

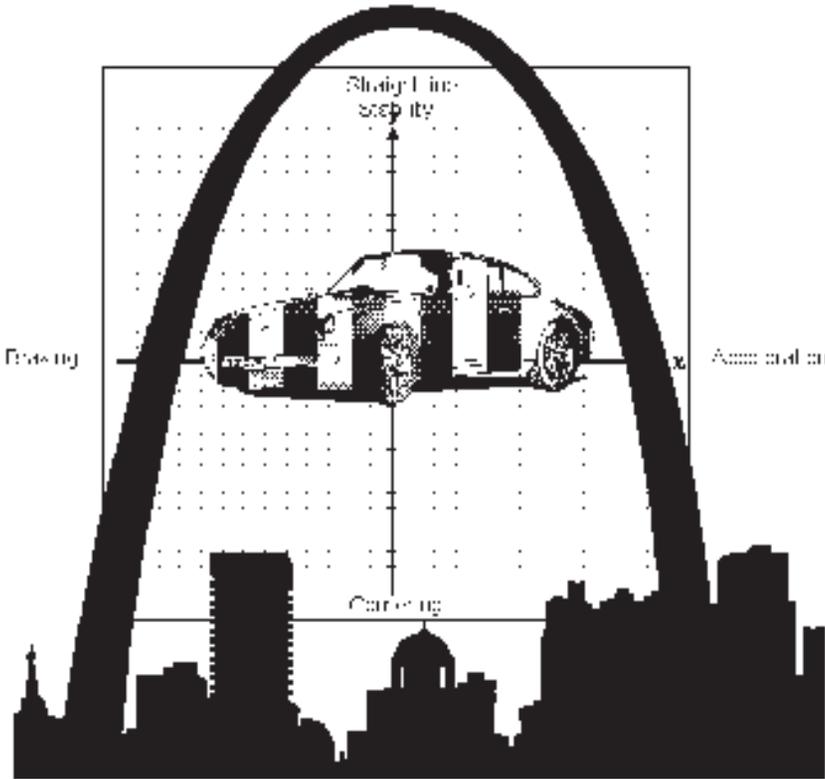
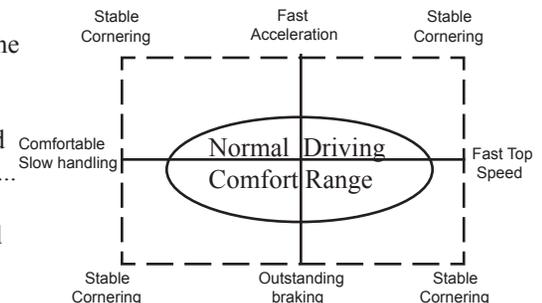
Forward

The fact that you are taking the time to leaf through these pages means you've probably given more than just a passing thought to discovering the extraordinary performance characteristics that have been engineered into your vehicle. Perhaps you've even gone so far as to enroll in a performance driving educational event such as the St. Louis Region, Porsche Club of America Carrera Classic. If so, congratulations. You have made a wise decision. With an ever increasing number of poorly trained drivers on our highways and byways joining the legions of those who may occupy a space behind a steering wheel but don't have time to be bothered with the task of driving because better things need to be done...like carrying on a conversation on a cellular telephone, reading a newspaper or book, putting on make-up, even working on a notebook computer, it's no wonder that our nation's highway accident rate continues to climb. Today, it's no longer good enough to be able to safely pilot our own cars, but we also have to make sure we can avoid the countless errors and mistakes made by our fellow drivers who simply aren't paying attention to what they are doing and what is going on around them. Today, driving in rush hour traffic around a major metropolitan area is not that much different than negotiating a bumper car at an amusement or theme park.

This has left those of us who prefer to keep our vehicles in pristine condition living in a state of constant nervousness. But there really is no need to look at our everyday driving tasks as a nerve-wrecking chore, so long as we feel confident that we know our abilities as drivers and what our vehicles are capable of in emergencies. That is the objective of drivers' educational events like the Carrera Classic - to allow you to experience the performance capabilities that have been engineered into your vehicle, capabilities far beyond those used in normal, everyday driving. Once you have a better understanding of what your vehicle truly can and CAN'T do, you will be better prepared to handle not just the challenges of everyday driving, but also any emergencies that might arise.

The fact that you are driving a performance vehicle is a definite plus in your favor. Performance vehicles have been engineered to be driven above and beyond the limits of your normal family sedan or sports-utility vehicle.

From the beginning more than 50 years ago, Dr. Ferry Porsche and his staff of talented engineers have always begun their engineering projects with a set of performance criteria for each new design project - criteria which make a Porsche the unique performance vehicle it is. Included in these 'design parameters' are such things as projected top speed and comfortable low speed handling.... stable straight line performance and predictable, stable cornering...desired acceleration rates and outstanding braking performance. If we were to



Exploring the Envelope

graph these factors on a 2-axis graph and connect the dots, you'd come up with what is known as the 'performance envelope'. Every vehicle ever to bear the proud Porsche name has been engineered to deliver a balanced package of performance, handling and safety - the best known to man at the time of the vehicle's construction. That, by no means, means all Porsches are equal. It would be ridiculous to believe that a 50 year-old 356 can accelerate as quickly, travel as fast and brake to a stop in as short a distance as a new 911 or Boxster. Afterall, the newer Porsches benefit from more than 5 decades of advances in metallurgy, automotive engineering and safety technology. But every Porsche, whether it be a 50 year old 356 or a 50 day old Boxster, has been built to deliver performance and safety unheard of in cars even decades after the year in which the Porsche was manufactured.

Most of us have, over the years, developed a driving style that, while it matches our transportation needs and personal comfort range, fails to come anywhere near the performance limits designed into our cars. Over time, we come to believe that our cars are incapable of performance outside our 'normal driving comfort range' or that we ourselves are not capable of controlling our cars in extreme conditions. This belief has led to many needlessly, expensive accidents - accidents which could have been avoided if the driver had only known the extra performance built into his vehicle and was confident of his/her ability to push the car outside his/her comfort ranges towards the outer edges of the car's 'performance envelope'. That is our goal at this performance driving exercise - to help you 'explore the envelope' outside your 'normal comfort range'. Hopefully, you will discover the ways to tap into that something extra built into your performance vehicle to avoid roadside hazards, careless drivers and road emergencies. That is why we can confidently say you will become a better driver after a little performance driving instruction.

Performance driving instruction like the Carrera Classic was devised to allow you to learn a little more about your car, your ability as a driver and perhaps a little about yourself - your reflexes, your nerves and your ability to handle potentially hazardous situations.

Performance driving education is not a race driver's school. Our objective is to allow you to experience how it feels to drive your car close to the edge of its performance envelope - and perhaps, some will discover what happens when you push your car and yourself over the edge of the envelope. Since that is always a possibility, we hold these driver's education events at race tracks. Road race facilities offer us a road-like setting with differing radius turns, elevation changes, and road-like driving surfaces, yet at the same time are free of trees, utility poles, bridge abutments and other obstacles that seriously threaten your safety and the safety of your vehicle on the open road. That's why we chose Gateway International Raceway.

Gateway International Raceway is a state-of-the-art motorsports facility. Gateway hosts a wide variety of SCCA races, NASCAR auto and truck races and other high speed events. It offers us an ideal venue to learn more about our vehicles and ourselves.

New Experiences Await You

Performance driving events like the Carrera Classic were never meant to encourage speeding or reckless driving, yet we recognize there will be times when driving on the highway or country roads when conditions may cause a loss of control of your vehicle or circumstances arise requiring you to take dramatic measures to avoid an accident. Chances are you may be driving at the speeds not frequently used in urban or suburban driving. That is why we come to a racing facility - to attempt to duplicate Interstate highway or open road speeds.

During the course of the Carrera Classic, you may experience things that you have never felt before. Our goal is to help you realize and experience the forces and feelings that speed, centrifugal force and rapid weight transfer put on you and your vehicle. And we hope to be able to give you some idea how to manipulate those physical forces in a manner that will make them work to your advantage to avoid accidents or trouble.

If, at times, you feel a little befuddled by some of the things you are told by your instructor or by the way your car behaves, take comfort in the fact that you are not alone. Some of the things you will be told and some of the things you will experience will be quite different from what you learned when you first started to drive. For example, we all know that when you want your car to turn, you simply turn the steering wheel and when you want to go a little faster, you just press a little harder on the accelerator. And of course, we were taught that applying the brakes when turning makes it more difficult to negotiate a corner. Before the end of the weekend, you may discover that there are times when turning that the accelerator is more important than the steering wheel and when the path you steer through a corner will increase the speed of your car. It's a matter of understanding your car and the laws of physics effecting it.

The 3 P's of Performance Driving - Precision, Power and Physics

If your instructor is successful and your time on the track is meaningful, you'll hopefully leave this performance driving session with a little better understanding of the 3 'P's' of performance driving: Precision...Power and Physics.

One of the keys of performance driving is to develop a precise, smooth, consistent driving style. One St. Louis SCCA Chief Race Instructor makes this point quite clear, even if it is a misquote of a law of physics - "In performance driving, a violent action by the driver will bring about an equal or probably even more violent reaction by your car." In short, when your car is travelling at a high rate of speed, a quick jerk on the steering wheel may result in an uncontrolled spin or a single hard jab on

the brake pedal can end up in a wild ride into the guardrail or retaining wall. If you learn anything this weekend, we hope it will be that it is crucial to develop a smooth, precise driving style behind the wheel.

Of course, at a Porsche Club driver's education event, there is little need to explain the need for power for performance driving. The key is knowing when and how to use that power. We would hope that you come away from this weekend with a better understanding about how the judicious use of the accelerator will help you power through a corner faster and safer.

And finally, the third 'P' - Physics. Whether you are interested in science or not, it does help to understand a couple of the most basic principles of physics which influence the way your car reacts to the control inputs you make while driving. We won't go too deeply into physics because frankly, I hated physics when I was in college and I don't like it any more now, but a little understanding of physics makes it easier to understand why your vehicle is doing what it is doing and to predict what it might do next.

We're really only concerned with three laws of physics: the physical laws of motion - "Bodies at rest tend to remain at rest" and "Bodies in motion tend to remain in motion." To these we add a third insidious law we all know too well - "Two bodies cannot occupy the same space at the same time."

The laws of motion are the most important in performance driving. They are responsible for the feeling of being punched back in the seat when we press on the accelerator and the feeling that the shoulder harness is about to cut through your chest when you stand hard on the brakes or when your car fights to go straight ahead even after you have turned the steering wheel. We'll try to explain that all a little later.

As for the law concerning two items in the same space at the same time, just ask any body shop technician about that law of physics and it's affect on your car. We sincerely hope that you don't experience the results of the third law of physics during this weekend. Your instructor will join you in your effort to learn techniques that will allow you to sidestep this law and come away with a little better understanding of the capabilities of you and your vehicle without sustaining any damage to either of you.

Getting Ready to Run

Preparing Your Car:

Your vehicle was required to pass a stringent set of technical standards before being allowed on the training circuit. Vehicles that fail technical inspection were not accepted to participate in this event.

While it sounds difficult and very serious, our technical standards are really nothing more than a comprehensive test of all the systems vital for the safe operation of your vehicle on the highway - brake pads, brake fluid purity and level, brake operation, wheel bearings, steering systems, shock absorbers and suspension members, oil and transmission seals, etc. The technical inspectors are really only looking for potential problems before they affect the safety of you, your vehicle and the others who will be taking part in the instructional activities alongside you.

Preparing Yourself:

How Big Is IT!

No, we're not talking about that, although I've heard some driver's described as having some pretty big ones. Get your mind out of the gutter and back to the matter at hand - I'm talking about your car. How big is it?

Whoa...don't panic. Nobody is going to ask you how long your car is in inches or centimeters or how wide it is or what is it's track or wheel base? I'm talking about a more basic idea of how big your car is - how big is it in your mind? Do you really know where the end of the bumper is or how far forward your front bumper sticks out from the windshield? Probably not.

