

Suspension Calculator Version 5

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1. BALANCE

When you hear about a well tuned high performance car the term "balanced" will frequently be used. It is this basic idea of balance that this calculator is focused on achieving.

The need to tune is based on the fact that all cars are not created equal. Weight distribution, tire width, aerodynamics, and even which axles of the car are powered all disrupt a cars potential balance in some way. Every car has it's own set of inherent imbalances that must be compensated for to maximize performance potential.

Understeer and oversteer are two basic conditions of an imbalance, so when we tune a car we are generally making adjustments to its parts in order to fix such a condition.

Understeer and oversteer are not conditions to be avoided by themselves though, but rather used as tools to cancel each other out. By combining these two imbalances in the right proportions we can achieve the balance we are looking for. Essentially, we can create a balanced car by tuning imbalances that counteract inherent imbalances.

Suspension components have complex relationships with each other. By tuning just one component of the suspension system we risk adversely affecting any or all of its related parts. This is important to consider when making changes to any single part.

To maintain these complimentary relationships a form of balance must be retained. By adjusting one part, we must compensate by adjusting others. This complexity of relationships is difficult to always understand, but with established relationships adjustments can be made with some confidence. The calculator uses such a base of relationships and does the adjustment work for you.

Version 5 has been designed to take all of these unbalanced parts and complex relationships, and combine them into a single, well balanced, and complimentary package.

It still isn't perfect, but it's better than it's ever been before.

- *feuerdog*

2. REQUIREMENTS

Software -

The need for simplicity of use has risen in proportion to the complexity of the calculations, so this calculator has been

developed with the help of software. With a minimum investment of time and space, the ease of use has improved greatly. You will need one of the following in order to use the calculators .xls file:

Microsoft Excel - <http://office.microsoft.com/en-us/excel>

or

Open Office - <http://www.openoffice.org>

Open Office is FREE, and is what I used to create Version 5.

Vehicle Information -

The following items can be found in the game and will be required to find the output settings:

1. Vehicle weight(lbs) -

The weight of the car determines the strength of the springs.

2. Vehicle front weight distribution -

The weight distribution of the car can be tuned by adjusting the spring strength distribution.

3. Drivetype -

The drivetype determines how the spring distribution is applied.

FF - Front engine, Front wheel drive

FR - Front engine, Rear wheel drive

FA - front engine, All wheel drive

MR - Mid engine, Rear wheel drive

MA - Mid engine, All wheel drive

RR - Rear engine, Rear wheel drive

RA - Rear engine, All wheel drive

4. Aerodynamic downforce -Aerodynamic downforce affects vehicle loading and handling balance.

5. Tire widths -

A difference of widths between the front and rear tires will affect handling balance.

Tire width is the first 3-digit number of the size.

$235/45/17 = 235$

$315/35/18 = 315$

NOTE: The calculator assumes the use of Standard units of measurement. A Metric version may be developed at a later date.

Upgraded Parts -

Racing Parts -

Racing Anti-roll bars

Racing Suspension

Racing Springs and Dampers

Racing Brakes

Racing Differential

Optional Parts -

Use of these parts is optional, but handling balance may be affected.

Sport Brakes (not adjustable)

1.5 Differential on rear wheel drive cars (deceleration not adjustable)

Assists -

STM - OFF - STM must be OFF, no exceptions. STM is not a complimentary performance system, it is invasive, and will detract from the calculators settings capabilities.

ABS - The brake settings that the calculator produces are designed to be used with ABS ON and activated, with full-lock trail-braking maneuverability in mind. However, the use of ABS and the calculators brake settings are optional.

TCS - OFF (Optional) - TCS only really needs to be used for very high powered vehicles if the transmission is set up well. Personally, I rarely ever use TCS on any of my calculator tuned cars that have their transmissions tuned. TCS ON will not disrupt handling with the calculator settings.

