HOW TO No. 7 --- Car Setup Guides

Stafford RCMCC Car Setup Guides

Setting	Explanation	Affect	Start Point	Min	Max
Tyres	Tyres easily have the biggest affect on the handling of the car. They are the only part of the car touching the track, so if they're wrong, the rest of the set-up is irrelevant.	**Softer:** More grip and more steering, But less duration and shorter tyre life. Use in colder conditions. **Harder:** Less grip and less steering, but more duration and longer tyre life. Use in hotter conditions. Always use the same compound front and rear.	Soft tyres will be damaged in too hot conditions, so start on a hard compound. Then, if the car has an overall lack of grip, use a softer compound. If the car oversteers, or if the tyres 'grain', use a harder compound. Only use treaded tyres when the track is at least 60% damp. Using them when it is any dryer will quickly wear them out. Use a soft slick instead.		
Shock Springs and Oil	Shock springs and oil control the body roll and damping of the car. Oil and springs should usually be adjusted together (if you stiffen the springs, thicken the oil). However, oil can be changed on it's own by 5 - 10wt to change the front to rear balance.	Softer Springs and/or Thinner Oil: More grip, but more body roll, slowing down the car's ability to change direction. Harder Springs and/or Thicker Oil: Car corners flatter, but has less grip. Also puts more pressure on the tyres, making them squeal or scrub.	Start off on equal springs and oil all round (try a medium spring and 40-50wt oil). Don't run more than one spring rate different front to rear (i.e. don't run one end very soft and the other very hard). Too bigger difference front to rear can cause bad oversteer. Use thinner oil at one end only to increase the grip at that end (maximum difference 10wt).		
Shock Pistons	Shock pistons can be used in conjunction with oil to change how a car handles bumps (no on-road track is perfectly flat).	Use more/bigger holes and thicken the oil to improve bump handling. E.g. 60wt 3 hole corners the same as 40wt 2 hole but handles bumps Better. Going too far can make the car 'bounce' though.	Start off on the kit pistons. If there are several choices in the kit, choose the medium pistons.		
Ride Height	The distance between the bottom of the chassis and the ground. Ride height affects the overall handling of the car, and can also be used to change the balance front to rear.	**Lower:** Better direction change, but chassis can 'ground' causing the car to spin. **Higher:** Better handling of curbs and bumps. Less likely to ground, but poorer direction change.	7mm front 8mm rear	6mm	10mm
			It is normal to run the rear 1mm higher than the front, as there is more weight at the rear.		
Droop	The maximum downward travel of the wishbones. Adjusted by unscrewing the shock rod-ends or on wishbone grub-screws.Can be measured by setting the car at maximum ride height (put lots of shock packers in)	More: Better bump handling but less stable cornering. Less: Poorer bump handling but more stable cornering. Make sure shock-lengths (or grub-screw settings) are equal left to right.	12mm	Ride height + 4mm (make sure there is 4mm more droop than ride height).	15mm
Camber	The angle of the wheel in relation to vertical (top of wheel leans inwards). Adjusted on the upper wishbone turnbuckle.	More: More grip and stability, but more tyre wear and more drag. Less: Less grip and stability, but better tyre wear and less drag.	1.0deg	0.5deg	2.0deg
			Increase the camber by ½-1deg at one end only to increase the grip at that end.		
Castor	The angle of the front hubs in relation to vertical (looking from the side). Adjusted by moving the front upper wishbone or by fitting different hub carriers and bulkheads.	**More:** Less steering into the corner and more steering out of the corner. More stable in a straight line. **Less:** More steering into the corner and less steering out of the corner. Less stable.	10deg	7deg	13deg
Anti Squat	The angle of the rear wishbones in relation to horizontal (looking from the side). Adjusted by inserting spacers under the front of the wishbone hangers, or by fitting different hubs or wishbone hangers.	More: More rear-end grip out of the corner but less through the corner. Less: Less rear-end grip out of the corner but more through the corner.	Level	Front of wishbone 3mm higher than the back.	Level
Rear toe-in	The angle of the rear wheels in relation to parallel, (looking from the top). Adjusted on the lower rear turnbuckles or by fitting different hubs and wishbone hangers.	**More:** More rear-end grip, but causes speed to be scrubbed off and increases tyre wear. **Less:** Less rear end grip, but more speed, duration and tyre life.	2 degrees	1 degree	3 degrees
Front toe-in / toe-out	The angle of the front wheels in relation to parallel (looking from the top). Toe-out is when the wheels point outwards, toe-in is when they point inwards. Adjusted on the front lower turnbuckles.	**Toe-out:** More steering into the corner, but less stable. **Toe-in:** Less steering into the corner but more stable. Both scrub off speed and increase tyre wear, so try to run the wheels parallel.	Parallel	1 degree toe-in	1 degree toe-out
Ackerman	The difference in turning angle between the inner and outer front wheel. Adjusted on the centre turnbuckle	**Less** (longer rod): More turn-in but less steering through the corner. **More** (shorter rod): Less stable and less turn-in but more steering through the corner.	Kit setting	Kit - 2mm	Kit + 2mm

Setup Guide

The aim is to set the car up with just enough grip so that it doesn't spin out or understeer, but with no extra grip. Excess grip wastes battery power and (even with a stock motor) slows the car down.
Adjustments should be done one at a time so that you can feel for yourself exactly what affect it has: if you do two at once, they might cancel each other out providing no improvement.
All adjustments should be done in small increments: half a degree change in camber or toe-in, one spring rate different, 5wt oil different and so on.
Try to keep the difference between the front and rear set-up at a minimum. Big differences in spring rate, ride height, shock oil and so on offer no advantage. If your car has major oversteer or understeer, then there is most likely a problem with the car, such as a bent hingepin or a binding wishbone or driveshaft. No amount of set-up work will get around this problem.

