Chassis Tuning 101

Matt Murphy's Dirt Oval Chassis Tuning Guide

PREFACE

Over the last 17 years of my life, I have raced Dirt Oval all over the United States, on foam tires and rubber, hard packed and loose dirt. I have learned a lot about chassis setup on many different track surfaces with many different types of cars. Much of what I have learned is from trial and error, and quite a bit I have learned from doing plain old research on race car chassis dynamics. My goal now is to take what I have learned, and share it with you, but I want to do so in the simplest, easiest to understand manner that I possibly can. I certainly do not know everything, and I am not always right, however I can say that it is rare that I work on a particular chassis setup, and do not find improvement with each adjustment. My theories are just that, and are intended only to help you better enjoy your RC race cars, no matter which make and model you choose. Some things I pay much more attention to than others when it comes to chassis setup, but please understand there is no right or wrong, there is simply what works best for YOU!

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Chapter 1: Introduction to Dirt Oval Chassis Setup:

Chassis Setup is the most important factor in having a fast Dirt Oval car. However, there is no magic setup that will work on every car and every track condition for every driver. One driver may a like a car that steers very aggressively, while another may like to drive a smooth, slower reacting car. The most important thing for each driver to find is BALANCE! Balance means that the front end and rear end of the car have equal traction, and gives the driver a comfortable feel when driving the car at speed. Typically, if your car turns into the corner well, and then the rear end slides out, you are experiencing a "loose" race car, and you will need to add traction to the rear end to improve the balance of your chassis. Likewise, if your car seems to lack steering entering the corner, and you have to slow down too much to get around the corner, you are experiencing a "tight" race car. Finding and maintaining balance is the key to a consistently fast car on any racing surface, and your goal should be to find a balanced setup, more so than a fast setup. A fast setup may yield that one lightning fast lap, but a balanced setup will be easier to driver for 4 minutes, often yielding in a faster overall run.

Knowing What to Adjust

Most racing chassis come with a "standard" or "Kit" setup. Most companies spend countless hours in development and testing to come up with their baseline setup, which is why I always suggest that you start with the standard/kit setup. The standard setup is typically the setup that they felt yielded a very comfortable handling chassis on many types of track surfaces. Think of this as your home. If you get "lost" with your tuning and find that you have lost the balance of your car, go back "home" to the baseline setup and start over!

The purpose of this tuning is to help you enjoy racing dirt oval, and help you understand the many chassis adjustments available to you to change your car to suit both track conditions and your driving capabilities. Please note that there are many ways to setup a car. I like to say that "there a thousand ways to bake a cake, you simply need to find the recipe that you like." Not all chassis adjustments will have the same exact effect in every situation; however, following the info provided in this guide should help you achieve a general understanding of chassis setup. Most of these chassis adjustments will apply to any track surface, however, in some extreme track conditions; an adjustment may not have the desired effect on handling. My goal is to help you to better understand which chassis adjustments you should make, what the adjustment should do, and why the adjustment does what it does. Once you understand this, then, hopefully, you will better understand when to make which adjustment, to achieve the best chassis setup possible for the given conditions.

Suspension Theory 101:

Your suspension has one main purpose; to control the amount of Weight Transfer to each corner of the chassis, which in turn changes the amount of traction that tire can achieve. Every component of the suspension plays a part in controlling weight transfer. Every adjustment you make to the chassis changes the amount of weight transfer created, and where it transfers to, changing the overall balance of the car. Chassis setup is the art of controlling weight transfer.

Generally speaking, a “tight car” is an easy to drive car, and a “loose car” is much harder to control. My personal motto in chassis setup is to “Hook up the rear, then make her steer.” Easy to drive is better for all racers. Even the most talented racers go faster with an easier to drive chassis.

To best understand what the chassis is doing, we need to go over the basic handling characteristics:
- On-power Steering: On-Power Steering refers to how the car steers when throttle is applied.
- Off-Power Steering: Off-Power Steering refers to how the car steers at neutral throttle or no throttle applied.
- Push: When a car is cornering but the front tires are sliding more than the rear. A car with a “push” does not have enough steering. Although a car that “pushes” is easier to drive, a car that pushes is slower in the turns than a car that is slightly “Loose”. (Also known as “Tight” or “Understeer”)
- Loose: When the rear of the car slides more than the front. A car that is loose has too much steering. A “Loose” car tends to rotate more easily; however, a car that is too loose is harder to control and may spin out easily. (Also known as “Free” or “Oversteer”)

Next, we need to break the track up into 4 segments to best analyze what part of the track we need to work on.
- Corner Entry: This is the first part of the turn where you begin turning in. This is where the front of the car dips towards the track and the rear of the car lifts up a little, causing weight to transfer to the front tires, giving more steering. (Off-Power Steering)
- Mid Corner: This is where you maintain balance of the car with your throttle and steering input. This is where the chassis leans over as far as it is going to lean. (Neutral Throttle)
- Corner Exit: This is the part of the turn where you begin to apply throttle. As you apply throttle, the front end rises up and the rear end squats down, transferring more weight to the rear tires causing the car to have more rear traction. (On-Power Steering)
- Straights: The straight part of the track after corner exit, typically where you are full throttle, and likely backing out of the throttle prior to corner entry.

If you can tell what your chassis is doing in each segment of the track, you can then determine what adjustments will best suit your needs. Understanding what your chassis is doing, and where it is doing it is half of the battle. This is often the hardest thing for new racers to “get a feel for”.

Chapter 2: Tires

Tires are the single most important part of your chassis setup. Tires are the ONLY part of your chassis setup in contact with the racing surface, and are the sole provider of directional forces such as acceleration and steering. Generally speaking, the softer the tire is, the more grip that the tire can give. However, if the tire is too soft, it may deflect or deform more under load and cause a reduction in traction. The goal in selecting race tires is to run the softest tire you can run to achieve maximum traction, while maintaining consistent performance throughout the duration of the race, without excessive deflection, tire heat, and tire degradation. The softest, most hooked up tire combination is no good if it does not last the duration of the race.

The best way to find out what tires you should be running is to go ask what the fast guys at your track are running. Use this as a starting point for tire selection, but do not be afraid to try other combinations. Each track typically has a known “go to tire” that works well. Asking the veterans and local fast guys is always a good way to know what to start with.

Foam Tires
There are two different “families” of foam tires; Synthetic Rubber and Natural Rubber.
Synthetic Rubber: These tires are best suited for tracks with moisture in them, and are usually the tires of choice for wet clay tracks. These tires typically are softer than natural rubber tires, and create the grip racers look for on wet tracks.

