

Expert Racing Tips & Techniques

Pinewood Derby-STYLE RACE CARS

*The Unauthorized
Builder's Workbook
for Pinewood Derby®
and Awana® racers*

WOODCARVING
*Special
Issue*

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Photos

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and Placing
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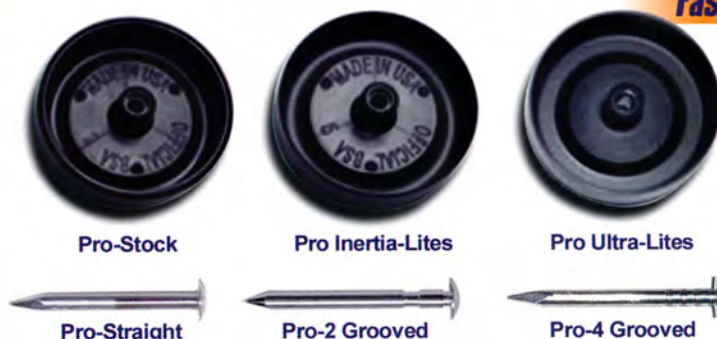
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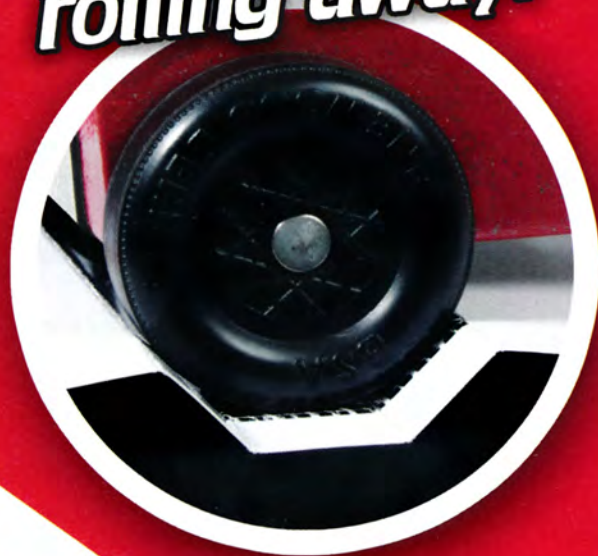
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ILLUSTRATED

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Building a Car with Your Child

Winning a first-place trophy with a car that speeds down the track, leaving other racers in the dust, is the dream of many Pinewood Derby participants. No matter how many modifications you make or speed tips you employ, it's difficult to know how your car will perform until it makes that first run down the racetrack.

When my son and I made our first car together, we weren't very confident in our ability to produce a fast car, so we felt the car needed to feature a cool design. Whether or not it was fast, we knew we'd have a car we could be proud of because it looked great. Our first car was almost as slow as we had feared. In subsequent years, we worked together to create cool-looking cars that were also super-fast. Now that my son has moved on to Boy Scouts, my daughter and I enjoy working together and building cars to compete in her Awana Club races.

For beginners, a Pinewood Derby car kit can resemble a puzzle with the picture missing. It's easy to look at the contents and wonder what to do next. Even experienced racers often wonder how to make a better, faster car. If that's how you feel, don't worry! This special issue was created to explain the basic process of creating a car. You'll also find speed tips that will help put your car at the head of the pack.

The basic wedge car on page 74 is a perfect project for first time racers. The detailed step-by-step instructions guide you through cutting an aerodynamic car, placing the weight correctly, and preparing the wheels and axles. It's a car your child can make with minimal help, and it should place well enough for him to feel proud of his accomplishment.

Experienced racers hoping to improve their time at this year's Derby should try the advanced speed tips related to weight placement, axle preparation, and wheel lubrication. There is no magic step or secret that will turn your car into a winner every time—just a series of steps, each of which will shave a fraction of a second off of your time. Those seconds can add up, making your car a winner.

Spending time with your child is the most important aspect of participating in the Pinewood Derby. It's also important to be aware of what you and your child can learn from building a car together. Following a few simple principles will help make the Pinewood Derby a truly rewarding experience for both of you. Remember to work as a team, let your child decide which body style to make, let your child pick the colors and detail options, and teach your child skills and techniques as you work.

If you don't own any tools or don't have a way of cutting out a car, pre-cut kits are available at your local craft store. Simply choose a design to your child's liking and start by sanding and painting the car.

No matter what approach you take to building a car, remember to have fun with the process. It's the experience of working together as a team that your child will remember.

Troy Thorne



Author of *Pinewood Derby Designs and Patterns*, Troy Thorne participates in Scouting activities with his son, Nathan, who was a national finalist in the All-Star Derby Design Contest.

“Spending time with your child is the most important aspect of participating in the Pinewood Derby.”

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Winning the Pinewood Derby

Winning the Pinewood Derby doesn't necessarily mean coming home with a trophy. The Derby is about spending time with your child, teaching him skills, and building his self esteem. The only way to win the Derby is to involve your child. If you don't take the opportunity to build the parent/child relationship through building a Derby car, you have already lost the race.

When my son Alex first came home announcing the Pinewood Derby, I was extremely anxious. My husband, Tony, works second shift, I had never built a Pinewood Derby car, and patience is not one of my virtues. Luckily, my husband was excited about the endeavor and set aside time to work with Alex on the car. That first car didn't fare very well in the race, but they had fun building it and the process strengthened their relationship.

The following year, Fox Chapel published *Pinewood Derby Speed Secrets*. I bought a copy of the book for my family and told everyone in the Pack about the new resource. Alex's car placed well in the Pack's race and was eligible to enter the District race. When we got to districts, we were told the car would be disqualified because it had an extended wheel base. While the extended wheel base was fine for the Pack race, it was not allowed in the District race. This is a perfect example of why it's so important to check the District rules before building your Pinewood Derby racer. With a very upset Cub Scout, we rushed home to drill new axle holes. We made it back in time to race, but the last-minute alteration prevented us from placing in the District race. The experience taught Alex to do the proper research before launching into a project. Alex also learned the advantage of being prepared to make adjustments.

Armed with two years of experience, my son's final entry in the Pinewood Derby took second place at the District Race. Watching him accept his trophy was a great source of pride, but the real joy was a result of working as a team to learn and improve.

This special issue is dedicated to all the first-time Derby participants, who read the requirements with a bit of apprehension. Once you get your feet wet with the tips and techniques in this issue, check out the additional resources on page 8. These two books contain advanced techniques that will have you leading the way to the winner's circle.

But remember, winning is not about the trophy, it's about the experience. My family will remember that second Derby and the axle fiasco long after memories of the winning race have faded.

Shannon Flowers

Shannon@FoxChapelPublishing.com



Using the tips and techniques included in this issue, my son Alex took home second place in the District race!

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Because working with wood and other materials inherently includes the risk of injury and damage, this book cannot guarantee that creating the projects in this book is safe for everyone. For this reason, this book is sold without warranties or guarantees of any kind, expressed or implied, and the publisher and the authors disclaim any liability for any injuries, losses, or damages caused in any way by the content of this book or the reader's use of the tools needed to complete the projects presented here. The publisher and the authors urge all readers to thoroughly review each project and to understand the use of all tools before beginning any project. Children should always be supervised by competent adults when attempting any project or technique in this issue.

A supplement to *Woodcarving Illustrated* Magazine

1970 Broad Street, East Petersburg, PA 17520

Phone: 717-560-4703 Fax: 717-560-4702

Website: www.WoodcarvingIllustrated.com

Publisher Alan Giagnocavo
Editorial Director John Kelsey
Editorial Manager Shannon Flowers
Technical Editor Bob Duncan
Creative Director Troy Thorne
Art Director Jon Deck
Associate Editorial Manager Mindy Kinsey
Studio Photographer Scott Kriner
Vice President of Sales Paul McGahren

Customer Service

Visit www.WoodcarvingIllustrated.com,
call 800-457-9112, or write: Fox Chapel Publishing,
1970 Broad Street, East Petersburg, PA 17520

Newsstand Distribution: Curtis Circulation Company
Circulation Consultant: National Publisher Services

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Woodcarving Illustrated Subscription rates in US dollars:

One year \$19.95
Two years \$39.90

Canada

One year \$24.95
Two years \$49.90

International

One year \$29.95
Two years \$59.90

Display Advertising/Classifieds

Please call or e-mail Cindy Fahs, (ext. 026) for rates and/or
a media kit. Cindy@FoxChapelPublishing.com

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Woodcarving Illustrated is available to retailers for resale on
advantageous terms. Contact Paul McGahren (ext. 042) for details.

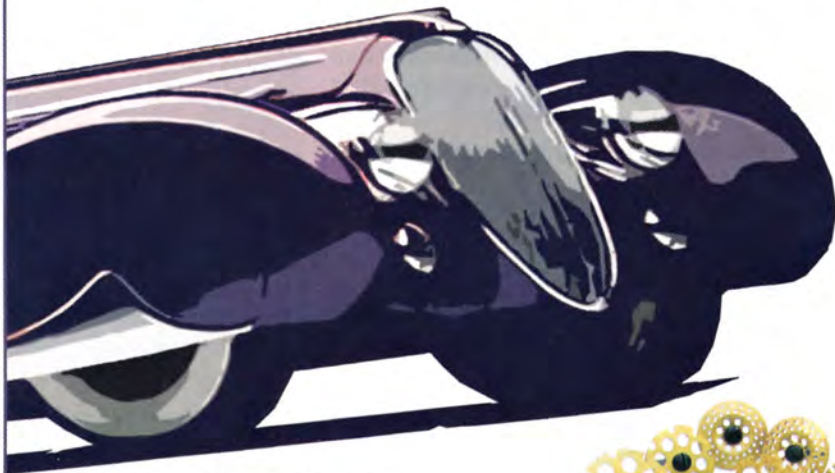
POSTMASTER: Send address changes to
Woodcarving Illustrated
1970 Broad Street, East Petersburg, PA 17520.

Publication Mail Agreement #40649125
Return Undeliverable Canadian Addresses to:
Station A, PO Box 54
Windsor, ON N9A 6J5
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David Meade

David Meade got his start in the Pinewood Derby as a boy, when his family was well known for building unbeatable Pinewood Derby cars. Today, David's own sons carry on the winning tradition, having garnered thirteen first-place championships over seven consecutive years.

Because of his success, David was interviewed by the *Wall Street Journal* and was quoted in "Driving Under the Influence—of Dad" for the March 4, 2005, issue.

By profession, David is a research scientist, holding a master's degree in statistics. His background in research and experimental design has enabled him to develop a unique and powerful approach to Pinewood Derby racing. He also enjoys model rocketry and astronomy.



Troy Thorne

A designer, woodworker, and active Scouting volunteer, Troy Thorne drew on his artistic roots and personal experience, as well as the experiences of other top Derby car designers, to create books for both the first-time derby participant and the experienced racer.

A graduate of Savannah College of Art and Design, Troy spent ten years as a senior art director for a large advertising agency before becoming creative director of Fox Chapel Publishing.

Troy builds furniture and canoes in his spare time. He also participates in Scouting activities with his son, Nathan, who was a national finalist in the All-Star Derby Design Contest. Troy's latest project is a street-legal AC Cobra replica. Check out Troy's website www.dashderby.com for all his latest tips, techniques and designs.

further reading

Pinewood Derby Speed Secrets

Design and Build the Ultimate Car

by David Meade

"If you want to compete successfully your first time out, or improve on last year's finish, this book is for you."

— Don Murphy, Founder, Pinewood Derby

With hundreds of color photographs, and clear diagrams and illustrations, this book guides first-timers and seasoned competitors through the process of building a winning Pinewood Derby race car. Step-by-step instructions enable you to build the car body, prepare the axles, and improve the wheels with minimal tools. As an undefeated Derby racer and parent, author David Meade gives you the inside secrets that will separate your racer from the rest of the pack.

Inside you'll find: winning car patterns, 27 diagrams and 200 photographs to make building easy, a gallery of Pinewood Derby cars, and secrets for shaving seconds off of your race time.

Available for \$12.95 + \$3.99 S&H (parcel post) from Fox Chapel Publishing, www.FoxChapelPublishing.com, 800-457-9112, 1970 Broad St., East Petersburg, PA 17520, or check your local retailer.



further reading

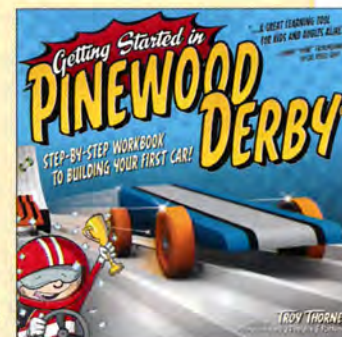
Getting Started in Pinewood Derby

Step-By-Step Workbook to Building Your First Car

by Troy Thorne

Follow along with cool kid Dash Derby as he takes you on an adventure through the seven easy steps to building your first Pinewood Derby race car. No woodworking skills are required for this family fun project, just patience and having a good time!

With 12 patterns and paint designs to choose from, this book will help you have a stress-free Pinewood Derby experience. There's even a really swell place in the back of the book to keep the memories of your first race. Just like Dash says, the Derby isn't about winning—it's about having fun and learning new skills along the way!



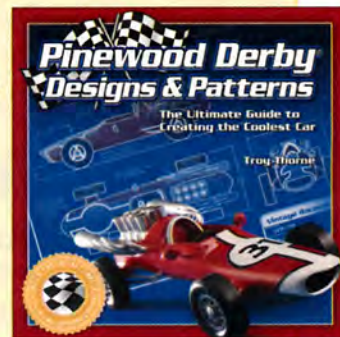
Pinewood Derby Designs & Patterns

The Ultimate Guide to Creating the Coolest Car

by Troy Thorne

Build the coolest car with jaw-dropping designs from a derby-winning dad. Learn techniques for increasing speed and making your own decals.

Both books are available for \$12.95 each plus \$3.99 S&H from Fox Chapel Publishing, 1970 Broad St., East Petersburg, Pa., 17520, 800-457-9112, www.foxchapelpublishing.com, or check your local retailer.



Building a Car Together

Keep your child actively involved in the entire process

By David Meade

The Pinewood Derby is about more than just winning; it's a time for children to learn skills and to develop a lasting relationship with an adult role model. Don't rob them of these opportunities. It is impossible for your child to win the Pinewood Derby if you, the parent, build the car. Even if your car comes in first place, your child will know that he is accepting a trophy that you earned. It is absolutely possible to build a winning car and still allow your child to do most of the work. Here are a few suggestions I use every year as I build cars with my sons.

Build Two Cars

When we build Derby cars, I build a car alongside my son. The technique I use is simple—my son watches me do each step of the process, then he does the same thing to his car. For example, I will demonstrate how to trace the car design onto my raw block of wood. When I'm finished, my son will trace the design onto his block of wood.

There will be steps that you must perform for safety reasons. In these situations, try to find some way your child can safely be involved. For instance, when I need to use a drill press and a Forstner bit, I let my son install the bit in the drill press.

Building two cars has saved us a lot of grief in the past. Having two cars allows you to make mistakes and have learning opportunities on your car. Then, your son can apply the techniques correctly to his car. This is especially true the first time you attempt to apply a particular speed tip or method. After all these years of racing, we still build two cars every time.

Let Your Child Help Design the Car

Your child will feel more connected to his car if he gets to help design it. While car design does have a significant impact upon speed, there is room for individuality and creativity. Let your child be creative and influential in the design of the car.



Building two cars allows you to teach techniques by example and to make any mistakes on your car.

Let Your Child Pick the Color and Detail Options

Color and stickers will not affect the speed of the car, so let your child take charge of this part of the car design. One year, my son chose to put non-matching stickers all over his car, and I let him do exactly what he wanted. The car looked kind of messy, but he liked it.

Teach Principles While You Work

Because the Pinewood Derby is, at least in part, devoted to developing woodworking skills, teach your child as you work on this project together. For example, don't use precut shapes; instead, start with the standard block so you and your child can design and cut the car together. Explain why each step of the process is important. If you ask my sons why we polish our car axles, they can tell you. The more your child understands, the more he will feel like he is a part of the process.

I always help my boys draw a pattern on a sheet of paper. They cut out that pattern and transfer the design to the pine block. We then use either a coping saw or a band saw to cut the design into the block. By doing this, my sons learn how to create and transfer a pattern. They also learn how to properly and safely use a saw to cut wood. I oversee this entire process and ensure they adhere to proper safety guidelines. It's so important that your child be involved in the work and that he learns skills as he builds his car.

For more information on David Meade, see page 8.

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By Mindy Kinsey



Pre-cut Pinewood Derby designs let kids be creative without the hassle of cutting complex car shapes.

Revell Pinewood Derby Car Kits



With Revell's pre-cut car kits, you can complete a Pinewood Derby car without using any tools. The cars meet all BSA standards and come with official BSA axles and wheels. The cars are pre-cut to one of eleven shapes—ready to sand and decorate.

The shapes range from a basic wedge to race cars, trucks, and a skateboard. To make a car, the child takes the blank out of the package, sands it, and adds any paint or decals to personalize the finish. It's that simple. No cutting, no carving, just sanding and painting! I love that kids can use these kits to make cool cars

without spending hours cutting and shaping a rectangular block of wood into a fun shape. These cars are the perfect solution for parents with little or no woodworking tools or experience. If you apply a few speed tips, you can make these very competitive racing cars.

The Racer Series kits contain decals, sandpaper, stick-on weights, and molded plastic accessories like roll cages, exhaust pipes, and drivers. Kits in the Trophy Series come with all of those items, plus paints and brushes. Both types of kits include photo-illustrated instructions and a sixteen-page tips and tricks booklet.

Some of the designs, such as the Wedge and Dragster, are more aerodynamic than others, like the Military and Monster trucks. When you choose a kit, explain airflow to your child so he understands why some styles might outperform others.

Revell's car kits are available at hobby and craft stores nationwide. Suggested retail prices range from \$4.49 to \$15.99. The company also makes a full line of Pinewood Derby supplies, including tuning tools, decorative decals, and paints. View the entire line and locate a retailer at Revell's website, www.revell.com.

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By Mindy Kinsey

Derby Worx

You can tune and align a competitive Derby car using little more than sandpaper and a power drill. However, several tuning techniques will be easier and the results more accurate if you use purpose-built tools. Derby Worx has built a business out of creating those tools, most of which are so unique—and useful—that they are patented or have patents pending. All of the tools include instructions and are available from the Derby Worx website, www.derbyworx.com, and selected Scout, hobby, and craft stores.



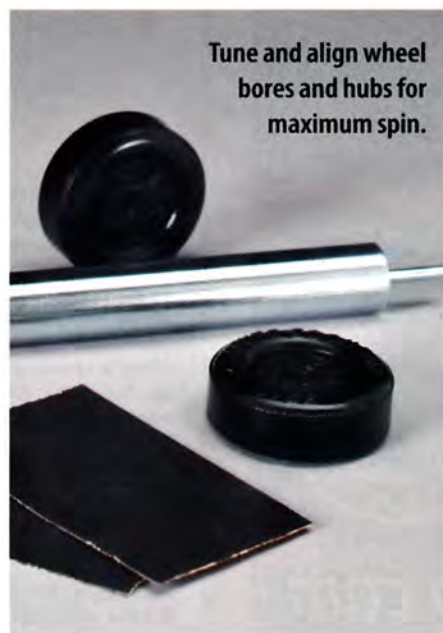
The Pro Axle Press II makes any axle straight and square.



Drill straight accurate holes for extended wheelbases without a drill press.

▲ **Pro Axle Press II:** Right out of the box, axles might look good, but they are rarely straight and square. The Pro Axle Press II straightens axles and ensures the head is square to the body of the nail. I found the patent-pending press easy to use: insert an axle, hit the press with a hammer, twist the axle, and hit it again. I deliberately bent an axle for a test, and the press easily straightened it, and then squared the head. One side of the press has a concave indentation, which you can use to round the head of the axle—a rounded head touches the wheel less, causing less friction. One caution: Don't hit an axle too many times; I overdid it and knocked the head off an axle. I recommend this tool for all car builders. Suggested retail \$16.95.

▲ **Pro Body Tool II:** Without a drill press, it's nearly impossible to drill new axle holes. Not every race allows you to change the location of the axle holes, but if you are allowed, it's easy to add stability to your car by extending the wheel base. The Pro Body Tool II fits exactly around the car block and helps you align the holes and drill straight axle holes with a hand-held drill. There is no way I would try to drill new axle holes without this tool, even if I had a drill press. This tool makes it simple. The tool also makes it easy to drill one front axle hole a little higher to reduce the amount of wheel friction (if that's allowed by your race rules). The metal tool comes with the required #44 drill bit. Suggested retail \$11.95.



Tune and align wheel bores and hubs for maximum spin.

◀ **Pro Hub Tool:** Not every wheel comes in racing condition. The Pro Hub Tool is designed to rectify that. My wheels, out of the box, didn't spin well, so I pushed the pins from the tool through the holes a couple of times and was surprised at how much better the wheels spun. While aligning the hub with the wheel bore sounds complicated, it's as simple as sanding with this tool. Fit the flat end of the tool with sandpaper, slide on a wheel, and twist. The sandpaper removes any molding imperfections. The tool comes with two grits of sandpaper. While you could use a file, the Pro Hub Tool makes the work quick and easy. Suggested retail \$9.95.

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History of the Pinewood Derby

Pinewood Derby strengthens relationships, while promoting craftsmanship and healthy competition

By David Meade

The moment the first group of miniature cars started down the 32-foot race ramp with the battery-run finish line made from doorbells, the Pinewood Derby enjoyed instant success.

The creation of California Cubmaster Donald Murphy, the Derby arose from his search for an activity that he and his ten-year-old son could work on together. Murphy, an art director, was inspired by his employer, North American Aviation, which sponsored Soap Box Derby races, as well as by his own childhood experiences.

"I'd made models of airplanes, cars, boats, and any number of other structures and remembered the pleasure I got out of doing it," Murphy told *Scouting* magazine in November 1999. "I also wanted to devise a wholesome constructive activity that would foster a closer father-son relationship and promote craftsmanship and good sportsmanship through competition."

Murphy presented his idea for carving and racing miniature cars to Cub Scout Pack 280C of Manhattan Beach, Calif. The pack heartily endorsed the project. Murphy then designed a gravity-propelled car that could be carved out of soft pine and wrote

the rules for racing the miniature vehicles. Those rules stated, "The Derby is run in heats on a two- to four-lane track. Two to four cars starting from a standstill will run self-propelled down an inclined track to the finish line. Cars are guided by a raised spacer on the track between the wheels."

The first Pinewood Derby was held May 15, 1953, at the pack's newly constructed Scout House in Manhattan Beach. The Management Club at North American Aviation sponsored the event. Contestants from the fifty-five-member Cub Scout pack, using kits consisting of a block of pine, two wooden axles, four nails, and four wheels, raced in three classes: Class A, for ten-year-olds; Class B, for nine-year-olds; and Class C, for eight-year-olds.

The following year, a local newspaper and the Los Angeles City Recreation and Parks Department sponsored a citywide Pinewood Derby, and the national office of the Boy Scouts of America® adopted the program for Cub Scout packs nationwide.

More than a half-century after the running of the first Pinewood Derby, the event continues to be immensely popular not only among Cub Scouts® (more than 100 million of which have participated in the Derby to date), but with members of other youth groups as well. The program has been adopted by the Girl Scouts®, Awana® Clubs International (as the Awana Grand Prix), Scouts Canada (as the Kub Kar Rally), the



Winners of the first Pinewood Derby, from left: Dennis Lowrie, Richard Hoffman, and Mike Thorne. Pack representative Jack Swofford stands with the boys.



This car raced in the first Pinewood Derby in 1953.

Christian Service Brigade® (as the Shape N Race Derby), the Royal Rangers®, the YMCA Adventure Guides®, and the Woodcar Independent Racing League (WIRL). It also has spawned related events, such as the Raingutter Regatta®, which uses boats instead of cars, and the Space Derby®, which uses rockets.

The Pinewood Derby has spawned a whole genre of products and services for car builders and racers.

When the Pinewood Derby observed its fiftieth birthday in 2003, Murphy, then 83 years old, was honored with a proclamation from the president of the United States. He also received commendations from the national director of Cub Scouting, the governor of California, both of California's U.S. senators, and the mayor of Los Angeles. In Manhattan Beach, the Derby's birthplace, Pack 713, a direct descendant of Pack 280C, hosted a commemoration for the city's Cub Scouts, staging several races with retro 1953 cars in the same Scout House that was the site of the first Derby.

Because of Don Murphy, father of the Pinewood Derby, generations of parents and children have built strong relationships as they developed valuable skills.

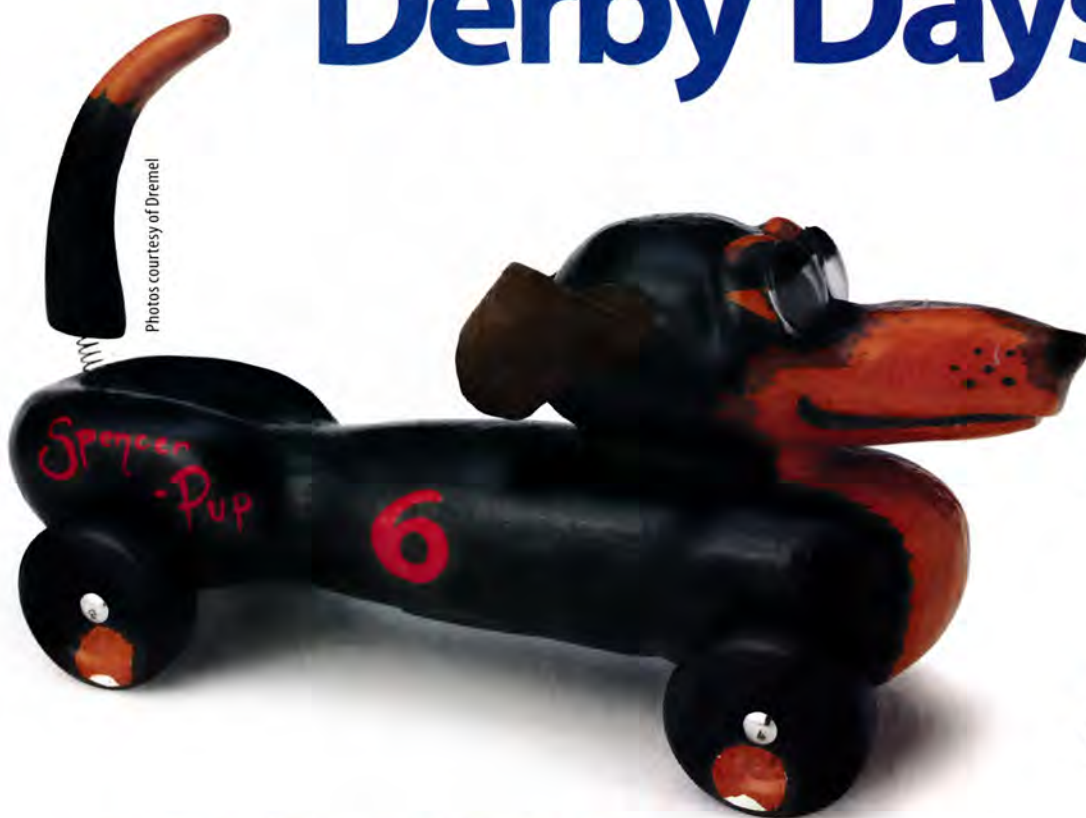
Murphy's legacy lives on.

For more information on David Meade, see page 8.



The first Pinewood Derby, held in Manhattan Beach, Calif., in 1953, was such a success, the Boy Scouts of America adopted the program nationwide the following year.

Derby Days



Lowe's® and Dremel® team up for Derby-car building demonstrations

By Mindy Kinsey

Dremel employees enjoy creating sample Derby cars to inspire Scouts.

In Cub Scout packs across the country, there are two common reactions when the annual Pinewood Derby is announced: kids say, "Yay! I get to build a car!" and their parents think, "Huh? I have to build a car?"

For ten years, Lowe's and Dremel have encouraged excited kids and assisted frustrated parents with their annual Derby Days program. Working together, the two companies present workshops at Lowe's stores across America to teach boys and their parents how to turn a block of wood into a race car.

"Both Lowe's and Dremel have a long-standing relationship with the Boy Scouts of America, and we recognize how important it is for the Boy Scouts to not only have the necessary tools and skills to be successful on the Pinewood Derby track, but on any projects they work on at home or in their communities," said David Vaughn, the vice

president of merchandising for tools at Lowe's. "Lowe's is proud to offer free in-store demonstrations for the Boy Scouts and their parents to learn key building skills that will help them achieve their goals at the Pinewood Derby and beyond."

The two-hour demonstrations, led by Lowe's employees and featuring Dremel rotary tools, show participants how to rough out a car, carve details, round the edges, and add weights. They also discuss car design, review safety tips, teach how to sand with progressively finer-grit sandpapers, describe priming and painting, and share tips on wheel and axle preparation.

In addition to their notes and ideas, Scouts leave the demonstration with a Lowe's/Dremel badge and a discount coupon for Dremel tools and accessories. A kit that includes Dremel accessories and official car-making supplies is also available. Back home,



Photo courtesy of Lowe's/Dremel

kids can use Dremel's Derby Days Website, www.DremelDerby.com, to design a car and print a cutting guide.

"The beauty of the Scouting program and a Pinewood Derby is that parents and children work together to create the car," said Kristy Hensel, the development officer for the Boy Scouts of America. "When a young child sees he can make an aerodynamic instrument from a block of wood and some very basic hardware—it opens that child's mind up to whatever he can imagine. Building a Pinewood Derby car the traditional way or learning new and different ways to create one while at a Dremel Derby Day guarantees a great time for the parent and Scout."

Although Lowe's does not track attendance at the Derby Days events, feedback from stores indicates thousands of children and parents participate each year.

Lowe's will host the workshops in every store nationwide on four dates in January and February.

"Lowe's and Dremel's support of the Derby Days events helps us build relationships with youth across the country who are tomorrow's community leaders and future homeowners," said David Vaughn. "Lowe's knows that education is the cornerstone to building brighter communities, and these in-store demonstrations will empower the Boy Scouts to use their skills not only during the Pinewood Derby races, but to make positive impacts in their communities."

Free Derby Days demonstrations will take place at Lowe's stores nationwide from 11 a.m. to 1 p.m. on January 7, January 21, February 4, and February 18, 2012. The Dremel Derby Car Accessory Kit will be available in December in stores and at www.Lowe's.com. Design a car or watch instructional videos at www.DremelDerby.com.

Cub Scouts and their parents learn car-building techniques and woodworking skills at the Derby Days demonstration at Lowe's.

The Winner's Circle

A gallery of great Derby-style cars



One of the most fun and fascinating parts of attending a Pinewood Derby is seeing all of the different car designs. While Scouts must obey their local rules regarding the size, weight, and wheel adjustments for their car, there's no limit on design creativity. The cars shown here, created by boys, dads, and adult racers, are a sampling of the cool cars that will be on tracks across the country this winter. Use them as inspiration to create your own dream design!



Formula One Racer (top) and Ford GT by Tom Tyson, Marietta, Ga. Note the wheels on the Formula One Racer are not legal for most Scout events; check with your local race coordinator before using alternate wheels.

THE WINNER'S CIRCLE



From Top: *Music On Wheels* and *Stinger*
by Bruce Edney, Shoreline, Wash.;
and *Racer* by Ben C., Lancaster, Pa.

THE WINNER'S CIRCLE



From top: *White Lightning* by Ben C., Lancaster, Pa.; *Red Head* by Troy Thorne, Lancaster, Pa.; and *Scout Spirit* by Ben C., Lancaster, Pa.



Landry Robbins

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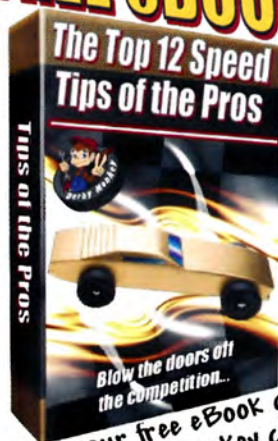


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THE WINNER'S CIRCLE



From top: *Roadster* by Tom Tyson, Marietta, Ga.; *Ace* by Ryan A., Lancaster, Pa.; and *No. 14* by Ben C., Lancaster, Pa.

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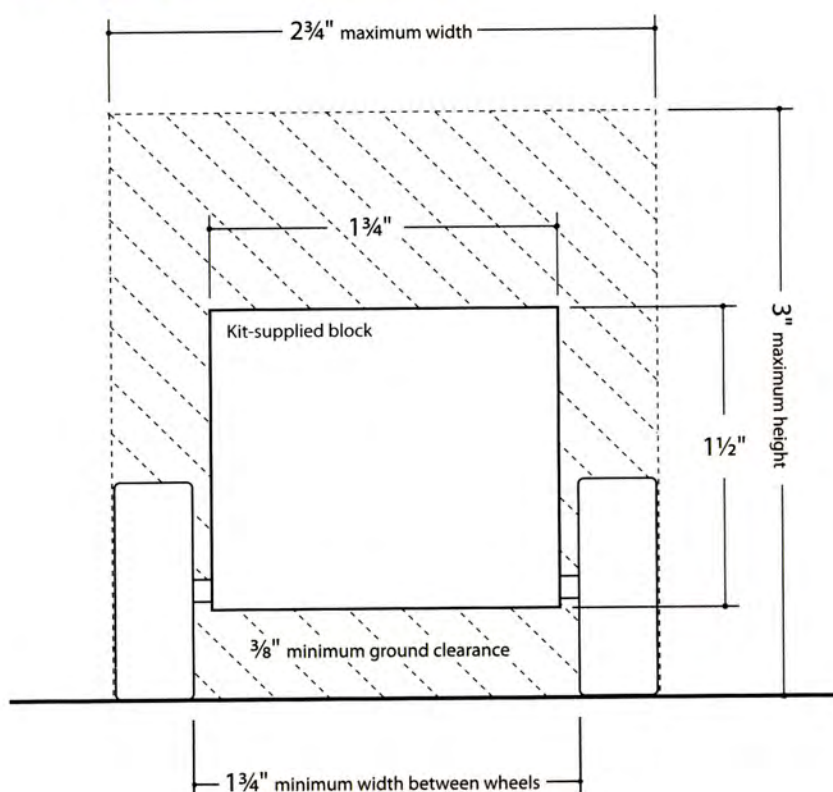
By Troy Thorne

As you gather the tools and materials to build a car with your child, review the official and local Pinewood Derby rules and the Official Grand Prix Pinewood Derby car specifications. If you don't have a copy of your local rules, ask your race committee for one. Then, abide by all of the rules. Remember the principle from the Boy Scout Law: a Scout is trustworthy. If you find a design or speed tip that doesn't fit within your local Derby's rules, don't use it. If you are unsure whether something is legal, check with your local race organizer before you build the car.

The suggested rules and specifications of the Official Grand Prix Pinewood Derby Kit® are provided for reference only. Request a list of your local pack's or district's rules from your Derby organizer.

For more information on Troy Thorne, see page 8.

Official size limitations



Official Grand Prix Pinewood Derby Rules

1. Wheel bearings and bushings are prohibited.
2. The car shall not ride on springs.
3. Only official Cub Scout Grand Prix Pinewood Derby wheels and axles are permitted.
4. Only dry lubricant is permitted.
5. Details, such as steering wheel and driver, are permissible as long as these details do not exceed the maximum length, width, and weight specifications.
6. The car must be free-wheeling, with no starting devices.
7. Each car must pass inspection by the official inspection committee before it may compete. If, at registration, a car does not pass inspection, the owner will be informed of the reason for failure and will be given time within the official weigh-in time period to make the adjustment. After approval, cars will not be re-inspected unless the car is damaged in handling or in a race.

Source: Boy Scouts of America Official Grand Prix Pinewood Derby Kit.

Keeping it Safe

Make safety your top priority

By Troy Thorne

As you and your child prepare to make your Pinewood Derby car, keep the following safety points in mind.

- **Take stock of your workspace.** Make sure it is clean and neat. Check for adequate lighting and ventilation.
- **Supervise your child as he uses any power tools.** Remind your child of any safety procedures—such as securing loose clothing, hair, or jewelry—before he turns on any tool.
- **Always follow the manufacturer's instructions** on any items you use.
- **Never melt or sand lead.** Beware of any Pinewood Derby websites, books, or videos that recommend melting or sanding lead. These techniques are very dangerous and will not help you win the Derby. Remember, lead is very poisonous, and, when you melt it or sand it, you create lead dust and fumes that can easily be inhaled. Lead should only be handled by adults, and with appropriate safety precautions.
- **Use saws safely.** Saws are sharp and potentially dangerous tools if not used properly. Cut in a slow deliberate manner. Do not force wood through the saw. Make sure your sawing area is clean. Eliminate distractions and keep your eyes on your work. Always wear safety glasses and a dust mask when working with wood-cutting tools.
- **Work in a well-ventilated area.** When using wood filler, glue, and other adhesives, be sure to follow the manufacturer's instructions. Work in a well-ventilated area. Be sure lids are closed tightly before storing. Avoid contact with eyes and skin by wearing protective gloves and goggles.

