

NATIONAL METAL AND ENGINEERING CURRICULUM

MODULE: REFRIGERANTS (NR03.1)

PURPOSE: This module aims to provide the student with the knowledge and skills required to safely handle, service and differentiate between various refrigerants, .

NOMINAL DURATION: 1.0 Module

*This module is designed on the assumption that most of the students will achieve the competencies specified in 36 - 40 hours.
The length of time taken to complete a module will vary depending on factors such as teaching method used, knowledge and skills at entry and individual student's ability.*

PREREQUISITES: Refrigeration Fundamentals (NR01)
Refrigeration Procedures (NR02)

LEARNING OUTCOMES: On completion of this module, the student will be able to:

1. Differentiate between the various refrigerants.
2. Demonstrate safe handling of refrigerants and explain the effects of ozone depleting substances on the ozone layer.
3. Demonstrate correct procedures for recovery of refrigerants from refrigeration systems.
4. Demonstrate correct procedure for evacuating refrigeration systems and methods of adding refrigerants to systems.
5. Demonstrate correct procedures for leak detecting refrigeration systems.
6. Explain the design, manufacturing and service requirements of the industry "Codes of Practice".
7. Identify the causes of contamination in refrigeration systems and procedures for dealing with them.
8. Identify properties and uses of refrigeration oils.

STUDENTS SHOULD BE MADE AWARE OF OCCUPATIONAL HEALTH AND SAFETY ISSUES IN ALL SITUATIONS AND BE EXPECTED TO DEMONSTRATE SAFE WORKING PRACTICES AT ALL TIMES.

OUTLINE OF CONTENT:

This module contains:

1. **Refrigerant cylinder Identification**
Refrigerant properties
Refrigerant applications
Codes and regulations
Safety and ozone depleting substances
2. **Refrigerant safe handling**
Ozone layer
Ozone awareness test
3. **Refrigerant recovery systems**
Liquid refrigerant recovery
Vapour refrigerant recovery
4. **Evacuation methods**
Vacuum gauges
Vacuum pump maintenance
Liquid refrigerant charging
Vapour refrigerant charging
5. **Leak detecting**
Pressure testing - safe pressure
Leak testing fluorocarbon system
Leak testing ammonia systems
6. **Codes of Practice**
Codes of Practice Test
7. **Contamination**
Moisture in systems
Refrigerant breakdown
System cleanup
Cold traps
8. **Oils**
Properties of refrigeration oil
Types of oils
Selection of oil

***Details of above Outline topics are available in APPENDIX 1**

ON-THE-JOB TRAINING:

For consolidation, the material in this module should be linked with and complemented by relevant on-job skill practice or other equivalent experience.

PERFORMANCE CRITERIA:

The criteria for each learning outcome should be:

Learning Outcome 1

Assessment: Short answer test.

- Performance:**
- a. State the correct Australian Standard colour code for common refrigerants.
 - b. Identify desirable properties for refrigerants.
 - c. Identify main applications for refrigerants.
 - d. Identify alternative 'ozone safe' refrigerants being developed and state their applications.

Learning Outcome 2

Assessment: Short answer test and practical demonstration.

- Performance:**
- a. List safety precautions necessary when handling or working with refrigerants.
 - b. Explain the functions of the Ozone layer.
 - c. Complete the Ozone Awareness Test.

Learning Outcome 3

Assessment: Short answer test and practical demonstration.

- Performance:**
- a. Recover refrigerant from a vapour compression system using a recovery unit.
 - b. Recover LIQUID refrigerant from a refrigeration system, to a suitable container, using the system's compressor.
 - c. Recover VAPOUR refrigerant from a refrigeration system, to a suitable container, using the system's compressor.

Learning Outcome 4

Assessment: Short answer test and practical demonstration.

- Performance:**
- a. Evacuate a vapour compression system using correct procedure and equipment.
 - b. Use a high vacuum gauge to measure vacuum.
 - c. Explain precautions to be observed during evacuation of a system.
 - d. Differentiate between the various methods of achieving a complete evacuation of a refrigeration system.
 - e. Demonstrate vacuum pump maintenance.
 - f. Add refrigerant to a refrigeration system using the LIQUID charging method.

- g. Add refrigerant to a refrigeration system using the VAPOUR charging method.

