# Small Engine Repair

## 8021 18 weeks

## 8082 36 weeks

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# Acknowledgments


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# Course Description

**Suggested Grade Level:** 9 or 10 or 11 or 12

This course offers an intensive study of the operation, maintenance, and repair of small gasoline engines. Instructional topics include principles of the operation of internal combustion engines, repair and service procedures, and disassembly, overhaul, and reassembly. Instruction includes the operation of two-stroke and four-stroke engines commonly found on lawn mowers, garden tractors, snow blowers, rotary tillers, chainsaws, and other equipment. Additionally, this course incorporates classroom and laboratory activities to emphasize leadership through opportunities in FFA and supervised agricultural experiences (SAEs).

*As noted in Superintendent's Memo #058-17 (2-28-2017), this Career and Technical Education (CTE) course must maintain a maximum pupil-to-teacher ratio of 20 students to one teacher, due to safety regulations. The 2016-2018 biennial budget waiver of the teacher-to-pupil ratio staffing requirement does not apply.*

# Task Essentials Table

| 8021 | 8082 | Tasks/Competencies |
|---|---|---|
| ⊕ | ⊕ | Identify the role of supervised agricultural experiences (SAEs) in agricultural education. |
| ⊕ | ⊕ | Participate in an SAE. |
| ⊕ | ⊕ | Identify the benefits and responsibilities of FFA membership. |
| ⊕ | ⊕ | Describe leadership characteristics and opportunities as they relate to agriculture and FFA. |
| ○ | ○ | Apply for an FFA degree and/or an agricultural proficiency award. |
| ⊕ | ⊕ | Demonstrate the use of personal protective equipment (PPE). |

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|---|---|---|
| ⊕ | ⊕ | Use safety shields and guards on all equipment. |
| ⊕ | ⊕ | Demonstrate safety practices for flammable materials. |
| ⊕ | ⊕ | Identify safety practices followed in the operation of small-engine equipment. |
| ⊕ | ⊕ | Identify marked safety zones and nonskid areas. |
| ⊕ | ⊕ | Identify the location and use of eye wash stations. |
| ⊕ | ⊕ | Identify the location of posted evacuation routes. |
| ⊕ | ⊕ | Demonstrate knowledge of Safety Data Sheets (SDS). |
| ⊕ | ⊕ | Demonstrate the precautions for the use of chemicals. |
| ⊕ | ⊕ | Demonstrate the use of standard and metric hand tools. |
| ⊕ | ⊕ | Demonstrate the use of power tools. |
| ⊕ | ⊕ | Demonstrate the use of standard and metric precision measuring tools. |
| ⊕ | ⊕ | Explain the use of fire protection equipment. |
| ⊕ | ⊕ | Demonstrate the use of specialty tools. |
| ⊕ | ⊕ | Follow federal, state, and local standards, regulations, and procedures. |
| ⊕ | ⊕ | Explain the operation of a four-stroke engine. |
| ⊕ | ⊕ | Explain the operation of a two-stroke engine. |
| ○ | ⊕ | Explain the interrelationship of parts during each stroke for an internal combustion engine. |
| ⊕ | ⊕ | Demonstrate torque technique for threaded fasteners. |
| ⊕ | ⊕ | Identify the basic hand tools and commonly used power tools in small engine repair. |
| ⊕ | ⊕ | Identify measuring and testing devices. |
| ⊕ | ⊕ | Demonstrate the use of measuring and testing devices. |
| ⊕ | ⊕ | Identify manufacturer, model number, serial number, specification number, and other unique equipment numbers. |
| ⊕ | ⊕ | Use service, repair, and operating manuals for equipment. |
| ⊕ | ⊕ | Locate replacement part numbers. |
| ⊕ | ⊕ | Identify the components of a manual starter. |

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|---|---|---|
| ○ | ○ | Repair a manual starter. |
| ⊕ | ⊕ | Identify the components of an electric starter. |
| ○ | ○ | Repair an electric starter. |
| ⊕ | ⊕ | Identify types of ignition systems used in small engines. |
| ⊕ | ⊕ | Identify parts used in repairing the ignition circuit. |
| ○ | ⊕ | Service ignition parts. |
| ⊕ | ⊕ | Describe the safety hazards associated with battery systems. |
| ○ | ⊕ | Evaluate system operation. |
| ○ | ⊕ | Install a battery. |
| ⊕ | ⊕ | Test a battery. |
| ⊕ | ⊕ | Explain the principles of a fuel delivery system. |
| ⊕ | ⊕ | Identify the types of fuel delivery systems, system components, and fuel types. |
| ○ | ⊕ | Evaluate and service the fuel system. |
| ⊕ | ⊕ | Identify types of carburetors and fuel injection systems. |
| ⊕ | ⊕ | Explain the operation of a carburetor and a fuel injection system. |
| ○ | ⊕ | Evaluate the operation of a carburetor. |
| ○ | ⊕ | Service a carburetor and/or fuel injection system. |
| ○ | ⊕ | Determine the replacement vs. repair of a carburetor and/or a fuel injection system. |
| ○ | ⊕ | Replace a carburetor. |
| ⊕ | ⊕ | Identify types of governors. |
| ⊕ | ⊕ | Explain the operation of a governor. |
| ○ | ⊕ | Evaluate operation of a governor. |
| ○ | ⊕ | Adjust the governor. |
| ⊕ | ⊕ | Describe the operation of intake and exhaust valves. |
| ⊕ | ⊕ | Describe the differences between the OVH and L-head valve design. |
| ⊕ | ⊕ | Evaluate valve clearance. |

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| ⊕ | ⊕ | Evaluate valves and accessories for defects. |
| ⊕ | ⊕ | Install valves and accessories. |
| ⊕ | ⊕ | Replace the cylinder head. |
| ⊕ | ⊕ | Identify types of valves. |
| ⊕ | ⊕ | Explain how valves work. |
| ○ | ○ | Evaluate the reed valve for proper operation. |
| ○ | ○ | Replace the reed valve assembly. |
| ⊕ | ⊕ | Remove internal engine parts. |
| ⊕ | ⊕ | Identify internal engine parts. |
| ⊕ | ⊕ | Explain how pistons and the compression system work. |
| ⊕ | ⊕ | Explain how various piston rings work. |
| ○ | ⊕ | Inspect the cylinders for wear. |
| ○ | ⊕ | Analyze the camshaft assembly for defects. |
| ○ | ⊕ | Evaluate a crankshaft. |
| ⊕ | ⊕ | Identify types of air filters. |
| ⊕ | ⊕ | Service air filters. |
| ⊕ | ⊕ | Select engine oil. |
| ○ | ⊕ | Change the engine oil. |
| ○ | ⊕ | Change the oil filter. |
| ⊕ | ⊕ | Inspect the breather. |
| ⊕ | ⊕ | Identify the components of a spark plug. |
| ⊕ | ⊕ | Evaluate the spark plug. |
| ⊕ | ⊕ | Set the spark plug electrode gap. |

Legend: ⊕Essential ○Non-essential ⊖Omitted

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**Note: Competencies 39-43 have been added to ensure compliance with federal legislation: National FFA Organization's Federal Charter Amendments Act (Public Law 116-7, https://www.congress.gov/116/plaws/publ7/PLAW-116publ7.pdf). All inquiries may be sent to**

**cte@doe.virginia.gov. Students are provided opportunities for leadership, personal growth, and career success. Instruction is delivered through three major components: classroom and laboratory instruction, supervised agricultural experience (SAE) program, and student leadership (FFA).**

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# Curriculum Framework

## Task Number 39

## Identify the role of supervised agricultural experiences (SAEs) in agricultural education.

### Definition

Identification should include

- defining an SAE program as *an opportunity for students to consider multiple careers and occupations in the agriculture, food, and natural resources (AFNR) industries, learn expected workplace behavior, develop specific skills within an industry, and apply academic and occupational skills in the workplace or a simulated workplace environment*
- researching the Foundational SAE
    - career exploration and planning
    - personal financial planning and management
    - workplace safety
    - employability skills for college and career readiness
    - agricultural literacy
- researching the Immersion SAE
    - entrepreneurship/ownership
    - placement/internships
    - research (experimental, analytical, invention)
    - school business enterprises
    - service learning
- developing a plan to participate in an SAE, based on personal and career goals
- researching available awards and degrees, based on SAE participation.

