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NEWSLETTER FOR TECHNICIANS IN REFRIGERATION AND AIRCONDITIONING (RAC) SECTOR

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Inside...

Editorial Team:

सत्यमेव जयते

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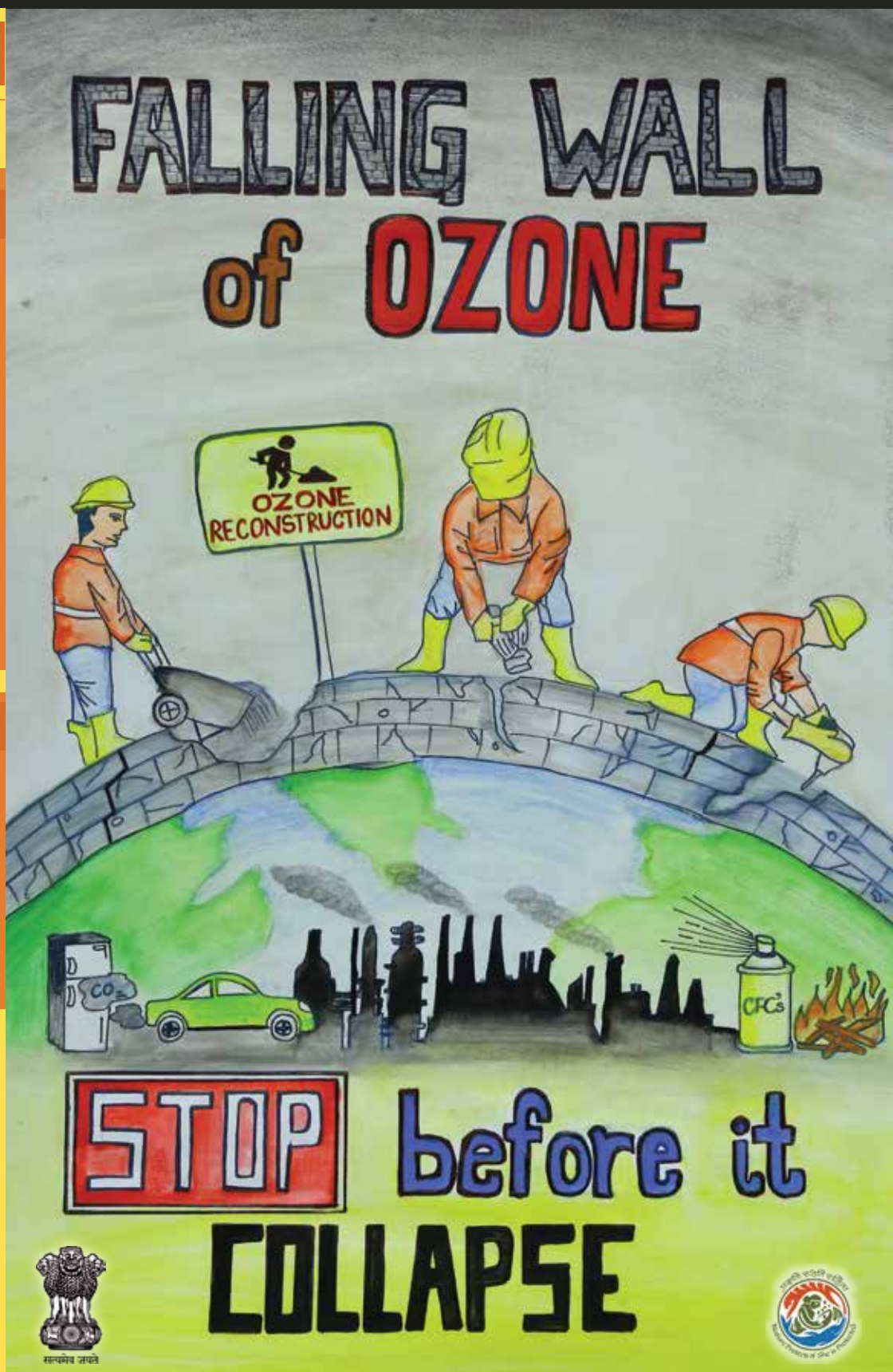

2nd Prize Winner in the Poster Competition Anita Sharma, Delhi Police Public School, Safdarjung Enclave, New Delhi for World Ozone Day 2019

Foreword

Dear Reader

The India Cooling Action plan, addresses the cooling requirement across sectors in a sustainable manner. Adequately skilled and certified service refrigeration and air-conditioning service technicians are key achieving sustainable cooling in different sectors. In India, the Refrigeration and Air-conditioning (RAC) service technicians are mostly in the informal sector. Against this background, the government is training and upskilling technicians in the Refrigeration and Air-conditioning (RAC) servicing sector under the HCFC Phaseout Management Plan (HPMP) Stage II and the Skill India Mission – Pradhan Mantri Kaushal Vikas Yojana (PMKVY). These trainings provide detailed information on occupational safety.

