MLS MasterClass Mini - 2005

"THE SINGLES"
Build a Classic American 4-2-4T Locomotive

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All Colour Photography by David Fletcher

MasterClass Mini 2005
Proudly supported by our friends at Hartland Locomotive Works
http://www.h-l-w.com/

Chapter 1 - Getting Started
Construction

We're back and its time to step things up…!
Right-tee-oh, its time we started to build this piece of 1860s artistry.

The MasterClass Forum:
First off, should you have any questions about the construction of the model, or would like to discuss parts etc, please drop a question into the **Articles and MasterClass Forum** on the www.mylargescale.com web site. You will get an answer inside of 24 hrs, either from me, or another modeler.

Also, should you have access to a digital camera, please photograph your models along the way, and post images of your progress in the MasterClass Forum. Others may learn more from your model's progress than this article!

Just for interest's sake, there are some on-line drawings of the actual Standard Gauge *'C.P. Huntington,'* kept at the Sacramento museum archives. You can download PDF's for the loco as measured by the SP in the 1930s, as well as the decorative lettering and trim as it is now applied to the loco, also measured in the 1930s:

Sacramento History Online - SP C.P. Huntington Measured Drawing

Sacramento History Online - SP C.P. Huntington Decorative Lettering Drawing

Let's start with the parts we need:

The Hartland Kit:

Most of the important parts of this model will be supplied from our friends at Hartland Locomotive Works in the form of a 'Kit of Parts.'

The Hartland kit is assembled from a large array of stock Hartland parts that come to a normal cost total of $185.00US. Hartland however are supporting this Mini-class, and will be offering this kits at a one-time **discount of $148.00US** only for the period of 4 weeks between Mid April 2005, and Mid May 2005. When you call Hartland Parts Dept. during this time, request the *"CP Huntington Kit."* After mid May 2005, you can still call the Parts dept, and request a kit, however the price will be back to normal rates.

> **The *Hartland* C.P. Huntington Kit $148.00 Discount offer will end 20th May 2005.**
> *(Please phone in your orders before this date.)*
>
> Phil Jensen, *Hartland Product Designer*, at Hartland Parts is putting together this kit for exclusive use in this Project. Your first port of call is to phone **Phil Jensen at Hartland Parts** and request the **'CP Huntington Kit'**. You can call Phil on Tuesdays and Thursdays only:
>
> Call **Tuesdays** between **8am-1pm CST**
> Call **Thursdays** between **1pm-6pm CST**
> **Phone:** 402-571-2933 or **Fax:** 402-573-7274

Just so you know - when you call Phil, you're speaking to one of the 'Little Giants' of the Large Scale industry. Listen to his advice, get ideas from him and try things out that he recommends. You can read about Phil Jensen's story in our On-line article:

The Phil Jensen Story, by David Fletcher

There are two aspects of the Kit to keep in mind when ordering:

1. The Prime CPH kit - That has all that you must have in order to build the model, this is the kit Phil will send to you when you order the CPH kit.
2. The secondary parts you can buy from Hartland at your pleasure. These secondary parts are optional, as other sources are available, as well as scratch building these parts if you choose too. The object here being to not sell you parts you may not want to use, and hence keep the cost of the prime kit down.

Contents Of The Prime CPH Kit:

The CPH kit you're requesting from Hartland is extensive and includes the following parts:

1 - Headlight Kit
1 - Belle Headlight Bracket
1 - Lilly Belle Smoke Stack
1 - Bell Assembly
1 - 4-4-0 Pilot Deck (lb)
2 - 4-4-0 Cylinders
2 - 4-4-0 Cylinders Caps (front)
2 - 4-4-0 Cylinders Caps (rear)
2 - 4-4-0 Valve Chest Covers
2 - 4-4-0 Valve Gear Cranks
2 - 4-4-0 Cylinder Oilers
2 - Handrail Ends
1 - Pair Lilly Belle Crossheads
2 - Crosshead Guides
1 - Crosshead Guide Support
1 - Pilot Truck Frame (for Metal Wheels)
4 - Axle Set With Metal Wheels
1 - C-16 Tender Truck Frame
2 - 4-4-0 2" Drivers (Red)
2 - Main Rod Modular Ends
2 - Crankpins (short)
1 - Gear Box Assembly (Large Motor)
1 - Cab Assembly with Flat Roof
2 - Cab Handrails
1 - Big John Tender Tank Assy
1 - Brass Whistle
1 - #1 Boiler Front Number
2 - Drive Wheel Electric Wiper Assembly
1 - 4-Wheel Electric Pickup Set For C-16 Truck
2 - Boiler Check Valves (boiler elbows as H-L-W puts it)

The above is the kit worth $185, but from Mid-April to Mid-May will be offered as a special *'kit'* for $148 for just those 4 weeks.

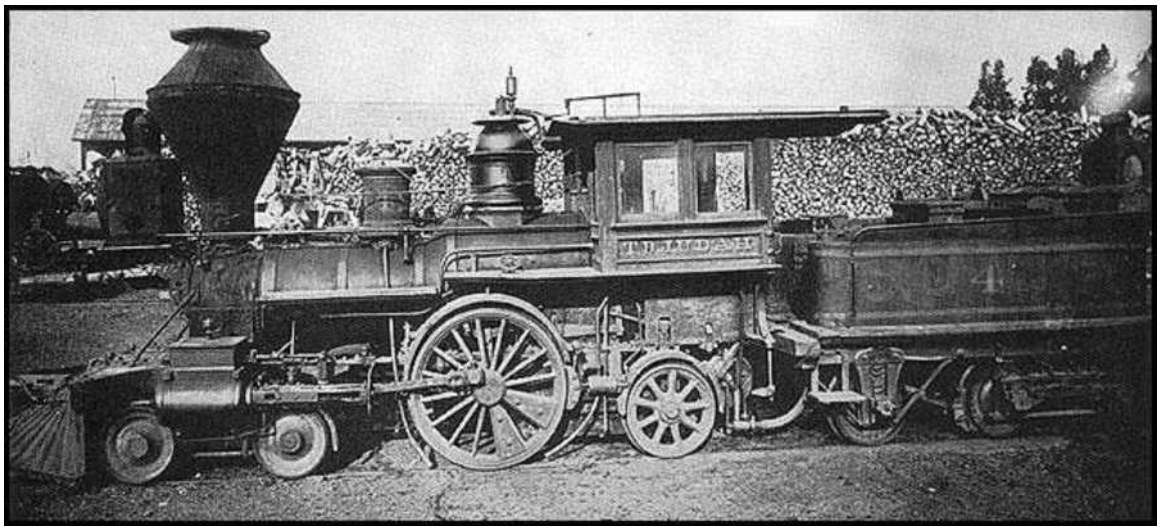
Optional Parts you can use on the CPH:

- 4-4-0 Lilly Belle Pilot (cow catcher), link pole and coupler pocket in red. (This pilot sits a little high above the rails, but may be all you can get for this model. It is an excellent pilot, but will sit 'high' on our CPH model. See below for preferred pilot options.). Pilot is $10.00US
- Ernest Marsh brass sand dome with sand cap. $10.00US
- 4-4-0 brass sand dome parts (to be used as steam dome on this loco). $10.00US
- Wood load or coal load for Forney tender tank.
- Anything else you might like to try!

The 'T.D. Judah' 4-2-2 Option:

The T.D. Judah of the Central Pacific began life as a 4-2-4T, identical to CP Huntington, however early in its career, modifications made to increase the range of the locomotive, and a 4-2-2 tender loco was bashed from the original 4-2-4T. For those that would like a tender version to the CP Huntington, please —

download the *'Judah'* PDF set, along with the standard PDF's above. There are a minimum number of parts to be cut differently in the chassis. The rest of the locomotive is essentially the same as the 4-2-4T. Since I won't be giving specific instructions for the assembly of the 4-2-2, beyond the special PDF's, it is recommended that you ask specific questions to problems that arise in the MasterClass Forum. The construction of this loco is straightforward.



There is also a PDF view of a Forney version of the 4-2-4T, in the form of a 2-4-4T. Not a difficult alteration from the 4-2-4T plans, but much care and precision is required in building the chassis for smooth operation. We best discuss that on-line if folks are interested in building this Forney.

Additional Parts If Building the T.D. Judah 4-2-2 Tender Loco:

In addition to the CPH kit, and optional parts such as domes, pilots etc. The Judah was a tender loco, with a 6-wheel tender. You have a choice for the tender.

You can:

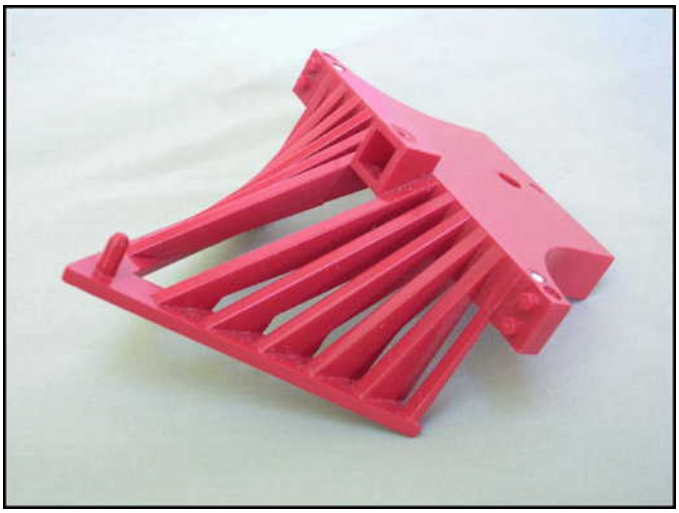
- Scratch make a new tender to the size in the Judah PDF's, following MasterClass 2001 Chapter 7 tender construction methods.
- Use the rear tender tank that comes with the CPH kit, cut the tank in half and use the two halves for the front and rear end of a bashed tender. Add new sides and top.
- Buy a tender tank, such as the full tender used on the Hartland 2-4-0. You only need the tender tank, not the deck and chassis. If you want to keep things simple, and don't care to bash the tender into a smaller 6-wheel unit, you can buy the deck, trucks and all, and use the Hartland tender as is, as an 8 wheels tender on your 4-2-2 loco.

If building a 6-wheel tender Judah style, this tender had a rear 4-wheel truck and a fixed single axle up front. You'll use the C-16 truck that came with the CPH kit, and ask Phil about a Hartland Mini-flat for the fixed wheel journals for the front of the tender.

The Thing about Pilots and Domes:

The C.P. Huntington has large pilot wheels for such a small loco. This is part of the loco's charm. The result is a pilot deck that is high above the rails, clearing the pilot wheels with the top of the deck right below the smokebox door. As such many of the commercial pilots available will not be tall enough to span from railhead up to the top of the pilot deck. Its a syndrome common in large-scale! Many models in our —

hobby have pilots that sit so far above the rails, in an un-prototypical way, that even cows would pass under them without a scratch! We should try to avoid this problem on our CPH models! There are two pilots on the market that will serve our purpose well but may not be that easy to obtain. Before ordering the optional pilot from Hartland, try and find one of these:



The Lionel 0-6-0T pilot - get one if you can! It should also come with a 'link pole' (not shown). If no link pole is available, then we can make one out of styrene, or 2.5mm diameter copper tube.

The Lionel 0-6-0T Pilot: This pilot was designed by Phil Jensen in the 1980s for Lionel, and is still used on all Lionel 0-6-0T Christmas and Rocky Mountain locos. It comes with a stylish deck that you won't need. This pilot is really cool, so should you have one in your junk box, please do use it in this project. This is the pilot of choice. If you don't have access to one of these, please drop a message into the MasterClass forum and ask, I'm sure there will be quite a number of these pilots out there, unused.

Applied to our model, it will look like this:

The Accucraft 4-4-0 Pilot: These are a brass pilot made in the mid 1990s, and still available in some stores. Caboose Hobbies stocks these parts in their 'on-line catalogue.' It is called the 1:24 4-4-0 wood pilot. Also you can call Accucraft directly to obtain this pilot. Cost is around the $25US mark.

The Accucraft 1:24 4-4-0 Pilot, is still out there for purchase.

Applied to our model it will look like this:

Other options for pilots that can work:

Bachmann Spectrum 4-4-0 Centennial Pilot: The pilot that comes with the Bachmann Spectrum 4-4-0 will just fit the bill. These are extremely hard to get, as they are not carried at Bachmann as 'parts'. If you have one in your junk box, you may as well use it! You will need to add a 2mm strip of styrene along the very bottom to add 2mm of height to the pilot and thicken up the thin base strip on the pilot.

The AMT 'General' kit Pilot: This is a very large and long pilot that comes with the plastic model *'The General.'* Out of the box, this pilot is too large, however if you cut off the base of the pilot, and remove the bottom 5mm off each stave, install a new styrene base plate along the bottom of the staves, then this pilot can work on our 4-2-4T.

FH&PB Mason Bogie/C-16 Wood Pilot: This is a laser cut wood pilot made by Vance Bass at FH&PB Railroad Supply Co. The pilot was originally designed for our MasterClass 2002 Mason Bogies, and is still produced by FH&PB. The Pilot is the correct size for our 4-2-4T models, however is quite a heavy, and thick looking pilot. It may look a little *'heavy'* on our neat lil loco. I have not tested its look on the CPH, so it may look pretty good. The pilot can be purchased here:

FH&PB Railroad Supply Co. - Wood Pilot

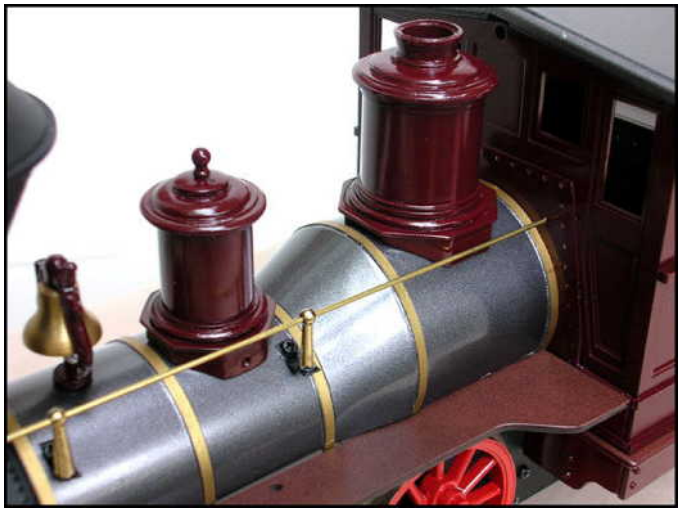
Domes:

I really debated this option! The first C.P. Huntington model I built used stock Hartland domes. These are the two domes listed in the optional parts above. A small brass sand dome (from the H-L-W Ernest Marsh model), and a larger sand dome taken from their 4-4-0, to be converted into a steam dome. Buy these two domes if you feel you don't want to scratch make the domes.

Applied to our CPH model, these commercial domes will look like this:

However I feel the CPH, Danforth-Cooke domes were quite distinctive and worth making the effort to scratch build. As such we will be demonstrating the scratch building of our own CPH domes, using pipes, plastic hex-nut pipe connectors, and discs of 1mm and 2mm styrene sheet. The domes will look like this:

Painted and installed on the loco, they will look like this:



Make a choice! If you feel you'd like to try and make your own domes, but are not sure if they will look all that hot, consider purchasing the Hartland domes and making your decision after trying the scratch build method.

