

NATIONAL METAL AND ENGINEERING CURRICULUM

MODULE: AUTOMOTIVE AIR CONDITIONING (NR021)

PURPOSE: This module aims to provide the student with the knowledge and skills to install and service automotive air conditioning systems.

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: 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 major cycle components and their function.
3. Reclaim, evacuate and re charge auto air conditioning systems.
4. Explain the operation of the control circuit and specialised components used in auto air conditioning.
5. Identify and repair operational faults in automotive 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. Heat, pressure and temperature
Heat Flow
Heat transfer
Pressure temperature relationships vapour compression cycle conditioning of Refrigerants throughout cycle.
2. Compressors (Auto)
Evaporators (Auto)
Condensers (Auto)
Refrigerant Controls (Auto)
Receiver dryer (Auto)

3. **Fitting Service Gauges**
 Service valves
 Reclaim units
 CFC Regulation
 Vacuum pumps - evacuation
 Refrigerant contaminants
 Graduated charging cylinders
 liquid charging
 vapour charging

4. **Thermostats**
 Relays
 Electro magnetic clutches
 Basic control circuits
 P.O.A. valves
 H.P. and L.P. switches
 Thermistors

5. **Pressure testing**
 Leak detecting (Halide, Electronic, soap bubbles)
 Condenser and Evaporators temperature differences
 Restrictions
 Compressor valve efficiency
 Filter Driers and Strainers
 TX valve faults
 Air filters (heavy equipment)

* 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 questions

Performance:

- a. **Differentiate between heat and temperature**
- b. **Describe three methods of heat transfer**
- c. **Explain how the principles of heat transfer aid the refrigeration process**
- d. **Differentiate between sensible and latent heat**
- e. **Identify and locate the major components of the vapour compression cycle on a cycle diagram**
- f. **Use a pressure temperature chart to find saturation temperature from given pressures**

Learning Outcome 2

Assessment: Short answer test

- Performance:**
- a. Explain the function of each of the major components in the vapour compression cycle
 - b. Explain the operation of major cycle component types specific to auto air conditioning

Learning Outcome 3

Assessment: Practical test

- Performance:**
- a. Fit gauges and reclaim refrigerant from an auto air conditioning system
 - b. Evacuate an auto air conditioning system to specified pressure
 - c. Charge a "critical charge" auto air conditioning system to specification
 - d. Charge a "non-critical charge" unit using approved methods
 - e. Observe safety precautions

Learning Outcome 4

Assessment: Short answer test

- Performance:**
- a. Explain the function and operation of the electro magnetic clutch, stationary field and rotating field
 - b. Identify common safety controls used in auto air conditioning systems
 - c. Explain the function of the common operating controls used in auto air conditioning systems

Learning Outcome 5

Assessment: Practical test

- Performance:**
- a. Observe safety precautions
 - b. Find leaks on operating systems using approved methods and equipment
 - c. Identify incorrect operating conditions using gauges and thermometers
 - d. Correctly identify and rectify system faults

APPENDIX 1

Suggested Module Content:

1. **Refrigeration Principles**
 - Heat as a form of energy
 - Heat Flow
 - Cold
 - Heat transfer:
 - Conduction
 - convection
 - radiation
 - Controlling heat flow:
 - insulation
 - Heat measurement kilo joules
 - Molecular Theory of Matter
 - Specific, sensible and latent heat
 - Temperature
 - Temperature Scales
 - Pressure
 - Pressure Measurement
 - Pressure Temperature Relationships
 - Saturation, superheating and subcooling
 - Vapour Compression cycle
2. **Major Components**
 - Compressors (Auto.
 - Swash plate
 - Reciprocating
 - Rotary
 - Scroll
 - Evaporators
 - Integrated
 - "Add On" type
 - Condensers
 - Radiator mounted
 - Roof Mounted
 - Refrigerant Controls
 - Thermostatic Expansion valve
 - Fixed Orifice
3. **Reclaim Evacuation and Charging**
 - Safety legislation
 - Compressor Service Valve Positioning for Service
 - Schraeder Valves
 - Service Gauges and Manifold Operation
 - Connection of Reclaim Units
 - Reclaim unit function and maintenance
 - Vacuum Pump connection and maintenance
 - Refrigerant Contaminants
 - System Cleaning
 - System Evacuation
 - Filling Graduated Charging Cylinders
 - Charging with a Graduated Charging Cylinder
 - Vapour Charging

4. **System Controls**
 - Thermostats operation and function**
 - Relays**
 - Stationary and Rotating Field Clutches**
 - H.P. & L.P. Switches**
 - Thermistors**
 - Fuses**
 - Specialised Controls e.g. P.O.A. Valves**
 - Basic Control Circuits**

5. **System Troubleshooting**
 - Safety precautions**
 - Pressure and leak testing**
 - Leak detecting equipment**
 - Use of manufacturers service manuals**
 - Use of temperature differences to predict condenser and evaporator saturation temperature**
 - Locating restrictions**
 - Filter Dries and Strainers**
 - Testing for compressor valve efficiency**
 - Cleaning Air filters**
 - Thermostatic Expansion Valve Faults**
 - Electrical Testing**

1. SUGGESTED TEACHING/LEARNING STRATEGIES

The basic principles of Refrigeration are required to enable the student to work safely, and carry out trouble shooting procedures. However, the similarity of the various Auto Air Conditioners negates the need for great depth in this area.

Many of the learning outcomes are practical in nature therefore a suggested teaching strategy for this module would be short lecture, followed by demonstration and student practices.

2. SUGGESTED MINIMUM RESOURCES

Australian Refrigeration and Air Conditioning (Trust Publications)

Automotive Air Conditioning (Open Learning Package Trust Publications)

Modern Refrigeration and Air Conditioning (Althouse, Turnquist & Bracciano)

Local CFC Refrigeration

"Heat and Pressure" VHS Video (Regency College)

"Basic Refrigeration Cycle" VHS Video (Regency College)

Automotive Air Conditioners (Simulators or Vehicles)

Refrigerant and Refrigerant Reclaim Unit

Automotive Refrigerant Charging and Evacuation Station

Leak Detectors - Halide & Electronic

Large Capacity Fan to force air over Condenser when testing

Gauge manifold sets Thermometers (preferably electronic)

ADDITIONAL RESOURCES

"Cut-aways" and models of components e.g. compressors, thermostatic expansion valves electro magnetic clutches etc.

NOTE: Incidental auxiliary equipment has not been included.

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

Any supplementary skills practices relating to the "Hands-on" component will be beneficial.

Some of the following practice exercises relate to time spent others relate to the number of times that the skill is repeated successfully.

Reclaim, evacuate and re charge auto air conditioning equipment 30 times)

Identification and repair of operational faults 25 days.