

Autocross Defined

When you arrive at the autocross, you'll see a course set up on a large parking lot. Soft, rubber traffic cones will be used to form the course, which consists of turns, slaloms, and straights. **Arrive early** — see what goes on, volunteer to get involved!

Prepare your car before you arrive

Ideally, you should prepare your car before you arrive. Remove all loose items from your car — floor mats, driver's carpet, coffee cups, etc. Check tire pressures and chalk your tires.

When you arrive

Register

- Find the registration area
- Select a run group and get a car number
- Complete waiver and registration form
- Sign up for a work station

Technical Inspection

- Drive car to Tech Inspection (or, they may find you)
- Give registration form to the inspector
- Your car will be inspected for safety
- Display your car number and class as directed

Driver's Meeting

Check the course map at the timing trailer and attend the driver's meeting where you will learn about the course:

- Safety
- Danger zones
- Tight corners
- Wet or oil spots
- Uneven or rough pavement
- Flagging and corner worker instructions
- Availability of instructors

Course Walk

Walk the course with an experienced driver (also known as walking the line):

- Study the course map, and then walk the course. If no map is provided, make your own.

- You will be given 10 - 20 minutes to walk the course before run sessions start. The first problem that confronts every autocrosser is staying on course, so the first step is to learn where it goes. Take opportunities to walk the course between run sessions if you are allowed to do so.
- Walk the line (path through the course) you plan to drive as if you were sitting in the driver's seat.
- Check for surface bumps, loose gravel and stones, uneven pavement, joints, etc.
- Take your time. Avoid following a crowd that blocks your view.
- Stop and study difficult or optional sections of the course to plan your line. Observe other drivers and note where they hit pylons or have difficulty staying on course. Move around the course to observe problem areas from different locations.
- At this point, decide how you want to drive the course (with help from your instructor and/or other experienced autocrossers). How to drive the course calls for a plan. And remember, an imperfect plan is always better than no plan at all.
- The question autocrossers ask most often is: "How do I determine the best line or path around the course?"
- Starting off, concentrate only on determining the best line, which may be compared to slalom skiing. In an autocross, we are concerned with three things: time, distance, and speed.
- The formula $time = distance / speed$ expresses the relationship of three key factors in autocross. To drive the course in the least possible amount of time, the line must offer the shortest distance and permit the greatest speed. As the formula illustrates, time can be decreased by either shortening the distance or increasing the speed — or better yet, both. Many times it becomes impossible to drive at the highest speed over the shortest distance. When this occurs, the best path is a compromise somewhere between the two extremes.

Once the Competition Starts

Watch other drivers

- What line are they driving?
- Where are the braking points?
- Where are the shifting points (up and down)?

Now it's your turn

- Bring your car to the staging area
- Proceed to start line
- Check your seat belt
- Double-check that all loose objects are out of the car
- Focus on how you want to drive the course

Starter gives the OK!

- Launch the car quickly (weigh pros and cons of driveline abuse vs preservation)
- Look several turns ahead if possible

- Know where you want to place the car
- Remember when to brake and shift

If you should spin

- BOTH FEET IN — depress the clutch and brake fully
- Stop the car and don't start again until corner workers re-start you
- Finish the course

If you see a Red Flag

- Quickly come to a complete stop
- Look for corner workers to re-start you

Drive the First Run at Reduced Throttle

- Learn to stay on course
- Drive a good line
- Drive *smoothly*
- Have a good time!

Sample Classification System

Stock

Cars must have been series produced and capable of being licensed for normal road use in the US. Cars should be equipped with street-legal equipment normally sold and delivered through manufacturer retail sales outlets in the US.

Allowable Modifications

- Accessories, gauges, indicators, lights and other appearance modifications which have no effect on performance and/or handling and do not materially reduce the weight of the car are permitted.
- Alternate steering wheels are allowed provided the outside diameter is not changed by more than one inch from the standard size.
- Any tire which is OEM on a car eligible for Stock class may be used. Unpermitted tires are: Hoosier (all), M&H (all), McCreary, and Mickey Thompson Indy Profile and Indy Profile S/S.
- Any type of wheel may be used provided: It is the same width and diameter as stock and it does not have an offset more than +/- .25 inch from the standard wheel for the car. Wheel spacers are not allowed.