Additionally, have the safety items pictured at right readily available and use them throughout the project to ensure a positive experience for you and your child.

For more information on Troy Thorne, see page 8.



Gloves

For safety, wear rubber or latex gloves when working with glues, paints, and lead. If you don't wear gloves when working with lead, wash your hands thoroughly afterward. Leather gloves that fit snugly can be helpful when working with sharp tools.

Wear dust masks to protect against harmful fumes and airborne particles when sanding, applying graphite, and spray painting. Form the metal strip at the top of the mask over the bridge of your child's nose to create a tight seal.

Dust Masks



Safety Glasses



Eye protection is very important when sanding wood and working with power tools. Invest in safety glasses or goggles that protect your eyes and your child's eyes from the front and the sides.

Ear protection is necessary whenever you run power equipment. Ear protection is available at home centers in the lawncare or the safety section.

Ear Protection



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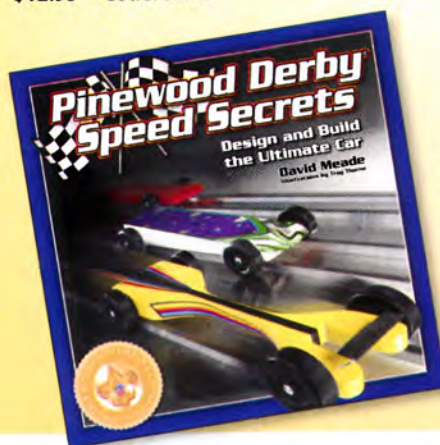


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Follow Dash Derby, your Pinewood Derby guide, on an adventure through the seven easy steps to building your first Pinewood Derby race car. No woodworking skills are required for this family fun project - just patience and the desire to have a good time!

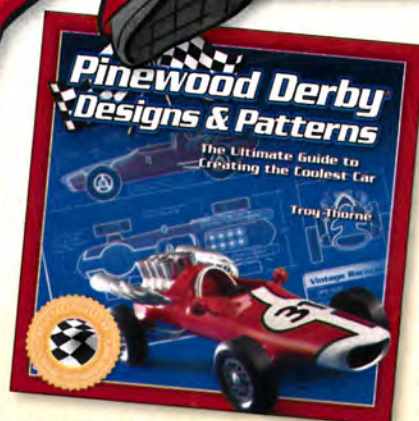
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Pinewood Derby Speed Secrets Design and Build the Ultimate Car By David Meade

Separate yourself from the rest of the pack with speed secrets from an undefeated pinewood derby champ. Hundreds of photos and diagrams for making the fastest car in the race.

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By Troy Thorne

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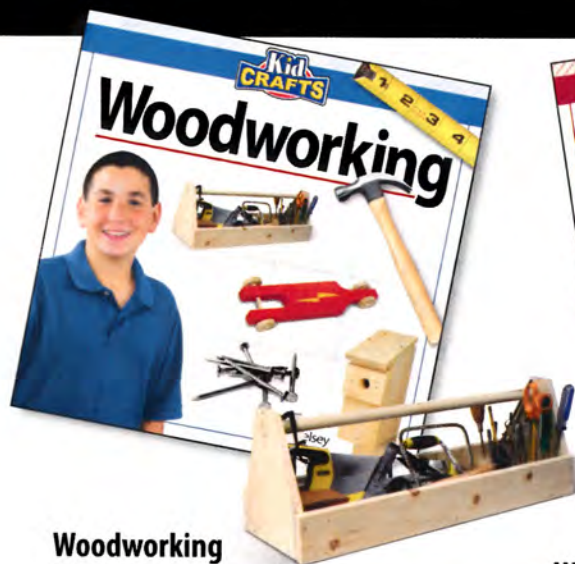
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By John Kelsey

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Woodcarving

By Everett Ellenwood

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Tools and Supplies

Review the equipment you will need to safely and efficiently build a Pinewood Derby car

By Troy Thorne

Start your Pinewood Derby car by understanding the tools you'll need, learning how to use them, and gathering those that best suit your working style. This is also the perfect time to go over safety procedures with your child so he knows how to stay safe throughout the building process (see page 27).

While you don't need a lot of equipment to build a car, several common woodworking tools and supplies will make the process easier and safer. These brief descriptions and tips on which items work best for specific tasks will help you select tools and supplies, and familiarize your child with the tools he will use.

WOOD-CUTTING TOOLS

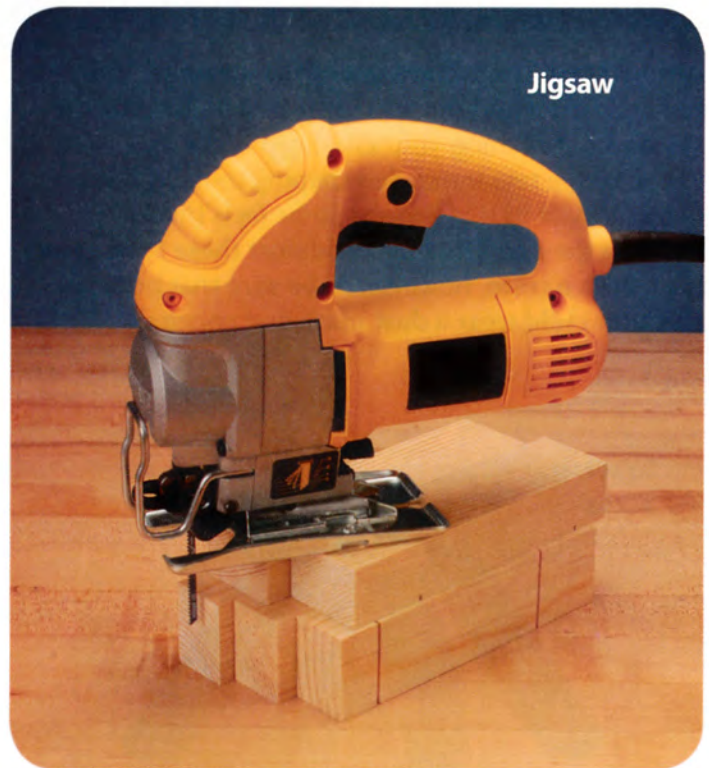
Wood-cutting tools are essential for the initial rough-cuts that form the basis for your design. The best and most efficient saws are the band saw, jigsaw, and scroll saw. However, these are not suitable for your child to use. If you have the time and would like to have your child cut the initial design, try letting him use a coping saw with your guidance. This is a great way to get your child involved in the process.

Any time you use a cutting tool, install a sharp blade. Doing so will ensure safety and make cutting easier and less time-consuming for both you and your child. You don't want your child to lose interest at this early stage.



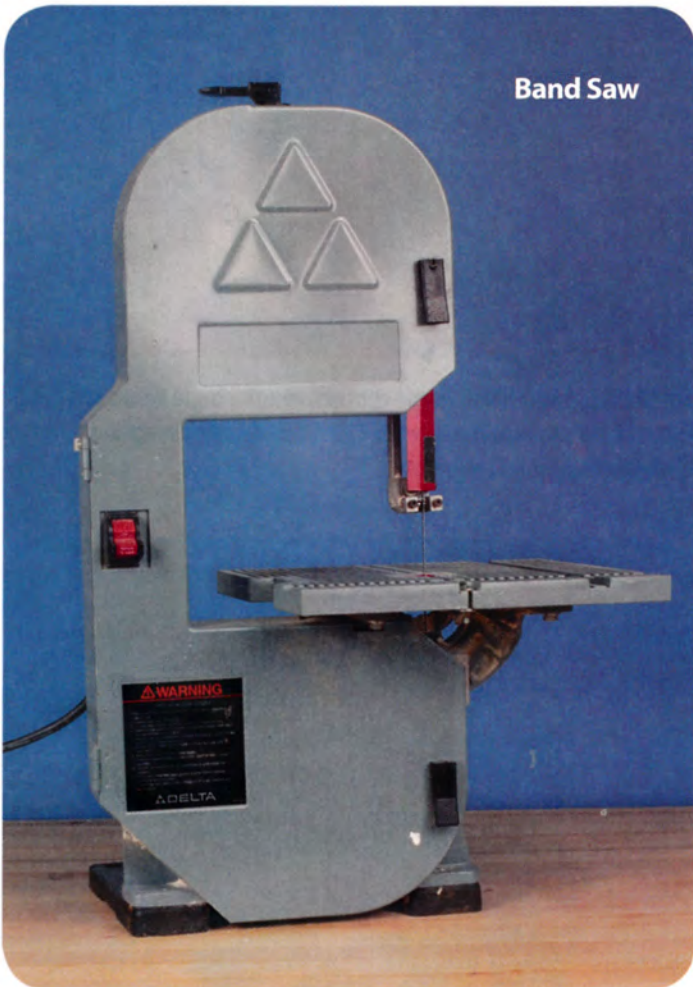
Coping Saw

Children can easily use a coping saw to cut most car patterns. Install the blade so it cuts on the pull stroke. Encourage your child to take his time and check both sides of the car to ensure that the cuts are parallel to the block.



Jigsaw

If you choose to use a jigsaw, install a thin fine wood blade to cut tighter curves, and use clamps to hold the block steady. You will need to reposition the clamps often.



Band Saw

Small benchtop band saws are great for cutting out Pinewood Derby cars. A fine $\frac{1}{8}$ "-wide blade produces the best results. Provide a secure platform that's a safe distance away from the front of the saw so your child can watch you cut and see how the saw works.



Scroll Saw

Scroll saws are perfect for Pinewood Derby cars because their fine blades cut very tight curves; however, they can only cut wood less than $2\frac{1}{2}$ " thick. Remember to find a safe spot for your child to stand and watch.

WOOD-SHAPING TOOLS

After you cut the pattern out of the wooden block, you and your child must shape it into its final form. With your guidance, your child can easily and safely use all of the recommended shaping tools. Allow him to participate in this process so he feels involved in building the car. The fine wood dust these tools create is a health hazard, however, so be sure that both you and your child wear a dust mask and goggles.

Sanding Sticks



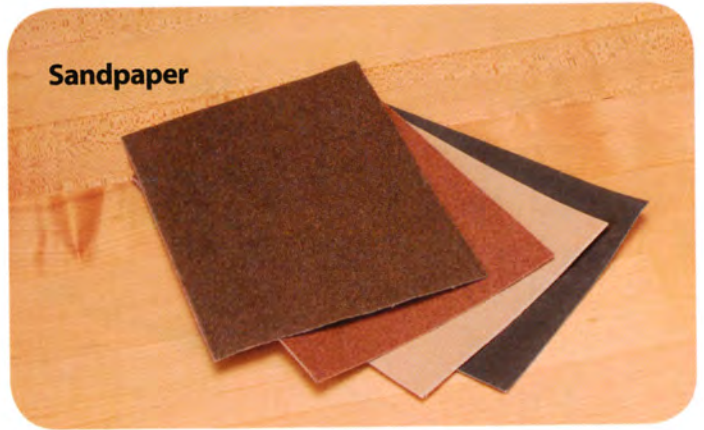
Make homemade sanding sticks to sand the car. Glue sandpaper to one end of a craft stick with spray mount and cut around the edge with scissors. Make one stick per grit (100-, 150-, 220-, and 400-grit sandpaper). Write the grit number on the back of the stick.

Power Sanders



Random orbital and pad sanders sand large areas. These sanders can be used for flat or convex surfaces.

Sandpaper



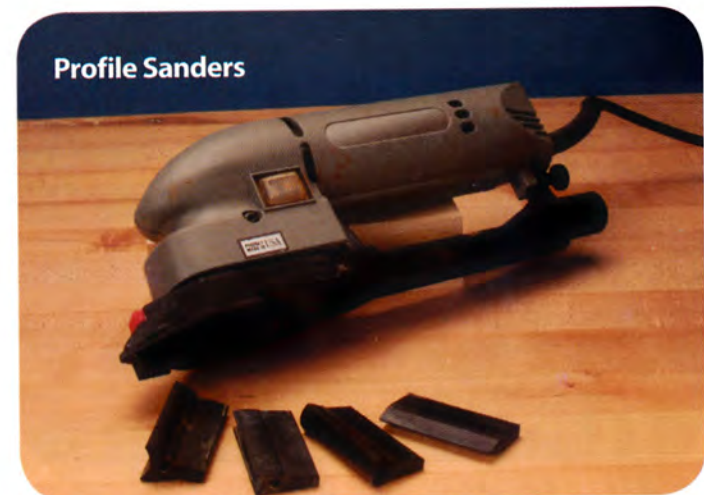
Use four sandpaper grits, such as 100, 150, 220, and 400, for your car. Cut each sheet of sandpaper into four pieces. Then, fold one piece in half, and in half again. As the sandpaper wears out, refold the paper to expose a fresh area. This makes the paper last longer.

Small Files



Small files, available at home centers, rough-shape wood and fillers. Files can also remove the burrs on the axles supplied with the Pinewood Derby kit.

Profile Sanders



Profile sanders come with a wide range of rubber profiles. Special adhesive-backed sandpaper wraps around the profiles, allowing the sander to sand hard-to-reach areas.

WOOD-SHAPING TOOLS

A Dremel or similar tool is the most useful shaping tool for your Pinewood Derby car. It cuts quickly and accepts a wide range of bits. You can adjust the speed, which ranges from 5,000 to 35,000 rpm, using the variable speed control. Slower speeds offer more control, while faster speeds can remove material quickly. The optional Flex Shaft hand piece gives you better control.

After attaching the Flex Shaft to the Dremel tool, hang the motor (which is separate from the handpiece) on a hook above your workbench. This setup decreases vibration and prevents the motor from falling off the workbench and pulling the bit from your hand. Always clamp the workpiece to the table before shaping it.



**Dremel Tool
with Flex Shaft**

The lighter, more comfortable, and smaller Flex Shaft handpiece is shaped like a pencil to give you better control.

Useful Dremel bits



A) small high-speed cutter (193), B) large high-speed cutter (196), C) cylinder-shaped, structured-tooth, tungsten, carbide cutter (9933), D) cone-shaped, structured-tooth, tungsten, carbide cutter (9934), E) 1/4" sanding drum (430), F) 1/2" sanding drum (407), G) Dremel chuck (4486), H) 1 1/4" cut-off disk (426). These bits are enlarged to show detail.

BITS

The basic bits that come with most shaping tools are also some of the most useful. The set often includes small steel-cylinder cutters and the large and small drum sanders. If you decide to purchase additional bits, choose the cylinder-shaped, structured-tooth, tungsten, carbide cutter (9933, bit C in the illustration). This bit has many uses, from shaping the outside of a car to cutting out the waste material inside a car.

Always wear safety glasses and a dust mask when using a shaping tool. Use hearing protection for your child; most children find the tool's high-pitched noise intolerable.

Whenever you cut with a bit for the first time, practice on a scrap piece of wood. It takes a few minutes to gauge how the bit cuts best. The wood grain will cause the bit to cut cleaner in one direction than the other.

SUPPLIES

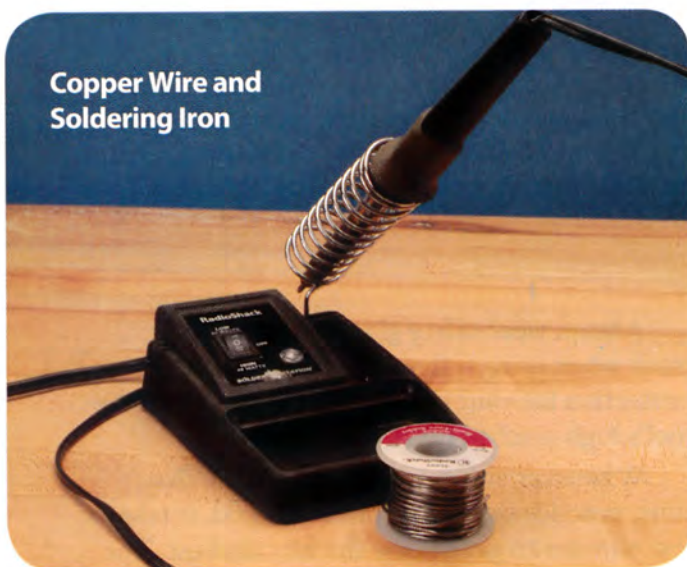
Generally, Derby cars don't require a lot of different supplies. Many are common household items. These items can be purchased from your local home center.

Adhesives



Spray mount, epoxy, cyanoacrylate glue (CA glue), and wood glue are all important for building a Derby car. Use spray mount to attach patterns to blocks of wood. Epoxy is a strong bonding glue used to attach wood and metal parts together. CA glue (like Krazy Glue® or Super Glue®) is fast drying and can quickly glue small wooden parts together—or to your fingers if you aren't careful. Wood glue is best for gluing large pieces of wood together.

Copper Wire and Soldering Iron



To construct detailed items, such as steering wheels, suspension parts, and window frames, use copper ground wire. This 14-gauge electrical wire is easy to solder with a simple soldering iron.

Wood Fillers



For painted cars, don't choose the standard wood-matching fillers. They are slow-drying and brittle. Instead, use fast-drying fillers.

Solder



Solder works well for making detailed parts for your Derby car. Purchase lead-free silver solder. It bends easily by hand, but is strong enough to survive being handled by children. It can be used to make exhaust pipes, roll bars, and bumpers.

Tape



Blue painter's tape is the best all-around tape. It has many uses, from taping off areas before painting to holding wood together during the sawing process. Blue, 1/8"-wide, fine-line tape makes perfect paint lines. Pinstriping tape is a great way to hide an imperfect paint edge.

PAINTING SUPPLIES

A perfect paint job is all about planning, preparing, and having patience. Always remember to wear a dust mask and to paint in a well-ventilated area.



Acrylic Craft Paints

Acrylic craft paints are great for kids to use because they clean up easily with soap and water. Most craft stores carry a variety of colors, and these paints cost only about \$1 per bottle.



Spray Primer

Spray paint primers are available in white, gray, and red. Primer is the base coat applied before the color coat. Primer dries fast and sands better than regular spray paint.



Clear Coat

Spray clear coat adds a shiny finish. The clear coat also protects pinstripes and decals from wear.



Enamel Paints

Small Testors® enamel paints are available in many flat and gloss colors. They can be brushed on or thinned and sprayed through an airbrush. You can purchase enamel paints at most home centers.



Spray Paint

Spray paint comes in a variety of colors. Always use the same brand of primer, color coat, and clear coat throughout the project. Otherwise, your paint may not set properly.



Automotive-Quality Spray Paint

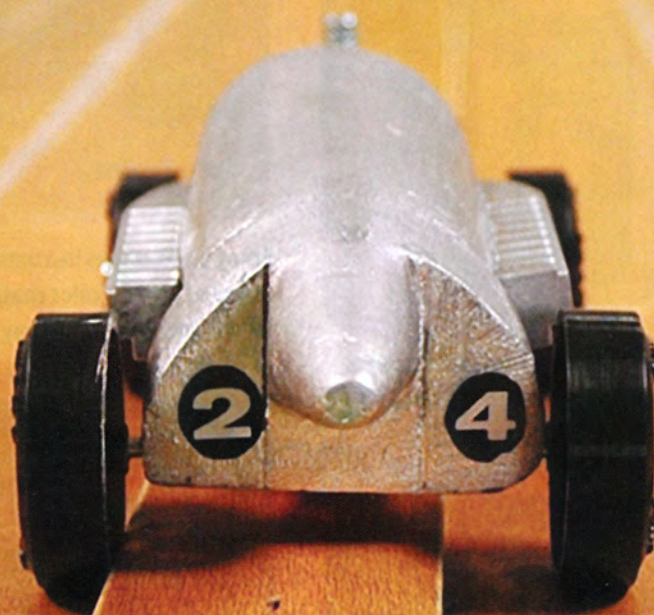
Automotive-quality spray paint can create a finish that looks as if it came from an auto body shop. Some brands come in a three-step process, such as candy base coat, color coat, and clear coat. These paint systems are available in candy and pearl finishes.

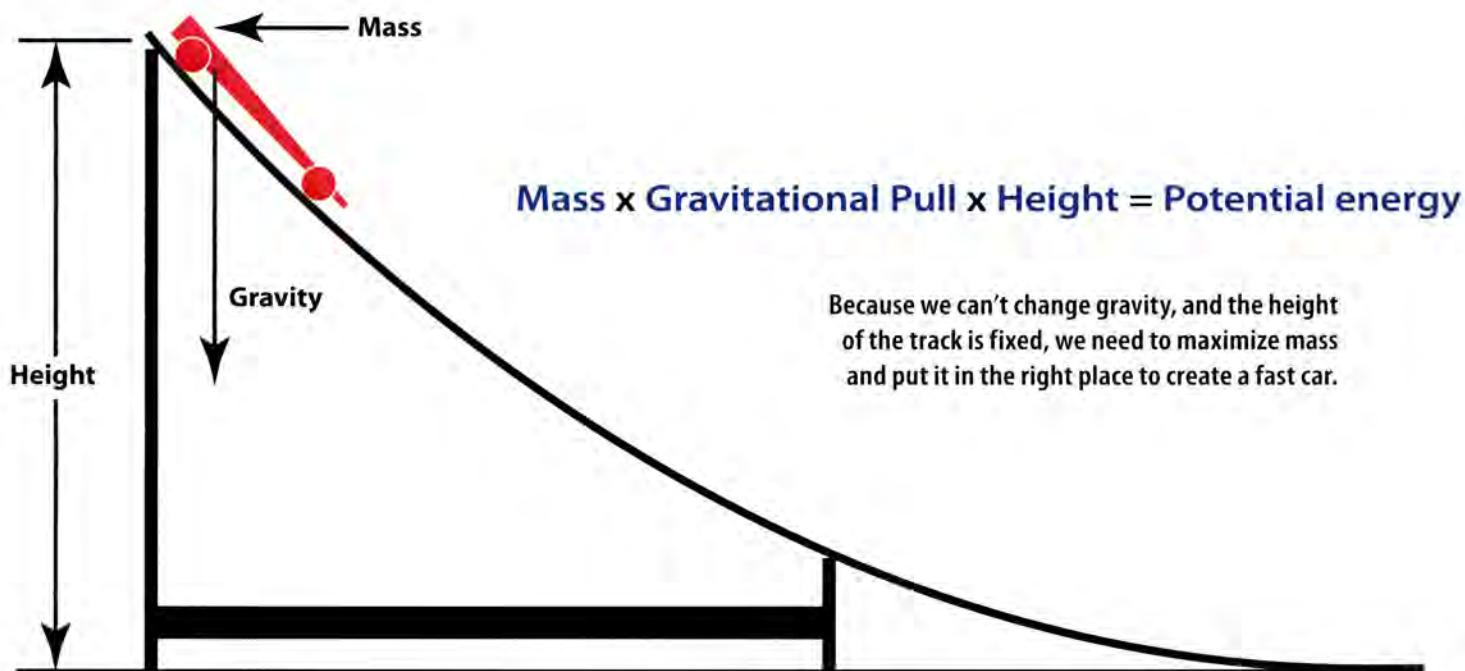
For more information on Troy Thorne, see page 8.

The Principles of Speed

**Understanding why cars win
and using that knowledge
to your advantage**

By David Meade





There are three basic principles that govern how fast a car will go. Every worthwhile speed tip works to give your car the maximum benefit from each of these three principles.

1) Maximize Potential Energy

Gravity provides the energy that makes your car roll down the track and is a strong force that pulls on your car. You can think of gravity as the engine in your car. Before the race begins, when your car is sitting stationary at the top of the track, it has what is called *potential energy*. Potential energy is the amount of energy available to make your car roll down the track. Cars with more potential energy will roll faster as they move down the track, just as an automobile with a 300-horsepower engine will go faster than one with a 100-horsepower engine. The first principle of maximizing speed is to maximize the amount of potential energy your car has.

To give your car that 300-horsepower engine, choose the design carefully (page 40), place the weight toward the back, and use as much weight as possible (page 44).

2) Reduce Friction

Friction is the enemy of speed. You've built a car with tons of potential energy, but unfortunately not all of that energy actually gets converted into speed. Some energy is converted into heat as surfaces rub against one another, causing friction. Most speed tips, such as choosing an aerodynamic design (page 40), polishing

the axles (page 58), and lubricating the wheels (page 64), are aimed at reducing friction. You want to save as much energy as possible so it can be used to make your car rocket down the track.

3) Reduce Wheel Inertia

According to Newton's first law of motion, any stationary object will tend to remain stationary until it is acted upon by an outside force. This law means that your wheels will stay motionless until a force pushes on them and makes them start moving. Objects at rest tend to resist a change in movement. This resistance to change is called inertia.

Heavy objects have more inertia than light objects. This means that lighter objects take a smaller force to make them start moving. So, if you put lightweight wheels on your car, it will take a smaller force to make them start rolling down the track than it would if you put heavy wheels on your car. Cars with lightweight wheels will begin rolling sooner than cars with heavy wheels. While you must use the wheels that come with the Official Grand Prix Pinewood Derby Kit®, some rules allow for modifications like shaving and shaping the wheels on a lathe. Check your local rules before modifying your wheels.

Don't:

The world is full of Derby tips and secrets, and I've tried most of them. Below are my favorite speed tips, along with some of the more common tips that I recommend you avoid.

Don't: Axle Hardening

Axle hardening requires heating an axle to red hot using a propane torch, then dropping the axle in water to cool it off quickly. This hardens the metal, making the axle scratch resistant.

On the surface, this technique sounds really cool. However, I've tested this method several times and there is a negative side effect which nobody seems to have noticed. The hardening process can warp the axles. If you observe hardened axles spinning in a drill press, the effect is obvious. In my opinion, axle hardening does little to help you win the Derby and a lot to help you lose. Plus, it's dangerous!

Don't: White Teflon® Powder

White Teflon powder was introduced some years ago as an alternative to graphite. Teflon works in frying pans, so it should work on Pinewood Derby wheels too, right? Absolutely not. Teflon powder doesn't lubricate wheels as well as graphite.



Axle hardening is dangerous and can warp the axles.



Polishing with pumice is messy and ineffective.

Don't: Polishing with Pumice

Traditional axle polishing calls for using a paste made of pumice after the 600-grit sandpaper, but this is a bad idea. In addition to being messier than using wet/dry sandpaper, moving from 600-grit sandpaper to pumice (equivalent to 1800-grit sandpaper) is too big of a jump. The pumice is too fine to tackle the scratches left behind by the 600-grit sandpaper. Stay away from the pumice and use successively finer-grit sandpaper instead.

“Your car will get a little faster each time it goes down the track.”

Do: Pre-Race Your Car

If you have ever been to a Pinewood Derby, you may have noticed that a lot of cars will not do very well their first or second time down the track. However, by the end of the Derby, those same cars will be running better and will sometimes even beat cars they lost to in the first or second heat. This isn't just your imagination playing tricks on you. As a general rule, your car will get a little faster each time it goes down the track because the wheels and axles wear into each other and get smoother. Your car will be faster the twentieth time it races than it was the first time.

So, race your car fifty or one hundred times before the Pinewood Derby! How do you accomplish this without a track? It's simple—use either your index finger or a Dremel tool. Your child can perform this step almost all on his own.

Wearing goggles and a dust mask, go outside or to the garage (or choose another suitable area in case the graphite makes a mess). Apply graphite to each wheel and spin the wheels a little bit.

Attach a large felt disk to a Dremel tool and turn the tool on high speed. Hold the car level and gently touch the spinning felt disk to one of the wheels. Once the wheel is spinning, move the Dremel tool away from the wheel. (If you hold the felt disk to the wheel continuously, you can damage the wheel.) As you see the wheel start to slow down slightly, touch the disk to it again. Repeat this process for about five minutes per wheel. If you are using your index finger to spin the

wheel, repeat the process for about fifteen minutes per wheel. You may want to put in a good movie.

Turn the car on its side and spin the wheels. Turn the car over on the other side and spin them. Every minute or so, apply more graphite. Spin each wheel for about five minutes on high speed. If you are using your index finger, periodically apply more graphite (after every five or ten minutes), and continue spinning your wheels until the movie is over. When you are finished, your car will have run at least one hundred races. It will be a finely tuned racing machine!



Test that each wheel spins for at least 20 seconds to ensure everything is correct and ready to go.

Do: Perform the 20-Second Test

After the wheels have been lubricated, aligned, and broken in, spin each wheel with your finger as fast as you can. Time how long each wheel spins. Repeat this procedure five or six times for each wheel.

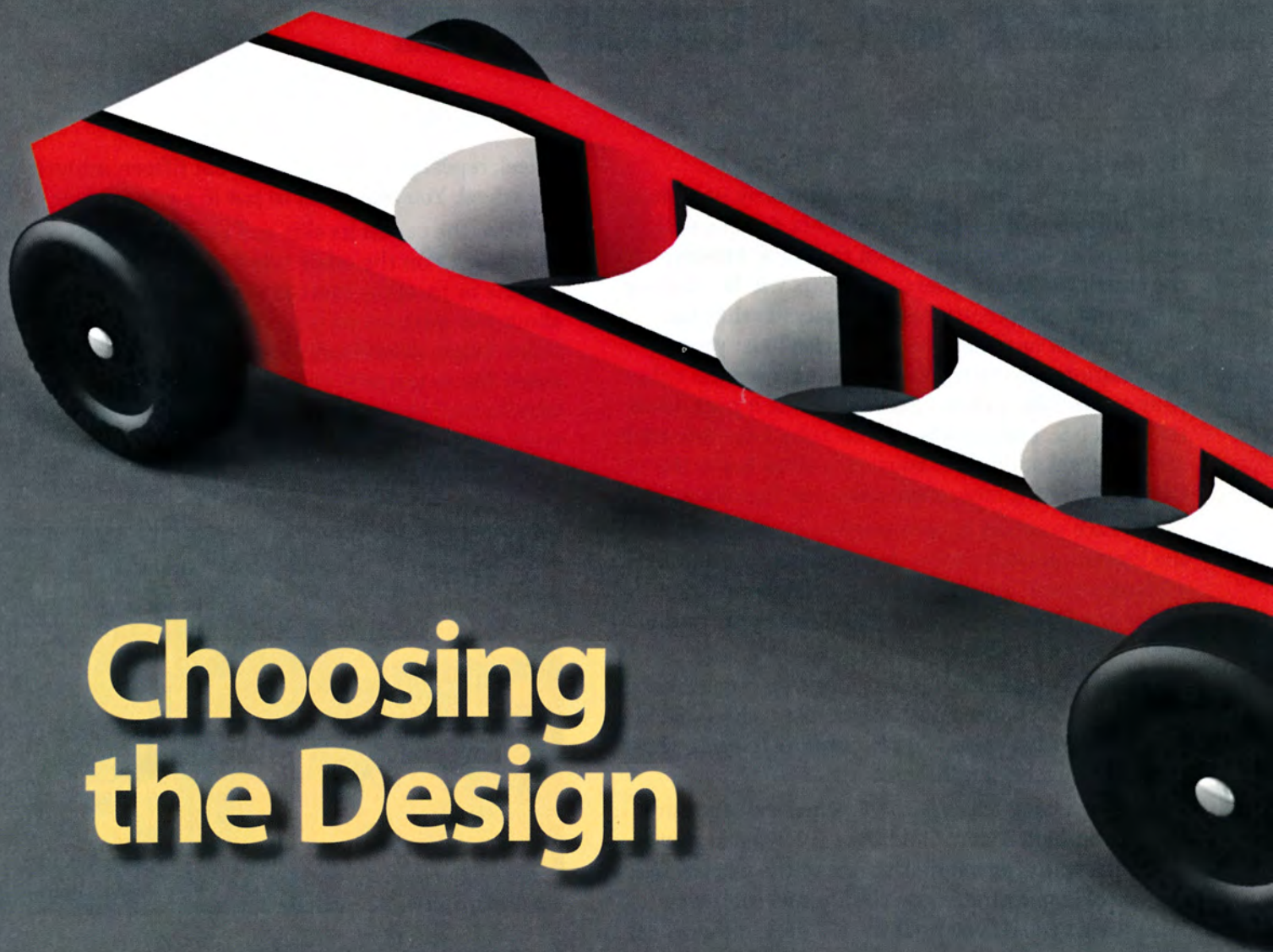
If everything is right, your wheels should spin for at least 20 seconds. If you find one wheel that just doesn't measure up, try adding more graphite. Spin that wheel again for a minute or so to break it in. When finished, try the 20-second test again. If the wheel now spins for 20 seconds, great! If it's still slow, I recommend you remove the wheel/axle pair and replace it with another set. If you replace a wheel, then you need to re-align your car and break that wheel in again.

In my experience, if a wheel will not spin for at least 20 seconds, then something is wrong. It's not performing at the level it should if you want a winning car. If you have done everything correctly, your wheels might spin for longer, up to 34 seconds.

For more information on David Meade, see page 8.



Pre-race your car to break in the wheels, axles, and graphite—simply spin the wheels with a Dremel tool or your finger.



Choosing the Design

Follow these basic guidelines to give your car the winning edge

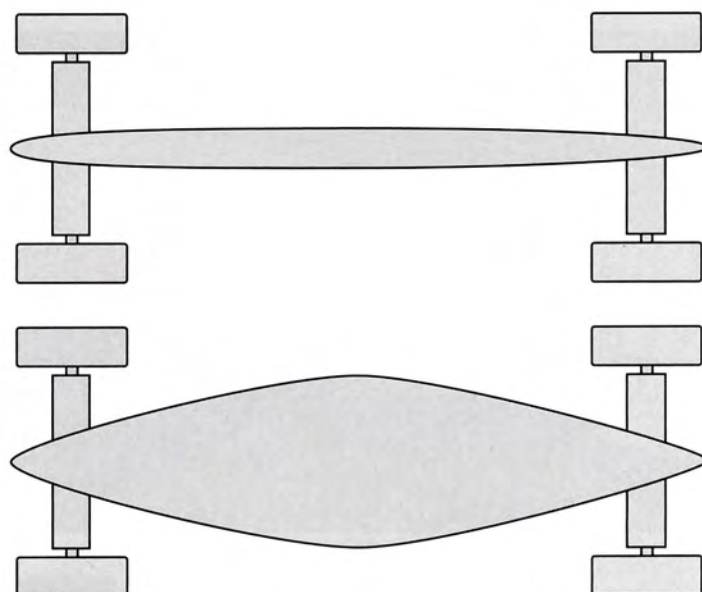
By David Meade

The number of possible shapes and designs that can be applied to Pinewood Derby cars is endless. While some designs inherently possess the features that make them faster, it is possible to take a standard design and improve it by making small changes. If your child has his heart set on a design that isn't inherently fast, you can use these tips to maximize the design's potential. Remember to let your child help design the car. This isn't your car. It's his.

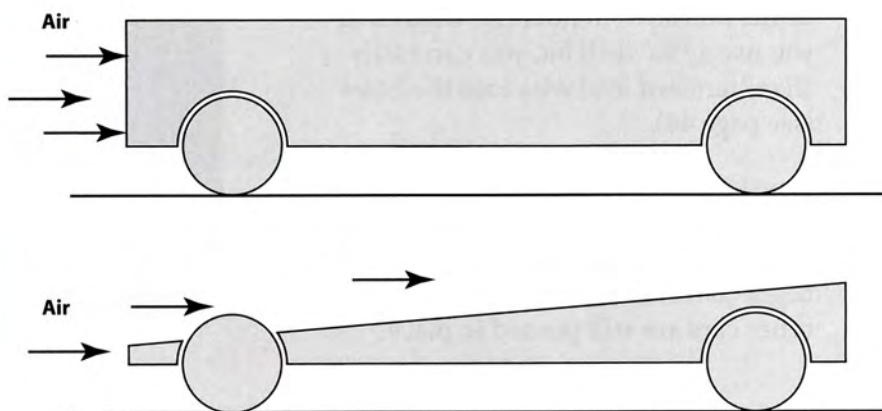
The Basics

- The dimensions of your car must remain within the width, height, length, and weight specifications listed in your Derby rules. You will find the official Boy Scouts of America (BSA) specifications in your car kit as well as on page 26.
- Do not select a design with a pointed nose. A pointed nose will make it difficult for your car to rest on the pin at the starting gate. It may cause your car to get bumped around when the pin drops and it can create problems for electronic timing systems. In most cases, electronic timers require something that is at least $\frac{1}{4}$ " in width before the system will detect it. A car with a very pointed nose may not trip the timer until an inch or so of the car has passed the sensor.

This wedge design is aerodynamic and maximizes weight placement by removing wood from the front and center of the car.



Pointed-nose designs, such as these, can cause problems with the pins at the starting gate and with electronic timing systems.

