The first time on scales…

Here is a great place to start…your Street Stock racecar is sitting on the scales right now. You have no ballast, no driver in the car. You have an engine with all fluids and the fuel cell with 1 gallon (6 pounds – 8 half mile laps) no more. The drive line including rear end is properly placed according to your rules (set both sides at minimum wheelbase). The battery is located behind the driver tub and just about 10 inches above the frame rail. Tires are all inflated to 10 pounds (8 or 10 inch) and the body as you will race the car is installed. The car is basically "test and tune" ready. *Note: This lecture can be used anytime during the season when you are in trouble and must start over.*

Very important: The ride height must be even all around the car. You will use a "dummy block" that is a piece of 2 by 4 cut to the length your ride height should be. If that is 7 inches floor to frame, then cut at least one, "dummy block". Now adjust your weight jacks so the ride height is equal all around. Don't forget, if you are on scales, you must add for the scale height. I suggest setting ride height while chassis is on your scales.

You are sitting at ride height, plus the scale height off the floor. Keep in mind that the car is about 2 inches higher than normal, unless your scale pads are at floor level. *Note: CGH is calculated from the top of the scales…more on this later.*

Let us assume you have a 2900 pound racecar. The **ideal corner weight** should look something like this. RF = 800, LF = 600 (this corner should always be the lightest). The RR = 700 and the LR = 800. *Note: If you do not have a set of digital scales but want to follow along here, go to my "Corner Weight Calculator" www.churchfield.racing/2020WeightCalc.html on the Internet.* Now note the RF and LR weight…these are equal and for good reason; but before I get into wedge and why it must be over 50%, I want you to look at your scales. In most all cases, your nose will be heavy. How heavy depends on your engine rules and your motor offset. Your track rules are going to define the nose weight of your racecar. If you are no allowed an internal clutch transmission your nose could go up rather dramatically and you might be closer to 55% in the front. My base-line percentages are important so follow along. First we must meet a minimum of 48% Front and 52% rear. That cannot be accomplished without ballast.

Think of ballast as the chassis steering mechanism. The "not so" scientific truth, you cannot control a racecar on dirt if the nose is heavier than 48%. That said you must then assume adding weight must be to the rear. This is true, but you don't want the weight behind the axle. I will explain how to use your fuel cell as dynamic ballast a little later on.

The first numbers are important because this tells you where along the centerline your CoG is located. The "center of gravity" is located along the drive line. If the care is 50/50 (F-R) and the wheel base is 110 inches the CoG is in the middle of the drive line 55 inches from front or rear. You can test this…car on scales jack the chassis up by 2 inches. The car will not lift off the scales, but the scales will decrease in weight. If all four corners decrease the same value, that is your CoG. But don't worry, if you don't get this result…you are not alone. But I want you to try something. Move the jack forward by 6 inches or so. Make sure you have a strong beam of steel say a 2 by 4 by 3/16. This should be 50 inches long. Find the center and mark it. Now place your jack at this center and begin to jack your chassis up off the scales by 2 inches. Do this along the chassis centerline but always remain inside the wheelbase. **Somewhere along the centerline toward the front of the car, you are going to lift the car up and the front weight is going to be at 48%.** Mark this spot. Now measure where it sits along the wheelbase. If it is "X" inches from center (55 inches) then measure "2X" from this mark toward the rear of the car. This location is where you will place your heaviest block of ballast. There is no way to calculate this weight, so use a trial and error method. *Note: Never place ballast behind or in front of the wheel base. Never place ballast below the axle center line.* The first block should be at least 50 pounds. This can be a pair of 25 pound blocks stacked, or a narrow but long block. This is important, because weight that is laid out long is sluggish, while small pieces stacked can become violent and over work the chassis. Add the weight, and if needed slide it aft to decrease the front percentage. Please understand 50 pounds is not going to offset a front percentage that is greater than 50% to start with. What we are looking for is chassis balance while we shoot for our track weight rules EoR (at the checker). I don't want you looking at "wedge" now, we want 48/52 front to rear percentage. This is where we start (period). If you end up with 47/53, that is fine by me. My baseline is what we are shooting for as a start point. My 48/52 will make the car handle very well turning right or left. Ok so look at the ballast you placed in the car. Note the weight and think about this…if the weight is too low, the transfer is going to be horizontal through the rear axle during a turn. This causes the rear end to be very loose. If we raise this weight up above the axle line the car will begin to roll with weight and plant the rear tire into the track for bite, both side and forward. Again if the weight is along centerline the car will handle very well for turning left and right.

I want to inject something at this point. We are about to add our driver and tune for "wedge". If your cross percentage is above 50% at this point, (it should be). I want you to jack some weight in on the LR and the RF springs so we are closer to 50% before adding the driver. Make notes of these changes. How many turns did it take to balance the car at 50%?? Now go back to your previous setting. What we are about to do is balance the car left to right with driver. When that is completed, we can set our "wedge"...**damn near any value we want**.

