

CHAPTER SEVEN

GS Ohlins Installation, Adjustment Tips & Tricks

Excellence and Wisdom from our local Zahnradkopf, Perfessor John, and MPM

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The author(s) have done their best to provide accurate information. However, they/we assume no liability for any damage or injury caused by any errors or omissions in this manual. Use at your own risk. Verify all values with your BMW shop manual.

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Install Ohlin Shocks (front)

Tools:

6 mm hex socket
15 mm socket
14 mm box end wrench
3/8" socket wrench
Torque wrench
Extension bars
Needle nose pliers
Plastic **mallet**
Loctite
Rag



Parts:

Replacement Shock

General Instructions

1. Use copper based anti-seize on all bolt threads except where Loctite is used
2. Use vasoline or silicone grease on the o-ring seals for the quick disconnects during re-assembly

Instructions:

3. Ride the bike 'till you're almost out of gas. This makes taking the tank off *much* easier.
4. Put the bike on the center stand.
5. Remove the seat and the right side panel.

6. Remove the fuel tank bolt on the right side of the bike using a 6 mm hex socket...



...There's a nut on the back side. Catch it so it doesn't fall down and get lost.



7. Luckily, I had my dealer install fuel line quick-disconnects when I bought the bike, so removing the tank is a piece of cake. There are two, each one faces the opposite direction, so there is no danger of re-connecting the wrong hose. Put a rag on the cylinder to catch any drops of fuel...



8. Pull breather and overflow hoses out. Put some masking tape or use zip ties on one line (both sides) so you can figure out which one goes where when you put the tank back on.



9. Unplug the fuel tank electrical plug. Lift the tank up, back and off.



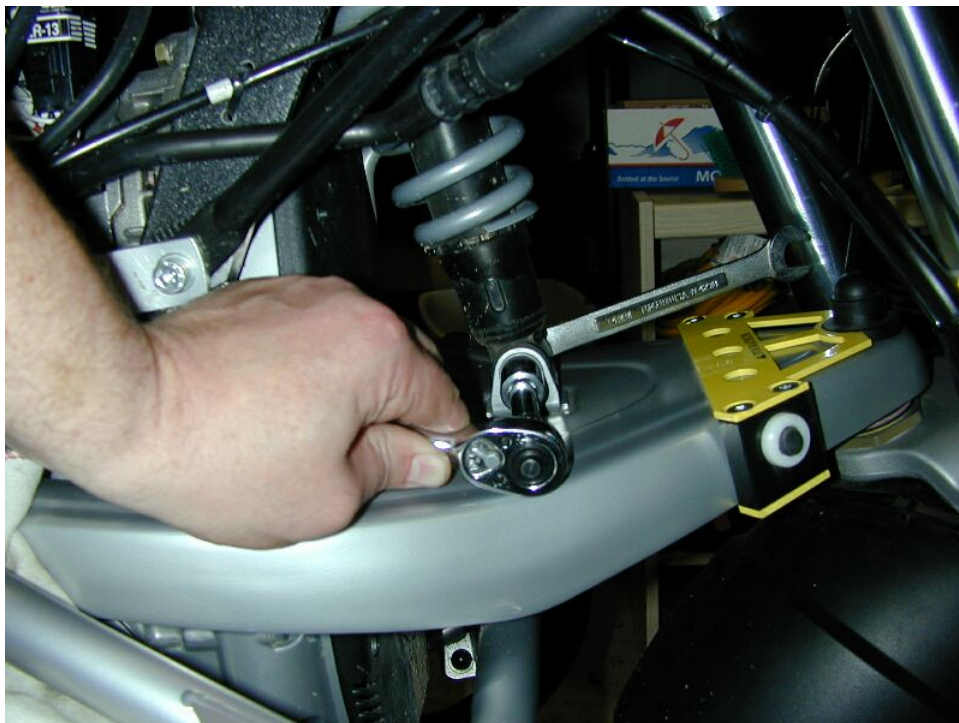
10. Put the tank on some soft surface out of the way. I put a plastic trash bag underneath the quick disconnects to catch any fuel drips.



