SER-Kits

Instructions for assembling the Cudworth 2-2-2 Mail locomotive and tender

Revision 18.3.2014

These instructions are offered in good faith, but modellers must use their own common sense in following them as SER-Kits cannot be held responsible for problems arising. Please contact SER-Kits at serkits1@aol.com with requests for further information or to make any suggestions for amendments.
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PROTOTYPE VARIANTS
The kit should make any known variation of the Mails with little or no compromise. However, for simplicity, it is sold in two versions: early Vulcan locos (including No.199 which pulled the Charles Dickens accident train) and the later Ashford variant fitted with Smith’s ‘simple’ vacuum brake. Modellers wanting to make other variants can purchase additional parts from SER-Kits or swap existing parts for a small handling and postage charge. Before cutting the etch you need to decide which version you wish to build and at what date so first read the historical booklet sold with the kit.

Can the kit make the later Mail with Stirling domeless boiler? Use a SER-Kits Stirling boiler casting. The boiler top should be set 2.3mm (4in) higher than the Cudworth with a new smokebox wing-plate. Except for the fussiest of modellers, a compromise (fudge?) is probably possible with the boiler lower than it should be, retaining the original wing-plate. If there’s enough demand (unlikely), I’ll consider putting a higher wing-plate on a future etch.

KIT DESIGN
Sub-assemblies
The kit is designed to be built with various sub-assemblies to make painting and lining possible, for example behind the springs. After completion, the whole loco body can be removed from the chassis as you would expect. To strip down the sub-assemblies will probably require removing various rods and tiny fittings.

Brass and copper fittings

Slipping driving wheels?
As pessimists told me when I started, singles are prone to slipping and I might be wasting my time. To my mind, it would be a matter of plenty of weight where it’s needed and appropriate springing. After experimenting with different combinations, my model will handle 30 axles (SER-Kits carriage and brake van kits) over 4ft radius curves on rising gradients of 1:40. There are one or two places where it was originally prone to slipping and these were all down to track irregularities. The model smokebox, boiler, firebox and ashpans are all filled with lead. The drivers are unsprung (a job saved) and the leading wheels have stronger springing than the trailing. Please read the full discussion in Appendix A.

The kit is sold with a mix of cast brass fittings and low-melt alloy castings. Firebox rear and axleboxes are electroplated LMA. The brass plating is actually a very thin layer of gold on top of copper and nickel and should be buffed up with care so as not to go through to the lower layers. If soldering the plated items, use a 70deg. solder.

Where the built-up chimney is supplied, it is in low-melt alloy with the top copper plated. The plating goes lower than necessary and discolours the rest of the casting. The whole chimney should be painted black up to and including the top beading.

NOTE: Before commencing the build, read the livery notes and decide which fittings you will retain in polished brass. Many prefer masking such parts, but others will paint certain parts separately (e.g the boiler/firebox/smokebox) and assemble as late as possible during the build. More on this later.

Frames, wheels and clearances
- The fold-up internal chassis gives frames an overall 26mm. across. They stop short behind the cylinder head/smokebox wing-plate and the frames in front of the wing-plate are a scale distance apart. This is so that the front ‘hole in the footplate’ has the correct width.
- Scale 7: separate internal spacers are provided. The GAs which I have had access to are ambiguous as to the exact width. Stirling – in his later locomotives - seems to have set the internal width as 4ft (28mm).
- The driving wheel cover (splasher) is an arc of slightly larger radius than the prototype, arranged so that the top is at the correct height. The result is that the splashers is wider at the footplate to help remove the likelihood of the wheel flange touching the inside. On the original the clearance is only around 3/4in. (0.4mm) and on a model, electrical shorting would be likely to occur. Few, I think, will ever notice the compromise.
- All loco wheels can be sprung, but only the leading and trailing need this. The tender wheels can be sprung or compensated, so read the introduction to the Tender instructions before starting it.
• Most trailing wheels were probably 4ft diameter. However, the clearance between tread and footplate is less than 2in (1.2mm), so to accommodate the overscale flanges of Finescale the etch has rectangular holes where fouling could occur.

