



Tips and Tricks Building an AWANA Grand Prix Car

RACE DAY
Friday April 27th, 2011

Table of Contents:

- I. Mandatory Racing Specifications
- II. Speed Tips
- III. Design Tips
- IV. Grand Prix Car Physics
- V. Construction Tips
- VI. Assisting Your Child
- VII. Putting Weight In



I. MANDATORY RACING SPECIFICATIONS

1. Overall car length shall not exceed 7", overall width shall not exceed 2 3/4", distance between the wheels shall be at least 1 3/4", and overall height shall not exceed 3"
2. Clearance to the bottom of the car when resting on its wheels must be at least 3/8" so it will not rub on the lane strip.
3. Car weight shall not exceed 5 oz. Weight may be added to lighter cars to bring them to 5 ounces, but the weight must be securely attached.
4. Wheel bearings, bushings, washers, and springs are prohibited.
5. The addition of decals, driver, steering wheel, car trim, accessories, and painting are permitted as long as they do not cause the car to exceed the maximum dimensions or weight.
6. Starting devices are prohibited. Cars must be freewheeling.
7. The assigned car number must be marked somewhere on the car. If you don't want it showing on your beautiful finish, it may be on the bottom of the car.
8. Wheels and axles from the AWANA kit must be used.
9. Wheels and axles may be lubricated with any dry type of lubricant, but excess lubricant must be wiped off, so as not to foul the track. Once a car is checked in, no further lubrication will be allowed.
10. Wheels can be lightly sanded but must not result in substantial removal of mass or in reducing the wheel width from the original kit wheels. Wheel shape may not be altered from the original condition (i.e. rounded, beveled, cupped, etc.).
11. The car must pass inspection by the AWANA Grand Prix Inspectors at check-in time. If the car does not pass initially, it may be modified at the repair station as long as it passes by the end of the check in period.

II. SPEED TIPS

1. Weight - Winning cars generally weigh the maximum 5.0 ounces. The more weight the more the potential energy the car has and thus the faster it will go.
2. Weight Placement - The weight should be concentrated as far back as possible, without causing the car to pop a wheelie.
3. Reduce Friction - Friction slows the car down, so you should try to reduce all possible sources of friction including:
 - Axles - Remove any burrs and polish to a mirror finish. Use a light lubricant like graphite on the axles.
 - Wheels - Trim the plastic stubs from the inside wheel edge and lightly sand. Lightly sand the wheel tread to remove any flat spots and plastic flashing. Be careful not to reshape or resize the wheels and if sanded too long or too hard the plastic will melt.
 - Aerodynamic Shape - Aerodynamic drag is very small, but if you want to reduce all possible sources of friction, then choose a streamlined shape.
4. Wheel Alignment - Check the axle slots to ensure they are square. Check the wheels on a flat surface before gluing in place.

III. DESIGN TIPS

1. Originality - Be creative and use your imagination. Your car doesn't need to look like a car. You can make it into whatever you want, as long as it is within the size limits.
2. Shaping - One of the judging criteria's is how much the design looks like what it was intended to look like. Draw the design on paper first then transfer it to the wood block.
3. Sanding - Once the car is cut out, fill any gouges or divots with wood putty. Use finer and finer grit sandpaper to remove all visible scratches.
4. Finishing
 - Prime - Use a couple of light coats of primer to hide the wood grain and any splotches on the wood. Sand very lightly with very fine sandpaper to remove any small bumps.
 - Paint - Apply several light coats of spray paint and lightly sand in-between each coat. Make sure the paint is thoroughly dry before handling your car or you may leave fingerprints.
 - Decals and Attachments - Add your car number and other decals or attachments carefully.
 - Finish Coat - Apply a clear coat of lacquer or use wax to give your car a nice shiny appearance.

V. GRAND PRIX CAR PHYSICS

Potential Energy is the biggest weight at the largest height differential, from the starting position to the finish line level. As you lift your car to the top of the track you have given it its potential energy.

Kinetic Energy is the potential energy turned into motion by gravity.

And the net result of speed of the pinewood car is the kinetic energy minus the friction of the car and the track that came from the initial potential energy.

To get the maximum potential energy, you need the maximum weight in the car that's possible as far up the track as is possible.

1. Have the rear wheels touch the rear of the car, as far back as possible. One can cut off the back of the block and then re-glue it on the front before shaping your car.
2. Get the car close to 5 oz. And then use modeling clay to get right to the maximum weight.
3. Make the longest car you can within the rules (7"), so you can put the weight as far back as possible to get the highest potential energy.

The enemy of speed is friction so let's look at all the ways friction slows down your car.

