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Setup Guide Version Two

(updated version)

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Note from me, JD

(Since 2004, I have over 230 separate responses I've made to SMers asking me questions. I enjoy assisting everyone that asks me to help. SpecMiata.com in 2008 will see more corporate involvement and our own Storefront. We would greatly appreciate your support! If this helps in anyway, hit the donate button at SpecMiata.com, Thanks! JD)

Several years ago I did a setup guide designed for the basic low budget owner with no knowledge of the cars just getting into Spec Miata racing. Those I considered were going to alignment shops, did not have setup tools etc... The face of the class today, especially since we won the battle to become a national class, has changed significantly. To be competitive and indeed to save time doing setup this new version will discuss the latest tools and methods needed to achieve and maintain suspension and alignment settings. At the conclusion I will add my trackside tuning thoughts.

There are many ways to arrive at a baseline; this is my personal preferred version for simplicity and effectiveness. You can use it in whole, part or just to further your knowledge of other methods. BASELINE does not mean set and leave for all tracks; never can you do that and be competitive in a competitive field. Guys run the cars lower, higher, and with just about everything else changed from a BASELINE. Gaining those ultimate setups is YOUR JOB, where the fun is and the only way you will ever be able to tune your car to your talent level! I'm trying to give you a very drivable starting point, how to get there and what I would change or adjust for an array of different situations. With every suggestion I make there are several possibilities that could be made, I'm giving you my thoughts based on what I would do personally. This is all to help you IGNORE the paddock experts we have at every event and do YOUR own thing for setup. It irks me to hear guys barking off suggestions when they never raced these cars (pick your local prep shop setup kid) or cannot get out of their own way in a race car. NEVER take anything for anything other than advice. Take into consideration, yes, and then find out for yourself, TEST TEST TEST!

HOWEVER, if you are going to "set-it and forget-it", I think this guide will yield the best results
☺

I welcome any suggestions you have, send them to me at Jim@JimDaniels.com.

Expect 6-8 hours the first time you do this yourself, sometimes longer depending on your mechanical ability. Terms and random thoughts on various issues listed below.

Tools and equipment needed to do the setup:

- Level surface (adjustable scale pads, platform, or shimmed floor using the clear tube and water method, absolutely level)
- Scales, camber/caster gauge, toe plates, string kit and maybe a laser pointing device and a tire psi gauge
- Normal hand tools, jack and stands
- Two helpers or one helper and enough ballast to replace your weight in the car (I prefer two so I can sit in the car and bark orders...)

Before you start, a few things need to be done to the car, a few assumptions have to be made and a couple techniques explained.

- The sway bars need to be disconnected on one side and make sure they move freely, bushings not restricting.
- You need to find the center of the steering rack, then lock down the column with a pair of vice grips and a bungee cord. This would be a good time to adjust the steering wheel adapter if it is off center from the rack's center. I use my steering wheel like a degree wheel to find the center. Then, I remove the hub and adjust the splines until the "T" on my steering wheel is square.
- The tires need to be at "hot" pressures, 38 will do.
- The driver's weight needs to be in the car at all times, I prefer a real person to sit there the whole time. If not, try to divide up body weight for torso, legs. Better yet, with the cars on the scales, record the individual wheel weights and add your weight back into the car trying to duplicate the prior recorded wheel weights.
- Do yourself a favor and make sure the suspension bolts, perch adjusters and other hardware you will be adjusting are free, clean and ready to adjust and not too tight. Check the bushings in your control arms and make sure they are not worn out as well.
- I make the assumption that no parts are bent and you have used your thumb to get toe and camber where it looks ok. **2" of toe out or +3 camber on one wheel is what I mean, correct that NOW by eye, do not spend too much time on it.**
- After each setting adjustment, bounce the car in place STOP, roll it 8-10" back then forward to where it was. NEVER, bounce again after you start rolling forward and never pull up on the car, just push down and release. Careful when pushing, the hood, fenders and quarters dent easily. I always open the hood and push down on shock tower area and radiator support. In the rear I always open the trunk and push down on the rear body panel and rear hardtop bolts. Don't bother asking me how I figured this out!
- You have a factory manual and know how to use it for finding out the procedures needed to make the OEM setup adjustments.
- Empty all fuel and put one gallon back in, late race handling wins events. If running

endurance race, perhaps use half tank to get as neutral as possible.

