



Pack 1152
Dearborn Heights, MI
Mahican District
Great Lakes Council

Pinewood Derby

RULES, REGULATIONS,
PROCEDURES,
AND MORE...

IF you have Fun and help others to have Fun,
then we are all WINNERS!

Revision A

WARNING!!!!

**THIS DOCUMENT IS SUBJECT TO CHANGE OFTEN AS WE ADD
ADDITIONAL TIPS, HINTS, AND INFORMATION.**

CHECK BACK FOR UPDATES OFTEN!

Questions concerning this document should be addressed to the Pinewood Derby Chairman, please refer to Section Error! Reference source not found. Error! Reference source not found. for a list of the current officials and contact information.

Parent Participation and Safety

Parents are encouraged to teach new skills and principles as the scouts build their cars. The Scout should do as much as he can by himself, try not to be too critical or expect perfection. Any technical assistance given by an adult should be fully explained to the Scout so that he may use the knowledge on future projects. Above all else, participating in the Pinewood Derby should be safe and fun. Power tools, sharp hand tools, paints, glues, and other potentially dangerous items must only be used under the careful and strict supervision of a knowledgeable adult. Under no circumstances must parents work on a Pinewood Derby racecar when the Scout is not present.

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1 PURPOSE

The purpose of this document is to make sure that the participants in the Pack's annual Pinewood Derby Event have as much fun as possible by understanding the rules and regulations of the event as well as learning a few tips along the way.

The Pack's Pinewood Derby Event is a parent/guardian and son event, and is recommended as such by the National Boy Scouts of America. The Pinewood Derby Committee **STRONGLY SUGGESTS** that each parent emphasize this idea with your son.

Two things the Pinewood Derby requires each participant to learn are

- 1) The craft skills necessary to build a car, and
- 2) The rules that must be followed. Even more important, though, is how we act and behave while participating in the Pinewood Derby or any other group activity.

This is called sportsmanship.

Sportsmanship:

The first thing to remember about sportsmanship is that everyone's skills are a little different.

You may be good at something like singing or drawing, but not as good at something else like basketball or computers. Parents have different skill levels, too. This doesn't mean that you are a good person one time and not good another time. You can always be a good person, whether or not you have good car-building skills. Remember, you and your friends are individuals first and racers second. This idea is often called having respect for others.

The second thing to remember is to follow the rules.

Without rules, there would be no Pinewood Derby. You will never know if you are really good at doing something unless you follow the rules. This is often called being honest.

The third thing to remember about good sportsmanship is that there are winners and losers in every competition.

You accept this when you choose to compete. There may be times when you win and feel happy, and times when you lose and feel unhappy. Being a winner is easy, and losing is sometimes hard. If you win, you must not brag or gloat. If you lose, you must not feel jealous or bitter. To be a good sportsman, you must be able to say "I did my best" and be satisfied with the results. You must also be able to appreciate and feel happy for someone else when they run a good race or build a neat car.

Remember, the main "Purpose" of this event is to have FUN! If you have fun and help others to have fun, then we are all winners!

2 SCOPE

The scope of this document will be to cover the following major topics:

- General Rules and Regulation
- Cub Scout Race Car Design Regulations
- Racing Environment - Track specifications
- Race Day Information, Rules & Regulations
- Parents & Siblings Car Design Regulations and Racing
- Important Dates to Remember
- Construction Tips
- Gilbert and The Pinewood Derby Prayer
- Mahican District Pinewood Derby Rules & Regulations

3 GENERAL RULES & REGULATIONS

The following Rules and Regulations apply to all Race Events.

NOTE: Each Scout is responsible for understanding and following all rules. Nothing would be more heartbreaking than to work hard on a car and then have it disqualified for a rule violation. Parents: please review the rules with your Scout and help him understand the regulations, science, and sportsmanship of Pinewood Derby.

3.1 Qualification to Race

- a.) All registered Pack members Tiger, Cub, and Webelos Scouts may design, build and enter cars that are eligible to participate in the "Cub Scout Race" event.

3.2 Essential Materials

- a.) All cars entered shall be constructed from the "Official Grand Prix Pinewood Derby Kit" (referred to below as the kit) as distributed at the December Pack meeting.



- b.) Additional kits may be purchased from the:

GLC - Great Lakes Council
1776 West Warren Ave.

Pack 1152 Pinewood Derby Rules & Regulations

Detroit, MI 48208

Phone: (313) 897-1965 Fax: (313) 897-9870

- c.) Kits may be purchased elsewhere if they are of the exact type manufactured by the BSA as specified above.

3.3 Competitor Categories

- a.) DENS: Cub Scouts will first compete in heats with others in the same Cub Scout Den.
- b.) PACK: The first, second and third place winners in each Den will move on to the Pack Grand Finals and compete for the overall Pack positions of first, second, and third place Pack Champions.

3.4 Attendance

The Cub Scout MUST enter his own car. This means that the Cub Scout must be present at "Inspection and Registration" to enter his car into competition. If for any reason he is unable to attend the race, he must notify one of the Pack leaders to discuss the matter, and to see if a substitute can be allowed to race his car .

3.5 New Work

- a.) Construction of ALL entries MUST have begun AFTER last year's Pack Pinewood Derby Races.
- b.) The car must be newly constructed each year.
- c.) Modifications to previous year cars shall not be accepted.

3.6 Registration and Inspection Date(s) and Time(s)

- a.) Each car must pass a technical inspection before it may compete.
- b.) Technical inspection and registration of cars shall occur on the date(s) and Time(s) announced by the pack.
- c.) The car drivers and their parents should be at the registration and inspection in case the car is too heavy and weight must be removed.
- d.) Single Entry per Person - Only one car may be registered by any person in the Pinewood Derby.

3.7 Late Registration and Inspection

- a.) If a Cub Scout fails to register his car by the close of registration, he may be unable to race due the commencement of race heat calculations.
- b.) Cars MAY NOT be registered after the close of registration on the day of the race. No exceptions.

3.8 Failure to Pass Inspection

- a.) The Inspection Committee shall disqualify cars which do not meet the rules as described herein.
- b.) If a car does not pass inspection, the owner will be informed of the reason his car did not pass.
- c.) Cars which fail the initial inspection may be taken for modifications and brought back no later than the close of registration for final inspection and registration. We will have tools and supplies necessary to assist each Scout in making their car legal, however, the responsibility of the car being race legal lies solely with each individual Scout.

3.9 Impound

- a.) After a car passes registration, it will be stored by the Pinewood Derby Race Committee until race day/time.
- b.) No car may be altered in any way after it has been registered.

3.10 Car Design Rules Interpretation

Interpretations of the rules described within this document are at the sole discretion of the Inspection Committee Judges present during the Registration and Inspection process.