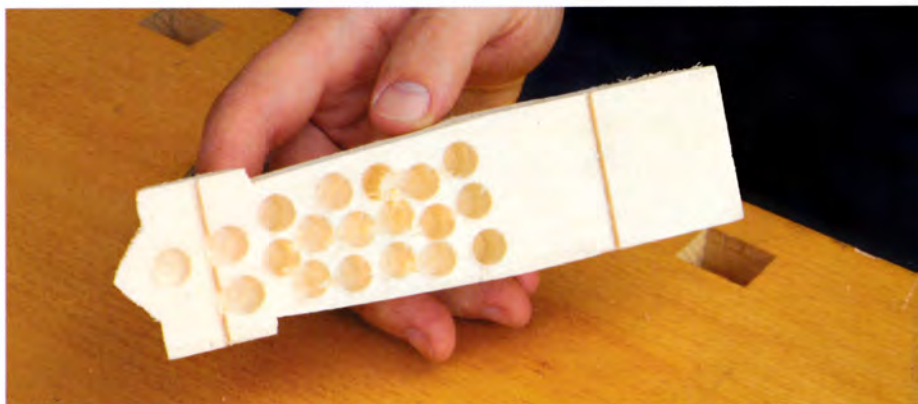


An aerodynamic design allows the air to move over and around the car body in a smooth manner. The most basic aerodynamic design is the simple wedge (bottom). If you don't have a lot of time available, the wedge is a proven design used by many Pinewood Derby winners.

- Be sure it is very clear which end of your car is the front and which is the back. In many races, the officials place each car on the track. I've seen situations where they put the car on the track backward because they couldn't tell which end was which.

Maximizing Speed

- Choose an aerodynamic design. In other words, choose a low sleek design that allows the air to move over and around the car body in a smooth manner. Cars with aerodynamic profiles go faster.
- Shift the weight from the middle and front by removing as much wood from those areas as possible. Cut out the sides so the car resembles a wrench or drill large holes down the middle—but remember to leave enough wood in the back to place the weights.

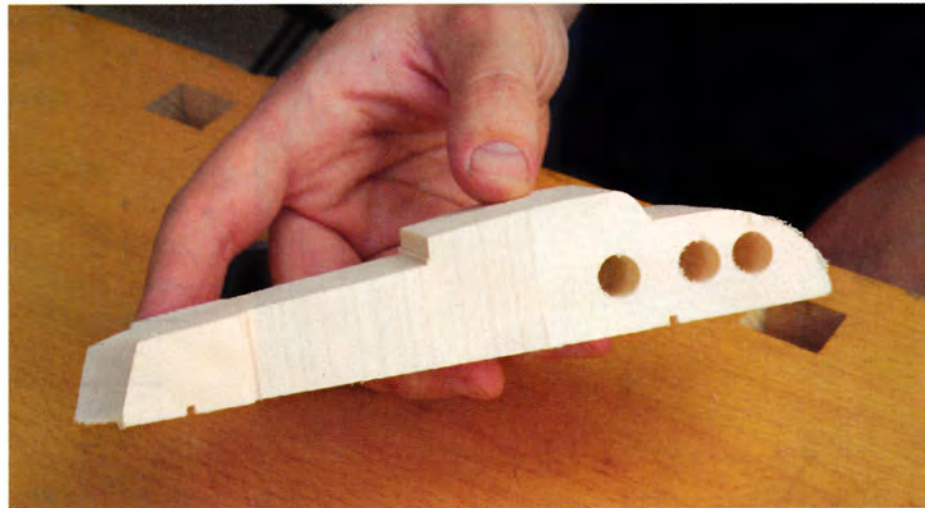


Improve the performance by drilling out the wood in the center of the body.

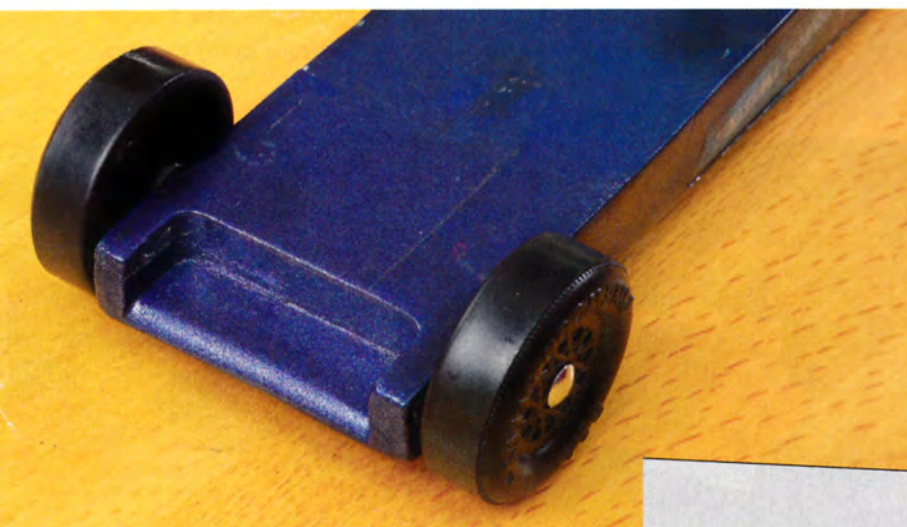


A bar placed on the bottom of the car, as seen on the left, does not maximize the weight placement. Focus the weight by drilling holes in the rear car body, as seen below, and filling them with weights.

- Cars with most of their weight in the rear go faster. Your design needs to leave enough wood at the back of the car so you can drill holes—either from the side or the bottom—to hold the weights. If you use a $\frac{25}{64}$ " drill bit, you can easily slide standard lead wire into the holes (see page 44).
- Consider a quick-start design—undercut the nose of the car. As soon as the starting pin drops below the thin lip, your car will begin to roll down the track while the other cars are still pinned in place.

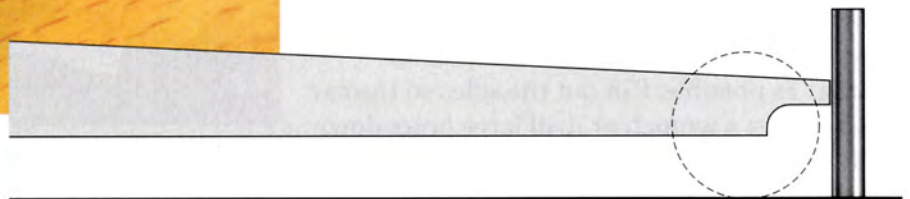


For more information on David Meade, see page 8.



Undercut the front to give the car an advantage on the starting line.

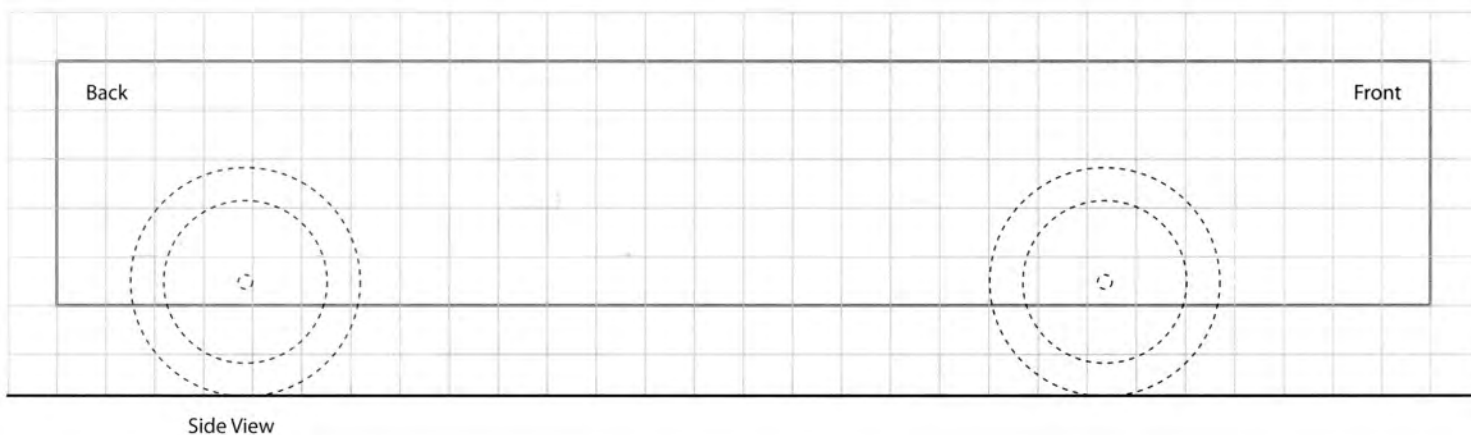
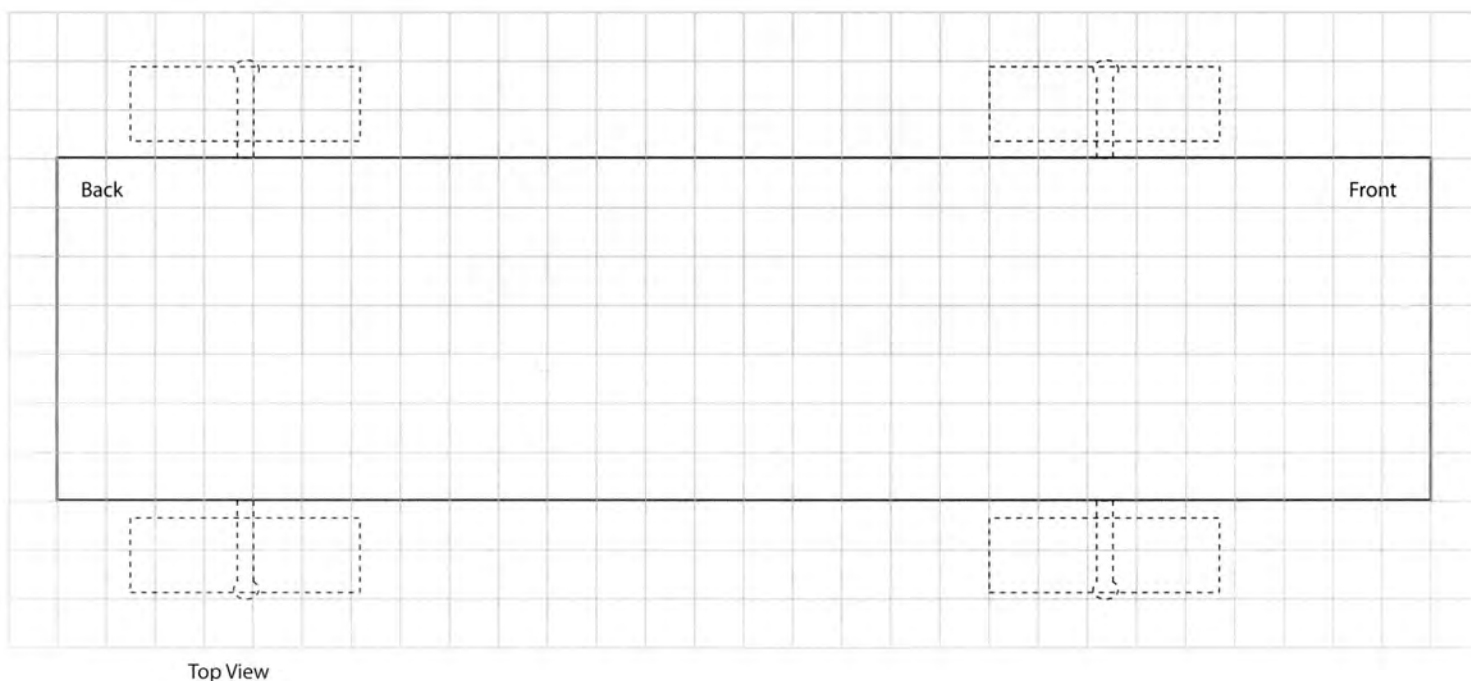
When viewed from the side, you can see how the undercut gives your car a competitive edge.



Design Worksheet

Sketch your own pattern for a truly custom car

This template shows the size and configuration of the wood block included in the Official Grand Prix Pinewood Derby Kit. Use the template to design your own car. Photocopy this page so you can experiment with different designs and then use your favorite design as a pattern to create your car.



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Weight Matters

The best way to choose, place, and attach weights

By David Meade and Troy Thorne

Weigh all the parts of your car. Add weights to the scale until the total combined weight is about 4.8 ounces.



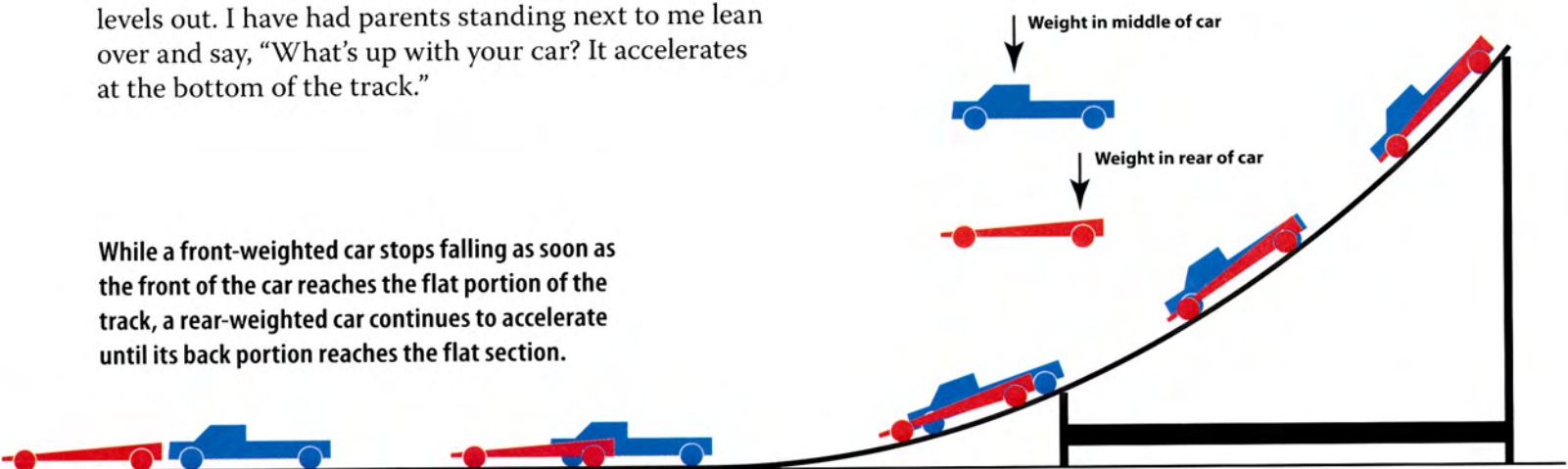
The two most important rules dealing with weight and weight placement are, 1) the heavier your car is, the faster it will go, and 2) rear-weighted cars go faster. By placing the weight in the rear of the car, you increase the potential energy of the car when it's at the starting gate. In other words, you have a larger gravity engine propelling your car down the track.

Observing the Effect of Rear-Weighted Cars

The effect of placing the weight in the rear of the car is actually observable. Rear-weighted cars will appear to accelerate at the bottom of the track where the ramp levels out. I have had parents standing next to me lean over and say, "What's up with your car? It accelerates at the bottom of the track."

While a front-weighted car stops falling as soon as the front of the car reaches the flat portion of the track, a rear-weighted car continues to accelerate until its back portion reaches the flat section.

What really happens is that a front-weighted car stops accelerating as soon as the front of the car reaches the flat portion of the track. It's no longer falling. From that point on, the car is slowing down. A rear-weighted car will continue to accelerate until the back of the car reaches the flat portion of the track because the car falls until all of its mass is located on the flat portion of the track.





Types of Weights

You can use different types of weight for your Pinewood Derby car, including lead, tungsten, and zinc. Lead works best because of its high weight-to-mass ratio, its availability, and its variety of sizes and shapes. Fishing sinkers, such as split shot and egg-shaped sinkers, are a good source of lead and are widely available. Lead wire is also available. It is easy to insert into drilled holes. Lead wire is easier to use than split shot, but harder to find.

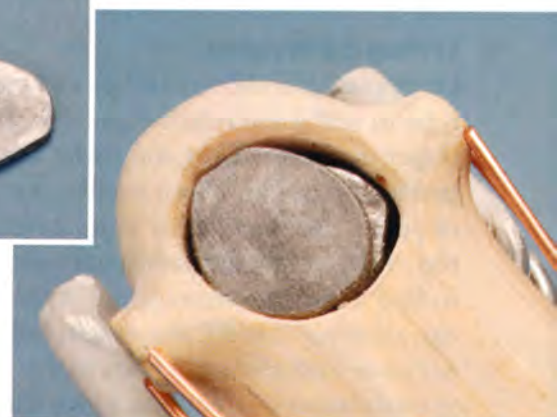
Tungsten is much denser than lead and does not have lead's toxic properties. Though it can be very expensive, tungsten is also ideal for adding weight to very thin cars. Zinc weights are about half as dense as lead. If you use zinc weights, you will end up putting some of your weight toward the front of the car because the amount required is so great. Weight in the front of the car will reduce speed.

Use lead wire or sinkers, or tungsten cylinders, for the main weights. Use split shot, tungsten disks, or tungsten putty for your final weight adjustments.

If you choose lead, remember it is a toxic substance. Never melt or sand lead. Wear latex gloves or be sure to wash your hands thoroughly after you handle lead. Keep lead out of the reach of children.

Placing the Weight

We've seen the advantage of putting the weight in the rear of the car. However, if you put the weight too far back, your car will pop a wheelie as it goes down the track, or it might even jump off the track. You want to place about a third of the weight behind the rear axle and two-thirds just in front of the axle.



If you use lead sinkers, flatten them, then trace one onto the bottom of the car over and in front of the rear axles. Use a Dremel or similar tool to drill a deep hole that will fit all of the weights.

You can accomplish this by drilling holes in the sides or bottom of the car near the rear axle. If you are using lead wire or tungsten cylinders, drill three $\frac{25}{64}$ " holes on each side of the car. If you are using egg-shaped sinkers, either insert them into holes in the sides of the car or pound them flat and trace them onto the bottom of the car, then use a Dremel or similar tool to create one large hole to hold all of the weights. Note that the latter method will not work on a thin car.

If you don't have access to a drill, glue the weights to the top of the car. If you decide to add a toy driver to the car, be sure to place him near the back to add weight in the correct location.

You will need a way to adjust the weight. Drill an additional $\frac{3}{8}$ " wide by $\frac{3}{16}$ " deep hole just in front of the rear axle and a second one near the nose so you have a place to put extra weights on race day.

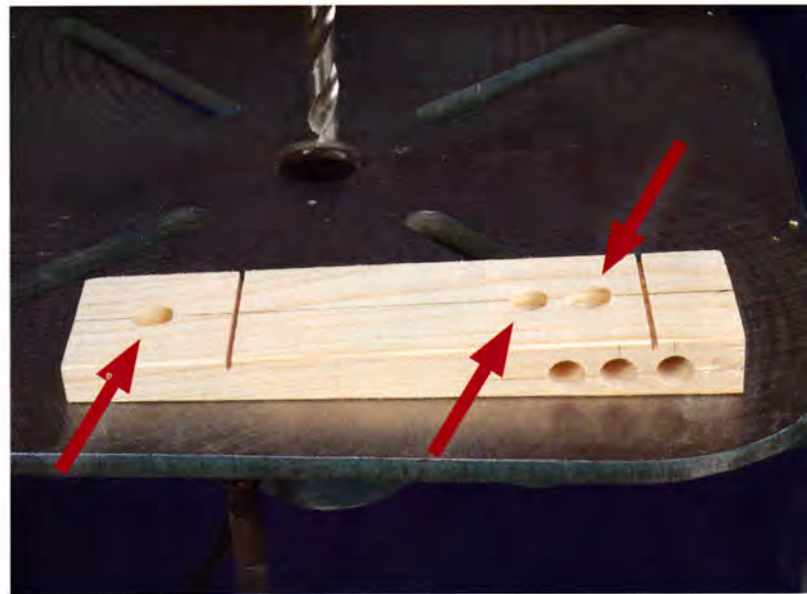
At this stage, add weight up to 4.8 ounces, which leaves 0.2 ounces for paint and decals. Weigh all of the parts of your car. If you don't have a small digital scale, you can take the car to your local post office and ask them to weigh the car. Add lead or tungsten to the scale until the weight is about 4.8 ounces.

Check your weight placement by finding the balance point, or center of gravity, of your car. Add the weights and use masking tape to hold them in place. Then locate the center of gravity of your car by placing it on a thin piece of wood, a ruler, or a wooden dowel. Slowly move your car back and forth until it balances. Ideally, the balance spot should be $\frac{3}{4}$ " to 1" in front of the rear axle. You'll need to continue checking the center of gravity throughout the process of adding weights to ensure the balance point remains in the correct place.

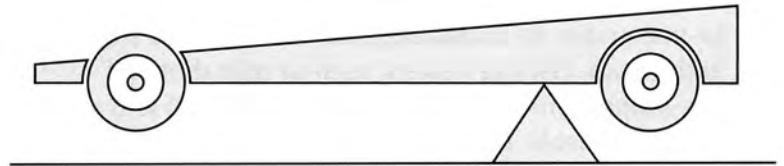
Sealing the Weights

Once you have chosen and placed your weights, it's time to seal them into the car. Put the weights in their respective holes. They should be about $\frac{1}{16}$ " below the surface of the car. Mix a small amount of wood filler or putty. Use the filler or putty carefully—if you have too much weight at the official weigh-in, you'll have to find a way to remove some. Apply the putty to the car, allowing it to fill the weight holes. Then, set the car aside and allow the filler to dry according to the manufacturer's directions. Once the filler dries, sand it flush with the car. Start with a file and then use 220- or 400-grit sandpaper. Wipe off any dust with a soft cloth.

For more information on the authors, see page 8.



Drill additional shallow holes in the car bottom for final adjustments.



Check the center of gravity by balancing your car on a thin piece of wood, a ruler, or a wooden dowel. A properly weighted car should balance $\frac{3}{4}$ " to 1" in front of the rear axle.



To seal the weights into the car, fill the holes with putty. This is also a good time to fill any nicks or scratches in the car body. Once the filler has dried, sand it flush with the car.

Spray Painting Made Simple

Six easy steps to a flawless finish

By David Meade and Troy Thorne



You have designed, cut, and sanded your car. Now it's time to paint and decorate it. This is a great place for your child to express his creativity. Spray paint creates a smooth even color and can be the final finish or a base for decals or stickers (see page 54). If your child prefers to paint by hand, see the instructions on page 48. Whatever method you choose, it's important to start with a well-prepared car. Before painting, sand the car with progressively finer grits of sandpaper until all surfaces are smooth.



1



2



3



4



5



6

PREPARING THE CAR

1. Cover the wheel wells. Cut painter's tape to fit over the car's axle areas. You don't want paint clogging the holes and causing friction.

2. Prime the car. Set up a paint area using a cardboard box and two pencils. Place the car inside of the box, on top of the pencils. Following the manufacturer's instructions, spray the car with a thin even coat of primer and let it dry.

3. Sand the primer. Using 0000-grade steel wool or 400-grit wet/dry sandpaper, lightly sand the primer coat. Wipe the car with a soft cloth to remove the dust and grit.

APPLYING THE FINISH

4. Apply the paint. Spray the car with a thin even coat of paint. Begin spraying to the side of the car and then sweep the paint past it about 6" to 8" from the surface, releasing the nozzle when you are past the car. If your child is spraying, teach him that several light coats are better than one heavy coat, which can result in drips. Let the paint dry for thirty minutes.

5. Sand the paint. Lightly sand the car with 0000-grade steel wool or 400-grit wet/dry sandpaper. Then wipe the car with a soft cloth.

6. Finishing painting. Apply a second and third coat of paint, lightly sanding between coats. After the third coat, let the car dry for at least two hours. If you are done decorating the car, apply clear coat to seal the car. However, if you plan to add decals or stickers, apply clear coat after you affix them.

MATERIALS:

- Cardboard box
- Spray paint: primer, main color, and clear finish (all the same brand)
- Painter's tape
- 0000-grade steel wool or 400-grit wet/dry sandpaper

materials & tools

TOOLS:

- Scissors
- Two pencils
- Soft cloth

*For more information on
the authors, see page 8.*

Creating a Custom Finish



Use handpainting or airbrushing techniques to create a unique racer

By Margaret Riley

Adding color, stripes, and patterns can really make your car stand out. There are few rules regarding the decoration of a racer, so this is a good chance for your child to take the lead and let his imagination run wild. Be sure to check your local rules before painting; if they require an unpainted car bottom, cover it with painter's tape before you begin.

Before painting your car, be sure it is sanded perfectly smooth. Wipe the surface with a soft cloth to remove dust.

Cover your workspace with newspaper. To contain overspray, turn a large cardboard box on its side and set the car within the box.

Always wear a mask so you don't breathe paint fumes and spray. If desired, elevate the car on small blocks of wood so it doesn't stick to the paper and to make it easier to paint all the way down the sides.

Have your child practice on a piece of cardboard or scrap wood before painting his car. Teach your child that several thin coats of paint are better than one thick coat. You can use any brand of paint. However, don't mix brands. Mixing brands can cause chemical reactions that ruin your paint job. If this happens to your car, you will need to sand it down to bare wood and start again.



HANDPAINTING

Handpainting your car provides countless options, limited only by your imagination. I use spray paint for the basecoat, but you can hand paint the basecoat. For complete instructions on spray painting the basecoat, refer to page 47. Use quality paintbrushes and apply a white basecoat before painting light colors on top of a dark background. I recommend Testors® brand paint.

Gather all of your materials, including tracing paper, pencils, scissors, paint, and paintbrushes before starting to paint your car.

HANDPAINTING: PREPARING TO PAINT DETAILS



1

Apply the primer and basecoat. Apply the primer coat using acrylic spray primer or a 1" foam brush and white paint. Cover the car with a thin coat, allow the paint to dry thoroughly, and then lightly sand the primer with 400-grit sandpaper. Wipe the car with a soft cloth. I use metallic deja blue spray paint for the basecoat. Lightly coat the car. Allow the paint to dry for 30 minutes. Repeat coats until the primer no longer shows through. Let the final coat dry for at least 2 hours.



2

Prepare the patterns. Sketch out several options until you are happy with the design. Trace the individual elements of the design onto tracing paper. Carefully cut out each piece. When the paint is dry, trace the pieces onto the car. Do not press too hard when tracing the designs. You don't want to leave an indentation in the car.



3

Basecoat the pattern areas. Using a #12 shader brush, paint all of the pattern areas white. Use light coats and repeat as necessary. Basecoating with white will enhance the brightness of the colors since the background color is dark.

HANDPAINTING: PAINTING THE DESIGN



4

Paint the main elements. Using a #4 round brush for narrow areas, such as the points on the stars, and a #4 shader for larger areas, such as filling the center of the stars, paint the main elements of the design. I added the yellow stripe at this point because I had yellow on my brush and I want the yellow stripe to dry before painting adjoining stripes.



5

Paint the secondary elements. Using a brush appropriate for the size and shape of the design, paint the remaining elements. I use a #4 shader brush to paint black checks around the cockpit edge and along the back edge of the car. I use the same brush to paint the rest of the stripes on the back and side of the car.



6

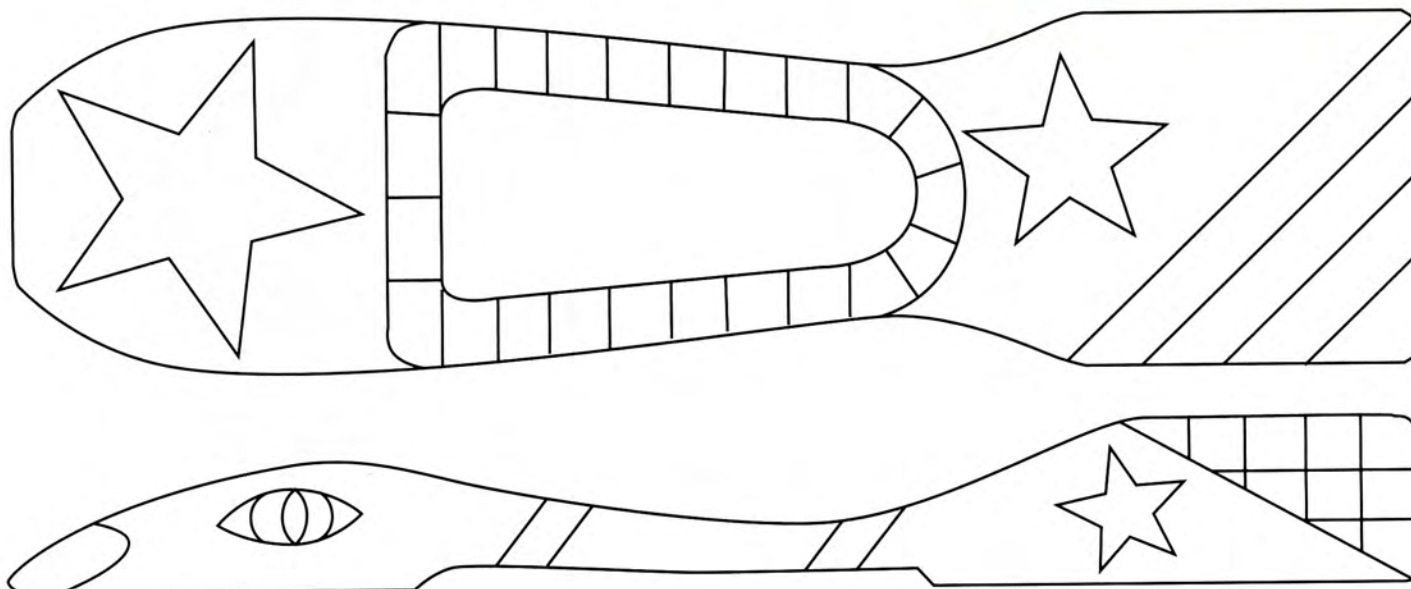
Add the accents. I use a #4 round brush to paint the eyes. Use a liner brush to paint fine details, such as a white line around each star and the green stripes. A liner brush is excellent for adding a number or letters to the car. Use a toothpick to add tiny dots, such as the highlight on the eye.



7

Finish the car. Allow the paint to dry overnight, and then spray a thin layer of clearcoat on all of the surfaces.

Handpainted car patterns



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AIRBRUSHING

An inexpensive airbrushing system and homemade stencils make it simple to create fun and unique patterns on your car. It's easy to fill in shapes and blend colors, and the spray dries quickly so multiple coats are no problem. There are several methods you can use to create airbrush stencils. I use Frisket Film, which is a transparent masking film with an adhesive backing. Frisket Film is easy to peel and leaves no residue on the car.

To create an airbrushed finish, you will need an airbrushing system, paints, and Frisket Film or some type of masking/stencil system.

AIRBRUSHING: PREPARING TO AIRBRUSH



1

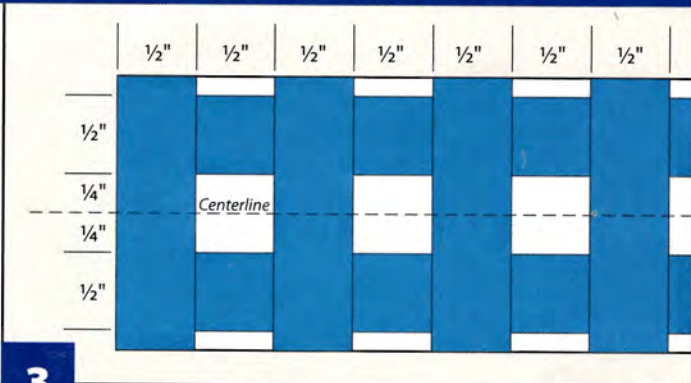
Basecoat the car. Follow the manufacturer's instructions to use the ColorArtz system or your choice of airbrush. Using white wedding (white), spray the car and allow it to dry completely. Lightly sand the paint with sandpaper. Wipe with a soft cloth to remove the sanding dust. Spray the car with white wedding again and let the car dry.



2

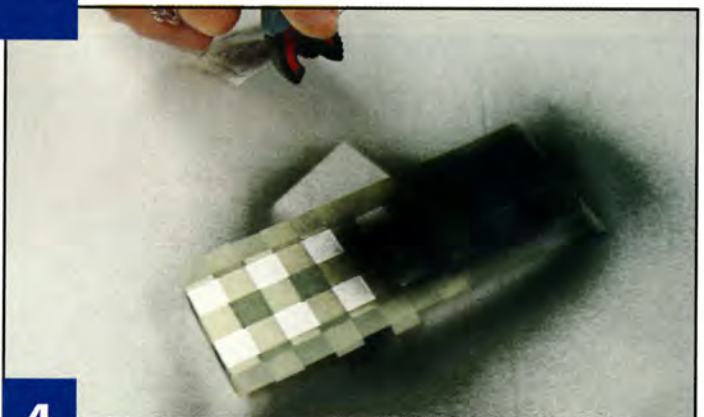
Make the stencils. Sketch out several designs and decide on your final painting pattern. Lay a piece of Frisket Film over the pattern. Using a fine-tip permanent marker, trace each airbrush pattern separately. Allow enough space between designs to prevent overspray. Use a hobby knife to cut the openings of the individual pattern elements on the Frisket Film.

AIRBRUSHING: PAINTING THE TOP



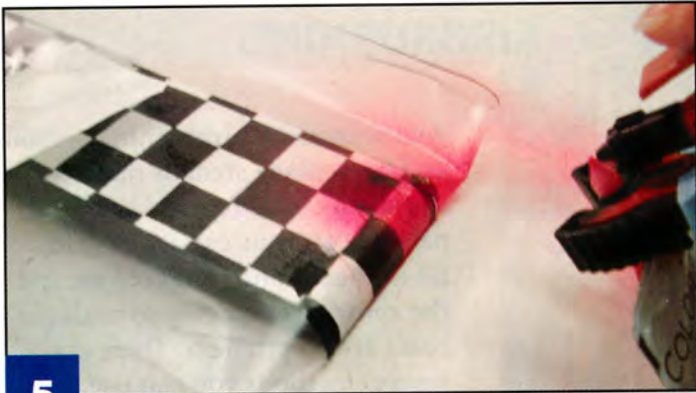
3

Paint the first checks. Locate the centerline of the car. Apply two 1/2"-wide strips of masking tape lengthwise down the car. Position the strips 1/4" out from either side of the centerline. Place a strip of 1/2"-wide masking tape across the width of the car closest to the front. Continue running strips across the car in 1/2" intervals. Spray the top of the car with black tie (black). Let the paint dry and remove the masking tape.



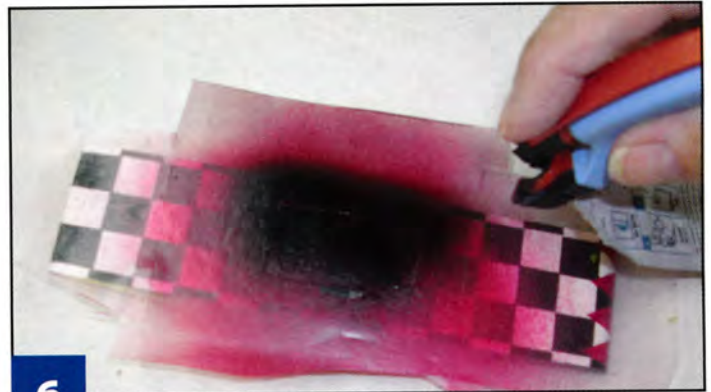
4

Paint the remaining checks. Apply 1/2"-wide strips of masking tape in a criss-cross pattern, covering the opposite areas from Step 3. Spray the top of the car with black tie to create the checkerboard effect. Cover the stripe areas on the sides of the car with masking tape. Turn the car over and paint the sides, back, and bottom (if allowed) with black tie. When the paint is dry, remove the masking tape.



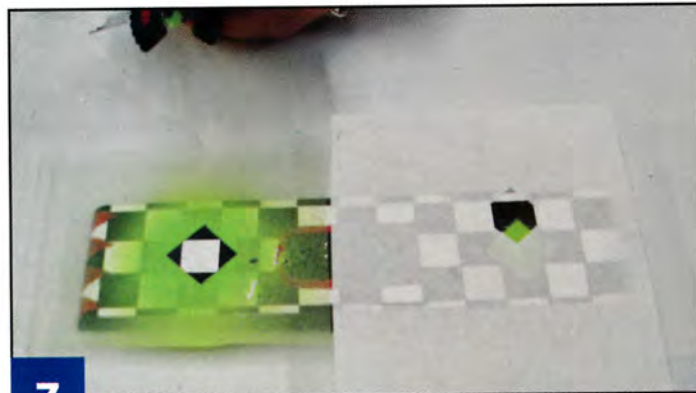
5

Paint the zigzag. Apply the zigzag design cut out of the Frisket Film to the car front and press firmly. Use Frisket Film or a paper towel to cover the rest of the car and prevent overspray. Spray the zigzag with atomic atomique (red). Let the paint dry. You may need multiple coats to cover the black checks. Remove the masking and stencil. If the paint bleeds under the Frisket Film, squeeze some paint out of the pouch and touch up with a small brush.



6

Paint the cockpit. Position the larger cockpit stencil on the car and press the film firmly in place. Spray with red and let dry. Position the smaller cockpit stencil in the center of the red cockpit you just painted and press it firmly in place. Spray with black, let the paint dry, and remove the stencil and any covering you used to protect against overspray.



