PENSKE
RACING SHOCKS®

Main Office
150 Franklin St. • P.O. Box 1056
Reading, PA 19603
(610) 375-6180 • (610) 375-6190 Fax

Motorcycle Suspension Tuning Guide

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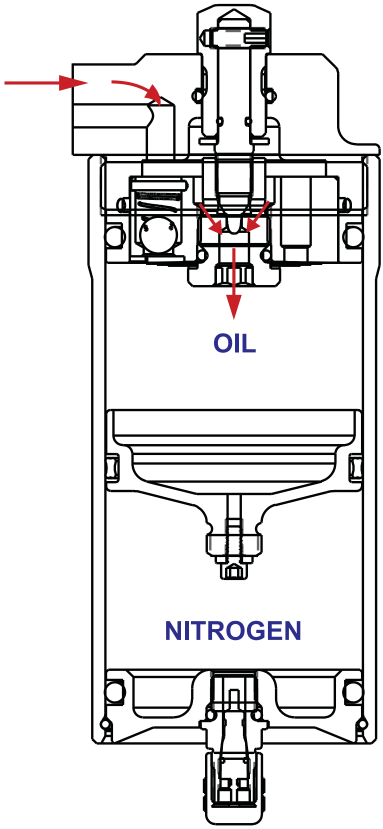

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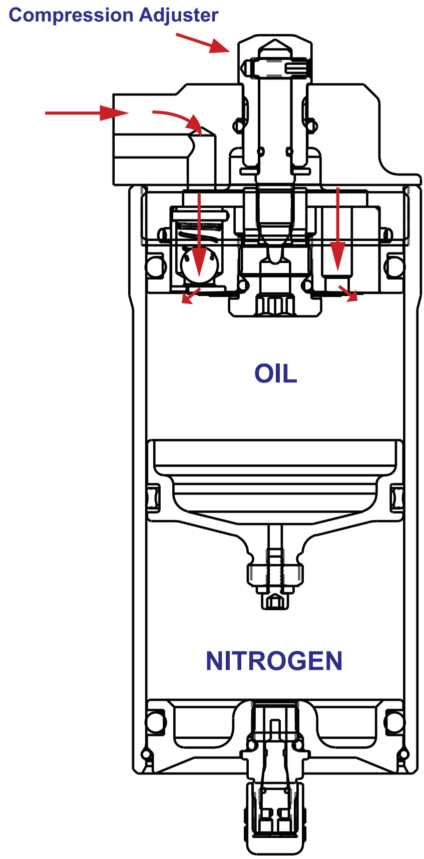


8983 Series Compression Adjuster

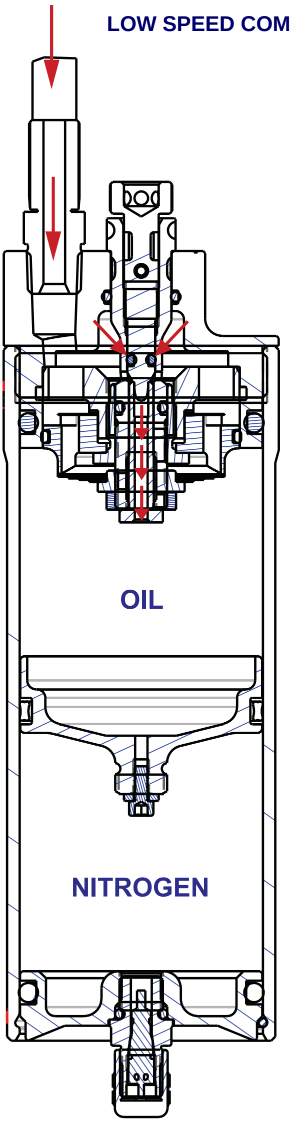
COMPRESSION ADJUSTMENT

In the state of low shaft velocities (i.e. corner entry, exit, and power down), oil is displaced within the damper in direct proportion to the volume of the shaft entering the body. The displaced fluid passes through the compression adjuster where it is metered through a fixed, low speed bleed orifice. Due to the small diameter of this orifice and the viscosity of the damper fluid, a pressure loss occurs across the orifice. This loss of pressure is a loss of energy in the fluid due to friction and the subsequent opposing damping force is generated.

