BMWCCA Heart of Dixie Chapter
Drivers Manual

Purpose

The purpose of the drivers' school is twofold. First, it will teach you about your car and what it can do. If you're like most of us, you'll discover that the initial limits to how precisely you drive are yours and not your cars.

The first few sessions on the track are designed to show you what the car feels like as it approaches its limits and to teach you how to control the car when it reaches them. You'll learn this at low speeds, with an instructor in the car.

Later in the day, you'll be able to apply what you've learned about car control as you drive the track at higher speeds. The track contains many of the conditions you encounter on public roads--both left- and right-hand curves of different radiuses and changing pavement. One thing you won't have to worry about at the track is oncoming traffic.

The second purpose of a drivers' school is to give you a chance to enjoy driving your car under controlled conditions. You'll be able to do things you can't do on the street, like go fast and use every inch of the road. If the school is a success, you'll have much more confidence in your driving abilities at the end of the day.

One thing that the drivers' school will not teach you is how to race. There will be no racing during any BMWCCA drivers' school. If you try to race at the drivers' school, your school experience will be over; we won't let you back on the track. You should feel no affront to your pride if another car passes you. In fact, you should help him or her to get around you. Your sole purpose in driving the track is to practice putting your car at exactly the right spot to negotiate the turns, not to beat another car to the next turn.
The main theme, which will be stressed during your day at the school, is vehicle control by you, the driver. This will be achieved by smoothness, consistency and concentration. The driving techniques you learn should be executed smoothly and consistently. To accomplish this, you will have to concentrate totally every second you are driving your vehicle. Hopefully, you will carry this approach away from the school and apply it to your everyday driving. Some of the important concepts and techniques which will be discussed by instructors during the classroom sessions and while they are with you in your vehicle are highlighted in the following paragraphs.

Driving Position

Sit in the seat by pressing into it - don't just sit on it. Adjust the position of the seat (and wheel if possible) so you can freely move your feet between the pedals with clearance under the wheel and so that your arms are bent when your hands are placed at the three o'clock and nine o'clock positions. Check that you can completely reach all positions on the steering wheel and all gears without leaning forward from your seated position. Make sure you can push all pedals to the floor without difficulty. Tighten your seat belt as tightly as possible and confirm you can still go through the required motions. For optimum vehicle control a tight belt is essential. You may wish to recline the back of the seat, lean back, pull the belt tight, lean forward against the belt to keep it tight and then raise the setback against your back.

Turning the Wheel

Except when shifting, you will be expected to keep both hands on the steering wheel at all times. For maximum car control, your hands should be positioned at or near the three o'clock and nine

o'clock positions as much as possible, even through a turn. If you are going to travel through a turn that requires more than one-quarter turn of the wheel, you should position your hands before entering a turn so that they will be in these positions during the turn. UNDER NO CIRCUM-STANCES SHOULD YOU EVER LET GO OF THE WHEEL COMPLETELY.

Handling - Oversteer and Understeer

Two important aspects of your car's handling are balance and weight transfer. Balance is a function of the car's weight and how it is distributed from front to rear and side to side. Your car's weight distribution is dramatically changed when you accelerate, decelerate, or change direction; this is called weight transfer. Control of weight transfer is a delicate balance of factors, maintained by the suspension.

One of the effects that weight transfer has on your car's handling is expressed as oversteer or understeer. Oversteer is the term used to describe the situation in which a vehicle tends to turn more sharply than intended for the amount the steering wheel is turned (Figure 1. Page 2). Also described as "looseness", it is the car's desire to "come around" on you in a turn when the rear wheels loose traction--the tail gets loose and feels like it wants to come around to the front. This is usually caused by more traction at the front of the vehicle than at the rear, possibly because of spinning or sliding rear tires due to too much throttle or locked rear wheels due to too much braking.

As you enter a turn, the car's weight transfers toward the outside front wheel, removing weight from the rear wheels. As the rear wheels loose downward force, they begin to lose their grip, and the rear of the car begins to slide toward the outside of the turn. Thus, the car will turn too much and you'll have to steer the front wheels toward the outside of the turn.

Another situation where oversteer occurs is when you suddenly apply deceleration or acceleration while turning. Jumping on the brake pedal while turning can cause the rear wheels to lock up, thereby breaking traction and causing a spin. Conversely, if you suddenly mash down on the accelerator, the rear tires will break loose and you'll spin. Spins are often the result of "terminal oversteer"--the car's rear wheels loose traction and cause the car to spin.

