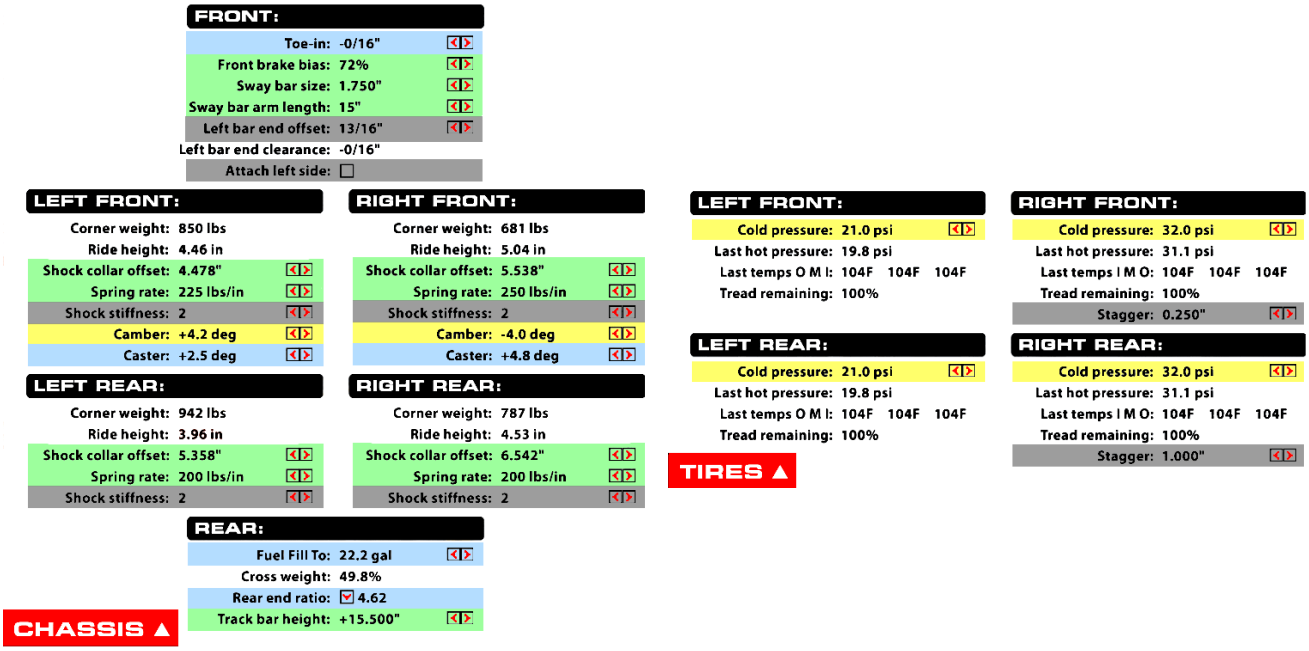
Oval Crew Chief 101 v5 – Mark A Carpenter



Stage 1 – determined by track

- Rear end ratio
- Fuel load
- Caster
- Toe in

Stage 2 – determined by tire temperatures

- Camber*
- Tire pressure*

Stage 3 – determined by feel and wear/temps between tires

- Shock collar offset* (wedge to balance tire wear)
- Spring rate (coarse mid, entry, and exit handling)
- Sway bar size (medium mid-corner handling)
- Sway bar arm length (fine mid-corner handling)
- Front brake bias (fine entry handling)
- Track bar height (fine exit handling)

Advanced settings

- Attach left side (front anti-sway bar)
- Left bar end offset
- Stagger
- Shock stiffness

*Continuously revisit as you build the set

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Adjustment Descriptions

Stage 1: Settings determined by track length and type

Rear end ratio: Adjust gearing so that shift light comes on at your braking point. For some short tracks, you may need to set this for 3rd gear and not use 4th.

