Car Modifications

• Handling

Tires, tires, tires. Why do you think the NASCAR drivers are always talking about tires? When we are testing engine component on real cars at the track, the difference in engine performance is often masked by the variation in tires. The stiffness of the side wall of the tire is a significant factor in the spring rate at each corner of the vehicle. The tires on a NASCAR car (or truck for that matter) are the same size front and rear, (lets discount stagger for the sake of this discussion). When a NASCAR vehicle goes through a turn, some of the potential turning force of the rear tires is used to brake or accelerate the vehicle. The term "front roll couple' is used to calculate spring rates at each corner to balance tractive forces. So when the NASCAR guys are talking about "a bad set of tires", what they mean is that variation of side wall stiffness in one or more of the tires upset the corner spring rate of the vehicle, and thus the percent front roll couple which results in a "push" or "loose" condition through the turn.

In a real race car, the ranking of factors which effect vehicle performance are as follow:

1. Tires
2. Chassis/Aero
3. Driver
4. Engine

If we replace Aero with Magnet and Engine with Motor, it is basically the same for slot cars.

1. Tires

A small to significant performance improvement will result from installing silicone tires on your slot car. The improvement will be small if the stock tire was round with good surface area to begin with, or if the silicone tire is of larger diameter than the stock rubber tire, (reduced magnetic down force due to increased clearance to plastic track rail or magnetic braid). In general, a slot car will have improved corner speed with the addition of silicone tires, especially after truing. Improved lap times are all about increasing the minimum corner speed, no matter if we are talking about slot cars or real cars.

There are many brands of silicone tires. Not every brand offers a tire for every slot car. As a matter of fact, some slot cars you can NOT find any brand of tire that will fit! This is something you should always consider before buying a car. Unless you are planning to race with stock tires, or host an IROC race where all of the cars are the same, you should avoid cars that you can't get a silicone tire to fit. Two reasons; 1.

The car will not be competitive with rubber tires vs. your competitors with **clean** silicone tires. 2. Sometimes the elastomer liberates from the stock tires, leaving them hard as a rock! You will see this especially with Fly cars, with a tell-tale of what looks like an oily residue in the case.

In general, the biggest tire you can fit under your slot car, the better. If you are willing to destroy the scale appearance of your car, put taller/wider tires under it (non-magnet racing). Note this may require a wheel change to get the tire that you desire. Most all of the aftermarket silicone tires are slightly wider than the stock tire you will be replacing, giving a fuller look to the sidewall. We run a lot of stock plastic wheel racing, with either stock tires or slip-on silicone tire change only. This keeps costs down and places more emphasis on car prep, (improving the deficiencies of the stock components). **This discussion will focus on slip-on silicone tires.**

Silicone tires must be clean to perform at their best. Thus, a dirty/dusty track will cause silicone tires to lose their grip, usually within the first lap! A good practice is to clean your silicone tires often, like between heats. I use a baby wipe soaked with Simple Green or a very watered-down (like 25:1) degreaser. (Note: Some degreasers will remove the Tampo printing on your car!)

I have done a fair amount of testing with tires, and my general ranking of silicone tire Manufacturers based on performance (lap times on a non-magnetic braid routed track):

- SuperTires
- Quick Slicks
- Paul Gauge
- Michael Ortmann
- Professor Motor Maxx Trac/Indy Grips
- Jel Claws
- Club Racer, Scale Racing

SuperTires are generally best with Quick Slicks XF (extra firm) a close second. Note "best" often depends on tire size availability, (either width or diameter). For example, I like the Quick Slicks SC02XF best for Scalextric Tran Am cars. I typically research tire availability and order as many different ones that will fit a particular car, and then test to see what performs best. Note what performs best on your track may not be best when you are visiting someone else's track. When I run on an AC2 track, I often bring two nearly identical cars with slightly different prep, (tires and total weight). Usually, the one that is most predictable will feel like the best handling car.

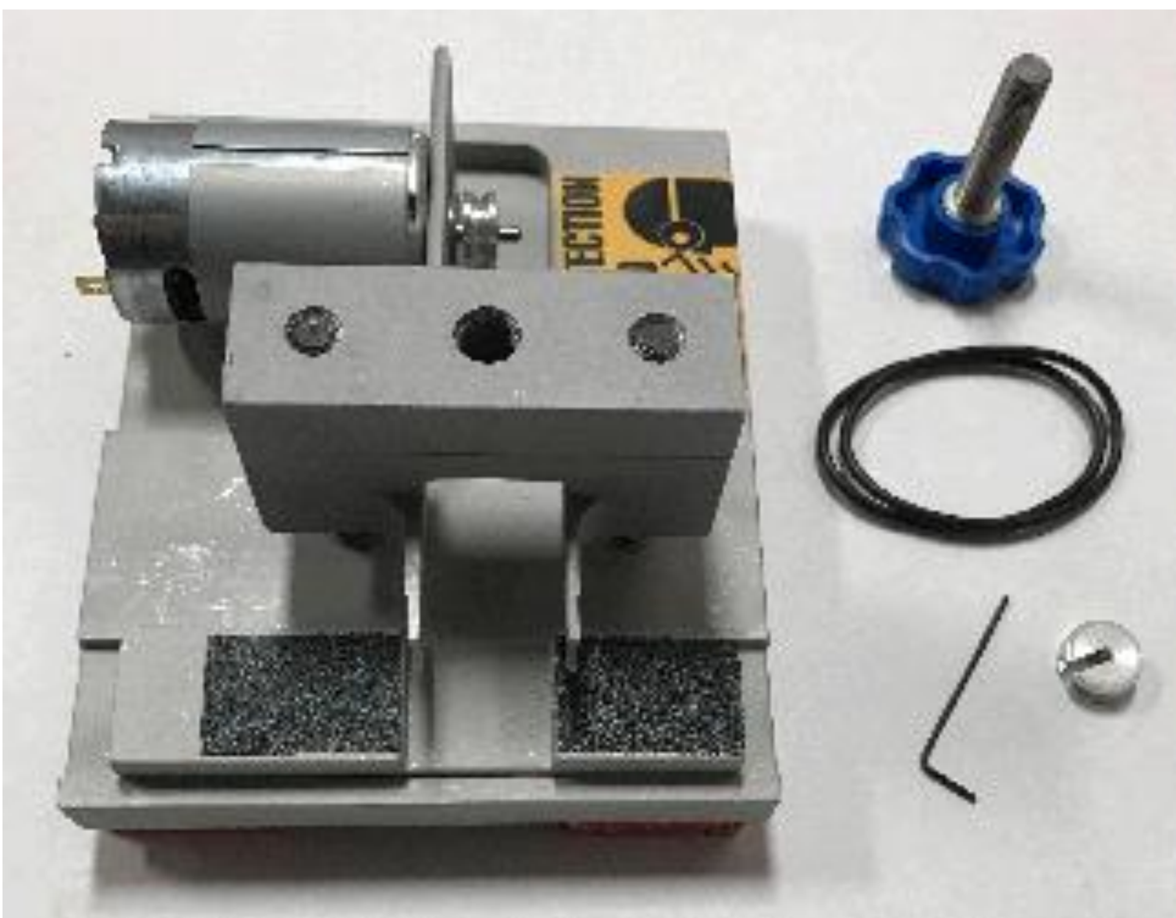
Sometimes you need a tire without the radius sidewall to fit in the wheel house of a car. Carrera Chevelle "street" car converted to a vintage NASCAR. Body is tight to the stock car rear wheels, so 1302 SuperTires without the radius sidewall were used to gain clearance. Guide was changed for clearance to solid front axle, and a Carrera Road Runner interior with roll cage was adapted.

Sometimes a Paul Gauge or Michael Ortmann tire is the only tire you can get to fit your particular car. They are very good tires, just not the ultimate grip like a SuperTire. However, they are much better than running stock tires and race well against Professor Motor's Maxx Trac or Indy Grips. Also, sometimes it is way cooler if the cars drive more like real (vintage) cars, drifting thru corners and overpowering the rear tires. I have a Carrera Cheetah with Paul Gauge and Monogram Corvette Grand Sport and Cobra Daytona Coupes with Indy Grips that are evenly matched and very fun to race. Don't discount any silicone tire, they all have a purpose and place.

We often call out a "spec tire" to keep the racing close. For example, we will run Slot.it Group C cars with a specified Quick Slicks. **I think some of the closest/most exciting racing we have had was using this format!**

Most of the "good" slip on silicone tires are very tough and don't take to run sanding. Rather than wear out a car trying to run sand a set of tires, it is recommended that you buy one of the standalone tire truing machines, like the Tire Razor.

Tire diameter is more important to those "Magnet Racers" on plastic track or MDF tracks with magnetic braid. Tire diameter is a tuning parameter for changing the clearance between the car magnet/track rail, which effects handling. Consider buying tires close to the final diameter, however, as you'll make a lot of tire dust to remove 0.010 inch from the diameter. Note the magnet gets closer to the track at half of the rate of rear tire diameter change. For more on this see the Chassis/Magnet section.



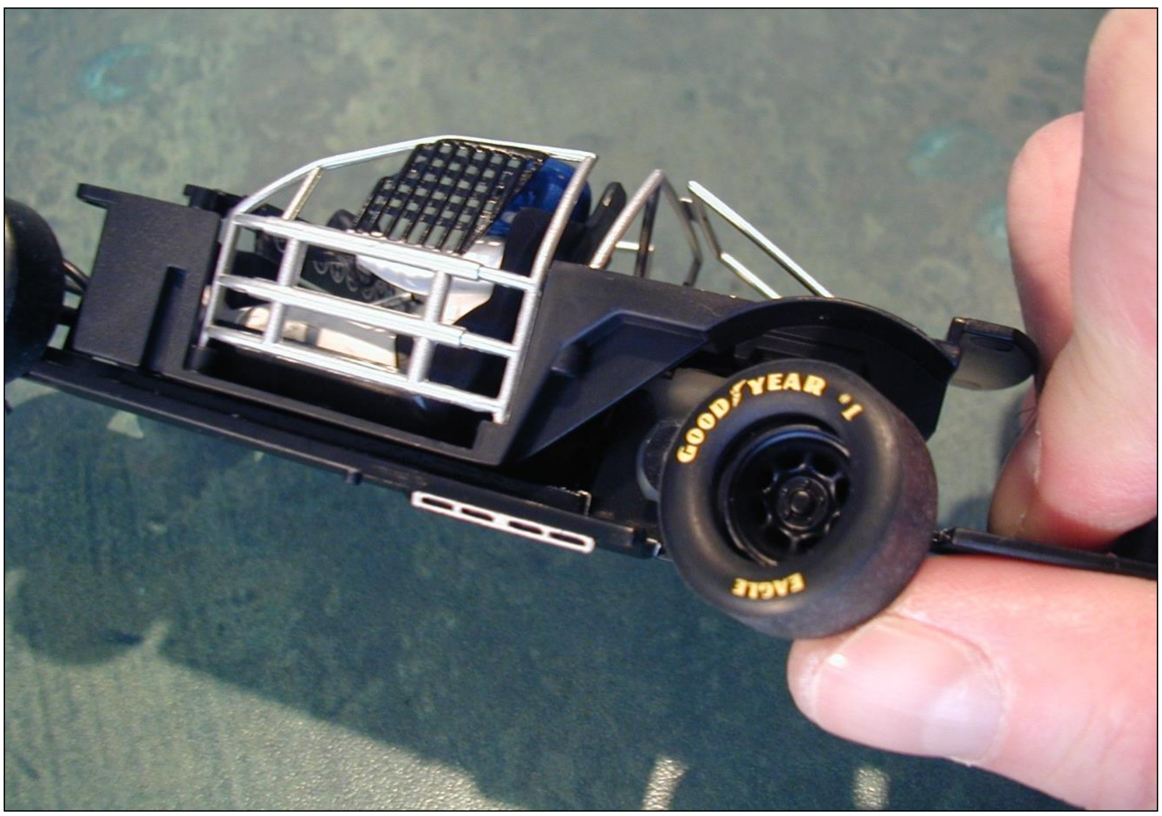
Tire Razor is a standalone machine for truing slot car tires using the axle/wheels. Look up their instructional video. Some day I'll invest in one…

There are other brands of silicone tires that address unique applications, like older slot cars. Experiment with different brands and sizes. I have a pair of Michael Ortmann tires (available from Professor Motor, PMTR4571) mounted on a Monogram Mustang that perform well with no run sanding. Tires are inexpensive relative to the performance gain they provide. The bigger hassle is the 2 hour round trip to the hobby store, to find out that the size you need is out of stock. I keep some of the more popular ones on hand just for this reason, or in case Visitors need a set to be competitive.

Silicone Tire Installation

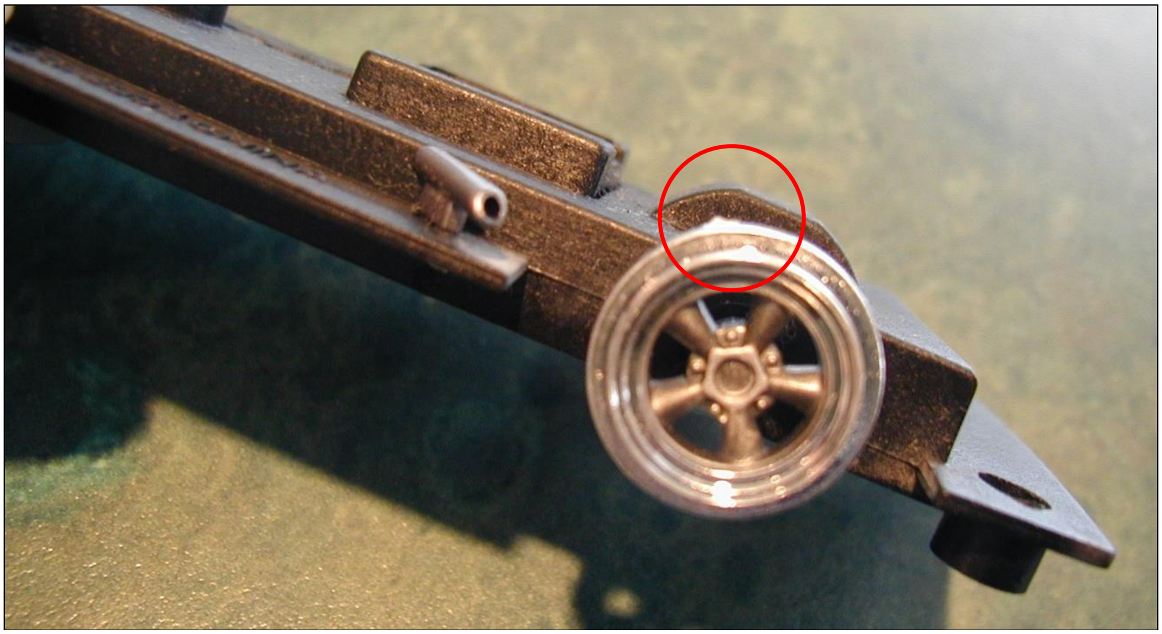
Before installing silicone tires, the body should be removed from the chassis. This can be tricky as sometimes the body attaching screws can be hard to break loose. Hold the slot car firmly in your hand, upside down, and apply significant force pushing a #0 Phillips screw driver axially towards the screw as you begin CCW rotation. You do not want to "strip" the head of the screw. Replacement screws are available through MRRC (MC9945), which have an aggressive thread pitch. If you split a body screw post, it can be repaired with A-B Epoxy. You can either wrap the existing post with epoxy, or cut off the split portion and rebuild the "post" with epoxy. Be sure to take a measurement of post length before cutting it off to rebuild it!