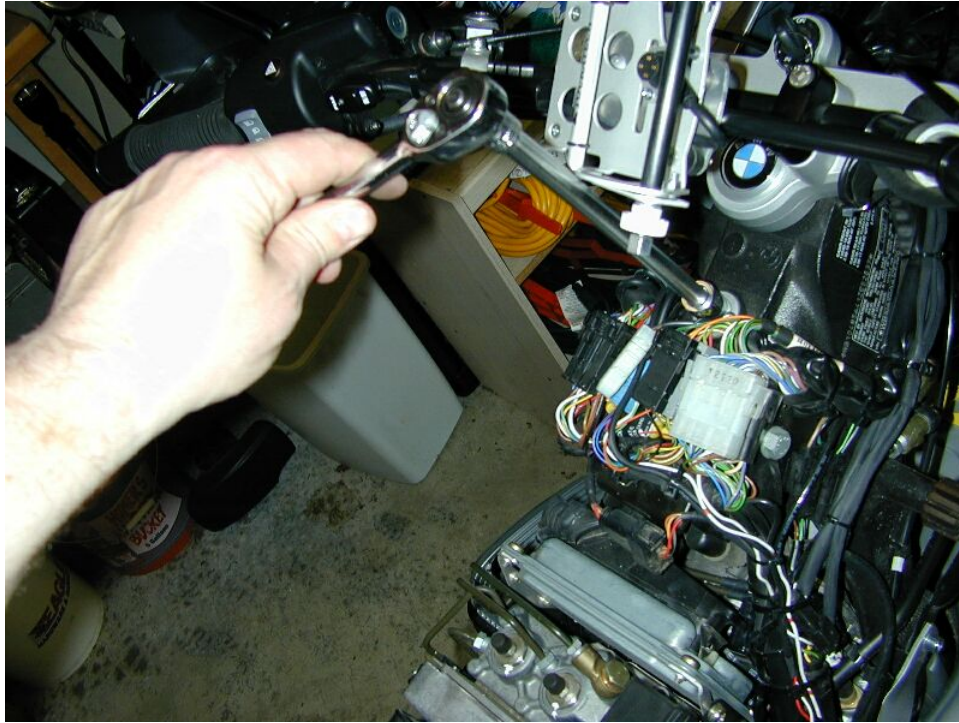
11. There's a whole lotta shit under there!



12. Remove bottom shock bolt using a 15 mm socket and a 14 mm box end wrench.



13. Remove the shock top bolt.



14. Out with the old...in with the new!

15. Test fit the top nut on the threads of the Ohlins shock. If need be, dress the threads so that the nut threads on easily.



16. Swap the rubber bushing.



17. Fit the shock in where the old one was... Use the bolt to hold it in place while you work on the top.



18. Put all the top crap back on. Be sure not to catch any wires underneath anything. Use Loctite. Torque the bolt to 45 NM using a 15 mm socket and the torque wrench.



19. Put the bottom nut on the bolt. Use Loctite. Torque to 50 NM using a 15 mm socket and the torque wrench.



20. Put the tank back on. Fit the tanks inside mounts on the frame rubber bumpers (you'll see 'em). Also make sure the rubber seal that mates the tank to the body panels doesn't get pinched. Re-connect all the hoses and the electrical plug. Install the nut and bolt - use Loctite. Torque to 22 NM with a 6 mm hex socket and the torque wrench.



21. Put the side cover and the seat back on
22. Grab a cool one and toast the fact that you've just saved ~ \$200 if you did the F & R shocks yourself!

Notes

(See Adjust your Ohlins section for tuning)

Install Ohlin Shocks (rear)

Tools:

hex sockets (4 mm, 6 mm, 8 mm)
metric sockets (15 mm - 3/8", 17 mm - 1/2")
box end wrenches (8 mm, 13 mm, 14 mm)
3/8" socket wrench
Torque wrench
Socket extensions (3/8" drive, 1/2" drive)
Breaker Bar
Dykes
Plastic mallet
Loctite
Rag



