Motown HO Speed and Machine - AFX Pan Build

By John Reimels

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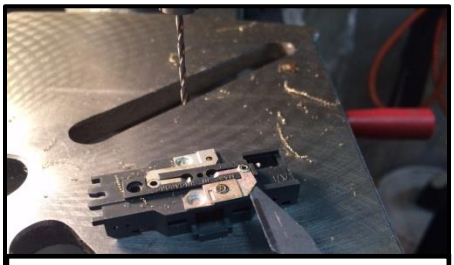
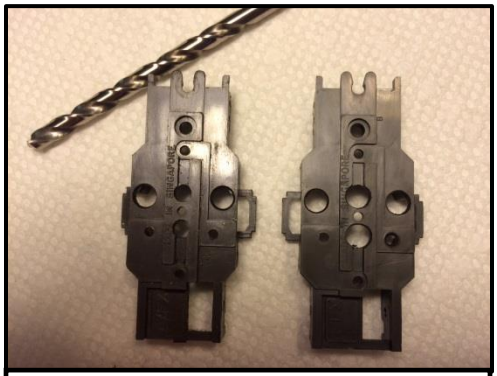
I was pleasantly surprised when I learned about Motown HO Speed and Machine's brass pan design for the Aurora AFX chassis. It incorporates the latest thinking by Doug Morris - the weight is concentrated around the perimeter of the chassis, not directly under the car as in the original TCP pan. While I'm not trying to compete with Doug and his various articles on building a pan car, I thought I'd document a build using this new pan – consider this a companion to the vast array of documentation written by Doug, the true guru of AFX brass pan cars! I'm building a car to compete in the very competitive Gravity class so I'm building it with wipers, brush tubes and rear bushings, however the reader can more-or-less pick the options they want to include in their build.

AFX Chassis Modifications



Using an X-Acto Knife blade to keep the rivet from spinning

I always like to tackle the hardest job first so I'm starting with the brush tubes. When installing brush tubes, the first step is to remove the existing sheet metal contacts and pickup holders. Using a 1/16" drill bit, carefully drill out the four rivets holding the contacts to the chassis. If the rivet starts to spin while performing this operation, carefully wedge an X-Acto knife blade between the chassis and the contacts, this usually creates enough drag on the rivet so it won't spin while being drilled out.



Stock chassis on the left, modified chassis on the right

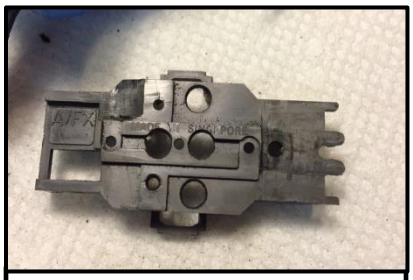
Now starts the serious modifications - enlarging the brush holes to accept the brush tubes. The tubes are 5/32" in diameter but the holes in the chassis cannot simply be drilled out, they must be moved outboard otherwise the tubes would get too close to the armature shaft hole. The idea is to increase the size of the hole away from the center of the chassis; the center line of the front tube gets moved forward, the centerline of the rear tube gets moved back. Begin by craving away plastic with a sharp X-Acto knife blade continually trial fitting the tubes and removing more plastic as needed. Once the openings are roughly the correct size, a 5/32" drill bit can be used to finish the job creating a nice round hole for the brush tube. The fit doesn't have to be perfect but the brush tube must be able to sit flat in the hole, any gaps will be filled by super glue and epoxy later in the build.

#00 HSS Combined Drill & Countersink

To facilitate attaching the lead wire to the brush tube, a small 0.025” hole needs to be drilled in the side of the tube towards its base. To drill the 0.025” hole there’s a few choices; the obvious one is to use a #72 drill bit but a drill this small is easily broken – especially when drilling into a curved surface. The alternative is to use a #00 HSS Combined Drill & Countersink; they’re fairly cheap (less than $5 on line), double ended (so you essentially get two for the price of 1), they have an 1/8” shank so they can be used in a standard Dremel tool and, most importantly, the 0.025” portion of the drill is very short so much less prone to breakage. Start by scribing a line 0.035” up from the base of the tube, using that as the center line for the hole should put the bottom of the hole just above the inside base of the tube. Use a center punch to create a small indent along that line and then use the #00 bit to drill the hole. Remove any burrs and place the tubes aside, we still have more modifications to do on the chassis.

