

## THE LOST ART OF REAR MAIN SEAL REPAIR



Words and Photography by Ray Bohacz

### If you spend any time around

muscle cars, you know that a good majority of them suffer from a leaking or dripping rear main crankshaft seal. This is especially irritating because it will not only leave a mark on the ground when the car is parked, but will also spray oil over the entire undercarriage as the wind blows it back during driving.

The result is a surface that attracts dust and dirt; plus, the oil degrades rubber components such as chassis bushings. In addition, the oil usually migrates onto the exhaust system and creates an odor emanating from the hot pipes. To me, nothing about a car is more embarrassing than a leaky rear main seal. Unfortunately, when it comes to sealing an engine for leaks, the rear of the crankshaft is not only the hardest part to keep dry, but also involves the most work. It also often produces disappointing results. That became the impetus for this installment of the Lost Art series.

### Seal types

There are three types of rear main crankshaft seals in use today; each offers its own features and benefits, along with concerns. The seal types are: Rope or wick, neoprene or split, one-piece.

Most older American engines originally used the rope or wick-style seal. To the best of my knowledge, the neoprene, or split, seal was first used by Chevrolet on its V-8 engines for the 1959 model year. The other General Motors divisions, along with their competitors, stayed with the rope seal for most applications.

On occasion, the factory would fit a rope seal, but the service replacement part would be a split seal; this was a manufacturer-specific decision (Chrysler, for instance, did this from time to time). Often, this replacement switch-out was done to limit warranty costs.

When these engines were new, it seemed that the rear main seal would either start to leak shortly after taking delivery of the car or would last for the entire service life of the vehicle. The restoration market is not that fortunate when it comes to success with the rear main oil control.

### Rope/wick seal

This seal got its name from its appearance; it resembles a piece of rope or an oil lamp wick. But the rope seal is far from a simple piece of cord. The material was engineered to withstand the high RPM of the crankshaft while rubbing against it during extreme temperature swings. The seal must not shrink excessively when cold, but cannot expand too much when heated, lest it wear out prematurely from friction.

As is common with most seals of any design that ride on a moving part, a small amount of the system fluid (in this case, motor oil) is required to keep the seal from operating dry. In addition, the oil is used as a swelling agent to expand the seal so that it fits tightly into the rear main cap/block and rides snugly against the crankshaft.

There are many different opinions on why today's rope seals are not as effective at controlling oil as they seemed to be years ago. The general consensus is that two main factors are impacting seal performance: the environmental laws that limit the use of asbestos and other materials used in the original seals, and the efforts of manufacturers to limit part numbers by manipulating the dimensions of the seal to fit as many applications as possible. The market for rope seals has greatly diminished, so compromises are often made in order to offer a cost-effective product.

For this reason, you should always stick with a name-brand parts supplier and not someone that is buying rope seal on a roll from an industrial supplier and cutting it to length so it can be marketed as an application-specific wick seal. The wick seal is very sensitive to the amount of contact area on the crankshaft, along with the speed of the engine. For instance, a certain material may only be rated to a given speed, such as 4,500 RPM. Beyond that speed, the seal will deteriorate and start to leak. Therefore, a seal designed for your engine is the only one you should use.

The proper procedure for installing a rope seal involves having the crankshaft removed, or at least dropped slightly by loosening the main caps.

## Neoprene/split seal

Made from a rubber-like material, this is a two-piece, lip-style seal that rides up against the crankshaft. Its design is similar to a front timing cover seal or a grease seal in the rear of a brake drum or rotor. The difference is that the split seal does not use any metal retainer and is installed separately in the main cap and block, similarly to a rope seal.

When looking at a two-piece seal, you'll see a lip on one side. The lip must face the inside of the engine to prevent the oil from leaking. If the seal is installed backwards, it will leak immediately on engine startup.

Neoprene seals are very effective at sealing oil, but seem to be just as sensitive to leakage as the wick design. Their main advantage is that they're easier to install when the crankshaft is still in the block, especially if the engine is in the car.