3. VEHICLE DATA INPUT

Add the appropriate Vehicle Information in the Input cells. Only add the actual numeric value, do not add decimals, or "%" and "lbs" suffixes.

Vehicle Weight -
2500lbs = 2500

Front Weight Distribution -
57% = 57

Drivetype - is selected from a drop down list, or entered directly.
Front engine, Front wheel drive = FF
Front engine, Rear wheel drive = FR
Front engine, All wheel drive = FA
Mid engine, Rear wheel drive = MR
Mid engine, All wheel drive = MA
Rear engine, Rear wheel drive = RR
Rear engine, All wheel drive = RA

NOTE: Occasionally you may encounter an "error" display in some of the output boxes. To clear these errors simply reenter the vehicle data, or different vehicle data and eventually the error will clear itself. I'm not sure what causes this to occur.

Aerodynamic Downforce -

If you have no downforce value to enter, or you do not wish to compensate for aerodynamic downforce then leave the cell blank.

The calculator will attempt to balance any combination of downforce ratio, but I recommend staying close to the factory ratios:

FWD = approx. 2:3

AWD = between 1:1 and 1:2

RWD = approx. 1:2

These ratios are merely observations however, and there are more than likely exceptions to these approximations.

NOTE: If one part is not adjustable then the other part should be adjusted to an equal slider length, which is in the middle. When tuning this way I recommend NOT using the aerodynamic compensation input.

Tire Widths -

If the Tire Widths are the same or you do not wish to compensate for tire widths then leave both input cells blank.

Tire width is the first three digits of the Tire Size, which is found in the Tire Size part selection screen, and Vehicle Details list.

235/45/17 = 235

315/35/18 = 315

4. SETTINGS OUTPUT

Once all of the inputs cells are completed the outputs are displayed. The calculations are immediate.

All of the output settings for the various vehicle parts are displayed in the output cells.

Some settings, like Caster and FF differential, are not displayed in blue cells, these are fixed values and will not change.

Some of the output settings will have other information shown nearby in gray. These percentages are included for advanced tuners to show various balances and relationships.

5. CALCULATOR MODIFICATION(optional)

This section of the calculator is somewhat complex and included for **ADVANCED TUNERS ONLY**. Use of any modified balance or strength modifier is not required to achieve a capable and balanced tune.

The Modifier cells are for modifying the Strength and Bias of the settings outputs they are next to.

It is possible to modify the base calculations if you wish, but diverse possibilities of the resulting settings have been too varied to test with any consistency.

Use these modifiers at your own risk.

The modifiers are based within the calculations themselves not directly to the output. All of the modifiers are independently calculated/adjusted.

Strength -

Strength is a direct multiplier of value within that parts calculation.

Example:

90% = softer

100% = default (displayed in gray below cell)

110% = stiffer

Bias -

Bias is a modifier to the default distribution balance for that part. The default balance is shown below the modifier cell, is based on the weight transfer calculations themselves, and is therefore variable.

Example:

40% = less front/more rear

50% = default (displayed in gray below cell)

60% = more front/less rear

Rebound Bias - The most important of the bias modifiers will most likely be rebound. By changing the bias by even 1% you should feel a significant change in vehicle handling.

Example:

51% and greater = oversteer

50% = default (displayed in gray below cell)

49% and lower = understeer

THE SUSPENSION CALCULATOR and TRANSMISSION TUNING

If suspension tuning is 50% of a successful tune, then transmission tuning is the other 50%.

The suspension calculator is exactly what the name implies, it is designed as a generic tuner for the suspension related settings. However, because of the wide variety of transmission tuning options it is important to consider the transmission tune as an important part of the overall chassis balance.

High torque, high power, and low or high gearing ratios can all affect how a chassis responds to throttle application.

If driver throttle control is adequate but there are still issues with throttle related oversteer or understeer, then consider adjusting the final drive or individual gearing to address the issue.

I'm not trying to imply that the calculator is not the problem, there are too many variables involved in building and tuning cars to prove anything, but I have found that retuning the transmission in conjunction with suspension tweaks is an effective method for a success and balanced tune.