The transitioning away from HCFC-22 to alternative refrigerants requiring focus on good servicing practices and occupational safety. In this context, the latest Issue of NewsTRAC has articles which focus on occupational safety of RAC service technicians. There is an article on safety risks and safe practices for servicing of air-conditioners, and a separate article on role of safe refrigerants handling in occupational safety. Overview of Good Practices for Copper Tube Operations, is also provided. The schedule for upcoming training programmes by GIZ-Proklima is given to help technicians participate in these programmes.

I congratulate The Energy and Resources Institute, GIZ-Proklima, the United Nations Environment Programme and the contributing authors for bringing out the 9th issue of the NewsTRAC.

My best wishes to all NewsTRAC readers.

Geeta Menon
Joint Secretary
Ministry of Environment, Forest & Climate Change

AN OVERVIEW OF GOOD PRACTICES FOR COPPER TUBE OPERATIONS

Alvin Jose & Shaofeng Hu, UN Environment (OzonAction)

A copper tube is one of the key components in air conditioning and refrigerant systems. It is used as a path for the refrigerant to flow between system components and to contain it from escaping to the atmosphere. In this article, we will focus on copper tube operations and the main aspects of this process that technicians should maintain to not only reduce detrimental environmental impact due to refrigerant leakages but also economically benefit their business.

Good practices for copper tube operations consists of the following process, such as: measuring, tube cutting, deburring, flare fitting, swaging, tube bending, brazing and leak testing. Following good practices during the copper tube repair and installation are critical for avoiding refrigerant leakage and ensuring well repaired AC systems. The good practices that AC technicians are encouraged to follow in the various process of copper tube operations are listed below.

a. Tube Selection

- select the right copper grade depending on the type of AC system and the refrigerant working pressures.
- Unroll copper tube coils by laying it on flat surface. Hold one end of the tube and try to unroll it slowly and softly. There should be no kinks formed in the copper tube during the unrolling of the copper coils.
- Foot should not be used to unroll copper coils as it is likely to damage the copper walls and impact the performance of the system.

b. Tube Cutting

- Measure the copper tube to be used for installation/ repair using measuring tape/scale instead of hand-based estimates. Take into account the tube bending surface length required during measurement. Correct measurement technique will avoid copper wastage which is of benefit of technicians.
- Use a tube cutter tool that is designed for soft copper tubes to ensure that tubes are cuts correctly. Place the tube in V groove. Always use tube cutter instead of hacksaw to prevent burr entering into tube. In case of urgency a saw is used, a wave set blade of 32 teeth per inch will do the best job.
- Once the tube has been cut, the tube ends must be reamed by using a deburring tool. In many cases, technicians use back end of file tool or pliers to remove burrs and this is not recommended as it might compromise the tube wall's thickness. The deburring should be at the bottom end and tube should be held upright, so that when the burrs are being removed should falls into the deburring tool.
- Capillary tube cutter is an important tool, as it can cut capillary tubes at an angle with no burrs and saves time. Wire cutters are not recommended as it may not provide the angle required.

c. Tube Bending

- Care should be taken when bending and should be done slowly and gradually, in particular for small sized tubes it is important that the technicians do not kink the bend as it would impact the flow of refrigerant and affect the performance of the system.
- Avoid bending by hand and use appropriate benders (preferred pulley type for greater accuracy) as much as possible as it avoids any wrinkles and/kinks on the tube that may restrict the flow of refrigerants.
- The minimum radius for a tubing bend is 5-10 times the diameter of the tube.

