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SAVE OUR ZONE LAYER

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Safe Refrigerant Handling: Protect Yourself, Your Customers, and the Planet

By Shaurya Anand, Associate Fellow, TERI

Imagine a drop of liquid that is invisible but packs the power to change our climate. That's the story of refrigerants: the chemicals running inside air conditioners, refrigerators, and cold storage units everywhere. While essential for modern comfort, some refrigerants can do silent harm to our air, our climate if not managed safely. Knowing the basics helps every technician stay safe while becoming a climate champion.

The Main Players: Types of Refrigerants

Refrigerants come in different families, each with unique chemical characteristics and effects on the environment and human safety.

Refrigerants are broadly classified by their chemical composition and safety characteristics, toxicity and flammability. The globally recognized ASHRAE Standard 34 and ISO 817 (Figure 1)[1] define safety groups that guide technicians on precautions, ventilation, and personal protective equipment (PPE). A clear understanding of these categories is essential for safe servicing and refrigerant recovery.

Therefore, it has become important for technicians to identify the refrigerant from the equipment label or Service Data Sheet before servicing. The correct classification helps in choosing the right recovery cylinder, evacuation procedure, and safety controls such as leak detectors or ventilation systems.

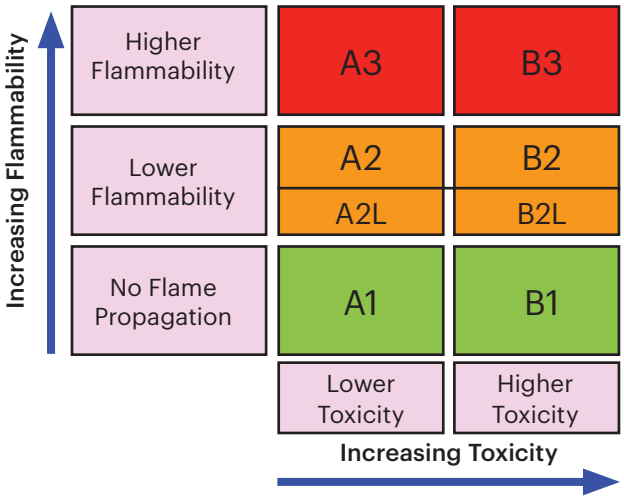


Figure 1: Classification of refrigerants

1 Adapted from AHRI (2021) ASHRAE 34 and ISO 817 Refrigerant Classification

How Refrigerants Have Evolved?

For decades, the cooling sector has undergone major shifts driven by environmental science and global policy. Chlorofluorocarbons (CFCs) such as R-12 and R-11 were once widely used but caused severe ozone layer damage. Their transitional replacements, hydrochlorofluorocarbons (HCFCs) like R-22, also harmed the ozone layer—though to a lesser degree—and carried a high global warming potential (GWP). Under the Montreal Protocol, CFCs have been eliminated and HCFCs are being phased out. HFCs—including R-134a and R-410A—solved the ozone problem but added a new challenge: very high climate impact. According to UNEP and IPCC assessments, many HFCs have GWPs in the thousands. This led to the Kigali Amendment, calling for a global phase-down of high-GWP HFCs.

The transition away from high-GWP refrigerants has paved the way for two families that are now defining the future of cooling: **natural refrigerants** and **hydrofluoroolefins (HFOs)**. Natural refrigerants—such as carbon dioxide (CO_2/R-744), ammonia (NH_3/R-717), and hydrocarbons like propane (R-290) and isobutane (R-600a)—offer a powerful combination of environmental and performance advantages. They have zero ozone-depletion potential, extremely low global warming potential (CO_2 = 1, R-290 ≈ 3, NH_3≈ 0), and deliver strong thermodynamic efficiency. This makes them ideal for applications ranging from supermarkets and cold-chain systems to industrial refrigeration and domestic appliances.

Alongside naturals, a new class of synthetic refrigerants known as HFOs—such as R-1234yf and R-1234ze(E)—has emerged as an important step forward in lowering climate impact. These refrigerants have ultra-low GWP values (typically between 1 and 7) while offering operating pressures and servicing characteristics that are familiar to technicians accustomed to HFC systems. As a result, HFOs are rapidly becoming the preferred choice in modern automotive air conditioning, high-efficiency chillers, and next-generation heat pumps.

New low-GWP blends like R-454B are also entering the market as drop-in replacements for R-410A, maintaining familiar pressures while significantly reducing climate impact. Table 1 summarizes the refrigerants which service technicians most often encounter.

The Two Big Problems: Ozone Layer Depletion and Global Warming

Once we understand the different types of refrigerants and how they have evolved over time, the next question is simple: **why did the world shift**

Table 1: Common refrigerants, environmental impact, and technician guidance

Family	Examples	Ozone Impact	GWP*	Key Technician Notes	Typical Applications
HCFCs	R-22, R-123	High	High (R-22 ≈ 1,960)	Avoid venting	Older ACs, old chillers
HFCs	R-134a, R-410A, R-32	None	R-134a ≈ 1,430; R-410A ≈ 2,088; R-32 ≈ 771	High GWP except R-32 (mid-GWP). Follow A2L safety for R-32; avoid mixing gases	Domestic and commercial AC; automotive AC (134a)
HFC/HFO Blends	R-454B, R-452B	None	R-454B ≈ 466; R-452B ≈ 698	Designed to replace R-410A. Similar pressures but require specific cylinders, charging tools, and A2L handling	New split ACs, VRF, rooftop units
HFOs (Ultra-Low GWP Synthetics)	R-1234yf, R-1234ze(E)	None	Very Low (1–7)	Ultra-low GWP; mildly flammable. Similar servicing with respect to HFCs but requires updated equipment	New automotive AC, modern chillers, heat pumps
Hydrocarbons (Naturals)	R-290 (propane), R-600a (isobutane)	None	Very Low (≈3)	High efficiency; strict flame-safety rules. Use spark-free tools, leak checks, charge-limit adherence	Domestic refrigerators, small ACs, display cabinets
CO_2 (Natural)	R-744	None	1	Very high pressure →needs specialized fittings, gauges, and training	Supermarkets, cold chain, buses, heat pumps
Ammonia (Natural)	R-717	None	≈0	Excellent efficiency; toxic. Requires trained operators, ventilation, gas detection	Industrial refrigeration, food processing

