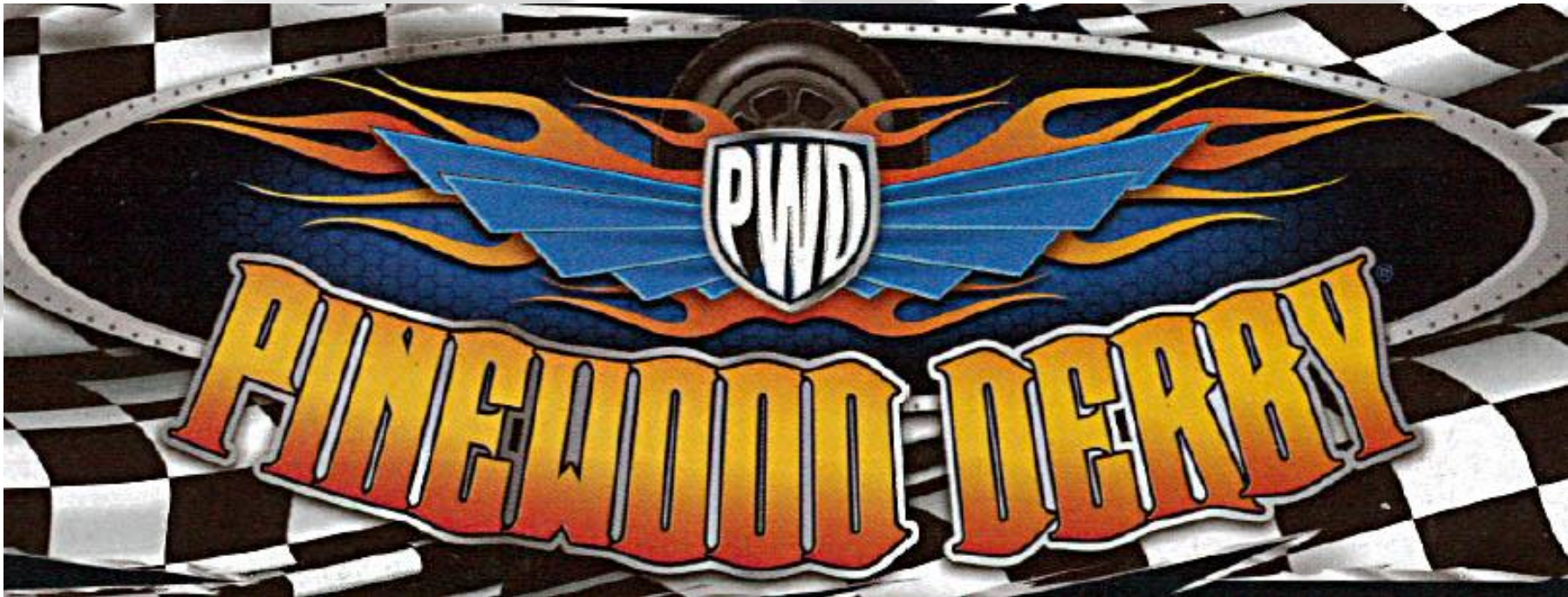


Pinewood Derby Build Orientation and Instructions



Five Ps

Proper Planning Prevents


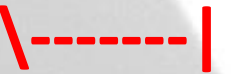
Poor Performance

Make sure you give yourself plenty of time to build your car. My experience has been that it normally takes about 8-12 hours of build time per car. Leave room for unexpected occurrences, and things to take a little longer than what you might plan for. For example, paints and waxes take longer to cure in cooler weather.... And this IS Ohio!

Agenda

1. Common Terms
2. Recommended Tools & Products
3. Pinewood Shopping Sites
4. Selecting Design & Template
5. How to Drill, Check, & Prep Your Car Body
6. Cutting the Car Profile & Weight Pockets
7. Painting
8. Axle Prep & Polishing
9. Wheel Prep & Polishing
10. Burnishing Wheels
11. Weighting Car and COG
12. Axle/Wheel Lubrication & installation
13. Tuning & Track Testing
14. Re-lubrication
15. Summary
16. Q & A

Common Terms

- **Rail Running** – Building your pinewood derby car so one wheel contacts the center rail while FLYING down the track.
- **Dominant Front Wheel or DFW** – This is the front wheel that contacts the rail. [The other front wheel does **not** touch the track.]
- **Steer** – The amount of turn your car has over a certain distance caused by adjusting the DFW axle.
- **Negative Cant** –  Angled rear axles allow the wheels to migrate away from the car body.
- **Positive Cant** –  A bent DFW axle allows steering on the car to be adjusted.
- **Center of Gravity or COG** – This is the balance point of your finished car.

Recommended Tools

Pooling resources to purchase some expensive items is recommended.

