Keep It Running: Small Engine Maintenance and Tune-Up

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Care for the mowers, tillers, chainsaws, generators and pumps that keep a homestead going.

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This guide covers general practice for air-cooled single- and twin-cylinder gasoline engines. Your engine's owner's manual and service manual have the final word on specifications. Specs quoted here are typical examples; check yours before you set a gap or a valve clearance.

1. Why maintenance matters

Most small engines that come into a repair shop aren't worn out. They're full of stale gasoline, running on dirty oil, or choking on a clogged air filter. Twenty minutes of care a season prevents nearly all of it.

On a homestead, small engines do real work: the mower, tiller, chainsaw, log splitter, water pump and backup generator. A generator that won't start during an ice storm, or a chainsaw that quits halfway through the firewood, costs far more than the oil and spark plug that would have prevented it.

The good news is that small engines are simple. A single-cylinder four-stroke has a few dozen moving parts, and you can learn to service one with a basic set of hand tools in an afternoon. Learn the handful of jobs in this booklet and you can keep most engines running for decades.

The three big killers of small engines:

1. **Stale and ethanol fuel** that gums up carburetors over the off-season.
2. **Dirt** let in by a missing, torn or clogged air filter. Dust grinds rings and cylinders like sandpaper.

3. **Low or worn-out oil.** Most small engines have no oil pump or filter, so the oil in the crankcase is all that protects the bearings.

2. Safety first

Pull the spark plug wire before you work on any engine. A half turn of a mower blade can fire the engine, and a blade or chain can take a finger in an instant.

- **Disconnect the plug wire** and tuck it away from the plug. On engines with electric start, disconnect the battery too.
- **Work outdoors or with the door open.** Exhaust carbon monoxide is odorless and deadly. Never run an engine in a closed garage or shed.
- **Let it cool.** Mufflers and cylinder heads burn skin, and they ignite spilled fuel.
- **Handle gasoline outside,** away from pilot lights, water heaters and sparks. Wipe up spills, and keep a Class B fire extinguisher handy.
- **Tip mowers carburetor side up** (air filter up) to reach the blade, or oil floods the air filter and fuel floods the cylinder. Better yet, drain the fuel first.
- **Wear safety glasses** when using compressed air or carburetor cleaner, and gloves when handling used oil and fuel.
- **Block the blade** with a piece of wood before loosening a blade bolt.
- **Dispose of used oil and old fuel properly.** Most auto parts stores and county convenience centers accept used oil. Never dump it on the ground.

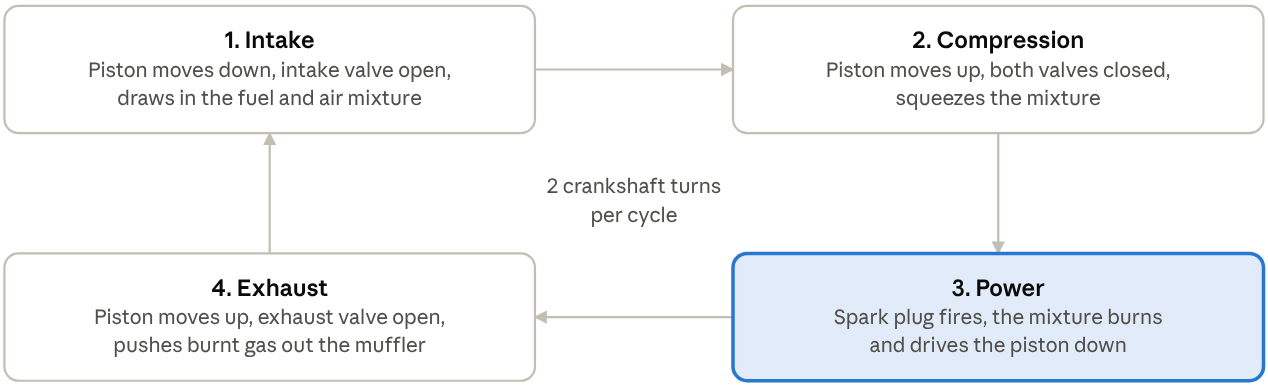
3. How a small engine works

Every gasoline engine needs four things to run: **fuel** mixed with air in the right ratio, **air**, a **spark** at the right moment, and **compression** to squeeze the mixture before it's lit. When an engine won't start or runs badly, one of those four is missing. Keep that list in mind; it's the basis of all troubleshooting.

The four-stroke cycle

Most mowers, tillers, generators, pumps and log splitters are four-stroke engines. They make one power stroke for every two turns of the crankshaft.

