iRacing Setup Guide

(With Technical Contributions by Dale Earnhardt Jr. & Barry Waddell)

Contents

1) Purpose:

a) This guide defines each listing in the Garage section for each car available in the iRacing.com Motorsport Simulation.

b) Explains the function of each adjustment.

c) Explains how to select adjustments that may address the car's deficiencies in the beginning, middle and end of a corner.

2) Important Points:

a) It is easier to dial a car out than to dial it in. The baseline setups supplied with each car are pretty good. Before you make any chassis change to a car it is essential that you first establish a repeatable lap time that will serve as a baseline to determine whether a change helps or hurts. Utilizing the Time Trial sessions within the simulation is a great tool to help establish a baseline. When you clearly can't decrease your lap time with the car as it is, then you can begin to adjust the car.

b) If you make several major adjustments at once, you will almost surely make the car worse rather than better. Make adjustments to the car in a deliberate, one-at-a-time fashion, so that you can tell if each adjustment makes the car better or worse. **Be Patient!**

c) Driveability, which is defined as making the car respond better to the driver's inputs, is often the main goal when making chassis adjustments. There is no "magic setup"!

d) Remember that all the components are affecting the behavior of the car at all times. Thus one may make an adjustment for a particular problem on track and create a negative response somewhere else. Compromising between the positive response a change made and the potential negative effect in the car's behavior is always involved in evaluating the value of a change. Note: The exception is brake bias when there is no brake pedal pressure.

e) For most settings there is a continuum of adjustment. Depending on where you are on the continuum, it's either "TOO SOFT" or "TOO STIFF". This is why we TEST!

f) You could think of the car going through the corner as the proverbial "rock on a string", but it's more useful in this analogy to think of it as "two rocks and two strings", where the front axle is one rock and the rear is a second rock. As cornering speeds increase sufficiently, generally, either the front tires or the rear ones will run out of grip first. When the front tires lose grip first, it feels to the driver like he/she needs to steer more in the direction of the turn. If the rear tires lose grip first, it feels to the driver as though the back end of the car is trying to come around. The technical terms for these two phenomena are "understeer" and "oversteer."

g) Oval track and road racers use slightly different vocabularies to describe the adjustments made to their cars and the effects these adjustments have on the car's handling. The important thing to remember is that the laws of physics are the same whether you are racing on an oval or a road course.

3) Definitions:

a) ***UNDERsteer*** : Synonymous with "push" and "tight." The slip angle of the front tires is greater than the slip angle of the rears when the car is cornering at the limit. The car is turning less than the steering input or radius would dictate and the driver will need to add steering in the direction of the turn. If the car is going fast enough, the driver can't add enough steering to prevent the car from running off the road, which it will do nose first.

b) ***OVERsteer*:** Synonymous with "loose." The slip angle of the rear tires is greater than the slip angle of the front tires when a car is cornering at the limit. There are numerous types of OVERsteer – steady-state, trailing-throttle, power, brake-bias induced, and aerodynamically induced. To the driver it feels as if the car is turning more than the steering input would dictate. Easing off on the steering without making any sudden moves with the throttle can bring the rear of the car back under control, but if the car is going too fast, or the driver doesn't respond quick enough, the car will spin, and tend to go off the track backwards.

c) Commit to memory the basic sequence of a corner: Braking Point, Entry (turn-in), Mid-Corner (apex) and Exit (track-out).

   i) **Brake Point:** A specific reference on or next to the track which drivers use to start the application of brakes. Smart drivers start with a conservative brake point and move it closer to the corner until exit speed is compromised. This is called "The Procedure to Find the Braking Point." (Learn to maintain the pressure on the brake that keeps the car at maximum controlled deceleration. With cars that generate little or no aerodynamic downforce this is a steady pressure – just short of brake lockup – throughout the braking zone. For cars that generate a good deal of aerodynamic downforce brake pressure will need to be modulated, decreasing as the car slows down and there is less downforce being applied to the tires.)

   ii) **Turn-In:** The point at which the driver first turns the steering wheel, transitioning the car from the straight into the corner.

   iii) **Apex:** The clipping point on the inside of a corner where the car is at the correct angle for a perfect exit onto the next section of track.

   iv) **Track-Out:** The point that the car touches the outside edge of the road at the exit of a corner. At this point the driver's hands should be straight with no cornering load felt through the wheel.

4) Road Course Chassis

a) Tires

i) Front and Rear

i) **<u>Tire Pressures:</u>** Probably the most powerful you can make as the tires' performance is has a strong effect every part of a lap.

(1) Ideal tire pressure is determined by the load the tire carries – higher pressures handle higher loads better. That is, in a heavier car, or a banked turn, or compression at the base of a hill, more grip will be retained with higher pressures, whereas with lighter loads, lower pressures tend to give better grip.

(2) Increasing the pressure will in effect STIFFEN the sidewall of the tire, which makes the tire more responsive to the driver's inputs, particularly during the initial turn-in for a corner. The compromise is that as the tire becomes stiffer it will start to lose compliance with the road. Therefore, bumps, curbs and violent inputs from the driver may result in a loss of traction.

(3) Decreasing tire pressure will SOFTEN the sidewall of the tire. As the tire softens, the compliance improves and, generally, grip improves. The downside is that the car will become less responsive to driver inputs, (i.e., the car feels sluggish).

ii) **<u>Cold Pressure</u>**: A measurement of inflation pressure (measured in "psi" – pounds per square inch) when the tire is at ambient temperature in the pits, before having been run on the race track.

iii) **<u>Last Hot Pressure</u>:** This is the tire pressure as recorded when you exit your car, or pull into your pit stall, whichever is first. As tire temperature increases in a run, so does the pressure in the tire. Generally, this pressure will stabilize after a few laps.

iv) **<u>Last Temps O M I</u>:** This is the tire temperature as recorded when you exit your car, or pull into your pit stall, whichever is first. At the end of a run the *surface* tire temperatures are displayed with readings taken at the outer edge (O), middle (M) and inner edge (I). Generally speaking, these readings hint at how well the tire is being maximized. A good rule of thumb is that the temperature differential should be about 10 degrees (+/- 5) from the outer to inner edge of the tire, with the inner edge being the hottest.

b) Camber

(1) An alignment measurement of how much the top of a tire is tilted IN toward or OUT away from the center of the car. When you ADD Negative Camber, such as -1.0 to -2.0, the top of the tire is tilted IN toward the center of the car.