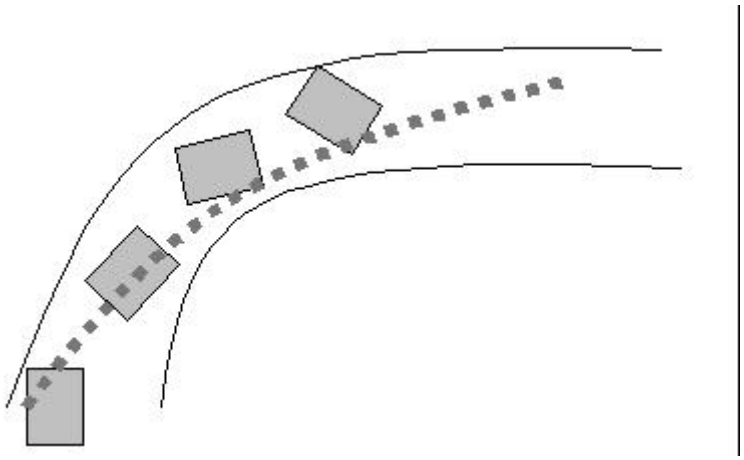


Figure 1 0versteer

Oversteer can be corrected by reducing brake pedal pressure to unlock the rear wheels and/or applying steering input in the direction the rear of the car is sliding (turn the front wheels in the direction you are skidding as you would on ice in a skid) and/or by reducing throttle. If oversteer occurs, it probably means you entered the turn too fast. Slowing a bit more before you enter the

turn will actually allow you to exit the turn faster, because you'll be able to apply power sooner and you'll be in better shape to point the car in the direction you want to go.

Understeer is the term used to describe the situation in which a vehicle tends to turn less sharply than intended, resulting in driving off the outside of the turn. Often described as "push" or "plow", "terminal understeer" (Figure 2) is the opposite of oversteer and occurs when the front wheels loose their grip and the car continues to move in the direction it's pointed instead of the direction you're steering it. This situation may be caused by locked front wheels under braking.

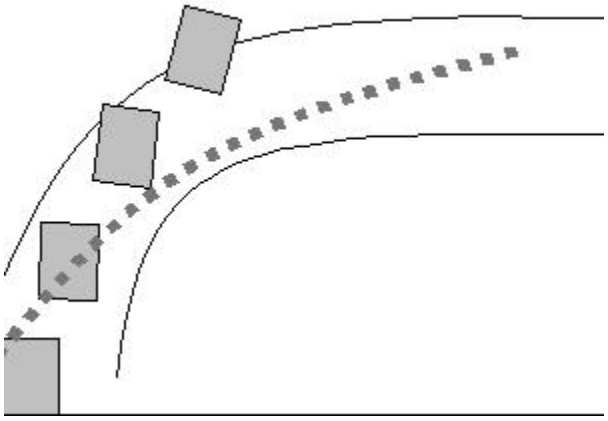


Figure 2 Understeer

To correct for understeer, you have to restore grip to the front wheels by slowing the car and straightening the wheels. This can be done by reducing brake pedal pressure to unlock the wheels or easing off the throttle to transfer weight to the front tires (or stop them from spinning on a front wheel drive car).

Another more advanced technique is to use oversteer to help correct understeer. You do this by accelerating, a difficult thing to get yourself to do when the car is already partly out of control. But think about it--if you can get the rear wheels to loose some of their grip, the forces of understeer and oversteer can be made to counteract each other. A note of warning, however, if you don't maintain some control, you'll just slide off the track sideways and possibly do some serious damage to your car. If you're going to go off the track, it is better to drive the car off under your control than it is to let the car slide off out of control.

One more warning about both oversteer and understeer. In some cars under some conditions, if you enter a corner too fast and then try to correct by taking your foot off the gas, you'll experience trailing throttle oversteer and the car will spin. In such a situation, it is better to maintain constant throttle than to decelerate. If you get in over your head, straighten the wheels, then get on the brakes hard (threshold braking), and then drive straight off the track.

Shifting

Treat the gearshift, linkage and transmission with respect, as if they were made of glass. Don't force anything. Move the lever smoothly and deliberately through the shift pattern with your fingers and palm of your hand. Speed shifting, power shifting and slamming the lever from gear to gear are ineffective and can be very expensive.

Downshifting for a turn should be executed before entering the rum. This will preclude upsetting the balance of the car caused by depressing and releasing the clutch for a lower gear in the turn

and will allow you to apply power in the lower gear as soon as possible to exit the turn. Unless you've revved the engine while the clutch is depressed, releasing the clutch after shifting to the lower gear will cause the engine to come up to speed. This may tend to cause the rear wheels to briefly lock up and will have the effect of additional braking from the rear wheels. This can be very upsetting to the balance of the car if it occurs in a turn.

