

Small Engine Tech Tips



A money-saving guide of
service and troubleshooting tips
for gasoline powered
small engines

IMPORTANT ITEMS

Type of Machine: _____

Model Number: _____

Serial Number: _____

Spark Plug Mfg. & Number: _____

Gasoline Octane Rating: _____

Oil Viscosity: SAE _____

MAINTENANCE HISTORY

Dates of Oil Changes

--	--	--	--	--	--

Dates of Spark Plug Changes

--	--	--	--	--	--

Dates of Air Filter Changes

--	--	--	--	--	--

OTHER NOTES AND COMMENTS

Troubleshooting Chart



		PROBLEM					
		Won't Start	Runs Rough	Fuel Leaks	Won't Idle Up	Won't Idle Down	Stalls
C A U S E	Fuel	X	X				X
	Gas Cap	X	X		X		X
	Fuel Line**	X	X	X	X		X
	Float*	X	X				X
	Idle Mixture Valve**	X	X	X	X		X
	High Idle**		X		X	X	X
	Choke**	X	X		X		X
	Fuel Shut off	X	X	X	X		X
	Fuel Filter	X	X	X	X		X
	Key	X					X
	Spark Plug	X	X				X
	Plug Wire**	X	X				X
	Points*	X	X		X		X
	Condenser*	X	X				X
	Magneto*	X					
	Stop Bar	X					
	Intake Valve*	X		X			
	Exhaust Valve*	X		X			
	Bowl Gasket**			X			
	Electric Starter**	X					
Battery**	X					X	
Speed Control				X			
Shorting Pin	X					X	

* Repairs/adjustments by trained technicians only.

** Repairable/adjustable by persons with very good mechanical knowledge.

Small Engine Tech Tips

This book was designed to compliment your owners manual which contains information that is specific to your machine.

From time to time you will have to refer to that manual for specifications such as fuel and oil requirements, spark plug type and gap.

Your owners manual should be looked upon as a good place to start. This book will help you move to the next step which is to properly service and maintain your machine.

If you have misplaced your owners manual, a new one can usually be acquired through the manufacturer by providing them with the model and serial numbers of your machine

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Troubleshooting Tips

Engine Starts But Won't Keep Running

POSSIBLE CAUSE	REMEDY
Fuel cap breather holes plugged	Clean or replace cap
Cracked spark plug	Replace plug
Bad Fuel	Change fuel
Old or bad condenser	Replace condenser*
Worn points	Replace points*
“On/Off” switch shorted	Replace switch**
Cracked plug wire	Replace/repair wire*

* Must be serviced by a trained repair technician
 ** May be serviced by persons with good mechanical aptitude

Engine Runs Rough

After checking the above without success, the problem may be that the **main valve, idle mixture valve, and/or idle screw** on the carburetor require adjustment.

These valves require very delicate adjustment which should be performed by a trained technician but are adjustable by persons with good mechanical knowledge.

Troubleshooting Tips

Other Possible Causes

Fuel System	Electrical System
<ul style="list-style-type: none"> • Stuck float • Stuck needle valve • Clogged valve • Improperly adjusted valve • Broken choke • Plugged fuel line • Fuel “shut off” valve is off • Key is off • Fuel filter is plugged • Hole in fuel cap plugged. 	<ul style="list-style-type: none"> • Primary ignition wire broken • Electrical short in system • Points burned out • Condenser burned out • Magneto malfunctioning • Bad coil • Dead battery • Electric Starter Malfunction

Mechanical

A vast number of mechanical problems may affect a small engine’s ability to start. Here is a short list of the most common ones.

Recoil starter rope broken

Recoil spring broken

Choke cable broken

Throttle cable broken

Lawnmower blade not attached

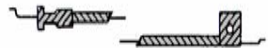
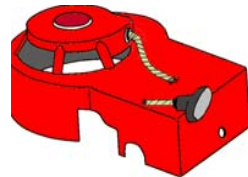


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Definitions

AIR FILTER: Usually covered by a metal case located on the side of the engine. The air filter is a foam or paper element (sometimes both) that prevents dust and dirt from mixing with the fuel in the carburetor.

CARBURETOR: Located directly beneath (or beside) the air filter. This device has fixed and adjustable valves that control the flow of air and gasoline. It allows the engine to run and controls the engine speed.

CHOKE: Located inside the "mouth" of the carburetor. A round metal plate that controls the amount of air allowed into the carburetor.

COMBUSTION CHAMBER: Located inside the engine. It is the space within the top of the cylinder, between the piston and the spark plug, where the fuel and air mixture is compressed and then ignited.

CYLINDER: Located inside the engine. It is a cylindrical hole bored through the center of the engine where the piston moves up and down.

ELECTRIC STARTER: Usually located on the side of the engine. Similar in appearance to the starter in an automobile. Operated by 120 volt household electricity or by a small-engine battery mounted to the machine. Performs the same function as a recoil starter but without the manual effort.

EMERGENCY STOP BAR: A safety feature that prevents the engine from being started accidentally, or stops the engine quickly in an emergency. On chain saws (known as "Chain Brakes") they stop the chain from moving when pushed forward. On lawnmowers it is a thin metal bar running parallel to the handle. You must pull the bar toward the handle to start the engine and hold it in that position to keep the engine running. The engine will stop as soon as you release the bar.

FEELER GAUGE: A tool used to set the space (or gap) between the electrodes on a spark plug. There are two popular designs of this tool. One employs wire loops around a circular handle, the other uses metal blades attached in a "jack-knife" effect. The wire loops and metal blades are of different thicknesses. Select the correct thickness for your spark plug per owners manual.

FLOAT: Located inside the fuel bowl. It controls the flow of gasoline from the fuel tank to the bowl by activating a needle valve as it floats up and down in the gasoline.

FUEL BOWL: Located beneath, and attached to, most carburetors. Provides a small reservoir of fuel to feed the engine

GAS CAP BREATHING HOLE: A small hole, or series of holes, in the fuel cap which allow air into the tank. A plugged cap can cause a vacuum in the fuel tank and impede or stop the flow of fuel.

Troubleshooting Tips

Compression Test

In order to get an accurate measurement of compression in your engine, a small-engine compression tester should be used. However, this tool would be used so rarely by the average small engine owner that it may not justify the expense.

The method I am about to suggest is an old favorite of the back-yard handyman.

1. Check to make sure that all parts that are driven by the engine are securely connected and bolts are tight. This is especially important on lawnmower blades. A missing or loose blade can imitate a compression problem.
2. Shift gears (if equipped) to **neutral**.
3. Disconnect the ignition wire from the spark plug.
4. Pull starter handle slowly. After a few inches you should feel significant resistance.
If little (or no) resistance is felt, repeat step one and try again.
If you still feel no resistance, this may indicate a compression problem in the engine. Have the machine checked by a service technician.

Other problems which may cause the engine not to start are listed on the next page but most **should not** be serviced by a novice.

Troubleshooting Tips

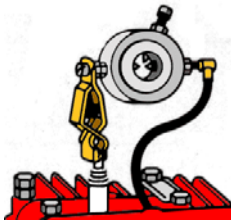
Electrical System

If you have performed all the preceding steps and your engine still won't start, there are a couple of tests you can perform to help pinpoint the problem. If these tests prove negative the machine should be repaired by a trained technician.