d. Swaging and Flaring

- Swaging tool should be used to make the copper pipe of same size available for quality brazing and permanent joints. Avoid using hammer from the horizontal side to close the gaps at swage ends as it would lead to poor brazing. For better swaging use the tools which comes with flaring block. Rotate slowly back and forth for better swage.
- Flaring should be done by using the correct flaring tool for appropriate size of copper tube for non-permanent joints using flare nuts. The size of the flare would depend on the working pressures of the refrigerant. For good flare use the flaring tool with ratchet yoke (Yoke become free when flare is ready, no extra pressure works on it)

e. Brazing

- It is important to understand that in brazing the base metal (in this case the copper tube) is never melted. Instead the base metal is heated to a temperature, at which the filler rod (made of special alloy) melts when in contact with the base metal.
- The base metal should be at the temperature (650°C-815°C) where the filler rod should melt when in contact. The melting of filler rod by direct torch flame should be avoided as it does not give uniform brazing. The filler rod should melt and flow into the clearance of overlapping copper tubes and forms strong uniform metallurgical bond between the outer and inner copper tubes.

- Ensure that the joints are correctly prepared for brazing by thorough cleaning of the surfaces to be joined. Use emery or wire brush for removal of dirt, grease, oil and other impurities that might be present on the surfaces and can prevent proper coating of the surfaces.
- Ensure that clearances between the two tubes to be joined are maintained correctly. The ideal clearance would be between 0.05 mm to 0.200 mm. If the tubes are the same diameter, this can be achieved using good swaging tools.
- The correct brazing temperature (650°C - 815°C) should be achieved, the best results can be had using oxy- acetylene or oxy-LPG torches, though air-LPG torches can also be used.
- It is also essential to use the right brazing filler rods. For Copper to Copper brazing, filler rods consisting of 7.5% phosphorus and the rest Copper. Brazing rods with 2% silver (Ag) – 35% can also be used depending upon the nature of job, as silver lowers the melting temperature.
- For brazing copper to a different metal (Copper to Iron), filler rods containing phosphorus must be strictly avoided. Rods containing at least 35% silver must be used, with the remaining composition of the rods being Cadmium and Zinc (Cd and Zn).
- brazing operation with a torch must be done in a way that ensures that the base metals (the tubes) are heated in a manner that facilitates the flow of the molten filler rod into the clearances.
- Passing dry nitrogen through the tubes while brazing flushes out all contaminants can avoid the deposit of carbon for good quality brazing.
- Conduct leak test using only oxygen free dry nitrogen (with 2 stage regulator) and detect any leakages. No air should be used.

f. Safety consideration during tubing operations

- Keep away all types of refrigerant cylinders away from any flame while brazing.
- No smoking during servicing.
- Remember that brazing is an art and only gets better with practice !

These are the steps that technicians should consider while repairing/installations of ACs with regards to tubing to avoids leakages. However, it is to be noted that the good practices for copper tube operations is one of the processes within overall Good Servicing Practices. Other Good Servicing Practices that technicians should consider would be covered in later issues. It is not only the environment that benefits by taking these steps, it saves the money and reputation of the RAC technician. When tubing of AC systems is such that there are no refrigerant leakages, it also put less working load on the compressor and avoids additional electricity use and benefits the end-users. Some studies[1] indicate that refrigerant leakage could result in degrading the performance of the system by 40%. Furthermore, avoiding the wastage of copper tubes is also economically beneficially for technicians. Some technicians have reported to observe avoiding copper wastage of up to 10% of their total use. Lastly, a good quality job always enables in building good customer relations and retention.

[1] As reported by Air-Conditioning, Heating & Refrigeration Institute (AHRI)

UPCOMING TRAINING PROGRAMMES FOR RAC TECHNICIANS

Ms. Smita Vichare, GIZ-Proklima

The energy consumption of an average air conditioner is higher than other electrical appliances in the household. This consumption rises even further, with the increasing age of the unit, defects and poor servicing. Thus, it becomes critical to impart training and skills to the service technicians, in the usage of the emerging technologies, refrigerants and equipment.

Additionally, some of the refrigerants used in the refrigeration and air conditioners have high ozone depletion potential and have to be phased out. The Montreal Protocol treaty was signed with that goal, through the implementation of measures to phase out the use ozone depleting substances. In India, GIZ - Proklima on behalf of the Government of Germany and in close co-operation with the Ozone Cell in the Ministry of Environment Forests and Climate Change (MoEF&CC) is implementing the HCFC phase-out activities for the Indian RAC servicing sector. The phase out activities are being implemented under the India's HPMP Stage – II (2017 – 2023) project.

