

## **0-8-0T Brigadelok**

### **History**

Like most countries at war, Germany used a variety of different locos in their war effort. Generally it was "whatever was to hand" that did the job. The track gauge was almost totally 600mm with a few minor 760mm and 1M lines. These were probably existing systems with commandeered stock where it would be stupid not to use it and were not connected to the main network anyway.

The one main advantage the Germans had was that World War One was planned for and with typical German efficiency, designs and factories were in place to produce the required equipment before it was needed. The French had a similar plan but it was not so far advanced. They had two main designs; an 0-6-0WT and the Pechot Bourdon articulated loco (not an unqualified success) with a fairly comprehensive range of track, wagons and equipment to back it up. The British only thought about railways after the war was well under way and the primitive lorries of the day were all bogged down in the French mud. Horses were the mainstay of the British army until 1916. The Hunslet 4-6-0T was considered "The British War Engine", but there were several other designs from other builders that were probably more useful behind the lines. When the Americans joined us they built more 4-6-0Ts of their own design but also sent over a lot of 2-6-2Ts for their own use, considering this wheel arrangement to be superior to the 4-6-0T.

The Brigadelok was the general purpose loco with light axle loading and, since it was mostly made from sheet metal and steel sections, was relatively cheap and easy to build. Although built to a standard design by many different builders, there were quite a few minor differences between them. There were a variety of 0-4-0Ts, 0-6-0Ts and 0-8-0s from various builders, even the strange Zwillinge, a twin loco that could be run individually or as a pair, all probably from the builders standard catalogues as they did not conform across different builders. The Brigadelok was the only one that was "built to order".

Builders included Borsig, Henschel & Sohn, Linke-Hoffmann, Maffei, Hartmann, Orenstien & Koppel, Smoschewer, Krauss, Hanomag, Esslingen, BMAG, Hohenzollern, Schwartzkopff and Jung. There were at least 2500 produced, but I have been unable to find a listing of numbers or quantities for the various builders. Some were still being built at the end of the war and emerged in peacetime with building dates as late as 1925.

As for the variations, it has proved almost impossible to work out whether locos were built as the pictures show, were modified to a plan later or just "improved" by their maintaining workshops. Major visual differences include hose reel on either dome, front sand dome missing, cylinders with all over covers or semi cut away ones with relief valves visible, the front girder under the smokebox could be L shaped or three sided, cab side locker doors vary in number, position and might be not there at all, the whistle could be on the roof, cab front or dome and there may or may not be a large bunker occupying half the L/H tank. The last main variation was level topped tanks, rather than the more common type with sloping front ends. I suspect that this was a post war variant as I haven't found any definitely dated prior to 1919. Also several of the restored examples have external rear bunkers, all added during restoration as far as I have discovered.

The biggest difference is actually not even visible. Brigadeloks were noted for having a chassis articulated on the Klein-Lindner system, sorry to disappoint but not many actually were. This was an expensive system to fit and maintain. I suspect it was only fitted when necessary for local working conditions and possibly only early in the war when time and materials were more plentiful.

The locos were backed up by a comprehensive range of wagons and track, not dissimilar to that supplied by most other countries involved in the conflict. The standard Brigadewagen was a wooden bodied wagon with stake posts and removable sides and ends. It could be used as a general purpose wagon, a flat wagon with or without stakes or anything in between by removing various body panels. There was a side door variant, a dropped centre version and alternative sides and ends for different uses. There was also a Wasserwagen (tender) which was a proper tender and a far more elegant solution to carrying extra water than the British Hudson tank wagon.

## **This kit**

This kit is a generic model incorporating as many variations as was practical at the design stage. It can be built as a specific example by choosing which options to use after reference to the pictures. Most pictures available are post war so not to be relied on for original detail. Restored ones are worse as changes are often made for convenience at the time, and the parts used may have come from various places and/or different makers.

I have had to make minor changes to some dimensions to be able to use over scale parts where correct parts are not available. I have attempted to maintain the overall look of the engine despite some parts being not quite where they should be. I have worked out a way of replicating Klein-Lindner articulation, but it would need some very expensive castings, custom wheels and would put the kit beyond the average modeller. For these reasons it is not included in the kit. If anyone really wants to have a go at it, I can supply information but no parts.

Read these instructions and examine the parts on the frets before cutting anything out. Some parts are contained within others and will need putting somewhere safe until they are needed. Do not clean the edges of the parts excessively as this can be detrimental to the fit, just clean off the tags that are in the way and any edges that will show when built.

Most folds are to 90° with the etched line in the inside of the fold. Fold double means to fold 180° with the etched line on the outside of the fold. Try to get it right first time as refolding a part the other way usually results in it breaking off.

If any of the tabs are too tight a fit in their slots, make an easing tool from a bit of scrap etch to ease the slots, see sketches. This also works for cleaning out solder if you have to have a second go at an assembly.

## **Body assembly**

Before starting on the body, you will need to have the chassis built to the point where the wheels are fitted at least. It is also a good idea to not have all the rods and valve gear fitted as it will all get a lot of unnecessary handling, possibly resulting in accidental damage.

### **Footplate and tanks**

Locate the footplate 10, tank frame 1 & 2, tank inner sides 6 and tank tops 7 & 8. Clean off the tags on the footplate around the cab area, clean the ends and bottoms of the tank frames and all the tags on the tank inners and tops. The remaining tags will be removed later.

Solder a 10BA nut over the two holes near the edges of the footplate and bend it into a zig-zag with square corners, as shown in the sketch. The two strips joining the footplate halves are sacrificial and will be removed later. Fold the top strips on the tank frames double and the gates to 90°

Engage the tabs on a tank inner in the slots in the footplate and try for fit. The tabs on the gates should engage in the slots in the tank inner and the bottom tabs in the footplate. Check that the vertical part at the cab end clears the vertical part of the footplate, and ease with files if required. Solder the gates to the inner sides first then fit and solder the bottom edge. It's best to tack in a couple of places, check that it is square from all angles then fully solder, but in stages so the thin bits don't warp with heat. This can all be done on a flat surface with the cab hanging over the edge as nothing protrudes below the footplate.

Rather than trying to curve the front ends of the frames for a perfect fit, it is a lot easier to trim 0.5mm off the ends and curve roughly to fit, soldering in place slightly recessed as shown in the sketches. File all protrusions of the footplate at the tank bottom but leave the joining strips for now.

Clean up the tank overlays 3 & 4, push out the five rivets at the front and try for fit. Curve the front end to match the tank bottom and fit the overlay by soldering along the bottom edge from underneath and where it meets the double thickness top. The bottom edge should be flush with the tank bottom and the rear edge at the cab doorway should line up with the inner frame.

Decide if you want the bunker in the tank version or not. If so, remove the rear third of the L/H tank top 7 at the etched line. You may also want to remove the internal tank gate which will be visible, or you can cover it with coal. Fit the blanking piece 29 in line with the row of rivets and check that the tank tops 7 & 8 fit. They can be fitted by eye but 13mm supports made from scrap etch will make it a lot easier, see sketch. Do not fit the tops until after the cab and boiler are fitted as the tanks become rigid when complete and cannot be adjusted for any misalignment that may show up. The bunker shield 28 fits around the top of the opening. If not having an extended bunker, just use 7 in one piece.

## **Cab**

Locate the cab rear 12 and front/sides 11. Clean off all the outer edge tabs but leave the ones in the window openings. Locate the window surrounds 13 and carefully clean off the outer tabs only. Push out all the rivets on the front and rear and solder the surrounds over the openings. Clean off the tags in the window openings. The slightly smaller frames 14 are for use if you want open windows, see sketch for details. Fit the rear into its slots in the footplate and solder in place, ensuring that it is vertical.

Fold the cab side frames and remove the tags at the bottom of the narrow rear pieces, see sketch. Test the fit, the front should but up against the rear of the tanks and the sides sit level with the top of the lower sides. You may have to trim a fraction off the bottom of the cab front to get this right. Also check that the cab front is not spreading the tanks apart as you push it in. Gentle filing of the lower side edges of the front will cure this. I presume that there must have been an opening for the coal in the bunker to get into the cab. I have found no evidence of this so have left the area solid. If you wish, you can cut an opening, or just disguise it with coal.

When happy with the fit, solder in place at the front where it touches the tank inners, and the half etched tags inside the cab. The rear narrow part has half etched edges that fit outside the edge of the rear. Align by hand and solder them together. Locate the cab upper overlays 9 & 10 but do not try and clean off the tags, solder them in place and clean the tags off afterwards. If the front edge is aligned with the front of the cab the rest will fit perfectly. Solder all round, but do it in stages to avoid any warping.

Clean up the tool locker 15 and door 16, fold the locker to shape, solder the seam and solder the door on the front with the hinges on the right. Drill a 0.5mm hole near the top left corner of the door and fit a short length of wire as a handle. Fit the locker on the raised footplate section on the right of the cab.

