

# newsTRAC

NEWSLETTER FOR TECHNICIANS IN REFRIGERATION AND AIRCONDITIONING (RAC) SECTOR

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United Nations  
Environment Programme



The Energy and Resources Institute



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## Foreword

The 29th Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer (MOP 29), held in November 2017, was an important milestone as it was the first meeting after the historic Kigali Amendment for phase down of Hydrofluorocarbons (HFCs) under the Montreal Protocol. Several important issues related to financing including support to RAC service during the HFC phase down were discussed. India piloted the adoption of an important decision at the meeting which requires a detailed report to be made inter alia on energy efficiency and RAC service sector while phasing down HFCs.

The interventions in service sector training and capacity building are an important component in the phase-out plans of Hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs) under the Kigali Amendment such as. This requires active participation from RAC service technicians for effective implementation. Besides, such interventions promote energy efficiency by training technicians in efficient maintenance of RAC equipment.

It gives me immense joy that 'NewsTRAC – a Newsletter for Technicians in RAC Sector' is coming up with its second issue as a continuation of its efforts to build

capacity of technicians on good practices and in keeping them abreast with new developments under the Montreal Protocol. The newsletter will keep the technicians and other stakeholders updated on the latest technology, servicing-related technical information and various activities and initiatives of the Government of India under its HPMP (HCFC Phase-out Management Plan) including training calendars and awareness workshops.

I hope this newsletter, through its print and electronic version, proves to be an effective enabler in achievement of India's commitment under the Montreal Protocol.

I acknowledge the support of UN Environment as cooperating agency under HPMP for enabling activities and, and active role of The Energy and Resources Institute (TERI), as the national knowledge and implementing partner associated with bringing out the newsletter.

My best wishes to all the readers of NewsTRAC.

Regards,

**Gyanesh Bharti**

Joint Secretary

Ministry of Environment, Forest and Climate Change

# Good Practice: Application tools for RAC servicing technicians

Author: Mr. Liazzat Rabbiosi, UN Environment (UNEP)

The article provides an overview of various information and capacity building tools - traditional and modern smartphone based - that many service technicians will find useful and handy in enhancing their knowledge and skills for the servicing and maintenance of RAC systems.

## Compliance Assistance Programme under Montreal Protocol, UN Environment Regional Office for Asia and the Pacific

UN Environment has been long helping developing countries to meet and sustain their compliance with the commitments under the Montreal Protocol on Substances that Deplete the Ozone Layer. A major area in this respect is building the capacity of servicing technicians in Refrigeration and Air-conditioning (RAC) sector to help them service equipment in a better way by applying good practice principles and techniques. RAC products tend to use refrigerant gases that deplete the protective ozone layer and contribute to global warming of the climate. The role of servicing technicians is critical in ensuring not only the longevity, efficiency, and safety of these products but also in minimising their impact on the environment during their use phase.

## Fact Sheet on Safe Use of HCFC Alternatives in Refrigeration and Air-Conditioning: - Flammable Refrigerant

As the phase out of HCFCs progresses, it is expected that there will be a considerably higher uptake in developing countries especially of alternatives such as hydrocarbons, ammonia, carbon dioxide, etc. Many of these refrigerants have characteristics in terms of toxicity, flammability, and high pressure which are different from the previously used substances. When RAC equipment is installed, serviced, repaired and dismantled, safety issues need to be carefully evaluated and considered, particularly when servicing technicians have to deal with refrigerants with properties that they were previously not familiar with. It is, therefore, important that RAC industry adds to the technical and safety issues concerning these refrigerants.



Two more factsheets deal specifically with two categories of refrigerant: high pressure, and higher toxicity.

### Phasing out HCFCs in the Refrigeration and Air-conditioning Servicing Sector

This guide for trainers is designed for organisations and institutes that conduct training workshops for servicing technicians involved in the maintenance of RAC equipment. It offers trainers up-to-date information on modern technologies and refrigerants as well as other issues related to their use and application.

### Tools commonly used by RAC technicians

This provides an overview of basic tools used by RAC technicians in the servicing sector.