> ***Synthetic Foam Tires***
> RC4LESS: Silver (25), Gold (30), Bronze (35)
> BSR: Silver (25), Orange (25), Red (30)

Natural Rubber: These tires have higher rubber content, and excel on dry track surfaces. These tires are harder than their synthetic counterparts, but offer longer wear, and better performance characteristics on abrasive surfaces. Natural Rubber tires gain traction as the tire heats up and the rubber gets “sticky”. Running too soft of a tire can cause overheating, excessive tire wear, and less overall grip. Running a tire that is too hard can result in a tire that does not build heat, and creates less than desired grip levels.

> ***Natural Rubber Tires***
> RC4LESS: Pink (30), Pink (35), Magenta (40), Purple (45)
> BSR: Pink (30), Double Pink (35), Purple (40), Double Purple (45)
> CW: V2 (30), V3 (37), V4 (45), V5 (55+)

Tire Grooving
Grooved tires generally provide more forward and side bite than do tires without grooves, but do have higher wear characteristics and do require break in for maximum grip. Grooved tires that have not been broken in will lack forward and side bite, until they get scuffed in. Generally speaking, on wet tracks, you want a tire with radial grooves and cross cuts in rear, and radial grooves in front. On dry tracks, we often run only radial grooves on all 4 tires. Radial grooves promote side bite by creating edges on the contact surface that increase side bite. Cross cuts are used to increase forward traction, however if the track has enough bite to run a harder compound tire, you typically are not looking for increased forward traction. There is a point at which the grooved tire becomes too worn or feathered, and it should be replaced to prevent a major loss in tire performance.

Tire Diameter
Tire Diameter is a huge factor in the amount of bite a tire produces. A good all-around tire diameter to start with is 2.65”. The larger the tire diameter, the more sidewall the tire has. More sidewall creates more side bite, and makes the tire feel like it has more grip than a smaller diameter tire of the same compound. Taller tires can sometimes create too much bite, causing traction rolls, or tire chunking from excess sidewall deflection. Typically, when bite goes up, you want to go to a smaller tire. Suggested tire diameters range from 2.45” for slower spec classes on high bite tracks up to 2.80” for faster classes, on lower traction surfaces. What is best for your application? Seek out the local fast guy and ask him!

Compound Selection
Foam tires do not have air in them; therefore you cannot adjust performance of the tire with air pressure. Instead, we use softer compound tires on different corners to achieve different amounts of traction. A common setup is to run 3 soft tires and a right front tire that is one step harder. This often results in a more balanced feel, and smoother steering response. Sometimes, on abrasive tracks, racers may opt for soft left sides, and one step harder right sides to balance out tire wear.

Stagger
Stagger is when your right side tire is larger in diameter than your left side tire. Some racers play with rear stagger, but in general we do not. Our chassis race at scale speeds of 400mph around scale 3/8 mile

tracks, lapping in 4 seconds. Our cars also feature independent rear suspensions, and differentials that are not locked. The differential will usually absorb any difference in tire diameter by controlling diff action on throttle. If the rear axle was solid and locked, stagger could be a helpful tool, but that is simply not the case with our cars.

Front stagger can be used to tune steering response and entry steering. Stagger will reduce responsiveness at initial turn in, and reduce steering on corner entry. Reverse stagger is when the right front tire is smaller than the left front. Reverse stagger will make your car more reactive at initial turn in, and give you more steering at corner entry. Front stagger is a good way to fine tune steering, but is recommended only as a fine tuning adjustment once your chassis is close.

Rubber Tires
Rubber Tires are typically used on “Looser” dirt surfaces, although loose dirt has pretty much disappeared from race tracks across the country. There are two distinct types of rubber tires: Street Tracs and Buggy Tires.

Street Tracs
Street Tracs are a Spec style rubber tire that are not particularly high in bite, but when used as a spec tire, can be a very good control tire. Street Tracs are available in two compounds, standard and high bite. If you are racing on dirt and the rules allow, you will want to use the High Bite (HB) compound. If you are running on a hard surface, the Standard compound will keep you from wearing out tires too quickly. I suggest the CW molded inserts for use in the Street Trac tires. The lower the bite, the softer your insert should be. The higher the bite, the harder you want. Yellow is soft, Orange is medium, and Red is firm. A good all-around combination is HB tires with Yellow inserts.

Buggy Tires
There are two types of Buggy Tire racing: Open Tire and Spec Tire.
SPEC Tire
If you run SPEC Tires, you need to talk to the local fast guys at each track and figure out what the handling tendencies are of the SPEC Tires. AKA “Rebar’s” are a common SPEC Tire. This tire is known to have very little side bite, and a good amount or forward bite. This tire is designed and used in off-road for super packed conditions, and is not the ideal tire for looser surfaces, but as a SPEC Tire, it is the same for everyone. The three tricks with SPEC Tires right now are insert selection, tread depth, and tire doping. Some tracks are so hooked up that foam tires would work very well, however certain parts of the country are afraid of foam tires. This brings “ghosting” into play. Ghosting is the practice of purposely wearing out your tires to make them have very little tread left, usually tiptoeing the fine line between worn out treaded tire and slicks. I have one issue with SPEC Buggy Tire racing today, there is 2 different compounds allowed, and no limit on tire inserts, which allows racers to have 10 different combinations of the same rear tire, which in the long run, saves nobody money. Throw in each tread depth, and tire costs can be very high.

Inserts
Open cell foam inserts are softer than their molded counterparts, and usually provide a more hooked up feel all the way around the track creating more side bite and more forward bite. Molded inserts are usually more firm, and reduce sidewall deflection and carcass stretch under acceleration. This promotes less side bite and forward bite, but in higher traction situations may give a more balanced feel by allowing the car to better rotate into the corner, and rotate more on throttle during corner exit.

Open Tires
Open Tire racing may seem like it would cost more than SPEC Tire racing, but there are a few tires that are known to be ideal in most situations. There is not much to say about Open Tires, instead I will list what Open Tires you should consider. Tire Insert selection is similar for Open and SPEC Tires. For best performance, seek out the fast guys, and see what they are using!

Front Tires
Pro-Line - Narrow 4 Rib - M3 Compound (Good on looser tracks)
Pro-Line - Scrubs M3 - Compound (Good on Harder Tracks)
Rear Tires
Pro-Line - Inside Job - M3 Compound
Hot Bodies - Gigabite - Pink Compound

Tire Dope
I hate tire dope. It is made up of toxic chemical solvents, known in the chemical industry to cause cancer, serious birth defects, and mutations. Somehow, the RC industry is allowed to sell such chemicals without supplying proper safety precautions and use instructions, and without MSDS or ingredient listings. Please avoid skin contact and inhalation of these products. Please do not use them indoors or without proper ventilation. If RC Racers would push for a doping ban, we could eliminate the need to have several $12 bottles of toxic chemicals in our pit boxes, increase tire life and lower tire bills, and race in a much healthier environment.