7

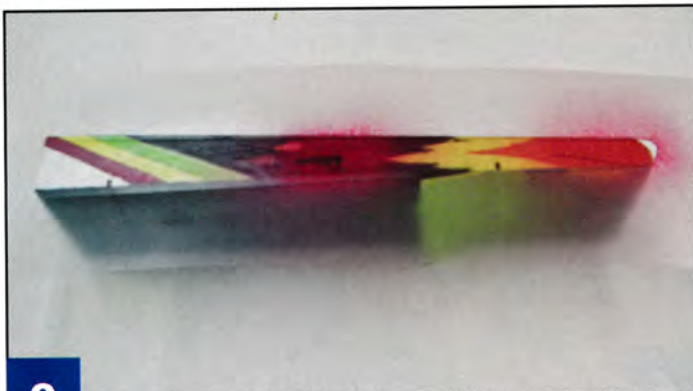
Paint the diamonds. Position the Frisket Film with the diamond cut-outs on the car and press firmly. Spray with gremlin (green). Several coats may be required; let the paint dry between coats. Repeat the process for the second diamond, and then remove the stencils. Use a small paintbrush to touch up the checkerboard pattern if necessary.

AIRBRUSHING: PAINTING THE SIDES



8

Paint the stripes. Cover the top of the car with a paper towel or Frisket Film. Cover the black areas of the sides with Frisket Film. Spray the stripe area with blonde ambition (yellow). Let the paint dry. Apply Frisket Film so only the red stripe area shows. Spray with red and let the paint dry. Carefully remove the Frisket Film from the green stripe area and cover the yellow and red stripes. Spray with green. When dry, remove the masking from the sides only.



9

Paint the flames. Position the stencil for the yellow flame on the side of the car and press it firmly in place. Spray, using numerous light coats of paint and drying between coats. Press the stencil for the orange flame in place, paint with mango tango (orange), and then press the stencil for the red flame in place and paint the red. Allow a little of each previous color to show through so the flame colors blend together.



10

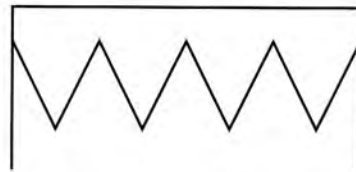
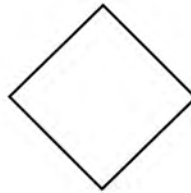
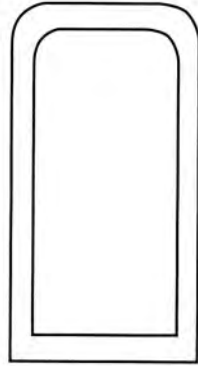
Finish the car. Remove all of the tape and masking materials. Spray the entire car lightly with clearcoat.

Airbrushed car patterns

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Cut 2 cockpit
stencils, one larger
and one smaller



materials & tools

HANDPAINTING MATERIALS:

- 400-grit sandpaper
- Tracing paper and pencil
- Testors One Coat Lacquer: 1836M deja blue or your choice of color
- Model Master Custom Lacquer System: ultra gloss clearcoat
- Testors Acrylic Project Paint: white, black, green, orange, red, yellow
- Toothpick
- Optional: Acrylic spray primer

HANDPAINTING TOOLS:

- Soft cloth
- Scissors
- Brushes (Loew-Cornell, La Corneille, or similar): 7300 Shader 4, 12; 7040 Round Stroke 4; 7050C Script Liner 10/0; 1" foam brush

AIRBRUSHING MATERIALS:

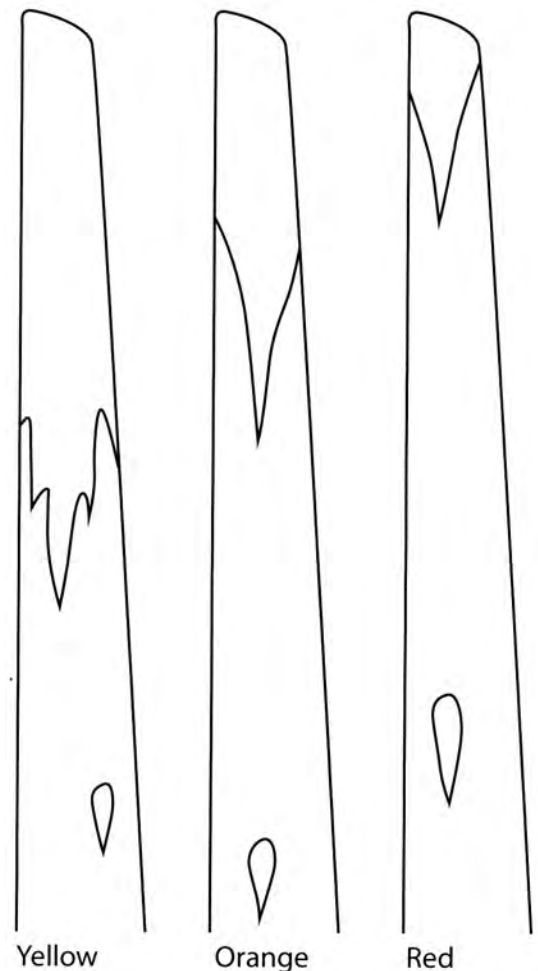
- ColorArtz Paint Pouches: atomic atomique (red),

black tie (black), blonde ambition (yellow), gremlin (green), mango tango (orange), white wedding (white), or your choice of paints for use with your airbrush

- 400-grit sandpaper
- Model Master ½"-wide masking tape
- All-purpose matte Frisket Film (lightweight adhesive stencil plastic)
- Paper or paper towel
- Fine-point permanent marker
- Model Master Custom Lacquer ultra gloss clearcoat

AIRBRUSHING TOOLS:

- Ruler
- Scissors
- ColorArtz Airbrush and Aerosource (canned air or propellant) or your choice of airbrush system
- Soft cloth
- Hobby knife
- Small paintbrush



About the Author

The author of many books and magazine articles about crafting, Margaret Riley has also owned two craft and hobby stores; designed, demonstrated, and taught for numerous craft companies; and assisted with the filming of craft-related television shows. A resident of Tallahassee, Fla., Margaret enjoys cooking, gardening, and camping. Contact her at designs.by.margaret@comcast.net.

Applying Decals

Complex decorations are easy with stickers, decals, and rub-ons

By David Meade and Troy Thorne



Stickers, decals, and dry-transfer decals are easy ways of adding complex patterns and interesting designs to a car. These easy-to-use accessories are a great way for your child to express his creativity. Stickers are adhesive, so they simply stick to the car. Decals are activated by water. Dry-transfer decals, sometimes called rub-ons, are rubbed until the design adheres. Stickers, decals, and rub-ons are readily available at craft and hobby stores, or you can create your own using your scanner and printer, plus commercial sticker, decal, or rub-on transfer paper. (See Resources on page 112.)

Be sure to apply stickers and decals after painting the car, but before attaching the wheels. After adhering the decorations, spray the car with a thin layer of clear coat to keep them in place.

LARGE DECALS



1 Choose the decal. After painting your car, let your child choose a decal and trace the shape of the car onto the back of the decal.



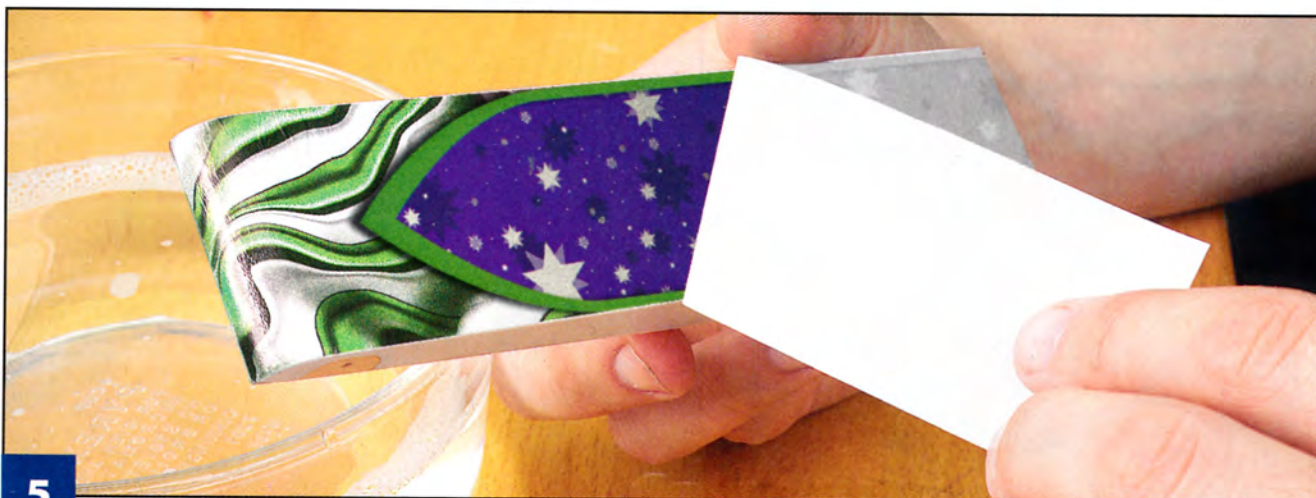
2 Cut out the decal. Using scissors, cut out the decal and remove the protective sheeting.



3 Fit the decal. Fold the decal over the car and trim as necessary.

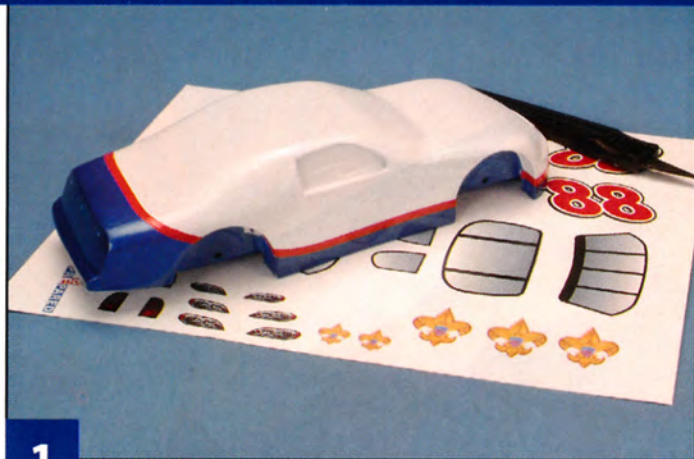


4 Wet the decal. Use a sponge to rub water onto the decal, soaking it through.



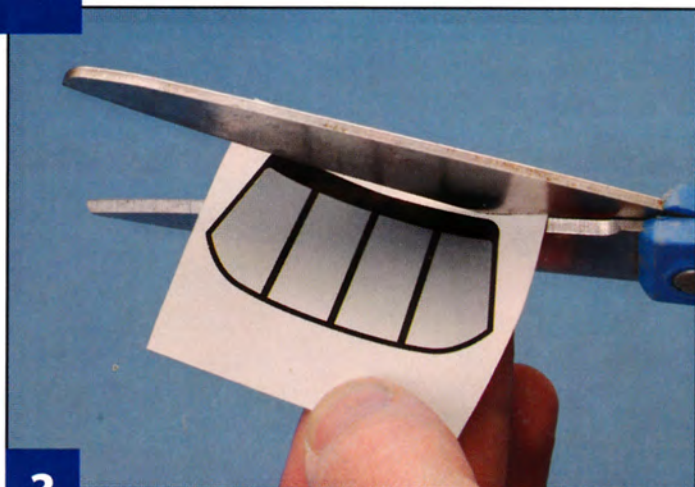
5 Remove the backing. Peel off the backing and gently rub out any wrinkles with your fingers or the sponge.

SMALL DECALS



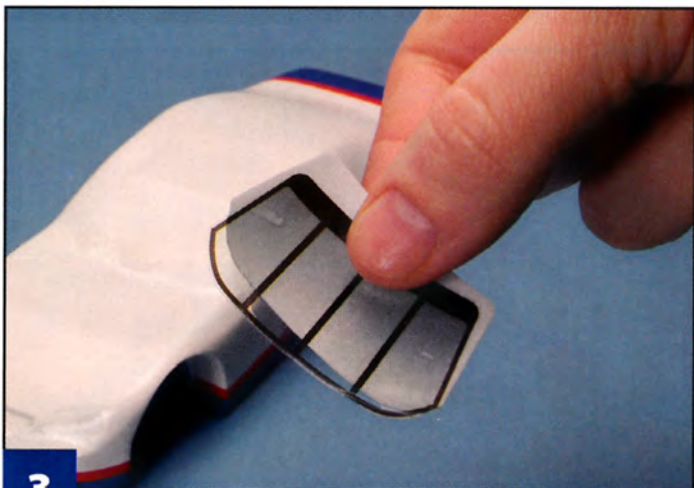
1

Choose the decals. After painting your car, let your child choose accent decals or print out custom decals.



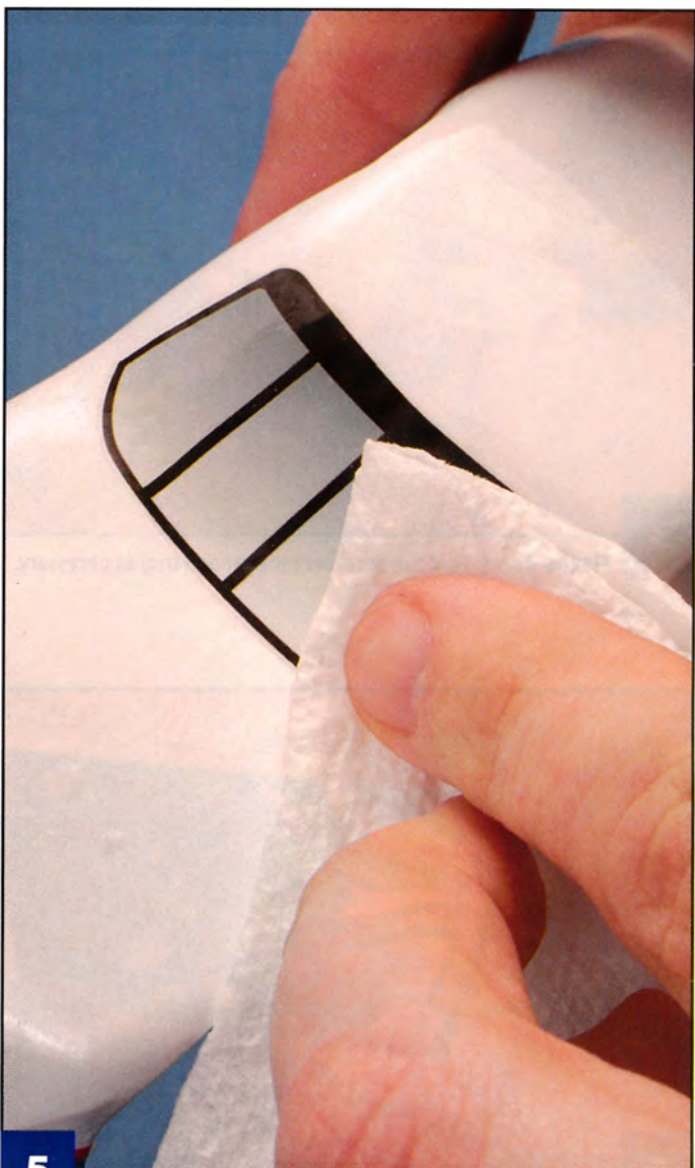
2

Cut out the decals. Trim around each decal with scissors, leaving about $\frac{1}{16}$ " all the way around.



3

Wet the decal. Soak the decal in a bowl of warm water. It will roll up and then slowly unroll in about thirty seconds. After that, the decal will slide off of the backing material. Slightly slide the decal off of the backing.



5

Blot the decal. Use a paper towel to press the decal onto the car body.



4

Position the decal. Position the decal on the car and slowly finish sliding the backing material away.

DRY-TRANSFER DECALS



1

Choose the dry-transfer decal. After painting your car, let your child choose a dry-transfer decal.



2

Cut out the decal. Using scissors, trim the decal to size. Remove the paper backing and position the decal on the car.



3

Rub the decal. Hold the decal securely in place. Then, use any smooth object, such as a craft stick, credit card, or bone folder, to burnish or rub the decal onto the car.



4

Remove the backing. Remove the overlay by peeling it off slowly at a steep angle.

For information about the authors, see page 8.

All About Axles

Properly prepare your car's axles to reduce friction and increase speed

By David Meade

All Official Pinewood Derby axles have burrs under the head. Remove the burrs and polish the axles to increase the speed of your car.

Correctly preparing your axles is the single most important thing you can do to increase the speed of your car. Remember, friction is the enemy of speed. The largest source of friction is the contact made between the axles and the wheels. However, there are several methods you can use to fight friction and make your car a winner.

This is a great place for your child to do a major portion of the work—just be sure to teach principles as you work. It's important that he understands why he is performing each step in the building process.

Choose the Best Axles

Bent axles affect the alignment of your wheels. If you use axles that are curved or bent, your wheels will wobble as they go down the track. Unfortunately, there's no such thing as a straight axle that comes directly out of the box—but some axles are much straighter than others.

The difference between a good axle and a bad axle is not normally visible to the naked eye. Using a drill press or a handheld drill, however, we can find the best axles of the bunch.

AXLES: CHOOSING THE BEST



1

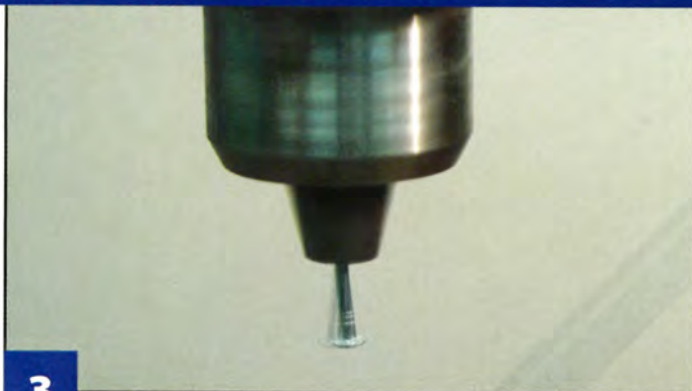
Start with choices. In order to find a good set of straight axles, you need to start with about twenty raw axles. To get additional axles, buy extra axle/wheel sets. Use only official Pinewood Derby axles for pack races.



2

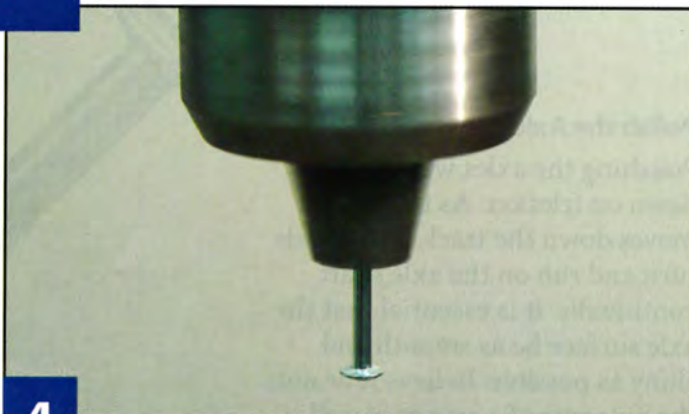
Establish a uniform clamping position. We'll be testing each axle in a drill and need to make sure we compare the axles consistently. Mark each axle $\frac{1}{2}$ " down from the pointed end with a permanent marker.

AXLES: CHOOSING THE BEST



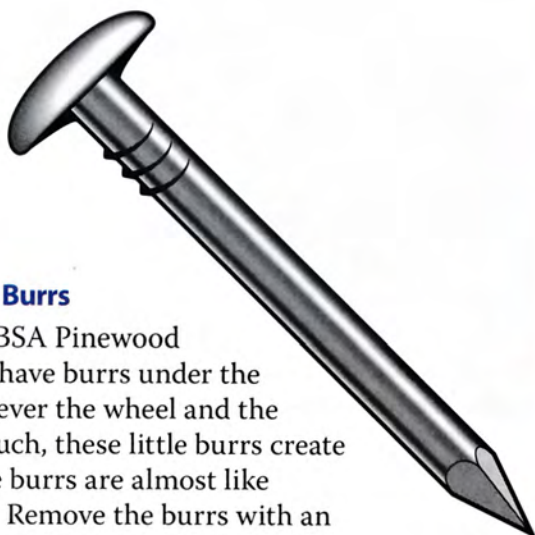
3

Discard the bent axles. Clamp a power drill in a vise or use a drill press. Insert one axle into the drill or drill press, clamping the axle at the previously marked location. Turn the drill on medium to high speed and observe the spinning axle. Bent axles will wobble as they turn in the drill.



4

Select the best axles. Relatively straight axles will wobble only a little. Please note that all axles will wobble to some degree. The idea here is to pick the four axles that appear to wobble the least. These will be the four straightest axles. If you start with twenty axles, you will be able to find four that are quite good.



Remove the Burrs

All Official BSA Pinewood Derby axles have burrs under the head. Whenever the wheel and the axle head touch, these little burrs create friction. The burrs are almost like mini brakes. Remove the burrs with an electric drill and a small triangular file to reduce friction.

AXLES: REMOVING THE BURRS



1

Clamp the axle in a drill. Clamp a drill in a vise. Insert an axle into the drill, leaving about 1/2" of the axle exposed. Be sure the axle is tightly secured in the drill.



2

Remove the burr. Turn the drill on medium to high speed. Using a triangular file, remove the burrs. Put only light pressure on the file so you do not damage the axle.



3

Inspect the axle. The finished axles should look like the axle on the bottom. The burrs are removed, but the area is rough from the triangular file. Remove the burrs on all four axles.

Polish the Axles

Polishing the axles will also cut down on friction. As the car moves down the track, the wheels turn and rub on the axle shaft continually. It is essential that the axle surface be as smooth and shiny as possible. Believe it or not, the outcome of a race may well depend upon who does the best job polishing axles.



AXLES: POLISHING THE AXLES



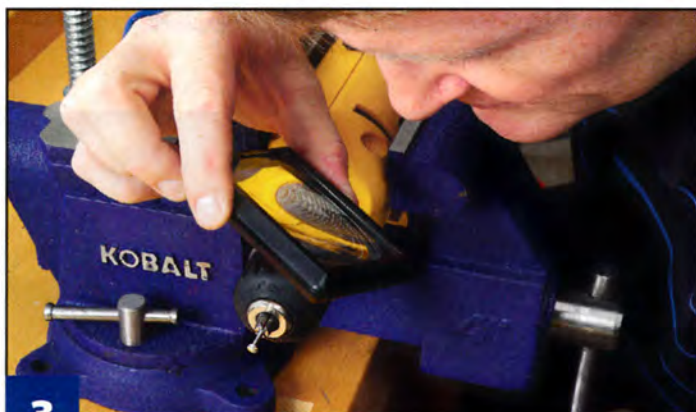
1

Prepare the sandpaper. Have a number of different grits of wet/dry sandpaper on hand. Select a sheet of 400-grit sandpaper to start, and cut a small strip about 1/4" wide and 4" long.



2

Sand with 400-grit sandpaper. Turn the drill on medium to high speed. Dip the strip of sandpaper into a small dish of water, and then apply the sandpaper to the axle. Be sure to sand the entire axle, including the inside surface of the head. This step should take about 15 seconds.



3

Inspect the axle. Turn off the drill. Look at the axle with a good magnifying glass. Are there any deep scratches left? If so, turn the drill back on and polish some more. Do not move to the next step until all of the deep scratches have been removed.



4

Sand with progressive grits of sandpaper. Repeat Steps 2 and 3 several more times using 600-, 1000-, 1200-, 1500-, 2000-, 2500-, and 3000-grit sandpaper. Look at the axle with a magnifying glass after each step to be sure the axle shaft is as smooth as it can be. Repeat Steps 1 through 4 to polish all four axles.

For more information on David Meade, see page 8.

Winning Wheels

Prepare and lubricate the wheels correctly to put your car ahead of the pack

By David Meade

Official BSA wheels, straight out of the box, sometimes have divots, bubbles, or other abnormalities that will reduce the speed of your car. To have a competitive car, you must remove these defective features and sand the wheels until they're smooth.

Many people either don't prepare the wheels for their cars or make mistakes that cause problems during the race. Used correctly, these methods will help your car speed past the rest.

PREPARING THE WHEELS

Choose the Best Wheels

BSA wheels are manufactured using a 16-mold plastic injection process. Wheels are numbered 1 to 16. The mold number associated with each wheel is stamped on the backside of each wheel. The last time I did an in-depth comparison, wheels from die molds 3, 8, 12, and 15 were better than other wheels. These wheels are usually defect free and tend to be more round than other wheels.

You can purchase extra wheels at your local Scout Shop or from www.scoutstuff.org. Sort through the wheels and use those from mold numbers 3, 8, 12, and 15 to build your car.



The BSA mold number is indicated on the backside of the wheel. Molds 3, 8, 12, and 15 have been known to produce the most defect-free wheels.

The BSA recently modified their wheels. The wheels shown in this article are the older style, however, it is still important to sort through the wheels to choose the best wheels for your car.

PREPARING: SMOOTH THE WHEELS

Remove the defects on stock wheels by sanding them using a wheel mandrel. This handy tool is available at most BSA Scout Shops or at www.scoutstuff.org, which offers a search engine to help you find your local BSA retailer. Do not attempt to sand the wheels without using a wheel mandrel. You will only create problems for your car.



1

Mount the wheel. Attach a wheel to a mandrel. Then, place the mandrel in an electric drill or a Dremel tool. If you choose to use a drill, clamp it in a vise. Do not tighten the vise so much that you damage your drill.



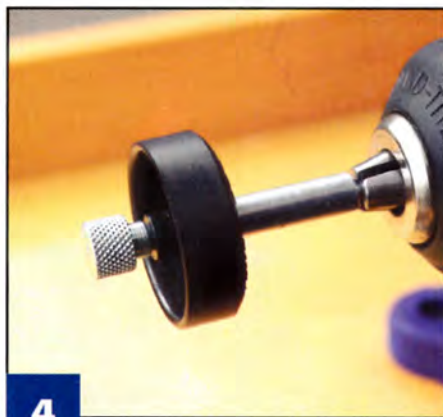
2

Prepare the sandpaper. Attach a small sheet of 600-grit wet/dry sandpaper to a flat block of wood or a sanding block. Apply water to the sandpaper to make it moist.



3

Smooth the wheel. Turn on the drill or Dremel tool and allow the spinning wheel to gently rub against the surface of the sandpaper. Add more water to the paper when it starts to look dry. The plastic will become hot and actually melt unless you keep the sandpaper damp and maintain minimal pressure. (Too much pressure can deform the wheels.)



4

Inspect the wheel. Sand until the mold bubble is gone and the perimeter of the wheel looks smooth.

PREPARING: SMOOTH THE INSIDE RIMS

As your car rolls down the track, the inside wheel rim will occasionally make contact with the center guide rail, so you need to make the inside rim as smooth as it can be. Polishing the rim will reduce friction.



5

Mount the wheel. Attach the wheel to a wheel mandrel and then spin the wheel using a power drill or a Dremel tool.



6

Smooth the rim. Gently sand the inside wheel rim using 400-, 600-, and then 1000-grit sandpaper. Repeat Steps 1 through 6 for all of the wheels.

PREPARING: POLISH THE WHEEL BORES

Though some of the other methods for polishing the wheel bore sound good, this one is the best.

Selecting a proper pipe cleaner is very important. The best ones can only be found at a tobacco store, but you can also try your local craft store. The right pipe cleaners have cotton fibers and fit snugly into the wheel bore. Choose pipe cleaners that are soft but firm. Don't use the stiff bristly type of pipe cleaners because they will damage your wheels.



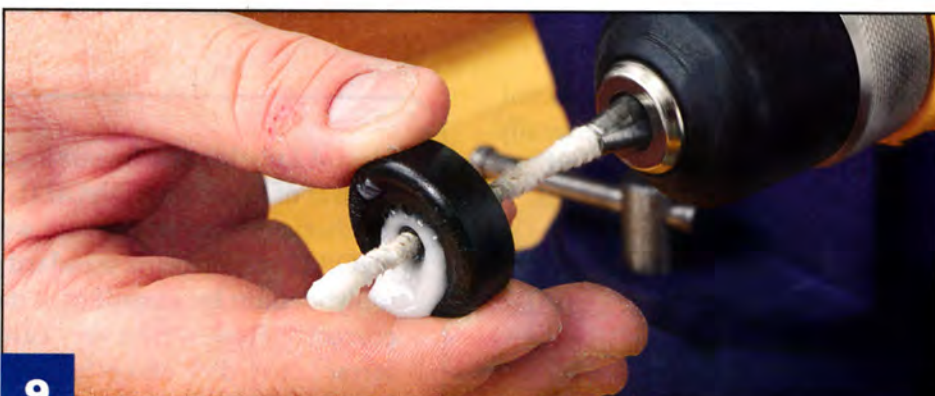
7

Mount the pipe cleaner. Secure the drill in a vise, being careful not to make it too tight. Cut a 5" section of pipe cleaner and place it through one of the wheels. Insert and secure the pipe cleaner in the drill.



8

Apply the toothpaste. Push the wheel toward the drill and coat the pipe cleaner with whitening toothpaste. Whitening toothpaste contains a fine abrasive polish.



9

Smooth the bore. Hold the wheel between your fingers and turn on the drill using medium speed. Slowly move the wheel up and down the pipe cleaner as it spins. Polish each wheel for about 45 seconds. Don't over-polish; 45 seconds will do just fine.



10

Wash the bore. Turn off the drill and remove the wheel from the pipe cleaner. Using warm water and a clean pipe cleaner, wash the wheel thoroughly. Be sure to remove all of the toothpaste from inside the wheel bore.



11

Dry the bore. Using another clean dry pipe cleaner, dry the inside of the bore. Do not leave any water droplets inside the bore. If water droplets remain, they may leave residue behind as they dry. Repeat Steps 7 through 11 with all four wheels.

LUBRICATING THE WHEELS

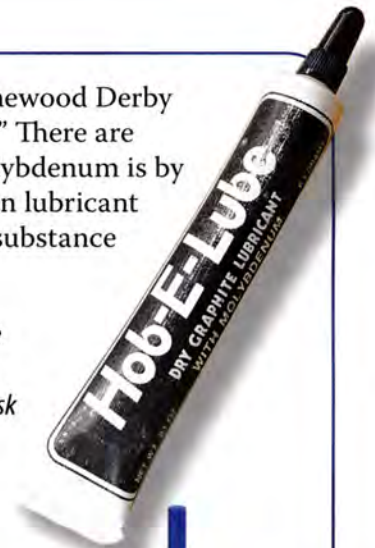
The second principle of speed is *reduce friction* (page 36). In order to convert as much potential energy into speed as possible, you need to eliminate as much friction as possible. One of the best ways to eliminate friction is to lubricate the wheels wherever they touch the axles and car body. There are three main areas to apply the lubricant: to the car's "wheel well," to the wheel, and inside the wheel bore. Apply lubricant to the wheel well and the wheels first, then attach the wheels and apply lubricant to the wheel bore.

Dry vs. Liquid Lubricant

There are several types of lubricant to choose from. These are generally classified as either dry or liquid lubricants. Be sure to check with your local race official to find out what types of lubricant are allowed. Apply lubricants after the car has been painted but, in most cases, before it is assembled.

Dry Lubricants: The Official Grand Prix Pinewood Derby rules state, "Only dry lubricant is permitted." There are several dry lubricants, but graphite with molybdenum is by far the most widely accepted and time-proven lubricant for Pinewood Derby cars. Molybdenum is a substance that acts like microscopic ball bearings.

The instructions that follow assume you will use graphite as a lubricant. Because graphite particles are very light, they can easily be inhaled. Remember to wear a dust mask and safety goggles whenever you work with graphite. Also, graphite tends to get all over everything; to prevent a mess, cover your work surface with newspaper or work outside.



Liquid Lubricants: If your local rules allow the use of liquids, try NyOil II, a refined synthetic oil that works very well in Derby cars. NyOil II outperforms standard graphite with molybdenum by a significant margin when used correctly. However, be very careful. Liquids attract dust, dirt, and other particles. Mix any liquid with dirt and you get a paste that will act like cement in your axles. Avoid letting dust or other particles get inside your wheel bore.



LUBRICATING: LUBRICATE THE WHEEL WELLS

One of the highest friction spots on your car is the small area where the wheel hub rubs against the car body. Every time contact is made in this area, you lose speed. Make the wheel well area as smooth as possible by first sanding and then lubricating the area.



1 **Protect the wheel wells.** Before painting the car, cut some painter's tape to fit over the axle holes on your car. You don't want paint or anything else clogging the holes and adding friction.



2 **Sand the wheel wells.** Once the paint is dry, remove the painter's tape and lightly sand all four wheel well areas with 600-grit sandpaper.



3

Apply lubricant. Use painter's tape to cover the area around the wheel well to keep the paint clean. Apply the graphite to a smooth piece of cloth and gently rub graphite into the wood around the axle hole area. Continue to apply graphite until the area looks as smooth as it can be. Lubricate all four wheel wells.



4

Check your work. Use a magnifying glass to be sure you don't have any big scratches or bumps. If you do, sand them down and reapply the graphite. Once you are happy with the area, remove the tape.

LUBRICATING: LUBRICATE THE WHEELS

Proper lubrication of the wheels reduces friction and maximizes performance. In addition to the following steps, you should lubricate your wheels while you are breaking them in (page 39) and take lubricant with you on race day.



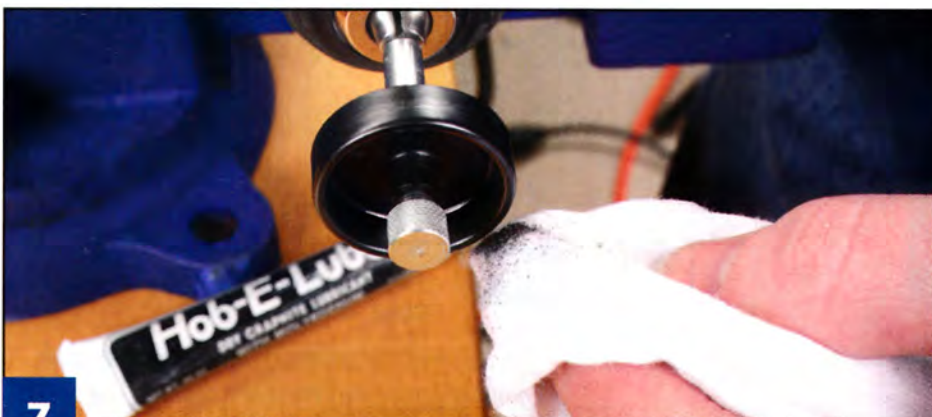
5

Lubricate the wheel hubs. Using a soft cloth, rub graphite into the tapered edge of the wheel hub.



6

Inspect the hubs. The final product should look like the wheel in the photo. Lubricate all four wheel hubs.



7

Lubricate the inside rim. Chuck the wheel on a wheel mandrel and insert the mandrel in a drill or Dremel. If using a drill, clamp the drill in a vise. Rub a small amount of graphite onto a soft piece of cloth. Turn the drill on low. Using a soft cloth and graphite, polish the inside rim of all the wheels.



8

Lubricate the wheel. Apply more graphite to the soft cloth and polish the wheel surface that will come in contact with the track. Polish all of the wheels until they shine.

ATTACHING THE WHEELS

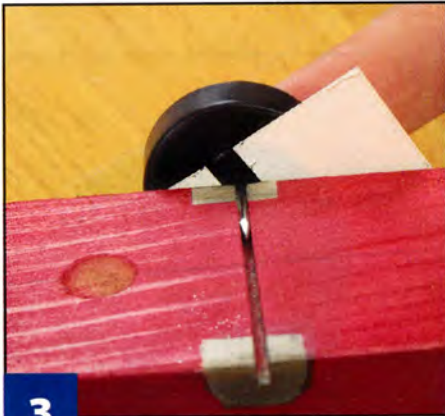
If you leave too much space between the wheel and car body, your wheels will shake and wobble as they turn. If you put the wheels too close to the body, the wheel hub will rub against the car almost the entire way down the track. So, we need to get the spacing right. The correct amount of space to leave between the wheel and the car body is $\frac{1}{32}$ ". Before attaching the wheels, construct a wheel spacer to ensure proper spacing.



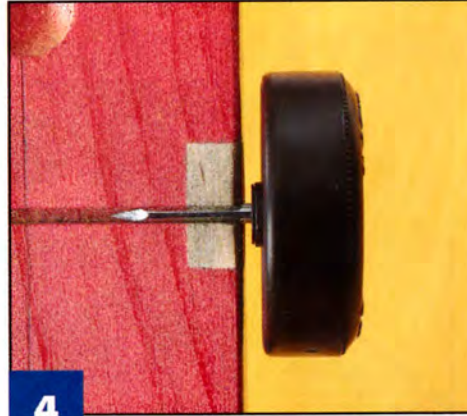
1 Assemble a spacer. Glue two or three business cards together (enough to equal a thickness of $\frac{1}{32}$ ") with white glue. Use a tape measure or ruler to make sure your stack of cards is the proper thickness.