• Ordering Wheels from Slaters:
  o **Leading**: Ashford Nos 27 & 116 for which no evidence of spoke number, could try 4ft 6in 14-spoke 7853LB; all other locos, 4ft 10in 16-spoke 7858LB (special addition to Slaters' range).
  o **Driving 7ft**: 24-spoke Slaters 7884CR
  o **Trailing**: 3ft 9in/4ft 12-spoke Slaters 7845E or 12-spoke 7848
  o **Tender 4ft**: For outside bearings use 7848MF but order six top-hat (wagon) bearings at the same time. Alternatively, use 12 spoke 7848 with non-prototype inner bearings. These alternatives are discussed at the start of the Tender instructions.

**Motor**
The long Cudworth firebox gives a lot of room. I've used an ABC Mini-S 30:1 gearbox with an 1833 motor, shown by dotted lines in the diagram, but there's no reason not to use a cheaper worm and wheel box if finance is a problem. There's room for a flywheel but to get the loco to pull loads up my gradients I did without and filled the space with lead. The loco is so heavy that – with the spur gearbox – it freewheels quite happily. You need a controller that can give slow running. If yours packs an initial punch, it will trigger wheelspin.

If for some reason you need to remove the motor and gearbox, there are two ways to do this. The brutal method is to loosen the final drive gear on the axle, and then support one of the driving wheels on a couple of strips of thin steel passed between it and the frames. A half-hole in each strip should locate around the axle to support the inner brass centre. The Slaters driving wheels are a tight push fit and so you then give the end of the axle a smart tap with a hammer. If your steel strips are not supporting the brass centre you can easily ruin the wheel. The better method is to make a cut-out below the bearings (marked with ½ etched lines) and fix it back with your own 16BA nuts and bolts (see later instructions). The complete wheel-set, gearbox and motor can then be juggled down and out.

**Other Details**
• Outer frames: these are laminated to recreate the double plates of the original.
• The smokebox, boiler and firebox are resin castings to avoid the need for rolling. The brass cladding rings are a push fit between them, and the whole assembly can be removed either as one or as separate units for painting.
• Parts for dummy motion are provided as etches and castings. It’s fairly visible under the boiler, but you may choose not to fit it.
• The ‘Ashford’ kit contains parts for Smiths vacuum brakes with Stirling brake blocks and linkage. These were fitted in the late 1870s for safety reasons (see historical notes). They are also available as a separate set of parts.

**Construction methods**
• The main etch is in nickel silver with separate brass etches for certain parts. Parts are slotted and tabbed for ease of soldering
• All my kits use high-quality Low Melt Alloys rather than white metal. LMAs can be bent within reason, usually several times, before the casting will snap.
• I do not subscribe to the view that all locomotive models must be soldered metal throughout. Good engineering practice uses a variety of materials and methods most suited to the job. I use 5min. epoxy resin glue (such as Araldite) and superglue for fixing many small parts. As superglue easily spreads out where it’s not wanted, I put a drop on a piece of scrap metal or styrene and apply with the tip of a length of fine wire. H&S: throw out the remnant or you’ll be breathing in too much of the superglue.
• Many of the parts are located with pins before soldering or glueing. For simplicity, I call these ‘lill pins’ though these can no longer be obtained (so far as I know). Instead I supply longer lacemakers’ pins
which are 0.5mm diameter to fit the etched holes. Keep cut-off ends for detailing (handles for fittings, etc). In some places where larger rivet heads are needed, I specify dressmakers’ pins which are usually 0.6mm diameter and may require the etched holes to be drilled out 0.65mm.

**Tools: the minimum**

Most modellers will already have built up the following kit.

