Rennsport Region PCA Advanced Driver Training Program Manual©

Introduction

RSR Advanced Driver Training Philosophy

- Driver Education Weekends are about increasing driving knowledge, and improving skills and techniques through exposure, instruction and practice.

- They are NOT about learning to be race drivers, providing opportunities for timed laps, or the encouragement of speed for the sake of competition.

- The objective of the program is to increase your knowledge and understanding of the physics of driving and to provide an opportunity to apply this knowledge through many hours of structured practice.

- Participants, organizers, workers, and instructors should have the opportunity to enjoy this experience while interacting with one another in such a manner that mutual respect, and common sense is understood and exercised.

INDEX

CONTENTS **Page No.**

SECTION 1 -THE PROGRAM

Rennsport Driver's Education begins with Ground School. Normally held in the spring, ground school covers the theory behind car control. Normally the classroom section is followed by a practical session on a skid-pad. Ground School is highly recommended since it prepares you for the application of theory and technique at the track. Further, in case of limited availability of space at events, preference will be given to ground school attendees.

Advanced driving techniques cannot be taught safely on streets or highways. For this reason, Rennsport Driver's Education Weekends (DEW for short) are held on closed course facilities normally reserved for racing. Rennsport's home track is the beautiful Circuit Mont-Tremblant although events are sometimes held at other locations.

You will learn and practice advanced driving skills on the racetrack. To start you'll be accompanied by A Rennsport Instructor. These men and women are chosen for their experience, skills, good humor and patience. They are volunteers who gladly share their knowledge with willing participants. We ask that you accord them the respect that they are entitled too.

Until you are ready for sign-off to drive solo, your instructor will be your teacher, mentor and friend. Many ask how many sessions it takes to be "signed-off". There is no hard and fast rule. You will be learning advanced techniques that no amount of street driving can prepare you for. Different people learn at different rates and it is not unusual to spend as many as six weekends in the company of an instructor. Don't consider this to be a hardship! You will be enjoying the experience

immensely. Driving your Porsche as it was intended is fun, and exciting to the point of being addictive.

Your development does not end when you are signed off to drive on your own. Depending on your personal goals, Rennsport Driver's Education is designed to further your driving skills as you gain experience and finesse. From time to time, an instructor may ask to ride with you. This is a great opportunity to ask questions, get hints or, even ask for additional training. Nothing pleases an instructor more than to have one of his "graduates" ask for additional training after building up some experience. Sometimes, a check ride will lead to a promotion to a higher run group. These promotions are not mandatory, if you aren't comfortable in the new group, don't be intimidated, just ask to return to where you were more at ease.

RUN GROUP MENTORS

Each run group has one or more "mentors". Their role is to ensure that the entire run group functions correctly, manage promotions to higher run groups and when necessary, correct problems. Your mentor conducts the pre-track briefing and encourages social contacts amongst the group. Driver's Ed Weekends are not only about cars and driving, they are wonderful social occasions as well.

SECTION 2 -THE FIRST DAY AT THE TRACK

Be at the track on time. You'll have to register, get your bracelet and have your car inspected in the "tech line". The tech line supervisor will give you the tech sticker as well as the colored dot corresponding to the your run group. For a beginner it will be a green dot, which you should affix to your windshield at the top

of the glass in the middle. The tech sticker is attached to the rear passenger side window of your car.

Before going to the tech line, remove all lose objects from the interior and trunk. You will experience enough "G" force to cause loose objects to slide around which can either distract you at an inopportune moment or, cause damage to your bodywork. If you have floor mats which are not securely attached to the floor of the car with screws or snaps, remove them to prevent them interfering with your pedals. Attach your numbers whether they are magnetic or tape. Please have all this done before entering the tech line. On busy weekends the inspectors will have to examine as many as 150 cars. Any delay can prevent the event from starting on time.

Proper attire is required to be on the track. Laces up shoes, long sleeved shirt and pants (cotton is preferred) and of course an approved helmet. Please be correctly dressed by the time your car is in the staging area just prior to going on track.

You will be called to a Driver's Meeting where the basic event rules are covered. You'll get to meet your assigned instructor right afterwards. Immediately following the general meeting, you'll attend a run group specific meeting which will address issues of particular importance to you.

Driver's Education is not racing. Timing is not permitted and is grounds for expulsion. Participants are organized into run groups of roughly equivalent cars and drivers. Within a run group there are always some cars and drivers who are faster than others. Passing is permitted but only in certain designated (safe) areas and only when the car in front signals that it is prepared to be passed. Your

instructor will cover these procedures in detail.

SAFETY IS THE MOST IMPORTANT ISSUE

Your instructor will work very hard to provide you with a fun and rewarding learning experience. His or her prime concern will be safety, yours and that of other participants! It is important to follow your instructor's directives promptly and without question. Feel free to ask why after the session is over and you are safely parked in the paddock. Failure to properly comply with your instructor's directions may result in expulsion from the event.

INSTRUCTOR COMPATIBILITY

Whenever possible, you will be assigned an instructor who has considerable experience in a car like your own. As a group, Rennsport instructors are convivial, likable people. If for any reason you find yourself uncomfortable with your instructor, ask to see the Chief Instructor (you will meet the CI at the driver's meeting) and ask for a replacement instructor. Rennsport will do it's best to find someone more compatible.

SECTION 3 - RESPONSIBILITY

Be aware that neither Le Circuit-Mont Tremblant nor the Rennsport Region of the Porsche Club of America provides you with insurance to cover losses to your person, to your equipment or to any part of the track and its facilities that you cause to be damaged. Be aware that your personal automobile insurance policy may not cover damages sustained during this event. You are personally responsible for all liabilities that you may incur as a result of participating in

this event. Be aware that you have signed a waiver that releases your Rennsport instructor(s) and the Directors and Executive members of the Rennsport Region from all liabilities that may result from your participation in this event. Be aware that you are solely responsible for your safety and for your actions during this event.

SECTION 4 - WHAT TO EXPECT

While all the instructors have gone through training, there are variations in teaching experience and style. Don't assume and don't feel that any of your questions are inappropriate or trivial. Ask lots of questions on and off the track.

The instructor(s) will not push you to speeds that you don't feel comfortable with. Conversely, please don't take your car to a speed that the instructor feels is inappropriate. Please listen and maintain an open mind. The fact that you may have been driving for years doesn't necessarily make you an expert driver.

Your initial driving sessions will be spent learning the layout of the track. After you're familiar with the passing zones, the flagging stations and the various corners, you will begin to learn more about the five basic driving inputs of vision, braking, accelerating, steering, and shifting. These all contribute to weight transfer during the operation of a vehicle and it is this understanding of the physics of driving that is so important to car control and learning to be an expert driver. To facilitate communications between us, we will be using an intercom system that tucks into the side of the helmet.

If you are like most of us when we began, you will probably find these two days rather draining. You are under the eye of an instructor, you're wearing a hot, confining helmet, you're trying to concentrate and master quite a few new ideas, and everything seems to happen at once. Relax during your rest sessions and drink lots of liquid. At Tremblant, there is a washroom under the tower that you can use while you're in staging. There are also toilets in the green building near the restaurant.

Be sure your car is up to operating temperature and has adequate fuel before we go out on the track. It is rather annoying when a car runs out of gas and we have to stop the event in order to retrieve the vehicle.

Open both windows completely, even if it is raining. Close the sunroof. Check your seat set-up for the proper arm length. As you drive around the circuit, look for the flag stations. Make a mental note of any activity. Obey the signal flags without fail. Check your temperature gauge and your oil pressure gauge on the back straight, after you have checked your mirrors for faster cars. We have very strict rules related to passing and I will be helping you with your mirrors and your passing procedures for the first run sessions.

Slow right down on the cool-down laps. Put your arm up as you enter the pits

and park the car without setting the hand brake. Check your oil and water levels.

If you leave the track for lunch, please remember not to consume any alcohol and to return on time. You may be asked to do a volunteer duty during the weekend. Please note the time and location and be there on time so the other volunteers can get to their sessions.

Sounds like lots of regulations? That's true, but the rules have resulted in a long history of successful events that in turn have generated a lot of fun for the participants. Relax and enjoy.

SIGN OFF CRITERIA

You will be signed off to drive the track on your own when:

- Your instructor would be comfortable and secure sharing the track with you.
- You have shown common sense and good judgment with traffic and the selection of appropriate speeds for all situations.
- You are comfortable with the idea of driving alone.
- You are not overconfident.
- You know the line, drive it consistently and are able to situate yourself anywhere on the circuit.
- You are completely aware of the rules and regulations associated with the event. i.e. flags, pit out procedures and track exit practices.
- You can demonstrate smooth, relatively seamless transitions from one driving input to another.
- You show progress towards mastering essential vision skills.
- You demonstrate the need for ongoing skill development and the necessity of seeking out instructors for continuous assistance and refinement.