Other Materials:

Other materials required for this model are as follows:

- 3 - Sheets (letter size) of 2mm thick styrene (evergreen or similar), compressed polystyrene, or High Impact Polystyrene.
- 2 - sheets of 1mm thick styrene.
- 1 - sheet of 0.5mm thick styrene.
- Handrail stanchions for the boiler - we require tall stanchions, approx 9mm tall, Ozark Miniatures or similar. On both models mine were old Bachmann 4-6-0 stanchions.
- 2 - lengths of Plastruct ABS (grey) 4.6x4.6mm Square Hollow Section (SHS) (framing).
- Evergreen 5.6mm styrene tube, approx 1ft length. (Pilot and rear truck supports, as well as details).
- 2 - 6.5mm x 6.5mm ABS SHS, Plastruct (deck framing).
- 1 - Pack of Evergreen 1/6" styrene rod, 1.6mm diameter (for rivet heads).
- 1 - length of Plastruct or Evergreen 3.2mm diameter styrene tube.
- 2 - lengths K&S 1mm diameter brass rod (for hand rails).
- 2 - lengths K&S 1.5mm brass rod for boiler braces and other details.
- A 6" length of 9mm x 9mm square hardwood timber (for the pilot beam).
- 1 - sheet of K&S 0.005" brass material. This is for the pilot truck and rear truck wipers. You can also buy strips 3-4mm wide, rather than cut strips from this sheet of brass. However the sheet of brass may be useful to you in making brass boiler bands and dome wrappers if you choose!
- A 1 ft. length of 40-42mm outside diameter PVC plumbing pipe.
- A 6 in. length of 50-52mm outside diameter PVC pipe.

Glues and other stuff:

I have used all kinds of solvent welding cements for the purpose of gluing styrene together, some were downright dangerous, others stunk so much we had to evacuate our Office once when I was making an architectural model. The most convenient and well bonding glue on the market I've found to be the Testors solvent welder, available at model shops. It comes in a small jar with a brush.

We will also use two other glues, such as CA (CyanoAcryate or Super Glue) and an epoxy glue in limited areas. We have discovered that the epoxy glues in the U.S. don't seem to glue. (That seems a bit silly since it's supposed to be a *'glue'*... well never mind! - don't know why that is. Why sell a glue that doesn't work?) Here we use Araldite, which is an epoxy-based glue, but has some other additives in that that actually, well, make it stick! Either way, we need some epoxy glue in this project, primarily to be used as a *'filler'* —

for the tapered boiler. Buy the glue from your hardware store in the form of a two-syringe pack, 5-minute setting type.

The 3 types of glue to be used in this project.

For the painting of this model, I prefer all Tamiya paints; both gloss spray paints for the main assemblies and flat sprays for the chassis and firebox. Additionally, I use the range of Tamiya brush-on paints for details and highlights. As has been mentioned on MLS, there is a need to take care when using any kind of paint on styrene and other plastics. Paint a test piece to ensure whatever paint you choose to use does not attack the plastic.

Finally I use a 'Semi-gloss' or 'satin' clear coat on all locomotive 'shiny' areas and dull-coat, or flat finish to smokeboxes, frame etc.

Tools:

- A knife (heavy-duty hands-on knife, not a scalpel. See below)
- Drills and Dremel or hand-held drilling/grinding device.
- Jeweler's saw.

Working With Styrene:

Gang, to avoid the risk of repeating myself on every class, you can go read the specific notes about using styrene in Chapter 1 of MasterClass 2002. The discussion is on this page, as is info about using construction PDF's:

http://www.mylargescale.com/articles/masterclass/mc2/mc2-02/mc2-02-03.asp

The only addition I want to make is about cutting knives. During previous classes, it became apparent that some guys were trying to cut 2mm thick styrene using surgical scalpels. Guys, it will take a million years to cut tough materials in large-scale using those kinds of knives. You need to use something you can apply some muscle to. The knife must have a grip on it that you can really hold onto, and a blade of significant strength, so you can really cut into stuff. I use a tradesman's knife. This is a large plastic handled knife with retractable blades. The blades have scored lines in them, allowing you to snap off the end when the tip and blade becomes blunt. I like these because you can apply serious muscle in cutting!

The kind of knife I use in large-scale model train building.

Gluing/Welding Styrene:

This is one of the delights with working with styrene. When bonding two styrene parts, you do not need to apply glue to both surfaces and then bring them together as other adhesives require. Bonding styrene requires you to use the welder cement, such as the Testors above. You simply hold the two parts together, placed in their final location, and then using the brush that comes with the solvent, just dab the end of the assembly, were the two parts interface. The solvent will run along the entire joint via capillary action, providing the perfect quantity to the joint. Hold the parts together for another 30 seconds and let go. The parts are now joined.

One more note before we start. To view the CP Huntington drawings, you will need to be able to 'unzip' a file and view PDF documents. We recommend **WinZip** or **Stuffit Expander** to unzip the files and you must have the **Adobe Acrobat Reader** to read the PDF files.

Let's get started:

Read the contents of this chapter before cutting anything, understand the context in which parts are cut and made. Study the PDF's, and see how they are used in the photos shown in this article. Try to assemble the model in your head first.

Please download the entire bunch of PDF's for Chapter 1 here:
Caution & Warning Light *- Please always check the scale bar on your printouts to ensure you have printed the pages to 100%, or exactly 1:1. Otherwise you may be cutting parts that are undersized!*

The *'C.P. Huntington'* Option:

Download the *'C.P. Huntington'* drawings here.
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We shall refer to them during the construction of the CPH chassis in this chapter.

The *'J.D. Judah'* 4-2-2 Option:

Download the JD Judah drawings here.
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The CPH Chassis Frame and Firebox Assembly:

From the pile of PDF's, take out the two pages entitled:

"**Frame inside layer**" and "**Frame outside layer**"

If building the *'J.D. Judah'* 4-2-2, then use your special PDF entitled *'JD Judah Frames.'*

You need to cut out these 4 frame pieces from 2mm thick styrene. These 4 parts represent the 4 hardest parts to cut in the entire project, because you must cut them with absolute precision. The frame sides are fabricated from two layers of 2mm styrene laminated together. The two layers are different, providing for a 'seat' in which the motor/gearbox sits with no more fixings required. The axles bearing holes and electrical wiper holes are provided through both layers. You will note also that the hole for the axle bearing is different on both layers. The inner layer is the real bearing hole, set at 1/4" diameter for the Hartland drive axle to pass through, in a reasonably tight fit. The bearing hole in the outer layer is larger, and is aligned with the plastic bearing surface on the back of the Hartland drive wheel.

Special Note:

So long as you're using this model, as the prototype was intended, pulling short trains and commissioner's specials etc, the low revs of the axle and light loading on the frame bearings requires no more special bearing treatment than the axle passing through 4mm of styrene. So long as you keep that bearing with some oil in it, topped up every 20-hrs. of operation, you should not see bearing wear. Remember there are no side rods between drive wheels as this is a *'Single'* and as such, much of the real stress applied to bearings on a steam loco are just not present. No quartering issues, no wheel/rod bind etc.

If, however, you are concerned about the level of operation your loco will receive, and the kind of wear your locos experience on your line, as seen on other locos in your roster, then by all means widen the bearing hole diameter holes in the frames and insert a bronze bearing or even a ball bearing, suited to 1/4" axles. You will need to grind off the backs of the plastic Hartland wheel hubs (easy to do), so that the wheel gauge is not compromised. Bronze or ball bearings can be obtained via the Internet, and only cost a couple of bucks. More important than anything is the need to anchor the bearing properly to the frame, otherwise the bearings spin around and eat out the frame anyway! Also along those lines, ball bearings should be a tight fit on the axle, because to work properly the balls section should spin, not the whole bearing spinning on the axle because of loose fit. Personally, I'd recommend the bronze bearing over the ball bearing on this model, simply because of the low rev situation, and because the frame is a *'sandwich'* type, where the two sides can be unbolted and the motor/gearbox slides out. In order to unbolt one side of the chassis, you need to slide the axles from the bearings. A proper tight fit ball bearing will be difficult to slide off, making it more difficult to remove the motor.

Here is a view of the type of bearings you can use, ball bearing and bronze greased bearings.

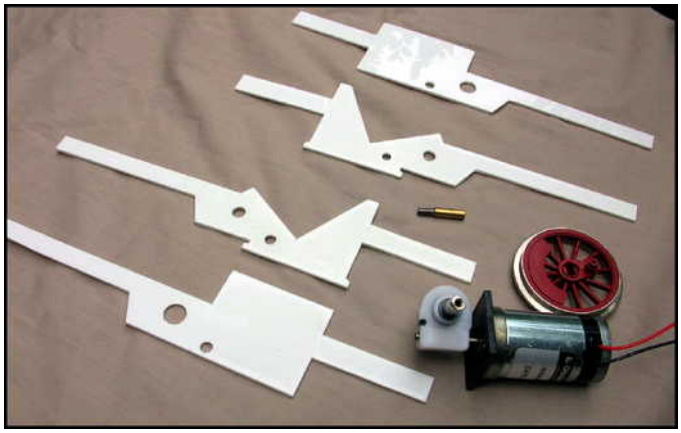
OK now, having decided on the bearing situation, begin cutting out those 4 frame templates from 2mm styrene. Cut them out with absolute precision. This can be achieved by:

- Being careful and taking your time to ensure you have transferred the template to styrene accurately.
- Photocopying or printing your frame PDF's to sticky translucent film, sticking the film to the styrene and cutting along the lines, with no risk of the template moving. Then after the part is cut, peel the sticky film off.
- Cutting the perimeters first, and then clamp the 4 layers together, and drill out the wheel bearing areas in one go, so that the bearing holes perfectly align. Then take the 4 layers apart, and widen the outer layer hole for the Hartland wheel hub or bronze bearing flange diameter.
- Also think about using your jeweler's saw (razor saw) to cut along the perimeters.

The most important thing to look for is to see that the tops and bottoms of the frames are in perfect alignment, and the wheel holes align. Once the 4 layers are cut, it is OK to tape them all together and trim the tops/bottoms of the frames to be absolutely level. Make note that the ash-pan area on the inner frame does extend further than the outside frame, therefore don't cut it off!!

Drilling the axle-bearing hole may be some task for you. Obviously the preference is to drill the frame using a 1/4" drill bit in a drill press. However, many of you may only have a small hand held drill/Dremel, and 1/4" bits are way outside of the size limit for the chuck. Insert the largest drill that will fit in the chuck, set the drill to the lowest speed. Drill the centre of the bearing hole, and then enlarge the hole by hand. You can do this by twisting a 1/4" bit with your fingers, or you can slowly work the edges of the hole with the Dremel bit, making it wider and wider. Using the 1/4" bit will keep the hole concentric with your original center point. If you open the hole with the Dremel, move in a circular motion, and keep steady. Periodically check if the Hartland axle will fit. You want a good semi-tight fit. If you find it downright impossible to drill out a circular hole by hand to the precision required, then buy two Bronze bearings; widen the holes to suite the bearing. Even if the hole were cut square, the bearing would slide in and provide more than enough support for your axle. Think it over. You will need to lock that bearing to the frame using CA.

If you want to, have a play with some scrap styrene to see how well you can drill out the wheel bearing area, and test the Hartland axle and wheel. **When removing the wheel from the Hartland axle, using a screw driver at the back of the hub to slide the wheel off, don't pull the wheel off from the front, or you risk pulling the axle off the drive gear!**

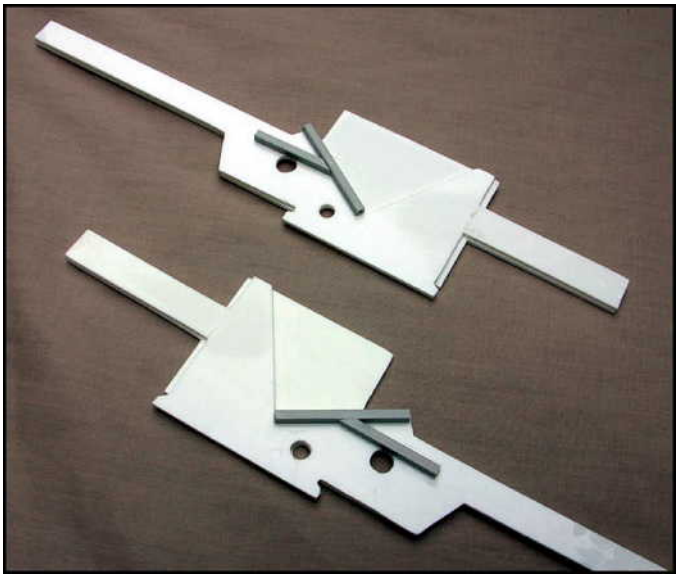


The 4 layers of cut styrene frame elements should look like this:

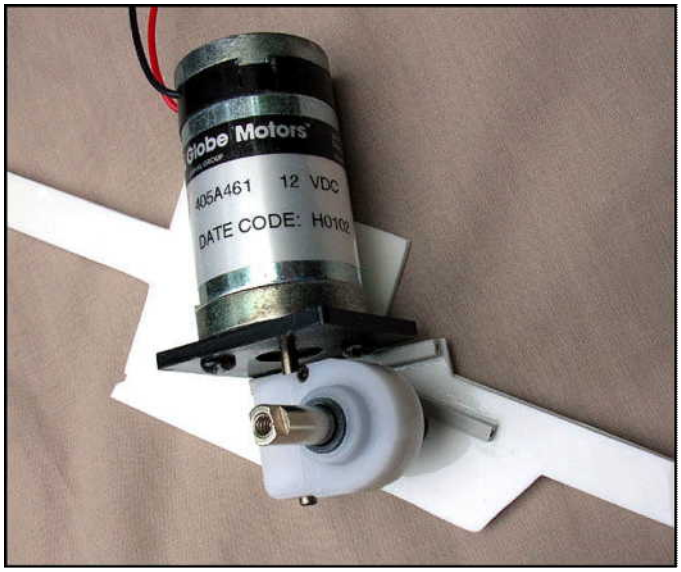
Step 1 - The Frame:

Using your Testors Welder cement, weld the two layer of styrene together. There should be an *'inner'* and *'outer'* layer to both frames (the frames should be symmetrical, not identical, when you finish welding them)!

This next bit is optional. If you're not inserting any metal bearings into the frame, consider welding to the insides of the frame some small lengths of 3.2mm.x 3.2mm ABS SHS from Plastruct. This is really tough plastic. I applied a 1" length, just above the wheel-bearing hole, which will literally touch the axle and help support, the model's weight. I also installed a short length along the base of the angled 'motor shelf.' This is where the base of the motor sits. The two frames shall look like this as seen from the inside:

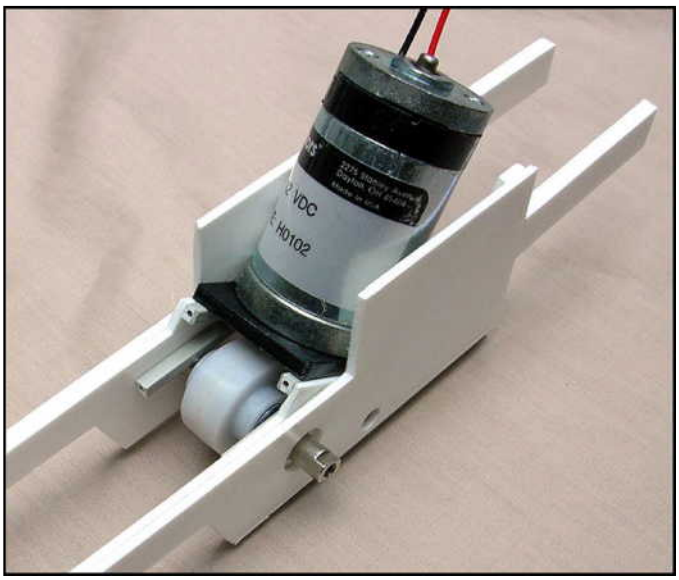


Please ignore some of the detail differences with the length of the frames in this picture or the unusual bottom edge, as changes were later done to make the model more accurate!