That's why this is the time for a little homework before heading for the track. Some day when you are home alone (you might not want to do this with anyone around or they might think you have slipped your mental clutch a little too often) head out to the garage and get really familiar with your car. Carefully lean a broom or rake or shovel handle against the front and rear bumpers, get in the seat and memorize the exact location of those objects. That will give you some understanding of exactly how large your car is and how close to other cars and objects you can get without making contact. This sounds a bit eccentric, but it's really the most important and practical exercise of the weekend. If you know how close you can get to other objects and cars, you'll also be able to judge how much you'll have to steer to just barely avoid contact with other cars or objects. Remember, the trick in performance driving, whether it be on the street or on the track, is to avoid contact. And when it comes to avoiding contact, a tenth of an inch is as good as a mile...a miss is a miss, no matter how close it may have been.

Become familiar with your car before heading to the track. Learn how big your car really is, and you will not only enjoy much safer and troublefree driving, you'll also be putting money in your bank account - not the body shop's.

Talk the Talk...Walk the Walk

During your instructional sessions, your instructor will probably start talking in the short hand of performance driving, which, to the uninitiated, sounds like a combination of inner city jive and astrophysics. Every world has it's

own language - terms unique to the profession or hobby in question. The world of performance driving is no different. Your instructor is not a true professional in the terms that he or she does not make his/her living driving cars fast. But all have years of experience in pushing cars towards their outer limits and often time, over the limit. After a few years of 'stretching the envelope', you pick up terms that other performance drivers commonly use to communicate. You might call it a sort of "driver's shorthand". You will undoubtedly hear some of those terms this weekend. Unfortunately, they will probably crop up in the middle of your instructional period, when things are happening so quickly that there may not be time to go back and define those terms in layman's words. Or, if you're human like the rest of us, you may just ignore these unfamiliar terms, because you don't want to look 'dumb'. Let me assure you that the only 'dumb' student out there is the one who DOES NOT ask questions, because sooner or later - most often sooner - the question that is not ask will come up again as your instructor tries to explain to you what went wrong to cause your car to careen uncontrollably off the track and possibly into the guard rail. It is far better and far wiser to ask questions first than learn the answers the hard way.

You may be able to save yourself the embarrassment of having to ask questions and the costly embarrassment of having your mangled pride and joy towed to your local body shop if you take a few moments to review some of the terms commonly used when talking about performance driving. Take a little time now to study these terms which will probably come up during your instructions. If you don't understand these definitions, please ask your instructor BEFORE you take your car out on the track. The classroom sessions you will attend this weekend will be the perfect time to clear up any questions you may have about these terms. If you and your instructor 'speak the same language', you will have a far better chance of understanding every instruction - every hint - your instructor is trying to share with you. If you can start your instruction with the confidence that you will understand your instructor's 'language', you will learn a great deal more during your instructional sessions.

These definitions are listed in categories according to the parts of the car to which they apply.

STEERING & HANDLING

Reaction time - The time it takes for something to happen. Usually it refers to the time between when a driver feels the need to respond to something he/she sees or feels and the time when the driver acts to counter the believed threat, i.e. from the time a driver feels the car beginning to skid and the time the driver turns the steering wheel into the skid to counter the uncontrolled movement of the vehicle (usually 0.25 to 0.50 seconds). But vehicles also have a reaction time, i.e. the amount of time from the moment you step on the brakes and the moment the brake pads or shoes come into contact with the wheels to slow the vehicle (usually 0.25 to 2 seconds)

Center of Gravity - The point within the vehicle where it is perfectly balanced in all directions

Weight Transfer - The movement of weight from one part of the vehicle to another - from the front to the back or from one side to the other due to an action of the vehicle, i.e. cornering, acceleration, braking, etc.

Lateral Resistance - The sideward forces generated by a tire during cornering

Lock - Any turn of the steering wheel

Sawing - Rapid oscillations or back and forth movements of the steering wheel

Head lean - Leaning the head excessively while negotiating a turn

Understeer - A condition during turning a corner when the vehicle wants to continue straight ahead even though the steering wheel has been turned. It usually requires some additional driver's input (acceleration, braking or additional turning of the steering wheel) to overcome the understeer and complete the turning maneuver.

Oversteer - A condition during turning a corner when the vehicle wants to turn into the corner sharply and the back end of the vehicle wants to break loose. An over-reactive vehicle. The opposite of Understeer.

Neutral Steering - When the vehicle neither oversteers or understeers, but rather all four wheels begin and maintain the same steering characteristics. The ideal situation for turning.

Plowing or Pushing - A slang expression for excessive understeer in a turn.

Hang It Out - A slang expression for purposefully forcing a vehicle to oversteer, causing the vehicle to perform a controlled rear end skid

Drift - Driving a vehicle in a state of controlled skidding during acceleration

Skid - To make the tires slide rather than roll when braking or moving around a corner

Braking Drift - The tendency for a vehicle to skid when braking in a corner

Power Slide - Driving with oversteer or forcing the vehicle's rear wheels to travel in a path outside the path of the front wheels by applying extra power with the engine

Spin - An uncontrolled slide or skid

Scrubbing - Causing the wheels to skid rather than roll which greatly reduces the vehicle speed and causes extra wear in tire surfaces

Broad Slide - A controlled slide or skid which causes the vehicle to lose speed. Not to be mistaken for a drift which usually occurs during increasing speed

Throttle Steer - Using the accelerator to induce a steering action. Usually associated with exiting a turn.

Feathering - To apply accelerator pedal pressure lightly

Heel & Toe - To use the ball of the foot on the brake pedal while the heel is used to control the accelerator

ENGINE & TRANSMISSION

- Power Curve** - The relationship between the horsepower available from a vehicle's engine at given engine speeds
- RPM** - Revolutions per minute or how fast the engine is turning
- REVS** - Slang for RPM
- Over-Rev** - To run the engine at a higher RPM than is recommended by the manufacturer and good for the longevity of the engine parts
- Lug** - To request large power outputs (step on the accelerator hard) when the engine is at too low an engine speed to respond. This is very hard on the engine. For example, applying full accelerator in 5th gear at 2000 RPM.
- Torque** - The ability of the engine to produce twisting force
- Max Torque** - The maximum amount of twisting force that can be produced by an engine and the RPM at which it occurs.
- Shift point** - The RPM at which a driver shifts to another gear, either as an upshift or a downshift.
- Red Line** - A designated range of RPM (Usually at high values) where possible engine damage or loss of power occurs. It is not recommended to drive in this range.
- Upshift** - To go from a lower gear to a higher gear as from first gear to second gear
- Downshift** - To go from a higher gear down to a lower gear as from fifth gear down to fourth gear
- Double Clutch** - To release the clutch in the middle of a shift as the shift lever passes through the neutral position. This is done to help extend the life of the transmission syncro gears.
- Gear chart** - A chart showing the speed in each gear for various engine speeds
- Riding the Clutch** - Driving with the clutch partially disengaged or with excessive clutch slip in making shifts
- Riding the Shift** - Driving with the hand resting on the shift lever (not good)
- Slip** (as in Clutch) - When a driver allows the engine to run fast while the car proceeds slowly by partially disengaging the clutch or to hold the car stationary on an uphill slope by partially disengaging the clutch (Very bad for the clutch and the engine)
- Accelerate** - To increase vehicle speed
- Decelerate** - To decrease vehicle speed

TIRES & BRAKES

- Contact Patch** - The small area of the tire (usually about 20 - 30 square inches) which is in contact with the driving surface at any one instant.
- Coefficient of Friction** - The ratio of the force a tire can generate compared to it's load. Typically, the values range from near zero when a vehicle is on ice to approximately one when the vehicle is on dry concrete.
- Traction** - The ability of a tire to adhere to a road surface. It is a function of vehicle weight and tire contact area.
- Traction Limit** - The maximum forward, rearward or sideways force at the tires while accelerating, braking or cornering.
- Wheel Spin** - To actually spin the wheels when accelerating
- Peeling** - A slang term for Wheel Spin
- Pumping the Brakes** - Modulating or Pumping the brake pedal to raise the fluid level or pressure. It is not an accepted braking technique.
- Cadence Braking** - Modulating or pressing down hard on the brake pedal and lifting off slightly to reduce some of the pressure on the brakes while maintaining a medium pressure on the brakes to achieve maximum braking efficiency.
- Jabbing the Brakes** - Sudden repeated brake pedal applications which lock the brakes and wheels causing the wheel to skid. A poor application of the cadence braking technique.
- Engine Braking** - Using the compression of the engine to provide added resistance to slow down a vehicle, for example, downshifting into a lower gear.
- Lifting Off** - To let up on the accelerator to allow the engine to slow the vehicle.
- Hard Braking** - To decelerate using the brakes to their maximum efficiency
- Trailing Braking** - Maintaining a low and decreasing level of brake application into a turn in contrast to the complete release of the brakes before entering a turn
- Braking Point** - A designated point at which you begin to apply the brakes, usually a fixed distance from a turn or other location which requires a lower speed.
- Stopping Distance** - The distance required to stop a car from a specified speed (usually meaning the minimum distance and may or may not include the time required for the driver to step on the brake after realizing a need to bring the vehicle to a stop).
- Rolling Resistance** - The force required to make a tire roll, as when pushing a car
- Balance** - The relationship between the load of the individual wheels and their ability to turn, brake or apply power. If they are nearly equal, the balance is good.

ROADS & CURVES

- Radius** - The distance from the center of a circle to the local path a vehicle is maintaining.
- Largest Possible Radius** - The largest radius which can be drawn and still stay on the road surface at the start, apex and exit of a curve. This is theoretically the fastest path through a corner.
- Theoretical Apex** - A point along a curve where the largest possible radius touches the inside edge of the turn
- Practical Apex** - A point along the curve where the path of a car should touch the inside edge of the corner.
- Clipping Point** - A point along a curve where a vehicle actually touches the inside edge of the road.
- Early Apex** - When the practical apex occurs before the theoretical one.
- Late Apex** - When the practical apex occurs after the theoretical one.
- Ideal Line** - The best possible path through a turn considering all factors.
- Entry Point** - The point at which one begins the turning maneuver.
- Exit Point Line** - The desired path at the point of exit from a cornering maneuver.
- Off Camber** - When the road slopes away from the inside (the side about which the car is turning) of a turn.
- Straights** - A portion of the road or track where no turning maneuvers are required to keep the vehicle on the driving surface.
- Kink** - A gradual, constant radius turn that is so gradual in its turning radius that it does not require deceleration or braking to safely transverse.
- Constant Arc** - When the radius of a turn is constant throughout the entry, center and exit of a corner.
- Decreasing Radius Turn** - A turn which gets sharper and sharper and sharper and require the application of more steering input the more you travel around the corner.
- Increasing Radius Turn** - A turn which gets wider and wider and wider and allows the driver to reduce the amount of steering input required to traverse the corner
- S Curve** - A curve that is shaped like an 'S' with two or more connected turns of alternating directions
- Slalom** - To weave between a series of designated markers or obstacles
- Hairpin** - A very sharp turn which cause the vehicle to reverse its direction of travel in a little over two widths of the road surface.

Tuning Your Body for Performance Driving

Just as it's important that you prepare your car for a performance driving experience, it's equally important that you prepare your body. Testing the outer edges of the performance envelope can be more stressful on your body than you think. The mental stress from really fast driving, the fear of potential problems that could injure either your vehicle or your body and the intense concentration required to keep your vehicle under control at high speeds can be quite tiring. The good news is that the more you do it, the easier it becomes. But for those new to pushing the envelope, a weekend of performance driving can take quite a toll. If you feel exhausted by the end of your driving instruction, don't be embarrassed. It's quite normal. If your performance driving experience happens to fall during a period when Mother Nature decides to turn up the heat to the triple digit range, you can bet you'll feel a little sapped of energy by the experience. It definitely helps if you tune your body for what lies ahead, especially if the weekend threatens to include high temperatures.

You DO Sweat the Little Things

When the trackside temperature soars, the temperature inside your vehicle hits highs that you have never experienced in your life. The sun bounces off the track surface, heating the tires to temperatures that can cause serious burns if touched by bare skin. Add the heat from oil and brakes pushed near their limit, and the heat radiating from hot exhaust, and you have the perfect prescription for serious heat fatigue and possibly heat stroke.

With the recent increase in interest in motorsports, there has been a significant increase in interest in the field of 'motorsports medicine' - the study of how the body reacts to the stress of motorsports and how to treat motorsports related injuries. Several physicians have come to the fore in the field of motorsports medicine, among them, Dr. Harlan Hunter of St. Louis, the doctor in charge of medical care for professional Sports Car Club of America drivers and workers. Dr. Hunter has completed a comprehensive study on the effects of heat on driver's performance.