Teacher resource: SAE Resources, National Council for Agricultural Education

### Process/Skill Questions

- What are examples of SAEs related to this course and in the AFNR industries?
- Where can a copy of the Virginia SAE Record Book be found?
- What is an Immersion SAE?
- How does a placement/internship SAE differ from an ownership/entrepreneurship SAE?

- How does an SAE provide relevant work experience and contribute to the development of critical thinking skills?
- How is the SAE an extended individualized instructional component of a student's Career Plan of Study?
- How can an SAE be used to provide evidence of student growth and participation in authentic, work-related tasks?
- What are the four types of SAEs?
- What are the advantages of participating in work-based learning experiences and projects?
- How does one choose an appropriate SAE in which to participate?

## Task Number 40

## Participate in an SAE.

### Definition

Participation should include

- developing, completing, or continuing a plan to participate in an SAE as a work-based learning experience, based on personal and career goals
- documenting experience, connections, positions held, and competencies attained, using the *Virginia SAE Record Book*
- researching available awards and degrees, based on SAE participation.

Teacher resources:
FFA SAE
The Agricultural Experience Tracker

### Process/Skill Questions

- What are the advantages of participating in work-based learning experiences and projects?
- How do SAEs help prepare students for the workforce?
- What are some examples of SAEs in AFNR?

# Exploring Leadership Opportunities through FFA

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## Task Number 41

## Identify the benefits and responsibilities of FFA membership.

### Definition

Identification should include

- benefits
    - listing opportunities to participate in community improvement projects and career development events (CDEs) and leadership development events (LDEs)
    - exploring leadership development opportunities

- responsibilities
    - researching the responsibilities of FFA officers, committees, and members
    - locating resources that guide participation in FFA activities
    - explaining the FFA Creed, Motto, Salute, and mission statement
    - explaining the meaning of the FFA emblem, colors, and symbols
    - explaining significant events and the history of the organization.

### Process/Skill Questions

- How does one become an FFA member?
- What is the FFA's mission and how does it accomplish its mission?
- What are the benefits and responsibilities of FFA membership?
- What five FFA activities are available through the local chapter?
- What are some significant events in FFA history? How have these events shaped membership over time?
- What is the FFA program of activities (POA), and how is it used?

# Task Number 42

# Describe leadership characteristics and opportunities as they relate to agriculture and FFA.

### Definition

Description should include

- examples of successful leaders
- types of leadership
    - autocratic
    - participative
    - laissez-faire
    - servant
    - followership
- positive leadership qualities and traits of successful leaders
- opportunities for participating in leadership activities in FFA
- demonstrating methods for conducting an effective meeting.

### Process/Skill Questions

- Who are some successful leaders in the agriculture industry?
- What qualities make a successful leader?

- What are leadership traits?
- What is the difference between positive and negative leadership?

## Task Number 43

## Apply for an FFA degree and/or an agricultural proficiency award.

### Definition

Application should include

- identifying types of FFA degrees
    - Greenhand
    - Chapter
    - State
    - American
- identifying proficiency award areas
    - entrepreneurship
    - placement
    - combined
    - agriscience research
- exploring CDEs and LDEs related to this course
- identifying all SAE criteria to be eligible for the award
- identifying the type of award
- applying for an FFA award.

Teacher resource: FFA Agricultural Proficiency Awards

### Process/Skill Questions

- Where are the awards and their application criteria located?
- What are the benefits of winning an FFA award?
- What are the benefits and requirements of an FFA degree?
- What FFA awards are available?
- How does the FFA degree program reward FFA members in all phases of leadership, skills, and occupational development?
- What is the highest degree that can be conferred upon an FFA member at the national level?
- What are the requirements for a Greenhand FFA degree?

# Applying Safety Practices

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## Task Number 44

# Demonstrate the use of personal protective equipment (PPE).

### Definition

Demonstration should include the types of protective clothing and equipment to use (e.g., protection of the eyes, respiratory system, auditory functions, feet, hands, and body) and grooming/hygiene precautions (e.g., hair length, loose clothing, jewelry, greasy hands, close-toed shoes, or dirty/scratched eye protection). Demonstration also should include the use, hazards, and the precautions associated with each, in accordance with manufacturers' instructions and industry/government regulations concerning hazardous material and shop safety.

### Process/Skill Questions

- Why is it important to use the proper hand tool for each job?
- When using a wrench, why should the wrench be pulled toward the body?
- Why is it necessary to keep hand tools clean and free of grease?

# Task Number 45

# Use safety shields and guards on all equipment.

### Definition

Use should meet the equipment manufacturer's specifications.

### Process/Skill Questions

- What are the hazards of not using equipment guards?
- Why is it a requirement to keep guards in place on tools, equipment, and machinery? What are possible consequences of removing guards?
- When is it necessary to wear a safety face shield?
- What tool, equipment, or machinery requires the use of a safety face shield?

# Task Number 46

# Demonstrate safety practices for flammable materials.

### Definition

Demonstration should include storage of flammable materials (e.g., oil, gasoline, solvents) according to the manufacturer or the Occupational Safety and Health Administration (OSHA), local ordinances, safety data sheet (SDS) specifications, or all.

### Process/Skill Questions

- What are the OSHA requirements for storage of oil, gasoline, and other solvents?

- What are safety data sheets (SDS)?
- What are your school/fire marshal's guidelines for storing flammable liquids?
- What could happen if these materials are stored incorrectly?

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# Task Number 47

# Identify safety practices followed in the operation of small-engine equipment.

### Definition

Identification should include following all prestart and shutdown procedures according to manufacturer's specifications, using industry standards and instructor guidelines.

### Process/Skill Questions

- What general equipment safety rules must be followed in the agricultural mechanics laboratory?
- What are possible consequences when one does not follow the established safety practices?
- What role does communication play in practicing equipment safety in the agricultural mechanics laboratory?
- Who is required to follow safety practices and guidelines?

# Task Number 48

# Identify marked safety zones and nonskid areas.

### Definition

Identification should include describing and translating signage and special markings (e.g., floor paint) that identify work and caution areas.

### Process/Skill Questions

- What are the different types of work zones?
- How does one know whether additional safety equipment or clothing is needed to enter a safety area?
- How are walkways identified in the lab/workshop area?
- What color or color combination is recommended as the best color for safety zone marking?

# Task Number 49

# Identify the location and use of eye wash stations.

### Definition

Identification should include describing the signage and operating procedures for the station.

### Process/Skill Questions

- What color sign identifies an eye wash station?
- When should one use an eye wash station?
- What PPE provides additional eye protection?

# Task Number 50

# Identify the location of posted evacuation routes.

### Definition

Identification should include

- events that could trigger an evacuation
- the location and interpretation of the posted evacuation route
- the evacuation procedures and destination point.