SECTION 5 – BEFORE STARTING YOUR ENGINE

Before you can drive your car properly, you have to be properly seated with all your controls properly accessible. High performance driving imposes greater demands on you physically than cruising down a boulevard. Your instructor will be checking these things out before you can get onto the track.

SEATING POSITION

Correct seating position is the starting point to good driving. The seat is the direct contact to the car. Drivers have to develop a feel for the signals that the seat is sending through their back and their bottom. As well, more information arriving from the steering wheel, the brake pedal and from the throttle has to be recognized. The driver needs a position such that he/she can both receive and take advantage of these external inputs and sensations.

PROPER SEATING PROCEDURE

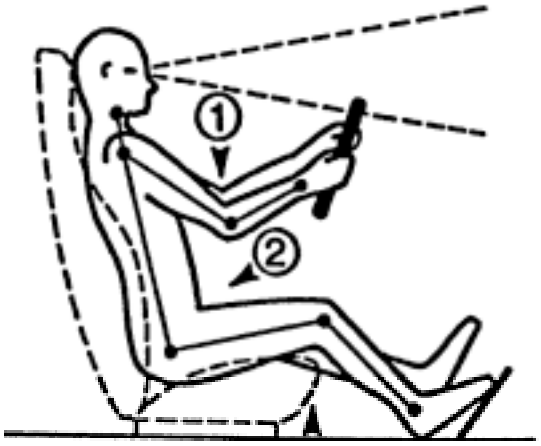


Fig. 1

1. Sit IN the seat, not on it. (Fig. 1) The small of the back should be pushed into the seat.

2. Adjust the seat so that the wrists hang limp over the most distant point on the wheel without leaning forward. The elbows should be slightly bent. Check the reach to the shift lever in the same way.

3. Check the feet. The legs should be able to fully depress the pedals and still have a slight bend in the knees. If the car has power-assisted brakes, do this with the engine running, otherwise the full extension of the brake pedal will not be achieved. Adjust the seat setting and the tilt of the seat back until all this is possible. Keep the seat tilt to the minimum and ensure the seat belt(s) are attached properly.

MIRRORS

Mirrors are useful tools only when they are adjusted properly. The goal is to have all of the mirrors work together to convey an optimum of information. The SAE method suggests that you put your left ear on the driver's side window (up), set the left outside mirror so that you can see a small sliver of bodywork in that mirror. Then bend over and try and get your head into the middle of the car with your head over the transmission tunnel. Try and keep your head far enough back so as to be in line with your normal head position when seated correctly. Adjust the right side mirror to see a sliver of bodywork with your head in the middle of the car.

Your instructor may ask you to slightly readjust the passenger side outside mirror to permit seeing cars approaching from behind.

STEERING WHEEL

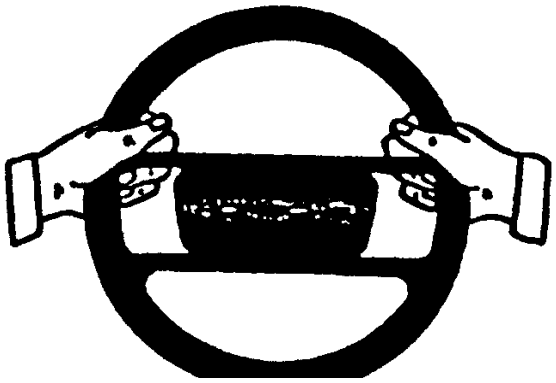


Fig. 2

Use both hands on the steering wheel! This maximizes control in all situations. Note that air bags have been known to go off accidentally and with one hand at the top of the wheel, such an incident could drive the hand into the driver's face. With the elbows bent, the hands should be placed approximately at

3 o'clock and 9 o'clock positions on the steering wheel (Fig. 2). Where possible, the thumbs should be hooked over the spokes of the wheel to allow the steering wheel to be pulled down with the left or right hand and wrist, as opposed to pushing the wheel with the larger, less motor sensitive shoulder muscles.

Correct hand positioning also aids in locating the wheel's position without looking. The wheel should not be held with the palm; it is far less sensitive than the fingers. Small steering corrections should be made with the wrists, not the arms.

If your car has airbags, you may prefer to use a "shuffling" technique which keeps the hands at the 3 and 9 o'clock position even as the wheel is being turned.

SECTION 6 - SMOOTHNESS

"ONE THING TO LEARN IF THE STUDENT CAN ONLY LEARN ONE THING" ***Patrick Bedard***

"IF BALANCE IS THE SINGLE MOST IMPORTANT WORD IN DRIVING, SMOOTHNESS IS A CLOSE SECOND" ***Vic Elford***

"SMOOTHNESS IS MORE THAN JUST AN ASPECT OF TECHNIQUE, IT IS VIRTUALLY A STATE OF MIND" ***Bob Bondurant***

"A DRIVER SHOULD NEVER FEEL THE END OF A CORNER - THE TRANSITION FROM CORNERING TO ACCELERATION SHOULD BE SO SMOOTH AS TO BE IMPERCEPTIBLE" ***Jackie Stewart***

The essence of good driving is high quality driving inputs, timed properly. The car will always follow the driver's lead... even if he/she is wrong. That's what machines do. Machines also follow the laws of physics, following them exactly. The trouble arises when one gives an input that's contrary to physics. In fact, most skids are caused by the driver who inadvertently gave a wrong input, simply because he/she didn't know any better. It is important to recall that an automobile is balanced on only four tire contact patches - four rubber feet, if you will. Any driver input, accelerating, braking, turning, or any combination of these - will change this balance. If the balance is changed too much the car will be tripped up.

For most drivers, this is not new. They know that accelerating too hard produces wheel spin; braking too hard produces lock up; cornering too hard results in a skid. They are usually aware of these limits and try not to exceed them.

What everybody does not know is that changing this balance too abruptly can be just as harmful as changing it too much. This knowledge is the first thing that separates the expert from the ordinary driver. The experts are as careful of balance as a dancer, and the smooth, seamless techniques are at the basis of their car control.

SMOOTHNESS IS NOT OPTIONAL - IT'S ESSENTIAL

(Some material taken from "Expert Driving" by Patrick Bedard)

SECTION 7 - STEERING

"Turning into a corner you must start by moving the steering a very small amount, then increasing the lock progressively.... think of it as a clock face. The first five minutes of the turn are slow and gentle, and then the next ten to fifteen minutes progressively get faster... it's the same thing coming back. Taking off the lock through the first five minutes is relatively gentle, then it speeds up slightly and slows down again in the last five minutes as you are completing the very last sections of the corner." ***Jackie Stewart***

Correct hand positioning will allow a full half turn of the steering wheel without moving the hands or crossing the arms. This will be adequate for most corners while driving a Porsche. If the steering input is greater than this position allows, keep the thumb of one hand on the spoke of the wheel and slide the other around towards it. That way one always knows which way the front wheels are pointed.

As Jackie Stewart was quoted: Turning into a corner, a small amount of steering wheel movement should be encouraged. This allows the car to transfer a portion of its weight to the suspension members on the outside of the turn. This results in a weight gain on the outside tires and a corresponding gain in traction. The weight on the tires on the opposite side will be reduced as well as the traction between those tires and road.

If one turns into a corner too abruptly, this weight transfer doesn't get a chance to happen soon enough. A tire that is asked to steer rapidly in a new direction without an increase in weight and a corresponding increase in its ability to push down on the road will try to continue in the direction that it was last heading and will usually begin to slide. Sliding friction is not as useful as rolling friction when it comes to steering.

As the initial weight transfer happens and the outside tires begin to press into the road, then the rest of the turn can take place. If we think of the wheel as a clock face, the first five minutes of the turn are slower than the next 10 to 15 minutes.

PANIC STEERING

There are two spots in every corner where drivers might attempt panic steering. The first occurs when they are rapidly approaching the turn entrance. The natural tendency is to worry that there isn't enough time to set up the proper

steering arc. They try to get it over with fast, with one big crank on the wheel. As previously discussed this tends to overpower the outside tires and promotes slip. The turn in must be blended so smoothly that, if the driver was to go back and examine the track of the turn, the transition from straight to curve would be so gradual that one couldn't tell where the turn began.

The second panic spot comes part way through the turn, at the instant that the driver decides the path of the car is widening to the extent that he/she feels that there is not enough road left to complete the turn. Once again, the tendency is to crank on more steering as fast as possible. Of course, this just gives the steering tires more responsibility and a greater loss of rolling friction. Smoothness is the answer here, with a smooth, minimal reduction in the throttle setting to reduce the radius of the turn.