- Using a fish scale, and after all prep is done, I measure the car's resistance on the setup surface. Record what it takes to just roll the car. Later, as you do maintenance, compare the freshly prepared car to the after raced car. If you gain resistance, look to see if there is a reason for that gain (brakes, fluid break down, bearings, tire compound etc...). Correct if you can keeping in mind that you might establish a new resistance number after the car has seen the track and become seated in.
- While doing your setup do not tighten anything beyond what it takes to hold it for the sake of doing the setup, aka rolling the car a bit. Saves you time and headache. Tighten all at once when you are done then recheck that nothing moved! When I say tighten, I mean tighten, throw away the torque spec and double wrench the cams bolts for all they are worth. You will need to change them once a year as they will stretch, but a cam bolt tightened with a single wrench will never hold.
- This is a straight forward guide and ALL banter aside I assume you have the right parts on your car. Camber range and the lowest bump steer possible, for example, is a must. I'm not trying to teach you folks how to build cars but I will advise you spend some time and money learning the difference between rule book and technical inspections. It is slight but in a spec class it's vital.

Regarding the frustration this can be for new folks and especially for new builds. The process below will not be very fun and you will chase yourself narrowing the gap of the various settings. As you get one thing right 3 others have moved etc... Be patient, the gap will lessen with each adjustment and it will be right before you know it. Remember the goal, learn setup so you can tune and improve, it is the least expensive way to find speed and get to the front!!!

It begins with a baseline of;

-3 camber front, -2.5 camber rear, +3 to 5 caster (equal each side), zero toe, 50% cross, stiff bars up front, middle bar setting out back, tires at 38 psi, fuel one gallon.

Step #1 (Ride Height, '99 hats)

Using the spring perches, adjust the ride height to 4 5/8" on the pinch welds at all four corners on the bottom of the car at the rocker panel (this is zero rake, meaning the back is same as front, rake is when rear is higher de-rake when the rear is lower). It is normal for the LR to have more threads showing on the bottom compensating for the driver's weight. This will take some time as you get used to how the car moves on one corner while you adjust another. BE PATIENT going back and forth until it is near perfect. Remember this step as you will be back here again many times. You will not be showing the same amount of threads corner to corner. Remember, the floor where your car sits AND where you measure from needs to be level!!! I prefer to measure off the scale stands as I know they are level.

#1 Note: If you want to go lower that is your call. But, few using the bump stops have success yet many not using them have won championships. Lower is not worse just a much smaller window for error.

Novice and many experienced pilots who choose to run low often catapult off the stops and into violent uncontrollable spins. Topeka in 2007 needed a lower car or maybe everyone just chased the faster guys who like it lower? I was not racing and I do not listen to the paddock experts so I have no comment on it. I do know that just like losing races because I ran rain tires I've also lost races from being too low, I've never won one because of being lower.

#2 Note: Left and right need not be the same. At Road Atlanta, mostly right turns, I run a higher left side number to compensate for the driver weight and all the right turns, front to rear is still zero rake. But we can use rake to alter handling characteristics and we will get into that later.

Step #2 (Toe and Camber, Caster)

We now need to square the car up so we can run through the first of several setting adjustments. There are two ways to do this. 1.) Using an alignment kit like the one Iron Canyon sells, string the car (see mfg. instructions for usage) to square the toe to zero, all four wheels. 2.) Use the toe plates and a laser pointing device to get you close (exact comes later). Simply lay the plate against a rear tire, place the pointer on the flat edge and cast the beam towards the front hub. Have someone there with a tape or steel ruler, match the measurement from the center of the hub casting lip on each side while the two toe plates on the rear tires read zero to each other. Then adjust the front toe until the front and rear rim lips are equal. At the end, you have the plates zero to each other, the hub distance the same side to side and the rim to laser beam the same on each side. If the rack was centered and locked down like I said before, you have a square car that tracks straight with a centered steering wheel.

