Brassmasters Scale Models

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GWR 43xx 2-6-0

FINE SCALE CHASSIS KIT

Designed by Frank Davies

INSTRUCTIONS

4mm SCALE

OO - EM - P4

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1 Introduction

The 43/53/63xx chassis kit has been designed specifically for the Dapol Mogul first released in late 2020 and caters for EM and S4 modellers. It only requires a loco body and a tender and **not a complete** Dapol loco**.** These are available from Peter's Spares (https://www.petersspares.com/c/spares/dapol-oo-spares/class-43xx-mogul?pg=6).

The locomotive chassis can either be built rigid or compensated and the tender chassis either rigid or sprung using continuous springy beams.

This chassis is unusual in that it is intended that the motor will be installed in the tender with a drive shaft running below the level of the fall plate to a gear box driving the rear axle of the loco. This enables the builder to install the maximum ballast possible in the loco to maximise the tractive potential of their model. This means that the tender and locomotive will ideally be permanently coupled although this is not mandated. If haulage potential is not an issue for the builder, the motor can be installed in the traditional manner. If you want an idea of what the Motor-In-Tender (M-I-T) drive system would look like then click on the following link:
https://1drv.ms/v/s!An3prmHwQb0n50EMeywP1NUTcZ3G?e=SEzkAn

We recommend the loco chassis is built compensated with a sprung tender chassis and these instructions reflect this.

A further feature of this kit is that it has been designed with the potential of using the American system for current collection whereby the locomotive frames pick up current from one rail and the tender frames from the other. The modification is simply that the tender's front frame spacer [**103]** to which the drawbar is attached can be replaced with a 1/16" piece of double-sided copper clad board. N.B. If the motor is to be installed in the locomotive, then the copper clad replaces spacer 9 in the locomotive's frames.

ADDITIONAL PARTS

The following items are needed to complete the kit:

Wheels:

The locos were fitted with 5' 8" 18 spoke wheels with crank pins on the spoke. A few were later fitted with crank between the spoke wheels.

The crank on spoke version are available from Ultrascale and the crank between spoke are available from Ultrascale, Alan Gibson and Markits.

3 pairs: 5' 8" 18 spoke

1 pair: 3' 2" 10 spoke pony truck wheels

3 pairs: 4' 1½" 12 spoke tender wheels

Loco and tender bearings:

For a compensated loco chassis - 6 x High Level 1/8" standard axle horn guides (compensated chassis). If building in EM then two of the horn blocks should be the 'space saver' reduced width option to allow for the gear box.

For a sprung tender chassis - 6 x 2mm High Level MiniBlox horn guides (sprung tender chassis)

For a rigid loco chassis - 6 x 1/8" top hat bearings

For a rigid tender chassis - 6 x 2mm i/d + 2.5mm o/d top hat bearings (rigid tender chassis).

For the Motor in Loco version a motor and gearbox to suit the builder's preferences

For the M-I-T solution: -

Motor: High Level 13/20 coreless motor.

Loco gear box: High Level Road Runner Compact gear box 45:1 ratio (or builder's preference) and 1.5mm shaft diameter.

Components for cast brake hangers for loco and tender are provided in the kit. If you want to model the twin brake hanger version the following additional parts are required:

Twin brake hanger brakes for loco – Brassmasters E236

Twin brake hanger brakes for the tender – Brassmasters E234

Also, as some modification is required to the loco footplate to fit sandboxes behind the steps (where they can hardly be seen!), the sandboxes are not included. If you want to add them, they are available from Brassmasters:

Rear sandbox – later style – left – Brassmasters MF40

Rear sandbox – later style – right – Brassmasters MF41

2 GENERAL

There are two etches sheets plus and additional sheet. Numbers shown in square brackets [ ] in the instructions refer to the numbers shown on the etch sheet. Certain parts, e.g. bolts, wire, springs, are not numbered. The parts list shows which part is on which sheet.

As you will see from the parts list, there are some component numbers that are not used, and some components that have numbers that are not used. There is even one number [54] that is used on both sheet 1 and sheet 2!

Some of the parts are small and easily damaged, so do please take care. Parts should be removed from the sheets as and when needed by use of a small scalpel etc., and the tabs and etch cusp removed with a small fine-cut file.

All folds and bends are made with the half-etched line on the inside unless otherwise stated.

On some parts it is necessary to emboss rivet / bolt heads from the reverse sides by use of a punch.

A simple method of cutting tube is to place the piece of tube on a smooth wooden board, hold a Stanley knife with a new blade at right angles to the tube where the cut is to be and then, with gentle pressure on the knife, roll the tube backwards and forwards with the knife blade until the tube parts. All the tube in this kit has been cut this way.

3 CONSTRUCTION OF LOCO CHASSIS

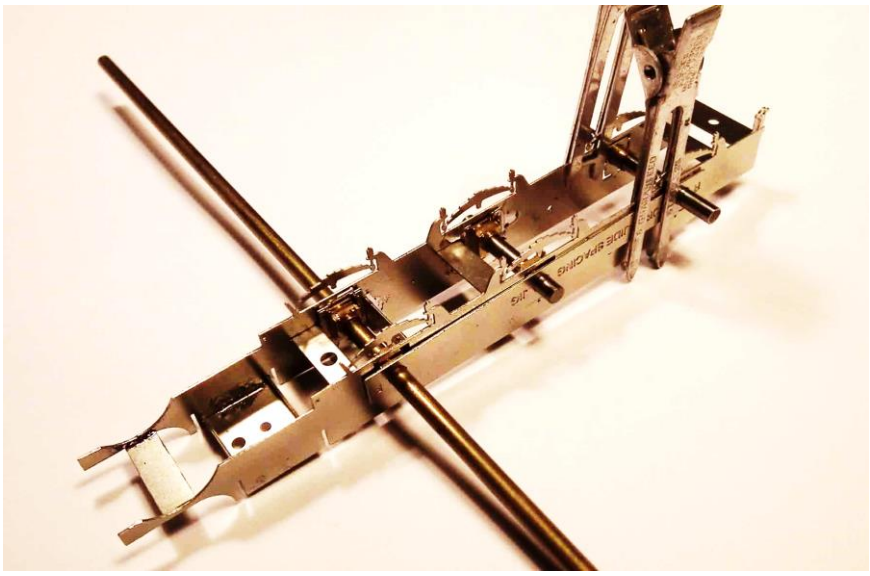
The loco chassis can either be built rigid or compensated. If compensated then the builder will need to remove the fixed axle holes for the horn guides but it is recommended that this is done in two stages, first cut out the middle and front holes from the frames [**1 & 2**] with a fret saw and temporarily fit top hat bearings in the rear axle holes in order to ensure accurate spacing of the middle and front horn guides. Once they are in place the rear axle holes can be removed and the rear horn guides installed. Horn guide spacing jigs have been provided to further assist with the installation. The holes in the jigs should be reamed out to 1/8" and then standard axles can be passed through the horn guides and jigs to ensure accurately spacing of the axles.

There are 8 frame spacers [**3 to 10**] numbered from the front of the frames to the back. Spacer 4 is fitted with the larger hole at the front and the rear spacer 10 is fitted with the notch at the bottom. There are alternative rear drag beam spacers [**10***] if you are not using a M-I-T drive solution. Remove frame spacers 4 and 7 for your chosen gauge, fold and solder them into their respective slots on the inside of one of the frames ensuring that they are square. Now solder them to the other frame and again check that all is square and using a long length of 1/8" rod ensure that the rear axle is also square to the frames making any adjustments if needed before proceeding further.

Install the remaining frame spacers each time ensuring that the frames remain square and straight (looking down their length). If the frames are to be built rigid then install 1/8" top hat bearings in all six axle holes and then proceed to 'Coupling Rods' below, otherwise:

Prepare six High Level horn guides and blocks. Please note that once installed the horn blocks will become captive to the frames because of the leaf springs and so it is important that any adjustments to the sliding action of the horn

blocks is resolved before installation. They should be free moving with no lateral slop. It is worth taking time and doing this carefully as it will have a significant effect on both the running quality and how many miles your chassis can run and therefore remain in traffic. If they are tight when initially constructed check that the 'tongue' that locates in the slot in the machined brass bearing is not 'bottoming out' in the slot – if so dress the tongue with a file. Pair each bearing and guide up and mark them accordingly. Note that for EM the rear pair of High Level hornblocks must be the 'space saver' type and for P4 gauge the rear bearings must have the inner extension rim removed (ie filed back to the actual square bearing in order to fit the gearbox between the bearings (it is easier to do this now than later!).



Ensure that the hole in the horn guide spacing jigs provided are a tight fit on a 1/8" axle and using them and 1/8" i/d top hat bearings in the rear axle holes, install the middle and front horn guides. Please note that we have provided 0.4mm indexing holes above the centre of the horn guide openings which coincide with the same in the High Level horn guides. By passing a length of 0.4mm brass wire through the two holes the vertical position of the horn guides can be set correctly. These holes may need cleaning out with a drill or broach. There is not much room to solder the front horn guides in place between the spacers but with a hot iron we had no problems.

Now remove the rear axle holes from the frames and install the rear horn guides utilising the horn guide spacing jigs.

Cut a 9.5mm length of 1.5mm brass rod and solder across the holes in spacers **5 & 6** to form the compensation beam for the front axle. N.B. a 1/8" i/d x 3.8mm o/d brass tube will be used to form a bearing for the front axle and the beam will rest on the tube.

The pivot for the rear twin beams is formed from a 1mm diameter n/silver wire core and a 1.5mm o/d brass tube. N.B. do not be tempted to use heavier material as the beam would then interfere catastrophically with either of the gear box options bespoke to this kit.

It is recommended that the holes in the frames for the compensation beam pivot are slightly countersunk with a small drill to give the solder somewhere to go. Cut a length of brass tube to match the width between the inside of the frames. This is then cut in half so that the twin beams can rock independently. Thread the tubes through the holes in the beams [**11, 12**] and then install between the frames by passing a length of 1mm nickel silver wire through the holes in the frames and the brass tubes.

Solder the n/silver wire to the outside of the frames and then file the ends flush with the outside face of the frames. Slide the beams so that they sit on top of the horn blocks but don't force them up against the horn guides or they won't move freely. Solder the beams to their respective brass tubes.