### The WhatGas?

This new smartphone app is a versatile and useful tool. It enables one to search chemicals database of Ozone-Depleting Substances (ODS), HFCs and their alternatives to quickly identify the information the user needs. It helps in quickly finding the following information on any specific refrigerant and other chemicals:

- Chemical name, formula, and type
- ASHRAE designation
- Trade names
- HS code
- CAS and UN numbers
- Montreal Protocol Annex and
- Control measures
- Ozone depleting potential (ODP)
- Global warming potential (GWP)
- Blend components
- Toxicity and flammability class
- Main uses

### Refrigeration and Air-Conditioning Technician Video Series

The Refrigeration and Air-conditioning Technician Video Series is a mobile application consisting of a series of short instructional videos on techniques, safety and best practice for refrigeration and air conditioning (RAC) technicians. This serves as a complementary training tool for technicians to help them revise and retain the skills they have acquired during hands-on training.

#### The videos cover the following topics:

- Basic Tools
- Copper Tube Handling
- Bending
- Copper-Copper Connections
- Copper-Brass Connections
- Flaring
- Press-Fit Connections
- Leak Detection (soap solution)
- Evacuation
- Refrigerant Charging
- Connecting RAC Unit to Manifold
- Electronic Leak Detection
- Refrigerant Recovery

- Thermal Insulation
- Preparing the Cables

### Guidebook on R290 Application in Room Air-conditioner

This recently produced publication shares the experience of Chinese and Indian industry and association with this technology. The content of the guidebook covers both policy and technical aspects of R290 safe use in room air-conditioners. This is not intended to be a practical guide for performing the installation and servicing of equipment but only highlights the issues that need to be addressed professionally and systematically at the national level by the government, industry and other relevant stakeholders.

### Refrigerants Literacy: eLearning Course

This is a web-based course titled "Refrigerants Literacy". It provides 4.5 hours of instruction covering the basics of refrigerants used in air conditioning and refrigeration applications. The course provides a basic understanding of refrigerants required by all involved in refrigerant policy and management, including policy makers, facility managers, and specialists. The course consists of 4 lessons:

- **Lesson 1** covers refrigerant types and addresses environmental considerations.
- **Lesson 2** deals with refrigerant classifications including ASHRAE Standards 15 and 34.
- **Lesson 3** addresses refrigeration selection, including residential and small commercial applications.
- **Lesson 4** covers Refrigerant Management, including development of a management plan, containers, storage, and recover, recycling and reclamation. The course includes interactivities in form of knowledge checks to test the learner's mastery of content as well as narration to keep the learner engaged. At the end of the course, there is a compulsory examination which, if the user passes, earns a successful course-completion certificate. The exam consists of 35 questions and has unlimited attempts.

### Upcoming: Sound Management of Refrigerants eLearning

UN Environment with partners is currently developing a Sound Management of Refrigerants eLearning course that reviews best practices for RAC specialists. Topics to be covered include principles of refrigerant recovery, recycling, and reclaiming. Lubricants, their properties and applications, including compatibility issues with various refrigerants, will be reviewed. The course will embrace safe handling, service, and installation of refrigeration equipment utilising modern refrigerants. It will also provide introduction to refrigerant management programs, certification schemes and relevant policies and regulations. This course is designed for end-users, operators, and contractors who service air conditioning and refrigeration equipment globally. The content is divided into seven (7) individual modules, which can be stand-alone, or offered sequentially as an entire course. Participants will be tested after each module and must achieve a 70% or higher on each test to obtain a

Certificate of Completion after finishing all the modules.

**The course will:**

- Examine global environmental issues as it pertains to refrigerants
- Become familiar with the various refrigerants and the ASHRAE numbering system
- Define pure refrigerants, azeotropic mixtures, and zeotropic mixtures
- Describe the differences between refrigerant recovery, recycling, and reclaiming
- Clarify the function and types of lubricants in air conditioning and refrigeration systems
- Recognise proper service and installation procedures with various refrigerants

- Demonstrate safe handling procedures with refrigerants, lubricants, tanks, and recovery equipment
- Introduction to refrigerant management programs, certification schemes and relevant policies and regulations

**OzonAction SCOOP**

All these tools including the mobile apps can be found and downloaded on UN Environmental website <http://web.unep.org/ozonaction/resources/ozonaction-library>