1. Axles polished and flash marks removed.
2. Make sure axles are straight and true to each other.
3. Make as smooth a finish as possible and also hard where the hubs of the wheels touch the car.
4. Increase the wheel base of your car if your rules allow it.
5. Lubricant is important: AWANA wheels are chemically inert but are soft plastic. You may use it Pledge furniture polish and a small amount of wax, carnuba. It is a dry lubricant if put on the day before a race or longer. Put on the carnuba wax on the axles, car surface that the wheels touch and wheels in small quantities and then let dry then buff these surfaces. Put on Pledge by spraying on to a cardboard surface and apply with a toothpick to the nail head, inside wheel hub and the surface of the car that will touch the hub. Graphite is very good at polishing the wheels and axles to a good bearing surface but as a lube it is messy and will fall out during the race and the car will slow down at the end.
6. Don't over weight one set of axles with too much weight, some recommend the balance point of the car should be about 3/4 to 1" in front of the rear axles. If the balance point gets too far to the rear of the car as the car hits the straight away it will lift up the front end of the car and you will have lost speed due to it.
7. Keep the weight you add concentrated and low on the car so it has more stability and can easier go straight and not hit the inside track guards and lose speed.

8. Wind resistance adds friction.

Each Grand Prix track is different and the list above will vary in priority depending on the track.

1. If the track is all down hill or mostly down hill: Where you place your weight becomes more critical.
2. If your track is mostly straight away then the axles polished and true to each other, as well as lube, is of most importance.
3. As the speeds of less than 5 MPH wind resistance is of small importance. You can do a test to this by taping a playing card to your car and checking an average time (5x) down one lane with and without the card. The playing card is light and should not increase the car's specific weight of gravity (the balance point of the car as well as the height of the car).
4. On all tracks normally the weight needs to be the maximum and the wheels need to be polished and true. It is also believed that the weight should be centered and low in the back of the car to get the most out of it. You may consider a lube that will stay on the car and doesn't get messy. A light lube that isn't gummy.

To polish the axles You could start by filing the flash marks off the nail head by hand with a jeweler's file and not by machine. Then chuck in the nail with about 1/2" exposed in a drill and using a 1/2" strip of 600 grit sand paper sand off the file marks working mainly on the nail head (flat part) and the file marks. Making sure you don't get the diameter of the nail too much smaller, then the wheels will wobble more and cause more friction as well as bounce of the guides. Then get the finest sand paper you can find (2000 grit or better) and sand all the surfaces of the nail in the drill very well. Then use a metal polisher, jeweler's rouge, some 5 to 1 micron polishing tape, etc. to do the final polish on the round part of the nail, that the wheel will be turning on, and spend a lot of time on each nail. Clean off all the residue and if your using graphite put the nail and wheel in the drill and polish by holding the wheel and turning the axle at slow speeds as you are poring in graphite into the wheel and the nail. This will polish the wheel and axle as a set, then don't trade them. If you are using any other lube the residue must be cleaned off at then put on a coat of car wax if your using a wax product of your lube so your can protect the nail from rusting. Test the nails with a wheels and find the fastest pair and use them for the back because that's where you have the most weight, (therefore friction).

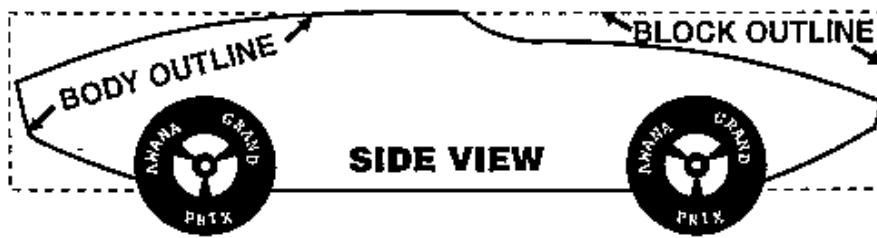
IV. CONSTRUCTION TIPS

NOTE: AWANA Clubs International strongly urges the participation of both parents/guardians and clubbers in constructing the car. **The clubber should be allowed to do as much of the construction as possible.**

1. Draw the car design on paper first. You may select a specific design from a magazine, brochure, or newspaper, or come up with your own. Cars may be built to look like real race cars or another creative design. Design judging will be based on how well your car resembles what it is meant to be, as well as how well it is constructed and finished. Use your imagination! Some examples of race cars and other designs are shown below.

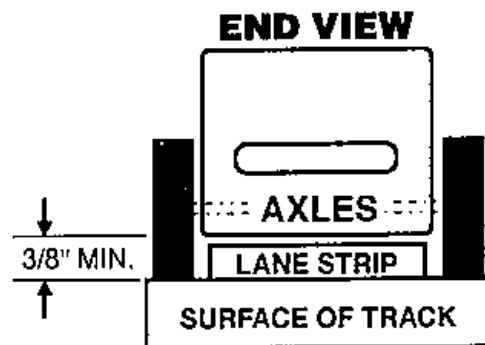


2. Outline your design on the wood block as shown. Rough cut the shape using a coping saw, jig saw, band saw, knife, or power sander (adult supervision is strongly recommended for this step!). Using successively finer grades of sandpaper, give the car its final shape and then smooth the surface. Before painting, add a couple coats of sanding sealer, let it dry, and sand with very fine sandpaper.