It is important to note that though these are commonly called

neoprene seals, not all are made from neoprene material. For example, Fel-Pro produces split rear main seals in a variety of materials for specific uses and applications. Thus, it is important to research your particular needs and purchase a seal made from the proper material.

## One-piece

The one-piece is a split-style seal that is completely round and is installed much like a timing cover seal. Engine manufacturers had to produce specific crankshafts and engine blocks to accommodate the one-piece design; they can't be used on just any crankshaft. Retrofit kits are offered for some engine blocks, but even these still require a one-piece-style crankshaft. Thus, you cannot upgrade an older rope-seal engine to a one-piece rear main seal without changing the crankshaft.

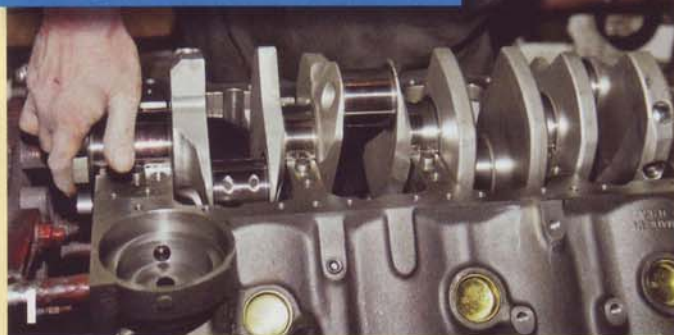
This style of seal has proven the most effective; it's largely trouble- and leak-free. Its pitfall is that when it does need to be serviced, either the engine or transmission has to be removed.

## Why does it leak?

If the engine in your car is very old and the seal is leaking, it is most likely the result of age and use. In this case, installing a new rear main seal of any design should end the problem. But if a rear main seal leak appears when the engine has been recently rebuilt or is fresh, you'll have to track down the cause. If quality parts were used, do not assume the seal is defective. The problem is most likely either the installation or the engine itself.

Persistent rear main leaks are usually the result of worn, pitted or degraded parts; the usual culprits are the main caps or

### Neoprene/split seal



Though you may not want to hear it, the best way to install a rear main seal is with the crankshaft removed. Still, an in-car installation is often possible if you follow good mechanical procedure.



Make sure the areas where the seal will sit in the block and rear main cap are clean and free of corrosion and burrs.



With a split seal, Larry Lempicki of Pro-Motion Engines likes to coat the area outside of where the seal sits (not the recess where it nests) with sealant. He uses Permatex Aviation Form-A-Gasket.



Carefully press the split seal into the part (either cap or block) with the lip facing the inside of the engine.

crankshaft. If the crankshaft has any burrs on it, the seal will have a very short life. If the block has experienced many rebuilds and the main caps have been machined excessively, it is very possible that the seal groove in the cap and the block are not aligned correctly. When main caps are cut, the block is aligned or align-bored, which will make each crank journal true to size and in line with the others. The procedure does not impact the relationship of the seal groove, though. The result can be a properly clearanced crankshaft that is actually sitting away from the rear main seal on one side. If this occurs, the engine will leak for sure.

Other concerns are all related to the parts used. Many are 40 or 50 years old and may have been mismatched over the years. When restoring a muscle car, you're often happy just to find the crankshaft or block that you want, even though the production years may be different. With some brands of engine, this makes little difference, but often a car company will make unpublished changes to a block or crankshaft. During a cursory inspection, the part looks the same, but the rear main seal part number may be different. The seal may be slightly wider, longer or wider. If you are fortunate enough to spot this issue, you may end up using a bottom seal from one year and a top seal from another to get a leak-free fit. If you've already changed the rear main seal once and it still leaks, you will need to figure out what is really going on in your engine.