OVERSTEER AND UNDERSTEER

Oversteer: A car OVERSTEERS when the rear wheels have less cornering ability. The rear of the car is beginning to slide out and the front is beginning to turn into the corner excessively. If this continues the car will soon facing the traffic that was behind it a few seconds ago.

To correct oversteer the following action is suggested:

- Gently apply a small increase in throttle to transfer weight to the rear tires and turn out into the direction of the sliding rear end. Be sure not to press heavily on the gas as this may provoke more wheel spin and a further loss of traction.

Understeer: A car UNDERSTEERS when the front tires are losing traction and the car is not turning into the corner as much as it should.

To correct understeer the following actions are suggested:

- Gently reduce the throttle application to transfer weight to the front thereby increase traction on the steering tires. Don't do this abruptly; the sudden weight

transfer to the front will cause a skid or a spin.

- Slightly and smoothly lessen the amount of steering input (turn less) to reduce the slip angle on the front tires and regain directional control

SECTION 8 - SHIFTING

"GEARS ARE FOR ACCELERATION - BRAKES ARE MADE TO STOP THE CAR. " ***Jackie Stewart***

Braking always precedes shifting when approaching a corner that will require a gearshift. Downshifting and using the engine's compression to brake a modern car is not the way to do it. Remember that brakes are much cheaper to replace than a transmission and clutch and much more efficient in slowing a vehicle's pace and in dissipating the resulting heat.

Speed shifting or slam shifting a synchromesh gearbox is not necessary and hard on the shifting mechanism. Pause in neutral. Ensure that the clutch pedal is ALL the way in before moving to the next gear.

Important! If your right hand is not shifting, it should be steering. THE RIGHT HAND SHOULDN'T REST ON THE GEAR LEVER

THE DOWNSHIFT - HEEL AND TOE

While we don't recommend teaching the technique known as "heel and toe downshifting" on the track, during our DE events, we would like you to set up your car and learn to perform this maneuver away from the event.

The term "heel and toe" is left over from the days when the throttle pedal was in the middle. In recent times, since the throttle was repositioned on the right, everyone downshifts by simply moving the shift lever in neutral while pressing in the clutch pedal, pivoting the ankle so as to "blip" the throttle with the side of the right food while maintaining optimum brake modulation. Just a microsecond after blipping, one moves the lever into the slot for the next lower gear and simultaneously releases the clutch. (See Fig. 4) So why is this necessary?

To maintain balance, a car should be in the correct gear PRIOR to entering a corner. Big sweeping corners, and even fast, tighter corners can usually be taken in the existing gear before you turn in. Naturally, this should be done at the same time that braking is taking place. This presents a problem. If you are braking AND shifting, your right foot is on the brake and the left is on the clutch. Since no appendage is left to press the throttle, the engine's RPM drops and when the clutch is reengaged, a large braking effort or sudden drag is caused by the drive wheels

trying to re-accelerate the engine. This unbalances the car, can cause the rear wheels to exceed their traction limit and precipitate a skid.

The "blipping" of the throttle, if it is done perfectly, should eliminate the sudden drag. If the car jumps forward, then you applied too much "blip" and the resultant RPM gain was too much. If there is drag, then you did not "blip" the throttle enough and rear wheels have to re-accelerate the engine. When learning this skill, that it is crucial to maintain a constant pressure on the brake pedal during the heel and toe operation.

This is a basic skill for smooth driving and will be very useful for everyday driving as well, especially during winter months when northern roads can be very slippery. Heel and toe also greatly reduces stress on the drive train and adds to its longevity.

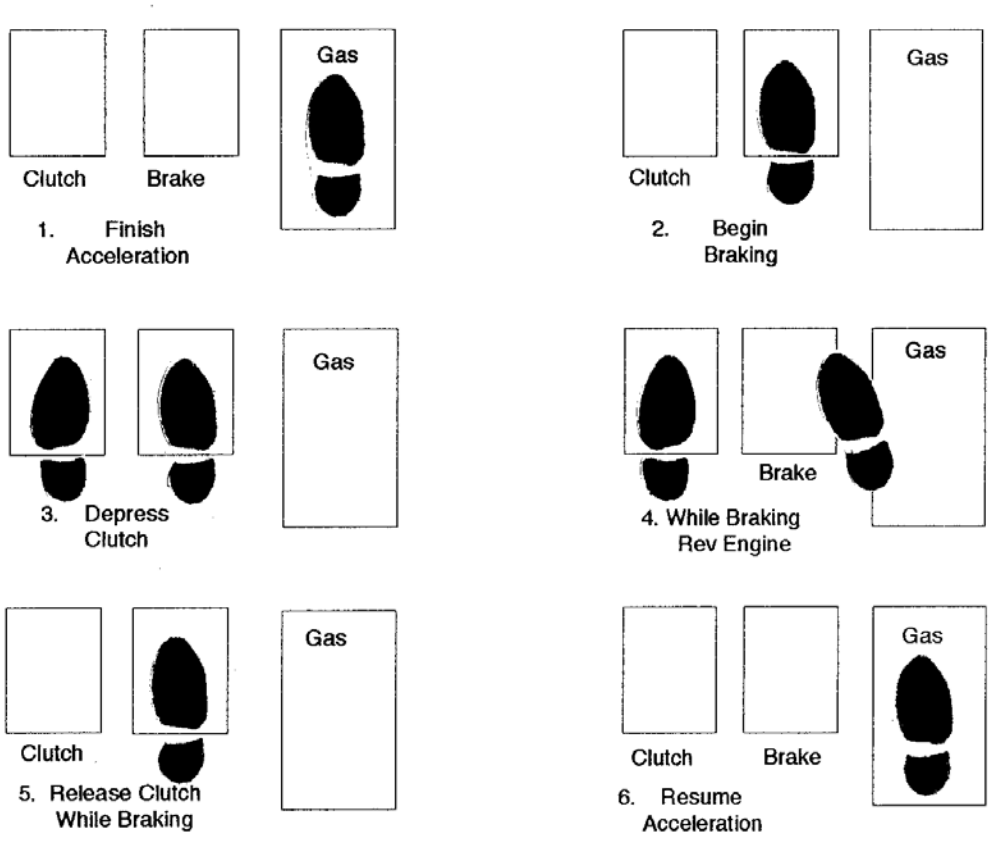


Fig. 4

SECTION 9 - THROTTLE CONTROL

"...there is no question of immediately taking your foot right of the throttle in one sudden movement... you should release the throttle gently, to the point where you are not really aware of the car slowing down. The throttle application should be a gentle progressive pressure." ***Jackie Stewart"***

Whenever you apply or reduce power, you must do so with a smooth transition. One should release or engage the throttle gently, to the point where the passenger is not thrown forward or backward in the seat. When the optimum speed has been set in a straight line, to negotiate any particular corner, speed is consistently maintained with throttle control. This is also known as balancing or feathering the throttle. Taking throttle off, results in a shift of weight from the back of the car to the front and corresponding changes in the tires' contact patches. (See Fig. 5) Applying throttle does the same thing, but in an opposite direction. (See Fig. 6)