Beginner Level

- Needle Nosed Vice-Grips or Axle Pliers
- Combination Square
- Electric Hand Drill
- Drill Bits
- Black Sharpie Marker
- 91% Isopropyl alcohol
- Masking / Painter's Tape



Advanced Level

- Drill Press
- Saw (i.e. coping, scroll, band)
- #43 Drill Bit
- 1/8" Regular Screwdriver
- Bench Vise or Metal Adjustable Clamp
- Axle Pliers
- Axle bender
- Jewelers Loupe
- Diamond Needle File
- 1/8" Regular Screwdriver
- Small Metal Rod for Burnishing

Recommended Products

Pooling resources to purchase waxes and polishes is recommended.

Beginner Level

- Pinewood Derby Car Kit
- Wheels – BSA or Revell wheels
- Axles – BSA or Revell (I recommend Revell... no burrs)
- Car wax
- Axle Polishing Kit
- Hob-E-Lub Graphite
- Lemon Pledge
- Mr. Clean Magic Eraser or Fingernail Buffing Bar
- Clear Packing Tape

Advanced Level

- Drill Jig or Pre-drilled body
- Teflon Fingernail Polish
- Tungsten Weight
- Tungsten Putty
- Ultra Fine Waterproof Finishing Kit
- Metal Polish
- Novus 2 Plastic Polish
- Synthetic Car Wax
- Extra Fluffy Pipe Cleaners
- Walgreens “Studio 35” Brand Q-Tips
- Tamiya Craft Swab (Model 87106)
- 3M 3350 Silver HVAC Tape or clear packing tape



Pinewood Derby Links

To order weight, wheels, axles, and tools, browse the recommended vendor sites below.

- **Derby Evolution** - <http://www.derbyevolution.com/>
- **Maximum Velocity** - <http://www.maximum-velocity.com/index.html>
- **DerbyDad4Hire** - <http://derbydad4hire.com/main.sc>
- **Derby Monkey** - <http://www.derbymonkeygarage.com/default.asp>
- **Derby Champ** - <http://www.derbychamp.com/>

These are in the order I would recommend. Timeliness is critical in these builds, and in my personal experience, the top three vendors have been quick to ship parts.

