

Pinewood Derby – super-fast standard division and Outlaw cars

You are going to read some of this and decide it is ridiculous. I'm telling you this upfront, so don't be surprised. My son and I did all of these techniques, and the only thing I can tell you, is they worked for us. Do what you want and make it your own – and HAVE FUN!

• BODY TYPES

Pinewood Derby cars can be found in almost every shape imaginable. Two years ago, we even built R2D2 to run in the Outlaw Division. You can go as over-the-top as you want. For us, though, we've had the best success with winning when we run a simple wedge design. We don't spend a ton of time on the body as you get most of the speed from the correct weights and wheels. The one thing I don't have in my workshop is a decent cutting mechanism. Since neither a hand saw nor a Dremel tool is ideal for cutting a Pinewood car, we either ask the nice folks at our local hardware store or our neighborhood handyman to help with the cutting. You can do it yourself if you have the appropriate equipment, I'm simply not willing to invest that money. As a bonus, both cutting sources have taken the time to teach my children proper techniques and safety.

- ◆ The only real trick to note with the body type is to sand, sand, sand. You want as many curved edges as smooth as possible. This reduces friction and makes the car "look cooler," to quote my son. He is in charge of sanding. It is hard to do this incorrectly and is the perfect way to get them involved at the start.
- ◆ **Outlaw Note:** if you are running in the Outlaw/anything-goes-division, I recommend extending the wheel base. This is rarely allowed in the standard Pinewood Derby races. If it is allowed in your general race, by all means EXTEND THE WHEEL BASE! You will want to do this BEFORE YOU CUT THE BODY. The extended wheel axels should be drilled 5/8" from the front and back of the car using a number 44 drill bit and 1/8" up from the base of the car. However, I prefer to use the Pinewood Axel Drilling Tool pictured below. It is a bit more than 1/8" up from the base, but I find the car runs faster and I know my axels are straight. (Hint: longer wheel base cars run straighter and also allow for more weight at the back. Thus, reducing friction and increasing potential energy.)



The Axel drill tool in use. If you don't have a clamp – what sort of shop are you running? Okay, ignore that, and go buy one. Actually, go buy ten!

- ◆ A note on painting, etc. I am going to be honest, all the paint jobs (with the exception of R2D2 which took hours) we have done, look horrible in person. We have yet to figure out the perfect painting for our cars. So, we gave up. Most craft stores sell Pinewood “skins.” These are basically water applied temporary tattoos for your car. We love them. They can be a pain to get on perfectly, but the designs are usually so busy, no one knows! The only trick we’ve learned is to seal them with a clear gloss paint after they are dry. Another note, COVER YOUR AXEL HOLES WITH PAINTER’S TAPE WHILE PAINTING OR APPLYING SKIN.



If you extend the wheel base, please drill several holes along the axel length. We will touch on their uses under wheel alignment and prep.

• WEIGHT

The more weight your car has when balanced at the top of the racing track, the more potential energy your car possess. This is basic physics. The standard race allows the car to weigh in at a maximum of 5oz. Leaving any of that weight off the car reduces your potential energy. First, INVEST IN A SCALE. we used a baking scale for a while. However, many different pinewood companies sell scales specifically calibrated for that 5 oz. weight.

◆ Bake the wood

This is when you can tell me I’m crazy. My son and I like to bake all the moisture out of our pine blocks before we begin this process. We actually do this before we cut the shape or extend the wheel base. Why? Because water is heavy and every block of pine has water inside. Just a little, but by backing the water out, you can add more weight at the rear of the car. I like 200-250

degrees for an hour per block. We usually do two blocks at 200 degrees for two hours.

◆ **Types**

Weight comes in many different forms. If you doubt me, check out the picture below! We prefer the Tungsten putty and lead tubes. The tubes generally come in the right length to fit through the middle of the car. The putty is great for removing and/or adding weight as needed.

◆ **Balance**

The car's center of gravity should be between $\frac{3}{4}$ " and 1" in front of the rear-wheel axel. We balance the car on a piece of triangular crown molding I got at the hardware store. The allows your car to get a "push" when the track moves from the hill to the straight-away. The more "push," the faster your car will travel. Front weighted cars will experience more drag and less "push." The first year, we had multiple dads ask us how our car got that extra burst of speed. Trust me on this one!