With the motor just sitting in place, you get an idea of how the motor and axle works into this frame. Please do not glue the motor in!

Now with both frames shown in place, as a loose fit: Never ever glue the motor into the frame. The motor will be a clip fit in this model!

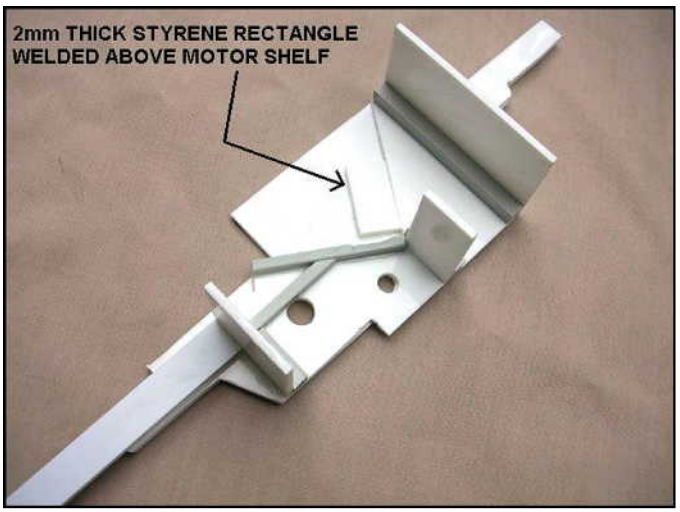


Step 2 - the Frame Spacers:

Following the PDF's cut out the 3 frame spacers from 2mm styrene.

The 3 spacers are as follows:

- Mid sized unit is applied at the front of the gearbox area.
- Small spacer to be installed at the base of the motor shelf.
- Large spacer to the rear of the gearbox.

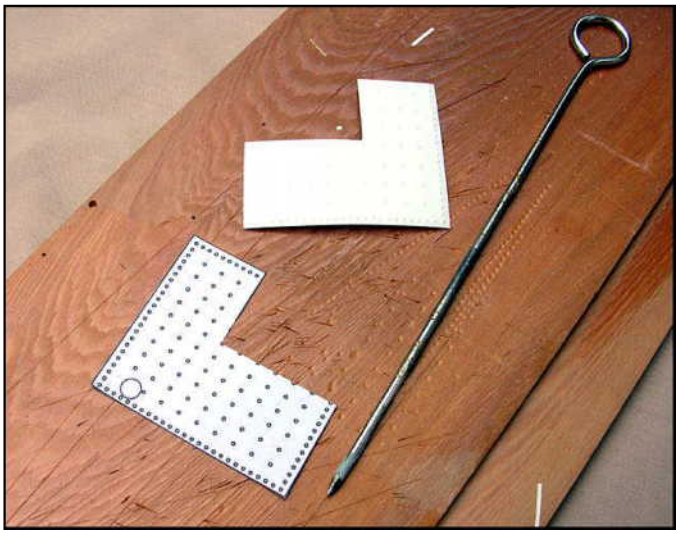


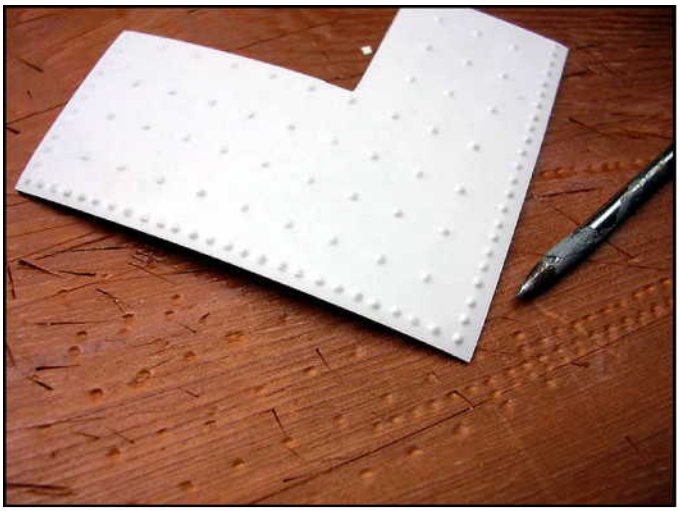
Use some of your 4.6 x 4.6mm Plastruct ABS SHS in the corners of each spacer where they attach to the frame. Weld the spacers and corner SHS to ONE side frame only. Cut out and install a 2mm thick rectangle of styrene to the inside the frame, directly above the motor shelf. This will hold down the top of the motor mount plate. Use the top of the motor mount plate to mark its position. The upper motor support and frame spacers should now look like this:

Step 3 - The Firebox Detail:

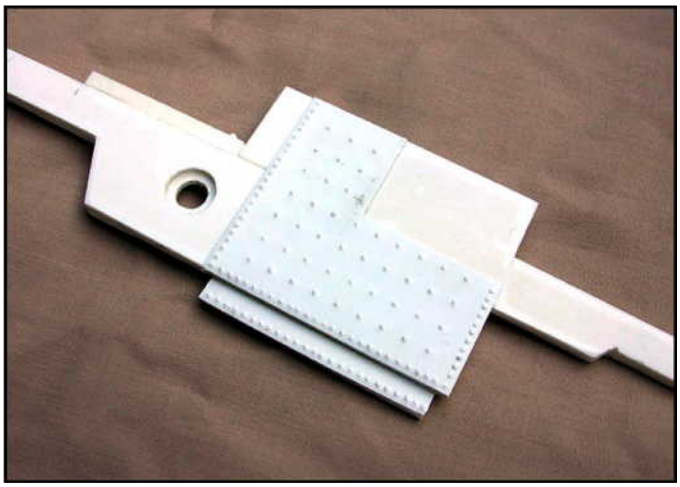
Following the PDF templates called "Firebox detail", cut out the two templates in 0.5mm styrene. Make a note of the rivet or 'stay' pattern on the firebox. Using a metal spike (I use a cooking spike, made to check whether a cake is baked properly), punch into the back of the styrene firebox sheet, creating the river or 'stay' pattern. Practice on some scrap styrene first if you wish. I used a plank of Western Red Cedar as a backing board to punch into. It is a good firm timber, which will 'give' when the spike is pressed into it, creating an effective 'rivet mold'. This supports the styrene around the rivet area, preventing distortion, while creating a nice domed topped rivet. I use a metal ruler to spike along in a straight line. Along the perimeter, the rivets are at 2mm centres. Through the middle area they are set a 5mm centres.

Note the rivets now punched into one firebox side. See the cedar timber has lots of dimples where the spike was pressed!





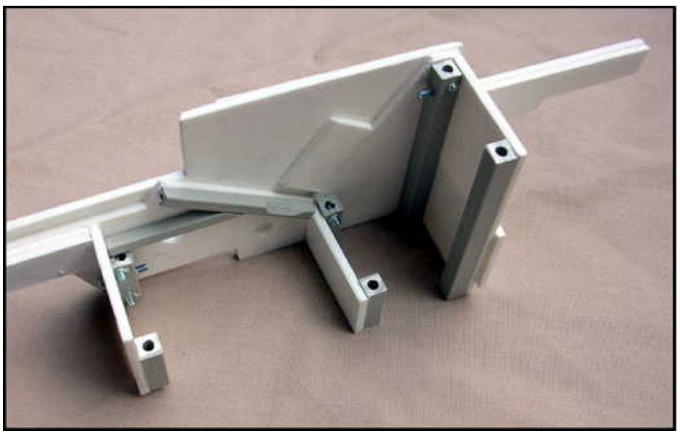
The completed firebox side.



Also following the PDF template cut out and press rivets into the *'ash pan'* templates. Using your welder cement extremely sparingly, apply welder to the back of the 0.5mm rivet embossed wrappers and stick them onto the outside face of the frame assemblies as follows. Note how the ash-pan section is applied to the bottom of the inner frame layer, while the firebox wrapper is applied to the outer frame layer.

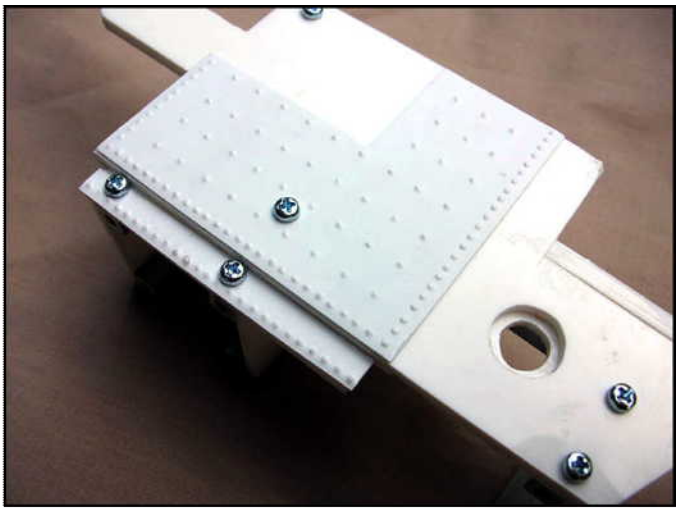
Step 4 - Bolting the Frame Together:

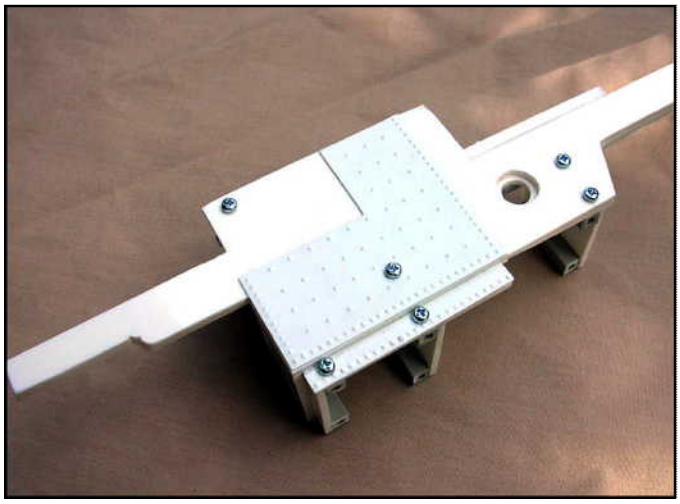
Now is the time to apply some bolts:
To make this frame mega-strong, we want to apply bolts to the spacers, frame and corner SHS's. We apply 2 bolts between the spacers and the corner SHS's, and two bolts from the outside of the frame to the same SHS's. A total of 4 bolts per SHS frame/spacer connection. I used small electrical circuit board bolts because they can be obtained easily and are cheap, with a bolt diameter of 1.5mm, similar to a #0-80 or 8BA bolt. You can use smaller bolts if you wish, for a more discrete look. Circuit board bolts can be obtained at Radio Shack or electronics stores. You can get hex-head #0-80 bolts from MicroFasteners or from many hobby shops.



The assembly will look like this:

From the outside the frame will look like this:





Step 5 - Completing the Gearbox Assembly:

Now the final part of this assembly. We need to apply the other side of the frame to this gearbox area. Now we glued and bolted the one side we've just done, the other side (which is the fireman's side of the chassis) cannot be glued. It must always be removable, so that you can remove the gearbox and motor if there are future problems. As such we apply the second frame side just by bolting it directly to the corner SHS's, without glue.

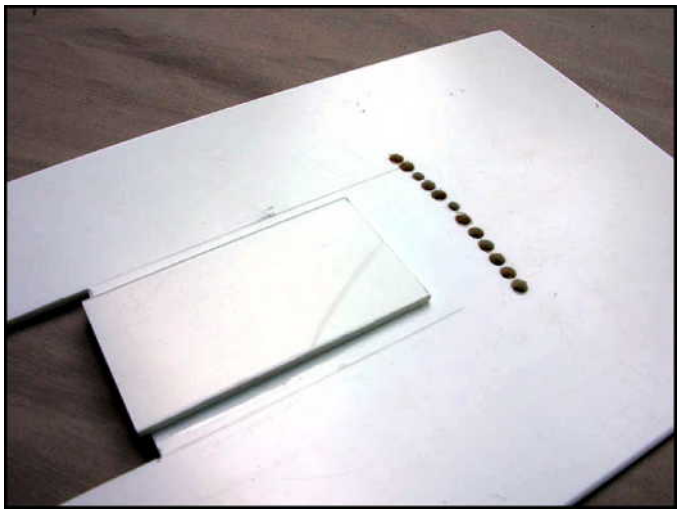
The trick is getting the frame square, so this is what I want you to do:
Stand the frame assembly up, with the frame and spacers standing vertical on a clean flat surface. It should be sitting on the ash pan base. Now rest the 2nd frame against the side of the main assembly. Using your styrene 5.5mm styrene rod, just loosely insert the rod through the wheel bearing holes. You are checking to see that the axle is *'square'* to the frame. Check to see that the styrene rod is parallel with the bench top (so that you know that the axle is level, and will not cause the loco to tilt to one side). Now looking directly down on the frame from the top, check to see that the styrene rod is perpendicular to the frame. You want to ensure that the axle will be plumb with the chassis, so that the frame points in the same direction that the loco is running! If the above tests show the axle is not square with the frame, adjust the fireman's frame position slightly until the axle is *'true.'* At that moment, hold the frame together and just top a daub of welder onto two of the 3 spacer/corner SHS attaching to the fireman's side. This is a temporary glue joint only. Recheck the axle alignment while the glue dries, and adjust as required.

Now that the axle and frame is all one, and the axle is plumb, meaning your loco will sit level and go the right direction; it is time to apply the bolts to the fireman's side. Drill the two holes per SHS as before and insert the bolts. The bolting of both sides of the frame should be identical.

Now, take the bolts out again from that one side and prise the fireman's side frame off from the main chassis assembly. We're just doing this to break out temporary glue joints. Then bolt the frame side back on, with no glue this time. You can snap the motor assembly into place if you wish, or add it later after the chassis is painted; it's up to you. You will need to later test the upper setouts of the frame you've just done to ensure that the loco attached to this frame will sit level! It may be you have got the axle perfect level now, but a slight error in the cutting of the upper part of the chassis could cause the locomotive deck to not sit level. We'll check that later; it's easy to fix if things are not quite right.

Step 6 - The Cab and Tender Deck:

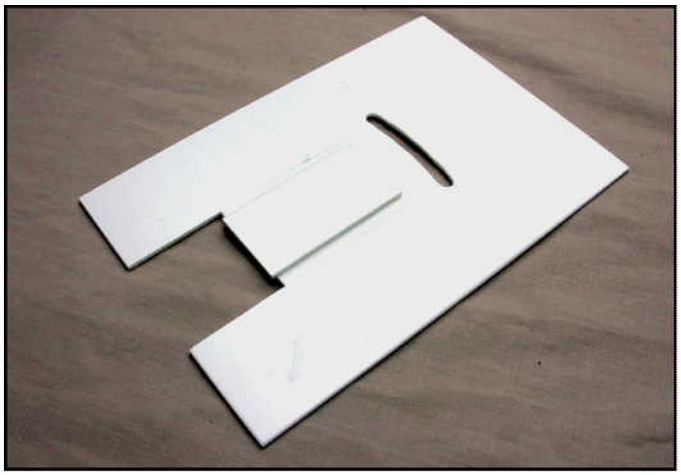
Following the PDF entitled *"Cab and tender deck"*, cut out the main deck piece in 2mm thick styrene. Also cut out that smaller rectangle of 2mm thick styrene, and weld it flat onto the bottom of the deck (choose which side you call the 'bottom'). The rectangular insert is exactly the inside width of the rear end of the chassis frame, and should fit between the frame. Following the template cut the curved slot into the deck. Take your time to get it right. This is the sliding slot for the rear truck of our loco. I did this by drilling a series of 3.5mm diameter holes in a row, like this:



Then using the knife, I cut out the areas between the holes. Then load your drill bit back into the Dremel, and on the slowest speed, run the drill through the slot along the edges carefully grinding the edges to a nice clean smooth line. Take your time. If you have a small grinding bit for the Dremel that can fit into this 5.5mm wide slot, than use it instead of using the drill bit as a grinder. Ultimately I want you to keep working on the sides of the slot until a 5.5mm wide slot, with nice smooth edges, is created.