Car Design Examples and Templates

Atomic Wedgie



Atomic Wedgie

Inferno



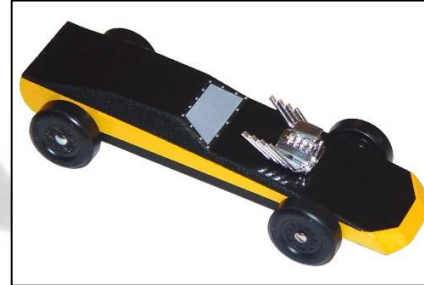
Inferno

Flashfire



Flashfire

Eliminator



Eliminator

Humvee



Humvee

Bullet



Bullet

Red Racer



Red Racer

Cyclone



Cyclone

Phantom



Phantom

Mad Max

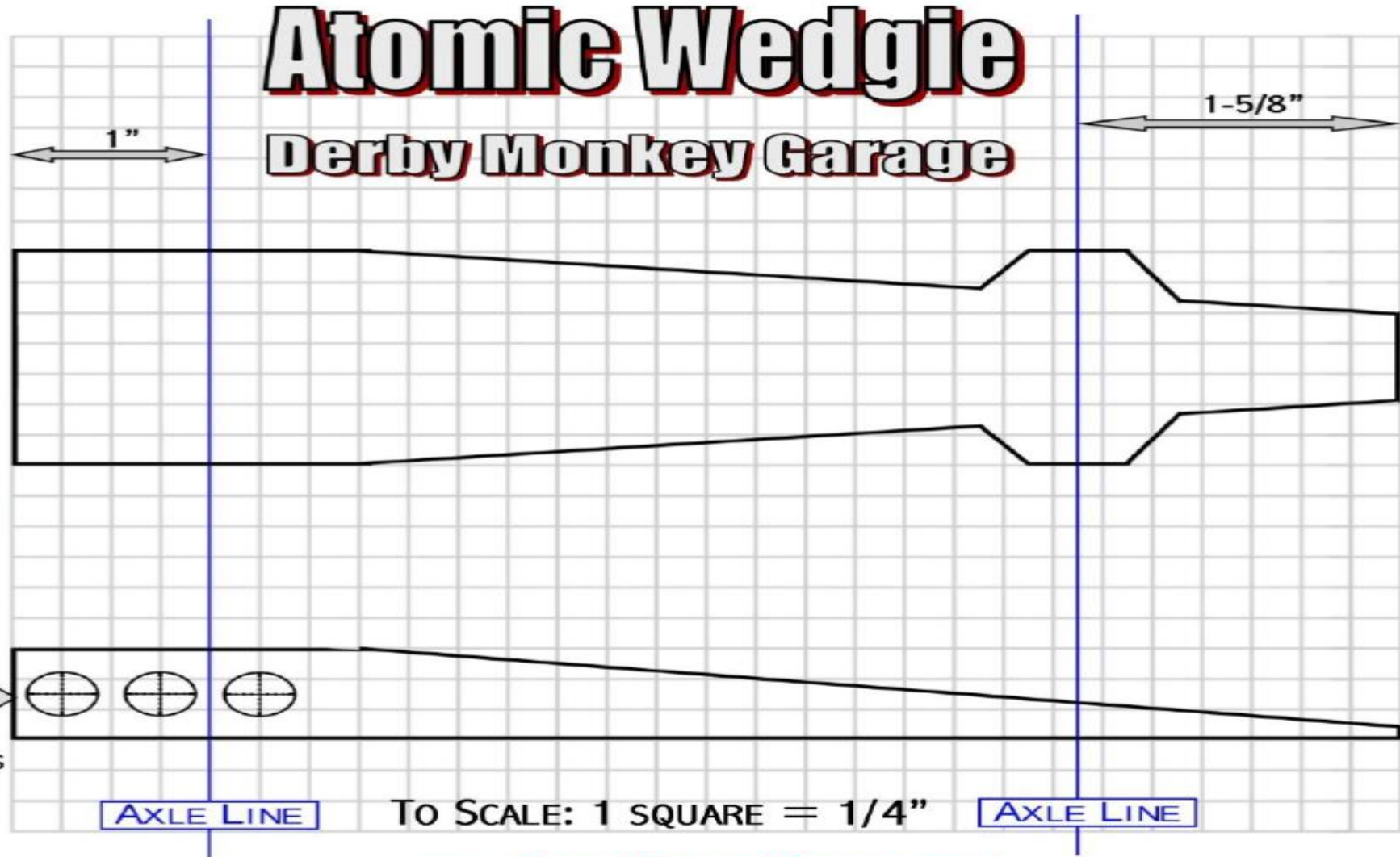


Mad Max

Choosing The Design



3/8" HOLES



WWW.DERBYMONKEYGARAGE.COM

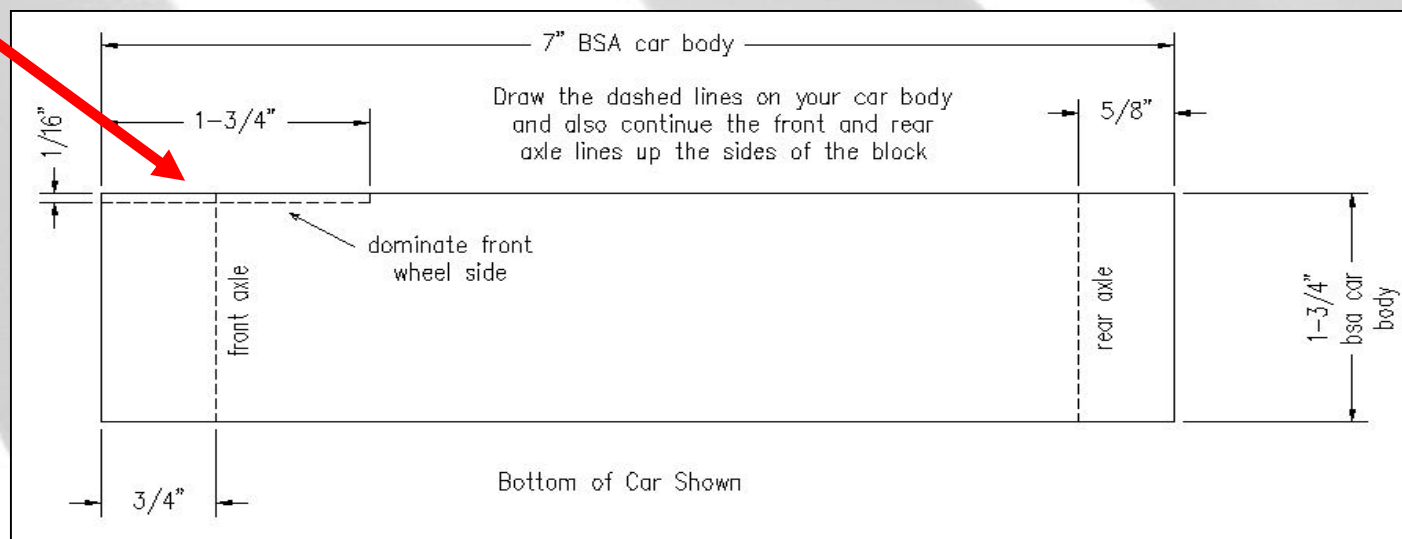
All works in these plans including text and graphics are sole property of Derby Monkey Garage. Reproduction and/or redistribution are prohibited.