Four strokes, two crankshaft turns, one power stroke



the four-stroke cycle · 4 strokes per power pulse

A heavy flywheel carries the engine through the three strokes that don't make power. The valves are opened by a camshaft turning at half crankshaft speed. Oil sits in the crankcase and is splashed onto the moving parts by a dipper on the connecting rod or a slinger gear.

Two-stroke engines

Chainsaws, string trimmers, leaf blowers and some older outboards are two-strokes. They fire on every crankshaft revolution and have no valves; ports in the cylinder wall open and close as the piston moves. The fuel and air mixture passes through the crankcase on its way to the cylinder, so the crankcase can't hold an oil bath. Instead, oil is mixed into the gasoline and lubricates the engine as it passes through. That's why two-strokes are light and powerful for their size, and why they need the correct fuel-oil mix every single tankful.

The main systems

System	Parts	What it does
Fuel	tank, filter, fuel line, carburetor	stores fuel and meters it into the air stream
Air	air filter, carburetor throat, intake	delivers clean air
Ignition	flywheel magnets, ignition coil (magneto), spark plug	makes a spark timed to the piston, no battery needed

System	Parts	What it does
Compression	piston, rings, cylinder, valves, head gasket	seals the combustion chamber
Lubrication	crankcase oil (four-stroke) or fuel mix (two-stroke)	protects bearings, cylinder and valve train
Cooling	flywheel fan, shroud, cylinder fins	moves air over the hot cylinder
Governor	flyweights or air vane, linkage, spring	holds a set speed as the load changes

4. Tools and supplies

A basic socket set, a few screwdrivers and about $60 of specialty tools will handle every job in this booklet.

Tools

Tool	Used for
3/8″ drive socket set, SAE and metric, with extensions	most fasteners
Spark plug socket (5/8″ and 13/16″, with rubber insert)	removing plugs without cracking the porcelain
Wire-type spark plug gap gauge	setting plug gap (flat feeler gauges read wrong on used plugs)
Feeler gauge set, 0.002″–0.025″	valve clearance, coil air gap
Screwdrivers, including a small flat blade	carburetor screws, clamps
Needle-nose and hose-clamp pliers	fuel lines, springs, linkage
Torque wrench, inch-pounds	spark plugs, head bolts, blade bolts
Inline spark tester	checking for spark under load
Compression gauge with 10 mm and 14 mm adapters	engine health check

Tool	Used for
Oil drain pan and funnel	oil changes
Siphon pump or fuel shutoff clamps	draining fuel
Blade balancer and file or grinder	mower blades

Supplies to keep on the shelf

- Engine oil matched to your engines (often SAE 30 and 10W-30), and two-stroke oil (JASO FD or ISO-L-EGD rated)
- Fuel stabilizer, and a few gallons of ethanol-free gasoline for storage and two-strokes
- Spare spark plugs, air filters and pre-filters for each engine
- Fuel filters and a few feet of fuel line in the common sizes (often 3/16″ and 1/4″ ID)
- Carburetor and choke cleaner, and a set of carburetor gaskets and bowl O-rings for your engines
- Shop towels, nitrile gloves, safety glasses
- A notebook or the record sheet at the end of this booklet

Find your engine's model and type numbers before buying parts. On Briggs & Stratton they're stamped on the valve cover or shroud; on Honda-style engines they're on the crankcase. The model number unlocks the correct parts list, specs and manual.

5. Fuel

Bad fuel causes more small engine problems than everything else combined. Buy fresh gas in small amounts, stabilize anything that will sit more than a month, and never use E15 or higher in a small engine.

How gasoline goes bad

Gasoline starts to change within a month. Its lightest, most volatile parts evaporate first, which makes it hard to start. Over months it oxidizes into varnish and gum that clog the tiny passages in a carburetor. A teaspoon of varnish in the wrong jet will stop an engine cold.

Most US pump gas is **E10**, up to 10 percent ethanol. Ethanol absorbs water from the air. Once it has absorbed enough, the ethanol and water separate out and sink to the bottom of the tank (phase separation). The engine then draws in a water-heavy mix that runs lean or won't burn at all, and it corrodes aluminum carburetor parts.

Fuel rules

- **Buy only what you'll use in about 30 days.** Write the purchase date on the can.
- **Add fuel stabilizer** to every can as soon as you fill it if it might sit, at the dose on the bottle. Stabilizer slows aging; it can't fix fuel that's already stale.
- **Use ethanol-free gasoline (E0)** when you can get it, especially for two-strokes, seasonal equipment, and anything that will be stored. It costs more and lasts much longer.
- **Never use E15, E85 or "flex fuel"** in small engines. Using them in non-road engines is prohibited in the US, and they damage fuel systems not built for them.
- **87 octane is fine** unless the manual calls for higher. Higher octane doesn't add power to an engine that doesn't need it.
- **Store fuel in approved, sealed cans,** out of the sun, away from living space and ignition sources.
- **Replace fuel line that's hard, cracked or swollen.** Use ethanol-rated line, and replace the inline fuel filter at the same time.

