

Heavy Duty Equipment Technician Level 3

Heavy Duty Equipment Technician

Unit: C1 Engines and Engine Support Systems II: Combustion Science/Emissions Controls

Level: Three

Duration: 35 hours

Theory: 21 hours

Practical: 14 hours

Overview:

This unit provides heavy duty equipment technician apprentices with knowledge about combustion science and emission control systems. The unit begins by covering terminology, safe work practices, and operating principles for emissions control systems. The unit then covers combustion science and emissions, and the tools and equipment used when servicing and repairing emission control systems. Finally, the unit covers the procedures used to inspect, diagnose and repair emissions control systems and components.

| Objectives and Content: | <u>Percent of Unit Mark (%)</u> |
|---|--|
| 1. Define terminology associated with combustion science and emissions controls. | 10% |
| 2. Identify hazards and describe safe work practices pertaining to combustion science and emissions controls. | 5% |
| 3. Identify and describe tools and equipment used to service and repair combustion science and emissions controls. | 5% |
| 4. Explain the principles of combustion science and emissions. | 20% |
| a. Combustion science theories/chemistry | |
| b. Types of emissions | |
| • CO and CO ₂ , NO _x (oxides of nitrogen), NH ₃ | |
| • Hydrocarbons and particulate matter | |
| 5. Identify emissions control system components and interpret related symbols. | 20% |
| a. Tier 1-4 levels | |
| b. Hydrocarbon and particulate matter control | |
| c. NO _x control | |
| 6. Describe and perform procedures used to diagnose and repair emissions control systems. | 40% |
| a. Hydrocarbon and particulate matter control system components | |
| b. NO _x (oxides of nitrogen) control system components | |

Heavy Duty Equipment Technician

Unit: C2 Engines and Engine Support Systems III: Diesel Fuel Systems

Level: Three

Duration: 70 hours

Theory: 35 hours

Practical: 35 hours

Overview:

This unit provides heavy duty equipment technician apprentices with knowledge of diesel fuel systems. The unit begins by covering terminology, safe work practices, and operating principles for diesel fuel systems. The unit then covers the tools and equipment for servicing and repairing diesel fuel systems. Finally, the unit covers the procedures used to inspect, diagnose, maintain and service diesel fuel systems and their components.

| Objectives and Content: | <u>Percent of Unit Mark (%)</u> |
|--|--|
| 1. Define terminology associated with diesel fuel systems. | 5% |
| 2. Identify hazards and describe safe work practices pertaining to diesel fuel systems. | 5% |
| 3. Identify and describe tools and equipment used to service and repair diesel fuel systems. | 5% |
| 4. Identify diesel fuel system components and their operating principles. | 15% |
| a. Mechanical fuel injection systems | |
| • Pumps | |
| • Injectors | |
| b. Electronic fuel injection systems | |
| • Pumps | |
| • Injectors | |
| • Unit injectors | |
| • Common rail | |
| 5. Describe and perform engine tune-up and performance testing. | 40% |
| a. Valve setting and timing | |
| b. Injection timing | |
| c. Intake and exhaust performance | |
| d. Dynamometer testing | |
| • Engine performance terminology | |
| • Horsepower/torque/fuel consumption | |
| e. Engine brakes | |
| 6. Describe and perform procedures used to diagnose and repair diesel fuel systems. | 30% |

- a. Mechanical fuel injection systems
 - Pumps
 - Injectors
- b. Electronic fuel injection systems
 - Pumps
 - Injectors
 - Unit injectors
 - Common rail

Heavy Duty Equipment Technician

Unit: C3 Alternate Fuels

Level: Three

Duration: 7 hours

Theory: 7 hours

Practical: 0 hours

Overview:

This unit provides heavy duty equipment technician apprentices with knowledge about alternate fuels. The unit begins by covering terminology and safe work practices for alternate fuels. The unit then covers the tools and equipment used when servicing and repairing alternate fuel systems. The unit focuses on the principles of operation of two main alternative fuel systems: propane fuel systems and gasoline fuel systems. Finally, the unit covers the procedures used to inspect, diagnose and maintain alternate fuel systems, and procedures for servicing them.

| Objectives and Content: | <u>Percent of Unit Mark (%)</u> |
|---|--|
| 1. Define terminology associated with alternative fuel systems. | 5% |
| 2. Identify hazards and describe safe work practices pertaining to alternative fuel systems. | 10% |
| a. Propane and gasoline fuel safety | |
| • Fire hazards | |
| b. Hazardous emissions | |
| • Carbon monoxide | |
| 3. Identify and describe tools and equipment used to service and repair powertrains. | 10% |
| a. Propane fuel systems | |
| • Conventional propane fuel systems | |
| b. Gasoline fuel systems | |
| • Electronic fuel injection | |
| • Emission control systems | |
| 4. Explain the principles of operation of alternative fuel systems. | 20% |
| a. Propane fuel systems | |
| • Conventional propane fuel systems | |
| b. Gasoline fuel systems | |
| • Electronic fuel injection | |
| • Emission control systems | |
| 5. Identify alternative fuel system components. | 15% |
| a. Propane fuel systems | |