If you want Tire Doping advice, seek out the local fast guy at your track, and do what he is doing.

In conclusion, for the fastest race car possible; TIRES, TIRES, and TIRES!!!!!! If your tires are not ideal for the track conditions, you WILL NOT be as fast as you could be on the right tire. A poor chassis setup racing on the right tires will often beat a well setup car on the wrong tires. For best results, do your homework, come prepared, and look to the veterans for guidance.

Chapter 3 - Springs, Shocks, and Chassis Height

Springs
Springs are the quickest, easiest, and most effective way to change weight transfer on your chassis. Springs have only one job; to control ride height. Softer springs allow more weight to transfer, while stiffer springs allow less weight transfer. The more weight transfer you have to a particular corner of the chassis, the more traction you can gain on that corner’s tire. In general, running softer springs will produce more traction until you get so soft that the chassis rolls over to the point where there is no suspension left and it starts to slide the tires. Also, running springs that are too soft can result in overloading of the tire, which can also result in a break of traction. A softer front spring will usually produce more steering while a firmer spring will tend to decrease steering response. A softer rear spring will usually produce more rear traction, but on higher bite tracks, you will need to increase your spring rate to keep the car sitting on the rear end, causing a push. Most chassis can achieve maximum balance with stiffer springs up front than in the rear. Rare situations may call for softer front springs than rear springs, usually when cars have extreme aerodynamic conditions such as EDM style bodies with high amounts of downforce and plenty of side panel for stability.

Shock Mount Positions

Shock Mount Positions on the suspension arms and the shock tower can change the effective rate of the shock/spring package. Moving the location of the shock mount changes the amount of leverage the shock has on the suspension as it compresses. The more a shock is laid down, the softer that shock becomes, due to decreased leverage against compression of the suspension. The more a shock is stood up, the stiffer that shock becomes, due to increased leverage against compression of the suspension. Laydown front ends typically have a more aggressive feel for the driver, due to decreased leverage of the shock, and increased weight transfer to the right front. Stand Up front ends typically have a more "positive" feel for the driver. This means the car feels more into the track, and more consistent, although possibly more of a "tight" feel. Stand Up and Laydown front ends need very different spring setups due to the varying amounts of leverage.

Shock Dampening

There are three key factors in shock dampening: Pistons, Oil, and Bladders. Shock Pistons move through the Shock Oil inside the shock body during compression and rebound, and the amount of resistance caused by this movement is known as dampening.

Shock Pistons

Most shocks have multiple shock pistons available for fine tuning of dampening. Shock pistons are mounted on the shock shaft and have holes in them that control the flow of the shock fluid as it moves up and down with the suspension movement. There are various options available for each brand of shock, usually varying in number of holes and the diameter of the holes in the piston. Using pistons with smaller and/or less holes provides stiffer damping, slower weight transfer, and slower response. Pistons with larger and/or more holes provides softer damping, increased traction, quicker weight transfer and response.

Shock Oil

Shock Oil is graded by its viscosity or thickness. On most dirt oval chassis, racers use between 30wt and 60wt Shock Fluid. Lighter shock fluid will give more overall traction and allows quicker response to suspension movement but also has a tendency to allow too much chassis roll in the corners. Heavier fluids have less overall traction and react slower but on high bite and smooth tracks, heavier fluid tends to be easier to drive. Heat makes shock fluids lighter and cold makes them heavier. You may need to adjust shock fluid when there is a drastic temperature change (20-25 degrees) to maintain the same dampening. If it gets cold you will need to go to a lighter weight shock fluid. If it gets hotter you will need to go to heavier weight shock fluid. In extreme temperatures, you can change 5wt and get very close to the feel of your dampening settings from typical temperatures.

Bladders

Not all shocks are designed to use a bladder; however I recommend bladder shocks for all racers looking for consistent handling. The shock bladder acts as a silicone membrane that keeps the shock oil and the air in the shock separated from one another. This prevents air bubbles for getting into the shock fluid, causing inconsistent dampening as the pistons moves past the fluid and into air pockets. Be sure to check your bladders for punctures any time you open your shocks up. I suggest that racers replace their bladders every time they replace their shock seals (which should be a somewhat regular maintenance procedure).

Chassis Height

Chassis Height is a very important measurement and setting that many racers neglect or simply do not understand. Chassis height is set by the amount of pressure applied to the springs by the spring collar on the shock. Adding Pre-Load to your shock collars DOES NOT do anything to the shock besides change chassis height. You cannot stiffen an 8 pound spring with more pre-load; instead preload simply jacks up the chassis height on that corner of the car. The proper way to stiffen up the chassis and maintain balance is to go to a stiffer spring, and reset your chassis height. Typically, we treat chassis height as a setting, not an adjustment. We use a particular chassis height setting that we have found to work well on a particular track surface, and no matter what spring changes we need to do to control weight transfer, we readjust our chassis to that chassis height before each run.

A 1mm change in chassis height can be a very significant in handling and weight transfer. The higher the chassis height is set, the higher your center of gravity will be. Higher center of gravity creates more chassis roll and weight transfer when cornering. This will also cause the car to transfer more weight when accelerating or decelerating. The higher you set your chassis height, the more weight transfer you are promoting. Likewise, the lower you set the chassis height, the lower you move the center of gravity. Lower center of gravity promotes maximum corner rotation and cornering speed, along with keeping the chassis flatter and resisting traction roll. If your chassis height is set too low, and your chassis is bottoming out, you will experience inconsistent handling. Just like any other chassis adjustment, when it comes to adjusting Chassis Height, you need to find balance.

Adjusting Balance and Setting Your Chassis with Chassis Height

A typical Foam Tire Chassis Height is 12mm all around measured to bottom of chassis plate. A typical Buggy Tire Chassis Height is 17.5mm up front and 19.5mm in the rear of the chassis. Chassis Height is measured on the flat portion of the chassis just behind the front wheels, and just ahead of the rear wheels. We typically measure Sprint Cars race ready, with body and cage and measure Late Models and EDM’s race ready minus body.