* AR6 IPCC Working Group I- Climate Change 2021, The Physical Science Basis- 7.SM Chapter 7: The Earth's 2 energy budget, climate feedbacks and climate sensitivity - Supplementary Material

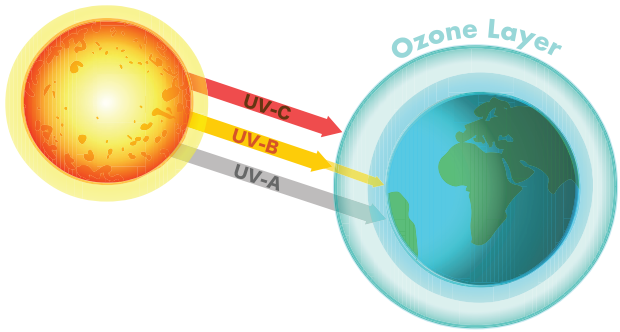
away from older refrigerants in the first place? The answer lies in two major environmental threats—one to the **ozone layer** and the other to the **global climate system**.

Refrigerants from earlier generations had ozone-depleting potential. When these gases leaked into the atmosphere, they contributed to thinning of the ozone layer, reducing Earth's natural protection from harmful UV rays. Figure 2 shows the problems caused by these refrigerants when they escape into the atmosphere.

The Hidden Dangers of Leakage and Venting

"Even a small leak today can cause big trouble tomorrow—for you, your customer, and the planet." When servicing a cooling system, a tiny leak of refrigerant may seem harmless. But what users and technicians **cannot see** or **smell** could be causing **serious harm** to the environment, public health, and your business. This section explains **why leaks and venting must be avoided**, and how every technician can be a **guardian of climate safety**.

The Two Big Problems: Ozone Layer Depeletion and Global Warming



- Older-generation refrigerants had ozone-depleting potential, meaning that when they leaked into the atmosphere, they contributed to the thinning of the Earth's ozone layer. This ozone layer acts as a natural shield, protecting us from the sun's harmful ultraviolet (UV) radiation.
- Because of this serious environmental impact, the world took collective action. The Montreal Protocol—a global environmental agreement—guided countries in phasing out these harmful substances to help the ozone layer recover.

- **Global Warming Impact:** Many commonly used refrigerants have a very high Global Warming Potential (GWP), meaning they trap far more heat in the atmosphere than carbon dioxide.
- **What GWP Means:** GWP measures how strongly a gas warms the atmosphere compared to the same amount of CO_2.
- **Example:** The refrigerant R-410A has a GWP of more than 2,000. This means **1 kg of R-410A leaking into the air causes as much warming as over 2,000 kg of CO_2.**

Figure 2: Dual climate challenge due to refrigerant emissions

Why Leakage is a Silent Threat?

Refrigerant leaks are silent, invisible, and extremely damaging. They slowly escape into the atmosphere, with effects that last for decades. Table 2 explains various consequences of refrigerant leakage.

Table 2: Impacts of refrigerant leaks

Consequence	What It Means
Environmental Harm	Just **1 kg of R-410** leaking has the same warming effect as **2.1 tonnes of CO_2**.
Health Hazards	Direct exposure to leaking refrigerant can cause frostbite, dizziness, breathing difficulties, or even asphyxiation in closed spaces.[#]
Financial Loss	Lost refrigerant = wasted money for technicians and customers.
System Damage	Leaks lower system pressure, reduce cooling efficiency, and cause compressor failure over time.

How Leaks Happen? Common Causes

Leaks usually occur because of poor maintenance, ageing systems, or careless handling during installation and servicing. Table 3 lists various causes of leakage and how to prevent it.

Venting: The Worst Practice

Venting is when refrigerant is intentionally released into the air instead of being properly recovered using tools like a recovery machine. It may seem quick and easy, but it is dangerous, and completely avoidable.

CONSUMER ALERT!

Watch out for these warning signs and contact a trained HVAC technician immediately if you notice them:

Reduced Cooling Performance: When the refrigerant is low, the AC cannot remove heat properly. This makes the room cool very slowly, and the air from the vents may not feel cold.

Hissing or Gurgling Noises: Cracks or holes in the refrigerant coils can cause a **hissing sound**. A larger leak may produce **gurgling noises**.

Frozen Coils & Water Drips: Without sufficient refrigerant, coils can freeze due to poor heat absorption. When the ice melts, you might see water puddles around the indoor unit. If ignored, this can lead to serious system damage.

Unusually High Electricity Bills: A leaking system works harder to maintain comfort, driving up energy consumption and utility costs.

⚠ **Tip:** Addressing a refrigerant leak early can prevent costly repairs, improve cooling performance, and reduce environmental harm.

