MODULE: **REFRIGERATION FUNDAMENTALS (NR001)**

PURPOSE: **This module aims to provide the student with knowledge of the principles of refrigeration and the way that these principles are currently applied within the industry.**

NOMINAL DURATION: **One Module**

This module is designed on the assumption that most of the students will achieve the competencies specified in 35 to 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: **Nil**

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

1. **Explain the operation of the vapour compression refrigeration cycle.**
2. **Identify the condition of the refrigerant in an operating vapour compression system.**
3. **Draw a simple diagram of pressure, temperature, heat and state cycles.**
4. **Identify the major applications for the vapour compression cycle in the refrigeration and air conditioning industry.**

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. **Heat, pressure and temperature**
   Heat flow
   Heat transfer - conduction, convection, radiation
   Application of Gas Laws
   Heat measurement
   Operation of the vapour compression cycle
   Compressor
   Evaporator
   Condenser
   Flow Control

2. **Pressure temperature relationships**
   Saturation
   Subcooling
   Superheating
   Pressure temperature chart

3. **Absolute and gauge pressure**
Plotting, basic cycles
Saturation curves
Subcooling
Superheating
Measuring heat content (enthalpy)

4. **Major applications**
Scope of industry
Domestic refrigeration
Commercial refrigeration
Industrial refrigeration
Transport/marine refrigeration
Comfort air conditioning
Industrial air conditioning

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. **Differentiate between heat and temperature.**

b. **Describe the three methods of heat transfer.**

c. **Explain how the principles of heat transfer aid the refrigeration process.**

d. **Explain the molecular theory of matter.**

e. **Differentiate between sensible, latent, and specific heat.**

f. **Identify and locate the major components of the vapour compression cycle on a cycle diagram.**

g. **Explain the function of each of the major components in the vapour compression cycle.**

Learning Outcome 2

Assessment: **Practical exercise.**

Performance:

a. **Observe safety precautions.**

b. **Using service gauges, thermometers (preferably digital. and a pressure temperature chart identify the condition of the refrigerant in various locations throughout an operating system i.e. saturated, superheated subcooled.**

Learning Outcome 3

Assessment: **Practical exercise.**

Performance:

a. **Observe safety precautions.**

b. **Using service gauges, thermometers (digital. and a pressure enthalpy chart; plot a simple cycle off an operating system "Ignore pressure drops".**

c. **From the pressure temperature and heat chart identify:**
- **i. the amount of heat absorbed in the low side**
- **ii. the amount of heat rejected in the high side of the system.**

Learning Outcome 4

Assessment: **Written project.**

Performance:

a. **Describe the six main classifications for refrigeration and air conditioning equipment.**

b. **Describe the main features of some of the equipment used in the various classifications.**

APPENDIX 1

Suggested module content

1. Refrigeration Principles

- Refrigeration defined
- Heat as a form of energy
- Heat flow
- Cold
- Heat transfer
  - Conduction
  - Convection
  - Radiation
- Controlling heat flow
  - Insulation
- Heat Measurement (kilojoules)
- Molecular Theory of Matter
- Specific, sensible and latent heat
- Temperature
- Temperature scales (Celsius and Kelvin)
- Absolute temperature
- Temperature conversion
- Ambient temperature
- Pressure
- Pressure units Bars, Kpa, mmhg
- Absolute pressure
- Pressure measurement
- Applied Gas Laws
- Vapour compression cycle
- Major cycle components and their function

2. Refrigeration Condition

- Saturation (vapour/liquid)
- Superheating
- Subcooling
- Effect of pressure on saturation temperature
- Pressure temperature charts
- Identify refrigerant condition in an operating cycle using thermometers and gauges

3. Pressure Enthalpy Chart

- Absolute pressure scale
- Converting from gauge to absolute pressure
- Enthalpy - enthalpy scale
- Saturation curves
- Basic system plot
- Measuring changes in heat content
- Measuring degrees of subcooling and superheating

4. Major Applications

- Domestic refrigeration
  - Refrigerators
  - Home freezers
- Commercial refrigeration
  - Hotel and supermarket display and dispensing equipment
  - Delicatessen and restaurant
  - Equipment

- Industrial refrigeration
  - Food processing and storage
  - Specialised equipment
  - Industrial ice machine

- Transport and marine
  - Fishing boats
  - Containers
  - Trucks and railcars

- Comfort air conditioning
  - Home air conditioning
  - Small to medium package units
  - High rise buildings

- Industrial air conditioning
  - Computer rooms
  - Switch rooms
  - Meat processing rooms

- Types of equipment
  - Feature of domestic refrigerators
  - Beverage coolers
  - Display refrigerators
    - i. blast freezers
    - ii. liquid nitrogen tunnels
    - iii. brine immersion freezers
  - Major features of transport and marine equipment
  - Comfort air conditioning
    - Central plant
    - Packaged equipment
  - Specialised computer air conditioning

ADDITIONAL INFORMATION: MODULE (NR01)

1. SUGGESTED TEACHING/LEARNING STRATEGIES

As this module deals with basic principles of refrigeration and knowledge of the industry there are a variety of delivery strategies that could be used:

a. Lecture/demonstration with an emphasis on demonstration and experimentation to reinforce theoretical concepts.

b. Self paced learning utilising written and audio visual aids.

c. Computer managed learning to direct students through learning experiences and assess progress.

Learning outcomes 2 and 3 should be achieved with the aid of refrigerators and refrigeration simulators to increase student interest and familiarity with the equipment.

Learning outcome 4 could be approached as a research assignment incorporating some site visits, if time permits.

2. SUGGESTED MINIMUM RESOURCES

Australian Refrigeration & Air Conditioning (Trust Publications)
Heat and Pressure VHS Video (Regency College)
Basic Refrigeration Cycle VHS Video (Regency College)
Supplementary Workbooks to suit Videos (S.A. TAFE)

List of Essential Resources
Refrigerators or Refrigeration Simulators
Gauge Manifold Sets fitted prior to use
Thermometers (Electronic)
Pressure Temperature Charts
Pressure Enthalpy Charts

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

Because of the theoretical nature of this module there are only limited skills to be "practised".

However, working on and around a variety of refrigeration and air conditioning equipment: Analysing pressure gauge readings and checking superheat and subcooling over a period of 10 days would prove beneficial.