



SMALL ENGINE

CARE & REPAIR

A step-by-step guide to maintaining your small engine



www.briggsandstratton.com



INTRODUCTION

Briggs & Stratton has been a major force behind the explosion in small engine popularity. This quintessential American company builds more than two-thirds of all lawn mower engines and is a major producer of four-stroke small engines for almost every application. You may find many brands of mowers, tractors and other equipment at your power equipment retailer. Look closely: chances are good the engines are built by Briggs & Stratton. Retailers like to point this out because the name stands for quality and experience.

Briggs & Stratton's knowledge and expertise is second to none. When you learn from Briggs & Stratton technicians, you're

learning from the company that has set the industry standard for decades.

You're also developing skills that apply to more than lawn equipment. With the information in this book, you can maintain and repair small engines on a variety of power equipment—from generators and pressure washers, to hydraulic lifts. In this booklet, we'll cover the basic procedures for maintaining your small engine. For more in depth explanation of engine systems, maintenance and repair, go to www.briggsandstratton.com or look for Briggs & Stratton *Small Engine Care & Repair* at your local Briggs & Stratton authorized dealer.

Contents

Introduction to Engines & Engine Components	3
Maintenance Checklist	4
Checking & Changing Oil	5
Checking & Replacing Spark Plugs	6
Checking & Changing Air Filters	7
Troubleshooting Guide	

WHERE TO FIND US

You never have to look far to find Briggs & Stratton support and service for your small engine. Consult your Yellow Pages under "Engines-Gasoline," "Gasoline-Engines," "Lawn Mowers" or similar categories. There are over 30,000 Briggs & Stratton authorized service dealers worldwide who provide quality service. You can also contact Briggs & Stratton Customer Service by phone at 1-800-233-3723, or on the Internet at <http://www.briggsandstratton.com>.

SAFETY

Small engines must burn fuel and induce electricity. Each of these involves special safety considerations—so you need to observe the precautions for both. Keep in mind all operational procedures as outlined in your owners manual when working with your engine. Additionally, by following the simple safety rules for engine maintenance, you will simplify the job of safely operating, maintaining and repairing your small engine.

Safe maintenance

To make small engine maintenance and repair tasks easier and safer:

- Make sure you have ample work space, with easy access to the tools you need.
- Use the correct tools for each job.
- Keep an approved fire extinguisher in a familiar location near your work area.
- Learn engine shutoff procedures so you can respond quickly in an emergency.
- Disengage the cutting blade, wheels or other equipment, if possible, before starting the engine.
- Disconnect the spark plug wire to prevent accidental starting when you are servicing the engine.
- Always disconnect the wire from the negative terminal when servicing an electric starter motor.
- Check that a spark plug or spark plug tester is attached to the engine before cranking.
- Avoid contact with hot engine parts, such as the muffler, cylinder head or cooling fins.
- Never strike the flywheel with a hammer or hard object; it may cause the flywheel to shatter during operation.

- Make sure the air cleaner assembly and blower housing are in place before starting the engine.
- Remove any fuel from the tank and close the fuel shutoff valve before transporting an engine.
- Use only the original manufacturer's replacement parts; any other parts may damage the engine and create safety hazards.
- Keep engine speed settings within manufacturer specifications. Higher speeds can ruin the engine.

Protecting your health

Fire, electric shock and asphyxiation are not the only dangers when working with small engines. Take care to avoid long-term or sudden injury to your eyes, ears, lungs, feet and back:

- Keep your feet, hands and clothing away from moving engine and equipment components.
- Use eye protection when you work with engines or power tools.
- Wear ear protection to reduce the risk of gradual hearing loss from exposure to engine noise.
- Wear a face mask, if required, when working with chemicals.
- Wear specially designed gloves to protect against heat, harmful chemicals and sharp objects.
- Wear safety shoes to protect against falling objects; safety shoes have soles that won't deteriorate when exposed to gasoline or oil.
- Use proper lifting techniques and seek help with heavy lifting.

INTRODUCTION TO ENGINES

The four-stroke small engine that powers your lawn mower, tiller, generator and many other types of equipment is a gasoline engine that generates the precise amount of power necessary to get the job done. Here's how the components in your engine interact.

Engine components & their function

The rewind cord is pulled to start the combustion process. On some models, a starter motor replaces the rewind, drawing on battery power to start the engine.

Revolving *magnets* work in conjunction with the *ignition armature* and *spark plug* to produce a spark in the *combustion chamber*.