### Process/Skill Questions

- What route should one follow in the event of an evacuation?
- Where is the evacuation route posted?
- Why is it important to establish a meeting place in the case of an evacuation?

# Task Number 51

# Demonstrate knowledge of Safety Data Sheets (SDS).

### Definition

Demonstration should include

- identifying the location of the sheets within the lab/workshop and the purpose they serve
- the administration's (ownership's) responsibility for workers' health and safety
- laws/regulations and practices affecting workers' health and safety
- health and safety hazards
- health and safety programs
- the responsibility for environmental stewardship
- environmental laws, regulations, and practices
- sustainability initiatives.

### Process/Skill Questions

- What environmental concerns should an industry address?
- What environmentally friendly practices and resources are available to an industry?
- What methods can be used to motivate employees to become involved in effective health, safety, and environmental practices?
- What are the three Rs of waste hierarchy and conservation of resources?

# Task Number 52

# Demonstrate the precautions for the use of chemicals.

### Definition

Demonstration should include the use of solvents, soaps, cleaning solutions, fuel, lubricants, specialty additives, and gases. Demonstration should also emphasize the use, hazards, and precautions associated with each, in accordance with manufacturers' instructions and industry/government regulations.

### Process/Skill Questions

- Why is it important to read the manufacturer's directions before using chemicals?
- What are possible consequences of the misuse of chemicals?
- Where should chemicals be stored in the lab/workshop?
- What is an SDS?

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# Task Number 53

# Demonstrate the use of standard and metric hand tools.

### Definition

Demonstration should include the hand tools (including specialty tools, fasteners, and measuring tools) used in the small-engine field. Demonstration should also emphasize the use, hazards, precautions, and maintenance procedures associated with each, in accordance with the manufacturers' instructions and industry/government regulations. Hand tools could include but are not limited to

- common end wrenches
- various socket set components
- various wrenches
- various screwdrivers
- various styles of pliers
- various hammers
- various punches and chisels
- specialty cutting tools (e.g., hacksaw, tubing cutter, hand reamer, file)
- specialty electrical system tools (e.g., volt/ohmmeter, dwell/tachometer, continuity light, timing light, remote starter switch)
- battery specialty tools (e.g., cable puller, terminal and post cleaner, battery lifting or carrying strap)

- lubrication specialty tools (e.g., transmission funnel, oil-filter-removing tool, grease gun)
- other miscellaneous specialty tools (e.g., air nozzles, C-clamp, puller set, pressure gauge, screw extractor).

### Process/Skill Questions

- Why is it important to use the proper hand tool for each job?
- When a wrench is used, why should it always be pulled toward the body?
- Why is it necessary to keep hand tools clean and free of grease?

# Task Number 54

# Demonstrate the use of power tools.

### Definition

Demonstration could include, but not be limited to, power tools (including pneumatic and electric tools) encountered in the small-engine-technology field. Demonstration should also emphasize the use, hazards, precautions, and maintenance procedures associated with each, in accordance with the manufacturers' instructions and industry/government regulations. Power tools could include, but are not limited to

- air impact gun
- air hammer
- air ratchet
- air drill
- electric drill
- electric grinder
- manual lifts.

### Process/Skill Questions

- What is the purpose of a dead-man switch on power tools?
- When should adjustments be made to power tools?
- Why is training on the use of a power tool necessary before using it?

# Task Number 55

# Demonstrate the use of standard and metric precision measuring tools.

### Definition

Demonstration should include micrometers, dial indicators, torque wrenches, and other manufacturers' specialty tools.

### Process/Skill Questions

- How does heat affect a micrometer?
- Why are standard and quality tools necessary when repairing small engines?
- What is torque, and why is proper torque important?

# Task Number 56

# Explain the use of fire protection equipment.

### Definition

Explanation should include

- types of fires encountered in the small-engine-technology field (Class A, B, C, and D)
- appropriate types of extinguishers to use with each fire hazard and the precautions associated with each
- fire emergency procedures that follow industry/government regulations and the instructor's guidelines.

### Process/Skill Questions

- What are the types of fire extinguishers?
- What types of fires is the fire extinguisher in your lab/workshop appropriate for? Explain.
- What procedure should students follow in case of an emergency or accident?

# Task Number 57

# Demonstrate the use of specialty tools.

### Definition

Demonstration should include using the equipment associated with the small-engine-repair-technology field, following industry-accepted procedures and using all precautions in accordance with the manufacturer's instructions and instructor guidelines.

### Process/Skill Questions

- What are unsafe uses of air compressors in the small-engine lab/workshop?
- What is the safest way to hold a part in a vise?
- When is the cleaning tank used?

# Task Number 58

# Follow federal, state, and local standards, regulations, and procedures.

### Definition

Following all safety standards, regulations, and procedures may include the following federal, state, and local agencies

- U.S. Environmental Protection Agency (EPA)
- Occupational Safety and Health Administration (OSHA)
- Equipment and Engine Training Council (EETC)
- Education Committee Safety Data Sheets (SDS).

**Process/Skill Questions**

- What procedure should students follow in case of an emergency or accident?
- What is the importance of following agency guidelines?
- Where do you find these guidelines?

# Describing the Operation of an Internal Combustion Engine

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## Task Number 59

## Explain the operation of a four-stroke engine.

**Definition**

Explanation should include the function and movement of parts during each engine event (intake, compression, ignition, power, exhaust).

**Process/Skill Questions**

- What is the difference between a two-stroke and four-stroke engine?
- What role does the induction/intake stroke serve in the operation of a four-stroke engine?
- What role does the compression stroke serve in the operation of a four-stroke engine?

## Task Number 60

## Explain the operation of a two-stroke engine.

**Definition**

Explanation should include the function and movement of parts during each engine event (intake and compression, ignition, power and exhaust).

**Process/Skill Questions**

- What principles of physics are involved in directing the air/fuel/oil mixture through the engine?
- What parts are included in the two-stroke but not the four-stroke engine to ensure the engine functions properly? What function do these parts serve?
- What four-stroke engine parts are unnecessary in a two-stroke engine? Explain.

## Task Number 61

## Explain the interrelationship of parts during each stroke for an internal combustion engine.

### Definition

Explanation should include description of the function, rotation, and position of internal and external parts of a two- and four-stroke engine.

### Process/Skill Questions

- What internal parts are being used in each stroke?
- What position are these parts in?
- What will happen if a part is not in its correct position?

# Selecting and Using Tools

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## Task Number 62

## Demonstrate torque technique for threaded fasteners.

### Definition

Demonstration should include selecting the torque tool for the application, differentiating between foot/pounds, inch/pounds, and newton meters (N/M), and applying torque in accordance with manufacturers' instructions/specifications and industry/government regulations.

### Process/Skill Questions

- How does one determine the torque for a fastener?
- How does one describe the differences among torques for different engine parts and/or systems?

## Task Number 63

# Identify the basic hand tools and commonly used power tools in small engine repair.

### Definition

Identification could include, but is not limited to, basic small-engine mechanics' hand tools, to include the following: belt, cable, carburetor, flywheel, main bearing, measurement, piston, spark plug, starter, cam bearing, crankshaft, valves (grinder, reamer, refacer, seat cutter, spring compressor, etc.), and power tools (e.g., pneumatic wrench, drill press).

### Process/Skill Questions

- What are some identifying characteristics among various sockets?
- How do we identify "combination" tools (e.g., those with differing bits incorporated into handles)?

# Task Number 64

# Identify measuring and testing devices.

### Definition

Identification could include, but is not limited to

- ignition testers
- compression testers
- precision measuring tools (e.g., feeler gauge, micrometer, dial caliper)
- telescoping gauges
- pressure/vacuum testers
- leak-down testers.