Note: Toe compared to the other wheel and not to the string or laser line is ultimately what you need to check. In theory it should be the same but never trust it, always end by checking toe with toe plates and making sure that number is right regardless what the strings or laser suggests. Why, you screwed up somewhere and the toe plates never lie... ☺ The reason we don't just start with the toe plates is because we need to insure we have the proper thrust angle (car square).

While setting toe, make the camber and caster adjustments (figure out why I said to loosen and clean up things we are going to adjust?). Pull the caster back to full negative (lower ball joint back as far as it will go, rearward cam is the adjuster) then forward one notch (notch may not be the same so use gauge to confirm) towards positive, secure but not too tight. Use the lower cams in the rear to adjust toe and camber, use the center cam in the front for camber. Remember; do along with toe as they affect each other.

At this point you should be -3 camber front, -2.5 camber rear, +3/5 caster, zero toe and at the RH from above.

Step #3 (Scaling)

I assume you have been on the scales this whole time, the extra height helps for all the floor work you needed to do. Some even setup their scales to coincide with a lift, that's great as long as you check everything to make sure it is square and level during the process. Sucks to spend hours setting up the car to find out the scales got off at some point.

First, let's record the total weight of the car. Add/subtract ballast now. Once it is where you are comfortable (6 pounds over with one gallon is what I do) we can move on to the scaling.

Note: First thing you do at the track is go weigh, adjust ballast, and add fuel to that one gallon.

We will be dealing mostly with percentages and not the actual weight numbers. I'd like to see the front weights as close as we can get but I NEVER give up a level platform, Ride Height, to accomplish this. We will never get the corners even in the rear AND have a level platform for the suspension. Few, you guys 150 pounds or so, might get the fronts on the number but when you start tuning at the track, it goes out the window. So, we change balance with percentages on these cars. Percentage to total weight is the recognized method and a feature most scales provide. Total weight is used to set ballast then cross weight (LR/RF % of total) is all we use in SM racing. Cross or Wedge is what I will be referring to from here on out.

Record the Cross (always defined as the left rear and right front % to total)

Trade offs have to be made so we will concentrate on Cross weight while maintaining ride height.

NOTE: If a car has 49% of CW (cross weight) it is considered de-wedged. If it has 51% CW it is considered wedged. De-wedge helps the car turn left while tightening up the balance on rights. Vice versa with 51% wedge. I'll explain it more later.

The fun begins! You are either REAL lucky and have a 50% car, it happens, or you see a car that is wedged or de-wedged (plus or minus cross weight 51% or 49% etc...). Based on this CW % number you need to make adjustments to the spring perches. **The following procedure is crucial, a must.** Keeping the ride height the same is your friend on track and in doing this setup. Forget what your brain tells you, just do what is instructed for this part.

If you are de-wedged (cross less than 50%) you need to do the following.

Up (extend) on the LR & RF (equal amounts, ¼ to full turns)
Down (retract) on the RR & LF (equal amounts, ¼ to full turns)

This will increase the CW with hardly any ride height change.

If you are "wedged" (cross more than 50%) you need to do the following.

Up on the RR & LF (equal amounts, ¼ to full turns)
Down on the LR & RF (equal amounts, ¼ to full turns)

This will decrease the CW with hardly any ride height change. Get it between 50.1 and 49.9 and call it 50%.

Try to change all four until close then just the rear, avoid front only at this point (at track adjustments are different because you might need RH increase and a cross change).

If you have to make more than a 2 round adjustment the RH and other settings can get off, welcome to the 6-8 hours parts of chasing the setup. Later you will start being able to make multiple adjustments at the same time, like driving it is a feel thing. Stick to few and inspect/measure until you start seeing the setup and what your car needs in your head.

Step #4 (the recheck)

GO BACK OVER ALL SETTINGS STARTING WITH ASSUMPTIONS THEN STEP ONE!