The real problem is not so much the heat itself, but rather the dehydration from heat and stress-related perspiration. Research has shown that it's not uncommon for a driver to lose several pounds of water through dehydration during the course of a performance driving weekend. Studies have shown that for each 2 to 3 pounds of water loss due to dehydration, your eye-muscle co-ordination deteriorates by about 10 percent. At first glance, that wouldn't appear to be much of a problem, but it can add up. Several years ago during a very hot August SCCA Race weekend, I completed a 30 minutes sprint race in 100+ degree heat. After bringing the vehicle to a stop, I could not stand up. A medical team had to remove me from the car and remove my perspiration soaked driver's apparel. I had lost seven pounds of water weight during that 30 minute race. According to Dr. Hunter's formula, my eye-muscle co-ordination had deteriorated by about 35% explaining my inability to stand.

While that is an extreme example, let us use an example that you might experience. When an average healthy person looks down at the speedometer or oil pressure gauge and then back up to the road, it takes one-half second for your eyes to refocus on the objects in the distance, send the image to your brain and for your brain to interpret the signal from your eyes and send commands to your muscles to avoid potential danger. During that one-half second, your car, travelling at 100 mph, will travel the length of a basketball court. If you're driving at 200 mph (hey, this is an example like in physics class, remember?), your car will travel the length of a football field. **For every 2 to 3 pounds of water lost to dehydration, the distance your car will travel during the time your eyes refocus and your mind reacts will increase 10%** - a real problem if you happen to be heading towards a bridge abutment or concrete wall.

It's in the Water

Dr. Hunter recommends a pre-session hydration program to help offset the potential loss of eye-muscle co-ordination. A healthy person should consume a minimum of 2 to 3 quarts of water or fluid every day for optimum health. Dr. Hunter prescribes that you drink **an additional 1 to 1 1/2 quarts of fluids each day for three days** before a performance driving event in outside air temperatures of 95 degrees or above. That's an extra 4 to 6 - 8 ounce glasses of fluid each day. Dr. Hunter warns that you will be making a couple extra stops in the restroom during those three days, and by the end of the third day, some may feel their feet and hands are a little puffy due to the heavy fluid loading of the body tissue, but that fluid will rapidly disappear when the 'heated driving' begins. And the dividend of better eye-muscle co-ordination and faster, more predictable reaction times are well worth the minor inconveniences.

Dr. Hunter also suggests you begin to acclimate your body to the increased temperatures it will experience by extending the time you spend outdoors in the heat each day as you approach the day of your time on the track.

Now for a little bathroom talk...and we apologize if this offends you, but Dr. Hunter warns it's essential if you are to end your performance driving experience in hot weather in good shape. The color of your urine is your chief indicator of the onset of dehydration. If, during the event, your urine remains relatively clear, your body fluid level is in balance. But when your urine begins to turn yellow, your fluid balance is 'out-of-balance', and you're headed for danger. By the time your urine turns bright yellow or wheat straw yellow in color, your body is in serious need of fluid replenishment. Dr. Hunter recommends water as your drink of choice as long as your body fluid levels are in balance. Once the fluid balance is upset, you must introduce electrolyte solutions to replace lost minerals and body salts. Dr. Hunter recommends any of the popular sports drinks such as Gatorade diluted with equal parts of water. These sports drinks should be consumed cool - not ice cold - to avoid thermal shock and cramping, and you should drink the sports drinks by the 'cupful'. Don't 'chug' a quart of cold Gatorade unless you're ready for some serious

abdominal cramping and bloating. As Dr. Hunter says, you didn't dehydrate in an instant, and it will take just as long - probably even longer - to return your body to a normal fluid balance. In serious cases, it may take a day and a half to three days to return to normal after serious heat exposure. For health's sake, take your time - don't try to rush your recovery.

The Day Has Arrived ***Pre-Session Cleaning:***

There may be a side benefit of performance training - your car may come out a little cleaner. We can not overstate the importance of removing all the loose objects from your vehicle's interior. And while you're at it, take a closer look at anything that could possibly come loose during your speedy travels around the course.

Be sure to check UNDER the Front Seats: You might be surprised what you'll find: loose change, pens, pencils, moldy french fries, tape cassettes or CD's, children's toys - you name it, it can take refuge under those front seats. Even though they are small objects, they can become very costly when driving at speed. A simple penny or old french fry can cause your foot to slide across the floorboard at a time when you need that foot to brace your body movement. That distraction can be enough to lose your concentration long enough to wind up off the pavement and headed towards who knows what. Large items, such as cassettes or children's toys, can slide under pedals and inhibit their range of travel. You may not be fully able to apply the brakes or complete a shift - neither of which you want to experience when travelling at speed.

Clean off the back seat and rear window tray: Any loose items in your vehicle can become flying projectiles when you go scooting around the track. Loose items as benign as a book can clunk around enough to cause you to direct your attention somewhere other than your driving - something you definitely can't afford when attempting to discover the limits of your car and your driving ability.

Floor Mats? It is also a good idea to remove the floor mats in the front to keep them from sliding around under your feet and getting tangled in the pedals. The last thing you want is a floor mat that keeps your accelerator from fully returning to the closed or off position.

And forget about the outside world: As difficult as it may be, turn off your beepers and cell phones when out on the circuit. A beeper can be very distracting at the most inopportune times, and a ringing cell phone can not only be distracting, but it can also be confused with major vehicle warning systems or mechanical malfunctions. You can always turn them back on at the end of your driving session, but better yet, tell everyone you've gone away for the weekend and can't be reached. It's better to focus on the matters at hand. If you must have a beeper or telephone during the instructional sessions, perhaps you should have stayed in the office.

Choosing the Right Tire Pressure

This is NOT an Autocross!

Performance driving on a high speed course is a long way from a short course autocross. Nothing is quite as scary for a driving instructor as drawing an experienced autocross driver for a student - you're guaranteed one of the wildest rides of your life. It's enough to make me lose my hair - if I still had some left. People who regularly compete in autocrosses have a tendency to over-inflate their tires. (At a recent driving school, I heard autocrossers who were positive they had to have their tires pumped up to 40 psi before rolling out on the track.) These high tire pressures are fine for autocrossing when a vehicle is on the course, twisting and turning, for 45 seconds to 1 minute, but take it from someone who has spent more than 20 years on a race track, 40 psi is way too high for performance driving.

At one school, I had the challenge of rolling out on the track with an autocross driver eager to try his hand at driving on a track. The first lap was a little scary, and it went downhill from there. By the middle of the second lap, the car would no longer steer around corners at moderate speed, and after two wild spins through the grass, I encouraged the driver to slow considerably. That's when I inquired about the tire pressures, but I already knew the answer I would hear. The answer guaranteed we were in for more excitement ahead. By the end of the session, we couldn't negotiate any of the corners at more than 40 mph.

The reason - heat generated by friction. (Here comes that nasty physics again.) When you're forcing a tire to work for only one minute, it doesn't have much time to heat up. But subject that tire to a long period of stressed cornering, hard braking and hot acceleration, and the tire pressure will soar. Simple general science tells us that when air is heated, it expands, and with no where to go inside the tire, the tire pressure skyrockets. That 40 psi in a cold tire can rocket to as high as 55 psi after 20 to 30 minutes of spirited driving. If you read the fine print on your tires, you'll see that tire pressure is never to exceed 60 or 65 psi. Over that, there's a very real possibility that the tire will explode. Car tires are not built to withstand such combined pressure and the heat caused by spirited driving. If they don't blow out (Let's hope not!), they will expand and lift the edges of the tire tread off the pavement, reducing the amount of rubber that comes in contact with the pavement. That means less surface friction to hold the vehicle on the road. **Bottom line: Get ready for a wild ride in the grass!**

If not 40 psi, where do you start? It's actually pretty much a matter of personal taste and driving style. Some driver's like their car to be a little loose on the pavement so they can feel it skid around and drift out in the corners. Others prefer the car be glued down to the pavement surface. You can achieve either feeling simply by modifying the tire pressures. Probably the best place to start is to begin the day with the tire pressures recommended by the vehicle manufacturer for cold tires. Note - I recommended you start the day this way, when outside air temperatures are

likely to be coolest. Your tire pressure will increase 1.) with an increase in outside air temperature, and 2.) with the increased heat from hard use on the track.

1.) The effect of outside air temperature: Every ten degree increase in the ambient air temperature will raise your tire pressure about one pound. That means your tire pressure will increase all day long, even if the car just sits still in the paddock. In a typical St. Louis summer day, it's not that unusual to see the outside air temperature climb 20 to 25 degrees from the morning low to the heat of the afternoon. That means a 2 1/2 pound increase in tire pressure from the increase in outside air temperature alone.

2.) The effect of heat from track use: It is not that unusual to increase tire pressure as much as 8 to 10 pounds in as little as three laps of the track on a hot afternoon. And that pressure will continue to rise with the increased number of laps you drive.

With these two factors in mind, you can see that the manufacturer's recommended air pressure may be too high for comfortable performance driving. Start the day at the recommended pressures, and if the tires become too slippery for comfort, reduce the tire pressures one or two pounds before beginning your next track session. You will almost always have to reduce the tire pressures. (Thank heavens. It's a lot easier to let air out of a tire than pump it in.) Once you achieve a tire pressure where the car feels comfortable on the track, stay with it, and repeat that pressure reading before each succeeding track run.

One more tip: Generally speaking, it's best to run slightly more pressure in the tires under the heavy end of your vehicle. For vehicles with the weight (that means the engine) up front, such as a 928, 968, 944 and 924 put more pressure in the front tires. For vehicles with the engine weight in the center or rear such as a 911, Cayman, Boxster, 914 and 356 put the extra pressure in the rear tires. You might want to start with two extra pounds of pressure under the heavy end.

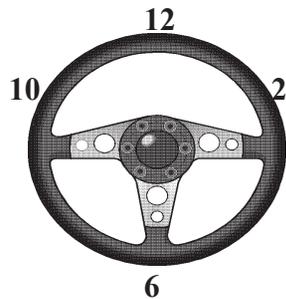
The most important thing to remember is that if the tire pressures feel right on the very first lap, you still have them too high. You want them to feel slightly mushy when you first roll out on a cold track on cold tires. As the tires warm, the pressure will increase to more comfortable levels. That's when you will start having fun. It's a lot better to end the session with a car handling the way you feel most comfortable than to have the handling go away from you as you become more fatigued as the session wears on.

Securing the Most Important Part of Your Vehicle - YOU !!

While we have talked about the problem of having loose items sliding around inside your car, there is one item that must be especially secure - YOU! To really get a good feel of how you and your car behave at speed, it is best if you almost become a part of your car. When you're sitting squarely in the driver's seat, you are able to feel the car sliding across the track surface. It also permits you to have the full range of motion and leverage with your arms and legs. But most importantly, when you're sitting securely behind the wheel, you can forget about bracing yourself and concentrate on your driving.

You must sit IN your seat - not just ON it. Once seated, push your "tush" deep into the seat cushion. It wouldn't hurt if you kind of wriggle your back into the seat and backrest - settle in tightly and check to make sure you can push the clutch and brake pedals through their full range of travel. If you can't, you'll have to move the seat forward a notch and start all over again, burrowing deep into the seat and back.

Now, it's finally time to grab hold of the steering wheel. You've no doubt heard of the 10 to 2 wheel hold - look at the steering wheel as if it were a clock and place your left hand at about the 10 o'clock position and the right hand at about the 2 o'clock position. That's not bad, but most performance drivers prefer to move their hands a little further apart - more like 9 and 3 (See figure 1.) Also, try to break the habit of wrapping your thumbs around the steering wheel and resting them inside the wheel. More than one driver has had his thumb broken by the inner spokes of the steering wheel when the wheel violently jerked out of his grip after the front wheels of the car hit a rut alongside the track or impacted the track wall or guard rail.



Your arms should be slightly bent. If they are straight, you're sitting too far away from the steering wheel. Sitting with your arms fully extended will cause you to either lean forward when making a turn or will limit your range of motion - either is bad driving technique. If your driving position forces you to lean forward, you will eventually find yourself using the steering wheel as a brace to keep from sliding out of the seat. If you need to keep the seat back to assure you have ample leg room, you may need to tilt your seat backrest forward to achieve the correct arm position.

