

Construction Notes

2mm Finescaling kit for Graham Farish

LMS Fairburn 2-6-4T

I. Introduction

This kit has been designed to convert a Graham Farish (Grafar) Fairburn 2-6-4T loco chassis to 2mm finescale. It includes etched replacement parts for most of the valve gear, and a pony truck and bogie. The original loco chassis and motor are retained for the conversion. Significant dismantling and modification to the original model, as described below, is involved, and this will INVALIDATE ANY WARRANTY you may have. I cannot be held responsible for any damage to your model incurred during the conversion process.

Parts required to complete are: -

Graham Farish LMS Fairburn 2-6-4T	1
Pony truck wheels	2 x 6.5mm
Bogie wheels	4 x 6.5mm
Driving wheels	6 x 11.5mm
Crankpins	6 flanged recommended for driving wheel
Crankpins	2 non-flanged type for crosshead/ connecting rod join
Crankpin cap washers	4
Motion pins	minimum 2 packs, or use 0.25mm nickel silver rod
Frame bushes	minimum 6 for bogie and pony truck wheels
Replacement Grafar frame bushes	6
Wheel muffs for bogies and pony truck	3 small diameter
Wheel muffs for Grafar conversions	2 small, one moulded gear
Thin double-sided PCB (say 0.25mm thick)	2 sq. inches should suffice
Screw, nut and washer 12BA cheesehead	1
16BA washers	2
Couplings	own choice
Nickel silver rod 0.3mm	2"

Tools required include: -

Soldering iron and solder, flux
Needle files – flat, round
Modelling knife
Broaches
12BA tap
Back to back gauges
Wet and dry paper, glass fibre brush
Set of jewellers screwdrivers
Chassis frame assembly jig
Tweezers
Flat-nosed pliers

I recommend you read and understand these instructions before you begin assembly. There are a number of small and delicate parts on the etch. It's best to leave parts on the etch until actually required. All folds are made with the half-etched line inside the fold unless otherwise stated. Traces of tabs holding parts in the etch should be removed with a needle file prior to assembly. It is recommended that work done is cleaned periodically to remove all traces of flux.

A supplementary drawing is provided to assist you with the conversion.

I posted a topic on RMWeb showing some aspects of the construction of this kit. It can be found at <http://www.rmweb.co.uk/community/index.php?/topic/93874-finescaling-a-farish-fairburn-tank/>

2. Dismantling the Grafar Loco

As already mentioned, dismantling the model will INVALIDATE ANY WARRANTY you may have. As you progress through these steps, make a note of how things went together, and keep all the bits safely, labelled if you think necessary. Refer to the Grafar instruction sheet for additional guidance. Note that there are a number of delicate plastic parts on the model, so be as gentle as possible as you take the model apart. If you are unsure how to proceed at any given point, please get in touch and I will try to help, but I will not accept liability for any damage you inflict on your model.

2.1 The Grafar instructions explain how to remove the loco body from the chassis and I tried this but found the exercise difficult, so I gave up. I did manage to remove the back end of the body, exposing the connections for the decoder, but there is no need to remove the back end either to carry out the conversion. I suggest you do try to remove the body, to reduce the risk of scuffing or damaging it.

2.1 I started dismantling the loco by removing the pony truck and bogie, then unscrewing the hexagonal screws retaining the coupling and connecting rods. Then remove the keeper plate and this should allow the driving wheels and coupling rods to be removed. Note that the front sandpipes get in the way of removing the keeper plate so need flexing out of the way or prising away from the chassis altogether. They are easily replaced at the end of the conversion work.

2.3 Next remove the expansion link. I did this by easing the motion bracket housing for the link open while at the same time twisting the expansion link so that the outside end of the expansion link pin was released from the hole in the motion bracket. This released the expansion link/ eccentric rod/ return crank assembly. I managed to fracture one of the plastic motion bracket assemblies when I did this. If you do too, just leave the motion bracket well alone until you insert the new expansion link assembly, then repair the bracket with a drop of superglue.

2.4 Next step is to remove the radius rod from the plastic moulding for the reversing lever rod and connecting lever, and remove the latter from the chassis block. If the pip on the inside of the plastic moulding connecting it to the radius rod comes off during this operation, then replace the pip with a short (3mm) length of 0.3mm nickel silver rod.