### Process/Skill Questions

- Why are accurate measurements of small-engine components critical in the repair of small engines?
- What are some sources of information for measuring small-engine components?

# Task Number 65

# Demonstrate the use of measuring and testing devices.

### Definition

Demonstration could include, but is not limited to, the selection and use of various testers (e.g., compression tester, ignition tester, leak-down tester).

### Process/Skill Questions

- What is the correct procedure for ignition or compression testing?
- How does one differentiate between a “good” or “bad” ignition or compression test?

# Selecting Repair Parts

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## Task Number 66

## Identify manufacturer, model number, serial number, specification number, and other unique equipment numbers.

### Definition

Identification should include locating the number(s) on equipment and recording the number(s).

### Process/Skill Questions

- Where are the model and the serial numbers on an overhead valve (OHV) engine located?
- Where are the model, type, and code number located on an L-head engine?
- Why are all of the numbers needed, when ordering replacement parts?

## Task Number 67

## Use service, repair, and operating manuals for equipment.

### Definition

Use should include

- electronic or printed materials for equipment
- identifying model, serial, specification, and other unique numbers
- locating service and maintenance specifications.

### Process/Skill Questions

- What types of information about an engine can be found in the repair and operating manuals?
- What manual is used to locate information regarding engine operating procedures/guidelines?
- Where can one purchase repair and operator manuals for a specific engine?

## Task Number 68

## Locate replacement part numbers.

### Definition

Locating should include identifying the replacement part from a schematic or illustrated parts list and recording the number.

### Process/Skill Questions

- Where can one locate an illustrated parts list?
- What information would one need when looking up an illustrated parts list?
- What is the difference between the reference number and the part number in an illustrated parts list?

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# Repairing Manual Starters

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## Task Number 69

## Identify the components of a manual starter.

### Definition

Identification should include

- starter grip
- starter rope
- rewind spring
- rewind housing
- starter pawls with springs
- starter clutch
- pulley.

### Process/Skill Questions

- What is the function of a starter and its parts?
- What would happen if the starter grip broke free from the starter rope?
- How does a manual starter move engine components?

## Task Number 70

## Repair a manual starter.

### Definition

Repair should include

- accessing starter parts
- evaluating missing/broken parts
- distinguishing a worn assembly from a repairable assembly
- replacing or repairing an assembly
- reassembling the starter

and be made in accordance with the manufacturer's specifications and repair procedures, using industry standards and instructor guidelines.

### Process/Skill Questions

- Where is a manual starter located on a small engine?
- When does a manual starter need repair or replacement?
- What are some common causes of a pull rope not returning to its original position?
- How is a manual starter assembled?

# Identifying Electric Starters

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## Task Number 71

## Identify the components of an electric starter.

### Definition

Identification should include

- starter motor
- AC plug
- solenoid
- wiring harness
- key switch
- battery

### Process/Skill Questions

- What components must be present for an electric starter to function?
- How does an electric starter move engine components?

## Task Number 72

## Repair an electric starter.

### Definition

Repair should include

- accessing solenoid and starter parts
- evaluating missing/broken parts
- distinguishing a worn assembly from a repairable assembly
- replacing or repairing assembly
- reassembling components

and be made in accordance with the manufacturer's specifications and repair procedures, using industry standards and instructor guidelines.

### Process/Skill Questions

- What parts are most likely to wear or break on an electric starter assembly?
- How can one distinguish worn and/or broken parts from parts that are functioning properly?
- Where would the diagnosis begin on an electric starter system, if the engine would not start, when the key was turned?
- Why is it important to repair the electric starter system in accordance with manufacturer's specifications?

# Repairing Ignition Systems

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## Task Number 73

## Identify types of ignition systems used in small engines.

### Definition

Identification could include, but is not limited to

- electronic ignition system
- magneto ignition system
- electronic ignition system
- capacitor-discharge ignitions (CDI)
- transistor-controlled ignitions (TCI)
- mechanical-breaker ignitions
- compression systems (diesel)
- battery ignition system.

### Process/Skill Questions

- How does one identify an engine's ignition system?

- In what ways are the operations of each ignition system different? In what ways are they similar?
- How do each of the different ignition systems generate electricity for fuel/air ignition?
- What are some scientific principles that relate to fuel/air ignition?

# Task Number 74

# Identify parts used in repairing the ignition circuit.

### Definition

Identification should include the following:

**Newer models:**

- spark plug
- spark plug wire (high-tension lead)
- flywheel magnets
- flywheel key (shear key)
- primary and secondary circuits
- coil and armature

**Older models:**

- condenser
- breaker arm
- breaker spring
- post
- plunger
- points
- points cover
- flywheel magnets
- flywheel key (shear key)

### Process/Skill Questions

- What is the function of each part of the ignition circuit?
- How does the movement of electrons through the ignition circuit generate ignition of the fuel/air mixture?

# Task Number 75

# Service ignition parts.

### Definition

Service should include

- evaluating
- adjusting
- repairing or replacing

and be done in accordance with the manufacturer's specifications and servicing procedures, using industry standards and instructor guidelines.

### Process/Skill Questions

- What are some requirements for replacing defective parts?
- What tests are available to determine whether the repair is successful?

# Evaluating Battery Systems

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## Task Number 76

## Describe the safety hazards associated with battery systems.

### Definition

Description could include

- identifying the types of batteries
- identifying types of health hazards
    - acute toxicity (inhalation)
    - skin corrosion/irritation
    - serious eye damage/eye irritation
    - carcinogenicity
    - germ cell mutagenicity
    - specific target organ toxicity
- explaining the hazards of explosive gases.

### Process/Skill Questions

- What should the voltage read on a good battery?
- What tools are used to test a battery for charge?
- What is the difference between measuring open-cell voltage and the voltage of a battery under load?

## Task Number 77

## Evaluate system operation.

### Definition

Evaluation should include

- ensuring battery cables are connected
- checking for damaged cables and corrosion
- checking voltage
- checking battery fluid level
- checking for case damage
- cleaning battery terminals.

### Process/Skill Questions

- Why is it important to have the correct battery fluid level?
- Why is it important to check battery cables for a loose connection?
- What is the specific gravity reading for a fully charged battery?
- What is the procedure for cleaning battery terminals?

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# Task Number 78

# Install a battery.

### Definition

Installation should include

- determining battery dimensions
- determining replacement requirements (e.g., deep-cycle, cranking amps, cold cranking amps, reserve amps voltage)
- identifying the post position
- identifying the polarity
- securing the battery to hold-down retainer
- attaching the battery cables
- confirming operation.

### Process/Skill Questions

- What color is the positive battery cable?
- What happens if the battery cable leads are reversed when connected?
- Why is the negative battery cable connected last?

# Task Number 79

# Test a battery.

### Definition

Test should include

- checking case for damage or leaks
- using proper testing equipment
- using a hydrometer/measuring specific gravity
- using a load tester/measuring voltage and under load

according to industry safety regulations, manufacturer's specifications, and instructor guidelines.

**Process/Skill Questions**

- What diagnostic tools should be used to test a battery?
- What safety precautions should be taken when testing/charging a battery?
- How does a battery lose its charge?
- What is the function of the alternator?

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# Examining Functions and Types of Fuel Systems

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## Task Number 80

## Explain the principles of a fuel delivery system.

**Definition**

Explanation should include the theory and method of delivery (e.g., gravity, pressurized, vacuum).

