Ohio CTE: Agricultural and Environmental Systems

Power Systems

Tool, Stationary and Mobile Equipment Maintenance: Inspect, clean, maintain, and perform preventative maintenance on equipment. 4.1

1. **Inspect, clean, maintain, and perform preventative maintenance on equipment.** 4.1.1
2. **Identify types of hand tools, power tools, and equipment and describe their functions.** 4.1.2
3. **Ensure the presence and functionality of safety equipment.** 4.1.3
4. **Identify potential hazards and limitations related to the use of equipment.** 4.1.4
5. **Maintain organization and cleanliness of facilities, machinery, equipment, and tools for safety and appearance.** 4.1.5
6. **Inspect and service electrical systems and components.** 4.1.6
7. **Inspect fluid leakage, fluid levels, and the condition of fluids.** 4.1.7
8. **Inspect, clean, lubricate, and adjust equipment for safe operation.** 4.1.8
9. **Select fluids, maintain fluid levels, and replace system filters per original equipment manufacturer specification (OEM).** 4.1.9
10. **Inspect and maintain fluid conveyance and storage components.** 4.1.10
11. **Identify and maintain accuracy of tooling, machinery, and equipment when performing preventive maintenance and repairs.** 4.1.11
12. **Compare alternative sources of power for equipment.** 4.1.12

Equipment Operations: Operate and maintain mechanical equipment and power systems. 4.2

1. **Follow Original Equipment Manufacturer (OEM) recommended operating procedures and adjustment specifications as found in the operator's manual.** 4.2.1
2. **Differentiate among the functions, limitations and proper use of equipment, equipment controls, and instrumentation.** 4.2.2
3. **Perform pre- and post-operation inspections and adjustments and report malfunctions.** 4.2.3
4. **Perform appropriate start-up, operating, and shut-down procedures.** 4.2.4

	5 Select and operate equipment and attachments needed to complete the task per the original equipment manufacturer (OEM) operator's manual. 4.2.5
	6 Identify onboard diagnostic procedures per original equipment manufacturer (OEM) specifications to identify the causes of drivability and emissions concerns. 4.2.6
	7 Identify, describe, and troubleshoot module communication errors (e.g., controller area network [CAN], BUS systems). 4.2.7
	8 Inspect and test computerized engine control system sensors, powertrain control modules (PCMs), actuators, and circuits. 4.2.8
Engines: Apply concepts to service components of both small and large internal combustion engines per the original equipment manufacturer (OEM) operator's manual. 4.3	1 Assess the physical and mechanical principles of engine operation, including motion, friction, and thermodynamics. 4.3.1
	2 Retrieve, record, and interpret stored on-board diagnostics (OBD) trouble codes and clear codes where applicable. 4.3.2
	3 Locate data plate and determine engine specifications. 4.3.3
	4 Analyze, evaluate, and troubleshoot an engine. 4.3.4
	5 Compare and contrast two-cycle and four-cycle engines and their operating principles. 4.3.5
	6 Evaluate engine head and engine block components to determine serviceability per the original equipment manufacturer (OEM) specification. 4.3.6
	7 Remove and replace components comprising the engine block and engine head. 4.3.7
	8 Perform the requirements of engine servicing per original equipment manufacturer (OEM) specification to maintain emissions requirements. 4.3.8
	9 Identify onboard diagnostic procedures per original equipment manufacturer (OEM) specifications to identify the causes of drivability and emissions concerns. 4.3.9
	10 Identify, describe, and troubleshoot module communication errors (e.g., controller area network [CAN], BUS systems). 4.3.10
	11 Inspect and test computerized engine control system sensors, powertrain control modules (PCMs), actuators, and circuits. 4.3.11
Lubrication and Cooling Systems: Inspect lubrication and cooling systems operation. 4.4	1 Explain principles of engine lubrication and cooling. 4.4.1
	2 Perform pressure and sensor test on lubrication and cooling systems. 4.4.2

