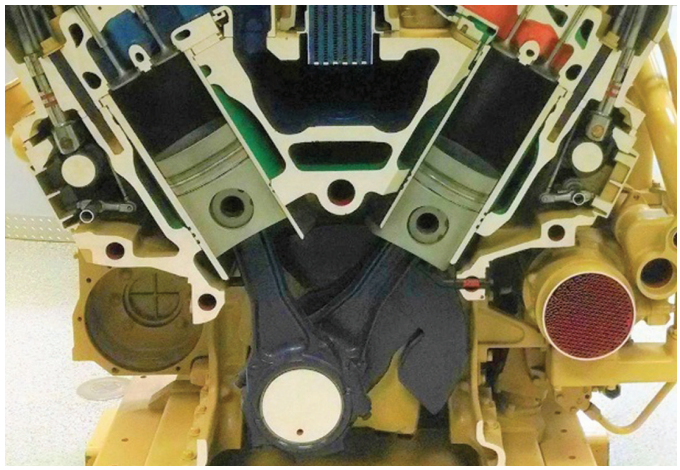
How to Break In a Rebuilt Engine

BY **STEVE SCOTT**

What process do you use, when there isn't a process for breaking in a rebuilt engine?

One process that is often missing from Original Engine Manufacturer's service publications is how to correctly break in a rebuilt engine, especially without the use of a dynamometer or load bank. Dynamometer or load bank testing are the preferred methods, but realistically it is not always an option. Regardless, breaking in the engine is critical. If this is not done correctly or completely, then the engine will most likely perform poorly, smoke, and consume oil. Often these symptoms are irreversible over time. The term, "breaking in" an engine refers to the process where combustion temperatures and operating conditions force the rings and cylinder bores to conform to each other sealing the combustion gasses within the cylinders. Idling will not produce the temperatures and forces needed.

Piston rings are designed to apply a certain amount of tangential force outward by themselves, but compression rings rely on greater combustion pressures to force them down against the bottom of the piston ring lands and outward to the cylinder wall. Without this combustion force, these rings may not seat or seal properly.



Oil control rings regulate the amount of oil film left on the cylinder wall to lubricate the compression (top and intermediate) rings, and each compression ring removes some amount of this oil film resulting in proper oil control. It is important that an adequate load be put on the engine to create enough combustion pressure and temperatures to seat the rings. This is most critical within the first few hours of the engine's new service life. Idling, increasing the RPM, and hauling light loads may not create

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enough combustion pressure or heat to seat new rings. Under load, you can obtain the pressure and temperatures needed.

Idle time and low load on a freshly rebuilt engine can result in "glazing" of the cylinder walls and prevent the rings from ever sealing correctly. "Glazing" is a condition where hard oil and fuel deposit buildup on the cylinder walls and prevent the rings from sealing properly. Once glazing forms, it can be difficult, if not impossible to remove without disassembling the engine.
The "old-timers" reading this are already thinking — "Bon Ami it."Bon Ami® household cleaner was available at their local grocery or hardware stores and was their substitute for Caterpillar's 7F5225 "Break-in Powder" (other manufacturers possibly offered something similar). Caterpillar's serviceman's reference guides gave the instructions for using their 7F5225 powder.

That's not to say that these miracle powders didn't have major side effects. Intentionally introducing abrasives into an engine sounds like fingernails on a chalkboard, as well as outdated. With the tighter tolerances, precise surface finishes, and coatings you can only imagine the amount of damage this can do to today's engines. There is no piston ring manufacturer who would ever suggest using such products for any of the current modern-day engines!

Once an engine is up to temperature and there are no leaks, rebuilders tend to have their own methods for break-in.

