

Hornby 700 Class Loco Chassis

Introduction

This chassis kit is designed as a modern sprung replacement for the Hornby 700 class model. As such it is suitable for the class post superheating. It includes CSB suspension as well as cosmetic inside motion and covers many of the prototype variations. The chassis can be built in EM and P4 and is designed to negotiate a 1m radius curve in both gauges using the same subframe. There is therefore only 1 set of 'framespacers'. The cosmetic inside motion is also available separately as a 3D print.

General Notes

Read through the instructions first and familiarise yourself with the components. Parts are numbered on the fret, and I've tried to do this in build order.

Check all holes before removing parts from the fret. The drawing process for etching, if you use a CAD program as I do, is extremely accurate but the actual etching process itself not an exact science. If the fret is slightly over etched, then there is no problem but if they are under etched the holes will need enlarging. I find that this is easiest to do before removing parts from the fret. The hole sizes will be noted at the appropriate points. Use an appropriate drill or a tapered reamer.

Remove one part at a time from the fret.

The instructions will assume that tags connecting parts to the fret will be cleaned up on removal of a part unless it is specified specifically in the instructions not to.

Very important:

All fold lines are through 90° with the fold line on the inside unless stated otherwise.

This means that when I say fold something up the folds should be made through 90° with the fold line on the inside. If the fold is to be done in any other way I will say so.

3D Printed Parts

The loco and tender kits include 3D printed fittings. These are resin prints from an SLA printer.

Remove them from the supports only when needed using a pair of flush cutters or a piercing saw with a fine blade (size 6/0 is recommended). Only use flush cutters, one side of the blade needs to be straight, so it makes a | / shape. Cutters where each blade forms a V / rather than being completely flat on one side should be avoided as they may cause damage. I tend to mostly use a piercing saw.

Fixing the printed parts in place can be done using either cyanoacrylate (superglue) or epoxy glue. I have used both successfully. Epoxy will give you more time for adjustment. In both cases makes sure the printed parts and what they are being attached to are free from any grease.

The printed parts need no special cleaning before painting. A wash with a cream cleaner to remove any grease will be sufficient. Like plastics avoid using prolonged contact with cellulose thinners as this may damage them. IPA will be fine as this is what is used to clean them after printing.

CSB Suspension

The kit is designed to use CSB suspension. Fulcrum points for the spring wire and carriers to attach to the High Level bearings are included with the etches.

The following calculations may be useful when choosing the CSB wire which will depend on the finished weight of the loco. They are based on a 0.5mm deflection of the wire.

Loco Weight for 0.5mm deflection

- 0.012" - 150g
- 0.013" - 210g
- 0.014" - 280g

Tender Weight for 0.5mm deflection

- 0.009" - 76g
- 0.010" - 115g

I have included 0.014" wire for the loco and 0.009" for the tender. These can be changed if your loco weight is different from the weights given for those wires above. Plain guitar wire is a good source. I use Ernie Ball plain steel strings as it's easily available, either online or in music shops.

For the loco the centre of gravity for the CSB plot is 8mm in front of the middle driving wheel. This is roughly where the centre of gravity on your loco will need to be.

Materials List

The following items are included in the kit:

Loco

- 2 x 115mm 0.014" steel spring wire
- 3D printed vacuum cylinder

Tender

- 2 x 90mm 0.009" steel spring wire
- 3D printed vacuum cylinder and reservoir

You will need to source some other items to complete.

Wire

After the demise of Eileen's Emporium, Cambrian Models took on the remaining stock and are a good source of wire.

- 0.31mm - Cylinder plate detail
- 0.4mm - Loco and tender brake cranks, motion
- 0.45mm - Loco and tender brake shoes and pull rods, motion
- 0.6mm - Motion, valve rods, tender brakes
- 1mm - Alignment pins, brake shaft, piston rods
- 2mm - Motion

Tube

Albion Alloys are a good source for the first two below. Hobby holidays list 1.5mm x 1mm tube and it should be available form elsewhere.

- 0.9mm x 0.45mm (MT3) - Brakes
- 1.2mm x 0.6mm (MT5) - Reversing shaft
- 1.5mm x 1mm - Piston valve guide

Other

- 14BA bolts (and nuts if you decide not to tap) for fixing the keeper plate
- M2 bolts and nuts for the tender coupling.

Wheels

The prototype wheel was 5'1" 16 spoke with a 9" crank throw. To avoid the confusion I had, the crank throw was different to half the cylinder stroke which was 13". Tender wheels were 4' 12 spoke (I think). The flowing are recommended and are what the chassis has been designed to use:

Alan Gibson 5' NER driving wheels are recommended for the loco. The code for P4 wheels is 4S60E and EM is 4860E. The chassis has been designed around this wheel. It is an old mounding where the holes for the crankpins will need drilling out. A simple jig has been included to help do this.

The tender is designed to use Alan Gibson 3'11" 12 spoke wheels. The code for P4 wheels is 4S47NW and EM is 4847NW.

Gearbox & Motor

The recommended combination of motor and gearbox is a High Level Roadrunner (the standard non-articulated version) mounted off the rear axle with a 1320C motor vertically in the firebox. This will give you lots of room for ballast in the firebox.

It is possible to fit a HiFlier gearbox on the middle axle with a 1320C motor vertically in the firebox but you won't be able to fit the inside motion.

Hornblocks

The kit is designed to use High Level hornblocks for the loco and tender.

The tender is straightforward as it requires three pairs of 2mm bore MiniBlox.

For the driven axle on the loco there is 8.7mm between standard Hornblocks. You should (just) be able to fit a standard Roadrunner but it will be tight. SpaceSaver Hornblocks are probably a safer option. If using a HiFlier or Roadrunner+ then standard Hornblocks will be fine. For everything else use the SpaceSaver version.

For the front axle you will need to use SpaceSaver hornblocks if you want to fit the slidebars on the motion bracket.

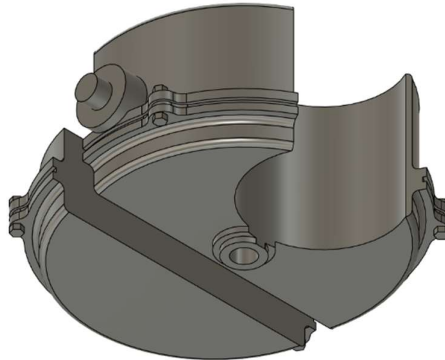
If you wish to fit the dummy inside motion, you will need SpaceSaver hornblocks on the middle axle.

For all the loco hornblocks make sure the bore matches the diameter of the loco axle.

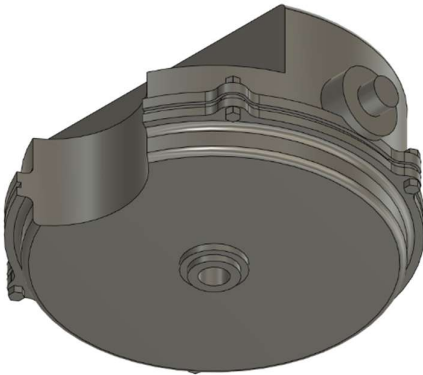
3D Prints

The following are included with the kit.

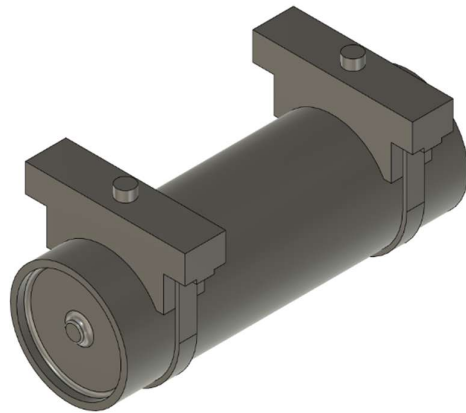
Loco Vacuum Cylinder



Tender Vacuum Cylinder



Tender Vacuum Reservoir



From this point onwards, I will deal with the loco and tender chassis separately.

Locomotive Chassis

Parts List

- 1 - Loco Subframe
- 2 - Sideframes
- 3a - Spring Carriers (Standard High Level bearings)
- 3b - Spring Carriers (SpaceSaver High Level bearings)
- 4a - Hornguides (Standard High Level bearings)
- 4b - Hornguides (SpaceSaver High Level bearings)
- 5 - Coupling Rods
- 6 - Driving Wheel Washers - Note there is also a separate fret of driving wheel washers, both full and thickness and half etched on 0.3mm brass included.

7 - Front Locating Bolt Bracket
8 - Frame Spacer Tapping Washers
9 - Front Keeper Plate Spacer
10 - Smokebox Frame Spacer
11a - Cylinder Detail
11b - Piston Detail
12 - Firebox Frame Spacer
13a - Firebox Reinforcing Angle Top
13b - Firebox Reinforcing Angle Back
14 - Rear Keeper Plate Spacer

15 - Vacuum Cylinder Brackets
16 - Tender Coupling Bracket
17 - Reversing Shaft Bracket Overlays
18 - Brake Shoe Brackets

19 - Front Keeper Plate
20 - Middle Keeper Plate
21 - Rear Keeper Plate
22 - Ashpan

23 - Brake Shoes (3 sets)
24 - Brake Shoe Washers
25 - Brake Pull Rods
26 - Brake Stretcher & Cranks
27 - Brake Stretcher Overlay
28 - Brake Crank Overlays

29 - Boiler Bottom

30a - Front & Rear Balance Weights
30b - Middle Balance Weight (Full)
30c - Middle Balance Weight (Alternative)

31 - Tender Coupling (2 Layers)

J1 - Driving Wheels Boss Filling Jig
J2a - Crankpin Drilling Jig (Back)
J2b - Crankpin Drilling Jig (Middle)
J2c - Crankpin Drilling Jig (Front)
J3 - Boiler Bottom Radius Jig

MB1 - Motion Bracket Front Layer
MB2 - Motion Bracket Middle Layer
MB3 - Motion Bracket Middle Layer
MB4 - Motion Bracket Back Layer

MB5 - Inner Slidebars
MB6 - Outer Slidebars

MB7LF - Outer Slidebar Supports (Left Front)
MB7LB - Outer Slidebar Supports (Left Back)
MB7RF - Outer Slidebar Supports (Right Front)
MB7RB - Outer Slidebar Supports (Right Back)
MB8LF - Inner Slidebar Supports (Left Front)
MB8LB - Inner Slidebar Supports (Left Back)
MB8RF - Inner Slidebar Supports (Right Front)
MB8RB - Inner Slidebar Supports (Right Back)

MB9 - Crosshead Support

M1-M25 - Inside Motion

M26 - Piston Link

M27L - Lifting Link (Mirrored Pair - Left Hand Side)