Fuel load: Fill to 9.5 gallons. Run 10+ full laps at race pace. Calculate (starting fuel - fuel remaining) * (# of laps in race / # of laps run). If this is for a typical 50 lap LM race and you have 8.3 gal. of fuel left after 12 laps, then your fuel load should be (9.5 - 8.1) * (50 / 12) = 1.4 * 4.17 = 5.8 gal. The two nearest choices are 5.3 gal. or 6.7 gal., so use 6.7 gal. After you have completed your car setup, run 50 laps in practice around traffic to verify.

Caster: Increase both sides to increase steering stability and feel. Increase split to increase leftward pull. 2º left and 4º right are good starting points.

Toe in: Toe in (+) will give stability on straights. Toe out (negative toe in) will give corner grip and stability. Too much in either direction will cause the tire to scrub, cost speed and time, and increase tire wear. Short tracks generally require some toe out. A toe of 0 or -1/16” is often appropriate for long tracks like Milwaukee. A toe of -3/16” or -4/16 may help on tracks like Oxford.

Stage 2: Settings determined by tire temperatures

Camber: Run 10 laps at race pace (not hot-lapping) and check tire temps in garage. Adjust camber so that the left side of both front tires are hotter than the right. The difference in temperature between the left side of the tire and the right side is called temperature spread. With the current tire model, the target spread for the right tire should be about even. This is the tire doing the most work, so the corners will have the biggest impact on tire temps. If any part of the tire ends up hotter than the rest, make sure it's the left edge and it's hotter by only a degree or two.

For the left tire, a spread of 0º-3º for a short track like Oxford would be good, while longer tracks like New Hampshire and Milwaukee may do better with a spread of 5º-7º. A banked track will require less spread than a flat track of the same size. Use these targets to start, and then after you build the set, you can adjust the camber up and down a click or two to see if you gain any speed. Rear camber is not adjustable with the D-Class oval cars, so you have to live with whatever spread you get there.

Tire pressure: Inflate tire pressure so that the middle tire temperature is within a couple degrees of the midpoint between the inner and outer temperatures.

Stage 3: Settings determined by feel and wear/temps between tires

Shock collar offset: Raising the collar will lower that corner's ride height and carried weight, and, to a smaller degree, the weight of the opposite corner; the other two corners will gain weight. Lowering the collar will raise that corner's ride height and carried weight and the weight of its opposite corner; the other two corners will lose weight. Wedge is the ratio of the RF+LR weight to LF+RR weight. The more wedge (crossweight) the car has, the tighter it will be in left-hand corners.

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Spring rate: In general, use the lowest spring rate that will give you the stability and response you need. A higher rate will cause the car to respond faster to steering input and can keep the car from bottoming out on bumps when using low ride heights, but it can cause an overall loss of grip for the car and make it skitter over bumps. When making adjustments, try lowering a spring rate first before raising an adjacent one. Lowering both front spring rates will loosen the car. Lowering both rear spring rates will tighten the car. Spring splits can also be useful. In the front, a lower spring rate on the left will tighten the car on entry; a lower rate on the right will loosen the car on entry. A rear spring split will affect the car when under throttle. A lower rate on the left will loosen the car, and a lower rate on the right will tighten the car. On flat tracks, a higher LF/lower RF will help the car turn. On banked tracks, a lower LF/higher RF can keep the car from bottoming out when coming onto the corner banking.

Sway bar size (diameter): Thicker bar = tighter; thinner = looser. Bar adjustments usually affect the entire corner. This is a coarser adjustment than bar arm length.

Sway bar arm length: Longer = looser; shorter = tighter. This is a finer adjustment than bar size (diameter).

Front brake bias: Higher bias (more forward) will tighten the car under braking. Lower bias will loosen the car under braking.

Track bar height: Higher = looser mid-corner to exit. Lower = tighter mid-corner to exit.

Advanced settings

Attach left side (front anti-sway bar): Keep attached for consistent handling. Should be disconnected before making corner weight changes and then reconnected. (Disconnect bar; click “Accept”; change left bar end offset so that the left bar end clearance is ~ 5/16; adjust corner weights; set offset so that clearance is back to +/- 0; reattach bar; click “Accept”)

Left bar end offset: Set the offset for a “left bar end clearance” of +/- 0.