To remove the stock rear tires, gently peel off by applying pressure to a small portion of the ***inner*** sidewall. Work the tire off the rim a bit at a time. Avoid touching the outer sidewall of the tire, as painted logos or striping can easily be marred. Once the stock tire is off the rim, inspect the wheel for burrs where it was separated from the casting sprue. Remove any roughness or proud plastic by trimming with a hobby knife, file or sanding stick. The wheel should be round, smooth and free of burrs before attempting to install a silicone tire.



A tire is being removed from the wheel of a Scalextric NASCAR stock car. Push the tire off from the back or inner side wall of the wheel as shown above. This is to avoid marring the lettering on the tire. You may want to stack the stock tires for pit dioramas or to create authentic looking tire walls.

Track width should be maximized within the limits of the bodywork, at this point. This is done by shimming the side play of the rear axle with #6 brass or nylon washers. Note: Your better sources for slot car parts carry a variety of shims, (Slot Car Corner, Cloverleaf Racing, Professor Motor, Electric Dreams). Gently twist the right wheel off the axle and install shims, (as viewed from top of chassis). This is the best time to clean the axle and axle bushings of lint before re-assembly, (see *fluids* discussion under **Car Modifications for Speed**). Most wheels go back on the axle tightly, could add a drop of CA glue if required. Allow a few thousands (like 0.003-0.004 inch) of side play of the rear wheel and axle assembly.



Evidence of a casting sprue was left on this Monogram Mustang rear wheel, (circled). This should be trimmed flush with the centering rib of the wheel before attempting to install a silicone tire. Otherwise the tire will appear to have a lump in it!

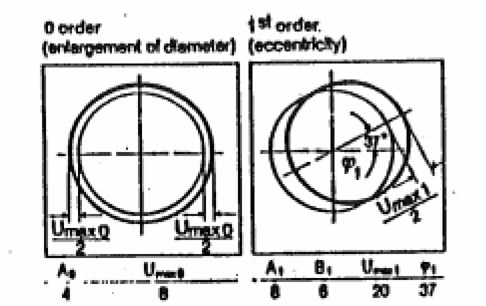
It is intuitively obvious to even the most casual observer that the rounded edge of a silicone tire should be installed towards the outer edge of the slot car. (If the rounded edge is minimal on both sides of the tire, then the outer edge of the tire must be slightly chamfered or radiused after installation.) Lubricate the I.D. of the silicone tire with water before installing on the wheel. (Water is the best lubricant for installing a tire because it leaves no residue.) Install the tire flush up to the center rib of the wheel. Then pull the tire slightly oval to start the tire over the center rib of the wheel. Slowly work the tire past the rib until it is seated on the wheel. Squeeze the tire to help shoulder the inner sidewall of the tire completely on the wheel, and check for any lumps as you rotate the wheel/tire assembly. A lump under the tire could be a chunk of silicone, which broke loose from the inner side wall while installing the tire, or missed burr from the casting sprue on the wheel.

I don't glue the silicone tire to the wheel. A properly fitted tire does not slip or rotate on the wheel, so I've seen no reason to bond the tire to the wheel. You may want to remove the tire from the wheel at some point, to replace it with a fresh set or different brand. However, if you are doing extensive tire truing with a machine, then you may need to glue the tire to the wheel. Mike Stott of Cloverleaf Racing has a YouTube video on how to properly glue tires to wheels. I'm sure other's have similar video's out there as well.

Tires, (and any elastomer) outgas and become harder with age. If you have a big race coming up and you suspect your tires are approaching 5 years old, it is probably worthwhile to replace them with a fresh set.

Wheel Run-Out

Wheel run-out (or lack on concentricity relative to the axle shaft axis) can occur as a zero order, but out of plane, or a first order, or a combination of both. See images from Goetze SAE paper #880142.

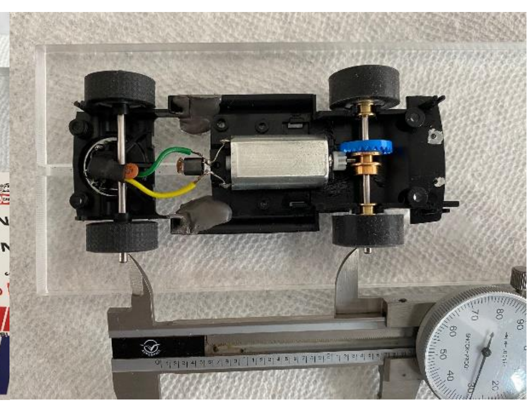


Distortion relative to a perfect circle, order definitions from Goetze SAE paper #880142, page 26.

Wheel run-out is easy to spot but quite difficult to correct on plastic wheels. Often it is the result of the plastic wheel being bored off center, (assumed exposed casting sprue moved wheel off center in fixture during boring operation), knurled shaft not properly piloting in the bored hole of the wheel, or the wheel hub itself is cracked. Of course, there is always the possibility that the car was dropped or ejected from the table during the heat of battle during a race, and landed such that a wheel or axle was bent. I have bought many “service” rear wheel/axle assemblies and found them to be just as bad as the wheel/axle assembly that I am trying to replace. Often, I end up using one wheel from the service wheel/axle and one from the original car to make one “good” assembly.

If you own a small lathe you could attempt to fill the plastic wheel axle hole with epoxy, carefully chuck the wheel and drill a new pilot hole. An alternative to all of this is to convert the car to a “Modified” and replace the crummy plastic wheel with precision turned wheels from aluminum, magnesium, or a tough plastic like Delrin.

If you go the aluminum wheel route most clubs require an “insert” to give the wheel the appropriate appearance. There are many plastic and resin inserts which you can fit to a precision turned wheel.


Here is an example of a model kit (Lindberg Datsun 280Z body) being adapted to a Scalextric MG chassis. The skinny MG plastic wire wheels were replaced with CB Design 14 x 7 (front) and 14 x 8 (rear) aluminum insert wheels. The images of the BRE 240Z Datsun that I found on the internet showed a wide 4 spoke as well as Minilite wheels on the car. I chose to use CG SlotCars 14 mm Minilites. Note I had to shorten the MG chassis to fit the body, (which makes me think the Lindberg is not true 1/32 scale), so bonded the front/rear back together with blobs of JB Weld epoxy. The extra long axles are for checking the wheelbase, to make sure it is exactly the same on each side of the car as the epoxy is curing. Short axles will be put on the car when finished. Decal set is from Jeff Sinfield, www.ebay.com/str/toycardecals.

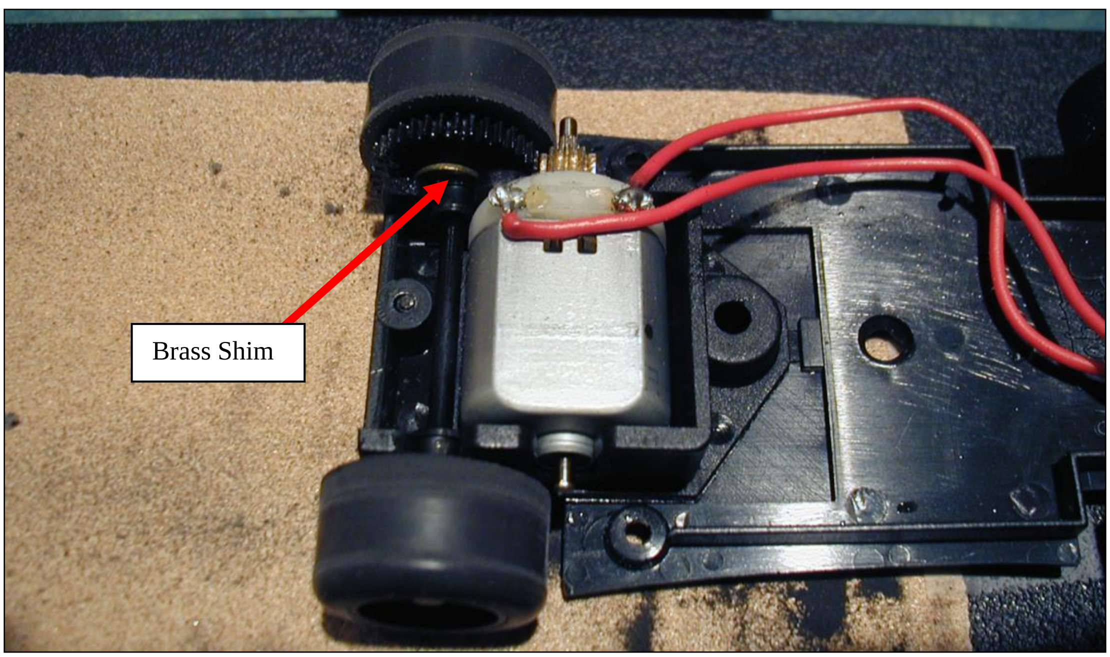
Tire Tuning, (Run Sanding)

If you are using the "new compound" silicone tires, attempting to run sand them is a moot point. The tire compound is so tough, sand paper will barely scuff the surface. You will spend hours on a tire razor sanding them to get a measurable change in diameter. Just rotate the mounted tire on the wheel slowly by hand to make sure it has minimal run-out, (wobble). The following discussion relates to tires which run sand easily, like Paul Gauge, Club Racer and Scale Racing tires.

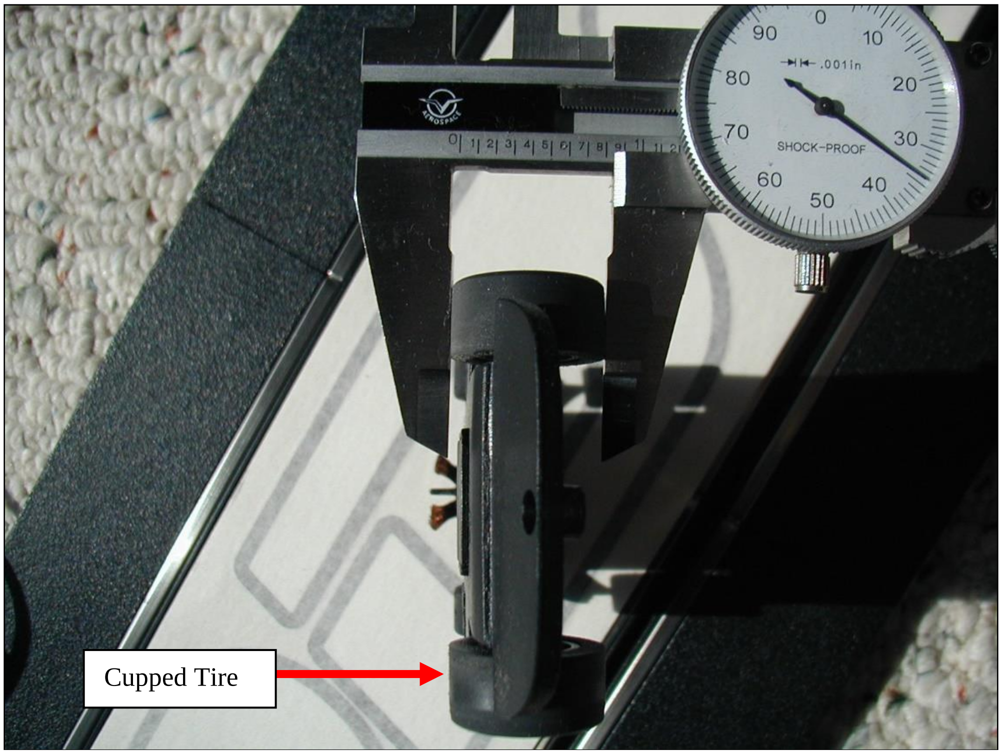
The best footprint for a silicone tire is **flat**, with radiused outer edge. As mentioned earlier, the outer transition from tractive footprint to sidewall should have a small radius. Run sanding of silicone tires should be done in two steps, first with 220 grit dry sand paper, then finished with 320 grit wet paper. The wet sanding will make the tire smoother for better grip, (increased surface area between the tire and track).

Remove the magnet before sanding the tires, so as to not over load the motor. Tape the sand paper down to the track and lower the rear tires of the chassis (with no body) onto the sand paper while the car is running at WOT. Gently let the tires scrub against the 220 grit dry sand paper with light strokes until the tire has sanding lines completely across it's surface. (Do not let the chassis bounce or 'chatter' as the tires are being sanded.) Do not let the motor bog down while run sanding the tires, it will overheat the motor and doesn't expedite the process. You will note the most slivers of rubber coming off the tires when the motor is turning high RPM. You should not see any "shadows" or shiny spots on the tire when nearly done. You will make a nice little pile of silicone rubber, with very little change in tire diameter (like 0.002 inch reduction in diameter, unless the tire is heavily cupped).

