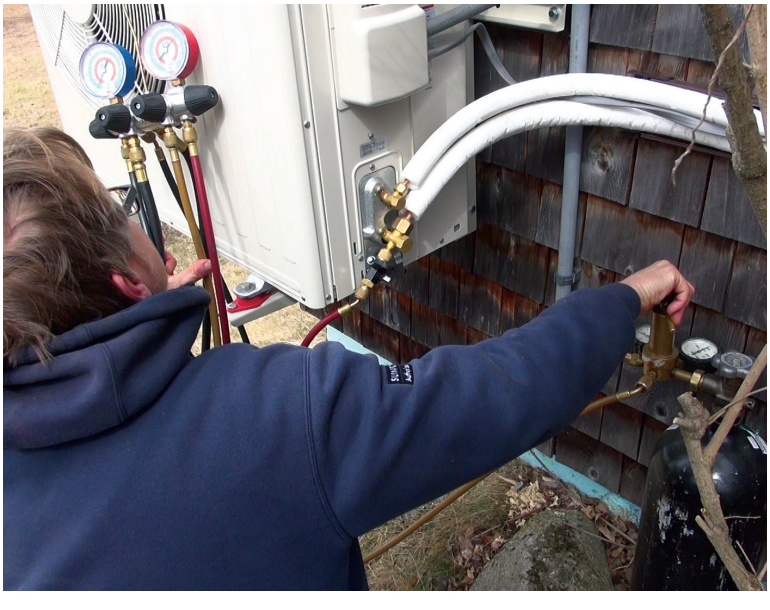
BY TED CUSHMAN

Commissioning Mini-Split Heat Pumps

Mini-split heat pumps are gaining ground in cold regions such as northern New England. Their growing popularity stems from two main strengths: First, with their low output and high coefficients of performance, mini-splits are a natural match for the low heating and cooling loads typical of high-performance homes. And second, mini-splits are a clever way to augment the heating systems of existing homes. When you add a mini-split to a moderately efficient house that already has oil or gas heat, you allow the fossil-fuel boiler or furnace to rest during the spring and fall, when heating loads are lowest and mini-splits perform at their best. But you can still call on that big burner in the basement if you need it on the coldest winter nights, when fossil-fuel heating appliances generally run at their top efficiency.

That's all great in theory. But in practice, your mileage may vary. Like any other technology, mini-splits work best when they're done right. And as their fame has spread, some HVAC contractors have been pitching mini-splits as a quick and cheap home improvement—and downplaying the quality-control measures that are important for good results. In that business environment, it's a challenge for non-expert builders, remodelers, or homeowners to be sure that the systems they're buying have been put in correctly or will perform as promised.



Photos by Ted Cushman

ReVision Energy tech Dave Ragsdale sets up equipment for the pressure test and triple-evacuation refrigerant-line-clearing procedure for a newly installed Mitsubishi mini-split at a rural home in Maine.

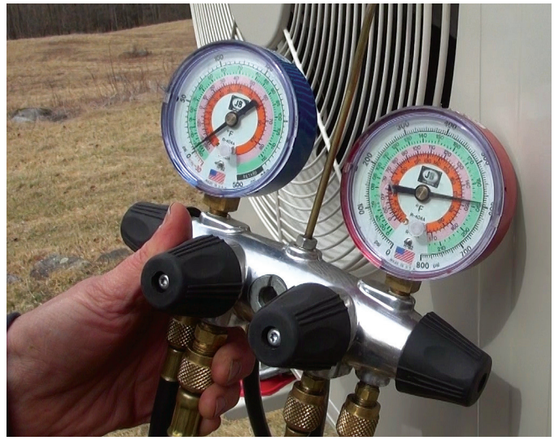
That's the concern that prompted a recent query by David Meiland, a *JLC* reader who owns Bailer Hill Construction, on San Juan Island near Seattle, Wash. Posting in a forum on the networking website LinkedIn, Meiland asked, "Some of the HVAC contractors in my market are trying hard to make their ductless heat pump installs into one-day deals, by skipping any testing or evacuation of the linesets. They install the indoor and outdoor units, connect the tubing, release the refrigerant, and they're done. The installer I have used charges the lines with nitrogen and then evacuates them with a vacuum pump, resulting in a couple of extra trips. What are you seeing in your area, and how much do you think it matters?"

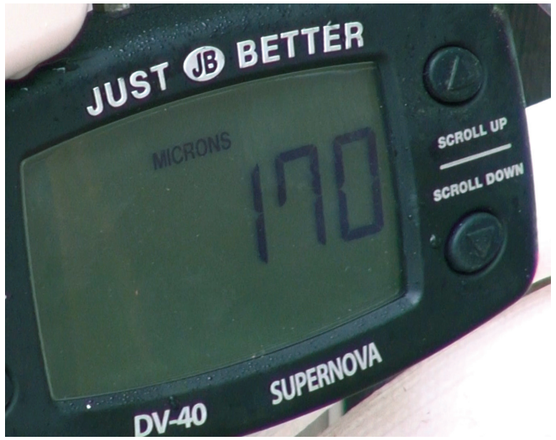
Others on the forum responded, saying that it's standard operating procedure to pressure test refrigerant lines and to purge with nitrogen and vacuum. Pressure testing ensures a leak-free refrigerant line, and the nitrogen purge clears moisture contamination out of the system, an essential step to prevent corrosion of the compressor. Anything less, forum members emphasized, is less than professional. But even so, some commented, the process might not always take more than one day.

