



Building a Grand Prix Car

The Awana Grand Prix is probably the most popular "fun event" in which clubbers participate. There are three classifications for awards: Speed, Design and Dress like Your Car.

Every year, boys and girls, with their parent's help, build cars of every description. The construction of the car is intended to be a parent and child project with the child doing the majority of the work. The parent should supply the advice and limited assistance with the more difficult tasks. Please remember that the Awana Grand Prix is supposed to be fun for all. Get started early. Take your time building and testing your car. Plan to spend at least 4 to 6 hours building the car over several days. Experienced racers may spend many times this amount of time and it shows in the appearance and racing performance.

The planning and construction of your car may be approached in many ways. The following information serves as a guide to provide good first-time information and pointers. The time spent working and learning with your child should be a lot of fun.

If you're designing a car for speed here are the important points about car design to keep in mind.

- Sleek Shape
- Maximum Weight
- Smooth, Round Wheels
- Polished Axles
- Good Lubrication
- Straight Running

On the other hand, if your objective is to create a unique or personal design, then think about these points.

- Model your car after something you like or adapt a theme from an Awana or other recognizable object or character.
- Use color and finish as a way to get your car noticed. A bright red or yellow paint job with a high gloss finish is always an attention-getter.
- Attention to the details of car construction shows in the final product
- Design on paper before you start cutting wood

Step 1 - The Plan

You may already have an idea as to what your car should look like when you're done, but in order to take this idea to a completed form you should have a plan. Take a little time to sketch out your idea on paper. Draw your design at full scale so you can transfer the profile and shape to the wood block later.

Starting with a block of wood is like a handful of clay. What are you going to do with it? What sort of car do you want to build? There are several basic types of car

classifications: cars that are fast, cars that are fast to build and character cars. Character cars are cars that model other types of cars or objects. Remember that a highly decorative car with characters, decals and other trim may not be as aerodynamic as a "plain" car. The sleek low profile designs may tend to have less wind drag and therefore faster. The fast car is *usually* not a handsome car. Don't limit your design ideas but we'll talk about the plain, more aerodynamic designs and remember, you can paint car just about any way you you'd like.

Step 2 - Gather Materials and Tools

You will, of course, need the basic car kit that includes the wood block, axles, wheels and decals. ***Do not substitute the wheels and axles from non-Grand Prix kits into your car design.*** This will make the car illegal in most races and you may be disqualified.

You will need the following tools and additional materials:

- Safety Glasses
- Coping Saw (A powered Dremel saw or scroll saw may also be used)
- Small File (Mill or Fine Cut)
- 3/8" Drill Bit
- Electric Drill Motor
- Tracing Paper
- Small Strip of Soft Cloth (like an old T-Shirt)
- 80 Grit and 220 Grit Garnet Sand Paper
- 400 or 600 Grit Wet or Dry Paper
- Metal Polish (for polishing the axles)
- 3/8" Tubular Weight (Available from hobby store or plumber supply)
- Wood Putty (or better yet - plastic auto body filler – a.k.a. Bondo)
- Sanding Sealer or Wood Primer
- Finish Paint (Either spray or brush on)
- Decals and Decorations as Desired

This set of tools and materials may vary depending what you have available and the extent of work you have in mind.

Step 3 - Cutting the Basic Car Shape

Decide how you want you car to look. When you have a design idea it's time to transfer the profile (side of the car) and plan view (top of the car) to your block of wood. The block included in your kit is usually close to 7 inches (17.8 cm) in length but may vary a little shorter or longer. Be careful to measure the final overall dimensions of the finished car to insure that your design does not violate the racing specifications.

Using your side profile drawing and a sheet of carbon tracing paper align the drawing to the block and carefully trace the outside lines of your car so that the image is transferred to the wood. If you prefer, you may find it just as easy to copy or duplicate your lines on the wood directly. Use a hard lead pencil or ball point-point pen so that the lines are easy to see while cutting out the design.