Two-stroke mix ratios

Use the ratio on the engine or in its manual, with a quality two-stroke oil (JASO FD or ISO-L-EGD). Mix in a can, never in the tool's tank, and shake before each fill.

Ratio	Oil per US gallon	Oil per liter
50:1	2.6 fl oz	20 mL
40:1	3.2 fl oz	25 mL
32:1	4.0 fl oz	31 mL
25:1	5.1 fl oz	40 mL

Too little oil scores the piston and cylinder in minutes. Too much oil makes smoke and carbon, but won't seize the engine. When in doubt, err slightly rich on oil. Mix only a month's supply; mixed fuel goes stale faster than straight gas.

6. Oil

Check the oil before every use and change it every 50 hours or once a season, whichever comes first. A small engine's few ounces of oil work harder than the oil in your truck, and there's usually no filter to catch the dirt.

Choosing oil

Use a detergent oil rated API SJ or newer (current oils are SN or SP). Match the viscosity to the temperature you'll run in.

Oil	Use it when	Notes
SAE 30	above about 40°F	the classic choice for mowers and summer equipment
10W-30	about 0°F to 100°F	good all-round choice; may use a little more oil in hot weather
5W-30 synthetic	all temperatures	best for generators and snow blowers that must start cold
Vanguard/heavy-duty 15W-50	as the manual specifies	some larger commercial engines

Four-stroke engines never get two-stroke oil in the crankcase, and two-stroke engines never run on straight gas.

Checking oil

1. Park the engine level and let it sit a few minutes so oil drains down.
2. Wipe around the dipstick or fill cap so dirt doesn't fall in.
3. Pull the dipstick, wipe it, reinsert it, and pull it again to read. Check your manual: some dipsticks are read screwed fully in, others resting on the threads. Getting this wrong gives a false reading.

4. Add oil a little at a time to the full mark. **Don't overfill.** Too much oil gets whipped into foam, blows out the breather into the air filter, and causes smoke and hard starting.

Many generators and pumps have a low-oil shutdown switch. It protects the engine; it doesn't replace checking.

Changing oil

- **New engine:** change after the first 5 hours of break-in to flush out metal particles from the new parts. Some manufacturers say up to 20 hours or the first month; sooner is cheap insurance.
- **After that:** every 50 hours or once a year. Every 25 hours in dusty conditions, heavy loads or high heat. Generators running long outages need an oil change about every 50 to 100 hours of run time, so keep oil on hand.
- **Oil filters** on larger twin-cylinder engines get replaced every other oil change, or as the manual says.

How to change it:

1. Run the engine a few minutes so the oil is warm and thin and the dirt is in suspension. Shut it off and pull the plug wire.
2. Drain it by the drain plug, by tipping the engine with the air filter **up** to pour oil out the fill tube, or with a siphon pump through the fill tube.
3. Look at the old oil. Milky oil means water; a shiny metallic glitter means wear; a fuel smell and overfull level means fuel is leaking past the carburetor into the crankcase.
4. Refill with the correct amount (a Honda GX160, for example, takes about 0.6 liter), check the level, run briefly, and check again.
5. Write down the date and engine hours.

7. Air filter service

An engine breathes about 10,000 gallons of air for every gallon of fuel it burns. Clean the filter every 25 hours, more often in dust, and replace it when it's torn, oil-soaked or won't come clean. Never run an engine without one, even for a minute.

A clogged filter makes the mixture rich: the engine runs rough, smokes black, loses power and fouls plugs. A missing or torn filter lets dust in, and dust wears out rings and cylinders in a single dusty season.

Filter types and how to service them

Type	How to tell	Service
Pleated paper	folded paper element, rubber or plastic frame	tap gently on a hard surface to knock dirt loose; replace when dirty. Never wash it, oil it or blow it out hard with compressed air, which tears the paper
Foam	open-cell foam	wash in warm water and dish soap, rinse, squeeze dry (don't wring), let dry fully. Oil it only if the manual says to: a few drops of clean engine oil, squeezed through and blotted
Dual element	foam pre-filter over a paper element	service each as above; the foam catches the big dirt and makes the paper last longer
Chainsaw felt or mesh	flat felt or nylon screen	brush or wash in warm soapy water; dry fully before refitting

While you're there

- Wipe the filter housing and base clean, and plug the carburetor throat with a clean rag while the filter is out so nothing falls in.
- Check the gasket and seal surfaces. Dirt on the clean side of the filter means air is bypassing it.
- Oil in the air filter housing points to overfilling, tipping the engine the wrong way, or worn rings pushing crankcase pressure out the breather.
- Keep a spare filter for every engine you rely on. They're cheap, and a dusty mowing season or a long generator run can use up two.

