January 2001

WELCOME

Mark Ortiz Automotive is a chassis consulting service primarily serving oval track and road racers. This newsletter is a free service intended to benefit racers and enthusiasts by offering answers to chassis questions. Readers may submit questions by mail to: 155 Wankel Dr., Kannapolis, NC 28083; by phone at 704-933-8876; by e-mail to: markortiz@vnet.net. Topics are also drawn from my posts on the tech forums at www.racecartech.com and www.rpmnet.com. Readers are invited to check out these sites, and to subscribe to this newsletter by e-mail.

Mark Ortiz

WIND TUNNEL TESTING FOR SHORT TRACK CARS

Many classes in short track racing involve cars that are aerodynamically very similar to each other, due both to tight bodywork rules and to copycat engineering. Most of these classes of cars are never tested scientifically to evaluate and improve their aerodynamic properties. This is due in considerable measure to the fact that wind tunnel time is expensive, and also to the fact that most short track racers don't know where to look for a wind tunnel that would have the time or inclination to work with them.

There is now a wind tunnel that is actually looking for short track cars to test. It's the tunnel at Langley, VA, which was originally built in the 1930's by NACA for running full-scale tests on fighters and similar-size aircraft. The tunnel is now leased to Old Dominion University. They have so far tested a DIRT modified, and are looking to test other types of dirt and pavement cars.

The DIRT mod test is described in a recent SAE paper by Drew Landman and Eric Koster. Among other things, the test revealed that the car generated net lift at the front axle, despite having a "snowplow" front end. This was of great interest to the team running the car, as they had been trying all sorts of chassis tweaks to cure an entry push.

This testing service is not free. In fact, it costs $1400/hour. For a one-day session long enough to do any good, you're looking at eight to ten thousand dollars. However, the payoffs are potentially enormous. Adding downforce can dramatically improve lap time. Small changes in the average pressures on the top or bottom side of a car can generate hundreds of pounds of vertical force, because the car's plan view area is so large.

The similarity of the cars in many classes means that racers can form groups to share the costs, provide one or more representative cars for test, and share the knowledge gained. If racers can get their friends – or maybe their car builders -- interested, there is a good chance that participants can make considerable gains at reasonable cost. I have volunteered to serve as a

coordinator and compile lists of interested racers by car class. E-mail or phone me if you might want to pursue this.

REAR CASTER

What is rear caster, and how does it affect the handling of a vehicle?

The term “rear caster” is normally applied to the side view inclination of the rear upright in an independent rear suspension. The concept is not applicable to beam axle rears. The upright often will not have an identifiable steering axis, but it should have some agreed features by which we can measure its inclination on a particular car.

We ordinarily don’t have a steering mechanism at the rear, but we have one or more links per wheel that provide toe location and give the suspension its bump steer properties. So on many cars setting rear caster is our main way of adjusting rear bump steer. Sometimes there is a factory-recommended spec, but it is best to establish the desired rear caster setting by dialing in rear bump steer properties using a bump steer gauge, then measuring what upright angle or rear caster we have when the bump steer is the way we want it. Measuring this angle then becomes a quick way to recover the setting without going through the whole bump steering process.

In general, tilting the upright back at the top (adding caster) adds roll understeer – makes the wheel toe in in bump and toe out in droop. Tilting the upright forward at the top does the opposite. In some designs rear caster has no effect at all, even though you can adjust it. This is uncommon nowadays since it is useful to be able to tune rear bump steer. On some other cars, you can’t adjust rear caster but you can adjust bump steer with shims on the toe control link.

STACKED COILOVER SPRINGS

Why do people use two springs of different rates stacked on top of each other on a coilover?How do you figure the rate of a combination like that?

The usual reason for stacking a soft coil spring on top of a firmer one is to get a stepped rising rate. One spring, usually the softer one, coil-binds before the coilover bottoms. With one spring coil-bound, the rate of the combination is the rate of the spring that can still move.

The rate of two stacked coils is less than the rate of either one alone. If we call the rates of the two individual springs A and B, and the rate of the combination C, then $C = (AB)/(A+B)$.

In many cases, neither spring is coil-bound at static ride height. The idea is to get a rising spring rate to avoid bottoming or to cope with increased aerodynamic downforce at higher speeds. In other cases, the softer spring is so soft that it is coil-bound in normal operation and only serves to take up clearance at full droop. This is sometimes called a tender spring. Finally, it is also possible to use a special stop that causes the assembly to go stiffer in extension rather than compression. This is most often used on the left front on dirt cars, to tighten exit.