3.11 Race-Day Rules Interpretation

- a.) On Race-Day, the Cub Scout must make all questions of rules interpretations and procedures to the Pinewood Derby Chairman or Race Officials promptly.
- b.) Decisions of Race Officials on questions of rules interpretations and procedure may be appealed to the Pinewood Derby Chairman.
- c.) All decisions of the Pinewood Derby Chairman are final.
- d.) Decisions of Race Officials on questions of fact (i.e. the result of a specific race) may not be appealed beyond the Trackmaster and/or Finish Line Judges.

NOTE: Unsportsmanlike conduct by any participant or spectator will be grounds for expulsion from the competition and/or the race area.

4 CUB SCOUT RACE CAR DESIGN REGULATIONS

4.1 Overall Car Specifications

- a.) Maximum Overall Width (outside edge-to-edge of wheels): - 2.75"
- b.) Minimum Width between wheels - 1-7/8"

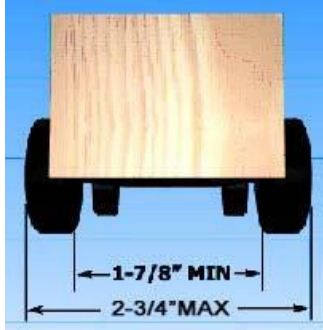


Figure 1 - Inside & Outside Wheel Specifications

NOTE: Typical track Guide Rails are 1-5/8" wide. The block of wood is 1-3/4" wide. Some race regulations specify 1-3/4" as the minimum requirement. This would only leave you 1/8" total space or 1/16" per side of your car down the track. The 1-7/8" requirement here offers you 1/8" on each side of your car to allow for any track irregularities and minimize the amount of time your wheels would rub on the Guide Rails.

- c.) Wheelbase – The distance between axles must NOT be changed.
- d.) Maximum Length - 7"
- e.) Maximum Height – Not to exceed 3"



Figure 2 - Length, Height, Wheelbase, & Clearance Requirements

- f.) Minimum Track Clearance - Bottom clearance between car and track - 3/8"

NOTE: Even though the lane strips are only 1/4" high. The extra clearance is to allow the car to go from the sloped portion of the tract to the flat portion without dragging.

- g.) Front of Car - No part of the car can extend beyond the starting post and the front of the car must be no higher than 1/2" where it contacts the starting post.
- h.) Maximum Weight - Not over 5.00 Ounces (141.75 grams)

4.2 Material

- a.) Race cars shall be constructed for this event from the parts contained in the Official Grand Prix Pinewood Derby Kit (referred to below as the kit) as sold by the local Scout Shop.
- b.) Molded metal bodies over wooden frames are beyond most parent/son team and are therefore not acceptable.
- c.) Materials from the kit may be supplemented but not replaced.
- d.) "ADD-ONS" are not restricted as long as they meet with the rules and regulations as specified within this document.
- e.) Special paint, decals, decorations, etc. are allowed, so long as they do not violate any of the other rules and regulations as specified within this document.
- f.) Unofficial kits will not be accepted. The "Pine Car" Pre-Cut Design bodies WILL NOT be allowed to enter, or any of the other speed or Hodges type kits.

4.3 Weight

"Weight" is considered to be any material on the car that is not provided in the kit.

- a.) Race cars may weigh no more than five (5.00) ounces (141.75 grams) total weight as determined on the official scales during the pre-race check-in.
- b.) Weight may be added to the car and will be considered part of the car for purposes of all measurements.
- c.) The car may be hollowed out and built up to the maximum weight by the addition of solid materials such as wood or metal provided it is securely attached or built into the body chassis.
- d.) The weight MUST NOT be taped on (i.e., masking tape, duct tape, scotch tape...). Heavy duty double back tape such as that used by the ones sold by the BSA - Stick-On Weights (WW7603).
- e.) No liquid weights are permitted inside or attached to the outside of the car body.

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- f.) No weights may be added after the car has been registered and impounded for the Pack race.
- g.) All weight must be securely fastened to the car, e.g. by permanent glue, nails or screws, but not by "sticky substances", e.g. tape, or tack spray.
- h.) Weights shall be passive, i.e. non-moveable, non-magnetic, non-electric, non-sticky, etc.

HINT: If you are unable to check the weight of your car on the official scales prior to registration, then it would be a good idea to be slightly over weight on any other scale you are using. On registration day, it is easier to remove excess weight by drilling holes in the bottom of the car than it is to add weight.

4.4 Wheels and Axles

- a.) All cars must have 4 (four) wheels. The car shall roll on all four (4) of the wheels from the official kit.
- b.) All four wheels **MUST** be in contact with a flat surface when the car is placed on it. Cars will **NOT** be allowed which roll on three wheels. With the car placed on a flat level surface, a slip of paper must be able to be slid beneath each wheel and movement of the wheel must be visible to the inspector.
- c.) The wheels shall turn about the axle nails from the official kit. It must be obvious to the judges that the grooves, wheels, and the nails from the kit are being used.
- d.) Only official BSA wheels and axles may be used as replacements.
- e.) The wheel base (distance between the axles) must not be changed from the standard locations of the official car kit.
- f.) Hubcaps/wheel covers are not allowed.
- g.) The axle nails shall be firmly affixed to the wood of the car body, and **MUST** be placed in the original 'axle grooves' in the supplied wooden block.
- h.) **THE SHAPE AND FORM OF THE WHEELS CANNOT BE MODIFIED OR RESHAPED**, however wheels may be sanded to remove molding burrs. Wheels may **NOT** be tapered or rounded, or in any way be altered from their originally intended shape.



Figure 3 - Example of Rule Breaking Modified Wheels, and Acceptable Wheels

- i.) Wheel treatment (hub and tread smoothing and polishing) may not result in substantial removal of mass or in reducing the wheel width from the original kit wheels.

4.5 Size

- a.) Race cars may be no longer than 7 inches, as determined by the official gages during the Registration and Inspection.
- b.) Race cars may be no wider than 2-3/4 (2.75) inches, as determined by the official gages during the Registration and Inspection.
- c.) Underside clearance of at least 3/8 (0.375) inches and inside wheel to wheel clearance of at least 1-3/4 (1.75) inches is recommended, so that the car will run on the race track.
- d.) Adequate clearance is the responsibility of the race car builder.

4.6 Shape

- a.) The front of the car must not come to a point, or be formed in such a way that it will not stage correctly.
- b.) If the car will not stage correctly against the starting pin on the starting gate, the starter has the option of reversing the direction of the car, and staging it with the opposite end.
- c.) The car should be labeled as to which end is intended to be the front edge (which end will be staged) as it is sometimes unclear which end of the car is the front.