8. The spark plug

Replace the spark plug once a year or every 100 hours, and read the old one before you throw it away. A plug costs a few dollars and tells you how the engine has been running.

Removing and installing

1. Pull the plug wire by its boot, not the wire.
2. Blow or brush dirt away from the base of the plug so it can't fall into the cylinder.
3. Remove the plug with a spark plug socket. If it's tight, apply a little penetrating oil and wait; aluminum threads strip easily.
4. Check the gap on the new plug with a wire-type gauge, and bend the side electrode gently to adjust. Never pry against the center electrode.
5. Thread the new plug in **by hand** until it seats, so you can feel it's not cross-threaded.
6. Tighten a new plug about 1/2 turn past seated to crush its gasket (a reused plug, 1/8 to 1/4 turn), or to the torque in the manual. Overtightening pulls the threads out of an aluminum head.
7. Push the boot on until it clicks.

Typical gaps

Engine	Typical gap
Briggs & Stratton four-stroke	0.030″ (0.76 mm)
Honda GX and clones (Predator, Champion, etc.)	0.028–0.031″ (0.7–0.8 mm)
Chainsaws and trimmers	often 0.020–0.025″ (0.5–0.6 mm)

These are examples. Use the gap and plug number in your manual or on the engine's emissions label.

Reading the plug

What you see	What it means	What to do
Light tan or gray insulator	healthy engine, correct mixture and heat range	nothing; gap and reinstall or replace on schedule
Dry, sooty black	running rich	clean or replace air filter; check choke opens fully; check carburetor

What you see	What it means	What to do
Wet, oily black	oil getting into the cylinder	overfilled crankcase, worn rings or valve guides, or engine tipped the wrong way
Wet with fuel	flooded, or no spark	check for spark; dry the plug; check the choke
White, blistered insulator	running lean or hot	check for air leaks, a clogged jet, low fuel level, blocked cooling fins
Heavy crusty deposits	oil or fuel additive buildup	replace; check oil consumption
Rounded electrodes, wide gap	simply worn out	replace

Checking for spark

Use an inline spark tester between the plug and the boot, and crank the engine. A bright blue flash means the ignition is working. No spark? In order, check:

1. The plug itself (try a new one).
2. The **kill switch and safety interlocks**: the blade brake bail, seat switch, or a stop wire touching ground. Disconnect the stop wire at the coil and test again; if you now have spark, the problem is in the switch circuit, not the coil.
3. The coil's air gap to the flywheel magnets. Typically about 0.010″ (roughly the thickness of a business card); check your manual.
4. A sheared flywheel key, which throws off timing. It often happens after a mower blade hits a stump.
5. The coil itself, if all else checks out.

9. The carburetor

If an engine starts on a squirt of fuel in the spark plug hole, then dies, the carburetor is starved or clogged. Nine times in ten the fix is draining old fuel and cleaning one tiny jet.

The carburetor mixes fuel into the incoming air at roughly 14 parts air to 1 part fuel by weight. It does that through jets with holes smaller than a pinhead, and varnish from stale fuel closes them.

Confirm it's the carburetor first

- Make sure there's fresh fuel in the tank and the fuel shutoff valve is open.
- Pull the fuel line at the carburetor (into a cup) and confirm fuel flows freely. If not, the problem is the tank outlet, filter, line or shutoff.
- Confirm a good spark (section 8).
- Pull the plug, add a teaspoon of fresh fuel to the cylinder, reinstall and start. If it runs a few seconds and dies, the carburetor isn't delivering fuel.

Basic cleaning, float-type carburetor (most four-strokes)

1. Shut off the fuel or clamp the line. Remove the air filter.
2. Take photos of the throttle and governor linkage and springs before you touch them. You'll want them on reassembly.
3. Remove the float bowl. On many Briggs engines, the bowl nut is also the main jet; on Honda-style carburetors the main jet threads into a center post above the bowl.
4. Remove the main jet and, if fitted, the pilot (idle) jet. Hold each up to a light; you must see a clean round hole.
5. Spray carburetor cleaner through every jet and passage and blow out with compressed air. Wear glasses: it sprays back. Clear a stubborn jet with a single strand of fine wire. **Never drill or ream a jet;** enlarging it ruins the mixture.
6. Check the float moves freely and the inlet needle seats cleanly. A worn needle lets fuel overflow into the engine.
7. Fit a new bowl gasket or O-ring, reassemble, reconnect linkage from your photos, and turn the fuel on. Watch for leaks.

For badly varnished carburetors, an inexpensive ultrasonic cleaner with a carburetor solution does what spray alone can't.