More information on the e-learning course and its subscription can be found in this flyer [http://www.unep.fr/ozonaction/information/mmcfiles/7895-e-UN\\_EnvironeLearning\\_flyer\\_FNL.pdf](http://www.unep.fr/ozonaction/information/mmcfiles/7895-e-UN_EnvironeLearning_flyer_FNL.pdf)

# Creating an eco-system of standardized learning, lab-tools, and certification

*Author: Mr. A. Balamurugan, Electronic Sector Skill Council of India*

*Capacity building of service technicians in the refrigeration and air-conditioning sector could prove to be a substantial step towards adoption of ozone-friendly refrigerants. The Electronics Sector Skills Council of India (ESSCI) has been working to build capacity of small and medium enterprises (SMEs) in the country.*

Though the industry is gradually adopting ozone-friendly material, there is still a huge scope to upskill technicians, especially in the unorganised sector. RAC technicians usually open the system while repairing refrigerators, commercial refrigeration appliances and air conditioners. Over the operation period of the system, a variety of contaminants accumulate in the refrigeration circuitry. Additionally, while servicing the RAC circuit, contaminants like moisture, chemical residues, dust, metal particles and organic compounds enter the system. During the brazing process, the carbon deposits on the inner walls of tubes get inside further contaminating the system. These contaminants, if not removed, circulate in the system and form sludge. To ensure a good performance, RAC systems are cleaned using alternate solvent. RAC technicians need to be trained in the use of these agents.

As per the industry estimation, there are more than 2,00,000 technicians in the RAC sector in India. ESSCI plans to enhance their capacity through a series of training programmes in 2018.

ESSCI envisages conducting a series of two-day training programmes in the coming months across India. The series will include 40 programs with 25 AC technicians in each. The training

would combine two aspects -- safe use of substitute of Carbontetrachloride (CTC) for cleaning the system (metal component cleaning) and good service practices for ACs. ESSCI will conduct these programmes in co-ordination with the Ozone Cell, Ministry of Environment, Forest and Climate Control (MoEFCC) and United Nations Development Programme (UNDP).

The technicians trained under the programme will be motivated to take a test for certification being conducted by ESSCI at regular intervals. It has been proposed to provide a safety kit to technicians as part of the training programme. The kit includes a fire extinguisher, among other equipment, as most of the small and tiny workshops/workplaces are not equipped to safely use such harmful chemicals.



A programme on 'Training of Trainers' commenced on Nov 2, 2017 in New Delhi. The programme was inaugurated by Shri Gyanesh Bharti, Joint Secretary, MoEFCC in the presence of Shri. Amit Love, Joint Director, Ozone Cell, and Shri N K Mohapatra, CEO, ESSCI. The programme trained and certified 20 trainers in the implementation of CTC project.

Additionally, a batch of 25 AC technicians underwent training for two days on CTC usage, recovery, re-cycling, and storage along with the best practices on usage of alternate refrigerants. The first workshop was held in Bangalore for two days and kits were distributed to all technicians .

Besides touching upon the basics of RAC equipment, the training module covered environmental impact of ozone-depleting substances, alternatives to CTC and HCFCs, quality installation, good service practices, recovery, recycling and reclamation of refrigerants, among others. There were practical sessions on recovery of refrigerant and installation of split AC, system cleaning and

flushing with dry nitrogen, leak test, evacuation and charging of refrigerant among others .

