

EASTERN ARIZONA COLLEGE

Vehicle Heating and Air Conditioning

Course Design
2016-2017

Course Information

Division Industrial Technology Education
Course Number AUT 266
Title Vehicle Heating and Air Conditioning
Credits 3
Developed by Brian Coppola
Lecture/Lab Ratio 2 Lecture/2 Lab

Transfer Status

| ASU | NAU | UA |
|-------------------|---------------------------|------------------|
| OMT Dept Elective | CTE Departmental Elective | Non Transferable |

Activity Course No
CIP Code 47.0604
Assessment Mode Pre/Post Test (25 Questions/100 Points)
Semester Taught Spring
GE Category None
Separate Lab No
Awareness Course No
Intensive Writing Course No

Prerequisites

None

Educational Value

This course is designed to reinforce and apply information, processes, and ideas gained in other courses. The major intent of this course is to enhance the individual's abilities to work with and diagnosis automotive heating and A/C systems.

Description

This course provides instruction on basic operating principles, diagnosis, and service of modern automotive heating and air conditioning systems. Course includes an in-depth study of a/c system operation, diagnostic and service procedures, and environmental concerns. Prepares students for ASE certification test on heating and air conditioning.

Supplies

Safety glasses

Competencies and Performance Standards

1. Apply proper safety procedures and processes.

Learning objectives

What you will learn as you master the competency:

- a. Acquaint self with shop environment and hazards.
- b. Acquaint self with emergency procedures and policy.
- c. Accept responsibility for personal well-being and practice and follow safety guidelines.
- d. Acquaint self with material safety data sheets and chemical used in shop.

Performance Standards

You will demonstrate your competence:

- when learner completes safety assignments and written exam at a satisfactory level

Your performance will be successful when:

- learner observes and practices safety procedures

2. Diagnose and repair various automotive air conditioning systems using a strategy-based process. (NATEF VII A)

Learning objectives

What you will learn as you master the competency:

- a. Determine root cause of air conditioning problems related to system noise and refrigerant level and type.
- b. Perform system performance assessment for proper operation and determine if repairs are needed.

Performance Standards

You will demonstrate your competence:

- when learner completes NATEF aligned assignment and job sheets listed in the related learning plan (The assignment and job sheets must be completed at a satisfactory level to the instructor)
- when learner performs the priority NATEF tasks listed in the related learning plan (The tasks must be completed with limited supervision- entry level)

Your performance will be successful when:

- learner is productive, works safely, and in a professional manner while working on NATEF task requirements listed in related learning plan
- learner provides acceptable oral and/or written responses to questions and/or situations asked by the instructor, while working on the NATEF task requirements listed in related learning plan
- learner actively participates in the NATEF task requirements listed in the related learning plan
- learner attends required class and lab sessions and shows up on time

3. Diagnose air conditioning systems' components for proper operation and/or failure. (NATEF VII B)

Learning objectives

What you will learn as you master the competency:

- a. Determine the condition of various air conditioning system components.

- b. Repair or replace various systems components as determined by component inspection and testing.

Performance Standards

You will demonstrate your competence:

- o when learner completes NATEF aligned assignment and job sheets listed in the related learning plan (The assignment and job sheets must be completed at a satisfactory level to the instructor)
- o when learner performs the priority NATEF tasks listed in the related learning plan (The tasks must be completed with limited supervision- entry level)

Your performance will be successful when:

- o learner is productive, works safely, and in a professional manner while working on NATEF task requirements listed in related learning plan
- o learner provides acceptable oral and/or written responses to questions and/or situations asked by the instructor, while working on the NATEF task requirements listed in related learning plan
- o learner actively participates in the NATEF task requirements listed in the related learning plan
- o learner attends required class and lab sessions and shows up on time

4. Diagnose and repair various vehicle heating, ventilation systems' and engines cooling system using techniques outlined by vehicle manufacturer. (NATEF VII C)

Learning objectives

What you will learn as you master the competency:

- a. Determine if air conditioning/heating ventilation and engine's cooling systems are operating as designed. If not, isolate root cause of problem.