- Any shock absorber may be substituted provided the number, type, and system of attachment points are not altered. Suspension geometry and range travel may not be altered.
- Substitution, addition, or removal of any front anti-roll bars is permitted.
- The make of spark plugs, points ignition, coil, and high tension wires is free.
- Air filters may be removed, however, no other components of the air induction system may be removed, replaced, or modified.

Street Prepared

Equipment and/or modifications may be exchanged between different years and models of a vehicle if the item is standard on the year/model from which it was taken. Vehicle attachment point(s) may not be altered, modified, machined, or otherwise changed to facilitate installation and function of any part that is updated/backdated. The updating/backdating of engines, transmissions, or transaxles must be done as a unit; component parts of these units may not be interchanged.

Allowable Modifications

- Fenders and bumpers may be modified for tire clearance.
- Any fully padded and upholstered front seat may be used.
- Any steering wheel may be used.
- Aerodynamic devices are permitted, however, wings are not allowed.
- Wheels of any diameter, width, or offset may be used.
- Shock absorber bump stops may be altered or removed.
- Any anti-roll bar is permitted.
- Suspension bushings may be replaced with bushings of any material (except metal) as long as they fit in the original location.
- Relocation of battery or batteries is permitted.
- Carburetors, fuel injection, intercoolers, and intake manifolds are unrestricted. Turbos may not be changed or modified.
- Limited-slip differentials are permitted.

Prepared

Allowable Modifications

- Removal of glass and/or headlights and front parking/turn signal light assemblies. Operational tail/brake lights are required.
- Mirrors are not required.
- Grilles may be removed.
- Any fuel tank may be used.
- Passenger seats are not required.
- Driver and passenger door glass may be removed.
- Floor covering and all interior trim may be removed.

- Component parts of the body may be lightened or replaced by ones of alternative materials.
- Roll bars and roll cages may be added.

Modified

Allowable Modifications

- Interiors may be gutted.
 - Suspension systems and wheels are free.
 - Windscreen, side mirrors, and tail/brake lights are not required.
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Driving Techniques

Proper Sitting Positions

Adjust the driver's seat so that your elbows are slightly bent while your hands are on the steering wheel either at the 10 and 2 o'clock position or the 9 and 3 o'clock position. Adjust the seat and/or steering wheel so that your legs are slightly bent, even when you operate the clutch and/or the brake pedal. You do not want to over-extend or straighten your legs when you operate the pedals. The seat back (rake) should be adjusted so that you can put the bottom of your wrists on the top of the steering wheel without stretching to do so.

Note: If you are very tall or have an unaccommodating body structure, you may have to compromise your driving position to be able to sit in the seat with your helmet on and not hit your head on the roof/headliner of your car. Adjust the rake of the seat before compromising leg position.

If possible, obtain and use a four or five point harness. If you use the standard shoulder/lap belt, try and adjust it tight enough so that you will not move around in your seat. This can be done by pulling out the belt until the locking mechanism engages and then tightening it up. This will enable you to concentrate more on your driving and less on trying to stay in your seat.

Adjust your left side view mirror and your rear view mirror so that you can see that traffic that may come up behind you. Your instructor should adjust the right side view mirror for his view so that he can also watch oncoming traffic.

Try and keep your head as erect as possible — that is, keep it in the same plane as the car is in. Leaning your head into the turn will not make the car handle any better. Leaning into turns more likely will distort your view of the course and negatively affect your driving.

Steering Techniques

Keep both hands on the steering wheel at all times, except at the start and when you're shifting.

Position your hands on the wheel at either the 10 and 2 o'clock positions or the 9 and 3 o'clock positions.