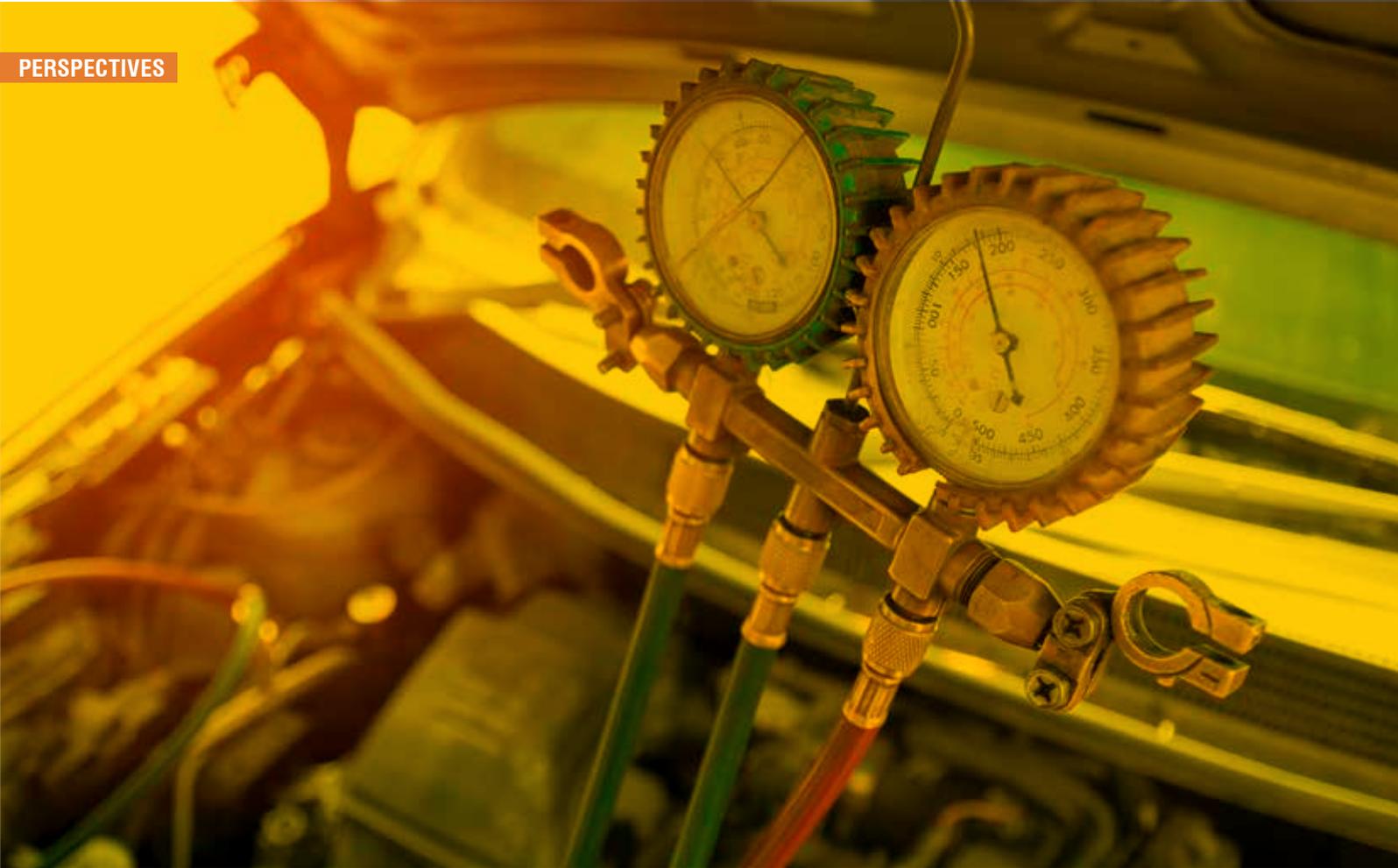
The safety kits distributed to technicians include:

Sl.No	Items	Number
1	Nitrogen Regulator	1
2	Face Mask	3
3	Hand Gloves	2
4	Goggles	2
5	30 Litre Plastic/ S.S.Tank, heavy duty.	1
6	Fire Extinguisher. 2KG ABC Dry powder type.	1
7	Crompton 12" 1400rpm Heavy Duty Exhaust Fan.	1

ESSCI has more than 200 pan-India training centres for AC technicians . We have trained and certified 200 trainers in 'AC Technician' qualification pack. ESSCI has developed a training eco-system on standardising the content, lab tools and certifying trainers. We have also developed a pan-India assessment and certification eco-system for AC technicians and other electronics design and manufacturing systems under which over 100 assessors have been trained and certificated.