	3 Understand the purpose of fluid sampling, perform fluid sampling procedures, and interpret sample reporting. 4.4.3
	4 Inspect the oil pump gears or rotors, housing, pressure relief devices, and pump drive. 4.4.4
	5 Inspect, test, and replace the radiator, pressure cap, and coolant recovery tank. 4.4.5
	6 Inspect and replace engine system hoses and belts. 4.4.6
	7 Inspect and replace the thermostat per original equipment manufacturer (OEM) specification. 4.4.7
	8 Test, drain, flush, and refill coolant and bleed the cooling system per original equipment manufacturer (OEM) specification. 4.4.8
	9 Inspect, remove, and replace the water pump per original equipment manufacturer (OEM) specification. 4.4.9
	10 Inspect and test mechanical and electrical fans, fan clutches, fan shrouds, and air dams. 4.4.10
Fuel, Air Induction and Exhaust Systems: Diagnose and repair fuel, air induction, exhaust systems, and aftertreatment devices (ATD). 4.5	1 Explain principles of exhaust, intake, aftertreatment, and turbocharger on designs and operations. 4.5.1
	2 Identify and understand starting and drivability issues or concerns. 4.5.2
	3 Understand and interpret fuel sampling report for contaminants and quality. 4.5.3
	4 Inspect and test fuel pumps and pump control systems for pressure, regulation, and volume. 4.5.4
	5 Inspect and test the cold start system. 4.5.5
	6 Inspect the air induction system, intake manifold, and gaskets for vacuum leaks and unmetered air. 4.5.6
	7 Inspect and service governor systems. 4.5.7
	8 Explain fuel injection theory. 4.5.8
	9 Inspect and test fuel injectors per original equipment manufacturer (OEM) specification. 4.5.9
	10 Inspect the integrity of the exhaust system and after-treatment components. 4.5.10

	11 Identify, remove, and replace positive crankcase ventilation system components. 4.5.11
	12 Identify the parts and describe the functions of evaporative emission control systems. 4.5.12
	13 Check and refill the diesel exhaust fluid and service the diesel particulate filter per original equipment manufacturer (OEM) specification. 4.5.13
	14 Identify and describe alternative power systems. 4.5.14
Ignition Systems: Perform ignition system diagnostics and repair. 4.6	1 Explain basic ignition system theory. 4.6.1
	2 Use wiring diagrams and schematics to troubleshoot and repair ignition system components. 4.6.2
	3 Diagnose and repair ignition system problems for drivability. 4.6.3
	4 Inspect, test, and replace ignition system circuit wiring and components. 4.6.4
	5 Identify, describe, and adjust ignition system timing, timing advance and retard. 4.6.5
Transmission of Power: Diagnose and service power train components. 4.7	1 Identify and describe the features, benefits, and applications of power transmission components. 4.7.1
	2 Identify and describe the physical and mechanical principles of mechanical, hydraulic, pneumatic, and electrical power transfer. 4.7.2
	3 Perform calculations involving speed, torque, and power. 4.7.3
	4 Remove, replace, and adjust hydrostatic transmissions. 4.7.4
	5 Remove, replace, and adjust clutches and brakes. 4.7.5
	6 Test, diagnose, remove, and replace electronic power train control systems components. 4.7.6
	7 Test, remove, and replace pneumatic components. 4.7.7
	8 Remove, replace, and adjust damaged and non-functioning power train components. 4.7.8
Starting and Charging Systems: Identify, inspect, and repair starting and charging system components. 4.8	1 Identify and differentiate between electrical and engine problems that cause a slow crank or no crank condition. 4.8.1
	2 Use wiring diagrams and schematics to troubleshoot starting and charging system components. 4.8.2

	3 Inspect, test, and replace fuses, relays, circuit breakers, and solenoids. 4.8.3
	4 Perform charging system output tests. 4.8.4
	5 Inspect, remove, replace, and adjust alternator drive belts, pulleys, and tensioners and check pulley and belt alignment. 4.8.5
	6 Remove, inspect, and install an alternator and starter per original equipment manufacturer (OME) specification. 4.8.6
	7 Measure and diagnose the causes of excessive key-off battery drain (parasitic draw). 4.8.7
	8 Identify the high voltage circuit of electric or hybrid electric vehicles and related safety precautions. 4.8.8
Steering, Suspension and Traction: Diagnose and repair steering, suspension, and traction systems. 4.9	1 Evaluate traction, ballasting and weight transfer of equipment, including towing and trailering systems per gross vehicle weight rating (GVWR). 4.9.1
	2 Evaluate and formulate solutions for vehicle stability to include automatic leveling devices, center of gravity, roll-over potential, and wheelbase dimensions. 4.9.2
	3 Remove, inspect, repair, or replace steering system components. 4.9.3
	4 Align steering components, including tires and tracks. 4.9.4
	5 Interpret tire and track wear patterns and evaluate replacement needs per original equipment manufacturer (OEM) specification. 4.9.5
	6 Identify and differentiate bearing noise, vehicle pull and wheel vibration, shimmy, and noise. 4.9.6
	7 Measure wheel, tire, axle, and hub runout to evaluate replacement needs. 4.9.7
	8 Remove, inspect, repair/replace, and reinstall the tire and wheel or track assembly per original equipment manufacturer (OEM) specification. 4.9.8
Drive Axle Universal and Differential: Identify, inspect, and replace drive axle and differential components. 4.10	1 Identify and inspect drive axle and differential assemblies. 4.10.1
	2 Service and replace the shaft, yokes, boots, and joints per original equipment manufacturer (OEM) specification. 4.10.2
	3 Replace drive axle seals, bearings, and retainers per original equipment manufacturer (OEM) specification. 4.10.3
	4 Inspect, adjust, and replace drive belts and chains per original equipment manufacturer (OEM) specification. 4.10.4

