# newsTRAC

NEWSLETTER FOR TECHNICIANS IN REFRIGERATION AND AIRCONDITIONING (RAC) SECTOR

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## Inside...




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# Foreword

Dear Reader

The training of Refrigeration and Air – conditioning (RAC) technicians has gained significance in the last few years, especially with the rising awareness around the need for sustainable cooling. Interventions in the RAC service sector lead to environmental protection in terms of reduced leakage of refrigerants and maintenance of rated energy efficiency of in-use equipment. In addition, it also leads to positive influence on livelihoods of service technicians.

Through NewsTRAC, it has been our endeavour to update service technicians on recent developments on alternative technologies and awareness for enhancement of livelihood opportunities. This issue provides updated information on alternative refrigerants and servicing of inverter technology-based air-conditioners. Information is also provided on the training centres of ESSCI. It also provides links to ready reference for Good Servicing Practices – videos and training material for RAC technicians.

I congratulate The Energy and Resources Institute, GIZ-Proklima, the United Nations Environment Programme and the contributing authors for bringing out the 11th issue of the NewsTRAC.

My best wishes to all NewsTRAC readers.

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

# ALTERNATIVE REFRIGERANTS TO HCFCS AND THEIR CHARACTERISTICS

Hydro chlorofluorocarbons (HCFCs) are a family of refrigerants that comprise of an array of variants such as HCFC-22, HCFC-123 etc. HCFCs, especially the HCFC-22 have been widely used refrigerant in room air conditioners (room ACs). HCFCs, including HCFC-22 are ozone depleting substances (ODSs) that are being phased-out through an accelerated schedule under the Montreal Protocol. Currently, the main alternative refrigerants are hydrofluorocarbons (HFCs), either single component or blends of two or more HFCs. HFCs and blends of HFCs are non-ODS but have impact on environment, particularly on climate due to their very high Global Warming Potential (GWP). Natural refrigerant like R-290 has also been considered for this application but it is highly flammable (A3 category as per the ASHRAE Safety classification). Recognizing that there is no ideal low-GWP refrigerant similar to HCFC-22 yet available, research and development work has been continuing for developing low-GWP alternative refrigerants for HCFC-22. Currently, room ACs are being manufactured and marketed with various refrigerants, HCFC-22, HFCs, blends of HFCs, R-290 not only in the country but globally, as well. It is becoming a challenging task for the service technicians to acquire skills for handling and servicing of room ACs with various refrigerants.

## Factors to consider when selecting an alternative refrigerant

HCFC-22 has a long history of use as refrigerant in room ACs due to its excellent thermodynamic & thermophysical properties, compatible with material used in ACs, non-toxic, inflammable and availability at a reasonable price. The following factors need to be considered for selection of alternative refrigerants:

- Alternative refrigerant should have good thermodynamic and thermophysical properties more or less similar to HCFC-22
- The air-conditioner with new refrigerant should have similar or higher efficiency as compared with HCFC-22.
- It must have zero ODP and minimum/negligible GWP;
- It must be available in the market at a comparable cost;
- It should be preferably non-toxic and non-flammable;
- It must be compatible with the materials used in air-conditioning system;
- The alternative refrigerant should have good miscibility with the lubricating oil;
- It should be stable in the presence other materials within the refrigeration system;
- It should be inert, non-reactive and must not act as solvent in the system.

## Safety features

When selecting alternatives to HCFCs, in addition to the above mentioned desirable properties of refrigerants, safety features must also be taken into account. Refrigerants are categorized for flammability and toxicity as per ASHRAE Standard 34. The flammability of refrigerant is referred with numbers and toxicity with symbols A or B. This classification includes:

- Flammability: "1" – No flammability, "2" – Flammable, "2L"– Mildly Flammable, "3" – Higher Flammability
- Toxicity: "A" – Lower toxicity, "B" – Higher toxicity

## Commercially used Alternative Refrigerants to HCFC-22

While, there is no perfect alternative to HCFC-22 that meets all the above selection criteria, some of the zero-ODP alternatives currently available and used in the industry in room ACs are briefly described below:

### R-410A

R-410A is a zeotropic blend with a very low temperature glide: 0.1°C. It is a blend of 50% HFC-32 and 50% HFC-125, and has zero Ozone Depleting Potential (ODP) and a GWP of 2090. R410A is chemically stable, non-toxic and non-flammable refrigerant. Currently, R410A is one of the widely used refrigerant in room ACs. The critical temperature of R-410 is low, so there is a significant drop in performance at high ambient temperatures. R410A has a higher volumetric cooling capacity than HCFC-22. Therefore, R410A room ACs can be downsized. Synthetic ester lubricant is used in systems with R410A; mineral oils which are commonly used with HCFC-22 are not compatible with R-410A. There are no compatibility issues with most of the other materials presently used in RAC systems, with the exception of only the polymer components. The working pressure of R-410A is 1.5 to 1.6 times higher than for HCFC-22; therefore the compressor, heat exchanger and pipes must be redesigned – specifically, thicker tubes should be used.

However, due to R410A's high GWP, it is considered as a transitional replacement for HCFC-22 and will be phased-down as per the Kigali Amendment to the Montreal Protocol, in accordance with agreed phase-down schedules for HFCs.

## HFC-32

HFC-32 is a single component HFC refrigerant and has similar thermophysical properties, but HFC-32 has an added climatic benefit over R-410A as its GWP is one third of R-410A (GWP-675). It may be noted that it is still higher than that of natural refrigerants like R-290. HFC-32 is non-toxic but it is mildly flammable. Its Lower Flammability Limit (LFL) is 0.306 kg/m$^3$ and the flame burning velocity is 6.7, quite lower than 10 m/s; hence, it has been classified as an A2L category refrigerant as per ASHRAE Standard 34. The system performance of HFC-32 is better than R-410A due to its thermodynamic and thermophysical properties. The energy efficiency of HFC-32 room ACs is higher than R-410A. The charge amount of HFC-32 is lower than the equivalent cooling capacity system using HCFC-22. The discharge temperature of HFC-32 is also higher than for R-410A. In moderate temperatures like prevalent most part of the country, this higher condenser pressure has been addressed by redesigning the condenser.

Some important characteristics of HFC-32 are:

- HFC-32 is one of the HFCs , It is controlled substance
- It is a single component refrigerant and thus easy to handle
- It has global warming potential of 675, 37% lower than HCFC-22 refrigerant
- It is a high-pressure refrigerant, boiling point is -51.7°C
- The refrigerant is miscible with Polyol Easter oils, the most suitable lubricant for system with this refrigerant
- HFC-32 is mildly flammable, with a flammability range of 14 to 31% volume present in air. Its ignition temperature is higher (648°C)
- It has high latent heat of vaporization resulting in higher refrigerating capacity, about 1.6 times, as compared to HCFC-22, Refrigerating charge quantity required is lower than the HCFC-22, and so the lower refrigerant circulating rate, thus require smaller size of compressor.
- The heat transfer coefficient of HFC-32 is higher than HCFC-22
- The cooling capacity and COP are higher

The refrigerant is available in the market at lower costHFC-32 has been successfully adopted by several manufactures within the country and in several other markets globally.

## R-290

R-290 is a natural refrigerant with zero ODP and a low GWP (3). It is therefore an environmentally friendly refrigerant. However, R-290 is a highly flammable refrigerant with an LFL of 2.1 per cent by volume in air and an Upper Flammability Limit (UFL) of about 9.5 per cent by volume in air. R-290 has been classified as an A3 category refrigerant as per ASHRAE Standard 34. R has excellent thermodynamic and thermophysical properties. R-290.

Some characteristics of R-290 are:

- It is a single fluid hydrocarbon refrigerant, so, easy to handle.
- It can be long term solutions due to their zero ODP and negligible GWP.
- Boiling point temperature of R-290 is -42.1°C which is slightly lower than HCFC-22.
- It is miscible with mineral oil and some other commonly used refrigeration oils with appropriate viscosities.
- No acid formation in combination with water
- R-290 is not applicable for retrofitting of room AC with HCFC-22, it can only be used in properly designed new system.
- Lower refrigerant charge for the same cooling capacity than HCFC-22.
- It has higher heat transfer coefficient.
- Reduction of electrical power consumption due to lower pressure ratio and lower density than HCFC-22.