If anything is out, repeat all the above steps, something has changed. Keep going through the steps until your step #4 yields the numbers we are after with no adjustments needed. It might take a few times or you might be blessed with the racing gods and get it right the first time. Once it is right, it should also be TIGHT!!!!!! Make sure you measure LAST, not tighten last and again, never tighten fully until you think you are done.

Step #5 (Bars, Fuel, Tires, Weight)

Once you are finished either because it is right or because you just gave up, we have a few more things to do.

Hook the sway bars back up to full stiff up front and the middle setting in the rear (I sure miss the old shocks....) Set to NO PRELOAD (bolts drop right in and when tight your cross did not change) even if one tenth, reset bars. I like to set my bars on the scale and make sure I dial in the exact cross weight number I had before installing the bar, all the while checking the links themselves to make sure there is no bind. I've lost races over .2 cross weight mistakes! .2 seems small until you multiply it by our national debt, a big number and a big handling problem too.

Now, remove the vise grips from the column and let the guy that's been in the car get out or remove the weight you used to simulate your body weight.

Get the fish scale out and measure roll, record it along with your baseline setup. Before doing this, I always check the rear brake adjusters and front calipers as they are the two most common causes of drag.

Remember that you already have 38 PSI in your tires so you can bleed before the first session. You will get 8/10 pounds growth on the loaded front tire and 4/6 pounds of growth on your unloaded rear tire. Example, Laguna might look like this cold 32lf, 34lr, 31rf, 32rr and Savannah 31lf, 32lr, 33rf, 34rr. You can adjust a 5 pound hot split front to rear for tuning out problems that car shows you on long runs. Continue to adjust your tires up or down to achieve the 38 or your number at hot pressures.

Remember you have one gallon in the car, you are ready to hit the scales to set you ballast for the race weekend.

The car will not look right, with no driver the platform is not level, and that's GOOD.

Test, practice, qualify and race. Make adjustments along the way, record where you end up and use that as your starting point next time at that track!

Tuning:

I'm not sure where to start on tuning so I'm going recount a recent event, then outline each

adjustment and how I use it for tuning.

Let's take Atlanta and the ARRC event that recently occurred.

The car was loose in high speed right hand turns, tight at turn five left hander, neutral at turn six a right hander with slight banking and tight at turn seven but with wheel spin from apex off. I also felt the bump stops a few times on the left side.

I raised the car ½ round on the left side and put the setup back like it was other than that. I adjusted the camber on all four corners to put more rubber to the ground, I had to add (add meaning more so a negative number) camber to the left side and take away from the right. On the right rear I took out an additional amount of camber to try and help the wheel spin while also taking grip from that tire to free the car up for the left turn five. I reduced the cross by one half a round and I adjusted the tire psi to achieve my desired hot number.

I went 4 tenths faster and now had a car that was still a bit free in rights, tic tight at turn 7 but much better on wheel spin and turn five was near perfect. The camber was near right, LF needed a bit more (which made more grip for turn 7 but also would free up the car on fast right hand turns).

I made another de-wedge adjustment for high speed and added 1/16" toe out to the front for turn 7. I feared this would make turn five loose again so I put a tad bit of toe in to the RR.

I now had a car that was perfect in the high speed RH turns, good at the turn five left hander and good at turn 7. Tire psi and camber was good, no adjustments needed. On longer runs it had a tendency to free up truing both ways (a sign that the cross is right, where you want to be to start in on bars and psi).

I actually made a bar change for qualifying to bring the car in faster, full stiff rear and 2 pounds added to my desired rear hot pressures. For the race, I went the other way to full soft starting with a tight car, it was the wrong call as it took too long to come in but was also the new TR, while setting the psi back to the desired hot. Hind site I needed the bar in the middle and to drop the rear psi one pound, a smaller compensation. Setup notes duly marked!

As it goes in a weekend of testing and tuning a SM for a race.

JD trackside setup thoughts:

Let me now tell you my formula for setting up my SM after session one and assuming I just went out with the setup in this guide.

I make a few changes all at once for RH, Camber and Cross.