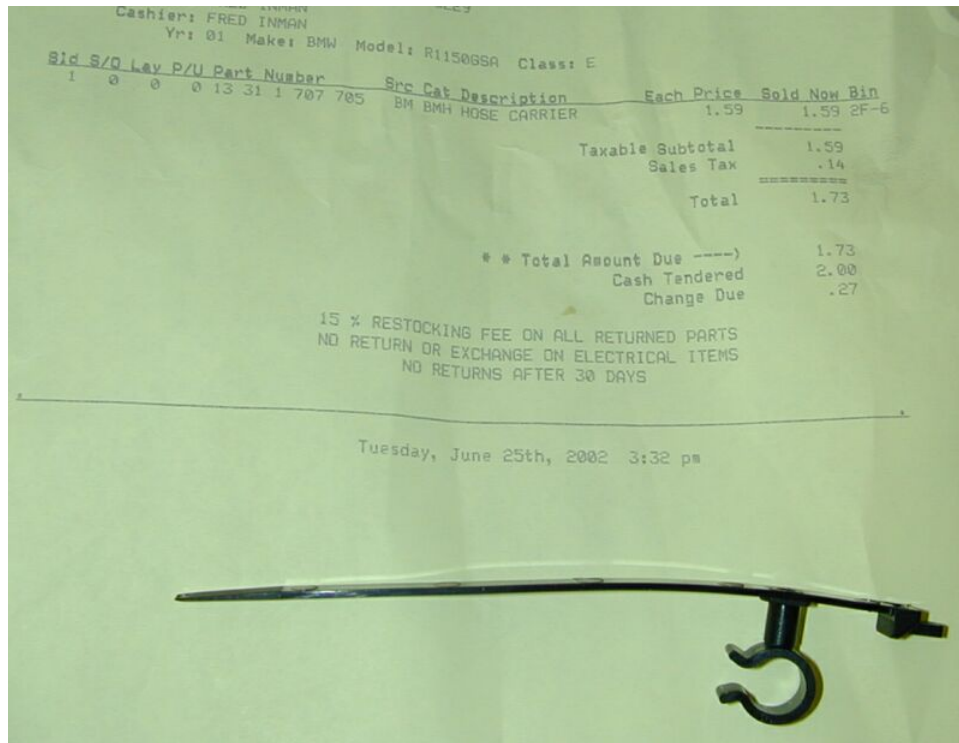
General Instructions

1. Use copper based anti-seize on all bolt threads except where Loctite is used

Parts:

Replacement Shock

BMW Hose Carrier (p/n 13 31 1 707 705)



Instructions:

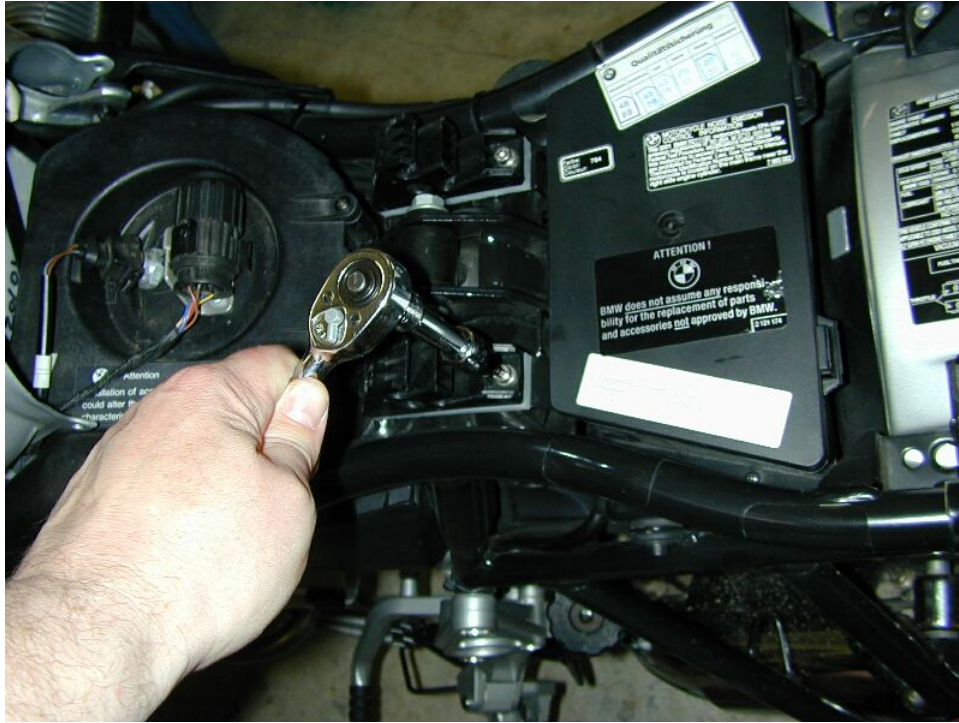
1. Put the bike on the center stand, put the bike in gear and take the seat off.
2. Remove the rear brake caliper (2 bolts) with an 8 mm hex. Cut the ty-wrap that holds the ABS sensor wire to the hydraulic hose nearest the caliper. Use a piece of bailing wire (or other suitable wire) to hold the caliper out of the way once it is free of the wheel. To aid in removal, rock the caliper back and forth to spread the pads apart. For further information on this procedure look for our paper, r-BFD.



