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Refrigerant Leak Detection Tools & Techniques

Courtesy of Bacharach Inc.

One of the most difficult areas of sealed-system servicing can be trying to find a refrigerant leak. The leak might exist within a series of tubing that could be up to hundreds of feet long or in a component that is not readily accessible, or it might even be totally concealed. It could be in an operating or safety control such as a pressure switch or possibly right under your nose and you wouldn't even suspect it.

Having the proper test equipment is half of the battle. There are so many methods of leak detection and so many types of test equipment that not just one fits every situation. Decisions must be made as to the method used and the type of equipment required for every leak you need to find.

All of these conditions make leak testing one of the most challenging tasks faced by service technicians today. The newer EPA rules are now requiring them to find leaks that are excessive of the law, thus not allowing technicians the choice of simply adding refrigerants occasionally to keep the system in operation. Add to this the cost of refrigerants today and it becomes imperative that leaks be identified.

The following are some of the most popular leak detection methods.

Bubble test (soap solution)

A soap solution can be used when you know the approximate area where a leak may exist because of a recent sealed service repair or when an electronic leak detector has indicated a leak exists in a particular area of the sealed system.

For example, if you have repaired a leak, replaced a component or know that a system has a leak somewhere, and/or you observe an area of the system that is oil-coated, you would probably use a soap solution in that area to test for and pinpoint a leak. It is the simplest method known today, and the least expensive in terms of materials. However, its labor costs could be higher if the technician does not have any idea as to the location of the leak.

Many different types of soap solutions are available. Some have a brush applicator and others have a dabber (an absorbent ball attached to a stiff wire inside the cap). Some brands may even have a spray applicator to quickly cover large areas of tubing in a short amount of time. This is an advantage but is also messy and time-consuming to clean up.

Some soap solutions even have an antifreeze base to prevent them from freezing during the winter. Others may have a lower density to make them even more sensitive to very tiny leaks.

Soap solution pointers: If the system does not contain sufficient pressure for leak detection, the refrigerant can be recovered from the system and the system re-pressurized with dry nitrogen to increase the pressure, making it a more probable and less time-consuming way of pin-pointing the leak.

WARNING: Do not pressurize the system or the component to be checked more than the manufacturer's leak-testing standards. This pressure is usually stated on the nameplate as factory test pressure. If it is not stated on the nameplate, a safe pressure is usually less than 150 psig.

There may be times in which an oil spot is noticed in an area of the sealed system. This is usually a sign that a refrigerant leak is present in that area. A soap solution can help pinpoint the leak.

Holding the dabber against the suspected leak for a period of time may provide better results for small leaks.

Water submersion method

This method can only be used if the system is small enough to be submerged in a tank of water or if the suspected leak exists in a component that can be cut from the system, sealed and pressurized with a high-pressure, dry nitrogen charge. That system or component of the system is then submerged into a water tank and the technician watches for bubbles escaping from the leak.

Submersion pointers: A detergent can be added to the water to decrease surface tension, which helps to prevent the leaking gas from clinging to the side of the component.

Hot water in the tank sometimes helps to increase the pressure inside the component or piping system. If dry nitrogen is used, this does not help because nitrogen does not increase significantly. If refrigerant is contained in the system or component, it may help considerably to increase the pressure and increase the chance of finding the leak.

Halide torch

A halide torch is an inexpensive leak detector that is fast and reliable, but can only be used to detect chlorinated refrigerants. It can be used to detect leaks as small as .5 ounce per year.

A halide torch works on the principle that air is drawn over a copper element heated by a hydrocarbon fuel. If halogenated refrigerant vapors are present, the flame changes from a blue color to a bluish green color.

This method is not as sensitive as electronic leak detectors, is somewhat awkward and could be dangerous due to the open flame.

Dye interception method

This is a method in which a dye is inserted into the system in hopes that eventually the leak allows the escape of a colored dye where the leak exists. This dye becomes visible after a period of time, notifying the technician where the leak is.

Ultraviolet leak detection dyes are also available. These dye kits sometimes require more expensive equipment to detect the leak. This may include an ultraviolet lamp, ultraviolet dye and some method of getting the dye into the system without letting any moisture or air into the system. These dye methods may be more time-consuming because of the time it takes to leak the dye and become visible to the human eye.

Dye considerations: The dye may be considered a contaminant to the sealed system and is difficult to get into the system without moisture contamination. Even the slightest bit of moisture is detrimental to the longevity of any sealed system.

This method can be messy, with the dye usually ending up in your test equipment (gauge manifold and/or refrigerant hoses), and it is usually time-consuming to clean up.

This method is usually time-consuming because it could take several hours or days for the dye to leak from the leak source indicating a leak. This method also means you must have access to all of the system, which may limit its use.

Standing hold test

This method consists of pressurizing the system with a high-pressure, dry nitrogen gas, usually

between 100 and 200 psig, for a period of time and then identifying whether or not the pressure drops during this time. The higher the pressure, the faster you can determine if a leak is present. Fortunately, dry nitrogen experiences very little pressure changes when it is exposed to small temperature changes.

WARNING: Do not pressurize the system or component to be checked more than the manufacturer's leak-testing standards. This pressure is sometimes stated on the nameplate as test pressure, but if not, using less than 150 psig is usually safe.

