Set-up Black Book

Written by Danny Bartholomew
daniel-bartholomew@uiowa.edu

2001 ROAR Carpet Oval National Champion

I decided to write this for two reasons: 1) to help racers new and old possibly get a better understanding of their racecars. 2) To get all our ideas down on paper because we forget about some of the stuff we have learned! I did this over several months and I had to go a change several things that we learned just in that short time. Racing is a never-ending learning process; I may have a totally different view about something I discuss on the following pages in only a few months. There will always be someone that may have a better way of explaining something. I in no way intend this to be the "Bible" I want guys to use it to learn and maybe make them think about things that they have never thought of before. I may not be 100% right on everything, but it is for you to enjoy.

I would like to start off by defining a bunch of technical terms that I will use extensively in my little "set-up black book" here. I will go more in-depth with each item later.

RF = right front
LF = left front
RR = right rear
LR = left rear

1) Tweak: Tweak is the amount of weight on the LR as opposed to the RR. In oval racing you always run more weight on the LR.

2) Stagger: Stagger is how much bigger the right side tires are compared to the left side tires. It is a critical set-up tool.

3) Reverse stagger: The opposite of stagger when your left side tires are bigger than you right side tires. We use this a great deal on flat tracks.

4) Camber: The amount of lean in or out in your front tires. The RF will have negative camber and the LF will have positive. Meaning the RF will lean in and the LF out. Camber is very useful in set-up.

5) Castor: Castor or Kingpin angle is what changes your castor. Castor literally is the amount of change up or down in the end of the spindle (front axle) from straight ahead to when the wheels are turn a set amount.

6) Wheelbase: Wheelbase is the distance between the front axle and the rear axle.

7) Rear track width: Rear track width is how wide your rear tires are outside edge to outside edge. Changing the rear track width is one of the easiest ways to adjust your car.

8) Spring preload: Spring preload is the amount of tension on your springs with just the static weight of the car on them. It can be a very important tool.

9) Ride height: Ride height is the distance from the ground to the bottom of the chassis.

10) Battery placement: The battery is the heaviest part of your car. Therefore is crucial to have it in the right place! Most cars have the option to locate the battery in different spots. Inward or front to back in some cases.

11) Center shock length: This suspension part sees the most movement on your car. When compressed the shock must have adequate down-travel. It also most have up-travel which is critical for the cars traction. Will be discussed later.

12) Toe-in/toe-out: This involves the front tires. Toe-in happens when the front width of the front tires is narrower than the back width of the front tires. Toe-out is the opposite. In a perfect world you want the toe-in/toe-out to be zero.

13) Foam rubber: Foam rubber involves the molecular structure of the tire. Foam rubber has less bite and more wear than other tires. The foam rubber compounds are Blue, Green, Orange and yellow.

14) Natural Rubber: Natural rubber is denser than foam; it provides higher traction and less wear. Compounds are Black, White, Gray, Aqua and Magenta

15) Exotic rubber: Exotic rubber is high traction with ultra low wear. Compounds are Red, Purple and Pink.

16) Car package: Every car is different even if they are the same model. Where you place your electronics, your wheelbase, and body position all affect your car package.

17) Progressive and Constant Rate: Progressive springs get stiffer the more you collapse the spring. They generally make the front suspension feel smoother. Constant rate or standard springs have the same rate throughout their travel.

18) Push: Your car has a pushing condition when it won't stay on the bottom of the corner. A pushing car scrubs off all its speed in the corners.

19) Loose: Your car is loose when it wants to spin out or slide sideways in the corner. "Loose is fast but on the edge you are out of control" Harry Hogge

I think that covers terminology for now. If I write something you don't understand ask me what the heck I'm takin' 'bout!

Now I am going to go in-depth with everything you need to know on how to go fast! Read carefully. If you don't understand something talk to me and I will try and explain better. Some things although they don't seem logical you just have to accept them!

Tweak is almost as important as charging the battery. Too much or not enough can slow the car down. First off, a ton of guys at the track have digital scale setups for setting tweak. Someone will let you use theirs, but remember there can be a great difference between scales. It is best to use the same ones all day. As a base start for everyone, I would run 12.5 ounces on the LR or 350 grams. When setting the tweak use equal movements on both shocks (or tweak screws). You want fairly equal preload on you springs. Depending on conditions, car package and class you may need a little more or less but this should get you close to start.

Since you set the tweak while the car is a rest (obviously), it is the basis for the weight transfer in the corners. When you go through the corner weight transfers from the left to the right. The more weight you start with on the left the more that will remain on the left through cornering. Too much tweak will make the car push and lose speed. Not enough and the car will feel loose and won't come off the corner with any speed if it doesn't spin out.

Tweak is not a great chassis-tuning device. I basically leave the tweak about the same everywhere I go. (Within a 1 oz.) The only thing I use it for is if the car is too tight or pushy going into the corner, then I may reduce it slightly, but too much and the car will lose forward bite coming off the corner. Which is extremely bad because getting off the corner fast is where the real speed is.

