Fast Refrigerant Recovery Made Easy

BY CHRISTIAN PEÑA
Images courtesy of Appion Inc.

The right tools and the best practices for speeding up the recovery process.

While refrigerant recovery is accepted as a fact of life for today’s AC/R technicians, it remains one of the most time-consuming steps in servicing AC/R systems. This can make it tempting to “skip” the recovery process for a technician on a tight schedule. However, with the proper understanding of equipment and methods, refrigerant recovery can be faster and easier than “venting.”

Importance of refrigerant recovery
Refrigerant recovery as we know it today had its beginnings about 30 years ago with the first ratification of the Montreal Protocol. This treaty was the result of Nobel Prize-winning research that proved CFCs and other ozone-depleting substances were damaging the ozone layer, with grave implications. The Montreal Protocol led to updates of the Clean Air Act in 1990, which mandates that refrigerant must be recovered and made “venting”—the intentional release of refrigerant to atmosphere—illegal.

The first substances (such as R-11 and R-12) were phased out of production by 1996, while the phaseout of R-22 only got underway in 2010. With each stage of phaseout, technicians have had the opportunity to benefit by selling recovered refrigerant for reclamation, while allowing the industry to responsibly move on to more environmentally friendly refrigerants. The result is a reduction of the ozone hole by more than 2 million square miles, or roughly half the size of the United States, since 2000.

With such a strong message about the importance of recovery, why is refrigerant “venting” still such a common problem? Perhaps it is because the recovery process can be time-consuming and frustrating, or so one might expect. This makes it all the more important to choose the right tools and connect them in a way that enables the best results.

Compressors designed for recovery
Nothing slows things down more than the failure of equipment in the middle of a job. A recovery machine has to face grueling conditions while pumping a combination of refrigerant and oil, as well as whatever might have caused the AC/R system to fail in the first place. For a recovery machine, reliability means being able to run the machine every time, whether at the start of the job, after a jobsite power interruption or to truly finish the recovery job.

The heart of a refrigerant recovery machine is the compressor. When recovered refrigerant, which often contains acids and system debris, is flooded into the crankcase of a recovery machine, hidden damage often occurs that can lead to a seized compressor or other internal component failures.
The refrigerant can also strip away essential bearing lubrication, which can severely damage the compressor if it runs too long in a vacuum. Refrigerant inside the crankcase can also be stubborn to remove, making “cross-contamination” between refrigerants more likely unless an external pump is used to clear out the recovery machine.

With some types of compressors, damage can occur when liquid reaches the compressor. However, liquid is sometimes an unavoidable result of compressing refrigerant. Choosing a recovery machine that is designed to take the full force of liquid flow can ensure that the entire process can be easily performed without intentionally reducing the flow.

These are some of the reasons why hermetic compressors are no longer used for refrigerant recovery. Machines that isolate the refrigerant flow completely from the compressor’s working components will generally last much longer and are much less expensive to service.

A recovery machine should also be able to start at high-pressure differentials between the input and output sides or be able to run in a vacuum for prolonged periods. High-pressure differentials exist and a power loss occurs, technicians want to be sure that the machine can be started without complicated “pressure relief” procedures. Similarly, the EPA requires a minimum vacuum on the system of 10–15 in. Hg. Reaching this vacuum level can take a while when pumping against the back pressure of a full recovery cylinder, leaving the recovery machine running in a vacuum for a prolonged period.
Keeping things cool
When it comes to recovery speeds, the EPA refers to AHRI Standard 740, which is one way of benchmarking a recovery machine’s performance. However, in many cases, refrigerant recovery is performed on a hot rooftop or a cozy mechanical room, which means that the machine will need to disperse the heat caused by compression while relying on hot ambient air. During this process, the recovery machine is essentially a condensing unit. Similar to a condensing unit, a condenser’s capacity for heat transfer is directly related to the cooling air flow across the condenser surface. Make sure that the recovery machine produces a high volume of cooling air flow, and make sure the air flow through the machine is unrestricted.

Full-flow connections
Just like tires can affect a car’s performance, the hoses, fittings, manifold, and recovery cylinder all play a role in how quickly and efficiently the recovery process is completed.

