Maximum Velocity! ®

Free
Pinewood Derby Car Plan

Maximum Velocity! ®

Free Pinewood Derby Car Plan

Published and Distributed by:

Maximum Velocity! Pinewood Derby Products

info@maximum-velocity.com

www.maximum-velocity.com

Fourteenth Edition

Important Printing Information

While the booklet is open, use the File > Print command of Adobe Acrobat Reader (not the shortcut on the toolbar) and make sure the 'Fit to page' 'Shrink' or 'Expand' options are NOT selected. This ensures that the templates are printed to scale.

This booklet has some complex drawings that can overwhelm some laser printers equipped with small amounts of printer memory. If the printer does not successfully print the booklet, try the following:

a) Using the printer's print properties, reduce the number of dots per inch (dpi) from 600 to 300 and try to print the booklet again. This usually resolves the problem.

b) If a problem still occurs, leave the printer setting at 300 dpi and print one page at a time.

c) Try printing on another printer, especially an inkjet printer.

Axle Slot Measurement

The standard wheelbase templates in this booklet use the official measurements from the Cub Scout Derby - Grand Prix Pinewood Derby Kit. However, the position of the axle slots in these kits (and kits from other manufacturers) are not always consistent with the official measurement.

If the slots on your block do not exactly match the slots on the template, line up the front axle slots and trace the front portion of the template, then line up the rear axle slots and trace the remainder of the template.

Maximum Velocity!

Free Pinewood Derby Car Plan

Introduction

Welcome to the world of Pinewood Derby racing! This booklet provides you with a plan for building a basic Pinewood Derby car.

The plan in this booklet provides for best weighting and weight location. However, to build a car that reaches *Maximum Velocity!* you must also prepare the wheels and axles, and lubricate and align the wheels. If you don't know how to do these steps, detailed information is provided in the companion booklet, "*Maximum Velocity - Speed to the Finish!*"

To reach *Maximum Velocity!*, you must fully understand the car building process, and allow enough time to build the car. Please read this entire booklet, and understand the plans *before* starting to build the car. Also, *follow the steps in order*. The sequence of construction was chosen based on actual experience from building the car.

The plan in this booklet is organized very similar to the car plans in our other booklets. The differences are as follows:

- This free booklet contains the plan for one car. Our other booklets have plans for three cars.
- The plan in this free booklet can be used to build a car with the standard (scouting) wheelbase. The plans in our other booklets (with a few exceptions) support the standard wheelbase and the extended wheelbase.
- A few informational sections contained in our other booklets have not been included in this free booklet. However, they do not affect the ability to build the car.

Tools and Supplies

In order to build the car in this booklet, you must have access to the tools and supplies listed below.

- 13/32 inch **Brad Point** or **Forstner** drill bit
- Coping saw or equivalent
- Wood chisel
- Cutting pliers to cut lead (if these are not available, use a hammer to drive a flat blade screwdriver through the lead.
- 3 ounces of Tundra Rod (available from Maximum Velocity)
- Pencil
- Ruler
- Drill - An electric hand drill is fine. A drill press is like heaven on earth!
- Clamp or vise - To hold the wood block when drilling and cutting
- Particle mask and eye protection
- Sanding block
- Sandpaper - 60, 150, 240, 400, and 600 grit
- Paint Supplies
  - ⇒ Masking Tape
  - ⇒ Long drywall screw
  - ⇒ Sanding sealer or wood primer (*Optional*)

  If spray painting *(suggested for older builders):*
  - ⇒ Spray paint - Krylon-brand paint is suggested
  - ⇒ Plastic bag - Large enough to cover your hand and wrist
  - ⇒ Rubber band - To hold the plastic bag to your wrist

  If brush painting *(suggested for younger builders):*
  - ⇒ Paint - Acrylic paint is suggested as it cleans up with water
  - ⇒ Paint brush (*1 to 2" wide*)
- Hot glue or Epoxy - 5 minute variety
- Toothpicks (optional) - To mix and apply the epoxy
- Wood Filler

Important Safety Information

To minimize the risk of injury, follow these rules:

1. **Protect your eyes** - Always wear eye protection.
2. **Protect your lungs** - Wear a particle mask when drilling, sawing, sanding, and spray painting.
3. **Protect your hands** - Be careful with sharp cutting edges. Treat them with respect.
4. **Be safe when using a drill** - To avoid serious injury, tie up long hair and avoid loose clothing when drilling.