- A pair of curved nail scissors is useful for snipping parts from etches.
- A selection of files is important, especially flat, triangular, round and oval needle files, also a flat warding file.
- A mini-drill is almost a necessity, preferably one that can be mounted in a vertical stand. The drill can substitute for a lathe when held in a vice. If it has a speed control so much the better, especially for drilling LMA where a lower speed is better. A box of drills from 0.5mm to 1.6mm, and larger drills (the instructions give the recommended sizes). Dental burrs are really useful for enlarging slots and holes, particularly after things have been fitted together and more clearance is needed. Sanding discs and cylinders are useful, but have the drawback that it’s easy to take off more than intended.
- A modeller’s vice is essential, and a finger vice can be very helpful as a third hand (wish I’d bought one years ago). Also pin vices for different diameters of drills and for holding tiny parts for soldering.
- Pliers, both square ended and fine-nosed. Several pairs of tweezers, fine pointed and square ended. Also a variety of crocodile clips and paper fasteners.
- A modeller’s vice is essential, and a finger vice can be very helpful as a third hand (wish I’d bought one years ago). Also pin vices for different diameters of drills and for holding tiny parts for soldering.
- A mini-drill is almost a necessity, preferably one that can be mounted in a vertical stand. The drill can substitute for a lathe when held in a vice. If it has a speed control so much the better, especially for drilling LMA where a lower speed is better. A box of drills from 0.5mm to 1.6mm, and larger drills (the instructions give the recommended sizes). Dental burrs are really useful for enlarging slots and holes, particularly after things have been fitted together and more clearance is needed. Sanding discs and cylinders are useful, but have the drawback that it’s easy to take off more than intended.
- A modeller’s vice is essential, and a finger vice can be very helpful as a third hand (wish I’d bought one years ago). Also pin vices for different diameters of drills and for holding tiny parts for soldering.
- Pliers, both square ended and fine-nosed. Several pairs of tweezers, fine pointed and square ended. Also a variety of crocodile clips and paper fasteners.
- A junior hacksaw or an Xacto saw is pretty much vital, as is a coping saw with fine-toothed blades. A pair of end-cutters are useful and quick.
- Soldering needs a couple of sizes of iron, say 15 and 40 watt. Ideally, the larger iron should have a large bit to hold the heat. Too many new irons have a small bit and run at high temperatures. Temperature control is vital if you want to solder low-melt, and the simplest thing is to use a household lighting dimmer in a box. Trial the setting on scrap LMA. Use an acid flux but be sure to wash off.
- A pack of mixed grades of emery cloth (or wet and dry) is good for cleaning up. A piece glued on a flat 75mm square of plywood is useful for rubbing things flat – e.g the base of the resin smokebox. Mini sanding discs (around 25mm diameter) are very useful, especially the Velcro sort. Scrapers made from old screwdrivers sharpened are good for removing excess solder. A glass fibre pen is valuable for a final clean-up and surface abrasion before priming.
- For springing a 12BA tap is useful, and can be held in a pin vice. Not very expensive.

All these items can be sourced from advertisements or on-line. I use Squires and Eileen’s Emporium a lot: both are helpful and orders from the latter arrive within a few days.

**Health and safety**

Burrrs and sanding discs/cylinders create a lot of fine dust which may not be good for the lungs. A suitable face mask should be worn. Solders and LMA castings contain lead and fluxes contain acid, so wash hands well after their use.
## Cudworth Mail Kit Contents