Now, before you move your car, it's time to test if you can move your arms through their full range of motion. Start by placing your hands in the correct driving position on the steering wheel. With your left hand on the wheel, place the palm of your right hand on the back of your left. Return your right hand to the proper driving position on the steering wheel and touch it with the palm of your left hand. If you can do this without leaning forward or moving your back from the seatback, you are probably sitting in the proper position.

But, there's one more test. With your hands in the driving position, turn the steering wheel to the right and then to the left without moving your hands from the steering wheel. If your elbows hit the seat or your body, you're sitting too close to the steering wheel. Tilt the seatback back until your arms are slightly bent.

If you are short or heavy, you may never find the proper driving position without modifying the car. For example, you may need to place blocks under the back seat mountings to tilt the seatback forward or you may need to mount blocks on the pedal surfaces to achieve full pedal movement. But these modifications may make it impossible for others to drive your car, so you may just have to settle for the best compromise that allows you to push the pedals through their full range of travel while holding your arms slightly bent.

You Can't Drive If You Can't See

Hopefully, you understand that you must be able to see to drive quickly. If your driving position behind the steering wheel limits your vision, you'll have to move the seat to the best compromise that allows you to see out of the car, but doesn't greatly hinder your driving movements.

Of course, you must also be able to see to the side and in the rear view mirrors. Before cinching yourself tightly into your seat, be sure to adjust your rear view mirrors, inside the car and on both sides. You know how important it is to see other drivers overtaking you on the road, but it is even more important on the race track. You **must** constantly monitor your mirrors on the track. The speeds and forces you and your car will experience on the track require that you make your movements **carefully and gradually**. Jerking the steering wheel in a panic reaction because you were startled by another vehicle may cause your car to jump into an uncontrolled slide or spin off the pavement - a spin that could be costly to your physical health and your financial health.

You will probably be too busy to glance at your mirrors when you are steering through a corner, but there is plenty of time to look in the mirrors on the straighter parts of the course. During your driving instruction period, passing will be limited to the straights so you will not be startled by an unexpected pass. You will need to glance at your mirrors several times on each straight. Make it a practice to look in your mirrors at least twice - immediately after exiting a corner and again just before entering the next corner. This will enable you to see more powerful cars which may

be waiting for you to exit the corner before passing and again to see faster cars which will be quickly closing in on you after their full speed run down the straight.

Performance drivers use the straight portions of the course to do a number of important things which they have to ignore when concentrating on correctly negotiating a corner. They usually develop a routine of things to do and look at as soon as they turn onto a straight stretch of track, no matter how short that straight stretch might be. The routine might go something like this: Look in the rear view mirrors, glance at the oil pressure and temperature gauges, glance in the mirrors again, gently relax one hand's tight grip on the steering wheel and wiggle the fingers on that hand to relax some of the tension and soreness in the fingers, once again tighten their grip on the steering wheel and relax the other hand, glance at the mirrors once again and begin setting up the car for the next turn. This sounds like a lot to do in a short time, but you'd be surprised how quickly you react when your mind is concentrating on driving at speed.

One more important thing: **DON'T LOOK AT THE SPEEDOMETER!** Personally, I would like to cover the speedometer of every car before it goes out on the track. Real race cars don't have speedometers. Even the most experienced drivers have a tendency to "chase the speedometer". We all like to say we got our car up to "130 on the straight" or that we were doing "70 miles an hour through turn 5". But when the car is not going as fast as we think it should at the end of the straight, we may delay applying the brakes just a fraction of a second longer in hopes of building up the speed to that 'magic number'. That tiny delay in applying the brakes could cause us to enter the corner too fast, and we find that our idea of the right speed ends up with our pride and joy very expensively perched on top of the wall or guard rail. The idea of performance driving is to **drive your car as fast as you safely can at all times** on every inch of the track, not just quickly in a straight line down one of the straights or fast through just one of the corners. Concentrate on **feeling** what the car's suspension and tires are telling you. Feel the feedback through your hands and arms and bottom. Listen to the tires, the strain of the engine, the whine of the transmission. Let these indicators tell you when your car is going quickly - not what you see on the speedometer.

Become A Part of Your Car

To really experience what your car is capable of, you have to literally become a part of your car. We have already touched on the importance of the correct driving position in the seat to fully control your car at speed. The regular seat belts installed in your vehicle are okay for highway driving and an occasional driver's education event. But if you are really serious about driving near the edge of the envelope, you really need to install what is known as a 5-point or 6-point restraint system. The common lap seat belt and shoulder harness is not enough. The 5 and 6 point systems include the normal lap and shoulder harnesses and another belt that is attached to the floor in front of your seat at either 1 (for the 5 point system) or 2 (in a 6 point system) places. This extra belt is referred to as the anti-submarine

belt. When a car is involved in a severe frontal impact (Heaven forbid that should ever happen!), the lap seat belt can ride up over your hips. You can then slide down (or 'submarine') under the lap belt and under the steering wheel and dashboard. The anti-submarine belt holds the lap belt down across your pelvis and hips, where it should be, to hold you in your seat - no matter how severe the impact. At worst, if you do slip forward in your seat on impact, you might find yourself talking an octave or two higher, but you'll be able to walk away. With the 5 or 6-point restraint system, you can pull the lap belt tight and cinch down the shoulder harness until it hurts - a little. The tight discomfort from the tight belts not only holds you in the seat - it reminds you that you're here for business and helps keep your mind on the business at hand.

It's Time to Roll!

It's finally time to roll out on the track and get down to the business of learning what you and your car are capable of. Lesson #1 is a simple one - You've got two hands - Use them on the steering wheel. Sure, you need one hand to shift, but once the shift is complete, your hand should go back on the steering wheel. It's nearly impossible to perform the smooth, gentle movements of the steering wheel required to accurately steer a vehicle at speed if you are using only one hand on the steering wheel. Once at speed, you will find that your steering wheel kicks and fights you like an angry cat.

Your first reaction will be to wrap your fingers around the steering wheel and hold on for dear life. It may be natural, but it's an open invitation to broken fingers. Get a firm, but light grip of the wheel. Locking your fingers around the wheel cuts off your circulation and deadens the feeling in your fingers and palms. You'll lose the critical feeling you need to recognize the first signs that your steering wheel gives you when the front wheels are losing their grip. And when your hands feel like they are falling asleep, you'll lose the concentration required to perform at your best.

Now that you have the grip down, it's time to work on your steering. The main rule in steering is to make sure that you don't get your arms crossed. There may be times when the turns are so tight that you can't negotiate them without moving your hands from the normal driving position. When that happens, you have one of two options. First, you can move your hands from the normal driving position before you reach the turn. For example, if you are approaching a sharp right turn, you may want to slide your right hand up on the wheel to about the 1 o'clock position and then slide your left hand down to about the 8 o'clock position. Then as you enter the turn, you can gently pull down on your right hand. (You'll find steering is smoother if you pull down on the wheel, rather than push up.) After you have completed the turn, you can return your hands to the correct and comfortable driving position.

Or you can move your hands through the 'move and slide' motion. In the move and slide motion, you always have a firm hold of the steering wheel with one hand. In the right turn described above, you move your right hand up higher on the

steering wheel - to the 1 o'clock position, for example. Then, relax the grip of the your left hand and pull down with the right, letting the wheel slide through your left hand until the part of the steering wheel directly across from your right hand is in your left hand. Then close your left hand, and complete the turn with both hands. When you are steering out of a turn, let the wheel slide through your left hand until the 9 o'clock position is back in the grasp of your left hand and you can tighten your grip and get back to the normal driving position.

It may take some time getting used to holding the steering wheel correctly. Afterall, we have spent years proving to the world that we can steer with one hand while eating, combing our hair, and hundreds of other things we do with our free hand. Old habits are hard to break, but if you are really serious about learning how to handle your car at speed, the proper use of the steering wheel will go a long way towards helping you achieve your goal without spending tons of money at the body shop.

Getting Up to Speed

It's going to take some time to get both you and your car up to speed. Don't expect to go fast immediately. It's going to take some time to get your car, your tires and your concentration ready to take on the task ahead of you. If you've never been on the track before, it might be a good idea to take the first two or three laps of each practice session to get everything warmed up and working on the same wavelength.

Once you are somewhat familiar with performance driving, it takes less time to get up to speed, but it still takes time. No one - not even the professionals can go lightening fast from the moment they start their engines. Why do you think races start with a warm-up or pace lap? Professional racers use the warm-up or pace laps to warm up their car's brakes, tires, engine and their minds, so don't feel bad about taking a little time to get used to performance driving.

Turning Curves Into Straight Lines Where Fun and Physics Meet

Before the weekend is over, you're going to be sick and tired of the term, 'line'. In performance driving, the term 'line' refers to the path which a vehicle travels when it is on the road. You will be encouraged to study each corner at the track, determining the 'fastest line', and consistently drive 'that line' at speed.

The quickest line around a corner will involve using all of the available road. Often one of the most difficult tasks instructors have during a driver's education weekend is to convince students to use every inch of the track, from one side all the way across the track to the other side. From the very first day you got behind the wheel, you were constantly admonished never to cross the highway center line, but

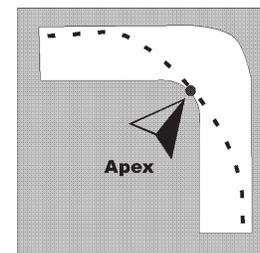
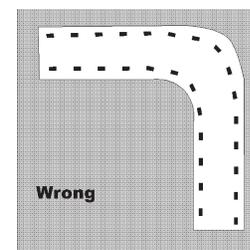
there is no center line on this track, so use it all. Granted, we don't have this option on the highway, but learning the best 'line' through a corner doesn't change, only the amount of road you can use does. On the race track, the amount you can use may be the entire width of the pavement. On the highway, it's probably only the area from the center line to the right edge of the pavement, but the principle of the 'best line' still holds true. Keep this in mind, so what you learn this weekend will be of use every time you climb behind the steering wheel.

As your instruction progresses, you'll probably notice that you hardly ever drive down the center of the track. You'll probably be on one edge of the pavement or the other, or crossing over the pavement from one edge to the other. About the only time you'll find yourself driving down the center of the course is when several turns are spaced so closely together that you can't move over to the edge of the pavement and still place your vehicle in the proper position to enter the next corner, like in the turn 3 - 4 complex at Gateway, but more on that later.

You might also be steering down the center when speeding down the straightaway or in the banked turn, because your 'line' on a straight is not really important until you must position your vehicle for the proper entry into the next corner or to exit the corner before the straight section of roadway.

Negotiating Turns Safely and Quickly

The 'fast line' around a corner will almost always be the path that takes you through the corner with the least amount of movement of the steering wheel. You want your vehicle to travel along the biggest possible arc around the corner because it minimizes the physical forces that naturally slow your car - forces like centrifugal force, tire scrub, etc. and allows your vehicle to move through the corner faster. If you stay along the inside of the track, from the beginning of the corner to the exit, the turn will be very sharp. The natural forces will force you to slow the vehicle considerably to stay on the pavement. If you choose to drive around the outside of the turn, you will be able to drive a little faster, and the forces on your car will not be quite as great, but your speed will still have to be relatively slow to negotiate the corner safely.



But by starting on the outside of the corner, steering smoothly to the inside of the corner and touching the inside of the corner in the middle of the turn, and then moving gradually back to the outside of the pavement,

you have made the turn as gently and straight as possible. Since you don't have to turn the steering wheel as sharply, you will also be travelling much more rapidly than in either of the previous examples. The point where your vehicle touches the inside of the turn is known as the "apex". I guarantee that you'll hear that term a lot during your instructional period. Every turn has an apex, and that apex is always the same for that turn as long as the physical conditions of the track remain the same... (Say, what?) In other words, as long as the pavement remains dry, the fast, safest line through the corner and the apex will always be the same. But when conditions change, such as when the pavement is wet or snow covered (which I truly hope we don't experience), the line and apex may change, but we won't address those changes in this elementary driving course.

