

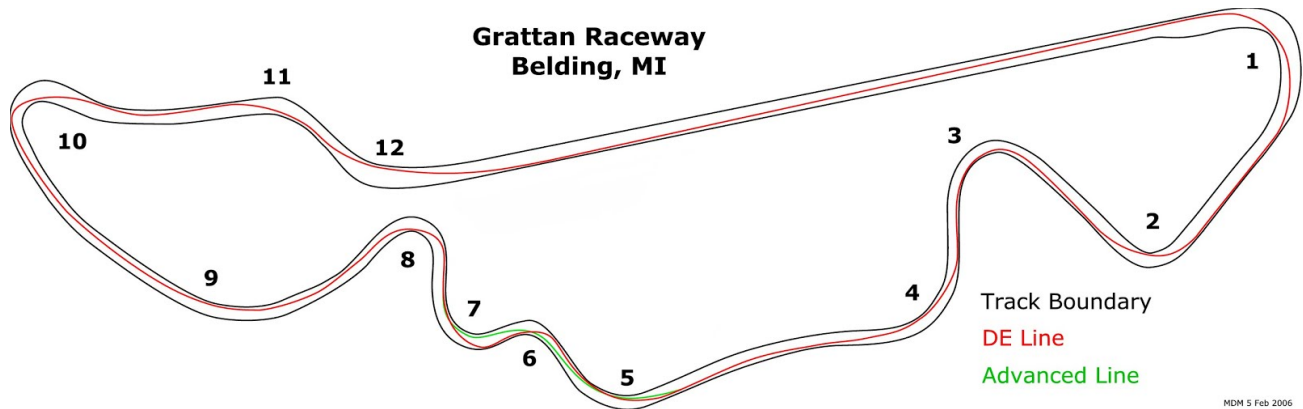
Performance Driving/Racing Terms

By [Scott Barton](#)

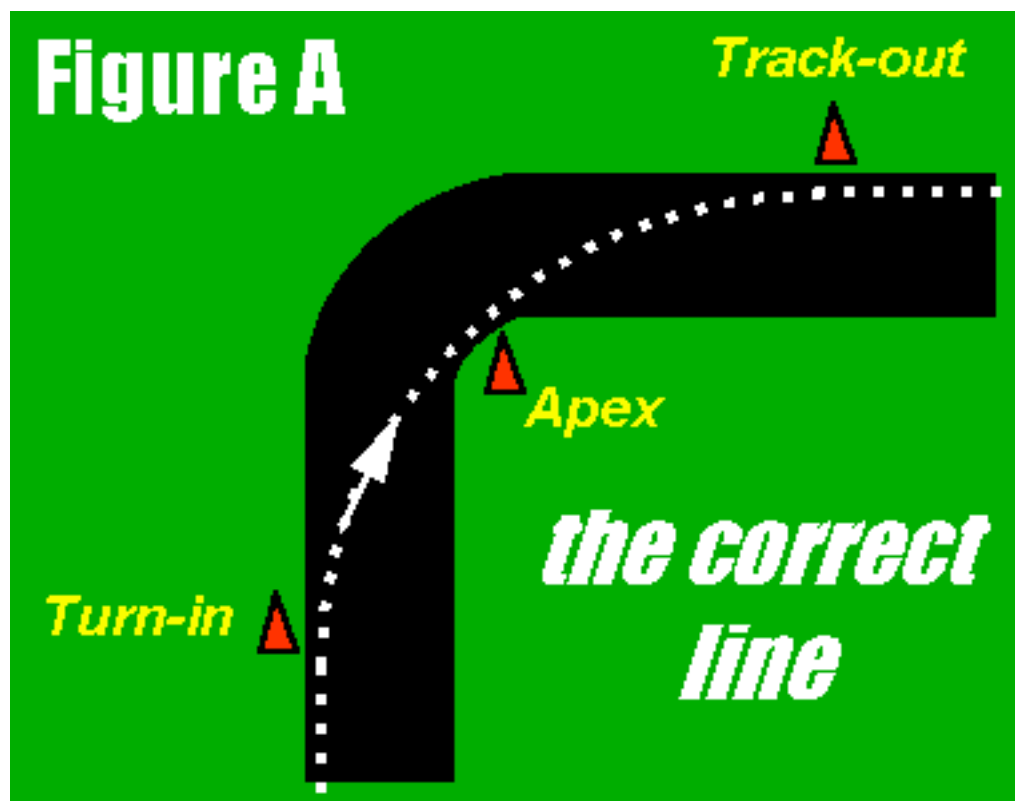
This Guide is to help Novices understand the common terms and jargon that will be used at the track so that when they get there, they will understand the basic terminology that everyone will be using, so that their learning curve won't be so steep. There is also basic information and guidance on what to do and what to expect. This guide should be used in addition to the club's introduction to HPDE document.

*note: all images are linked to their original site. see site for more info.

The Line - Path the car takes around the race track in order to complete the lap in the shortest amount of time.



Anatomy of a Corner - A corner can be broken down into several parts. The Braking Zone, Turn In Point, Entry Phase, Apex, Exit Phase, and Track Out Point.



Increase speed through a turn by increasing the radius.

Braking Zone - The section of track coming up to a corner when the brakes are first applied to when they are released. Typically the brakes are released just before the Turn-In point, but the braking zone can extend into the Entry Phase of the turn.

Turn In - The point on the track where the steering wheel is first turned in order to navigate the turn. This is typically on the far outside of the track just after the braking zone.

Entry - The initial stage of the turn from the Turn In point to the Apex.

Apex - The point in the middle of the turn where the car is closest to the inside of the track.

Exit - The stage of the turn where the car is leaving the Apex and heading towards the Track Out point. Typically the car should be accelerating during the Exit phase of the turn.

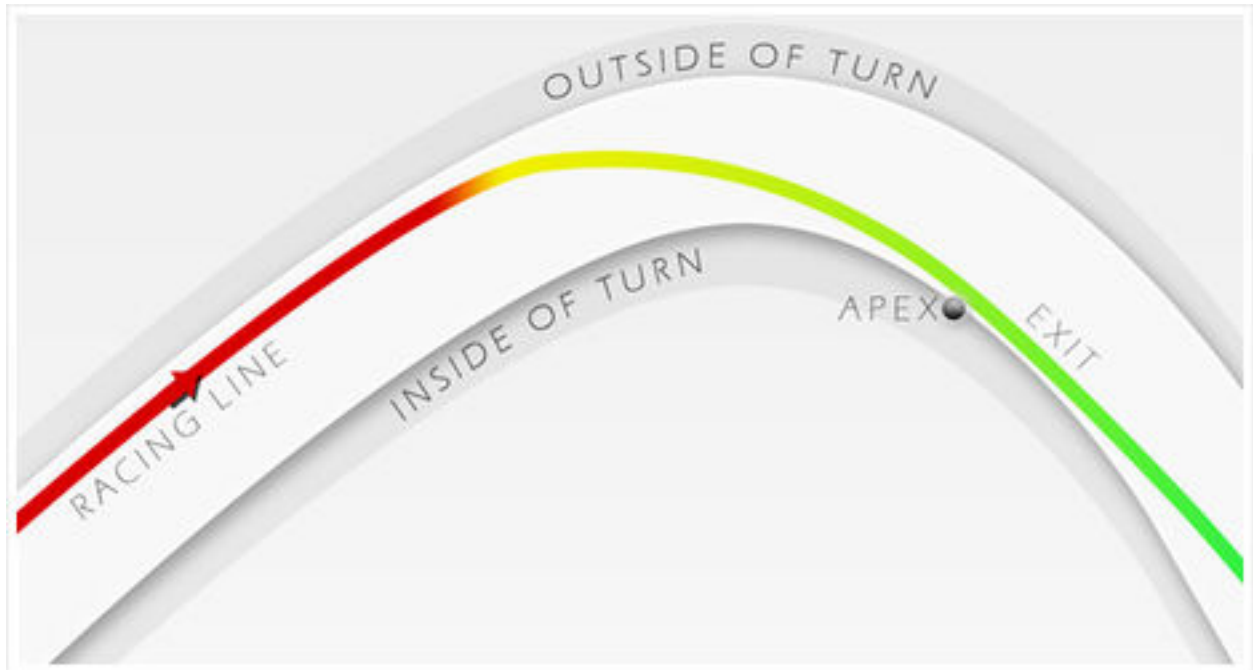
Track Out - The initial point on the far outside of the track where the car is starting to go straight again after the turn.

Early Apex - In a normal 90° turn, the Apex will be exactly halfway between the Turn In point and the Track Out point. An Early Apex is where the Apex is before the halfway point of the turn. Typically you would Early Apex an Increasing Radius Turn.

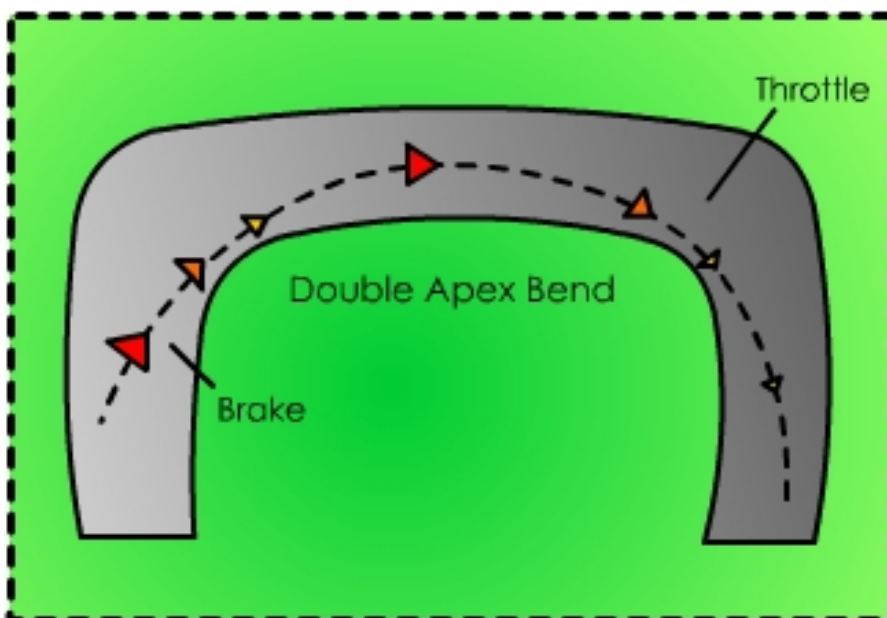
Need a pic of Early Apex turn

Late Apex - In a normal 90° turn, the Apex will be exactly halfway between the Turn In point and the Track Out point. A Late Apex is where the Apex is after the halfway point of the turn.

Typically you would Late Apex a Decreasing Radius Turn.



Double Apex - The line taken when two corners are close enough together and turning in the same direction, where you Turn In from the Outside of the first turn, come down into the Apex, Track Out and then come back down to the 2nd Apex in one big arc, essentially making it one big turn.



