AL MUELLER'S MANTUA GENERAL REBUILD
December 8, 2010

I have tried to produce here a narrative of the modifications I made to improve the looks and performance of my HO scale Mantua General Locomotives.

I wish to say THANK YOU to John Smallshaw, an old friend who is of great help in performing the machining operations on these locomotives. His knowhow, wisdom and patience are much appreciated.

I divided the narrative into sections, as follows:

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Locomotive Lead Truck

I replaced the stock plastic wheels with metal wheel sets to improve tracking, appearance and electrical pick-up.

1. Remove the lead truck from the locomotive and file off the four "Crimped" axle retainers. I used an 8" bastard mill file for this operation.

2. Remove the stock wheel sets and file the bottom of the lead truck frame smooth. I dressed the surface with a flat diamond file after rough filing.

3. Drill out (enlarge) the axle slots, progressing from a 1/16" bit to a #46 bit.

4. Scribe a line 0.065" in from the screw slot on the front surface and the back surface. Scribe a line down the center of the truck frame surface, intersecting the other two lines you scribed.

   If you are operating only on broad radius curves (36" or more) or are using replacement wheel sets of less than 30" diameter (such as PSC 26" spoked wheel sets), proceed to step 17. Otherwise, the lead truck must be modified so the front wheel set does not short against the cylinder on curves. This is accomplished by centering the pivot point of the lead truck. Proceed to step 5.

5. File the top of the lead truck smooth (remove about 0.014"). I used a 10" bastard mill file for this operation.

6. Cut a piece of 0.015" thick brass stock 0.438" wide by 1.000" long.

7. Scribe a line across the center of the piece, 0.500 from each end.

8. Scribe two lines intersecting the centerline 0.100 in from each side. Center punch the intersection points for drilling.

9. Drill two holes at the intersection points using a #29 drill bit.

10. Use a jeweler's saw to form a slot by cutting away the material between the two holes.

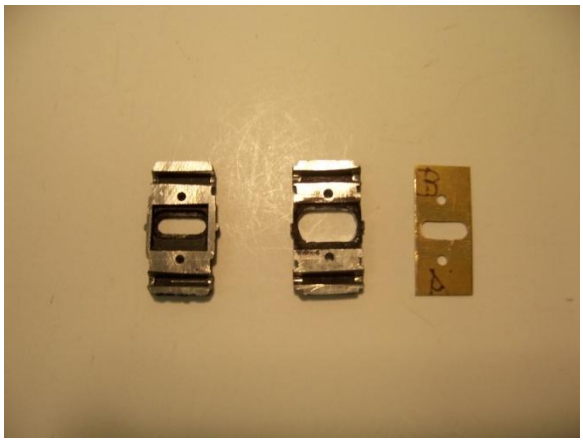
11. Clamp the brass piece to the top of the lead truck casting so that it is centered.

12. Drill a hole at each intersection point of the lines you scribed in step 4. using a #53 bit. Remove the brass piece and tap the holes in the casting 1-72.

13. Clearance drill the holes in the brass piece using a #48 drill bit.

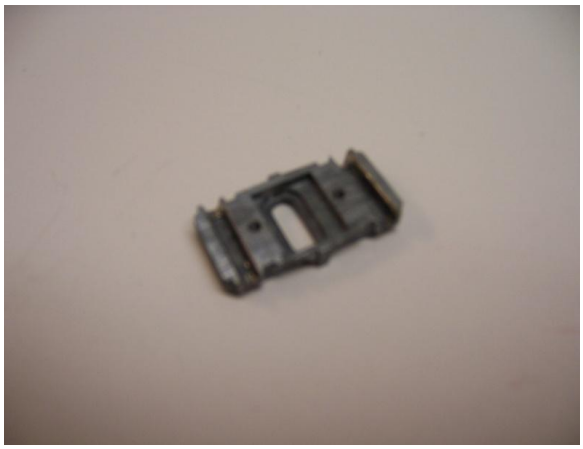
14. Cut the entire recessed slot out of the cast lead truck frame using a jeweler's saw.

15. File back the slot hole on the long end of the lead truck casting an additional 0.040". This is necessary to provide room for the lead truck screw to slide on the new brass top of the lead truck. The photo below shows a stock lead truck casting on the left, the modified one in the center and the new brass top on the right



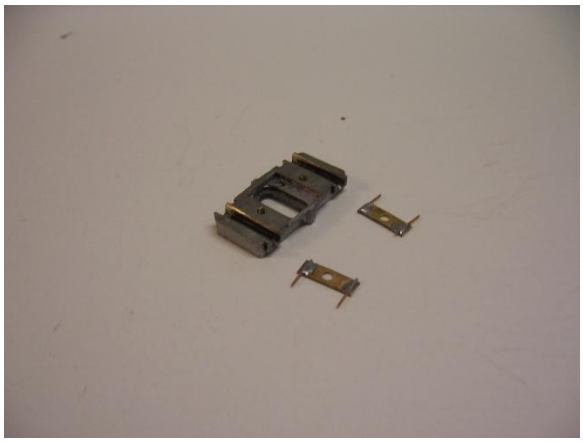
16. Attach the brass piece to the top of the lead truck casting using 1-72 screws cut to a length of 0.060". The result should appear as in the two photos below. . Proceed to step 18.

17. Drill a hole at each intersection point of the lines you scribed in step 4. using a #53 bit. The lead truck casting should appear as in the photo below.



18. Create two axle retainers/wipers by cutting two pieces of 0.125" X 0.015" flat brass stock to a length of 0.415". Drill a hole in the center of each piece using a #47 drill bit.

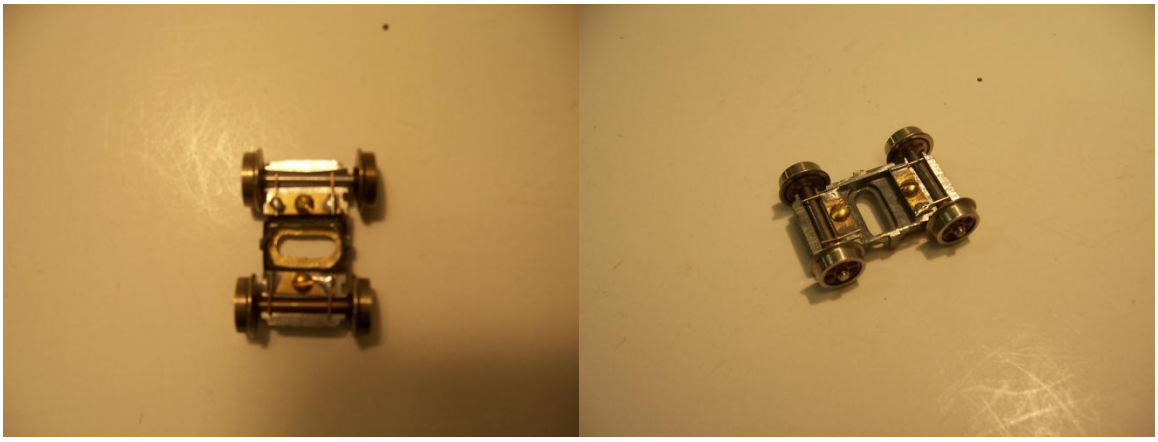
19. Solder a piece of 0.015" phosphor bronze wire 0.020" in from each end of each axle retainer/wiper. Cut the wires flush with one edge of each Axle retainer/wiper. Cut the other end of each wire 0.115" from the edge of the axle retainer/wiper. The finished parts appear in the photo below.



20. Screw the Axle retainers/wipers to the truck frame using 1-72 screws cut to a length of 0.060". Loosen the screws.

21. Insert two metal wheel sets of your choice. I use NorthWest Short Line (Hereinafter referred to as NWSL) #37116-4 30" pointed axle wheel sets for solid wheels. I cut off the axle ends flush with a cutting disk in a Dremel Moto Tool (ALWAYS wear safety glasses when working with any power tool!). I use Precision Scale Company (hereinafter referred to as PSC) #31937, 6-spoke, 26", flush

axle insulated wheel sets for spoked wheels. With the truck frame upside down (axle slots facing up) and the short end of the truck frame facing the top, the insulated wheels should be on the right. The truck mounts to the locomotive with the short end of the truck toward the pilot (If you added a new brass top, ignore "short"). Tighten the retainer screws and gently bend the phosphor bronze wipers so that they make contact with the axles but allow the wheels to turn when pushing the truck from behind. I found that sliding a #17 XACTO chisel blade under the front point of the wire and butting it against the brass piece was sufficient to let the axle revolve freely. The completed lead truck appears in the two photos below.



Tender Trucks

I replaced the stock plastic wheel sets with metal ones to improve tracking, appearance and electrical pick-up.

1. Remove the truck and place it right side up on the workbench. File the top of the rivet on one side flush with the spring metal bolster. Drill out this rivet with a #50 drill bit and disassemble the truck.

2. Drill the spring metal bolster rivet hole using a #42 drill bit. Tap the white metal bolster rivet hole 2-56. Smooth the edges of both holes to remove any flash.

3. File down the head of a 2-56 X ¼" hex head machine screw until the head is 0.020" thick or less (minimum thickness is 0.015"). I made a tool for filing the heads and cutting off brass screws by drilling and tapping a piece of 0.060" X 0.375" X 3.0" brass bar stock with holes 0-90, 0-80, 1-72, 2-56 and 3-48. The tool is also handy for determining screw sizes. A photo of the tool appears below.

4. Cut the screw to a length of 0.110" By spacing it with 2-56 washers and screwing it into the tool until the desired length is obtained.

5. File the top end of the spring metal bolster's side which has been drilled out to remove the black finish and clean the metal in preparation for soldering.

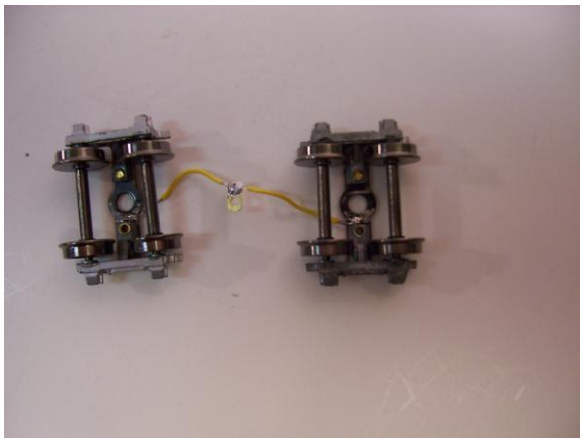
6. Solder a piece of 0.015" phosphor bronze wire to this spring metal bolster top to act as a wheel contact wiper. The wire should be soldered approximately 0.080" in from the end of the bolster. This distance is not critical, as the wire can be bent later.

7. Cut each end of the contact wiper so that it is 0.270" from the edge of the bolster.

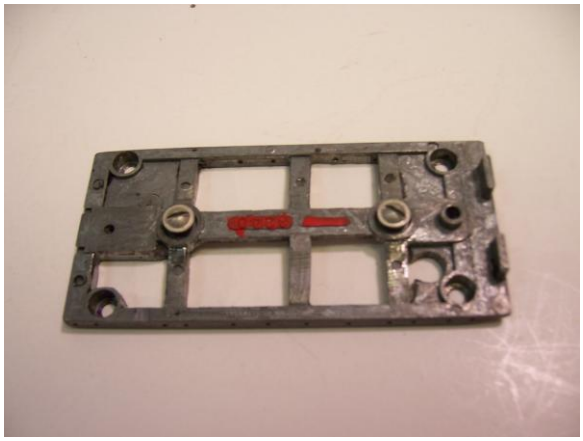
8. Loosely assemble the truck and insert the wheel sets. I use Intermountain 33" wheels, either #IRC 40050 or #IRC 40052 (Semi-Scale). The axles are just the right length (it isn't necessary to drill out the side frame axle holes).