The weight, weight distribution, tires, tire size and condition and other factors will cause the 'apex' of the turn to vary with each specific vehicle. Therefore, it's important that you listen to your instructor as to the location of the 'apex' in your specific vehicle. Don't worry about the line or apex taken by other cars around you, especially if those cars are different models than the one you are driving. The apex of a corner is a little different for every model vehicle, especially different for newer vehicles compared to those manufactured 15 to 20 years ago.

The location of the apex will also vary with the radius of the turn. The apex is located in the exact center of the turn if it is a constant radius turn taken at a constant speed, but there are very few of those on race tracks or highways. Our roads are made with a few constant radius turns and a few increasing radius and decreasing radius turns thrown in for excitement. So you will have to be able to judge the radius of an upcoming turn to determine where your apex will be located and what technique will be required to speed through the corner with the greatest velocity. Your instructor will help you with these variations, and we'll try to cover a few later on in this booklet.

Better 'Late' Than Never

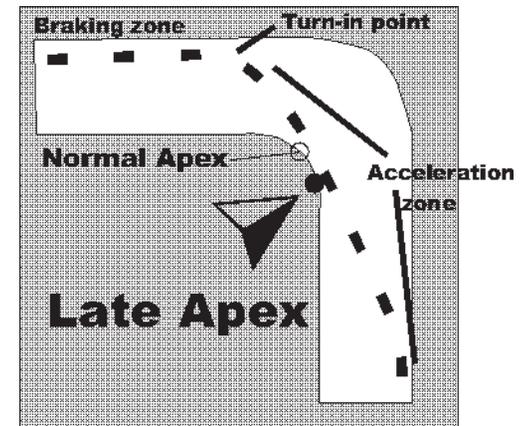
Most time, you'll find that the safest, quickest line through a corner will often be what is called a 'late apex' line. Not every turn is a late apex turn, and not every car should take a late apex line through the turn, but there are several reasons why 'late apex' lines are usually your best option.

Our objective in performance driving is to safely and comfortably negotiate the entire track at relatively high speeds. A 'late apex' line will most often allow you to exit a turn at as high a speed as possible. That makes it possible for you to travel down the next straight section of the course immediately after the turn in less time, because you don't have to wait while your car recovers the speed you lost when going through the turn.

"Late apexing" a turn can also help you counteract 'oversteer' in your car. Oversteer is the tendency of the front of a car to sharply veer into a corner when turned. Oversteer also causes the back of a car to swing out. If you can't counteract the

oversteer, the back of the car can continue to swing around to the outside of the corner until the car spins off the pavement backwards. When you 'late apex' a corner, you can apply the throttle earlier in the exit of the turn. The acceleration transfers weight back onto the rear tires. That gives you a two-fold benefit - 1.) pressing down on the rear tires giving them more traction and 2.) transferring the weight back and down lowering the car's center of gravity. This decreases the tendency of the rear of the car to spin towards the outside of the turn, and also cancels the natural tendency of a car's suspension to lean towards the outside of a turn. As a result, your car executes the turn faster, flatter and more stable.

Which leads us to the third reason to 'late apex' a corner, it is usually a safer, more stable way to negotiate a corner. To properly 'late apex' a corner, you have to approach a corner in a manner that allows you to be accelerating throughout the turn. The laws of physics say that when a body accelerates while it is turning, the mass of that body will cause the turn to get wider at the end of the turn. Therefore, to counteract the laws of physics, you must slow the car before beginning your turn-in. When you reach the corner's turn-in point, you must turn in sharply and begin to apply pressure on the accelerator to transfer power and weight back to the rear wheels. As the car accelerates and centrifugal force pushes the car towards the outside of the turn, you must slowly unwind the steering wheel, allowing the car to naturally drift from the inside apex of the turn to the outside edge of the pavement. Since you accelerate out of the turn with only a gradual movement of the steering wheel, you have more control of the vehicle, and have less of a tendency to lose control when exiting the turn.



Multiple Turn Combinations

As mentioned, the ideal road or race track would have all turns equally spaced apart with enough distance between the turns to allow you to catch your car as centrifugal force forces it to the outside as you exit one turn and then give you enough room to steer your car across the track to set it up for the proper entry into the next turn. As you already know, there is no such road or track. Engineers love to put together multiple turn combinations to upset our driving style, but once you learn the secrets of multiple turn combinations, they can be a lot of fun. Here is where you can feel physics at work as you drift your car around in your efforts to set up for the next turn. Once you have confidence that you can handle multiple turn combinations, you might even go out looking for some, just for fun.

The secret to multiple turn combinations is compromise. Your goal is not be to be fast through all parts of the turn...just make sure you're fast coming out of the last turn. Most times that will mean you have to settle for less than an ideal line in the first turn in order to properly late-apex the last turn. The turn 3 - 4 combination at Gateway International is a perfect example. If you try to execute your normal entry - apex - exit through turn 3, you will be so far off the line for turn 4 that your car will slide off the track before you get to 4. The answer is to compromise by taking a later apex through turn 3 that will leave your car in the middle of the track at the entrance to turn 4. That way you can still salvage much of a normal late apex exit out of 4 for the run to turn 5.

The Sinister Decreasing Radii

If there is one corner guaranteed to give you fits, it is the dreaded decreasing radius turn such as Gateway International's turn 6. In most cases there are two different ways to speed through a decreasing radius turn - which one you choose depends on your car, the track conditions, and your abilities as a driver. The approach to a decreasing radius turn ---one that gets tighter and tighter, is usually to come in fairly fast, begin your turn in and back off the throttle a little to transfer weight forward to the front wheels to create oversteer which will naturally tighten your turn. As the oversteer induced sliding of the back end of the car begins to scrub off speed, continue to turn in for a very late apex. As the very late apex approaches, begin feeding in power to transfer weight back onto the rear wheels, stopping the back slide and forcing the back end down for increased traction. Continue gently feeding on the power to power out of the turn.

The very late apex of a decreasing radius turn is very difficult to find. Our natural tendencies will tell us to turn in to the corner way too early. It will take hours of practice to develop the skill to hold off your turn in until you can touch the very late apex and power out of the corner. It is common to either enter the turn too slowly and take what seems like an eternity to 'motor' around the corner that seems like it will never end or to enter the corner with too much speed and watch as centrifugal force pushes your car way wide of the apex, and across the pavement and onto the grass on the outside of the turn.

Decreasing radius turns and hairpin (more than 90 degree) turns also open the opportunity to turn the corner into two smaller corners - 'double apex' the turn. The wide pavement surface makes it possible to 'Double apex' turn 6 at Gateway International, but it is a tricky maneuver at best. A light, balanced car with lots of power is relatively easy to double apex. But if the vehicle is end heavy such as an older 911, double apexing is not only challenging, but it can also be disastrous, especially if the track surface is wet or your tires are cold. More on double apexing later.

Use Up the Brakes, Not the Transmission

For years, auto enthusiasts have spoken almost religiously of the miracle of a perfectly executed downshift, elevating downshifting to an art form. But while many of us have been grinding the gears into iron shavings and turning the clutch plate into dust trying to perfect the perfect row through the gearbox, professional race drivers have learned that the best way to slow a car is to use the brakes - not the transmission. They have discovered that changing brake pads is a lot faster and cheaper than opening up a gearbox to shake out those little metal pieces that come from an ill-timed downshift.

So as you rocket towards the next turn, concentrate on using the brakes to slow your car. Downshifting is still necessary, because you need to get on the power as quickly as possible coming out of a turn. You want to have the transmission in the right gear coming out of the turn, but use the transmission for the purpose it was originally designed - power management, not as a brake. I hope the great legends of racing forgive me, but the bottom line is that you should drive your car in much the same manner as if you had an automatic transmission.

To ABS or Not ABS, That is the Question

Once again, contrary to everything you have been taught about using your car's brakes, the proper use of the brakes is often to use them as hard as possible over as short a distance as possible. I'm not talking about jumping on the brake pedal until it lock the wheels, but rather applying the brakes smoothly and progressively (pushing the pedal down by applying more and more pressure) until the wheels almost lock. The modern ABS system will usually prevent you from locking up the wheels during braking. Which leads us to the natural question, "Should I use the ABS system or turn it off?"

The early ABS systems kept the wheels from locking up, but they were not really rugged enough and sophisticated enough to withstand the punishment of high performance driving. Besides, their violent pulsing and loud chattering noise was often distracting, and may have actually led to some incidents when drivers thought their cars were coming apart. So a few years ago, some professional drivers said they always turned off the ABS systems and used manual braking instead.

But if you look at the modern professional race cars, you'll see that ABS is standard equipment. The fact is that after the early 1990's, ABS technology advanced to the point that it was no longer necessary to disable the ABS system in performance driving situations. That applies to both road cars and purpose built race cars. **Just remember, the technique for using ABS brakes is the exact opposite of manual braking. ABS brakes must be applied hard and evenly - never relaxing pressure on the pedal. Manual braking requires the hard, firm application of the**

brake pedal and then a gradual release of pressure on the pedal to keep the brakes from grabbing hold of the rotors and locking the wheels.

Keep in mind that if you're good at braking, your tires will make noise. If you're real good at braking, the brakes will smoke. But one word of warning - when you get to the point that the brakes smoke, just don't stop and let those little red hot binders smoke their heart out. Keep driving around very slowly - slowly enough to keep air moving past the hot rotors and pads and slowly enough that you don't have to use the brake to stop. Hot, smoking brakes can warp and stick to the rotors if allowed to sit and cool. When the smoking stops, so can you.

Ready to pop another old time driving myth? **Don't pump your brakes.** Despite what you have been told, pumping the brakes only works in two very specific situations - 1.) snow - and I sure as heck we don't have a snow covered track at a driver's education week-end or we'll all be in for an education, and 2.) when the brake pedal sinks all the way to the floor indicating a loss of braking power due either to a loss of brake fluid or boiling fluid. Sometimes pumping the brakes can bring back enough pedal in a failing brake system to provide some stopping power.

Brakes Do More Than Stop a Car

With practice, you can use your brakes to improve the steering performance of your car. This is especially true with front-wheel drive cars, but it also applies to rear drive and rear engine cars like many Porsches. To understand how, it helps to understand a little physics. When you step on the brakes and feel the upper part of your body move forward towards the steering wheel, you're feeling one of the principle laws of physics - bodies in motion tend to stay in motion. Your car is feeling the same thing. That's why the nose of your car dips downward when you apply the brakes hard. What you're really doing is moving the center of gravity forward and transferring weight around the car. When you brake hard, weight moves forward off the rear wheels, sometimes lifting the rear tires and lessening the rear tire patch (the amount of tire rubber that is in contact with the pavement), thereby lessening the braking power of the rear wheels. The weight has to go somewhere - and that somewhere is forward. When the weight moves forward, the front suspension compresses a little more, presses harder on the front tires, thereby increasing the front tire patch and increasing the braking power of the front tires and brakes. When you lift off the brakes, the weight begins to transfer towards the back of the car, thereby reversing the action explained above. That is one of the primary reasons you don't want to pump the brakes: Push the pedal down - the weight goes forward...let the pedal up - the weight goes back...push down on the pedal again and the weight goes forward...let up on the pedal again and the weight goes back...forward...back...forward...back. You wind up with a car that is porpoising, (nose up...nose down...nose up...nose down) bouncing on an unstable suspension while rocketing forward on the track. When you press down on the pedal smoothly, the weight transfers forward evenly and stays there to give you smoother, more even braking.

WHEN POSSIBLE, BRAKE IN A STRAIGHT LINE.

Your tires are designed to give you the best performance when the entire width of the tread patch is in contact with the pavement. Every time the wheel turns, the tire twists a little, lifting one edge off the pavement and lessening its ability to turn and brake effectively. So you get the best braking performance when the tire is rolling straight ahead. That's why it's recommended that you brake while the car is traveling in a straight line before you turn into the corner. Brake hard while approaching the turn, and start lifting off the brake as you begin your turn. This action gives you the most effective braking action and also begins the weight transfer back to the rear wheels to give you better, almost equal, traction on all four wheels as the car travels around the corner.

Don't get too upset if you have difficulty at first with your straight line braking, downshifting and finding the fastest line through the turn all at the same time. It's a lot more difficult than walking and chewing gum, and probably quite different than your usually driving habits. The idea now is to go slowly and concentrate on getting 'the line'. As you become more confident and more fluid with your steering wheel and pedal usage, you can work on increasing your speed.

