

Audi Club North America

# *Safety School Driving Primer*



G r e y   B o o k

This Student Manual is intended to emphasize points that will be made in the Classroom Instruction at this Audi Club Safety Seminar Driving School. It will hopefully become a reference students can use to refresh their memories about lessons learned in the classroom and on the track.

Classroom instruction will follow the same basic outline used to prepare this manual, although the demands of each event may dictate some alteration in how much, and in what order, this information is presented. Instructors will also be provided with a copy of this manual, so that they will have some idea about what their students have been exposed to during the classroom sessions.

This was introduced at the Quattro Club USA Waterfront Hills event, 1997. Please direct comments or suggestions regarding this manual or the classroom instruction to your Event Coordinator. Please direct criticism to your congressman. Finally, do not hesitate to ask your instructor(s) any questions you may have about the content of either this manual, or your on-track instruction.

*written by Phil Smith, August 1997*  
*revision March 1998*  
*revision May 1998*  
*revision December 1998*  
*revision March 2001*  
*revision March 2002*

## Table Of Contents:

<b>1.</b> Some Basics, Useful To Novice And Expert Alike.....	Page 4
<b>2.</b> Driving, The Most Basics.....	Page 7
<b>3.</b> Corners, That Which Connects The Straights.....	Page 8
<b>4.</b> How To Take A Corner.....	Page 11
<b>5.</b> Transitions.....	Page 12
<b>6.</b> The “Rain Line”.....	Page 14
<b>7.</b> The Car Is Loose.....	Page 15
<b>8.</b> Hooking It All Up.....	Page 16
<b>9.</b> The Translation To Real Life.....	Page 17
<b>10.</b> Before You Leave This Safety Seminar.....	Page 18
<b>11.</b> Listing of Terminology.....	Page 19
<b>12.</b> Notes.....	Page 20

## Some Basics, Useful To Novice And Expert Alike

Welcome to this Audi Club Safety Seminar. Learning high performance driving in the relative safety of a closed track will add to your enjoyment of your Audi, as well as make you a better street driver. High performance driving in any car is all about learning to control the car, and not having the car control you. It is about concentration and vision. And it is about familiarity with your car, its responses to your inputs, and your reactions to its responses. It is **NOT** about racing, and this is **NOT** a racing school! Put your brain in a learning gear, and check the racing ego at the door. If that racing "red mist" should settle over you during the school, give yourself and your fellow students a break; come off the track and relax for awhile. Remember that this school is about safety, control, and enjoying these great cars.

### *Real Basic Stuff*

In your Registration package you will find details about the Run Groups, the Instructor Assignments, and the Schedule. Please review these materials if you haven't yet done so. Direct questions to your Instructor, or the Event Organizer. Any of the Instructors can help you with questions you may have, and sometimes different Instructors can offer different perspectives on a problem that may be perplexing you. At some point during this Safety Seminar, you and your Instructor may feel that you are ready to go out on the track "solo." Until your Instructor signs off for you to run solo, you must have your Instructor with you in the car whenever you are on the track. Even after you've been "signed off," you may still wish to have an Instructor with you; just ask!

The policy regarding alcohol ingestion ("drinking beer", etc.), during the school is very simple: if you are found to have alcoholic drinks at the track while the track is open, you **WILL** be banned from the event, there are **NO** warnings given!. There is absolutely no excuse to impair your ability to perform while at a performance driving school.

Pay attention to your Instructors and fellow students. If an Instructor asks you to do something, please try to cooperate. And Event Organizers are always happy for volunteer help for corner workers, clean-up, etc. Just walk right up and say, "How can I help you?"

### *Prepare To Learn*

Be sure you and your car are well prepared. These events are not necessarily hard on the car or its driver. They do not void your factory warranty. But they do require some preparation. Get a good night's sleep before driving on the track, and eat some breakfast. Be sure you are wearing comfortable all-cotton clothing, if not an actual driving suit. Leather driving gloves can help with your grip on the wheel. Your shoes should be leather, with a fairly thin sole. This is not the place for your wingtips and pumps. Be sure your helmet is of an approved type and fits well. Check this by strapping on the helmet, reach up over your head, and try to "roll" it off forwards; it shouldn't be possible. Yes, this is an uncomfortable exercise, but if a noggin-threatening event happens, you don't want your helmet running away without you.

During the day, it is advisable to drink lots of fluids. It is easy to become dehydrated at these events, and your thinking will be impaired. One of the "athletic beverages" (Gatorade, PowerAde, etc.) or even plain water is best; stay away from soft drinks or too much coffee or tea. The simple carbohydrates (i.e. "sugar") and excessive caffeine will not help your ability to focus your attention.

The Technical Inspection of your car is only a brief overview of its readiness for this activity. You are responsible for ensuring that the car will safely operate throughout the event. Look at your brake pads again, be sure there is at least 1/4" of pad remaining. Check all your fluid levels, especially the oil and coolant levels; keep them topped up! Look at your tires, and be sure there are no cuts or

abrasions that might impair their safe performance. Inflate the tires to 36-40 psi, to help with sidewall rigidity. Your Instructor can give you some guidance here. Keep your windows clean. Sunroofs must be closed. Be absolutely certain that there are no loose items anywhere in or on the car. You should review all these items every time you are preparing to go out on the track, it only takes a moment and will prevent small problems from mushrooming into large problems.

