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NEWSLETTER FOR TECHNICIANS IN REFRIGERATION AND AIR CONDITIONING (RAC) SERVICING SECTOR

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Inside...

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Refrigerant Cylinder Safety: Essential Practices for RAC Technicians

By ***Mr Anand Gupta***
CEO, DewGas Refrigerants - Gupta Oxygen Pvt Ltd

India's Refrigeration and Air-Conditioning (RAC) sector is changing fast. Today, technicians are increasingly working with high-pressure and low-GWP refrigerants such as R-410A and R-32. While refrigerants have advanced, cylinder practices on the ground have not always kept pace. Continuing to use traditional pipe-welded, locally made cylinders with modern refrigerants can significantly increase safety risks for technicians and the public.

Why Should Technicians Care About Cylinder Safety?

Whenever we see a gas cylinder, several question comes to mind which gas is inside? What happens if it leaks? Will it burst? Unfortunately, most of these questions often remain unanswered. However, for technicians who handle cylinders every day, knowing these answers is important for working safely.

The working fluid of RAC system refrigerants have changed significantly over time not just in environmental impact, but also in operating pressure and safety characteristics. Refrigerant technology has also moved forward, while majority of technicians are still using old-style pipe-welded cylinders originally designed for an earlier generation of refrigerants. When R-12 was introduced in the late 1920s, the world's refrigeration workshops were stocked with locally fabricated pipe-welded cylinders compact, inexpensive, and suited to the low-pressure refrigerants of the day. R-12 and its successor R-22 operated at relatively modest pressures approximately 140 psi and 222 psi at 40°C, respectively .These cylinders served their purpose adequately for decades.

Everything changed in the late 1990s when the HFC generation arrived. R-410A, a near-azeotropic blend of R-32 and R-125, operates at roughly 300 psi (~20.7 bar) at 40°C. Its successor R-32 now the dominant refrigerant in Indian room air conditioners reaches approximately 360 psi (~24.8 bar) under the same conditions . That is more than double the operating pressure of R-22, yet in many servicing centres across India, the same old pipe-welded cylinder that once held R-22 is now being filled with R-32. The consequences of this mismatch can be catastrophic.

THINK ABOUT IT !

Using an old pipe-welded cylinder with modern refrigerants is like using a **basic keypad phone in today's smartphone world** it may still function, but it is **not designed for current demands and risks failure under pressure**

Gas Cylinder Rules, 2016: What the Law Says?

To strengthen safety requirements and address evolving gas technologies, the Government of India notified the Gas Cylinders Rules, 2016 under the Explosives Act, 1884. These rules superseded the earlier Gas Cylinders Rules, 2004 and are administered by the Petroleum and Explosives Safety Organisation (PESO).[1]

Under these rules:

- Manufacturing, importing, filling, storing, transporting, testing, and handling of compressed gas cylinders must comply with applicable PESO approvals and licensing requirements.
- Cylinder filling facilities must operate according to approved layouts, safety provisions, and Cylinder filling facilities must follow approved layouts and Indian Standards (IS).
- Filling, inspection and handling operations should be carried out under the supervision of competent and adequately trained personnel.

[1] https://peso.gov.in/web/sites/default/files/2019-12/GCR-2016_bilingual.pdf

- Smoking, open flames, and unsafe handling practices that may damage cylinders or valves must be prevented in cylinder storage and filling areas.
- Material Safety Data Sheets (MSDS) must be displayed clearly.

Most importantly, compressed gases should only be filled into cylinders that are approved, tested, and certified for the intended gas service. Locally fabricated or non-approved pipe-welded cylinders that do not conform to applicable BIS standards and PESO requirements are unsafe and unsuitable for handling modern high-pressure refrigerants.

BIS Standards and ISI Certification

The Bureau of Indian Standards (BIS) is India's apex national standards authority, established under the Bureau of Indian Standards Act, 2016. The ISI mark India's most widely recognised product safety certification signals that a product has been independently tested, verified, and found conformant with the relevant Indian Standard.