**Process/Skill Questions**

- What principles of physics explain the processes used in fuel delivery systems?
- What is fuel pressure? How is fuel pressure regulated?
- How does the fuel pump work?

## Task Number 81

## Identify the types of fuel delivery systems, system components, and fuel types.

**Definition**

Identification should include

- types of fuel systems
    - carburetion
        - natural draft
        - updraft
        - downdraft
    - fuel injection systems
        - electronic
        - mechanical
        - throttle-body injection (TBI)
        - central fuel injection (CFI)
        - port injection
        - sequential fuel injection
        - multiport fuel injection (MFI)
        - central multiport fuel injection (CMFI)
- fuel delivery system components
    - fuel storage tank and cap
    - fuel pump
    - pressure regulator
    - fuel injectors
    - fuel filters
    - fuel strainers
    - fuel lines
    - hoses
    - fuel shut-off valve
    - fuel manifolds
- types of fuels
- grades of fuels
- alternative fuels (e.g., ethanol, biodiesel, propane, natural gas)
- vapor collection system.

### Process/Skill Questions

- What are the most commonly used fuels in small engines?
- What has influenced fuel usage the most, historically: technology, economics, or politics?
- What are the functions of the individual components of a fuel delivery system?
- How do these components work together to filter and deliver fuel?
- What path does the fuel follow from the tank to the engine through each of these components?

# Task Number 82

# Evaluate and service the fuel system.

### Definition

Evaluation should include examination of all components for physical and/or chemical damage, and servicing in accordance with manufacturer's specifications, current industry standards, safety precautions and procedures, and instructor guidelines.

### Process/Skill Questions

- What are the signs or indicators of physical and/or chemical damage to fuel system components?
- When would one clean/service a component vs. replacing it?

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# Repairing Carburetors and/or Fuel Injection Systems

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## Task Number 83

## Identify types of carburetors and fuel injection systems.

### Definition

Identification could include

- tank-mounted
- cylinder-mounted (i.e., two-stroke)
- gravity-feed systems (i.e., float bowl)
- fuel injection systems.

### Process/Skill Questions

- What is the purpose of a carburetor?
- What is the Venturi effect? How is this related to carburetor performance?
- Does the type of carburetor used affect the performance of the engine? Why or why not?
- What are the steps for properly identifying a carburetor?

## Task Number 84

## Explain the operation of a carburetor and a fuel injection system.

### Definition

Explanation should include an examination of accessible parts to explain and demonstrate how each fuel delivery system functions, the differences between the fuel systems, and how each system's components function (e.g., fuel tank, fuel filter, fuel lines, fuel pump, carburetor, injectors, etc.).

### Process/Skill Questions

- What is the difference between a carburetor and a fuel-injected system?
- Where is the fuel-air mixture created in carburetor? How does the carburetor work in the fuel system?
- How do the fuel injectors work?
- Which system is more efficient? Explain.
- What are the symptoms of a bad fuel injector?
- What are the different types of fuel injection systems?
- How are electronic fuel injection (EFI) engines more efficient? Explain.

# Task Number 85

# Evaluate the operation of a carburetor.

### Definition

Evaluation should include examination of the carburetor for function and damage, according to manufacturer's specifications, current industry standards and instructor guidelines.

### Process/Skill Questions

- What is the difference between the high- and low-idle circuits?
- What is the difference between an adjustable carburetor and a fixed-jet carburetor?
- How does fuel quality affect the performance of the carburetor?
- What alternative fuels are available for use in small engines? Which engines would they be used in?

# Task Number 86

# Service a carburetor and/or fuel injection system.

### Definition

Service should include

- examination
- adjustment (if applicable)
- cleaning
- replacement of parts

and be done in accordance with the manufacturer's specifications and servicing procedures, using industry standards and instructor guidelines.

### Process/Skill Questions

- What are some visual or operational signs exhibited by a carburetor that would require it to be serviced?
- What are some considerations to keep in mind, before servicing the carburetor or fuel injection system?
- Why would a technician remove the carburetor from the engine to service it?
- Why are extra components placed in carburetor rebuild kits, which may not be needed, for a carburetor in need of repair?

## Task Number 87

## Determine the replacement vs. repair of a carburetor and/or a fuel injection system.

### Definition

Determination regarding replacement vs. repair should be based on the most cost-efficient solution (e.g., budget, time, and the extent of damage to the carburetor and/or fuel injection system) and be done in accordance with the manufacturer's specifications, using industry standards and instructor guidelines.

### Process/Skill Questions

- What should be done with old carburetors no longer fit for use?
- How does one determine cost effectiveness of repair vs. replacement?

## Task Number 88

## Replace a carburetor.

### Definition

Replace a carburetor in accordance with manufacturer's specifications, using industry standards and instructor guidelines.

### Process/Skill Questions

- What factors would warrant carburetor replacement?
- What is the process for replacing a carburetor?

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# Repairing Governors

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## Task Number 89

# Identify types of governors.

### Definition

Identification could include

- pneumatic (air vane).
- mechanical (centrifugal)
- electronic.

### Process/Skill Questions

- What is the purpose of a governor?
- What are the different types of governors?
- How do governors operate?
- What correlation, if any, is there between engine size and the type of governor? Why?
- What principles of physics are being used?
- How do the components of the governor work together? What is the purpose of the governor?

# Task Number 90

# Explain the operation of a governor.

### Definition

Explanation should include how the governor system maintains engine speed.

### Process/Skill Questions

- How does the governor respond, if the engine does not maintain consistent speed? Does it open or close the throttle? Why?
- What could be wrong with the engine if the governor is attempting to open or close the throttle, yet the engine is not maintaining consistent speed? How does one determine consistent speed?

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# Task Number 91

# Evaluate operation of a governor.

### Definition

Evaluate the operation of a governor based on its stability (e.g., ability to maintain a desired engine speed without fluctuation) and sensitivity (e.g., percent of speed change required to produce corrective action on the throttle).

### Process/Skill Questions

- What happens as the load on the engine increases?
- When the centrifugal force on the flyweight decreases, what happens to the governor control spring and how does this affect engine performance?

## Task Number 92

## Adjust the governor.

### Definition

Adjustment should be made in accordance with manufacturer's specifications and adjustment procedures, using industry standards and instructor guidelines.

### Process/Skill Questions

- What part of the carburetor does the governor control?
- What adjustments does the manufacturer specify?
- What tools are needed to adjust the governor?

# Servicing Valves on Four-Stroke Engines

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## Task Number 93

## Describe the operation of intake and exhaust valves.

### Definition

Description should include

- identifying the type of valve (intake vs. exhaust)
- identifying parts of a valve train
- explaining the operation of valves and valve parts
- explaining the importance of timing to valves.

### Process/Skill Questions

- What is the function of the intake valve?
- What is the function of the exhaust valve?
- What are the parts of the valves, and how do they relate to the overall operation of the engine?
- When are the intake valves and the exhaust valves both closed? When are they open?

# Task Number 94

# Describe the differences between the OVH and L-head valve design.

### Definition

Description should include differences in

- parts
- function
- efficiencies between the two
- adjustments.

### Process/Skill Questions

- What is the difference between OVH valve design and L-head?
- Why is the overhead more efficient?
- What are the differences in the adjustments?

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# Task Number 95

# Evaluate valve clearance.

### Definition

Evaluation should include

- measurement and/or adjustment of clearance using feeler gauges, according to manufacturer's specifications
- valve guide clearance.

### Process/Skill Questions

- Where would one look in the manual to determine the valve clearance?
- Why is it important to evaluate the clearance?
- What would happen if one does not ensure the proper clearance?