RECOMMENDED ACCESSORIES:

- Atomic Wedgie Decals – [CLICK HERE](#)
- Lead Wire for weight – [CLICK HERE](#)
- Monkey Dust Premium Graphite – [CLICK HERE](#)
- Pinewood Derby Wheels – [CLICK HERE](#)
- Testors One-Coat Spray Paint – [CLICK HERE](#)
- Tungsten Cylinders for weight – [CLICK HERE](#)

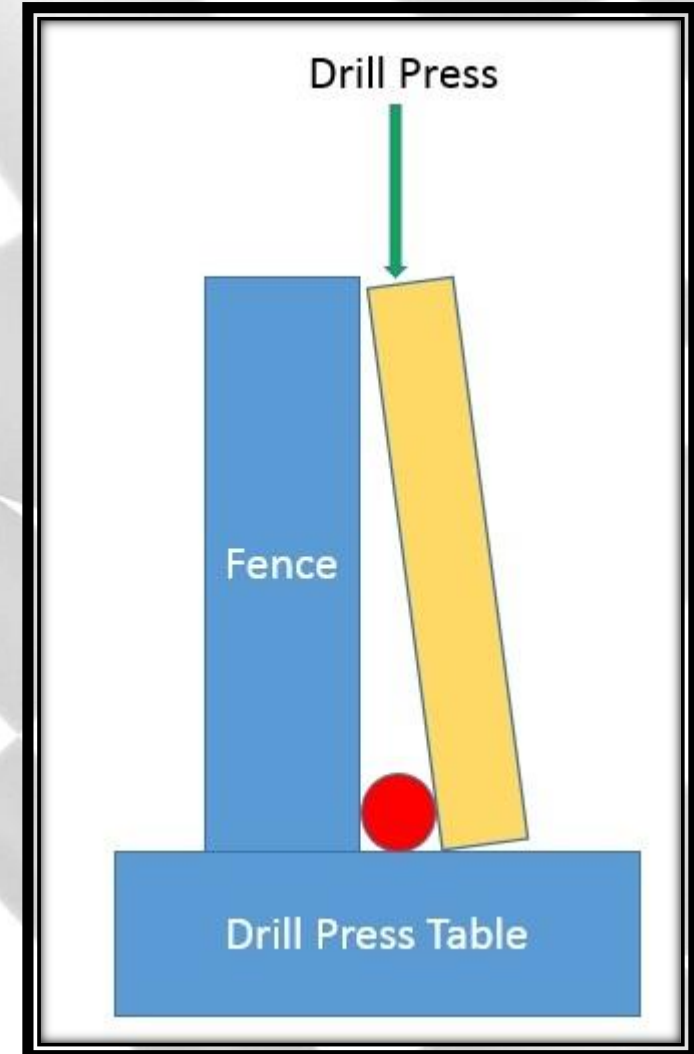
Choosing The Design

- Aerodynamics affects your speed in Pinewood Derby Racing !!!
 - When every other factor is equal, a thinner car will be faster than a thicker car.
- Leave the nose full width or almost full width.
- Use or make fenders for your car if possible. (Aero... Shhhhh!)
- Cut a profile that is at most $\frac{1}{2}$ " thick at the rear of the car and taper it down to a thin front ($\frac{1}{32}$ "- $\frac{1}{16}$ ").
- **Mark and sand, or cut off, $\frac{1}{16}$ "- $\frac{3}{32}$ " off the DFW side of the car.**



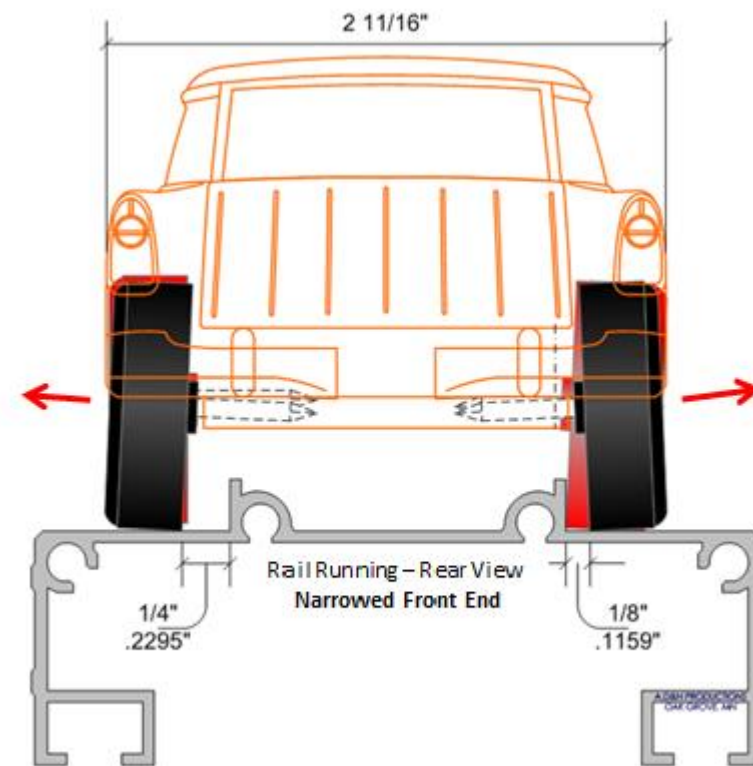
Building Your Car Body – Drilling the Body

- 1. Layout the axles / wheelbase (5 inches)**
 1. $5/8$ " from the rear of the block
- 2. From bottom of car, measure $1/8$ " up on the sides to determine axle hole position.**
- 3. To drill accurate canted rear axles**
 1. Using a drill press with a #43 drill bit, place car body on side with the bottom of the car facing the fence.
 2. Insert $3/32$ " – $1/8$ " drill bit as spacer between bottom of the car and the fence (drill $7/8$ " deep)
- 4. Remove spacing drill bit and drill front axles in same manner**