2.5 Prise the sidebar assembly away from the back of the cylinders and release the connecting rod/ crosshead assembly. The crosshead castings are quite delicate so proceed with caution for the next bit. File the head of the lug on the crosshead retaining the union link down until the union link can be removed. Do the same for the lug retaining the connecting rod. With both rod and union link removed, continuing filing the lugs away until they have almost completely disappeared. At this point mark the centre of the lugs and drill holes through the crosshead for the connections for the new union link (0.3mm) and crosshead (0.5mm). Finally remove all remaining traces of the lugs.

2.6 Remove the driving wheels from Grafar gear muff axle and slide the gear off the axle if you want to use the gear as an alternative to the Association version.

3. Valve gear assembly.

(Refer to supplementary drawing for general arrangement of the various parts of valve gear. If you have never assembled valve gear before, the chapter on the subject in Pete Wright's book is well worth reading).

3.1 Solder together pairs of coupling rods, connecting rods, combination levers, eccentric and radius rods (a single layer will bend too easily), fluted sides being on the outside. When the parts have been soldered together, clean up any excess solder, and remove any traces of attachment tabs remaining on the parts. Do this for the single layer parts too. Form 'kinks' in the combination levers and return cranks as shown in the drawing. These bends provide clearance past adjacent parts of the motion when the loco is moving. The pictures below gives some idea of what's required.



3.2 The valve gear can be joined together using 0.31mm nickel silver rod or Association rivets. I will describe the former method, using the link between the combination lever and the union link as an example. Before starting, open out the small holes of the items to be joined, and any washers, with a 0.35mm drill, and file the areas around the holes smooth with a needle file.

The bottom end of the combination lever is attached over the top of the union link. First then, put a 10mm length of rod vertically in a vice. Place a piece of greaseproof paper over the rod, then place the union link upside down on the rod. Hold the union link down and solder to the rod. Place this assembly back in the vice, right way up, then put a piece of greaseproof paper on the rod over the union link. Put the bottom end of the combination lever on the rod, then another piece of greaseproof paper, and finally a small etched washer. Hold the washer down on the union link etc and solder the washer to the rod with a quick dab of your soldering iron. Check that the combination lever rotates, even if stiffly. Remove the assembly from the vice, and carefully pull the two bits of greaseproof paper away from the joint. Rinse flux residue away with water, dry the assembly and clean up with a glass fibre brush. File the back of the joint flush, and file the other end of the rod until no more than 0.25mm protrudes above the washer. If you solder the joint up solid, you will need to dismantle the parts, clean them thoroughly to remove all traces of solder and start again. The following parts are joined together in similar fashion:

Combination lever top end on top of the front end of the radius rod
Eccentric rod front end on top of the expansion link
Eccentric rod rear end on top of the return crank narrow end

3.3 Solder a short length of 0.25mm nickel silver rod in the top hole of the expansion link, and file the rod back until about 0.75mm protrudes either side of the expansion link.

You should end up with two separate sub assemblies for each side: the union link, combination lever and radius rod, and the expansion link, eccentric rod and return crank.

4. Front bogie

4.1 Remove the bogie sideframes from the etch, clean up as usual and open out the axle holes so that a frame bearing fits snugly in the hole, then solder in place. File the outside face of the bearings flush with the frames, and open them out until an Association wheel spins freely in the bearing. Note that the bearings need to be inserted in the holes from the inside of the frames, and the fold down section (side control bolster?) in the middle of the top of the frames fold out away from the bogie centre.

4.2 Solder a 12 BA nut over the hole in the bogie spacer and remove excess solder with a 12 BA tap. Then fold down the outer ends of the spacer to right angles with the middle section.

4.3 Cut thin pcb pads slightly larger than the bent up outline of the spacer and solder the pads to the inside of the bogie sideframes as shown by the hatched area in the supplementary drawing.

4.4 Solder the bogie spacer to one of the sideframes, ensuring the hole in the spacer is midway between the axle holes and check the spacer is electrically isolated from the side frame. Place this sideframe on a frame assembly jig, then other sideframe, tighten up with the bobbins and solder the spacer to the second frame. Check both frames are isolated from the spacer.