◆ **Placement**

We like to drill holes through the middle of our car, right at, in front of, and behind, the center of gravity. We then fill those holes with the right amount of weight. REMEMBER TO WEIGH YOUR CAR, THE WHEELS, AXELS AND WEIGHTS TO REACH THE 5 OZ. We like to be a smidge under the 5oz when we weight all these items together, that way, as we add Bondo (see note) we stay under weight. We then add the tungsten putty to hit the 5 oz. on the nose.



Yup, we're crazy. Here we are baking this year's cars. I wouldn't say it is necessary, but we enjoy the whole idea.



Various weights of various types are available. We like the tungsten putty (on scale, bottom right) and the lead cylinder/tubes (above putty) The tungsten tubes are nice and able to be trimmed, but you get less weight per mass.



Bondo is one of the most important tools of the trade. Personally, my son and I have an either-or relationship with Bondo. When we mix in the epoxy hardener, we either manage to add too much and it hardens before we're don't mixing, or too little and it hardens five days later. I highly recommend this product – and may the odds be every in your favor!

- ❖ NOTE: We also like to make a small hole at the front, center, bottom of the car for Tungsten putty. This allows us to add or remove a little of the putty when we are the official weigh in to make our car exactly 5 oz.
- ❖ **Outlaw Note:** there are no weight limits in the outlaw division. I suggest you go as heavy as your wheels will allow. This year we ran “razor” wheels that we purchased from a pinewood derby supplier. We found that they could safely handle up to 15 oz. Our winning car (by a mile) ran at 12 oz. on super thin, perforated razor wheels – only three touching the track. (more on that under friction reduction) Our number two car had four wheels, all on the track, no perforations and ran super fast at just under 15 oz. We put the weight at the back, it isn't entirely balanced, it is a bit back heavy. We used egg-style fishing weights and un-cut square keys from the hardware store to add the extra weight.

• Wheels

There are really two parts to this: first, you need to reduce the friction of the actual spinning and second, you need to get the car running straight. This in turn reduces friction by not having your car bouncing along the edges of the track.

◆ Axle Prep

Two issues can occur with axels. First, the axle may be bent. Second, the official BSA axels all have grooves running around their circumference.

- First, you need to find the four straightest axels you can get your mitts on. You can do your best to straighten the four in your box, but I've found it is usually best to buy several kits from the hardware or hobby store and then check them individually for the straightest. We put each axle into a drill and spin it. The straightest axels wobble the least. Once you have the four straightest, go ahead and use an axle press to straighten them even more.



Axel straightener. I mark the axel with a straight line and then hammer it flat at 0 degrees, 90 degrees, 180 degrees, and 270 degrees.

◆ **Axel Prep continued**

Now that you have four straight axels, you need to get rid of those friction causing ridges. Place axels, individually, in your drill. Make sure they are in tight. We then put the drill in a vice. This allows us to use our hands and have the drill supported. We also wear safety eye gear, just in case. Using various grits of sandpaper, ending in 2000 grit – you may again call us crazy- we shine those axels to a high polish.



This is my son at work polishing up the axels. Note the ridges – we sand until those are nothing but a memory!

◆ **Wheel prep**

Since you've already bought a couple of pinewood kits while looking for the perfect axels, now take a look at the wheels as well. The wheels come out of molds and like all molded plastic, some of them are not as perfect as others. The main thing to check for in the inner bore is any hanging plastic. Find the four cleanest, widest bores and use those to work with. If your troop allows you to remove all grooves on the outer wheels, do so. Ours does not, so we polish while leaving the outer markings intact. We use very fine grit, water usable sandpaper to sand the outer rim of the wheels. We also use PineCar wheel tools to polish and taper the inner wheel hub, as per the tool's instructions. Lastly, using whitening toothpaste, we use a pipecleaner inserted

into the drill to polish the inside of the wheel bore. We have seen various polishing kits, but we've found nothing works like sandpaper, pipecleaners and toothpaste.



Wheel tools and a wheel. The red tipped tool allows for tapering and polishing of the wheel hub. Don't skip this step! The other tool allows you to insert one end into your drill and attach the wheel to the other end. This way the drill can spin the wheel while you polish. Once again, this is a kid activity only. No need to even have an adult touch this step.