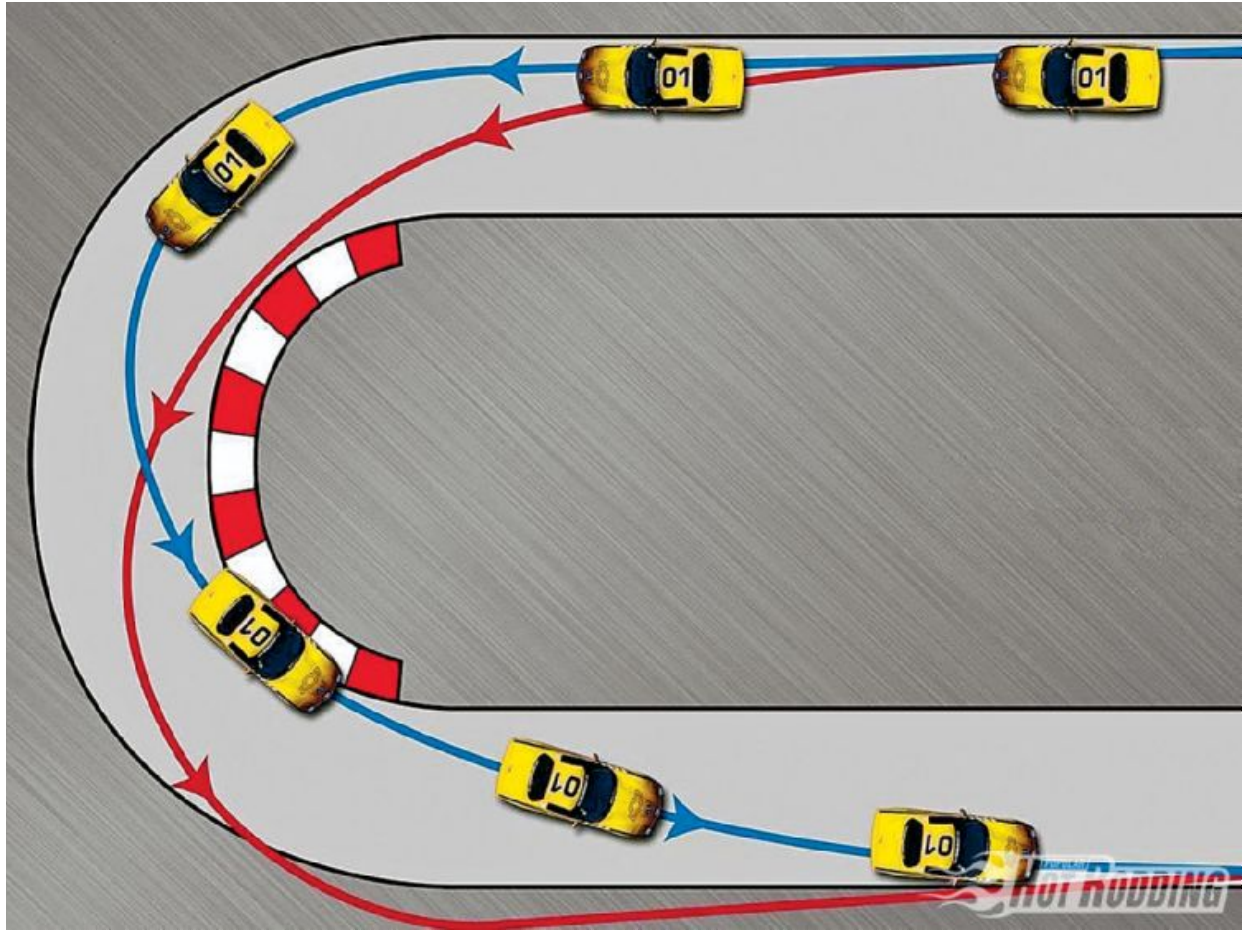
Too Early - Turning in before the correct Turn In point. Turning in Too Early will result in you Apexing too early (before the actual Apex) and can then cause you to run out of track at your Track Out point and go Off Track. This is usually caused by driving too fast for your comfort level or just too fast for the turn. If you turn in too early, you need to be very patient getting back on the throttle and wait until you are after the correct Apex, otherwise you run the risk of running out of track on Track Out and having an Off.

Too Late - Turning in after the correct Turn In point. Turning in Too Late will usually result in you scrubbing too much speed, missing the Apex (not getting close enough to the inside of the turn), but usually you can make the turn.

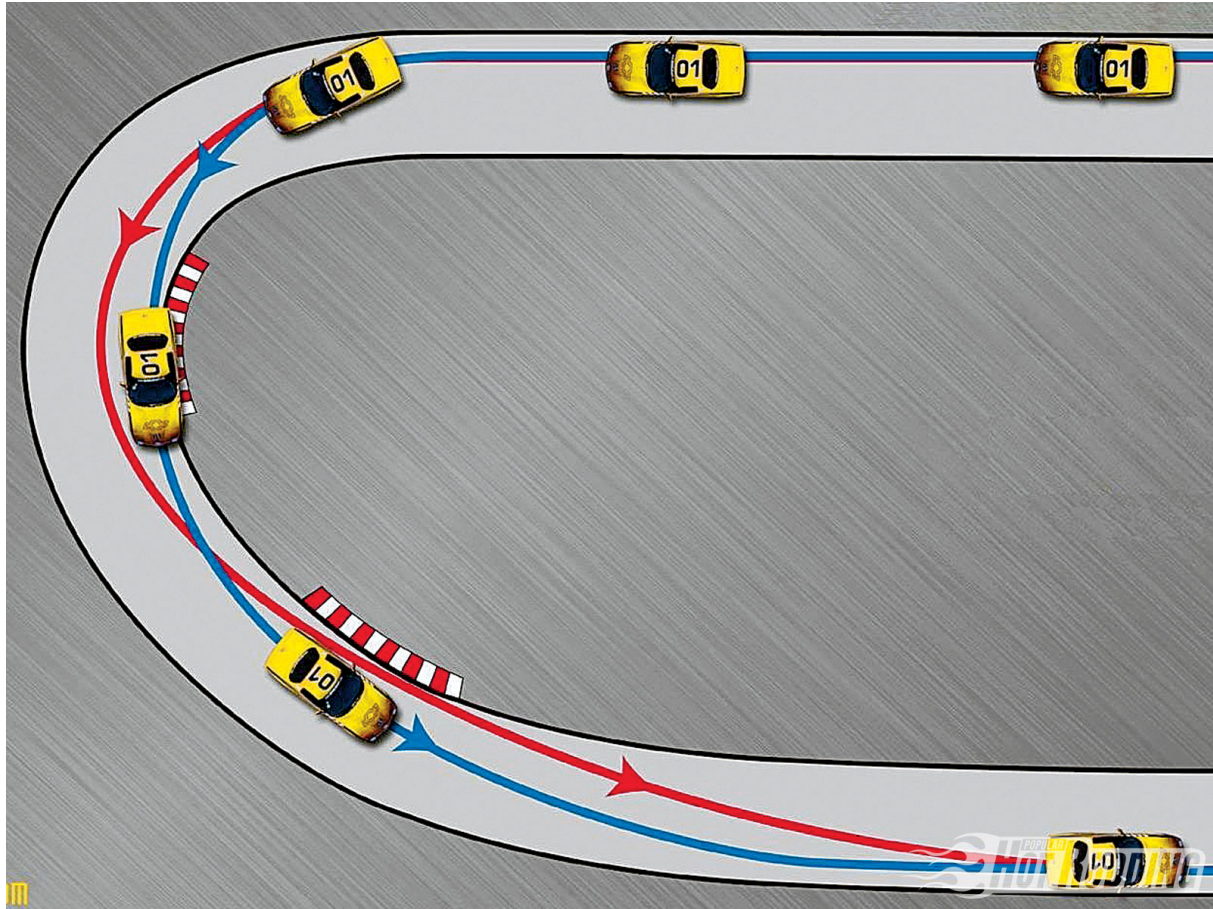


Types of Turns:

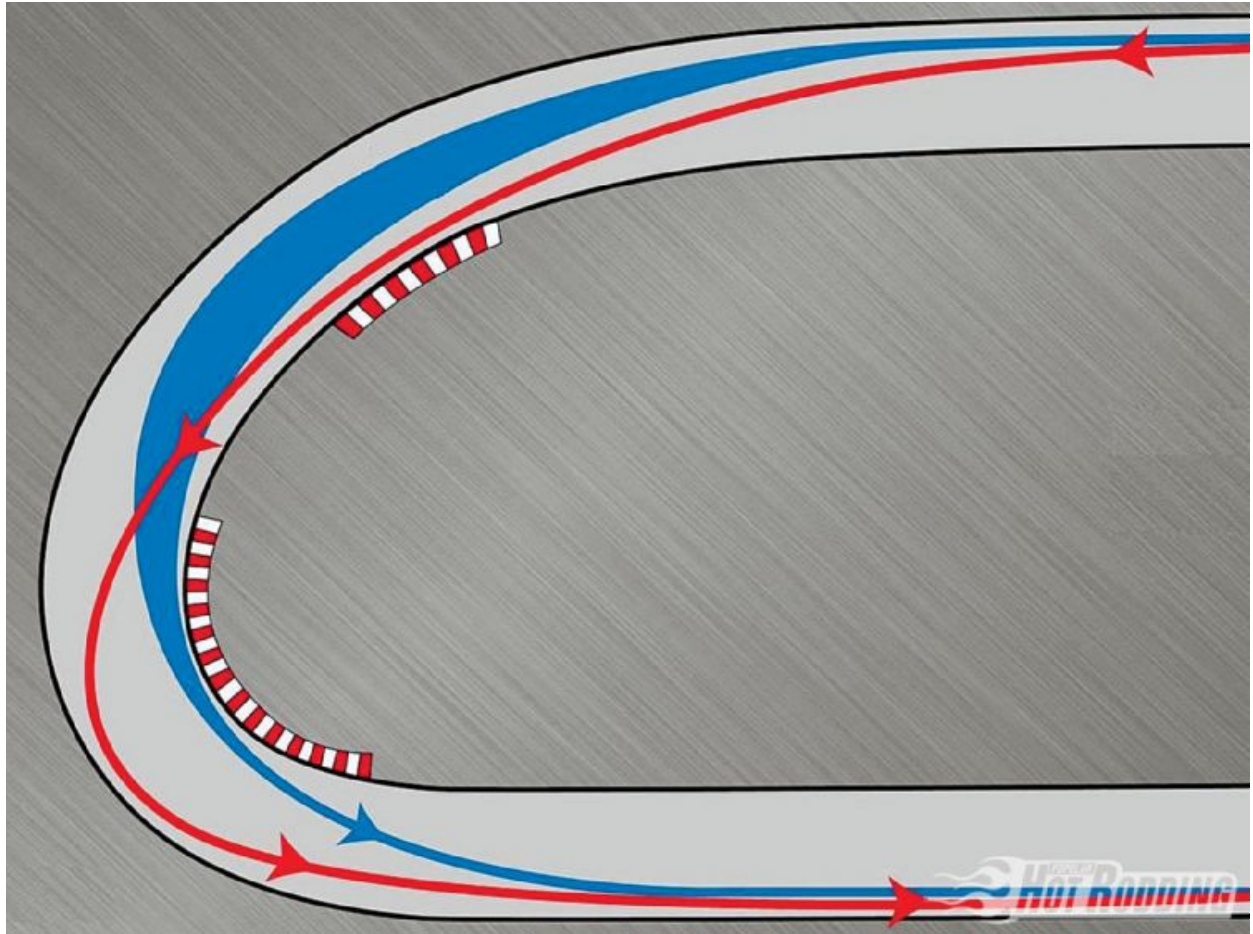
Normal/Constant - The radius of the turn is constant and does not change throughout the turn.