Wheel Bases

The car plan in this booklet supports wheel bases (distance between the front and rear axles - see Figure 1) as follows:

- **Standard Wheel Base: Supported** - Scouting kits have this wheel base. One pre-cut axle slot is closer to the end of the car than the other. *The slot closer to the end is used for the rear axle.*
- **Extended Wheel Base:** ***Not Supported*** in this free booklet.
- **Centered Wheel Base:** ***Not Supported*** - Awana kits have this wheel base. To use these plans you must purchase a block with a standard wheel base.

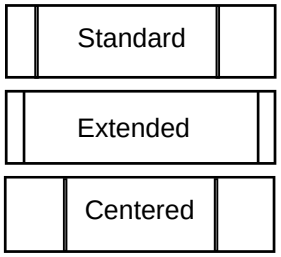


FIGURE 1
Wheel Bases

THE MUSCLE CAR

FIGURE 2
THE MUSCLE CAR

THE MUSCLE CAR (Figure 2) was inspired by the Chevrolet Corvette. To ensure proper weighting, a portion of the car body is hollowed out from the underside. This removes wood weight, allowing more ballast weight to be placed at the back of the car. The hollow area is left open, but can be covered with a thin piece of plastic if desired.

Step by Step Plans for THE MUSCLE CAR

Marking the Block

1. Locate the templates at the end of this booklet. *Make a copy of the templates onto cardstock, and use the copy, not the original.*
2. Select one end of the block as the back (the end closest to an axle slot should be the back). Write "Back" on that end, then write "Right" on the right side of the block.
3. If axle slots will be used, perform the steps under "*Preparing Axle Slots*" on page 7.
4. Cut out template MC2. Place MC2 on the right side of the block, making sure that the bottom and back of the drawing are aligned with the bottom and back of the block. Check to make sure that the axle slots/holes on the block line up reasonably well with the slots marked on the template. Trace the outline on the block, and mark the side drilling locations by pressing the pencil tip through the round crosshairs on the template.
5. Turn template MC2 over to the blank side and place it on the left side of the block. Trace the outline and remove the template.
6. Cut out template MC1, then cut out the gray rectangle with a sharp knife.
7. Place MC1 on the bottom of the block, making sure that the back of the template is at the back of the block. Trace the outline of the car, trace the rectangle cutout, mark the drilling locations, then remove the template.

Drilling the Block

1. Clamp the wood block with the right side facing upward.
2. On the 13/32 inch drill bit mark a depth of 1-1/2 inches with masking

tape (see Figure 3). *Measure the distance from the outside tips of the bit, not from the center tip.*

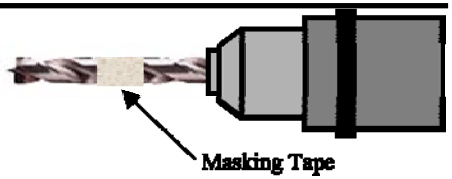


FIGURE 3
Marking the Weight Well Depth

3. Drill the two right side holes going no deeper than the tape on the drill bit.
4. Clamp the wood block with the bottom facing upward.
5. On the drill bit mark a depth of 3/8 inch.
6. Drill the three bottom holes, going no deeper than the tape on the drill bit.
7. Mark a depth of 1/2 inch on the drill.
8. Repeatedly drill around the perimeter of the rectangle, staying within the lines and going no deeper than the tape on the drill bit.
9. Repeatedly drill into the center of the rectangle, removing as much wood as possible.
10. With a wood chisel, carefully remove the remainder of the wood from the rectangular area.

Cutting the Block

1. Clamp the wood block in place.
2. Using the drawing on the right and left sides, cut along the lines, leaving no more than 1/16 inch of material outside of the line. ***Make sure the cut is outside the line.***

Cutting and Installing the Lead Wire

1. Cut the Tundra Rod as follows:

   Two pieces: 1-1/4 inches long - for side holes

   Three pieces: 3/8 inches long - for bottom holes
2. Put a small amount of white glue into one of the side holes, and place one of the 1-1/4 inch Tundra pieces into the side hole.
3. Repeat the previous step for the other side hole.
4. Allow the glue to dry before continuing.
5. Fill the remainder of the side holes with wood filler, dry wall compound (Spackle), or car body filler (Bondo).
6. Allow the wood filler to dry before continuing.
7. **DO NOT install the bottom weight at this time.**

Sanding, Detailing, and Painting

1. Follow the steps under "*Sanding the Car Body*" on page 8.
2. Follow the steps under "*Painting the Car Body*" on page 8.

Finishing the Car Body

1. Remove the paint handle screw, and lay the car on a clean rag.
2. Apply any desired decals, personalized painting, etc.
3. Attach the car numbers (if required for your race).

(Use an accurate scale for these steps. Avoid over-weighting the car.)