Performance Standards

You will demonstrate your competence:

- o when learner completes NATEF aligned assignment and job sheets listed in the related learning plan (The assignment and job sheets must be completed at a satisfactory level to the instructor)
- o when learner performs the priority NATEF tasks listed in the related learning plan (The tasks must be completed with limited supervision- entry level)

Your performance will be successful when:

- o learner is productive, works safely, and in a professional manner while working on NATEF task requirements listed in related learning plan
- o learner provides acceptable oral and/or written responses to questions and/or situations asked by the instructor, while working on the NATEF task requirements listed in related learning plan
- o learner actively participates in the NATEF task requirements listed in the related learning plan
- o learner attends required class and lab sessions and shows up on time

5. Diagnose and repair various vehicle heating and air conditioning electrical, vacuum and mechanical control systems. (NATEF VII D)

Learning objectives

What you will learn as you master the competency:

- a. Determine if air conditioning/heating ventilation systems are operating as designed. If not, isolate root cause of problem.

Performance Standards

You will demonstrate your competence:

- when learner completes NATEF aligned assignment and job sheets listed in the related learning plan (The assignment and job sheets must be completed at a satisfactory level to the instructor)
- when the learner performs the priority NATEF tasks listed in the related learning plan (The tasks must be completed with limited supervision- entry level)

Your performance will be successful when:

- learner is productive, works safely, and in a professional manner while working on NATEF task requirements listed in related learning plan
- learner provides acceptable oral and/or written responses to questions and/or situations asked by the instructor, while working on the NATEF task requirements listed in related learning plan
- learner actively participates in the NATEF task requirements listed in the related learning plan
- learner attends required class and lab sessions and shows up on time

6. Demonstrate the ability to properly handle, recover, and recycle air conditioning refrigerant according to EPA and manufacturer guidelines. (NATEF VII E)

Learning objectives

What you will learn as you master the competency:

- a. Perform R-12 and R134a air condition systems recovery and recycle process according to instructions provided.
- b. Handle air condition refrigerant according to OSHA and EPA guidelines.

Performance Standards

You will demonstrate your competence:

- when learner completes NATEF aligned assignment and job sheets listed in the related learning plan (The assignment and job sheets must be completed at a satisfactory level to the instructor)
- when learner performs the priority NATEF tasks listed in the related learning plan (The tasks must be completed with limited supervision- entry level)

Your performance will be successful when:

- learner is productive, works safely, and in a professional manner while working on NATEF task requirements listed in related learning plan
- learner provides acceptable oral and/or written responses to questions and/or situations asked by the instructor, while working on the NATEF task requirements listed in related learning plan
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- learner attends required class and lab sessions and shows up on time

Types of Instruction

Classroom presentation

Lab & cooperative learning

Simulated or actual work experience

Individualized/independent study

Grading Information***Grading Rationale***

Each instructor has the flexibility to develop evaluative procedures within the following parameters:

1. The Post Test will represent 10% of the course grade.
2. Course learning activities shall represent 90% of the course grade.

Grading Scale

| | |
|---|-----------|
| A | 90%-100% |
| B | 80%-89% |
| C | 70%-79% |
| D | 60%-69% |
| F | Below 60% |

Learning Plan

Safety

Overview

In this learning plan you will develop the knowledge needed to work safely in a shop environment. You will learn safety procedures, the location of safety equipment, and the safety features of various shop equipment. The instruction will cover general shop safety processes, fire safety, battery safety, lifting procedures, and health-related hazards.

1. Apply proper safety procedures and processes.

Learning Activities

- ____ 1. Complete a worksheet/assignment sheet.

- ____ 2. Collect a current article that relates to concepts and issues about which you are studying.

- ____ 3. Listen and observe a lecture covering safety procedures and practices -review a safety and hazards video.

- ____ 4. Operate hoist, floor jack (jack stands) and any equipment needed during assigned lab activities.

- ____ 5. Identify location of safety equipment, first aid kit, phone fire blanket, fire extinguishers, exits, light switches, and vents.

Assessment Activities

- ____ 1. Participate in safety discussion.

- ____ 2. Complete activities in lesson.

- ____ 3. Complete written safety test.