For refrigerant cylinders, three standards are of primary importance :

1. **IS 3196** covers welded low-carbon steel cylinders exceeding 5 litres water capacity for low-pressure liquefiable gases.
2. **IS 7142** covers welded low-carbon steel cylinders not exceeding 5 litres water capacity for low-pressure liquefiable gases.
3. **IS 7285** specifies requirements for refillable seamless steel gas cylinders intended for higher-pressure service.

These standards prescribe requirements for materials, design, manufacturing quality, welding, heat treatment, dimensional tolerances, inspection, testing, and marking.

Before being placed in service, cylinders must successfully undergo prescribed tests such as hydrostatic pressure testing, leak testing, and other safety evaluations specified in applicable BIS standards. During service life, cylinders must also undergo periodic inspection and retesting at intervals prescribed under the Gas Cylinders Rules, 2016.

A BIS/ISI-certified cylinder is not merely a legal requirement; it is an engineered safety system designed to safely withstand pressure, temperature variation, handling stresses, and long-term service conditions. In contrast, locally fabricated non-standard cylinders may lack the design verification, testing, traceability, and safety margins necessary for modern refrigerants.

Using approved cylinders is therefore not only a matter of compliance, it is essential for protecting technicians, customers, and the public.

Two-Wheeler Transportation: A Hidden Danger

Across India, it is a common sight: a refrigerant cylinder balanced precariously on the footboard of a two-wheeler, the technician navigating city traffic with one hand on the handlebar and one steadying the load. This practice, born from the economic pressure to minimise transport costs, is both illegal and lethal.

Cylinders are heavy, with a high centre of gravity, and inherently unstable when not secured. A pothole, a sudden brake, or a minor collision can bring the cylinder crashing to the ground. The fall may shear the valve, trigger a rapid gas release, ignite an A2L or A3 refrigerant against a hot exhaust pipe, or project the cylinder like a missile into oncoming traffic. The consequences have been documented. Figure 1 illustrates a common field practice where refrigerant cylinders are transported on two-wheelers without proper securing mechanisms. It also shows examples of locally used cylinders, which may lack essential safety features such as valve protection, increasing the risk of leakage, valve damage, or accidents during handling and transport.

Figure 1 Unsafe cylinder transport on a two-wheeler (left) and examples of locally used refrigerant cylinders (right), highlighting risks associated with improper handling

During peak summer and high-humidity seasons, we often read about similar incidences. Most of these incidents are caused by use of unsafe cylinders, their improper handling, and lack of awareness about pressure and refrigerant behaviour. Each accident is a reminder that **Cylinder safety is not optional, it is a matter of life and death for RAC technicians**.

WHEN A CYLINDER'S SAFETY IS IGNORED!

A 27-year-old air-conditioning technician lost his life and another was critically injured when a refrigerant gas cylinder exploded in Nagpur.[2] The blast reportedly occurred due to heat while the cylinder was being transported for repair work. The incident highlights the severe risks associated with improper handling and exposure of pressurised cylinders to high temperatures. It underscores the critical need for strict safety protocols in storage, transport, and servicing operations.

Safe cylinder transportation is not logistically complex it requires only the discipline to follow established protocols. Cylinders must be transported in an upright position, properly secured using restraining chains, clamps, or vehicle-mounted racks. Valve protection caps must be fitted and verified before loading. Suitable vehicles preferably closed vans with ventilation, or at minimum a three-wheeler must be used. No cylinder should ever be transported in the passenger compartment of a car or on a two-wheeler, regardless of distance or urgency.

Understanding Cylinder Pressure: Working, Design & Test

One of the most under-appreciated aspects of cylinder safety is the layered pressure hierarchy embedded in every certified cylinder's design. There is no single "pressure" there are three distinct, inter-related values, each serving a specific engineering purpose (Figure 2).

The working pressure represents the maximum pressure under normal operating conditions during routine service. The design pressure is a higher reference pressure used by engineers to determine the required wall thickness of the cylinder, incorporating safety margins to account for temperature variations, pressure fluctuations, and material fatigue over its service life. The test pressure typically around 1.5 times the working pressure is applied during mandatory hydrostatic testing and must be sustained without leakage, permanent deformation, or structural failure, as specified under relevant BIS standards (e.g., IS 3196, IS 7285) and the Gas Cylinder Rules, 2016. If it survives the test without leaks or damage, it is approved. This safety margin ensures cylinders remain safe even in extreme conditions.