Step 4 - Wheel Mount Preparation

It has been discovered over the years that cars with a longer wheelbase can be faster than shorter wheelbase cars. With this in mind you may want to consider relocating the two axle slots in the car block toward the ends of the block. Perform this modification only if club rules permit it. Remember to set the wheel slots back at least half the diameter of the wheel so that it doesn't extend over the end of the car body. The overall length of the car (including wheels) cannot exceed 7 inches. It is *very important* to cut the new axle slots exactly square to the sides of the block so that the axles provide a good alignment for tracking. An alternate method is to use a drill press to make the holes, but in either method make sure that the final position of the axle isn't too high so that it creates a problem for the block dragging on the track's guide strip. Use a #43 drill bit. Insert the axles in each of the slots or holes so that you know they'll fit later. Install the axles at the top of the slots so that they have plenty of wood under them. Now that we have opened the wood fiber remove the axles. Wheels are permanently installed after the body paint has dried.

Step 5 - Drilling Holes for Weight

Your finished wood block, along with the wheels, axles and trim will not usually weigh much over 2.5 ounces. The finished car is allowed to weigh in up to 5.0 ounces. ***Adding weight is critical if you want to be race competitive.*** The weight of your car overcomes friction. You must make gravity work for you. Your car must overcome both breakaway friction and minimize air resistance. Being as heavy as allowed while presenting the smallest profile to the air-stream accomplishes this goal.

There are two basic approaches to adding weight to a Grand Prix car. The easiest way is to attach pre-drilled and shaped lead or zinc weights to the outside of the car. Some of the commercial varieties are cast such that they provide a tapered shape and break-off ribs that permit convenient adjustment to overall weight after the car is assembled. It is best to attach this type of weight to the bottom of the car so the center of gravity may be kept low. If you use this type of weight on the bottom of your car, *insure that the weight doesn't hang down too far.* It may not be obvious until race-day, but the weight could drag on the track guide. This could prevent the car from moving off the starting line. Mortise or carve out a void in the wood on the underside of the car and then attach the weight inside the void.

The other method for adding weight involves the installation of weight internal to the body so that there is no additional wind resistance. This may be only a small advantage but it just might make the difference of a winning inch or two at the end of the track. Most car profiles may be narrower at the nose and provide little space for adding lead internally. There is an advantage in placing the weight in the back. The front wheels perform the function of guiding or steering and the less weight on these wheels the easier the car corrects itself when it strikes the guide strip. Fewer and shorter contacts with the guide strip mean a faster car. Each internally weighted car may have a little different cavity placement based on the wheel/axle position and amount of wood available to accommodate the weight. The hole or cavity for the lead weight must be large enough to accommodate the weight. You will need fewer holes for lead than you will for other materials. Plan on drilling at least 2 or 3 holes of 3/8" or 7/16" diameter at a depth of 1 1/2" each. Experience has shown that holes drilled from the side or back tend to work the best. Locate and drill the holes being

careful not to drill all the way through the wood. Also make sure that you are leaving enough wood around the hole to provide a margin of safety in your drilling operation.

Step 6 - Adding the Weight

There are many things that you might use to add weight to the car but you may find that lead and zinc are probably used most often. These are the heaviest materials easily available for their volume. Lead works easily and is commonly available in a number of forms. As options you can use steel plate, tubular forms or even common bolts. Other metals may be used but you may find them difficult to work with and sometimes awkward to attach or insert.

Warnings

Lead is toxic and should be handled as little as possible. Use gloves and never put your hands in or near your mouth after handling it. Always wash your hands thoroughly after handling lead.

Do not use mercury at all! It is toxic, difficult to handle and should not be touched by clubbers or adults.

Weigh your car on accurate scales. Most household scales are not very accurate. Allow for scale inaccuracies by not adding to exactly the 5.0 oz. indication. ***It is better to be slightly light than to have to remove weight on race day.*** Also, while *you* may have an accurate scale your *club* may not. It could be weighing items heavier than they actually are!