Hoses and hose fittings—During refrigerant recovery, 1/4-in.-diameter charging hoses are effectively capillary tubes, greatly reducing flow and potentially causing trouble throughout the process. Charging hoses often include “quick disconnect” and “auto-shutoff” hose fittings, which incorporate valve mechanisms that not only restrict the flow of refrigerant, but can act as a metering device during liquid recovery, leading to other problems such as overheating tanks. Using hoses equipped with ball valves meets the EPA’s “low loss fitting” requirement, while ensuring full refrigerant flow during the recovery process.

Even when recovering from systems with 1/4-in. service valves, using 3/8-in.-diameter hoses reduces resistance and allows a full flow of refrigerant to reach the recovery machine, and ultimately, the recovery cylinder. Using a shorter length of hose between the recovery machine and cylinder will also reduce the amount of refrigerant released, ensuring de minimis thresholds are not exceeded.

Manifold—Using a manifold can make it easier to start a typical recovery job in liquid, but some charging manifolds are designed to regulate a reduced flow. This design is not necessarily ideal when looking to increase flow during recovery. Either use a manifold with a large internal bore, or skip it entirely by using ball valves equipped with an additional “side” port. In the setup shown in Figure 2, the vapor side of the system is connected to the side port of a valve on the liquid side. This allows the technician to start the process in liquid only, while finishing with the full system open to the recovery machine.

Recovery Cylinder Capacity & Ratings—For safety reasons, it is important to never exceed 80% of a recovery cylinder’s rated capacity. In addition to safety, using a cylinder with extra capacity reduces back-pressure towards the end of the recovery process, making the EPA’s 10–15 in. Hg vacuum requirement much easier to reach. For the best results, start with a new recovery cylinder that has already been evacuated below 500 microns. As always, make sure the recovery cylinder is rated for the refrigerant being recovered.

Removing restrictions for recovery
Refrigerant recovery is subject to a number of factors that can make the difference between “quick and easy” or “long and frustrating.” Many of the common headaches result from one type of problem: flow restrictions. Because of the shared symptoms, flow restrictions can be categorized as either “input restrictions” or “output restrictions,” based on whether they are on the input or output side of the recovery machine.

“Input restrictions” are points between the AC/R system and the recovery machine that can severely reduce the liquid flow. Typically, this includes valve cores, core depressors, restrictive hose fittings, partially-opened manifold valves, or worn-out hoses. A valve core blocks about 90% of the inside of an access valve, while a core depressor blocks about 50% of the hose fitting. Overheating of the recovery cylinder and high cylinder pressures are often symptoms of input restrictions.

Just like a metering device in the AC/R system, the pressure drop caused by the restriction can result in low-density superheated vapor being fed to the recovery machine. Recall that a recovery machine is essentially a condensing unit; a condenser works best when there is enough refrigerant inside to be cooled into liquid, but a severe undercharge can render a condenser useless. When the heat from the recovery machine’s compressor is added, the recovery cylinder is slowly filled with hot vapor refrigerant, increasing back pressure and greatly slowing down the process.
due to greater pressure drops on the input side, and higher backpressure on the output side. Suddenly, ice buckets seem like an attractive solution again, but this is only patching up the symptom rather than addressing the causes.

Using larger diameter hoses while removing valve cores and core depressors opens the recovery machine and cylinder up to a full flow of refrigerant, enabling fast, trouble-free refrigerant recovery on every job.

References

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While buckets of ice and external cooling may still be helpful, allowing a full liquid flow to reach the recovery cylinder will enable better thermal transfer through the cylinder walls, and ultimately reduce cylinder pressures and temperatures overall.

“Output restrictions” are points between the recovery machine and recovery cylinder than can increase the back pressure on the recovery machine. Damage to the gauges on the recovery machine, or loud “knocking” noises during recovery typically indicate a significant output restriction. These can both be symptoms of rapid pressure spikes caused by the output hose being filled faster than it flows into the tank, and can also result in significantly-reduced recovery speeds.

Just as with the input side, it is helpful to use larger-diameter hoses and remove unnecessary core depressors. Additionally, connect the output hose from the recovery machine to the vapor port of the recovery cylinder. This allows the refrigerant to quickly empty into the tank, instead of traveling through the “liquid” port dip tube (see Figure 5), which is often smaller than 1/4-in. diameter.

The greater the flow, the faster it will go
Recovery machines have gotten smaller, faster and more reliable in the last 30 years. A recovery machine designed for greater throughput will magnify the symptoms caused by flow restrictions,