It is **NEVER** worth skimping on your safety equipment. This is one area where the dictum "there is no cheap tool" really applies. High performance driving is impossible if you can no longer drive! Examine your helmet and your seatbelts or harness before every driving session. These items are your protection should there be any loss of control of your car. It never hurts to find another student to be your "buddy". Use your buddy as the objective judge of your car's and your condition. Get a buddy and be a buddy. Talk with your buddy frequently throughout the event. You will be surprised at how much you can learn this way.

### **Track Communications**

You will note several places around the track where people are holding colored Flags. This Flag system is your on-track communication system. You **MUST** learn and obey these Flags if Safety Seminars are to be safe and productive events. Flags fall into two categories:

#### INFORMATION FLAGS



**GREEN:** Track is clear, run at your comfortable speed.



**YELLOW:** Trouble ahead, slow down and be ready to take evasive action.



**WHITE:** One lap to go, cool down your equipment.



**BLUE/YELLOW STRIPE** (not at all events): A faster car wants around you. Check your mirrors and signal a pass at the next Passing Zone. Now is not the time to play at Speed Racer. Let the car around you *early* in the passing zone so you both can set up properly for the next corner.

#### COMMAND FLAGS



**RED:** Stop and do not proceed further. Bring car to a safe halt on the track and await further instructions.



**BLACK:** There is trouble with you or your car. Pit in at first opportunity.



**CHECKER:** Session is over, pit in next opportunity.

As you drive the track, make certain you know the meaning of the Flags, and where the Flag Stations are. The corner workers at the Flag Stations are your "eyes" for what is further down the track. Be sure you know where they are, and include them in your vision every single lap. All Flag Stations have Yellow, Red, and Black Flags. Track Entrance (or nearby) has Green, White, and Checkered in addition to the others. Don't forget, at many of the Club's Safety Seminars, the corner workers are **YOU!** Help do your part and volunteer for this duty. Not only will you be helping to ensure a smooth-running event, you will also find that you will learn from watching other students drive.

### **Track Etiquette And Safety**

**NEVER** enter the track until the flag worker at the end of the pit lane gives you the signal, and even then carefully check your mirrors and stay "off line" until up to track speed. When leaving the track, make your last lap a "cool down" lap. Drive a little slower, giving the clutch and brakes a rest. When you come in off the track, do not set the handbrake, since the brake rotors and pads will be quite hot. They will possibly fuse or warp if the handbrake is engaged. If the engine is hot, open the hood. Bleed your brakes if the pedal has become soft or mushy. You may pass only in the indicated passing zones. The Passeur has the responsibility of signalling the pass, as discussed in your Drivers' Meeting. Slow down, and allow the Passor to get around you, so that you both can set up properly for the next corner. The Passor has the responsibility of making a quick and effective pass. If you do not intend to pass, do not follow so close! Both Passeur and Passor are well advised to take the next corner slower than usual, paying particular attention to their form through that corner; this helps reduce the Red Mist Effect.

### **Emergency Procedures**

What to do if you go "off track." Two wheels off, pit-in is **SUGGESTED** to inspect car and settle its human contents. Four wheels off, pit-in is **MANDATORY** for same reasons. If you go four wheels off, **STAY IN THE CAR!** If the car can still be driven, wait for a hole in traffic and move out, staying off-line all the way around and pit-in. **DO NOT** resume track speed, how do you know your car is safe? If the car cannot be driven, stay in the car until told to get out. If there is fire, get out immediately and move well away from the car and the track.

After each run session and at the end of each day, look the car over carefully. Check the brake pads, and inspect your tires. Be sure there are no fluids leaking. Check the wheel bolt torques after they have cooled. Give yourself and your car a General Inspection for Safety! If brakes or fluids are too hot, seek help. If the brake pedal is mushy, think about bleeding the brakes. Make necessary repairs or adjustments now, while they're fresh in your mind. **NEVER, EVER** compromise your equipment. If something can fail, it will, and at 90 mph on the straight or in heavy traffic on I-75 is not the time to test your "makeshift" repair. Have a car and person "debriefing" with your buddy before heading home.

### **Final Preparations**

Some information is specific to this track, such as the on-track and off-track procedures, the Exercise and Run Group organization, windows up or down, etc...will be reviewed in your Driver's Meeting and the other handouts. Be sure you understand these items. Before going out on the track, be sure you have reviewed the following (check 'em off):

- \_\_\_\_\_ **The location of the Paddock and the pit lane**
- \_\_\_\_\_ **How and where to stage before your Run Group goes out on the track**
- \_\_\_\_\_ **How to enter the track and how to exit the track**
- \_\_\_\_\_ **The Flag System**
- \_\_\_\_\_ **The passing procedure and passing zones.**
- \_\_\_\_\_ **The Event's schedule and where to be when**
- \_\_\_\_\_ **Have you met your Instructor?**
- \_\_\_\_\_ **Your Audi's preparation and safety, and last but not least,...**
- \_\_\_\_\_ **Your personal preparation and attitude**

Finally, keep the interest of our mutual safety in mind. If you have a question about something, ask. If there are no applicable rules, use your common sense. Safe performance driving requires a

healthy dose of common sense. Everybody who completes the Safety Seminar with person and car intact and who has learned something is a Winner in this game. Let's have nothing but Winners by the end of this school.