Tuning Balance with Chassis Height and Springs

Now let’s assume that we have a chassis that is setup with the right tires, and setup with the “standard setup” and set to 12mm chassis height. Now we go out and practice, and the car is a little too aggressive getting into the corner, so we end up putting two turns into the right front spring to counter the less than desirable handling situation. Now the car is feeling more drivable. What adjustment do we make next? First thing you should do, is remember what changes you made, and since we put turns into the RF, we should replace the RF spring with the next rate stiffer spring, and then reset your chassis height to 12mm. Now we go back out for more practice and find that the track is losing some grip on corner exit, so we end up cranking a turn into the LR and taking a turn out of the RR. This helps us get the feel we are looking for. So what do we need to change after the run? We need to go up one rate on the LR spring and down one rate on the RR spring, and then reset our chassis height to 12mm all around. By changing springs, we are controlling the amount of weight transfer to find the balance we need. Likewise, by maintaining the 12mm chassis height, we maintain a consistent Center of Gravity, keeping a consistent and comfortable feel, and we always have a reference point, just in case we go too far or get lost. For best results, take plenty of notes, and work on writing down detailed descriptions of how the car felt in each of the 4 segments of the track (Straights, Corner Entry, Mid Corner, and Corner Exit).

Basic Spring Adjustment Cheat Sheet

Loose In: Stiffer RF Spring
Tight In: Softer RF Spring
Loose Off: Stiffer LR Spring, Softer RR Spring
Tight Off: Softer LR Spring, Stiffer RR Spring
(Stiffer RF Spring will tend to tighten up the car all around the track)

Chapter 4 - Toe, Camber, Caster, and Wheel Spacing

Toe
Toe is a word that describes the angle of a particular wheel, relative to the centerline of the chassis. Toe in refers to when the front edge of the wheel is closer to the centerline than the rear edge of the wheel. Toe out refers to when the rear edge of the wheel is closer to the centerline than the front edge of the wheel.

Front Toe
Front toe is adjustable by lengthening or shortening the steering turnbuckles. Front toe should ALWAYS be set after your camber and chassis heights have been set. Front toe is typically measured using a ruler, calipers, or other measuring device. In general, I like to consider front toe as a setting, rather than an adjustment. Although you can adjust your front toe to be toed in, neutral, or toed out, I like to keep things simple by always running a very slight amount of front toe out. For 1/10th scale cars, I run 1/16" of toe out (.063"). For 1/8th scale cars, I run 1/8" of toe out (.125"). Again this is something I use as a setting, and I literally never adjust the amount of front toe; however you must check your toe after each camber, chassis height, caster, or camber link adjustment. All of these adjustments play a role in what length steering turnbuckles you must have for proper front toe.

If you decide to tune with front toe, here is a basic guide to what each adjustment does:
Front Toe In - Less turn in steering, more exit steering, more aggressive down the straights, sometimes twitchy or darty feeling.
Front Toe Out - More turn in steering, less exit steering, more balanced down the straights, usually the most comfortable feel.

Rear Toe
Rear toe is adjustable by changing the rear toe blocks and/or the holes through which they mount to the chassis. Rear Toe is measured in degrees. In general, the more toe in you run, the less overall steering you will have. The lesser the amount of toe in you run, the more overall steering you will have. In dirt oval cars, rear toe technology has evolved greatly over the past 4-5 years. Now it is somewhat common to run up to 6 degrees of left rear toe in, and sometimes racers even run right rear toe out! One very tricky aspect to tuning your dirt oval chassis and its rear toe in setting is that each corner affects the car differently.

Left Rear Toe
Left Rear Toe is ALWAYS run toed in on today's dirt oval chassis. Typical amounts of RR Toe in are between 0 and 6 degrees. In general, we use the LR toe angle to adjust how the car ENTERS the corner. The more degrees that the LR is toed in, the more rotation the chassis will have on corner entry, both on and off power. The fewer degrees that the LR is toed in, the less rotation the chassis will have on corner entry. Foam tire setups often run between 1-3 degrees of LR Toe in, while Buggy tire setups often use 4-6 degrees of LR toe in.

Right Rear Toe
Right rear toe is usually set at fewer degrees than the LR, and sometimes in extreme conditions, is even run toed out. Typical amounts of RR toe are between 3 degrees of toe in and 3 degrees of toe out. In general, we use the RR toe angle to adjust how the car EXITS the corner. The more degrees that the RR tire is toed in, the more forward drive, and less on throttle rotation the car will have. The fewer degrees that the RR is toed in, the less forward drive, and more on throttle rotation the car will have. Foam tire setups often run between -1 to +3 degrees of RR Toe, while Buggy tire setups often use 0-4 degrees of RR toe in.

Rear Toe Cheat Sheet:
Tight on Entry - Increase LR Toe In
Loose on Entry - Decrease LR Toe In
Tight on Exit - Decrease RR Toe In
Loose on Exit - Increase RR Toe In

Camber
Camber is the angle of the wheel and tire in relation to the ground or flat surface. This is measured using a Camber Gauge. If the tire leans in towards the centerline of the chassis at the top it has negative camber. If the tire leans out at the top it has positive camber. The camber link controls the position of the wheel and tire as it moves up and down through its suspension travel. Camber is adjusted by lengthening or shortening the camber link turnbuckle until the desired camber angle is achieved. Camber has a tremendous effect on how the tires react and provide grip on the surface you are running on.

Foam Tires
With foam tires, the tire has a consistent density throughout the tire, and running higher camber angles will usually increase tire wear and create a wear situation known as "coning". This situation also results in a reduced amount of traction for that particular tire. With foam tires, the goal is to set your camber so that all 4 tires wear evenly. My foam tire cars usually have the tops of both front tires leaning towards the right, and the tops of both rear tires leaning to the left. I read my tire wear after each run, and adjust my camber link length accordingly, in an effort to have all 4 tires wearing flat.

Rubber Tires
With rubber tires, the tires have foam inserts which act like air pressure, and often gain more grip when the camber settings force the tire to transfer the cornering forces to the inside edge of the tires. More negative camber on the right front wheel produces more steering and is more responsive. Less negative camber on the right front will have less steering but will be smoother. To a point, more front positive camber on the left front wheel will give better steering into and out of a turn. Less positive camber will similarly smooth out the steering but be less responsive. Typically, with rubber tires, all four wheels will have the top of the tire leaning to the left.

Camber Cheat Sheet:
<u>Foam Tires</u>
LF - Negative 1*
RF - Positive 1*
LR - Positive 1*
RR - Negative 1*

<u>Rubber Tires</u>
LF - Positive 1.5*
RF - Negative 1.5*
LR - Positive 2*
RR - Negative 2*

Caster

Caster is the angle of your kingpin relative to an imaginary line perpendicular to the chassis plate. If you were to look at your chassis, and draw an imaginary line through the middle of your kingpin, and then measure the angle between the kingpin and a line perpendicular to the chassis plate, the measured angle would be your caster angle. Total caster is figured by adding your kick-up angle and your caster block angle, to come up with total caster. We will get into kick-up in a later chapter, but for now, we will focus on total caster and its effects on chassis handling.

What Does Caster Do?
Caster affects the handling of your chassis in two ways: Straight Line stability and Camber increase as steering input is given.