Common symptoms

Symptom	Likely carburetor cause
Starts on choke, dies when choke opens	clogged main or pilot jet
Surges or "hunts" up and down at steady speed	partially clogged pilot or main jet (lean); also check for an air leak at the intake gasket

Symptom	Likely carburetor cause
Fuel leaking from the carburetor or air filter	stuck float or worn inlet needle
Black smoke, sooty plug	choke not opening fully, dirty air filter, flooding
Fuel in the crankcase oil	inlet needle leaking with the shutoff left open

Rebuild or replace?

A rebuild kit (gaskets, needle and seat) costs a few dollars and fixes a basically good carburetor. If the body is corroded, a passage won't clear, or the throttle shaft is worn loose, replace it. Inexpensive aftermarket carburetors for Honda GX-type engines often work well; for others, an OEM part is worth the extra money.

Most modern carburetors have fixed jets and sealed or capped mixture screws to meet emissions rules, so there's little to adjust. If yours has an adjustable mixture screw, follow the manual's starting setting, usually a set number of turns out from lightly seated.

Two-stroke diaphragm carburetors

Chainsaws and trimmers use diaphragm carburetors that work in any position. Diaphragms stiffen with age and ethanol. A rebuild kit replaces the pump and metering diaphragms, gaskets and the inlet needle. At the same time, replace the fuel filter on the pickup line inside the tank and any hardened fuel lines; cracked fuel lines are the most common cause of a saw that won't stay running.

10. Cooling, valves and compression

Keep the cooling fins clean every season, check valve clearance about every 300 hours on overhead-valve engines, and run a compression or leak-down test whenever an engine is hard to start or down on power.

Cooling

Air-cooled engines rely on a fan built into the flywheel blowing air under a sheet-metal shroud and across the cylinder fins. Packed grass, leaves, chaff, mud daubers and mouse nests block that air, and the engine overheats, scores the cylinder and burns valves.

- Remove the shroud (usually three to five bolts) once a season, or more often in dusty, grassy work.
- Clean the fins with a brush, a plastic scraper and compressed air. Don't use a pressure washer; it forces water into the engine and electrics.
- Clear the flywheel screen and check that the fan fins aren't broken.
- Clean debris from around the muffler. It's a fire hazard.

Valve clearance

Engines need a small gap in the valve train so the valves close fully when hot. As valves and seats wear, the gap usually shrinks. Too little clearance holds a valve slightly open, causing hard starting, lost compression and burned valves. Too much makes a ticking noise and reduces power.

On overhead-valve (OHV) engines it's a 15-minute job:

1. Work on a **cold** engine. Remove the valve cover.
2. Turn the engine slowly by hand until the piston is at top dead center on the compression stroke: both valves closed and both rocker arms loose. Watching the intake valve open and close, then turning until the piston reaches the top, gets you there.
3. Slide the correct feeler gauge between the rocker arm and valve stem. It should drag slightly.
4. To adjust, loosen the lock nut, turn the pivot nut until the gauge drags, hold the pivot and tighten the lock nut, then recheck.
5. Fit a new valve cover gasket if the old one is torn.

As an example, the Honda GX160 and GX200 specify about 0.15 mm (0.006″) intake and 0.20 mm (0.008″) exhaust. Clearances vary by engine; always use your manual's figures. Older side-valve engines need the valves ground to set clearance, a job for the service manual.

Compression

An engine with good compression resists a firm, even pull on the starter rope. One that spins over easily with little resistance has lost compression.

Compression test. Remove the plug, thread in the gauge, open the throttle, and crank several times. Most small engines have an automatic compression release that lowers cranking pressure, so readings vary widely between models. Compare against the service

manual figure, not a car engine's.

Leak-down test tells you more. With the piston at top dead center on compression, feed regulated shop air into the cylinder through the plug hole and listen:

Air escaping from	Points to
Carburetor or intake	intake valve not sealing (or clearance too tight)
Muffler	exhaust valve not sealing (or clearance too tight)
Oil fill or dipstick tube	worn or stuck piston rings
Between head and cylinder, or bubbles in the cooling fins	blown head gasket

Hold the flywheel or blade securely when pressurizing the cylinder; the air will try to spin the engine.

11. Starter, governor, blades and belts

These are the parts around the engine that wear out with use. Most need only an inspection each season.

Recoil starter

- A frayed rope will break at the worst moment. Replace it with the correct diameter starter rope, and melt the cut ends so they don't unravel.
- If the rope pulls but the engine doesn't turn, the pawls (dogs) that grab the flywheel cup are worn, sticky or broken, or their retainer is loose.
- If the rope won't rewind, the recoil spring is broken or unhooked. Wear gloves and safety glasses when you open a recoil housing; the coiled spring can fly out with real force.
- A rope that suddenly won't pull at all usually means hydraulic lock (fuel or oil in the cylinder) or a seized blade. Pull the plug and investigate before you pull harder.

