

Suspension Basics

For improved comfort and safety



Motorcyclists travel under an extremely wide variety of conditions. Busy city traffic, country lanes with potholes, motorways and slippery mountain roads with hairpin bends.

In every situation you should be able to place blind faith in your shock absorbers, which in fact form the link between you and the road. The road holding of your motorcycle determines your safety. With this in mind, it's vital that the factors which control the road-holding are in good order. This is true not only for the speed-kings on the circuit, but also for relaxed tourers.

In this section we want to explain to you the basics of motorcycle suspension and some of the effects it can have. Reading this information contained is well worthwhile, especially if you wish to equip your machine with high quality components and are interested in increasing your comfort and safety on the road.

You will also find a table that will help you to test your shock absorbers and front forks yourself. With the test results and the additional information you will be able to gain considerably more pleasure from motorcycling.

BASICS OF SUSPENSION

If the shock absorbers and front forks function optimally, you will hardly notice the effects from the surface you are driving over. The mass of your motorcycle moves forward in a constant line, while the wheels and shock absorbers soak up the 'jolts and bumps'.

That absorption of the 'jolts' is achieved by the spring and the damper that are incorporated into the shock absorbers. The spring, but especially the damper, repress the jolts and bumps from the surface. The outgoing force from the spring is also absorbed by the same damper. The positive result of this is that you do not roll and pitch, or even worse, leave the road surface. Briefly, in other words: The most important function of the spring is to bear the weight of the motorcycle and prevent the shock absorber from being fully compressed. The spring also helps ensure that the motorcycle is always returned to its original position. The damper represses all in and outgoing movements and contributes to stability. With a well functioning shock absorber and front forks you are able to ride with stability, comfort and safety.

Poorly functioning shock absorbers are always dangerous and inhibit optimum comfort. What are the effects of poorly functioning front forks and/or shock absorber?

- Bouncing and rolling of the motorcycle after riding over a bump or pothole.
- Shocks through the suspension after riding over a bump or pothole.
- Continuous heavy steering required to keep the motorcycle in one line.
- Steering difficult in bends and tyre 'wandering'.
- Front forks pull towards the straight line and the rear suspension swings (unstable motorcycle).

On the following pages you can read how to perform a test to help you determine the cause of dangerous conditions as described above. A cause requires a solution, so solutions have been included too. Even if the above conditions cannot be clearly established, but you nevertheless have a feeling that the 'handling' of your machine could be improved, you can still perform the same tests. The results of the test will enable you to determine if the performance of your shock absorber and front forks can be improved.

Test your bike's suspension performance yourself

Three first test routines are described below which can all be performed on a stationary motorcycle. Go through the three steps one after the other. It is always useful if someone is there to help you, by holding the motorcycle upright, while you carry out the examination.

1. Pull in the front brake and apply your full weight onto the front suspension, release your weight at the lowest point.

Ideally, the motorcycle will spring rapidly back into the upright position. The front forks should be adjusted so that motorcycle springs back evenly and stop at once. The machine should not bounce, neither should it shoot up roughly or rise back up very slowly.

2. Force down the rear of the motorcycle into the spring(s) as far as you can, releasing it at the lowest point. The motorcycle should rise back up with a smooth and flowing motion (controlled by the shock absorber). Too rapid spring back is undesirable, so is bouncing or a very slow spring reaction (too much rebound damping).

3. Sit on the motorcycle in your normal riding position. This will apply normal static load to the springs. The motorcycle should move evenly on the springs at both the front and the rear. If this is not the case the adjustment between front and rear is not in balance.

If your motorcycle shows normal behaviour in the above tests your suspension and damping seem to be in order, but 'standard'. If you don't think standard is good enough and would like the suspension effects of your shock absorber and front forks to meet your 'personal' preferences, we suggest you perform a more extensive road test (see next). You may have a personal preference with respect to the comfort and characteristics of your motorcycle. The ideal suspension for yourself can be realised if you take the weight with which your motorcycle will be loaded into account (solo and/or with pillion passenger or luggage). If you wish to ride comfortably and safely, the suspension should be adjusted to the circumstances under which you usually ride for long periods of time. Using the results of the road test you can determine which components require adjustment and how they can best be adjusted.

The road test is especially recommended if, following the three stationary tests, you have established that the suspension is functioning properly. You can also try to solve the problems encountered by readjusting your shock absorbers and front forks. If readjustment does not provide the required result you can make use of the trouble shooting section mentioned further. The solutions can also be applied in case you have a shock absorber and front forks that do not function correctly, and which you cannot adjust because no adjustment options are available.

Some important notes to performing a road test:

- Always use the same test route.
- First, set all adjustments to the standard factory settings (only applicable if these adjustments

have been changed).

- Naturally, you must always wear a helmet and protective clothing.
- Wear the same clothing, sit in the same position and drive at the same speed.
- Drive with extra caution. Driving a road test requires double concentration. You not only have to pay attention to traffic, but also to the behaviour of your machine.
- Test critically. A modern sport motorcycle often has so many adjustment possibilities, that an inexperienced mechanic will have difficulty in making the correct adjustments. In any case, first try the standard settings recommended by the manufacturer.
- When making adjustments, always only adjust one setting at a time.
- Always record any adjustments you make, and the effects they have. You don't need to be afraid of getting confused. After all, you can always return the motorcycle to the standard factory settings when you take notes.)