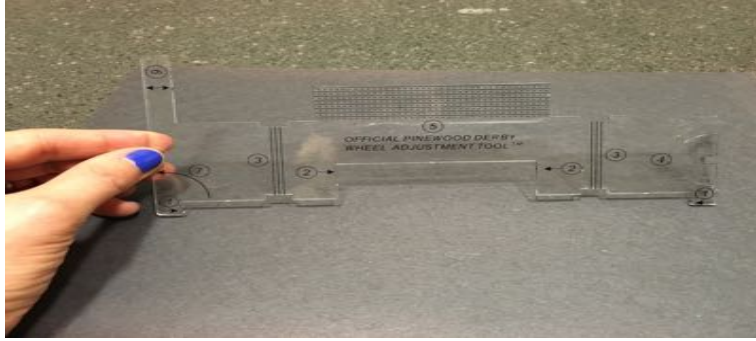
I should really trim my son's nails... (remember to keep that sandpaper wet – otherwise the friction will melt the wheel)



This is my drill in my vice clamping the pipe cleaner. It really works well.

◆ **Wheel Alignment**

We cannot stress this importance too much. Once you have prepped your axels to tin woodman shine and the wheels spin like no one's business, you need to insert them into the axel holes. If you have extended the wheel base or are using the pre-drilled holes, we suggest the pinecar wheel alignment tool. This is what we've used to figure out how close to the car our wheels should be. However, we've never used this tool for anything else, so if it isn't worth the money, glue four notecards together and use that as a guide. Once the wheels are in, prep some sort of test ramp. I've seen various guides that tell you to basically build your own track – I don't have that much room or patience. We use a fairly flat piece of wood we found when we moved in to our house. We used a level to put painter's tape straight down the edges and then we prop it up on a box, once again using a level to be sure we are as straight as possible. Then we roll the car down a bunch of times. We use needle nose pliers to gently turn the axels to change the angle of the tires. This can take a long time, as it isn't an exact science. But once you have the car running (mostly) straight, you will want to glue the axels in place. See the pictures below.



The wheel adjustment tool in question. Honestly, this was given to me by another father, so it might not be worth the money.



Our state of the art test track – I expect BMW to call any day... But it works!



If you are using the pre-drilled axel beds, once your wheels are aligned, fill in the trench with super glue. NOTE: use the super glue gel – sad to say, but that stuff has changed my life!



If you have extended the wheel base – remember you needed to have drilled the above holes – squirt super glue gel into the holes to solidfy the axel position. Do this AFTER you hae aligned the wheels.

- **REDUCE THE FRICTION**

Now, all that axel prep, wheel prep, sanding and wheel aligning has reduced friction A LOT, but there is still more to go. At this point, your main focus needs to be the lubricant. We suggest powdered graphite – ONLY. There are lots of lubricants on the market, but this is the only one we’ve found that is reliable. First off, liquid lubricants are rarely allowed but secondly, if your car gets the slightest bit dusty, that liquid turns to sludge. And sludge, sad to say, is SLOW. So, here are a list of the following places/ways to use dry graphite:

- **Rub graphite on to the wheel base after painting/skin but before the wheels and axels are added. (see picture)**
- **Place dry graphite on a clean rag and after sanding, use the power drill to spin graphite onto the wheel. Do this until the entire wheel shines like fresh-rubbed pencil.**
- **Rub that same graphite rag onto the wheel hub until it too shines. (note, when using dry graphite loose, wear a mask. The fine flakes will get everywhere)**
- **Use a small paintbrush to help push dry graphite into the wheel bore once the axels are glued into place. Once done, use a dremel with a felt head to spin the wheels for five minutes at a time. Repeat the addition of graphite and spin again. We do this “spin in” for no less than 15 minutes per wheel. We usually put in a movie and take turns. My son enjoys this part of the process. You will know your wheel is a winner when you can get it spinning at full Dremel speed and it stays spinning for 15-25 seconds on its own. No, that isn’t a mistype.**



Adding the graphite with the enclosed tip, before using the paintbrush to push it inside the wheel bore.



Adding the graphite with the paintbrush. Note: We have the car blanced on the molding we use for weight balance as well Below:Rub the graphite into the wheel bed after the skin is added and before the wheel and axel are attached.



Dremel with felt head used to wear in the graphite. Take your time, this is where most folks slack off.



I really wasn't kidding about using sandpaper up to 2000 grit. This stuff isn't easy to find – I still buy it any time I see anything over 600 grit.



Tools of the trade: Various super glues, the crown molding for balancing, safety gear, dry graphite, a square with built in level and of course, the pliers!



R2D2 in process. If interested, contact me via GeekMom and I'll tell you how to make him.