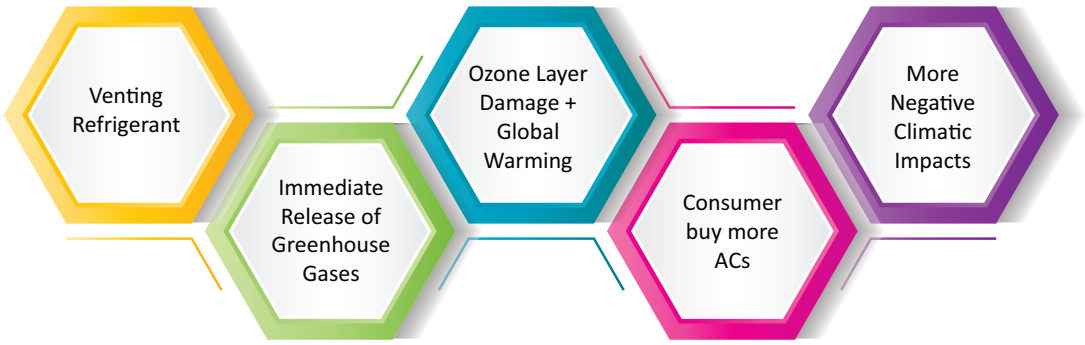
Table 3: Common cause of leakages

Cause	Example	How to Prevent
Worn Seals or O-Rings	Cracked or hardened seals after long use	Replace seals and O-rings during regular servicing
Improper Charging	Overcharging increases system pressure and causes leaks	Use correct charging methods with calibrated gauges/scales
Loose Connections	Vibrations loosen flare joints or fittings	Check and tighten all connections during each service
Corrosion or Rust	Pipes/coils corrode in humid, coastal, or industrial areas, leading to pinhole leaks	Replace damaged parts; use corrosion-resistant materials/coatings
Physical Damage	Dents or damage during transport or installation	Handle equipment carefully; use protective caps

[#] Details available at https://pubmed.ncbi.nlm.nih.gov/1891741/

What Happens When Refrigerant is Vented Out

The flowchart below shows how venting refrigerants creates a harmful chain reaction. When gases are released into the air, they immediately contribute to greenhouse gas emissions, leading to ozone layer damage and global warming. This rise in temperatures drives more people to purchase cooling systems, increasing energy use and refrigerant demand, ultimately worsening the effects of climate change.



Action Point for Technicians: Checklist for Spotting and Stopping Leaks

Technicians can prevent disasters by following this simple 5-step checklist:

Step	Action
1	Look for oil stains or frost build-up on pipes
2	Use soap bubble test or electronic leak detector
3	Recover remaining refrigerant using a recovery machine before repairs
4	Replace faulty parts using approved methods and tools
5	Recharge the system, conduct a final leak test, and label clearly with refrigerant details

Pro Tip: Always carry basic safety gear — gloves, goggles, and a mask — when handling refrigerants.

By handling refrigerants safely and avoiding leaks or venting, technicians play a vital role in protecting both the environment and their communities. Every safe recovery and repair helps fight climate change while building trust with customers. With the right skills and practices, technicians can lead the way towards a cleaner, greener, and more sustainable cooling in future.

Understanding Refrigerant Recovery and Reclamation Tools

by Sneha Kashyap, Research Associate, TERI

Refrigerant recovery is the essential first step in proper refrigerant management. It involves removing used refrigerants from cooling systems to prevent them from being released into the atmosphere. Refrigerant needs to be removed from the system as a result of compressor breakdown, coil replacement, relocation, and decommissioning. By doing so, this protects the ozone layer, reduces greenhouse gases, saves money, and keeps equipment running efficiently.

Tools Required for the Refrigerant Recovery

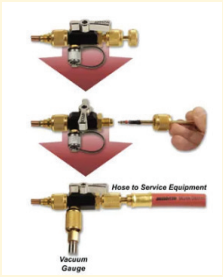
Refrigerant recovery requires the right set of tools to make the recovery safe, efficient, and effective. The most important piece of equipment is the recovery machine, which pulls the refrigerant out of the system. Once recovered, the refrigerant is stored in a recovery cylinder, a specially designed container that keeps it secure until it can be reused, recycled, or reclaimed.

To keep track of pressures and flow during the process, technicians rely on a manifold gauge set, while oil separators and in-line filters help prevent dirt or oil from contaminating the refrigerant. Alongside these, hoses create leak-proof connections between the system and recovery unit; while a valve core removal tool speeds up refrigerant flow; digital thermometer helps monitor system and cylinder temperatures for safety; and a leak detector ensures no refrigerant escapes into the atmosphere.

Together, these tools complement the core equipment and make recovery faster, cleaner, and compliant with regulations (Table 4).

Table 4: Refrigerant recovery tools, their application and use precautions

Tools and Equipment	Application	Precautions While Handling
 **Recovery Machine**	Pulls refrigerant out of the system during recovery.	▪ Keep it on a flat surface. ▪ Don't pull it by the hoses. ▪ Protect from water and dust.
 **Recovery Cylinder/Tank**	Special container to securely store recovered refrigerant for reuse, recycle, or reclaim.	▪ Always keep tank upright. ▪ Store away from heat and sun. ▪ Use a trolley to move, don't drop or roll.
 **Manifold Gauge Set**	Monitors system pressure and refrigerant flow during the recovery process.	▪ Avoid tightening valves too hard. ▪ Keep gauges clean and in a case when not in use.

Tools and Equipment	Application	Precautions While Handling
 **Oil Separators and In-line Filters**	Prevent dirt, oil, and moisture from contaminating recovered refrigerant.	• Change filters with clean hands or gloves.
 **Hoses**	Provide leak-proof connections between the system, gauges, and recovery unit.	• Avoid bending or pulling sharply. • Keep away from sharp edges. • Roll loosely after use.
 **Valve Core Removal Tool**	Removes valve cores to speed up refrigerant flow and improve recovery efficiency.	• Don't apply extra force. • Keep clean and dry after use.
 **Digital Thermometer**	Monitors system and cylinder temperatures to ensure safe operation.	• Don't bend the probe. • Protect display from heat and water.
 **Leak Detector**	Detects refrigerant leaks, preventing environmental release.	• Keep sensor covered when not in use. • Check batteries. • Don't drop or shake.