For most of your steering inputs, you will not have to adjust your hand positions. However, on some courses that have very tight turns, you may want to use what we term "Shuffle Steering." This will enable you to feed the wheel from hand to hand without taking either hand off of the steering wheel. First imagine that there is a vertical line through the steering wheel at 12 and 6 o'clock. The left hand stays on the left side of the wheel and the right hand stays on the right side. To turn right, slide the right hand up to the top of the steering wheel at 12 o'clock then pull the wheel down to the 6 o'clock position, meeting the right hand with the left hand which has slid around the steering wheel to that position. To continue to turn the wheel, the left hand will now pull the wheel to the 12 o'clock position, and so on. To turn left, the left hand begins the process by starting to pull the wheel from the 12 o'clock position down the left side to the 6 o'clock position where the right hand will meet it and continue the arc to the left. Remember: you use this process to turn into a corner and to turn out of the corner, so you're guiding the wheel through the whole turn. Don't let the steering wheel loose in your hands when coming out of a turn and then grab it when you think it is straight. You will only be playing a guessing game. Also, most of the movement that you will do with this method will go beyond the 9 and 3 o'clock positions on the steering wheel. The more you practice this method, the easier it will work, and eventually it will be second nature. As you exercise the procedure, you will appear to be moving the wheel slowly but deliberately. Slow is smooth, smooth is fast. Take your time in a hurry!

Heel-and-toe Downshifting

Heel-and-toe downshifting is a technique crucial to making smooth, rev-matched downshifts (matching engine speed with road speed in the selected gear) while braking in a car with a manual transmission. It involves using your right foot to brake and blip the throttle while depressing the clutch with your left foot for each gear change. The technique is used in braking zones, and if you get it right, you'll experience a smooth downshift when you let out the clutch pedal that doesn't disturb vehicle balance. Additionally, you'll be in the right gear to accelerate through the apex and out of the turn.

There are three positions that can be used to accomplish heel-and-toe:

- Ball of the right foot on the brake, heel on the bottom or middle of the accelerator
- Ball of the right foot on the accelerator, heel on the brake
- Left side of the right foot on the brake, and right side of the same foot on the accelerator — rolling the foot to the right to blip the accelerator.

There is no position that is most correct — choose the position that you are most comfortable with. Keep in mind that vehicles differ in pedal setup, which may affect your heel-and-toe position.

Here's a scenario where you might heel-and-toe downshift: You are accelerating down a long straight on the course and will be approaching a turn. To proceed through the turn properly, you will need to be in a lower gear once you're off the brakes. As you approach the turn, you brake. As you near the end of the brake zone, while still braking the car, you push in the clutch with your left foot, then move your right foot to blip the accelerator. With the clutch pedal still depressed, you shift from the higher gear to the lower gear, blip the throttle, then let out the clutch. If it's done correctly, there will be no jolt forward (or screeching tires) when you let out the clutch pedal. With practice, the technique becomes seamless, with the end of one action blending into the next. It keeps the vehicle's balance stable and ready for turn-in, and your driving line smooth.

Remember, this is a technique that should be practiced at slow speeds, in a parking lot, etc., until you can perform the routine smoothly and not have to concentrate too hard on it. It is an important technique which you can use in autocross, on a race track, or on the road.