9. Tighten the screw and bend the contact wipers so they just barely touch the wheel tread when the weight is off the wheels (i.e., when the wheel is hanging down a few thousandths).

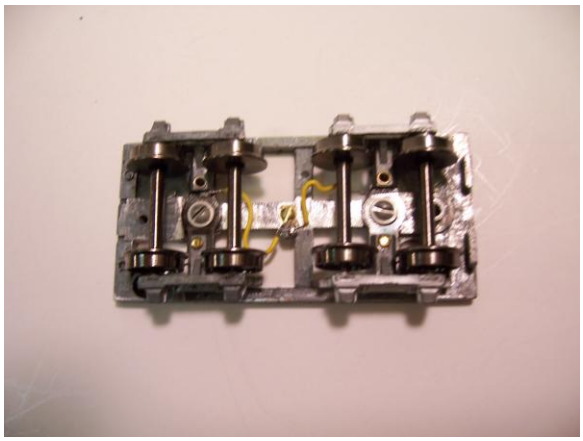
10. Prepare a wire harness to insure good electrical contact between trucks and tender frame. Solder wires to each truck and to a piece of 0.010" thick brass that is clearance drilled for an 0-80 screw. See photo below.



11. File off the raised lettering on the underside of the frame as indicated in red below.



12. Drill and tap (0-80) the underside of the frame and attach the trucks as shown below.



Tender Truck Brake Beams

I added brakes to the rear tender truck after the truck was completely painted and assembled.

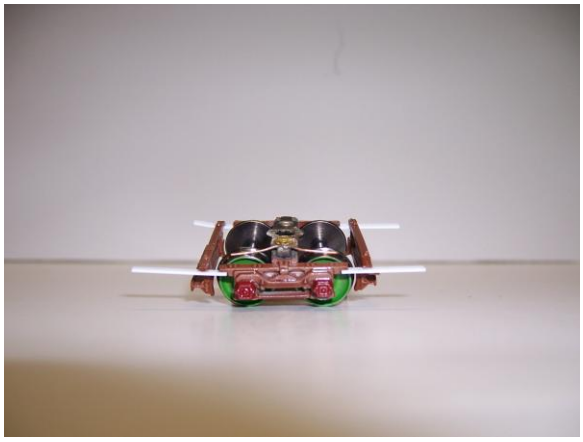
1. I used PSC #3001 Shay Brake Beams.

2. Super glue four pieces of 0.020" X 0.060" strip styrene to the bottom edge of the outermost extensions of the truck side frames.

3. Position the brake beams on the styrene using a 0.010" thick plastic to space the brake shoes away from the outer edges of the wheel rims. I used small metal spring clamps to hold the brake beams in position.

4. Super glue the brake beams to the styrene. When dry, trim off excess styrene and paint.

The completed brake beam installation is shown below.



Tender Shell

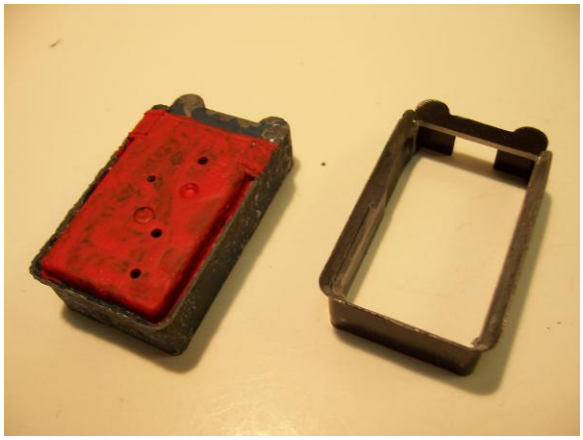
The following steps assume that you are going to replace the original open-frame motor.

1. Remove the four corner screws that hold the tender shell to the tender frame.

2. Remove the plastic wood pile from the tender shell.

3. Drill holes around the tender top. I glued0.060" thick plastic blocks around the rear and side tender walls with "GOO" to act as drill guides. This helped me avoid damaging the tender walls and top lip. I drilled 1/16" holes a little over 1/8" apart and tight against the plastic blocks. I then removed the

plastic blocks and drilled out the 1/16" holes with a 1/8" drill bit. The area you want to remove is shown in red in the photo below.



4. Use a jeweler's saw to saw between all the holes you drilled, thus removing the tender top.

5. Use the jeweler's saw or a hack saw to cut down the two rear screw towers until they are lower than 0.430 above the bottom of the shell. Lay the saw against the side lip and then end lip of the shell AFTER putting two layers of masking tape on the lip to protect it.

6. Remove all traces of the tender top and tool boxes by filing with progressively finer files (I started with an 8" bastard mill file and ended with a flat diamond file. Exercising patience and caution here will pay dividends later. The finished product should appear as in the right side of the above photo.

7. I used a milling machine to mill a 0.020" deep shelf around the tender shell 0.430" up from the bottom of the tender shell. This slot will receive a piece of 0.020" thick brass which will be the new tender top. How long the side slot is milled will depend on the type of can motor you install in the tender, If the motor will protrude above the new deck, the slots need only extend from the back of the tender to the back of the motor's position. If not, the slots can extend all the way to the front. The shell should appear as in the photo below.

If you don't have access to a milling machine or a friend who has one, you can glue a 0.020" thick shelf around the inner edge of the shell using the material of your choice.

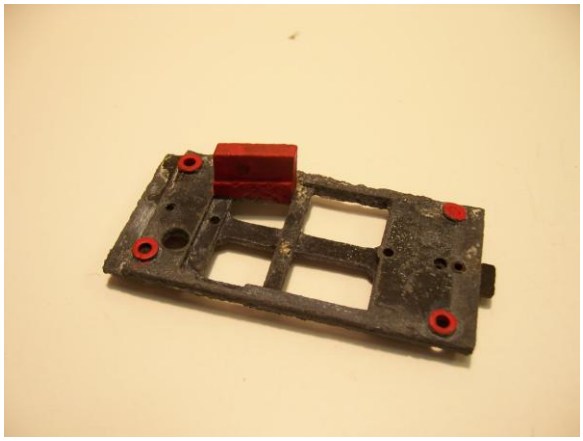
8. Determine the position of any grab irons and other detail parts to be added (I usually add PSC water valves, either #3029 or 31519) and drill holes as needed.

9. Use a fine (diamond) file to smooth any rough spots on the casting.

10. Shorten the four tender shell mounting screws you removed by 0.040.

Tender Frame

1. Using a hacksaw and a file, cut off the original motor mount and the four (4) raised rings around the screw holes. You should remove the areas in red in the photo below. That's a junk frame, by the way.



2. Carefully file the top of the frame smooth. I used an 8" bastard mill file for this operation.

3. Determine the pattern for any nut-bolt-washer (nbw) castings you will add to the sides and rear of the tender frame by reference to the drawing or photos of the locomotive and tender you are modeling and drill all necessary holes. I generally use 0.030" nbw castings from PSC, their #48218.

4. Decide on the type coupler pocket or draw head you will use. Usually, you must file off the two "nubs" sticking up alongside the coupler box pad on the tender frame. File them flush with the pad. On Some tenders, I use Alexander Link & Pin #A-6004. I prepare these by drilling out the center pin in the base 0.025" with a #72 drill bit. Next, I drill a 0.025" hole in the cover using the base hole as a guide. Next I hold the base against the back of the tender frame and use it as a guide to mark and drill a 0.025" hole in the tender frame from the bottom. Next I drill all three pieces with a #55 drill bit. I tap the frame hole 0-80 and then clearance drill the coupler box and base using a #51 drill bit. Procedures should be similar for installing a Kadee coupler box.

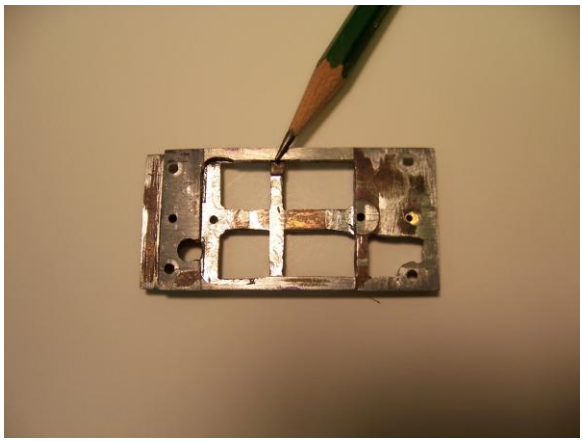
5. Grind about 0.015" off the "hot" (fireman's side) of the bottom of the bolsters to clear the hex screws on top of the trucks. I used a Dremel #194 High Speed Cutter in a Moto Tool to do this.

The rest of the tender frame modifications depend on the type of can motor used and whether or not you install DCC with or without sound and a speaker. I will describe the specific installs I am doing below by motor type. I obtain all of my motors from Micro Locomotion (motorman@micro-loco-motion.com). I use either Faulhaber or Maxon 12-volt DC motors. Hopefully, at least one of the installs will involve mounting a motor in the locomotive instead of the tender.

2020A Faulhaber Motor with 3.9:1 Gear Head

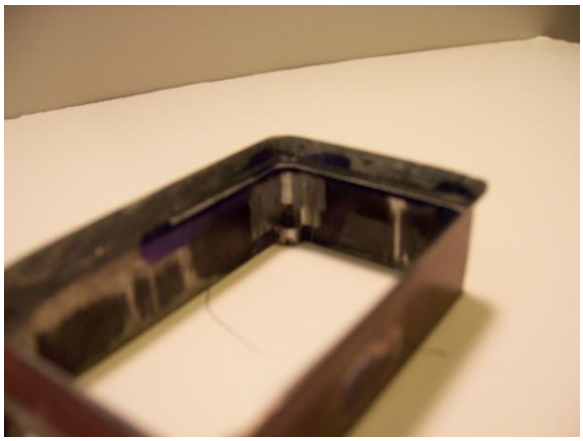
This motor is 20mm in diameter and 20mm long, including the gear head. I chose it because the output shaft is off center, allowing me to rotate the motor until the output shaft lines up height-wise with the worm shaft in the locomotive and mount it in that position. Many different motors could be used. The motor mount dimensions would vary depending on motor type.

1. Mill out the recessed center of the tender frame (from the top) to a depth of 0.098" EXCEPT for the engineer's side center cross brace. Stop milling 0.100 from the inside edge, as this brace is too thin to mill fully on most tender frames (pencil points to this area in the photo). Also, mill the front of the recess to slightly enlarge the recessed opening to 1.270". In addition, mill out the Fireman's side rear floor to provide a speaker outlet. The photo below shows the completely milled frame.