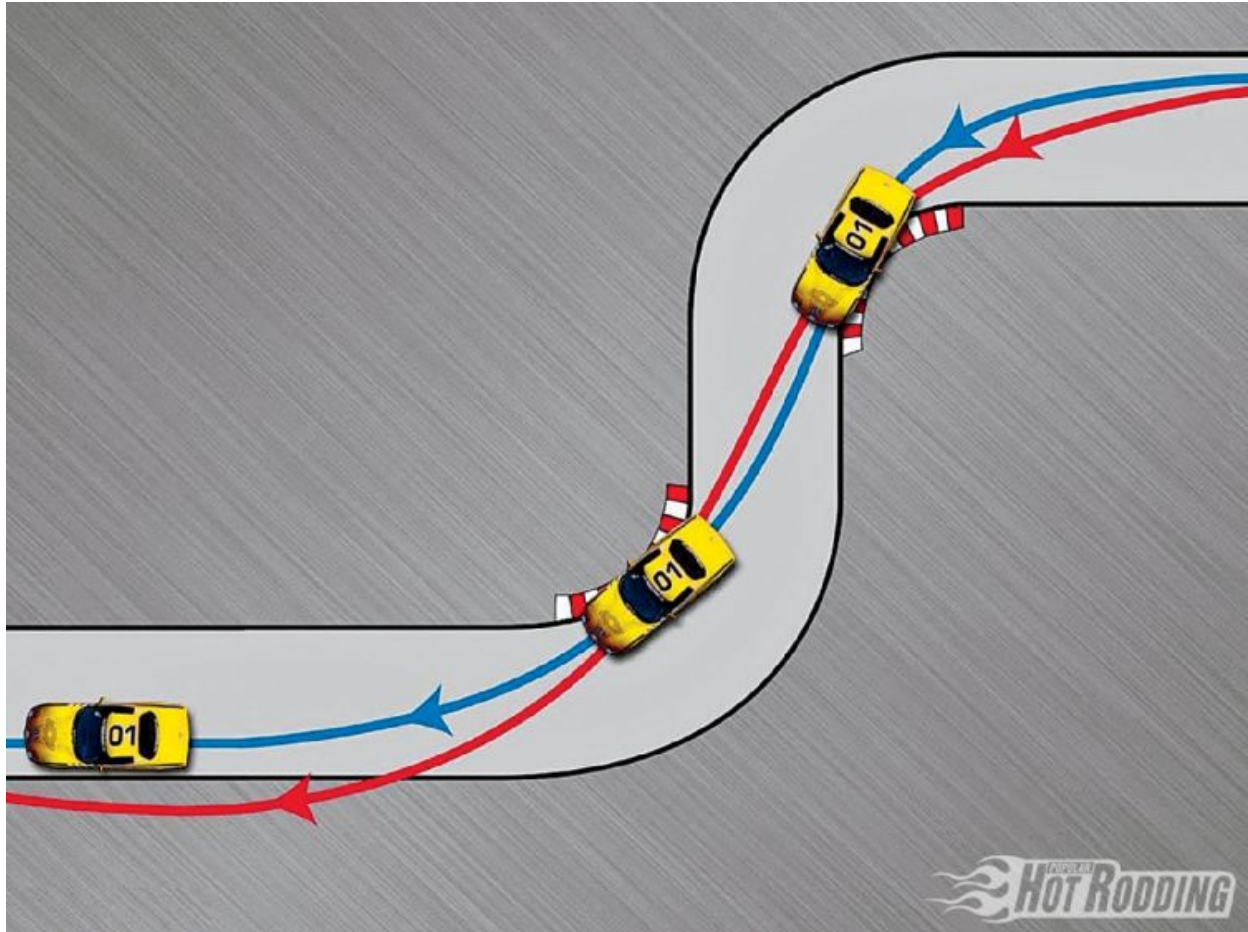
Increasing Radius Turn - Where the radius of the Exit of the turn is larger than the Entry of the turn. Therefore the Entry is usually much slower than the Exit, allowing you to accelerate harder on Exit.



Decreasing Radius Turns - Where the radius of the Entry of the turn is larger than the Exit of the turn.



Chicane or Esses - A series of left then right (or right then left) turns that are connected.



Throw Away Turn - A turn in which you adjust your apex or reduce your entry speed in one turn, sacrificing speed in that turn, in order to take the following connected turn faster. This allows you to exit the 2nd turn faster and carry more speed down the following straight, making up more time than was lost by going through the first turn a little slower. Just because they are called Throw Away turns, does not mean they are unimportant to reducing lap times.

On Camber - Where the outside of the turn is higher than the inside of the turn. This causes the car to have more grip and can be taken faster than if the turn was flat. Think of the banking at Daytona.

Off Camber - Where the inside of the turn is higher than the outside of the turn. This causes the car to lose grip and must be taking slower.

Blind Turn - A turn with elevation changes such that you cannot see all of the turn or where the track goes.

Reference Points - Visual Points on or around the track you can use to alert you when to brake, turn in, apex, and track out. Braking markers placed at the 500, 400, 300, 200, and 100 foot

marks are Reference Points for when to brake. Typically during a HPDE event, the track will put out cones designating the Turn In, Apex, and Track Out points. You can also use pavement changing color, patches of dirt, painted spots, immovable objects in the background, curbing, and other objects as Reference Points. For example, curbing on the outside of the track during a Blind Turn can give you a clue as to where the track goes even though you can't see it.

Smooth Inputs - In order to be fast, you need make the car work efficiently. You must manage Weight Transfer in order to place the weight where you want it for maximum traction. Smoothly transitioning the weight allows the car to take a set and build up cornering forces up to the maximum potential. Jerking the steering wheel does not allow the car to build up maximum cornering force, the overall grip level will be down, cornering G's will be down, and so will maximum speed through the corner, even though the tires will be screeching and sound like there isn't any way to go faster through that turn. Turning in and unwinding the steering wheel should be smooth and constant. The throttle and brakes are not On/Off switches. Much the same way you wouldn't jerk the steering wheel to full lock on turn in, hold it, and then snap it back to center at track out. You need to smoothly but rapidly transition from acceleration to braking and back to acceleration.

Look Up/Look Ahead - In high performance driving it is important to be looking much farther ahead than you normally would on the street. This takes practice. You need to always be looking one step ahead. As you approach the Turn-In Point, you should not be looking at the Turn-In Point, but rather the Apex. When driving towards the Apex, you should not be focusing on the Apex, but the Track Out Point, etc. Looking ahead will help you not be surprised and reacting to what is coming up, but instead you will be anticipating and planning. As a by product, looking ahead naturally helps you be smooth.

Unwind (the steering wheel) - Smoothly bring the steering wheel back to center after turning.

Open (the steering wheel) - Unwinding the steering wheel to prevent a spin. You may even have to counter-steer.

Counter-Steer - Turning the wheel in the opposite direction of the turn to catch the spin. If you are turning right and the rear end starts coming around in a spin, you may have to turn the steering wheel to the left in order to catch the spin.

Stay In - Keep your car closer to the inside of the turn.

Stay Out - Keep your car closer to the outside of the turn.

Squeeze (Throttle or Brakes) - Refers to method of throttle (or brake) application where you slowly but consistently add more and more throttle over a period of time, usually when exiting a turn. Imagine there is a small balloon under your throttle pedal. If you stomp on the pedal, you

will pop the balloon. But if you squeeze the throttle, the balloon will be able to expand and you won't pop the balloon. Don't pop the balloon! Squeezing the brakes is done over a much shorter period of time than squeezing the throttle.

Roll On (the throttle) - Similar to Squeeze but a little faster.

Feathering (Throttle) - Refers to a method of throttle application where you slowly feed in the throttle until you find the maximum throttle the car will take, before pushing the car too wide or spinning the tires, and then keeping the throttle close to that throttle position but still feeling out where the limit is.

Throttle Control - Not treating the throttle as an On/Off switch, but smoothly and gently using the throttle pedal to find the limits of adhesion.

Maintenance Throttle - Refers to the the amount of throttle application, where you are not slowing down, but not really accelerating very much. Maybe 1 mph or so acceleration per second. It should be enough that you can hear the exhaust. Usually you do this to transfer some weight to the rear tires so that the front tires aren't scrubbing. This is usually done during the Entry Phase of the turn.

Brush (Brakes) - Applying the brakes just enough to transfer weight to the front of the car to help the car turn in, but not significantly slow the car down.

Threshold Braking - Braking at the limits of the car, where the tires are almost locking up in order to slow down rapidly in the shortest amount of time possible.

CPR (Correct, Pause, Recover) - A technique to save the car from a spin. **Correct** refers to catching the spin by counter-steering (steering in the opposite direction of the turn) to stop the car from rotating. **Pause** refers to holding the steering wheel in place once the spin has been caught for a very brief period of time once the rotation has stopped. **Recover** refers to straightening the steering wheel or turning it back into the turn to prevent the car from snapping back and spinning the other way (also known as a tank-slapper).

<http://www.youtube.com/watch?v=4NFKYel9A1Y>

Going "Off" - There may come a time where you have pushed too hard or lost control and the car is about to go off track. It is usually best to try to drive Off in a semi-controlled manner, than to try to save it. Typically there is usually a lot of run-off room on the outside of the track for you to drive safely off on without hitting anything. Once off, get the car straight, under control, gently navigate away from hitting anything, and gradually slow the car down. Treat grass as if it were ice. Do not make any sudden or big inputs with the steering wheel, brakes, or gas. If you come to a safe stop, wait for the nearest flagger to tell you it is safe to enter the track again. When pulling back on track try to enter as straight as possible. If your steering wheel is turned, you will

not have much traction on the grass, but as soon as one wheel gets on the pavement, it will get traction, grab and could spin the car.

If you try to save it instead of driving off, there is a good chance you could hook the car across the track (into traffic) and into the inside where the wall is usually a lot closer. If you hit something, shut the car off, make sure you and your passenger are OK, and look for the flagger or nearest worker for directions. Stay buckled up with your helmet on, and do not get out of the car unless it is on fire.

Flaggers/Corner Workers - These are the workers who are in the Flag Stations located around the track. They watch what is going on around the track and notify the drivers of situations on track via Flags, and also notify the Stewards of on track situations via radios.

Marshalls/Stewards - These are the workers who are not in the flagging station who are in charge of making sure the event runs smoothly and safely. Pit In/Pit Out Marshals, Safety Steward, Tech Steward, Control Steward, etc.

Track Chair - Person who is the overall manager of track events for the club or organization hosting the track event.

Registrar - Person who manages student registration/sign-ups for the club.

Chief Instructor (CI) - Person who manages the instructors and makes student-instructor pairings.

Flags:

Green - Track is Green, you can go. Usually only displayed at Start/Finish. If you do not see a flag at a flag station, you can assume it is Green and can pass.

Yellow - Caution Flag. Hazard ahead. Slow down, be cautious, and look for the incident. No Passing! Do not pass until you see the next manned flag station that is not displaying a yellow.

Waving Yellow - Immediately dangerous conditions ahead. Safely slow way down and look for incident. Be prepared to take evasive actions. The more vigorous the waving, the more serious the incident. No Passing!

Double Yellow - Standing Yellow displayed at all Flag Stations. Caution, No Passing. Form a single file line at reduced speeds.

Yellow/Red Striped - Debris Flag. There is something on the track. Could be oil, coolant, water, dirt, grass, cone, fluid, animal, or car parts.

Red - Emergency. Something bad has happened and they need to get emergency crews out as quickly as possible. Check your mirrors and come to a controlled slow stop off to the side of the track and in view of a flag station. Stop on a flat surface of track if you can. Do NOT slam on your brakes and come to a dead stop in the middle of the track. Others behind you may not see

the Red Flag and hit you hard. It is only necessary that you slow down in a controlled fashion. Once you are slow and off to the side of the track, you can creep up to a flat section of track in view of a flagger and wait their direction. Do not park in the grass because if it is dry and your brakes are hot, you can start a grass fire under your car.

White - Slow moving vehicle ahead. This could be a car with problems or it could be an emergency vehicle. Slow down and pass them with care, giving them a lot of room.

Black - Something is wrong, come into the pits. .

Black w/Red Dot - Meatball Flag. Something mechanical is wrong with your car. Come into the pits.

Blue w/Yellow Stripe - Faster car approaching you. Give them a point by at first available Passing Zone.

Checkered - You won! Your session is up. Complete the rest of the lap as a Cool Down Lap and come into the Pits and Paddock.