## Comparative Characteristics of Commercially used Alternative Refrigerants

Service technicians need to handle and service room ACs with HCFC-22 as well as alternative refrigerants. It is very essential to understand their characteristics of all these refrigerants.

Table 1 gives the comparative characteristics of all the four refrigerants.

Table 1: Comparative Characteristics of Commercially Used Refrigerants

**ASHRAE Std. 34 designation (ASHRAE, 2013)

## Practical Considerations to keep in mind whilst using HFC-32 and R-290 refrigerants

HFC-32 is a high pressure and mildly flammable refrigerant. Although R-290 is low pressure, it is highly flammable and thus requires safer design. Therefore, to handle R-290 and charge quantity the technician should have knowledge of regulation and standards relating to flammable refrigerant. HFC-32 is miscible with POE lubricants which is highly hygroscopic. On the part of manufacturer safer design is required, but at the same time technicians must follow good service practices considering safety. **It must be recommended that technicians handling R-290 and HFC-32 refrigerant are well trained and always use the PPE.**

- *This article is adapted from : Chapter no. 3 " Alternative Refrigerants to HCFC 22 - Good Service Practices and Installation of Room Air conditioners with HCFC–22 and Flammable refrigerants " of the Technicians Handbook published by Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ) GmbH under India: HPMP Stage II* [1].

[1] http://ozonecell.in/wp-content/themes/twentyseventeen-child/Documentation/assets/pdf/Technician%20Handbook.pdf

| Property | R-22 | R-32 | R-290 | R-410A |
|---|---|---|---|---|
| Chemical formula | $CHClF_2$ | $CH_2F_2$ | $C_3H_8$ | $CH_2F_2/C_2HF_5$(50% R-32+50% R-125) |
| Molecular mass | 86.5 | 52.0 | 44.0 | 72.6 |
| Liquid density (kg/m3) | 1409.2 | 1212.9 | 581.4 | 1349.7 |
| Critical temperature (0C) | 96.2 | 78.1 | 96.7 | 71.4 |
| Normal boiling temperature (0C) | -40.8 | -51.7 | -42.1 | -51.5 |
| Evaporator pressure (MP) at design condition | 0.62556 | 1.017 | 0.588 | 1.0 |
| Condensing pressure (MPa) at design condition | 2.1464 | 3.473 | 1.884 | 3.4 |
| Cooling capacity relative to R-22 | 100 | 160 | 94 | 140 |
| Ozone Depleting Potential (ODP) | 0.055 | 0 | 0 | 0 |
| Global Warming Potential (GWP) | 1810 | 677 | 3 | 2090 |
| Flammability* | Non- flammable (A1) | Mild-flammable (A2L) | Flammable (A3) | Non- flammable (A1) |
| Toxicity | Low | Low | Low | Low |

# HPMP RPL PROJECT IMPACT ASSESSMENT AND CURRENT TRAINING SCHEDULE

***N K Mohapatra, CEO, Electronics Sector Skills Council of India***

The Ministry of Environment Forest and Climate Change (MoEFCC) and Ministry of Skill Development and Entrepreneurship (MSDE) is jointly undertaking the upskilling and certification of 100,000 RAC service technicians on good servicing practices and knowledge of alternative refrigerants to ozone-depleting chemicals under the HCFC Phase out Management Plan (HPMP) Project under the Recognition of Prior Learning (RPL) Type 3 of the Pradhan Mantri Kaushal VikasYojana- PMKVY 2.0.

To measure the impact of the initiatives of HCFC Phase out Management Plan (HPMP) Project, ESSCI engaged the Indian Institute of Corporate Affairs to conduct an assessment, to derive a holistic view from the targeted beneficiaries about the HPMP project and to see environmental benefits and influence on the livelihoods of technicians.

The methodology adopted for this assessment was a mixed method approach which involved qualitative as well as quantitative methods. After conducting detailed literature review, IICA team conducted telephonic interview of sample beneficiaries and analysed the primary data using statistical software followed by interpretation and logical conclusions.

