# Agricultural and Environmental Systems Career Field

## Engines & Fuel Systems

**Subject Code: 010220**

**Outcome & Competency Descriptions**

**Course Description:**

Students will identify, diagnose, maintain and repair engines and fuel systems. Topics include differentiation of fuels and fueling systems along with their characteristics, designations, and additives. Students will learn the principles of cooling, lubrication, intake, exhaust and after-treatment systems and how to make necessary repairs while maintaining system cleanliness. Throughout the course, site and personal safety along with business and employability skills are emphasized.

**Strand 1. Business Operations/21st Century Skills**

Learners apply principles of economics, business management, marketing and employability in an entrepreneur, manager and employee role to the leadership, planning, developing and analyzing of business enterprises related to the career field.

**Outcome: 1.1. Employability Skills**

Develop career awareness and employability skills (e.g., face-to-face, online) needed for gaining and maintaining employment in diverse business settings.

**Competencies**

1.1.3. Develop a career plan that reflects career interests, pathways and secondary and postsecondary options.

1.1.5. Develop strategies for self-promotion in the hiring process (e.g., filling out job applications, resumé writing, interviewing skills, portfolio development).

1.1.7. Apply problem-solving and critical-thinking skills to work-related issues when making decisions and formulating solutions.

1.1.9. Give and receive constructive feedback to improve work habits.

**Outcome: 1.2. Leadership and Communications**

Process, maintain, evaluate and disseminate information in a business. Develop leadership and team building to promote collaboration.

**Competencies**

1.2.1. Extract relevant, valid information from materials and cite sources of information.

1.2.3. Identify and use verbal, nonverbal and active listening skills to communicate effectively.

1.2.5. Communicate information (e.g., directions, ideas, vision, workplace expectations) for an intended audience and purpose.

1.2.7. Use problem-solving and consensus-building techniques to draw conclusions and determine next steps.

1.2.12. Use technical writing skills to complete forms and create reports.

**Outcome: 1.3. Business Ethics and Law**

Analyze how professional, ethical and legal behavior contributes to continuous improvement in organizational performance and regulatory compliance.

**Competencies**

1.3.1. Analyze how regulatory compliance (e.g., United States Department of Agriculture [USDA], Food and Drug Administration [FDA], United States Department of Interior [USDI], Ohio Livestock Care Standards, water quality standards, local water regulations, building codes) affects business operations and organizational performance.

1.3.2. Follow protocols and practices necessary to maintain a clean, safe and healthy work environment.

1.3.4. Identify how federal and state consumer protection laws affect products and services.

1.3.5. Access and implement safety compliance measures (e.g., quality assurance information, safety data sheets [SDSs], product safety data sheets [PSDSs], United States Environmental Protection Agency [EPA], United States Occupational Safety and Health Administration [OSHA]) that contribute to the continuous improvement of the organization.

**Outcome: 1.4. Knowledge Management and Information Technology**

Demonstrate current and emerging strategies and technologies used to collect, analyze, record and share information in business operations.

**Competencies**

1.4.1. Use office equipment to communicate (e.g., phone, radio equipment, fax machine, scanner, public address systems).

1.4.6. Use an electronic database to access and create business and technical information.

**Outcome: 1.12. Site and Personal Safety Procedures**

Follow site and personal safety procedures in specific situations with specialized tools and equipment, evaluate the situation and take corrective action.

**Competencies**

1.12.2. Interpret safety signs and symbols.

1.12.5. Identify the location of emergency flush showers, eyewash fountains, Safety Data Sheets (SDSs), fire alarms and exits.

1.12.6. Identify procedures for the handling, storage and disposal of hazardous materials.

1.12.7. Select, use, store, maintain and dispose of personal protective equipment (PPE), appropriate to job tasks, conditions and materials.

1.12.8. Identify safety hazards and take corrective measures.

1.12.9. Identify, inspect and use safety equipment appropriate for the task.

1.12.10. Follow established procedures for the administration of first aid and contact emergency medical personnel when necessary.

1.12.12. Apply inspection, rejection criteria, hitch configurations and load handling practices to slings and rigging hardware.

1.12.15. Select and operate fire extinguishers based on the class of fire.

**Strand 4. Power Systems**

Learners apply principles of tool use, power transmission, hydraulics, two- and four-stroke cycle combustion, exhaust, ignition, fuel, starting and charging, steering, HVAC and lubrication systems to operate, maintain and repair equipment.

**Outcome: 4.1. Tool, Stationary and Mobile Equipment Maintenance**

Inspect, clean, maintain and perform preventative maintenance on equipment.

**Competencies**

4.1.1. Inspect, clean, maintain and perform preventative maintenance on equipment.

4.1.2. Identify the types of hand tools, power tools and equipment and describe their functions.

4.1.3. Ensure the presence and functionality of safety equipment.

4.1.4. Identify potential hazards and limitations related to the use of equipment.

4.1.5. Maintain organization, and cleanliness of facilities, machinery, equipment, and tools for safety and appearance.

4.1.7. Inspect for fluid leakage, fluid levels and the condition of fluids.

4.1.9. Select fluids, maintain fluid levels and replace system filters per original equipment manufacturer (OEM) specification.