Flag	What it means	What to do
	-Start of session, end of hazard, or restart	-DRIVE!!!
	<u>Single Motionless</u> - Danger ahead. <u>Single Waving</u> - Great Danger Ahead. <u>Double</u> - Full course yellow conditions.	<u>Single Motionless</u> - Slow down, no passing until you pass incident or next flag stand without a yellow flag. <u>Single Waving</u> - Slow down and be prepared to stop. No passing until past accident or flag stand without yellow flag. <u>Double</u> - Prepare to encounter pace car or other emergency vehicles. No passing until pace car has pulled off AND you pass a flag stand without a yellow flag.
	-Debris, oil, or other adverse conditions on track	-Proceed with caution.
	-Emergency	-Come to an immediate and controlled stop on the side of the track, in a safe location. Stay in your car.
	-Emergency or slow moving vehicle on track	-Proceed and pass with caution
	<u>Open</u> - Officials want to talk <u>Furled</u> -You are driving unsafe <u>All stations</u> - Black conditions whole track	<u>Open</u> -Complete lap and go to pits <u>Furled</u> -Stop driving unsafe or you'll be black flagged <u>All</u> - Go to pits. No passing.
	-You have a close following vehicle that may attempt a pass.	-Be prepared to be passed and don't cause an accident. -In DE, point the person by in the next passing zone.
	-End of race or session	-Complete current lap cautiously and exit via pit lane. You shouldn't be passing.

http://911wiki.wowisme.com/index.php?title=HPDE#Track_Flags

Preparing for the event - Make sure your car has at least 50% or more tire tread and brake pads left. You should have your brake fluid flushed with high quality DOT 4 brake fluid. Get your car Tech Inspected by a reputable shop.

Print out and bring all of the forms required, including the Tech Form, copy of your registration form, track map, schedule, and run group and student-instructor assignments if available.

These forms should be in your confirmation email or available on the club website. Go to the track website and print out the facility map. The facility map will show you the location of the Paddock, Classroom, Pits, garages, timing tower, bathrooms, concession stands, etc.

Search [Youtube](#) for video of the track so you can get an idea of where the track goes before you get there. Try to find video of a car similar to yours and with data overlay if possible. Watch video a few times each day leading up to the event. Do not worry about speeds or braking points or the line, just try to learn where the track goes. Can you close your eyes and drive the track from memory or can you fast forward to any point in the video and know which turn is coming up next. It helps to print out a track map when you watch. This will help immensely when driving the track for the first time, and is highly recommended.

Get plenty of rest and drink lots of water the day before your event. Stay away from alcohol or drugs before the event. Performance Driving is a mental sport. You need a well rested and clear head in order to drive your car at the limit. Consider staying over in a hotel near the track the night before instead of driving up in the morning. Prepare to arrive at the track at least an hour before Drivers Meeting. This will give you enough time to register, clean out your car, and go through Tech, and not feel rushed. Arrive with a full tank of gas. Check your tire pressures and bump up the pressures 2-3psi over stock recommendation. You will need long pants, closed toe shoes, long sleeve shirt, in date SA helmet. Bring a hat, sunscreen, snacks, a lot of water and Gatorade, and a folding chair. Bring paper towels, windshield cleaner, oil, water, DOT 3/4 brake fluid, blue painters tape, a good tire pressure gauge, and a torque wrench. If you find you forgot something or need something at the track, don't hesitate to ask anyone. Track Junkies are some of the friendliest people you'll ever meet.

Arriving at the Track - When you first get to the track, find a spot in the Paddock to park and unpack, preferably near someone with a car similar to yours. Take out everything that is loose in your car, including cleaning out your trunk and glove box, and remove the driver's side floor mat. You may also want to remove the spare tire and tools to reduce weight. Remember weight is the enemy. Clean your windshield, torque your lug nuts, check your tire pressures, and check your oil and coolant levels. Go to Registration and check in and get your registration packet. You should get a schedule, track map, number decals, and find out your run group and instructor. Take note of your Run Group's on track times and classroom times, and find out where and when the Drivers Meeting is. If you have any questions don't hesitate to ask while at Registration or Drivers Meeting. Apply your car numbers and go to Tech with your completed Tech Sheet and helmet. Some groups need you to go through Tech before you go through Registration. Go to the Drivers Meeting and meet up with your instructor after. Give your instructor a little background about you and your car. What type of tires, brakes, and any mods. Any previous performance driving experience you may have. Let him know what your goals are for the weekend, even if your only goal is just to have fun. Let him know if you are there with

anyone. Go to your classroom sessions.

Run Groups - Groups of cars and drivers broken down by driver experience level. Car capability is not a factor in Run Group selection, only driver skill level. Expect to see an instructor with a Miata in the Advanced Run Group and a novice with a Porsche GT3 in the Beginner Run Group. Yes, that [instructor in the Miata will be faster than the novice in the GT3](#). Typical Run Groups are Beginner, Intermediate, Advanced, and Instructor, but may be broken down further if there are a lot of participants.

Tech Sheet/ Form - Before the track event, you need to get your car Tech Inspected to make sure it is safe for track use. Some groups require that an approved shop must fill out and approve your Tech Form; you may not approve the Tech Form for your own car. The club will provide you with a Tech Form for you to take to a shop for them to check and fill out. Bring the filled out and approved Tech Form with you when you go to the track event.

Registration - This is where you check-in with the club running the event so they know that you are there. Registration should be one of the first things you do when you get to the track. You will sign a waiver and get a colored wristband designating your Run Group. You will usually need to bring a copy of your registration form, and some groups ask that you bring a copy of your Tech Form and helmet to Registration.

Tech - This is where your car will be looked over at the track to make sure that it is safe for track use. You must have everything out of your car, numbers applied, and ready to go on track when you go through Tech. You should go to Tech immediately after you check in at Registration and clean out your car. You will need to bring a copy of your completed Tech Form and your helmet with you to Tech. Track side Tech is not a thorough check of your car, and it is your responsibility to make sure your car is safe and ready for track use before you get to the track as well as before you go out on track.

Drivers Meeting - Meeting time when everyone gathers before the first cars go out on track so the organizers can inform you on how the event will be run, what is expected of you, go over passing zones and passing rules, safety, and flags. Drivers Meeting is mandatory for everyone.

Classroom - Typically students will have classroom sessions scheduled throughout the day when they are not on track. Novices will learn HPDE procedures, go over passing rules, flagging, Pit In/Pit Out procedures, track etiquette, and basic high performance driving terms and techniques. Classroom is usually mandatory for Novices. Intermediate and Advanced students will cover advanced driving skills and techniques as well as ways to practice them.

Riding as a passenger - Most clubs allow instructors to take students out on track as passengers. A few clubs even allow signed off Advanced drivers to take passengers. Take advantage of this! Seat Time is Seat Time, even if it is in the passenger seat. There is a lot you

can learn from the passenger seat, from where the track goes, to the correct line, to how the car should feel at the limit, new techniques, different lines, etc. Try to get a ride as often as you can! You can ride with any instructor, not just your own. Just ask!

Requesting a new instructor - Just because you are assigned to an instructor does not mean you are stuck with them the whole day if things aren't working out. Different people learn in different ways, and each instructor has their own way of instructing. Sometimes the way a student learns and the way an instructor teaches doesn't mesh. Do not be afraid or hesitant to talk to the Chief Instructor and request a new instructor. If you're not having a good time, chances are neither is your instructor. He's there to ensure that you progress and have a good time. If that's not happening, he's not happy either. You're not doing anyone any good by sucking it up and sticking with it. No feelings will be hurt if you switch instructors.

Passing Rules - In order to keep HPDE events controlled and safe, all passing must be done only at designated Passing Zones and with proper Point By's.

Passing Zones/Locations - Passing Locations will usually be defined for you in the Drivers Meeting or classroom. For beginner groups, typically Passing Zones are limited to the longer straight(ish) sections of the track.

Point By's - HPDE is a team sport. Everyone out there is sharing the track together, and we must work together as a team in order to have a safe, fun, and productive track event. The event is a lot more fun when everyone co-operates together and is courteous to each other.

Hand signals are how drivers communicate to each other about their wishes and intentions. The car being passed gives a hand signal called a Point By. You do this by pointing your arm out the window in the direction you want the car behind you to pass. You would point straight out the window, pointing to the left, to indicate that you want the car behind you to pass you on the left. You stick your arm out the window and then over the roof, pointing to the right, to indicate that you want the car behind you to pass you on the right. You must give one Point By signal for each car you want to pass you. If there are 2 cars, you must signal twice, and so on. Typically, the car being passed stays On Line, and the car doing the passing goes Off Line. Once you give a Point By it is your obligation to help facilitate a safe and complete pass before the braking zone. Unless the car is much faster than yours, you will probably have to lift off the throttle or even brake early. Do not lift or brake until after the car behind you pulls out to pass. If you brake when they are directly behind you at full throttle trying to pass, they could easily run into the back of you.

If you have a fast car, but a driver was able to catch you and is behind you, he is faster than you. Point him by and follow them to watch what they are doing in the corners to see how he caught you. Just because your car is much faster in a straight line does not mean you should drag race them down to the next corner and hope he doesn't catch you again. He will catch you again, and that means that you are slowing him down in the corners. Let him by. In the HPDE world, there

is nothing worse than getting a reputation for not giving Point By's. That is far far worse than being the slowest guy at the track. Being courteous with Point By's is how you make friends; being stingy with Point By's is how you get people to dislike you. [Don't be that guy](#) who is stingy with giving Point By's.

Paddock - This is the parking area for cars when they are not on track.

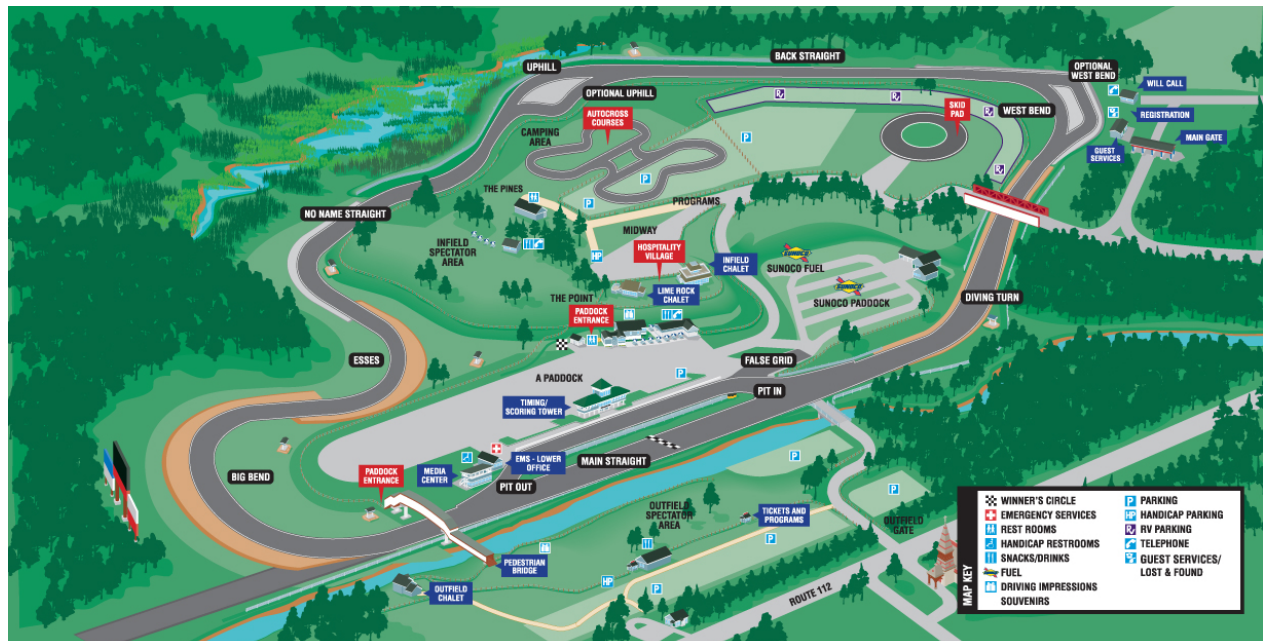
Grid/Stage/Staging - Lining the cars up and checking them before going out for their session.

