Tuning 1/32nd Slot Cars For Non-Magnet Racing

This article is intended to be a guide for beginning to intermediate level slot racers. I would be the first to admit that I am not the best tuner around, but I do win races and my cars rarely fold up during a race.
Since my club, Shoreline Model Raceways, hosts a lot of proxy races I get to examine and race a lot of cars built by other people. Some of those cars have had obvious problems that I will address in this article.

Most RTR 1/32nd cars have traction magnets and tuning those is somewhat different from tuning cars without them. It has been some time since SMR got away from running cars with magnets, so beyond some general advice I don't feel qualified to discuss them.

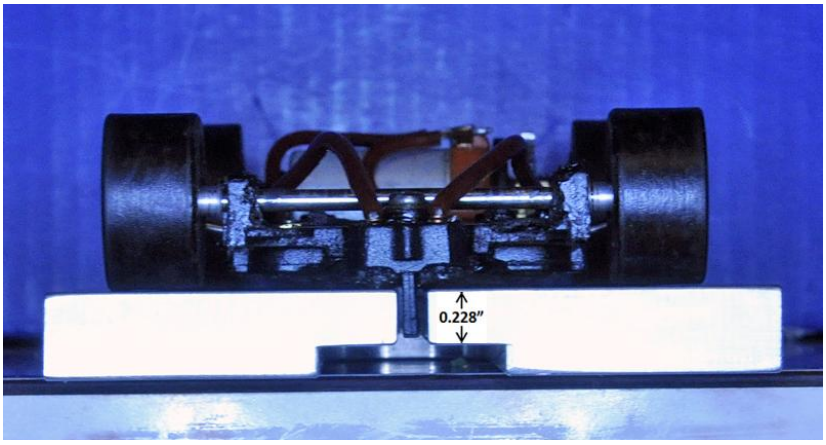
If you plan on racing your cars be sure to consult the rules before you make any modifications or substitute parts. If you have any questions about the rules it is best to inquire directly with the club or proxy series official that handles rules issues.

Plastic Versus Wood Tracks

There are slight differences between the way that you would set up a car for a wood versus a conventional plastic sectional track. Plastic track has a lot of joints that might be out of alignment and those can upset the handling of a car, wood tracks are much less likely to suffer from that problem. There is one brand of plastic track that can get very bumpy as it ages and that will cause handling problems as well. Generally speaking if a car is good on a plastic track it will handle well on a wood track as well, but the reverse would not necessarily be true.

Guide Flag Pickup Braids and Motor Leads

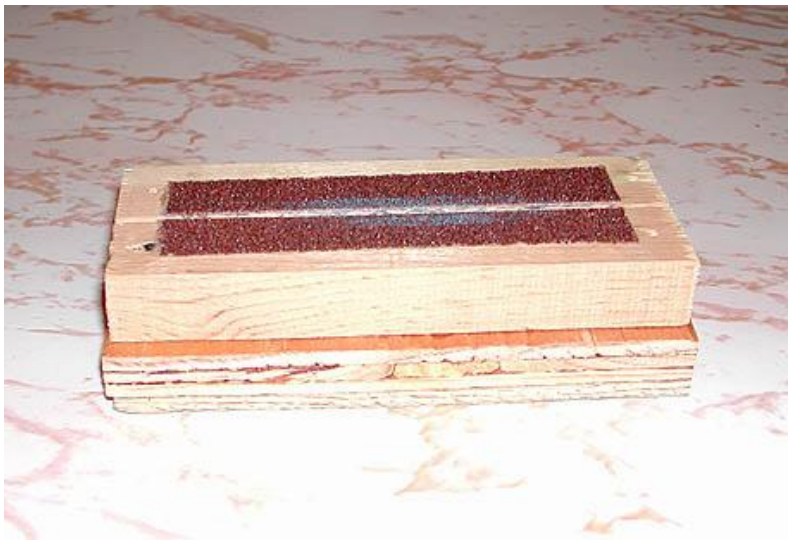
The guide flag is an important part of the car that does not always get as much attention as it deserves. The guide flag steers the car around the track and also holds the braids that are critical to getting good electrical contact. The guide flags that come with ready to run (RTR) cars, even expensive ones, are often less than ideal. RTR cars are often designed for easy assembly at the factory, not necessarily for the best performance on the track and one of the things that is frequently compromised is the guide flag. Some RTR cars, including older Scalextric and SCX cars, have feelers attached to the chassis to make contact with the braids and a few cars have spring loaded guides. When you run cars without traction magnets either of those systems tend to lift the front of the car and cause handling problems. If the feelers are not adjusted properly they may not make good contact with the braids. The depth of the guide blade in the slot is one thing that will affect how fast the car will go around a corner. In the illustration a chassis is shown on a setup block that incorporates a guide blade depth gauge.



The car will handle best with the bottom of the blade as close to the bottom of the slot as possible. If you expect to run your car on different tracks you would usually want to set the guide blade depth to work with the track with the shallowest slot, otherwise you could change guides accordingly. Aftermarket guides are available that go deeper than many stock guides, especially those designed for wood tracks.
Possibly there could be so much clearance that the blade would be closer to the bottom of the slot if there was a spacer between the guide flag and the chassis guide flag holder. Low friction Teflon spacers are recommended in that case.
If the guide has a spring to keep it centered you would be better off removing it. If there is a spring that pushes down on the guide flag that will tend to lift the front wheels and should be removed as well.

The post part of many guide flags is too small in diameter so that the flag will wobble in its holder. Many guide flags simply snap in place and if the post is too small in diameter the blade will tilt in the corners so that it is no longer perpendicular to the track. Some replacement guide flags have a post that is slightly bigger in diameter, otherwise the easy fix for that problem is to use a guide flag that is held in place by a screw and washer. By tightening the screw just short of the point where the flag does not rotate freely the wobble can be eliminated. The guide flag post might have to be shortened for that to work. There are modifications to the chassis that can be done as well and those will be discussed in the Chassis section.
Be certain that the guide flag turns freely and does not want to stick at the extreme ends of its travel. A little oil or grease on the post and the top of the horizontal surface would not hurt.
For non magnet racing your cars will handle better if the weight of the front of the car is not carried by the guide flag. In the following illustration you will see that looking from the back of the car there is a little space between the horizontal part of the guide flag and the tops of the braids.

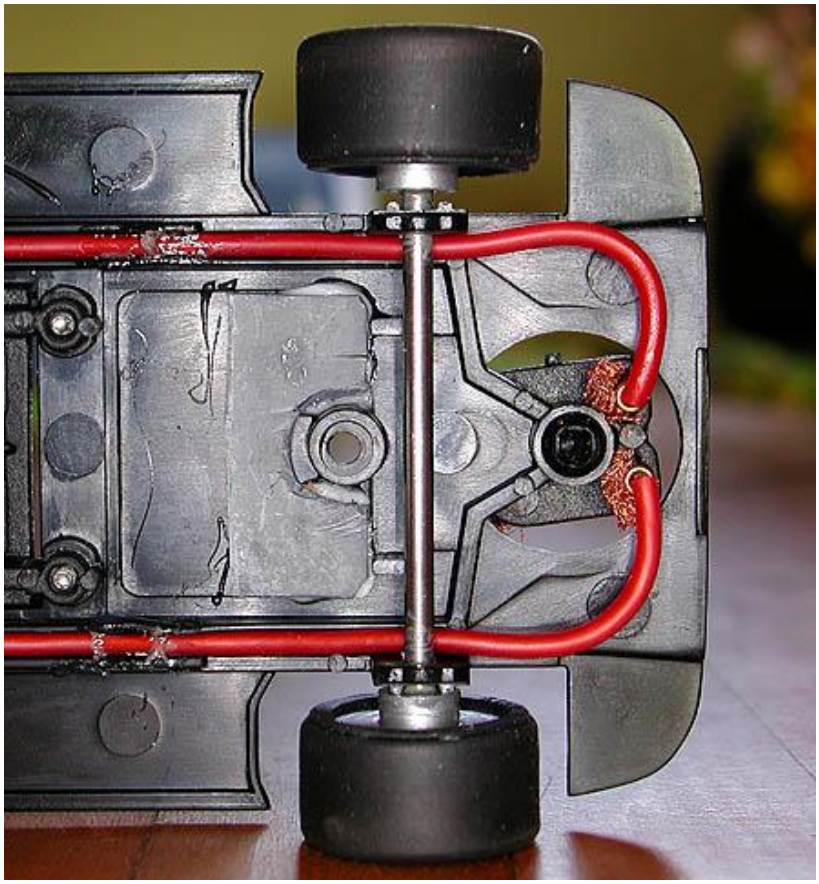
If the braids are touching you could use bigger diameter tires or adjust the front axle ride height, but the first thing to do is usually to sand the bottom of the horizontal part of the flag.



