STEP-BY-STEP PROCEDURE

SMALL ENGINE SERVICE AND REPAIR

Set of 8 Student Manuals

Instructional Materials Laboratory
University of Missouri - Columbia
Small Engine Repair Series

Step-By-Step Procedure Manuals

10-7661-I  Instructor  Small Engine Service and Repair - Instructor Guide
10-7651-S  Module 1  Installing Magnetron Ignition and Breaker Points
10-7652-S  Module 2  Carburetor Service and Repair
10-7653-S  Module 3  Rewind Starters
10-7654-S  Module 4  Compression
10-7655-S  Module 5  Governors
10-7656-S  Module 6  Lubricating Small Engines
10-7657-S  Module 7  Troubleshooting Small Engines
10-7658-S  Module 8  Operation and Maintenance of Small Engines

These manuals are available from:
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10 London Hall
Columbia, Missouri 65211

1-800-669-2465
Installing Magnetron Ignition and Breaker Points

Revised Edition

INSTRUCTIONAL MATERIALS LABORATORY
UNIVERSITY OF MISSOURI-COLUMBIA
COLUMBIA, MISSOURI
MODULE 1

Installing Magnetron Ignition and Breaker Points

Prepared by: Amon Herd
Preface

This manual is designed to bring the student or home owner to a minimum performance level in properly servicing a small engine's ignition system. These step-by-step procedures include illustrations clarifying each procedure. The accompanying performance task list may be used as an evaluation or as a quick reference of repair procedures.

For many years those responsible for teaching small engine repair have needed materials that are basic, readable and usable. Although this series was written primarily for adult education, it can become a vital teaching tool in any program through live demonstrations and classroom instruction.

The author, Amon Herd, brings to this new series many years of small engine experience. Amon's "hands on" knowledge comes from twenty-five years of classroom teaching and small engine repair.
Acknowledgments

Appreciation is extended to those individuals who contributed their time and talents in the development of Installing Magnetron® Ignition and Breaker Points, Second Edition.

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American Association for Vocational Instructional Materials

Appreciation is expressed to:
Dan Hostetler, Boonville, Missouri; Harold Bossaler, Columbia, Missouri; Dr. Milo Spurgeon, Columbia, Missouri for their contributions to this manual.

References

Service and Repair Instructions, Briggs and Stratton Corporation, Milwaukee, Wisconsin.

Small Engines Operation Maintenance and Repair, J. Howard Turner, American Association for Vocational Instructional Materials, Athens, Georgia.


Fuels and Lubricants, Harold Parady and Thomas Colvin, American Association for Vocational Instructional Materials, Athens, Georgia.


Unit Objectives

After completion of this unit, you should be able to identify tools and their appropriate use, properly install the Composite Magnetron® Ignition, and test the system. This knowledge will be evidenced by your ability to properly install the Composite Magnetron® Ignition System, test it, and have it perform correctly.

Specific Objectives

After completing this unit, you should be able to:

1. Identify and use Magnetron® Ignition System installation tools.
2. Identify Composite Magnetron® Ignition Systems.
3. Install Composite Magnetron® Ignition Systems.
4. Test the Magnetron® Ignition Systems.
Installing and Servicing
Composite Magnetron® Ignition Systems
Step-by-Step Procedure

Introduction

The Magnetron® Ignition System is now a standard feature on all Briggs & Stratton small engines. The Magnetron® transistor and inductor coil are encased around the ignition coil body. It has proven to be a high-quality ignition system.

The Magnetron® Ignition System is designed to provide a strong spark in the combustion chamber of a small engine at the proper time for igniting the fuel-air mixture.

Detailed procedures for servicing the system are covered in this module.
Tools

- Starter Clutch Wrench
- Side Cutting Pliers
- Flywheel Holder
- 60-40 Solder
- Flywheel Puller
- Needle Nose Pliers
- Slot Head Screwdriver
- Spark Tester
- Starter Clutch Wrench
- Feeler Gauge
- Plunger Plug
- Penetrating Oil
- Pocket Knife
- Permatex Sealer
- Soldering Iron
- Spark Plug Gap Tool
- Torque Wrench
- Condenser Spring Compressor
Breaker Points and Condenser

Phillips Screwdriver

Shim Stock .010"

Mallet

Box Wrench

Socket Set

Flywheel Holder

Spark Tester
B. Step-By-Step Procedure For Servicing a Composite Magnetron® Ignition Armature

**Testing**

1. Read operator’s manual and *Briggs & Stratton’s Service And Repair Instructions*.

2. Organize your work station. When disassembling engine, place bolts, nuts and parts in containers for safekeeping.

3. Wear proper safety equipment.

4. Select proper tools and supplies (see section A).

5. Disconnect spark plug wire and remove spark plug.

6. Check ignition. Use a new spark plug and gap electrode to .060". Install spark plug. If the engine will start and accelerate properly with this wide gap, the spark is good. Remove and regap new plug to .030 and install.

   If engine does not start and accelerate properly and is **not equipped with a 12-volt starter**, proceed to Step 7. If the engine does not start properly and is **equipped with a 12-volt starter**, proceed to Optional Step 7.

7. Troubleshoot Magnetron® Ignition System without 12-volt system.

**WARNING:** **DO NOT REMOVE SPARK PLUG WHEN CHECKING IGNITION. A fire or explosion may occur.**

a. Two methods of testing spark can be used:

   1. Use *Briggs & Stratton tester 19051 or 19368*. Spin flywheel rapidly with one end of the ignition cable clipped to the tester and with the other end of the tester grounded to the cylinder head. If spark jumps the .166" tester gap the system is functioning satisfactorily. In testing Magnetron® ignition, the flywheel must rotate at least 350 RPM.
(2) Using a test plug, rotate flywheel a minimum of 350 RPM and observe the spark. If the gap is a bright blue color, the system is functioning satisfactorily.

If spark does not jump the tester gap, check the following:
- Armature air gap is too wide.
- Kill switch wire is grounded.
- Ignition armature ground wire is broken.
- Other external wires are broken.
- Ignition switch is defective.
- Armature is defective.

OPTIONAL 7. Troubleshoot ignition armature equipped with Magnetron® on engines with 12-volt starters.

a. Observe condition of the armature. If the plastic case of the coil has burst open, or if the coil’s primary wires and insulation are charred, check the ignition switch and electrical connections before installing new ignition armature.

NOTE: Complete armature assembly MUST be replaced if equipped with an Integral Magnetron®.

NOTE: Damage can occur when high current from the battery is accidentally directed through the primary windings of the armature coil. This is caused by a defective ignition switch. If battery current flows through the primary windings of the armature coil, even for a few seconds, the coil can be damaged. The Magnetron® module is usually not affected when the armature coils are damaged.

b. Check for a defective ignition switch. Disconnect ground wire at terminal on engine. Connect a test lamp or voltmeter between ground and the end of the ground wire lead as illustrated. If test lamp lights even momentarily, switch is defective and must be replaced. Actuate switch a minimum of 50 times during the test.

8. Disable engine from starting. Short the spark plug wire to ground, or attach a jumper wire between ground and the remote magnet to ground wire terminal as illustrated.
Disassembly

9. Remove tank assembly to access blower housing.
   a. Finder guard
   b. Oil cap
   c. Gas line
   d. Primer line (if available)

   NOTE: On some models you may not have tank assembly.

10. Remove blower housing, oil tube and casing clamp.
    You now have access to the armature.


    NOTE: Removal of flywheel is not required when removing Magnetron® armatures except to inspect flywheel key and key ways on crankshaft and flywheel.

12. Replace and check flywheel key. Remove screen from flywheel. Remove starter clutch or flywheel nut. Remove flywheel.

   1. Fasten flywheel puller to flywheel with two self tapping screws
   2. Turn down these two nuts to loosen flywheel

Illustrations courtesy of Briggs & Stratton Corporation
13. Inspect flywheel key and key ways, flywheel and crankshaft.

**NOTE:** Timing of Magnetron® ignition is controlled by the flywheel key on all model series except 230000, 240000 and 320000.

![Breaker Points Early Magnetron® Current Magnetron® Sheared (replace)]

**NOTE:** You will have determined if the Magnetron® Armature needs to be replaced. Use the following procedures to replace the Magnetron Armature.

14. To service the Composite Magnetron® ignition armature assembly, first remove armature mounting screws and lift off armature. Disconnect stop switch wire at spade terminal on composite armatures.

**Note:** Magnetrons® are produced in two versions, composite (Type I, Type II) and replaceable module.

![Composite Magnetron® ignition armature](TYPE I)

![Spade terminal](TYPE II)

**Reassembly**

15. Clean crankshaft and flywheel taper of oil or dirt. Slide the flywheel onto crankshaft and line up both key ways. Insert new flywheel key into key way.
16. Install Belleville Washer on crankshaft with hollow side toward flywheel. Place starter clutch onto crankshaft and torque to specification. See chart.

<table>
<thead>
<tr>
<th>Basic Model Series</th>
<th>Ft./Lbs.</th>
<th>Mkg</th>
</tr>
</thead>
<tbody>
<tr>
<td>60000, 80000, 90000, 110000</td>
<td>55</td>
<td>7.9</td>
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<tr>
<td>100000, 130000</td>
<td>60</td>
<td>8.3</td>
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<tr>
<td>140000, 170000, 190000, 220000, 250000</td>
<td>65</td>
<td>9.3</td>
</tr>
<tr>
<td>233400, 243400, 326400, 400000, 420000</td>
<td>145</td>
<td>20.0</td>
</tr>
</tbody>
</table>

17. Attach flywheel screen.

18. Install (when used) fan retainer or rotating screen cup and flywheel nut. Torque to specifications.

*NOTE: Torque flywheel nut to 55 ft. lbs.*


   a. On engines with optional internal governor. Route and connect stop switch wire to kill switch.

   *NOTE: Make sure you have installed armature with rivet head up.*
b. On engines with an air vane governor, the mounting holes of the armature are slotted. Push armature away from flywheel as far as possible and tighten one mounting screw. You are now ready to set the air gap.

20. With armature away from flywheel, place the proper thickness gauge between armature and flywheel. While holding gauge, turn flywheel until magnets are directly below laminations. Loosen the one screw holding armature and let magnets pull armature down against flywheel. Tighten both mounting screws. Rotate flywheel and remove gauge.


<table>
<thead>
<tr>
<th>Basic Model Series</th>
<th>Inches</th>
<th>mm</th>
</tr>
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<tbody>
<tr>
<td>60000, 80000, 90000, 110000</td>
<td>.010</td>
<td>0.15/0.25</td>
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<td>100000, 130000</td>
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<tr>
<td>400000, 420000</td>
<td>.010/.014</td>
<td>0.25/0.36</td>
</tr>
</tbody>
</table>

22. Install blower housing, oil tube and casing clamp.

23. Install tank assembly (when used).
   a. Finger guard
   b. Oil cap
   c. Gas line
   d. Primer line (if available)
Testing

24. Check Ignition (Magnamatic).

(a) Use a new spark plug. Gap electrode to .060". Install spark plug. If the engine will start and accelerate properly with this wide gap, the spark is good.

(b) Using a test spark plug, rotate flywheel a minimum of 350 RPM and observe the spark. The gap should be a bright blue color. The system is functioning satisfactorily.

25. Gap new spark plug to .030" gap and install.

NOTE: Always use a wire gauge.

26. Clean your work area and return tools and equipment to their proper places.
Installing and Servicing Composite Magnetron® Ignition
Competency Profile

Directions: This profile provides a record for student, instructor, and/or industry representative. The competencies listed below represent the tasks to be performed when installing and servicing a Composite Magnetron® ignition system. Compile your evaluation of the student (trainee) by checking the appropriate “yes/no” rating.

NOTE: This profile can be used as repair procedure for disassembly, repair and assembly.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Disassembly</th>
</tr>
</thead>
<tbody>
<tr>
<td>___</td>
<td>___</td>
<td>1. Read Briggs &amp; Stratton Service and Repair Instructions.</td>
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<tr>
<td>___</td>
<td>___</td>
<td>2. Organize your work station.</td>
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<tr>
<td>___</td>
<td>___</td>
<td>3. Wear proper safety clothing.</td>
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<tr>
<td>___</td>
<td>___</td>
<td>4. Select proper tools and equipment.</td>
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<tr>
<td>___</td>
<td>___</td>
<td>5. Disconnect spark plug wire and remove spark plug.</td>
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<td>___</td>
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<td>6. Check ignition.</td>
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<td>___</td>
<td>___</td>
<td>7. Troubleshoot Ignition System.</td>
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<td>___</td>
<td>___</td>
<td>8. Disable engine from starting.</td>
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<tr>
<td>___</td>
<td>___</td>
<td>9. Remove tank assembly.</td>
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<tr>
<td>___</td>
<td>___</td>
<td>10. Remove blower housing, oil tube and casing clamp.</td>
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<tr>
<td>___</td>
<td>___</td>
<td>11. Test Magnetron® armature.</td>
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<tr>
<td>___</td>
<td>___</td>
<td>12. Replace and check flywheel key.</td>
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<tr>
<td>___</td>
<td>___</td>
<td>13. Inspect flywheel key and key ways, flywheel and crankshaft.</td>
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<td></td>
<td>Reassembly</td>
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<tr>
<td>___</td>
<td>___</td>
<td>14. Service the Composite Magnetron® armature assembly.</td>
</tr>
<tr>
<td>___</td>
<td>___</td>
<td>15. Clean crankshaft and flywheel taper.</td>
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<tr>
<td>___</td>
<td>___</td>
<td>16. Install Belleville Washer.</td>
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<tr>
<td>___</td>
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<td>17. Attach flywheel screen.</td>
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<tr>
<td>___</td>
<td>___</td>
<td>18. Install fan retainer. Torque to specifications.</td>
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<td>20. Adjust proper armature and flywheel gap.</td>
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<td>___</td>
<td>___</td>
<td>21. Adjust flywheel and armature air gap.</td>
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<tr>
<td>___</td>
<td>___</td>
<td>22. Install blower housing, oil tube and casing clamp.</td>
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<td>___</td>
<td>25. Gap new spark plug to specifications.</td>
</tr>
<tr>
<td>___</td>
<td>___</td>
<td>26. Clean work area and return tools and equipment to proper places.</td>
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</tbody>
</table>

Student's Signature ____________________________ Instructor's Signature ____________________________ Date ____________________________
Introduction

The new Briggs & Stratton ignition system (no breaker points and condenser) is called Magnetron®. It is possible, with a minimum effort, to retrofit the Magnetron® ignition system to most older engines equipped with breaker points and condenser.

Magnetron® Module

FRONT VIEW

REAR VIEW

Magnetron® Module
Magnetron Retrofit Installation
Step-by-Step Procedure

Unit Objectives

After completing this unit, you should be able to identify tools and how to properly use them, properly install a Magnetron Retrofit ignition, and test the system. This knowledge will be evidenced through your ability to properly install Magnetron Retrofit Ignition, test it and have it perform correctly.

Specific Objectives

After completion of this unit, you should be able to:

1. Identify tools and their proper use.
2. Identify component parts of the Magnetron.
3. Install the "Magnetron" Retrofit module.
4. Test the "Magnetron" Retrofit ignition.
A. Tools and Supplies

**Tools**
- Spark plug wrench 3/4", 13/16"
- Slot head screwdrivers 4", 6"
- Phillips head screwdrivers 4", 6"
- Putty knife
- Socket set 3/8", 7/16"
- Wire feeler gage
- Flywheel holder tool
- Starter clutch wrench
- Flywheel puller
- Torque wrench
- Needle nose pliers
- Soldering iron
- Side cutting pliers
- Condenser spring compressor
- Air gap gauge .010

**Supplies**
- Penetrating oil
- New spark plug
- Magnetron Ignition Kit
- 60/40 solder (rosin core)
- Permatex No. 2 (or similar sealer)
B. Installing Magnetron® Retrofit Kit

Disassembly

1. Read operator’s manual and Briggs & Stratton Service and Repair Instructions. Magnetron® Ignition System Module can only be used on 7-hp (or larger) engines equipped with a two-leg armature.

2. Wear proper safety equipment.

3. Select proper tools and equipment.

4. Disconnect spark plug wire and remove spark plug. Remove blower housing, screen, starter clutch or nut, flywheel and flywheel key.

**NOTE:** Discard the old key. A new key is furnished in Magnetron® Ignition Kit.

**NOTE:** The old ignition will be inactive. You may leave it in place as in step 5 or remove it as in step 6.

5. Cut armature primary and stop switch wires as close as possible to the dust cover when leaving the old ignition.

**NOTE:** This step applies only when leaving the old ignition on the engine.

**NOTE:** Magnetron Ignition System Module can only be used on engines equipped with a two-leg armature.

6. Remove dust cover, breaker points, condenser, and plunger. **Plunger hole must be plugged using part #231143.** Place dust cover on engine.

**NOTE:** Follow this step only when removing the breaker points, condenser and plunger. Do this when excessive oil is entering the plunger hole into the ignition.

Illustrations courtesy of Briggs & Stratton Corporation
7. Remove screws and armature from the engine. Now cut armature primary wire 3". Strip insulation 5/8" and clean wire. Be sure varnish is removed and wire is not nicked or cut.

8. Install module as shown in illustration. Air vane brackets or guides on armature must be altered for module clearance.

**NOTE:** On 7 h.p. engines and larger, the Magnetron module can only be used on a two-leg armature.

9. Insert spring and wire clip into module. Use a condenser or similar tool to press spring and insert armature primary wire, new stop switch wire and module primary wire.
10. Twist armature ground wire and module ground wires together (two turns) close to armature coil and solder. Remove shortest ground wire by cutting it off close to soldered connection. (Only one ground wire terminal needs to be attached under the armature mounting screw.) **Do not install ground wire terminal on governor blade side of armature.** Solder wire ends using 60/40 resin core solder.

11. Fasten armature to the cylinder. The module ground wire terminal must be attached to armature with screws as shown in illustration. **DO NOT install ground wire terminal on governor blade side of armature.** Module terminal MUST be toward the cylinder after assembly of armature to the engine.

12. Route stop switch wire from module, following the same path as the original wire. Fasten wire to kill switch terminal. Keep wire away from flywheel.

13. Install flywheel using the new flywheel key. **Do not use the original flywheel key.**
14. Torque the flywheel hex nut or starter clutch to specification. See chart for flywheel torque.

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<td>20.0</td>
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</table>

**WARNING:** FAILURE TO APPLY PROPER TORQUE MAY RESULT IN A SHEARED FLYWHEEL KEY. This may produce a dangerous kickback when starting engine.

15. Set the flywheel/armature air gap to specification noted for your engine. See illustration.

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16. Install blower housing, oil tube and casing clamp.
17. Test spark. See illustration.

**NOTE:** This test must be performed before starting engine to determine if STOP switch is functioning properly.

(a) Place the equipment stop switch control in "STOP" position.

(b) Pull starter. The engine is required to obtain a speed of approximately 350 RPM to produce a spark. There should be no spark. If spark occurs, check the stop switch and connections. Retest.

(c) Place the stop switch control in "START" position and pull starter. There should be a spark. If no spark occurs, check for broken wires, shorts, grounds, or defective kill switch.

18. Remove spark tester and fasten wire to spark plug.

19. Start the engine.

**NOTE:** If spark occurs and engine does not start, check for a sheared flywheel key.

20. Clean your work area and return tools and equipment to their proper places.
**Magnetron® Retrofit Installation Competency Profile**

**Directions:** This profile provides a record for student, instructor, and/or industry representative. The competencies listed below represent the tasks to be performed when installing the Magnetron® ignition system. Compile your evaluation of the student (trainee) by checking the appropriate “yes/no” rating.

**NOTE:** This profile can be used as repair procedure for disassembly, repair and reassembly.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Disassembly</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1. Read Briggs &amp; Stratton Service and Repair Instructions.</td>
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<tr>
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<td>2. Wear proper safety equipment.</td>
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<tr>
<td></td>
<td></td>
<td>3. Select proper tools and equipment.</td>
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<tr>
<td></td>
<td></td>
<td>4. Disconnect the spark plug wire and remove spark plug.</td>
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<tr>
<td></td>
<td></td>
<td>5. Cut armature primary and stop switch wires.</td>
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<td></td>
<td></td>
<td>6. Remove dust cover, breaker points, condenser and plunger.</td>
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<tr>
<td></td>
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<td>7. Remove screws and armature.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Reassembly</strong></td>
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<tr>
<td></td>
<td></td>
<td>8. Install module.</td>
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<tr>
<td></td>
<td></td>
<td>9. Insert spring and wire clip.</td>
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<td></td>
<td></td>
<td>10. Connect armature ground and module wires.</td>
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<tr>
<td></td>
<td></td>
<td>11. Fasten armature to cylinder.</td>
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<tr>
<td></td>
<td></td>
<td>12. Route stop switch wire from module.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13. Install flywheel.</td>
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<tr>
<td></td>
<td></td>
<td>14. Torque flywheel hex nut to specification.</td>
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<tr>
<td></td>
<td></td>
<td>15. Set flywheel/armature air gap to specification.</td>
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<tr>
<td></td>
<td></td>
<td>16. Install screen, blower housing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17. Test spark.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18. Remove spark tester and connect spark plug wire.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20. Clean work area and return tools and equipment to proper places.</td>
</tr>
</tbody>
</table>

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Student's Signature       Instructor's Signature       Date
Installing Breaker Points and Condenser

Step-by-Step Procedure

Introduction

As a small engine mechanic, you must know how to remove and replace breaker points and condensers. This unit will cover tools and supplies that are needed and a step-by-step procedure for removing and installing breaker points and condensers. This unit also shows how to check the ignition system.
Installing Breaker Points and Condenser
Step-by-step Procedure

Unit Objectives
After completion of this unit, you should be able to identify special tools and their appropriate use, identify ignition parts and their use, properly install points and check out the ignition system. This will be evidenced through your ability to properly install points and condenser.

Specific Objectives
After completing this unit, you should be able to:

1. Identify special tools and their use.
2. Identify ignition parts and their use.
3. Demonstrate the ability to install points and condensers.
4. Demonstrate the ability to test the ignition system.
A. Tools and Supplies

- Starter Clutch Wrench
- Side Cutting Pliers
- Flywheel Holder
- 60-40 Solder
- Flywheel Puller
- Needle Nose Pliers
- Slot Head Screwdriver
- Spark Tester
- Starter Clutch Wrench
- Feeler Gauge
- Plunger Plug
- Penetrating Oil
- Pocket Knife
- Permatex Sealer
- Soldering Iron
- Spark Plug Gap Tool
- Torque Wrench
- Condenser Spring Compressor
Breaker Points and Condenser

Phillips Screwdriver

Shim Stock .010"

Mallet

Box Wrench

Socket Set

Flywheel Holder

Spark Tester
B. Step-by-Step Procedure for Installing Breaker Points and Condenser

Testing and Disassembly

1. Read operator’s manual and Briggs & Stratton's Service and Repair Instructions.

2. Organize your tools and work bench. Use an engine holder to secure engine for disassembly. Place parts, nuts and bolts in containers for safekeeping.

⚠️ 3. Follow all safety procedures.

4. Disconnect wire. Remove and clean spark plug. Clean spark plug with a penknife or wire brush and solvent and set gap at .030" (0.75 mm) for all models. If electrodes are burned away, or if the porcelain is cracked, replace with a new plug. Do not use abrasive cleaning machines.

**NOTE:** The plugs recommended for Briggs & Stratton engines are as follows:

<table>
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<tr>
<th>R-CJ-8</th>
<th>Resistor</th>
<th>Spark plug number</th>
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<th>Part Number</th>
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<tr>
<td>CJ-8</td>
<td>J-8C</td>
<td>J-19LM*</td>
<td>Champion</td>
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<td>J-19LM*</td>
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<td>Champion Resistor</td>
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<td>RJ-19LM*</td>
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<tr>
<td>235</td>
<td>295</td>
<td></td>
<td>Autolite</td>
</tr>
<tr>
<td>245</td>
<td>306</td>
<td></td>
<td>Autolite Resistor</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>13/16&quot;</td>
<td></td>
<td>Spark Plug Wrench (deep socket)</td>
</tr>
</tbody>
</table>

**NOTE:** Use resistor spark plug to suppress ignition signals.

5. Using a test plug, connect the high-tension lead to the test plug and ground test plug to the cylinder head bolt.

Crank the engine 2 to 3 times and observe the spark at the test plug. The spark should jump the gap and should be a bright blue color. This indicates the ignition system is functioning properly.
6. Unscrew the bolt to the throttle cable clamp and remove throttle cable.

7. Remove flywheel shroud using a 7/16" socket. There will be three bolts on the flywheel shroud.

8. Remove flywheel screen from flywheel.

9. Place flywheel holder securely on flywheel.
10. Place starter clutch wrench securely on starter clutch.

11. Tap wrench handle with mallet to loosen and remove starter clutch.

   NOTE: Use penetrating oil around flywheel to help loosen.

12. Place flywheel puller on flywheel.

   NOTE: Always turn magnet away from the armature so you can easily remove the flywheel.

13. Fasten flywheel puller to flywheel with the two self-tapping screws.

   NOTE: Alternate between the self-tapping screws when tightening. Complete one to two turns at a time to insure proper alignment with flywheel holes. Make sure you thread self-tapping screws into flywheel as far as they can go.
14. Turn the two bottom nuts tightly against flywheel.

15. Alternate turn the two top nuts to loosen flywheel.

16. Remove and inspect flywheel and key.

**NOTE:** If the magnet is rusty, clean with emery cloth and cleaner brush. Do not drop.

**NOTE:** Check condition of flywheel keyway and magnet. Check key closely for damage. If damaged, replace with new key.

17. Wrap flywheel in a shop towel to prevent magnet from picking up bolts and nuts.

18. Remove breaker point dust cover.

**NOTE:** Dust cover may "stick" at site of wire entrance. Remove carefully to prevent bending cover.
19. Rotate crankshaft clockwise with your hand until the key way is in line with breaker point plunger. At this point the cam is at its highest position. Points are installed at the highest position of the cam.

20. Remove bolt and clamp over the condenser.

21. While compressing the spring, pull the two wires out of the hole in the condenser. Use either of the two methods illustrated.

22. Remove and discard the condenser.
23. Loosen mounting bolt and remove the movable contact point.

**NOTE:** When mounting bolt is loosened, the contact point loses its tension.

24. Lift spring from post and remove mounting bolt, contact point, mounting post and spring.

**NOTE:** Keep the mounting bolt. Always replace old contact points with a new set.

25. Remove and inspect the breaker point plunger.

26. Check breaker point plunger hole.

**NOTE:** A worn breaker point plunger hole can cause oil to leak past the plunger and contaminate the breaker points, causing them to burn.

**NOTE:** To check the plunger hole for wear, use Tool #19055. If the flat end of the plug gauge will enter plunger hole 1/4" or more, the hole must be rebushed.

**NOTE:** When breaker point plunger hole is worn beyond tolerance, install Magnetron® instead of rebushing breaker point plunger hole.
Reassembly

27. Insert the breaker point plunger with the groove side up before installing the breaker point assembly.

28. Before installing the points recheck the position of the crankshaft. Make sure keyway aligns with breaker point plunger hole. This will ensure the cam is at its highest position.

29. Install new movable contact point. Hook open loop of spring through large hole, then through small hole.

30. Place mounting bolt into post and tighten.

NOTE: Handle movable points carefully to prevent breaking wire connection to post.

31. To install the breaker arm assembly, first place the contact point arm into the groove in mounting post. Hold arm in place while using needle nose pliers to hook the closed loop of the spring onto the anchor post. Push breaker arm up and over the breaker point plunger. Check and tighten mounting bolt. See illustration.
32. Place spring on condenser and hold it in place.

   **NOTE:** Flatten wire ends around fixed point.

33. Compress spring and slip the two wires into the hole on condenser.

34. Install new condenser and clamp in place. Tighten the clamp bolt.

35. Select correct size feeler gauge.

   **NOTE:** Make sure the crankshaft keyway is lined up with the breaker plunger.
36. Tighten the condenser clamp. Place feeler gauge between contact points, push condenser forward with a screwdriver and set the points at .020. Make sure condenser clamp is secured.

*NOTE: The condenser should move back and forth to properly set points.*

37. Make sure the two contact points fit squarely together, and not at an angle. Adjust the movable contact points, if necessary.

After the breaker point gap has been set at .020", rotate the crankshaft until the points are closed. Lift the breaker arm and insert a clean piece of paper. Release the breaker arm and draw the paper back and forth to clean the points.

38. Open breaker points to remove paper so it will not tear or leave dirt on breaker points.

39. Place sealer around wiring. Replace dust cover and bolts on the points and condenser.
40. Place flywheel on crankshaft and line up the keyway.

41. Place flywheel key in keyway.

42. Place flywheel holder on flywheel and starter clutch wrench on starter clutch. While holding the flywheel holder, tighten starter clutch.

43. Torque the flywheel hex nut or starter clutch to specification. See chart for flywheel torque.

**CAUTION:** FAILURE TO APPLY PROPER TORQUE MAY RESULT IN A SHEARED FLYWHEEL KEY. This can produce a kickback when starting engine.

**Flywheel Torque**

<table>
<thead>
<tr>
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<th>Ft. Lbs.</th>
<th>Mkg.</th>
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</thead>
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<td>9.3</td>
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<td>220000, 250000</td>
<td>75</td>
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<td>233400, 243400, 326400, 400000, 420000</td>
<td>145</td>
<td>20.0</td>
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</tbody>
</table>
44. Add a drop or two of oil to the hole in the starter clutch. This will keep the crankshaft stub lubricated and prevent squealing and seizing.

45. Check air gap by loosening the two armature bolts, inserting .010 shim stock between flywheel and armature, and rotating the flywheel until magnets pull armature down to shim stock. Tighten armature bolts and remove shim stock.

46. Attach flywheel screen over starter clutch.

47. Replace flywheel shroud and tighten the bolts. Reconnect throttle cable if necessary.
48. Replace throttle cable and adjust.

*NOTE:* Using a test plug, rotate flywheel a minimum of 350 RPM and observe the spark. The spark should be a bright blue color. If the spark is blue and jumps the .166" tester gap, the system is functioning satisfactorily.

49. Gap spark plug to .030" gap and install.

*NOTE:* Always use a wire gauge.

50. Crank the engine to see if it runs properly.

*CAUTION:* Check with your instructor before starting engine. Make sure area under and around engine is clear before starting it.

51. Clean your work area and return tools and equipment to their proper places.
### Installing Breaker Points and Condenser Competency Profile

**Directions:** This profile provides a record for student, instructor, and/or industry representative. The competencies listed below represent the tasks to be performed in Installing Breaker Points and Condenser. Compile your evaluation of the student (trainee) by transferring the appropriate “yes/no” rating.