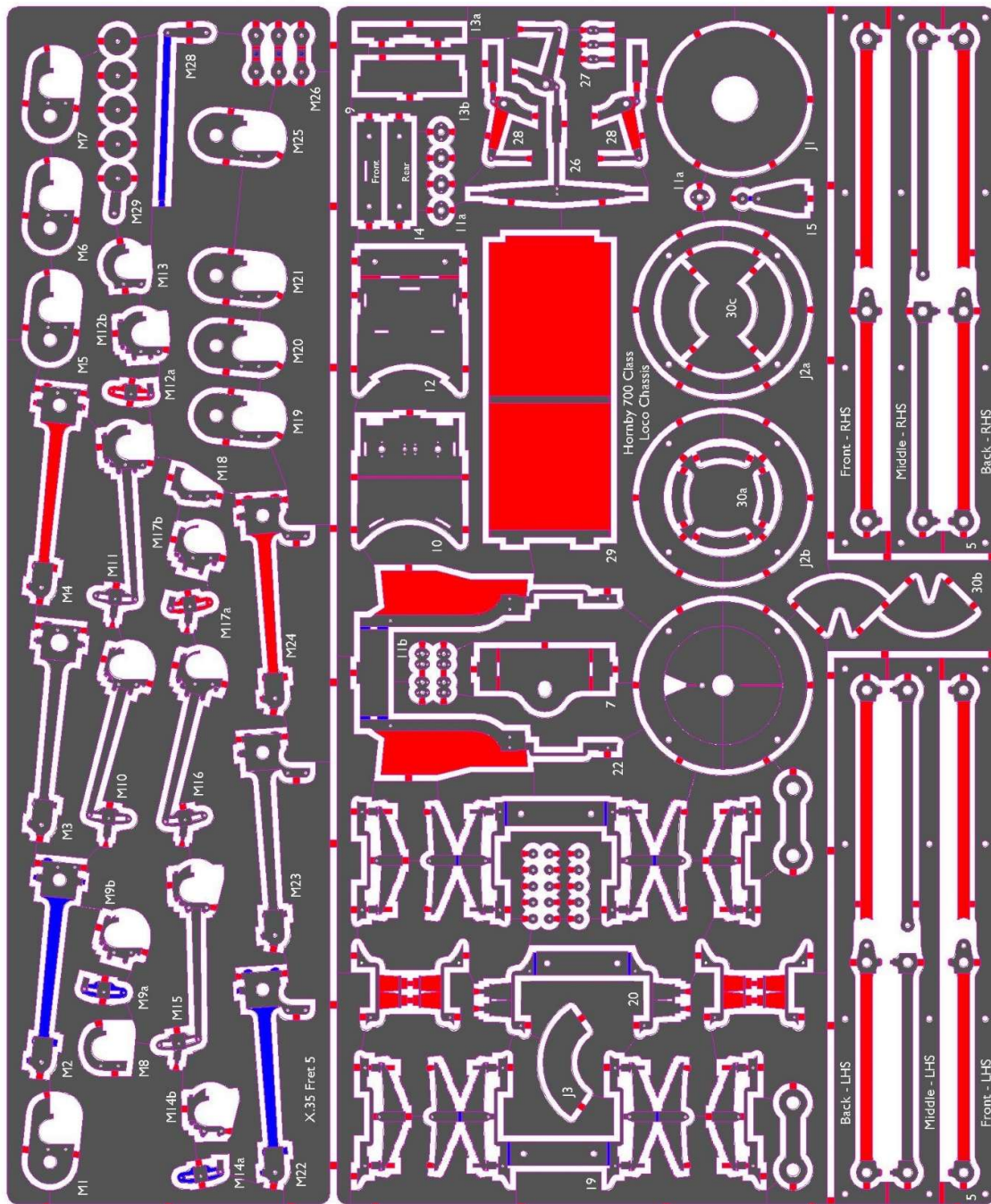
M27R - Lifting Link (Mirrored Pair - Right Hand Side)

