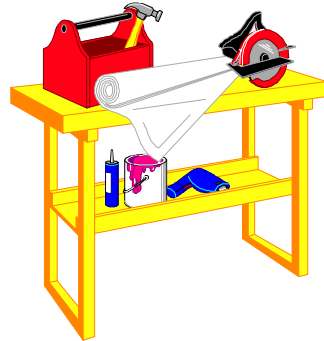


Maximum Velocity![®]



Free
Pine Derby Car Plan

Maximum Velocity![®]

Free Pine Derby Car Plan

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www.maximum-velocity.com

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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:

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

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[®]Pinewood Derby is a registered trademark of Boy Scouts of America.

Maximum Velocity!

Free Pine Derby Car Plan

Introduction

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

Maximum Velocity!

Visit us at: www.maximum-velocity.com

- | | |
|----------------------------|--------------------------|
| • Car Plan Booklets | • Speed Supplies |
| • Lead and Tungsten Weight | • Speed Wheels and Axles |
| • Decals | • Wood Blocks and Kits |
| • Specialty Tools | • Display Cases |

Tools and Supplies

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

- 25/64 inch **Brad Point** or **Forstner** drill bit
- 3/32 inch standard drill bit
- Coping saw or equivalent
- Cutting pliers to cut lead (if these are not available, use a hammer to drive a flat blade screwdriver through the lead.
- **Lead:** 3/8 inch lead wire (*from Maximum Velocity*) - Do not use the zinc cylinder weights sold at hobby shops under the brand name 'PineCar'.
- 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 - Avoid enamel paint
 - ⇒ 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 inches wide*)
- Hot glue or Epoxy - 5 minute variety
- Toothpicks (optional) - To mix and apply the epoxy
- Wood Filler, Bondo, or Spackle
- 2 feet of 3/32" aluminum rod (Available at www.maximum-hobby.com, and from many hobby and hardware stores. Look for the "K&S Metal Center".)

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.

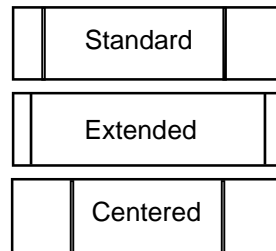


FIGURE 1
Wheel Bases

THE DUNE BUGGY

THE DUNE BUGGY (Figure 2) is easy to build, but the frame requires some careful bending of the aluminum tubing. About 2-3/4 ounces of lead weight are required for THE DUNE BUGGY. The weight is placed into holes drilled in the back and bottom of the car.



FIGURE 2
THE DUNE BUGGY

Step by Step Plans for THE DUNE BUGGY

Marking the Block

1. Locate and remove the templates from the center 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. Write “Back” on that end. If a standard wheel base will be used, the end closest to an axle slot should be the back. 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 8.
4. Cut out template DB2 on the *solid lines*. Place DB2 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. Trace the outline on the block.
5. Turn template DB2 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 DB1. Place DB1 on the bottom of the block, making sure that the back of the template is at the back of the block. Mark the center of the lead wells by pushing a pencil tip through the template into the wood. Trace the outline, and then remove the template.
7. Cut out template DB3 and place it on the back of the block, making sure that the bottom of the template is aligned with the bottom of the block. Mark the center of the two lead holes by pushing a pencil tip through the template into the wood. Remove the template.

Cutting the Lead Wire

1. Using the cutters, cut the lead wire per the following table:

Lead Length and Drilling Depth

Lead Length: Two: 1-1/4 inches ; Three: 3/8 inch

Rear Hole Depth: 1-1/2 inches

Bottom Hole Depth: 3/8 inch

2. If the lead pieces are bent, reshape them as needed by tapping the lead segments with a hammer on a hard surface (concrete floor).

Drilling the Block

1. Clamp the wood block with the back facing upwards. Mark the rear hole depth on the 25/64 inch drill bit (see table above) with masking tape (see Figure 3). *Measure the distance from the outside tips of the bit, not from the center tip.*
2. Drill the two rear weight holes. Make sure that both of the holes are parallel with the wood block, and are drilled no deeper than the tape on the drill bit.
3. Clamp the wood block with the bottom facing upward. Mark the bottom hole depth on the drill bit with masking tape.
4. Drill the bottom weight holes. Make sure that the holes are drilled no deeper than the tape on the drill bit.