If you want, you make up a jig to keep the slot exactly positioned and concentric with the pivot hole. See the PDF "Rear Truck Pivot". Take a strip of scrap 2mm styrene about 75mm long. We're going to make a sacrificial pivot beam using the dimensions in this drawing. Drill two holes spaced 2.528" apart (the distance from the pivot hole to the centerline of the curved slot). One hole should be 4mm diameter to match the pivot hole. The other should be the size of the shaft on your grinding bit. Insert the bit into the Dremel with the shaft through the jig, secure the other hole to the pivot hole with something 4mm diameter, such as the drill bit you made the holes with. Now, you will be able to move the Dremel tool in an arc exactly the right distance from the pivot and the edges of the slot should come out perfectly concentric to the hole. If your bit is not exactly 5.5mm (7/32"), then make two jigs with holes spaced so they cut the inside and outside of the 5.5mm slot, or use a 7/32" drill bit and be careful to keep the cutting edges out of your jig.

To test the width of the slot, take that 5.5mm diameter styrene rod again, and see how well it slides along the slot. You want it to be a neat fit, not too tight. The assembly should look like this:

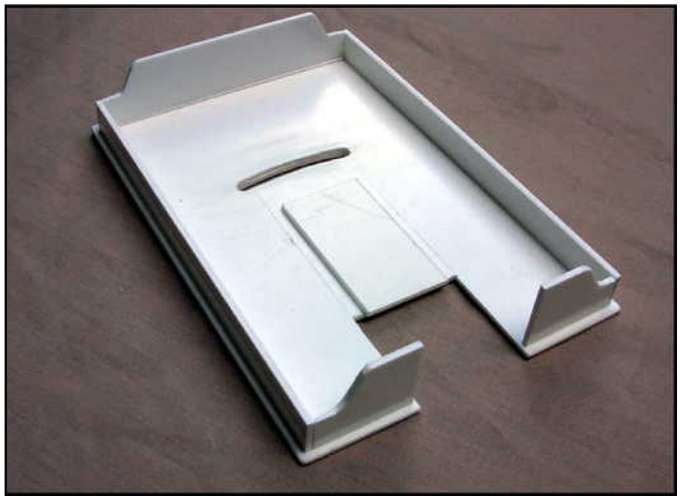


Note the slot length is longer in your models, as I did not get the length correct in this photo for the loco to round a 2ft radius curve. If you follow the PDF correctly, the loco's rear truck will swing laterally enough to meet that 2-ft. curve requirement.

Copy the PDF template of the tender base to 2mm styrene. Carefully sand the upper edge to a nice rounded edge all the way around. When this plate is applied to the top rear of the cab/tender deck, it forms the sculptured base of the tender shell. You will need to grind out the tender truck slot again in this tender base, thus creating a slot 4mm thick for the tender truck. I would loosely get the slot cut, then weld this plate to the tender deck, then following the slot already cut into the deck, grind out the tender base slot to match. Use the radius jig again, if you made it already. The finished slot and base in place, should look like this:

Step 7 - The Cab & Tender Deck Sides:

Following the tender deck PDF templates cut out the 5 pieces from 2mm styrene sheet. There are two sidepieces, a rear piece and two front pieces. With the deck placed onto the table upside down, weld the sides and end pieces to the underside of the deck, with the sidepieces standing perfectly vertical. They will be installed approx 2mm inboard from the very edge of the deck. Set it up such that the joints at the corners face to the front and rear, and are not visible from the deck side. The gap between the two front pieces must match the width of the chassis and should be a nice slide fit against the sides of the firebox. With all 5 pieces installed, the deck assembly will look like this:

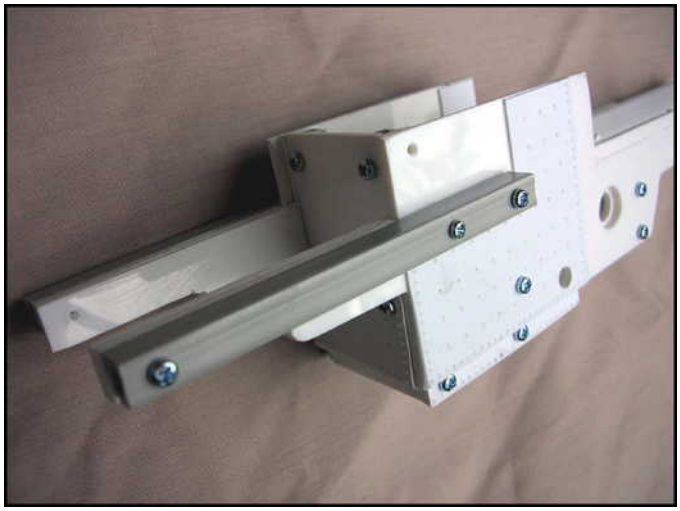


Step 8 - Chassis Frame Extensions:

OK, now it's time to extend the frame to reach from the pilot deck all the way back to the tender deck. I must emphasize the need for this frame to be robust. With such large overhangs from the drive wheels to the front and rear, there is a huge potential for the loco's frame to be too springy. The loco will appear to bounce as she goes over rough track, with the tender springing up and down! For this reason, we make a really rigid frame in this way.

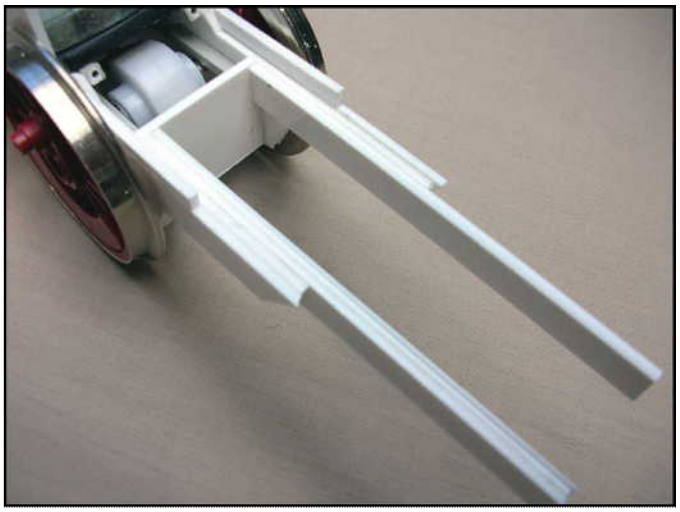
The Tender Deck Bracing: Taking your 6.5 x 6.5mm Plastruct ABS (grey) SHS, first cut two pieces exactly the length of the tender deck, inside the side framing. Weld the two lengths along the inside edge where the side members weld onto the tender deck.

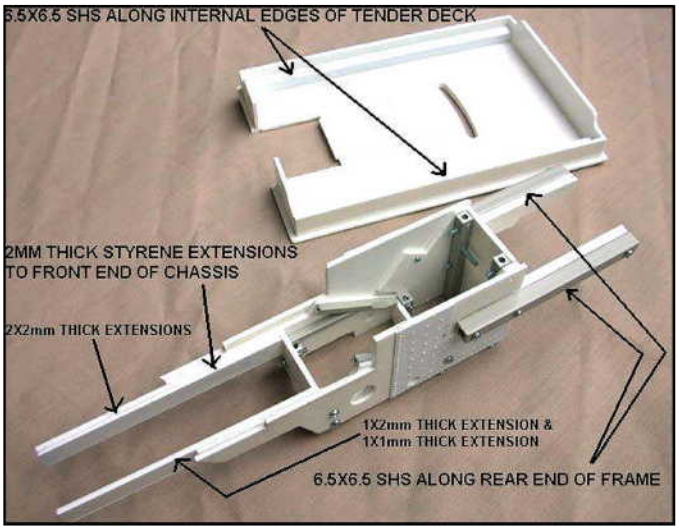
The Chassis Rear Extensions: Using the same SHS, weld two lengths along the upper sides of the rear chassis extensions. Insert three bolts into the side of this SHS, into the side of the rear frame area and firebox as follows:



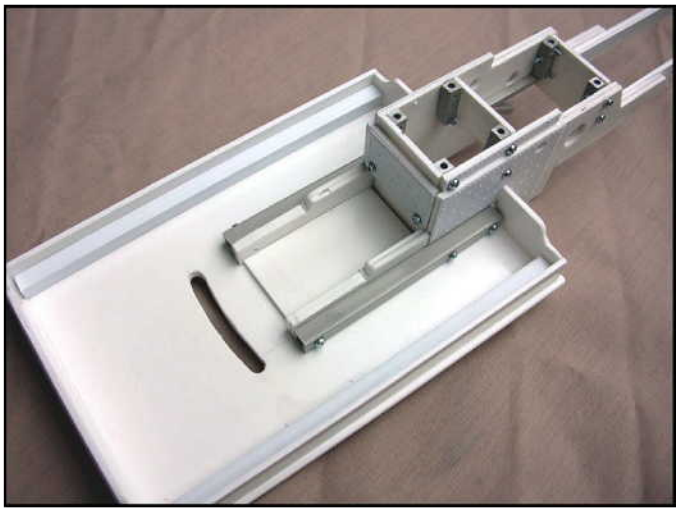
The Chassis Forward Extensions: Following the PDF's entitled "Chassis forward end Extensions", cut out these 4 strips of styrene. 3 of the strips cut from 2mm thick styrene, and the 4th strip is cut from 1mm thick styrene. There is reason for this uneven madness, which will become apparent when we mate the Hartland pilot deck and cylinder assembly. Laminate 2 of the 2mm thick extensions together, forming a 4mm thick extension, and weld this directly to the inside face of the chassis frame on the Engineer's side.

Laminate the remaining 1mm and 2mm thick extensions together forming a 3mm thick extension member, to be welded to the fireman's side of the frame. The front-end extensions will look like this.



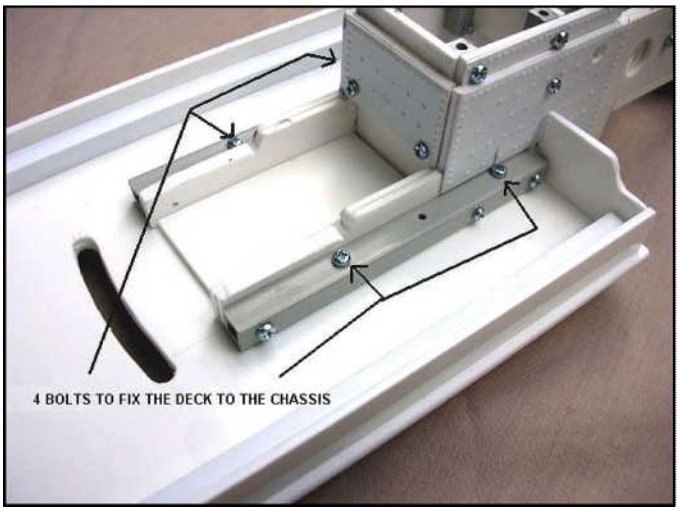


The chassis with all the support and extensions in place shall look like this.



Now with the deck placed onto the chassis frame, the set up from below looks like this:

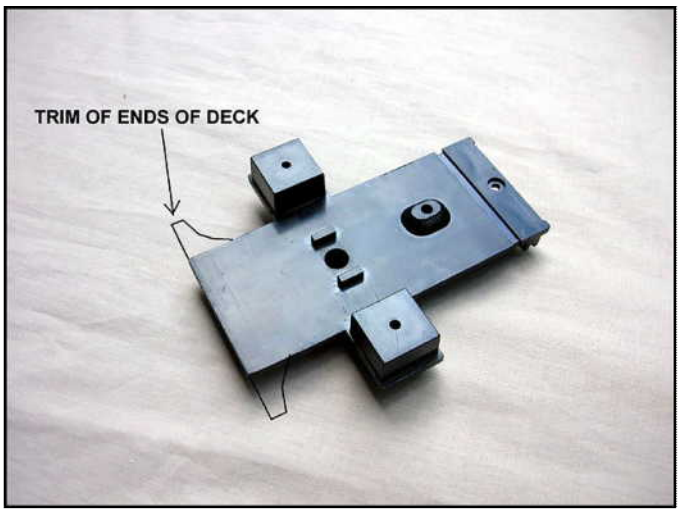
Step 9 - Bolting the Rear Deck to the Chassis Frame:



Time to bolt the deck to the rear end of the chassis frame. Like the engineer's side of the chassis, the deck must not be glued to the chassis, but bolted instead. You will want this deck to be removable so that the chassis can be dismantled for future servicing. Therefore, the deck essentially clips into place, and then insert 4 bolts into the rear chassis extensions to run up into the tender deck plate as follows:

Step 10 - The Pilot:

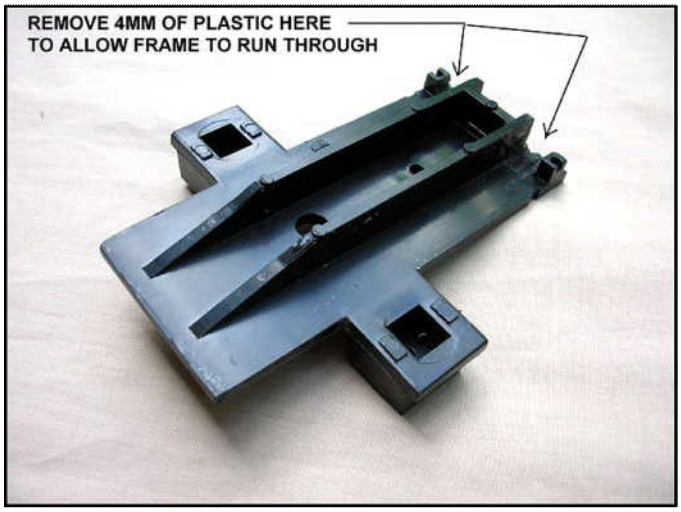
Time to start working on some of these Hartland parts. The Hartland forward deck we're using comes from their standard 4-4-0. It's a pretty cool design because this one simple part has the pilot deck, steam chest assembly and framing all in one neat unit. We have to make a couple of minor revisions to make it suitable to our C.P. Huntington.

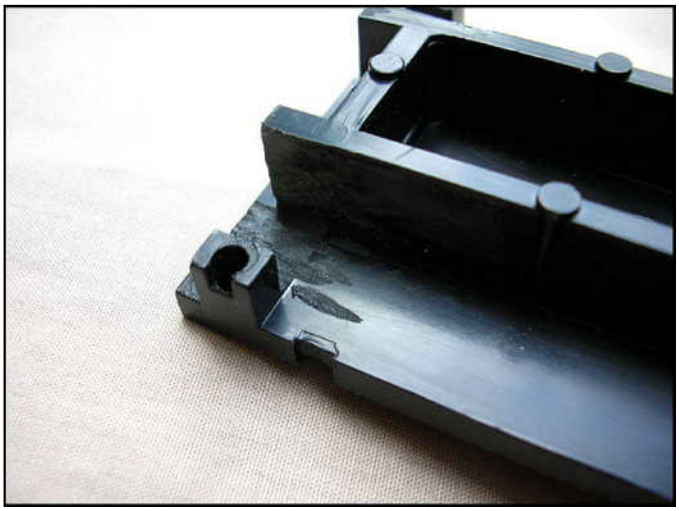


First off, using the jeweler's saw, trim off the tips of the pilot deck, also trim off the narrow tab along the very front edge of the deck, sand and clean up so that it looks like this:

At this point I also want you to grind down the top of that conical shaped button on the middle rear of the deck Its that one shallow cone shaped bump in the centreline of the deck to the rear of the steam chests. This dome is too tall, and will prevent the boiler from snugging down low enough. Grind the cone down so that only 1mm is left standing above the deck level.