WARNING: The electrical system on a small engine can develop up to 20,000 VOLTS. The following test must be performed with extreme care. Failure to follow instructions fully may result in electrical shock!

Spark Plug Test

1. Carefully remove the spark plug and connect it to an approved spark plug tester (available in most automotive stores).
2. Shift gears (if equipped) to **neutral**,
3. Inspect spark plug wire for cracks. Look into rubber boot and make sure the connection is not broken,
4. Keep hands and body parts away from the spark plug, the tester, and all moving parts. Pull the starter rope or engage the electric starter, and watch to see if the plug is sparking (firing).
5. If plug fires, reconnect and go to next page.
6. If no spark, take machine to a service technician as this could indicate a problem with the magneto, points, condenser or other areas of the electrical system.



Definitions

HORIZONTAL SHAFT: Located inside the engine. This shaft may extend outside the engine on one (or both) sides of the machine. As the piston moves inside the engine it turns this shaft which is used to propel some mechanical part of the machine. A horizontal shaft runs across the engine from left to right.

IDLE MIXTURE VALVE: A screw-like adjustable valve (similar to the Main Valve) located at the top or side of the carburetor. This device controls the precise mixture of gasoline and air that makes the engine run.

IDLE SPEED SCREW: A spring tensioned screw located at the top or side of the carburetor. Turning this screw causes the engine to run faster or slower.

MAIN VALVE: A screw-like adjustable valve located on the bottom of the fuel bowl. Controls the amount of fuel going to the carburetor.

POINTS, CONDENSER, MAGNETO: Located under the engine cover. These items make up the "ignition system" which creates, stores, and distributes the electrical charge which fires the spark plug and runs the engine.

RECOIL STARTER: Located on the top or side of the engine. It is a rubber or plastic handle connected to a coiled rope. Pulling the rope briskly starts the engine. Releasing the rope recoils it inside a metal case.

SHORTING PIN: Located on or near the carburetor. It is a metal lever that passes between two electrical contacts. It is controlled by moving the speed control (mounted on the machines handle) to the "stop" position. This cuts off the flow of electricity and the engine stops.

SPARK PLUG TESTER: A tool used to determine whether or not the spark plug is firing. Placed between the spark plug and the ignition wire, it will allow you visually check for the presence of a spark and minimize the potential for electrical shock.

THERMAL (COOLING) FINS: Located at the top or side of the engine (sometimes both). These are a series of metal fins molded as part of the engine. These fins are very important to the engines ability to "air cool" itself. They conduct heat from the engine to the outside where it radiates into the air.

THROTTLE: Located inside the carburetor and connected to a control lever mounted on the handle. Sometimes known as the SPEED CONTROL, it controls the amount of fuel and air mixture allowed to reach the combustion chamber.

VERTICAL SHAFT: Located inside the engine. This shaft extends out the bottom of the engine. It functions in the same manner as the horizontal shaft. A vertical shaft runs down through the engine from top to bottom.

Tools

Below you will find a list of tools which are recommended for servicing your small engine

- ◆ Eye and hearing protection
- ◆ Gloves
- ◆ Assorted wrenches
- ◆ Ratchet & assorted sockets
- ◆ Spark plug wrench
- ◆ Pliers
- ◆ Phillips screwdriver
- ◆ Slotted screwdriver
- ◆ Sparkplug tester
- ◆ Feeler gauge
- ◆ Spray lubricant
- ◆ Spray carburetor cleaner
- ◆ Owners manual

Friendly Note

It would be wise to have several large rags, a can of professional strength hand cleaner, and a few Band-Aids nearby.

Troubleshooting Tips

General

There are many things that can affect the performance and operation of a small engine. The following instructions may not resolve your specific problem, but they have proven to be a very good “rule-of-thumb” procedure for locating and resolving many of the most common problems.

Engine Won't Start

1. Insure that **Emergency Stop Bar** is in proper position and key (if equipped) is in the "on" position

Engine Still Won't Start

2. Remove and clean or replace air filter. Clean carburetor fully with spray carburetor cleaner. Put filter back on before attempting to start

Engine Still Won't Start

3. Drain gasoline and replace with clean, fresh fuel
4. Clean or replace fuel filter (if equipped)
5. Pull starter rope rapidly, several times. (it may take a while to get bad gasoline out of the system)

Engine Still Won't Start

6. Remove and replace spark plug, making sure ignition wire is not damaged and is securely attached to tip of new plug

If Engine Still Won't Start Go To Next Page

General Information

TroubleShooting

Recommended Service Program

Periodic Service and Maintenance Chart

Frequency	First Use Of	Before Each	After Each	Last Use Of	Every 20	Every 40	Once A
Clean Machine	X	X	X	X			
Lubricate Parts	X		X	X			
Check Fuel		X					
Change Fuel	X			X			
Check Oil		X					
Change Oil	X					X	
Check Air Filter		X		X	X		
Change Air Filter	X				X		
Check Spark Plug		X					
Change Spark Plug	X						X
Sharpen Blades	X				X		

TECH TIP: The frequency of service noted in this chart is an average minimum based upon the different requirements of various engines. They would be considered acceptable for a machine running under ideal conditions.

Your machine may require more frequent servicing.

General Information

Before we get started it would be beneficial to know some basic information about small engine operations.

There are many manufacturers of gasoline operated equipment who produce thousands of different machines. It would be difficult to provide specific information for every part of every machine; therefore, we will only concentrate on the main “power-plant” of all of them, **the engine**.

It is very important to determine what type of engine is on your machine before trying to service it. Small engines fall into two categories: 2-cycle and 4-cycle. There are mechanical differences in the two types of engines but the easiest way to distinguish between them is by the type of fuel used.

2-Cycle Engine

Runs on a mixture of gasoline and 2-cycle oil

(oil and gasoline mixed together before filling the fuel tank).

Chainsaws
String Trimmers
Small Lawnmowers
Small Snow-blowers



2-Cycle

4-Cycle Engine

Runs on straight gasoline

Has a separate reservoir for the oil.

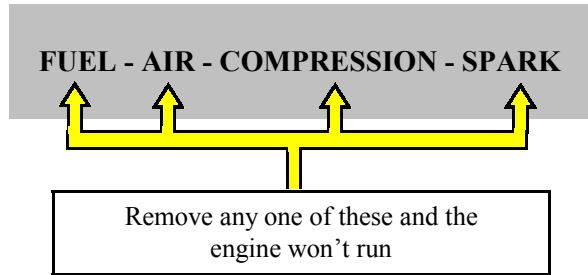
Generators
Garden Tractors
Large Lawnmowers
Large Snow-blowers



4-Cycle

General Information

All engines require the same basic elements in order to operate:



These basic elements will be our main concern as we service and troubleshoot your engine.

- ◆ **FUEL** - Fresh, clean gasoline with the octane rating recommended by the manufacturer.
- ◆ **AIR** - Mixes with fuel to make it combustible.
- ◆ **COMPRESSION** - Fuel and air mixture are compressed inside the engine.
- ◆ **SPARK** - Produced by the "spark plug". It ignites the compressed fuel and air mixture and forces the piston to turn the engine.

A good program of regular service can minimize the potential for problems and extend the life of your small engine.

