

MERCER COUNTY COMMUNITY COLLEGE

Division of Business and Technology

AUT 212

Automotive Air Conditioning

COURSE DESCRIPTION:

Automotive air conditioning/heating systems used today. Topics range from fundamentals of refrigeration to automatic temperature control (ATC) system operation. Proper diagnosis and repair of systems and components will be emphasized. Federal and State environmental policies will be discussed in detail as to their impact and implementation.

Text (s): **Reference Division Booklist**

Prerequisites: **AUT114 Automotive Electricity and Electronics**

Corequisites:

Credits: **3** Lecture Hours: **2** Studio/Lab Hours: **2**

**Food and drink are strictly prohibited in classrooms as per health and safety laws.
Students may not bring in chemicals or cleaning fluids of any kind without the
appropriate MSD sheets.**

Course Coordinator: **Fred Bassini**

Latest Review: Summer 2003

GENERAL LEARNING OBJECTIVES

1. To acquaint the student/apprentice with the types of A/C systems currently used on Daimler Chrysler vehicles.
2. To provide the student/apprentice with intermediate level skills in air conditioning systems service and diagnosis.
3. To develop an awareness of safe working habits with the student/apprentice while working with A/C chemicals and gases.
4. To acquaint the student/apprentice with current Federal and State environmental polices and their impact on the automotive industry.

TOPIC SUMMARY

- I. Fundamentals of Refrigeration**
 - A. Fundamental Refrigeration Process
 - B. Operation of the A/C System
- II. Components and Operation**
- III. Heater Systems**
 - A. Types and Operation
- IV. Heater Diagnosis and Service Procedures**
 - A. Problems and Possible Causes
- V. Air Conditioning Systems**
 - A. Types and Operation
- VI. Air Conditioning Diagnosis**
- VII. Air Conditioning Tests and Troubleshooting**
- VIII. System Service and Compressor Overhaul Procedures**
 - A. Service Procedures
 - B. Compressor
- IX. Electronic Automotive Temperature Control (ATC)**
 - A. Operation
 - B. Components
 - C. Diagnostics
- X. Course Review/Final Exam**

I. FUNDAMENTALS OF REFRIGERATION

Performance Tasks

- A. Fundamentals of Refrigeration Process
 - 1. Evaporation Cools
 - 2. Relative Humidity
 - a. The Psychrometer
 - b. Amount of moisture in air
- B. Behavior and Measurement of Heat
 - 1. Conduction
 - a. Heat transfer through a solid object
 - 2. Convection
 - a. Heat transfer through air movement
 - 3. Radiation
 - a. Radiated Heat
 - 4. Removal of Heat Energy
 - a. Refrigerant R-12 and R-134A
 - b. Heat transfer through change of state
 - c. Heat
 - (1) “Sensible” Heat
 - 5. Pressure-Temperature Relationship
 - a. Change of State
 - b. Boiling Point
 - (1) Pressure – Vacuum
 - 6. Refrigerant R-12
 - a. Liquid vs. Vapor
 - b. Safety in handling and leak detection
 - c. Operation of the Air Conditioning System
 - (1) Components
 - a. Evaporation
 - b. Cycling Switch and “H” Valve Assembly
 - c. Filter/Drier
 - d. Condenser
 - e. Compressor
 - f. Refrigerant Lines
 - g. Service Valves
 - (2) Flow of Refrigerant
 - (3) Removal of Heat
 - 7. Refrigerant R-134A
 - a. Safety in handling and leak detection

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II. COMPONENTS AND OPERATION	<u>Performance Tasks</u>
<ul style="list-style-type: none"> A. Evaporator/Heater Assembly <ul style="list-style-type: none"> 1. Function and Location 2. Air Outlet Assemblies 3. Air Distribution Ducts 4. Door Activation Methods B. Cycling Clutch and “H” Valve Assembly <ul style="list-style-type: none"> 1. Function and Location 2. Low Pressure Cut-Out Switch 3. A/C Pressure Transducer C. Filter/Drier <ul style="list-style-type: none"> 1. Function and Location 2. High Pressure Relief Valve 3. Sight Glass D. Condenser <ul style="list-style-type: none"> 1. Function 2. Construction 3. Electric Fan(s) E. Compressor <ul style="list-style-type: none"> 1. Model C-171 <ul style="list-style-type: none"> a. Applications 2. Function 3. A/C Clutch 4. Variable Displacement Compressor F. Refrigerant Lines and Service Valves <ul style="list-style-type: none"> 1. Function and Locations 2. R-12 vs. R-134A Components 3. R-12 to R-134A Conversions 	

