

Four Lane Pinewood Derby Track

Why build this track?

If you're looking for a quick and dirty weekend project this isn't it! On the other hand, if you want a track that'll be around for many years giving kids (and adults too) great memories then read on.

Three of these tracks have been constructed and have been in service for 6 years. They are used a fund raiser for a Boy Scout Troop and also help raise money council-level Pinewood Derby events. They are rented 5 months a year and stay out in use most of that time. They see an extreme amount of use. Far more than a single group would ever subject it to. Spray paint and minor repairs are the only care they've required.

- The track design is an evolution of years of experimentation, observation and study of many other tracks
- The hard laminate (Formica) surface helps equal the lane characteristics and makes cleanup easy
- The release mechanism is effective and fair
- Setup and tear-down is quick and requires no tools.
- Legs are built-in to the track sections, minimizing the number of pieces to carry and store

GETTING STARTED

While none of the tasks in the building of this track are difficult there is an assumption of basic wood shop skills. You'll be cutting plywood, boring holes, setting hardware and gluing laminate. It is recommended that you get help for at least some of these tasks for safety's sake. Besides easing the chores and making the work go faster the company can be a good thing.

Gather The Parts. The bill of materials (BOM) lists of the items you'll need to build the track. They include the lumber, hardware, glue and paint. The BOM also lists the prices of the parts for estimating the expenditures you'll make for each item. These prices will vary depending on your sources. Donations of parts or money for construction can save you considerable out-of-pocket expenses.

Yes, I know, some of items seem expensive and you can substitute cheaper items but be careful. For instance, the over-center draw latches are ten dollars each for over a total of over \$60 after taxes. Trust me, you'll find that justified after you have used them. Most latches are not adjustable and that alone will save a lot aggravation after assembly when you find that the draw distance too long or too short.

Tools, tools tools. If you're going to do this project the tool resources needed can span shops of the novice to the craftsman level. Who knows, maybe you'll find this project to buy yet another power or hand tool. Here's what you'll find handy:

Table saw (preferred) or radial arm saw or circular saw with full-length guide

Router with 1/4" straight bit and a carbide laminate trimming bit

3/8" variable speed drill motor, drill bits, Phillips head driver bit

Hand tools should include squares, clamps, measuring tapes, combination end wrenches, screwdrivers, disposal glue brushes, paint brushes and more

CUTTING THE PLYWOOD SHEETS

The 1/2" plywood sheets can be cut on a radial arm saw, table saw or even a circular saw but I recommend a larger stationary table saw. You'll want to reference the straight edges of the long sections for other work later so the more accuracy you have here, the better. I have provided cutting guides for the sheets. The guides provide for a blade kerf (the amount wood lost to the cutting blade) of 3/16". This is typical for many blades. Larger saws and their will blades take more wood on a cut so be mindful of your kerf if you haven't done a lot woodworking.

The plywood used in this type of track design relies on the strength of the span to generate a natural curve in the first two sections. For this reason, the sheets need to be free of excessive voids in the core that would compromise that strength. Most ACX (one finish side, one patch side) will should work just fine. I have never experienced a failure in the spans but I don't buy bargain plywood either.

This design takes two sheets of plywood to get the four lanes and the splicing pieces. There is only a little waste so as they say "mark, check twice and cut once".

THE RELEASE BOX

The release mechanism at the top of the track poses the most work in a single section of the track. I'd recommend that the builder assemble this early in the build cycle. Cut the three 2x4 pieces that make the primary sides and connecting span. Drill and counterbore the 6 holes that will mount those pieces to the track base, then drill the larger holes for the release control and car restraints. Now, select the plywood section that will become the top section of track. Drill and countersink the 6 mating holes for box the top end of the 1st section. I selected the good side of the plywood to be the bottom side as the top will be covered in laminate. You may want to clamp the 2x4 box pieces to the top section to use as a drilling guide to assure alignment of the holes.