The techniques of double clutching and heel and toe eliminate these problems. They take practice and will not be taught in depth at the school. If you desire to learn these very effective methods for smoothly braking, downshifting and accelerating through a turn, ask an instructor for a special session. You can practice and apply these techniques everyday.

Braking

Brakes on a typical street vehicle can decelerate the vehicle much more quickly than the engine can accelerate it. Perhaps the most noticeable difference between what we experience during normal highway driving and the driving you will be doing during the drivers' school is the level of braking entering a turn and the repetition of this level as you circulate around the track. Your brakes may get hot and begin to fade (more about this later).

Maximum braking can be achieved when the wheels are still rolling and just on the threshold of locking up. This situation is referred to as threshold braking. Locked wheels during the braking are to be avoided. Not only is this less effective, but it will flat spot your tires and potentially ruin them. Proper maximum braking results in just a faint squeal from the tires, not a loud screech. If you have ABS, the system will induce this situation for you. Without ABS, if you do lock a wheel, you should reduce pedal pressure slightly until the wheel unlocks and then reapply pressure.

In a panic situation on the highway, you will probably slam on the brakes in reaction to the situation. With the front wheels locked, you cannot steer the vehicle because a sliding tire is just a hunk of rubber that has no preference for direction. But in a panic don't hesitate to stand on the brake pedal. Hopefully, you will be able to slow down enough to eventually back off enough to unlock the wheels and steer if necessary.

On the track or highway when approaching a corner, you are in a controlled situation. You are in control, so initiate braking early so you DO NOT HAVE TO SLAM ON THE BRAKES. Instead squeeze the brakes on, gradually building pressure until the wheels are on the threshold or at a lower level at which you feel comfortable. This allows vehicle weight to be transferred to the front tires, providing more down force and therefore, allows them to generate more braking.

Braking should be done as much as possible in a straight line when approaching a turn. If the tires are braking at or near the threshold, they cannot be expected to do even more work of turning the car. One objective of performance driving is to provide a smooth transition from braking for the turn and turning into the turn. Ideally, after maximum braking on the straight, the brakes should be gradually released as turning of the steering wheel is initiated. This keeps the loading on the front tire on the outside of the turn constant and avoids rocking of the vehicle on the suspension, which would disturb the balance of the vehicle. The term trail braking is used to refer to this technique of gradually reducing braking force (trailing off the braking), and perhaps even keeping the brakes on slightly longer than necessary to cause the rear end of the car to come around slightly (oversteer), so that power can be applied sooner. Trail braking is particularly effective with front wheel drive cars, which inherently understeer with the application of power.

In performance driving you should use the brakes hard for as brief a time as possible without locking the wheels. This allows air to cool the brakes as much as possible while the brakes are released. Because you will be braking hard and often, your brakes may get hot and start to fade as evidenced by a spongy or soft pedal that requires more and more pressure. (This is why good pads and fresh fluid are so important.) Be very alert to this situation--slow down or come into the pits and let your brakes cool. At the end of the session on the track, slow down enough so you

don't have to use your brakes so they can cool. When you do stop, park the car in gear and do not set your handbrake so the brakes can cool. This will prevent warping of drums and rotors.

Tires and Pressure

Perhaps the most amazing vehicle components contributing to performance driving and enjoyable highway driving are the tires. All steering, cornering and braking forces are transferred to the vehicle through the four contact patches, possibly less than two square feet of rubber. A drivers school will demand a lot from your tires and you can expect to observe noticeable wear. You can minimize this wear, however, by driving smoothly and sensibly without locking the wheels under braking. If you are squealing your tires in turns or can hear them complaining you are driving incorrectly. Back off and either get on the proper line (see below) and/or slow down.

For the performance driving you will be doing, you should inflate your tires to pressures above those normally used on the highway. By using higher pressures, the tires will be able to generate higher cornering forces and will not roll over on their sidewall during cornering.

The Proper Line

A general technique used in high speed driving is to take the path of maximum possible radius through every turn. This yields the fastest speed through the turn. However, the high performance driver is interested in not just the maximum speed through a particular turn, but the safest, most comfortable minimum time and maximum speed through a section of highway or around the track. Because of particular characteristics of the track this path may not simply be the path of maximum radius. Through every turn on a racetrack or a highway there is an optimum path which yields one or more of the following:

Maximum comfort for occupants for a given vehicle speed

Minimum wear on the tires and suspension

Minimum time and maximum speed through the turn

Margin of safety through the turn and exiting the turn.