# Task Number 96

# Evaluate valves and accessories for defects.

### Definition

Evaluation should include

- removal of engine components (e.g., valve cover, gaskets, cylinder head) to access the valves
- examination for damage, foreign material, burrs, and/or wear.

### Process/Skill Questions

- What are the parts of the valve?
- What are the valves exposed to during engine operation?
- What are some common causes that contribute to valves malfunctioning?
- What are the differences between the intake and exhaust valves?

# Task Number 97

# Install valves and accessories.

### Definition

Installation should include use of a valve spring compressor and other tools (e.g., feeler gauge, torque wrench, torx bits) to insert valves and accessories in accordance with manufacturer's specifications and installation procedures, using industry standards and instructor guidelines.

### Process/Skill Questions

- How would you look up the replacement part number for valves?
- What manufacturer's specifications must one follow to install valves properly?
- What manufacturer's specifications must one follow to install valve seats properly?
- What tools are required to install valves properly?

# Task Number 98

# Replace the cylinder head.

### Definition

Replacement should include the following process:

- Evaluate the condition of head gasket and combustion chamber
- Replace the cylinder head gasket
- Install the cylinder head and/or components according to manufacturer's specifications (torque and bolt pattern).

### Process/Skill Questions

- What are the manufacturer's specifications for replacing the cylinder head?
- What bolt pattern and torque specifications are required for bolt installation? Where would one find or reference this information?
- What procedures should be followed before the installation of the cylinder head?
- What is the correct torque one should apply to bolts?

# Repairing Valves on Two-Stroke Engines

## Task Number 99

## Identify types of valves.

### Definition

Identification should include

- reed valves
- rotary valves.

### Process/Skill Questions

- What type of valve would one find on a two-stroke motorcycle engine?
- What type of valve would one find on a two-stroke string trimmer?
- What is a reed valve? How does it work?
- What is a rotary valve? How does it work?

## Task Number 100

## Explain how valves work.

### Definition

Explanation should include the

- function and operation of the reed valve
- function and operation of the rotary valve
- advantages and disadvantages of each.

### Process/Skill Questions

- What two things must a valve do for a two-stroke engine to function properly?
- Why must a valve seal be airtight?

## Task Number 101

## Evaluate the reed valve for proper operation.

### Definition

Evaluation should meet the minimum requirements based on manufacturer’s specifications, using current industry standards and instructor guidelines.

### Process/Skill Questions

- What would one look for to determine whether a reed valve was in good working order?
- How can one tell whether a valve is malfunctioning while the engine is running?
- What effect will a bad valve have on compression?

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## Task Number 102

## Replace the reed valve assembly.

### Definition

Replacement should follow the manufacturer’s specifications, replacement procedures, industry standards, and instructor guidelines.

### Process/Skill Questions

- Why are reed valve assemblies reassembled to manufacturer's specifications?
- What does “per or in accordance with manufacturer's specifications” mean?

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# Remove Internal Engine Parts

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## Task Number 103

## Remove internal engine parts.

### Definition

Removal could include, but is not limited to, the removal of

- pistons
- rings
- piston connecting rod
- bearing
- piston pin
- retaining ring
- camshaft assembly
- crankshaft
- oil slinger/dipper.

Removal should be completed in accordance with the manufacturer's specifications and removal procedures, using current industry standards and instructor guidelines.

### Process/Skill Questions

- What parts need to be removed before removing the piston rod and assembly?
- What tools are necessary to remove the piston rod and assembly?
- Why is it important to follow the manufacturer's directions and specifications for removal of parts from the engine?
- What strategies may be effective in disassembling the piston and rod assembly?
- What tools are required to accomplish this disassembly?
- What are the implications of improper disassembly of the piston and rod assembly?
- Why is it important to rotate the camshaft to the proper position in order to remove it?
- Why are some camshafts made of plastic?

# Task Number 104

# Identify internal engine parts.

### Definition

Identification should include

- pistons
- rings
- piston connecting rod
- bearing
- piston pin
- retaining ring
- camshaft assembly
- crankshaft
- oil slinger/dipper.

### Process/Skill Questions

- What are the manufacturer's specifications for cleaning or replacing the piston rings and piston?
- What are the implications of not having a clean piston and rings?
- What conflicts might one encounter when inspecting the piston rod and bearings?

- What causes wear on the piston rod and bearings?
- What tools are necessary for the installation of the piston and rod assembly?
- What direction should the piston be installed into the cylinder?
- What consequences may result if a person does not follow the manufacturer's directions and specifications when reinstalling the piston?
- What is the manufacturer's recommendation for torque on the rod cap bolts?
- What are the timing marks? How should they be positioned? If the timing marks are one or two teeth off in any direction, how will this affect the valve timing and engine performance?
- What is the procedure for installing a crankshaft?
- Where are the timing marks located?
- Which end of the crankshaft should be installed first?
- What happens if the timing marks are improperly aligned?

# Task Number 105

# Explain how pistons and the compression system work.

### Definition

Explanation should include how the piston and piston rings seal to create compression in the cylinder bore (combustion chamber) to make the air/gas mixture more combustible.

### Process/Skill Questions

- What is the job of the piston?
- What are the parts of the engine that help the piston do its job?
- What are the four strokes that the piston must go through for the engine to function properly?

# Task Number 106

# Explain how various piston rings work.

### Definition

Explanation should include

- the function of oil rings
- the function of the compression rings
- the function of the Napier/scraper/wiper ring.

### Process/Skill Questions

- What are the different roles of the piston rings?
- What are the implications if these rings break?
- How should the piston rings be installed?
- What is the ultimate job of the piston rings?
- How do the rings control blow-by?

# Task Number 107

# Inspect the cylinders for wear.

### Definition

Inspection should include measurement for roundness, taper, and signs of damage.

### Process/Skill Questions

- What are signs of wear on a cylinder?
- What could cause excessive wear on the cylinder?
- What other parts of the engine should one check for performance if one finds wear on the cylinder?

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# Task Number 108

# Analyze the camshaft assembly for defects.

### Definition

Analysis should include

- visual inspection of camshaft parts
- measurement of cam lobes and bearings for unacceptable wear.

### Process/Skill Questions

- What are the reject sizes for the lobes and bearings?
- How will lobe wear detected during visual/physical inspection affect the engine's performance?
- How will lobe wear affect the life of the engine?

# Task Number 109

# Evaluate a crankshaft.

### Definition

Evaluation could include, but is not limited to, visual inspection, free movement of the crankshaft, and ensuring that journal measurements are within manufacturer’s tolerances (reject size).

### Process/Skill Questions

- Where are the specifications for the crankshaft found?
- What would determine whether a crankshaft would need to be replaced?

- Why would one check for end play when replacing a crankshaft?
- What is the correct tool for measuring the journals on a crankshaft?

# Servicing Air Filters

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## Task Number 110

## Identify types of air filters.

### Definition

Identification could include

- foam air filter
- dry-element air filter
- prefilter
- dual element air filter.

### Process/Skill Questions

- Why do some engines have precleaners while others do not?
- Why do some snow blowers have no prefilter or air filter element?
- What is the procedure for servicing a foam air filter element?
- When should the foam air filter element be replaced?

## Task Number 111

## Service air filters.

### Definition

Service could include, but not be limited to

- inspecting for contamination
- inspecting for damage
- removing loose dirt and debris
- replacing or reusing, as necessary.

Service should be completed in accordance with the manufacturer’s specifications and servicing procedures, current industry standards, and instructor guidelines.

### Process/Skill Questions

- When should a dry-element air filter be replaced?
- What is the procedure for servicing a dry-element air filter?
- Why should compressed air not be used to clean an air filter?