Inserting Lead in the Rear Holes

1. Place a small amount of yellow or white glue into a rear weight hole and insert one of the 1-1/4 inch pieces of lead. Repeat for the other rear weigh hole.
2. Allow the glue to dry before continuing.
3. Fill the remainder of the rear holes with wood filler, Bondo, or Spackle.

Do not put weight in the bottom holes at this time.

Cutting the Block

1. Clamp the wood block in place.
2. Cut off the excess dowel rod on the back of the block. Avoid scarring the rear of the car with the saw. Using the drawing on the right and

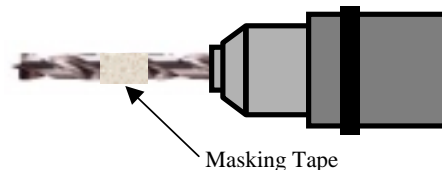


FIGURE 3

Marking the Weight Well Depth

leaving no more than 1/16 inch of material outside of the line. ***Make sure the cut is outside the line.***

3. Clamp the wood block with the bottom in view.
4. Use the saw to cut out the outline drawn on the bottom of the car, leaving no more than 1/16 inch of material outside of the line. ***Make sure the cut is outside the line.***
5. Use the 60 grit sandpaper to sand the newly cut surfaces down to the line, and to remove any remaining dowel rod on the back of the car.

Sanding and Painting

1. Follow the steps under “*Sanding the Car Body*” on page 9. Skip the 60 grit sandpaper step.
2. Cut out template DB5 and place it on the top-rear of car. Mark the eight drilling locations (identified with an ‘X’) by pushing a pencil tip through the template into the wood. Remove the template.
3. Clamp the wood block with the top facing upwards. Mark a depth of 1/8 inch on the 3/32 inch drill bit with masking tape (see Figure 3 on page 5).
4. Drill the eight frame holes. Drill no deeper than the tape on the drill bit.
5. Follow the steps under “*Painting the Car Body*” on page 9.

Finishing the Car Body

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

Build the Frame

1. The frame consists of six pieces of 3/32 inch aluminum rod labeled A through D. There are two of pieces each A and C, and one each of B and D. Each part will be bent to match the shapes on templates DB4 to DB6.
2. Three suggestions: (1) Before cutting or bending, use Templates DB4, DB5, DB7, and the car photo to understand how the frame is assembled.; (2) To bend the rod, use a pair of small pliers; and (3) Don't cut the rod to length until the shape is made.

3. Begin by forming one of the A pieces. First bend the rod to match the A drawing on template DB4, then bend it to match the *left side A* drawing on template DB5.
4. Next, form a second A piece, but make sure to use the *right side A* drawing on template DB5.
5. Form a B piece using template DB6.
6. Form two C pieces using template DB4.
7. Form a D piece using template DB5.
8. Place all pieces on the car body - *without glue* - and make any needed adjustments.
9. Using one or two toothpicks, mix a small amount of epoxy per the epoxy instructions.
10. Glue the aluminum pieces to the car using the epoxy.
11. Wipe off any excess epoxy and allow the epoxy to dry.

Final Weighting

(Use an accurate scale to assist in these final weighting steps. Avoid overweighting the car by more than 0.1 ounce)

1. Weigh the car body, the wheels, and the axles. Determine the number of 3/8 inch lead weights needed to make the car weigh 5 ounces. Trim a 3/8 inch lead weight as needed.
2. Using one or two toothpicks, mix a small amount of epoxy per the epoxy instructions.
3. Place epoxy into the bottom weight holes and insert the lead weights. Start with the rear hole and work forward.
4. Wipe off any excess epoxy and leave the car on its back until firm.
5. Complete the car as described under “*Completing The Car*” on page 10.
6. Store the car until the weigh-in. See page 11 for weigh-in instructions.

