

**AUT 171**  
**HEATING AND AIR CONDITIONING**

**COURSE DESCRIPTION:**

Prerequisites: None

Corequisites: None

This course covers the theory of refrigeration and heating; electrical, electronic, and pneumatic controls; and diagnosis and repair of climate control systems. Topics include diagnosis and repair of climate control components and systems; recovery and recycling of refrigerant; and safety and environmental regulations. Upon completion, students should be able to describe the operation, diagnose, and safely service climate control systems using appropriate tools, equipment, and service information. Course Hours Per Week: Class, 2. Lab, 3. Semester Hours Credit, 3.

**COURSE OBJECTIVES:**

Upon successful completion of this course, the student will be able to:

- a. Explain basic air conditioning, heating and cooling theory and system operation.
- b. Identify refrigeration components.
- c. Identify refrigeration and cooling system safety precautions.
- d. Inspect refrigeration and cooling system components.
- e. Perform system performance tests of heating, cooling and air conditioning systems.
- f. Perform leak testing of air conditioning systems.
- g. Identify vehicle refrigerant type.
- h. Recover and recycle refrigerants.
- i. Discharge and service air conditioning system components.
- j. Evacuate and charge air conditioning systems.
- k. Determine R-12 system retrofit feasibility.
- l. Perform component repair/replacement procedures.

**OUTLINE OF INSTRUCTION:**

- I. Class orientation
  - A. Class routine and lab policy
  - B. Required materials
- Automotive lab safety
  - C. Lab equipment use/operation

## II. Air Conditioning System

### A. Basic Principles of Refrigeration

- 1) Temperature/pressure relationship
- 2) Latent heat of evaporation/fusion

### B. System Components, Purpose, Operation of Each, Inspection and Service

- 1) Evaporator
  - (a) Water Drain
  - (b) Blower Motor
- 2) Compressor
  - (a) Various Types
  - (b) Electromagnetic clutch
- 2) Condenser
- 3) Receiver-drier
  - (a) Installation
  - (b) Fusible safety plug
  - (c) Desiccant
  - (d) Sight Glass
- 5) Expansion Valve/orifice tube
  - (a) Sensing bulb- internally or externally equalized
  - (b) Inlet screen
- 5) Accumulator

### B. Refrigerant Flow

### C. Types of Systems (Temperature Controls) and Test Procedures

- 1) Cycling
- 2) STV and STV/BPO
- 3) POA
- 4) EPR
- 5) VIR and EEVIR
- 6) Fixed orifice tube
- 7) Manual and vacuum controls
- 8) ETR
- 9) "H" valve
- 10) Combination valve
- 11) Automatic systems
  - (a) Sensors
  - (b) Servos
  - (c) Amplifiers
  - (d) Aspirators
  - (e) Programmers
  - (f) Trouble codes

### E. High and Low Side

### F. "Touch" Test

### G. Condition of Refrigerant at Various Circuit Points

### H. Basic Controls for Compressor Operations

- 1) Ambient temperature switch
- 2) Thermostatic switch

- 3) Cycling clutch switch
- 4) Low pressure cut-out switch
- 5) High pressure cut-out switch
- 6) High pressure relief valve
- 7) Thermal limiter and superheat switch
- 8) Compressor control valve
- 9) Pressure sensing switch

## I. System Service

### A. Manifold Gauge Set

- 1) Hose hook up
  - (a) Purging test hoses
  - (b) Stabilizing system
  - (c) Attachment with third gauge
- 2) Hand valve positions
- 3) Normal gauge readings

### A. Service Valves

- 1) Schrader connections

### A. Safety in Handling of Refrigerant

- 1) Storage
- 2) Discharging
- 3) Recycling
- 4) Can tap installation
- 5) Phosgene gas
- 6) Environmental concerns

### A. Evacuation Procedure

### B. Isolation of Compressor

### C. Check and Add Compressor Oil

### D. Charging Procedures

### E. Recovery and Recycling

- 1) Adding refrigerant as a liquid
- 2) Charging with vapor
- 3) Adding refrigerant to accumulator type systems
- 4) EPA regulations