Problem Solver

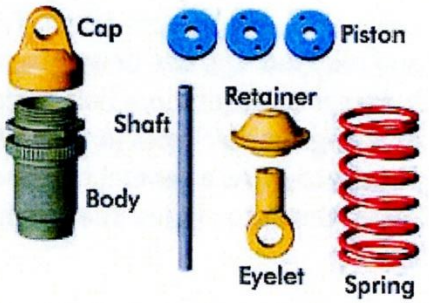
When your car has understeer or oversteer, follow these changes in the order given. Remember also to follow the rules given above (don't use softer tyres if they are already scrubbing, don't use harder front springs if the front is already harder than the rear and so on). If your car has both oversteer and understeer (at different points of the corner) try adjusting castor first. If you can't cure the problem, try asking advice from someone who is going well with the same car as you.

UNDERSTEER				OVERSTEER		
Tyres	Softer	1 compound		Tyres	Harder	1 compound
Rear Springs	Harder	1 spring		Rear Springs	Softer	1 spring
Front Springs	Softer	1 spring		Front Springs	Harder	1 spring
Rear toe-in	Less	1/2 degree		Rear toe-in	More	1/2 degree
Front Camber	More	1/2degree		Rear shock oil	oil	5wt
Front shock oil	Thinner	5wt		Rear Camber	Lengthen	1/2degree
Rear Camber	Less	1/2degree		Ackerman	Less	Lenghten rod
Front toe_out	More	1/2degree		Front toe_out	Less	Wheels parrallel
Ackerman	More	Shorten rod		Front Camber	Less	1/2degree

Shocks.

What are Shocks?

Also called Dampers, the Shocks purpose is to dampen the movements of the spring. They also affect handling conditions during cornering. Too stiff, and they can cause harshness and a bumpy ride. Too soft, and they can feel mushy and reduce responsiveness. Every part of the Shock can be tuned for the perfect Shock absortion.



Probably the most important handling feature, the shocks control the damping of the vehicle on any given surface.

Most performance vehicles have 4 shocks. They are (typically) oil filled and have adjustable pistons, springs, and travel. Other 'entry level' vehicles can have from 2 to 8 shocks. Entry level vehicles also have adjustable features, but typically have plastic bodies. They can be upgraded to aluminum for maximum performance.

Tuning with the Shocks

In this section we will cover the Shocks and all it's parts: Shafts, Bodies, Pistons, Oils, and Springs.

Shock Shafts:

The Shaft runs through the entire Shock Body. Inside the Body, the Shaft has the Piston attached to it. There are a couple different types of Shock Shafts.

1) Standard Shock Shaft. Excellent unit, but not hard coated or treated with any type of covering.
2) Unobtanium Shock Shaft (Associated Upgrade Unit). Same as the Standard Shaft, but coated to produce a much smoother shock action. Highly recommended for racing.
3) MIP's Gold Nitrade. Same as a stock unit, but Gold Nitrade coated to produce better Shock action.
4) Others. I'm sure there are other 'coated' Shafts available, but they're all going to do the same basic thing. It is recommended to upgrade for a stronger, smoother Shock action.

Shock Body:

The Shock Bodies hold the Oil, Shaft and Piston and are normally made of either 2 materials: Plastic or Aluminum. While plastic units are light, they wear out fast due to the friction of the Shaft and Piston moving up and down. Plus, I've seen alot of people blow the plastic caps off the Shocks. Plastic Bodies use plastic threads and will not be as strong to impacts as aluminum units. It is suggested that you upgrade to Aluminum Shock Bodies for racing. It is also suggested that, if your budget allows, you upgrade to Threaded Aluminum Shock Bodies. They are far easier to tune and more precise than normal un-threaded units using pre-load spacers.

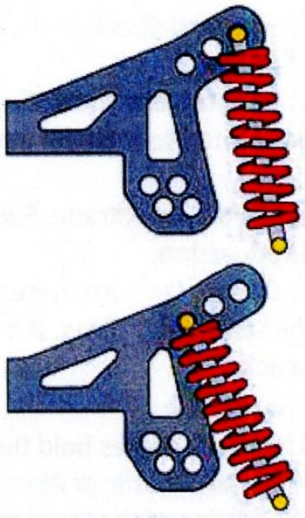
Shock Pistons:
The Piston is usually a round disc (with holes in it) attached to the Shock Shaft. Pistons can have 1, 2, 3 or more holes. The Oil travels though the holes during compression and rebound. The size or number of holes determines how fast the Oil travels through it. Larger holes (or more holes) allow Oil though quicker, making for responsive Shock damping. Smaller holes (or fewer holes) allow Oil though slower, resulting in sluggish Shock action. As a general rule, the smoother the track conditions, the smaller (or fewer) the Piston holes. The rougher or bumpier, the larger (or more) holes in the Piston.