Subsequently, the officials visited 10 training centres across India for physical inspection of the centres and verification of the data collected through telephonic interviews from the beneficiaries during the course of this assessment. With respect to the qualitative data, a zone-wise SWOC (strengths, weaknesses, opportunities and challenges) analysis was conducted to provide a realistic, fact-based, data-driven findings of the project, and its impact.

The assessment of certain measures was carried out by IICA. Indicators such as trainings undertaken at the centres, infrastructure available at the training centres, quality of trainers and assessors available at the centres and direct feedback from the trainees. The assessment report found the Training was successfully conducted as per the schedule at all the ten centres and after making an assessment advised certain steps to improve the programme.

The beneficiaries have indicated that theoretical and practical sessions were conducted as per the schedule and the satisfaction level on most of the lectures based on topics such as: safety and first aid, refrigerant recovery, alternative refrigerants and lubricants, installation and services of window air conditioner & tools, impact of refrigerants on environments, were quite high among the respondents which is received through the call validation.

It can be stated that the majority of technicians joined RPL training program for upskilling training and certification. While reviewing the access of infrastructure available at the training centres through physical verification, it was found that each centre had different set of findings with respect to the size of classroom, availability of equipment's, first-aid facility etc. for which zone wise detailed analysis has been provided in the SWOC analysis conducted for the 10 centres visited.

The next allocation of 40,000 numbers were done in mid-January 2020 and the programme is under implementation with an active number of centres conducting the training across the country.

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# SERVICING AND REPAIR OF INVERTER TECHNOLOGY BASED ACS

*D. Arun Kumar, General Manager, Unitary Product Service Division, Blue Star Limited*

## Operation of Inverter and Fixed Speed AC :

An inverter air conditioner adjusts the speed of the compressor to control the flow of the refrigerant in order to regulate the conditioned-space temperature as required. When the unit is switched on, the compressor inside the unit runs at full speed all the time without starting and stopping frequently. This ensures precise cooling or heating power as required. A fixed speed air conditioner ( Fixed speed compressor ) consumes constant power irrespective of the load of the conditioned space. This makes the compressor go off when the desired room temperature is reached and start again when the temperature increases.

The basic difference between the construction of fixed speed and Inverter unit are as tabulated below :

| | Inverter | Fixed speed |
|---|---|---|
| Communication | Two way communication | One way communication |
| Compressor | Variable speed compressor | Fixed speed compressor |
| Controller | Indoor PCB | Indoor PCB |
| Controller | Outdoor PCB | There is no PCB / Controller |
| Motor | AC/DC fan motor | Ac motor |

## Wiring :

- The indoor and outdoor unit is connected by a 4 core wire.
- In case of Inverter unit communication between the indoor and outdoor unit is through a signal wire.
- It is important that the signal wire should not have any joints. Loose joint can lead to a communication error.
- Different colour coded wire to be used in Inverter AC and same colour wire should not be used.

## Earthing :

- Earthing is very important for trouble free operation of an Inverter air conditioners.
- We need to ensure that proper earthing is available at the site as well as proper earthing is done in both IDU as well as ODU.
- The recommended voltage between Neutral and Earth should be less than 2 V.

## Compressor.

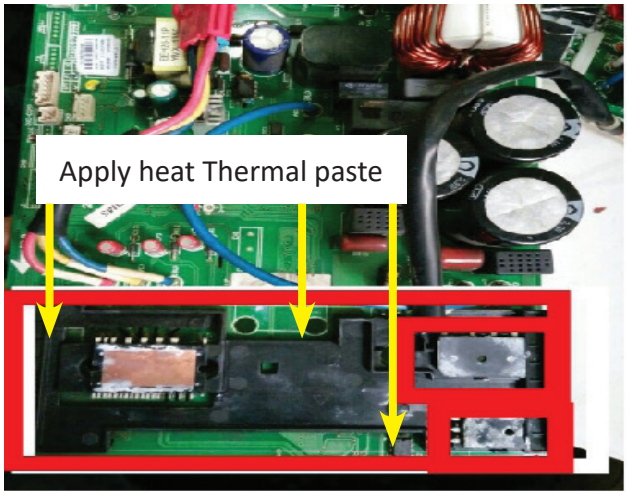
- The Inverter compressor is coupled with the outdoor drive and the electrical supply to an Inverter compressor is only through the outdoor drive.
- At the time of checking an inverter compressor do not check the compressor by giving direct power supply to the compressor. The Inverter compressor is to be checked ONLY by measuring the resistance across the windings in power off condition.
- The Inverter Compressor has 3 winding like any other normal Rotary compressor. The three winding terminals are named as U-V-W.
- A healthy compressor would have same resistance across all the 3 windings. UV=UW=VW The table below is for reference purpose