3. Cars should be carefully painted to compete for design awards. The quality of the car's finish may be determined by the number of paint coats and proper drying time between coats (hint: don't wait until the day before the race to paint your car). Put your assigned number somewhere on your car by hand painting or using decals. If you don't want it incorporated in your design, put it on the bottom of the car. **DO NOT** put any numbers other than your assigned number on your car. You may also use the AWANA Grand Prix decals provided with your kit or other commercially available decals to enhance your design. Waxing or coating with a clear, high-gloss overcoat can further improve appearance. After fine sanding put on 2 coats of sealer (clear brushed on of the same type of paint you will use), sanding between each coat (300 to 400 grit or extra fine steel wool). If the car isn't smooth you will not get a good paint job! Wipe car clean of dust and paint thin coats of paint to cover the complete car (You may consider water base acrylic brush on paint with a number of clear gloss spray coats to smooth and shine.) You can then add details, windows etc., only one clear coat and then decals and the at least 3 coat of gloss clear spray paint. Make sure the paints you use are compatible with each other before you work on the car by testing on scrape pieces. Most spray paints are enamel type paint and take over 3 days to dry, and it's hard to find a clear coat spray that won't bubble the paint, so many don't recommend this type of paint.

4. The AWANA Grand Prix track is designed so that the lane strips keep the cars in their proper lanes. Use only the wheels and axles furnished in the kit. The axles may be polished, if desired. The tread surface of the wheels may be lightly sanded, if desired, but must not be modified to a different shape (e.g., they may not be cut down to be narrower or beveled). Be careful when sanding wheels as too much friction can melt the plastic. Slots for the axles have been pre-cut in the wood block. You may use them or drill your own. If you reposition or camber the axles, make sure the distance between the wheels is at least 1 3/4" and the bottom of the car is at least 3/8" above the ground so it will not rub on the lane strip and slow the car. Insert the axles into the wheels and tap them into the slots or holes. Do not tap in too far or the wheel will bind on the car body.



5. Winning speed cars usually weigh the maximum 5 ounces. Once cars are carved, they usually weigh only 2 to 3 ounces (make sure you include wheels and axles). Weight may be added by drilling a hole in the bottom of the car and pouring in melted lead (**UNDER ADULT SUPERVISION!**) or by securely attaching commercially purchased or homemade weights with screws or glue (stay within size limits, including ground clearance). No loose or moving weights are allowed. If a car is a little too heavy, drill out some wood from the bottom. If a little too light, add screw(s) to the bottom (countersunk) or other small weights. These fine adjustments can be made on the day of Check In at the pit area. Once a car has been officially weighed and accepted, no additional weight may be added.

6. **INSTALLING WHEELS AND AXLES.** After your are very sure the paint is completely dry use a pin vise with a #43 drill to enlarge the slits for the axles, this will direct the axles where you want them to go. **MAKE SURE YOU DRILL STRAIGHT & PARALLEL!** Drill deeper then the original holes so you can get a gap of 1/16” to 1/32” between the car body and wheel hub. Some recommend using the furniture wax polish “Pledge” as the lubrication using a tooth pick to apply as you are mounting the wheels using your thumb to gently push in place. It’s best to match the wheels and axles for the best pair where you put the must weight. (rear axles) The pledge works best if you put it on a day or more (1 or more weeks is better) before the race as it will dry and the car will be faster if you polished the axles.