Coupling Rods

The rear (articulated) rods are identical on both sides and comprise two outer layers [**13,15**] (shortened) layer [**14**] which is sandwiched between them. If using Markits wheels find the largest drill that will pass through the crankpin holes; if using Alan Gibson or Ultrascale wheels, open the crankpin holes using a 1.5 mm drill. When complete drill a hole using the same size drill perpendicular in a scrap piece of wood. Leave the drill in the hole in the wood. Tin the mating surfaces of the coupling rods and place over the drill. This holds one end of the rods accurately ready for soldering. It is critical to align the parts exactly in order to make one rod so take some time tweaking. Try and avoid

getting solder in the slot for the hinge by inserting an offcut of thin cardboard into the mortice before running in the solder. If solder does get into the slot then this can be opened up (carefully) with a fine fret saw blade. The centre layer has a notch above the crankpin hole as a guide for the addition of a cork. The cork is made from a short length of 0.5mm brass wire. Having soldered up the rod, using a 0.5mm drill bit, open the hole, solder in the wire and then trim to length. The outside of the crank pin boss is then thickened by adding an overlay [**20**].

Place a little flux along the top surface of the rod and apply heat; the solder on the soldering iron will fill the "cusp" and give the impression of a solid rod. The secret is to apply only a little solder at a time. Repeat for the whole length of the rod. Clean up and square off each rod with files.

The front pair of coupling rods are now built up. Left side [**16,17**], right side [**18,19**]. Please note the these are handed, the outer layer left side [**17**], right side [**18**] have an enlarged crank pin hole to take the (reduced) head of an Ultrascale recessed crank pin nut. The head of the crank pin nut must be reduced to 2.2mm diameter by temporarily mounting it on a 14BA screw thread and spinning it in a mini drill and carefully filling down the head, regularly checking the diameter with a pair of callipers or if you don't have callipers then just keep attempting to introduce the coupling rod until it fits over the head. If using Gibson driving wheels the front half of the crank pin hole in the wheel must be opened up to 1.2mm to accept the foot of the recessed nut. Solder the two layers together, again using a drill, ensuring that holes for the hinge are properly aligned. If the front crankpin rod recess fills up with solder use a burr to clean the solder out. Drill out the holes for the corks, solder 0.5mm brass wire in place and trim to length. Again, fill the cusp with solder and clean up and square off the rods.

Finally, connect the front and rear coupling rod sections together. Open up the joint holes to just take 0.6mm NS wire - you don't want any slop in the hinge. There are several methods that can be used to join the rods.

a. The first involves using aluminium foil to prevent the joint locking up.
Once you are ready, fold some silver foil over the hinge's tenon, introduce the tenon into the mortice of the rear coupling rod, and having created a pin sharp point on the brass wire push it through the assembly piercing the silver foil as you go. Now with the minimum of solder possible solder the ends of the hinge pin to the outside faces of the coupling rod, the silver foil should have prevented any solder from running into the centre of the hinge rendering it solid. File the ends of the pin flush with the front and back surfaces of the coupling rod and pull away the foil.

b. The second uses oil to prevent the joint locking up.
Slightly countersink the back of the hole in the rear rods. To stop solder flooding the joint apply a little oil to the surfaces not to be soldered - this will prevent the solder running into the joint. Keep the rear of the rod clean. Solder can then be quickly applied with a very hot iron to the back of the rod to fix the wire in place. Clean off excess solder leaving enough to keep a strong joint.

Build up the left-hand connecting rods [**21,22**] and right-hand connecting rods [**23,24**], again using a drill to ensure alignment. The bottom edge of the rear layer of each connecting rod has a small rebate. This rebate is to provide better clearance when the rod travels past the rear of the bottom slide bar, in so doing it is only the front layer of the connecting rod that drops through the slot. After assembling the connecting rods clean any surplus solder away from this rebate.

The big end of the connecting rod can be made thicker by adding front and back overlays [**25**] (but marked as 26 on the fret) but please note that if the back overlay is fitted the combined width of the coupling and connecting rod bosses will be greater than the length of Ultrascale's long crankpins so replacement crankpin sleeves will need to be fabricated. A longer crankpin and bushes will be needed for Gibson crankpins as well.

In P4/S4 18.83mm gauge and if using Ultrascale wheels the clearances are tight behind the crossheads (Gibson wheels are thinner over the boss so less of a problem, EM should be OK). Across wheel bosses the dimension is 22.40 mm, plus there are the two rods (with recessed crankpins) at 1.70mm plus the washers that fit behind these as supplied are each 0.40 mm. This totals 24.90mm. The assembled crossheads should have a clearance dimension of 25.20mm so

this gives a clearance of 0.30mm, but the axle 'rocks' with its central compensation and this is without side movement. It is wise to thin the washers to 0.20mm (but remember the rods still need to clear the centre axle boss). If you consider this too tight then reduce the central boss on the leading axle in height and shorten the axle. In all cases check the front axle does not extend beyond the central boss (mine as supplied by Ultrascale were all 22.70mm long so needed shortening).

If you are prepared to remove the wheels from the axles then test fit the wheels and coupling rods to ensure that the chassis runs smoothly. Quarter the wheels with the right-hand wheel leading the left-hand wheel by 90 degrees ie when the left hand (looking forwards) crank is at bottom the right hand is facing towards the rear of the loco.

Cut a 6mm length of 1/8th inch i/d brass tube as a central bearing for the front axle. In order to stop this rotating either solder a 'hoop' over it or alternatively it is suggested that a short length of 0.5mm wire be soldered to the centre of the tube and inserted through a 0.6mm hole in the centre of the compensation beam to locate the bearing and to prevent it rotating in operation.

Carefully open out the crank pin holes with a broach as necessary to eliminate any binding.

Remove the wheels and coupling rods and set aside.

Frame overlays

Prepare 6 x 10mm x 0.5mm n/s wire brake hanger supports. Bend a (tight) right angle 3mm from one end to form an L shaped wire and then feed the longer end of the wire through the hanger support holes in the frames from the inside. Solder the short end to the inside face of the frames so that the hanger supports are square to the frames. The rear ones around the compensation beams are a little fiddly, ensure the beams are not soldered solid by placing a small amount of oil around the pivot. Using these wires as a guide place the left frame overlay [**26L**] over the frames and carefully solder in place around the edges avoiding getting any solder on the outer face of the overlays. Repeat for the right frame overlay [**26R**]. Clean any excess solder from the top of the frames otherwise this may cause the chassis to sit incorrectly below the body.

Attach the leaf spring overlays [**27, 28L, 28R**] noting that the front leaf springs have a different front hanger arrangement and are therefore handed.

Attach the ash pan side plates [**29L, 29R**] to the bottom edge of the frames. The narrowest part of the ash pan is to the back of the frames and the rear rebate of the ashpan etch butts up against the horn guide.

Cylinders and slide bars

Start by soldering a 10BA nut on the underside of the central hole in the second spacer from the front [**4**].

Fold up the cylinder frame [**29**] ensuring that the front and back faces of the cylinders are precisely at 90^{o} to the spacer.

Cut two 18mm lengths of 3/16"mm o/d and two 16.5mm lengths of 1/16" x 3/64" thin wall brass tube. Solder the 3/16"mm tube into the top holes of the cylinders ensuring that the ends overhang the front and rear of the cylinders evenly. Make sure you know which is the front and rear of the cylinders (one cross member bolt hole is offset to the front) Now solder the 1/16" tube into the piston holes of the frame so that the tube is **just** proud of the front face of the cylinders with all the overhang to the rear, this should be about 1.75mm. File the front of this tube flush to the front face of the cylinders.

Carefully roll the cylinder wrappers [**30**] ensuring the small holes for the drain cocks are exactly to the bottom of the cylinders. Solder the wrappers in place and file flush with the front and back faces of the cylinders.

Take the rear cylinder covers front layer [**31L/F, 31R/F**] and back layer [**31B**]. Please note that the front layers are handed whereas the rear (thickening) layers are interchangeable but should be turned to match the fronts before soldering together. Slide over the 1/16" piston rod guides ensuring that all holes are properly aligned and solder to the rear of the cylinders.

This is the best time to fit the piston rod gland cover plates [**32**] using 0.5mm brass wire to represent the securing bolt heads. Cut and file the wire to length to represent the bolts.

Make up the top and bottom slide bars [**33, 34**] by folding the etch through 180 degrees along the half-etched lines, holding together and flooding the join with solder. Make note of the etched slot at the end of the bottom slide bars. Once soldered the etched slot will have been flooded with solder but can be carefully opened out again with a razor saw. The slot should be to half the depth of the slide bar at the back edge tapering up so that it is flush with the top face at the front. This slot is a clearance slot for the connecting rod which would otherwise collide with the bottom slide bar when the crank pin is at the bottom of its stroke.

The slide bars are full thickness to coincide with the slide bar bracket but should then taper from this point towards the front and rear to almost half thickness at either end of their visible length. (The prototype is 2½" wide at the hanger tapering to 1½" at the inner and outer ends). This shape can be reproduced with careful filing if the builder wishes.

After filing the taper on the slide bars, fit three slide bar oiling boxes (0.6mm brass wire) into the holes in the top of each slide bar so that they are flush with the bottom face and protruding by 0.6mm (approx.) above the slide bar. Re-check the 1mm n/silver rod intended to be used for the piston rod fits within its guide tube.

Insert the slide bars into the cylinder frames from the rear with the single continuous piece of metal to the inner face (i.e. crosshead side) and fix in place by soldering them where they protrude beyond the front face of the cylinders. It is not necessary to solder them where they exit the rear of the cylinders. File the fronts of the slide bars flush with the front face of the cylinders.

There are two pressure relief valves on the front and rear of each cylinder. Fit the cylinder front covers [**35L & 35R**] using the small hole for the pressure release valve at the bottom to ensure correct positioning. Open the holes out to 1.0mm with a drill or broaches

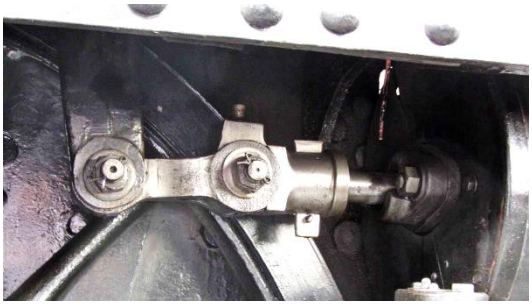
To represent the pressure relief valves cut two 17mm lengths of 1.0mm brass wire and dome the ends by spinning up in a mini drill and filing into a hemispherical shape. Thread them through the pressure release valve's hole in the front cover plate and out through the equivalent hole in the rear cover plate (again this will need opening up to 1.0mm). The wire will need to be jiggled to enable it to pass through the cylinder's void. Ensuring that the wire projects squarely and equally front and back solder or glue into place.