	5 Inspect and replace drive axle housing cover plates, gaskets, sealants, vents, plugs, and seals per original equipment manufacturer (OEM) specification. 4.10.5
Hydraulic Systems: Diagnose, repair, and rebuild hydraulic systems. 4.11	1 Interpret symbols and schematic drawings related to hydraulic system design. 4.11.1
	2 Describe the physical and mechanical principles of hydraulics. 4.11.2
	3 Identify and describe the features, benefits, and applications of the different types of hydraulic and hydrostatic systems. 4.11.3
	4 Identify and describe the applications and operations of major hydraulic system components. 4.11.4
	5 Inspect, test, diagnose, repair, or replace hydraulic systems and components. 4.11.5
	6 Test and diagnose electronic controls for hydraulic systems. 4.11.6
	7 Identify and describe the purpose of fluid sampling, perform fluid sampling procedures, and interpret sample reporting. 4.11.7
	8 Identify and describe hydraulic fitting types and sizes per the International Standard Organization (ISO). 4.11.8
	9 Measure flow rate, pressure, and temperature. 4.11.9
Brakes: Identify, inspect, and replace components of braking systems. 4.12	1 Identify and locate components of braking systems. 4.12.1
	2 Identify and describe pressure concerns in the brake systems. 4.12.2
	3 Identify poor stopping, pulling, noise, vibration, premature wear, or dragging. 4.12.3
	4 Remove and replace a master cylinder per original equipment manufacturer (OEM) specification. 4.12.4
	5 Inspect and install lines and fittings per original equipment manufacturer (OEM) specification. 4.12.5
	6 Remove, inspect, and replace brake components and inspect for leaks. 4.12.6
	7 Inspect the condition of the parking brake, and service or replace as needed. 4.12.7
Heating and Air Conditioning Systems: Diagnose and repair heating, ventilating, and	1 Identify and describe the physical and mechanical principles of heating, ventilating, and air conditioning (HVAC) systems. 4.13.1

air conditioning systems (HVAC). 4.13	**2** Use schematics and diagrams to troubleshoot heating, ventilating, and air conditioning (HVAC) systems. 4.13.2
	3 Identify and describe refrigerant types, major components, and functions in the overall operation of the heating, ventilating, and air conditioning (HVAC) system. 4.13.3
	4 Diagnose heating and air conditioning systems by performing pressure and leak testing. 4.13.4
	5 Identify, evacuate/recover, recycle/charge the air conditioning system per EPA standards. 4.13.5
Pneumatics Systems: Diagnose, repair, and rebuild Pneumatic systems. 4.14	**1** Interpret symbols and schematic drawings related to pneumatic system design. 4.14.1
	2 Describe the physical and mechanical principles of pneumatics. 4.14.2
	3 Identify and describe the features, benefits, and applications of the different types of pneumatic systems. 4.14.3
	4 Identify and describe the applications and operations of major pneumatic system components. 4.14.4
	5 Inspect, test, diagnose, repair, or replace pneumatic systems and components to maintain system integrity. 4.14.5
	6 Test and diagnose electronic controls for pneumatic systems. 4.14.6
	7 Identify and describe the pneumatic system contaminates and methods of testing and control. 4.14.7
	8 Identify and describe pneumatic fittings and hose by types and sizes per international standard organization (ISO). 4.14.8
	9 Measure system flow, pressure, temperature, and dew point. 4.14.9