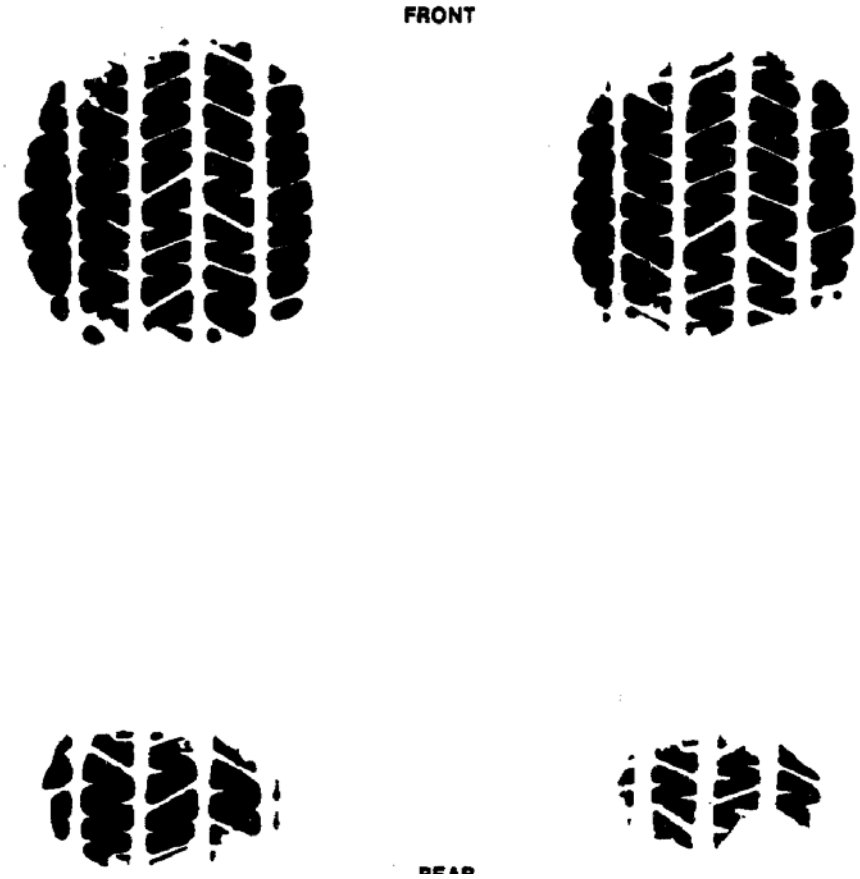


Fig. 5

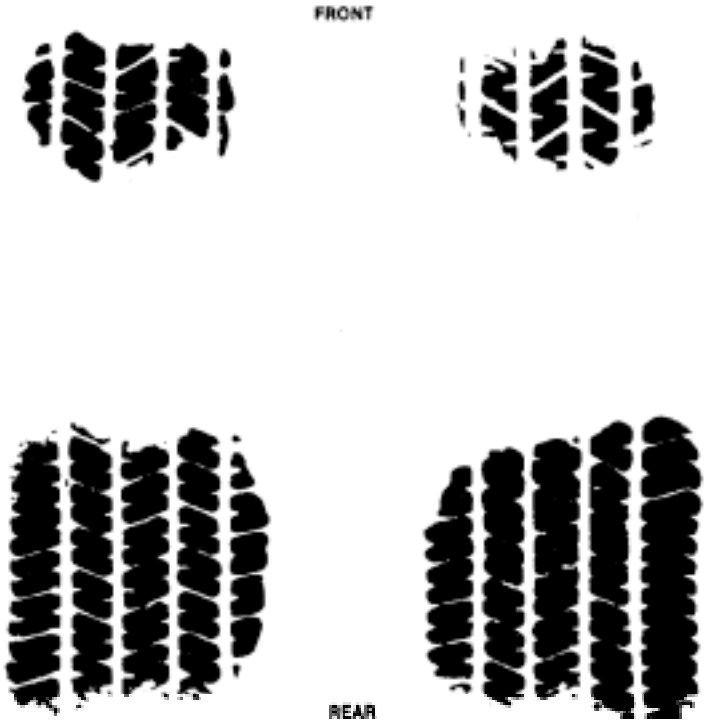


Fig. 6

The steering wheel and the throttle work cooperatively together for expert drivers. Generally speaking, the more steering input that a car is receiving, the less the throttle pedal is used. Conversely, as the steering wheel unwinds from a turn and the car begins to finish a curve, more power can be applied through the throttle pedal. The tires can only do one task at 100% capacity. They cannot handle full acceleration if they are being asked to steer into a corner.

Tip:

Imagine a string tied between your big toe and the bottom of the steering wheel. With the steering wheel pointing the tires straight ahead the string allows the foot to press down on the throttle or the brake. As the wheel turns into a corner, full throttle or full braking is no longer possible due the foot being moved away from the pedal by the string attached to the rotating steering wheel. Imagine that the more the wheel is straightened out, the closer the foot can get to the gas to increase the speed of the car. The reverse is also true. (Fig. 7)

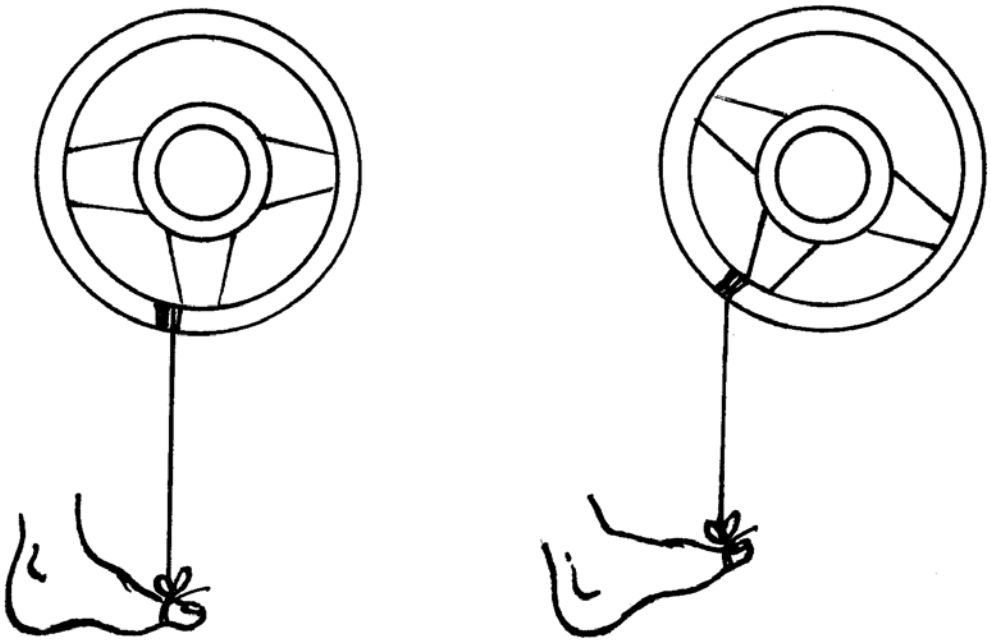


Fig. 7

ACCELERATION

"The craftsman doesn't hammer the gas, nor lift off the gas. He must progressively apply the power, then gently withdraw it." ***Patrick Bedard***

When starting from rest, gently engage the clutch and increase engine RPM. As soon as the car is rolling, smoothly engage the clutch fully before applying any serious power. This will greatly reduce the strain on the drive train components.

Accelerate smoothly. The faster the car is going, the more power that can be applied to it. In a corner, throttle application is relatively constant from the turn in point to the apex. Minute, subtle adjustments to the throttle are made to maintain a constant speed against the loss of momentum from the cornering forces.

From the apex point, throttle is applied gently and progressively, synchronizing the throttle application with the opening of the steering wheel to the exit point of the corner and beyond. Jamming the foot into the throttle as soon as the apex has been reached will result in an instant weight transfer to the rear wheels, depriving the front wheels of the traction that they still need to steer at this

critical time in the corner. The harder one accelerates, the more steering that has to be dialed on with the resultant decrease in steering ability as the front tires lose their weight and the car begins to exhibit a behavior known as UNDERSTEER. In extreme cases excess power will cause the rear wheels to lose traction, causing a spin.

DECELERATION

As mentioned at the beginning of this section on Throttle Control, both acceleration and DECELERATION must be done smoothly. If you enter a corner feathering the throttle to maintain a constant speed from the turn in point to the apex, and suddenly come off the gas, (perhaps to avoid an obstacle) you will experience a sudden weight transfer from the back of the car to the front.

The result will be that the front wheels will suddenly receive more grip from increasing loading and the rear wheels will loose grip. The car now wants to turn into the corner and slide the rear end out. This is known as OVERSTEER and can result in a loss of car control.

SECTION 10 - BRAKING

"... very gentle to begin with, then brake progressively. ... release the brake very gently and progressively so that you do not feel it coming off. The whole sequence should be one gentle, sensitive, flowing movement. You want the nose of the car to come up gently and un-dramatically." ***Jackie Stewart***

"...taking your foot off the brake pedal properly is almost certainly the last thing you will learn to do well". ***Carroll Smith***

Our goal is teach drivers to come as close as possible to the ideal condition of not having to ever upset the balance and distribution of the car's weight. If we are to achieve this goal, then braking must also be done in a smooth, seamless manner. Recognizing that weight transfers are inevitable in a rolling object that has to slow down, negotiate turns and accelerate, we must have those weight transfers working for us rather than against us.

Each corner has a braking box in which we complete the braking process. This box represents the distance required to gently release the throttle, to squeeze on the initial braking force and then progressively increase the force, to downshift if necessary and then to gently release the brakes. The pedal pressure must be modulated as the car loses both speed and aerodynamic downforce (and the grip that the downforce was producing) and reacts to road surface irregularities. This ability to maximize the power of the brakes without having them lock up is known as THRESHOLD BRAKING.

The length of the braking box should be extended for a beginner and adjusted as the skill levels and understanding of the process develops. In other words, begin the process of braking for a corner a safe distance from the turn in point. In some cases you will brake too early - in extreme cases having to accelerate again before reaching the corner. This is rare and the lesson is usually quickly learned. As Carroll Smith points out in *Drive to Win, ."...* if it isn't learned, than other sports beckon.

Smoothness is essential when it comes to braking at the limit of adhesion.

Again, here in eastern Canada, it's not just high speeds where threshold

braking is a valuable skill. Driving on ice and snow offer daily opportunities to practice braking at the limit of adhesion and at much slower speeds.