There are other things that can cause a rear main seal to fail, even if the seal is not faulty. If the engine has no way to breathe through either the valve covers or the PCV, then the crankcase will become pressurized and push oil past the rear seal. In some

forced-induction engines such as the Buick turbo V-6, the oil pan is very small. When the piston rings wear, the cylinder pressure leaks past the rings and into the oil pan during boosted operation. Due to the small capacity design of the sump, the dipstick is usually blown out of its tube and the rear main begins leaking.

If there are no ventilation issues with the crankcase and the rear main has trouble sealing, you'll need to do an in-depth study of the area. Remove and disassemble the engine. Accurately measure the part of the crankshaft that rides on the seal. Torque the main cap in place with the seal installed, and check it for fit against the block.

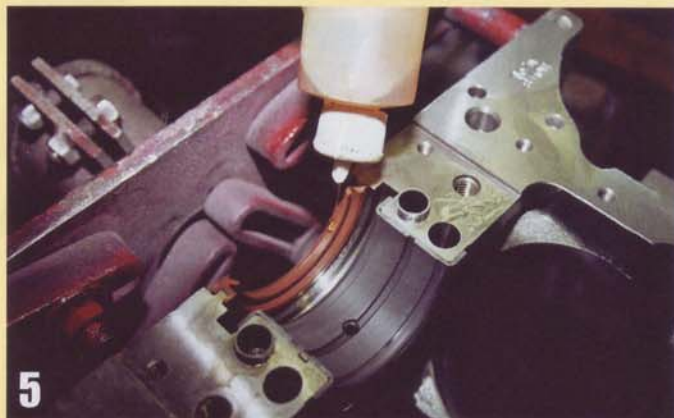
There is no great science to controlling the oil at the rear of the block. Any excessive clearance or misalignment will allow the hot oil (which is very thin) to escape.

## What can be done?

When faced with a rear main seal leak, you'll need to make some choices. Analyzing the leak itself, along with the situation, is important. In many applications, the engine will have to come out of the car. You may also have to remove the crankshaft, especially with a rope-seal application.

To properly install the rope into the cavity in the block and the cap, roll it into place with a pipe or large dowel. Though tools (such as Chinese fingers) exist to try and pull the seal around, the results are often only marginal. If you don't want to remove the engine and crankshaft, you will have much better luck with a split seal (if one is offered for your application).

Sometimes, it's not necessary to replace the seal in order to stop a leak. There are products on the market that will temporari-

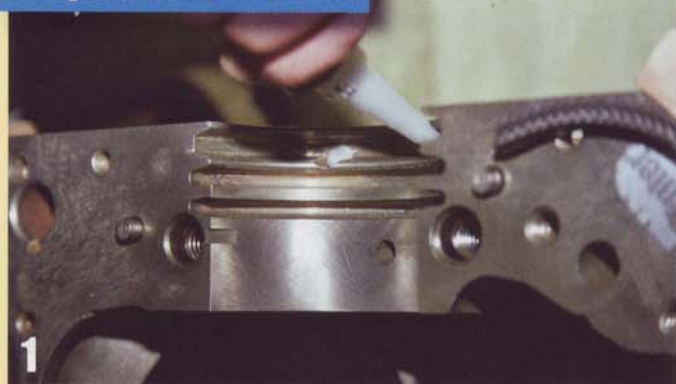


**5** With the seal firmly in place, coat it with either motor oil or an assembly lubricant. If you start the engine with the seal dry, it will burn up almost immediately.



**6** Follow the same procedure for installing the seal in the cap. Larry likes to place some sealant on the block where the cap meets the seal.

## Rope/wick seal



**1** Mark Erney at Jim Taylor Engine Service chooses to use a small amount of silicone sealant in the anti-rotation holes to close them off.



**2** He then distributes the silicone evenly around the receiver groove for the rear main seal.

ly swell the seal and either eliminate or slow the leak sufficiently to make it acceptable for limited use. Motor oil that is labeled for "high mileage engines" traditionally has a higher level of swelling agent; using this may be a good first step before adding a "stop-leak product" to the crankcase. Keep in mind, though, that this is not a repair—it's a stop-gap measure. It can be acceptable for a car that is only driven a few miles each year.

