RESTORING POWER TO SMALL ENGINES

By Daniel Ingham, Equipment Editor

Is your mower *sounding* winded rather than *running* with the wind? Does the engine bog down if you try to mow more than a quarter inch of *dry* grass or tough weeds?

If you have noticed any of these symptoms you're probably already considering a new engine or mower. Depending on the severity of the problem, a new engine or mower may be in order. However, such drastic measures may not be needed.

If the mower, or any other piece of powered equipment for that matter, is in relatively good shape, replacing or overhauling the engine is usually the most economical thing to do. Deciding to overhaul or replace an engine is not especially difficult if you follow some basic rules and guidelines.

Surprising as it may seem, most engine manufacturers are not that eager to sell you a new engine at the first sign of trouble with the old one. A company's reputation rides on the durability and rebuildability of its engines. So, if there's usable life left in it, they would rather see it remain in service for as long as possible with their name emblazoned across it. What better advertising can there be for an engine manufacturer than a 20-year lawnmower engine humming along like it did the day it was purchased? Engine manufacturers cannot afford to make throw-aways.

Regardless of whether you intend to repair or rebuild, the decision must be made before a crisis occurs. The signs of impending engine failure are usually visible long before the failure occurs. High oil consumption is usually the most reliable sign that internal engine wear has gone beyond the point where simple repairs will solve the problem. That, accompanied by low power, low oil pressure, misfiring or excessive noise are signs that trouble is on the horizon.

Repair or Rebuild?

If an engine is well maintained during its normal operational life it will cost less to rebuild and return it to its original performance. A properly maintained engine can usually be rebuilt twice. A not-so-well-maintained engine, probably once.

The reason has to do with the engine's cylinder, which needs to be refinished and bored out each time (removing some of the metal), and requiring the installation of an oversized piston and rings. The more wear and damage in the cylinder bore, the more metal will need to be removed and the fewer rebuilds that can be accomplished. Theoretically, a properly maintained and repaired engine can keep running forever.

Herein lies the difference between repairing and rebuilding.

With repair we're talking about minor things like gasket replacement, carburetor repair/adjustment, spark plugs, fuel lines, head and valve cleaning to remove carbon build-up and servicing electrical components or connections. These are the types of things that most novice or self-taught mechanics can tackle in the garage on a Saturday afternoon or be quickly repaired by the dealer.

Rebuilding goes deeper. It includes things like replacing valves, valve springs, gaskets, seals, piston rings, crankshaft bearings and more. When you rebuild an engine, you are machining and reusing most of the basic components and bringing it back to new tolerances by replacing the remaining parts. Depending on the condition of the engine before rebuild, the skill of the mechanic and the quality of the replacement parts used, a rebuilt engine can achieve "like-new" performance.

The decision to rebuild or repair is based on how the engine is performing, and what is necessary to bring performance back to an acceptable level. If performance has deteriorated only a little and can be brought back with minor parts replacement, fine. If performance is way down, chances are that minor repairs will only be a waste of money because they will not bring the engine back to previous performance levels and will simply delay the inevitable.