3. Take off the rear wheel (4 bolts) with the 17 mm socket.



4. Remove the front seat supports (4 bolts) with a 4 mm hex.



5. Remove the spring preload adjuster (nut & bolt) with a 6 mm hex and 13 mm box.



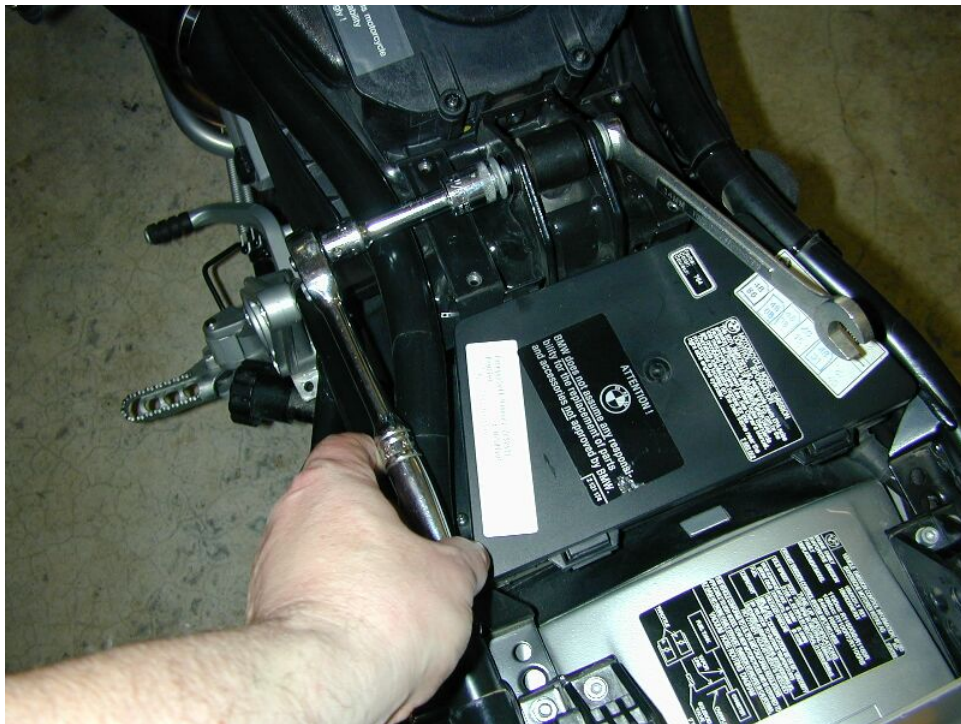
6. Cut the zip tie holding the spring preload adjuster fluid line using the dykes.



7. Remove the bottom shock bolt with a 8mm hex and a 8 mm box. Because the socket wrench contacts the exhaust system, I had to use an 8 mm box and the socket to get the bolt out. If you chose to remove the muffler, it will add another step, but this will make removing the bolt easier. It's a good idea to put upward pressure on the rear swing arm to release the load on the bolt. Remember to support the final drive/drive shaft, BEFORE removing the bolt.



8. Remove the shock top bolt with a 15 mm socket and a 14 mm box.



9. Take the old shock out!!!



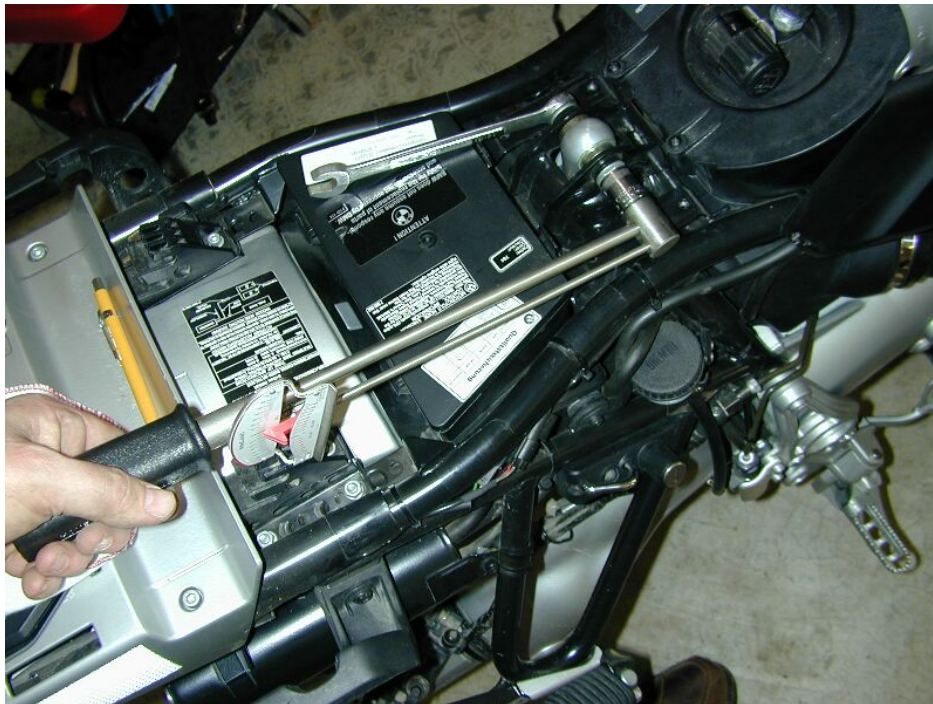
10. Fit the new Ohlin in. Be sure the spring preload adjuster line is on the back side. Slide the top bolt in place to hold it the shock while you fit everything up.



11. Route the spring preload adjuster fluid line (BE SURE NOT TO KINK THIS LINE). Hand tighten the bolt and nut for the spring preload adjuster to hold it in place.