- I look to see if the RH is right using shocks sensors or a zip tie on the shaft as a measuring tool along with what I felt on track when loaded up. I want the car as low as I can get it short going full stiff and becoming skittish.
- I adjust the camber to put the most rubber down I can using temps AND sidewall markings. I NEVER use camber to adjust a loose or tight situation. With all the

adjustments we have I want as much tire on the ground as I can get. Yes, I will stand one up to gain traction under power like at Atlanta and yes that took grip away from that turn five problem. BUT, that was a side effect of gaining grip at turn 7 WOT point and not a direct intention of mine. I never take grip from a tire as the primary use for adjusting handling.

- I adjust cross with my goal of nearly getting the car to turn the same both ways or at least perfect on dominating direction turns.
- I leave the bars alone checking for zero preload only.
- I work on tire psi each session but only to get to my desired hot number for now.

After I work on the RH, Camber and Cross I get to a point where it is much better. Now, one of the following is where I find myself; it is great everywhere (park it), tight everywhere, loose everywhere, tight one way and perfect on the dominating direction or loose one way and perfect on the dominating direction. I will give examples of what to try below, I assume you have the RH, Camber and Cross close already and are riding on good rubber.

Every adjustment has an effect on handling, you may correct one problem and create another. That is not bad, you want least evil that is the fastest of all you try then you drive!!

Tight Everywhere Remedies:

Raise the rear of the car, add rake (all adjustments remain the same, go through setup)
Stiffen the rear bar or soften the front
Decrease the front tire psi (within range of that tire, 35/40 lets say)
Increase the rear tire psi (equals spring rate, rate has more effect than temps)
Toe out in the front
Toe out in the rear

Loose Everywhere:

Raise the front of the car, de-rake (all adjustments remain the same, go through setup)
Soften the rear bar or stiffen the front
Increase the front tire psi (equals spring rate, rate has more effect than temps)
Decrease the rear tire psi (within range of that tire, 35/40 lets say)

Tight on the few left or right turns but perfect turning the dominant direction:

Increase the tire psi on the loaded rear (I've seen and won with 70 psi)
Add toe out to the rear loaded tire
Decrease tire psi to the front loaded wheel (never below the min range, prefer to adjust rears)

Loose on the few left or right turns but perfect turning the dominant direction:

Decrease the tire psi on the loaded rear (never below the min range)
Add toe in to the rear loaded tire

Increase tire psi to the front loaded wheel (be careful, it works hard in turns the other way)

I'm not exactly sure what else to say, that is a great starting point. Email me if you have a specific question, hopefully right after you donated to the specmiata.com web site ☺

Random Rant and Thoughts:

Closing out the guide I want to point out a few things that come to mind when thinking about car prep and tuning.

- Dyno, Dyno, Dyno and more Dyno... 3 new trannys will have 3 different RWHP numbers, swap them in and out and find a peach, rear end too!
- Build to the spec, no need to have those 13 pound wheels and then run pump gas!
- Know what you have, let the paddock experts coach themselves!
- Free everything up, if it spins swap parts until you have what passes tech and makes more power. Alternator to CV joints and hubs, FREE!
- Read the rules, know there is not a spec on brake line office size and ask yourself can you go faster by working on that item. Apply that thinking to all parts still open, there are many if you just look.
- Just TRY, change stuff, make mistakes, run in the back. One of my biggest mistakes when starting was not trying changes for fear of going backwards. The remote chance of going backwards is far outweighed by a very good handling race car. But, keep notes and track your progress. This is not that hard but hobby or not it IS WORK!!!

The class has grown so much thanks to the great folks that support it. For my part I'm both humble and proud to know this group of people. One such person is my dear friend, Jim Drago. Few newcomers to SM have impressed me as much in such a short time. Jim proves that two ears, one mouth and hard work pay off. I'm proud be his friend, drive his cars and thankful for the support he gave me editing this guide. (Yes grammar is entirely his fault....).

Lastly, anyone interested in a "Dyno Tuning Guide"? Make a post at SpecMiata.com if you are.

Peace!

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Jim Daniels
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