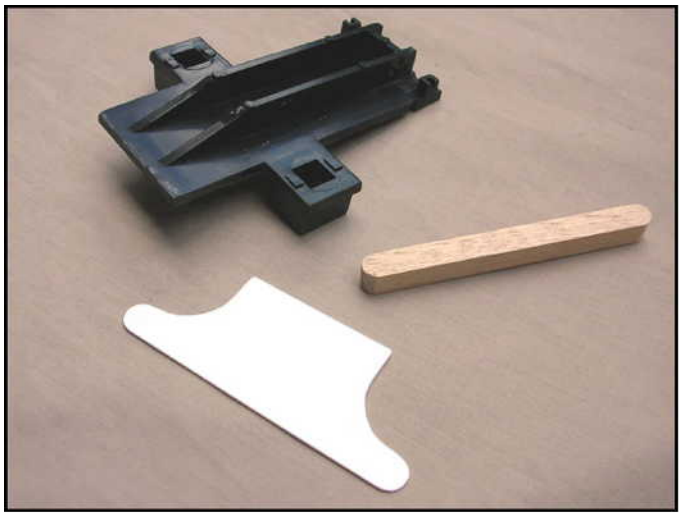
Next, in order for this deck to be fixed adequately to our chassis frame, strong and solid, we need to be able to run our chassis frame extensions right up to the steam chest area. Unfortunately there are a couple of thick plastic 'blocks' molded onto the rear end of the Hartland deck piece that prevent our frame from running through. These 'blocks' are used to support the Stephenson valve cranks, a necessary part of the valve gear here, so we need to simply remove the rear half of these blocks. Using a Dremel tool with a cutting disk attached, cut out a 4mm wide slot in the back of these blocks so that the frame looks like this:





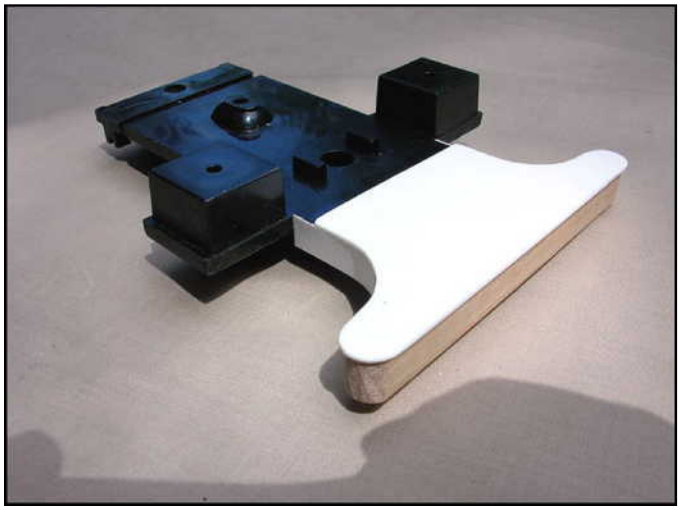
The Pilot Deck:

Following the template entitled "Pilot Deck", cut out that deck shaped piece from 1mm styrene sheet. This deck is actually wider than the deck that came with the Hartland frame. Sand the edges to a nice rounded feel.



Take your 9mmx9mm square hardwood and cut it to the PDF profile. You want to round off the ends perfectly to match the styrene deck, with about 0.5mm overhang of the deck over the timber beam. I usually cut the wood to the correct length, then using a knife, cut the corners off, forming an semi-octagon end to the rod, then sand the whole end to a nice smooth curve. The components of the deck will look like this:

Attach the timber beam directly to the bottom of the styrene deck piece. Use CA for this bond. It will glue instantly and won't come off again, so get it on there straight the first time! Using CA again, bond your new deck directly on top of the Hartland deck. The front end of the H-L-W deck will butt into the timber beam. Now cut a strip of 0.5mm thick styrene sheet, 8mm tall. With this strip you will make the deck sides as follows:

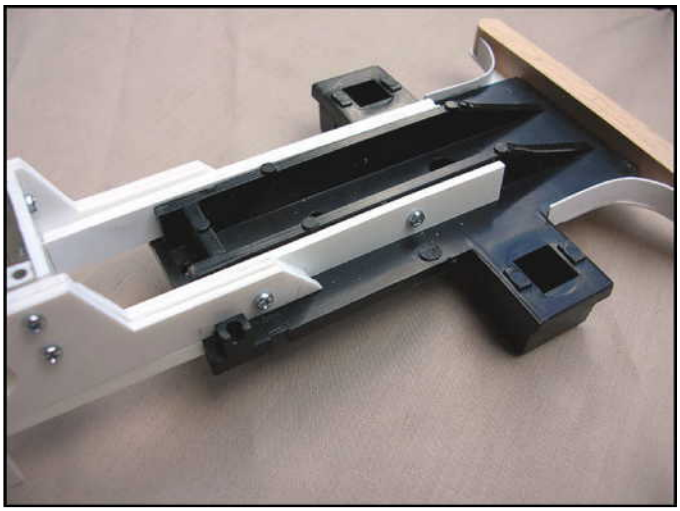


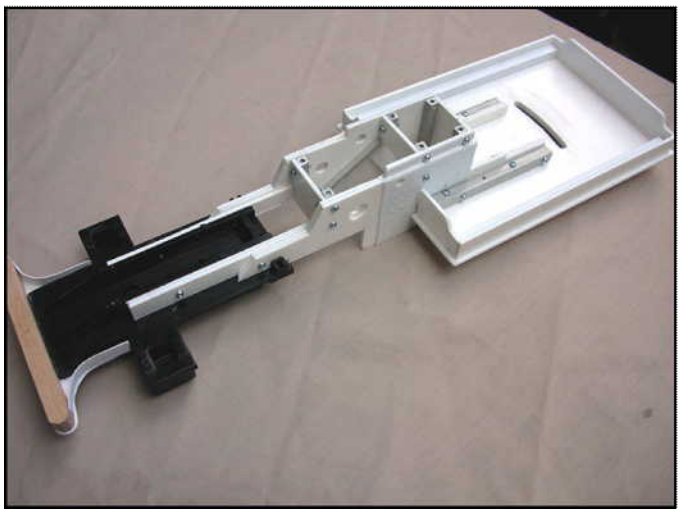
Step 11 - Aligning Everything to be Level:

OK, now it's time to check your levels again. You can either insert the foot long 5.5mm styrene tube into the axle hole again, or unbolt the chassis and insert the gearbox and drive wheels. Either way, it is time to check whether the rear cab/tender deck is parallel to the axle, and that the pilot deck is parallel with the axle. Set the chassis flat on a level work top (the axle should now be parallel with the work top as arranged before), looking from the front of the chassis, check to see that the rear deck is perfectly level... and does not angle to one side. If the deck is not level, loosen the two bolts holding the cab deck to the rear end of the chassis and insert some 0.5mm styrene strips into the joint, tighten the two bolts again. These styrene shims will pack the deck up a little, leveling it out for you. Recheck and pack more if you have to. If the deck is a long way out of level, you may need to unbolt all 4 bolts, and grind off a little from one frame extension, while adding shims to the other. It is imperative you level up this deck as seen from the front/rear of the loco, or the cab will look like it's leaning over. You can check the level with a ruler standing on end. Place the ruler against a number of points checking the height of the deck above the bench top. This will not only reveal if the deck is level from the front, but will reveal any twists in the deck and also check that the deck is level along its length, too. Add shims as required to level the whole deck out.

Now with the chassis still on the bench, drop the new pilot deck assembly onto the tops of the forward frame extensions, slide it back until the butts into the 'step' cut in the top of your styrene chassis. The setout should be correct by default, but you can recheck against the side view PDF of the loco. Ensure that the steam chest location is the correct distance from the drive axle location. Look at the chassis from the front end, and check to see that the pilot beam is level. If not, again add shims above the frame extension until it is all leveled out. Weld those shims to the frame extension tops.

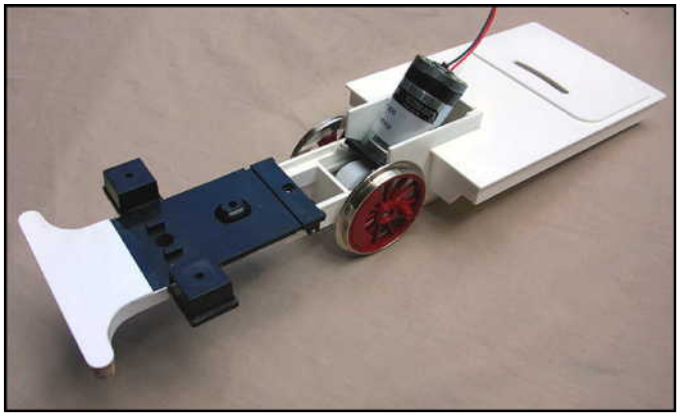
Now, holding the Hartland deck piece to the chassis, all leveled out, drill two holes per side and bolt the chassis extensions into the Hartland forward deck like this:





Now, the reason why the engineer's side frame extension is 4mm thick, while the fireman's side extension is only 3mm thick, is because the beams molded to the bottom of the Hartland deck are exactly 1mm out of centre... they are too far over to the fireman's side. By making the extensions to the thickness we did, the whole Hartland deck is now centred about the chassis properly.

I rechecked the deck levels again with the drive wheels inserted. My loco is level!



Step 12 - Detailing the Chassis:

Referring to the PDF's for the cab/tender deck, mark on placement of rivets, bolts and details. Using your Evergreen 1.6mm diameter rods, slice up a bunch of rivets like slicing carrots. You want the lengths of each slice to be around 0.5mm thick, making 0.5mm high rivets. Dice them up, and weld them onto the deck sides in the locations shown on the PDF. These are the actual bolt positions on the real C.P. Huntington. Dicing the rivet rod will look kinda like this:

Using your 0.5mm thick styrene sheet cut some lengths of strip, only 0.5mm wide, creating a 0.5 x 0.5mm styrene rod. Weld this rod around the entire perimeter of the deck sides, at the interface of the vertical sides to the deck top, creating a decorative cornice.

The rear end has some special details. Specifically two poling Pockets and a link coupler pocket. The poling pockets are easy to make, cut out the rectangular bases from 0.5mm styrene, using your rivet punch, punch in a rivet to each corner of the plate, and weld them to the corners of the side and rear of the deck. Cut a two 1mm thick slices of your 5.5mm styrene tube. Weld these onto the plates. You now have poling pockets applied to the rear! Cool, eh?

The rear coupler pocket is optional. You can make it up using the PDF templates, or you can go and buy an Ozark coupler pocket and just bang it in, or you can just leave it off if you wish to insert body mounted Kadee couplers, etc.

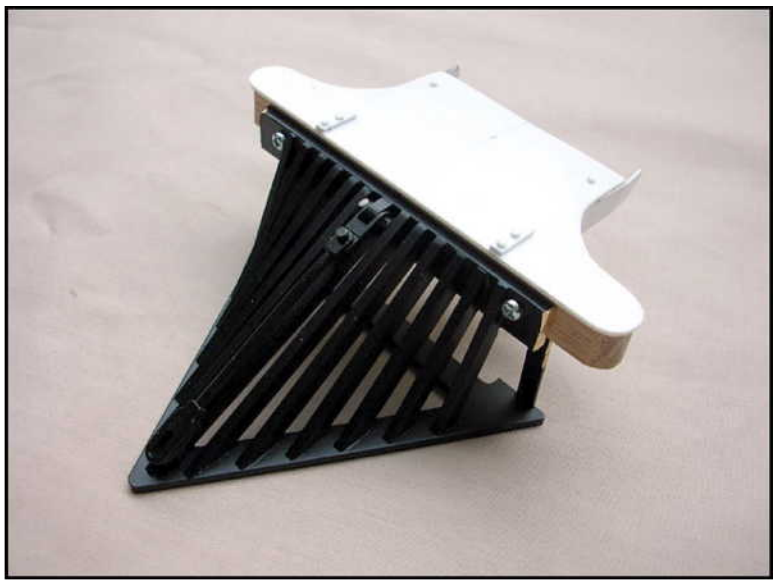
If making the coupler pocket, you need to cut a 0.5mm thick backing plate, a 5mm length of your 6.5mm styrene SHS, and then weld the oval shaped coupler plate on top. Add styrene bolt heads to the corners. The whole back end should look like this:

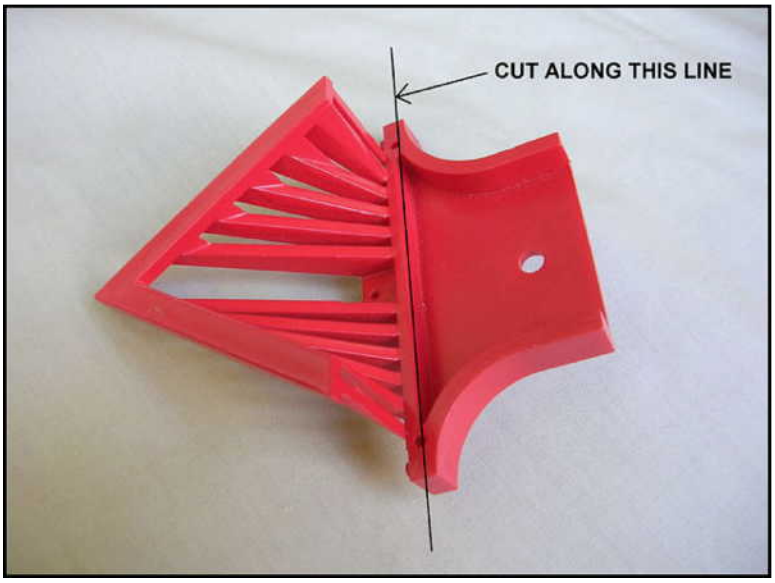
Pilot Deck Detail:

Now is the time to attach the pilot! If you bought the Accucraft 4-4-0 pilot, I want you to trim the ends of the brass beam on it, to the actual width of the pilot staves. We want to see our wood pilot beam only beyond the width of the pilot staves. Also the Accucraft pilot has two brass tabs at the top of the outer most staves. Cut the ends of these outer staves back by 8mm, so that they now butt into the bottom of our timber beam. Use the two bolt holes provided in the brass beam to bolt the pilot directly into our timber beam.

On top of the pilot deck weld two 2mm wide strips to represent some small cleats on the deck top, plus two rivet heads from the 1.6mm rod, toward the rear end of the deck. The two cleats will later become of the ends of the smokebox braces, so placement needs to be accurate. Follow the PDF of the deck to locate these properly.

If using the Lionel pilot (the preferred pilot), it has a deck cast into the whole pilot. We need to cut this deck off, because it was too small for our project and we have made a better one! You will need to turn the pilot over so you can see the underside of the Lionel deck, using the Jeweler's saw, cut off the deck from the pilot here:





Now attach the Lionel pilot to the timber beam. You can either use small bolts, or glue it to the beam with CA.