The *carburetor* draws in fuel from the fuel tank and outside air to form a combustible vapor that is fed into the combustion chamber.

Intake and exhaust valves open and close at precisely timed intervals to let air and fuel enter the engine and to let spent gases exit.

The *piston* is pushed through the *cylinder* by the force of expanding gases. The piston's motion causes the *crankshaft* to turn. Momentum then carries the piston back toward the top of the cylinder.

Oil stored in the *crankcase* circulates through the engine to lubricate key components like the piston and crankshaft and to provide generalized cooling by drawing away heat from internal engine surfaces.

A *flywheel brake* and *stop switch* are included on engines for equipment such as mowers that require constant supervision. The two components are designed to stop the engine if you release the controls.

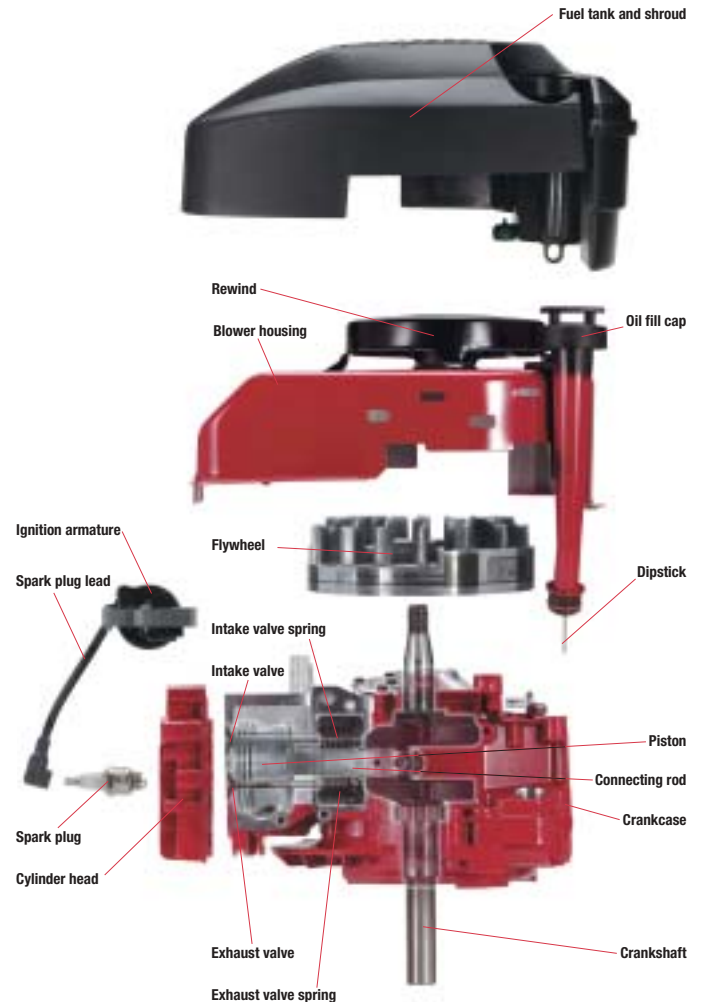
An *air vane* or *flyweights* monitor engine RPMs so the governor can maintain the selected engine speed.

Cooling fins help reduce engine temperatures when air circulates across the hottest engine surfaces.

Parts of the small engine – front view



Parts of the small engine – side view



MAINTENANCE



Regular maintenance schedule

You can avoid many small engine problems and save money on parts and repairs if you follow a regular maintenance schedule. Make good maintenance a habit when your engine is new, and always consult your owner's manual for special guidelines for your make and model. Service the engine more frequently if you use it heavily or under dusty or dirty conditions.



After the first five hours of use:

- Change the oil and filter.

After each use:

- Check the oil.
- Remove debris around the muffler.

Every 25 hours or every season:

- Change the oil if operating under heavy load or in hot weather.
- Service the air cleaner assembly.
- Clean the fuel tank and line.
- Clean the carburetor float bowl, if equipped.
- Inspect the rewind rope for wear.
- Clean the cooling fins on the engine block.
- Remove debris from the blower housing.
- Check engine compression.
- Inspect governor springs and linkages.
- Inspect ignition armature and wires.
- Inspect the muffler.
- Check the valve tappet clearances.
- Replace the spark plug.
- Adjust the carburetor.
- Check the engine mounting bolts/nuts.

Every 100 hours or every season:

- Clean the cooling system.*
- Change the oil filter, if equipped.
- Decarbonize the cylinder head.