4.7 Lubricants

- a.) The wheels and axles may be lubricated with WHITE TEFLON LUBE OR DRY POWDERED GRAPHITE.
- b.) Lubricants may not foul the track.
- c.) There will be NO lubrication allowed the day of the race.
- d.) No graphite powder is allowed in the building on race day, except by race officials for the use in repairs only. Spilled graphite powder makes a considerable mess of the floor, and is very hard to clean up.
- e.) If wheel or axle repairs are necessary during the race, the replacement part may be re-lubricated under the supervision of a race official.

4.8 Unacceptable Construction

- a.) The following may NOT be used in conjunction with the wheels or axles:
 - Hubcaps

- Washers
- Inserts
- Sleeves
- Bearings

b.) No loose material of any kind is permitted in or on the car.

4.9 Gravity Powered

- a.) The race car may not be constructed or treated in such a way that the track's starting mechanism imparts momentum to the car.
- b.) Cars with sticky substances on the front of the car and protrusions which may catch on the starting pin shall be disqualified.
- c.) The car shall not run on any type of springs.
- d.) The car must be freewheeling with no starting devices.

5 THE RACING ENVIRONMENT

5.1 Track Length and Drop

The track shall have a racing surface (starting line to finish line distance) of approximately 30 feet with a drop of approximately 4 feet.

5.2 Track Slope

The track slope shall decrease from approximately 35 degrees at the starting line to approximately 0 degrees at the finish line.

5.3 Lanes

The Packs Pinewood Derby Track has three (3) lanes.

Each lane will consist of a straight, smooth wooden strip approximately 1-1/2 (1.50) inches, but certainly less than 1-3/4 (1.75) inches, wide and approximately 1/4 (0.25) inches, but certainly less than 3/8 (0.375) inches thick, centered on a smooth surface no less than 4 inches wide. Each race car shall straddle such a strip during its heats.

5.4 Starting Mechanism

The "starting line" shall consist of vertical pins of approximately 1/4 inch diameter, extending approximately 1 inch above the track surface and approximately centered in the each lane.

The starting gate will be activated by a solenoid which is triggered through the race management software used by the pack. A Christmas tree light system will begin each heat, with the gate falling on the trees green light. The Christmas tree light sequence will be initiated through the race management software used by the pack.

5.5 Finish Line Sensor Location

- a.) The track has electronics called "finish line sensors" that shall be in alignment with the corresponding starting line pin and be approximately centered in its lane.

- b.) The primary finish line sensors shall be connected to the computer system that will be managing the race. Placement and times shall be displayed by this system on a screen viewable to all participants. The times will also be viewable on the finish line detector itself.

5.6 Finish Line Judging

- a.) Impartial Finish Line Judges shall be at station to observe each heat, on the track.
- b.) Heat finish judging is determined by the finish line sensor, but may be challenged by the Finish Line Judges in the event of an electrical or human error.
- c.) If the track's electronic finish line sensor's result is challenged by the Finish Line Judges, the race will be re-staged and re-run with the same starting order and lane assignments.

5.7 Finish Line Judge Backup

- a.) Finish Line Judges will temporarily excuse themselves if they know that one of the heat contestants is a son or relative.
- b.) Backup Finish Line Judges shall be available in case a judge needs to be excused for any reason.

6 RACE DAY RULES, REGULATIONS, AND INFORMATION

Competition will consist of heat races within each Den, and a series of Grand Final heats at the Pack level. Track officials are responsible for the proper conduct of the races.

6.1 Inspection Gages

- a.) The race-day "Pit Stop" area will have the official scale and length box.
- b.) The check-in equipment used during the Inspection and Registration of racers shall be the official equipment for the race.
- c.) The same 5 oz. Master Weight used for scale calibration in pre-race check-in will also be available on race day.

NOTE: Please stress this fact to all Cub Scouts. They should be prepared to make adjustments to their cars if necessary.

HINT: If you are unable to check the weight of your car on the official scale prior to registration, then it would be a good idea to be slightly over weight on any other scale you are using. It is typically easier to remove weight than it is to add it.

6.2 Race Day Lubrication

There will be no lubrication allowed on race day. All lubrication must be completed prior to the cars being confiscated at registration.

6.3 Car Handling Responsibility

- a.) Scouts shall be responsible to present their own cars in the pit area and carried to the starting line for staging.
- b.) Cars will be staged on the tracks by the "Starter".
- c.) If a scout's physical limitations prevent him from fully complying with this requirement, the scout may nominate an assistant of approximately the same age who serves subject to approval of the track chairman. In any case, the scout shall participate up to his limitations.

6.4 Lane Assignment

Lane assignments shall be determined by the racing software used to manage the race.

6.5 Car Leaves Lane

- a.) If, during a race heat, a car leaves its lane but proceeds down the track in a manner that does not interfere with its opponent, then the race will be called normally.
- b.) If the car leaves it's lane and interferes with another car, the race will be re-staged and re-run.

- c.) If the same car again leaves it's lane and interferes with another car, that car will be judged last place and the race will be re-staged and re-run without that car.

6.6 Car Leaves Track

If, during a race heat, a car leaves the track without interfering with its opponent, it shall be considered to have ended its heat at that point.

6.7 Car Repair (Without Fault)

- a.) If, during the race, a wheel falls off or the car becomes otherwise damaged, then the SCOUT may, to the best of his ability perform repairs with the assistance of his adult partner or Pit Crewmember.
- b.) The car shall be re-qualified for racing in accordance with Rules above.

6.8 Car Repair (With Fault)

- a.) If a car is damaged due to track fault, or damage caused by another car or person, then the Trackmaster, at his sole discretion, may allow additional repair assistance to the Cub.
- b.) The car shall be re-qualified for racing in accordance with Rules above.

6.9 Call to Race

- a.) Competitors will be called by Den prior to each heat.
- b.) When his Den number is called, each SCOUT should be prepared to retrieve his car from the pit area and present himself, with his car, to "Starter".
- c.) If the Cub does not respond, his name will be called a second and third time.
- d.) If the Cub has not presented himself in time for his heat, he will be judged as placing last for that race heat with a default time of 9.99 seconds.
- e.) If no competitor is present, the track chairman may, at his sole discretion, allow for a substitute scout of the same Den to present the car for the race.

6.10 Track Champion

- a.) The Champion from each Den may be accompanied, with his car, from the track to the stage by his parent or other designee.
- b.) The car will be impounded on the stage until the start of the Grand Final Heats.
- c.) Inspection and repairs to any car prior to the Grand Finals are the sole discretion of the Trackmaster.

6.11 Track Fault

If a car leaves its lane, at his sole discretion, the Trackmaster may inspect the track and, if a track fault is found which probably caused the initial violation, the Trackmaster may order the race heat to be rerun after the track is repaired.