GIZ Proklima is conducting training programs for the RAC technicians in the country with support of Training Partners and team of trainers. The training programs (include theory and practical / hands on training), primarily the topics included are - importance of good service practices like refrigerant recovery and system pump down process, refrigerant handling and piping work, cleaning, flushing and pressure testing. System evacuation and refrigerant charging methods, steps for installation and servicing of the room air conditioners. Duration of the training is for two days. In order to register for the training, technicians must contact the training partners, whose details are mentioned below.

Please visit http://www.ozonecell.in/ for more information on the training. Following is the detailed calendar for the upcoming training programmes by GIZ, under HPMP-II.

STATE	TRAINING PARTNER	TRAINING DATES	CITY	PARTNER DETAILS
Chandigarh and Northern States	Anant Enterprises	3-4 Feb 2020	Sonepat	**Anant Wadhwa** Ho: 5397/1, Modern Residential Complex, Manimajra-160101. Chandigarh (U.T.) Office: Shop No. 782/15, Khalsa Market, Opp. Community Centre, Gobind Pura, Manimajra Mob no.: +91 98123 02544 E-mail: dj.anant@ymail.com
		1-2 Feb 2020	Kurukushetra	
		11-12 Jan 2020	Una	
		6-7 Jan 2020	Paonta Sahib	
		17-18 Jan 2020	Amritsar	
		1-2 Feb 2020	Barnala	
		24-25 Jan 2020	Hoshirapur	
		19-20 Jan 2020	Jalandhar	
		3-4 Feb 2020	Ludhiana	
		4-5 Jan 2020	Haridwar	
Delhi	KeyPath	03-04 Jan 2020	Delhi	**Rao** Key Path India Pvt Ltd. Plot No: 143, 02nd Floor, F.I.E, Patparganj, Delhi - 110092 Ph no.: 011-49090613, Mob no.: +91 9873001382 Email : rao@keypath.in keypathindia@gmail.com
		10-11 Jan 2020	Delhi	
		17-18 Jan 2020	Delhi	
		24-25 Jan 2020	Delhi	
		30-31 Jan 2020	Delhi	
		03-04 Feb 2020	Delhi	
		07-08 Feb 2020	Delhi	
		14-15 Feb 2020	Delhi	
		21-22 Feb 2020	Delhi	
		28-29 Feb 2020	Delhi	
		06-07 Mar 2020	Delhi	
		13-14 Mar 2020	Delhi	
		20-21 Mar 2020	Delhi	

STATE	TRAINING PARTNER	TRAINING DATES	CITY	PARTNER DETAILS
Maharashtra and Goa	Max Cooling Systems	11-12 Jan-20	Sholapur	**Mathew Abraham** Max Cooling Systems 2.Butte Patil Residency 363/5 Shivajinagar Pune 411005 Ph no.020- 25534737 Mob no.: +91 9422011095 Email: maxcoolengg@yahoo
		18-19 Jan-20	Sangli	
		1-2 Feb-20	Satara	
		15-16 Feb-20	Pune	
Odisha	Mishra Refrigeration	11 - 12 Jan 2020	Cuttack	**S K Mishra** SD-2, V.S.S. NAGAR Bhubaneswar-751007 Mob no.: +91 9861035473, 9437668720 Email: sunilformr@gmail.com
		18 - 19 Jan 2020	Bhubaneswar	
Uttar Pradesh	Isha Enterprises	04-05 Jan 2020	kanpur	**Rajesh Misra,** ISHA ENTERPRISES A-1/3, Sector-B, Aliganj, Opp. Aliganj Post Office, Lucknow- 226 024. Mob no.: +91 9415024423, 9956297523 Email: Isha.enterprises@rediffmail.com
		20-21 Jan 2020	Mau	
		22-23 Jan 2020	Ambedkar Nagar	
		26-27 Jan 2020	Lucknow	
		03-04 Feb 2020	Deoria	
		05-06 Feb 2020	Gorakhpur	
Rajasthan	Bohra Services	18-19 Jan.20	Pali	**Surendra Bohra** Bohra Services, 62-63, Gem Enclave, Setu Path, Pradhan Marg, Malviya Nagar, Jaipur (Rajasthan)-302017 Mob no.: +91 9414066848 Email: surendra.bohra@galaxyens.com, surandrabohra@gmail.com
		20-21 Jan.20	Pali	
		1-2 Feb.20	Alwar	
		8-9 Feb.20	Alwar	
		20-21 Feb.20	Udaipur	
		22-23 Feb.20	Udaipur	
Karnataka	Dewpoint Appliances Pvt. Ltd.	11- 12 Jan 2020	KGF	**Jessy Mathew** No. 808, 10th A Main, 1st Stage, Indiranagar, Bangalore, 560 038 Mob no.: +91 8025299325 Email: dewpoint.blr@gmail.com
		25-26 Jan 2020	Bengaluru	
		01-02 Feb 2020	Bengaluru	

