
BMW Club of Canada

ADVANCED DRIVING SCHOOL



STUDENT MANUAL

Rob Foreman & Rolf Lange

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EXECUTIVE'S MESSAGE

The fun and thrill of driving a BMW in a performance situation does not mean that you have to be sitting behind the wheel of a 2-litre touring car spec race machine. There are many different performance opportunities in which to test your car control skills and your car's abilities either on a solo drive at our monthly slaloms or having a great time along side other BMW enthusiasts at our more formal 2-day driving schools.

By participating in the BMW Club of Canada (BMWCC) club events, local track events, those of other sports car clubs and professional driving schools you too can experience the exhilaration of driving to the limit.

The BMWCC offers several opportunities to enhance your driving performance and pleasure, keep in touch with current technical information and build friendships with other enthusiasts, no matter what your driving style.

Your BMW has an impressive heritage of performance engineering and design. Race winning BMWs have been involved in international competition including British, German, Italian and French touring car series, Formula One, IMSA, FIA Groups A, N and C, SCCA and various other enduro series.

The purpose of BMWCC driving schools is to instruct students in the art of advanced driving technique. Whether you have attended our schools before, or other similar schools, you can be assured that there is always more to learn and experience. You can expect to polish skills through excellent in-car instruction. Our classroom instructor gives a series of lectures on a rotation basis throughout the weekend. We teach you in a classroom situation and reinforce that with on-track experience in your own car. Our instructors have been selected carefully and we are proud to say that they are the finest available.

The reason for using a "race track" is that most circuits represent a series of corners and straights as we find them during normal countryside driving. However, for teaching purposes it is a one-way street, and we control access to it. You will be practicing advanced driving techniques without the worry of cars with untrained drivers coming the other way. We even have marshals at most corners to indicate with flags to you whether the road ahead is clear.

The BMW Club of Canada wishes you an informative, enjoyable and safe driving experience. We look forward to seeing you again.

Club Executive

GENERAL INFORMATION

The purpose of our school is quite simple - to improve your driving skills in a safe and controlled environment. You will be taught that Men confronted with an emergency situation, how to instinctively react in a safe and controlled manner. Repeat students will be able to further improve and polish these techniques. The following information is designed to make the event both safe and relaxed. FUN is a pleasant extra.

ACCOMMODATION

HOTELS - We suggest you stay overnight close to the track so as to be fresh and alert in the morning.

WHAT TO WEAR

HELMETS - Helmets are mandatory and must be Snell or DOT approved. If you do not have a helmet, then try and borrow one. Failing that, contact us and well try - NOT PROMISE - to provide one. If you have a spare helmet available, please put your name on it and bring it along too.

DRIVING SUITES - Driving Suits (Racing Suits) are NOT permitted, but regular driving gloves are a good idea as they help if your steering wheel is slippery and your palms are wet.

SUITABLE CLOTHING - We recommend long-sleeved cotton shirts, long cotton pants and smooth soled shoes. Shirts and pants should be comfortable without restricting movement. Dress for the weather Men not in your car as the weather has been known to be quite variable.

STUDENT PREPARATION

DOCUMENTATION - Please read all enclosed documentation prior to arriving at registration. You will be asked for your Technical Inspection Form and for your Waiver. **PLEASE have these ready at registration on Saturday morning.**

REGISTRATION -Registration starts at 6:45 am at the track entrance. Please allow sufficient time as we have to process over 100 cars.

GENERAL

GROUP ASSIGNMENTS - Each driver **will** be assigned to a run group based on his/her driving experience and Type of car. All drivers will be assigned an instructor prior to each in-car session. You are not allowed to drive on the track without an instructor. If you experience difficulties in communicating with the assigned instructor see the chief instructor for a change.

CLASSROOM - Classroom participation is mandatory. Check your schedule to be on time. As all upcoming events are discussed in the classroom prior to going out on the track, you **MUST** participate to know Mat is going on.

CAR PREPARATION

CONTENTS - Before or upon arrival at the track, all loose contents in your car must be removed before your car will be allowed on the track. This includes all floor mats, jack, glove compartment contents, door pocket contents, trunk items and wheel cover/hub Gaps.

CLEANERS - Bring glass cleaner and paper towels to dean your windows.

TIRES - Tires must be in good condition with no cuts. Air is generally available at the track, however, it is strongly recommended that you inflate your tires to at least 40 psi cold before you leave for the track- This is so as to reduce tire mar and improve car control. Bring a tire gauge.

SPECIAL CARS - Convertibles must be equipped with a roll bar or must have a hard top in place. T-Tops are acceptable with panels in place.

ACCEPTED CARS - This school is for a learning experience only and is NOT a test arena for racing vehicles or for drivers. Where MILD modifications have taken place, the event organizers will rule on the vehicle acceptability. All cars must be street legal. If in doubt, contact the club.

If it looks like a Race Car and Sounds like a Race Car, we will judge it to be a Race Car, and it will not be allowed on the track!!

Don't bring this car and hope to convince us to allow it on the track. IF YOU HAVE ANY DOUBTS, contact us -there are no **refunds!!**

TECHNICAL INSPECTION - A technical inspection of your car is mandatory and it is your responsibility to have your car inspected by a qualified mechanic according to the guidelines on the technical inspection form.

SEAT BELTS - Seat belts must be of equal quality and condition for both driver and passenger. No refunds are given for any mechanical breakdowns at the school.

GASOLINE - At this moment we do not know if Gasoline will or will not be available at the track, so make sure that you arrive with a full tank.

MISCELLANEOUS

CAMERAS - No cameras or video equipment of any kind will be allowed in a student's car without prior arrangement with the organizers.

TIMING DEVICES - Timing or other measuring devices including stopwatches and/or G-meters will not be allowed as these violate insurance requirements and compromises our school status. Anyone found using such devices will be asked to leave.

LIABILITY

RISK & DAMAGE - As an entrant, you assume all risks of damage to persons and property during the event. This includes times when your instructor drives your car with you in the passenger seat.

PASSENGER - Passengers will not be allowed in student's cars. Passengers will be allowed in instructor's cars at the discretion of the organizer and the instructor. All guests (i.e. observers) must sign the appropriate waiver forms Mile on the property of Mosport Park Ltd.

UNSAFE BEHAVIOR - The organizers reserve the right to expel any individual who, in the organizers' view, is acting in an unsafe or unacceptable manner.

MOSPORTPARK

A Historical Perspective

Mosport Park opened in 1961 and represents the first major Canadian racing facility. It is a scenic and spectacular track set in rolling hills 28 kilometers north of Bowmanville.

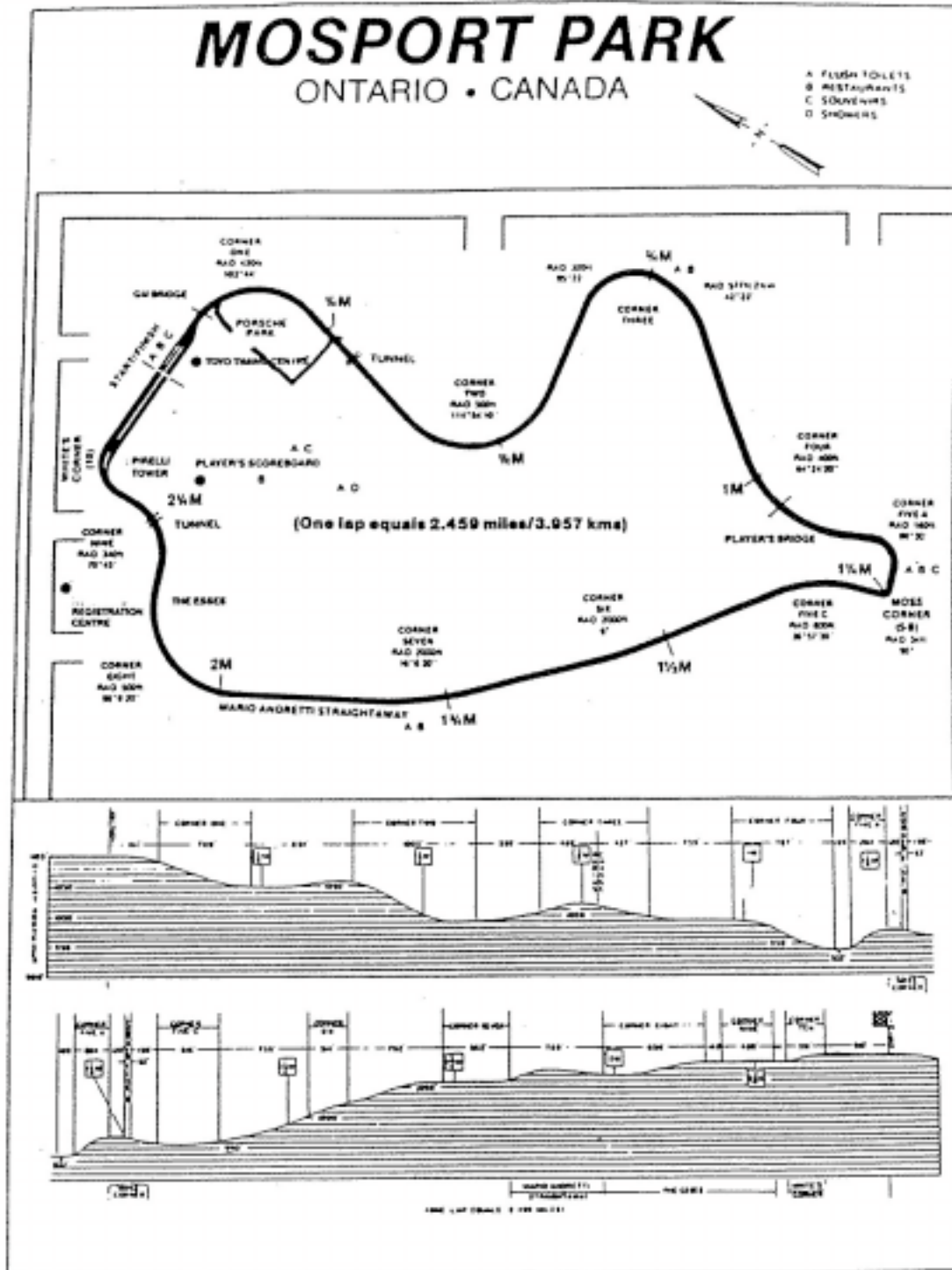
Mosport's inaugural race, (the first international race to be held in Canada), was the Players 200, took place that year and was won by Sterling Moss driving for the mythical Team Lotus. That same race meet saw the first Canadian Grand Prix for sportscars. Most drivers found Mosport to be a tricky, undulating challenge. Well known IMSA commentator, David Hobbs, described corner two as a "ballbreaker" and Jackie Stewart has ranked it as one of the top 10 most challenging corners on any race track worldwide

The Players 200 and the Canadian Grand Prix continued throughout the sixties as sportscar races until the first FIA Formula One grand prix event and the introduction of the Canadian American (CanAm) Challenge.

The FIA Formula One Grand Prix circus arrived in 1967. With a late fall spot on the schedule, it was often accompanied by rain! That race was won by Sir Jack Brabham. CanAm began in earnest in 1966 and until its demise in the early eighties, Mosport was a regular venue - and a popular one at that, for this was a driver's circuit.

As with all Driver's circuits, there were some monumental accidents here. John Surtees had the worst accident of his racing career here in 1965. When the World Sportscar Championship visited the track in 1985 - the race at which Jaguar returned to sportscar events - Manfred Winkelhock was killed after an accident at the now infamous turn two.

Throughout the eighties and early nineties, despite the FIA Canadian Grand Prix moving on to Mont Tremblant and finally Montreal, Mosport park has been host to several national and international events including the now defunct Honda- and Porsche-challenges, and IMSA GTO/GTU events. Today, it is still the thrilling venue of several national events and Club driving schools.



**LE CIRCUIT - MONT TREMBLANT
A Historical Perspective**

Le Circuit - Mont Tremblant at St. Jovite, Quebec, is a scenic spot set in the spectacular rolling woodlands of the Laurentian Mountains. As with Mosport Park, this is a driver's circuit, the track swerving and diving through the hills, with 14 comers and 85 ft (28 m) of elevation change. it is ideally located within a mile of the village of Mont Tremblant, with spectacular vistas of the alpine skiing area.

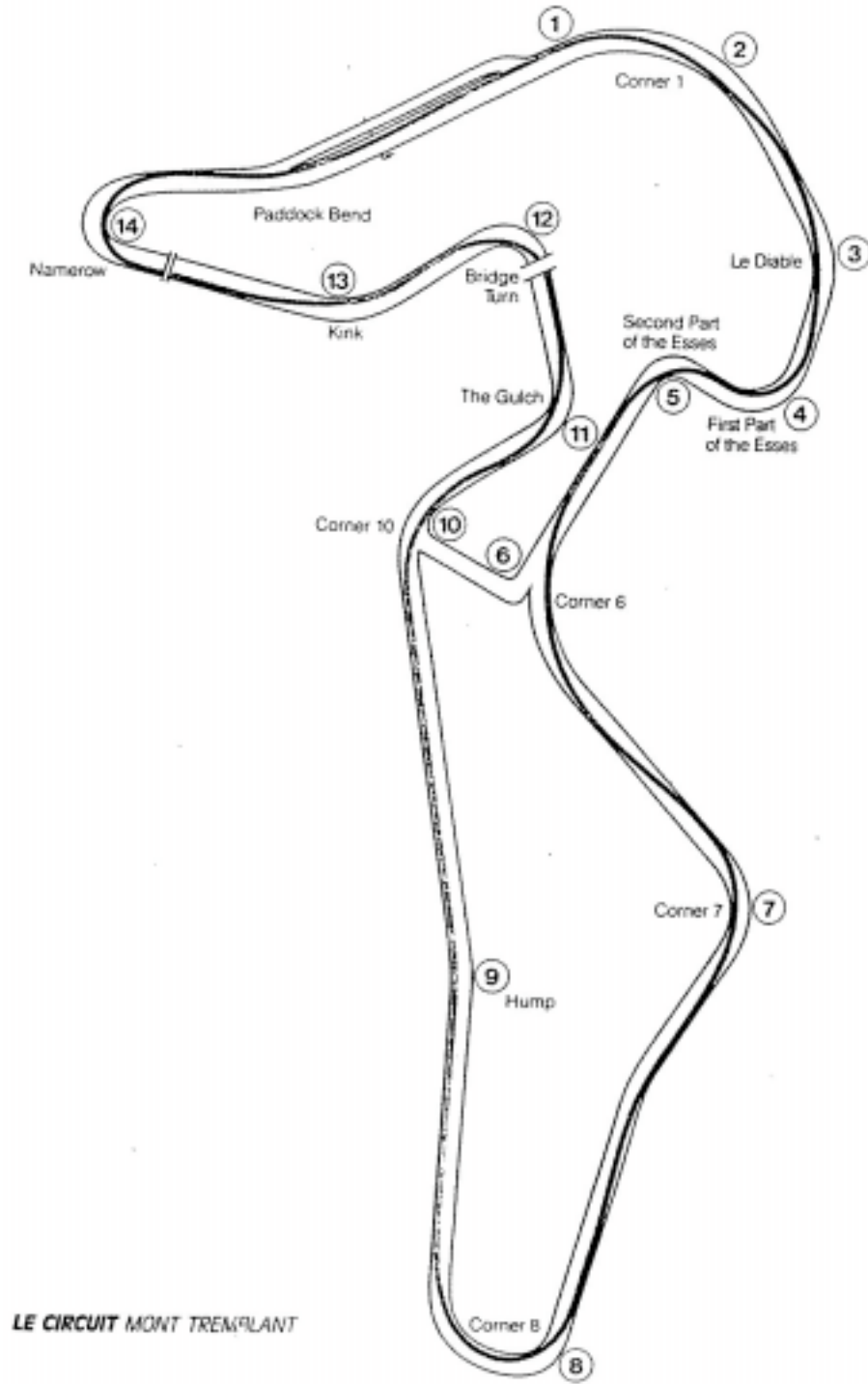
"That was a hell of a frightening place," recalls David Hobbs, "with its undulating main straight and sweeping comers ... there was a famous jump too, just after the first comer, Mere Paul Hawkins looped the loop in the old days and Mere Brain Redman hurt himself so badly in 1977."

Opened in September 1964, some three years after Mosport, the circuit was soon extended to its Fuji 2.65 mile (4.27 km) length. The track played host to its first ever Canadian-American (CanAm) Challenge race in 1966, an event won by the Lola of John Surtees at an average speed of 96 mph (154 kph).