Tips and Guidelines

General Rules

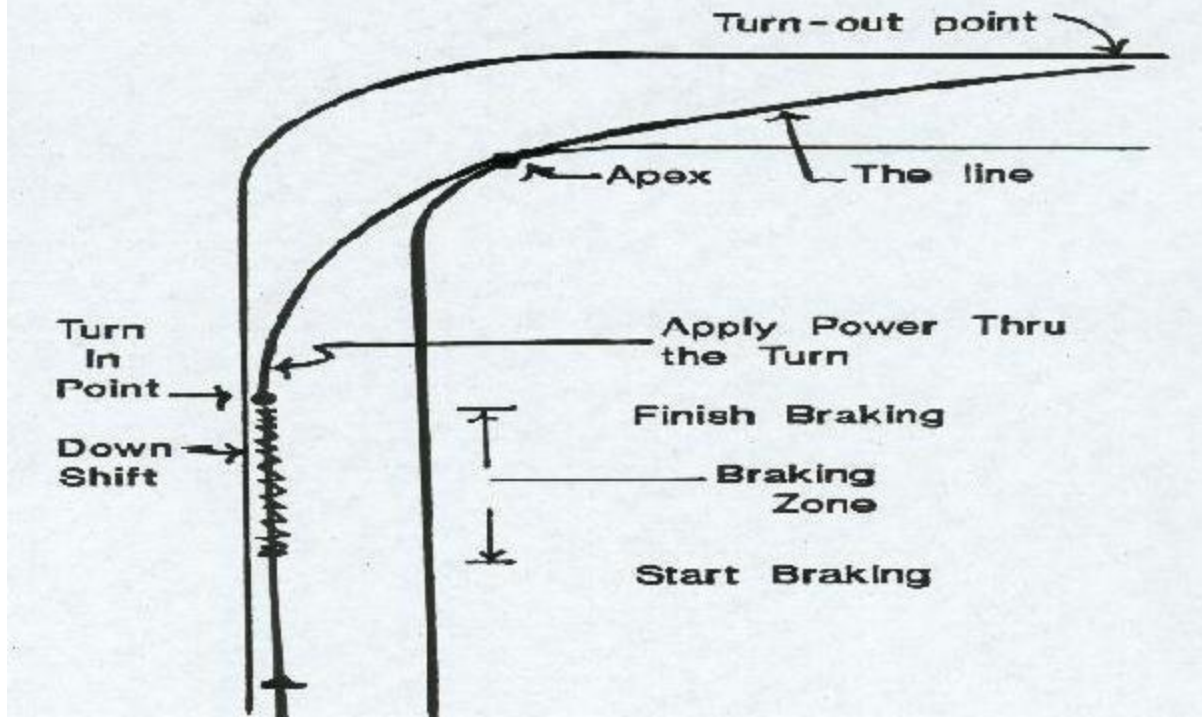
- Never brake in a corner unless you are an advanced driver
- Enter turns slow, exit fast
- Use a consistent, comfortable braking point
- Maximize turn exit speeds by applying power sooner driving out of corners rather than trying to carry faster entry speeds

The Line

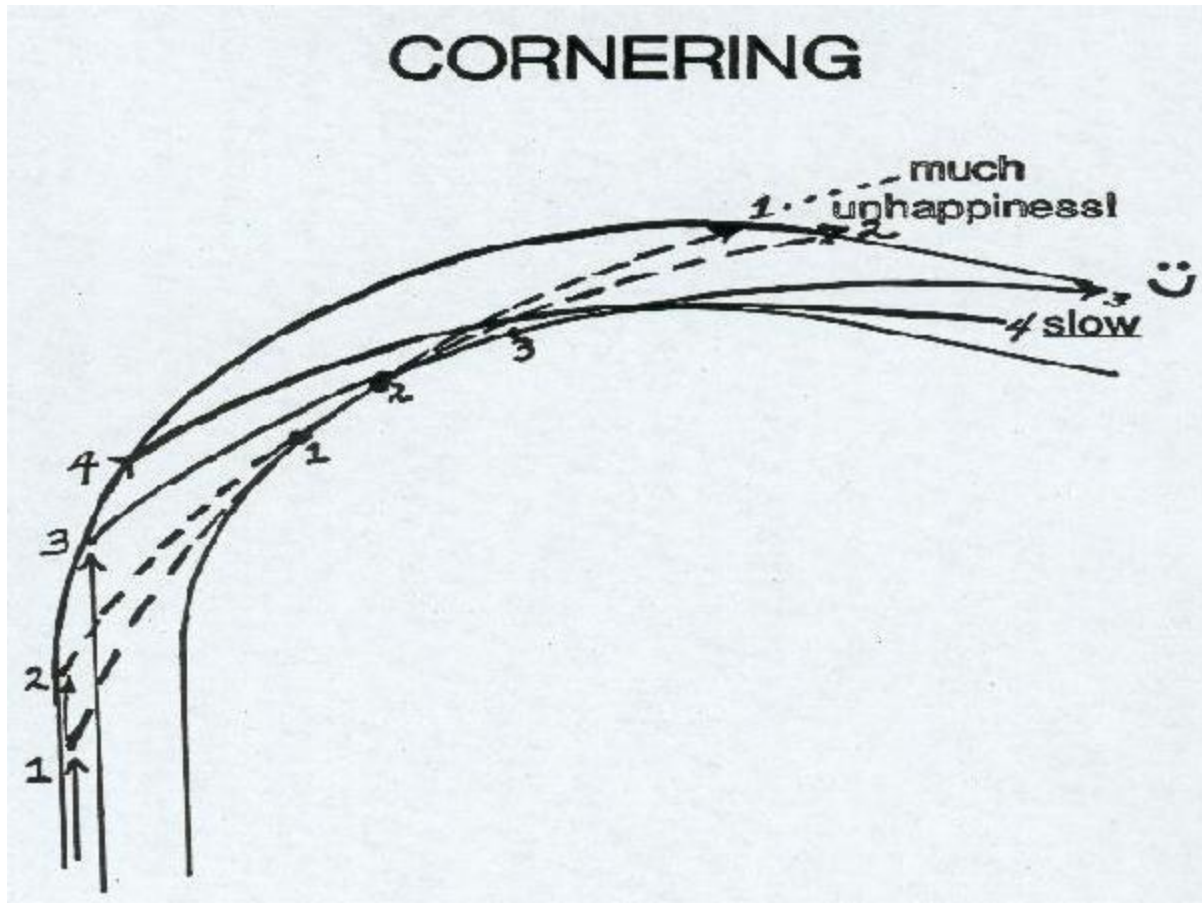
- "The line" is the route through a course which yields the lowest elapsed time.
- In a corner, it's the broadest arc that maximizes speed, given "g" as a constant in $V(2) = 15 \text{ gr}$
- The line and the geometry of the edges of the pavement are usually different.
- There is only one line, but some people may have slight variations.
- Different cars require different approaches to stay on the line
- The most important corners are those leading to the longest straights.