This gets all of the cars out on track in an efficient manner so they get the most track time available. Staging is usually located near Pit In or in Pit Lane. Usually you will begin Staging 10 minutes before your session starts.

Pits/Pit Lane - You enter and exit the track from Pit Lane. Sometimes clubs will have you Stage in Pit Lane before going out. This is also where you see race car teams working on their car during pit stops during a race.

Pit In - Pit In is where you enter Pit Lane. If you are on track, Pit In is the section of track where you leave the track to enter the Pits. If you are in the Paddock it is the entrance to Pit Lane.

Pit Out - Pit Out is where you leave Pit Lane. If you are in Pit Lane going out on track, it is the section of Pit Lane just before entering the track. Usually there will be a Pit Marshal there who will let you know when it is safe to enter the track. Pit Out is also used to describe where you exit Pit Lane to get back into the Paddock.



Pit Speed - Maximum speed allowed while driving through Pit Lane is usually no more than 35MPH, but can be lower. Pit Speed will usually be covered in the Drivers Meeting or Classroom.

Paddock Speed - Paddock speed limit is usually only 5-10MPH.

Blend Line - When first entering the track, there will be a yellow line between you and the hot portion of the track. Usually the blend line will go all the way to the first corner as you enter the track. Do Not Cross The Blend Line! The Blend Line prevents you from swerving into much faster oncoming traffic and creating a huge accident. Do not cross the blend line, even if you are the first person on track.

Pit In Procedure - When entering the Pits from the track, you need to signal your intentions so that the cars behind you and also the track workers know what you are doing. You signal your intention to Pit by sticking your arm up out the window as high as possible and making a fist. Your elbow should be touching the roof of the car. This ensures that your fist is high above the roof of your car and the cars behind you can see your fist. When you give the Pit In signal, you should be pulled over to the side of the track where the Pit In is and start slowing down. Cars will be passing you if you are giving the Pit In signal so be prepared and make room for them to do so.

Outlap/Warmup Lap - The first lap of the session. This lap should be used to warm up the tires, brakes and engine, refresh your memory of where the track goes and the correct line, where the corner workers are, and recon the track for any debris or fluid down on the track, or any other changes in condition since the last time you were on it. Take it easy during the Outlap and wave hi to the flaggers.

Cool Down Lap - The last lap of your session. This lap should be used to cool down the engine, brakes, and tires, and wave thanks to flaggers. You should use this time to do quick review of the session with your instructor or by yourself. You should also have a detailed debrief once you get back to the Pits/Paddock.

Back in the pits/paddock - Once you are back in the pits/paddock, do not use the e-brake as your brakes will be hot and could warp your rotors. Instead shut the car off and put it in gear. You should debrief with your instructor or by yourself if Solo. Go over what you did right and what you need to work on, and set goals for the next session. Check your tire pressures and oil level, and clean your windshield. Visually check to see how much brake pad you have left. Before you go back out on track, check your coolant level, but wait until it has cooled off. Review your goals and what you need to work on right before going out for your next session.

Setting Goals - The goal of your first event may be just to have fun and return home safely with your shiny car, albeit with a lot less brakes and tires, and a huge smile on your face. Once you start going to more events, you should set goals for the weekend and for each session. Setting goals is the only way to ensure that you keep progressing and learning, and that challenge and improvement will keep you coming back. Simply circulating the track will not help you improve. Practice does not make perfect, only perfect practice makes perfect. Having a journal or log book can help. Make notes about each session, and write down the goals

for that session, what you did right, what you need to work on and what your goals for next session will be. After the event, do a complete turn by turn writeup of a lap at the track. Review this next time you go to the track. Reviewing video and/or data can also help you find what you need to work on as well as set goals.

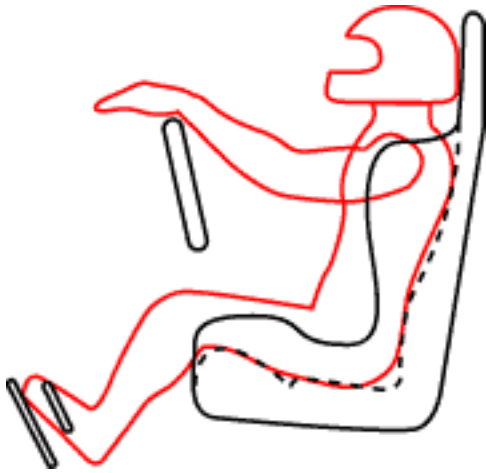
Solo - Being able to drive without an instructor. Usually this occurs when you get to the Intermediate Run Group or higher. Just because you are Solo qualified, does not mean you should never run with an instructor. In fact you should ask an instructor to ride with you at least once per event just to get some feedback and help you look for areas of improvement. Most students stagnate and remain in the Intermediate Run Group for a long time because they never ask to have an instructor ride with them. You should also always ask for an instructor whenever you go to a new track. This does not mean you will be put in the Beginner Run Group, it just means you will drive in your current run group with an instructor.

Seat Position - Proper seating position for a race track is different than driving on the street. You need to be able to reach and operate fully all of the controls easily without straining during high speed, high G turns. Typically the seating position for the track is with the seat reclined forward and moved closer to the steering wheel than you would on the street. Proper seating position should be tested with your butt slid as far back in the seat as it will go and your shoulders touching the back of the seat. Do not cheat and lean forward, it is important that your shoulders are firmly touching the back of the seat. With your legs extended, fully pushing in the throttle and the clutch at the same time, there should be a slight bend in your knees. You should not have to point your toes in order to push in the throttle or clutch all the way. This will allow you to reach the foot controls easily when driving and also be able to push yourself back into the seat so you don't slide around. Slide the seat forward until you get a bend in both of your knees. Now with your shoulders firmly touching the back of the seat, place your arms on top of the steering wheel. Your wrists should rest comfortably on top of the steering wheel without having to stretch. This will allow you to turn the steering wheel through the full range of motion without having to take your hands off the wheel. More importantly it allows you to use the smaller muscles in your hands and arms in order to get precise control of the steering wheel and better feedback. If your arms are too outstretched when driving, you are using the larger muscles in your shoulders to steer and they don't have the precision and control of the smaller muscles. You should hold the steering wheel at the 3 O'clock and 9 O'clock positions and not shuffle steer.

If using a factory 3-point seat belt, you can get it to lock into place and hold you better in place in the seat. This way you don't have to use your arms and legs to hold you in place while you are trying to use them to steer, brake and accelerate.

To do this you need to figure out where your optimal seating position is first as mentioned above. Then slide and/or recline the seat back a little. Grab the seat belt towards the top mechanism and pull hard so that the seat belt is extremely tight on you. Your hand should be as close to the mechanism as possible. Now quickly yank it forward hard until it locks. Hold the seat belt firmly

in this position and now slide or recline your seat forward until the seat belt is snug against you. This will prevent the seatbelt from unlocking and will hold you snugly in place so you don't slide around as much during cornering and braking.



Commonly heard phrases explained:

Brake in a straight line - When you brake hard, you transfer weight from the rear tires to the front tires. This results in increased grip of the front tires, and reduced grip of the rear tires. If you brake while turning, the rear tires will have less traction than the fronts and the rear end could try to come around and spin you out. If you are braking hard and try to turn, you will overwhelm the front tires and you'll just continue to go straight. For a beginners, it is best to plan on doing all of your hard braking in a straight line.

Slow In, Fast Out - Refers to slowing for the entry of the turn in order to accelerate out. This allows you to get on the gas sooner and results in higher exit speeds into the following straight which reduces lap times. It's also a lot easier and safer.

Smooth is Fast - In order to be fast, you need make the car work efficiently. You need Smooth Inputs to make the car work efficiently. The faster the turn, the slower the inputs.

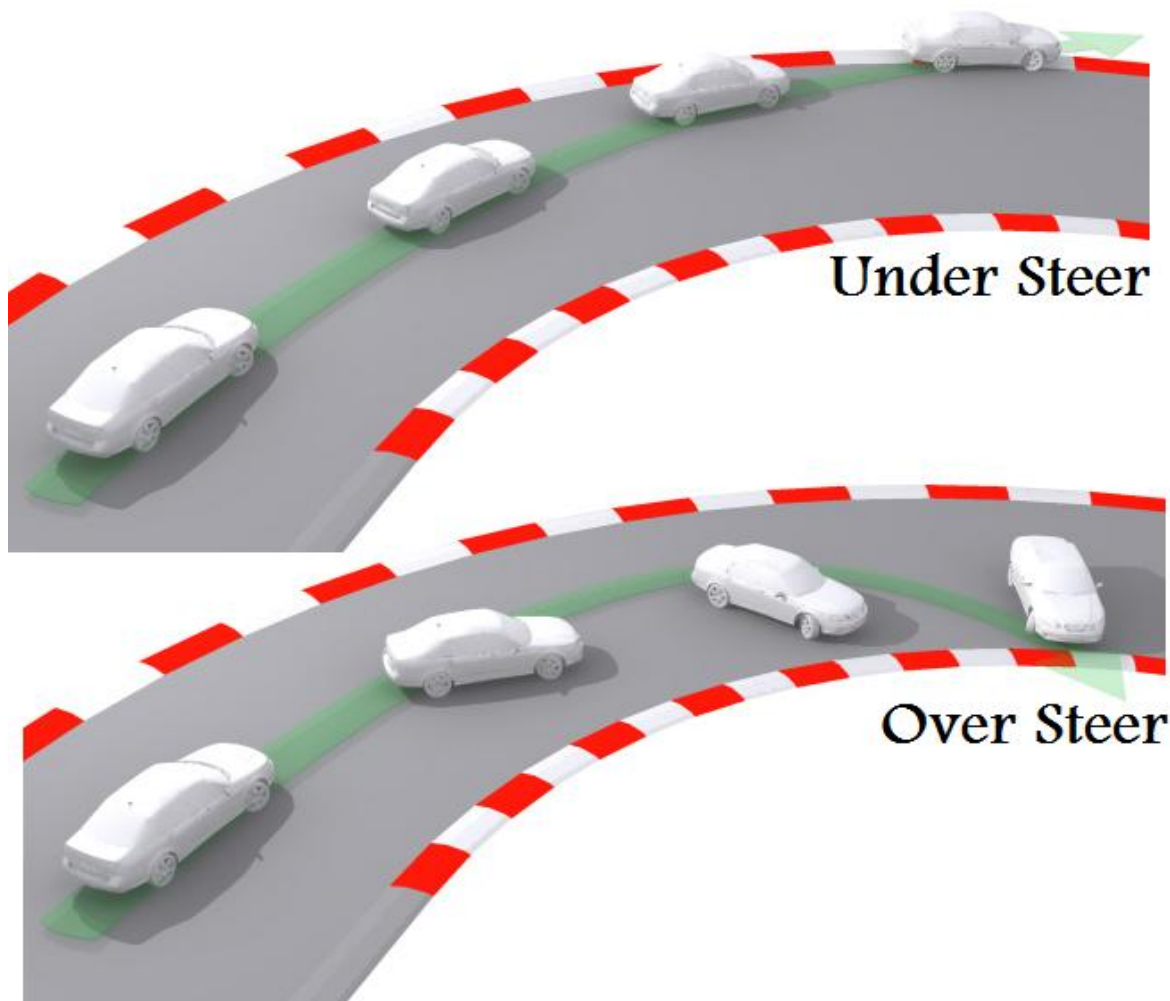
Understeer (aka Push) - When attempting to navigate a turn, the front tires lose grip before the rear tires, causing you to continue to go straight and/or off to the outside of the turn.

Most street cars have understeer designed into their handling characteristics because understeer is usually safer and easier to control than oversteer for the average driver.

<http://www.trackpedia.com/wiki/Understeer>

Oversteer (aka Loose) - When attempting to navigate a turn and the rear tires lose grip before the front tires, causing the rear end of the car to come around more than desired. This usually results in a spin.