Picture from training organized by ESSCI, New Delhi, 2nd November 2017



## Factors impacting efficiency of AC servicing sector

*Lekha Sridhar, Consultant, United Nations Environment Programme & Vaibhav Chaturvedi, Research Fellow, Council on Energy, Environment and Water*

The servicing of air-conditioners (ACs) and refrigeration equipment in India uses anywhere between 40-60% of the total refrigerants consumed, as per industry experts. Moreover, good or bad practices during servicing, operations and maintenance of air-conditioners has an impact on the energy efficiency of the equipment, electricity consumption and associated carbon dioxide emissions. As India transitions away from hydrochlorofluorocarbons (HCFCs), this transition could have a significant impact on global warming, if the transition leads to adoption of high global warming potential (GWP) hydrofluorocarbons (HFCs). The Kigali Agreement highlights the need to phase down as well as leap from high GWP HFCs.

Since 1994, India has been party to the 'Montreal Protocol on Substances that Deplete the Ozone Layer', an international agreement to phase out the use of ozone-depleting substances including refrigerants. Under the Montreal Protocol, a Multilateral Fund (MLF) was set up to assist developing countries financially

to meet their HCFC and HFC phase-out obligations. So far, the MLF has funded over USD 2.5 million towards various activities in the servicing sector under Stage I of the HCFC Phase-out Management Plan. This fund has been primarily diverted to training technicians, setting up reclamation centres, and conducting awareness activities for technicians.

As per informal industry estimates, India has more than 200,000 servicing technicians. A majority of them operate in the informal servicing sector. Whether these technicians comply with prescribed 'good servicing practices' has implications on refrigerant consumption, energy efficiency, and direct and indirect emissions. Understanding the incentives and challenges these technicians face is critical for devising appropriate policies to minimise greenhouse gas emissions and maximise energy efficiency.

The Council on Energy, Environment and Water (CEEW) surveyed 642 service technicians in the formal and

informal sectors, representing residential, commercial and mobile air-conditioning sectors across Delhi, Jaipur and Madurai to understand their practices in order to inform policy. The survey results provide some important insights for industry, civil society stakeholders and policy makers:

1. **AC servicing is a year-round activity for many technicians:** While the received wisdom about AC servicing is that it is a seasonal activity, the survey points to a trend of year-round servicing work. In the survey, over 96 per cent of the respondents reported being involved in AC servicing work for nine months or more in a year. According to them, many customers, especially in office buildings were running their ACs longer every year. For technicians increasingly involved in AC servicing or installation all year round, formal training would be a good investment to make as it is becoming their primary profession.
2. **Servicing training can improve service practices:** Based on their adherence to 'good service practices' (like leak testing, flushing without refrigerant, recovery, etc.), technicians were grouped into three categories: 'poor' 'moderate' and 'best'. Analysis of the survey results found that a technician who received AC servicing training was three times more likely to not follow poor practices. This is an indication that training technicians can be an effective way to improve service practices.
3. **Knowledge about flammable refrigerants:** While over 80 per cent of the respondents were aware that refrigerants could be flammable, less than a third were able to identify R290 or R32 as flammable refrigerants. Though many technicians had worked with flammable refrigerants in domestic refrigerators (R600a), far fewer had worked with R290 or R32. This is a cause for concern as more ACs containing flammable or mildly flammable refrigerants will become available in the market in the coming years. Raising technicians' awareness about refrigerants

and safety practices during servicing is extremely important for industry associations as well as the government to prevent accidents.

4. **Knowledge about impact of refrigerants on ozone:** India has been a party to the Montreal Protocol since 1992 in view of the damaging impacts of ozone-depleting substances used commonly as refrigerants. Since then, India has not only totally phased out chlorofluorocarbons (CFCs) it is also on track to phasing out HCFCs. Despite this, the CEEW survey found that only about 20 per cent of technicians were aware that refrigerants had ozone-depleting, and global warming impacts. Raising awareness of technicians in this regard is important, since servicing practices can directly reduce refrigerant emissions by the use of good service practices.
5. **Customer awareness about good service practices has an impact on technicians' servicing practices:** The survey observed that if customers had knowledge about refrigerants, then service technicians were more than twice as likely to not follow poor practices. Many technicians reported that even if they were aware of the right servicing techniques, a customers' unwillingness to pay for proper servicing or not setting aside sufficient time for servicing prevented them from following best practices. As a result, technicians were often constrained by customers' demands and lack of awareness about good service practices.

