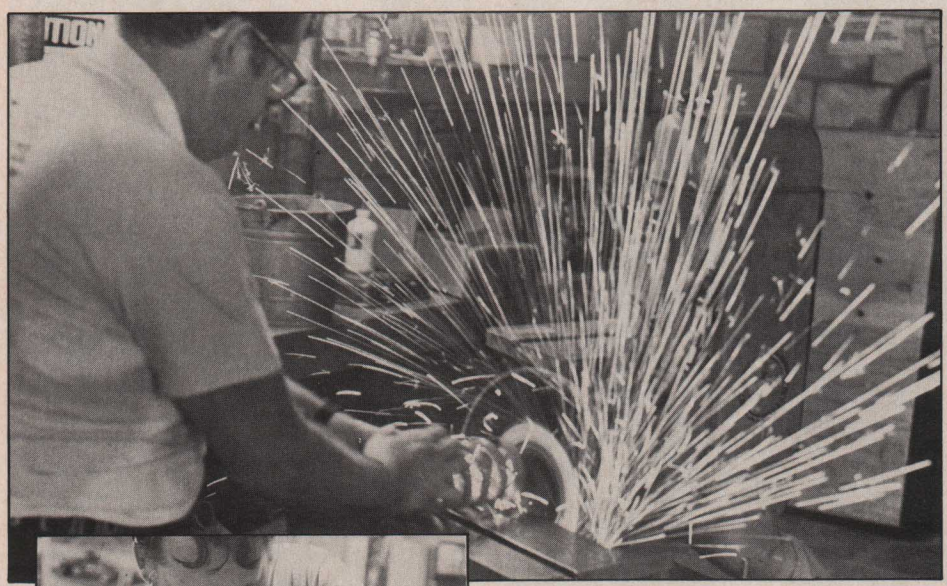
MAKE YOUR SPRING STIFFER FOR FREE!

SPRING TUNING SECRETS

Can you divide, multiply & fill a bucket with cold water?

By Rick Sieman, with special thanks to Gil Vaillancourt of Works Performance Products for technical assistance



Gil checks the rate in his spring tester and finds that his math was right on the button.

Gil of Works Performance puts the finishing touches to a modified spring.

Dear Dirt Bike,

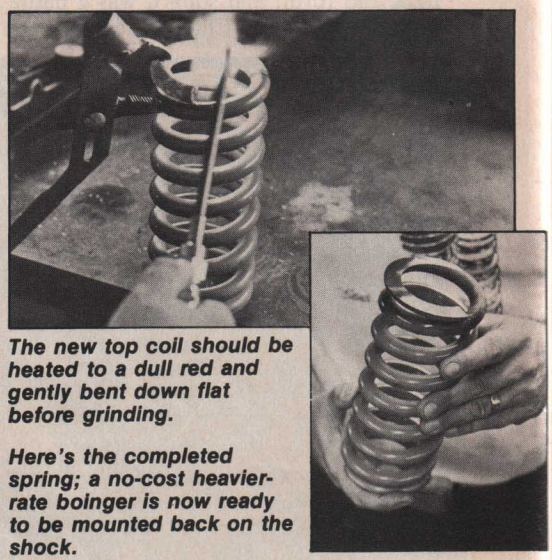
I have a KDX175 and my rear shock spring is way too soft. My dealer wants almost 50 bucks for a heavier spring. Is there anything I can do to stiffen the rear end without popping for the half a hundred? Thank you severely.

Marvin Grinder
Spinoza Flats, UT

This mythical letter is actually representative of many we've received here at *Dirt Bike*. The problem is not isolated to the excellent KDX enduro bike. Nope. Just about any rider who gets better on his bike will find out that the standard spring(s) that came on the bike were made for that mythical "average" rider.

To get our new spring rate, we cut the spring off at this point.

For maximum safety, hang the spring over a bucket filled with water before torching off the unwanted coils.



The new top coil should be heated to a dull red and gently bent down flat before grinding.