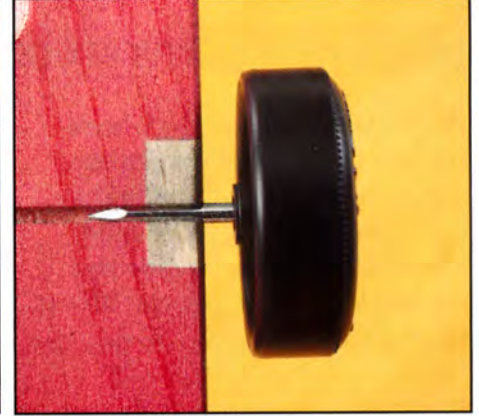
2 Cut a notch for the axle. Cut a small notch approximately $\frac{1}{8}$ " wide by $\frac{1}{4}$ " deep in the top of the cards with scissors.



3 Attach the wheels. Attach each wheel to the car (they should stay in place without any type of adhesive). Use the wheel spacer to control the amount of space left between the wheel and the car body.



4 Check the spacing. The wheels should be spaced like the one in the photo on the left. The photo on the right shows an improperly spaced wheel.



5 Check the alignment. Once all four wheels are attached to the car, place the car on a flat surface. The kitchen table or a countertop will work well. Get on your knees and look directly underneath the car. Each wheel should be resting flat and square on the table. If any of the wheels are not flat and square, adjust them until all four wheels are properly positioned.

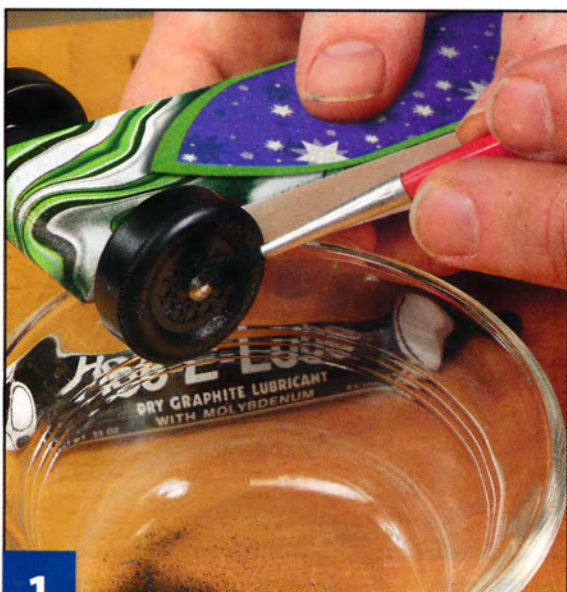


TIPS REMOVING GRAPHITE FROM PAINT

Though great for lubricating around the axle holes, graphite can get very messy if it comes in contact with the paint. If you accidentally get graphite on the paint, use a little WD-40® on a rag to wipe off the extra. Do not spray the WD-40 right on the car because it could ruin your paint job.

LUBRICATE THE WHEEL BORES

Lubricate the wheels after you fully assemble the car. Once the wheels have been attached, inserting graphite into the small space between the wheel and car body can be difficult. The best method is to use a small paintbrush to apply the graphite (the small brushes that come in watercolor kits work great).



1

Lubricate the wheel bores. Squeeze some graphite from the tube into a small dish. Dip the brush into the graphite and then gently transfer the graphite from the brush to the axle on the outside of each wheel. As you apply the graphite, gently shake or tap each wheel. This will help move the graphite down inside the wheel bore. Repeat the process on all four wheels.

For more information on David Meade, see page 8.



Adjusting Alignment

Fine-tune the wheel alignment for maximum performance

By David Meade

Proper wheel alignment is an important aspect of a competitive car. At the present time there are two methods being used for wheel alignment. The method discussed in this article is the straight alignment method. Its purpose is to align the wheels so the car travels in a straight line down the track and avoids contact with the center guide rail. The other method, known as the Rail Riding method, is discussed on page 72. Both methods have advantages and difficulties. This publication will help you select the alignment method that works best for you. The important thing to remember is that you need to align your wheels for top performance.

ALIGNMENT: MAKE A TEST TRACK



1

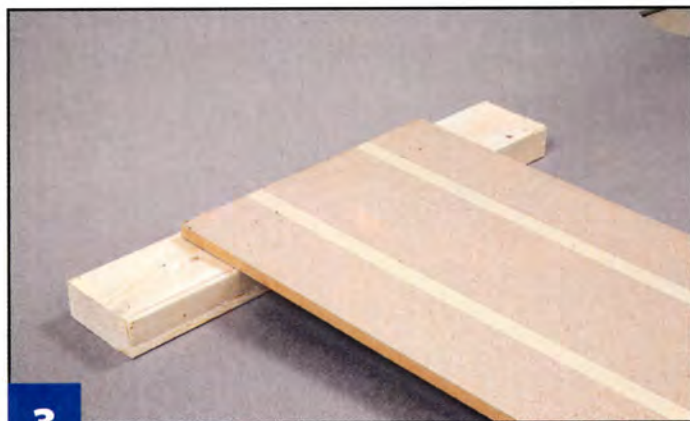
Create a ramp. Make an inclined ramp that is 7' to 10' long.

Use a sheet of plywood or a dining room table. Use two strips of masking tape to mark a straight path down the middle of the ramp. The path should be about 6" wide.



2

Make a safe stop. Place some pillows at the bottom of the ramp to stop the car. You don't want to risk damaging your car at this stage.



3

Angle the ramp. Prop the ramp up on a very slight angle. A

scrap 2 by 4 under one end works nicely. The angle does not need to be steep, just enough to get the car rolling.



4

Level the ramp. Use a 3' or 4' level to be sure the ramp is horizontally level. If the ramp is tilted right or left, the car will roll in that direction and you will not be able to accurately align the wheels.

ALIGNMENT: UP/DOWN ADJUSTMENTS



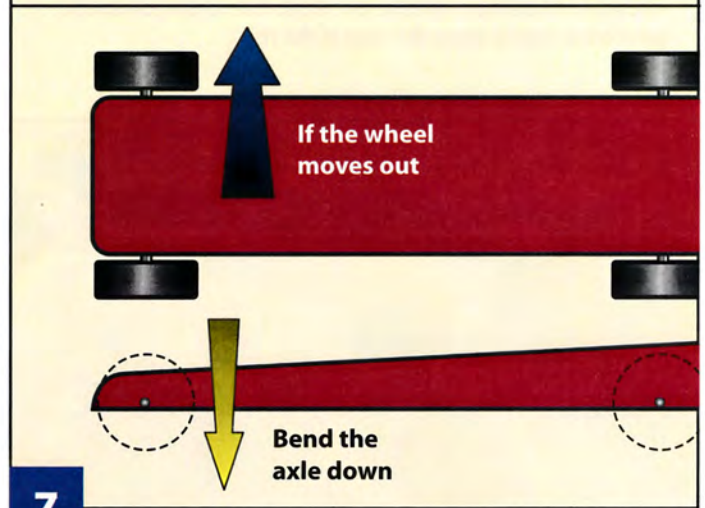
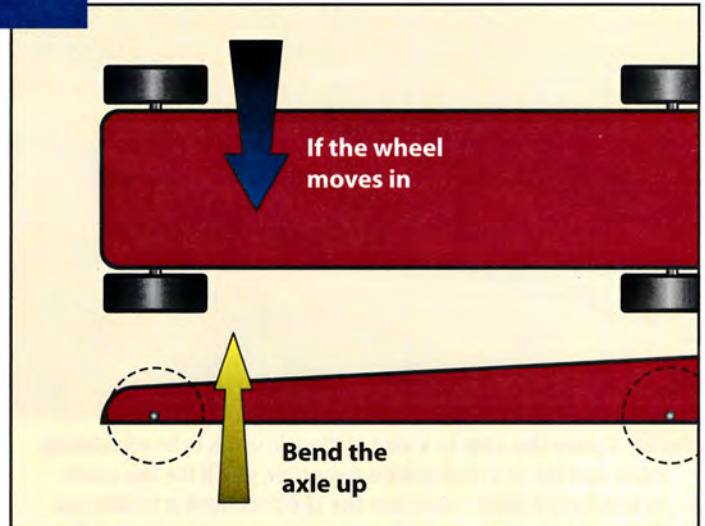
5

Position the car. Place the car at the top of the ramp. Make sure each wheel is centered in the middle of its axle. Let the car start rolling very slowly down the ramp.



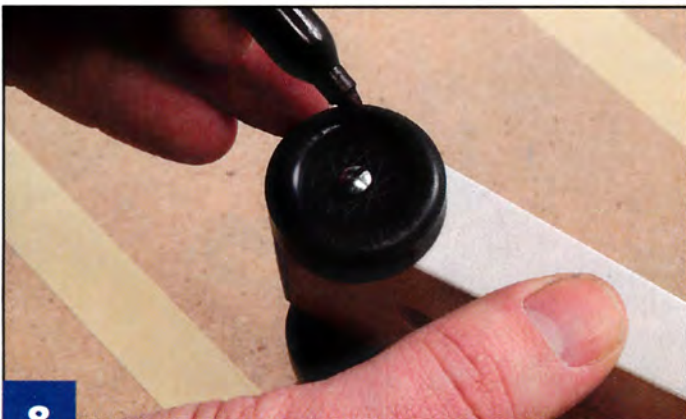
6

Observe the wheels. Allow the car to roll two or three feet, taking note of whether each wheel moves inward toward the car body, outward toward the axle head, or whether it just rolls in the middle of the axle. Repeat this process until you are confident you understand how each wheel is moving.



7

Determine how to adjust the axles. If a wheel moves in toward the car body, the axle needs to be adjusted up. If a wheel moves out toward the axle head, the axle needs to be adjusted down. The idea is to slightly bend the axle without bending the portion of the axle where the wheel rides.



8

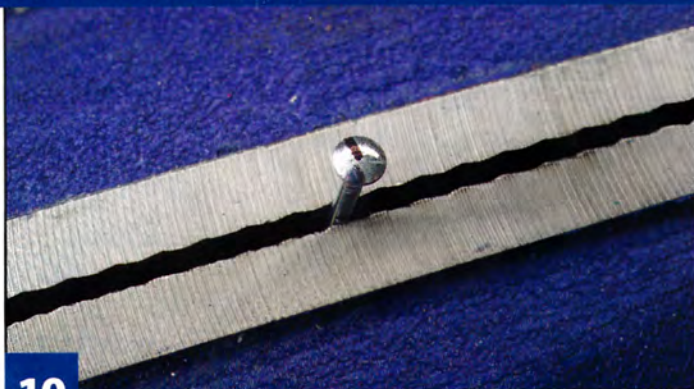
Mark the axle. Before removing the axle from the car body, place a mark on the axle at exactly 12 o'clock. This will ensure that you always know the original orientation of the axle. Also place a mark at the exact location where the axle meets the car body.



9

Remove the wheel and axle. Carefully remove the axle from the car body. Be very careful not to damage the wheel in the process. Remove the wheel from the axle and set the wheel aside.

ALIGNMENT: UP/DOWN ADJUSTMENTS



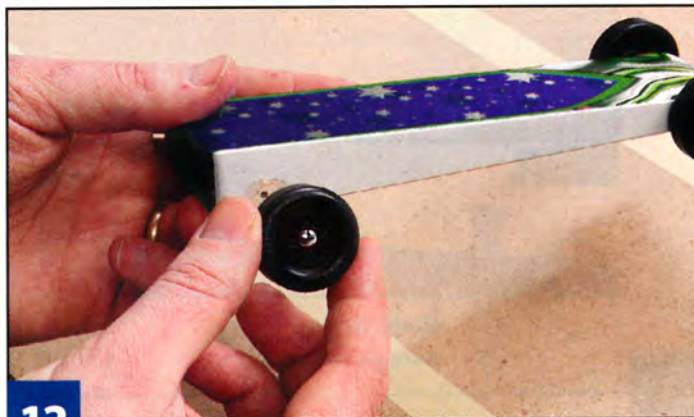
10

Clamp the axle in a vise. If the axle needs to be adjusted up, make sure the 12 o'clock mark is away from you. If the axle needs to be adjusted down, make sure the 12 o'clock mark is toward you. The mark indicating where the axle meets the car body should be positioned slightly above the edge of the vise.



11

Bend the axle. Place a flat regular screwdriver on the vise, squarely at the base of the axle, just below the mark. Gently tap on the screwdriver with a small hammer or rubber mallet. This will create a slight bend at the marked location. Don't bend the axle too much. Small adjustments are the key to the process.



12

Reinstall the axle. Remove the axle from the vise and reattach the axle and wheel to the car body. Be sure the 12 o'clock mark is pointing straight up and the axle is inserted into the car body to the proper depth as indicated by the mark on the axle.



13

Test the car again. Place the car on the ramp and allow the car to roll down the ramp two or three feet. If the wheel stays pretty much in the center of the axle, then you are finished with the up/down adjustments for that axle. If the wheel does not remain centered on the axle, repeat the adjustments and test again. There have been occasions when we repeated this process seven or eight times before everything was perfect.

ALIGNMENT: FORWARD/BACKWARD ADJUSTMENTS



14

Increase the angle of the ramp. Elevate the ramp so that, when released, the car will roll down the ramp at a fairly good speed. Be sure you have pillows at the end of the ramp. A 4 by 4 added on top of the 2 by 4 is usually sufficient.



15

Position the car. Place the car at the top of the ramp. Make sure it is lined up straight in the middle of the taped path.



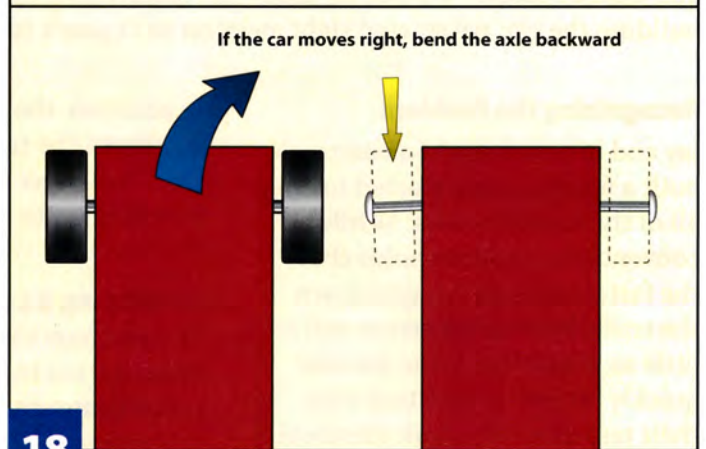
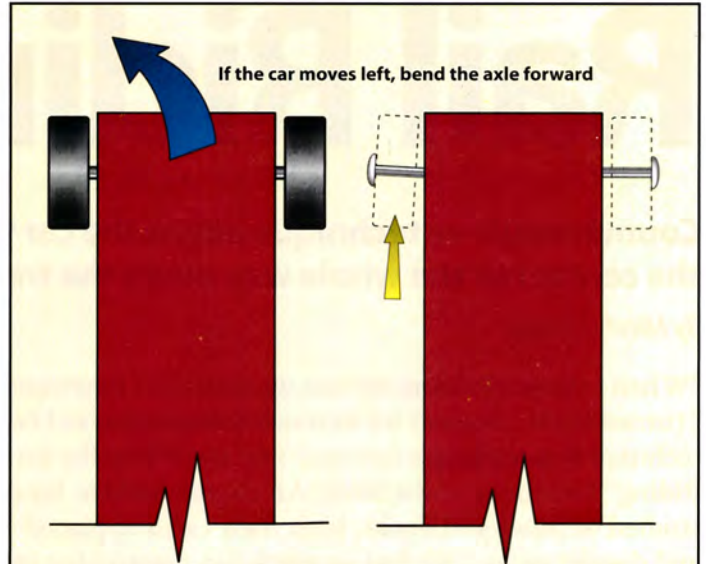
16

Observe the results. Release the car and let it roll all the way down the track. Did it stay within the taped path? Did it roll to the right or to the left? If it didn't roll straight down the middle of the path, then you need to make some adjustments to the front axles.



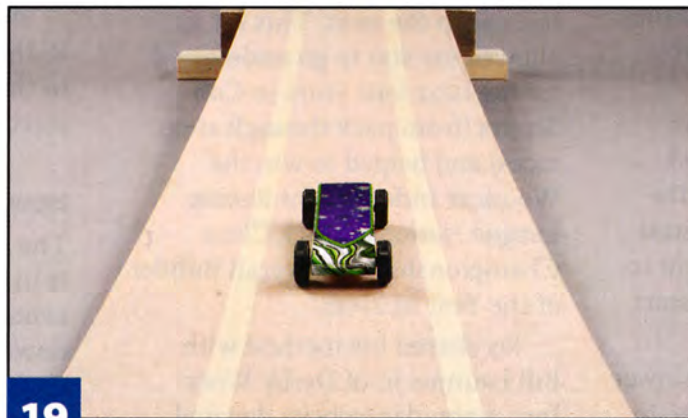
17

Identify which wheel is dominant. The dominant wheel is the wheel that is carrying most of the weight. Place the car on a flat level surface. Place your index finger directly on the front center of the car. Gently press down. As you press down, you will feel the car slightly shift toward one of the front wheels. The dominant wheel is the wheel in the opposite direction of the shift.



18

Adjust the axles. Check to be sure the dominant axle head has a mark located at 12 o'clock. Remove the axle and repeat the adjustment process described in Steps 8 through 12. However, this time you will be adjusting the axle forward and backward. If your car turns to the left as it rolls, then adjust the axle forward. If the car rolls right, then adjust the axle backward.



19

Lock the axles in place. Repeat this process until your car rolls straight down the ramp consistently five or six times. When all four axles are adjusted to perfection, you are ready to glue them in place. Turn your car over on its back and apply one or two drops of quick-drying cement or epoxy to the axle slots. Allow the glue to dry overnight before turning the car back over. Note: Do not use cyanoacrylate (CA) glue. Because it is very thin, CA glue tends to run down the axle and get on the wheel hub.

For more information on David Meade, see page 8.

Rail Riding™

Counterintuitive technique aligns the car to ride the center rail the whole way down the track

By Mindy Kinsey

"When I started helping my son with his first Pinewood Derby in 2001, I turned to the Internet for as much information as I could get on the techniques of making a fast car," said Jay Wiles, the inventor of the Rail Riding™ technique and a NASCAR engine builder. Jay and his son Jesse studied websites and books, built their car, and placed well in their pack and district races. "We had so much fun researching information and building the car, we started right away on next year's car," Jay said.

Recognizing the Problem

Jay and his son bought a test track, built a few cars, and started testing all of the basic theories. While conventional wisdom holds that the fastest cars go straight down the track, hitting the center rail as little as possible, Jay and his son quickly noticed a variation with their test cars. "We built identical cars, put the same wheels and axles on them, aligned them to go perfectly straight, and noticed a huge difference in time between the cars," Jay explained. "The fastest cars were always the most steady (no side-to-side oscillation), but some were markedly faster than others.

"I started watching the cars from the finish end of the track and from behind the track at the starting gate. I noticed the fastest cars didn't go straight, but went to the center rail soon after the start gate dropped."

Jay hypothesized that the slower cars were, despite their careful alignment, occasionally hitting the center rail, bouncing off, and then hitting the center rail with the opposite side. The back-and-forth motion, although slight, caused friction—a braking effect.

In addition, the motion effectively lengthens the traveled path of the car. The longer the path, the more time it takes to travel this distance.

Developing a Solution

To overcome the problem, Jay aligned a car to move immediately to the center rail and slide down the rail throughout the race. Although the method was counterintuitive, Jay said, "Through more testing we found riding the center rail was by far the fastest way to set up a car, and it could be easily duplicated from one car to the next. This set up allowed my son to go undefeated for the next four years in Cub Scouts (from pack through state races) and helped to win the Woodcar Independent Racing League National Stock Class Championship and overall Builder of the Year in 2005."

Jay shared his method with Bill Launius Jr. of Derby Worx Inc., a popular website devoted to building Derby cars. "I took the knowledge Jay shared with me about building a Rail Riding car and turned it into a tool that everyone can use to get easy repeatable results," said Bill. The

The inventor of the Rail Rider™ method, Jay Wiles, and his son, Jesse, after winning their district championship race several years ago.



duo has a patent pending on the resulting Rail Rider Tool™.

Bill recently used the tool to tune a friend's car at the last minute—and the car took second place out of 100 participants at the district race, beating three other cars also built in Bill's shop, but tuned on a test track using traditional methods.

As Jay said, "We believe Rail Riding is the single biggest change to the Pinewood Derby since the start of it 59 years ago!"

How the Rail Rider Method Works

The goal of the Rail Rider method is to cause the car to swerve to the center rail and hug it all the way down the track, eliminating the slight back-and-forth motion of even the best-aligned Pinewood Derby car and preventing the back wheels from ever touching the rail. While it's possible to adjust the car's axles by hand, it's faster and easier to use the Derby Worx Pro Rail Rider Tool.



The Rail Rider Tool has become one of the company's most popular products. "We received an unbelievable amount of e-mail from customers who could not believe how well their cars performed with a simple Rail Rider alignment," said Bill.

Implementing the Technique

If you intend to build a Rail Riding car, you need to plan ahead. Although you want one front wheel to touch the center rail, you do not want the rear wheels to touch the rail at all. Therefore, you need to create a slight wheel well indentation for the front wheel so it's closer to the center than the back wheel. Sand the wheel area until the car is $\frac{1}{16}$ " more narrow in the front than in the rear, on one side only. Then paint and lubricate the car as usual. Attach all four wheels, but only adjust the rear wheels. Remove the front wheels.

Next, you must raise one front wheel off of the track. Raise the

wheel opposite the indentation. The front wheel which still touches the track and will steer the car is called the dominant wheel. To raise a wheel using the standard axle slots, bend the axle slightly so the wheel raises off of the track.

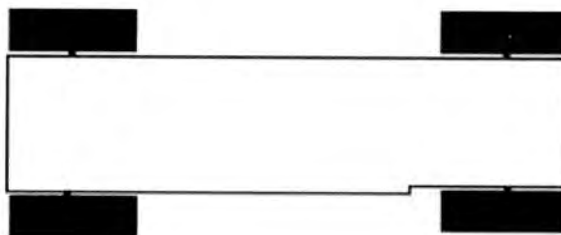
Before bending the dominant axle, use a permanent marker to put a dot on the axle's head close to the edge. Then, insert the axle into the Rail Rider Tool and follow the instructions to tap it with a hammer and set the 1.5° bend.

Install the front wheels on the car, ensuring the non-dominant wheel is raised and the mark on the bent dominant axle is in the twelve o'clock position. Tape a line down a table and roll the car down the line. The goal is for the car to gently drift approximately 1" away from the dominant wheel side over the course of a 4' roll. If the car drifts too far, use pliers to turn the dominant axle clockwise. If the

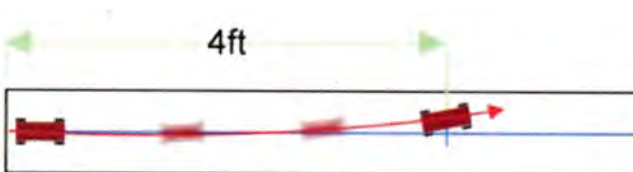
car doesn't drift far enough, or it swerves in the opposite direction, turn the axle counterclockwise. When you achieve the desired drift, use epoxy or cyanoacrylate (CA) glue, such as Super Glue, to fix all four axles in place. Be cautious with the CA glue, because it can run down the axle and lock the wheel.



To learn more about the Rail Rider™ method or tool, visit the Derby Worx Website at www.derbyworx.com.



In a Rail Rider car, the right-front portion of the car body is narrowed by $\frac{1}{16}$ ". That right-front axle is slightly bent to steer the car into the rail, while the left front axle is bent to lift the wheel off of the track.



The goal of Rail Riding is to steer the car so it drifts into the rail and slides along it throughout the race. During testing, a properly tuned car should drift about 1" to the left over the course of a 4' run.

Making a Basic Wedge Car



Step-by-step instructions for a competitive racer your child can build himself

By Troy Thorne

Although this car isn't fancy, it is a competitive racer. The project is simple enough so a child can build both the car and his confidence. Your child will be proud and excited to race a car he built, and he will learn principles of woodworking and science. Making this wedge car will be fun and rewarding for both of you.

Don't wait until the last minute to start building the car. If you try to rush, you and your child will get frustrated with each other. Remember, a young child's attention span is only forty-five minutes to an hour. Plan to work on this project over several nights.

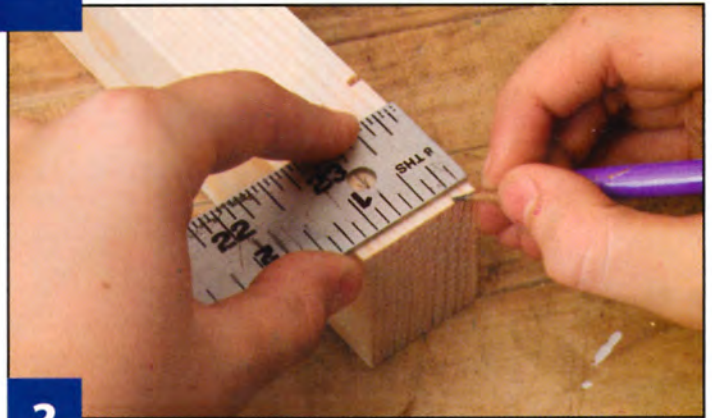
The toughest part of this project is cutting the block into a wedge. If your pack or club has a work night with power tools, it would be a good idea to get help with that step. Otherwise, the only power tool you need is a drill. Remind your child to wear safety goggles and a dust mask when cutting and sanding the car, and when working with dry graphite lubricant.

This project focuses on basic techniques. For more advanced instructions, see the articles on painting your car (page 47), adding weight (page 44), wheel and axle preparation (page 58), and wheel alignment (page 68).

WEDGE CAR: PREPARING THE BLANK



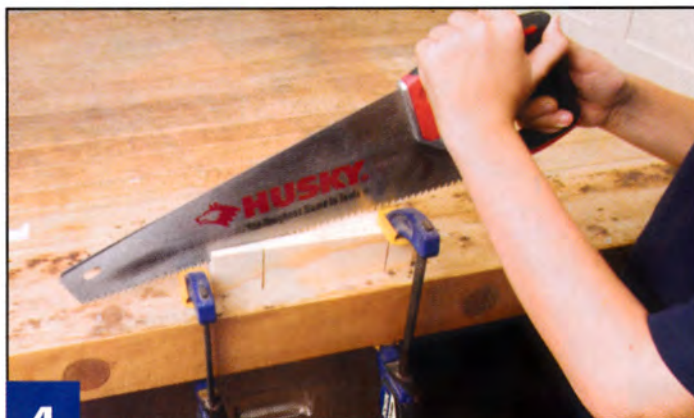
- 1 Gather your materials.** This project uses the Cub Scout Grand Prix Pinewood Derby Kit, but the instructions can be used for other styles of racers as well. Set the wheels and axles aside for later use.



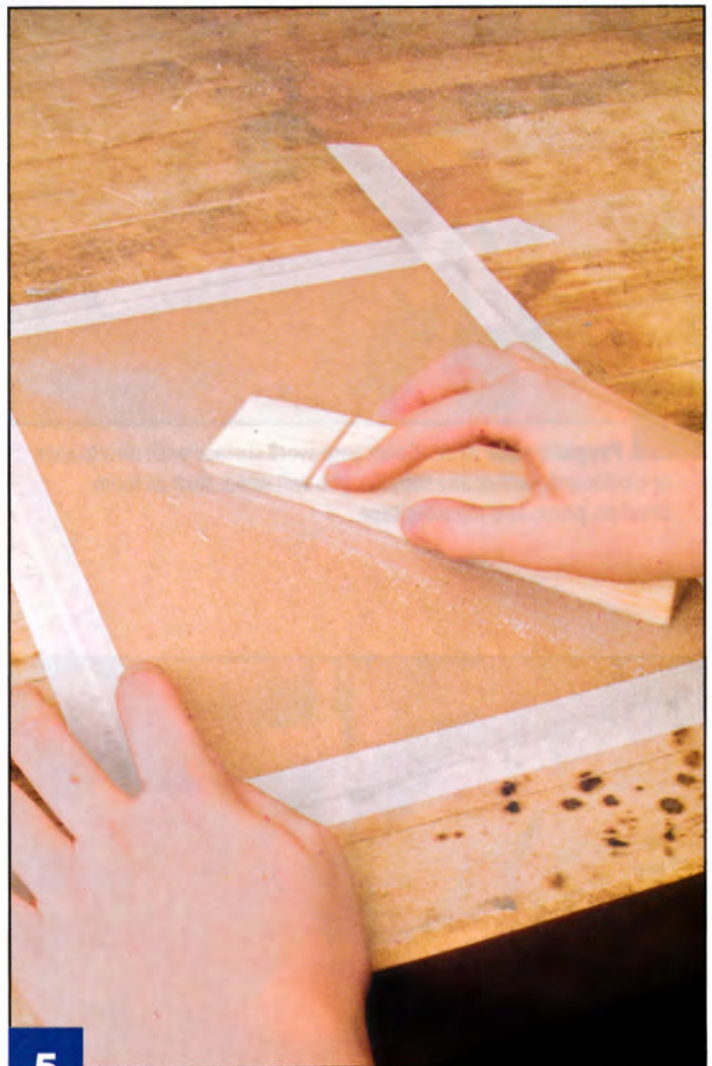
- 2 Mark the block.** The end with the axle slot farther from the end of the block is the front of the car. Mark the front. On the front of the block, measure $\frac{1}{4}$ " from the bottom and place a mark. On the back of the block, measure 1" from the bottom and place a mark. Repeat on the other side.



- 3 Draw the pattern.** Use a pencil and ruler to carefully connect the marks on both sides. This forms a wedge shape with the front of the car being $\frac{1}{4}$ " thick and the back of the car being 1" thick.



- 4 Cut the car.** Clamp the block to a work surface. Using a hand saw, carefully cut along the line. When you're about halfway through the block, flip it over and cut from the other side.

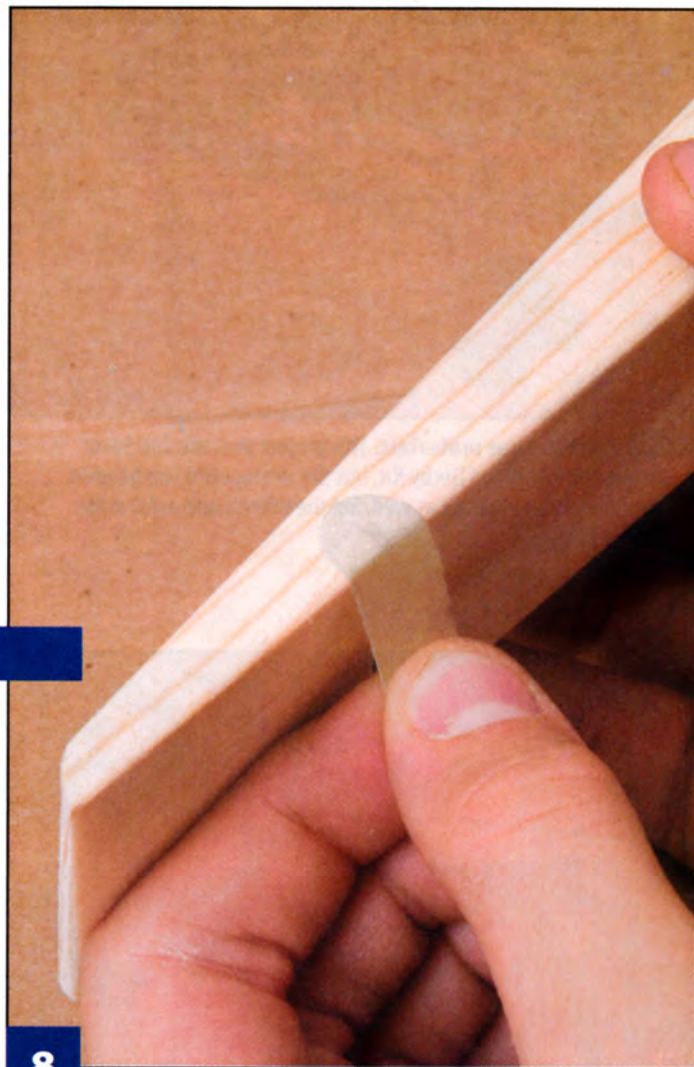


- 5 Sand the top.** Using masking tape, tape all four edges of a sheet of 150-grit sandpaper to the work surface. Rub the car over the secured sandpaper, sanding until the top of the car is smooth.



6

Sand the edges. Round the nose of the car. The front of the car should have a smooth taper, rounded from the bottom edge to the top of the car. Unstick the sandpaper and lightly sand the entire car to remove any sharp edges.



8

Prepare to paint. Cover the area around the axle slots with masking tape to keep paint from filling the slots. Press the tape firmly in place. Paint around the axle slots will cause friction with the wheels and slow your car.

WEDGE CAR: PAINTING THE CAR



7

Prepare your area. Cover your work surface with newspaper or cardboard. Gather any supplies you will need, such as foam brushes, paint, and masking tape.



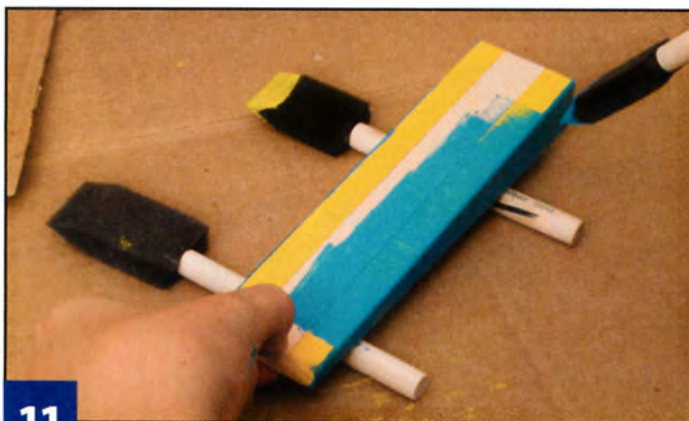
9

Paint the stripe. Using a foam brush and acrylic paint, paint the top of the car with the color for the center stripe. Allow the paint to dry for an hour. If desired, use a hair dryer to speed up the drying time.



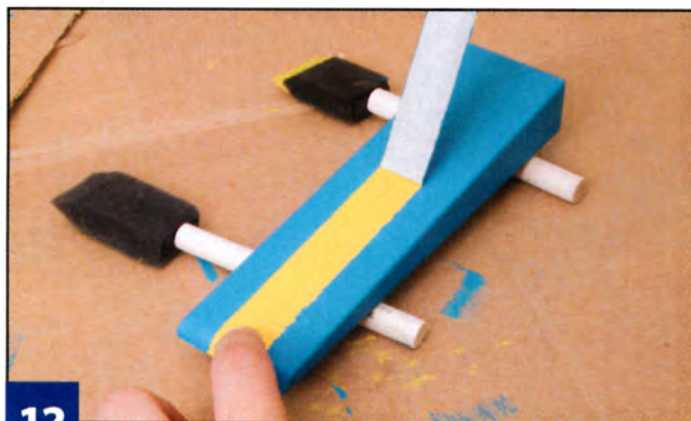
10

Cover the stripe. Place a piece of $\frac{3}{4}$ "-wide masking tape down the center of the block. Firmly press down the tape. This will keep the second color off of the center area, giving you a clean striped effect.



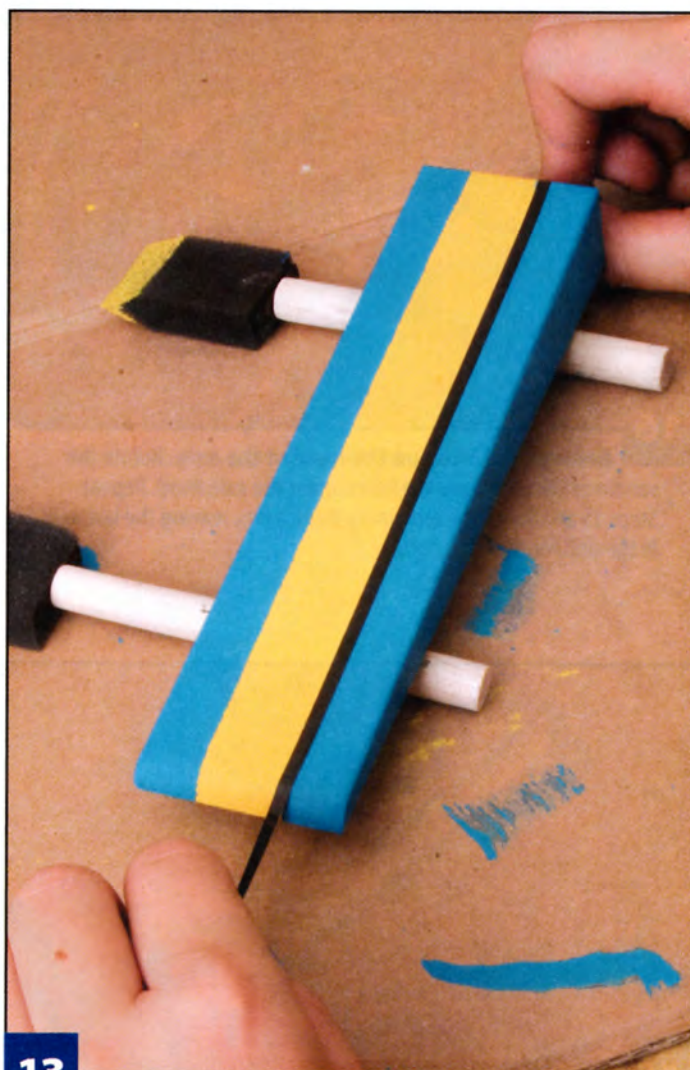
11

Paint the second color. Paint the second color over the entire car. Place the car over the handles of two foam brushes to raise the car so you can paint down the sides. This keeps the car from sticking to the work surface. Allow the paint to dry.



