ENGINE IRREGULARITIES

Armed with a few simple facts, your field-level employees can often isolate minor engine problems before they grow into expensive major breakdowns.

by John Peterson

The engine is the heart of any piece of outdoor equipment. Keeping it in good working condition helps maintain the equipment's overall efficiency.

Although many engine problems can be complex and require a trained mechanic to repair, the field operator can often detect irregularities that indicate when a major mechanical failure is developing. With a few simple facts and a few extra minutes, the operator can often isolate these minor problems before they become more expensive.

Before startup

The morning equipment inspection is the first line of defense in diagnosing potential engine problems. It should start with a walk around the vehicle, checking for puddles, which can indicate leaks in any one of a number of systems. Also, check engine surfaces for unusual amounts of fluid and try to trace them.

For example, if the piston rings are worn, several drops of oil will appear around the blow-by pipe. Normally, the area at the end of the pipe will be covered with oil-soaked dust. If the engine has excessive blow-by, oil may be washing the dust away. A compression check will determine if the rings have worn to a point that engine efficiency is affected.

After a visual inspection for leaks, check the oil. Unexpectedly low levels are another indication of a leak that needs attention.

To check for both fuel and coolant in the oil, a simple test can be conducted on a weekly basis. After running the engine for five minutes to get the oil warm, pull out the dipstick and put a drop or two of oil on a paper towel. Unless the oil has been changed in the last few hours, a dark circle surrounded by a lighter, less distinct, ring will appear. The inner circle is oil and the outer ring is diesel fuel, which is thinner than the oil and spreads faster on the paper towel.

The fuel ring should be a thin halo around the oil. A fuel ring twice the diameter of the oil circle indicates there is enough fuel in the crankcase to start interfering with the oil's lubricating effects.

Although some fuel seepage into the oil is normal, too much before a scheduled oil change may indicate a leak in the fuel system.

Prolonged idling at low speeds also causes fuel dilution. If this is the case, the engine will not warm up enough to expand the rings and the resulting poor rings-to-cylinder sealing will lead to lower compression, allowing more unburnt fuel and oil to mix.

Milky-looking oil may indicate a leak in the cooling system. This can be verified by opening the oil pan drain plug slightly and catching the drippings in a cup. Since antifreeze (even mixed with water) is heavier than oil, it will separate from the oil and a blue or green color will appear. Again, have a mechanic address this problem immediately.

The next step in the daily inspection is to check fan and alternator belts. Try to turn the fan or alternator cooling fins by hand while the engine is not running. The resistance offered by the engine should make these components difficult to move if the belt is properly adjusted and in good condition. If you suspect a belt is loose, run the machine five or 10 minutes and then check the temperature of the pulleys. If belts are loose, the pulleys will be hot.

A quick visual check can detect slippage on a standard V-belt, as the sides of the belt will be glazed from wear.

After inspecting the belts, look for loose hoses or hose clamps.

Next, check the air filter. Many have warning indicators to show that the filter is clogged. If this is the case, have it replaced or cleaned.

The morning equipment inspection should also include an inspection of systems that are related to the engine. Often a minor malfunction in one of these systems may appear to be a major engine problem but is, in fact, far less serious.

Here is a brief list of other systems that should be inspected before startup:

continued on page 32

Unexpectedly low oil levels are a sign that a leak needs attention. Excessive oil use or very dirty oil is a cause for concern.

Peterson is a service engineer at JI Case in Racine, Wisc.

● Check the fuel filter drains. If fluid does not drain and the weather is cold, water in the fuel pump or line may have frozen. If the temperature is above freezing, there is probably a blockage in the fuel system. Check the fuel filters to see if they are clogged with dirt.

● Check to make certain that fuel shutoff valves are open at the tank. Mechanics occasionally forget to reopen these valves after working on a unit, causing operators to crank an engine that is getting no fuel.

● Check the cooling system. Is it at the proper level when cool? If there is an overflow tank, is it at the proper level indicated on the tank?

● Check the antifreeze. It should be bright green or blue in color. If it is rusty or dirty, it may need changing.

● Check the radiator fins to see if they are clean and undamaged. Debris in the radiator fins will reduce the efficiency of a cooling system considerably and can cause engine overheating.

● Run a quick visual check of the wiring, looking for dangling, frayed wires.

While this seems like a long complicated process, it actually takes only five to 10 minutes, and it should become a part of an operator's routine.

Engine startup

Most engine problems can be diagnosed during the pre-start check or within five minutes of starting and operating the machine. Strange noises or unusual-looking smoke are common warning signs.

If the engine does not turn over at all, check to see if the master disconnect switch is deactivated.

If this is not the problem, check the battery by turning on the unit's lights and turning over the starter. If the lights dim excessively, the battery may be low, or electrical or ground connections may be corroded. A good ground connection is as important as the positive battery cable connection. Check all ground straps.

If the engine cranks, but still will not start, it can mean the battery needs recharging or that the connections to the battery are corroded. In cold weather, it might be a sign that engine oil is too thick.