12. Use Loctite on bottom bolt. Insert it while lifting the swing arm so it slides through easily. Torque it to 58 NM.
13. Use Loctite on top bolt. Torque it to 50 NM.



14. Use Loctite on the spring preload adjuster plate securing bolt.



15. Zip tie the spring preload adjuster fluid line for strain relief using the BMW Hose Carrier.



16. Put the rear wheel back on. Cross-tighten first to 72 NM, then to 105 NM

17. Re-attach the rear brake. Tighten to 40 NM.
18. Put seat supports back on.
19. Put seat back on.
20. Beer time!!!

Notes

(See Adjust your Ohlins section for tuning)

Adjust Your Ohlins

Part I

R1150GS - Ohlins

Front - 46ER



Rear - 46DRS



What does this all mean? Well, here are the Ohlins codes.

Type

E - Emulsion type of shock absorber.

D - De Carbon type of shock absorber with internal reservoir in the main body.

P - De Carbon type of shock absorber with external "piggy back" reservoir.

H - De Carbon type of shock absorber with hose mounted external reservoir.

W - Shock absorber delivered without spring.

K - Emulsion type of shock absorber for cruiser bikes.

Q - Progressive damping shock absorber with two pistons.

Features

C - Adjustable compression damping. Adjuster wheel on the reservoir.

R - Adjustable rebound damping. Adjuster wheel on the piston shaft above the end eye.

S - Hose mounted hydraulic spring load adjuster. Adjuster wheel on the hose.

B - Integrated hydraulic spring preload adjuster. Adjuster wheel on the adjuster.

L - Adjustable length. Adjuster nuts above the end eye.

So, at the front of your GS, you have a POS *emulsion* type damper (oil and gas mixed in main body) with rebound and pre-load adjustability only! Sorry about the

POS description, but there is no polite word for a \$600 Emulsion Damper! 🤔

Never add air to an emulsion type damper! Air + Oil + High Press. = KaBoom!! Use Nitrogen (an inert gas) only!

At the rear, you have a DeCarbon type damper (oil and gas *separated* in main body) with rebound damping and spring pre-load adjustability only (though the pre-load adjustment is via a remote hydraulic control). 🤔

Never add air to a DeCarbon type damper either! If the seals separating the two elements fail, well, Air + Oil + High Press. = KaBoom!! Use Nitrogen (an inert gas) only!

What you *want*, but can't have, at both ends are....

46HRCLS



A DeCarbon damper with adjustable rebound *and* compression damping, a remote reservoir, hydraulically controlled pre-load, and adjustability for length. But don't despair...

Part II

So you spent a fair amount of money on a pair of dampers that have only pre-load and rebound damping adjustment. (Jeebus, the front end of my cheap-ass Dakar has more adjustability, well, at least it does with the emulators installed). What are we going to do?

Well, some good news: Adjustable Compression Damping (you know, the stuff *you ain't got*) is over-rated as a tuning device, especially when the total motorcycle/rider package weighs 700-800lbs with fuel. And unless you can tune the high and low speed compression circuits separately, you may be better off leaving them alone. We will talk about it, but later. And low-speed rebound damping adjustability is probably best left to road racers on smooth courses. You have *High-Speed* Rebound Damping Adjustment and Pre-load. You also have a Damper built by some Nordic dudes who know their shit. They gave you their best estimates for the Damping that is not adjustable (the fact that low/high speed Compression Damping, and low speed Rebound Damping, etc., are not adjustable do not mean they don't exist. It just means you can't change them without taking the Damper apart and re-valving.) What you do have are quality springs (of, perhaps, the correct rate) and low friction shafts and seals. Without the quality of these components, adjustability doesn't matter, because the Damper will never respond the same way twice. This is what you spent your money for. Be happy. And get to work.

No Motorcycle Suspension system can be effectively tuned with the wrong springs!
But first, we need to agree on a few things.

Springs absorb loads, but do not dissipate them. Springs, absent friction, will continue to oscillate indefinitely. I hear the Swiss can make a pretty nice watch from an un-damped spring.

Pre-load does not effect spring rate (stiffness). In fact, IMHO, pre-load is the Devil's own playground. I hate pre-load. It has screwed up the handling of more bikes than all other suspension adjustments combined. I try to run all my bikes at near ZERO pre-load (almost impossible, but less, IMHO, is generally better), and go to more expensive progressive springs if required to attain this. And understand what I mean by progressive. "Soft initially and rising to a constant early in the travel, and remaining constant after that" The same applies to linkages. Most "rising rate" linkages, IMHO, are exactly WRONG! *"You do not want to be increasing spring rates with the bike under heavy loads"* (unless, of course, you are jumping the thing. MX bikes use up to 25% rising rate, and huge travel, for this reason). This is a guaranteed loss of traction event. *"You want to soften the spring rate when this load is small"*. A fine point? Maybe, and by that I mean *"Hell No"*.
PS - Some GP teams run linkages that go to a *decreasing* rate near max travel. Think about it. Damn, where was I? Right.