Recommended Service Program

Empty Tank Storage

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Run engine until it runs out of fuel. (see TECH TIP below) 2. Remove air filter and clean or replace. 3. Spray lubricant on carburetor, choke and all moving parts. 4. Spray a heavy dose of carburetor cleaner directly into carburetor. 5. Reinstall cleaned or new air filter. 6. Disconnect spark plug wire and remove spark plug. | <ol style="list-style-type: none"> 7. Spray heavy dose of lubricant into spark plug hole. 8. Pull starter rope slowly twice. 9. Reinstall spark plug. 10. Leave plug wire off for safety 11. Clean exterior and under-side of machine thoroughly |
|---|---|
- YOUR MACHINE IS NOW READY FOR STORAGE**
- TECH TIP:** If **gasohol** has been used during the season: Add one pint of regular, unleaded gasoline to the empty tank and run engine until empty again.

Full Tank Storage

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Run engine until it runs out of fuel. 2. In separate container: combine fresh gasoline and fuel stabilizer as directed by stabilizer mfg. 3. Fill fuel tank with stabilized fuel 4. Run engine for ten minutes 5. Remove air filter and clean or replace. 6. Spray lubricant on carburetor, choke and governor linkages. 7. Spray a heavy dose of carburetor cleaner directly into carburetor. | <ol style="list-style-type: none"> 8. Reinstall cleaned or new air filter. 9. Disconnect spark plug wire and remove spark plug. 10. Spray heavy dose of lubricant into spark plug hole. 11. Pull starter rope slowly twice. 12. Reinstall spark plug. 13. Leave plug wire off for safety 14. Clean exterior and under-side of machine thoroughly |
|---|---|
- YOUR MACHINE IS NOW READY FOR STORAGE**
- TECH TIP:** Gasoline Stabilizer is designed for use with regular gasoline. **DO NOT USE STABILIZER WITH GASOHOL**

Recommended Service Program

Everyday Use

2-Cycle & 4-Cycle

BEFORE STARTING MACHINE

- Check ignition wire for cracks (make sure wire is secured to spark plug)
- Check gasoline for freshness and fill fuel tank.
- Check oil for coloration and level: (fill if low, change if blackish)
- Check air filter (clean or replace if needed)

AFTER EACH USE

- Clean debris from machine and engine
- Spray lube all moving parts

TECH TIP:

A clean machine runs better and last longer

Storing Your Machine

Most manufacturers recommend storing your machine for more than two months with an empty fuel tank. Their school of thought is to run the machine until it runs out of fuel and then store the machine empty.

Many service technicians (including this one) disagree with this. They believe that it is impossible to remove *all* of the fuel from your machine. The remaining residue, which will coat the walls of the fuel line, tank and bowl, will “varnish” much more rapidly than one that is full of fuel.

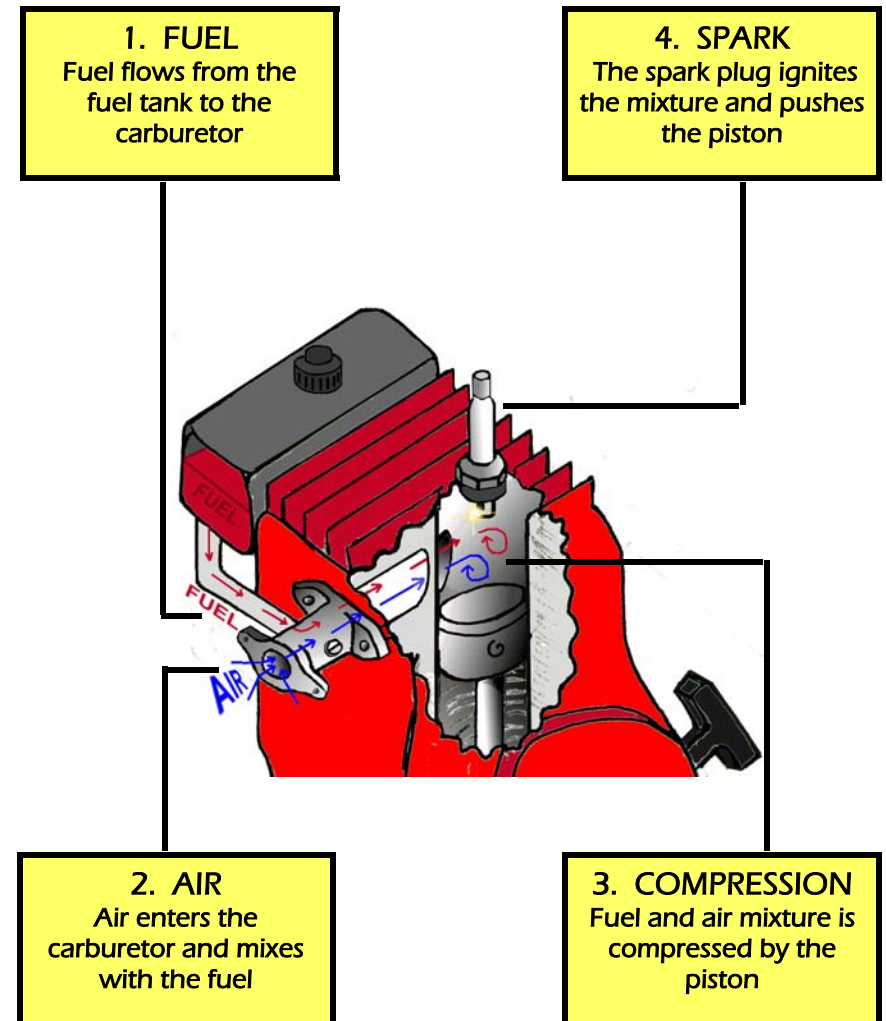
Here the second school of thought emerges:

- Run the machine dry of fuel.
- Refill the tank with a mixture of gasoline and fuel stabilizer.
- Run engine ten minutes to allow stabilized fuel to reach carburetor.

Both methods are presented on the following page.

General Information

How It Works



General Information

2-Cycle/4-Cycle Comparison

2-Cycle	4-Cycle
<p>Two-Stroke Engine: Piston moves from bottom of cylinder to top of cylinder; drawing in fuel and compressing it at the same time (first stroke). Spark plug ignites compressed fuel forcing piston back to bottom and expelling exhaust at same time (second stroke)</p>	<p>Four-Stroke Engine: Piston moves from top of cylinder to bottom; drawing in fuel (first stroke). Piston moves back to top; compressing fuel (second stroke). Spark plug ignites fuel forcing piston back to bottom (third stroke). Piston moves back to top; expelling exhaust (fourth stroke)</p>
<p>Every DOWN STROKE is a power stroke: Every time the piston moves downward, the spark plug fires and drives the engine.</p>	<p>Every second DOWN STROKE is a power stroke: Every SECOND time the piston moves downward, the spark plug fires and drives the engine.</p>
<p>One Valve: Fuel is drawn into the cylinder through a “reed valve” that opens when the piston moves upward (up-stroke) and closes on the down-stroke. Exhaust is expelled through an “exhaust port”</p>	<p>Two valves: Fuel is drawn into the cylinder through the “intake valve” which opens on the first down-stroke, then closes. Exhaust is expelled through the “exhaust valve” which opens on the second down-stroke, then closes.</p>
<p>Fuel: Runs on a mixture of REGULAR gasoline and 2-cycle oil</p>	<p>Fuel: Runs on REGULAR gasoline only</p>
<p>Oil: 2-cycle oil mixed with the gasoline. No separate oil reservoir (crankcase)</p>	<p>Oil: SAE Grade motor oil Has a separate crankcase</p>
<p>Misc:</p> <ul style="list-style-type: none"> relatively light weigh 	<p>Misc:</p> <ul style="list-style-type: none"> heavier than 2-cycle engine

Recommended Service Program

First Use of the Season

2-Cycle & 4-Cycle

- Clean machine by removing dust, dirt, sawdust or clippings, **especially between cooling fins**, with a soft brush (such as a paint brush).
- Wipe off excess oil and grime with a clean rag.
- Sharpen or replace cutting blades, strings or augers. (a sharp tool reduces wear on the engine and extends the life of the machine)
- Insure that nuts, bolts, and screws are tight, especially on blades, augers and other moving parts.
- Remove and thoroughly clean and dry (or replace) air filter.
- Lubricate all moving parts with spray lubricant or other lubricant recommended by the manufacturer.
- Remove and replace old spark plug with new one.