If the engine turns over easily in the cold, but is not starting, try cranking for 30 seconds. Then let the engine rest for 30 seconds and try again. Batteries work better when warm, and cranking heats them up quickly. A brief cranking also heats the air in the engine, which seals the rings and creates better compression.

If the engine still will not start, do not continue cranking. This can burn out the starter. Re-check fuel lines and fuel tank valves. If you are still unable to find any reason the engine will not start, call a mechanic.

If the engine misses after starting, call a mechanic immediately. This can indicate a serious problem such as a faulty injector valve, a piston problem or a blown head gasket. Although the engine will work when firing poorly, unburnt diesel fuel seeping down the cylinder walls washes the oil off the pistons, which can cause serious damage.

Exhaust fumes

One of the best indications that an engine is running properly is the color of the exhaust fumes. Under normal idle conditions, the engine should emit only a slight haze. Under load or acceleration, some black smoke is normal because of less efficient fuel burning.

Here is a review of what an operator can learn from the color of exhaust fumes:

continued on page 34

ENGINE *from page 32*

● **Blue smoke**: During idle, this means oil is seeping past the rings or the intake seal on a turbocharger. Some is normal, but excessive amounts of blue smoke signal problems requiring a mechanic's attention.

● **Black smoke**: This usually means the air to fuel mix is too rich and too much fuel is going unburned. This is often caused by a dirty air cleaner or the air filter being blocked by leaves, debris or even a rag. Occasionally, a mechanic will increase fuel to oil mix to increase power. This will give temporary results, but will eventually destroy the engine.

● **White smoke**: A small amount is normal during cranking. This indicates that the invectors and fuel pump are delivering fuel to the cylinder but combustion is not taking place.

● **Misty, white smoke**: This is often visible at the initial startup. In large amounts it may be a sign that abnormal amounts of coolant are entering the combustion chamber due to a blown head gasket, cracked head, cracked block or cracked sleeves. These problems will also cause bubbles in the radiator while the engine is running. This situation requires immediate attention by a mechanic.

● **Gray smoke**: Often an indication that engine compression is too low, gray smoke usually results from broken sealing rings, burnt valves, a cracked engine block, etc. It requires a mechanic's immediate attention.

Power loss

If an operator notes a steady loss of power over time, it may indicate an engine problem. However, such a power loss is just as likely to be caused by other factors. Here is a checklist of possible causes *not* related to the engine:

● **Changed operating conditions**: Wet, muddy conditions will drastically alter the performance of many machines. In fact, mud packed in the tracks of a crawler dozer, loader or excavator can require at least 30 hp more to drive than clean, dry tracks. Solve this by loosening the tracks in muddy conditions and using open grouser pads.

● **Tracks too tight**: A mechanic may have overtightened tracks, which will overwork the machine and require more horsepower.

● **Tracks too large**: Some users put larger-than-recommended tracks on a machine, thinking it will increase traction. To an extent, it does, but it also demands more horsepower from the engine. The rule is to not try to make a machine do more than it is built to do.

● **Blades or buckets too large**: Using blades and buckets larger than recommended for the equipment reduces overall performance. Refer to the manufacturer's requirements to make sure the machine is not being overloaded.

● **Wrong gear**: Running a piece of equipment in third or fourth gear in a situation where first or second gear is required will result in inefficiency.

● **Hydraulic lever not in neutral**: If a hydraulic lever is not in the neutral position, the machine will probably be difficult to start because the starter is forced to turn over both the engine and a loaded hydraulic pump. Putting the lever in neutral should solve the problem.

These are simple points, but in a surprising number of cases, they will isolate the problem. If not, there is a three-step test to further track the source of the power loss.

First, run the engine at full throttle with the transmission and all hydraulics in neutral. Accelerate to maximum rpm. If maximum rpm is not attainable it may be nothing more than a clogged fuel or air filter inhibiting the engine's operation. Locate and correct the problem.

Second, if engine rpm is normal, isolate the hydraulics. Actuate a valve (for example, loader up) and hold it open until the function has reached its limit. At this point, the oil will be deadheaded, causing the main relief valve to open. This will demand greater horsepower. Normally a drop of 100 to 200 rpm will occur. If the hydraulic system pressures are set too high there will be a drop of more than 200 rpms.

Finally, if the unit passes the second test, put the transmission in high gear and, with the hydraulics in neutral, engage the parking brake (this can be done only if the equipment has a torque converter). Go to full throttle. The engine should drop 200 to 400 rpm. If it drops more, the problem then lies with the engine, not the hydraulics.

Throughout the process, watch the exhaust stack to obtain additional information about fuel burning, water or coolant in the system, etc.

If the machine passes all three steps in this test, there may be a problem with the power train or transmission, or it may be an indication of locked brakes or tracks that are too tight.

These sample tests will detect many engine problems. As a result, the small amount of extra time spent checking out equipment in the field can save thousands of dollars in repair bills and make more efficient, effective use of construction equipment. **LM**