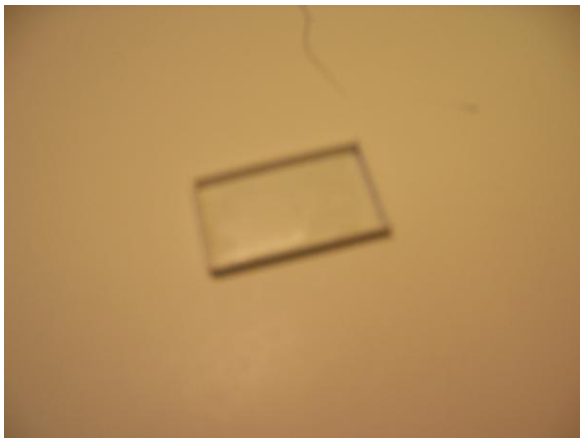


2. Shorten the front tender truck screw so that it is even with the milled out bolster top when tightened.

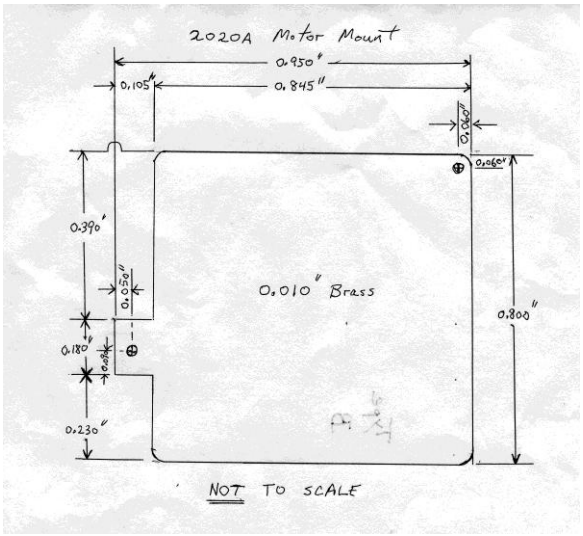
3. Mill out the right (engineer's side) interior corner post (screw lug post) of the tender shell so that it is flush with the tender side walls and 0.110" up from the floor to allow room for the sound capacitor. You will need to further shorten this tender screw, as well. See the photo below.

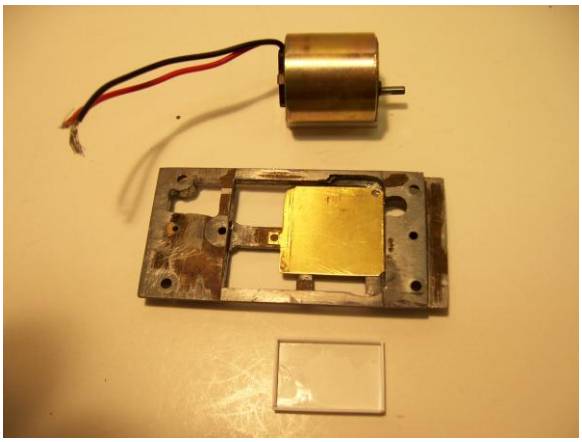


4. Build a pan from styrene to contain the motor. We will fill this pan with clear silicone, position the motor in it in order to electrically insolate the motor. The floor of the pan is 0.010" styrene with approximately 0.845" X 0.550" outside measurements. The side walls are 0.020" styrene 0.080" tall. The finished pan appears in the photo below.



5. Cut a motor mount from 0.010" sheet brass to the dimensions shown below.





6. Drill two 0.052" holes in the motor mount where shown using a #55 bit.

7. Use the motor mount as a template to drill two 0.052" holes in the top of the frame. The motor mount is nestled in the left front corner of the frame as shown in the photo above.

8. Tap the frame holes you drilled with an 0-80 tap.

9. Drill out the motor mount holes with a 0.067" (#51) drill bit.

10. Shorten two (2) 0-80 round head brass screws so they do not extend past the bottom of the frame when the motor mount is screwed in.

11. Screw the motor mount to the frame and screw the tender shell to the frame.

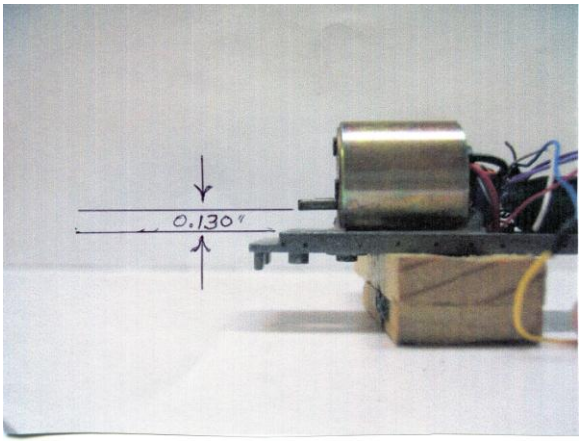
12. Make a styrene mock-up of the SOUNDTRAXX Micro-Tsunami Model TSU-750, #826001 "Light Steam" sound decoder to act as a test spacer when installing the motor. The decoder dimensions are 1.380" long, 0.555" wide and 0.165" high.

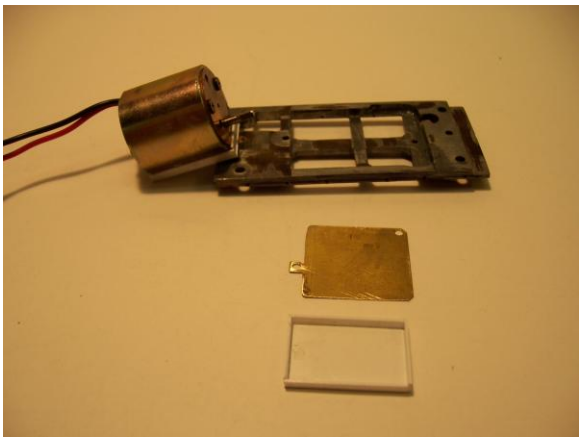
13. Set the motor in the styrene motor mount tray and place it on the motor mount with the motor and tray butted in the left front corner of the frame. Place a 0.030" thick piece of styrene between the motor and the left side of the tender (this provides motor clearance). Test fit the decoder mock-up to be sure the tender shell has been milled enough. Rotate and position the motor so the shaft is centered and the distance between the bottom of the shaft and the top of the frame is 0.130". **This dimension is critical.** The dimension would change depending on motor type, tender truck type and tender wheel diameter. The object is to have the motor shaft level with the worm shaft in the locomotive. Make note of the relative rotation/position of the motor in the Styrene tray after you have the motor positioned properly. This will enable you to set the motor in the silicone tray at approximately the correct rotation/position.

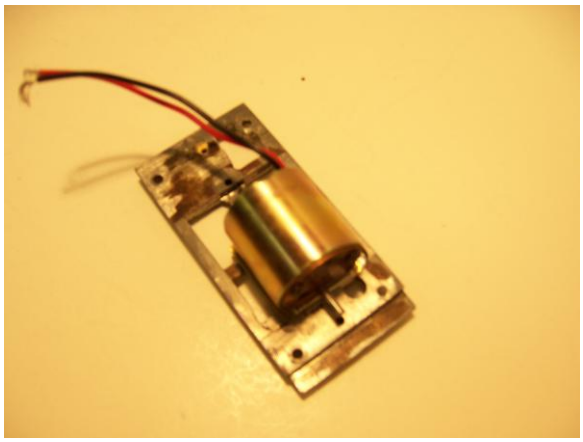
14. Fill the Styrene tray with clear silicone and repeat step 12., above.

15. Allow the silicone to set up for 24-hours before attempting to move the tray.

16. The photos below illustrate the installation.







DCC Sound Decoder and Speaker

1. I used a SOUNDTRAXX Micro-Tsunami Model TSU-750, #826001 "Light Steam" sound decoder. It fits in the right front of the tender next to the motor. Place it with the component side toward the tender side wall so that the wall will act as a heat sink.

2. I used a TDS 0.50" diameter speaker and enclosure from Tony's Train Exchange. Make sure you install the speaker into the enclosure so that the cone points out of the enclosure. The speaker fits in the left rear of the tender with the cone facing toward the track.

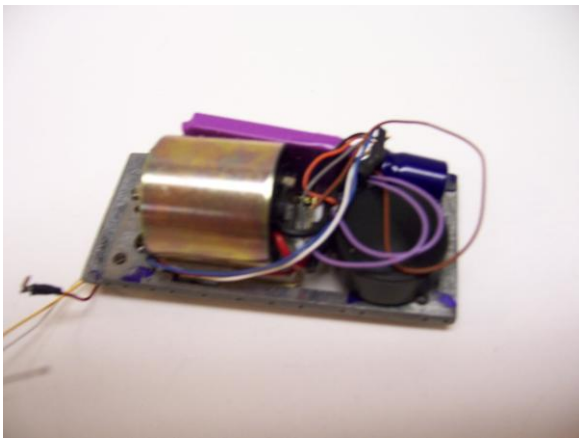
3. Wire the decoder according to the SOUNDTRAXX instructions. **BE SU**RE to install the capacitor in the right rear of the tender.

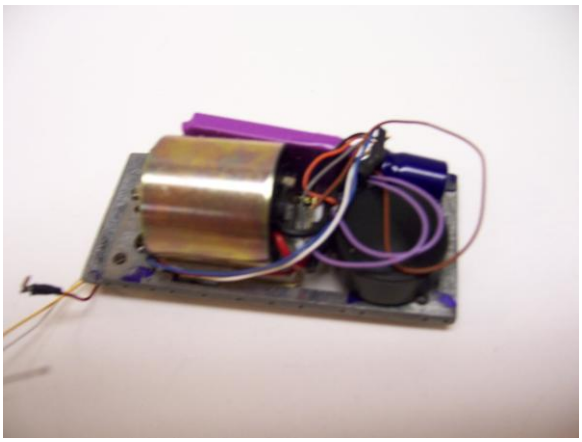
4. I connected the red wire to the locomotive frame by soldering a short length of 0.030" wire from the end of a capacitor to it. I then drilled a 0.292" hole (using a #69 bit) in the bottom right rear (engineer's side) of the frame 0.080" and 0.080" in from the side. Filed the tip of the wire and reamed the hole until I had a snug press fit.

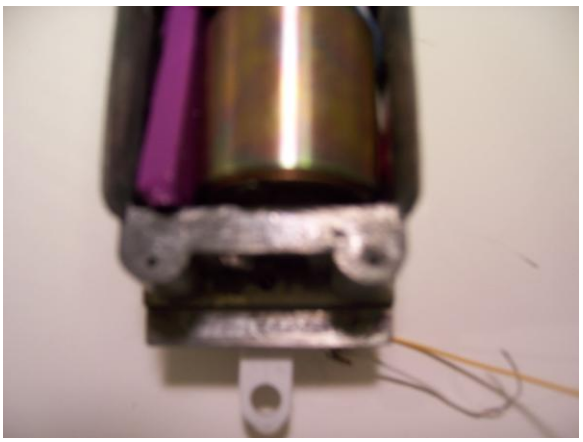
5. I made the locomotive to tender headlight wire connections by using male and female Micro-Mini Connectors, SOUNDTRAXX #810058. I soldered a male and a female to the tender wires and did the same for the locomotive wires. I used the smallest shrink tubing I could find to cover the soldered wires/connector ends.

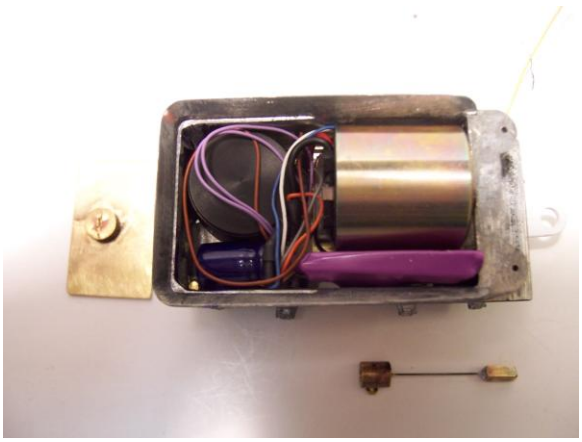
6. I use a Miniatronics 1.5-volt, 30-mA, 1.2-mm diameter yellow bulb , #18-Y03-330 with a 270 – 330 ohm resistor, depending on the bulb brightness desired.