M28 - Reversing Rod

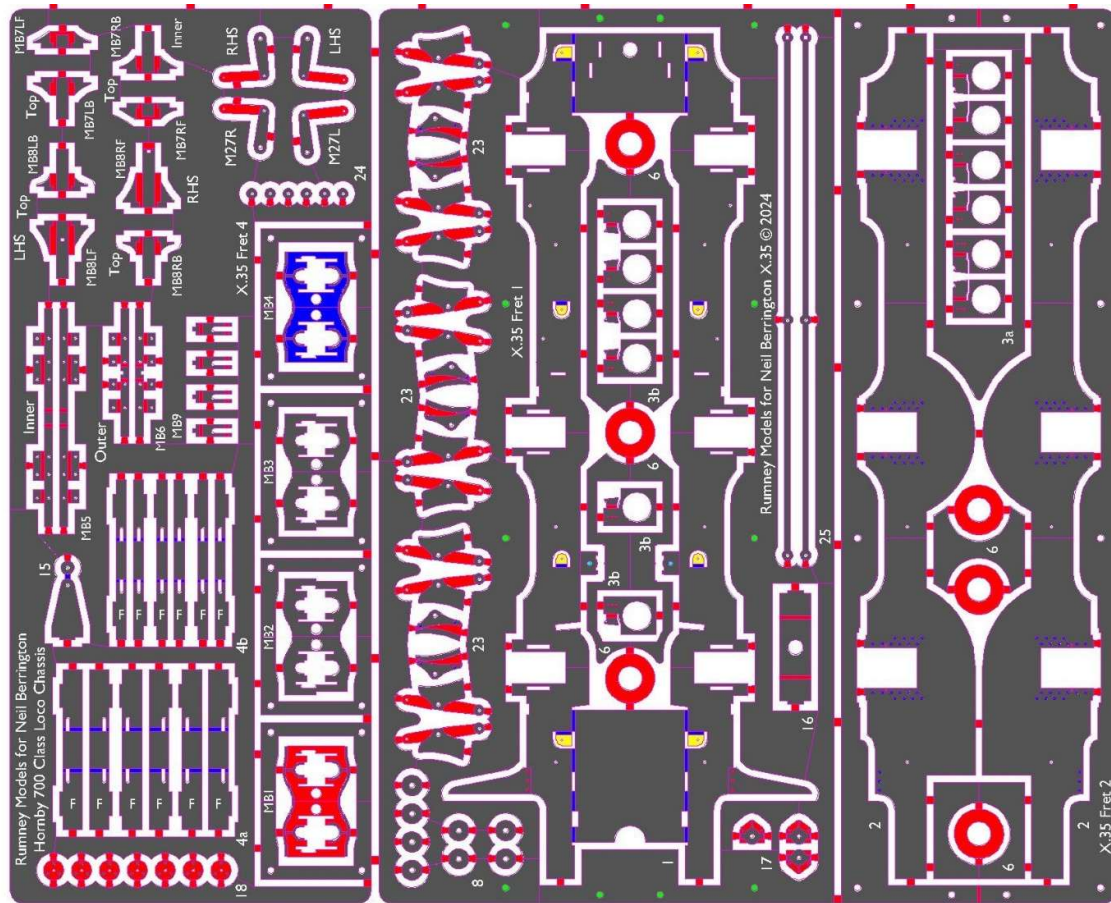
M29 - Balance Weight

Loco Parts Diagrams

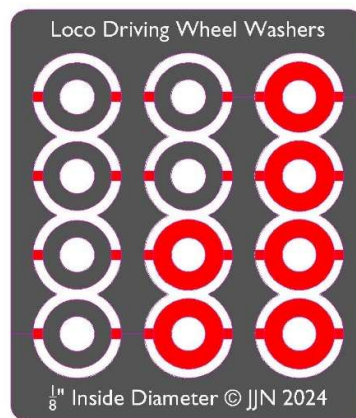
Fret 1&2



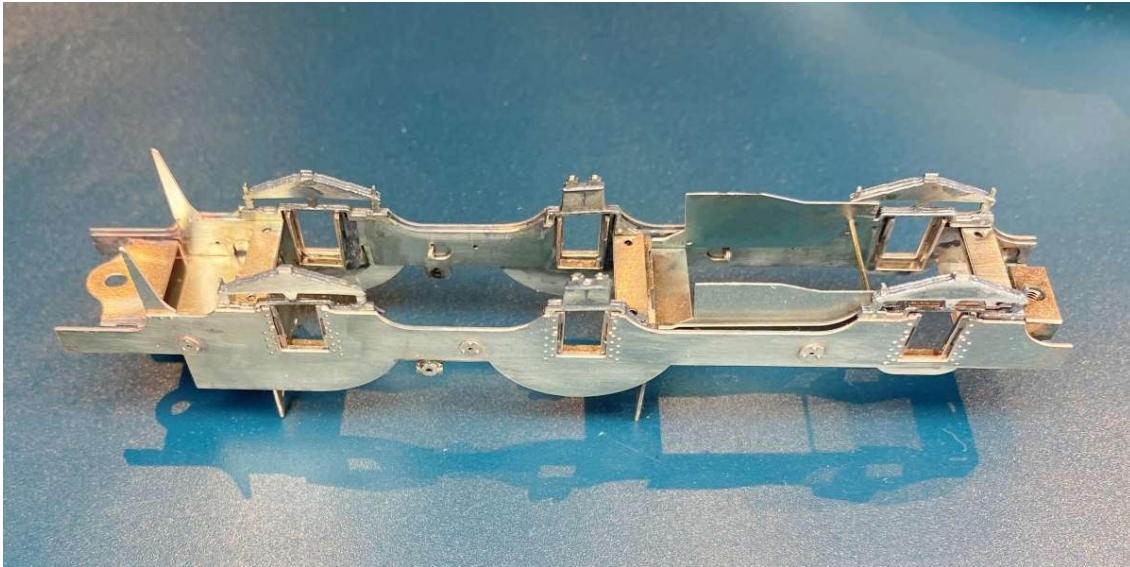
Frets 2,3&4



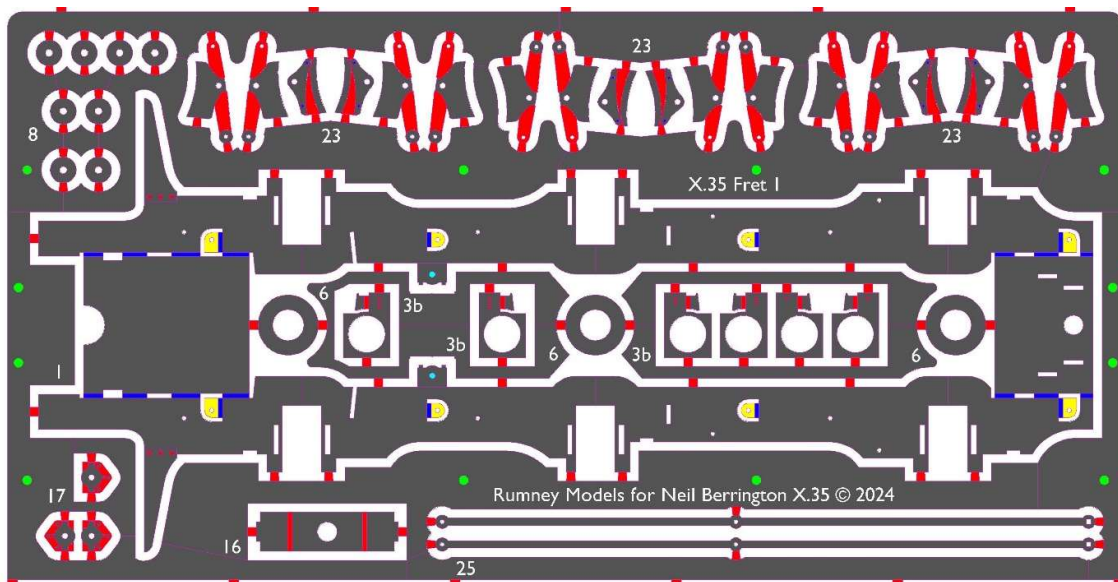
Driving Wheel Washers



Loco Construction



The basis of the loco chassis is a fold up subframe onto which the sideframes are fixed. This should be done before either the sideframes or the subframe are removed from their frets as the surrounding fret will be used to align the parts. To aid joining the parts together it is useful to create a jig to locate the parts on. Take Fret 1 with the loco subframe (1) and drill 1mm diameter holes into a piece of suitable mdf or similar using the holes etched in the surrounding fret. These are marked in green in Fig.1. Remove the subframe from the jig but not from the fret at this point.



Run a 0.5mm drill through the CSB fulcrum points on the loco subframe. These are the parts shaded yellow in Fig.1. Run a 0.45mm drill through the remaining holes in the sides of the subframe except the two marked in cyan which should be done with a 0.6mm drill.

Remove the washers and springs carriers from the middle of Fret 2. Leave the sideframes (2) attached to the surrounding fret but split it in two down the middle. There is a half-etched line on the fret midway along the short side to mark where it should be cut.

Whilst still attached to the surrounding fret press out the half etched rivets on the sideframes (2). Also run a 0.45mm drill through the 6 holes for the brake shoes. Make sure the holes on the surrounding fret are a tight fit on 1mm wire.

Use short lengths of 1mm wire to align the sideframes on the jig created earlier. They should be arranged so that the pushed out rivets are facing the piece of mdf or similar.

Remove the washers and spring carriers from the middle of the subframe and fold out the 8 fulcrum points for the CSB suspension. The later items are shaded yellow in Fig.1 above. Place the subframe over the sideframes using the short lengths of 1mm wire to align everything. The subframe should be arranged so that the half etched fold lines and the CSB fulcrum points are facing away from the piece of mdf. The sideframes and subframe can then be soldered together.

Once securely soldered together the subframe/sideframe assembly can be removed from the jig and cut away from the surrounding frets. Any connecting tags can then be cleaned up. Do not fold up for the moment.

There are two types of spring carriers depending on whether you are using Standard High Level Hornblocks (3a) or Spacesaver Hornblocks (3b). The choice of bearing was covered in the introduction. The hornblocks should be kept to their specific guides on the chassis. To this end arrange the ears on the spring carriers so they all face towards the front (the spring carriers come in mirrored pairs for this) and they are marked with either 1, 2 or 3 half etched dots to locate to each axle. Mixing up hornblocks could result in a chassis that doesn't work as well or no longer works.

Before removing from the fret check the fit of the bearing in the circular hole and use a broach to open the hole up if too tight. The bearing should be a nice fit in the hole. Remove from the fret. The spring carriers have ears on them with a small V etched into the top into which the spring wire will fit. Fold out these ears and then fit and solder to the back of the bearing. Polish the sides of the bearings and make sure there are no sharp edges.

The bearings can be fitted in the cut outs in the chassis with the ears for the CSB springs to the top. It is essential to keep each bearing in its own cut out.

The hornguides can be removed, folded into a U shape and fitted into slots in the subframe either side of the cut outs. As with the spring carriers, there are two types depending on whether you are using Standard High Level Hornblocks (4a) or Spacesaver High Level Hornblocks (4b). The slot at the front should be a tight fit but the one at the rear allows for a little lateral movement in case some tweaking is necessary with the hornguides. The hornblocks are machined from square section stock brass which may not be 100% consistent along its length and the axle hole may not be dead centre either.

The front slots will set the datum for each axle so don't feel the urge to tweak them.

The loco frames can now be folded up. Take care to make sure that both sides are at 90 degrees to the spacers.

Coupling Rods

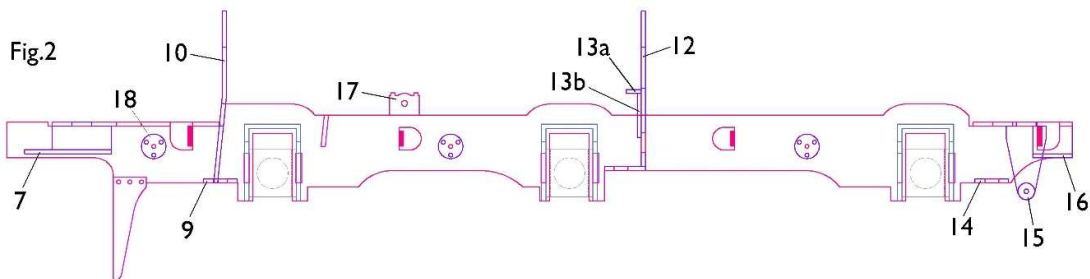
Next assemble the coupling rods (5). There are three layers to the coupling rods, and they should be assembled whilst still attached to the surrounding fret. Before putting the rods together split each layer down the middle to separate them for each side. There are 4 holes etched into the surrounding fret which will be used in a similar fashion to those on the fret for the subframe to pin everything together. Take the two halves of one of the layers and use the fret to drill 1mm holes into a piece of mdf or similar. The three layers for each side can be layered up using 1mm wire and these holes to locate everything. They are marked back, middle and front. Layer them up from back to front. Solder together then remove from the fret. Clean up the connecting tags and fix the front and back parts for each set of coupling rods using or piece of 0.8mm diameter nickel silver wire. Carefully solder the wire to the outer layer only to create the joint. This joint goes to the rear of the middle axle.

Frame Spacers

Next attention turns to the frame spacers. Most need some work before fitting and it's best to fit in a certain order so I think the best approach is to sort out each spacer and then fit them once they are all ready. Fig.2 below will aid you with their location.

Remove the front locating bolt bracket (7) and fold up into a U shape. Fit to the front of the frames. There are slots to locate the tabs on the sides of the bracket. The hole for the locating bolt should face towards the front of the loco. Solder in place.

Frame spacer tapping washers (8) are included for soldering to frame spacers 9, 12 and 14 to thicken up the material to tap for 14BA. These will be used to retain the keeper plate. You can use 14BA nuts instead but the holes in spacers 9, 12 and 14 will then need to be opened out to 1mm.



Remove the front keeper plate spacer (9). If using the tapping washers, solder one over each hole on the side the writing is using something 0.8mm in diameter to locate them. Tap for 14BA. If using 14BA nuts solder one above each hole on the side the writing is. Put to one side for the moment.

Remove the smokebox frame spacer (10) from the fret. There are numerous holes for the cylinder and piston rods and detail. The smaller holes are supposed to be 0.3mm but won't have etched cleanly due to the material thickness. If you want to use the cylinder detail (11a) and piston detail (11b) then drill out these holes using a 0.3mm drill. If you don't fancy the detail don't worry about drilling out the smaller holes. Of the four larger holes the two on the outside should be able to accept 1mm wire and the two in the middle 0.6mm. Adjust if necessary.

If fitting the cylinder and piston detail drill 0.3mm holes into a piece of suitable wood or mdf using the smokebox frame spacer as a jig and pin the spacer to the jig using 0.3mm wire. Note that the spacer should be fitted to the jig with the fold line facing the wood/mdf. Fit two of the cylinder detail (11a) to each side using the 0.3mm wire to locate them. Solder in place and trim the wire to resemble bolt heads. Fit two piston detail to the middle of the frame spacer in a similar manner. Solder in place and trim the wire to resemble bolt heads.

Remove the firebox frame spacer (12). If using the tapping washers, solder one over each hole on the side the half etched fold lines are using something 0.8mm in diameter to locate them. Tap for 14BA. If using 14BA nuts solder one above each hole on the side the fold lines are. Fold the spacer into an L making sure the fold is at 90 degrees. On the inside of the L that has been created, solder the firebox reinforcing angle top (13a) in place using the slots in the spacer to align things. Fit the firebox reinforcing angle back (13b) in place using the slot in the middle of the firebox reinforcing angle top to locate it and solder to the frame spacer.

Remove the rear keeper plate spacer (14). If using the tapping washers, solder one over each hole on the side the writing is using something 0.8mm in diameter to locate them. Tap for 14BA. If using 14BA nuts solder one above each hole on the side the writing is. Put to one side.

Fit the firebox frame spacer (12) first as you will need to gently pull the sideframes apart to get it in. The short side of the L goes towards the front. Solder in place.

Fit the front and rear keeper plate spacers (9 & 14). The front spacer should be fitted with the slot towards the front of the loco.

The smokebox frame spacer (10) will need to be folded slightly with the fold line on the inside. At the bottom of the spacer there is a tab in the middle which fits onto the slot in the front keeper plate spacer. Tweak the bend so that when fitted the upper part is vertical.

Wheeling Up

The wheels will need a little preparation before fitting.

If working in P4 the boss on the back of the wheels for the centre axle only will need reducing in width so the boss is 0.4mm deep. There is a driving wheels boss filling jig (J1) to help you do this. Remove the jig from the fret and place over the back of the wheel. File down the boss to flush with the jig. The outer wheels will need a half etched washer (6) between the wheel boss and bearing.

If you are working in EM then file down the boss on the back of the wheels intended for the middle axle only flush with the tyres. The outer wheels should be a good fit as they are. You won't need much sideplay on the centre axle due to the amount of wriggle room built into the EM standards.