FAQ:

- 1) *Quick question race car tuning. How we supposed to fill in the box for "tyre width" with the race cars since they don't allow parts upgrading so I can't see what the tyre width is. Thank you for any suggestions.*
 1. If you go to your vehicles gagarge and select show all and scroll across will give u options on tyre width
 2. Another way, if you are in "Career", choose "My Cars", press the "X" button, to get your car list. Scroll to the car for which you need the details. Press the foot peddle or trigger to the right to display the detail you need. Everything is there, from PI stats, weight, HP and Torque, RPM's, tires. Go back to "Tune My Car" mode, everything is there, tranny ratios, suspension, diffs, breaks, down force, etc., etc. Even though they are not upgradeable, they are adjustable. Hope that helps.
- 2) Ride Height:
 1. *I noticed that there was no output for Ride Height on the calculator and wondered if I should just leave it at the default level or if this is like the transmission and needs personal tuning to my tastes. Any thoughts on this is greatly appreciated.*
 1. My oppinion if it is worth anything is to go as low as you can without significant grounding. You will find that the lower the suspension the more issues you will have when running over kerbs ie being thrown off line. So unless you are very precise in the lines you take go on the safe side and raise the ride height
 2. Tribal knowledge is, the lower the centre of gravity, the more stable the ride and the less drag. But if you are bottoming out on a bumpy track like Sebring, raise it one tick at a time until your springs don't go red. Also, a stiffer setup will help. Best bet is to go with the default height, tune for best handling, then lower it, run a lap, lower again until you bottom out, then raise one tick.
 2. *I've been watching the telemtry replays a lot and I notice that my springs under the suspension screen go red from time to time. Sometime just through normal turns other times when I hit a rumble?*

How do I change that, stiffer or softer springs, ride height?

1. A few occasional flashes into the red is fine, it's normal and expected.

However, if during a corner the springs go red and stay there for longer than full second then you might need to make an adjustment.

Most cars tuned with the calculator won't need to adjust any spring levels to fix this so that leaves ride height.

As a general rule I don't like any suspension set lower than about 4.4

Some cars will be lower and some will be higher, but I try to keep most of my cars around this height.

The jury is still out on whether red spring travel is even detrimental for handling anyways, so I wouldn't sweat it too much.

- 3) Downforce:
 1. *hi im a lil confused with the downforce input on v5.1*

for rwd do i enter

1 = front

2 = rear

or the load in pounds the downforce is givin the car

say

125 = front

165 = rear

1. No, the actual yellow box input is for the actual pounds of Df that you want to use.

My recommendation is a ratio of 1:2. Which means that you rear DF would be double your front DF,.....a 1-to-2 RATIO.

A 1:2 ratio =

50 front 100 rear

60 front 120 rear
45 front 90 rear
etc.

But it's only an observation, you can use whatever you want.

2. You can enter the DF settings from the game, say 125/165, as you stated. Or, you enter whatever value you want into the calc, as feuerdog suggested, in a ratio of 1:2. So 125/250. Then you go back to the game tuning pages and enter the new values, including your new DF of choice.
2. This thing has been bothering me for a while and I haven't found an answer anywhere yet...

Does anyone know what kind of downforce values those un-adjustable upgrade wings (front & rear) give?

1. I believe and don't quote me on this quite yet, but I believe 85ish is the DF default value
2. I'm just guessing here, but my DF ratios are based on adjustable values, and I don't think the non-adjustable parts deviate from that ratio. Given this theory, a typical FR car will have a 1:2 DF ratio.

If the center point of an adjustable rear only winged car had a value of 100, then we could extrapolate a theoretical non-adjustable front center value of 50.

But it's just a theory.

With mixed adjustable/non-adjustable parts I tend to only use 50% aero DF compensation or none at all.