The valve end plates are fitted next. Cut two 19.5mm lengths of 1/16" x 1/32" brass tube. Solder a spacing ring [**36**] approx. 3mm from the start of the tube and another approx. 12 mm further along. These rings help to hold the tube centrally within the 5mm o/d tube of the valve chest. Now solder a valve end plate [**37**] on the start of the tube with the 1/16" tube almost flush with it and thread the assembly into the valve chest from the front until the end plates sits against the end of the valve chest. Solder the end plate to the front of the valve chest. Thread another valve end plate [**37**] over the back end of the tube and solder against the rear of the valve chest.

Unfortunately, the front of the valve chests will now foul the curved drop of the footplate and so the top/front of the valve chests must be radiused using a curved needle file until the cylinders sit neatly under the footplate. It is best to first assemble the cylinders into the frames using a 10BA bolt to locate them correctly under the footplate. N.B. It may be necessary to create a slight chamfer on the inner edge of the valance to allow the cylinders to sit fully square against the foot plate. The inner stiffening ribs on the rear screw stubs of the Mazak footplate also need removing or

the etched chassis will not sit correctly (I use a burr in a minidrill). It also may be necessary to file a little off the top of the cylinder wrappers to allow the chassis to sit correctly against the footplate.

On the prototype the piston valve rod assembly looks like this:



For the model, drill out a piece of 1mm o/d tube with a 0.6mm diameter drill to a depth of about 15mm and check that a length of 0.6mm n/s wire will slide into this hole. Cut two 6mm lengths of this 1mm o/d brass tube. Drill out the 1/16" tube previously installed at the rear end of the valve chests 1mm diameter by 7mm deep and insert and solder (or glue) in the 1mm tube so that the ends are flush. Re-check the 0.6mm n/s wire will slide into this hole. Ease the fit with a broach or drill if required. Cut two 10mm x 0.6mm n/s wire to form the valve spindles. Create a flat for 1mm at one end of each wire. This can most easily be done by crushing the last 1mm of the wire in the smooth jaws of a vice. There are two possibilities now so read ahead.

Option 1. With the point of a scriber make a centre pop hole in the centre of the flat and then drill out to 0.4mm then clean up the sides and radius the end of the flats.

Option 2. Hold the valve spindle securely and file a v shaped notch in the top of the valve spindle ½ mm so it goes half way down the flat.

For each side you will require one valve rod [**42**] and one rocking lever [**43**]. Tin the back of the valve rod [**42**] and rocking lever [**43**]. Place the coupling rod on a piece of scrap wood and drill through the holes at either end with a 0.4mm drill down into the wood so that some 0.4 brass wire can be pressed into the wood to hold the valve rod assembly whilst it is soldered together. Slide the hole (or push the 'V') in the 0.6mm valve rod down over one of the captive wires, slide the hole in the rocking lever [**43**] over the other captive wire, both with the tinned side upwards. Slide the valve rod [**42**] down over both captive wires with the tinned side facing down. Now align the piston rod and the valve rod so that they are straight and then align the rocking lever at 90° to the valve rod. Solder the three components together. Repeat for the opposite side ensuring that the rocking lever is turned 90° in the opposite direction to the first. Insert the valve rod assembly into the valve chest and using the foot plate as a reference superglue the assembly into the valve chest, repeating for the opposite side.

Tin the rear of all four of the motion brackets halves [**38F and 38B**] whilst still on the fret. Solder together and clean up. To position the brackets accurately, fit the cylinder/frame assembly under the footplate (hold with elastic bands), and align the bracket on one side to the front edge of the motion bracket above the footplate. Now solder the bracket to the slide bars ensuring that the rear edge of the slide bar is aligned to the back of the motion bracket and does not become contaminated with solder which will prevent the crosshead from passing the bracket. This is a bit fiddly but needs to be got right. Repeat for the other side.

The optional final task to complete the cylinder assembly is (with reference to photographs) to fabricate some cylinder drain cocks and install them in the holes provided in the bottom of the cylinder wrappers. We suggest that these are built around short hand rail knobs.

Attach the cylinders to the frame using a 10BA x 1/8" cheesehead screw.

Crossheads and Fitting Connecting Rods

N.B. The front face of the crosshead has a small lubrication access hole which should be above the connecting rod gudgeon pin if you have the parts orientated correctly. Furthermore, the rear of the right-hand crosshead has a vertical arm which connects to a piston rod for the vacuum pump for the train's brakes. Whilst the vacuum pump and rod are not modelled (because they are hidden behind the footplate's valance) the crosshead's arm is.

Take the crosshead core [**46**] and fold the two sliding faces at 90°. Take the right hand rear crosshead rear [**44R**] push the tabs of a crosshead core through the slots so that, when looking from the font, the vertical arm is at the left hand end and the extension on the crosshead core is to the right. Solder in place and file the tabs flush to the back of the crosshead. Using the point of a cocktail stick through the gudgeon pin holes to help with alignment, solder the front of the crosshead [**45R**] to the core ensuring it is the correct way round. Repeat for the other crosshead core and crosshead rear [**44L**] and crosshead front [**45L**]. Check that the crossheads slide cleanly along the slide bars and adjust accordingly by carefully filing the crossheads. Don't overdo it as too much slop may cause the connecting rods to miss the slot in the bottom slide bars in operation.

Cut two 17mm lengths of 1.0mm n/silver rod to represent the piston rods. Now carefully file flats front and back in the rod until the piston rods fit neatly between the faces of the crosshead without distortion. I test this with the crosshead in the slide bars and carefully introducing the rod in the end looking for zero movement of the crosshead, the rod needs to be perfectly aligned or you will introduce unnecessary friction or binding. When happy slide the piston rod halfway into the piston tube and slide the crosshead into the slide bars and over the end of the piston rod. Solder the piston rod into the crosshead. Check that the crosshead still slides freely up and down the slide bars making sure that when the crosshead is aligned at the back of the slide bars that the front of the piston rod is still in the cylinder.

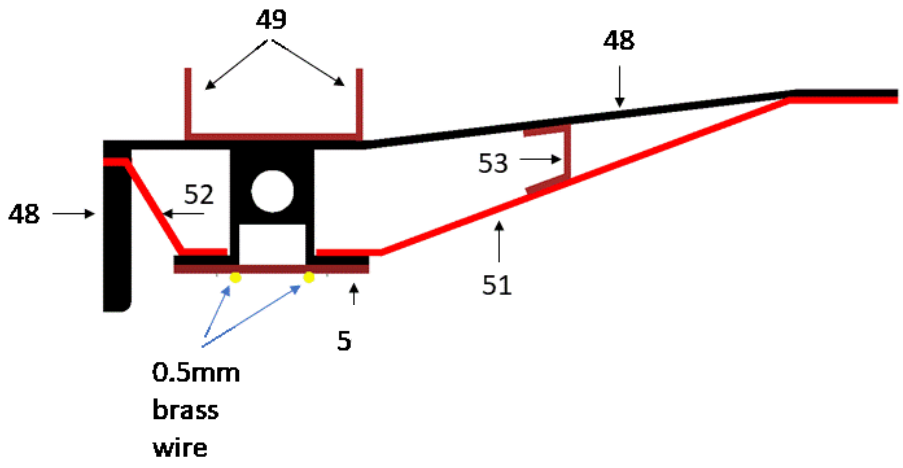
The connecting rods can now be attached to the crossheads. Countersink the hole at the back of the crosshead slightly. Mount a piece of 0.5mm wire in a mini drill and file the end to a point. To ensure that the connecting rod doesn't become soldered solid inside the crosshead, either oil the little end of the connecting rod or fold a narrow strip of aluminium foil around the end of the connecting rod, slip it into the crosshead and push the pointed wire through the crosshead and connecting rod piercing the aluminium foil as you go. Solder the wire at the rear of the crosshead only and file the wire flush front and back. Pull the aluminium foil out of the crosshead. A small amount of foil may get left behind but it won't do any damage and can be left.

Test fit the wheels and rods and whilst rolling the chassis along a length of track ensure that the connecting rods pass cleanly through the slots in the bottom slide bars and adjust the width/depth of the slot with a needle file if there is an issue. If all else fails file a bevel across the entire width of the back of the slide bar to provide clearance but I would not expect this to be necessary so double check everything before taking such drastic action.

Pony Truck

With all the parts still attached to the main etch, turn over to the back. Using the etched lines as a guide, scribe lines on the two guard irons. Also, whilst still attached to the main etch, open out all the small holes in the pony truck parts [**48,49,51 and 52**] to clear 0.6mm wire. Open out the axle holes to accept the 2mm top hat bushes.

PONY TRUCK: LOCATION OF PARTS



Take the pony truck top frame [**48**] and bend up as follows:

a. fold keeper plates through 180 degree with the fold line on the outsides. Make sure the holes are in line by passing a wire through the holes. Tweak the bottom plates if necessary, then solder the two parts together.