The holes for the crankpins will need drilling out so the crank throw is a scale 9" (3mm). Note that this differs from the cylinder throw. A jig is provided to enable you to do that consistently. The jig comes in three layers that need to be soldered together.

Remove the crankpin drilling jig (back) (J2a) from the fret and remove the balance weights from the inside. Carefully clean up the connecting tags. Using a 1mm drill, drill 4 holes into a spare piece of wood or mdf to assemble the jigs on. Pin the drilling jig (back) to the wood with four short lengths of 1mm wire. Remove the crankpin drilling jig (middle) (J2b) from the fret and remove the balance weights from the inside. Carefully clean up the connecting tags and fit over the drilling jig (back) using the 1mm wire pins to align. Solder the two parts and the four lengths of wire together. Finally remove the crankpin drilling jig (front) (J2c) clean up the connecting tags and fit over the four wire pins on the assembly jig and solder in place.

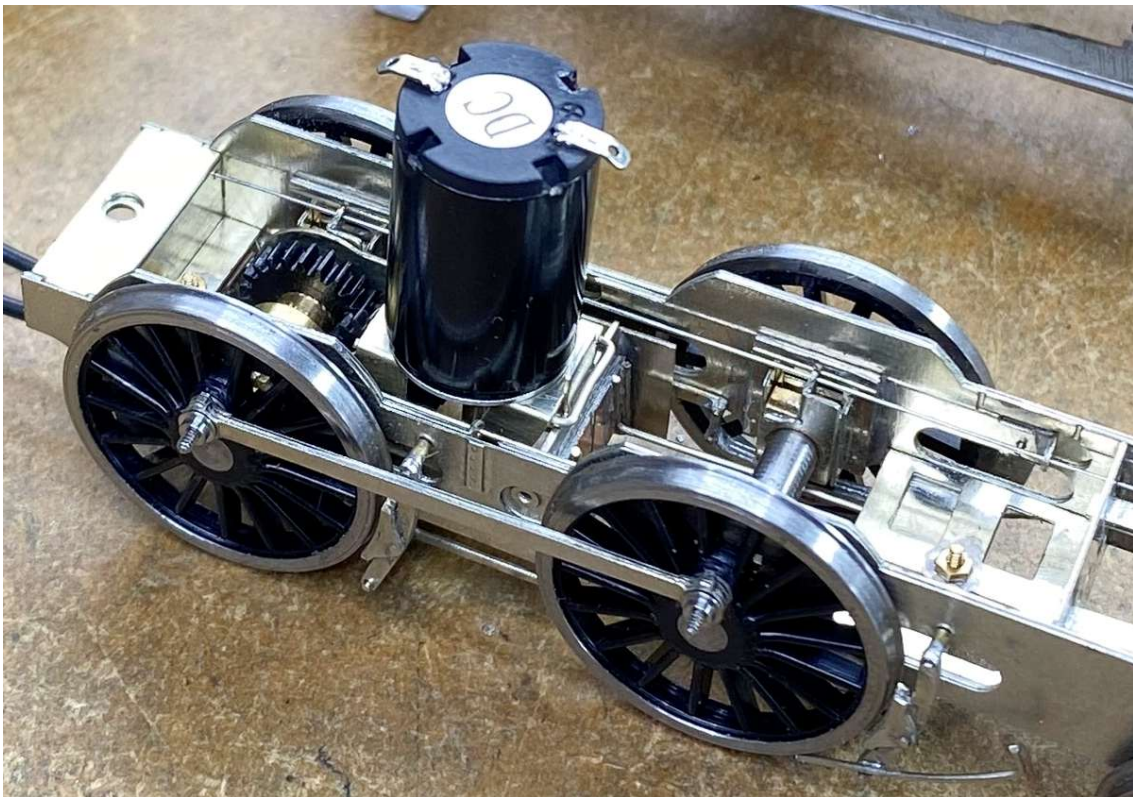
The completed crankpin drilling jig can then be used to drill out the crankpin holes using a 1mm drill. The crankpin screws can now be fitted.

The wheels can be fitted next using the hornblocks in their correct hornguides along with the gearbox. If working in P4 you will need full thickness axle washers (6) to remove side play on the front and rear axles. You will not need any washers if working in EM.

Fit the CSB wire, threading it through the fulcrums and make sure the wire sits in the small indentations in the spring carriers.

Fit the coupling rods to the wheels and check the rolling chassis. If any tweaks need to be made now is the time.

Some form of torque control will be necessary to stop the gearbox from rotating. You want something that allows the motor and gearbox to move vertically and rock from side to side but not rotate forward to backwards about the axle. I usually try and arrange for either a plate soldered to the front of the gearbox to move in guides attached to the frames or ashpan or to have a slot attached to the gearbox engaging with a vertical tab fixed to the loco. The latter is illustrated below. Whatever arrangement you decide on, make sure you allow for dropping the driven axle out.



Once happy remove the wheels and hornblocks and put to one side.

Finishing off the Frames

Remove the vacuum cylinder brackets (15) from the fret and fold the small circular 'washers' at the narrow ends over with the fold lines on the outside. Solder in place and then run a 0.5mm drill through the holes. The brackets need to be fitted to the underside of the chassis at the rear. There are two sets of slots, and these brackets use the wider pair.

Remove the tender coupling bracket (16) and fold into a U shape. Solder an M2 nut to the inside of the U over the hole. Make sure the flats of the nut align with the sides of the bracket. The bracket can then be fitted to the underside of the chassis at the rear using the other pair of slots. The edge of the bracket should align with the back of the chassis.

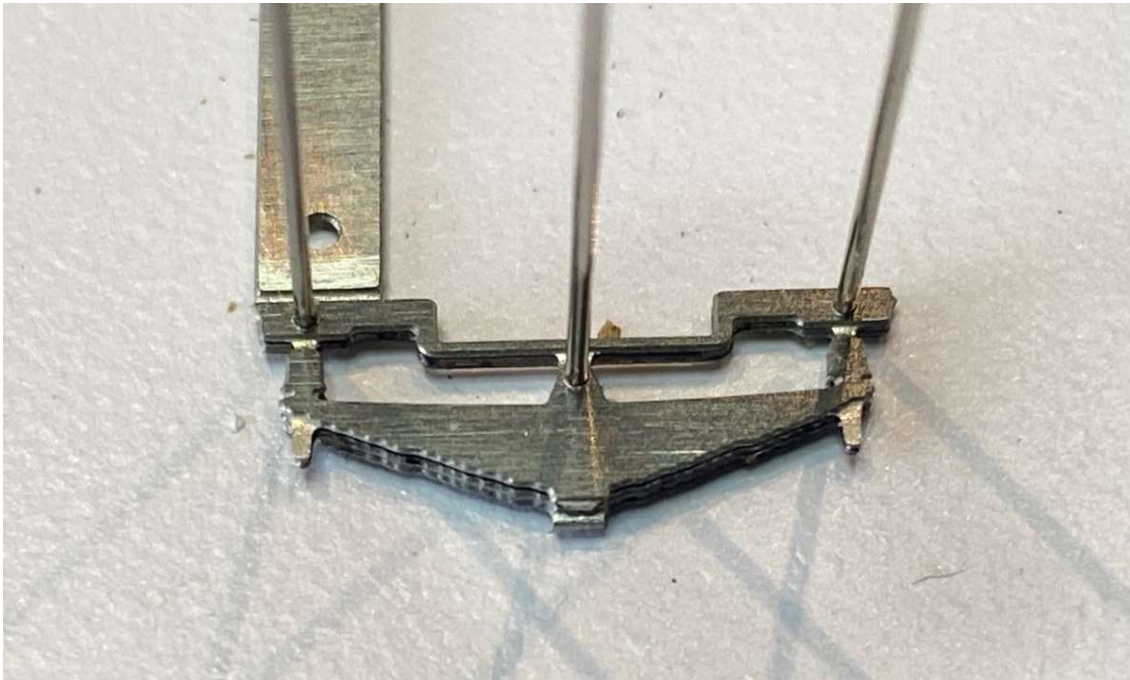
On the inside of the chassis fit the reversing shaft bracket overlays (17) using the hole to align it. Part of the bracket is already etched on the subframe. Fig.2 shows the location. Don't fit any 0.6mm wire through the holes at the moment.

Fit the brake shoe brackets (18) using 0.5mm wire through the holes to align them. Don't solder the wire in place at the moment. The triangular pattern of rivets should be arranged so the triangle faces down. See Fig.2.

Keeper Plates

The outlines of the prototype chassis don't allow for a full length keeper plate so there are three individual ones instead, a front (19), middle (20) and rear (21). They all feature three laminations for the springs to try and provide prototypical depth. They are designed to be fitted to the chassis with 14BA bolts into the bolts/tapped washers on the frames.

The front keeper plate features a spacer and two outlines of the springs and two overlays with half etched areas for the spring droppers. Remove the part with the spacer, clean up the tags and then fold the two outer spring outlines double so that the fold is through 180° with the fold line on the outside. When happy with the alignment solder the layers together on each side. The separate springs layers should then be fitted to the keeper plate using 0.4mm wire through the holes to align them. These bits of wire should be trimmed back to represent bolts after soldering. A drilling jig might be useful here. The separate layers should go on the same side as the two fold lines on the spacer. Once fitted fold the two sides of the keeper plate up and reinforce with solder.



The middle keeper plate is similar except there are two half etched layers to attach to the part with the spacer. There half etched layers should be fitted either side of the full thickness spring outline. Again use 0.4mm wire to align and trim after soldering. Fold both sides up.



The rear keeper plate follows the same principle as the front except that the ashpan (22) will need to be folded up and fitted at the same time using the two alignment holes above the springs. The outlines of the ashpan should be on the opposite side of the springs to the spacer with the locating holes in.

Fit the keeper plates to the chassis. The front keeper plate will fit to the front keeper plate spacer, the middle one to the bottom of the firebox frame spacer and the rear keeper plate to the rear keeper plate spacer. Note that there is also a tab on the ashpan spacer which needs to be fitted into the firebox frame spacer.



Brakes

Assemble the brake shoes (23). For each shoe there are three layers, two with half etched hangers and a further shoe layer. Use 0.6mm wire through the middle hole to align them and solder together. The two layers with the half etched hangers should be arranged back to back (there is only a single hanger for the brakes) and the shoe layer fitted with the half etched area visible. Trim the 0.6mm wire to resemble a bolt.

The brakegear will be assembled with 0.45mm wire so make sure that the top and bottom holes in the brake shoes can accept 0.45mm wire along with the brake shoe washers (24) and pull rods (25). The latter two items will be easier to check whilst attached to the fret.