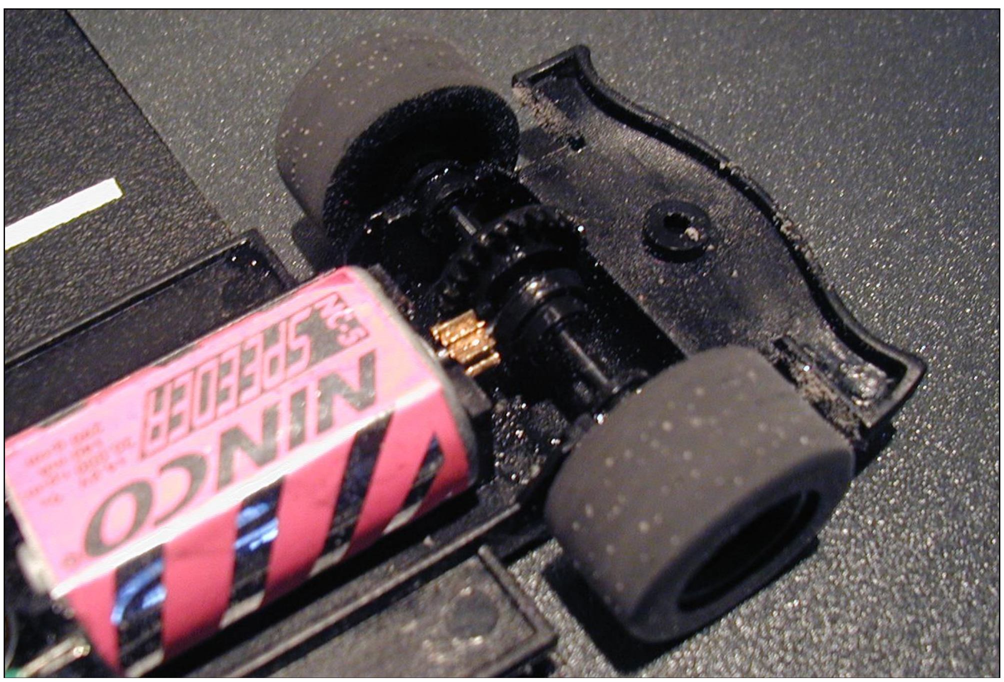
Measure each tire outer diameter with a caliper and equalize to the smaller of the two. During measurement, you will notice a slight drag when swiping the tire through the opening of the caliper. Then repeat with wet 320 grit sand paper. This whole process should only take a few minutes, don't go hog wild until you read the next section.



Scale Racing silicone tires mounted on a Fly Porsche 908 with rounded edge of tire facing outward. The rear end width has been maximized within body limits with shims on either side of the axle bearing. The chassis "down force" magnet has been removed, (See the next section on magnets for a Talladega tip before reinstalling the magnet), and the first step in run sanding of the tires has begun. Note that the tires are heavily cupped, (concave), as evident by only the edges of the tires being in contact with the 220 grit sand paper. These tires will have to be sanded until the entire width of the tire contacts the sand paper (no shine left in center of tire).



Measuring tire diameter on a Fly Viper. The tire will drag but pass through the jaws of the caliper, in this case at 0.834 inch diameter. Note tire not being measured requires more sanding to flatten the cupped center. The tires should not be cupped or tapered and should measure within 0.001” diameter of each other.



Club Racer tires on MRRC axle/wheels adapted to a Ninco Corvette are completely flat across after sanding with 220 grit. Tire O.D. has been equalized to 0.810 inch on each side. Now wet sand with 320 grit paper to reduce the sanding lines left by the 220 grit. As you can see, the chassis has silicone rubber debris that needs to be cleaned with a toothbrush and water. Then oil all axle bearings and gears with your top secret snake oil before remounting the body. See discussion on fluids and lubrication points later in this chapter.

Available tire sizes for Scalextric wheels vary the most. I've measured tires from 0.795 – 0.870 inch diameter. These same tires also varied tremendously in width, from 0.385 – 0.490 inch (with the smallest diameter tire also being the narrowest). The small tire allowed fun drift action on an inline motored Scalextric NASCAR stock car with a (weak) brown magnet. The tallest tire and aftermarket neodimum bar magnet made for a very grippy F1 car, (fast but boring to drive on Carrera track).

Rather than list available silicone tires for various cars, it is best to check availability on the internet. SuperTires, Slot Car Corner, Cloverleaf Racing, and Professor Motor are my recommended sites. The generally have the best application charts. If you want to run the stock tires, (because you like the way they look), they can usually be improved by run sanding as well. My experience, though, is that it is hard to beat a silicone tire.

Cleaning Silicone Tires

Car performance will degrade as the silicone tires pick up dust from the track. I think this is an interesting aspect of silicone tires, as you have to change your driving style as the tires "go away", just like a real car! A lot of Racers choose to clean their tires by swiping across the sticky side of a piece of masking tape. I have found that soaking a baby wipe with Simple Green or ZEP Industrial Purple de-greaser watered down 25:1 to be the best. De-greasers stronger than this may remove the Tampo printing on the slot car body. I take extra care and leave the wet baby wipe in a zip lock bag and only expose what is necessary to clean the tires, thus touching as little of the wipe and car as possible.

I know many people like to clean their tires using lighter fluid. They run them through a pool of lighter fluid on a sturdy (Formica or other type of laminated or sealed) table top. Then wipe off the dust and excess lighter fluid with a paper towel. I think this is a somewhat hazardous method of tire cleaning!

Be sure to dispose of the lighter fluid laden paper towel properly, (like putting it in an air tight zip lock bag), so it doesn't self combust!

I wouldn't put the lighter fluid on the track and drive the car through it to clean the tires, as it is only going to transfer the tire dirt to the track.

Tire Softeners

Tire softeners, (otherwise known as "traction compounds"), are effective at improving traction. This is especially true with the stock rubber tires on Sport/Scalextric cars.

You should never, never, never use real race car tire softening products such as Hot Lap or Track Claw. These are highly toxic and hazardous! They are likely to harm you, your slot car and track!

The product I am about to mention does enough damage to the paint (and possibly track surface) on slot cars. It is WD-40, a common household lubricant.

Talladega Tip #25. **Extreme care must be taken to avoid getting WD-40 on the painted surface of the car!** I have experience with this, trust me. If you even think you got some WD-40 on your hands, wash them before handling your cars. WD-40 will take the striping/lettering off the body and stock tires!

Spray WD-40 onto a folded paper towel and swipe the rear tires through the "wet spot" until completely cleaned. It works as a cleaner and softener. Do not touch the tires or wheels. Do not remove your run sanded tires to soak them in WD-40. It may be good practice to clean the tires before storing your car, so the softener has time to work.

If the tires coated with WD-40 leave a "wet streak" on the track, it is highly recommended that you immediately clean the track with Rhino blue or watered down ZEP degreaser. I don't know what the long term effects of WD-40 are on plastic or painted MDF track surfaces, and I don't intend to find out!

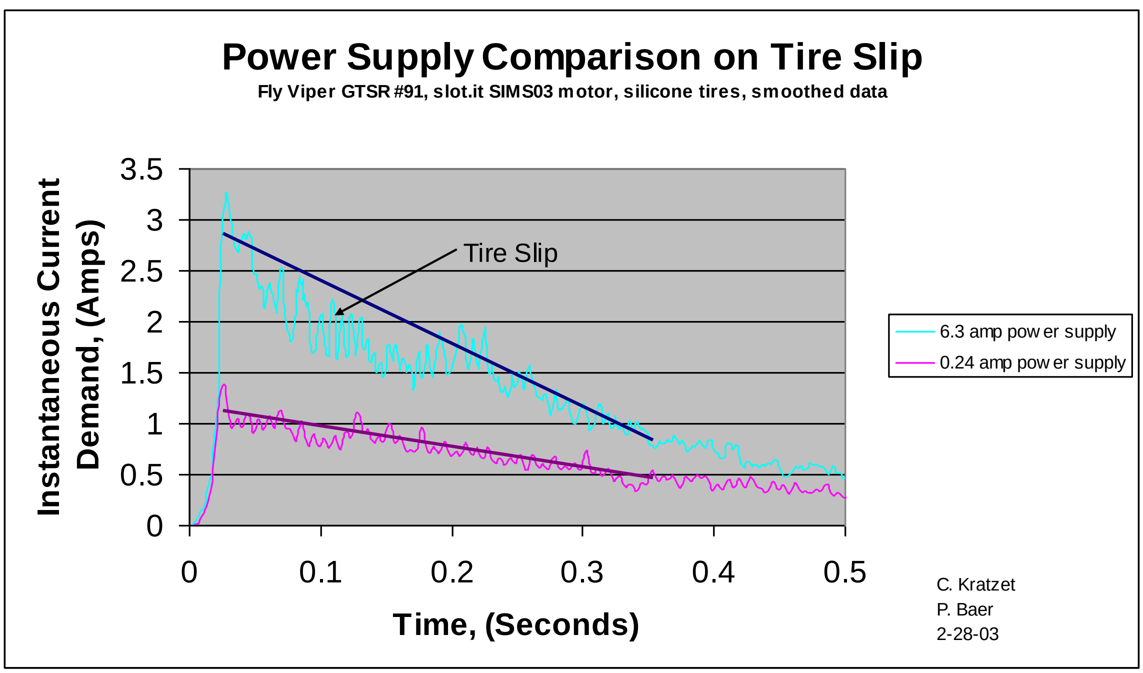
Tire Aging

Tires, large or small, continue to cure and oxidize over time. This means they harden and lose their grip as they age. I have experienced this racing against my peers with a car on old tires to their car with new tires. It was impossible to keep up with their new tires, (Couldn't possibly have been my driving!). Run sanding to remove the "glaze" helps, but to be competitive you really should replace (rather than treat) aged tires.

Your slot car should be stored so that the weight of the car is not resting on the tires, as this could lead to flat-spotting. I keep my cars in their display case and make sure I have enough spacer on the hold down screw to keep the car elevated so the tires don't touch the display base. Another plan might be to store your cars upside down so the tires are up.

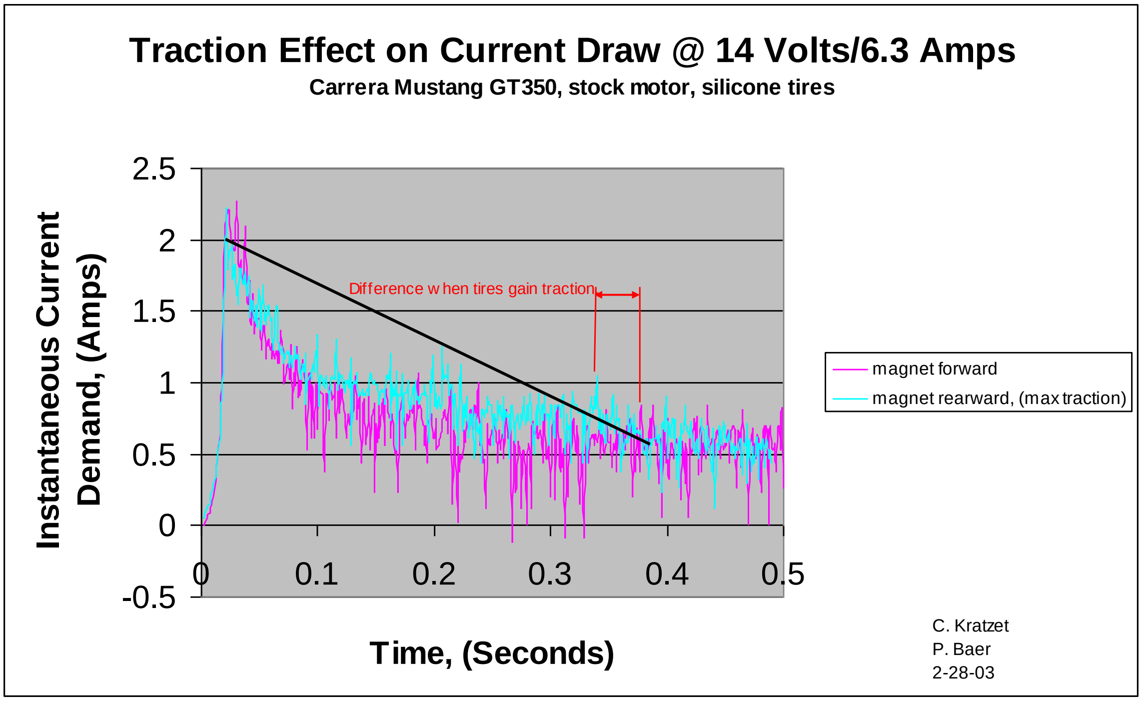
Experiments with Tire Slip, (See "Track Power" link on CNC Track Design website for more information)

The purpose of upgrading to silicone rear tires, run sanding them, and softening them with WD-40 is to improve traction, both at the starting line and through the corner. What does wheel spin (or more properly termed "tire slip") look like, from a current draw perspective? It is a drop in current demand due to reduced load on the motor. It is easiest to see after start-up demand as a sag or droop relative to the normal linear decay to running power demand. The graph titled "Power Supply Comparison on Tire Slip" shows that with the standard weak Carrera 0.24 Amp set transformer, start-up demand decays in a linear fashion. The car is not getting enough power to spin the tires from a dead start. With an ample 6.3 Amp power supply, you could hear the wheel spin and see a drop in current demand during the first 0.17 seconds of launching the car, (all experiments were run on Carrera plastic track).



A power supply with ample current will increase wheel spin (tire slip). Note there is virtually no tire slip with the 0.24 Amp standard Carrera set power supply, (linear decay of current demand). The silicone tires and grippy magnet on the Fly Viper result in a car that is "hooked-up" after 0.2 seconds.

A more dramatic example of tire slip is shown in the graph titled “Traction Effect on Current Draw @ 14 volts/6.3 Amps”. The Carrera cars have a sliding/sloped magnet holder that has a significant effect on magnetic down force. The Carrera Mustang GT350 (old chassis w/o rear axle magnet) smokes the rear silicone tires with ample current. Throttle induced oversteer can be invoked exiting any turn on a road course with ease, and that is with the magnet in the rear most (maximum traction) position! Most cars approach steady state current draw on the 6.3 Amp power supply after 0.35 seconds, and you can see from the graph that is where the magnet forward/rearward data starts to come together. The rearward magnet offers slightly more traction up to that point, as evident by the higher average current draw. However, the non-linear trend shows the car is spinning its tires from launch to at least 0.35 seconds.



Most Carrera slot cars have a sliding center magnet. The magnet is captured in a sloping groove that tailors the down force of the car. Moving the magnet in the rearward position on a Carrera Mustang increases traction, current draw, and lets the tires “hook-up” sooner.

Upon further investigation, we found magnets play a greater role than aero…FCA photo at Lockheed wind tunnel. Note this was Research and Development car #002, with tire set #11. Can you imagine how much 121 tests in the wind tunnel cost?