Weigh your car body, wheels, axles and any other parts that will be on your car all at once. This weight is usually less than 3 ounces. Now, with your car lying with the weight holes facing up carefully add your weight until the weight is just over 4.5 ounces. Allow enough space in the holes so that you can add filler material in the next step. If you find there isn't enough room to add weight to get to 4.5 ounces you will have to drill an additional hole or holes. Remember, you will be adding wood filler and paint to your car later and this will add a little more weight.

Step 7 - Sealing the Holes

Once the correct amount of weight is installed, you are ready to seal the hole(s) in your car body. There are a number of materials that you can use to cover the weight holes. If you are in a hurry and want to insure a good seal try using automobile body putty (like Bondo®). This type of filler material is a two-part mix that sets in 15 minutes. You will need only a small amount but it works very easily and may be sanded, drilled and painted. Standard wood fillers that don't use a catalyst will take longer to harden (usually overnight) and may need to be applied with several thin coats. Apply the filler so that it may be sanded down smooth to the original wood surface. You'll want to recheck you total car weight at this time.

Step 8 - Sanding and Smoothing

Sanding the wood body will eliminate any saw blade marks as well as any small blemishes in the wood surface. If you have access to a motorized belt-disc sander

your work will be quickly done, but for most of us a sheet of sandpaper and a sanding block will do just fine. Start by using a 100 or 120 grit paper and wood or rubber block on the filler and rough portions of the wood car body. Gently smooth the edges and corners of the car while using a little more pressure on the flat areas. Then switch to a 220 grit paper to smooth the sanding marks left from the initial sanding. When you have the wood smoothed, switch to the 400 grit paper. It will provide an excellent surface for your final finish. DO NOT WET-SAND UNPAINTED WOOD.

Step 9 - Painting and Finishing

The bare wood surface will act much like a sponge when paint is first applied. It may take several coats of paint to seal and finish the wood. A better approach is to apply sanding sealer to the wood. The sanding sealer acts like a primer coat for the wood and provides a good base to apply the color finish paint.

Prepare a place to paint your car that will be out of the house while you are painting and out of the reach of younger children while your car is drying. You may either paint one side at a time waiting between coats or suspend the car on a string with a nail in the axle slot and paint all of it. Brush or spray the sanding sealer on the car with a complete coat and wait for it to thoroughly dry. You will see that the grain of the wood will rise slightly. After the paint is thoroughly dry, sand it with 400 grit wet or dry sandpaper. You may find that the finish is smoother if you use a wet-sanding process. Wet the paper and the painted car body. Lightly sand until the sanding-sealer is smooth. Don't sand through the sealer to the wood.

You are now ready for the finish color coats of paint. The best and smoothest finishes may be had with spray paint but brush-on paint will not affect the overall speed of the car. Use fast drying enamels and avoid using different brands on top of each other. Above all don't use lacquer paint on top of enamel paint. The paint will wrinkle and bubble. If the paint runs or droops, let it dry and sand it smooth. Re-coat it later. You can achieve a very, very smooth finish if you wet-sand between coats with 600 grit wet-or-dry sandpaper. Your car can look like it has a glasslike finish with several coats of paint and fine sanding.

If you are going to apply decals and detail work now is time to do this type of work. If you are careful, you can apply a clear coat of finish over the decals to seal them. Don't use too much clear-coat at one time or you'll wrinkle the decals.

Step 10 - Wheel Work.

Next to the weight of the car the wheels are the most important element in the car. The biggest problem is that there is not a great deal that you can legally do with them. You must insure that the wheels roll smoothly, in a straight line and roll very easily. There are things to check and fix on each of the wheels. First, the wheels must be perfectly round. To check for an out of round condition, put the wheel on an axle and spin it. It should turn with the outside surface at a single reference point never varying. The run-out or the wheel movement along the axle axis should also be minimal. If you suspect the wheel is out-of-round, discard it and buy another car kit using the wheels from that kit. There isn't much you can do to correct a bad wheel. Check the wheel for burrs on the running surface of the tire and hub areas. These surfaces need to be free of any extra plastic residue or molding marks. The

outside wheel surface can be sanded or filed to make it flat across the width of the wheel. To perform this work you may use either a very small machine screw or nail about 3 inches long to stack all 4 wheels onto and chuck them in to a drill motor. Using a fine flat mill file, turn the drill on and at an angle to the rotating wheels and apply very light pressure to the wheel surface touching at least two wheels at a time. Insure you don't create a rounded wheel surface which may be illegal. Alternately, purchase a commercially-available wheel turning kit from a local hobby store. These wheel turning mandrels are designed to hold a single wheel in a drill motor for turning. Observe the local rules for what may be allowed.