6.12 The Race Area

Only race officials may enter the track area. This rule will be strictly enforced.

6.13 Rewards and Recognition

The most important values in Pinewood Derby competition are parent/son participation, good sportsmanship and learning how to follow rules.

The Awards Committee is responsible for recognizing and encouraging these qualities in addition to traditional racing awards.

Racers will be recognized as follows:

- a.) Every participating Scout will receive a Pinewood Derby Patch.
- b.) Awards will be given to the First, Second and Third place finishers in each Den.
- c.) Awards will be given for the First, Second and Third place finishers overall in the Pack.
- d.) Certificates will be awarded for: "Best Scout Theme", "Best Design", "Most Colorful", "Fastest Racer", and "Most Fuel Efficient Racer"

7 APPENDIX A: Important Dates to Remember

DATE	TIME	LOCATION	DESCRIPTION	COMMENTS
12/15/11 Thursday	7:00pm	St. Sebastian Activity Center	Derby Kits Distributed	HO! HO! HO!
1/19/12 Thursday	7:00pm	St. Sebastian Activity Center	Pinewood Derby Weigh-in CARS ARE IMPOUNDED TILL RACE	BRING YOUR CARS!!!
01/21/12 Saturday	7:00pm	St. Sebastian Activity Center	Pinewood Derby Set Up	Adult Derby Enthusiasts Only Please!
01/22/12 Sunday	1:00pm	St. Sebastian Activity Center	RACE DAY!	VROOooM
TBD	TBD	TBD	Mahican District Pinewood Derby Race!	Den Finalist Can Race

8 APPENDIX C: The Science of the Race and Construction Tips

This purpose of this section of the document is to offer you a better understanding of the science involved in the race as well as a few tips along the way.

The information we are presenting here has been gathered from numerous articles and websites over they years. As this information is neither proprietary nor patentable and is available to the public in many forms from text books to the internet it would be impossible to list all the sources from which you might be able to gather the information.

8.1 The Goal of The Race

Get from the Starting Line to the Finishing Line as fast as possible!!!

This may seem to many to be very obvious, but you would be surprised that many feel that it's to make the coolest fastest looking and most aerodynamic looking car than anyone else. The thinking here is that if you can do this, than obviously you will win the race. Right? Well no not quite right... We have held many races over the years and you would be surprised as to how many times a Cub Scout shows up to the race, pulls the block of wood out of the box, puts on the wheels and wins the race.

You may ask, "How can this be?" Read on a little about the Science involved and a few of the tips and tricks and you will see.

8.2 The Science Involved in The Race

8.2.1 What Makes My Car Go?

Hmm, most racing cars use a special blend of racing high octane fuel. What do you think fuels our cars? Rockets, Springs, Rubber Bands, a good push from a Scout.... Nope not any of these..... OK it's GRAVITY!

This is why all of the races start up high on a sloped portion of track. Gravity pulls on our cars at a rate of 32 feet per second per second. Once the starting line is dropped, gravity literally pulls the car down the sloped portion of the track. OK, so now we know that Gravity fuels our cars. But guess what, you run out of this fuel as soon as the car hits the flat level straight section of the track!

Now back to more scientific stuff... Gravity imparts a "Force" that moves the car. The formula that applies here would be $F=ma$ or Force=mass X acceleration. Alright we have more technical words to explain here. What is Mass? Mass is defined as a property of matter equal to the measure of an object's resistance to changes in either the speed or direction of its motion. The mass of an object is not dependent on gravity and therefore is different from but proportional to its weight. The key here is that the mass of your racing car "is proportional to its weight." Acceleration is defined as the rate of change of velocity with respect to time. Here, you remember that we spoke of 32 feet per second per second.

Now if it was only that easy. We actually have two forces of Gravity working on our cars. The force that is pulling the car "along" the track and the force that

pulling the car down onto the track. These two forces are part of what is referred to as the car's gravity force vectors.

OK, so now we know that Gravity is the fuel, but where or how does our car store this fuel? Gravity provides us with the fuel we need to store "Energy" up for the race while we are behind the starting gate waiting for it to drop. The amount of Energy our car stores up is equal to the mass of our car times the height it is from the level section of the track. The formula $E=mh$ describes how much energy our car will be able to store up for the race. When the car is behind the starting gate waiting for the race to start it has stored "potential" energy. When the car is moving down the track it has "kinetic" energy. When the starting gate is dropped, the potential energy is transformed into kinetic energy.

So now we know what makes our car go. You should also know that this is what makes all our cars go. So why aren't all the races ending in a tie? Ahh, to understand this we need to look at what makes our cars slow... or stop...

8.2.2 What Makes My Car Slow?

The bad guy here is FRICTION! Friction is the main force (there's that word again) that slows our car. Friction is defined as a force that resists the relative motion or tendency to such motion of two bodies in contact. Our car's wheels and the track are the two bodies that are in contact here. OK, yes air is also in contact and some may say that reducing this contact by building the most aerodynamic high polished car would reduce this "air" friction. Bah-humbug is about all I can say to this. I have read a number of articles and the vast majority say that if all of your race cars are of equal weight of 5 oz. and at the size these cars are, air friction is negligible. Remember the block of wood out of the box that won the race!

Remember that Friction was defined as a force that resists the relative motion or tendency to such motion of two bodies in contact. Two bodies in contact... Many of you are now thinking of the wheels touching the track, but there are so many more body combinations you should also be concerned about. Here are a few that come to mind; wheels to track, wheels spinning on axles, wheels rubbing on car, and the inside of wheels rubbing on track guide rail. Friction turns our energy into heat rather than the motion we need down the track.

So now we know that Gravity fuels our car and we store it up as "Potential Energy" before the race and transform it into "Kinetic Energy" as the race starts. We also know that Friction is the main culprit that slows our "motion" down the track and wastes our energy by turning it into heat instead of motion.

8.3 How Can I Make My Car Go Faster?

8.3.1 The Fuel

Let's look at the "Fuel" side of the race first.

We first talked about Gravity and we can't do much about it. If anyone knows how to increase the force of Gravity, let alone on only their car and not the others, please let us know. There has to be a Nobel Prize in it somewhere ☐

8.3.1.1 Weight – How Much?

So if not Gravity, we can only affect the “Mass” of our car. In all my research, the agreement here is to make your car as heavy as the rules and regulation allow. Typically this is 5 ounces or 141.75 grams. So go out, grab some lead and glue it on and your done... right... ahh if it was only that simple.

8.3.1.2 Weight – Where Do I Put It?

It ends up that there are a number of ideas as to the best approach here. Many ideas with as equally as many supporting arguments can be found. Rather than presenting them all here for you, I will present you the most popular location for performance.