Stagger: Too much or too little rear stagger will cause a loss in rear grip. Leaving the default stagger from the Advanced set is a good bet until you have more experience. You could also set a low stagger (front and rear) for wide corners and high stagger for tight corners at the start and then leave them be.

Shock stiffness: Voodoo, extra spicy. For simplicity, use the following chart to match the dampening strength with the spring rate for that corner:

Spring rate in lbs.	Shock setting
175-225	1
250-300	2
325-375	3
400-450	4
475-550	5

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Building a Set

In most cases, you won't have to start from scratch. Each track has a Basic and an Advanced set for the Late Model already within iRacing, plus there are often sets posted on the forum. If a track is similar to one you already built a set for, that may be a better place to start. When I built a set for NHMS, I also found that it drove fine at both Milwaukee and Phoenix. I still tweaked those sets to try and get the most out of them, but not by much. If you are using an iRacing set, the gear ratio should already be good, but if you are using a set you built for a different track, it may need to be adjusted.

Before getting too far into the setup, I think it's good to take a look at how you are driving the car. A tight condition will be often be caused by driving too deep into the corner and not be the fault of the set. It's important to distinguish the difference between conditions caused by the set and those caused by driver error. One thing that helps me is to picture the traction circle in my head. If you brake late, you are using a good amount of the available grip for braking, so there isn't much left for turning grip.

Think of the traction circle as having a grip budget. You can spend it all on braking, all on turning, or some combination of the two. If you spend more than you have, you slide, heat up the tires, and wear them out quickly. Your tires are your emergency fund, and there's only so much of it. You can dig into it quickly, or spread it out until payday (your next pit stop). The trick is to have your set and driving style give you the biggest budget to spend from, that way you can do more of both without dipping into the emergency fund much. A set that runs fast in at the start of the race may fall off after only 15 laps, and then you have to fight to keep from losing positions.

The next step is to drive your chosen starting set for several laps to get a feel for it. This is a good time to do the initial fuel calculations. Just remember to look at how much fuel you have left before going back into the garage.

Choosing caster will take some experience. Once you get a feel for how high you like each side and how much split works for you, you can usually dial it in pretty quick. For now, start with 2º on the left and 4º on the right. For a tight track like Oxford, you can try a higher angle on both sides, a higher split, or both. For banked tracks, you can try a lower angle and split.

For toe in, the above guidelines are a good starting point. After you have more of the set dialed in, try moving the toe in either direction to see if you pick up consistent speed or a better feel in the corner. A more correct toe may gain you front grip, which can make the car a little looser.

For the anti-sway bar, keep the left side attached. It will make corner entry to mid-point transitions more predictable and will give consistent roll resistance if you have to turn right for any reason. If we had a very bumpy track the LM ran on, leaving it disconnected would help prevent the jolt of a bump from being transmitted from one wheel to another. This helps maintain grip, but when entering a corner, that clearance has to be taken up by body roll before the bar starts having an effect, so it can delay tightening the car. This can also be a useful tuning tool, but for starting out, I wouldn't recommend it. I'd leave the bar attached until you are comfortable with both your driving and tuning techniques. It will make the other changes you apply easier to feel and understand. To keep handling consistent, the “left bar end clearance” should be at + or - 0. This number will change as you make adjustments to the car, so keep an eye on it after every tweak and move the “left bar end offset” to re-zero the clearance. (Disconnect bar; click “Accept”; change left bar end offset so that the left bar end

clearance is ~ 5/16; adjust corner weights; set offset so that clearance is back to +/- 0; reattach bar; click “Accept”)

For stagger, leaving the default from the Advanced set is a good bet until you have more experience. You could also set a low stagger (front and rear) for wide corners and high stagger for tight corners at the start and then leave them alone.

For Stage 2, we start to look at tire temperatures. Aim for a spread of 0º-7º on the LF tire and 0º on the right tire. The middle temperature should be close to the mid-point between the two.

