# Basic Small Engine Repair

**8724 36 weeks / 140 hours**

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The task list was originally validated by the following members of a technical panel:

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    John G. Keeler, Stihl Inc.
    W.V. Turpin, Turpin OPE

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    Virginia Department of Education

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Course Description

Suggested Grade Level: 10 or 11

Students enrolled in this program learn skills associated with general maintenance and repair of lawnmowers, rotary tillers and portable power equipment.

“Basic Small Engine Repair” may be offered as a complement to an existing concentration sequence in any CTE program area. In some instances, where noted, it may be combined with specific courses to create concentration sequences.

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 List

- Tasks/competencies designated by plus icons (⊕) in the left-hand column(s) are essential
- Tasks/competencies designated by empty-circle icons (○) are optional
- Tasks/competencies designated by minus icons (⊖) are omitted
- Tasks marked with an asterisk (*) are sensitive.

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**Diagnosing and Servicing 4-Cycle Engine**

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Developing Employability Skills

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Legend: ☑Essential ☐Non-essential ☐Omitted

Curriculum Framework

Applying Safety Practices on the Job

Task Number 39

Describe the safe use of chemicals.

Definition

Description should include correct uses, hazards, and precautions associated with different types of solvents, soaps, cleaning solutions, oils, greases, specialty additives, and gases, in accordance with manufacturers’ instructions and government regulations.

Process/Skill Questions

- Why is it important to read the manufacturer's directions when using chemicals?
- What may be the effects of using chemicals incorrectly?
- Where should chemicals be stored within the shop?
- What is an MSDS? Why is it important?

Task Number 40

Describe the safe use of standard and metric hand tools.

Definition
Description should include the correct uses, hazards, precautions, and maintenance procedures associated with various types of hand tools (including specialty tools, fasteners, and measuring tools) used in the small engine field, in accordance with manufacturers' instructions and government regulations. Hand tools to be described should include

- 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., hack saw, 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 41

Describe the safe use of power tools.

Definition

Description should include the correct uses, hazards, precautions, and maintenance procedures associated with the various types of power tools (including pneumatic and electric tools) encountered in the small engine field, in accordance with manufacturers’ instructions and government regulations. Power tools to be described should include

- air impact gun
- air hammer
- air ratchet
- air drill
- drop light
- electric drill
- electric grinder.

**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 42**

**Describe the safe use of precision standard and metric measuring tools.**

**Definition**

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

**Process/Skill Questions**

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

---

**Task Number 43**

**Describe the safe use of protective clothing and equipment.**

**Definition**

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

**Process/Skill Questions**
• What hazards exist due to loose-fitting clothing or long hair?
• When is it advisable to use goggles in a small engine shop?
• What are examples of times when it is necessary to wear ear protection in the small engine repair shop?
• Why are steel-toed boots and shoes worn in shops?

Task Number 44

Describe the safe use of fire protection equipment.

Definition

Description should include

• different types of fires encountered in the small engine repair technology field (Class A, B, C, and D)
• appropriate type of extinguisher to use with each fire
• hazards and the precautions associated with each fire
• fire emergency procedures that follow government regulations and instructor’s guidelines.

Process/Skill Questions

• Are there different types of fire extinguishers? Why or why not?
• Is the fire extinguisher in your shop appropriate for all types of fires?
• In case of an emergency or accident, what procedure should students follow?

Task Number 45

Describe the safe use of shop equipment.

Definition

Description should include the different types of shop equipment used in the small engine repair technology field, along with the correct use, the hazards, and the precautions associated with each, in accordance with manufacturer's specifications and instructor’s guidelines. Equipment to be described should include

• pneumatic equipment (e.g., tire machine, pneumatic jack)
• hydraulic equipment (e.g., floor jack, lift rack, hydraulic press, engine hoist)
• electrical equipment (e.g., bench grinder, drill press, battery testers and chargers).

Process/Skill Questions

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

Task Number 46

Follow safety standards and regulations of the Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA), the Education Committee of the Equipment and Engine Training Council (EETC), and Material Safety Data Sheets (MSDS).

Definition

Following safety standards and regulations of the EPA, OSHA, EETC, and MSDS should include the use, storage, and disposal of hazardous materials. Demonstration should reflect an understanding of the correct applications, the training, and the penalties associated with each regulation/requirement, according to government ordinances and instructor’s guidelines.

Process/Skill Questions

• If a chemical is splashed in an eye or wound, what information should be sent with emergency responders to the hospital with the student?
• Are state and national safety standards followed in school shops? How would you support your answer?
• What agency requires shops and businesses to use the services of companies such as Safety Clean?

Performing Shop Operations

Task Number 47

Read a shop manual.

Definition
Reading should include the various types of shop manuals (e.g., manufacturer, professional general, after-market specialty), the formats of manuals (e.g., printed, Web-based, microfiche, compact disc), and the methods of locating information in them (e.g., table of contents, index, special numbering systems).

**Process/Skill Questions**

- Will one manual answer questions for all small engines? Why, or why not?
- Why use a shop manual?
- How can troubleshooting charts be helpful? What kinds of information do they contain?
- Where would torque specifications be found?