This line is a function of the shape of the turn, the banking (camber) of the turn, the characteristics of the section of the track or road leading into and out of the turn, and some-times, the condition of the track surface. Except for racing situations where every fraction of a second may be critical, the correct line is essentially independent of vehicle type and characteristics.

Curves and Apexes

The quickest way between two points is a straight line. This is the first principle of getting the most out of your car. When you go around a curve, you're no longer traveling in a straight line. The next best thing to a straight line is to change direction as little as possible. Whatever you can do to "straighten out" a curve will allow you to get through it more quickly and safely. This technique is called apexing. The theoretical apex of a turn is the point where the largest possible radius through a turn touches the inside of the turn. A vehicle takes an early apex if it follows a path that results in the wheels touching the inside of the track upstream or earlier than the theoretical apex. A vehicle takes a late apex if it follows a path that results in the wheels touching the inside of the track downstream or later than the theoretical apex.
Except in unusual situations in which a series of tight turns follow a long straight, the late apex is the preferred path. This is the path that you will be encouraged to follow through all turns at your drivers' school. This is likely the fastest, smoothest and safest path on the course. This path allows you to apply throttle before you reach the late apex and therefore results in maximum exit speed from the turn and down the following straight. It also avoids the problem of an early apex in

which you run off the outside edge of the track after passing the early apex point (oops!).

It is important to use the entire available pavement to generate the largest possible arcs through every turn. As long as the pavement is in good condition, don't hesitate to "clip" the apex of every turn with your inside wheels. As you approach a turn and initiate braking, you should already be looking ahead for the apex. Well before you pass the apex you should be looking ahead for the exit; Looking well ahead of your current location on the track is one of the most important and effective techniques of high performance driving.

Consider the series of curves below in Figure 3 (called an "S" curve). If you follow the shape of the curve, your path will be something like this:

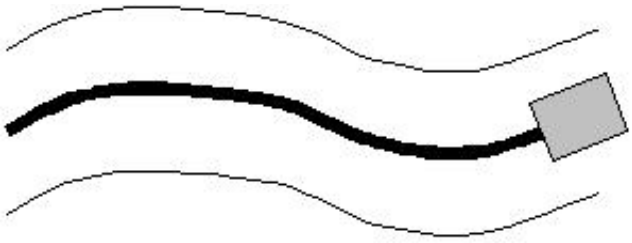


Figure 3 "S" Curve

If you "apex" the curve, your path will be much straighter as in Figure 4.

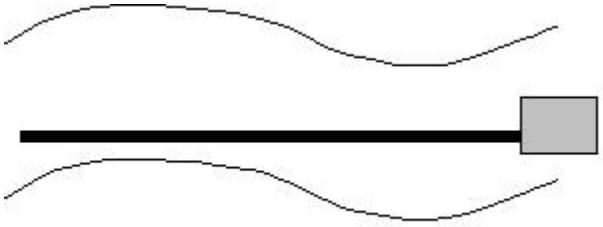


Figure 4 #Apexing" a curve

This lets you get through the curve faster, for two reasons: you don't have to turn the car as much, and you cover a shorter distance.

But how does this help on the street? You can't apex every curve or use the whole road, and you can't go through most curves at the limits of the car. But you can take the principle illustrated here - turning the car as little as possible and apply it to everyday driving.

We'll use some standard terms in talking about curves. The braking point is the point at which you begin to slow the ca] down enough to negotiate the curve. The turn-in point is where you begin to steer the car across the road to straighten out the curve. The entrance is the path you take from the turn-in point to the apex. The apex is the midpoint of the curve, where you should be as close to the inside edge of the road as possible. The exit is the path you take from the apex to the outside edge of the road, or track out.

There are different types of curves. One way to describe a curve is by its radius. Every curve follows part of the circumference of one or more circles (an arc), and the radius is the distance from the center of the circle to the curve itself. The larger the radius, the gentler the curve and the easier it is to negotiate.

A curve that follows the circumference of just one circle is called a constant-radius curve. An

example of a constant-radius curve is shown in the diagram below (Figure 5).