4.1.10. Inspect and maintain fluid conveyance and storage components.

4.1.11. Identify and maintain accuracy of tooling, machinery, and equipment when performing preventive maintenance and repairs.

**Outcome: 4.2. Equipment Operations**

Operate and maintain mechanical equipment and power systems.

**Competencies**

4.2.1. Follow original equipment manufacturer (OEM) recommended operating procedures and adjustment specifications as found in the operator's manual.

**Outcome: 4.3. Engines**

Apply concepts to service components of both small and large internal combustion engines per the original equipment manufacturer (OEM) operators manual.

**Competencies**

4.3.1. Assess the physical and mechanical principles of engine operation, including motion, friction and thermodynamics.

4.3.2. Retrieve, record and interpret stored on-board diagnostics (OBD) trouble codes and clear codes where applicable.

4.3.3. Locate data plate and determine engine specifications.

4.3.4. Analyze, evaluate and troubleshoot an engine.

4.3.5. Compare and contrast two-cycle and four-cycle engines and their operating principles.

4.3.6. Evaluate engine head and engine block components to determine serviceability per the original equipment manufacturer (OEM) specification.

4.3.7. Remove and replace components comprising the engine block and engine head.

4.3.8. Perform the requirements for engine servicing per original equipment manufacturer (OEM) specification to maintain emissions requirements.

**Outcome: 4.4. Lubrication and Cooling Systems**

Inspect lubrication and cooling systems operation.

**Competencies**

4.4.1. Explain principles of engine lubrication and cooling.

4.4.2. Perform pressure and sensor test on lubrication, and cooling systems.

4.4.3. Understand the purpose fluid sampling, perform fluid sampling procedures and interpret sample reporting.

4.4.4. Inspect the oil pump gears or rotors, housing, pressure relief devices and pump drive.

4.4.5. Inspect, test and replace the radiator, pressure cap, coolant recovery tank.

4.4.6. Inspect and replace engine system hoses and belts.

4.4.7. Inspect and replace the thermostat per original equipment manufacturer (OEM) specification.

4.4.8. Test, drain, flush and refill coolant and bleed the cooling system per original equipment manufacturer (OEM) specification.

4.4.9. Inspect, remove and replace the water pump per original equipment manufacturer (OEM) specification.

4.4.10. Inspect and test mechanical and electrical fans, fan clutches, fan shrouds and air dams.

**Outcome: 4.5. Fuel, Air Induction and Exhaust System**

Diagnose and repair fuel, air induction, exhaust systems, and aftertreatment devices (ATD).

**Competencies**

4.5.1. Explain principles of exhaust, intake, aftertreatment and turbocharger designs and operations.

4.5.2. Identify and understand starting and drivability issues or concerns.

4.5.3. Understand and interpret fuel sampling report for contaminants and quality.

4.5.4. Inspect and test fuel pumps and pump control systems for pressure, regulation and volume.

4.5.5. Inspect and test the cold start system.

4.5.6. Inspect the air induction system, intake manifold and gaskets for vacuum leaks and unmetered air.

4.5.7. Inspect and service governor systems.

4.5.8. Explain fuel injection theory.

4.5.9. Inspect and test fuel injectors per original equipment manufacturer (OEM) specification.

4.5.10. Inspect the integrity of the exhaust system and after-treatment components.

4.5.11. Identify, remove and replace positive crankcase ventilation system components.

4.5.12. Identify the parts and functions of evaporative emissions controls systems.

4.5.13. Check and refill the diesel exhaust fluid and service the diesel particulate filter per original equipment manufacturer (OEM) specification.

4.5.14. Identify and describe alternative power systems.

**Outcome: 4.6. Ignition System**

Perform ignition system diagnostics and repair.

**Competencies**

4.6.1. Explain basic ignition system theory.

4.6.2. Use wiring diagrams and schematics to troubleshoot and repair ignition system components.

**Outcome: 4.8. Starting and Charging Systems**

Identify, inspect and repair starting and charging system components.

**Competencies**

4.8.1. Identify and differentiate between electrical and engine mechanical problems that cause a slow crank or no crank condition.

4.8.2. Use wiring diagrams and schematics to troubleshoot and repair starting and charging system components.

4.8.5. Inspect, remove, replace and adjust alternator drive belts, pulleys, tensioners and check pulley and belt alignment.

4.8.6. Remove, inspect and install an alternator and starter per original equipment manufacturer (OEM) specification.

**Strand 5. Elements of Production**

Learners apply principles of practice related to the management and maintenance of food, agriculture and natural resources systems.

**Outcome: 5.1. Electrical Theory**

Interpret and apply electrical and electronic principles and theories.

**Competencies**

5.1.1. Read and interpret wiring diagrams and symbols.