---

**Task Number 48**

**Determine economic feasibility of repair.**

**Definition**

Determination must be made based on extent of damage, age of engine, and cost of full replacement versus the cost of labor and parts necessary for repair. These factors must be communicated clearly to customer/owner so that he/she can make an informed decision.

**Process/Skill Questions**

- What is the meaning of the term *economic feasibility of repair*?
- How is economic feasibility determined?
- What are the benefits of accurately estimating prices and repairs?

---

**Task Number 49**

**Maintain a clean and orderly work area.**

**Definition**

Maintenance should ensure neat and well-maintained office, storage, customer, shop, and grounds areas; clean and regularly maintained tools and equipment; and precautions for keeping customer’s unit and unit contents clean.

**Process/Skill Questions**
• As long as the specific repair technician knows where everything is, does it matter whether a work area is orderly?
• What are the benefits of maintaining a clean and orderly workspace?
• In a typical small engine repair shop with multiple workers, who will do the cleanup?

Identifying Fasteners and Their Uses

Task Number 50

Choose appropriate fastener for corresponding job.

Definition

Choice should be based on industry standards and instructor’s guidelines.

Process/Skill Questions

• When is a bolt used? A screw?
• What fastener is used for pulleys, gears, and shafts?
• When is a self-tapping screw used?

Task Number 51

Repair damaged thread, using a tap and die set.

Definition

Repair must be first evaluated by identifying thread (pitch and size, metric or S.A.E.) and then correlated to proper tap or die, according to industry standards and instructor’s guidelines.

Process/Skill Questions

• What is the difference between a tap and a die?
• When drilling for a given thread size, how is the correct hole size determined?
• Is a tapping fluid always used when repairing damaged thread?
• Is there a pattern to follow when using a tap wrench?

Task Number 52
**Repair damaged thread, using thread inserts (e.g., a Heli-coil thread insert).**

**Definition**

Repair should be made by determining appropriate size of threads to be installed, using the appropriate kit, and following kit instructions, according to manufacturer’s instructions and instructor’s guidelines.

**Process/Skill Questions**

- Where can thread inserts be found?
- Thread inserts consist of which materials?
- Why are thread inserts used?

---

**Diagnosing and Servicing 4-Cycle Engine**

**Task Number 53**

**Apply 4-cycle engine theory.**

**Definition**

Application should involve intake, compression, power, and exhaust, as well as the events taking place during each of these strokes (cycles).

**Process/Skill Questions**

- How does understanding 4-cycle theory benefit the small engine technician?
- What are some possible consequences of applying incorrect 4-cycle theory?
- Why is so much importance placed on the proper understanding of 4-cycle theory?

---

**Task Number 54**

**Diagnose and determine needed repair on 4-cycle engine components.**

**Definition**
Diagnostic process should include

- interpreting and verifying complaint; determining needed repairs
- inspecting engine assembly for fuel, oil, coolant, and other leaks; determining needed repairs
- listening to engine noises; determining needed repairs
- identifying problem area for no-start condition
- diagnosing the cause of excessive oil consumption and unusual engine exhaust color, odor, and sound; determining needed repairs
- performing engine vacuum tests; determining needed repairs
- performing cylinder compression tests; determining needed repairs
- performing cylinder leakage tests; determining needed repairs.

Process/Skill Questions

- What procedure is used to diagnose problems with a 4-cycle engine?
- How is the economic feasibility of repairing a 4-cycle engine determined?
- What customer-related issues are involved with determining needed repairs?

Task Number 55

Remove and disassemble 4-cycle engine.

Definition

Process should include removing and properly disposing of liquids, cleaning all engine components, and preparing for inspection of components and reassembly, according to manufacturer’s specifications and instructor’s guidelines.

Process/Skill Questions

- What safety-related issues would apply to removal and disassembly of a 4-cycle engine?
- Where can the proper procedures for disassembling a 4-cycle engine be found?
- What special tools might be necessary when removing a 4-cycle engine?

Task Number 56

Determine wear on internal engine parts, using precision standard and metric measuring tools.
Definition

Determination should be made by identifying wear points of internal engine parts and checking them for wear, using appropriate tools and precision measuring devices, according to manufacturer's specifications and instructor's guidelines.

Process/Skill Questions

- What precision tools are used to measure internal engine parts?
- Why are precise measurements critical in the process of rebuilding a 4-cycle engine?
- Why must extreme care be given to precision measuring instruments?

Task Number 57

Reassemble long block.

Definition

Reassembly should include reinstalling cylinder head, remaining gasket pans, covers, and shielding, as well as torquing all fasteners, according to manufacturer’s specifications and instructor’s guidelines.

Process/Skill Questions

- What resources do repair technicians use to determine reassembly clearances and tolerances?
- Why is cleanliness an important part of engine reassembly?
- How can proper reassembly prevent future problems for the customer?

Task Number 58

Apply lubrication systems theory.

