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# REF: Suspension

## Suspension - General Information

### Rear Shocks & Springs

- Generally, dive in a motorcycle is not a problem. Running out of suspension at either end of the shock travel is. <sup>1)</sup>
- Shock travel should almost never be controlled by the shock. Travel should always be controlled by the spring. <sup>2)</sup>
- Shock damping is just there to provide as little damping as required to keep the chassis movement from over shooting and bouncing. Shocks are not there to control total travel. <sup>3)</sup>
- Shocks have two types of resistance in compression “low speed damping” and “high speed damping”. High speed damping controls when the tire hits things like a speed bump. Low speed damping is things like a big dip in the highway. Extension damping only controls bounce or overshoot as the tires recover from a bump. Think of extension damping as the thing that only controls the spring. Compression damping controls the ride. Most of the time if you take the spring off the shock and pull in and out with your hands the resistance of the shock should be about the same going in and out. If you end up with way more of one than the other you must be trying to cover one problem with some other problem. Harley, on the Low bikes, is trying to cover up for too little extension travel with too much extension damping. Ride fast in fast bumps and the chassis will jack down or lower as you go thru the bumps. <sup>4)</sup>
- If, when trying to follow the above rules, you end up with too tight of springs for comfort then you do not have enough suspension travel. Add shock travel and start over. <sup>5)</sup>
- There is no such thing as upgrading springs. What you can change is spring rates and preload. The trick is knowing what direction to go. It is impossible for the shock guys to help you if there first question is not “what problem are we trying to solve”. If you don't know what the problem is. You can't answer his first question. I was horrified the first time I rode my 2007 1200 Low and have since spent about \$600 getting parts an pieces off e-bay to have parts to test with. I have not found the front suspension that much of a problem. The rear was a mess from the factory. <sup>6)</sup>
- For a great schooling in suspension design, watch the moto-cross pros on TV and then reread the above rules several times during the program. Every lap will make this more clear. Google “Motion ratio” “shock tuning” “motorcycle shock tuning” for plenty more info. <sup>7)</sup>
- Harleys try to break every one of these rules. Follow the rules and all is good. <sup>8)</sup>

- Generally, there are only 2 choices for shock springs, heavy and light. Although I have not looked in

what Ohlins and Penske offers, Works is the only company that offers Dual Rate springs for shocks. But from my experience with Works Pro Racers, they are only guessing. Progressive does offer different spring rates for different lengths of shocks, but tuning the spring rate is limited to preload changes. Progressive has admitted to me that the shock valving is not changed, only the spring is changed from heavy to light. <sup>9)</sup>

- Since our choice of springs is so limited, so is our ability to fine tune our suspension. The other big part of the problem is that most bikes with twin shocks are not considered hi performance, and therefor the aftermarket companies are not putting any effort into making good suspension for our specific bikes. <sup>10)</sup>
- So it seems to me that the greatest amount of adjustability to spring rates is offered by the Works Dual Rate springs. <sup>11)</sup>

### **Here is a simple series of steps to get to your goal**

- Take a bunch of mixed up Harley parts, matched the spring rate to your weight, unload the spring so it can work the way it is supposed to, match the damping curve to the spring rate, and then you end up with a better ride than HD put on the bike originally. <sup>12)</sup>
- Pick a shock that has the most possible available stroke that when in the most compressed position will provide enough clearance for wires, fenders and other expensive things that the tire or belt may contact OR set this up so that you are 1 1/2" below the ride height that you are looking for. Measure this totally compressed length at the lower of these two points in the suspension travel. We will be aiming to only get the shock to this point at the biggest bump you ever intend to hit. Hopefully you can find a shock with around 3" of available stroke. <sup>13)</sup>
- Next you need to find a spring that with the shock at full droop can be installed on the shock by hand. This guarantees that at full droop the spring has no more energy that needs to be controlled. With a sportster and with a rider in the 140 lb range the spring will end up at about 75 lb / per inch. At 250 lbs., I would expect the spring rate to end up in the 140 lb. / inch range. The spring rate needs to now support the bike and you so that there is still about 1 1/2" available shock travel to deal with bumps. Air shocks may be an option but I have never had a set to play with. They still need to meet these rules. <sup>14)</sup>

### **How to Compress the Shock Springs for removal of Shocks**

- I have a way to hang the shock in a press and then I have a tool I built that grabs the top cap and pushes the cap down so that I can grab the top C clip. <sup>15)</sup>

### **The definition of Motion Ratio**

- Vertical wheel movement / Change in shock length <sup>16)</sup>

1. Jack up the bike
2. Remove the shocks
3. Let the tire drop to the ground and measure what the shock lenth would be if it was there. say 13.5"

4. Raise the tire exactly some amount of distance say 4"
5. Now measure the new shock length say 10"

- The motion ratio =  $4" / (13.5" - 10") = 4" / 3.5" = 1.14$  <sup>17)</sup>

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1) , 2) , 3) , 4) , 5) , 6) , 7) , 8) , 13) , 14)

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<https://www.xlforum.net/forum/sportster-motorcycle-forum/sportster-motorcycle-suspension-frame-forks-handlebars-fuel-tank-oil-tank-fenders/28685-harley-database-of-springs-and-shocks/page3?t=47542&highlight=1200s+shocks&page=3>

9) , 10) , 11)

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16) , 17)

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