

John's Tips for Building Pinewood Derby Cars Updated for 2008

There isn't one tip or secret that will make a fast pinewood derby car. There are several things that need to be done to make a fast pinewood derby car, (see below). Also the type of track, how the track is setup, and how the winner is determined affects the relative importance of the tips given below. A car that wins on one track may not win on another track or the same track setup on a different day. Also there is luck. I have heard of blocks of wood that win pinewood derby races. I have my own a little pinewood derby story to illustrate luck.

For several years I have helped make 3 or 4 cars for my four kids and we are always finishing them the day of the weigh-in. One year, as usual we were having trouble getting my oldest son car aligned. It never seemed to run straight enough. We were tweaking it right before the weigh-in. Finally we had to go. My son was bringing the car up the basement steps when **HE DROPPED HIS CAR!!** Nothing broke and nothing looked bent but the axles are not very sturdy. We couldn't check the alignment so we took the car as is to the weigh-in. At the weigh-in we checked the alignment again by rolling it along a table. It seemed to be about the same, so we checked it in. He won every race, which was the first time we had won 1st place. To this day I don't know whether dropping the car fixed our alignment problem. **NOW, I DO NOT RECOMMEND DROPPING YOUR CAR TO IMPROVE ITS ALIGNMENT!!!!**

The most important tip is to work with your son and have fun. Most kids remember the time spent working with their parent on their car; not the actual race. Also every year we have OUTLAW races for dads, siblings, and cub scouts with illegal cars. It is just for fun and no prizes are awarded, but you are allowed to violate the rules (as long as the car doesn't damage the track so keep the weight reasonable and don't use razor thin wheels that would cut into the track). Then if there is time we open up the track for anyone to race.

Pack 88 uses a six lane, plastic track called SuperTrack. We got the complete system: track, electronic finish, and race manager software. Go to <http://www.supertimer.com/track/supertrack.html> for more information. Besides being plastic instead of wood, one difference is that this track uses side rails instead of a center guide strip. So cars with a front wheel lifted too high and with a lot of weight in the back or cars that have very poor alignment tend to cross-lanes. We have a procedure to handle these cases, see the official rules at <http://www.cubpack88.org>. We also have the bought the electronic finish, so all the races are timed. Each car goes down each lane once (a total of six races for each car) and the cars' times are recorded for each race. The cars are actually racing against the clock not against other cars. The final winners are determined by the fastest average times, so it is possible for a car to win every race but not be an overall winner if it is racing slow cars. The race manager software records the times automatically (so there won't be a manual recording error). Also the race manager software schedules the races and tends to race slower cars against slower cars and faster cars against faster cars as the racing progresses. This way the individual races tend to be more competitive.

Every year our Pack has a Pinewood Derby Help session please check the calendar for the date and time. Several experienced pinewood derby dads and tools will be available to help you and

your son build your car. I will bring my little drill press to help drill out the axle slots. My tips below are not a step-by-step guide to building a fast pinewood derby car, since two very good step-by-step guides exist. The first is free at <http://www.lastufka.net/lab/cars/html/index.htm>. The second cost ~\$7 or \$8 at http://www.maximum-velocity.com/speed_tips.htm. However, if you use these guides there are several suggestions that are not legal in our race, so don't use them. See the first tip below.

- Obey **all** the rules; see the Pack 88 website, <http://www.cubpack88.org>, for the official rules. If you want to use trimmed wheels, longer length between axles or other improvements that violate the rules, build an "outlaw" car and race it in the outlaw race.
- Make suggestions to your son, but have him make decisions. Also let your son do as much work as possible. (Car shape/aerodynamics does not affect performance very much so let him choose the shape/style of the car; however, most of the fastest cars have a flat or wedge shape). However, don't make your car too tall or it won't go into the stopping garage or fit under the finish gate on other tracks. Since every finish gate and garage are different, as a general rule I would keep the total height under 2.75".
- Check your pieces. Make sure that the axle slots are square and that the wheels and axles don't look damaged. If they are damaged contact the cub master or me and we will get you a replacement.
- My first step while I still have a block of wood is to drill out the axle slots to allow the nails to go in easier. Then we cut the car's shape, sand, paint, etc. Then one of the last steps is to epoxy the axles with their wheel in place. I use a small drill press with a 3/32" drill bit. 3/32" is actually a little large, a #44 is better, but I don't have one. If you don't have a drill press you can do it by hand or you can go to www.maximum-velocity.com for a ~\$11 tool to aid in drilling the holes. Note: many items at www.maximum-velocity.com will violate the Pack88 rules so don't use them on your son's official car. You can use them for your outlaw car.
- Align your car so it travels straight. A car that is pulling to one side will be pushing against the side rails or bouncing between the rails, which will slow it down. This is by far the hardest thing to do. I test alignment by pushing the car on a flat surface to see which way it curves. The alignment is usually done by slightly bending the axles, but be careful you can break the wood very easily. ~~One trick if you are running on three wheels is as follows: Assuming that one of the front wheels is raised, very slightly bend the axle of the wheel on the ground, don't glue the axle yet, test the alignment, then rotate the bent axle until the car goes straight.~~ **For 2008, the District Pinewood derby rules require that all four wheels touch the ground, so this tip cannot be used.**
- ~~Slightly raise 1 wheel so it doesn't touch the ground. (If the weight is toward the back, raise a front wheel.) Don't raise the wheel too much, (1/16" to 1/8" is enough), if it is too high then the wheel may go over the side guard rails and the car will spin out.~~ **For 2008, the District Pinewood derby rules require that all four wheels touch the ground, so this tip cannot be used.**
- Add weight to get close to 5 oz. You can add the final weight at the weigh-in to get to 5 oz. Since all scales are slightly different, being a little under 5 oz at the weigh-in is better, since it is usually easier to add weight than to remove weight. We will have the official Pack 88 scale at the help session.