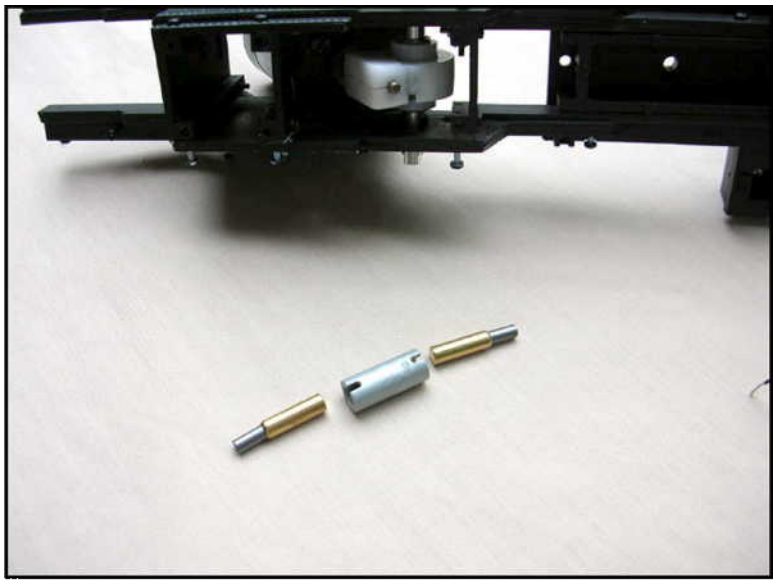
Step 13 - The Drive Wheel Electrical Wipers:

Now is the time to start thinking about painting your chassis. Remove the motor/gearbox, decks etc, unbolt those 3 main assemblies. Spray paint the entire chassis part (less the rear deck and pilot/steam chest assembly). I would paint that assembly flat black or a dark gunmetal. The pilot deck and rear deck assemblies can be painted either red (per today's CP Huntington paint job), or another colour of your choice. I'm painting the loco how it might have looked in the 1880s, prior to the CP's repaint of around 1914. Therefore most of my loco is a wine colour, both front and rear decks are entirely wine coloured.

When dry, bolt the 3 assemblies back together, with the motor/gearbox fitted in place. At this point, we shall insert the driving wheel wipers into the chassis, before she's bolted together again. It won't be coming out again from here on, unless you have mechanical problems or leveling issues!

The Hartland wipers are an LGB style plunger type, with graphite plungers. The system is dead simple, and is one of Phil Jensen's really clever designs. You need not attach the actual wipers to anything, nor is any soldering required. You simply stuff two brass wiper casing straight into the ends of the plastic tubular receptacle, while you slide the wipers into this reception, slide some electric wires in with it. The press fit of the wiper casing, against the plastic receptacle holds the wires firm to the sides of the brass wiper casing.

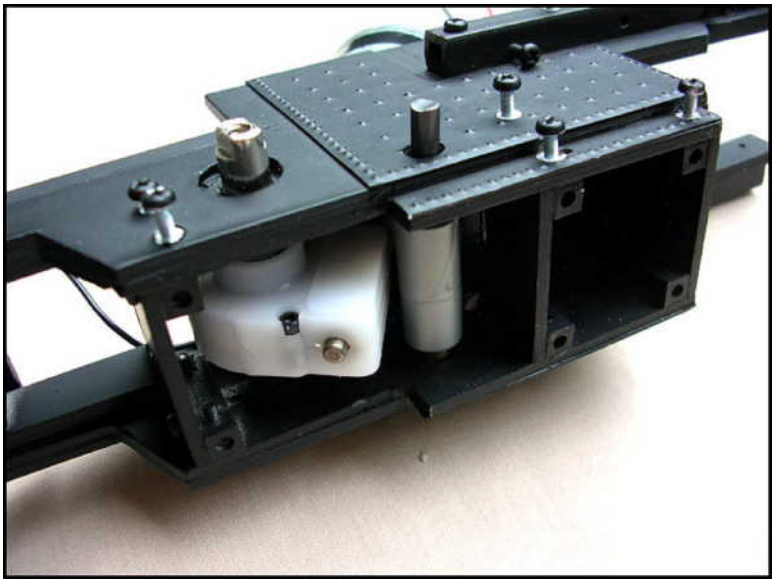
The two wipers and receptacle.



The wipers installed into the receptacle with wires pressed in with the wipers.

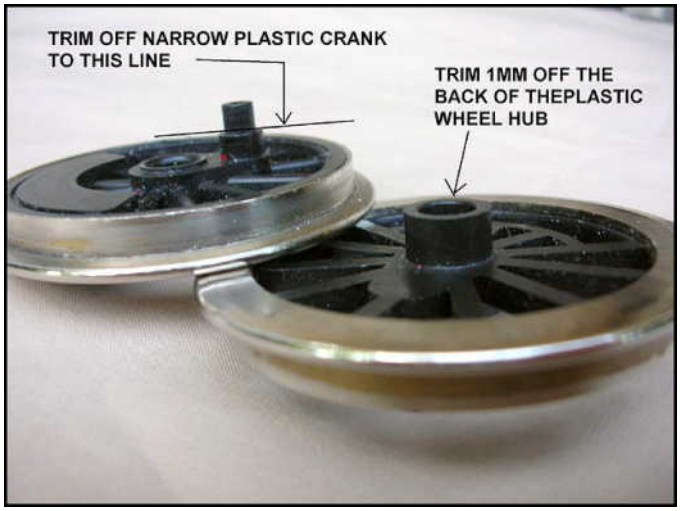
Insert the wiper assembly into the holes provided in your chassis frame, firebox area. Close the frame side back into place and screw the assembly closed again, with wipers, motor and gearbox in place.

Wipers, motor and gearbox in place, frame side about to be bolted tight for the last time.



Pull the wires from the wipers directly up through the firebox, running along the underside of the motor. Cut the wires on the motor back to about a 2" length Solder the wiper wires to the motor wires to the rear of the motor. (Check your polarity, NMRA or LGB standard). It would be best to get another loco of yours and wire the wipers to the motor wires such that both CPH and your other loco run in the same direction.

Two Minor Drive Wheel Modifications:
There are two small mods I want you to do to the Hartland drive wheels. Look at the back of the drive wheel. Note the hub extensions that protrude out the back of the wheel by some 5mm. I want you to carefully grind off about 1mm from these extensions, so that they don't stick out quite as far. This will reduce the tightness of the wheels hubs against the frame. Next, look at the front of the wheel. The wheel crank has a step in the plastic molding about 4mm from the outer end of the crank pin. I want you to slice off that narrower end of the crank pin. We will replace this crank end with a metal bolt later on.

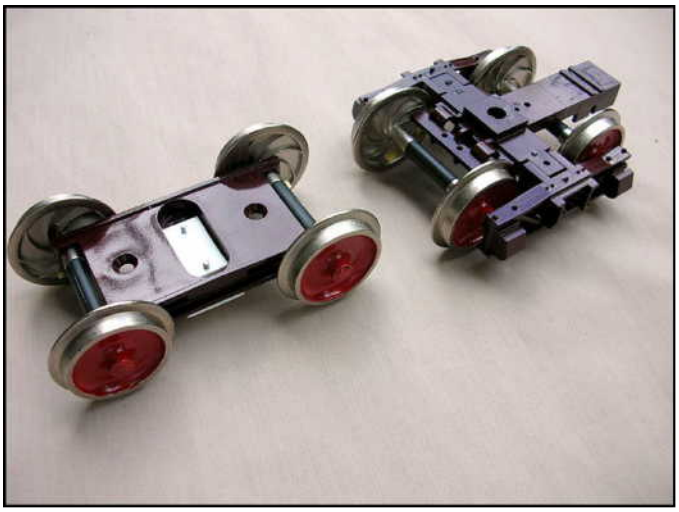


It would be a good time to apply power to the motor and see that the axles turns freely, no binding. Also check the drive wheel fit to the axle. Slide the wheels onto the axle as far as they will go and insert the H-L-W screws provided into the wheel hubs from the outside.

Step 14 - The Pilot Truck:

For each pilot and rear truck assembly, you're going to need a 40mm long (or close to) 4mm thick bolt, matching nuts and matching washers. Also, a couple of large washers with inside hole diameter of 5.5mm - 6mm.

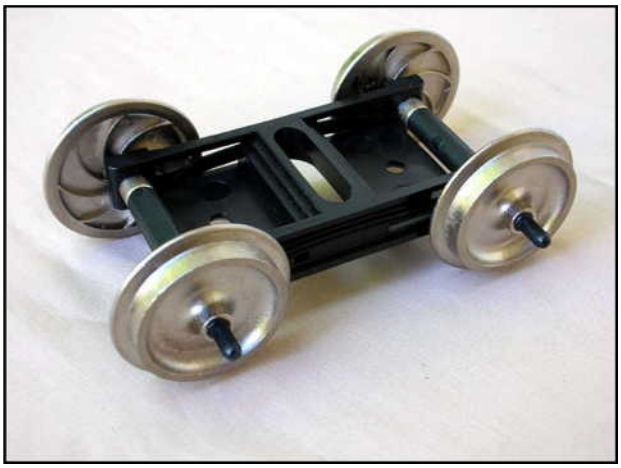
Begin by deciding what colour you want your pilot truck to be. In the 1860s/70s, black was a colour seldom used on locomotives unless requested. The only blacks to be found would be heat resistant paints on the stack, smokebox and firebox. As such the locomotive pilot and rear truck frames were painted in colour. Since my loco has a base colour of deep wine, I paint the pilot and tender truck to match. Therefore, now is the time to paint your pilot and tender truck parts.



Here is a picture of my pilot and rear trucks all painted up, ready for fitments. Both trucks as seen looking down at their top.

In your Hartland CPH kit, you will find 4 axles with metal wheels. Two axles are for the pilot truck, and two axles for the rear truck. Take two of these axles with metal wheels, and store the other 2 away - do not get them mixed up from here on!

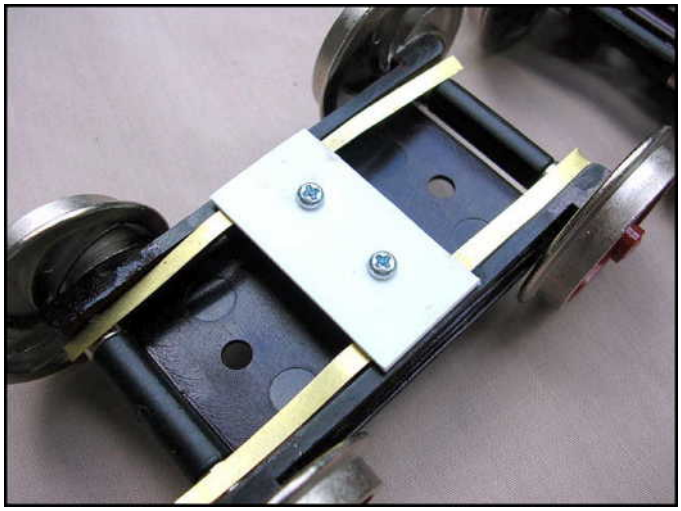
Using your razor saw or knife, cut off the plastic axle extensions on the two axles, right back to the metal wheel hub. The pilot truck is an inside frame setup and hence these axle extensions are not needed. Now paint your wheel centres, including the cut end of the axles. These were typically painted red, or Vermillion (an orange red) in the 1860s/70s. When dry, carefully pull the metal wheels off one end of both axles, insert the axle and remaining wheel into the pilot truck assembly, and then press the metal wheels back onto the axles. Make sure the metal hub to the rear of the wheels is hard up against the axle step to ensure your back-to-back wheel gauge is right. Take care pushing the wheels onto these plastic axles. They are strong axles, but will not fare well against bending forces! Now you have a nice 4-wheel truck ready to be applied to the chassis.



Picture of stock Hartland pilot truck with wheels. Note truck is not yet painted, nor are the axle extensions cut off yet. Truck is seen from the bottom.

The Pilot Truck Wipers:
For maximum reliability, we're going to set up this loco chassis such that all wheels have electrical contact to the rails. We have already dealt with the electrical contracts for the drive wheels. Now we do the pilot truck.

Take your 0.005" thick brass sheet and cut two 3mm wide, 75mm lengths of brass strip. If you already bought 3mm wide springy brass strip, use that instead of cutting your own. Next lightly bend the strip into a shallow 'V' shape. With the truck bottom facing up (the top of the truck is flat across the entire top) Invert the strips and place them down onto the central bolster of the truck base. Place the two strips such that they run hard along the inside face of the truck side frames, with the strip ends wiping on the metal wheel hubs. Use some CA to glue the strips to the central bolster.



Next cut a rectangle of 1mm thick styrene, exactly to the width of the bolster. Drill and bolt this styrene plate down over the top of the brass strips. This plate will now clamp the strips in place on the truck thus:

Now choose which end of the truck will be the 'front end'. Mark the front if you wish with an 'F' or an arrow scored into the truck's plastic. On the rear end of the truck, right next to your styrene bolster clamp, solder two 20mm lengths of thin black floppy electrical wires onto the tops of the brass strips.

Making the Truck Pivot:
Now the big surprise. You would expect the pivot to this pilot truck to be the exact centre of the truck, pivoting on the chassis directly between the loco's cylinders. Normally you would be correct, however, on this model there are some interesting operational dynamics! If you want to, hold the pilot truck in place at the front of the loco and pivot the truck by hand. Imagine the rail line running between the two wheels on one side of the truck. Now as you pivot that truck about the centre point, and follow that imaginary rail line, see how far you can pivot that truck before the direction of the rail line, appears to go way outside of the location where the drive wheel is. Basically, as the truck pivots, the rear wheel of the truck moves outward relative to the frame. On tighter curves this is actually a point some distance outside of the railhead. On a 2ft radius curve your 4-2-4T would either bind up on the curve or derail!! The solution is to move the pivot point on the truck back to a position closer to the drive axle. Just enough to allow the loco to round that 2ft radius curve without binding. By doing so you are also changing the angle of attack of loco on the rails, the rear end of the loco won't hang quite so far over the curve.

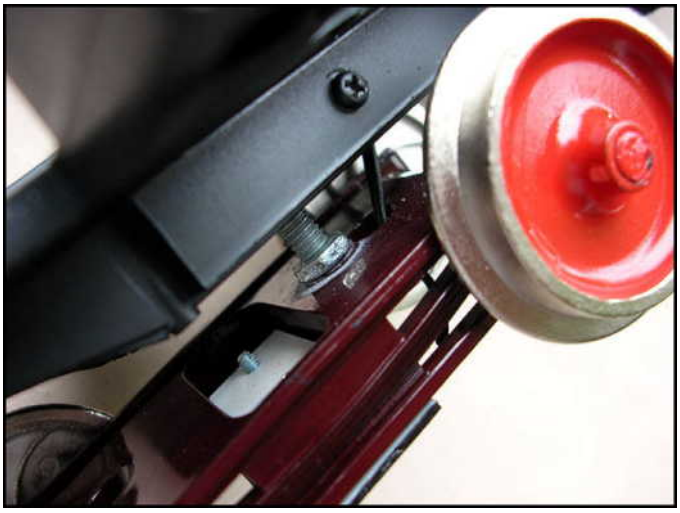
I recommend making the pivot point of the truck exactly 12mm to the rear of the truck's dead centre. A little more than 12mm will be OK, but no less. Take a look at the PDF drawing showing the truck fixing and pivot location.