Below is a chart showing the correct line through a 90-degree turn:

TERMINOLOGY & SEQUENCE OF ACTIONS

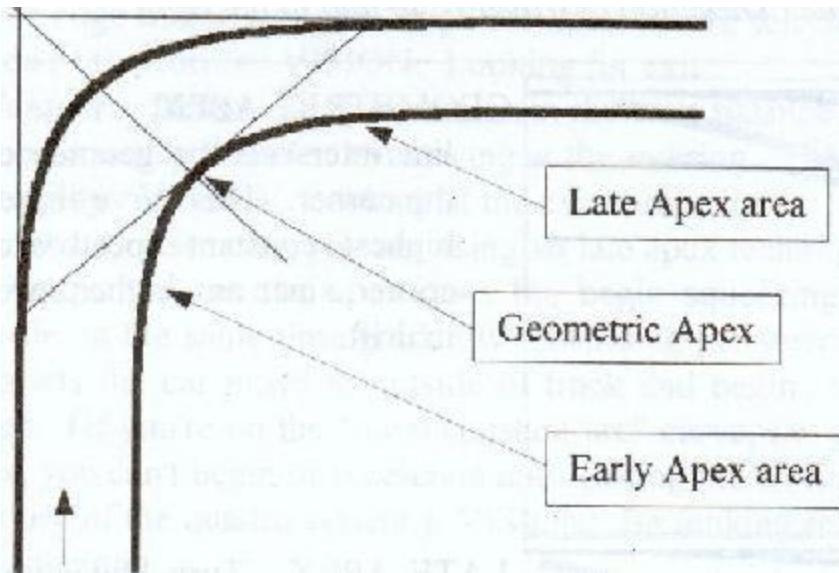


Below is a chart showing four different lines through a corner, one of which is correct (no. 3):



Apex

The geometric apex is at the point where the bisection of the angle of the tangent lines drawn from the turn entry and 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. In general, "late apex = safe apex." See the chart below for an example:



Vision

Vision is the most important element of high performance driving

- Eyes up - don't look at the nose of the car.
- Where you're looking is where you're going.
- Look through a corner and beyond; expand your field of vision.
- When exiting a corner look ahead for:
 - Flag Station and Corner Workers.
 - Traffic - all around.
 - Mirrors, gauges, etc.
- Do not fixate your attention on the car ahead of you.
- Do not fixate your attention on the cones.