Locate and clean up the roof 21 and roof guides 24. If you wish to use the ventilator, cut out the half etched section in the middle of the roof, locate and clean up the ventilator body 22 and top 23. Put a very slight curve in the roof to match the curve at the top of the front and rear panels. Position the guides about 1mm in from the ends of the roof and tack in place. Check that the roof fits, adjust if necessary and solder fully. Bend the side strips up about 30°. Fold the ventilator body and solder the ends together. Note that the narrow strips are curved to match the roof on one side. Position it centrally flat side down on the top and solder just the ends. Position squarely over the roof hole and again solder just the ends. The roof remains removable to aid painting and show off the cab interior.

Fold the edges of the cab floor 20 and solder 2 strips of waste etch across the underside to stiffen it. File the strips back to match the side strips a try for fit. You may have to trim the two front edges of the floor, depending on how accurately you folded the footplate. Locate and assemble the reverser parts 18 and 19. Pin them together with 0.5mm wire and solder to the floor where shown in the sketches. The floor can be glued in after painting or left loose if it is a tight enough fit. By tilting the rear upwards, the floor is still removable even after fitting all the cab detail.

The rivet strips around the cab 37 x2 and 38 and tanks 35 and 36 need to be fitted now. They need careful holding while cleaning off the tags. If you catch one and bend it, straighten it out on a flat surface and make sure that bit is soldered flat when you fit it. It will probably never be noticed. For the tank strips, only remove the lower tags as the upper ones can be filed off after fitting. Not all locos had the tank strips but all had the ones around the cab.

There is no easy way to do this, just lay the strip in place and tack every 15mm or so. Flood the strip with flux and melt the solder tacks so they flow out under the strip whilst holding the strip down with a knife tip. If you oil the knife first it won't end up soldered to the strip. The rear one is best soldered to the back first then bent around the sides. The tank strips are best soldered almost up to the front curve, which can then be formed and soldered in place. The tank strips may need slight trimming as they should end at the full thickness bracket at the front. Clean up by scraping the worst of the excess solder off, then using wire brushes to remove the rest. Rotary wire brushes in a mini drill work well here.

## **Boiler**

Anneal the boiler 30 by heating with a blowtorch or over a gas ring until it turns a silvery colour, a little before it starts glowing red. After it has cooled down, roll it around a tube or bar of about 15mm diameter, the extra two holes in the rear half need to be on the right. Once it is mostly circular, stand it on end on a flat surface and hold the seam together. Drop the smokebox front 31 down the tube and push it to the bottom, ensuring that it is square. Apply flux to the boiler seam where the smokebox front is and solder from the outside. Add another 2 tacks of solder further up the boiler seam before letting it go. Inspect the result and make sure that the boiler seam lines up and the front is square. If so, run a thick seam of solder along the length of the boiler. If not, take it apart and try again. 2 intermediate ring formers are supplied 32 which you can use or not as you wish. If you do, be careful of the rearmost ring fouling the motor.

The boiler bands can be done in several ways. If the loco is to be in a plain colour, use either the bands 33 supplied, or shim strip of your own as some people prefer to do. If you are going for a more decorative finish with lined boiler bands, try using painted and lined transfer paper applied after painting. Either way they need to be 1mm wide and positioned as follows. Measuring from the smokebox front to the front edge of the boiler band, they should be 1<sup>st</sup> - 16.5mm, 2<sup>nd</sup> - 37mm, 3<sup>rd</sup> - 55.5mm and the last should have its rear edge flush with the

firebox end of the boiler. The first boiler band must stop 7mm either side of the seam or it will foul the saddle.

Locate the smokebox saddle 25, base 26 and side detail 27, use the parts on sheet 3 not sheet 1, they are incorrect. Fold the saddle and solder the ends together. The base will fit exactly lengthwise but will be too wide, it fits with the number on it nearest to the front. Trim the width until the base fits into the saddle and is slightly recessed, not flush. Solder a 10BA nut over the hole and solder centrally into the saddle. Push out the rivets in the side trims 27, fold to shape and fit to the sides of the saddle.

Try the smokebox saddle for fit and you will find out just how round your boiler is. The seam usually protrudes and the saddle will rock on it. File back just the area needed for the saddle to seat properly. You can do the whole seam if you like, but only you will know it has been done as it is all but invisible on the finished loco.

Test fit the body on the chassis. The rear holes in the chassis may need minor adjustment to get the screws in easily. The front hole will need filing rearwards into an oval by about 1mm. Remove the front tank spacer and loosely fit the saddle with a screw. Make sure that the wings on the tank fronts are square to the tanks and in line with each other. They should also rest on the top plate on the chassis. Move the saddle around until it is square to the tanks and touching the tank wings. Fit the boiler in place and check that it runs centrally between the tanks and sits horizontally. The smokebox front should be flush with the tank wings and overhang the saddle very slightly. The holes along the top of the boiler should be central. Gently squeeze the tanks together until the wings touch the smokebox whilst checking.

If any of these criteria cannot be reached, find out why before proceeding. Look for items that are not square, crooked, twisted or the boiler not being round. When all seems OK, solder the smokebox to the saddle at the front, but not to the tank wings. Remove the boiler and solder the rear of the saddle. Fold the tank supports 33 on the chassis etch to shape and try for fit. The front one goes just behind the smokebox saddle, the other goes directly above the square opening in the frames. The open side of the girder faces rearwards. If they don't quite fit, gently bend them so they touch the frame top and the tank bottom. Solder them in place centrally on the chassis top plate OR to the tank underside, but not both.

Try the firebox casting for fit on the boiler, then try the boiler on the loco. The cab front opening will need adjusting a little to get it in. The ledge either side of the ash pan sits on the footplate (not the planked floor) and should be glued there when everything fits. Due to the variables of castings and the accuracy of etches, the two almost never go together well without adjustments. The bottom of the mounting ledge will need filing to get the height right. Part of the centre of the ash pan will need to be removed to give room for the gearbox to flex during fitting of the body. Also the inner sides of the part that fits into the boiler will need thinning as well. All these things can be done before or after fitting the boiler with a rotary cutter but take breathing precautions against the resin dust, do it outdoors or wear a filter mask. When it fits and is square and level, glue it to the boiler from the inside but do not glue to the footplate yet.

To glue brass to resin, I would use a two part epoxy. Some prefer super glue, which may be OK if you have an expensive one, but the stuff from the pound shop is only just suitable for repairing china cat ornaments. Whatever you use, roughen up the brass and resin and clean thoroughly before gluing. Try the assembled boiler again for fit, ensuring that it sits on the footplate squarely at both ends, is parallel to the footplate and tank tops and looks square from all directions. Remove the boiler and locate the casting for the gauge glass. The lower hole for the gauge glass is too low (my mistake). Drill a new hole 3mm higher and shave off the surface detail with a sharp knife. Also clean up the firebox door 46 and hinge 47. Fold the ends of the hinge over and thread a length of 0.6mm wire through the holes. Lay this in place over the R/H edge of the door and solder together. Trim the wire to around 1mm at each end and glue it in position on the firebox.

Drill out the dimples in the gauge glass to take 0.5mm wire and solder in a 30mm length. Make try cocks from wire and glue the parts into their holes, routing the pipes as shown in the sketches. Fit the boiler and body to the chassis with all three screws and glue the ledge at the rear to the footplate. The boiler may be reluctant to stay sitting on the footplate but can be wedged there by putting a piece of wire between the firebox top and cab front. Put aside until the glue is fully cured.

Once the glue has cured, solder the wings of the side tanks to the smokebox, but not to the frame top. Check to see how much weight is needed, you can go by weight or just judgement. Test the balance by lifting both ends of the loco to see if they weigh about the same. The domes will not affect the balance but the chimney and a white metal crew will. Allow for this and add more lead as you see fit. If you are not sure, leave the tank tops loose until you have run the loco on a layout.

## **Castings and small details**

Locate and clean up all the remaining castings. Several have dimples for starting drill holes. Check the sketches and drill holes of the correct size before fitting any of them. In some cases it may be easier to fit the relevant wires or other castings before fitting to the loco, use your own judgement.

### **Boiler fittings**

Test fit the chimney, steam dome and two sand domes. Make sure that they stand upright on the boiler and are central. The best way to fit them is to heavily tin the base, place in position, flux and heat the casting with a blow torch. As the solder melts the casting almost always drops and ends up slightly crooked, so be ready with a small screwdriver to prod it back into position. You can reflux and reheat a casting as many times as you like to get it right, but never heat the boiler direct and do not allow the casting to get too hot as small ones can be melted with a blow torch. You may not notice immediately from the pictures but the steam dome can be either way round. This may be as originally fitted or after rebuilds but the hose reel, when fitted, will always be on the sand dome furthest from the safety valves.

