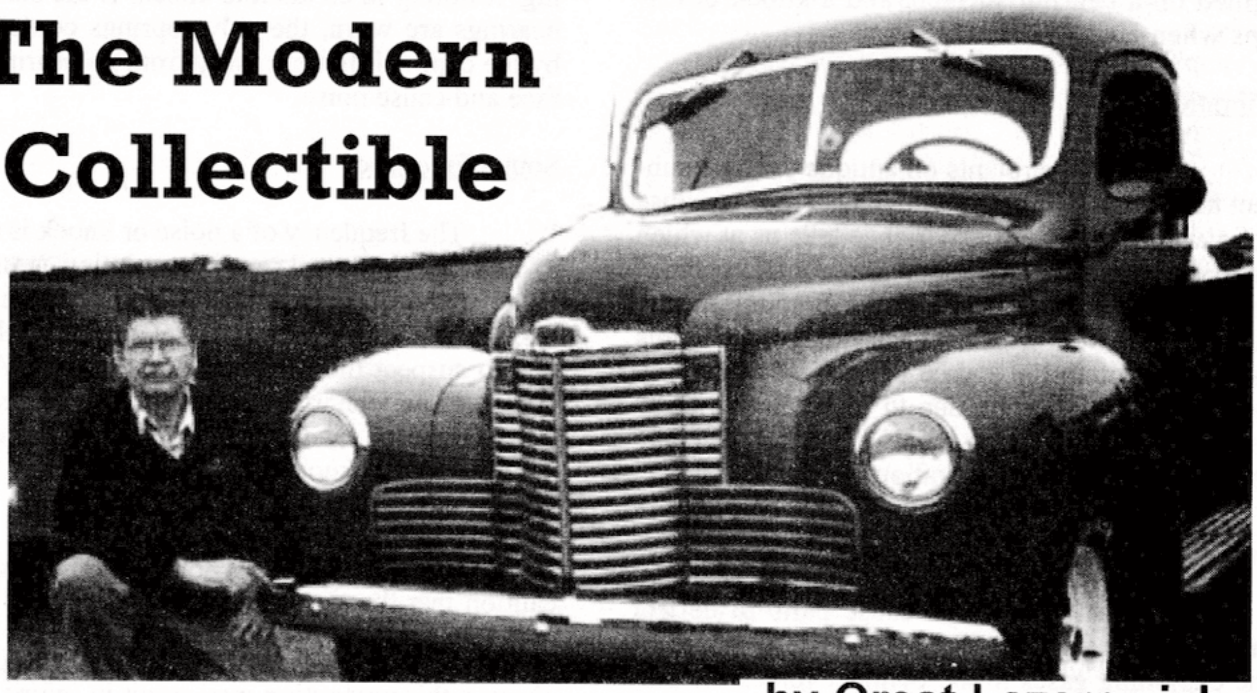
The Modern Collectible



by Orest Lazarowich

A DETAILED TECHNICAL COLUMN INTENDED TO TARGET MANY MAKES AND MODELS OF POST-WAR CARS AND PICK-UP TRUCKS

Pistons and Rings Part III

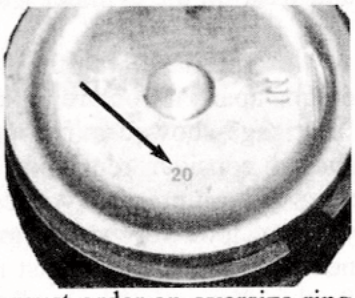
Let's see what we have left to do. The head(s) were removed because the compression test indicated low compression. This could be caused by burned valves, worn cylinders, pistons and rings. Further testing proved up worn or 'cooked' rings. The oil pan was removed, and the bearing clearances were checked. The pistons/rings were pushed out of the block after the piston ring ridge was cut away. If the test would have proved up valve leakage, you would not remove the oil pan. You would only remove the head(s). Valve leakage can be caused by carbon buildup on the valve or valve seat, a burned valve or valve seat or loose valve guides causing the valve to seat unevenly. If there is no leakage past the valves, the head(s) could be put back on after the pistons/rings are serviced.