First the Don'ts:

- Don't place your weight all the way to the front or rear of the car as this will cause the car to chatter down the track as the lighter end tends to bounce around. You may even bounce off the track!
- Don't attach the weight to the bottom of the car without making room for it first. The bottom of the car to the tracks guide rails for the race needs to be maintained or your car may, or will, rub on the rails or hang-up on the transition from the downhill portion of the track to the flat section. This rubbing causes friction and from what you've read you know that friction is... bad very bad for speed.
- Don't cheat! This is a personal note... some people say to place all the weight off to one side so one of your front wheels will float up off the track. Our organization requires that all four tires ride completely flat on their complete surface and that they all spin and contact the surface of the track. Anything less is simply cheating.

So now that we covered a few of the basic things not to do, here is a summary of the recommendations I have found in my research. It ends up that the best place is somewhere close to the rear or back of the car. The thinking here is that this will help the front wheels perform the function of guiding or steering and the less weight on these wheels the easier the car will be able to correct itself when it hits the guide strip. The fewer and shorter the contacts with the guide strip are, the faster your car will go.

Now you need to be careful here, remember the “Don'ts” above. What you need to do here is to place a portion of the weight behind the rear axle and just enough in front to prevent the bouncing around of the front of the car. Now we are not saying to cut your weight to accomplish this. You can place the weight on top of the car in the area the cross over the axle or below the car startling across the and through the axle groove. Just remember not to mess up the groove area where your axles (nails) will be inserted!

Before we get into the specifics here we need to get into more scientific technical talk. What we need to cover now is “Center of Gravity” sometimes referred to as CG. If an object [your car] is acted on by a net gravitational force mg causing it to have an acceleration a , the center of gravity is the point where a single force F (with the same direction and magnitude as the previous net gravitational force, that is $F = mg$) would act to cause the same acceleration a .

WOW, now that can be a brain full... Let's try putting it a different way, The Center of Gravity of an object is defined as the point in which we can imagine all of the mass of the object to be concentrated.

If you took your race car and support it directly below the center of mass by a pin, the car stays balanced, it does not rotate. There are only two forces; the force of gravity and the force of the pin supporting the car. These forces act along the same line and produce no turning or twisting force (torque).

Some sources say that a good place for the CG of your car at about 1" to 1-1/4" in front of the rear axle. About 25 to 30% of the total wheel base. I measured two pinewood blocks from the kit and found the wheelbase on one to be 4-3/8" and the other to be 4-5/16" If we focus on the 4-3/8" wheel base that puts the placement of your CG at approximately 1.1" to 1.3"

So how do you accomplish this? You need to make sure your design allows for the placement of weight such that when you try and balance it on the point of a sharp pencil, pen or nail that point is centered left and right and somewhere between 1" to 1-1/4" in front of the rear axle. OK, if you're having a hard time balancing your car on a point, let's try drawing a straight line 1" from the front of the axle and another at 1-1/4". Now try balancing the car on a straight thin edge of a ruler. Your car should balance somewhere between these lines. The closer your car's CG is to the back line the better. Adjust the placement of your weight as needed.

8.3.2 The Friction

The second area we need to discuss is what makes our car slow - Friction. How can we minimize friction? Whatever you do, remember to follow the Rules and Regulations of your organizations race and always ask question to your officials prior to race day. It sure would be sad to show up with what you think is a cool idea to take advantage of what you think is a loophole in the regulations and have your car disqualified. Remember, the Rules and Regulations of most organizations are left to the interpretation and final judgment of the Race Officials and Race Commissioner. Just because you may not have explicitly read something in the rules, the Race Officials are free to extrapolate rules that may affect your design. A good example would be the use of a plastic sleeve on your axle that makes sure that the wheel does not rub on the car. You could argue to your blue in the face that this is not a "washer," but you will lose the argument. If you have a question, contact your officials.

- e.) So Friction is our challenge to overcome and wheels rubbing on or touching things are the cause. We want our wheels to spin as freely on the axles as possible, not to rub on the car or the track's guide rails. We can't do much about the flat surface of the wheels touching the track, or can we? Remember the rules of your organization!! Our organization insists that ALL FOUR wheels ride flat and touch the track and that they are NOT modified in any way that changes their shape or size. This eliminates all the ideas of angling the axles or beveling and/or rounding the tires to minimize the amount of tire touching the track (see

Figure 3 - Example of Rule Breaking Modified Wheels, on page 8). This also puts a stop to the idea of off-centering your weight so that one tire floats down the track and you ride on effectively three tires.

The two most important things you can do to minimize friction is Wheel Alignment and Lubrication. In that order! Making sure your wheels are as perfectly aligned as possible and then lubricating them will win you more races than fancy aerodynamic shapes.

Some may insist that “aerodynamics” plays a part in winning. However, we have seen the best built, most aerodynamic car come in last while the plain block of wood straight out of the box come in first! This was due to perfect Wheel Alignment.

8.4 WHEEL ALIGNMENT

The most important factor in winning a race is that you make sure your wheels are aligned.

Wheel alignment refers to how flat your wheels sit on the ground, and how straight they are pointed down the road. In technical terms, your vehicle’s wheel alignment can be measured in terms of (1) Camber, (2) Toe, and (3) Caster.

The two most important of all of these for your Pinewood Derby Car would be “Camber” and “Toe.” We will explain Caster here as well so you have a better understanding of Wheel Alignment in general.

8.4.1 Camber

Camber refers to how flat your tires sit on the ground. Over time a vehicle’s suspension gets weaker and the vehicle actually begins to slowly sag. As this happens the tires can start to ride on the inside or outside edge.

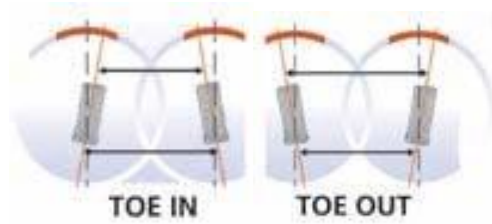


View looking from or standing in Front of the car.

This is referred to as positive and negative camber. The result of positive and negative camber is usually very fast tire wear on the edge of the tire. It can also result in poor steering and handling.

NOTE: This is EXTREMELY IMPORTANT to your Pinewood Derby Car!!.

Toe refers to how straight your wheels are pointed down the road. Wheels that point slightly in towards each other have "toe in." Wheels that point slightly out away from each other have "toe out."

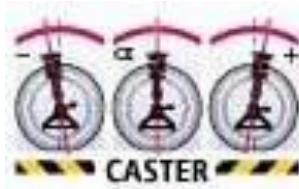


View looking down from above the car.

When your wheels have significant positive or negative toe, your tires are literally dragged down the road. The result is a slow car!!!

NOTE: This is EXTREMELY IMPORTANT to your Pinewood Derby Car!!!