The exact choice of recovery method and tools depends on the type of cooling system and the refrigerant being handled. For example, a small split air-conditioning unit may only need a portable recovery machine, while a large chiller requires high-capacity equipment. By matching the right tools and techniques to each system, technicians can ensure the recovery process is not only efficient but also safe and compliant with regulations.

These tools form the backbone of any recovery job, and the exact combination used will depend on the system and refrigerant in question. Figure 3 shows refrigerant being recovered from an AC.

Refrigerant recovery generally follows three key stages (Figure 5). It begins with system preparation, where the unit is safely shut down, hoses are connected, and the right recovery cylinder is selected. Figure 4 shows a typical refrigerant recovery system and its components. Next comes the recovery operation, which involves using the recovery machine to extract refrigerant while maintaining proper temperature and pressure, with gauges ensuring the process runs smoothly. Finally, during post-recovery handling, the cylinder is weighed, checked for leaks, and clearly labelled with the refrigerant type to ensure safe storage and compliance.

There are three fundamental methods for recovering refrigerants: liquid, vapour, and push-pull. Different HVAC

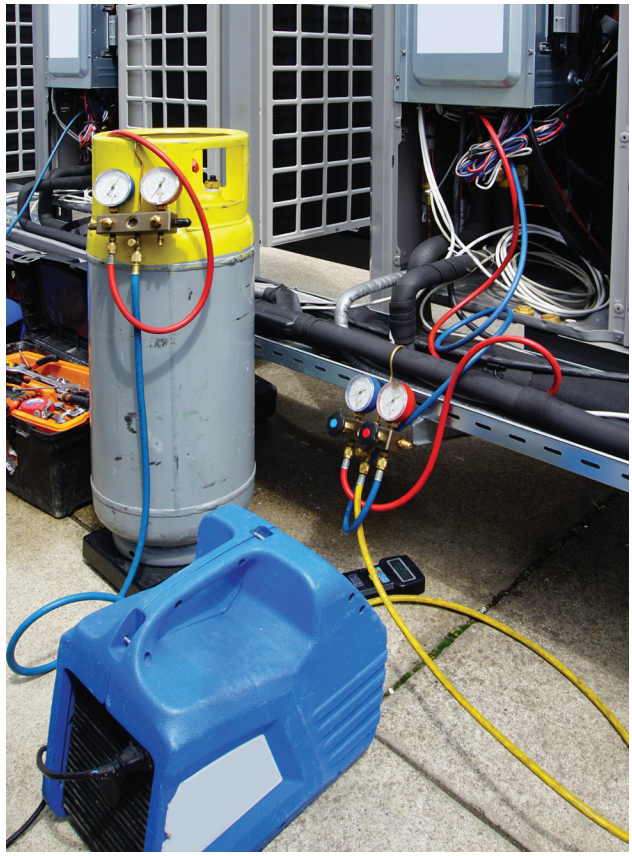


Figure 3: Refrigerant being recovered from an AC

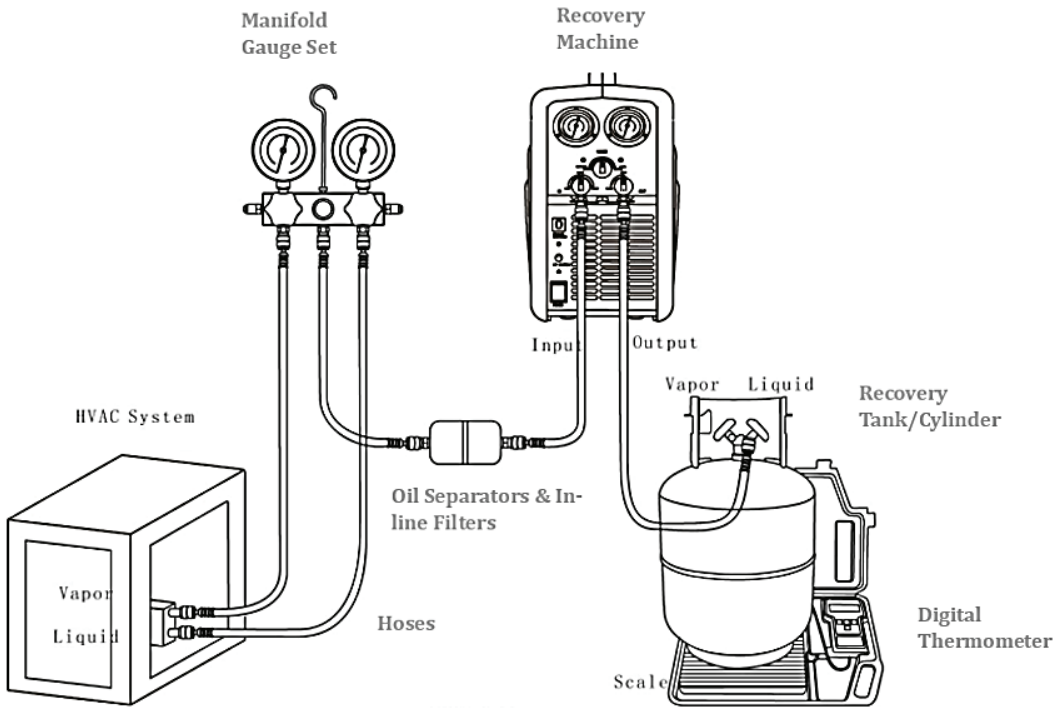


Figure 4 : Typical refrigerant recovery system

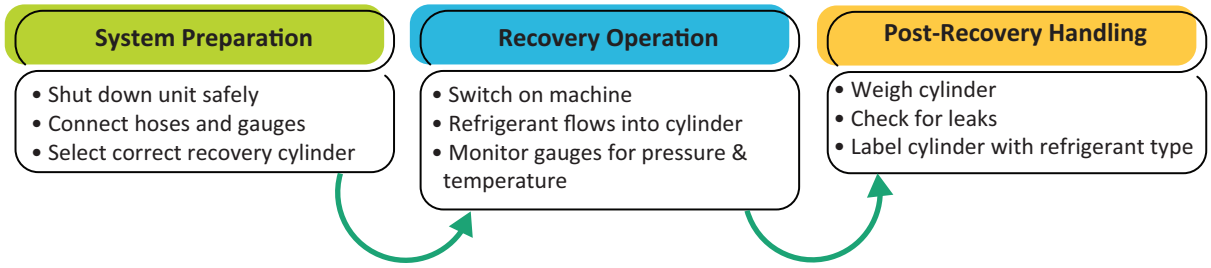


Figure 5: Stages of recovery

systems call for different recovery methods. Refer Table 5 to understand when to use and why to use a particular method.

No matter which recovery method a service technician uses, the job is safe only if the refrigerant is stored properly. To ensure this, technicians should:

- Always keep enough recovery cylinders on-site and make sure they are the right size (13.6 kg or 22.6 kg).
- Never mix different refrigerants. Store each refrigerant type in its own separate cylinder.
- Send a small sample to an AHRI-certified lab for testing, if unsure of refrigerant's purity.
- Don't fill cylinders more than 80% of their total capacity, because refrigerants expand as temperature rises. Overfilling can cause leaks, pressure build-up, or even cylinder damage. Also, the safe weight limit is different for each refrigerant type.

Efficient refrigerant recovery is important, but safety always comes first. Technicians should always wear gloves and goggles for protection and work in a well-ventilated area. Use only approved recovery machines and cylinders to keep the process safe and smooth. Venting refrigerants into the air harms the environment, so it should always be avoided. Rules like India's ODS Rules (2000) and the US EPA Section 608 guide us on how to handle refrigerants the right way. See do's and don'ts in Figure 6 while recovering refrigerants from an equipment.

What Happens after Recovering Refrigerants?

Once refrigerants are recovered, they can be recycled, reclaimed, or destroyed (Figure 5). Recycling usually means filtering and cleaning refrigerant for reuse in the same system. Reclamation, however, goes further as it restores used refrigerant to the same purity standards as new gas (such as AHRI-700 specifications). This is done at certified facilities where the refrigerant is reprocessed, tested, and verified before re-entering the market.