However, there might be oil leakage caused by loose valve guides and/or worn valve seals that will draw oil into the combustion chamber. You might have noticed a puff of blue smoke during acceleration which indicates that the valve guides and/or valve seals are worn. With the head(s) off (and if this engine is of the OHV style) you could replace the worn valve seals, if the valve guide wear is not excessive. When the wear is excessive, the valve guides, if removable, may be replaced. When the guides are part of the head or block they may be reamed oversize and new valves with oversize stems installed. In the next article we will cover the servicing of valves and seats.

Inspect Cylinders

Borrow or rent a dial gauge or an inside micrometer to measure the cylinder. Write down each measurement. If the measurements are the same or not more than 0.009" larger, the cylinders are standard size. If the measurements are 0.010" to 0.019" larger, the engine has already been rebored to 0.010" to 0.020" oversize. If 0.020"-

0.029" larger, it has been rebored to 0.020" oversize, etc. Check the head of a piston for an oversize stamp (010, 020, etc). An engine can only be rebored to a certain size because the wall thickness needs to be wide enough to handle the stresses produced during running. Otherwise, it may crack the cylinder wall. If the pistons are oversize, you must order an oversize ring set. You can not use an oversize ring set in a standard size piston. Oversize pistons come with a matching oversize ring set.



Compare the measurements you have taken with the service manual standard measurements. The amount of taper and out-of-round wear will decide if a ring set will fix the oil burning problem. The engines that we are working on allow a greater amount of taper and out-of-round than the newer engines. Taper wear can just about reach the first piston oversize which is 0.010". The out-of-round measurement should not be greater than 0.005" or the engine will have to be rebored to the first piston oversize. The engine that we are discussing has combustion leakage into the crankcase (blow-by) because the rings were 'cooked' due to overheating or the rings are worn. The cylinder walls are not scored and a taper of up to a maximum of 0.010" is allowable.

Checking Connecting Rods

Clean the connecting rod with the rod cap in place. Check for a diagonal wear pattern on the right side of the piston skirt that extends to the bottom. This is a sign of a twisted (bent) connecting rod. A shiny surface on the edge of the piston pin boss can also be a sign of a twisted connecting rod. Have this connecting rod and any others checked at a machine shop. The piston can stay on the connecting rod. The bend can be removed by cold bending in a machine called a rod aligner. Do not confuse a bent connecting rod with an offset connecting rod. Some rods are offset to provide correct alignment between cylinders and crankshaft journal. Check the connecting rod for any signs of discoloration, nicks or burrs that could weaken the connecting rod and lead to possible breakage. Inspect the surface finish of the big end. It must be smooth and free of scoring or nicks. Check that the spit holes, where used, are open. Clamp the connecting rod in a vise with soft jaws. Try to rock the piston on the piston pin. There should not be any movement between the piston pin and the piston or the piston pin and the connecting rod bushing. If there is, the engine will have a 'piston pin' knock when running. If there is excessive clearance coupled with maximum cylinder wall taper, your ring replacement is bordering on a complete rebuild.

Cleaning Pistons

Do a visual check of the piston skirts. If they are black or brown in color, this is evidence of blow-by. Look for any signs of corrosion on the piston skirt caused by a coolant leak because of a cracked head or cylinder, warped head or damaged head gasket. Check for scuffing or scoring. This is caused by metal-to-metal contact. Excessive heat transfers metal particles from one surface to another. The excessive heat could be caused by something as simple as a low coolant level or a plugged radiator. Check the piston for any signs of cracking especially around the piston pin bosses and the piston skirt. If a visual check indicates any of the problems noted above, the pistons cannot be reused.