Definition

Application of theory should be based on knowledge of

- differences between 4- and 2-cycle lubrication
- effects of clearances on lubrication systems
- criteria for choosing lubricants
• types of lubricating systems, including splash, combination splash and force feed, force feed, and full force feed.

Process/Skill Questions

• How does 4-cycle lubrication differ from 2-cycle lubrication?
• How is lubrication connected to clearances within the engine?
• How is the proper type of lubricant determined for different types of engines?

Diagnosing and Servicing Fuel System

Task Number 59

Diagnose and determine needed repair on fuel system.

Definition

Diagnosis should be made by visual inspection of filter elements and checking for restrictions, according to instructor’s guidelines.

Process/Skill Questions

• What is the proper way to dispose of used gasoline?
• How often should fuel be tested for spoilage?
• Why should a fuel system maintain good fuel pressure?

Task Number 60

Remove and replace the fuel tank and fuel lines.

Definition

Service should include removal of applicable fasteners and clamps and reinstallation, according to factory specifications and safety guidelines for handling fuel.

Process/Skill Questions

• What is the first step in replacing a fuel tank?
• When replacing gas lines, how can you prevent gas from leaking out of the lines?
• When do you use a fuel shutoff valve?
Task Number 61

Remove and replace the fuel filter systems.

Definition

Service should include removal of applicable fasteners and clamps and reinstallation, according to factory specifications, instructor’s guidelines, and safety guidelines for handling fuel. Used filter must be properly disposed of, according to EPA regulations.

Process/Skill Questions

- What are some types of fuel filters?
- What is the function of a fuel filter?
- How will an engine run once the fuel filter stops working?

Task Number 62

Diagnose and determine needed repair on air cleaner system.

Definition

Diagnosis should be made by visual inspection of filter elements and checking for restrictions, according to instructor’s guidelines.

Process/Skill Questions

- When should the air cleaner system be cleaned?
- Why should the air cleaner system be cleaned each year?
- What are some types of air cleaners?

Task Number 63

Disassemble, clean, and inspect diaphragm-type carburetor.
Definition

Service should include checking for shrinkage, warping, and flexibility of diaphragm, as well as inspecting passageways for obstructions, according to manufacturer’s specifications and instructor’s guidelines.

Process/Skill Questions

- What is the composition of the diaphragm?
- Where should the spring fit on the diaphragm-type carburetor?
- Why does a carburetor need a diaphragm?

Task Number 64

Reassemble and adjust a diaphragm-type carburetor.

Definition

Reassembly and adjustment must be made according to manufacturer’s specifications and instructor’s guidelines.

Process/Skill Questions

- Where are the specifications for adjusting a carburetor located?
- What kind of tools are needed to reassemble a carburetor?
- Why should a diaphragm-type carburetor be adjusted after reassembly?

Task Number 65

Disassemble, clean, and inspect a float-type carburetor.

Definition

Inspection should include checking passageways for obstructions, checking float for buoyancy, and inspecting needle valve and seat for proper operation, according to manufacturer's specifications and instructor's guidelines.

Process/Skill Questions
Task Number 66

Reassemble and adjust float-type carburetor.

Definition

Reassembly and adjustment must be made while checking for proper operation of unit, according to manufacturer’s specifications and instructor’s guidelines.

Process/Skill Questions

- Why should the float be set level?
- How is the float set level?
- Where are the specifications for setting a float level?

Task Number 67

Clean crankcase breather.

Definition

Cleaning breather may require disassembly, and technician must use only industry-approved solvents, according to industry regulations and instructor’s guidelines.

Process/Skill Questions

- What is used to clean a crankcase breather?
- What is the function of a crankcase breather?

Diagnosing and Servicing General Electrical System

Task Number 68
Read a multimeter.

Definition

Reading should include following manufacturer’s specifications and instructor’s guidelines to

- set meter to proper specifications
- determine desired range
- determine proper lead placement
- adhere to safety guidelines
- determine electrical function.

Process/Skill Questions

- How can proper use of a multimeter aid in troubleshooting a problem in the electrical system?
- Why is it necessary to obtain correct readings when diagnosing an electrical problem?
- What could result from an incorrect reading of the multimeter?

Task Number 69

Apply electrical theory.

Definition

Application of theory should be based on knowledge of

- Ohm’s law
- electricity produced mechanically, chemically, statically
- magnetism
- units of measurement—Ohm, voltage, amperage
- conductors, semiconductors, and insulators
- electrical function
- current flow
- schematic reading.

Process/Skill Questions

- How can knowledge of electrical theory aid in the repair of a small engine?
- What are some possible consequences of applying incorrect electrical theory?
- Why is electrical theory taught in the Small Engine Repair class?
Task Number 70

Test and charge the battery.

Definition

Test should include an inspection of battery for leakage and physical damage, according to industry safety regulations, manufacturer's specifications, and instructor’s guidelines, by using a hydrometer and a load tester.

Process/Skill Questions

- What diagnostic tools could be used to test a battery?
- What safety precautions would be used in testing/charging a battery?
- How does a battery lose charge?

Task Number 71

Repair and replace starter.