Reclamation is becoming increasingly important as the production of high-GWP refrigerants is phased down under international agreements like the Kigali Amendment to the Montreal Protocol. By reclaiming refrigerant, we reduce demand for virgin production, cut greenhouse gas emissions, and ensure a steady supply of quality refrigerants for future servicing needs.

In short, reclaiming gives refrigerants a "second life" combining environmental responsibility with cost savings and regulatory compliance.

After collecting refrigerant, it is transported to the reclamation facility in leak-proof, upright cylinders handled with care and in compliance with PESO and local transport regulations, where this used refrigerant is purified through chemical treatment, distillation, and filtered to restore it to a high standard of purity (AHRI-

Table 5: Methods of recovering refrigerants

Recovery Method	When to Use	Why Suitable for Use
Vapour Recovery	Small to medium systems, or when only vapour is left in the system	Works with all types of systems, safe and reliable, but slower than liquid recovery
Liquid Recovery	Large systems with big refrigerant charges (e.g., chillers)	Faster removal since refrigerant is recovered directly as liquid; reduces job time
Push-Pull Recovery	Systems with >8–10 kg of liquid refrigerant stored in receivers or large tanks	Moves large amounts of liquid quickly using pressure difference; requires finishing with vapour recovery

Do's

- Wear safety gear – always use gloves, goggles, and ensure good ventilation.
- Check refrigerant type – identify before recovery; keep different gases separate.
- Follow the machine manual – every recovery unit has its own instructions.
- Recover liquid first, then vapour. The vapour makes up most of the total recovery.
- Use short and wide hoses – speeds up recovery and reduces losses.
- Fit an inline filter – prevents dirt or slivers from damaging the machine.
- Purge equipment after every job – keeps the machine clean and efficient.
- Use PESO-certified cylinders only – fill max 80% and recertify every 5 years.
- Maintain proper records for- refrigerant type and quantity recovered.

Don'ts

- Don't mix different refrigerant types.
- Don't overfill cylinders beyond 80% capacity, gas expands.
- Don't connect gauges carelessly – low-side gauges can burst from high pressure.
- Don't expose recovery machines to dirt or moisture.
- Don't forget to purge or service equipment between jobs.
- Don't release refrigerant into the air – follow India's ODS Rules, 2000.

Figure 6: Do's and Don'ts of refrigerant recovery process

Figure 7: Stages of LRM

700), equivalent to that of new, or "virgin," refrigerant. The entire process of reclamation is explained as follows:

The reclaimed refrigerant, restored to virgin-quality, is repackaged in certified cylinders and can be safely reused in any compatible HVAC system, ensuring full safety. The Government of India has taken several steps to train the trainers/instructors in RAC Skills Trade. It has given out hundreds of recovery machines at subsidized rates so that more technicians can use them, and has also set up 18 mini-reclamation centres across the country to process range of refrigerants.[2] To upgrade skills, the Ozone Cell regularly trains service technicians under the HCFC Phase-out Management Plan (HPMP) to learn the right way to handle refrigerants.

Steps	Application	Tools Used	Precaution
Sample Testing	Check refrigerant for contamination or mixing	 **Gas analysers**	Handle samples in a ventilated lab; avoid exposure to leaked vapours.