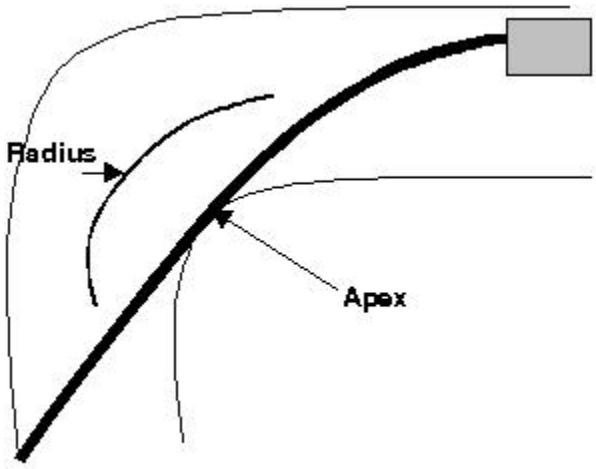


Figure 5 Constant radius curve

The radius remains constant throughout the curve and the apex (where you should touch the inside edge of the read) is halfway through the curve.

Another type of curve is the increasing-radius curve (Figure 6).

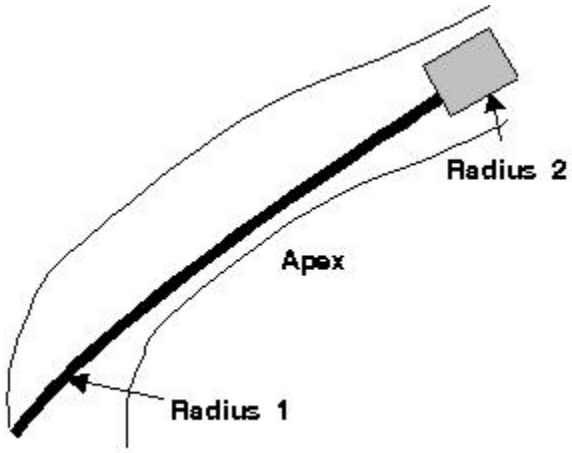


Figure 6 Increasing radius curve

Here, the radius of the curve as you enter it is smaller than the radius of the curve as you exit.

There is also a decreasing-radius curve (Figure 7), where the radius as you enter is larger than the radius as you leave:

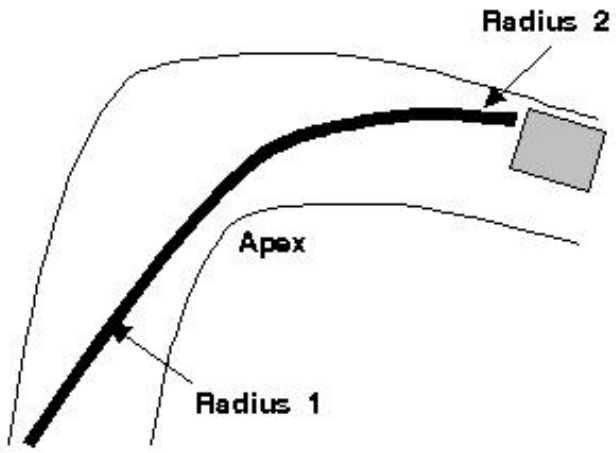


Figure 7 Decreasing-radius curve

The apex of a decreasing-radius curve occurs later in the Curve.

We've mentioned an S curve, which is a curve in one direction followed by a curve in the opposite direction, forming the shape of the letter S.

These are the basics of negotiating a curve. As long as you understand the principle of straightening out the curve and the terms used to describe them, you've got a foundation on which to build. If you're negotiating an unfamiliar curve, a good rule of thumb is to plan a late apex rather than an early one; this will prevent you from "running out of road" at the end of the curve.

Where to Look

Whenever you're driving, you should watch where you're going. This seems to be self-evident, but you'd be surprised how much time you spend looking where you are--at your hood or at the bumper of the car in front of you, for instance. You can't change where you are without a time machine, but you can change where you're going.

As you become familiar with the track and its turns, you will naturally develop reference points to guide you around the track. Initially, you'll find yourself concentrating very hard on these reference points: looking at the braking marker, look at the turn-in point, look at the apex, and so on. Chances are, you'll still be looking at the turn-in point as you begin to turn the car.

The technique to develop is to look at where you want to go, not where you are. This is called ocular driving. If you always look ahead, you'll find your driving becomes much smoother and with smoothness comes speed.

After you've mastered looking ahead, the next technique to master is enlarging your field of vision. If you're looking ahead at the apex, you probably won't see the flag person off to your right; if you're concentrating on the next braking point, you may not notice the car overtaking you in your rear-view mirror. By expanding your field of vision, you'll find you are much more aware of your surroundings--not just the next reference point, but the next two or three reference points. This will again make your driving smoother and, consequently, faster. Also, if you're taking in more than just one upcoming braking point, you may notice the car in front of you getting loose in the turn, or you may notice the sheen of oil on the entry to the turn. Likewise, on the highway, you may see the brake lights of the cars a quarter mile ahead and know that you need to do

something immediately in order to avoid disaster.