Definition

Following manufacturer's specifications and instructor's guidelines, service should include cleaning starter/generator and checking for

- open or short circuits
- condition of commentator with growler
- condition of brushes
- condition of bearings
- proper function of starter bendix.

Process/Skill Questions

- Why would a starter need to be replaced instead of repaired?
- What diagnostic procedures should be used to determine the problem?
- What safety procedure should be used in repair or replacement of the starter?
Task Number 72

Troubleshoot and repair starting circuit.

Definition

Following manufacturer's specifications and instructor's guidelines, repair should include checking

- ignition switch
- wiring
- fuses
- safety switches
- starter solenoid
- battery cables
- ground straps.

Process/Skill Questions

- Why is correct procedure important in troubleshooting electrical starting circuit problems?
- What potential problems could result by improperly troubleshooting a starting circuit problem?
- How could improper diagnosis of a starting circuit problem lead to customer dissatisfaction?

Diagnosing and Servicing Manual Starting System

Task Number 73

Diagnose and determine needed repair on manual starting system.

Definition

Determine if starting system engages and recoils properly, according to manufacturer’s specifications and instructor’s guidelines.

Process/Skill Questions
• How is diagnosis of a manual starting system different from that of an electrical starting system?
• What steps are taken in diagnosis of a manual starter problem?
• Where would you find information on the different types of manual starters?

Task Number 74

Replace starter spring.

Definition

Replacement should require technician to disassemble starter spring with attention paid to spring tension, to clean and inspect spring for damage, and to reassemble, according to manufacturer’s specifications and instructor’s guidelines.

Process/Skill Questions

• What safety-related issues apply to starter spring replacement?
• How is proper spring tension determined?
• What defects would cause a spring to need replacing?

Task Number 75

Replace a starter clutch if needed.

Definition

Replacement should require technician to remove starter clutch using appropriate tools, to inspect for damage, and to replace and torque, according to manufacturer’s specifications and instructor’s guidelines.

Process/Skill Questions

• What safety-related issues apply to starter clutch replacement?
• How do you determine if the clutch needs replacement?
• What special tools would be necessary to replace a starter clutch?
Task Number 76

Replace starter pawls.

Definition

Replacement should require technician to remove recoil starter, to inspect for damage and wear to related parts, and to inspect pawls for proper operation, according to manufacturer's specifications and instructor's guidelines.

Process/Skill Questions

- What safety-related issues apply to starter pawl replacement?
- How would you determine if a starter cup needs replacement?
- What related parts should be checked when replacing a starter cup?

Task Number 77

Replace a worn or defective cup.

Definition

Replacement should require technician to remove recoil starter, to remove flywheel nut, and to replace and torque, according to manufacturer's specifications and instructor's guidelines.

Process/Skill Questions

- Why are torque specifications important in starter cup replacement?
- How would you determine if a starter cup needs replacement?
- What related parts should be checked when replacing a starter cup?

Task Number 78

Replace starter rope.

Definition

Following manufacturer's specifications and instructor's guidelines, replacement should require technician
• to remove recoil starter
• to disassemble with attention paid to spring tension
• to check proper rope size
• to reassemble.

Process/Skill Questions

• How would you determine the need for a new starter rope?
• What safety related issues would be involved in the replacement of a starter rope?
• What special tools would be needed to replace a starter rope?

Diagnosing and Servicing Ignition System

Task Number 79

Remove, inspect, adjust, and install the spark plugs.

Definition

Process should include using proper tools and following manufacturer's specifications and instructor's guidelines to

• remove spark plug
• inspect for fouling, wear, and damaged insulator
• adjust air gap.

Process/Skill Questions

• What measuring tool is used when installing a spark plug?
• How would you determine proper torque specification when installing a spark plug?
• What conditions would require replacement of a spark plug?

Task Number 80

Remove, inspect, and replace the flywheel.

Definition

Process includes following manufacturer's specifications and instructor's guidelines to inspect for

• cracks in flywheel
• damage to fins, taper, keyway scot, magnets
• loose magnets
• quality of flywheel key
• foreign objects on taper surface
• torque of flywheel retainer.

Process/Skill Questions

• What safety-related issues would be involved in removal and replacement of the flywheel?
• Why are torque specifications important when replacing a flywheel?
• Why are proper tools needed in removal of a flywheel?

Task Number 81

Adjust armature air gap.

Definition

Process should require technician to adjust air gap between armature and flywheel magnets, according to manufacturer’s specifications and instructor’s guidelines.

Process/Skill Questions

• What measuring tool is needed to adjust armature air gap?
• What are some conditions that could cause the armature air gap to change?
• Why is an armature air gap needed?

Diagnosing and Servicing 2-Cycle Engine

Task Number 82

Apply 2-cycle engine theory.

Definition

Application should address intake/compression and power/exhaust, as well as the events taking place during each of these 2-stroke cycles, according to instructor’s guidelines.

Process/Skill Questions
• What are some ways 2-cycle theory differs from 4-cycle theory?
• Why is so much importance placed on the proper understanding of 2-cycle theory?
• Why can a 2-cycle engine run on its side and not a 4-cycle?