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# Servicing the Lubrication System

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## Task Number 112

## Select engine oil.

### Definition

Selection should include the correct viscosity and following manufacturer's specifications.

### Process/Skill Questions

- What do the ratings and grade numbers for engine oil represent?
- What complications, if any, could be experienced when using an oil that is different from the recommended grade?

## Task Number 113

## Change the engine oil.

### Definition

Change should be performed in accordance with procedures outlined in the owner's or service manual and following instructor guidelines.

### Process/Skill Questions

- What precautions should be in place to handle the used engine oil, filter, rags, and other items upon completing the oil change?
- What advantages or disadvantages do synthetic oils have in comparison to the standard oils?

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## Task Number 114

## Change the oil filter.

### Definition

Change should be performed in accordance with procedures outlined in the owner's or service manual and following instructor guidelines.

### Process/Skill Questions

- How should the new filter be prepared before installation?
- What is the procedure for installing a new oil filter?

## Task Number 115

## Inspect the breather.

### Definition

Inspection should include determining the physical or operational capacity, referring to the service manual for operation, and following instructor guidelines.

### Process/Skill Questions

- What is the purpose of the breather?
- How does the operation of the breather affect the performance of other engine components?

# Servicing Spark Plugs

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## Task Number 116

## Identify the components of a spark plug.

### Definition

Identification should include

- terminal
- ground electrode
- center electrode
- insulator
- thread diameter
- reach

- seat
- hex body
- gasket/tapered seat
- knurled surface shell.

### Process/Skill Questions

- Why are all of these parts necessary for a spark plug to function?
- What is the purpose of a gasket or tapered seat on a spark plug?
- Why is thread diameter important when installing/replacing a spark plug?
- How is a spark plug's heat range, identified?
- What are the differences between a resistor and nonresistor plug?

# Task Number 117

# Evaluate the spark plug.

### Definition

Evaluation should include removing the spark plug from the engine and visually inspecting the threads, insulator, and electrode for wear and/or damage.

### Process/Skill Questions

- What tool is used to remove a spark plug?
- What should one look for during a visual inspection of a spark plug?
- How can one determine whether a spark plug should be replaced?

# Task Number 118

# Set the spark plug electrode gap.

### Definition

Setting should include

- examining the gap
- measuring the gap
- adjusting the gap between the center and ground electrodes.

### Process/Skill Questions

- What tool should be used to check the gap on a spark plug?
- Why is the manufacturer-recommended gap important for an engine's performance?
- What are the consequences of using a spark plug with the wrong heat range?

# SOL Correlation by Task

| | | |
|---|---|---|
| 39 | Identify the role of supervised agricultural experiences (SAEs) in agricultural education. | English: 9.3, 9.5, 10.3, 10.5, 11.3, 11.5, 12.3, 12.5 |
| 40 | Participate in an SAE. | English: 9.5, 9.8, 10.5, 10.8, 11.5, 11.8, 12.5, 12.8 |
| 41 | Identify the benefits and responsibilities of FFA membership. | English: 9.5, 9.6, 9.7, 9.8, 10.5, 10.6, 10.7, 10.8, 11.5, 11.6, 11.7, 11.8, 12.5, 12.6, 12.7, 12.8 |
| 42 | Describe leadership characteristics and opportunities as they relate to agriculture and FFA. | English: 9.5, 10.5, 11.5, 12.5<br><br>History and Social Science: VUS.8, VUS.9, VUS.10, VUS.11, WHII.8, WHII.10, WHII.11 |
| 43 | Apply for an FFA degree and/or an agricultural proficiency award. | English: 9.5, 10.5, 11.5, 12.5 |
| 44 | Demonstrate the use of personal protective equipment (PPE). | English: 9.5, 10.5, 11.5, 12.5<br><br>Science: CH.1 |
| 45 | Use safety shields and guards on all equipment. | English: 9.5, 10.5, 11.5, 12.5 |
| 46 | Demonstrate safety practices for flammable materials. | English: 9.5, 10.5, 11.5, 12.5<br><br>History and Social Science: GOVT.15 |
| 47 | Identify safety practices followed in the operation of small-engine equipment. | English: 9.5, 10.5, 11.5, 12.5 |
| 48 | Identify marked safety zones and nonskid areas. | English: 9.5, 10.5, 11.5, 12.5 |
| 49 | Identify the location and use of eye wash stations. | English: 9.5, 10.5, 11.5, 12.5<br><br>Science: CH.1 |
| 50 | Identify the location of posted evacuation routes. | English: 9.5, 10.5, 11.5, 12.5 |
| 51 | Demonstrate knowledge of Safety Data Sheets (SDS). | English: 9.5, 10.5, 11.5, 12.5<br><br>History and Social Science: GOVT.15<br><br>Science: CH.1 |
| 52 | Demonstrate the precautions for the use of chemicals. | |
| 53 | Demonstrate the use of standard and metric hand tools. | English: 9.5, 10.5, 11.5, 12.5 |
| 54 | Demonstrate the use of power tools. | English: 9.5, 10.5, 11.5, 12.5 |
| 55 | Demonstrate the use of standard and metric precision measuring tools. | English: 9.5, 10.5, 11.5, 12.5 |
| 56 | Explain the use of fire protection equipment. | English: 9.5, 10.5, 11.5, 12.5 |
| 57 | Demonstrate the use of specialty tools. | English: 9.5, 10.5, 11.5, 12.5 |
| 58 | Follow federal, state, and local standards, regulations, and procedures. | English: 9.5, 9.8, 10.5, 10.8, 11.5, 11.8, 12.5, 12.8<br><br>History and Social Science: GOVT.15 |
| 59 | Explain the operation of a four-stroke engine. | English: 9.5, 10.5, 11.5, 12.5 |

| | | |
|---|---|---|
| | | Science: PH.5, PH.6, PH.7 |
| 60 | Explain the operation of a two-stroke engine. | English: 9.5, 10.5, 11.5, 12.5<br><br>Science: PH.5, PH.6, PH.7 |
| 61 | Explain the interrelationship of parts during each stroke for an internal combustion engine. | English: 9.5, 10.5, 11.5, 12.5<br><br>Science: PH.5, PH.6 |
| 62 | Demonstrate torque technique for threaded fasteners. | English: 9.5, 10.5, 11.5, 12.5 |
| 63 | Identify the basic hand tools and commonly used power tools in small engine repair. | English: 9.5, 10.5, 11.5, 12.5 |
| 64 | Identify measuring and testing devices. | English: 9.5, 10.5, 11.5, 12.5 |
| 65 | Demonstrate the use of measuring and testing devices. | English: 9.5, 10.5, 11.5, 12.5 |
| 66 | Identify manufacturer, model number, serial number, specification number, and other unique equipment numbers. | English: 9.5, 10.5, 11.5, 12.5 |
| 67 | Use service, repair, and operating manuals for equipment. | English: 9.5, 10.5, 11.5, 12.5 |
| 68 | Locate replacement part numbers. | |
| 69 | Identify the components of a manual starter. | English: 9.5, 10.5, 11.5, 12.5 |
| 70 | Repair a manual starter. | English: 9.5, 10.5, 11.5, 12.5 |
| 71 | Identify the components of an electric starter. | English: 9.5, 10.5, 11.5, 12.5 |
| 72 | Repair an electric starter. | English: 9.5, 10.5, 11.5, 12.5 |
| 73 | Identify types of ignition systems used in small engines. | English: 9.5, 10.5, 11.5, 12.5 |
| 74 | Identify parts used in repairing the ignition circuit. | English: 9.5, 10.5, 11.5, 12.5 |
| 75 | Service ignition parts. | English: 9.5, 10.5, 11.5, 12.5 |
| 76 | Describe the safety hazards associated with battery systems. | English: 9.5, 10.5, 11.5, 12.5 |
| 77 | Evaluate system operation. | |
| 78 | Install a battery. | English: 9.5, 10.5, 11.5, 12.5 |
| 79 | Test a battery. | |
| 80 | Explain the principles of a fuel delivery system. | English: 9.5, 10.5, 11.5, 12.5<br><br>Science: PH.5, PH.6, PH.7 |
| 81 | Identify the types of fuel delivery systems, system components, and fuel types. | English: 9.5, 10.5, 11.5, 12.5 |
| 82 | Evaluate and service the fuel system. | English: 9.5, 10.5, 11.5, 12.5 |
| 83 | Identify types of carburetors and fuel injection systems. | English: 9.5, 10.5, 11.5, 12.5 |
| 84 | Explain the operation of a carburetor and a fuel injection system. | English: 9.5, 10.5, 11.5, 12.5 |
| 85 | Evaluate the operation of a carburetor. | English: 9.5, 10.5, 11.5, 12.5 |
| 86 | Service a carburetor and/or fuel injection system. | |
| 87 | Determine the replacement vs. repair of a carburetor and/or a fuel injection system. | English: 9.5, 10.5, 11.5, 12.5 |
| 88 | Replace a carburetor. | English: 9.5, 10.5, 11.5, 12.5 |
| 89 | Identify types of governors. | English: 9.5, 10.5, 11.5, 12.5<br><br>Science: PH.5, PH.7 |
| 90 | Explain the operation of a governor. | |
| 91 | Evaluate operation of a governor. | |