Valve Protection: The Small Component That Prevents the Worst

The cylinder valve is the most critical component in any pressure containment system. If the valve is damagedwhether due to a fall, collision during transport, or improper handlingthe pressurised gas can escape suddenly and uncontrollably. In such situations, the cylinder can behave like an uncontrolled projectile, reaching speeds capable of causing severe damage, including penetrating walls and leading to fatal injuries.

To prevent such risks, BIS-certified cylinders are designed with integrated valve protection systems, typically in the form of permanently fitted guards or caps. depicts BIS-compliant refrigerant cylinders, highlighting standardised design features and integrated safety elements such as valve protection. Figure 3 depicts BIS-compliant refrigerant cylinders, highlighting standardised design features and integrated safety elements such as valve protection.

These protective features are engineered to absorb impact forces and shield the valve from direct damage, without requiring removal during routine use.

In contrast, locally fabricated pipe-welded cylinders often lack adequate valve protection, and the valves themselves may not meet verified quality or pressure standards. The

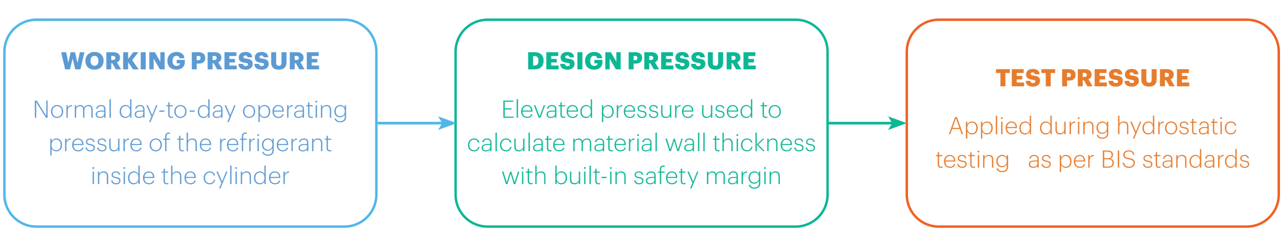


Figure 2 The Three-Layer Pressure Safety Hierarchy

[2] https://theprint.in/india/air-conditioning-technician-killed-in-cylinder-explosion/2122052/

Figure 3 BIS-certified refrigerant cylinders (R-32 and R-410A) with integrated valve protection and standardised design for safe handling and high-pressure applications

absence of a valve guardor a missing capis not a minor issue; it is a clear indicator of a significant underlying safety risk.

Key Safety Features in BIS-Certified Cylinders

- Permanently fitted valve protection caps
- Designs that eliminate the need to remove caps during operation

Without these protections, cylinders become far more vulnerable during handling and transport, significantly increasing the risk of accidents.

Why Standard Cylinders Matter

The difference between locally fabricated cylinders and BIS/ISI-certified cylinders is not just about compliance it directly impacts safety and reliability. The Table 1 highlights key differences in design, testing, and usage, helping technicians make informed and safer choices

Table 1 Comparison between locally fabricated cylinders and BIS/ISI-certified cylinders across key safety, compliance, and performance parameters

Parameter	Local Cylinder	BIS / ISI Cylinder
Pressure Test	✗	✓
Valve Guard	✗	✓
Hydro Test	✗	✓
Flammable Gas Use	✗ Illegal	✓ Allowed
Traceability	✗	✓ QR Code / Stamp

Final Message for Technicians

Refrigerants have evolved, operating pressures have increased, and the risks associated with cylinder handling have grown accordingly. In this context, cylinder safety is no longer optional it is essential. Using BIS/ISI-certified cylinders, complying with the Gas Cylinder Rules, 2016, and following safe transport and handling practices are critical to protecting technicians, customers, and the environment. Ultimately, safety is not an extra step, but a fundamental part of professional practice in today's RAC sector.