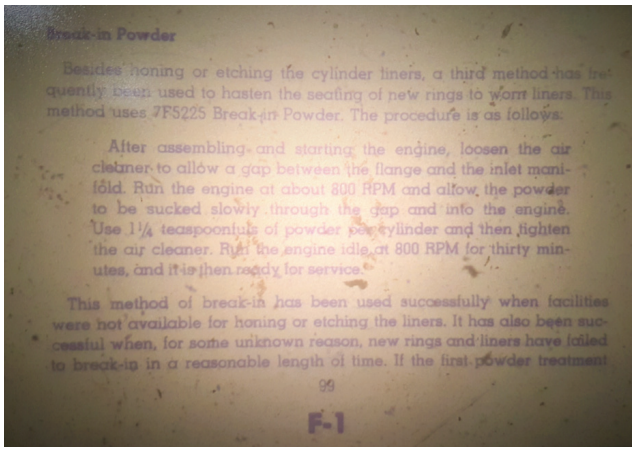
These can range from:

- "drive it like you stole it"
- "run up to the speed limit as fast as possible, and then while still in gear, let off the throttle and let it coast to the stop—repeat as often as needed"
- "use the heaviest trailer and steepest hill you can find and drive up it."

These individuals can be secretive about the processes they've worked out from years of experience, but what they have in common is they focus on getting approximately 75% of full load on the engine for three to four hours and keeping idle time to a minimum produces the results they are looking for to seat the rings.

Outside of the operational processes, there are several break-in oils and additives on the market. These need to be considered with some degree of caution since many can only remain in the engine for a set number of hours, and most original engine manufacturers do not approve them. However, much like the individual break-in processes, some rebuilders use them faithfully, and others don't like them at all.

The focus of this article is not to say every engine must be dyno tested, or that one process or fluid is better than the other. The purpose is to bring attention to a critical part of the entire rebuild process. Consult with your rebuilder, or original engine manufacturers publications (if available) about their recommended break-in procedures and service intervals. The first oil samples on freshly rebuilt engines tend to be high in metals, so they may recommend the oil be changed after a shorter number of hours or miles. What happens to a freshly rebuilt engine after it is picked up at the shop or driven off the lot can determine how satisfied you are with the service life of the engine.■



Break-in Powder

Besides honing or etching the cylinder liners, a third method has frequently been used to hasten the seating of new rings to worn liners. This method uses 7F5225 Break-in Powder. The procedure is as follows:

After assembling and starting the engine, loosen the air cleaner to allow a gap between the flange and the inlet manifold. Run the engine at about 800 RPM and allow the powder to be sucked slowly through the gap and into the engine. Use 1¼ teaspoonfuls of powder per cylinder and then tighten the air cleaner. Run the engine idle at 800 RPM for thirty minutes, and it is then ready for service.

This method of break-in has been used successfully when facilities were not available for honing or etching the liners. It has also been successful when, for some unknown reason, new rings and liners have failed to break-in in a reasonable length of time. If the first powder treatment

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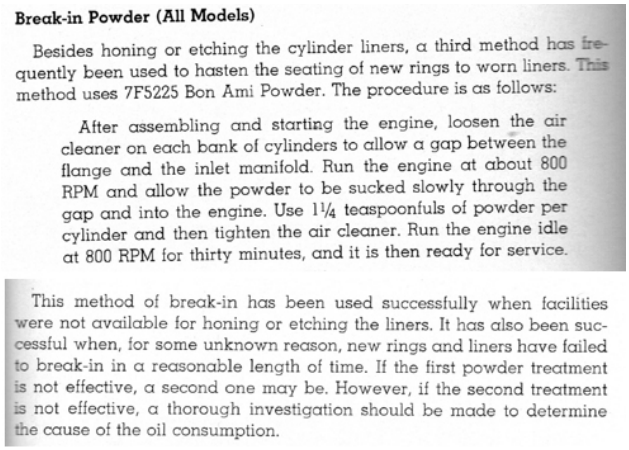
Photo of a Cat D318 reference from December 1978 microfiche.



Break-in Powder (All Models)

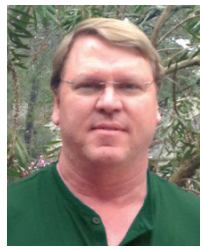
Besides honing or etching the cylinder liners, a third method has frequently been used to hasten the seating of new rings to worn liners. This method uses 7F5225 Bon Ami Powder. The procedure is as follows:

After assembling and starting the engine, loosen the air cleaner on each bank of cylinders to allow a gap between the flange and the inlet manifold. Run the engine at about 800 RPM and allow the powder to be sucked slowly through the gap and into the engine. Use 1¼ teaspoonfuls of powder per cylinder and then tighten the air cleaner. Run the engine idle at 800 RPM for thirty minutes, and it is then ready for service.