Drill out a 4.5mm hole in the pilot truck centreline 12mm to the rear of the truck's dead centre. Insert your 40mm long bolt from the bottom (the wiper side) with a single washer under the truck. Next insert a 2nd washer down the bolt onto the truck's top. Wind a single nut down the bolt until it is exactly 1mm shy of the top of the truck. If you want, you can insert a sliver of 1mm thick styrene and wind the nut down onto it (thus spacing the nut 1mm from the top of the truck). Use a daub of Loctite onto that nut, or even a drop of CA if you don't have any Loctite. Now pull your styrene spacer out, and the truck should rotate freely on the bolt. That nut and washer on top of the truck is your bearing plate for the pilot truck. It doesn't matter how much you tighten this long bolt into the loco's frame, the pilot truck will always pivot freely. You won't be able to remove the truck from the bolt unless by breaking the Loc-Tite or CA.

Now measure a point exactly 12mm to the rear of the old pivot hole seen in the Hartland deck - this is the existing hole seen between the steam chests. We're not going to use this hole. Instead we want to drill a new hole 12mm to the rear of this existing hole. Drill the new hole to match the bolt diameter you have. You want it to be a tight fit, such that you can literally screw this bolt into the thick plastic of the Hartland deck. This will form the fixing point for the pivot bolt for the truck.

Now add a second nut onto the top of the bolt, and wind it down to about 10mm above the truck. Next screw the truck/bolt to your locomotive frame. The end of the bolt should come right out of the top of the Hartland deck. Place the chassis on a piece of track, and look from the side of the loco to level her up. Screw the bolt farther into the deck to lower the front end to level. If you're gone too far, then unwind the bolt a bit to bring the nose up. Use a vertical ruler and measure the hight of the deck, rear tender deck and so on. Adjust that pilot truck bolt until you're satisfied that the whole chassis is now sitting perfectly level. Now thread that nut hanging 10mm above the truck all the way back up to the underside of the Hartland deck. Do not rotate the bolt, or you change the chassis level, but tighten that nut hard into the underside of the deck. This will lock the bolt from turning, and thus maintain your chassis level.

Take the loose end of the two wires coming off the truck, pull then up through the rear hole in the pilot truck, then insert them into the existing hole at the very rear end of the Hartland deck. Allow the wires to be flexible enough to enable the truck to pivot. Use a patch of electrical tape to tape the two wires to the underside of the Hartland deck between the two frames. Solder the ends of the wires to the motor wires to the rear of the motor. Check your polarity such that the left-hand drive wheel wire and left-hand truck wheel wires are soldered together, and the two right-hand side wires are soldered together. NO short circuits!!



The pilot truck inserted into the loco frame with the two nuts setting the loco's level will look like this. Note how the bolt is inserted in the truck 12mm to the rear of the original centre of the truck, close to the rear axle. The front of the loco is seen to the left-hand side of the picture. The two wires come up from the wipers though an existing hole in the truck then up to the underside of the loco's frame.

Step 15 - The Rear Truck:

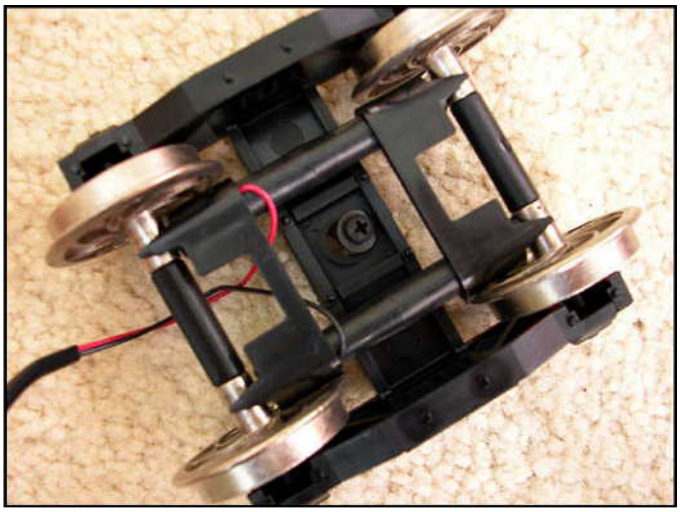
Take the remaining two axles with metal wheels, two C-16 truck side frames and the bolster part in hand. Insert the axle ends into the rear of one truck frame. Slide the bolster end into the corresponding area in the truck frame. There is only one way it will fit. Then slide the 2nd truck frame over the other ends of the axles. You will see that the truck sides can slide in and out a little relative to the bolster. I find it best to not slide the frames all the way in so as to allow the wheels to spin freely without binding. Insert two small self-tapping screws into the bolster to hold the frames in place.

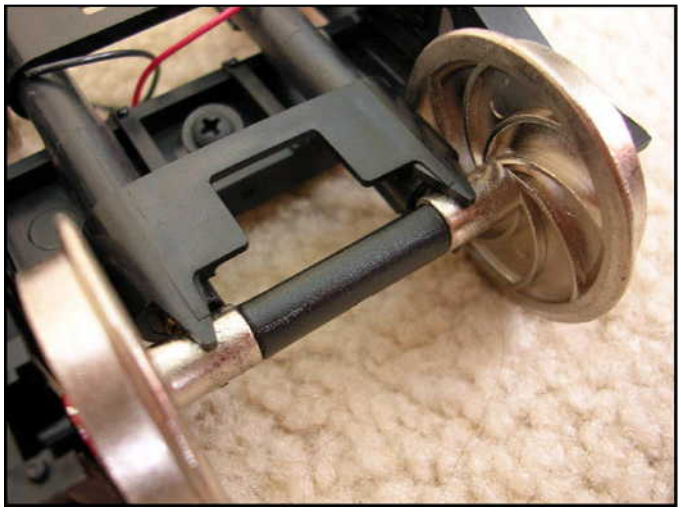
If building the TD Judah, 4-2-2 loco, you won't be doing any complex fitting of the rear truck to the loco. Instead just keep that rear truck for your 6-wheel tender instead.

Rear Truck Electrical Wipers:

The rear truck electrical pick-up can be done in two ways. Included in the CPH kit is a wiper assembly made up of 4 plunger wipers. The unit is snap together and requires no soldering. Take 4 plunger wipers; insert them into the black plastic 4-wiper holder unit. Press electric wires along the plunger sides in the same way as you did the drive wheel plungers. Carefully insert the 4-wiper unit into the tender truck. It will snap in directly between both axles and is held in place only by the axles. The system is downright clever. It is no physically attached to the truck at all, but held by the springs of the wipers, and works against the axles for power pickup. This is a low drag system. The 4-wiper unit installed into the rear truck will look something like this:

The 4-wiper assembly inserted into the rear truck.

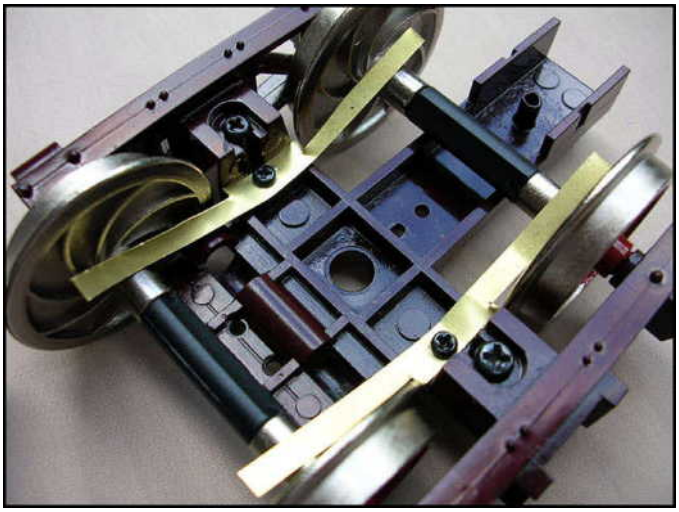




Note how the unit is held in place only by clipping around the axles.

Home Made Electric Wipers For the Rear Truck:
An option (this was the way we were going to make the rear truck wipers until Hartland offered their pickup unit as part of the CPH kit). Ignore this next little bit. This info is useful to those that want to add wipers to their own models the easy way, when no wiper kits exist!

The rear truck can have electrical wipers very similar to the pilot truck. Again cut two 65mm strips of 3mm wide 0.005" thick brass. I allowed for a 5mm wider section in the middle of each strip to help with screwing the wipers to the rear truck, but that is optional. This time we can apply the wipers to the existing truck bolster using small self-tapping screws. Drill and screw the wipers directly to the bolster. Make sure you have the strips back from the rear of the wheels so that they don't get hung up on the wheels. You want them to have good contact to the metal axle hubs. The completed electrical wiper installation will look like this:



This is the view of the truck as seen from the bottom. Note the wipers screwed into the plastic bolster, and the larger screws holding the side frames to the bolster proper. Again cut two 200mm lengths of black floppy wire, solder to the wipers close to the bolster.

The Rear Truck Pivot Design:
This is a curious bit of engineering you need to do. The rear truck will swing a long way laterally under the rear deck of the loco. At the same time it needs to support the rear deck to prevent it springing, bouncing and flexing in an undesirable way on rough trackage. There are two elements to the pivot design:

1. The vertical sliding spring assembly that keeps the truck pressed on the rail, while supporting the rear deck of the loco. This spring arrangement will slide along the entire length of your elongated curved slot cut into the rear deck - that's how much lateral play is in the truck!
2. A pivot beam that ties the truck to the loco frame, transferring rear train loads to the loco frame without causing binding in the vertical spring-loaded assembly above.

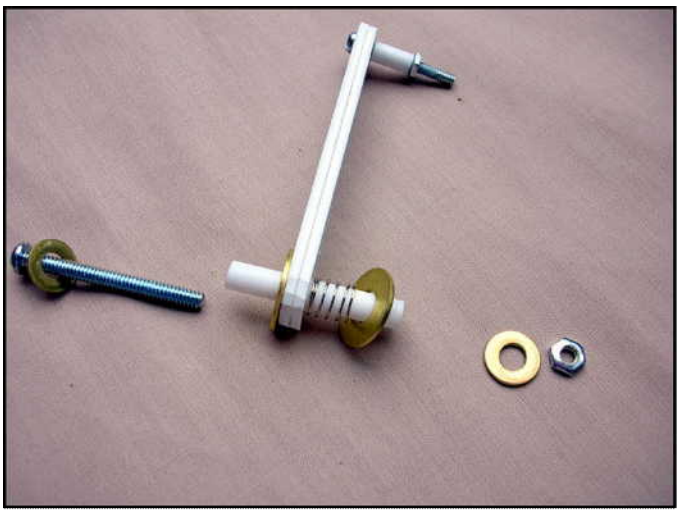
Item 2 is of paramount importance if you are running on tight curves. In the tight curve situation, the rear deck of the loco will hang over the curve. Any body-mounted coupler will swing too far outside the rail line to be practical in hauling trains. In this scenario the coupler will need to be mounted to the truck itself. Use the coupler pocket provided in the Hartland truck to insert a coupler. The old Delton/Aristo Classics knuckle coupler will fit exactly without alteration. If using Hook and Loop, ask Phil at Hartland for a loop coupler to fit. This design of coupler pocket is not immediately compatible with LGB/Bachmann. With the weight of the train pulling on that rear truck, the truck would literally lift off the rails in tension if it weren't for the spring assembly above the truck. Also the back wheels of the truck would lift off the rails if the only fixing of the truck was that rear vertical spring assembly. The pivot beam keeps the truck level, and transfers the train load from the truck back to the loco's frame without the truck coming off the rails.

If you're going to run on wider curves, 4ft radius or wider, then you can body mount a coupler into the rear beam of the loco's tender deck. In this scenario you need to apply the spring pivot above the truck, but the pivot beam is not so important, and can be deleted if you like. I'd still put it in anyway.

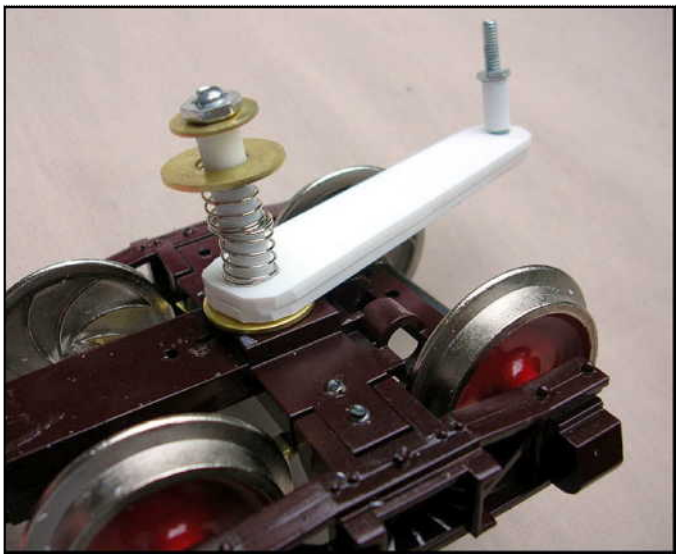
The assembly of the beam and spring detail is easy to make, but complex to describe. I think it best to refer to the diagrammatic PDF entitled 'Rear Truck Pivot'.

What you do is this:

1. Take the 40mm long bolt; insert a washer on the head end.
2. Insert the bolt into the bottom of the truck. You'll see the bolt is too narrow for the wide pivot hole in the top of the truck. Cut a 3mm tall sliver of your 5.5mm styrene tube. Insert that onto the bolt. This will make the bolt a better fit into that truck pivot hole.
3. Insert a washer onto the bolt and slide it down to the top of the truck bolster.
4. Insert a nut onto the bolt and wind it down to the truck bolster level. Now tighten that nut hard onto the bolt, clamping the truck firm to the bolt. Loc-tite it. The bolt is now perfectly vertical, sticking firm out the top of the truck.
5. Insert a large washer of inside hole diameter 5.5-6mm onto the bolt. It should slide around the nut width.
6. Cut out the two rear pivot beams in 2mm thick styrene following the PDF drawing. Weld the two beams into one, making a 4mm thick solid beam. The beam has a hole drilled at both ends. The end with the hole 6mm wide is be inserted onto the bolt so that it rests on top of the larger washer.
7. Cut a 25mm length of 5.5mm diameter Evergreen tube. Insert that tube onto the bolt so that the base of it rests on the large washer, with the beam sliding around it.
8. Insert a spring outside of the 5.5mm tube. I used old Bachmann 4-6-0 plot truck springs. You're after a coiled spring that can slide over that 5.5mm tube easily. Think about spring-loaded pens, go to the local hardware and look at springs used in door locks etc. If you have trouble sourcing a spring, ask the question in the forum for help. There are lots of ideas! You want the spring to be about 15mm tall, uncompressed, or two shorter ones that can sit on top of each other.
9. Place a 2nd large washer onto the bolt, sliding around the 5.5mm tube and resting on top of the coiled spring. The pivot bolt/spring assembly is like this, note that for clarity the truck is removed.



On the very top end of the bolt insert another small washer and a nut. The entire assembly, with truck applied will look like this:



Note that the far end of the styrene beam has a 10mm length of 5.5mm styrene tube applied along with another bolt. This will be bolted into the loco's deck, directly behind the firebox. The bolt size is up to you, somewhere in the 3mm wide, 25mm length. You might need to experiment.

Take the top washer and nut off again for a moment, and insert the end of the bolt into the elongated slot in the tender deck. The styrene tube should slide right through the slot, leaving only the large washer pressed up against the underside of the deck, with the spring below that. With the nut and washer re-applied, It should look like this as seen from the top of the deck:

Insert the bolt at the lead end of the styrene beam into the base of the deck. Apply a nut from above. This bolt should be only a firm fit, allowing the beam to pivot, but not be too floppy. The assembly will look like this, as seen from the bottom.

Press the rear truck up and down in the slot, the truck should be able to glide up and down with the styrene tube sliding smoothly through the slot. The washer under the deck acts as a glide and bearing plate for the upper end of the spring. As the truck moves closer to the deck, the spring compresses, keeping that truck on the rails.