(2) Camber change is an adjustment intended to optimize the tire's contact patch as the car rolls toward the outside of the corner at maximum loads. Therefore, camber changes are most effective in tuning the car for the mid-corner (apex) during maximum cornering loads.

(a) **Front:** If grip at mid-corner (apex) is desired, ADDING negative camber to the FRONT of the car should help. However the compromise is that since the tire is tilted in, less contact patch is on the road when in a straight line, and therefore less performance is available – the negative effect of ADDING negative camber is in straight-line functions such as braking where the tire will have a tendency to lockup sooner with less pedal pressure. Too much negative camber can also cause a "snap" UNDERsteer slide, similar to hitting a patch of oil in the road. This type slide is also known as a "FLAT" slide.

(b) **REAR:** If grip at mid-corner is desired, ADDING negative camber should help. The compromise in the rear is that too much negative camber may cause snap exit OVERsteer and excessive tire wear.

c) Caster

(1) An alignment measurement on the *front* suspension that relates the tire contact patches to the steering axis. As caster increases, the forces attempting to straighten the steering wheel will increase.

(2) Caster changes in road racing are best used to adjust the amount of steering wheel feedback the driver wants to feel. This effect is generally positive until instability occurs in corner exit or all the way through high-speed corners.

Note: On many cars when a caster adjustment is made the camber setting may also change. This is simply the nature of these suspension geometries.

d) Toe

i) An alignment setting that represents the direction the two tires of either the front or rear are pointed in relation to the center-line of the car. If the tire(s) is pointed absolutely straight ahead in parallel to the center-line of the car it is at ZERO TOE. If, for example, both front tires are set to be pointing IN toward the center-line (i.e., "pigeon-toed"), they then have positive (+) TOE or TOE "IN". The amount of TOE an axle has is measured in fractions of inches or mm and represents the deviation off zero toe and is cumulative.

ii) Having the two tires on an axle slightly working against each other keeps the car stable over slight imperfections in the road. Thus a small amount of positive TOE in the car is good for overall stability and driveability. Generally speaking, most cars have a baseline setting with one axle running (+) TOE and the other running (-) TOE.

(1) **Front Toe:** This is a powerful tool to tune how the car behaves in a straight-line and at corner-entry.

(a) **Toe-In (+):** Adding TOE should increase stability in the braking zones and slow-down the response to the initial turn of the wheel. The compromise is that TOE-IN will produce an increase in scrub that will slow straightline speeds. more deviation to having the tires pointed straight, the more straight-away speeds are negatively affected.

(b) **Toe-Out (-):** Increasing TOE-OUT will have the largest effect at corner-entry by speeding up the car's response to the initial turn of the wheel. The tradeoff can be straightline speed and stability.

(2) **Rear Toe:** This adjustment affects the general feel and behavior of the rear throughout the corner.

(a) **Toe-In (+):** Generally, having the outside loaded tire in a corner slightly pointed IN or toward the apex of a corner helps rear grip and overall stability.

(b) **Toe-Out (-):** At corner entry the outside tire is slightly pointed to the outside of the corner. The result is usually that the car rapidly transitions to oversteer as the grip limit is reached. Generally, Toe-out is only used in road racing cars to combat a significant UNDERsteer condition that cannot be otherwise addressed.

e) Roll Bars

i) The more appropriate name is ANTI-roll bars. As a car turns, the cornering forces cause the chassis to lean, or roll, toward the outside of the corner. The amount of chassis roll needs to be limited in order to keep side-to-side tire loading and the camber of the tires in the optimal range. The anti-roll bars combine with the wheel-springs to do just that. Anti-roll bars are transverse springs designed to act only when the car is rolling; they may be fitted to the front or rear axle or both. The primary function of the anti-roll bar is to adjust the understeer/oversteer balance of the car during cornering, which it accomplishes by fine-tuning the amount of load that transfers to the outside tires at the front versus the rear. A stiffer anti-roll bar at one end of the car will increase the load on the outside tire at that end. If both bars are made stiffer, the load transferred will remain the same, but overall chassis roll will be reduced, which may require a camber adjustment.

ii) Remember, one of the primary goals is to find a good balance between grip at the front and rear of the car. When adjusting the roll bar settings the higher number represents an INCREASE in roll resistance, in effect making the car *stiffer.* Some cars only have a front anti-roll bar, and on some cars, the rear bar can be disconnected. Some cars have no anti-roll bars at all, in which case any tuning of roll stiffness must be done with the regular wheel springs.

iii) **Front Anti-Roll Bar:** A powerful tuning tool to affect the overall behavior of the car.

(1) **Stiffer:** Will increase overall car stability and shift the car's balance toward UNDERsteer (push), thus allowing the driver to be more aggressive with the steering. The compromise can be on bumps and/or braking. A stiffer front bar will reduce compliance, so when one tire hits a bump the entire front axle will be affected through a loss of overall grip.

(2) **Softer:** Will shift the cars balance toward OVERsteer (or *less* UNDERsteer.) And the front will improve in compliance, which improves performance in brake zones and over bumps.

iv) **Rear Anti-Roll Bar**: A valuable tool for tuning the behavior of the car particularly from mid-corner out to the exit.

(1) **Stiffer:** As you add throttle through the corner while the steering wheel is still turned, the *rear anti-roll bar* becomes very effective. Stiffening the bar supports the rear and shifts the balance to less UNDERsteer at corner exit. Again, the compromise is in compliance; a possible SNAP or FLAT OVERsteer may result if rear anti-roll bar is TOO stiff.

(2) **Softer:** Allows more roll at the back of the car, which will be most evident at corner exit. If the bar is TOO soft, the car will exhibit exit OVERsteer. In this case, compared to a rear bar that is TOO stiff, the exit OVERsteer condition will be more gradual instead of a snap, hence the phrase "roll OVERsteer."

f) Brake Bias

i) As a car decelerates, load transfers to the front tires, which generally improves their grip, while decreasing the grip at the rear of the car. The goal is to adjust the proportion of the braking forces between front and rear (brake bias) in order to maximize overall braking efficiency. If the brakes are still applied as the car turns into the corner, the brake-bias setting will also have an effect on the car's turn-in balance.

ii) **Increasing Front bias**: Shown as a larger number, increasing brake bias to the front will put more braking force into the front tires. This will stabilize the car in braking zones and increase understeer at corner entry. The compromise is that with too much front bias the rear tires are being under-utilized and overall braking efficiency will suffer.