VI. Assist Your Child

1. Plan to have enough time to finish the car for the race. We suggest 4 weeks minimum, best to have an extra week for problems.
 - a) Know what tools your child can and can’t use do to safety, insurance!
2. Need an Idea and it should be from the AWANA clubber!
3. You must help the clubber to turn that idea into a plan to scale!
 - a) Don’t spend too much time on this step, because you need to finish it for the race.
 - b) Try to make it simple and sturdy for play by the clubber after the race.
 - c) Don’t try to do a difficult car if your son or daughter isn’t up to it or you don’t have the time.
 - d) You should pray for help before you try to find that simple grand prix plan, example to the clubber.
4. Help the clubber to draw a plan on card stock to scale, both top and bottom view.
 - a) Aid them. Don’t do all the work yourself, hold the tool, ruler, than let them draw the line.
 - b) Cut out the top and side views of the plan and trace onto the block of wood for cutting.
5. Cut the block of wood and shape it to the idea and plan. A bandsaw is best for this as it cuts through this thick wood easier than a jig saw. We always have workshop at church in which we provide the tools
 - a) Make sure the plan has the proper distance width between wheels so it can run down the guide of the track for the race.
 - b) Always cut the side view first but not all the way through, then the top, and finish the side cut.
 - c) Shaping is done with files, 60-grit sandpaper, carving tools. Carving tools must be sharp and always take small bits with the tool. In wood when carving, there is one direction that cuts and the other that splits the wood.
6. After the block is shaped you need to prepare the base for the painting.
 - a) You need to use sandpaper to remove the saw and shaping marks from the block of wood.
 - b) Depending on the roughness of the car, start with coarsest sandpaper and go to finer sandpaper in stages (100-grit to 150-grit to 220-grit). It takes less time this way, but don’t let the clubber sand away the unique shape of the design of his car.
 - c) Some times I have to use wood putty for some of the deep marks.
 - d) Finally use a sanding sealer, let it dry, then sand with 280 to 360 grit sand paper to smooth for the car for the painting.
7. When painting the car, make sure you keep all the paint the same type including sanding sealer. Don’t put acrylic on top of enamel or lacquer on top of either.
 - a) Don’t try painting to cover with only one coat of paint but plan on using many layers of paint.
 - b) Paint the whole car one color, as it’s easier for a clubber to do this.

- c) After the car is one solid color the paint on the large details, (windows, etc.) the clubber will likely need your help to do this.
8. Add the fine details to the car such as decals, stickers, spare tire, etc.
- a) Before the decal or other details put at least one coat of clear on the car to give it a smooth finish so the decals will stick good.
 - b) Assist the clubbers with these details don't do it all yourself, remember its their car not yours.
 - c) When all the details are right or close enough put 3 or more coats of clear spray to make the car shine waiting long enough to dry between coats.
9. Put in the extra weight into the car to get the maximum of 5.00 oz.
- a) To make the car go faster, add this weight to the bottom rear of the car.
 - b) If you use hot lead do it before, by guess, you paint or seal the car as it will melt and destroy your paint job.
 - c) The car wheels & axles weigh about ½ oz., so set the car to 4.50 oz. and later add a little clay to get the maximum weight using the race officials scale.
10. Prepare for making the car ready for speed by following my speed tips.
- a) Polish the axles "nails" using a drill leaving the about 5/8" of nail head exposed.
 - b) Start with 600-grit, then 3000-grit, then metal polish or 300000-grit.
 - c) Select the wheels & axles pairs, for front & back, having the fastest ones in the back.
 - d) Prepare the axle slots for inserting the nails using a pin vise and #34 drill bit to make sure the axles go in straight.
 - e) Use Pledge furniture polish in spray form as lubricant and apply using a tooth pick to the nail head, inside hub of wheel, and the car surface it will rub on.
 - f) Push on wheels with hands, not with a hammer, leaving 1/32" to 1/16" gap between car and wheels. Take great care as wheels are easy to deform, don't pull on them instead if the gap is too small use a screw driver to push on the tips of the nail to increase that gap.
 - g) Steer the car to go straight by angling one of the front axles up or down to adjust direction.
 - h) Carefully glue the axle in place so it won't change for the race, if the wheel & axle is glued your in trouble.
11. Put the car away for the race and then after the race the clubber can play with it. If the car gets dropped the wheels will be damage and the car will definitely go slower.

Remind your child that this car is their trophy that they keep and should be proud of all, even if they don't receive an award!

VII. PUTTING WEIGHT IN

1. Put car on scale, don't let it roll, add lead to about 4.95 oz.
2. Drill 1" diameter hole, 1 or more, just before rear axle (¼") no more than 1/3 of the slugs behind rear axle. The car will go fastest if the weight is in the back of car close to the bottom (highest Potential Energy). Make sure all the chips of wood are removed from the cars before weighing. Make sure there's enough room for some clay to make the perfect weight.
3. Split all slugs into individual slugs and deform slug into mushroom shapes (aluminum tools, pedestal a mortise) and drop them one at a time use screwdriver to check that the outside edges of slugs are at the bottom, with the dimple up. Then press the dimple flat using brass tool. Repeat this until all the slugs are installed. Make sure there's enough room for some clay to make the perfect weight.
4. Use wood glue to put a small bead of wood glue on the outside of the last slug and smear the slug surface with the left-over glue to ensure children don't touch the lead.

5. After about 10 to 15 min. with the car upside down, adjust the final weight with clay. If one is concerned with wind resistance put thin clear tape (magic) over and test the car weight again. Before each car is weighed, tare scale with nothing on it, for zeroing the scale.
6. All cars should have names and numbers and then get put into storage boxes for safekeeping.