## Driving, The Most Basics

### *Driving Position And Attitude*

This is the Most Basic Item in your quest to be in control of the car and not vice versa. Adjust seat fore and aft so that pedals can be pushed in all the way without stretching your hip, leg, or ankle. Then adjust seat back so that elbows are slightly bent when wheel is held at "9 & 3", and your wrist will drape over the top of the steering wheel.

Sit **IN** the seat, not **ON** it. Cinch down your belts or harness; if you're sliding in the seat, that's wasted motion and therefore wasted control. You don't want to use the steering wheel as a support.

### *Use Of Controls*

Your hands belong at the "9 & 3" positions on the wheel. Keep them there unless shifting; hands-off is a loss of control.

Handle the shifter only when shifting, and then do not force it. Holding the shifter not only prematurely wears the shifting forks inside the gearbox, it also means one of your hands is off the steering wheel. This impairs your control.

Make quick and confident, but not stabbing, use of the foot controls (the pedals). Push the clutch **ALL THE WAY** in when shifting; unless you enjoy repairing gearboxes, do not shortcut on this. Ease on and ease off throttle, to keep fore-and-aft weight transfers smooth. The Dead Pedal is left-most and is useful to brace yourself if necessary.

### *Vision! You Cannot React To What You Do Not See*

Keep it up! Don't look where the car is going, but be looking where you want the car to go. The car will go where you are looking! Your head is connected to the opposite hand...look left, the right hand goes up, vice versa.

### *Drive Your Car*

Be looking where *you* want to go, and do not "drive the car in front," as is the common tendency.

### *The Brake Pedal*

It doesn't matter how fast you can go, if you can't safely slow down. While you will later learn the reasons for the following two Rules, you should commit the following to memory **NOW**:

- **Braking Rule #1:** All Braking is to be done in a Straight Line...don't ask the tires to do too much.
- **Braking Rule #2:** Always err on the side of braking too soon. Braking distances increase exponentially as speed increases, magnifying the effect of even small errors of judgment in where you begin braking.

### Some helpful brake pedal hints:

When approaching a corner, get all the braking done before turning, and allow just a hesitant pause between finishing braking and turning in, to allow the car to settle. The best braking comes from a tire that is rotating just slower than the car is moving. Skidding tires mean a loss of braking efficiency, as well as a loss of directional control. "Threshold braking" is the technique of finding this fine line representing maximal braking. ABS (anti-lock braking system) simplifies your braking technique. Just stand on that pedal and the ABS keeps the wheels from locking, so you can steer. But keep in mind that whether or not the car has ABS, when the tires just start to lock up (or the ABS just kicks in), curl the toes to just barely ease up on the brake...let the wheels rotate, albeit slightly slower than the car is moving. If you master this, you can slow the car even faster than full engagement of the ABS. This is something to practice during The Exercises, as well as at home.

### **The Exercises**

Why they're done, and what to get from them.

- **Threshold Braking**...feel the ABS (if so equipped), and learn how to modulate that middle pedal to shorten braking distances. Also, practice smooth acceleration and shifts.
- **Slalom**...learn how the car transfers weight side-to-side and how your steering inputs affect this weight transfer. At first you will do the slalom at constant throttle, but later you will experience the effect of the accelerator on the car's balance.
- **Lane Toss**...learn about reaction times and keeping the vision up. Avoidance, not Slow Collisions!
- **Cornering**...see why proper cornering technique is Basic Survival at speed. Demonstration of Late and Early Apex techniques. Find out why an Early Apex is an Early End to your day.

At any ACNA Safety Seminar, you may encounter some or all of these, as well as perhaps other exercises. If you are unclear about what you are expected to do or learn from the Exercises, speak up and ask an Instructor!

## **Corners, That Which Connects The Straights**

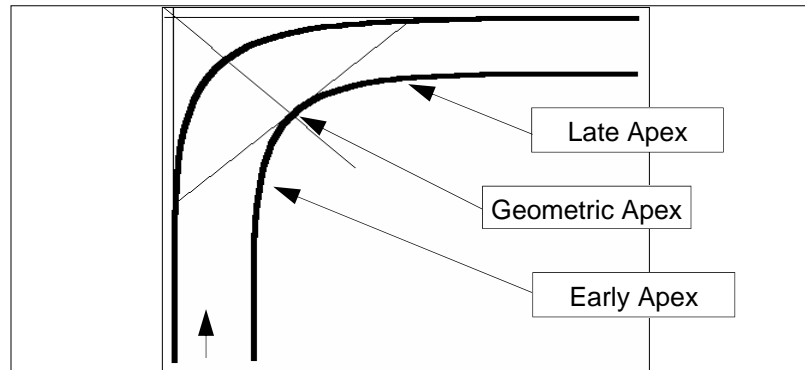
**Anybody can point a car in a straight line and push the gas pedal. The Good Driver knows how to safely and efficiently connect the straights.** One of the very first concepts you must grasp is how to safely negotiate a corner. Without getting into details about how to link up corners, let's examine **The Anatomy of A Corner**, and how to safely get through any corner you encounter. Call them corners, curves, or turns, the basics are the same.