12

Remove the tape. Carefully remove the masking tape from the center stripe. Remove the tape from the axle areas as well.



13

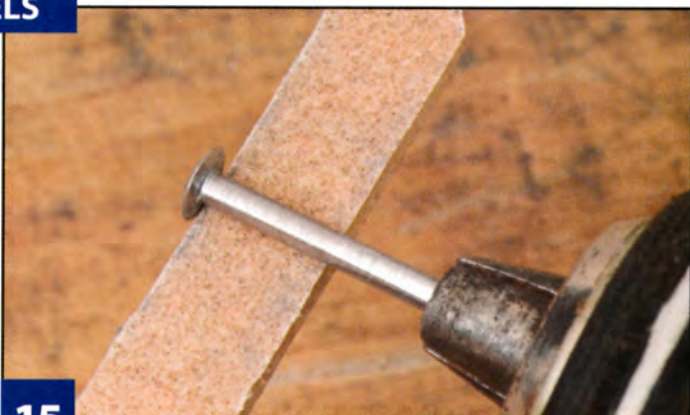
Add pin stripes. Press 1/8" pin-stripping tape where the colors join to cover any areas where the paint seeped under the masking tape.

WEDGE CAR: PREPARING THE AXLES AND WHEELS



14

Prepare your tools. Glue 150-grit sandpaper to both sides of two craft sticks. Trim the sandpaper flush with the edges of the craft sticks. You will need a power drill and an adult helper to prepare the axles.



15

Remove the burrs on the shaft of the axle. Clamp an axle in the drill. Run the drill at a medium speed and use one side of a sanding stick to remove the burrs from the sides of the axle.



16

Remove the burrs on the head of the axle. Rotate the sanding stick to remove the burrs under the axle head. Repeat Steps 15 and 16 for the remaining three axles, leaving the last axle in the drill for the next step.



17

Polish the axle. Cut a sheet of 400-grit wet/dry sandpaper into four 1/2"-wide strips, each 4" long. Dip the sandpaper into water. With the drill running at medium speed, sand the axle to remove the scratches from the sanding sticks. Keep the sandpaper wet during the entire process.



18

Finish polishing the axles. Rotate the sandpaper to sand under the head of the axle. Change sandpaper strips for each axle and remember to keep the sandpaper wet. Repeat Steps 17 and 18 for all of the axles.



19

Prepare to smooth the wheels. Do not attempt this step without a wheel mandrel. Clamp a wheel mandrel into the drill. Attach a wheel to the mandrel, being careful not to over-tighten. Tape a piece of 400-grit sandpaper to a block of wood. (Use the flat side of the scrap from the original block.)



20

Remove the mold marks. Wet the sandpaper. Run the drill at a low speed. Apply only light pressure and sand until the wheel surface is flat and smooth. Repeat for the remaining three wheels.

WEDGE CAR: ADDING THE WEIGHTS

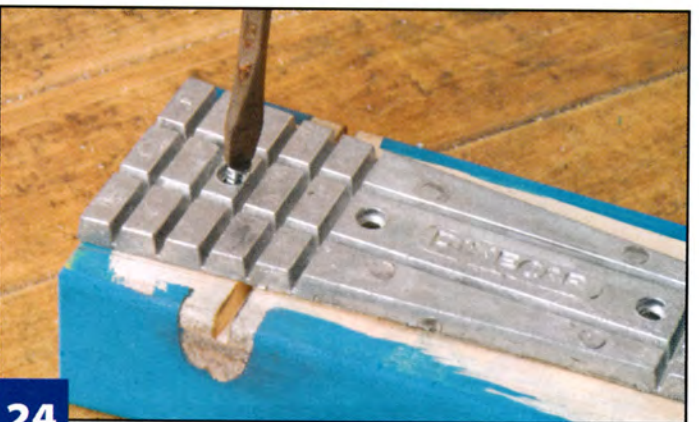


21

Measure the weight. For maximum performance, the car should weigh as close to five ounces as possible. Put the car, axles, and wheels on a scale. Add a tapered weight bar and its screws. If necessary, add split shot sinkers until the scale reads five ounces.

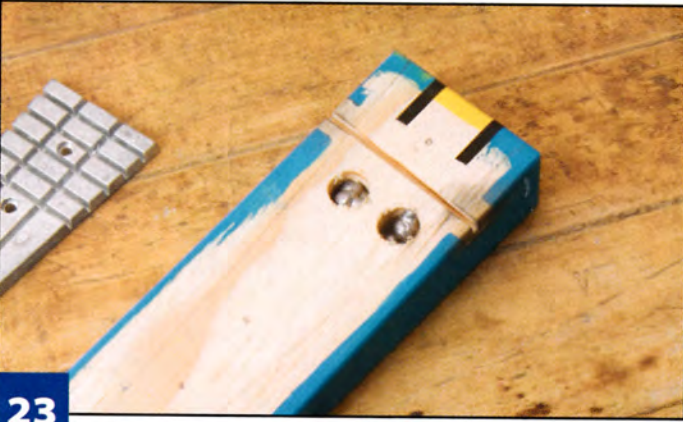
22

Drill holes for the split shot. Mark the depth of the holes by wrapping a piece of masking tape around the drill bit. This ensures you won't drill too deeply into the car. Drill two $\frac{3}{8}$ "-diameter holes into the bottom of the car, just in front of the rear axle slot.



24

Attach the weight bar. Using the screws supplied, attach the tapered weight bar to the bottom of the car. Position the wide end of the bar as close to the back of the car as possible and make sure the bar covers the holes for the split shot.



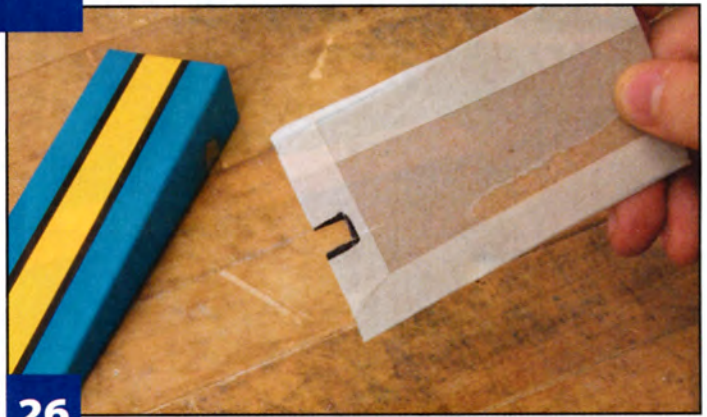
23

Put the split shot into the holes. Do not glue the split shot into the holes. If the car is overweight at the race's weigh-in, you can easily unscrew the weight bar and remove some split shot.

WEDGE CAR: ATTACHING THE WHEELS



25 **Lubricate the wheel wells.** Squeeze a small amount of dry graphite lubricant onto a paper towel. Rub the graphite over the wheel slots where the axles attach on both sides of the car. This helps reduce friction where the wheels rub against the car.



26 **Make a wheel spacer.** Cut two small rectangles from a cereal box. Place the two rectangles together and tape them on three sides. On one side, cut a $\frac{1}{4}$ "-square notch in the center.



27 **Attach the first wheel.** Place the wheel spacer between the wheel and the car. Firmly press the axle into the axle slot. The bottom end of a Sharpie marker makes a good tool to push the axle into the slot. Remove the wheel spacer.



28 **Attach the other wheels.** Use the same technique to attach the other three wheels. All of the wheels should be spaced an even distance from the car. The cardboard spacer helps you obtain the correct spacing.



29

Balance the wheels. After you attach all four wheels, place the car on a flat surface. Position yourself so you can look directly underneath the car. If any of the wheels do not rest flat and square on the surface, adjust them until they do.



30

Lubricate the axles. Squeeze a small amount of lubricant onto each axle. Use your finger to spin each wheel several times to work the lubricant into the axles. Your car is ready to race!

materials & tools

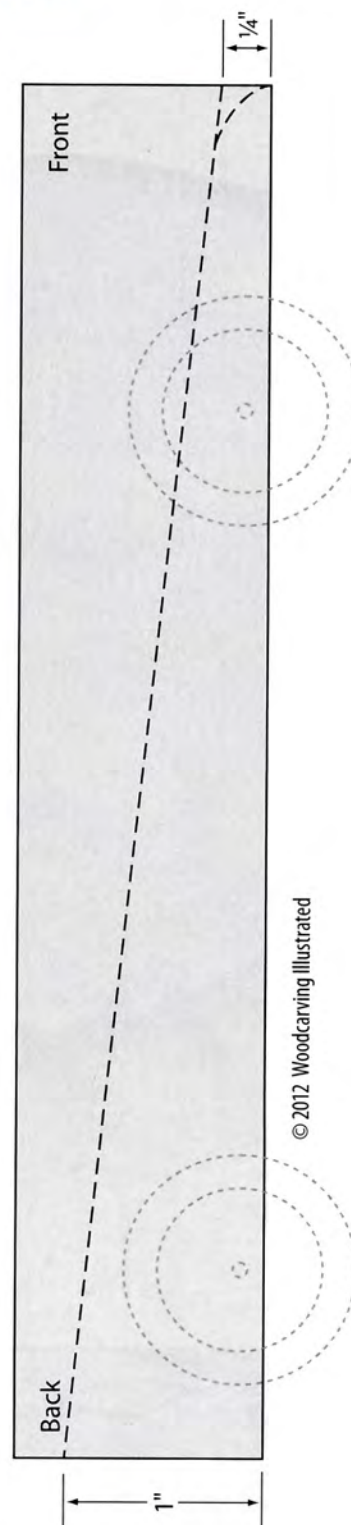
MATERIALS:

- Official BSA Pinewood Derby Kit (available at craft and Scout stores)
- 3/4"-wide masking tape
- Sandpaper: 150-grit; 400-grit wet/dry
- Acrylic paint, two colors of your choice
- 1/8" pin-striping tape (available at auto parts stores)
- 2 each craft sticks
- White glue
- Tapered weight bar (available at craft and Scout stores)
- Split shot sinkers (available at sporting goods stores)
- Dry graphite lubricant (available at craft and Scout stores)
- Paper towels
- Cereal box (wheel spacer)

TOOLS:

- Pencil
- Ruler
- Clamps
- Hand saw
- 3 each 1" foam brushes
- Scissors
- Power drill
- 3/8" drill bit
- Sharpie marker (inserting axles)
- Hair dryer (optional, to dry paint)
- Wheel mandrel (to smooth wheels; available at craft and Scout stores)

Wedge car pattern



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For more information on Troy Thorne, see page 8.

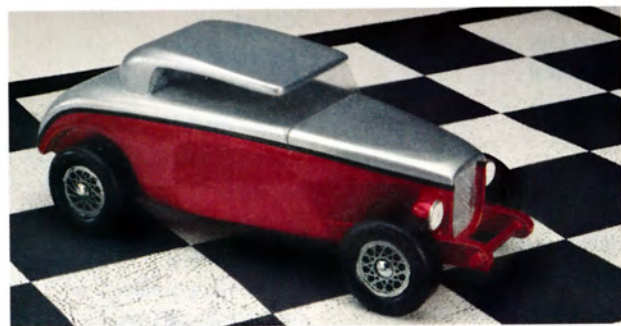
Build a Hot Rod Racer

**Customize this sleek racer
with a variety of options**

By Troy Thorne



This simple version of the hot rod has no engine or hard top.



This hard-top version simplifies construction with no engine or interior.

With this design, just like with a real hot rod, you have the choice of many options, including an exposed engine, a complete interior, and a removable hardtop.

Use the chart at right to determine which steps are required for the car you want to build.

Start by cutting the block to size. I use a knot-free piece of a pine 2 by 4. If you purchase a Pinewood Derby kit, you will need to glue a ¼" by 1¾" by 7" piece of wood to the top of the blank.

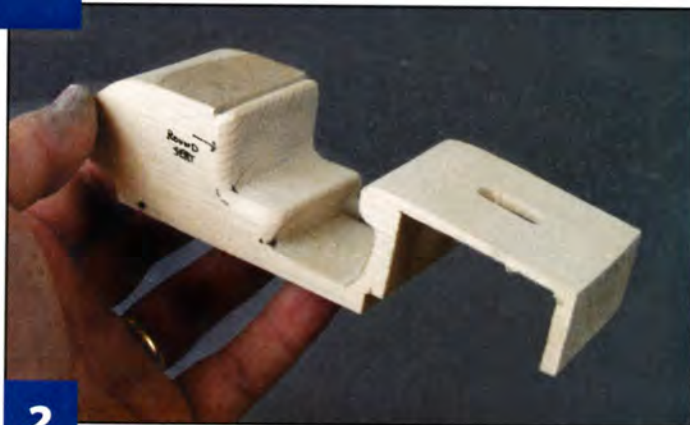
Hot Rod Options	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8	Step 9	Step 10	Step 11	Step 12	Step 13
No engine/no interior	X	X	X	X		X		X	X	X	X	X	X
No engine/no hardtop	X	X	X	X		X		X		X	X	X	X
With engine & hardtop	X	X	X	X	X	X	X	X	X	X	X	X	X
With engine/no hardtop	X	X	X	X	X	X	X	X		X	X	X	X

HOT ROD: CREATING THE MAIN BODY



1

Cut the primary pieces. Fold the patterns along the dashed lines and attach patterns A, B, and C to the appropriate stock. Drill axle holes in the main body and front frame with a #44 drill bit mounted in a drill press. Cut the main body, the body sides, and the front frame. Cut the interior and hood opening if desired.



2

Sand the pieces. Cut the windshield groove on the main body. Remove the patterns and sand any rough edges on all four pieces. If you cut the optional interior, round the corners of the bench seat with sandpaper and sand the other interior surfaces, including the floor and dashboard.

HOT ROD: ADDING THE MAIN ELEMENTS



3

Glue the body sides to the main body of the car.

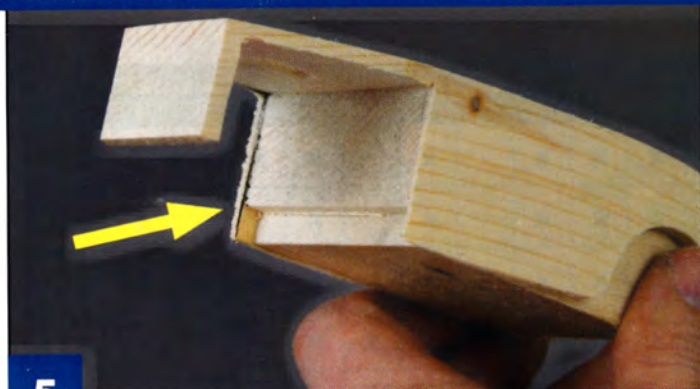
Carefully align both body sides with the main body and glue them in place with wood glue. Clamp the sides in place and allow the glue to dry thoroughly.



4

Taper the front of the car. Cover the top of the car with painter's tape. Attach pattern D to the top of the car, aligning the pattern with the front edge of the blank. Cut along the solid pattern lines.

HOT ROD: ADDING THE MAIN ELEMENTS



5 **Clean up the fire walls.** Trim the excess wood on the body sides even with the fire wall in the hood opening area. Do not cut the body sides at the notched area on the bottom of the fire wall. The sides should form end caps on the notch. You only need to do this step if you cut the area for the exposed engine.

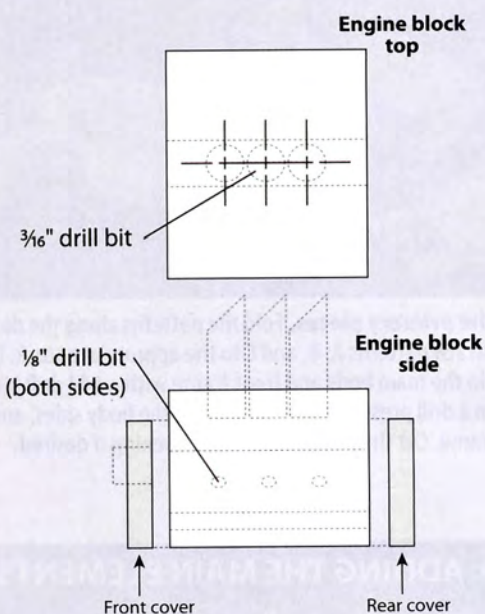


6 **Add the front frame and grill.** Cut the grill and attach it to the front of the car with cyanoacrylate (CA) glue. Drill $\frac{1}{16}$ "-diameter holes in the front frame and glue a $\frac{1}{16}$ "-diameter dowel through the holes. Glue the front frame below the engine compartment, aligning the back with the notch on the main body. Sand the car and round the top edges of the car and front edges of the grill.



7 **Make the engine.** Cut the engine block and engine covers. Drill the holes for the engine intakes and the headers. Bend plumber's solder to create the headers. If the headers are loose, smash the ends of the solder to make them fit tightly into the holes. Glue the dowel into the front engine cover and glue both covers in place. Do not glue the intakes or headers in place until the engine is installed after the car is painted.

Engine drilling and assembly guide



Use plumber's solder to form the headers on the engine.

HOT ROD: ADDING FINAL DETAILS



8

Build the windshield. Use plastic sheeting from discarded packaging material. Extend the windshield groove created in step 2 through the side panels of the car. Place the plastic into the groove and mark the width. Trim the sides with scissors. Cut the windshield so it extends $\frac{3}{8}$ " to $\frac{1}{2}$ " above the top of the car. If you are adding the hardtop, trim the height of the windshield after you fit the top.



9

Create the optional hardtop. Fold pattern E on the dashed line and attach it to the stock. Cut the top and then round the corners with sandpaper. Carve in a rear window with a drum sander and a rotary-power carver. Drill matching $\frac{1}{16}$ "-diameter holes in the top and body, and use $\frac{1}{16}$ "-diameter dowels to join the pieces. For a removable top, do not glue the dowels in place.



10

Dry assemble the car. Test the fit of all of the pieces. If adding the optional hardtop, trim the windshield to fit under the front of the hard top. Add the panel lines to show the hood edges and doors if desired. Pencil the lines in and then use a woodburner to trace the lines. You can add rear tail lights by drilling $\frac{3}{16}$ "-diameter holes in the rear edge of the body.



11

Create the headlights. Drill a $\frac{1}{16}$ "-diameter by $\frac{3}{16}$ "-deep hole into the side of a $\frac{3}{8}$ "-diameter dowel rod, $\frac{3}{16}$ " from the end of the dowel. Insert a $\frac{1}{16}$ "-diameter by 4"-long dowel into the hole. Cut the $\frac{3}{8}$ "-diameter dowel to $\frac{3}{8}$ " long. Repeat the process to make a second headlight.



12

Finish the headlights. Round one end of the $\frac{3}{8}$ "-diameter dowel with a sander to create the back of the headlight. Cut the $\frac{1}{16}$ "-diameter dowel to $\frac{3}{16}$ " long. Drill $\frac{1}{16}$ "-diameter holes in the front edges of the hood and glue the headlights in place.



13

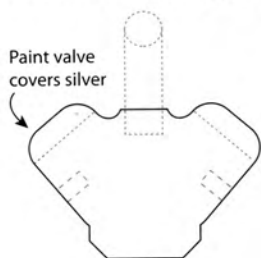
Painting the car.

Sand the entire car with 220-grit sandpaper. Apply spray primer to all of the parts. Sand the primer with 320- or 400-grit wet/dry sandpaper. Do not use any water. Apply light coats of the final color of spray paint to the car. Paint the inside of the car with matte craft acrylic paints. Paint the engine and attach it to the car with CA glue. Then attach the intakes and headers. Glue the windshield in place with a drop of white glue. Do not use CA glue or the plastic will get foggy.

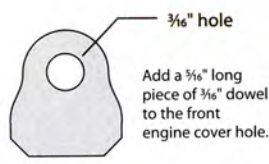
Attaching the wheels

You must use the wheels and axles supplied in the Boy Scouts of America kit. You will also need to add weight to the rear of the car for best performance. Be sure to follow the official Pinewood Derby rules.

For more information on Troy Thorne, see page 8.

Hot rod engine patterns

Engine block front



Engine covers
Cut 2 - 1/8" thick

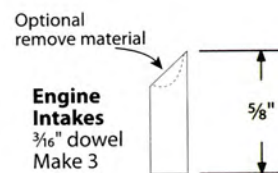
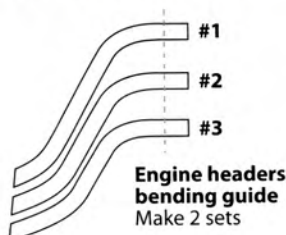
MATERIALS:

- 1½" x 1¾" x 7" knot-free piece of a pine 2x4 (or Pinewood Derby kit blank with additional ¼" x 1¾" x 7" piece of pine)
- ¼" x 1¾" x 2½" pine (front frame)
- 2 each ½" x 1½" x 5¾" pine (sides)
- Wheels from kit
- 4 each ⅜"-diameter by 1" nails (axles, or use nails from kit)
- ⅝" x 1⅞" x 2½" pine (optional hardtop)
- ⅛"-diameter by 12"-long dowel
- ⅜"-diameter by 5"-long dowel
- Scrap plastic (windshield)
- Plumber's solder (engine headers)
- 1" x 1" x 1⅜" pine (engine block)
- ⅛"-thick wood scraps (engine covers)
- ⅜"-diameter by 3"-long dowel (engine intakes)
- Painter's tape

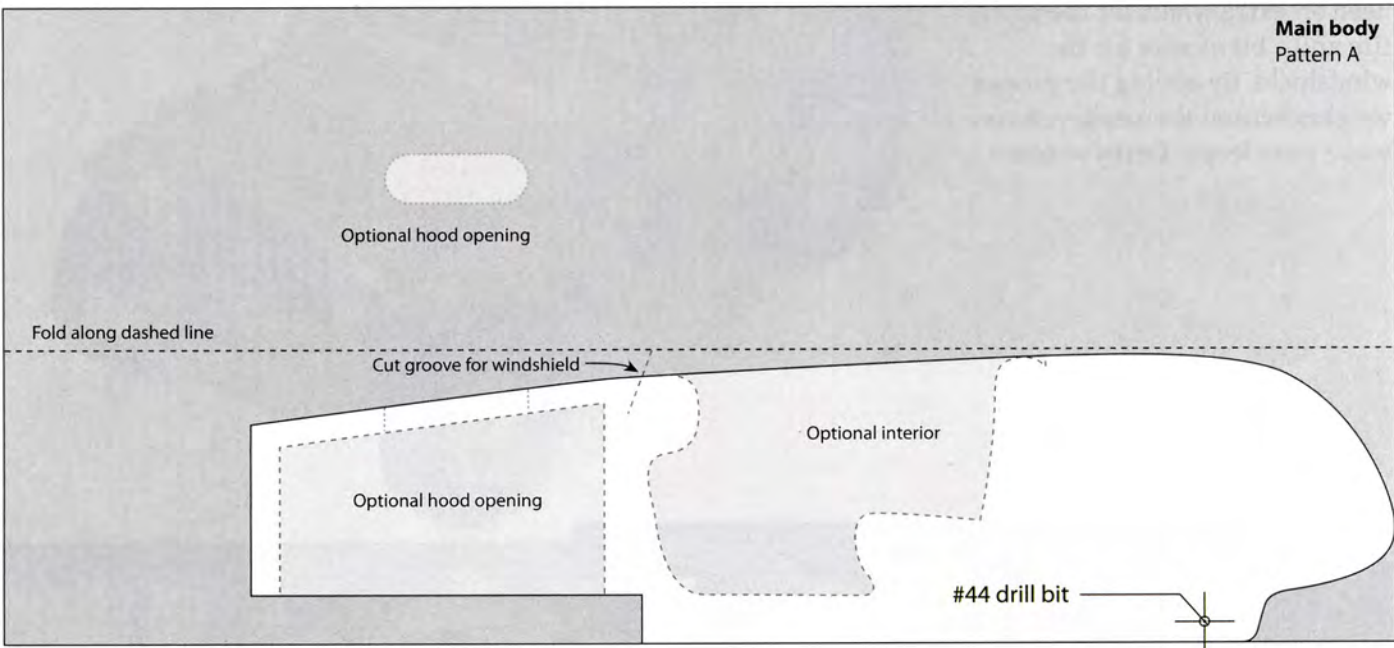
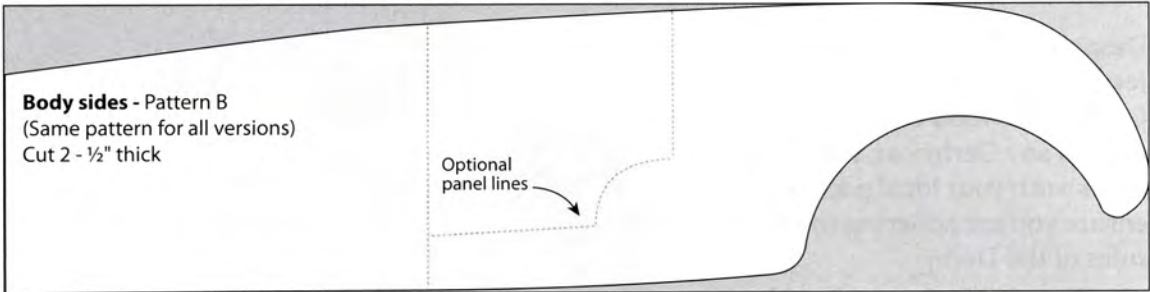
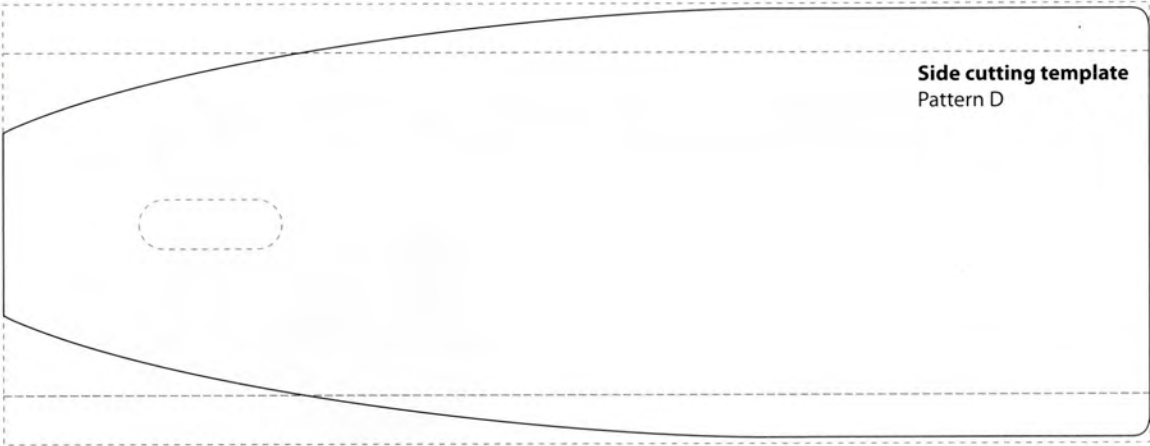
- Spray adhesive
- Cyanoacrylate (CA) glue (such as Super Glue)
- Wood glue
- Assorted grits of sandpaper
- Acrylic paints of choice
- Spray paint & primer of choice

TOOLS:

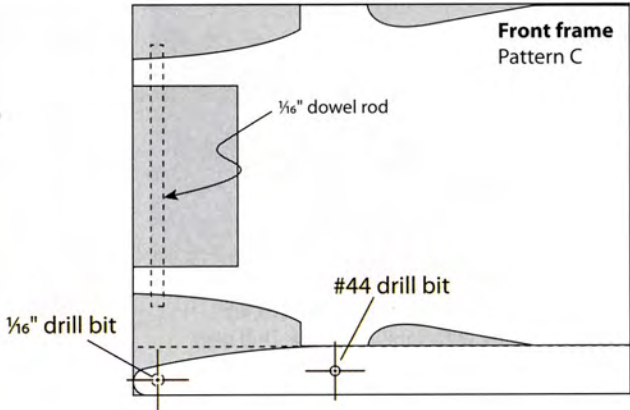
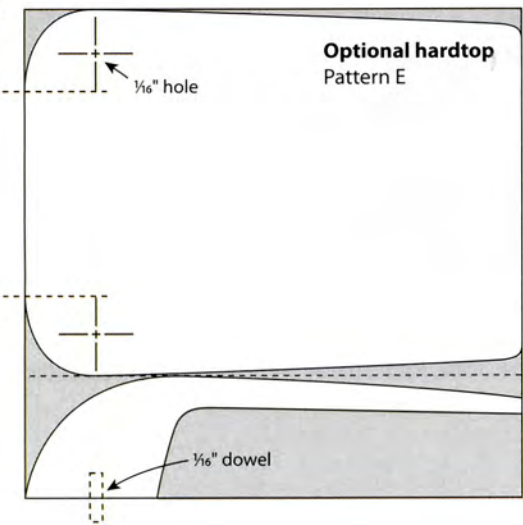
- Scroll saw with #9 skip-tooth blades (or saw and blades of choice)
- Drill with #44, ⅛"-, ⅛"-, and ⅜"-diameter drill bits
- 12" wood clamps
- Rotary power carver (window in hard top)
- Miniature sanding drum (window in hard top)
- Assorted paintbrushes of choice

Header and intake guide

Hot rod racer patterns



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Off-Road Racing Jeep

Customize the finish to create a unique car

By Troy Thorne

Despite its short wheelbase, this Jeep design meets the official rules for the Pinewood Derby. However, as with any Derby car, you should check with your local pack to ensure you are adhering to all the rules of the Derby.

To make the Jeep, you will need an extra wheel for the spare tire and a bit of wire for the windshield. By adding the proper weights behind the seats, you can make your Jeep a Derby winner!



JEEP: CUTTING THE PIECES



1 Set up the blank. Fold the pattern along the dashed line and attach the pattern to the blank with spray adhesive. Drill new axle holes where indicated on the pattern. Use a #44 drill bit. Set the wheels and axles aside for now.



2 Cut the pieces. Be careful when cutting the thick wood of the Jeep body. Use a large scroll saw blade and do not force the wood into the blade. Round the edges of the hood and bevel the bottom edge of the windshield with sandpaper.

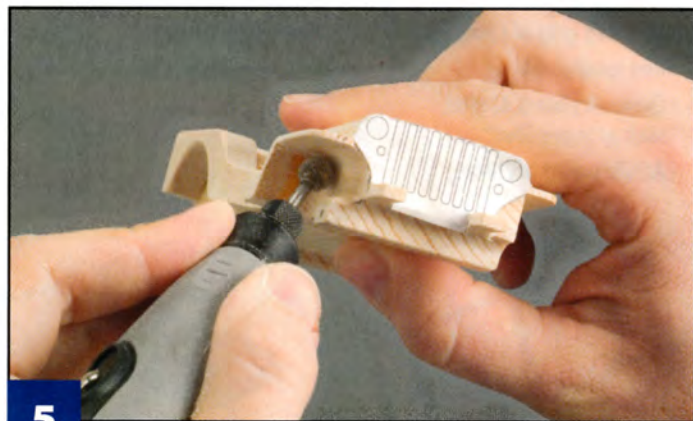
JEEP: SHAPING THE MAIN PARTS



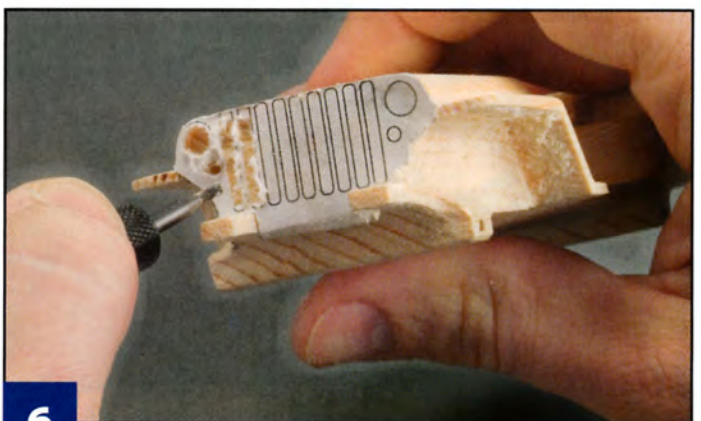
3 **Attach the back fenders.** Round the back corners and the wheel wells with sandpaper. Use the photo as a guide to properly align the rear fenders. Attach the fenders to the blank with cyanoacrylate (CA) glue.



4 **Attach the front fenders and inner wheel wells.** Use CA glue to attach the front fenders. Then attach the wheel wells behind the seat area with CA glue. The wheel wells will hide the slight gap between the rear fenders and the body of the Jeep.



5 **Shape the front.** Attach the front-end pattern to the blank with spray adhesive. Remove the wood around the front axles (the shaded area) with a Dremel flexible shaft tool and a ball-shaped carbide-point rotary carving bit.

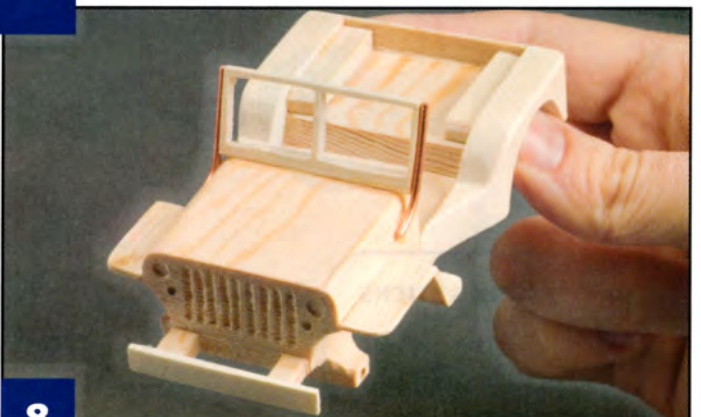


6 **Shape the grill and headlights.** Use a small, cylinder-shaped, high-speed cutter in a rotary-power carver to carve the grill and headlights. The flexible shaft of the Dremel lets you hold and use the tool like a pencil, making it easy to carve the details.

JEEP: ADDING THE DETAILS



7 **Attach the windshield.** Apply CA glue to the bevel on the bottom of the windshield and position it on the hood. Cut two short lengths of copper wire, bend them to shape, and glue them to the sides of the windshield and hood for added support.



8 **Attach the front bumper.** Center the bumper and glue it in place with CA glue. Then add a bit more CA glue to the windshield-wire joint. The CA glue helps to build up the area between the wire and windshield to smooth the transition.

JEEP: ADDING SEATS AND WHEELS



9

Shape the seats. Shape the seat cushions by rounding the corners and relieving some of the wood at the bend. Use a small, cylinder-shaped, high-speed cutter. Use CA glue to attach the seats and the rear bumper to the Jeep body.



10

Dry assemble the wheels. Slide the axles through the wheels and carefully push them into the axle holes. Friction should hold the axles in place. Rotate the wheels to make sure they spin freely. Sand wood away from any areas where the wheels bind.

Finishing

I prefer to paint the seats and Jeep separately before gluing the seats in place. I use matte brown paint for the seats to resemble leather, and a glossy red for the Jeep body. You can choose any color scheme you want. Cut a notch in the spare tire to accommodate the bumper and glue it in place with CA glue.

For more information on Troy Thorne, see page 8.

