Vacuum pump
   a. Did you blank off the vacuum pump with a known accurate micron gauge to make sure that it will pull down below 100 microns?
   b. Did you change the oil the last time it was used?
   c. Do you have extra oil?
2. Vacuum rated hoses with a larger diameter than the service port.
   a. Did you check the gaskets and O-rings before you started?
   b. Did you use an acceptable sealant in the connections like Nylog or an approved high vacuum grease?
3. Vacuum rated core removal tools
   a. Did you check the core removal tool, as well as all gaskets and O-rings?
4. A good micron gauge
   a. Have you taken care to ensure that oil did not get into the sensor?
   b. Has it been stored properly?
5. New valve cores
   a. Cores are cheap, real cheap when compared to the cost of a call back.
Three test vacuum pulls

To demonstrate the importance of proper procedure we are going to see how long it takes to pull a known tight and dry system down to 500 microns when connected three ways. Before each test, the vacuum will be broken by charging the system to 2 psig with dry nitrogen and letting it sit for one hour as a starting point.

**Test #1—The wrong way:** This method makes many HVACR instructors absolutely crazy, not just because it is wrong, but because they have seen many people using this method under the mistaken impression that it is the correct method.

All 1/4 in. pressure rated hoses, valves in, core depressors in, refrigerant hose between the micron gauge and the unit being evacuated, pulling vacuum through a pressure manifold, and oil only changed when it looks cloudy. After one hour and 11 min. the tester still does not know what the actual vacuum is at the condensing unit because the micron gauge location, the 1/4-in. hoses, and the obstruction are already installed. Test #1 time to 500 microns: 1 hour, 11 min., 15 sec. (oil changed when vacuum process stalled at 2,500 microns).

**Test #2—Still not right:** This method is commonly used by well-meaning, experienced technicians who have not yet read this article. Pulling through a pressure manifold, cores removed, micron gauge attached to the side port of the core re-
Deep vacuum best practices

No matter how one looks at it, best practices save time and money.

1. Change oil in vacuum pump.
2. Perform a blank off test to make sure the pump can pull down below 100 microns.
3. Check valve positions on the unit.
4. Connect core removal tools to unit.
5. Connect the micron gauge to the side port of the Schrader core tool.
6. Remove the cores and close the valve.
7. Connect 1/2-in. diameter vacuum hoses to the unit.
8. Connect 1/2-in. diameter vacuum hoses to the vacuum pump.
9. Pull the system down below 500 microns and evaluate:
   a. System dry
   b. System has moisture in it
   c. System leaks
10. Make repairs or adjustments as necessary.
11. Remove vacuum equipment and weigh in the appropriate charge.

Before the evacuation, large diameter short hoses. Test #3 time to 500 microns: 11 min., 15 sec.

Now, back to the point of this series, the benefits of best practices. If the manufacturer requires that the system be pulled down to 500 microns three times after breaking the vacuum with dry nitrogen, how much time (and money) can be saved by using core tools and 1/2 in. hoses? By the authors’ calculations on a 2.5 ton Goodman unit used for this article, an HVACR tech would be done 52 min. and 55 sec. sooner than they would have pulling through a manifold. No matter how one looks at it, best practices save time and money.

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This photo shows the proper set up for a deep vacuum pull.