Even then, the track was narrow and bumpy, and its arrival in FIA Grand Prix racing, (after the demise of Mosport), in 1968 coincided with the tail end of the "anything goes" era. That year Denny Hulme won by a lap from Bruce McLaren. But the tragedies in the following years would mean that almost from it's inception, Le Circuit - Mont Tremblant would be living on borrowed time as the campaign to improve safety in Formula 1 gained momentum. After the 1970 race (Mich was won by Jackie Ickx in the wake of Jochen Rindt's death at Monza), the circuit was strongly criticized on safety grounds, and the Canadian Grand Prix never returned.

Indycar racing also had a brief flirtation with the track, holding two races in both 1967 and 1968 with Mario Andretti winning all four events.

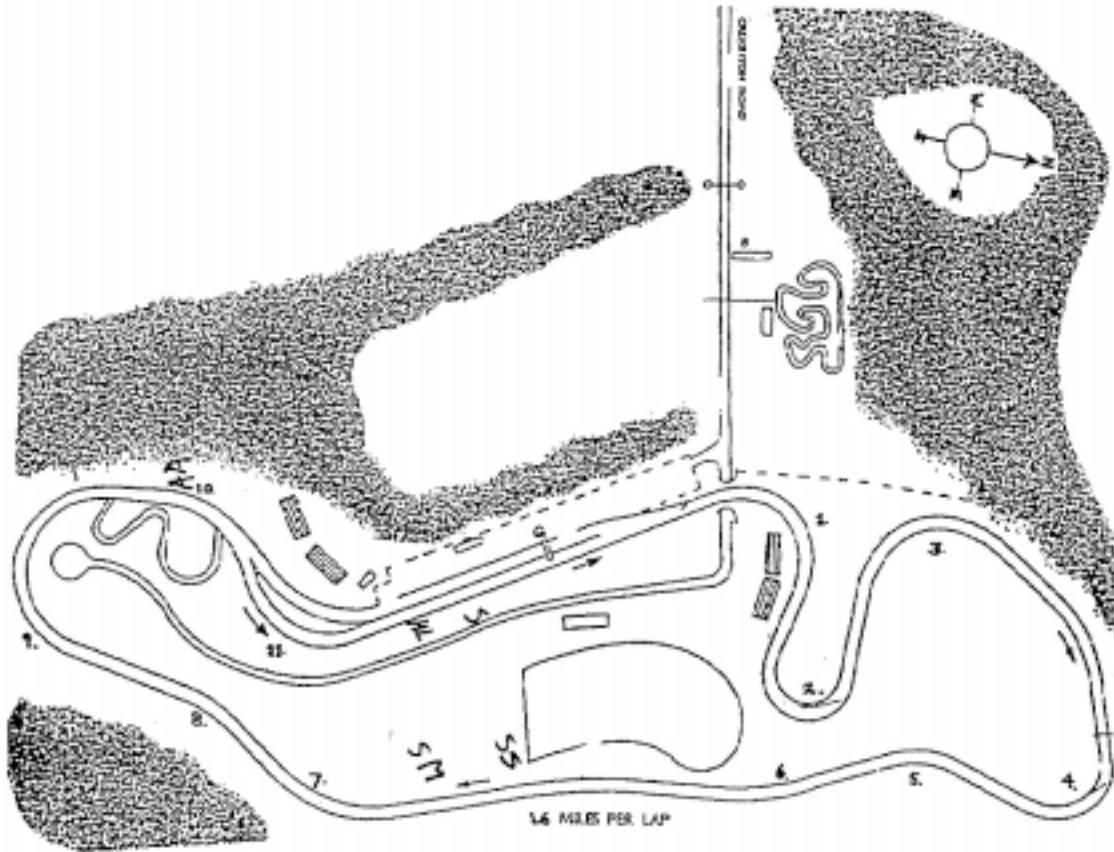
Throughout the eighties and early nineties, despite the FIA Canadian Grand Prix moving on to Montreal's Ile Circuit Notre Dame, Le Circuit - Mont Tremblant has played host to several national and international events including Trans Am, Formula Atlantic, Formula 1200 and Formula 1600, and the now defunct Hondas and Porsche challenges. Today, it is still the thrilling venue of several national racing events and Club driving schools. Le Circuit - Mont Tremblant is most importantly, the Canadian home of the world famous Jim Russell Race Driver school, whose graduates over the years have included the late Gilles Villeneuve and his brother Jacques, Bobby Rahal, Michael Andretti, Emerson Fittipaldi, Greg Moore, Danny Sullivan and young Jacques Villeneuve.

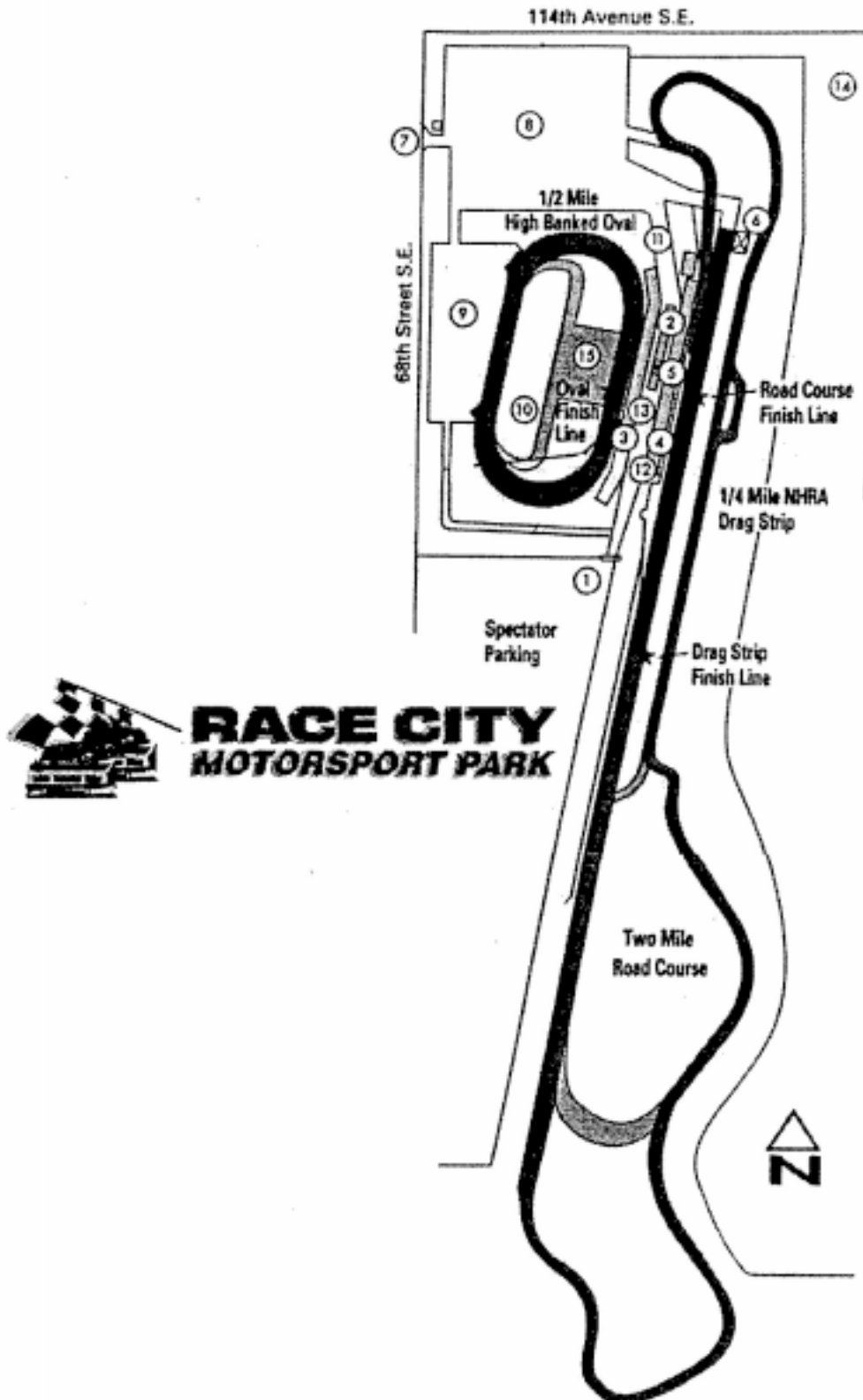


LE CIRCUIT MONT TREMLANT

Atlantic Motorsport Park

Skubenacadie, Nova Scotia, Canada.





A LAP OF RACECITY SPEEDWAY

EXITING PIT Wait for pit marshal to direct that it is safe to enter the track. Accelerate onto main straight keeping right to avoid any traffic.

MAIN STRAIGHT - AFTER PIT EXIT Keep to the right about 3 - 4 ft from edge of track. As you approach the braking area for Turn 1, ease the vehicle all the way to the right side edge.

TURN 1 (High speed left hander)

Brake in a straight line at the appropriate brake marker while continuing to travel along the right side edge. Avoid the temptation to start turning left. Look for the turn-in point which is a small depression in the asphalt at the right side edge. The right front tire should approximately touch this depression as the turn-in point. Hold a constant left turn on the steering wheel to achieve the late clipping point near the end of the left side curbing. After clipping, do not let the vehicle move more than half the track width to the right, Brake in a straight line to the middle area of the track.

TURN 2 (Medium speed right hander)

The vehicle should be at approximately the mid point of the track width at the turn-in point. Hold a constant right turn on the steering wheel to achieve a very late clipping point near the end of the right side curbing. Keep the vehicle at the very right edge of the pavement at the end of the curbing. After the right side curbing ends, brake in a straight line while staying as far right as possible.

TURN 3 (Slow speed left hander)

This is the slowest corner on the track and most vehicles will have a tendency to understeer or push through this corner. It is important to brake enough prior to the turn-in point so as not to overshoot. Although a slow corner, it is important to get this one right as it leads onto a fast section of the track. Better to slightly over-brake on entrance to ensure hitting the clip point and exit perfect. The clip point is fairly late on the left side curbing. Let the vehicle move to the right edge of the track on the exit of this turn. You should be at the right edge just prior to the start of the right side curbing.

TURN 4 (Medium speed left hander)

Run down the edge of the right side curbing for the entrance to turn 4. Avoid running on the curb as it will have a tendency to jerk the car to the right. This corner will probably require a slight brake prior to turn-in This will settle the front of the car for good bite on turn-in which is near the end of the right side curbing. The clip point is approximately at the mid-point of the left side curbing. At speed, the vehicle will drift to the right side curbing at the exit. Keep a constant left turn on the wheel to bring the vehicle back to the left side of the track to prepare for the turn-in for 5.

TURN 5 (High speed right hander)

You should be approximately one car width from the left side of the track at the turn-in point. Do not start from too far left. Some vehicles may require a short shift to a higher gear as this corner is quite long and fast and you do not want to shift during the corner. The turn-in is started quite wide from the curbing. Continuously bring the vehicle closer to the curbing through the turn until the clip point, which is very late. The last 10 ft of the curbing will appear to be straight and it is this straight curbing section that is the clip point. Keep the vehicle as far to the right as possible after the end of the curbing.

TURN 6 (High speed left hander)

From the exit of turn 5 to the entrance to turn 6, you are climbing a slight hill. Stay to the right edge. There is a slight depression at the top of the hill near the turn-in point. If you stay at the right edge of the track, you will minimize the affect of the depression. Most vehicles will require a slight amount of braking. Start the turn-in for the clip point which is near the end of the left side curbing. Stay as far to the left as possible on exit after the curbing.

TURNS 7 & 8 (Medium speed chicane)

- The chicane is entered from the far left edge of the short straight after turn 6.
- Start the turn-in and aim for the right side curbing clip point. Heavy braking is required after the right side clip point on the way to the left side curbing clip point. Missing the first clip point on the right will make the next section more difficult and will therefore require more braking. If the turn-in and clip points have been properly executed, you will be able to apply full power at the left clip point. The third clip point is on the next right hand curbing. Maintain a steady turn and the vehicle will enter the back straight all the way to the left side straightaway curbing. If you find the vehicle sliding over the left side straightaway curbing, do not pull the wheel to try and regain the pavement. Just ease the gas slightly and drive parallel to the curbing until it ends. Then gently edge back onto the straightaway. It is very easy to over correct and end up leaving the track on the right side, backwards into the swamp.

TURN 9 (High speed left hander)

Stay to the left side on the back straight unless you are passing. Wait until you can see straight up the hill through the kink before you turn-in. The brake point is around the bottom of the hill just past the right side curbing. You are climbing a hill and will brake more than you would first think. Stay near the middle to right side of the track at the crest of the hill. There is curbing on the left but you need to be at least a full car width away from it. This will make turn 9 a long sweeper. The clip point is near the middle of the left side curbing. After the clip point, aim the vehicle for the far right side at the start of turn 10. Heavy braking is required after the exit of turn 9 and when you are aimed at the far right side.

TURN 10 (Slow speed left hander)

Turn 10 is relatively slow, quite long and quite hard on the front right tire. As such, it is better to slightly over-brake before turn-in. This is the set-up for turn 11 which is the most important turn as it leads to the longest straight. Better to enter slow and exit fast. The turn-in is started about a car width away from the left side curbing. Throughout the turn, the vehicle is brought closer to the curbing until at the very end you have started to nibble it with the left front tire.

TURN 11 (Medium speed right hander)

The turn-in is immediately at the end of the left side curbing of turn 10 and is somewhat blind. Start to accelerate at the turn-in and get the vehicle close to the right side wall at the clip point. Allow the vehicle to exit from the right side clip point and travel in a smooth arc across the track to the left side curbing where you will be at full power. Continue to accelerate while staying about a car width from the left side wall. Stay to the right side of the painted line

down the middle of the drag strip unless you are passing. Avoid straddling the line as there is a metal plate near the end of the pits.

Lance Hogarth

SECTION I - BASIC TRACK ETIQUETTE

PIT AREA

The track driving direction will be ONE WAY AT ALL TIMES unless otherwise directed by the Driving School officials. The pit area will be broadly divided into 2 **lanes**. One lane will be reserved for cars waiting for track time. This will be designated as the "cold lane". It is generally the lane closest to the pit wall, between the race track and the pit area. Please use this lane when waiting for track time and/or driving instructors. The other lane is the "hot lane" and is used by cars exiting and re-entering the track.

SAFETY NOTE: - AT ALL TIMES BE AWARE OF MOVING CARS IN THE PIT AREA.

BLEED LINE

The "bleed line" is the painted white line on the track at the exit of the pits -of most circuits. Where marked, cars entering the track must stay between the bleed line and the edge of the pavement until past the line. This minimizes the risk of collision between fast moving cars which are already on the track, and slower moving cars exiting the pit area. You can enter the track only under the direction of the Track Steward who will be located in the flagstand at START/FINISH, or at the entry to the track. He/she will direct you to proceed onto the track only when it is safe to do so.

SAFETY NOTE: - 4 WHEELS OVER THE BLEED LINE (4 at a time or 2 at two separate times) AND YOU GO HOME.

ENTERING THE PIT AREA

You will have two situations when you will have to enter the pit area. The first will be when your group is called to line up in the cold lane, and subsequently when you are coming off the track.

When you are entering the pit area from the parking area, watch very carefully for other cars. Make sure that there are no cars signaling to enter the pit area before proceeding. Enter the pit area and immediately proceed to the COLD lane. Run group members will line up on a first come first serve basis.

When exiting the track, stay on the outside of corner nine (9). Move over onto the concrete apron as quickly and as smoothly as possible. Roll down your window, and raise your left hand to indicate your intention to drivers behind you and to those entering the pit lane(s) from the parking area. Proceed into the HOT lane. **DO NOT USE TURN SIGNALS IN THE PIT AREA.**



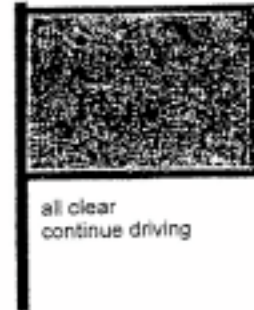
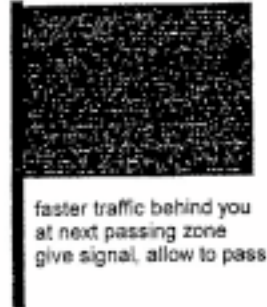
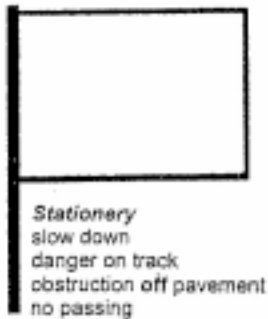
FLAG SIGNALS

Students must learn to recognize and heed flag signals from the track marshal and the corner workers. The circuit workers are trained to give the drivers a continuous update on the dangers which may arise in the course of an on-track session, and the decisions that the track director may take during the session. They will use the driver identification numbers assigned to you, (and fixed to the car on the inside rear windows), to report any incident to the Chief Instructor, Get to know where your flag stations are located!