Task Number 83

Diagnose and determine needed repair on 2-cycle engine components.

Definition

Using manufacturer’s specifications and instructor’s guidelines, process should include

• interpreting and verifying complaint
• inspecting engine assembly for leaks
• listening to engine noises
• diagnosing the cause of excessive oil consumption, unusual engine exhaust color, odor, and sound
• performing engine vacuum tests
• performing cylinder compression tests
• performing cylinder leakage tests
• determining needed repairs for each component.

Process/Skill Questions

• What procedure would you use to diagnose problems with a 2-cycle engine?
• How would you determine the economic feasibility of repairing a 2-cycle engine?
• What customer-related issues are involved with determining needed repairs?

Task Number 84

Remove and disassemble 2-cycle engine.

Definition

Process should include disassembly of engine with care not to damage or distort components and cleaning all components thoroughly, according to manufacturer’s specifications and instructor’s guidelines.
Process/Skill Questions

- What safety related issues would apply to removal and disassembly of a 2-cycle engine?
- What special tools could be needed for removal of a 2-cycle engine?
- Where would you find the proper procedures to follow in disassembly of a 2-cycle engine?

Task Number 85

Determine wear on internal engine parts, using precision standard and metric measuring tools.

Definition

Determination should be made by identifying wear points of internal engine parts and checking them for wear, using appropriate tools and precision measuring devices, according to manufacturer's specifications and instructor's guidelines.

Process/Skill Questions

- What precision tools are used in the measurement of internal engine parts?
- Why are precision measurements critical in the process of rebuilding a 2-cycle engine?
- Why must extreme care be given to precision measuring instruments?

Task Number 86

Reassemble 2-cycle engine.

Definition

Process should include reinstalling remaining gaskets pans, covers, and shielding, as well as torquing all fasteners, according to manufacturer’s specifications and instructor’s guidelines.

Process/Skill Questions

- Where would the technician go to find reassembly clearances and tolerances?
- Why is cleanliness an important part of engine reassembly?
- How can proper reassembly prevent future problems for the customer?
Task Number 87

Service and repair diaphragm-type carburetor used on 2-cycle engine.

Definition

Service and repair should include

- removing carburetor
- disassembling carburetor
- washing all parts in appropriate solution
- inspecting parts for damage and wear
- replacing parts as needed
- reassembling and reinstalling carburetor.

Process/Skill Questions

- What is the difference between a 2-cycle and a 4-cycle carburetor?
- How does a 2-cycle carburetor control the fuel?
- How does the built-in fuel pump on a 2-cycle carburetor work?

Task Number 88

Mix fuel at appropriate ratio.

Definition

Mixture should be made using appropriate type of oil and grade of fuel at appropriate ratio, according to manufacturer's specifications.

Process/Skill Questions

- What are the ratios used on 2-cycle engines?
- What type of oil do you mix with what grade of fuel?
- Why use different ratios?

Diagnosing and Servicing Lawn Mower
Task Number 89

Adjust clutch controls (e.g., cables, rods, and springs).

Definition

Following manufacturer's specifications and instructor's guidelines, process should include:

- adjusting for proper releasing
- adjusting to proper full engagement
- inspecting for any sticking or binding that would impede function of related part.

Process/Skill Questions

- Where do you find information on how to make control adjustments?
- What part does safety play in all adjustments?
- What types of adjusters will you find on lawn mowers?

Task Number 90

Inspect and service mower decks.

Definition

Inspection and service should include:

- inspecting for rust
- inspecting for corrosion
- inspecting pulleys, breaks, belts, and bearings (if equipped)
- inspecting for physical damage
- inspecting for missing shields or safety devices
- removing foreign material from deck
- lubricating appropriate parts
- using manufacturer’s specifications and instructor’s guidelines.

Process/Skill Questions

- How do you sharpen and balance a mower blade?
- What type of mower bearings are used on mower decks?
- How do you check for belt wear and why?
Task Number 91

Set height of cut.

Definition

Process should include adjusting blade height for even cut, according to manufacturer’s specifications and instructor’s guidelines.

Process/Skill Questions

- How do you level a mower deck?
- Why do you level a mower deck, and should it be level or down in the front?
- What does tire pressure have to do with deck height?

Task Number 92

Lubricate mower.

Definition

According to manufacturer’s specifications and instructor’s guidelines, process should include

- lubricating wheel bearings
- lubricating engine oil and filter (if required) with proper grade of oil
- lubricating transmission, gear boxes, steering, and other related linkages or bearings.

Process/Skill Questions

- What type of lubricants do you use on mowers other than engine oil?
- How much do you put in a bearing at one time?
- What is a seal, and what is a sealed bearing?

Task Number 93

Grind and balance rotary blade.

Definition
Process should include

- inspecting blade for physical damage or wear
- grinding top edge to a 45° angle
- balancing to minimize vibration
- checking all mounting hardware for damage and alignment
- following manufacturer's specifications and instructor's guidelines.

Process/Skill Questions

- What safety factors are involved in working with a sharp blade?
- Why balance a blade?
- How do you sharpen a blade?