For 4-cell set the tweak with about 10.5 oz or 300 grams on the LR.

Stagger is a biggie. Think of an axle with one big wheel and one small wheel. When the axle rolls it will pull in the direction of whatever side the smaller wheel is on. That is why running stagger in the car helps the car turn. On a real racecar they run stagger in the inches. But remember these are 1/10 scale cars! We run stagger in the thousands of an inch! Running stagger is not a necessity, especially on flat tracks. Most of the time I run a little bigger LR or reverse stagger.

Stagger in the front tires is also very important. Running a bigger RF will pick up weight on the LR making the car have more push. A Bigger LF than RF will loosen the car.

To start, I would run the car with no stagger. Depending on the cars handling add or take away stagger. If you have to run more than .050 stagger or reverse stagger you need to change other things. Generally I end up with .010-.030 reverse stagger on the final set-up. WATCH! As your tires wear you will lose your stagger settings!

Camber! As a general rule most guys will tell you to set the camber so the tires wear flat. This is a good rule of thumb. But Camber can do a ton for your cars handling.

On the RF I run -2 to -2 1/2 degrees of camber. Measured with a RPM Camber Gauge (a necessary pit tool!). On the LF start with +1 degree. If the car needs more steering in the corners increase the camber even if the tire doesn't wear flat. Reduce it to take away steering. Moving 1/2 degree can make a huge difference!

Castor is important but not something that is of great help to beginners. First off, when looking at the kingpin from the side the upper part should always be leaning toward the back of the car. Secondly, the LF should always have less castor than the RF.

Some of the affects of castor are this. Running lots of castor will make the car stable on the straight-aways, but this will add a ton of scrub to the car, slowing it down. It is best to run as little castor as possible. That equals the least amount of scrub. Adding castor will make the car turn into the corner better and make it push more coming off the corner. Running less castor will make the car tighter entering the corner and loosen it coming off.

Run what Associated calls 0 castor in the LF and 2 in the RF. This will work at most every track. Like I said this is a very fine tune adjustment.

Wheelbase is a hot topic of debate. It is my belief that short wheelbase cars are faster but they can be more difficult to set-up. I would always run short wheelbase and focus on working out your problems; you will be quicker for your troubles.

When you shorten the wheelbase, you have to move the body back with it. This moves your rear down force point (spoiler/wing/both) back further, giving you more rear traction. In turn this will make the car push, then you can take steps to loosen your car back up. The end result is a car with the necessary traction and a looser overall set-up, which equals faster lap times! By looser overall set-up I mean harder tires (less rolling resistance), softer springs, etc.

Rear track width, another biggie. Basically the wider the rear track the looser the car will be and a narrower rear track will tend to be tighter.

The rear axle of your car is like a lever. If you move just the RR out, it will have more leverage and the car will turn better. And in reverse if you move the LR out the car will drive toward the outside more, tightening the car.

For flat tracks I like to keep the rear track width as narrow as possible, Preferably close to the same as the front track width. A good starting point, using a straight edge line up the RR with the RF, Line LR up about an 1/8 inch outside the LF.

I will start the spring preload section, discussing the front springs. How do you know how much pre-load? As a general rule with all the proper shims in place, you want to compress the spring a 1/16 of an inch so you can install the final e-clip. I'll spill the secret on how to properly build a front end later.

If you increase the preload on the spring, the spring will act stiffer. Increasing the preload on the RF will make the car push a little more, doing so on the LF will loosen the car slightly. This usually comes into play when the car needs a minor adjustment and not a whole spring rate change.

Setting you side spring preload is simple. With the shock fully extended, turn the adjuster until it just takes up all the play in the spring. Do the same for the other shock and set your tweak. Remember to move shock adjusters equally so not to end up with one spring preloaded way more than the other.

Your initial center spring preload should be to establish the proper ride height. Then to increase steering in your car you can add preload, even if it makes your ride height a little off. To take steering or looseness away reduce the preload.

Chassis ride height is critical. Too low and the car will drag and too high the car will tend to tip over in the corner rather than be smooth. You want to keep the distance from the chassis to the ground between a 1/4" and 5/16 of an inch. This will keep the car safely from hitting the track or looking like a Mack truck riding around out there.

Personally I always run the battery all the way to the left and all the way back if your car has that option. With the battery all the way left the car will want to continue in a left circle, this is good in most cases, because you want the car to turn freely through the corner. I only move the battery inward as a last resort.

Moving the battery weight forward and back is a complicated deal and hard to explain on paper. The best way I can explain it is like so, your car transfers weight from the back to the front entering the corner. The more weight you have in the back to start with, the more can be transferred to the front while cornering. Therefore, with the battery all the way back will in reality loosen your car!

