THE GUIDE TO PISTON PROBLEMS

Examining a used piston can give mechanics helpful information on the condition of a two-stroke engine. When engine failure occurs, the piston is likely to take the brunt of the damage. Careful examination of the piston can help a mechanic trace the source of a mechanical or tuning problem. This is a guide for the most common mechanical problems.

Cold Seizure

A cold seizure happens when the engine isn't warmed up long enough before it goes under a full load at wide-open throttle. A cold seizure pattern looks like four vertical streaks positioned equally around the piston. Cold seizures occur when the piston expands faster than the cylinder. To fix a cold seizure, you have to hone the scratch marks off the cylinder and replace the piston kit.

Hot Seizure

A hot seizure happens at full throttle and load after the engine is up to temperature. A hot seizure pattern looks like a horizontal melting of the piston on and above the top ring groove. Hot seizures occur because the main jet is too lean, a crankcase has an air leak, a detonation occurred from too-low-octane fuel, or a spark plug range was too hot.

Worn Ring

A worn ring happens when the ring is run for hours past the normal service life. A worn ring pattern looks like a flat spot on the exhaust side of the piston, aligned with the bridge of the exhaust port.

Cracked Skirt

A cracked piston skirt happens when a piston is allowed to run with too much piston-to-cylinder wall clearance, or when it's simply worn out. Cracks appear on the intake side of the piston, and the engine makes a rattling noise, especially at idle. If the piston runs too long, sometimes the skirt can break off and cause catastrophic engine damage.

Coolant Leak

A coolant leak at the head gasket allows coolant to contact the piston crown's outer edge, making an erosion pattern. Eventually the ring will seize in the groove and cause a loss of compression and shut the engine off. The worst-case scenario is that the combustion gases pressurize the radiator and all the coolant blows out the overflow tube. This makes the engine run hot and overheat.

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This piston has a hole in the crown from detonation and low-quality fuel. When your engine makes rattling noises under acceleration, that is detonation.

This piston is deeply scratched and dry because the engine was run with straight gas and no premix oil.

This piston has a hole burned on the exhaust side. The engine had a blown left crankshaft seal and an air leak that leaned the carb jetting.

This piston has a dark spot under the crown. The engine ran very hot and oil burned on the crankcase side of the piston.

This piston had a circlip pop out. The clip wasn't seated properly and wedged between the piston and cylinder, causing a seizure.

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Top-End Reassembly

Assuming that the cylinder is clean and ready to install, and you have your new piston kit and gaskets laid out, start by assembling the piston kit. The piston kit consists of a piston, a pin, a ring, and a set of circlips. Needle bearings are sold separately. Two-stroke pistons have centering pins for the rings so they don't rotate and snag on port edges. Look for the letter marking on the ring near one of the ends and position it up. Stretch the ring open with your thumbs slightly and lower it onto the piston ring groove. Always use a new needle bearing when you change the piston. That is the small bearing that fits in the top of the connecting rod. Coat the needle bearing with premix oil. Now you're ready to follow these 10 steps to finishing the top-end rebuilding process.

1) Install one of the circlips in the piston and use the pin to snap it into the groove. Try to install the circlips with your fingers rather than pliers. It is very easy to damage the circlips with pliers, causing them to break and

This piston overheated from a blown head gasket that forced all the coolant out of the blow-off vent hose.

pop out of the groove, which can damage the cylinder bore. Put a dab of pre-mix oil on the piston, ring, and cylinder to make it easier to fit the piston into the cylinder.

2) Grease the cylinder alignment pins.

3) Set the exhaust valves in the closed position.

4) On cylinders with reed valves, leave the intake port open because you will need to reach in through the port to push the piston-ring ends back in place.

5) The best way to slip the piston into the bottom of the cylinder is to rotate the rings toward one side of the locating pins and squeeze the rings with your middle finger and thumb. That will leave your other hand free to position the cylinder.

6) There are two methods used to assemble the top end. The first method is to attach the piston to the connecting rod and lower the cylinder onto the piston assembly. The second method is to install the piston assembly into

This piston seized because water passed the air filter and washed the oil off of the intake skirt.

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This piston shattered because it was run way past its service life.

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the cylinder and lower the cylinder and piston onto the connecting rod. The second method is easier but involves pinning the piston and installing one circlip with a minimum amount of free space.

7) Take care to align the exhaust-valve control mechanism as the cylinder is bolted to the crankcases.

8) Tighten the cylinder-base nuts with a six-point box wrench in a crisscross pattern. Don't be concerned about fitting a torque wrench to the nuts because the cylinder shrouds most of the nuts; just get the nuts tight without stripping them.

9) If the head uses a steel gasket, you should spray-coat it with a gasket adhesive like Permatex Spray-A-Gasket or Copper-Coat. If the head uses O-rings, coat them with a thin film of grease to make them stick in the grooves when you put the head on. Some O-rings will be slightly undersized when you take them out of the package. If they keep popping out of the groove, you can stretch them a bit, but be careful. Never reuse old O-rings.