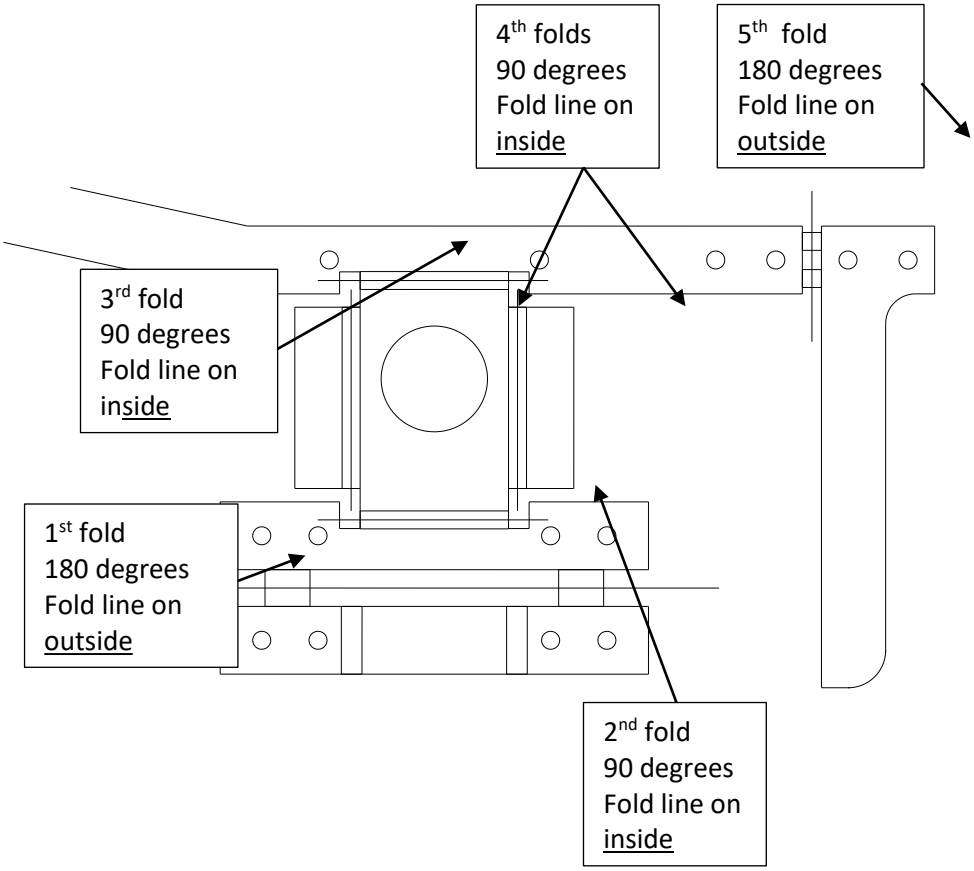
b. fold up the bottom plates to 90 degrees.

c. fold the pony sides at 90 degrees to the top plate

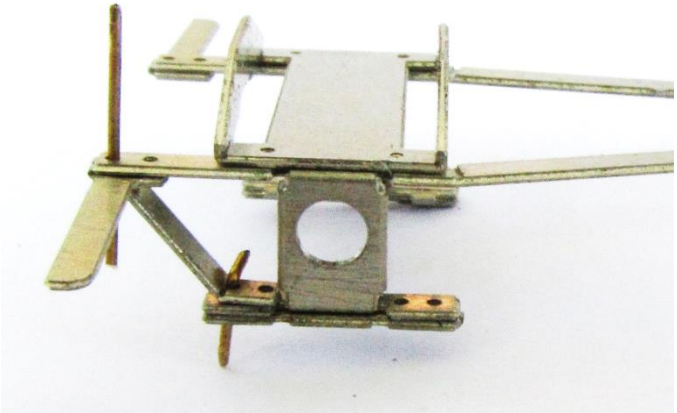
d. fold the two 'wings' each side to 90 degrees.

e. fold over the guard irons through 180 degrees with the fold line on the outside, again using wire to ensure the holes are in line. Solder the guard iron to the top frame.

(see diagram below)



Fold up the pony truck top casting [**49**]. Position the top casting on top of the top frame, align with four pieces of 0.6mm wire and solder the two parts together.



Take the pony truck bottom frame [**51**] and bend roughly to shape. Locate on the bottom of the pony truck top frame with four pieces of 0.6mm wire and solder the two pieces together.

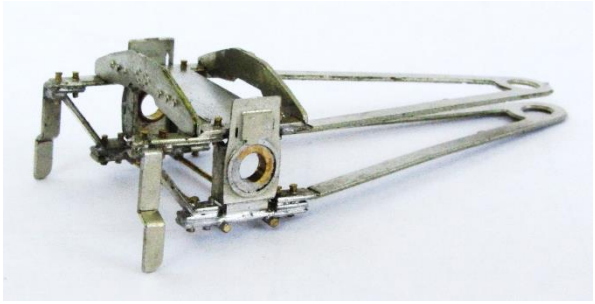
Carefully bend up the pony truck diagonal struts [52]. Getting the bends exactly right is important so check the fit with pieces of 0.6mm wire through the top and bottom holes, two holes at the bottom, one at the top through the guard

iron. When happy that they are correct solder in place. Add another two pieces of 0.6mm wire in the rearmost holes at the top front and solder these in place.

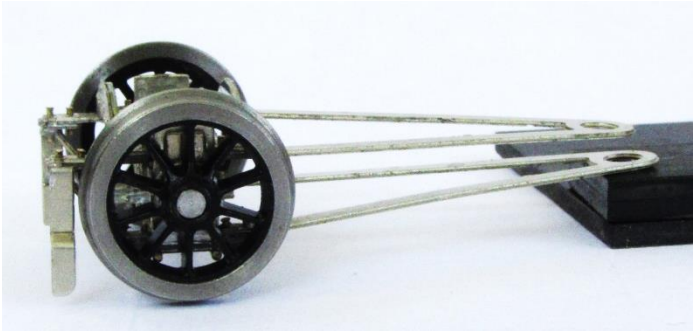
Cut back and file all the pieces of wire to represent the bolts holding the pony truck together.

Fold down the guard irons and form the reverse curves, making sure that the front edges of the guard irons are at right angle to the frame.

Solder the two 2mm top hat bearings into place. Open out the holes in the pony truck axle boxes [**54**] so that they pass over the bearings and solder in place. Note, there are two un-numbered alternative axle boxes located inside the frame of the EM gauge pony truck top frame [**48-EM**].



Solder two 16mm lengths of 0.5 mm brass wire to form the crossbars across the bottom of the pony trucks in the half-etched lines so that an equal amount overhangs each side.



Assemble the pony truck wheels using the axle spacing washers as necessary.

Bend up the rear arms of the pony truck top and bottom frames such that when it is attached to the loco chassis, the top frame is horizontal. A little bit of tweaking may be necessary.

When happy with the pony truck shape, solder the top and bottom frames together by the pivot hole.

Fold the rear struts [**53**] and locate them at the position where they best fit the distance between the top and bottom arms of the frame ensuring that they are both at the same distance along the arms. N.B. holes for the bolts were not attempted because there were too many variables to accurately determine their final positions. Two holes can be drilled at each top and bottom location and 0.6mm wire inserted if the builder is so inclined.

Solder a 2mm top hat bearing (from above) into the frame spacer [**5**) located immediately to the front of the front driven axle. Solder a 10BA cheese head bolt down through the top hat bearing. Place the pony trucks pivot over the top hat bearing from below and use a 10BA washer and nut to hold the truck in place. The truck should swing freely.

We have not mandated how the truck is to be controlled. This tends to be a personal preference. The designer has soldered a light coil spring to the main frame spacer directly above the pony truck axle, and a small rubbing plate to the bottom of the same spring so that it presses down lightly on the upturned cross channel [**49**) of the pony truck. Others may prefer to add some lead to the framing or install a side control spring wire.

Gear box

You can now install the gear box. Two bespoke gear box frames have been provided, one for the motor-in-tender and one for the motor-in-locomotive configurations. Both configurations are based around High Level gears and motors. If installing the motor in the firebox of the loco then build up the gear box following High Level Kit's standard method. The frame provided in this kit is slotted so that it passes over the pivot for the compensation beam to stop it rocking in the chassis.

If utilising the motor-in-tender solution (marked M-I-T on the etches) then remove the alternate High Level frame from the fret and install two 1/8th inch i/d top hat bearings into the axle holes in the sides of the frame with the rim of the hat on the same side as the fold lines (inside).

Fold the gear box frame making sure that the sides are square and solder the joint. Check that the final gear fits between the two top hat bearings and slim down the tops of the bearings with a file if required. Check that the gear box fits between the rear horn blocks (it needs about 6.5mm) and adjust the thickness of the horn blocks and/or the gear box bearings so that it fits. Ream out the bearings to a free fit for the loco axle.
Note that the sideplay of the rear axle is limited by the clearance between the gearbox top hat bearings and the hornblocks. Therefore if you require 1mm sideplay there must be this clearance around the gearbox bearings. Remember there will be zero sideplay on the front wheels due to the crossheads in their slidebars!

Install the intermediate gear into the gear box using the High Level spindle, remembering to fit the brass spacer beside the gear to keep the pinion gear central to the worm. Super glue or (if you are brave and quick) solder the axle to the gearbox as per the High Level instructions.

Cut a 25.0mm length of 1.5mm dia. steel rod for the drive shaft. This will need polishing with very fine wet and dry until it is a fit into the ball races. Solder a 2mm length of 2.0mm x 1.5mm inside diameter tube flush and square to the end to prevent the shaft from coming away from the gear box (the worm will prevent movement in the other direction). With a minimal amount of Superglue fit ball races (4mm o/d x 1.5mm i/d) into both ends of the gear box frame (from the outside) then thread the drive shaft through the rear bearing then the worm, and then the front bearing finally attaching the brass socket from the ball & socket universal joint (UJ).

Temporarily fit the final drive gear into the gear box and then Loctite the worm gear to the drive shaft ensuring that it does not interfere either with the final drive gear or with the front ball bearing.

Test fit the gear box. The arms protruding from the back of the box locate into slots in the rear frame spacer and prevent the gear box from twisting. At this stage the only way to test run the chassis is to temporarily fit the ball of the UJ to the end of a short length of 1.5mm steel rod, you can then test the chassis by rotating the rod in your fingertips. Alternately mount the rod in a mini drill set to low speed, and then insert the ball into the UJ's socket and use the drill to turn the wheels.