If you are fitting the hose reel you will have to either assemble the parts to the dome first then glue it in place, see sketch, or solder the dome in place and fit the hose reel after, whichever you find easiest. There are two different reels supplied, 42 with its supports 43 being generic and not very accurate but easy to fit, or 50 with extra supports 43 which is much more accurate but awkward to fit. In both cases fit the supports while the reel is still flat then fold up the ends, curve to fit and solder in place. 42 just drops onto the dome and sits on top of the sanding mechanism whereas 50 will need positioning squarely and held while fitting. I would suggest 145° solder where the top plate touches the dome. The side strips on 50 can be removed after fitting then the edges cleaned up with files.

The regulator needs a hole drilled in the dome, see sketch for details. There is no drill start as the dome can go either way round. Solder a 40mm length of 1.2mm wire into the front hole and 50mm of 0.6mm wire into the rear hole. The front wire needs to be curved as shown and the assembly is best glued in place. Fold the regulator support 51 to shape, offer up to the firebox and mark the holes. Drill 0.5mm and solder wire into the holes in 51. Push out the rivets in the regulator lever 52, fold double and solder. Attach to 51 with wire and try for fit in the holes in the firebox. Trim the regulator rod so it ends in front of the lever. You can fit this now or leave it to after painting as you wish. A short length of tubing over the end of the regulator rod will finish it nicely.

Fold the strip on the lamp platform 53 double and fold the ends down. Position this on the smokebox front overhanging the front by about 1/3<sup>rd</sup>, bend the rear tags so that the platform sits level and the tags lay flat on the smokebox. Solder in place and either solder or glue the lamp in place. The lamp can be glazed with clear plastic if you wish.

### **Cab and tank fittings**

There are two different whistles supplied, one to go on the roof and the other either on the dome or the cab front. The roof whistle needs two holes 3mm apart, usually on the centre line but sometimes nearer the right, the dome whistle needs a single hole in the dome top and one in the cab front for the cord. The cab front version uses the bracket 49 and is usually central or to the left with the top of the whistle at about roof level. A hole will be needed in the cab front below the whistle for the pipe.

Some locos have tank level taps and/or lubricators on the front of the tanks. Drill appropriate holes as shown in the sketches. The taps are made from 0.5mm wire with a twist of fine wire to represent the handle, see the sketch for the boiler try cocks. The lubricators just need the pipes curved to disappear into holes drilled in the wing plates and the bodies soldered to the plate a few millimetres above the holes.

The water lifter lever 58 is inside the cab frame 1 and fits on the spigot near the bottom of the lifter. The lifter usually sits on the tank top just behind the water filler, the exact position is not important as they varied a lot but most were about halfway between the centre lines of the dome and water filler with the base against the inner lip of the tank. Drill a 1.5mm hole 8mm down from the top of the dome and fit the valve and its hand wheel. The pipe of the valve can point down or forward with the pipe curved to suit so that it fits in its hole. I have not found anything really suitable to replicate the water hose. I have been told that electrical wire works but I find that it doesn't like staying coiled up. If you can source single core wire rather than multi strand around 1.5 to 2mm outside diameter, that might work.

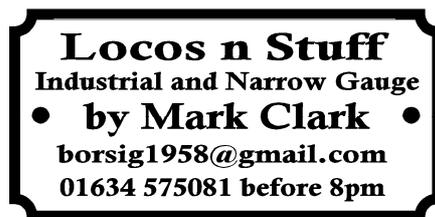
Interior cab details can be fitted now or after painting as you wish. Solder the hinge 47 to the firebox door 46 and glue in place. There are a lot of variations in cab interior fittings including different types of lubricator, gauge glass and pipe work. I have supplied most of the common parts but feel free to add any other bits you might like. The three things that I can find no pictures of are the pressure gauge, injectors and hand brake. I have included a generic pressure gauge which is better than nothing but I have no idea what form the injectors or handbrake take so I have supplied nothing. If anyone happens to photograph one on a visit somewhere, email it to me and I will make castings from that.

Check all the castings for drill start dimples and drill out to take the wire size indicated in the sketches. Fold all the hand wheels double and solder to the tap spindles. The displacement lubricator is best soldered to the cab front where shown in the sketch. Fill the two holes with PVA glue which will dry mostly clear to represent the inspection windows. Bend all the wires (pipes) to shape before trying to fit them then spring them into place, they can be secured at one or both ends with glue or solder as you wish. The ones that go down to floor level turn forward then down behind the rear wheels. The heavy injector feed pipes can be cut to end against the front bulkhead about 4mm above the floor.

The steam fountain is one of several types used on Brigadeloks and will look pretty convincing if pipes are fitted to all the outlets, just run them in all likely directions unless you happen to have good pictures of the real pipe runs. If so please email them to me at [borsig1958@gmail.com](mailto:borsig1958@gmail.com).

That just about covers the entire kit and I hope I haven't missed too much. This was supposed to be my first kit and was started 4 years ago, but I decided it was too ambitious and did the Joffre instead, basically I chickened out. The whole thing had to be redrawn due to me changing CAD program when I carried on after finishing the Joffre, CAD programs are not 100% compatible, not enough to produce accurate etches anyway. I hope you enjoy it.

Any problems or queries email me at [borsig1958@gmail.com](mailto:borsig1958@gmail.com).



## **0-8-0T Brigadelok**

### **Chassis assembly**

You will need to assemble the chassis at least to the point where it has wheels before starting the body. It is best not to completely finish it as the rods and valve gear are bound to suffer some damage with all the extra handling involved.

#### **Valve gear pins**

The pins supplied are needlework pins which will need their heads reduced. Put a pin in the chuck of a mini drill and, with it running and the head of the pin resting on a piece of wood, apply a file to the side and top of the pin head. You are after a head around twice the diameter of the pin and around half the depth of the head as supplied. Do enough to complete the model now and they will be ready when needed.

#### **Basic chassis**

The chassis comes with compensation and hornblocks on all axles. If you want to build the chassis rigid, blanking plates 36 are included and you won't need the hornblocks. Fold the plates according to the sketches and solder in place from behind the frames. Solder only around the fold up square part and not the half etched areas. When fitted, cut away most of the half etched areas so you can get to the slots for the frame spacers.

As a rigid loco, performance will be seriously compromised as never more than three or four wheels will be on the track at any particular time. Power pick up will be reduced and derailing is much more likely. Since everything is included for compensation, why not give it a go.

The rigid blanking plates double up as hornblock guides, so put them aside until needed. Cut out the frames 1 and 2, fold down the top strips and solder a rivet strip 23 under each one. One end of the rivet strips has three rivets then a gap, this goes to the rear. Fold up all the bottom strips, curving the extension on the rear one to follow the frames. Solder rivet strips 22 above all the short sections, the lengths will match. Solder rivet strips 30 and 31 around the rear section. Solder 14BA nuts over the compensation holes between the rear two axles.

Select the spacers 4 – 7 for your gauge, the wider being 16.5mm, narrower 14mm. They should all look like No 4 but due to over scale flanges and some other model related considerations, 5 – 7 have had to be trimmed to fit. Fold the top strips down and check that they all fit in their relative positions and put to one side. The angle on 4 points forward, on the other three it points backward. Locate and clean up the rear buffer beam 8 and stiffener 9, front plate 3 and front buffer beam 10 for your gauge, also the front angle beam 11. Push out the rivets in parts 8, 10 and 11 and fold where shown in the sketches. If you are going to use the German couplings supplied you need to do nothing at the moment, but for other types you will need to open out the square half etched patch to the size required for your couplings. There will be more than enough room behind both buffer beams for anything you choose.

Solder spacer 4 squarely into its slot in one frame and spacer 7 into the other frame. Put the two frames together and solder the other ends of the spacers. Take five minutes out to check that the frames are 100% square in all respects and correct them if they are not. Spring into place and solder spacers 5 and 6. Fit the front plate by engaging the slots with the ends of the frames, it should be a fraction below the tops of the frames. This fraction can be measured by holding the top plate 12 in place and lining the front plate up hard underneath it. The front buffer beam 10 needs to be 1mm up from the bottom of the front plate. Use 12 to position the front girder 11 which should also be hard underneath it, and central, best to measure it or it will look silly if it's not spot on. Position it, remove 12 and solder in place.

Locate, clean up, rivet and fold the rear gusset plates 13 and 14 for 14mm, 15 and 16 for 16.5mm. Fold the rear buffer beam and solder in the stiffener, slots facing into the loco. Position over the ends of the frames engaging the relevant slots and solder flush with the frame tops. The gusset plates plug into slots in the frames and the side parts of the buffer beam are soldered to its top edge, see sketch. Finish by riveting and folding the cab steps 35 and soldering where shown, they must be level. Finally fit the top 12 after folding the eight small tabs double onto the top. The rear edge should line up with the corner where the frame top changes level.