**NOTE:** This profile can be used as repair procedure for disassembly, repair and assembly.

<table>
<thead>
<tr>
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<th>No</th>
<th>Ignition System Disassembly</th>
</tr>
</thead>
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<tr>
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<td>1. Read Briggs &amp; Stratton’s Service and Repair Instructions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Organize your tools and work bench.</td>
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<tr>
<td></td>
<td></td>
<td>3. Follow all safety procedures.</td>
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<tr>
<td></td>
<td></td>
<td>4. Disconnect wire; remove and clean spark plug.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Use test plug to see if ignition system is functioning properly.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6. Remove throttle cable.</td>
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<tr>
<td></td>
<td></td>
<td>7. Remove flywheel shroud.</td>
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<tr>
<td></td>
<td></td>
<td>8. Remove flywheel screen from flywheel.</td>
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<td>9. Place flywheel holder securely on flywheel.</td>
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<td>10. Place starter clutch wrench securely on starter clutch.</td>
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<td></td>
<td>11. Loosen and remove starter clutch.</td>
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<td></td>
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<td>12. Place flywheel puller on flywheel.</td>
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<td></td>
<td></td>
<td>13. Fasten flywheel puller to flywheel.</td>
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<td>14. Turn two bottom nuts tightly against flywheel.</td>
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<td>15. Alternately turn the two top nuts to loosen flywheel.</td>
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<td>16. Remove and inspect flywheel and key</td>
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<td></td>
<td>17. Wrap flywheel in a shop towel.</td>
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<tr>
<td></td>
<td></td>
<td>18. Remove breaker point dust cover.</td>
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<tr>
<td></td>
<td></td>
<td>19. Rotate crankshaft clockwise until key way is in line with breaker point plunger.</td>
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<tr>
<td></td>
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<td>20. Remove bolt and clamp over the condenser.</td>
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<td></td>
<td>21. While compressing the spring, pull the two wires out of the hold on the condenser.</td>
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<tr>
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<td></td>
<td>22. Remove and discard the condenser.</td>
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<tr>
<td></td>
<td></td>
<td>23. Loosen mounting bolt and remove the movable contact point.</td>
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<tr>
<td></td>
<td></td>
<td>24. Lift spring from post and remove mounting bolt, contact point, mounting post and spring.</td>
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<tr>
<td></td>
<td></td>
<td>25. Remove and inspect the breaker point plunger.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>26. Check breaker point plunger hole.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>27. Insert the breaker point plunger with the groove side up.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>28. Recheck the position of the crankshaft.</td>
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</table>

**Ignition System - Reassembly**

<table>
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<tr>
<th>Yes</th>
<th>No</th>
<th>Ignition System Disassembly</th>
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<tr>
<td></td>
<td></td>
<td>29. Install new movable contact point.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30. Place mounting bolt into post and tighten.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>31. Install the breaker arm assembly.</td>
</tr>
</tbody>
</table>
32. Place spring on condenser and hold it in place.
33. Compress spring and slip the two wires into the hole on condenser.
34. Install new condenser.
35. Select correct size feeler gauge.
36. Tighten the condenser clamp.
37. Make sure the two contact points fit squarely together.
38. Open breaker points to remove paper so it will not tear or leave dirt on breaker points.
39. Place sealer around wiring. Replace dust cover.
40. Place flywheel on crankshaft and line up the key way.
41. Place flywheel key in key way.
42. Place flywheel holder on flywheel and starter clutch wrench on starter clutch. Tighten starter clutch.
43. Torque the flywheel hex nut or starter clutch to specification.
44. Add a drop or two of oil to the hole in the starter clutch.
45. Check air gap. Tighten armature bolts and remove shim stock.
46. Attach flywheel shroud over starter clutch.
47. Replace flywheel shroud and tighten the bolts.
48. Replace throttle cable and adjust.
49. Gap spark plug to .030" gap and install.
50. Crank the engine to see if it runs properly.
51. Clean work area and return tools and equipment to their proper places.
Specifications For All Popular Briggs & Stratton Engines

1. Spark plug gap: .030"
2. Condenser capacity: .18 to .24 MFD.
3. Breaker point gap: .020"

Engine Specifications for Briggs and Stratton Engines

Contact Point Gap: .020 All Models
Spark Plug Gap: .030 All Models
Condenser Capacity: .18 to .24 MFD All Models
Idle Speed for Aluminum Engines: 1750 RPM.
(60000-250000 model series)

Personal Engine Data For Ordering Parts

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### Specifications for all Popular Briggs & Stratton Engines

1. Spark plug gap: .030"  
2. Condenser capacity: .18 to .24 M.F.D.  
3. Break point gap: .020"

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♦ Use 19244 starter clutch wrench on rewind starter engines.  
• Use 19203 on Model Series 250000 built after 1975 and all Model Series 220000.  
• Use 19165 on Model Series 250000 built 1975 and before.

Courtesy of Briggs & Stratton Corporation
Carburetor Service and Repair

Revised Edition

INSTRUCTIONAL MATERIALS LABORATORY
UNIVERSITY OF MISSOURI-COLUMBIA
COLUMBIA, MISSOURI
MODULE 2

Carburetor Service and Repair

Prepared by: Amon Herd
Preface

This manual is designed to bring the student or home owner to a minimum performance level in properly servicing a small engine's ignition system. These step-by-step procedures include illustrations clarifying each procedure. The accompanying performance task list may be used as an evaluation or as a quick reference of repair procedures.

For many years those responsible for teaching small engine repair have needed materials that are basic, readable and usable. Although this series was written primarily for adult education, it can become a vital teaching tool in any program through live demonstrations and classroom instruction.

The author, Amon Herd, brings to this new series many years of small engine experience. Amon's "hands on" knowledge comes from twenty-five years of classroom teaching and small engine repair.
Acknowledgments

Appreciation is extended to those individuals who contributed time and talents in the development of Small Engine Carburetor Service and Repair, Second Edition.

Instructional Materials Laboratory Staff:
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Dan Stapleton, Assistant Director
Eileen Woody, Administrative Assistant

Linda Winn, Graphic Designer
Randy Mertens, Editor
Kristin Desborough, Assistant Editor
Lori Holliday, Word Processor III

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American Association for Vocational Instructional Materials

Appreciation is expressed to:
Dan Hostetler, Boonville, Missouri, Harold Bossaler, Columbia, Missouri, Dr. Milo Spurgeon, Columbia, Missouri for their contributions to this manual.

References


Small Engines Operation Maintenance and Repair, J. Howard Turner, American Association for Vocational Instructional Materials, -Athens, Georgia.


Fuels and Lubricants, Harold Parady and Thomas Colvin, American Association for Vocational Instructional Materials, Athens, Georgia.


Carburetor
Service and Repair

Unit Objectives

After completing this unit, the student should be able to identify carburetor types and their components. The student should be able to identify and service air filters. The student should also be able to remove, service, and replace Walbro, Flo-Jet, Puls-Jet, and Vacu-Jet carburetors. This knowledge will be evidenced through the student's ability to properly service these carburetors, fuel filters, and air cleaners.

Specific Objectives

After completion of this unit, the student should be able to:

1. Identify types of air and fuel filters.

2. Identify small engine carburetor parts and their uses.

3. Demonstrate the ability to:
   a. Service air cleaners.
   b. Service and repair Walbro carburetors.
   c. Service and repair Flo-Jet carburetors.
   d. Service and repair Puls-Jet carburetors.
   e. Service and repair Vacu-jet carburetors.
Carburetor
Service and Repair

Introduction

The purpose of the carburetor is to properly mix fuel and air into the combustible mixture necessary to make ignition occur in a small engine. The carburetor does this by vaporizing the fuel, mixing it with the proper portion of air, and delivering this correct mix to the cylinder for ignition. Economical fuel consumption and smooth engine operation require a correctly-adjusted and properly-maintained carburetor.

The carburetor is part of a fuel delivery system which also includes the air cleaner, fuel tank, and gas line.
Important Safety Notice

The procedures used in this manual are effective in performing the service operation. Throughout the manual are various safety procedures and cautions that must be followed to prevent personal injury. The University and author cannot assume the responsibility for any changes, errors or omissions. Always consult the approved service manual for specific information.

In the Interest of Safety

This symbol means WARNING or CAUTION. Personal injury and property damage may occur unless instructions are followed carefully.

WARNING
DO NOT run engine in an enclosed area. Exhaust gases contain carbon monoxide, an odorless and deadly poison.

DO NOT check for spark with spark plug or spark plug wire removed. Use an approved tester.

DO NOT crank engine with spark plug removed. If engine is flooded, place throttle in “Fast” position and crank until engine starts.

DO NOT smoke when filling fuel tank.

DO NOT FILL FUEL TANK while engine is running. Allow engine to cool for two minutes before refueling.

DO NOT operate engine if gasoline has been spilled. Move machine away from the spill and avoid creating any ignition until the gasoline has evaporated.

DO NOT STORE, SPILL, OR USE GASOLINE NEAR AN OPEN FLAME or devices such as a stove, furnace, or water heater which utilize a pilot light or devices which can create a spark.

DO NOT refuel indoors or in any area that is not well ventilated. Outdoor refueling is preferred.

DO NOT OPERATE ENGINE WITHOUT A MUFFLER. Inspect periodically and replace if defective.

DO NOT operate engine with an accumulation of grass, leaves, dirt, or other combustible material in the muffler area.

DO NOT use an engine on any forest covered, brush covered, or grass covered unimproved land unless a spark arrester is installed on the muffler.

DO NOT run engine with air cleaner or cover removed.

CAUTION
DO NOT run engine at excessive speeds. This may result in injury.

DO NOT tamper with governor springs, governor links, or other parts which may increase the governed engine speed.

DO NOT tamper with the engine idle speed selected by the original equipment manufacturer.

DO NOT touch hot mufflers, cylinders, or fins as contact may cause burns.

DO NOT place hands or feet near moving or rotating parts.

TO PREVENT ACCIDENTAL STARTING when servicing the engine or equipment, always remove the spark plug or wire from the spark plug. Disconnect negative wire from battery terminal if equipped with a 12-volt starting system.

DO pull starter cord slowly until resistance is felt. Then pull cord rapidly to avoid kickback and prevent hand or arm injury.

DO use fresh gasoline. Stale fuel can cause leakage.
A. Tools and Materials Needed to Service the Air Cleaner and Carburetor

Tools
Standard and Phillips screwdrivers (4" and 6")
Open end wrenches (1/4" x 5/16"; 3/8" x 7/16"; and 9/16" x 1 1/2")
Nut drivers (1/4"; 5/16"; 3/8"; and 7/16")
Feeler gauges (.002)
Ballpeen hammer
Oil fill tube
Steel rule
Pliers
Set of sockets (3/8" and ratchet)
Special Briggs and Stratton carburetor screwdrivers
Parts cleaning brush
Parts scraper or putty knife
Tachometer
Needle-nose pliers
#19057 Briggs and Stratton brushing driver
Safety glasses

Supplies
Air filter and gasket
Penetrating oil
Detergent (soap)
O-ring
Cleaning solvent
Carburetor cleaner
Gasoline
Carburetor repair kit (needle and seat and gaskets)
Diaphragm
Metal container for carburetor cleaner
Parts cleaning pan
Shop towels
30W oil

Reference Manuals
Operator's manual
Briggs & Stratton Service and Repair Manual
B. Step-By-Step Procedure for Servicing an Oil Foam Air Cleaner


⚠ CAUTION: Wear proper safety equipment and observe this symbol as a WARNING OR CAUTION. Personal injury may occur unless instructions are followed carefully.

2. Disconnect the spark plug wire.

3. Clean area around the air cleaner.

4. Remove the air cleaner.
5. Cover carburetor air intake.

6. Disassemble air cleaner.

7. Check condition of filter element and other air cleaner parts.

   *Note:* Polyurethane filters become brittle and will crumble. Replace filter when this condition exists.

8. Clean filter element using liquid detergent and hot water.

9. Dry the filter element.

10. Saturate filter element with engine oil.

11. Squeeze to remove excess oil.

12. Remove protective cover from the carburetor intake.
13. Clean the carburetor intake with soft cloth and solvent.

14. Replace air cleaner gaskets that are worn or damaged.

*Note: Clean and reoil air cleaner element every 25 hours or at three month intervals under normal conditions. Clean every few hours under extremely dusty conditions.*

15. Reassemble air cleaner and tighten the cover securely with screw or wing nut.

16. Reconnect spark plug wire.
**Engine Carburetor Service and Repair Competency Profile**

**Directions:** The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate “yes/no” rating.

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**Servicing an Oil Foam Air Cleaner**

1. Read operator's manual.
2. Disconnect spark plug wire.
3. Clean area around air cleaner.
4. Remove air cleaner.
5. Cover carburetor air intake.
6. Disassemble air cleaner.
7. Check condition of filter element.
8. Clean filter element.
9. Dry filter element.
10. Saturate filter element with engine oil.
11. Squeeze to remove excess oil.
12. Remove protective cover from intake.
13. Clean carburetor intake.
14. Replace air cleaner gaskets.
15. Reassemble air cleaner.
16. Reconnect spark plug wire.

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Student's Signature ____________________  Instructor's Signature ____________________  Date ____________
C. Servicing a Cartridge Air Cleaner (Round)

1. Always read the operator's manual and
   Briggs & Stratton Service and Repair
   Manual.

⚠️ CAUTION: Wear proper safety equipment.

2. Disconnect the spark plug wire.

3. Clean area around the air cleaner.

4. Remove wing nut and cover.

5. Carefully remove air cleaner from engine and
disassemble.

6. Check condition of filter element and other
parts of air cleaner.

7. To clean cartridge, tap top or bottom on a flat
surface or wash in a non-sudsing detergent
and flush from the inside until water is clear.
After washing, air dry thoroughly before using.

Note: Do not oil.

⚠️ CAUTION: Do not use pressurized air
to clean dry cartridge.

8. Reassemble air cleaner.

9. Check air cleaner gasket and replace if worn
or damaged.

10. Carefully install air cleaner on engine and
    reconnect the spark plug wire.

Illustrations courtesy of Briggs & Stratton Corporation
Small Engine Carburetor Service and Repair Competency Profile

Directions: The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate "yes/no" rating.

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Servicing a Cartridge Air Cleaner (Round)

1. Read operator's manual.
2. Disconnect the spark plug wire.
3. Clean area around the air cleaner.
4. Remove wing nut and cover.
5. Remove air cleaner and disassemble.
6. Check condition of filter.
7. Clean filter cartridge.
8. Reassemble air cleaner.
9. Check air cleaner gasket.
10. Install air cleaner. Reconnect spark plug wire.
11. Reassemble air cleaner.
12. Clean carburetor intake.
13. Replace air cleaner gaskets.

Student's Signature       Instructor's Signature       Date
D. Servicing a Reverse Air Flow Cartridge Air Cleaner

1. Always read the operator's manual and Briggs and Stratton Service and Repair Manual.

⚠️ CAUTION: Wear proper safety equipment.

2. Disconnect the spark plug wire.

3. Clean area around air cleaner.

**Disassembly**

4. Remove air cleaner stud, cover screw, cover, and gasket. Replace gasket if worn or damaged.

5. Remove plate screw, washer, and plate.

6. Remove cartridge and clean body of air cleaner.

*Note: Place a protective cover over the carburetor intake.*

7. Clean cartridge by tapping gently on a flat surface.

8. If the cartridge is very dirty, it should be replaced or washed in a low-sudsing detergent and warm water.

⚠️ WARNING: Do not use petroleum solvents, such as kerosene, to clean cartridge. Do not oil cartridge.

9. Rinse thoroughly from the outside until water is clear.

10. Dry thoroughly before using.
Reassembly

11. Reassemble air cleaner.

*Note:* If air cleaner stud is bent, straighten or replace with a new one.

12. Remove the protective cover from carburetor intake and clean intake with a lint-free cloth and solvent.

13. Replace worn or damaged air cleaner gaskets.

14. Carefully install air cleaner on engine and reconnect the spark plug wire.
## Small Engine Carburetor Service and Repair Competency Profile

### Directions:
The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate “yes/no” rating.

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**Servicing a Reverse Air Flow Cartridge Air Cleaner**

1. Read the operator’s manual.
2. Disconnect the spark plug wire.
3. Clean area around air cleaner.
4. Remove air cleaner stud, cover screw, cover, gasket.
5. Remove plate screw, washer, and plate.
6. Remove cartridge and clean body of air cleaner.
7. Clean cartridge.
8. Replace cartridge if too dirty.
9. Rinse cartridge.
10. Dry cartridge.
11. Reassemble air cleaner.
12. Remove cover from carburetor intake and clean.
13. Replace worn or damaged air cleaner gaskets.

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**Student’s Signature**  
**Instructor’s Signature**  
**Date**
E. Servicing a Flat Cartridge (Vertical Crankshaft) Air Cleaner

1. Read operator’s manual and Briggs & Stratton Service and Repair Manual.

⚠️ CAUTION: Wear proper safety equipment.

2. Disconnect the spark plug wire.

3. Clean area around air cleaner before removing.

Disassembly

4. Loosen cover screw and remove cover. Clean for reassembly.

5. Carefully remove cartridge and foam pre-cleaner (when equipped).

6. Clean cartridge by tapping gently on a flat surface. If very dirty, replace the cartridge and pre-cleaner or clean as follows:

   a. Wash cartridge and pre-cleaner in a low- or non-sudsing detergent and warm water solution.
   b. Rinse thoroughly with flowing water from inside out until water is clear.
   c. Allow cartridge and pre-cleaner to stand and air dry thoroughly before using.
CAUTION: DO NOT OIL CARTRIDGE OR USE PRESSURIZED AIR TO CLEAN OR DRY CARTRIDGE.

* Petroleum solvents are not to be use to clean the cartridge.

7. Air Cleaner Maintenance
   a. Service pre-cleaner, if so equipped, every 25 hours or every season, whichever occurs first.
   b. Service cartridge every 100 hours or every season, whichever occurs first, if equipped with pre-cleaner.
   c. Service cartridge every 25 hours or every season, whichever occurs first, if NOT equipped with pre-cleaner.

Note: Service more often under dusty conditions.

d. Loosen screw and tilt cover as illustrated.
e. Carefully remove foam pre-cleaner when so equipped.

8. Install pre-cleaner and cartridge in cover; insert tabs on cover into slots in bottom of base, tilt cover up and fasten screw securely to base.

9. Reconnect the spark plug wire.
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**Servicing a Flat Cartridge (Vertical Crankshaft) Air Cleaner**

1. Read operator's manual.
2. Disconnect the spark plug wire.
3. Clean area around air cleaner before removing.
4. Remove cover. Clean for reassembly.
5. Remove cartridge and foam pre-cleaner.
6. Clean cartridge.
7. Service air cleaner.
8. Install new pre-cleaner and cartridge in cover.
9. Reconnect spark plug wire.

**Student's Signature** __________________________  **Instructor's Signature** __________________________  **Date** __________________________
F. Servicing a Flat Cartridge (Horizontal Crankshaft) Air Cleaner


⚠️ CAUTION: Wear proper safety equipment.

2. Disconnect spark plug wire.

3. Clean area around air cleaner before removing.

**Disassembly**

4. Service air cleaner. Loosen two screws and remove cover.

5. Carefully remove pre-cleaner (if equipped) and cartridge.

6. Clean air cleaner housing and carburetor intake.

7. Clean cartridge by tapping gently on a flat surface. If very dirty, replace cartridge and pre-cleaner or clean as follows:
   a. Wash cartridge and pre-cleaner in a non-sudsing detergent and warm water solution.
   b. Rinse thoroughly with flowing water from mesh side until water is clear.
   c. Wrap foam pre-cleaner in cloth and squeeze dry.
   d. Saturate foam pre-cleaner in engine oil. Squeeze to remove excess oil.
   e. Dry thoroughly before using.

⚠️ CAUTION: Petroleum solvents, such as kerosene, should not be used to clean cartridge. They may damage the cartridge. Do not oil cartridge. Do not use pressurized air to clean or dry cartridge.

*Note: With dual element air cleaner, service pre-cleaner (if equipped) every 2 hours or every season, whichever occurs first.*

Service cartridge every 100 hours or every season, whichever occurs first, if equipped with pre-cleaner.

Service cartridge every 25 hours or every season, whichever occurs first, if NOT equipped with pre-cleaner.

Service more often under dusty conditions.
Reassembly

8. Service air cleaner.
   a. Loosen screw and tilt cover as illustrated.
   b. Carefully remove foam pre-cleaner when so equipped.

9. Install pre-cleaner and cartridge in base plate.

10. Install cover plate and tighten screws securely.

11. Reconnect spark plug wire.
## Small Engine Carburetor Service and Repair Competency Profile

### Directions:
The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate "yes/no" rating.

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### Servicing a Flat Cartridge (Horizontal Crankshaft) Air Cleaner

1. Read operator's manual.
2. Disconnect spark plug wire.
3. Clean area around air cleaner.
4. Service air cleaner.
5. Remove pre-cleaner and cartridge.
6. Clean air cleaner housing and carburetor intake.
7. Clean cartridge.
8. Service air cleaner.
9. Install pre-cleaner and cartridge.
10. Install cover plate.
11. Reconnect spark plug wire.

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**Student's Signature**

**Instructor's Signature**

**Date**
G. Servicing an Oil Bath Air Cleaner


⚠️ CAUTION: Wear proper safety equipment.

2. Disconnect spark plug wire.

3. Clean area around the air cleaner before removing.

## Disassembly

4. Service air cleaner.
   a. Remove air cleaner cover.
   b. Remove air cleaner bowl and pour out old oil.
   c. Wash air cleaner with solvent and refill with the same type of oil used in the crankcase.

⚠️ CAUTION: Do not over fill with oil.

⚠️ WARNING: Safety goggles and rubber gloves should always be worn when working with solvents and commercial carburetor cleaners.

5. Replace air cleaner gaskets if worn or damaged.

⚠️ CAUTION: Do not over fill with oil.

## Reassembly

6. Carefully install air cleaner on engine and reconnect spark plug wire.
Small Engine Carburetor Service and Repair Competency Profile

Directions: The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate "yes/no" rating.

Yes  No

Servicing an Oil Bath Air Cleaner

1. Read operator's manual.
2. Disconnect spark plug wire.
3. Clean area around the air cleaner before removing.
4. Service air cleaner.
5. Replace air cleaner gaskets.
6. Install air cleaner.
7. Reconnect spark plug wire.

Student's Signature  Instructor's Signature  Date
H. Servicing Briggs and Stratton Walbro One-Piece Flo-Jet Carburetor

Note: There are two basic versions of this type carburetor:
   a. Fixed high-speed main jet.
   b. Adjustable high-speed main jet.

1. Read operator's manual and Briggs's and Stratton Service and Repair Manual.
2. Organize your work station. When disassembling carburetor, place bolts, nuts, and parts in containers for safekeeping.
3. Wear proper clothing and safety equipment.

⚠️ Observe this symbol as a WARNING OR CAUTION. Personal injury may occur unless instructions are followed carefully.

Disassembly

4. Disconnect spark plug wire and place in V-Notch on engine.
5. Turn the fuel petcock to OFF position.
6. Inspect carburetor and fuel tank for signs of air leakage.
7. Remove remote control.
8. Use screwdriver to remove the static guard.

9. Remove tank assembly.
   a. Remove oil cap.
   b. Remove fuel line from fuel tank.
   c. Remove primer line from carburetor (not installed on all models).
   d. Remove tank assembly.

10. Remove air cleaner and back plate.

11. Remove gasket and venting grommet from the back plate.

12. Inspect gasket and venting grommet for damage and proper seal.

13. Remove two mounting bolts from carburetor and engine. Check O-ring for damage.

14. Remove fuel line from carburetor.
15. Disconnect governor linkage from carburetor and remove carburetor. Tilt carburetor to remove linkage.

*Note: Removal of Welch plug, choke and throttle shaft were omitted in this procedure. They can be repaired or replaced, if needed.*

16. Remove bowl nut and/or high-speed needle nut and fiber washer.

17. Remove float bowl and bowl gasket from carburetor.

*WARNING: Remove gasoline from bowl and store in an approved container.*

18. Remove float hinge pin, float, and inlet valve.

19. Remove idle mixture screw with spring and observe condition. Do not remove idle speed screw unless you see a problem.

*Note: On Model Series 120000 engines the bowl nut may be removable fixed jet.*

20. Adjust for high altitude compensation, if needed, by removing main jet air bleed.
21. Clean and inspect carburetor. After cleaning, inspect for wear, damage, cracks, or plugged openings. Replace body if any of the above conditions exist.

Note: Inspect idle mixture needle for bent needle point or a groove in tip of needle. Replace if bent or grooved.

Note: Use a good commercial grade carburetor cleaner.

22. Use compressed air to clean carburetor parts.

Reassembly

23. Install inlet needle seat with GROOVE DOWN using Tool #19057 Bushing Driver, until seated.

Note: The inlet needle seat should only be replaced when carburetor is flooding or not functioning properly. Always replace needle and seat as a unit.

24. Install inlet needle on float and install assembly on carburetor body. Insert float hinge pin and center pin.

Note: Float height is not adjustable.

Note: Complete repair kits are available.

25. Install rubber gasket on carburetor and lay float bowl on body. Place fiber washer on bowl nut and torque to 50 inch-lbs. torque.
26. Install carburetor and fuel line.
   a. Install O-ring seal on fuel intake pipe and attach the governor link to the throttle lever.
   b. Install fuel line on carburetor and fuel tank.
   c. Ease carburetor onto fuel intake pipe and install two mounting screws.
   d. Torque screws to 90 inch-lbs.
   e. Open fuel line and check for leaks.

27. Perform initial adjustment.
   a. Install idle speed screw and spring.
   b. Install idle mixture screw and spring.
   c. Turn idle speed screw in until it just touches needle seat. Back out screw 1 and 1/4 turn to permit engine to start.
   d. Turn idle mixture screw in until it just touches needle seat. Back out screw 1 and 1/4 turn to permit engine to start.

   Note: On carburetors with adjustable high-speed needle, turn high-speed adjustment needle clockwise until it just touches needle seat. Then back off 1 and 1/4 turn.

28. Reconnect the spark plug wire.

⚠️ CAUTION: Check with your instructor before starting engine. Make sure area under and around engine is clear before starting.

29. Install remote control.
   a. Move remote control lever B to “Choke” position.
   b. Loosen casing clamp screw “A.”
   c. Hold remote control lever in “Choke” position while moving casing and wire “C” to left end of travel until choke valve is closed. Tighten casing clamp screw “A.”
   d. Check operation of controls.
30. Install air cleaner.
   a. Insert venting elbow into back plate and install on engine with three screws.
   b. Install pre-cleaner and cartridge in cover.
   c. Insert tabs on cover into slots in bottom of base plate. Tilt cover up and fasten securely to base with one screw.

31. Install tank assembly.
   a. Fuel line.
   b. Oil cap.

32. Install static guard on tank assembly.

33. Perform final carburetor adjustment.
   a. Turn idle speed screw in until it touches needle seat and back off 1 and 1/4 turns.
   b. Turn idle mixture screw in until it touches needle seat and back off 1 and 1/4 turns.
   c. On carburetors with adjustable high-speed needle, turn high-speed adjustment needle clockwise until it just touches needle seat. Then back off 1 and 1/4 turns.
34. Perform RPM adjustments.
   a. Run engine at normal operating speed for five minutes.
   b. Move idle speed screw to idle position.
   c. Turn idle speed screw to obtain 1750 RPM minimum. The idle speed should be set with a tachometer.
   d. Turn idle mixture screw clockwise slowly until engine just begins to slow down.
   e. Turn idle mixture screw counterclockwise direction until engine begins to slow down.
   e. Turn idle mixture screw clockwise to a smooth operating point between rich and lean mixture.

   Note: On carburetors with adjustable high-speed needle, move speed control to fast position. Adjust high-speed mixture needle in the same way as the idle mixture screw.

35. Move speed control from idle to high-speed position. The engine should accelerate smoothly. If adjustment is needed. open idle mixture screw 1/8 turn.

   Note: If engine does not accelerate properly, the carburetor should be readjusted, usually to a slightly richer mixture.

36. Clean your work area and return tools to their proper places.
**Small Engine Carburetor Service and Repair Competency Profile**

**Directions:** The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate “yes/no” rating.

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**Servicing Briggs and Stratton Walbro One-Piece Flo-Jet Carburetor**

**Disassembly**

- 1. Read operator’s manual.
- 2. Organize your work station.
- 3. Wear proper safety equipment.
- 4. Disconnect spark plug wire.
- 5. Turn fuel petcock to OFF position.
- 6. Inspect carburetor and fuel tank for air leakage.
- 7. Remove remote control.
- 8. Remove the static guard.
- 10. Remove air cleaner and back plate.
- 11. Remove gasket and venting grommet.
- 12. Inspect gasket and venting grommet.
- 13. Remove two mounting bolts from carburetor and inspect.
- 14. Remove fuel line from carburetor.
- 16. Remove bowl nut, high-speed needle nut, fiber washer.
- 17. Remove float bowl and bowl gasket.
- 18. Remove float hinge pin, float, inlet valve.
- 19. Remove idle mixture screw with spring.
- 20. Adjust for high altitude compensation.
- 21. Clean and inspect carburetor.

**Reassembly**

- 22. Use compressed air to clean carburetor.
- 23. Install inlet needle seat.
- 24. Install inlet needle, float pin, center pin on carburetor body.
- 25. Install gaskets on carburetor.
- 26. Install carburetor and fuel line.
- 27. Perform initial adjustment.
- 28. Reconnect the spark plug wire.
- 29. Install remote control.
- 30. Install air cleaner.
- 31. Install tank assembly.
- 32. Install static guard on tank assembly.
- 33. Perform carburetor adjustment.
- 34. Perform RPM adjustments.
- 35. Adjust speed control.
- 36. Clean your work area.

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**Student's Signature**  
**Instructor's Signature**

**Date**  
33

1. Read operator’s manual and Briggs & Stratton Service and Repair Manual.

2. Organize your work station. When disassembling carburetor, place bolts, nuts, and parts in containers for safekeeping.

⚠️ CAUTION: Wear proper safety equipment. Remove rings, watches, necktie, and jewelry.