Once the wheels are locked up, the tires are no longer capable of steering the car. If the car is on an absolutely flat surface, this presents few problems, but if the road is crowned or the car is approaching a corner then a possible loss of control can be imminent.

In order to avoid locking up the front wheels, weight must be transferred to them before braking heavily. Therefore, initial brake pedal pressure must be firm but light. As the weight of the car begins to transfer through the suspension from back to front, the brake pedal pressure can be increased in earnest. Think of it as a parabolic curve again. The more weight transferred from the rear, the more one can increase the brake pedal pressure. Of course we must be aware of the possibility of too much pressure and the resultant lock up.

The opposite approach to braking is to jump hard on the pedal at the last minute. Such an action usually locks up the wheels as the tires haven't yet received the weight transfer from the rear of the car.

Be aware that releasing the brake pedal progressively is also critical to the entire process. This is probably the least understood and less practiced part of the process. Ignorance, a lack of a practiced foot, and an insensitive set of lower leg muscles are usually the culprits. Most folks can lower their food against the brake pedal with some degree of precision and control; however very few seem able to raise the foot away from the pedal with the same sensitivity. Most beginners just side step the pedal or jump off it without a thought to the consequence of the resultant rapid weight transfer to the rear of car and the loss of tire grip at the front of the car. A slow, unhurried release allows some grip for the front tires just as they begin the turn. Some drivers CURL THEIR TOES as they finish the braking input. This acts to reduce the brake pedal pressure in a slower, more progressive manner. Have them practice this against the floor.

Contrary to popular opinion, pumping the brakes or Cadence braking is not the best way to stop from high speed. ABS systems work well because most of the drivers on our roads do not have the skills or the understanding of Threshold Braking. ABS offers the less skilled driver the advantage of being able to both brake and steer at the same time. Threshold Braking turns out to be superior in most conditions. Ask the vehicle engineers!

Tips

When we talk about the braking box, remember that the size of the box will vary with the your skill level and confidence. Don't pressure yourself to go faster or deeper into a corner. Your instructor will help and encourage you but doesn't want to work against your own intuitive understanding of their situation. By emphasizing the smooth operations of the brake pedal, one of the most challenging of the all of the driving skills, you will have helped your driving immensely.

Talk out loud, describe the entire braking process while you are doing it. i.e. "I am approaching the braking box... releasing the throttle... gently applying the brakes..."

TRAIL BRAKING

It is traditional for driving education programs that are not in the business of teaching racing, to emphasize the idea that braking should be completed while the car is traveling down the road in a straight line and before a corner is attempted. This is a safe and prudent way for the driver to negotiate the road.

This technique is based on the Friction/Traction Circle. (discussed further on in this manual) The Circle demonstrates that a tire can only do 100 percent of one thing at a time. If the tire is being used to provide 100 percent braking and is very close to losing the tractive force between it and the road, then it has little or nothing left to generate a steering force. In other words, if you are at absolute threshold braking in a straight line, you cannot steer the car. This is most noticeable in winter, while driving on hard snow or ice.

The term, Trail Braking, is often understood to mean that the driver maintains the braking force input well into a corner. Trail Braking does not include braking hard into the corner. What Trail Braking really refers to is the technique of gently releasing the brakes as you increase the steering input into a corner. The front shocks and springs are compressed and you maintain the forward-directed weight transfer creating more down force on the front wheels. This increases the tire contact patches, which maximizes traction and provides better control.

As noted in the Steering Section of this manual, the initial turning into a corner is very gradual and very transitional so the steering effort required from the tires is relatively small, perhaps 10 percent of the tire's capability to perform. That

leaves, in our example, 90 percent of the tire's ability available for braking. The deeper the car goes into the corner, the more steering is required and thus, the less is available from the tires for braking, which is allowed to "trail" off.

Several thoughts about Trail Braking:

- An inexperienced driver might apply the brake pedal with too much force, too late into the corner. This will have the affect of transferring too much weight to the front wheels and reduce the ability of the rear wheels to maintain traction, due to the resultant weight loss. Unwanted oversteer may occur with the loss of car control.

- An inexperienced driver might enter a corner and lift off of the brake too abruptly. This will cause the car's weight to transfer to the rear and the front end will lighten rapidly. The result will be 'understeer' or 'push' and the car will tend to steer away from the corner and off the road. As Carroll Smith says, "*...taking your foot off the brake pedal properly is almost certainly the last thing you will learn to do well".*

- Smith suggests that Trail Braking basically works in medium and low speed corners. It doesn't work well in bumpy corners or in very fast corners because it changes the pitch attitude of the car. He goes on to say, *"Done properly, Trail Braking can significantly reduce corner entry understeer by a combination of degrading the rear tires' lateral capacity and increasing the vertical load on the font tires."*

- A driver who brakes in a straight line and then carries excessive speed into a corner, is asking his/her rear tires to spend too much of their tractive ability on cornering force. There is little or none left for the acceleration required to pull the car out of the corner and onto the straight section of the road. The old saying is still the key:

SLOW IN AND FAST OUT is safer and more productive than fast in and slow out.

One last thought from a recognized expert in the field of advanced driver training. Patrick Bedard, in his book, "Expert Driving" points out that when the

driver has achieved excellence in pure braking, accelerating and cornering, he/she may want to explore a combination of turning and braking. (Trail Braking).

To quote Bedard:

"The real world poses such opportunities all the time. For example, the typical turn consists of braking to reduce speed, tapering out of the brakes, tapering into the turn, going through the corner, tapering out of the turn, then accelerating away. These phases can be completed in a series of discrete maneuvers, one after the other... or each can overlap the next; braking can taper off as you steer into the arc of the turn and acceleration can begin before you've completed the arc. The expert is fluent in the overlapping method. It covers the distance more efficiently. It's more comfortable for passengers and should some hazard threaten, a combination of overlapping moves may be the only possible path to safety. Carrying your braking into a turn, and picking up acceleration before the exit, are easy ideas to contemplate. But making the tradeoff from one to the other with the necessary balance and smoothness is an acquired skill. And as with any skill, only through practice can you become an expert.

For our teaching purposes, the skill of "Trail Braking" is better left for an experienced driver who has mastered the basic skills introduced in the DE program and wishes to move on to more advanced levels of understanding. Rennsport Instructors d**o not teach trail braking to any driver who has not shown consistent mastery of the correct braking technique, particularly to one who has not fully mastered the gentle release of the brake pedal.** Since most beginners have a hard time "fading off" the brakes, trail braking could be a hazard until you can perform this technique consistently.

SECTION 11 - VISION

"You're going to learn something that only about a thousand people in the whole world know how to do. I'm going to teach you to see properly".
Bill Buff

An exaggeration perhaps, but it was enough to get the Rennsport instructors' attention. Bob Rouleau described Vision as The Fifth Input in an article written for Der Auspuff magazine. An interesting idea but Vision, as we came to know it, is more than an input - it's a part of us - albeit under utilized at times, if we were to believe Bill Buff.

. The ideas that Bill presented during his visit are laid out in the next part of this manual. They are probably the key to becoming an expert driver or for that matter, a skilled participant in any form of athletic endeavor.

"Your eyes are the source of a high percentage of your sensory input when driving a car. We often say we have a seat-of-the-pants feeling, but really it's our eyes and our inner ear telling us what's going on. The fact is that the car will go were you're looking, so why not look where you'd like to go? Look further ahead!"
Bill Buff

Buff recommends that we look a minimum of three seconds ahead - look where the car will be in three seconds from now. Look further ahead if it's appropriate. Watch out, though! Don't look farther than you need to, as this will introduce information that's not required at that moment.

On the track, most drivers tend to look at things sequentially, focusing on the braking point, then the turn in point, then the apex, followed by the exit and so on. They tend to drive in straight lines as they attempt to connect the dots; much like a child connecting numbered dots on a puzzle page. It's known as "point-to-point" driving.

Unfortunately, a car following this point-to-point process, with the resulting series of steering changes necessary to move the vehicle on to the next reference point, experiences multiple alterations to its weight distribution and corresponding changes to the balance of the automobile. This is not what we want happening in a corner! The trick is to make one smooth curve through the corner, rather than a series of three or four smaller turns.

The secret to doing this is to look ahead at where you want to go, in such a

way that your focused vision moves around the corner while less focused, peripheral vision handles what is immediately around the car. We tend to ignore most of the input that our peripheral vision brings to the brain. Once the driver has learned to process that "extra" visual information and trust its accuracy, then they can raise their eyes and look farther ahead.

Hank Watts, author of the respected driving book, *"Secrets of Solo Racing"* talks about imagining the eyes "clawing" at the corner, as though they are trying to pull the car around it. A superb analogy, and one worth repeating, as it brings out the idea of having the focused vision move in a continuous track around the corner, rather than looking at one point and then on to the next and so on. The eyes "search ahead," though the corner.