Fitting the wheels and rods

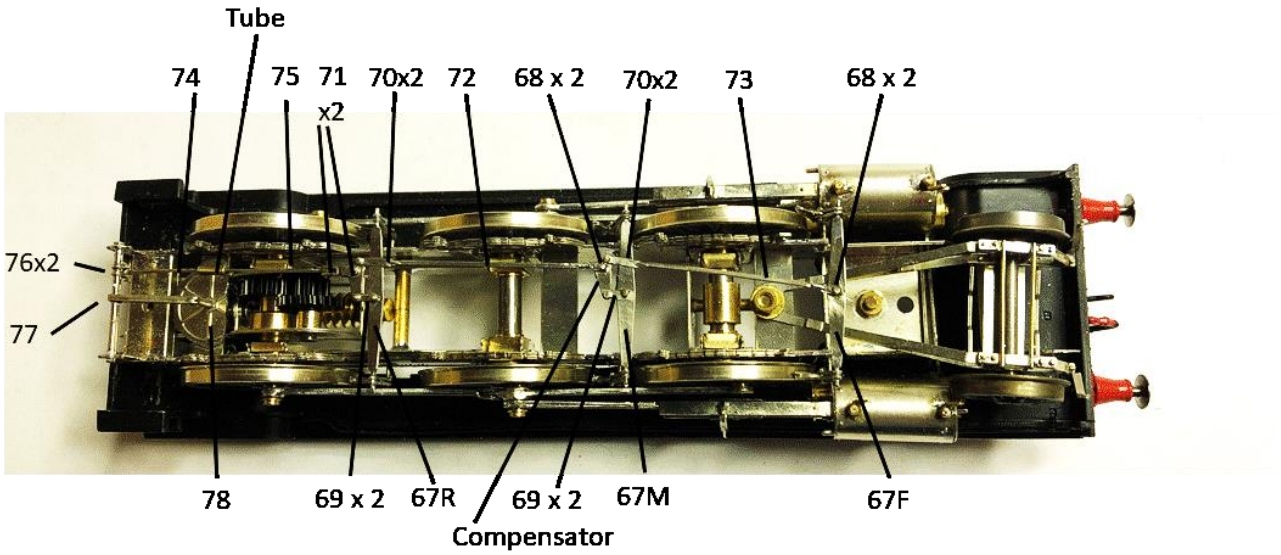
Check that the crankpin rear screw heads and shorting strip (if used) do not catch on the frame rivets and thin the screw heads if necessary. Fit the wheels and coupling rods to ensure that the chassis runs smoothly. Quarter the wheels with the right-hand wheel leading the left hand wheel by 90 degrees ie when the left hand (looking forwards) crank is at bottom the right hand is facing towards the rear of the loco.

For guidance we used Ultrascale wheels in P4 and fitted one and a half washer to each side of the leading axle, one full one to the centre and none to the rear (the MIT gearbox acts as side restraint). Remember the Con rod needs to be

parallel to the sides of the frames or the 'cut out' fouls the bottom slide bar – therefore a washer is needed on the centre crank pins.

Brakes

Make up the brake hangers [**54 – 65**] (Note parts 55, 58, 61, 64 are not used). Each hanger comprises two elements: A hanger front face with brake block attached and a hanger the rear face. It is suggested that you place the front face-down on a piece of wood and drill through the three holes (0.45mm) so that you can then insert three lengths of 0.45mm brass wire into the wood, and then tin the centre area on the reverse of the rear face and slide that down over the wires. Now whilst applying slight downward pressure around the centre hole with a small screwdriver blade, introduce the soldering iron's tip to the seam and wait for the solder to melt. If the end wires have been soldered to the hangers apply a small amount of localised heat to the end of the hanger and remove the offending wire/s. Trim the ends of the centre wire to length to resemble the retaining bolt.



Next comes the assembly of the brake yokes. Please note that to ease the construction the compensators are already attached to their yokes by small tags. These should not be separated when removing the yokes from the fret. 0.4mm brass wire is used throughout to represent the bolts holding the various forked ends and links to the yokes and compensators.

Starting at the front yoke [**67F**] solder the two halves (top and bottom) [68] of the forked joint to the yoke using a short length of 0.4mm brass wire to represent the bolt. Ensure that all the slots into which the brake pull rod subsequently attaches are aligned.

Make up the middle yoke [**67M**]. Again, I recommend resulting to the wooden block and wire pins again, completing one side before turning the yoke over and completing the other. Install the top and bottom links [**69**] between the compensator and the yoke using 0.4mm wire to represent the bolt. Install the forked joint for the pull rod to the front yoke [70]. This forked joint passes right over/under the yoke and will connect to the front pull rod. Ensure that the slots that the pull rod is inserted into are aligned. Finally make up the forked joint that connects to the rear pull rod from the rear compensator by soldering forked joint [**68**] top and bottom to the back of the compensator again aligning the slots.

Now make up the back yoke[**67R**] in a similar way to the middle yoke using the compensator links [69] and forked ends [**70**] but this time the rear connection (to the brake cross shaft operated by the vacuum cylinder) is a U-shaped forked end [**71**]. The centre hole should be re-opened up to 0.4mm after making the two right angled folds around a piece of scrap etch before the component is attached to the rear of the compensator. The second U shaped forked end [**71**] is similarly formed. Open up the centre hole to 0.4mm and solder a 1mm length of 0.4mm brass wire into this

hole leaving half of it protruding. Insert this wire into the back of the identical part attached to the rear compensator with the two halves at 90° to each other and solder the two halves together (back-to-back).

Note: in the picture the two U-shaped forked ends [**71**] are shown separated on their piece of wire – they should be touching

You can now start to install the brake hangers and operating levers. Following the above illustration, fit the top holes of the front brake hangers over the 0.5mm brake hanger wire and insert the front yoke into the bottom holes but don't yet solder the yoke.

Fit the middle hangers and yoke (as for the front) and now you can lay a flat edge across the front and middle yokes to ensure that they are horizontally aligned and now you solder the yokes to their hangers. Install the rear hangers and yoke repeating the alignment process. You can now fit the pull rods [**rear 72, front 73**] into the slots in the forked ends. Ensure you are happy with the positioning of the brake shoes in relation to the wheels (to avoid shorting) and then solder the rods into their slots. There is a slight amount of adjustment available for setting the gap between the brake shoes and wheels.

Optionally install the part representation of the bottom of the vacuum cylinder [**78**] onto the main frame spacer [**8**]. This has been truncated to avoid it interfering with the gear box. See photo above.

Build brake cross shaft operating lever by soldering the two halves [**77**] back-to-back to form the fork that attaches to the vacuum cylinder's piston rod. The piston rod is made in the same way as the valve rods were made for the cylinders. Take a 10mm length of 0.6mm n/silver wire and crush the last 1mm in the jaws of a vice. Now drill a 0.4mm hole in the flat and clean the end with a needle file.

Cut a length of 1mm n/silver rod slightly wider than the width across the main frames to form the cross shaft. Thread the rod through brackets under the back of the main frames at the same time threading on the previously made cross shaft operating lever and 2 off brake pull levers [**76**]. Solder the cross shaft to the main frame brackets and remove the surplus ends.

Insert the vacuum cylinder's piston rod into the hole in the centre of the cylinder and with a short length of 0.4mm brass wire connect the flat end of the rod to the cross shaft operating lever. Adjust the lever so that it is just below level and solder the operating lever to the cross shaft so that the piston rod is vertical. Now solder the piston rod to the mainframe spacer (from above), and solder the brass wire to the fork of the lever.

Cut a 6mm length of 1.0mm o/d brass tube to represent the brake lever adjuster. The two halves of the brake adjuster pull rod [**rear 74, front 75**] should fit inside the tube so use a broach to open the hole if necessary. Do not solder. Using a short length of 0.4mm brass wire as a pin attach the front section of brake adjuster pull rod [**75**] to the previously installed forked joint but leave it loose for now.

Solder the rear section of the brake adjuster pull rod [**74**] into the 6mm tube representing the adjuster so that it is only half-way in. Using another short length of 0.4mm wire attach the other end of this assembly between the two brake pull levers [**76**], previously threaded onto the brake cross shaft, so that the levers are oriented above the pull rod and at 90° to the vacuum cylinder operating lever having first threaded the open end of the tube onto the front section of the brake adjuster pull rod [**75**].

Solder the two brake pull levers to the cross shaft ensuring that the two halves of the rear pull rod are straight and in line with the forked joints on the rear yoke. Solder the brass wire across the top of the brake pull levers and solder the front half of the brake pull rod [**75**] into the tube.

Finishing Off the Chassis

With reference to photographs, glue the centre wheel balance weights [**79**] and leading and trailing wheel balance weights [**80**] to the driving wheels.

The draw bar [**83**] is double thickness to minimise the risk of it bending in use. It is designed to lie on top of the spacer in the locomotive and below the spacer of the tender and so the double thickness is also required to keep the drawbar level in use. It is assumed that the builder is installing the motor in the tender and therefore requires a permanently coupled draw bar. Solder a small 2mm i/d top hat bearing into the hole in spacer 9 from underneath. At the loco end the drawbar is then installed over the top hat bearing and secured with a 10BA nut, 10BA washer, and 10BA 1/8" screw. If the screw fouls the universal joint socket, reduce the length of the screw slightly.

At the tender end of the draw bar take a 2mm top hat bearing and solder from the bottom. Bush this with a piece of 1.5mm i/d, 2.0mm o/d tube and solder both in place. Solder a piece of spring phosphor bronze wire to the coupling so it rubs against the tender coupling pin when it is inserted.

Install pick-ups (if any) to the locomotive's wheels. I am recommending the American current collection system because this is the easiest to install. For the American system you just need to short the rims of the wheels on the left side of the loco to the axles to make the frames electrically live and then the draw bar can transmit the current to the tender. Shorting tags have been provided for this purpose. To install them file a small recess in the rear of the wheel's rim just large enough to accept the tail of the tag so that the rim can be filed flat once the tag is soldered in position.

The last items to fit are the sand boxes and sand pipes. The rear sand boxes are located behind the rear steps and are hard to see and so you may choose to fit the pipes only in order to save you the trouble of having to remove two threaded pillars from the underside of the Mazak footplate which would otherwise occupy the same space as the boxes. If you are going to fit the sand boxes then delay this until you have installed the chassis in the locomotive (next step) because there is some more soldering to be done and the white metal castings could be damaged as a result.