Disassembly

3. Disconnect spark plug wire.

4. Remove air cleaner.

5. Inspect carburetor, rubber elbow, and bimetal spring cavity for signs of leaks or damage.

6. Remove remote control.

7. Remove two mounting bolts from the carburetor and engine.

Illustrations courtesy of Briggs & Stratton Corporation
8. Remove carburetor and fuel tank assembly from end of fuel intake tube and turn carburetor to free governor link.

9. Remove five screws from carburetor. Use a screwdriver as illustrated to loosen carburetor from tank.

10. Remove carburetor from fuel tank.

*Note:* Carburetor must be removed slowly to prevent damage to diaphragm.

11. Loosen screw and remove choke link cover.

12. Slide choke link out of choke shaft lever to free diaphragm.
13. Remove diaphragm.
   a. Hold carburetor body upside down and guide choke link through hole.
   b. Inspect the diaphragm for punctures or cracks.

   a. Use screwdriver to apply pressure on end of bi-metal spring shaft and slide out.
   b. Repeat procedure for removing choke shaft. Remove choke plate.
   c. Inspect shaft, choke plate and bi-metal spring for excessive wear or damage. Replace if necessary.

*Note:* Scrape off the flared portion before removing the bi-metal spring and shaft assembly.

15. The needle valve and seat are one unit on a Minlon carburetor. To remove valve and seat unit, rotate needle valve assembly 4 to 5 turns in a counterclockwise direction. Grasp assembly with pliers and pull out.

16. Remove O-ring and inspect. Inspect metering holes and air passage in carburetor for dirt or obstructions. Use compressed air to clean out passages.

*Note:* Do not use sharp objects to clean metering holes.
17. Without removing fuel pipes from carburetor body, inspect screen for gum deposits and dirt. Clean screen with a solvent and air dry. Remove pipe only when being replaced.

18. The fuel pipe on Minlon carburetors is a "snap fit" design. To remove, use needle nose pliers and force out.

19. Inspect top surface of fuel tank for flatness. If the machined surface on tank is not flat, gasoline can enter the vacuum chamber by passing between the machined surface and diaphragm.

   Note: A .002 feeler gauge should not fit between the straight edge and machined surface (see illustration). Tank should be replaced if gauge will enter.

20. Clean Minlon carburetor, tank and metering holes with a solvent and compressed air.

   Note: Check O-rings for wear or damage.

   WARNING: If carburetor cleaner is used, do not exceed 15 minutes of contact as it will damage carburetor components.
Reassembly

21. Install O-ring and needle valve assembly. Make sure that the flat surface on valve seat lines up with flat surface in carburetor body.

22. Use an oil fill tube or similar tool to firmly seat valve. Turn needle valve clockwise to close it. Then open 1 and 1/2 turns. This will permit engine to be started and warmed up before making final adjustments.

NOTE: All carburetor adjustments must be made with the air cleaner on engine.

23. Place choke plate in carburetor (closed position) by using needle nose pliers. Insert shaft into carburetor until notch slides on choke plate. Place spring loop on anchor post and slide shaft on the choke plate until it locks in position.
24. In installing a new diaphragm, assemble choke spring to diaphragm. Make sure spring is in clip on both sides.

25. Holding carburetor body upside down, place spring and cap in fuel pump well on carburetor body. Place diaphragm on body while guiding choke link through hole.

26. Still holding carburetor upside down, lower tank onto carburetor and guide choke spring into spring well. To prevent damage to the diaphragm, align holes in carburetor, diaphragm, and fuel tank.

27. Holding carburetor and tank together, turn assembly right side up. Thread screws into tank top about two turns. DO NOT TIGHTEN.
28. Move choke plate to an "over-center" position to place diaphragm in pre-loaded condition. Insert choke link into shaft and replace choke link cover.

29. Check O-ring for a proper seal. The carburetor is sealed to the intake tube with an O-ring. Always replace O-ring when carburetor doesn't seal with the intake tube. Apply a light film of oil to the O-ring to prevent damage when carburetor is installed on engine.

30. Inspect the rubber elbow (breather tube grommet) for damage and proper seal.

31. Check fuel intake tube gasket and tighten bolts securely before installing carburetor.
32. Install carburetor and tank assembly onto engine and attach the governor link to throttle lever.

33. Slowly slip carburetor into place, making sure the fuel intake tube is aligned with the carburetor at the O-ring and the breather tube is aligned with the rubber elbow.

34. Attach bolt to carburetor, add spacer and blower housing part. Mount carburetor to engine. Install air cleaner.

35. Install remote control assembly. The control lever should move from "Stop" position to "Choke" or "Start" position.
36. The control wire should have a minimum travel of 1 and 3/8 inch. With this adjustment made, set in "choke" or "start" position and tighten mounting screw.

37. Reconnect the spark plug wire.

**CAUTION:** Check with your instructor before starting engine. Make sure area under and around engine is clear.

38. Start engine and warm up to operating temperature. (Tank should be 1/4 full or more.)

39. Perform initial carburetor adjustment.
   a. Turn needle valve clockwise to close it. Then open 1 and 1/2 turns. This will permit engine to be started and warmed up before making final adjustments.
   b. Turn needle valve in, clockwise, until engine begins to miss (lean mixture).
   c. Slowly turn needle valve out, counterclockwise, until engine runs unevenly (rich mixture).
   d. Turn needle clockwise to a smooth operating point between rich and lean mixture.

*Note: If engine does not accelerate properly, the carburetor should be readjusted, usually to a slightly richer mixture.*

40. Adjust idle speed.
   a. Turn idle speed adjustment screw counterclockwise until screw does not touch stop block when valve is closed.
   b. Holding valve closed, turn screw clockwise until it just touches stop block.
   c. Turn screw clockwise 1 and 1/2 more turns for initial setting.
   d. Start engine and allow to run until engine is warm. Adjust needle valve.
   e. Move remote control lever to "Idle" and hold idle speed adjustment screw against the stop block. Check speed with tachometer and adjust to 1750 RPM.
**Small Engine Carburetor Service and Repair Competency Profile**

**Directions:** The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate “yes/no” rating.

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<td>Servicing Pulsa-Jet, Vacu-Jet All Temperature Automatic Choke</td>
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<td><strong>Disassembly</strong></td>
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<tr>
<td>1. Read operator’s manual.</td>
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<td>2. Organize your work station.</td>
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<td>3. Disconnect spark plug wire.</td>
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<td>4. Remove air cleaner.</td>
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<td>5. Inspect carburetor.</td>
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<td>6. Remove remote control.</td>
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<td>7. Remove mounting bolts from the carburetor and engine.</td>
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<td>8. Remove carburetor and fuel tank assembly.</td>
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<td>9. Remove five screws from carburetor.</td>
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<td>10. Remove carburetor from fuel tank.</td>
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<td>11. Loosen screw and remove choke link cover.</td>
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<td>12. Slide choke link out of choke shaft.</td>
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<td>13. Remove diaphragm.</td>
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<td>15. Remove valve and seat on Minlon carburetor (if equipped).</td>
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<td>16. Remove O-ring and inspect.</td>
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<td>17. Clean screen.</td>
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<td>18. Remove fuel pipe on Minlon carburetor (if equipped).</td>
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<td>19. Inspect fuel tank.</td>
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<td>20. Clean Minlon carburetor (if equipped).</td>
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<td><strong>Reassembly</strong></td>
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<tr>
<td>22. Seat needle valve.</td>
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<td>23. Place choke plate in carburetor.</td>
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<td>24. Install a diaphragm.</td>
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<td>25. Place spring and cap in fuel pump well on carburetor body.</td>
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<td>26. Install carburetor and guide choke spring into spring well.</td>
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<td>27. Thread screws into tank top about two turns.</td>
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<td>28. Insert choke link into shaft and replace choke link.</td>
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<td>29. Check O-ring for a proper seal.</td>
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<td>30. Inspect the rubber elbow.</td>
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<td>31. Check fuel intake tube gasket.</td>
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<td>32. Install carburetor and tank assembly.</td>
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<td>33. Slip carburetor into place.</td>
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<td>34. Mount carburetor to engine.</td>
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<td>35. Install remote control assembly.</td>
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36. Check/adjust remote control assembly.
37. Reconnect the spark plug wire.
38. Start engine and warm up to operating temperature.
39. Perform initial carburetor adjustment.
40. Adjust idle speed.

_________________________  ___________________________  ____________
Student's Signature        Instructor's Signature        Date
J. Step-By-Step Procedure for Servicing Pulsa-Jet (Suction Feed) Carburetor and Fuel Tank Assembly with Automatic Choke


2. Organize your work station. When disassembling carburetor, place bolts, nuts, and parts in containers for safekeeping.

3. Wear proper clothing and safety equipment.

⚠️ Observe this symbol as a WARNING OR CAUTION. Personal injury may occur unless instructions are followed carefully.

Disassembly

4. Disconnect spark plug wire.

5. Remove air cleaner.

6. Inspect the carburetor and fuel tank for signs of air leakage.

7. Remove remote control.

Illustrations courtesy of Briggs & Stratton Corporation.
8. Remove mounting bolts from the carburetor and engine.

9. Remove carburetor and fuel tank assembly from end of fuel intake tube and turn carburetor to free governor link.

10. Remove screws from carburetor. Use a screwdriver as illustrated to loosen carburetor from tank.

11. Remove carburetor from fuel tank.

*Note: Carburetor must be removed slowly to prevent damage to diaphragm.*
12. Loosen screw and remove choke link cover.

13. Slide choke link out of choke shaft lever.
   (This will free diaphragm.)

   a. Hold carburetor body upside down and guide choke link through hole.
   b. Inspect the diaphragm for punctures and cracks.

15. Disassemble choke.
   a. Use a screwdriver to slide the choke shaft from the choke plate
   b. Remove choke plate with needle-nose pliers.
   c. Inspect shaft and plate for excessive wear or damage and replace if necessary.
16. Loosen nut to remove needle valve. Inspect needle for damage.

17. Remove brass seat using a special carburetor screwdriver. Inspect seat for damage.

*Note:* A needle valve kit includes both the needle and the seat. If either is damaged, both must be replaced.

18. Inspect metering holes and air passages in the carburetor for dirt or obstructions. Use compressed air to clean out passages.

*Note:* Do not use sharp objects to clean metering holes.

19. Inspect screens for gum deposits and dirt without removing the fuel pipes from carburetor body. Clean screens with a solvent and air dry. Remove pipes only if they are being replaced.

*Note:* Fuel pipes are threaded into the carburetor body. If they must be replaced, use a socket wrench to loosen and remove. Do not over torque new pipes. When removing the fuel pipes, support pipe shaft near the carburetor body to prevent breakage.
20. Inspect the top surface of the fuel tank for flatness. If the machined surface on the tank is not flat, it is possible for gasoline to enter the vacuum chamber by passing between the machined surface and diaphragm.

*Note:* A .002" feeler gauge should not fit between the straight edge and machined surface. Tank should be replaced if gauge will enter.

21. Clean the fuel system. Gummy or dirty fuel tanks, lines and carburetors should be cleaned in a carburetor cleaner. Do not soak diaphragm, gaskets, or nylon parts in the carburetor cleaner.

22. Use compressed air to clean carburetor parts.

**Reassembly**

23. Install needle valve seat in carburetor and tighten securely.

*Note:* New needle valve kits arrive with the needle protruding. Before installing, screw the needle in until it is flush with the threads. This prevents damage to the new needle and seat.

Illustrations courtesy of Briggs & Stratton Corporation
24. Insert the needle valve into seat and turn clockwise to close it. Then open 1 and 1/2 turns. This will permit engine to be started and warmed before making final adjustments.

25. Install choke plate in carburetor so poppet valve spring is visible (full choke position). Then insert choke shaft and push in place on the plate.

26. If installing a new diaphragm, assemble choke spring to diaphragm. Make sure spring is in clip on both sides.

27. Holding carburetor body upside down, place spring and cap in fuel pump well on carburetor body. Place diaphragm on body while guiding choke link through hole.
28. Still holding carburetor upside down, lower tank onto carburetor and guide choke spring into spring well. To prevent damage to the diaphragm, align holes in carburetor, diaphragm, and fuel tank.

29. Holding carburetor and tank together, now turn assembly right side up. Thread screws into tank top about two turns. DO NOT TIGHTEN.

30. Move choke plate to an "over-center" position to place diaphragm in preloaded condition. Insert choke link into shaft and replace choke link cover.

31. Test for proper choke hook up by pressing down on the choke plate. Choke should open and close automatically when properly installed. Securely tighten screws to tank in a staggered sequence.
32. Check O-ring for a proper seal. The carburetor is sealed to the intake tube with an O-ring. Always replace O-ring when carburetor doesn't seal with the intake tube. Apply a light film of oil to the O-ring to prevent damage when carburetor is installed on engine.

33. Inspect the venting elbow (breather tube grommet) for damage and proper seal.

34. Check fuel intake tube gasket and tighten bolts securely before installing carburetor.

35. Install carburetor and tank assembly onto engine and attach the governor link to throttle lever.
36. Slowly slip carburetor into place, making sure the fuel intake tube is aligned with the carburetor at the O-ring and the breather tube is aligned with the venting elbow.

37. Attach bolt to carburetor. Add spacer and blower housing part. Mount carburetor to engine.

38. Route ground wire from ignition to switch.

39. Hook up ground wire to switch.

40. Install air cleaner.
41. Install remote control assembly. The control wire should move from "Stop" position to "Choke" or "Start" position.

42. The control wire should have a minimum travel of 1 and 3/8." With this adjustment made, set in "Choke" or "Start" position and tighten mounting screw.

43. Reconnect the spark plug wire.

⚠️ **CAUTION:** Check with your instructor before starting engine. Make sure area under and around engine is clear before starting.

44. Start engine and warm up to operating temperature. (Tank should be full of fuel.)

45. Run engine at normal operating speed and make the following adjustments to obtain the proper fuel mixture:
   a. Turn needle valve in, clockwise, until engine begins to miss (lean mixture).
   b. Slowly turn needle valve out, counterclockwise, until engine runs unevenly (rich mixture).
   c. Turn needle clockwise to a smooth operating point between rich and lean mixture.

**Note:** If engine does not accelerate properly, the carburetor should be readjusted, usually to a slightly richer mixture.
46. Adjust idle speed by turning idle adjusting screw until a fast idle is obtained (1750 RPM). The idle speed should be set with a tachometer.

47. Clean your work area and return tools to their proper places.

*Note:* If engine does not accelerate properly, the carburetor should be readjusted, usually to a slightly richer mixture.
### Small Engine Carburetor Service and Repair Competency Profile

**Directions:** The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate "yes/no" rating.

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**Servicing Pulsa-Jet (Suction Feed) Carburetor and Fuel Tank Assembly with Automatic Choke**

**Disassembly**

1. Read operator's manual.
2. Organize your work station.
3. Wear proper safety equipment.
4. Disconnect spark plug wire.
5. Remove air cleaner.
6. Inspect carburetor and fuel tank.
7. Remove remote control.
8. Remove mounting bolts from the carburetor and engine.
9. Remove carburetor and fuel tank assembly.
10. Remove screws from carburetor.
11. Remove carburetor from fuel tank.
12. Loosen screw and remove choke link cover.
13. Slide choke link out of choke shaft lever.
15. Disassemble choke.
16. Loosen nut to remove needle valve.
17. Remove brass seat.
18. Inspect metering holes and air passages.
19. Inspect screens for gum deposits and dirt.
20. Inspect top surface of fuel tank.
21. Clean the fuel system.
22. Use compressed air to clean carburetor parts.

**Reassembly**

23. Install needle valve seat.
24. Insert the needle valve into seat.
25. Install choke plate in carburetor.
26. Install choke spring to diaphragm.
27. Place spring and cap in fuel pump.
28. Lower tank onto carburetor.
29. Thread screws into tank top.
30. Insert choke link into shaft and replace choke link cover.
31. Test for proper choke hook up.
32. Check O-ring for a proper seal.
33. Inspect the venting elbow.
34. Check fuel intake tube gasket.
35. Install carburetor and tank assembly.
36. Install fuel intake tube, O-ring, breather tube.
37. Mount carburetor to engine.
38. Route ground wire from ignition to switch.
39. Hook up ground wire to switch.
40. Install air cleaner.
41. Install remote control assembly.
42. Adjust control wire.
43. Reconnect the spark plug wire.
44. Start engine and warm up to operating temperature.
45. Adjust carburetor mixture.
46. Adjust idle speed.
47. Clean your work area.
K. Step-By-Step Procedure for Servicing Minlon (Vacu-Jet) Carburetor

Disassembly

1. Follow steps of procedure numbers 1 through 15 of Section I, "Servicing Pulsa-Jet (Suction Feed) Carburetors."

2. The needle valve and seat are one unit on a Minlon carburetor. To remove unit, rotate needle valve assembly 5 and 1/2 turns in a counterclockwise direction. Grasp assembly and pull out.

Note: Do not use sharp objects to clean metering holes.

3. Inspect metering holes and air passage in carburetor for dirt or obstructions. Use compressed air to clean out passages.

4. Without removing fuel pipes from carburetor body, inspect screen for gum deposits and dirt. Clean screen with a solvent and air dry. Remove pipe only when being replaced.

5. The fuel pipe on Minlon carburetors is a "snap-fit" design. To remove, use needle nose pliers and force out.

Illustrations courtesy of Briggs & Stratton Corporation
6. Inspect the top surface of the fuel tank for flatness. If the machined surface on the tank is not flat, it is possible for gasoline to enter the vacuum chamber by passing between the machined surface and diaphragm.

*Note:* A .002 feeler gauge should not fit between the straight edge and machined surface. (See illustration.) Tank should be replaced if gauge will enter.

7. Clean Minlon carburetor and metering holes with a solvent and compressed air.

8. Use compressed air to dry carburetor parts.

*Note:* Do not use a cloth rag, as lint could become trapped in carburetor parts.

⚠️ **CAUTION:** If carburetor cleaner is used, DO NOT EXCEED 15 MINUTES contact time as it will damage Minlon.

---

**Reassembly**

9. Install needle valve assembly. Make sure the flat surface on valve seat lines up with flat surface in carburetor body. Use an oil fill tube or similar tool to firmly seat valve. Turn needle valve clockwise to close it. Then open 1 and 1/2 turns. This will permit engine to be started and warmed up before making final adjustments.
10. Follow steps of procedure numbers 27 through 45 of Section I, "Servicing Pulsar-Jet (Suction Feed) Carburetor."

**Note:** All carburetor adjustments must be made with the air cleaner on engine.

11. Start engine and warm up to operating temperature. (Tank should be full of fuel.)

12. Run engine at normal operating speed and make the following adjustments to obtain the proper fuel mixture:
   a. Turn needle valve in, clockwise, until engine begins to miss (lean mixture).
   b. Slowly turn needle valve out, counterclockwise, until engine runs unevenly (rich mixture).
   c. Turn needle clockwise to a smooth operating point between rich and lean mixture.

**Note:** If engine does not accelerate properly, the carburetor should be readjusted, usually to a slightly richer mixture.

   a. Turn idle speed adjustment screw counterclockwise until the screw does not touch the stop block when valve is closed.
   b. Holding valve closed, turn screw clockwise until it just touches the stop block.
   c. Turn screw clockwise 1 and 1/2 more turns which gives you initial setting.
   d. Start engine and allow to run long enough until engine is warm. Adjust needle valve as required.
   e. Move remote control to "idle" and hold idle speed adjustment screw against the stop block. Check speed with tachometer and adjust to 1750 RPM.

14. Clean your work area and return tools to their proper places.
# Small Engine Carburetor Service and Repair Competency Profile

**Directions:** The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate “yes/no” rating.

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**Servicing Minlon (Vacu-Jet) Carburetor**

**Disassembly**

1. Steps of procedure numbers 1 through 15 of Section C, “Servicing Pulsajet (Suction Feed) Carburetors.”
2. Remove needle valve and seat from Minlon carburetor, if equipped.
3. Inspect metering holes and air passage in carburetor for dirt or obstructions.
4. Clean screen with a solvent and air dry.
5. Remove Minlon carburetor fuel pipe, if equipped.
6. Inspect the top surface of the fuel tank.
7. Clean Minlon carburetor and metering holes with a solvent and compressed air.
8. Dry carburetor parts.

**Reassembly**

9. Install needle valve assembly
10. Steps of procedure numbers 27 through 45 of Section C, “Servicing Pulsajet (Suction Feed) Carburetor.”
11. Start engine and warm up to operating temperature.
12. Adjust carburetor mixture.
14. Clean your work area.

---

Student's Signature

Instructor's Signature

Date
L. Step-By-Step Procedure for Servicing Pulsa-Jet (Suction Feed) Carburetor and Fuel Tank Assembly

**Disassembly**

1. Follow steps of procedure numbers 1 through 8 of Section J, “Servicing Pulsa-Jet (Suction Feed) Carburetor with Automatic Choke.”

2. While holding carburetor and tank assembly, remove governor control and spring.

3. Remove screws from carburetor. Use a screwdriver as illustrated to loosen carburetor from tank.

4. Slowly remove carburetor from fuel tank.

5. Inspect gasket surface of carburetor. Replace with new gasket.
6. Replace worn throttle, if needed.
   a. Remove spiral. Fasten carburetor in a vise and grasp spiral firmly with a pair of pliers. Place a screwdriver under ledge of pliers (as shown). Using edge of vise, push down on screwdriver handle to pry out spiral.
   b. Use a Phillips screwdriver to remove the throttle valve and screw. The throttle can now be lifted out.

7. Inspect the screens for gum deposits and dirt without removing the fuel pipes from carburetor body. Clean the screens with a solvent and air dry. Remove pipes only if they are being replaced.

8. Nylon fuel pipes are threaded into the carburetor body. If they must be replaced, use a socket wrench to loosen and remove. Do not over torque when inserting new pipes. No sealer is required.

   **Note:** When removing the fuel pipes, support pipe shaft near the carburetor body to prevent breakage.

9. When brass pipes are used, only the screen housing is replaced. Place fuel pipe in a vise and pry off the brass housing with a screwdriver. Remove screen housing only if it is being replaced.
10. Inspect the top surface of the fuel tank for flatness. If the machined surface on the tank is not flat, it is possible for gasoline to enter the vacuum chamber by passing between the machined surface and diaphragm.

*Note:* A .002" feeler gauge should not fit between the straight edge and machined surface (see illustration). Tank should be replaced if gauge will enter.

11. Loosen nut to remove needle valve. Inspect needle for damage (see illustration).

12. Remove brass seat, using a special carburetor screwdriver. Inspect seat for damage.

*Note:* Needle valve kit includes both the needle and the seat. If either is damaged, both must be replaced.

13. Inspect metering holes and air passages in the carburetor for dirt or obstructions. Use compressed air to clean out passages.

*Note:* Do not use sharp objects to clean metering holes.
14. Remove screws from fuel pump cover.
   Remove diaphragm, spring, and cap.
   Inspect diaphragm for cracks and punctures.

15. Clean the fuel system. Gummy or dirty fuel tanks, lines, and carburetors should be cleaned in a carburetor cleaner.

   **WARNING:** Do not soak diaphragm, gaskets, or nylon parts in the carburetor cleaner.

16. Use compressed air to clean carburetor parts.

   **Note:** Do not use a cloth rag, as lint could become trapped in carburetor parts.

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**Reassembly**

17. Install throttle in carburetor. Guide the throttle valve in place and tighten screw securely.
18. Install spiral in carburetor. Use a vise to hold carburetor and slowly twist spiral in carburetor. Top of spiral must be flush or 1/32" below carburetor flange.

19. Install needle valve seat in carburetor and tighten securely.

Note: New needle valves from kits arrive with the needle protruding. Before installing, screw the needle out until it is flush with the threads. This prevents damage to the new needle and seat.

20. Insert the needle valve into seat and tighten nut securely. Turn the needle valve clockwise to close it. Then open 1 and 1/2 turns. This will permit engine to be started and warmed up before making final adjustments.
21. To reassemble pump, place spring and cup in carburetor body. Insert diaphragm and cover. Tighten the screws in a staggered sequence to insure a good seal.

*Note: Always install a new diaphragm when servicing carburetor.*

22. Place gasket on fuel tank. Install carburetor onto fuel tank and tighten screws securely.

23. Place gasket on carburetor. While holding carburetor in place, hook up governor control and spring. Thread screws into engine and tighten securely.

24. On models equipped with a stop switch, install the ground wire.
25. Install remote control assembly.

26. The control wire should have a minimum travel of 1 and 3/8." Adjust remote control lever to "Stop" position and tighten mounting screws.

27. Reconnect spark plug wire.

28. Install air cleaner.

29. Start engine and warm up to operating temperature. Tank should be full of fuel.

30. Place governor speed control in "Fast" position and make the following adjustment to obtain the proper fuel mixture:
   a. Turn needle valve in, clockwise, until engine begins to miss (lean mixture).
   b. Slowly turn needle valve out, counterclockwise, until engine runs unevenly (rich mixture).
   c. Turn needle valve clockwise to a smooth operating point between rich and lean mixture.

Note: If engine does not accelerate properly, the carburetor should be readjusted to a slightly richer mixture.
31. Adjust idle speed.
   a. Rotate throttle counterclockwise and hold against the stop.
   b. Adjust idle speed adjustment screw to 1750 RPM. The idle speed should be set with a tachometer.

32. Clean your work area and return tools to their proper place.
Small Engine Carburetor Service and Repair Competency Profile

Directions: The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate "yes/no" rating.

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**Servicing Pulsa-Jet (Suction Feed) Carburetor and Fuel Tank Assembly Disassembly**

1. Steps of procedure numbers 1 through 8 of Section K, "Servicing Pulsa-Jet (Suction Feed) Carburetor with Automatic Choke."
2. Remove governor control and spring.
3. Remove screws from carburetor.
4. Remove carburetor from fuel tank.
5. Inspect gasket surface of carburetor.
6. Replace worn throttle, if needed.
7. Inspect screens for gum deposits and dirt.
8. Replace nylon fuel pipes, if needed.
9. Replace screen housing.
10. Inspect the top surface of the fuel tank.
11. Remove needle valve.
12. Remove brass seat.
13. Inspect metering holes and air passages.
14. Remove screws from fuel pump cover.
15. Clean the fuel system.
16. Use compressed air to clean carburetor parts.

**Reassembly**

17. Install throttle in carburetor.
18. Install spiral in carburetor.
19. Install needle valve seat in carburetor.
20. Insert needle valve into seat.
22. Place gasket on fuel tank.
23. Place gasket on carburetor.
24. Install the ground wire.
25. Install remote control assembly.
26. Adjust remote control.
27. Reconnect spark plug wire.
28. Install air cleaner.
29. Start engine and warm to operating temperature.
30. Adjust for proper fuel mixture.
31. Adjust idle speed.
32. Clean your work area.

---

Student's Signature

Instructor's Signature

Date

70
Step-By-Step Procedures for Servicing a Large One-Piece Flow-Jet Carburetor


2. Organize your work station. When disassembling carburetor, place bolts, nuts, and parts in containers for safekeeping.

⚠️ CAUTION: Wear proper safety equipment and observe this symbol as a WARNING OR CAUTION. Personal injury may occur unless instructions are followed carefully.

3. Disconnect spark plug wire.

4. Inspect carburetor fuel tank and fuel line for signs of leakage.

5. Remove air cleaner.

6. Turn the fuel petcock to off position at tank and disconnect fuel line to carburetor.

7. Observe carburetor linkage and make a careful drawing of the linkage.

8. Remove carburetor linkage and carburetor from engine.

Illustrations courtesy of Briggs & Stratton Corporation

10. Remove high-speed needle valve assembly from float bowl.


12. Remove float pin to remove float and float needle. Observe condition of float needle.

13. Remove high-speed jet and nozzle from carburetor. Use special screwdriver B & S #19280 for easy removal of jet and nozzle.

14. Check throttle shaft and bushings for wear. Wear between throttle shaft and bushings should not exceed .010.”

15. Remove Welch plug.

Illustrations courtesy of Briggs & Stratton Corporation

17. Remove throttle shaft and bushings (do not remove unless changing throttle or bushings).
   a. Using a pin punch, drive out pin holding throttle stop to shaft.
   b. Remove throttle valve.
   c. Pull out throttle shaft.

18. Use a 1/4-20 tap and screw or a screw extractor to remove pressed-in seat in carburetors equipped with a removable Viton inlet seat. See illustration.

19. Clean carburetor with solvent. Use compressed air to dry carburetor and parts.
Reassembly

20. Install throttle shaft and bushing.
   a. Install throttle shaft and throttle valve.
   b. Place throttle stop on shaft.
   c. Use a pin punch to drive in pin.

21. Install choke shaft and choke valve.
   a. Install nylon choke shaft.
   b. Install screw, spring, and washer as illustrated.
   c. Install choke valve using needle nose pliers.

   Note: Make sure the choke is working properly.

22. Install new Welch plug.
   a. Press in new Welch plug.
   b. Install plug by pounding it into place and use a sealer around the edge.

   Note: Seal of Welch plug is very important as it prevents entry of dirt into the engine.

23. Install high-speed jet and nozzle in carburetor.
24. Install pressed-in float valve seat.

*Note: On carburetors with removable Viton inlet seat.*

- a. Press new seat flush with body using screw extractor and old seat as driver.
- b. Use care to ensure seat is not pressed below body surface.

25. Install new bowl gasket.

26. Install float needle to float.

27. Install needle valve with open end of hook or spring facing away from venturi.

28. Confirm that float is parallel to the body mounting surface.

29. Bend the tank on the float until they are parallel. Do not press on float to adjust.
30. Install float bowl gasket and high-speed needle valve assembly.
   a. Tighten valve nut to secure float bowl. Do not tighten packing nut.
   b. Turn needle valve in until it just seats and then back off 1 and 1/2 turns.

Note: Final adjustment will be made when engine is running.

31. Install idle needle valve. Turn idle needle valve in until it just seats and then back off 1 1/2 turns.

Note: Final adjustment will be made when engine is running.

32. Install carburetor on engine. Make sure you have used the proper procedure in hooking up the carburetor linkage. Observe your notes.

33. Connect fuel line to carburetor and turn to “On” position. Check fuel line and carburetor for signs of leakage.

34. Install air cleaner and connect spark plug wire.

Note: All carburetor adjustments must be made with air cleaner installed.

35. Perform initial carburetor adjustment.
   a. Start engine and run to warm up.
   b. Place speed control lever to “Fast” position.
   c. Turn high-speed needle valve clockwise until engine slows (lean mixture).
   d. Turn high-speed needle valve counterclockwise until engine slows (rich mixture).
   e. Turn high-speed needle valve to midpoint between rich and lean until engine runs smoothly.
36. Adjust idle speed.
   a. Rotate throttle counterclockwise and hold against stop.
   b. Adjust idle speed screw to obtain 1750 RPM.
   c. Holding throttle against idle stop, turn idle valve in (lean) and out (rich).
   d. Set idle valve to midpoint between rich and lean.
   e. Recheck idle RPM.
   f. Release throttle.