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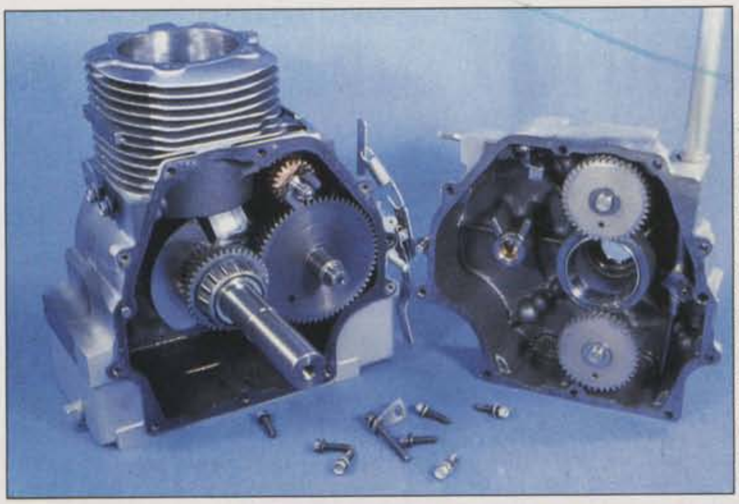
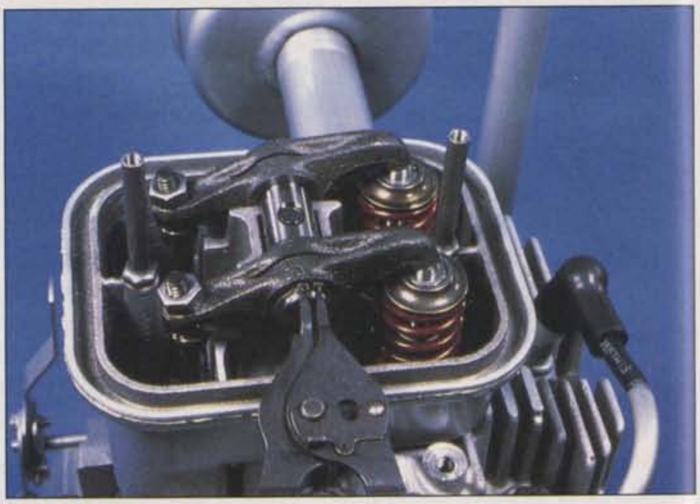
The decision to rebuild or replace is based on cost as well as the condition of the engine (the probability that it can be successfully rebuilt). A new engine, depending on the model and horsepower, can cost from $200 to over $1,000. As a rule of thumb, if the cost of rebuilding an engine is going to be 50 percent of the cost of a new engine or less—rebuild it. If the cost is going to be 50 to 70 percent of a new engine there are additional factors to be considered. If the cost will exceed 70 percent of a new engine—buy a new one.

The closer the cost of a rebuild moves toward the cost of a new engine, the more considerations there are. Today, those include things like pending CARB regulations, fuel economy, engine type, power requirements and equipment standardization. Phase one of the new EPA emissions regulations will hit soon, and if you rebuild now, you may be forced into a situation where you are required to buy a new engine after phase-two kicks in, giving you no choice but to buy a significantly more expensive engine sooner than you would like (most current overhead valve engines meet phase-one requirements—it's phase-two that worries manufacturers).



Overhaul generally consists of replacing all those parts that are subject to wear during normal operation, replacing seals and the removal of carbon and sludge deposits in the engine.



Valves can usually be cleaned-up and the valve seats re-ground during overhaul.

You may have an older engine that, even with a successful rebuild is going to consume more gas than a new one, thus making it uneconomical in the long run. The older "L-Head" engines, for example, use about 25 percent more gas than the new overhead-valve engines and produce about 20 to 30 percent less horsepower for the same engine size (displacement). Also, standardizing equipment types can reduce overall maintenance costs because you can keep the same spare parts on hand to repair several different pieces of equipment—the same type of spark plug, for instance.

What to Look For

The old saying, "Where there's smoke, there's fire," goes a long way in identifying an engine in need of overhaul. Poor oil maintenance practices will cause most *significant* engine problems, and excessive oil consumption and blue smoke from the exhaust will tell you they have or are occurring.

Engines designed for mowers and other outdoor power equipment are usually air-cooled and operate in very dirty conditions at high temperatures. Their oil requirements are different from liquid-cooled automobile engines. Most people use multi-viscosity oils (like 10W-40) in trucks and autos and usually carry and extra quart or two under the seat. Chances are you've used some in your mower because you were out of the factory recommended oil.

Because of the operating temperatures and speeds of these small engines, multi-viscosity automotive oils do not hold up well and will break down. As they begin to break down, the thinner elements will enter the combustion chamber and result in the excessive oil consumption and blue smoke associated with burning oil (smoke may not be produced in visible quantities until actual damage has occurred, so oil consumption should be monitored). If allowed to continue, this will damage the engine.

Drain the oil from the engine and use the oil recommended by the manufacturer. If excessive oil consumption persists, then there is probably significant internal wear or damage.

If excessive oil consumption is accompanied by power loss, there is probably a loss of compression in the cylinder. Loss of compression may just require a new head gasket, but could also be due to badly worn piston rings or valves not closing completely because of carbon build-up. The dealer can do a compression or crankcase vacuum test to check cylinder compression.