Installing the Locomotive Chassis

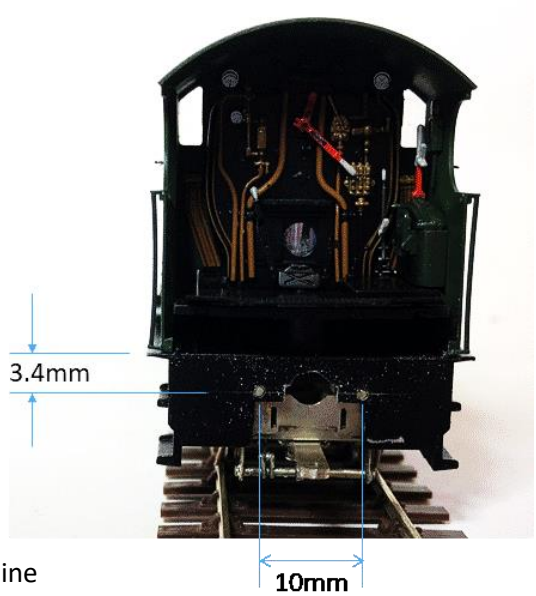
If using the locomotive body from a Dapol model, remove the chassis as follows:

First remove the DCC chip installation board from the smokebox. The smokebox door is a press fit into the smokebox and can be released with the plastic tool supplied by Dapol (or the point of a cocktail stick). Once you have access to the DCC board either hook the plastic tool through the hole in the board, or gently grip it with a pair of smooth nosed pliers, and pull it forwards and out through the smokebox opening.

The three screws retaining the chassis to the footplate are now removed. One is accessed through the gap in the pony truck's frame and the other two are under the cab. The chassis will now pull away from the footplate. N.B. the front screw also attaches the smokebox saddle to the footplate and so the saddle will now be loose, so take care not to allow the saddle to separate from the footplate.

The bottom of the boiler's wrapper will come out with the chassis. This should be removed from the chassis and put to one side.

If you have decided to fit the sand boxes then you now need to remove the two Mazak pillars under the cab to which the chassis was attached. To do this we first used drills of increasing size to remove the metal from the centre of the pillars and then once there is hardly any metal left remove the rest with a dentist's burr in a mini drill. The Brassmasters castings will need to be thinned down to fit. Drill a 0.5mm hole in the centre of the bottom of each. Glue the sandboxes to the frames and then glue a piece of 0.5mm wire into each of the holes. Bend to shape so that they end close to the wheel treads. **Make sure they touch neither the wheels or the track.**



Set the points of a pair of dividers to 3.4 mm and then scribe a line across the rear of the drag box using the top of the footplate as the reference.

Now make two centre pop marks 10mm apart and central to this scribed line and then drill two 1mm diameter holes. Temporarily install the chassis and check that these holes align with the 1mm holes in the back of the chassis. If they are mis-aligned then open up the holes in the chassis to match the holes in the footplate.

Cut two 10mm lengths of 1mm n/silver rod and bend the last 3mm at 90° to make an L shape keeping the bend as tight as possible. (I recommend using the jaws of a vice and a pin hammer to tighten up the bend). Thread the long arm of the L through the holes in the chassis from the inside out, and solder in place. Check that the pins sticking out from the rear of the chassis locate accurately into the holes in the footplate and adjust if necessary until the chassis is lying centrally and neatly against the underside of the footplate. File the rod flush to the back of the footplate.

The front chassis securing screw should now pass through the front spacer and up into the original hole in the smokebox saddle.

For the motor in tender solution the footplate must now be filed to provide clearance for the ball of the universal joint to enter the chassis.

The reach rod on some of Dapol's models is quite bowed. A replacement etched reach rod [**81**] and support [**82**] are provided. At the end of the reach rod [**81**] bend the half-etched end of the lever on itself and a short piece of 0.4mm brass rod inserted into the hole to represent the bolt. Bend up the reach rod support into a U shape, place the reach rod between the arms and thread a piece of 0.4mm wire through the holes in the top of the support and through the curved slot in the reach rod. After having removed the plastic reach rod, attach the replacement reach rod and reach rod support to the loco with glue.

Ballast the locomotive and finish off by gluing the bottom of the boiler's wrapper into the gap in the boiler.

Tender Chassis

The tender chassis can either be built rigid or sprung using continuous springy beams (CSB's) made from 14 gauge guitar wire. The reason for utilising CSB's rather than compensation in the tender is because compensation beams would obstruct the installation of the drive shaft. If the builder intends to install the motor in the locomotive and compensation is preferred, then compensation beams can be fabricated.

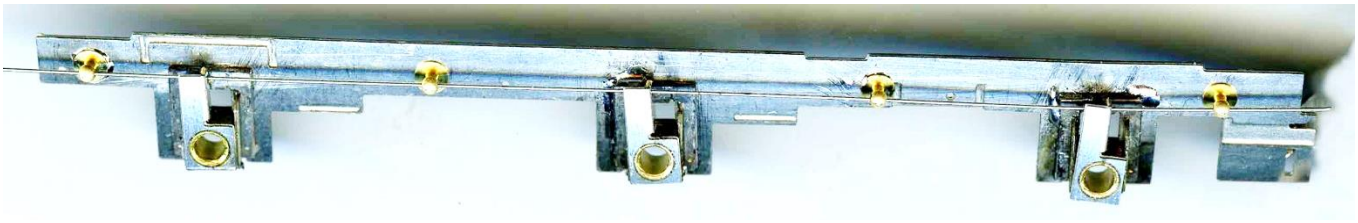
Important: Ultrascale and Gibson tender wheels have a central boss that extends beyond the face of the wheels. Clearances between the Dapol axleboxes are extremely tight, in P4 it is necessary to essentially make the faces of the wheels 'flat'. This means shortening the axles as well and is best done before fitting the wheels to the axles. It is advisable to also do this in EM although the area around each wheel boss can be cut out behind the plastic axleboxes.

If the chassis is to be built rigid then solder 2mm i/d top hat bearings into the axle holes of tender frames [**100, 101**] and move to the paragraph on fitting the frame spacers; otherwise cut out the holes for the horn guides.

The inside of the frames are the sides with half-etched detail.

Prepare the Hi Level mini horn blocks and horn guides and then, following the Hi Level instructions, install them in the tender frames [**100, 101**] using the 0.45mm guide holes in the guides and frames to ensure correct spacing These will probably need cleaning out with a broach. Fold up and solder the CSB stand-offs [**102**] to the horn blocks so that the folded element faces in towards the inside of the frame. Using very fine wire retain the horn blocks in their guides by inserting the wire through the holes in the bottom of the High Level guides.

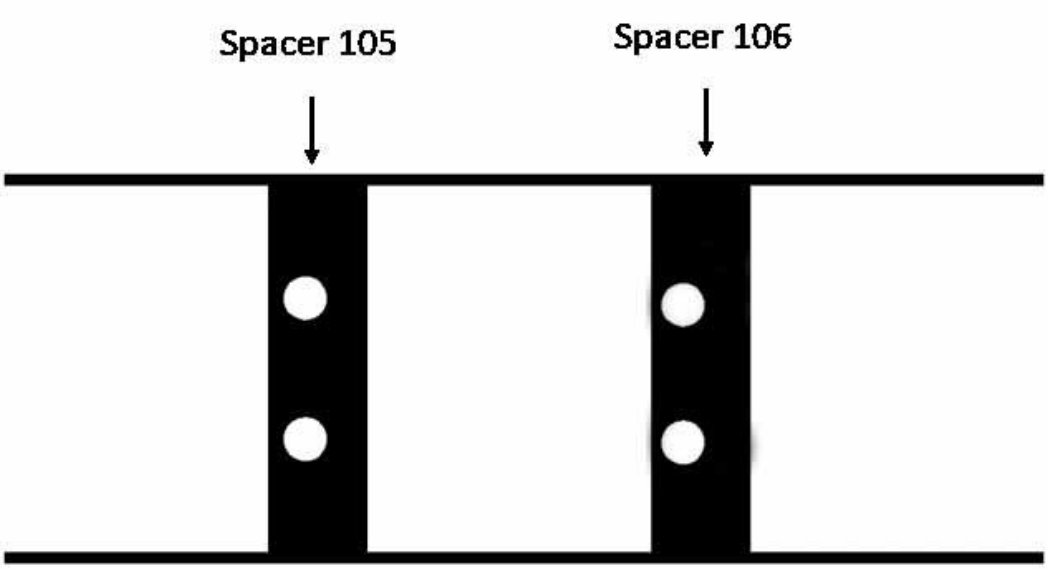
Solder the 8 CSB pillars into the inside of the frames and file flush to the outside. It is recommended to countersink the outside of the holes in the frames to increase the amount of solder holding these pillars in place.



The frame spacers [**103 – 107**]) are numbered in sequence from the front to the back of the chassis. If installing the American current collection system replace the front spacer [**103**] with a piece of double-sided copper clad 13.9mm x 6mm (EM) or 14.9mm x 6mm (S4). Cut through the copper on both sides to make an isolated centre at least 6mm wide. If using the American pickup system drill a 1.5mm hole central in this spacer. Insert and solder 1.5mm steel rod so it extends below the spacer to form the coupling pin.

Form the 'U' shaped rear frame spacer [**107**]. Trial fit the spring CSB wire through the CSB stand-offs and pillars. You will see the wire touches the spacer 107 when the bearing is deflected – file 4 notches out of spacer to clear the wire.

Install all the frame spacers in the frames starting with the two U shaped spacers [**104, 107**] checking that all is square as you go. If the motor is being installed in the locomotive, then the 4th and 5th spacers [**105, 106**] can be omitted, otherwise they should be installed with the holes offset towards the front of the tender and 10BA nuts soldered under the holes.

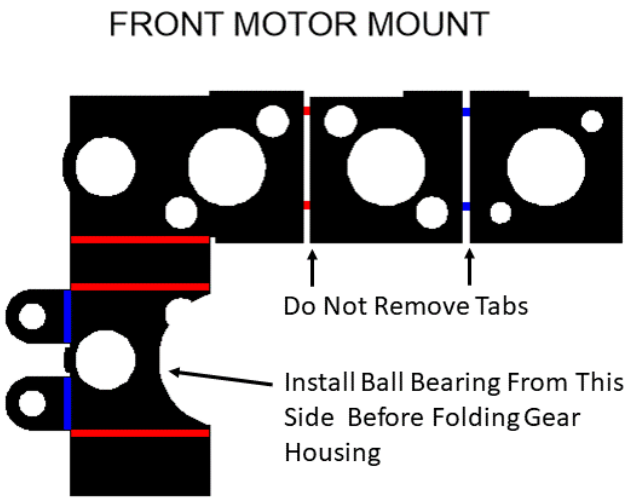


If installing CSB suspension cut 2 off 83mm lengths of 14 gauge (14 thou) guitar wire, bend at 90° 1mm from one end and thread the wire through the CSB pillars and stand-offs. Put a 90° bend at the other end to keep the wire in place.