7. The installation is shown in the photos below.









Tender Wood Load

1. Assemble the tender and frame with the motor and all electrical sound components in it.

2. Cut a length of masking tape to the width of the motor.

3. Add four (4) layers of masking tape over the top of the motor and decoder. This creates "wiggle room" between the wood load and the motor/decoder.

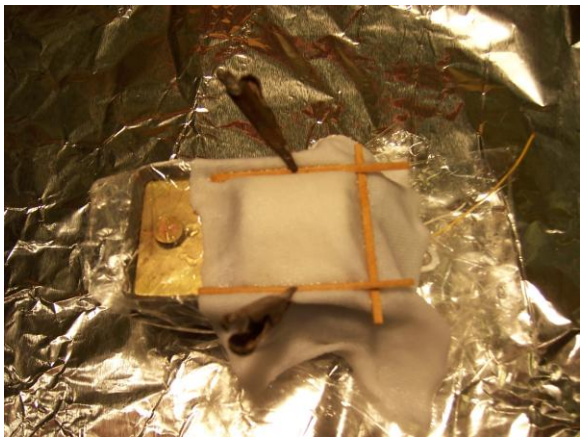
4. Completely wrap the tender in clear kitchen plastic wrap ("Cling" or a similar product). **BE CAREFUL** not to make **ANY** holes in the wrap (or you'll super glue the entire tender together)!! Set the tender right side up on a piece of aluminum foil.

5. **GENTLY** form the clear plastic wrap down around the motor and decoder using a cotton tipped swap. **DON'T** make **ANY** holes!!

6. Completely wet a scrap of cotton T-shirt and **GENTLY** lay it over the area of the wood load.

7. **GENTLY** press the T-shirt down with a Q-tip to cover the motor and decoder. **DON'T** make **ANY** holes!!

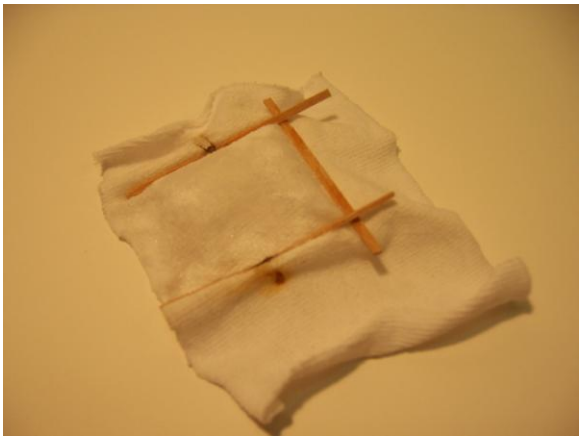
8. Use scrap strip wood (approximately 0.040" thick X 0.060" wide) to temporarily batten down the wet T-shirt.



9. Saturate the wet T-shirt with thin cyanoacrylate (super) glue. I used Balsa USA's "Gold CA" as it bonds wood and cloth well. Let dry for 24-hours.

10. After 24-hours, resaturate the (dry) T-shirt with super glue again.

11. After waiting another 24-hours for the glue to dry, carefully remove the T-shirt base for your wood load. Remove the clear plastic wrap from the tender. Trim the base to its final size. See the photos below.



Long Toolbox (PSC #3050 – SP Tender) for Rear of Tender

1. Drill a #55 (0.052") hole 0.064" in from rear of frame and centered side-to-side.

2. Clean flash from toolbox.

3. Measure the inside length of the toolbox and cut a piece of 0.090" square brass stock to that length (0.687"?). I used a piece of Hobby town/Micro Mark universal joint shaft material.

4. Measure the inside width of the toolbox (0.088"?) and carefully draw file one side of the square stock to that dimension. The stock should slide inside the toolbox when you are done.

5. Assemble the tender body to the tender frame with four (4) screws.

6. Center the toolbox (with the filler stock inside) at the rear of the tender and clamp in place with alligator clips.

7. Use a #55 drill bit to mark the start of a hole in the toolbox filler stock thru the hole you drilled in step 1, above.

8. Remove the tender body from the tender frame.

9. Remove the filler stock from the toolbox and finish drilling the #55 hole thru it, preferably with a drill press so that the hole is straight through the stock.

10. Tap the hole you drilled in step 8, above with an 0-80 tap.

11. Clearance drill the frame hole you drilled in step 1, above with a #51 (0.067") drill bit.

12. Use a 7/64" drill bit to countersink the hole in step 10, above to a depth of 0.080". Countersink from the BOTTOM/COUPLER SIDE of the frame!

13. Use an 0-80 flat head brass screw to attach the filler stock to the frame. If the screw head is not below the surface of the coupler pad, countersink the hole some more.

14. Cut off the screw level with the filler stock.

15. Press the toolbox onto the filler stock and attach the tender shell to the frame. Check the fit and file as necessary.

16. Carefully unscrew the toolbox so as not to change the position of the filler inside it.

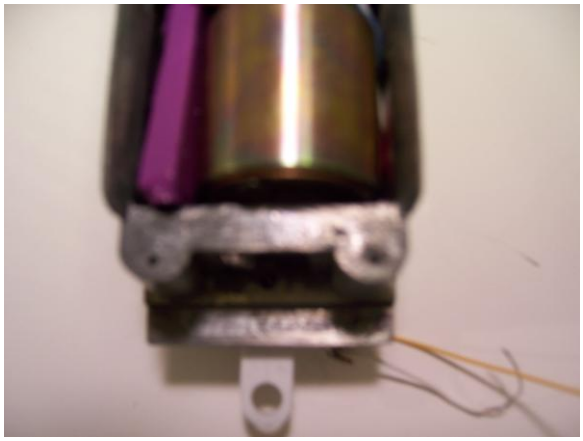
17. Carefully solder the filler stock inside the toolbox.

Tender Water Valves

1. Clean flash from castings (PSC #'s 3029 or 31519).

2. Mark centers for holes 0.080" in from each front corner of tender centered between the 0.300" wide tank fronts.

3. Drill holes using a #65 bit (X0.035").



Tender Rivets

I used Archer Surface Details decals #25, "HO Scale 1:87 ½" Rivets, spaced 3 ¾"" to add rivets to the tender wrapper. Archer has other rivet spacings and sizes available.

AL MUELLER'S MANTUA GENERAL REBUILD
December 8, 2010

1. Prime (all painting was done with an airbrush) the tender shell with Floquil Gray Primer #F110009. Bake the tender shell for 2-hours at 170-degrees Fahrenheit.

2. Gloss coat the tender shell with Floquil Crystal Cote #F110004. Bake the tender shell in the oven for 2-hours at 170-degrees.

3. Determine the rivet pattern for your tender by reference to photos and/or drawings. Make cardboard fixtures to lightly pencil the vertical rivet lines on the tender shell.

4. Cut out the decals from the decal sheet on a piece of plate glass using an Xacto knife.

5. Mark the vertical rivet lines lightly on the tender shell using a very sharp #2H pencil.

6. **GO SLOW** in applying the decals ! Apply the horizontal row on one side and 1/2 of the rear and let it dry for a day. Then, apply the vertical rows to that side and let them dry for a day. Do **NOT** use **ANY** decal set until the decals have dried for a day. Then, apply Micro scale's **BLUE** (gentle) decal set and let that dry for a day. The next day, apply Micro scale's **RED** decal set and let that dry for a day. The key to making these decals work is to **GO SLOWLY** !

7. Repeat step 6., above for the other side.

8. After all decals and setting solution has dry for at least a day, bake the tender shell in the oven for 2-hours at 170-degrees.

9. Apply a second coat of primer to the tender shell and bake in the oven for 2-hours at 170-degrees.

The completed shell is shown in the photo below prior to the application of the second primer coat.

Tender Deck

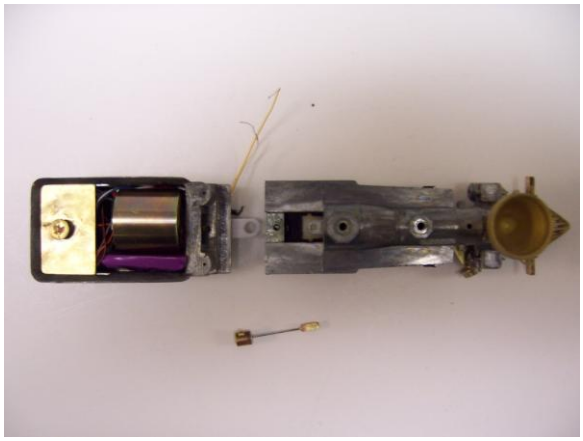
1. Cut the rear deck from 0.020" sheet brass. The width and length is determined by using a caliper to measure the distance of the milled surface of the tender sides (see **Tender Shell** step 7.) My example measured 1.106" wide and 0.695' long.

2. Round the rear corners of the deck. File carefully and test fit often until a loose snap fit into the tender shell is achieved

3. Drill a hole 2 scale feet from the rear of the deck and centered side to side using a #56 bit.

4. Solder a brass water hatch in the hole (I used a PSC #32373 hatch).

The completed deck is shown in the photo below.



Draw Heads

I use either PSC #31574 or #3132 draw heads on the tender for link and pin couplers.

1. Drill all draw head pin holes 0.031" (#68 bit). This will accommodate and Alexander pin.

2. Test fit a link and pin . File the draw head slots deeper, if necessary, so the link swivels freely in all positions.

3. Cut 0.025" thick brass stock 0.300" X 0.300" square. These will become frame attachment projections on the draw heads.

4. Mill or file 0.015" off of the top of the existing rear projection on # 31574.

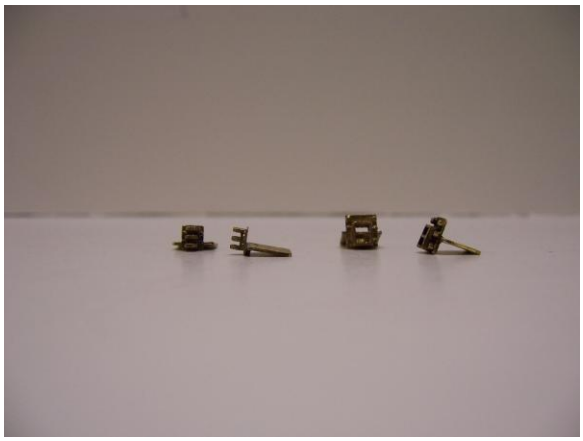
5. For #3132, file a 0.100" notch 0.020" deep in the end of the square frame attachment projection created in step 2., above. This is necessary to provide clearance for inserting a link in the upper slot.

6. For #3132, solder the frame attachment projection to the top of the existing projection with the notch toward the upper slot in the draw head.

7. For #31574, solder the frame attachment projection to the top of the remaining rear projection.

8. Position the draw head at the rear of the tender frame, mark the coupler screw hole on the projection and drill a clearance hole for an 0-80 screw using a #56 bit.

   Completed draw heads are shown in the photo below.



