FORK SEAL LEAKS

Preventing One of Motorcycling's Most Common Maladies

by Fred Rau

In letters and e-mails, and during seminar sessions, one of the most common problems we hear about from our readers are leaking front fork seals on their bikes. It seems, though this condition has become much less prevalent than it was, say, 10 years ago, that it still causes a lot of headaches and expense for motorcycle owners—especially those that own older machines.

I wrote a "How-To" article nearly 10 years ago on the subject (RR/MCN, June 1992), and we decided perhaps it was time to rerun that piece, with a few updates. —FR

IT SEEMS TO me that the most common mechanical affliction to eat away at motorcyclists' wallets (aside from dead batteries) is the dreaded fork seal disease. If you don't believe it, just walk around the parking lot at any gathering of 50 or more bikes and I'll bet you can find at least two or three with leaking front fork seals.

Besides being about as common as dirt, fork seal leaks are relatively expensive to repair, messy to clean up after, and potentially dangerous to both you and your machine. And, unfortunately, seals of any kind are considered by most bike manufacturers to be "normal wear items," meaning they are rarely, if ever, covered under your bike's warranty terms.

For those reasons we decided to do a little research to help us all understand how fork seals work, why they fail and, most importantly, what can be done to lengthen their service life.

How They Work

There are numerous types and styles of sealing arrangements on different motorcycle front suspensions, but most commonly all are made up of five basic parts or elements: A dust seal, a stopper ring, an oil seal, a backup ring and a slider bushing. Each performs a specific function, though in some bikes you may find two elements combined into one, performing double duty.

The dust seal is nothing more complicated than its name implies. It is the only part of the sealing system normally visible on the bike, and consists of simply a rubber or plastic "grommet" seated where the two halves of your shock assembly come together, sometimes covered by a chrome appearance cap. It is the only element of the system that can usually be removed from its seat with nothing more than your bare hands, and it serves to keep dirt and debris from reaching the actual oil seal. It does this both by covering the area where the two halves mate, and by acting as a sort of "wiper," cleaning the surface of the shock tube on its downward slide, just before it reaches the seal. (Note: For the purpose of this article, I am referring always to a standard front fork setup. Naturally, on a bike with "upside-down forks," some things would be reversed, such as the wiping action described here.)

Next in line, going from top to bottom, is the stopper ring. The stopper ring is usually a ring of steel spring wire or a large C-clip that fits into a machined groove in the shock housing below the dust seal. Its one and only purpose is to keep the seal below it from being forced upward and out of position by the force of the springs during shock compression.

Below the stopper ring will be the actual oil seal itself. The oil seal is usually made of steel, for strength, yet covered completely in rubber, for an oil-proof fit. The oil seal is generally pressed or "hammered" into its seat in the housing, using a specially-fit driver. The seal's purpose, obviously, is to keep the oil inside the fork, though an almost equally important purpose is to keep the dirt out.

Below the oil seal will usually be a backup ring, which looks like nothing more than a large washer—which is essentially what it is. The backup ring serves several purposes, most notably dissipating the upward forces against the seal, causing them to spread evenly over the sealing surface. It also protects the seal from the slider bushing inadvertently being driven too far up the tube and into the delicate rubber parts of the seal.

Last, but definitely not least, is the slider bushing. Those of you with an engineering or mechanical background will recognize the slider bushing as being a type of "tilted pad" bearing. The slider bushing (usually made of brass) creates a compression zone, wherein the oil can form a low-friction film between the shock tube and the housing. Think of it sort of like a piston ring.

All of these elements combine to form a combination seal/bushing area where the shock tube can slide freely in and out of the housing without losing the fork oil bath contained within the housing. This is crucial because the fork oil, besides providing lubrication for the springs, is the primary control for your rebound damping.

When the springs are compressed from a sudden shock, it is the resistance of the oil that causes them to re-extend in a relatively slow and controlled manner. Without the oil to "damp" their reactions, the springs would do what springs like to do best, which is bounce up and down several times. With-

out oil damping, each of your front forks becomes exactly like a child's pogo stick. Try to imagine controlling a bike with two pogo sticks as a front suspension!