A jig such as the one in the picture makes the sanding easier to do. If sanding does not get you enough clearance you will have to do a chassis modification.
With some tracks the rails or braid can be a little below the track surface, that is often seen with Scalextric Sport track. If that is that case and the pickup braids are adjusted to be parallel to the rails or braid the pickup braid can ride on the track surface and not make good contact with the rails/braid. The cure for the problem is to angle the pickup braid to get a shallow V, as shown below.

The braids themselves require some attention. As it comes braid is usually rather narrow. You can pull on it to make it wider and thinner at the end that contacts the rails. On wood tracks with copper tape you may need to spread the braid more. Some makes of plain copper braid tends to fluff up and get thicker, that can lift the front tires off of the track and degrade handling. You need braid with the right amount of spring for the best results. Too much spring can lift the front of the car and if there is not enough the braid may flatten out and stay that way so electrical contact is lost. I prefer tinned copper braid, I like to buy braid by the roll and cut off as much as I need. I have had good luck with Slot.it braid and braid from Slot Car Corner has survived several 24 hour races without needing to be replaced.

The lead wires carry electricity from the guide flag to the cars motor and they can also be overlooked. Note that SCX cars do not have lead wires, they have feelers at the end of the conductors that are part of the chassis and which contact the pickup braids and a second set of feelers that connect the motor to the chassis conductors. If you have any choice in the matter you should use wires to connect the pickup directly to the motor. Very thick wire is really not needed with most 1/32nd cars. Very flexible multi-stranded copper wire with silicone insulation is the best thing to use. Many guide flags are made to be used with wires that have metal eyelets at the end. With some guide flags the eyelets tend to pull out rather easily. If that is the case you can replace the original eyelets with ones from Professor Motor, they are bigger in diameter and are made of copper, which is a better conductor than the brass that is normally used. When using eyelets the ends of the lead wires should be stripped to leave bare wire about three times the length of the eyelet. Insert the wire into the eyelet just short of the insulation touching the top. Fold the part of the wire below the lower end of the eyelet back up, when you insert the eyelet into the guide flag it should be with the folded end between the eyelet and the pickup braid. The latest guide flags from Slot.it use set screws to hold the wire in place.
How you route the wire should also be considered.

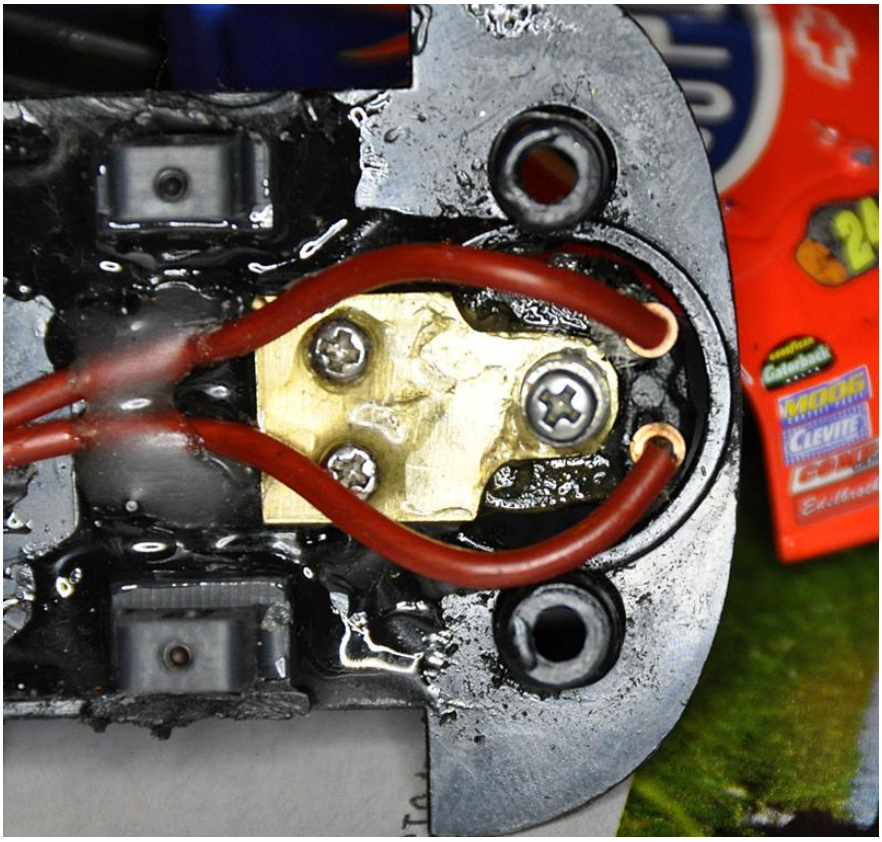


Note the wire in the illustration, it is parallel to the chassis near the guide flag so that it does not foul on the body work, it has enough slack so the flag is free to turn through its full travel, but the wires will also tend to center the flag when the car comes out of the slot, which is an important consideration when you are racing. Sometimes there are little clips or channels for the wires molded into the car's chassis, you should make use of those. A little silicone glue or hot glue will keep the wires where they belong. Make sure that the wires will not chafe on a moving part like a tire or gear or interfere with motor pod movement or body float.

Chassis and Front Axles

It is a good idea to make sure that the chassis is straight, you can remove the body and wheels (or maybe just the tires) and put the chassis on a flat surface like a setup block to check that. If the chassis is warped and your car has an adjustable front axle and/or motor pod you could compensate for the warp by adjusting those, but it is not good practice to do so. It is better to correct the warp, you can put the chassis in a pan with a flat bottom, like an old fashioned iron frying pan. Place neodymium magnets (they won't be much good for anything else!) on the chassis to hold it down. Pour boiling water over the chassis to cover it well and let the pan sit until the water has cooled to room temperature.
Some cars have an interior that is screwed to the chassis, in that case if you plan on retaining the interior you can loosen the screws, apply a reverse twist to the chassis and tighten the screws down to correct the problem.

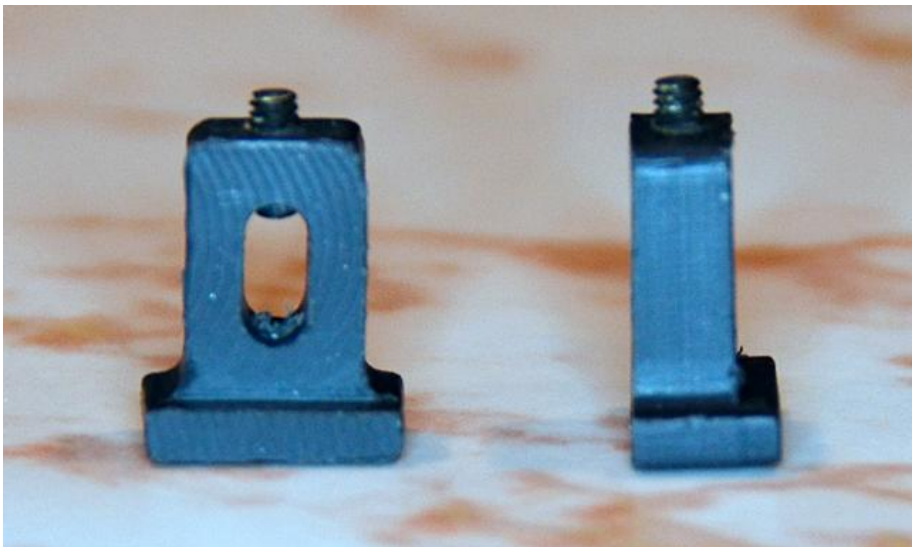
At the front of the chassis is the guide flag holder, if you run on tracks with 12 volts or more you will be likely to break the guide flag holder sooner or later. Even at 10 volts or so it may eventually break. You might possibly be able to buy a replacement chassis, those are usually overpriced and it is a lot of work to swap chassis. To me it makes more sense to just replace the holder with something that can't break.