Straight Line Stability
The higher degree of Caster you run, the more the car will want to stay straight while driving straight. The lesser degree of Caster you run, the more the car may want to wander while driving straight. Typically, more caster is better for straight line stability in low bite conditions and less caster can keep a car from feeling numb in high bite situations.

Camber Increase via Steering Input
As you turn the wheels, the angle of Caster affects the angle of camber. The greater the amount of caster you run, the more camber you will gain with steering input. The lesser the amount of caster you run, the less camber gain you will achieve with steering input. Generally speaking, as you increase caster, you will gain steering as a result of increased camber. This is not an absolute scenario however; because if you have too much camber gain, you can actually reduce the amount of traction that a particular wheel can make causing the tire to be overloaded and slip. In some conditions, Caster may need to be reduced, to reduce camber gain via steering input, in order to increase contact patch on a particular corner which can result in improved grip for that particular tire. Like any adjustment, too much caster can be a bad thing. The goal when tuning with caster is to find the ideal handling characteristics both in a straight line and while cornering.

Caster Split
Caster Split is the difference between LF and RF caster angles. Typically, I suggest no more than 5 degrees of Caster Split. Five degrees of caster split is achieved by running 5 degrees less caster on the LF than the RF. Caster split helps the car turn into the corner easier, and in most instances, increases mid corner steering. Caster Split usually allows a racer to run less steering throw or dual rate, which in turn reduces corner speed scrub. In some extreme situations, racers have been running very aggressive rear toe settings, and in order to make these setups easier to drive, have been running negative Caster Split. Negative Split is when the RF has less caster than the LF. I suggest that racers keep caster adjustments simple, and run either 0 or 5 degrees of caster split for a balanced, easy to drive race car.

Wheel Spacing
Wheel Spacing is an easy way to change the way your chassis drives, without changing the balance of your chassis. Front Wheel Spacing has a greater effect off power during corner entry, while rear wheel spacing has a greater effect on power during corner exit.

Front Spacing
In general, as you space your front wheels to the right, you tighten up corner entry. Spacing your front wheels to the left will free up your corner entry.

Tighter entry = easier to drive but less potential for corner speed
Freer entry = harder to drive but more potential for corner speed

Rear Spacing
In general, as you space your rear wheels to the right, you free up corner exit. Spacing your rear wheels to the left will tighten up your corner exit.

Tighter exit = More forward drive and less on throttle rotation
Freer exit = More on throttle rotation and less forward drive

Chapter 5 - Droop

Droop
Droop is a word that by definition means to hang downward. How this applies to RC Suspension tuning is along the same lines. Droop is a measurement that determines how far your suspension arms "hang down" at full suspension travel. Droop is measured by measuring the center to center length of the shock. Center to center length means the center of the upper shock mount eyelet to the center of the lower eyelet or rod end. More droop is achieved with a longer length, and less droop is achieved with a shorter length. Droop is a tuning tool used by ALL of the top RC Racers, in every form of racing, especially dirt oval racing. I use droop adjustment at nearly every race I attend, and sometimes I adjust it after each run to fine tune the handling of my chassis. Droop is an advanced chassis adjustment, and is not recommended for all racers until a firm grasp of chassis basics is obtained.

Droop - How does it work?
As one end of the car is raised, it transfers weight to the opposite end of the car. The higher you lift that end of the chassis, the more weight is transferred to the opposite end. The more droop you have on one end of the chassis increases the amount of weight you can transfer to the opposite end of the chassis during acceleration, cornering, or braking. More droop allows you to transfer more weight, while less droop limits the amount of weight you can transfer.

What Does Droop Do?
Droop controls the amount of weight transfer that the chassis can achieve by changing the amount of travel at one end of the vehicle. Droop DOES NOT change the overall balance of your chassis setup, it simply controls the amount of weight transfer. Droop adjustments are considered a fine tuning adjustment, because droop should be adjusted to change characteristics entering and exiting the corner. If your chassis is not already "close" on setup, and the balance is not right, Droop will not save your car from ill handling characteristics.

Front Droop
Front Droop affects the amount of weight transfer to the rear end of the car during acceleration. Front Droop has one main job: to control weight transfer front to rear and help add or take away forward drive. Front Droop affects ON-POWER handling.

If you decide to tune with front droop, here is a basic guide to what each adjustment does:
More Front Droop - Increased weight transfer from the front to the rear wheels, resulting in more forward drive, and a tighter car on throttle. The car will want to drive straighter up off of the corner, and

will have more rear grip while having less on throttle steering. Ideal in lower bite/loose conditions where forward drive is hard to come by.
Less Front Droop - Reduced weight transfer from the front to the rear wheels, resulting in less forward drive, and a looser car on throttle. The car will want to rotate more up off the corner and will have less rear grip while increasing on throttle steering. Ideal in Higher bite/hooked up conditions where you have plenty of forward drive.

Rear Droop
Rear Droop affects the amount of weight transfer to the front end of the car during deceleration and braking. Rear Droop has one main job: to control weight transfer rear to front and help add or take away off power steering on corner entry. Front Droop affects OFF-POWER handling.

If you decide to tune with rear droop, here is a basic guide to what each adjustment does:
More Rear Droop - Increased weight transfer from the rear to the front wheels, resulting in more entry steering, and a looser car off power. The car will want to turn more aggressively into the corner, and will have more front grip and more overall steering. Ideal in lower bite/loose conditions where steering is hard to gain.
Less Rear Droop - Reduced weight transfer from the rear to the front wheels, resulting in less entry steering, and a tighter car off power. The car will want to turn less aggressively into the corner and will have less front grip and less overall steering. Ideal in Higher bite/hooked up conditions where you have plenty of steering.

Measuring Droop
Droop is measured using a pair of calipers. Simply measure the center to center length of the shock to determine your current droop setting. On the car, this can be measured from the center of the upper shock mount screw to the center of the lower shock mount screw.

Adjusting Droop
Droop can be adjusted or set using the following four methods:
- Shock Tower
- Droop Screw
- Limiters
- Rod Ends

Shock Tower
Many chassis are designed to have droop adjustments built into the shock towers. This allows racers to quickly and easily adjust droop, with touching their shocks. Moving up on the tower takes droop away, while moving down on the tower adds droop. If your shocks were matched for length when built, there is no need to measure droop after adjusting, because you are changing droop equally left to right with the shock tower hole change.

Droop Screws
Some chassis have suspensions that utilize droop screws. Droop screws limit the downward travel of the suspension arm regardless of the shocks total length off of the car. The more you thread a droop screw into the arm, the more you reduce the droop of the chassis. The more you unscrew the droop screw, the more droop you allow the arm/shock to have. When using droop screws, it is imperative that you measure the center to center length of both shocks to ensure that you have equal droop left to right. If not, adjust droop screws as needed until matched lengths are achieved.