A few technical terms explained

Before you actually start your test rides, it is worthwhile knowing a little shock-absorber jargon. To start with, **spring pre-load**. This setting influences the height at which your motorcycle will ride. The higher the spring pre-load, the higher the riding height of the motorcycle. The spring pre-load can be adjusted by turning the spring collar/spring retainers, which may also be fitted with a locking ring. When you place the motorcycle on its wheels, the front fork will settle, by several centimetres, under the weight (sprung mass) of the bike. This is known as the "**negative spring distance**", "**sag**" or "**neutral riding position**". This negative spring distance (without rider) should be somewhere between 15% and 35% of the **total spring distance** (fork or shock stroke). Example: the total spring distance is 120 mm. The negative spring distance therefore should be between 20 and 40 mm. This can be easily measured by winding a cable tie around the shock-absorber spindle(s). With rider, the spring distance should be between 35% and 50%. Example: the total spring distance is 70 mm, so the negative spring distance should vary between 25 and 35 mm.

Compression absorption occurs when a shock-absorber or front fork is compressed, while **rebound or bump absorption** describes the opposite effect.

From diagnosis to therapy.

To help you rapidly find the source of your problems (and then solve them) what follows is a brief total overview of several different suspension problems.

[TROUBLE SHOOTING OVERVIEW]

REAR SUSPENSION

Complaint

1. - too little negative suspension travel

- motorcycle shocks through the steering in ruts or when accelerating
- shock absorber appears immobile
- uncomfortable
- overloading on front forks when travelling downhill or braking

Cause

- spring pre load too high

Solution

- reduce spring pre load
- fit a softer spring if necessary

Complaint

2. - motorcycle dips too deeply on suspension
- too much negative suspension travel ("sag")
 - uncomfortable
 - tendency to shocking
 - motorcycle wanders on uneven surfaces

Cause

- spring pre load too low

Solution

- increase spring pre load
- fit a harder spring (or springs)

Complaint

3. - very uncomfortable
- rear wheel tends to bounce in fast bends especially when accelerating
 - rear wheel bounces over uneven surfaces

Cause

- compression damping too hard

Solution

- adjust damping to softer level
- have the shock absorber adjusted internally
- have worn shock absorbers repaired or replaced

Complaint

4. - Rear suspension bottoms out
- motorcycle and rider subject to hard bumps
 - Noticeable movements in the frame, particularly when accelerating out of bends

Cause

- compression damping too soft

Solution

- set compression damping harder
- have the shock absorber adjusted internally
- have worn shock absorbers repaired or replaced

Complaint

5. - motorcycle suspension extremely sluggish
- rear wheel unable to cope well with uneven surfaces
 - tendency to bounce on bumpy surfaces
 - uncomfortable
 - tendency to snake in ruts

Cause

- rebound damping too hard

Solution

- decrease the rebound damping
- possibly increase spring pre-load
- replace shock absorber

Complaint

6. - motorcycle suspension extremely lively
- constant movement in the rear suspension
 - rear wheel has tendency to bounce / wobble

Cause

- rebound damping (rebound) too soft

Solution

- increase the rebound damping
- reduce the spring pretension if necessary
- have worn shock absorbers repaired or replaced

FRONT SUSPENSION

Complaint

1. - front forks sluggish/nearly immobile
- handlebars "jump" in your hand when accelerating and crossing ruts
 - uncomfortable
 - front wheel bounces / chatters on poor road surfaces

Cause

1. - spring pre load too high
- spring too hard
 - air chamber too small

Solution

1. - reduce spring pre load
 - fit softer springs or progressive springs with a lighter initial strength
 - increase air chamber (reduce oil level in front fork)
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Complaint

2. - motorcycle sags too deeply on the springs
 - too much negative suspension travel
 - Suspension occasionally bottoms out
 - front forks shake when braking and travelling downhill
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Cause

2. - spring pre load too low
 - springs too soft
 - air chamber too large
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Solution

2. - increase spring pre load
 - fit stiffer springs or progressive front fork springs with a heavier initial strength
 - reduce air chamber (increase oil level in front fork)
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Complaint

3. - front forks sluggish/nearly immobile
 - shocks in the steering when accelerating
 - front wheel chatters when braking hard
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Cause

3. - ingoing (compression) damping too hard
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Solution

3. - reduce the ingoing (compression) damping
 - possibly use lower viscosity fork oil
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Complaint

4. - front forks shock when braking and on uneven road surfaces
 - dips rapidly when braking
-

Cause

4. - ingoing (compression) damping too soft
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Solution

4. - increase the ingoing (compression) damping
 - possibly use higher viscosity fork oil
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Complaint

5. - front forks spring back slowly

- uncomfortable
- front wheel unable to cope with uneven surfaces
- indirect steering behaviour

Cause

- 5. - outgoing (rebound) damping too hard

Solution

- 5. - reduce the outgoing (rebound) damping
- possibly use a lower viscosity fork oil

Complaint

- 6. - front end is lively
- bouncing and shocking on uneven surfaces
- front forks spring back too quickly

Cause

- 6. - outgoing (rebound) damping too soft

Solution

- 6. - increase the outgoing (rebound) damping
- possibly use a higher viscosity fork oil

Complaint

- 7. - front forks shock
- front wheel shudders
- not enough progressive hardening of the spring towards the end of travel

Cause

- 7. - air chamber too large

Solution

- 7. - increase the oil level in small steps of 5 to 10 mm

Complaint

- 8. - forks hard
- tendency to shock in the steering
- front wheel bounces when braking due to hydraulic stop blocking
- uncomfortable

Cause

- 8. - air chamber too small

Solution

- 8. - decrease the oil level in small steps of 5 to 10 mm
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