In the car shown in the picture above I removed the original holder completely and substituted one made from sheet brass. The holder is secured to the chassis with a couple of self tapping screws and some epoxy glue. If you have an SCX car and you want to replace the stock guide flag with an aftermarket one you would also have to make a new guide flag holder. An alternative to a homemade holder would be one of the B-Nova Adapters.
In order to get the correct guide flag height it might be necessary to remove material from the lower end of the guide flag holder and also from the nearby part of the chassis.
When you obtain a new car it is a wise precaution to reinforce the guide flag holder with slow setting epoxy glue.

The front axle is critical to the performance of the car, with magnet cars it is often only along for the ride. Plastic chassis slot cars have a rather high center of gravity, especially if they have a full interior. With magnet cars the magnet lowers the effective center of gravity besides giving better traction. It is important to understand what a non-magnet car is doing as it rounds a corner. At the limit the inside rear tire will tend to lift off of the track, when that happens only the outside shoulder of the outside tire will be on the track as shown in the illustration below.

Once that happens the back of the car is likely to snap around abruptly resulting in a spinout. In order to eliminate, or at least minimize this effect the first thing to do is to look at the front axle. Keeping the front tires firmly planted on the track will greatly reduce chassis roll. With some cars the front axle is a sloppy fit in the axle carriers. Older Slot.it cars had a floating front axle, so the tires were on the track but the front of the car was not really supported. The front axle should be a close fit in the supports, but still be able to turn freely. If there is any drag on the front axle handling will be degraded to a degree because any drag at the front of the car will cause the car to overseer more. If the front axle is a sloppy fit in the supports many people shim it with bits of plastic that are cemented to the supports. Where you want the axle to end up with respect to the chassis would be determined by the amount of clearance needed for the guide flag and also for the bottom of the car. With some cars the front ride height can be set with screws in the axle carriers, unfortunately with some makers that feature has not always been well implemented.



For cars lacking this useful feature Slot Car Corner has adjustable front axle holders, click the link for more information on those. Installing-Adjustable-Front-Axle-Mounts

Some slot cars, mostly front motored types, have front stub axles which often have a lot of wobble. In some cases it is possible to substitute a solid axle, in other cases the motor is in the way and the stub axles need to be fixed. Here is a good article on fixing stub axles.

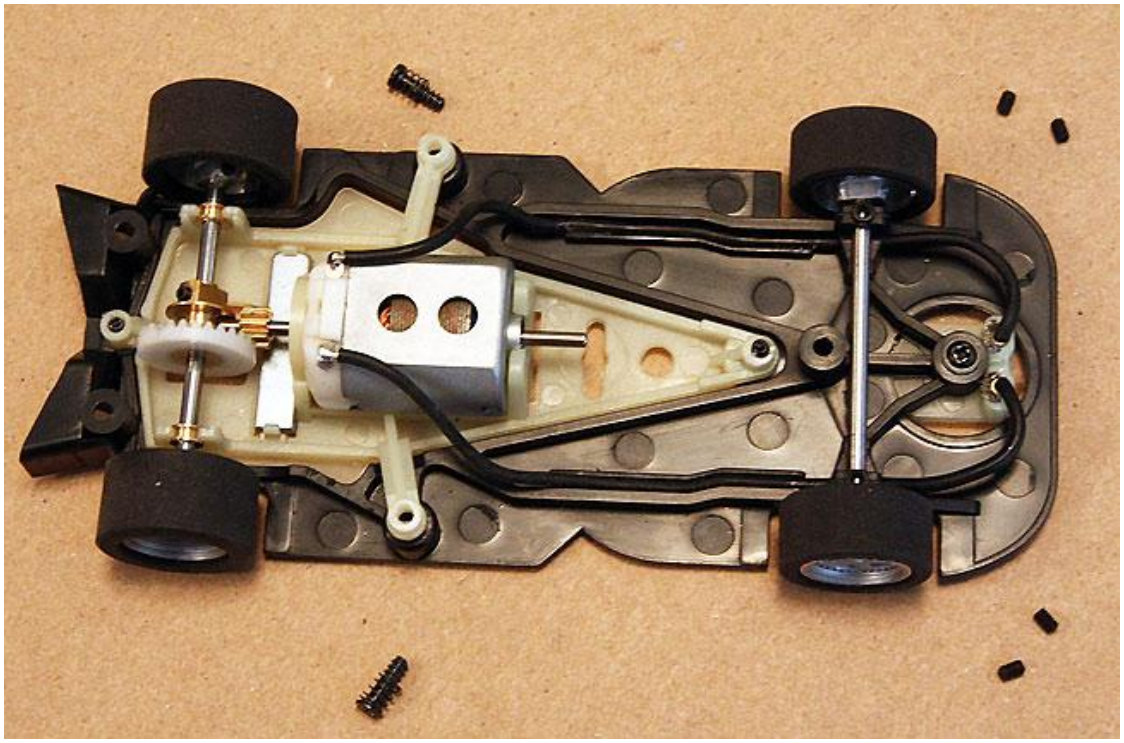
It may be helpful if the front wheels rotate independently, that can reduce drag from the front end in the corners. One way to make the front wheels rotate independently is to use a hollow axle. Put a little Superglue on an eyelet and insert that into one end of the axle to act as a keeper. Put a wheel with no setscrew on that end of the axle and a wheel with a setscrew at the other end. One wheel will rotate with the axle, the other will not.

Front Tires

If you replace a car's front tires with aftermarket aluminum wheels in most cases you will also have to replace the front tires. Front tires with minimum grip work best on non-magnet cars, Slot.it sells Zero Grip front tires and Super Tires has Low Grip hard urethane front tires.

Some cars have motor pods, Slot.its and NSRs are among those. Using a separate motor pod can allow the same chassis to be configured with an inline, anglewinder or sidewinder motor. Slot.it has motor pods for different combinations of gear diameters and also ones with different offsets. An offset can allow for bigger diameter wheels/tires without increasing the height of the car or it can be used to lower the motor without lowering the rest of the car. Special crown gears should be used with offset inline motor pods. The motor pod can be used as a form of rear suspension that will keep the rear

tires planted when the chassis starts to roll. In order to take advantage of that feature the screws holding the pod must be loosened. The amount of loosening would usually be from a half turn to a turn and a half, this is something that has to be experimented with however. Make sure that the edges of the pod do not rub on the chassis, the pod or chassis might need to be sanded. With Slot.it pods you can get better control of the float by installing the motor pod hardware from Slot Car Corner. With some cars springs can be inserted between the chassis and the pod, that would be another thing that you might try, however very few of the fast cars that I have examined have used that feature. Motor pods work better if they only have a side to side rocking motion, side to side, fore and aft and fore and aft rocking motions are not desirable. Pod motions of those types can be controlled by placing a strip of reinforced packing tape on the bottom of the car. Some of the latest motor pod designs have outriggers with adjusting screws to control the amount of side to side rock.