Shock Oil:
Shock Oil determines the damping of your car. Heavy Oil will make your car seem sluggish. Lighter weight Oil will make your car seem more responsive. Oil is sold in small bottles from (usually) 10wt to 100wt. The higher the number, the heavier (or thicker) the Oil. As a general rule, lighter Oil is better for bumpy conditions, but allows more chassis roll. Heavier Oil is better for smooth tracks, but decreases responsiveness.

Shock Springs:
The purpose of the Springs is to keep the car level during acceleration, deceleration, and cornering. Springs come in many different Spring rates (or pound ratings) that are usually designated by their color. Generally, stiffer Springs make your car respond quicker and reduce chassis roll, but will not work well on bumpy tracks. Stiffer is better on smooth or high traction tracks. Softer Springs are better on slippery or bumpy tracks. You will normally run heavier Springs on the front than the rear.

What are Shock Mounting Positions?
There are many different configurations for mounting the Shocks. On most cars, there are multiple locations on the shock tower as well as on the suspension arm.

Each location changes the handling of the car. It is also suggested that you check the ride height of your car every time you change the Shock Mounting Location.

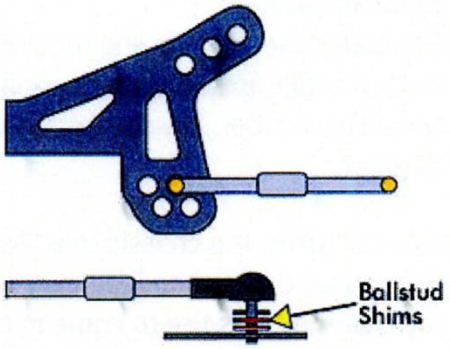


Most RC vehicles using shock mounting positions on the shock tower and suspension arm.

Tuning with Shock Mounting Positions
On the front, laying the Shock down will make the Shock feel softer (as the car rolls) and will increase steering, but decrease damping. Standing the front Shock up will make the Shock feel stiffer (as the car rolls) and will decrease steering, but increase damping. On the rear, standing the Shock up will decrease traction (or add steering), but increase damping. Laying the rear shock down will increase traction, but decrease damping. As a rule, the more traction the track has, the more you can stand the Shocks up.

Camber Links.

What are Camber Link Locations?
The Camber Link is the adjustable rod or fixed-length rod that connects the chassis to the caster block or hub carrier. Camber Link adjustments have been a mystery to many for a long time. While I will give you the general rule to use them, you may find slightly different results depending on the rest of your setup. Basically, the Camber Link will affect how much the Camber changes during suspension travel.



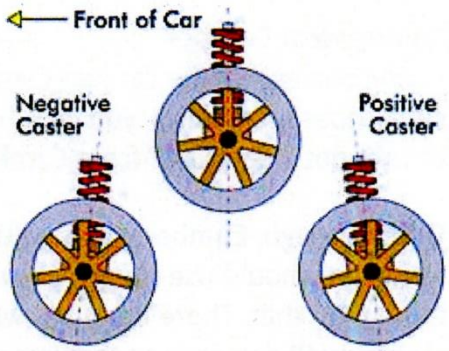
Changing the camber link location wil change the camber gain during suspension compression.

Tuning with the Camber Link
Making the Camber Link longer or higher will result in less Camber change during suspension travel, which will increase traction but decrease stability. A shorter Camber Link will result in more Camber change, or a decrease in traction but more stability.

As the pictures shows, some vehicles use vertial links and other use horizontal links. The tune is the same, its merely the adjustment that differs.

Caster.

What is Caster?
Caster is the angle of the steering block kingpin as it leans toward the rear of the car. There is more to it than that, though. Caster is also directly affected by Kickup. If you have 0deg Caster blocks and 2deg of Kickup, you really still have 2deg of Caster. So, using this formula, 4deg Caster blocks (and 2deg of Kickup) actually gives you 6deg of Caster (4 in the blocks and 2 in the Kickup).



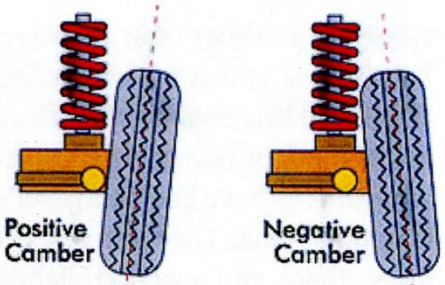
Caster changes the on- and off-power steering.

Tuning with Caster
More Caster will make your car easier to drive. It will also make it more stable on the straights and through bumpy sections. Less Caster will give the car more front bite into corners and make it react quicker to steering inputs. Less Caster will also make your car feel a little more twitchy.

Camber

What is Camber?

Camber is the angle of the tops of the wheels from straight up and down. Leaning in is Negative Camber, leaning out is Positive Camber.



Adding camber helps provide grip in the corners.