Gate Summary

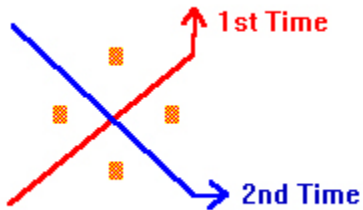
Start Gate

- Line up on start line as directed.
- Start when ready after the start line worker gives the signal.
- Accelerate past timing beam at highest attainable speed.



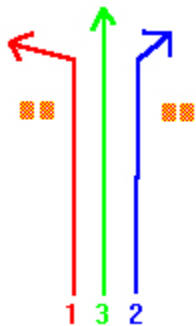
Box

- Boxes are usually driven through at least twice.
- The course line crosses within the box.



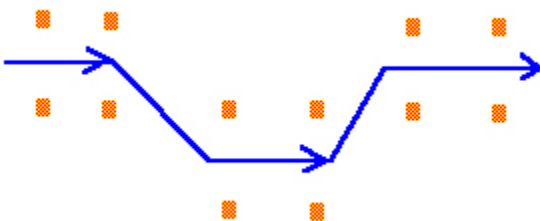
Decision Gate

- Locate decision gates and memorize sequence of direction changes when passing through gate, i.e., first time, turn left; second time, turn right; etc.
- Decision gate sequence can be in any order or combination of that shown above.



Offset Gates

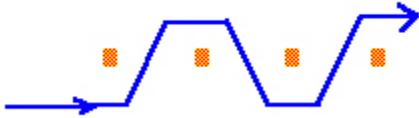
- Smooth control inputs
- Maintain flowing line without abrupt changes.



Slaloms

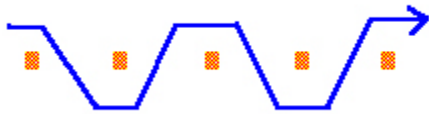
Even Slaloms

Constant speed, smooth steering inputs. Slalom entry and exit are on the opposite sides.



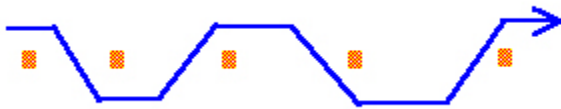
Odd Slaloms

Constant speed, smooth steering inputs. Slalom entry and exit are on the same side.



Expanding Slaloms

Increase speed gradually, maintain smooth steering.



Decreasing or Compressing Slaloms

Decrease speed (possibly using brakes), maintain smooth steering.



Optional Slaloms

Enter on either side.



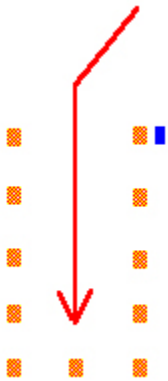
Mandatory Slaloms

Enter side opposite the arrow.



Stop Gate

- Come to a complete stop in the stop garage.
- Hitting large center (end) cone disqualifies run.