Another approach is to use a leak repair kit—if you can still find one. The kit uses a pushrod to drive a pointed steel spacer pin between the upper rear main seal and the block. This procedure tightens the old seal and may stop the oil leak. Again, this is a good alternative to removing the engine for a limited-use vehicle.

If you decide to replace the rear main seal, you have a few decisions to make—mostly regarding what type of seal to use. In general, engine builders believe that if a split seal is offered for your engine, it's best to use that instead of a rope/wick seal. The most important part of the installation is to read the manufacturer's instructions carefully and follow all steps. For example, silicone sealant may be required on the sides of the cap; some engines use side pins that are no longer necessary, and so on. Do not assume

the seal installation is a direct drop-in with no special procedures.

If a wick seal is the only one offered, there is no reason to be afraid of it—just recognize that you may need to remove the engine and crankshaft to install it properly.

Of special interest here is a company from California called Best Gasket that specializes in rear main seals and head gaskets for vintage American cars. Best Gasket offers a wick-style rear main seal made from a trademarked material called Graph-Tite. Offered as a complete kit, it includes a spacer, the proper amount of material to protrude above the cap and block, a razor knife and a cutting shield. The GraphTite material cuts very cleanly and does an excellent job of sealing up problematic rear main leaks on rope-style crankshafts.

To photograph the proper procedures for installing a rear main seal, we visited with Larry Lempicki of Pro-Motion Engines in East Hanover, New Jersey. There we installed a Fel-Pro split seal in a big-block Chevy engine. For the rope seal procedures, we went to Jim Taylor Engine Service in Phillipsburg, New Jersey. Our subject engine was a 400 Pontiac, which was treated to a Best Gasket GraphTite seal. 🛠️



The Best Gasket GraphTite wick seal is then pressed into place.



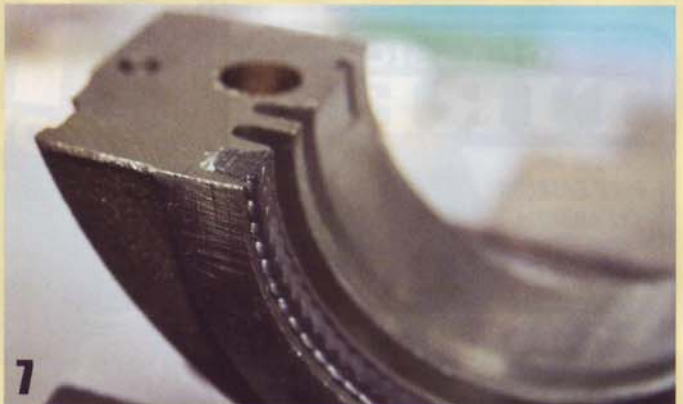
The wick seals are longer than required and need to be trimmed. Note the small amount of silicone protruding from only one side of the seal.



Rolling the seal into the groove using a dowel is the most important step of the installation. This cannot be done with the crank in the engine. When rolling the seal in with the engine in the car, some installers like to tighten the cap with both seals in place and then turn the engine over by hand. Afterwards, remove the cap to check the fit of the seal.



Best Gasket recommends that the GraphTite material should protrude 0.015 inch above the surface. The company provides a spacer, razor knife and finger shield to easily accomplish this.



A properly installed wick seal will fit in all areas and work effectively to seal the crankshaft from oil leaks. 🛠️

### Sources:

**Pro-Motion Engines, LLC**  
2 Great Meadow Lane  
East Hanover, New Jersey 07936  
973-884-5936

**Jim Taylor Engine Service**  
120 South 5th Street  
Phillipsburg, New Jersey 08865  
908-213-3456

**Best Gasket**  
888-333-2378  
www.bestgasket.com

**Fel-Pro**  
248-354-7700  
www.fel-progaskets.com