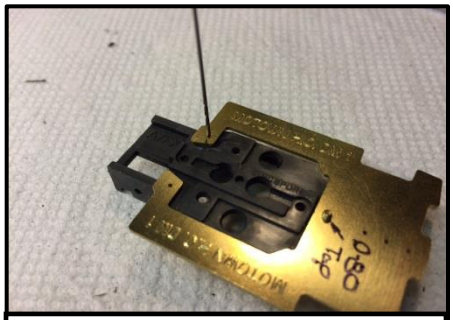
Brush Tubes w/ 0.025” Hole

Areas marked where plastic needs to be removed



Modified chassis with plastic removed

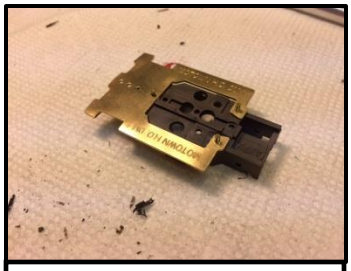
The next biggest task is fitting the pan to the chassis. For the pan to sit properly against the chassis, plastic must be removed from the front section and the right rear section where the pan attaches to the chassis. I use a Dremel tool with a sanding drum to remove the bulk of the plastic. A good sharp X-Acto knife is needed for the final clean up. Hold the pan to the chassis and measure from the bottom of the pan to the top of the chassis at the four corners. The idea is to get the pan to sit so the measurements taken at various locations around the assembly are all the same. This is important so the front and rear axles are parallel to the bottom of the pan. Once you get the measurements close, it’s time to attach the pan to the chassis using screws, this will allow for more accurate measurements to be taken so the final tweaks can be made to the chassis to get the pan to sit perfectly. The pan is designed to be held to the chassis with three 0-80 screws, one at the front utilizing an existing hole in the AFX chassis and two at the back that must be added. If your brass pan does not have the mounting holes pre-threaded, it’s time to do so on the front hole, do NOT thread the rear holes just yet, we’re going to use the rear holes in the brass pan has a drill guide for locating the holes in the chassis. Open up the front pilot hole with a 3/64” drill



Tap the front hole while using the rear holes as a drill guide to properly locate the rear mounting screws

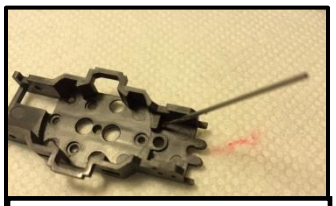
(or a #56 drill bit) and then use a 0-80 tap to thread the brass pan. Using a ¼" long 0-80 flat head screw in the front hole of the chassis, snug the pan to the chassis. Using calipers, a straight edge or good eyesight, center the rear of the pan on the chassis. Once centered, use a #60 drill bit to transfer the location of the rear mounting holes to the chassis using the pilot holes in the brass pan as a drill guide. Remove the pan, open up the rear holes in the chassis with a 1/16" drill bit and then counter sink them on the inside of the chassis to accept an 0-80 flat head screw. You can now thread the rear holes in the pan using the same process you used on the front hole. If your pan comes with the holes already threaded, follow the same process just be careful not to bugger up the threads in the pan when transferring the hole location to the chassis. In the earlier pans, the rear holes in the chassis end up too close to the back wall of the chassis to accept a 0-80 flat head screw. If this is the case, the diameter of the head of the screws need to be reduced, this can be done by filing down the top surface of the head -the more material that's removed, the smaller the head becomes. If the screw slot becomes too shallow for use, the slot can be deepened with a razor saw. Now you can fit the pan to the chassis using screws. Measure the height from the bottom of the pan to the top of the chassis in various positions around the assembly marking the areas that need to have more plastic removed from the chassis. You should be able to get the measurements from the bottom of the pan to the top of the chassis to be within a few thousandths of each other around the entire perimeter of the assembly.