<table>
<thead>
<tr>
<th>Item</th>
<th>Bag</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main N/S</strong></td>
<td>1</td>
<td>1</td>
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<tr>
<td><strong>Extra brass etch</strong></td>
<td>1</td>
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<tr>
<td><strong>Etched Brass splasher</strong></td>
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<tr>
<td><strong>Boiler castings, resin</strong></td>
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<tr>
<td><strong>Foil, approx 30mm square - for coupling steam pipe to tender - “Vulcan” kit only.</strong></td>
<td>4</td>
<td>4</td>
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<tr>
<td><strong>Wooden buffer beam (loco)</strong></td>
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<td>1</td>
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<tr>
<td><strong>BAG 1 – Boiler Fittings</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chimney, built up: copper plated</td>
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<tr>
<td>– Vulc/Kits</td>
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<td></td>
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<tr>
<td>Chimney – stovepipe - Ashford</td>
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</tr>
<tr>
<td>Firebox rear (backhead)</td>
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<tr>
<td>Flared Dome – Vulcan/Kitson</td>
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<td>Flat base Dome - Ashford</td>
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<tr>
<td>Rear Safety Valve Cover: Ashford/Vulcan, or Kitson:</td>
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<tr>
<td>Cladding ring 1 thick, 1 thin</td>
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<tr>
<td>Smokebox door</td>
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<tr>
<td>Smokebox darts A&amp;B</td>
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<tr>
<td>Clack valve – 2 types, include both</td>
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<tr>
<td>Loco lamps</td>
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<tr>
<td>Salter balances and arms for safety valves</td>
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<tr>
<td><strong>TOTAL</strong></td>
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<tr>
<td><strong>BAG 2 – Underframe Fittings</strong></td>
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<tr>
<td>Axleboxes – lead &amp; trail (and tender)</td>
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<tr>
<td>Axleboxes - driver</td>
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<tr>
<td>Spring – Driver outer</td>
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</tr>
<tr>
<td>Spring – Driver inner</td>
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<tr>
<td>Spring – Loco lead, trail</td>
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<td><strong>TOTAL</strong></td>
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</tr>
<tr>
<td><strong>BAG 3 – Small Loco Fittings</strong></td>
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<td></td>
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<tr>
<td>Buffers - Kitson/Vulcan, 2 short (loco), 2 long (tender) - Ashford, ‘fancy’ base</td>
<td>4</td>
<td>4</td>
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<tr>
<td>Front coupling hook, 4 med. links, 1 long link (Vulcan/Kitson) or Slators coupling kit for loco and tender</td>
<td>6</td>
<td>6</td>
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<tr>
<td>Sandbox</td>
<td>2</td>
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</tr>
<tr>
<td>Sanding lever stanchion</td>
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<td></td>
</tr>
<tr>
<td>Sanding crank</td>
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</tr>
<tr>
<td><strong>TOTAL</strong></td>
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<td>20/15</td>
</tr>
<tr>
<td><strong>BAG 4 – N.A</strong></td>
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<tr>
<td><strong>Bag 5 – Stirling Brakes</strong> (‘Ashford’ kits only)</td>
<td></td>
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</tr>
<tr>
<td>Loco driver brake blocks</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Loco trailing brake blocks</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Tender Iron brake blocks on hangers</td>
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<td></td>
</tr>
<tr>
<td>Little brake adjuster castings</td>
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<tr>
<td>Smith’s Vacuum pipes A (not on loco)</td>
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</tr>
<tr>
<td>Smith’s Vacuum pipes B (not on loco)</td>
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</tr>
<tr>
<td>Smith’s Ejector</td>
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</tr>
<tr>
<td>Smith’s release valve</td>
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<tr>
<td>Smiths Vac. cylinder loco</td>
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<td></td>
</tr>
<tr>
<td>Smiths Vac. cylinder tender</td>
<td>1</td>
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<tr>
<td>Vacuum gauge</td>
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<tr>
<td>Rod, 1mm (loco hangers)</td>
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<tr>
<td>Rod, 1.2mm rod (through tender trunnions)</td>
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<tr>
<td>Tube 1.2mm for loco and tender brake spacers: 5 x 30mm + 15mm = 175mm or 8in total</td>
<td>1/2</td>
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<td><strong>TOTAL</strong></td>
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<tr>
<td><strong>BAG 6 - Cab Fittings</strong></td>
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<tr>
<td>Regulator handle</td>
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<tr>
<td>Regulator bearing</td>
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<td>Firebox rear tray</td>
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<tr>
<td>Water gauge</td>
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<tr>
<td>12BA washer for water gauge top pipe</td>
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<tr>
<td>Injector take-off cock RH</td>
<td>1</td>
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</tr>
<tr>
<td>Injector take-off cock LH</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Whistle and combined cocks</td>
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</tr>
<tr>
<td>Whistle single</td>
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<td></td>
</tr>
<tr>
<td>Firebox rear cocks A&amp;B</td>
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</tr>
<tr>
<td>Try cocks</td>
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<tr>
<td>Reversing lever</td>
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<tr>
<td>Pressure gauge</td>
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<tr>
<td>Giffard Injector</td>
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<tr>
<td><strong>TOTAL</strong></td>
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<td>18</td>
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<tr>
<td><strong>BAG 7 – Grab-rails</strong></td>
<td></td>
<td></td>
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<tr>
<td>Grab stanchions</td>
<td>6 + spare</td>
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<td><strong>TOTAL</strong></td>
<td></td>
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<tr>
<td><strong>BAG 8 – Motion</strong></td>
<td></td>
<td></td>
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<tr>
<td>Top slide bars and support</td>
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</tr>
<tr>
<td>Bar support extension</td>
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</tr>
<tr>
<td>Bottom slide bars</td>
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<td></td>
</tr>
<tr>
<td>Crosshead</td>
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</tr>
<tr>
<td>Con rod</td>
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<tr>
<td>Front valve rod cover</td>
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</tr>
<tr>
<td>Valve guide short</td>
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<tr>
<td>Valve guide long</td>
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</tr>
<tr>
<td><strong>TOTAL</strong></td>
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<td>16</td>
</tr>
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</table>
### BAG 9 – Safety chains
- Safety Chain Hooks: 4
- Safety Chain Eyes: 4
- 60mm chain: 1
- **TOTAL**: 9