iii) **Reducing Front bias:** This puts more braking on the rear tires, which, within limits, improves braking efficiency. Too much rear brake bias, though, hurts performance in two ways. First, it reduces overall braking efficiency. More seriously, too much rear brake bias, particularly if the driver is not braking in a straight line or has weak footwork on downshifts, can cause the rear tires to lock up, which puts the car in a dynamically unstable condition that can easily result in loss of vehicle control. Note that with a moderate amount of rear-brake bias, the car will have a tendency to rotate (OVERsteer) at corner entry upon brake release.

g) Spring Perch Offset

i) In effect this is a RIDE-HEIGHT adjustment. For cars with coil-over spring/damper units, the spring perch offset is the distance from the spring seat of the spring perch (or shock collar) on the shock body to the rod end of the shock body. With no other spring changes, reducing this offset will extend the shock (raising the ride height at that corner of the car), whereas increasing it will collapse the shock (lowering the ride height). This number simply represents the lengthening or shortening of the spring with zero being a baseline starting point. Though asymmetrical (left-to-right) ride heights and spring rates are very common in oval-track tuning, in the vast majority of cases, keeping the car symmetrical (left-to-right) is best. This is a very powerful tool affecting the overall behavior of the car throughout the lap. Notice that when ride-height changes are made symmetrically, the at-rest corner weights will generally stay the same; it is in dynamic circumstances (i.e. while running on the track) that handling performance changes occur.

NOTE: The term used when comparing the front ride-height to the rear ride-height is RAKE. When the front suspension is set lower than the rear, the car is said to have "POSITIVE RAKE".

ii) **<u>Front:</u>**

(1) **<u>Increasing Offset</u>**: LOWERS the ride height of the front of the car. This will shift more weight to front, improving front-tire grip and thus shifting the balance to *less UNDER*steer and/or more OVERsteer.

(2) **<u>Decreasing Offset:</u>** RAISES the ride height of the front. The change will shift weight to the rear, improving the grip of the tires at that end of the car and shifting the handling balance toward UNDERsteer.

iii) **<u>Rear:</u>**

(1) **<u>Increasing Offset</u>**: LOWERS the ride height at the rear, which shifts weight and grip to that end of the car. This shifts the handling balance toward UNDERsteer.

(2) **<u>Decreasing Offset:</u>** RAISES the ride height at the rear, which shifts weight and grip to that front end of the car. This shifts the handling balance toward OVERsteer.

h) Corner Weights

iv) This number reflects the amount of load on each tire as it sits in the garage. As noted above, ride heights and corner weights should almost always be symmetric (side-to-side) for a road-racing car. Corner-weight adjustment is most often used on ovals. As noted above, when ride-height changes are made symmetrically, the at-rest corner weights will generally stay the same; it is in dynamic circumstances (i.e., while running on the track) that handling performance changes occur. Take care to insure that the steering wheel is straight while in the garage, because of caster, having the wheel turned will shift the baseline corner weights and cause differences in corner weights once the steering is returned to the straight-ahead position.

i) Wings

i) Wings are different than the other handling-adjustment tools for several reasons. The magic of a wing is that it produces load on the tires – which translates to increased corner speed and in the case of very powerful cars, stronger acceleration off the corner without wheelspin – without a significant weight penalty. The downforce produced by the wing increases as vehicle speed (and therefore the speed of the air over the wing) increases, albeit with a concurrent increase in aerodynamic drag that slows the car's straightaway speed.

ii) Different wing designs have different lift/drag ratios, but in most racing classes today the aerodynamic design of the wing is set by the rules. What is adjustable is the angle of attack of the wing. The number shown is in reference to the horizontal. The higher the number, which is given in degrees, the steeper the angle of the wing relative to the airflow. Up to the point that the wing becomes aerodynamically stalled, as the angle of attack increases so does the level of down-force, as well as the amount of drag, which slows straightaway speeds. (A stalled wing produces the worst of all possible worlds; downforce is greatly reduced and drag increases sharply.)

iii) It is important to note that with properly adjusted wings, the speed lost on the straightaway due to drag is far exceeded by the beneficial effects of increased corner speeds. Not only does the car spend less time negotiating the corner, but the sharply increased speed at which the car enters the straightway means a shorter time from the exit of one corner to the entry of the next, even if terminal speed on the straightaway is decreased.

iv) **Front Wing:** Typically used as a tuning tool to balance with the rear wing.

(1) **Raising the angle of attack of the front wing**: Increases the level of front grip, especially at the higher-speed sections, such as the braking zones at end of straights. The compromise is an increase in drag, but a similar change to the rear wing will generally result in an even greater increase in drag.

v) **Rear Wing:** Tends to be much larger than the front wing and has a major effect on the car's overall performance.

(1) **Raising the rear wing:** Shown as an increase in degrees of angle of attack, will add grip and shift the balance to UNDERsteer. The compromise is that drag increases and straight-line speeds will be lower.

(2) **Lowering the rear wing:** Shown as a decrease in degrees of angle of attack, will reduce the rear grip level while reducing drag.

j) Springs

i) The springs are what hold the car off the ground. The relative stiffness of a spring is based on the amount of force needed to compress the spring one inch. Thus a 900 lb. spring is stiffer than an 800 lb. spring. Quite literally, every bit of feedback that a driver senses from the road's surface comes through the springs. Changing the springs in the car is one of the most powerful tools available.

ii) **Front:**

(1) **Stiffer:** Stabilizes the car and shifts the handling balance toward UNDERsteer. The compromise is less compliance.

(2) **Softer**: Adds a significant amount of front grip. The compromise is a less stable car.

iii) **Rear:**

(1) **Stiffer:** Reduces UNDERsteer, particularly at mid-corner and exit. The compromise is less compliance in the rear and less grip.

(2) **Softer:** Adds rear grip and shifts the balance to UNDERsteer.

k) Dampers (Shocks)

ii) The primary function of the shock absorbers (or "dampers" as they are properly known), is to control or "dampen" the energy as it enters and exits the springs, which when compressed ("bump") and then released ("rebound") have a natural tendency to overshoot their original length as they release the energy imparted by the original compression. (Anyone who has driven a car with a broken shock can attest to the deleterious effect on handling; a car without shocks is literally undrivable at speeds faster than a walk.)

Dampers won't limit the total amount of load transfer through the car, but will affect the amount of time it takes the loads to transfer. Therefore, the car's behavior during moments of *transition*; such as initial brake application, brake release, initial turn-in and application of throttle can be affected by a damper setting change.