Flags are the primary and often times the only means for the marshals to communicate with the driver (and his/her instructor). They must be able to use their **peripheral vision** to keep an eye on track-side, where the marshals stand, while he/she is driving. Most of the time the flags are used to warn the drivers of potential situations - if a faster car is about to lap

him/her; if there is oil on the track or other slippery conditions; an accident or blockage ahead; unsportsmanlike conduct resulting in endangerment to other drivers or a mechanical problem/failure which the driver has failed to notice.

It must be remembered that the marshals are there to ensure your safety and that of the other motorists in the session, so it is important that you heed their warnings. They will also report (via radio) bad passes, unsportsmanlike conduct, potential mechanical problems, and changing track conditions to the chief **instructor, who will then bring in the offending vehicle(s)** for consultation.



PASSING RULES

IF YOU BREAK THESE RULES ONCE, YOU GET A WARNING.
IF YOU BREAK THESE RULES AGAIN, YOU GO HOME WITHOUT A REFUND.

RULE 1 - PASSING ZONES: AT MOSPORT

Passing will be allowed in three areas of the track only.

- on the Front Straight, between corner Ten (10) and corner One (1);
- between corner Three (3) and corner Four (4);
- and on the Back Straight between corner Five C (5C) and the top of the hill at corner Eight (8).

AT LE CIRCUIT MONT TREMBLANT

Passing will be allowed in three areas of the track only.

- on the Front Straight, between corner Fourteen (14) and corner One (1);
- between corner Seven (7) and corner Eight (8);
- and on the Back Straight between corner Eight (8) and corner Ten (10).

AT ATLANTIC MOTORSPORT PARK

Passing will be allowed in two areas of the track only.

- on the Front Straight, between corner Eleven (11) and corner One (1) and
- on the Back Straight between corner Five (5) and corner Seven (7).

AT RACE CITY MOTORSPORT PARK (CALGARY)

Passing will be allowed in two areas of the track only.

- on the Front Straight (which is the Dragstrip), and
- on the Back Straight between corner Six (6) and corner seven (7).

Please refer to the section on proper rear-view mirror adjustment and ensure that all mirrors are correctly adjusted before entering the track.

RULE 2 - SLOWER CAR

Stay on the line that you are driving.

- Signal with your turn signals on which side you want to be passed.
- Slow down (even if you have more horsepower than the car which is attempting to pass you).
- Give 3 or 4 signal flashes to each car you want to let by. Wait for a few seconds, then signal the next car. Repeat this maneuver, waiting for a few seconds between signalling, until all the faster drivers have passed safely.

RULE 3 - FASTER CAR

Stay at least 8 car lengths back of the slower car (do not fill his/her mirrors and make them nervous).

- On the corner prior to the passing zone, stay at least 4 car lengths back and wait for YOUR signal to pass.
- Let the slower car complete the turn safely.
- NO SIGNAL, NO PASSING!
- Do not drive in the slower car's blind spot and expect to get a passing signal.
- Stay directly behind the slower car.
- If you are the second, third or fourth faster car, then each driver must wait for his/her signal to ensure the acknowledged your presence.
- Pass with care.

RULE 4 - FOUR OFF RULES

If you make a driving error, do not try to force the car back onto the pavement. Continue your chosen path off the pavement, over the speed bumps, or onto the gravel/grass. Get your steering under control first, before attempting to get back onto the pavement. Make sure that you check for approaching cars before any attempt is made to rejoin the track.

If you do get off with all four wheels and come to a sliding stop, make sure that you get out and check the car for signs of damage before attempting to rejoin the track. You may have damaged your suspension, or could be leaking fluid which may prove hazardous to other drivers.

In any case, whether you put two wheels off or four wheels off, you will incur a **black flag** and will have to come into the pits for consultation with the Chief Instructor.

During the course of the weekend you are granted two (2) two wheels off, and one (1) four wheels off. An additional offense suggests that you have been driving beyond your capabilities and are a danger to yourself and to other drivers in your run group. You will be asked to leave the school and will NOT receive a refund.

BRAKE COOLING

When you have been shown the checkered flag at the end of a track session, you should use the next lap as a "cool-down" lap, to cool down the fluids and the brakes before coming back into the pits. Try to approach all corners slower so as not to heat your brakes up excessively. Throttle back, maintain your line and Absolutely No Passing.

Once you have exited the pit area after coming off the track, you may still want to cool your brakes some more. Try doing a few slow laps around the parking area to ensure the brakes are cooled as much as possible.

When you do park your car do not use the handbrake. Your rotors will still be quite hot and there is a chance that the brake pads may bond to the hot rotors. Simply leave the car in gear.

SECTION 2 - DRIVING EXERCISES

The driving exercises are designed to allow you to explore the handling limits of you and your car. That said, many of the techniques that you will be introduced to during the course of the 2-day school **will** of necessity have to become habitual or "instinctive", if you are to master high performance driving. For a technique to become habitual, you must consciously practice it for at least twenty (20) times before you will be able to commit it to the subconscious. Only then **will** you be able to react quickly enough at high speed to be able to catch a car that you have pushed momentarily over the performance envelop.

Wherever possible the driving exercises will be moved from the circuit to a closed loop slalom in the parking areas, as this will free up the track for other on-track activities. The organizers will try to maintain aspects of the exercises outlined below within the closed loop slalom. Please bear in mind that some exercises requiring higher speeds or long run-off areas may be kept on track for safety reasons. Changes to the format of the driving exercises will be discussed at the Drivers' Meeting of the event.

SKID PAD

This exercise is designed to allow students to explore the handling characteristics of their car at the limits of adhesion. You will learn to feel what it is like to exceed traction limits, (while still being able to recover) in a safe environment. You will explore car control using throttle and steering modulation.

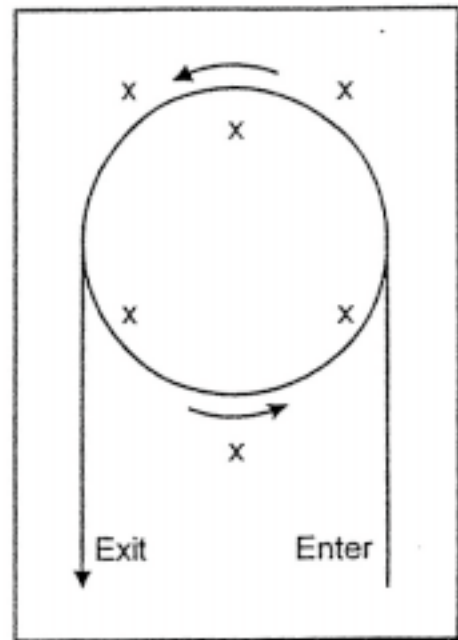
Drivers will line up facing the skid pad. The skid pad is described by an equilateral triangle formed with 3 pylons. As the name implies, the pad will be hosed down with water to exaggerate steering input.

You will learn to transfer weight to the **front** of the car (by lifting off the throttle) or to the back of the car (by sharply pressing down on the throttle) thereby inducing understeer and oversteer respectively, (See Section 5 for a more complete explanation). This exercise will be done first as the process of using throttle inputs to help steer the car is basic to all other aspects of car control near the limit of traction.

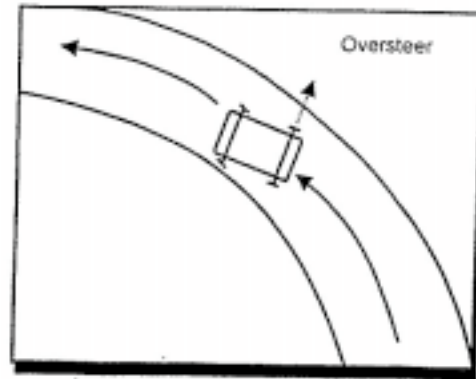
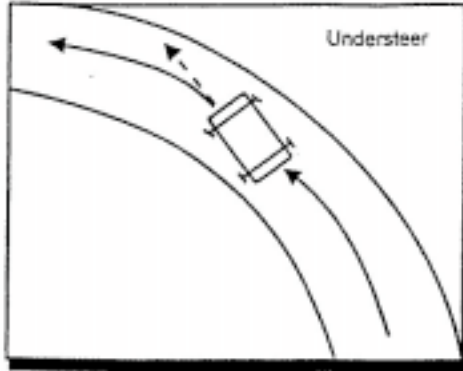
As you enter the skid pad, you will turn in and adjust your steering input to describe a constant radius circle. By modulating the throttle while keeping the steering input constant, you will be able to experience understeer and oversteer.

By applying gentle throttle pressure, you will feel the car push to the outside of the circle, in spite of the front wheels being turned, (a condition known as understeer).

Repeat the above exercise, but this time instead of applying gentle throttle pressure, simply floor the throttle. In rear-wheel drive cars, the rear end of the car will break loose; (this condition is known as oversteer).



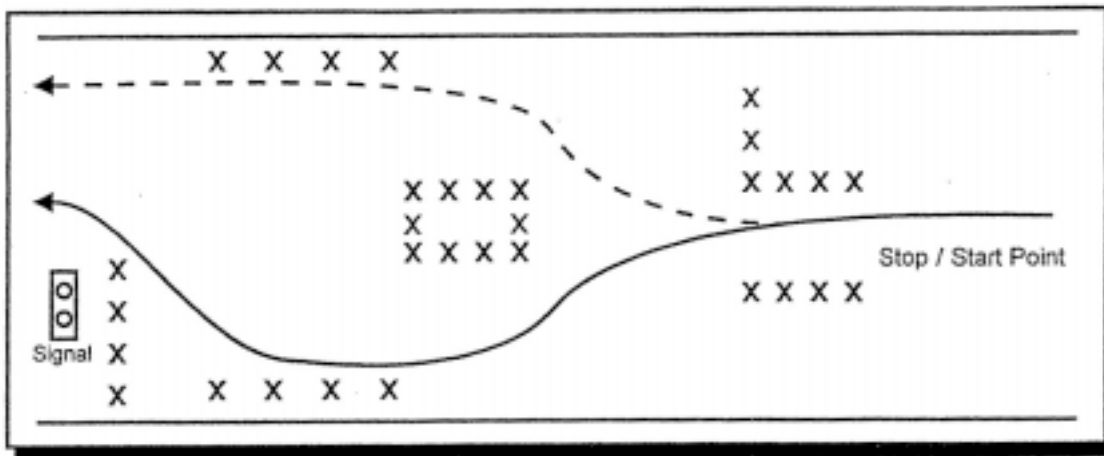
You will normally do three to four revolutions around the skid pad each time out, then exit and return to the waiting grid.



ACCIDENT AVOIDANCE

The accident avoidance exercise has been devised to simulate a condition that could occur on a public road wherein you, the driver, are following a truck which happens to be carrying a load of boxes. The truck hits an unexpected bump, dislodging a box which falls into your path. You will be forced to take avoidance action to prevent hitting the obstacle in your path.

The simulation will use a series of pylons outlining an obstacle which must be avoided. You will accelerate up to a minimum of 70 km/h. (Entry speed will vary depending on available run-off). Upon entering the pylon box, you see the "obstacle" and must brake hard to slow down; release the brakes and steer to the left side (the oncoming lane) under acceleration, and then steer back to the right (your lane) and carry on.



Some distance behind the pylons you will see a marshal with a flag. As you enter the pylon box the marshal will wave the flag left or right, indicating the direction you should turn to avoid the obstacle. If the flag is pointed to the LEFT, then turn and go to the LEFT, before returning to your original lane. If the flag is to the RIGHT, turn to the RIGHT and come to a complete STOP.

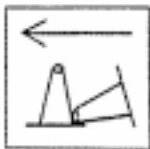
By going to the right, you have simulated driving onto the shoulder of the road. Once you have stopped, start and continue to the next exercise. If no flag is shown - USE YOUR JUDGEMENT! (Keep in mind that the purpose of this exercise is to try and avoid the obstacle in your path).

WIDE SLALOM

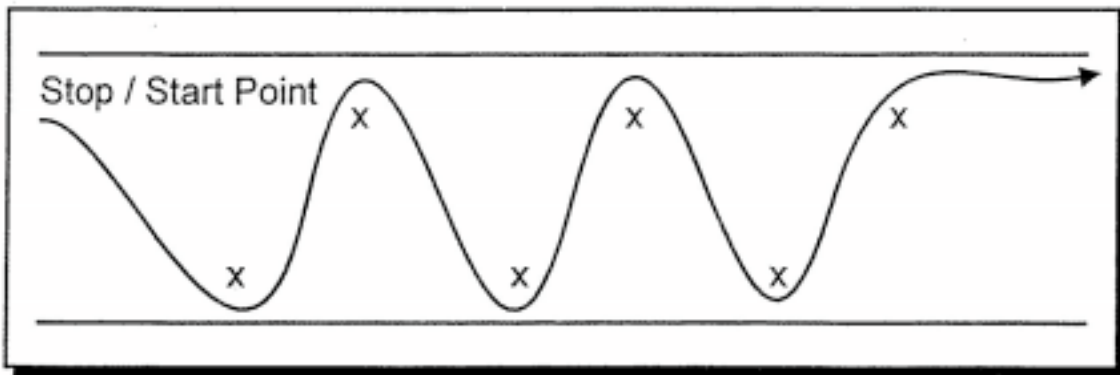
The wide slalom has been set up to give you an appreciation of the feel of your car during transitions. The basic approach in slaloms is similar to any other set of turns that are very tightly linked. If your car tends to understeer, you will need to find a way to get the back end around. If on the other hand, your car wants to oversteer, you will need to apply some throttle as you turn around each pylon, and do any braking or lifting of the throttle that is needed in the little straights between the pylons.

Remember that the car has a slight delayed response to steering input, and you will need to turn the wheels just a little before you think you need the car to turn. This effect will be particularly noticeable when you run a slalom, because of the rapid back and forth transitions.

The sensation of a slalom at moderate speeds should be quite pleasant. Try to take a smooth approach, not a Sunday drive mind you, but do not get the car unsettled. On higher speed slaloms, you may need to lift the throttle or tap the brakes to balance the car. All this is at first tricky to coordinate, and you will need to practice before you become expert at it. You must learn to "dance" with the car.



Pylon Marker - (set up at the entrance to the slalom) stay to the left.

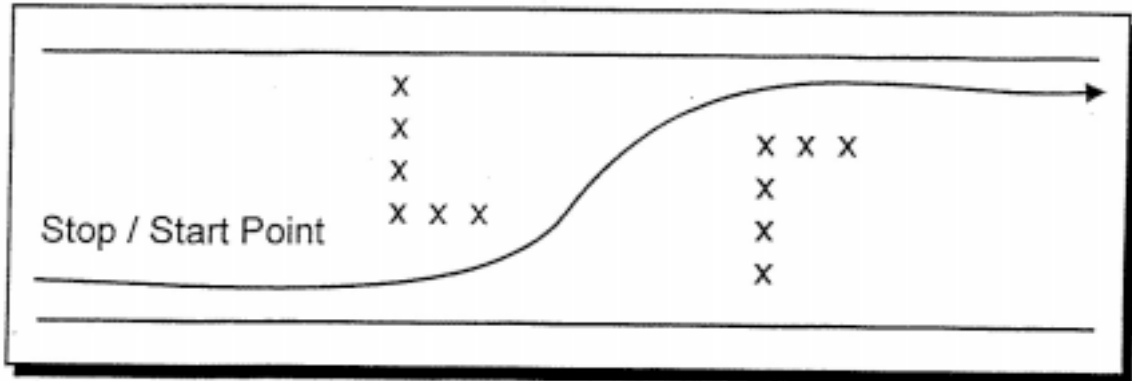


EMERGENCY LANE CHANGE

There are two groups of cones. Approach the pylons while accelerating to around 50-60 km/h. You will enter on the side that is open and switch lanes without braking. Try to be as smooth as possible during the transition to avoid unbalancing the car.

This exercise will also train your alertness and vision. Note that the lane change exercises will

be varied without warning from right-to-left to left-to-right during the session. Don't get caught out on public roads!
ALWAYS KEEP YOUR HEAD UP!