## **Hornblocks**

**If you HAVE used High Level hornblocks before, stop and read this bit.**

Fold up the hornblock etches according to High Level's instructions and fit brass bearing into each one. Don't try to do a proper "fitting" job on them yet as this is best done after soldering in place. On this loco the horn guides are used as a cosmetic feature and the guides are fitted from the outside, not the inside as is usual. Fit a horn guide centrally in one of the rear slots with the side guides pushed up as far as they will go and solder in place. Put one of the axles through this hornblock and thread another on the other end. Position this second hornblock so that the axle is dead square to the chassis and tack this guide in place. Make 100% sure that the axle is really square then solder the guide fully.

Loosely assemble the chassis, axles, remaining six hornblocks and the two hornblock guides 36 as shown in the sketch. Gently manoeuvre this lot over the jaws of a vice so that you can clamp the axles lightly, holding it all together. Lift the top 36 up a little and solder the three upward facing horn guides in place, gently remove from the vice, reverse and repeat with the remaining three horn guides. This can be done without a vice but becomes more of a juggling act. You can of course use the traditional method of hornblock jigs and the outside rods if you wish.

Remove the hornblock bearings and "fit" them one by one, marking each with an indelible pen as you do. I use blue for one side and red for the other, making them with dots, one, two, three or four. Once "fitted" to a particular guide, the blocks must not be moved around or fitted a different way up as they won't necessarily fit well elsewhere. Fitting means to rub two opposing faces of the bearing on very fine abrasive paper until you achieve an easy fit with no slop. Check also for solder showing around the joins from when you fitted the guides; scrape out any visible with a knife tip. Once "fitted", check the axles are free to move and ease the bearings if required. Check that each axle can twist (lift one end only up) and still turn freely. If your track has vicious curves, remove the short stub on the inside of the bearing to give more free play.

## **Wheels**

Study the wheel sets shown in the sketches to see how they fit together. The blackening on the wheel treads, flanges and some of the back needs removing as it does not conduct electricity. The easiest way is with a rotary brush in a mini drill. It can be done on the axles as supplied or loose as you prefer. See the sketch to see how much needs removing.

Remove the wheels from the axles supplied, trim off any plastic bush protruding from the face of the wheel and put to one side. Assemble the bottom half of the gearbox, thoroughly wash it and put this with the wheels. Cut the axles to length, 28.7mm for 14mm gauge and 31.0mm for 16.5mm gauge. Dress the ends with a very slight chamfers to ease assembly and put with the wheels. Assemble the outside cranks as shown in the sketch. Use 3 layers of etch per crank, spares are supplied, thread onto an oiled broach, line up the layers and solder. Counter sink the rear of the small hole with a drill bit, fit a crankpin screw and solder. Open the larger hole until it just fits on the axle. File the back of the crank flat then thoroughly wash them and put with the wheels.

Push the wheels onto the axles remembering to include the gearbox part and final drive gear on the rear one and two plastic washers between one wheel and the gearbox. The gearbox open side needs to face forward or there won't be enough swing at the pivot to position it right. Set the wheels to gauge, ensuring that they are central with an equal length either side and that they run true. Set the gearbox central and push the gear to touch the gearbox inner face on the side with the two plastic washers. Fit a plastic washer on each end followed by the correct horn block and fit in the frames. Push a crank onto the end of each axle and check the side play you have available. It will be limited by either the outside cranks or the plastic washers hitting the horn blocks depending on the accuracy of your assembly so far. You must decide how much free play to allow. On the front three axles you need around 0.5 – 1mm but you can have as much as you like on the rear axle.

To reduce free play, add washers 50 either between horn block and crank or horn block and plastic washer. To increase free play file the lip off the back of the horn block and a little off the back of the crank. You still have to fit the rear compensation beams 21 to the rear two axles so, to allow for this, add a washer 50 next to the plastic washer at each end of these two axles. They will be removed on proper assembly later. Double check that the axle ends can still be moved up and down independently and address any sticking issues.

## **Compensation**

The compensation method used here is a combination of two different methods used on 0-6-0s, both of the three point principle. The front beam bears on the middle of the front two axles, giving a fixed point at the centre of the beam. The rear twin beams work on the outside of the rear two axles and pivot on two points, one on each frame. This gives two more mounting points, one on each side. This means that all four axles are floating, there being no fixed rear axle as most compensated locos have. It also gives the smoothest ride, best power pick up and replicates springing as closely as can be done. The real springs on the Brigadelok were compensated and, although this is included in the castings etc, it is purely cosmetic.

Locate the front compensation supports 37 which were in frame spacer 5 and the rear beams 21. Open the holes in the two 37s to take 1mm wire and solder them over the edge of frame spacer 5 about 8mm apart. Cut a 10mm length of 1mm wire and a length of 1mm bore tube that will fit loosely between the 37s. Hold the tube in place and thread the wire through, oil the gaps and solder from the outside. Add a 22mm length of 1mm wire centrally across the tube and solder in place. Do not oil anything else on the chassis at this stage as it can mask problems.

Check that 14BA screws will fit into the nuts soldered to the rear frames, and then countersink the frame holes from the outside so that the screw heads are mostly sunken. Cut the screws so that they are around 3 – 3.5mm long and insert from the outside by two turns. Check that the screws will fit in the holes in the beams 21 and open the slots so that they are an easy fit on the axles. Take out the rear axles, remove the temporary washers and replace with the beams. Refit in the frames positioning the beams so that the screw will enter into the hole when tightened up. Put short pieces of 0.3mm wire through the bottom eyes of the front four horn guides and try on a piece of track.

The chassis will probably be a little high at one end. This can be adjusted by gently bending the front 1mm wire to make the front rise or fall a little. Once it sits level, try lifting each axle

end in turn to check that all the other wheels stay on the track as you do, a bit of lead on the chassis top can be beneficial here. Try pushing it around curves and through points both ways. View it from above as you do this so you can watch the axles sliding sideways. The most common cause of kit built locos derailing is banana shaped frames and axles moving further one way than the other. Check that neither of these apply to this case.

## **Cranks**

Before fitting the cranks, check that there is no solder on the threads of the crankpin screws. If there is, it can be removed easiest with a rotary wire brush in a mini drill. Make sure that the bushes will screw on right up to the crank. Fold up the quartering jig as shown in the sketch and fit the axle guides in the slots relevant to your gauge. Remove all four axles but keep note of where they go and which way round.

The purpose of the jig is to ensure that the cranks are set the same on all four axles, not that they are exactly at  $90^\circ$ , but they won't be far off. Unfortunately you will have to spoil the back to back and push each wheel in 1mm or so to create space to use the jig. In a perfect world, the cranks would be a dead square push fit and could be secured with Loctite or similar. In our not so perfect real world, they will need soldering as they will not fit accurately enough. Fortunately the nickel silver axles solder easily.

Fit a crank to one end of each axle flush with the end. Apply flux, check that it is square and solder quickly with a hot iron. If you linger too long with the iron the crankpin screw may come loose and need re-soldering. Lay the axle in the jig with the soldered crank in the vertical position. Fit the crank to the other end positioning it in the horizontal position, put a tiny spot of oil on the axle cradle, flux on the outside of the crank and solder in place. Repeat with all four axles then re-gauge the wheels. If all goes well, the cranks should all be firmly soldered in place and not to the jig, and be at the same quarter to each other. Clean up the cranks, double check for solder on the crankpin threads and refit in the chassis.

## **Coupling rods**

The coupling rods 51 are laid out on the fret in the way they must be used. They can be used either side, but the front and rear ends must not be switched. Layer them in pairs as shown in the sketch and solder together after putting bends in 3mm from the end of each end rod. Locate the boss detail 45 on the body etch 3, solder into the front recesses. Open the holes out until they fit easily onto a crankpin bush. Form the steps by squeezing around a craft knife blade and open the smaller holes to take a pin. The male halves of the joints on the centre section are etched full thickness and will need filing down to around 0.5mm. File equally from both sides. Ensure that the rod joints fit together easily and fit a pin through each joint. The trick here is to apply a tiny drop of oil to the joint, paste flux to the pin at the back of the rod and solder quickly. It usually works first time but you can always do one again if it seizes up. Cut off the excess pin and file almost flush.

Put a 1mm washer 55 on each crankpin followed by the assembled rods. Screw the bushes into place and see if you can push the chassis along. The holes will probably need opening out further, try doing one side at a time then reassembling both to try again. To speed things up, try using a drill pin chuck set to just grip the bush flange. This can be pushed onto a bush and the bush screwed on or off in seconds. If you have problems picking up the bushes and getting them started on their threads, try pushing a broach into the bush from the plain end, use this to position the bush in a pin chuck, remove the broach and screw the bush on using the drill chuck.