Leave the Saw At Home

While you're concentrating on the fluid use of the brakes, it would also be an excellent time to practice the smooth, fluid use of the steering wheel. The same law of physics that moves the weight of the car forward and back while braking also moves the weight from side to side while you corner. You feel it when making a turn and your upper body rubs up against the seat bolster in the opposite direction of the turn, i.e. you move towards the door when making a right turn and visa versa.

This weight transfer from side to side in turns can reek havoc on your driving if you "saw" at the steering wheel when turning a corner. You've probably ridden with someone who turns the wheel too sharply when entering a turn. That person has to turn the wheel in the opposite direction to keep from hitting the curb, and invariably winds up turning out too far and winds up turning into the turn again. This action of turning in - turning out - turning in - turning out is called 'sawing' the steering wheel. The laws of physics make the car want to continue heading in the direction it was going before you started turning. As a result, the weight moves in the opposite direction in which you turn the steering wheel. It doesn't take much imagination to see that when everything is going in the opposite direction that you want to go, things can get out of hand real fast.

That is why it is critical you make every steering movement as smoothly as possible. Ideally, each turn of the steering wheel should be one continuous, smooth movement. As you approach a corner and complete your braking action and have the car travelling slowly enough to travel through the corner without skidding off

the pavement, it's time to turn. Your initial turning input will probably be a strong, gradual turn of the wheel. It's easier if you turn the wheel by pulling down with your hand on the same side of the steering wheel in the direction of your turn, i.e. pull down with your right hand when making a right turn, etc. Pulling down in the direction of the turn gives you an easier, smoother movement of the wheel than pushing up with the opposite hand. The pulling down motion also makes it easier to counteract any jerks in the movement of the steering wheel caused when the front tires hit bumps, ruts or stones on the pavement. Try to avoid turning too much or too little. This is even harder than it sounds, and will take quite a bit of practice. Once you've hit the 'apex' of the turn, you can begin the smooth and gradual unwinding of the steering wheel which will allow your car to move across the pavement all the way to the opposite edge of the track. When your car is travelling at speed, it will want to take itself back out to the opposite edge of the pavement. Your steering action in the last half of the turn will probably be more of a motion to hold the car on the pavement by gradually unwinding the steering wheel.

This gradual unwinding of the wheel is especially important on the banking at Gateway International. One of the most difficult lessons you will have to learn at our St. Louis driver's education event is that there will be a time that you must turn towards the outside concrete wall at the end of the banked north corner. It doesn't take a genius to understand that when you're speeding around the banked oval turn at the north end of the Gateway oval, about the last thing your mind wants you to do is to turn the steering wheel **towards** the wall. The north end of the banked oval (known as turns 3 and 4 for the roundy-round drivers) are some of the highest G-force turns pro drivers experience on the racing circuit. Only the superspeedways like Daytona put more stress on drivers and cars. As you build up speed in the driver's education event, you will begin to feel the increased G loading and it's effects on your car. One thing you will notice is that at speed, the back of your car will want to naturally drift towards the outside wall. In most cases, this is not violent and really not too scary. It's so gradual, you may not even notice it at first. But as you go faster and faster, the back of the car will want to drift higher and higher to the wall. The only way to keep the car off the wall at speed is to ever so slightly unwind the steering wheel, actually steering towards the wall, to catch the back end slide and put the back end in line with the front. If you attempt to hold the car off the wall by steering away from the wall, the centrifugal and G forces will bring the back of the car around, causing a fast spin right up against the wall - a potentially painful and very expensive maneuver which it would behoove you to avoid. This may sound a little scary at first, but as you practice the maneuver over and over, you'll find that it gets to be quite fun as you experiment with just how close you come to the concrete wall without hitting it. (Who said these guys are sane ? ?)

Once you get your car up to speed, you'll be surprised how little you have to move the steering wheel. You have just discovered one of the primary rules of performance driving - Move the steering wheel as little as necessary to put the car where you want it to go. The less you move the wheel, the faster the car will go. When

you're just cruising around town, you can get by with jerky steering wheel inputs, but when you're pushing the edge of the performance envelope, jerk the steering wheel around and you will experience some wild and real 'expensive' rides.

LEARN TO DO IT RIGHT NOW ! !

The Fastest Way Around A Corner is with Your RIGHT Foot!

Up to now, every time we've talked about the laws of physics, it's because they cause your car to do things you don't want it to do, but you can put physics to work for you by using your right foot at the right time. As I mentioned earlier, your accelerator can play a large role in faster cornering. The same laws of physics that transfer a car's weight around while braking and make it a bad idea to pump the brakes or 'saw' at the steering wheel can also improve your car's traction for faster cornering and faster acceleration out of a turn.

Let's say your car is entering a turn...Let's recap what has happened to your car up to this point. As you approached the turn and applied the brakes to slow the car, the car's weight moved forward, applying extra weight on the front suspension and front tires. As you began your turn, the weight slid to the side away from the direction of your turn. Up to now, the laws of physics were acting on their own, but now it's time for you to take control and make the weight do what you want it to do - and you can do that with the use of the brake and the accelerator. When you get really good, you might want to use your left foot on the brake and experiment with 'trail braking'. This is especially helpful with front-wheel drive cars. (We'll leave that to our efforts to '*Stretch the Envelope*'.) For now, we'll simply concentrate on using the accelerator to transfer the weight back on the rear wheels for more traction for more stable cornering and faster acceleration out of the turn.

Ideally, as soon as you've entered the turn and have the car pointed towards the 'apex' of the turn, it's time to begin gently and continuously pushing down on the accelerator. **Never coast through a corner.** When you coast through a corner, you're simply turning control of your car over to the laws of physics - you're letting the relatively unpredictable laws take you for a ride. I say "unpredictable" because, although we know exactly what the laws of physics will make the car do, we can't really predict exactly when they will happen, so you just end up sitting there and waiting for things to go wrong. The objective of our driver's education efforts is to insure that you are the one in control of what your car will do in all situations and when it will do what you want it to. As you apply the power, the weight transfers back towards the rear wheels (even in front-wheel drive vehicles). That increases the weight on the rear suspension and tires, helps prevent the lifting of the inside rear wheel, increases the size of the tire patch in contact with the pavement and settles the back of the car - all increasing the back end's stick to the pavement. If the rear wheels are transmitting power to the road as in rear-wheel drive cars, this will shoot the car out of the turn and begin the car accelerating down the track. If the

rear end is just coming along for the ride as in front-wheel drive cars, this will increase the traction of the back wheels, keeping the back of the car from breaking loose and spinning the car off the pavement.

How soon you apply the power and how far you push the pedal down depends on a number of things, especially the vehicle you're driving, but ideally, you should be well on the way to full acceleration when you clip the apex of the corner. No matter what happens to your vehicle - **NEVER SUDDENLY LIFT YOUR FOOT OFF THE ACCELERATOR IN THE MIDDLE OF A TURN.** Any driver of a rear engine car, especially those built before 1984, can tell you of the exciting ride when you back off the gas suddenly in a turn. In cars with the engine hanging back behind the rear wheels, suddenly backing off the accelerator violently throws the weight of the car back past the rear wheels. The weight continue to move backward, taking the weight (and thereby the traction) off the rear wheels. With the weight far back behind the rear wheels and the traction of the rear wheels almost gone, cars such as early 911's will snap into a fast, rather violent spin. Luckily, Weissach engineered most of the 'tail-happiness' out of the late model 911's, 993's, 996's and 997's, but 911's built in the '60's and '70's can be a challenge to drive at speed, to say the least.

Shifting

You've probably seen races on television where the commentators talked about drivers shifting 50 or more times per lap. Keep in mind that every time you move from one gear to the next, you have completed a shift. In a race, a professional driver may easily shift more than 50 times per lap - once from First to Second...once from Second to Third...46 times from Third to Fourth and Fourth to Third and back and forth again and again.

For the sake of your transmission, don't try to heel-and-toe downshift during your early track sessions unless you're really familiar with the rather sophisticated shifting maneuver. If this is your first time on a road course, shift into Third gear and leave it there until you're on the long, main straight. Once you have become familiar with driving the correct line on the track, you can then begin to experiment with shifting into other gears.

If you're good at downshifting and are confident you can do it without damaging your gearbox, feel free to do so, but complete your shift before turning the steering wheels into a turn. You should have completed the shift and released the clutch while the car is still travelling in a straight line. This allows the weight to transfer back to the rear tires and settles down the suspension before you turn the steering wheel and add turning forces to the cornering equation. Completing the shift while the car is still travelling in a straight line also allows you to get both hands back on the steering wheel before beginning the turning action.

The longer you wait before completing the downshift and the deeper into the corner you push the car before selecting a lower gear, the more you increase your

chances of overrevving your engine. Overrevving an engine can lead to bent valves and very expensive repair bills - still one more reason to leave the downshifting to experienced drivers.

What Do We Expect From YOU ? Hopefully, We Hope You'll Have Fun

When you first roll out on the track, the co-ordination of speed, driving line, shifting and braking can almost seem overwhelming. The only word of advice we can give you is - "Take a deep breath, relax and enjoy this weekend." No one really expects you to come away from this weekend an expert performance driver. If you try too hard, the main thing you will accomplish this weekend is building up a great deal of anger at your car and yourself.

No one - NO ONE - expects you to be the 'Master' of your vehicle on the first try. By the end of your first session, we would like you to be able to identify the fastest line through the corners and hopefully begin to consistently steer your car on that line. Speed is not important at this time. In fact, it may be counterproductive. Our goal in the first session is to familiarize you with what it looks and feels like to drive through each turn correctly. Speed really doesn't matter - believe me, you're not going to impress your instructor. (You may be able to scare the daylights out of him/her, but please don't try - You'll scare the daylights out of yourself, as well.) Our goal is to help you establish a smooth driving style which is a complex combination of driving the fastest line, braking properly and accelerating smoothly and boldly. During the first session, drive at the speed that allows you to smoothly drive the "line" at all times. Don't pay any attention to the speedometer. Speed is not important at this time - developing a smooth driving style is. As you become more accustomed to performance driving, the speed will come naturally.

Relax and Have Fun !!

Any time you push your vehicle near the edge of the performance envelope, you're dabbling in some pretty serious territory, but one of the biggest mistakes you can make this weekend is to take it all too seriously. Relax - don't tense up. Listen to your instructor and follow his/her instructions. Stay alert, and drive calmly.

As crazy as this may sound, be sure not to hold your breath. Sometimes you may be concentrating so hard on all the details of driving that you may forget to breathe. Your chest will tighten, and you're first thoughts will be that you're having a heart attack. That's when you're taking this all too seriously. Breathe deeply - think - relax and enjoy the experience of performance driving. You'll learn a lot more, and this weekend will be a much, much more enjoyable experience.

A Few Added Suggestions: When Things Start Going Awry

Up to this time, we've concentrated on the techniques that will allow you to push your vehicle to the outer edges of the performance envelope. But every time you push near the edge, there comes a time when it becomes very possible that you might push over the edge. When the car goes over the edge, there's no need to sit back as a passenger on a wild ride out in the weeds. You can still bring your vehicle back under control before it collects a guard rail or tire wall.

You first need to recognize the first signs of your vehicle going out of control. As you gain more experience in performance driving, you will be able to detect these conditions very early and take action to retain control - such as very, very slowly backing out of the accelerator or adding a small amount of steering correction or power to retain control. The key is in judging the amount of action to take. Don't correct the problem before it become a problem, but when it does become a problem, you must be prepared to act immediately to regain control of your vehicle. And don't overreact.

When It Goes Away - BIG TIME

Ideally, you will never experience a big time loss of vehicle control. But when you push things near the edge, be prepared for things to happen - like an uncontrolled spin. When it all goes awry, you have to assess the situation and be prepared to act fast.

Unfortunately, there is no one thing you can do that will work every time, but there are recommendations that can be made in various situations.