<http://www.trackpedia.com/wiki/Oversteer>



Neutral (Balanced) - When navigating a turn, the front and rear tires lose grip at roughly the same time. Predominantly neutral handling characteristics is usually preferred over predominantly understeer or oversteer in race cars.

In a Spin – Two Feet In - If you spin, put your feet on the brakes and the clutch. This will prevent the engine from stalling or worse, spinning backwards.

brake Brake BRAKE! - Your instructor is yelling because he wants to you to brake a lot harder than you are. Brake harder immediately!

Train (of cars) - A line of several cars backed up behind a slower car or driver. Usually this happens when a driver is not paying attention to his mirrors and is not giving Point By's or enough of them (you can give multiple point by's on the longer straights). If you find yourself with

a train of cars behind you, the easiest way to get them all by is to pull through the pits and go back out. You do not have to stop in the pits or lose any track time. If you are stuck in a Train, sometimes it is better to pull into the pits and ask the steward at Pit Out for more space to get some open track, than to try to work your way through the Train.

Seat Time, Seat Time, Seat Time - The only way to get faster/better is through practice or 'Seat Time'. Money spent on DE's will yield better results than spending it on go-fast bits for your car, and those performance results transfer when you get a new car.

Practice does not make perfect however. Only perfect practice makes perfect, which is why you should regularly ask for an instructor even after you are signed off Solo.

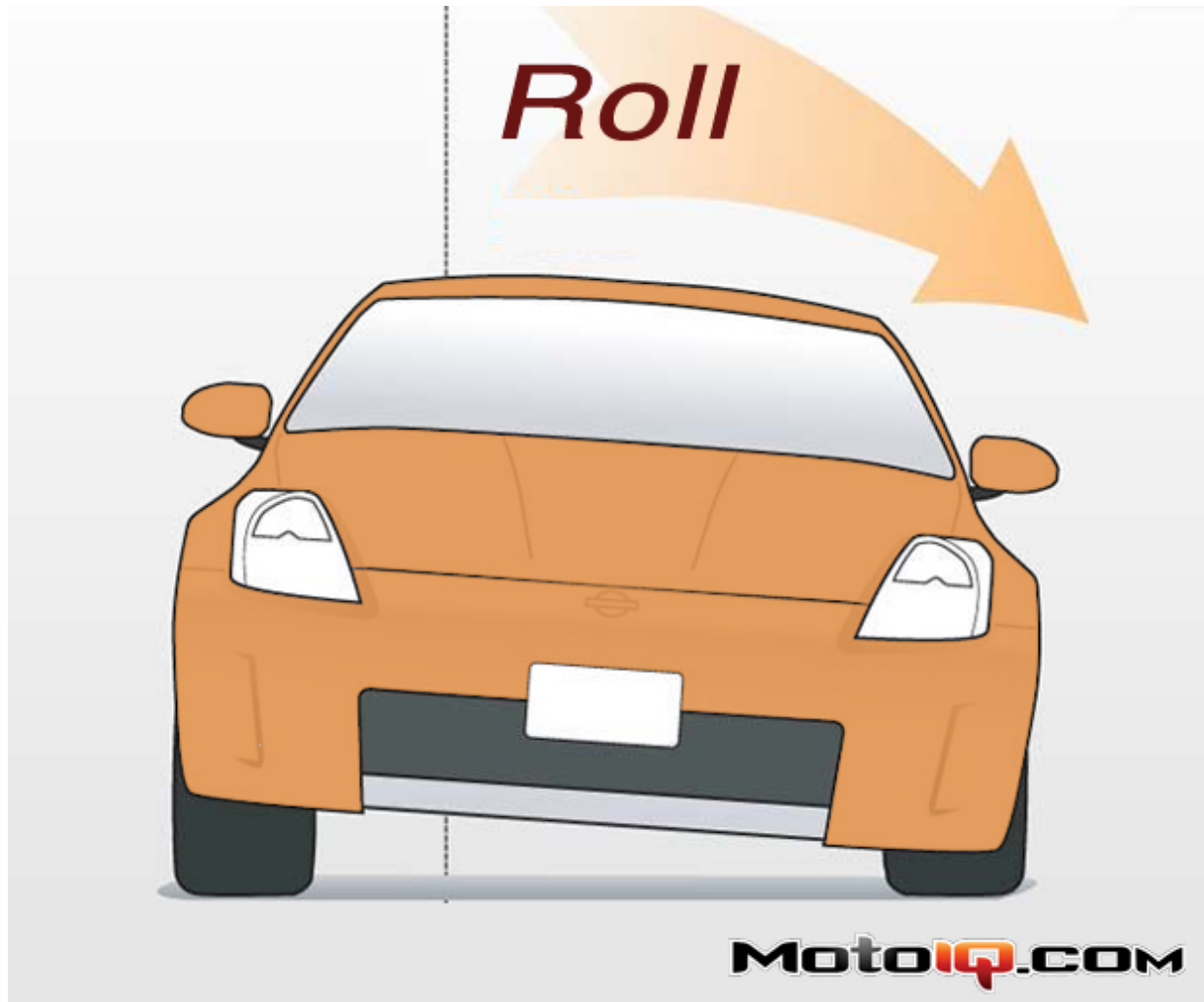
Seat Time is Seat Time, even if it is in the passenger seat. There is a lot you can learn from the passenger seat, from where the track goes, to the correct line, to how the car should feel at the limit, new techniques, different lines, etc. Try to get a ride as often as you can.

Hydrate, Hydrate, Hydrate - It is important to stay hydrated throughout the day. If you aren't driving, you should be carrying a bottle of water or Gatorade with you. Dehydration causes mental mistakes that are usually only realized after it is too late. If you find yourself making 2 or more mistakes in a row, or making mistakes you normally don't make, come into the pits and rest and hydrate. There is a good chance you are dehydrated and the next mistake you make could total your car. It is better to be safe than sorry.

Advanced Terminology and Techniques:

Note: Novices should not worry about learning or understanding advanced techniques and terms at this point.

Weight Transfer - As you turn, accelerate, and brake, you transfer weight around the car. You can feel this as you accelerate, you are pushed back into your seat and the rear of the car squats and the front of the car rises as weight is transferred from the front to the rear of the car. As you brake the front of the car dips and the rear rises as the weight is transferred to the front of the car. When you turn right, you are thrown left, and the car leans or rolls to the left as weight is transferred to the left. When you turn left, you are thrown right and the car leans to the right as weight is transferred to the right.



Managing Weight Transfer - You can use the inputs of the car to transfer weight where you want it. For example, when you turn, you want more traction on the front tires, so you brush the brakes in order to transfer weight to the front tires right before you turn in. If you have a high horsepower car that can spin the tires easily, you roll on the throttle in order to transfer weight to the rear tires so they get more traction as you accelerate harder. When you turn in, you do so smoothly so as more weight is transferred the more grip is available. If you are in the middle of a long sweeping turn and you want the car to tuck into the turn, you can slightly lift off the throttle, transferring weight off of the rear tires and onto the fronts. If you are in the middle of a long sweeping turn and you want the car to push out to the outside of the turn, you can add a little more throttle, transferring weight off of the front tires and onto the rears. .

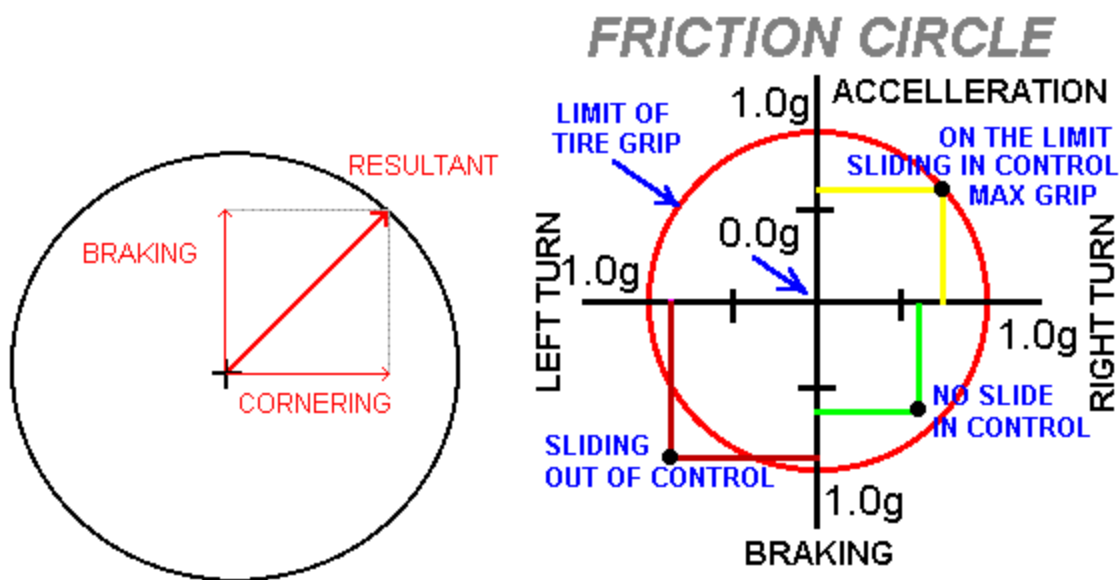
Throttle Steer - Using the throttle to control the placement of the car while turning without adjusting the steering wheel. Reduce throttle to get the car to tuck to the inside of the turn. Add throttle to push the car to the outside of the turn.

Trailing Throttle Oversteer (TTO) - This is where you are turning and lift off the throttle

abruptly (or even hitting the brakes) causing weight (and therefore traction) to transfer from the rear tires to the front and the rear tires lose traction and the rear end starts to come around in a spin.

Trail Braking - The art of turning while still braking. As you turn in, you gently release the brakes. This keeps the weight on the front of the car and helps rotate the car into the turn. The more turning you do the more you need to release the brakes. This is an advanced technique, and if done incorrectly it can easily lead to a spin.

Friction Circle (overview) - The Friction Circle is a representation of the grip level of a car plotted on an X,Y graph. If a car can sustain 1.0G cornering force, it can turn, accelerate, or brake at 1.0G and is said to have a Friction Circle with a radius of 1.0G. Because the radius of a circle is $r^2 = x^2 + y^2$ where x=right/left G-Forces and y=braking/acceleration G-Forces, the combined grip level (if you were to add the braking and turning grip levels together) can be higher if you combine braking and turning (or acceleration and turning). For example, using $r^2 = x^2 + y^2$, if $r=1.0G$, and $x=0.25G$ (braking G's), then $y=0.97G$ (maximum turning G's available), the combined grip would be 1.22G (0.25G+0.97G). If $r=1.0$, and $x=0.71$, then $y=0.71$ (equal amounts of braking and turning) the combined grip is 1.42G. If $r=1.0$, $x=0.5$, $y=0.87$, and combined grip is 1.37G, etc. Most Data Analysis systems can plot a Friction Circle for you to analyze your driving technique.