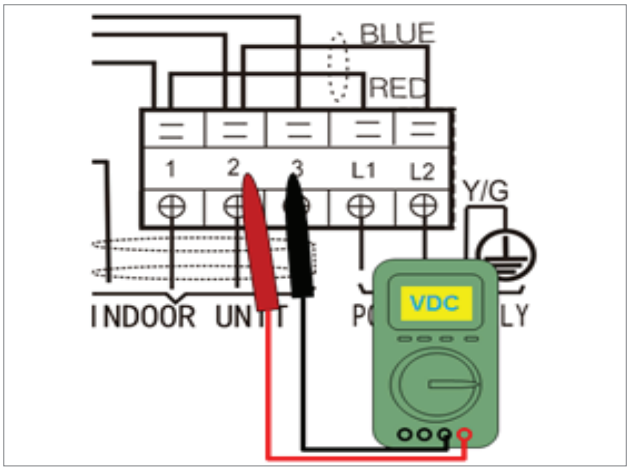
| Position | Resistance value |
|---|---|
| Blue - Red | 2.35 Ω |
| Blue - Black | 2.35 Ω |
| Red - Blue | 2.35 Ω |

## Controller :

- A high-capacity electrolytic capacitors are used inside the outdoor unit controller ( inverter). They retain an electrical charge (charging voltage DC 310V ) even after the power is turned OFF, hence some time is required for the charge to dissipate. Be careful not to touch any electrified parts before the controller turns OFF.
- If the outdoor controller is normal, approximately 30 seconds will be required for the charge to dissipate. However, allow at least 5 minutes for the charge to dissipate if there is thought to be any trouble with the outdoor controller.

- When replacing the outdoor PCB, ensure thermal paste is applied. Thermal paste is applied to ensure that the heat from the IPM and IGBT In the outdoor PCB is uniformly rejected out and thereby maintaining the temperature of the IPM.
- Refer to the picture below, yellow arrow indicating the location where thermal paste is to be applied. Always use heat sinking compound ( Anabond 652c ) and do not use fevicol for this purpose.




## What is communication error in Inverter AC ?

- The indoor controller board will transmit signal to outdoor controller board every 0.5 seconds.
- The outdoor unit will response to indoor once the valid data is received. If there is any disruption in the signal between the indoor and outdoor unit will trip in communication error.

## How to check communication error ?

- Always Use a multi meter to test the DC voltage between port 2 and port 3 of outdoor unit. The red pin of multi meter connects with port 2 while the black pin is for port 3.
- When AC is in normal running condition , the voltage will move alternately between -25V to 25V (mentioned voltage can change with respect to model)
- If the outdoor unit has malfunction, the voltage will move alternately with positive value.
- But if the indoor unit has malfunction, the voltage will be a certain value.

## How to Check the " Temperature Sensor " functioning ?

a. Disconnect the temperature sensor from PCB, measure the resistance value with a multi meter Room temp.(T1) sensor,

b. Indoor coil temp.(T2) sensor,

c. Outdoor coil temp.(T3) sensor,

d. Outdoor ambient temp.(T4) sensor,

e. Compressor discharge temp.(Tp) sensor.

f. Measure the resistance value of each winding by using the multi-meter.

g. Below is the temperature resistance chart which should be referred for trouble shooting a resistance. Table below is for reference purpose, we should refer to the temperature resistance chart of the manufacturer.