Your first task is to become familiar with the track. You can refine your ocular driving techniques once you've learned which way the track turns and where you need to be to get around it.

Off-Track Excursions

You may find that you cannot stay on the track because you have entered a turn too fast or your brakes have faded. In this situation you should not panic, but go ahead and drive off the course in a straight line, continue to apply the brakes to reduce speed. Don't attempt to return to the track until you are traveling very slowly and are sure that there is no approaching traffic. ESTABLISH EYE CONTACTWITH THE CORNER WORKERS AND LET THEM ASSIST YOU AS YOU RE-ENTER THETRACK. If you slide sideways off the track rather than straight ahead, the tires may dig into the dirt and tend to roll your vehicle. Also if you attempt to return to the track at high speed, the tires on one side of the vehicle may really grip on the asphalt and spin you to the other side of the track. By driving straight off and greatly reducing speed before returning, you will avoid unnecessary excitement.

Instructors

Your instructors are experienced in performance driving. Many of them have obtained competition racing licenses and have driven hundreds of laps around the course at speeds and cornering limits above those which you will experience during your driving sessions. Your instructors will be most impressed by smooth driving and following the proper line.

They know that these techniques will result in safe high speed driving. They have been instructed to attempt to keep you from getting in over your head and may ask you to slow down so that you can better follow the line. Feel free to ask for a different instructor at any time--simply pull into the pit and indicate you'd appreciate another perspective.

You may wish to ask an instructor to drive your car to demonstrate techniques to you. You can learn a lot from this experience, but are not expected to do this and should feel no obligation to do so. The instructor will drive smoothly and under control, not abusing your vehicle in any way.

Your instructors are given track time during the day, and will be pleased to take you as a passenger in their vehicles. This can be a very informative and exhilarating experience.

Putting It All Together

When you're driving the track--and anytime you're driving fast and skillfully--you need to combine your knowledge of cornering, braking and accelerating, into a smooth flowing process. If you practice driving smoothly, speed will follow naturally. If your actions are abrupt, you'll find it very difficult to handle your car. If you practice these driving techniques, you'll find driving fast is comfortable and enjoyable.

Ocular driving- Look where you want the car to go rather than where the car is at the moment. If you're entering a turn, look at the apex. If you're at the apex, look at the exit. If you're driving down a straightaway, look well ahead, toward the next turn. If you do this, you'll find you automatically steer the car toward where you want it to go. If you just look at the road immediately in front of you, you won't be prepared for the next turn or obstacle.

Braking and downshifting - As you approach a turn, do all of your braking and downshifting while you're still traveling in a straight line. Then, as you enter the turn, you can concentrate on steering the car toward the apex. Make sure you've let the clutch out before you begin to turn.

Entering a turn - As you reach the turn-in point, look to the apex and steer the car toward it, controlling the car's speed with a light pressure on the accelerator to maintain your speed or

accelerate slightly, as conditions require. Your path from the turn-in point should be smooth curve; if you have to "saw" the steering wheel back and forth, or if you're still on the brakes, then you've entered the turn too fast. Remember, it's not how fast you enter the turn that counts, but rather how fast you leave it.

Crossing the apex - As you approach the apex of the turn, look ahead to the exit, the spot at the outside of the turn where you want the car to go. Start accelerating gently at the apex. If you've entered the turn properly, the car will head toward the exit almost effortlessly.

Exiting - As you approach the exit of the turn, look ahead to the next turn or down the upcoming straightaway. Keep accelerating steadily and begin to steer the car toward your next "mark", if necessary.

REMEMBER, SMOOTHNESS, **CONSISTENCY, AND CONCENTRATION AND MOST IMPORTANTLY--HAVE FUN**.