If you want to make the brakes removable then the easiest way is to use short lengths of 0.9mm x 0.45mm tube (Albion Alloys MT3) over the 0.45mm wire that attaches the tops of the hangers to the chassis. These tubes should be 1.85mm long. Cut and put (safely) to one side.

Before assembling the brakegear the brake stretcher can also be assembled. This links from the rear set of brake shoes to the vacuum cylinder at the rear of the loco. It consists of three parts, the brake stretcher and cranks (26), brake stretcher overlay (27) and brake crank overlays (28). Make sure the smaller holes in all these items can accept 0.4mm wire and the larger holes 1mm. Remove from the fret.

Fit two of the brake stretcher overlays either side of the brake stretcher and cranks using 0.4mm wire to align them. Solder in place and trim the wire to represent bolts. The 'tail' on the overlays goes along the shaft linking the stretcher to the cranks.

Fit the two brake crank overlays either side of the brake stretcher and cranks using 0.4mm wire to align them. Solder in place and trim the wire to represent bolts. Fit a short length of 1mm wire through the big hole and solder in place. Trim the 1mm wire so that it protrudes a little either side of the assembly. Round the spigots on the end of the stretchers a little with a file as these will need to go into the brake shoes and pull rods. Twist the shaft on the assembly just behind the stretcher so that the stretcher is at 90° to the cranks.

Drill a 0.6mm hole into the centre of the loco vacuum cylinder and then fit in place between the vacuum cylinder brackets at the rear of the loco. There is a circular cutout in the vacuum cylinder which should go towards the rear of the loco. This is for the loco to tender coupling.

Finally assemble the brakegear.

Hang the brake shoes from the chassis using lengths of 0.45mm wire with the short length of 0.9mm x 0.45mm tube between the brake shoes and the chassis. Make the 0.45mm wire over long at the point and perhaps add a dab of solder at the ends so that things don't fall off. Don't solder the shoes or tube to the wire at this point.

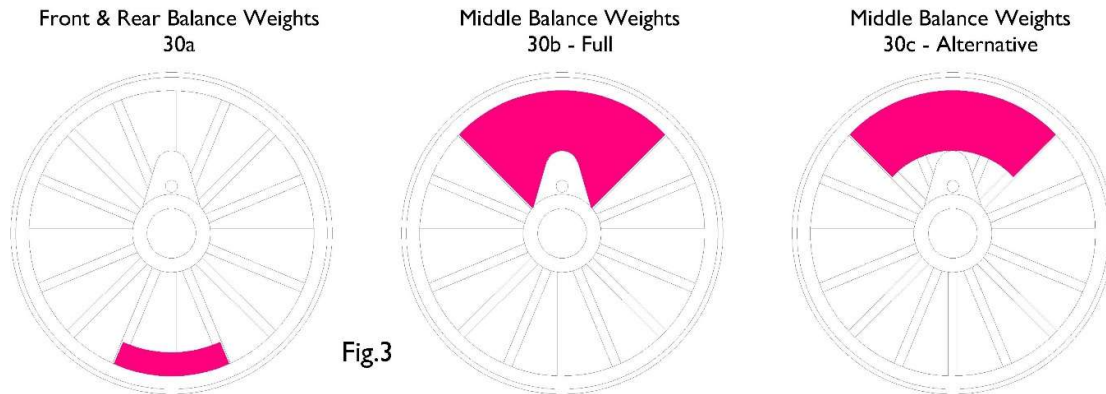
Fit lengths of 0.45mm wire through the bottom holes in the front and middle sets of brake shoes leaving them overly long so nothing falls out. Fit the brake stretcher into the bottom holes in the rear set of brake shoes so that the small shaft at the very end of the assembly goes into the hole in the vacuum cylinder. Fit one brake shoe washer onto the wire/stretcher on the outside of the bottom holes in each of the brake shoes. These will help keep the pull rods away from the wheels. Fit the brake pull rods. The holes are not symmetrical, the shorter end goes towards the front.

When you are happy with the alignment of everything solder it all together but don't solder the tubes or wire to the chassis, just to the brake shoes. Trim all the wire and snip the brake shoe hanger wire just on the inside of the chassis. You will then be able to pull the brake shoes at the top to remove the assembly.

Sundries

Fit the 3D printed vacuum cylinder. This comes in two halves as the smaller part of it will need to be attached to the keeper plate so you can get it off. The larger part should fit between the brackets at the rear, the smaller to the rear keeper plate. The hole for the vacuum cylinder piston will need to be drilled 1mm diameter.

Roll the boiler bottom and fit between the smokebox and firebox frame spacers. There is a boiler bottom radius jig (J3) to help to get the correct radius. It should be obvious from the tabs and slots which way around it goes. If you're not using rolling bars, it can be tricky to get the radius through the edges of the part. A neat trick to help is to fix the part to the rod you are using to roll it with masking tape.



There are three types of balance weight for fitting to the driving wheels. Fig.3 above shows how they are to be fitted. There are two choices for the middle set of driving wheels. Consult your prototype for which you should use.

A tender coupling (31) is included. This will allow the loco to traverse a 1m radius curve which is the design minimum. There are two layers which should be soldered together. The holes are etched to accept M2 bolts.

Inside Motion

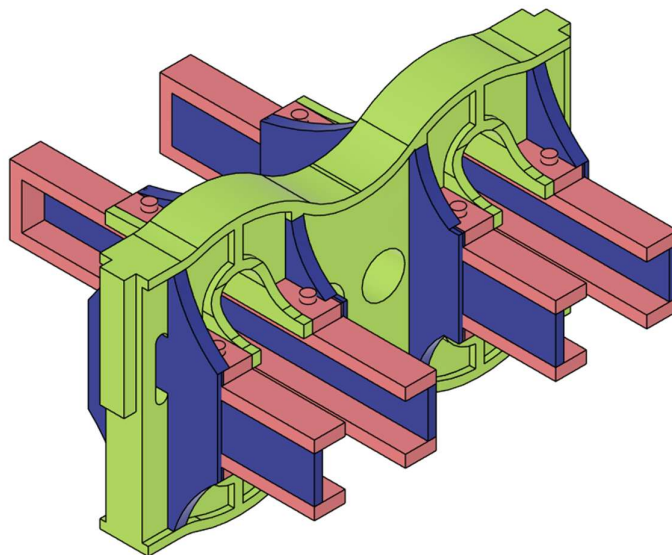
The loco chassis etches come with a cosmetic representation of the inside motion. The motion bracket is pretty complicated and there is a 3D printed version available (Rumney Models PX.35IM) available if it's all a bit too much. If using the 3D printed version note that you will still need the etched balance weights and reversing rod.



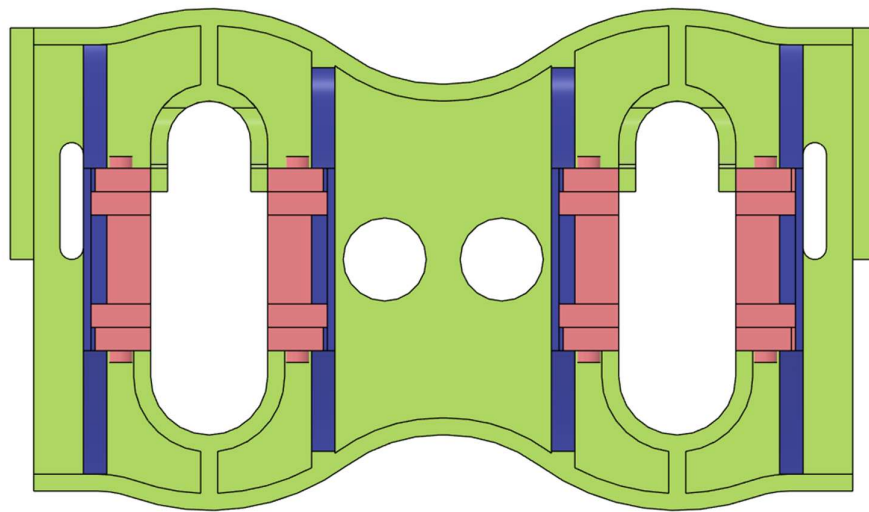
Motion Bracket

I have to confess that this is fiendish. The motion bracket on the real thing was a great big casting from which the slidebars were entirely suspended and supported using integral 'wings'. This makes representing it from etches tricky. A degree of step soldering would seem to be the way to go.

Diagram A in the Motion Appendix at the end of the instructions should prove useful as should the images of the 3D artwork used to create them and the 3D printed inside motion that can be found below.

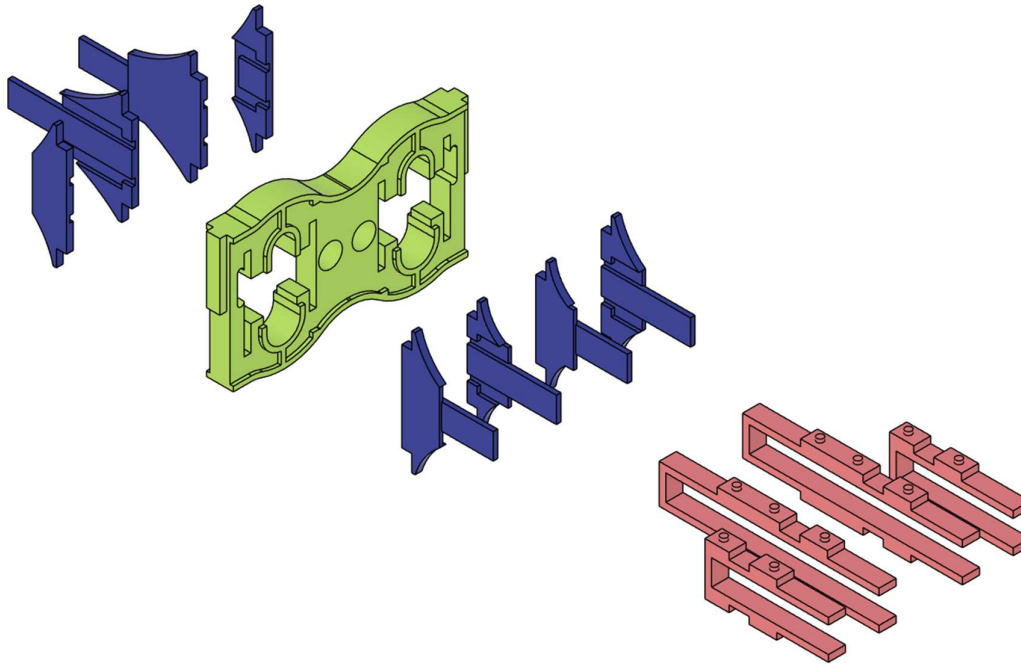


The first part, forming what amounts to a frame spacer, is relatively straightforward. The four layers that make up the motion bracket (MB1-MB4) are each attached to their own little frets. They should remain in these frets until soldered together. Use layer MB1 to create an assembly jig on a piece of mdf or wood. Place the layer down so that the MB1 half etched in the fret is visible and use a 1mm drill to drill four holes through the fret to create a jig into which 1mm lengths of rod can be placed to align the four layers. Place layer MB2 on top of MB1 with the text visible followed by MB3 and MB4. Solder together. You may want to use a high temperature solder for this as other items will need to be soldered to the motion bracket. Solder two 5mm lengths of 1.5mm x 1mm tube into the two holes in the middle. These should be flush to one edge of the motion bracket and protrude from the other. The side to which they protrude is the front. Once the four layers are safely soldered together remove from the surrounding frets. Note that there is a tab protruding on each side of the motion bracket. These are designed to fit into slots in the mainframe. The half with the tabs is defined as the top of the motion bracket. This is important later.