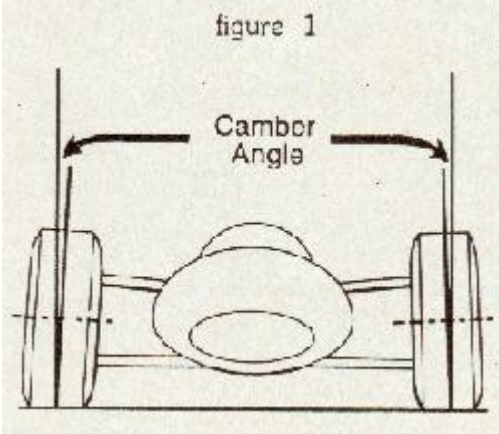


Suspension Adjustments

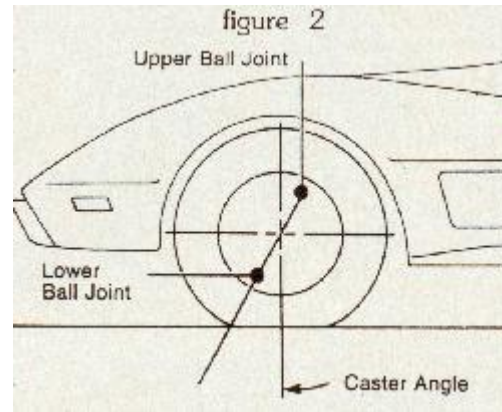
Suspension Component	Causes Oversteer	Causes Understeer
Front Spring Rate	Thinner torsion bars or spring wire (lighter)	Thicker torsion bars or spring wire (heavier)

Rear Spring Rate	Thicker torsion bars or spring wire (heavier)	Thinner torsion bars or spring wire (lighter)
Front Anti-roll Bar	Thinner or longer arms (lighter)	Thicker or shorter arms (heavier)
Rear Anti-roll Bar	Thicker or shorter arms (heavier)	Thinner or longer arms (lighter)
Weight Distribution	Rear-biased	Front-biased
Front Shock Absorber	Softer	Harder
Rear Shock Absorber	Harder	Softer
Front Camber	More negative	More positive
Rear Camber	More positive	More negative
Front Tire Width	Wider	Narrower
Rear Tire Width	Narrower	Wider
Front Tire Pressure	Lower	Higher
Rear Tire Pressure	Higher	Lower
Front Track	Wider	Narrower
Rear Track	Narrower	Wider
Front Spoiler	Larger	Smaller
Rear Spoiler	Smaller or less angle	Larger or more angle

Glossary

Acceleration	The addition of speed, normally caused by an engine either pulling or pushing a car.
Aerodynamics	The science dealing with a car passing through air.
Apex	The center point of a turn with respect to entering and exiting
Brake Modulation	Easing off of the brakes slightly when you feel the wheels locking and then reapplying the brakes. ABS does the automatically.
Camber	<p>The tilt of a wheel from the vertical, viewed head on (see figure 1). Positive camber means the top of the wheel leans away from the vehicle centerline. Negative camber has the wheel leaning toward the centerline. Any wheel camber has two effects: A wheel tends to run in a circular path toward the direction in which it leans, and at any time a wheel is not running at a right angle with the road surface, the flat tread is not fully in contact with the road. Since a vehicle tends to lean away from a turn due to centrifugal force and the wheels tend to lean with it, negative camber is sometimes used so that the tread is flat on the road surface when it is on the outside of a corner. This is when you most need traction if you are in a hurry.</p> <p style="text-align: center;">figure 1</p> 
Caster	The more-or-less vertical axis about which a wheel rotates during steering (see figure 2). When the top of this axis leans toward the rear, like the front fork of a cycle, it is positive caster. The primary effect of

positive caster is that the tire contact patch on the pavement trails behind the point at which this axis contacts the pavement. This causes the wheel to tend to follow the caster axis and run straight ahead after a turn.



Center of Gravity

The center point at which the vehicle will balance

Centrifugal Force

The force towards the outside of the circle

Centripetal Force

The force towards the center of a circle

Cornering

Driving in an arc predetermined by either a limiting barrier such as a pylon, or by mental design on part of the driver.

Deceleration

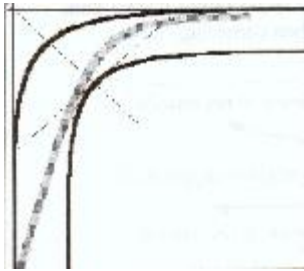
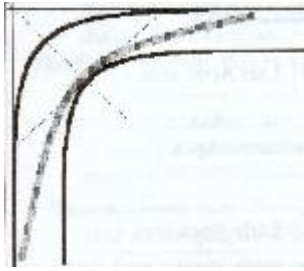
The slowing of a vehicle, normally done by applying braking pressure

