A Look at Ultra-High-Pressure Refrigerant Recovery

With strict EPA and ARI regulations for high-pressure refrigerant recovery, it is important to make sure that your system is a safe one. Here's how you can implement a peak recovery system.

By Mark Key, Redi Controls Inc.

Recovery, recycle and reclaim were terms that once were used interchangeably in the refrigeration industry. In the late 1980s and early 1990s when new service procedures were mandated by the U.S. Environmental Protection Agency (EPA) and Clean Air Act regulations, these words acquired specific meanings. Industrial refrigeration and service technicians were made aware of the new terms and regulations through the required Air-Conditioning and Refrigerant Institute (ARI) training courses and certification.

Before the regulations took effect, most technicians simply released the refrigerant charge into the atmosphere and charged the system with new refrigerant. In the early 1980s, a growing concern about the effect that chlorofluorocarbons (CFCs) had on the ozone layer led to the passing of laws that minimize refrigerant emissions. The current regulations and increased taxation of refrigerants have made the use of these older recovery techniques illegal and unreasonably expensive.

Today, recovering refrigerant from an industrial refrigeration system involves removing the charge from the system and storing it in a container, cylinder or absorption (granulated carbon or molecular sieve) device. The service technician should transfer the charge carefully and comply with the recovery unit manufacturer's recommended operation and service instructions. This will help prevent contamination of the refrigerant charge and help maintain safe conditions during the service procedure.

It is strongly recommended that you test the purity of the charge and keep a log for each system to track the charge condition. This way, future recovery, recycling, reclaiming and charge replacement procedures can be implemented appropriately to keep the refrigeration system operating at peak performance. In some cases, the refrigerant charge can be recovered and returned to the system after repair. It is important to note that in such instances, the service technician assumes liability for future system performance. Returning the charge to a system without checking purity might lead to the returning of a contaminated charge. It is advisable to replace the charge if the system has experienced a hermetic motor burnout. Some ultra-high-pressure refrigerant systems are charged with trace amounts of pentane, propane, methane or similar substances. You should consider any filter dryer's ability to absorb these substances if the charge is going to be put back into the system because the mixture percentages could change.

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Utilizing a Safe Recovery System

All technicians should be familiar with the EPA codes and standards for handling refrigerants and servicing equipment as required by Type I, Type II, Type III or Universal certifications. Ultra-high-pressure refrigerants utilized primarily in low temperature systems, cascade systems, environmental chambers and other specialty systems have saturated pressures that range from 250 to 700 psi at room temperature.

Cascade systems typically maintain two charge types. One side will contain R-12, 22, 502, etc., and the other side typically will contain the ultra-high-pressure refrigerant charge such as R-503, 13, 23 or SUVA-95. Whether you are repairing an existing system or changing out the existing charge with the new and environmentally safer alternative refrigerants (e.g., SUVA-95), the existing refrigerant will have to be recovered

properly. A recovery system designed specifically to handle ultra-high-pressure refrigerants is necessary to accomplish this, and there are certain characteristics to look for when choosing this type of recovery unit. These types of recovery units also are utilized to recover halon charges out of fire suppression systems used in some heavy industrial manufacturing applications and pharmaceutical company facilities.

The ultra-high-pressure refrigerant recovery unit must be ARI-certified for use with the ultra-high-pressure refrigerants, as required by the EPA. It is important that a technician understands that recovery systems are certified for the types of refrigerants they are meant to recover; thus, a unit certified for recovery of R-12 or R-134a is not suitable for recovering R-503, R-13, R-23 or SUVA-95. Using a recovery unit that is not ARI-certified for the type of refrigerant being serviced is a violation of EPA regulations. Additionally, it is extremely dangerous to use a recovery unit that is not built to handle the higher pressures associated with the ultra-high-pressure refrigerants.

Serious injuries can occur when one does not utilize the properly rated and certified equipment designed specifically for use with these ultra-high-pressure refrigerants. In one case, a technician was injured when the cylinder in the ice bath was exposed to ambient temperature. The rapidly increasing pressure built up in the cylinder and escaped back into the recovery unit. The recovery unit's internal piping was not designed to handle the excessive pressure. The unit simply overpressurized and exploded. There have been several cases of injury and equipment damage when ARI-certified equipment for R-12 recovery was utilized to recover the very high-pressure refrigerant R-503.

