PENSKE RACING SHOCKS®

KAZ TECHNOLOGIES

Formula SAE

PS-78PB-DA

Shock, Double Adjustable

TECHNICAL MANUAL

Introduction

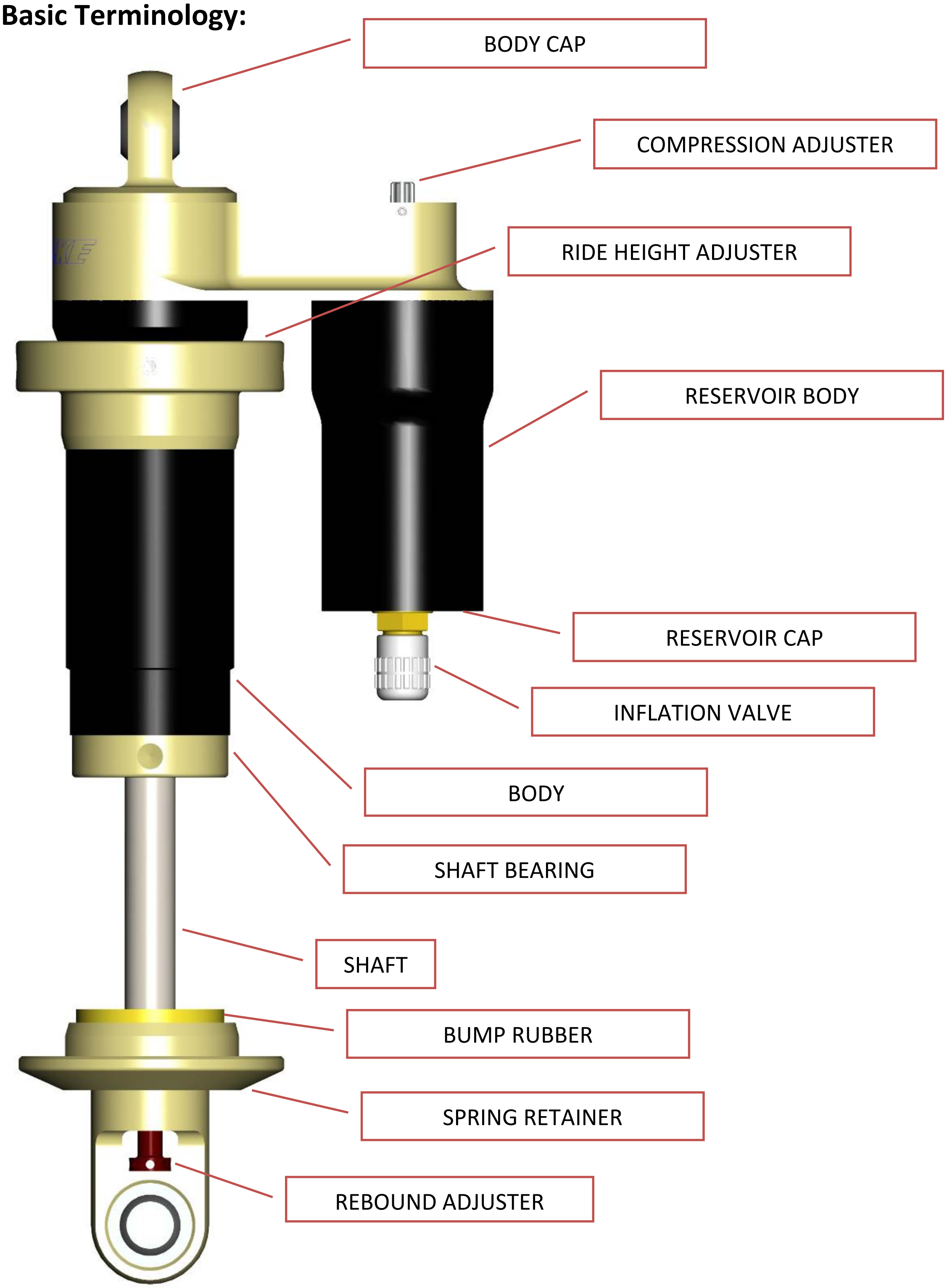
Thank you for your purchase from Penske Racing Shocks!