Learning Plan

A/C System Diagnosis and Repair

Overview

To diagnose and repair A/C problems

2. Diagnose and repair various automotive air conditioning systems using a strategy-based process. (NATEF VII A)

Learning Activities

- _____ 1. Diagnose unusual operating noises in the A/C system and determine necessary action. (P-2 NATEF VII A1)
- _____ 2. Identify refrigerant type; conduct a performance test of the A/C system and determine necessary action. (P-1 NATEF VII A2)
- _____ 3. Leak test A/C system and determine necessary action. (P-1 NATEF VII A3)
- _____ 4. Inspect the condition of discharged oil and determine necessary action. (P-2 NATEF VII A4)
- _____ 5. Select oil type; measure, and add oil to the A/C system as needed. (P-2 NATEF VII A5)

Assessment Activities

- _____ 1. Participate in discussion of subject matter. Lecture and discussion covering A/C systems components, design, and various operating principles.
- _____ 2. Develop understanding of operating principles and describe the operation of various operating principles to instructor.
- _____ 3. View A/V material covering A/C systems' operating principles.
- _____ 4. Complete all assigned assignment sheets. - AS1-L2-UI, AS1-L2-UII
- _____ 5. Complete unit test covering systems components and A/C system operational theory.
- _____ 6. Participate in lecture and discussion of A/C system diagnosis. Discussion should cover performance testing and service on A/C systems.
- _____ 7. Complete assignment sheet covering system service. - AS1-L1-UIV, AS2-L1-UIV, AS3-L1-UVI, AS4-L1-UVI
- _____ 8. Complete job sheets which cover A/C systems service. - JS1-L1-UVI, JS2-L1-UVI, JS3-L1-UVI, JS4-L1-UVI, JS5-L1-UVI, JS6-L1-UVI, JS7-L1-UVI

- _____9. View A/V material covering A/C system diagnosis.

- _____10. Complete unit test covering A/C systems diagnosis.

Learning Plan

Refrigeration System Component Diagnosis and Repair

Overview

To be able to diagnose and repair refrigeration system components.

3. Diagnose air conditioning systems' components for proper operation and/or failure. (NATEF VII B)

Learning Activities

- ____ 1. Diagnose A/C system conditions that cause the protection devices (pressure, thermal, and PCM) to interrupt system operation and determine necessary action. (P-2 NATEF VII B1-1)
- ____ 2. Inspect A/C compressor drive belts and replace and adjust as needed. (P-2 NATEF VII B1-2)
- ____ 3. Inspect, test, and replace A/C compressor clutch components or assembly. (P-2 NATEF VII B1-3)
- ____ 4. Remove and replace A/C compressor and mountings. (P-2 NATEF VII B1-4)
- ____ 5. Determine need for A/C system filter and perform necessary action. (P-3 NATEF VII B2-1)
- ____ 6. Remove and inspect A/C system mufflers, hoses, lines, fittings, o-rings, seals, and service valves and perform necessary action. (P-2 NATEF VII B2-2)
- ____ 7. Inspect A/C condenser for airflow restrictions and perform necessary action. (P-1 NATEF VII B2-3)
- ____ 8. Remove and install receiver/drier or accumulator/drier. (P-2 NATEF VII B2-4)
- ____ 9. Remove and install expansion valve or orifice (expansion) tube. (P-2 NATEF VII B2-5)
- ____ 10. Inspect evaporator housing water drain and perform necessary action. (P-3 NATEF VII B2-6)

Assessment Activities

- ____ 1. Participate in discussion of subject matter. Listen, take notes, and take notes on information covering A/C system's component service and repair.
- ____ 2. Complete assignment sheets covering component service. - AS1-L1-UV, AS2-L1-UV, AS3-L3-UV, AS4-L1-UV, As1-L1-UVI, AS2-L1-UVI
- ____ 3. Complete job sheets related to component service. JS1-L1-UV, Js2-L1-UV, JS3-L1-UV, JS4-L1-UV, JS5-L1-UV, JS1-L1-UVI, JS2-L1-UVI, JS3-L1-UVI, JS4-L1-UVI, JS5-L1-UVI

- _____4. Interact in lab demonstrations & group activity covering component removal and repair.
- _____5. Complete unit test covering component service and repair.

Learning Plan

Heating, Ventilation, and Engine Cooling Systems Diagnosis and Repair

Overview

To be able to diagnose and repair various heating, ventilation, and engine cooling systems.