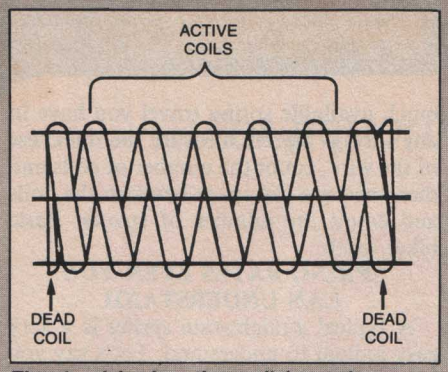
Here's the completed spring; a no-cost heavier-rate boinger is now ready to be mounted back on the shock.

The owner of a new bike will often not notice that his spring is too soft at first, because of the sensation of a fresh, tight new bike and the attendant careful riding. However, once he gets the unit broken in and scratched up a few times he may find himself resorting to the preload adjustment rings.

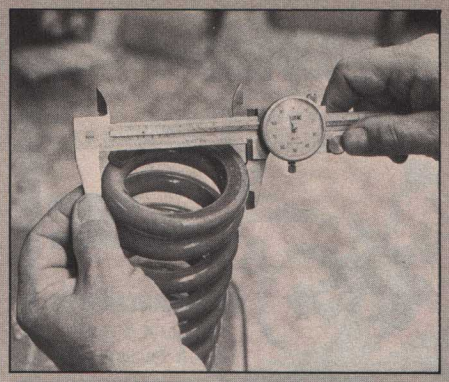
And, no matter what his owner's manual states, increasing the preload will not keep the shock from bottoming out under hard riding conditions. The answer, of course, is a heavier spring. Naturally, the correct amount of sag in the rear end and *reasonable* amounts of preload will have substantial effects on the action of the rear end, but it's possible to have the right amount of sag for the rear suspension and still have a too soft spring.

SAVE BIG BUCKS— MODIFY YOUR OWN SPRING

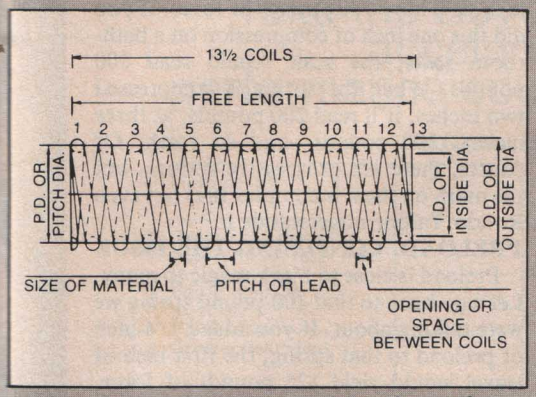
Let's say you've exhausted all the normal preload and have, in fact, determined that your spring is too soft. You can avoid spending anywhere from 40 to 75 dollars for a shock spring and equivalent bucks for fork springs. Yes, the *DB* low-bucks approach to customizing your springs works



The dead (or inactive coils) are those that touch at both ends.



A number of factors determine the actual rate of the spring, including the diameter of the wire. . .



Basic info needed to determine spring rate.

. . .and the thickness of the wire.

on the fork boingers as well as on the rear suspenders.

You're going to need access to a set of torches and a decent bench grinder to get the job done right. First, here's how the procedure is done, then we'll show you how to calculate just how much you want to cut off your spring to increase the stiffness.

WAIT A MINUTE, *DIRT BIKE!* HOW CAN CUTTING A SPRING MAKE IT STRONGER?

Hah! Gotcha, didn't we. You see, a number of things determine the rate of a spring, among them the thickness of the wire, the diameter of the coils (to their centerline) and the number of active coils. As a rule of thumb, the fewer active coils, the higher the spring rate—all other things being equal. Since we can't change the thickness of the wire or the diameter, this leaves the number of active coils as the only variable we have control over.

Dead coils are those at each end of the spring that make contact with something. If you have a spring with, say, ten coils, then two of them are dead (inactive) and eight of them are live (active) coils. But enough theory for now. Let's get back to the actual operation of making our springs stronger.