Modified screw on the left with a standard screw on the right

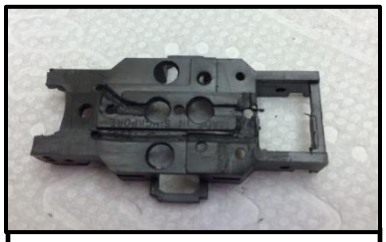


Ready for final measurements – tweak plastic removal as needed to ensure pan sits parallel to the top of the chassis

The next step is to create a channel for the lead wire going from the brush tubes to the front of the chassis – the idea is to bury the wire so it will be lower than the pan. Start by drilling holes for the wire to pass through from the bottom of the chassis to the top of the chassis just in front of the magnet (see picture); angling these holes at a 45 degree angle makes it easier to route the wire. The diameter of this hole depends on the type of lead wire used. In prior builds, I've used 24 AWG multi-stranded lead wire requiring a 1/16" diameter through hole. For this build I'm using 22 AWG magnet wire. The 22AGW magnet wire is only 0.025" in diameter so a #60 drill bit can be used to create the through hole. Being rated at 22 AGW, it actually has a higher electrical capacity than 24 AWG multi-stranded wire. An additional benefit of the smaller wire diameter is the wire channel doesn't have to be as deep to bury the wire along the bottom of the chassis. Use a #426 fiber reinforced cut-off wheel in a Dremel tool to make the wire trough going from the hole you just created in the chassis to the brush tubes - fine tune the trough with scrapers, X-Acto knifes and various Dremel tool bits to ensure the wire

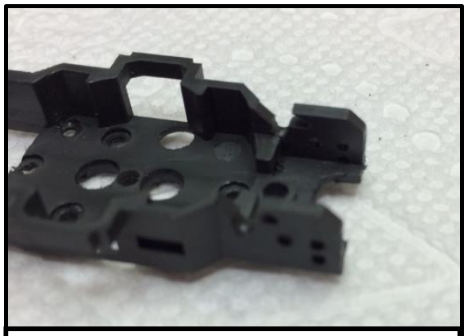


Drilling hole for lead wire



Modified chassis showing grooves for wire routing

sits below the bottom of the brass pan . Don't worry about neatness; this entire area will be buried in epoxy later in the build.

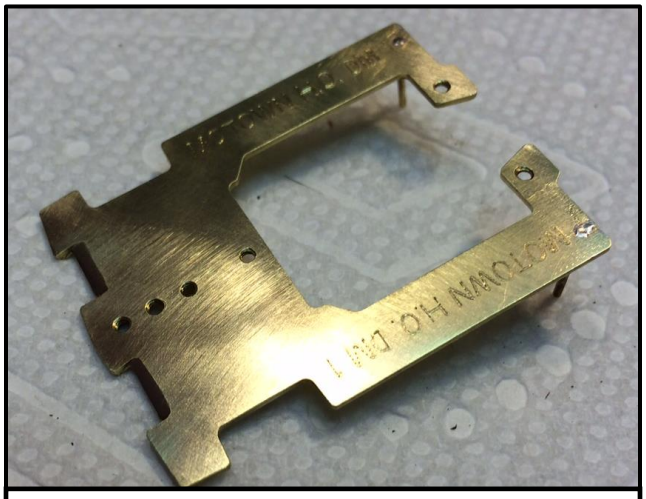


Adding groves for floating pan cross-member, removing pickup shoe tabs and opening front of chassis for guide pin

Next up is creating a groove in the front of the chassis for the floating pan cross-member to nest in. Once again, use a Dremel tool with the cut-off wheel, the groove sits right in front of the magnet and goes as deep as the step in the chassis (see picture). The cross member will be fabricated out of 0.047" brass rod so the groove should be about 1/16" wide. While the cut-off wheel is still in the Dremel tool, remove the stock pick up shoe tabs at the very front of the chassis to create room for the wiper attachment tubes. Also open up the front of the chassis that blocks the location of the new guide pin that will attach to the brass pan.

