

COPA Implementation Models Working Group 2026

Session 1: Refrigerant Recovery, the First Building Block for Scalable
Lifecycle Refrigerant Management
10:00-11:30 am CEST; 11 June 2026;

Sukumar Devotta
Former Director, CSIR-NEERI, Nagpur &
Former Professor of Eminence, Anna University, Chennai
sdevotta@gmail.com

This presentation has been prepared using various documents published by UNEP

Recover, Recycle and Reclaim

ISO – 11650: “Performance of refrigerant recovery and/or recycling equipment & UNEP Montreal Protocol Handbook

- **Recover:** remove refrigerant in any condition from a system and store in an external container
collection and storage of controlled substances from machinery, equipment, containment vessels, etc., during servicing or prior to disposal.
- **Recycle:** reduce contaminants in used refrigerants by separating oil, removing non-condensable gases, and using devices such as filter- driers to reduce moisture, acidity and particulate matter.
reuse of a recovered controlled substance following a basic cleaning process such as filtering and drying; normally involves recharge back into equipment, it often occurs “on-site”.
- **Reclaim:** process used refrigerant to a new product (gas) specifications, and verify by chemical analysis of the refrigerant that new product specifications have been met.
re-processing and upgrading of a recovered controlled substance through such mechanisms as filtering, drying, distillation and chemical treatment to restore the substance to a specified standard of performance; often involves processing “off-site” at a central facility.

Refrigerants – Currently Used and their Safety Issues

Refrig.	Inhalation	Flammability	Pressure
R744	Low toxicity	Non flammable	Much higher
R717	Highly toxic	Mildly flammable	Lower
R32	Asphyxiant	Mildly flammable	Higher
R1234ze	Asphyxiant	Mildly flammable	Lower
R600a	Asphyxiant	Highly flammable	Much lower
R290	Asphyxiant	Highly flammable	Similar
R1270	Asphyxiant	Highly flammable	Similar

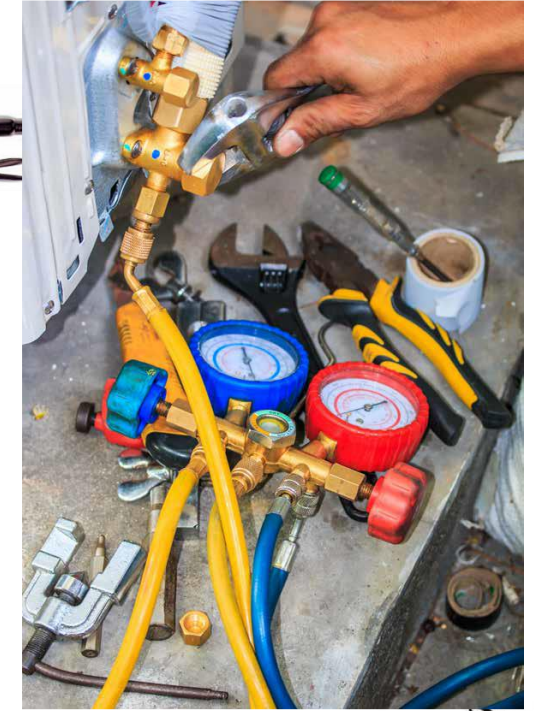
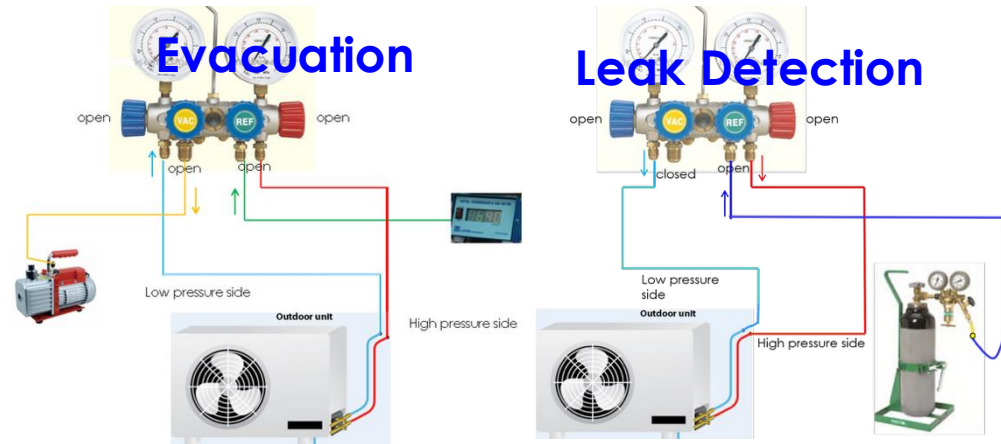
- Currently HPMP is still going on in many A5 parties
- HPMP is dealing with mainly the phase out of HCFC-22 using lower GWP refrigerants
- KIPs is simultaneously addressing phase down of HFCs using Lower GWP refrigerants
- Lower GWP refrigerants include both synthetic (HFC-32, HFO-1234yf, HFO-1234ze and HFO/HFC blends) and natural refrigerants, R-717, R-744, R-290, R-600a and HC Blends)
- The technicians so far handled mostly non-flammable and non-toxic refrigerants and safety was not a major concern with respect to flammability
- There are safety issues with all of them, with respect to flammability - A2L(e.g., HFC-32 and HFO1234ze) and A3 – HFC-32), toxicity B2L – R-717 and high pressure (R-744 supercritical pressure).