- Adjust the center of gravity so that it is 0.75" to 1.5" in front of the rear axle. The center of gravity is the location where a car will balance. I check the center of gravity by balancing the car on a square edge ruler. Before I figured out about the square edged ruler I used my finger. The location of the center of gravity involves a trade-off between stability (weight towards front) and maximum speed or potential energy (weight towards back). Basically the optimal position depends on the car and the track. I feel that cars with poor alignment will do better with the center of gravity closer to 1.5" in front of the rear wheels, while cars with excellent alignment will do better with the center of gravity closer to 0.75" in front of the rear wheels. I wouldn't go less than 0.75" in front of the rear axle because the front end will become very "light", which makes it easier for the front wheels to go over the side rails and for the car to cross lanes. So your car could be very fast, but if it can't stay in its lane it will be disqualified. The primary way to adjust the center of gravity is by positioning the weights. You can also remove weight by drilling or cutting away wood.
- Rear axle as far back as possible, since you want the weight as far back as possible while keeping the center of gravity in front of the rear axle. At a minimum have the axle slot closest to the end be the back of the car. For a further improvement cut off part of back end and add it to front to get to 7" since you have to use the original slots that came with the car. You can't drill new holes or cut new slots. This trick allows you to move the center of gravity farther back while allowing it to be in front of the rear axle.
- Don't shorten the car (i.e. keep length at 7"). Make sure the car length including wheels and accessories (like tail lights or tail pipes) is at most 7". Remember if you cut off the back of the car and the rear wheels stick past the body, then total length includes the wheels.
- Remove the burs on the axle and polish them. I place the axle in a drill press which spins the axle so it can be sanded and polished easily. You can also clamp a hand drill in a vice instead of using a drill press.
- Lightly sand the wheels to remove the little stubs on the other edge. (Don't reshape the wheels, which is against the Pack88 rules). Some of the original "tread marks" must remain visible to the inspector at weigh-in. You can get a special axle/hub at the scout shop or www.maximum-velocity.com that can be mounted in a drill to spin the wheel to make sanding it easier. Special wheels can be purchased but that is against the Pack88 rules.
- Use graphite, preferably with moly (**Don't use the White Teflon sold at the Scout Shop**). I work graphite into the axles and rub it around the wheels. I also graphite the spot on the body where the wheel hits.
- After adding graphite to the wheel axles, the graphite needs to be worked in. Spin the wheels several times or roll it gently along a table several times before turning your car in at check in. The Weigh-in will be the last chance to add graphite before the race. You cannot add graphite during the races. I don't know exactly how much to add or how long to spin the wheels. I put about two or three puffs into each wheel before spinning them.
- Raising the front end may or may not be helpful on our track since we have an automatic starting gate and a strip sensor that extends from the bottom of the track. It is usually helpful on tracks with LED diodes at the finishing line and manual starting gates. Don't raise the front end to much, since if the front end goes over the starting peg the car will be disqualified for having a lead at the start of the race.
- Don't make the front end too pointed. It doesn't significantly help with aerodynamics and it may disqualify your car if it can't stay on the starting peg. At the District Pinewood derby race one year, a car's front end had a sharp point and the starting peg was rounded. The car

always slid forward before the race started, so it had a lead and was disqualified. Another reason not to do it is that if the car is over to one side of the lane at the finish line, a car with a pointed front may pass the finish sensor in the center of the lane without triggering it. The sensor won't be trigger until a wider part of the car crosses the sensor. Another car whose front end is behind the other car's pointed front end but trips the sensors first will have a faster time. Most packs with electronic timers use the official time from the electronics and won't re-run races based upon what people saw at the finish.

Finally I suggest going to <http://www.maximumvelocity.com> and sign-up for their free newsletter. They were offering a free car plan if you signed up. Visit our website, <http://www.cubpack88.org>, which list lots of links for additional information on building pinewood derby cars. If you have any questions or want a more detailed explanation send me an email, salmentoj@asme.org, or give me a call 610 614 0379. Please excuse all typographical and grammatical errors. **Finally, if I inadvertently stated anything that violates the Official Pack 88 rules, then the rules take precedence.**

Good luck and have fun,
John Salmento
Pinewood Derby Chairman