Note: If engine does not accelerate properly, the carburetor should be adjusted, usually to a slightly richer mixture.

37. Return tools and materials to their proper places.
# Small Engine Carburetor Service and Repair Competency Profile

**Directions:** The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate “yes/no” rating.

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**Servicing a Large One-Piece Flow-Jet Carburetor**

**Disassembly**

1. Read operator’s manual.
2. Organize your work station.
3. Disconnect spark plug wire.
4. Inspect carburetor fuel tank and fuel line.
5. Remove air cleaner.
6. Disconnect fuel line to carburetor.
7. Observe carburetor linkage.
8. Remove carburetor linkage and carburetor.
9. Remove idle needle valve.
10. Remove high-speed needle valve assembly from float bowl.
11. Remove float bowl.
12. Remove float and float needle.
13. Remove high-speed jet and nozzle.
14. Check throttle shaft and bushings for wear.
15. Remove Welch plug.
16. Remove choke valve.
17. Remove throttle shaft and bushings.
18. Remove pressed-in seat in carburetors equipped with a removable Viton inlet seat.
19. Clean carburetor with solvent.

**Reassembly**

20. Install throttle shaft and bushing.
21. Install choke shaft and choke valve.
22. Install new Welch plug.
23. Install high-speed jet and nozzle in carburetor.
24. Install pressed in float valve seat.
25. Install new bowl gasket.
26. Install float needle to float.
27. Install needle valve.
28. Confirm float is parallel to the body mounting surface.
29. Bend the tank on the float until they are parallel.
30. Install float bowl gasket and high-speed needle valve assembly.
31. Install idle needle valve.
Yes

No

32. Install carburetor on engine.
33. Connect fuel line to carburetor and turn to "On" position.
34. Install air cleaner and connect spark plug wire.
35. Perform initial carburetor adjustment.
36. Adjust idle speed.
37. Return tools and materials
P. Step-By-Step Procedures for Servicing Briggs and Stratton Pulsa-Prime Carburetor Model Series 95900 to 95999

1. Read operator’s manual and Briggs & Stratton Service and Repair Manual.

2. Organize your work station. When disassembling carburetor, place bolts, nuts, and parts in containers for safekeeping.

⚠ CAUTION: Wear proper safety equipment and observe this symbol as a WARNING OR CAUTION. Personal injury may occur unless instructions are followed carefully.

Disassembly

3. Disconnect spark plug wire and place in V-notch on engine.

4. Remove air filter and disassemble for cleaning.

5. Remove throttle control cable from starter housing.

6. Remove carburetor and tank.
   a. With mounting bolts removed slowly ease carburetor off intake tube.
   b. Tilt the carburetor slightly to disengage linkage.
   c. Remove venting elbow and inspect for proper seal.

Note: Always observe the carburetor linkage and make a drawing.
7. Observe carburetor for signs of leakage.

8. Remove fuel from tank.

\textbf{CAUTION: Use approved containers for storage of gasoline.}

9. Remove carburetor from tank. Use a screwdriver, as illustrated, to loosen carburetor from tank.

10. Check condition of primer bulb, diaphragm gaskets, and spring. Remove screen jet and check the fuel pipe screen.

11. Clean carburetor parts and tank. Use an approved cleaning solvent. Use compressed air to dry and finish cleaning all carburetor parts and tank.

\textbf{Note: Do not soak diaphragm, gaskets, nylon, or rubber parts in the carburetor cleaner.}

\textbf{Reassembly}

12. Install screen jet filter on fuel intake pipe.

13. Holding carburetor body upside down, place spring in pump well on carburetor body. Holding spring place diaphragm over spring and slowly move carburetor fuel pipe into tank.

\textbf{Note: Make sure spring is in pump well.}
14. Return carburetor to upright position. Install the five screws and tighten.

15. Check fuel intake tube seal.

16. Check venting elbow (breather tube grommet) for damage and proper seal.

17. Before installing carburetor, check fuel intake tube gasket and tighten bolts securely.
18. Install carburetor and tank assembly onto engine and attach the governor link to the throttle lever.

19. Slowly slip carburetor into place, making sure the fuel intake tube is aligned with the carburetor at the O-ring and the breather tube is aligned with venting elbow.

20. Attach bolt to carburetor. Mount carburetor to engine.

21. Install air cleaner.

22. Install remote control assembly. The remote control lever should move from "Stop" position to "Fast" position.
23. The remote control wire should have a minimum travel of 1 and 3/8" when mounted on engine.

24. Reconnect spark plug wire.

**CAUTION:** Check with your instructor before starting engine. Make sure area under and around engine is clear before starting.

**Note:** The Pulsa Prime Carburetor has no adjustments. A primer bulb has been added to eliminate the need for a choke. The primer bulb injects fuel directly into the throttle of for quick starting with a cold engine. The Pulsa Prime Carburetor has no idle system and no air/fuel adjustment. The governor system controls the speed of the engine. This carburetor has a fixed-speed jet that provides fuel throughout the engine operating range.

25. Place remote control in start position and crank engine. Warm to operating temperature.

26. Clean your work area and return tools to their proper places.
# Small Engine Carburetor Service and Repair Competency Profile

**Directions:** The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate "yes/no" rating.

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**Servicing Briggs and Stratton Pulsa-Prime Carburetor Model Series 95900 to 95999**

**Disassembly**

1. Read operator's manual.
2. Organize your work station.
3. Disconnect spark plug wire.
4. Remove air filter for cleaning.
5. Remove throttle control cable from starter housing.
6. Remove carburetor and tank.
7. Observe carburetor for signs of leakage.
8. Remove fuel from tank.
9. Remove carburetor from tank.
10. Check condition of primer bulb, diaphragm gaskets, and spring.
11. Clean carburetor parts and tank.
12. Install screen jet filter on fuel intake pipe.
13. Place spring in pump well on carburetor body.
14. Install the five carburetor screws and tighten.
15. Check fuel intake tube seal.
16. Check venting elbow.
17. Check fuel intake tube gasket.

**Reassembly**

18. Install carburetor and tank assembly onto engine and attach the governor link to the throttle lever.
19. Slip carburetor into place.
20. Mount carburetor to engine.
21. Install air cleaner.
22. Install remote control assembly.
23. Adjust remote control assembly.
24. Reconnect spark plug wire.
25. Start engine. Warm to operating temperature.
26. Clean your work area.

---

Student's Signature

Instructor's Signature

Date
Rewind Starters

Revised Edition

INSTRUCTIONAL MATERIALS LABORATORY
UNIVERSITY OF MISSOURI-COLUMBIA
COLUMBIA, MISSOURI
MODULE 3

Rewind Starters

Prepared by: Amon Herd
Preface

This manual is designed to bring the student or home owner to a minimum performance level in properly servicing a small engine's ignition system. These step-by-step procedures include illustrations clarifying each procedure. The accompanying performance task list may be used as an evaluation or as a quick reference of repair procedures.

For many years those responsible for teaching small engine repair have needed materials that are basic, readable and usable. Although this series was written primarily for adult education, it can become a vital teaching tool in any program through live demonstrations and classroom instruction.

The author, Amon Herd, brings to this new series many years of small engine experience. Amon's "hands on" knowledge comes from twenty-five years of classroom teaching and small engine repair.
Acknowledgments

Appreciation is extended to those individuals who contributed time and talents in the development of Small Engine Carburetor Service and Repair, Second Edition.

Instructional Materials Laboratory Staff:
Harley Schlichting, Ph.D., Director
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American Association for Vocational Instructional Materials

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Dan Hostetter, Boonville, Missouri, Harold Bossaler, Columbia, Missouri, Dr. Milo Spurgeon, Columbia, Missouri for their contributions to this manual.

References


Small Engines Operation Maintenance and Repair, J. Howard Turner, American Association for Vocational Instructional Materials, -Athens, Georgia.


Fuels and Lubricants, Harold Parady and Thomas Colvin, American Association for Vocational Instructional Materials, Athens, Georgia.


Rewind Starters

Unit Objectives

After completing this unit, the student should be able to remove and replace a starter, replace a starter rewind spring, replace a starter rope, service a starter clutch, and service a vertical pull starter. Competencies will be demonstrated through the student’s ability to properly service and repair small engine starters.

Specific Objectives

After completion of this unit, the student should be able to:

1. Identify the types of small gas engine starters.

2. Identify the starter parts.

3. Demonstrate the ability to:
   a. Remove, disassemble, service, reassemble, and test a starter.
   b. Replace a starter rewind spring.
   c. Replace a starter rope.
   d. Service a vertical pull starter.
   e. Service a starter clutch assembly.
Rewind Starters
Step-by-step Procedure

Introduction

The purpose of the starter is to crank the engine. Most operators fail to maintain good maintenance procedures of small engines and the starter becomes overworked. Starter maintenance can be minimized by keeping your small engine in good running condition. Information in this unit will help expand your knowledge in servicing rewind starters on small engines.
A. Tools and Supplies Needed to Service Starters

Tools
Socket set (3/8" ratchet, Sockets 3/8", 5/16", 1/4"
Nut drivers 1/4", 3/8", 5/16"
Slot head screwdriver, 4" and 6"
5/8" pin punch
Cylinder support
Tang tool
Rawhide mallet
Rope inserter tool
Needle nose pliers
Scratch awl
C-clamp, 6"
Bench vice
Rewind starter tool (3/4" x 9" square tubing)
Starter clutch wrench and torque adapter
Putty knife
Knife
Safety glasses
2" x 4" block 12" long
Flywheel holder

Supplies
Parts cleaning pan
Petroleum solvent
Shop towels
Penetrating oil
Matches
Nylon bumpers
Starter rope
Starter spring
Multi-purpose grease
Gloves
Special Starter Tools

Starter Tang Tool
Used for lifting tangs on Windup Starters

1. Material required is 7 1/2" length of 5/8" square stock steel.
2. Drill 3/32" hole as indicated in the drawing.
3. Cut and grind to dimensions as shown in the drawing
Special Starter Tools That Can Be Made In Your Shop

Rope Inserter

Rewind Starter Tool
B. Servicing Model Series 120000 Quantum Power Rewind Starter

Quantum Power Rewind Starter

1. Read operator's manual and Briggs & Stratton Service and Repair Instructions for Quantum Rewind Starter.

2. Wear proper clothing and safety equipment.

⚠️ CAUTION: Observe this symbol as a WARNING or CAUTION. Personal injury may occur unless instructions are followed carefully.

3. Organize your work station. When disassembling the starter, place bolts, nuts and parts in containers for safekeeping.

4. Disconnect the spark plug wire and place in the safety notch on the engine.

---

**Disassembly**

5. Remove tank assembly.
   a. Finger guard.
   b. Gas line.
   c. Primer line (if available).
   d. Throttle control casing clamp.

Illustrations courtesy of Briggs & Stratton Corporation
6. Remove blower housing, oil tube and casing clamp.

7. Place a 2" x 4" x 12" wood block in a vice, as shown. Use a 6" C-clamp to hold blower housing. This keeps both hands free to work on the starter.

⚠️ CAUTION: Pulley, spring and spring retainer are serviced as an assembly. DO NOT ATTEMPT TO REMOVE SPRING RETAINER FROM PULLEY.

8. Pull starter rope out as far as it will go. Place a screwdriver in one of the openings of the blower housing to hold spring tension.

9. Pull pulley end of rope out and untie knot at end of rope. Remove rope and handle from starter. Remove screwdriver and slowly release pulley to release spring tension.

10. To disassemble starter, remove roll pin holding the starter together. CAUTION: The underside of the starter must be supported when removing the roll pin. Support blower housing with a cylinder support and a 2" x 4" block and drive out roll pin with a 5/16" diameter pin punch.

Note: On early engines the starter housing must be removed from blower housing by drilling out the pop rivets.

Note: A 5/16" valve works well in removing the roll pin.

⚠️ WARNING: ALWAYS wear eye protection to prevent eye injury while disassembling and reassembling starters.
11. Holding rewind starter and retainer, remove blower housing from support tool. Place starter upside down on the work bench and lift off retainer. See illustration.

Note: Blower housing has been removed from starter assembly.

12. With the center roll pin removed, the starter can be disassembled and any service part can be replaced. When reassembling the starter, grease the rewind spring and replace the spring and roll pin with a new one.

13. Lift off pulley and spring assembly.

Note: Plastic washer is used on pulley.

14. Inspect pulley for cracks, rough edges or burrs in pulley groove. Replace if damaged or worn.

Note: Pulley and spring assembly are purchased as a unit.

Illustrations courtesy of Briggs & Stratton Corporation
15. Inspect the starter housing for wear or burrs at rope eyelet, center pivot post and at inner spring retainer. Replace if worn.

Reassembly

16. Locate free end of spring in pulley. Locate spring retainer in starter housing.

17. Line up free end of spring with spring retainer in housing and assembly pulley in housing.

18. Install spring assembly in starter housing and rotate pulley COUNTER-CLOCKWISE until spring engages retainer.
19. Install dogs and dog spring in pulley assembly.

20. Place retainer on pulley with pierced holes between dogs and stops on pulley.

**Note:** See illustration for correct order of reassembly.

21. Place plastic washer in center of retainer.

22. Place steel washer and torsion spring on new roll pin and start pin in center hole.

23. Press or drive roll pin in until pin is flush with retainer.
Section: Installing Rope

24. Place a 2" x 4" x 12" block of wood in a vice. Use a 6" C-clamp to hold blower housing and starter. Wind spring and pulley COUNTERCLOCKWISE until spring is tight.

25. Holding tension on spring, adjust pulley until rope eyelet in housing and rope hole in pulley are in line. Place a screwdriver between the spikes to hold spring tension.

Burn both ends of the nylon rope with a match. Wipe with a cloth—use caution while rope ends are still hot. Burning the rope ends prevents swelling and unraveling.

*Note:* When installing a new rope, check the parts list to be sure correct diameter and length rope are used.

26. Using a rope inserter tool, install the rope end through eyelet and pulley hole. Tie a single overhand knot and pull rope into cavity.

Illustrations courtesy of Briggs & Stratton Corporation.
27. Install handle and remove screwdriver. Slowly let pulley and spring unwind.

28. Install blower housing and oil tube. Check O-ring and make sure it snaps into place.

*Note: Check operation of starter.*

29. Install tank assembly
   a. Finger guard.
   b. Gas line.
   c. Primer line (if available).
   d. Throttle control casing clamp.

30. Reconnect the spark plug wire.

31. Clean your work area and return tools to their proper places.

32. See your instructor.
Rewind Starters Service And Repair Competency Profile

Directions: The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks to be performed when servicing and repairing rewind starters. Compile your evaluation by checking the appropriate “yes/no” rating.

NOTE: Profile can be used as repair procedure for servicing and repairing starters.

Starters Service and Repair/Disassembly/Reassembly

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Model 120000 Quantum Power Rewind Starters

Disassembly
1. Rear operator’s manual.
2. Wear proper safety equipment.
3. Organize your work station.
4. Disconnect the spark plug wire.
5. Remove tank assembly (if applicable).
6. Remove blower housing from engine.
7. Secure blowing housing.
8. Secure spring tension.
9. Remove rope.
10. Disassemble starter.
11. Remove blower housing from support tool.
12. Replace starter parts, as necessary.
13. Lift off pulley and spring assembly.
15. Inspect starter housing for wear or burrs.

Reassembly
16. Place spring retainer in starter housing.
17. Align spring, spring retainer and assembly pulley.
18. Install spring assembly.
19. Install dogs and dog spring.
20. Place retainer on pulley.
21. Place plastic washer.
22. Place steel washer and torsion spring.
23. Install roll pin.
24. Secure Blower housing and starter.
25. Adjust pulley.
26. Install rope.
27. Install handle.
28. Install blower housing and oil tube. Check operation of starter.
29. Install tank assembly.
30. Reconnect spark plug.
31. Clean work area.

Student's Signature

Instructor's Signature

Date

16
C. Rewind Starters
Model Series 60000, 80000, 90000, 100200, 100900 and 110000

1. Read operator's manual and Briggs and Stratton Service and Repair Instruction Rewind Starter.

2. Wear proper clothing and safety equipment.

⚠️ CAUTION: Observe this symbol as a WARNING or CAUTION. Personal injury may occur unless instructions are followed carefully.

3. Organize your work station. When disassembling the starter, place bolts, nuts and parts in containers for safekeeping.

4. Disconnect the spark plug wire and place in the safety notch on the engine.

Disassembly

5. Remove tank assembly
   a. Finger guard.
   b. Gas line.
   c. Primer line (if available).
   d. Throttle control casing clamp.

Note: Skip Step 5 if your engine does not have a tank assembly.
6. Remove blower housing from engine.
   a. Throttle control casing clamp.
   b. Oil tube (if available).

   Note: On some models the casing clamp will not be attached to blower housing.

7. When working on a rewind starter you need to have both hands free. Place a 2" x 4" block 12 inches long in a vise. Secure the housing with a "C" clamp.

---

**Removing Rope**

8. Pull starter rope all the way out and lock the pulley using the winding tool. Cut rope at starter pulley and remove rope. Using the winding tool, slowly relax spring.

9. Firmly grasp the spring anchor tip with pliers. Pull the spring from the housing until the spring stops. Rotate the spring 90 degrees and unhook the anchor tip from the pulley. Remove spring. Clean the spring with a shop towel as you remove.

   CAUTION: Use caution in removing the pulley and spring assembly if the spring anchor tip is broken or missing.
10. With the spring removed, use a tang bending tool to bend up only one tab to free the pulley. Remove pulley and clean starter housing.

11. Clean starter housing pulley and spring in solvent and wipe dry.

12. Straighten spring to allow easier installation and restore tension. Oil the spring. Replace it if damaged.

Reassembly

13. The new starter pulley is wider to accept the additional length of rope needed to comply with current regulations. This pulley also has a new locking-style cavity to accept the rope knot. A simple overhand knot is now used to secure the rope into the rope knot cavity. New pulleys can be interchanged with older model pulleys.
14. Insert either end of spring through slot in blower housing. Hook the end of spring into pulley hub.

Note: The pulley is shown outside the housing to allow a full view of the spring anchor slot.

15. Place a small amount of grease on the pulley. Place pulley into housing with the spring facing the blower housing. Bend the tang down. Adjust tang gap as shown. Make sure pulley is fully depressed into blower housing when measuring tang gap.

Note: Do not remove nylon bumper from old style tang when replacing metal pulley with nylon pulley. Replace nylon bumpers if worn.

16. With starter housing secured, place the 3/4" square tubing into the center of the pulley hub for winding starter.

17. Place a 2" x 4" x 12" wood block in a vise. Use a C-clamp to hold starter housing. Place screwdriver through one of the holes at the top end of the square tubing and wind pulley COUNTERCLOCKWISE until spring is tight.

⚠️ CAUTION: Wear safety glasses.

Note: Spring should be securely locked in smaller portion of tapered hole. (See illustration.)
18. Hold square tubing securely and back off the pulley one turn or until hole in pulley for rope and eyelet inblower housing are in alignment. Secure this position by relocating the screwdriver through one of the holes at the bottom of the tubing.

19. In selecting new rope, use parts number for correct length and diameter of rope.

20. Singe the end of nylon rope with a match flame. While rope is hot, wipe it with a cloth to prevent swelling and fraying.

21. Insert rope through T-handle and loosely tie a figure eight knot. Place the pin through the knot and pull it tightly into handle.

22. Use a rope inserter tool to thread rope through rope eyelet in housing and out the pulley hole. Tie a knot in rope and pull it tightly into knot cavity.
23. Remove square tubing to release spring tension and allow rope to slowly rewind onto pulley.

*Note: It may be necessary to cut about six inches off the starter rope for it to fully rewind.*

24. Install blower housing on engine.

25. Reconnect the spark plug wire.

26. Start engine several times to be sure starter is operating correctly.

27. Clean your work area and return tools to their proper places.

28. See your instructor.
Rewind Starters Service And Repair Competency Profile

Directions: The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks to be performed when servicing and repairing rewind starters. Compile your evaluation by checking the appropriate “yes/no” rating.

Note: Profile can be used as repair procedure for servicing and repairing starters.

| Starters Service and Repair Model 60000, 80000, 90000, 100200, 100900, and 110000 Rewind Starters | Yes | No |
| Disassembly                                                                                     |     |    |
| 1. Read operator’s manual.                                                                      |     |    |
| 2. Wear proper safety equipment.                                                                 |     |    |
| 3. Organize your work station.                                                                  |     |    |
| 4. Disconnect the spark plug wire.                                                               |     |    |
| 5. Remove tank assembly (if applicable).                                                         |     |    |
| 6. Remove blower housing from engine.                                                            |     |    |
| 7. Secure blowing housing.                                                                     |     |    |
| 8. Remove rope.                                                                                 |     |    |
| 10. Remove pulley.                                                                              |     |    |
| 11. Clean starter housing pulley.                                                                |     |    |
| 12. Service anchor spring.                                                                      |     |    |

| Reassembly                                                                                     |     |    |
| 13. Secure rope to pulley.                                                                     |     |    |
| 15. Secure pulley to blower housing.                                                            |     |    |
| 17. Wind pulley counterclockwise until spring is tight.                                        |     |    |
| 18. Align pulley and blower housing.                                                             |     |    |
| 20. Singe end of rope with flame.                                                               |     |    |
| 21. Insert rope into T-handle.                                                                  |     |    |
| 22. Insert rope into rope eyelet.                                                                |     |    |
| 23. Release spring tension.                                                                    |     |    |
| 24. Install blower housing on engine.                                                            |     |    |
| 25. Reconnect spark plug.                                                                      |     |    |
| 26. Start engine several times to check performance.                                           |     |    |
| 27. Clean work area.                                                                           |     |    |

Student’s Signature ___________________________ Instructor’s Signature ___________________________ Date ________
D. Servicing Vertical Pull Starter

1. Read operator's manual and Briggs & Stratton Service and Repair Instruction.

2. Wear proper clothing and safety equipment.

⚠️ CAUTION: Observe this symbol as a WARNING or CAUTION. Personal injury may occur unless instructions are followed carefully.

3. Organize your work station. When disassembling the starter, place bolts, nuts and parts in containers for safekeeping.

4. Disconnect the spark plug wire and place in the safety notch on the engine.

5. Remove starter from engine.

Disassembly

6. Remove tension from rope. Use a screwdriver to lift the rope up 10 to 12 inches. Wind the rope and pulley 2 or 3 turns COUNTERCLOCKWISE to release spring tension.

⚠️ CAUTION: Do not pull rope with pulley cover removed, unless the spring is released.

7. Remove cover with a screwdriver.

⚠️ CAUTION: Read warning on cover and wear safety glasses.
8. Remove anchor bolt and spring anchor to loosen pulley assembly from housing.

9. Carefully unwind spring, remove and inspect for breakage. (If spring is not being removed, always replace pulley cover after removing the anchor bolt and spring anchor.)

⚠️ CAUTION: Wear safety glasses.

10. Remove rope guide. (Before removing pulley from housing, note position of the link for reassembly.) Slowly remove pulley assembly from housing.
11. Remove insert from handle and untie knot. Unwind rope from pulley. Grasp knotted end with needle nose pliers and remove rope.

12. Clean all dirty or oily parts in solvent.

Reassembly

13. Insert new rope into the pulley, using the rope inserter tool. Tie small knot, heat seal knot and pull back into pulley. Make sure rope does not interfere with gear assembly.

*Note: Forty-eight inches of Number 4 rope will be needed.*

14. When installing the break spring, note the position of the loop on the anchor wire. The rounded portion should point toward the teeth of the gear.
15. Holding the link, install pulley assembly into housing.

16. Using appropriate illustration, install link into housing. (Older link styles may be modified as illustrated.)

*Note: With plier or vice bend link pin 90° to Horizontal Position so it will lie flat on shaded surface, if required.*

17. Lead rope over small pulley and through rope grommet. Install rope guide.

18. Check the link for proper friction by manually rotating pulley assembly. The gear should move to both extremes of its travel; if not, replace the link assembly.
19. Thread rope through grip and into insert. Tie a small tight knot and heat seal to prevent loosening. Pull knot into pocket and snap insert into grip.

20. Wind pulley in a COUNTERCLOCKWISE direction until rope is fully retrieved.

21. Check position of rope. It should not be touching the rope guide.

22. Secure starter in vice. Oil the spring lightly. Install spring by hooking end in pulley retainer slot and wind spring into housing.
23. Hook end of spring to anchor and install bolt. Torque to 75-90 inch-pounds and replace cover.

24. To wind starter spring, pull approximately one foot of rope out of pulley. Wind rope in a CLOCKWISE direction two to three turns around pulley to secure proper spring tension.

25. Check spring tension.
   
   a. *Too little spring tension*. When rope will not fully retract, wrap rope around pulley one more turn in a CLOCKWISE direction.

   b. *Too much spring tension*. Pull the rope out so that it is fully extended and hold lightly. Rotate the pulley clockwise. The pulley should rotate no more than 1/2 turn. If pulley cannot be rotated, the spring is wound too tight. Unwind the rope one turn at a time until proper spring tension is obtained.

26. Before installing the starter assembly on engine, check for proper operation. Hold starter assembly, pull rope and observe movement of the gear. The gear should move in and out.
27. Install starter assembly on engine. Check operation by pulling starter rope. Pulley gear should engage the flywheel.

28. Reconnect the spark plug wire.

29. Start engine several times to be sure starter is operating correctly.

30. Clean your work area and return tools to their proper places.

31. See your instructor.
**Rewind Starters Service And Repair Competency Profile**

**Directions:** The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks to be performed when servicing and repairing rewind starters. Compile your evaluation by checking the appropriate “yes/no” rating.

**Note:** Profile can be used as repair procedure for servicing and repairing starters.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Vertical Pull Starters</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Disassembly</strong></td>
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<tr>
<td></td>
<td></td>
<td>1. Read operator's manual.</td>
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<td></td>
<td></td>
<td>2. Wear proper safety equipment.</td>
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<td></td>
<td></td>
<td>3. Organize work station.</td>
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<td>4. Disconnect spark plug wire.</td>
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<td>5. Remove starter from engine.</td>
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<td>6. Remove tension from rope and spring.</td>
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<td>7. Remove cover.</td>
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<td>8. Remove anchor bolt and spring anchor.</td>
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<td></td>
<td>9. Remove and inspect spring.</td>
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<td></td>
<td>10. Remove rope guide.</td>
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<td></td>
<td>11. Remove rope from handle and pulley.</td>
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<td></td>
<td></td>
<td>12. Clean dirty parts.</td>
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<td></td>
<td><strong>Reassembly</strong></td>
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<tr>
<td></td>
<td></td>
<td>13. Install new rope.</td>
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<td></td>
<td>15. Install pulley.</td>
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<td></td>
<td>16. Install link into housing.</td>
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<td></td>
<td></td>
<td>17. Install rope and rope guide.</td>
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<td></td>
<td>18. Check link for proper friction.</td>
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<tr>
<td></td>
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<td>19. Install rope.</td>
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<td></td>
<td></td>
<td>20. Wind pulley in counterclockwise direction until rope is retrieved.</td>
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<tr>
<td></td>
<td></td>
<td>21. Check position of rope.</td>
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<td>22. Install spring.</td>
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<td></td>
<td></td>
<td>23. Attach spring to anchor and install bolt.</td>
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<td></td>
<td>24. Wind starter spring.</td>
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<td></td>
<td>25. Check spring tension.</td>
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<td></td>
<td>26. Check for proper operation.</td>
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<td></td>
<td>27. Install starter assembly.</td>
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<td>28. Reconnect spark plug.</td>
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<td>29. Start engine to determine proper operation.</td>
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<td>30. Clean your work area.</td>
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</tbody>
</table>

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**Student's Signature**  
**Instructor's Signature**  
**Date**
E. Servicing the Starter Clutch

1. Read operator's manual and Briggs & Stratton Service and Repair Instruction.

2. Wear proper clothing and safety equipment.

⚠️ CAUTION: Observe this symbol as a WARNING or CAUTION. Personal injury may occur unless instructions are followed carefully.

3. Organize your work station. When disassembling the starter, place bolts, nuts and parts in containers for safekeeping.

4. Using 7/16" socket remove Blower Housing and screen.

5. Place flywheel holder securely on flywheel.

Note: Always push flywheel holder all the way back so you won't break the flywheel fins.

6. Place starter clutch wrench securely on starter clutch. Tap wrench handle with mallet to loosen and remove starter clutch.
7. Rotate starter clutch assembly. The clutch should ratchet and the ball bearings should rattle in housing.

8. Insert a thin-bladed putty knife under the edge of the retainer cover as illustrated. Loosen evenly by prying up all the way around the cover.

9. Remove retainer cover, ratchet and six ball bearings. Clean in solvent. Check condition of seal and replace, if necessary.

**Reassembly**

10. Place ratchet in clutch housing and drop in the six ball bearings, as illustrated.
11. Replace retainer cover and use plastic face hammer to attach cover to clutch housing.

12. When installing the starter clutch, place one drop of engine oil on the crankshaft. Use torque adapter and tighten clutch to 55 foot-pounds. Replace flywheel screen and shroud (blower housing).

*Note: DO NOT run engine without screen screws assembled to clutch.*

13. To check operation of clutch, pull on starter rope. Clutch should engage the starter and rope should retract fully.

14. Reconnect the spark plug wire.

15. Start engine several times to be sure starter and clutch are operating correctly.

16. Clean your work area and return tools to their proper places.

17. See your instructor.
Rewind Starters Service And Repair Competency Profile

Directions: The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks to be performed when servicing and repairing rewind starters. Compile your evaluation by checking the appropriate “yes/no” rating.