SAFETY RISKS FOR THE SERVICE TECHNICIANS AND SAFE PRACTICES FOR THE SERVICING OF AIR CONDITIONERS

By Dr R. S. Agarwal, Retd. Professor, IIT Delhi

1. Background

The use of air conditioners is growing in the country, with about 7-8 million ACs being installed every year with more than 40 million units in operation. Most of these units are installed and serviced during the summer months. A large percentage of service personnel engaged in this important trade are from the informal sector with limited or no opportunity to pursue formal education and have learnt on the job through their seniors.

RAC Servicing demand temporally shoots-up during summer season. Due to a short supply of workforce, the technicians need to take up more installation/servicing calls per day and work 7 days a week even leading to induction of semiskilled technicians/helpers to cope with the workload. Although technicians are familiar with R-22 technology, the newer systems involve a higher risk of flammability and/or high pressure which the technician needs to understand before initiating the work

RAC equipment servicing is a complex trade. This sector now demands knowledge of various disciplines such as mechanical, electrical and electronics. With the introduction of new refrigerants and change in technologies, and, the service technicians should not only be well-versed in the subject knowledge/skills of RAC but should also have a thorough understanding of handling flammable & high-pressure refrigerants/gasses, lubricants, brazing/soldering, etc. There is a need to acquire knowledge/hands-on practice of these technologies. Any lack of understanding and mishandling of these technologies could lead to accidents. Unfortunately, it is impossible for an industry as vast as the RAC industry to operate without accidents and fatalities. However, a thorough understanding of the of safe work practices s could reduce the chances and order of fatality in such incidents. Some tips related to safety during servicing are briefly discussed in following sections.

2. Properties of Commonly Used Refrigerants in Room ACs

There are several refrigerants that are commonly used in air conditioners (ACs) namely- R-22, R-32, R-290, R-410A, etc. It may be noted that R-22 is being phased out due to its ozone depleting characteristic, however several million units of R-22 is still being installed every year and tens of million R-22 units are still being in operation and would require servicing.

Other refrigerants are either flammable or high pressure or both. It is recommended that service technicians should take note of the refrigerant charged in the AC and its properties prior to installation/servicing, for their own safety as well as safe and successful installation/servicing of AC. Some of the key properties of these refrigerants are given in Table 1.

Table 1: Properties of commonly used Refrigerants in Air Conditioners

Property	HCFC-22	HFC-32	R-290	R-410A
Chemical formula	CHClF2	CH2F2	C3H8	CH2F2/C2HF5 (50% HFC-32+ 50% HFC-125)
Cooling capacity relative to HCFC-22	100	160	94	140
ODP	0.055	0	0	0
GWP	1810	675	3	2100
Flammability*	Non- flammable (A1)	Mild-flammable (A2L)	Higher Flammable (A3)	Non- flammable (A1)
Toxicity	Low	Low	Low	Low

ASHRAE Std. 34 designation (ASHRAE, 2013)

In figure 1 the pressure temperature of R-22, R-290, R-32 and R-410A are compared. The vapour pressure curves for R-22 and R-290 are very similar. At higher temperature, the pressure of R-290 is slightly lower than R-22. However, for R-32 and R-410A, the pressures are higher than R-22 and R-290.