STEP-BY-STEP SPRING MODIFICATION

Once you've determined just how much you need to cut off your spring to make it stiffer, here's the procedure. Put some water in a bucket and lay the spring over the edge. Not only will this make a solid holder for the spring, but it will give the hot coils and sparks a very safe place in which to drown themselves out.

A mark should be scribed on the coil where the cut is to be made. Heat up the coil with a normal welding tip until it's cherry red and just starting to turn yellow. When the metal starts to puddle or melt, turn off the acetylene. The oxygen will feed the hot spot and the wire will literally burn. At this point, you are merely feeding oxygen to an existing point of combustion. The wire is actually burning! Of course, you can simply take a cutting torch and blaze it off, but this technique is much cleaner and very easy to master. You might experiment with a scrap piece of metal first to get the feel.

Next, place the shortened spring firmly on a flat surface or in a sturdy vise. Then start heating the top coil about an inch from the freshly cut end, very slowly. Do not overheat it. Once it turns cherry red, you can squeeze it gently together with a sturdy set of pliers.

The key here is *gentle* pressure. If you force it too much, there's a chance that you'll crack the spring and render it useless. Remember, easy pressure and fairly low heat—just enough to let the coil start to sag under a light squeeze.

After the first part of the coil has been bent down a bit, back up another inch and heat some more, then gently put additional pressure on the coil. After a few minutes of coaxing and sensible use of the torch, the top (freshly cut) coil will be flattened out to the approximate desired shape.

Now you have to flatten it so it'll fit flush against the top (or bottom) of the shock. A grinder is essential. You probably won't have access to one as strong as the one at Works Performance, but the job can be done with a bench grinder. Plan on taking about a half hour of work with the average home bench grinder. You can also take the shock spring to almost any machine shop and talk the guy into surfacing it for you for a few bucks.

One word of caution: After you heat and bend the top coil, do not quench it in water to cool it down too quickly or you might make the spring take a set. Wait a few minutes until all the color has disappeared from the spring. Your spring is now ready to be sanded clean and repainted. And, if your calculations were correct, you would now have the new heavier spring rate you were after, at no cost to you.

HOW TO FIGURE OUT HOW MUCH TO CUT OFF

First off, you should know what the rate of the spring you're using is. That's easy enough. All springs are coded in some fashion and the owner's manual tells you what the different springs are. Some use a grind mark, while others use paint to identify the rate.

Let's say you're starting out with a 600-pound shock spring. If your shock is too soft, a ten-percent increase in poundage would be a logical place to start.

You have to take the rate of the spring (600 pounds) times the number of active coils (in this case, 8.875 coils) and divide this by the desired rate. Sounds like tough math, but it isn't. Here's how it looks on paper:

$$\begin{array}{r} 600 \text{ pounds} \\ \times\ 8.875 \text{ active coils} \\ \hline 5325.000 \end{array}$$

Now, take this number and divide it by the rate you want, which in our case is a ten-percent increase, or a rate of 660 pounds. On paper, again, here's the story:

$$660 \overline{)\ 5325.000}\quad 8.0682$$

This leaves you with the magic number of 8.0682, which is the number of active coils that will give you a 660-pound spring. Pretty neat, eh? In our spring, that means that we would have to cut off 7/8 of one full coil to get what we were after.

Once again: It's only the active coils that count. So, out with the torch, zap on the grinder, and 7/8 of a coil later, you have your 660-pound spring.

VARIOUS WORDS OF WARNING, SOME OF THEM DIRE

Don't get in over your head. And don't try to ask a spring to do too much. One of the things you *must* watch out for is coil bind. A spring should never be forced to bottom out against itself. If, for example, you have five inches of available spring movement and the shock travels 4-1/2 inches, it's clear that you should cut no more than half an inch off that particular spring.

It's not too difficult to calculate just how

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much available spring travel you have in any spring. Merely measure the thickness of the wire, count the number of coils and then measure the space between the coils and count the number of spaces. Basic biker math.