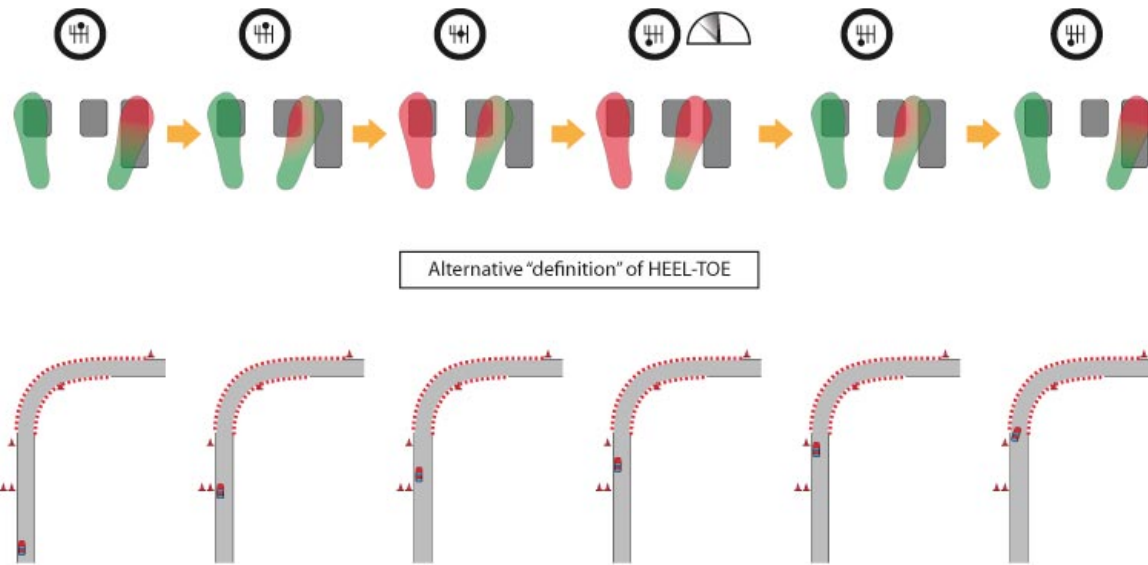


Data Logger - A basic data logging system measures and records G-Forces, track location (via GPS), lap times, speed, etc. Most data logging systems allow you to add on and record other sensors like tach, throttle position, steering angle, brake pressure, temp, oil pressure, etc as well

as OBDII info if available. Some Data Logging systems can integrate with video and can be used to record track map, track position, speed, RPM, G-Forces, Lap Times, and other info onto the video. The Data Logging system will also come with Analysis Software to allow you to easily review, compare, and analyze all of the data in order to improve your driving, improve the car, and monitor the car's health.

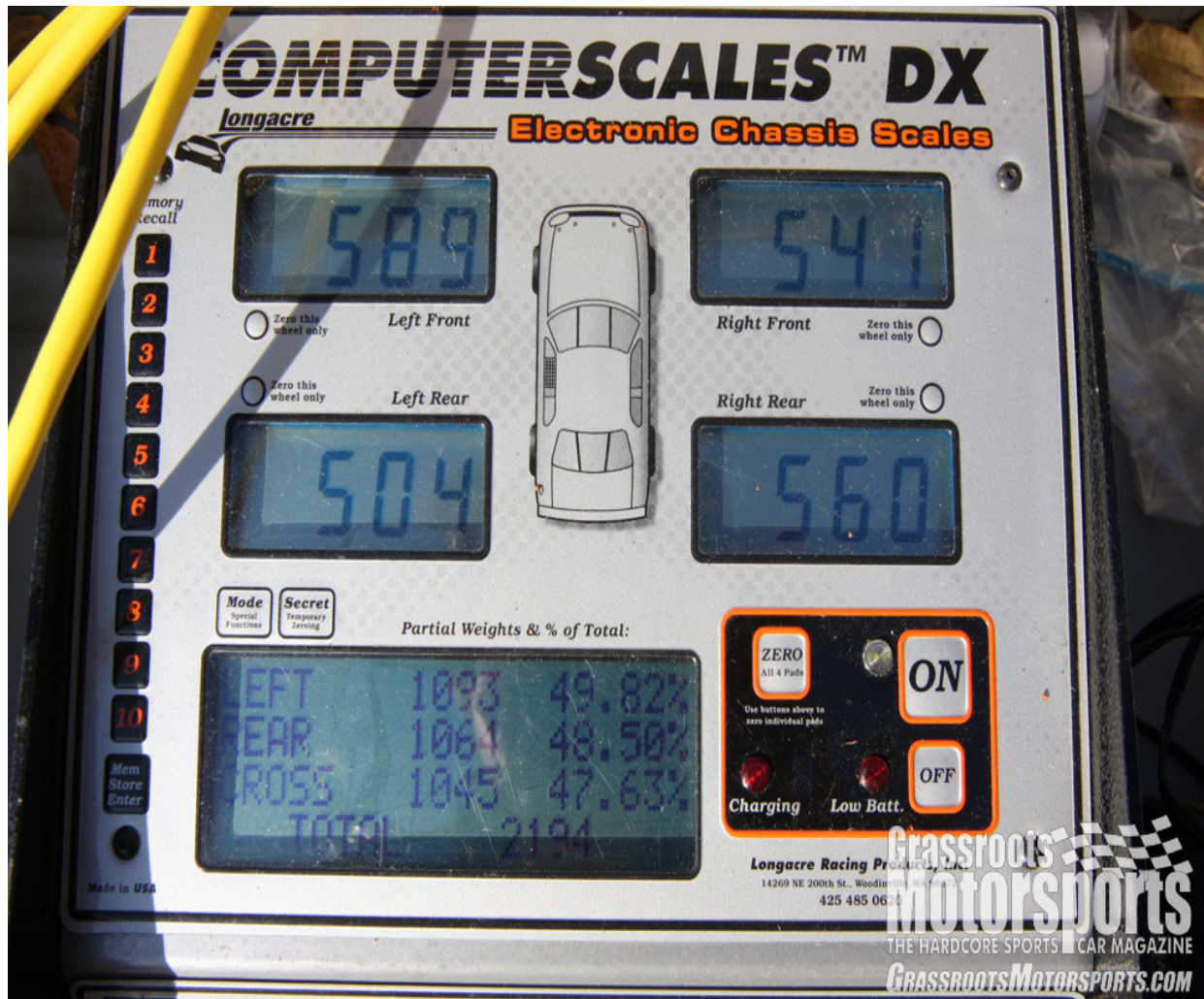
http://www.trackpedia.com/wiki/Data_Collection_and_Analysis

Heel-Toe - The art of blipping the throttle in order to downshift while braking with the right foot. You are basically operating the brakes and throttle at the same time with the same foot. This is best initially learned/practiced on the street and not at the track.

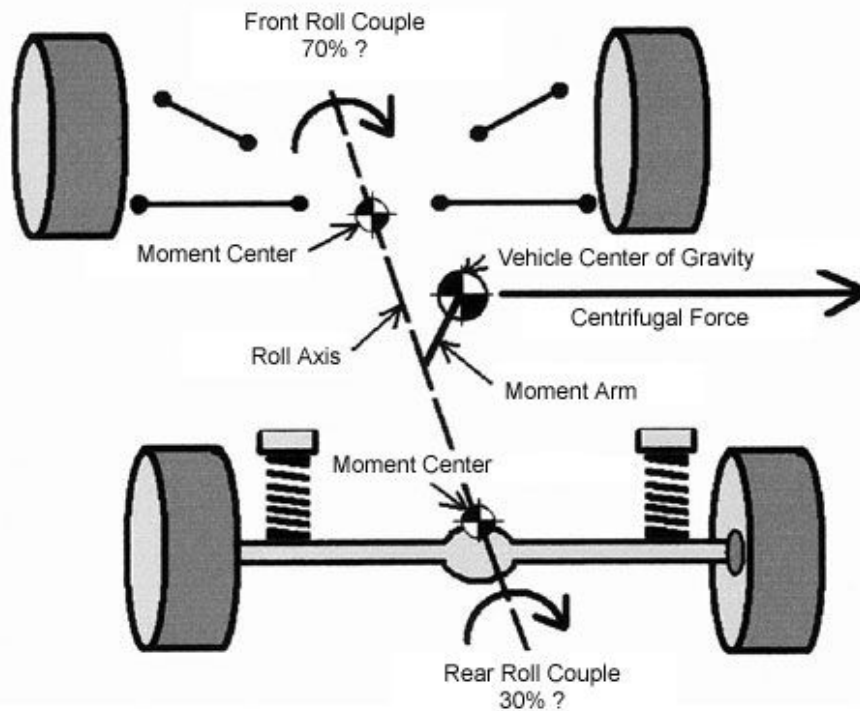


Weight Balance - The percentage of weight on the front tires vs the rear tires. Ideal weight balance is 50/50 (ie 50% of the weight is on the front tires, and 50% of the weight is on the rear tires).

Corner Weighting - The method of adjusting the height of a corner or corners of the car via adjustable coil-overs, in order to make the corner weights of the car even. Corner weights are measured with scales under each wheel. Ideally the FL + RR corners should equal the FR + RL corners. Corner Weight is more important to proper handling than Weight Balance.



Center Of Gravity (COG) - Ideally the COG will be down the centerline of the car and as low as possible for ideal handling. The location fore/aft of the COG is affected by the Weight Balance of the car. The higher the COG, the more the car will lean during turns (and accelerating and braking). If the COG isn't found near the centerline of the car, it will handle differently turning left vs right. The location of the COG fore or aft affects the handling characteristics of the car. You can change the COG by where you remove/place weight in the car as well as adjusting the ride height.



Old School Roll Couple Distribution Method

Sprung vs Unsprung Weight - Sprung weight is the weight of the car resting on the springs. This includes half of the weight of the springs and shocks. Unsprung weight is the weight of the components of the car that are not supported by the springs. This includes wheels, tires, brakes, and half the weight of the shocks and springs. Reducing the Unsprung Weight improves the handling because the springs and shocks have less work to do.

Rotational Mass - Parts of the car that are rotating. This includes the wheels and tires, and also moving parts of the engine. Reducing the rotational mass of the wheels and tires allows the car to accelerate and brake better. Reducing the weight of the moving parts of the engine, help the engine accelerate better. It is said that for every 1lb of rotational mass reduced is the equivalent of reducing 3lbs of non-rotational mass in terms of acceleration performance, although this may be a bit of an exaggeration.

HP to Weight Ratio - Weight of the car divided by the Horsepower of the car. The lower the number the better (ie. less pounds per horsepower = more power per pound). An indicator of the acceleration performance and speed potential of the car. Increasing the Horsepower or reducing the Weight will increase the cars performance. Reducing the weight is usually easier and cheaper.

Weight Reduction - Weight is the enemy. Reducing the weight of the car has a huge impact on the performance of the vehicle. Obviously reducing weight will help the car's HP/Weight ratio which will help the car accelerate faster, but reducing weight has a positive effect on all aspects of the car's performance. Less weight means less work for the suspension to manage, and less mass for the car to have to slow down. Removing weight from the car will improve the performance of the suspension, brakes, and engine without even touching them. Where the weight is lost also has a big impact on performance, and therefore some places that lose weight will see more positive gains than others. Removing weight from the top of the vehicle will lower the car's Center Of Gravity and greatly improves handling. Even relocating weight (such as a battery) to a lower or more center part of the car can improve weight balance and COG, improving handling. Reducing the weight of the rims and tires will reduce the rotational mass and help with acceleration and deceleration (braking). It will also reduce the weight of Unsprung Mass which improves handling.

Suspension Terms Explained:

Springs - Coiled metal springs used to allow the suspension to move to absorb bumps and imperfections in the road.

Shocks - Used to dampen the springs so they don't oscillate uncontrollably.

Struts - Shock components which have spring perches and spindles/wheel hubs on them and are an integral part of the suspension.

Coil Overs - Where the springs are on threaded perches that allow you to raise and lower the perch in order to raise or lower each corner of the car individually. This allows you to set ride height and corner-weights.

Sway Bars (Anti-Roll Bars)- Correctly called Anti-Sway or Anti-Roll bars. U-shaped bars that connect the right side of the suspension to the left side. There is usually front and rear sway bars. As the car turns, it leans and pushes the outside wheel up into the wheel arch, and inside rear wheel down out of the wheel arch. Since the sway bar is connected to both sides of the suspension, this twists the sway bar (one side of the U goes up, and the other side goes down). The sway bar is designed to resist being twisted it, so it helps push the outside tire down, resulting in less lean. The larger the sway bar's diameter, the more it resists being twisted, and therefore the more roll it will control.