4. Diagnose and repair various vehicle heating, ventilation systems' and engine cooling system using techniques outlined by vehicle manufacturer. (NATEF VII C)

Assessment Activities

- ____ 1. Participate in discussion of subject matter. Listen, take notes and discuss material presented related to vehicle heating, ventilation and the engine's cooling system.

- ____ 2. Complete assignment sheets related to vehicles heating, ventilation and cooling systems. - Components ID worksheet, AS1-L1-UVIII & AS2-L1-UVIII

- ____ 3. Participate in group activity covering heating, ventilation and cooling systems testing.

- ____ 4. Complete assigned job sheets related to heating, ventilation, and engine's cooling system. - JS1-L1-UVIII, JS2-L1-UVIII, JS3-L1-UVIII, JS4-L1-UVIII, JS5-L1-UVIII.

- ____ 5. Complete unit test related to vehicles heating, ventilation, and engine cooling system.

Learning Plan

Operating Systems and Related Controls Diagnosis and Repair

Overview

To be able to diagnose and repair operating systems and related controls.

5. Diagnose and repair various vehicle heating and air conditioning electrical, vacuum and mechanical control systems. (NATEF VII D)

Learning Activities

- _____ 1. Diagnose failures in the electrical controls of heating, ventilation, and A/C (HVAC) systems and determine necessary action. (P-2 NATEF VII D1)
- _____ 2. Inspect and test A/C- heater blower, motors, resistors, switches, relays, wiring, and protection devices and perform necessary action. (P-2 NATEF VII D2)
- _____ 3. Test A/C compressor load cut-off systems and determine necessary action. (P-3 NATEF VII D3)
- _____ 4. Diagnose failures in the vacuum and mechanical components and controls of the heating, ventilation, and A/C (HVAC) system and determine necessary action. (P-2 NATEF VII D4)
- _____ 5. Inspect and test A/C- heater control panel assembly and determine necessary action. (P-3 NATEF VII D5)
- _____ 6. Inspect and test A/C- heater control cables and linkages and perform necessary action. (P-3 NATEF VII D6)
- _____ 7. Inspect and test A/C- heater ducts, doors, hoses, and outlets and perform necessary action. (P-3 NATEF VII D7)
- _____ 8. Check operation of automatic and semi-automatic heating, ventilation, and air-conditioning (HVAC) control systems and determine necessary action. (P-3 NATEF VII D8)

Assessment Activities

- _____ 1. Participate in discussion of subject matter. Listen, take notes, and discuss A/C and heating systems control devices (manual and electronic controls).
- _____ 2. Complete assignment sheets related to control devices. -Complete MACS work books titled Diagnosing electronic Air Conditioning controls AND Automatic Temperature Control Systems. - AS1-L1-UX, AS2-L1-UX, AS1-L1-UXI, AS2-L2-UXI, AS3-L1-UXI, AS4-L1-UXI.
- _____ 3. Complete job sheets during lab activities - JS1-L1-UX, JS2-L1-UX, JS3-L1-UX

- _____4. View MACS A/V videos covering Automatic and Electronic A/C system control devices.
- _____5. Complete unit test covering A/C system control devices.

Learning Plan

Refrigerant Recovery, Recycling, and Handling

Overview

To be able to properly handle used refrigerant.

6. Demonstrate the ability to properly handle, recover, and recycle air conditioning refrigerant according to EPA and manufacturer guidelines. (NATEF VII E)

Learning Activities

- ____ 1. Verify correct operation and maintenance of refrigerant handling equipment. (P-1 NATEF VII E1)

- ____ 2. Identify (by label application or use of a refrigerant identifier) and recover A/C system refrigerant. (P-1 NATEF VII E2)

- ____ 3. Recycle refrigerant. (P-1 NATEF VII E3)

- ____ 4. Label and store refrigerant. (P-1 NATEF VII E4)

- ____ 5. Test recycle refrigerant for non-condensable gases. (P-1 NATEF VII E5)

- ____ 6. Evacuate and charge A/C system. (P-1 NATEF VII E6)

Assessment Activities

- ____ 1. Participate in discussion of subject matter. Listen, take notes, and discuss A/C refrigerant handling, recovery and recycling.

- ____ 2. Complete all assigned work book activity. Complete ASE or MACS A/C refrigerant & recovery information work book and Quiz.

- ____ 3. View A/V covering proper handling of refrigerant and EPA guidelines.