4.5 Bend the guard irons to shape as shown in the supplementary drawing, and bend the side control bolsters down to right angles with the frames. You may want to further embellish these rather basic representations with additional layers or bits of scrap as you see fit.

4.6 Prepare two small diameter axle muffs by drilling 1mm holes right through the muffs about 1.5mm either side of the middle of the muffs, then ream the muffs until the bogie wheels are tight but easily removable from the muffs.

4.7 Insert the bogie wheels in the frames and muffs, with the muffs centred in the middle of the bogie. Set the back to back of each wheel set, check the wheels run free and true and then drop some superglue in all the holes in the muffs.

4.8 Solder a 12 BA washer over the top of a 12 BA screw, and check the head of the screw passes through the hole in the Grafar bogie swing link, then screw the swing link to the top of the bogies to check it moves back and forth OK. Be careful to make sure you use the right hole for this as I recall that the two holes are different.

5. Pony truck

5.1 Open out the holes in the pony truck side frames and solder frame bearings, shaped as shown in the supplementary diagram, in place on the inside of the frames. File the outside of the bearings flush with the outside of the frames. Ream the bearing holes so that a wheel spins freely in the holes.

5.2 Solder appropriately shaped pieces of 0.25mm PCB to the pony truck side frames. Form right angle bends in the pony truck spacer using the half-etched fold lines, and solder the spacer to one of the side frames. Mount this on a loco frame assembly jig, then add the other side frame and the remaining part of the jig. Then solder the spacer to the side frames and with the frame spacer jig removed check that the side frames are in line with each other as viewed from the side.

5.3 Insert a small diameter muff, prepared as for the bogie axle muffs, between the frames and then insert the pony truck wheels into the muff, set the gauge, and check that the wheels rotate freely. If so glue the wheels in the muff.

5.4 Bend the guard irons as shown in the supplementary drawing. Kink the section between the pivot point and the front section as per the supplementary drawing to set the front end of the truck to the right angle in relation to the track. The etch includes several rings the same size as the pivot for the pony truck to be used as packing to help get this right.

