

# Pinewood Derby Tips

Compiled from the Design and Build  
Classes held at the  
Walter P. Chrysler Museum

# Design Tips

1. Draw a design on paper then cut it out and use it as a template. Use the paper with the little squares on it to make it easier. Draw a side and top view on the paper by tracing around the block of wood.
2. Keep the car a full seven inches. It has to do with the physics of velocity and length of travel of the weights.
3. Use the full 2 3/4 inches (outside wheel to outside wheel) that the rules give you. This will allow the wheels to travel farther before hitting the center strip.
4. Leave a lot of wood in the back to put in the weights.
5. Use the groove closest to the end of the block of wood as the rear axle. Trust me, it helps.
6. Do not make the front of the car pointed. It is hard to set up against the starting dowels.
7. Be aware of how sensitive your electronic timers are. You want the car to set them off at the end of the race and not before.
8. Use your imagination. Be creative. Shape has the least to do with winning. A beaver driving a log or even a pickup truck is more interesting than a wedge and will be just as fast. The aerodynamics of a small block of wood doesn't mean much in thirty feet.

- Hot Dog
- Shark
- Dragster Rocket Car
- Ice Cream Bar
- Carrot Ridden by a Rabbit
- Pencil
- Coffin Ridden by a Skeleton
- Fire Truck
- Swiss Cheese Wedge with a Mouse Driver
- Banana
- Watermelon Wedge
- Ambulance with Lights
- Batmobile
- Police Car
- Tow Truck
- Giant Lego Car
- Train Engine

# SOME POSSIBLE FINISHES FOR PINEWOOD DERBY CARS

This is a list of some possible finishes that can be applied to your car. All finishes require that the wood be sanded with 220 sandpaper prior to application.

1. Shoe polish  
The wax type polishes come in a variety of colors. Rub into the wood with a cloth, let dry and buff with a clean, soft doth. The more coats applied, the deeper the color and gloss. Non toxic and very little smell. Available in grocery stores.
2. Tung Oil  
This clear finish can be applied with a rag and buffed. Some aroma. Available at Home Depot and hardware stores. Can be used over stain.
3. Latex paint  
Available in a variety of colors. Apply with brush or sponge applicator. Clean up with soap and water, low smell, flat or semi gloss finish. Can be applied over bare wood.
4. Enamel paint  
Comes in a variety of colors, high gloss. Requires mineral spirits or lacquer thinner for clean up. High smell factor. Apply with brush or sponge applicator. For better results use over a primer sealer. Available at Home Depot and hardware stores.
5. Spray cans  
Variety of colors, requires a primer sealer for best results. Very high smell factor, requires ventilation. Can also be difficult to achieve smooth run-free finish.

## The Finish

1. Buy a gloss finish for the car. It's worth it. After all that work, this is the final touch. The more coats that you put on the shinier your car will be. Be sure the paint is dry before putting on the gloss coat. Some gloss products may be incompatible with the paint.
2. Sand in the direction of the grain when smoothing and against the grain when shaping.
3. Use a sandable primer or wood sealer. White is for light colors and gray for dark colors.
4. Water based paints dry quicker (1 hour) than oil based paints (24 hours).
5. Decals are COOL. The more the better!

## Friction Is Your Enemy

1. Debur the wheels. Take off the flashing and seam that was produced when the wheel was molded with 600 grit or better sandpaper. Inside as well as out. Sand any bumps off the wheel the sandpaper. Metal polish will restore the gloss. Be careful not to break any rules your race has regarding wheel modification. (Narrower wheels have less friction and are better, but often disallowed). Don't sand too much or you'll create a flat spot. Sand by hand not in the drill. Heat from the high speed of a drill will damage the plastic wheel.
2. Polish the axles. First with 400 grit paper if you have a really bad spot. Then 600 grit, and then a jewelers rouge. Finish off with a chrome/metal polish.
3. Have only three wheels touching the track. Raise a front one slightly. There is less friction with 3 wheels rolling than 4.
4. The head of the axle should be tapered about 15 degrees so it rubs against the wheel less.
5. Wax the wheels with furniture polish. Make sure the polish does not contain a solvent of any sort.

## Lube Jobs

1. Use graphite only. Oil damages the paint and collects dust. I'm told that the graphite works better than the new white Teflon.
2. Break in the wheels by spinning them with lots of graphite.
3. Right before check-in, fill the wheels wells with graphite and cover with stickers like a hub cap. You can paint the 1 inch stickers in a contrasting color. It looks great!
4. Put a small drop of white glue where the axle goes into the car body and put powdered graphite on it there. That causes less friction if the wheel should nib against the car body.
5. Other than the good polishing of the axles, dump the axles and wheels in a Ziploc bag with some graphite and shake them for a few days prior to the race. That way the wheel and the axles are as slick as can be.

## It's Time To Go Straight!

1. Put the axle in at a downward (5-10 degrees) angle. This provides two benefits. The first is the only the inside edge of the wheel is in contact with the track. This seems to make the car go straighter with less wobble. The second benefit is that the wheel rides to the outside of the axle and doesn't come in contact with the body. This tip is for experts only. First timers have trouble getting this right.
2. Axles must be in straight front to back. That is square to the body. True the axles, don't trust the slots! If you have one, use a drill press to ensure all axles are straight. One of the fronts and two of the back should be measured to be the same height.
3. After pressing in the axles, test the car for crooked wheels, roll it on the floor. If the wheels are on straight, the car should roll 8-10 feet in a fairly straight line. Should the car turn left or right, you need to tinker with the axle placement without removing them from the car body, until it rolls straight.
4. Do not put the axles in at the top of the groove. Put them in at the middle. This lifts the car off the track a bit more and reduces the chance of rubbing on the center strip.
5. Glue the axles in place. Nothing is worse than having the wheel fall off as you cross the finish line.
6. Once you match a wheel and axle together with graphite, keep them together. They wear into each other as a matched set.