Limiters
Some racers like to tune droop by adding internal shock limiters. Most racers use .030" limiters, and sometimes run up to 5 or 6 of them inside the shock to adjust droop. Simply unthread your shock rod end and install on the shock shaft below the piston, reassemble, and you are ready to go. Be sure to match shock lengths before installing on chassis.

Rod Ends
A simple way to fine tune your droop adjustments is to use your lower shock rod ends. You can thread them in or out one turn at a time which typically equals .020" of droop adjustment. This is great to fine tune your droop, as it is less of an adjustment as using the shock tower holes, and easier than adding limiters.

No matter which method(s) you choose to utilize for droop adjustment, one key thing needs to be focused on before you hit the track. RECHECK YOUR CHASSIS HEIGHTS!!! After EVERY chassis adjustment, and before EVERY run, you should check your chassis heights. Be sure you have the right settings. Most race days have limited practice time, so why waste a run by not ensuring proper settings?! Adjusting droop will change your chassis heights, so please, do the right thing and get your chassis acquainted with your setup board… Your setup board and Ride Height Gauge should be your best friends as a competitive racer.

Racers Note:
All MurfDogg Chassis are designed with symmetrical suspension geometry. Both front shocks can be built to the exact same length, and this will result in a perfectly balanced front droop setting. The same can be said for our rear end geometry and droop settings. The MurfDogg Team suggests tuning with droop equally to maintain balance, meaning to adjust the droop setting of BOTH front shocks equally during each adjustment. This maintains balance and prevents weight jacking which can change the handling of the car elsewhere beyond the desired droop adjustment. The same thing goes for rear droop adjustments. (Some racers with advanced chassis tuning knowledge play with more RF Droop in certain situations. This is not "wrong", but is suggested to be left to the advanced tuners out there, because this changes weight jacking and balance of the chassis, as well as lateral weight transfer. I suggest keeping things simple and tuning equally front or rear.)

Chapter 6 - Camber Links and Roll Centers

Roll Center is perhaps the most complicated and hard to understand concept of chassis setup. Roll Center is adjusted with Camber Links by changing camber link locations and lengths. I highly suggest leaving Camber Link and Roll Center adjustments to the expert racers with a firm grasp on chassis setup and handling. Roll Centers are difficult to explain even when using lots of drawings and diagrams. I am going to do my best to teach you the basics, without getting overly complicated and getting you completely lost. Roll Center basically describes the relationship between the upper and lower arm of the suspension. The lower arm would be the A-Arm, while the upper arm would be the turnbuckle.

What is Roll Center?
Roll Center (RC) is the point of which the chassis rolls while cornering. Your chassis will have a front roll center, and a rear roll center. RC is something that we can change on the chassis by using various chassis

adjustments. (Further details later)If you would rather not get too complicated about RC, please feel free to skip the next 2 paragraphs.

How do you determine where the Roll Center is?
Without getting too complicated, RC is figured by taking measurements and drawing a diagram based on data compiled from you chassis such as pivot locations of upper and lower arms and the center of the contact patch of the tire. Calculating RC is a pretty complicated and tricky process involving many factors, however the information obtained can be quite helpful to a racer trying to fine tune their suspension. For a basic understanding of RC, look at the rear of your chassis, at race ready chassis height. Now draw an imaginary line between the outer and inner hinge pins on your LR A-Arm. Next, draw a similar imaginary line between the inner and outer camber link mounts on the LR A-Arm. Where these lines intersect is known as your Instant Center (IC). Now draw a line from the IC to the center of the LR Tire's Tread Width where it contacts the track surface. The point that this line crosses the centerline of the car is your RC. This can be further complicated on Dirt Oval chassis by offset chassis and by setups utilizing staggered camber link locations and angles.

What is Center of Gravity?
Center of Gravity (CG) is a generalization for the center of mass. The CG is the point where a chassis' weight can be balanced, and will stay there until the application of an external source of energy. CG can be changed by physically changing the location of mass/weight on the chassis.

Roll Center and Center of Gravity
Dirt Oval Chassis ALWAYS have a RC that is much lower than the CG. This is important to know, so any RC adjustment we make will make a change in a particular direction.

Moment Arm
The Moment Arm is the imaginary line connecting the RC and CG. The length and subsequent leverage of the Moment Arm is the controlling factor of chassis roll while cornering. All of this calculating is done so we can find and change the leverage of the Moment Arm and how it acts on the CG during cornering.

Raising Roll Center
Raising the RC moves it closer to the CG, which results in less leverage of the Moment Arm. Less leverage (shorter moment arm) results in less chassis roll during cornering.

Lowering Roll Center
Lowering the RC moves it farther away from the CG, which results in more leverage of the Moment Arm. More Leverage (longer moment arm) results in more chassis roll during cornering.

Roll Center Cliff Notes
Adjustments That Raise Roll Center
- Lowering the inner camber link mounts.
- Raising the outer camber link mounts.
- Raising the suspension mount relative to the chassis.

Adjustments That Lower Roll Center
- Raising the inner camber link mounts.
- Lowering the outer camber link mounts.
- Lowering the suspension mount relative to the chassis.

Camber Links
Now that we have covered what the various Camber Link angles do for us regarding chassis roll and controlling weight transfer, let's get into what various camber link lengths do for us. Remember, your lower A-Arms are an acting force of your suspension geometry, and in general we are figuring the effects of the Upper Link (Camber Link) on the lower link (A-Arm).

Neutral Camber Links
When your car has equal length upper and lower links that are parallel to one another, this is called Neutral Camber Links. This will be the most neutral handling, easy driving, and predictable setup. All MurfDogg Chassis are designed to have the ability to run Neutral Camber Links. We run Neutral Links 95% of the time, and only stray from this setup in extreme conditions (Extreme Low-Grip or Extreme High Bite).

Camber Link Lengths
- Shorter Links typically result in more camber change. More Camber Change equals more initial weight transfer to that corner.
- A short link that is parallel to the lower arm will have a very low RC, which will initially cause the chassis to roll easily, but a longer link at the same angle will have increased chassis roll into the corner. This is because the as the car leans into the corner, the RC of the longer link actually will get to a point that is lower than the RC of the shorter link. Basically, the longer parallel link will have less initial roll, but will roll more as you get farther into the roll than the short link which provides more initial roll.
- Longer Links typically result in less camber change. Less Camber Change equals less initial weight transfer to that corner.
- A long link that is parallel to the lower arm will have a slightly higher roll center during

Camber Link Cliff Notes
- Higher Inner Camber Link Pivot = More Chassis Roll
- Lower Inner Camber Link Pivot = Less Chassis Roll
- Lower Bite Tracks = More desired chassis roll to create more traction.
- Higher Bite Tracks = Less desired chassis roll to control bite and increase steering.