Strengthening India's Cooling Workforce: Training Equipment Support to Industrial Training Institutes (ITIs)

By ***Mr Shaurya Anand***
Associate Fellow, Centre for Climate Change Research, TERI

India's demand for refrigeration and air conditioning (RAC) is growing rapidly. From preserving food in cold chains to providing thermal comfort in homes, offices, hospitals, and transport systems, cooling technologies have become an essential part of modern life.

With rapid urbanization, population growth, and rising incomes, the need for cooling solutions is expected to increase significantly in the coming years. As the number of Refrigeration and Air Conditioning (RAC) systems grows, so does the demand for skilled technicians capable of installing, servicing, and maintaining these systems safely and efficiently.

Recognizing this need, the Ozone Cell, Ministry of Environment, Forest and Climate Change (MoEF&CC), Government of India, under the HCFC Phase-out Management Plan (HPMP) Stage-III, is supporting the strengthening of technical training infrastructure in the country. With financial assistance from the Multilateral Fund of the Montreal Protocol, modern RAC training equipment has been provided to 119 Industrial Training Institutes (ITIs) recommended by the Directorate General of Training (DGT).This initiative aims to equip future RAC technicians with hands-on skills for modern, energy-efficient, and environmentally responsible cooling technologies.

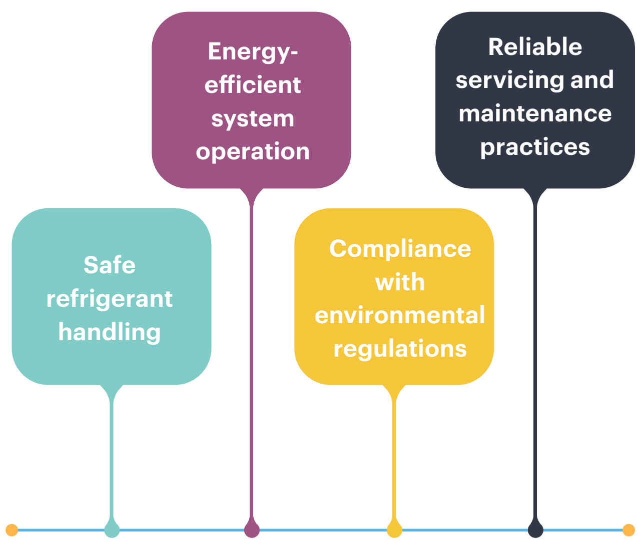
Why Skilled RAC Technicians Matter

The RAC sector is undergoing a major technological transformation. Modern RAC systems now increasingly use:

- Low Global Warming Potential (GWP) refrigerants
- Energy-efficient inverter technologies
- Smart electronic controls
- Advanced refrigeration systems used in commercial and industrial cooling

At the same time, the industry is transitioning away from HCFC refrigerants such as HCFC-22 in accordance with the Montreal Protocol and moving toward climate-friendly alternatives such as R-290, CO_2, and low-GWP refrigerant blends.

These new refrigerants often involve different operating characteristics and safety considerations, including flammability. Therefore, proper technician training becomes essential to ensure:



RAC Training in India: The Role of ITIs

In India, the Refrigeration and Air Conditioning (RAC) Trade is offered as a two-year vocational training programme in Industrial Training Institutes (ITIs) under the Directorate General of Training (DGT), Ministry of Skill Development and Entrepreneurship (MSDE).

The programme focuses on developing practical skills in depicted in Figure 4:

Students who complete the course receive a nationally recognized certification, enabling them to work across the RAC servicing sector.

To further strengthen instructor capability, Craft Instructor Training Scheme (CITS) courses are offered at National

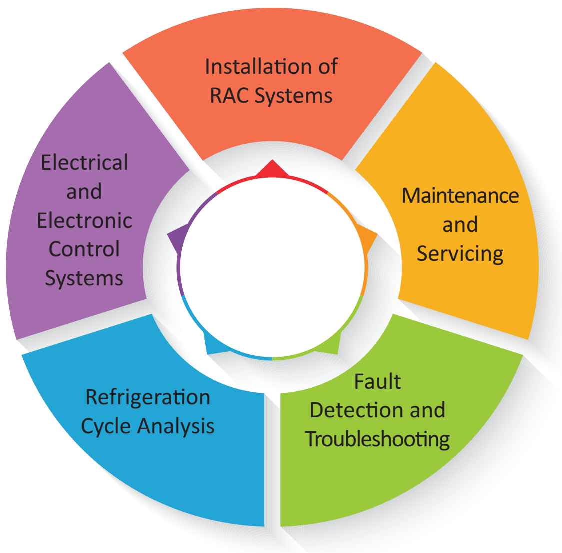


Figure 4 Key practical skill areas covered in the RAC training programme at Industrial Training Institutes (ITIs)

Skill Training Institutes (NSTIs) and Institutes of Training of Trainers (IToTs).