One way to see if you have the front end and motor pod adjusted correctly is to push down on a front fender and see if the rear wheel at the opposite corner wants to lift up. It is best to do the test with the body tightened down.

Slot cars handle better if 60 to 70 percent of the weight is on the rear tires. The side winder configuration puts the weight of the motor further back so that less weight has to be added to get the desirable distribution.

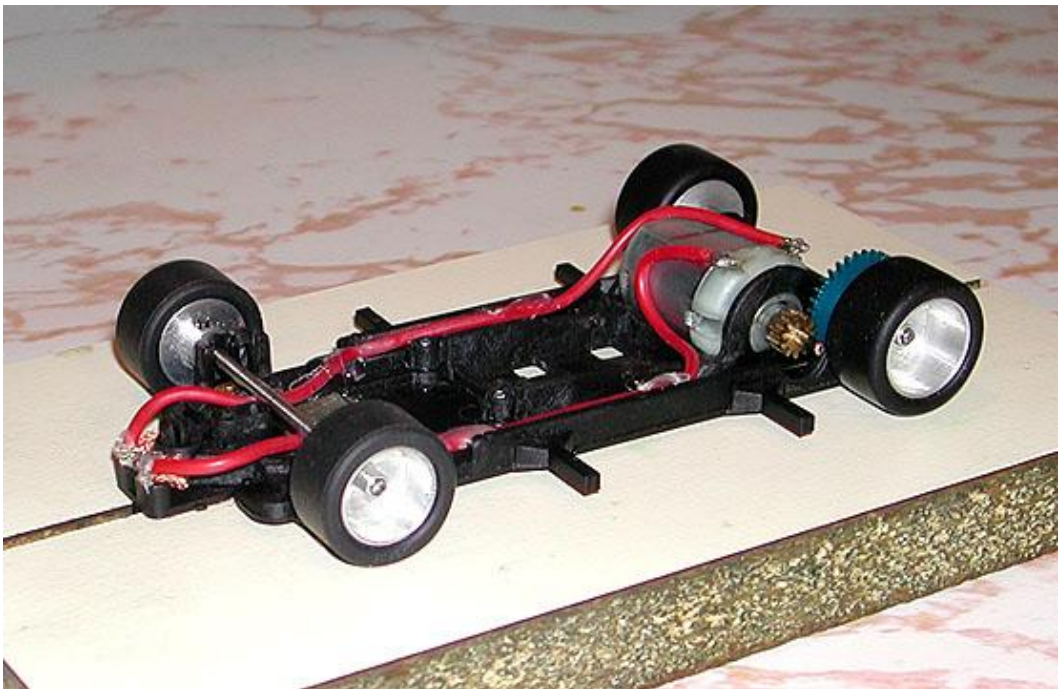
The rear axle carriers can be part of the chassis or motor pod. With chassis that use snap-in rear axle assemblies it is best to glue the bearings in place, but first the bearings should be aligned to minimize friction. With regular snap-in bearings a diamond coated burr tool is used to enlarge the axle carrier holes slightly. the bearings are installed and a reamer blank that is a smidge bigger in diameter than an axle is inserted through both bearings, it might not be a bad idea to oil the blank first. The final step is to glue the bearings in place. Superglue works just fine, use a toothpick to transfer small amounts of glue. Click the link for more information on aligning bearings. bushing alignment kit

Be aware that a chassis might develop a warp with time, so it is not a bad idea to check the alignment periodically.

A few cars, including Slot.its, have spherical self-aligning bearings, make sure those are not loose in their holders. If the bearings want to move in the holders they can be glued in place or the fingers that make up the holders can be pinched together with pliers.

Chassis flex is an issue that I do not feel comfortable with. Chassis that are stiff and ones with some flex can both work well. Some makers, like NSR, make chassis with varying degrees of flex, so feel free to experiment with that. One place that you don't want flex for sure is between the motor and the rear axle carriers. That sort of flex can cause wheel hop or chatter and that is a common problem with Ninco cars with angle winder motors. As the car goes around a corner the chassis will twist, when it has twisted as far as possible it will snap back and that causes the hop in some cases. Other causes of hop will be discussed in the next section. The cycle of flex and snap can repeat several times in the same corner and can also occur when the car is accelerating. Gluing the motor to the chassis can reduce or eliminate hop and chatter and is recommended in any case. It is best to use something that can be removed fairly easily if you need to change motors, silicone cement or hot glue work well. If gluing in the motor does not cure the problem some extra chassis bracing will be needed. Especially in the case of anglewinder chassis it helps to run short lengths of tubing between the motor and the tops of the axle carriers.

Some people like to build cars on an aftermarket chassis, the Slot.it HRS and HRS2 chassis have been very popular with people who enter proxy races.



Slot.it HRS chassis

In the last year or so 3D printed chassis have become available, for the most part they are intended to replace OEM chassis and they often include nice features like adjustable front axle carriers. In addition printed chassis are sometimes available in different amounts of stiffness. These chassis can allow for different motor orientations and usually take a motor pod. Several makers are listed at the end of this article.

Rear Axles and Bearings

For the best performance use an axle that is straight and round. Slot.it axles are popular and drill blanks make great axles as well. If the axle is loose in the bearings it could contribute to a wheel hop problem or otherwise degrade handling and rob power. Many RTR cars have loose rear bearings because the ends of the axles are knurled to hold plastic wheels on. The knurling is larger in diameter than the rest of the axle so the bearings have to be oversized. The expensive way to fix the problem is to replace the entire rear axle assembly with aftermarket parts. If the rear wheels are reasonably straight it is possible to close up the bearings using what I call the Superglue trick. First flush any oil

out of the bearings with contact cleaner or lighter fluid. Next put a drop of Super glue on the end of a toothpick and use that to transfer the glue to the place where the axle passes through a bearing, allowing it to wick inside. Repeat on the other side and wait about a minute for the glue to begin to set up. Roll the tires back and forth on a flat surface without lifting them for about five minutes. Wait about an hour before oiling the axle and running the car.
The axle needs to be a close fit in the bearings, but not so close that there is any drag. Some RTR cars have plastic bearings, others use bronze bearings. Aftermarket bearings are usually bronze and should be made to closer tolerances than the ones that come with most RTR cars. One drawback to using axles and bearings with close tolerances is that the bearing alignment becomes more critical. Slot.it cars all have self aligning bearings and Sloting Plus makes snap-in self aligning bearings. Slot Car Corner sells bearings that have been counter-bored, which have several advantages. See the Chassis section for aligning regular snap-in bearings.
The side play of the rear axle must be adjusted carefully. If the car has an inline motor with most RTR cars the end of the motor shaft fits into a grove in the gear boss and that (hopefully) keeps the gears in mesh and locates the rear axle. That arrangement is used because it requires little care when the car is assembled. I prefer to limit the side play to get the minimum amount, perhaps a thousandth of an inch and trim the motor shaft so that it is no longer used to locate the gear and axle
Unless you are running stock RTR cars you will need to get some spacers of varying sizes. The spacers should all fit a standard 3/32nd inch axle. Thin spacers are often referred to as shims. Thicker ones are often short lengths of aluminum tubing, nylon spacers can help to reduce friction.
Some RTR cars with plastic wheels have too much side play and it is not a good idea to remove a wheel to add a spacer. A common fix for that is to make a spacer out of something like coffee can lid material and split that so it can be fit over the axle.