Why They Fail

Once upon a time, one of my job responsibilities was overseeing the maintenance of literally thousands of pieces of "auxiliary equipment" in an eight-story electrical power generating plant. The machinery involved contained no less than 5000 seal-and-bushing arrangements virtually identical to those found in your bike's front forks. Yet despite constant, 24-hour a day use, the failure rate of these seals was less than one in a three-month period. The reason for this was very simple: They were operated in a controlled environment, where there was never any exposure to wind, rain, salt, dirt, dust or sand.

Obviously, the exact opposite is true of your front forks. Not only are they exposed to the elements, they are stuck right out in front of the bike, where we literally drive them at high speeds through every conceivable weather condition possible. Not to mention hammering them with road debris and bugs.

To ensure a proper seal, the shaft, or fork tube in this case, must maintain a perfectly smooth, clean, machined surface on those sections that pass through or come in contact with the seal and bushing. Even the smallest nick or scratch will, after rubbing against the seal's rubber edge several hundred times, abrade the sealing surface and create an opening for oil to leak through. Sand and rocks striking the fork tubes will inevitably create this condition, after which even replacing the seals becomes nothing more than a temporary fix.

Other culprits in damaging the tube surfaces are rust and/or corrosion caused by water and road salt. Along the coastlines of our country, many bikers' favorite thing is to ride alongside the ocean, but the salt spray that feels so good on their faces is tantamount to spraying battery acid on their fork tubes.

Sometimes, you don't even need to damage the fork surfaces to cause damage to the seals. Some of the most common causes of fork seal failure are bugs. More specifically, incredibly thin pieces of insect shells sticking to the fork tube and being carried down into the seal during the compression stroke. Most of these are small enough to get by the dust seal, and some are even thin enough to actually slide under the oil seal and get into the oil bath itself.

The worst of these are the amazingly hard and thin shells of certain beetles and grasshoppers, which are thinner than a human hair and sharper on the edges than a razor blade. These can stick to your fork tubes and, during the up-and-down motion of the tubes, actually slice tiny pieces out of your seals as they go by. The same thing can happen with very fine particles of sand, often carried by even light winds you can encounter when riding through desert areas.

The corrosion on this fork tube makes it a sure bet no oil seal will last for long. The simple act of regular cleaning could have saved this owner hundreds of dollars in needed repairs.

Finally, a significant contributor to fork seal failure that is often overlooked is air pressure. Front forks on many large bikes are air-adjustable, allowing the owner to add or subtract air pressure to vary the stiffness and ride height of his suspension. This air pressure creates an increased load on the seals, trying to force a separation between them and the walls of the tubes and housings. The force exerted against the seals increases dramatically when you hit a bump, compressing the area within the shock tube and thereby compressing the air even more. Very simply put, the higher the air pressure you run in your forks, the greater the risk of seal failure.

How To Make Them Last

While you can never totally avoid all the situations that can contribute to fork seal failure, there are a number of things you can do to reduce their effects and prolong the life of your seals.

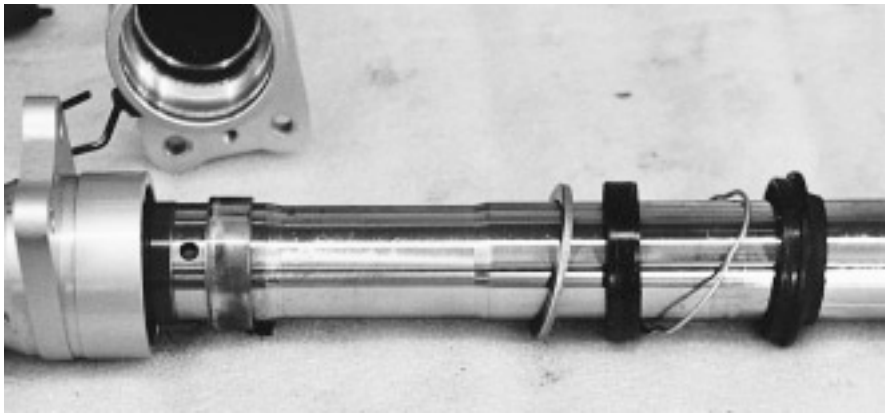
First, and by far the easiest of these, is to run the lowest air pressure possible that still gives you the support you need on bikes equipped with air-adjustable front forks. On most bikes with air-adjustable forks, replacing the OEM springs with stronger, progressive-type springs will eliminate the need to use any air pressure at all. This will give you the best of both worlds: A stronger front suspension, and less likelihood of fork seal failure.