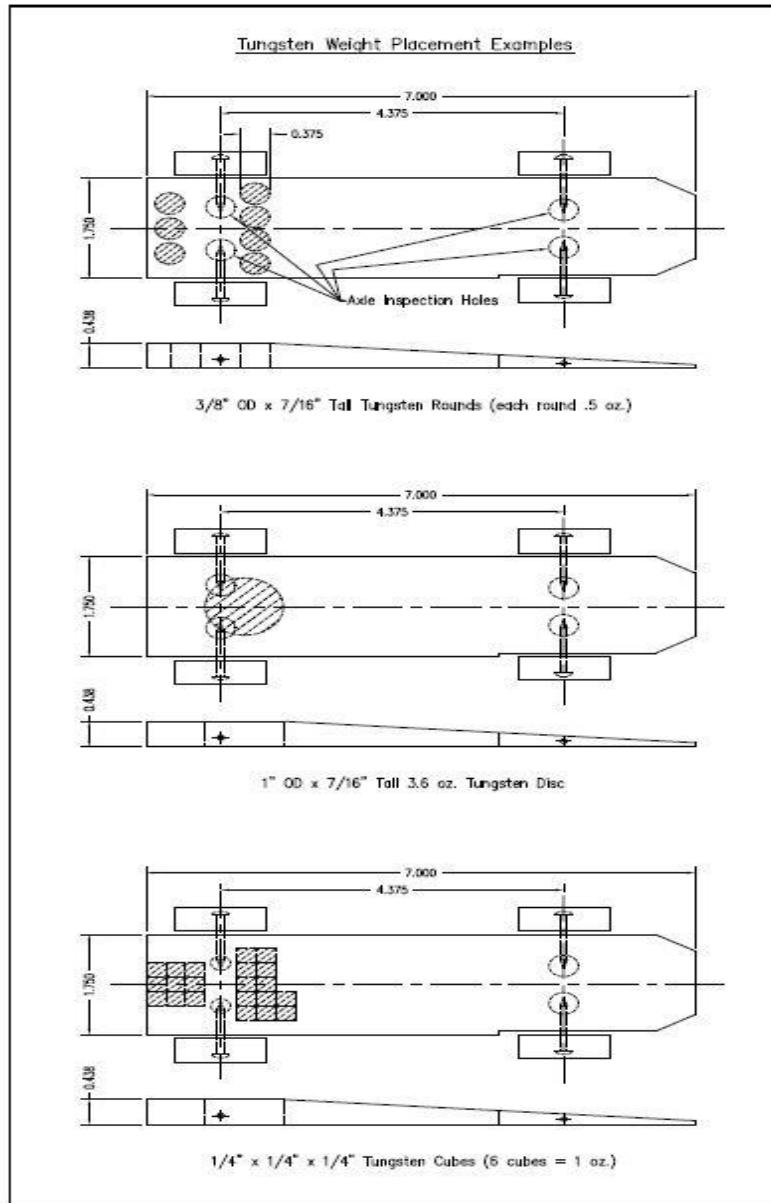
Checking Your Drill

1. Take the body with the finished drilled axle holes and put in three straight axles with wheels on them.
2. Roll the car forward and reverse in a straight line.
 1. Check to see the rear wheels migrate to the axle heads away from the car body.
 2. This checks the “toe” of your axles.
3. If the wheels migrate toward the body at any time, re-drill the car body.
 1. Use toothpicks and wood glue to fill the holes
 2. Sand smooth then re-drill

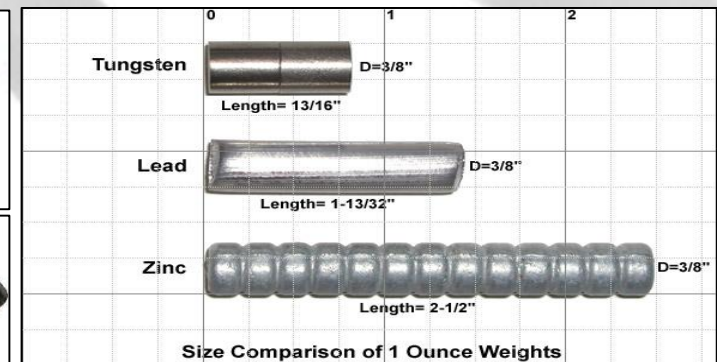


This illustration shows how your wheels should look when viewing from the rear of your car. You should see the rears with the top inward, and the front right with the bottom inward.

Cutting the Weight Pockets / Holes



- There are many ways to weight a car
 - Each type has its advantages and disadvantages.
 - Tungsten is expensive but the weight/volume ratio is great!
 - Lead is cheap but is toxic.
 - Zinc is cheap but takes up a lot of space.
- Before cutting your car profile, drill or cut your weight pockets.
- Drill holes so weights fit flush with bottom of car
- Cover all holes in the body with putty or filler and weight pockets with clear packing tape or HVAC tape



Painting the Car

Caution !!! – **DO NOT** put your car into an oven to “dry” it. In the past this was done to remove excess moisture from the block, lightening the body.