[2] https://ozonecell.nic.in/wp-content/uploads/2019/03/INDIA-COOLING-ACTION-PLAN-e-circulation-version080319.pdf

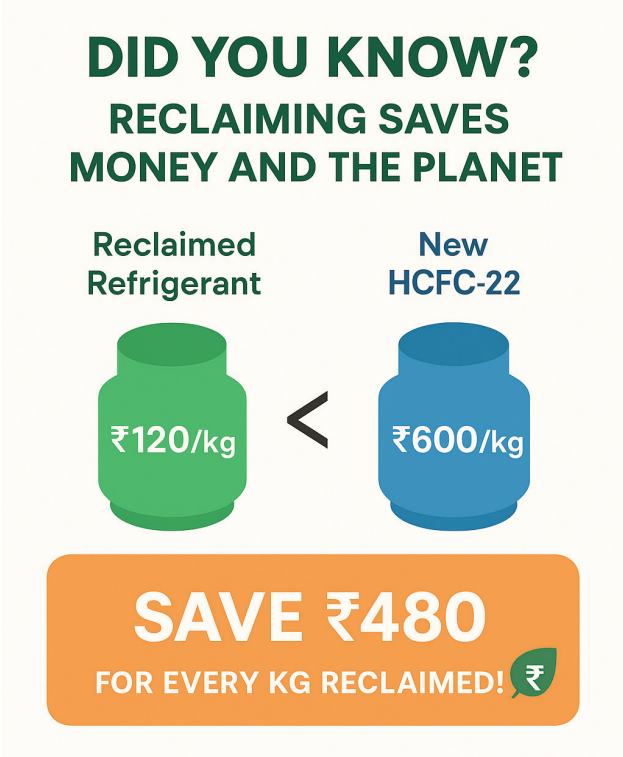
Cleaning	Remove oil, moisture, acids, and particulates	 **Filtration units, dryers, oil separators**	Regularly check filters/dryers for clogging; wear gloves when handling oil residues.
Distillation and Purification	Separate refrigerant from contaminants or mixed gases	 **Distillation columns, compressors**	Monitor pressure/temperature carefully; ensure compressor safety valves are working.
Quality Testing	Verify refrigerant meets AHRI-700 purity standard	 **Purity analysers**	Calibrate analysers before testing; avoid contact with sample outlets.
Repackaging and Resaling	Fill purified refrigerant into certified cylinders for resale/ reuse	 **Certified cylinders, sealing equipment**	Fill only up to 80% of cylinder capacity; check valves and seals for leaks.

Figure 8: Training of Trainers on good RAC servicing practices with HCFC-22 and flammable refrigerants, organized by GIZ Proklima and Ozone Cell, MoEFCC at ITI Pusa, New Delhi from October 21–25, 2024

70 refrigeration and air conditioning (RAC) technicians from the Delhi Metro Rail Corporation (DMRC) completed hands-on training in safe servicing practices under India's HPMP Stage II. Under these training initiatives, a dedicated programme was recently conducted for technicians from the Delhi Metro Rail Corporation.

Reclaiming refrigerant not only protects the environment but also makes strong financial sense. The cost of reclaiming one kilogram of refrigerant is about INR 120, while buying the same quantity of new HCFC-22 costs nearly INR 600. This means a dealer or RAC technician saves around INR 480 for every kilogram of refrigerant reclaimed turning proper refrigerant management into both an eco-friendly and cost-saving practice.[3]

Refrigerant recovery and reclamation are important steps as these reduce the need to buy fresh refrigerant and help in following safety and government rules. With more training, better tools, and small reclamation centres, technicians in India can manage refrigerants in a way that is good for both their work and the environment.



[3] https://ozonecell.nic.in/wp-content/uploads/2021/08/Vikram-Murthy-1.pdf

Skills and Training for Service Technicians

What is Recovery and Reclamation?

Recovery involves extracting refrigerants from systems during servicing, upgrades, or before disposal to prevent harmful gases from escaping and allow safe storage for future use. The process begins with collecting refrigerants into storage cylinders, though they may still contain impurities such as oil or moisture. For example, a technician may recover refrigerant from an air conditioner before dismantling it.

On the other hand, reclamation is the process of purifying used refrigerants to meet industry standards so they can be reused like new. It involves multi-step purification and testing at specialized facilities to remove contaminants and degradation byproducts. For example, a reclamation facility processes used refrigerant, removes impurities, and certifies it to meet strict purity standards for reuse.

Recovery, Recycling, and Reclamation are all key components of Lifecycle Refrigerant Management (LRM). Together, they ensure that refrigerants are managed safely, reused wherever possible and disposed of responsibly. Table 6 summarizes these processes and their roles in effective LRM.

Essential Skills for Technicians in Refrigerant Recovery and Reclamation

Service technicians are the backbone of refrigerant management, ensuring recovery and reclamation are carried out safely and efficiently. Their expertise protects the environment, ensures compliance, and supports sustainable cooling practices. Figure 9 highlights the essential skills technicians need for effective refrigerant recovery and reclamation.

Refrigeration and Air Conditioning (RAC) ITI Courses

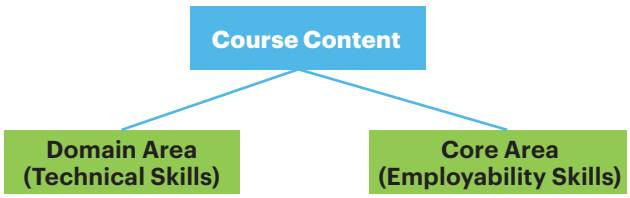
The Refrigeration and Air Conditioning (RAC) ITI course trains students to become skilled technicians who can install, service, and repair refrigerators, air conditioners, and other cooling systems. It is a two-year course under the Craftsmen Training Scheme (CTS), offered by Industrial Training Institutes (ITIs) all over India. After completing the training, candidates receive the National Trade Certificate (NTC), which is recognized in India and abroad.