When the chassis pushes along easily, remove one rod, lay it flat with a bush in place and file the bush almost flush with the rod. Do this for the rear two bushes on both rods. The front two need to be recessed. File a slot in the outer face of the rod to about  $\frac{1}{2}$  depth, fit the bush in this slot, lay flat and file the bush almost flush. Refit the rods but before fitting each bush, gently countersink the threaded hole before fitting each one. Double check that all is still OK, then trim the front two and rear crankpins flush each side.

Now is a good time to start the body, before the chassis gets too delicate to stand all the handling it will get.

## **Cylinders and motion brackets**

Locate the cylinder back plates 29 and push out the rivets. Locate the cylinders 39 and 40, which can be built with full wrappers or the cut away ones. If using full wrappers, curve the wrapper part to match the shape of the cylinder ends, fold the ends and solder in place. Open out the large holes to take the 2mm tube and fit a 13mm length in each cylinder, flush with the front face. Rivet the end covers 54 and solder centrally over the holes, plain ones first.

For the cut away wrappers, break off the solid wrapper at the angled line and form the separate wrapper to fit. Assemble the rest of the cylinder assembly as above. Parts 41 and 42 will form the inside detail that can now be seen. The sketches show how it all fits together. Reinforce the inside of the top folds of the cylinder assembly and radius with files, see relevant pictures. Fit short lengths of 1mm wire in the two upper holes on each cylinder and finish less than 1mm long with rounded ends. Fit short lengths of 0.6mm wire in the lower holes and trim to around 1.5mm to represent the drain cocks.

Push the tags on the cylinders through the slots in the backing plate then into the frames. They will stay in place well enough to work on but when painting is finished, the tags can be bent over a little to hold the cylinders in place. The steam pipe union plates 43 can be soldered on top of the frame top plate as shown. The larger pipe hole is at the front with the flanges angled inwards at the front. Remove the cylinders and drill through the holes in the union plate and cylinder top 1.6mm (front) and 1.3mm (rear) and fit 8mm lengths of wire standing vertically. Do not allow any of these wires to protrude under the top plate as they will foul the cylinder tag.

Fold the motion brackets 17 & 18 to shape and solder the plain layers 19 & 20 in place. Add the rivet strip 24 to the front face. Insert it into its holes and rotate the wheels. You may find that the front coupling rod will hit the bottom of the motion bracket. File away a little metal here to give clearance. Refit the motion bracket and spread the tags slightly with a knife blade to hold it in place. Make sure that the tags do not touch the wheels.

Fold the slide bars 49 in a zigzag to form a three layer strip, solder and clean up all faces. Test fit these in the crosshead castings. If the hole has obstructions, they can be cleared with drills or diamond burrs. The slidebars may need a little filing to achieve a smooth sliding fit, gently rounding the corners will help as well. Insert the slidebars in the square holes in the cylinder rear and hold in place touching the small L bracket on the motion bracket. Make sure it is parallel to the frames and solder to the cylinder rear only.

Slide a crosshead onto each slidebar. It is unlikely that they will be a perfect sliding fit as one is a casting and the other etched. Likely problems are that the slidebar is slightly too high or does not run parallel to the piston rod tube. The slidebar can be gently bent with a shallow zigzag at the cylinder end to lower it slightly and the tube can be opened out to 1.1 or 1.2mm to give more leeway. The square hole through the crosshead can also be eased a little if you have any jeweller's riffer files. Once you have got it to slide smoothly over its full travel, assemble the connecting rods 52 and brass inserts 45 as you did the coupling rods, and fit to the crosshead with a needlework pin in the same manner as assembling the coupling rods.

Trim the crankpin bushes to length in the connecting rods as before and loosely fit the connecting rods to the crankpins, with a washer 55 fitted first, and test on a piece of track. If everything seems OK, solder the slidebar rear ends under the L of the motion brackets. Make sure that the slidebars run parallel to the frames and the motion brackets are square. Re-test on a piece of track. If all is OK, carefully remove the cylinder/motion brackets assemblies and clean up any solder joints that need it.

## **Motor, gearbox and pick ups**

Fold the top half of the gearbox and trim of the sections marked in the sketches. Fit the motor loosely using the side screw holes and the flats of the motor at the sides. Fit to the bottom half of the gearbox with a shaft cut to length but no gears. If you have part built the body, try it for fit. Some material may need removing from the inside of the firebox to clear the motor and gearbox, which should be able to move around loosely in the firebox. If you haven't built the body yet then leave the gearbox at this stage until you have.

Fit the gear and bush to the intermediate shaft so that it meshes with the gears below. The worm is supposed to be a tight push fit but I find it difficult to handle like this. I prefer to open out the worm to a looser push fit and secure it with Loctite when all the fitting and testing is done. Test fit the body, and note the angle between the two parts of the gearbox when it is fitting nicely. There will still be room to fit a flywheel if you want one, but test run it first as you may find it is not necessary.

Fit the pick up mounts 38 to the frame spacer edges. The PCB can either be glued to the mounts or nuts can be soldered to the mounts and the PCB can be screwed in place. Either way it must be gapped down the centre and around the screw heads if you use that method. Use 0.3mm PB wire to make pick ups. Four twin pick ups are easiest to fit in, see the sketches, then wire to the motor. Make sure that the pick-up wires rub on the part of the wheel with the blackening removed. Run the wires up the front of the gearbox and along the under side of the motor. Tape them as shown in the sketch but leave enough flex to allow the motor to be fitted in the body. Give the chassis a thorough test with and without the body fitted to find and fix any minor running issues that may appear. A weight will be needed on the chassis when the body is not fitted.

In use the motor will tend to bob up and down when you change direction. The motor cannot be secured in place because it needs to pivot to get it in the body. Also it is on a floating axle so securing it will impair the compensation. The solution is to pad the motor slightly so that it can still move but will not make noise while doing so. There are many ways of doing this, the simplest being a strip of masking tape about 3mm wide, wrapped around the motor three or four times near the brush end. I have also used an elastic band in the same way. Some people use a blob of silicon sealant top and bottom, allowed to cure before trying. Slivers of packaging foam can also be glued to the motor. Whatever you do, it must not be a tight enough fit in the boiler to stop the rear axle moving.

## **Valve gear - preparation**

There are two ways to assemble the valve gear. A true working model can be made but would be delicate and very difficult to disassemble later, I really wouldn't recommend it. It involves using all three layers of the expansion link with the centre section of the middle one cut away, see sketch. The valve rod needs to have a T section at the rear end, using tube for the valve rod and a filed pin for the T would work well. Once assembled this would give valve gear that could be moved into forward and reverse but is way beyond the average modeller. The method shown for general assembly uses two layers of expansion link with a hole drilled in the centre of the front face. The valve rod fits into this and holds everything together. The valve position can't be changed, but at least it can be dismantled and it certainly looks fine.

Locate the valve gear parts expansion links 44, lifting links 45, lifting arms 46, fly cranks 47, eccentric rods 48 and eccentric castings. Some spares are supplied in case of accidents or loss. Study the sketches to see how they all fit together. The entire valve gear assembly hangs from the lifting links therefore, once assembled so never pick the loco up by holding in the region of the valve gear, always hold it by the tanks.

Fold the fly cranks 47 double, solder and clean up the edges. Solder 10mm lengths of 0.6mm wire into the two small holes in both cranks and file the back flush. Tin the screw and bush face of the third crankpin then fit the crank lined up with the axle centre and solder in place. Repeat with the other side. Study the sketches and pictures until you understand how the valve gear goes together. The eccentric rods 48 are supplied in two lengths, they are marked

left and right, inner and outer on the etch, but this can also be worked out from the sketches. The outer rod has an outer layer with an etched recess in its face and is paired with a plain long inner rod. This rod goes to the bottom of the expansion link 44 and sits outside the rod going to the top. The other rod has two plain layers, the longer one to the outside and the shorter to the inside. This rod goes to the top of the expansion link 44 and sits inside the rod going to the bottom.

Pair up the rods and solder together but only the boss end for now. Put a kink in the longer rod half so it will clear the expansion link and the holes line up, see sketches, then finish soldering the pairs together. Open out the holes with broaches until a needlework pin fits easily, also the holes in the expansion links, lifting links 45 and lifting arms 46. Also drill a 0.7mm hole centrally in the front of the expansion link.

Clear the holes in the eccentric castings so that they fit on the two 0.6mm wires in the fly cranks. Polish the outside of the eccentrics and the inside of the large holes in the eccentric rods so that they fit together. The eccentrics are a little too long and need trimming to length. Place an eccentric flange down and put a rod onto it. Gently file the back of the eccentric until it is almost flush. The outer rods have the eccentric flange recessed in the front face and will need a little more filing. Make sure that the back face remains square and keep the eccentrics and rods in matched pairs once they are finished.

## Valve gear - assembly

Study the drawing, sketches and pictures to see how the valve gear fits onto the loco.