2-Cycle

- In a clean gas can, combine the proper amount of new 2-cycle engine oil with recommended amount of clean, fresh gasoline blended for the season and of the octane rated for your machine.

4-Cycle (only)

- Drain and properly discard old oil.
- Fill crankcase with fresh oil of the viscosity and blend recommended by mfg.

2-Cycle & 4-Cycle

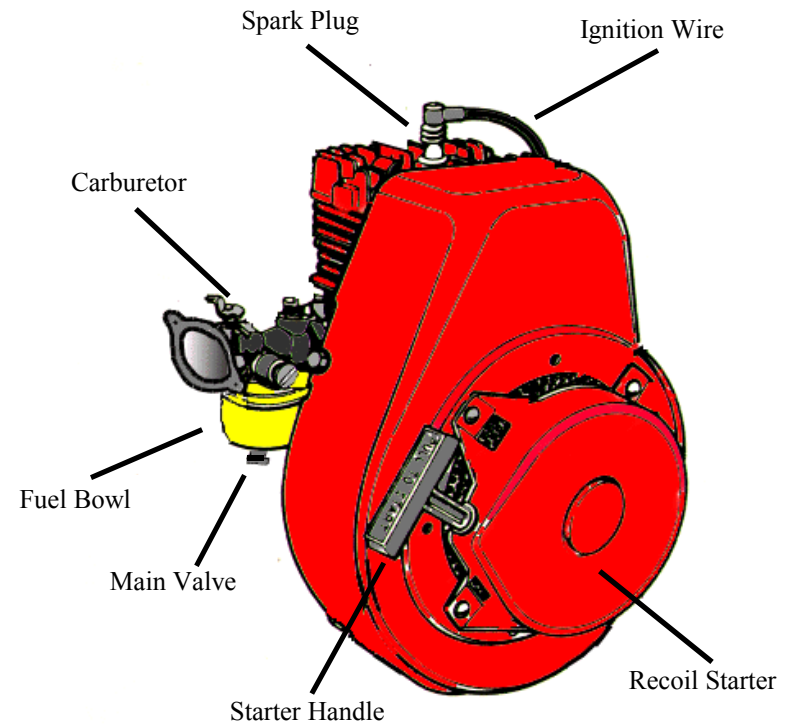
- Drain and properly dispose of any fuel stored in machine more than two months (even if stabilized).
- Fill machine with: fuel/oil mix (2-cycle) or fresh fuel (4-cycle).
- Start machine

General Information

Typical 2-Cycle Engine

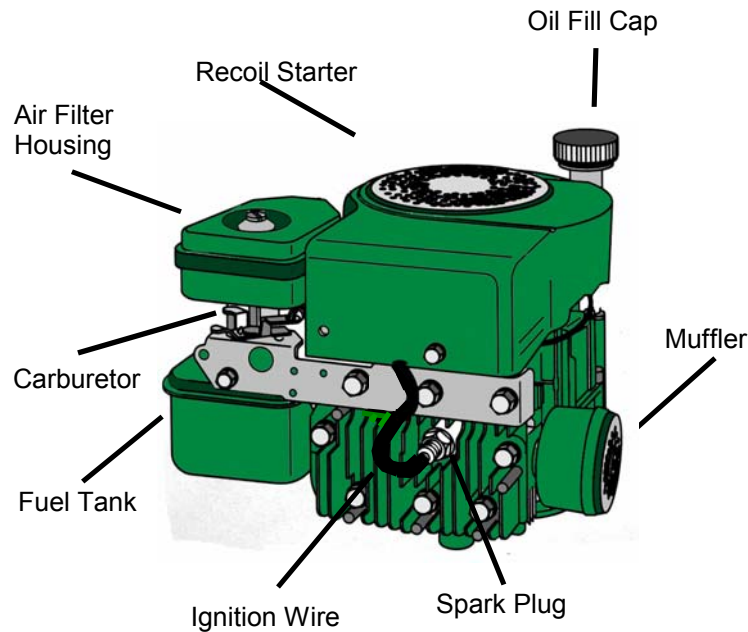
At first glance you will notice that the typical 2-cycle engine is very similar in appearance to the horizontal shaft 4-cycle engine. This is why it is very important to determine exactly what kind of engine is on your machine before attempting to service it.

On many machines, the engine will be completely enclosed, making it even more difficult to determine what kind of engine is being used. Your owners manual will be your first and *most important* method of making this determination. The fuel being used, and presence of a separate oil fill, will be your next method of determining the type of engine.

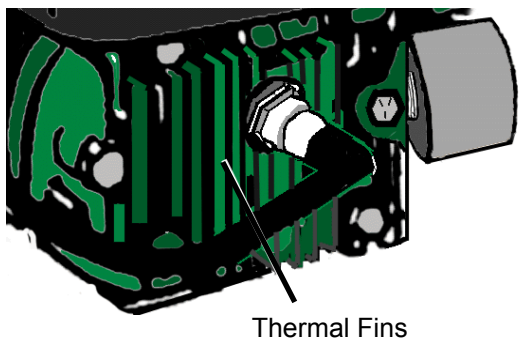


General Information

Typical Vertical Shaft 4-Cycle Engine



Recommended Service Program



TECH TIP:

"Thermal Fins" are designed to help cool the engine. It is important that they be kept clean of dirt, grass-clippings & sawdust

Starting Your Small Engine

Knowing how to **STOP** your small engine is just as important as knowing how to start it!

Different “stopping” methods are used by different manufacturers. Quite frequently, different methods will be used on a variety of machines produced by the **same** manufacturer. The stopping method used is based upon the type of machine being built and it’s designed use.

EXAMPLES:

An engine designed to run a portable, commercial water pump

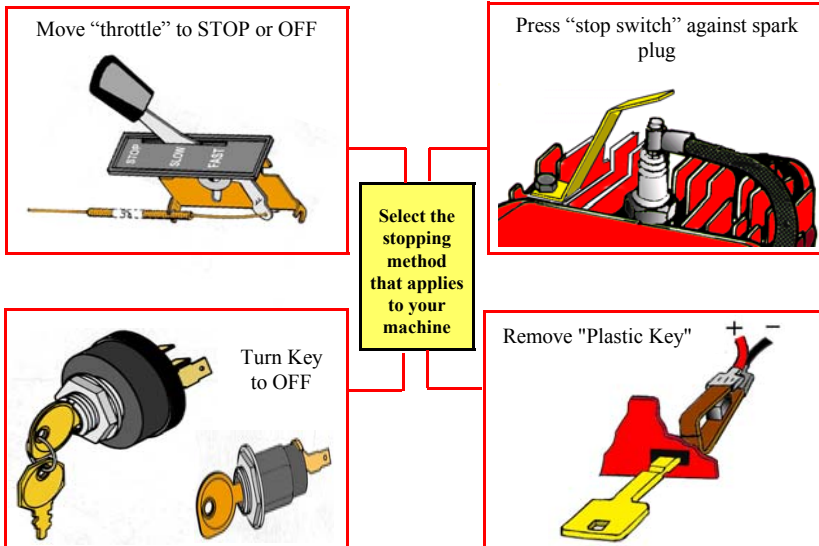
This machine will be thrown in and out of a truck, dragged through mud, and used in all kinds of weather. It must be rugged and dependable. The stopping method must be simple and effective. A spark plug “stop switch” (illustrated below) would be used because it has only one moving part (no linkage to break or keys to lose), and it is very effective.