6. Re-assembly

- 6.1 Drill 1mm holes 1mm either side of centre line right through the three Grafar conversion muffs including the one with the gear moulded on, and ream them until the Assoc driving wheels are a firm fit inside the muffs
- 6.2 If you are re-using the Grafar gear, open out the hole in it until it's a force fit on a standard 2.3mm diameter muff, position the gear centrally on the muff and superglue in place. Then reduce the width equally on each side until it's the same as the Grafar conversion muffs, and drill 1mm holes through the muff as before.
- 6.3 Solder flanged crankpins into the holes in the driving wheels. Then solder or glue the driving wheel balance weights onto the wheels if you wish though you may want to leave this until the coupling rods and valve gear have been attached if you intend to glue the weights on. Refer to the Grafar wheels for positions of the weights on the wheels.
- 6.4 Assemble the driving wheels on the muffs with the Grafar bearings either side of the muffs, and the raised ridge on the bearing nearer the centre. Set the back to backs of the three sets of drivers and drop into the slots in the loco chassis. Check the wheels spin freely. For the geared axle, use one of the outer chassis holes for test purposes.
- 6.6 Remove the three sets of drivers, and quarter them approximately by eye, then put them back in the chassis. Line up the crankpins on one side of the chassis and keep them in line, then turn the wheels on the other side until the crankpins are in a line on that side too. Attach the coupling rods temporarily, and check that the rod on each side is horizontal.
- 6.7 Re-attach the keeper plate and apply power to the motor via the wheels. Run the motor slowly, and observe the position of the crankpins in the coupling rod holes at any point where binding occurs. Open out the crankpin holes where binding occurs, and re-test. If all appears OK on one side of the chassis, repeat the process as you inspect the other side until the driving wheels rotate without any binding. When you are satisfied that the quartering is correct, remove the keeper plate and drop superglue into the holes in the muffs.
- 6.8 Now the coupling rods can be attached, with washers on the front and rear wheel crankpins only. Put larger washers on each of the three crankpins, then put a piece of greaseproof paper over the outer pins, then the coupling rod, more greaseproof on the outer pins, and another washer. Solder the top crankpin washer to the crankpin while holding the washer down, but not too firmly. Check the two wheels rotate, then remove the greaseproof paper and do the other side of the chassis.
- 6.9 Rinse the four crankpins with water to remove any traces of flux and dry thoroughly. Avoid getting any water near the motor. Trim the crankpins to about 0.5mm above the washers, and clean up any stray solder with a glass fibre brush.
- 6.10 Insert a crankpin through the hole in the crosshead after first filing the head down to about half its height. Mount a connecting rod over the protruding crankpin, then a piece of greaseproof paper, then the small round Grafar disc. Keep this all pressed down and retain in place by soldering one of the larger etched washers on end of the crankpin. Check the connecting rod swing freely up and down, then wash the assembly in water to remove all traces of flux. Insert the crosshead assembly between the slidebars and check the crosshead slides smoothly along the slidebars. Repeat this for the other crosshead and connecting rod.
- 6.11 Remove the crosshead assembly from the slidebars, and insert an 'L' shaped piece of 0.3mm rod through the hole at the bottom of the crosshead. The shorter side of the 'L' should be about 1mm long and be positioned on the inside of the crosshead. The longer side of the 'L' needs to be say 5mm long. Place the free end of the union link previously attached to the combination lever over the rod protruding from the crosshead. Then put a piece of greaseproof paper over the rod and union link, and finally one of the small etched washers. Keep the washer held down and solder it to the rod. Check the union link swings freely then remove the greaseproof paper and wash the assembly as usual. Trim the rod to about 0.25mm above the washer. You can glue the short part of the 'L' behind the bottom of the crosshead, but this is not essential. Repeat for the other crosshead and union link.
- 6.12 You should now have the crosshead connected to the union link, combination lever and radius rod. The final stages of assembly of the motion can now be dealt with. Things start to get a bit fiddly from now on! Clearance between the upper end of the combination lever and the slidebars is limited and it is worth filing the inside face of the cosmetic plastic valve spindle guide away slightly so that the join between the combination lever and the radius rod is kept as far away from the centre of the chassis as possible. You might also want to file a slight chamfer along the top edge of the crosshead, especially at the front end. This will give extra clearance for the combination lever where it kinks outwards past the crosshead.
- 6.13 Insert one of the crosshead assemblies inside the slide bars and pass the rear end of the radius rod through the slot in the face of the motion bracket. Then re-insert the slide bar assembly into the rear of the cylinder on the Grafar chassis. Ease the slide bars between the apertures in the plastic slide bar brackets, and check the crosshead moves freely between the slidebars.
- 6.14 Squeeze the plastic lifting link assembly into the rear hole in the radius rod using the lug on the inside of the lifting link. Then insert the lifting link into its locating hole in the Grafar chassis. Check again that the crossheads slide freely along the slidebars. Secure the lifting link in the chassis with a drop of superglue.

6.15. Twist the expansion link into place between the motion bracket and the radius rod so that the pin in the expansion link engages in the holes in the motion bracket and the radius rod, and check that the expansion link swings back and forth freely.

6.16 Place a 16BA washer over the middle driving wheel crankpin, then a piece of greaseproof paper, then the connecting rod, another piece of greaseproof paper and finally the return crank.

6.17 Position the return crank so that the join between it and the eccentric rod is just forward (c. 1mm) of the centre of the driving wheel boss when the crankpin is in the bottom centre position. Have a look at prototype photographs if you need to clarify this. Then solder the return crank to the crankpin with the upper end of the return crank held angled outwards away from the driving wheel. Check driving wheels still rotate back and forth slightly. If you have soldered the join up solid you will need to unsolder the return crank and connecting rod, thoroughly clean away all traces of solder from the crankpin, connecting rod and return crank and start again.

6.18 If the driving wheels are now moveable, remove the greaseproof paper, rinse the join with water to remove any flux residue, and clean up the joint with a glass fibre brush and a needle file. The crankpin should be filed almost flush with the return crank so that the top of the crankpin passes under the inside of the return crank as the wheels rotate.