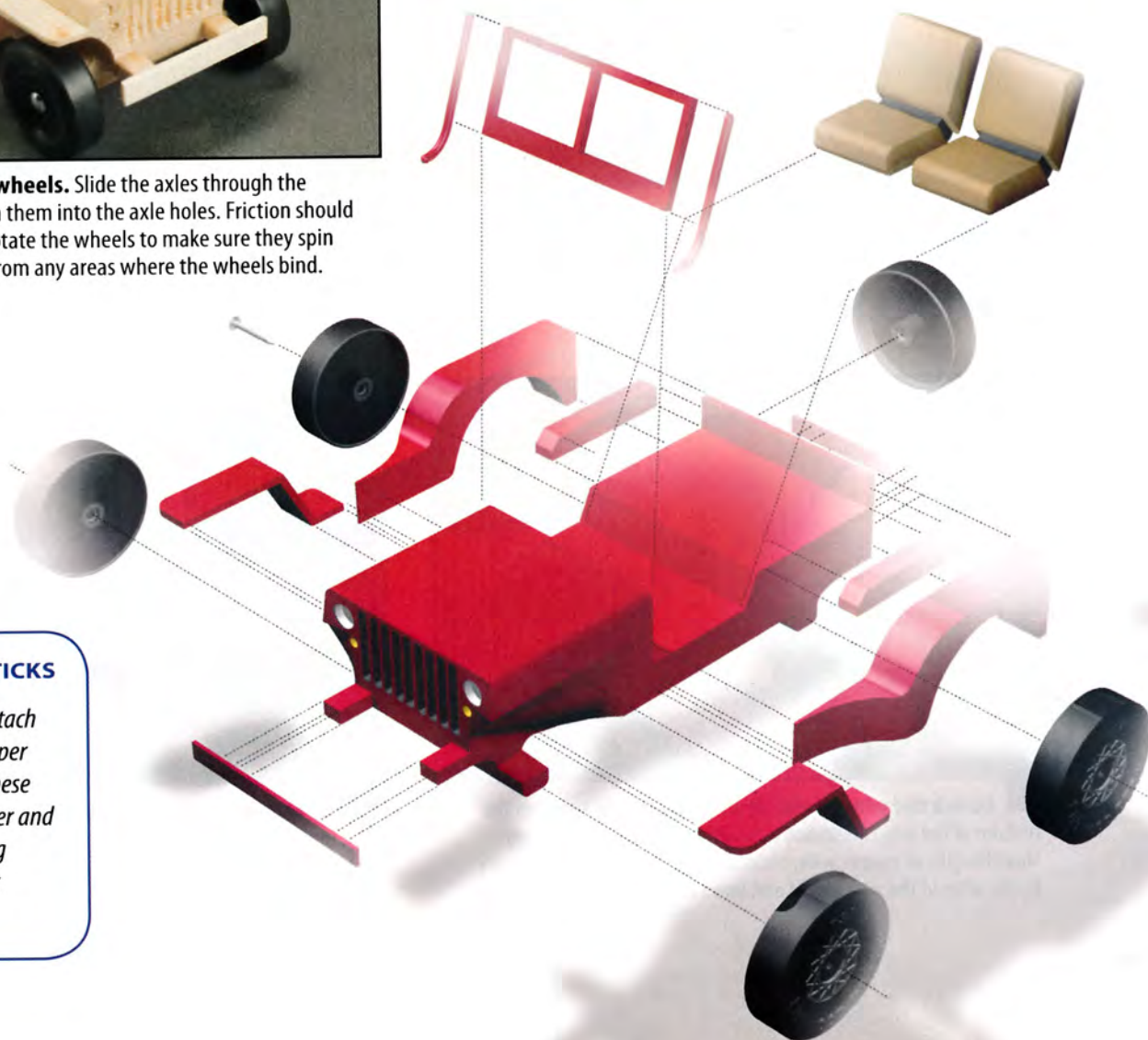
materials & tools

MATERIALS:

- Pinewood Derby kit, or 1¼" x 1¾" x 7" wood of choice (body)
- 5 each BSA wheels
- 4 each ⅜"-diameter x 1" nails (axles, if not using the kit)
- 4" 14-gauge copper ground wire (windshield support)
- Assorted grits of sandpaper
- Red spray paint
- Cyanoacrylate (CA) glue, such as Super Glue®
- Acrylic paints of choice

TOOLS:

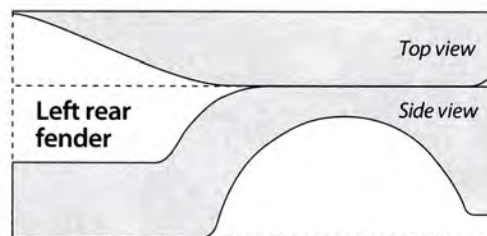
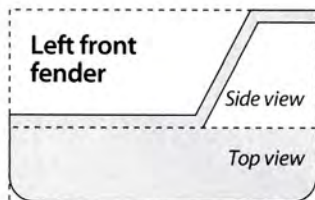
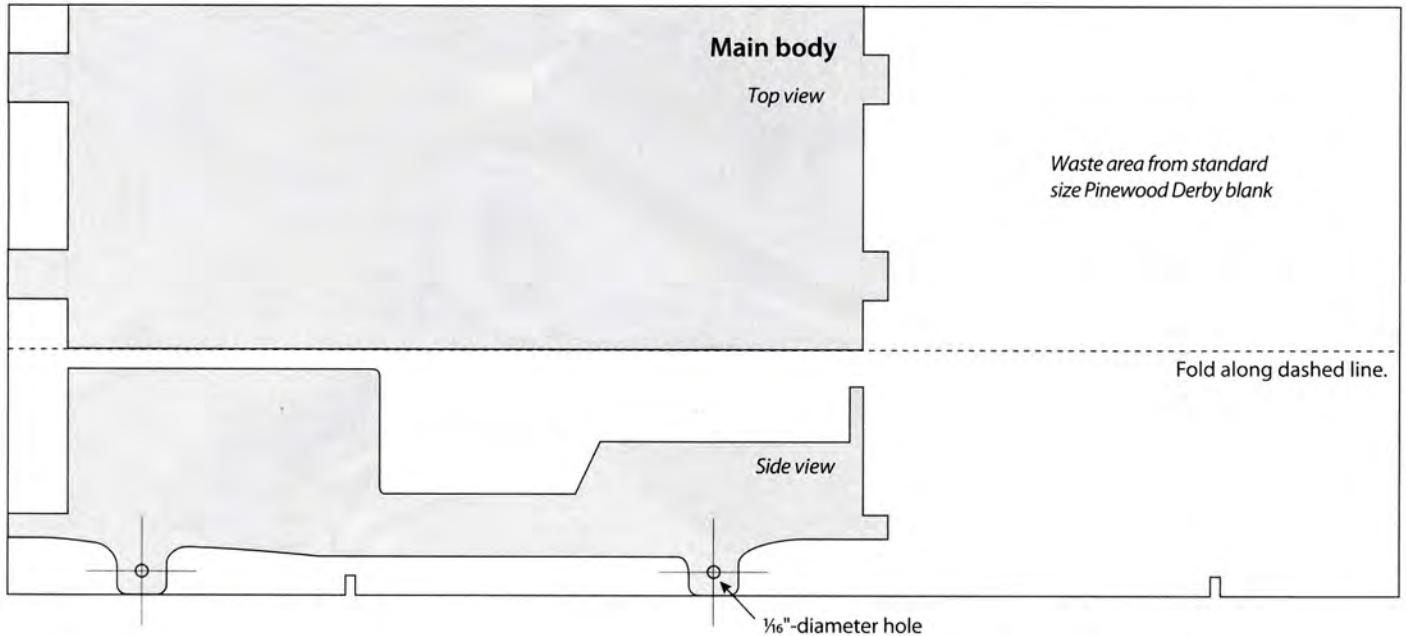
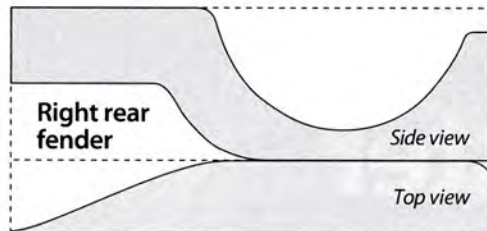
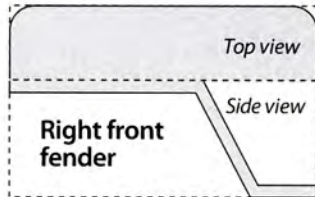
- Scroll saw with #9 skip-tooth blades (or saw/blades of choice)
- Rotary-power carver
- ¼"-diameter, carbide-point, ball-shaped, rotary-carving bit
- Small, cylinder-shaped, high-speed cutter
- Assorted paintbrushes of choice



TIPS SANDING STICKS

Use spray adhesive to attach assorted grits of sandpaper to tongue depressors. These sanding sticks last forever and are handy when sanding small parts like the back fender supports.

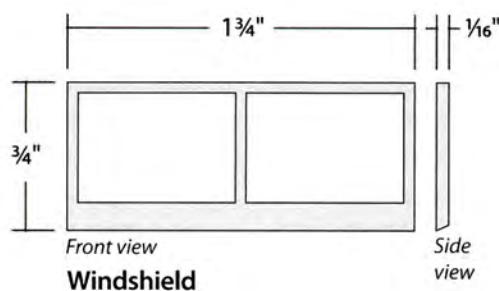
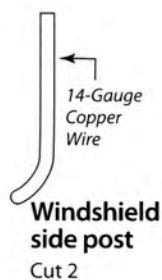
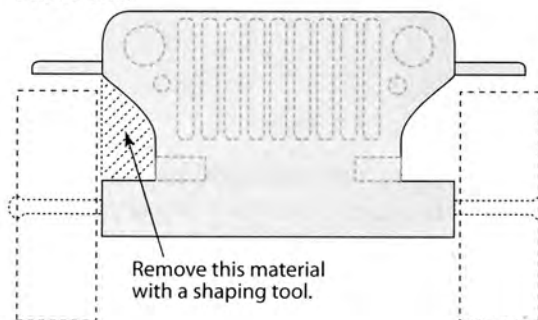
Racing Jeep patterns



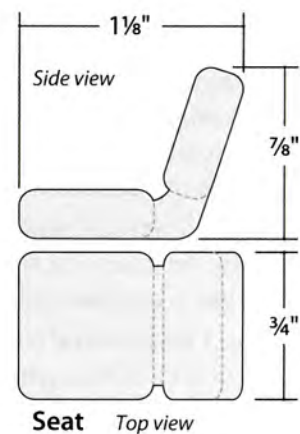
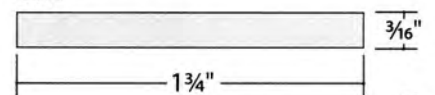
Inner wheel well



Front end



Bumper - $\frac{1}{16}$ " thick



Creating an MG Roadster



**Compound cut
parts and careful
shaping bring this
British classic to life**

By Jon Deck

As a high school junior, at a seven o'clock showing of the teen crush film *Love Story*, I fell in love. Not with the sweet and sassy Radcliffe coed played by Ali MacGraw, but with the car that Harvard preppy Oliver Barrett IV (Ryan O'Neal's character) drove around the Ivy League campus. The brief cameo appearances of the MG-TC roadster were more than enough to make it the object of my affection.

To this day, I am still smitten by the MG-TC roadster. The very form of the car exudes a rugged sportiness, yet is elegant and sophisticated.

Last year, I was invited to build and race a car in the adult heats of a local Pinewood Derby. There was little doubt in my mind what my entry would be.

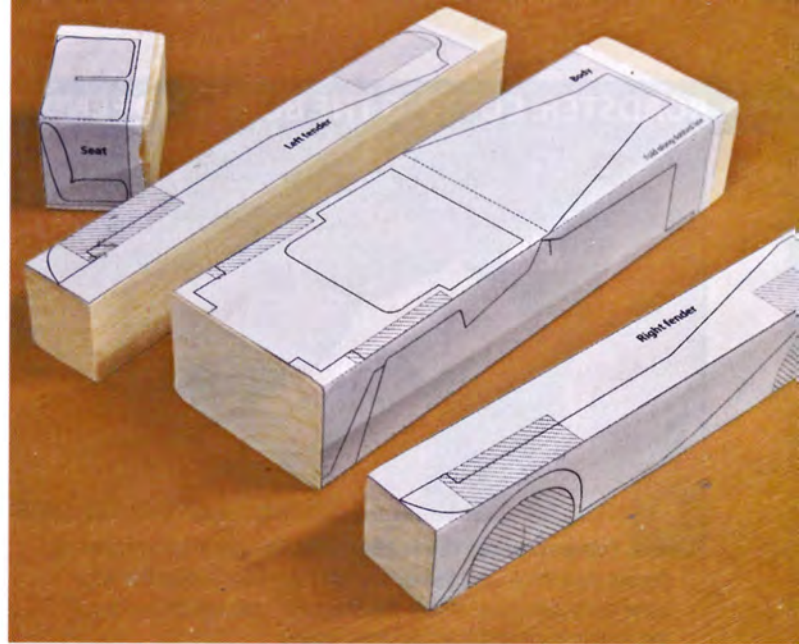
I drew this design from photographs I found on Internet searches, and I built my prototype with great care. The results of my efforts were most satisfying.

Unfortunately, when I took my car to the track on race day, the wheel base was too narrow to fit on the track properly. I did run two heats that day, with my car illegally straddling two lanes of the track. The car was disqualified, but won both heats even though there was a lot of play in its run down the track. I realized the car was not only beautiful, but fast too.

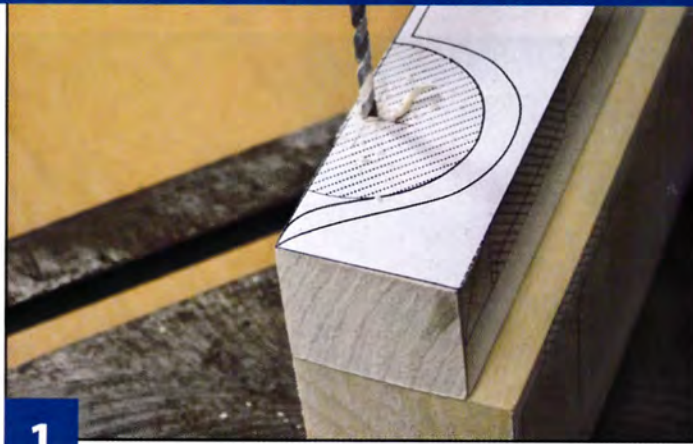
The pattern published here is legal size, and I hope it will produce a champion for you. If not, it will give you great pleasure to build, and will make a fantastic addition to the bookcase in your den.

Preparing the body and fender blanks

Cut the blanks as close to the pattern size as possible, making sure all sides are square. The length can be longer than the pattern size, but one end of the body and fender blanks should be cut square. Cut the body and fender patterns accurately, and score and fold the patterns along the dashed lines. Mount the patterns onto the blanks with temporary spray adhesive. Be sure to position the pattern with the rear end of the car flush with the square-cut end of the blanks. This is critical to the alignment of the wheels and the car as a whole. Cut the slot in the top of the hood for the windshield with a hand saw, band saw, or scroll saw.



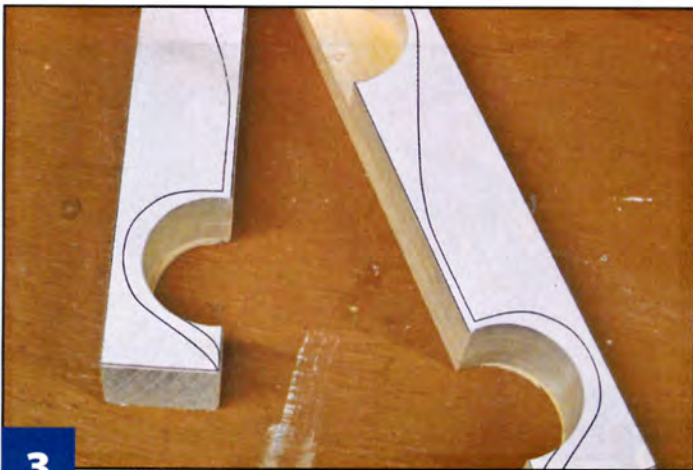
ROADSTER: CUTTING THE WHEEL WELLS



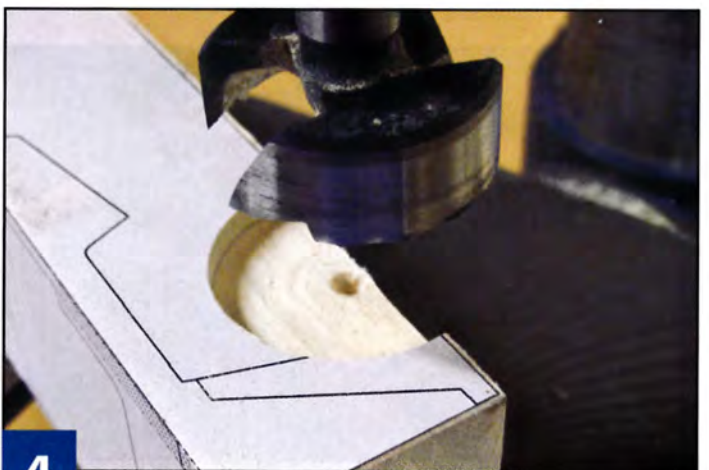
1 Drill the axle holes. Align the body and left fender blanks along the rear end and the bottom. Clamp the blanks together. Using a drill press, drill the front and rear axle holes with a $\frac{5}{64}$ "-diameter bit through the fender blank and into the body. Repeat on the right side of the car.



2 Bore out the front wheel wells. Chuck a $1\frac{3}{8}$ "-diameter Forstner bit into a drill press and set the depth stop to match the depth of the hatched portion of the left fender pattern. Using the axle hole as a pilot hole, bore out the front wheel well to the set depth. Repeat on the right fender blank.



3 Bore out the rear wheel wells. Place a waste block under the fender blank, remove the depth stop, and bore the rear wheel well through the blank, using the axle hole as a pilot hole. Repeat on the other fender blank.



4 Bore the rear wheel wells into the body. Set the depth stop to match the hatched portion of the rear wheel well on the body. Use the axle hole as a pilot hole and bore the well to the set depth. Flip the body and bore the other side to the set depth.

ROADSTER: CUTTING THE BODY AND FENDERS



5 **Compound cut the fenders.** Cut the side profile of the left fender on a scroll saw. Secure the cut pieces back together with clear packaging tape, rotate the blank 90°, and cut the top profile. Repeat the process to cut the right fender.



6 **Compound cut the body.** Cut the side profile of the body on a scroll saw. Secure the cut pieces back together with clear packaging tape, rotate the blank 90°, and cut the top profile.

ROADSTER: SHAPING THE BODY



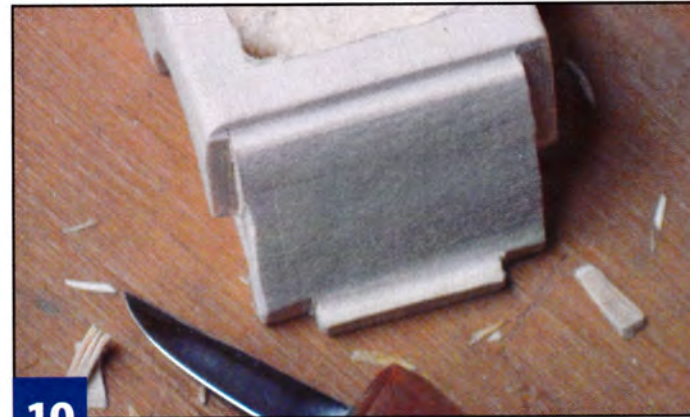
7 **Sand the body.** Sand the sides, hood, and trunk with a sanding block and 150-grit sandpaper. Keep these areas as flat as possible to retain the side profiles that match up with the fenders. Sand completely until all flaws are gone and the surface is smooth.



8 **Hollow the cockpit.** Transfer the outline of the cockpit onto the top of the body. Chuck a 1/4"-diameter bit into a drill press, and set the depth stop to 3/16" from the bottom of the body. Drill holes in the body in the corners of the cockpit. Remove the bulk of the waste inside the cockpit with a 3/4"-diameter Forstner bit set to the same depth.



9 **Clean out the cockpit.** Use a Dremel with a sanding drum to clean out the sides and floor of the cockpit. Use carving tools or other rotary bits to shape the corners.



10 **Cut in the trunk detail.** Notch out the edges that separate the gas tank from the trunk with a bench knife or carve them with a rotary bit or sanding wheel.



11

Shape the body. Ease off the sharp edges of the body by hand sanding with 150-grit sandpaper. Sand the top edges of the hood to round them. Draw the dashboard profile onto the front of the cockpit and sand it to match the profile.



12

Detail the body. Transfer the burn line patterns for the door, hood edge, and side vents to the body. Woodburn the side vents with a skew nib and the other details with a writing nib. Use a drill press to drill two 1/8"-diameter holes in the front bumper support. The fog lamps will be mounted in these holes.

ROADSTER: SHAPING THE FENDERS



13

Shape the top of the front fenders. Nothing you do will define your car more than creating the fenders. Use a Dremel with a sanding drum to rough-shape the top side of the fenders. Carve the flaring profile between the front fender and the hood, and round all of the edges. Do not sand the bottom edge of the fender where it meets the body. Be careful near the front of the fender; do not sand through into the wheel well cutout.



14

Shape the top of the rear fenders. The point where the rear fender meets the running board is fragile—be careful when sanding near this point. Round the rear fender from where it meets the body at the edge of the wheel well. Hand sand the fender with 150-grit sandpaper until it is smooth. Complete one fender first, and compare it often while shaping the second fender so you get a good match.



15

Shape the underside of the fenders. Use a sanding drum to carve underneath the front fenders, removing the excess wood to an even thickness. Work your way down the fenders to the running board area. Sand the underside of the rear fenders to an even thickness. Do not sand the edges that meet the body. Remove any roughness by hand sanding with 150-grit sandpaper.

TIPS

BURNING STRAIGHT LINES

Use a metal ruler as a guide when burning in straight lines, such as the side vents on the hood or the fins on the grill. Place blocks of equal thickness on either side of small pieces to rest the ruler on, so it won't shift as you woodburn the lines.

ONLINE REFERENCES

A quick check on Google images returns thousands of photos of MG roadsters to use for reference. They are invaluable aids when shaping, detailing, and making color choices for your car.

ROADSTER: PREPARING THE CAR FOR PAINTING



- 16** **Fit the fenders to the body.** Dry fit the fenders to the body. With a pencil, mark areas that need to be reduced. Shave or sand these areas to achieve the best possible fit. Wood putty will fill slight gaps after the fenders are glued in place.



- 17** **Sand and prime the entire car.** Hand sand the body and fenders with 400-grit sandpaper and blow off the sanding dust with compressed air. Spray the body pieces with a couple of coats of sandable primer. When fully dry, lightly sand with 600-grit sandpaper. Blow off any sanding dust.



- 18** **Paint the cockpit and wheel wells.** Use a brush to paint the inside of the cockpit and the underside of the fenders with satin finish black paint. When the paint is dry, tape off these areas before painting the car.



- 19** **Attach the fenders.** Run a light bead of cyanoacrylate (CA) glue along the inner fenders and carefully mount the fenders onto the body. Fill any gaps between the body and fenders with wood putty on the underside of the car. Sand the putty after it has fully dried. Note: If you are painting the fenders a different color than the body, skip this step until after the car is painted.



- 20** **Paint the car.** Spray paint the car with several light coats of paint (see page 47). When the paint is completely dry, remove the tape used to protect the cockpit and underside of the fenders. If painting the fenders a different color than the body, paint the pieces separately, then return to Step 19 after the car is completely dry and follow the directions to attach the fenders to the car body.



21

Make the seat. Compound cut the seat using the techniques explained in Step 5. Sand and shape the seat with a sanding drum or by hand sanding. Dry fit the seat into the car and adjust the size as needed to achieve a good fit. Add ribs to the seat with a cone-shaped rotary-carving bit or burn them in with a woodburner and skew nib. Paint the seat with the satin paint of your choice.



22

Make the dashboard and windshield. Cut the dashboard from a scrap of wood veneer with a hobby knife. Use a paper punch to cut circles for gauges. Drill a $\frac{5}{64}$ " hole for the steering wheel. Sand the veneer lightly, and stain and varnish as desired. Back up the holes in the dash with glossy white paper. Cut the windshield from your clear plastic of choice. I used a CD jewel case cut on a scroll saw. Paint the windshield frame metallic silver on both sides.

TIPS

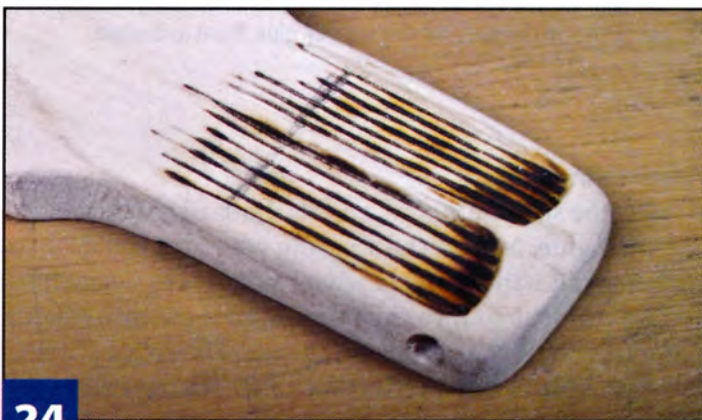
SIMPLE SILVER TRIM

Painting chrome trim on your car can be difficult, and as one of the final steps, it can ruin a terrific paint job. For faster and cleaner trim, try a silver Sharpie to add the chrome trim, the windshield frame, and the wheel spokes.



23

Make the grill. Using a scroll saw, cut the grill's front profile from a piece of $\frac{3}{16}$ "-thick wood, leaving it long enough to hold while sanding and burning. Drill $\frac{1}{8}$ " headlamp holes in the sides of the grill where indicated on the pattern. Hand sand with 150-grit sandpaper to round and shape the grill. Follow with 400-grit sandpaper to prepare the grill for painting.



24

Detail the grill. Draw on the grill lines and sand two shallow recesses where the fins are located using a cylinder-shaped rotary-carving bit. Woodburn the fins into the recesses with a woodburner and a fine writing nib. Cut the grill to size and paint it with metallic chrome spray paint.



25

Make the bumpers. Compound cut two bumpers using the technique explained in Step 5. Shape the bumpers using rotary-carving bits of your choice. Hand sand the bumpers with 150-grit sandpaper to define the shape and finish sand with 400-grit sandpaper. Paint the bumpers with metallic chrome spray paint.



27

Create a steering wheel. For the steering ring, cut a slice of $\frac{3}{4}$ "-diameter CPVC pipe, about the same thickness as the walls of the pipe. Round the ring with 220-grit sandpaper. Drill a $\frac{3}{32}$ " hole through the center of the material you plan to use for the spokes (I used the plastic insert from a CD jewel case). Mark the spokes around the hole and cut the spokes with a hobby knife. Cut the spokes a bit longer than the inner diameter of the steering ring. Fit and trim the ends of the spokes until you achieve a snug fit. Attach the spokes to the steering ring with CA glue. Paint as desired.

Assembling the car

Attach the seat, bumpers, and dashboard to the car with CA glue. Mount the steering wheel on the dash with a small nail (an extra wheel axle works perfectly). Fit the windshield into the hood slot and secure it with CA glue. Color the spokes on the wheels with a silver Sharpie. Mount one prefinished wheel in the center of the trunk with an axle. Mount the prefinished and race-tuned wheels and axles onto the car. Add lead fishing weights in the compartment behind the seat until the car is the proper weight. Glue on the tonneau cover with CA glue to secure and conceal the weights.



26

Make the tonneau cover. Apply the pattern to $\frac{1}{8}$ "-thick wood and cut the cover on a scroll saw. Round all of the edges with 150-grit sandpaper, finish sand with 400-grit sandpaper, and paint with a satin finish paint.

materials
& tools

MATERIALS:

Cut the following blanks from basswood or wood of choice:

- $1\frac{1}{8}$ " x 2" x 7" (body)
- 2 each 1" x $1\frac{1}{8}$ " x 7" (fenders)
- $1\frac{1}{4}$ " x $1\frac{1}{4}$ " x 2" (seat)
- $\frac{3}{16}$ " x 1" x $1\frac{1}{8}$ " (grill)
- 2 each $\frac{3}{4}$ " x $\frac{3}{4}$ " x 3" (bumpers)
- $\frac{1}{8}$ " x $1\frac{1}{4}$ " x 2" (tonneau cover)

Other materials:

- $\frac{7}{16}$ " dowel at least 6" long (headlamps)
- $\frac{5}{16}$ " dowel at least 6" long (fog lamps)
- $\frac{1}{8}$ " dowel at least 6" long (light supports)
- 4 each size 11-0 seed beads (headlamps and fog lamps)
- 2 each $\frac{1}{4}$ "-diameter red craft jewels (taillights)
- $\frac{3}{4}$ " x 1" x 3" wood veneer of choice (dashboard)
- CD jewel case (windshield and steering wheel spokes)
- $\frac{3}{4}$ " CPVC pipe at least 6" long (steering wheel ring)
- Temporary-bond adhesive spray
- Clear packaging tape
- Cyanoacrylate (CA) glue (such as Super Glue)
- Wood putty of choice
- Sandable primer

- Satin black paint
- Metallic chrome spray enamel
- Spray enamel of choice
- Silver Sharpie (optional)
- Clear epoxy resin
- 5 each standard BSA Pinewood Derby wheels
- 6 each standard BSA Pinewood Derby axles

TOOLS:

- Table saw (to cut blanks)
- Scrow saw with #7 skip-tooth blades or blades of choice
- Drill press with $\frac{5}{64}$ "-, $\frac{3}{32}$ "-, $\frac{1}{4}$ "-, $\frac{5}{16}$ "-, and $\frac{7}{16}$ "- diameter bits
- $\frac{3}{4}$ "- and $1\frac{1}{8}$ "-diameter Forstner bits
- Dremel rotary tool
- Dremel sanding drums
- Dremel rotary carving bits of choice
- Bench knife
- Hobby knife
- Carving tools of choice
- Woodburner with skew and writing nibs
- Paper punch
- Assorted sandpaper from 150 to 600 grits
- Artist's paintbrushes



About the Author

Jon Deck is the magazine art director at Fox Chapel Publishing. A former Boy Scout, and Scout leader, Jon has been woodworking for most of his adult life. You can reach him at Jon@FoxChapelPublishing.com.

ROADSTER: MAKING THE HEADLAMPS

The following instructions are for the headlamps, but the same procedure is used to make the fog lamps. The fog lamps are smaller and have amber lenses.

Use CA glue to attach all of the lights in the appropriate positions. Glue the finished headlamps onto the grill and glue the grill onto the car. Glue the fog lamps onto the front bumper supports using $\frac{1}{8}$ " dowels. Glue the taillights onto the rear fenders.



The grill and headlamps are prominent features that distinguish the classic look of the MG-TC roadster.



For taillights, fashion two $\frac{1}{4}$ "-diameter red craft jewels into rectangular shapes by rubbing opposite edges on a flat sheet of 220-grit sandpaper.



1 Make a quick jig. With a drill press, drill $\frac{7}{16}$ "-diameter holes through a block of $\frac{3}{4}$ "-thick wood. Cut two short lengths of $\frac{7}{16}$ "-diameter dowel and place them upright in the jig. Mark the center of the dowels with an awl or punch.



3 Drill the support holes. Remove the dowels and drill a $\frac{1}{8}$ "-diameter hole $\frac{1}{4}$ " deep in the side of each dowel, approximately $\frac{1}{4}$ " from the flared end. Make a pencil line around the dowel $\frac{1}{2}$ " from the end.



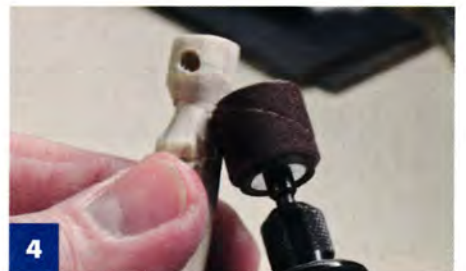
5 Add a light support. Cut the headlamps from the dowels and finish rounding the back with 220-grit sandpaper. Insert a 3"-long $\frac{1}{8}$ "-diameter dowel into the hole on the side of each headlamp and secure with CA glue.



7 Finish the lens. Place a size 11-0 seed bead in the recess of each headlamp. Mix a small amount of clear epoxy resin in a small cup. Using an eyedropper, fill the flared end of each headlamp with the resin to encase the bead and form a lens. Allow the resin to dry thoroughly before proceeding.



2 Drill flares into the dowels. Chuck a countersink bit into a drill press and bore a flare into the end of each dowel.



4 Shape the headlamp. Using a Dremel with a sanding drum, carve a notch around each dowel on the pencil line. Widen the notch, as you round and shape the back of the headlamp. Finish sand with 220-grit sandpaper.



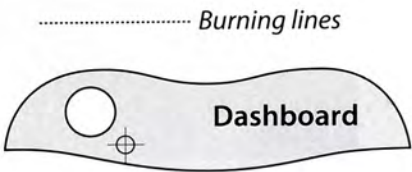
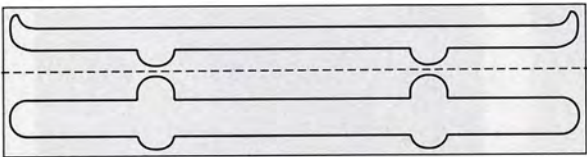
6 Paint the headlamps. Spray the headlamps with metallic chrome paint. When dry, paint the inside of the headlamps with shadows and highlights.



8 Attach the headlamps to the grill. Trim off the light supports to a length that will fit the depth of the holes in the sides of the grill. Make sure the headlamps align properly before securing them with CA glue. Use the same techniques to make the fog lamps and glue them in the holes in the front bumper support.