| | | |
|---|---|---|
| 92 | Adjust the governor. | |
| 93 | Describe the operation of intake and exhaust valves. | English: 9.5, 10.5, 11.5, 12.5 |
| 94 | Describe the differences between the OVH and L-head valve design. | |
| 95 | Evaluate valve clearance. | |
| 96 | Evaluate valves and accessories for defects. | |
| 97 | Install valves and accessories. | |
| 98 | Replace the cylinder head. | English: 9.5, 10.5, 11.5, 12.5 |
| 99 | Identify types of valves. | English: 9.5, 10.5, 11.5, 12.5 |
| 100 | Explain how valves work. | English: 9.5, 10.5, 11.5, 12.5<br><br>Science: PH.7 |
| 101 | Evaluate the reed valve for proper operation. | English: 9.5, 10.5, 11.5, 12.5 |
| 102 | Replace the reed valve assembly. | English: 9.5, 10.5, 11.5, 12.5 |
| 103 | Remove internal engine parts. | English: 9.5, 10.5, 11.5, 12.5 |
| 104 | Identify internal engine parts. | English: 9.5, 10.5, 11.5, 12.5 |
| 105 | Explain how pistons and the compression system work. | English: 9.5, 10.5, 11.5, 12.5 |
| 106 | Explain how various piston rings work. | English: 9.5, 10.5, 11.5, 12.5 |
| 107 | Inspect the cylinders for wear. | |
| 108 | Analyze the camshaft assembly for defects. | English: 9.5, 10.5, 11.5, 12.5 |
| 109 | Evaluate a crankshaft. | English: 9.5, 10.5, 11.5, 12.5 |
| 110 | Identify types of air filters. | English: 10.5, 11.5, 12.5 |
| 111 | Service air filters. | English: 10.5, 11.5, 12.5 |
| 112 | Select engine oil. | English: 10.5, 11.5, 12.5 |
| 113 | Change the engine oil. | English: 9.5, 10.5, 11.5, 12.5 |
| 114 | Change the oil filter. | English: 9.5, 10.5, 11.5, 12.5 |
| 115 | Inspect the breather. | English: 9.5, 10.5, 11.5, 12.5 |
| 116 | Identify the components of a spark plug. | English: 9.5, 10.5, 11.5, 12.5 |
| 117 | Evaluate the spark plug. | |
| 118 | Set the spark plug electrode gap. | |

# FFA Information

The National FFA is an organization dedicated to preparing members for leadership and careers in the science, business, and technology of agriculture. Local, state, and national activities and award programs provide opportunities to apply knowledge and skills acquired through agriculture education.

For additional information about the student organization, see the National FFA website and the Virginia FFA Association website.

# Entrepreneurship Infusion Units

Entrepreneurship Infusion Units may be used to help students achieve additional, focused competencies and enhance the validated tasks/competencies related to identifying and starting a new business venture. Because the unit is a complement to certain designated courses and is not mandatory, all tasks/competencies are marked "optional."

# Appendix: Credentials, Course Sequences, and Career Cluster Information

**Industry Credentials: Only apply to 36-week courses**

- College and Work Readiness Assessment (CWRA+)
- Customer Service Specialist (CSS) Examination
- EETC Technician Certification Tests
- Master Service Technician Examinations
- National Career Readiness Certificate Assessment
- Power Equipment Technology Examination
- Small Engine Technology Assessment
- Workplace Readiness Skills for the Commonwealth Examination

**Concentration sequences:** *A combination of this course and those below, equivalent to two 36-week courses, is a concentration sequence. Students wishing to complete a specialization may take additional courses based on their career pathways. A program completer is a student who has met the requirements for a CTE concentration sequence and all other requirements for high school graduation or an approved alternative education program.*

- Agricultural Business Fundamentals I (8022/36 weeks)
- Agricultural Business Management III (8026/36 weeks)
- Agricultural Business Operations II (8024/36 weeks)
- Agricultural Fabrication and Emerging Technologies (8019/36 weeks)
- Agricultural Power Systems (8018/36 weeks)
- Agricultural Power Systems, Advanced (8020/36 weeks)
- Foundations of Agriculture, Food, and Natural Resources (8006/36 weeks)
- Introduction to Power, Structural, and Technical Systems (8016/36 weeks)
- Small Engine Technology I (8725/36 weeks, 140 hours)

| **Career Cluster: Agriculture, Food and Natural Resources** | |
|---|---|
| **Pathway** | **Occupations** |
| **Natural Resources Systems** | **Logging Equipment Operator**<br>**Park Technician**<br>**Range Technician** |
| **Plant Systems** | **Machine Setter, Operator** |
| **Power, Structural, and Technical Systems** | **Agricultural Engineer**<br>**Agricultural Equipment Operator**<br>**Agricultural Equipment Parts Manager**<br>**Agricultural Equipment Parts Salesperson**<br>**Machinist**<br>**Parts Manager**<br>**Welder** |

| **Career Cluster: Education and Training** | |
|---|---|
| **Pathway** | **Occupations** |
| **Teaching and Training** | **Secondary School Teacher**<br>**Training Consultant/Training Specialist** |

| Career Cluster: Science, Technology, Engineering and Mathematics | |
|---|---|
| **Pathway** | **Occupations** |
| **Engineering and Technology** | **Agricultural Engineer**<br>**Electrical Engineer**<br>**Electrical Engineering Technician**<br>**Electro-Mechanical Technician**<br>**Electronic Drafter**<br>**Electronics Engineering Technician**<br>**Engineer**<br>**Engineering Manager**<br>**Engineering Technician**<br>**Machine Setter, Operator**<br>**Manufacturing Systems Engineer**<br>**Marine Engineer**<br>**Materials Engineer**<br>**Mechanical Drafter**<br>**Mechanical Engineer**<br>**Mechanical Engineering Technician**<br>**Technical Writer** |