Caster is the orientation of the wheel on the axle. Imagine standing to the side of a vehicle and looking at the wheel and its position within the fender or wheel-well. If the wheel was pushed towards the front of the wheel-well it would have negative caster. If the wheel was pushed towards the back of the wheel-well it would have positive caster.



A vehicle is designed with a specific caster. As the caster changes the vehicle's steering and handling can be effected.

NOTE: As your Pinewood Derby Car does not have a suspension, and should not according to the rules, you don't have to worry about Caster.

8.5 Lubrication

There are only two (2) types of Lubrication that are allowed:

- WHITE TEFLON LUBE
- DRY POWDERED GRAPHITE

Of these two the Dry Powder Graphite seems to be the best choice. My research on the web as well as personal experience with my son's car has shown this to be the lubrication of choice.

8.5.1 Lubrication Application

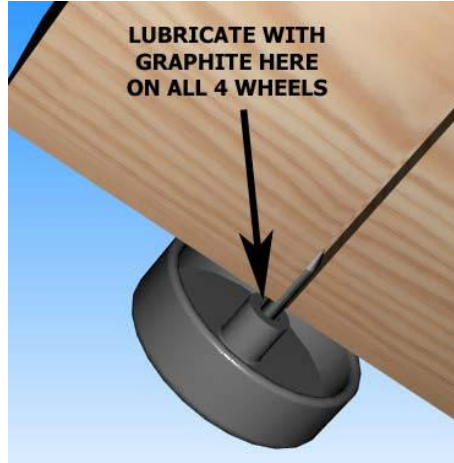
First you need to remember, as all good scouts should, to "Be Prepared." Be prepared to make a big mess. Be prepared to control the mess and you will be able to cut down on cleanup time.

First cover all surfaces of your area with paper or plastic. Once finished, you will be able to carefully fold the cover onto itself and toss it in the can. Second, make sure you have plenty of "Zip-Lock" bags. Third, you should also have a roll or two of paper towels around so racers can try and control their mess on their paper towel and then throw it away when they leave the Pit Area. This will help to keep the Pit Area cleaner for other racers.

Wheel lubrications should start prior to installation, but after you have cleaned, de-burred, and prepared your wheels in accordance with your organizations rules. Remember the Zip-Lock bags above. These bags with graphite in them will allow racers to easily lubricate their wheels prior to installation. Think of it as the "Shake-and-Bake" of racing. Place your tires in the bag, close it up, and shake them around to coat all the surfaces, including inside the axle holes. Use another bag so you can transfer your wheels into it until your ready to install them. If there is enough graphite for all the racers, you could keep your wheels in the bag with the graphite.

Tilt your car to its side and squirt in the graphite from the inside of the wheel while spinning the wheel “slowly” (see Figure 4).

Figure 4 - Wheel Lubrication Location



Keep this up until you have graphite coming out on the spokes side of the wheel onto the paper towel. Repeat this for the other wheels as well until all four have a generous amount of graphite. This should also give you a little graphite on the surface of the wheel that may rub on the car. Feel free to push the wheel in a little towards the body of the car and give yet another shot of graphite on the end of the nail and wheel. Just remember that you don't want your car to be leaving a slick of graphite in it's wake 🚗

8.6 Wheel & Axle Preparation

Proper examination and preparation of your Wheels & Axles can also play a big part in minimizing Friction.

8.6.1 Wheel Preparation

Again, remember to follow the rules of your organization. Our organization basic rule is that **THE SHAPE AND FORM OF THE WHEELS CANNOT BE MODIFIED OR RESHAPED**, however wheels may be sanded to remove molding burrs. Wheels may not be tapered or rounded.

So the basic recommendation here is to exam you wheels and outside and inside the axle hole. On outside you will want to make sure that all burrs and any mold or seam material is removed from wheels (inside and out). You might consider polishing the wheels surface. However, be careful not to change it's shape and not to remove all the tread pattern on the side as this would disqualify the cal in our organization. Inside the axle hole you will want to make sure there are no burrs and/or irregularities in the plastic that would keep the wheel from spinning freely or cause it to wobble on the axle.

8.6.2 Axle Preparation


Axle preparation is somewhat straight forward. You again want to remove any burrs. These are typically found near the head of the nail. Once you have removed the burrs and made sure that your axles are straight you need to polish

them with very fine grit sandpaper, emery paper, or pumice paste. Be careful not to remove too much material from the nail. If reduce the diameter of the nail too much with polishing, it will cause the wheel to wobble on the axle.

8.7 Car Shape

Remember that aerodynamics is not as important as wheel alignment and weight placement. Also, from what you have read about weight in Section 8.3.1 entitled "The Fuel" you know that you want your shape of the car to accommodate the majority of the weight towards the rear and a balance point 1" to 1-1/4" in front of the rear axle.

8.7.1 What End is The Front of The Car?

Again, we want the weight to be as close to the rear of the car, so which end of your block of pine do you think you want to be the rear? OK we'll get straight to the point, what you already peek at the Figure below 

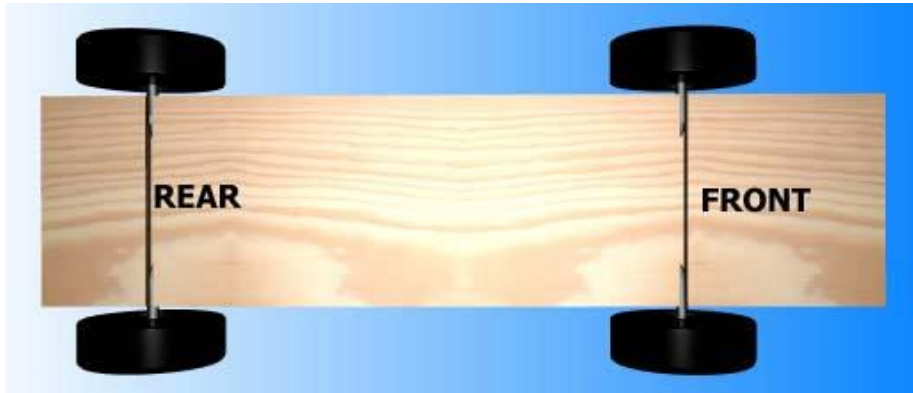


Figure 5 - Rear & Front

You want the rear of the car to be the closest to the axle groove and the front of the car to be the farthest away from the axle as shown in the figure above. This allows you to get that weight as far back on the car as possible following the guidelines we covered about weight in Section 8.3.1 entitled "The Fuel."

8.7.2 What Shape Should The Front of My Car Be?

Here you need to make sure you first understand and follow the rules of your organization on height. It is important that the front of your car makes contact with the starting mechanism of your track. For our organization, and most others, this is a starting post centered in the lane that sticks up from the surface of the track a certain distance.