4. Place the car, the wheels, and the axles on the scale.
5. Add the remaining pieces of Tundra onto the scale until the car reaches 4.9 ounces (final weighting will be done at the weigh-in). Trim one or more Tundra pieces as needed.
6. Glue the Tundra pieces into the bottom holes using epoxy or hot glue. For more conservative weighting (rougher or longer tracks) place the weight in the front-most holes. For more aggressive weighting (smoother or shorter tracks), place the weight in the rear-most holes.
7. Complete the car as described under "*Completing The Car*" on page 9.
8. Store the car in a safe location until the weigh-in.
9. Follow the instructions under "*The Weigh-in*" on page 10.

Congratulations - You have built THE MUSCLE CAR!

Preparing Axle Slots

Before beginning construction, perform the following steps to prepare your axle slots.

1. Use a piece of notebook paper (or a square if you have one) to check if the slots are square with the car body (see Figure 4). If a slot is not perfectly square with the body, either re-cut the axle slots on the opposite side of the car, exchange the car kit for a new car kit, or purchase a new block at a hobby store.
2. Sometimes the wood block will split when the axles are inserted into the axle slots. To prevent this from occurring, ***before*** you build the car, place the block on its side, insert an axle, and use a hammer to *gently* tap the axle into one slot (see Figure 5). Pull the axle back out of the slot by hand (or with a pair of pliers), and repeat the process for the other three slot positions. If the wood block splits, exchange the car kit, or purchase a new block at a hobby store. ***If you have nail-type axles, do not insert the axles into the wheels until after the axles are prepared. The burrs on the axles can permanently damage the wheel hubs.***
3. A more accurate way to prepare the axles slots is to drill pilot holes into the slots. This can be done with a drill press, or with a hand drill using the Pro-Body Tool offered at Maximum Velocity.

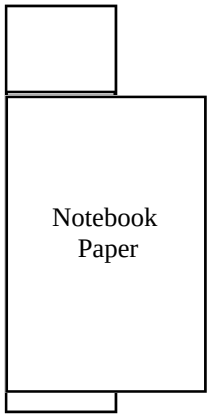


FIGURE 4
Checking for Square Axle Slots

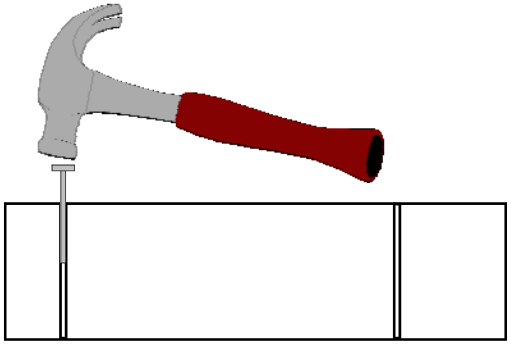


FIGURE 5
Pre-inserting Axles to Check for Splitting

Sanding the Car Body

Perform the following steps to sand the car body:

1. Fill any gouges, holes, etc. with wood putty.
2. Allow the wood putty to dry before continuing.
3. Using the 60 grit sandpaper in a sanding block, sand the car down to the lines. Always sand with the grain of the wood.
4. Re-sand all sides with the 150, 240 and 400 grit sandpaper.
5. Lightly sand all edges of the car to remove any sharp corners.
6. Use a rag to wipe off all excess wood dust, and remove any wood dust in the axle slots/holes.

Painting the Car Body

Perform the following steps to paint the car body:

1. Create a painting handle by inserting a long drywall screw into one of the bottom holes. The screw will be used to hold the car while painting and drying. While the paint is drying, the screw can be placed in a vise, clamped to the side of a work bench with a clamp, or clipping onto a 'drying line' with a clothespin or binder clip. Make sure the drying location is in a dust-free and wind-free area.
2. If desired, apply one or more coats of sealer/primer per the recommendation on the container. Lightly sand with 600 grit sandpaper between coats.
3. Apply a coat of paint. If spray painting, put the plastic bag over one hand and secure it with a rubber band around the wrist. Allow the car to dry.
4. Using the 600 grit sandpaper, *gently* sand all surfaces of the car.
5. Repeat steps 4 to 5 until you are satisfied with the paint job. Don't sand the car the last time!