Governor

The governor holds engine speed steady as the load changes, opening the throttle when a generator picks up a load or a mower hits thick grass. It works through flyweights inside the crankcase or an air vane under the shroud, linked to the throttle by a rod and spring.

- Keep the linkage clean, free and unbent. Sticky linkage causes surging and overspeed.
- Don't bend governor springs or links to make an engine run faster. Small engines are built for a maximum speed (often about 3,600 rpm, which is also what a non-inverter generator needs to make 60 Hz). Overspeed can burst a flywheel or throw a connecting rod.
- Speed adjustments on generators should be made with a frequency meter, following the service manual.

Mower blades

- Sharpen at least once a season, more often in sandy soil. A dull blade tears grass and makes the engine work harder.
- Remove the blade (block it with wood first), and note which way up it goes; the sail or wing points toward the deck.
- File or grind the cutting edge at its original angle, removing equal metal from each end.
- **Balance it** on a blade balancer or a nail in the wall. An unbalanced blade vibrates, wears crankshaft bearings and can bend the crankshaft.
- Replace a blade that's bent, cracked or worn thin at the sail.
- Torque the blade bolt to the manual's spec. Check the blade adapter and key for damage after any strike.

Belts and drives

- Check belts for cracks, glazing, fraying and stretch each season. A slipping or squealing belt means it's worn or the idler spring is weak.
- Replace belts with the exact OEM length and section. A generic belt that's a little long or the wrong profile won't engage clutches and decks properly.
- Clean debris from pulleys and under decks. Check that pulleys spin freely without wobble.
- On chainsaws, keep the chain sharp and correctly tensioned, and keep the bar oil reservoir full.

12. The annual tune-up, step by step

A full tune-up takes about an hour per engine and needs an oil change, a spark plug, an air filter and a fuel filter. Do it at the start of each engine's working season, or before storage for equipment you'll need in an emergency.

Parts to have on hand: correct oil, spark plug, air filter (and pre-filter), inline fuel filter, fresh stabilized fuel, and a bowl gasket in case you open the carburetor.

