

# MACHINERY Maintenance

## MAKING AN OLD DOG, MAN'S BEST FRIEND

Scott Nisbet looks at your old faithful friend the two stroke engine.

The two-cycle (two-stroke) engine is like an old dog. It's been around for 100 years. It can stink. It will snarl and snap. It can be an ill-tempered beast that won't obey your desires. Or, like a good hound, it can be a trusty companion and helper as you roam the golf course taking care of chores. Its behaviour depends on whether you feed it well, keep it clean and give it a good home.

Two-cycle engines are found on hand-held equipment – string trimmers, power blowers and chain saws. Occasionally you'll find a two-cycle walk-behind lawn mower or on a specialised piece of equipment like a post-hole auger. Your golf course may have two-cycle engines in golf carts. If you like to have vehicular fun off the golf course, you'll find two-cycles powering snowmobiles, smaller boats and "personal watercraft" such as jet skis, some motorcycles and even aircraft – ranging from radio-controlled model planes to ultra-lights.

Many landscape professionals assume two-cycles are dodgy things that can't be trusted to start easily, idle smoothly, or keep running. But the fact that people trust their lives to a two-cycle engine when they take off in an ultra-light demonstrates that these quirky little engines can be tamed and trusted.

There are no special secrets to handling two-cycle, but there are a few common practices that are worth adopting as habits of operation and maintenance. These good practices will become more important in the years ahead, because two-cycle design changes being forced by pollution-control laws are likely to further emphasize them. The little engines are changing in ways that will make care and feeding even more critical to their value as helpers on the course.

### UPS AND DOWNS

The two-cycle is called that because to produce power, the piston needs only two journeys through the cylinder bore – one up, one down. The engines used in cars and trucks need twice as many trips to produce one power stroke, and is called a four-cycle. Despite making twice as many power strokes at a given rotating

speed, the two-cycle doesn't produce twice the power of a four-cycle. But, it does produce twice as many exhaust pulses, so it sounds as if it is running twice as fast.

The two-cycle is suited for high-speed operation because it needs only 3 major moving parts – the piston, connecting rod and crankshaft. The piston, as it moves up and down, serves to control the flow of air-fuel mix into the cylinder and the release of exhaust. A tiny bit of oil is mixed into the fuel, so all the internal pieces are bathed in a lubricating mist. The oil is burned along with the fuel and helps produce the characteristic gray exhaust plume that marks a two-cycle. By contrast, a four-cycle needs a bewildering array of valves, levers, camshafts and more to control intake and exhaust, and a complex pumping and plumbing system for lubrication.

Design simplicity and high operating speed give small air-cooled two-cycle engines a superb power-to-weight ratio that suits them well for hand-carried tools and light vehicles.

However, simplicity has a dark side – pollution – that threatens the two-cycle's future. The problem lies in the fact that during the piston down-stroke, two incompatible things happen in the cylinder: The hot exhaust gas is moved out at the same time a cool supply of fresh air moves in. These two incompatible 'blobs' of gas can't be separated by a solid wall. Some exhaust gas remains behind to weaken the potential power from the fresh fuel charge. Worse, some unburned fuel and oil leaves with the exhaust. This discharge of raw hydrocarbon vapour and particles is amongst the most reviled mobile-source air pollutants on the planet.

A United States Environmental Protection Agency action in October 2001 set up new standards that raise the emissions bar extremely high. Major technical changes will be needed to permit



continued US use of two-cycle motorcycles, all-terrain vehicles and snowmobiles. Comparable rules are popping up all over the developed world. A World Bank report in July 2001 said a leading cause of premature deaths in South Asian cities is the air pollution from the inexpensive two-stroke motor vehicles that are commonly used in developing countries. Legislation to follow? The annoying exhaust bark and intake growl of two-cycles has also spawned laws in various US cities, based on noise pollution.

The hand-held equipment currently sold incorporates technical changes adopted to meet the regulations and more changes are in the pipeline. While some manufacturers, notably Honda and Ryobi, have developed four-cycle engines for string trimmers and power blowers, the bulk of manufacturers are building modified two-cycles that meet current regulations. In development are many different designs aimed at meeting future standards. It is likely that these future products will need special care and feeding. It's worthwhile to start adopting today the operating and maintenance habits they will call for.

