Article by Paul Thede, founder of Race Tech, from 1995.

Suspension and Springs

What's all this ruckus about suspension these days? It seems everyone is clued in that suspension setup can be a key to riding fast and safely, but how do you do it? No matter what shock or fork you have, they all require proper adjustment to work to their maximum potential. Suspension tuning isn't rocket science, and if you follow step-by-step procedures you can make remarkable improvements in your bike's handling characteristics.

The first step to setting up any bike is to set the spring sag and determine if you have the correct-rate springs. Spring sag is the amount the springs compress between fully topped out and fully loaded with the rider on board in riding position. It is also referred to as static ride height or static sag. My company, Race Tech, (909/594-7755) has an advanced method of checking spring sag that I'll describe.

If you've ever measured sag before, you may have noticed that if you check it three or four times, you can get three or four times, you can get three or four different numbers without changed anything. We'll tell you why this occurs and how to handle it.

REAR END

***Step 1*:** Extend the suspension completely by getting the wheel off the ground. It helps to have a few friends around. On bikes with sidestands the bike can usually be carefully rocked up on the stand to unload the suspension. Most race stands will not work because the suspension will still be loaded by resting on the swingarm rather than the wheel. Measure the distance from the axle vertically to some point on the chassis (metric figures are easiest and more precise; Figure 1). Mark this reference point because you'll need to refer to it again. This measurement is L1. If the measurement is not exactly vertical the sag numbers will be inaccurate (too low).

***Step 2*:** Take the bike off the stand and put the rider on board in riding position. Have a third person balance the bike from the front. If accuracy is important to you, you must take friction of the linkage into account. This is where our procedure is different: We take two additional measurements. First, push down on the rear end about 25mm (1") and let it extend very slowly. Where it stops, measure the distance between the axle and the mark on chassis again. If there were no drag in the linkage the bike would come up a little further. It's important that you do not bounce! This measurement is L2.

***Step 3*:** Have your assistant lift up on the rear of the bike about 25mm and let it down very slowly. Where it stops, measure it. If there were no drag it would drop a little further. Remember, don't bounce! This measurement it L3.

***Step 4*:** The spring sag is in the middle of these two measurements. In fact, if there were no drag in the linkage, L2 and L3 would be the same. To get the actual sag figure you find the midpoint by averaging the two numbers and subtracting them from the fully extended measurement L1: static spring sag=L1 -[(L2 + L3) / 2].

***Step 5*:** Adjust the preload with whatever method applies to your bike. Spring collars are common, and some benefit from the use of special tools. In a pinch you can use a blunt chisel to unlock the collars and turn the main adjusting collar. If you have too much sag you need more preload; if you have too little sag you need less preload. For road race bikes, rear sag is typically 25 to 30mm. Street riders usually use 30 to 35mm. Bikes set up for the track are compromise when ridden on the street. The firmer settings commonly used on the tract are generally not recommended (or desirable) for road work.

You might notice the Sag Master measuring tool (available from Race Tech) in the pictures. It's a special tool made to assist you in measuring sag by allowing you to read sag directly without subtracting. It can also be used as a standard tape measure.

Measuring front-end sag is very similar to the rear. However, it' much more critical to take seal drag into account on the front end because it is more pronounced.

FRONT END

***Step 1*:** Extend the fork completely and measure from the wiper (the dust seal atop the slider) to the bottom of the triple clamp (or lower fork casting on inverted forks; Figure 2). This measurement is L1.

***Step 2*:** Take the bike off the sidestand, and put the rider on board in riding position. Get and assistant to balance the bike from the rear, then push down on the front end and let it extend very slowly.

Where it stops, measure the distance between the wiper and the bottom of the triple clamp again. Do not bounce. This measurement is L2.

***Step 3*:** Lift up on the front end and let it drop very slowly. Where it stops, measure again. Don't bounce. This measurement is L3. Once again, L2 and L3 are different due to stiction or drag in the seals and bushings, which is particularly high for telescopic front ends.

***Step 4*:** Just as with the front, halfway between L2 and L3 is where the sag would be with no drag or stiction. Therefore L2 and L3 must be averaged and subtracted from L1 to calculate true spring sag: static spring sag=L1 - [l2 + l3) / 2].

***Step 5*:** To adjust sag use the preload adjusters, if available, or vary the length of the preload spaces inside the fork.

Street bikes run between 25 and 33 percent of their total travel, which equates to 30 to 35mm. Roadrace bikes usually run between 25 and 30mm.

This method of checking sag and taking stiction into account also allows you to check the drag of the linkage and seals. It follows that the greater the difference between the measurements (pushing down and pulling up), the worse the stiction. A good linkage (rear sag) has less than 3mm (0.12") difference, and a bad one has more than 10mm (0.39"). Good forks have less than 15mm difference, and we've seen forks with more than 50mm. (Gee, I wonder why they're harsh?)

It's important to stress that there is no magic number. If you like the feel of the bike with less or more sag than these guidelines, great. Your personal sag and front-to-rear sag bias will depend on chassis geometry, track or road conditions, tire selection and rider weight and riding preference.

Using different sag front and rear will have huge effect on steering characteristics. More sag on the front or less sag on the rear will make the bike turn more slowly. Increasing sag will also decrease bottoming resistance, though spring rate has a bigger effect than sag. Racers often use less sag to keep the bike clearance, and since roadraces work greater than we see on the street, they require a stiffer setup. Of course, setting spring sag is only first step of dialing in your suspension, so stay tuned for future articles on spring rates and damping.