Check the pistons and the piston ring grooves next. Carefully remove the rings using a piston ring expander or your fingers, and set the rings aside. Do not discard them. Soak the pistons in a carbon removing solvent or carburetor cleaner to soften the carbon. Rinse and blow dry. Wire buff or scrape the top of the piston, but do not buff the piston skirt. A fine-grade Scotchbrite pad can be used to clean the carbon on the skirt. Soak the pistons again, if the carbon is difficult to remove. Examine the ring grooves for signs of carbon build-up. If this has been an oil burner, you will find carbon build-up between and behind the top rings. This is caused by the combustion gases leaking behind the rings and baking the oil into carbon. Clean the ring grooves with a ring groove cleaner. Do not remove any metal from the side or

the bottom of the grooves. Using a broken ring sharpened to a point is not the best way to remove carbon deposits. It is difficult to keep the cleaning tool parallel to the ring grooves. Clean the oil return holes in the bottom of the oil control ring grooves with a twist drill of the same size as the original holes. Examine all the ring grooves for burrs and side wear. The top and bottom surfaces of every ring groove must be smooth so the ring can seal against it.

Use a broken ring sharpened to a point to clean carbon from the grooves.

The top compression ring groove wears the most. Groove width must not be tapered. It has to be parallel. The vertical clearance between the ring and the ring land can be checked with a new ring and should be between 0.002-0.004". More than this the ring will leak and less the ring will not move around in the groove. The ring must be free to move so it can push out against the cylinder wall to make an effective seal. Piston ring grooves can be reconditioned by cutting the groove wider and installing a steel spacer on the top edge. If the pistons in this engine need reconditioning, it is possible the engine needs a complete rebuild. A remanufactured engine with a warranty would be a good exchange for your old worn out engine. If the pistons can be reused, you can install a ring set and extend the mileage life of the engine.

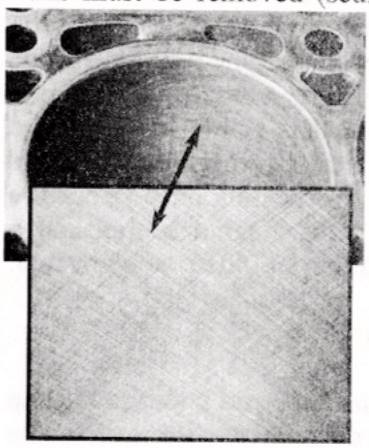
Piston Ring Types

The two basic ring types, compression and oil control, are available in many designs. Compression rings are usually of the torsional twist, taper face or a combination of the two. Oil rings can be of one or more piece construction using either a hump type or coil type expander. Rings for repair work are available in sets designed for either a rebored cylinder or a worn cylinder. Check with the piston ring supplier and tell him exactly what you are doing so you can purchase the correct ring set. The ring set for a worn cylinder is sometimes called an engineered or oil control set. It has stiffer expander springs to force the rings to follow the tapered walls. Because of its design it will produce more drag and wear on the cylinder walls.

You have both the top and bottom of this engine apart, if you are replacing the rings. If the Plastigage showed maximum bearing wear, you should consider replacing the bearings at this time. The oil pressure will certainly improve, and you can look forward to more miles before the next overhaul. At the least replace the oil pump. Replace the main bearings and rear seal after you deglaze the engine block. Buy the parts in kits if you can because it is cheaper. This is an in-chassis repair so the camshaft and bearings are not being replaced. The timing chain and front crankshaft seal are also not being replaced at this time. If the engine uses hydraulic lifters and they are noisy, replace them.

Preparing Cylinder Walls

The shiny, glazed surface of the cylinder walls must be removed (scuffed to a cross-hatch pattern) before new rings are installed. This allows the new rings to seat against the cylinder wall, and provide a tight seal by holding the oil in the cross-hatch pattern. and providing lubrication for the rings. The cross-hatch pattern should be about 45 degrees to each other and the same throughout the length of the cylinder and not flatten out at either end. Machine shops use a rigid type hone when cylinder wear has reached maximum taper and out-of-round condition. With minor taper and out-of-roundness you should be able to use a spring loaded hone or a Flex-Hone which is a flexible honing tool. If your club is one that shares tools, see what is available for deglazing cylinders.