- **This is no longer done for a couple of reasons:**

- It is a safety risk – the car can catch on fire (one of the professional racers put his car in an oven after it was painted... Whooooosh !!!)
- The car will warp – You already have your car drilled, the chance of warping when the moisture leaves the car will change the alignment on your car.

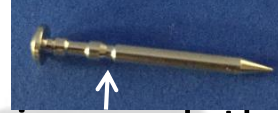


- **Place painters tape over the axle holes and where the hubs hit the body**
- **Paint the car and let dry thoroughly.**
- **When paint is dry, use Teflon fingernail polish to coat bare wood around axle holes.**
 - After applying 5-6 coats, sand and polish the fingernail polish to high shine

Axles – Initial Prep

If aftermarket axles are allowed, then.... For goodness sakes, use them !!! (Check your rules!)

- **Cut a “bend groove” in the DFW.**



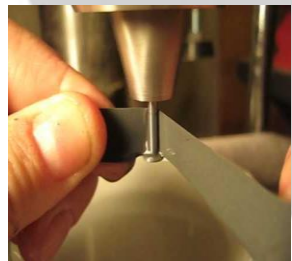
- Place a wheel on the axle and with a sharpie, mark the location just past the inside wheel hub. Chuck the axle in a drill or drill press and use a diamond needle file to notch your axle.

- **Cut a “tuning groove” in the top of all of the axle heads.**



- **Wet sand the axles with a good polishing kit**

- With stainless axles, a good grit to start is 1,000 grit (box stock axles, start at 600 grit). Continue to 8,000-12,000 grit.



- Take each grit of paper and cut them into 1/4” wide strips about 3” long
- Chuck the axle into a drill press, hand drill, or Dremel, spinning it at medium speed.
- Starting with the coarsest grit and working to the finest, use each paper for about 5-7 seconds on the 1,000-4,000 grits, and 8-12 seconds on the finer grits. **Don't forget the inner axle head**

- **After turning off drill, clean axle with 91% alcohol on clean rag after wet sanding axles.**

Axles – Polishing

If aftermarket axles are allowed, then.... For goodness sakes, use them !!! (Check your rules!)

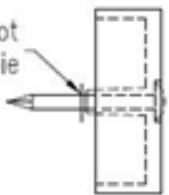
- **Apply a pea sized amount of Brasso to a clean rag or soft leather strip for final axle polish.**
 - Polish axle for 20-30 seconds while spinning the axle at medium speed.
- **Again, clean axle with 91% alcohol on clean rag.**
 - Turn drill off for this step.
- **Axles should have “mirror-like” finish upon inspection**
- **Spray axles with lemon Pledge furniture polish**
 - Let dry for 30 minutes and wipe off excess with clean, lint free cloth.
- **Place axles aside in a sealed container to keep dust and debris from axles.**



Axles – Bending the DFW Axle

- **Bending tools are made for this but are quite expensive.**
 - I recommend pooling money together as a pack to purchase one of these
- **Take the DFW axle and place into a vise**
 - Place a screwdriver in the bend groove and lightly tap with a hammer to bend the axle so it just fits through the bore of the wheel (about 3-4 degrees)
 - This is not an exact science, underbend is okay... too much overbend will scratch your bore... **never force an axle through a wheel bore.**
- **This is where the axle bending tool comes in VERY handy. Sometimes the scout shop carries them or you can order online. Bending only takes a minute. 😊**

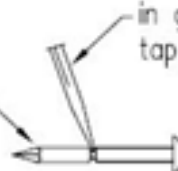
1. Mark this spot with sharpie



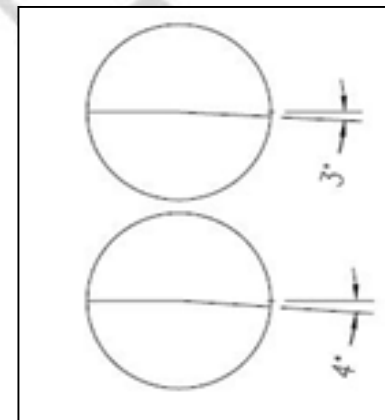
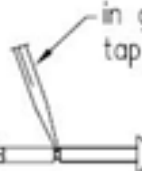
2. While spinning in a drill press cut a groove half way through axle on mark