The damper adjustments available in the simulation are for the compression (bump) motion and rebound motion of the spring. If we take the front suspension as an example, the compression (bump) happens when additional load is put on the spring, as when hitting a bump and/or hitting the brake pedal. As the spring compresses in response to this additional load, the compression setting on the dampers provides additional resistance. The rebound motion is simply the spring trying to "rebound" to normal after being compressed, as when the car comes off a bump or the driver releases the brake pedal. Resistance to how fast this happens comes from the damper's rebound setting.

iii) When an *increase in resistance (stiffer)* in either motion is desired, select a *larger number, which represents added resistance*. The zero setting is simply the midpoint in the range of resistance available; it could also be a five (5) on a zero-to-ten scale. Even the lowest (softest) number provides some resistance. A -5 setting provides more resistance (stiffer) than a -10 setting.

iv) Because of the variety of corners in road racing it is a good idea to keep the car symmetrical on its longitudinal (left-right) axis.

v) Compression (Front)

(1) **Stiffer Compression:** Slows down the car's frontward weight transfer upon initial brake application. The compromise is a slight loss of compliance.

(2) **Softer Compression:** Adds grip to the front tires through better compliance, but at the cost of stability of the vehicle.

vi) Compression (Rear)

(1) **Stiffer Compression:** This change is most effective at reducing UNDERsteer at turn-in and mid-corner and resisting UNDERsteer at initial throttle application, at the cost of possible OVERsteer both at turn-in and throttle-on at the exit of the corner.

(2) **Softer Compression:** This change should improve rear grip through better compliance. The corner-entry handling balance will move toward UNDERsteer along with improved power-down. The compromise is increased UNDERsteer at turn-in and under throttle-on conditions, such as at the corner exit.

vii) Rebound (Front)

(1) **Stiffer Rebound:** As the brakes are released at corner-entry, the initial turn-in should be more positive, with less UNDERsteer. Taken too far, this can produce turn-entry OVERsteer.

(2) **Softer Rebound:** As the brakes are released at corner-entry, the tires will have better compliance, while the handling balance will shift toward UNDERsteer. The compromise is the potential for increased UNDERsteer at corner exit.

viii) Rebound (Rear)

(1) **Stiffer Rebound:** Will produce increased UNDERsteer at corner entry. The potential downside is less compliance when the throttle is opened.

(2) **Softer Rebound:** This change will be best felt at corner entry with less UNDERsteer and improved throttle-open compliance. The potential downside is that the driver may have less control at corner entry.

l) Gears

i) The choices for gearing for a given car in the simulation are dictated by the series rules. Some cars have wide gearing options, while others, such as showroom stock or “spec” series, may have one fixed set of gears.

(1) **Short:** Refers to a selection of gears that are best suited for quick acceleration and shorter straights.

(2) **Tall:** Refers to gearing that is best suited for long straights and higher top speeds.

(3) **Oval:** Gearing that is suited for the car to be running continuously at high speeds with little deviation between cornering and straight speeds.

m) Push Rod Length

ii) The push rod is the component on some cars that is used to adjust ride height. Lengthening the push rod at one corner of the car will increase the ride height at that corner. (Again, it’s generally a good idea to keep the car symmetrical from left to right with ride-height adjustments.)

iii) Front:

(1) **Lengthening the Rods:** *Raises* the front ride height of the car, shifting the handling balance toward UNDERsteer by taking some performance from the front of the car.

(2) **Shortening the Rods**: *Lowers* the front ride height, providing better grip from the front tires and shifting the balance toward OVERsteer (or less UNDERsteer.)

iv) Rear:

(1) **<u>Lengthening the Rods:</u>** *Raises* the rear of the car, shifting the balance toward OVERsteer (or less UNDERsteer.) The potential downside – less rear braking available – may need to be addressed with an increase in brake bias to the front of the car.

(2) **<u>Shortening the Rods</u>**: *Lowers* the rear ride height and shifts the balance toward UNDERsteer.

5) Oval Chassis

a) Tires (Front and Rear)

i) **<u>Tire Pressures:</u>** Changing tire pressures is probably the most powerful adjustment available as tire performance affects every part of a lap.

(3) Ideal tire pressure is determined by the load the tire carries – higher pressures handle higher loads better. That is, in a heavier car, or a banked turn, or compression at the base of a hill, more grip will be retained with higher pressures, whereas with lighter loads, lower pressures tend to give better grip.

(4) Increasing the pressure will in effect STIFFEN the sidewall of the tire, which makes the tire more responsive to the driver's inputs, particularly during the initial turn-in for a corner. The compromise is that as the tire becomes stiffer it will start to lose compliance with the road. Therefore, bumps, curbs and violent inputs from the driver may result in a loss of traction.

(5) Decreasing tire pressure will SOFTEN the sidewall of the tire. As the tire softens, the compliance improves and, generally, grip improves. The downside is that the car will become less responsive to driver inputs, (i.e., the car feels sluggish).

ii) **<u>Cold Pressure</u>**: A measurement of inflation pressure (measured in "psi" – pounds per square inch) when the tire is at ambient temperature in the pits, before having been run on the race track.

iii) **<u>Last Hot Pressure</u>:** This is the tire pressure as recorded when you exit your car, or pull into your pit stall, whichever is first. As tire temperature increases in a run, so does the pressure in the tire. Generally, this pressure will stabilize after a few laps.

iv) **<u>Last Temps O M I</u>:** This is the tire temperature as recorded when you exit your car, or pull into your pit stall, whichever is first. At the end of a run the surface tire temperatures are displayed with readings taken at the outer edge (O), middle (M) and inner edge (I). Generally speaking, these readings hint at how well the tire is being maximized. A good rule of thumb is that the temperature differential should be about 10 degrees (+/- 5) from the outer to inner edge of the tire, with the inner edge being the hottest.

b) Front:

i) **<u>Toe-in:</u>** Toe-in will help your car turn, particularly at exit of the corner. Reducing toe-in (or going to toe-out) will make the car tighter and noticeably more stable on exit of the corner.

ii) **<u>Front Brake bias:</u>** Raising this percentage will increase brake pressure to the front of the car, which will typically make the handling under braking tend toward understeer and may result in some loss of braking efficiency. Lowering this number will decrease the front brake pressure.

iii) **<u>Front Wheel offset</u>:** On the Legends Car the front lower control arms can be changed so that the left side is shorter than the right by 5/8”. This just puts more weight on the left side, which improves cornering in left-hand turns. On ovals, set it to 5/8”. On road circuits, it is best at 0”.

iv) **<u>Sway Bar</u>:** A smaller sway bar will cause the car to roll more to the outside in corners. The result is that the car will tend to be “looser” (handling shifts toward OVERsteer) as the right front travels and takes weight off the left-rear of the car. Sway bar settings are mostly driver preference. There is no wrong answer or sweet spot. When you like the car’s attitude mid-corner the sway bar is doing its job. Changing the sway bar diameter gives bigger changes in bar stiffness. For finer adjustment, use the sway bar arms (see below.)

v) **<u>Sway bar Arm Length</u>:** The sway bar arm length can be adjusted in three settings: 14”, 15”, and 16”. This arm is connected from the sway bar itself directly to the lower “A” frame on both the right- and left-front suspension, one arm for each side. Changing the arm length fine-tunes the stiffness of the sway bar.