Gears

The gears that come with many RTR cars are usually not perfect. If you are lucky the gears will be smoother when they are broken in, you can hasten that by running the gears with some toothpaste, metal polish or automotive buffing compound on them.
While the cheap molded gears that come on a lot or RTR cars may be satisfactory for casual running high quality aftermarket gear are likely to give you a better mesh and greater reliability.
With regular RTR cars changing gear ratios is complicated by the fact that the axle gear cannot be replaced unless the axle, wheels and tires are replaced as well. There are several things that confuse people when they are trying to pick the right gears for their cars. I get the impression that many people do not understand the concept of gear ratios. To state it simply the number of teeth on the bigger gear is divided by the number of teeth on the smaller gear to get the gear ratio and that is usually expressed as XXX:1, meaning that there will be XXX turns of the smaller gear for 1 turn of the larger gear. The small gear, called the pinion gear, is on the motor shaft. The larger gear, which can be a crown (called a contrate in the UK) gear for inline motored cars and a spur gear for anglewinder and sidewinder cars, is located on the axle. For every XXX turns of the motor there will be 1 turn of the axle. The higher the gear ratio is when it is expressed numerically the more torque will be available at the rear axle and the lower the top speed of the car will be. You always have to find the best compromise between top speed and torque, which gives more acceleration and brakes. A gear ratio where the XXX number is larger is sometimes referred to as short gear ratio and one where it is smaller is a tall gear ratio.
Pitch is another term that people find confusing. Pitch is the number of teeth a gear will have for a given diameter, so pinion and crown or spur gears would have to be the same pitch to mesh properly. With 1/32nd slot cars things get murky with respect to pitch. With cars that use sidewinder, and to a lesser extent anglewinder gears, the motor will be in a fixed position with respect to the axle and the motor can't easily be moved to adjust the gear mesh. In the case of sidewinder Scalextric and Fly cars the pinion gear is 6.5 mm in diameter and the spur gear is 19 mm in diameter. Aftermarket gears are available for those cars that are all the same diameter but have different tooth counts. in that case

it would seem that all of the gears must be a different pitch, but the shape of the teeth is adjusted so that the contact areas are not the same as with standard gears and they do mesh well. Slot.it makes the greatest variety of gears and NSR has a good variety as well. The crown and spur gears from both makers are usually color coded. I believe that NSR is the only company that offers a 7.5 mm diameter pinion gear, that would be useful if you wanted to use an 18 mm diameter spur gear in a Scalextric or Fly sidewinder car. With those cars the diameters of the pinion and spur gear must add up to 25.5 mm. With Slot.it sidewinder cars the total would usually be 24.5 mm. Using a 18 mm diameter spur gear would make it possible to use smaller diameter tires/wheels.
With anglewinder gears the mesh can be adjusted by moving the spur gear from side to side. Slot.it cars can use a stopper to adjust the position of the spur gear, I prefer to dispense with the stopper and position the spur gear with spacers.
5.5 mm diameter pinion gears are used with crown gears in inline setups. The end of the motor shaft fits into a groove in the hub of a crown gear and that both sets the gear mesh and locates the rear axle. From my point of view that is not the best arrangement, for one thing it puts undue stress on the motor bearing, especially in the case of oval track cars. With RTR cars that have plastic wheels and gears you are stuck with using a gear boss to locate the axle/gear. Aftermarket wheels and gears are held in place with setscrews and can be moved to control axle side play and gear mesh. I prefer to trim off the end of the motor shaft with a rotary tool, like a Dremel, and a cutoff saw. I use spacers to adjust the distance between the chassis and wheels and set the side play at about a thousandth of an inch. If the gear mesh is too loose the wrong parts of the gear teeth will be in contact, the gear will wear out more quickly and may even strip. If the mesh is too tight there will be excess friction. To get a perfect mesh between a crown and pinion leave the setscrew loose, put one layer of plastic bag material, of the sort that small parts come in, between the crown and pinion, push the two gears together, tighten the set screw and remove the plastic.
Inspect spur gears for run out, gears with that defect will waste power. A gear with just one damaged tooth will also degrade performance.

If you are going to use aftermarket gears there are several tools that you should have. Use a quality gear puller to remove metal pinion gears. Plastic pinion gears are easier to remove. Do not put much faith in a plastic pinion gear unless the motor shaft is splined. Sometimes a plastic pinion gear can split, so they should be examined from time to time. You can install a metal pinion using improvised methods, like hammering it on, however you would be taking a chance on bending the motor shaft or damaging the gear. A proper gear press is the thing to use and there are tools that both press and remove gears.


pinion gear puller


combination gear puller and gear press

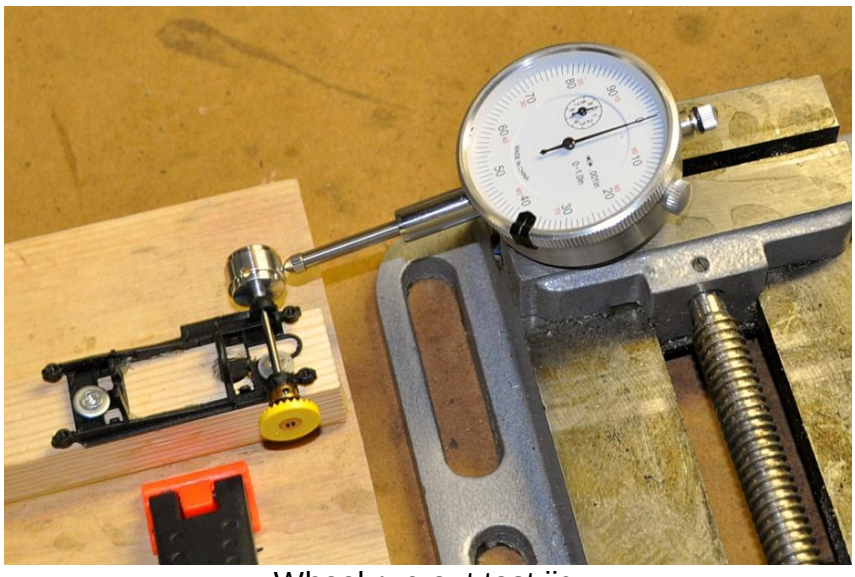
You will also need a wrench for the set screws, 0.90mm is the correct size, except for NSR gears which use a 1.3mm screw. The same wrench(es) will be needed with metal wheels and the best types will be discussed in the next section.

RTR cars are usually geared about 3:1, which is fine if you are running with magnets, but would be too high for non-magnet running in many cases. Remember that higher numerical gear ratios give you more acceleration and lower ones give you more top speed, but there are practical limits to what you can do with gears alone. If you don't have enough grip you will get wheel spin with a high gear ratio and drag will keep a motor from achieving its maximum RPMs if you use a low gear ratio.
If a car is very light, down around 70 grams (2.47 ounces), you can usually go as low as 2.4:1, with a heavier car, say 91 grams (3.2 ounces) 3:1 would be more appropriate. If a car seems sluggish coming off the turns or has poor brakes a higher numeric gear ratio is needed, if it has reached its full speed half way down the longest straight you might need to go to a lower numeric ratio. Changing the pinion gear will have a bigger effect on the gear ratio, a one or two tooth change with a crown, or more so a spur gear, will have a relatively small effect. Click here for gear ratio tables.

The torque and RPMs of the motor that you use must also be considered when you pick a gear ratio. Another factor is tire diameter, using a larger diameter tire will have the same effect as going to a numerically lower gear ratio.
There are no hard and fast rules on how to pick the best gear ratio, so it will not hurt to experiment a little.

Wheels and Tires

It is important to use good wheels on any slot car. Some makes of RTR cars come with good plastic wheels, but those can break or strip out leaving your car dead in the water, which really hurts if your car is entered in a proxy series.
If plastic wheels strip or the hub breaks you may be able to glue the wheel back on or put a collar over the broken hub. Either repair may not hold up and the wheel might not run true after it is repaired. If your club rules call for stock plastic wheels you will have to find a replacement axle/wheel assembly.
Premium cars from makes like Slot.it and NSR do come with metal wheels, if the rules allow it is probably best to change to aftermarket metal wheels. You would expect that metal wheels that are made using modern CNC equipment would always run true, however I have come across some wheels that have a few thousandths of an inch runout, so a thorough builder would need to check for that using a jig such as the one shown below.