6.19 Repeat 6.10 to 6.18 for the other side of the chassis.

6.20 The running of the chassis can now be tested. Run the loco slowly under power. If the wheels stop rotating suddenly, it's likely some part of the valve gear is catching. Cut the power and inspect the valve gear carefully to identify the problem. Possible causes could be the bottom of the expansion link catching against the connecting rod, the middle crankpin catching the return crank or the combination lever catching the crosshead. It's possible to correct any of these issues by filing or sanding away with wet and dry paper the relevant parts to create more clearance. If the wheels rotate without any obvious catching, but with a degree of stiffness, you can try further cleaning of the soldered joints with a glass fibre brush. A likely candidate causing stiffness is the joint between the return crank and the middle crankpin.

Some modellers frown on this, but an alternative method to improve the running is to put small amounts of CIF on the soldered joint of the valve gear and crankpins, and run the chassis under power, slowly at first, then gradually increasing the speed, and reversing the direction of movement now and then. You must be careful to keep any moisture away from the motor while running the chassis and when you clean the CIF away, which must be done thoroughly to avoid continuing wear in any of the joints.

6.21. Once you are happy with the running of the chassis, lubricate all the joints, the gear wheel and the axle bearings with lubricating oil and re-test the running. The oiling round should make a difference to the smoothness of running.

6.22 The etch includes parts to make a pair of front steps, not provided by Grafar. The main frame for the steps is on the etch just under the washers. Fold the outer sections to right angles to the middle section, and solder a middle step into the notches in the legs. There are four of these, including two spares. Clean up any excess soldering and epoxy in place under the grab handles on the front platform.

6.23 Replace the loco body if previously removed, then the pony truck and bogie using the original Grafar screws, and that's it for the construction work!

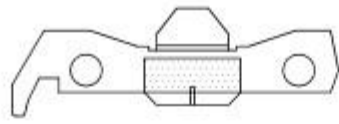
7. Painting etc

7.1 The loco driving, bogie and pony truck wheels, bogie and pony truck can be painted after any soldering work has been completed and prior to final assembly. You may find that the valve gear paintwork gets chipped during final assembly so you might consider painting the valve gear once it's assembled and fully tested. The front steps can be painted before or after attaching to the loco.

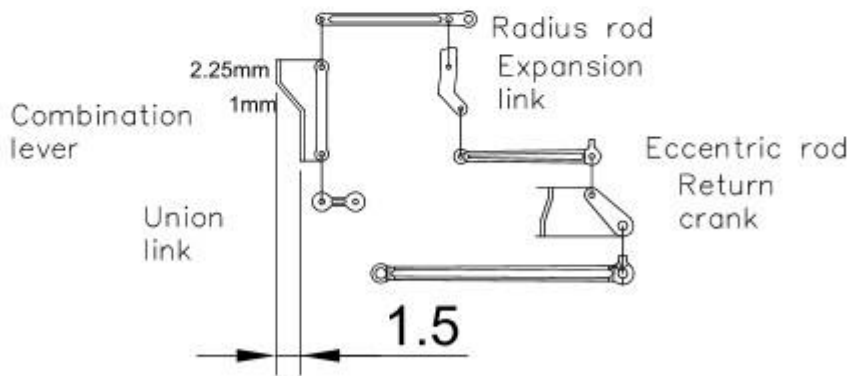
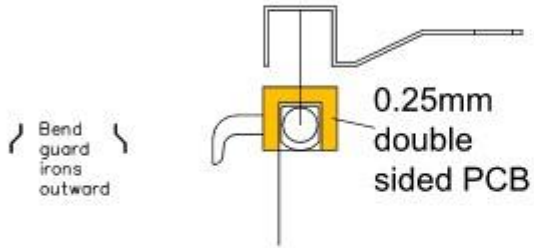
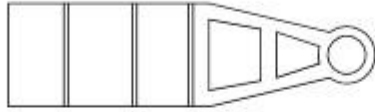
7.2 Once all the paintwork has been completed, you can re-attach any other bits you may have removed, such as the sand pipes on the side of the loco chassis, and the various accessories included with the model.

References

- 1 Stanier Locomotive Classes, A.J. Powell
- 2 Loco Bits and Pieces, Pete Wright



Bend
guard
irons
outward



Open out left and
centre crankpin holes
to ease quartering