

**1. Module details**

**Module name**

**High Pressure Refrigerants**

**Suggested structured learning time**

A learner possessing the prerequisite skills and knowledge should achieve the module purpose in 18 hours.

**Module code**

NUE358

**Field of Education code**

031315 Refrigeration and Air Conditioning Mechanics

**2. Module purpose**

This module will provide students with the underpinning knowledge and skills necessary to safely use high pressure refrigerants, associated tools, equipment and compatible oils.

Learners will also gain an understanding of the issues that have caused the shift to high pressure refrigerants and the safety principles for their use.

It covers the reasons why R22 is being phased out, revision of the fundamentals of an air conditioning refrigeration system cycle, properties and applications of HVAC refrigerants and oils, essential service tools and materials used with high pressure refrigerants, working procedures when working with high pressure refrigerants, Australian Standard Code of Good Practice for the Reduction in the Emission of Controlled Ozone Depleting Refrigerants, personal safety protection equipment when handling refrigerants and the correct handling and storage of high pressure refrigerants and POE oils.

**3. Learning pathway**

**Intended use in the structured learning program**

This module intended to supplement extensive workplace exposure to refrigeration and/or air conditioning installation and servicing work. In particular it applies to the installation and servicing systems using high pressure refrigerants to ensure they comply with requirements and are safe to use. Therefore before undertaking this module a student should have a clear understanding and experience of:

- refrigeration vapour compression cycle principles, pressure temperature relationships, gas laws, system operating pressures, temperatures, states and conditions.
- working safety with CFC, HCFC and HFC refrigerants to correctly pressure test, evacuate, charge leak test a system and recover the refrigerant.

<b>Recommended prerequisites</b>	For the most effective learning and safety it is mandatory that this module should only be undertaken only after attaining a relevant Certificate III in Refrigeration / Air Conditioning trade or Certificate III in Domestic Appliance Servicing, plus CFC / HCFC accreditation.
<b>4. Relationship to competency standards</b>	This module provides part of the underpinning knowledge and skills in the 'Evidence Guide' of specific units of competency in the National Electrotechnology Training Package and provides similar support, where mapped, to equivalent units in the National Metals and Engineering Competency Standards. For details refer to the module to unit maps, available from EE-Oz Training Standards.
<b>5. Content</b>	
<b>Summary of content</b>	<ol style="list-style-type: none"><li>1. Introduction to High Pressure Refrigerants<ul style="list-style-type: none"><li>• Background</li><li>• CFC/HCFC phase out schedule</li><li>• Montreal Protocol, relevant National (proposed Green House Management Act) and State Acts and Regulations (Ozone)</li><li>• Installer's and manufactures' responsibilities</li><li>• Future directions</li><li>• Safety overview</li></ul></li><li>2. Refrigeration and Air Conditioning Fundamentals<ul style="list-style-type: none"><li>• Vapour compression system comparison (R22 and R410A)</li><li>• System operating characteristics<ul style="list-style-type: none"><li>○ Pressures and temperatures</li><li>○ Refrigerant states and conditions (Saturation, Superheat and Subcooling)</li></ul></li><li>• Effects of high pressure refrigerants on system components</li><li>• Hydrostatic pressure</li></ul></li></ol>

### 3. Refrigerant Chemistry and Applications

- Chemistry of CFC, HCFC and HFC's
- Replacement refrigerants for R22
- Blended refrigerants
  - Fractionation and recharging of blended refrigerants
  - Temperature glide
  - Superheat and subcooling
    - Calculations methods for near Azeotropic Blends with temperature glide
    - Evaporator superheat calculations
    - Condenser subcooling calculations

### 4. Refrigerant Oils and their Applications

- Function of oil
- Oil Groups
- Lubricants for high pressure refrigerants
- POE lubricants
  - Advantages and disadvantages of POE lubricant
  - Concerns with POE oils
  - Handling POE oils
- Disposal of waste oils

### 5. Essential Service Tools for High Pressure Refrigerants

- Gauge manifold and hoses
- Vacuum Gauge (Microns)
- Leak Detectors
- Flaring Tools
- Torque wrench for flare nuts
- Refrigeration Scales
- Digital temperature measuring thermocouples

### 6. Materials Used in High Pressure Systems

- Copper tube
- Copper tube fittings
- Brazing materials / flux

- 7. Procedures to be used with High Pressure Refrigerants
  - Flaring
  - Brazing
  - Evacuation
  - Pressure testing (as per HB40 and AS/NZS 1677)
  - Charging and Recharging
  - Leak detection
  - Recovery
- 8. Safety
  - Personal safety protection equipment
  - Refrigerant and oil handling
    - Material Safety Data Sheets (MSDS)
    - HB40, AS/NZS 1677, AS2030, copper tube code
  - Storage, filling and transport of refrigerant cylinders
  - Equipment rooms and job site safety
  - Ventilation
  - Environmental considerations

## **6. Assessment strategy**

### **Assessment methods**

Assessment should be progressive reflecting a holistic approach to ensure the module is met. To assist in ensuring validity, reliability and fairness assessment instruments should include practical exercises, assignments and written tests consisting of item types, such as multiple choice, short answer and problem solving.