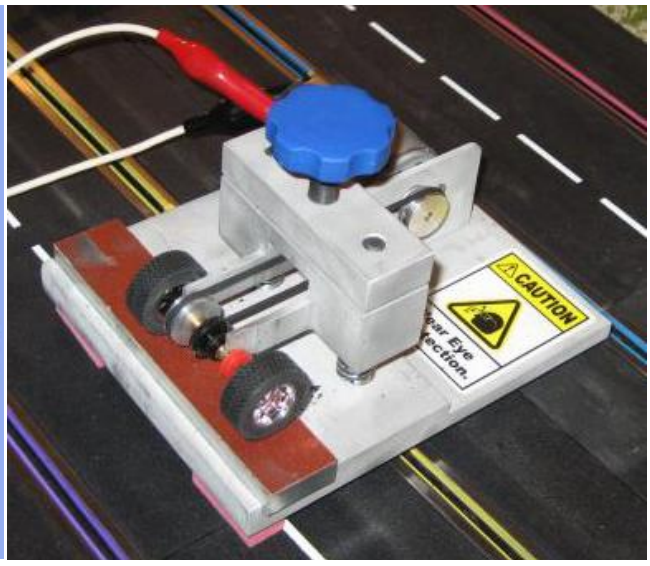
Wheel run-out test jig

If you do use aftermarket wheels they should be a snug fit on the axle, otherwise when you make up the set screw there will be some runout for sure.
If you expect to use aftermarket wheels a lot you should invest in a good hex wrench. Two different screw sizes are used, 0.9mm is the most common, those are used by Slot.it and CB Design. A 1.3mm (0.05") size is used mostly by NSR as well as the wheels used on 1/24th commercial raceway cars. Cheap L shaped hex wrenches round off very easily and when they do the socket in the screw is often damaged as well and the screw will have to be replaced. A rounded wrench can be repaired by grinding a little bit off the end. The tip of the wrench must be hard enough to resist rounding off, but no so brittle that it will break easily. The shank portion of the wrench must be long enough to reach deeply recessed screws. Relatively inexpensive wrenches are made by Wiha and Wera. I like the orange PA23 torque limiting wrench that was sold by Slot.it, it is no longer in production, but it has been replaced by newer versions PA67a and PA67b. Scale Auto also has a torque limiting wrench.
Some of the screws that come with aftermarket wheels can strip easily as well and replacements tend to be overpriced. Slot Car Corner offers a selection of reasonably priced high quality screws.

A variety of aftermarket wheels are available, some are plain and are usually intended to take inserts, so you can preserve the original look of a car. Slot.it, CB Design insert and BWA wheels fall into that category. Some wheels have hubs so it is easier to find the set screws, but the hubs will limit the width of the tires that you can use in many cases. Hubless wheels allow you to fit wider tires, but you must use a wrench that can reach the set screw and it may be necessary to make a hole in the tire as well.
If you are looking for wheels that look good without inserts CB Design "Five Spoke", "Classic Steel", "F1", "LMP" or "Stock Car" wheels are worth considering.

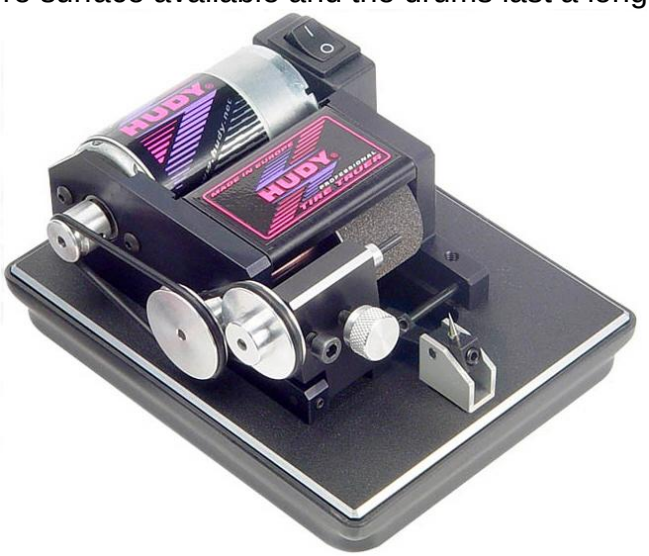
The tires that come with most RTR cars are made from some sort of natural rubber formulation and are injection molded. Since those tires are used on cars with traction magnets they usually do not have a great deal of grip. It is not unusual for stock tires to have a tread that is bulged or cupped. For better performance it is common practice to sand the tread flat by putting some ~100 grit sand paper on the track and carefully lowering the back of the running car down on the sandpaper. If the wheels/tires are out of round this procedure may not be effective because to get the tires perfectly true you have to keep a constant distance between the sand paper and the center of the wheel. To get a perfectly true tire you should use a truing machine. If you are using non-removable wheels there are special machines that can accommodate the entire stock rear axle assembly. The Area 3 and Tire Razor machines are examples of that type and they can also do tires mounted on set screw wheels. Depending on the material that the tires are made of the sanding pads may need to be replaced often.

Area 3



Tire Razor

Another type of truing machine can only be used with tires that are mounted on removable wheels, the Hudy and Slotcars.it Technology machines are examples of that type. Both machines have sanding drums that turn in the opposite direction from the tires. With a sanding drum there is a lot more surface available and the drums last a long time.



Hudy

Slotcars.it Technology

A separate power supply is needed to run any truing machine that I know of. A variable voltage power supply that is good for at least five amps is necessary.

Slot.it and NSR are examples of cars that come with high quality rubber tires that need little, if any, truing. Both companies offer a variety of rubber compounds. Generally softer compounds will have more grip but may be more difficult to true and can wear quickly.
Some RTR cars come with rubber tires that are made of a synthetic material, such as Neoprene or PVC.
Rubber tires work best on tracks where rubber tires are used exclusively so that the track is "rubbered in". The grip of tires that are made of natural rubber may be improved by various treatments. NSR makes a treatment for their tires. 3in1 oil and suntan lotion are also known to improve grip. Some clubs may forbid the use of any sort of traction improving treatment.

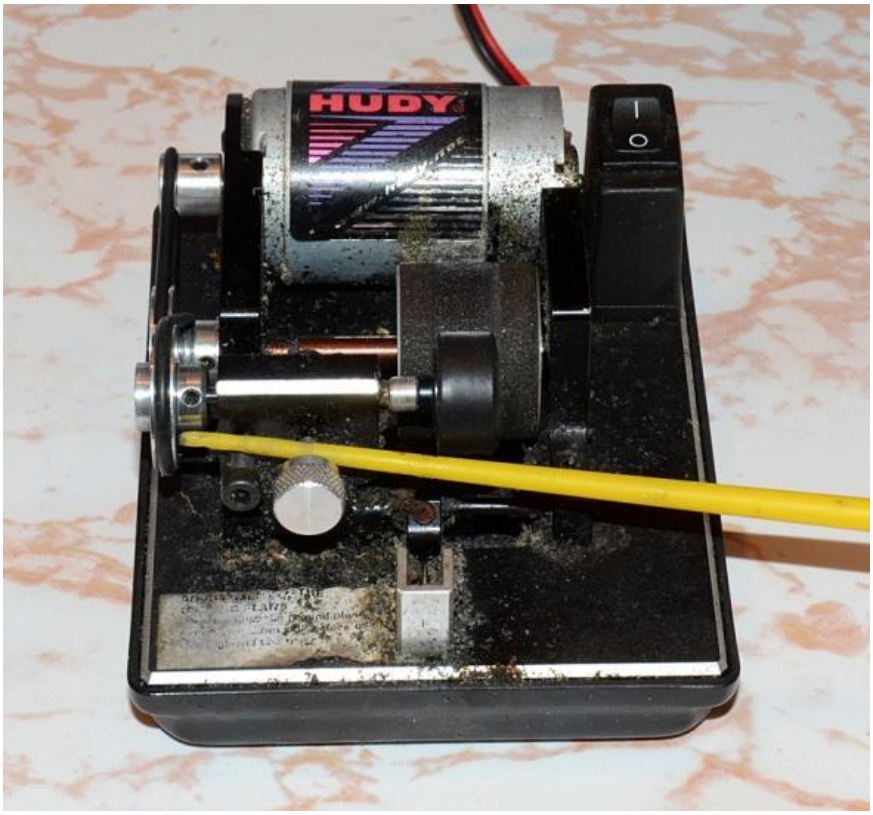
Tires that are made of silicone, EPDM or urethane are usually not classified as "rubber". Some people do tend to lump urethane tires in with rubber tires however.
The only EPDM tires that I know of are Gel Claws, I have minimal experience with those, I have heard mixed reports on them from sources that I regard as being less reliable.
Ortmann, Paul Gage and Super Tires Yellow Dogs are examples of urethane tires. All three types are poured into molds, I believe that Ortmanns and some Paul Gauge tires are made in flexible molds and I know that Yellow Dogs are made in CNC machined molds, so the first two types may need a little extra truing.
Professor Motor MaxxTrac, Super Tires and Quick Slicks are examples of silicone tires. I believe that MaxxTrac are injection molded, I know that the other two are poured into CNC molds.