Next make up the slidebars. There are two types, an inner pair (MB5) and an outer pair (MB6). The outer pair are shorter as they will clash with the front hornblocks if left the correct length. On both types there are four tabs with holes into one side. These need to be folded double with the fold lines on the outside. If you wish lengths of 0.4mm wire can be soldered into the holes to represent bolts. These should then be trimmed and then filed flush on the side with the two remaining visible fold lines. The slidebars can then be folded into a U shape. File off the tabs that protrude to one side. Put the slidebars to one side.

Next comes the trick bit. The slidebars need to be fitted with their supports. There are supports for both the front and back of the motion bracket and these are arranged in pairs for the left and right side of the motion bracket and for inner and outer. It's best to do one at a time. There are slots in the motion bracket to accept the sidebar supports and then half etched areas on the sidebar supports to accept the slidebars. See Motion Appendix - Diagram A



Start with the left outer slidebars supports, front (MB7LF) and back (MB7LB) noting which is the top. Insert the two supports into the motion bracket so that the front support is on the side with the two protruding bits of tube and is to the left when viewed from the side on which the tubes are flush. The back support goes into the same slot on the other side of the motion bracket to form a pair. Tack solder in place. Fit one of the outer slidebars in place. This should fit into the slots in the slidebar supports with the connecting piece between the two long parts towards the front. Solder everything up securely.

Repeat for the right outer slidebar supports, front (MB7RF) and back (MB7RB) taking care to note which is the top.

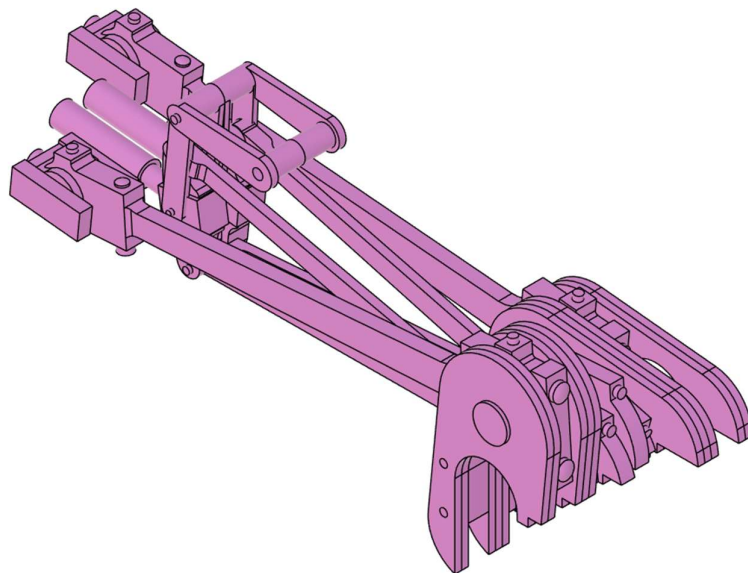
The left inner supports, front (MB8LF) and back (MB8LB) can be done next in a similar manner.

Then the right inner supports, front (MB8RF) and back (MB8RB) can be done.

On the inner slidebar supports at the front you will note a small rectangular hole. This is to locate a crosshead support (MB9). This will make sure the crossheads are located in the correct place. Remove two crosshead supports and fold each end through 90°. Fit the tab at the end of the crosshead support without the slot into the hole in the slidebar support so it is between the inner slidebars. The slot should face towards the back. Solder in place.

Inside Motion

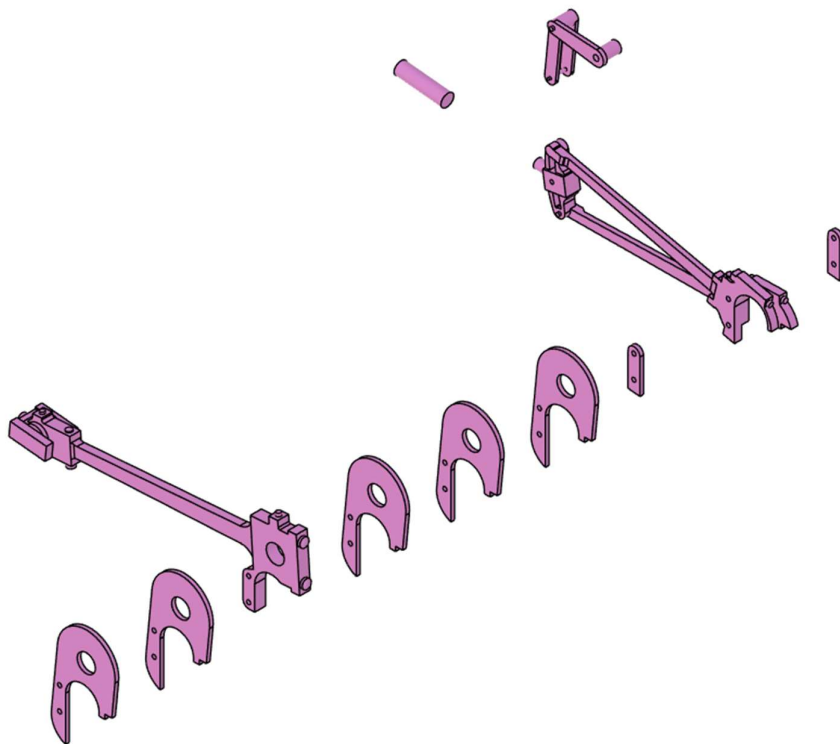
The inside motion is designed to be purely cosmetic and cannot be made to work. The bulk of the motion is designed to be pinned together using two lengths of 0.45mm wire. There is however a lot of layers so you may want to do it in two halves with a break between layer 13 and 14. The layers are numbered in order and are all orientated the same way. You should start with M1 then add M2 in front. M3 can be added in front of layer M2, etc. Some layers for the valve gear (as distinct from the connecting rods and cranks)) come in two parts, an a and a b. Parts a go at the expansion link end and b at the big end. It probably makes sense to only remove 1 layer at a time, so you don't lose the numbering. Note that part 13 is the centre of the motion. See Motion Appendix - Diagram B for an exploded drawing of the right hand side of the motion.



To assemble the expansion link area on layers M9 to M12 and M14 to M17 use 0.4mm wire but only through the middle and bottom holes. Leave the top hole clear for the moment. 2mm wire can be used to represent the pin through the cranks in layers M1 to M7 and M22 to M25.

A piston link (M26) can be fitted to the end of each of the connecting rods using 0.6mm wire. The piston link folds into an L. The 0.6mm wire should protrude at least 0.5mm either side of the piston link as it will locate into the motion bracket.

Diagram B in the Motion Appendix at the end of these instructions shows an exploded drawing of the right hand side of the inside motion. The left hand side of the motion follows the same idea using parts M14-M25.



Assembly

The completed motion bracket should slide into the frames from the top.

The two halves of the inside motion need to be added with their hangers, the reversing shaft and balance weights.

The lifting links (M27) come in mirrored pairs. It's important you keep each pair on its correct side. M27L is for the left hand side and M27R for the right. Remember left and right are as you'd view the loco from the cab looking forward. The small holes in the half etched parts will need to accept 0.4mm wire, the smaller hole in the full thickness part needs a piece of 0.4mm wire soldering into it to resemble a pin and the larger hole needs to accept 0.6mm wire. Adjust if necessary whilst still on the fret.

The reversing rod (M28) needs a piece of 0.4mm wire soldering into the smaller hole in the crank to represent a pin and the larger hole needs to accept 0.6mm wire.

The five layers of the balance weight (M29) need soldering together. Use a piece of 0.6mm wire through the large circle to align them. There should be two of the circles either side of the part with the additional crank. Solder together and file the wire flush. The hole in the end of the crank needs to take 0.6mm wire.

To assemble everything cut a length of 0.6mm wire for the reversing shaft. This will go between the brackets on the top of the frames. Leave over long for the moment. Fit the shaft along with the left hand set of lifting links. The links should be arranged so that the full thickness part is on the reversing shaft and the half etched parts are away from each other. Insert the crosshead of the left hand motion set into the left hand slidebars and insert a length of 0.4mm wire to pin the lifting links either side of the expansion link. Solder the lifting links to the expansion links. Remove the reversing shaft and then the motion and file the 0.4mm wire flush. Repeat for the right hand side.