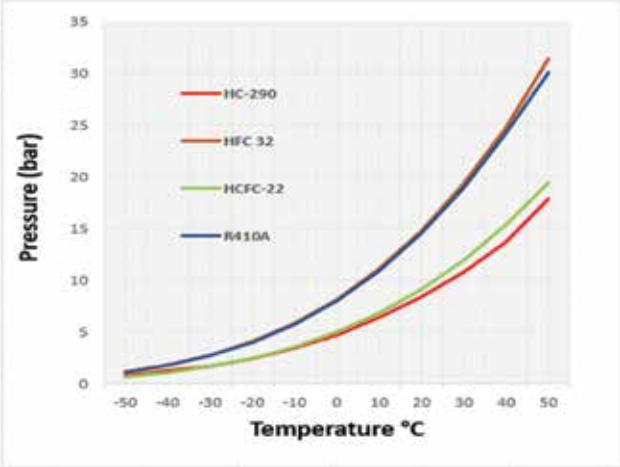

Figure 1: Pressure - temperature characteristics of commonly used refrigerants

It may be noted that refrigerant R-290 is highly flammable while R-32 and R-410A has high pressure. The design condenser pressure of R-32 and R-410A is about 1.25 times that of R-22. The refrigerants charge qualities will also be different for each refrigerant due to their characteristics. The service personnel must read about the refrigerant and quantity charge on the title plate affixed by the manufacturer on the outdoor unit prior to installation/ servicing of unit to avoid any accident.

3. Safety Risks and Safe Practices for Servicing Operations of ACs

3.1 Access to Outdoor unit

Split ACs have two distinct units, the outdoor and indoor unit. The outdoor unit is to be installed outside the room. In the absence of specific provision made for installation of AC during construction of building, it is installed in any location available close to room. In case of high-rise buildings, servicing becomes quite risky for the service technicians due to poor accessibility to outdoor unit. It is recommended that the manufacturers/ installers must advise the users about the proper site which is safe to access. The installers/service technicians/service technicians must take due care for their own safety and also to use personal protection devices.

3.2 General Safety Checks

Following safety checks are recommended prior to servicing systems containing flammable and or high-pressure refrigerants:

- Ventilation: The work area should be in the open air or be adequately ventilated
- Sources of ignition: All potential sources of ignition must be far away from the installation and servicing
- No Smoking: Technicians must not smoke during work, No Smoking' labels should be displayed
- Electrical Safety: Power to the equipment should be shut off, switch-on only when necessary. The electrical wires/ cables in an air-conditioning unit must be grounded. Fire extinguishing equipment should be close at hand – a dry powder or CO2 fire extinguisher adjacent to the charging area
- • PPEs: PPE viz. safety glasses, protective shoes, gloves, safety belt and clothing which covers the body should be worn when handling refrigerant

3.3 Opening of Refrigeration Circuit

The opening of refrigeration system is one of the important steps for technician's personal safety as well the site. The following procedure should be followed for opening the refrigeration circuit:

- Remove refrigerant in a cylinder by passive or active recovery process;
- Purge the refrigeration circuit with inert gas (Oxygen-free dry nitrogen (OFDN)). Never use gases other than dry nitrogen for purging and other similar operations like, pressure, leakage testing, etc., Use of oxygen/air may form explosive mixture and become cause of fatal accident, Ensure Nitrogen cylinder is fitted with two stages pressure regulator. Figure 2 shows the nitrogen cylinder fitted with the two-stage pressure regulator.
- Open the circuit for repair

3.4 Repair and/or Replacement of Inoperative Components

In the current scenario, where service technicians need to handle and install/service AC with various refrigerants, it is of utmost importance to replace the faulty parts with genuine and recommended spare parts only for safe and efficient

operation of the system Each time a system is being opened/ repaired, a new strainer and filter should be installed. This will properly desiccate and clean the refrigerant.

3.5 Cleaning and Flushing

The repaired system needs to be cleaned and flushed to remove the moisture and foreign particles that may be present in the system. It is recommended to use only an inert gas - Oxygen-free Dry Nitrogen (OFDN) for this purpose. The service personnel must note that for their own safety they should always use an OFDN cylinder with a two stage regulator. It is becoming more and more essential for personal safety of technicians as the refrigerants used could be flammable.

3.6 Brazing of Tubes

Brazing is one of important operations in servicing. It is a non-detachable joining process, most common in RAC parts or lines/tubes for producing strong and tough joints. Brazing can be done between Copper to Copper, Copper to Aluminum and Copper to Steel tubes to withstand vibrations, shocks and tension etc. . Oxygen-acetylene, oxygen-LPG brazing, air-LPG torches are used as heat source for brazing. Following safety measures should be taken during brazing:

- Torch should never be pointed towards an open flame or source of sparks. It is recommended to always use a sparker to light the torch and to not use matches or cigarette lighters. Be sure to use flashback arrestors for both the acetylene and oxygen regulators.
- During brazing, the personnel should always wear Personal Protective Equipment (PPE) like goggles, shoes, apron/lab coat and gloves exclusively designed for safety. It may be noted by the service technicians that safety is for you, your property and customer's property too.