While it is very important to ensure that all service technicians have access to quality training programmes and more awareness-building exercises to improve service practices, it is also important to note that training technicians is only the first step towards environment-friendly air-conditioning. Just training technicians is not sufficient. Customers too need to be made aware of how good service practices can maintain their air-conditioners better, and how employing trained technicians can ensure proper servicing is done without cutting any corners.

### References:

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**1. What is the nature of your job?**

I have a permanent job where I am employed throughout the year with a business centre. I repair and maintain commercial refrigeration and air-conditioning systems, and elevators.

However, after my eight-hour shift gets over, I repair refrigerators, domestic air-conditioners, and washing machines as a part-time job.

**2. Are you happy with your work? How would you rate your happiness on a scale of one to ten?**

I would rate my happiness at eight. I derive happiness from my work. When I repair a machine, I get a sense of achievement.

**3. How would you rate your happiness with your organisation's conduct?**

I will rate it at five. I believe my salary is inadequate. However, there is job security. I have work throughout the year and do not have to worry about the seasonal nature of the profession. Also, my organisation treats every employee equally.

**4. Are you happy with the kind of customers you work for? How would you rate your happiness on a scale of one to ten?**

I am very happy with the commercial clients. I will give them a perfect ten. Speaking of the residential clients, I would rate my happiness at five. There are all kinds of customers. Sometimes, I get good customers and sometimes I don't. It is a mixed bag.

**5. How would you rate your happiness with government interventions in your field?**

I would rate my happiness at nine. I believe the trainings conducted for technicians help a great deal in skill development and capacity building.

**Kamlesh Patel**

'From the field' is a series of interviews with service technicians to help them share their experience with the fraternity. The series is aimed at promoting mutual learning and camaraderie among RAC technicians.

The first technician to be covered under this series is Kamlesh Patel, 26, who works at a business centre in Gurgaon, Haryana. In an interaction with newsTRAC, Patel talks about the happiness he derives from his work and the zeal to acquire advanced training for his professional and personal growth.

**6. Are you professionally trained?**

Yes, I completed my training at an Industrial Training Institute in Deoria, Uttar Pradesh.

**7. Do you feel your salary is adequate?**

No. I feel my salary is inadequate. On a scale of one to ten, I would rate it at six. Though my friends who work as freelancers in the RAC sector earn a lot of money, but the nature of their earnings is seasonal. Often, during off-season they are unemployed. My salary is inadequate, but I have a permanent job which, I believe, is better.

**8. Do you feel your technical skills are adequate?**

I feel I can learn more and enhance my skill set. The technology in the sector keeps evolving and in order to grow professionally, I believe I need advanced training. I currently have skills in domestic and commercial refrigeration and air conditioning, elevators, and washing machines but I want to acquire skills in the repair and maintenance of all electrical appliances.

**9. How willing are you to learn more skills in this field?**



I want to receive advanced training in RAC technology. If I get an opportunity, I will take a leave from work and attend the training for technicians to enhance my skills.

**10. What are your views on the evolving developments and practices in the RAC sector?**

Technology keeps evolving. Service technicians should keep attending trainings to stay abreast with the developments. And I think the government (agencies) should conduct more trainings for upskilling technicians.



**PRACTICE BRIEF**

# Do It Yourself (DIY) Refrigerant Recovery

*Refrigerant recovery is a good practice with environmental and economic benefits. It is important to recover refrigerants as they have ozone-depleting and global warming potential.*

*Under the DIY series, we will share good practices for service technicians. The first chapter in this series will provide you information on refrigerant recovery along with a detailed guide.*

## Methods of Recovery

There are two primary recovery methods – passive and active. Under the active method, the refrigerant is recovered with external machines unlike the passive method.

The two most common passive recovery techniques are:

1. **Charge Migration:** Refrigerant is recovered due to a pressure differential between the system and the recovery cylinder. The greater the pressure differential, the faster will be the recovery. The process can be made faster by:
  - a) Evacuating the recovery cylinder; or
  - b) Placing the recovery cylinder in an ice bath; or
  - c) A combination of the above
2. **Accelerated Passive Recovery Using a System Compressor:** System compressor is used to create the pressure differential, thus, accelerating the pumping of the refrigerant into the recovery cylinder. The system compressor can pump out refrigerant either as vapor (if the service valve is used), or as liquid (if the condenser exit is used). Service technicians must ensure that the system compressor should not run below '0' PSIG

## Active Methods of Recovery

Under this mode, recovery can be done in either vapor or liquid mode.