### **Conditions of assessment**

Normally learning and assessment will take place in a formal learning environment.

**7. Learning outcome details**

**Learning outcome 1**

Describe the reasons for the phase out CFC / HCFC refrigerants in favour of environmentally friendly refrigerants and identify the responsibilities of installers' and manufacturers' with regards this phase out.

**Assessment criteria**

- 1.1 Describe the reasons for, and the period of, the phase out of CFC / HCFC refrigerants.
- 1.2 Identify and explain the regulations that relate to the phasing out of CFC / HCFC refrigerants.
- 1.3 Identify the responsibilities of both installers and manufacturers' to meet environmental, OH&S and customer needs
- 1.4 Describe future trends for refrigerants in the HVAC industry

**Learning outcome 2**

Explain the operation of the vapour compression refrigeration cycle of an air conditioning system.

**Assessment criteria**

- 2.1 Draw and label a vapour compression refrigeration system
- 2.2 Identify and compare the condition of R22 and R410A in an operating vapour compression system including refrigerant pressures, states and conditions.
- 2.3 Describe the effects on the refrigeration system components of a high pressure refrigerant.
- 2.4 Describe hydrostatic pressure and its relevance to 'due care'.

**Learning outcome 3**

List the refrigerant chemistry of R22 and its replacement refrigerants (R407C and R410A) and identify their properties and applications.

**Assessment criteria**

- 3.1 List the refrigerant chemistry of R22 and its replacement refrigerants.
- 3.2 Identify applications for these replacement refrigerants.
- 3.3 Describe terms, definitions and properties relating to high pressure refrigerants: blends, fractionation of blends, temperature glide, Near-Azeotropic, etc.
- 3.4 Calculate evaporator superheat and condenser subcooling.

**Learning outcome 4**

3.5 Identify issues arising with recharging of systems containing blends.

Identify the function, types, properties, applications and requirements of refrigerant oils used in the high pressure systems.

**Assessment criteria**

4.1 Describe the function of oils in a HVAC system.

4.2 List the five groups of refrigerant oils.

4.3 Identify the oils suitable for high pressure refrigerants.

4.4 List advantages and disadvantages of POE oils over mineral oils.

4.5 Identify problems associated with POE oils.

4.6 Identify safety issues relating to the handling of POE oils.

**Learning outcome 5**

Identify the essential service tools required to work with high pressure refrigerants.

5.1 Identify the essential service tools required for high pressure refrigerants

5.2 Describe why these special tools are required for high pressure refrigerants.

**Learning outcome 6**

Identify the differences in the materials required for high pressure refrigerant systems.

**Assessment criteria**

6.1 Identify the copper tube and copper fitting requirements for high pressure refrigerant systems.

6.2 Identify the brazing materials and flux requirements for high pressure refrigerant systems.

**Learning outcome 7**

Describe the correct installation, commissioning and service procedures required for high pressure refrigerant systems.

**Assessment criteria**

7.1 Describe the correct procedures for installing, commissioning and servicing high pressure refrigerant systems, including: flaring, brazing, evacuation, pressure testing (as per HB40 and AS/NZS 1677), charging and recharging, leak detection, recovery.

**Learning outcome 8**

Describe the correct safety procedures required to work with high pressure refrigerants.

**Assessment criteria**

- 8.1 Identify the personal safety protection equipment required to work with high pressure refrigerants /systems.
- 8.2 Describe the safety procedures required to be used when working with high pressure refrigerants and POE oils.
- 8.3 Describe the safety requirements for: storage, filling and transportation of high pressure refrigerant cylinders, equipment rooms and job sites, ventilation, environmental considerations

**8. Delivery of the module**

**Delivery strategy**

Delivery strategies must be suitable for learning both theoretical and practical aspects described in the module purpose. It is considered that the most effective method to achieve this is by integration of theory and practice where students learn by experimentation, research and reports. It is recommended that learning and assessment be facilitated in a holistic manner that may require a learning outcome sequence other than that indicated in the module.

**Resource requirements**

Resources should be sufficient for students to carry out exercises on an individual basis.

Suggested Learning Resources:

- Various Standard of Australian Codes (ASA Codes) eg,
  - Australian Refrigeration and Air-conditioning Code of Good Practice -Reduction of emissions of fluorocarbons in residential air-conditioning applications - HB 40.2 – Latest Edition
  - Refrigeration Code: AS1677 - Latest Edition
  - Cylinders Code: AS2030 - Latest Edition
  - Refrigerant Gas Cylinder Identification Code: AS1942 - Latest Edition.
  - Boiler and Pressure Vessels Regulations, and relevant codes.

**Occupational health  
and safety requirements**

Where this module is used in an approved Traineeship or Apprenticeship program learners should be advised to obtain, where available, respective EE-Oz Training Standards<sup>1</sup> *User Guides* (these outline in detail what training and work performance the Learner is required to undertake for the program).

A safe and healthy environment will be provided for learners and teachers. Safety procedures for the particular learning facilities shall be followed as part of the learning / teaching activity and assessment.

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<sup>1</sup> EE-Oz Training Standards is an ANTA declared Industry Skills Council for the ElectroComms and EnergyUtilities Industry