- Conventional propane fuel systems
 - b. Gasoline fuel systems
 - Electronic fuel injection
 - Emission control systems
- 6. Describe procedures used to inspect, diagnose and maintain alternative fuel systems. 20%**
- a. Propane fuel systems
 - Emissions testing
 - Component inspection
 - b. Gasoline fuel systems
 - Fuel injection system tests
 - Emission control system tests
 - Electronic scan tool usage
- 7. Describe servicing procedures for alternative fuel systems. 20%**
- a. Propane fuel systems
 - Mixture adjustment
 - Component repair or replacement
 - b. Gasoline fuel systems
 - Actuator service and cleaning (injectors, throttle body actuator, IAC, EGR)
 - EVAP system service
 - PCV system service

Heavy Duty Equipment Technician

Unit: C4 HVAC and Environmental Controls II

Level: Three

Duration: 35 hours

Theory: 7 hours

Practical: 28 hours

Overview:

This unit provides heavy duty equipment technician apprentices with knowledge about heating, ventilation and air conditioning (HVAC) systems when working with today's agricultural equipment. The unit begins by covering terminology and safe work practices for HVAC systems. The unit then covers the tools and equipment used when servicing and repairing HVAC systems. Finally, the unit covers the procedures used to inspect, diagnose and maintain HVAC systems, and procedures for servicing them.

| Objectives and Content: | <u>Percent of Unit Mark (%)</u> |
|--|--|
| 1. Define terminology associated with heating, ventilation and air conditioning (HVAC) systems and system components. | 5% |
| 2. Identify hazards and describe safe work practices pertaining to HVAC systems. | 10% |
| a. Air conditioning, including: <ul style="list-style-type: none">• Refrigerants• High pressure gas safety (nitrogen testing) | |
| b. Heating system | |
| c. Environmental licensing requirements | |
| 3. Identify and describe tools and equipment used to service and repair HVAC systems. | 10% |
| a. Air conditioning <ul style="list-style-type: none">• Recovery/recycle/recharge unit• Manifold gauge set• Leak testing equipment• Refrigerant identifier• Evacuation equipment | |
| b. Heating system <ul style="list-style-type: none">• Flushing equipment• Unit pressurizer (filling and bleeding) | |
| c. Ventilation system <ul style="list-style-type: none">• Cleaning equipment | |
| 4. Explain the principles of operation of air conditioning systems. | 20% |
| a. Refrigerant | |

- Heat movement
- Refrigeration cycle
- b. Refrigeration
 - Expansion valve systems
 - Orifice tube systems
- c. Dehumidification

5. Identify HVAC system components and identify refrigerant types. 15%

- a. Air conditioning
 - Compressor types
 - Heat exchangers
 - Hoses and fittings
 - Valves
 - Controls and pressure switches
- b. Heating system
 - Heat exchangers
 - Hoses and fittings
 - Valves
 - Control types
- c. Ventilation system
 - Climate controls (automatic and manual)
 - Air flow control
 - Cab air filtration
 - Ducting and sound suppression systems

6. Describe and perform procedures used to diagnose and repair HVAC systems. 40%

- a. Air conditioning systems
 - System performance testing
 - Recover
 - Recharge
 - Evacuate
 - Leak test
 - Component replacement
- b. Heating systems
 - System performance testing
 - Flushing
 - Filling
- c. Ventilation systems
 - System performance testing
 - Air flow
 - Cleaning and filter replacement

Heavy Duty Equipment Technician

Unit: C5 Hydraulics Service and Repair

Level: Three

Duration: 35 hours

Theory: 7 hours

Practical: 28 hours

Overview:

This unit provides heavy duty equipment technician apprentices with knowledge about other hydraulic system components, with a focus on hydraulic pumps and motors, hydraulic cylinders, advanced hydraulic control valves, and accumulators when working with today's agricultural equipment. The unit also covers safe work practices and operating principles for these hydraulic system components. Finally, the unit covers the procedures to inspect, diagnose and maintain hydraulic system components, and the related servicing procedures.

| Objectives and Content: | <u>Percent of Unit Mark (%)</u> |
|---|--|
| 1. Define terminology associated with hydraulic system components. | 5% |
| 2. Identify hazards and describe safe work practices pertaining to: | 10% |
| a. Hydraulic pumps and motors | |
| b. Hydraulic cylinders | |
| c. Advanced hydraulic control valves | |
| d. Accumulators | |
| 3. Identify and describe tools and equipment used to service and repair hydraulic systems. | 5% |
| a. Flow meters | |
| b. Pressure gauges | |
| c. Regulator sets | |
| d. Hose crimper | |
| e. Electronic testing tools | |
| 4. Explain the operating principles of hydraulic system components. | 20% |
| a. Hydraulic pumps and motors | |
| • Fixed displacement pumps and motors | |
| • Variable displacement motors | |
| • Pressure-compensated pumps | |
| • Pressure- and flow-compensated pumps | |
| b. Hydraulic cylinders | |
| c. Advanced hydraulic control valves | |
| • Pilot | |
| • Electro-hydraulics | |