### Recovery in Vapor mode

Technicians must ensure that the compressor does not pull in liquid refrigerant even if it is taken out of the receiver, as this will cause serious damage to the equipment. The connection hoses between recovery units, systems and recovery cylinders should be kept as short as possible and with as large a diameter as practicable.

### Recovery in Liquid Mode (Push and Pull)

The technician must connect the recovery cylinder to the disabled unit's vapor side, and its liquid valve to the unit's liquid side. The recovery unit will pull the liquid refrigerant from the disabled unit when the pressure decreases in the recovery cylinder. Vapor pulled from the recovery cylinder will then be pushed to the disabled unit's vapor side.

## Points to Note:

- ✓ Technicians must avoid reusing refrigerant recovered from burnt-out compressor systems or from damaged or neglected appliances.
- ✓ If the gas or oil has a blackish colour or acidic smell, it is irrecoverable.
- ✓ If the recovered refrigerant is in a good condition, it can be reused. For example, to repair a leak or to replace a valve.
- ✓ If the contamination is excessive, the refrigerant should be stored in a safe place before sending it for destruction.
- ✓ Do not vent any refrigerants. Hydrocarbon (HC) recovery must be done with specially designed recovery machines.
- ✓ Do not use compressors for recovering HC refrigerant as it may ignite a fire.
- ✓ If the refrigeration and air-conditioning system has suffered a compressor motor burn-out, the refrigerant should be recovered but not reused, as it will have to be reclaimed
- ✓ Recovered refrigerants can be reused after testing the oil extracted from the recovery machine for acidity with an acid test kit and for moisture with a moisture test kit. The acceptable limit for acidity is 0.2 TAN and the limit for moisture is 100 ppm. Recovered refrigerant with readings above these limits must be stored separately.

For more details, please visit: <http://bit.ly/2n4ANXs>

# CODE OF PRACTICES FOR RAC SYSTEM SERVICING



## DO'S & DON'TS



- ✓ Always apply best practices within a safe working environment;
- ✓ Always recover refrigerants before servicing or scrapping a system;
- ✓ Recycle refrigerants for reuse whenever possible;
- ✓ Contaminated refrigerants must be stored safely prior to destruction;
- ✓ Leaks must be identified and repaired before the system is recharged with refrigerants. Never assume that only one leak is possible!
- ✓ Improve your handling of refrigerants, e.g. minimize purging refrigerant hoses;
- ✓ Completely empty disposable refrigerant cylinders before scrapping;
- ✓ Maintain the best possible and energy-efficient operational conditions of the RAC system;
- ✓ Keep record of service and maintenance and manage the RAC systems logbook;
- ✓ Maintain good relations with equipment operators and inform them about important, general system features.

- ✗ If you can't work safe, don't do it;
- ✗ A well operating and leakproof system should not be subjected to retrofit or conversion;
- ✗ Never vent ODS or refrigerants with high GWP into the atmosphere;
- ✗ Never use ODS or refrigerants with high GWP as a cleaning solvent for the system (except secured in a closed loop), or blowing-out the heat exchanger's surface;
- ✗ Do not break vacuum with refrigerant for multiple evacuation process, always use OFDN (Oxygen Free and Dry Nitrogen);
- ✗ Do not top-up the refrigerant charge of a RAC system without knowing the correct actual filling amount;
- ✗ Never use a recovery cylinder (or any other cylinder) which is not designed, certified or clearly labeled for the intended purpose;
- ✗ Never mix different types of refrigerants in one recovery cylinder;
- ✗ A RAC system designed for the use of low GWP refrigerants (such as HCs) should never be reverse-retrofitted to the use with HFCs/HCFs/CFCs;
- ✗ Never attempt to work with damaged or defective tools or equipment, do not use longer refrigerant transfer hoses than necessary.

Source: GIZ Proklima



Ministry of Environment,  
Forest & Climate Change  
Government of India

**For further information**  
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