Ross Bentley's High Performance Driving Tips - #13

DRIVING THE CIRCLE

Some of you may have heard or read about the "Friction Circle" or "Traction Circle" concept at one time or another. Some of you may even understand it - although I'm sure if you do, you are in the minority. Unfortunately, most of the information on the subject has been written by engineers, in very technical terms. I say unfortunately because understanding, and being able to put its principles into practice will make you a much more effective (read "faster") driver. In this article I will attempt to explain it, and what it actually means to you and I, the average High Performance driver. Although this technique can be practised on the street at legal speeds, it is primarily for those of you who do some track driving or slalom events.

First, some background. The Friction Circle concept was originally developed in the late '60s by Paul Van Valkenburgh, the late Mark Donohue and the Chevrolet R & D Department. They used multi-million dollar computer systems and hundreds of research engineers to measure and record a car and driver's theoretical and practical cornering and acceleration limits. Nowadays, practically the same results can be had with a device called the g-Analyst, which is sold for a few hundred dollars.

The Friction Circle is a simple graphic way of showing the performance of any driver in any car in any single manoeuvre. Basically, it is a graph of the g-forces during braking, cornering and acceleration that the car experiences while being driven through a series of corners. Remember that 1 g is equal to the force of 1 times the weight of the vehicle; i.e. if a 2000 pound car is cornering at 1.0 g, there is a centrifugal force of 2000 pounds pushing outward on the car.

Consider that a tire has relatively equal traction capabilities in any one directional force - braking, cornering or acceleration - 0.9 g for example. In other words, the car and tire combination is capable of braking at 0.9 g, cornering at 0.9 g, and accelerating at 0.9 g. In the transition from one directional force to another, say from braking to cornering, there are two ways to get from one limit of traction to the other. The driver may, upon reaching the end of the braking zone (where he/she braked at 0.9 g), suddenly lift off the brakes, and then turn the steering wheel into the corner (building up to 0.9 g of cornering force).

Or, he/she may gradually ease off the brakes, while at the same time, gradually applying more and more steering angle - overlapping some of the braking and cornering. In the first option the car goes through a short period (possibly only a fraction of a second) where the tires are doing no work - they are not being used to their full potential. This wastes time, no matter how short. It has been proven that the second option, which keeps the tire and car on the outside edge of the Friction Circle graph, is a measurably faster way around a racetrack. As well, it reduces the stresses on the car and tires, which are created by sudden movements, and is almost the definition of smoothness in driving technique.

So, what you as the driver must do - and what the Friction Circle is telling us to do - is to continue the braking into the corner entry phase so that, while the tires are in the process of building up cornering force, they are still contributing some braking force. Or, brake at 0.9 g up to the corner, begin to ease off the brakes as you begin to turn in, trading off some of the braking force for cornering force (at the point where you are braking at 0.45 g, you will have built up 0.45 g of cornering force), until you are cornering at the limit, 0.9 g. Then, you must start to open up the exit line from the corner - "unwinding the car" out of the turn early, so that the tires have traction capacity for the acceleration phase.

Again, all of these forces can be graphed as you drive through the corner. If you use the proper driving technique, the graphed line will somewhat follow a circle - the Friction Circle - telling you that you are using the tire's full potential.

The real key to the Friction Circle is the smooth progressive overlap of braking, cornering and acceleration. If you follow the old theory, "do all of the braking in a straight line, go through the corner at maximum cornering force, then accelerate in a straight line", you are going to waste a lot of the car's potential and a lot of lap time. You must "drive the circle" by balancing the braking, cornering and acceleration forces so as to keep the tire's traction limit **just** inside the boundary of the circle. This will lead to the fastest possible lap, and to another type of circle - the winner's circle.

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