Part of the secret is to:

POINT YOUR NOSE WHERE THEY WANT THE CAR TO GO!

The main points to keep in mind are:

- Your head should be level when turning. It should not be tilted. Tilts confuse the inner ear.
- The seat position should be adjusted so that you can turn the wheel without moving the shoulders off the backrest. If the shoulders move, the head tilts.
- The hands are at the 9 and 3 o'clock position. The wheel must be turned without moving the hands and never have the hands go over each other. (See the section on Steering)
- You should look ahead and see the entire turn - not a close up view directly in front of the car. Look a minimum of 3 seconds ahead of the car at all times.
- Point your nose in the direction you want to go. That means turn the head and look out the side window if they have to. Be sure that they you aren't turning your nose and then peeking back at the front of the car by looking out the sides of your eyes. You will be tempted at first.
- Freeze the steering wheel in the straight-ahead position until they you have looked into the corner and only then begin to turn the wheel.

It is interesting to note that most of the instructors, who were attending this

training session, were sure that they were already masters of this skill and understood it well. Ask any instructor who was there. We were wrong!

A useful exercise to go through was to drive through a tight figure eight pattern of cones. During the Buff training session, all of the instructors initially tended to focus their eyes down onto the cones nearest the car, instead of looking ahead at the cones coming up in the pattern. As a result they often found their car unable to negotiate the path ahead, without hitting another cone. Once they learned to get their eyes up, to see the oncoming cones, the car began tracing smooth arcs around the course and the speed increased. No cones were hit. The instructors learned to trust and use the information that was coming in from the unfocused section of the field of vision.

It was pointed out that the star hockey player, Wayne Gretsky was always able to find his four other team mates at any given moment on the ice surface and usually make blind passes that seemed to be impossibly accurate. He surely was using (and trusting) his peripheral vision's inputs to a very high degree. By the end of the skid pad demonstration, we learned that:

- Most drivers tend to never look outside the windshield post (the 'A' pillar).

- Most drivers tend to look down at the road and not far enough ahead.

- Most drivers do not really trust the accuracy of the information that reaches their retinas beyond that the main, narrow central field of focus. They tend to ignore it unless a quick movement occurs in that area.

- Considerable practice is required before people feel comfortable with looking farther ahead while recognizing and trusting the peripheral information.

- When the driver begins to look into an approaching corner, they tend to turn the wheel too soon and early apex the corner.

- This last point comes up whenever we try to teach an experienced "trackie" to re-examine their vision skills. They invariably come back to us with the statement that they are turning in way to soon. To deal with this tendency try this tip. It works!

Tip:

Remember and recite the following "mantra" when about to corner:
BRAKE.. FREEZE.... LOOK... TURN....DIAL

BRAKE for the corner, FREEZE the position of the wheel, LOOK into the corner, about three seconds ahead, TURN the wheel a small amount to allow the weight to begin to transfer, then DIAL the wheel into the turn at a progressively faster rate.

Another place to observe the positive benefits of looking ahead and advancing vision is on a tight entry ramp to a major expressway. Using the techniques described in this section, you will easily move well ahead of virtually any driver negotiating the turn behind them. The driver behind will be slower because he/she is constantly making corrections throughout the corner. Each correction induces friction through the tires and a corresponding loss of momentum. This technique does not have to be practiced at high speed. The technique works at any pace.

Bill Buff specializes in training company fleet drivers around the world. The Vision Technique training has proven to reduce traffic accidents by up to 90 % based on actual statistics supplied by his corporate clients.

The technique takes lots of practice, initially, because it's rather foreign to actively process and trust the whole picture that is reaching our brains, rather than relying on just what you see in the center of your focus.

Tips:

Use caution when trying this concept. Discuss it with your instructor. Some instructors feel that there is far too much going on at the early stages to ask a novice to begin this phase of the instruction. Others feel that with this Vision Technique, any capable driver can easily find his/her way around any new piece of road. After all, we often drive an unknown road in daily driving. These skills allow one to be far safer in that situation. Buff was of the opinion that using three cones in every corner on the track encourages point-to-point driving. He believes that an experienced driver, who has an understanding and mastery of the 'vision' techniques, will find an appropriate line through any corner by looking ahead and driving in a smooth seamless arc.

Even if you aren't ready (or your instructor isn't ready) to try this technique on the track, try it on the road. With a little practice it will become second nature.

Thanks to Bob Rouleau who took excellent notes during Bill Buff's training

session and permitted us to include, verbatim, much of what Bill passed along to us.

SECTION 12 - TECHNICAL INFORMATION

THE FRICTION/TRACTION CIRCLE - TRACTION LIMITS

A tire is capable of generating almost equal force in acceleration, deceleration or cornering. Once it reaches its limit of adhesion doing any of these tasks, it slips against the road surface and looses its effectiveness. If we plot the maximum forces that any given tire can develop in each of these operations, we end up with what is known as the Friction/Traction Circle. The diagram shows a single tire with a constant vertical load. In his book, "Drive to Win", Carroll Smith uses the following diagram (fig. 8) to show that a tire can generate either 1.4-g of acceleration thrust or 1.4-g of cornering force. (braking thrust can be substituted for accelerative thrust). It cannot, however develop 1.4-g of both at the same time. In fact, if it is generating 1.4-g of either, it can generate exactly 0.0-g of the other.

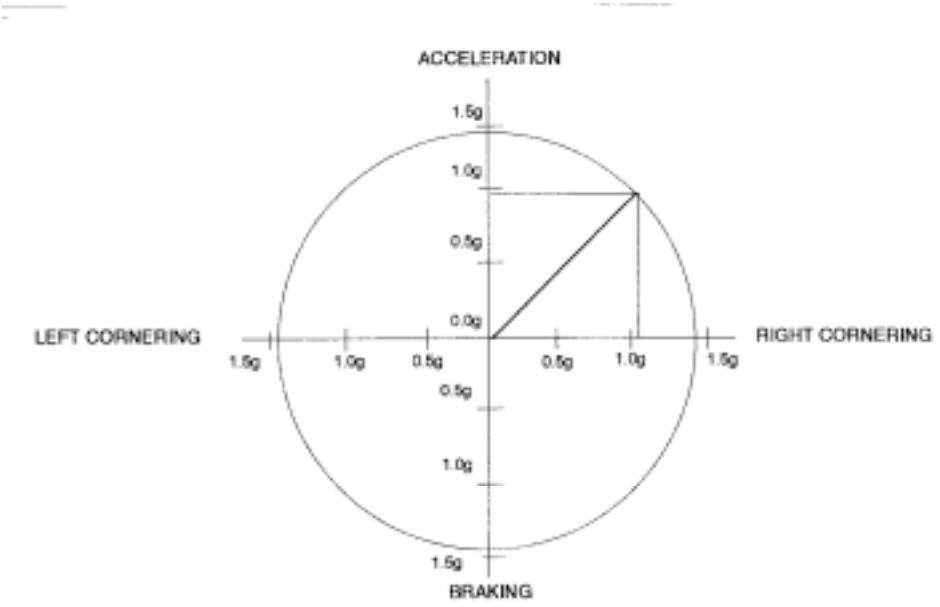


Fig 8

If a tire is generating both a lateral and a longitudinal force, it must develop a lesson amount of each than it could of either one singly. This is illustrated by the vector marked FT, which shows the tire generating a cornering force of, 1.1-g while accelerating a 0.8-g with a resultant force vector of 1.4-g. (Fig. 8)

Due to the geometry of the Friction/Traction Circle and the resolution of the vectors, the tire can and does generate forces in each direction, the sum of which is greater than the total g-force capacity of the tire. In this case, 1.1 + 0.8 = 1.9-g. In other words, the tire can simultaneously generate an amount of braking thrust and an amount of cornering force which, added together, will total more force than the tire is capable of generating in any one direction.

If we are going to utilize all of the performance potential designed and built into our tires, then we must keep the tire operating at a very high level of combined forces at all times while the car is turning. We must 'ride the rim' of the Friction/Traction Circle by balancing the brakes, cornering force and throttle so as to keep the tires' resultant line of force just inside the boundary of the Circle. ***Carroll Smith***

Just for the record, because a tire's longitudinal capacity is greater than its lateral capacity, the Friction/Traction Circle it is not actually a circle. Nor is it ever the same size, as available traction constantly changes from being large on dry pavement to very small on slippery, icy surfaces. The acceleration side of the circle will usually be underdeveloped, as cars can't accelerate as hard as they brake and turn.