Oil analysis is another method of determining engine problems and what to do about them. Companies with large fleets of equipment often send regular oil samples to labs so they can detect potential failures before they happen. The analysis will show what kinds of metals or abrasives are in the oil. Different materials indicate different problems. Copper, for example, will let you know that the bearings are wearing out. The presence of chrome might let you know that the piston rings are wearing since many are chrome plated. How much of the material is present, measured in parts-per-million, will tell you how much wear is occurring and if it indicates a major problem.

Oil Maintenance Practices

Engine oil is a major factor affecting the performance and service life of your

Crankshaft bearings and seals are commoly replaced during overhaul. Excessive vibration that continues after tune-up is often a sign that crankshaft bearings need replacing.

engines. Monitoring the oil levels and frequent oil changes are essential for maintaining and prolonging the life of your commercial equipment.

Engine oil performs the following vital functions:

Lubrication. Oil maintains a film between moving parts to help prevent metal-to-metal contact, which causes friction (heat) and engine wear. The key to an oil's ability to lubricate is its viscosity, or resistance to flow. The higher an oil's number, the higher its viscosity—40-weight is thicker than 20-weight. Unless operating at very low temperatures, multi-viscosity oil is not recommended. During summer months, straight 30-weight oil should be used. Refer to the owner's manual for specific oil recommendations.

Sealing. The same oil film that provides lubrication also assists seals to maintain engine efficiency. Oil provides sealing both in the combustion chamber and with seals and shafts. It helps the piston rings seal pressure in the combustion chamber, maintaining compression and power.

Cooling. Your engine's oil also carries heat away from hot areas, especially the piston and cylinder head.

Cleaning. The term "detergent oil" refers to the cleaning capabilities of engine oil. Many engine oil additives assist in keeping the engine clean. About half the test criteria engine oils must meet have to do with detergent properties. These detergents are necessary because of combustion by-products that find their way into the oil. Detergents keep varnish and deposits from forming in the engine, and to some degree, remove existing deposits. Most small engine manufacturers recommend using oil with an API service class of SF or SG. Using oils that do not meet this certification can result in damage to the engine.

Running an engine with insufficient oil can cause serious damage, resulting in costly repairs or down time.

Adding oil regularly isn't enough. You need periodically to drain the old oil and replace it with clean oil. As crankcase oil lubricates, seals, cools and cleans, it becomes contaminated with acids, dirt and abrasives. These contaminants stay in the oil and will damage the engine if allowed to build-up. Also, prolonged use depletes many oil additives, rendering them ineffective.

Synthetic oils, new to the market, offer some potential benefits to small

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engines. According to David Kunkel, vice president of national accounts at Penzoil, "The attributes of synthetic oils are perfect for small engines, especially for air-cooled engines that run at hotter consistent temperatures. Synthetics remain stable at these higher temperatures." However, he says, "The jury is still out whether small engine users will actually realize a cost benefit in the long-term because of the significantly higher cost of the oil. We are still doing testing in this area."

Dirt that gets into the engine oil and the use of the wrong type of oil, says Kunkel, are the two main factors contributing to small-engine damage. One of the things Penzoil is doing is downsizing some of its product line, like oil and engine cleaner containers, to sizes more convenient for small engine users.

Troubleshooting

The following troubleshooting guide will help you diagnose engine problems and what to do about them. When using a trouble shooting chart, finding the common denominator is the best way to find the problem. For example, your engine may have more than one symptom originating from a single cause.

Check under each symptom that your engine exhibits such as *Engine starts hard, Engine runs but misses* and *Engine will not idle.* In each of these categories the common causes are faulty spark plugs, dirt or water in fuel and improperly adjusted carburetor. Using this method will help isolate the problem quicker and reduce your frustration level. Check and correct the easiest problem first and then go to the next until the problem is solved.

Engine cranks but will not start. Empty fuel tank. Fuel shutoff valve closed. Clogged fuel line. Spark plug lead disconnected. Keyswitch or kill switch in "off" position. Faulty spark plug. Faulty ignition module. Dirt or water in fuel system.