### **What Happens In A Turn?**

Seems like a straightforward question, doesn't it? In reality, it's not. As the driver approaches the curve, he/she turns the steering wheel, and the front wheels turn. The tires (hopefully) grip the road and steer the car in the new direction. Anybody who has ever slid on a wet or icy road intuitively knows that the faster one is cornering, the less grip the front wheels seem to have. And, sharper turns means the car must be moving more slowly, lest it slide or roll over.

### **Concept Of Apex** (the Technical Paragraph).

The Geometric Apex is at the point where the bisection of the angle of the tangent lines drawn from the turn entry and the turn exit crosses the inside edge of the track. The Driven Apex is the point on the inside of the track that the driver chooses (hopefully intentionally) to divide the turn. If before the Geometric Apex, it is termed an Early Apex. If after the Geometric Apex, it is termed a Late Apex. For now, please remember that a *Late Apex is a Safe Apex*.



### **What The Apex Means**

From a practical standpoint, the apex is where the car is the closest to the inside edge of a corner or turn. If that apex comes before the turn's center (the geometric apex), the driver has chosen an "early apex" technique. If the driver comes closest to the curve's inside edge after the turn's geometric apex, the driver is making a "late apex."

### **Using The Apex**

If the driver chooses a perfect arc through a corner, the car meets the geometric apex. If the car is going as fast as it can and still has grip on the road, the driver cannot speed up at all until the corner is completed and the steering straight.

A Late Apex requires the driver to dial in the most steering input upon initiating the turn. The sharpest turn is at the start of the curve. Therefore, the slowest part of the turn is at the start of the turn. As the driven apex is passed, the steering input may be gradually decreased; "unwind" the wheel. Thus the turn radius increases, and the driver may now begin to increase speed as the corner is exited.

Early Apex, on the other hand, puts the largest steering input at the end of the turn, therefore invites entering a corner too fast. The driver may slam on the brakes, which can spin the car. Or the driver tries to turn more sharply despite the speed and the car does not turn; the driver quickly runs out of track. In general, Early Apex is an invitation to go gardening, and should be avoided. It is almost always a careless and dangerous manner of executing a corner.

So here we see why the Late Apex technique is desirable. First, because the first part of the turn is the slowest, the driver will have done all decelerating before the corner. The corner is entered with a nice stable car. Second, if there are surprises lurking in the curve, the slower speed gives the driver a chance to react. Unexpected traction losses or foreign objects can be handled at a slower/safer speed. Third, the driver can now accelerate out of the corner...besides being generally quicker, the experienced driver learns that the throttle can now be used to help compensate for any slipping that might occur. Finally, a Late Apex technique ensures that the driver does not run out of road in the corner.

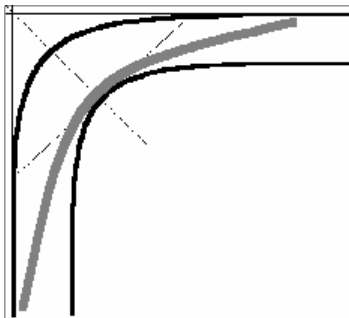
### **Warning!**

Now that you are convinced to always Late Apex, you will find that putting this in practice is very difficult. Humans carry some counterproductive reactions, probably left over from the days when a snapping twig in the underbrush meant Mr. Cave Man was about to be eaten by Mr. Tiger.

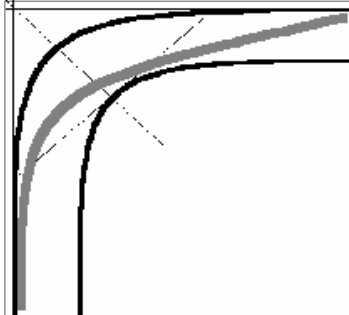
This tendency results in the average driver *anticipating* a corner and turning the steering wheel way too soon. Now our Average Driver (A.D.) has committed to an Early Apex. What if A.D. is going too fast? Or the road is unexpectedly slick? Or there is a motorcycle coming the other way? A.D. has no room to compensate. If you don't believe this, analyze the cornering technique you see on the street....Early Apex happens all the time. You will have to genuinely work at making Late Apex your habitual cornering technique. And if you do, it may someday save some bent metal or personal injury.

## **DIAGRAMS OF APEX TECHNIQUES**

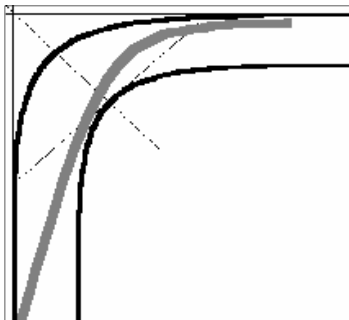
***In all cases, the heavy grey line is the driven line.  
Direction of travel is up and to the right.***



**GEOMETRIC APEX.** Note that turn line intersects the geometric apex of the corner. This curve represents the highest constant speed around the corner, since any higher speed results in drift.



**LATE APEX.** Turn line intersects the inside of the curve after the geometric apex. Note that sharpest, and therefore slowest, part of the turn is at initial turn-in. After that, the curve becomes less sharp, thus the driver can accelerate out of the turn.



**EARLY APEX.** Turn line intersects the inside of the curve before the geometric apex. Note that the sharpest and slowest part of this turn happens at the end. If the driver hasn't slowed sufficiently, the car will drift right on off the track beyond this point, if the driver is lucky.