Center shock length is sooo important. This part does the most moving when you are racing. You need to have the proper down-travel and up-travel. The down-travel or compression of your shock should allow the chassis to bottom out before the shock runs out of travel. Up-travel is necessary for traction. If the shock is too short the shock will be topped out or fully extended when you smash on the throttle. When the shock tops out you will loose traction. A good way to tell if your length is ok is to look at how far the rear pod hangs when the car is off the ground. The back of the pod should be at about a 5-10 degree angle when compared to the chassis. There is no magic number but it does affect the way your car handles.

Choosing between constant rate or progressive springs is not that critical. I run progressive springs on flat tracks and constant rate on banked tracks. There isn't a great difference in performance on the track, but to me progressive springs just feel better in the car. The one draw back is they tend to collapse or wear out faster than constant rate springs. This means you have to replace them more often. Front springs wear out fast, watch how much the spring sags when at ride height, this will tell you when the springs are getting soft as the car will sag more and more. You can compensate by adding pre-load shims or replacing the spring.

Every type of racing comes down to who makes the right tire choice. R/C is no different, the right tires wins you the race. I can't tell you that there are certain tires that are perfect at every track. What I can tell you from experience is a Purple RF Green LF and two white rears are a safe start at most any flat track. There are exceptions like places with "funny" carpet but that set-up should get you around the track.

Shocks are so important it isn't even funny. One of the biggest problems with guys cars are there isn't any oil in the oil filled shock we use! We spend all this money on batteries, speed controls etc and it is the $7.00 shock that holds you back. These shocks leak badly, I rebuild mine every week before I race! No matter what.

Roll center and camber gain are two things that can be complicated, but they are a major part of oval racing. Camber gain is rather simple. When the spring is compressed the top of the tire leans in on the RF and the LF. On the RF this is ok a little camber gain makes it so you don't have to run as much camber in the RF giving you more contact with the track on the straight-away which provides more stability. In the LF you don't want to loose and camber in the corner. The more parallel the upper and lower a-arms the less camber gain you will have. You will see quite of few guys that will put an aftermarket castor block on the LF which allows you to have the LF a-arm perfectly flat, but they will leave a little angle on the RF to still have some camber gain there. I personally run

the stock parts on flats tracks mainly because there isn't a whole lot of spring travel on the LF on a flat track. On a banked track I take all the camber gain out of the LF.

The more parallel the upper and lower a-arms are the lower the roll center for your car will be. The roll center in its simplest form is how much the front end will roll in the corner. The lower the roll center the higher the center of gravity and vice versa. A good analogy is to think of a flagpole, if you were to grab a flagpole at the bottom (low roll center) the pole would sway back and forth easily. If you were to grab the pole in the center (high roll center) the pole would not sway as easily. The roll center is one of those things that is not a chassis adjustment but more of a building thing. You want the car with a low roll center; this will help the car turn in the corner. More roll equals more weight transfer therefore giving the car more steering. Once you get the car planted in the rear you will need this to make the car turn freely.

Building a good front end is one of the most critical things on your car. Assembly the front end according to the Associated instructions with the exception of the upper a-arm eyelet. On the upper eyelet put the square corner up and the rounded corner down. I believe the instructions tell you to do the opposite but I have found that this works better especially with Pro-long kingpins. Make sure all of the pivot balls are free and don't bind. If they are tight try taking them out and putting them back in a few times that usually frees them up. If all else fails use a different pivot ball. I recommend you use the Wolfe Pro-long kingpins as a replacement for the stock ones. This gives you a better spring selection and you can do a little more with the roll center stuff. Throw both kingpins in a dremel or drill and polish them to a high luster with MOTHER'S MAG POLISH or SEMICHROME. Repeat this process every few weeks. (Also polish you t-plate pivot balls too!!)

Install your polished Kingpins per instructions. Don't put the on spring yet. With everything installed move the whole assembly up and down; you will most likely find that it will bind. There are two main areas that the front end will bind. First, the inside edge of the steering block and the bottom of the upper a-arm, the remedy is to grind the inside edge of the steering block so it doesn't touch the upper a-arm on up travel. You will find that the top of the kingpin will bind on the outer edge of the upper eyelet. Solution: remove the upper pivot ball and remove Small amounts of material from the upper eyelet with your x-acto knife. You may have to do this several times to get it right, reassemble it make sure the whole assembly moves up and down freely with little or no resistance.

Install your springs, provided you are using Wolfe springs: for progressive springs, use one spring retainer on the large end and put that end to the top. Remember that the spring should be compressed about a 1/16" for a starting pre-load; the small end will rest on the e-clip. For standard springs use a spring retainer on both ends (standard springs are shorter than progressive) same pre-load. Always use a little lube on your kingpins, this provides smoothness and a little dampening. Don't use anything that has a sticky feel to it, I personally use Losi Hydra fluid (clear).

The main thing to remember when someone tells you what springs to run, think if their front end is bound up or not. A green spring in a bound up front end is way stiffer than a green spring in a free front end.