---

Task Number 94

Diagnose needed repair for self-propelled drive system on walk-behind mower.

Definition

Following manufacturer's specifications and instructor's guidelines, process should include

- checking engagement and disengagement of drive system
- adjusting, repairing, or replacing if needed
- replacing or adjusting drive cogs if equipped.

Process/Skill Questions

- What does the term self-propelled mean?
- What safety factors are involved with proper repair?
- How many different types of self-propelled mowers are there?

---

Task Number 95

Inspect and service steering assembly.

Definition
Process should include

- inspecting for reasonable alignment
- inspecting pivot points
- adjusting steering stops.

Process/Skill Questions

- Why is safety a factor when doing steering repairs?
- What is the meaning of the term toe-in?
- What types of joints are used in steering systems?

---

Task Number 96

Replace and adjust throttle cable.

Definition

Replacement and adjustment should be made according to manufacturer’s specifications and instructor’s guidelines.

Process/Skill Questions

- Why is the adjustment a safety factor?
- What is the process for making or repairing a throttle cable?
- What area the considerations when selecting the proper cable?

---

Task Number 97

Test and adjust the blade/operator-presence control system (engine brake).

Definition

Tests and adjustments should be made according to manufacturer’s specifications and instructor’s guidelines.

Process/Skill Questions
• How does an operator-presence control system work?
• In what way is an operator-presence control system a safety feature?
• Is an operator-presence control system a legal requirement for lawn mowers?
• What is a blade, or engine brake?

Task Number 98

Inspect and/or replace brake pad.

Definition

Inspection and/or replacement should be made according to manufacturer’s specifications and instructor’s guidelines.

Process/Skill Questions

• What is a brake pad?
• What are the safety factors involved in brake work?
• What is the correct procedures for adjusting a brake?

Task Number 99

Test the kill switch.

Definition

Process should include inspecting wiring to switch and releasing O.P.G. to kill engine, according to manufacturer’s specifications and instructor’s guidelines.

Process/Skill Questions

• What is a kill switch?
• How many ways are kill switches wired?
• How do you test a kill switch?

Diagnosing and Servicing Chain Saw

Task Number 100
Diagnose needed repair on chain saw.

Definition

Process should include checking for proper operation of engine according to manufacturer’s specifications and instructor’s guidelines.

Process/Skill Questions

- What safety factors should be followed when working with a chain saw?
- How are needed repairs diagnosed?
- What tools are necessary for accurate testing of chain saw?

Task Number 101

Sharpen and adjust or replace chain.

Definition

Process should include determining proper size of file, stone, or blade, and adjusting to desired depth, according to manufacturer’s specifications and instructor’s guidelines.

Process/Skill Questions

- When sharpening a chain, what safety procedures are most important?
- How is it determined that the replacement of a chain is necessary?
- What type and size of file is used to sharpen the chain?

Diagnosing and Servicing String Trimmer

Task Number 102

Diagnose needed repair on string trimmer.

Definition

Diagnosis should include inspecting shaft and inspecting cutter head, according to manufacturer’s specifications and instructor’s guidelines.

Process/Skill Questions
• What special tools are needed to diagnose the repair?
• How are needed repairs diagnosed?
• How is the economic feasibility of repair determined?

Task Number 103

Conduct maintenance on shaft.

Definition

Maintenance should include removing cable or shaft and lubricating as needed, according to manufacturer’s specifications and instructor’s guidelines.

Process/Skill Questions

• How should the head bearing be oiled?
• How should a cable be replaced?
• How should a gear drive be repaired?

Task Number 104

Wind and trim cutter head.

Definition

Process should include determining proper diameter of string and winding, according to manufacturer’s specifications and instructor’s guidelines.

Process/Skill Questions

• What size and type of string should be used on a string trimmer?
• Which way should the string be wound?
• How should a two-string head trimmer be wound?

Diagnosing and Servicing Cooling Systems

Task Number 105
Apply cooling system theory.

Definition

Application of cooling system theory involves maintaining engine operation temperature within desired range and according to manufacturer’s specifications and instructor’s guidelines.

Process/Skill Questions

- How does heat move through an engine?
- Why does heat need to be removed from an engine?
- What are the main two types of cooling systems?

Task Number 106

Identify air cooling system components.

Definition

Identification should include

- filtering screen
- blower housing
- deflector shields
- engine fins
- flywheel fins.

Process/Skill Questions

- How does air cool the engine?
- How is air channeled through the cooling system?
- Why should air be kept clean or filtered?

Diagnosing and Servicing Governor Systems

Task Number 107

Apply governor system theory.

Definition
Application of governor system theory should include the need to maintain constant desired engine speed, according to instructor’s guidelines.

Process/Skill Questions

- What are the two most common governor systems on small engines?
- Why is a governor necessary?
- How does a governor work with a spring?

Task Number 108

Inspect, adjust, and replace pneumatic system.

Definition

Process should include inspecting air intake screen, inspecting for debris in governor vane or linkage, replacing worn or broken parts, and adjusting governor to operate, according to manufacturer’s specifications and instructor’s guidelines.