Learning Outcome 5

Assessment: Short answer test and practical demonstration.

- Performance:**
- a. Observe safety precautions.
 - b. Find leaks on refrigeration systems using appropriate method and equipment.
 - c. Identify required safety procedures for leak testing refrigeration systems.
 - d. Explain precautions to be taken when pressure testing.

Learning Outcome 6

Assessment: Short answer test .

- Performance:**
- a. Identify the requirements of the regulatory authorities 'Codes of Practice' for an air conditioning, commercial refrigeration, industrial refrigeration, domestic refrigeration and auto air conditioning.
 - b. Complete the 'Codes of Practice' test.

Learning Outcome 7

Assessment: Short answer test.

- Performance:**
- a. Identify causes of contamination in a vapour compression refrigeration system.
 - b. Describe recommended methods of system clean-up after:
 - (i) Burnout
 - (ii) Moisturehave contaminated the system.

Learning Outcome 8

Assessment: Short answer test and practical demonstration.

- Performance:**
- a. Select appropriate refrigeration oil for different applications.
 - b. Identify the particular properties of refrigeration oil.
 - c. Demonstrate how oil may be added to a refrigeration system.

APPENDIX 1

Suggested module content

Refrigerants

- Australian standard colour codes for cylinders**
- Characteristics of refrigerants**
- General requisites of refrigerants**
- Classification of refrigerants (Group 1, 2 & 3)**
- Refrigerant applications**

Refrigerant Safety

- Safe handling of refrigeration cylinders**
- First aid treatment for refrigerant related injuries**
- Rescue procedures for people overcome by refrigerants**
- Impact of refrigerants on the environment**
- Local regulation of refrigerants**
- Industrial planning for replacement of current refrigerants**

Reclaim and Evacuation

- Reclaim units Reclaiming from large and small systems**
- Vacuum pumps**
 - Sizing vacuum pumps**
 - Use and care of vacuum pumps**
 - Connecting to system**
- Cold traps**
- Evacuation methods**
 - Single deep vacuum**
 - Multiple evacuation method**
- Evacuation "drop test"**
- Vacuum pump maintenance**
- Reading vacuum measuring instruments**
- Care and connection of vacuum measuring instruments**

Leak Detection

- Safety procedure when leak testing**
- Pressure testing - safe test pressure**
- Halide lamps**
- Electronic leak detectors**
- Soap bubbles**
- Immersion**
- Chemical leak tracers**
- Smell, sight, sound**
- Ammonia - sulfur sticks - lithmus paper**

System Contamination

- Moisture contamination**
- Evacuation with "cold traps"**
- Breakdown of refrigerant and oil**
- Causes of sealed unit burnout**
- Clean-up of system after burnout**
- Burnout driers**
- Removal of contaminated pipe**
- Acid test kits**

Refrigeration Oil

- Properties of refrigeration oils**
- Selection of oil for application**
- Adding and removing oil from a system**

ADDITIONAL INFORMATION: MODULE (NR03)

1. SUGGESTED TEACHING/LEARNING STRATEGIES

Care should be taken when delivering this module to ensure that there isn't an over emphasis of properties of refrigerants. The practical areas of safe handling and recognition of refrigerants should be regarded as essential to meet the learning outcomes.

Delivery strategies should integrate theory with demonstration and student practical as much as possible.

2. SUGGESTED MINIMUM RESOURCES

Australian Refrigeration and Air Conditioning (Irrust Publications)
Refrigerants and Service Pointers (Dupont)
Refrigeration System or Simulators
Refrigeration Cylinders (various refrigerants)
Refrigerant Reclaim Units and Cylinders
Vacuum Pumps
Vacuum Gauges - Electronic and Mercury Manometer
Halide Lamps
Electronic Leak Detectors
Refrigeration Oil and Vacuum Pump Oil

3. SUGGESTED ON-JOB TRAINING - FOR MAXIMUM SKILL ACQUISITION

Reclaiming refrigerant from system	15 times
Evacuating system to specification	15 times
Finding leaks in systems	30 times
System cleanup on contaminated systems including fitting of burnout driers and replacement of liquid line driers	5 times
Adding oil to refrigeration systems	5 times

As the time taken to perform some of these skills varies depending upon the situation, the number of times that the skill should be repeated has been used rather than a time factor.