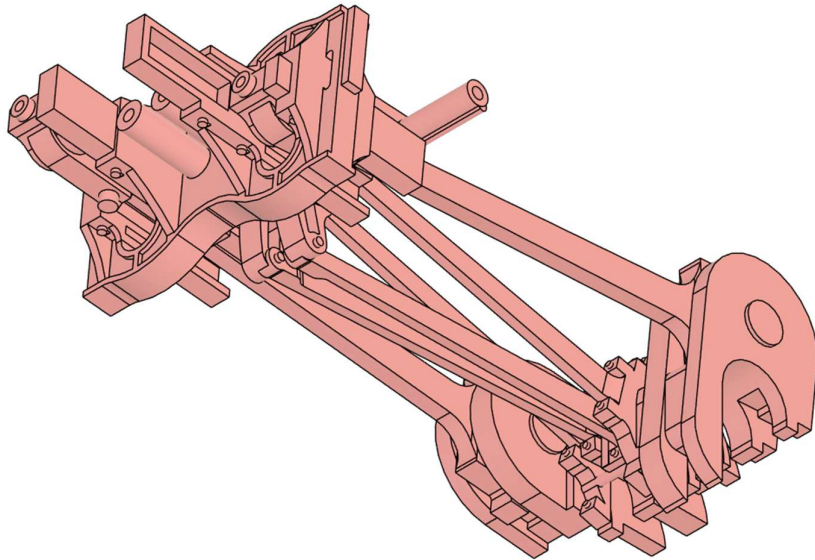
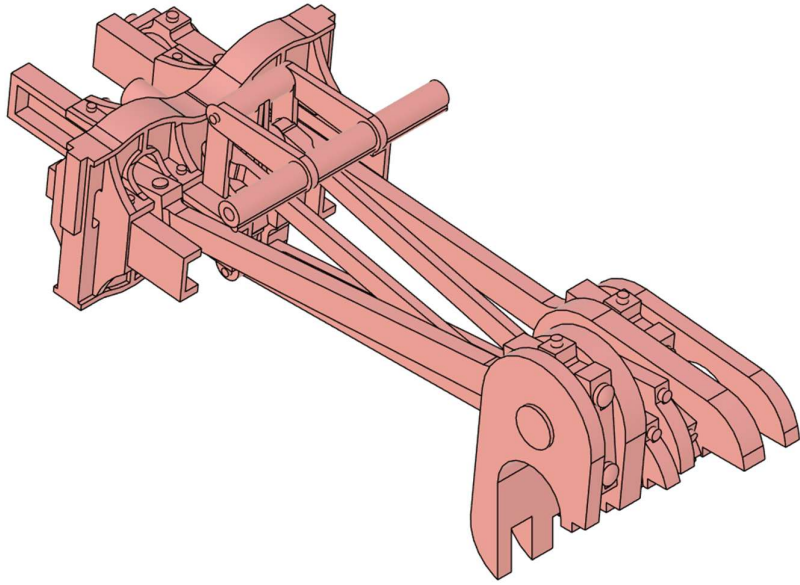
On final assembly fit the motion and reversing shaft along with the balance weight on the right hand side (hard up against the inside the bracket) so that the weights are towards the back of the loco and the reversing rod on the left hand side. On the prototype this is on the outside of the reversing shaft bracket but it may need to be fitted on the inside depending on space.

On the prototype the reversing shaft was a whopping 4" diameter thing so you could consider using lengths of 1.2mm x 0.6mm tube (Albion Alloys MT5) to fill in the gaps between brackets, lifting links and balance weight on the reversing shaft.

Finally, piston rods can be added from 1mm wire and valve rods from 0.6mm wire between the motion bracket and the smokebox frame spacer.

3D Printed Inside Motion

The 3D printed inside motion will be a lot quicker to fit than the etched. Carefully remove the supports and clean up. Carefully drill the ends of the reversing shaft 0.6mm. You only need to go in 1-2mm. The printed motion should fit into the slots in the mainframes and then you can finish off the reversing shaft with the reversing rod and balance weights using 0.6mm wire and perhaps 1.2mm x 0.6mm tube if necessary. See above for instructions on the reversing rod and balance weights.



Tender Chassis

Parts List

T1 - Tender Subframe

T2 - Spring Carriers

T3 - Tender Axle and Location Bolt Washers

T4 - Loco Coupling Bracket (if discarding the boss on the Hornby tender)

T5 - Fixing Plate

T6 - Brake Shoes (3 Sets)

T7 - Brake Pull Rods

T8 - Brake Pull Rod Detail

T9 - Hand Brake Crank

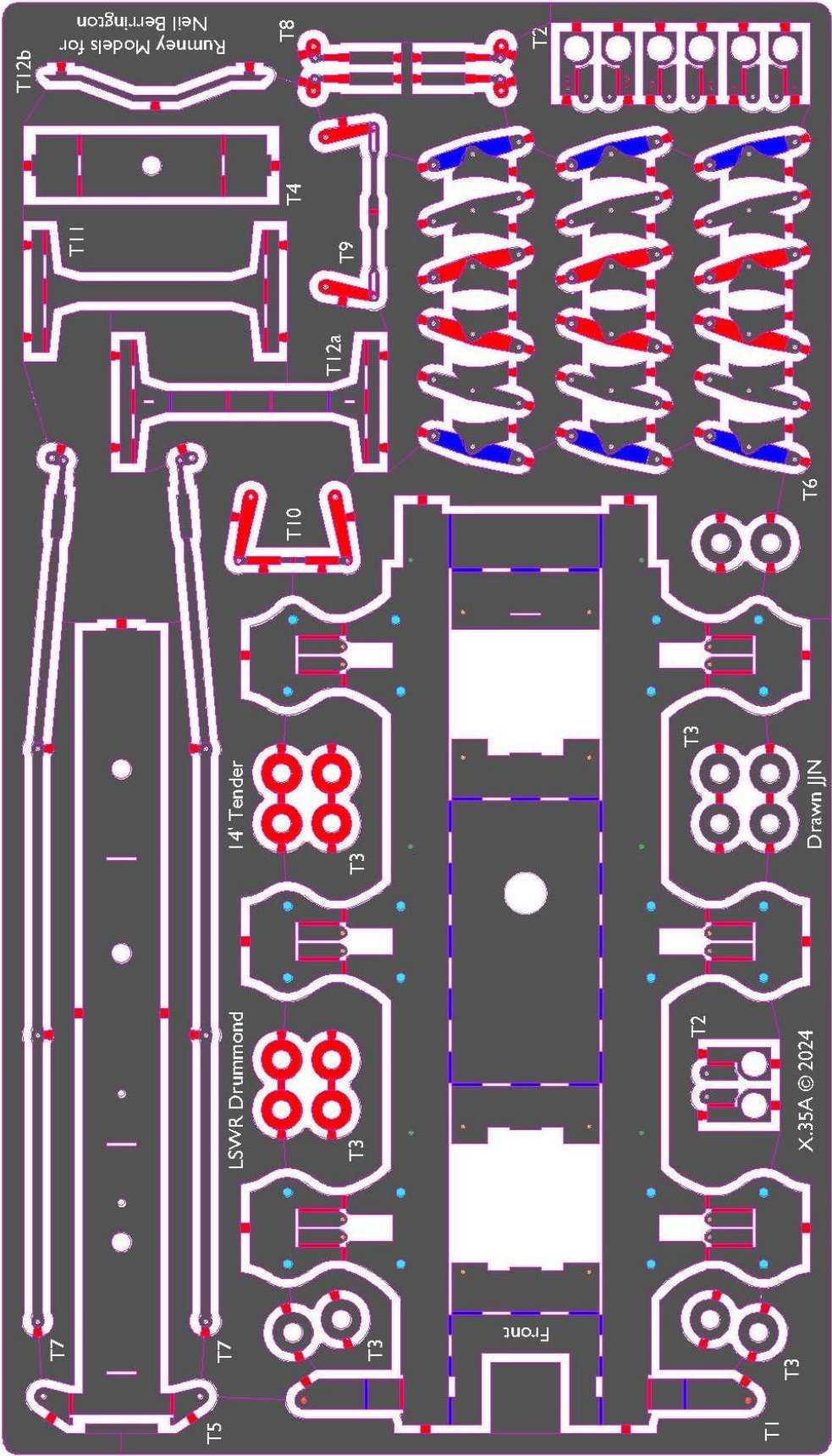
T10 - Vacuum Brake Crank

T11 - Frame Stay (Rear)

T12a - Frame Stay (Front)

T12b - Frame Stay (Front) Angle

Parts Diagram

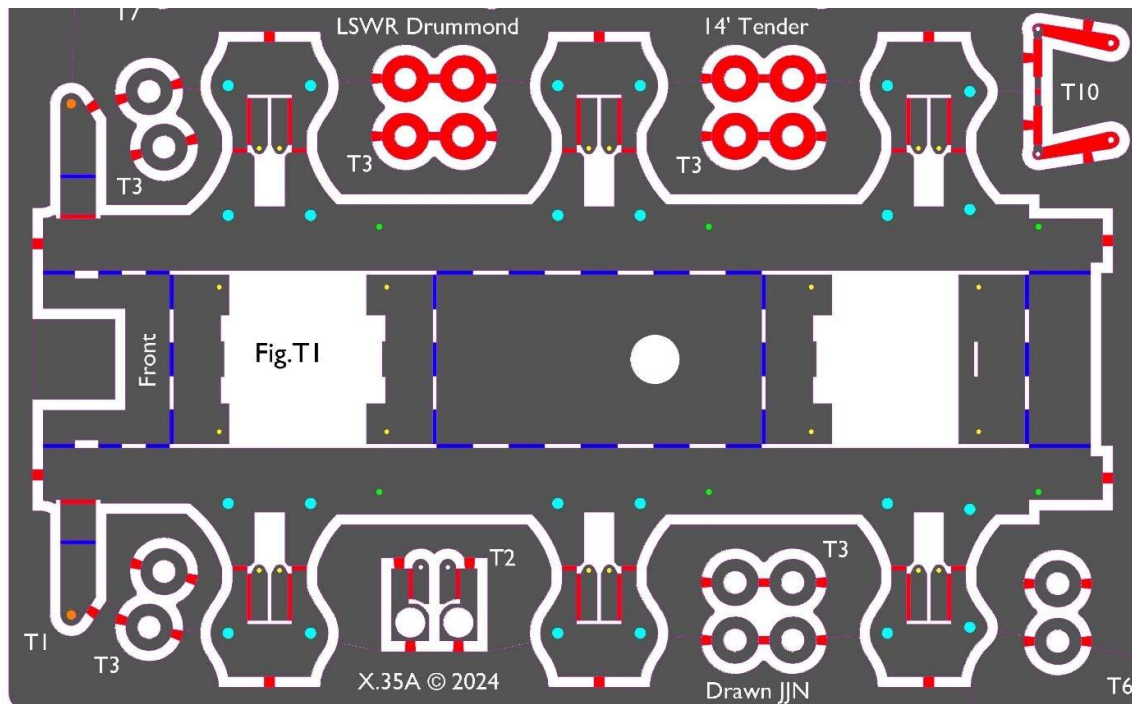


Tender Construction

Like the loco chassis, the tender features a fold up subframe to which everything is attached. To aid assembly, the hornguides for the hornblocks are attached to the subframe meaning they just need folding up rather than having to accurately fit separate items.

Start with the tender subframe (T1). There are numerous holes in the part which need to be checked. The easiest time to do this whilst the part is still attached to the fret. Refer to Fig.T1 below as you go along. The holes sizes and their colour coding are as follows:

- Cyan: There are four holes around each of the six hornguides which need to be a tight fit on 1mm wire. A tapered reamer might be better in this instance than a 1mm drill. These will be used to make sure the fold in the hornguides is accurate.
- Yellow: The holes in the bottom of the hornguides and the small holes in the frame spacers need to be 0.4mm
- Green. These six holes are for the brakes and need accept 0.45mm wire.
- Orange. The two holes in the brake shaft brackets at the front of the tender need to accept 0.6mm wire.



