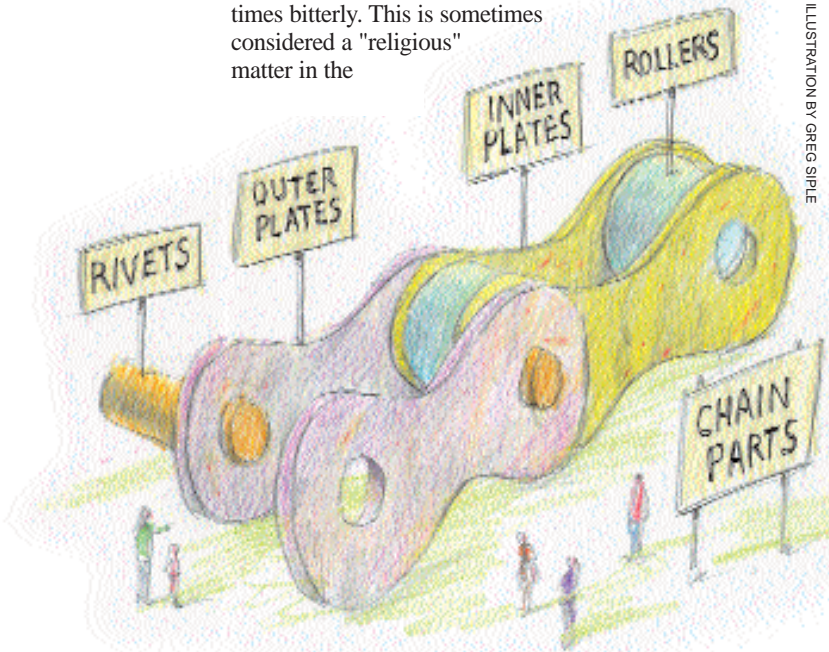


## A Healthy Chain

*Keeping all 456 parts in working order*

By Sheldon Brown

Chain maintenance is one of the most controversial aspects of bicycle mechanics. Chain durability is affected by factors ranging from riding style to lubrication techniques. Because there are so many variables, it has not been possible to do controlled experiments under real-world conditions. As a result, everybody's advice about chain maintenance is based on anecdotal "evidence." Experts disagree on this subject, sometimes bitterly. This is sometimes considered a "religious" matter in the



**Bicycle chains have lots of parts, but they break down into four simple categories, shown here.**

bicycle community, and much vituperative invective has been uttered about chains.

This article is based on my personal and professional experience and my own theories. If you disagree with them, I won't call you a fool or a villain — you may be right. I hope you will extend me the same courtesy.

### Chains: Old And New

People don't pay much attention to bicycle chains. After all, they all look basically alike. A modern bicycle chain has eight parts per link, so the typical 57-link chain has 456 parts — more than the rest of the bicycle put together. There are 114 outer plates, 114 inner plates, 114 rollers, and 114 rivets, and all of these parts are small and subject to very high stresses.

### Chain "Stretch"

Cyclists often speak of chain "stretch," as if the side plates of an old chain were pulled out of shape by the repeated stresses of pedaling. This is not actually how chains elongate. The major cause of chain "stretch" is wearing away of the metal where the rivet rotates inside of the inner cage plates as the chain links flex and straighten. If you take apart an old, worn-out chain, you can easily see the little notches worn into the sides of the rivets by the inside edges of the inner plates.

### Lubricant Flow

There are three points where a chain needs lubrication:

First, and most importantly, the rivets need to be lubricated where they move inside the inner links as the chain bends and straightens.

Second, the insides of the rollers need lubrication to let them revolve freely around the bushings as they engage and disengage the sprocket teeth. If the rollers don't roll, they slide along the sprocket teeth, causing accelerated wear.

Third, the surface where the outer side plates overlap the inner side plates can benefit from lubrication as well, although this contact surface is much more lightly loaded than the first two.

### Oiling Chains

One of the great controversies of chain maintenance is whether you should oil a chain or not. The downside of oiling a chain is that the oil may carry grit into the interior of the chain, and that this grit-mixed-with-oil will act as grinding compound, causing accelerated wear. Many experts whose judgement I highly respect hold this opinion, but I do not believe that this is always the case. I have no doubt that this "grinding-compound" effect can occur, but the severity of the risk depends upon the sort of dust/soil prevalent in a given area, and, particularly, the oiling technique used.