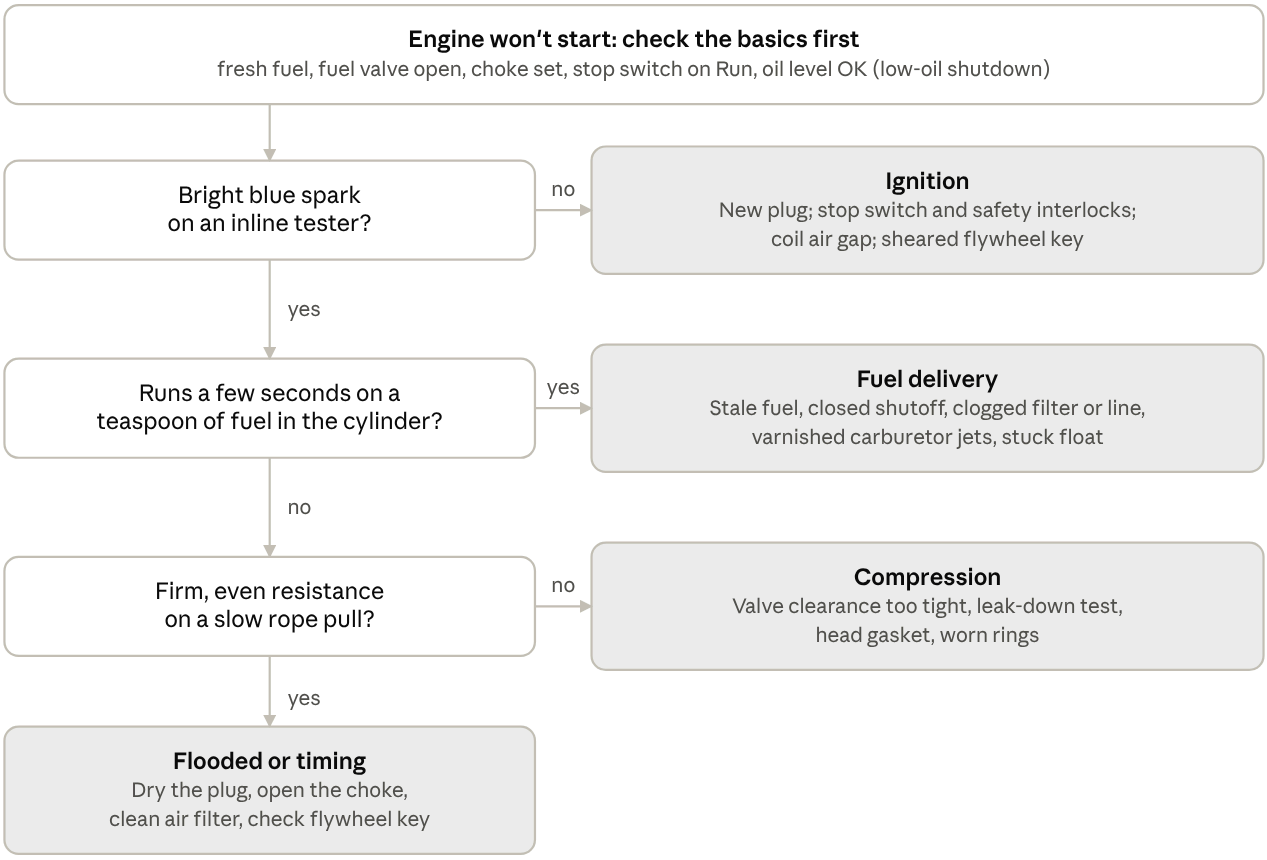
- [ ] **1. Inspect.** Walk around the machine. Look for loose bolts, fuel and oil leaks, frayed wires, cracked fuel lines, worn belts and damaged guards.
- [ ] **2. Disconnect the spark plug wire** (and battery on electric-start engines).
- [ ] **3. Drain old fuel** if it's more than a month old or unstabilized. Dispose of it properly.
- [ ] **4. Change the oil** with the engine warm (section 6).
- [ ] **5. Service the air filter.** Replace paper, wash or replace foam (section 7).
- [ ] **6. Replace the spark plug,** gapped to spec. Read the old one first (section 8).
- [ ] **7. Replace the fuel filter and any hardened fuel line.** Arrow on the filter points toward the carburetor.
- [ ] **8. Clean the carburetor float bowl and main jet** if the engine ran poorly or sat with old fuel (section 9).
- [ ] **9. Remove the shroud and clean the cooling fins** (section 10).
- [ ] **10. Check valve clearance** on OHV engines at the manual's interval.
- [ ] **11. Check the starter rope, governor linkage, blades and belts** (section 11). Sharpen and balance blades.
- [ ] **12. Lubricate** pivot points, cables and wheel bearings as the manual directs. Grease fittings on tillers and splitters.
- [ ] **13. Refill with fresh fuel,** reconnect the plug wire, and start it. Let it warm up and listen for steady running.
- [ ] **14. Check for leaks** and confirm the governor holds steady speed under load.
- [ ] **15. Record** the date, engine hours and what you did on the record sheet.

An inexpensive inductive hour meter clipped to the plug wire makes "every 50 hours" an actual number rather than a guess.

13. Troubleshooting

Work through spark, fuel and compression in that order, cheapest and most likely first. Most no-starts end at step two with stale fuel and a clogged carburetor jet.

Test spark first, then fuel, then compression



no-start troubleshooting · 3 tests, 4 outcomes

Don't keep cranking an engine that won't start. You'll flood it, wear out the starter, and on electric-start engines, drain the battery. Stop and test.

Runs, but not right

Symptom	Common causes
Surges or hunts at steady throttle	partly clogged carburetor jet, air leak at intake gasket, sticky governor linkage, stale fuel
Loses power under load	dirty air filter, clogged fuel filter, dull blade, low compression, governor linkage binding

Symptom	Common causes
Dies when warm, restarts when cool	vapor lock, tank cap vent blocked (engine dies, opening the cap restores it), failing ignition coil
Backfires	lean mixture, valve clearance too tight, sheared flywheel key, or on shutdown, carburetor running lean
Starts, then stops after a few minutes	fuel tank vent blocked, fuel filter clogged, low oil shutdown tripping
Excessive vibration	bent or unbalanced blade, bent crankshaft, loose mounting bolts
Overheats	blocked cooling fins or screen, low oil, lean mixture

Reading the smoke

Smoke	Meaning	Fix
Black	too much fuel (rich)	air filter, choke, carburetor float or jet
Blue-white, smells of oil	oil burning	overfilled oil, engine tipped the wrong way (clears in a few minutes), or worn rings and valve guides if it persists
White, steady	water or coolant (rare in air-cooled engines)	water in fuel; drain tank and carburetor
Blue on a two-stroke	normal in small amounts	heavy smoke means too much oil in the mix

14. Seasonal storage

An engine stored with a tank of untreated gas will very likely need a carburetor cleaning next season. Either stabilize the fuel and run it through the system, or run the fuel system dry. Then change the oil and protect the cylinder.