# How To Take A Corner

## *The Six Zones Of A Turn*

To condense the previous discussion, you will recall that the corner starts with Turn In, where the driver begins to turn the steering wheel. The Apex defines the type of turn being made. And the Turn Out, or Turn Exit, is where the driver again has the steering wheel straight. But it's not quite that simple. The cornering action actually starts well before the steering wheel is ever turned. The Good Driver observes the following sequence when encountering a corner (I've included some comments about where our Good Driver is looking in each of these Zones)...

- **Approach:** Stay to outside of the track. Brake and accomplish necessary downshift. (do in two or three steps if necessary). **VISION:** braking landmarks, look for turn-in reference.
- **Hesitate** to settle the car....Steering wheel stays straight ahead. Let the "balance" return after you've loaded up the front and lightened the rear. **VISION:** Look for desired apex briefly then for turn exit point; this is your "window" for turn-in.
- **Turn-in:** Dial in desired steering input, should be as slow here as you're ever going to be in this turn. Input should be sufficient that inside edge of car will just "clip" the apex you've selected on the inside of the corner. **VISION:** Looking for exit.
- **Modulation:** Before the apex, maintain the car's balance by maintaining a steady throttle. No sawing at the steering. The key here is stability. **VISION:** Looking at the exit and beyond.
- **Accelerate:** Assuming you are using a late apex technique (good in the quattro), as the apex goes by, begin squeezing into the throttle, at the same time gradually unwinding the steering input. This lets the car move to outside of track and begins to rebuild speed. (If you're on the "ideal constant arc" curve, i.e. geometric apex, you can't begin to accelerate until exiting the corner; not the best use of the quattro system.) **VISION:** Be looking for the next braking zone.
- **Turn Out:** The steering wheel is straight again.

## *Shifting*

Get it done before Turn-In. Avoid gear changing in the corner, although it may be necessary as you approach the exit. Keep the tach needle in your peripheral vision as you accelerate out of the corner. The act of gear changing moves the fore-aft weighting of the car, hence introduces a potential instability, not desirable in a corner.

## *Cornering Technique Is Basic*

Quick and safe laps result from smooth linking of sequential corners, each taken with a well-placed apex. *Everything else is refinement of this basic premise! Master this at the track and practice and use these techniques on the road. You will be a safer driver!*

## Let's Go Through That Zone Sequence Again!

- **Approach...**Get all the braking and downshifting done in a straight line! Note that the car is all the way to the outside edge of the track. The driver is looking for his/her turn-in point, often marked by a cone at ACNA events. It is often better to choose some marking on the track itself as your reference. The cones are set up as a compromise position, and every quattro model and driver will require some variation. Use the cone as a starting point as you learn the corner.

- **Hesitation...**Let the car's suspension settle just before turning in. Be looking for your apex before you turn in. Note that there is very little track left between the front of the car and the turn-in cone, perhaps a car length or so. At this point, you should be neither slowing nor speeding up.
- **Turn-in...**At your turn-in point, pointedly look at your desired apex and turn the steering wheel. If you are really looking up at the apex, you will almost automatically turn in the right amount. Make it a smooth deliberate turn in, not jerky. Keep both hands on the wheel. At ACNA events, a cone will be set up to indicate a late apex.
- **Modulation....**the turn-in is complete, the car is on a late-apex trajectory. Between here and the apex, it is important not to upset the car's balance by adjusting the steering wheel or changing the accelerator setting. Here is where you start looking for the turn's exit. Maintain a steady throttle and steering wheel input, and the car is perfectly set up for...
- **Acceleration...**after passing the apex, you should be accelerating away out of the corner. This is the quattro's strong point. With all wheels driving, power can be more effectively applied without losing traction. Remember to keep your vision way up, scanning the horizon for your next turn-in point. Your peripheral vision will help you make a smooth arc towards it, as the car drifts out as you finish this corner.
- **Turn Out...**having completed execution of this corner, move your thoughts and vision on down the road to the next corner. Focus your concentration on what's coming up, not where you just were.

Your time is well-spent working on mastering basic cornering technique. Make it smooth and consistent. To reiterate, one way of viewing driving is as a bunch of corner turns linked by straights. Anybody can point a car straight and push the gas pedal down. It requires a good dollop of practiced skill to corner well. Each corner is different, and you must learn how to "read" the road. Using the cones as a guide, practice your turn in, apex, and exit until you can drive the same line through the corner consistently. Then you can try moving these points to learn what works best for you and your car.

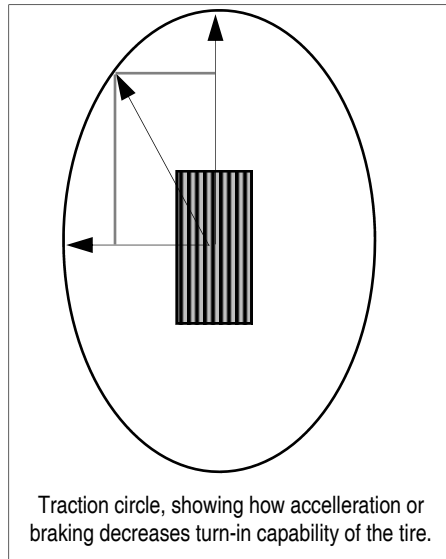
## Transitions

### **No Corner Or Straight Exists In Isolation**

TRANSITIONS are how you go from one to the other. Good cornering is only part of the Safe and Efficient Driving equation. The Good Driver knows how to keep the car stable and predict the car's response to control inputs. This ability comes from working on smooth Transitions. This includes understanding the tires, suspension and concepts of weight transfer.