All of the fundamental attributes found in any Penske Racing Shock have been incorporated into the Formula SAE shocks including:

- *Separate compression and rebound adjustment*
- *Low-friction shaft and piston seals*
- *Anodized, aluminum bodies and components for superior durability and performance*
- *Durable ACME thread body that allows quick adjustment of spring preload (.100" per turn)*
- *Winning heritage – Penske Racing Shocks continue to help our customers win races and championships in all forms of Motorsport.*
- *Made in U.S.A. – The Formula SAE shocks have been 100% designed, machined, assembled, and tested for quality in the United States.*

Table of Contents:

Basic Terminology:



Getting Started:

The Formula SAE shocks are set from the factory at recommended starting settings for your application. They are pressurized and ready to go. The starting pressure for the Formula SAE shocks will vary depending on the specified valving codes used and can range from 50-200 psi.

Adjusters:

- Compression Adjuster (Screwdriver) : 15 clicks

  (stiffer = clockwise; 0 = full hard, -15 = full soft)

- Rebound Adjuster (1/6 Pin): 45 clicks

  (stiffer = clockwise; 0 = full hard, -45 = full soft)

Adjustment Range: COMPRESSION (15 Clicks)

The compression adjuster has most effect in the 0-10 in/sec velocity range of the shock.

Adjustment Range: REBOUND (45 Clicks)

The rebound adjuster has most effect in the 0-5 in/sec velocity range of the shock.

Factory Settings:

Adjusters:

- -5 (Compression)
- -10 (Rebound)

Track Tuning:

Compression Adjuster:

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 full soft.
Step 2 - Starting with the compression setting at full soft, drive a lap then return to increase the bump settings. Continue this process of adding bump control to minimize the upsets until the car 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.

Rebound Adjuster:

The idea is to tighten up the car, stabilize the platform and eliminate the floating "Cadillac feeling". This will also reduce the rate of body roll.
Step 1 - Set the rebound adjuster at full soft.
Step 2 - Add 5 clicks of rebound adjustment at a time, then return to continue the process until the car becomes "skittish" or the rear wheels hop 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.

Gas Pressure:

We do not recommend altering the factory gas pressure setting.

Troubleshooting:

Signs of Fluid:

If the area around the shaft bearing and shaft exhibits a small amount of moisture, this is normal. In order to reduce friction in the system, seal squeezes are slightly relaxed which serves the purpose to allow a small amount of fluid to be wicked onto the shaft when the strut operates. If you see excessive amount of fluid that may “pool” on the top of the shaft bearing, you may have a seal problem. Contact your Penske representative at once.

Loss of Gas Pressure:

If the shock for some reason loses its gas charge, a tell-tale sign of reduced or no gas pressure is that the shock (without a spring) when compressed, will not return to its fully extended position.

Failure of Shaft to Extend:

If the shock has lost pressure or lost excessive fluid, you may find that the strut shaft does not extend fully when compressed. In some situations, you may need to physically “pull” the shaft out in order for it to reach full extension.