Once all the holes have been checked remove the part from the fret and clean up the connecting tags.

Before folding the frames up the hornguides need to be attended to. Each pair of hornguides need to be folded out to 90° and then the hornguide plate to which they are attached needs folding through 180° with the fold line on the outside. The 1mm holes that you checked earlier will then line up between the frames and the hornguide plate. Short lengths of 1mm wire can be inserted to make sure the alignment is accurate. Clamp the hornguide plate to the frames and solder to the frames. The six hornguides that are towards the front of the chassis (the front of the chassis is marked) in each pair can be soldered to the hornguide plate. Don't solder the rear ones for the moment. There is a bit of excess material in the fold to allow for adjustment once the hornblocks are fitted.

When all six horn guides have been folded up the frames can be folded up. Fold the sides either side of the stretchers in the middle making sure they are at 90° to the top. The frame spacers can then be folded down. Again, make sure they are at 90° to the top and solder to the sides. Fold up the brake shaft bracket at the front and reinforce the fold lines with solder.

Spring Carriers, Hornblocks & Wheels

The spring carriers (T2) need to be fitted to the High Level Miniblox. The hornblocks should be kept to their specific guides on the chassis. To this end arrange the ears on the spring carriers so they all face towards the front (the spring carriers come in mirrored pairs for this) and they are marked with either 1, 2 or 3 half etched dots to locate to each axle. There is also a spare set with no dots.

Before removing from the fret check the fit of the bearing in the circular hole and use a broach to open the hole up if too tight. The bearing should be a nice fit in the hole. The small hole for the spring wire should be 0.4mm diameter. Check and tweak if necessary. Remove from the fret. Fold out the ears with the hole in on the spring carrier and then fit and solder to the back of the bearing. Polish the sides of the bearings and make sure there are no sharp edges.

The bearings can be fitted in the cut outs in the chassis with the ears for the CSB springs to the top. Keep each bearing in its own cut out. If the fit is a bit loose then adjust the rear horn guide to be a good fit. Once you are happy, solder the rear horn guides to the horn guide plate.

The wheels can be fitted next with spacing washers (T3) to take out any sideplay on the front and rear axle. You will need to allow for 0.3mm (a full thickness washer) sideplay on the centre axle to negotiate a 1m radius curve.

Finishing off the Frames

On the Hornby Tender there is a big block at the front to which the loco is coupled. The frames have been designed to allow this to be retained if you want but it sticks out a bit and means the coupling will be in the wrong place. If you decide that it needs to go there is a loco coupling bracket (T4) to replace it. This folds into a U shape and needs an M2 nut soldering on the inside of the U over the hole. The bracket fits into small slots between the frames at the front. Use an M2 bolt for the loco to tender coupling.

The fixing plate (T5) is used to fix the chassis to the body, but it also contains the brackets for the vacuum cylinder at one end. Make sure the holes are 0.8mm diameter, remove from the fret and fold up. Fit the plate to the underside of the frames. There are slots and tabs on the frame spacers to aid location and the brackets for the vacuum cylinder go towards the front and face towards the rails.

Brakes

Assemble the brake shoes (T6). For each shoe there are three layers, two with half etched hangers and one that is full thickness throughout. The full thickness layer goes in the middle of the three. Use 0.6mm wire through the middle hole to align them and solder together. Trim the 0.6mm wire to resemble a bolt.

The brake gear will be assembled with 0.45mm wire so make sure that the top and bottom holes in the brake shoes can accept 0.45mm wire.

If you want to make the brakes removable then the easiest way is to use short lengths of 0.9mm x 0.45mm tube (Albion Alloys MT3) over the 0.45mm wire that attaches the tops of the hangers to the chassis. These tubes should be 2.4mm long. Cut and put (safely) to one side.

The brake pull rods (T5) will need assembling along with their brake pull rod detail (T8). The three holes along each straight section need to be able to accept 0.45mm wire. These will be attached to the brake shoes. At one end there is a pair of holes. The smaller one needs to accept 0.4mm wire. Remove from the fret and clean up the connecting tags. The brake pull rod detail (T8) needs to be added to the end with the pair of holes. Use 0.4mm wire through the small hole to align the parts and solder together with a detail layer each side of the pull rods. Trim the 0.4mm wire to represent a bolt. Make sure the larger of the pair of holes can accept 0.6mm wire.

Fit the brake shoes along with the pull rods which go behind the wheels. Hang the brake shoes from the chassis using lengths of 0.45mm wire with the short length of 0.9mm x 0.45mm tube between the brake shoes and the chassis. Make the 0.45mm wire over long at the point and perhaps add a dab of solder at the ends so that things don't fall off. Don't solder the shoes or tube to the wire at this point.

Fit lengths of 0.45mm wire through the bottom holes in the brake shoes leaving them overly long so nothing falls out. When you are happy with the alignment of everything solder it all together but don't solder the tubes or wire to the chassis, just to the brake shoes. Trim all the wire and snip the brake shoe hanger wire just on the inside of the chassis. You will then be able to pull the brake shoes at the top to remove the assembly.

Both the hand brake crank (T9) and the vacuum brake crank (T10) need to be folded double about the middle with the fold line on the outside and soldered together with a piece of 0.4mm wire through the smaller hole that joins the crank part and the link.

Drill a 0.6mm hole in the centre of the tender vacuum cylinder print and fit between the brackets on the fixing plate (T5). There is a cutout at one end which goes towards the front of the tender to clear the coupling mounting and/or the bolt for the tender coupling.

Fit the brake shaft (0.6mm wire), the hand brake crank and the vacuum brake crank. The latter part also needs to fit into the vacuum cylinder. Solder the parts in place and trim the wire flush with the outside of the brackets.

Finally fit the vacuum reservoir. There are two lugs on the hangers for the cylindrical reservoir which fit onto a pair of holes on fixing plate (T5).

The chassis can then be fitted to the tender body using the screws that come with it to retain it.

Frame Stays

The tender kit includes two frame stays to fit between the plastic sideframes of the Hornby underframe if you wish. If you do fit them though you won't be able to get the subframe out.

There are two types depending on whether it goes at the bottom of the front or rear cutout in the frames.

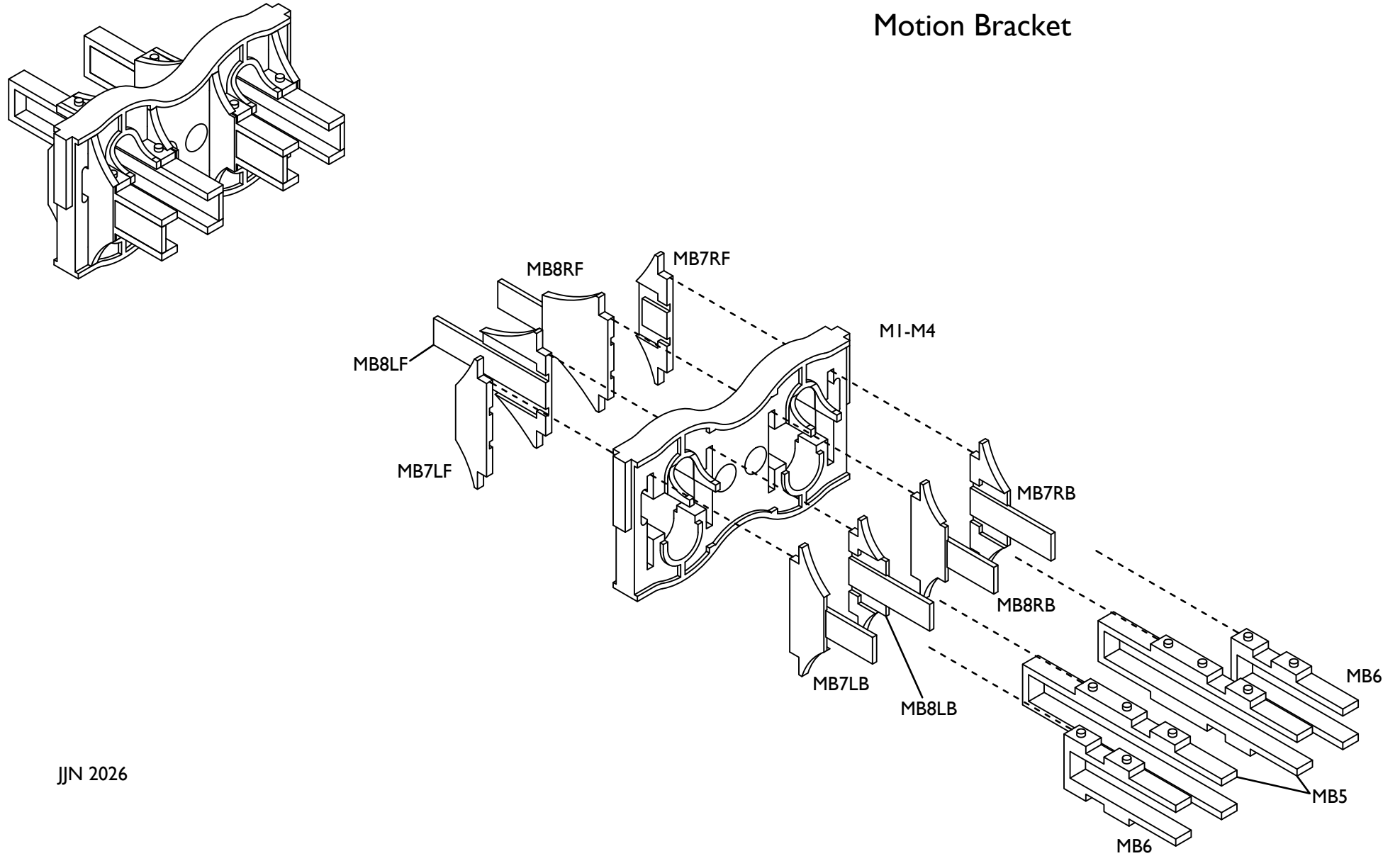
The rear frame stay (T11) simply folds into a U shape.

The front frame stay comes in two parts. The frame stay (T12a) needs to be folded so the two outer parts are at 90° and then the middle section bent to match the profile of the frame stay angle (T12b). The angle can then be fitted to the stay using the tabs and slots to align them. Solder together. To avoid any confusion, the angle goes on the opposite side to the fold up sides. The reason for this shape is to clear the vacuum reservoir.

Justin Newitt - September 2026

Motion Appendix - Diagram A

Motion Bracket



JJN 2026

Motion Appendix - Diagram B

Inside Motion

Right Hand Side Only