As a car turns, the chassis rolls. As the car rolls, this causes the tires to lean over towards the turn, causing less tire to come in contact with the ground (at 0deg Camber). So to compensate, we add a few degrees of negative Camber. When the same car rolls, it rolls up on to the negative Cambered tire, now setting the tire at 0deg, or the largest possible contact patch the tire can have. As we all know, the larger the contact patch, the more the tire is in contact with the ground, and the most possible traction you can have.

Camber is usually adjusted by turnbuckles that pivot the wheel from the lower outer hinge pin. Some cars use what's called a Pivot Ball Suspension...the steering block is attached to the A-Arm by a Pivot Ball. Screwing the upper Pivot Ball in will add Negative Camber, while unscrewing the same Pivot Ball will remove Camber, setting it closer to 0deg.

Tuning with Camber

Giving one end of the car less Camber gives that end less traction. For instance, if your car is loose (oversteer), you could either add a degree of rear Camber (recommended) or take out a degree of front Camber.

Oddly enough, Camber works a little differently on either end of a touring car. On the front, you should use roughy around -1 to -2deg of Camber. It is rare that you will use more than that. There is a point where you can add TOO much front Camber. If so, steering will decrease as the tires will roll OVER the perfect contact patch area.

On the rear, Camber affects two things. In a straight line, maximum acceleration is achieved with 0 degrees of Camber. Adding Camber reduces forward traction slightly, but you will gain cornering grip. So, there is a fine line on rear Camber. Starting at about -1deg is your best bet, and work from there.

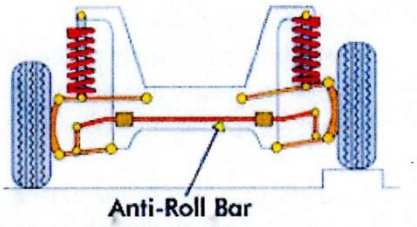
While positive Camber is not normally recommended, I have seen some off-roaders us it. This helps get traction to the INSIDE wheel while cornering. I haven't used this myself, so I can't tell you from experience if this is a good thing or a bad thing.

-2deg to -3deg of negative Camber is the norm for most vehicles.

Anti-Roll Bars.

What is an Anti-Roll Bar?

Anti-Roll Bars, also know as Sway Bars, are used to reduce chassis roll while cornering by connecting the left side of the car to the right side. Typically, Anti-Roll Bars are used on high-traction surfaces to keep the chassis flat through the turns. This will also provide even traction for all 4 tires resulting in a more responsive car.



The anti-roll bar connects the left and right side of the car to keep it flat during cornering.

An Anti-Roll Bar uses a fixed diameter piece of wire that is bent to fit your vehicle. The middle of the bar is then attached to the chassis while the ends have ball ends attached. These ball ends have links that attach to the suspension arms of the vehicle.

Tuning with an Anti-Roll Bar

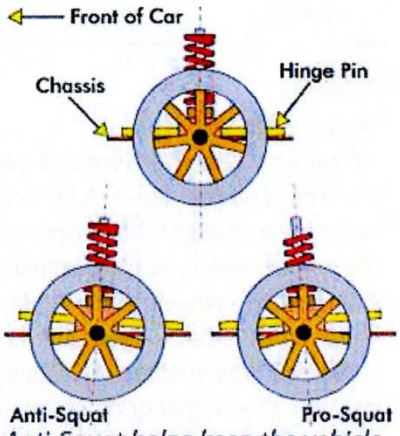
Using only the front Anti-Roll Bar will decrease front chassis roll, giving the feeling of more rear traction, or less front bite (less steering). Using the rear Anti-Roll Bar will decrease rear chassis roll, giving the feeling of more steering, or less rear traction.

It is not recommended to use Anti-Roll Bars in bumpy conditions. If you use the bars on a bumpy track, you lose the benefits of the cars independent suspension, making it difficult to drive.

Anti-Squat.

What is Anti-Squat?

Anti-Squat is best described as Caster for the rear wheels...it changes the relation of the inner hinge pins parallel to the ground. The more anti-squat the vehicle has, the less the suspension will squat during acceleration. Anti-Squat is most effective from a stand-still.



Anti-Squat helps keep the vehicle from squatting during acceleration.

Tuning with Anti-Squat

Most vehicles allow the adjustment of Anti-Squat in similar ways: somehow adjusting the height of the front or rear hingepin mounts of the rear suspension arms.

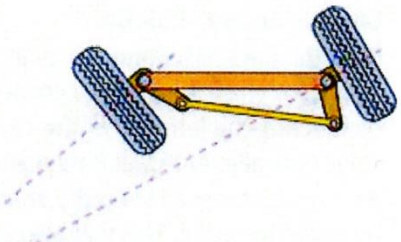
Adding Anti-Squat will make the car Squat less during acceleration. This will cause your car to track straight on straightaways. It will also make your car push coming out of corners, but loose entering corners.

Less Anti-Squat will result in the opposite: a little less forward traction, more stable entering corners, and will track through bumpy sections much better.

Ackermann.

What is Ackermann?

Ackermann is the angle of the inside tire in relation to the outside tire when the wheels are turned completely to either the left or the right.



The 'Ackermann Effect'; where the inside wheel is turning at a sharper angle than the outside wheel.