| °C | K Ohm | °C | K Ohm | °C | K Ohm | °C | K Ohm |
|---|---|---|---|---|---|---|---|
| -20 | 115.266 | 20 | 12.6431 | 60 | 2.35774 | 100 | 0.62973 |
| -19 | 108.146 | 21 | 12.0561 | 61 | 2.27249 | 101 | 0.61148 |
| -18 | 101.517 | 22 | 11.5000 | 62 | 2.19073 | 102 | 0.59386 |
| -17 | 96.3423 | 23 | 10.9731 | 63 | 2.11241 | 103 | 0.57683 |
| -16 | 89.5865 | 24 | 10.4736 | 64 | 1.96532 | 104 | 0.56038 |
| -15 | 84.2190 | 25 | 10.000 | 65 | 1.89627 | 105 | 0.54448 |
| -14 | 79.3110 | 26 | 9.55074 | 66 | 1.83003 | 106 | 0.52912 |
| -13 | 74.5360 | 27 | 9.12445 | 67 | 1.76647 | 107 | 0.51426 |
| -12 | 70.1698 | 28 | 8.71983 | 68 | 1.76647 | 108 | 0.49989 |
| -11 | 66.0898 | 29 | 8.33566 | 69 | 1.70547 | 109 | 0.48600 |
| -10 | 62.2756 | 30 | 7.97078 | 70 | 1.64691 | 110 | 0.47256 |

## How to check Outdoor PCB IPM Continuity Check ?

- Turn off the power, wait for 10minutes to let the large capacity electrolytic capacitors in the outdoor PCB discharge completely, and dismount the IPM. Use a digital tester to measure the resistance between P and UVWN; UVW and N.

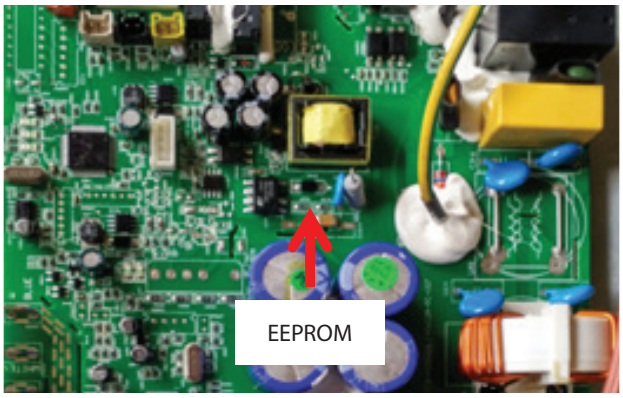
| Digital tester | | Normal resistance value | Digital tester | | Normal resistance value |
|---|---|---|---|---|---|
| (+)Red | (-)Black | | (+)Red | (-)Black | |
| P | N | ∞ | U | N | ∞ |
| | U | | V | | |
| | V | | W | | |
| | W | | (+)Red | | |

## How to correct EEPROM parameter error ?

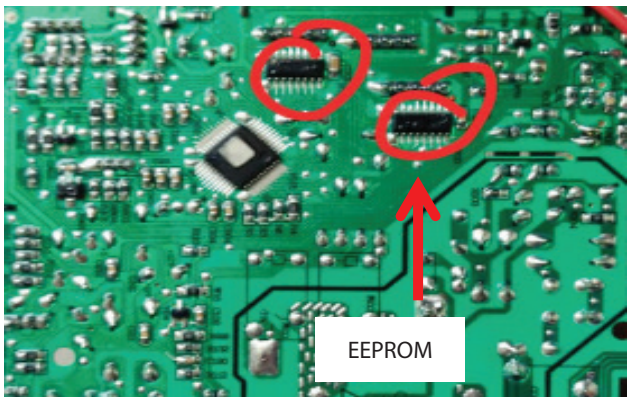
The EEPROM chip is a read-only memory whose contents can be erased and reprogrammed using a pulsed voltage. The indoor or outdoor PCB main chip does not receive feedback from EEPROM chip. For the location of EEPROM chip, please refer to the below photos.