Note: Profile can be used as repair procedure for servicing and repairing starters.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Starter Clutch</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>1. Read operator's manual.</td>
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<tr>
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<td>2. Wear proper safety equipment.</td>
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<td></td>
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<td>3. Organize your work station.</td>
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<td></td>
<td></td>
<td>4. Remove flywheel shroud and screen.</td>
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<td></td>
<td></td>
<td>5. Place flywheel shroud and screen.</td>
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<td></td>
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<td>6. Remove starter clutch.</td>
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<td></td>
<td>7. Inspect starter clutch for proper operation.</td>
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<td></td>
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<td>8. Remove retainer cover, ratchet, and ball bearings.</td>
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<td></td>
<td>9. Clean and check condition of starter clutch parts.</td>
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<tr>
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<td></td>
<td>10. Reassemble starter clutch.</td>
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<tr>
<td></td>
<td></td>
<td>11. Replace retainer cover.</td>
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<tr>
<td></td>
<td></td>
<td>12. Install starter clutch and torque to 55 foot-pounds.</td>
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<td>13. Check clutch operation.</td>
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<td>14. Reconnect the spark plug wire.</td>
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<td>15. Start engine several times to be sure starter and clutch are operating correctly.</td>
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<td>16. Clean your work area.</td>
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</tbody>
</table>

Student's Signature ___________________________ Instructor's Signature ___________________________ Date ____________
Compression Valve Service and Repair
Compression
Assessment and Repair

Step 1: Identify Issue

Step 2: Check Valve Clearance

Step 3: Inspect Piston and Ring

Step 4: Adjust Valve Train

Step 5: Replace Wear Parts

Step 6: Test Engine Performance
Preface

This manual is designed to bring the student or home owner to a minimum performance level in properly servicing a small engine's ignition system. These step-by-step procedures include illustrations clarifying each procedure. The accompanying performance task list may be used as an evaluation or as a quick reference of repair procedures.

For many years those responsible for teaching small engine repair have needed materials that are basic, readable and usable. Although this series was written primarily for adult education, it can become a vital teaching tool in any program through live demonstrations and classroom instruction.

The author, Amon Herd, brings to this new series many years of small engine experience. Amon's "hands on" knowledge comes from twenty-five years of classroom teaching and small engine repair.
Acknowledgments

Appreciation is extended to those individuals who contributed time and talents in the development of Small Engine Carburetor Service and Repair, Second Edition.

Instructional Materials Laboratory Staff:
Harley Schlichting, Ph.D., Director
Phyllis Miller, Ed.D., Assistant Director
Dan Stapleton, Assistant Director
Eileen Woody, Administrative Assistant
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Randy Mertens, Editor
Kristin Desborough, Assistant Editor
Lori Holliday, Word Processor III

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Dan Hostetler, Boonville, Missouri, Harold Bossaler, Columbia, Missouri, Dr. Milo Spurgeon, Columbia, Missouri for their contributions to this manual.

References


Small Engines Operation Maintenance and Repair, J. Howard Turner, American Association for Vocational Instructional Materials, -Athens, Georgia.


Fuels and Lubricants, Harold Parady and Thomas Colvin, American Association for Vocational Instructional Materials, Athens, Georgia.


Compression
Valve Service and Repair

Unit Objectives

After completion of this unit, the student should be able to inspect and service the valve train of a small engine. The student should also be able to identify valve tools and their uses. This knowledge will be evidenced through the student's ability to properly install and service valves.

Specific Objectives

After completion of this unit, the student should be able to:

1. Identify valve tools and their uses.

2. Identify parts of the valve train.

3. Demonstrate the ability to:
   a. Check compression
   b. Remove cylinder head
   c. Remove the valves
   d. Disassemble the valve train
   e. Inspect the valve assembly
   f. Replace the valve guide
   g. Reface valve seats
   h. Replace valve seats
   i. Install valves and adjust valve-tappet clearance
   j. Install the cylinder head
Compression

Valve Service and Repair

Introduction

Valves play an important role in how an engine operates. They must operate precisely, yet withstand tremendous pressures and temperatures.

Valves typically must seal well enough to withstand pressures up to 500 pounds per square inch. The exhaust valves are exposed to such temperatures under load that they operate red-hot. High temperature exhaust gases pass over these valves increasing the temperature even more. The intake valves, often less than an inch away, are not subject to these high temperatures. Typically, these valves are cooled by the incoming fuel mixture.

Valves operate in a dirty environment. Under normal operating conditions the valves, seats, and guides must be inspected for carbon build up, wear, and damage. Carbon deposits may form on the valve or seat preventing the valve from seating properly. As a result, the valves become pitted, burned, or warped. Even a moderate amount of valve damage will result in the need for an overhaul.

There are many techniques in servicing valves in a 4-cycle engine. Typical service procedures for valve train maintenance are covered here. You may find it necessary to use only a portion, or add to, these steps.
A. Tools and Materials Needed to Service and Repair Valves

**Tools**
- Socket wrenches (1/4" through 9/16")
- Wire brush
- Valve spring compressor
- Valve lapping tool
- Valve seat puller kit (Briggs & Stratton #19138)
- Valve-seat cutter kit
- Valve grinder
- Feeler gauge
- Torque wrench and socket set (3/8" through 9/16" - 3/8" drive, and a 3/4" or 11/16" spark plug socket)
- Slot-head screwdriver (6" regular)
- Phillips-head screwdriver (6")
- Pocket knife
- Micrometer (0" to 2" and 0" to 6")
- Spark plug wire gauge
- Putty knife
- Fine flat file
- Valve guide reject gauge (Briggs and Stratton #19122)
- Valve guide bushing counter bore reamer (Briggs & Stratton #19064)
- Valve guide driver (Briggs & Stratton #19065)
- Reamer guide bushing (Briggs & Stratton #19191)
- Try square
- Ballpeen hammer
- Metal punch
- Metal plate
- Steel rule

**Supplies**
- Prussian blue
- Lapping compound
- Cleaning solvent
- 30W oil
- Led-Plate
- Shop towels
- Hand cleaner
- Emery cloth
- Small engine parts as needed
- Penetrating oil
B. Step-By-Step Procedure for Servicing Valves

1. Read operator's manual and Briggs and Stratton Service and Repair Manual.

2. Wear proper clothing and safety equipment.

⚠️ CAUTION: Observe this symbol as a WARNING or CAUTION. Personal injury may occur unless instructions are followed carefully.

3. Organize your work station.

---

**Checking Compression**

4. Disconnect spark plug wire.

5. Drain oil from crankcase.

6. Disconnect remote throttle control linkage.

*Note: Be sure to note throttle and choke connections; sketch the linkage on paper.*

7. Remove engine from implement or vehicle.

*Note: Disconnect fuel lines from engine if remote fuel tank is used.*

8. Mount engine on a suitable stand.

*Note: Some smaller engines are easier to disassemble on a work bench.*

9. Remove tank assembly.
   a. Finger guard.
   b. Gas line.
   c. Primer line (if available).
   d. Throttle control casing clamp.
10. Remove blower housing, oil tube, and casing clamp.

Note: On some models the casing clamp will not be attached to blower housing.

11. Test Compression.
   a. Screw the compression gauge hand-tight into the spark plug hole.
   b. Pull the engine over until the needle on the gauge stops advancing.
   c. Note the reading on the gauge. It should be a minimum of 90 PSI (pounds per square inch). This indicates upper cylinder compression is sufficient for starting the engine. Lower pressures indicate excessive wear or defect.

Note: If a compression gauge is not available, check compression by manually spinning the flywheel counterclockwise against the compression stroke. A sharp rebound indicates compression is satisfactory. Slight or no rebound indicates poor compression.

Note: Briggs & Stratton does not publish compression pressures, as it is extremely difficult to obtain accurate readings.

12. Remove exhaust pipe and muffler.

13. Remove the spark plug.

Note: Use a spark plug wrench to avoid breaking the spark plug.

14. Remove carburetor from engine. On some models the carburetor must be removed to have access to valve cover plate or breather.

CAUTION: Before removing carburetor, note position of governor linkage for reassembly.
15. Remove crankcase breather or valve cover plate (usually located behind the carburetor).

**CAUTION**: Handle breather with care.

16. Check breather clearance using a .045" wire gauge. The wire gauge should not enter the space between the fiber disc valve and body. Do not apply force when checking with wire gauge.

---

**Removing the Cylinder Head**

17. Remove the cylinder head bolts with a socket wrench.
   a. Note length of bolts so you can properly reassemble them in the right position.
   b. Remove cylinder head gasket and shields. See illustration.

Illustrations courtesy of Briggs & Stratton Corporation
18. Clean the carbon from the cylinder head, piston, and area around valve seats using a putty knife and wire brush. Aluminum is soft—be careful to avoid scratching machined surface.

19. Check cylinder head for warpage.
   a. Use a thick metal plate that has a true surface.
   b. Apply a thin layer of Prussian blue to plate and place the head (gasket-side) down on the plate.
   c. Move the head back and forth 2 to 3 times.
   d. Remove and check to see if bluing has transferred to all contact surfaces of cylinder head.
   e. Replace cylinder head if required.

**Removing the Valves**

20. Remove Prussian blue from head using a clean dry cloth.

21. Clean all removed parts with solvent and store in an organized manner for reassembly.
22. Remove valves.
   a. Adjust compressor jaws until they just touch the top and bottom of the valve chamber.
   b. Push the compressor in until the upper jaw slips over the upper end of the spring.
   c. Tighten the jaws to compress the spring.
   d. Remove pin or collars and lift out valve.
   e. Remove compressor and spring.

**Note:** If spring slips through jaws, re-insert, then tighten jaws using side adjusting screws before compressing spring

**Note:** Always identify the valves and springs so they may be replaced in the same position.

**Note:** An alternative way to remove valves using retainers. In this method, slip the upper jaw of the compressor over the top of the valve chamber and lower jaw between spring and retainer. Compress the spring and remove the retainer. Remove the valve, compressor, and spring. (See illustrations.)

23. Another alternative way to remove valves using retainers. Compress the valve spring with a screwdriver. Rotate the notch (on retainer) 90 degrees from top center. Place screwdriver in corner of valve chamber and press up on spring to remove retainer.
24. File away burrs on the valve-stem if valves do not remove easily. Use a fine flat file to remove burrs from valve-stem to prevent damage to valve guide. Do not over file. Place a cloth in the valve chamber to prevent metal filings from falling into crankcase.

CAUTION: Do not use force to remove valves.

25. Remove carbon deposits from valves with a wire brush or brush wheel. Carburetor cleaner may be used to remove gum deposits from valve stems and accessories.

26. Label the valves and springs for reassembly.

Note: The exhaust spring is heavier than the intake spring in some engines.
Inspecting Valves and Accessories

27. Note position of parts of the valve train on your engine.

Note: Before proceeding with valve repair, check the cylinder and bearings. The engine may be too worn to repair.

28. Inspect the valve head for proper margin. When the margin of the valve is 1/64\" or less after refacing, it should be replaced.

29. Examine the valves for warps, nicks, worn stems, burns, dishing, necking, or cracks.

30. Clean the valve guide with a solvent and check for wear.
   a. Insert the flat end of the plug gauge in the valve guide.
   b. If the plug gauge enters the valve guide, the valve guide is worn and should be replaced.
31. Inspect the valve spring.
   a. Check that valve spring is square at the top and bottom.
   b. Inspect the valve spring for distortion, pits, and cracks.

   **Note:** Valve spring condition is determined by comparing the spring to a new one. If the old spring is weaker, it will be shorter and will usually lean to one side. Replace any worn springs.

32. Inspect the valve seats for cracks and pitting.

   **Note:** Valve seat width should be 3/64 to 1/16 inch. If the seat is wider, a narrowing cutter should be used. Always replace a valve or seat that is badly burned. Replace valve when the margin is 1/64 inch or less.

---

**Replacing the Valve Guide**

33. Protect the engine from metal cuttings by placing a clean cloth in the valve chamber.
34. Select the proper size reamer. You will need the following Briggs and Stratton tools:

<table>
<thead>
<tr>
<th>#</th>
<th>Tool Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>#19269</td>
<td>Valve guide repair kit (1/4&quot; valve guides)</td>
</tr>
<tr>
<td>#19064</td>
<td>Counter bore reamer</td>
</tr>
<tr>
<td>#19066</td>
<td>Finish reamer</td>
</tr>
<tr>
<td>#19122</td>
<td>Plug gauge</td>
</tr>
<tr>
<td>#19191</td>
<td>Reamer guide bushing</td>
</tr>
<tr>
<td>#19270</td>
<td>Puller washer</td>
</tr>
<tr>
<td>#19271</td>
<td>Puller screw</td>
</tr>
<tr>
<td>#19272</td>
<td>Hex nut</td>
</tr>
<tr>
<td>#19273</td>
<td>Tap 7 mm</td>
</tr>
<tr>
<td>#19274</td>
<td>Bushing driver</td>
</tr>
</tbody>
</table>

35. Ream the cylinder block to accommodate the valve-guide bushing.
   a. Place pilot of counter bore reamer #19064 in valve guide.
   b. Install pilot bushing #19191 over counter bore reamer and lower pilot bushing to rest in valve seat.
   c. Hold replacement valve guide bushing #63709 on top of pilot bushing next to reamer.
   d. Make a mark on reamer 1/16" above top of replacement bushing.

   **Note:** Use a "T" handle wrench for hand drilling. Drill press is not recommended unless you can be sure it is absolutely square.

   e. Ream out valve guide until mark on counter bore reamer is level with top of pilot bushing. (See illustration.)
   f. Lubricate reamer with kerosene or equivalent lubricant.
36. Place replacement bushing in reamed-out hole. Press replacement bushing down with valve guide bushing driver #19065 until it is flush with the top of the hole.

*Note:* For easier installation, chill bushing in freezer for an hour. The bushing will become tight when it reaches the temperature of the block.

37. Finish reaming the replacement bushing with a valve guide bushing finish reamer #19066. Lubricate reamer with kerosene.

*Note:* Do not finish ream until bushing has warmed to same temperature as block.

38. Use compressed air to remove metal clippings.

39. Check dimension and condition of the newly reamed guide. See that there are no burrs or pieces of metal left.
40. Lubricate the valve-guide bushing with crankcase oil.

Refacing The Valves

Note: Steps 41 through 50 are to be used when valve grinding equipment is available. Local machine shops provide valve grinding service.

41. Dress the grinding wheel when glazed or surface is irregular. Use a diamond-tipped dressing tool.

42. Adjust the valve grinder for grinding at the proper face angle.

Note: Most valves on small engines are ground at a 45-degree angle. Some engine models have a 30-degree angle. Check engine specifications before doing any machine work.

43. Place the valve in the grinder chuck and tighten securely. Make sure that it is straight and will not wobble.

44. Check for proper position of valve face so that it makes proper contact with the grinding wheel. Move the valve in and out before starting the grinder while observing its position. Set the machine so the wheel will not contact the valve stem.

45. Start grinder and make sure the cutting oil is flowing properly.

46. Move the valve face up to the wheel and start grinding lightly. Take light cuts and continue until the grinding sound is regular. Check your progress often.

47. Stop the grinder and remove the valve from the grinding wheel. Check the face width. If the margin is less than 1/64" (less than one half the thickness of a new valve margin), discard the valve.

48. Clean the valve with a petroleum solvent.

49. Place valves in a storage rack for reassembly.

50. Determine valve seat angle.
   a. Take the exhaust valve and mate the valve face against the intake valve face.
   b. If both valve stems are parallel to each other, both seats should be cut at a 45-degree angle.
   c. If both valve stems are not parallel to each other, the exhaust valve seat should be cut at a 45-degree angle, and the intake should be cut at a 30-degree angle.
Refacing the Valve Seats

Note: All exhaust valves have a 45-degree angle.

51. Select appropriate valve seat cutter. Valve seats are cut using a Neway Valve Seat Cutter #19237. Exhaust valves are cut at a 45-degree angle and intake valves are cut at 30-degrees. Some intake seats are 45 degrees. Check engine specifications.

52. Check valve seat dimensions. Valve seat width should be 3/64 to 1/16.”

53. Install pilot in the valve guide. The pilot aligns itself with the unworn portion of the guide and will produce a near perfect alignment.

54. Place 45-degree cutting head over pilot. The cutting head is a precision tool with tungsten carbide blades. Handle with care.
Note: Do not drop cutter head on the pilot as it will break cutters and/or nick valve seat.

55. Reface the valve seat.
   a. Place the T-handle on the cutter head.
   b. Press down slightly on the T-handle and turn one to two turns in a clockwise direction.
   c. Make a visual check of the valve seat surface.
   d. Continue one to two more turns using very light pressure.

Note: Your finish cut should be a smooth satin finish.

56. Remove chatter marks. (If a large amount of material is removed from the seat or if the cutter blades are somewhat dull, chatter marks can occur on the newly-cut seat surface.)
   a. Place a piece of wax paper on paper towel between the cutting head and the valve seat.
   b. With a steady pressure on the cutting head, rotate the head 5 or 6 times. The paper will prevent the cutters from removing a large amount of material, but it will allow the tips of the cutters to shave the seat and remove the chatter marks, leaving behind a smooth seat surface.

57. Check valve seat for condition and width.

Note: If the seat is too wide, turn the valve seat cutter over and trim the width with the 30-degree angle cutter. Valve seat width should be 3/64" to 1/16."
58. Lap the valve to the seat.

**Replacing Valve Seats**

59. Obtain Briggs and Stratton Valve Seat Puller Kit #19138.

*Note: Cast iron cylinder models must be counter-bored to allow installation of the intake valve seat insert.*

<table>
<thead>
<tr>
<th>Basic Model Series</th>
<th>Insert * Puller Assembly</th>
<th>Puller Nut</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aluminum Cylinder</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6B, 8B</td>
<td>19138</td>
<td>19140 Ex.</td>
</tr>
<tr>
<td>60000, 8000</td>
<td>19138</td>
<td>19182 In.</td>
</tr>
<tr>
<td>82000, 92000, 94000, 95000, 11000</td>
<td>19138</td>
<td>19140 Ex.</td>
</tr>
<tr>
<td>100200, 100900, 130000</td>
<td>19138</td>
<td>19182 In.</td>
</tr>
<tr>
<td>120000</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>140000, 170000, 190000</td>
<td>19138</td>
<td>19141</td>
</tr>
<tr>
<td>220000, 250000, 280000</td>
<td>19138</td>
<td>19141 Ex.</td>
</tr>
<tr>
<td><strong>Cast Iron Cylinder</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N, 5, 6</td>
<td>19138</td>
<td>19140</td>
</tr>
<tr>
<td>8</td>
<td>19138</td>
<td>19140</td>
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<tr>
<td>9</td>
<td>19138</td>
<td>19139</td>
</tr>
<tr>
<td>14, 19, 190000</td>
<td>19138</td>
<td>19141</td>
</tr>
<tr>
<td>23, 200000, 230000</td>
<td>19138</td>
<td>19141</td>
</tr>
<tr>
<td>240000</td>
<td>19138</td>
<td>19141</td>
</tr>
<tr>
<td>300000, 320000</td>
<td>19138</td>
<td>19141 Ex.</td>
</tr>
</tbody>
</table>
60. Select the proper size puller nut using the valve seat puller as a reference. Place the puller nut under the valve seat insert. (See illustration.)

*Note: On aluminum cylinder models, it may be necessary to grind the puller nut until the edge is 1/32" thick in order to get the puller nut under the valve insert. (See illustration.)*

61. Place the puller body on top of the cylinder block and slide under bolt. Make sure puller body does not rest on the valve seat insert. (See illustration.)

62. Turn the 5/16" bolt with a wrench until seat insert is pulled out of the block.

63. Select the correct pilot and driver for installing the valve seat.

64. Select the proper valve seat insert. Note one side of the seat insert is chamfered at the outer edge. This side should be inserted into the cylinder.
65. Insert the pilot into the valve guide.

*Note:* On aluminum cylinders use the old insert as a spacer between the driver and the new insert. Drive the valve insert into place until it bottoms. The top of the insert will be slightly below cylinder and gasket surface.

66. Stake over the edge of cylinder block around entire insert using a metal punch. Metal should be squeezed against the insert.

67. Prepare the valve seat.
   a. Lightly face the seats at a 45-degree angle using the valve seat cutter.
   b. Install the pilot in the valve guide.
   c. Install the cutter head on the pilot.
   d. Place the T-handle on the cutter head.
   e. Press down slightly on the T-handle and turn one to two turns in a clockwise direction.
   f. Make a visual check of the valve seat surface.
   g. Continue one to two more turns using very light pressure.
   h. Check valve seat for condition and width.
68. Thoroughly clean grinding compound from valves and seats using cleaning solvent and compressed air.

**Lapping the Valves**

69. Apply a thin coat of lapping compound (carborundum paste) to the valve face.

70. Insert valve into the cylinder block.

*Note: Make sure to use the proper valve. The intake and exhaust valves are different sizes.*
71. Place the lapping tool on the head of the valve.

*Note:* It has a suction cup to hold the valve and a spring-loaded cap so you can apply constant and uniform pressure.

72. Rotate the valve back and forth on the seat.

*Note:* DO NOT rotate the valve all the way around 360 degrees. Work the valve back and forth, a very short distance, approximately 20 degrees on each turn.

73. Inspect the seat impression.
   a. After lapping the valve, remove the valve and wipe off the excess compound.
   b. Inspect the impression left by the lapping compound. Make sure it is of equal width all the way around the valve. If this is evident, there is no need to check the valve with machinist's ink. If there are gaps in the impression or if it does not have an equal width all the way around, the valve is warped or bent and should be replaced.

⚠️ **CAUTION:** Any amount of lapping compound left in your engine will get into lubricating oil and grind away vital parts.
Installing Valves and Adjusting Valve-Tappet Clearance

74. Apply crankcase oil or “Led-Plate” to valve stems and guides before installing.

Note: The “Led-Plate” grease provides long term lubrication for extended valve guide and stem life.

⚠️ CAUTION: “Led-Plate” contains lead. Wash hands thoroughly after use.

75. Place the valve in the cylinder block.

76. Turn the crankshaft to top-dead-center at the end of compression stroke. This will assure both valves are closed and without any pressure on the tappets.
77. Determine the recommended valve-tappet clearance in your operator's manual. Illustration is for aluminum engines only.

<table>
<thead>
<tr>
<th>Basic Model Series</th>
<th>Idle Speed</th>
<th>Armature Air Gap</th>
<th>Valve Clearance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Two Leg</td>
<td>Three Leg</td>
</tr>
<tr>
<td>60000, 68</td>
<td>1750</td>
<td>.006,.010</td>
<td>.012,.016</td>
</tr>
<tr>
<td>80000, 81000, 82000, 88</td>
<td>1750</td>
<td>.006,.010</td>
<td>.012,.016</td>
</tr>
<tr>
<td>90000, 91000, 92000, 93000, 94000, 95000</td>
<td>1750</td>
<td>.006,.010</td>
<td>.012,.016</td>
</tr>
<tr>
<td>100200, 100300</td>
<td>1750</td>
<td>.010,.014</td>
<td>.012,.016</td>
</tr>
<tr>
<td>100700</td>
<td>1750</td>
<td>.006,.010</td>
<td>.005,.007</td>
</tr>
<tr>
<td>110000</td>
<td>1750</td>
<td>.006,.010</td>
<td>.005,.007</td>
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<td>.006,.010</td>
<td>.005,.007</td>
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<tr>
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<td>.010,.014</td>
<td>.005,.007</td>
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<tr>
<td>170000, 171700</td>
<td>1750</td>
<td>.010,.014</td>
<td>.005,.007</td>
</tr>
<tr>
<td>190000, 191700</td>
<td>1750</td>
<td>.010,.014</td>
<td>.005,.007</td>
</tr>
<tr>
<td>192700, 193700</td>
<td>1750</td>
<td>.010,.014</td>
<td>.005,.007</td>
</tr>
<tr>
<td>220000, 250000</td>
<td>1750</td>
<td>.010,.014</td>
<td>.005,.007</td>
</tr>
<tr>
<td>230000</td>
<td>1750</td>
<td>.010,.014</td>
<td>.005,.007</td>
</tr>
<tr>
<td>240000</td>
<td>1750</td>
<td>.010,.014</td>
<td>.006,.008</td>
</tr>
<tr>
<td>300000</td>
<td>1750</td>
<td>.010,.014</td>
<td>.007,.009</td>
</tr>
<tr>
<td>320000</td>
<td>1750</td>
<td>.010,.014</td>
<td>.007,.009</td>
</tr>
</tbody>
</table>

78. Check the valve-tappet clearance with a feeler gauge. There should be a slight drag as you move the feeler gauge between the valve stem and tappet. (Check the clearance before installing the spring).

79. Grind stems and adjust valves.
   a. Make sure that stems are ground square with a grinding wheel. The use of a V-block or some commercial valve stem grinder will produce good results.
   b. Adjust valves by placing the piston 1/4" past top dead center on the power stroke. At this point, check the valve tappet clearance for both valves, and compare this to the specifications in the Service and Repair Instruction Manual.
80. Observe the winding before compressing each spring. One end of spring should be wound closer together. The more closely wound part of spring should be installed toward head of valve. The stronger spring always goes to the exhaust valve.

81. Compress retainer and spring in compressor when installing self-lock retainer. Note that large hole in retainer should be toward front of valve chamber.

**NOTE: Some retainers have a notch in the rim opposite the large hole.**

82. Insert compressed spring and retainer into valve chamber.
83. Insert valve stem.
   a. Insert valve stem through large hole in retainer slot and move compressor so as to center small hole of valve retainer slot onto valve stem shoulder.
   b. Release spring tension and remove compressor.
   c. Check to be sure spring is straight.

84. Rotate crankshaft two complete turns and recheck valve clearance.

85. Install valve-cover plate (breather).
Installing the Cylinder Head

86. Check piston, cylinder, valves, and cylinder head for cleanliness.

87. Install new head gasket and place cylinder head on cylinder block.

88. Install all cylinder head bolts snugly. Do not tighten. Check to see if head bolts are in correct position. Remember, some cylinder head bolts are longer than others.

89. Tighten head bolts according to procedures given by operator's manual.
90. Torque head bolts to specifications.

**Note:** How to convert foot-pounds to inch-pounds.

<table>
<thead>
<tr>
<th>To Convert</th>
<th>Into</th>
<th>Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foot-pounds</td>
<td>Inch-pounds</td>
<td>multiply by 12</td>
</tr>
<tr>
<td>Foot-pounds</td>
<td>foot-pounds</td>
<td>divide 12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Basic Model Series</th>
<th>Torque Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>6B, 60000</td>
<td>55</td>
</tr>
<tr>
<td>8B, 80000, 8100, 8200</td>
<td>55</td>
</tr>
<tr>
<td>92000, 94000</td>
<td>55</td>
</tr>
<tr>
<td>100000</td>
<td>60</td>
</tr>
<tr>
<td>110000</td>
<td>55</td>
</tr>
<tr>
<td>130000</td>
<td>60</td>
</tr>
<tr>
<td>140000</td>
<td>65</td>
</tr>
<tr>
<td>170000, 171700</td>
<td>65</td>
</tr>
<tr>
<td>190000, 191700</td>
<td>65</td>
</tr>
<tr>
<td>220000, 250000</td>
<td>65</td>
</tr>
</tbody>
</table>

91. Install carburetor on engine and properly hook up linkage.

92. Install exhaust pipe and muffler.

93. Install blower housing.

94. Install tank assembly and connect gas line.

95. Install engine on implement or vehicle and hook up remote controls.

96. Service crankcase. Check engine specifications for amount of oil.

97. Install spark plug and check proper gap.
Compression - Valve Service and Repair Competency Profile

Directions: This profile provides a record for student, instructor, and/or industry representative. The competencies listed below represent the tasks to be performed in Valves Service and Repair. Compile your evaluation of the student (trainee) by transferring the appropriate "yes/no" rating.

NOTE: This profile can be used as repair procedure for disassembly, repair and reassembly.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Checking Compression</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1. Read operator's manual.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Wear proper safety equipment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Organize your work station.</td>
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<tr>
<td></td>
<td></td>
<td>4. Disconnect spark plug wire.</td>
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<tr>
<td></td>
<td></td>
<td>5. Drain oil from crankcase.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6. Disconnect remote throttle control linkage.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7. Remove engine from implement or vehicle.</td>
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<tr>
<td></td>
<td></td>
<td>8. Mount engine on a suitable stand.</td>
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<tr>
<td></td>
<td></td>
<td>9. Remove tank assembly.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10. Remove blower housing, oil tube, and casing clamp.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11. Test Compression.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Removing Cylinder Head</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12. Remove exhaust pipe and muffler.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13. Remove the spark plug.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14. Remove carburetor from engine.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15. Remove crankcase breather or valve cover plate.</td>
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<tr>
<td></td>
<td></td>
<td>16. Check breather clearance.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17. Remove the cylinder head bolts.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18. Clean the carbon from the cylinder head, piston, and area around valve seats.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19. Check cylinder head for warpage.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20. Remove Prussian blue from head.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>21. Clean all removed parts with solvent and store.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Removing the Valves</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22. Remove valves.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>23. Compress the valve spring with a screwdriver.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24. Remove carbon deposits from valves.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>26. Label the valves and springs for reassembly.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>27. Note position of parts of the valve train.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>28. Inspect the valve head for proper margin.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inspecting the Valves and Accessories</td>
</tr>
<tr>
<td></td>
<td></td>
<td>29. Examine the valves for damage.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30. Clean the valve guide and check for wear.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>31. Inspect the valve spring.</td>
</tr>
</tbody>
</table>
### Replacing the Valve Guide

32. Inspect the valve seats for cracks and pitting.
33. Protect the engine from metal cuttings.
34. Select the proper size reamer.
35. Ream the cylinder block to accommodate the valve-guide bushing.
36. Place replacement bushing in reamed-out hole.
37. Finish reaming.
38. Remove metal clippings.
39. Check dimension and condition of the newly reamed guide.
40. Lubricate the valve-guide bushing.
41. Dress the grinding wheel.

#### Refacing the Valves

42. Adjust the valve grinder for grinding at the proper face angle.
43. Place the valve in the grinder chuck and tighten securely.
44. Check for proper position of valve face so that it makes proper contact with the grinding wheel.
45. Start grinder and make sure the cutting oil is flowing properly.
46. Move the valve face up to the wheel and start grinding lightly.
47. Stop the grinder and remove the valve from the grinding wheel. Check the face width.
48. Clean the valve with a petroleum solvent.
49. Place valves in a storage rack for reassembly.

#### Refacing Valve Seats

50. Determine valve seat angle.
51. Select appropriate valve seat cutter.
52. Check valve seat dimensions.
53. Install pilot in the valve guide.
54. Place 45-degree cutting head over pilot.
55. Reface the valve seat.
56. Remove chatter marks.