*Clean more often if the engine operates under dusty conditions or in tall, dry grass.

CHECKING & CHANGING OIL

When you pour fresh oil into the crankcase, it's a golden or amber color. Gradually, the heat, dirt particles and agitated air in the crankcase cause the oil to darken. Dark oil is not only dirty; it has also lost much of its ability to coat and protect engine components.

Manufacturers recommend changing the oil in your small engine after every 25 hours of operation. For a new engine, you'll also need to change the oil after the first five hours of operation. New engines require this extra step to flush out small particles that accumulate naturally during the break-in period.

Hours of use are just one factor in determining how often the oil should be changed; the amount of wear and tear is equally important. Just like the oil in a vehicle operated in extremely dirty or dusty conditions or at high speeds, the oil in a lawn mower or other small engine breaks down faster under tough conditions, such as wet grass, heavy dust, high temperatures and rough or hilly terrain.

Checking the oil

Make it a habit to check the oil level and appearance each time you're about to start a small engine. Checking the oil while the engine is cold and most of the oil is in the crankcase yields the most accurate reading. You won't need to change or add oil every time. But you'll ensure a better-running engine and avoid problems down the road if you keep the crankcase full and change the oil on schedule and any time the oil loses its amber hue.

1. Start by locating the oil fill cap on the crankcase (photo A). Fill cap locations vary, depending on the make and model of your engine. On newer models, look for an oil can symbol or the word "oil" or "fill" stamped on the plug. On small tractors, you may have to lift the hood to locate this cap.

Some engines contain either an extended oil fill tube or a standard fill hole with a dipstick for inspection. Others require you to remove the fill cap to check that the oil is at the fill line or the top of the fill hole.

2. To prevent dirt and debris from falling into the crankcase, wipe the area around the cap with a clean cloth before removing the cap. If there is no dipstick, dab the oil with a clean tip of the cloth to inspect the oil (photo B).

3. If the engine includes a dipstick cap, remove the dipstick and wipe it with a clean cloth. To ensure an accurate reading, reinsert the dipstick completely. Then, remove it again and check the oil level. If the dipstick cap is a screw-in type, ensure an accurate reading by screwing it in all the way before removing it a second time to check the level. The oil mark on the dipstick should be between the lines shown on the dipstick (photo C). It should never be above the FULL line or below the ADD line.



A



B



C

Tools & materials:

Socket wrench set, box/wrench or adjustable wrench, screwdriver or hex key, oil filter or pipe wrench (for models with filters), oil drain pan, funnel.

Time required:

30 minutes.

Changing the oil

Once you decide the oil needs changing, check your owner's manual to determine the type of oil, and make sure you have enough on hand. Then, run the engine for several minutes. Draining the oil while it's warm will carry off many floating particles that would otherwise settle in the engine.

1. Stop the engine, disconnect the spark plug lead and secure it away from the spark plug. Then, locate the oil drain plug. On mowers, the plug is typically below the deck and may be obscured by a layer of grass and debris.

2. Wipe the area with a rag to prevent debris from falling into the crankcase when you open the drain plug. Tilt the mower deck and position some newspaper and an oil pan or jug beneath the mower. Use a socket wrench to turn the plug counterclockwise, allowing the old oil to drain (photo A). If the plug also serves as a fill cap, it may have two prongs so you can loosen it by hand or use a screwdriver or hex key for additional torque. Replace the drain plug by twisting clockwise and tightening with a box wrench or adjustable wrench.

3. If your engine has a filter, replace it at least once a season, more often under heavy use. Replace the filter by twisting counterclockwise on the body, using a filter wrench or pipe wrench.

4. Lightly oil the filter gasket with clean engine oil. Install a new filter rated for your engine. Screw in the filter by hand until the gasket contacts the filter adapter (photo B). Tighten the filter an additional 1/2 to 3/4 turn.

5. Add the appropriate quantity of oil (see your owner's manual). Then, run the engine at idle and check for leaks.

6. After an oil change, dispose of oil and soiled rags in accordance with local environmental statutes (photo C). In many areas, oil can be left at curbside with other recyclables, provided it is sealed in a recyclable container. Check the regulations in your area.



A



B



C

CHECKING SPARK PLUGS

Tools & materials:

Spark tester, spark plug socket (sizes vary), socket wrench, wire brush, plug/point cleaner, spark plug gauge.

Time required:
15 minutes.

The electrodes on a spark plug must be clean and sharp to produce the powerful spark required for ignition. The more worn or dirty a spark plug, the more voltage—and the greater the tug on the rewind—required to produce an adequate spark.