Ultimately you need to Loctite the nuts on the top end of both pivot bolts, so that they don't unwind and let the whole assembly fall apart! However, place that on your 'to-do' list. I would recommend you test the truck first on curves. This to test for:

When the truck slides laterally, does the beam bind up - i.e. is the curved slot not a perfect radius about the pivot of the beam? If it gets tight at the ends, open up the slot a little more. If it gets tight, that means the beam swing is forming a slightly different arc to the curved slot you cut in the deck.

How does the spring on the truck feel? It must apply some upward pressure to the deck, but not so much that it lifts the drive wheels off the rails! It should not be so loose either that the spring doesn't compress at all!

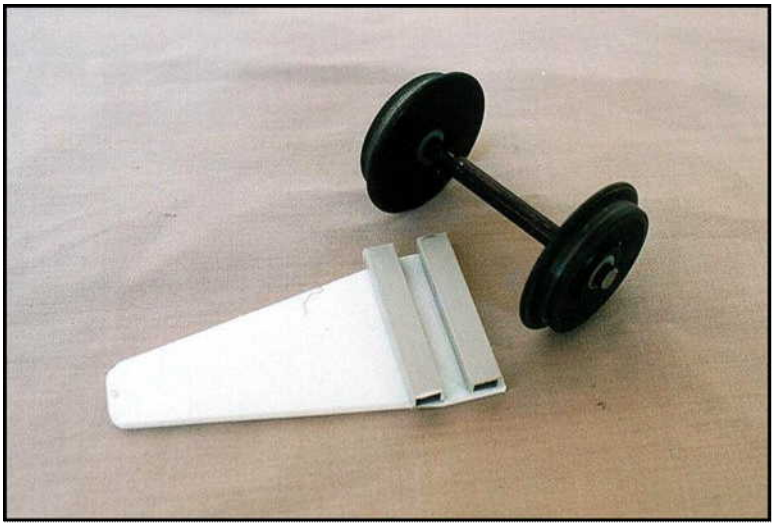
How does the styrene pipe glide up and down in the slot It should be nice and easy, no bind-ups in any of the curved slot.

Connecting the wires:
Run the two electrical wires into the back of the firebox below the deck (you may need to drill a hole), pull them up to the back of the motor, and again solder the wires into the wires leading to the other wipers. Again ensure right-hand and left-hand sides match so there are no short circuits.

You can now take the chassis out and give it a run. Add a rock or something on top the Hartland deck between the cylinders and drive wheels so as to apply some weight where it is needed. The entire loco's ballast will ultimately be inserted only in the boiler, placing all the weight directly in the space between drive wheels and pilot truck.

Rear truck for TD Judah 4-2-2:
This is a special rear single axle truck for folks building the 4-2-2 tender loco. You'll need to acquire a nice 32mm diameter spoke wheel: LGB or similar, preferably a metal-rimmed wheel.

Cut out the templates in the Judah PDF page entitled 'Judah rear truck frame'. This is basically a wedge shaped plate, two 4.6 x 4.6mm Plastruct SHS's, and a top plate.



The parts go together like this, all nicely clamped together:

Affixed to the front side of the middle spacer on your Judah loco frame is a vertical length of 4.6x4.6mm Plastruct SHS. Refer to the PDF page entitled "Judah Frame Spacers". You must bolt the tip of the rear truck plate onto this vertical pivot SHS. Just drill a hole in the end of the truck plate, and insert a bolt straight into the SHS. That's all you need to do in making a rear truck for the 4-2-2.

Step 16 - Main Rods, Crossheads and Guides:

Now, it's time to complete the cylinders and rods. This is real easy, as 99% of it is already provided in your Hartland kit.

Take a look at the PDF entitled "Cylinder Assembly" to get an idea of what the various parts look like installed.

You'll need to rummage through your Hartland kit of parts to find the following:

- 2 - Front cylinder heads - these will most likely have a pre-brassed finish.
- 2 - Rear cylinder heads - again brassed finish, with two holes in them, one for the piston and one for the crosshead guide.
- 2 - Crosshead guides. These are usually provided with a chrome finish.
- 2 - Chromed Crossheads and Crosshead backing plates.
- 2 - Main Rod end patches - little plastic blocks with rod detail cast on.
- 2 - Stephenson valve cranks - these are fully chromed cranks.
- 2 - Turned brass oil cups - real brass items.
- 2 - Steam chest tops - again usually have a brassed finish.
- 2 - Wheel Crank bolts. - polished steel, with hex shape on top.
- 1 - Crosshead guide support. (black plastic)

Assembling the Cylinders:

This is the easy bit: You may want to paint your cylinders etc. prior to anymore assembly.

1. Take the two front cylinder heads and glue them to the cylinders, either end is OK because there is no front or back to the cylinder tube. Use CA sparingly to glue them to the plastic cylinders.
2. Take the two rear cylinder heads (the plain ones!), glue them to the cylinders. You'll note that the rear heads can only go on 'one way', with the hole for the crosshead guide facing up, or toward the flat section of the cylinder.
3. Using your welder cement, weld the cylinder assemblies to the underside of the steam chests on the Hartland deck. Make sure you have the cylinder heads facing the correct way! Fancy caps to the front, piston holes etc to the rear.
4. Take your crosshead guide support bracket. You need to make a quick modification to it. The boiler is going to sit low over the frame and this support piece. Our boiler will be 42mm in diameter. Please cut a curved chunk out from the centre of the support bracket to a diameter of approx 45mm. This can be done by following the PDF template. I used the Dremel with a grinding block, running at the slowest speed to slowly grind out the curved section. Also at the bottom ends of the slots noted on the PDF, we need to angle the inside surface of the slot. Basically the slot at the base has a horizontal surface. We need to grind it slightly to an angled surface so that the main rod can pass through this slot and not bind into the bottom of the slot, when the drive wheel crank is in the down position. When installing the bracket, be sure the angled slot points down towards the *rear* of the frame!

The support bracket when finished should look like this:

Take the two chrome crosshead guides. These are the two 40mm long chromed plastic featureless square section rods. You will need to lightly file both ends of each guide so that they fit snug into the cylinder head above the piston hole, and into the square holes in the support bracket as shown above.

Press the crosshead guides into the support bracket, and then apply the support bracket and guides into the cylinder heads. The bracket should come down to rest in a slot provided in the H-L-W deck toward the rear end. Do not apply force to this assembly. If the guides won't fit into the cylinder head slots, then file the ends of the guides a little more. Take the assembly off the model until the main rods are made.

Take the two steam chest tops - these are square brass coated details. Using CA glue them directly to the top of the steam chest blocks on the Hartland deck piece.

Take the two brass turned oil cups and just press them into the centre holes in the steam chest tops.

Assembling the Main Rods:
Take your PDF entitled "Main Rods"; there are two identical templates to follow. Cut out the profile in 2mm thick styrene, and drill the holes at both ends with some precision. These main rods have very little stress or wear, so 2mm styrene is perfectly fit for purpose. However if metal is your thing, then go ahead and cut out the same template in nickel silver, brass or what ever metal you choose.

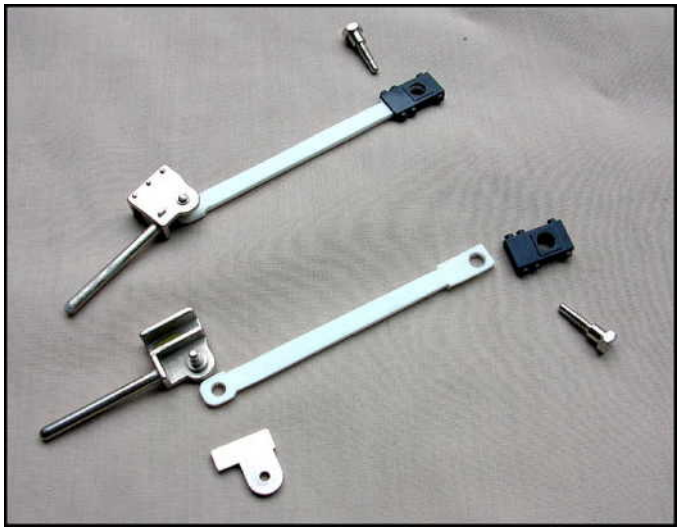
The rounded end should slide neatly onto the back of the crosshead pole. The chrome bolts should slide nicely through the holes at the squared end.

Using a file, or sandpaper, carefully sand down the thickness of the 2mm styrene at the square end, to the limit of the wider section only. We want this to be slightly thinner so that it slides into the Hartland rod end patches. Slide the patches onto the rod ends, align the holes of the patch with the hole in the rod.

NOTE: there is a front side and a back side to these rod patches! Make sure you assemble the rods with the detailed 'front side' facing OUT or you won't see the detail!

Weld the patch in place, and paint the entire rod a polished steel colour. I use Tamiya Light Gunmetal Spray. The Main rod with crosshead parts will look like this:

A completed rod/crosshead is seen at the top. The rod in its parts is seen at the bottom. The crosshead should be able to pivot feely about the rod, but not too loose.



Rod Length Test:
Now to test the rod lengths on the loco! Slide the rod through the crosshead guide support. This is best done from the front, where you can just slide the rear end of the rod through the slot. Pushing the rod all the way through the bracket slot, let the crossheads slide onto the chrome guide from the front. Apply the main rods to both crosshead guides. Then place the support bracket/rod assembly back onto the loco, sliding the ends of the crosshead guides into the cylinder heads. Test to see that that crossheads slide long the guides nice and easy. Lightly bolt the rod to the drive wheel, and place the piston end into the cylinder. Rotate the driving wheel so that the wheel crank is facing all the way forward, facing toward the cylinder. Check to see that your main rod is not so long that the crosshead touches the cylinder head! Now rotate the wheel so that the crank is facing all the way to the rear. Check to see that the crosshead is not touching the support bracket. If the crosshead *does* touch either the cylinder of support bracket, you need to adjust the length of the rod to suite, either making it 1mm longer or shorter.

Take the assembly off again, and remove the main rods.

The back plate of the crosshead now need to be applied. Take great care with this. The back can only go on in one way... see photo above. Put a daub of CA onto the top of the pole well above where the rod pivots. This is to hold the crosshead back plate on. Do NOT glue the main rod to the crosshead pole!! Also apply a small daub of CA onto the horizontal ledge just above the pivot pole. Press the back piece onto the crosshead, with the rod in place. It will snap into place, and be held by the CA. No taking it apart now!

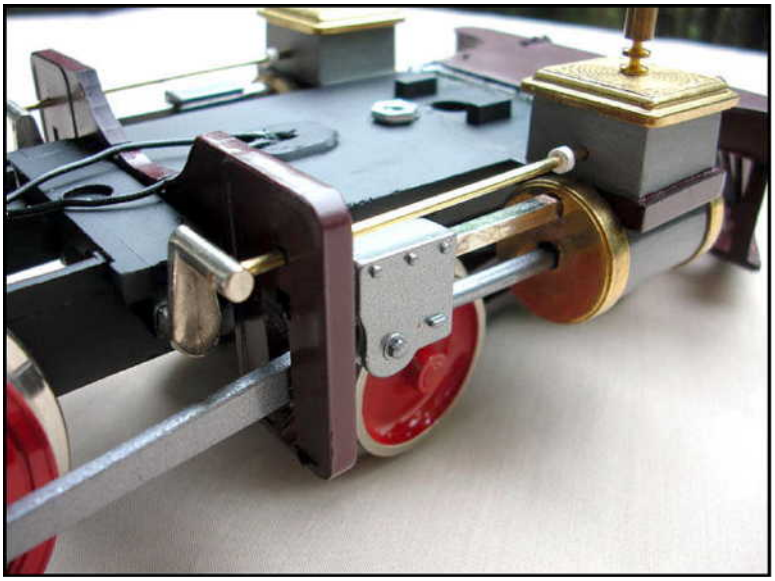
Re-apply the main rods to the support bracket assembly and fit the assembly in place on the loco. Tighten up the crank bolts on the wheels all the way this time. The rods won't be coming off again.

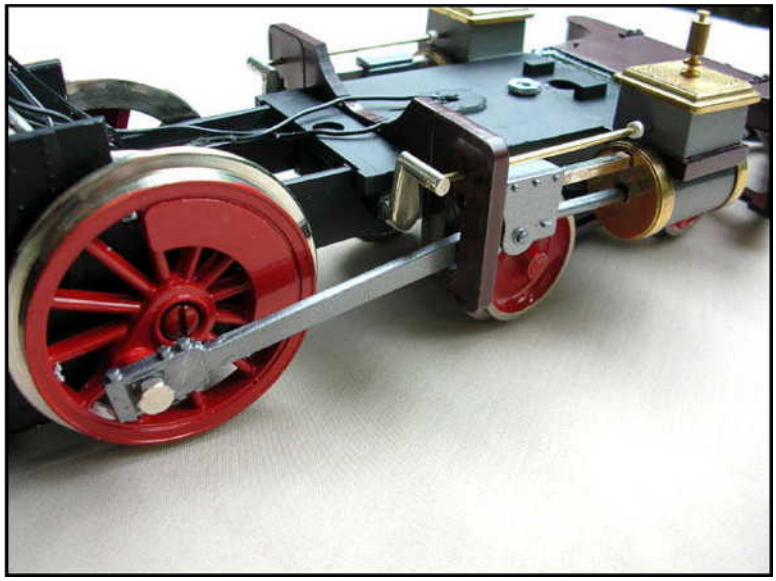
The Stephenson Valve Cranks:
One last detail to add! The Stephenson valve gear is all inside the frames on this locomotive, out of sight. We need only make the exposed part of the valve gear by apply the valve cranks and valve rods.

Cut two 65mm lengths of brass 1.5mm diameter rod.

Insert the end of the brass rod, into the middle rear of both steam chests, directly above the rear cylinder heads, and directly above the crosshead guides. This is best done by inserting the rod through a small hole in the support bracket, directly above where the crosshead guides are. Run the brass rod forward to the steam chest. Just before you insert the rod into the steam chest cut a sliver of your 3.2mm styrene tube, about a 2mm length. This will be our 'connector' between rod and slide valve on the loco. Slide it onto the end of the brass rod, then slide the end of the rod into the steam chest. Leave it loose there for a moment.

Take the chromed Stephenson valve cranks; press them onto the rear end of the brass rod. Apply a daub of CA onto the 'T' tab on the back of the valve crank and slide the tab into the slot provided in the side of the H-L-W chassis deck. The whole assembly will look like this:





Note in the above pictures I have not run the wires from the pilot truck through the correct holes in the deck. The wires should come up through the deck in the hole directly behind the crosshead guide support bracket... not in front of it as I show!

With the valve rods in place, use a daub of CA to glue to the 3.2mm styrene tube slithers to the valve rods at approx 5mm back from the steam chest. Then hand-paint the brass rod a sliver colour.

With the locomotive rods in place, go out and test run your chassis again. Check for tolerances, binds etc. Remember the mechanism will need to wear in, so don't be too hard on it.

Flag Staffs on the Pilot Beam:
No 1860s/70s loco would be complete without flag staffs on the pilot beam. The CPH is no exception. You've spent some good time building a fine working chassis; I'll let you blow of some steam with the flag staffs. Try some things; see what works and report back to the group on your ultimate flag staff design! Make them yourself, bash them, make them from 1:12 dollhouse candle sticks... you name it. This is what you want to try and make:

The chassis is essentially finished. Next, we build the superstructure, including our own home-made wagon top boiler. This will be in the next and final chapter!

Good luck and have fun!
David Fletcher,
April 2005.

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