On Dry Pavement - If your vehicle goes out of control on dry pavement, the word is JUMP IN WITH BOTH FEET - left foot down on the clutch and right foot down on the brakes. This will inevitably lock up the brakes. Yes, I told you earlier to never do that because it might lead to a loss of vehicle control, but since you've already lost control, it can't get that much worse. To paraphrase an old saying, "If it's already broke, you probably aren't going to make it much worse." If the vehicle is on dry pavement, the locked brakes will put the car in a spin that will quickly scrub off the speed on the track surface. Pushing in the clutch will keep the engine running, and it will also disconnect the drive train that wants to continue to power your car forward into more trouble. Once the car stops, you can simply put the transmission in first gear and motor off to an area clear of oncoming traffic where you can allow your heart and bowels to calm down.

On Wet Pavement or Grass - If your vehicle goes out of control on wet pavement or is headed for the grass, GO EASY ON THE BRAKES. Locking the brakes on the wet or on grass will result in a situation very similar to driving on ice. Locked brakes will only compound the problem. On wet pavement or grass, push in the

clutch to disengage the drive and bleed off some of the momentum the engine is adding to the problem. Immediately, begin pumping the brakes to slow the forward momentum while maintaining the ability to steer the vehicle clear of obstacles until the vehicle returns to your control. Of course, if your vehicle is equipped with ABS, retain steady but hard pressure on the brakes, and let the ABS system pulse the brakes to slow the car while retaining steering control.

Keeping Almost from Becoming a Sure Thing

When you are pushing the edge of the performance envelope, your vehicle is apt to do a lot of things that you seldom normally experience. Note, I said normally. Many owners of performance automobiles don't like to take their precious toys out in the slush and salt of winter, but driving on ice and snow lets you experience many of the same feelings you will feel when your vehicle approaches the breaking point on dry pavement.

It is in ice and snow that you are most apt to experience skids and can practice skid control maneuvers. There is one significant difference. The skids are faster and more violent on dry pavement, but the control movements are exactly the same. As you have been told time and time again, you recover from a skid by turning the steering wheel in the direction of the skid - turn the wheels in the direction you want the front of the car to go (a maneuver sometimes referred to as counter-steering.)

Counter-steer only enough to correct the original skid. Too little steering correction is better than too much. If you don't crank in enough counter-steer, your vehicle will slide sideways off the pavement in a broadside slide. This is not exactly what you want to happen, but it is preferable to the alternative. Crank in too much counter-steer at speed and your vehicle will very, very quickly stop the skid and snap into a spin in the opposite direction. Take your choice - sliding off the pavement in a semi-controlled slide or spinning uncontrollably in the opposite direction.

When You "Run Out of Pavement"

There will undoubtedly come a time during your performance driving instruction when you will run out of pavement coming out of a corner - when you will drift right off the outside of a turn. We don't recommend you do this for fun, but you will undoubtedly come out of a corner with a little too much speed and feel your vehicle heading for the edge of the pavement. What now?

Do not - **DO NOT** - suddenly lift off the accelerator. First, make sure you're really going to run off the pavement. Many times, it just looks and feels like you will skid off the track, but often the tires hold on and just drop one or two outside wheels off the pavement or the curbing at the outer edge of the track might catch your side-ways slide. Do not crank in more steering correction. With your car already sliding towards the edge of the pavement, the tires are already near their traction limit. Turning the wheels to righten the radius of the turn will only result in a spin.

When in doubt, Drive it off.

When it appears that your vehicle is headed for the edge of the pavement and you aren't sure if you can hold it on the pavement, it's better to drive your car off the track than let it skid or spin off uncontrollably. As the car slides over towards the edge of the pavement, don't turn the wheel until you're sure that you have control of the car. Gradually back off the accelerator, let the car slip off the edge of the pavement and very gingerly continue to steer the car through the corner. Don't make any quick movements of the steering wheel. By now, you're off the pavement and on the much more slippery grass surface. As long as there are no trees or visible obstacles in your way, continue to steer through the corner. It may feel a little rougher, but your vehicle is just as capable of driving on grass as it is on the pavement. By continuing to steer around the corner even when it is off the pavement, you are simply increasing the radius of the turn which will often allow you to regain control of the vehicle. Gradually let off the accelerator, and when the vehicle has slowed, gently steer back onto the pavement.

If you are speeding towards a corner and don't think you'll be able to make the turn, **don't even try.** The wise move is to continue braking and steering straight ahead - right off the pavement if necessary. Your vehicle will continue to slow and you will, for the most part, still be in control of the vehicle. When it has slowed enough to safely negotiate the turn, you can then turn the vehicle and gradually rejoin the pavement a little further down the course. Although you may have run off course, it is a whole lot smarter, safer and cheaper than losing control of your vehicle in a corner and hitting a retaining wall. Your ego may be bruised, but your car and your wallet are not.

"When should I step on the brakes?"

I don't mean to sound like a wise guy, but the truth is "You know as well as I do." Your braking point when entering a turn depends on your driving ability, your car, the maintenance condition of your car, the brand and condition of your tires, the condition of the driving surface and more. The best we can do is give you a few hints on how to find your braking point. Select some pavement mark on or near the track at the entrance of a turn (a patch in the pavement, a puddle alongside the course, etc.) When you get to that point, step on the brakes. If you can stop before you get to the point where you begin to turn into the corner, you need to pick a braking point closer to the corner until your car is moving at your desired speed when you reach the turn-in point.

The ideal braking point is one which allows you to slow your vehicle just enough to negotiate the turn on the proper line and permits the earliest possible application of power to accelerate out of the corner.

Your braking point will vary as you improve your driving technique and as pavement conditions change. As you become more familiar with performance driving, you may find that you're entering the corner faster than when you selected your

original braking point. That extra speed may require you to move your braking point earlier before the turn. But as you become more familiar with performance driving, you may be able to negotiate the turn quicker and may be able to actually move your braking point closer to the corner. The decision will have to be yours. Your braking point will vary as the track surface gets warmer, as dirt or gravel is kicked up on the pavement or as oil or coolant is spilled on the pavement. When racers take to the track, they select their braking points immediately and are then constantly adjusting them as the track conditions and condition of their tires change. It's a never-ending activity.

Wet and Wild

If we are unfortunate enough to suffer a wet weekend, you may just learn more about your vehicle than you want. Driving on slippery, wet pavement requires 10 times more attention to smooth driving style than practicing on dry pavement.

On a wet track, your vehicle will have considerably less acceleration and braking capabilities than in the dry. It will also be considerably less capable of cornering at speed. On wet pavement, it is estimated that you will have only about 70 percent of the dry acceleration traction you have on dry pavement, but less than half the braking ability. The real trick comes in cornering. A wet track offers less than 20 percent the cornering traction you have available on dry pavement. It doesn't take a lot of imagination to realize that wet conditions require a considerable decrease in speed. If the pavement becomes extremely wet and slippery, it is best to slowly motor through the turns and delay applying power until the car is once again headed in a straight line on the other side of the corner.

On a race track such as Gateway International, the fastest driving line in the dry may turn out to be the slowest, most slippery line in the wet. All year long, race cars are powering over the dry line, depositing rubber, oil and coolant on the 'line'. When it rains, the rubber and oil float to the surface and then ride on top of the water. If it becomes extremely slippery, it might be a good idea to avoid the fastest line, and drive around the outside edges of the turns. The outer edges are seldom used in racing conditions and are most likely to be the cleanest in rainy weather. But you will undoubtedly have to cross the 'line' several times each lap, and that line will be extremely slippery. Exercise **extreme** care.

Also listen to the chief instructor concerning the condition of the track shoulders. If the track shoulders are very soft due to recent heavy rains, the chief instructor will warn you to exercise extreme caution when not on the track surface. The majority of vehicle roll-overs occur when the shoulder is soft. Out-of-control vehicles slide off the pavement, and one or more of the wheels sink into the soft shoulder alongside the pavement. If the vehicle still has quite a bit of momentum, that force will have to go somewhere. Often, the force causes the vehicle to pivot around the wheel or

wheels that have sunken into the soft shoulder, and the vehicle rolls over onto it's top. If you feel you can not negotiate a turn and could possibly wind up skidding off onto the soft shoulder, don't even try to turn. Steer straight ahead into the mud and slowly brake to a stop. The straight ahead movement will cause your vehicle to plow into the mud, rapidly slowing it to a stop. You may be stuck, but you'll still be on all four wheels. We have vehicles that can pull you out of the mud. A little water and elbow grease to remove the mud is a lot less costly and less painful than bodywork, new windows and new paint.

Driving in the wet is unquestionably the best way to work on your smooth driving technique, but it is also the most tiring and least forgiving - read that 'very expensive' if you make a mistake.

A Word for Front-Wheel Drive Fans

Many of our everyday drives are now front-wheel drive. If you have brought one of those vehicles for practice at the driver's educational event, there is one more driving technique which may come in helpful. In fact, some performance drivers say it is important for every performance driver to master. I can tell you from experience it also comes in handy when driving mid-engine cars such as with the Cayman, Boxster or 914. I'm talking about the technique called "trail braking".

Time and again in this booklet, we noted the importance of braking in a straight line before a corner and entering the corner with your foot off the brake pedal and on the accelerator. Well, it's time to contradict ourselves with trail braking.

With trail braking, you brake up to the entrance of the corner just as you would normally. But instead of removing your foot from the brake entirely when you reach the turn-in point, you continue to apply a slight pressure on the brakes. This is a very delicate maneuver - too much braking could cause the vehicle to spin. As you turn the steering wheel to enter the turn, you must gradually let up on the pressure on the brake pedal to allow the front wheels to roll more freely and bite into the pavement. At the same time, you should be increasing the pressure on the accelerator to transfer weight back onto the rear drive wheel to increase traction. As you can see, I've just said your foot should be on the brake and accelerator both. That indicates you should be using your left foot on the brake while your right is on the accelerator. This takes some real practice to get right.

By maintaining some pressure on the brake pedal, you slow the natural transfer of weight back over the rear wheels and keep some of the weight on the front to improve turn-in performance. Maintaining some pressure on the brakes keeps some of the weight focused on the front drive/steering wheels for better traction and better turning performance. This means there will be less weight on the rear wheels, but in front-wheel drive or nearly balanced mid-engine vehicles, the weight is better used on the front wheels or in the middle of the vehicle near the car's center of gravity. As the vehicle is turned into the corner, the rear of the vehicle begins a slightly

faster rotation towards the outside of the corner because there is less weight on the rear end of the vehicle. As soon as the nose of the car is pointed towards the apex, power is applied to transfer weight onto the rear wheels to stop the rotation of the rear end and to begin the acceleration out of the corner. If you are a little late in applying the power, the back end of the car may keep coming around and you end up spinning out into the weeds.

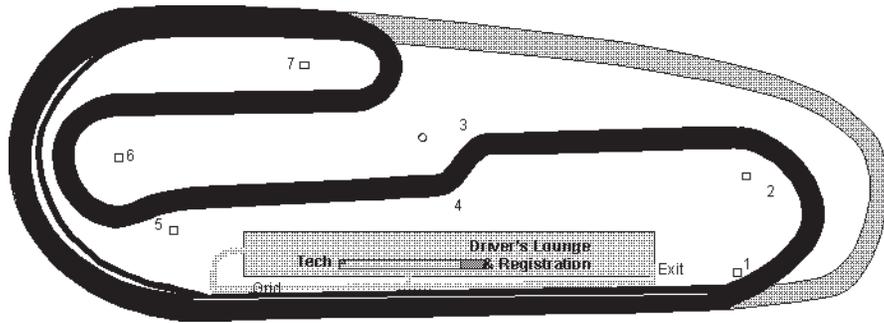
This maneuver takes quite a bit of practice, and is quite different from anything you may learn this weekend. It requires an extraordinarily smooth style. With trail braking, you are actually using the brakes to 'throw' the back end of the car around, and you have to 'catch' it before it goes too far. Needless to say, it takes a great deal of practice. Trail braking is clearly only for the more experienced driver.

Have A Good Time !

We don't expect you to understand everything in this booklet, and we don't expect you to be able to perform everything discussed here. We only ask that you seriously analyze the way you drive to find the areas where you could use some improvement. And then using either the ideas found in this booklet, in the wisdom of your driving instructor, or in the experiments you conduct while you are behind the wheel on the road course, you make some headways into improving your driving skills, and thereby, your enjoyment of our very special automobiles. We hope you have a very enjoyable and very educational weekend. Now, GO FOR IT !!