### TENDER
#### BAG 10 – Tender U’frame Fittings
- Tender Leaf Springs: 6
- ’Wooden’ brake blocks on hanger – Cudworth (Not “Ashford” kits – see Bag 5): 6
- Brake crank and spindle: 1
- Tiny brake crank: 2
- Brake adjuster: 2
- Isolating cock handle for water supply: 2
- **TOTAL**: 19/13

#### BAG 11 - Small Tender Parts
- Brake standard: 1
- Tank filler cap: 1
- Water cock lever-handles: 2
- **TOTAL**: 4

### Slaters Screw Couplings
- “Vulcan” kits: ½ pack
- “Ashford” kits: 1 pack

### Slaters Bearings
- Square: 6
- Round: 6
- **TOTAL**: 12

### Nuts & Bolts Bag/Box
- 6 BA Brass round-head bolts 2 for tender, 2 for loco: 4
- 6 BA Brass nuts 2 for tender, 2 for loco: 6
- 2 for loco sandboxes: 4
- 8 BA brass cheesehead bolts: 4
- 8 BA brass nuts: 4
- 12 BA Steel C/sunk bolts – Loco springing: 4
- 12 BA brass c/sunk bolts Tender 2: 6
- Hornblock springs (31 SWG on 3/64) 550 mm: 1
- **TOTAL**: 29

### Bag Of Lill/Dressmakers Pins
- 1

### ROD, WIRE, Etc
- Rod: N/S 0.5mm Spring rods, water cocks: 2
- Rod: N/S 0.7mm (handrails): 2
- Rod: Brass 1/16” (in addition to rod in pickup bag – brake spindle 2”, comp beam, 2”): 1
- Rod: Brass 1/16” feed water heater pipe, “Vulcan” kit only: 1
- Rod or wire 1.2mm 19SWG: (slide bar casting 1”), loco sandpipes 6”, tender feedwater pipes 6”: 1
- 20 SWG 0.9mm copper wire (cab injectors & clacks): 1
- 22 SWG N/S wire S’box handrail: 1
- 24 or 26 SWG Copper wire (pipes): 1
- **TOTAL**: 10
INSTRUCTIONS: MAIL CHASSIS

Before doing anything, read through the next few instructions and only start cutting and drilling when you’re sure of the various options.

1. Don’t be alarmed by the chassis seeming to be much shorter than the footplate. The intention is that the chassis stops short where the cylinders project below the frames. This is so that the hole in the front of the footplate is scale width with dummy frames, not the narrower frames of F/S. For Scale 7, cut the frames from the spacers, and cut out the relevant etched S7 spacers.

2. The front halves of Ashford frames were narrower than the Kitson’s and Vulcan’s. Cut to the ½ etched line as in the diagram below. Note that I don’t recommend springing the drivers but if you wish to, then cut along the dotted line.