Process/Skill Questions

- What is an air governor?
- How does a pneumatic governor work?
- How is RPM set in a pneumatic system?

Task Number 109

Inspect, adjust, and replace mechanical system.

Definition

Process should include inspecting external linkages, making any necessary adjustments according to manufacturer's specifications, testing for proper operation, and replacing defective parts as needed.

Process/Skill Questions

- Where is the governor gear located? How does it work?
- How is a governor set before starting an engine?
- How is RPM set in a mechanical system?
Diagnosing and Servicing Exhaust Systems

Task Number 110

Apply exhaust system theory, 2-cycle engine.

Definition

Application should include engine cooling, back pressure, noise pollution, engine compression, scavenging, and emissions.

Process/Skill Questions

- How does the exhaust system function on a 2-cycle engine?
- What is the function of a muffler?
- What is back pressure?

Task Number 111

Diagnose common equipment problems in a damaged exhaust system, 2-cycle engine.

Definition

Diagnosis should include exhaust system restrictions, power loss, overheating, and burned pistons.

Process/Skill Questions

- What typically obstructs the exhaust port or muffler on a 2-cycle engine?
- How are exhaust ports and mufflers cleaned?

Task Number 112

Identify exhaust components, 2-cycle engine.

Definition
Identification should include deflector, spark arrestor, and baffles.

Process/Skill Questions

- What is an exhaust port?
- What is a muffler?
- What is a deflector?

---

**Task Number 113**

**Apply exhaust system theory, 4-cycle engine.**

**Definition**

Application should include engine cooling, back pressure, noise pollution, scavenging, emissions, and blower effect.

**Process/Skill Questions**

- Why is a muffler necessary? What is its function?
- What is back pressure?
- Why should exhaust be carried away from the engine?

---

**Task Number 114**

**Identify cleaning procedures for exhaust ports and spark arrestor screens, 2-cycle engine.**

**Definition**

Identification should include decarbonizing fluids and cleaning port with non-abrasive instruments.

**Process/Skill Questions**

- What is a spark arrestor screen, and where is it needed?
- How is an exhaust port cleaned without putting carbon in the engine?
- How is a muffler cleaned without taking it apart?
Analyzing Engine Failure

Task Number 115

Identify the five major categories of failure analysis.

Definition

Identification should include the following categories of failure analysis:

- Abrasives
- Insufficient lubrication
- Breakage
- Overspeeding
- Overheating

Process/Skill Questions

- What is meant by failure?
- After the failure is identified, how is its cause determined?
- What are the objectives of conducting a failure analysis?

Developing Employability Skills

Task Number 116

Map certification and educational opportunities.

Definition

Mapping should identify alternative career opportunities based on coursework in Small Engine Repair, as well as postsecondary education and training routes.

Process/Skill Questions

- What is OPE certification?
- What are other certification opportunities related to small engine repair?
- What are some additional postsecondary education opportunities related to small engine repair?
### SOL Correlation by Task

