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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 useful insights into chassis engineering and answers to questions. Readers may mail questions to: 155 Wankel Dr., Kannapolis, NC 28083-8200; submit questions by phone at 704-933-8876; or submit questions by e-mail to: markortiz@vnet.net.

RACECARTECH DIES (I THINK)

The owners of www.racecartech.com, where I used to give free advice, have announced that they are closing the site due to unprofitability, effective Sept. 30. I would take this as final word, only a client of mine has recently expressed interest in possibly taking over the site. By next month I'll know if anything is going to come of this.

BALANCING THE CAR WITH CAMBER AND TIRE PRESSURE

Thanks for your July newsletter – the troubleshooting guide is very meaningful, even for a road racer such as myself. Could you comment on how camber and tire pressure might be used to address tight and loose conditions?

A tire has a preferred camber and pressure. If you go either direction from the optimum, you lose grip. Therefore, if you deliberately depart from best camber and pressure, you are throwing grip away. Ordinarily, you don't want to do that. It's better to balance the car by managing wheel loads, because that way you are redistributing the available "grip budget" rather than throwing some away at the end that sticks better.

Okay, that's the basic answer. But beyond that, there are complex and fascinating nuances.

To begin with, optimum camber and pressure for longitudinal acceleration (braking and propulsion) are different than for lateral acceleration (cornering). For longitudinal forces, we want the tire at zero degrees camber – straight up. For cornering, we want it leaning slightly into the turn if possible. The optimum pressure for longitudinal acceleration will generally be less than for lateral. So we have to compromise.

The compromise we strike has some effect on the tire's behavior in various parts of the turn. With a less aggressive camber setting, we may improve the tire's grip in early entry and late exit, when longitudinal forces are great and lateral ones are moderate, and reduce its grip in the middle of the turn. We can also do this with a moderate pressure reduction.

Reducing pressure will, in some cases, make the tire work better in the first part of a turn at the expense of the latter part, particularly on ovals. This happens because with lower pressure, the contact patch is longer. The rearmost portion of the contact patch has a form of interaction with the road surface which is characterized by cyclical sliding and reattachment. This builds huge amounts of heat in the outer layer of the tread rubber. Surface temperatures in normal racing use can exceed 400 deg. F. at corner exit, in a tire that shows half that temperature when we measure it after a run. This means the rubber temperature is well above optimum in the last part of a turn.

At lower pressure, the tire heats faster as it corners. Therefore, slightly lower pressure may improve grip early in the turn, and reduce grip through the last 2/3 of the turn. Lower pressure will also usually help the tire early in a run, at the expense of the rest of the run.

There is some difference between oval applications and road racing applications or street or autocross use. In oval racing, especially ovals of a mile or more, the turns are big and last a long time. On a 1.5 mile track, a 180 mph lap takes 30 seconds. The turns are around half the lap distance, and are taken at somewhat lower speed than the straights. This translates to sustained cornering for up to ten seconds, depending on the track and where we define the beginning and end of the cornering process to be. Steering inputs are small and gentle. This means that tire heating during the turn is a major factor, and tire rigidity on turn-in is not very important. Consequently, the driver may report better front grip on entry with slightly reduced front pressure on an oval. Conversely, when turns are tight and last only a second or so, steering inputs are large and abrupt, tire heating is less of a factor, and tire rigidity counts more. In such situations, turn-in may be improved with *higher* front pressures than optimum for steady-state cornering.

One problem with using these principles to tune the car is that we don't really have very precise control over tire pressure. If the front tires are a little on the soft side and the rears are ideal when the sun is behind clouds, what happens when the sun comes out? What happens when the driver presses a little harder and the tires heat up? The fronts will optimize, and the rears will have too much pressure. The car will get looser. Tuning a race car with tire pressures makes it inconsistent. Therefore, when possible I try to make the fronts and rears optimize together, and be too soft or too hard together as conditions vary.

You hear a lot about tuning tire spring rates with pressures. This is mostly smoke, especially in cars with compliant suspensions, such as stock cars. Contact patch length, contact patch loading distribution, and tire heat buildup are the big factors that change when we vary pressure. When a team adds or subtracts a pound on one tire on a pit stop, they are mainly throwing away a little grip on that corner to balance the car. Often they can either add or reduce pressure to kill the grip, but the effect comes later in the run, and later in the turn, if underinflation is chosen, and earlier if overinflation is used. Using tire pressure instead of suspension adjustment during a race makes sense because balance is so important, and adjusting suspension during a pit stop costs time and track position.