THE MANUFACTURER'S STORY

For a heat-pump supplier's view, *JLC* touched base with Maine and New Hampshire Mitsubishi sales manager Roger Willett. We caught up with Willett at an indoor air quality conference in Portland, Maine. "We have about 80 to 90 factory-trained contractors that specialize in our product, and then probably 300 or 400 other contractors that sell it as part of their mix," Willett said.

Willett helped develop the installation spec that Mitsubishi's U.S. installers follow. "The most important part of that is what we call the vacuuming process," Willett said. "Once we connect the lines, we use a triple evacuation, which is a process of pulling a vacuum, introducing nitrogen, pulling a vacuum a little bit deeper,





Technician David Ragsdale's pressure gauge shows the reading during a pressure test of the system at 600 psi (left) and during system evacuation at 170 microns (right) to purge moisture from the refrigerant lines.

reintroducing the nitrogen, and then pulling a vacuum as deep as 500 microns or less. That process eliminates all moisture, any air, any noncompressed gases from the copper lines before we introduce the refrigerant."

Omitting the evacuation process runs the risk of premature failure, Willett confirmed. "If there's water in the lines, it will take out the bearings of the compressor. It shortens the life of the system. If there's a warranty [claim] on a compressor within the first two or three years, we usually can tell that it wasn't installed properly."

Failures are rare, said Willett—less than .005% of systems fail every year, according to company statistics. And water in the refrigerant lines isn't the leading problem in New Hampshire and Maine, he said. More common is freeze damage that can happen if there's inadequate clearance underneath the outdoor compressor. Units come with a defrosting system for the outdoor coil, he explained, and a drain pan to direct melted frost onto the ground. "The No. 1 thing we see is improper mounting—people mounting the appliance right on the ground," said Willett. "That will cause catastrophic failure, because the defrost cycle causes the water to re-freeze underneath the unit, and it will usually crush the coil. So you lose all your refrigerant charge, and you can lose a compressor if it continues to run with no refrigerant."

Mitsubishi's service department investigates failures to determine the cause, Willett said. "We have a gentleman who works out of Dover, N.H. He'll make a site visit and make a determination on whether it was premature failure due to a defect in our manufacturing, or if it was neglect in the install process. We will usually warranty the equipment either way, because at the end of the day, that homeowner needs to be taken care of. But we will also do an on-site training with the contractor: 'Okay, here's what we think you probably did wrong, here's how you do it right going forward.'"

The installers also have skin in the game, Willett noted: Mitsubishi pays for the new equipment, but the installer has to do the work for free. "So most of them have an incentive to do it right," he said. "But there are always those ones that are out there doing work for less, so they cut corners."

AN INSTALLER'S VIEW

For the view from the field, *JLC* turned to Fortunat Mueller, a partner at solar-energy and HVAC contractor ReVision Energy, based in Portland, Maine. "We believe strongly in the importance of thorough commissioning to maximize system performance and system life," Mueller confirmed in an email. "I would agree this is where an awful lot of installers cut corners."

"We pressure test with nitrogen rather than air," Mueller explained, "because it helps limit impurities in the system. Because the N2 is dry, it minimizes the introduction of moisture into the lineset. Moisture is a compressor killer in the long run." Ideally, the lineset is left under pressure overnight, said Mueller—but not always. "Realistically," he said, "a lot of the simple one-to-one jobs [with just one outdoor compressor and one indoor condenser and fan] are one-day installs, and so we can't always do an overnight test. We plan our installation practice to get the lineset completed as quickly as possible, so we can get the pressure test and evacuation started as soon as possible while we work on the rest of the project. Our goal is to get the system on pressure test before lunch."

"After the N2 pressure test," Mueller went on, "we follow Mitsubishi's specifications for a triple-evacuation procedure, breaking the vacuum only with dry nitrogen between steps. The final evacuation needs to be able to pull a vac down to below 500 microns, and we often shoot for much lower if we can. This is important not only because it may expose pinhole leaks in the lineset, but also because getting all the moisture and contaminants out of the lineset before charging it with refrigerant is critical to maximizing performance and system longevity."

"If you're in a rush (or you are determined to be the cheapest heat-pump installer in the county)," Mueller noted, "you can skip the pressure test, evacuate for 10 minutes, and charge the heat pump, and chances are it will blow hot and cold as is. I've even heard of do-it-yourselfers who skip the evacuation completely because they don't have the tools. But the customer will certainly be spending more in electricity than they should, and the equipment will fail prematurely when the moisture gets in the compressor oil and the compressor fails."

The quality-control measures are important not only for system performance, but for environmental reasons, ReVision Energy project engineer Joseph Maisonave pointed out. "The most common service call for heat pumps is a refrigerant leak within the first year of service," Maisonave explained. "R410a refrigerant, though more environmentally friendly than most refrigerants, has a Global Warming Potential of 1,725. This means that every pound of refrigerant released to the atmosphere is equivalent to 1,725 pounds of CO2 released. The average mini-split heat pump has three to four pounds of refrigerant in the system. Releasing four pounds of refrigerant is equivalent to the carbon dioxide emissions from burning approximately 300 gallons of oil or 350 gallons of gasoline. ReVision's core mission is to reduce carbon emissions, so ensuring system tightness and preventing the release of refrigerant is critical for accomplishing that mission."

Ted Cushman is a senior editor at JLC.