An engine designed to run a residential garden tractor

The sale of this type of machine depends greatly upon appearance and ease of use. The stopping system must be attractive, easy to operate, and familiar to the user. A simple “key switch” would be used on this machine.

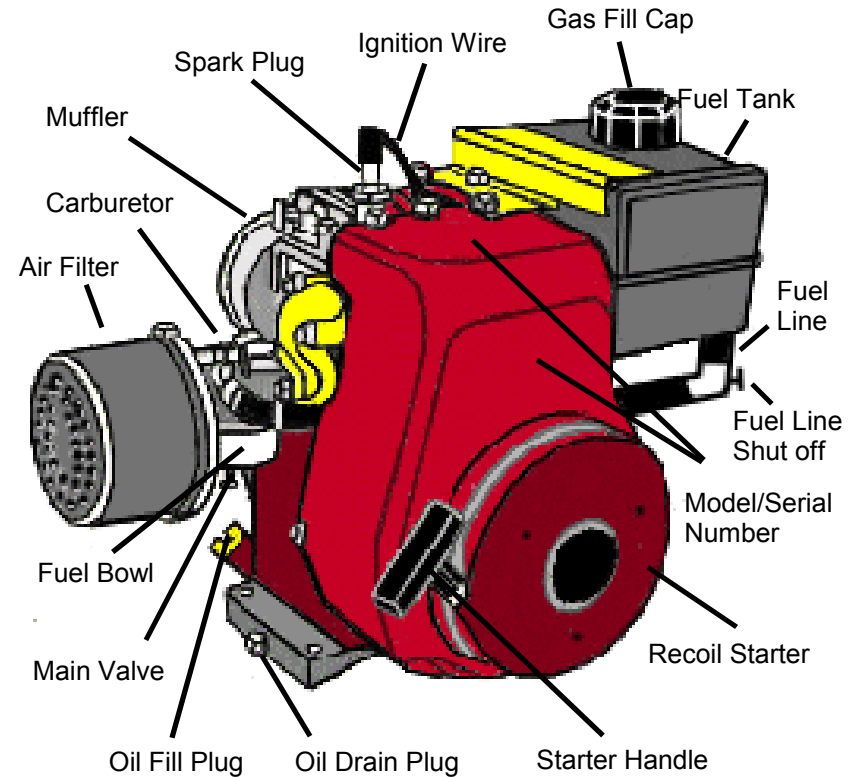
How To Stop Your Engine

Reduce engine speed to slowest setting. Let idle a few moments. Then...



General Information

Typical Horizontal Shaft 4-Cycle Engine



TECH TIP:

Horizontal shaft engines are commonly found on machines that require the gear (or belt) that drives the machine to be located on the **side** of the engine.

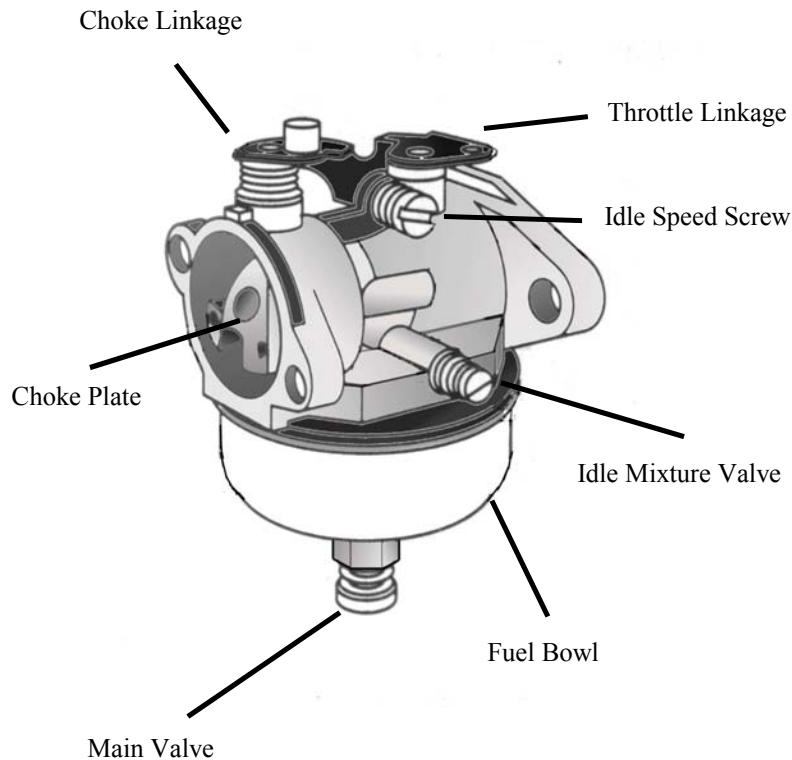
Some examples of machines with horizontal engines would be: Go-karts, Snow-blowers, Generators, Commercial Lawnmowers and Lawn Tractors.

General Information

Carburetor

The carburetor is the heart of the small engine. This is where fuel and air are mixed in exact proportions. There are almost as many types of carburetors as there are different types and manufacturers of machines. Some have subtle differences, others are significantly different. The diagram below represents the most common design: a basic "bowl type" carburetor with adjustable valves. The carburetor on your machine may be somewhat different, but the parts will be basically the same and in approximately the same location.

Unless you have prior knowledge of how a carburetor works, you should **not** attempt to service it yourself.



Starting Your Small Engine

Starting A Cold Engine

NEVER OPERATE A GASOLINE POWERED MACHINE INDOORS

- 1 Move choke lever to **Full Choke** position
- 2 Press and release **Primer Bulb** (if equipped) slowly two or three times (four or five times in extreme cold)
- 3 Move ignition switch or key (if equipped) to ON position
- 4 Pull starter rope slowly until resistance is felt
- 5 **KEEPING HANDS AND FEET CLEAR OF ALL MOVING PARTS:** pull starter rope with a brisk, full stroke. Allow rope to rewind slowly between pulls. Continue pulling until engine starts
If engine fails to start after four or five pulls, check choke to insure it is in the **Full Choke** position. Re-prime engine and try again
- 6 When engine starts, slowly move choke from **Full Choke** toward **Run**
- 7 If engine begins to hesitate or stall while moving choke, immediately return it to the **Full Choke** position then slowly toward **Run** again until engine

Restarting A Warm Engine

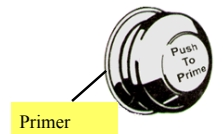
To restart a warm engine, follow the same starting procedures as for a cold engine but leave the choke in the RUN (off) position and **do not** prime. If engine fails to start, move choke half way toward FULL CHOKE and try again. Repeat until engine continues to run smoothly.