Many cyclists oil their chains by spraying, usually aiming the spray can at the rear of the derailleur cage, because this reduces the risk of overspray getting on their rims or tires. In my opinion, spray lubricants should not be used on bicycle chains, because they get too much oil where you don't need it and/or too little where you do.

Most of the schmutz that contaminates a chain is thrown up by the front tire. This lands on the outer circumference of the chain. For this reason, you should always oil a chain on the inner circumference, the side that faces the sprockets. The best way to apply the oil is with a drip-type oil container, along the top of the lower run of the chain. This applies the oil to the cleanest part of the chain.

I just run the pedals backwards while applying a line of oil down the rollers. It takes 15 or 20 seconds to oil a chain this way. I have used many different oils; my favorite is Phil Wood Tenacious oil.

### Solvent-carrier Chain Lubes

The problem with lubricating conventional chains is that thick lubricants can't penetrate into the inaccessible crannies where they are really needed, but thin lubricants don't last long enough. There is a family of popular chain lubricants

that deals with this by mixing a thick oil or wax-type lubricant with a volatile solvent. The resulting mix is thin enough to penetrate by capillary action, then the solvent evaporates and leaves the thick oil or wax behind. This type of lube is easy to apply, and is very popular for that reason. These lubricants work pretty well for fair-weather cyclists, but not so well for those who ride in wet conditions.

### Hot Waxing Chains

An alternative approach to chain lubrication is to immerse the chain in hot wax. The hot wax can theoretically penetrate the chain, then when it cools off, you have a nice thick lubricant in place where it can do the most good. The major advantage to this approach is that, once cooled off, the wax is not sticky, and doesn't attract dirt to the outside of the chain as readily.

Waxed chains work okay for fair-weather cyclists, but wax doesn't offer very good protection against rust for those of us who ride in the rain.

### Cleaning Chains

The traditional way to clean a bicycle chain is to remove it from the bike, then soak and scrub it in solvent. This is a problem with newer chains, however, because they have tighter-fitting rivets designed for

the higher stresses caused by the full-power shifting made possible by newer sprocket designs. The new rivets are difficult to remove and reinstall. The best approach is to buy a master link, such as the Sram Power Link, which allows removal and re-installation of the chain without tools.

I always used a parts cleaning tank and a toothbrush to clean chains, but Zaven Ghazarian, an excellent mechanic I used to work with, came up with a better system: drop the chain into a plastic Coke bottle with a couple of ounces of un-diluted citrus degreaser, cap it, and shake thoroughly. Fish the chain out with a spoke, rinse and go!

The other good way to clean chains is with an on-the-bike cleaning machine, which clips over the lower run of chain and uses brushes and rollers to flex the chain and run it through a bath of solvent as you rotate the pedals.

The off-the-bike approach has the advantage of using more solvent than will fit into an on-the-bike cleaning machine, thus diluting away more of the grime from the chain.

The on-the-bike system has the advantage that the cleaning machine flexes the links and spins the rollers. This scrubbing action may do a better job of cleaning the innards of the chain.

### Measuring Chain Wear

The standard way to measure chain wear is with a ruler or steel tape measure. This can be done without removing the chain from the bicycle. The normal technique is to measure a one-foot length, placing an inch mark of the ruler exactly in the middle of one rivet, then looking at the corresponding rivet 12 complete links away.

This gives a direct measurement of the wear to the chain, and an indirect measurement of the wear to the sprockets:

If the rivet is less than 1/16" past the mark, all is well.

If the rivet is 1/16" past the mark, you should replace the chain, but the sprockets are probably undamaged.

If the rivet is 1/8" past the mark, you have left it too long, and the sprockets (at least the favorite ones) will be badly worn. If you replace a chain at the 1/8" point without replacing the sprockets, it may work fine, but the worn sprockets will cause the new chain to wear quickly.

If the rivet is past the 1/8" mark, a new chain will almost certainly skip on the worn sprockets, especially the smaller ones. ●

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