Learn by others mistakes, er uh let's make that experience. I laminated all the sections before drilling the holes for attaching the release box. The exposed bolt heads don't interfere with the car wheels as they set just outside of the car track but they tend to

detract from the appearance. On the other hand it would permit easier disassembly of the release assembly if necessary. The two corner braces add strength to the 2x4 cross-member that will support the legs. Fasten these inside the box with the screws included in the brace kit.

Assemble the box sides to the inside span-stiffener. Install the two 1/4" screw-in bolt studs (hanger bolts) that will support the top legs. Check the location on the drawing. Now, install the inside angle brackets to connect the two 13" outside pieces to the span-stiffener. At this point you can install the box on the track base with the 1/4" flat head bolts. Observe the order of the components installed on the threaded shaft. It is frustrating to remove half of the nuts, washers and levers to install a missing part. Use washers and tighten the nuts to pull the assembly snug. Grind any portion of the protruding bolt flush to the wood surface.

CUT AND CEMENT THE LAMINATE TO THE PLYWOOD

If you haven't worked with plastic laminate before please get some help or study before you start. Cut the laminate to the 15 7/8" widths. You'll need a fine pitch carbide blade and help guiding the material through the saw.. Better yet, sometimes you can have the material precut by the supplier and save yourself the grief.

Now, glue the laminate to the plywood base sections. Follow the directions on the contact cement but basically, you'll paint on the cement to both the clean plywood and laminate, allow it dry, then place. *Not so quick!* Use the safe method for placing the laminate on the plywood because once they contact each other you're committed. Before bringing the surfaces together place 10 or 12 wood dowels or 1x2's (about 2 feet long) spaced along the dry cement surface of the plywood. This provides separation between the pieces. Align the laminate to the plywood base and gently pull out one or two of the center dowels. While insuring the edges align press the laminate end to the plywood. Now, pull one dowel at a time and press the laminate as you move toward each end. Use a solid rubber roller to press the laminate in place. Trim any excess laminate overhang with a router and a flush trim bit. If you came up short to the plywood on an edge don't worry it can be covered with the quarter-round wood trim later. Now that you're this far it starting to look like something!

CREATE THE LANE_CENTER SLOTS

Measure carefully and mark the center of each of the four lanes on the each of the track sections. On the top part of the first section these lines will also mark the center of the slots that the release bars will move through. Using a 1/4" straight bit and router, plunge cut and route a slot starting at 7 inches down from the track top edge. You'll want to create a reference edge to hold the router on a straight line down these cuts. The slots should be 5 inches long.

INSTALL THE SIDE RAILS

The side rails serve two functions. The most important function is to provide additional stiffness and uniformity in the natural curve of the slope in the first two sections. While it may seem a bit too stiff to flex in the individual sections it works just right when controlled by the second and third swinging legs. Its second purpose is to provide a crash barrier for the occasional car that tries to leave the track.

Since the rails are being used for their strength make sure you're using **Fir** not the lightweight "Whitewood" often found in the home centers today. Each piece should be free of knots that would weaken the span. Drill a clearance hole and countersink each of the rail locations for the 1 5/8" drywall screws. A #6 drywall screw has a small mass and will slightly split the plywood as it enters. Make sure to drill and position the holes so that the screws run true into the center core of the track surface. If you error, it is best to angle down and away from the laminate and not create a dimple in the surface. Glue the rail if you like. The bonded rail does provide a greater security and a little more rigidity but the bond makes the part more difficult to repair if it becomes necessary later. The ends of each of the rails should run flush to the end of the track surface but you may it helpful to provide a slight (2-3 degree) angle to the end cuts to provide a relief for the two pairs of mating rails as they meet at the top of the rail surface.