Bushings - Bushings are used when mounting suspension pieces to the car to isolate the car from Noise, Vibrations, and Harshness (NVH). Street car bushings are usually soft rubber to keep NVH to a minimum. They also flex and deform a lot, reducing the ability of the suspension to work accurately by introducing a lot of play or slop. Race cars usually replace bushings with a harder material like polyurethane, delrin, or solid metal. The harder the material, the less play there will be, but at a cost of more NVH. The vibration can be so bad with metal bushing that it can crack the suspension or frame if not reinforced. Polyurethane is usually a good compromise for street driven track cars.

Camber - When looking from the front of the car, the top of the tire will be leaned in towards the

center of the car more than the bottom. This affects handling and how much of the tire is in contact with the pavement during cornering. Race cars have a lot of negative camber.

Caster - When looking at the front strut from the side of the car, the top of the strut will be leaned towards the rear of the car. This affects the wheels tendency to self center as well as high speed stability.

Toe In - The front of the tires are pointed in towards the center of the car in relation to the rear of the tires. Helps with high speed stability.

Toe Out - The front of the tire is pointed out in relation to the rear of the tire. Helps with initial turn in, but can make the car dart.

Ride Height - Height of the bottom of the car off of the ground.

Upgrade Path - Most people who get into this sport think they need to upgrade their car in order to improve their performance. The best way to go faster is to upgrade the nut behind the wheel (that's you!). Many times people think the first thing they need to upgrade is the engine's performance. In reality, this should be the LAST thing to upgrade. Here's a better upgrade path:

1) Tires - Tires have the biggest impact on performance. Better tires will allow you to corner better, brake better, and accelerate better. As a Beginner or Intermediate student you should not use dedicated Race Tires or R-Comps, but instead use a [Ultra-High or Max Performance Summer Tire](#). While the grip level can be higher, R-Comps do not give you the audible and tactile feedback that street tires do, and therefore you will not have the confidence in the car to push it as hard as you would with street tires. Street tires also last significantly longer, are better in the wet, and can be driven to and from the event. Today's modern Ultra-High or Max Performance tires are so good that they rival the performance of yesterday's race tires.

2) Brakes - After your first few events, you will notice that the OEM brakes may not be up to the task of track use. The easiest solution is to upgrade to better performing brake pads and fluid, like a street/autocross/track pad or even a dedicated track pad, and a good DOT 4 brake fluid. You may also want to replace the rubber brake lines with Stainless Steel flex-lines, replace the rotors with new, and refresh the calipers if they are old.

<http://www.MyTrackSchedule.com/UpgradingBrakes.html>

3) Suspension - You will probably want to upgrade to polyurethane bushings, bigger sway bars, and possibly more performance oriented springs and shocks, or even coil-overs, and get a performance oriented alignment.

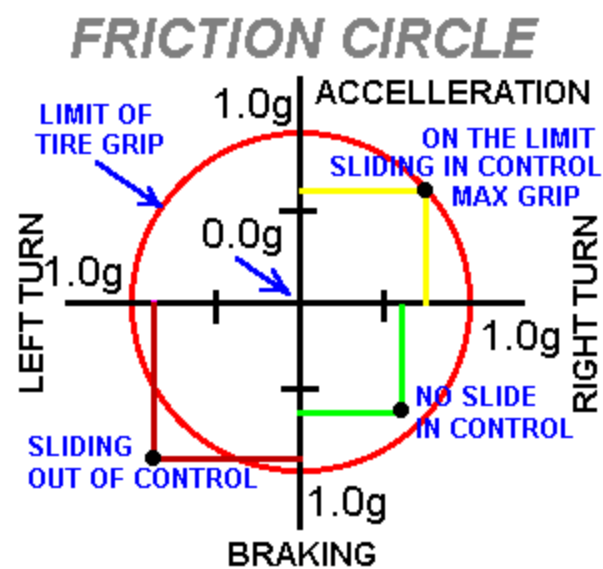
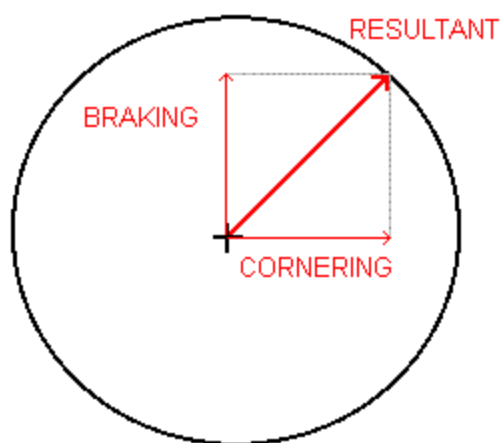
4) Safety - Consider a roll bar, race seats, harnesses, and fire extinguisher. Remember that you must have equal safety equipment for both driver and passenger, and that race seats and harnesses should not be used without a roll bar or cage.

5) Weight Reduction - Weight reduction will improve all aspects of the vehicles performance.

6) Engine - This should be the last thing you upgrade as it only affects one aspect of performance, acceleration. Quick and easy mods include cold air intake, performance chip, and exhaust.

Friction Circle (in depth) - The Friction Circle is a graph of the plotted grip levels (G-Forces) of the car. The radius of a circle is defined $r^2 = x^2 + y^2$. Acceleration/Braking are plotted in the Y plane, and Left/Right turning in the X plane. Because it is representative of the G-Forces acting on the car, acceleration (weight transfers forward) is plotted in the positive Y axis (upper portion of the graph), braking (weight transfers rearward) in the negative Y axis (lower portion of the graph), turning right (weight transfers to the left) in the negative X-axis (left portion of the graph), and turning left (weight transfers to the right) in the positive X-axis (right portion of the graph). If a car can generate 1G of traction, it can do so in either braking, acceleration, or turning. The radius of it's Friction Circle would be 1.0G. If the car is braking at 1G, there is no available traction to turn. This would be represented by x,y co-ordinates (0,1). If a car is turning left at 1G, there is no available traction to accelerate or brake. This would be represented as x,y co-ordinates (1,0). However because the friction circle is a circle and the radius of a circle is $r^2 = x^2 + y^2$, if you combine turning and braking or turning and accelerating, the combined grip level (adding braking and turning G-forces together) can be greater than 1.0G. If you were only using 0.5G for braking and 0.5G for turning (1.0G combined), you would plot that point on the graph at 0.5, 0.5. The distance from this point (0.5,0.5) to the center (0,0) would actually only be 0.71 or 0.71G's ($x^2+y^2=r^2$; $0.5^2 + 0.5^2 = 0.71^2$) and therefore would actually be using less than the full 1.0G grip the car is capable of. A car with 1.0G Friction Circle radius can turn at 0.71G and Brake at 0.71G ($0.71^2 + 0.71^2 = 1.0^2$). That's a combined G's of 1.42G's. If that car is braking at 0.25G, it can turn at 0.97G ($0.25^2 + 0.97^2 = 1.0^2$). If the car is braking at 0.5G it can actually turn at 0.87G ($0.5^2 + 0.87^2 = 1.0^2$). Now lets say we put stickier race tires on that car and it can now generate 1.25G's, it has a Friction Circle of 1.25G. It could brake at 0.5G and turn at 1.15G's ($0.5^2 + 1.15^2 = 1.25^2$) for a total of 1.65 combined G's. If that car with 1.25G Friction Circle did equal amounts of braking and turning it could brake at 0.88G's and turn at 0.88G's ($0.88^2 + 0.88^2 = 1.25^2$), the combined G's would be 1.76G's.

In order to get the most out of the car you must master the art of combining weight transfer, being smooth, heel-toe braking, threshold braking, trail braking, releasing the brakes, and transitioning from braking to turning, etc and their relationship and effects on the Friction Circle. The goal is to keep the car at the limits of the Friction Circle at all times. Consider reading one of the books listed below that covers the Friction Circle in much more detail. Most Data Analysis systems can plot a Friction Circle using the recorded G-Forces for you to analyze your driving technique.



Friction Circle

Often you can get a quick idea of driver's skill by simply looking at their Friction Circle plot. A beginning driver will generally have a plot that appears like an inverted T with dips on the sides. This is because they brake straight, get off the brakes, then turn.

As a driver gains experience, his Friction Circle will be much more triangular and follow the perimeter of a triangle. This happens because the driver is transitioning from braking to turn-in in a coordinated fashion. A very experienced driver's Friction Circle will have a visible hole in the center showing that the maximum grip of the car is being used at all times. When playing back in real-time you can see the cursor go around the outside of the triangle during transitions from braking to turning and back.

To determine how much of the performance of the car is being utilized, do a skidpad test as described in the vehicle performance section below.

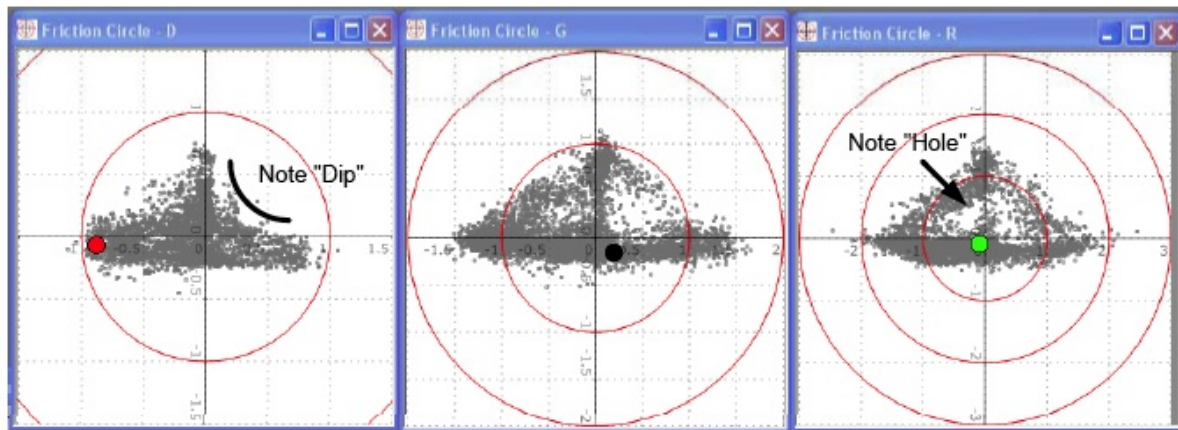


Figure 65 - Friction Circle Comparison

<http://www.caranddriver.com/features/how-to-read-a-friction-circle>

More Resources:

MyTrackSchedule.com - You key to more track events! List of all track events.

DriveFasterNow.com - Professional coaching and track side support

DuctTapeMotorsports.com - Competative budget endurance racing rentals

GoAheadTakeTheWheel.com - Novice guides to AutoX, HPDE, and Racing

TrackProAdvisors.com - Access the knowledge of some of the most talented and experienced drivers, racers, coaches and technicians in the motorsport industry.

Trackpedia.com - Wikipedia for the Track Enthusiast

AutoX4u.com - Autocross events and info

[How to Become a Better Driver](#) - Other ways to become a better driver

Recommended Books:

[Going Faster](#) by Skip Barber

[Drive to Win](#) by Carroll Smith (anything by Carroll Smith is good)

The [Speed Secrets](#) series by Ross Bently

[Secrets of Solo Racing](#) by Henry Watts

[Tune to Win](#) by Carroll Smith

[How to make your car Handle](#) by Fred Puhn

[High Performance Handling](#) by Don Alexander

[Competition Car Suspension](#) by Allan Staniforth

Other Novice Guides:

[Performance Drivers Guide - Boston BMWCCA](#)

[Driver School Handbook - NJ BMWCCA](#)

[Beginner's Guide to Preparing for HPDE](#)

[Driver's Education Guide - Carolina's PCA](#)

[Track Guide - Solo Racer](#)

[10 Common Driving Errors - HPDEDriver](#)

*note: all images are linked to their original site. see site for more info.