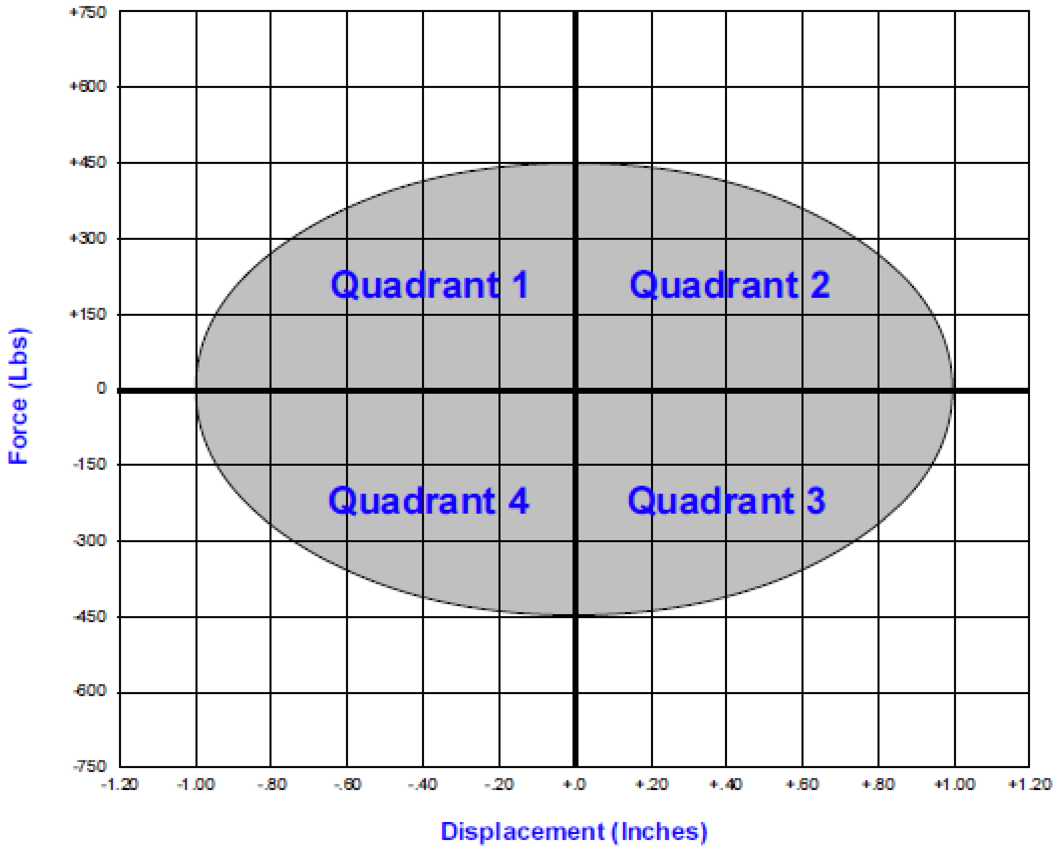
Disassembly Instructions:

1. Adjust the rebound adjuster to full soft and **depressurize the reservoir**.
2. Clamp the body cap eyelet in a vise with the shaft pointing up.
3. Unscrew the shaft bearing assembly and remove the shaft assembly.
4. Drain the oil. (Please dispose of properly)
5. Push the reservoir end cap up into the reservoir body.
6. Using a scribe, pry the wire retaining ring out of the reservoir body and remove the reservoir end cap.
7. Remove the reservoir with a strap wrench.
8. Push the floating piston out of the reservoir body.
9. Clamp the 9/16 wide top-out plate in a vise, making sure you do not clamp the shims.
10. Remove the ring-nut with an 11mm socket.
11. Use solvent to clean all parts, then dry and inspect them. ***NOTE:*** Brake cleaner use is discouraged due to the possible damaging effects on seals and wipers.
12. Inspect and replace the o-rings and seals as needed.

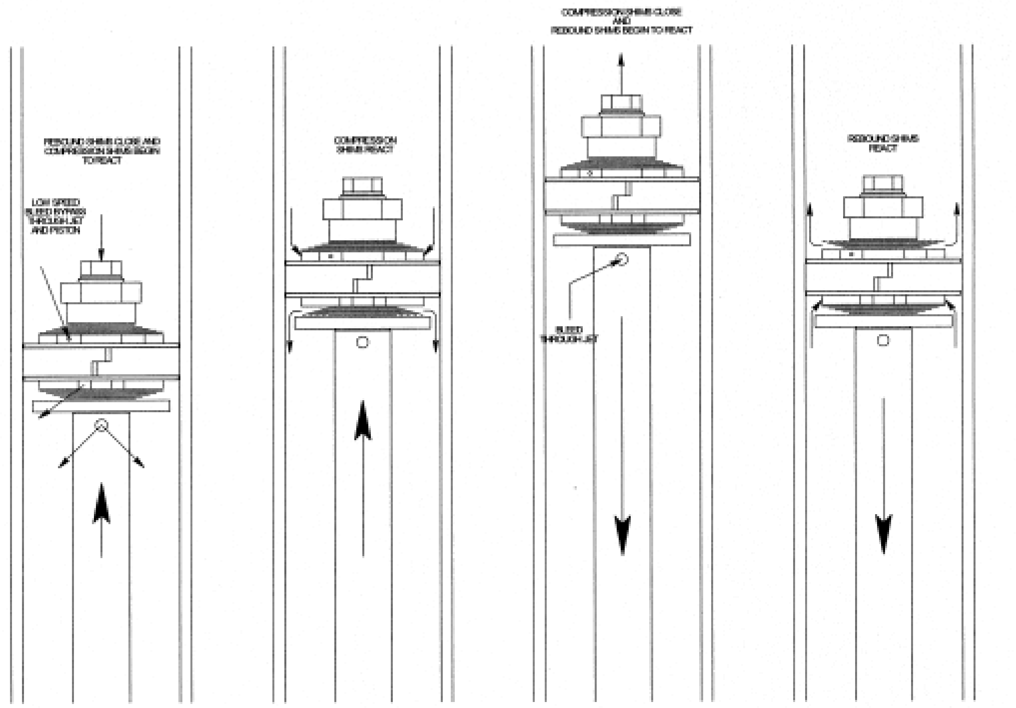
Assembly Instructions:

1. Reassemble the shaft and piston assembly. Be sure to add sufficient constants to be able to properly torque the ring nut to 80 in•lbs.
2. Thread the reservoir body onto the piggyback housing with a strap wrench.
3. With the shock returned to the vise, open the compression adjuster to full soft and fill the remote reservoir to the top with oil.
4. Look into the shock body. When the oil level is above the fitting port, fill the reservoir to the top with oil.
5. Before the oil lowers, insert the floating piston with the dish side facing down*Make sure the quad ring is not twisted.
6. Replace the reservoir end cap and snap ring.
11. Pressurize the remote reservoir to reposition the floating piston (approx. 150 psi).
12. Fill the shock body with oil to the bottom of the threads (1/2" from the top of the body).
13. Insert the piston/shaft assembly with the piston band into the shock body, pushing the piston just below the surface of the oil, until the 4 shaft bleed hole ports are covered.
14. It is very important to remove as much air as possible from the piston assembly. To do this, start by moving the shaft up slowly and pushing down a few times using a .5" - 1 " stroke, being sure to keep the two ports in the shaft below the surface of the oil, or air will be sucked back into the piston assembly. Lightly tap the eyelet a few times with a mallet to assure that all the air is released from the piston. ***NOTE:*** *this step is very important; take your time, repeat as needed.*
15. Slowly pull up on the shaft assembly until the four ports are just below the surface of the oil. Top off with oil to fill the shock body.
16. Slide the shaft bearing down without moving the shaft until the o-ring contacts the body. Thread the shaft bearing into the body until there is approximately 1/10” left of exposed thread. Depressurize the reservoir, and tighten the shaft bearing.
17. Pressurize the shock to the recommended pressure. Please call if you have any questions on specific pressures.

Dyno Graph Overview:



This section of the manual illustrates different valving combinations in the form of graphs. The graph shown is force vs. displacement graph. The force vs. displacement graph is a very accurate and simple way to assess valving characteristics. If you are not familiar with this type of graph, it is explained on the following page along with the graph above, showing the four different quadrants.



QUADRANT #1

This is the beginning of the compression stroke. Where the graph crosses the zero line (pounds) in quadrant #1 begins the compression stroke. Approximately the first 1/2" of displacement is formed with relation to the low speed bleed bypass. When the shaft reaches a certain velocity, the low speed bleed bypass shuts off and the compression valve stack begins to react.

QUADRANT #2

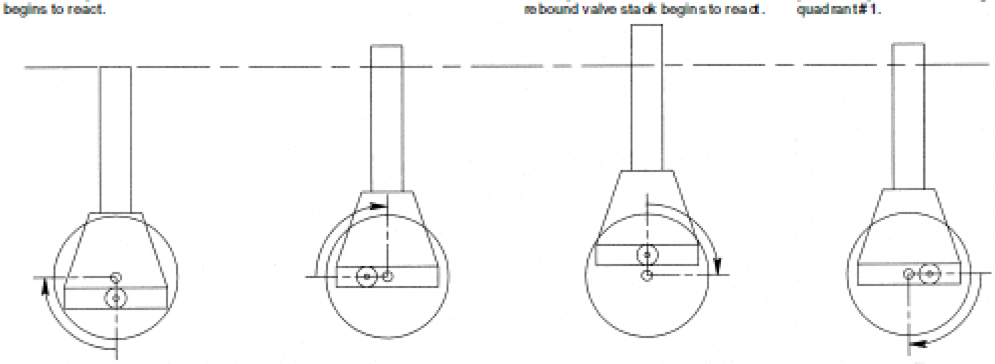
This quadrant begins with the compression valve stack open. Where the graph crosses the zero line (inches) in quadrant #2 is the maximum force produced by the compression valving. As the shock approaches the full compression point, the compression valve stack begins to close as it approaches the rebound movement.