Engine starts but does not keep running. Restricted fuel tank vent. Dirt or water in fuel system. Faulty choke or throttle controls/cables. Loose wires or connections which short the kill terminal of the ignition module to ground. Carburetor improperly adjusted. Faulty cylinder head gasket. Faulty fuel pump.

Engine starts hard. Hydrostatic transmission is not in neutral/PTO drive is engaged. Loose wires or connections. Dirt or water in fuel systems. Clogged or restricted fuel lines. Faulty choke or throttle controls/cables. Faulty spark plug. Carburetor improperly adjusted. Incorrect valve-to-tappet clearance. Low compression. Faulty ACR mechanism.

Engine will not crank. Hydrostatic transmission is not in neutral/PTO drive is engaged. Battery is discharged. Safety interlock switch is engaged. Loose or faulty wires or connections. Faulty keyswitch or ignition switch. Faulty electric starter/starter solenoid. Retractable starter not engaging in drive cup. *Seized internal engine components.*

Engine runs but misses. Dirt or water in fuel system. Spark plug lead loose. Loose wires or connections which intermittently short kill terminal of ignition module to ground. Carburetor improperly adjusted. Engine overheating. Incorrect valve-to-tappet clearance. Faulty ignition module.

Engine will not idle. Idle speed adjusting screw improperly set. Dirt or water in fuel system. Idle fuel adjusting screw improperly set. Restricted fuel tank vent. Faulty spark plug. Incorrect valve-to-tappet clearance. Low compression.

Engine overheats. Grass screen, cooling fins, or shrouding clogged. Excessive engine load. Low crankcase oil level. High crankcase oil level (overfilled). Carburetor improperly adjusted.

Engine knocks. Low crankcase oil level. Excessive engine load.

Engine loses power. Low crankcase oil level. High crankcase oil level. Restricted air cleaner element. Dirt or water in fuel system. Excessive engine load. Engine overheating. Faulty spark plug. Carburetor improperly adjusted. Low compression.

Engine uses excessive amount of oil. Incorrect oil viscosity or type. Clogged or improperly assembled breather system. Worn or broken piston rings. Worn cylinder bore. Worn valve stems and/or valve guides.

In addition to these symptoms, there are some external checks that can give clues to what might be found inside the engine once it is disassembled.

- Check for buildup of dirt and debris on the crankcase, cooling fins, grass screen, and other external surfaces. Dirt and debris in these areas are causes of overheating.
- Check for obvious fuel and oil leaks, and damaged components. Excessive oil leakage can indicate a clogged or improperly assembled breather, worn or damaged seals and gaskets, or loose or improperly torqued fasteners.
- Check the air cleaner cover, element cover, and air cleaner base for damage or indication of improper fit and seal.
- Check the air cleaner element. Look for holes, tears, cracked or damaged sealing surfaces, or other damage that could allow dirt to enter the engine. Also note if the element is clogged or restricted. These could indicate that the air cleaner has been underserviced.
- Check the carburetor throat for dirt. Dirt in the throat is further indication that the air cleaner is not functioning properly.
- Check the oil level. Note if the level is within the operating range on the dipstick, or if it's low or overfilled.
- Check the condition of the oil. Drain the oil into a container—it should flow freely. Check for metal chips or other foreign particles (a magnet can be used to detect and remove metal chips in the oil for examination). Sludge is a natural byproduct of combustion; a small accumulation is normal. Excessive sludge formation could indicate that the oil has not been changed as recommended, and incorrect type or weight of oil was used, overrich carburetor settings and weak ignition to name a few.

One of the best things you can do for yourself and your equipment is to order the appropriate service manuals for the equipment and the engines on that equipment. These are the manuals that mechanics use when repairing engines and contain useful information you should know. Even if you do not intend to use them for doing your own repairs, it is a good idea to read them and increase your understanding of the equipment. They will help you understand what the service technician tells you when discussing needed repairs and let you know if they are being honest with you (dishonest mechanics are a fact of life). If you don't understand what he is telling you, pull out your manual and ask him to show you the page that explains it. A good, honest mechanic should be happy to show you. ❑

Editor's note: Technical information provided by Kohler Engines and Tecumseh Product Company.