SECTION 13 - THE CORNERING SEQUENCE

For our purposes, let's consider the cornering sequence to start when the driver begins to reduce the braking pressure preparatory to turning the steering wheel for the first time. Let's break every corner into three sections or phases

PHASE ONE - INITIAL TURN IN

On the surface, pretty simple - you turn the wheel. Not quite! Remember Jackie Stewart's comments about releasing the brake pedal. Carroll Smith points out that if the student removes his foot from the center pedal suddenly, the nose of the car will come up, load will be suddenly transferred from the front tires onto the rear. If the car is asked to turn at this point, it won't. If you watch an experienced driver who is not Trail Braking at a corner you will observe the nose comes up gradually just as the car turns in. As a point of interest, the same thing happens if he/she is Trail Braking - it's just harder to see, as the vertical displacement is less.

Phase one also includes the Vision technique of freezing the wheel before the driver turns in. They may want to turn in too soon as a result of turning their heads and pointing their noses in the direction they want to go. There's a terrific amount happening at Phase One!

PHASE TWO - FROM TURN IN TO APEX

As a novice, this is the point where you should have completed your braking and if needed a downshift. This is the part of the turn where the foot has to reengage the throttle pedal. The brake pedal should be smoothly released and the throttle should be engaged with just enough force to produce what we call "constant throttle". It's a bit of a misnomer, because in reality, the driver is asked to maintain a constant speed by varying the throttle. Allowing for the energy lost from the steering input, the car will begin to slow at this time unless the throttle is adjusted. If the car slows it will have a tendency to load the front tires causing the car to turn into the corner. If the car speeds up too much, the front tires will loose weight and the car will have a tendency to push or understeer to the outside of the corner. In either case,

momentum is lost unless the throttle pedal is judiciously used.
This "constant throttle" is maintained from the turn in area to the apex area on medium to tight corners. On a long sweeping turn, the throttle can be gently increased sooner as the car nears the apex area. The larger the radius of the corner, the faster a car can negotiate it safely.

If you are an experienced driver, assigned to more advanced run groups, you may be Trail Braking. Let's examine what happens as the corner approaches.

Approaching the corner, the car is under acceleration. Cornering forces and braking forces are at zero. When the braking begins, acceleration drops to zero. Cornering continues to be at zero.

Just before the turn in point, the braking begins to diminish. Remember, that if all the tire's tractive capacity is being used in braking, the car cannot turn. As the car enters the corner the braking continues to diminish as cornering force builds.

At some point before the apex, braking forces have diminished to zero and enough throttle has been applied to maintain the pace and cornering forces on the tires have reached the maximum.

PHASE THREE - CORNER EXIT

Here it is useful to refer back to the example of the string that goes from the bottom of the steering wheel to the big toe of the throttle foot. (fig. 7) As the car reaches the apex area, the corner is beginning to end. If this is the beginning of a straight area of road, then this is the point where the throttle setting can be increased. Remember, if the cornering forces are diminishing and the wheel is being straightened, the imaginary string tied to the toe of the throttle foot lengthens, allowing the gas pedal to be depressed.

This is known as "releasing the car". As the tires are asked to do less steering, they can now allow the car to return to the task of accelerating. The analogy encourages the driver not to slam down the throttle but to engage it smoothly and progressively. It's important not to ask the tires to handle 100 percent accelerative force while they are still producing 10 percent steering force. A useful trick is to count "one-thousand and one, one-thousand and two until you reach one thousand and four. At this point the throttle will be fully applied. If you floored it before then you are applying power too abruptly.

On less powerful cars, one hundred and ten percent will cause the slip angle of the front tires to increase to the point where traction is lost and so is control. Power-on understeer is the result.

On more powerful cars, with lots of torque, slamming the throttle down will cause the rear end to jump into oversteer. In either case, the throttle will have to be released and momentum is lost. One has to stay inside the imaginary Traction/Friction circle!

Tips:

Begin by using a very conservative brake point, well before the turn in point so that there is enough time to practice the smooth release of the brake. Build the braking forces smoothly. Emphasize the tapered release of the brake pedal so that the car's nose gently comes up as it nears the corner. As you improve very, gradually move the brake point closer to the turn in area. Feel free to use permanently fixed reference points on the side of the road. Be sure not to fixate on this points but continues to advance your field of vision by looking ahead. Don't talk to other driver about their braking points or watch cars around you for comparisons. You and your instructor have to be comfortable with the braking points and use them in order to be absolutely safe at all times.

THE CORNER AND THE IDEAL LINE

The safest possible speed around a corner is obtained by driving the curve line formed by the largest possible radius. The smaller the radius, the lower the attainable speed. The principle of safe motoring is to strive for the maximum possible radius that can be followed within the allowable traveled surface of the corner. (see fig. 9) However, advanced driving is not concerned with any ONE corner on the road, but rather with linking all encountered corners in a smooth fashion.

Consider not only the corners themselves, but also the straights leading into, or out of the various corners encountered.

Keeping this in mind, and the fact that a car's brakes are substantially more powerful than its acceleration capability, the best exit speed out of corner is more important than the entrance speed.

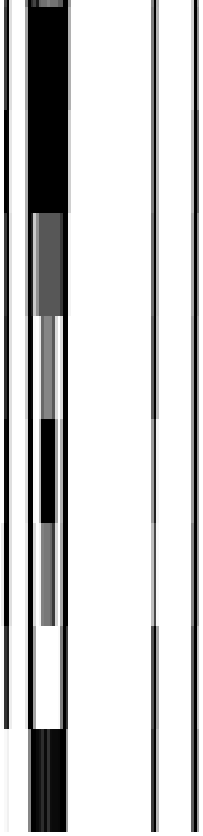


Fig. 9

Cornering speed depends on the RADIUS of the curve. The smaller the radius, the lower the attainable speed. The principle of safe cornering is to strive for the maximum possible radius that can be followed within the allowable traveled surface of the corner

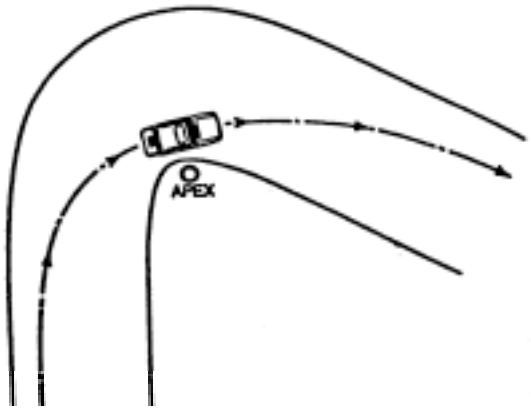
The APEX is that point where the largest possible radius touches the inside midpoint of the turn.

Fig. 10

TYPES OF CORNERS

As we mentioned earlier, the larger the radius of the corner, the faster you can drive through it. Conversely and perhaps more important to the daily driver, the faster you are going, the larger the radius must be in order to negotiate a corner safely. Ignoring the latter or being ignorant of the geometry of an approaching corner is often what causes traffic fatalities.

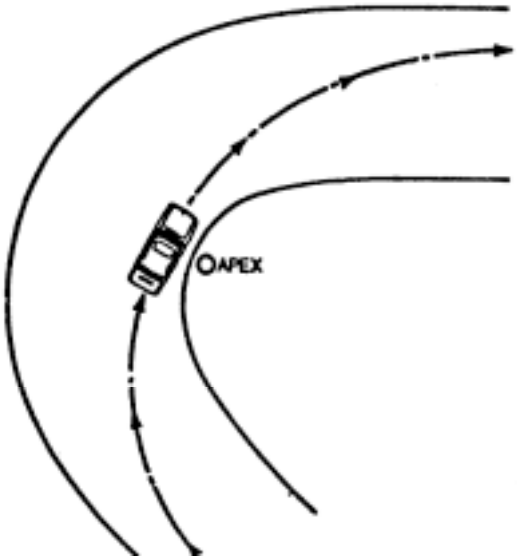
DECREASING RADIUS CURVE



As the name implies this is a turn that keeps getting tighter. This type of corner requires a very late apex. With an early apex, the driver would run of road at the exit. This corner requires patience to stay out or wide at the entrance, even though it doesn't look right at the time. Care must be taken with a decreasing radius curve and if their is any doubt about the entrance point, then stay to the outside of the turn until you can actually see the late apex before turning in.