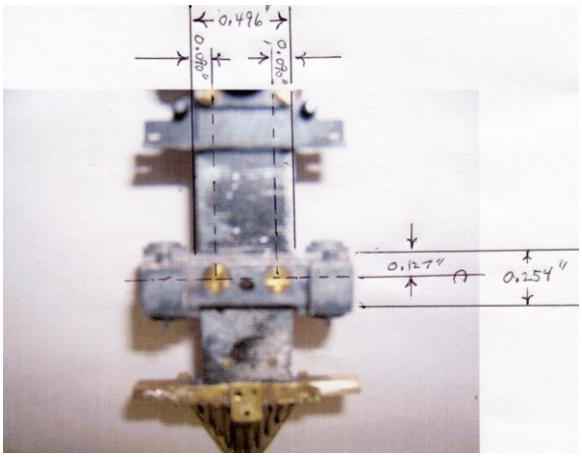
Attach Cylinders to Frame

Semi-permanently attaching the cylinders to the frame makes it easier to disassemble and reassemble the locomotive boiler to the frame and saves wear and tear on the crosshead guides.

1. Clean all flash from cylinders and frame.

2. Attach the cylinders to the frame with a 2-56 screw and nut. Tighten so that the cylinder butts tight against the rear of the frame slot (toward drivers).

3. Using a #53 (0.060) bit, drill two holes through the cylinders and frame positioned as shown in the drawing below.



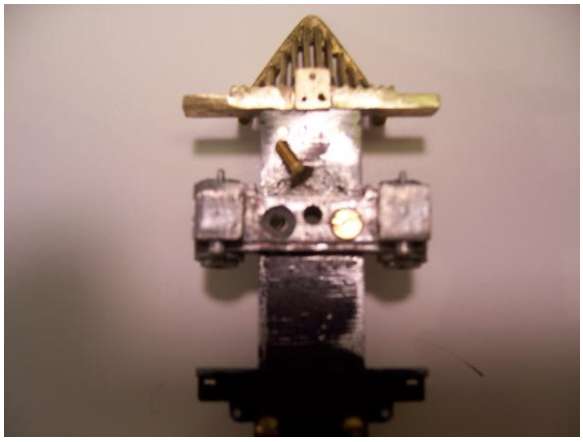
4. Remove the cylinders from the frame and clearance drill the two holes using a #47 (0.079") bit.

5. Use a 5/32" drill bit to countersink the holes to a depth of 0.085". Countersink the TOP of the cylinder casting! Test fit the 1-72 flat head brass screws in the cylinder casting. If the heads are not flush with or below the casting's surface, countersink the holes some more.

6. Tap the frame holes using a 1-72 tap. Be sure to use plenty of "Tap Eze" or light oil to prevent the tap from breaking.

7. Cut two 1-72 flat head brass screws 0.215" long including the head. (Nut + 3 washers on 0.060" bar).

The finished product appears in the photo below.

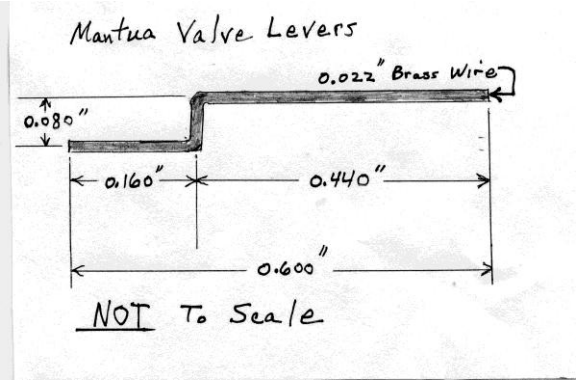


8. When doing the final assembly of the locomotive, insert the crosshead guides during the process of screwing the cylinder block to the frame.

Cylinder Valve Levers

These represent the valve rods that go into the square box on top of each cylinder.

1. Bend and cut 0.022" brass wire according to the diagram below.



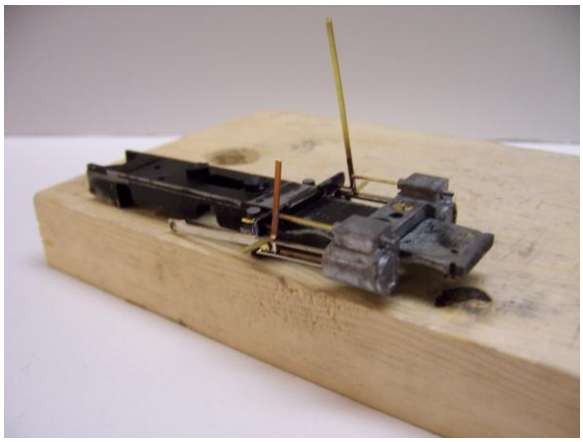
2. Drill a 0.024" hole (#73 bit) in each side of the guide yoke (which holds the back of the crosshead guides) portion of the white metal frame, 0.090" in from the end and 0.050" from the bottom.

3. Increase the depth of the top (valve rod) holes in the cylinder casting to 0.275" with a #73 bit.

4. Temporarily install a crosshead guide (do NOT bend the tab over the guide yoke) and the valve lever rod with the 0.160" end of the rod in the guide yoke and the 0.440" end of the valve lever rod in the cylinder.

5. Bend a 90-degree "L" in a short piece of 0.015" X 0.042" flat brass stock and solder it to the valve lever rod as shown in the photo below.

6. Cut the bottom of the brass strip even with the edge of the crosshead guide (so that an "L" remains) and cut the top 0.020" above the valve lever rod. Round the top corners with a file.



Repairing Damaged Crosshead Guides

The rear tab breaks off after being bent a few times on the Mantua crosshead guides. This tab is what is inserted in the guide yoke (which is cast on the frame) and bent over to hold the rear of the crosshead guide. Repairing one is simple.

1. Bend a 90-degree "L" in a piece of 0.015" X 0.042" flat brass stock.

2. Trim one leg of the "L" to 0.140".

3. Solder the 0.140"end of the "L" to the top rear of the crosshead guide with the long leg of the "L" sticking up.

4. Cut off the long leg of the "L" to a length of 0.140".

Cab Grab Irons

I use 0.012" brass wire for all grabs.

1. Bend wire into a U-shape around a piece of 0.080" thick brass stock.

2. Place a piece of tape 0.060" in from the end of a flat nosed pliers.

3. Butt the formed grab against the tape and bend the legs of the grab at a 90-degree angle.

4. I install the grabs (on a Mantua cab) 0.045" from the bottom edge of the cab and 0.035" in from the outer edge of the cab.

Cab Steps

1. Tape a piece of masking tape sticky side up on a scrap piece of 1" X 2" wood. Tape one long edge to the wood, as well as taping the ends, to keep the tape from shifting.

2. Press a piece of 0.015" X 0.100" styrene onto the tape, using a straightedge to keep the plastic straight.

3. Set a caliper at 0.100" and scribe cutting lines on the styrene to produce 0.100" square steps.

4. Use a #79 bit to drill a 0.015" hole 0.080" from the front edge of the step.

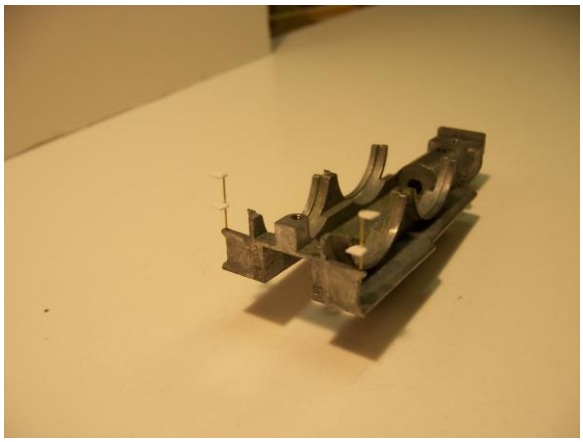
5. Cut off the step with the hole in it and then drill and cut some more steps.

6. Cut sufficient pieces of 0.015" brass wire to a length of 0.473".

7. Insert a wire into a step so that about 0.003" of the wire shows through at the bottom of the hole. Make sure the step is at right angles to the wire and super glue it in place.

8. After the first step is dry, thread another step onto the wire. Position it 18 scale inches (0.2068") above the lower step and at a 90-degree angle to the left of it; i.e., if the lower step faces south, the upper step should face either east or west (you need one of each kind for each cab).

The completed steps appear in the photo below.



Drawbar

This drawbar will close couple the locomotive and tender, resulting in a more prototypical appearance. The locomotive will negotiate a 24" or larger radius curve. Smaller radii require longer draw bars.

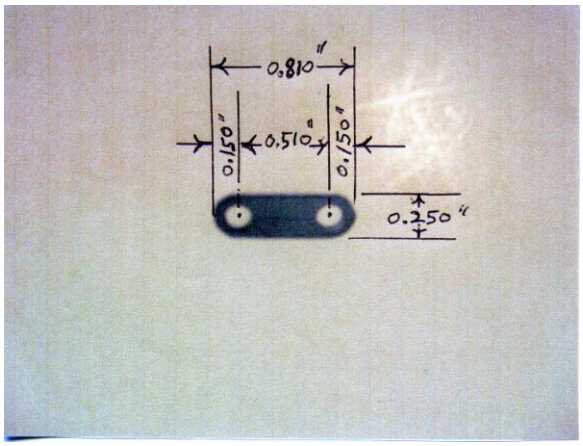
1. Cut a piece of 0.040' styrene to a width of 0.250" and a length of 0.810".

2. Score a line down the center of the piece.

3. Mark centers 0.150" in from each end on the center line.

4. Drill two 0.147" holes at the marked centers using a #26 drill bit.

5. Round the edges of the drawbar as shown in the photo below (photo is not to scale).



Driveshaft

This driveshaft is almost invisible and will allow the locomotive to negotiate a 24" radius curve (or less).

1. Cut 3/16" (0.1875") brass rod to a length of approximately 0.225".

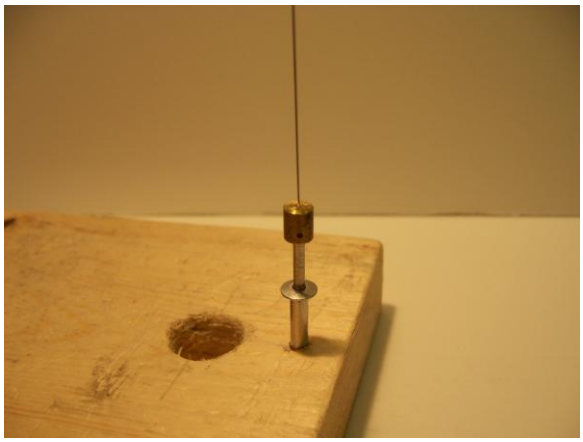
2. Drill **HALFWAY** thru the end of the rod using a drill bit equal to the diameter of your motor shaft (0.079", #47 bit, for a 2020A motor). Center the hole, of course.

3. Drill **HALFWAY** thru the opposite end of the rod using a 0.016" (#78) bit. Center the hole.

4. Drill a 0.037" hole using a #63 bit in the side of the rod at the midpoint of the **LARGE** hole in order to install a 00-90 set screw.

5. Tap the side hole 00-90.

6. Solder a piece of 0.015" music wire into the 0.016" hole. I insert a 1/8" aluminum pop rivet into the motor shaft end of the piece to insure that the music wire does not protrude into the motor shaft side of the hole.



7. Install a cup from a Hobbytown universal (available from Micro Mark) onto the worm shaft. The end of the shaft should be flush with the inner edge of the cup.

8. Punch a 3/16" disk from 0.010" thick plastic sheet using a leather punch.

9. Insert the plastic disk into the universal joint cup so it lies against the back of the cup. This will prevent a short circuit by stopping the end of the square tubing from contacting the end of the worm shaft.