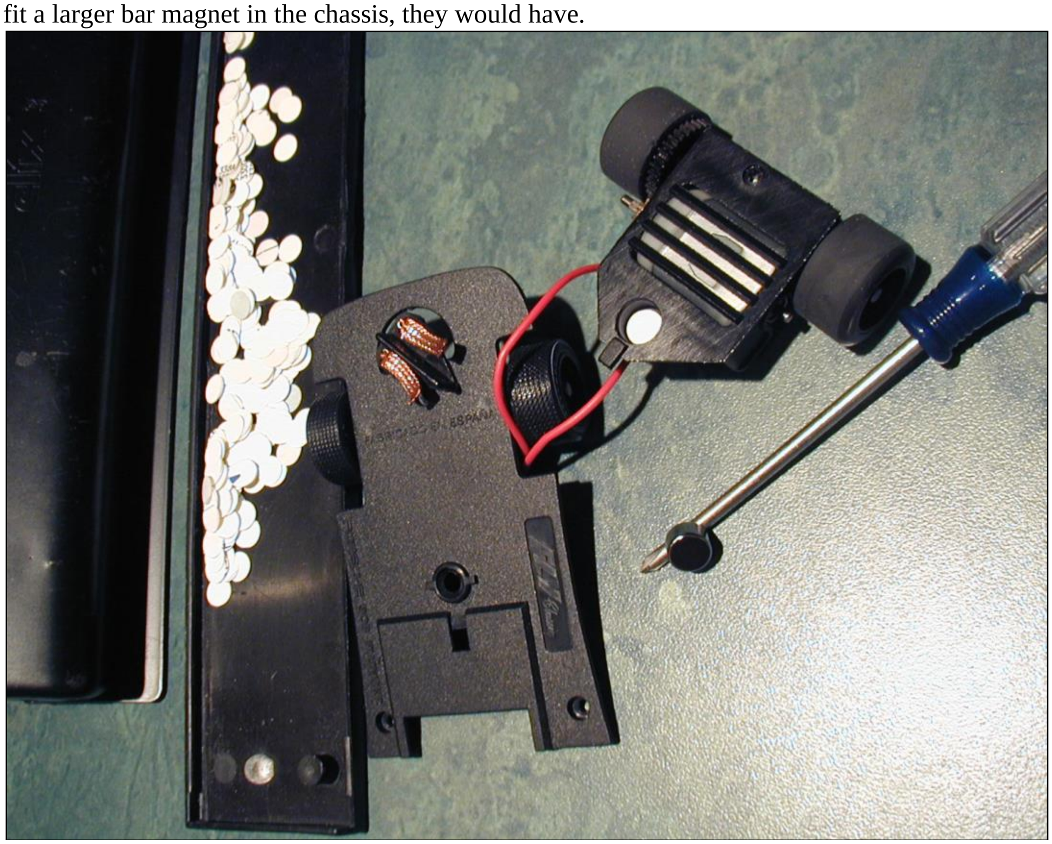
2. Chassis/Magnet

Chassis improvements relate mainly to magnet position (for plastic track or magnetic braid), or positioning of lead for non-magnetic racing. Some cars may need more flag travel, better bearing alignment or tighter clearance for the axles, or modifications for different wheels/tires. However, we will just discuss chassis details that relate to improving magnetic attraction and influence of mass and location of mass.

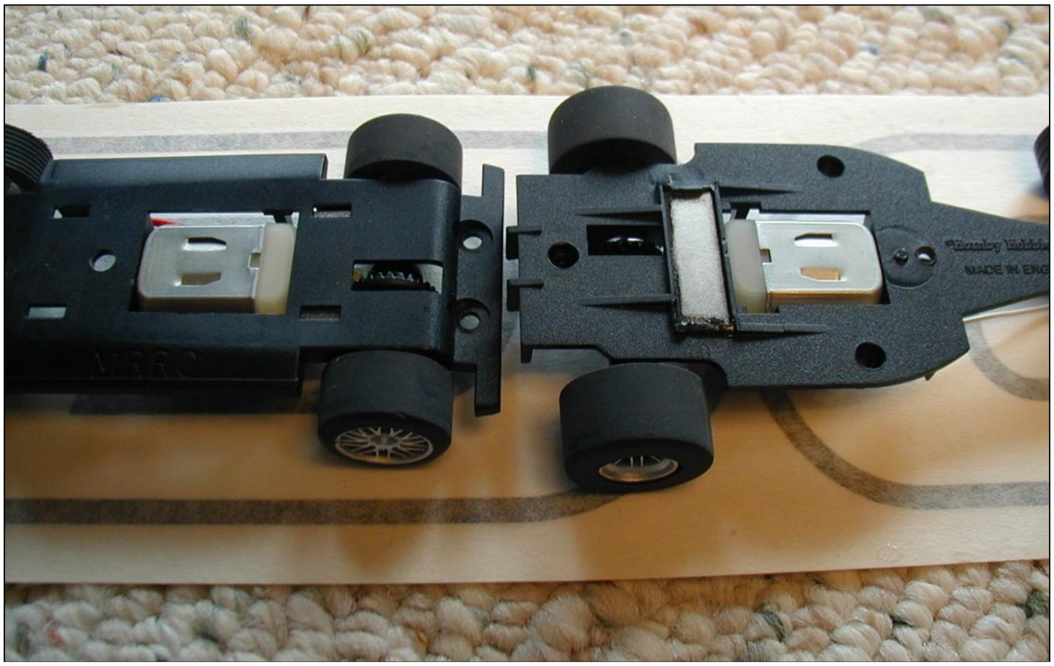
Magnet

Magnet to track rail clearance has a profound effect on vehicle handling. Reducing the clearance between the magnet and plastic track rail or magnetic braid improves magnetic attraction, making the car easier to drive through corners. Some loss of straight-line speed will occur as magnetic attraction is improved. However, making a car easier to drive, so it deslots less, is always a better compromise relative to the amount of lost speed. Note that it is not unusual to lose a lap to your competitor when retrieving a deslotted car.

Magnet size, location and/or strength are the variables that we need to 'tune' for each race car. Many cars, (Fly and Ninco in particular) use a single small round magnet. A nice upgrade for these cars is to modify the chassis for a neodimium bar magnet. These high power 25x8x2mm flat bar magnets are sold by Slot.it (SICN01), Professor Motor (variety of sizes), or come as standard on MRRC Cobra and Chaparral slot cars. Another possibility is to use a Slot.it "progressive" (SICN02 – 'C') bar magnet in addition to the standard round magnet, (packaging permitting). However, you'll generally find that if the Manufacturer could have fit a larger bar magnet in the chassis, they would have.



Paper punch shims can be used on some Fly cars with round magnets to position the magnet closer to the track for greater down force. Stack shims until the magnet is slightly proud of the motor/rear axle carrier surface. This will cause the front chassis to bow slightly behind the locating tab when reassembled, positioning the magnet closer to the track rails.

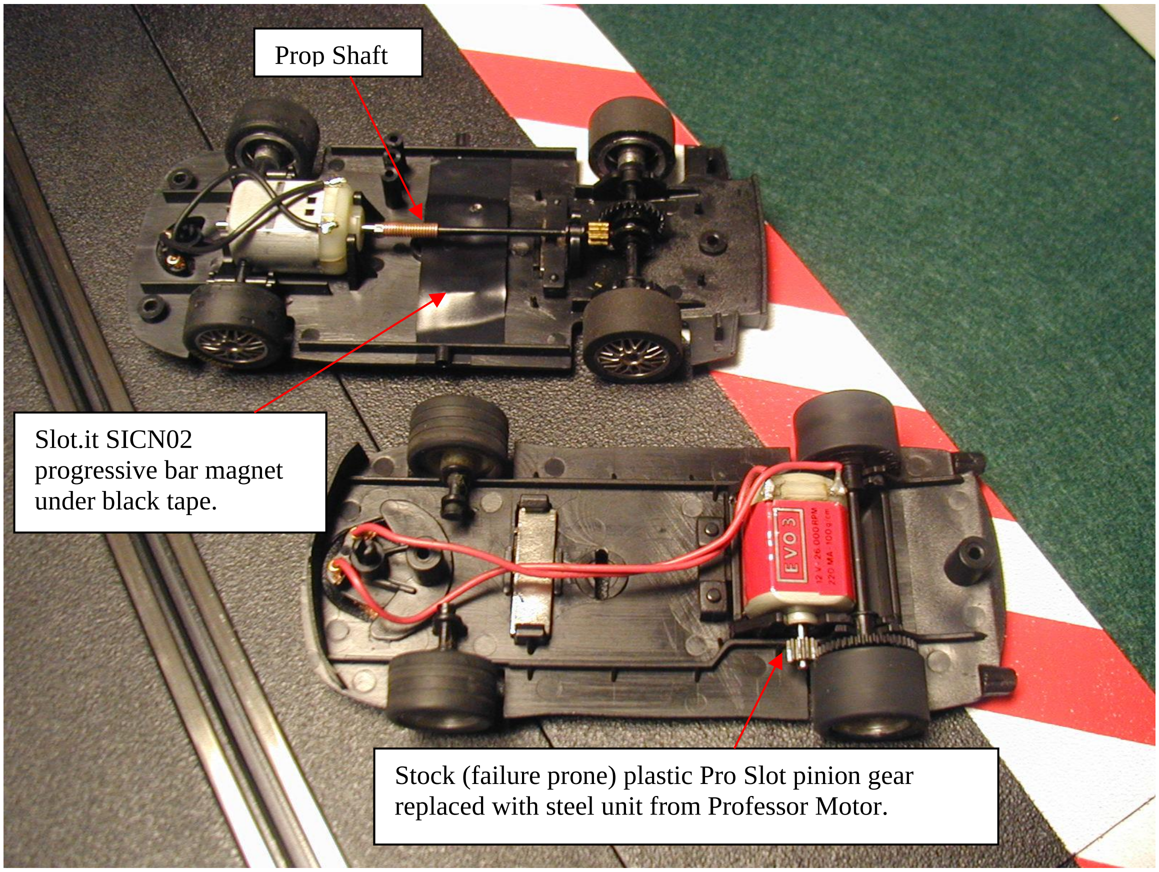

Two bar magnet cars. A MRRC Chaparral with Ninco BBC wheels to get the bar magnet hidden in the chassis closer to the track, (left). An old Scalextric F1 (non-Sport model) with exposed Slot.it SICN01 bar magnet and big honk'n tires. See the graphs for more details.

Inline motor cars with big bar magnets between the motor and rear axle seem to work the best, in general. See the MRRC Chaparral and old Scalextric F1 image at bottom of page 12. If your inline motored car came with a small or weak magnet, replace it or supplement it by adding an aftermarket bar magnet. In some cases, you may want to glue or epoxy the bar magnet directly to the underside of the car.

Talladega Tip #26. If you add a bar magnet to the underside of your car, you should shoot for at least 0.025" clearance (air gap) between it and the track. Layouts with elevation change or proud rails may require greater clearance to avoid the magnet contacting the steel rails and shorting the track!

Front motor/rear magnet cars also work well on Carrera track. Front motored cars have a "prop shaft' drive to the rear crown gear. The Fly Viper is one example of a front motored car that has decent handling with just the addition of silicone tires.

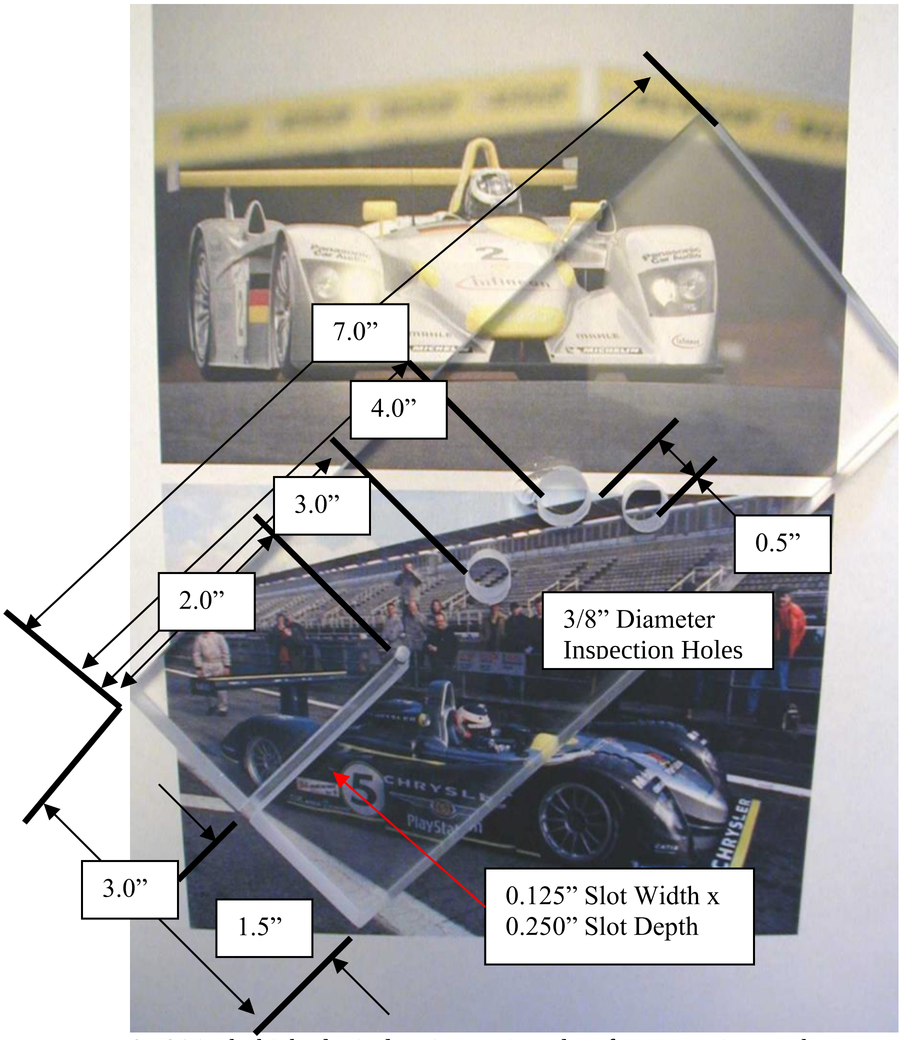
Exceptional handling cars which are not inline or front motor/rear magnet include the Fly Porsche 908/3 and Ferrari 512S, which have a single round magnet ahead of the sidewinder motor. Scalextric sidewinders also have the magnet ahead of the motor, but use a desirable large bar magnet. Other sidewinder motored cars do not handle as well. For example, the Fly Porsche 917 series cars are best described as 'ill' handling even though they have a similar magnet location to the Ferrari 512S cars. Thus, one would conclude that there are other factors that effect handling as well, (see Wheelbase, Body Overhangs and CG discussion).