- 4) As I progressed through first using standard car setups, to adjusting tire pressure to 31 or 32 for "quick fix", to using the calculator, then understanding the calculator formulas, to then reading the tuning guides and trying to tweak the calculator values, I not only spent a lot of time and pissed off my wife, I created some more questions.

Normally I use the tire screen to adjust angles and tire pressure to get consistent temps. What I noticed was that on all the Nissan Skyline GTRs (Front Engine AWD), the front tires got nice and warm (green) but the rears never even got to light green. I checked the guides and they stated to adjust springs to stiffen front to push weight to rear. The front weight percentage for the vehicles were always 54-59 % range so I would expect the calculator to have more spring tension in front to counteract weight. In reality the calculator shifts more tension to rear which can be seen in the tire screen where the fronts heat up but the rears don't. When I adjusted the tensions to evenly distribute weight, then the car handled a little different like a RWD. I counteracted with ARB adjustments.

Is there a flaw in the thinking behind the calc values or is tire wear not really that important. Or is it just an Skyline specific issue. Thoughts?

1. It might not be the suspension at all,.....go back to your warm front tire setup and try this; tighten the rear diff. to about 80/70 and loosen the front diff. to about 25/0 with a 25/75 split. It won't take much, maybe only 5% here or there to balance the heating issues by tuning just the diff. on an AWD.

Good luck, and remember, just because the calculator treats all cars the same doesn't mean you can tune them properly that way. Use ALL of your settings and test and develop your own methods.

- 5) What's up people, I just downloaded the new tuner and I am having a little problem understanding some of the information the calculator is telling me. First is ARB, what does it mean and how does it affect the performance of the car?? Next is the STRENGTH AND BIAS values, how do these values affect the performance of the car. And finally is the UNMODIFIED SPRING value.... what is this thing????? 😞 any help would be great to understand this beast of a tuner.

1. ARB is your Anti-Roll (sway) Bar setting. Basically, you can modify this based on your desire for a setup of a car that requires heavy cornering by giving it a lower Strength modifier (example: the default modifier value is 100%, you can make it less for tracks with slow hairpins by changing the value to say 80%. In the opposite direction, say you're at Twin Ring Motegi's Oval, you'll want a stiffer sway bar, because you require high-speed cornering and less roll, so you'll up the strength to 120% and see what happens).

Strength is simply a numerical value to the flash program that is out, rather than a dropdown box, you actually MAKE the value, which pays dividends in little tweaks. Similar tweaks can be made to your Unmodified Springs (more on that in a sec) and Dampers. This spreadsheet totally eliminates guesswork on the setup screen!

Unmodified Springs is a value that becomes modified based on the downforce you're using, and other values

you've entered. You can choose to modify these as well. I haven't really managed to figure out springs again, since getting back into the habit of making setups.

Bias modifiers basically changes the front to rear status of the car. Mostly, bias lets you work on oversteer and understeer problems directly. These are touchy, and only require slight changes to make big improvements. The default values are based on realistic terms for how to make a car neutral, based on the drivetrain.

The only other advice I can give is experiment, see what works for you, and what doesn't. I find the spreadsheet makes cars generally stiffer than the previous Version 3, but much more stable, and exhibit slight understeer, in comparison to what I usually run for settings on V3.

2. First, as fd advised when you joined the forum, read this...

<http://feuerhund.proboards57.com/index.c...ge=1#1204440072>

This will direct you to the many sources of information that explain how the calc and modifiers work.

And, also, here is everything you wanted to know about suspension tuning, but were not afraid to ask... 😊

<http://feuerhund.proboards57.com/index.c...ge=1#1206491274>

Spend an evening reading these tutorials, and you will be much the wiser and be better able to get to a good tune that much quicker. Enjoy!

- 6) [what is the diff of modified springs vs unmodified springs....is it just race vs. stock springs???](#)

1. Unmodified springs are just that, unmodified basic calculator values that DO NOT take into account aero or tire size compensation.

Modified springs DO add the tire size and aero compensations.