This method of break-in has been used successfully when facilities were not available for honing or etching the liners. It has also been successful when, for some unknown reason, new rings and liners have failed to break-in in a reasonable length of time. If the first powder treatment is not effective, a second one may be. However, if the second treatment is not effective, a thorough investigation should be made to determine the cause of the oil consumption.

Scanned from a Cat D8800 serviceman's reference book (mid-'70s).

Failed Cam Bearing From Dry Start-Up



Steve Scott joined the service department at IPD in 1982, working with parts, service and sales for a variety of equipment, diesel, and natural gas engines. Since 2004, he has been the director of product development and technical support for IPD. For more information, email sscott@ipdparts.com.

Recommendations from Cummins and AERA

Very few original engine manufacturers publications detail the process for breaking in an engine outside of the controlled environment of a dynamometer.

The Cummins Bulletin #014-004 for On-Highway Engines states: “Operate the vehicle pulling the heaviest available trailer allowed for the first 80 to 160 Km [50 to 100mi] after rebuild. Operate the vehicle in the highest gear possible within the normal operating rpm range of the engine. It will be necessary to operate the engine at or near full throttle at 75-85% of maximum horsepower rpm indicated on the dataplate. Do not idle the engine for more than five minutes at any one time during the first 160 Km [100 mi] of operation.”

For Off-Highway Engines, this bulletin states: “Operate the engine under the highest load possible at full throttle within the normal operating rpm range of the engine for the first three hours of operation after rebuild. Do not idle the engine for more than five minutes at any one time during the first three hours of operation after a rebuild.”

Another caution expressed by Cummins for their ISX DOHC engines concerns their storage time since last started, or first start, read on:

- The AERA Technical Committee offers the following information on engine damage after engine assembly or storage on 1997-2017 Cummins 15.0L ISX engines.
- There have been numerous reports of engine damage such as cam bearing failures on these engines. After engine assembly, if the engine oiling system is not charged (primed) immediately before starting engine damage may result. Due to the extensive length and volume of this oiling system, it could take several minutes for all the cavities, filters, coolers and galleries to become filled after the engine first starts. It is important to realize that is ample time for unlubricated components to initialize potential engine damage.
- Cummins provides the following information on pressurizing the oil system on these engines before startup after engine assembly has occurred.
- CAUTION: The lubricating oil system must be primed before operating the engine after any internal engine repairs or extended engine storage (beyond 6 months) to avoid internal component damage.
- Remove the oil plug from the lubricating oil cooler housing and install fitting and hose.
- Use the coupler, Part Number 3376859, to connect the priming pump to the coupling.
- Connect the priming pump oil supply hose to the lubricating oil pump coupling. Use clean 15W-40 lubricating oil from a drum or a container to supply oil to the lubricating oil pump and engine.
- Turn the priming pump on.

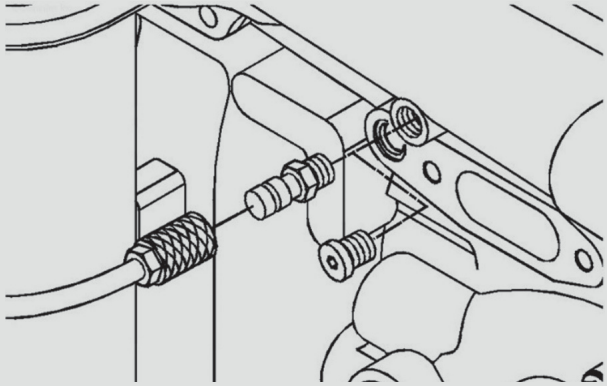


Figure 1. Oil Plug and #3376859 Connector Location

- Allow the oil to flow until the oil pressure gauge indicates a maximum pressure of 10-20 Psi (69-138 kPa) at the main oil rifle.
- Turn the priming pump off. Remove the priming pump oil supply hose and fitting. Install the oil cooler housing plug and torque to 25 FT/LB (34 Nm).
- The engine oil level may need adjustment (add/remove oil) and then the engine is ready to start.

One may not always remember or realize the volume of oil this engine pumps to adequately lubricate critical engine components. That volume may be one only one reason the oil pan capacity is 12 gallons (45.420 liters).■