Electric Start

120 VOLT ELECTRIC: First connect **power cord** to engine, then connect it to a three pronged, **grounded**, 120 volt, household outlet.

BATTERY: Inspect and tighten battery terminals

1. Move choke to **Full**
2. Press and release **Primer Bulb** (if equipped) once
3. Move ignition switch (if equipped) to ON
4. **KEEPING HANDS AND FEET CLEAR OF ALL MOVING OBJECTS:** press and hold **starter button** or turn **key**
5. When engine starts, release button or key
6. Slowly move choke to the **run** (off) position. If engine begins to hesitate or stall, immediately return choke to **Full** position then slowly toward **Run** until engine continues to run smoothly
7. Remove **power cord** from household outlet first, then from machine



Starting Your Small Engine

Keys and What They Do

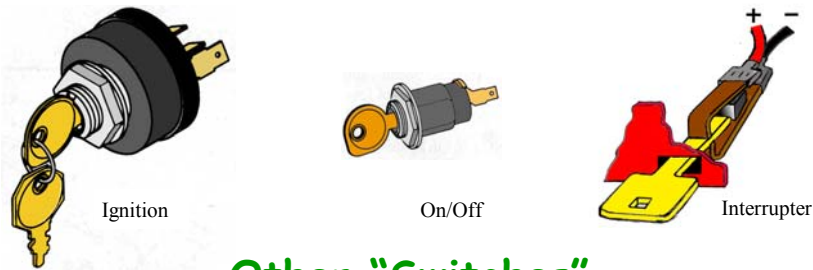
A key is simply an electrical switch, much like a light switch in your home. However, keys have the added ability of being removed. This prevents the accidental starting of the machine.

On small-engine powered machines, keys can be used in three different ways:

IGNITION KEY: Much the same as the key to your automobile, this key has three positions. Turning the key fully to the right causes the machine to start. When you release the key it automatically returns to the center (or “run”) position. Turning it fully to the left, shuts the machine off.

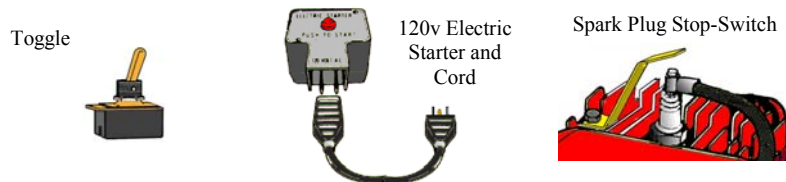
ON/OFF KEY: As the title implies, this key is used only as an ON/OFF switch. In the ON position it allows voltage from the 110 volt starter box, battery, or magneto to pass to the engine or starter. In the OFF position it stops the flow of electricity and shuts off the engine.

INTERRUPTER KEY: This is a "key" only in the sense that it is usually designed to “look” like a key. Made of plastic, it is used to separate the electrical contacts in the shorting pin. When the key is inserted into a slot it separates two electrical contacts which diverted the power to ground and prevented the engine from starting. With the contacts separated, electricity is allowed to flow to the engine or starter. Removing the key stops the engine.



Other “Switches”

Other switches which may be used instead of keys are illustrated below



Service And Maintenance

Starting Your Small Engine

Starters

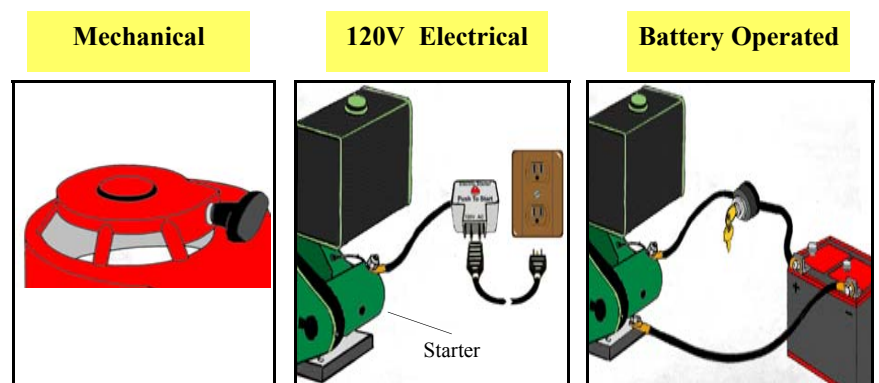
In order for a small engine to start, some outside source must spin it first. This spinning causes fuel and air to enter the carburetor, the piston to compress the fuel and air mixture, and the magneto to create the electricity to make the spark plug spark. When all these things happen correctly, the engine will “start” and continue to run on it’s own until you shut it off.

As the name implies, the STARTER provides that outside source needed to “start” the engine. The power to run the starter may be...

MECHANICAL: Such as a *recoil starter* where a rope is physically pulled to spin the engine. The recoil starter is usually located on the top or side of the engine. It consists of a rubber or plastic handle connected to a coiled rope. The coil of rope sits under a metal housing and is attached to the recoil spring. As the rope is pulled it tightens the spring and spins the engine at the same time. As tension is released, the spring recoils the rope.

120 VOLT ELECTRICAL: *Electric starters* are located on the side of the engine. This starter is very similar in appearance to the starter in an automobile, but considerably smaller. It requires an electrical **starter cord** connected to a grounded 120 volt household outlet and to the **starter box** on the engine. Pressing a starter button, or turning a key, causes the starter to spin the engine.

BATTERY OPERATED: *Battery Starters* are also located on the side of the engine. This starter gets it’s power from a small-engine battery, usually mounted on the machine. It looks just like the 120 volt electric version and is activated (and functions) in the same manner.



Service and Maintenance

The vast majority of small engine repairs are caused by:
bad gas or oil * dirty air filters * fouled spark plugs
This service program is designed to prevent these problems.

GASOLINE

Your first line of defense against service related problems is **fresh, clean gasoline**, blended for the season, and of the correct octane rating designed for your machine.

Never use fuel that has been stored for more than two months.
Never use fuels that are mixed with alcohol unless recommended by the manufacturer.

OIL

Frequent oil changes (**not less than twice a year**) are an important step in reducing wear and extending the life of your small engine.

Oil level and color should always be checked before starting machine.

- Low oil level should be filled before starting.
- Dark (blackish) oil should be changed before starting.

AIR FILTER

A clean air filter insures that adequate air-flow reaches the carburetor to mix with the fuel and minimizes the risk of contaminants that can cause service related problems.

Air filter should be checked before every use.

- Especially important in chainsaws.
- Clean or replace after every 20 hours of use.

SPARK PLUG

A clean, properly gapped spark plug will insure that your machine starts easily and runs smoothly.

Spark plug should be changed at least once a year regardless of condition.
Deposits on the plug can indicate a serious engine problem.

Service and Maintenance

CAUTION

Gasoline is **FLAMMABLE, EXPLOSIVE,**
and **TOXIC**

Improper handling of gasoline may result in
FIRE - EXPLOSION - INJURY - DEATH

ALWAYS

- ◆ Work in a well ventilated area (outdoors is best)
- ◆ Store fuel in an approved container (check local codes)
- ◆ Shut off engine and allow to cool before fueling
- ◆ Clean fuel spills

NEVER

- ◆ Handle fuel near sparks or flame, or while smoking
- ◆ Service machines in your home
- ◆ Store more than one gallon of fuel
- ◆ Remove fuel cap with machine hot or running

Gasoline

Almost all small engines are designed to run on automotive gasoline which is rated by "octane" level. OCTANE is a measurement of hydrocarbon compounds that occur in petroleum: the higher the octane level, the more combustible the fuel becomes.