10. Snap a white Hobbytown ball into the cup. Trim the two prongs of the ball flush with the outside of the cup.

11. Drill the center of one end of the Hobbytown square brass tubing 0.016" (#78 bit).

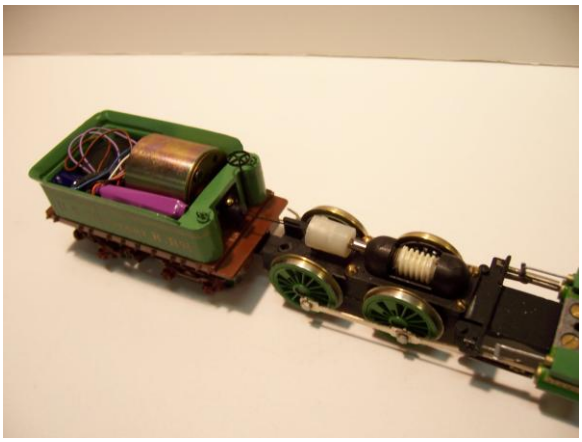
12. With the motor installed in the tender, connect the tender to the locomotive with the draw bar.

13. Install the round collet and wire assembly on the motor shaft with a 00-90 screw. The screw must be cut short enough so that it does not hit the tender deck when the motor shaft rotates.

14. Measure and cut the square tubing and music wire so that the square tubing, after being soldered to the music wire, fits completely into the universal ball.

15. Insert the end of the music Wire into the hole in the square tubing and solder it in place.

The photos below illustrate the parts and completed drawbar.



Modifying Mantua Boilers

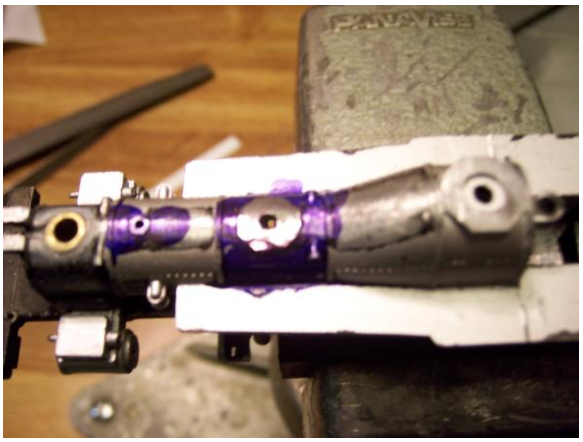
I use a combination of a milling machine and hand filing to modify the white metal boiler. All of the modifications can be done by hand filing. The milling machine is just faster in some cases. Removing all or a portion of the running boards, removing or changing nameplates, changing cabs, changing smokestacks and domes (number and location) are all easier than you think, once you "take the plunge".

All filing and machining operations are easier if you coat the work area on the boiler with layout dye. This is a blue dye that will assist you in seeing scribed lines and determining how much material you are removing.

I use many types of files, from 10" bastard mill files to very small diamond files.

If I accidentally gouge the boiler or remove too much material, I use Bondo Glazing & Spot Putty. After sanding this red putty smooth, I use Squadron Green Putty to finish the area (sanding with 400 – 600 wet or dry sandpaper). If some rivet detail is removed, it can be re-added using Archer Surface Details HO rivets (mentioned earlier).

Below are some photos of reworked Mantua boilers.



Steam and Sand Domes

Brass dome bases must be lapped to match the contour of the boiler. I made a mandrel from a pine dowel by turning it on a lathe. Allowing for the 0.0205" thickness of emery paper, I turned the rear portion of the dowel to a 0.545" diameter to match the diameter of the boiler at the rear steam dome and then turned the front portion of the dowel to 0.460" diameter to match the front portion of the boiler. I glued medium emery paper around the dowels. I used pliobond glue, applying it to both the dowel and the emery paper, letting it dry before gluing the pieces together. This allows easy changing of the emery paper when it wears out. I turn the mandrel in a lathe (chucked on one end and a live center on the other end) at low speed and rub the dome base back and forth while keeping the emery paper wet with a light oil. Frequently check the fit of the dome base against the boiler until it is exact.

I sometimes use the octagonal base of a Cal Scale dome with a Precision Scale dome on top of it. This is easily dome by chucking the dome in a lathe (or electric drill clamped to the work bench), spinning it and cutting with a jeweler's saw.

When replacing the Mantua domes with brass ones, I like to screw the brass domes to the boiler from the inside of the boiler. To do this, I turn brass rod on a lathe so that it fits inside the dome. After drilling and tapping the "slug" I solder it into the dome.

Slug measurements for the domes I use are shown below.

Dome Make		Diameter (inches)	Length (inches)
Calscale #DO-342 (fluted)	Steam	0.240	0.115
	Sand	0.191	0.190
Calscale #DO-338	Steam	0.2375	0.220

Calscale #DO-338	Sand	0.195	0.175
Precision Scale #31227	Steam	0.296	0.080
Precision Scale #31228	Sand	0.240	0.075

Below is a photo of completed slugs, domes and the mandrel used to lap them.

Smoke Stacks

I. use the following procedure to replace the cast on Mantua smoke stack with a brass one:

1. Cut off the Mantua stack and file the boiler area smooth.

2. Early Mantua boilers have a 0.125" diameter vertical hole in the boiler below the stack. Simply file the flash from the brass stack (Cal Scale #190-326 or PSC #3516). The brass stub (after filing) is 0.125". The finished stack will fit right into the boiler hole. Shorten the stub so that it's maximum length is 0.140" (to allow clearance for headlight wires).

3. Later Mantua boilers have a 0.190" vertical hole below the stack. I soldered together 3-pieces of brass tubing, the smallest of which has a 0.125" inside diameter.

4. I turned down the nested tubing on a lathe to an outside diameter of 0.190"

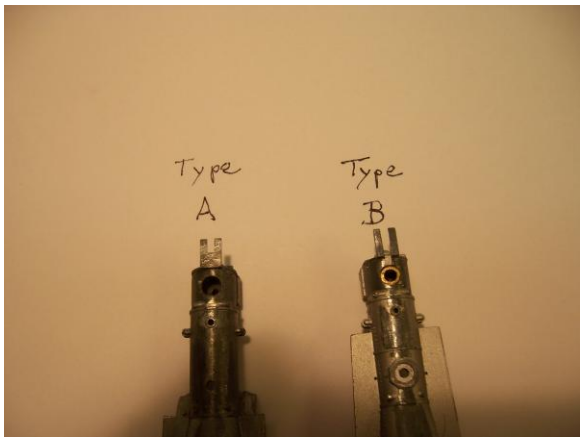
5. I cut off a piece of tubing 0.140" in length and press it all the way onto the stack stub.

6. Use gap-filling super glue or epoxy to attach the stack to the boiler **after** all other machining, filing and drilling operations on the boiler are complete.

Headlight Wires Through Boiler

Changing the stack requires some work to provide a path for the headlight wires. Also, early Mantua boilers do not have a longitudinal hole to fish headlight bulb wires through. I remedy this problem as follows:

1.There are two types of cast on headlight bracket, types A and B, as shown in the photo below.



The type A bracket must have a half-moon milled in the rear even with the boiler top, as shown in the photo below.

For type B brackets, proceed directly to step 2.

2. Using a 5/64" bit, drill a hole 0.150" deep just in the rear of the cast on white metal headlight bracket at the boiler front, as close to the front as possible without ruining the smoke box front.

3. For type A brackets only, mill out or file out the metal between the hole you just drilled and the existing smoke stack hole.

4. For Type A brackets only, file the notch in the headlight bracket so that it looks like the type B bracket.

5. For Early boilers only, using a long #29 bit, drill from the rear of the boiler at an upward angle to intercept the hole you drilled in step 2., above.

6. Test fit the bulb by solder the two bulb wire ends to a small diameter wire. Fish the small diameter wire, followed by the bulb wires, through the holes until they emerge from the back of the boiler.

Pilots

I replace the Mantua pilot with a cast brass pilot by Precision Scale Company (PSC).

A. PSC #31378 (horizontal bar type). I use this for Confederate locomotives.

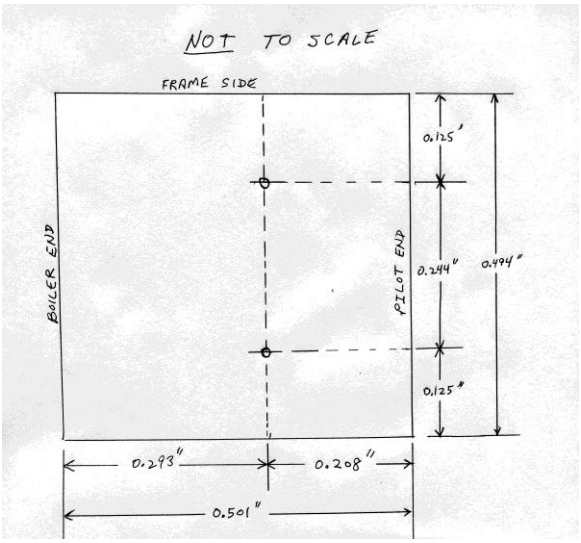
   1. Cut off the Mantua pilot and pilot beam, but do **NOT** remove **ANY** of the frame behind the pilot beam.

   2. File or mill the frame front so that it is square vertically and horizontally.

   3. Remove all flash from the brass pilot and cut off the mounting "tang" 0.125" behind the brass pilot beam.

   4. Cut a 0.030" thick piece of brass stock as wide as the Mantua frame (0.492") and 0.500" long.

   5. Scribe lines as shown below.



6. Drill two (2) 0.060" holes at the intersections of the lines using a #53 bit.

7. With the cylinders firmly screwed to the frame, securely clamp the brass piece to the top of the frame using the orientation in the drawing above.

8. Using the existing holes as pilot holes, drill two (2) 0.060" holes thru the frame with a #53 bit.

9. Remove the brass piece and drill the frame holes 0.079" using a #47 bit.

10. Counter sink the bottom of the frame holes approximately 0.040" so that a 1-72 flat head machine screw does not protrude above the frame's surface.

11. Tap the holes in the brass piece 1-72.

12. Screw the brass piece on top of the frame using 1-72 flat head brass screws.

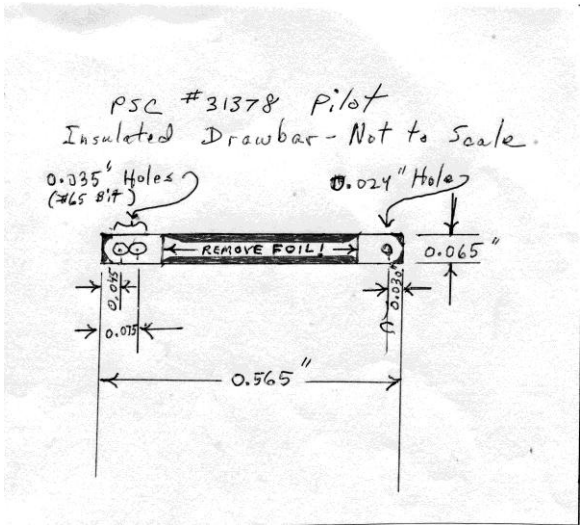
13. Securely clamp the pilot to the brass piece so that it is centered and it's top edge is almost even with the top of the brass piece.