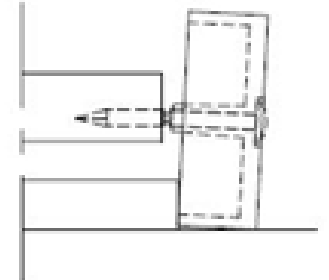
3. Clamp this end in a vise



4. Place Screwdriver in groove and gently tap with rubber mallet



Positive Cant FDW



Wheels – Initial Prep

- **With aftermarket wheels, there is no need to sand the tread or edge of the wheel. Just leave these surfaces as you receive them.**
 - Check rules to see if these are allowed.
- **Outer hub – Generally aftermarket wheels are already coned.**
 - If the second step is NOT removed, use a hub tool and hub shaver (available online or at scout shop) to remove the second step and leave flat.
- **Initial bore polish - polish the bore with Novus 2 plastic polish and Walgreen's "Studio-35" Q-tip (Caution: other brands might be too large for the bore)**
 - Cut the ends off the Q-tip at 45* and mount into cordless drill
 - Squeeze pea sized amount of Novus 2 into wheel bore
 - **SLOWLY... as in VERY SLOW**, turn the drill on and insert Q-tip stalk into wheel bore
 - Move the wheel up and down the Q-tip stalk (do not come off the Q-tip stalk). You will notice squeaking... This is normal..
 - It should take about 5 second to travel each direction on the stalk. Total polish time should be 20-30 seconds.

Wheels – Polishing the Hubs

- **Clean the bore with 91% alcohol and an extra fluffy pipe cleaner**
 - Wash out with dishwashing soap and warm water afterward, rinsing thoroughly
 - Let dry – assist with compressed air if possible
- **Use Novus 2 on a cotton rag to polish the outer hub**
 - This is done by hand and takes some work to get into the small area.
 - Fold a cotton rag two times and use the corner
 - Apply a pea sized amount of Novus 2 onto the corner
 - With the wheel in one hand and the rag in another, use a back and forth twisting motion to work the Novus 2 into the hub area
- **Repeat same action with inner hub area and inner tread area**
- **Clean the bore with 91% alcohol and an extra fluffy pipe cleaner**
 - Wash out with dishwashing soap and warm water afterward, rinsing thoroughly
 - Let dry – blow out with compressed air if possible

Wheels – Polishing

- **Inspect bores with jeweler's loupe... they should be shiny and scratch free**
- **Apply synthetic car wax (i.e. Meguiars Ultimate... Shhhh!) to inside of wheel bore with extra fluffy pipe cleaner or small no scratch applicator**
 - Let sit for 5 minutes then blow out with light air pressure
 - Let sit for additional 30 minutes or until haze appears on hubs
 - Use clean and dry extra fluffy pipe cleaner to remove haze from inside bore
 - ***This step can be done with a drill mounted pipe cleaner or by hand. I prefer to do it by hand.*
 - Apply another coat of wax in the bore and let it sit for 5 minutes before blowing out
 - Let sit again for 30 minutes or until haze appears on hubs
 - Use clean and dry extra fluffy pipe cleaner to remove haze from inside bore.
 - Blow out with compressed air and **let sit for 24 hours** to allow wax to fully cure.
- **Inspect bores with jeweler's loupe again... they should be VERY shiny**

Graphite and Burnishing the Wheels

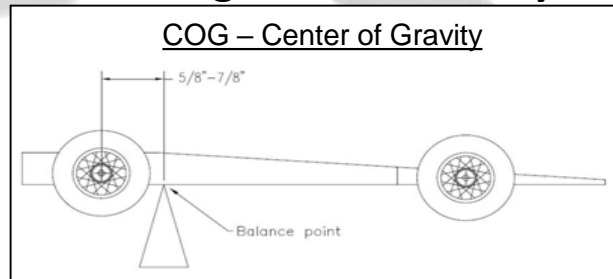
- Use Hob-E-Lub graphite if possible... Available at Hobby Lobby
- Take a #43 drill bit or small metal rod that is smaller than the wheel inside diameter and polish the end like you did for your axles.
 - Insert polished end into the bore and pour in some graphite
 - While holding both sides of the rim and while using some pressure, roll the wheel back and forth on a clean, flat, smooth surface.
 - While doing this, use your fingers to rub graphite into each side of the wheel hubs
 - Do this 4-5 times, adding graphite each time.
 - Rub graphite on the inside edge of the DFW until it is silver shiny. This is the edge that will run down the rail

This procedure presses graphite into the wheel. You will have graphite in the wheel even after all of your “loose” graphite falls out.

***** Some people recommend using a Q-tip in a drill or an extra fluffy pipe cleaner filled with graphite in a drill. This runs the risk of enlarging the bore or scratching your already polished wheel bores. I do not advise these methods.**

Weighting the Car and Center of Gravity

- Cover all holes on the bottom of the car with 3M 3350 HVAC tape (Clear packing tape also works)
- Weigh the finished body, wheels, and axles... add some tungsten putty to the scale until you reach 5.0 ounces
- Lightly put the wheels and axles into the car
 - Don't push them all the way in
- Balance your car on the edge of a ruler or something similar to find your balance point.