Option A: stabilize (best for equipment you may need on short notice)

1. Fill the tank about 95 percent full with fresh fuel and stabilizer (a full tank leaves less air for moisture to condense from).
2. Run the engine 5 to 10 minutes so treated fuel reaches the carburetor.
3. Shut off the fuel valve if there is one, then run until the engine stalls to empty the float bowl. Or drain the bowl through its drain screw.

This suits generators and pumps you may need in an emergency. Start them once a month, run under load for 15 to 20 minutes, and top up with fresh treated fuel.

Option B: run dry (best for long storage)

1. Drain the tank into an approved can, or run the engine until it stops.
2. Drain the carburetor float bowl.
3. Better yet, run the last tank on ethanol-free fuel so nothing left behind absorbs water.

Then, either way

- [ ] Change the oil while the engine is warm. Old oil holds acids that etch bearings over winter.
- [ ] Pull the spark plug, put about a teaspoon of engine oil (or fogging oil) in the cylinder, and pull the rope slowly a few times to spread it. Reinstall the plug.
- [ ] Pull the rope slowly until you feel compression, then stop. This closes both valves and seals the cylinder from moist air.
- [ ] Clean the engine, deck and cooling fins. Grass and dirt hold moisture and rust decks.
- [ ] Service the air filter.
- [ ] Remove batteries from electric-start equipment, charge them fully, and keep them on a maintainer somewhere that doesn't freeze.
- [ ] Sharpen blades and chains so they're ready.
- [ ] Store under cover, away from furnaces, water heaters and other pilot lights, and stuff a rag or steel wool in the muffler and air intake if mice are a problem. Leave yourself a tag reminding you to remove it.

Two-stroke tools: empty the tank, then start and run until they stall to clear the carburetor. Diaphragms last much longer dry.

15. Maintenance schedule and record sheet

Use these as typical intervals for air-cooled four-stroke engines, and shorten them for dusty, heavy or hot work. Your manual's schedule takes priority.

Task	Every use	First 5 hours	25 hours	50 hours or yearly	100 hours or yearly	About 300 hours
Check oil level	•					
Look over for leaks, loose parts, debris	•					
Change oil (break-in)		•				
Clean air filter / pre-filter			•			
Change oil				•		
Clean cooling fins and shroud				•		
Sharpen and balance blade				•		
Replace air filter					•	
Replace spark plug					•	
Replace fuel filter					•	
Clean carburetor bowl and jets					as needed	
Check and adjust valve clearance (OHV)						•
Clean combustion chamber carbon						as needed

Record sheet

Print a copy for each engine and keep it with the machine.

Machine: _____ Engine model / type / code: _____

Oil type and capacity: _____ Plug and gap: _____ Air filter part no.: _____

Date	Hours	Oil	Air filter	Plug	Fuel filter	Other work and notes

16. Glossary and resources

Glossary

Term	Meaning
BDC / TDC	Bottom and top dead center: the piston's lowest and highest points
Carburetor	Mixes fuel into the incoming air in the right proportion
Choke	A plate that restricts air for a rich mixture to start a cold engine
Compression release	A cam feature that bleeds off compression while cranking, for easier pulls
E0 / E10 / E15	Gasoline with 0, up to 10, or up to 15 percent ethanol
Float bowl	The fuel reservoir under the carburetor, kept level by a float and needle
Flywheel key	A soft metal key locating the flywheel on the crankshaft; shears to protect the engine and sets ignition timing
Governor	Holds engine speed steady under changing load
Jet	A precisely sized orifice that meters fuel
Magneto	The flywheel magnets and coil that make spark without a battery
OHV	Overhead valve: valves in the cylinder head, worked by pushrods and rockers

Term	Meaning
Phase separation	Water-laden ethanol separating from gasoline and sinking in the tank
Side-valve (L-head, flathead)	An older design with valves in the block beside the cylinder
Stabilizer	A fuel additive that slows oxidation and varnish formation
Valve clearance (lash)	The gap in the valve train that lets valves close fully when hot

Resources

- Your engine's owner's manual and service manual, from the manufacturer's website by model number. Briggs & Stratton, Honda Engines, Kohler and Kawasaki all post manuals and parts lookups free.
- *Small Engine Repair* manuals from Haynes and Clymer (Penton) for step-by-step procedures across many engines.
- Your county convenience center or an auto parts store for used oil and old fuel disposal.
- The companion booklet, *Sunlight to Socket: A Beginner's Guide to Off-Grid Solar*, for keeping your generator's run time to a minimum.

About the author

Steve Spence, KK4HFJ, is a Navy veteran, engineer, homesteader and certified small engine mechanic. He grew up on a farm in northern New York cutting hay behind a Ford 9N and a Massey Harris, and has been keeping engines running ever since. More free guides, including *Resilience Gardens*, are at kk4hfj.com.