SPRING RATES EVEN *YOU* CAN UNDERSTAND

A typical straight-rate spring is a very easy animal to understand. Let's say you have a 100-pound spring. This means that when the spring is compressed one full inch, it'll have 100 pounds of force. If you did this one inch of compression on a bathroom scale, the scale would read 100 pounds. When the spring is compressed two inches, it'll read 200 pounds, at three inches, 300 pounds—and so forth. Of course, there are progressive springs, but the math on them is complex that not even Rondo Talbot understands it.

PRELOAD, CONFUSING THE ISSUE

Preload is close to black magic to many. Let's go back to that 100-pound spring we were talking about. If you added 1/4-inch of preload to that spring, the first inch of travel would yield 125 pounds of force. One-half inch of preload would bring it up to 150 pounds, and so on.

However, preload affects only the first inch of travel. After the first inch of travel, the spring will still gain only 100 pounds with each additional inch of travel, no matter how much the preload. This is where a lot of people blow it. Ideally, a light preload will let the wheel react to small bumps properly. Way too much preload will make the finest shock (or forks) feel miserable on the small bumps, then the suspension will still wallow through the mid-stroke.

CAN I DO THE SAME BASIC STUFF TO FORK SPRINGS?

Of course you can. You just have a much longer spring and may have to count a lot more when you add up the active coils. Let's assume you have an 18-pound fork spring and you feel that it's too soft. Your calculations show that if you cut off three coils, you'll end up with a 20-pound fork spring, which is what you want.

Fine. Go for it. But make sure that you make up the space you take away. If you cut off two inches of fork spring, you must replace those two inches with some sort of a spacer. If not, the forks will tend to sag and dive too much from lack of proper preload. The same, naturally, is true of the rear. If you don't have enough threaded area in your shock body to make up for the removed coil area, you will have to fabricate a simple spacer to take up the room.

MYTH DESTRUCTION FOR YOUR AMUSEMENT

Some years ago, several companies offered "booster" springs for forks. These were said to stiffen up the stock fork

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springs and make the forks work better. Hundreds were sold, most often to owners of Yamaha enduro bikes.

Think about this for a moment. If you had a set of 20-pound fork springs and then added a 100-pound "booster" spring on top of them, in effect you would be softening the actual spring rate. Preposterous, you say? Impossible? Not really.

The formula for figuring out rates with double springs is as follows: Take the individual rates multiplied and divide them by the individual rates added. Therefore, we have 100 x 20 ÷ 120, or an actual spring rate of 16.6 pounds. Obviously, the initial feel of the forks would be stiffer, but only because of greatly increased preload. The mid-stroke rate would actually be less than with the stock spring. There would be a slight gain in resistance to bottoming out with this setup, as the oil level would be raised a bit.

HELPFUL HINTS AND COMMON SENSE

You might run into kg readings instead of pounds when you check your owner's manual. Do not be intimidated. Should you want to change them into something real 'Mericans understand, merely take the number and multiply it by 56 pounds. For example, you have a 7.9 kg spring: 7.9 x 56 pounds = 442.4 pounds.

Ideally, your spring should be matched to your damper. If you run a horribly heavy spring that the shock is not capable of controlling, then you'll have a rear suspension that'll bounce around like a basketball every time it recoils from a bump.

When you do increase your spring rate, you should also (normally) increase your rebound damping. Most modern shocks have some sort of adjustment that will let you change the rebound settings.

To increase the rebound on forks it may be necessary to go to a heavier fork oil, as very few forks have adjustable rebound, even though many of the Showa and KYB units do offer adjustable compression damping.

Here's a great formula to have handy if you want to calculate the rate of a spring you don't know the rate of: RATE = 11.5 x Wire Diameter to the fourth power (D^4) ÷ by 8 x Number of Active Coils x Mean Diameter cubed. You won't be doing this between rounds of the TV boxing match. Better you should look it up in your manual.

IF ALL THIS LOOKS LIKE TOO MUCH WORK...

...do what we usually do. Send your spring to Gil at Works Performance and have him do it for you. For $19.95 plus $5.00 for shipping and handling, WP can modify your spring properly. Call first to see if your spring will take the new rate without going into coil bind.

Works Performance Products, 8730 Shirley Ave., Northridge, CA 91324; (213) 701-1010. Ask for Gil. □