In a tight turn, where the wheels are turned to full 'lock' (either to the left or right), the inside wheel is turning at a sharper angle than the outside wheel, allowing the inside wheel to follow a smaller radius than the outside wheel. This is called the 'Ackermann Effect'.

If both the wheels were turned by the same amount, the inside wheel would scrub (effectively sliding sideways) and lessen the effectiveness of the steering. This tire scrubbing, which also creates unwanted heat and wear in the tire, can be eliminated by turning the inside wheel at a greater angle than the outside one.

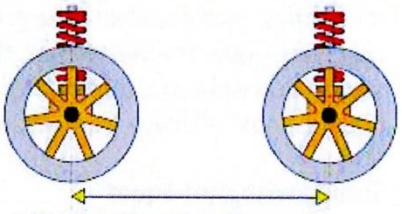
Tuning with Ackermann

The standard setting (kit setting) on most vehicles is so as to make the vehicle easy to drive. Making the Ackermann Link longer (in most cases, the link will be swept back instead of parallel with the front suspension arms) will take away Ackermann, but make the steering more aggressive entering a corner. Making the link shorter (in most cases, the link will be more parallel with the front suspension arm) will result in more Ackermann, or less aggressive, and make the steering smoother and more predictable.

Wheelbase.

What is Wheelbase?

Wheelbase is the horizontal distance between the front and rear axles. Adjusting the wheelbase changes the weight distribution on the wheels which, in turn, adjusts traction. Adjusting the wheelbase is as simple as moving shims front to back. These shims are located either in at the suspension arm mounts or out near the steering knuckle or rear hub carrier. Note: not all vehicles have this adjustment.



Adjusting the wheelbase of a vehicle puts more weight over the wheels.

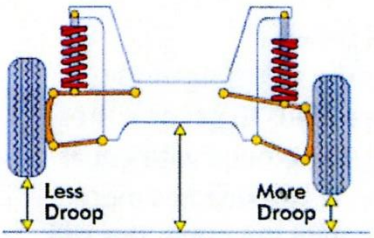
Tuning with Wheelbase

Making the wheelbase longer increases stability and is better on rough tracks or open tracks with high-speed corners. A longer wheelbase is not recommended for a track with sharp, 180deg style corners.

Making the wheelbase shorter places more weight over the wheels and helps the car rotate around sharper corners as well as increases steering response.

Droop.

What is Droop?
Droop is the amount of down travel a suspension arm has. Droop can be set independently from front to back, but should be the same (normally) from side to side.



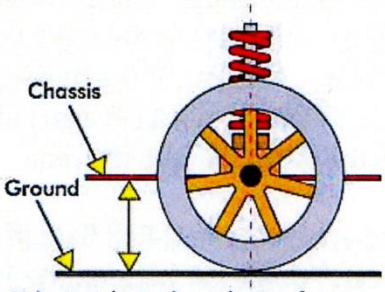
Droop measures the amount of downtravel a suspension arm has.

Tuning with Droop
Typically, less Droop reduces body roll. Less in the rear will free up the rear a bit, giving more steering. More Droop in the front is good for better on-power steering. It should always be necessary to increase Droop for bumpy tracks, and decrease Droop for high-traction tracks, such as carpet.

You can limit Droop in a couple of ways. Touring Cars offer Droop screws located in the suspension arms. By screwing these in or out, you adjust how much Droop that corner of the car has. On vehicles without Droop screws, Droop is adjusted by placing small limiters IN the shock itself (also known as down-travel limiters). These are placed on the shock shaft below the piston. This limits how much the shaft extends out of the shock body. You can also adjust Droop by screwing up or down the shock shaft eyelets on the bottom of the shock shaft.

Ride Height.

What is Ride Height?
Ride Height is the distance measured from the bottom of the chassis to the ground. This adjustment should always be made with the car in race ready condition, meaning all electronics installed, including the motor and battery. Basically, Ride Height changes the speed of how the car reacts while changing directions. It will be really noticeable in chicanes, or S-turns, where changing directions is crucial.



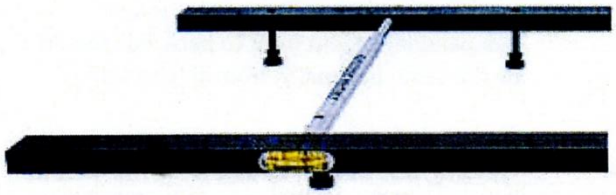
Ride Height is the relation from the bottom of the vehicle's chassis to the ground.

Ride Height is easily changed on all cars. Some cars have 'pre-load clips' on the shocks, others threaded shocks. To change the Ride Height, first place the vehicle on a flat surface (this is crucial!!!). Make sure you have some sort of gauge to keep accurate measurements (simply making the shock collars or pre-load clips even on each side of the car will not work). Some companies sell a Ride Height gauges for a couple bucks, and can be invaluable in this situation. Slide the gauge under the car until one of the steps comes in contact with the bottom of the chassis. This is the Ride Height of this part of the car. Add/remove pre-load clips, or adjust the shock collars, until the desired Ride Height is achieved. Now repeat for the other side of the car, making sure you take the measurement from the exact place you took it from on the other side of the car.

