

NATIONAL METAL AND ENGINEERING CURRICULUM

MODULE: AIR CONDITIONING SYSTEMS (NR014)

PURPOSE: This module aims to provide the student with the knowledge and skills to identify, explain and apply operating principles to air conditioning system componentry, and to diagnose and rectify faults within typical air conditioning systems of the packaged, central station, evaporative or thermal storage type.

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 students ability.*

PREREQUISITES: A/C Fundamentals (NRO5)
Installation (NR11)
Systems Control (NR12)
Ventilation (NR13)

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

1. Describe the application construction, design features, and operation of packaged, central station, evaporative and thermal storage air conditioning systems by applying the fundamental operating principles of refrigeration and air conditioning.
2. Construct routine maintenance servicing schedules for packaged, central station, evaporative and thermal storage air conditioning systems.
3. Identify and prepare reports on system faults and rectify these faults on packaged, central station, evaporative and thermal storage air conditioning systems.

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. **Air Conditioning System Components**
 - Types
 - Applications
 - Safety, Environmental and Legislative Issues
 - Terminology
 - Construction
 - Design Features
 - Component Characteristics
 - Ancillary Equipment
 - Symbols
2. **Air Conditioning Systems**
 - Types
 - Design Features and Heat Loads
 - System Characteristics
 - System Layout and Constructional Drawing Interpretation
3. **Air Conditioning Systems Servicing**
 - Routine Scheduled
 - Fault Tracing
 - Rectification

* 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:

Written short answer questions/calculations and practical exercises, with log books.

Performance:

- a. List applications employing/requiring packaged, central station, evaporative or thermal storage air conditioning systems.
- b. Identify air conditioning system components.
- c. Describe the operating concepts of air conditioning system components.
- d. Explain the application of various principles/concepts to system operation and performance.
- e. Accurately measure system operating conditions or from given information, plot these on a psychrometric chart and determine system performance and operations.
- f. Determine partial heat loads for a basic space to be air conditioned.
- g. A log is to be kept of industrial visits - assignments are to be set around these visits.

Learning Outcome 2

- Assessment:** Written short answer questions and practical tests.
- Performance:**
- a. Identify routine maintenance schedule items, frequency and type of maintenance required.
 - b. Demonstrate the practical skills required to perform routine maintenance procedures on air conditioning systems.

Learning Outcome 3

- Assessment:** Practical tests, log books and written short answer questions.
- Performance:**
- a. Demonstrate the practical skills required to perform fault -tracing on air conditioning systems.
 - b. Identify typical fault symptoms of air conditioning systems.
 - c. List rectification procedures for typical faults.
 - d. Keep a detailed log of practical classroom experiments/exercises of typical faults.

APPENDIX 1

Suggested module content

1. **Air Conditioning Systems Introduction**
 - Purpose of Air Conditioning
 - Define "Air Conditioning Systems"
 - Air Conditioning requirements
 - Types (brief overview - see no.3)
 - Packaged Systems
 - Self contained
 - air cooled condenser
 - water cooled condenser
 - Remote/Split Systems
 - air cooled condenser
 - water cooled condenser
 - evaporative condenser
 - Central Station Systems
 - Define "Central Station Systems"
 - Types
 - constant volume, variable temperature systems
 - all air systems
 - air/water systems
 - all water systems
 - variable volume, constant temperature systems
 - Evaporative Cooling Systems
 - Thermal Storage Systems

- **Applications**
 - Typical applications of each system type
 - e.g. Commercial, Industrial and Process.
 - Computer rooms
 - Hospitals
 - Hotels
 - Motels
 - Office Blocks etc.....
- **Safety, Environmental and Legislative Issues**
 - Occupational Health and Safety issues
 - workplace
 - personal
 - work sites
 - Acts of Parliament
 - Federal
 - State
 - e.g. Ozone Protection
 - CFC Handling
 - Mechanical/Electrical Licensing
 - Australian Standards
 - e.g. AS3666 noise

2. Air Conditioning Systems Components

- **Terminology**
 - "Free Air Cycle" or "Economy Cycle"
 - Primary Air
 - Secondary Air
 - Zoning
 - Fan coil units
 - Induction Unit
 - Terminal Unit
 - Dampers
 - Face/Bypass
 - Mixing
 - Mixing Box
 - Coanda Effect
- **Components**
 - Component Construction
 - design Features
 - Component Characteristics
 - Operating Characteristics
 - psychrometric Characteristics
- **Ancillary Equipment**
 - Air Distribution Systems
 - Water Distribution Systems
 - Chilled Water Systems
 - Chiller sets
 - Reciprocating
 - Centrifugal
 - Screw
 - Ice Bank Systems
 - Heating Systems
 - Methods of Production
 - Gas
 - Electric
 - Steam
 - Hot water
 - Methods of Production
 - Low Temperature
 - High Temperature
- **Graphical Symbols (with reference to Aust. Std.)**
 - Definitions
 - Mechanical
 - electrical
 - Rules
 - Composition