3. If you want to be able to remove the motor and gearbox without hammering the drivers off their axle then cut out below the driver bearing holes to make the shape shown. Drill holes to take your own tiny bolts (16BA), then cut off the keeper plates and solder to the cut-outs.

4. Referring to the scale drawings, you will see that the motion (con rods, eccentrics, etc) is in a different place depending on the maker. The Ashford motion plate is further forward, but the weigh-shaft trunnions (brackets) are the opposite. The ovals in the diagram above point to two trios of pinholes for the trunnions. For Kitson/Vulcan locos do nothing but note that you will later use the front trio and the rear trio can be filled with solder. For Ashford locos, drill the ½ etched holes 0.55mm to take lill pins.

5. There are various arrangements of sand-pipes catered for by three holes labelled SP above. Of course in the prototype the pipes go up through the footplate, but in the model they are to be bent at right-angles and soldered into the holes to make dismantling easier.

6. The etched inner spring is there for Ashford locos. It doesn’t seem to have been originally fitted to Kitson and Vulcan locos, but may have been retro-fitted. If you don’t like the etch, there are parts to build up a 3D inner spring just like the outer one, but lower, as in the prototype.

7. Drill out the ½-etched holes for the six plunger pick-ups, first pipping a centre for the drill. Drill a pilot hole and for SER-Kits pickups, open out successively to 4.35mm diameter/No.17 drill. WARNING: The front ½ -etched holes are sited wrongly and they should be 4.5mm further forward, 6mm from the front edge, as in the diagram. Because different locos had different rear wheelbases, note that for Kitson and Vulcan locos in original condition you only drill the forward of the (trailing wheel) pick-up holes, while for the later and Ashford versions you only drill the rear holes (for safety, check with scale drawings and historical info).

8. The electrical wire (from the front pick-ups) is intended to run along the outside of the chassis between the holes before disappearing inside so that it doesn’t foul or spoil the look of the motion. Later on, drill a 1.2mm hole for wire through each pin-hole intended for locating front hornguides, but at this stage only mark and drill the other hole 38mm to its rear.

9. Once you’ve carried out the drilling and cutting, fold the chassis sides (frames) down, taking care not to distort the chassis around the motor hole above the firebox. Some modellers worry about the flimsiness of a folded chassis: with this one, by the time you have fitted hornguides, firebox and spacers, you will find it’s rather like a box girder. Extra strength comes from the footplate/outer frame combination.

10. Cut out the front inner hornguides Parts 2, the rear inner hornguides 3, and the rear outer hornguides 4. If needed, the driver hornguides are 5.

11. The Slatters square brass bearings slide up and down in slots in the inner hornguides which will be laminated inside the main frames. The bearings are prevented from rotating by the slots in the frames,
and from falling out by keeper plates as in the prototype. The keeper plates can be folded up later and if you choose this method, then punch rivets at each keeper plate. For subsequent maintenance, it’s probably better to make removable keeper plates. In this case, drill through the rivet holes 0.8mm, then cut off and keep the keeper plates safe. Later you can fix them in place with glued Lill pins. (Or your own 16BA nuts & bolts).

SPRINGING (leading and trailing wheels)

12. The axle-boxes are fitted with the lip facing inwards to allow sideways axle play when the loco rounds curves. There are 3/16" washers in the etch if you need them. The vertical movement of the axle-boxes is controlled by light coil springs and restricted by an adjustable 12BA bolt. This system is also used for the sub-frame method on the tender (see start of Tender section). The top photo shows what you're aiming for.

13. When you’re sure you understand the intended construction method, proceed as follows: take the axle-box guides 9 & 10. Prepare the holes in the tags above each axle-box slot as follows: If possible, cut a thread with a 12BA tap. If you don’t possess a tap, improvise one as follows. Take one of the steel 12 BA bolts and file the last couple of millimetres almost to a point. Then drill a 1.3mm hole in a small block of MDF to support the tag while you use a screwdriver to drive the tapered bolt into the hole in the tag, turning it as you go to cut a thread. (See lower of the two photos:)

14. Alternatively, open out the tapping hole to clearance, file down one of the flats on a 12BA nut (not supplied) and solder to the top of the tag – but do this later, after soldering the axle-box guides into place.

