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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 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.

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CHECKING REAR AXLES

Last month's piece on stringing cars to measure wheel alignment on the vehicle has proven very popular, and has also engendered further discussion. One topic that's come up has been how to check a rear axle before installing it. Here's a good method. You need a pair of v-block stands to support the axle, and a bump steer gauge with two dial indicators or the digital equivalent.

Install the bump steer plate where one wheel would mount. Position the indicators against the plate as you would when measuring bump steer, and zero the indicators. While you hold the bump steer plate so it can't rotate, have a helper rotate the axle housing, while you watch the dial indicators. Start at zero degrees pinion angle, or a pinion angle of your choice, and record readings at 90 degree intervals. Repeat for the other wheel. Compare the difference in indicator readings at positions 180 degrees opposite, then DIVIDE BY TWO to get camber and toe in inches at indicator span.

Many people use a somewhat similar method, turning the housing with the axle resting on its wheels, and just measure wheel-to-wheel toe, using a tape or a trammel bar. The problem with this is that both snouts can be cocked the same direction, and if you only measure wheel-to-wheel you won't pick that up. If you place a stationary object next to each tire, you can see any large individual wheel misalignment. An axle with both wheels aimed to the right, or both aimed left, can be made to work acceptably if you string the car as described in last month's issue. But if you just check wheel-to-wheel toe, then align the axle to the frame, you can get unexplained handling problems.

Since nothing is perfect in the real world, the question arises of what constitutes an acceptable axle. The answer is that a bit of overall toe-in is acceptable, perhaps even desirable. Toe-in adds drag, but stabilizes the car under power. Any amount of toe-out is unacceptable. Toe-out makes a car loose and directionally unstable under power. It is possible to use toe-out as a crutch to make a spool work on a road course, but this is a desperation measure.

Camber can be used to improve cornering. For road racing, we generally want a little negative camber on both wheels. Sometimes we may want more camber on one wheel than the other, for courses that are predominantly right or left. For oval track, we want positive camber on the left and negative on the right. On oval track cars, camber comes from both the axle and from tire stagger. With a track of 60", each inch of stagger adds about .15 degree of camber, negative on the right, positive on the left.

How much camber you can run will be limited either by the rules or by component life. On full-floater axles, with standard shafts and drive flanges, a prudent limit is .75 degree at the axle, plus whatever you get from tire stagger. This would correspond to a maximum camber reading of about .013" per inch of indicator span when checking the axle as described above. You can push this limit, depending on how much torque you are transmitting through the splines, at what wheel rpm, for how long. Axles with convex splines are available for more aggressive angles. In general, non-full-floating axles will not accept as much toe or camber as full-floaters. You only have one set of splines to work with, at the inboard end of the shaft. Cocking the bearing at the outboard end just gets you bearing failures.

TORQUE ARM OR PULL BAR?

Will a torque arm give more forward bite than a pull bar?

Not necessarily. All either system does is generate an anti-squat jacking force, which only helps a little anyway. Either layout can be made to produce any amount of anti-squat desired.

One advantage of pull bars is that they can be made short enough to go behind the driver, although many you see are too long for that. If you mount the pull bar left of center, its lift force adds wedge under power. In most classes where torque arms are legal, you can't fit an adequately long one behind the driver. Another advantage for the pull bar is that you usually save some overall and unsprung weight.

In general, torque arms provide better damping of axle rotation. Their shocks act at a greater distance from the axle. Also, in most existing cars, torque arm layouts provide more anti-squat, and the anti-squat changes less with ride height. This doesn't always have to be the case, however. Actual geometry of the particular layout is very important.

One interesting possibility with torque arms is to use two springs or coilovers - one ahead, one further back on the arm. You then use a conventional single spring for the rear one, and a conventional spring stacked with a very light "tender spring" for the front position. This makes the arm act short when grip is poor and axle torque is low, and effectively lengthen as axle torque increases. Most of the damping should be at the front spring, or forward of it. It probably is also possible to get a similar effect using two pull bars, or even a pull bar and a torque arm together. Bottom line: you can get good results with either layout, and both hold unrealized potential for those who are willing to reason from first principles and innovate.