Equipment Support to ITIs under HPMP Stage-III

To enhance hands-on technical learning, the Ozone Cell, MoEF&CC, has provided modern RAC training equipment to 119 ITIs across India. The objective is to ensure that trainees gain practical exposure to the latest technologies used in modern refrigeration and air-conditioning systems.

Key Objectives of the Initiative are described as follows:

Objective	Description
Modern Training	Introduce students to advanced RAC technologies such as Variable frequency drives and smart controls.
Environmental Protection	Train technicians on low-GWP and alternative refrigerants
Energy Efficiency	Promote knowledge of inverters and energy-efficient systems
Good Servicing Practices	Build technician capacity in safe refrigerant handling
Industry Readiness	Align technician skills with evolving industry needs

Types of Training Equipment Provided

To strengthen practical training infrastructure in Industrial Training Institutes (ITIs), the Ozone Cell, MoEF&CC, has supported the installation of modern refrigeration and air-conditioning training equipment. These training kits simulate real-world refrigeration and air-conditioning working systems, allowing students to learn through practical experimentation and troubleshooting. Table 2 presents the different types of training equipment provided to ITIs and the key technical skills that students develop through hands-on training using these systems.

Table 2 RAC Training Equipment Provided to ITIs and the Key Skills Developed through Practical Training

Training Equipment	Purpose of the Training Unit	Key Components / Features	Skills Developed in Trainees	Training Kits
Basic Refrigeration and Electrical Cycle Training Unit	Demonstrates the vapour compression refrigeration cycle and helps students understand system operation and performance analysis.	» Compressor, condenser, expansion device and evaporator forming a closed-loop refrigeration cycle » Electrical components such as pressure switches, thermostats, timers, relays and circuit breakers » Instrumentation for monitoring system performance	» Understanding refrigeration cycle operation » Calculation of Coefficient of Performance (COP) » Analysis of system parameters such as pressure and temperature » Understanding electrical controls in refrigeration systems	 **Figure 5** Basic Refrigeration Cycle Training Unit
Split AC Training Unit (1.5 Ton – Inverter Technology Compatible)	Provides hands-on learning of modern energy-efficient air conditioning systems using inverter technology.	» Split AC system with indoor and outdoor units » Variable Frequency Drive (VFD)/ Inverter for compressor speed control » Sensors, gauges and monitoring instruments » Electronic control systems	» Installation and servicing of inverter AC systems » Understanding compressor speed control » Performance monitoring and diagnostics » Troubleshooting faults in inverter systems	 **Figure 6** Inverter Split AC Training Unit
Commercial Refrigeration Training Unit	Simulates refrigeration systems used in commercial applications such as supermarkets, restaurants and food processing facilities.	» Modular or bench-top refrigeration system » Visible refrigeration circuit for demonstration » Fault simulation capability » Standard refrigeration components used in field systems	» Understanding commercial refrigeration systems » Component identification and operation » Troubleshooting faults such as blocked lines or thermostat issues » Practical servicing techniques	 **Figure 7** Commercial Refrigeration Training Unit
Industrial Refrigeration Rack System Training Unit	Demonstrates large-scale refrigeration systems used in supermarkets, cold storages and industrial applications.	» Multiple compressors mounted on a rack system » Parallel compressor operation » Control systems for load management » Industrial refrigeration components	» Understanding multi-compressor refrigeration systems » System capacity management and load balancing » Energy-efficient operation of large refrigeration systems » Industrial refrigeration maintenance practices	 **Figure 8** Industrial Refrigeration Rack System Training Unit
Split AC Training Unit (Metal Frame Model)	Practical training in installation and servicing of split AC systems.	» Metal frame structure exposing system components » Refrigeration circuit components » Electrical wiring and control elements accessible for demonstration	» Installation and maintenance of split AC systems	 **Figure 9** Split AC Training Unit with Metal Frame Training Unit