14. Solder the pilot to the brass piece ("tang").

15. Remove the pilot from the frame by unscrewing the tang.

16. Make a draw bar from 1/32" printed circuit board using the dimensions in the drawing below. **BE SURE** to remove the foil as shown or you will experience a dead short when attempting to double-head locomotives. File out the 0.035" holes to make an oblong slot.

File out the black shaded areas. These draw bars can be used on PSC pilot #'s 31373 and 31366, too.



17. Drill two 0.016" holes in the vertical center brace of the pilot using a #78 bit. The holes should be drilled 0.040" and 0.100" above the first vertical bar.

18. Wrap a piece of 0.015" brass wire around the shank of a #61 drill bit to form a loop.

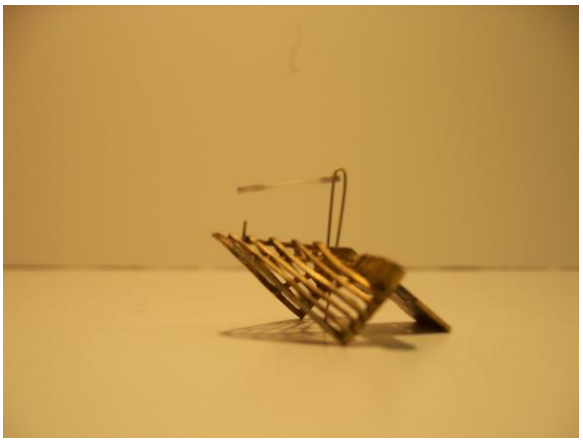
19. Add a "peg" to the pilot to restrict the draw bar's side-to-side motion when it is not in use. Drill a 0.016" hole in the vertical center brace of the pilot 0.150" above the bottom of the pilot.

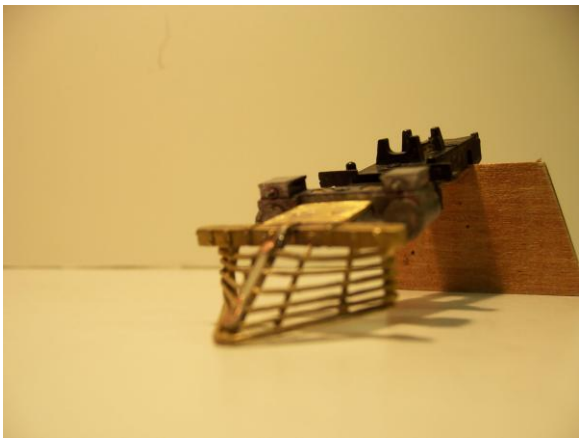
20. Insert a length of 0.015" brass wire thru the hole drilled in step 19., above and solder it in place. Cut the wire flush with the back of the pilot and cut the front of the wire so that it extends 0.070".

21. Insert the loop thru the draw bar so the draw bar's foil faces up. Insert the loop thru the pilot holes drilled in step 17., above and pull tight until the draw bar rests flat over the pilot.

22. Solder the loop in place from the rear of the pilot and trim wires flush.

23. The assembly appears in the photos below.





B. PSC #31373 (Horizontal bar type). I use this type for Union locomotives.

1. Cut off the Mantua pilot and pilot beam so that 0.090" of the pilot beam remains.

2. File or mill the Mantua pilot beam so that it is square vertically and horizontally. The finished thickness of the pilot beam should not be less than 0.080".

3. File the top of the remaining Mantua pilot beam smooth.

4. Drill two (2) #55 holes in the front of the brass pilot beam 0.050" down from the top and 0.040" out from the point where the pilot meets the pilot beam.

5. Clamp the brass pilot to the Mantua pilot beam, centered and flush with the top of the Mantua pilot beam.

6. Using the brass pilot beam holes as a guide/drift, drill two (2) #55 holes thru the Mantua pilot beam.

7. With the beams clamped together and holes aligned, tap the holes 0-80.

8. Open the coupler pocket on the pilot with a #50 bit and small files so that a PSC #40186 draw bar fits inside the pocket. Bend the draw bar slightly to lie against the pilot.

9. Cut a plate 0.176" wide and 0.200" deep/long from 0.025" thick brass.

10. Solder the plate to the brass pilot beam, centered over the coupler pocket and flush with the back of the beam.

11. Drill a 0.032" hole in the plate for a coupler pin using a #67 bit.

12. Drill two 0.028" holes near the rear of the plate for 0.030" nut-bolt-washer (NBW) castings.

13. Solder the NBW castings into the holes in the plate.

14. Drill a PSC #40186 draw bar 0.035" with a #68 bit, using the dimple provided.

15. Thin and narrow the drilled end of the draw bar so that it fits inside the pocket. Bend the draw bar slightly to lay flat on the pilot. When coupling locomotives together, remove this draw bar and replace it with the one created in the section on pilot #31378, above.

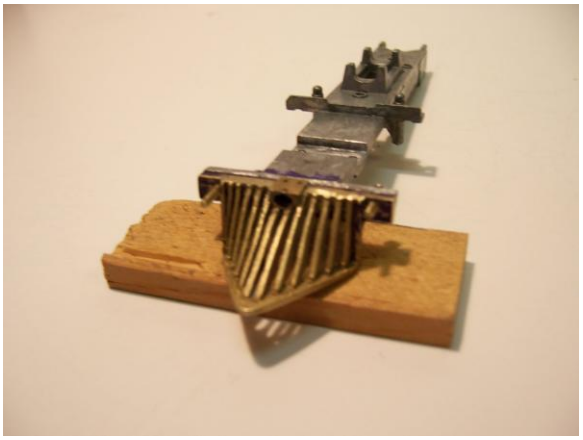
16. Drill the center of the bottom front edge of the pilot 0.016' using a #78 bit. This will hold a pin to secure the bottom of the draw bar.

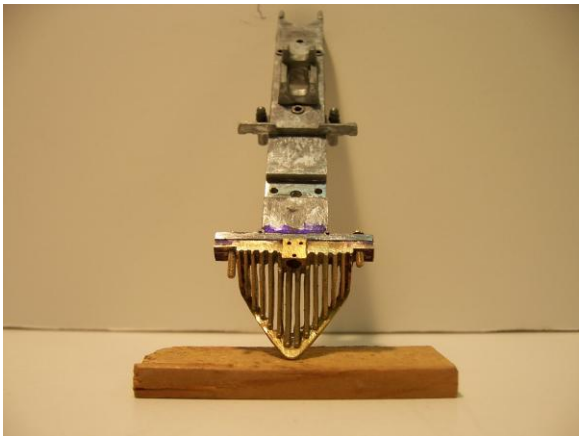
17. Solder a piece of 0.015" brass wire into the hole in the pilot. Trim to length to hold the bottom of the draw bar.

18. With the brass pilot clamped tightly to the Mantua pilot beam and the screw holes aligned. screw the pilot to the Mantua beam with two (2) 0-80 screws. The screws should be started thru the Mantua beam so that they face the rear of the locomotive.

19. Cut the brass pilot beam ends off flush with the Mantua beam ends and file smooth.

20. The photos below show the completed attachment to this point.





21. After **ALL** machining, filing and drilling is complete on the frame, make sure the screws are tight and cut them off flush with the brass pilot beam. File them smooth.

22. Solder the screw ends to the brass pilot beam and file smooth.

23. Cut off the screw heads flush with the Mantua beam and file smooth.

24. Use body putty to fill the gap between pilots. Sand the putty smooth when it is dry.

25. I have also attached this type of pilot by butt soldering a brass tang to the back and screwing it to the Mantua frame similar to the attachment method on the #31378 pilot. I believe the butt joint is inferior to the above method of attachment, as the butt joint is weaker.

C. PSC #31366 (Horizontal bar type). I use this type for Union locomotives.

1. Cut the Mantua pilot off of the frame, leaving the entire pilot beam.

2. Mill or file the front of the pilot beam flat and square.

3. Drill two (2) 0.037" holes in the face of the pilot using a #63 bit, 0.040" from each edge and 0.050" from the top.

4. Firmly clamp the pilot to the beam with the pilot centered and flush with the bottom of the beam.

5. Using the holes drilled in step 3., above as pilot holes, drill two (2) 0.037" holes thru the pilot beam using a #63 bit.

6. Drill the coupler pocket pin hole 0.031" using a #68 bit.

7. Drill a PSC #31177 draw bar 0.028" with a #70 bit, using the dimple provided.

8. Thin and narrow the drilled end of the draw bar so that it fits inside the pocket. Bend the draw bar slightly to lay flat on the pilot. When coupling locomotives together, remove this draw bar and replace it with the one created in the section on pilot #31378, above.

9. Drill the center of the bottom front edge of the pilot 0.016' using a #78 bit. This will hold a pin to secure the bottom of the draw bar.

10. Solder a piece of 0.015" brass wire into the hole in the pilot. Trim to length to hold the bottom of the draw bar.

11. Securely clamp the pilot to the pilot beam with the holes aligned.

12. Tap the holes 00-90.

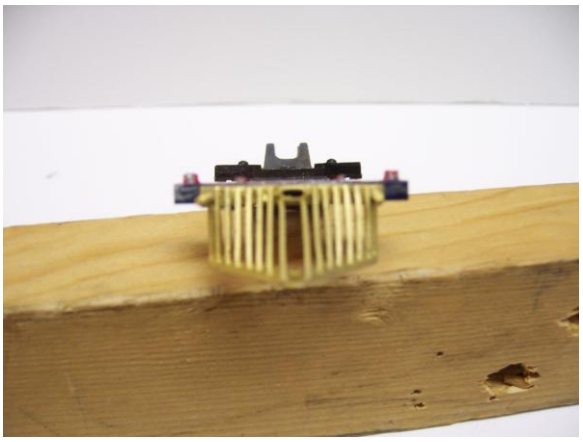
13. With the brass pilot clamped tightly to the Mantua pilot beam and the screw holes aligned. screw the pilot to the Mantua beam with two (2) 00-90 screws. The screws should be started thru the Mantua beam so that they face the rear of the locomotive.

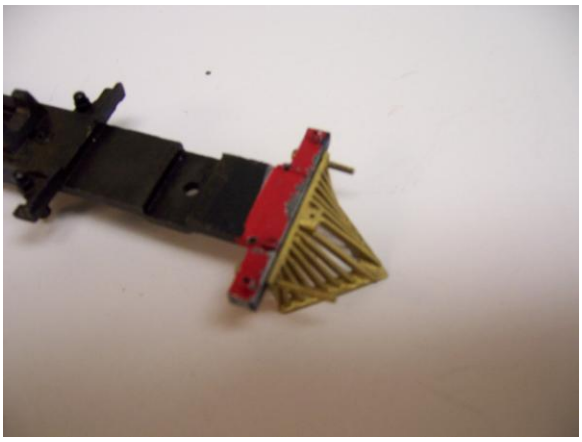
14. After **ALL** machining, filing and drilling is complete on the frame, make sure the screws are tight and cut them off flush with the brass pilot beam. File them smooth.

15. Solder the screw ends to the brass pilot beam and file smooth.

16. Cut off the screw heads flush with the Mantua beam and file smooth.

17. The completed assembly is shown in the photos below.





Pilot Beam Details

1. I add PSC #31395 flag holders to the brass pilots #31373 and 31378.

2. Cut the flag holders from the sprue and remove all flash.

3. Drill the hole in the top of each holder 0.016" (#78 bit) deep enough to hold a piece of 0.015" brass or stainless steel wire vertically.