Choosing the correct type of tire is obviously very important if you are racing. In formal club type or proxy racing the choice of tires may not be open.
Rubber tires, except for some of the softer types, tend to have the least grip, they wear faster and may become hard with time. If you treat rubber tires the treatment will have to be repeated periodically.
Urethane tires have more grip than most rubber tires, they work best on tracks where urethane tires are used exclusively, but are OK on a rubbered in track. Urethane tires are more tolerant of dust on the track than silicone tires because dust does not stick to urethane. If the track is also used for cars

with silicone tires urethane tires may get coated with something and lose grip unless they are washed with soapy water.
On a perfectly clean track silicone tires have the best grip in most cases, no special treatment is necessary beyond cleaning. The easy and quick way to clean silicone tires is to roll them on sticky tape.
There is no specific tire that will be the best for all conditions, in addition within each basic type there are several makers and those often sell a number of different compounds. Do not be afraid to experiment with different tire compounds.
All types of tires will work their best if they are glued to the wheels and trued. If the tires are not glued and you are getting half way decent grip they will peel away from the wheels in the corners reducing the contact patch greatly. If you do not want to glue the tires at least make sure that they are fully seated on the wheels. It helps to put a little soapy water on the inside of the tire before you slip it on the wheel.
It is best to wash your wheels and tires before applying glue, if there is any oil or mold release agent present the glue will not stick for long. I use denatured alcohol. Some people use IC2000 or nail polish to glue on their tires, I have used slow setting Loctite Superglue. The Loctite comes in a little squeeze bottle, rather than a tube, so it is easier to control the flow. It is a good idea to wear gloves when you work with Superglue. First I put the tire on the wheel and try to get it fully seated by putting an axle through the wheel and applying pressure while rolling the tire/wheel on a hard flat surface. Next I lay the tire/wheel flat on its side and pry the tire away from the rim with a toothpick. I put the tip of the Loctite container in the gap and apply the glue all around the rim. I wipe off any excess glue and roll the tire to spread the glue evenly. I turn the tire/wheel over and repeat the procedure on the other side. Although the Superglue should be fully set in about 30 minutes I prefer to play it safe and give it at least a couple of hours.
I have had a problem using Superglue with one pair of Quick Slicks, I could not get the tires glued no matter how much Superglue I used. VersaChem Mega Black Silicone Gasket Maker works well with these tires. The method of application is about the same. I use two toothpicks, one to pry the tire away from the rim and the other with a dab of glue on the end to apply the glue. The glue cures slowly, 12-24 hours is needed.
There is now a special tool available that makes gluing tires easier. The tool allows you to coat the wheel evenly with your adhesive of choice. The tire gets stretched so it fits on the wheel without disturbing the coat of glue.

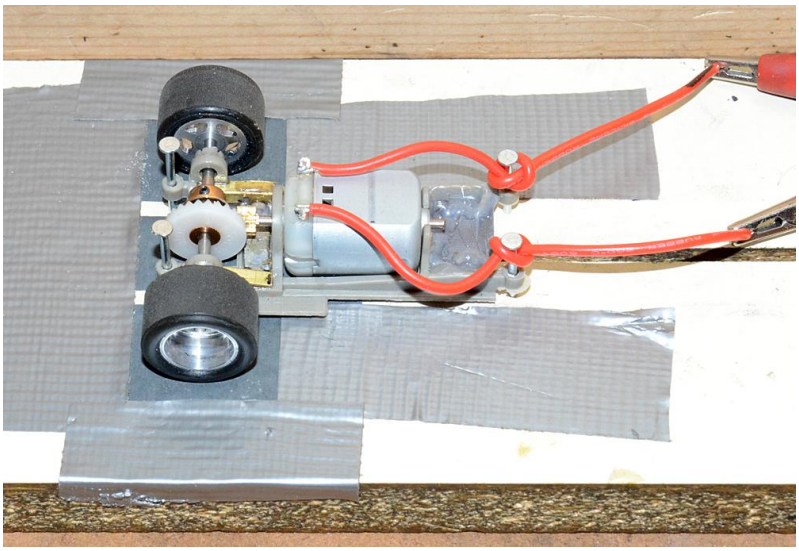
Here is a video on using the tool: https://www.youtube.com/watch?v=6ED1xDx-uxI&feature=youtu.be

You can true most rubber tires and even reduce their diameter rather quickly. Very soft rubber has to be trued at a lower than normal speed, about five volts should work. I true urethane and silicone tires at 10 volts. Urethane is easier to true than silicone. Soft Quick Slicks are softer than Super Tires and are easier to true. Quick Slicks are also available in Firm and X-Firm versions. It might be difficult to reduce the diameter of any silicone tire no matter what sort of machine you use.



I use a Hudy machine that has had its axle drive pulley reversed so that there can be a little side to side motion of the axle. My machine draws 1 amp when the tire is not in contact with the sanding drum. If you try to true a tire with too much pressure you will not remove the high spots, you will only reduce the diameter of the tire. I adjust the pressure to read 2 amps on my power supply and drip soapy water on the tire to keep it cool and to keep the sanding drum from getting clogged with sticky goo. If the tire gets too hot Superglue will de-bond. If the drum gets clogged it will have to be cleaned. I use a piece of gum rubber that hardware stores sell for the purpose. After a few minutes of grinding I stop the drip and poke the axle drive pulley to move the tire from side to side for about 10 seconds, that removes any grooves that were made on the surface of the tire.

At that point I wipe off the tread of the tire and examine it carefully, the appearance of the tread should be uniform, if it is mottled it needs more grinding. After a tire appears to be done I like to give it an extra pass or two, just to be sure. When silicone Super Tires are done they will not be perfectly smooth, they will have a slightly stippled texture until they are polished with fine sandpaper or run for a few dozen laps on the track. Here is a rig that I made for polishing tires.



The shoulders of the tires will need to be rounded off when you are done truing. A common emery board can be used for that. With Super Tires something with 60 grit will be needed first, followed by a pass with a finer grade abrasive.
If the tires have been properly trued the car will be quiet when you run it on a wood track. Tires that are not true make a drumming sound that would not be heard on a regular plastic track.
With some truing machines you could end up with tires that are tapered if the machine is out of alignment. You can see the taper if you put the car on a clean, flat shiny surface and hold it up to the light. I use a setup block from Slot Car Corner that has been polished. Rolling the car to rotate the tires will show any spots that are not true. With the Hudy machine it is possible to loosen the screws that hold the axle carrier in place to reposition the axle. Another way to avoid this problem is to turn the wheel around with every other pass, but the axle might not be long enough to do that with certain wheels.

