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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. Readers are invited to subscribe to this newsletter by e-mail. Just e-mail me and request to be added to the list.

OILY TIRES

I recently blew an engine and got oil all over a nearly new set of racing tires. Are they junk? Is there a way to clean them?

It may surprise you to learn that many people put oil and related substances on tires deliberately, to soften them. Substances used for this include automatic transmission fluid, diesel fuel, paint thinner, and WD-40.

Does it work? The answer, in Pogo's words, is "an unequivocable maybe". There is no doubt that the rubber will get softer. Whether this will actually improve grip is harder to predict. There is a difference between soft and sticky and soft and greasy. In some cases you really do get a grip improvement. In some cases you don't. The only way to really know is to use a test day to try out a particular tire/solvent combination.

When you put oil on a tire, the rubber starts absorbing the oil immediately. But it takes a while to absorb a lot, especially deeper into the rubber. So if you get oil on a rubber item that you don't want to soften, you can usually avoid any major impact on longevity if you wash the item off promptly with detergent. You can even just wipe it off thoroughly with a paper towel, depending on the importance of the item and the situation. Wiping first, and then washing, is the most thorough. If you're on the road, a car wash is generally the venue of choice. Use the foam brush, then rinse.

If, on the other hand, you're trying to soften the tread compound of a tire, you try to maximize absorption instead. Some people use electrically driven tire rotisseries to apply softening agents to tires. If the softener contains volatile compounds (ones that tend to evaporate), it helps to apply the liquid to the tread, then bag the tire for days or weeks.

Are such procedures safe? Again, maybe. Certainly many racers use tread softeners and usually don't cause the tires to come apart. Then again, there are no guarantees, and inevitably tire manufacturers discourage this sort of tampering. Once a tire has failed, it is uncommon for any systematic investigation to be conducted to determine what may have caused the failure, particularly in small-time racing. Even if a tire does fail structurally, and even if it can be determined that it was softened, there is usually room for doubt as to whether the softening really was the cause, as opposed to inflation pressure, aggressive driving, suspension settings, or track conditions.

Finally, there is the question of legality. Rules on tire soaking, and enforcement of those rules, vary widely. This is between the racer and the officials. All I can say is investigate before you experiment, and proceed at your own risk. Most petrochemicals do have an odor and are detectable with a sniffer.

One other thought, for situations where an engine lets go and oils down most of the car. Try to think of all the other rubber items that may have gotten oiled: silicone insulation, motor mounts, suspension bushings, vibration isolators for the radiator or electrical components . Usually we don't want to soften any of those pieces. Any foam rubber will tend to be especially susceptible to damage from oil, and especially hard to rid of oil.

SOME BASIC OVAL TRACK CONCEPTS FOR ROAD RACERS

Could you please clarify what you mean by "diagonal percentage" and "stagger"?

"Diagonal percentage" and "stagger" are oval track terms. However, the concepts are useful in road racing as well. Diagonal percentage is the combined loading of the outside front and inside rear tires (RF and LR for left turns, or if no turn direction is stated or implied), expressed as a percentage of the total for all four wheels. We can speak of *static* diagonal percentage, which is diagonal percentage as measured on wheel scales when setting up the car. We can also speak of *dynamic* or *instantaneous running* diagonal percentage, which is the percentage of total wheel loading on the outside front and inside rear, at a particular instant while running.

As a general rule, more diagonal tightens the car (adds understeer).

Spring rates do not affect static diagonal, since we can set that wherever we want with any spring combination. Springs do affect the way dynamic diagonal varies as the car runs.

Stagger is generally understood to mean the difference in tire circumference between the right and left tires at one end of the car. A car can have tire stagger at the front and/or rear, but if not otherwise stated, we mean the rear. Many oval track cars use locked, or spool, rear ends, so rear stagger has a big effect on cornering balance. With significant amounts of stagger on an axle that forces both wheels to run at identical rpm, the smaller tire drags. This tends to rotate the car toward that side. At the front end, or at the rear when the wheels can turn at different speeds, stagger does not cause the smaller tire to drag, but it does affect left/right brake bias,

and also left/right propulsion force bias with an open differential. If brake or drive torques are equal, on two unequal-size tires, the smaller tire produces a greater rearward or forward force.