Dampers are what dissipate the load. They do this by removing the energy absorbed by the springs via the heat caused by restricting the flow of damping fluid inside your unit. This energy is lost forever. Second Law of Thermodynamics. More important than any political dogma you may study. Trust me on this one.

And damping is indeed the Devil's limb. Because what we want is damping that changes to match the energy we are storing in our springs. Store more energy quickly (as in hitting a big bump at speed), employ more damping. And viscous damping does exactly that. But you can't have it. Viscous damping is caused for the most part by internal friction within the fluid as it flows over a surface or through a pipe. So if we pushed our damping fluid through a long tube, we would have a very nice linear damping system. If the flow velocity doubled, so would the viscous damping resistance. But the damping would change properties with temperature and such a system won't fit on the motorcycle. So we stuff our fluid through orifices and past discs, which also results in shearing but dissipates a lot of energy through turbulent flow. The problem here is that the resistance goes up as the *square* of the velocity. So if our damping "Z" matches our spring at "X" velocity, it will be 4Z at 2X, which is twice what we want. But the good people at Ohlins and elsewhere are quite aware of this, so they combine washer stacks and orifices that expose greater areas to flow at higher velocities and give us a very good approximation of linear damping response at all velocities. It also means that internally modifying dampers should be left to those who have taken the time to understand the various circuits and how they effect one another. And there is a ration-and-a-half of information regarding what frequencies we ant to damp and which we want to allow in the three texts I recommend at the end of this piece.

So maybe a little set-up wisdom?

Part III

Set-Up, Pre-Load

First things first

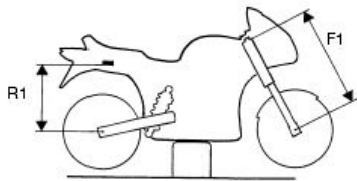
Check your tire pressure! No point in working on the rest if this is wrong. Get it right.

You will need a friend to help you. (Sorry, Pep, guess you will have to hire someone!)

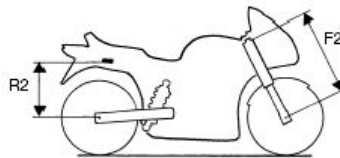
Step 1 - (And this is right out of the Ohlins manual) Place the bike on a smooth level surface off the center stand. Find a place to measure from the chassis to the axles as near to directly above the axles as possible (like the front fender and the seat). (OK, now you may need *two* friends, and another 25% of you are fucked). Place a little piece of tape to mark horizontally your measuring spots on both the front and rear of the bike. Be precise! With no rider on board (I would add 1/2 tank of fuel) lift each end of the bike until the suspension is totally extended. Measure from the axle to your previously marked horizontal points. Record these as **A-front and A-rear**.

Step 2 - Let the bike settle under its own weight. Ohlins doesn't address this, but if it were me, I would back off *ALL* the rebound damping (and write down where it *was* set so we don't get confused) and bounce it up and down a few times. Take another set of measurements from the axles to our horizontal marks. Then do it again and make sure we are getting repeatable numbers. If worse come to worse, compress the springs and slowly release. Record this number. Extend the springs and slowly release. Take the *average* and record these as **B-front and B-rear**.

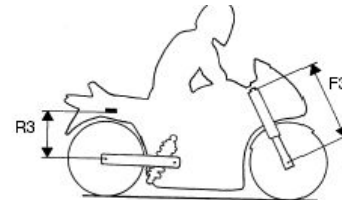
Step 3 - Same as step 2, but this time with the rider seated in the normal position, feet on the pegs (*Three* friends? Another 25% of you are shit-out-of-luck!) Again, take the numbers front and rear, and repeat until we get repeatable readings. Compress and extend (slowly), and extend and compress slowly, to attain an *average* if required. Record these as **C-front and C-rear**. Go have a beer, and don't forget a few for your mates.



A-D. Bike on a stand.



E. Bike on the ground.



F. Bike with rider on.

Settings

Basic settings

Always ensure that the basic setting made by Öhlins is correct. It is adapted to the make and model (in its original state) and for a rider of average weight.

Everything must harmonize

In the recommendation table there are Öhlins front fork springs that are specifically adapted to the shock absorbers recommended to your motorcycle. If none is noted in the table then "intact" original springs is the right choice. Incorrect spring action can give a fork angle that is too steep or too flat. This in turn will give a tendency for oversteering or understeering, which could seriously affect the handling characteristics of the motorcycle.