It is important to note that manufacturers will not warranty units that are not utilized within their stated guidelines; manufacturers design these guidelines for the safety of the operators. Claim issues may arise with insurance companies if the improper service procedures and equipment are used on a job. The entire burden of responsibility easily would fall to the service technician and his or her employer.

The refrigerant recovery unit should be ARI certified for the type of refrigerant it will be used to recover.

Old Days of Dry Ice Recovery Are Gone

When these EPA regulations first appeared, system operators used dry ice baths — an inefficient method — to attempt to recover ultra-high-pressure refrigerants. The first series of very high-pressure refrigerant recovery units had on-board cylinder cooling chambers. The cool down process took a significant amount of time and the units were large. Today, these methods are obsolete: Current technology in recovery units provides portable machines capable of pumping against the high pressures created by the refrigerant as it is collected in the recovery cylinder.

Portable recovery units offer several advantages over dry ice recovery. Because no dry ice bath is needed, the potential for dry ice burns and other dangers associated with using dry ice in confined spaces are eliminated. Dry ice baths also were deemed inefficient because a large number of cylinders — each holding only a small amount of the charge — were required to evacuate the machine to the appropriate vacuum level required by EPA. Also a significant amount of time was needed to transfer the charge to the cylinders. Finally, the time needed to precool the cylinder and the need to monitor and keep the cylinder at a constant temperature are eliminated.

HVACR Universal certified technician Brian Burnett and Duncan Supply representative Cary Warner monitor a very-high-pressure refrigerant recovery system's cylinder evacuation process.

Things to Remember During the Recovery Process

Because ultra-high-pressure systems range in refrigerant charge capacities, it is important to note the size of the charge being recovered. System charge sizes range from a few ounces to several hundred pounds — an important factor to consider when selecting a recovery unit. The transfer rate of the recovery system is important for larger charges. The internal piping of the system should be minimized to reduce or eliminate the amount of charge that may be left in this area.

Additional important features and benefits to consider:

- Units must be ca-pable of recovering to atmospheric pressure as required by EPA. ARI certification implies this capability. A unit that can recover to 25 in-Hg minimizes the amount of refrigerat that can be left in the system being evacuated.

- The recovery unit should not be sensitive to ambient temperatures.
- The unit should be capable of recovering into standard seamless steel DOT 3AA cylinders, which are designed specifically for use with very-high-pressure refrigerants. Regular refrigerant cylinders (i.e., R-12 and R-134a) cannot be used as they are not designed for these ultra-high pressures.
- The unit should be portable to allow transporting it from one facility to another.
- The unit should include all hoses and other devices required to perform the recovery process on ultra-high-pressure refrigerants. Standard manifold gauges are used to connect from the refrigeration system to the recovery unit (refrigeration system should be shut down, not operating). Steel hoses must be used to transfer the refrigerant from the recovery system into the storage cylinder.
- Technical service availability should be provided. The manufacturer should be able to support technical calls with trained technicians and engineers familiar with their recovery systems. Call the manufacturer to determine his or her ability to assist with technical questions prior to purchasing the recovery unit.
- The system should be ARI-certified for very-high-pressure refrigerant applications. It is not safe — and a violation of EPA guidelines — to utilize a recovery unit that is not ARI-certified for operation with the type of refrigerant being recovered.
- The system should be adequate to meet any special needs of your operation. For example, can the recovery unit be used to recover refrigerant from both sides of the machine?

Very-high-pressure refrigerant recovery has a significant amount of cost involved. The refrigerant is extremely expensive when compared to other refrigerants. The equipment that utilizes these refrigerants is typically specialty extreme low and high temperature systems that are fairly expensive. The technicians who work on these systems are highly trained, and this is a valuable asset. The recovery equipment must be specially designed to handle these high pressure refrigerants and must obtain ARI-certification requirements; thus, they are more expensive than the basic recycle and recovery units. As there is a significant amount of investment involved in the refrigerant, refrigeration system and personnel involved, the user should take the time necessary to consider his or her options when selecting a very-high-pressure recovery unit. **PCE**

Small environmental chambers are used to research and develop process cooling application requirements. This Agree environmental chamber has a temperature range of -100 to 350°F (-73 to 177°C).

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