Tuning with Ride Height
For high bite tracks, use a lower Ride Height. For low traction surfaces, raise the car up slightly. Raising the Ride Height will cause the car to roll more, allowing for more traction. Raising the car up will also help in bumpy situations.

Tweak.

What is Tweak?



Tweak is the adjusting of the shock pre-loads to get all 4 tires touching the ground with equal pressure. If one side has more pressure than the other, this will cause your car to not handle consistently turning left and right. In other words, your car will be Tweaked.

Tuning with Tweak

First, I would suggest getting a tweak station, similar to MIP's unit. To adjust Tweak on a Touring Car, a few minor checks need to be made first. Make sure all the suspension parts are free and are not binding. Also check your turnbuckles for correct length. Disconnect the Anti-Roll Bars and place the car on the tweak station, making sure the car is centered. Now (assuming you placed the front on the swing arm), push down on the front and rear of the car to settle the suspension. Look at the bubble; it should be centered on the gauge. If it is, Tweak is good. If it isn't, Tweak is off and needs to be fixed. If the bubble is to the right, you need to add more pre-load to the LEFT front (or RIGHT rear) of the car. If the bubble is to the left, you need to add more pre-load to the RIGHT front (or the LEFT rear) of the car. Once you've corrected this, rotate the car and do the same thing to the rear.

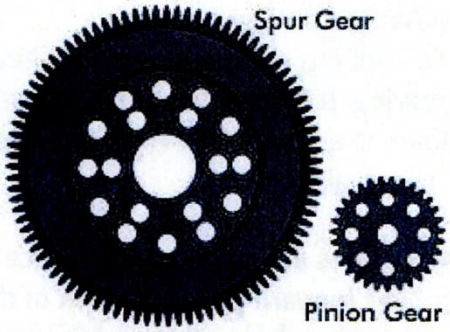
Now, re-attach the Anti-Roll Bars (if you are using them). This MIGHT upset the Tweak of the car. Put the car back on the Tweak station and re-check it. If is off to the left, remove the right Anti-Roll Bar Mount and lenghten it slightly and then re-attach. If it off to the right, remove the left Anti-Roll Bar Mount and lengthen it slightly and then re-attach. Do this until you get the Tweak bubble in the middle of the gauge.

Tweak for pan cars is a bit different. You can use the Tweak Station or you can use the penny trick (the penny trick is a little less expensive!!!!) To Tweak using the penny trick, first set your pan car up on a flat surface in race ready trim. Now, place one penny on each front tire, but not quite in the dead center. Place it slightly forward of dead center. Find a center point under the front of the chassis and take an Xacto (or other pointy object) and lift SLOWLY. If both pennies fall at the same time, your Tweak is good. If the left one falls before the right, slightly tighten the right Tweak screw (located on the T-Bar). If the right one falls first, slightly tighten the left Tweak screw. The same system can be used to adjust Tweak on 1/12 scale cars.

Gearing.

What is Gearing?

On an electric car, there are 2 Gears on your car that you need to worry about changing: the Spur Gear and the Pinion Gear. The Pinion Gear is the one attached to the motor, the Spur Gear being the gear the pinion comes in contact with. On a Nitro vehicle, you might have 4 gears...2 for the 2-speed on the engine and 2 for the 2-speed on the 'drivetrain'.



A vehicles gearing can make or break a race.

On an electric car, the Pinion is changed by loosening the screws to the motor (or, in some cases, removing it from the car) and then removing the Pinion. Slide the new Pinion on, re-install the motor in the car (if applicable), and adjust the Gear mesh.

To change the Spur requires a little more work. Depending on the vehicle you own, it could be as easy as removing 2 screws or disassembling a whole portion of the car. See your instruction manual for the procedure as it applies to your vehicle.

On a Nitro vehicle, changing the Pinion gears requires the removal of the engine from the car (in most cases). You will then need to remove the gears from the clutch bell and replace with the appropriate gears.

Changing the Spur Gears on a Nitro vehicle requires the disassembly of a portion of the car (in most cases) to remove the gears and replace with the appropriate ones. See your instruction manual for the procedure as it applies to your vehicle.

Tuning with Gearing

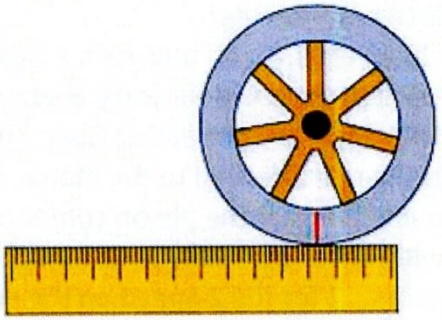
On the Pinion Gear, the higher the number of teeth, the faster (top end) your car will have, but you will lose acceleration. The lower the number of teeth, the faster your car will accelerate, but you will lose top end. More top end usually results in less run time, also.

On the Spur Gear, the higher the number of teeth, the more acceleration the car will have, but the less top end. The lower the number of teeth the more top end you will have, but you will lose acceleration.

Roll Out.

What is Roll Out?

Roll out is a measurement that helps calculate gearing. It is something that is used more for foam tire setups, but can be applied to rubber setups, also.