### **What Tires Can And Can't Do**

Consider the concept of the "*traction circle*." There is only so much friction the tire can generate in any direction. If you are using some of the tire's friction to slow down, you have less friction to get the car to turn in. Therefore, for example, a car under heavy braking will not turn well. A car under heavy acceleration will tend to have the rear tires come loose. It's almost like you have a bank account of traction, and if you have made a withdrawal for braking, you have less to spend on turning. Because of these limitations, the policy of "**SLOW IN, FAST OUT**" is wise to follow. The absolute traction limit of a tire depends on tire, pressure, suspension settings, track, and temperatures, for any given car.



### ***What The Suspension Can Do***

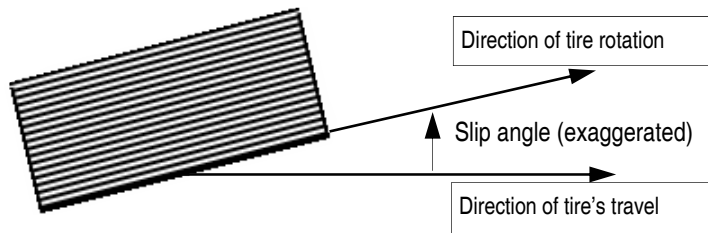
The suspension controls how well the car relates to its tires. A stable suspension is most responsive to input. If the suspension is not settled, the tires are not going to be able to provide their full measure of grip. Hence, allow the car to settle after braking, before turning. Keep inputs smooth, not herky-jerky.

### **How To Keep The Suspension Stable**

- ***Fore/aft...***careful transitions from brake to gas, gas to brake. The Good Driver does not have to stab at, or leap off of, the brake pedal or accelerator. Consider these controls to be fine instruments needing to be caressed by the trained foot.
- ***Side-to-side...***rather than sudden turns of the steering wheel, the Good Driver “introduces the car to the corner” (I think Stirling Moss said that). Make turn-ins deliberate and smooth, keeping the line of vision up. This then eliminates “sawing” at the steering wheel. Sawing back and forth swings the car’s weight back and forth, and thus makes the car more difficult to control.

### ***Tech Talk***

*Slip angle* is the angle formed by the line parallel with the tire and a line parallel with the car's direction of travel.. It is determined by tire and suspension design, and ultimately by the amount of grip the tire has on the road. It increases with speed. Drift is the summation effect of the slip angles of the front and rear wheels. It determines which direction the car is going to go for any given speed and steering input. Since front slip angles are generally larger than rear slip angles, drift determines the maximum speed at which a given radius turn may be made. Higher speeds mean larger radius turns. This, then, is the limitation you must work with when cornering.



### **Transitions Are All About Weight Transfers**

Up to a point, increased weight on a tire results in better grip (the traction circle “gets bigger”). By controlling the degree of weight transfer, a good driver can increase the ability of the car to brake and turn-in. Sloppy weight transfers can result in real trouble, however. For example, braking into a corner will certainly increase the car’s ability to turn in, since the car’s weight is transferred to the front wheels. However, that extra weight at the front had to come from somewhere; and that “somewhere” is the car’s rear tires. Now the driver has great turn-in, but the back end of the car is less likely to grip well enough to follow the front, and thus continues travelling in a straight line. Let’s see...front turns, back end goes straight. Sounds like a spin generator, and indeed it is.

Secondly, suddenly shifting weight to one end or one side by an abrupt input loads up the suspension on that end/side. The thus tightly compressed suspension is anxious to release that stored energy, and it quickly will, thus forcing the weight back to the opposite end/side. That end/side responds in kind, and very quickly one finds the car oscillating back and forth, end-to-end or side-to-side. Clearly this is not the stable platform one desires for precision driving.

The above paragraphs illustrate why smooth control inputs are necessary for good driving. Smooth transitions result from smooth and controlled (as well as well-considered) weight transfers.

**Good transitions result in quick, smooth, and safe driving.** They require good turn-in and exit technique.

- Since the brakes have to work harder at higher speeds, when slowing use your hardest braking at first application, then ever so gradually ease off the pedal as the car slows. An exercise to practice at home is the Chauffeur Stop; as you approach a stop sign, gradually release the brake as the car slows, so that you are completely off the brake at the exact moment that the car stops. If done correctly, there will be no front-end bob as the car stops.
- Practice smoothness at turn entries. Smoothly move feet from brake to gas pedal before turning in, and use a stable foot on the throttle until the apex is reached. At the apex, ease into the gas (no sudden moves and no-one gets hurt here), make deliberate steering inputs as you gradually unwind the wheel. Smooth shifting technique before and after the turn requires careful use of the clutch and an ability to match the engine speed with the car's speed. Practice your clutch technique every time you accelerate.

## **The “Rain Line”**

### **How Do I Control My Car On A Wet Or Slippery Surface?**

Unless you are a trained rally driver, you want all four wheels to always have full contact and traction with the road. In at least one State, ALL single car accidents are classified as **“TOO FAST FOR CONDITIONS”**...there’s a lesson in that! First and foremost, **Slow Down.**

### **Late Apex**

The Late Apex becomes even more important, for all the reasons discussed earlier in this manual.