MAKE THE SECTION JOINTS

The three section joints create the contiguous track. They must support the weight of the adjacent sections and align the lanes and track surface to permit the cars to roll without jumping. Measure and mark the centers of the holes for all section ends. Drill the eight 9/32" holes in the track ends. The smart builder will create a drilling template to make this work quicker and repeatable. Once the holes are drilled use these holes as the reference for the mating plywood parts. Clamp the two parts (boot/tongue or spacer/lip) on each section as indicated on the drawing and drill through the track section to create the joints. You will find that the thickness of the tongue on each of the joints must be reduced to permit the sections to easily slide together.

Install the draw latches. First, build the metal plates for the hook portion of the latch. These plates prevent the pull-outs that will occur if you rely only on the small plywood area under the hook to support the weight and pull of the latch forces. The rectangular plate holes the latch hook with two countersunk screws while the plate is fastened to the plywood lip with 5/8" long #10 wood screws. I used a part of a "Simpson Strong Tie" corner brace as the basis for the plate. The draw latch is attached to the boot of the uphill side of the joints with four wood screws. Carefully check the alignment before finalizing the positions.

The alignment pins and sockets insure the lane alignment of all sections. The brass pins I used are actually table pins used in dining room table construction. They come in packages of 8 pairs to a bag. Install the pins by drilling a hole (3/8" diameter, 1/2" deep) centered under the lane guide on the downhill portion of each section. To insure a centered and straight hole I used a dowel jig as a drill guide. Verify the hole size and depth with your pins since they may vary. Tap the fluted pins into place flush to the

plywood edge with only the pins exposed. Slide the adjacent track section together with a sheet of carbon paper in front of each of the pins. Gently push the sections together to allow the pins to transfer a mark to the mating side. Use this mark to install the brass receivers. Test the alignment to insure fit and proper alignment.

INSTALL THE LANE GUIDES

The lane guides cannot be successfully installed until the track sections have been joined. The lane guides will insure that the cars track straight and maintain separation between lanes. The lane guide separation is designed to be 4 inches. Carefully verify the center of each of the four lanes.

The lane guide strips must be first drilled on their own centerline. Use an 1/8" bit to drill the guide on 6" intervals. Countersink the holes to allow the 5/8" #6 wood screws to pull flush to the guide strip surface. Place the guide strips on the track surface lane center lines and transfer the hole locations along the length of the guides. Remove the strip and drill pilot holes for the screws. Install the strips. As you transition from one track section to the next insure that the lane center lines match. In some cases you may it necessary to taper the leading edges (top end) of the lane guide to insure a smooth transition. You'll need three 100-count boxes of screws to complete the installation of the lane guides. I used steel screws in the first tracks I built then later went to stainless steel. They're more expensive but worth it if you use and clean the track often.

THE TOP LEGS

The legs for the top portion of the track are built-in to the track. Cut the seven parts as indicated in the drawing. (Two sides, two swing supports, a X-cross brace and a single horizontal brace. The X-cross has dado a cut at its midpoint to half thickness to facilitate the lap joint. Install the two main legs on the 1/4" screw-in bolt (hanger bolt) on the release box and check for rotating clearance. Sand as necessary. Fasten with wing nuts and washers. Screw the lower horizontal support in place. Glue and clamp the lap joint in the X-cross and install onto the legs with screws. I painted the *removable* hardware (Wing Nuts and bolts) yellow so that it is easy to tell what gets removed for setup.

THE LOWER SUPPORT LEGS

The lower leg supports are plywood panels that swing down from track section 2. They help support and form the curvature of the track profile. The specific points of attachment can vary slightly from the suggested installation points. This is because the plywood stiffness can vary a little from sheet to sheet. Assemble the panels with the hinges attached and test the locations by clamping the supports in place and check the curvature. When these supports are permanently installed secure a 2"x3" plywood block adjacent to the support and install a slide bolt latch. This will hold the legs in place during transit.