- d. Accumulators
- 5. Identify hydraulic system components and interpret hydraulic-related symbols. 20%**
- a. Hydraulic pumps and motors
 - Fixed displacement pumps and motors
 - Variable displacement motors
 - Pressure-compensated pumps
 - Pressure- and flow-compensated pumps
 - b. Hydraulic cylinders
 - c. Advanced hydraulic control valves
 - Pilot
 - Electro-hydraulics
 - d. Accumulators
- 6. Describe and perform procedures used to inspect, diagnose and maintain: 20%**
- a. Hydraulic pumps and motors
 - Fixed displacement pumps and motors
 - Variable displacement motors
 - Pressure-compensated pumps
 - Pressure- and flow-compensated pumps
 - b. Hydraulic cylinders
 - c. Advanced hydraulic control valves
 - Pilot
 - Electro-hydraulics
 - d. Accumulators
 - Testing
- 7. Describe and perform servicing procedures for hydraulic systems: 20%**
- a. Hydraulic pumps and motors
 - Fixed displacement pumps and motors
 - Variable displacement motors
 - Pressure-compensated pumps
 - Pressure- and flow-compensated pumps
 - b. Hydraulic cylinders
 - c. Advanced hydraulic control valves
 - Pilot
 - Electro-hydraulics
 - d. Accumulators
 - Recharging
 - e. Hydraulic system flush

Heavy Duty Equipment Technician

Unit: C6 Powertrains II: Heavy Duty Transmissions

Level: Three

Duration: 49 hours

Theory: 14 hours

Practical: 35 hours

Overview:

This unit provides heavy duty equipment technician apprentices with knowledge about transmission systems. The unit begins by covering terminology, safe work practices, and operating principles for transmissions. The unit then covers the tools and equipment used when servicing and repairing transmissions. Finally, the unit covers the procedures used to inspect, diagnose, maintain and service transmissions.

| Objectives and Content: | <u>Percent of Unit Mark (%)</u> |
|---|--|
| 1. Define terminology associated with heavy duty transmissions. | 10% |
| 2. Identify hazards and describe safe work practices pertaining to heavy duty transmissions. | 10% |
| 3. Identify and describe tools and equipment used to service and repair heavy duty transmissions. | 10% |
| a. Lifting and hoisting equipment | |
| b. Dial indicators | |
| c. Clearance/preload measurement tools | |
| d. Pressure testing | |
| e. Calibration tools | |
| 4. Identify the types of heavy duty transmissions and their operating principles. | 30% |
| a. Power shift | |
| • Hi-lo shift | |
| • Full-power shift | |
| b. Hydrostatic drive system | |
| • Pump | |
| • Motor | |
| • Charge pump | |
| • Filters, reservoir and cooler | |
| • Valves | |
| c. Automatic transmissions | |
| • Torque converters and fluid couplers | |
| 5. Describe and perform procedures used to diagnose and repair heavy duty transmissions. | 40% |

- a. Power shift and automatic transmissions
 - Pressure testing
 - Clutch engagement (calibration)
 - Oil analysis
 - Major overhaul (reading schematic diagrams and power flow charts)

Heavy Duty Equipment Technician

Unit: C7 Spark Ignition Systems

Level: Three

Duration: 14 hours

Theory: 7 hours

Practical: 7 hours

Overview:

This unit provides heavy duty equipment technician apprentices with knowledge about spark ignition systems. The unit begins by covering terminology and safe work practices for spark ignition systems. The unit then covers the tools and equipment used when servicing and repairing spark ignition systems. Finally, the unit covers the procedures used to inspect, diagnose and maintain spark ignition systems, and procedures for servicing them.

| Objectives and Content: | <u>Percent of Unit Mark (%)</u> |
|---|--|
| 1. Define terminology associated with spark ignition systems. | 10% |
| 2. Identify hazards and describe safe work practices pertaining to spark ignition systems. | 10% |
| 3. Identify and describe tools and equipment used to service and repair spark ignition systems. | 20% |
| 4. Identify the following spark ignition system components and describe their purpose and operation. <ul style="list-style-type: none"> a. Ignition coil b. Distributor c. Advanced mechanisms <ul style="list-style-type: none"> • Centrifugal • Vacuum • Electronic d. Triggering devices <ul style="list-style-type: none"> • Breaker point • Magnetic pulse generator • Hall effect • Optical • Distributorless e. Ignition module f. Spark plugs | 20% |
| 5. Describe and demonstrate procedures used to inspect, diagnose and maintain spark ignition systems. | 20% |

6. Describe and demonstrate servicing and adjustment procedures for spark ignition systems. 20%