Our organization has the following rules and regulations concerning the Front of the Car:

“Front of Car - No part of the car can extend beyond the starting post and the front of the car must be no higher than 1/2” where it contacts the starting post.”

This is straight forward and tells you that the starting post sticks up above the track at least 1/2”, more like 3/4”. It also is explicit in stating that no part of your car can extend “beyond” the starting post. This rules out a smiling face, concaved, or Bat Man style car with points or fins sticking out in front of the center of the car.

Your cars front must either be flat or shaped that the center front of the car touches the starting post and nothing else passes the front of the starting post.

Now you need to be careful here as you do not want to make the front of your car too pointy (as seen from overhead). This not only makes it harder to position against the starting dowel, it also may delay your car from breaking the finish line beam due to the front end being off center at the end of the race. You want to make sure that the front of your car is wide enough to make up for any left and right motion it might have as it travels down the track.

Most timers use an infrared sensor in each lane at the finish line and a start switch connected to the starting gate. As the starting gate drops the timer is activated – as each car crosses the finish line, a light beam centered on the respective lane stops the timer. It can be critical that the car be wide enough in the front end that it breaks the light beam as the first part of the car crosses the finish line. A car that has a sharp point at the front may be running far enough to the side of its lane that the front of the point will miss the light beam and another, trailing part of the car will break the beam. This can result in slower times – please plan your car accordingly.

MORE WINNING TIPS ON THE DETAILED DESIGN OF THE FRONT OF THE CAR TO COME....

8.7.3 Closing Comments on Car Shape

Well we have said it over and over, so what the heck, we'll say it again...

The alignment of your wheels, the weight of your car, and the balancing point or center of gravity of your car is what is important, NOT the shape.

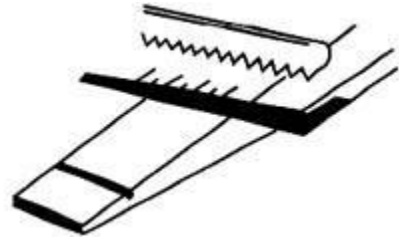
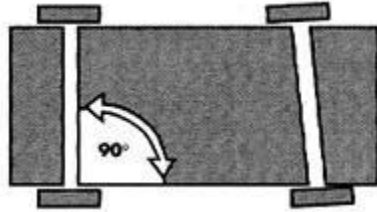
Your shape only needs to stay within the rules of your organization for the overall size, clearance, and front of car rules and regulation. Other than this, get the alignment of your wheels right, get the car as close to 5 ounces (141.75 grams) as possible, place that weight as suggested and lubricate with graphite.

8.8 Closing Comments

Your set, go out and HAVE FUN and you're guaranteed to be a WINNER! Remember, it's not the winning that's important in this race. It's spending time with your boy, teaching him a few skills, building the car together, learning and following the rules, having fun, and on race day helping others to have as much fun as possible! If we all have fun then we are ALL WINNERS!!

9 APPENDIX D: BUILDING INSTRUCTIONS

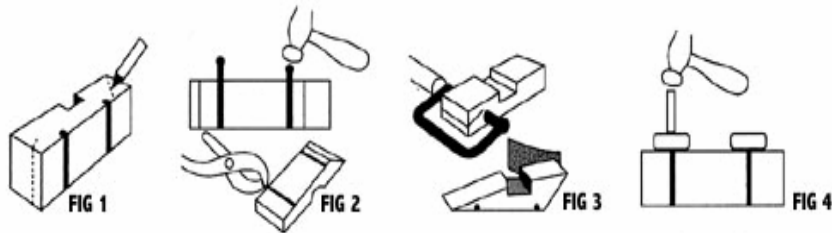
Check the axle grooves to ensure that each is at a perfect 90-degree angle to the car body.



A car with untrue axles tends to steer to one side or the other, causing it to rub up against the side of the lane strip, slowing it down. You can check the groove angles by using a square, a protractor, or even a piece of paper.

Lay square on block to check for squareness and alignment of slot.

Use two hacksaw blades side by side to redress the slots. Use the edge of the square as a guide.



Choose your favorite design, then mark the block accordingly (See Figure 1). Lay car body on the side, then gently drive the axles into the grooves within a $\frac{1}{4}$ " of the axle head. Axles should fit tight. With a pair of pliers, remove axles by pulling and turning gradually (See Figure 2). Repeat on the other side of block. Most of the cutting can be done with a hand saw, then finished with sandpaper (See Figure 3). Details such as fins and scoops should be added now. Any additional weight needed to achieve a total of 5 ounces should be built into the car.

NOTE: If the car design you chose has a narrow body, make sure the area where the axles are inserted into the body remains 1-3/4" wide, or wheels will not fit over the guide strips of the track.

9.1 PAINTING AND WHEEL ASSEMBLY

Apply several coats of sanding sealer; then sand entire car with a fine-grade sandpaper.

Give model at least two coats of fast drying paint, in your choice of color.

When paint is completely dry sand with a fine sandpaper, apply a final coat of paint and allow to dry thoroughly.

TO FINISH, rub entire car with a rubbing compound.

Details such as windshield, driver, racing numbers, etc., should be added now.

For a super finish apply a coat of auto wax and rub to a high gloss.

Pre-lubricate axles and wheels using, dry powdered lubricant. Do not use regular oil or silicone spray, since it may soften the plastic.

Slide wheels over axles, then gently tap them into the car body grooves with a 1/4" dowel or similar object to within 1/32" of car body (See Figure 4). Make sure wheels turn freely.

10 APPENDIX G: Gilbert and the Pinewood Derby - A Simple Prayer

by Peggy Porter

My son Gilbert was eight years old and had been in Cub Scouts only a short time. During one of his meetings he was handed a sheet of paper, a block of wood and four tires and told to return home and give all to "dad."

That was not an easy task for Gilbert to do. Dad was not receptive to doing things with his son. But Gilbert tried. Dad read the paper and scoffed at the idea of making a pine wood derby car with his young, eager son. The block of wood remained untouched as the weeks passed. Finally, mom stepped in to see if I could figure this all out. The project began. Having no carpentry skills, I decided it would be best if I simply read the directions and let Gilbert do the work. And he did. I read aloud the measurements, the rules of what we could do and what we couldn't do.

Within days his block of wood was turning into a pinewood derby car. A little lopsided, but looking great (at least through the eyes of mom). Gilbert had not seen any of the other kids' cars and was feeling pretty proud of his "Blue Lightning," the pride that comes with knowing you did something on your own.

Then the big night came. With his blue pinewood derby in his hand and pride in his heart we headed to the big race. Once there my little one's pride turned to humility. Gilbert's car was obviously the only car made entirely on his own. All the other cars were a father-son partnership, with cool paint jobs and sleek body styles made for speed.