If you haven't tuned your engine recently and have to tug repeatedly on the rewind to start the engine, a damaged spark plug may be the culprit.

Luckily, a spark plug is one of the easiest engine components to repair and an inexpensive one to replace. And your standard socket set may already include the most important tool—a spark plug socket.

Cleaning and inspecting a spark plug

1. Disconnect the spark plug lead. Then, clean the area around the spark plug to avoid getting debris in the combustion chamber when you remove the plug.

2. Remove the spark plug using a spark plug socket.

3. Clean light deposits from the plug with a wire brush and spray-on plug cleaner. Then, use a sturdy knife if necessary to scrape off tough deposits. **NOTE:** Never clean a spark plug with a shot blaster or abrasives.

4. Inspect the spark plug for very stubborn deposits, or for cracked porcelain or electrodes that have been burned away. If any of these conditions exists, replace the spark plug.

5. Use a spark plug gauge to measure the gap between the two electrodes (one straight, one curved) at the tip of your spark plug (**photo A**). Many small engines require a .030" gap. Check the specifications for your model with your power equipment dealer. If

necessary, use a spark plug gauge to adjust the gap by gently bending the curved electrode. When the gap is correct, the gauge will drag slightly as you pull it through the gap.

6. Reinstall the plug, taking care not to overtighten. Then, attach the spark plug lead.

Checking ignition with a spark tester

A spark tester offers an inexpensive, easy way to diagnose ignition problems (see "Checking for Spark Miss").

If you find a problem, remove and inspect the spark plug. Replace the spark plug if you find evidence of wear or burning at the spark plug tip. Spark plugs are inexpensive and a new one may solve the problem.

1. Connect the spark plug lead to the long terminal of your tester and ground the tester to the engine with the tester's alligator clip (**photo B**).

2. Use the rewind or electric starter to crank the engine, and look for a spark in the tester's window.

3. If you see a spark jump the gap in the tester, the ignition is functioning. The absence of a visible spark indicates a problem in the ignition system.

Checking for spark miss

A spark plug that is fouled or improperly gapped may not allow sparks to jump the gap between electrodes consistently. The spark plug will fire erratically or may occasionally fail to spark. Test for this problem—known as spark "miss"—if your engine stumbles, with a noticeable decrease in engine sound. Spark miss can also cause the engine to emit black smoke or a popping sound, as unburned fuel exits with the exhaust and ignites inside the muffler.

1. With the spark plug screwed into the cylinder head, attach the spark plug lead to the long terminal of the spark tester. Attach the tester's alligator clip to the spark plug (**photo C**).

2. Start the engine and watch the tester's spark gap. You'll recognize spark miss by the uneven timing of the sparks in the tester.



A



B



C

SERVICING AIR CLEANERS

A properly maintained air cleaner is your engine's first line of defense against the destructive effects of dirt. When the air cleaner is in good condition, it keeps airborne dirt particles from entering through the carburetor. If the air cleaner is not maintained, dirt and dust will gradually make their way into the engine. And don't underestimate dirt's potential to cause damage. It can lead to a sharp drop in engine power, or—worse—cause premature wear of critical engine components.

Many types of air cleaners are used in small engines. Most contain a foam or pleated-paper element.

Dual-element air cleaners contain a pleated-paper element with a foam pre-cleaner, offering two layers of protection. Discard the paper element when you can no longer remove dirt from the pleats by tapping the element on a hard, dry surface. You may be able to wash and reuse the foam pre-cleaner. Foam elements can be cleaned with hot water and liquid dish detergent that contains a grease-cutting agent.

Single-element air cleaners should be serviced every 25 hours (or once a season). In a dual-element system, the pre-cleaner should be cleaned every 25 hours. The cartridge should be cleaned every 100 hours.

Servicing a foam air cleaner

1. Loosen the screws or wing nuts that hold the air cleaner assembly in place (photo A). Disassemble.
2. Inspect the foam element. Replace it if it is torn or shows signs of considerable wear.
4. Saturate the element with engine oil (photo B). Then, squeeze it to spread the oil throughout.
5. Inspect the rubbery sealing gasket between the air cleaner and carburetor. Replace it if it is worn.
6. Reassemble and reinstall the air cleaner.

Don't wait until your air cleaner element looks like this to replace it. If your element has become permanently discolored or has begun to break down or tear, extend the life of your small engine by installing a new one.



Tools & materials:
Engine oil, screwdrivers, liquid detergent.