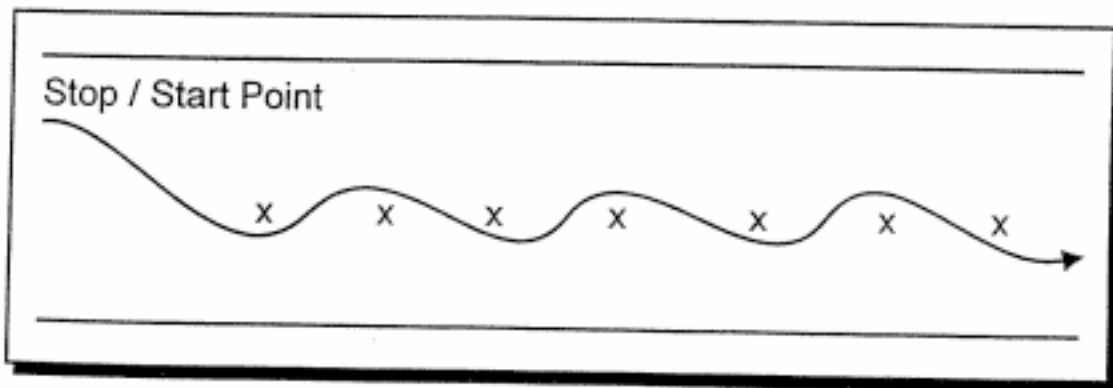


Always look as far ahead as possible, and try to be aware of possible escape routes (into other lanes) should an emergency situation arise.

STRAIGHT SLALOM

The primary difference between this slalom and the previous one, is that the pylons in this case are now evenly spaced, and thus requires a slightly different approach. You will accelerate from a standstill to about 45 km/h, which allows you weave through the pylons (or "debris" on the road) evenly. As in the previous case, try to develop a pleasant back and forth sensation while negotiating the course. Transitions between throttle-on and throttle-off should be as smooth. Throttle modulation should be firm but gentle. Remember, "dance" with the car - try to be smooth!

You should try to maintain a constant hand position on the steering wheel, turn in smoothly and completely, and unwind smoothly and completely. If it feels good, then try it the next time through at 50 or 55 km/h. With increased speed, throttle modulation will become essential to smooth car control. In some cars, however, depending on steering ratios, it may be necessary to have your hands change position on the wheel during this maneuver.



CORNERING

This exercise is best done out on the circuit, as you familiarize yourself with the track. It will demonstrate to you that by taking different "driving lines" through a given turn at speed, you can still safely negotiate the turn. Always keep your head up, and be aware that you might encounter potential obstacles around the next bend.

Notice how throttle and steering modulation is used to get the car to the apex and to "peel off" upon exit. The speed at which this is done becomes a function of speed relative to how close one is to the limits of (tire) adhesion. Smoothness in this maneuver will depend on entry speed and subsequent velocity through the curve.

In principle, your eyes should "scan" as much of the corner as possible; the less you see, the slower you should enter the bend. Most accidents happen because drivers take too much speed into a corner, and leave themselves no margin to accelerate out to avoid the unexpected - (debris or Pedestrians) around a blind corner.

PROPER CORNERING TECHNIQUE

There are 6 elements to every corner:

- Maximum braking - downshifting into the proper EXIT gear before reaching the turn-in point.
- Maximum braking complete - ease off brakes; begin Turning Into corner, carving an arc around to the apex,
- Transition zone - balance important transition from braking to gentle throttle application.
- Apex - approximately 2/3 of way through corner. Begin squeezing on more throttle.
- Unwind - allow the car to unwind out of the corner.
- Exit and accelerate - making a smooth arc onto the following straight.

Use the "Turn-in", "Apex" and "Exit" pylons as a guide in your **peripheral vision**, (see Section 3), but in general try to start using objects along the road as a guide, should the pylons start to disappear later on in the weekend. There are no "pylons" in your daily driving. Always keep in mind that the pavement that you are driving on represents your lane on the highway, and the grass on the left represents the oncoming lane which you really do not want to get into. The whole concept of corners and cornering techniques will be discussed in greater detail latter on.

THRESHOLD BRAKING

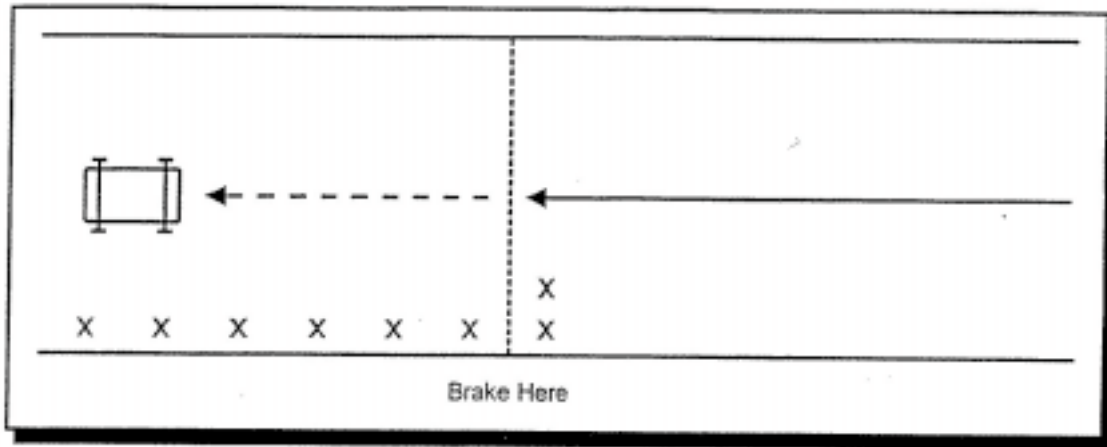
This exercise is intended to graphically illustrate the concept of threshold braking (in cars without ABS brake systems). You will be accelerating down the straight up to 80-100 km/h. The braking zone will be outlined by the pylons on the left side of the pavement. As you pass the double pylons, you will apply the brakes by squeezing the brake pedal down (as opposed to stomping on the pedal). Continue squeezing the pedal down as hard as possible until the brakes begin "locking up". At this point, you should back off slightly until the wheels begin to turn once more. This will be the threshold of maximum braking force, hence the term "threshold braking".

For cars with ABS braking systems, continue squeezing the pedal down as hard as possible, and hold it down no matter what, letting the system do the modulating to avoid lock-up. This will require some practice as most people find it unnatural at first to just press the brake pedal as hard as possible without worrying about locking-up and skidding. You will feel some degree of

throbbing in the brake pedal once the ABS kicks in, which can be unnerving at first! Find the distance that it takes your ABS-equipped car to come to a complete stop from a given speed. Remember, every production BMWs can decelerate faster than they can accelerate! Get to know your brakes and their ability!

Wherever possible, each student will have several laps of either the circuit exercises or the parking lot slalom course, and thus will be able to do each exercise several times, as time and space permit. In cases where the exercises are set up in the parking area, every effort will be made to leave the slalom course set up throughout the weekend.

MAKE EVERY EFFORT TO TAKE ADVANTAGE OF THIS OPPORTUNITY!



SHIFTING GEARS

Most people do not realize that there are generally four (4) pedals in the footwells of most manual transmission cars. From the right these are the accelerator, the brake, the clutch and the DEAD PEDAL. Under severe braking, the driver steadies him/herself by pressing down firmly on the dead pedal with the left foot, which allows the upper body and arms to remain relaxed and ready to delivery steering input. This allows far greater accuracy during hard braking. Inputs should always be relatively slow and gentle. You should gradually ease on brake pressure. Remember to go faster on the track, you must first slow down you inputs in the cockpit. Every maneuver has to be done gently and slowly to keep the car balanced at all times. **KEEP COCKPIT MOVEMENT TO A MINIMUM!**

HEEL-AND-TOE DOWN-SHIFTING

This is a concept which is much talked about, but which few drivers have actually mastered. Heel-and-Toe shifting or downshifting allows you to match the engine revs to the optimum RPM range required for the newly selected gear, required for exiting a corner, thus allowing smoother acceleration out of the turn. It describes the method of downshifting in which the left foot depresses the clutch pedal and the right foot operates both the brake and the throttle. Specifically, the right knee is cocked towards the left knee, allowing the right foot to be placed in such a way that the ball of the foot is on the brake pedal, while the outside of the foot is held

over the throttle pedal, but not yet touching it. When you need to blip the throttle, a rotation (or rolling over) of the foot allows you to blip the throttle pedal while maintaining maximum pressure on the brake pedal. The foot does not actually move from side to side. The right side of the foot moves up and down as needed.

You want to blip the throttle, waiting until the revs just start to fall back before releasing the clutch and slipping into the next lower gear. If you blip too much the car will want to accelerate. If you blip too little, the car will slow down against the compression of the engine.

Smoothness, precision and finesse are the keys to good shifting technique. Many drivers feel that they have to bang off their shifts as fast as possible to go quickly. Wrong! In fact the amount of time you save is minimal, especially compared to the time you can lose if you miss one single shift. A shift should be made gently and with finesse. Simply place the shifter into gear as smoothly as possible. A shift should never be felt by other passengers in the car. Generally, you will only need three fingers to change gears; try to "feel" the car into gear. There is no need to fight it. As a good rule of thumb, treat the shift knob like an eggshell - try to be firm but gentle when selecting gears; don't force it into the next gear, you will crack the shell!

The reason for downshifting is not to slow the car. That is what the brakes are for. Too many drivers try to use the engine compression braking effect to slow the car. All they really achieve is upsetting the balance of the car by making jerky downshifts, So BRAKE - THEN DOWNSHIFT. You will add a lot to your engine's life as well - replacing brake pads are much cheaper than bits and pieces, of an over-revved engine.

Try to remember the following points

When finished making a shift, get your right hand back on the steering wheel as quickly as possible; don't ride the shifter.

Do not ride the clutch pedal with the left foot. All modern BMW's and most sports cars have a genuine dead pedal. Use this to brace your upper body with your left foot when not changing gears.

Do not slip the clutch. Let the clutch out smoothly as it will last longer.

Never downshift in the middle of a corner. It will unbalance the car and can possibly cause a skid, which you may be unable to correct. Remember, complete your downshift in the braking zone, before turning in towards the apex.

Shifting up to a higher gear is fairly straightforward. Wait until the car is at or near the redline or rev-limiter and be quick about making a gear change. You will want to select the next gear at or slightly above maximum power and be back on the throttle before the revs have fallen below the point of maximum torque. (If you are unsure of the engine speeds at which your car achieves its maximum power output measured in brake horsepower, (bhp), and maximum torque, measured in foot-pounds, (ft-lb.), please consult the engine and performance data charts in your car's *Owner's Manual*).

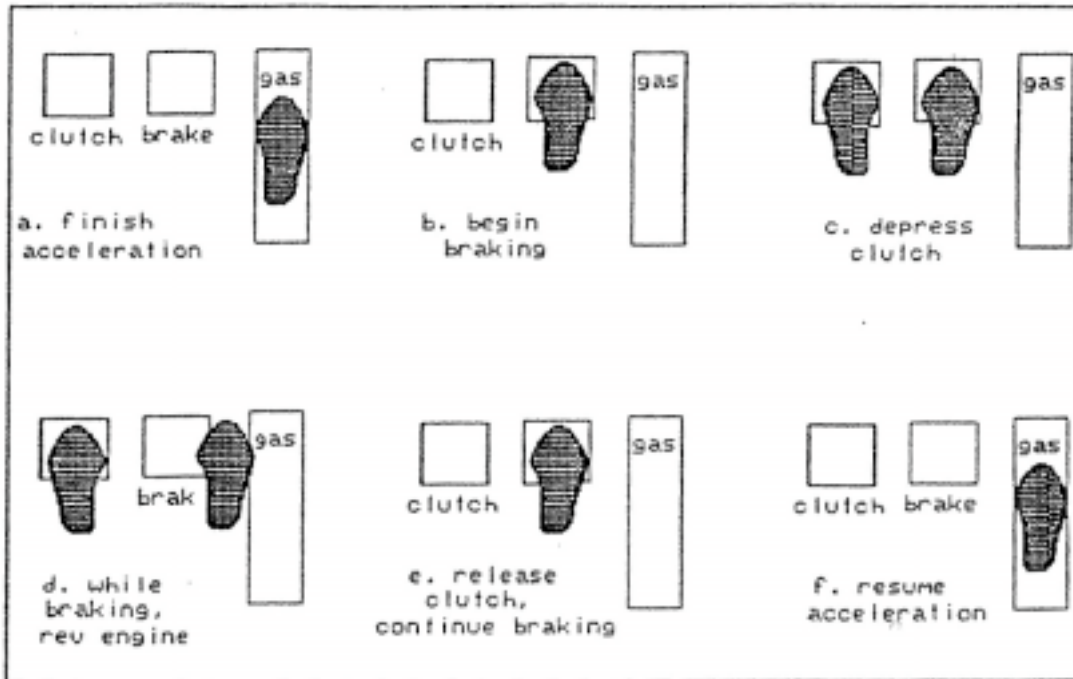
Remember - BRAKE FIRST, THEN DOWNSHIFT.

Heel-and-Toe Downshifting requires inputs from the ear and forces on the body. Try not to look directly at the tachometer. Get used to scanning the position of the tachometer needle using your peripheral vision. (With practice you will be able to scan the approaching corner and see your tachometer needle approach the redline). Your attention should be directed to the approaching corner. Remember, if you do not blip enough, the drive wheels may lock up when the clutch is re-engaged. If you blip too much, the car will attempt to accelerate (when you are supposed to be slowing down). The best way is to rev the engine up slightly higher than is necessary selecting the required gear as the revs drop, and quickly engage the

clutch. You can downshift two gears at once but remember that you must slow the car down even more with the brakes before downshifting.

Heel-and-Toe Downshifting takes lots of practice. The best way to learn and practice this technique is to try shifting even before the car is started. Once you can do it properly standing still, you can begin to work on getting it right with the car moving.

Please refer to the step by step schematic illustrated below.



A MOTORSPORT TRACK IS NO PLACE TO PRACTICE!

Try practicing in an industrial estate early on a weekend morning. Remember - smoothness and overall car control are paramount. If you are still not sure of the technique, ask your instructor to show you on the track or in the parking lot.

PEDAL APPLICATION

Correct application of both throttle and brakes is something that not many drivers are aware of. **THE GAS PEDAL IS NOT AN ON-OFF SWITCH.** Always use the gas pedal gently - progressively squeezing mote throttle as you accelerate and gently easing off as you slow down. Anytime that you pounce on the gas pedal or abruptly lift off, it causes an extreme weight transfer which reduces traction. The smoother you are with the throttle, the better balanced the car will be, and ultimately the more traction and speed you will have.

SQUEEZE THE BRAKE PEDAL DOWN AND EASE BACK OFF IT. Again, the smoother you are with the brakes - the better balanced the car will be. Jackie Stewart often claims that the main reason that he won so many Grand Prix was because he eased off the brakes smoother than his competitors. It allowed him to enter the corners a fraction faster because the car was better balanced. Obviously the squeezing on and easing off the gas and brake pedal must be done quickly, **BUT** you should always emphasize smoothness.

SECTION 3 - DRIVING BASICS

INTRODUCTION

During this school, we will be teaching you advanced driving skills and high performance driving techniques. There are however, a few basic rules that you should be aware of before continuing.

- Never drive with impaired vision. Wear corrective eyeglasses or contact lenses should you need them, and regular eye protection (sunglasses), to cut down on the glare.
- Never drive if over-tired. You can quickly become visually and mentally impaired.
- **DO NOT DRINK AND DRIVE!** Remember that the effects of alcohol consumption can last up to 24 hours.

While driving, try not to concentrate on any one object in front of you, such as the car that you are following. Look as far ahead as possible, and be prepared to react. By keeping your eyes level, this gives you a reference point for **proper BALANCE**.

CONDITIONING

High speed driving DEMANDS total concentration, split second timing, and fully coordinated muscle involvement. If a driver is bothered with muscular aches and pains, is uncomfortable or overly tired, then it becomes impossible to perform at his/her maximum potential. As a high performance driver, you should ensure that you eat a good breakfast and/or lunch, and drink lots of fluids, (i.e. water, *Gatorade*, etc.), to keep you hydrated and to ensure proper anion/cation balance following fluid loss through sweating. If you do start to become fatigued, **PULL IN AT ONCE AND REST!**

A tired driver makes mistakes, and may become a danger to himself or herself as well as to other drivers on the track. For obvious reasons, no alcohol or other prescription drugs, (including drowsiness-inducing antihistamines), should be consumed during the event.

IF WE SUSPECT THAT YOU ARE DRIVING IMPAIRED, THE ORGANIZERS WILL ASK THAT YOU LEAVE THE TRACK AT ONCE.