Motors

Performance testing results for many of the available motors may be found here:
http://slotcarnews.blogspot.com/2007/02/slot-car-news-motor-list.html

The motor is one of the last things to think about when you set up a car. In some cases a spec motor is called for, but there is usually a considerable difference in performance between different examples of the same motor.
In some cases proxy rules might specify a particular type or even make and model of motor, in that case it does not hurt to check them out with a non-contact digital tachometer. The motor speed can be determined at the rear tires using the gear ratio to calculate the motor speed. If the motor is out of the car you can put a disc on the motor shaft. With some tachometers marking a stripe on the disc will work OK, in some cases you will need to use a reflective sticker that comes with the tachometer. You would usually want to run the motor with 12 volts, published performance figures are usually determined at that setting.
If you have a choice of motors you might start by using the same motor as the faster racers do. If a car does not handle well a more powerful motor will usually make it slower. You may find that at your level of tuning expertise that going for less power would be helpful. If your cars are really hooked up they can take more power. The site that I referred to earlier is very helpful in selecting a motor. There are three measurements to be considered, RPMs, torque and power. Torque is measured in gram-centimeters (g-cm) and power is measured in watts. The power figure is calculated using the RPM and torque numbers. In the end power is what really matters. Motors with the same power will usually give the same performance on the track if the correct gear ratio is chosen. For example you could have two motors with the same power rating, but one might have high RPMs and low torque while the other is the opposite. The high RPM, low torque motor might have to be geared closer to 3.5:1, while the low RPM, high torque motor would be geared 2.5:1. In extreme cases you might not be able to find gear to get the right ratio.
If you run on plastic track or on a wood track with Magnabraid the magnetic downforce of the motor will be a factor. The downforce of FK type motors with open cans is not huge but it does make a difference and some makers do publish a downforce rating.

FC130

FK130

FK180

FLAT 6

16-D

FF

Most of the motors used in 1/32nd cars do not benefit from a special break-in procedure, you can just put the car on the track and run it normally. The car might be a little faster after the motor brushes have broken in. I do not have a track, so before I bring a new car to a race I run in the motor for about 30 minutes at 6 volts, then I flush the commutator with contact cleaner and re-oil the bearings.

Bodies and Interiors

Often you will not be able to choose the best body to put on a car, but if you can one that is low and wide will outperform one that is high and narrow in most cases. It does not hurt if a body is low in weight, but a thin body may not be as durable. Most of the time your cars will handle better if the body is free to rock a little on the chassis. You will have to loosen the body screws and probably sand the edges of the chassis to allow enough movement. Make sure that the tires will never rub on the body or interior, that can cause erratic handling. The rules might require a stock full interior, make sure that it does not impede body motion. You may be able to substitute a tray style interior for a full interior. Vacuum formed tray style interiors are available for many cars and those will lower the weight and center of gravity of a car.

Weights

When you run cars without traction magnets you will usually have to add weight, the trick is to put the weight in the right place. It is best to make adding weight the last step in tuning a car. A heavy car can have slower acceleration, less braking and be reluctant to change direction. Some tuners save all the weight they can so that added weight for tuning purposes will have less of an impact on the total weight of the car.
With slot cars that lack grip adding weight is not going to get you much. If the front of the car lifts on acceleration or the front of the car comes out of the slot at the limit it needs more weight up front, the best place to put the weight is just behind the front axle and only a small amount should be needed. If the car wants to tip over in the corners weight needs to be added as low as possible. I stick thin sheet lead on the bottom of the chassis or motor pod if possible. If a car wants to slide out a lot at the limit it used to be recommended that you add weight higher up, perhaps on top of or on the sides of the

motor. That has never worked for me. If you are building a car strictly for oval racing a good place to add weight is just in front of the inside rear wheel.
While you are fussing around with weights recall that most of it should be towards the back of the car, I usually put it from a point an inch or two forward of the motor to just ahead of the rear axle. I might put it off center if the car is heavier on one side. Electronic scales have become inexpensive, some people use a pair of them to determine the weight distribution of the car. There should be blocks under the tires to keep the guide flag from touching and keep the car level. If the car is tilted the measurements will not be accurate.

Oil, Grease and Braid Conditioners

Before each race you should oil the car's axles where they pass through a bearing surface, the motor bearings and the guide flag post. Be sure to use a lubricant that is plastic safe, only a small drop in each place is needed, excess oil will just make a mess. I like Superlube from Slot Car Corner, it comes in a bottle with a pinpoint tip and has a captive cap. Use a little grease on the gears, oil will just sling off. I use a lithium grease. Be sure to check the car's braids and replace them if they are worn. Lighter fluid can be used to remove gunk from the braid. The type of braid conditioner that is used on 1/24th commercial raceway cars also works well, but it may damage plastic and painted surfaces.
There are products, usually referred to as "comm drops", that are applied to the motor's commutator that are supposed to enhance performance, I have tried a number of those and found that any improvement is temporary and frequently they cause motor brush dust to short the commutator.

General Considerations

Anything that causes the car to vibrate will degrade performance to a greater or lesser degree. Vibrations signal wasted power and less than optimal handling because those vibrations get transmitted to the car's wheels and tires. Chances are that a quiet car has less problems with poor gear mesh, loose axles and out of balance rotating parts.
One rather frustrating aspect of tuning these cars is that the setup that works perfectly for one car can be wrong for another example of the same one. Sometimes a half turn of a body or motor pod screw can make a bigger difference than you would expect.

Parts Suppliers

132slotcar http://www.132slotcar.us/store/

Dart Hobbies http://www.darthobbies.com/132wheels.htm

Electric Dreams http://www.electricdreams.com/

Professor Motor http://www.professormotor.com/

Pendle Slot Racing http://www.pendleslotracing.co.uk/

Scale Racing http://scaleracing.com/

Slot Car Corner http://www.slotcarcorner.com/

Super Tires http://www.supertires.com/

3D Printed Chassis and Motor Pods

CG Slot Cars https://www.shapeways.com/shops/slotcars

Olifer Performance Slot Car Parts https://www.shapeways.com/shops/3d_olifer

Gear Ratio Tables

Slot.it Anglewinder/Sidewinder Gears

Pinion 6.5mm	24	25	26	27	28	29	30	31	32	33	34	35	36	38
8	3.00	3.13	3.25	3.38	3.50	3.63	3.75	3.88	4.00	4.13	4.25	4.38	4.50	4.75
9	2.67	2.78	2.89	3.00	3.11	3.22	3.33	3.44	3.56	3.67	3.78	3.89	4.00	4.22
10†	2.40	2.50	2.60	2.70	2.80	2.90	3.00	3.10	3.20	3.30	3.40	3.50	3.60	3.80
11†*	2.18	2.27	2.36	2.46	2.55	2.64	2.73	2.83	2.91	3.00	3.09	3.18	3.27	3.45
12*	2.00	2.08	2.17	2.25	2.33	2.42	2.50	2.58	2.67	2.75	2.83	2.92	3.00	3.17
13	1.85	1.92	2.00	2.08	2.15	2.23	2.31	2.39	2.46	2.54	2.62	2.69	2.77	2.92
*Also 6.75mm									∅ 18		∅ 18 ∅ 19		∅ 18 ∅ 19	∅ 19
† Also 6mm	AW /LH	AW /LH	AW /LH	AW	AW	AW	AW		AW		AW		AW	
Lightweight →								∅ 18		∅ 18	∅18 ∅19	∅ 18	∅ 19	∅ 19

Slot.it Inline Gears

Pinion 5.5mm	23	24	25	26	27	28	29	30
8	2.88	3.00	3.13	3.25	3.38	3.50	3.63	3.75
9	2.56	2.67	2.78	2.89	3.00	3.11	3.22	3.33
10	2.30	2.40	2.50	2.60	2.70	2.80	2.90	3.00
11	2.09	2.18	2.27	2.36	2.46	2.55	2.64	2.73
Pinion 5.5mm								
→ Offset								