Step 11 - Axle Polishing

The pin type axles that come in the Grand Prix kit must be used in the construction of your car. These axles provide no bearing surface so there is friction between the plastic wheel surface and the metal axle. Since this friction reduces speed we need to minimize the contact surface area, make the surfaces smooth and lubricate the mating surfaces. The following suggestions are things you can do with simple hand tools to improve the performance of the axles.

Axle Burr Removal. First, the heads of the pins used as axles in the kit will often have a mold or casting mark in two places just where the head attaches to the shaft the pin. Remove this web of metal with a file being careful not to gouge or scratch the running surface of the shaft. Removing this burr will prevent the axle from grinding the plastic hub area and slowing down your car. You might be surprised to how "out of round" the shaft of the axle really is. Chuck/secure the axle in a drill press or electric hand drill secured into a stable position.

Optional step. This step can be performed before actual polishing but is designed for those creating "the ultimate" racing machine. It's not necessary for the average racer. Use a fine flat file to reduce the overall diameter of the axle. To do this, chuck the pointed end of the axle into a drill press or drill motor that has been secured with a vise or clamp. Place the file against the rotating axle and apply even pressure while moving the file slowly. Do this until the area within ½" of the head is smaller than the rest of the axle body. The more metal that is removed the less contact surface available to create friction. The drawback to removing too much metal is that the axle becomes weaker and will not tolerate being dropped or withstand rough handling without bending. This is often a trial and error procedure with much testing required to result in a fast turning wheel. You may want to buy extra axles to try this and use the best of the lot for your car.

Surface Polishing. The axle can be finished to a high luster by following the steps detailed here. First, mount the axle in drill motor chuck exposing the head and the first ¾" of the axle. Secure the drill so that it doesn't move. Cut a piece of 400-600 grit wet or dry sandpaper to a strip approximately ½" wide and 4 to 6 inches in length. Wet the surface of the sand paper with water or light machine oil, start the drill and loop the sandpaper over the axle and pull the paper back and forth like a shoe polish cloth. Work the paper until the metal is smooth in the wheel running area (next to the head of the axle). This usually takes about a minute for each axle. Now, using either pumice paste or metal polish in a soft cloth (like a tee-shirt), start the drill again and press the cloth and polish compound into the axle with a slight movement back and forth. This will also take about a minute. The finished axle will be very smooth and bright in appearance

Step 12 - Lubrication

The type of lubrication is usually restricted to dry lubricants. There are great advantages to using the right lubrication. By the same token there is harm in using the wrong lubricate.

The wheel should turn on the dry axle without any undo force but the friction between the two parts will quickly act to slow it down. It's this friction that you want to eliminate. While friction cannot be completely eliminated, it can certainly be reduced. An automobile uses steel roller or ball bearings to reduce friction on its wheels but Grand Prix cars are not permitted to use any type of bearing. We can only lubricate what we already have. A lubricant is any agent that reduces friction. While there are many types of lubricants, many will either not work on lightweight parts or are not formulated to work with plastics. Petroleum products such as motor and household oil may soften the plastic wheels. The wheels could, after a time, fail to turn at all. Liquid or aerosol lubricants include spray-on Teflon, WD-40, CRC and 3 in 1 oil. Except for Teflon, these are all petroleum based products and should not be used on plastic Grand Prix wheels.