At one time gasoline contained lead, which increased the octane. In the United States, "leaded" fuel has been replaced by "unleaded" gasoline. There are older machines still in use that were designed to run on leaded gasoline. These machines may require a lead additive to be mixed with the gasoline. Modern machines are designed to run on the unleaded fuel without the need for such additives. However, they will run equally as well on leaded fuel.

The use of gasoline mixed with alcohol (**gasohol**) should be avoided. This type of fuel can damage the fuel system and cause operating problems within the engine. If "reformulated" gasoline are the only fuel available in your area, be sure to select one that does not have more than 10% alcohol. If operating problems occur while using this type of fuel, change to a lower octane rating.

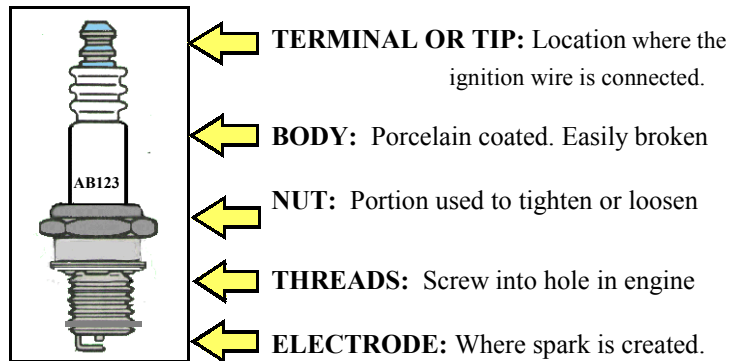
Most engines are designed to use REGULAR unleaded gasoline with a minimum of 85 octane (unless otherwise noted in your owners manual)

Starting Your Small Engine

Service and Maintenance

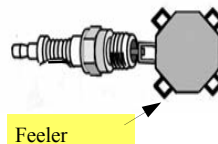
Typical Spark Plug

A spark plug can become fouled by bad gasoline, oil leakage, or high temperatures. They can be cleaned and reused, but are relatively inexpensive. Since the performance of your small engine relies on this plug, I recommend installing a new one as needed, but not less than once a year.



Changing a Spark Plug

1. Remove ignition wire by carefully sliding the wire off the tip of the spark plug.
2. Using the proper size spark plug wrench, and making sure it is securely around the nut, unscrew and remove the plug. Inspect for excess oil, carbon or discoloration which would indicate a problem.
3. Check body of the plug for plug number and purchase same.
4. Most new plugs are pre-gapped (**gap** is the space between the electrodes) but you should double check this. Typically, the gap should be between .025 and .030 on a “feeler” gauge.
5. Screw in new plug until hand tight then add 1/4 turn with wrench.
6. Reattach ignition wire securely.



Service and Maintenance

Fuel Filters

Gasoline contains sediment and water that can cause problems in your engine. To reduce these contaminants, most engines are equipped with a **Fuel Filter**.

BOWL FILTER: Located on the fuel line, between the tank and carburetor. Used primarily on larger engines, it may be found on older models and commercial machines. It consists of a fuel **inlet**, an **outlet** and a glass **bowl**.

Fuel enters through the inlet, fills the bowl, and exits through the outlet. The contaminants are heavier than gasoline, so they settle at the bottom of the bowl, allowing only clean fuel to the carburetor. Modern filters of this type are made of plastic and may have a paper-like filter inside the plastic bowl.

SCREEN FILTER: Cylindrical in shape, it is found at the end of the fuel line where it enters the tank or carburetor. Made of a fine wire-like mesh, this filter traps contaminants in the mesh.

WEIGHTED STRAINER: Some machines must run in any position (like chainsaws and string trimmers). To accomplish this, a light-weight tube extends into the fuel tank and hangs there loosely. Inside the end of this tube is the **weighted strainer**. There, it weights the end of the fuel line so that it always drops to the lowest point and strains the fuel before allowing it to leave the tank. This reduces the contaminants that reach the carburetor.

Gasoline Stabilizer

Over long periods of time, gasoline can break-down and leave behind a residue referred to as **varnish**. This residue will coat the fuel tank, fuel lines, bowl, and valves. It will prevent your engine from running. For this reason, storing gasoline for more than two months, or using gasoline that has been in storage, is not recommended.

Machines that must be stored "ready for immediate use" (such as emergency generators) should be treated with a **gasoline stabilizer** to prevent *varnishing*.

Gasoline Stabilizer is a liquid product that is added to gasoline to extend the life of the fuel and insure long term freshness. It is available at most auto parts dealers and where small-engine powered machines are sold. Instructions for proper mixing will be included with the stabilizer.

Stabilizer can also be used for seasonal storage when the machine will be stored for more than two months with a full tank of fuel.

Service and Maintenance

What Oil Should I Use

4-Cycle Engine

After determining that you have a 4-cycle engine (separate oil fill, oil **not** mixed with gasoline) you are ready to purchase the correct oil for that machine. Your choice of oil will be determined mainly by the seasonal temperature during which your machine will be operated.

4-cycle engines run on the same automotive "motor oil" that is used in cars and trucks. This oil is widely available at service stations, auto parts dealers, department stores and in many local convenience stores.

A high quality, "detergent" oil, classified "For Service SE, SF, SG" (written on oil container) is recommended. These oils are rated in SAE Viscosity Grades such as SAE 30 and SAE 10W/30. Viscosity is the oil's ability to lubricate (remain slippery).

Because oil can thicken in cold temperatures and thin in hot temperatures, different grades or "weights" of oil are recommended for different seasonal temperatures.

Temperature	Oil Viscosity
40° and up	SAE 30
20° to 40°	10W/30
0° to 40°	5W/30
0° to -20°	Synthetic 5W/20 or 5W/30

TECH TIP:

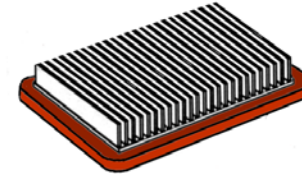
Do not use multi viscosity oil in temperatures above 40 degrees, nor straight 30 weight oil in temperatures below 40 degrees.

ENGINE DAMAGE WILL RESULT

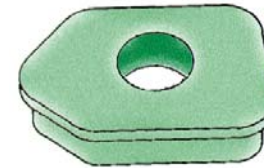
Service and Maintenance

Filter Types

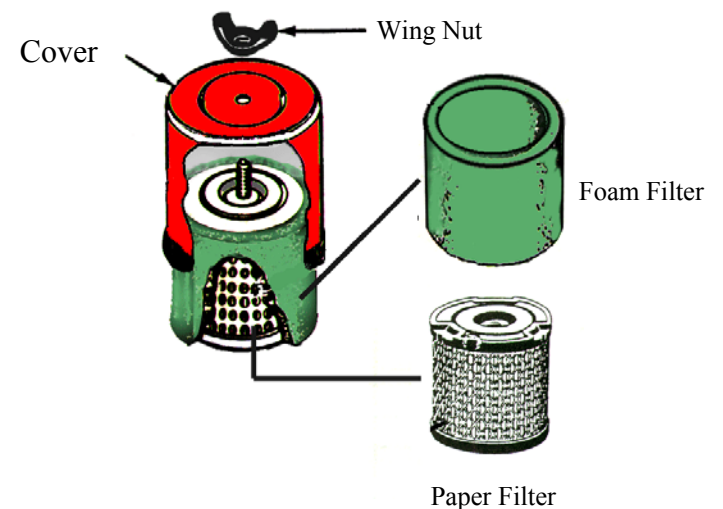
Paper Filter



Foam Filter



Two Stage Filter



Service and Maintenance

Air Filters

Air filters are designed for engines used in dusty areas, like lawnmowers and chainsaws. Not all engines will have an air filter but those that do, will have one of three types: "paper element", "foam filter", or "two-stage filter" consisting of a paper element surrounded by a foam filter.