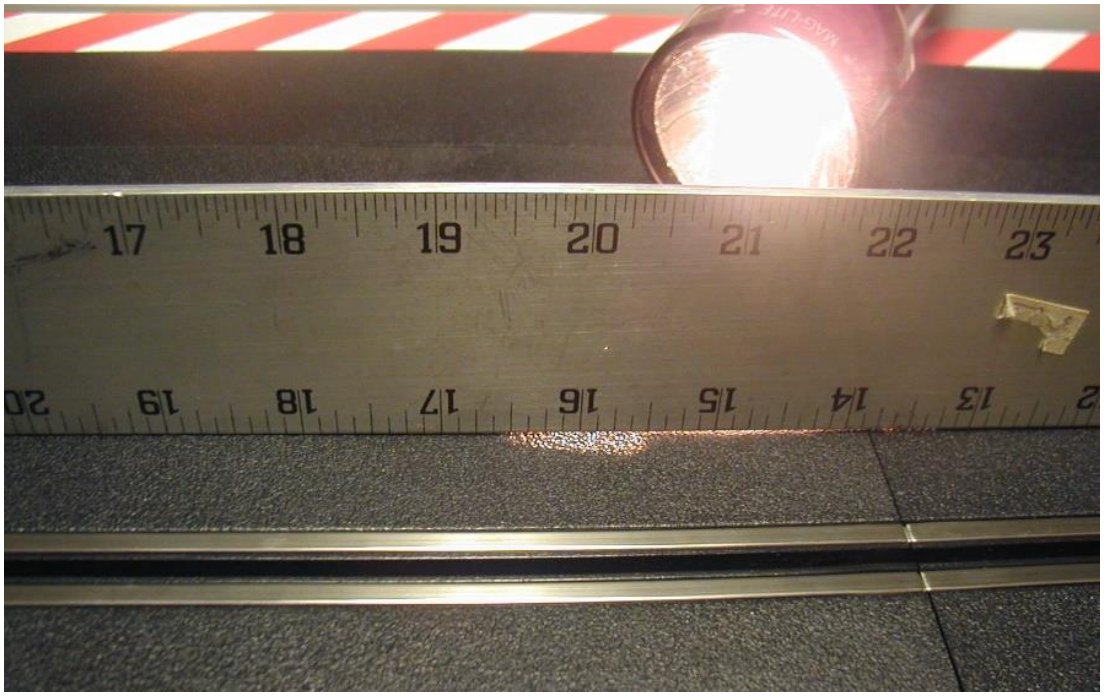
A Fly Corvette chassis (top) exposed to show its front motor with "prop shaft" drive. Adding a Slot.it "progressive" (SICN02 – 'C') bar magnet behind the hold down tab (underneath black tape) adds enough incremental grip to the stock magnet to make it handle on par with a Fly Viper. Sidewinder chassis typically have a large bar magnet ahead of the motor, because there is no other place to package it. The Pro Slot Porsche 911 Carrera chassis (foreground with red Evo 3 motor) has the magnet well ahead of the motor, almost in-line with the front axle. This makes for a very loose handling car that almost never de-slots. Very fun to drive!

To benchmark the handling differences between different cars, we need a way to measure magnet clearance. (For example; Fly Ferrari 512S has no better magnet location and clearance to the track than the Porsche 917 cars. This leads one to conclude that body overhangs play a significant role in handling, as will be discussed later.)

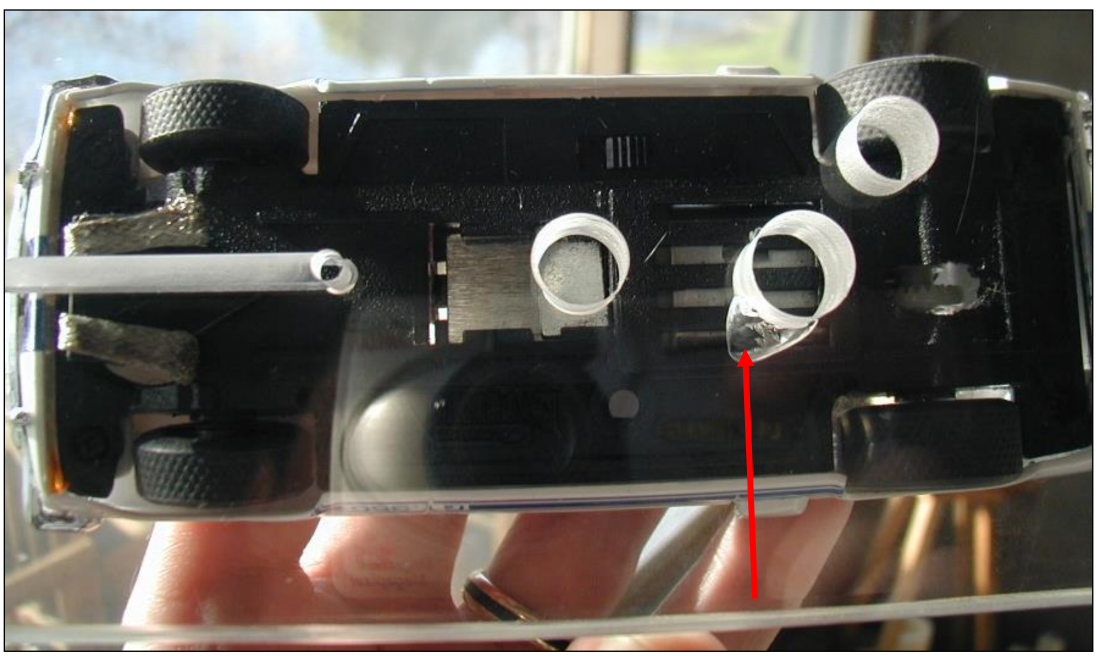
The chassis or magnet to track clearance can be measured with a depth micrometer and fixture plate. The fixture is easiest to use if machined from clear plexi-glass, but aluminum could be used as well. Just mill a slot 0.250" deep by 0.125" wide into a 4" wide by 7" long piece of 0.5" thick stock. Drill multiple 0.375" diameter inspection holes to accommodate cars with different magnet positions. Use the depth rod of the micrometer to measure through the inspection plate to the magnet surface on the car. Then subtract out the thickness of the plate to determine the air gap between the magnet and the track. The plate can also be used to make sure the tire patches of all 4 tires are planar. This is best done by backlighting and sighting along the surface of the inspection plate.



0.486 inch thick plexi-glass inspection plate for measuring track to magnet clearance. These can be purchased or made from either plexi-glass or aluminum plate. I prefer the clear plexi-glass, for obvious reasons when you are trying to determine if all 4 tires are planar/touching and to determine the magnet to track air gap distance. **This is an invaluable tool for setting up your car. You will be amazed how many cars will be resting on 3 wheels in stock form!**



Plastic track may seem flat, but… I wouldn't set up a car on anything but a dedicated, flat, clear inspection plate.


A Carrera Mustang with mid-mounted magnet utilizes the first inspection hole for checking magnet to track clearance. I chipped the plexi-glass while drilling the middle hole, and had to go oversize for clean-up.

Talladega Tip #27. Drilling plexi-glass requires special care not to overheat the material! Drill a short depth, then let the drill cool before continuing to proceed. Drilling a small pilot hole is a good idea, but step your way through the material. I blew-out a chunk of material while getting too aggressive with a 3/8" drill bit, and had to go oversize on the middle hole to clean up the rough edge.


Use a depth micrometer or depth rod ‘tail’ of a caliper to measure from the underside of the fixture plate to a point on the chassis in line with the magnet. Backlight the fixture plate so you can sight along the plate surface to make sure all 4 tires are touching and the base of the caliper is square. Table 1 on page 17 shows measurements I have made using a 0.486 inch thick plexi-glass inspection plate.

Whilst you have a car, inspection plate, and a caliper in your hands, you might as well take some other measurements. Table 1 shows some important measurements for a variety of cars. The most important dimension is the magnet to track clearance, highlighted in red. This is an in-direct measurement, as the thickness of the inspection plate is subtracted from the physical measurement (“magnet inspection” column) made through the plate to the underside of the car. For my 0.486” thick inspection plate:

Magnet Inspection – 0.486” = Magnet to Track
Example: 0.613” – 0.486” = 0.127” for an MRRC Chaparral with 0.801” tall tires.

On some cars this is a true measurement to the magnet, (if the magnet is exposed), on other cars it is to the underside of the chassis. You would have to add the thickness of the chassis under the magnet for a true magnet to track clearance.

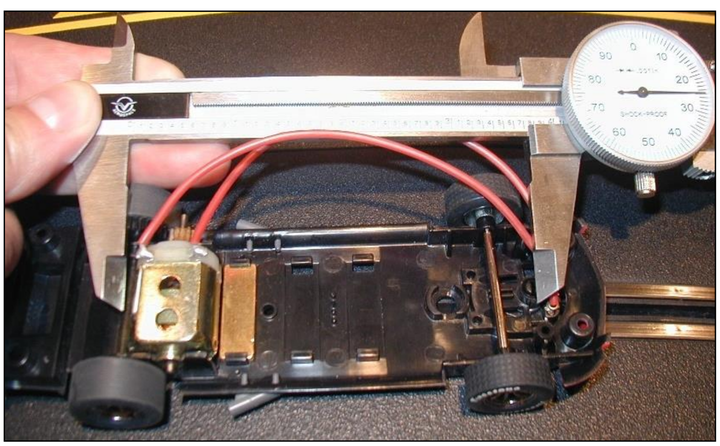
All of the cars listed have silicone rear tires. Note the rear tire diameter is a factor in magnet to track clearance. However, magnet to track clearance only changes at half the rate of change in tire diameter.

Wheelbase and Magnet to Track Clearance for a Variety of Slot Cars

			Wheelbase inch	Rear Axle to Rear Over Hang inch	Rear Over Hang as a percentage of Wheelbase	Rear tire dia. inch	magnet inspection inch	magnet to track inch
Carrera	Mercedes F1 Mika	1	3.385	0.625	18.5	0.875	0.600	0.114
Carrera	Chevrolet Corvette	427	3.195	1.340	41.9	0.830	0.624	0.138
Carrera	Ford Mustang	GT350	3.610	1.160	32.1	0.822	0.643	0.157
Carrera	Pontiac GTO		4.035	1.725	42.8	0.830	0.625	0.139
Fly	Dodge Viper GTSR	91	3.583	1.390	38.8	0.834	0.534	0.048
Fly	Porsche Gulf 908/3	1P	3.520	0.553	15.7	0.818	0.575	0.089
Fly	Ferrari 512S	22	3.655	0.910	24.9	0.820	0.608	0.122
Fly	Lola T70 MKIIIB	1	3.510	1.100	31.3	0.817	0.584	0.098
Fly	Porsche 917 Spyder	0	3.495	0.800	22.9	0.823	0.597	0.111
Fly	Porsche 917-K	23	3.455	1.140	33.0	0.820	0.575	0.089
Ninco	Mercedes CLK GTR	10	3.957	1.250	31.6	0.801	0.613	0.127
MRRC	Shelby Cobra Tango	146	2.937	1.110	37.8	0.837	0.661	0.175
MRRC	Chaparral Can-Am	65	3.379	0.730	21.6	0.801	0.613	0.127
Scalextric	Cadillac LMP	1	3.712	0.565	15.2	0.825	0.583	0.097
Scalextric	Ford NASCAR inline	2	3.900			0.795	0.519	0.033

Table 1

I define “wheelbase” as the distance from the pivot point of the guide shoe to rear axle centerline. This is not the typical wheelbase of a car, which is centerline of front wheel spindle to rear axle. However, the pivot point of the guide shoe determines the turning point of a slot car, not the front tire patch. The front tires on a slot car merely limit front roll angle, if vertical axle motion is limited.



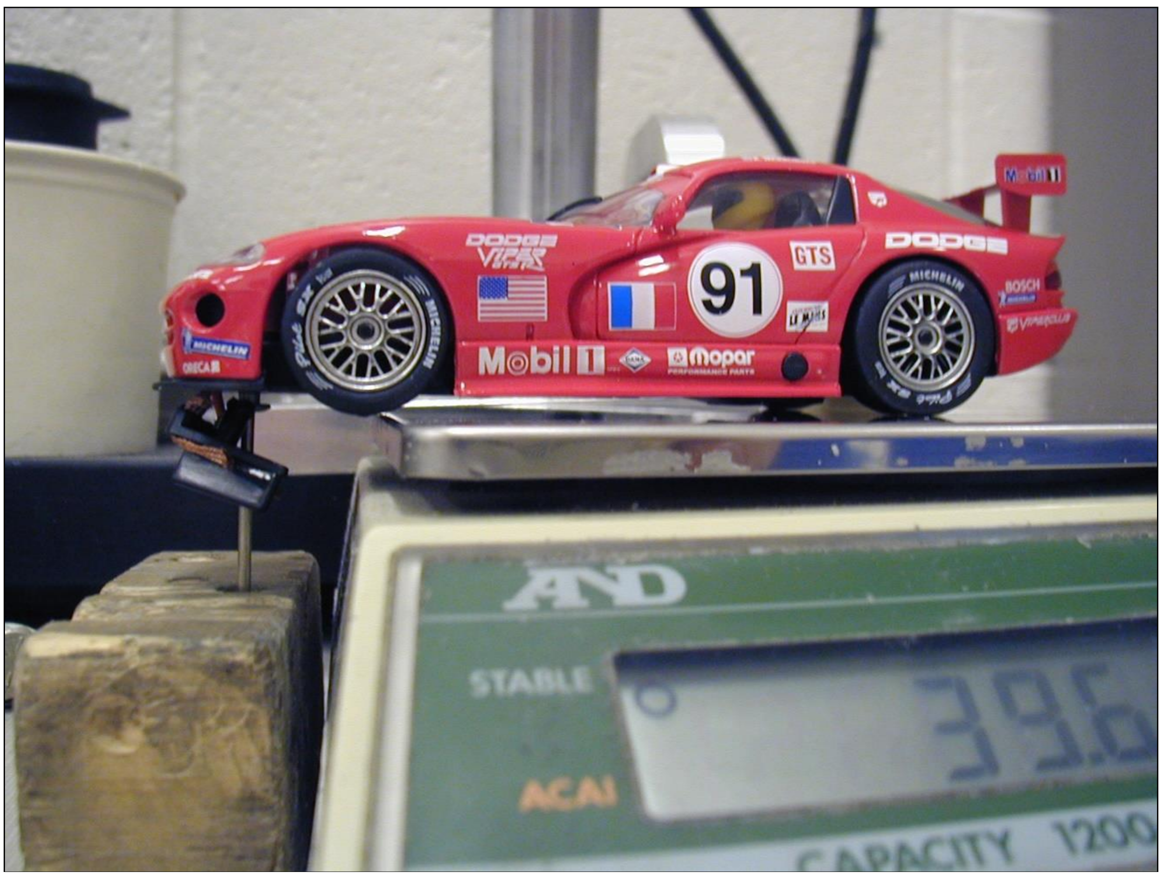
The wheelbase of a slot car is measured from the pivot point of the guide shoe, to the centerline of the rear axle. At 3.725” the Scalextric Trans-Am Mustang (above) is average among the cars in Table 1. Please ignore the Slot.it SIMF03 29,000 RPM motor, Professor Motor PMTR4571gold plated Neodymium traction magnet and IG1009 new compound Indy Grip silicone rear tires…they only turn this car into a real animal when magnet racing! The motor leads plug directly into a MRRC pick-up shoe, eliminating the standard Scalextric spring/sliding contact interface. The MRRC pick-up shoe must be shimmed 0.050” down towards the track via adding a washer between it and the chassis. I also had to shorten the motor shaft, (opposite of gear end), to clear the body. When grinding to shorten a motor shaft, remove tiny amounts of material at a time, and cool the shaft with water so you don’t overheat the internal motor components and plastic end bell.