SEATING POSITION

The right driving position is the starting point for a correct driving technique and whatever your views on just how things should be done, the position of arms, legs, the height of your body, distance from the controls and instruments, are all of vital importance in maintaining car control in all circumstances. The way your body fits into the seat, and the way you use your hands and feet are both vitally important to driving effectively. You touch the car through your hands, your feet, and your entire seating position. It is important that these be correct, so that you and your car can become a single highly-tuned unit. In so doing, you'll be sensitive to the various vibrations and g-forces you require so that you can effectively interpret what the car is doing. You should ensure that you are as comfortable as possible, as it is



much less tiring, and easier to concentrate if you are.

If you are a believer in the straight-arm school of driving, forget it. No one, whether he be a Formula One driver, Rally driver or Police instructor would advocate it. Much has been said about Race and Rally drivers "becoming a part of the car". It is a cliché perhaps, but true none the less. And to achieve the ultimate in car control and safety, it is the essential first step. Arms should be slightly (and comfortably) bent, you should be able to achieve maximum braking pressure with the leg slightly bent and there should be adequate clearance between the lower rim of the steering wheel and the top of your thighs and knees.

The driver must ALWAYS be able to reach the pedals, steering wheel and shift lever with ease. If you are unable to do so, then you are unconsciously making some compensation which will lessen your overall concentration in the long run. Try to carry out the following adjustments before venturing onto the track.

DRIVER'S SEAT

Dig yourself into **the seat back** by pushing back with your feet. Don't sit on the seat SIT IN IT! Become a part of it! Next adjust the rake of the seat back, and extend your right arm so that you are able to rest the pad of the thumb on the top of the steering wheel without lifting your shoulders away from the seat back. You should still have your arms bent slightly at the elbow. (This may pose some problems for tall drivers in some BMW models, as there is no steering adjust. In such instances, it may be difficult to rest your wrist on the top of the steering wheel, while keeping your shoulders on the seat back). You should of course make sure that you still have a clear view of the instruments.

SHIFTER & PEDALS

Next, check your reach to the shift lever. Again, try not to lean forward while doing this. Keep your back pressed firmly against the seat back while you make this adjustment. You usually need only three fingers to effectively feel the car into the next gear. There is no need to fight with it. You may have to concentrate to effect smooth gear changes. Quickness will come with time.

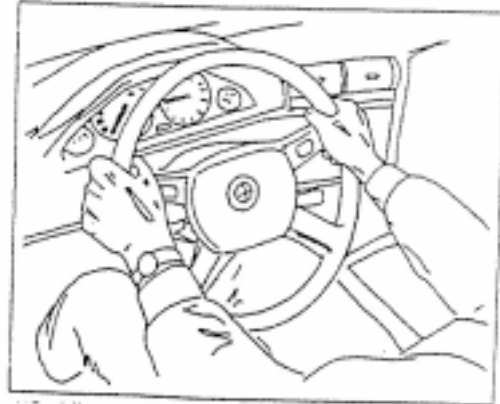
When seated in the car, you should be able to fully reach and depress all four (4) pedals and still have a slight bend in your legs. To achieve this, pull the seat cushion forward so that you are able to rest the sole of your foot on the floor under the pedals, while still able to bend your knees slightly. This will be the least tiring position and permits the use of the balls of the feet, (the most sensitive areas), on the pedals. The driver must be able to use the Dead pedal to firmly anchor him/herself in the seat. Remember, under severe braking, the driver will use the dead pedal to steady him/herself, so you must be as comfortable as possible. Repeat the above procedure until a manageable compromise can be achieved.

SEATBELT

Lastly, tighten the seatbelt or harness as tightly as possible, without cutting off circulation or causing discomfort. After a few laps even a tight belt will begin to feel loose, so you may have to come back into the pits to readjust your belts as required. Seat belts or harnesses are very important as they keep you in your seat, and ready to control the car instead of being tossed about inside it.

HOLDING THE STEERING WHEEL

Again, try to be as comfortable as possible. Firstly, and most importantly, **ALWAYS DRIVE WITH BOTH HANDS** on the steering wheel except when shifting gears. Do not drive with one hand on the wheel and one on the shifter. The position of your hands on the steering wheel should be at 3 and 9 o'clock, or 2 and 10 o'clock. Do not keep your hands at the top of the steering wheel like a taxi driver. You can either rest your thumbs on the wheel itself or hook them over the lateral spokes. (By always holding the wheel in the same position you'll always know the extent of steering input dialed in and where the straight ahead position is). Try to grip the wheel firmly, but don't choke it. Try holding the wheel between the fingers and the ball of the thumb. This allows freer movement of the thumb, which should translate into better steering feel. (If any of you have caught and held a bird you'll appreciate the correct pressure to be exerted).



When you turn into a corner, you should try to pull the steering wheel into the corner, rather than push it. This movement uses the forearms and the biceps, which is a much more natural movement than pushing the wheel, and allows for greater accuracy of movement. Pushing the wheel uses the triceps and wrist, which is not as natural.

Either of the above two hand positions should allow you to make most turns without moving your hands around the wheel. For very sharp turns, try to reposition your hands before entering the corner. Always try to make the minimum of hand movements on the wheel. Every movement with the wheel should be made smoothly and progressively. Never jerk the steering into a turn - it should be turned in a gentle, smooth arc.

At higher entry speeds, it may become necessary to balance the car through the bend either by "sawing" back and forth on the wheel, or using a "stepped-steering" motion. Either method requires that the driver modulate his/her steering input, to get the car through the bend as quickly as possible.

An important rule of thumb to remember is that the less you turn the steering wheel, the more traction you will have. The front tires have all the traction you need going forward in a straight line. Every time you turn them there is the possibility of breaking traction as the tire scrubs sideways on the road (which also decreases your speed). So for safety and speed, keep the front wheels pointed straight ahead as much as possible, (driving as straight a line as you can through the corner), and then straightening out as soon as possible afterwards - unwinding the wheel upon exiting.

VISION

It is generally accepted that vision is the primary sense used for driving. Of all the various human motor skills necessary to control a car, vision would rank as number one. If you are visually impaired, it becomes impossible to drive. Vision starts with the eyes. As with all hunting animals, we have the ability to see three dimensionally. Each eye sees an object from a slightly different perspective, but there is considerable overlap in the middle, producing binocular vision. The brain is able to combine the two images and thus interpret signals.

We use light to interpret our surroundings, and concentrate on what is important. We are able to identify important situations under different conditions by first scanning an object and then analyzing for known characteristics. Light entering the eye falls on the retina which is packed with sight receptors, either cones (for detecting color) or rods (for detecting the degree of light or dark). The retina is thinnest at the fovea, which is in the center of our visual field. This area has the greatest concentration of cones and is ideal for detecting fine detail. Consequently, our vision is sharpest in the center of our visual field, and fuzziest at the periphery. We are however, able to detect movement easiest nearer the periphery of our visual field, hence the term "peripheral vision".

Light falling on the retina catalyses a chemical reaction in the rods and cones. A purple-colored molecule known as visual purple absorbs energy and bleaches out, rather like photographic film. (This reaction is fully reversible, however). In order to minimize this effect, the eyes tend to constantly dart around, never fixating on a single point for too long; rather they naturally fix on and analyze a series of points along a line.

At least ninety percent of our reactions while driving are a result of what our eyes report to our brain. Driving faster than your eyes can process information to your brain results in overdriving and can potentially lead to an accident, as you will be unable to react to the changing conditions ahead. **NEVER OVERDRIVE YOUR VISION!** (it takes about 0.7 seconds for an image to form on the retina, so try to keep this in mind and drive within your limits).

One of the first steps you can take in refining your driving skills is learning to look farther down the road. Your eyes actually lead your physical movement, hence your tendency to steer in the direction that you are looking in. Therefore, it is important that you focus your eyes in the direction that you want to go - not where you don't want to go! If there is an object in the road that you want to avoid, such as a pothole, don't look at it. Instead, focus on where you need to go, and the car will follow. Use your peripheral vision to detect cars beside you and their relative speed. Once you look directly at a vehicle beside you, you will tend to lose some of that sense of speed.

A thin tape-line applied across the middle of the windshield will serve as a graphic reminder to always keep your eyes up. This will broaden your vision field, slow down the environment, and allow you to drive more precisely and smoothly.

On the track, try not to concentrate on any particular object in front of you, such as the car you are following. Remember, if you fixate on the car in front of you, you will end up following his/her line, which may not be correct. Keep your eyes moving, scanning to the front and the rear. Check your mirrors often. Look well ahead, and watch for anything coming into your overall field of vision. Pay attention all the time and don't just look farther ahead, think farther ahead!

VISION EXERCISE

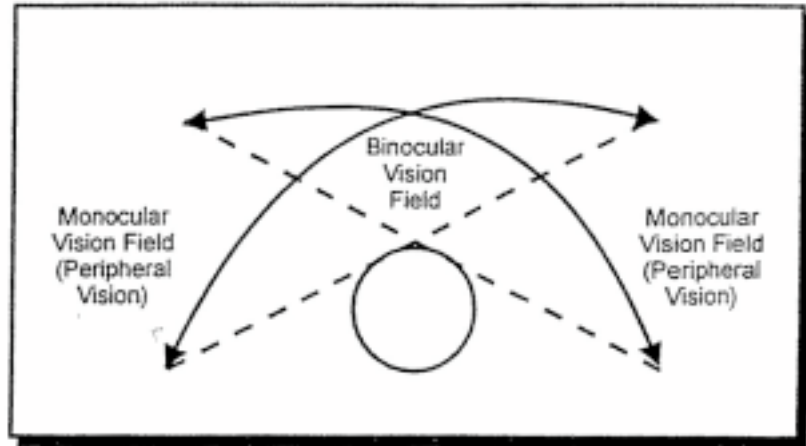
Here is an exercise that you can do around the house. It graphically illustrates the difference between "binocular" and "monocular" or "peripheral" vision.

Start by looking straight ahead and close your right eye. Hold your left hand straight out and slightly behind you. Raise your left index finger. Slowly bring your arm around until you can just see your finger with your left eye. Describe an arc with your left finger, until it just disappears from view on the right side of your head. Hold your left finger at this position.

Repeat the exercise, closing your left eye this time and moving your right index finger. Once both fingers have been moved until they are situated off to the sides of your head, open both eyes. Your index fingers will have described the area of overlap or "binocular" vision. Your

"peripheral " vision is described by one eye only, on either side of your head, hence the term "monocular" vision. Make a mental note where this area of peripheral vision is, and be prepared to hone you skills of observation using your peripheral vision.

THE CONCEPT OF SOFT FOCUS

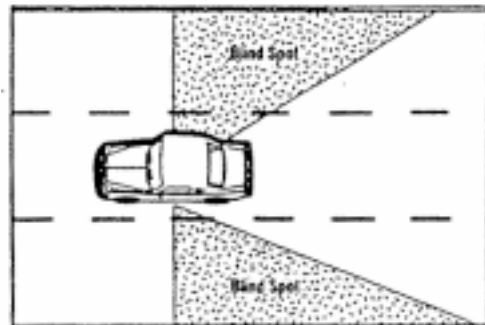


Soft focus may best be described as a relaxation of any effort what-so-ever to focus your eyes on any one object in your visual field. This should be the one time when you consciously try to relinquish control. Our eyes have a natural tendency to flit around or scan a visual field leading to total awareness of our surroundings. No part of the visual field will be in sharp focus. Remember, relaxing your focus is not necessarily to collapse (and nod off to sleep), but simply to undo tension. As stress levels increase, your peripheral vision will tend to close down. If you have to, try practicing deep breathing to remain relaxed.

MIRROR ADJUSTMENT

On the track, you will find it necessary to allow faster cars to pass you from time to time, regardless of your skill level, It is imperative that you be able to see fast approaching traffic as early as possible so that you can let them pass as quickly as possible upon entering the next passing zone.

Adjust each of your side mirrors so that you can just see that side of your car when your head is slightly tilted in that direction. Adjust your rear view mirror so that it best covers the view out of the rear window. Try to adapt this procedure to your own car on the straights of the track, during the familiarization sessions when you are driving relatively slowly.



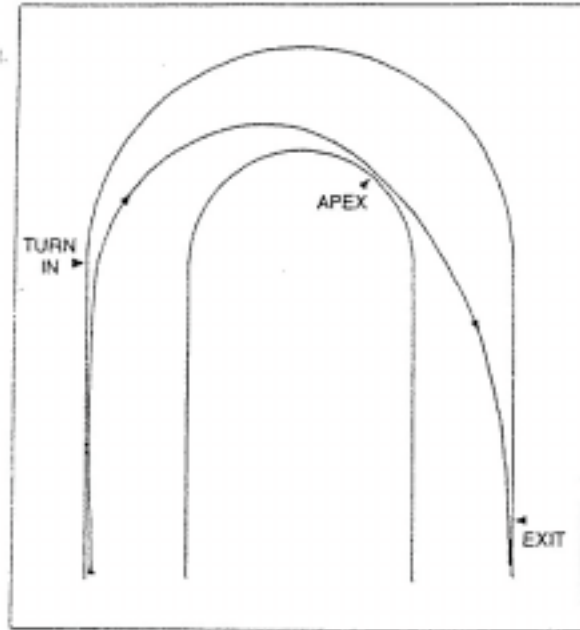
Use the following procedure to check for blind spots. As you are driving on the highway up to the track, watch for a car approaching to pass from behind then follow it in your rear-view mirror until it is out of sight up the side of your car. At that instant it should be clearly visible in the side mirror - follow it until you can see it with your peripheral vision. If it disappears for even a fraction of a second, you have a blind spot and should adjust your mirrors to compensate. This procedure should be done every time you get into a car with mirrors not adjusted by you - it only takes a few seconds, and can go a long way to preventing an accident.

TURNS AND CORNERING TECHNIQUE

Any given corner can be divided into three basic segments:

- Turn-in
- Apex
- Exit

The theoretical apex is that area of the turn where the largest possible radius of travel just touches the inside of the turn. The corner shown is a typical 90 degree right-hand turn.



The Turn-in is probably the most important part of a turn, as this dictates where you exit, how fast you exit and how balanced you exit. In lay terms, this is the part of the track where you have completed your braking and downshifting, and now begin your turn into the corner. The initial turn-in point is determined by where you want to apex the corner. That said, while braking around any road course in dry conditions, should the ABS system be activated in cars so equipped then it suggests that the driver is either very hard on the brakes in his/her braking zones, or too abrupt in his/her transitions.

The Apex of the corner is not so much a point but an area of the track where you come L closest to the curb. The apex can also be thought of as the portion of the track where you are no longer driving into a turn but are driving out. For any given corner we can draw a smooth curve that will touch the outside of the course at the entry and the exit of the turn, and touches the inside of the turn at some

point. The largest-radius curve that will do this will touch the middle of the curve at the geometric apex. This would be your perfect line if you were going around the turn at constant speed and had no particular preference about getting into the turn at high speed or getting out of the turn at high speed.

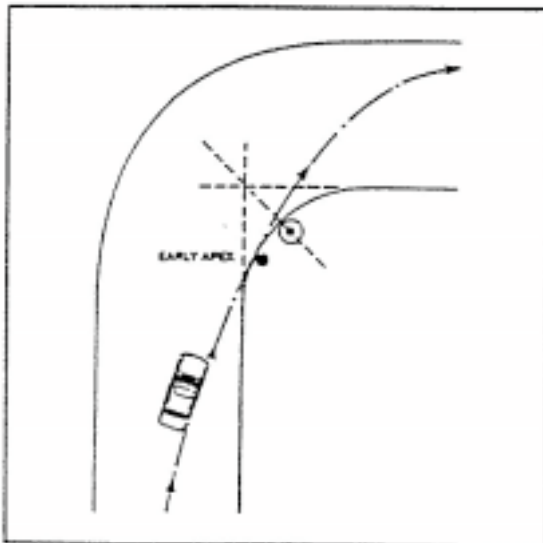


Figure A

It is important that you understand the precision that is involved with achieving the perfect apex.

If you are 25 centimeters (10 inches) away from the curb, then you are about 18 centimeters (7 inches) too far away.

As a general rule, drive all corners on the road with an apex approximately two-thirds of the way around the turn. If you come out of a corner having to apply more steering to keep

from running off the road, then you had too early an apex (Figure A) - which can be very dangerous. If on the other hand you choose too late an apex, the car will not be using all the road on exit (it will still be too close to the inside of the corner - safe, but much too slow, not the ideal line).