If there is a club member who has deglazed cylinders, see if he would be willing to

help you. You should be installing a cast iron ring set for this rebuild. Follow the ring manufacturer's recommendation regarding the grit size of the stones. A 180 or 240 grit is suitable for the condition of these cylinders. Cover the crankshaft with rags. Use a multi-speed drill, and fasten a flexible hone into the chuck. Tighten the chuck securely. Oil the cylinder wall with 10-30W engine oil. Insert the hone into the cylinder, and start the hone spinning. Move the hone up and down in the cylinder bore at 600-800 rpms rapidly enough to produce a 45 degree cross hatch in the bore. You have to move your arms about as fast as you can. While honing have your helper squirt oil into the bore to help remove the cylinder material. After about 12 strokes wipe the bore clean, and inspect the cross hatch. If the hone pattern is visible over most of the ring travel area, stop honing. If not visible, repeat and check again. It takes some skill and experience to hone the desirable pattern on the bore. If the first cylinder that you deglaze does not have a 45 degree cross-hatch; increase the stroke rate and decrease the drill rpms. A pattern from 20 to 60 degrees will work. Continue and finish honing the rest of the cylinders. You will probably get the 45 degree cross hatch pattern right by the time you finish the last cylinder.

Cylinder Clean-up

Make sure the crankshaft is covered. Use a clean cloth soaked in warm soapy water, and scrub the bore up and down. Rinse the cloth regularly. After scrubbing take a clean lint free cloth with warm water and rinse down the bore. If you see any grey on the cloth, clean the bore again with warm soapy water. Repeat until you see no grey on the rinse cloth. Once the bore is perfectly clean, coat each cylinder with oil to prevent surface rust. Carefully remove the cloths covering the crankshaft. If the cylinders are not perfectly clean, the remaining cuttings will act as a grinding compound and quickly wear out the new ring set.

Cover the top of the engine.

Installing Rings

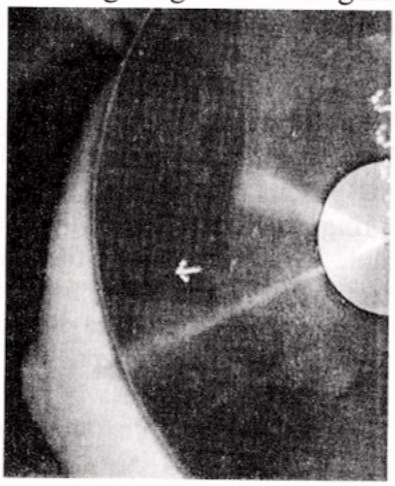
Read the manufacturer's instructions. Check the compression rings for end gap. Two measurements are necessary: one just below the upper limit of ring travel and the other within the lower limit of travel. Start the ring by hand, and then use a piston to push it down just below the upper limit of travel. This will square the ring with the bore. Measure the gap with a feeler gauge. Push the ring down to the bottom of the ring travel. Measure the gap with a feeler gauge. Compare the measurements to the manufacturer's specifications. Rings can be filed for proper gap. After ensuring proper gap clearance roll the rings around in their respective grooves to check for binding. Measure the side clearance with a feeler gauge. Clearance should not exceed 0.006" nor be less than 0.0015" for top rings. If the clearance is too small, the ring may bind or seize, allowing blow-by. If excessive, the ring may flutter and break itself or the piston land. Install the rings on the pistons starting with the bottom oil ring. Use a ring expander.. Spread the rings as little as possible to avoid breaking the rings. Follow manufacturer's instructions for rings that are not marked 'TOP.' Space the ring around the piston so they are not in alignment.