All of the required chassis modifications are now complete. However I noticed that Doug goes the extra mile and removes the plastic from the rear of the chassis adjacent to the opening for the crown gear. He also lowers the front axle hole allowing the use of smaller wheels so the front of the body can be lowered as much as possible. Every little bit helps…

Brass Pan Preparations

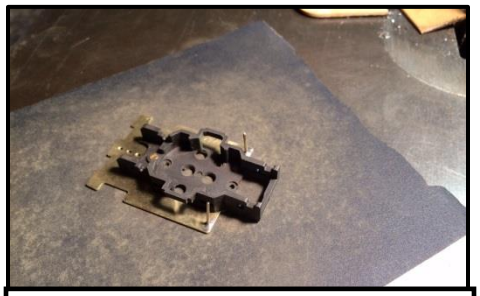


Pan with reliefs for wipers and floating pan hold-down rods

Some of the earlier pans do not have the reliefs in front to protect the wipers. If your pan doesn't have them, add them, they protect the wipers from getting damaged in a front end collision. They should be 0.25" wide and about 0.050" deep centered over the track rails. On the bottom of the pan, the reliefs should be blended back to allow easier adjustment of the pickup wipers; the use of a ¼" wide jeweler's file makes this task easy... I also like to make provisions for a hold-down for the rear of the floating pan otherwise the rear of the pan can lift making life difficult for the turn marshalls. Drill a 1/32" hole in the back of the pan (0.050" from the back and 0.100" inboard of the side) into which a 3/8" long piece of 1/32" brass rod is soldered. This rod will be bent to shape during the final assembly process. Verify the pan passes through a tech block, some require a few swipes with a file to

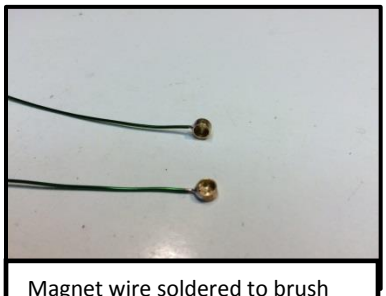
pass. The final step is to deburr the entire pan using the small 3M Radial Bristle Discs, the yellow 80 grit disc makes quick work of this task.

Chassis Assembly



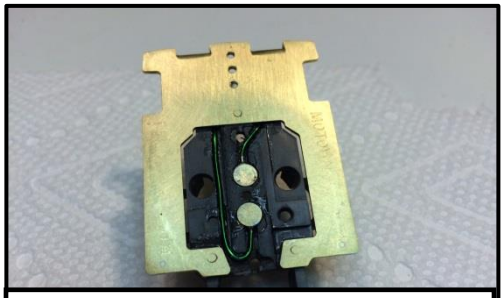
Initial sanding to get chassis level with the bottom of the pan

Attach the pan to the chassis using the three flathead 0-80 screws. Using a piece of 400 grit wet-dry sandpaper on a flat surface, sand the bottom of the chassis until the center section of the plastic chassis is level with the brass pan. Once the chassis is flat, it's time to install the brush tubes but first the lead wire needs to be soldered to the tubes. I've had lots of issues in the past soldering stranded wire to the tubes, in an attempt to get a good solder joint, solder always wicks inside the tube making a mess. Any solder that does migrate inside the tube must be removed to allow the brush and spring to sit properly. Which brings me to the third advantage of using 22AWG magnet wire; it's solid, not multi-stranded and the diameter of the wire matches the hole we drilled in the tube so it's a fairly tight fit minimizing the solder that does make it to inside the tube.