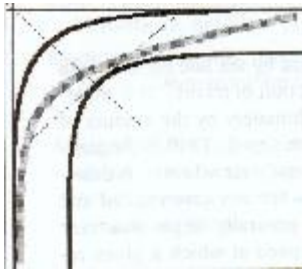
Dive

A word sometimes used to describe the pitch motion in a car under braking

Early Apex

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

	
Entry Angle	The position of a car relative to an approaching corner
Esses	A series of turns in the shape of an S
Exit Angle	The position of a car relative to leaving a corner and approaching a straightaway
Geometric Apex	<p>Note that the turn line intersects the geometric apex of the corner. This curve represents the highest constant speed around the corner, since any high speed results in drift.</p> 
Heel-and-Toe	A driving method whereby the right foot is used to control both the accelerator and the brake.
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.



Left-Foot Braking

Using the left foot to operate the brakes in an autocross car, thereby maintaining chassis set.

Line

The physical line of movement that a car takes through a turn from turn-in-point to apex, to the track-out-point. The correct line will make you fast and smooth.

Negative Camber

A situation where the wheel leans away from the car at the road level. The top of the tire is leaning inward from vertical

Neutral Handling

The car feels balanced and responsive; the driver feels more comfortable and in control.

Oversteer

The car wants to over-respond to your steering inputs. The rear end of the car feels light, and the car acts as if it wants to spin to the inside of the corner.

Pylon

Those critters we try not to hit when autocrossing, usually a fluorescent-orange rubber or plastic traffic cone.

Pyrometer

A technical instrument used to accurately gauge the temperature of the rubber compound on a tire.

Roll Bar

More correctly call an anti-roll bar, this device reduces body roll and is normally mounted laterally at the front and rear of the car. Also called a sway-bar or anti-sway-bar

Shock Absorber

A dampening device used in conjunction with springs to reduce bounce, and stabilize the ride of a vehicle

Springs

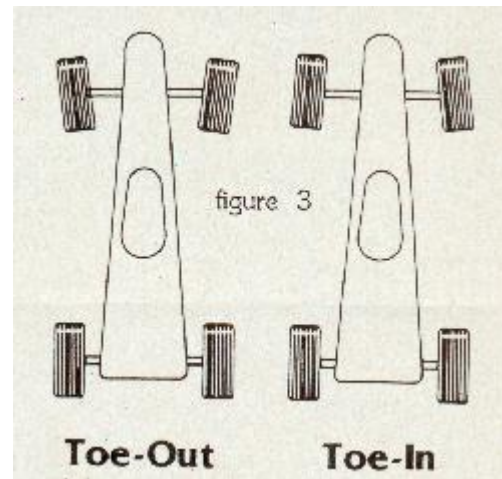
Devices of various shapes that support the weight of a vehicle in a resilient fashion

Threshold Braking

Maximum braking with the wheels on the verge of locking

Toe

The alignment of the wheels as viewed from above (see figure 3). "Toe-out" means each wheel points away from the centerline. "Toe-in" means each wheel points in, toward the vehicle centerline. The primary purpose for the seeming misalignment of toe-in is to preload the steering and suspension linkage and take out all the linkage slack or springiness. It does this because the centerline of the tire usually lies outboard of the caster axis, and forward motion tends to push the wheel and tire rearwards in an arc so that the wheels tend to toe-out. The amount of static toe-in is such that the wheels are pointing at or near straight ahead after the car is in motion and all the slack is taken out of the system.



Torsion Bars

A supporting device much like a spring, only instead of moving up and down, they torque or twist.

Track-out Point

The point on the course at which the car should be when you have completed the turn.

Trailing Accelerator

A condition whereby the driver maintains a lag in acceleration while beginning to apply the brakes.

Trailing Brake

A condition whereby the driver maintains a lag in braking while cornering, the accelerating

**Trailing
Throttle
Oversteer**

Oversteer caused by lifting off the gas or braking while in a corner. Rear engine cars are noted for doing this.

Understeer

Often called "push" or "plow", the car feels like it is unresponsive to your steering inputs, will continue straight ahead, and feels like the wheels are not turned enough. The initial response -- the wrong response -- is to turn the wheels more.