### I. Leak Testing

- 1) Halide
- 2) Electronic
- 3) Soap
- 4) Dytel

### I. Compressor Reed Valve Replacement

### J. Compressor Front Seal Replacement

### K. Replace Low Pressure Protection Devices

### L. Replace Clutch Components

### M. Replace Hoses, Lines, Fittings, and Seals

### N. Expansion Valve Screen Replacement

### O. VIR Overhaul

- P. Receiver-Drier/Desiccant Replacement
- Q. Accumulator Replacement
- R. Expansion Tube Replacement
- S. STV and EPR Valve Replacement
- T. Compressor Replacement/Flushing System

I. Problem/Diagnosis

- A. Engine Overheating
- B. Noisy System Operation
  - 1) Mounts
  - 2) Bearings
    - (a) pulley
    - (b) clutch
  - 3) Belts
  - 4) Excessive high or low charge
  - 5) Moisture in the refrigerant
- C. Insufficient Cooling
- D. Intermittent Cooling
- E. No cooling at all
- F. Windshield Fogging
- G. Abnormal Low-Side Readings
- H. Abnormal High-Side Readings
- I. Frost on Evaporator
- J. Sight Glass
  - 1) Clear
  - 2) Bubbles
  - 3) Oily
  - 4) Cloudy
- K. Electrical Circuit Problems
  - 1) Blown fuse
  - 2) Defective wiring
  - 3) Bad connections
  - 4) Defective thermostat
  - 5) Magnetic clutch
- K. Effects of moisture in System
- L. POA Systems/Pressures
- M. EPR Systems/Pressures
- N. Air Distribution
  - 1) Vacuum motors
  - 2) Manual cables
  - 3) Blower motor
    - (a) Relays
    - (b) Fuses
    - (c) Resistors
- P. Driveability/Compressor Control Check Areas
  - 1) Constant run relay

- 2) Time delay relay
- 3) Wide open throttle switch
- 4) Low vacuum switch
- 5) Power steering pressure switch
- 6) Power brake time relay
- 7) High coolant temperature switch
- 8) Electronic control module delay timer
- 9) Anti-dieseling relay

## I. Heating Systems

### A. Components

- 1) Blend doors
- 2) Blower motor
- 3) Control valves
- 4) Plenum chamber
- 5) Vacuum reservoir and check valve
- 6) Electrical controls

### A. Flow Control Valve Operation

- 1) "Bowden" cable operated
- 2) Restricted heater
- 3) Small hose usually inlet

### A. Thermostat and By-pass

### B. Radiator, Pressure Cap, and Expansion Tank Operation

### C. Service

- 1) Electrolysis damage
- 2) "Bloc-Chek" test
- 3) Testing radiator pressure cap
- 4) Reverse flushing
- 5) Fluid fan inspection
- 6) Replace heater coolant valve
- 7) Replace heater core
- 8) Replace hoses
- 9) Replace drive belts
- 10) Replace pulleys
- 11) Replace fan shroud
- 12) Replace electric fan
- 13) Replace control panel

### F. Problem/Diagnosis

- 1) No heat
- 2) Too much heat (no control)

### F. Blower Motors

- 1) Ducting-AC/heating
- 2) Heater core position
- 3) Evaporator position

4) Inspect/test/replace resistors

**REQUIRED TEXTBOOKS AND MATERIALS:**

Today's Technician Series, Automotive Heating and Air Conditioning, Boyce Dwiggin, Delmar Publishers.

Tools as listed in the "Durham Technical Community College Tool List for Automotive Systems Technology Students."

**STATEMENT FOR STUDENTS WITH DISABILITIES:**

Students who require academic accommodations due to any physical, psychological, or learning disability are encouraged to request assistance from a disability services counselor within the first two weeks of class. Likewise, students who potentially require emergency medical attention due to any chronic health condition are encouraged to disclose this information to a disability services counselor within the first two weeks of class. Counselors can be contacted by calling 686-3652 or by visiting the Student Development Office in the Phail Wynn Jr. Student Services Center, room 1309.