The disadvantage of this method of leak detection is that it can only be used if you have a system that can be shut down for a period of time (usually overnight or longer). This can be very time-consuming because some low-level leaks may require a holding period of up to 48 hours or more. It's not that you have to stay with the system for that period of time; it's just the fact that the system may need to be out of operation for that amount of time.

The advantage, however, is that this method will positively identify whether or not a leak exists by monitoring pressure drop. If any pressure drop occurs, it means a leak is definitely present. The disadvantage is that this method does not identify where the leak exists, only whether or not a leak is present.

Isolation of the sealed system

This is a time-consuming method of the standing hold test, but it is sometimes your only choice. It is usually used when you have no physical access to components that you suspect are leaking or when you want to identify which part of the system contains the leak. Some examples might be: a concealed refrigerant line, an in-wall condenser, an in-wall evaporator or any component to which you do not have access.

This process would include isolation of the component suspected of leaking from the rest of the system. This is done by breaking that part of the system apart from the rest of system, sealing it and pressurizing only that component with dry nitrogen. Then use the standing hold test described above. If the system's pressure drops fast, there is a large leak present in that component or section of the system. If the system's pressure drops slowly, there is a small leak present. If the pressure remains the same, that component does not leak.

This method can limit your leak detection labor time only if the system can be out of order for a period of time. Once the component leaking is identified, determine whether or not repairs can be made. If not, that particular component can be replaced. A process tube adapter kit could save you time. It can be quickly connected to the part of the system that has been cut out. This eliminates having to make a mechanical or brazed connection.

Electronic leak detectors

Electronic leak detectors are generally the fastest way to find an unknown leak. They can be used to quickly find a leak or to find the location of a leak in a sealed system when you don't even know where to start. An electronic leak detector gets you close to the leak. Operation usually depends on a variation of current flow caused by ionization of decomposed refrigerant between two oppositely charged platinum electrodes.

After you find the area in which the leak is detected, you can usually adjust the sensitivity of some types of detectors to pinpoint the leak. The leak area is then coated with soap solution to verify the exact point of the leak.

Electronic leak detector pointers: Electronic leak detectors must be designed to detect specific types of refrigerant, e.g., CFC, HFC, HCFC, etc. Be careful, because you can waste a lot of time if you're using a detector that is not compatible with the refrigerant that is contained in the system you

are leak testing.

Know your leak detector's capabilities and its limitations.

Carbon monoxide and alcohol can affect the sensitivity of most electronic leak detectors. Be sure neither is present when leak detecting.

WARNING: Most electronic leak detectors are not recommended for use in atmospheres that contain flammable or explosive vapors. The sensor operates at extremely high temperatures. If this sensor comes in contact with a combustible gas, an explosion will occur. Most manufacturers will not honor warranty products against abuse, and exposing a refrigerant sensor to combustible gases constitutes abuse.

If the leak is suspected to be very small, it may be possible to enclose the suspected area for a period of time to allow the leaking refrigerant time to accumulate. When accumulated, it is then more readily sensed by the detector. This may be done by wrapping a suspected leak in cellophane and leaving it pressurized with a refrigerant charge for a period of time. Then cut the cellophane at the bottom while using an electronic detector to detect any refrigerant that may have accumulated in the pouch over time.

It is permissible to add a little vapor R-22 to a system and then re-pressurize it to a higher pressure by adding nitrogen to the system containing the R-22 holding charge. This increases the chance of finding the leak and is considered by the EPA to be "de minimis release" (a good-faith effort of finding a leak that may prevent future refrigerant venting through a leak that is not found).

If a refrigerant component or piping section that is suspected of leaking is inside a compartment (such as a freezer/refrigerator compartment or a small room) and a leak is suspected in that part of the system, that section can be isolated by closing a door and trapping the components in an enclosed space before re-entering with an electronic leak detector. If the detector's alarm goes off, you have verified the leak exists in that component, tubing or area.

Again, re-pressurizing the system to a higher pressure and, of course, having refrigerant in the system will accelerate the process.

Refrigerant has a higher specific volume than air, therefore refrigerants will fall when exposed to atmospheric pressures. This means leak detecting on the bottom side of the piping or components will be more effective in detecting a leak and will save time.

Ultrasonic leak detectors

This type of leak detector is relatively new to our industry. It consists of a device that is capable of amplification so the human ear can recognize very small noises. Most detectors will allow a technician to hear minute sounds such as a very small leak in a sealed system. This procedure can be very successful if, and only if, the area in which you're trying to detect the leak is **ABSOLUTELY QUIET**. This is usually impossible, which imposes great limits on the ultrasonic leak detector.

As usual, the higher the pressure in the system, the greater the chance of finding or in this case, hearing the leak. It can be used in the same manner as an electronic leak detector with one exception. It is more effective using dry nitrogen as a pressure medium than refrigerant because nitrogen has a lower specific volume than refrigerant. This will permit the nitrogen to escape faster thus being more easily detected.

Pennsylvania-based Bacharach Inc. is a leading manufacturer of gas analysis, leak detection, refrigerant monitoring and recovery products.