As the shaft velocities increase, the same amount of fluid must pass through the low speed bleed orifice, but at a much higher rate. The viscosity of the fluid causes a greater resistance to flow at the orifice entrance which in turn produces a large internal force on the CD housing. The other major internal components, namely the piston and shim cage, are designed to handle this extra force by allowing the shims to “blow off” proportionally to the extra force generated, much like a coil spring compresses proportionally to the axial load applied. With this arrangement, the low speed bleed orifice still meters fluid during high speed shaft movements, but the extra forces generated are handled with the shims which have less resistance to flow at higher velocities. They are designed to virtually bypass the low speed orifice and form a new fluid circuit. The force at which this occurs can be varied by turning the compression adjuster in or out, which preloads the shims. Therefore, as the preload on the shims increases, the static force required for them to activate is increased as well. The name designation for the parts also clue one in to their purpose, with the low speed bleed orifice handling low velocity bleed flows and the piston/ shim arrangement handling high velocity flows. This principle originated in the main shaft piston/shim arrangement and follows similar behavior.

NOTE: When making adjustments, use the **full soft** setting (adjuster wound all the way in against the reservoir body) as a starting point when counting the number of “clicks” to the desired setting. The full soft setting should correspond to a clicker number designation of **0**. This starting datum has been proven to be most reliable and repeatable when making compression adjustments. There are 22 +/- clicks of adjustment.

8987 Series Compression Adjuster

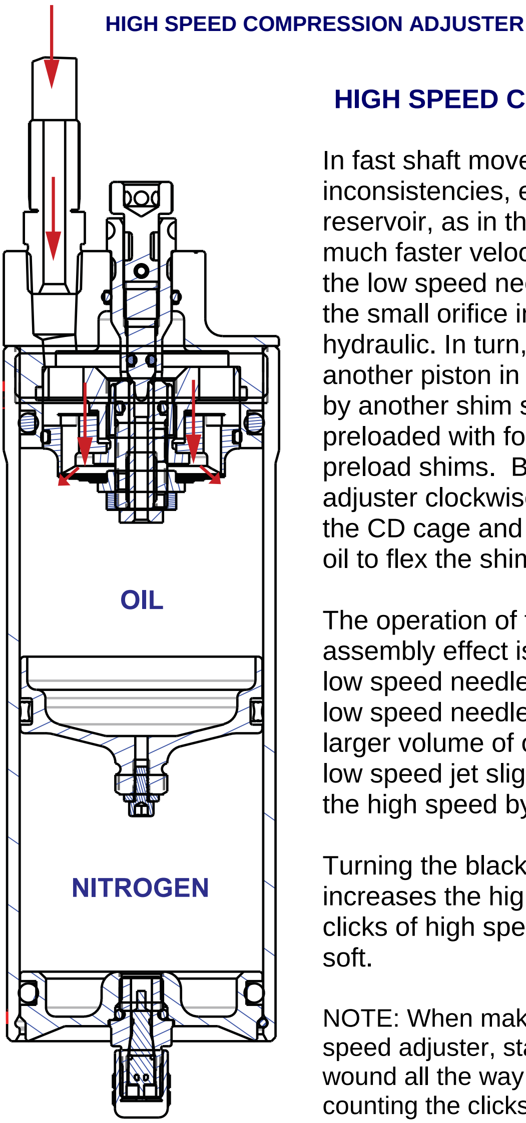


LOW SPEED COMPRESSION ADJUSTMENT

In the state of slow shaft movement (i.e., corner entry, exit, and power down), oil is displaced into the reservoir in direct proportion to the area of the shaft entering the shock body. The oil passes through the compression adjuster where it is metered through an adjustable needle and jet assembly. By shutting down the flow of oil, the oil is restricted, causing a stiffer feel in low speed circumstances. The low speed adjuster works in conjunction with the high speed adjuster to delay the high speed circuit.

The low speed compression bleed bypass adjuster has approximately 30 “clicks” of adjustment. Turning the adjuster knob clockwise increases the low speed damping.

8987 Series Compression Adjuster



HIGH SPEED COMPRESSION ADJUSTMENT

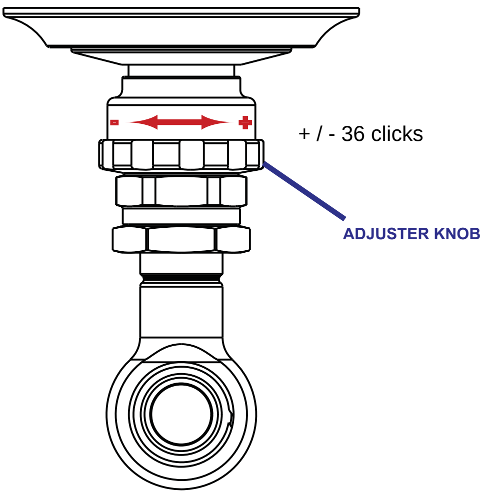
In fast shaft movement (i.e. bumps, track inconsistencies, etc.), oil is displaced into the reservoir, as in the low speed state, but at a much faster velocity. The oil is forced to bypass the low speed needle and jet due to the fact that the small orifice in the jet causes the oil to hydraulic. In turn, the oil is forced through another piston in which it's orifices are covered by another shim stack. This shim stack is preloaded with force from the CD cage and preload shims. By turning the high speed adjuster clockwise (stiffer), you are preloading the CD cage and shims, making it tougher for the oil to flex the shims.