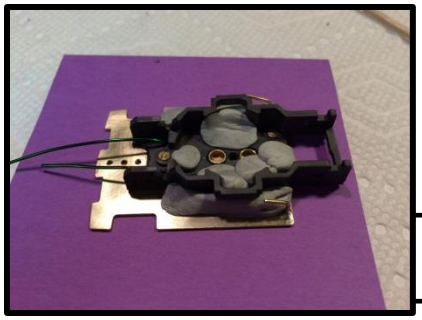


Magnet wire soldered to brush tubes

Remember to scrape away the magnet wire insulation before soldering to ensure a good electrical connection. Some magnet wire claims to be solderable but I like to scrape away the insulation anyway to be safe. Once the tubes have the lead wire soldered in place, fit them into the chassis ensuring they sit level with the bottom of the newly sanded chassis. Once positioned correctly tack them in place with a small drop of super glue. When the super glue kicks, ensure everything is still aligned correctly. If not, pop out the offending tube and reposition and start again. When you're sure everything is aligned correctly, flood the gap between the chassis and the tubes with super glue to nail them in place. Also, using super glue, tack the lead wire down into the wire channel to ensure it doesn't move during the potting process. Once the super glue cures, it's time to fill the bottom of the chassis with epoxy but first the various openings in the chassis must be sealed. I use putty that's designed for hanging posters - it's sold under various names (such as Elmer's Poster Tack), it sticks well to the chassis and it's very good at sealing the openings including the side gap between the pan and the chassis. Once everything is sealed, mix up a batch of JB Weld and fill the bottom of the chassis assembly. Over filling is better than under filling but remember, once the epoxy cures, it's back to sanding the bottom – the more you over-fill, the more you have to sand away... For me, sanding the bottom is the most satisfying part of the build - once everything is sanded smooth, all the flaws are hidden! Don't go crazy, I over did the sanding a bit on my first build and I ended up sanding

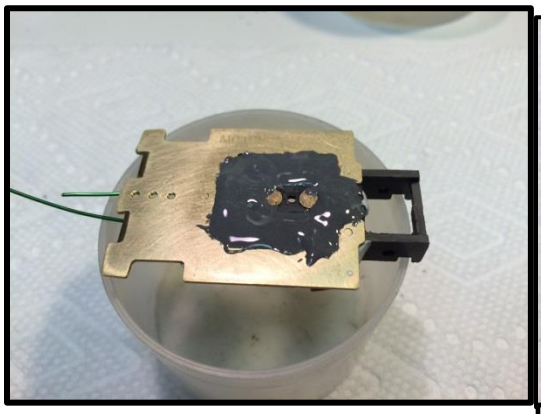


Brush tubes and wire super glued in place

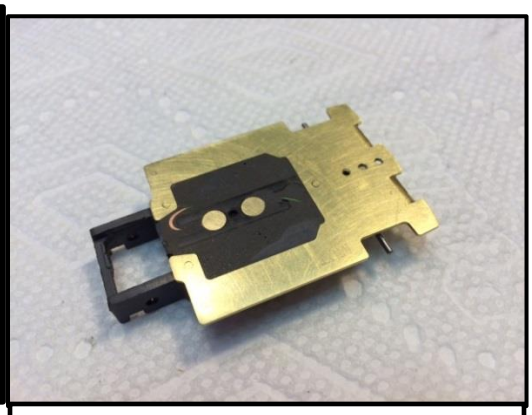


Using “poster putty” to seal holes for potting

right through the bottom of one of the brush tubes… Let’s just say I learned my lesson the hard way – that’s the reason for the initial sanding of the chassis / brass pan before installing the brush tubes, I know minimal sanding will be required after the tubes are installed.

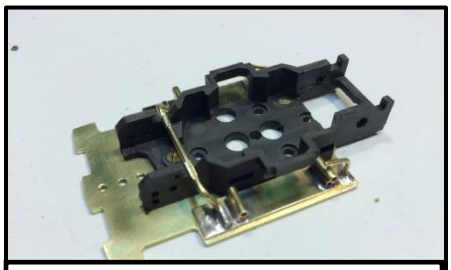


Waiting for the epoxy to harden



After final sanding – I should have buried the rear wire deeper… But otherwise a successful build!