COMPLETE THE RELEASE BOX

At this point you have release box installed on section 1 of the track. You are now ready to add the interior hardware. From the 1/8" thick 3/4" wide Aluminum bar stock, fabricate the 4 car restraint bars, 2 spring levers, the release control, the set control and the latch bar. Use the dimensions given in the drawing. Also modify the 7/16" collar with a file to create a concentric or tapered surface through 90 degrees of the outside. This collar is available in most larger hardware stores or home improvement stores. They will have a 7/16" ID, a 7/8" OD and a 7/16" width. Variations won't matter at all. The modification of the collar will create an 1/8" fall at the end of the taper. This is the latch bar catch point on the release collar.

The 7/16" thread rod holds the 4 car release bars, a spring lever, the release collar, two washers and associated jam nuts and lock washers all on the interior while the outside holds the set lever and its jam nuts and lock washer. It's a tedious process treading all parts onto the rod so make sure you don't forget something along the way and have to start over. By the way, a jam nut is just thin nut.

The shorter threaded rod holds the latch bar, a spring lever and the retaining hardware on the inside of the box while the outside portion of the part holds the release control and its associated retaining hardware. The length of this rod is about 4 1/2 inches.

The springs used in my release box may well be different than what you'll find. I won't be specific as to the spring length, diameter, wire gage and coil length. Many springs will work in the two level positions. Trial and error will aid you determining the final spring size and tension. You don't want too heavy a pull force just enough to return the lever and hold the release paw.

BUILDING THE CAR STOP

There are two designs for a car stop. The parts list includes the items necessary to construct the skip ramp version. This device receives the cars after they have completed their run on the track and brings them to a complete stop without damage. In this version the cars roll off the track and onto the car stop where the guide ramp is elevated and the cars skid on the car bottoms.

Due to car construction techniques it can not be guaranteed that any car stop is without fault. Car trim, bottom weights may cause unpredictable results. Padding is always recommended where possible.

The skid ramp consists of a 3/4" plywood base on which the side rails and special lane guides are attached. Cut the base shape, the side rails and the lane strips. The guide strips form a ramp from the track surface guide to the elevated guide surface. The profile of this ramp can vary but is typically similar to one shown in the drawing.

USING AND TESTING THE TRACK

These assembly instructions are brief but I hope complete enough for you to complete this project. I'll enhance them where I can or you indicate they need help. Let's talk a little on setting up and using the track .

First, you'll need plenty of length (at least 40 feet.) You'll be lucky to find that much linear space in your home. Next, you'll need some help, two to four people. Hopefully this is obvious but the space you have selected must be level. We've seen differently. Follow the steps given to complete setup.

SETTING UP THE TRACK

- 1) Organize the track sections 1,2,3 & 4 from top to bottom along the intended run length.
- 2) With the top section "leg side up" **remove the wing nuts** that pin the legs in place. (Not the top pivot bolt) **Leave the bolt in place**. It will be removed in a few steps.
- 3) Turn the top section of track (section 1) onto its **side**.
- 4) Align and slide track section 2 into the receiver of track section 1. Latch the two sections together. Don't force the sections together if they don't slide easily.
- 5) Now, while supporting the first two sections slide in and latch sections 3 and 4. This where it's helpful to have those extra folks giving you a hand.
- 6) All together now, turn the track to let it rest face side up.
- 7) Position help on either side of the track two toward the top and another pair just below the first section joint to lift it into position.
- 8) Lift the track evenly side to side and higher at the top. Pull the bolts holding the top legs in place and support their swing to the floor. Unlatch the second and third sets of supports and let them also swing to the floor.
- 9) Adjust the legs to align the support strut and bolt it in place with the bolt just removed in the last step.
- 10) Insure that the track is level side-to-side and the joints are smooth. Adjust as necessary.
- 11) Slide on the car stop device onto the end of the track.

RUNNING TESTS

- 1) Once the track is set verify that the track is performing correctly.
- 2) Verify that the car restraint/release system is functioning correctly.
- 3) Run a test car down each lane. Verify that the car runs smoothly and doesn't jump or hop.
- 4) Sight up the track and verify that the lanes run a true and straight fashion without discernible curves or jogs.

PICTURES OF THE TRACK