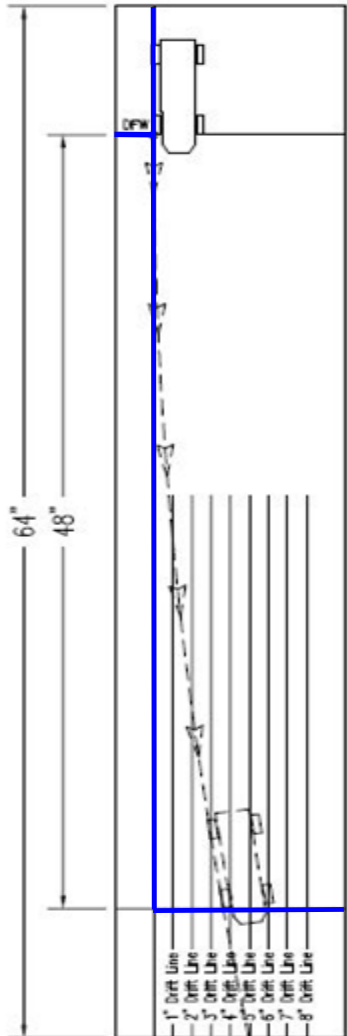
- The distance from the center of your axles to this balance point is your COG
- Place tungsten putty on top of your car until the COG is $5/8'' - 7/8''$ in front of the rear axle.
- Remove the wheels and axles, turn the car over, and place putty into the areas directly below where you had the putty on top of the car.
 - Verify the car's weight

Lubricating and Installing the Axles and Wheels

- **Place the DFW wheel on the DFW axle (the one with the bend).**
 - Pour some graphite into the bore from both sides and tap the wheel to get it to migrate into the bore.
 - Hold the axle by the pointed end with the wheel resting on the axle head, tilt to a 45* angle and spin the wheel for 10 seconds.
 - *We are looking for how it looks and sounds while spinning than how long it spins.*
 - Repeat this procedure four more times
 - Holding the wheel and axle, press the axle into the front right axle hole or slot leaving a 0.010" to 0.020" gap.
- **Perform the process above for each wheel. On the non DFW, push axle and the wheel all the way in so the wheel does not spin**
- **Clean all treads with clean cloth and 91% alcohol.... Clean tread = fast tread**

Tuning the Car

Tuning Board Visual



- **Create a “tuning board”**
 - Using a Sharpie (or painters tape to keep from ruining your dining room table), make a straight line 5’ long.
 - Make a “0” line perpendicular to this line 12” from the top end
 - Make another line (piece of tape) 48” down from the “0” Line.
 - This line is perpendicular also... Mark it 1-12 at 1” increments
- **Raise the “0” end of the tuning board (or dining room table) 1” – 1 ½”**
- **Set the car with the wheels lined up (parallel) on the Long line, front wheel at the “0” line.**
 - Let the car roll to the other end, noting how many inches it turned when it rolled across the tape / line at the other end
 - Using small increments, turn the front axle to adjust the steer on your car, counter-clockwise for more, clockwise for less.
- **3 ½ ” – 4” of steer is usually the magic number**

Track Testing

The Timer Tells The Tale !

- If you have access to a track, by all means, run your car !!! This is your best way to know how your car will run
- When your car goes down the track, if it wiggles, add more steer to your car (in small increments)
- If your car does not wiggle, you might take some steer out.
 - Note the changes in your speed – Write them down
- Once you are happy with the DFW steer and speed, adjust the rear axles
 - Do this in the same manner you did the DFW. Not all axles are straight, so you might notice speed changes in your times

Only make one change at a time !

Re-lubricating

- **When you run your car down the track, you will need to re-lubricate your wheels**
 - The cars are only good for about 8-10 runs before it needs more graphite
- **To re-graphite the wheels, add graphite to the outer hub**
 - To do this you turn that wheel so it is horizontal and add around the axle head and hub.
 - Tap the inside tread, bouncing the wheel up and down, and turning it slightly at the same time.
 - When you think the car has enough graphite, graphite for 5 more minutes
 - Turn car over and put graphite down the inside hub and axle also, using the same tapping motion you used on the outside hub.
- **Repeat on all wheels except for the non-DFW**
- **Clean treads with clean rag and 91% alcohol**

Did You Fall Asleep Yet?

Building a car fast... makes your car slow

- Take your time and plan things out with your build.
- Look over the recommended tools and products. Use as many as you can. These items really do help increase the speeds of your cars.
- Choose your design. Remember... slicing the wind is better than pushing it.
- Layout axles and drill the holes before anything else.
- **Check axle alignment** – alignment of your car is critical for speed
- Don't let the weights stick out of the car body
- For safety reasons, **DO NOT** put your car next to a heat source.
- Axles need two grooves... The “bend groove” and “tuning groove”
- Polish the axles so they have a “mirror-like” finish
- Go **SLOW** with the Q-Tips in the wheels... This cannot be stressed enough
- When done polishing wheels, the inside looks almost “mirror-like” also.
- Ensure your COG is 5/8” – 7/8”
- Burnish your wheels – This helps your car stay consistent
- You cannot put too much graphite in your wheels
- Tune the steer on your car to 3 1/2” – 4” on a tuning board
- **Lubricate your wheels, and spin them, right before check-in**

Good luck and have fun ! ! !

Questions

? ? ?

If you have **ANY** questions during your build, please
feel free to contact me !

Jay Monk – MOJO

Cell - 330-907-1512

Email – Mojo_n_Crawfish@yahoo.com