Common Student Errors

POOR DRIVING POSITION. Check to see that fully depressing the clutch pedal doesn't require maximum leg extension. Check to see that reaching the steering wheel still leaves a slight bend at the elbow. Check the seat belt and helmet strap.
POOR HAND POSITION. Depending on exact steering wheel design, probably about "10 and 2 o'clock." Failure to maintain this hand position once on the track: "crossing over" when making turns and not returning to the steering wheel after shifting.
ABRUPT USE OF CONTROLS: steering, brake and throttle. Smoothness is a basic skill/minimum requirement.
INDECISIVE USE OF CONTROLS:
-getting on and off the throttle unnecessarily
-pumping the brakes," lack of effective, consistent brakes.
FAILURE TO USE ALL OF THE TRACK to get biggest (fastest) radius.
"CREEPING IN" from the edge of the track near turn-in point.
EARLY APEXING
--early turn-in caused by too much pressure/over-driving. ---failure to recognize the "acuteness" of the corner (angle.)
"DROPPED" CLUTCH AFTER TURN-IN POINT. Too late with all the decisions, putting this one after the turn-in instead of before! Big spin risk if the car's near the actual limit.
SHIFTING GEARS WHILE IN A CORNER, unnecessary/risky.
FAILURE TO DO MINIMUM CAR PREPARATION. Basic safety demands appropriate tires, suspension and brake pads/brake fluid for usage. Significant re-checking at track (i.e. tire pressure.
"LATE" TURN-IN. Usually caused by failure to recognize that the turn is (probably) less than 90 degrees. Spin risk as student tries to wrestle the car to the proper apex (anyway.)
BRAKING TOO LATE. Problem is worst when consequences are at maximum! Largest errors are made when the difference between straight-away speed and cornering speed is large. Students tend to enter slow turns too fast (and fast turns too slow.)
FAILURE TO BUILD BRAKING (PRESSURE) SMOOTHLY ENOUGH to prevent "locking" of tires. If the fronts lock first, the student will lose steering control. If the rears lock first, there will be immediate directional stability problems.
POOR USE OF RPM's. Failure to use tachometer to shift neither early or late, missing up or downshifts completely.
FAILURE TO "BALANCE" CAR AT (TURN) ENTRANCE:
-over "rotation" of the car with too much trail-braking and/ or sudden and jerky steering motions. (Oversteer.)
-throttle too soon, no rotation, front "push." (Understeer.)

TRAILING-THROTTLE OVERSTEER
"Dropping" the throttle abruptly when in the corner. This is an all-to-typical reaction to the mid-corner realization of having made an error. Solution: the idea of "temporarily taking a slightly larger radius." Suggest to: momentarily steer "out" with a steady throttle.
POWER OVERSTEER. Too much power applied, too abruptly, with car already near critical grip limits. (rear wheel drive)
FAILURE TO RECOGNIZE MISTAKES. Failure to accept the necessity for full concentration and discipline. Symptom: inconsistency.
FAILURE TO ANTICIPATE/AND ADJUST as speed changes require.
PREMATURE EMPHASIS ON LAP TIMES. Failure to realize/accept that nobody starts "on top" or gets there easily.

Flags

Flags are the only method for track personnel to communicate with drivers on the track. There are flag stations placed around the track primarily where visibility of the track ahead is limited. Drivers must be observant of the flags and failure to follow instructions conveyed by the flag stations will result in loss of driving privileges for the day or even the event depending on the severity of the infraction. The primary flags you are likely to see during the event are the green, checkered, yellow, and black flags. However all the flags and their meaning are included below and all drivers must know the meaning of all flags.

Green Flag

Signifies the start of the event. Or after a caution flag, that the track ahead is clear and normal driving can resume. Sometimes the green flag will be displayed at the starter's stand as long as the course is open and not under caution (green flag condition).

Yellow Flag

A solid yellow, or caution flag, is a signal to the drivers to slow down due to some hazard on the track. The yellow can be displayed at one or more flag stations signifying that a hazard exists ahead. Or it can be displayed at all flag stations (a full course yellow). If the yellow flag is being waved the hazard exists on the course. If the yellow is being held stationary the hazard is off course. In either case the driver must slow down and passing is prohibited. At most tracks a single yellow is a local yellow and a double yellow is a full course yellow. If a single yellow is displayed it is in effect until the next flag station not displaying a yellow flag.

Surface Flag

The yellow and red striped flag is displayed at a local flag station to indicate that the track is contaminated with materials that will reduce tire grip or cause a car to go out of control. Generally this flag is shown when oil, coolant, dirt, or small debris is on the track.

Red Flag

A solid red flag is displayed when conditions are too hazardous to continue driving. When the red flag is shown each car must safely come to a stop and clear the track, to allow unobstructed use of the track by safety vehicles. The corner workers will signal when it is safe to move the cars (usually via a yellow flag).

White Flag

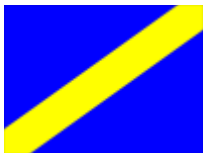
Emergency or slow moving vehicle ahead no passing, use caution.

Black Flag

A solid black flag is used to summon a car to pit lane. The car's number will be displayed at one or more flag stations along with the black flag. An off-course excursion, unsafe driving, or mechanical problem can result in a car being black flagged. The driver must slow down, acknowledge the flag with a raised fist, and enter pit lane immediately.