Ordinarily, we think of road racing cars as symmetrical. We tend to assume that if the car has to turn both ways, we want close to 50% diagonal, and no stagger. However, that isn't necessarily strictly true.

Many road courses are predominantly right-turn tracks. A few are predominantly left-turn. It is not uncommon for the car to spend more than three times more seconds per lap cornering one way than it spends cornering the other way. In such cases, we can often gain lap time by optimizing the car for the dominant turn direction. We want good handling balance in both right and left turns, but it may pay to sacrifice some speed turning one way to gain some speed turning the other way.

This most commonly involves moving ballast to the inside for the dominant turn direction. When we do that to a significant degree, in a nose-heavy or tail-heavy car, a funny thing happens. 50% diagonal doesn't give us equal left percentage at the front and rear. If we want similar cornering balance in both right and left turns, a good starting point is to have equal left percentages for the front and rear wheel pairs, rather than 50% diagonal. The diagonal percentage will not be really far from 50%, but there will be some difference. For a car with 60% rear and 55% left, for instance, we have 55% left at both front and rear when the diagonal is 51%.

Another reason to depart from 50% static diagonal in a road racing car is driveshaft torque in a live-axle rear suspension. Driveshaft torque acts through the suspension with a live axle. With conventional engine rotation, it rolls the car rightward, and unloads the right rear and left front tires. To compensate for this, we may want to run less than 50% static diagonal.

Ordinarily, we do not deliberately use tire stagger in road racing, but we can if we want to. We can also have tire stagger inadvertently. Oval track racers often use manufacturing variation in tire diameter to tune stagger. Road racers often do not even measure tire size to see if they have stagger. Even if your desired stagger is zero, the only way to be sure you have that is to measure. This is particularly important if you race on bias-ply tires, which in general are more prone to diameter variation than radials, both when new and due to change after they've run. We not only need to measure our tires to avoid inadvertently having undesired stagger, we also need to understand what stagger does to car behavior so we can recognize the clues that we might have undesired stagger.

It is also worth noting that there is a difference between stagger as usually measured (difference in unloaded circumference) and *effective* stagger, which is the difference in *effective circumference*, or 2π times *effective radius*. Effective radius is neither unloaded radius nor loaded radius (distance from hub center to ground, under load). It is approximately the unloaded radius minus 1/3 of the deflection under load (difference between unloaded and loaded radii). One important consequence of this is that we can achieve considerable effective stagger with radial tires through pressure variation, even though pressure changes have little effect on unloaded circumference.

NARROWER REAR TRACK THAN FRONT

Why do rear-engine and mid-engine cars so often have narrower track widths at the rear than at the front?

The reasons for this are more practical than theoretical. In racing, we are usually designing to an overall width limit, rather than a track width limit. Likewise, for road use overall width is realistically the most important constraint. If the car is tail-heavy, we will often use wider wheels and tires at the rear than at the front. Track width is measured between the centerplanes of the right and left tires. So it's mathematically inevitable that we will end up with the rear track narrower than the front if the overall width is the same front and rear, and the rear tires are wider than the fronts.

There is also a rational case to be made for having the overall width slightly greater at the front than at the rear, simply to place the widest portion of the car in the driver's field of view, and discourage the tendency to hit curbs or other obstructions with the inside rear wheel in tight turns.

There is one more reason to make the rear track narrow, which applies more often to road cars than race cars, but may apply to race cars as well if the car is power-limited and has full-width bodywork. For least aerodynamic drag, it is best to have the car taper toward the rear. Therefore, when top speed and/or fuel economy are top-priority design objectives, it is common to see a narrower rear track than one would otherwise expect.