A shorter arm will enhance the sway bar’s effect on cornering. A longer arm will lessen the sway bar’s effects. Shorter arms will tighten the car up. This increases the bar’s effective stiffness by reducing the length of the lever-arm through which the wheel acts on the bar. A longer arm will soften the sway bar and allow the car to turn better. The effects of the sway-bar-arm changes will mostly be felt on entrance and exit of the corner, and less so during steady-state cornering.

vi) **<u>Left Bar end offset:</u>** Offset is how is how sway-bar gap (discussed immediately below) is determined.

vii) **Sway bar gap:** The sway bar gap setting is measured on the left-front suspension. Where the sway bar arm connects to the lower "A" frame, there is an adjustable Heim joint. This Heim joint determines the sway-bar gap. In iRacing, sway-bar gap has positive and negative measurements. Negative measurements mean the sway bar is loaded and will act as an anti-roll bar immediately upon left- and right-hand steering inputs. This will make the car less likely to rotate or turn. Load can increase comfort on a car that is loose on entry. Positive numbers means the sway bar is not loaded. The gap will allow a certain amount of roll to occur as a result right-hand-steering inputs before the anti-roll bar will begin acting on the suspension. Increasing this number will make a car rotate heavily on entry and turning ability will increase throughout the rest of the corner. A neutral bar will have a setting of 0. Sway bar gap is typically a setting of driver preference. Find a spot you like and remember that this setting is highly affected by many other changes within the garage. It is imperative you keep a good watch on your sway bar gap as it is likely to change drastically with minor adjustments to the car's other components. To avoid unintentionally changing your sway bar gap, set it to a large positive number (large gap), make your other adjustments and then re-adjust the sway bar gap to your preferred setting.

c) Left Front:

i) **Corner weight:** This is the weight of the left front as it would show if the car were on a scale. Increasing this number helps the car turn.

ii) **Ride height:** This is the height of the left-front corner of the car's chassis. Raising this will likely result in a lack of grip; lowering it will increase grip at the front of the car.

iii) **Shock-collar offset:** This is the measurement from the shock collar to the lower end of the shock body. Increasing this measurement will lower the ride height and tighten the car up. Decreasing this measurement will have the opposite effect.

iv) **Spring Rate:** This is the rate of the left-front spring. Increasing this will help the car turn and lowering the spring rate will tighten the car up (move the handling balance toward UNDERsteer.)

v) **Camber:** This is the adjustable angle (left to right) of the tire to ensure you have the maximum amount of tire on the ground while cornering. On ovals, where the car is always turning left, this setting will be in the positive numbers, so that as the car rolls in the turn, the tire stands up and generates maximum grip. Note that too much camber can overheat the tire's outer edge and in the end result in loss of grip.

vi) **Caster:** This is the adjustable angle of the spindle (front to rear), which allows the left-front tire to be forced into the race track surface. Most oval cars maintain somewhere around a two-degree split in caster left to right. The left will typically have a lower caster setting than the right. Less caster in the left front will help the car turn, particularly from corner entrance through the center of the corner. Closing the split between left and right will tighten the car, while increasing the split will loosen it.

vii) **Shock Stiffness:** Shock stiffness is the measure of how much force is required to compress the shock. This setting works much like the springs themselves. Changes in shock stiffness affect the car much less than increasing spring-rate by 50 or 100 pounds, which means that shock adjustment can be a good way to dial the car in. A stiffer shock on the right-front or left-rear will increase the dynamic wedge while cornering and make the car more stable and reduce rotation. A stiffer shock on the right-rear or left-front of the car will decrease the dynamic wedge while cornering and increase rotation.

d) Right Rear:

i) **Corner weight:** This is the weight of the right rear as it would show on a scale. Increasing right-rear corner weight helps the car turn.

ii) **Ride height:** This is the height of the right-rear corner of the car's chassis. Raising the ride height will reduce rear grip.

iii) **Shock-collar offset:** This is the measurement from the shock collar to the lower end of the shock body. Increasing shock-collar offset raises the ride height and tightens the car (changes the handling balance toward understeer.) Decreasing the offset has the opposite effect.

iv) **Spring Rate:** This is the rate of the right-rear spring. Increasing the spring rate helps the car turn, while lowering it has the opposite effect.

v) **Shock Stiffness:** Shock stiffness is the measure of how much force is required to compress the shock. This setting works much like the springs themselves. Changes in shock stiffness affect the car much less than increasing spring-rate by 50 or 100 pounds, which means that shock adjustment can be a good way to dial the car in. A stiffer shock on the right-front or left-rear will increase the dynamic wedge while cornering and make the car more stable and less likely to rotate. A stiffer shock on the right-rear or left-front of the car will decrease the dynamic wedge while cornering and allow the car to rotate more.

e) Right Front

i) **Corner Weight**: This is the weight of the right front as it would show on a scale. Increasing this number tightens the car.

ii) **Ride Height:** This is the height of the right-front corner of the car's chassis. Raising the right-front ride height can increase front grip if the right-front tire is being overloaded, resulting in an adverse camber effect. Optimum ride height can vary greatly depending on other chassis settings and the degree of banking at a particular track.

iii) **Shock-collar Offset:** This is the measurement from the shock collar to the lower end of the shock body. Increasing right-front shock-collar offset lowers the ride height and helps the car turn. Decreasing shock-collar offset will have the opposite effect.

iv) **Spring Rate:** This is the rate of the right-front spring. Increasing the right-front spring rate tightens the car, while lowering it has the opposite effect.