#### Replacing Valve Seats

57. Check valve seat for condition and width.
58. Lap the valve to the seat.
59. Obtain Valve Seat Puller Kit.
60. Select the proper size puller nut using the valve seat puller as a reference.
61. Place the puller body on top of the cylinder block and slide under bolt.
62. Turn the 5/16" bolt with a wrench until seat insert is pulled out of the block.
63. Select the correct pilot and driver for installing the valve seat.
64. Select the proper valve seat insert.
65. Insert the pilot into the valve guide.
66. Stake over the edge of cylinder block around entire insert using a metal punch.
67. Prepare the valve seat.
68. Clean grinding compound from valves and seats.
Lapping the Valves

69. Apply lapping compound to the valve face.
70. Insert valve into the cylinder block.
71. Place the lapping tool on the head of the valve.
72. Rotate the valve back and forth on the seat.
73. Inspect the seat impression.
74. Apply crankcase oil or "Led-Plate" to valve stems and guides.
75. Place valve in the cylinder block.
76. Turn the crankshaft to top-dead-center at the end of compression stroke.
77. Determine recommended valve-tappet clearance.
78. Check the valve-tappet clearance with a feeler gauge.
79. Grind stems and adjust valves.
80. Observe the winding before compressing each spring.
81. Compress retainer and spring in compressor when installing self-lock retainer.
82. Insert compressed spring and retainer into valve chamber.
83. Insert valve stem.
84. Rotate crankshaft two complete turns to recheck valve clearance.
85. Install valve-cover plate.

Installing the Cylinder Head

86. Check piston, cylinder, valves, and cylinder head for cleanliness.
87. Install new head gasket and place cylinder head on cylinder block.
88. Install all cylinder head bolts.
89. Tighten head bolts.
90. Torque head bolts to specifications.
91. Install carburetor on engine and properly hook up linkage.
92. Install exhaust pipe and muffler.
93. Install blower housing.
94. Install tank assembly and connect gas line.
95. Install engine on implement or vehicle and hook up controls.
96. Service crankcase.
97. Install spark plug and check proper gap.

________________________________________________________________________
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Student's Signature  Instructor's Signature  Date
Governors
Module 5

Governors

Prepared by: Amon Herd
Preface

This manual is designed to bring the student or home owner to a minimum performance level in properly servicing a small engine's ignition system. These step-by-step procedures include illustrations clarifying each procedure. The accompanying performance task list may be used as an evaluation or as a quick reference of repair procedures.

For many years those responsible for teaching small engine repair have needed materials that are basic, readable and usable. Although this series was written primarily for adult education, it can become a vital teaching tool in any program through live demonstrations and classroom instruction.

The author, Amon Herd, brings to this new series many years of small engine experience. Amon's "hands on" knowledge comes from twenty-five years of classroom teaching and small engine repair.
Acknowledgments

Appreciation is extended to those individuals who contributed time and talents in the development of Small Engine Carburetor Service and Repair, Second Edition.

Instructional Materials Laboratory Staff:
Harley Schlichting, Ph.D., Director
Phyllis Miller, Ed.D., Assistant Director
Dan Stapleton, Assistant Director
Eileen Woody, Administrative Assistant

Linda Winn, Graphic Designer
Randy Mertens, Editor
Kristin Desborough, Assistant Editor
Lori Holliday, Word Processor III

Special thanks for information and illustrations:
Briggs and Stratton Corporation
American Association for Vocational Instructional Materials

Appreciation is expressed to:
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References


Small Engines Operation Maintenance and Repair, J. Howard Turner, American Association for Vocational Instructional Materials, -Athens, Georgia.


Fuels and Lubricants, Harold Parady and Thomas Colvin, American Association for Vocational Instructional Materials, Athens, Georgia.


Governors

Adjustment and Repair

Unit Objectives

After completing this unit, you should know the purpose of the governor system and be able to identify its components. You should also be able to adjust and repair the governor system. This knowledge will be demonstrated through your ability to properly service and repair the governor.

Specific Objectives

After completing this unit, you should be able to:

1. List two purposes of the governor system.

2. List two types of governor systems.

3. Identify the parts of the governor system.

4. Demonstrate the ability to:
   a. Inspect, adjust and repair the air vane governor.
   b. Inspect and adjust external parts of the mechanical governor.
Governors

Adjustment and Repair

Introduction

The governor on a small engine serves two purposes: It keeps the engine operating at a constant speed in spite of load demands and prevents the engine from running above a predetermined speed set by the manufacturer.

The governor controls the speed of the engine by automatically adjusting the amount of fuel-air mixture fed through the carburetor. As the load increases, the governor opens the throttle valve to provide a greater fuel-air mixture allowing the engine to increase its power and maintain a constant speed. When the load decreases, the governor closes the throttle valve. Less fuel to the engine reduces the horsepower output while maintaining a constant speed.

This unit covers special tools, needed supplies, and a detailed step-by-step procedure for adjusting and servicing governors.
A. Special Tools and Materials Needed to Adjust and Repair Governors

Tools
Open-end wrenches (3/8" through 1/2")
Long-nose pliers (7")
Combination pliers (7")
Tachometer
Screwdriver
Nut drivers (1/4", 5/16", 3/8", and 7/16")
Safety glasses
Screwdriver torque wrench
Oil seal protector kit #19334

Supplies
Cleaning solvent
Shop towels
Small pan
Penetrating oil
B. Step-By-Step Procedure for Adjusting and Repairing Air Vane Governors

1. Read operator’s manual and Briggs and Stratton Service and Repair Instructions.

2. Wear proper safety equipment and observe this symbol as a WARNING or CAUTION. Personal injury may occur unless instructions are followed carefully.

3. Organize your work station.

---

Check Governor

4. Disconnect spark plug wire.

5. Drain oil from crankcase.

6. Disconnect remote throttle control linkage.

**Note:** Be sure to note throttle and choke connections. Sketch the linkage on paper for later reference.

7. Remove engine from implement or vehicle.

**Note:** If remote fuel tank is used, disconnect fuel line from engine.

8. Mount engine on a suitable stand.

**Note:** Some smaller engines are easier to disassemble on a work bench.
9. Remove the blower housing to access the air vane governor. Inspect the air vane governor and spring. The air vane should be parallel to the crankshaft. Improper spring tension will pull the air vane to one side.

10. Observe the operation of the air vane governor and spring. The air vane is connected by linkage to the throttle valve in such a way that when it moves, the throttle valve opens or closes. The air vane is also connected by a spring to the throttle control. When the engine is stopped, the throttle valve is open by spring tension.
11. Check the position of the air vane when the engine is not running.

Note: The governed speed can be varied by changing the spring tension.

12. Check the position of the air vane when the engine is running.

Note: As the air vane moves, the throttle closes. This reduces engine speed back to that selected by the throttle setting.
13. Check the condition of the governor linkage. Check for bent links and worn connections. Check the air vane for cracks and freedom of movement.

*Note:* Make sure the governor spring is installed correctly.

14. Check to see if the throttle valve is open when the engine is stopped. It should be completely open when the engine is stopped.

15. Remove carburetor to free the governor link. Do not use pliers to force the link free. Remove the mounting bolts from the carburetor and engine.

Illustrations courtesy of Briggs & Stratton Corporation
16. Remove the fuel tank assembly from the end of fuel intake tube and turn the carburetor to free governor link.

17. Observe how the spring is attached to the governor and control lever. Remove link and spring from the air vane.

18. Remove spring from control lever.
   a. Twist spring toward engine until end of loop can be pushed under lever.
   b. Push spring forward.
   c. Twist spring toward engine until end of loop snaps out of hole in lever.

19. Remove spring from eyelet in link. Grasp spring and twist to open loop and pull out.
20. Remove bolt to free air vane governor from engine. Inspect air vane and replace if necessary.

21. Clean governor assembly with solvent.

**Reassembly**

22. Install air vane governor and tighten bolt.

23. Select the proper governor spring. (See operator's manual.)
24. Install link on air vane. Steady link with finger and grasp spring as shown.

25. Assemble end of loop into link eyelet.

26. Twist spring toward you until eyelet snaps into link.

27. Connect spring to control lever.
   a. Grasp end of spring, and twist spring 3/4 turn toward engine until end of loop is up as shown.
   b. Insert end of loop into hole and twist spring toward you until end of loop snaps into hole.

28. Check for proper position of new spring. (See illustration.)
29. Install governor link to carburetor.

30. Install carburetor into place slowly. Make sure the fuel intake tube is aligned with the carburetor at the O-ring and the breather tube is aligned with the venting elbow. Replace mounting bolts.

31. Install the shroud on the engine.

32. Install engine on implement and reconnect gas line.
33. Reconnect the spark plug wire.

34. Refill the engine with new oil. Use a high quality detergent oil 10W-30 or 30W. No additives should be used. See oil capacity chart.

35. Reconnect the remote throttle control linkage.

36. Start engine and run at about one-half throttle until engine reaches normal operating temperature before checking with tachometer.

37. Check the top governed speed with an accurate tachometer. Refer to chart for top governed speed. Always adjust top governed speed at least 200 rpm lower than speed shown in chart.

Note: A tachometer is a device for measuring and indicating the rotational speed of an engine.

38. Use a tachometer to check no-load idle speed. Adjust the idle speed to 1750 rpm.

39. Clean your work area and return tools and equipment to their proper places.
Governor Adjustment and Repair Competency Profile

Directions: This profile provides a record for student, instructor, and industry representative. Competencies listed represent tasks performed when adjusting and repairing small engine governors. Compile your evaluation by checking the appropriate "yes/no" rating.

<table>
<thead>
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Adjusting and Repairing Air Vane Governors

**Disassembly**

1. Read operator's manual.
2. Wear proper safety equipment.
3. Organize your work station.
4. Disconnect spark plug wire.
5. Drain oil from crankcase.
6. Disconnect remote throttle control linkage.
7. Remove engine from implement or vehicle.
8. Mount engine on a suitable stand.
9. Remove blower housing to access the air-vane governor.
10. Observe operation of the air-vane governor and spring.
11. Check position of the air vane when the engine is stopped.
12. Check position of the air vane when the engine is running.
13. Check condition of the governor linkage.
14. Check for open throttle valve when the engine is stopped.
15. Remove carburetor and free governor link.
16. Remove fuel tank assembly to free governor link.
17. Remove governor link and spring from the air vane.
18. Remove spring from control lever.
19. Remove spring from eyelet in link.
20. Remove bolt to free air vane governor from engine.
21. Clean governor assembly with solvent.

**Reassembly**

22. Install air vane governor and tighten bolt.
23. Select the proper governor spring.
24. Install link on air vane.
25. Assemble end of loop into link eyelet.
26. Twist spring until eyelet snaps into link.
27. Attach spring to control lever.
28. Check proper position of new spring.
29. Install governor link to carburetor.
30. Slip carburetor into place.
31. Install shroud on engine.
32. Install engine and reconnect gas line.
33. Reconnect spark plug wire.
34. Refill the engine with new oil.
35. Reconnect remote throttle control linkage.
36. Start and warm engine.
37. Check the top governed speed with an accurate tachometer.
38. Check no-load idle speed.
39. Clean your work area.

__________________________
Student's Signature

__________________________
Instructor's Signature

__________________________
Date
C. Step-By-Step Procedure for Servicing Mechanical Governors
(Aluminum Engine model number 6B, 8B, 60000, 80000, and 140000)

1. Read operator's manual and Briggs and Stratton Service and Repair Instructions.

2. Wear proper safety equipment and observe this symbol as a WARNING or CAUTION. Personal injury may occur unless instructions are followed.

3. Organize your work station.

---

Check Governor

4. Disconnect spark plug wire.

5. Study component location on the mechanical governor before disassembly.

6. Inspect the mechanical governor for worn linkage or damaged governor spring. Manually check linkage for freedom of operation. Check to see if the throttle valve is open when the engine is stopped. The throttle valve should be completely open when the engine is stopped.
7. Draw a sketch of the governor linkage before removal. Be sure to note position of the spring in governor lever. This is very important for proper reassembly.

8. Remove mounting bolts from carburetor. Slowly position carburetor to free throttle linkage. Unhook linkage from governor lever.

⚠️ **CAUTION: Do not use pliers to remove or install the governor linkage.**

9. Remove spring from governor lever and linkage control.

10. Install new linkage onto carburetor and governor lever. Remount carburetor to engine and tighten bolts securely.
11. Install a new spring onto linkage control and in third hole in governor lever. A new spring will change top governed speed. Check new speed with a tachometer.

12. Loosen bolt holding governor lever to governor shaft. Do not remove bolt.

⚠️ CAUTION: The governor shaft can slide inside the engine when the governor lever bolt is loosened. Make sure you secure the governor shaft when making adjustments. (A spring clip may be used.)

Reassembly

13. Adjust governor lever.
   a. Open throttle to high-speed position by placing throttle control completely against stop.
   b. Hold throttle in this position.
   c. Use a screwdriver to turn governor shaft counterclockwise as far as it will go.
14. Torque bolt holding governor lever to 35-45 inch-lbs.

15. Manually check governor linkage for any binding. Use a good penetrating oil to correct any problems.

16. Reconnect spark plug wire.

17. Start engine and warm to operating temperature.

18. Check the no-load idle speed with a tachometer. **The throttle control should be in the closed position.** Adjust the no-load idle speed by adjusting the idle-stop screw. **The idle-stop screw should be adjusted to 1750 rpm.**

19. Check the no-load high-idle engine speed with a tachometer. Move the throttle control to full-open and the engine speed should remain constant. **Check the recommended speed in your operator's manual.**

<table>
<thead>
<tr>
<th>No-load high speed</th>
<th>3200 r.p.m.</th>
<th>3200 r.p.m.</th>
<th>2700 r.p.m.</th>
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<tbody>
<tr>
<td>Tiller</td>
<td>3200 r.p.m.</td>
<td>3200 r.p.m.</td>
<td>2700 r.p.m.</td>
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<tr>
<td>Generator</td>
<td>3200 r.p.m.</td>
<td>3200 r.p.m.</td>
<td>2700 r.p.m.</td>
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<tr>
<td>Pump</td>
<td>3200 r.p.m.</td>
<td>3200 r.p.m.</td>
<td>2700 r.p.m.</td>
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</table>

Illustrations courtesy of Briggs & Stratton Corporation
20. Adjust the governor if the engine does not come up to speed or overspeeds.
   a. Recheck steps 11-14.
   b. Check for binding in governor linkage.
   c. Check governor spring. It may be too loose if the spring has lost its tension.
   d. Check remote control lever for adjustment.

21. Check for surging.
   a. If surging occurs when changing from one load to another, check to see if the spring is too tight.
   b. If a substantial drop in rpm occurs when load is increased, the spring may be too loose.

22. Check for engine overspeed.
   a. Check spring tension.
   b. Check throttle linkage for binding and adjustment.

23. Clean your work area and return tools to their proper places.

24. See your instructor.
**Governor Adjustment and Repair Competency Profile**

**Directions:** This profile provides a record for student, instructor, and industry representative. Competencies listed represent tasks performed when adjusting and repairing small engine governors. Compile your evaluation by checking the appropriate “yes/no” rating.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th><strong>Servicing Mechanical Governors</strong></th>
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<td><strong>Disassembly</strong></td>
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<td>1. Read operator’s manual.</td>
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<td>2. Wear proper safety equipment.</td>
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<td>3. Organize your work station.</td>
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<td>4. Disconnect spark plug wire.</td>
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<td>5. Study governor component location.</td>
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<td>6. Inspect governor.</td>
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<td>7. Draw a sketch of the governor linkage.</td>
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<td>8. Remove mounting bolts from carburetor.</td>
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<td><strong>Reassembly</strong></td>
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<td>9. Remove spring from governor lever and linkage control.</td>
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<td>14. Torque bolt holding governor lever.</td>
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<td>17. Start engine and allow it to warm up.</td>
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<td>18. Check the no-load idle speed with a tachometer.</td>
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<td>19. Check the no-load high-idle engine speed.</td>
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<td>20. Adjust the governor, if needed.</td>
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<td>21. Check for surging.</td>
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<td>22. Check for engine overspeed.</td>
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<td>23. Clean your work area.</td>
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</tbody>
</table>

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Student's Signature  
Instructor's Signature  
Date
D. Step-By-Step Procedure for Servicing Mechanical Governor
(New Style) Aluminum Model Series 91700, 94500, 94900, 111700, 113900, 114700, 114900

1. Read operator's manual and Briggs and Stratton Service and Repair Instructions.

2. Wear proper safety equipment and observe this symbol as a WARNING or CAUTION. Personal injury may occur unless instructions are followed.

3. Organize your work station.

---

**Disassembly**

4. Disconnect spark plug wire.

5. Study mechanical governor component location before disassembly. Note that the governor gear is part of the oil slinger assembly.

*Note: Oil sump is removed from illustration.*

6. Inspect the mechanical governor for linkage wear or governor spring damage. Observe the amount of play in the governor shaft.
Disassembly

7. Service the governor.
   a. Remove the engine sump.
   b. Draw a sketch of the governor linkage before removal. Be sure to note position of spring in governor lever. This is very important for reassembly.
   c. Remove governor crank and carefully remove governor linkage.
   d. Remove hair pin and washer from governor crank.
   e. Use emery paper to remove any paint or burrs from governor crank.
   f. Remove governor crank.
   g. Clean and inspect all governor parts. Replace all damaged or worn parts.

8. Replace governor shaft bushing.
   a. Press old governor shaft bushing out of cylinder.
   b. Press new bushing into cylinder until housing is 1/16 inch above outside surface of cylinder.
   c. Use tool #19058 to finish ream bushing. Use kerosene or other lubricant to make a smooth finish.

Reassembly

   a. Install the governor crank. See illustration.
   b. Place washer onto the governor crank and install hair pin.
   c. Install governor lever onto governor crank and tighten bolt and nut.
   d. Turn crank until paddle contacts governor cup on oil slinger.
   e. Snap governor link into the retainer on the governor lever.

Illustrations courtesy of Briggs & Stratton Corporation
f. Install new gasket.
g. Install sump. (Use seal protector #19334 when installing the engine's sump base over the crankshaft.)
h. Place a non-hardening sealant on Screw "A" and install sump screws to seal the sump. Torque screws to 90 inch-lbs.

10. Adjust the governor.
   a. Move the throttle control to full open position.
   b. Turn the governor crank counterclockwise (with a screwdriver) as far as it will go and while holding governor crank. Torque governor bolt nut to 35 to 45 inch-lbs.

11. Check governor linkage for binding.

12. Reconnect spark plug wire.

13. Refer to steps 17-22 if adjustment is necessary.

14. Clean your work area and return tools to their proper places.
**Governor Adjustment and Repair Competency Profile**

**Directions:** This profile provides a record for student, instructor, and industry representative. Competencies listed represent tasks performed when adjusting and repairing small engine governors. Compile your evaluation by checking the appropriate "yes/no" rating.

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<th>Servicing Mechanical Governor (New Style)</th>
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<tr>
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<td>2. Wear proper safety equipment.</td>
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<td>3. Organize your work station.</td>
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<td>4. Disconnect spark plug wire.</td>
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Student's Signature   Instructor's Signature   Date
Lubricating Small Engines

Revised Edition

INSTRUCTIONAL MATERIALS LABORATORY
UNIVERSITY OF MISSOURI-COLUMBIA
COLUMBIA, MISSOURI
Module 6

Lubricating Small Engines

Prepared by: Amon Herd
Preface

This manual is designed to bring the student or home owner to a minimum performance level in properly servicing a small engine's ignition system. These step-by-step procedures include illustrations clarifying each procedure. The accompanying performance task list may be used as an evaluation or as a quick reference of repair procedures.

For many years those responsible for teaching small engine repair have needed materials that are basic, readable and usable. Although this series was written primarily for adult education, it can become a vital teaching tool in any program through live demonstrations and classroom instruction.

The author, Amon Herd, brings to this new series many years of small engine experience. Amon's "hands on" knowledge comes from twenty-five years of classroom teaching and small engine repair.
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Special thanks for information and illustrations:
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Lubricating Small Engines

Unit Objectives

After completing this unit the student should be able to select the type and grade of oil to use in a four-cycle engine. The student should also be able to properly inspect the lubrication system and remove and replace the oil. This knowledge will be evidenced through the ability to properly service the lubrication system.

Specific Objectives

After completing this unit, the student should be able to:

1. Identify the correct type and grade of oil.

2. Demonstrate the ability to:
   a. Check the breather for proper clearance.
   b. Check the venting elbows and tubes for proper fit.
   c. Check the oil in the crankcase.
   d. Check the oil in the gear reduction case.
   e. Check the O-ring for proper seal.
   f. Properly change the oil in a four-cycle engine.
   g. Check the engine for oil leaks.
Introduction

Oil is essential in engine operation. It lubricates, seals, cleans, removes heat, and reduces corrosion. Engine life depends on how well the engine is lubricated. Because of the high cost of replacing or overhauling a small engine, it is important to know how to properly service these powerplants. Charts are provided at the end of this unit for recording service information.

A high quality detergent oil should always be used in a small engine. Detergent oils keep the engine cleaner and retard formation of gum and varnish deposits. Special oil treatments should not be added to an engine.

Proper oil selection is also an important factor in small engine maintenance. Oil has two specification ratings. The first is the American Petroleum Institute (API) classifications of SC, SD, SE, or SF. The second is the Society of Automotive Engineers (SAE) viscosity rating, SAE 30 for example. When choosing lubricants for your engine, always refer to your service manual for recommended oil ratings.
How the Lubrication System Works

All four-cycle engines are lubricated from an oil reservoir. Two common methods of lubrication used in Briggs and Stratton engines are:

- **Dipper and Sump.** As the crankshaft turns, oil is picked up from the sump by the dipper which is attached to the rod bearing cap. The oil is splashed to all moving parts in the crankcase.

- **Slinger.** Oil is picked up from the oil sump by a rotating slinger and oil is splashed to all moving parts inside the crankcase. The oil slinger is driven by the cam gear.

Both lubrication systems are effective under normal operating conditions. However, when an engine is tilted at an angle greater than 45 degrees, oil in the crankcase is shifted to one side. Therefore, do not to run an engine at this angle for extended periods.
A. Tools and Materials Needed in Lubricating Small Engines

Tools
Safety glasses
Slot-head screwdriver (8")
Standard screwdriver (8")
Combination pliers (7")
End wrenches (7/16", 1/2", 9/16", and 5/8")
Funnel with flexible spout
Drain pan
Container for old oil
Wire feeler gauge

Supplies
Container for cleaning parts
Shop towels
Oil as recommended
Solvent
Hand cleaner
New breather gasket
Gasket for oil-fill plug
O-ring for oil-fill tube
B. Step-By-Step Procedure in Checking and Adding Oil to the Lubrication System

1. Read operator’s manual and Briggs and Stratton Service and Repair Instructions.

2. Wear proper clothing and safety equipment.

⚠️ CAUTION: Observe this symbol as a WARNING or CAUTION. Personal injury may occur unless instructions are followed carefully.

3. Organize your work station.

4. Disconnect spark plug wire from spark plug and place wire in V-notch on engine.

5. Locate the crankcase oil-fill plug on your engine.

Note: On small tractors it will be necessary to raise the hood to locate the crankcase oil-fill plug. A dipstick may be attached to the filler plug on the crankcase or to a cap on the filler neck. Some engines do not have a dipstick and the oil-fill plug is located on the oil sump.
6. Remove crankcase oil-fill plug with a screwdriver.

7. Check oil level in crankcase
   a. Place engine in level position.
   b. If your engine does not have a dipstick, check to see if oil comes to top of filler hole or to a place that indicates full oil level.
   c. If your engine has a dipstick, remove and wipe it with a clean rag. Reinsert dipstick and check oil level. Some dipsticks must be screwed or pushed in for accurate reading. Keep oil level between “full” and “add” lines.

8. Check operator’s manual for crankcase oil recommendations. Use a high quality detergent oil such as “10W-30” or 30 weight classified “For Service SC, SD, SE, or SF.” Classification markings are on the container.
9. Add oil in crankcase filler plug or dipstick opening (if needed) until oil reaches the full mark. Do not overfill. Replace oil-fill plug or dipstick.

Note: Steps 10, 11, and 12 are appropriate for the models illustrated. Cast iron engines and other models will differ. (See operator's manual.)

10. Check oil level in the gear reduction case (if equipped).
   a. Place engine in level position.
   b. Remove oil-level plug in lower half of gear cover.
   c. Oil should be level with the opening when plug is removed.

Note: Gear reduction oil is generally replaced every 100 hours of operation.
11. Add gear reduction case oil (if needed).
   a. Remove gear reduction case oil-filler plug and oil-level plug.
   b. Add SAE 10W-30 or crankcase oil to upper oil-fill plug until oil runs out of lower opening.

12. Replace both gear reduction case plugs. The oil-filler plug has a vent hole and must be placed in the top opening. The oil-level plug has no vent hole.

*Note: To drain gear reduction case, remove oil level plug and oil fill plug. Loosen the four screws holding gear case cover. Replace cover screws and torque to 85 inch-lbs. Replace oil level to recommended level and oil fill plugs.*

13. Check O-ring seal between crankcase oil-fill tube and sump for oil leakage.

*Note: A poor fit will result in a loss of crankcase vacuum and a discharge of smoke through the muffler.*
   a. Remove gas tank (on some models).
   b. Remove bracket screw from blower housing.
   c. Pull up on the oil-fill tube and remove from sump.
   d. Remove damaged O-ring seal from oil-fill tube.
   e. Clean tube and around sump with solvent.

15. Install new O-ring (if needed).
   a. Place O-ring into groove in sump. (On some models the O-ring should be placed in groove on oil-fill tube.)
   b. Push oil-fill tube downward into sump.
   c. Tighten bracket screw to blower housing to secure the tube.

16. Check breather for signs of oil leakage.

   Note: A fiber disc valve in the breather limits the direction of air flow caused by movement of the piston. Air can flow out of the crankcase but the disc valve prevents the return flow of air. This maintains a vacuum in the crankcase.

17. Remove breather from engine and check for proper clearance.

   Note: A new breather should be installed if a .045 wire gauge will enter the space between fiber disc valve and body. Do not apply force when checking with wire gauge. (See illustration.)
18. Inspect venting elbows for loose fit and damaged tubes. Replace if necessary.

*Note:* It is very important to have a good seal at all venting elbows to prevent dirt from entering the crankcase.

19. Check for oil leaks and level.
   a. Reconnect spark plug wire.
   b. Start engine and run for 10 minutes or until engine reaches operating temperature.
   c. Check for oil leaks.
   d. After engine has cooled somewhat, check oil level.

20. Clean your work area and return tools to proper places.

*Note:* Properly dispose of oily rags to avoid spontaneous combustion. Seal any partially used oil cans to protect oil from dirt.

Illustrations courtesy of Briggs & Stratton Corporation
Lubricating Small Engines Competency Profile

Directions: This profile provides a record for student, instructor and industry representative. These competencies represent tasks performed when servicing and repairing small engines. Compile your evaluation by checking the appropriate “yes/no” rating.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

**Checking and Adding Oil to the Lubrication System**

1. Read operator’s manual.
2. Wear proper safety equipment.
3. Organize work station.
4. Disconnect spark plug wire.
5. Locate the crankcase oil-fill plug.
6. Remove crankcase oil-fill plug.
7. Check oil level in crankcase.
8. Check oil recommendations.
9. Add oil.
10. Check oil level in the gear reduction case.
11. Add gear reduction case oil.
12. Replace both gear reduction case plugs.
13. Check O-ring seal for oil leakage.
15. Install new O-ring (if needed).
16. Check breather for signs of oil leakage.
17. Remove breather from engine and check for proper clearance.
18. Inspect venting elbows for loose fit and damaged tubes.
19. Check for oil leaks and proper level.
20. Clean your work area.

Student’s Signature ____________________________ Instructor’s Signature ____________________________ Date ___________
C. Step-by-Step Procedure in Changing Crankcase Oil (4-Cycle Engines).

1. Read operator's manual and Briggs and Stratton Service and Repair Instructions.

2. Wear proper clothing and safety equipment.

⚠️ CAUTION: Observe this symbol as a WARNING or CAUTION. Personal injury may occur unless instructions are followed carefully.

3. Organize your work station.

4. Start engine and run for 10 minutes or until it has reached normal operating temperature.

Note: More contaminants are removed with the oil change when oil is hot.

5. Stop engine and disconnect spark plug wire. Place spark plug wire in V-notch.


Note: On most engines the drain plug will be located on the bottom of the oil sump or on the edge of crankcase. On some engines the oil is drained through the filler neck.

7. Remove dirt and oil around drain plug using a solvent.

Illustrations courtesy of Briggs & Stratton Corporation
8. Remove drain plug with appropriate wrench.

Note: Do not use pliers. Pliers will round off corners of drain plug.

9. Place engine on level surface and allow oil to drain for about five minutes. Replace drain plug.

10. Refill crankcase with new oil. Refer to operator’s manual for correct oil amount.

Note: Use a high quality detergent oil classified “For Service SC, SD, SE, or SF.” Detergent oil keeps engine cleaner and retards formation of gum and varnish deposits. Nothing should be added to the oil. See chart on page 19 for recommended SAE viscosity grades. See oil capacity chart for Briggs and Stratton engines on this page. (10W-40 oil may be used if 10W-30 is not available. A synthetic oil having 5W-30 or 5W-40 viscosity may also be used.)

11. Check for oil leaks.
   a. Reconnect spark plug wire.
   b. Start engine.
   c. Run engine until it has reached operating temperature.
   d. Check for oil leaks.

Oil Capacity Chart

<table>
<thead>
<tr>
<th>Basic Model Series</th>
<th>Capacity/Pints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical Crankshaft Aluminum Cylinders</td>
<td></td>
</tr>
<tr>
<td>60000, 80000, 90000, 100700, 110000, 120000</td>
<td>1-1/4</td>
</tr>
<tr>
<td>100900, 130000</td>
<td>1-3/4</td>
</tr>
<tr>
<td>140000, 170000, 190000</td>
<td>2-1/4</td>
</tr>
<tr>
<td>220000, 250000, 280000</td>
<td>3</td>
</tr>
<tr>
<td>Horizontal Crankshaft Aluminum Cylinders</td>
<td></td>
</tr>
<tr>
<td>60000, 80000, 100200, 130000</td>
<td>1-1/4</td>
</tr>
<tr>
<td>140000, 170000, 190000</td>
<td>2-3/4</td>
</tr>
<tr>
<td>220000, 250000</td>
<td>2-1/2</td>
</tr>
<tr>
<td>Horizontal Crankshaft Cast Iron Cylinders</td>
<td></td>
</tr>
<tr>
<td>9, 14, 19, 190000, 200000</td>
<td>3</td>
</tr>
<tr>
<td>230000, 240000, 300000, 320000</td>
<td>4</td>
</tr>
</tbody>
</table>

Illustrations courtesy of Briggs & Stratton Corporation
12. Check oil level.
   a. Stop engine.
   b. Allow engine to cool somewhat.
   c. Recheck oil level. If oil is not to the "full"
      line, add oil until it reaches that level. Do
      not overfill.