- 3. **Air Conditioning Systems**
 - **Types**
 - **Packaged Systems**
 - self contained
 - air cooled condenser
 - water cooled condenser
 - Cooling Towers
 - **Remote/Split Systems**
 - air cooled condenser
 - water cooled condenser
 - evaporative condenser
 - **Central Station Systems**
 - Define "Central Station Systems"
 - **Types**
 - constant volume, variable temperature systems
 - all air systems
 - air/water systems
 - all water systems
 - variable volume, constant temperature systems
 - **Evaporative Cooling**
 - Construction
 - Operation
 - Psychrometric Characteristics
 - **Thermal Storage Systems**
 - Construction
 - Operation
 - **Design Features and Heat Loads**
 - **Design Specifications**
 - Comfort
 - Industrial
 - Process
 - **Heat Load Estimation**
 - AREMA Load Estimation Sheet
 - **Sources of Heat Gain**
 - Infiltration/Exfiltration
 - Solar Heat
 - Conduction
 - Appliances and Lights
 - Duct Heat Gains
 - Sensible Heat Gains
 - Latent Heat Gains
 - Air Quantity Calculations
 - System Capacity
 - **System Characteristics**
 - Operating Characteristics
 - Psychrometric Characteristics
 - **Systems Layout and Constructional Drawing and Interpretation**
 - **Mechanical and Electrical Circuitry**
 - Refrigeration Piping
 - Air Distribution Ductworks
 - **Control Systems**
 - Electrical
 - Electronic
 - Pneumatic
 - Combinations
 - Power Supply Circuits
 - Motor Starting Systems

- 4. Air Conditioning Systems Servicing**
 - Routine Scheduled
 - Programmed maintenance
 - Routine Servicing
 - Fault Tracing
 - Refrigeration System
 - Air Distribution System
 - Water Distribution System
 - Chilled
 - Hot
 - Low
 - High
 - Rectification
 - Refrigeration System
 - Air Distribution System
 - Water Distribution System
 - Chilled
 - Hot
 - Low
 - High

1. SUGGESTED TEACHING/LEARNING STRATEGIES

LEARNING OUTCOME 1

The student should be conversant with the physical principles and fundamental concepts of refrigeration and air conditioning and their application to air conditioning systems; and be able to identify various components used in air conditioning systems, and understand their respective function in the various systems.

The student should also be conversant with the operating characteristics of air conditioning systems and be able to determine system performance, utilising psychrometrics and the completion of a basic heat load sheet (AREMA), thus attaining a better understanding of the operation of air conditioning systems and system performance. This will provide the student with an appreciation of the complete system operation of packaged, central station, evaporative and thermal storage air conditioning systems, and the relevance of each type of system.

Several industrial visits to manufacturers and user buildings could consolidate the knowledge learned in this outcome.

It should only be necessary to discuss the application of these principles and concepts to air conditioning systems, as they have been previously dealt with in previous modules.

The S.I. System of measurement and calculations should have also been covered in previous modules.

LEARNING OUTCOME 2

The students should be able to construct routine maintenance schedules for packaged, central station, evaporative and thermal storage air conditioning systems and monitor the component and system operation.

Practical competency in the recognition of correct ("normal") system operation is essential for the successful completion of this outcome.

LEARNING OUTCOME 3

The student should be considered sufficiently competent in their knowledge of refrigeration and air conditioning systems to perform fault-tracing duties, this would involve them in system operational analysis, report writing, fault recognition and rectification.

Practical competency in the use of test instruments, system operational analysis and component function would be expected at this level.

2. SUGGESTED MINIMUM RESOURCES

Most of the practical aspects of this module would be by demonstration or group participation, however where applicable, a maximum of one student per item of equipment is advised for competency to be attained.

Air Conditioning Systems

- Demonstration Unit
 - Packaged System
 - Simulators
- Practical
 - Commercial Training Units
 - Package Systems
 - Test Instrument Sets
 - Mechanical
 - Refrigeration
 - Air
 - Water
 - Noise
 - Electrical

Air conditioning Components

- Demonstration
 - various complete
 - cutway models
- Practical
 - various complete

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

The student would be employed in an industry or section which has involvement, either directly or indirectly, with air conditioning systems of either packaged, central station, evaporative or thermal storage type.

This module would be suitable for refrigeration/airconditioning personnel training to become competent service persons, and for those requiring a prerequisite for further study.