Setting the spring preload

Measuring:

Preload on the spring/springs is very important, because it affects the height of the motorcycle and the fork angle. Consequently, handling characteristics can be changed, even negatively.

Proceed as follows (it will be much easier if done by two persons):

- A** Place the motorcycle on a stand.
- B** Lift up the rear end to a fully extended position.
- C** Measure the distance, eg, from the lower edge of the rear mud guard or from a point marked by a piece of tape, immediately above the rear wheel axle, to the wheel axle. (R1)
- D** Make a similar measurement on the front axle, e.g., from the bottom of the upper fork crown to the front wheel axle. The fork must also be fully extended. (F1)

E Allow the motorcycle (without rider) to apply load on the springs and repeat the measuring procedure. (R2, F2)

F Then take the same measurements with the rider and equipment on the motorcycle. It is important that the rider has a correct riding posture, so that the weight is balanced on the front and rear wheel in the same way as when riding. (R3, F3)

The measurements may not differ from the following sizes:

Without rider:

Rear: 5-10 mm (R1-R2)
Front: 25-30 mm (F1-F2)

With rider:

Rear: 30-40 mm (R1-R3)
Front: 35-48 mm (F1-F3)

What do Ohlins consider acceptable?

(These seem to be generic street bike #'s)

A-B (front) = 25-30mm

A-C (front) = 35-48mm

A-B (rear) = 5-10mm

A-C (rear) = 30-40mm

What do I consider acceptable for a GS?

(Allowing for GS's increased travel, and maybe a little consideration of BMW's rather unique suspension geometry. I flipped Ohlins off an email about this. Their response was fuck-all)

A-B (front) = 25-30mm

A-C (front) = 35-55mm

A-B (rear) = 5-10mm

A-C (rear) = 30-63mm

What do I have on the Dakar?

(210mm travel F/R)

A-B (front) = 30mm (smooooooth)

A-C (front) = 55mm (seems high, but this is a progressive spring!)

A-B (rear) = 5mm (pre-load on the high end)

A-C (rear) = 68mm (Probably need a stiffer spring!)

What does this all mean? Well, if when A-B is at min value (max pre-load) and A-C is higher than the allowable range, your spring is too soft. When A-B is at max value (min pre-load) and A-C is lower than the allowable range, your spring is too stiff.

Everything in between is just rider preference, and (should be) within the tuning range of your Adjustable Rebound Damping.

If your pre-load cannot be adjusted to arrive at this range of settings, you have the wrong bloody spring. I would raise hell, since all of the internal damping (except High-Speed Rebound, and probably most of that) is set by the factory to match the installed spring, I would be looking to trade *The Spring and Damper Assy* for a new calibrated set. Ohlins will not want to do this. TS - Raise Holy Hell!

If you can achieve these numbers, and considering that a GS has somewhat longer travel, *I would try for the high end of all of these ranges*. A-C for road racers is generally 25% of available travel. For street bikes 30%. For *long travel* dirt bikes, 23%. I personally think that 1/3 travel in droop and 2/3 in bump is what is really wanted if the springs are correct and the damping is properly set and of high quality. But I do seem to be in the minority with those numbers. I also think 9" of properly designed travel F/R is near optimum for a dual sport. YMMV.

Final thoughts on pre-load: The world is not just bumps, it is holes as well. If the pre-load is too high, your suspension will not be able to "drop" very much into all the holes you encounter, and will have to overcome the pre-load to react to the bumps as well. Use pre-load to set your bike's attitude. Change the springs if your suspension is too soft or too firm. And be honest about how and where you ride.

Part IV

Fuck me, Almost 10pm and here I am sober as a judge. Crap. Well, let's get rebound damping out of the way so I can mix up a pitcher of Cosmopolitans and get, well, civilized. 😊

Ok, we all wrote down where the factory rebound settings were, didn't we? Put them back there. Ready for a ride now? Hell no, not after all those beers you and your mates just drank while measuring pre-load. Sober up.

When, and if, that finally occurs, here are the symptoms that you will be looking for, and how to adjust them. Make small changes, and *Write Everything Down!!* Try all sorts of surfaces. You may find one set of settings best for around town, one type best for gravel, and yet a third best for fast sweepers. It's *ADJUSTABLE* mate, so learn how to use it. How nice to be able to change your bike from "Canyon Carver" to "Fire-roader" in three minutes (or less). If you write your settings down in a little notebook, it will be a snap to do so. Ignore your mates "Dorkus Maximus" comments. Smile politely when you pass them.

Front: Lack of Rebound - Symptoms:

- Forks are plush. But increasing speed causes loss of control and traction.
- The motorcycle wallows exiting the turn causing fading traction and loss of control.
- When taking a corner a speed, you experience front-end chatter, loss of traction and control.
- Aggressive input at speed lessons control and chassis attitude suffers.
- Front end fails to recover after aggressive input over bumpy surfaces.