Start with the pins through the top and bottom of the expansion link. Reduce the heads of all pins used using files with the pins in a mini drill. A head around twice the width of the pin and around 0.5mm thick will be fine. Push the pins through from the outside, add paste flux to the back and a tiny drop of oil to the inner pivot **in that order**, then solder quickly, 145° detailing solder is useful here. If the joint doesn't "take" first time, reflux and re-oil and try again. Do not rely on the oil to last two attempts as it usually won't. Assemble and solder the lifting links 45 with a pin in the same manner and trim all pins to around 0.5mm. Do the same with the parts on the other side.

If you have completely assembled the motor and gearbox, it will make life easier during assembly and testing if the worm is removed from the motor, or the entire motor removed if the worm is a tight fit.

Fit the valve guide casting into the hole in the back of the cylinder on one side but do not solder yet. Tack a 52mm (50mm for 14mm gauge) length of 0.6mm wire onto the top plate of the chassis 38mm back from the front edge, see sketch. This is temporary so use as little solder as possible, it could be superglued or held with tape if you prefer. Assemble the eccentrics back onto the fly crank and hang the front on the temporary wire adding lifting arms 46 in pairs between the lifting links. Cut a 2.5mm length of square tube, slip this onto a 25mm length of 0.6mm wire and insert into the guide. Fit the rear end of the wire into the hole in the front of the expansion link. Position it so that the tube is touching the motion bracket and the wire is parallel to the frames. Solder the guide and tube in place but not the wire.

Try pushing the chassis along to check clearances. There should be ample room as the valve gear hangs a fair way out from the connecting rods. Check that everything moves freely and sits parallel to the frames then solder the valve rod to the valve guide. This will hold it all together but can be dismantled by removing the eccentrics and disengaging the rod from the front of the expansion link. Assemble the valve gear on the other side in the same manner. If you find that an unexplained sticky point appears in the motion after soldering the valve rod, you may find that the rod is pressing against the expansion link and restricting its movement. Melt the solder where the rod and guide are joined and move the wire forward by around 0.5mm, this should fix the problem.

This is a good time for a track test so refit the motor/worm and give it a try. Run it with no oil at first as this will show up problems easier. Once all mechanical problems are eliminated, oil all moving parts and keep it running for a while. If you have a rolling road or a circuit to run it on, run it for five minutes or so in each direction.

## Small details

Drill out the holes in the lifting arms and in the trunnion castings to 0.7mm. Thread a 50mm length of 0.7mm wire through the trunnions to represent the cross shaft and position this over the rear edge of the motion brackets. Position the trunnions just inside the inner lifting links then solder them both to the motion brackets. Put a lifting arm on one end, break the join of the temporary wire to the frame top and slide it away to release the outer lifting link. Fit the lifting arm onto this wire followed by the lifting link just removed. Repeat with the same parts on the other side. Make sure that all parts are sitting square and are equally spaced on both sides then solder the arms to the wire, and the wire to the trunnions, do not solder the temporary wire. Reduce the heads of two pins and replace the temporary wire with these. It is safest to glue them but oil the joint first as they must not be glued solid. Cut away the excess cross shaft wire outside of the trunnions. Dress all the ends almost flush.

If you want to make the valve gear easier to dismantle, the centre part of the cross shaft can be cut away leaving 10mm each side. The centre can be bridged with fine tube (0.7 x 1.0mm is available on Ebay). This will allow both sides of the cylinder/valve gear assembly to be removed if required, but it is fiddly and not actually necessary, your choice.

Locate all the spring and hanger castings, see sketches for details. Clean off all the casting feeds and check them all for fit. Follow the instructions in the sketches for fitting the various parts. Once everything fits, solder all the pushrods to the springs. It is not necessary to solder to the frames and would be hard to clean up after. Small straps 57 are included which guide the spring push rods on the real loco. They are a pain to fit and there are 16 of them. Whether you fit them or not is up to you. They need folding into a square U and soldering or gluing in place. One goes on the top rivet strip under the top plate overhang and another just above the horn guide, see sketch for details.

Solder a length of 1.4mm rod through the brake shaft holes and add the brake mechanism casting to the L/H end with the screw vertical. Trim the exposed ends of the rod almost flush. Solder the rail guard brackets 44 to the inside of the frames as shown in the sketches. Solder lengths of 1.5mm angle to them, open side facing inwards. The lengths vary from loco to loco but 40mm at the rear and 32mm at the front are popular sizes.

## Finally

Finally, you should have run out of parts by now so it must be finished. Those of you who like to paint the chassis during assembly will have done so by now but it can be painted after assembly, just use an old brush when getting in the awkward corners. Colour choices will be Army grey or black, unless you are modelling a preserved one that happens to be in a body colour. Give it a good long test with weights on top, or the body, to eliminate any last minute issues. Mine ran quite happily at the first attempt which is always nice, particularly when it is a test build.

Any problems or queries email me at [borsig1958@gmail.com](mailto:borsig1958@gmail.com).

## SlimLiner+ 30/40/54:1 Gearbox

FEB 2003

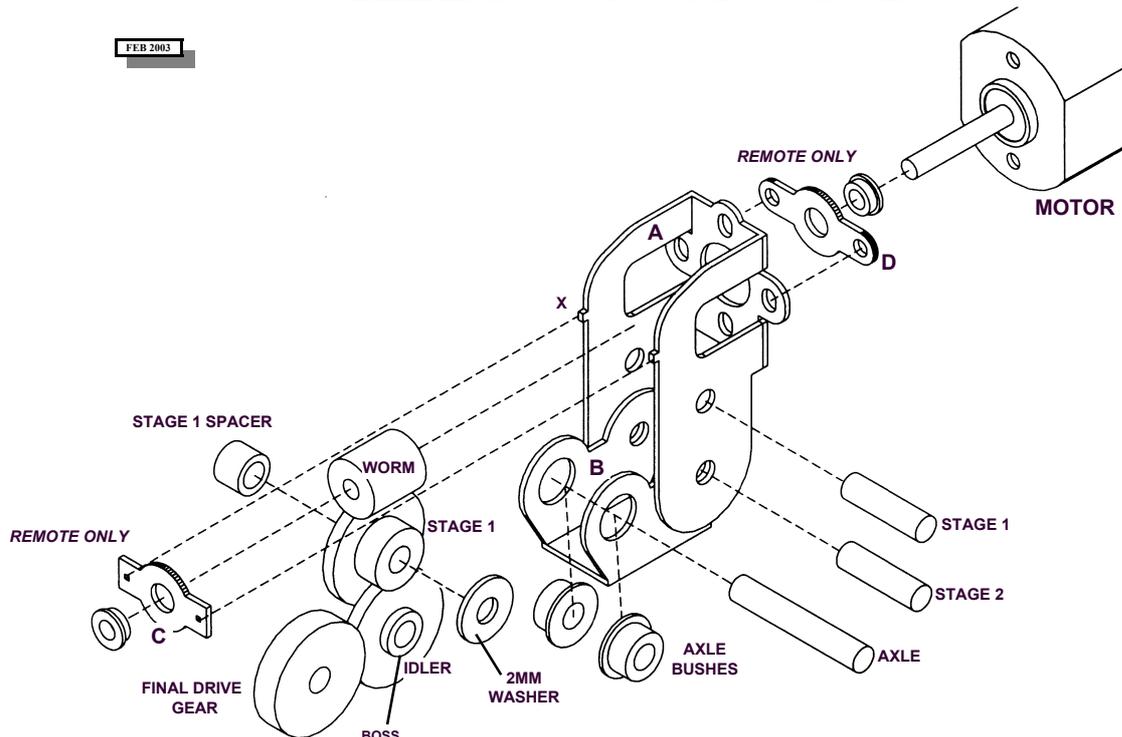


FIG. 1

Study Figs 1 and 2. Before cutting the gearbox etch from the fret, progressively ream out each of the **holes** to the sizes shown in Fig 2. Components should be offered up until they a tight push-fit in their holes. Once the gearbox is assembled, the shafts are fixed but the gears are free to revolve. Remove burrs by inserting the tip of a drill bit (of much larger diameter than the hole) and gently rotating it between your fingers.

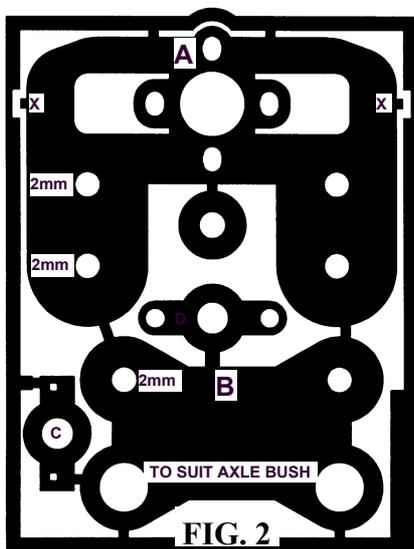
The axle bushes will be one of two types, depending on the axle diameter. Solder the **axle bushes** into place on the final drive carriage (B) with the larger-diameter shoulders on the same side of the etch as the bend lines. You can file the outside (non-shouldered) face of the bush flush or, alternatively, file the bushes to length so they eliminate any sideplay on the gearbox when fitted into the chassis. Remove burrs as above. Check that the motor mounting screws will pass through their slots and into the motor.