Bend up the brackets for the vacuum brake cross shaft [**110L, 110R**] and solder the tabs into the slots in the front of the frames so that the holes for the cross shaft will half show below the front steps of the tender. N.B. alternate brackets are provided for EM and S4 frames and note the open end of the 'box' is towards the front of the tender chassis.

Motor-In-Tender (M-I-T)

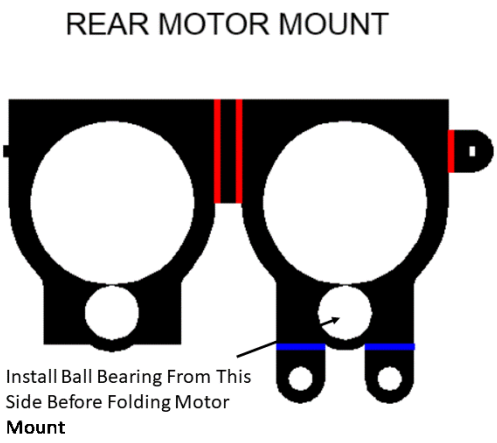
If not using this option proceed to 'Brakes and brake rods'; otherwise:



Please note that the front motor mount [**108**] is in three sections, the two square sections are attached by small tabs.

Check the clearance for the motor mounting screws in the front motor mount [**108**]. The larger holes should be a clearance width for the head of the screw, the smaller holes in the top layer should be a clearance for the thread but not the head. Open these holes if necessary. Remove the motor mount from the fret taking sure not to cut the tabs between the three sections as these have been provided to ensure correct alignment when folding up the mount. First fold the three sections the three sections that make up the mounting plate for the motor through 180 degrees with the half-etch on the outside of the bend and run solder between the layers. Fold the mounting tabs for attaching the mount to the frames at 90° and reinforce the folds with solder.

Insert a ball race into the bottom hole of the gear housing from the side with the fold lines before folding up the housing.



Fold up the gear housing and making sure that the front face of the housing is square to the rear, solder the 4th side against the side of the motor mounting plate. N.B. the ball race will be captive but leave it loose for now

Fold up the rear motor mount [**109**]. Before closing the mount install a ball race from the inside of the housing facing to the back of the frames. Solder the fixing tab and strengthen the bolt mounting tabs with solder in the joints.

Cut a 51mm length of 1.5mm steel rod for the drive shaft. Polish the surface with fine emery cloth until the rod smoothly slides through the ball races without sticking. Cut 4 x 6mm lengths of 2.0mm x 1.5mm tube and insert one into one of the 20 tooth spur so that the gear is flush with one end of the sleeve (Loctite or Superglue the gear to the sleeve). Repeat for the second gear and sleeve. Thread the drive shaft through the front ball race, through the gear enclosed by the gear housing of the front motor mount, through the third 6mm long 2.0mm x 1.5mm tube sleeve and then through the rear motor mount. Please note that the brackets on the mounts face away from each other. Using 10BA x 1/8" c/h bolts install the motor mounts onto spacers **105 and 106**.

Adjust the components of the drive shaft so that it just extends beyond the rear ball bearing and the gear is central to the gap in the front motor mount. Loctite the sleeve of the gear to the drive shaft. Making sure that the ball bearings are fully pushed home in their sockets, apply a small amount of Superglue to the ball bearings so that it runs into the gap to hold them permanently in place. The drive shaft should spin freely.

Install the High Level 13/20 motor in the mount at the same time installing the 2nd plastic gear and the last 6mm long 2.0mm x 1.5mm tube sleeve on the shaft of the motor such that the gear aligns with that of the drive shaft. Apply Loctite or Superglue to lock the gear firmly to the shaft of the motor. Test run the motor to confirm that the drive shaft is turning freely.

Cut a 27mm length of 1.5mm steel rod. Press the UJ's steel ball onto one end of the shaft, and then push a length of 1.2mm i/d Neoprene tube half over the other end. Now push the other end of the Neoprene tube over the previously installed drive shaft completing the assembly of the drive train. You may wish to take this opportunity to complete installation of the draw bar so that you can test run the loco and tender together for the first time.

Brakes and Brake Rods

The brake pull rod parts on the main fret [**113 -121**] are for the later type of compensated brake gear fitted to Collett tenders so a replacement etch has been supplied for the uncompensated type fitted to this type of tender. The parts on this etch are prefixed with the letter E.

To help alignment, the front and back halves of the left-hand brake hangers [**111L**] and right-hand brake hanger [**111R**] are joined by a half-etched tab (in the fret), it is recommended you leave this in place until you have soldered up the assembly and then you can file it off afterwards. Build up the 6 brake hangers and blocks by folding over the two parts of the brake hanger with a brake block front [**112**] between. Construction is similar to that adopted for the locomotive's brakes. Once soldered and cleaned up set them to one side.

It is now time to install the brakes on the tender. Bend up 6 x 6mm L shaped pieces of 0.5mm n/silver wire to act as the brake hanger supports. Thread these through the holes in the frames and solder the short end of the L to the inside face of the frames. **Be careful not to disturb the CSB supports**. Cut six 2mm lengths of 1.0mm x 0.5mm tube and slide one over each of the brake support wires.

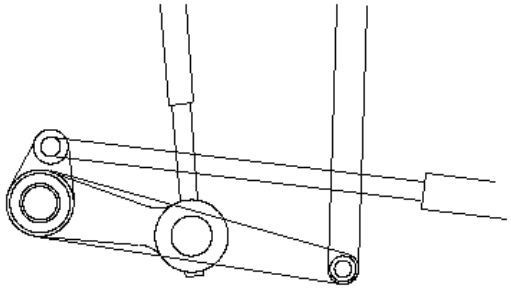
Cut three 22mm lengths of 0.6mm brass wire to form the cross bars. Take a left hand and right-hand brake hanger and thread a length wire through the bottom hole of one, then through the rear holes of two brake pull rods [**E1**], making sure they are the correct way up, and then through the second brake hanger. With the pull rods inside the wheels, locate the top of the brake hangers over the rear brake hanger support wire, align with the wheels and solder hanger to the cross bar. If everything is correct, it should be possible to spring the brake hangers on and off the support wire. Repeat for the middle and leading brake hangers.

Solder the brake pull rods to the cross wires just inboard of the wheels, ensuring that the wheel backs can't touch them.

Solder together the two halves of the vacuum brake cylinder's operating lever [**122**] – previously set aside when removing the tender's frames from the fret). To form the brake cylinder's piston rod, take a 6mm length of 0.6mm n/silver wire and crush the last 1mm in the jaws of a vice. Now drill a 0.4mm hole in the flat and clean the end with a needle file. With a short length of 0.4mm brass wire, connect the flat end of the rod to the operating lever and solder at the angle shown in the diagram. Solder together the two handbrake levers [**E2 and E3**].

Cut a 29mm length of 1.0mm n/silver rod. Check that 0.45mm wire will go through the small holes in the pull rod levers [**76**] previously set aside. Thread two pull rod levers [**76**], the brake cylinder operating lever assembly, two more pull rod levers [**76**] and then hand brake lever assembly onto the rod, ensuring that the two assemblies are the correct way round (see diagram). Solder the rod between the brackets that sit between the front steps and clean up the ends.

When looking from the front, and with the tender the right way up, solder the brake cylinder operating lever 3mm to the left of the centre line and at the angle shown and the handbrake lever 11mm to the right of the centre line and at the same angle.



Cut the two brake adjust pull rods [**117**] such that there are two parts 12mm long from the pivot hole. Using a length of 0.45mm brass wire to represent the pins insert the front end of each brake adjust pull rod between two brake pull levers (parts **76**) such that the levers point upwards above the cross shaft, at right angles to the other two levers and are spaced along the shaft so that they are just in line with the brake pull rods. With the compensator pull rods lined up with the front part of the brake pull rods, solder the brake pull levers to the brake shaft and to the compensator pull rods. Do not solder the compensator pull rods to the front extension of the pull rods.

Finishing Off

Install pick-ups. If utilising the American system then short the rims of the wheels on the right hand side of the tender to their axles. The M-I-T motor can then be connected electrically to the frame of the tender and the draw bar pivot.

Fold and install the vacuum reservoir support bracket [**123**] across the top of the frames.

If you haven't already done so install the rear drawbar mount. This is made from a 2mm i/d top hat bearing and a 10BA nut bolt and washer to secure the draw bar to the tender.

If using the American system for current collection, whilst the draw bar is intended to carry the current from the loco to the tender the use of top hat bearings will not make for a reliable passage of current. It is suggested that a length of thin and flexible multicore copper wire be soldered to the washers that are used to retain the drawbar at both ends passing through the small hole in the centre of the draw bar to reflect the fact that the bar is connected above the loco's frame spacer but below the tender's frame spacer.

Modifying the Dapol Tender

Regrettably this involves significantly more work than modifying the loco's footplate. This is not Fun! Most components that need removing are fixed on 'pins' with a small amount of glue and can be pulled out with force (pushing the back of the pin also helps). For the M-I-T option considerable cutting away of the floor is required and these instructions focus on this option.

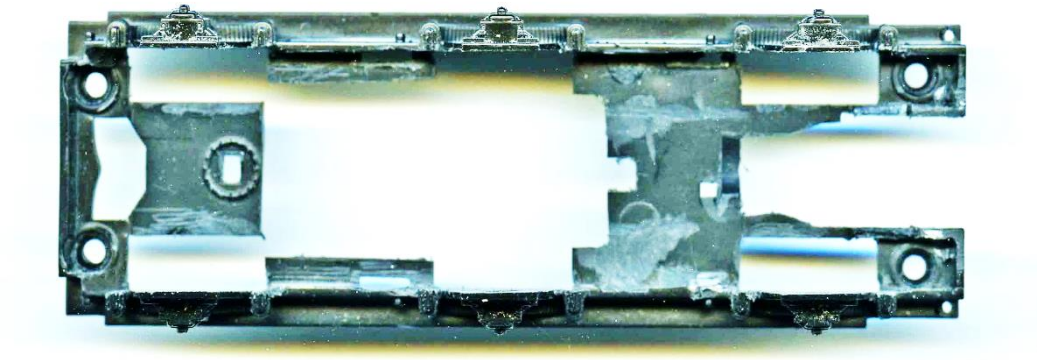
First separate the outside frames and wheels from the superstructure by removing the four small screws from the underside four corners of the tender. Put these somewhere safe as they will be needed to reassemble the tender later. Unscrew the top weight.