Congratulations! You have built THE DUNE BUGGY.

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.

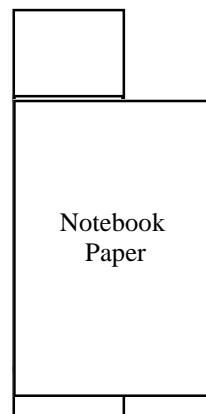


FIGURE 4
Checking for Square Axle Slots

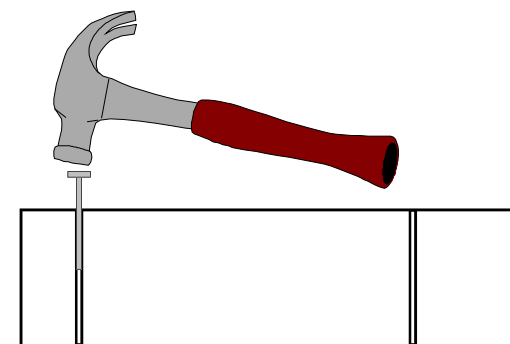


FIGURE 5
Pre-inserting Axles to Check for Splitting

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.

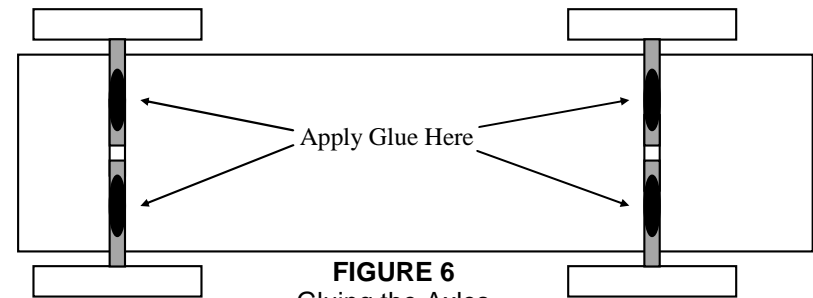


FIGURE 6
Gluing the Axles

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 inch 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 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.

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 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 in front of the rear wheels, until reaching the lead inside.
6. Re-weigh the car.
7. 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 pine 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.

Max-V-Lube - A top quality graphite. This is the lube of choice of many pine derby champions.

Pro-Axle Guide - Simplify accurate axle insertion with this easy-to-use axle installation tool.

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

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, rounds, 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 Awana³ 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"). This booklet focuses on the techniques needed to build a fast car, and only slightly covers 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.

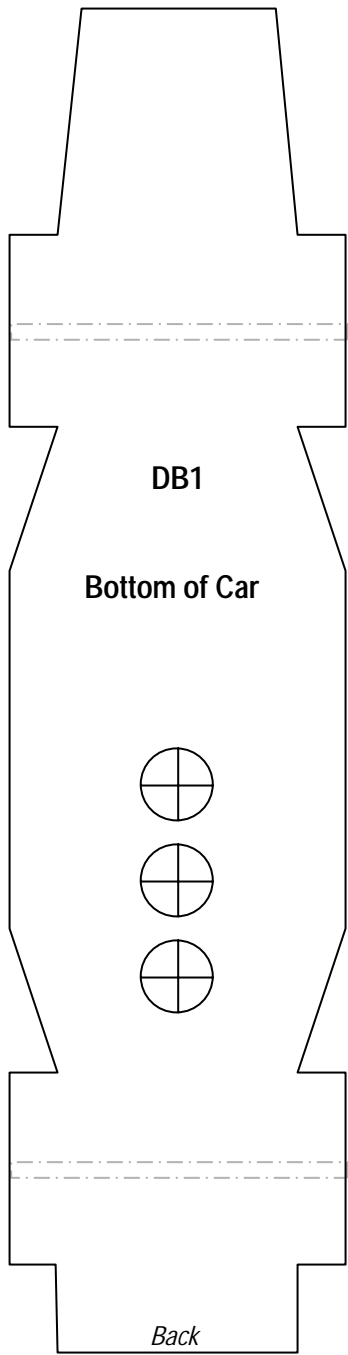
I would greatly appreciate any feedback as to how to make this booklet more useful to you. I would also like to hear about the results of your race. You can reach me by e-mail at:

info@maximum-velocity.com

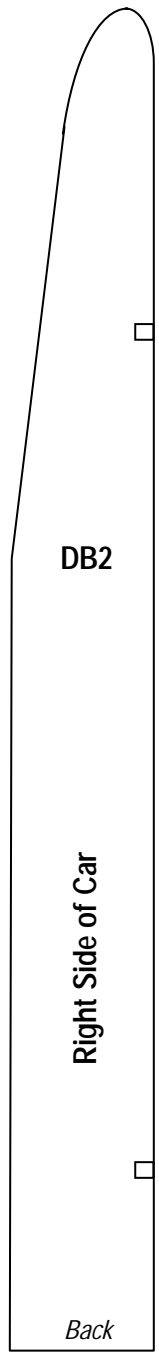
Good luck in your races, and may God bless you and your family!

Randy Davis

¹Awana (Approved Workmen Are Not Ashamed) is a Bible-based club which began in 1950 and now has 17,000 clubs world-wide. The purpose of the club is to evangelize, challenge, and train the youth of the world to serve God. For more information on Awana, visit: www.awana.org.



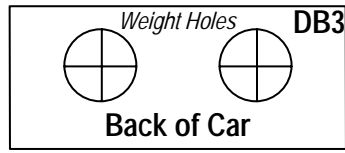
Template DB1
Bottom of Car



Template DB2
Right Side of Car

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

THE DUNE BUGGY



Template DB3
Back of Car

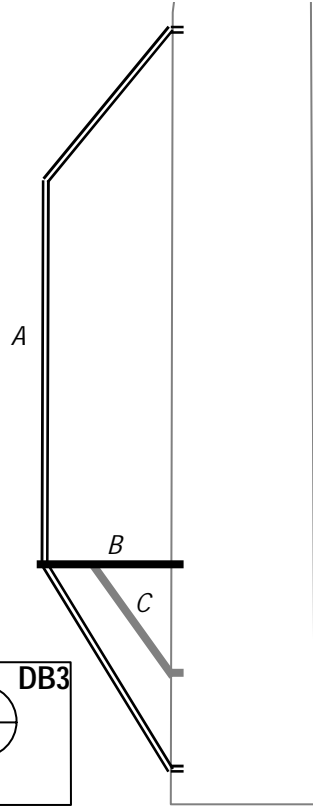
A Use DB4 and DB5



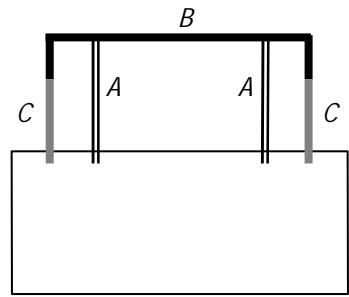
C Use DB4

D Use DB5

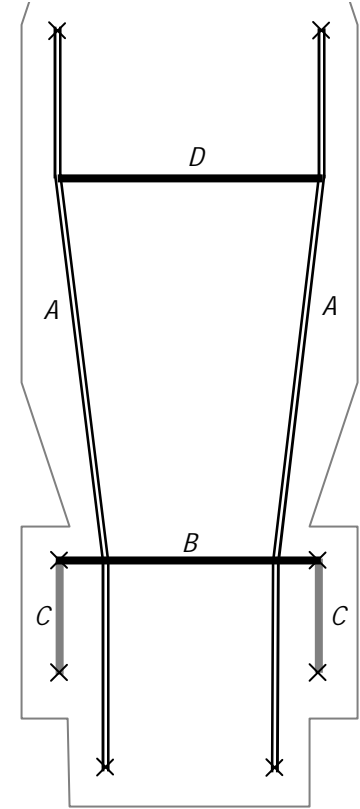
Template DB4
Frame Members



Template DB4
Side View of Frame



Template DB7
Rear View of Frame



Template DB5
Top View of Frame