QUADRANT #3

This quadrant begins with the shock at full compression and the compression valve stack closed. Where the graph crosses the zero line (pounds) in quadrant #3 begins the rebound stroke. Approximately the first 1/2" of displacement is formed with relation to the rebound bleed through the shaft and jet. When the shaft reaches a certain velocity, the bleed shuts off and the rebound valve stack begins to react.

QUADRANT #4

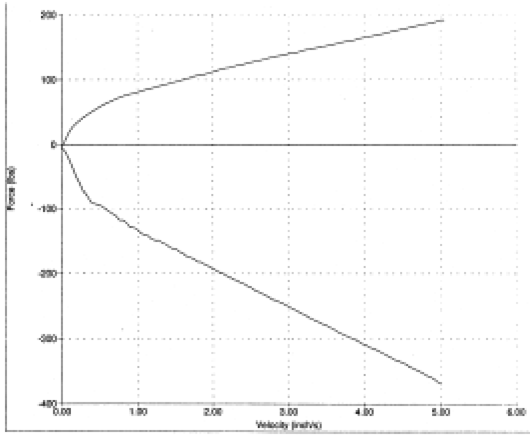
This quadrant begins with the rebound valve stack open. Where the graph crosses the zero line (inches) in quadrant #4 is the maximum force produced by the rebound valving. As the shock approaches the full extension point, the rebound valve stack begins to close as it approaches the compression movement. At this point the cycle starts over again in quadrant #1.



An easy way to help picture what is going on here is to relate the graph's shape to what the dyno is doing to the shock. The dyno uses a scotch yoke system (shown above), where the motor turns a crank and the sliding yoke allows the main dyno shaft to make the up and down movement at the preset stroke. The dyno software takes thousands of measurements throughout a single revolution of the crank. The sampled points are connected to form the graph. By relating the crank's position to the corresponding graph quadrant and the circular crank movement may help in reading the graphs.

Force / Velocity Average

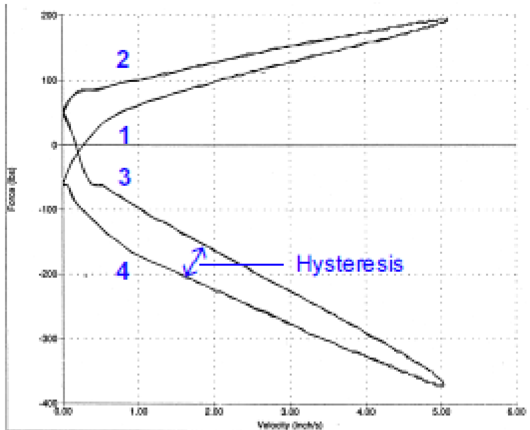
This graph shows the averages of the accelerating and decelerating compression and rebound forces. It is a good quick, general review of the shock curve, but is the least accurate of the options displayed.



Force / Velocity

This graph displays the accelerating and decelerating compression and rebound forces. Think of this graph as the Force / Displacement graph (below) folded in half.

* Hysteresis is the gap between accelerating and decelerating compression and rebound damping. It is affected by the type of piston, the shims used and the relative position of high and low speed adjusters. The bleed hole will close the gap or soften the low speed forces.



OVAL (Force / Displacement)

QUADRANT #1

This is the beginning of the compression stroke. Where the graph crosses the zero line (pounds) in quadrant #1 begins the compression stroke. Approximately the first 1/2" of displacement is formed with relation to the low speed bleed bypass. When the shaft reaches a certain velocity, the low speed bleed bypass chokes off and the compression valve stack begins to react.