v) **Camber:** This is the adjustable angle (left to right) of the tire to ensure you have the maximum amount of tire on the ground while cornering. On ovals the right-front tire should be negative, so that as the car rolls in the turn, the tire stands up and produces maximum grip. Too much camber overheats the tire's inner edge, which reduces the tire's total grip.

vi) **Caster:** This is the adjustable angle of the spindle (front to rear), which allows the right-front tire to be forced into the race track surface. Most oval cars require approximately a two-degree split in caster left to right, with the left front running a lower caster setting than the right. Less caster in the right-front will help the car turn, particularly from the entrance to the turn through the center. Closing the split between left and right will make the car more stable and possibly tighter.

vii) **Shock Stiffness**: Shock stiffness is the measure of how much force is required to compress the shock. This setting works much like the springs themselves. Changes in shock stiffness affect the car much less than increasing spring-rate by 50 or 100 pounds, which means that shock adjustment can be a good way to dial the car in. A stiffer shock on the right-front or left-rear will increase the dynamic wedge while cornering and make the car more stable and less likely to rotate. A stiffer shock on the right-rear or left-front of the car will decrease the dynamic wedge while cornering and allow the car to rotate more.

f) Left Rear

i) **Corner Weight:** This is the weight of the left rear as it would show on a weight scale. Increasing left-rear corner weight tightens the car (changes the handling balance toward UNDERsteer.)

ii) **Ride Height:** This is the height of the left-rear corner of the car's chassis. Adjusted in isolation, changes to ride height will affect cross weight. See Shock-collar Offset for more info about changing the ride height.

iii) **Shock-collar Offset:** This is the measurement from the shock collar to the lower end of the shock body. Increasing left-rear shock-collar offset lowers the ride height and helps the car turn. Decreasing left-rear shock-collar offset will move the handling balance toward UNDERsteer.

iv) **Spring Rate:** This is the rate of the left-rear spring. Increasing the rate of this spring will tighten the car, while lowering the spring rate will move the handling balance toward oversteer.

v) **Shock Stiffness:** Shock stiffness is the measure of how much force is required to compress the shock. This setting works much like the springs themselves. Changes in shock stiffness affect the car much less than increasing spring-rate by 50 or 100 pounds, which means that shock adjustment can be a good way to dial the car in. A stiffer shock on the right-front or left-rear will increase the dynamic wedge while cornering and make the car more stable and less likely to rotate. A stiffer shock on the right-rear or left-front of the car will decrease the dynamic wedge while cornering and allow the car to rotate more.

6) Racing Terms

AERO – Short for aerodynamic. Aero adjustments on a racecar affect the behavior of the car in the speed range where the flow of air is fast enough to create down-force on the tires.

ANGLE OF ATTACK – The angle of an aerodynamic device relative to the air stream. If not excessive, increases in angle of attack create more down-force and drag.

APEX – The clipping point on the inside of a corner where the car is at the correct angle for a perfect exit onto the next section of track.

ASPECT RATIO – The relationship between a tire's sidewall height and its tread width. Smaller aspect ratios describe a tire that is low profile and wide, versus tall and thin.

BALANCE – The mix of front versus rear grip that is determined by chassis, aero and brake-bias settings. Chassis settings, as well as acceleration and braking, influence handling at all speeds. Aero adjustments affect balance mainly in high-speed turns. Brake bias determines which tires lock up first under deceleration.

BIND – Excess steering angle limiting a car's acceleration.

BLIP – Proper downshifting technique requires that the engine revs be increased to allow smooth engagement of the next lowest gear, and to match engine speed with road speed. The "Blip" is a quick application of the throttle pedal, usually done using the heel-and-toe technique, to momentarily increase the engine RPM.

BRAKE BIAS – The relative proportion, front to rear, of braking force. In most modern racecars, brake bias is adjustable to compensate for changes in track conditions, fuel load, and aerodynamic down-force.

BRAKE POINT – A specific reference on or next to the track which drivers use to start the application of brakes. Smart drivers start with a conservative brake point and move it closer to the corner until exit speed is compromised. This is called "The Procedure to Find the Braking Point."

BRAKE-TURNING – Combining the car`s braking and turning abilities simultaneously in the area beyond the turn-in point. This is a very efficient use of a tire's traction capability and enables the driver to safely brake later. It also helps the car turn into a corner.

BREATHING THE THROTTLE – A lift (in varying degrees) off the throttle to neutralize under steer or induce TTO.

CF – Co-efficient of friction: A convenient way of comparing the grip of tires from one to another. It is a measure of the ratio at which a tire converts downloading to traction.

CG – Center of gravity: The point in space where the car`s mass is centered.

CHOP – Abruptly turning into a corner to prevent a pass.

COMMAND FLAG – Flag requiring action on the part of the driver.

COMPROMISE CORNERS
A corner where you compromise or modify your line to gain or benefit in another corner.

CONSTANT RADIUS CORNERS – Turns which can be measured with one arc starting at the turn-in point.

CONTACT PATCH – That part of a tire that's in contact with the road at any one point in time.

CORNER ENTRY – The section of track between the brake point and where throttle application starts.

CORRECTION – The first phase in handling a slide (See "CPR", below) is the "Correction." The driver looks where he would like to go and turns the steering wheel toward the direction that the rear of the car is sliding.

CPI – driver`s Safety Rating is derived from their Corners Per incident (CPI) average. Each track has a set number of corners. For example Lime Rock Park has seven corners. If you get one incident point every lap, your CPI would be seven. If you drove 100 laps, with only one incident, your CPI would be 700.

CPR – A skid-control technique involving the Correction, the Pause, and the Recovery.

CRAB/CRABBING – Gradually drifting toward the inside of the road and sacrificing radius on the approach to a corner. Crabbing is a symptom of low eyes and slow hand speed, and results in an early apex.

DAMPER – The technically correct term for "shock absorber." It dampens the frequency of a spring's motion; it does not support the weight of the car.

DECREASING RADIUS CORNER – A corner where the first section of the turn has a larger radius than the second.

DEEP/GOING DEEP – Going to the brakes as close as possible to a corner.

DIVE-BOMB – An ill-advised, late attempt at a pass.

DOUBLE-CLUTCH – A downshifting technique used to manually speed up the main-shaft in a non-synchronized transmission. Does not apply to sequential gearboxes.

DRAFT – Using the slipstream to approach and pass other cars. Also known as "tow."

DROP WHEELS – The act of driving with one or more wheels of the car off the race track.

DUMP SHIFT – Skipping gears when downshifting. Typically going directly from top gear to first rather than downshifting through each gear.