Strengthening RAC Servicing Capacity: Ozone Cell Engagement with Technician Training Programme under HPMP Stage-III

By ***Ms Pratiksha Kaushik***
Research Associate, Centre for Climate Change Research, TERI

On February 18, 2026, the Ozone Cell of the Ministry of Environment, Forest and Climate Change visited the CARE Foundation training facility in Patparganj, Delhi. The visit was part of the RAC Technician Training and Certification Program implemented under GIZ Proklima HPMP Stage III. The training emphasizes safety, efficiency, and environmentally friendly maintenance techniques for installing and repairing room air conditioners, especially those that use HFC-32, HCFC-22, and combustible refrigerants.

The Director of the Ozone Cell, during the visit, interacted with the candidates who were currently undergoing training as well as with the trainers to understand the progress and implementation of the programme. He highlighted the critical role of the RAC servicing sector and capacity-building initiatives such as these training programmes in advancing the objectives of the Montreal Protocol and supporting India's preparedness for the upcoming HFC phasedown, stressing the need for skilled technicians to ensure safe handling of refrigerants and adoption of sustainable servicing practices.

Under HPMP Stage-III, a total of 25,000 RAC service technicians across India are to be trained and certified. GIZ Proklima serves as the implementing agency, while CARE Foundation is one of the training partners responsible for delivering the training. The training programme is conducted over two days, with the assessment taking place on the second day. Candidates who successfully complete the assessment are awarded certificates. During the visit, certificates were distributed to the trainees from the first two batches trained by CARE Foundation

Figure 10 Shri Aditya Naryan Singh, Director of Ozone Cell, MoEF&CC, interacting with RAC Technicians at Training and Certification Program implemented under GIZ Proklima HPMP Stage III

Figure 11 Distribution of certificates to participants of the RAC Technician Training and Certification Programme.

The qualification pack for the training has been approved by the National Council for Vocational Education and Training (NCVET) under the Ministry of Skill Development and Entrepreneurship (MSDE), and the Electronics Sector

Figure 12 Discussion among officials during the RAC Technician Training Programme visit.

Skills Council of India (ESSCI) serves as the awarding body.

Upon completion of the training, participants are awarded a micro-credential certificate by Electronics Sector Skills Council of India. The qualification is recognized by the National Council for Vocational Education and Training under the Skill India framework (Figure 13).


NCVET
इलेक्ट्रॉनिक्स सेक्टर स्किल्स काउंसिल ऑफ इंडिया
Electronics Sector Skills Council of India
राष्ट्रीय व्यावसायिक शिक्षा एवं प्रशिक्षण परिषद द्वारा मान्यता प्राप्त
Recognised by NCVET
कौशल योग्यता प्रमाणपत्र
Certificate for Micro Credential

Skill India
कौशल भारत - कुशल भारत

Certificate No: AFMPA0010NM-03-EH-02835-2024-V1-ESSC-003362
APAAR ID : NA

This is to certify that Mr./Ms./Mx
Son/Daughter/Ward of
Date of Birth 30/12/1993
Enrolment No CAN_39507736
has been assessed by Induslynk Training Services Private Ltd (Mercer Mettl) and cleared the assessment
in the job role/qualification Essentials Of Refrigeration And Air Conditioning at NSQF Level 3
of Duration 15 hrs having earned 0.5 Credits at Training Centre Able Technomart, Sagar
District SAGAR State MADHYA PRADESH with 89 % / Grade

Place of Issue Delhi Date of Issue 26/02/2026

Name Mr. Vinod Sharma
Designation Chairperson
Signature

e-Verification link
Digitally Generated Certificate NSQF - National Skills Qualification Framework

Figure 13 Certificates awarded to participants upon successful completion of the training programme

Experience

Mr. Satish. Kumar is a Craft Instructor in Refrigeration and Air Conditioning (RAC) at ITI Pusa, with over 27 years of experience in technical training.