QUANDRANT #2

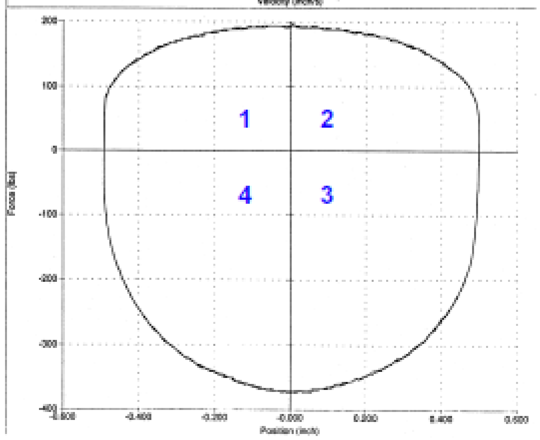
This quadrant begins with the compression valve stack open. Where the graph crosses the zero line (inches) in quadrant #2 is the maximum force produced by the compression valving. As the shock approaches the full compression point, the compression valve stack begins to close as it approaches the rebound movement.

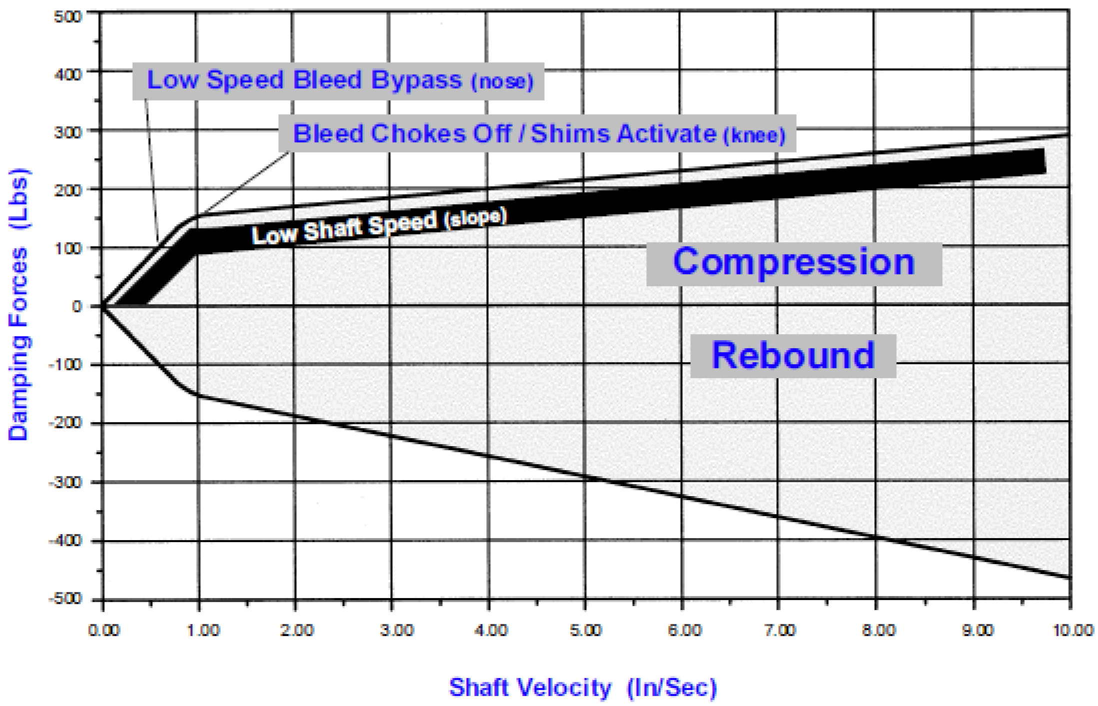
QUADRANT #3

This quadrant begins with the shock at full compression and the compression valve stack closed. Where the graph crosses the zero line (pounds) in quadrant #3 begins the rebound stroke. Approximately the first 1/2" of displacement is formed with relation to the rebound bleed through the shaft and jet. When the shaft reaches a certain velocity, the bleed chokes off and the rebound valve stack begins to react.

QUADRANT #4

This quadrant begins with the rebound valve stack open. Where the graph crosses the zero line (inches) in quadrant #4 is the maximum force produced by the rebound valving. As the shock approaches the full extension point, the rebound valve stack begins to close as it approaches the compression movement. At this point the cycle starts over again in quadrant #1.





Note: Remember that low speed damping characteristics are controlled by bleed through the low speed adjuster and the bleed hole in the piston, not the valve stacks.

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