EARLY APEX – An early apex requires additional steering input beyond the clipping point of a corner. This is generally the most common line mistake, but "early apexing" can be used if there is an increase in elevation and/or cornering grip after the apex.

EXIT SPEED – The speed of a car at the track-out point of the corner.

FAST HANDS – Moving the steering wheel quickly.

FLAGS – Used to communicate with the driver.

FLAT/FLAT OUT – Never lifting off full throttle. Also defined as driving absolutely at the limit, leaving no margin for error.

FRICTION CIRCLE – A graph used to show a tire's maximum capabilities in the three forces it can generate: Braking, Cornering, Accelerating.

G (g) – The measure of force that gravity exerts on earth. It is used as a reference point to compare the lateral acceleration forces that cars generate during braking, turning and accelerating.

GRID – Starting positions for the beginning of a race.

GRIP – The traction of tires in braking, turning and accelerating. Generally measured in units of "G" (g).

HAIRPIN – A relatively slow corner with more than 120 degrees of direction change.

HEEL AND TOE – The process of keeping consistent pressure on the brake pedal while blipping the throttle for downshifts. This technique is actually a misnomer (it has historical equity, however) since modern pedal layouts enable the use of the ball of the foot on the brake while at the same time using the right side of the same foot to rev (blip) the throttle. This is an essential skill that all great drivers use to shorten braking zones and turn fast laps.

HOOK – A spin generally to the inside of a turn. This is the most common spin in racing. Differs from a "second reaction hook-slide."

HOOK SLIDE – The second-reaction slide.

INCREASING RADIUS CORNER – A corner where the radius of the early part of the corner is tighter than the radius of the later section.

INFORMATION FLAGS – Track advisory flags.

IRATING – Your iRating is a measure of your skill as compared to other iRacing.com drivers. iRatings are used to ensure similarly skilled drivers compete against each other in official sessions and Race Series.

KINK – A jog in the road, normally found on part of a straight.

LADDER SYSTEM – iRacing.com`s unique system that can take drivers from a racing school all the way up to motorsports top ranks

LATE APEX – A clipping point on the inside of a turn that permits a decrease of steering angle during the second half of a corner. Generally used to permit acceleration, especially if grip is decreased for any reason in the last part of a turn.

LEAD-FOLLOW – A method used to learn the racing line, where the driver follows an instructor around the race track.

LIFT – Coming off or reducing throttle.

LINE – The optimum path around the racetrack. The line can vary with track conditions and the type of racecar being driven. Other variables include elevation change, pavement change, and how well a car turns into a corner.

LOAD TRANSFER – The change in the vertical down force on a tire that results from braking, turning or accelerating.

LOCKUP – Occurs under braking when a tire stops rotating. Loss of steering control, flat-spotted tires, and a 30% decrease in braking traction are the results of lockup. Causes include over-braking, improper brake bias, or crabbing the entry into a corner.

LOOSE – Synonymous with oversteer.

MAINTENANCE THROTTLE – Throttle application intended to maintain the current speed of the car, and thereby settle the balance of the chassis.

MODULATION – Changing the pressure on the brake or throttle in an effort to keep the tires near, but not over, their traction limits.

NEUTRAL HANDLING – When both front and rear sets of tires operate in the same slip-angle range when a car is cornering at the limit.

OUT-BRAKING – Braking later than another driver.

OVER-REV – High RPM in a range that is likely to cause damage to an engine’s internal components.

OVERSTEER – Synonymous with “loose,” occurs when the slip angle of the rear tires is greater than the slip angle of the front tires when a car is cornering at the limit. Numerous types: Steady state, trailing throttle, trailing clutch, power, brake bias, and aerodynamically induced OVERsteer are all examples. Another description: The car is turning more than the steering input or radius would dictate.

PACE LAP – The warm-up lap prior to a race start.

PAUSE – During a skid, that moment when the movement of the rear of the car toward the outside stops. The springs are about to rebound and transfer weight toward the inside tires. This precedes the Recovery phase of CPR. Also described as the moment during a skid when the rotation of the spin is "caught" and converted to a sideways slide.

PINCHING – Adding steering input to a car when it's cornering. Most frequent in the second half of the corner to recover from an early apex, adding acceleration too soon or a poorly timed pass.

PIT LANE/HOT PITS – An area adjacent to the racetrack where cars are worked on during practice, qualifying or a race. "To pit" means to make a pit-stop.

PITCH – Changes of the front-to-rear ride height; also, the angle of attack of a car in response to acceleration and braking.

POLESITTER – The fastest qualifier.

RECOVERY – Recovery is the third phase of skid control (CPR). As a slide stops, the outside springs unload, transferring weight to the inside tires. Good drivers know that they must straighten the steering wheel to prevent a second-reaction hook-slide.

REDLINE/REV LIMIT – The maximum RPM depicted on the tachometer that an engine can turn without damage to its internal components.

REFERENCE POINT – Any point on or beside the racetrack that a driver uses to trigger some action; turning in, apexing, brake application point, etc.

REVS – Term used to describe the RPM (revolutions per minute) of the engine.

ROAD CAMBER – The angle of the road surface relative to the horizon. Positive road camber ("banking") helps the car`s cornering force. Negative camber reduces the grip of the car.

ROLL – The upward or downward movement, left or right along a car's centerline, in response to cornering forces.

ROLLCENTER – A point in space determined by suspension geometry that the CG rolls around at each end of the car.

ROTATION – Deliberate OVERsteer caused by the release of the brakes during the trail-braking phase of brake turning.

RPM – Revolutions per minute.

SCCA – Sports Car Club Of America, a sanctioning body.

SECOND REACTION – The rebound of the chassis toward the inside springs after a slide stops. Must be countered by the Recovery phase of CPR to prevent a hook-slide.

SEGMENT TIME – The time it takes to drive from point to point on a section of racetrack.

SEQUENTIAL TRANSMISSION – A fast shifting, constant-mesh, motorcycle-type gearbox that shifts directly to each gear without going through neutral.

SHAVED TIRES – Street tires can be shaved so that their tread depth is greatly reduced to make them race-ready. This prevents the tire from overheating and provides more traction.

SIGHT PICTURE – A visual template that drivers use to locate themselves precisely on the racetrack. After using The Procedure to Find the Line, a driver takes a visual snapshot of each turn. He/she now will know where to be in every turn and be able to catch mistakes early.