A few of the boys giggled as they looked at Gilbert's, lopsided, wobbly, unattractive vehicle. To add to the humiliation Gilbert was the only boy without a man at his side. A couple of the boys who were from single parent homes at least had an uncle or grandfather by their side, Gilbert had "mom."

As the race began it was done in elimination fashion. You kept racing as long as you were the winner. One by one the cars raced down the finely sanded ramp. Finally it was between Gilbert and the sleekest, fastest looking car there. As the last race was about to begin, my wide eyed, shy eight year old ask if they could stop the race for a minute, because he wanted to pray. The race stopped.

Gilbert hit his knees clutching his funny looking block of wood between his hands. With a wrinkled brow he set to converse with his Father. He prayed in earnest for a very long minute and a half. Then he stood, smile on his face and announced, 'Okay, I am ready.'

As the crowd cheered, a boy named Tommy stood with his father as their car sped down the ramp. Gilbert stood with his Father within his heart and watched his block of wood wobble down the ramp with surprisingly great speed and rushed over the finish line a fraction of a second before Tommy's car.

Gilbert leaped into the air with a loud "Thank you" as the crowd roared in approval. The Cub Master came up to Gilbert with microphone in hand and asked the obvious question, "So you prayed to win, huh, Gilbert?"

To which my young son answered, "Oh, no sir. That wouldn't be fair to ask God to help you beat someone else. I just asked Him to make it so I don't cry when I lose."

Children seem to have a wisdom far beyond us. Gilbert didn't ask God to win the race, he didn't ask God to fix the out come, Gilbert asked God to give him strength in the outcome. When Gilbert first saw the other cars he didn't cry out to God, "No fair, they had a fathers help."

No, he went to his Father for strength. Perhaps we spend too much of our prayer time asking God to rig the race, to make us number one, or too much time asking God to remove us from the struggle, when we should be seeking God's strength to get through the struggle. "I can do everything through Him who gives me strength." Philppines 4:13

Gilbert's simple prayer spoke volumes to those present that night. He never doubted that God would indeed answer his request. He didn't pray to win, thus hurt someone else, he prayed that God supply the grace to lose with dignity. Gilbert, by his stopping the race to speak to his Father also showed the crowd that he wasn't there without a "dad," but His Father was most definitely there with him. Yes, Gilbert walked away a winner that night, with his Father at his side.

(Source: U. S. Scouting Service Project
<http://usscouts.org/usscouts/pinewood/gilbert.htm>)

11 APPENDIX P: Mahican District Pinewood Derby Rules & Regulations

11.1 Dates & Time

Please refer to Section 7 APPENDIX A: Important Dates to Remember for the following important dates and time:

TBD

11.2 Qualification to Race (Who)

From each Pack you are eligible to enter the following four (4) Pack Members in the District Race:

- 1st, 2nd, and 3rd Den finalist from each den.

Only "Grand Prix" cars allowed!

11.3 Race Location

TBD

All Scouts and their families are invited to come and watch the representatives from their Pack.

11.4 Registration Cost

\$6.00 per car (due at weigh-in).

For more information contact William Powell 734-284-8660
subdeacon@wowway.com

11.5 Mahican District Race Rules

2012 Official Rules and Regulations

Car Specifications

Width: The width of the car may not exceed 2.75 inches.

Length: The overall length of the car may not exceed 7 inches.

Weight: The total weight of the car may not exceed 5 ounces.

Ground Clearance: The minimum ground clearance must be 0.375 inches.

Wheels and Axles: The wheels and axles must be those supplied by the BSA in their kits. NO SUBSTITUTIONS! The wheels may be trimmed, but not rounded, pointed, or thinned. The tread must remain original width. No hubcaps (stickers on the outside of the wheel). Axles may not be altered in anyway, except for polishing. Wheel bearings, washers and bushings are prohibited. Wheel hubs (

the part of the wheel that contacts the car) shall not be rounded, drilled, filed, or altered in any way. Wheels shall not be lightened by removal of excess plastic.

Wheel Base: The distance between the front and rear axles must not be changed from the kit body distance of 4.25 inches. The minimum width between the wheels must be at least 1.75 inches.

Materials: No loose materials of any kind are permitted.

Lubrication: Only graphite or powdered Teflon "white lube" is allowed for lubricating the wheels. Cars with any type of oil, synthetic lubes, etc. will not be allowed to race.

Car Body: Car bodies must use the block of wood supplied in the BSA Grand Prix Pinewood Derby Kit; body may be shaped to a custom design within the above specs. Body may be hollowed out and built up to maximum weight, provided all additions are securely attached. The use of altered front ends of cars with "cheater bars" will not be allowed.

Details: Details such as steering wheels, driver decals, paintings, interior details are permissible as long as the inclusion of these details does not exceed the length, width, weight and ground specifications.

Propulsion: Gravity is the only allowed method of propulsion.

Inspection: Each car must pass inspection by race officials before competition. Race officials will disqualify those cars, which do not meet these specs. Once a car is accepted, only race officials may handle it. If a car does not meet the above specs at the time of registration, it may be modified and resubmitted as long as registration is still open.

Car Specifications and inspection Decisions: The Race Official's decision(s) in any car specification and/or inspection matter will be final.

Race Rules

Eligibility: (1) The car must be newly built for the current year by the Scout with parental help if needed. (2) The car must have competed in their respective Pinewood Derby and placed 1st, 2nd, or 3rd in their respective den. (Substitutions will be allowed if the 1st, 2nd, or 3rd place finishers cannot compete on the day of the District Derby)

Maintenance: Once the Pinewood Derby car has been accepted by the inspection committee, no maintenance of any kind is permitted, including additional lubrication. No modifications are allowed with the exception of pushing the wheels back on if they become dislodged. All repairs will be made by a race official.

Disabled Cars: If a car becomes disabled during the race, it may continue until it no longer will go down the track or is eliminated.

Race Decisions: The Race Officials decision(s) in any race matter will be final.

Race Format

Each car gets one trip down each lane (4 trips) on one of the two tracks. (Track choice is not permitted)

The cars are then ranked by total time.

Pack 1152 Pinewood Derby Rules & Regulations

The 3 lowest total time cars in each den win a trophy and then go on to compete in the finals.

Final Round:

Each car gets one trip down each lane (4 trips) on the track designated for the finals.

The cars are then ranked by total time for the final races.

The 3 lowest total time cars in the final races win 1st 2nd and 3rd place trophies.

11.5.1 Check-in and Racing

- a.) The Tiger Cub or Cub Scout is expected to race their car.
- b.) If due to illness, they are unable to race their car, another child may drive their car with the approval of the District Race Committee.