### **Brake Earlier And More**

The quattro system does not make the car impervious to road conditions. A wet road offers much less grip to the tires, especially in the first few minutes after a rain starts. Braking distances greatly increase, something that quattro will not help. Compared to front- or rear-drive cars, the quattro system does give you the ability to accelerate more quickly out of a corner, but it does not allow you to turn in at a higher speed. Therefore, **SLOW IN FAST OUT** becomes that much more important.

### **Hydroplaning**

The tires ride up on a cushion of water, losing all grip with the road. You feel this as a sudden "lightness" in the steering. Ease off the throttle, maybe even push the clutch in so that the wheels can turn easier. Do **NOT** jump off the throttle or get on the brakes. Your goal is to allow the tires to settle back down onto the road so that you can regain control.

### **Examination**

of asphalt smoothing on the "ideal line." The place on the road where everyone normally drives is going to be smoother, slicker, and more likely contaminated with oil, antifreeze, and other automotive juices. So get off that line. Move about a half-car width in on the track. Turn in a little later, so that you avoid crossing the normal line with the front wheels turned. Don't get quite as excited about really tucking that apex clear to the inside of the track, especially if the steering wheel is turned at all. Exit about a half-car width in from the edge of the track.

### **Exaggerate**

Everything you've learned about Transitions in dry conditions must be carried to the extreme on slippery conditions...Control input smoothness, smooth weight transfers, etc....Let the car work for you, not vice-versa.

## **The Car Is Loose**

**Sooner or later, one end and/or the other of your car will no longer have complete traction on the road.** This is what is meant by The Car is Loose. Sometimes looseness is intentional, but more often, and more significantly, it isn't. The Good Driver knows how to avoid unintentional looseness, and what to do when it does happen.

### **How To Get A Loose Car -**

make it unstable. This happens any time the front and/or rear tires lose sufficient grip to keep the car in its present attitude. Some of the causes are carrying too much speed into a corner, non-smooth inputs, frightened reflexive braking moves or sudden throttle lifts in the middle of corners, or over-exuberant use of the loud-pedal.

How do you know when the car is loose? The happy tires of a controlled car will sing to you; they're just at their traction limits. You and your car are travelling as fast as your chosen driving line will allow, and this is good. The unhappy tires of a loose car will squeal like a pig. This is an unpleasant sound. For those at trackside there is the unhappy thought of a fellow driver not fully in control. For the person behind the wheel, there are thoughts of frequent tire replacement (best case scenario), or...(worse case scenario).

## **How To Handle The Loose Car**

No matter which of the four following scenarios confront you, it is all-important to remember to keep looking where **YOU want** to go, and not where the **CAR is** going! This will help your brain come up with the proper reflexes and make recovery much easier.

- **Understeer**; the front end is "plowing", not obeying your steering input. Ease off the throttle, open up the steering a little bit, let those front wheels hook-up again.
- **Oversteer**; the back end wants in front of the rear. Keep the vision up, watch where you want to go, not where you're going. You will reflexively steer into the turn. Maintain steady throttle or **VERY** gently lift a little. No big moves with the gas pedal, certainly none with the brake pedal, unless you want to see where you've been.
- **Skids/slides**; like oversteer, only worse. If the car gets fully sideways on the track, you will not save it. Push the clutch and the brake all the way in, hold the steering wheel pointed straight, and ride that wild hog until the car stops. Those who have done this a few times eventually learn how to manipulate the steering, brake, and throttle to bring the car on around; but the first few times you spin, it is not humanly possible to have the presence of mind to try and control it. Just don't make it worse! It is easy to overcorrect a slide and spin in the opposite direction, a truly frightening event. One notable exception to the full clutch/full brake rule is if it appears the car is going off the pavement. In that case, make every attempt to leave the pavement straight ahead or straight backwards. Hold the wheel straight, and wait for the car to stop.
- **Wheels off the pavement**; **NO JERKY MOVES** unless you want to flip your car over. Keep the steering wheel straight and do **NOT** try to immediately get back on track. Ease off the throttle, let the car slow down and stabilize. Now you can ease the car back onto the track. If all four go off track, move the car to a "safe" place in the run-off area and wait until a nice big opening in traffic. If all four go off, you **MUST** pit, if two go off, it is **SUGGESTED** that you pit. Both car and driver should be inspected!

## **Hooking It All Up**

### **The "Three Cs": Consistency, Concentration, And Seeing**

- **Consistency**: By now you should be shifting and braking in Consistent locations on the track. Pick permanent landmarks (trees, towers, etc.), not landmarks likely to change (paint on the wall, a dog wandering around, etc.), to use as reference points. Consistency in when you initiate control inputs allows you to focus on how much input to use. Then you will soon drive a smooth consistent line.
- **Concentration**: To be consistent and therefore smooth, you must concentrate on the driving. It's intuitively obvious that talking on the cell phone, reading the newspaper, or eating a Big Whopper while driving is not helpful in paying attention to your driving. On the track, everything is more intense than on I-75, and thus your full attention is even more important to your safety.
- **Seeing**: You must remember the overriding importance of Vision. Always be looking up and ahead. By looking up and ahead and seeing where you want to go, you are giving your brain a chance to process those details necessary to make the car go there. Your peripheral vision will pick up the near-field details and allow those last moment variations. This concept of keeping the vision up is not only necessary for smooth driving, it also contributes largely to safe driving.