When making tuning runs, it's important that the laps are consistent and that you don't lock up the tires. Run a normal race pace and resist the urge to hotlap and beat your best time. Yeah, I know it's tough, but it will give you better readings. Go to the garage immediately after stopping. If you lock up the tires, they will hot-spot and you will have to make the run again.

You will often see both camber and tire pressure on cheat sheets as ways to adjust handling when building a set. Since there are a number of other ways to do this, I prefer to optimize the tires' contact patches for grip. Basing camber and tire pressure on tire temperatures will do this. Both will probably have to be revisited as you build your set and make other adjustments. If you go into the garage after a run and see that the temps have changed enough, make the necessary tweaks to camber and pressure before moving on.

Stage 3 is about both making the car comfortable for the driver and making sure it stays stable through the run. We are going to work on both of these goals at the same time, as adjusting the car for one will affect the other. A neutral handling car with neither understeer nor oversteer is not necessarily a balanced car, which is one that will give you even tire wear. An unbalanced car may start the race feeling neutral, but will develop either a push or a looseness as you drive it.

Both tire temperatures and tire wear will point us in the direction of finding a balanced set. A car that loads the RF tire more then the RR will heat up more and wear quicker. As the RF tire wears out, it will lose grip faster than the RR, and this will show as a developing push the further you get into a race. If, after 20 laps, the RF show an average temp of 15º more than the RR average temp and 6% more tire wear, you'll know that it will be in pretty bad shape after 50 laps. The goal is to get the right side with even wear, though this can be difficult. If you can get it within 2-3% over 50 laps, the set should serve you well. If you are new to driving the car, having the greater wear on the front will be safer than on the rear, as you don't want to be spinning out at the end of the race.

The main adjustment for affecting this tire wear balance is wedge. Wedge is the ratio of the RF+LR weight to the LF+RR weight. The more wedge (crossweight) the car has, the tighter it will be in left-hand corners. More wedge will cause the RF to load up more than the RR. The more a tire is loaded, the harder it works, the hotter it gets, and the faster it wears out. Less wedge will move the loading onto the RR, and that will begin to wear more. If we see that we are wearing out the RF too much, for example, then we need to drop the wedge so that the RR will take more of the load.

We change the wedge by adjusting the shock collar offsets. Raising the collar will lower that corner's ride height and carried weight, and, to a smaller degree, the weight of the diagonally opposite corner; the other two corners will gain weight. Lowering the collar will raise that corner's ride height and

carried weight and the weight of its diagonally opposite corner; the other two corners will lose weight.

Following the example of the RF wearing too much, to fix this, we can raise the shock collar of the RF or LR (to lower it's height and weight) or lower the collar on the LF or RR, or any combination of these adjustments. All of this will decrease the wedge an move wear to the RR. It is good to keep the car fairly level, so don't make all your changes on just one corner. Don't forget to disconnect the front anti-sway bar before making the adjustments. You want to end up with a bar clearance of +/- 0. (Disconnect bar; click "Accept"; change left bar end offset so that the left bar end clearance is ~ 5/16; adjust corner weights; set offset so that clearance is back to +/- 0; reattach bar; click "Accept")

Whenever you change wedge, the adjustment will also change how the car handles. Adding wedge will move the car towards understeer, and removing wedge will move the car towards oversteer. Since we are using wedge to balance tire wear, we need to use other adjustments to get the car to feel neutral in handling. All the remaining adjustments (spring rates, front brake bias, sway bar size, sway bar arm length, and track bar height) can be used to get the car to handle the way the driver would like. Some settings, like the anti-sway bar and spring splits, can also affect dynamic wedge. You won't see the change while the car is sitting there, but the wedge the car develops in the corner will be affected. This can make your static wedge changes using the shock collars less effective on tire wear. It's not a problem, just something to be aware of. This can actually be useful for making more subtle adjustments to both tire wear and handling.