The second, and perhaps most important, thing you can do for your fork seals can be expressed in three little words: Keep them clean! At the end of every ride, or even during rest stops along the road, take a rag and wipe down your fork tubes. The grit, grime and insect parts you remove may be so small you can't even see them, but you will undoubtedly be extending the life of your fork seals.

Another part of keeping your fork seals clean, and one which can also greatly reduce the risk of damaging the tubes themselves, is to thoroughly wash, or at least rinse off, the entire bike—especially the forks—after exposing it to sea air or salt water, or even road salt used for de-icing.

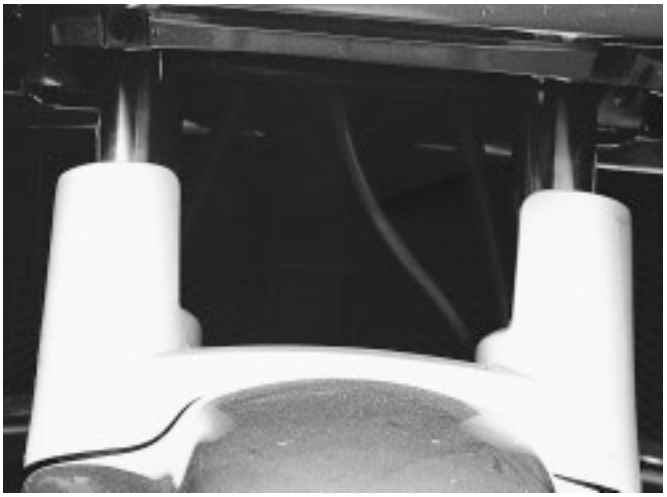
Be sure to regularly check your dust seals to see that they are not damaged in any way or loose in their seats. These are your first line of defense against foreign matter contacting and damaging your seals. Since most dust seal caps sell for around $5–$10, while a fork seal overhaul can run you up to $400, it's pretty cheap insurance.

But by far the most effective method of preventing both fork tube damage and the



From right to left: The dust cap, the stopper ring, the oil seal, the backup ring and, just before the housing, the brass slider bushing.

Owners of Gold Wing models (through 1987), among others, found that covering the exposed fork tubes with wrap-around vinyl "sliders" could extend fork seal life as much as 200 percent.



Honda got wise to the problem in 1988, adding plastic shields to the front fenders of GL1500 models to protect the fork tubes. Dealerships reported an 80% drop in fork seal replacements needed with this model.

subsequent seal failure it can cause, is to cover or "shield" the tubes in some manner that goes beyond the normal protection offered by dust seals.

My old CB200T has the traditional, accordion-rubber "gaiters" over the shock tubes, and the seals have failed only once in 12 years, at 80,000 miles. That's why you still see gaiters on virtually every off-road bike made. But somewhere along the line "fashion" and "design" overcame common sense, and we all started insisting on street bikes with modern-looking, totally exposed, polished fork tubes. Gaiters were dropped almost entirely, determined to be much too old-fashioned-looking, or as contributing in some miniscule manner to fork "stiction." Maybe so—but they worked.

Some riders, wise to the ways of seal failure, have developed "home remedies" to protect their forks. Among the ones I've seen are sections of rubber hose attached to fork housings with hose clamps, or the more attractive addition of vinyl "wrap-arounds" that velcro around the tubes and slide up and down with the forks. Some of these are even color-matched to the bikes.

I used to own a Honda GL1200 that needed the fork seals replaced at 21,000 miles, 43,000 miles, and 62,000 miles. Then I covered the exposed upper tubes with vinyl "sliders," and never had to replace the seals again. The bike's current owner now has the odometer up to 124,000 miles, and the seals are still holding.

Honda must have gotten wise to this, because the GL1500 models came with plastic "fork shields" built right onto the front fender. Even though they don't quite cover the entire exposed area of the tubes, they must do a pretty good job because the Honda shops we interviewed said fork seal replacements on the GL1500 series were running about 50,000 to 70,000 miles apart, as opposed to an average of 25,000 miles apart on earlier GL models. The new GL1800, and many of Honda's and other manufacturers' sport and touring models now utilize some form of these shields.

Of course, remedies that involve shields and covers like the old gaiters are practically unthinkable if you ride a standard cruiser like say, a Virago or a Shadow. The aesthetic beauty of the machine would be severely compromised. In cases like that, refer to Rule #1: Clean!