3.7 Leak and Pressure Testing

The serviced systems need to be pressure tested prior to refrigerant charging to ensure there is no leakage in the unit. For reliability and environment protection the system must be pressure and leak tested using OFDN. The system should not be pressurized to very high pressure. The system test pressures should be about 1.1 times the operating pressure. Use only OFDN cylinder fitted with two stage regulator. Ensure that there is no leakage in the system, release the nitrogen to the atmosphere. Never start the system when it is pressurized with OFDN.

Note: Most of the fatal accidents have been noticed during servicing of Room ACs and other unitary systems due to the use gases other than dry nitrogen for testing and the usage of nitrogen cylinders with a single stage regulator.

3.8 Refrigerant Charge

Service technicians should ensure that the system is adequately evacuated and free from air, moisture, and non-condensable gases before charging the refrigerant. It is advised that, in addition to conventional charging procedures, the technicians should ensure the following:

- Refrigerant is the same as written on the title plate and of good quality and free from impurities. Use of different refrigerant could be a safety risk
- Refrigerant cylinder must be kept upright. Charging lines should be as short as possible to minimise the amount of refrigerant contained in them
- Connect the charging line to the refrigerant cylinder and to the charging port of the system before opening the cylinder and system valve. First open the cylinder valve and purge the line prior to begin charging
- The charge quantity should not exceed the quantity specified by the manufacturer. Extreme care should be taken not to overfill the refrigeration system
- Label the system once the charging is complete (if not already)

3.9 Closing the charging Port

Switch on the air-conditioner and run it for 20 to 25 minutes. Observe suction pressure, supply and return air temperature. Reinstall the locknuts on the service valves. Do the final leak testing with soap solution/refrigerant leak detector. Ensure that there are no leaks.

Note: It is recommended that the technicians must look for opportunities to upgrade their subject knowledge and skills to cope with changing technologies. Personal safety is very important in the current scenario where multiple technologies are to be handled simultaneously. The training programmes are being conducted by various bodies/ organization. For training programme details look at the website http://ozonecell.in/.

'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.

Mr. Virendra Verma is a GIZ trained RAC technician, working for commercial consumers. He currently works for Ultrakool and JS Refrigeration

Can you take us through the nature of your job?

Ans: I have been working in the RAC sector since 2009. I work with Ultrakool and JS Refrigeration. I service industrial refrigeration units, cold stores, kitchen industry and chillers etc. I also service commercial air conditioning units ranging from 10-15 tons for various organisations.

Do you work for residential consumers? If yes, what has been your experience?

Ans: I work just for the commercial sector. I do not interact with residential consumers.

Can you talk in detail about the trainings that you have undergone?

Ans: I have been undergoing various trainings since 2013. These trainings have been from GIZ and others and comprise of the usage of ozone friendly refrigerants. They have made me realise the importance of saving and maintaining our ozone layer. We used to earlier use just R 22 refrigerant, which is really bad for the environment. These trainings helped us explore alternative eco-friendly refrigerants. Additionally, I was also trained on how to avoid wastage and leakage of refrigerants, through proper use of equipment. I was also trained in the brazing process and how to properly manage and handle the copper tube.

How satisfied are you with your job? How will you rate it between 1-10?

Ans: I am quite satisfied with my job. Through the various trainings I have gone through, I believe that being aware of the latest industry standard and technologies has been very helpful. I will rate it right at 10, as I am completely up to date with my skills, which helps me service effectively.

Do you believe that the trainings have added value?

Ans: I firmly believe in the value of training. Most of the technicians undergo informal trainings under current technicians (*ustaad*), who train them on the job for 1-2 years. However, these technicians themselves are not aware of the latest developments such as new technologies, safety measures and new refrigerants. So, these trainings help technicians upskill and stay up to date.

Are you satisfied with your salary? Do you think salaries are good in this sector?

Ans: I am satisfied with my salary. I believe that a trained technician, equipped with the latest skills can earn well in the sector.

ROLE OF SAFE REFRIGERANTS HANDLING IN OCCUPATIONAL SAFETY AND HEALTH OF RAC SERVICING TECHNICIANS

By Shaofeng Hu and Alvin Jose, UNEP OzonAction

Refrigeration and Air-conditioning (RAC) sector has several occupational safety and health (OSH) challenges that impact servicing technicians. The installation and maintenance of RAC equipment is a field job that comes along with various safety issues that is similar to any other infrastructure related sector, such as being on the roofs of buildings and being exposed to electrical circuits. Thereby it is important to ensure that safety is central part of training and skills development of RAC technicians, and to inculcate safe practices in the culture of RAC servicing sector in the country, which would require enthusiasm and strong cooperation of the RAC technicians' community.