The operation of the high speed adjuster assembly effect is timed by the adjustment of the low speed needle and shaft velocity. (i.e., if the low speed needle is full soft, at high speed a larger volume of oil will initially pass through the low speed jet slightly delaying the operation of the high speed bypass mode.)

Turning the black hex adjuster clockwise increases the high speed damping. There are 18 clicks of high speed adjustment counting from full soft.

NOTE: When making adjustments on the high speed adjuster, start at the full soft setting (adjuster wound all the way in against the reservoir body) counting the clicks toward full firm. When adjusting low speed, start at the full firm setting (adjuster wound all the way in against high speed adjuster) counting the clicks toward full soft. This makes your settings more precise and less confusing for your records.

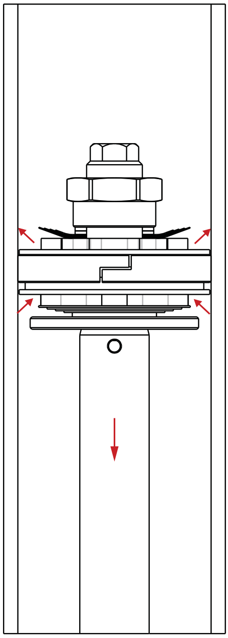
8900 Series Rebound Adjuster



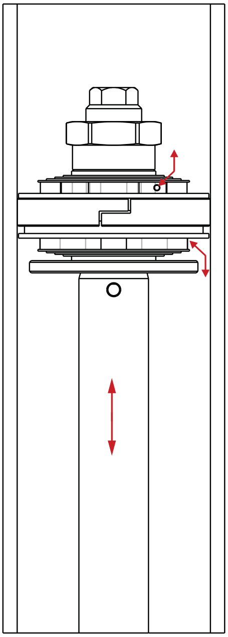
+ = More Damping
- = Less Damping

The adjuster (red knob) is located at the base of the adjustable platform. During the compression or rebound stage of the shock movement, fluid is forced through two ports in the main shaft. Inside the main shaft is a needle and jet assembly, which adjusts the amount of fluid passing through the jet. By turning in the adjuster (clockwise), the needle is forced up into the jet, restricting the fluid, causing firmer damping forces. In reverse, by turning the adjuster out (counter clock-wise), more oil is allowed to pass through the jet causing lighter damping forces. The adjustment assembly, is a timed control for the shims located on the main piston to work.

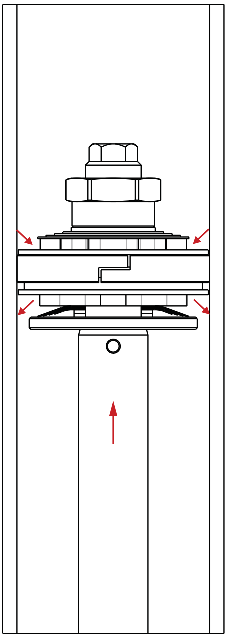
General Valving Characteristics



High Speed Rebound



Low Speed Compression and Rebound



High Speed Compression

The damping characteristics of your shock are determined by the compression and rebound valve stacks located on the main piston.

The valve stacks are made up of a series of high quality shims, which are made to flex under the force of oil flowing through the piston ports and then return to their original state.

The thickness of the individual shims determines the amount of damping force the shock will produce. By changing the thickness of the individual shims, damping forces will be altered. For example, if you are running an “A” compression valving, where all the shims in the stack are .006 thick and you replace them with a “B” compression valving, which consists of all .008 thick shims, the compression damping will increase.

* When the shaft is moving very slowly oil passes through the bleed hole, if there is one, before it passes to the shims.

Guide to Damper Tuning

The ultimate purpose of a shock is to work together with the spring to keep the tire on the track. In compression (bump) to help control the movement of the wheel and in rebound to help absorb the stored energy of the compressed spring.