#### CARE AND FEEDING

"Barking" and "growling" were traditionally ignored in two-cycle design. Minimalist mufflers and air intakes noise control saved a lot of weight. New designs increase the size and weight of these external parts. To keep total engine weight about the same, designers have reduced the weight of core components like cylinders, crankshafts, starters, etc. This shift has serious impacts on operation and maintenance.

Newer engine designs typically squeeze more power from each cubic centimeter. This is done with a leaner fuel mixture and higher engine speed; both result in higher engine heat loads. This means some new practices for operators and technicians. Carburetor



passages are physically smaller, with higher precision needles. They are less tolerant of particles coming in with the fuel, so the filters are much better. Partial blockage of a fuel passage can 'over-lean' an already lean-burning engine, causing destruction through under-lubrication and excess heat. Change the fuel filter often. Fuel can't be allowed to linger for months in the tank and evaporate into solids that will load up the filters. Get in the habit of emptying two-cycle hand-held fuel tanks when a unit will be in storage more than a week.

The cooling system has a higher load. So attention must be paid to keeping air intake screens free of debris. Cooling fins, on both the fan and cylinder, should be cleaned more often.



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That means opening up the shrouds more often to blow away chaff. The higher heat and speed demand better spark plugs. The electrodes are more likely to burn away, opening up the spark gap. This can lead to harder starting. It can also alter the ignition timing because it may take longer for an electron charge to build enough to jump a larger gap. Altered timing can change power output and increase engine heat production. So check, re-gap and replace spark plugs frequently. On daily-use machines, this may mean monthly plug checks. When you do this, make sure the engine is cool to avoid stripping out the plug threads in the cylinder head.

It may be worth considering switching to synthetic lubricants for two-cycle engines? Many users have experienced extended engine life with these products. A significant advantage is that a single batch of synthetic fuel-oil blend can serve a wide range of different two cycle engines which may call for fuel-oil blends ranging from 16:1 up to 100:1.

Beside simplifying inventory, the synthetics seem to leave fewer deposits in the critical piston ring area. A seized piston ring is often fatal to a two-cycle engine, so preventing that is usually worth the higher price of the synthetic lube.

## KEEP IT FAST

Newer engines get more power per cubic centimeter, but they often have less "flywheel effect" than old designs. Equipment operators need to learn to keep engine speed up. When using a brush blade, for example, it's best to take many small high-speed bites rather than trying to "lug through" with a steady cut. It's imperative to frequently sharpen chain saw chains and brush blades, to reduce the engine load and allow higher operating speeds.

The mechanisms downstream from the engine, items like the gear heads in string trimmers and clutches on chain saws, should be checked for proper operation. Any binding or maladjustment should be cured in the interest of safety, reducing engine load and permitting full-speed operation.

Throttle cables and linkages should be checked frequently to verify that they are pulling the carburetor fully open. Air filter elements should be checked and changed more often to allow the free flow of air into the engine. And the muffler system should be frequently checked for blockage.

Carburetor fuel-mixture adjustment is one of the more critical elements to two-cycle operation, since it controls both the leanness of fuel and the quantity of lubricant. Each machine will have a specific system for adjustment. Some will permit no adjustment, while others will. Read the operating manual and follow it strictly.

## STORE IT RIGHT

Storage is an important issue for two-cycles. Some are showing up with catalytic converters. These platinum-bearing, ceramic honeycomb exhaust filters have been used on cars for decades. They make unburned fuel molecules combine with oxygen, to eliminate troublesome emissions. But the converter, which looks like a regular muffler, is more fragile because of the internal ceramic honeycomb. It retains its heat longer after the engine is shut down. The extra heat may be enough to start a fire by inadvertently storing a hand-held power tool in a position where the converter contacts flammable materials.

Assess the storage setting for your two-cycle equipment to eliminate wood, grass clippings or any other potentially flammable materials. Train operators to store the equipment so fuel left in the tank can't inadvertently dribble onto the muffler or converter. Also, be careful of wildlife, particularly insects. For some reason, spiders seem to take a special liking to two-cycle engines. Some species like to build nests in the exhaust outlets, causing a clog. Operators have received painful stings. Whatever the reason, take some extra time to verify there's no fauna cluttering up the storage area.

Goodness knows the little pups with two-cycle engines are enough responsibility for anyone.

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