Most alternative refrigerants have relative safety issues that needs to be considered for parameters ranging from flammability to working pressures. In addition, the Montreal Protocol led phase-out of HCFCs and the global move towards phasing down of HFCs is changing the refrigerant technology landscape, which will further complicate the safety challenges for the servicing technicians. There are multiple refrigerant technologies entering the market that are based on synthetic chemicals such as low GWP HFCs and others based on natural substances such as hydrocarbons, ammonia and carbon dioxide. A summary of the safety issues of the new climate friendly refrigerants are as follows:

Given this context, with consideration that a significant share of the technicians in the country have got informal training and education background, Good Servicing Practices with safe use and handling of refrigerants is one of the main areas training and awareness that is promoted by the Ozone Cell, Government of India with support from United Nations Environment Program and GIZ Proklima.

RAC technicians need to be aware of characteristics such as flammability, toxicity, and working pressures of refrigerants that are being used in the RAC systems during installation and maintenance, and undertake good servicing practices including safe procedures during flushing, vacuuming, recovering, charging etc. and ensure working area safe and use of PPE (personal protective equipment). For handling flammable refrigerants, it is very important to use tools and equipment that are spark proof and compatible with flammable refrigerants and relative RAC systems. It is also important to note that even non-flammable refrigerants such as R-410A in Room ACs could also lead to safety incidents if they are not properly handled in line with characteristic of the refrigerant. For example, there have been incidents where R-410A based compressors have exploded because flushing was done with air instead of nitrogen. The use of components that are compatible with flammable technologies, high pressure leak detection, complete removal of refrigerant during evacuation, brazing with dry nitrogen, and use of gas sensors are all critical to good servicing practices with safety. For the RAC technicians, it would be useful to review the servicing practices that are being undertaken with the

Refrigerant	Natural Refrigerants			Synthetic HFCs	
	Hydrocarbons	Ammonia	Carbon Dioxide	Saturated HFC	Unsaturated HFCs (HFOs)
Global Warming Potential (GWP)	Low	Low	Low	Low to Medium	Low
Flammability	Flammable	Flammable in certain conditions	Not Flammable	Some are slightly flammable	Slightly Flammable
Toxicity	No	Yes	In certain conditions	No	No
Pressure	Medium	Medium	High	Medium	Medium

requisite safety standards in the field, and what are the issues that are leading to safety risks incidents, and how they should upgrade their servicing practices.

There is a need for reporting and documentation of safety incidents of RAC servicing sector that occur in the country in order to analyze the causes and aware the technicians' community of such potential occupational hazards. NewsTRAC requests its readers to report safety incidents that they may have come across or heard about in their business area. This would help NewsTRAC to create a database of such events and aware its readers of avoiding any similar potential incidents from taking place. You may send the information to <Manjeet.Singh@teri.res.in> with the following details:

- incident area/place and date;
- details of the incident;
- damage or casualty if any;
- Potential reason of the incident; and

Ready Reference for Good Servicing Practices

Flyer on Training and Certification of Refrigeration and Air-Conditioning Service Technicians (English)

Flyer on Training and Certification of Refrigeration and Air-Conditioning Service Technicians (Hindi)

Technician Handbook on Good Service Practices and Installation of Room Air-conditioners

Quick guide on Good Servicing Practices for Flammable Refrigerants

Booklet on Efficient and Sustainable Cooling

Ministry of Environment, Forest & Climate Change
Government of India

For further information
Ozone Cell, Ministry of Environment, Forest and Climate Change
Government of India
Core-4B, 2nd Floor, India Habitat Centre,
Lodhi Road, New Delhi-110 003
Tel: 011-24642176; Fax: 011-24642175
Email: pmucfc-mef@nic.in,
Website: http://ozonecell.in/

The Energy and Resources Institute
Creating Innovative Solutions for a Sustainable Future

For further information
Karan Mangotra
TERI, Darbari Seth Block, IHC
Lodhi Road, New Delhi-110 003
Tel: 011-24682100; **Fax:** 011-41504900
Email: karan.mangotra@teri.res.in
Website: www.teriin.org