To tune the car for handling, it's good to break the corner down into three parts: entry, middle, and exit. First we tune for entry, as changes that affect the middle of the corner often affect either entry, exit, or both. If we tune the exit first and then make a change for the middle, the exit will often then need to be readjusted and we end up wasting time. Each part of the corner also has both coarse and fine adjustments. When starting out, it will probably be best to start with the coarse adjustments for each part of the corner first, then go through the fine adjustments for each part of the corner. Even after a year of tuning these cars, I still find it difficult to feel what the car needs without going back and forth between adjusting the sections of the corner.

Coarse-tuning mid-corner: A good place to start is the front to rear spring rate difference, as this is one of the coarser adjustments. Lowering both front rates will make the car looser and raising them will make the car tighter. Lowering both rear rates will make the car tighter and raising them will make the car looser. Again, it's good to try a lower set of springs before trying to raise the opposite pair. This can help maintain grip, as long as the car doesn't bottom out or start to feel too sloppy. Don't forget to match the shock rates to the spring rates using the chart above.

Coarse-tuning entry: Start with the front spring split. If the spring rate is higher on the LF than the RF, this will loosen the car on entry and help the car turn into the corner. This is particularly helpful for flat tracks. On high-banked tracks like Bristol, you may have to use a higher RF spring rate to keep the car from bottoming out as the car hits the banking. A higher RF than LF rate also tightens the car.

Coarse-tuning corner exit: Start with rear spring split. If the spring rate is higher on the RR than the LR, the car will be looser on entry. If the rate is lower on the RR than the LR, the car will be tighter on exit.

Fine-tuning mid-corner: The next finer adjustment for mid-corner is the sway bar size (diameter). The thicker the bar, the tighter the car, and the thinner the bar, the looser the car. After that, the sway bar arm length is next. The shorter the arm, the tighter the car. The longer the arm, the looser the car. Remember that both settings will also affect the dynamic wedge of the car in the corner, so you may see some impact on tire wear also.

Fine-tuning entry: Use brake bias. The higher the number, the more forward the brake bias and the tighter the car will be on entry. It's important to note that this only works while you are using your brakes. Brake bias will have no impact if you roll into the turn without using the brakes. Keep in mind that the anti-sway bar will also affect entry.

Fine-tuning exit: Use the track bar. The higher the track bar, the looser the car. The lower the track bar, the tighter the car.

Using this method, each setting has it's own job, but once you get a set that feels good and wears well, don't be afraid to play with various settings to see if you can pick up some more speed. Stagger, toe, and shocks are all settings you can try moving up or down to see if they help or hurt the set.

Other Notes

Road courses: Put both front and rear stagger to zero, the track bar at 9” (the lowest setting), and both caster angles the same (or as close as the garage will let you). Items that will affect both left and right corners the same are: the ratio between the front and rear spring rates, the anti-sway bar, brake bias, and toe-in. For everything else, swap tight and loose for right-hand turns. Build the set as you would an oval set, except the left hand tires should be hottest on the right edge instead of the left. You'll just have to make compromises so that the car both preforms well and feels good going in both directions. Start with symmetrical settings for the left and right side of the car and then make small adjustments from there. I would recommend against spring splits at either the front or rear of the car. When adjusting wedge for tire wear, you can either look at the side that is the outside for most of the turns (left side for LRP) or the two front tires. I haven't experimented much with this yet.

Qualifying sets: Build your race set first. Short qualifying runs don't heat the tires up enough to get a consistent read for camber. After you build your race set, run tuning segments of 4 laps at a time. Readjust tire pressures, which will probably be higher than the ones you use for a race set. You will also be running hot-laps. Since you don't have to worry about keeping the car under you for a full 50 laps, tire wear becomes a non-issue, and you also may gain some speed with a looser set.

Telemetry: I would recommend looking at either “optimum sector” times for tracks that are fairly symmetrical, like USA and Oxford, or “best lap” times for tracks that aren't, like Concord and Stafford. When in doubt, use “best lap”. This will give you a good idea of how your set deals with the track as a whole, rather than building the set for a specific corner. “Optimal sector” is great for learning to drive a track, however.