The most common and successfully used lubricants are the graphite formulations and Graphite-Moly blends. They provide a very thin plating of microscopic spheres that greatly reduce rolling friction. Plain graphite is available in hardware stores and some variety stores. When installing your wheels fill the axle hole of the wheel while capping the other side. Gently push the axle through the wheel. Do this several times and spin the wheel to help distribute the graphite through the running surface. A good test of the wheel, axle and the lubrication is a spin test. While holding the wheel in the axle in a horizontal position, spin the wheel with a flick of your finger. It should spin freely for 20 to 30 seconds, then slowly come to a stop. If the wheel does not spin that long, take a close at your wheel clearance, axle finish and lubrication. Correct the problems than test them again.

Step 13 - Wheel Installation and Alignment

The guide strip on a Grand Prix track will keep the cars on the track and prevent them from hitting each other. This strip is necessary, but each time your car's wheels hit it the car slows down a little. This is where wheel installation becomes important. If the car runs straight it will hit the guide strip less often.

There are a number of little tricks to consider at this stage. First, while you must install all 4 wheels, they all don't necessarily have to touch the track surface. Since each wheel has rolling resistance, don't roll *all* of them. Usually, the best one to elevate off the track is one of the front wheels. Second, to prevent additional rolling resistance install the axles at an angle to the body so that wheels ride the end of the axle not against the car body. Install your wheels so that there is sufficient clearance between the body and wheel and insure that the car body surface has a hard finish (no washers though) next where the wheel hub might touch the body.

Test roll the car until you are satisfied that the car rolls in a perfect line. Put the car on a flat board or other smooth surface that has a straight line scribed for reference. Lift the board so that the car begins to roll. It should roll very close to the line. If it doesn't, then a front end alignment is required. Slightly bend the wheel axle(s) to correct the drift.

Checking Alignment. Use a long smooth surface to check for tracking or wheel alignment. Draw a straight reference line on your surface and place the car on the surface with the wheels over the top of the line. Now elevate the surface to the rear of the car to start the car rolling. Your car should roll along the line as much as possible.

Step 14 - Other Testing

Now that you have finished construction and initial wheel alignment of your car, you will want to test and re-test your car until you're sure that you have reached optimum performance. This will involve reviewing the last few steps in the construction phase and verifying those details. Go back to any of the previous steps if you feel the car isn't right.

Breakaway Friction. Using a smooth board or table, evaluate how soon the car(s) start to roll. To judge the rolling resistance and the initial breakaway friction resistance place your car(s) on the surface then slowly elevate one side until the car just starts to roll. Note the angle at which the car starts to roll. The lower the angle, the lower the breakaway friction.

You may find that sometimes, for reasons that you can't explain, some cars may run faster when run backwards. Maybe it's the weight position, alignment, wheel placement or other more obscure reason. For whatever reason, it is a fact that most cars may run slightly faster in one direction than in another. Please understand that, while there is a slight difference, it may not be enough to make a huge difference in the long run. Just the same, if there's difference, take advantage of it. Run your car against another car and try racing it both forward and backwards to see which is faster.

Step 15 - Racing Your Car

Remember what the Awana Grand Prix this is all about. **Fun!** Of course you have spent a considerable amount of time building this car and you expect to do well, but so did a lot of other racers. At the end of all the racing there will be one car declared the fastest. It may or may not be yours. It may not be your fault. It may be something over which you have control. This is where your good attitude will come into play. Sometimes it's hard to be a good loser, but remember, you are in good company and you will have done your best!

Review

The following hints will help give you the best chance to win:

1. Insure that your car is tracking (steering) in a straight line before you check-in your car.
2. Insure that you have thoroughly lubricated your car before the check-in.
3. Check your wheels for freedom. Can you spin all the wheels and have them spin 20 seconds before they come to a stop?
4. Always handle your car by the body not the wheels.
5. Don't roll your car in the dirt or on concrete surfaces. It's a sure way to ruin the wheels and axles.

6. Don't run while carrying you car. You may to drop it which may break something you cannot repair.
7. Place your car on the track with the wheels spaced so that the wheels do not touch the lane guide.
8. Take your time in placing the car on the track. Point it straight down the track.
9. If your car doesn't do very well rolling forward try racing it backwards. Cars may run faster one way than another.