From the field:

Mr. Satish. Kumar is a Craft Instructor in Refrigeration and Air Conditioning (RAC) at ITI Pusa, with over 27 years of experience in technical training. He has extensive expertise in teaching RAC fundamentals, modern refrigerant practices, and hands-on servicing skills. Over the years, he has taught numerous students, helping them build strong technical capabilities and prepare for careers in the RAC servicing sector.

From your experience as an RAC instructor, what are the most important skills that students should learn to work as refrigeration and air-conditioning technicians?

Ans: Students need to build a strong foundation in both theoretical concepts and practical skills. At ITIs, training focuses on understanding RAC systems such as room air conditioners and refrigerators, along with key concepts like refrigeration cycles and refrigerants. In addition, essential hands-on skills such as welding and brazing are emphasized, as they are critical for installation, servicing, and repair work in the field.

In recent years, how has RAC training in ITIs changed with the introduction of new technologies and refrigerants?

Ans: RAC training has evolved significantly over the years. Earlier, refrigerants such as R-12 were commonly used, but today the focus has shifted to newer refrigerants like R-32,R-600a R-134a, along with emerging options such as R-290. Students are trained not only in their characteristics but also in their safe handling. Additionally, modern technologies such as inverter-based air conditioners and components like variable frequency drives (VFDs) are now part of the curriculum, ensuring that students are better prepared for current industry requirements.

With the transition to environmentally friendly (low-GWP) refrigerants, how are ITIs preparing students to safely handle and service these refrigerants?

Ans: Safety is an integral part of RAC training in ITIs. Students are trained in the safe handling of refrigerants, including the use of gas detection tools and proper servicing practices. Special emphasis is given to handling flammable refrigerants, including safety precautions, electrical protection, and controlled working conditions. Proper charging techniques, evacuation processes, and minimising refrigerant loss are also taught to ensure both safety and efficiency in real-world applications.

ITIs have received training equipment kits supported by the Ozone Cell, MoEF&CC. What types of equipment or training kits were provided, and how do they help students learn better?

Ans: The Ozone Cell, MoEF&CC has provided a comprehensive set of training equipment to ITIs, significantly enhancing practical learning. These include units such as the Basic Refrigeration and Electrical Cycle Training Unit, Split AC Training Units (including inverter-compatible and metal frame models), Commercial Refrigeration Training Unit, and an Industrial Refrigeration Rack System Training Unit.

These systems enable students to directly observe and work with real RAC components and configurations. By engaging with actual equipment, students gain a clearer understanding of system operation, component functions, and servicing practices. This hands-on exposure helps bridge the gap between theory and practice, improving technical competence, troubleshooting skills, and overall confidence in handling real-world applications.

When newly trained technicians start working in the field, what are some common mistakes or challenges they face?

Ans: One of the common challenges faced by new technicians is a lack of clarity in basic concepts and fundamentals. Strong foundational knowledge, combined with active learning during training, is essential for success in the field. When students focus on building these fundamentals and practice regularly, they are better equipped to handle real-world challenges with confidence.

In your view, what more can be done to strengthen RAC training for students in ITIs across India?

Ans: The introduction of dual system of training, where students combine classroom learning with industry exposure, is a positive step. Practical experience in real working environments helps students better understand field conditions and industry expectations. Additionally, encouraging greater participation of women in RAC trades can further strengthen the workforce. The use of digital tools in training is also improving accessibility and making learning more effective.

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

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Ozone Cell, Ministry of Environment, Forest and Climate Change

1st Floor, 9 Institutional Area, Lodhi Road, New Delhi -110003
Phone No.: 011-24642176
Fax: 011-24642175
Website: http://ozonecell.nic.in/

Email: pmucfc-mef@nic.in
twitter: https://twitter.com/OMoefcc
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teri
The Energy and Resources Institute
Creating Innovative Solutions for a Sustainable Future

For further information

Shaurya Anand
TERI, Darbari Seth Block, IHC
Lodhi Road, New Delhi-110 003

Tel: 011-24682100; Fax: 011-41504900

Email: shaurya.anand@teri.res.in
Website: www.teriin.org