III. HEATER SYSTEMS	<u>Performance Tasks</u>
<ul style="list-style-type: none"> A. Types and Operation <ul style="list-style-type: none"> 1. “Blend-Air” Type 2. Front-Wheel Drive B. Components <ul style="list-style-type: none"> 1. Blower Motor 2. Heater Core 3. Heater Control Valve 4. Control Head C. “Blend Air” Type <ul style="list-style-type: none"> 1. Air Intake 2. Air through Heater Core 3. Air through Heater Core By-Pass 4. Button positions and selectors <ul style="list-style-type: none"> a. OFF b. BI-LEVEL c. HEAT d. DEFROST e. TEMPERATURE LEVEL f. BLOWER 5. Coolant Requirements (Rear Wheel Drive) <ul style="list-style-type: none"> a. -20 Degrees F b. 50/50 MIX c. Ethylene Glycol d. Corrosion Protection e. Five-Year Coolant D. Front-Wheel Drive <ul style="list-style-type: none"> 1. Coolant Requirements <ul style="list-style-type: none"> a. Aluminum Corrosion Inhibitors b. Minimum 50% mixture 2. Demisters <ul style="list-style-type: none"> a. Function 3. Blend-Air Type Heater <ul style="list-style-type: none"> a. Operation 4. Ducts and Airflow <ul style="list-style-type: none"> a. Applications b. Airflows E. Rear Heater Systems <ul style="list-style-type: none"> 1. Applications 2. Operation 	

<p>B. Component Service: R & R</p> <ol style="list-style-type: none"> 1. Control Cables 2. Resister Block 3. Blower Motor Assembly 4. Heater Core <p>LAB ACTIVITY: C-1: Heater System Problem Diagnosis C-2: Heater Assembly Service</p>	<p><u>Performance Tasks</u> AC31</p>
<p>V. AIR CONDITIONING SYSTEMS</p> <p>A. Types</p> <ol style="list-style-type: none"> 1. Bi-Level System 2. Blend-air A/C System (Front-Wheel Drive) <p>B. Bi-Level System</p> <ol style="list-style-type: none"> 1. Bi-Level Controls <ol style="list-style-type: none"> a. Fast cool down b. Normal cooling c. Cooling for special conditions d. Operation in traffic and pulling <p>C. Blend-Air A/C System (Front-Wheel Drive)</p> <ol style="list-style-type: none"> 1. System Operation 2. Controls <ol style="list-style-type: none"> a. Ram air vent (Vans and Wagons) b. Temperature lever c. Blower switch d. Air directional vanes 3. Fast Cool Down 4. Normal Cooling <ol style="list-style-type: none"> a. Cooling with outside air 5. Cooling for special conditions 	<p><u>Performance Tasks</u></p>

VII. AIR CONDITIONING TESTS AND TROUBLESHOOTING	<u>Performance Tasks</u>
<p>A. A/C tests</p> <ol style="list-style-type: none"> 1. Vacuum tests 2. Sight glass test 3. Leak test 4. Gauge test 5. Performance test 6. Operation checks (review) 7. “H” valve test <p>B. Vacuum Tests</p> <ol style="list-style-type: none"> 1. Blend valve adjustment 2. Push-button vacuum test 3. Vacuum tube assembly 4. Vacuum actuator <p>C. Manifold Gauge Set Installation</p> <ol style="list-style-type: none"> 1. Schrader Valves 2. Gauge interpretation <p>D. Sight Glass Test</p> <ol style="list-style-type: none"> 1. Clear – fully charged 2. Clear – nearly empty 3. Clear – fault conditions 4. Foam or bubbles – low charge <p>E. Leak Test</p> <ol style="list-style-type: none"> 1. Visual Inspection 2. Electronic Leak Detector 3. <u>Caution:</u> Do Not Use Torch Tester <ol style="list-style-type: none"> a. Poisonous gas released 4. Refrigerant leak repair procedure <ol style="list-style-type: none"> a. Lost charge b. Low charge 5. Correcting low refrigerant level <ol style="list-style-type: none"> a. Leak repaired <p>F. Overhaul Performance Test</p> <ol style="list-style-type: none"> 1. Air Temperature: 70°F (21°C) or higher 2. Performance Temperature Chart 3. Test Procedure <p>G. “H” Valve Test with C-171 Compressor</p> <ol style="list-style-type: none"> 1. Test Procedure 	<p>AC14, AC15, AC16, AC17</p> <p>AC29, AC32</p> <p>AC12</p> <p>AC03</p> <p>AC02</p>
<p>LAB ACTIVITIES: C-3 A/C System Diagnosis and Testing C-4 A/C System Service</p>	

