WELCOME

This newsletter is a free service intended to benefit racers and enthusiasts by offering answers to chassis questions. Selected questions will be presented, at my discretion. Readers are invited to submit questions by mail to: 155 Wankel Dr., Kannapolis, NC 28083; by phone at 704-933-8876;
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<div align="right">Mark Ortiz</div>

"THE SHOCK DYNO LIES!"

How come if I dyno a Bilstein shock (Roehrig dyno, using their software), and then duplicate the graph exactly on an Ohlins, the shock feels completely different to the driver? I mean different as in no side bite, and no forward bite – but the driver says the car doesn't feel any stiffer.

Also, if I vary the gas pressure, the dyno displays the same graph, but the driver can feel a difference in the shock. Why?

At what point in rebound/compression valving split will jacking occur? We valved an Ohlins to be exactly like our Bilsteins, and the Ohlins ratcheted down in the turn until it bottomed out and almost scared the driver to death.

How do I match the shocks to the track surface for maximum compliance and therefore maximum forward bite? The tires of the winning car in the 100 lap day show seemed to just roll over the washboard surface, and on all the other cars you could see the tires bouncing up and down.

The tracks get rough, and because the roughness is caused by the same type of vehicle, the roughness always has the same look. I would think that since the pattern of 3" to 4" holes and bumps is always similar, the "perfect" spring frequency and shock valving could be found. How do I test for this?

The shock dyno doesn't lie, but it doesn't tell the whole truth.

First of all, I believe your dyno cycles the shock through a 2" stroke, normally near mid-travel, at 100 cycles/min (1.67 Hz). This gives a peak velocity at mid-stroke of just over 10 in/sec. A rough dirt track may give you shaft speeds above that.

Your dyno only generates simple harmonic motion. Other companies make more expensive dynos that can generate approximately square-wave (very high acceleration) motion, or can reproduce on-track motions recorded by electronic data acquisition. These modes of testing have value because shocks are sensitive to acceleration as well as velocity.

Your software can be programmed to show you various outputs. Many people look only at one end of the stroke, most often the extended end (rebound valving closing, compression valving opening). It helps to look at both ends. A plot showing both ends of the stroke, force versus absolute velocity, will have two points or noses at the left side, and four traces. I have seen instances where looking at the full stroke showed me acceleration sensitivities that I never would have known about if I had only looked at the extended end of the stroke.

The usual thing the program does with the gas force is to re-zero the load readout after stopping momentarily at mid-stroke and reading the gas force. However, the program should tell you, as a numerical readout, what that gas force is. It will vary with the pressure you put in at build, and also with the volume of the gas, which you control by varying the floating piston's position at build or the oil volume you pour in.

You don't always get the same trace with different gas pressures, even with re-zeroing. More gas pressure actually increases rebound damping force (with gas force omitted), due to reduced nucleate boiling (incipient cavitation) on the downstream side of the piston. This effect is greatest at high velocity, with a stiff rebound stack, low gas pressures, and hot oil. The effect is least – sometimes unnoticeable – at low velocity, with a soft rebound stack, high gas pressures, and cooler oil.

Valving split is sometimes expressed in terms of *control ratio* – the ratio between rebound and compression damping, at a particular shaft speed. As a rule of thumb, a control ratio of 1.3 to 2.5 is pretty normal; <1.3 is somewhat bump-stiff; >4.0 is likely to jack down. Jacking is also promoted by stiffer dampers, softer springs, or a bumpier track.

Tuning for a particular disturbance frequency is mainly a matter of making sure your natural frequencies *don't* match the excitation frequency. Since your unsprung masses and tires are similar to the other cars', this means using spring rates that don't match theirs, or using stiffer damping. Sometimes it helps to stiffen just rebound, but if you're jacking down to the bump stops you may be too far down that path now. Soft damping gives better roadholding, except when the bumps excite the system at one of its natural frequencies. Stiff damping raises natural frequencies, and also makes the system less frequency-sensitive.

You can also raise natural frequency by using somewhat stiffer springs than your competitors. In the days of cart-sprung cars with primitive dampers, this was a major reason people sprung race cars stiffly. Another approach is to run substantially softer instead. With everybody so soft nowadays, that can be difficult, but if you add a sway bar and good bump rubbers it can work.

Finding a good combination is mainly cut-and-try at the track. Electronic data acquisition can be a big help. I have an associate who specializes in that. His name is John Chapman. He's in Charlotte at 704-549-1309, e-mail jchap56756@aol.com. For shock dyno and build service, I recommend Scott Munksgard at Munksgard Technical Services in Concord, NC at 704-782-2611, e-mail MTSdyno@aol.com. He custom-builds Bilstein, Ohlins, Penske, and Carrera shocks, and sells AFCO and Pro shocks and Afcoil and Hypercoil springs.