Chapter 7 - Wheelbase, Kickup, and Squat
Now we move into some of the more complex chassis adjustments. Most racers will benefit by using the more basic adjustments, because it is easy to dial yourself out with some of the adjustments we are going to cover from this point on.

<u>Wheelbase</u>

What is Wheelbase?
Wheelbase is the distance between the center of the front axle and the center of the rear axle.

How do you determine what your wheelbase is?
Typically one would use a ruler, calipers, or any measuring tool that can measure the distance between center of front and rear axles.

How do you adjust wheelbase?
Wheelbase can be adjusted several ways. The most common adjustment is by moving shims on the rear outer hinge pin to move your rear hub carriers forward or back. Some cars are designed and built with

multiple holes in the chassis to run long or short wheelbase, and some cars are designed to use shims on the inner rear hinge pins to allow movement of the rear arms forward and back as well. No one way is right or wrong, and all have similar effects on handling.

How does Wheelbase affect the handling of my chassis?
In General, the shorter your wheelbase, the more your car will want to rotate in the corner. Likewise a longer wheelbase will tend to rotate less in the corner. Shorter wheelbase chassis tend to be more aggressive and harder to drive, while longer wheelbase chassis tend to numb down the steering and make the car more forgiving.

Wheelbase and How It Affects Weight Transfer
Adjusting wheelbase changes the location of your static weight relative to the front and rear axle. In simple terms, one must take note of how their wheelbase adjustments change location of the weight fore and aft.

Off Power:
If you lengthen the wheelbase, you reduce chassis rotation because the static weight is further ahead of the rear axle. The further your weight is to the rear of the chassis, the more weight can and will be transferred to the front upon corner entry (off power). Lengthening the wheelbase reduces Off Power Steering by reducing weight transfer to the front of the chassis. Shortening the wheelbase moves the weight more toward the rear, allowing more weight transfer, which increases off power rotation.

On Power:
Just like with Off Power weight transfer, lengthening the wheelbase reduces on throttle rotation, however to a lesser extent, and not because of weight transfer, but because of the nature of a longer wheelbase chassis resisting rotation. Likewise, if you are tight on throttle, shortening your wheelbase can help your chassis rotate on power because a shorter wheelbase promotes more rotation.

Wheelbase Quick Notes:
- Longer Wheelbase is ALWAYS more stable and easier to drive
- Shorter wheelbase is ALWAYS more aggressive and rotates easier
- On tight tracks, Short Wheelbase may be the answer to get the chassis to rotate like you want
- On tracks with wide flowing corners, Long Wheelbase can be much smoother and consistent

Kickup

What is Kickup?
Kickup is the front inner hinge pin angle, as measured in relation to the chassis plate. Almost ALL chassis used in RC Dirt Oval have a kickup angle. Typical angles range between 10-35 degrees. If your chassis had its front inner hinge pins parallel to the chassis you would have zero kickup. Positive Kickup is found on all chassis, and means that the front of the hinge pin is higher than the rear of the hinge pin.

What does Kickup do?
Kickup controls how much the chassis will squat during braking and/or deceleration during corner entry. Kickup also sets the plane for which your caster blocks will be measured to figure total caster. For example, if you have 25 degrees of kickup, your total caster will be dependent on the degrees built in the block relative to your kickup angle. So with a 25 degree kickup, and a 10 degree caster block, you will have 35 degrees of total caster. If you have a 25 degree kickup and a -5 caster block, you will have 20 degrees of total caster.

How Do We Use Kickup to Control Weight Transfer?
- Running more kickup affectively puts more bind into the front end reducing how much the chassis will dive, also reducing weight transfer. The more positive kickup you run, the more resistance to weight transfer you will have, resulting in less initial turn in steering.
- Running less kickup affectively reduces the chassis' resistance to dive, which increases weight transfer. The less kickup you run, the more easily the weight will transfer, which will increase initial turn in steering.

No Free Lunch:
One of the downsides to tuning with Kickup is that your kickup directly affects your total caster.
- Adding kickup reduces weight transfer, but increases caster. The more caster you run, the more camber gain you will have, which can actually increase the grip level of the front tires creating more weight transfer to the front.
- Taking away kickup increases weight transfer, but reduces caster. The less caster you run, the less camber gain you will have, which can actually reduce the grip level of the front tires creating less weight transfer to the front.

SQUAT

What is Squat?
Squat is the angle of the rear inner hinge pin, as measured in relation to the chassis plate. The squat angle controls the rear end of the chassis' ability to "Squat" under acceleration, thus controlling weight transfer.

How is Squat Adjusted?
Some cars have independent front and rear suspension mounts that use various pills or spacers to raise or lower the front or rear of the hinge pin. Other chassis use tapered shims under the rear suspension mounts to raise or lower one end of the hinge pin relative to the chassis. Either method you use, the effects are the same.

There are three types of squat. Pro-Squat, Anti-Squat, and Zero-Squat.

Anti-Squat:
Anti-Squat is achieved by elevating the front of the Rear Inner hinge pin, or dropping the rear of the inner rear hinge pin. The angle created in doing so becomes your amount of anti-squat. Typical amounts of anti-squat are 1 to 5 degrees. Anti-Squat will reduce the amount the rear of the chassis squats down, thus reducing weight transfer to the rear, which means the chassis will have more on and off power steering. Anti-Squat is typically used ONLY on higher bite surfaces.

Pro-Squat:
Pro-Squat is achieved by elevating the rear of the Rear Inner hinge pin, or dropping the front of the inner rear hinge pin. The angle created in doing so becomes your amount of pro-squat. Typical amounts of pro-squat are 1 to 3 degrees. Pro-Squat will increase the amount the rear of the chassis squats down, thus increasing weight transfer to the rear, which means the chassis will have less on and off power steering. Pro-Squat is typically ONLY used on lower bite surfaces.

Zero-Squat:

Zero-Squat is the most typical setting and is achieved by adjusting your rear inner hinge pin to be parallel to the chassis plate. It is called Zero-Squat, because you are not using Pro-Squat or Anti-Squat to manipulate the weight transfer to the rear of the chassis. Zero-Squat will usually be the best balance of rear traction and steering, and give the racer a nice balanced feel. Zero-Squat is ideal for use in most conditions.

Racer's Tip:
Squat is a fine tuning adjustment, and larger gains can be had by adjusting springs first. Squat, when used properly can help fine tune a chassis and improve lap times, however, do not expect massive gains by tuning with Squat. Squat adjustments will not turn a chassis that is a 6 out of 10 in to a 9 out of 10; but it can help a chassis that is 8.5 out of 10 become a 9 out of 10.