A late apex is the safest way to approach a high-speed turn (Figure B). A late apex approach is much more forgiving of driver miscalculation. It forces the driver to brake earlier. If the driver misjudges the turn, there is more likelihood that the car will still be able to stay on the track. If you actually hit the late apex (as opposed to never getting to the inside edge of the course) it is difficult to be going fast enough to be forced off the course at the exit. A misjudged early apex leaves very little room for error, and an early apex can be achieved at speeds high enough that there is no chance the car will stay on the course at the exit of the corner. In other words, you will crash.

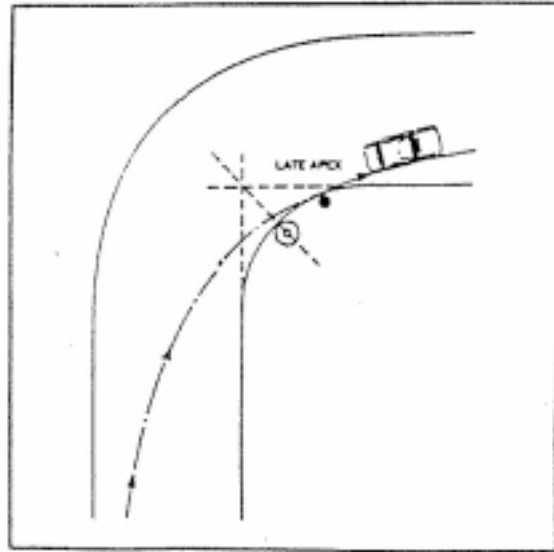


Figure B

To properly Exit a corner, you want to use up all the track (or your lane on public roads). Allow the car to come out wide, right to the edge of the course. This allows the car to smoothly and gently balance its weight, which gives you good control of the vehicle. If you come out of a corner faster, you will cover every meter of the following straight at a higher speed.

To help illustrate this concept on the track, pylons will be placed at the Turn-in points (the end of the braking zone) and the Apex of all corners on the track.

DRIVING THE IDEAL LINE

First of all, there is no one line in cornering. There will of course be an ideal line through a bend which will involve minimal turning of the steering wheel and result in maximum speed. This will be the fastest and safest way to drive through a corner. You do this by taking the largest possible radius through the bend. The less you turn the steering wheel, the less chance you have of losing traction and sliding. The person that is best at keeping the front tires as straight as possible will be the fastest.

On public roads or on an unfamiliar track, you will want to drive all corners with a late apex. While this may not be the fastest line, late apexing will allow you a little extra room on the exit if the corner happens to be tighter than you originally thought. When approaching a corner, your head should be facing straight ahead, directing your attention to the braking zone. Before getting to the turn-in point, slowly turn your head towards the apex. This transfers your peripheral vision to binocular vision, thereby accessing the image that is already in the peripheral vision. As you approach the apex, lift your head slightly and look out past the apex towards the exit of the corner. Use your soft focus to pick up the apex while looking out past it towards the exit. While the concept is difficult to describe, it will become more obvious out on the track. As you become faster and more familiar with the track, you can gradually adjust the start of your braking; but the end of the braking zone (or the start of your turn -in) remains fairly constant. GO IN SLOW - COME OUT FAST.

EYES IN CORNERING

In this chapter, we have discussed some very basic concepts, many of which may be self-evident to some of you. As we have said, perhaps the most essential sense to driving in general and cornering in particular is vision. During cornering, try to observe the following sequence:

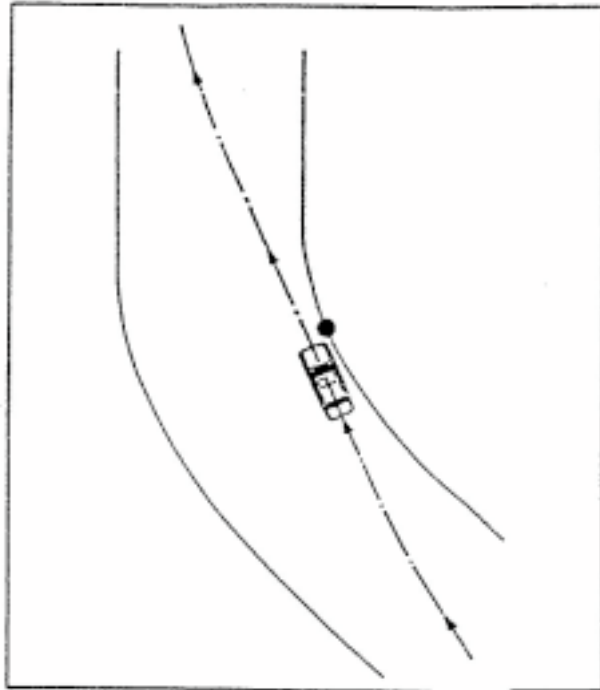
- Keep your eyes in "Soft Focus", looking from directly in front of the car out towards the corner and beyond.
- Next, move your eyes through the Braking zone and Turn-in point.
- Move your eyes to the region of the Apex, only after braking is fully under control.
- Be sure to note where the apex is before arriving there.
- Just before arriving at the apex, lift your eyes gradually towards the Exit of the corner.
- No effort should be made to control the focusing of the eyes during this sequence. Your pre-programmed brain's mode of operation should be automatic and will be correct.
- Be visually and mentally aware of the space around your car. To be aware does not necessarily mean looking directly in any given direction. Use your peripheral vision.
- When looking towards any given region, try turning your whole head to face the direction in which you want to go. Thus, if you are looking towards the apex, then turn your head to face the apex.

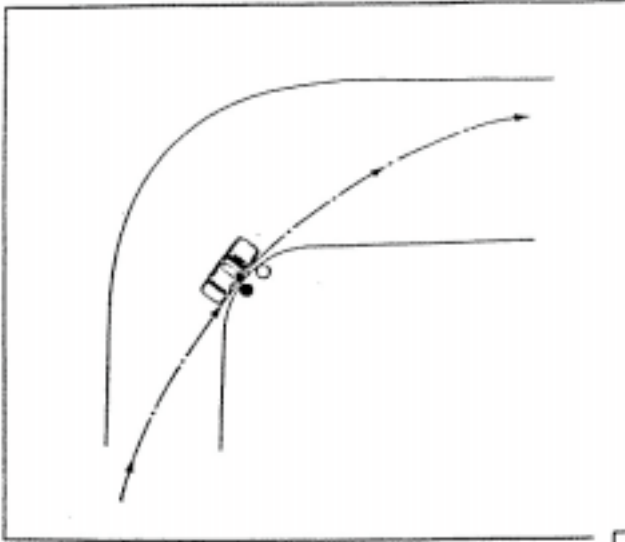
TYPES OF CORNERS

Having described the ideal turn, we should now turn our attention to dealing with commonly encountered corners in everyday driving.

A FAST CORNER

In the case of the fast corner, the driver turns in, passes the apex and maintains his/her line through the corner. The entire procedure should be as smooth as possible with no abrupt movements of the steering wheel, as you will be carrying a lot of speed through. After braking for the turn, you will want to ease back on the throttle to balance the car through the turn.



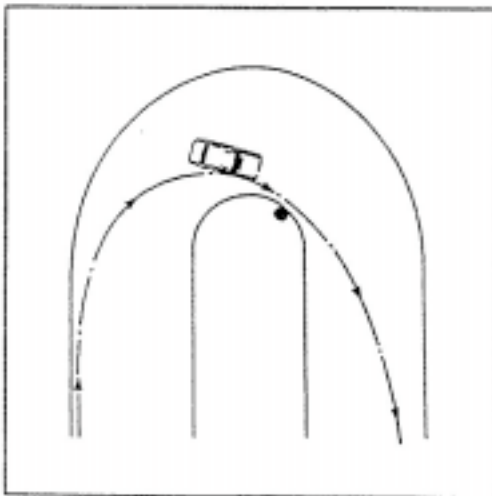
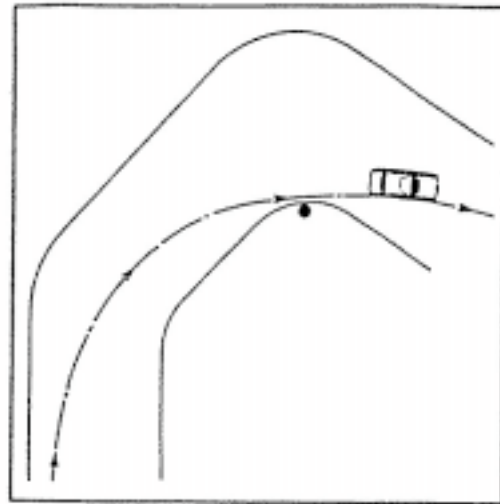


INCREASING RADIUS TURNS

In this case, the angle of this type of corner progressively widens at the exit. The driver steers in and gets on line early, for the corner widens at the point where he/she will want to move to the outside. High acceleration rates are possible at the exit.

IRREGULAR CURVE

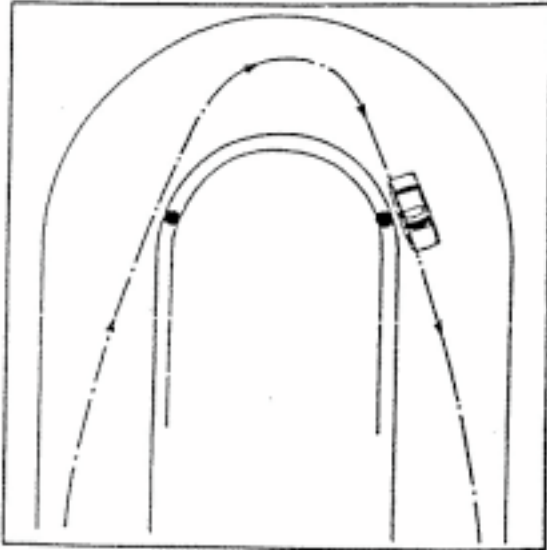
The adjacent schematic shows how the ideal line can all but eliminate some bends. Concentrate on the turn which provides the best exit speed when properly apexed; the other(s) don't matter.



CONSTANT-RADIUS (HAIRPIN) CORNER

The driver leaves his/her turn-in late continuing to the outside of the bend in order to create the widest possible angle. In this way, he/she can treat the remainder of the operation like a fast corner. The intention is to be as fast as possible out of the corner; therefore don't hesitate to sacrifice the entry phase.

A much tighter version of this curve is the hairpin; it is taken in the same fashion, but at a much slower entry speed.



DOUBLE-APEX CORNER

It is sometimes possible to find a line which allows a driver to make one corner out of two. The exit line of the first becomes the entry line for the second. The best line is usually to use two apexes, hence the name.

Brake at relatively high speed on entry; make a slow, sharp turn in the middle of the corner, straighten and use the second apex for a high speed exit.

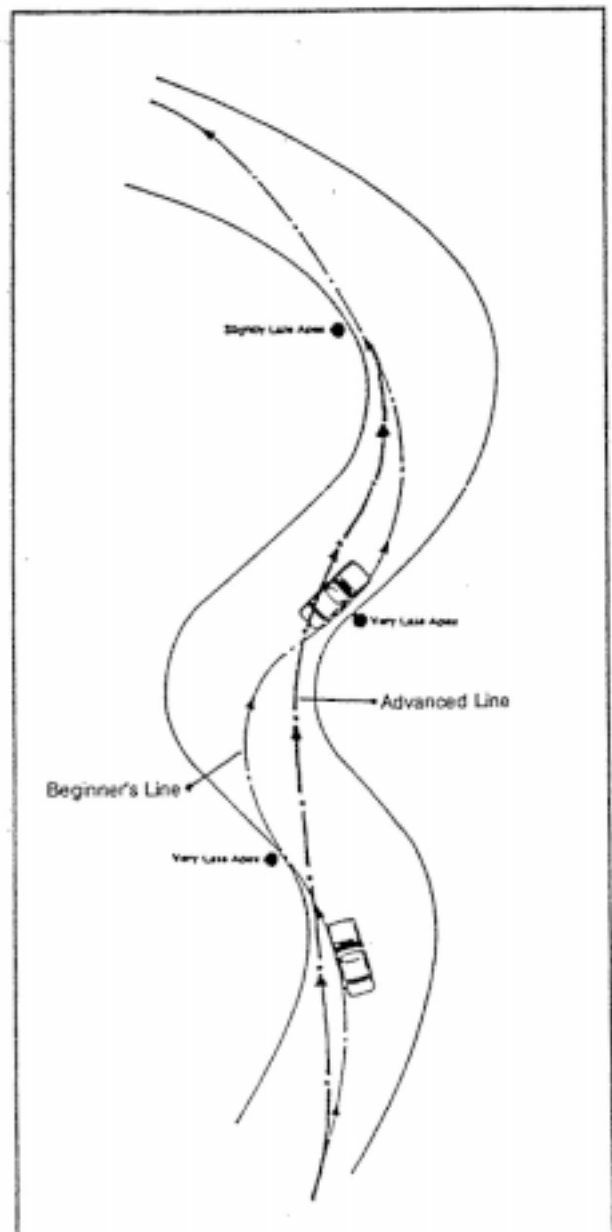
COMPOUND CURVE

The adjacent schematic shows a situation in which two or more turns cannot be treated as one turn. The first two turns are handled as very late apexes, to accommodate the best entry into the next turn in the series.

These turns must be driven smoothly and accurately for highest speed exit. Bear in mind that excessive speed will upset the car's balance, so brake effectively upon entrance.

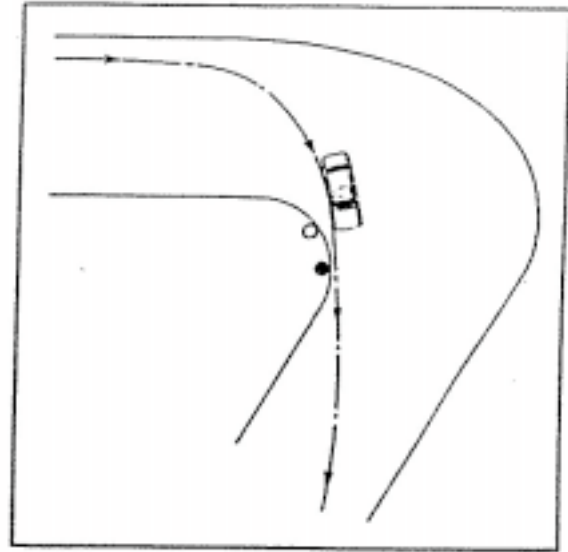
For more advanced drivers (hatched line), all connecting curves can be driven to produce the least change in direction and dynamic weight transfer to the tires.

The driver turns in slightly as he/she approaches the first left hander to get himself/herself ideally set up at the start. Thereafter, he/she barely needs to modify his/her line until the approach to the last left hander.



DECREASING RADIUS CURVE

A very deceptive turn as it keeps getting tighter. The driver stays wide as long as possible in order to hit the apex very late. He/she brakes and downshifts to the selected gear on the outside as he/she follows the curve of the bend to find the smoothest exit angle possible.



SECTION 4 - CAR CONTROL TECHNIQUES

A QUESTION OF BALANCE

Your car's entire weight is supported by the four contact patches between its tires and the road surface. Braking, acceleration and turning are all handled through this contact patch. Your tires can only handle a finite amount of force (acceleration, braking and/or turning) before they lose grip with the road surface.

Think of your car as a "teeter totter". Under full acceleration, without wheel spin, weight is dynamically transferred to the rear and therefore steering effort will be reduced. Similarly, under full braking without wheel lock-up, your car will allow little or no steering input. Remember, a locked wheel will not steer a car. A car at its cornering limit, without sliding, can not handle either acceleration or braking without losing traction.

These are extreme examples which are simply used to demonstrate -the concept. In the real world of driving, if an avoidance maneuver is required, you must be able to recognize that the balance between these forces must be maintained, if you are to successfully carry out driving techniques taught in this school. You must be able to recognize your limits and that of the cars under the conditions present, and adapt to them. Subtle changes in balance can be made with the use of steering, accelerator and/or brake pedal. For instance, once you are in a corner, your car can have its course altered with subtle use of the accelerator and/or brake pedal. Your steering wheel input is not required (think back to the skid pad). Students will practice the basic fundamentals of car control before they start lapping on the track.

BRAKING EFFORT

Most people think of engines when you mention power. The fact is that the most powerful component of your car is not the engine but the braking system! Just think how many feet it takes for you to come to a complete stop from 80 km/h. Can you accelerate from 0-80 km/h in the same distance? Highly unlikely.

Most people only use about 20% to 30% of their braking capacity in every day driving. Under high speed conditions, proper braking should sound like maximum acceleration; just a faint squeal from the tires, not a loud screech! A locked wheel while braking is a not at all effective. It is losing traction and braking efficiency, and cannot be steered. This results in a skid and consequent loss of control.