The kit includes the additional etched components (C, D) you will need to convert the gearbox into a remote-drive system, using cardan shafts linked to the motor by universal joints. The last will need to be sourced separately - Formil, NWSL and Exactoscale produce suitable designs. As the diameter of the input/output shaft varies between makes, you will need to provide your own bearings to fit into our remote drive attachments. Ordinary 'straw hat' bearings available from Gibson, Sharman etc. will work reasonably well but for a proper engineering job, try to get some turned up from sintered bronze. The worm driveshaft should ideally be of hardened steel (like a motor shaft) but again, the silver steel supplied with the kit will do at a pinch. Before beginning construction, read the notes overleaf, covering remote drive attachments.

If you intend to use the **remote drive attachments**, open out their central holes to accept either a 1.5mm or 2mm bore bush, depending upon the diameter of your motor shaft. Solder these bushes into their holes, making sure they sit dead square.

Now cut the etches from the fret with a heavy blade and trim off the tabs, taking care not to accidentally remove any locators. **Fold up the gearbox** (A) as shown in Fig. 1, using flat nosed pliers to grip the motor mounting plate near the bend lines when doing so. This will prevent the plate from accidentally buckling across the hole centres. All bends are 90 degrees, with the bend lines on the inside of the gearbox. Add fillets of solder to the inside of the folds to strengthen the gearbox. If you are using the **remote attachments**, open out the small location holes in the front attachment (C) so they fit snugly over the locators (X) on the main gearbox etch, and then solder it in place. Now fold up the final drive carriage (B) and strengthen with solder, as above. De-flux the gearbox and carriage by scrubbing them with household cleaner, then rinse and allow to dry. If they are likely to be visible then **paint** them black.

Using a carborundum disc in a mini-drill, cut the stage 1 and idler **gearshafts** so their length equals the overall width of the gearbox. Wear effective eye protection – cutting discs can and do disintegrate if they snag. Remove any burrs with a fine file. If shafts are a tight fit, you will only be able to pass them through both sides of the etches if they are truly square. If they won't go through, then the etches haven't been folded accurately. Light finger tweaking should put things right.



Push the **worm** onto the motor shaft until its mid-point is 6mm from the front face of the motor. The worms provided may be either **brass or nylon**, according to type and gear ratio (they are not interchangeable). The nylon type worms should be a firm push fit on the motor shaft. Some brass worms supplied to us are fractionally tighter than others and if they aren't an easy push-fit, they can be gently forced onto the shaft in a vice. Don't use excessive force or the shaft may bend. Instead, use a broach to ease the fit of the worm and then, if necessary, secure the brass worm with a small drop of Loctite 601 at the outer end of the motor shaft.

A variety of **motor fixings options** is provided, to allow for different motor types. The vertical slots will accommodate the Mashima 10 series motors (these have 8.5mm mounting screw centres) as well as narrower open-framed motors, such as the Mashima 9/16 (which have 8mm screw centres). The horizontal slots are spaced to suit the 10 series only. If possible use the latter as this will allow you to fit (and remove) the motor once the power unit is assembled and installed in the chassis. This will enable you to add wheels, valve gear and other fittings to a free-rolling chassis, and makes it much easier to identify and put right any tight spots or clearance problems. The motor can be removed or refitted at any stage of construction.

If clearance restrictions dictate that the vertical motor mounting holes must be used, we suggest that the motor is fitted before the Stage 1 gearshaft and then the latter is lightly glued at one end only. Should the motor require attention, then the gearshaft can be easily removed by gently tapping it out with a drift. If you are using these vertical motor mounting holes, you can now **fit the motor** and worm assembly onto the gearbox and secure it with the fixing screws supplied with the motor.

Refer to Fig. 1. The stage 1 double gear will be one of three types - 15/10T (30:1), 20/10T (40:1) or 27/10 (54:1) - depending on the overall reduction ratio of the gearbox. Fit the **stage 1 gearshaft**, double gear (according to ratio) the spacer bush and the etched thrust washer (with the ribbed side facing the gear) into the gearbox. Sight through the opening in the gearbox sides to check the mesh with the worm - there should be daylight between the gear and the worm, but avoid having too much backlash. Some modellers may prefer a deeper mesh (especially for a heavily loaded loco) but avoid 'bottoming out' the gears. If the mesh is too shallow, the gears may wear or even come out of mesh. If necessary, loosen the motor fixing screws, adjust the mesh and then lightly glue the shaft in place.

The **final drive carriage** can be mounted facing backward or forward, depending on the configuration you require. Offer up the final drive carriage and slot the **idler gearshaft** through the carriage and gearbox, slipping on the thin 20T. gear as you do so. (Note that the larger boss on this gear runs nearest the gearbox side). Secure the shaft to the carriage side using a tiny amount of glue. The unit will run smoothly if the final drive carriage is free to pivot about the idler shaft, but suitable restraint must be provided for the gearbox and motor in order to prevent the carriage from curling up on itself when torque is applied. It may be preferable fix the final drive carriage in one position (this position can be determined later, when the gearbox is installed).

Temporarily fit the final **brass 20T.** gear and axle into the final drive carriage. If the motor is not fitted, check that all the gears revolve smoothly. Now **test the gearbox** under power by fitting the motor and worm assembly as described above. Remove the drive axle and brass gear. Fit the gearbox into the **chassis** by slotting the axle through the frames, the gearbox and the brass gear, making sure the latter is correctly meshed with the idler gear. You may need to fit washers between the gearbox sides and the frames in order to prevent the gearbox from moving sideways on the axle. It is also advisable to fit washers behind the wheels on this axle in order to eliminate any sideplay. When you are happy with the position of the gear and gearbox on the axle, glue the brass gear to the axle using tiny spots of Loctite 601 applied with a pin. Rotate the axle to ensure an even distribution of the adhesive.

To use the **remote drive attachments** push the worm onto the driveshaft so that 3mm of the shaft is protruding and secure the worm with Loctite if necessary. Slot the short end of the shaft through the motor mounting plate and into the bearing in the front remote attachment (C). Slot the rear remote attachment (D) over the opposite end of the driveshaft and slide it up to the motor mounting plate (The gearbox can be driven from the opposite end by reversing the shaft). Work out how many washers you will need to centre the worm directly over the stage 1 gear and eliminate endfloat. Remove the shaft assembly, fit the washers on either side of the worm and then refit the shaft along with the washers. Secure the rear remote attachment to the motor mounting plate using 12B.A. nuts and bolts through the side holes. With the bolts partially tightened, position the attachment so its circular middle sits centrally over the hole in the motor mounting plate (like lining up a gun sight). Tighten up the bolts and test the gearbox. The worm and drive shaft can be removed at any time simply by unbolting the front remote attachment plate.

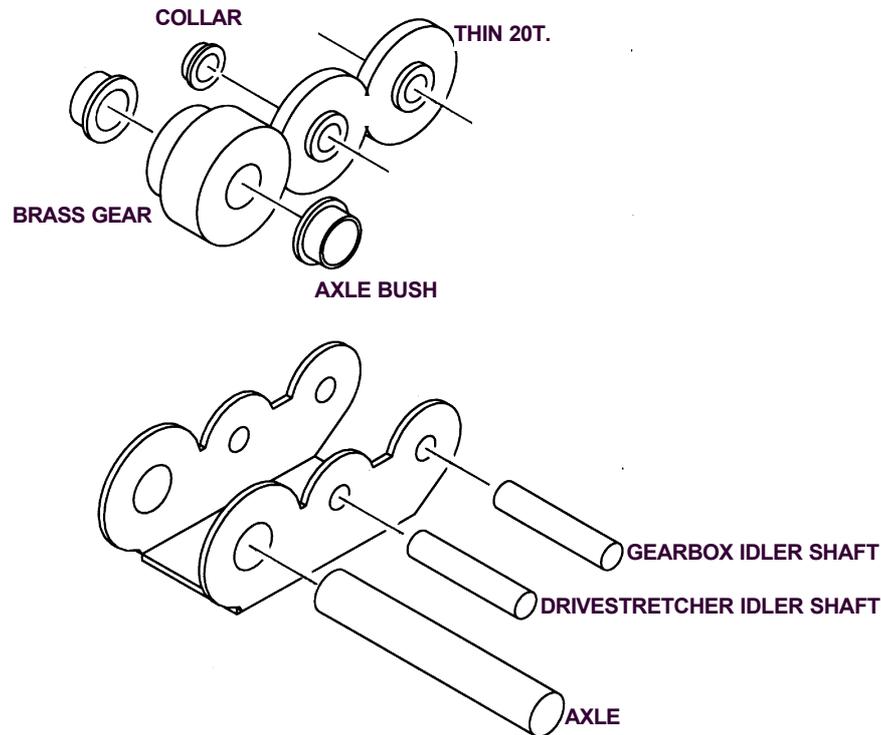
*The gears are effectively self-lubricating but a little plastics-compatible grease will do no harm. Do not use general-purpose modelling oil, which attracts dust and grit. Metal-on-metal contact areas (motor bearings, axle bushes) should be lubricated with a tiny amount of Zeuthen ultra-adhesive oil.*