Recover, Recycle and Reclaim

- This presentation focuses only on recover, recycling and reclamation
- Most of the refrigerant banks are in smaller volumes in Air-conditioners (Split ACs and MAC)
- The refrigerants being dealt includes HCFC, HFC, HFOs, HCs, Blends.
- Most of the service for MACs is done in OEMs workshops and is generally well organised, including R&R.
- Refrigerators, Appliances and ACs are serviced in field with limited tools, which can be carried in two wheelers.

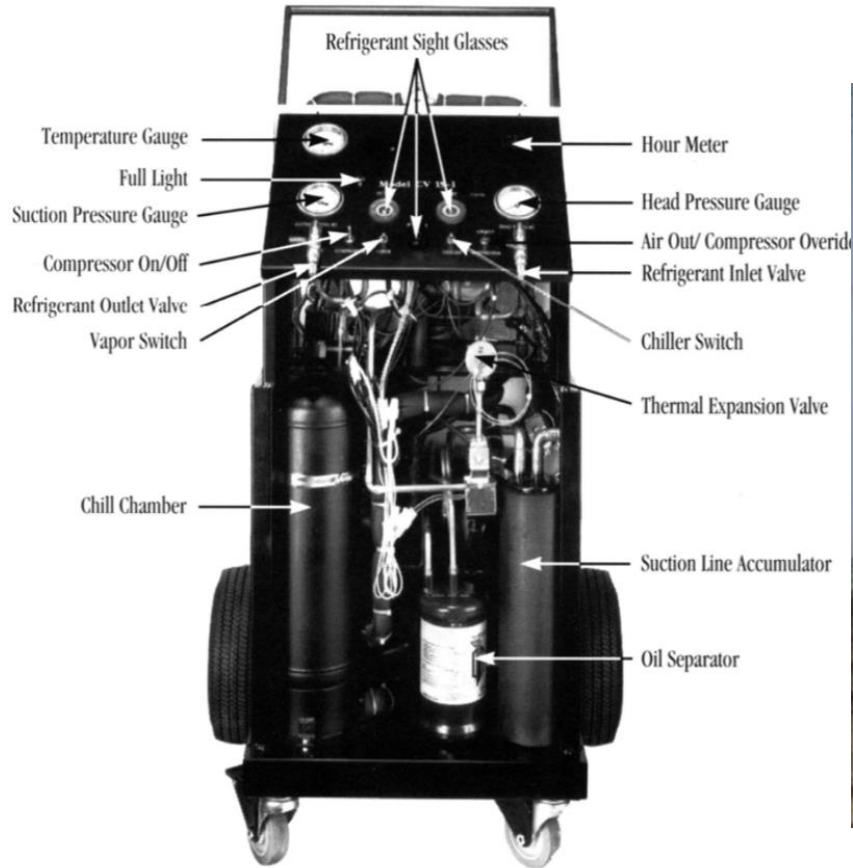


Tools for Servicing, Recovery & Recycling



Mini-Reclamation

- This is to process used refrigerant to new product specification, by means which include distillation.
- Chemical analysis of the refrigerant is required to determine that appropriate product specifications are met.
- Reclaiming usually implies the use of processes or procedure available only at a manufacturing facility and involves expensive equipment and can be expensive.
- Mini reclamation centers are available in the market to reclaim refrigerant now a day.



Technicians Training – Why?

- To safely handle alternative refrigerants, including HFCs, HFOs, HCs or their blends, ammonia and CO₂, as these are either lower or higher flammable or higher toxicity or high-pressure refrigerants. These types of refrigerants were not commonly used in the recent past.
- To train to the use of appropriate tools, evacuation and leak testing and minimization of venting and R&R of refrigerants,.
- Reduce accidents occur due to human error and ignoring SOPs (e.g., leaky joints, improper handling of toxic refrigerants e.g., R-717 (ammonia), leak testing with air while using flammable refrigerants, inaccurate/ inappropriate charging of refrigerants, or careless handling relatively high-pressure fluids e.g., R-744
- Safe and good service practices are not still common in many A5 parties as the technicians may not have access to all the required tools. It is also a challenge to carry the tools, recovery machines and cylinders in A5 parties as they generally travel by two wheelers

Technician Training Certification

- Most of the advanced countries have technician certification for safe handling of flammable refrigerants or to avoid venting of refrigerants.
- Only certified service technicians are permitted to install and service to ensure regulatory compliance.
- Certification act as an ‘added value’ for technicians social status and identity, prove their competence, employability and proficiency leading to extra earnings.
- The service sector in A5 parties is largely an informal one, operating fully during summer and migrate to other service during off-seasons.
- Several training programmes have been initiated across many A5 parties under the MP HPMP programmes; still numbers with all required tools remain low.
- The certification programmes are being implemented through some training agencies involving competency tests, covering both theoretical and practical aspects of servicing of major RACHP sectors.
- These certification programmes mostly on voluntary basis and eventually these should become mandatory. .

Lessons Learned & Concluding Remarks

- Tools and associated costs for recovery, storage and transportation of refrigerants to a reclamation centre is a serious deterrents.
- To recover refrigerants from appliances economically, with adequate purity levels to be recycled/ reused is a major challenge
- In countries like India, where refrigerants and appliances are manufactured, the economics works unfavourable for R& R.
- Dismantling appliances at the end of their life and recovering refrigerant are more challenging.
- Absence of financing mechanisms and lack of regulations are major hurdle for R&R at the end-of-life of equipment in A5 parties.

Mandatory certification of technicians and financial assistance to equip them with all required tools and service vans are to be considered.

Thank You!
Any Questions?