Winning the Battle Against Leaks

A review of leak detection tools covers the advantages and disadvantages of the various options available  By R.B. “Buzz” Estes

It requires no special equipment, skill or great intelligence to detect a leak in a refrigeration system. If equipment repeatedly loses refrigerant, or will not hold pressure or a vacuum, then there is a leak. The trick is to find the leak so it can be repaired. This article offers a cursory review of leak detection tools and provides some suggestions for techniques that may not be widely used.
Detection systems

One type of detection system, the halide torch, is regarded as obsolete by most mechanics as other methods have distinct advantages. Halide torches are slow, sensitive to winds, difficult to use in bright sunlight, and require more skill, experience and patience than what many of today's mechanics possess. An advantage of a halide torch is that it will indicate a mixture of refrigerant and nitrogen better than an electronic leak detector, and the initial investment and operating cost is well below electronic leak detectors.

If, by chance, you still use a halide torch or if you should ever use one, be aware that the results of burning a fluorocarbon in the presence of copper will yield phosgene gas, which is toxic, noxious and obnoxious. Normally, though, this is not a problem since the amount used is so little and phosgene is so pungent that it won't be inhaled unknowingly.

"Tenting" equipment with a black polyethylene or lightweight tarp can be very beneficial for blocking out winds or sunlight, and it aids the process of leak finding. Keep in mind, this must be done judiciously because of the possibility of generating phosgene. Tenting also can be very beneficial for leak seeking with a UV light.

Electronic leak detectors are not as sensitive to wind and sunlight as the halide detectors, but still require a rather slow sweep of all the unit's accessible surfaces. Unfortunately, maintenance of the leak detector too often is neglected, and the filters and/or elements are never checked or changed but are assumed to work forever. A quick test of the detector should be conducted before every use to ensure that it's working. If used with care, this equipment can find the majority of leaks. Patience, though, is definitely required.

Ultrasonic detectors utilize an entirely different principle of operation. They also work equally as well with air and nitrogen leaks as they do with fluorocarbon leaks. Another plus is that they work well with a vacuum. Ultrasonic detectors selectively modify and amplify the sound of high velocity vapor through a small orifice, which is the audible signature of a vapor leak.

For new installation or major refrigeration repair that will not pump down to a required vacuum, ultrasonic detectors can save time when looking for a leak while the system is under vacuum. This is better than pressurizing the system before trying to find the leak, dumping or recovering refrigerant and then restarting the evacuation process.

The sweep/scan of ultrasonic leak detectors can be much faster than those detectors already mentioned and can be guided from the general area to the specific point so that bubble water can be used. On a good day it can look as good as a bird dog picking up the scent of a coyote of quail and immediately coming to a point.

Pros and cons of dyes

All of the above methods require the leak occurring while the search is being conducted and with the detection device in proximity to the leak. Inserting dye into the system can find some intermittent leaks. However, various equipment and compressor manufacturers disagree as to whether this voids the warranty or has any detrimental effect.

Some filter/drier manufacturers claim that the dye may be largely removed by the filter/drier, which can cause excessive pressure drop across the filter. While they may claim this, I've never actually seen this happen.

In the end, dye still might be prudent since it can find intermittent leaks that cannot be found any other way. With earlier dye systems, technicians just needed to add a red dye to the unit and look for a red or pink stain to appear.

More advanced systems utilize a fluorescent dye and an ultraviolet light that yields a glow at the leak site. This can get the "leak find" rate up to 80 to 85 percent without expending an inordinate amount of labor. This system cannot be hurried as the dye stain will not be there until enough refrigerant and dye have leaked out to leave residue.

An excellent procedure is to make a preliminary search with another detection device, and then add dye, sticker the equipment and leave. Advise the customer that you are attempting to save time and money in the long run by leaving.

Also, ask them to observe the system and notify you of any indications regarding low refrigerant charge such as the home or office not cooling as it should or the coil
freezing up. It doesn’t make any sense to put dye in a system and then start looking for the leak. It doesn’t happen that fast. Depending on the size of the leak, it could take hours, days, weeks or even months before enough refrigerant leaks out for the dye to be seen.

Furthermore, I would advise you to put your company’s customized stickers on the unit to remind the customer who was servicing the equipment or to advise any other technician that dye is in the system.

After using any of these systems to find the leak, usually it is necessary to flood or spray the suspected area with bubble water or a soap solution. Generally, it is not advisable to start with the liquid unless one area is suspected, such as a recent repair. It could be time-consuming to try to cover this entire system following this method.

Remember, refrigeration systems are a dynamic assembly of components that operate under changing conditions of pressure, stresses, temperature and vibrations. An intermittent leak can be almost impossible to pinpoint until the leaking conditions are simulated.

Field situations

Following are a couple of situations and the end result of the leak-finding mission. One example includes a 10-ton, 20-year-old air-conditioning system with a refrigeration coil attached to a hot water heating coil. The unit lost its charge each winter but not in the summer. After localizing the leak with fluorescent dye, the evaporator coil had to be gently heated with a propane torch to approximately 120° F before bubble water pinpointed seepage on the solder joints. Evidently, the hot water coil heated the evaporator coil enough to leak each winter.

A 3-ton heat pump was observed to lose its charge every summer, but not in the winter. Red dye localized the leak to the indoor coil that was removed and placed in a water bath with 150 pounds of nitrogen pressure. No bubbles were observed until ice was added to the water bath and then the leak became rather large. In this case, the evaporator coil leaked only when it was cold and tried to freeze the coil, making things even worse.

It is important to note that a system may leak under one condition, but not under another. That is why it is important to check for dye several months after you put it into the system.

There are many strategies at our disposal when searching for a leak. One solution is an inexpensive, lightweight, portable dip vat for submerging coils, which can be a 6-foot diameter plastic wading pool. It may not be high tech, but it works quite well.

Another possible solution is disconnecting the condenser fan motor to raise the head pressure and temperature, and to stop the air sweep that erases any refrigerant leak signature. This can help if the leak is suspected in the high side of the system. It must be done judiciously and intermittently, and it is not for the novice. In a similar manner, the indoor blower might be stopped to check the indoor coil either as the condenser of a heat pump on the heating cycle or as the evaporator on the cooling cycle.

When troubleshooting a split system, a pair of walkie-talkies and a competent helper would be extremely valuable. Because split systems are separated, caution must be exercised to not endanger the mechanic or damage the equipment. Furthermore, it should be done during a low-load condition and during mild weather, which is usually a slower time for most refrigeration companies.

By following good procedures and the manufacturer’s directions, the success rate in finding leaks should exceed 90 percent. In the final analysis, none of the detection systems is the best for finding leaks, but each has its place in the toolbox. "The best" tool is a clear head with an understanding of the system so that an intelligent approach can be made to the problem.