Remove the coupling, remove the front buffers and brake rigging plus activating cylinder and cross shaft. Remove the wheels by springing out the W-irons. Remove the brass pickups and wires from the top face of the frames and the four-way draw bar socket. Remove the water scoop and the vacuum reservoir and set aside to re-install later. Carefully trim away the plastic brake hangers. Before removing any of the floor thin the rear of the plastic frames around the axleguards so that the wheels fit. P4 wheels need at least 21.9mm, EM 21.3mm. Hopefully you will already made them flat across the face of the wheel removing the raised central boss as mentioned earlier – if not you will have problems in P4! Remove anything that sticks up above the surface of the tender's base and keep removing anything that sticks down below the surface until the new frames look like they will lay flat against the base of the tender.

N.B. due to the design of the inside face of Dapol's frames the tops of the brake hangers are too wide to fit between the frames. It will be necessary to remove approximately 1 mm depth of anything sticking out from the inside face of the frames to make room for the new hangers.

Eventually you will reach a point where the new frames will fit!

For MIT the tender base plate will need cutting back to look like this



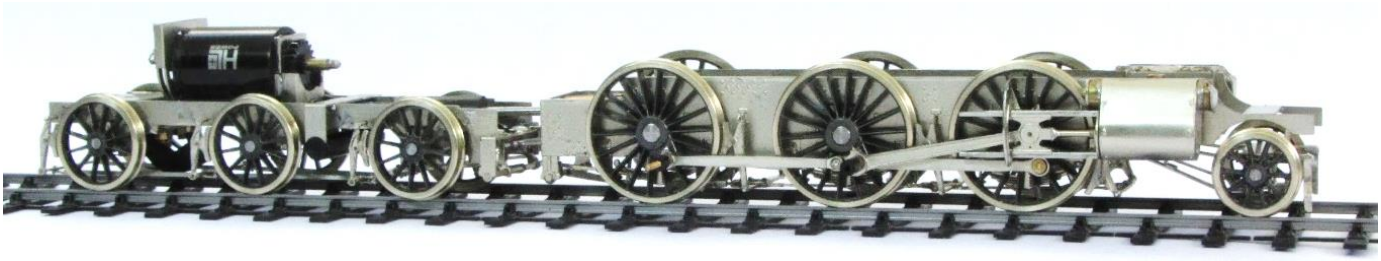
Solder a 10BA nut over the hole at the thin end of rear tender retaining plate [**124**]. The other hole has been provided as a potential aid to fitting auto couplings, e.g. Alex Jackson, and an additional nut can be soldered over this hole if considered needed. Solder two 10BA nuts over the holes in the front tender retaining plate [**125**]. The rear plate [**124]** is now glued into the same shaped rebate on the top rear of the plastic bed of the tender. The front plate is glued centrally across the top face of the bed so that distance between the front and rear mounting nuts is 49mm. With a 1mm bit, drill through the nuts and the bed of the plastic and then from the other side open the holes in the plastic to permit the passage of a 10BA bolt (1.7mm diameter).

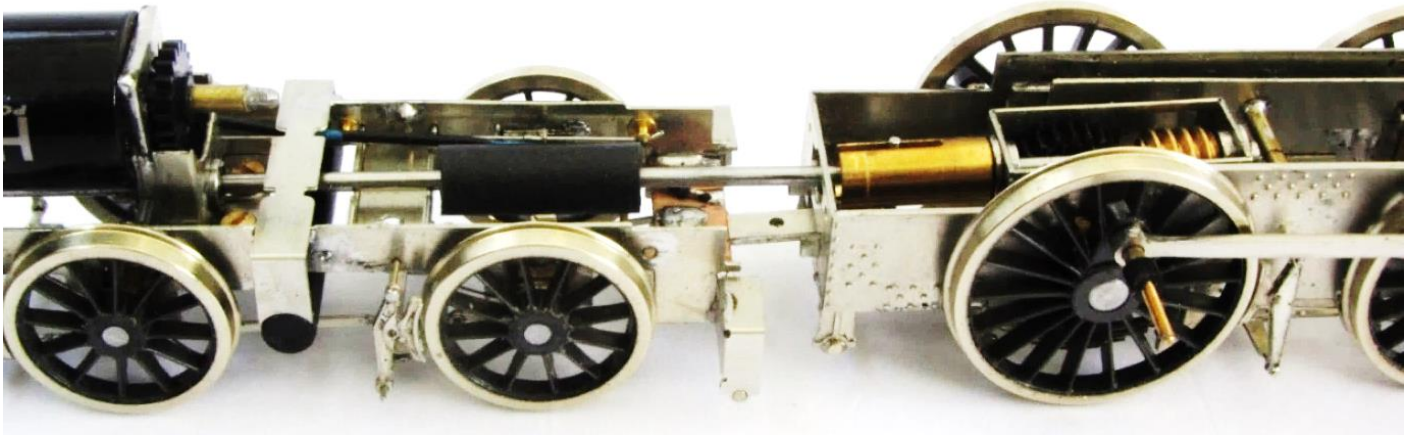
Test fit the chassis using two x 3/8" and one x ¼" 10 BA c/h bolts and adjust if necessary.

The vacuum reservoir must be modified so that it can be attached to the new bracket. File off the plastic legs and make round fit on the legs of the n/silver bracket [**123**]. Alternately you may choose to use a 22mm length of 4.5mm diameter brass rod or tube instead. We also cut the water scoop down and pinned and glued it to the rear motor mount spacer.

Add sufficient ballast to the inside of the tender until the tender sits at the correct height, i.e. when the CSB wire is compressed so that the steps and footplate of the tender are aligned with those of the locomotive. We used four

lengths of 80mm x 12mm lead flashing glued two each side to the inside of the tanks which gave a total tender weight of 140g.





Etched parts List

	Locomotive				
1	Frames right hand	1	42	Valve rod (2)	1
2	Frames left hand	1	43	Rocking lever (2)	1
3	Front frame spacer	1	44	Left- and Right-hand crosshead rear (2)	2
4	Frame spacer	1	45	Left- and Right-hand crosshead front (2)	2
5	Frame spacer	1	46	Crosshead core (2)	2
6	Frame spacer	1	47	No part	
7	Frame spacer	1	48	Pony truck top frame	2
8	Frame spacer	1	49	Pony truck top casting	2
9	Frame spacer	1	50	No part	
10	Rear Frame spacer	1	51	Pony truck bottom frame	2
10*	Alternative rear frame spacer	1	52	Pony truck diagonal struts (2)	2
11	Compensation beam	1	53	Pony truck vertical struts (2)	2
12	Compensation beam	1	54	Pony truck axleboxes (2)	2
13	Rear coupling rod outer (2)	1	54	Front left brake hanger front face	1
14	Rear coupling rod inner (2)	1	55	Part not used	1
15	Rear coupling rod outer (2)	1	56	Front left brake hanger rear face	1
16	Front left coupling rod inner	1	57	Front right brake hanger front face	1
17	Front left coupling rod outer	1	58	Part not used	1
18	Front right coupling rod inner	1	59	Front right brake hanger rear face	1
19	Front right coupling rod outer	1	60	Middle and rear left brake hanger front face (2)	1
20	Crank pin boss overlay (2)	1	61	Part not used	1
21	Left hand connecting rod outer	1	62	Middle and rear left brake hanger front face (2)	1
22	Left hand connecting rod inner	1	63	Middle and rear right brake hanger front face (2)	1
23	Right hand connecting rod outer	1	64	Part not used	1
24	Right hand connecting rod inner	1	65	Middle and rear right brake hanger front face (2)	1
25	Connecting rod boss overlay (4)	1	66	No part	
26	Left and Right frame overlays (2)	1	67F	Front brake yoke (no compensator)	1
27	Middle and rear spring overlays (4)	1	67M	Middle brake yoke (compensator attached)	1
28	Left and Right front spring overlays (2)	1	67R	Rear brake yoke (compensator attached)	1
29L	Ashpan side plate left	2	68	Short forked ends for brake pull rods (4)	1
29R	Ashpan side plate right	2	69	Top and bottom links (4)	1
29	Cylinder frame	2	70	Long forked ends for brake pull rods (4)	1
30	Cylinder wrappers (2)	2	71	Rear forked ends for brake pull rods (2)	1
31	Left and Right rear cylinder covers (2)	2	72	Rear brake pull rod	1
31B	Rear piston end cover back layer (2)	2	73	Front brake pull rod	1
32	Piston rod gland cover plates (2)	2	74	Brake adjuster pull rod rear section	1
33	Top slide bar (2)	2	75	Brake adjuster pull rod front section	1
34	Bottom slide bar (2)	2	76	Brake pull levers (6)	1,2
35	Left and right front cylinder covers	2	77	Vacuum cylinder lever (2)	1
36	Spacing ring (4)	2	78	Vacuum cylinder bottom	1
37	Valve end plate (4)	2	79	Balance weight centre wheel (2)	2
38	Front and Back motion bracket halves (4)	2	80	Balance weight leading and trailing wheels (4)	2
39	No part		81	Reach rod	2
40	No part		82	Reach rod support	2
41	No part		83	Draw bar (2)	2

Etched parts list – Tender

100	Tender frame right	2
101	Tender frame left	2
102	CSB stand-offs (6)	2
103	Front frame spacer	2
104	Frame spacer	2
105	Frame spacer	2
106	Frame spacer	2
107	Rear frame spacer	2
108	Front motor mount	2
109	Rear motor mount	2
110	Left and Right brake cross shaft bracket (2)	2
111	Left and Right brake hangers (6)	2
112	Brake block front (6)	2
113-121	Parts not used	2
122	Brake cylinder operating lever (2)	2
123	Vacuum reservoir support bracket	2
124	Rear tender retaining plate	2
125	Front tender retaining plate	2

Additional Etch

E1	Brake pull rods (2)
E2	Hand brake lever left
E3	Hand brake lever right