Just The Basics – 9 - Loose & Poosh or Oversteer & Understeer

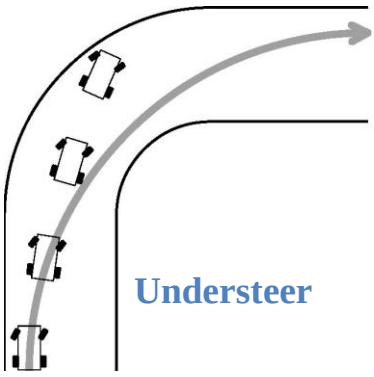
If you watch racing, especially NASCAR racing, you should have a good idea what this article is all about. Since this column is for beginners, I will attempt to explain how a car behaves near its limits.

If you have been reading the previous articles, you know that physics and dynamics of motion affect a car. Having a car driving on springs and shock absorbers plus riding around on balloons known as tires, creates a special set of circumstances unique to automobiles. Even though a car has 4 wheels, when it is in motion, it usually depends on 1 or 2 at any given situation because of weight transfer of the car. When you take off from a stop, you will feel the weight of the car shift to the back. It will squat on the rear springs, and the nose of the car will rise. Upon braking, the nose will dive and the rear will rise indicating a weight transfer to the front. On turning, the weight shifts to the outside of the turn. When you combine turning with accelerating or braking, the bulk of the activity goes to one wheel & tire. Springs, shocks, sway bars and electronic driver aids all attempt to minimize excessive weight transfer while maintaining tire contact with the road. And without creating a harsh ride.

Most people can understand the Friction Circle concept when you think of 'laying a patch' or doing a 'burn out' or locking the wheels under panic braking. Finding the limit while turning and the tires are rolling is more challenging.

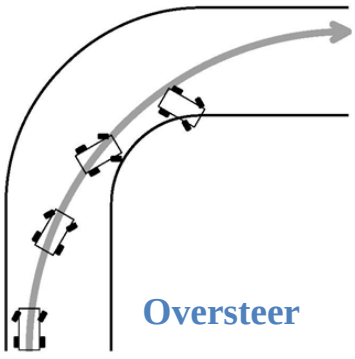
When we are at the track, we are attempting to explore the limits of adhesion in a controlled environment. I touched on slip angle in the "Friction Circle and Slip Angle" topic. . In addition to tire flex and tread squirm, tires can actually slide a bit on the road surface without losing control. The slip angle becomes greater the closer to the limit you go. The rule of thumb is a slip angle of 10% or less is 'under control'. More than that and you lose maximum efficiency.

The high slip angles can occur on the front, the rear or both. Note in both diagrams the arrows show the intended line based on steering input.



High slip angle at the front is known as Understeer (also push or tight in NASCAR terms). The car steers less than (or under) what the steering input is and is being pushed straight ahead.

High slip angle at the rear is known as Oversteer (or loose). The car steers more than (or over) what the steering input is. The rear end gets loose and wants to come around.



Equal slip angles on both front and rear is known as Neutral. I am sure you have seen racing cars, under control, in full 4 wheel drifts.

When you start reaching the limits of the tires, you will hear the tires start to make a soft squeal (what I call 'talking to you'). Think of the squeal you hear when driving on very smooth concrete, like under buildings. I tell my students that if the tires are *talking* to you, that is a good thing. If they start *screaming* at you, it is not. Then it is time to put 'both feet in!' (clutch and brake). You have lost control of the car and it will come to a stop. Fairly soon…. It is all great fun.

Usually, you can control understeering or oversteering conditions with the throttle. If you remember the Friction Circle, you know you have maximum steering capability using an even throttle (neither accelerating nor decelerating). Adding throttle shifts the weight to the rear, giving the rear better traction. Reducing throttle shifts the weight forward, allowing more grip in the front.

Here is a picture of a car that is oversteering. How do I know? Look at the road behind it. It is "S" shaped and the driver is negotiating a right hand turn. But if you look at the front wheels, the driver is steering to the left and not the right. You can tell the driver is on the throttle and not the brake as the nose of the car is raised. By keeping on the throttle, the rear tires have more grip even though they are sliding sideways. A bit of steering to the left keeps it all in control. This is a classic example of how it should be done.

What would have happened if the driver gotten off the throttle or hit the brakes in this instance? The weight would have shifted forward, giving the front tires more grip and the rears would lose grip immediately. The car would spin to the right and take aim at the photographer based on the steering angle. I would bet that, if the side mirror was not there, you would see a huge grin on the drivers face!