Rear axle to rear overhang is a somewhat subjective measurement, as it is to the rearmost piece of body work on the car. Some cars have a rear spoiler that adds to the rear overhang, but not significantly to rear weight bias. Others are truly tail heavy. As the percentage of rear overhang becomes a greater percentage of the wheelbase, you are looking at a tail happy car, or one that is more likely to exit the track via oversteer.

Weight and % Bias

Since we are talking about weight, rear weight bias, etc., we might as well locate a (preferably accurate gram) scale. Total vehicle weight is easy to measure, just set your car on a scale. Measuring the weight on just the rear tires (to determine rear weight bias) is a bit tricky. I remove the vehicle guide shoe and insert an un-used pop rivet, with the nail point down. Set the rear tires of the car on the scale and use wood blocks/wedges to get the car horizontal and the rivet perfectly vertical.

$$\text{Rear weight bias (\%)} = \frac{\text{vehicle weight on rear tires only}}{\text{total vehicle weight}} \times 100$$



Vehicle rear weight determination: Pop the guide shoe loose and insert an un-used rivet into the pivot hole. Level the car with wood blocks/shims, and make sure the front tires are NOT touching the scale. The rivet should be perfectly vertical, the car perfectly horizontal. I would expect you crafty types to make a small screw jack so you don't have to play with shims…

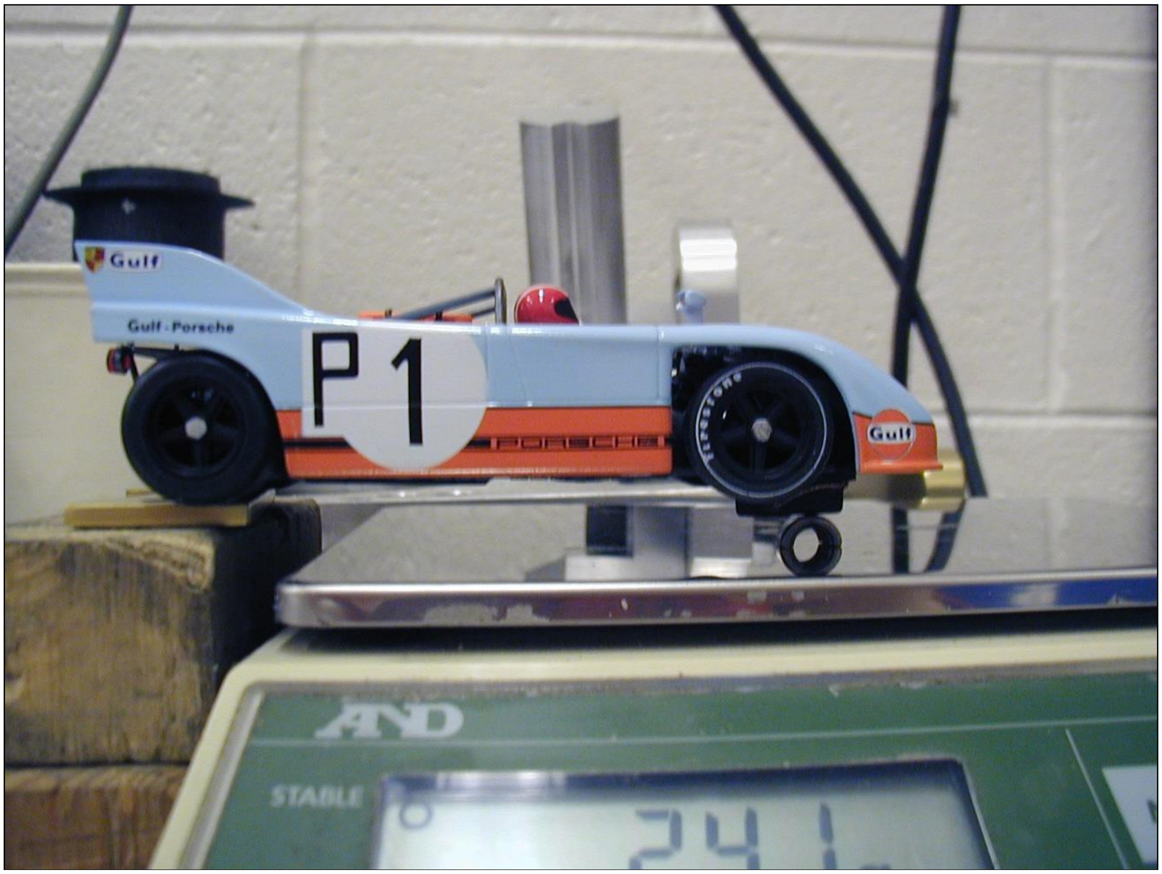
Table 2 shows weights for some of my cars. It is interesting to note that some cars drive better than others, even though they have similar weights. For example, a Fly Lola T70 handles better than a Fly Porsche 917-K. The Lola is 3.5 gm heavier, and has 4.5 gm more weight on the rear tires than the Porsche. Obviously, there are other factors which determine how well a car handles other than just rear weight bias.

Weight and % Rear/Front for a Variety of Slot Cars

Manuf	Model	Number	Measured Total	Measured Rear	% Rear	Calculated Front	% Front	Measured Front	% Front	% Error Band
Carrera	Mercedes F1 Mika	1	74.4	38.3	51.5	36.1	48.5	36.6	49.2	0.7
Carrera	Chevrolet Corvette	427	82.1	50.2	61.1	31.9	38.9			
Carrera	Ford Mustang	GT350	86.3	51.4	59.6	34.9	40.4			
Carrera	Pontiac GTO		108.4	58.1	53.6	50.3	46.4			
Fly	Dodge Viper GTSR	91	70.3	39.6	54.9	31.7	45.1	32.0	45.5	0.4
Fly	Porsche Gulf 908/3	1P	68.5	44	64.2	24.5	35.8	24.1	35.2	0.6
Fly	Ferrari 512S	22	69.9	47.2	67.5	22.7	32.5			
Fly	Lola T70 MKIIIB	1	80.3	54.9	68.4	25.4	31.6			
Fly	Porsche 917 Spyder	0	67.6	43.7	64.6	23.9	35.4			
Fly	Porsche 917-K	23	76.8	50.4	65.6	26.4	34.4			
Ninco	Mercedes CLK GTR	10	96	63.4	66.0	32.6	34.0	31.9	33.2	0.7
MRRC	Shelby Cobra Tango	146	69.9	37.1	53.1	32.8	46.9	33.1	47.4	0.4
MRRC	Chaparral Can-Am	65	63.1	39.5	62.6	23.6	37.4	24.1	38.2	0.8
Scalextric	Cadillac LMP	1	75.2	42.5	56.5	32.7	43.5	32.2	42.8	0.7
Scalextric	Ford NASCAR inline	2	89.2	58.1	65.1	31.1	34.9			
Scalextric	Ford NASCAR inline	6	88.3	58	65.7	30.3	34.3			
Scalextric	No interior	6	74.6	49.1	65.8	25.5	34.2			
Scalextric	chassis only	6	53.4	34.2	64.0	19.2	36.0			
Scalextric	Benetton F1	2	56	33.8	60.4	22.2	39.6			
Scalextric	chassis only		47.3	29.3	61.9	18	38.1			
Scalextric	F1 + NASCAR		82.5	51.3	62.2	31.2	37.8			
	No interior		68.9	44.5	64.6	24.4	35.4			

Table 2

Note that the error in my calculated front weight (front = total – rear) vs. measured for a variety of cars was less than 1% of total vehicle weight. Front vehicle weight (point measurement at the guide shoe pivot point) is measured in a similar manner to the rear.



Front vehicle weight is accomplished in a similar manner to the rear. However, the pop rivet should be shortened as I found it easier to level the car when it is close to the scale. I used a valve spring retainer lock in this case, with the contact point with the guide shoe directly beneath the pivot point. Be sure to zero the scale with the rivet or retainer lock, so it doesn't falsely contribute to the weight of the car!

I would recommend that you measure the following parameters for all of your slot cars:

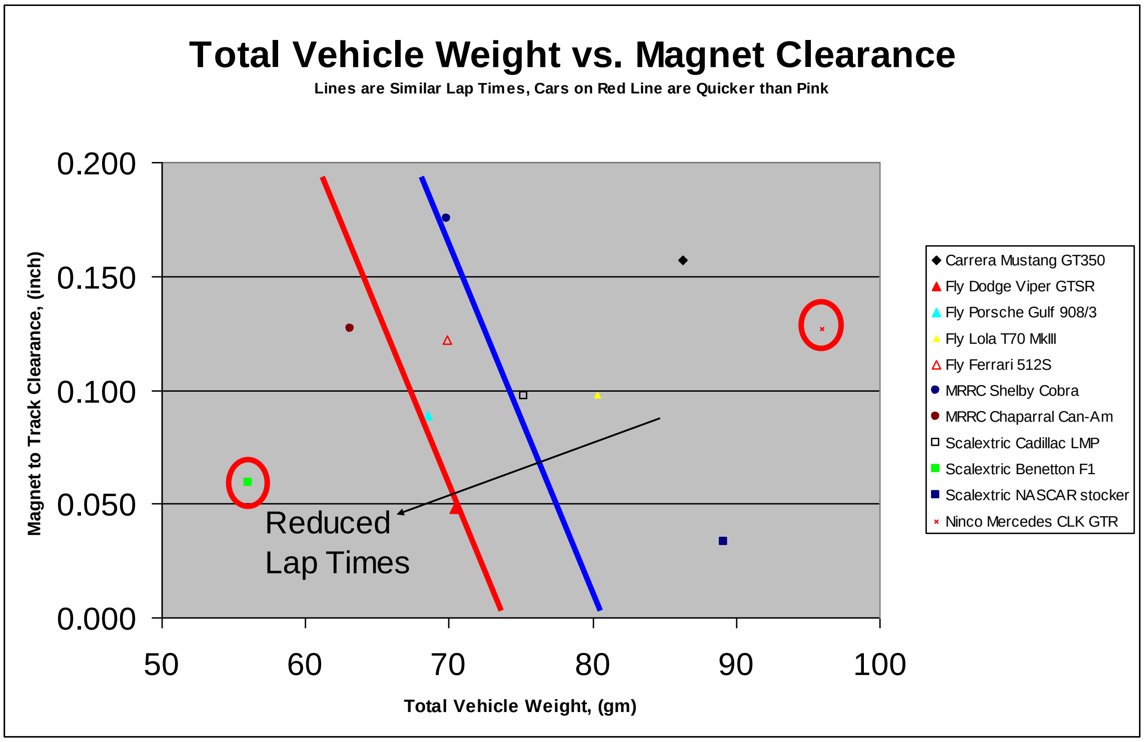
- Total weight, (gm)
- Rear weight bias, (%)
- Rear track width from outer edge of tires, (inch)
- Rear silicone tire brand and model number
- Rear tire O.D., (inch)
- Rear tire width, (inch)
- Magnet to track air gap, (inch)
- Wheelbase, (inch)

As you plot these parameters against each other, you will see some trends emerge. If you can put some relative lap time measurements on your car database, then you will be able to determine your own "rules" for improving your slot cars, for the type of tracks and your driving style. Of course, the rules are different for "Magnet Racing" vs. non-magnetic braid racing. Assuming you race on both types of surfaces, you will want to have cars "tuned" for each type of racing.

In SE Michigan, the club that I belong to runs mainly non-magnetic braid racing. However, there are magnetic braid races as well and a Magnet Marshal is used to set the downforce limit for each event.

Plotting magnet to track clearance vs. total vehicle weight and overlaying lines for similar lap times shows there is a steep relationship. If a car on the blue line wants to improve it's time to those cars on the red line, it needs to lose about 8 gm of weight. If you can't get the weight out of the car, then you must reduce the magnet to track clearance significantly to get the same lap time improvement. See graph titled "Total Vehicle Weight vs. Magnet Clearance". Some cars are almost beyond help, like the Ninco Mercedes CLK GTR. It is too heavy, and has an average track to magnet position even with small tires. Its long wheelbase and mid-mounted magnet position make it a long pendulum, resulting in easy to control drift action, but poor overall lap times.

Note by the slopes of the parallel red and blue lines for cars of similar performance in the graph titled "Total Vehicle Weight vs. Magnet Clearance" that from a percentage standpoint, it is far more effective to reduce vehicle weight than reduce magnet to track clearance to improve performance. Makes you want to gut the interiors out of your cars to put them on a diet – eh!



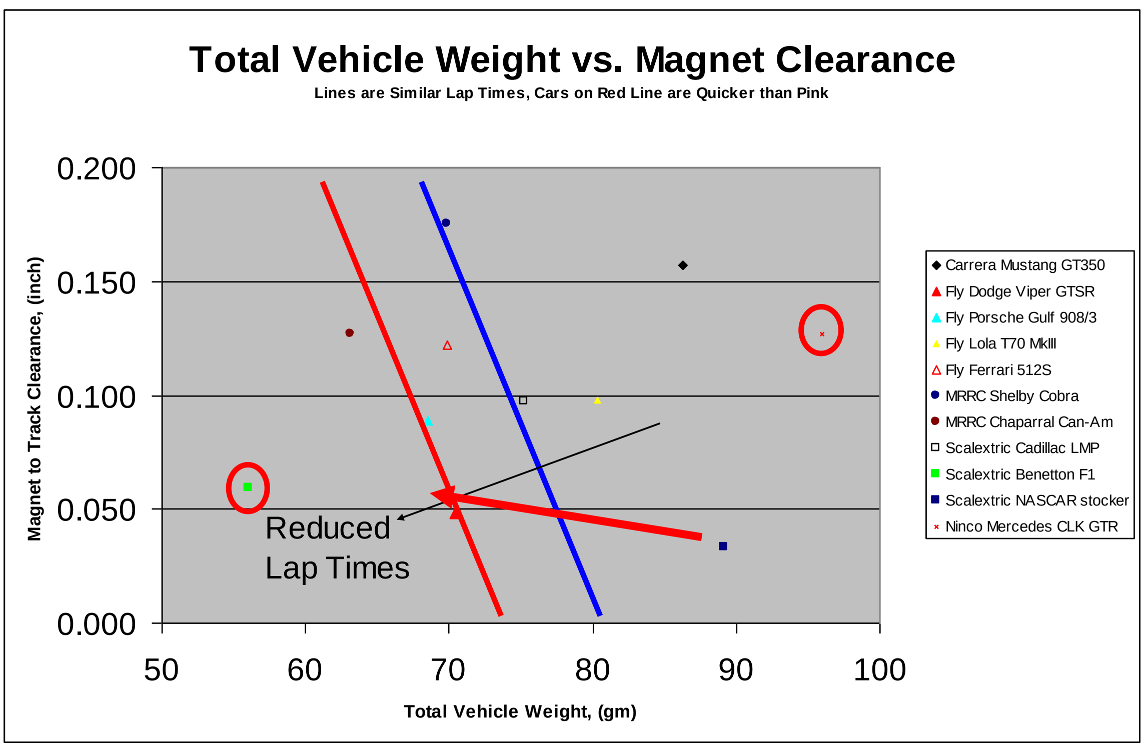
Graph of total vehicle weight vs. magnet clearance, with an indication of the relationship to reduce lap times. Cars become "quicker" as the total weight is reduced. Cars become easier to drive as the magnet to track clearance is reduced. Parallel red and blue lines are for similar performing cars, with cars along the red line being quicker. The slopes of the lines show the relationship between total vehicle weight, magnet to track clearance, and lap time. Two similar performing Fly cars – the Dodge Viper and Porsche 908/3 vary in weight by 2 grams and track to magnet clearance by 0.040 inch. You can see how important the weight factor is!