13. Clean your work area and return tools to proper
    places. Properly dispose of oily rags to avoid
    spontaneous combustion. Properly seal any
    partially used oil containers to protect oil from
    dirt.
Lubricating Small Engines Competency Profile

Directions: This profile provides a record for student, instructor and industry representative. These competencies represent tasks performed when servicing and repairing small engines. Compile your evaluation by checking the appropriate "yes/no" rating.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
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<tbody>
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</table>

Changing the Crankcase Oil (4-Cycle Engines).

1. Read operator's manual.
2. Wear proper safety equipment.
3. Organize your work station.
4. Warm engine.
5. Disconnect spark plug wire.
7. Remove dirt and oil around drain plug.
8. Remove drain plug.
10. Refill crankcase with new oil.
11. Check for oil leaks.
12. Check oil level.
13. Clean your work area.

Student's Signature  Instructor's Signature  Date
Troubleshooting The Lubrication System

If engine starts but consumes oil excessively, check the following:

- Crankcase breather clogged
- Piston burned or warped
- Cylinder bore worn
- Piston rings worn
- Engine overheating
- Wrong oil used
- Oil diluted by rich mixture

Recommended SAE Viscosity Grades

<table>
<thead>
<tr>
<th>°F</th>
<th>°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>-20</td>
<td>-30</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
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<tr>
<td>20</td>
<td>10</td>
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<tr>
<td>40</td>
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<tr>
<td>60</td>
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</tr>
<tr>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Temperature Range Anticipated Before Next Oil Change

10W-30
5W-20, 5W-30
30
Lubrication Service Chart

Keep a record of oil changes on your small engines.

Change oil after first five hours of operation.

Thereafter change oil every 25 hours of operation.

<table>
<thead>
<tr>
<th>Equipment Model Number</th>
<th>Date Oil Changed</th>
<th>Hours of Operation</th>
<th>Type of Oil Used</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>
Troubleshooting Small Engines

- Carburetion
- Compression
- Spark Plug
- Ignition
Module 7

Troubleshooting Small Engines

- Carburetor
- Spark Plug
- Ignition
- Compression

Prepared by: Amon Herd
Preface

This manual is designed to bring the student or home owner to a minimum performance level in properly servicing a small engine’s ignition system. These step-by-step procedures include illustrations clarifying each procedure. The accompanying performance task list may be used as an evaluation or as a quick reference of repair procedures.

For many years those responsible for teaching small engine repair have needed materials that are basic, readable and usable. Although this series was written primarily for adult education, it can become a vital teaching tool in any program through live demonstrations and classroom instruction.

The author, Amon Herd, brings to this new series many years of small engine experience. Amon’s “hands on” knowledge comes from twenty-five years of classroom teaching and small engine repair.
Acknowledgments

Appreciation is extended to those individuals who contributed time and talents in the development of Small Engine Carburetor Service and Repair, Second Edition.

Instructional Materials Laboratory Staff:
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References


Small Engines Operation Maintenance and Repair, J. Howard Turner, American Association for Vocational Instructional Materials, Athens, Georgia.


Fuels and Lubricants, Harold Parady and Thomas Colvin, American Association for Vocational Instructional Materials, Athens, Georgia.


Troubleshooting Small Engines

Unit Objectives

After completion of this unit, the student should be able to troubleshoot the four basic engine systems: ignition system, spark plug condition, fuel system, and compression. This knowledge will be evidenced through the ability to properly troubleshoot small engines.

Specific Objectives

After completion of this unit, you should be able to:

1. List the safety cautions while troubleshooting small engines.

2. List requirements for an engine to run properly.

3. List the four basic tests of the troubleshooting procedure.

4. Demonstrate the ability to:
   a. Troubleshoot the fuel system.
   b. Troubleshoot the ignition system.
   c. Check spark plug condition.
   d. Troubleshoot engine compression.
Troubleshooting Small Engines

Introduction

An engine must have compression, fuel, and ignition in order to start and run. Troubleshooting is the process of locating and eliminating sources of trouble in the engine which prevent starting and running requirements.

Take a systematic approach when you troubleshoot a small engine. Observe the easiest things first. Before making any adjustments or corrections on the engine, carefully check oil level, fuel in the tank and carburetor, loose blade, air filter contamination, and cooling fin blockage. Also, check all parts to make sure they are securely mounted. After these checks have been made you are ready to perform the four basic engine tests:

1. Check fuel supply to the combustion chamber.
2. Check the ignition system.
3. Check the spark plug.
4. Check compression.

Before attempting to troubleshoot a small engine, always follow safety procedures and remove any unsafe material from your work area.

This unit covers special tools and supplies needed, a detailed step-by-step procedure for performing the four basic engine tests in troubleshooting, and reference tables of suggested repair procedures.
A. Tools and Materials Needed in Testing the Four Basic Engine Systems

Tools

Common 8" screwdriver
Phillips screwdriver (6"
Spark plug sockets (13/16", 3/4", and 5/8"
Drive ratchet (3/8"
Adjustable wrench (6"
Combination wrenches (1/2", 7/16", 9/16", and 3/4"
Combination pliers
Long nose pliers
Tester tool
Wire brush
Knife
Wire feeler gauge
Ignition file
Compression gauge
Safety glasses

Supplies

Shop towels
Hand cleaner

Note: Additional tools will be needed for suggested repair procedures listed in the Troubleshooting Tables. Tool lists are located in the front of each Step-By-Step Procedure Manual.
B. Step-By-Step Procedure for Performing the Four Basic Engine Tests

Note: Use the Four Basic Engine Tests to diagnose an engine problem. All four tests should be performed. After the problem area has been identified, refer to Table I through Table IX which list possible specific problems and repair procedures.

**Check Fuel Supply**

1. Read operator's manual and Briggs and Stratton Service and Repair Instructions.

2. Wear proper clothing and safety equipment.

***CAUTION: Observe this symbol as a WARNING or CAUTION. Personal injury may occur unless instructions are followed carefully.***

3. Organize your work station.

4. Determine if fuel is entering combustion chamber.
   a. Close the choke.
   b. Remove the spark plug and place the plug wire in a grounded position.
   c. Place your thumb or finger over the spark plug hole.
   d. Pull the starter 2 to 3 times. Your finger will be wet if fuel is getting to the combustion chamber.
   e. If finger is dry, check further for a fuel problem.
   f. Install spark plug and spark plug wire.
5. Check for fuel in the fuel tank.

6. Check to see if fuel shut-off valve is closed.

7. Check for plugged fuel tank cap vents. A plugged vent will cause excessive vapor pressure to build up in the tank and result in engine stoppage.

8. Check carburetor equipped with a bowl drain valve.
   a. Press the valve and let a small amount of fuel drain into a container.
   b. When fuel drains from valve, this indicates that fuel is getting from the tank to the carburetor.

9. Check carburetor not equipped with a drain valve.
   a. Remove bowl from the carburetor.
   b. Loosen bolt or nut from bowl drain and check for gas in the bowl.
10. Check for fuel obstruction from the tank to the carburetor.
   a. Verify that fuel shut-off valve is closed.
   b. Remove and inspect fuel shut-off valve and strainer.

11. Check for foreign matter or water in fuel. If water or foreign material is present, the carburetor will need to be serviced.

12. Check fuel filter for clogged element. If dirty, remove and replace with a new in-line filter.
Test Ignition System

1. Read operator’s manual and Briggs and Stratton Service and Repair Manual.

   WARNING: Wear proper safety equipment and observe this symbol as a WARNING or CAUTION. Personal injury may occur unless instructions are followed carefully.

2. Organize your work station.

   WARNING: Do not remove spark plug when checking ignition.

   WARNING: Do not test ignition when fuel vapor is present.

3. Check for spark at spark plug.
   a. Use Briggs and Stratton test tools #19051 or 19368.
   b. Connect the spark plug wire to the long terminal of spark tester.
   c. Ground test to engine using the alligator clip.
   d. Crank the engine 2 to 3 times and observe the spark at the test plug. The spark should jump the gap and should be a bright blue color. This indicates the ignition system is functioning properly. A spark that does not jump the tester gap indicates you have an ignition problem.

Note: Engines equipped with Magnetron Ignition the flywheel must rotate at least 350 RPM to properly test ignition.

4. Check engine for a spark miss.
   a. Place test tool #19051 or #19368 in series with engine spark plug and spark plug wire.
   b. Start engine to check engine miss.
   c. A miss usually indicates the spark plug is fouled or faulty. Replace with a new spark plug.
Check the Spark Plug

1. Wear proper safety equipment.

2. Read operator's manual.

3. Organize your work station.

4. Use compressed air to blow away the dirt around the plug before removing the spark plug. Remove the spark plug and secure the spark plug wire.

5. Inspect spark plug. If the plug is wet with fuel, this indicates that fuel is getting to the combustion chamber.

6. Inspect spark plug. If the plug is dry, this indicates a fuel system problem.

7. Inspect spark plug for fouling or damage. Spark plugs with combustion or oil deposits, burned or cracked insulators, or damaged electrodes should be replaced.

Combustion Deposits on Spark Plug
Oil Fouled Spark Plug
Overheated and Burned Porcelain Insulator Tip
Cracked, Chipped, or Broken Porcelain Insulator Tip
8. Service spark plugs with slight carbon build-up. Clean plug to remove carbon.

Note: *Do not use an abrasive cleaning machine to clean spark plugs.*

9. Check the spark plug gap. Regap the plug to engine specifications.
Checking Compression

1. Wear proper safety equipment.

2. Read operator’s manual.

3. Organize your work station.

4. Remove the spark plug wire from the spark plug and secure.

5. Test compression stroke.
   a. Manually spin the flywheel counter-clockwise against the compression stroke.
   b. A sharp rebound indicates satisfactory compression.
   c. Slight or no rebound indicates poor compression.

   a. Remove spark plug wire from spark plug and secure.
   b. Pull starter rope slowly and observe the compression.
   c. Resistance to the pull of the starter indicates there is compression.

7. Check the engine compression with a compression gauge.
   a. Crank the engine over at least six times and read the compression gauge.

Note: For satisfactory operation the minimum gauge reading should read above 60-psi on most engines.

Note: Briggs and Stratton does not publish any compression pressures, as it is extremely difficult to obtain an accurate reading.

<table>
<thead>
<tr>
<th>Engine</th>
<th>Through 4.5 hp</th>
<th>Above 4.5 hp</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 cycle engine</td>
<td>65-75 psi</td>
<td>over 70 psi</td>
</tr>
</tbody>
</table>
Maintenance Procedures Competency Profile

Directions: This profile provides a record for student, instructor, and/or industry representative. Competencies listed below represent the tasks to be performed in troubleshooting small engines. Compile your evaluation of the student (trainee) by checking the appropriate “yes/no” rating.

Yes  No  Troubleshooting Small Engines

Check Fuel Supply
1. Read operator’s manual.
2. Wear proper safety equipment.
3. Organize your work station.
4. Determine if fuel is entering combustion chamber.
5. Check for fuel in the fuel tank.
6. Check to see if fuel shut-off valve is closed.
7. Check for plugged fuel tank cap vents.
8. Check carburetor equipped with a bowl drain valve.
9. Check carburetor not equipped with a drain valve.
10. Check for fuel obstruction from the tank to the carburetor.
11. Check for foreign matter or water in fuel.
12. Check fuel filter for clogged element.

Test Ignition System
1. Read operator’s manual.
2. Organize your work station.
3. Check for spark at spark plug.
4. Check engine for a spark miss.

Check the Spark Plug
1. Wear proper safety equipment.
2. Read operator’s manual.
3. Organize your work station.
4. Remove spark plug and secure the spark plug wire.
5. Inspect spark plug to determine if fuel is entering combustion chamber.
6. Inspect spark plug to see if fuel is not entering combustion chamber.
7. Inspect spark plug for fouling or damage.
8. Service spark plugs with slight carbon build-up
9. Regap the plug to engine specifications.

Checking Compression
1. Wear proper safety equipment.
2. Read operator’s manual.
3. Organize your work station.
4. Remove the spark plug wire.
5. Test compression stroke.
7. Check the engine compression with a compression gauge.

Student’s Signature  Instructor’s Signature  Date
# Troubleshooting Charts

## Table 1

**Engine Will Not Start or Starts with Difficulty**

<table>
<thead>
<tr>
<th>Problem</th>
<th>Repair Procedure</th>
<th>Refer To Step-By-Step Manuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Switch in “kill” or “stop” position</td>
<td>Move remote control switch to “start” or “run” position.</td>
<td>Module 1</td>
</tr>
<tr>
<td>2. Fuel shutoff valve closed</td>
<td>Open shutoff valve.</td>
<td>Module 2</td>
</tr>
<tr>
<td>3. Out of fuel</td>
<td>Fill the fuel tank with fresh gasoline.</td>
<td>Module 7</td>
</tr>
<tr>
<td>4. Fuel tank cap clogged</td>
<td>Remove tank cap and clean the vent holes.</td>
<td>Module 7</td>
</tr>
<tr>
<td>5. Fuel filter clogged</td>
<td>Remove filter and replace with a new one.</td>
<td>Module 7</td>
</tr>
<tr>
<td>6. Fuel line clogged</td>
<td>Remove fuel line and replace with a new one or use air to clean old line.</td>
<td>Module 7</td>
</tr>
<tr>
<td>7. Water in fuel</td>
<td>Remove carburetor and fuel tank assembly. Drain and clean the tank assembly. Remount carburetor and fill tank with clean, fresh gasoline. Remove spark plug and dry water from electrode and replace.</td>
<td>Module 2</td>
</tr>
<tr>
<td>8. Stale gas in tank</td>
<td>Drain the tank and clean the carburetor. Remove spark plug and clean stale gas from electrode and replace. Fill tank with clean, fresh gasoline.</td>
<td>Module 2</td>
</tr>
<tr>
<td>9. Carburetor fuel pipes clogged</td>
<td>Remove carburetor tank assembly. Remove carburetor from tank. Clean fuel pipe screens and tank. Remount carburetor and fill tank with clean, fresh gasoline.</td>
<td>Module 2</td>
</tr>
<tr>
<td>10. Engine flooded</td>
<td>Remove air cleaner, clean and service. Check and service choke. Remove the spark plug and dry excess gas from the electrode. Install spark plug and air cleaner.</td>
<td>Module 2</td>
</tr>
<tr>
<td>Problem</td>
<td>Repair Procedure</td>
<td>Refer To Step-By-Step Manuals</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>11. Hot Restart</td>
<td>Check the spark plug to determine if a flooded condition exists.</td>
<td>Modules 1 &amp; 2</td>
</tr>
<tr>
<td></td>
<td>Check, clean and service the air cleaner.</td>
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</tr>
<tr>
<td></td>
<td>Check for a damaged adjusting needle, O-ring, or loose needle and seat.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Check the RPM of the engine. The primary cause for hot restart is a rich or flooded condition.</td>
<td></td>
</tr>
<tr>
<td>12. Choke valve not closing in carburetor</td>
<td>Adjust remote control cable.</td>
<td>Module 2</td>
</tr>
<tr>
<td></td>
<td>The choke valve should be completely closed.</td>
<td></td>
</tr>
<tr>
<td>13. Carburetor out of adjustment</td>
<td>Adjust needle valve.</td>
<td>Module 2</td>
</tr>
<tr>
<td>14. Carburetor throttle will not open far enough</td>
<td>Check remote control lever. Check for binding in cable linkage, and check for unhooked governor spring.</td>
<td>Module 2</td>
</tr>
<tr>
<td>15. No spark</td>
<td>Check ignition and flywheel key.</td>
<td>Module 1</td>
</tr>
<tr>
<td>16. Fouled spark plug</td>
<td>Clean or replace spark plug.</td>
<td>Module 1</td>
</tr>
<tr>
<td></td>
<td>Regap to specifications.</td>
<td></td>
</tr>
<tr>
<td>17. Poor compression</td>
<td>The following should be checked: a) valves, b) blown head gasket, c) cylinder.</td>
<td>Module 4</td>
</tr>
</tbody>
</table>

**Note:** The following list should be used in checking the performance of Automatic Choke Briggs & Stratton Engines.

18. Engine underchoked
   a. Carburetor adjusted too lean
      Turn needle valve slowly counterclockwise with engine running in “fast” position. Module 2

   b. Fuel pipe check valve inoperative
      Remove carburetor and fuel tank assembly. Clean (Vacu-Jet only) screen on the fuel pipe and make sure check ball is free. If screen and ball cannot be cleaned, remove and replace. Module 2
<table>
<thead>
<tr>
<th>Problem</th>
<th>Repair Procedure</th>
<th>Refer To Step-By-Step Manuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. Bent air cleaner stud</td>
<td>Replace air cleaner stud bolt.</td>
<td>Module 2</td>
</tr>
<tr>
<td>d. Sticking choke shaft</td>
<td>Spray carburetor cleaner on choke and choke shaft. It may be necessary to install a new choke shaft.</td>
<td>Module 2</td>
</tr>
<tr>
<td>e. Choke spring damaged or too short</td>
<td>Replace choke spring.</td>
<td>Module 2</td>
</tr>
<tr>
<td>f. Diaphragm not preloaded</td>
<td>Move choke plate to an &quot;over-center&quot; position and install choke linkage.</td>
<td>Module 2</td>
</tr>
<tr>
<td>19. Engine overchoked</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Carburetor adjusted too rich</td>
<td>Turn needle valve slowly clockwise with engine running in &quot;fast&quot; position.</td>
<td>Module 2</td>
</tr>
<tr>
<td>b. Bent air cleaner stud</td>
<td>Replace air cleaner stud bolt.</td>
<td>Module 2</td>
</tr>
<tr>
<td>c. Sticking choke shaft</td>
<td>Spray carburetor cleaner on choke and choke shaft.</td>
<td>Module 2</td>
</tr>
<tr>
<td>d. Ruptured diaphragm</td>
<td>Replace diaphragm.</td>
<td>Module 2</td>
</tr>
<tr>
<td>e. Choke spring stretched</td>
<td>Replace choke spring.</td>
<td>Module 2</td>
</tr>
<tr>
<td>f. Needle valve seat loose</td>
<td>Tighten needle valve seat.</td>
<td>Module 2</td>
</tr>
<tr>
<td>20. Governor faulty</td>
<td>Repair or replace. Check linkage and adjust.</td>
<td>Module 5</td>
</tr>
<tr>
<td>21. Carburetor jet clogged</td>
<td>Service carburetor and air cleaner.</td>
<td>Module 2</td>
</tr>
<tr>
<td>22. Armature air gap incorrect</td>
<td>Check the correct air gap setting and adjust.</td>
<td>Module 1</td>
</tr>
<tr>
<td>23. Vapor lock</td>
<td>Cool down the engine. Check engine for proper ventilation and cooling.</td>
<td>Module 7</td>
</tr>
</tbody>
</table>
### Table I (continued)

<table>
<thead>
<tr>
<th>Problem</th>
<th>Repair Procedure</th>
<th>Refer To Step-By-Step Manuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>24. Sheared flywheel key</td>
<td>Check condition of crankshaft and flywheel. Install new flywheel key.</td>
<td>Module 1</td>
</tr>
<tr>
<td>25. Poor compression</td>
<td>Run a compression check to determine faulty parts of the engine.</td>
<td>Module 4</td>
</tr>
<tr>
<td>26. Carburetor loose on engine</td>
<td>Check and tighten the bolts holding the carburetor in place.</td>
<td>Module 2</td>
</tr>
<tr>
<td>27. Ignition switch defective</td>
<td>Install new ignition switch.</td>
<td>Module 1</td>
</tr>
<tr>
<td>28. Spark plug</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. No spark</td>
<td>Service spark plug.</td>
<td>Modules 1 &amp; 7</td>
</tr>
<tr>
<td>b. Porcelain cracked</td>
<td>Service spark plug.</td>
<td>Modules 1 &amp; 7</td>
</tr>
<tr>
<td>c. Wire disconnected from spark plug</td>
<td>Service spark plug.</td>
<td>Modules 1 &amp; 7</td>
</tr>
</tbody>
</table>

### Table II - Engine Kickbacks or Hard to Start

<table>
<thead>
<tr>
<th>Problem</th>
<th>Repair Procedure</th>
<th>Refer To Step-By-Step Manuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Loose or thrown belt</td>
<td>Check for proper alignment. Replace belt on pulley.</td>
<td>Module 8</td>
</tr>
<tr>
<td>2. Loose blade</td>
<td>Check blade for proper installation and torque bolt to 45-60 foot pounds.</td>
<td>Module 8</td>
</tr>
<tr>
<td>3. Kickback</td>
<td>Check breaker-point gap. Check ignition timing. Check for a partially sheared key. Check air gap.</td>
<td>Module 1</td>
</tr>
<tr>
<td>Problem</td>
<td>Repair Procedure</td>
<td>Refer To Step-By-Step Manuals</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>1. Ignition switch in “off” position</td>
<td>Turn ignition switch on.</td>
<td>Module 1 &amp; 7</td>
</tr>
<tr>
<td>2. Ignition wire broken or grounding out</td>
<td>Inspect ignition wires, replace or reconnect.</td>
<td>Module 1</td>
</tr>
<tr>
<td>3. Ignition switch faulty</td>
<td>Remove wires from switch.              If you have a spark, the switch is faulty. Replace switch.</td>
<td>Module 1</td>
</tr>
<tr>
<td>4. Spark plug defective</td>
<td>Replace the spark plug with plug recommended by manufacturer. Use wire gauge to gap plug correctly.</td>
<td>Module 1</td>
</tr>
<tr>
<td>5. Solid-state ignition module is faulty</td>
<td>Test solid-state module.              Replace if necessary. Check air gap. Check leads for grounding loose connections.</td>
<td>Module 1</td>
</tr>
<tr>
<td>6. Breaker points</td>
<td>Check breaker points. Replace with pitted.</td>
<td>Module 1</td>
</tr>
<tr>
<td>7. Condenser faulty</td>
<td>Check condenser with a tester. Replace if necessary.</td>
<td>Module 1</td>
</tr>
<tr>
<td>8. Ignition coil faulty</td>
<td>Check ignition coil with a tester. Replace if necessary.</td>
<td>Module 1</td>
</tr>
<tr>
<td>9. Sheared flywheel key</td>
<td>Replace with new flywheel key.</td>
<td>Module 1</td>
</tr>
<tr>
<td>10. Stop switch grounded</td>
<td>Check wiring and switch.</td>
<td>Module 1</td>
</tr>
<tr>
<td>11. Operator presence control bar defective</td>
<td>Replace control bar.</td>
<td>Module 7</td>
</tr>
<tr>
<td>Problem</td>
<td>Repair Procedure</td>
<td>Refer To Step-By-Step Manuals</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-------------------------------------------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>1. Spark plug gap incorrect</td>
<td>Regap plug.</td>
<td>Module 1</td>
</tr>
<tr>
<td>2. Wrong spark plug</td>
<td>Replace spark plug using manufacturer's recommendations.</td>
<td>Module 1</td>
</tr>
<tr>
<td>3. Wet spark plug</td>
<td>Remove spark plug and dry.</td>
<td>Module 1</td>
</tr>
<tr>
<td>4. Breaker points gapped incorrectly</td>
<td>Use a flat feeler gauge and regap points.</td>
<td>Module 1</td>
</tr>
<tr>
<td>5. Magneto (armature) air gap too wide</td>
<td>Set air gap.</td>
<td>Module 1</td>
</tr>
<tr>
<td>6. Defective coil</td>
<td>Check coil and replace if required.</td>
<td>Module 1</td>
</tr>
<tr>
<td>7. Defective condenser</td>
<td>Check condenser; replace if required.</td>
<td>Module 1</td>
</tr>
<tr>
<td>8. Flywheel magnets have lost magnetism</td>
<td>Replace flywheel.</td>
<td>Module 1</td>
</tr>
<tr>
<td>9. Defective solid state module</td>
<td>Check and replace if necessary.</td>
<td>Module 1</td>
</tr>
<tr>
<td>Problem</td>
<td>Repair Procedure</td>
<td>Refer To Step-By-Step Manuals</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-------------------------------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>1. Water in fuel</td>
<td>Drain the complete fuel system and service the carburetor.</td>
<td>Module 2</td>
</tr>
<tr>
<td>2. Spark plug defective</td>
<td>Replace spark plug and set gap correctly.</td>
<td>Module 1</td>
</tr>
<tr>
<td>3. Spark plug fouled</td>
<td>Clean and regap the spark plug.</td>
<td>Module 1</td>
</tr>
<tr>
<td>4. Pitted magneto breaker points</td>
<td>Install new points.</td>
<td>Module 1</td>
</tr>
<tr>
<td>5. Armature faulty</td>
<td>Have armature tested and replace if needed.</td>
<td>Module 1</td>
</tr>
<tr>
<td>6. Kill switch wire worn and is making contact with engine ground</td>
<td>Replace wire.</td>
<td>Module 1</td>
</tr>
<tr>
<td>7. Improper valve clearance</td>
<td>Adjust valves to correct clearance.</td>
<td>Module 4</td>
</tr>
<tr>
<td>8. Sheared flywheel key</td>
<td>Check crankshaft and flywheel. Replace with new key.</td>
<td>Module 1</td>
</tr>
</tbody>
</table>
Table VI - Low Compression

<table>
<thead>
<tr>
<th>Problem</th>
<th>Repair Procedure</th>
<th>Refer To Step-By-Step Manuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Head gasket blown or leaking</td>
<td>Replace head gasket and torque head bolts to specifications.</td>
<td>Module 4</td>
</tr>
<tr>
<td>2. Loose head bolts</td>
<td>Check head bolts and torque to specifications.</td>
<td>Module 4</td>
</tr>
<tr>
<td>3. Loose spark plug</td>
<td>Check spark plug and torque to specifications.</td>
<td>Module 1</td>
</tr>
<tr>
<td>4. Valves sticking or not seating properly</td>
<td>Inspect the valves, seats, and guides. Replace or recondition as required.</td>
<td>Module 4</td>
</tr>
<tr>
<td>5. Valve clearance incorrect</td>
<td>Check intake and exhaust valve for proper clearance.</td>
<td>Module 4</td>
</tr>
<tr>
<td>6. Worn cylinder or rings</td>
<td>Check cylinder and rings for wear. Recondition or replace as needed.</td>
<td>Module 4</td>
</tr>
<tr>
<td>7. Broken valve spring</td>
<td>Remove breather and check valve springs. Replace as needed.</td>
<td>Module 4</td>
</tr>
<tr>
<td>8. Breather loose or not functioning properly</td>
<td>Install new gasket and tighten breather securely. Check the breather fiber disc valve for proper clearance.</td>
<td>Module 2</td>
</tr>
<tr>
<td>Problem</td>
<td>Repair Procedure</td>
<td>Refer To Step-By-Step Manuals</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>Valves not seating properly</td>
<td>Clean carbon from the valves and reseat. Reset the valve tappet clearance.</td>
<td>Module 4</td>
</tr>
<tr>
<td>Valve tappet clearance incorrect</td>
<td>Check the valve tappet clearance.</td>
<td>Module 4</td>
</tr>
<tr>
<td>Valve spring weak</td>
<td>Replace valve spring.</td>
<td>Module 4</td>
</tr>
<tr>
<td>Timing incorrect</td>
<td>Check timing. Line up keyway with breaker plunger.</td>
<td>Module 1</td>
</tr>
<tr>
<td>Spark plug defective</td>
<td>Replace spark plug and regap.</td>
<td>Module 1</td>
</tr>
<tr>
<td>Breaker points gapped incorrectly</td>
<td>Regap points using a flat feeler gauge.</td>
<td>Module 1</td>
</tr>
<tr>
<td>Choke out of adjustment</td>
<td>Check choke for open and closed position.</td>
<td>Module 2</td>
</tr>
<tr>
<td>Carburetor out of adjustment</td>
<td>Reset high speed and idle adjustment.</td>
<td>Module 2</td>
</tr>
<tr>
<td>Fuel line clogged</td>
<td>Check fuel line for obstructions.</td>
<td>Module 1</td>
</tr>
<tr>
<td>Dirty air cleaner</td>
<td>Clean and service air cleaner.</td>
<td>Module 2</td>
</tr>
<tr>
<td>Clogged muffler</td>
<td>Remove and replace with a new muffler.</td>
<td>Module 8</td>
</tr>
<tr>
<td>Throttle set incorrectly</td>
<td>Check remote controls to carburetor.</td>
<td>Module 2</td>
</tr>
<tr>
<td>Poor compression</td>
<td>Check for blown head gasket, loose spark plug, burned valves, or worn bore and rings.</td>
<td>Module 4</td>
</tr>
<tr>
<td>Defective governor</td>
<td>Check governor for proper adjustment. Replace or repair.</td>
<td>Module 5</td>
</tr>
<tr>
<td>Spark plug wire defective or loose</td>
<td>Adjust spark plug wire terminal or replace wire.</td>
<td>Module 1</td>
</tr>
<tr>
<td>Head bolts loose</td>
<td>Check all head bolts and torque to specifications.</td>
<td>Module 4</td>
</tr>
</tbody>
</table>
# Table VIII - Engine Overheating

<table>
<thead>
<tr>
<th>Problem</th>
<th>Repair Procedure</th>
<th>Refer To Step-By-Step Manuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Engine dirty and/or cooling fins blocked</td>
<td>Thoroughly clean the rotating screen, and cooling fins.</td>
<td>Module 8</td>
</tr>
<tr>
<td>2. Overloaded engine</td>
<td>Check the horsepower of the engine. You may need a larger engine.</td>
<td>Module 8</td>
</tr>
<tr>
<td>3. Governor out of adjustment</td>
<td>Adjust governor to correct speed. Use a tachometer to determine proper speed.</td>
<td>Module 5</td>
</tr>
<tr>
<td>4. Engine out of time</td>
<td>Check timing. Check for damaged key in flywheel.</td>
<td>Module 1</td>
</tr>
<tr>
<td>5. Piston or rings fitted too tight</td>
<td>Check rings and piston for proper clearance.</td>
<td></td>
</tr>
<tr>
<td>6. Lack of oil in crankcase</td>
<td>Check the oil level in the crankcase.</td>
<td>Module 6</td>
</tr>
<tr>
<td>7. Carbon deposit on cylinder head</td>
<td>Remove head and clean out carbon deposits.</td>
<td>Module 4</td>
</tr>
<tr>
<td>8. Clogged exhaust system</td>
<td>Remove and replace with a new muffler.</td>
<td>Module 8</td>
</tr>
<tr>
<td>9. Carburetor out of adjustment</td>
<td>Adjust carburetor to specifications.</td>
<td>Module 2</td>
</tr>
<tr>
<td>10. Air flow obstructed</td>
<td>Remove shroud and clean.</td>
<td>Module 8</td>
</tr>
<tr>
<td>11. Cooling fins clogged</td>
<td>Clean cooling fins.</td>
<td>Module 8</td>
</tr>
<tr>
<td>12. Shroud or air baffles missing</td>
<td>Replace missing parts.</td>
<td>Module 8</td>
</tr>
</tbody>
</table>
## Table IX - Engine Runs Unevenly and/or Surges