Completing The Car

Now that the car body is finished, it is time to complete the car. Note that steps 1 and 2 below can be performed while the glue and/or paint is drying on the car. If you are not sure how to perform any of the steps below, please refer to the companion booklet *Maximum Velocity - Speed to the Finish!*

1. Prepare the wheels and axles
2. Apply Lubrication
3. **Axle Slots Only** - Press the axles into the axle slots with your hand, or use the Pro-Axle Guide from Maximum Velocity.
4. **Axle Holes Only** - Insert the axles into the axle holes. If the axles do not fit tightly, then a tiny amount of glue can be placed into the hole with a toothpick before inserting the axle. ***Before inserting the axle, wipe off any glue that got on the body!***
5. Align Wheels
6. **Axle Slots Only** - To keep the axles from becoming misaligned during the race, place glue in the axle slots on top of the axles (see Figure 6). Use epoxy, hot glue, white glue, or a similar product. *Keep the glue away from the wheels!* Remove excess glue, making sure that the glue does not hang down below the car, reducing the clearance to less than 3/8 inch. Set the car on its back to dry for 24 hours.

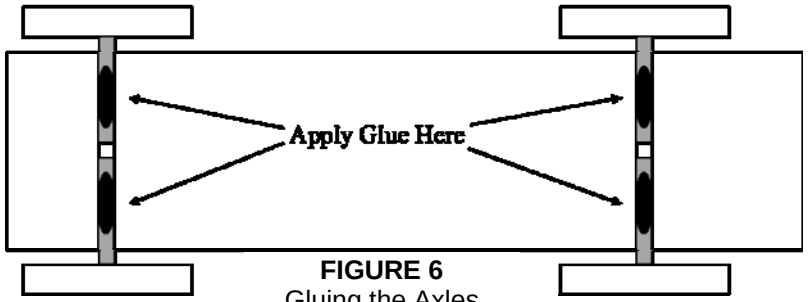


FIGURE 6
Gluing the Axles

Important!

Apply glue to the axles at least 24 hours before the weigh-in. If the glue is not dry, the wheels could become misaligned during the weigh-in and staging/storage process. Do not use a thin glue such as super glue. The glue may run down the axle and into the wheels, causing the wheels to become glued to the axles.

The Weigh-In

At the weigh-in, the weight of the car may need to be adjusted to equal 5 ounces. Along with your car, bring the following materials to the weigh-in:

- Drill and 3/16" drill bit
- 2 clean rags
- Additional lead
- Hot glue or epoxy

Use the scale at the weigh-in to determine the weight of your car.

If the Car is Overweight

1. Lay the car on its back on a clean rag.
2. Hold on to the car very tightly with your hand, and slowly drill out a small portion of the rearmost lead weight on the bottom of the car.
3. Re-weigh the car.
4. Repeat the previous steps until the car weighs 5 ounces.

If the Car is still Overweight

5. Drill into the bottom of the car behind the rear wheels, until reaching the lead inside.
6. Re-weigh the car.
7. Repeat the previous steps until the car weighs 5 ounces.

If the Car is Underweight

1. Glue additional weight into one or more of the bottom holes.
2. Re-weigh the car.
3. Repeat the previous steps until the car weighs 5 ounces.

When the car is properly weighted, remove any debris.

Specialty Tools and Supplies

Specialty tools and supplies can help your car reach *Maximum Velocity! Here are a few of the supplies we offer to assist you:*

Axle Polishing Kit - Take the guess work out of axle polishing! This set of industrial grade cushioned abrasive papers is designed for polishing metal to a high shine, and is thus ideal for polishing pinewood derby axles. The kit consists of five papers ranging from 30 micron to 3 micron (finer than pumice). One set of axle polishing papers will polish at least eight axles.

Tube-O-Lube - A top quality graphite. This is the lube of choice of many pinewood derby champions.

NyOil II - A thin film lubricant that can provide better performance than graphite.

Pro-Axle Press - A precision device that produces straight and round nail axles, and accurately squares the axle head to the axle shaft.

Pro-Body Tool - A guide for drilling precise guide holes into existing axle slots, or drilling new axle holes with a hand drill. Versions are available for BSA, PineCar, Awana, and Royal Rangers.

Pro-Hub Tool - Squares the wheel hub to the wheel bore, easily cones the inside wheel hub, and reams undersized wheel bores.

Pro-Wheel Mandrel - An accurate wheel mandrel equipped with a thumbscrew for easy wheel mounting. The step-down tool face allows reverse mounting of BSA wheels (easier access to inside tread surface).

Pro-Wheel Shaver - Create perfectly round wheels with this simple substitute for a lathe (for BSA, PineCar, and other hard plastic wheels).

Solid Lead - The traditional choice for car weighting, solid lead is much denser than the zinc product sold in hobby stores, and is easily cut and shaped. Available as a 3/8 inch diameter wire, or in segmented form.