Roll out is a calculation to help figure out your vehicle's gearing.

Roll Out is defined as the distance a vehicle moves forward per revolution of the motor. It can change due to tire wear or a tire swap (on foam tires). Roll Out is measured using this equation:

Tire Circumference x Transmission Ratio x (Spur x Pinion) = Final Drive Ratio

Your Roll Out depends on your tires circumference. You can calculate the circumference by doing the math: Tire Diameter x 3.14 = Circumference. Or, you can do it the easy way and use a ruler to measure. Place a mark on the tire. Start with the mark pointing down and roll it along the edge of the ruler until the mark comes around to the bottom. This is your circumference.

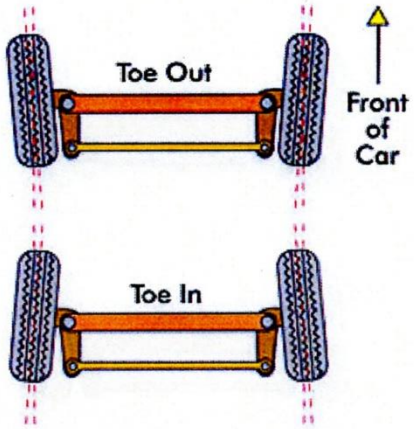
Tuning with Roll Out

Roll Out is best used to match a faster racer's gearing. Simply using the same spur/pinion combo will probably not work if he is using larger or smaller tires or his transmission ratio is different. If you know the circumference of his tires (and transmission ratio), you can use the above equation, determine his ratio, then plug in your numbers until you reach a similar ratio.

All rubber tires are basically the same circumference, and since wear isn't that much of a problem, equal Roll Out is much easier to achieve. All that is basically needed is transmission ratio and you can find a faster drivers Roll Out.

Toe. In / Out.

What is Toe In / Toe Out?
Toe In / Toe Out describes the angle of the front (or rear) tires when viewed from above. If the front of the tires angles in (or towards the chassis), that is Toe In. If the front of the tires angles out (or away from the chassis), that is Toe Out.



Toe is used to help with steering response and cornerspeed.

Tuning with Toe In / Toe Out
Toe In / Toe Out can be adjusted to increase or decrease steering and steering response. You adjust Toe In / Toe Out by turning the turnbuckles attached to the steering knuckles or hub carriers.

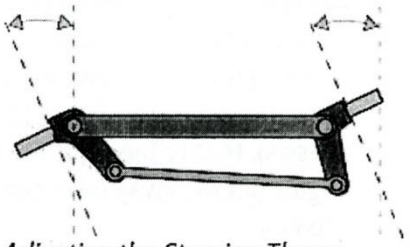
Front:
Adding Toe In will decrease steering into a corner, but add steering out of a corner during acceleration. Toe In will also stabilize the car under acceleration. Toe Out will increase steering into a corner, but cause the car to wander a little on the straights and in bumpy sections. It is not normally suggested that you use more than 1deg of Toe In or Toe Out.

Rear:
More Toe In results in less on-power steering and slightly more entering a corner. Less Toe In results in more on-power steering and slightly less entering a corner. Less Toe In will also increase staightaway speed, as the rear tires will scrub less.

On the rear, there will always be Toe In or 0deg of Toe. You will never use Toe Out in the rear. On most cars, a Toe Block designates the degree of Toe, while others have turnbuckles to adjust (similar to the front). To change rear Toe, either adjust the turnbuckles or remove the Toe block and replace with another block.

Steering throw.

What is Steering Throw Symmetry
When you build your RC car for the first time (or pull it out of the box if it's an RTR), the steering turnbuckles are set to the correct length so that your front tires turn an equal distance to the left and right. This is call Steering Throw Symmetry, and it ensures your car will turn equally to the left and right. If for some reason it doesn't, the throw can be easily adjusted using the steering turnbuckles.



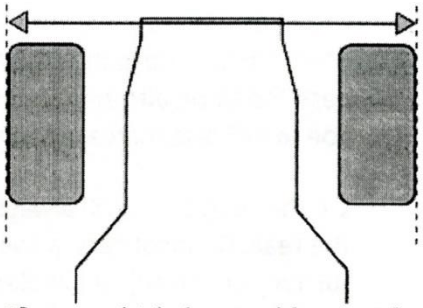
Adjusting the Steering Throw Symmetry ensures you have equal steering left-to-right.

Tuning with Steering Throw Symmetry
Turning equally left-to-right is important to make sure you car handles the same in both directions. There are two ways to adjust this throw.

1) One way is adjust the steering throw is to lengthen or shorten the steering turnbuckles until the throw is the same.
2) If your transmitter has EPA (End Point Adjustment), you can dial in or remove steering throw. This is the easiest way. Just be sure not to over-extend the steering. This could cause binding or additional stress on the steering servo.

Track Width.

What is Track Width?
Track Width is measured from the outside edge of the wheels, ie, front track width is from the outside edge of one front wheel to the outside edge of the other front wheel. Track width must be adjusted equally on both side so that the left and right wheels are the same distance from the center of the vehicle. You can do this by placing thin shims between the wheel and axle hex. Unfortunately you can't adjust track width on vehicles that don't use a wheel hex adapter, ie, most offroad vehicles.