Do not slam on the brakes. Always brake smoothly. Sudden hard braking dynamically transfers weight to the front wheels, putting all the braking effort on the front brakes, while lightening the rear end, which throws the car out of balance, and can result in the car sluing from side to side. Try to avoid such sudden maneuvers.

The correct braking procedure should be as follows:

- Touch the brakes lightly to be sure that they are there.
- Continue to apply increasing pressure. Squeeze the brakes smoothly and very firmly.

Compared to normal braking this will feel like you are standing on the brake pedal! Develop a sensitive brake touch so you can keep the brakes on hard and not lock up. The main thing to remember in performance driving is that, if you are required to use the brakes, you should use them hard, for as brief a period as possible.

ACCELERATION

When starting out, gently engage the clutch into an engine that is increasing its revolutions. As soon as the car is rolling, engage the clutch fully before applying any serious power. This will greatly reduce the strain on drivetrain components. Always squeeze the accelerator and brake pedals gently. Do not stomp on them. Give the engine and tires a chance to react to your driving inputs.

Red line shifts are not always necessary for maximum acceleration. You are usually above the maximum torque point for the engine in the new gear. (The maximum torque point can be found in your car manual or from your local dealer). Maximum acceleration occurs when there is about 15% wheel spin (due to the natural elasticity of the rubber compound). You will hear a faint squealing of tires, and faint gray lines will appear on the road. Exceeding these limits results in loud screeching and black stripes on the road. If this happens, back off until you have control again.

Keep in mind that on the track, correctly balanced acceleration from the region of the apex to the exit will bring the car automatically to the next point without much steering input, for a perfect approach to the next part of the road.

THE HAZARDS OF DRIVING - SLIPPING AND SLIDING

Most posted speed limits on public roads cause no problems for our cars. Heavy traffic and/or wet surfaces require a reduction in speed and more heightened awareness of what's happening around us. This is particularly so in the early part of a rain storm when roads become greasy through a combination of water mixed with oil and road debris.

Traction will thus decrease on wet roads accordingly:

- Acceleration - 30% less
- Braking - 50% less
- Cornering - 80% less

.... better tires will help, but the percentages stay the same.

A rolling wheel and tire with no lateral forces acting upon it will naturally roll in a straight line. This is simply Newtonian physics. An applied lateral force, such as the centrifugal force generated during cornering, will deflect the tire in the direction of that force. If the total force does not exceed the traction limit, this is called slip. If it does exceed the traction limit, you will have a slide.

The tires on any car being turned into a corner will not exactly follow the path in which they are pointed, even at low speeds. The difference between the path a tire follows, and the direction of the tire at any given point in time is called the slip angle. Slip angles are affected by the lateral forces acting on the wheel; increased tire pressure will reduce the slip angle (less will increase it), and the slip angle is reduced if weight on the wheel is increased, (such as occurs on the front wheels during braking). A car is deemed to have good road holding if it has a low or small slip angle.

OVERSTEERING AND UNDERSTEERING

When the slip angle of the front wheels is smaller than that of the rear, the car will tend to oversteer, or turn into the corner more than intended. When the slip angle of the front wheels

is larger than that of the rear, the car will tend to understeer, or take a wider turn than required.

When your car begins to understeer, the front tires are losing traction and the car is not turning into to the corner as much as it should. There are three things you can do:

1. Turn the steering wheel gently into the corner, even sharper if you are not traveling too fast.
2. Gently lift off the accelerator until the car has slowed enough to regain traction.
3. If you are in the right gear in a rear-wheel drive car, engine torque applied with a delicate touch on the accelerator can break traction at the rear wheels, (creating wheel spin); this will introduce oversteer to neutralize the angle of the car.

When your car oversteers, it means that the rear wheels are losing traction. The rear of the car is beginning to slide out and is causing the front to turn more quickly into the corner. If this continues, you will soon be facing the traffic that was following you. There is only one thing to do: QUICKLY TURN THE STEERING WHEEL THE OTHER WAY, out of the turn, and thereby increase the radius of the turn, reducing slippage at the rear wheels. A more dramatic effect is achieved if the steering wheel is turned more severely out of the corner, and lots of throttle is applied to induce wheel spin at the rear. This combination still equals a correct line through the corner, albeit with the tail hung out. You now have power-on oversteer. Whatever you do, avoid any rapid deceleration, as it will result in a skid.

If dynamic weight transfers are done smoothly, the driver will always have the car under control.

SKID CONTROL

A skid can happen to anyone. They are the result of loss of driver control, which upsets the balance of the car; Skids are primarily caused because the driver is over-driving the road conditions. They can be divided into two main types:

- Oversteer skids
- Understeer skids

Oversteer skids are the most common form of skids. Should you begin to skid due to an oversteer in adverse conditions, stay off the brakes! Braking only heightens the problem since you transfer weight to the front wheels, further lightening the rear wheels, making the problem worse. Maintain even throttle application to balance the car and prevent any such weight transfers. Try to look and steer where you want to go.

Remember, once you have succeeded in catching the first skid, be prepared to catch the "second" skid. This second skid is a phenomena known as a rebound skid (a reaction caused by the sudden release of built up pressure in the suspension system). The secret of staying on top of the rebound is to first know that it is coming, and to then counter-steer without delay. Steering control must be quick and decisive. The steering wheel must be turned in the direction you wish the car to go and then returned to its original position. Do this again and again until the skid has been mitigated.

To correct oversteer caused by braking too far into a turn, one should get on the throttle quickly, and then immediately back off, then right back on again and again, until the car has straightened out for the exit. This scenario results in very rapid dynamic weight transfers which will be necessary to regain traction.

BE PREPARED TO CATCH THE CAR WITH STEERING INPUTS!

The second type of skid is the Understeer skid wherein the car does not respond to steering

inputs, and ploughs off the road. Try to correct these skids by easing off the throttle, which will result in weight transfer to the front axle, thereby increasing traction to the front tires. And remember, stay off the brakes! All that you will achieve by braking hard, is a rapid dynamic weight transfer to the front axle, which will overload the traction capabilities of the front tires, causing further understeer. Rapid modulation of the steering, (through "sawing" back and forth on the steering wheel - unwinding and repositioning), and the throttle will help to regain traction.

If you are not traveling too fast, most skids can be controlled with steering inputs only. However, if you have overcooked it and you are looking in the direction you came from, you are obviously way over your head, in trouble and have lost control completely!

THIS IS THE TIME TO LOCK-UP!

Evidence shows that lock-up is the quickest and least expensive method to correct an out-of-control car. Slam your right foot on the brake and de-clutch with your left foot. Hold both pedals down until you have come to a complete stop! Keep them there for another 10 seconds until you get your bearings straight. Having saved your car, you may want to check yourself over to make sure that you are all right.

Locking-up is the last resort and you should keep this in mind. With all four wheels locked, the car will continue to slide in the direction you were going when you first lost it, regardless of which way the steering wheel is turned. In such an emergency, it is still the quickest way to stop, even if you end up hitting something. The impact will be a lot less severe than if you hit the guard rail with an out-of-control, spinning car.

Remember that you can't lock up in ABS-equipped cars. You have the benefit of steering control under maximum braking, but once your car starts spinning around, you will not slide in a straight line. Stay cle-clutched and on the brakes. Keep looking where you want to go and keep steering in that direction until you have slowed sufficiently to regain control.

If you do go wide into a turn, over the shoulder (speed bump) and heading for the guard rail, quickly de-clutch, holding the steering wheel in the direction you want to travel. You may want to consider using the guard rail as a "lean-on" until you have straightened out the car. The damage will be noisy and you will be in for a paint job, but it is a lot better than locking-up and heavily impacting the guard-rail or wall, or, trying to steer away from the initial impact and careening across the track and into other objects, (a wall, traffic or pedestrians).

SUMMARY

In the last few paragraphs we talked about various problems which may be encountered on the track or the road. Please always remember: if you drive smoothly and are under control you will never have to experience these problems. Please note that front-wheel drive cars should be handled differently in some situations. Ask your instructor for guidance.

SECTION 5 - UNDERSTANDING THEORY

TIRE TRACTION

In general, a tire is most effective when there is a certain amount of slippage: approximately 15 % on dry pavement, 2-5 % on wet pavement, and 0- 142 % on ice. It develops its optimum grip when there is some wheel-spin due to the elasticity of the rubber compound. The maximum traction point is called the Traction limit.

You may think it strange that slipping or sliding is considered in this manual. While it is not a beginner's technique, controlled sliding is basic to performance driving and must be understood in theory if it is to be mastered on the track.

Four concepts which are of the utmost importance when discussing high performance driving are the slip angle of the tires (the difference between where the tires are pointed and where they are going); the friction circle (which describes the extent to which we can combine braking and turning or acceleration and turning); and understeer and oversteer.

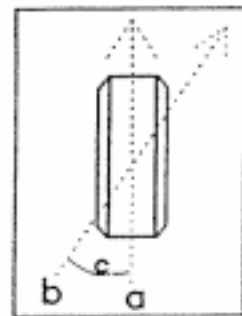
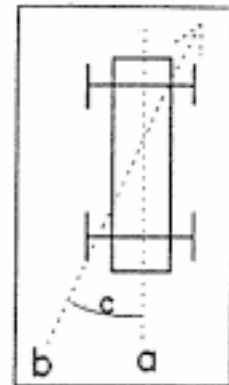
SLIP ANGLES

The Slip Angle for any tire that is not fully sliding is the difference between the direction it is pointed in and the direction it is traveling. Once the tire is fully sliding, the term slip angle has no further meaning. The cornering force will increase as the slip angle increases, up to a certain point. If both ends of the car are slipping within a good range, the perceived effect is a gentle crabbing to the side while the car corners.

This is called drifting. As slip angles increase, the tire also acts to slow the car down.

The slip angle at both ends of the car are a function of weighting on each corner and the lateral forces on the tire. The weighting or dynamic mass of the car can be shifted by the use of the brakes and/or the throttle, shifting weight from one end of the car to the other. This is known as Dynamic weight transfer (and will be dealt with later).

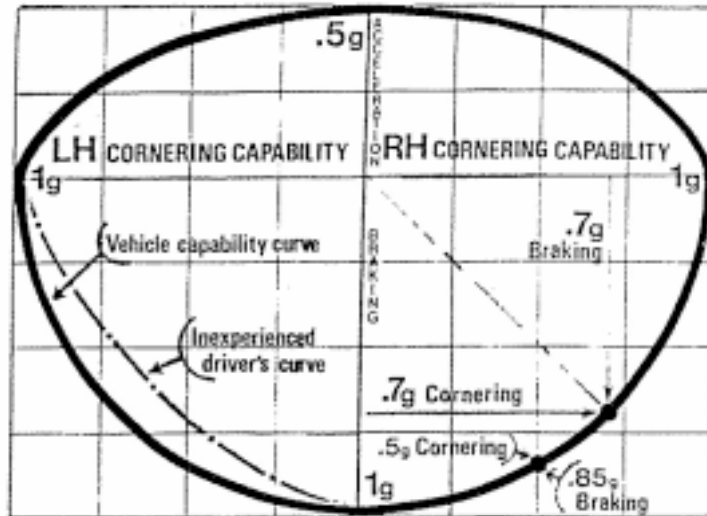
The lateral forces are, in turn, a function of the direction the tire is pointed compared to the direction the tire is being pushed. It is worth keeping in mind that the slip angle at the front can be changed almost immediately and fairly precisely by making steering corrections. Changing the rear slip angle may be done through adjustments in the throttle (for rear-wheel drive cars), braking and steering. Your path through a turn will be a combination of the slip angles at the front and rear of the car, as well as the direction the front tires are pointed in.



THE FRICTION CIRCLE

Beginners are often told not to brake and turn in at the same time. This is very good advice; spins result very rapidly when the novice driver tries to combine too much braking with too much turning. The tire however, does not care very much which direction it has to push, as long as it keeps rolling. Remember, a tire's effectiveness decreases by up to 15 to 20% when locked up - so it is important to keep it rolling.

Tires are the link between the mechanical system, (the car), and the road surface - they generate the acceleration required to make a car change speed and direction in either a positive or negative sense, the tire or rather the set of four tires is capable of either **lateral** (change of direction) or straight line (change of speed) acceleration, or a combination of the two. The upper limit of the acceleration that a tire can generate can be graphically depicted as the Friction Circle.



The Friction Circle concept was originally developed in the late '60's by Paul Van Valkenburgh, the late Mark Donahue and the Chevrolet R & D Department. It is a simple graphic way of showing the performance of any driver in any car in any single maneuver. Basically, it is a graph of the gravitational- or g-forces during braking, cornering and acceleration that the car experiences while being driven through a series of corners. Remember that 1.0g is equal to the force of 1 times the weight of the vehicle: i.e. if a 2000 lb. (1000 kg) car is cornering at 1.0g, there will be a centrifugal force of 2000 lb. (1000 kg) pushing outward on the car.

If you consider that a tire has relatively equal traction capabilities in any one directional force braking, cornering or acceleration of say 0.9g., (in other words, the car and tire combination is capable of braking at 0.9g, cornering at 0.9g, and accelerating at 0.9g.), during the transition from one directional force to another, say from braking to cornering, there are two ways to get from one limit of traction to another. The driver may, upon reaching the end of the braking zone (where he/she braked at 0.9g) suddenly lift off the brakes, and then turn the steering wheel into the corner (building up to 0.9g of cornering force); or he/she may gradually ease off the brakes, while at the same time, gradually apply more and more steering angle - effectively overlapping some of his/her braking with his/her cornering.

In the first option, the car goes through an albeit short period, (possibly only a fraction of a second), where the tires are doing no work at all - they are not being used to their full potential. This wastes time, no matter how short, because the car cannot instantaneously change its motion from straight-line braking to tracking through a curved path. It has been proven that the second option, which keeps the tire and the car on the outside edge of the Friction Circle graph, is a measurably faster way around a track. This option will also reduce the stresses on both the chassis and the tires, (stresses which are created by sudden movements), and is almost the definition of smoothness in driving technique.

So what you the driver must do - and what the Friction Circle is telling you to do - is to continue braking into the corner entry phase so that, while the tires are in the process of

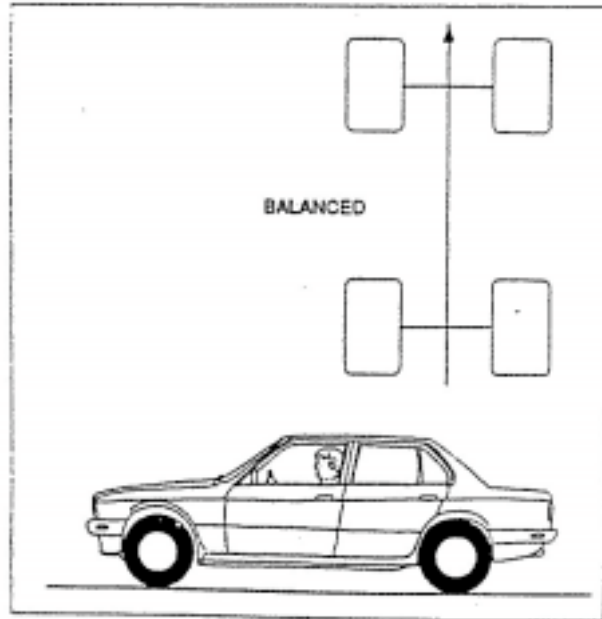
building up cornering force, they are still subjected to braking as you begin to turn in, trading off some of

the braking force for cornering force. At the point where you are braking at 0.45g, you will have built up 0.45g of cornering force until you are cornering at the limit of 0.9g. As you leave the apex, you must start to open up the exit line from the corner, ("unwinding the car" out of the turn early), so that the tires again have traction capacity for the acceleration phase out of the corner. If you use the proper driving technique, the graphed line will somewhat follow a circle, telling you that you are using the tire's full potential. The real key to the Friction Circle, is the smooth progressive overlap of braking, cornering and acceleration.