VIII. SYSTEM SERVICE AND COMPRESSOR OVERHAUL PROCEDURES	<u>Performance Tasks</u>
<p>A. Service Procedures</p> <ol style="list-style-type: none"> 1. Discharging the system <ol style="list-style-type: none"> a. Recycling and recovery procedures 2. Evacuating the system 3. Complete charge 4. Component checks and replacement <ol style="list-style-type: none"> a. Low pressure cut-out switch b. Cycling clutch switch c. "H" valve d. Evaporator temperature sensor e. WOT cut-out relay turbo/automatic f. Refrigerant lines g. Compressor h. Condenser 5. Charging the system <ol style="list-style-type: none"> a. R-12 refrigerant/R-134A refrigerant b. Charging with A/C charging station c. Charging with recycling and recovery machine 	<p>AC35, AC36, AC37, AC38, AC39</p> <p>AC06, AC10, AC13, AC28</p>
<p>B. Compressor Service</p> <ol style="list-style-type: none"> 1. A/C Clutch <ol style="list-style-type: none"> a. Car voltage and current draw b. Clutch removal c. Installation (all) d. Clutch burnish 2. Compressor <ol style="list-style-type: none"> a. Cleanliness: extremely important b. Removal c. Disassembly procedure d. Assembly procedures e. Installation f. Oil level <ol style="list-style-type: none"> (1) Refrigerant oils – R-12/R-134A (2) Measuring oil level 	<p>AC08, AC09</p> <p>AC11</p> <p>AC04, AC05</p>
<p>LAB ACTIVITY: C-5 Compressor Overhaul and Service</p>	

<p>D. The Refrigerant Section</p> <ol style="list-style-type: none"> 1. Refrigerant Level Test (Sight Glass) <ol style="list-style-type: none"> a. Clear b. Foam c. Oil streaks 2. Pressure – Temperature Relationship <ol style="list-style-type: none"> a. R-12 b. R-134A 3. Problem Conditions <ol style="list-style-type: none"> a. Overcharge/restricted condenser b. Excessive air and moisture c. Low refrigerant charge d. H-valve stuck (closed) <p>E. Vacuum Section</p> <ol style="list-style-type: none"> 1. Vacuum diagram components 2. Off mode vacuum diagram 3. Panel mode vacuum diagram 4. Bi-level mode vacuum diagram 5. Floor mode vacuum diagram 6. Defrost mode vacuum diagram 7. Re-circulation (Auto) mode vacuum diagram 8. Re-circulation (Part) mode vacuum diagram <p>LAB ACTIVITY: C-6 Electronic Automatic Temperature Control (ATC) System Diagnosis</p>	<p><u>Performance Tasks</u></p>
<p>X. COURSE REVIEW FINAL EXAM</p> <p>A. Course Review Topics:</p> <ol style="list-style-type: none"> 1. Fundamentals of Refrigeration 2. System Components and Operation 3. Heater Systems 4. Heater Diagnosis and Service Procedures 5. Air Conditioning Systems 6. Air Conditioning Diagnosis 7. Air Conditioning Tests and Trouble Shooting 8. System Service and Compressor Overhaul Procedures 9. Electronic Automatic Temperature Control (ATC) <p>B. Final Exam</p>	

LAB REQUIREMENTS

<u>LAB</u>	<u>#</u>	<u>DATE COMPLETED</u>
1. Heater System Problem Diagnosis	C-1	_____
2. A/C System Diagnosis and Testing	C-3	_____
3. A/C System Service	C-4	_____
4. Evaporator Assembly Service	C-5	_____
5. Compressor Overhaul and Service	C-6	_____
6. Electronic Automatic Temperature Control (ATC) System Diagnosis	C-7	_____

EVALUATION

- 50% Direct Evaluation of Shop Activities
- 40% Four quizzes, midterm and final exams
- 10% Class participation