Front : Too Much Rebound - Symptoms:

- Front end feels locked up resulting in harsh ride.
- Suspension packs in and fails to return, giving a harsh ride.
- Typically after the first bump, the bike will skip over subsequent bumps.
- With acceleration, the front end will tank slap or shake violently due to lack of front wheel tire contact.

Yes, too much rebound will give exactly the same symptoms as too stiff a spring!!!!
 But we have already determined that "our" spring rates are close. Which is why we pretended to like those people that held up our bike and drank all our beer while we set the spring rates *before* we adjusted our damping.

Rear: Lack of Rebound - Symptoms:

- The ride will feel soft or vague and as speed increases, the rear end will want to wallow and/or weave over bumpy surfaces and traction suffers.
- Loss of traction will cause rear end to pogo or chatter due to shock returning too fast on exiting a corner.

Rear: Too Much Rebound - Symptoms:

- Ride is harsh, suspension control is limited and traction is lost.
- Rear end will pack in, forcing the bike wide in corners, due to rear squat.

It will slow steering because front end is tiding high. When rear end packs in, tires generally will overheat and will skip over bumps.

- When chopping throttle, rear end will tend to skip or hop on entries

Last piece of wisdom: Avoid the "Hero" settings (Gee, I'm so fucking fast that I *MUST* need everything cranked up to the max). I know people who are faster than you. Most of them like to run as soft as control allows. It's your bike, set it up for your style. And just lie about the "hero" settings like the rest of us.

The following titles are all highly recommended and expensive:

Motorcycle Design & Technology: How and Why

- Gaetano Cocco

Motorcycle Handling & Chassis Design

- Tony Foale

Motorcycle Dynamics

- Vittorio Cossalter

More:

http://www.ohlins.com/pdf/road_and...k_absorbers.pdf

http://www.ohlins.com/pdf/ultimate_tuning_bike.pdf

<http://www.ohlins.nl/kroon.htm>

<http://www.geocities.com/MotorCity/...Suspension.html>

<http://www.ansusa.com/SuspensionGuide.htm>

<http://www.motocross.com/motoprof/m...s/sustable.html>

<http://www.race-tech.com/rt/ServicesDetail.asp?pid=15>

<http://www.stmotorcycles.com/stm/ar...on%20Tuning.htm>

<http://www.racebikesite.com/motorcy...difications.htm>

4-Way Damping

FWIW - I have had excellent results with the following set-up:

Low-speed compression damping - Medium (helps to control pitch by damping the motion of motorcycle on the *loaded* wheel, front under braking, rear under acceleration). But this is also affected by the MC's geometry (anti-squat / anti-dive).

High-speed compression damping - As light as possible. This is the spring's job. Tune the spring rates.

Low Speed rebound damping - As light as possible (I want the *unloaded* wheel on the ground)

High-speed rebound damping - Medium to firm, but most of all, matched to the spring rate.

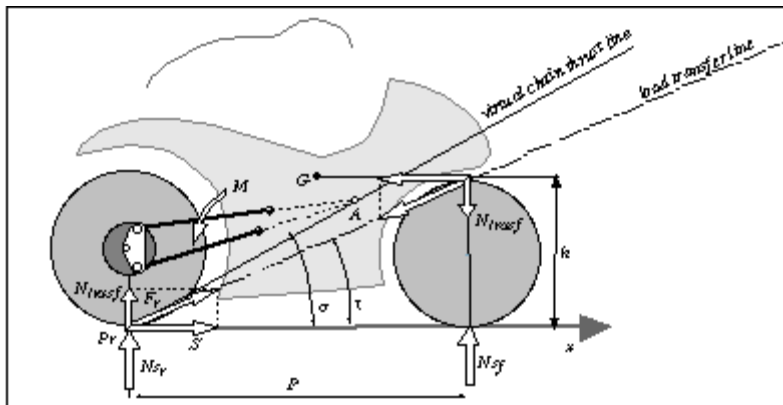
The problem is describing what these terms mean. Two of them (high speed compression and low-speed rebound) are easy enough. I try to take as much out as I can. But what do we mean by "medium" or "firm"? The only solution is to ride and tune.

What is interesting about BMW's unique suspension solutions is how they affect dive and squat, and my thinking would be to go easy on the low-speed compression damping. I would think you would want to test under power, under braking, and steady state for all of these conditions.

Telelever Thread

<http://www.advrider.com/forums/show...=&threadid=3179>

Paralever Geometry and Article



<http://translate.google.com/transla...l%3Den%26sa%3DG>

About the Author

Jinx is a reclusive hermit who occasionally makes pilgrimages to the statue of Lenin, proudly displayed in Fremont, WA. I think he does something in the realm of science (political or physical). Little else is known...