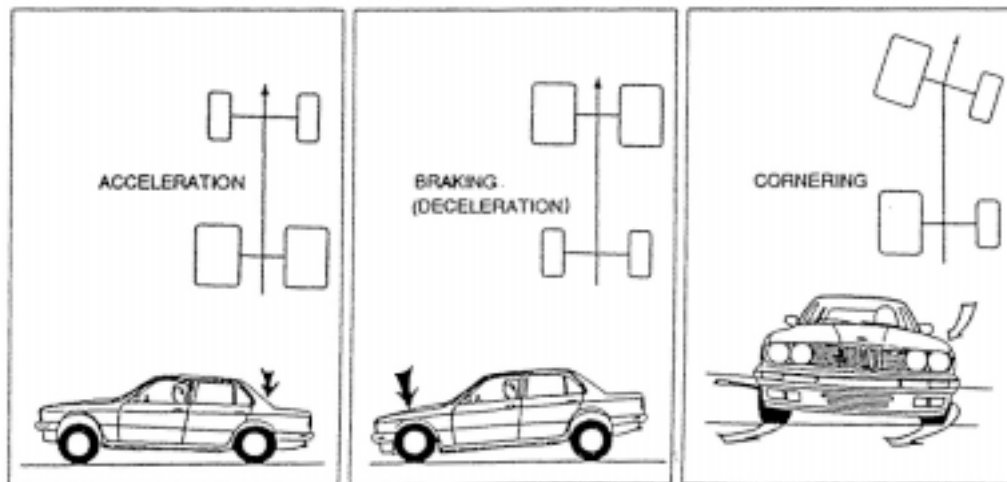
DYNAMIC WEIGHT TRANSFER

When you consider a car's performance potential, you should always consider that there are only four small tire contact patches (the actual patch of tire that is in direct contact with the road at any one time) that are holding the car to the road. The larger the contact patch, the more grip or the higher the traction limit that the tire has. By putting more weight over a particular axle or tire, you will effectively increase the size of the contact patch by deforming the tire, and will therefore increase the traction capabilities of that tire.

It is sometimes easier to think in terms of pressure being exerted rather than an increase in tire contact patch size (there is definitely an increase in contact patch size with pressure, but the increase is not very great).



As a car accelerates, the rear-end tends to squat down. This is the result of a dynamic weight transfer to the rear of the vehicle. Remember that the mass of a car cannot be shifted and is thus fixed. Dynamic weight transfer can and will change the pressure exerted on the tires. Under braking, the car will tend to



nose-dive, Once again, weight is said to be dynamically transferred to the front of the vehicle, loading up the front tires. In a corner however, weight is transferred laterally (the will load up its outside tires -both front and rear), causing the car to lean to the outside.

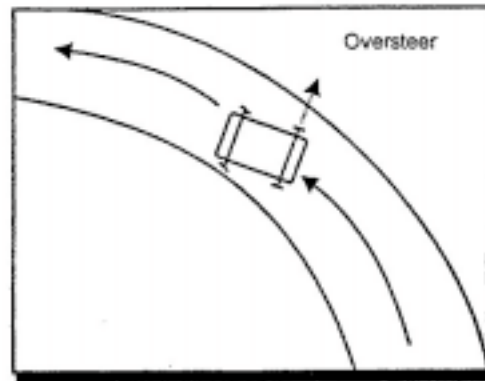
As the weight transfers onto a pair of wheels we achieve better traction with those wheels. Conversely, the wheels that become unweighted lose traction. The unweighted tires tend to lose more traction than the weighted tires gain.

By driving smoothly - turning the steering wheel as slowly and as little as possible, and squeezing on and easing off the brakes and gas pedal, you will be able to balance the car as far as possible. Never make any sudden or jerky movements as this will certainly upset the balance of the car.

During cornering, this weight transfer and balance affects the handling characteristics, resulting in either understeer or oversteer.

OVERSTEER

Once again, oversteer is that condition where the rear tires have less traction than the front tires, and the rear end wants to come around. It is called oversteer because the car rotates or turns to a greater degree than your steering input. Its effect is to decrease the radius of a turn and if controlled properly, can sometimes increase your speed through a corner.



Abruptly lifting off the throttle in mid-corner will cause the weight to transfer forward, making the rear end lighter, thus reducing rear wheel traction, resulting in oversteer.

To control oversteer, simply look and steer where you want to go. What this does is forces you to turn into the slide, thus increasing the radius of the corner. At the same time you should gently ease on the throttle to balance the car, transferring weight to the rear, thus increasing traction. The tendency to early apex will result in oversteer if you happen to be carrying too much speed into a turn and have to brake and lift off the throttle at the same time.

Oversteer

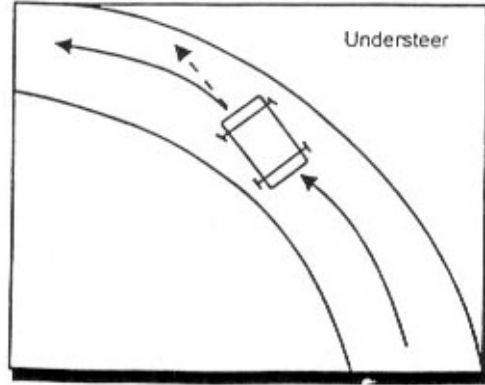
UNDERSTEER

Understeer is the term used to describe the condition wherein the front tires lose traction in relationship to the rear, and regardless of your steering corrections, the car continues to "plough" or "push" straight ahead to the outside of the curve. It is just the opposite of oversteer. The car will turn less (i.e. push) than the steering input.

On the track, understeer effectively increases the radius of a corner, and is thus rarely desirable if excessive. With that in mind, it should be said that most manufacturers, regardless of whether they make front- or rear-wheel drive vehicles, will design their suspension settings to produce varying amounts of understeer, since it is a more predictable driving characteristic than is oversteer.

Should a driver enter a corner too fast, and exceed the front tires' traction limits, or accelerate too fast through a slow-speed curve, which in itself transfers excessive weight to the rear

(particularly in the wet), then he/she will more than likely experience understeer. The first reaction of most novice drivers is to turn the steering wheel more., which in fact increases understeer, since the tires will be pushing laterally (in the direction of the sidewall) - not rolling (along the tread profile) (see the discussion on **Friction Circles**). This just exacerbates the problem, further reducing traction.



The obvious cure for understeer is to either reduce cornering speed or reduce steering input. By reducing steering input, essentially steering in the direction of the skid, you are allowing the tires to begin rolling again along the tread profile, thereby increasing traction. Reducing cornering speed by backing off the throttle, allows for some weight transfer onto the front axle, thus increasing their traction limit, allowing the driver to regain control.

SECTION 6 - SCHOOL SUMMARY

Our intention at this school is not to create street racers or indeed race car drivers. Rather it is to offer students the opportunity to learn more about the handling characteristics of their cars and their personal limits in a safe, controlled environment. Having completed an Advanced Driving School, you may ask yourself "Where do I go from here?" The most logical action would be to take what you have learnt on the track, and translate it to your everyday driving. You do not need to drive at your limit to appreciate the passive safety systems engineered into your car. You should always **drive defensively** and always obey the rules of the road. Driving cars quickly and safely demands top rate self examination and observation of other users of the road:

Do you read the road or merely look at it?

Do fellow motorists merely become part of the visual scenery that is your peripheral vision or do you take into account which way the driver of the car waiting at the approaching road junction is looking?

Can you see the whites of his/her eyes or the back of his/her head?

The common assumption that the car waiting at that next junction won't pull out simply because you are approaching, and have the right of way, results in many accidents. Staying in one piece on today's overcrowded roads is about high-speed human watching. You might take pride in your driving technique, but most people do not.

Keeping your distance might sound like a boringly familiar "*Big Brother*" dictum, but it is still undoubtedly one of the most important, and most abused aspects of road driving. The teachings of the Ministry of Transportation might seem prim and proper, but like it or not, they have hit the nail on the head when it comes to making space.

Anticipating speed and distance are the two things we, as drivers, are probably worst at. Try to let tailgaters pass as quickly as possible; there is no point to racing someone on public roads and/or in heavy traffic. They may not be as well schooled as you are, and it can often lead to serious accidents. On multi-laned highways, remember that the left lane is designated as a passing lane only. Try to keep right except when passing someone, and when you do pass slower traffic, give slower drivers ample time to pull over and let you by. When you crowd the person in front, instead of waiting a decent distance behind, it becomes impossible to watch the road well ahead of the other motorist, and creates the potential for some nasty surprises.

When you are travelling on the highway, an interesting exercise is to try to anticipate the reactions of other drivers. Try to look at the seating position of other drivers around you and envision what their next move might be. Do they appear alert? Are they talking on a cellular phone? Are they paying attention to other drivers or do they appear to be lost in their own little world? Remember, if you pull out to pass someone and you can't see his/her face in their rear-view mirror, they may not have seen you and may not even know that you're trying to pass. So be prepared for the unexpected. Again, you should always drive defensively - other drivers may not be as well informed as you are. Try to look beyond the car right in front of you, and look as far down the road as possible. You want to be able to get as much warning as possible of an upcoming situation, and react before the car three (3) to four (4) cars in front of you. If you wait to see the reaction of the driver directly in front of you, chances are you'll hit him.

Consider this: If you are traveling at 100 km/h, your velocity will be 1.67 km/min. or 27.78 meters per second. Consider that on average your reaction time to a given situation will be less than 1 second. If you are alert, you will have traveled about 28 meters before hitting the brakes, or steering out of harm's way!

Proper observation means just that. Look for problems. Take notice of hidden entrances and decide where the greatest likelihood is of someone emerging from them. Watch pedestrians and look for areas where children may run out from behind parked cars. Among the things to look for are, first of all, Ministry of Transportation road signs. If there is a school sign and the time is 3:00 p.m., then it is very likely that there will be kids milling around.

One of the most important aspects of defensive driving is the ability to alter your driving style to changing road conditions and anticipate your response to an emergency situation. Never put yourself into a situation from which there is no way out. You should always try to leave some room so that you can correct possible errors, should one occur.

When travelling on unfamiliar roads, try to use features of the surrounding countryside such as utility lines to envision where an unknown highway may lead. Again, remember, anticipating impending situations is the best form of defensive driving. There may be rough areas or potholes which may require you to slow or take evasive action. On rainy days these may become filled with water, so be prepared to slow down and take evasive action.

At night, particularly in open countryside, try to use road shadows to your advantage. Travelling with your high beams on and/or your foglights will help to define changes in the road surface. Since light travels in a straight line, the light from your headlights will accentuate bumps (the road appears brighter) or dips (the road appears dimmer), in the pavement. Since oil and antifreeze tends to be shaken off cars and trucks over bumps, stains in the road will indicate bumps which might not have been otherwise apparent. When you leave home on rainy mornings, always check your traction at low speeds on familiar roads so that you can adjust your speed accordingly. Don't wait until you get to your first traffic light!

One of the biggest driver error on public roads is a combination of people not watching their mirrors and not signalling where they are going. Motorists are not mind readers, turn signals are the most effective -means of indicating your intentions to other drivers. Indicate a good few seconds before you make a maneuver, not just as you change lanes. Most people who do not communicate in time, in the right sequence, or at all, do however, give unconscious signs through their positioning of their cars. Anticipate! Try and read the intentions of others by their actions, and if someone is signally one thing, but their position suggests that they are about to do something else, then they probably will!

THE NOT-SO-INEVITABLE ACCIDENT

When confronted with an accident situation, most drivers will "instinctively" slam on the brakes, where braking may not be the most desirable reaction. If you are able to get around the obstacle, try to ease off the throttle, steer to avoid the object, then ease on more throttle once you have past (refer back to the "emergency lane change" exercise). You do not want to upset the balance of the car and create the potential for (another) accident. Always try to look as far ahead as possible and anticipate possible events before they occur.

Braking too hard will result in a rapid dynamic weight transfer to the front axle, and may lead to locking up of the front tires with a resultant loss of steering control. Once you have locked up, you are likely to just plough straight into the object in front of you. If you do not have any other choice but to brake, try to threshold brake or, for cars with ABS, brake and steer out of harms' way. Remember that for ABS to work effectively, you must hold the pedal down to the floor, thus allowing the on-board computer to take over. Since the computer is rapidly applying and releasing the brakes, it will be possible to steer around the obstacle in your path. Once again, always drive with an escape route in mind.

Should you accidentally put two wheels off the edge of the pavement, keep the steering wheel pointed straight ahead. Do not try to steer straight back onto the highway, as you are likely to hook a wheel on the edge of the pavement, sending the car skidding back across the pavement. Once the wheels are straight, ease off the throttle until the car has slowed down to a reasonable speed, then gently ease it back on to the road.

DRIVING IN RAIN OR SNOW

Adverse weather conditions can create greater hazards and it is even more critical to be smooth in your transitions, and to concentrate on the driving task. Smoothness in these conditions cannot be stressed enough. Due to generally low and variable traction conditions during the winter months, it is imperative that drivers indicate their intentions in advance. Be on the safe side and give yourself lots of room to manoeuvre. We have all seen the chevrons on Highway 401; double the distance for safety in bad driving conditions.

Remember, you must make smooth transitions between power-on and power-off, and smooth steering inputs. In rainy conditions, try to drive just outside the ruts in-the lanes, which tend to become packed with rubber and oil, thus trapping surface water. Stay on the granular surface just off to the side wherever possible, as this will give you the best traction.

At speed, water tends to form a wedge ahead of the front tires, which may not be evacuated and can lead to a phenomenon called hydroplaning, which results in loss of traction and steering control. Should you car begin to hydroplane in wet or wet/slushy conditions, your first indication will be a light steering feel, Immediately ease off the throttle. Do not turn the wheel. Easing off the throttle will not only slow you down but will transfer weight back to the front tires, through dynamic weight transfer, allowing them to "bite" better.

Try to maintain good outward visibility at all times by keeping you windows de-fogged. You should change your windshield wiper blades every 6 months, to maintain optimal effectiveness. Bright sunshine, summer heat, exposure to ozone from car exhausts, and acid rain all conspire to accelerate the deterioration of the rubber compound in your windshield wiper blades, leading to smearing and streaking.

Knowing the traction limit differences between various conditions can help you cope with them, be it rain, sleet or packed snow. While winter driving conditions may first appear a lot more hazardous than rain conditions, in many instances, roads will merely be wet because of added salt or mild temperatures. Try to distinguish between different types of snow conditions. Packed, dry snow for example, will require much slower steering inputs. Loose, wet snow presents the most challenges and will be the most hazardous, since it presents little traction, and will become glazed over with snow melt when packed by the weight of the car. This slush lubricates the snow at or near zero (much lower when roads have been salted), making driving treacherous.

With the very low traction limits of snow and ice, dynamic weight transfer characteristics will have little effect on the ability of the good driver to control his/her car. Additionally, tires will have little grip on icy roads, so please slow down. Changing over to dedicated winter tires or all-season tires can improve the road-holding properties of your car, but cannot change the laws of physics.

The only real difference between safe travel on ice and snow and that on a dry highway is speed. It is not always easy to convince a driver that a highway which is safe at 90 km/h under dry conditions should be driven at no more than 55 km/h in the rain; and the same road may be unsafe to only 25 km/h under snowy or icy conditions. There is no magic to driving in snow or

ice. If You slow down and drive smoothly, with more sensitivity, there is no reason that you should not arrive safely at your destination.

ooOoo

Being thus aware of your surrounding may very well help you to avoid potentially dangerous situations, by being able to react quickly and safely. Above all, DO NOT DRINK AND DRIVE, and always ensure that all occupants of the vehicle are CORRECTLY BUCKLED UP. You should always ensure that you in observation of the laws governing our public roads and drive with patience and consideration for the safety of all road users. Do not succumb to "Road Rage".

It takes a great deal of practice to find the limits of both yourself and your car. It can be impractical and down-right dangerous, not to mention illegal, to explore these limits on the street. Work on it with your instructor in the controlled environment of this driving school.

Above all, try to have fun while driving. As organizers of this event , we hope that we have introduced you to techniques that will allow you to more fully enjoy your daily drive and increase the satisfaction derived from a job well done. Remember that the skills you have been introduced to will require practice, practice, practice. Take every opportunity to hone your new-found skills, as this can only build on the foundation we have laid this weekend.

Whether you are on the track, a rally stage, or simply on the public roads, the *principles* of observation remain the same. Anticipation and **interpretation** are what will save your neck in the end, and will also enable you to position your car to take best advantage of traffic flow.

Finally, we would like to leave you with these quotes as it very nicely sums up the essence of this school.

ooOoo

"There is no virtue in not knowing what can be known."

... A. Huxley

*"Those who fall in love with practice without science **are like sailors who steer a ship without** helm or compass, and who never can be certain whither they are going."*

... Leonardo da Vinci

"The mind needs to get clear, logically connected messages from the senses, and, at the same time, it needs to be free to doubt and open to receive and reject all kinds of information."

Surely an open mind is an intelligent mind. A brain that knows all the answers is a dead brain. From an inquiring, questioning brain arises a healthy curiosity where there will be freedom to explore, freedom to understand and freedom to discover.

We must give the body clear directions (as we would a horse), and these should be dictated not by ambition, duties or reactions, but by a precise and lucid perception of what we feel. "

... D. Hanson