## Race Day-Be Prepared

1. Have extra axles and wheels on hand. You never know when your car may be the one dropped by your son as he shows off his handiwork.
2. Have a derby tool kit handy. It should include superglue, sandpaper, a drill, extra screws for your weights, extra weights, and a small screwdriver. You may not use it, but it will make you the most popular person at the event.
3. Transport your car in a shoebox. Dropped cars are unfortunately a too common experience.
4. Add LOTS of graphite right before check in.
5. Explain to your son that running the car along the floor prior to the race will cause it to lose!
6. Put the weight in the back of the car. On a concave track such as ours, this means that the center of gravity of the car falls a greater distance. In other words, there is more potential energy to convert into kinetic energy. The tradeoff is that your car will be less stable, but if do everything else correctly, it's a favorable tradeoff.
7. Put the rear wheels near the back of the car. Even if you have to use the pre-cut grooves, you can do this. This makes a car whose weight is in the back more stable. "Popping a wheelie" during a race does add excitement, but it won't make your car run faster.
8. Car as long as rules allow. The longer your car, the farther back you can put the center of gravity.
9. Prepare your wheels. Sand away the mold projections left behind from the wheel casting process. Do this on the wheel tread and on the wheel hub. Be careful not to fundamentally alter the shape of the wheel. Failing to sand away the molding on the wheel tread can cause your car not to roll straight, which means you'll spend the entire race rubbing the center guide rail.
10. Prepare your axles. Put each axle in a drill chuck so you can spin it at high RPMs. Use a small file to remove the burrs on the underside of the "nail head". Then use a strip of moistened fine grit sandpaper on the cylindrical part of the nail, where it will contact the wheel. Finally, put some toothpaste, chrome polish, or jeweler's rouge on a small strip of cloth and polish the axle to a high gloss.
11. Align your axles carefully. Your axles should be square to the car body. If they are not, the wheels will spend too much time rubbing against the axle heads and the car body. Additionally, your car may not roll straight and will therefore spend too much time rubbing against the center guide. Don't trust the pre-cut grooves in the block. Sometimes they aren't square. Drill out the grooves so your axles go in straight, or if your rules allow, don't use the grooves at all. Do this drilling before you cut out the car body. It's easier to drill a good hole into a square block of wood than into a car-shaped block of wood.
12. Make your car aerodynamic. This may make only a small difference, but every little bit helps.

# Weigh In

1. Get the weight as close to the 5 ounce limit as possible. Add the last little bit of weight with lead tape from the golf shop. This can be trimmed with scissors at the last minute. Remember, the official scale may not weigh the same as yours.
2. Everyone has an opinion on where to put the weight. My belief is that the weight needs to be predominantly in the rear so that gravity can act upon the weight further up the incline and for a longer period of time. A car with more weight to the rear generally grabs more speed down the slope. Many suggest having the center of gravity at 1 to 1 1/2 inches in front of the rear wheels. But be careful not to put too much in the rear or you'll pop a wheelie.
3. What kind of weight? I think the melted lead is dangerous and unnecessary. Tubular weights can be sunk in the sides; flat weights, like those sold at hobby & council stores can be attached to the car bottom if it is carved in a bit. Incremental weights (with pre-marked grooves) are easier to snap off into the size you need. Some folks just use BB's, nuts & bolts, etc., but these must be glued so that they can not move. No movable weights or mercury are allowed.
4. We use the round weights found at the hobby shops and craft stores. This allows us to stick the weights out the back of the car. We paint them and tell everyone that they are jet engines or tail pipes. What they really do is allow us to get the weights as far back as possible. Keep the weight low on the car and in the center (Left/Right of the car). Put the weight just in front or behind the rear wheels for less wheel chatter.

# Obey Your Derby's Rules!

This is the most important advice I can offer. If you break one of your derby's rules and your car is disqualified, it doesn't matter how fast it is. Some of the suggestions that follow are illegal in many derbies, including derbies that I have helped organize. Ignore any speed tips that violate the rules for your derby.

## **Height of Center of Mass above Wheelbase**

I have run on-track comparisons between identical cars in which only the height of the Center of Mass (CM) above the wheelbase varied. My test setup was not sufficiently sensitive to differentiate performance of the cases. The reason that I ran the test is as follows: As the CM is raised above the wheelbase (on a Modern Track), the distance that the CM moves from the starting line to the finish line decreases, i.e. makes the track shorter. However, at the same time, the potential energy available (on a Modern Track) is reduced. So the shortening of the track is accomplished at the expense of speed at the bottom of the fall.

Engineering simulations of a Modern Track of usual dimensions (i.e. 4 foot drop and less than 32 feet length and a long flat) show that raising the center of mass helps. All else being equal, the car with a higher center of mass reaches the flat with a slight lead and a slightly lower speed. The lead is held through the finish line. On a longer track, the lead would be yielded to the faster, low center of mass car. Raising the center of mass decreases your Car's stability. If you will race on a rough, uneven track surface, this could cause increased losses. Weigh the risks carefully.