Tungsten - An alternate weight, tungsten is non-toxic and much heavier than lead (tungsten weighs the same as pure gold). Available in cylinders, plates, cubes, beads, and disks.

BSA Speed Wheels - Precision-trued BSA wheels for top performance.

We also offer **Speed Axles**, a **digital caliper**, and a **digital scale**. Come visit us at:

www.maximum-velocity.com

About the Author

My wife and I, and our four children live in the greater Phoenix area (it's a dry heat!). My family was involved in the Awana program at our local church for many years.

In 1995 we began participating in the Awana pine derby (known as the Awana Grand Prix). Then in 1997, I began leading the derby, and started studying pine derby techniques. In a desire to improve the competition by making the techniques known to all the entrants, I wrote the booklet "Maximum Velocity! - Speed to the Finish!" (formerly "Car Construction Guidelines"). That booklet focused on the techniques needed to build a fast car, and only slightly covered the design of the car, and the actual wood-working techniques.

Since the basic design of the car is critical to the performance of the car, and since many people are unfamiliar with the proper construction of a pine derby car, I created a series of car plan booklets.

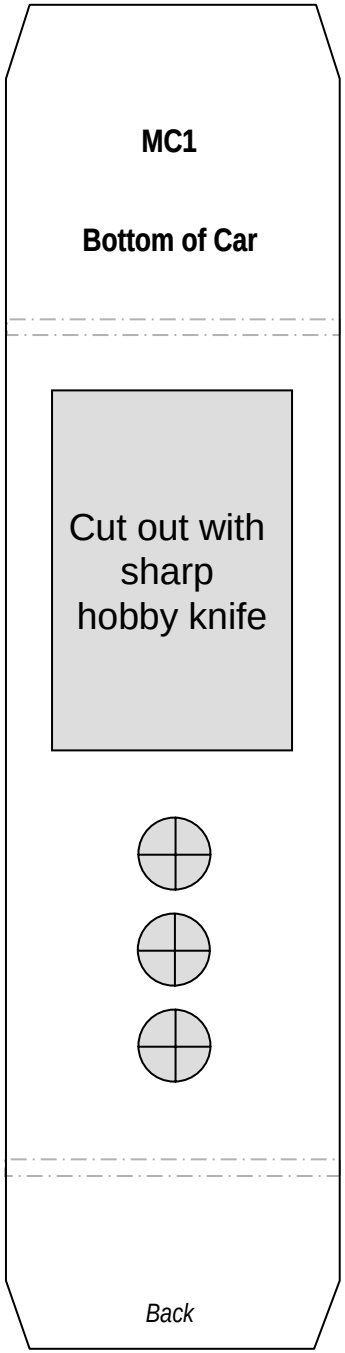
My desire is that by using this booklet, not only will you create a competitive car, but that you and your parent (or guardian) will more thoroughly enjoy the car building process. Winning the race can be the secondary goal, but the primary goal should be the enjoyment of building and racing a pine derby car with someone you care about.

I would greatly appreciate any feedback as to how to make this booklet more useful to you. I would also like to hear about the results of your races. You can reach me by e-mail at:

info@maximum-velocity.com

Good luck in your races, and may God bless you and your family!

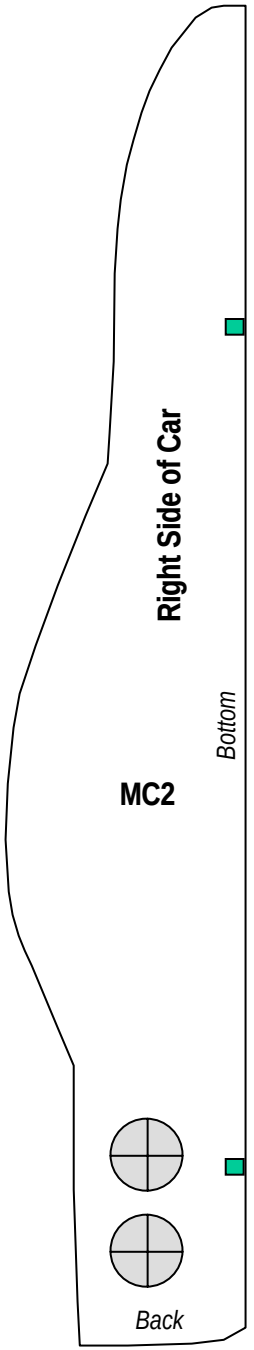
Randy Davis



Template MC1
Bottom Profile

Verify that this measurement is exactly - **7”**
If not, see “Important Printing Information” at the front of the booklet

THE MUSCLE CAR



Template MC2
Side Profile