Fig. 11

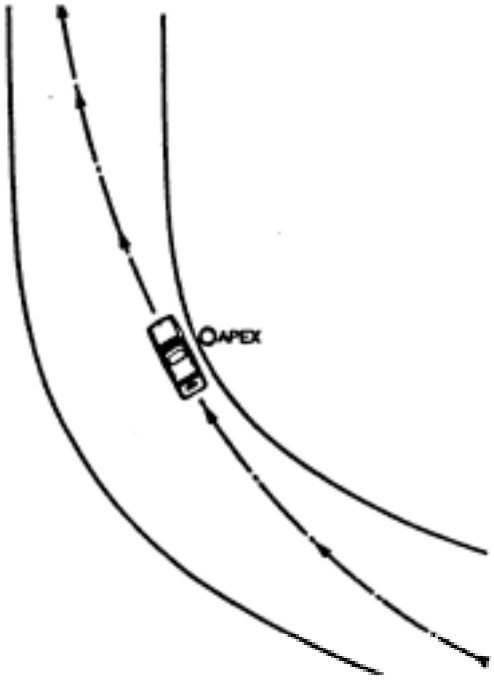
INCREASING RADIUS



This corner widens and increases its radius as it progresses. An earlier apex can be used as the road opens out at the exit and provides more surface for the car.

Fig. 12

LONG CURVES - THE SWEEPERS



Remember, the larger the radius of the corner, the more speed can be carried through it. The idea is to follow a line that is as straight as possible.

Fig. 13

COMPOUND CURVES

Fig. 14

Two or more turns which cannot be driven as one curve. The last curve is the most important and each line through the preceding corner has been modified to accommodate the best entry into the following corner.

It's interesting to note that if the car entered the second corner with a normal apex, 2/3 of the way through the corner, it would undoubtedly run out of road before it was able to enter the third and last corner, leading onto the following straight.

DIFFERENT APPROACHES TO A CORNER

As previously stated, the safest possible speed around a corner is obtained by driving the curve line formed by the largest possible radius. However, advanced driving is not concerned with any ONE corner on the road, but rather with linking sequential corners in a smooth fashion. This skill maintains the car's momentum, reduces the number of unnecessary inputs and contributes to better operational economy.

You must learn to consider not only the corners themselves, but also the straights leading into or out of the various corners you will encounter.

Keeping this in mind, and the fact that a car's brakes are substantially more powerful that it s acceleration capability, the best exit speed out of corner is more important than entrance speed.

LATE APEX CURVE

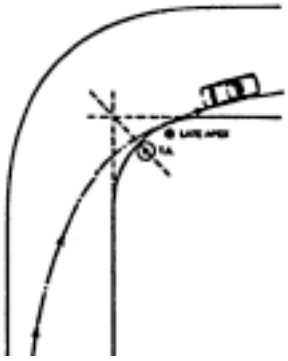


Fig. 15

A faster exit speed produces a higher final speed in the following straight, such as a highway on-ramp merge. This a LATE APEX situation where the late apex point is past the geometric apex (the center of the corner's arc) .The exit line allows the driver to increase the power sooner in the corner and develop more exit speed due to the extra margin of road area at the exit. The later apex is very useful when driving on unfamiliar roads or when road traction conditions are uncertain. It is the ideal line for every corner of constant or decreasing radius. It forces the driver to make a sharper turn at the entrance to the corner and a corresponding slower entry speed.

EARLY VS LATE APEX CURVE

It is a natural tendency for drivers to use an early apex for most daily driving. They are not patient enough when entering the corner and crank on too much steering input before they get a chance to judge the shape of the curve. This often results in multiple steering corrections, which can, under slippery conditions, upset the balance of the car. An early Apex can and usually results in the car running out of road before the exit of the corner. (See fig. 16)

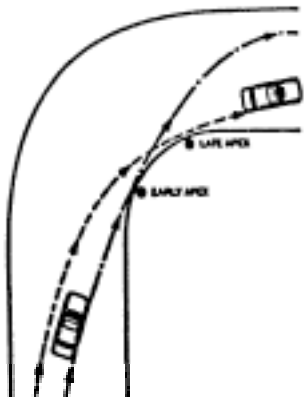


Fig. 16

PUTTING IT ALL TOGETHER

The correct sequence of events for a typical corner is as follows:

- Approach on the outside edge of the straight leading to the corner
- At the brake point squeeze on the brakes, increasing the pressure after the first initial contact
- If you cannot Heel and Toe, and need a lower gear, be sure that a safe entry speed is firmly established and the downshift is done before the corner. It may be preferable for you to steer through the corner and then shift down after the corner is finished. If you can Heel and Toe, as discussed earlier in this manual, use the technique to smoothly engage the new gear. Beginners who haven't mastered this technique, and try to downshift before the corner, inevitably find the nose of the car going up and down as they try to brake, de-clutch, select the

lower gear, release the clutch, and get back on the gas for the throttle feathering into the corner.

- Tiptronic transmission drivers should not downshift anywhere in the corner
- If your are not ready to use Trail Braking (and only experienced drivers should be doing this skill) then ideally, the car should reach the Turn-In Point just as the braking has been completed. If you find the car coasting to this point after braking, try a slightly later position in the braking box. If you are in too deep and fighting the corner, you have braked too late or not hard enough. Select an earlier braking point for the next few times you enter that corner
- When the car has reached the Turn-In Point, turn the steering wheel as we discussed in the section on Steering
- Maintain a constant speed (through the feathering of the throttle) from the Turn-In Point to the Apex
- At the Apex, gently unwind the wheel and begin accelerating out of the corner. Use as much of the lane as practical within safe limits
- IF TRAVELLING AN UNKNOWN ROAD, TREAT ALL BLIND CORNERS AS LATE APEX CORNERS

SECTION 14 - CAR CONTROL

ALL ABOUT SKIDS, SLIDES AND SPINS

Hopefully you your instructor will never find yourselves having to use the following information and advice. To avoid skidding when road conditions are bad, you must use almost excessive smoothness. To avoid skidding during the driver training exercise, you must use the advice found on the previous pages.

Reality is, especially living in areas that experience winter conditions, that sooner or later, a driver will likely find himself or herself in a situation where their car is no longer under their control.

Improper braking and acceleration inputs are the usual cause of skids with variations on these themes ready to upset the balance.

TRAILING THROTTLE OVERSTEER

Lifting off the throttle in a corner can also cause the rear wheels to lose adhesion and slide. Once a car is set into a balanced mode and the throttle is being feathered to maintain control, snapping off the gas will cause Trailing Throttle Oversteer. The release of the throttle gives an instant weight transfer to the front of the car causing the front tires to suddenly have more grip to steer with while the rear tires lose weight and have less grip to maintain their contact with the road.

REGAINING CONTROL FROM A SKID

Drivers usually react to a skid by instinctively steering in the direction of the skid. Virtually all driving schools teach this. Most drivers learn little else.

The process can be further refined by understanding that there is more to do than just steering into the skid. Further, there are some things you don't want to do.

The first reaction of turning into the skid is the correct response. Your

immediate concern is car CONTROL. You don't want the car to continue in the direction of the skid.

That must be followed by a PAUSE PERIOD. The PAUSE PERIOD is necessary in order to allow the weight transfer to load up the suspension on the side of the car opposite to the direction of the skid.

The next stage of the process is the RECOVERY PERIOD. The RECOVERY PERIOD requires that you slowly unwind the steering wheel as the car starts to go in a straight line again. What you must not do is touch the pedals. No clutch, no brake, and above all, no throttle. The steering wheel is your only solution to returning the balance to the car.

At this point, one has to be watchful for a counter skid generated by an excess of steering input at the onset of the skid or by not pausing to let the weight transfer occur during the PAUSE stage. Most road accidents are caused not by the initial skid, but by the overreaction to it. At this point, the car swings back so viciously that you have probably lost control completely and a SPIN begins.

Only after control has been lost and the spin has begun is it important to remember the phrase that all drivers should have committed to memory:

IN A SPIN, BOTH FEET IN

Left foot 'in' on the clutch, right foot 'in' hard on the brakes. By disengaging the clutch, you will keep the engine running ready for immediate reaction when the skid has stopped. By pressing 'in', hard on the brake pedal you ensure that the car will stop in the shortest possible distance and in the mean time continue going straight in the direction that it was traveling at the time you locked up the brakes.

On a flat surface, when a car is spinning with all four wheels locked up, it will always travel in a straight line. With this knowledge, a driver following behind can observe that you have all four wheels locked up and be better able to select a piece of the road, that you are not going to occupy, for himself.

SUMMARY

The one word that reappears time and time again in this manual is SMOOTH. No matter what sport or athletic endeavor, the most successful participant, among many with similar athletic ability, is the one who is able to demonstrate smooth inputs and seamless movements. As Bob Bondurant once put it:

"Smoothness is the work of methodically blending functions. In the beginning it is infinitely more important to be smooth than to be fast. Fast comes later. Concentrate on learning to drive smoothly and properly before concerning yourself with going fast. When you first try to make all the functions blend together, you'll probably feel like a cow on ice. Don't be discouraged and don't worry about speed or how long it takes you to develop the skill. You must learn how go smooth slowly before you'll every go smooth quickly. It takes a lot of time and it is difficult to achieve. That's probably the reason very few drivers ever really accomplish it."