Chapter 8 - Sway-Bars

<u>Sway-Bars</u>

What Is A Sway-Bar?
A Sway-Bar is a solid metal link that connections the left side of the suspension to the right side of the suspension.

What Does a Sway-Bar do?
During cornering, the outer or right side suspension compresses due to the cornering forces of the chassis. By design, a Sway-Bar will rotate upward as the RF suspension compresses. Because the bar is also hooked to the LF suspension, the LF suspension will compress as well, increasing roll resistance of the chassis. Sway-Bars are typically only used on the front of most $1/10^{th}$ scale Dirt Oval Chassis. Some racers will attempt to run rear Sway-Bars in extreme traction situations. We will focus only on Front Sway Bars

How Do We Control Roll Resistance?
Sway-Bars are available in various diameters. The larger the diameter or "heavier" your Sway-Bar is, the more the LF suspension will compress as the RF compresses, thus increasing roll resistance. The smaller the diameter or "lighter" your Sway-Bar is, the lesser the LF suspension will compress as the RF compresses, thus reducing roll resistance.

<u>Roll Resistance Cheat Sheet:</u>
- Heavier/Thicker bar = Less Chassis Roll (Used to take away steering)
- Lighter/Thinner bar = More Chassis Roll (Used to add steering)

Why would I use a sway bar?
Sway-Bars only have an effect on the suspension as the chassis rolls side to side. This means that if you compress the front suspension equally left and right, the Sway-Bar will have no effect on stiffness of your suspension. Sway-Bars are especially helpful when you want to use softer springs, while still maintaining roll resistance in the corners. Running a front Sway-Bar paired with softer springs can help

the chassis absorb bumps and improve straight line handling, while still maintaining a nice balanced feel upon corner entry. The tricky part is, running a Sway-Bar adds several more factors to your chassis setup "package" and that can further complicate things and make it harder to hit that magic setup. In extremely high bite conditions, a Sway-Bar will help prevent Traction Rolling.

Keys to A Properly Working Sway-Bar
To check your Sway-Bar for proper operation, you must ensure that the Sway-Bar creates equal resistance on both sides of the suspension. The best way to do this is to remove all 4 tires and the front shocks, and set the chassis flat on a setup board. Lift the LF suspension up about ¼" and note how much the RF suspension reacts. Now do the same to the RF suspension, and take note of how much the LF suspension compresses. A properly setup Sway-Bar assembly will have the same amount of lift on the opposite side from the side you compress, at the same amount of compression. If your Sway-Bar does not have equal leverage on both sides, you will need to play with the length of the Sway-Bar links or the Torsion Arm mount depending on the type of Sway-Bar you are using.

Should I be using a Sway-Bar?
In general, if you are racing on a high bite, high speed surface, you should consider trying a Sway-Bar.

Chapter 9 - Transmissions and Drive Train

<u>Transmission</u>

What Is A Transmission?
A Transmission is the mechanism by which power is transmitted from an engine/motor to the wheels of a motor driven vehicle.

What Does a Transmission do?
Transmissions convert the RPM and Torque of the motor along the drivetrain. The objective is to maximize the efficiency of the motor which means to achieve the lowest amp draw and voltage consumption with the greatest speed and torque.

How does a Transmission achieve the maximum efficiency of the motors power output?
To maximize efficiency, Transmissions feature gear reductions, which help us create more torque. Higher final drive ratios will create more torque than lower final drive ratios. Higher final drive ratios are best suited for lower turn motors that have much higher RPM's and much lower torque. Lower final drive ratios are better suited for high turn motors which have far greater torque, but much less RPM.

<u>Final Drive Ratio Cheat Sheet:</u>
- Higher FDR = More Torque, Less RPM (Low turn motors, bigger, heavier tires and chassis)
- Lower FDR = More RPM, Less Torque (High turn motors, smaller, lighter tires and chassis)

Why are there so many types of transmissions?
Over the years, RC Engineers have designed several different types of transmissions. Each style of transmission has a time and place at which that style transmission can excel over the other types.

What are the various types of Transmissions?

Traditional 3-Gear Transmission:
This style of transmission is optimal in medium to high bite, Spec and Modified Racing on Foam Tires.
2-Gear Transmission:
This style of transmission is used in Foam-tire high-bite racing where lower rotating mass and friction is desired, and the driver does not want to use a direct drive transmission. Often, this setup is used with the motor running in reverse direction.
4-Gear Transmission:
This style of transmission is optimal in low to medium bite, rubber tire classes with Modified Motors. The main advantage to this style transmission in lower bite conditions is that it uses the natural weight jacking effects of the motor to create more forward drive while on throttle and more off power steering under deceleration.
Direct-Drive Transmission:
This style of transmission is optimal in high bite, lower power classes. It has the lowest rotating mass and least amount of friction of all the transmission types. In high bite SPEC motor racing, if a Direct Drive Transmission is legal in your racing division, you better be running one if you want to compete.

Ball Differential vs. Gear Differential
Perhaps one of the most frequently asked questions that I receive, is “When do I want a Gear Diff as opposed to a ball diff?”

Well, in 90% of situations, a ball diff will give you the most consistent and comfortable feel. Problem with a ball diff is that they wear out, and require maintenance and rebuilding on occasion. What about the other 10%? Well, Typically, Gear Differentials will unload off power during corner entry and increase off throttle steering and rotation. Likewise, Gear Differentials will “Lock Up” on throttle and thus increase forward drive tremendously.

What about Gear Differential Fluids?
Typically, the MurfDogg Team always uses Losi 3,000wt Diff Fluid in our Gear Diffs for high bite racing, and Lucas Oil “Red ‘N’ Tacky” grease in our gear diffs for Loose Dirt Racing. This eliminates variables, and helps us to tune our chassis with two basic diffs for each type of car. Yes, there are an infinite number of various fluids and varying viscosities of these fluids available for you to play with. No, we don’t play with them, and do not recommend you do so either. We NEVER do, and frankly do not see any reason to, knowing that we have a firm grasp on what each style diff does already, and how changing between the two styles of diffs will affect our chassis’. For those of you, who must know what changing the diff fluids will do, keep on reading.

Tuning with Diff Fluids:
Differential Fluids are just like shock fluids in that the larger the number the thicker the fluid. Using different viscosity fluids in the diffs is a way we can control how much power is applied to each wheel by controlling the action of the gear differential.
- Thinner fluid in the gear differential provides more off power steering and increases forward drive coming out of the turn. This also results in less on power steering.
- Thicker fluid in the gear differential provides less off power steering and decreases forward drive coming out of the turn. This also results in more on power steering.