**Recommended parts to replace.**

- Indoor PCB
- Outdoor PCB




ODU PCB




IDU PCB

Green Refrigerants : Inverter AC's use widely green refrigerants for their operation

- In global moves towards lower GWP refrigerants, R32 is considered a key future replacement for R410A in air conditioners.
- R32 uses 78% lesser refrigerant to operate compared to R-410A. This gas is categorized under flammability level A2( ISO 817:2014) hence care has to be taken when using this gas. It is very close to R-410A in terms of operating conditions and performance.

### The Benefits

i. Zero ODP

ii. One third of R-410A GWP.

iii. Required less charge as it has a 20% higher volumetric capacity.

iv. Similar saturated pressure hence development is easier.

v. Higher critical temperature hence higher COP.

vi. Lower density hence the amount of charge required is smaller.

vii. Single component of gas, therefore it is easier to be produced and managed.

- However R410A based Inverter AC's are there in use in market with large numbers and hence the following key precautions to be taken while handling R410a Refrigerant :
  - The composition of refrigerant R410A changes whether it is in a gaseous phase or liquid phase. Thus, when there is a refrigerant leak the basic performance of the air conditioner may be degraded because of a change in composition of the remaining refrigerant. Therefore, do not add new refrigerant. Instead, recover the remaining refrigerant with the refrigerant recovery unit. Then, after evacuation, totally recharge the specified amount of refrigerant with the new refrigerant at its normal mixed composition state (in liquid phase).
  - Ether-type oil is used for compressor oil for R410A-type units, which is different from the mineral oil used for R22. Thus more attention to moisture prevention and faster replacement work compared with conventional models are required.

In conclusion , the repair and servicing of Inverter air conditioners requires sound technical knowledge on the components and on their functioning.

**'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.**

## From the field:

**Virender Kumar, 38 has vast experience in working as RAC technician and electrician. In an interaction with newsTRAC, he talks about his job, goals and hurdles, while working in the field. Excerpts from the interview are shared below**

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

Ans: I work full time with JV Electrical Works as a RAC technician and electrician. My work involves servicing home AC units and other appliances, in high-rise residential buildings.

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

Ans: I will rate it as 7. While, I am happy with the autonomy I enjoy at work, the work hours are sometime very hectic.

**How would you rate your happiness on your organisation's conduct?**

Ans: I will rate it at 6. There is good support from my seniors and we get leaves, if applied in advance, but the remuneration can be better.

**Do you work with residential customers as well?**

Ans: Yes, I work solely with residential customers and I do AC servicing, lighting and electrical wiring. My role involves dealing with residential consumers on a daily basis.

**Are you professionally trained?**

Ans: I underwent a training programme at ITI after my 10th Standard and I have an electrician's license. Although I have learned AC servicing on the job, from my seniors and from working for the last 20 years.

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

Ans: While, it is on par with others working in the same field, I feel it can be bit more. Although I just got a hike of INR 1,000 last month and extra money for working during COVID.

**Do you feel your technical skills are adequate? How willing are you to learn more skills in this field?**

Ans: I have a lot of field experience and I have trained others as well in electrical work. However, I am not quipped to service new inverter ACs, so that is something I wish to learn.

**Would you be interested in undergoing trainings for RAC technicians to hone your skills?**

Ans: Yes, I want to learn how to service the new ACs in the market. However, I support a large family, so I am not sure how I can take out the time and money for trainings

## Web Based Information Resources for Refrigeration and Air-Conditioning (RAC) Service Technicians

### Ready Reference for Good Servicing Practices - Videos

English

Installation of Split AC

Flammable Refrigerant Handling

Good Service Practices

Recovery, Recycling and Reclamation

Hindi

Basic tools overview

Evacuation of AC

Flaring

Leak detection

Refrigerant charging

### Ready Reference for Good Servicing Practices – Training Material

Good Service Practices and Installation of Room Air-conditioners with HCFC–22 and Flammable Refrigerants – Technician Handbook

Good Service Practices and Installation of Room Air-conditioners with HCFC–22 and Flammable Refrigerants – Trainers Handbook

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)

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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**Website:** http://ozonecell.in/
**twitter:** https://twitter.com/OMoefcc
**YouTube:** https://www.youtube.com/channel/UC82wIRSvgzUEzOys5SZWrpg

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

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