15. Fold up the tags above the axle-box slots and strengthen with a fillet of solder.

16. Using lill pins as locators, fit the inner and outer rear hornblocks with the ½ etched sides facing each other so that the projecting parts fit flush together (unlike the outer frame hornguides). There are different lill pin holes according to the wheelbase version. Despite the lill pins, you still need to check that the inner and outer axlebox guides are parallel to each other, and to clamp them with a croc clip before soldering.

17. Repeat with the inner front hornguides 2 (and centre hornguides 5 if you’re springing the drivers, though I don’t recommend it).

18. Finally, bend the keeper plates to one side, and trial the axleboxes. The narrower inner guides are deliberately tight so that they can be carefully filed wider: a few strokes on either edge at a time to get a smooth fit without slop.

19. Cut out the various spacers: rear cylinder head and chassis spacer 8; motion plate 9 (two versions for F/S and S7); support for dummy motion between driving wheels, 10 (number to face to rear).

20. Before fitting the spacers, remove the cylinder heads 8A. Refer to the photo. Those for the rear have a centre hole, and an offset hole in the valve covers. The F/S version is elliptical to fit between the frames, but seen from the side looks like the circle it should be. Use S7 valve covers with F/S heads and file to clear each other when soldered in place. They should be laminated to the rear cylinder head 8.

21. While you’re at it, it’s worth making up the smokebox plate/front cylinder head 28. Before laminating, punch the rivet heads using the ½ etched circles. Note that the rivet heads around the smokebox are only on some locos with later modifications. The photo shows the rivets on all locos. But note that one or two photos suggest that an extra cover plate with more rivets was fitted.
later to some locos. Laminate the cylinder heads and valve rod glands as in the photo. Then drill for the front valve rod cover and guide castings 1.2 mm as in the photo.

22. Spring the rear rear cylinder head into its slots in the front hornguide. Note that it will foul the edge of a Slaters square axlebox. The axleboxes will need about 1/3mm removed on the corresponding top inner edge later on when fitting. (The photo shows them upside-down before sliding into the frames.)

23. Next fit the motion plate 9 - two versions for F/S and S7. (The photo was taken at a later stage and shows the chassis upside down on the footplate. The outside frames are visible in the top LH and bottom RH corners.) Remember that there are two slots for the motion plate: the forward for Ashford locos, the rear for Vulcan and Kitson. (See the diagram at the start of this section.) The dummy motion plate 10 is not prototypical and supports the rear of the dummy motion which can’t hang from the driving axle if your motor is to drive the driving wheels. If your motor is to be in the tender, then you needn’t use part 10, but can obtain dummy cranks to hang on the driving wheels and full con-rods from SER-Kits. At the top of the motion plate are two brackets to be folded forward (as shown in the little photo for Vulcan/Kitson), but cut off for Ashford. Solder both motion plates into their slots.

FIREBOX/ASHPAN

The photo shows what you’re aiming for in the next few steps (but it’s shown fitted to the footplate, a stage you won’t have reached yet:

24. First fit the firebox sides 11. Pencil a vertical on the frames 11.7mm behind the driving wheel centres. (This is not a critical distance, so long as the sides are directly opposite each other.) The sides should be offered up and on the short wheelbase locos trimmed to clear the rear axleboxes. The ashpan is tapered inwards by a partial fold (bend) along the ½ etched line which itself has a crook in it, causing a taper from back to front. This was obviously intended to rattle the ash towards the front ashdoor. After bending, punch the rivet holes and solder in place.

25. Cut the firebox/ashpan front 12 down the long ½-etched line for fine scale’s narrow frames but leave for S7. Joggle along the horizontal thick ½ etched line to match the sides of the firebox. It reaches the top of the frames, but for most motors the top edge should be cut down a few mm. for clearance. The lower photo shows the deep semicircle I cut out, coupled with a dip in the cross-bearer, in order that an ABC motor, can be removed with the driving wheels and bearings in place on the gearbox axle, as discussed in the introduction.) Solder the front in place.