Meatball Flag

A black flag with an orange center is used to summon a car to pit lane for mechanical problems that may pose a hazard for other cars, such as loose body panels or an oil/gas, or coolant leak. Like the black flag the car's number will be displayed and the driver must acknowledge the flag and go straight to pit lane.



Blue Flag

A solid blue flag with a diagonal orange or yellow strip informs a driver that a faster car is behind him and that the driver should allow a pass at the next opportunity.

Checkered Flag

Signifies the end of the session. Drivers are to continue around the course at reduced speed and enter pit lane at the first opportunity. The checkered flag is traditionally displayed at the starter's stand (allowing a full cool-down lap), but it may be displayed at flag stations for HPDE's. If the checkered is displayed at flag stations, it takes affect immediately and the session stops at that

point and the cars will enter pit lane as they reach it.

Glossary

Some of the terms you'll hear (probably over and over) are:

APEX – is the point of closest approach to the inside edge of the track in a corner.
CONTACT PATCH – is the “footprint” of each tire where it meets the road.
MARBLES – are small pieces of rubber scrubbed off of tires. They'll be seen around the out side of turns and reduce grip. Best to stay out of the marbles if possible. They can also stick to your tires and cause vibrations.
OVERSTEER– is when the car is turning more than the driver is commanding with the steering wheel. You feel oversteer in the seat of your pants.
PINCHING – the act of failing to open the steering wheel enough while the car is moving from the apex of a turn to the track-out point. This maintains the lateral forces on the car unnecessarily.
PIT-IN SIGNAL – A raised fist held out the driver's window to signal that the car is slowing down and will be exiting the track.
POINT-BY – a hand signal given by the driver to indicate that a pass is allowed and which side of the car the pass is to take place
PLOWING or PUSHING – is the result of understeer.
ROTATION – is the turning of the car by use of brakes or throttle.
SHIFT-POINT – is the point where the driver makes an up or down shift. Shift points are a function of the vehicle's speed and gear ratios, not a physical point on the track.
SLIDE – is the condition where the tires have lost their grip and are sliding across the surface.
SLIP ANGLE – is the angular difference between where a tire is pointed and where it is actually going. When understeering, you have slip angles in the front tires. When oversteering, you have slip angles in the rear tires. When slip angles are present the tires will be making noise. A mild complaint from the tires is a small slip angle and you probably still have control. A loud complaint is a high slip angle and you may be on the verge of loss of control (or may have lost it).
SPIN – is an uncontrolled slide.
STEERING LOCK – is the amount of steering input provided by the driver.
THRESHOLD BRAKING – is the application of the brakes just less than the point at which they lock up. Maintaining that level of braking generates the most braking force while still allowing the car to be steered.
TRACK-OUT– is the point of closest approach to the outside edge of the track as you exit a corner.
TRAIL BRAKING – is where the brakes are used beyond the entrance to a turn and are gradually released as your drive towards the apex. The car may oversteer while doing this and extreme care must be taken to avoid excessive oversteer or a spin.
TRAILING THROTTLE OVERSTEER – is the tendency of the car to turn sharper if the driver lifts off the throttle while cornering. Weight shifts to the front of the car, increasing the size of the contact patches of the front wheels, and thus increases their grip. At the same time the rear tire's contact patches are becoming smaller from loss of weight and thus loosing grip. This combination causes oversteer and can lead to rotation of the car.
TURN-IN – is the point on the track where you begin your turn for a corner
UNDERSTEER – is when the car is not turning as much as the driver is commanding with the steering wheel. You feel understeer in your hands and it feels like the car is just not responding to your steering input.
UNWIND – is the act of opening the wheel (reducing the steering angle) as the car travels from apex to track-out.
WARM UP LAP – the first lap, or few laps, of a session devoted to warming up the tires and brakes. Warm up laps are taken at slower speeds and provide an opportunity for the drive to familiarize themselves with the track.

WEIGHT TRANSFER – is the change in weight distribution among the wheels as a result of acceleration, deceleration, or cornering.

The information in this handbook has been compiled from materials of the National Capital and Windy City Chapters, and the driving school manual prepared for Oktoberfest '95 by Gordon Haines and Gregg Ten Eyck of the Rocky Mountain Chapter as well as other public domain sources. We hope these pointers haven't overwhelmed or confused you. It is important that it's the laws of physics that determine what your car can and can't do; if you try to break those laws, you'll get caught every time, and the penalty you pay can be very high.

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