MG roadster patterns

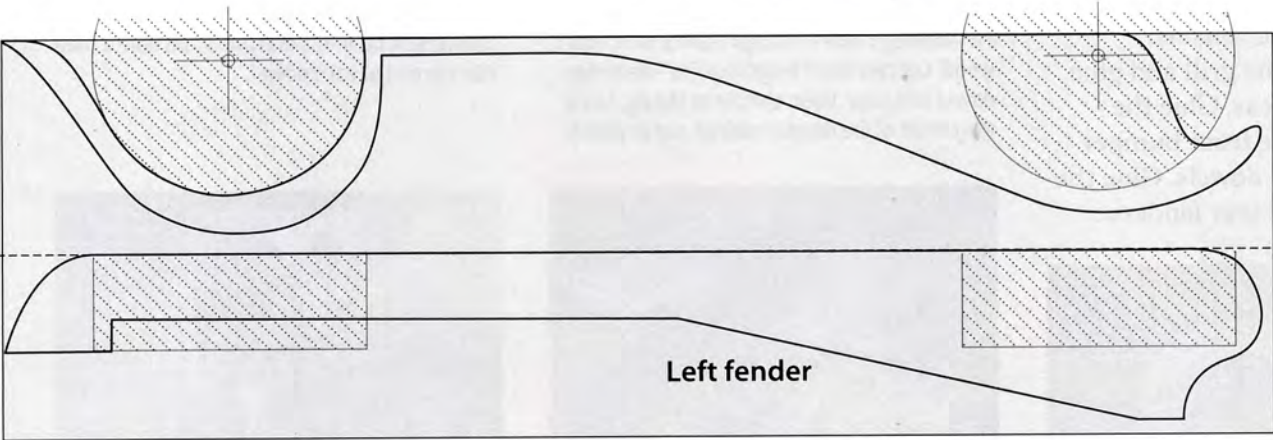
Bumper - Cut 2



Burning lines

Dashboard

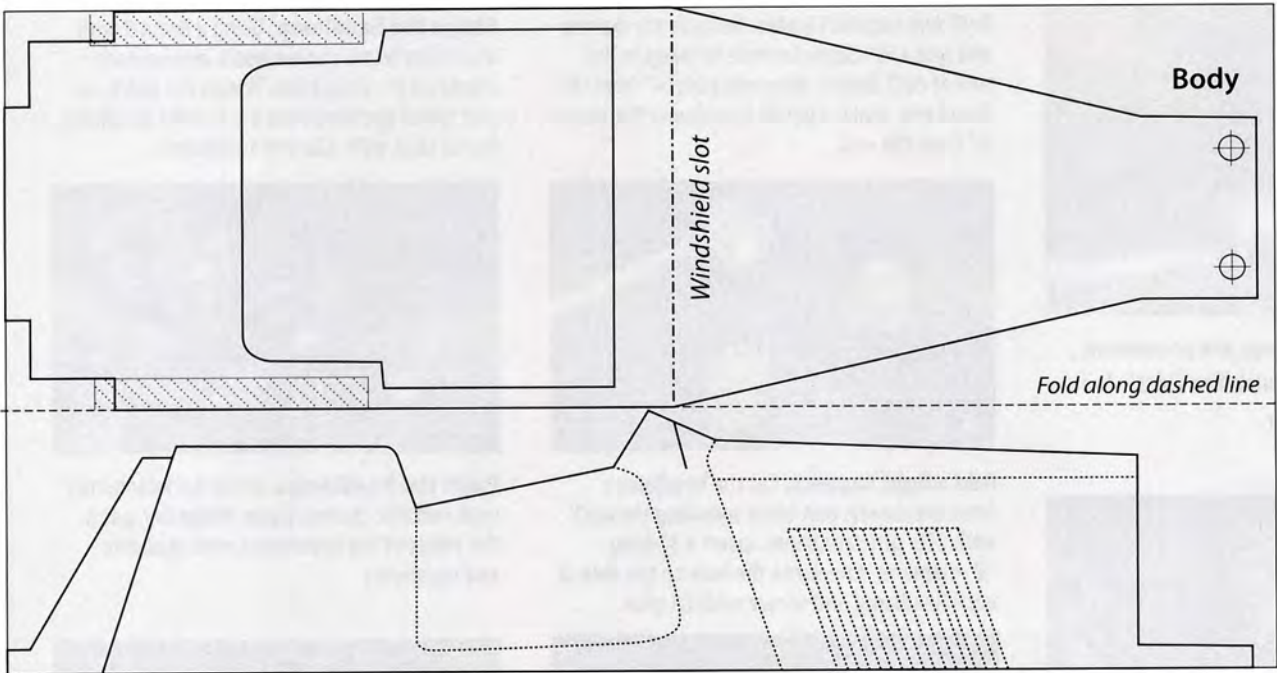
Windshield



Left fender



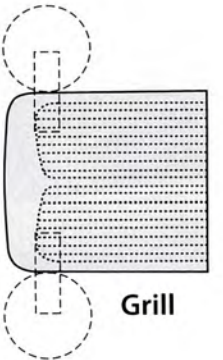
Tonneau cover



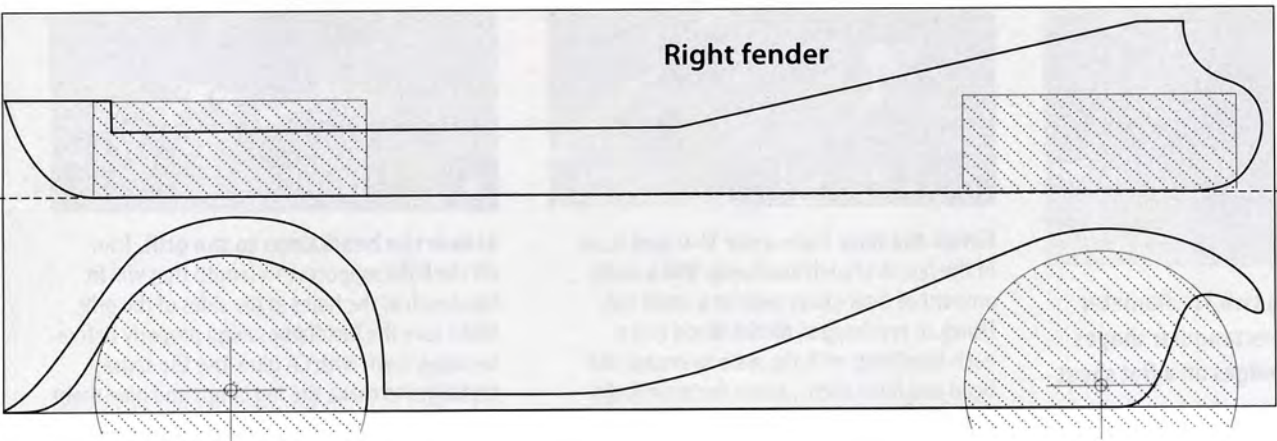
Body

Windshield slot

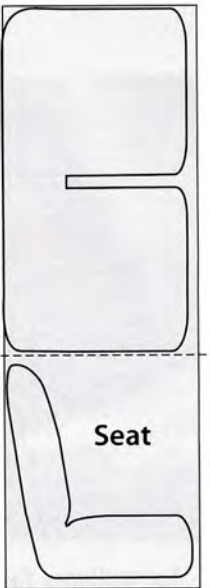
Fold along dashed line



Grill



Right fender



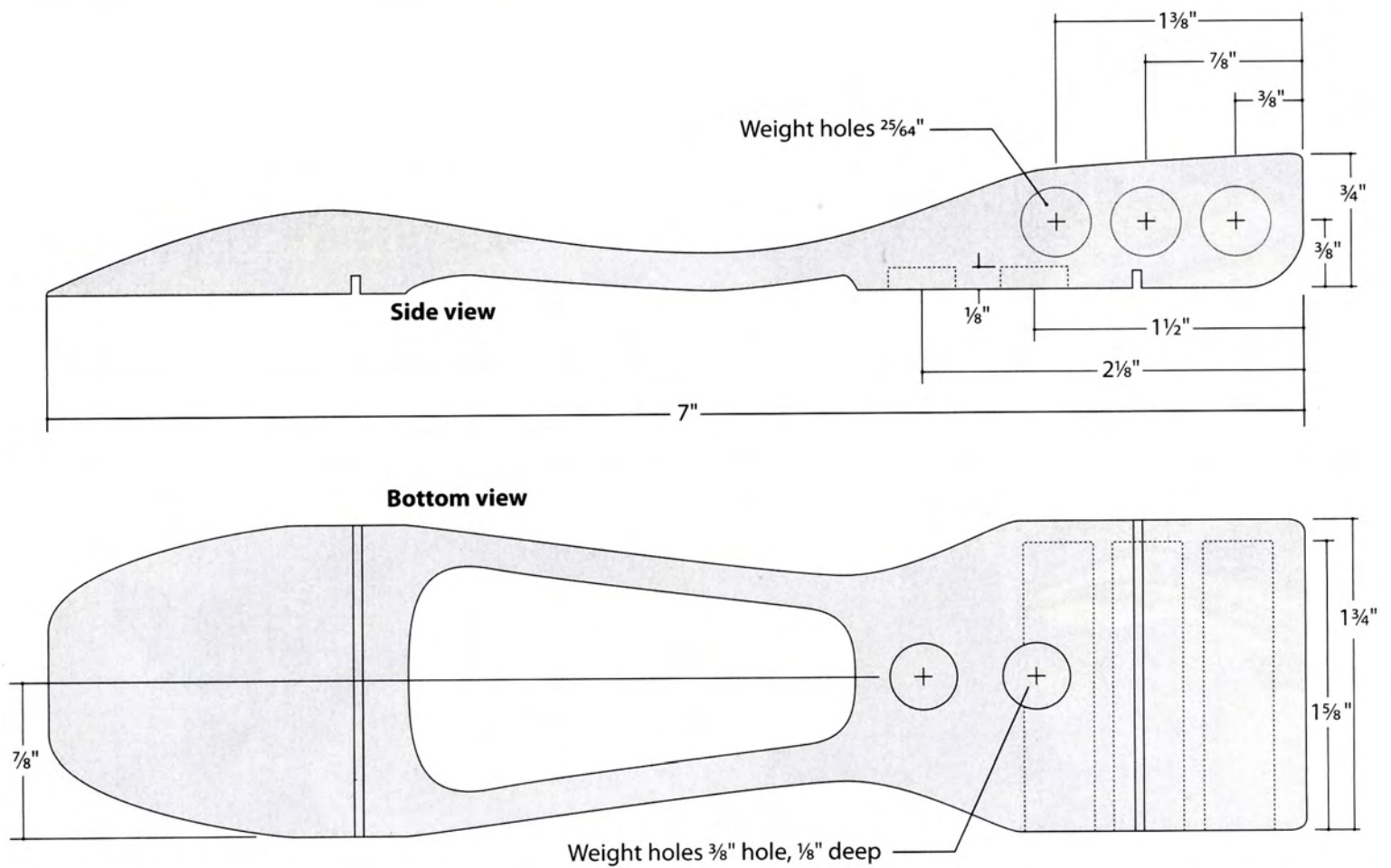
Seat

Shop-Tested Car Patterns



Build an award-winning car with these expert designs

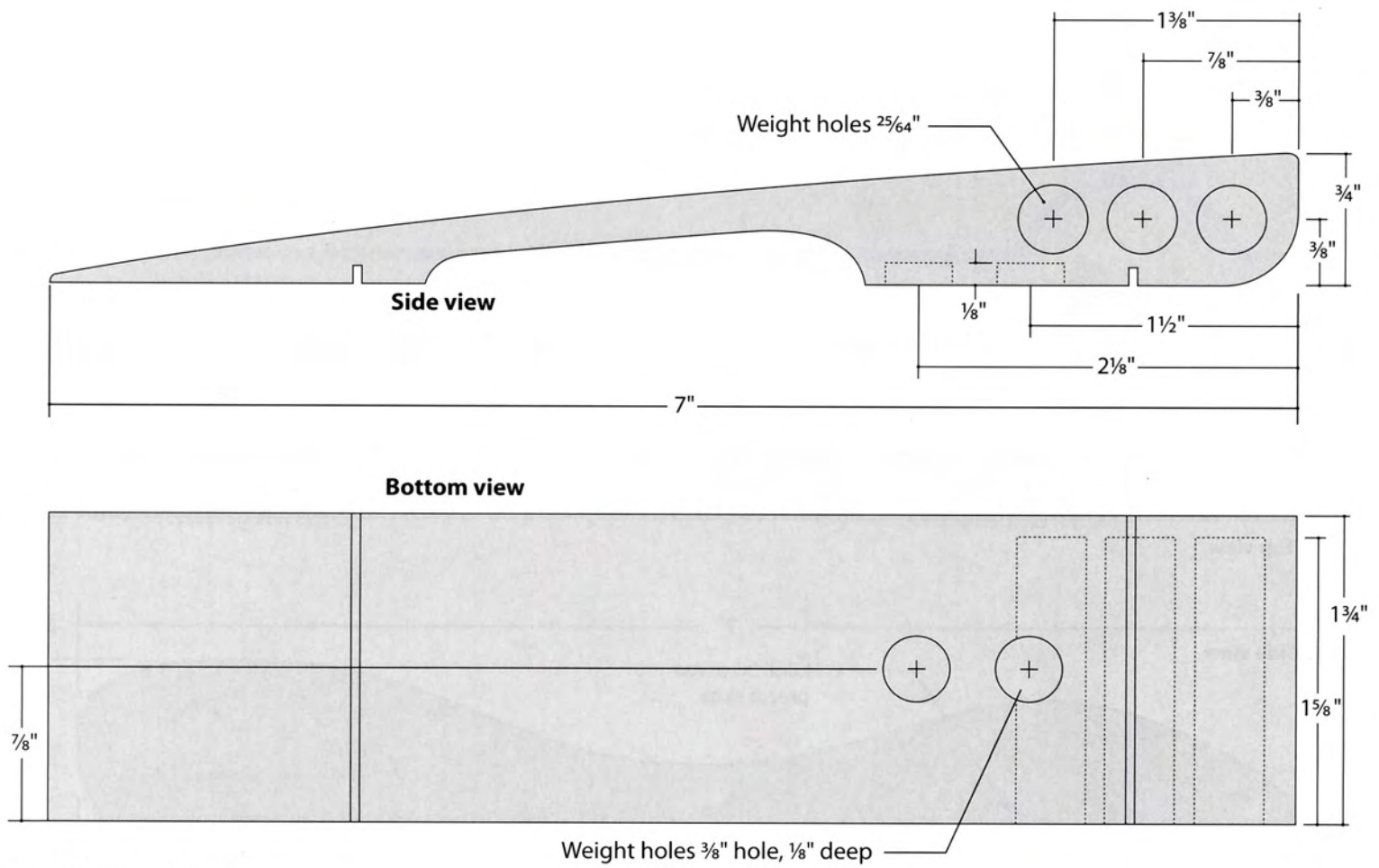
Use these Derby-tested patterns to skip the design step and get right to work. The patterns also make an excellent starting point for custom designs. Remember to trace or photocopy the pattern so you can easily transfer the design to the car and keep the master copy for future reference.



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Design courtesy of David Meade and Troy Thorne

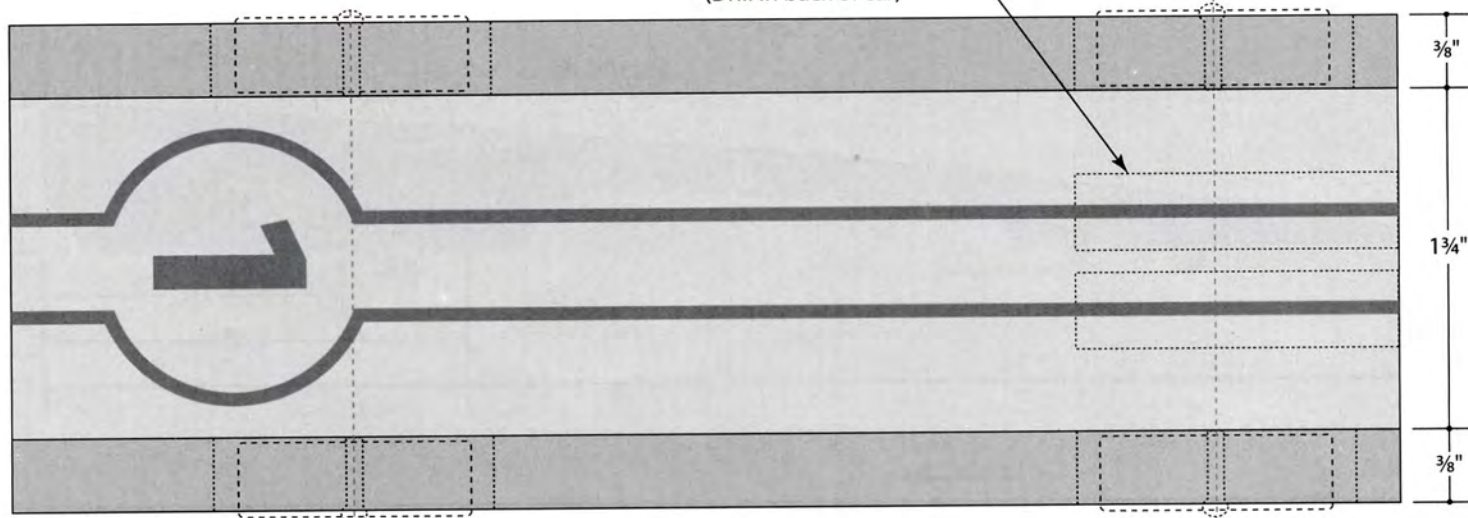


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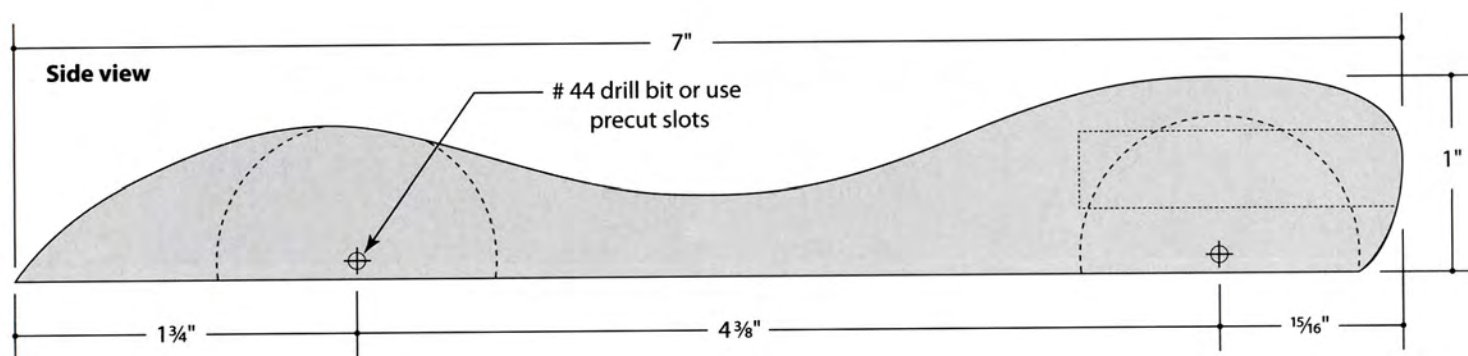


Design courtesy of David Meade and Troy Thorne

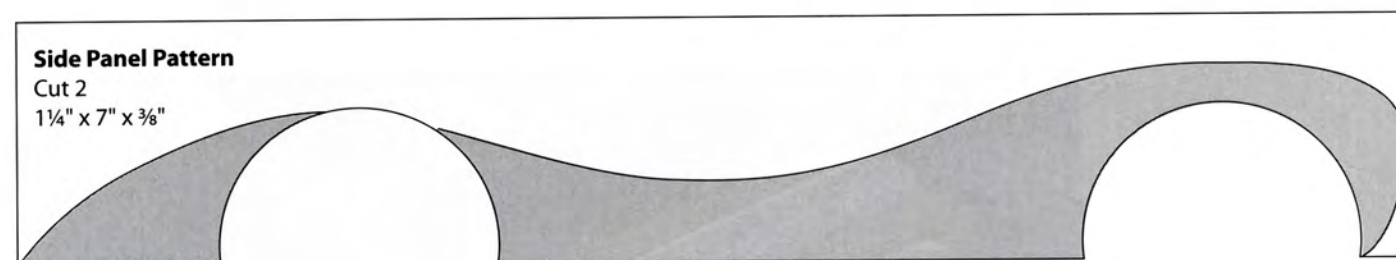
Weight holes $\frac{25}{64}$ "
(Drill in back of car)



Top view



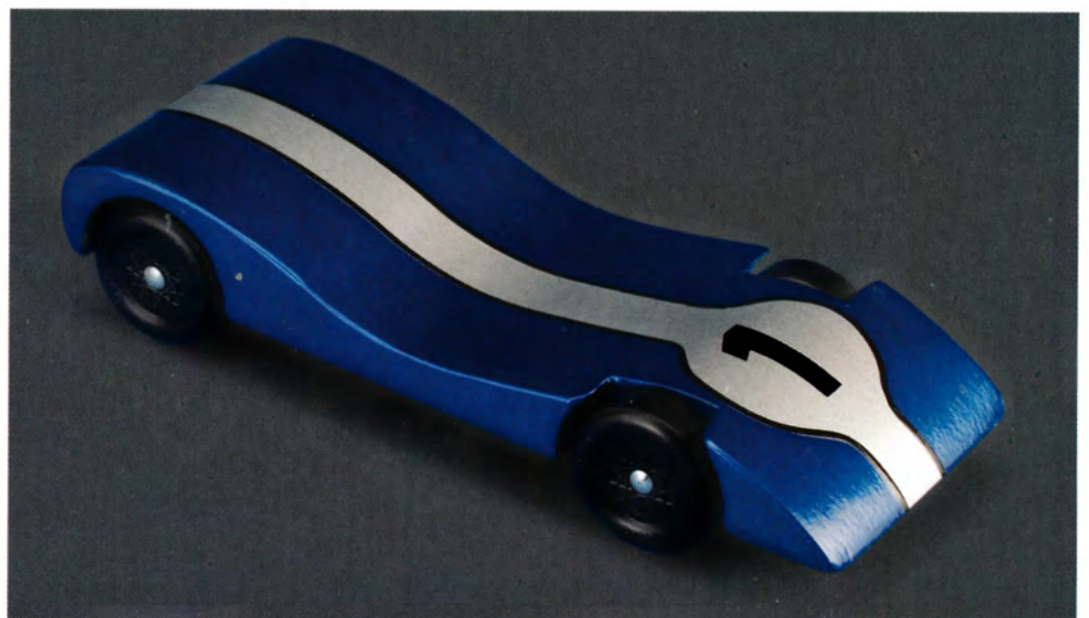
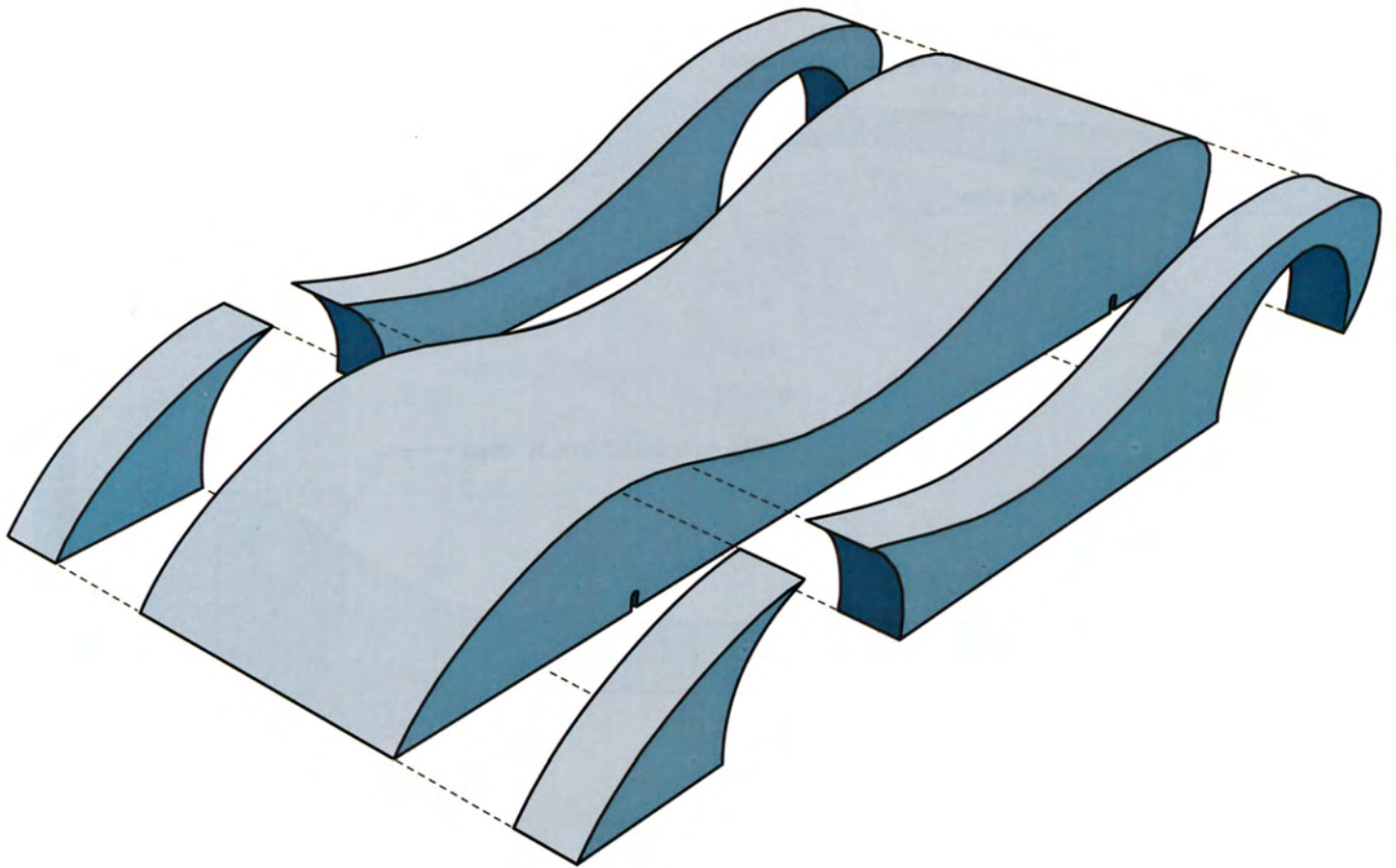
Side view



Side Panel Pattern

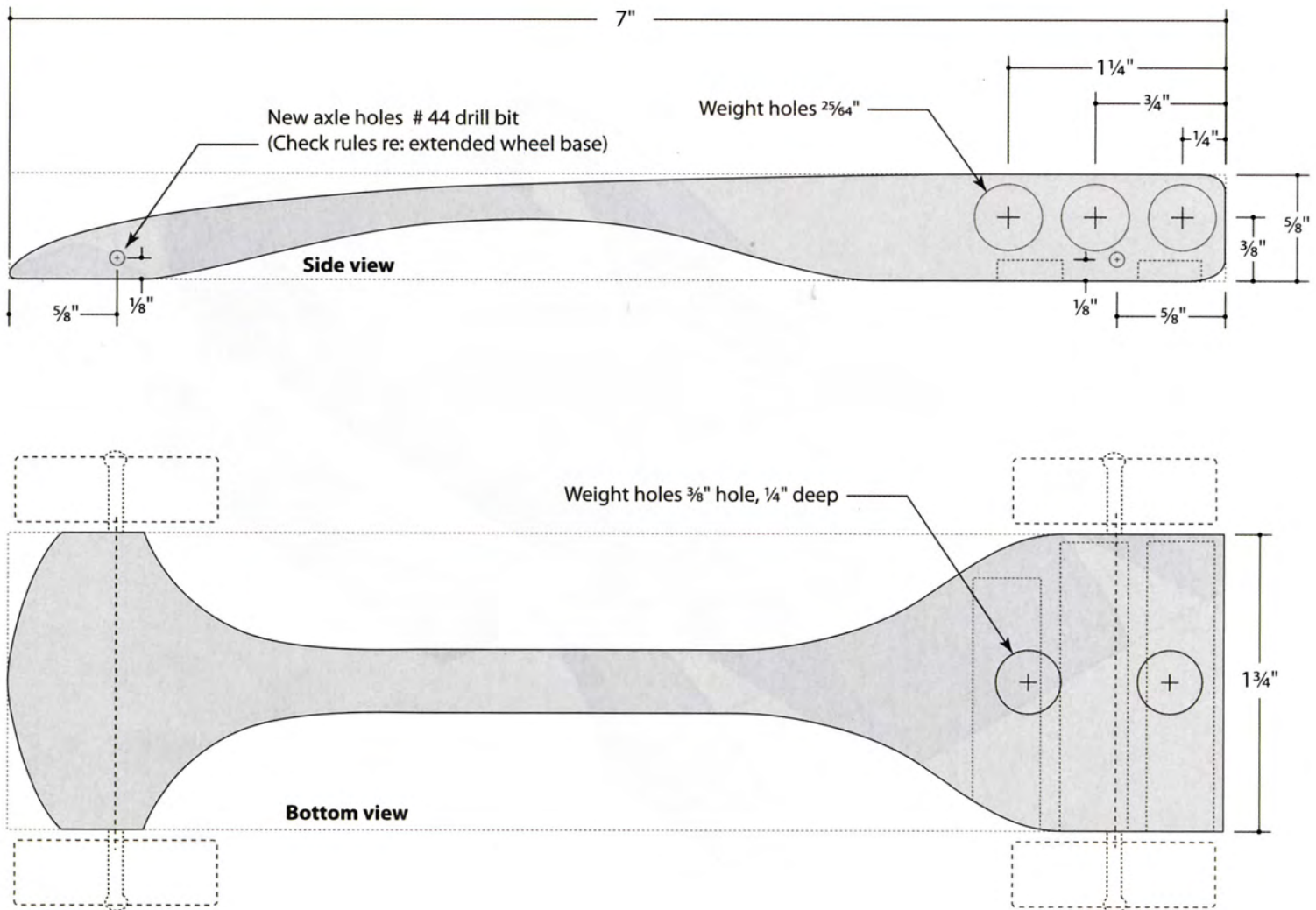
Cut 2
 $1\frac{1}{4}$ " x 7" x $\frac{3}{8}$ "

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Design courtesy of Troy Thorne

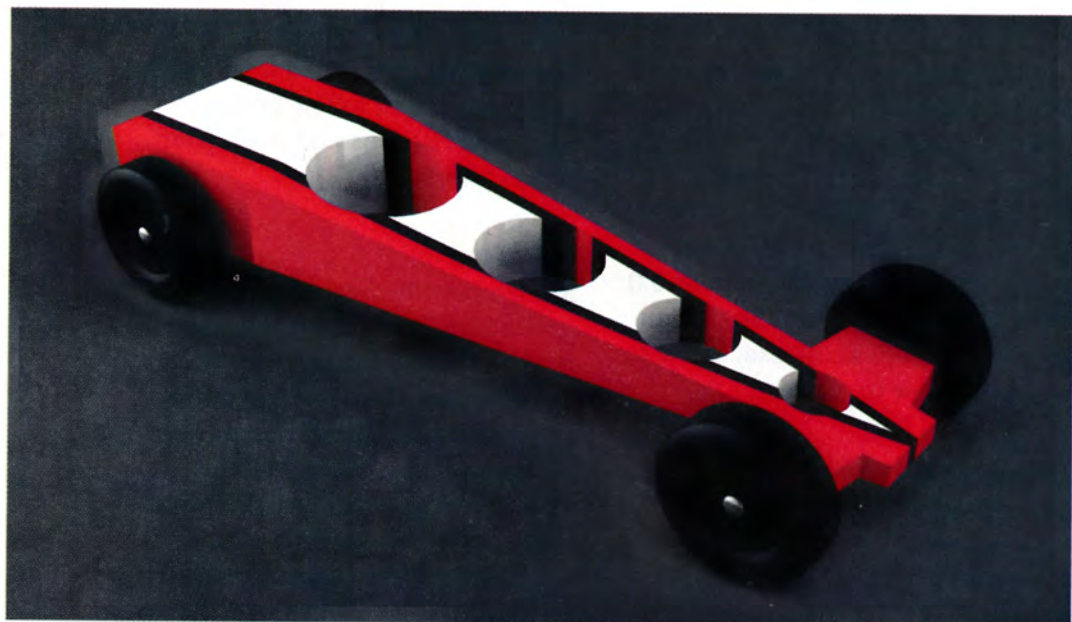
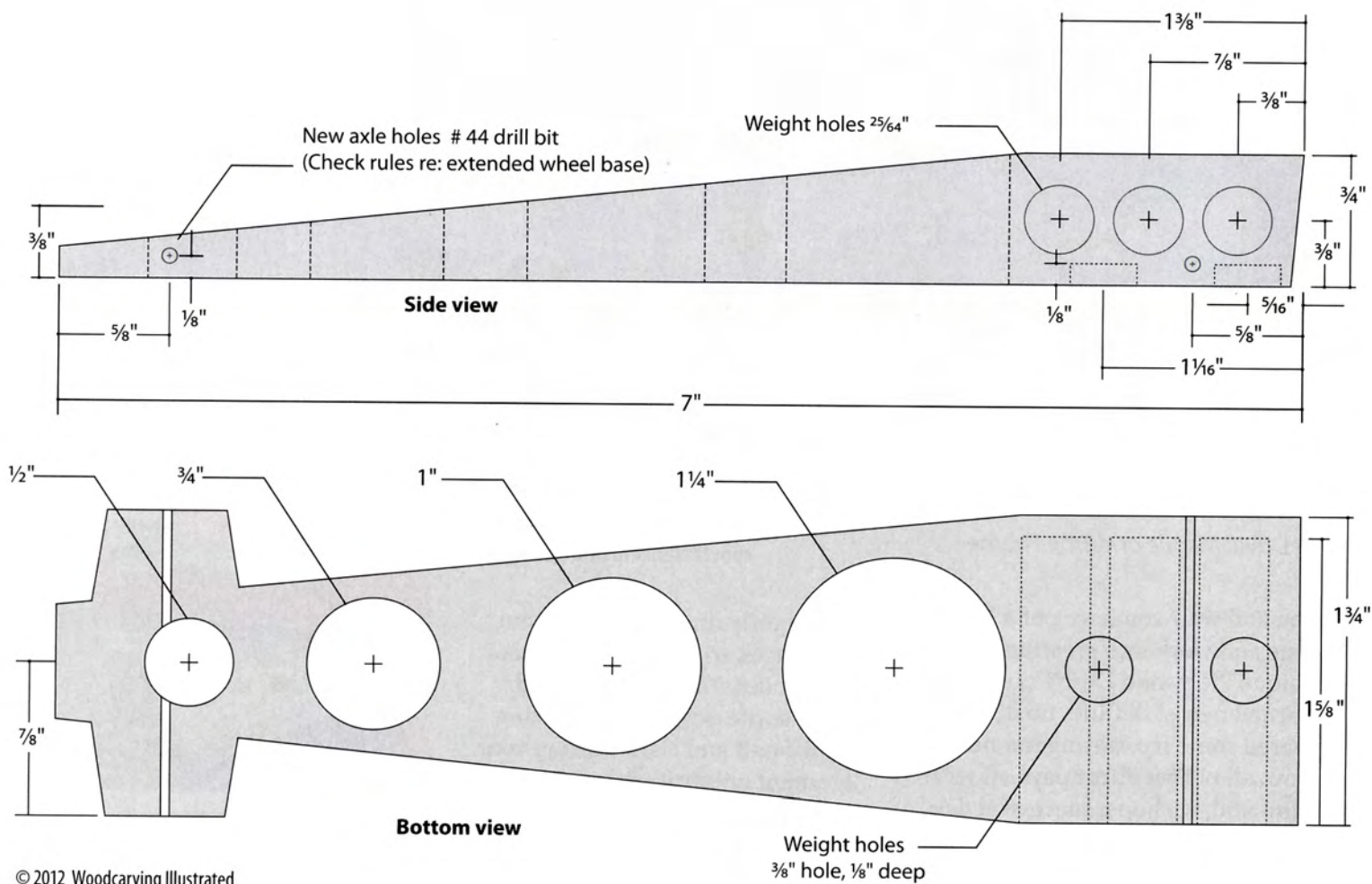
SHOP-TESTED CAR PATTERNS



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Design courtesy of Troy Thorne



Design courtesy of David Meade and Troy Thorne

Race Day



Be prepared for the big day

By David Meade and Troy Thorne

You and your son have put a lot of time and work into creating your unique Pinewood Derby car. You've learned new skills and, no doubt, shared some frustrating moments. Now, all of that effort pays off with a fun and, we hope, successful day at the Derby!

Practice the Weigh-In

At many Pinewood Derby weigh-ins, you will see parents lining up to place their child's car on the scale. Instead, allow your son to weigh the car. Practice at home—put the scale on the table and let your son carefully place the car on the scale, upside down so it won't roll off. Then, have him practice putting small weights (split shot, tiny screws, or bits of tungsten putty) on the scale until it reads 5.0 ounces.

Adjust the Weight

You should know from your previous work on the car, as well as the practice weigh-ins, how much the car weighs. Aim for the car

The key to a successful Pinewood Derby is to show good sportsmanship and have fun.

to be slightly under weight, about 4.95 ounces, to allow for variances in the scales. You can easily add weight at the event, but removing it is difficult and risks ruining your alignment or lubrication.

To add weight, use small weights such as split shot, tiny screws, or bits of tungsten putty. Once your son determines the proper amount at weigh-in, place the weights or press the putty into the previously drilled holes in the bottom of the car. The putty will stick; use quick-drying CA glue to secure weights. If you use tungsten putty, be sure to follow proper safety precautions and wash your hands afterward.

Have Fun!

Remember the most important goal of the Pinewood Derby is to have fun! Have fun by being safe, being honest, and showing good sportsmanship. Even though we have spent a lot of time talking about principles that will help you win the Pinewood Derby, don't forget your Derby experience is only a success if you enjoy the ride.



Have your son practice placing the car upside down on a scale and adding your weights of choice until the scale reads 5.0 ounces.

Pinewood Derby Car First Aid Kit

Follow the Boy Scout motto and be prepared for anything that might happen on race day with this handy first aid kit:

- Cyanocrylate glue (CA glue, such as Super Glue)
- Tungsten putty or extra weights
- Extra graphite lube
- Black electrical tape
- Pliers
- Hot glue gun
- Drill and bit to remove extra weight if needed



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Race Day Log

Heat Race #1

Lane Number	Lane # 1	Lane # 2	Lane # 3	Lane # 4
Time				
Position				

Heat Race #2

Lane Number	Lane # 1	Lane # 2	Lane # 3	Lane # 4
Time				
Position				

Heat Race #3

Lane Number	Lane # 1	Lane # 2	Lane # 3	Lane # 4
Time				
Position				

FINALS

Lane Number	Lane # 1	Lane # 2	Lane # 3	Lane # 4
Time				
Position				

FINISHING POSITIONS

Race Date _____
 Scout's Age _____

Den Number _____
 Car Number _____
 Best Finish _____

Use this handy worksheet to track your car's race results

Performance Evaluation

Race day is the first time most Scouts see their cars perform on a track. You can learn a lot about your design if you watch your car closely as it zooms down the track. Does your car wobble, pop wheelies, or speed up at the bottom? Take notes now so you can build a better car next year!



Observation: Does your car weave around or bounce back and forth as it goes down the track?

Solution: Wheels are not aligned. (See page 68.)



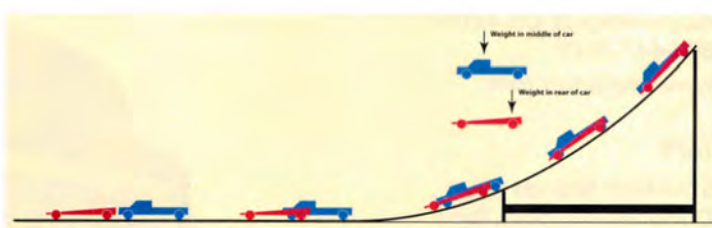
Observation: Does your car get slower and slower from heat to heat?

Solution: Lube your wheels better and break in the graphite well before the race. In other words, your lube is getting worse as time goes on. (See page 64.)



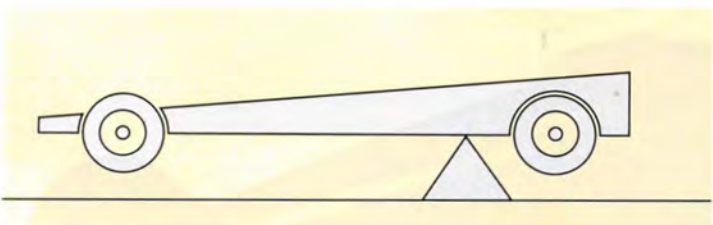
Observation: Does your car get significantly faster each time it goes down the track?

Solution: Break in your graphite better before the race. Each time you race, your graphite is getting more broken in. You need to have your car in top condition on the first race. (See page 39.)



Observation: Does your car look like it is speeding up when it gets to the flat portion of the track?

Solution: If your car does not seem to speed up at the bottom of the track, then you most likely need to put more of your weight in the rear of the car. (See page 44.)



Observation: Does your car pop wheelies or does the front end bounce around a lot?

Solution: Too much weight too far to the rear of the car. Move the center of gravity forward a little bit. (See page 46.)

Areas the car can be improved for next year

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Mini Derby Car Gallery

Dremel employees create unique cars to inspire Scouts at Derby Days held at local Lowe's stores



Photos courtesy of Dremel

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