Putting What You Have Learned to Work at Gateway International Raceway

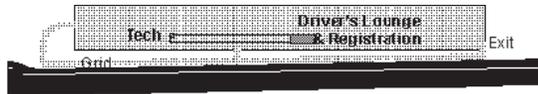
Let's take a few moments to try to apply the lessons discussed in this booklet into work at the remarkable Gateway International Raceway facility. Gateway is as close to a state-of-the-art motorsports facility as you'll find in most parts of the nation. So let's take a closer look at what you'll see at GIR.



Getting on the track:

When your instructional group is called to the Grid, you will be asked to bring your car to the area behind the professional pit wall along the Start/Finish straight. Here the cars in your group will be assembled and held until the last of the previous group have cleared the track. As soon as the track is 'clean and green', your group will be ushered onto the track, so please do not delay in making your way to the Grid as soon as your group is called.

To get to the Grid, drive past the garage complex towards the northern banked turn. Directly ahead at the northern end of the asphalt paddock area is a road to the paved pit service

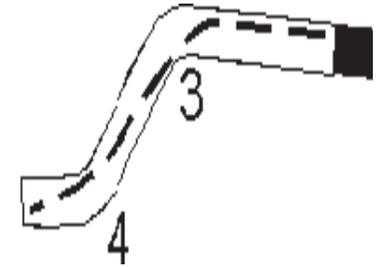


area. Follow the turn to the back of the pits and form a line behind the other cars in your group. When the track is cleared of all cars from the previous group, you will be waved through the center gate in the pit wall to proceed down the pit lane to the pit exit to the track. An orange gloved worker will be at the end of the pit wall to direct you onto the track. If you are waved onto the track, stay on the left of the painted line separating the hot track from the pit acceleration lane. If the track is free of oncoming traffic, you are free to turn onto the track once you have passed the end of the painted line.

If other fast traffic is on the track when you exit the pit, stay on the left side of the track until you are through turn 2. Then, when traffic allows, steer to the right edge of the pavement and prepare your entry into the turn 3 - 4 complex.

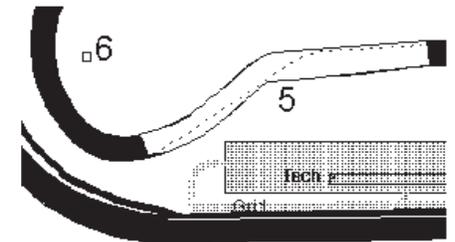
Turns 3 & 4

Turns 3 and 4 are one of the linked turn complexes discussed earlier in this booklet. Like the turns mentioned in the booklet, turns 3 & 4 can not really be driven as you would normally drive a turn because it would put your car in such bad track position that you could not possibly complete turn 4 without running off the pavement. You need to delay your turn in to turn 3 a little later than usual. Many drivers prefer to use the point where the entry road crosses the road course as their turn-in point, and hold the car in the center of the track for the exit of 3 to make your entry into turn 4 immediately thereafter. Here again, your apex will be late but you can allow the car to power out to the left edge of the pavement. From there you can gradually cross the pavement to the right side of the track for your entry to turn 5.



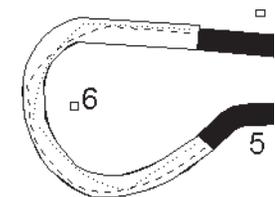
Turn 5

Turn 5 is a fairly normal turn although the speed you will achieve coming up from turn 4 will make it seem much tighter and more challenging than it need be. You don't have a lot of time to get back across to the right side of the pavement to set up for turn 5. If you carry a great deal of speed out of 4, you may not be able to make it all the way to the right edge of the pavement. It is possible and is actually preferred that you enter turn 5 from the center of the track to successfully complete the turn without too much loss of speed.



Turn 6

Turn six is one of those dreaded decreasing radius turns which requires a decision as outlined in this booklet - to very late apex or double apex. The decision will depend on your car, it's weight and power. If your car is light and capable of fast acceleration, a double apex could work, but heavy cars with cold tires on a cold track may best opt for the very late apex.



To very late apex turn 6, hold the left edge of the corner well passed the three-quarter distance of the turn. Trail-braking can help transfer weight back on the rear suspension and tires and still keep enough weight on the front to assist in the fast turn-in. Your very late apex will carry your car well out to the left edge of the pavement. Puddles along the track where cars commonly drop a wheel off are a good indication if you are apexing and accelerating early enough. Ideally, you will want to drift out to the left edge of the track just where the curbing comes to an end.

You do have the option to double apex turn 6, but I recommend you let double apexing to later in the session when your tires and the track are warm and sticky. And you may not want to attempt a double apex if your car is down on power and slow to accelerate.

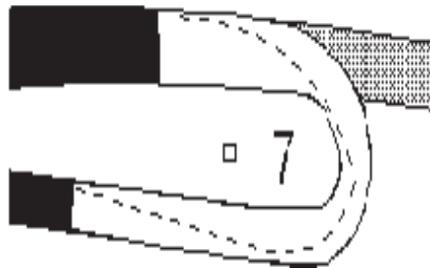
Turn 6 is important because you surely want to carry as much speed as possible out of the turn. If you're carrying the proper speed into turn 7, the turn will come up so fast, it might catch you unaware. Don't get caught napping.

Turn 7

Turn 7 is a tight hairpin of slightly more than 180 degrees. After exiting turn 6, quickly steer to the right edge of the pavement and prepare for a late apex in 7.

Be careful not to apex too late or the centrifugal force will carry your car out against the concrete wall on the outside of the oval. You want to come as close to the wall as possible. During the driver's educational event, you will be allowed to pass on the back straight and banking, but we will require that you pass only on the driver's left.

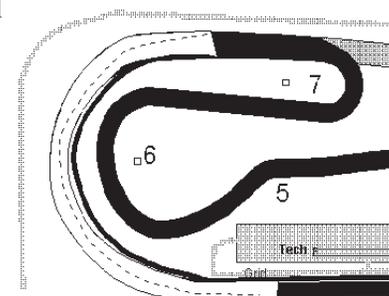
The reason for the restricted passing is that it is extremely easy to clip the wall when passing on the right. Check your mirror when approaching turn 7 to see if faster cars are wanting to pass. If they are, complete turn 7 and then slowly steer towards the wall to allow the faster cars to pass on your left. That way you, the slower car, will be more likely to be able to approach the wall without centrifugal force carrying you into the concrete.



Banking

The traditional line for banking would have you speeding from your natural exit of turn 7 up against the wall and slowly steering down to the lower, innermost lane about half way through the banking before allowing the forces to carry your car out to the wall at the exit of the banking. But in most cases except in the heaviest and fastest vehicles, there really is no need to drop much below the second lane. Let the lower (first lane against the grassy apron) lane to the faster cars.

The banking is one place at GIR that you will eventually have to get used to the idea of steering towards the concrete wall at speed. The faster you exit the banking onto the Start/ Finish straight, the more centrifugal force will push the back of your car out towards the outside wall. The faster you exit the banking, the more you will have to steer towards the wall to counteract the forces swinging the back of your car towards the wall. A number of accidents have happened when drivers attempted to hold their car away from the wall. In most cases, the back of the cars crept out towards the wall as the drivers attempted to hold the car low on the banking. The back end of the cars break loose, sending the back of the cars into the wall and often then shooting the cars across the track to impact the inside wall as well - a very expensive proposition. The answer - learn to catch the back end by steering towards the wall. Once you get used to it, it's not as scary as you think.



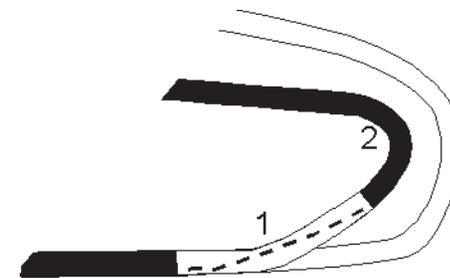
The Straight

The Start / Finish straight is the one area on the GIR road course that you can somewhat relax, but you have to do it quickly because you'll be rocketing down the track rather fast. Here is where you check the gauges, wiggle your fingers, check your mirrors and set up for Turn 1.

Turn 1

As you approach the end of the Start / Finish Straight, you'll want to work your way up to the outside wall to set up for your entry into turn 1. Turn 1 is a very fast corner, which can easily unnerve beginning drivers. Just keep one thing in mind... **USE THE OVAL TRACK AS AN ESCAPE ROAD.** If you have any doubts about your ability to negotiate the turn, just keep going straight ahead on the oval, gradually letting off the accelerator and bringing your car back under control. You can always turn around on the oval and back-track to turn 1 to rejoin the course.

Turn 1 is a text book corner. You go from the outside wall, dive down across the banking, apex near the end of pit wall, and allow the car to drift out to the right edge of the pavement. For the smoothest, fastest line through turn 1, you need to turn-in early enough to just miss clipping the end of the concrete pit wall. As you move further out in turn 1, the oval track banking increases, making the transition from



from banked oval to flat road course more difficult. If you apex at the end of the concrete wall, the turn will be relatively smooth, but if you allow your car to drift out into the center or outer edge of turn 1, you will feel a sharp bump as your car passes from the increasingly banked oval to the flat road course. The bump not only upsets your concentration, it also destabilizes your car's suspension, making the turning and braking maneuver more difficult.

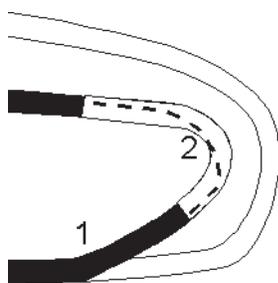
Also, keep an eye out for slower cars exiting the pits and entering the road course. They should give you the right-of-way, but as always, don't bet your life or your car on it.

Turn 2

Turn 2 is also a rather simple corner, made more complicated by the fact that you'll be bearing down on the turn at tremendous speed. Your major concern in your entry to turn 2 will be to brake down to a

controllable speed for entry into the turn. From the right edge of the pavement, late apex the corner, and allow the car to exit the corner by drifting to the right edge of the pavement. You don't want to slow down too much, because the straight between 2 and the 3 / 4 complex is the second longest

straight on the track, so it's crucial to carry as much speed onto the straight as possible. Once again, watch for slower traffic exiting the pits, accelerating to speed and entering the traffic flow.



And now you can continue on your full speed lap of Gateway International.

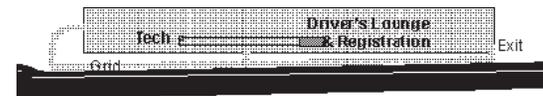
Exiting the Track

After your session is over, you will exit the track through the pit entrance along the back straight after turn 7. **When you are ready to exit the track, complete turn 7 and indicate to the other drivers that you intend to enter the pit lane by raising your hand outside the driver's window. Push your hand or fist straight up to indicate you intend to enter the pits.**

Steer to the left side of the back straight, and cross the line that lead to the narrow pit entrance that runs inside the north banking. Allow the car to naturally slow and cool. Drive through the pits at reduced speed.

The exit to the paddock is at the south end of the pits just short of the entrance to the road course. Slowly motor past the Grid...passed the Start / Finish opening in the

pit wall and indicate to the marshal at the end of the pit that you wish to enter the paddock by pointing towards the infield area. The pit marshall will point you to the opening of the paddock drive at the south end of the asphalt paved paddock. Please continue to slowly motor to your paddock parking area.



The best line through the corners will vary with your car, your tires and your abilities. Please listen to your instructor for his / her input. He / She will be more familiar with your car and your ability than I. Please don't be afraid to ask questions, and ask for help whenever you feel you need it.

As the weekend progresses and your instructor clears you to practice on the track alone and you become more confident about your abilities to negotiate GIR quickly and safely, you might want to consider asking another instructor to ride with you to critique your driving style. Or you might want to ask another instructor if you can ride with them during one of the instructor drive sessions. Every driver has his / her own ideas about how to speed around GIR. You might be able to pick up some valuable tips or pointers from another instructor - tips which your assigned instructor might have forgotten to share with you or which your instructor might not know. You have come to this driver's education event to learn all that you can about high performance driving, and there is no better way than to gather as much wisdom from as many different instructors as you can. You paid your money - you might as well get as much value from it as you can.

Thanks for coming to Gateway International. We hope you have enjoyed our facility, and we hope you will come back to join us in the future...perhaps for a PCA Club race or future driver's education event. Hope to see you again soon.