Usually in rain or low grip situations allowing more bleed or less low speed damping is desirable to delay tire loading upon initial roll.

In dry high grip conditions adding damping or restricting bleed will load the tire sooner upon initial roll increasing platform stability.

A motorcycle with too much low speed damping will usually lack grip in change of directions, cannot put power down in slower corners (wheel spin) and lack overall grip after initial turn in. If traction is a problem coming off slow corners, reducing low speed damping or adding more bleed will help weight transfer at the rear thus increasing traction.

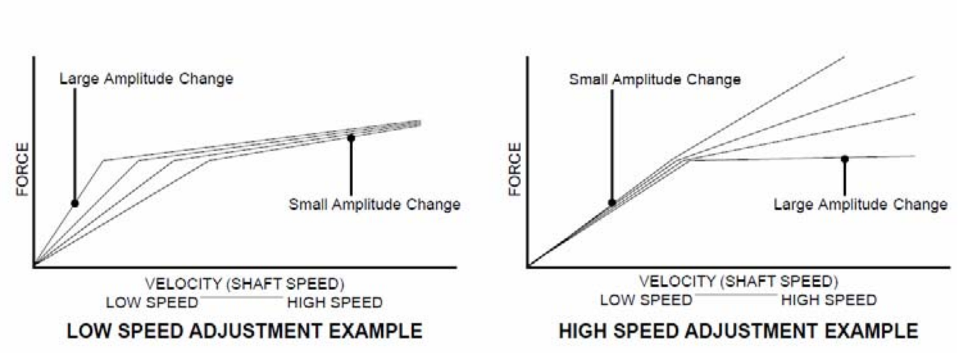
One of the most important things to know about these adjusters is their relative position to one an-other. If for instance you have the low speed set at 25 to 30 clicks (soft), the range of high speed adjustment will be lessened. Or in the opposite direction, if the high speed is set at 0 to 1 (off soft), the low speed adjustment range will be lessened.

Guide to Damper Tuning (cont'd)

Also, when making a big adjustment in high or low speed, the change will affect the other in a small percentage. As an example, the high speed is set at (+4) and the low speed at (-6). Now you want to set the low speed to (-2), this will also increase a percentage of the high speed force figure. By dropping the high speed from (+4) to (+3) would compensate for this low speed change so the overall "damper curve" would remain intact. The more experience you have with these the easier it will become to recognize what changes can occur in relation to different valvings. The tendency of these circuits to "cross talk" is greatly reduced in our new digressive CD piston.

The rebound adjuster consists of a needle metering flow across a hole. This metered flow bypasses the main piston/shim assembly until flow is choked off. The shims then modulate the flow.

Depending on valving, there will be an affect on adjustment range. The softer the valving (A - B), the less force range it will have. This is due to a lower pressure required to blow the valves on the main piston. Obviously the heavier the valving (C - E), the more effective the bleed becomes. On digressive pistons, pre-load also affects the range of adjustment.
Also, the amount of rebound can have a great influence on weight transfer.



Less front rebound allows weight transfer to the rear under acceleration. Less rebound in the rear allows for a greater amount of weight transfer to the front under braking and turn in.

When a motorcycle is over damped in rebound it can pack down in a series of bumps and a driver will recognize this as too stiff and usually will think it is compression damping. Too much rebound can cause lack of grip on cornering.

When making a large spring change keep in mind where the rebound adjuster is and do you have enough range to compensate. Sometimes a spring change will bring a better balance to the damping values after the spring change. If the spring/shock combination was balanced, the rule of thumb is a stiffer spring requires lower compression and higher rebound. A softer spring requires higher compression and lower rebound.

Basic Start-Up Procedure

The following setup procedures are basic recommendations for reaching an initial starting point using double adjustable Penske Racing Shocks. This procedure is ideal for use on an open test schedule. A race weekend may not allow enough time. Start by making the compression adjustments as described below, until it feels right, then move to the rebound adjustments.

COMPRESSION

The idea is to set the compression damping forces to suit the bumps in critical areas, such as corners, corner exits and braking zones.

Step 1 -Set the rebound adjuster at mid-range.

Step 2 -Starting with the compression setting at mid-range, ride a lap then return. If the bike feels harsh, decrease the settings one click at a time until the harshness goes away. If the bike feels plush, increase the setting on click at a time until the bike becomes harsh, loses tire compliance and traction. At this point you know that you have gone too far on the compression settings; back off one click.

COMPRESSION

The idea is to tighten up the bike, stabilize the platform and eliminate the floating "Cadillac feeling". This will also reduce the rate of weight transfer.