FOR MORE INFORMATION ON HIGH LEVEL *PRECISION* GEARBOXES CONTACT  
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E MAIL - [ENQUIRIES@HIGHLEVELKITS.CO.UK](mailto:ENQUIRIES@HIGHLEVELKITS.CO.UK)

## D 3 DriveStretcher Final Drive Carriage (For SlimLiner+)



Study the diagram before starting work. Before cutting the etch from the fret, progressively ream out each of the **holes** to suit their shafts or bushes. Components should be offered up until they a tight push-fit in their holes. Remove burrs by inserting the tip of a drill bit (of much larger diameter than the hole) and gently rotating it between your fingers.

The axle bushes will be one of two types, depending on the axle diameter. Solder the **axle bushes** into place on the DriveStretcher with the larger-diameter shoulders on the same side of the etch as the bend lines. You can file the outside (non-shouldered) face of the bush flush or, alternatively, file the bushes to length so they eliminate any sideplay on the gearbox when fitted into the chassis.

**Fit the DriveStretcher into the gearbox** in the same way as you would fit the final drive carriage, using the **gearbox idler shaft** as the pivot. This shaft should include a thin 20T. The raised boss on the gear runs nearest the frame side. After checking the gear is still free to revolve, secure the shaft ends to the gearbox etch using a tiny amount of glue.

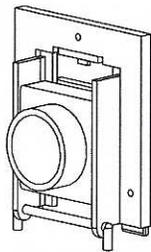
Fit the **DriveStretcher idler shaft** and gear into the DriveStretcher, along with the collar, and position and fix them as above.

Temporarily fit the axle and final **brass 20T.** gear into the DriveStretcher. If the motor is not fitted, check that all the gears revolve smoothly. Now **test the gearbox** under power. Remove the drive axle and brass gear. Fit the gearbox into the **chassis** by slotting the axle through the frames, the DriveStretcher and the brass gear, making sure the latter is correctly meshed with the idler gear.

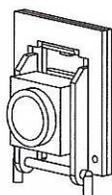
If necessary, **fit washers** between the outside faces of the carriage and the inside of the frames, to stop the gearbox/carriage sliding along the axle, causing the gears to go out of mesh. The brass gear should run close up against axle bush.

*The gears are effectively self-lubricating but a little plastics-compatible grease will do no harm. Do not use general-purpose modelling oil, which attracts dust and grit. Metal-on-metal contact areas (motor bearings, axle*

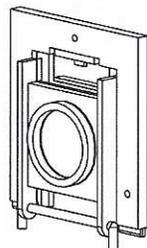
**These instructions cover three types of High Level Hornblocks:**



STANDARD



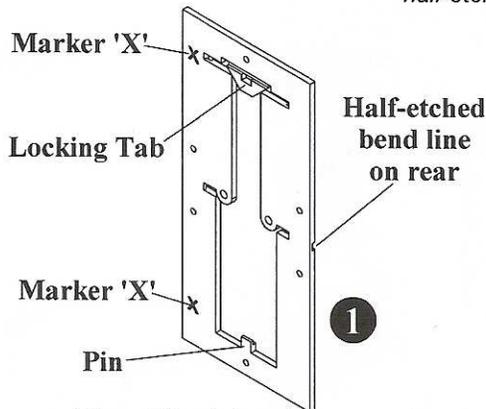
MINIBLOX



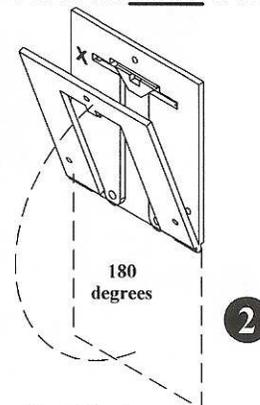
SPACESAVER

Although their size may differ, the procedure for folding the hornblock etch is the same for each type.

Fold the etch through 180 degrees, so the markers 'X' face each other. The half-etched line is on the outside of the fold.

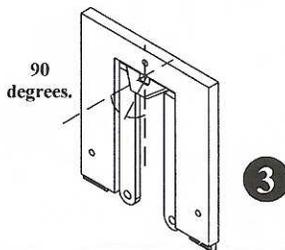


Clip out the etch and clean off any mounting tabs.

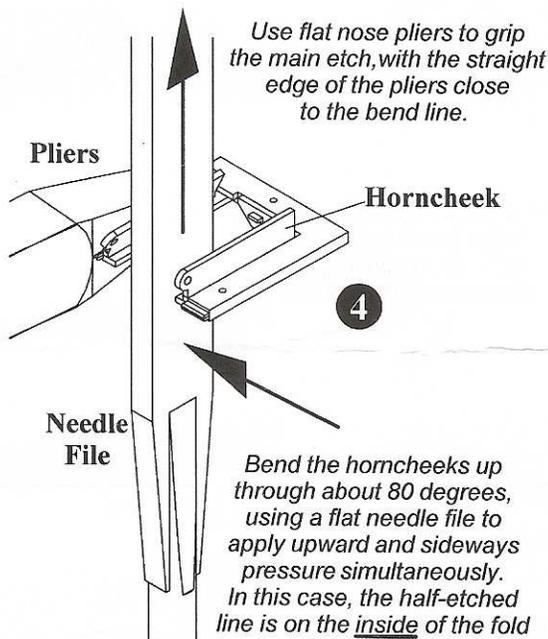


When it's folded, tap the layers between two pieces of hardwood, so they sit absolutely flat.

Hold the layers tightly together and fold the locking tab through 90 degrees, so it locates on the small pin.

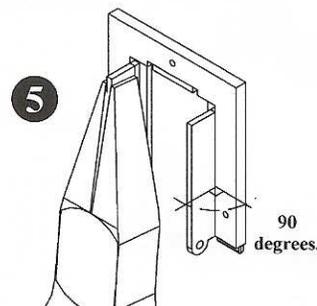


The end of a flat, pointed needle file is a good tool for this job. The tab locks the layers together, eliminating the need for solder.



Use flat nose pliers to grip the main etch, with the straight edge of the pliers close to the bend line.

Bend the horncheeks up through about 80 degrees, using a flat needle file to apply upward and sideways pressure simultaneously. In this case, the half-etched line is on the inside of the fold



Finish off the horncheek bends so they are at 90 degrees. Check this through a magnifying glass and adjust as necessary.

For SpaceSaver 'CSB' units, follow the instructions (overleaf) at this point...

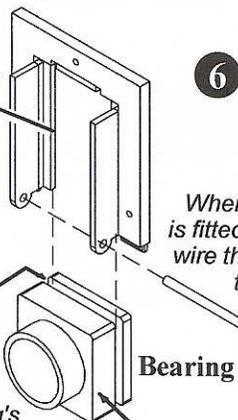
Use fine emery to clean up the bearing, remove any burrs and then try it in place - the groove on the block locates on the front layer of the etches.

If the bearing's tight in the etch, check that these edges aren't 'bottoming out' in the groove...

...If they are, use a file to remove the sharp 'cusp' from the edge of the etch...

... so there is clearance in this groove...

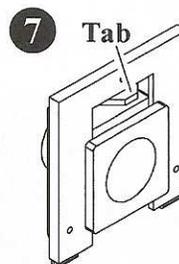
...then polish the bearing's side faces until it's a smooth, sliding fit in the etch.



When the bearing (and tag) is fitted, slot a length of 0.4mm wire through the bottom holes to keep it in place.

To fit Standard or MiniBlox 'CSB' Tags, turn to the instructions (overleaf) at this point...

The completed assembly can now be soldered to the inside face of the chassis, using axle jigs. If you fit it with the bearing in place, make sure the sliding surfaces are lightly oiled, to prevent the bearing being soldered to the etch.



The top edge of the cut-outs on most loco chassis is 4mm above the axle centre. For 'Standard' and 'SpaceSaver' hornblocks, butt the tab up to the top of the cut-out, to set the unit at the correct height.

For MiniBlox, the top edge of the tab is 3mm above the axle centreline.