Installing Rod and Piston Assembly

Work in a safe clean environment. Clean your hands, and work with clean tools. Wear safety glasses. If you have a buddy who is helping either at the top or bottom end, make sure you both understand the procedures. If you are using the original bearings which you paired up and marked to the connecting rod, have them at hand. Clean the back of the shell with brake cleaner to remove any tape residue. Locate a ring compressor that will fit around the rings properly. Find a small plastic container, and pour enough engine oil into it so you can dip the top of the piston in it. Hold the number 1 connecting rod in a vise, and slide a clean ring compressor down over the rings until the lower tightening band is below the lower ring. The wide section of the ring compressor goes away from the piston. Tighten the ring compressor. Make sure the rings are fully compressed by tapping the outside of the compressor and then retightening. Wipe the connecting rod bearing surface clean. Snap in the upper rod bearing insert and lubricate. Keep your finger prints off the insert. Install a short piece of clear plastic hose

over the connecting rod bolts to protect the crankshaft journal. Turn the crankshaft so the journal is at bottom dead center for cylinder number 1.

In-line engines number cylinders starting at the front with number 1. Ford V8s number 1-2-3-4 on right side and 5-6-7-8 on the other facing front. Chevy and Chrysler V8s number 2-4-6-8 right side and 1-3-5-7 left side all facing toward the front. Check the service manual. Slide the exposed piston skirt into the correct cylinder keeping the connecting rod aligned with the journal and the compressor tight against the engine block. Make certain the piston identification marks face toward the front of the engine and the connecting rod numbers face the camshaft. Using a hammer handle, tap the piston through the compressor and into the cylinder. If the piston catches on the way in, a ring may be hung up. STOP! Do not force the piston in or you will break a ring. It is nearly impossible to buy one new ring. You might have to use one of the least worn old rings. Remove the piston and reinstall the compressor.



Be sure piston is installed with arrow (or other directional indicator) pointing to front of engine.

If your buddy is helping at the bottom end, keep tapping the piston downward, and have him guide the connecting rod around the journal. If not, slip under and pull the connecting rod down to the crankshaft journal. Remove the journal protectors. Wipe the bearing cap clean. Snap the correct insert into the bearing cap. Lubricate the insert, and install the cap so that the numbers line up. If you wish, you may use thread-locking compound. Snug up the bolts or nuts. If this is a single connecting rod on the journal, turn the crankshaft a couple of turns to allow the rod to center before final torquing. If two connecting rods operate on the same journal, install both rods, then turn the crankshaft a couple of turns before final torquing. Check the service manual for specifications as they vary depending on bolt size. After torquing check the side clearance on twin rods (0.004"-0.010"). The crankshaft must rotate without binding or excessive drag. As you connect the other connecting rods it will become harder to turn the crankshaft, but it must not bind. If it does, remove the last bearing cap you installed, and look for the cause.

If you wish, you may use a thread-locking compound like Permatex Threadlocker.

Recheck the torque on all the main bearing bolts and the connecting rod bolts/nuts. Clean the block rails and oil pan edges with brake cleaner. Clean the oil pickup tube/pump screen, and install it on the pump or the block. Replace the oil pump and torque and/or wire the bolt(s) in place. Read and follow the oil pan gasket installation tips. If the rear and/or front seal is cork, soak it in water to make it more pliable around the rear main bearing cap or the oil pan. Working overhead is a pain so make up two aligning bolts or two lengths of threaded rod with screwdriver slots cut in the ends for easy removal. Screw one into the middle of each block rail. Apply an oil resistant adhesive to the block rails and oil pan edges. Depending on the style of gasket place it on the oil pan or block rails. Fit the end gaskets to the pan or the or to the bearing caps. Have the pan bolts clean and at hand. Lift the pan to the block and into the aligning studs. Holding the pan with your knee or one hand fit some of the pan bolts in place. Take a break. Remove the aligning studs and fit in the other bolts. Tighten all the pan bolts snug and then to torque specifications. Work in a spiral outward to the rear and front bolts. Tighten the drain plug now. Recheck the torque. Connect any steering linkage that was disconnected when the oil pan was removed.

S.K.

NEXT MONTH

Valve and Valve Seat Service