Step 1 -With the rebound setting at mid-range, add 4 or clicks of rebound adjustment at a time, then return to continue the process until the bike becomes "skittish" or the rear wheel hops under braking. At this point you know you have gone too far on the rebound settings, back off one click at a time for final balance.

Once again, this is a basic procedure for finding your initial setup for a given track. If you find that you are at the end of your adjustment range and feel that the bike is feeling better, you will need to revalve the shocks to allow for further adjustment in the given direction.

Setting the Sag of the Shock

STEP 1

1. Without a rider on the bike, have an assistant lift the rear of the motorcycle until the rear wheel is off the ground slightly.

2. Using a tape measure, measure the distance between the axle center line and a convenient location on the rear sub frame.

3. Record this measurement as "A". Your Bike:___________

STEP 2

1. One person should hold the front of the motorcycle, straddling the front tire.

2. Measure the distance between the axle center line and a convenient location on the rear sub frame (same locations used in Step 1).

3. Record this measurement as "B". Your Bike:___________

STEP 3

1. One person should hold the front of the motorcycle, straddling the front tire.

2. Have the rider, wearing all of their gear, sit on the bike in a tuck position.

3. The third person should then measure the distance between the axle center line and a convenient location on the rear sub frame (same locations used in Step 1).

4. Record this measurement as "C". Your Bike:___________

STEP 4

1. Subtract "B" from "A". This number is your static sag or free sag.
   Target: 6mm - 12mm Free Sag Your Free Sag:______________

2. Subtract "C" from "A". This number is your rider sag.
   Target: 22mm – 35mm Rider Sag Your Rider Sag:_____________

Setting the Sag of the Forks

STEP 1

1. Without a rider on the bike, have an assistant lift the front of the motorcycle until the front wheel is off the ground slightly.

2. Using a tape measure, measure the distance between the bottom of the chrome fork tube and the top, the total distance of exposed “chrome” fork tube.

3. Record this measurement as "A". Your Bike:____________

STEP 2

1. One person should hold the rear of the motorcycle, straddling the rear tire.

2. Measure the distance between the bottom of the chrome fork tube and the top, the total distance of exposed “chrome” fork tube. (same locations used in Step 1).

3. Record this measurement as "B". Your Bike:____________

STEP 3

1. One person should hold the rear of the motorcycle, straddling the rear tire.

2. Have the rider, wearing all of their gear, sit on the bike in a tuck position.

3. The third person should then measure the distance between the bottom of the chrome fork tube and the top, the total distance of exposed “chrome” fork tube. (same locations used in Step 1).

4. Record this measurement as "C". Your Bike:____________

STEP 4

1. Subtract "B" from "A". This number is your static sag or free sag.
   Target: 15mm - 20mm Free Sag Your Free Sag:______________

2. Subtract "C" from "A". This number is your rider sag.
   Target: 30mm – 40mm Rider Sag Your Rider Sag:_____________

Race Track Tuning

Road Race Track Tuning: Symptoms and Suggestions

A. Change only one adjustment at a time, and send the rider out for evaluation and feedback.
B. Take notes: Keep track of rider comments, lap times, tire conditions, and current weather conditions.
C. Be patient, go back to your original settings if you get lost.

Symptom: Tuning List:

Harsh over bumps:

1. Go softer with low speed compression, 2 to 4 clicks at a time (counter clockwise)
2. Go softer with high speed compression, 1 to 2 clicks at a time.
3. Increase rear spring sag, -1/2 to 1 turn at a time on spring perch.
4. Change to a softer spring rate.
5. Note: Too soft on compression can bring about a harsh feeling by allowing too much shock travel.

Excessive wheel spin exiting corners:

1. Repeat above steps.
2. Rebound can be too fast, allowing the rear to unload and spin the tire. Use caution when changing rebound.

Wallowing exiting corner:

1. Stiffen low speed compression (clockwise).
2. Stiffen high speed compression, 1 to 2 clicks at a time.
3. Decrease rear spring sag.
4. Slow down rebound, 1 to 2 clicks at a time (clockwise).
5. Change to a stiffer spring rate.

Slow turn-in:

1. Raise fork legs in triple clamps
2. Increase rear eyelet length, 1/2 to 1 turn at a time. Cannot exceed 12mm of thread exposed.
3. Soften fork compression
4. Increase front fork sag
5. Speed-up rear rebound.

Mid corner push - front:

1. Stiffen rear low speed compression
2. Slow down fork rebound

Notes

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Notes