### **Smoothness Counts**

As you gain experience, your speed will probably increase. The natural tendency is then for transitions to become rougher. Obviously this is even less desirable at higher speeds than it was during your early tentative efforts. You must keep in mind that by allowing the suspension to adapt to weight transfers gradually, you will be driving a more controllable car. This can only happen if your control inputs and transitions are smooth. If you find your tires howling and the car pitching about, you are not paying close enough attention to your weight transfers. You are travelling too fast, and have insufficient time to make smooth transitions. Either you are too tired and/or you are driving too far beyond your ability. Rather than be an accident waiting to happen, either slow down, or come into the pits for a rest.

### **Connecting The Turns**

Consider that in a series of turns, setting up for the first one determines how you come through the last one. Sometimes deviating from the "ideal line" in any one corner may actually work to your advantage in subsequent corners in the series. For example, consider "esses"; apexing very late and staying to the inside of the turn at the exit of the first turn sets you up for an ideal arc in the second turn, resulting in a faster exit from the esses.

### **Quattros And Front-drivers Like To Understeer**

Remember that turn-in speed is limited. There is an advantage to be had by getting on throttle early, therefore, late apex technique is not only the safest, but perhaps the fastest in our cars. However, in some situations, you may choose other apex techniques for specific reasons. Keep in mind, though, that you lose a margin of safety when you stray from a Late Apex-based cornering technique.

### **AT THE END OF EACH SESSION / DAY / SCHOOL**

- **Review The Safety Rules; Check Your Car And Person.** Check your ego at the door. Check your equipment thoroughly.
- **Review Basic Driving Safety:** Check mirrors often, always brake in a straight line, always brake too soon, and remember "slow in fast out."
- **Review Basic Cornering And Braking Technique.** Think about the Anatomy of a Turn, The Six Zones of Cornering, and Transitions, make these concepts your own.
- **Remember The Concert Pianist Principle:** Just when you start to get a piece under your fingers is the worst time to start taking it "up tempo." You'll never really learn it then. This lesson applies to any skill, including performance driving. Now is the time to **SLOW DOWN**, evaluate every move, practice what you've learned to be right and proper, and exorcise any evil habits you may have. Speed will come.

### **The Fatigue Factor**

When you are tired (such as halfway through Day 2) is not the time to find out how fast you can go. Slow down, concentrate on the basics, and go home in one piece. Tired drivers always end up taking a rest, whether or not they intended to!

## **The Translation To Real Life**

Everything about the Safety Seminar has been geared for the track. The track is a great place to learn high performance driving, because to really learn, you must test the limits of your skills. Occassionally this means a slide or spin. Public roads are obviously not the place for this. At the

track, on the other hand, these can happen with relative safety. Do not be ashamed or alarmed if you do have a spin. But do learn from it! Ask your instructor what went wrong. Too much speed into the corner is a very frequent mistake; remember Braking Rule #2; always err on the side of braking too much or too soon!

**There are some techniques that you can safely practice at home.**

- Every stop sign can become a “chauffeur stop,” and every shift is an exercise in smoothness. These things will help you make smooth fore-aft weight transfers.
- Threshold braking is easily practiced on a little-travelled back-road; you do not have to go fast!
- When turning onto your side street, practice identifying turn-in, apex, and exit. Make your everyday turns into perfect low-speed late apex cornering exercises. (Crossing lanes is **NOT** recommended, though!)
- And always practice alertness, attention to your equipment, good driving posture, scanning the gauges and mirrors, and the myriad of other little details that add up to high performance driving.

## **Before You Leave This Safety Seminar....**

Hopefully, you have by now safely completed an Audi Club Safety Seminar. You will leave this event that much more secure in the control of your quattro, and hopefully able to enjoy it even more. And the more often you come to a session such as this at the track, the more you will make the lessons learned part of your ordinary daily driving routine. Paying attention to the dynamics of driving will become second nature, and not the mental effort it is at your first Seminar. Remember, though, that nearly everybody else on the road is still driving according to what they were supposedly taught in Driver’s Ed., way back when, if even that. The fact that you are here indicates that you have an interest in driving; most of **“THEM”** do not! Expect utter idiocy. Even if you don’t immediately see it, expecting it means that you are driving defensively and will hopefully therefore miss out on accidents! Watch out for the non-Driver behind the wheel of a Roadmonster or Exploder eating a burger while they read the paper and talk on the phone, all at once. That person is just another hazard for you to avoid.

**SEE YOU AT THE NEXT SAFETY SEMINAR!**



## Listing Of Terminology

**A partial list of important terms used in this manual and in the classroom sessions. Be sure you understand them all.**

Apex, driven  
Apex, early  
Apex, geometric  
Apex, late  
Braking point  
Circle of Traction  
Constant arc turn  
Drift  
Feathering, i.e. brake or throttle  
Flag, Command  
Flag, Information  
Heel and Toe  
Hesitation  
Hydroplane  
Lift  
Line  
Modulation  
Off Camber  
Overcooked  
Radius, Decreasing  
Radius, Increasing  
Red Line  
Red Mist  
Slip Angle  
Skid  
Oversteer  
Pit In, Pit Out  
Understeer  
Transition  
Turn In  
Track Out  
Threshold braking  
Throttle Steer  
Vision  
Weight Transfer