Table 6: Overview of Refrigerant Handling Processes

Process	Description
LRM (Lifecycle Refrigerant Management)	Comprehensive management of refrigerants throughout their life: recovery, recycling, reclamation, reuse, and safe disposal to minimize environmental impact.
Recovery	Safely remove refrigerant from AC or cooling systems during servicing, maintenance, or end-of-life, preventing leaks into the atmosphere.
Recycling	Filter and clean recovered refrigerant so it can be reused in the same system without compromising performance.
Reclamation	Purify used refrigerant at specialized facilities to meet industry standards, making it safe for reuse in any system.

Figure 9: Key skills technicians need for effective refrigerant recovery and reclamation

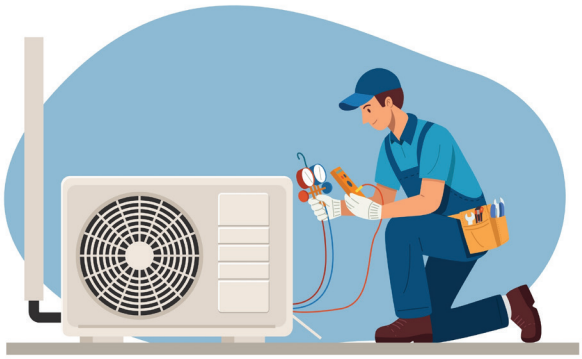
During the two-year RAC ITI course, trainees undergo workshop practice, on-the-job training, and project work on refrigeration and air conditioning systems. After



completion, they are skilled in installation, servicing, troubleshooting, refrigerant handling, and maintenance of domestic as well as commercial RAC units.

Lifecycle Refrigerant Management in ITI Courses

At present, RAC ITI courses effectively teach refrigerant recovery and safe handling, giving students strong practical skills for servicing. While reclamation is not yet fully included, adding it in the future will further enhance technicians' expertise and support sustainable refrigerant



management. With comprehensive training, students acquire the skills to safely recover and handle refrigerant gases, develop LRM expertise, and, in the future, reclaim refrigerants for reuse and waste reduction. Through practical projects, industrial visits, and on-the-job training, ITI graduates are equipped to implement sustainable refrigerant practices, minimize emissions, support circular economy principles, generate employment opportunities, and ensure that modern cooling technologies remain efficient, safe, and environmentally responsible.

From Recovery to Recycling: EPR in India's Cooling Sector

Service technicians play a key role in India's Extended Producer Responsibility (EPR) system for air conditioners and refrigerants. Under the Government of India's E-waste Management Rules, manufacturers are responsible for managing old or end-of-life AC units, including the collection, recycling, and safe disposal of refrigerants.

In this process, service technicians are often the first point of contact, ensuring that refrigerants are properly recovered and not released into the atmosphere. From there, the units and refrigerants are transferred to the manufacturer's collection system and eventually reach authorized recycling or reclamation centres. To comply with Extended Producer Responsibility (EPR) guidelines, producers must register with the Central Pollution Control Board (CPCB), prepare and follow an EPR Plan, meet collection targets, and collaborate with Producer Responsibility Organizations (PROs) and authorized recyclers. By taking these precautions, old AC units can be securely transported to recycling and reclamation facilities, establishing a closed-loop system that promotes sustainable, eco-friendly, and effective cooling technology.

The end-to-end process from the point at which an AC unit stops functioning to the stage where refrigerant can be reclaimed and returned to manufacturers is illustrated in Figure 10. This flow chart shows how technicians can recover refrigerant, how it moves through authorized collection centres, and how reclaimed refrigerant can re-enter the supply chain.

As the cooling industry continues to grow, the demand for qualified technicians will increase significantly. Expanding ITI courses and strengthening training in refrigerant recovery, recycling, and reclamation will equip a larger workforce with the skills needed for sustainable refrigerant management. This approach will support environmentally responsible growth, enhance energy efficiency, promote circular economy practices, and create substantial employment opportunities in the sector.

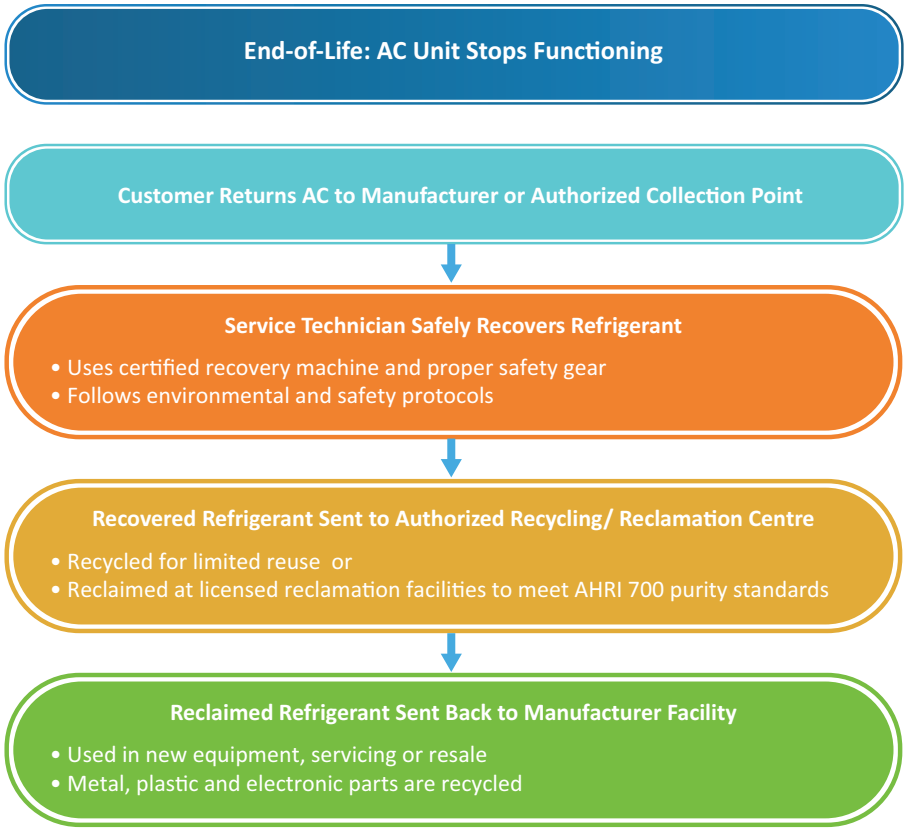


Figure 10: Steps in safe AC disposal and refrigerant management

Mr Hiralal is Chandigarh-based Room AC service technician and has 10 years of working experience.