Magnet Racing adds a lot of drag to what could be considered a low power/weight vehicle. This is why light weight is so important to Magnet Racing.

To sum up what we have learned thus far, Magnet Racing favors:

- Biggest possible silicone tires.
- Lightest car, for best power/weight ratio.
- Reduced magnet to plastic track or magnetic braid clearance.

To show you how effective this is, I took the Scalextric Benetton F1 chassis and put a Scalextric NASCAR body on it. This reduced the Scalextric NASCAR weight from 89 to 69 grams and got much wider rear tires. The body was lightened by grinding on the inside to thin it, and replaced the interior with a Champion Lexan sheet. The body was mounted with a pin on either side, and then supported at the front with a post – this allowed the body to "float" on the chassis. The magnet was replaced with a "Neo" bar, see image below. With Indy Grip 1001 tires (wide and hard, not the best for grip but good for low rolling resistance with the high downforce magnet) the F1/NASCAR hybrid car should have run with a Fly Viper, (red arrow in graph below), but was actually over 6% quicker. That is a bunch!

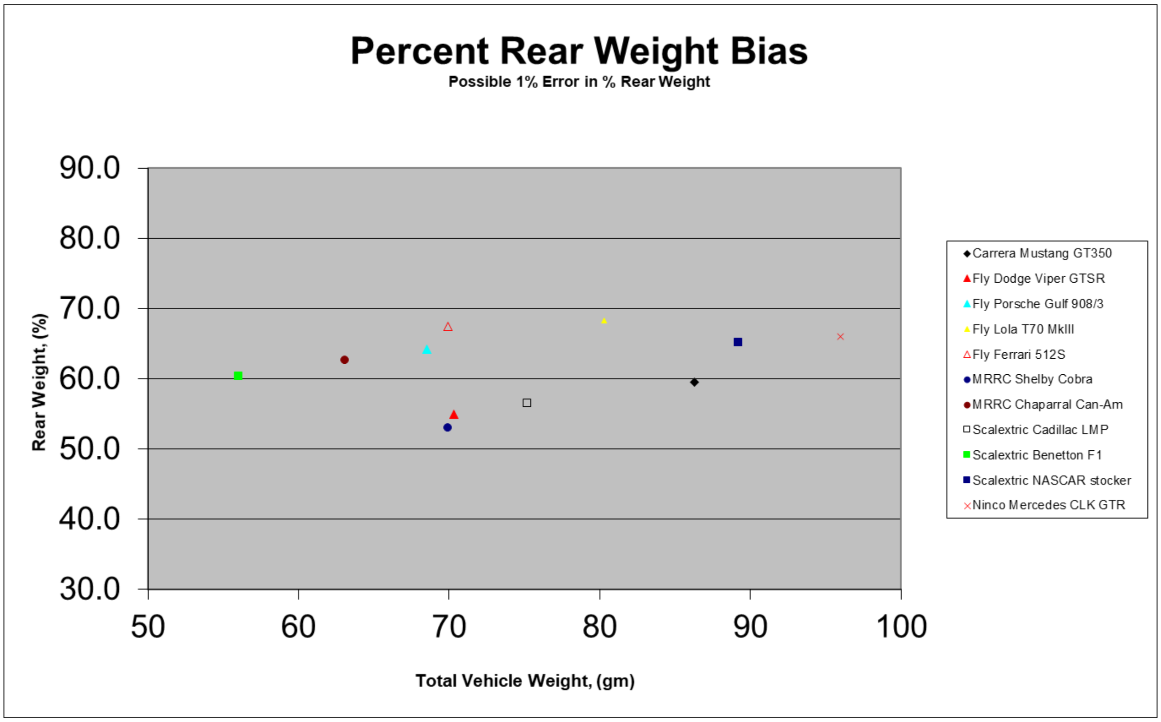


Rear Weight Bias for Non-Magnetic Racing

Some people *add* weight to the front of a car to reduce its tendency to de-slot. However, this reduces the acceleration of the car, especially out of low speed corners. Instead, they should be looking at the percentage of weight on the rear tires. There is a fairly consistent trend among slot cars to have approximately 60% rear weight bias, see graph titled, "Percent Rear Weight Bias".

Talladega Tip #28. The best performing non-magnetic cars have 2/3 rear weight bias.

I have arrived at this "2/3 rule" thru experimentation. You can see that some cars are at 2/3 or 66.6% from the Manufacturer, like the Fly Ferrari 512S. This is a very good car with just the addition of silicone tires. Other cars will need lead ballast to improve the rear weight bias from < 60% to achieve 66.6%. Of course, adding lead hurts the power/weight ratio of the car, so you are better off to start with a car that has the right rear weight bias from the Manufacturer.



If you start with a car that has a low rear weight bias, the data point will move to the right and up as you add lead weight. This will make the car easier to drive, (slower accel/decell, but handle better in the corners), and improve lap times.

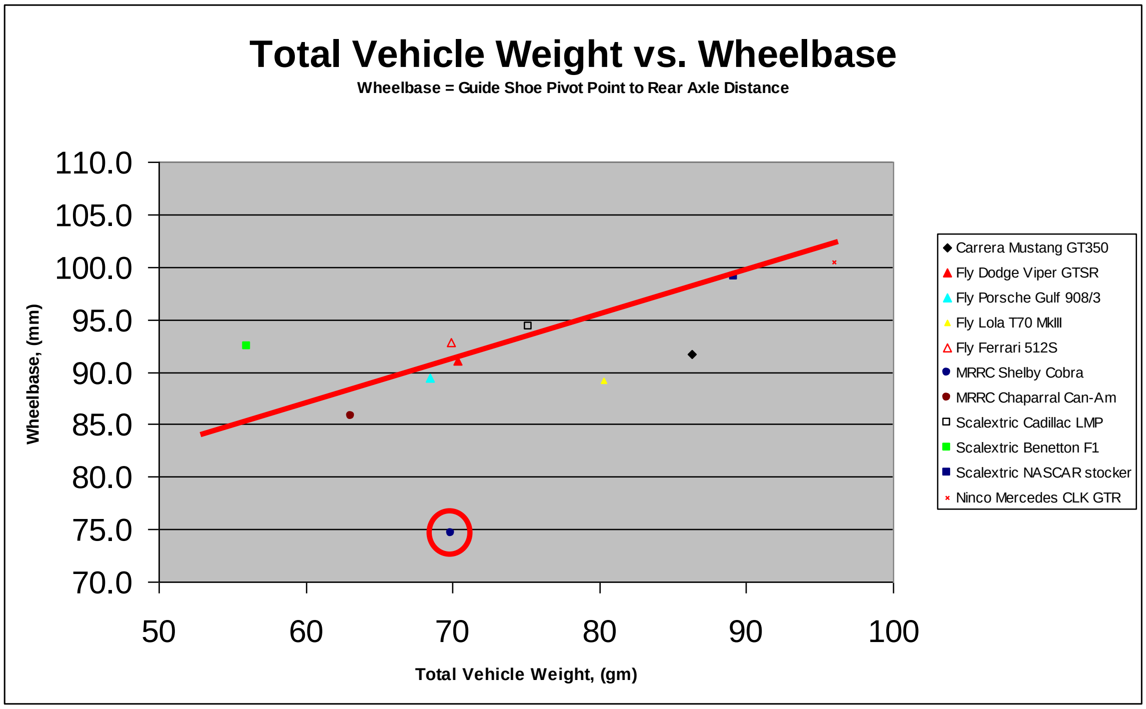
Specifications for my track record setting Scalextric 1969 Camaro Trans Am, (Note, we race @ 9 VDC):

Total Vehicle Weight	90 gm
Rear Weight Bias	66.6%
Rear Track Width	2.380"
Tire	SuperTires 1405 RC
Tire O.D./Width	0.794" O.D./0.375" Wide
Power	10.6 Watts, Scaleauto SC-0009 TECH-2 motor, 25K @ 12 V
Power/Weight	0.1178W/gm
Pinion/Spur Gear	13/35 Tooth
Final Drive Ratio	2.69

Wheelbase, Body Overhangs, and CG

There is a fairly strong relationship between wheelbase and weight, see graph titled, "Total Vehicle Weight vs. Wheelbase". In general, the shortest cars are the lightest. The cars that fall from the linear relationship do so for a reason. For example, the MRRC cobra has the guide shoe tucked under the bodywork for aesthetic reasons. The pivot point of the guide shoe really wants to be much further ahead of the front axle, like a Fly Ferrari 512S, (similar front/rear axle centerline distance and weight). Note, as you increase slot car wheelbase, a greater percentage of the total vehicle weight falls on the rear axle. This would increase traction on the MRRC Cobra. The Cobra instead has a super strong magnet to compensate for this shortfall.

Motor placement is also an important determinant of rear weight bias. Note from Table 2 that only the sidewinder motor cars achieve a rear weight bias above 64%, (with the exception of the very long and heavy Ninco Mercedes CLK GTR and Scalextric NASCAR stock cars).



Check out the strong relationship between wheelbase and vehicle weight, with the exception of the MRRC Cobra (circled). Shorter wheelbase generally translates into a lighter car, which will reduce lap times. Longer wheelbase cars can be easier to drive on the edge of tractive adhesion, because their greater pendulum or high polar moment of inertia causes the drift to occur at lower vehicle speeds. But don't expect a long wheelbase car to keep up with a short one, unless it has been extensively lightened or has superior tires.

Front body overhangs are typically not significant on slot cars, rather it is the rear overhang as a percentage of wheelbase that affects handling. A classic example is a Fly Porsche 917K vs, 917 Spyder. The Spyder has a much shorter rear overhang, with almost 9 gm less total vehicle weight for about the same wheelbase.

CG or "Center of Gravity" is the theoretical height above the track surface where forces are applied against your car. CG is difficult to measure, but its effect on de-sloting your car is easy to see. A car with a heavy body or interior will flip or roll out of the slot at a lower corner speed that one with a low or light body work. In general, it is much more productive to reduce weight above the axle centerline. This can be accomplished by replacing the interior with a Lexan sheet style and/or lowering the body. Body mounting screws should be backed off (and chassis trimmed if necessary) to allow the body to "rattle" or float.

This Scalextric Penske Trans-Am Camaro has been improved. The overall vehicle weight was reduced 12 grams by replacing the interior with a sheet of flat black construction paper, and gluing a driver from an old Scalextric F-1 car and roll bar from a NASCAR stocker. Removing the interior from any slot car is a constructive way to reduce the weight and lower the CG. This could be termed "The Unfair Advantage", which is also the title of a book written by Mark Donohue and Paul Van Valkenburgh that you should own.

3. Driver

Spend as much time at WOT as possible. Completely lift your throttle finger (or thumb) for maximum braking on the straight before you enter a turn. Don't keep changing cars until you learn the rhythm of the track with one car. Don't drink and drive.

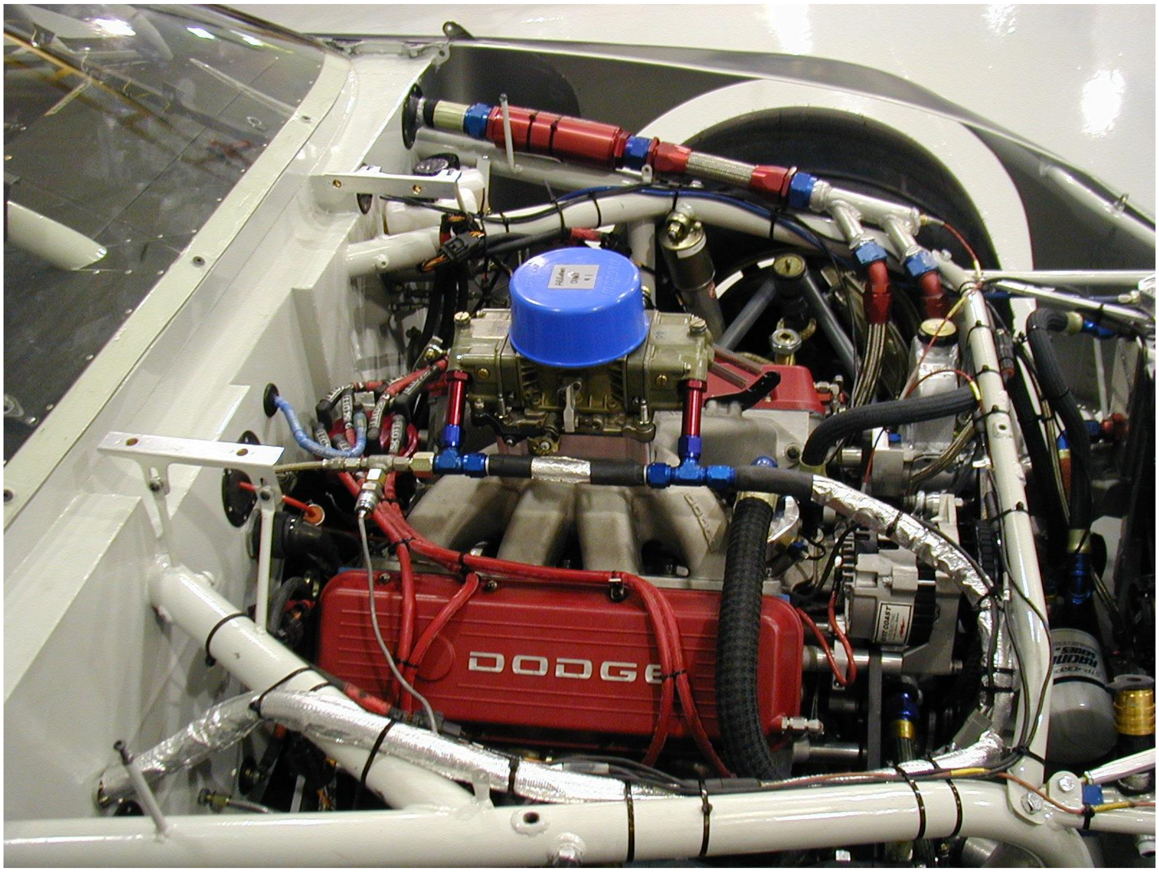
Talladega Tip #29. Always start out racing your absolute best car when invited over to someone else's house. Demoralize them right away, and you will have them beat the rest of the night.