10) Use an inch-pounds torque wrench to tighten the head nuts. The average torque rating on head nuts is 250 inch-pounds, but check your service manual for the exact rating. Torque the head nuts in a crisscross pattern in two increments: half torque and full torque. Over-tightening the head nuts is the biggest cause of head-gasket leaks. The cylinder head can warp if you tighten it too much in one spot.

Break-In

There are different break-in procedures for electroplated and iron-sleeved cylinders. Electroplated cylinders are very hard and use chrome-faced rings, so there is no special break-in. Freshly bored iron-sleeved cylinders need to be run at less than 3/4 throttle for 30 minutes before putting a full load at full throttle on the engine.

Chapter 6
Four-Stroke Top-End Rebuild

There are two basic types of four-stroke engine configurations used on dirt bikes. The traditional two-valve, single overhead-cam engine used in the Honda XR and KLX is basically a hopped-up lawnmower engine. The four-valve, dual-cam engines used in late-model CRF and YZF150s are more like scaled-down, detuned Formula 1 engines.

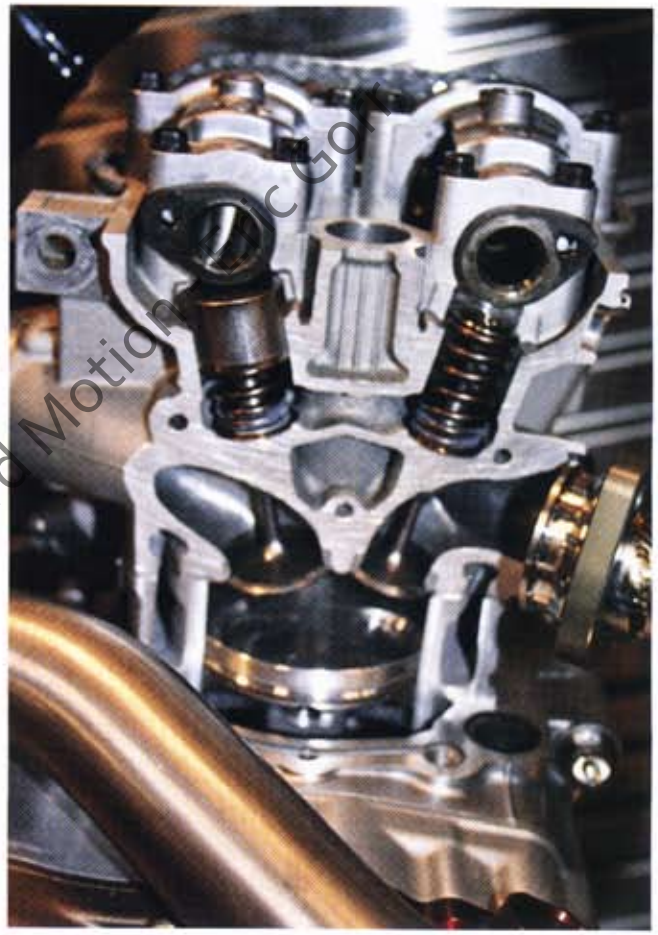
In both engines, the basic process of burning fuel and making power is the same. A four-stroke engine uses four strokes of the piston up and down and two revolutions of the crankshaft in order to complete one power cycle.

With the piston at top dead center (TDC), the first downstroke of the piston is the intake phase, with the cam opening the intake valve; fuel/air mixture flows in from the carb through the intake port and into the cylinder bore.

When the piston reaches bottom dead center (BDC), the cam closes the intake valve. When the piston starts on the up-stroke, this is called the compression phase. The piston compresses the fuel/air mixture, and just before the piston reaches top dead center, the ignition sparks and starts burning the fuel/air mixture.

The next phase is called the power stroke, as the burning mixture gases expand and push the piston down the cylinder. When the piston reaches bottom dead center, the cam opens the exhaust valve, and the up-stroke of the piston pushes the burnt gases out of the cylinder, down the exhaust port, and into the exhaust pipe. Four-stroke engines produce more average cylinder pressure at higher temperatures than two-stroke engines, that's why they make better low-end torque.

Four-stroke engines are very reliable, but when they finally break down, there are so many engine components that problems can be hard to diagnose. A four-stroke engine has more moving parts than a two-stroke engine, especially in the top end. Components like the valves, guides, pistons, and rings wear at different rates based on service intervals and riding use. For example, if you run the engine with a dirty air filter, the piston and rings will wear faster than the valves. Conversely, if the valve-to-tappet clearance is too tight and the valves hang slightly open from the valve seats, the valves are subject to overheating from the high combustion temperature and pressure. So how are you supposed to diagnose top-end engine components without totally disassembling the engine? A simple diagnostic test—the leakdown test—can be performed on any four-stroke



Pro Circuit made this cutaway of a KXF250 engine. The camshafts and valves regulate the flow of fuel/air mixture during the four engine phases of intake, compression, power, and exhaust.

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