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<td>46</td>
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<tr>
<td>62</td>
<td>Diagnose and determine needed repair on air cleaner system.</td>
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<tr>
<td>63</td>
<td>Disassemble, clean, and inspect diaphragm-type carburetor.</td>
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<tr>
<td>64</td>
<td>Reassemble and adjust a diaphragm-type carburetor.</td>
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<tr>
<td>65</td>
<td>Disassemble, clean, and inspect a float-type carburetor.</td>
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<tr>
<td>66</td>
<td>Reassemble and adjust float-type carburetor.</td>
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<tr>
<td>67</td>
<td>Clean crankcase breather.</td>
<td></td>
</tr>
<tr>
<td>68</td>
<td>Read a multimeter.</td>
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</tr>
<tr>
<td>69</td>
<td>Apply electrical theory.</td>
<td>Science: PH.7, PH.11</td>
</tr>
<tr>
<td>70</td>
<td>Test and charge the battery.</td>
<td></td>
</tr>
<tr>
<td>71</td>
<td>Repair and replace starter.</td>
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</tr>
<tr>
<td>72</td>
<td>Troubleshoot and repair starting circuit.</td>
<td></td>
</tr>
<tr>
<td>73</td>
<td>Diagnose and determine needed repair on manual starting system.</td>
<td></td>
</tr>
<tr>
<td>74</td>
<td>Replace starter spring.</td>
<td></td>
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<tr>
<td>75</td>
<td>Replace a starter clutch if needed.</td>
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<tr>
<td>76</td>
<td>Replace starter pawls.</td>
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<tr>
<td>77</td>
<td>Replace a worn or defective cup.</td>
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<tr>
<td>78</td>
<td>Replace starter rope.</td>
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<tr>
<td>79</td>
<td>Remove, inspect, adjust, and install the spark plugs.</td>
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<tr>
<td>80</td>
<td>Remove, inspect, and replace the flywheel.</td>
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<tr>
<td>81</td>
<td>Adjust armature air gap.</td>
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<tr>
<td>82</td>
<td>Apply 2-cycle engine theory.</td>
<td>Science: PH.4, PH.7</td>
</tr>
<tr>
<td>83</td>
<td>Diagnose and determine needed repair on 2-cycle engine components.</td>
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<tr>
<td>84</td>
<td>Remove and disassemble 2-cycle engine.</td>
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</tr>
<tr>
<td>85</td>
<td>Determine wear on internal engine parts, using precision standard and metric measuring tools.</td>
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<tr>
<td>86</td>
<td>Reassemble 2-cycle engine.</td>
<td></td>
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<tr>
<td>87</td>
<td>Service and repair diaphragm-type carburetor used on 2-cycle engine.</td>
<td></td>
</tr>
<tr>
<td>88</td>
<td>Mix fuel at appropriate ratio.</td>
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</tr>
<tr>
<td>89</td>
<td>Adjust clutch controls (e.g., cables, rods, and springs).</td>
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<tr>
<td>90</td>
<td>Inspect and service mower decks.</td>
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<tr>
<td>91</td>
<td>Set height of cut.</td>
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</tr>
<tr>
<td>92</td>
<td>Lubricate mower.</td>
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</tr>
<tr>
<td>93</td>
<td>Grind and balance rotary blade.</td>
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</tr>
<tr>
<td>94</td>
<td>Diagnose needed repair for self-propelled drive system on walk-behind mower.</td>
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<tr>
<td></td>
<td>Task Description</td>
<td>Science or English Course</td>
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<tr>
<td>95</td>
<td>Inspect and service steering assembly.</td>
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<tr>
<td>96</td>
<td>Replace and adjust throttle cable.</td>
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<tr>
<td>97</td>
<td>Test and adjust the blade/operator-presence control system (engine brake).</td>
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<tr>
<td>98</td>
<td>Inspect and/or replace brake pad.</td>
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<tr>
<td>99</td>
<td>Test the kill switch.</td>
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<tr>
<td>100</td>
<td>Diagnose needed repair on chain saw.</td>
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<tr>
<td>101</td>
<td>Sharpen and adjust or replace chain.</td>
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<tr>
<td>102</td>
<td>Diagnose needed repair on string trimmer.</td>
<td></td>
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<tr>
<td>103</td>
<td>Conduct maintenance on shaft.</td>
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<tr>
<td>104</td>
<td>Wind and trim cutter head.</td>
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<tr>
<td>105</td>
<td>Apply cooling system theory.</td>
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<tr>
<td>106</td>
<td>Identify air cooling system components.</td>
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<tr>
<td>107</td>
<td>Apply governor system theory.</td>
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<tr>
<td>108</td>
<td>Inspect, adjust, and replace pneumatic system.</td>
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<tr>
<td>109</td>
<td>Inspect, adjust, and replace mechanical system.</td>
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<tr>
<td>110</td>
<td>Apply exhaust system theory, 2-cycle engine.</td>
<td>Science: CH.1, PH.4, PH.7</td>
</tr>
<tr>
<td>111</td>
<td>Diagnose common equipment problems in a damaged exhaust system, 2-cycle engine.</td>
<td></td>
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<tr>
<td>112</td>
<td>Identify exhaust components, 2-cycle engine.</td>
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<tr>
<td>113</td>
<td>Apply exhaust system theory, 4-cycle engine.</td>
<td>Science: CH.1, PH.4, PH.7</td>
</tr>
<tr>
<td>114</td>
<td>Identify cleaning procedures for exhaust ports and spark arrestor screens, 2-cycle engine.</td>
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<tr>
<td>115</td>
<td>Identify the five major categories of failure analysis.</td>
<td></td>
</tr>
<tr>
<td>116</td>
<td>Map certification and educational opportunities.</td>
<td>English: 10.3, 10.5, 11.3</td>
</tr>
</tbody>
</table>

**Outdoor Power Equipment Accreditation from EETC**

The Equipment and Engine Training Council (EETC) is a non-profit professional organization that promotes and supports the education and training of service technicians in outdoor power equipment, agriculture, commercial, and heavy equipment technology. EETC has articulated five levels of OPE Accreditation. Virginia's Small Engine Technology course corresponds to Level 1: Two and Four-Stroke Gas Engines. Only a selection of Small Engine Technology tasks/competencies are included within the Small Engine Repair framework. Therefore, they do
not apply in entirety to the full EETC levels of accreditation. More information can be found at the EETC Web site: [http://www.eetc.org](http://www.eetc.org).


**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.” Teachers can find the infusion/unit in the course listing.
Appendix: Credentials and Career Cluster Information

Industry Credentials: Only apply to 36-week courses

- College and Work Readiness Assessment (CWRA+)
- Customer Service Examination
- Customer Service Specialist (CSS) Examination
- National Career Readiness Certificate Assessment
- Professional Communications Certification Examination
- Workplace Readiness Skills for the Commonwealth Examination

<table>
<thead>
<tr>
<th>Career Cluster: Transportation, Distribution and Logistics</th>
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<tbody>
<tr>
<td>Pathway</td>
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<tr>
<td>Facility and Mobile Equipment Maintenance</td>
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