4. For pilot #31378 (vertical bars)clamp a piece of 0.060" brass stock to the rear of the brass pilot beam and flush with the top of the beam. Drill holes 0.060" from each end of the beam and centered on the lone/crack between the two brass pieces. This results in a ½ circle holes in the brass pilot beam. Unclamp the pilot and screw it tightly to the Mantua pilot beam. Also, clamp the ends of the two pilot beams tightly together in a steel jawed vice. Drill the holes with a #69 bit again. The above is

necessary because, if you initially try to drill the hole in the beams while they are screwed together, the drill bit will "walk" toward the softer white metal beam and the hole won't be centered.

5. For pilot #31373 (horizontal bars) drill two (2) 0.0292" (#69 bit) holes in the pilot beam, 0.060" in from each end and centered side to side.

6. Solder the flag holders to the brass pilot beam.

Ornate Headlight and Bracket

I use PSC headlight #31633 and bracket #31307 on some locomotives.

1. Clean flash from parts and cut off the two (2) pointed, rounded ends from the bracket scrolls and file the scroll backs round.

2. Cut the supplied 0.015" sheet brass headlight back to 0.220" wide by 0.295" long.

3. Drill the headlight top vent 0.028" (#70 bit) crosswise. This improves the looks of the vent.

4. Drill a 0.052" (#55 bit) in the center of the round protrusion on the bottom of the headlight.

5. Tap the 0.052" hole 0-80.

6. Solder the 0.015" back to the headlight.

7. Drill a 0.055" (#54 bit) hole through the bottom of the back, centered., for headlight wires. Test fit the bulb to be sure the hole size is adequate. Drill a larger hole if necessary.

8. Solder the bracket to the headlight.

9. Cut an 0-80 flat head screw to an overall length of 0.110".

10. Screw the headlight to the cast bracket on the front of the boiler so the screw rests against the back of the slot in the cast bracket. You may file the slot deeper (further back to the boiler) if you want the headlight closer to the stack.

11. GENTLY bend the scrolled sides of the bracket down until the rear of each scroll touches the edge of the smokebox front.

12. Using a leather punch, punch a 0.005" lens from clear styrene.

13. Install the bulb and lens after painting. I use white glue sparingly to install the lens.

14. The completed assembly appears in the photo below.

Ornate Bell and Bracket

I prepare and install the PSC #31063 ornate bell and bracket as follows:

1. Remove all flash from the parts.

2. Drill one side of the bracket 0.024" (#73 bit) for the straight bell tang. Drill the other side of the bracket 0.035" (#65 bit) for the angled bell tang. This allows insertion of the angled tang without bending/breaking it.

3. Remove the bell from the sprue, clean with files and solder to the bell hanger while the hanger is still attached to the sprue.

4. Cut the bell hanger and bell assembly from the sprue with a side cutter/nipper and clean up with a file.

5. Cut the bell bracket from the sprue with a jeweler's saw using the finest blade available (70-teeth per inch).

6. Do **NOT** yet try bending the sides of the bell bracket up 90degrees! Instead, carefully bend only the base of the bracket around the boiler until it assumes the curvature of the boiler.

7. Drill the base of the bracket 0.052" (#55 bit) and tap it 0-80.

8. To use the existing bell mounting hole in the boiler, drill completely through it with a #53 bit (0.060"). File off the existing bell lug around the hole. For old solid boilers only, from the bottom of the boiler drill a 0.107" (#36 bit) hole exactly 0.400" deep using the 0.060" hole as a pilot hole.

9. To mount the new bell in a different position, drill the existing bell hole 0.052" (#55 bit), tap it 0-80, screw in a brass screw, cut off the screw flush with the bell lug and file the boiler smooth. Drill a 0.060" (#53 bit) hole all the way through the boiler at the new mounting position. From the bottom of the boiler drill a 0.107" (#36 bit) hole exactly 0.400" deep using the 0.060" hole as a pilot hole.

10. Insert an 0-80 round head brass screw through the 0.107" hole from the bottom of the boiler and screw the bell bracket to it (don't over-tighten the screw or you will strip the hole in the bracket).

11. Cut the 0-80 screw off flush with the bracket and remove it.

12. **CAREFULLY** bend the side of the bracket having the 0.035" hole up 90-degrees.

13. Insert the angled tang of the bell top through the 0.035" hole.

14. **CAREFULLY** bend the other side of the bracket upwards, passing the straight tang of the bell top through the 0.024" hole.

15. Screw the bell and bracket to the boiler after painting everything.

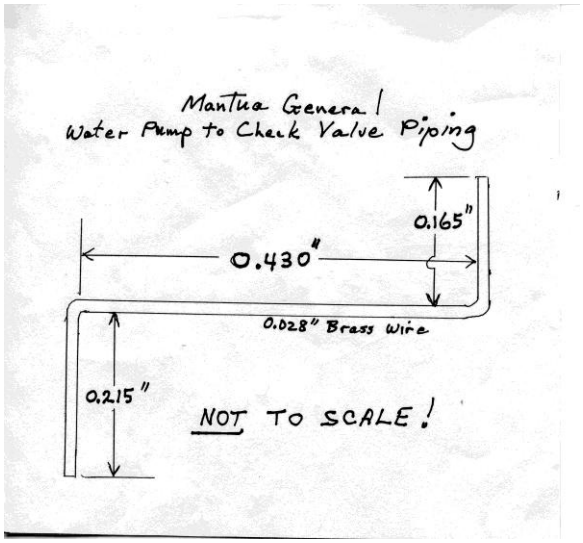
Water Pump to Check Valve Piping

1. Drill a 0.028" hole 0.150" deep in the bottom of each boiler check valve using a #70 bit. Lightly file the bottom of each pump first to give a good drilling surface. You may wish to use a smaller size bit first to create a pilot hole that prevents the #70 bit from "walking".

2. File the rounded tops of the water pump castings on the frame flat.

3. Drill a 0.031" hole 0.150" deep in the top of each water pump using a #68 bit.

4. Bend and cut 0.028" brass wire as shown in the drawing below. I made a simple rig by pounding two (2) 4d finish nails into a piece of plywood.



5. When assembling the boiler to the frame. Insert the short end of the pipe into the boiler check valve first. Then, line the pipes up with the water pumps as you place the boiler on the frame.

Running Boards

1. Make a jig from 0.125" styrene so that the boiler can be laid therein with the running boards lying on top of and being supported by the jig.

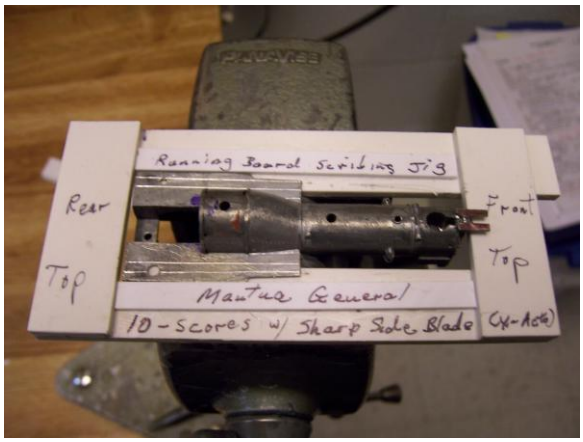
2. Clamp the boiler and jig in a nylon-jawed vice.

3. Lay styrene strip(s) against the side of the fixture. The width of the strip depends on the board width you decide on (I use scale 6" wide boards).

4. Heavily scribe each line 10-times with the pointed end of a #10 Xacto blade. BE CAREFUL !

5. File or sand the top of the running boards to remove the scribe ridges.

6. The jig appears in the photo below.



Sand Pipes

1. Drill a 0.020" hole 0.200" deep in the base of each side of the sand dome using a #76 bit.

2. Wrap 0.019" brass wire around the boiler mandrel you made earlier. Then, wrap the wire around the handle of a small Xacto knife.

3. Test fit the sand pipes with the drivers in place. Cut them to length.

4. Do not install the sand pipes until the locomotive is painted and otherwise finished.

Cab Windows

1. The Mantua cab can be made more distinctive by CAREFULLY removing some of the window sashes with a file.

2. Use 0.010" clear styrene to cut and sand each remaining window pane to fit.

3. Cement window panes in place with thin super glue after the cab is painted.

Handrails

1. Make new handrails from 0.022" brass wire.

Steam Dome to Cab Roof Levers

1. I used 0.010" X 0.030" flat brass stock for the levers, soldered into an elongated, inverted "U" shape. The dimensions will vary depending on what type of rear steam dome is used.

2. I used the existing holes in the Mantua cab roof and drilled two (2) 0.031" holes 0.115" deep and 0.062" from the dome rear.

3. I cut the legs of the levers so that one was 0.060" above the cab roof and the other was 0.125" above the cab roof.

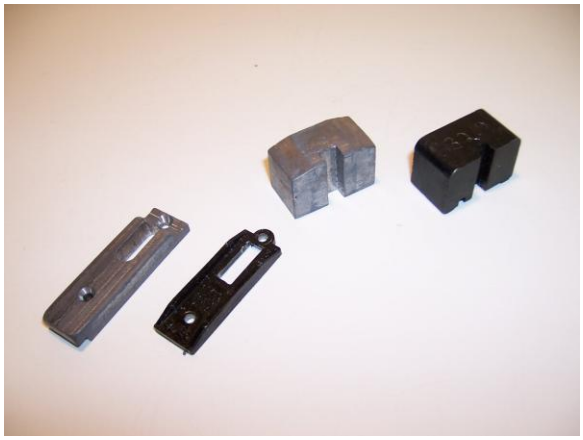
Adding Weight to the Locomotive

1. I cast lead weights and machined them with a lathe and file to increase pulling power. Lead is DANGEROUS and TOXIC to work with! Use caution if you try this.

2. To make a thicker axle retainer, I built molds from soft pine wood, each cavity being 0.250" deep, 0.500 wide and 1.700" long. I drilled a 1/16" hole in the bottom of each cavity to prevent air being trapped at the bottom. After machining these lead slugs, they look like the firebox under the locomotive. The weight of the Mantua white metal axle retainer is 6.2 grams. The weight of my lead axle retainer/firebox is 26.5 grams.

3. The Mantua cab weight is white metal in all but the earliest locomotives produced (the earliest ones had a lead cab weight). I built molds from soft pine wood, each cavity being 0.650" deep, 0.600 wide and 1.025" long. I drilled a 1/16" hole in the bottom of each cavity to prevent air being trapped at the bottom. The weight of a Mantua white metal cab weight is 32.0 grams. The weight of my lead cab weight is 63.0 grams

4. The finished lead weights are shown in the photo below. (The lead pieces are silver, Mantua pieces are black).



AL MUELLER'S MANTUA GENERAL REBUILD
December 8, 2010

Painting

1. I do not use water-based paint because I'm not good at applying them.

2. I use Floquil, Scalecoat, Model Master and Tamiya paints, depending on color.

3. I always begin with a coat of Floquil primer.

4. I use a Binks single action airbrush that is probably 35-years old, and an old Binks diaphragm compressor.

5. I ALWAYS spray in a well ventilated spray booth and wear a painting mask with a good filter.

6. I bake each coat of paint for 2-hours at 170-degrees Fahrenheit in a natural gas oven (I never bake plastic parts). BE SURE your oven's thermostat is accurate! Test by baking some scrap white metal first.

7. I cut thin strips of cheap masking tape to apply after each color.

8. I made a boiler holder from brass rod by drilling and tapping the end 2-56. I screw it to the inside of the boiler using a screw through a dome hole. The fixture appears below.

Finished Product

Photos of the W.W. Wright appear below.

AL MUELLER'S MANTUA GENERAL REBUILD
December 8, 2010