Foam, and cloth, filters can be easily cleaned and reused. Paper elements should be replaced.

Chainsaws and some other 2-Cycle machines, have a filter made of a thin, cloth-like material.

Most manufacturers recommend that you clean or replace the filter after every 20 hours of use. Machines used in dusty areas, such as chainsaws and chippers, should have the filter changed much more often.

If your machine won't start, or stalls, the air filter should be the first item that you check, especially on a chainsaw!

Cleaning a Foam Filter

1. Remove screw or nut that holds the filter housing to the carburetor.
2. Remove the filter housing.
3. Remove the foam filter
4. Wash filter thoroughly in warm water and a mild dish soap.
5. Wring out and let stand until completely dry
6. Saturate foam in clean, motor oil and squeeze out excess oil.
7. Reinstall filter, housing and screw or nut.

Paper Filter

Paper filters should be replaced, but can be "blown-out" with an air hose or washed with a garden hose and pressure nozzle (**do not use soap**). Allow filter to dry completely before reinstalling

Service and Maintenance

Changing Oil

Small engine manufacturers recommend changing the oil after the first five hours of use in a **new** engine and every 30 - 40 hours of use thereafter.

Machines used under "heavy load" conditions, such as snow-blowers that move heavy, wet snow and log-splitters that develop high pressure, should have the oil changed much more often.

How to Change Oil

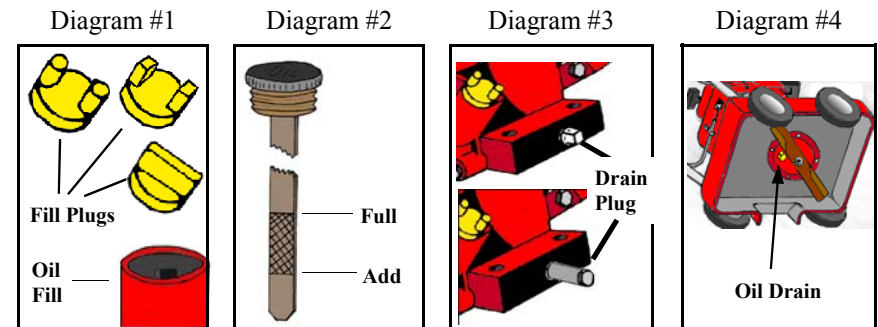
1. Locate the OIL FILL PLUG and the OIL DRAIN PLUG

OIL FILL PLUG: Usually located near the bottom of the engine, it is a "screw in" plug with a raised tab or tabs (diagram #1 below). Some engines have an oil "dip stick" near the top of the engine which acts as the fill plug (diagram #2)

OIL DRAIN PLUG: Always located at the bottom of the machine it is usually a metal plug resembling a bolt head. It can be square or hexagonal. On some machines it may be a short "pipe" extending from either or both sides of the base of the engine (diagram #3). On lawnmowers and some other machines it will be located UNDER the machine where the cutting blade is found (diagram #4)

2. Start engine and let run at slow idle for five minutes.
This will allow oil to warm up and flow more easily.
3. Stop engine and allow oil to settle (two or three minutes).
4. Remove OIL FILL PLUG to allow air into oil reservoir.
Position empty container directly under drain (may require a funnel)
5. Carefully remove OIL DRAIN PLUG (caution: oil may be hot)
Oil will begin to flow.
6. When oil stops flowing, replace drain plug and fill with fresh oil

DO NOT OVERFILL



Service and Maintenance

What Oil Should I use

2-Cycle Engine

**Oil used in a 2-cycle engine
is a very special blend!**

After determining that you have a 2-cycle engine (oil and gasoline mixed together) you are ready to purchase the correct oil for that machine. Unlike 4-cycle engines, temperature does not play an important role in the selection of oil for a 2-cycle engine. However, the oil used in these engines is a very special blend and is called "2-cycle engine oil".

**NEVER USE AUTOMOTIVE MOTOR OIL
IN A 2-CYCLE ENGINE**

2-cycle oil is available wherever small-engine powered machines are sold and in some department stores and auto parts dealers.

This oil must be mixed with gasoline before it can be used in your machine. The percentages of gasoline and oil that must be combined (the "ratio") must be fairly precise. Too little oil will reduce the ability to lubricate the machine and too much oil will cause hard starting and excessive smoke. Both will cause engine damage. Different engines require different ratios, consult your owners manual or contact a local dealer or repair shop for the correct ratio for your engine.

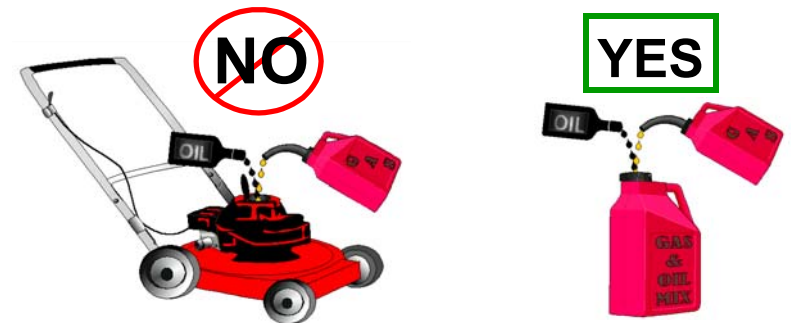
Service and Maintenance

Mixing Oil and Fuel

TO BE PERFORMED IN A WELL VENTILATED AREA, AWAY FROM SPARKS AND OPEN FLAMES (PREFERABLY OUTDOORS),

Always begin with a clean, approved fuel container and a **new** container of 2-cycle engine oil. **Do Not Combine Oil And Fuel In The Machine.**

- Pour approximately one third of the recommended amount of gasoline into the container
- Add the recommended amount of oil to the gasoline
- Screw cap on container and shake vigorously for several minutes
- Let stand a while then SLOWLY unscrew cap to relieve pressure.
- Remove cap and pour in remainder of gasoline



EXAMPLE:

The Tecumseh Model AH 600 2-cycle engine requires a gasoline to oil ratio of 32:1* (32 parts fuel to 1 part oil) This translates to one gallon (128 oz) of gasoline for every 4 ounces of oil

To mix this ratio:

- ◆ Pour approximately one third of the gallon of fuel into container
- ◆ Add four ounces of 2-cycle engine oil
- ◆ Shake vigorously
- ◆ Let stand
- ◆ Unscrew cap
- ◆ Add remainder of the gallon of gasoline.

* Taken from Tecumseh owners manual #181-562-1