If your vehicle has problems with traction rolling, adjust the track width to help prevent this.

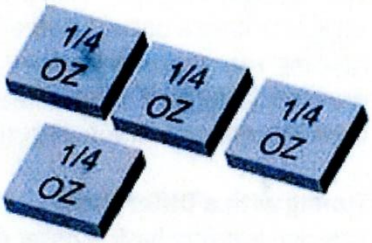
Tuning with Track Width
Making the track width wider on the front of your car reduces front grip and slows steering response. It also helps reduce traction rolling. Making the front track width narrower increases front grip and quickens steering response.

Making the track width wider on the rear of your car increases rear grip and high speed steering. It also helps reduce traction rolling. Making the rear track width narrower increases rear grip on tighter turns. It also induces a bit of high-speed understeer.

Weight.

What is Vehicle Weight?

At most club races, legal Vehicle Weight is not something that is strictly enforced. But, at major events (Divisionals, Nationals, and The Worlds), there is a weight requirement. All cars must be AT or OVER the legal Weight. This is so that all cars are on a 'somewhat' equal playing field.



Adding weight to your vehicle can help balance the car and affect handling.

If you car is under weight, small lead weights are available to bring your vehicle up to minimum weight. If you car is over weight, there are a number of ways to reduce weight.

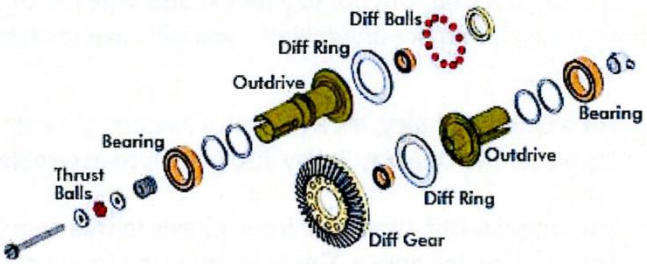
Tuning with Vehicle Weight

Some companies sell small lead squares that can be broken off in 1/4oz increments and added to the car. The benefit of this is that now, instead of having a race ready car that is overweight, you can add weight ANYWHERE you want to reach the legal limit. Remember, the heavier the car, the more power it takes to move it. So, by getting the car as close to legal as possible (at or over, of course), you make your car as light as legally possible.

Differential (Diff)

What is a Differential?

There are two different types of Differentials; a gear-style diff and a ball-style diff.



The differential helps control traction or wheelslip upon acceleration.

Gear diffs are comprised of a series of gears that transfer power from the input shaft to the wheels. Gear diffs are inexpensive to produce and can be quite durable, so you will find them in alot of RTR or Monster Truck vehicles. Gear diffs are also not externally adjustable. Adjusting a gear diff means removal from the vehicle and adding different viscosities of fluid to limit slip.

Balls diffs are more of an upgrade, or competition style diff. They use small balls and rings to limit slip. The more you tighten down the ball diff, the more pressure it takes to slip. Ball diffs do require a bit more maintenance, but can be externally adjusted to help the performance of your vehicle.

What is a OneWay Differential?
The One Way Differential simply removes diff action from the front of the car. You will no longer have a ball style differential in the front of your car. Instead, the 'OneWay housing' uses two (sometimes 4) 'OneWay' roller bearings that spin in one direction. Once your input shafts have been installed, the roller bearings will only allow them to spin in one direction…HOPEFULLY forward!!!

Tuning with a Differential
This one is pretty basic. Looser diff: low-traction tracks. Tighter diff: high-traction tracks. A tighter diff will allow more instant throttle response and greater acceleration.

All cars have their own adjustment rule. On most cars, there is a standard setting for the lightweight diffs and a standard setting for the steel diffs to make sure they work their best. As you tighten the diff bolt, make sure you tighten it down to where it is fully compressed, but DO NOT OVERTIGHTEN! This is extremely important. Once compressed, follow the manufacturers settings – no more, no less. Run the car for a complete pack, and re-check the diff setting.

In offroad, you want the diff as loose as possible without slipping. If you land off a jump and hear a 'barking' sound, your diff is too loose and you should tighten it up slightly.

Tuning with a OneWay Differential
Changing to the OneWay Diff is fairly simple. For the OneWay Diff, it requires you to remove the front Diff out of your car and slide the OneWay assembly in it's place. All OneWays come pre-assembled…you will have to attach the gear and the outdrive cups.

For a OneWay Pulley, it's a matter of removing the stock Pulley and just sliding this in it's place. The OneWay Pulley also come pre-assembled.

The OneWay Diff allows the front wheels to free-spin (off power), giving you a much better cornering ability. This is because the front tires will not be fighting each other through the turn. You will, however, need to change your setup and driving style. Setup changes will include (possibly) a stiffer front spring, maybe heavier front oil, a softer rear spring or softer rear oil. As far as driving style, you will have to change that to a smoother, flowing style. No longer can you full throttle into a corner, slam the brakes, and power out of it! It does take some getting used to, but it is by far a much faster way around the track.

OneWay Diffs are recommended mostly on high bite tracks. The exception to this rule might be carpet, as the aggressiveness of the OneWay might be a bit too much.

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