Seriously, have a plan before you start each heat:

- Have your cars prepared/ready. Bring cars with different characteristics if you don't know which is best for the event. Don't expect that you will have time to swap parts during practice.
- Know your Competitors. Decide before the race if you are going to try to jump out in the lead, or hang back slightly and pressure them into a mistake.
- Don't put yourself in a bad situation, and expect a good outcome.
    - Don't get into a 3 or 4 wide racing situation, especially in S-turns.
    - Don't try to pass someone on an adjacent lane, when you are on the outside.
- Know what position you need to finish (to lead the points) before starting each heat.
    - You don't have to win all of the heats to promote to the next ladder.
- If your car is not the class of the field, don't try to force it. Instead hope for a crash fest where you are the last person on the track, (without getting lapped, of course).

Car Modifications

- ## Speed



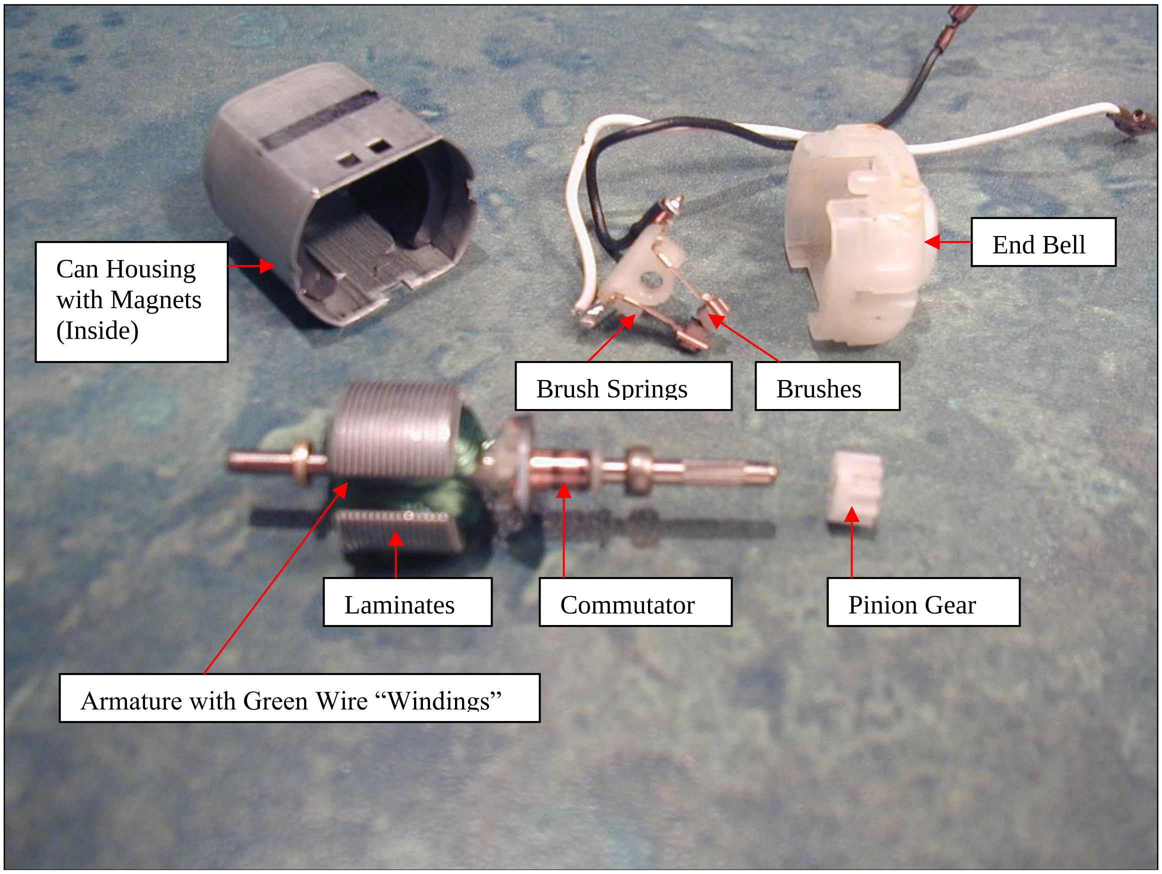
The Dodge R5P7 NASCAR engine. We did something right, as the second engine built by Penske made more power than their best Ford with trick Ilmor valvetrain.

4. Motor For clarification, motors run on electricity, engines run on fuel.

There are 4 basic types of can motors for modern 1/32 scale slot cars, (the Slot.it Flat 6 is a low profile version of the FK180). Plan to race these at 9 VDC unless the cars are very heavy or otherwise noted:

- FF Long, skinny can. Typically used in lighter cars. We run these @ 7.5 VDC
- FC 130 Most common. Brushes contained in a plastic end bell.
- FK 130 Probably least common. Could generalize these as higher torque than FC
- FK 180 Long can higher torque motors that are often mounted as inline or angle winders.

Proper break-in of the stock motor in your slot car is accomplished by running on a 1.5V AA battery until the battery is dead, (overnight). The objective is to wear or "form" the motor brushes to the commutator to increase surface area and reduce arcing. Typical motor tricks are to replace the brushes with a "softer" compound, increase brush spring tension to reduce "bounce", change the "timing" on the commutator for a power bias, and shim the magnets closer to the armature to pick the torque back up.



Exploded view of a typical Mabuishi FC "can" motor. To disassemble just bend the folded can tabs back from the sides of the end bell and slide apart. The brushes ride on either side of the commutator. The commutator should be cleaned (with an eraser) but never oiled. Burnishing the leading and trailing edges of the commutator segments with a ball pen will reduce brush bounce. Increasing the brush spring tension also reduces brush bounce. Armatures often benefit from balancing, (drilling holes to balance the weight of the 3 laminates). I'm lame and don't do anything to my motors. I'll buy an upgraded replacement motor if a car has poor straight line speed relative to other competitive cars.

The next upgrade is to rewind the armature with a shorter length of heavier gauge wire, for the same effective section area of wire, but less resistance. Remember, Power = V * I and V = I * R, thus Power = (I)^2*(R). So power goes up squared as you increase the amperage appetite of the motor. After rewinding, the armature windings are epoxy coated and balanced. Consult the Internet for motor "building" techniques.

Motor power is measured in Watts. A typical Mabuishi FC 130 18K RPM motor measures 5 +/- 0.3 Watts. Motors that actually measure 20K – 21K RPM are becoming more popular as slot car Manufacturers want to build a performance reputation. These motors typically deliver 8 +/- 0.2 Watts. Motors with even more power that "snap-in" are available. However, high power motors add very little performance until you replace the wall mounted power supply that came with your race set with one that has current measured in amps, not milliamps. Likewise, SCX cars with the stock motor are not competitive against other brands. They require an SCX "Pro Turbo Plus" motor upgrade, Part #50210.

Higher power motors will measure less resistance, as noted above. Thus, you will need a controller with less Ohm rating to provide a linear, progressive throttle response. If you suspect an erroneously high Ohm reading when checking the resistance across the pick-up braids, run the car for a few seconds. It will polish the oxidation off the motor brushes/commutator interface.

Changing motors (to aftermarket higher RPM/power) on all of your slot cars can be an expensive game. However, there comes a time when the stock motor gets tired, (like after 200 hours of racing, or a couple of evenings on an AC2 track), and there are some very good aftermarket replacements that have similar power to the stock motor, for less cost. The Piranha line is an example of a good Club spec replacement. Slot Car News has a motor list with measured torque and power ratings for many new and vintage motors.

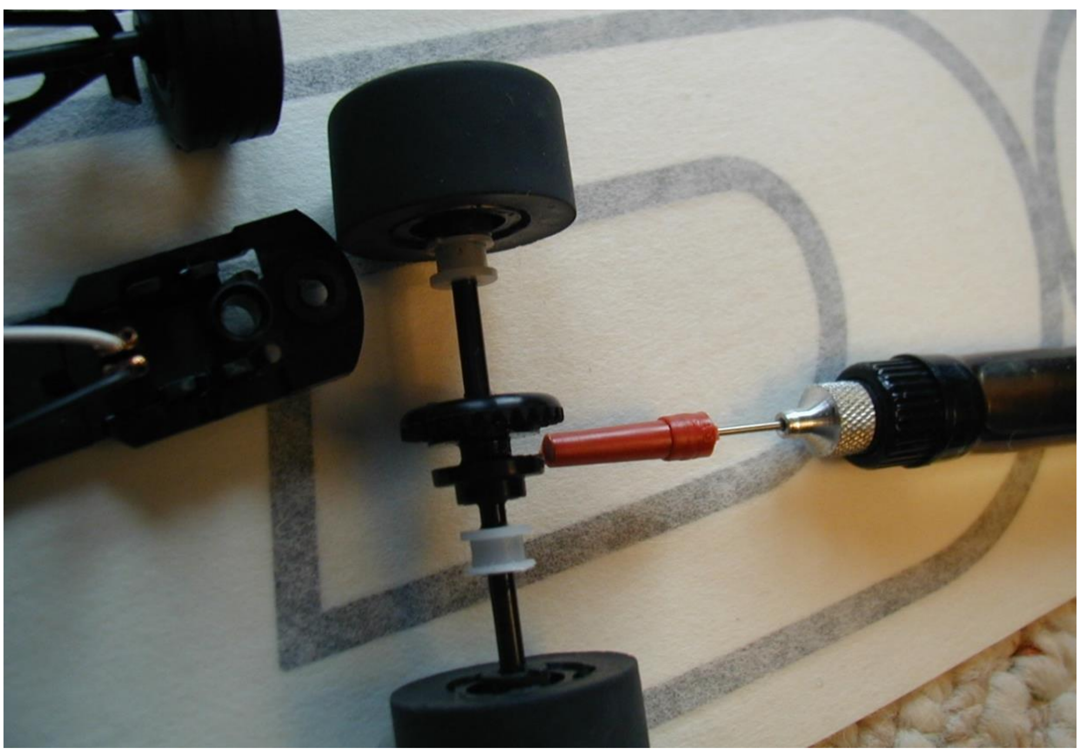
Lubricants/Fluids

The first fluid you need in your tool box is a very light oil. I have used Royal Purple brand synthetics, which are widely used as an engine oil in Drag Racing. Get the lowest possible viscosity, (you may have to order from the regional Rep.). The Royal Purple has a noticeable effect on the performance of HO scale cars, less so on the 1/32 cars. Now I am "sponsored" by Shell. I will see if I can get a quantity of oil from them to sell.

Every location where relative motion occurs should be lubricated. Pay particular attention to the pinion extension that runs between the crown and centering guide on inline chassis as some sliding occurs at this point. A synthetic grease with PTFE is preferred at this location, and is available in a micro-syringe from Slot Car Corner, Cloverleaf Racing, and I'm sure others. Likewise, these shops carry micro-oilers.

Other fluids include motor juices, like "Reedy in a Can, Power Spray" by Associated Electrics, Costa Mesa, CA. This is a cleaner of sorts for the motor commutator. "COLOR contact Shield" by Channel Master, Smithfield, NC is an excellent commutator cleaner/lubricant that brings old motors back to life, (especially HO scale Aurora pancake designs).

Talladega Tip #30. Some cleaners or fluids like "Reedy in a Can, Power Spray" will discolor plastic track surface. It will leave a white streak that is impossible to remove. I suspect that it may also attack painted MDF.



Micro-oiler, pointing to centering guide on crown gear that requires oiling as well as axle shafts, gears, etc.

The electric RC Racers seem to be most in tune with motor commutator cleaner/lubricant sprays. You may want to visit your local RC shop and see what they recommend. I have found that most slot cars are very robust and will run for hundreds of trouble-free hours. This is especially true if you are racing on a table and the track cleanliness is maintained. Probably the highest wear item is the guide shoe brushes, which should be periodically cleaned. I almost NEVER clean the commutator.

<u>Gearing</u>

Most slot cars come with a 3.0:1 – 3.27:1 final drive ratio. Many slot cars (especially non-magnetic braid racing) will improve lap times if the numeric gear ratio is reduced, say to 2.7:1. The electric motors typically produce ample torque, when given adequate Amperage. This is especially true of the FK 180 can motors often found in Ninco cars and some higher end slot cars. The "taller" gear ratio will also make the car a little less "jumpy" (smoother), although it adds more load on the motor (heat). One track in our Club has hard wired controllers with no brakes. I recently built a "special" Vintage Scalextric Trans Am '70 Camaro for an event where we were allowed to change the motor and pinion gear. I went for a 25K RPM motor with high torque, and geared the car to 10/36 or 3.6:1 to gain breaking effect. Won the event, and everyone claimed I had a 7.0L under the hood, instead of the SCCA 5.0L limit. No one knew what I had done with the gear…

<u>Traveling Case/Tool Box</u>

You can show up to someone's house with your cars in a bag, looking like a Hobo, or you can look like a professional and see them start to sweat! I prefer the latter. You don't have to spend a ton of money for a carbon fiber case, there are plenty of other options like the nice looking Carrera aluminum case or a custom wood pit box. Of course, Pelican cases are also nice and come in a variety of sizes.

I have found that Sears makes a tool box which works well for carrying your traveling cars and trinkets. The 26 inch long Craftsman #65426 has perfect clearance for stacking two slot car cases beneath the tote tray within. It also has a "small parts" container that works well for holding tires/tools, etc. I have found a Holley carburetor jet container works even better for smaller parts like axle washers and gears. Similar size containers are manufactured by Plano tackle systems for fishing lures, and work perfectly for containing loose parts.

Sears #65426 plastic tool box makes an ideal travel case. Most slot car cases will fit perfectly stacked two high beneath tote tray. Other brands of cars won't stack, (like Carrera) but fit snugly if left in their case. The tote tray organizes my screw drivers, oiler, caliper, inspection plate, Carrol Smith's pocket Crew Chief (purely for intimidation purposes), business cards, etc. Small parts can be stored in clear Plano tackle storage boxes.