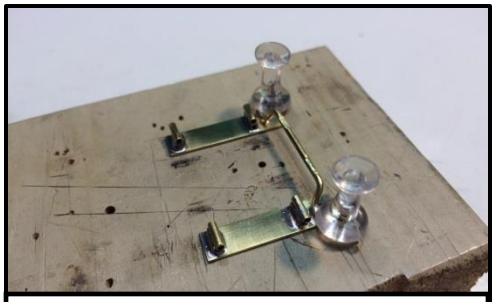
Floating Pan Assembly



Soldering the cross member to the floating pans

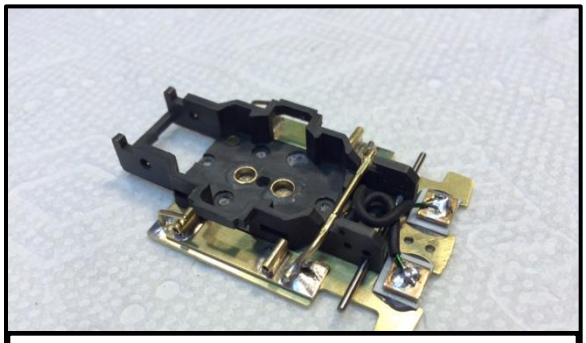
The floating pan assembly should be built 1.245” wide; this will allow the use of standard body pins and reinforcement tape while still allowing the assembly to pass through the tech block. To allow 0.010” of side-to-side float, the pans should be made so they’re 0.230” wide. To ensure clearance with the hold down rods, make them 0.975” long. I fabricate them from 0.025” brass stock. The cross member is made from 3/64” brass rod and bent so the rod sits against the bottom of the slot in the chassis with the ends of the rod touching the side pans. Brass rod is easy to bend, grab a pair of needle nose pliers and start bending. The pin tubes are made from 1/16” brass tubing cut 0.200” long. I drill out the tubing with a #60 drill so standard body pins can be used. To make things easier to hold, the tubes can be opened up after the floating pan assembly is complete – trying to drill out the tubes before assembly can be difficult. If you don’t want to open up the tubing, you can go with smaller diameter body pins purchased at your local

sewing store. Regardless of your body pin choice, soldering the pin tubes directly to the floating pan assembly results in a very small distance between the tube and the bottom of the floating pan. The Motown pan is designed so the bottom of the body must be level with the bottom of the floating pan to allow the assembly to float on the brass pan. This short distance makes it easy for the pin hole in the body to tear through in an accident. I prefer to add a spacer between the pin tube and the side pan increasing the distance between the pin tube hole and the bottom edge of the body. I use 1/16" square tubing, its light and it raises the pin tube significantly. Now it's time to solder everything together. To get the pan spacing correct, use small alligator clips to clamp the side pans to the chassis making sure there's approximately 0.010" (0.005" per side) between the side pans and the plastic chassis. Holding the cross member in position against the chassis, solder the ends of the cross member to the pans. Remove the side pan assembly from the chassis and solder the spacers and the pin tubes in place. To keep the cross member from getting unsoldering while installing the spacers and pin tubes, use a piece of wood as a soldering platform with push pins to hold the ends of the cross member in place. Using a high wattage soldering iron also helps, the higher temperature will quickly heat the local area being soldered before it can migrate to other areas and start unsoldering things. It seems counter intuitive but it works… Once complete, a quick wash using warm water, a tooth brush and some powdered kitchen cleaner (such as Bon Ami) will remove any soldering flux. Follow this up with a quick deburr session using a 3M bristle brush. Once this assembly is finished, it can be installed in the chassis so the 1/32" brass hold down rods can be bent in place to minimize the rear pan lift.



Soldering the pin tubes top the floating pan assembly clamping the cross member in place so it doesn't move if it gets unsoldered when adding the pin tubes

The final step in completing the chassis is to add the wiper holders to the front of the chassis. The best way to fabricate the holders is to use a piece of 5/32" brass tubing about 0.20" long. Insert a piece of wiper material (0.003" phosphor bronze) inside the tube and flatten the tube in a vise; the bronze material leaves just the right sized gap for holding the wipers in place. Remember, when attaching these tubes to the chassis, they must be insulated from the pan to prevent an electrical short. Some folks use epoxy to attach the tubes directly to the brass pan relying on the thickness of the epoxy to act as the insulator. I prefer to use a small piece of 0.010" styrene plastic as an insulator. Attach the styrene to the chassis using epoxy, tin the top of the holder with solder and then use a small dot of super glue to attach the flattened tube to the plastic. This creates the perfect holder for 0.180" wide wipers. Once the super glue kicks, the lead wire can be soldered to the



Chassis assembly complete – floating pan in place, wiper holders installed, lead wire soldered to holders and the rear hold down wire bent to shape

holder. If using magnet wire, slip a piece of small shrink wrap over the wire to act as an additional insulator before soldering the wire to the holder. The chassis is now complete; all that's required is final assembly.