Other Considerations

Despite all your best efforts, odds are that sooner or later you are going to suffer a fork

The best preventative medicine ever found for fork seal failures are the old style "gaiters." Some may argue they increase fork stiction and hide minor leaks or tube damage, but no one can argue with the fact they dramatically increase the fork seals' service life.

Unfortunately, "gaiters" would look downright ugly on most cruisers like this Honda Shadow. That's when you have to resort to old-fashioned elbow grease to save your seals, unless you're lucky enough to own one of the very new models with built-in fork shields (usually those bikes with upside-down forks).

Left—Oil seals should be installed with a special "driver" made specifically to fit your make and model motorcycle. Any twisting, binding or uneven pressure on the seal during installation will virtually ensure reduced service life, if not result in almost immediate seal failure. Right—Even though the exact amount of carefully measured fluid was installed with reassembly, you should double-check the levels by measuring from the tops of the tubes with the forks fully compressed.

seal failure. When you do, try to keep these few tips in mind to save yourself unnecessary expense and headaches.

1. Don't put it off.

Once a seal has blown, try to get it repaired as soon as possible. Besides providing rebound damping, that oil you lost was responsible for lubricating the slider bushing inside your fork. Without it, the bushing will eventually score the fork tube surface and you could be facing a much larger repair bill in the end. In addition, always remember that if the oil can get out, dirt can get in.

2. Do both of them.

The odds against the seals blowing in both forks at the same time are pretty slim, but it will usually be to your advantage to go ahead and overhaul both sides at the same time. Though not always true, it stands to reason that the undamaged side has been subjected to almost exactly the same amount of wear as the side that failed, and is close to following suit. Doing both sides at once can save you as much as $100 in labor charges from doing each separately.

3. Check those brake pads.

The most overlooked and potentially dangerous problem arising from fork seal failure is damage to your front brakes caused by the oil leakage. In many cases, the oil leaking from your forks will drop directly onto one or more of your front brake pads, permeating the pad material. In some cases, depending on the amount of oil that contacts the pads, you might be able to get by with sanding the pad surfaces enough to clean them up and make them usable. However, in all good conscience we would have to recommend against this.

It is nearly impossible to tell just how much fork oil has permeated the pads, or to what extent that contamination is going to affect your braking ability at any given time in the future. By far the smartest, safest thing to do is to simply replace your front brake pads in conjunction with the fork seal overhaul. Better safe than sorry.

4. Double-check the oil levels.

During fork reassembly you (or preferably, your mechanic) will refill the fork tubes with a precisely measured amount of fork oil, as designated by the shop manual for your bike. This should be all the measurement of your fork oil level that is needed—but don't count on it. The amount of oil needed for proper damping can be altered by several factors, including whether or not you have replaced the OEM spring assemblies in your bike. Also, we have found at least two shop manuals that contained errors in listing the proper amount of oil to add.

To protect yourself from inadvertently creating an over- or under-damped suspension, double-check the oil levels in both forks using the "top end measurement" system. With the front suspension fully compressed, the springs removed and the top caps off, carefully measure the distance between the tops of the tubes and the oil, using a good ruler. The proper lengths of these distances should be listed in your shop manual. Check to make sure your measurements agree with the manual's. If not, add or subtract oil to the forks until they do.

The easiest way to make sure you have the correct amount of oil is to purposely overfill the tubes and then "pump out" the excess. Shop Foreman Tom Smith at Huntington Honda in Huntington Beach, Calif., demonstrated his own method of doing this: Using a steel tube with a piece of rubber hose slipped over the outside, Tom slides the hose back from the end of the tube into the fork until the rubber hose hits the top. With the pump turned on, the oil level is automatically pumped down to the exact level called for by the manual.

Tom was surprised when we told him a hand-pump device for performing this exact same operation is manufactured and sold by Progressive Suspensions of Hesperia, California.

In Conclusion

Back when I rode only about 5000 miles a year and a fork seal job cost me around $40, I didn't pay much attention to why the seals failed, or how I might have prolonged their life. Now that I ride about 40,000 miles a year, and fork seal overhauls cost me over $350, it has become a major concern. That's why I set about to learn as much as I could about fork seals, to save me from the time, expense and hassle of replacing them.