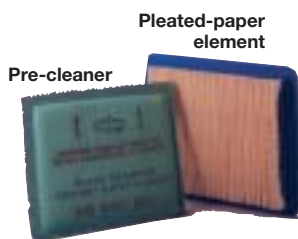
Time required:
30 minutes.

Pleats in a paper element that are discolored, bent or water-damaged can no longer provide adequate air to the carburetor. Replace the element when it approaches this condition.

Servicing a pleated-paper or dual-element air cleaner

Dual-element air cleaners come in a variety of designs. Two of the most common are shown here.

1. With the cover removed, separate the pre-cleaner (if equipped) from the cartridge (photo C).
2. Tap the cartridge gently on a flat surface to remove any loose dirt. Inspect the element and replace it if it is heavily soiled, wet or crushed.
3. Inspect the pre-cleaner, if equipped. Note the mesh backing, designed to act as a barrier between the oily pre-cleaner and the pleated-paper element. Replace it when soiled or worn.
4. Look for oiling instructions on the pre-cleaner (photo D). If directed, lubricate the pre-cleaner with oil. NOTE: Not all foam pre-cleaners should be oiled.
5. Clean the cartridge housing with a dry cloth (photo E). Do not clean with solvents or compressed air.
6. Reassemble the air cleaner. If the pre-cleaner is the oiled type, take care to insert the mesh toward the paper element so that the paper is never exposed to the oil.
7. Reinstall, making sure that any tabs on the cartridge are in their slots on the engine housing. Gaps around the cartridge permit unfiltered air and damaging dirt particles to enter the engine.



If the engine won't start

Ask this question:

If the answer is yes:

(Fuel line)



Is the fuel tank empty?

Fill fuel tank; if engine is still hot, wait until it cools before filling tank.

Is the shut-off valve closed?

Open fuel shut-off valve.

Is the fuel diluted with water?

Empty tank, replace fuel and check for leaks in fuel tank cap.

Is the fuel line or inlet screen blocked?

Disconnect inlet screen from engine and clean using compressed air. Do not use compressed air near engine.*

Is the fuel tank cap clogged or unvented?

Make sure cap is vented and air holes are not clogged.*

(Carburetor)



Is the carburetor blocked?

Remove spark plug lead and spark plug; pour teaspoon of fuel directly into cylinder; reinsert spark plug and lead; start engine; if it runs shortly before quitting, overhaul carburetor.*

Is the engine flooded?

Adjust float in fuel bowl, if adjustable; make sure choke isn't set too high.*

(Ignition)



Is the spark plug fouled?

Remove spark plug; clean contacts or replace plug.

Is the spark plug gap set incorrectly?

Remove spark plug; reset gap.

Is the spark plug lead faulty?

Test lead with spark tester, then test engine.

Is the kill switch shorted?

Repair or replace kill switch.*

Is the flywheel key damaged?

Replace flywheel key, then try to start engine; if it still won't start, check ignition armature, wire connections or points.*

(Compression)



Are the valves, piston, cylinder or connecting rod damaged?

Perform compression test. If test indicates poor compression, inspect valves, piston and cylinder for damage and repair as needed.*

If the engine runs poorly

Ask this question:

If the answer is yes:

Is the fuel mixture too rich?

Adjust the carburetor.*

Is the air filter plugged?

Replace the air cleaner.

Is the engine dirty?

Clean the engine.*

Is the oil level low?

Add oil to the engine. NOTE: Never add oil to the gasoline for a four-stroke engine.*

Are any shrouds or cooling fins missing or broken?

Install new parts as needed.*

Is the fuel mixture too lean?

Adjust the carburetor.*

Is there a leaky gasket?

Replace the gasket.*

Is the fuel tank vent or fuel tank screen plugged?

Clean the fuel tank vent and fuel tank screen.*

Does the combustion chamber contain excess carbon?

Clean carbon from the piston and head.*

Is the flywheel loose?

Inspect the flywheel and key; replace as needed.*

Is the spark plug fouled?

Clean the spark plug.

Is the spark plug faulty or gap incorrect?

Replace the spark plug or adjust the spark plug gap.

Are the breaker points faulty?

Install a solid-state ignition.*

Is the carburetor set incorrectly?

Adjust the carburetor.

Is the valve spring weak?

Replace the valve spring.

Is the valve clearance set incorrectly?

Adjust the valve clearance to recommended settings.

(Engine smokes)



(Engine overheats)



(Engine knocks)



(Spark plug misses under load)