SLIP ANGLE – While cornering, there is a difference between the direction that the centerline of the wheel is pointing and the direction that the tire is traveling. This difference is measured in degrees and referred to as slip angle. Tires have a range of slip angles where they deliver their maximum level of cornering traction.

SLIPSTREAM – The area of clean air behind a moving car. Also defined as following closely in the draft behind other cars.

SLOW HANDS – The opposite of “fast hands.”

STACK-UP – At the start of the race, the tendency for all the cars to arrive in the first turn at the same time.

STEERING LOCK – The maximum degree of steering input available on a car.

STRAIGHT (“straightaway”) – Self-explanatory, except that if the portion of the circuit can be driven as fast as the car can go, the road doesn`t necessarily have to be perfectly straight to be considered part of the straight-away.

SWAYBAR/ANTI-ROLL BAR – An adjustable suspension device at one or both ends of a car that limits weight transfer. Some are cockpit actuated. Sway-bars control the rate of chassis roll relative to the suspension.

SWEEPER – A fast, “sweeping” corner.

TACHOMETER (“tach”) – Device for measuring engine speed in revolutions per minute (RPM).

TFTS – Too Fast, Too Soon.

THE PROCEDURE – The method of working your way up to the limit by starting off conservatively and taking small, incremental steps to increase your speed.

THRESHOLD BRAKING – Using 100% of a car`s braking capability while braking in a straight line. At the "threshold" limit, the tire will be revolving approximately 15% slower than it would be if freely rolling over the road.

THROTTLE – The "gas pedal."

THROTTLE APPLICATION POINT – The point in a turn where a driver begins to apply power to drive away from the corner.

TIGHT – Synonymous with UNDERsteer and "push."

TIRE PERFORMANCE CURVE – A graph to show a tires grip and slip angle are related.

TOW – See "Draft."

TRACK-OUT – The point that the car touches the outside edge of the road at the exit of a corner. Or the point in a corner when the hands are straight and there is no cornering load.

TRAIL-BRAKING – A gradual release of the brakes during brake-turning that leads to "rotation" at the limit.

TRAILING THROTTLE OVERSTEER (TTO) – OVERsteer caused by lifting off or "trailing" the throttle when the car is near its cornering limit.

TURN-IN – The point at which the driver first turns the steering wheel, transitioning the car from the straight into the corner.

TYPE ONE TURNS – Corners that precede long straights. These are the most common types of turns and generally require a late apex to maximize exit speed.

TYPE THREE TURNS – Set-up (or "compromise") turns. Always precedes Type One Turns. These are the most challenging corners since you must know where to go slow to turn a fast lap.

TYPE TWO TURNS – Corners that come at the end of long straights where carrying entry speed produces a better lap time.

UNDERSTEER – Synonymous with "push" and "tight." The slip angle of the front tires is greater than the slip angle of the rears when the car is cornering at the limit. The car is turning less than the steering input or radius would dictate.

WEIGHT TRANSFER – Also Known as "Load Transfer." The lateral and longitudinal movement of the mass of the car as determined by the driver's inputs.

YAW ANGLE – The angle between the centerline of a car and the direction the car is traveling when cornering.

7) iRacing Setup Guide Quick Reference Chart

The attached Quick Reference Chart offers a color-coded "cheat sheet" providing suggested setup adjustments to address general handling issues. Remember, there are no absolutes. Each adjustment involves compromise between intended results and side-effects. Be patient and make changes one at a time.

Below is an example of how to use the Quick Reference Chart.

EXAMPLE:

i) Upon completing a few test laps, you conclude that your car needs a big addition of FRONT GRIP.

ii) Find the FRONT GRIP column in the Quick Reference Guide.

iii) Following the column down; all the areas in green represent changes that would increase the FRONT GRIP.

iv) For example, we pick TIRE PRESSURE/ FRONTS/ decrease (-).

v) By then following the row to the right one can quickly reference other characteristics of decreasing FRONT TIRE pressure.

vi) In this example the RED box indicates a potential loss of stability. Understand that a loss of stability may show-up as an OVERsteer condition and be interpreted as a loss of performance in the REAR of the car. But in fact it may be a situation where the increase in FRONT performance overpowered the REAR.

vii) Also, by continuing to scroll to the right, into the "Most Affected" part of the table, we see that every part of corner sequence is significantly affected, indicated by the lightly-shaded boxes. The Mid-corner section of the corner would be the _most_ affected as indicated by high-lighted box.

iRacing Setup Guide Quick Reference Chart

			FRONT		REAR		MOST AFFECTED			
TIRES		CHANGE	**GRIP**	STABILITY	**GRIP**	STABILITY	Braking	ENTRY	Mid-Corner	Exit
PRESSURES	FRONT	tire pressure increase(+)					*	*	*	*
		tire pressure decrease(-)					*	*	*	*
	REAR	tire pressure increase(+)					*	*	*	*
		tire pressure decrease(-)					*	*	*	*
BARS	FRONT	STIFFEN						*	*	
		SOFTEN						*	*	
	REAR	STIFFEN							*	*
		SOFTEN							*	*
CAMBERS	FRONT	MORE Negative (tilt-in)							*	
		LESS Negative (stand-up)							*	
	REAR	MORE Negative (tilt-in)							*	
		LESS Negative (stand-up)							*	
TOES	FRONT	MORE (+ or -)					*	*		
		LESS					*	*		
	REAR	MORE (+ or -)						*	*	
		LESS						*	*	
BRAKE BIAS		MORE FRONT (+)					*	*		
		LESS FRONT (-)					*	*		
RIDE HEIGHTS	FRONT	MORE (+)						*	*	
		LESS (-)						*	*	
	REAR	MORE (+)						*	*	
		LESS (-)						*	*	
WINGS	FRONT	MORE (+)					*	*	*	*
		LESS (-)					*	*	*	*
	REAR	MORE (+)					*	*	*	*
		LESS (-)					*	*	*	*
SPRINGS	FRONT	STIFFER (+)					*	*	*	*
		SOFTEN (-)					*	*	*	*
	REAR	STIFFER (+)								
		SOFTEN (-)								
DAMPERS	FRONT	STIFFER (+)					*	*		
	Compression	SOFTEN (-)					*	*		
	REAR	STIFFER (+)						*	*	
	Compression	SOFTEN (-)						*	*	
	FRONT	STIFFER (+)						*	*	
	Rebound	SOFTEN (-)						*	*	
	REAR	STIFFER (+)						*	*	
	Rebound	SOFTEN (-)						*	*	

NEGATIVE
POSITVE
MOST AFFECTED
some effect

*
*