From the field:

Mr Hiralal is Chandigarh-based Room AC service technician and has 10 years of working experience.

What is the nature of your job?

Ans: I work full-time with Aar Aar Enterprises as an air-conditioning (AC) technician. My primary responsibilities include the installation and servicing of various room air-conditioning systems such as split ACs, cassette ACs, and window ACs. The work requires both technical skills and attention to detail to ensure that every system functions safely and efficiently for the end user.

Which refrigerants do you commonly handle, and how do you manage flammable refrigerants safely?

Ans: In my day-to-day work, I most commonly handle R-410A, R-32, and R-22 refrigerants. While I first learned about these during my ITI course, it was practical, on-site experience that truly helped me build confidence and develop safe handling techniques. Through this hands-on learning, I have also become familiar with flammable refrigerants and the precautions required when working with them. This experience has been especially important as the market gradually shifts towards new-generation, environmentally friendly refrigerants.

Are you professionally trained? What training have you undergone?

Ans: Yes, I completed the full RAC technician course at the State ITI, which provided me with the fundamental skills required for installation and servicing. This included training in brazing, evacuation, and refrigerant charging, among other key operations.

In addition, I receive continuous, practical training through Aar Aar Enterprises and attend refresher sessions that are periodically organized in collaboration with equipment manufacturers and government-led initiatives. Currently, I am expanding my skills to work with Variable Refrigerant Volume (VRV) systems, which are becoming more common in the market.

Would you be interested in future training programmes to stay up-to-date with new refrigerants and technologies?

Ans: Yes, certainly. Training on next-generation refrigerants, including their safety protocols and advanced servicing techniques, will be very valuable in the coming years. Such programmes will help technicians like me keep pace with industry developments and deliver safe, reliable services to customers.

What type of information would you like to see in the newsTRAC newsletter for service technicians?

Ans: I would be keen to read about the latest refrigerants, new tools, and emerging technologies in the RAC sector. This kind of information helps service technicians stay informed and better prepared to meet changing market needs, while also maintaining safe and sustainable practices.

HPMP
HCFC Phase-Out Management Plan, Servicing Sector

GOOD SERVICE PRACTICES FOR ROOM AIR-CONDITIONERS

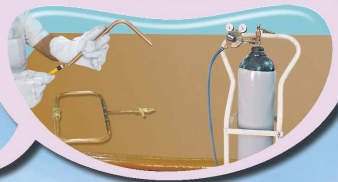
RECOVER RECYCLE RECLAIM

RECOVERY OF REFRIGERANT FROM SYSTEM FOR REUSE IN THE SAME SYSTEM

REPAIR/REPLACE DEFECTIVE PARTS WITH OEM PARTS

PROPER BRAZING &/OR FLARING

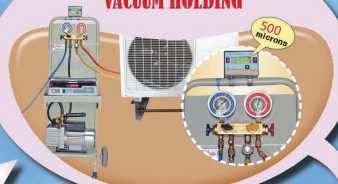
CLEANING/ POLISHING AND FLUSHING WITH OXYGEN FREE DRY NITROGEN



Committed to **Quality Service**
Committed to **The Environment**

LEAK/ PRESSURE TESTING WITH OXYGEN FREE DRY NITROGEN

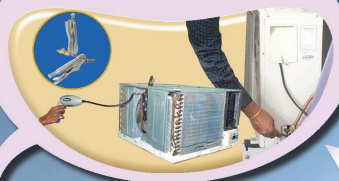
EVACUATION AND VACUUM HOLDING



Boiling Point of Water °C	Vapor Pressure in Microns
100	7,59,968
50	92,456
30	31,750
10	8,641
0	4,572
-10	1,722
-23.35	500

Our aim 500 microns

SEALING PROCESS TUBE/CLOSING VALVES

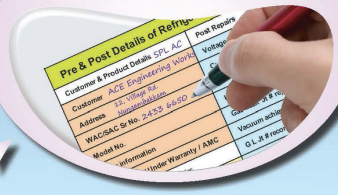


REFRIGERANT CHARGING BY WEIGHT

SAFETY ALWAYS

CHECK FOR PROPER OPERATION AND FINAL LEAK CHECK

RECORD DETAILS OF WORK DONE



SAVE OUR OZONE LAYER

HPMP (HCFC PHASE-OUT MANAGEMENT PLAN): SERVICING SECTOR

A Project of the Ozone Cell, Ministry of Environment & Forests (MoEF), Government of India in co-operation with the Government of Germany represented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and United Nations Environment Programme (UNEP)

giz

UN environment programme

www.ozonecell.nic.in

Ready Reference for Good Servicing Practices Videos

Basic tools overview

Evacuation of Air Conditioner

Flaring

Leak Detection

Refrigerant Charging

Want to learn and explore more about good servicing practices, scan here:

Ministry of Environment, Forest & Climate Change
Government of India

For further information

Ozone Cell, Ministry of Environment, Forest and Climate Change

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