<table>
<thead>
<tr>
<th>Problem</th>
<th>Repair Procedure</th>
<th>Refer To Step-By-Step Manuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Governor out of adjustment or binding</td>
<td>Check governor for binding or dirt. Replace or repair the governor.</td>
<td>Module 5</td>
</tr>
<tr>
<td>2. Vent holes clogged in gas cap</td>
<td>Clean vent holes or replace with a new cap.</td>
<td>Modules 2 &amp; 7</td>
</tr>
<tr>
<td>3. Carburetor out of adjustment</td>
<td>Check needle valve setting and float level.</td>
<td>Module 2</td>
</tr>
<tr>
<td>4. Blocked fuel line</td>
<td>Clean fuel line, tank, inlet needle and seat in carburetor.</td>
<td>Modules 2 &amp; 7</td>
</tr>
<tr>
<td>5. Engine vibrates</td>
<td>Check for bent crankshaft and/or mower blade out of balance.</td>
<td>Module 8</td>
</tr>
<tr>
<td>6. Choke out of adjustment</td>
<td>Clean and adjust linkage. Check for ruptured diaphragm, and burr on throttle shaft or choke plate.</td>
<td>Module 2</td>
</tr>
<tr>
<td>7. Intermittent spark</td>
<td>Check ignition. Check wires for poor connection. Check ignition switch.</td>
<td>Module 1</td>
</tr>
<tr>
<td>8. Wrong governor spring</td>
<td>Replace with correct governor spring.</td>
<td>Module 5</td>
</tr>
<tr>
<td>9. Worn internal governor parts</td>
<td>Check and replace worn parts.</td>
<td>Module 5</td>
</tr>
<tr>
<td>10. Fuel supply low to empty</td>
<td>Fill fuel tank with fresh gasoline.</td>
<td>Module 2</td>
</tr>
<tr>
<td>11. Air cleaner dirty</td>
<td>Clean air cleaner.</td>
<td>Module 8</td>
</tr>
<tr>
<td>12. Over loading engine</td>
<td>Reduce engine load.</td>
<td>Module 1</td>
</tr>
</tbody>
</table>
### Table X - Engine Knocks and is Noisy

<table>
<thead>
<tr>
<th>Problem</th>
<th>Repair Procedure</th>
<th>Refer To Step-By-Step Manuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Loose blade</td>
<td>Torque to specifications.</td>
<td>Module 8</td>
</tr>
<tr>
<td>2. Flywheel loose</td>
<td>Check flywheel and key; torque to specifications.</td>
<td>Module 1</td>
</tr>
<tr>
<td>3. Loose or worn connecting rod</td>
<td>Check connecting rod for damage. Torque bolts as required or replace.</td>
<td></td>
</tr>
<tr>
<td>4. Starter clutch noisy</td>
<td>Service starter clutch or replace.</td>
<td>Module 3</td>
</tr>
<tr>
<td>5. Flywheel screen hitting blower housing</td>
<td>Check for proper clearance and remount screen.</td>
<td>Module 3</td>
</tr>
<tr>
<td>6. Carbon in the combustion chamber</td>
<td>Remove cylinder head and clean carbon from head and top of cylinder.</td>
<td>Module 4</td>
</tr>
<tr>
<td>7. Lack of oil in crankcase</td>
<td>Check oil level in crankcase.</td>
<td>Module 6</td>
</tr>
</tbody>
</table>

### Table XI - Engine Vibrating

<table>
<thead>
<tr>
<th>Problem</th>
<th>Repair Procedure</th>
<th>Refer To Step-By-Step Manuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Blade out of balance or loose</td>
<td>Sharpen and balance blade and torque to specifications.</td>
<td>Module 8</td>
</tr>
<tr>
<td>2. Bent crankshaft</td>
<td>Check crankcase and replace if necessary.</td>
<td>Module 8</td>
</tr>
<tr>
<td>3. Engine not securely mounted to equipment</td>
<td>Tighten all mounting bolts securely.</td>
<td>Module 8</td>
</tr>
<tr>
<td>4. Carburetor out of adjustment</td>
<td>Check carburetor for proper adjustment.</td>
<td>Module 2</td>
</tr>
</tbody>
</table>
### Table XII - Engine Will Not Stop

<table>
<thead>
<tr>
<th>Problem</th>
<th>Repair Procedure</th>
<th>Refer To Step-By-Step Manuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Engine keeps running</td>
<td>Check ignition stop switch.</td>
<td>Module 1</td>
</tr>
<tr>
<td>2. Stop switch wire not connected to kill switch</td>
<td>Check kill switch.</td>
<td>Module 1</td>
</tr>
</tbody>
</table>

### Table XIII - Starter Rope Hard to Pull

<table>
<thead>
<tr>
<th>Problem</th>
<th>Repair Procedure</th>
<th>Refer To Step-By-Step Manuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Flywheel brake is on when operator presence control bar is released</td>
<td>Depress operator presence control bar to upper handle before pulling on starter rope.</td>
<td>Module 8</td>
</tr>
<tr>
<td>2. Blade adapter sheared</td>
<td>Install new blade adapter.</td>
<td>Module 8</td>
</tr>
<tr>
<td>3. Crankshaft bent</td>
<td>Install new crankshaft.</td>
<td>Module 3</td>
</tr>
<tr>
<td>4. Starter rope is binding</td>
<td>Service starter.</td>
<td>Module 3</td>
</tr>
</tbody>
</table>
Operation and Maintenance of Small Engines

Revised Edition

INSTRUCTIONAL MATERIALS LABORATORY
UNIVERSITY OF MISSOURI-COLUMBIA
COLUMBIA, MISSOURI
Module 8

Operation and Maintenance of Small Engines

Prepared by: Amon Herd
Preface

This manual is designed to bring the student or home owner to a minimum performance level in properly servicing a small engine's ignition system. These step-by-step procedures include illustrations clarifying each procedure. The accompanying performance task list may be used as an evaluation or as a quick reference of repair procedures.

For many years those responsible for teaching small engine repair have needed materials that are basic, readable and usable. Although this series was written primarily for adult education, it can become a vital teaching tool in any program through live demonstrations and classroom instruction.

The author, Amon Herd, brings to this new series many years of small engine experience. Amon's "hands on" knowledge comes from twenty-five years of classroom teaching and small engine repair.
Acknowledgments

Appreciation is extended to those individuals who contributed time and talents in the development of Small Engines, Second Edition.

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Briggs and Stratton Corporation
American Association for Vocational Instructional Materials

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References

Service and Repair Instructions, Briggs and Stratton Corporation, Milwaukee, Wisconsin.

Small Engines Operation Maintenance and Repair, J. Howard Turner, American Association for Vocational Instructional Materials, Athens, Georgia.


Fuels and Lubricants, Harold Parady and Thomas Colvin, American Association for Vocational Instructional Materials, Athens, Georgia.


Small Engine Mechanics, William Crouse and Donald Anglin, McGraw-Hill Book company, St. Louis, Missouri.
Operation and Maintenance of Small Engines

Unit Objectives

After completion of this unit, the student should be able to safely operate and maintain a small engine. This knowledge will be demonstrated by the ability to properly follow maintenance procedures.

Specific Objectives

After completion of this unit, you should be able to:

1. Demonstrate a working knowledge of small engine operation safety procedures, particularly those involving use of a lawn mower.

2. Demonstrate a working knowledge of operation and basic maintenance of a small engine.

3. Demonstrate the procedure for servicing a cutting blade.

4. Demonstrate the procedure for servicing a small engine muffler.

5. Demonstrate the procedure for servicing and adjusting “System 2” and “System 4” CPSC compliance engines.

6. Demonstrate the procedure for servicing small engine ignition stop switches.
Operation and Maintenance of Small Engines

Introduction

Proper operation and maintenance of a small engine will ensure long engine life. The owner of a small engine will save both time and money by performing simple and routine maintenance chores. A properly serviced small engine is also safer than one that has had haphazard maintenance.
A. Tools and Materials Needed in Maintenance and Compliance Procedures

Tools
Gloves
Safety glasses
Gear puller
Adjustable end 8" wrench
Mallet
Torque wrench with 3/8" drive
3/8" drive socket set
Open end wrenches (1/4", 5/16", 3/8", 7/16", 1/2", 5/8" and 9/16")
Oil can with flexible spout
Grease gun
Standard 6" screwdriver
Putty knife
Parts brush
Pen knife
Ball-peen hammer
Punch
Pipe wrench
Yardstick (straight edge)
Steel rule
Siphon
Power grinder (6")
File
Blade balancer
Nut drivers (1/4", 3/8", 7/16", and 1/2")
Longnose pliers (6 1/2")
Phillips screwdrivers (4" and 6")
Round and flat filler gauge
Spark plug tester
Wire brush
Torque wrench with 3/8" drive
Ignition file
Power grinder (6")
Mill file (10")
Blade balancer
Cleaning pan
Hand sprayer
Container for oil
Fire extinguisher (dry chemical)
Oil can

Supplies
Penetrating oil
Emery paper
Shop towels
Number 2 grease
Muffler and gasket
Blade adapter
Anti-seizing compound
Woodruff key
SAE 30 oil
Stabil (or equivalent)
Light grease
Paint brush
Fresh gasoline

Tools and Materials Needed to Service and Adjust “System 2” and “System 4” CPSC Compliance Engines

Ratchet (3/8") with 5/16" and 7/16" sockets
Slot head screwdriver (6")
Nut drivers (1/4" and 5/16")
Pliers (8")
Combination wrench (5/16")
Brake adjustment gauge #19256 Briggs & Stratton
Tang bending tool #19229 Briggs & Stratton
Shop towels
Penetrating oil
B. Step-By-Step Procedure For Safe Lawn Mower Operation

1. Read the operator's manual and become familiar with the controls.

2. Always start the engine outdoors, never in an enclosed area.

3. Always stop engine and let it cool before refueling.

4. Always stop engine and remove spark plug wire before working on the engine or mower deck.

5. Do not touch any part of a running engine or engine that has just been stopped because most components will be hot enough to cause severe skin burns.

6. Never remove or alter safety devices.

7. Tighten all nuts, bolts and screws often to make sure mower is in safe operating condition.

8. Do not alter engine governor speeds.

9. Always turn off the engine when adjusting mower cutting height.

10. Verify that the drive control (on self-propelled machines) is disengaged before starting the engine. Never stand in front of a self-propelled machine as the drive unit may accidentally engage and cause the machine to lurch forward.

11. Keep hands and feet away from all operating parts (especially the blade).

12. Always use safety glasses when sharpening the mower blade.

13. Always use approved containers to store fuel. Never smoke or allow sparks or open flame near the fuel.

14. Do not operate without a muffler or tamper with the exhaust system.

15. Check area to be mowed and remove any obstructions before starting engine. People, children or pets should be kept away from the mowing area.

16. Never allow children to operate the mower.

17. Always mow during daylight hours.

18. Verify that any mower deck washout port is closed when mowing.

19. Wear long trousers and safety shoes while mowing. Do not wear tennis or open-toed shoes.


21. Always follow the contour of the slope when mowing slopes or terraces. Never mow up and down the slope.

22. Never mow wet grass.

23. Always mow using a forward motion.
**Maintenance Procedures Competency Profile**

**Directions:** This profile provides a record for student, instructor, and/or industry representative. Competencies listed below represent the tasks to be performed in maintaining and operating lawn mowers. Compile your evaluation of the student (trainee) by checking the appropriate "yes/no" rating.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Procedure For Safe Lawn Mower Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1. Read the operator's manual.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Start the engine outdoors.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Stop the engine and let it cool down before refueling.</td>
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<tr>
<td></td>
<td></td>
<td>4. Remove spark plug wire before working on mower.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Do not touch any part of a hot engine.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6. Do not remove or alter safety devices.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7. Tighten all nuts, bolts and screws often.</td>
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<tr>
<td></td>
<td></td>
<td>8. Do not alter engine governor speeds.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9. Turn off the engine when adjusting cutting height.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10. Verify drive control (on self-propelled machines) is disengaged before starting the engine.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11. Keep hands and feet away from operating parts.</td>
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<tr>
<td></td>
<td></td>
<td>12. Use safety glasses when sharpening mower blade.</td>
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<tr>
<td></td>
<td></td>
<td>13. Use approved containers to store fuel.</td>
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<tr>
<td></td>
<td></td>
<td>14. Do not tamper with exhaust system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15. Check area to be mowed and remove any obstructions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17. Mow during daylight hours.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18. Verify washout port is closed when mowing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19. Wear long trousers and safety shoes while mowing.</td>
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<tr>
<td></td>
<td></td>
<td>20. Do not leave a running mower unattended.</td>
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<tr>
<td></td>
<td></td>
<td>21. Follow the contour of the slope when mowing slopes.</td>
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<tr>
<td></td>
<td></td>
<td>22. Never mow wet grass.</td>
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<tr>
<td></td>
<td></td>
<td>23. Mow using a forward motion.</td>
</tr>
</tbody>
</table>

__________________________________________  ____________________________________________  ___________________________
Student's Signature                              Instructor's Signature                           Date
C. Step-By-Step Procedure For Operating Small Engines

1. Read and understand operator’s manual.

2. Follow safety procedures when operating a small engine. Consult the operator’s manual for specific safety rules.

3. Check crankcase oil level each time engine is refueled. Use a high quality detergent oil classified “For Service SC, SD, SE or SF.” Nothing should be added to the recommended oil.

4. Check the oil dipstick assembly for a good fit. The O-ring should seal the lower end of the filler tube. A leak at the seal will result in a loss of crankcase vacuum and cause a discharge of smoke through the muffler.

5. Check the gear reduction case oil level at the beginning of the season (if equipped). Change oil in the gear reduction case every 100 hours of operation.
6. Change oil in new or rebuilt engines after first eight hours of operation. The oil, thereafter, should be changed each season or every fifty hours of operation. Oil should be changed every twenty-five hours of operation under heavy use or dusty conditions.

7. Check the air cleaner filter before using the engine. Clean and oil the foam element every 25 hours of operation. Service daily under dusty conditions.

8. Check breather for signs of oil leakage during engine operation. Tighten screws securely to prevent oil leakage or replace breather.
9. Clean debris and grease from cylinder fins, flywheel and screen. This should be done every 50 hours of operation.

10. Clean and regap the spark plug to .030" every 100 hours of operation. Use a round wire gauge to assure accurate reading.

11. Operate the engine so it does not overload.

Note: Overloading small engines is a common abuse which can cause severe damage to the engine. For example, do not mow extremely tall or wet grass. Damage resulting from overloading includes: engine overheating, excessive bearing wear, loss of power and low compression, and burned valves.

12. Check and clean fuel cap vent holes when necessary. Plugged vents cause pressure to build up; the flow of gas is stopped resulting in engine shut down.

14. Oil wheel axles and height adjusting linkage with a few drops of SAE 30 oil every 10 hours of operation.

15. Clean the outside of the engine and remove grass clippings from the mower deck after each operation while the engine is still warm.

16. Monitor the operation of your mower. When the engine uses more fuel than usual, check for the following:
   a. Dull mower blade.
   b. Dirty air cleaner.
   c. Out of adjustment carburetor.

17. Sharpen and balance mower blade as needed. Do not use a bent blade.
18. Check for engine vibration. If the engine vibrates, check for a bent blade using the following steps:
   a. Disconnect the spark plug wire.
   b. Tilt the mower base to approximately 45-degrees and secure.
   c. Place a straight edge across the bottom of the mower base.
   d. Rotate blade until one end strikes the straight edge. Mark the point of contact with a pencil.
   e. Rotate the blade again until the other end strikes the straight edge and mark second contact point.
   f. The marks should be within approximately 1/8" of each other. If the marks are more than 1/8" apart, the blade is bent and should be replaced.
Maintenance Procedures Competency Profile

**Directions:**
This profile provides a record for student, instructor, and/or industry representative. Competencies listed below represent the tasks to be performed in maintenance procedures on lawn mowers. Compile your evaluation of the student (trainee) by checking the appropriate “yes/no” rating.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Operating Small Engines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1. Read and understand operator’s manual.</td>
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<tr>
<td></td>
<td></td>
<td>2. Follow safety procedures.</td>
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<tr>
<td></td>
<td></td>
<td>3. Check crankcase oil level.</td>
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<tr>
<td></td>
<td></td>
<td>4. Check the oil dipstick assembly for a good fit.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Check gear reduction case oil level at the beginning of the season.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6. Change oil in new or rebuilt engines after eight hours of operation.</td>
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<tr>
<td></td>
<td></td>
<td>7. Check the air cleaner filter before using the engine.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8. Check breather for signs of oil leakage during engine operation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9. Clean debris and grease from cylinder fins, flywheel and screen.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10. Clean and regap the spark plug at .030&quot; every 100 hours of operation.</td>
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<tr>
<td></td>
<td></td>
<td>11. Operate the engine so it does not overload.</td>
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<td></td>
<td></td>
<td>12. Check and clean fuel cap vent holes when necessary.</td>
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<tr>
<td></td>
<td></td>
<td>13. Change the fuel filter yearly.</td>
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<tr>
<td></td>
<td></td>
<td>14. Oil wheels and height adjusting linkage.</td>
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<td></td>
<td></td>
<td>15. Clean the outside of the engine.</td>
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<td>16. Monitor the operation of mower.</td>
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<td></td>
<td></td>
<td>17. Sharpen and balance mower blade as needed.</td>
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<td></td>
<td></td>
<td>18. Check for engine vibration.</td>
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</tbody>
</table>

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Student's Signature  
Instructor's Signature  
Date
D. Step-By-Step Procedure For Servicing Cutter Blade

1. Read your owner's manual.

2. Wear proper safety equipment.

3. Organize your work station. When disassembling, place bolts, nuts, and parts in containers.

4. Disconnect spark plug wire and place in V-notch. On older models, tape spark plug wire to shroud to prevent accidental starting.

5. Examine blade periodically for sharpness, wear, or damage. If the blade is worn or bent, it should be replaced. (See illustration.)

6. Grasp end of blade using a thick rag or gloves and remove bolt, washer, and blade.
7. Sharpen blade’s cutting edges on a power grinder. Sharpen top side of blade and maintain the original cutting angle. Finish cutting edges with a file.

8. Balance the blade after sharpening.

*Note: An inexpensive blade balancer can be purchased at a hardware store.*

9. Install sharp, balanced blade and blade assembly. Some models may vary in blade installation.

10. Torque bolt to 45-60 foot-pounds. After blade is completely installed, recheck for bent blade.

11. Install spark plug wire. Start engine and check blade balance. If there is vibration, repeat blade balancing procedure.

12. Return all tools to their proper places and clean the work area.
# Maintenance Procedures Competency Profile

**Directions:** This profile provides a record for student, instructor, and/or industry representative. Competencies listed below represent the tasks to be performed in maintenance procedures on lawn mowers. Compile your evaluation of the student (trainee) by checking the appropriate “yes/no” rating.

<table>
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<tr>
<th>Yes</th>
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</table>

### Servicing Cutter Blade

1. Read your owner’s manual.
2. Wear proper safety equipment.
3. Organize your work station.
4. Disconnect spark plug wire and place in V-notch.
5. Examine blade periodically for sharpness, wear, or damage.
6. Remove bolt, washer, and blade.
7. Sharpen blade’s cutting edges.
8. Balance the blade after sharpening.
9. Install sharp, balanced blade and blade assembly.
10. Torque bolt to 45-60 foot-pounds.
12. Clean the work area.

---

**Student’s Signature**

**Instructor’s Signature**

**Date**
E. Step-By-Step Procedure For Servicing Mufflers

Note: Perform all procedures detailed in your owner’s manual. Certain procedures are not recorded here because of equipment variation.

1. Read operator's manual.

2. Wear proper safety equipment.

3. Organize your work station. When disassembling, place bolts, nuts, and parts in containers.

4. Secure engine to be serviced and disconnect spark plug wire. Secure the spark plug wire in the V-notch or tape the wire in place on older models.

Bolt-On Muffler

5. Inspect the condition of the muffler to be replaced.

6. Squirt a few drops of penetrating oil on bolt threads prior to removing muffler bolts. Let it set overnight to loosen rust.

Note: Replace mufflers before they rust through. Check periodically by squeezing cold muffler barrel with your hand. If barrel is soft, replace muffler. Do not touch a hot muffler. Mufflers get very hot even if engine has run only a few seconds. Touching a hot muffler can cause severe skin burns.
7. Remove muffler bolts.

8. Remove muffler and gasket.

⚠️ **CAUTION:** Be careful not to twist off bolts in block.

*Note: Some bolts have locking clips which must be separated from the bolt heads.*


10. Clean exhaust port and bolt holes.
11. Install new gasket, muffler, and bolts.

12. Return engine and tools to proper places and clean work area.

⚠️ **CAUTION:** Do not over tighten bolts.

*Note:* The wrong size muffler will cause the engine to perform improperly. Always follow manufacturer's specifications when replacing the muffler.

---

**Pipe Thread Muffler**

13. Secure engine to be serviced and disconnect and secure the spark plug wire.

14. Inspect the condition of the muffler to replaced.

*Note:* Replace mufflers before they rust through.

15. Squirt penetrating oil on muffler pipe threads to loosen rust before replacing muffler. The penetrating oil should be applied and let set overnight.

16. Tap locknut loose using a punch and hammer (on some models).
17. Place pipe wrench on muffler pipe as illustrated.

18. Apply steady pressure on wrench until pipe turns in block. Continue turning until muffler is removed.

19. Inspect and clean exhaust port and threads.

20. Install new locknut and muffler. Lubricate thread with anti-seizing compound.

*Note: The wrong size muffler will cause the engine to perform improperly. Always follow manufacturer's specifications when replacing the muffler.*

21. Tighten muffler pipe firmly in block (hand tighten only).

*Note: On some mufflers a locknut is not used.*

Illustrations courtesy of Briggs & Stratton Corporation
22. Tighten locknut with punch and hammer (on some models).

23. Return engine and tools to their proper places and clean work area.
Maintenance Procedures Competency Profile

Directions: This profile provides a record for student, instructor, and/or industry representative. Competencies listed below represent the tasks to be performed in maintenance procedures on lawn mowers. Compile your evaluation of the student (trainee) by checking the appropriate "yes/no" rating.

Yes No Servicing Mufflers

1. Read operator's manual.
2. Wear proper safety equipment.
3. Organize your work station.
4. Secure engine to be serviced and disconnect spark plug wire.

Bolt-On Muffler
5. Inspect the condition of the muffler to be replaced.
6. Squirt a few drops of penetrating oil on bolt threads.
7. Remove muffler bolts.
8. Remove muffler and gasket.
10. Clean exhaust port and bolt holes.
11. Install new gasket, muffler, and bolts.
12. Clean work area.

Pipe Thread Muffler
13. Secure engine to be serviced and disconnect the spark plug wire.
14. Inspect condition of the muffler to be replaced.
15. Squirt penetrating oil on muffler pipe threads.
16. Tap loose locknut using a punch and hammer.
17. Place pipe wrench on muffler pipe.
18. Remove muffler.
19. Inspect and clean exhaust port and threads.
20. Install new locknut and muffler.
21. Tighten muffler pipe firmly in block.
22. Tighten locknut.
23. Clean work area.

Student's Signature ________________ Instructor's Signature ________________ Date ________________
F. Step-By-Step Procedure For Servicing and Adjusting “System 2” and “System 4” CPSC Compliance Engines

1. Wear proper safety equipment.
2. Read operator’s manual.
3. Select proper tools and equipment.
4. Organize your work station.
5. Remove starter assembly and throttle cable.

**Remove, Inspect and Reinstall Brake Band**

6. Remove the brake band.
   a. Disconnect the brake spring.
   b. Use the tang bending tool to bend the retainer tab on the brake control bracket.
   c. Remove the brake band.

7. Inspect the brake band. If damaged or distorted, replace the brake band. Also inspect the band pad for damage. Do not attempt to reuse or reshape a distorted or damaged brake band.

8. Reinstall the brake band with the “cut out” section above the brake control bracket. Place brake band over retainer tab and bend tab to lock band in place.

9. Reconnect the brake spring.
## Maintenance Procedures Competency Profile

**Directions:** This profile provides a record for student, instructor, and/or industry representative. Competencies listed below represent the tasks to be performed in maintenance procedures on lawn mowers. Compile your evaluation of the student (trainee) by checking the appropriate "yes/no" rating.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
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</thead>
</table>

**Adjusting “System 2” and “System 4” CPSC Compliance Engines**

1. Wear proper safety equipment.
2. Read operator's manual.
3. Select proper tools and equipment.
4. Organize your work station.
5. Remove starter assembly and throttle cable.
6. Remove the brake band.
7. Inspect the brake band.
8. Reinstall the brake band.
9. Reconnect the brake spring.

---

Student Signature   Instructor Signature   Date
G. Step-By-Step Procedure For Adjusting the Brake for “System 2” and “System 4” CPSC Compliance Engines

1. Remove brake cable.
   a. Release brake spring from brake control bracket.
   b. Move brake actuating lever back.
   c. Slip cable out of brake mechanism.

2. Adjust brake.
   a. Place one end of the gauge into the control cable hole of the brake actuating lever.
   b. Move the actuating lever sideways until the 90-degree end of the gauge can be inserted into the tapped hole of the brake control bracket.

   Note: The brake adjustment gauge #19256 is available from Briggs and Stratton.

   c. Move the brake control bracket sideways until the 90-degree bend of the brake adjustment gauge can slide “in and out” with a slight amount of friction against the inner surface of the tapered hole.
   d. Tighten the brake control bracket without losing the friction.
   e. Remove the brake adjustment gauge.

3. Install control cable to the brake control bracket.
4. Reconnect spring to brake mechanism. Check switch.

5. Install starter assembly and brake control cover.

6. Start engine and check safety system.

Note: The blade must stop within three seconds upon release of a blade control.
**Maintenance Procedures Competency Profile**

**Directions:** This profile provides a record for student, instructor, and/or industry representative. Competencies listed below represent the tasks to be performed in maintenance procedures on lawn mowers. Compile your evaluation of the student (trainee) by checking the appropriate “yes/no” rating.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
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<tbody>
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</table>

**Adjusting the Brake for “System 2” and “System 4” CPSC Compliance Engines**

1. Remove brake cable.
2. Adjust brake.
3. Install control cable to the brake control bracket.
4. Reconnect spring to brake mechanism. Check switch.
5. Install starter assembly and brake control cover.
6. Start engine and check safety system.

---

Student's Signature  
Instructor's Signature  
Date
H. Step-By-Step Procedures For Servicing Ignition Stop Switches

1. Wear proper safety equipment.

2. Read operator's manual.

3. Select proper tools and equipment.

4. Check stationary mechanical stop switch.
   a. Move control lever away from stop switch using the safety control on the mower handle or by moving control lever at engine.

![Control Lever, RUN Position]

5. Release control lever completely. The control lever at the engine must contact the tang stop switch. To adjust the stop switch it may be necessary to adjust the control bracket.

![Cut-Away View - Control Bracket]
### Maintenance Procedures Competency Profile

**Directions:** This profile provides a record for student, instructor, and/or industry representative. Competencies listed below represent the tasks to be performed in maintenance procedures on lawn mowers. Compile your evaluation of the student (trainee) by checking the appropriate "yes/no" rating.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Servicing Ignition Stop Switches</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1. Wear proper safety equipment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Read operator's manual.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Select proper tools and equipment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Check stationary mechanical stop switch.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Adjust control lever.</td>
</tr>
</tbody>
</table>

__________________________  __________________________  ____________________
Student's Signature          Instructor's Signature        Date
# Small Engine Service Chart

To ensure trouble-free and long-life service, your equipment will require frequent maintenance. Use the following schedule to maintain your small engine.

<table>
<thead>
<tr>
<th>Maintenance Procedure</th>
<th>Refer to Manual No.</th>
<th>Begin Season</th>
<th>Each Use</th>
<th>As Required</th>
<th>10 Hours</th>
<th>25 Hours</th>
<th>50 Hours</th>
<th>100 Hours</th>
<th>100-300 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Check oil in crankcase</td>
<td>Module 6</td>
<td>X</td>
<td>X</td>
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<tr>
<td>2. Change oil in crankcase</td>
<td>Module 6</td>
<td>X</td>
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<td>X</td>
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<tr>
<td>3. Check oil in gear reduction case</td>
<td>Module 6</td>
<td>X</td>
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## Comparison of Small Engine Hours to Vehicle Miles

The above service chart is given in hours of operation. To better illustrate what this means in engine wear, the following table shows a comparison between the hours of operation of a small engine and the miles traveled by a vehicle such as an automobile. The ratio commonly used is: One engine hour equals forty miles. When making comparisons, use the following table or multiply hours of operation by forty.

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<th>Engine Hours</th>
<th>Vehicle Miles</th>
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<tr>
<td>1000</td>
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## Small Engine Maintenance Record

This chart is for you to keep a record of maintenance on your small engine.

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<th>Maintenance Procedure</th>
<th>Date Completed</th>
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Engine Specifications
for Briggs and Stratton Engines

Contact Point Gap: .020 All Models
Spark Plug Gap: .030 All Models
Condenser Capacity: .18 to .24 MFD All Models
Idle Speed for Aluminum Engines: 1750 R.P.M.
(60000-250000 model series)

Personal Engine Data for Ordering Parts

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<th>Model Number</th>
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<th>Code Number</th>
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### Torque Value Conversions
(Flow-Pounds to Inch Pounds)

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<th>Ft-Lb to In-Lb</th>
<th>In-Lb to Ft-Lb</th>
<th>In-Lb to Ft-Lb</th>
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<td>70 840</td>
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### Metric Torque Value Conversions

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<th>In-Lb to Ft-Lb</th>
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<td>70 95</td>
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### Suggested Maximum Torque Values for Fasteners of Different Materials

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<th>Brass in-lbs</th>
<th>Silicon Bronze in-lbs</th>
<th>Aluminum 24ST-4 in-lbs</th>
<th>316 St St in-lbs</th>
<th>Monel in-lbs</th>
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