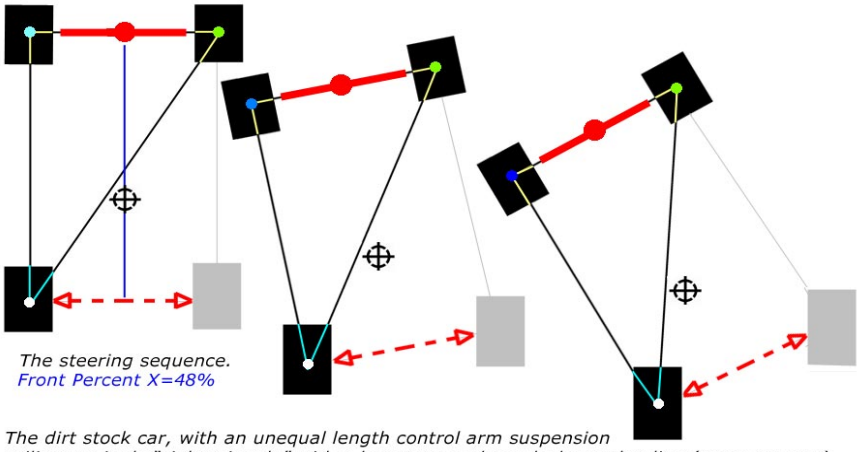
When the driver gets in the car, depending on his mass, the weight will affect our left side higher and our right side lower. Now the car will have a harder time rolling onto the right. We must prepare our cross percentage in order to regain chassis roll. If our driver weighs 200 pounds, we can basically assume 100 pounds will be applied to front and the same mass to the rear corner. Don't guess, actually read this value and make a note. How much went to front and to rear. If half your drivers weight went front than your cross percentage should have not changed. What did change was right side weight. This weight went down in percent to 46% maybe 48%...read the scales. If your cross percentage is above 54% this car will race. What is may not do is meet your drivers style. It may not meet the track banking or turn style. **But it should be capable of running top to middle on any dirt surface**. <u>This is the 48/52/54 percent rule</u>. Now the L-R side weight rule. This is what you change to satisfy your driver and meet the track conditions. At this stage you cannot reduce mass at the corners. You can reduce spring load weight, at one corner, but it will go elsewhere on the car. The mass is the mass and there is nothing more you can do at this point except increase the mass, and that will slow you down.
(1) Add weight to RF or LR will increase the "wedge".
(2) Add weight to LF or RR will decrease the "wedge".
(3) Add weight to RF increases "wedge" and increases front and rear percentage (tighten).
(4) Add weight to LF decreases "wedge" and increases front percentage (not good).
(5) Add weight to RR decreases "wedge" and increases right and rear percentage (slick track).
(6) Add weight to LR increases s "wedge" and increases left and rear percentage (heavy track).
(7) Add weight to RR and LR increases rear percentage with no other effect (loosen).
Remember adding weight slows the car, but proper chassis roll using ballast to tune the car will make the car faster.
The fuel cell is an important tuning tool. You scale your car without fuel, you meet your track rules, and then you add fuel to increase rear weight. The car will change dynamically with the track surface if you use your fuel weight (6 pound per gallon) to tune the car.

This is a factor that very few racers consider. If your car is a gas hog, it will cause fits on a track surface which changes rapidly. You may need a large amount of fuel to start the race, but the rear percentage is too high in the car. The car will be loose, so you must decrease your "wedge" lower than normal. As the car burns fuel, the amount of wedge will tighten up the car late in the race. This is good when the "wedge" is at 54-55%, but anything much less and the car will push on the bottom, you will be relegated to the top and that may not be the fastest way around. Big motors win a lot of races, but you must be sure your tires and fuel remain in check for the last 3 or 4 laps. If that "hammer" burns up tires and your fuel supply has your car below 48/52 percent…the little guy is coming around you on the bottom.

To simplify this article…

Start the setup at 48/52/54 percent. Add heaviest ballast at the "center of gravity". Keep all ballast above the axle line. Do not go above the cars "center gravity height". Ballast control is done by stacking weight properly. Place the heavy ballast high in the car for a quick response race track or bull-ring. Lower the heavy ballast in the car when you are dealing with large tracks with sweeping turns. Try not to add a lot of weight on the left…this slows down chassis roll. If you need side bite add small amounts to the right-rear. If you need left rear weight move your battery back or closer to the outside of the frame rails. Consider the battery as ballast. Consider the fuel as dynamic ballast.

One last trick: Your racecar is a right triangle. The hypotenuse runs through your "wedge". The higher the wedge the more your car will "over steer". You control this over steer by using a counter steer to the outside of the track. Your right triangle and the chassis roll places all the wheel control on the RF tire patch. Making this patch as large as possible is very important. You want "after race" tire temperatures to be as even as possible across the tire tread. If the tire is colder on the inside you have too little camber. If the outside temperature is too warm you have too much camber. Setting the camber is a good place to start, but if you cannot get your camber under control, change the upper control arm length. Forcing a short arm to do more than 3.5 degrees of camber will cause other issues such as nose dive, shock binding, ball joint bind, bump steer problems and linkage binds. You want the proper spindle angle created by the ratio of upper to lower arm axis rotation. This is what will keep your tire patch flat on the surface no matter where you are on the track. This wins races.



The dirt stock car, with an unequal length control arm suspension utilizes a single "right triangle" with a hypotenuse through the wedge line (cross percent). The higher this percentage the more the racecar over-steers. Over steer is controlled by rotating the shorter catheus around a center of gravity located approximately "X%" from the front axle center line.

The lower this percentage is the less down-force is applied on the RF. The largest circle appears around the wedge-line. The top of this circle is the green dot, the bottom is the white dot. These dots represent the contact patch which the car rotates around center.

If the wedge-line exceeds 90 degrees the car will rotate around istelf and spin. Proper chassis tuning with ballast, springs, shocks, the weight transfer be concentrated on placing the highest percentage of down force on these two dots. When tuning suspension and tires, the white dot (RF) must plant as much force when entering a turn, the green dot must receive a reactionary force of equal pressure to properly exit the turn. The blue dot is controlled by the throttle and adjusts the amount of rotation around a turn apex. The cathetus controls the over-steer moment.