26. Now is the time to check that the gearbox and motor will fit and can be removed. Some of the gearbox corners may need to be filed to juggle it out.

27. The ashpan base 13 is tapered, and is S7 width, so cut down along the ½-etched line as with the front. Some further slight trimming may be needed. Curve the wider end to the profile of the ashpan sides and solder in place. The bottom horizontal hole can be left open for access or a piece of scrap etch cut and fitted. The large firebox is very useful for filling with lead to help adhesion, and DCC enthusiasts will note that it’s convenient for fitting a decoder (on top of the lead). A further piece of scrap etch can be curved to form the rear of the firebox for short wheelbase locos. For long wheelbase locos it’s probably hidden by the steps and horn blocks and therefore not worth bothering with.
TRIAL WITHOUT MOTOR

28. At this stage it's worth assembling the axleboxes, and putting the wheels in to see they revolve freely.

29. Remove the top of each of the 4 bearings as shown, to form a seating for the coil spring. I find a spherical burr more useful than a file for this. The lips on the driving bearings may need reducing to make room for the gearbox. Finally, insert each axle-box and gently bend the keeper plates into position. Screw in the 12 BA adjusting bolts, but don't bother with the coil springs at this stage. (Ideally, turn the bolts into grub screws by removing the head and sawing a cross-slot – not too deep or the screwdriver will break one side off.) Because the keeper plates are in the correct position for the prototype, the axleboxes have too much travel and the sprung pickups can pop out. Limit the travel by soldering two narrow strips of spare etch to the bottom of the axlebox, one under the other to make 1mm thickness.

30. Fit wheels and axles into bearings. Check that each axle turns freely in its axle-box. If necessary run a 3/16" drill through. A slightly loose vertical fit is needed to avoid binding on rough track.

31. Adjust the grub screws so that the height of the tops of the frames is 30mm above the rails. (When the footplate is added, it's top face should be 52.25in. over the rails on the prototype, 30.5mm on the model.) The chassis should happily run down a very slight gradient. Disassemble.

PICK-UPS

32. Cut 6 strips of scrap brass etch about 20mm x 3mm, as well as 6 x 7mm lengths of 1/8" brass tube. Slightly taper each tube so that it will enter the nylon bush without force. Using higher melting point solder, solder a strip over the end of the tube to form a closer and electrical tag. Tin the other end for the electrical wire. The tags for leading and trailing wheels can be bent at right angles (as in the lower photo) which allows the leads to be soldered after fitting other items such as the cylinder base. However, try to arrange them so that you could get a rod through the two piston rod holes as you may need to do this to fit the dummy motion, especially the Ashford type.

33. Push each tube a little way into the nylon bush with the clips as shown – I squeeze it in with longish fine-nosed pliers. Then push the whole assembly into the pick-up holes in the frames. Firmly but not forcefully. If you find force might be needed, open the hole out a little. The photo shows the front pickups before the base has been fitted.

34. Superglue the bushes in place, and file back the outside of the bush so that it will not foul the wheels. Later on, use lower melting point solder with a hot iron to attach the leads. Run a 1/16in drill gently into the tube to remove any burrs or solder, and check that 1/16in rod will slide freely inside.

35. For each plunger, round the end of a piece of 1/16" rod almost to a point, and cut off a 6mm length. (TIP: To taper, turn the rod in a drill, and hold a file against it at about 45°.) Repeat until you have 6 plungers plus a couple of spares. If you can use the edge of a file to create the shape in the diagram, so much the better, as it will centre the plunger on the spring. The overall length will then be about 5mm, with narrow part about 1mm long. Check that the plungers slide easily in the tubes. In the final assembly stages you should complete the pick-ups by snipping off lengths of the fine 1.5mm diam. spring, but for the moment put the plungers and spring carefully aside where they will not be lost.

36. Finally fit the cylinder block base 14, after cutting it along the ½-etched line for F/S, and gently curving it. A little bit of filing at the rear is needed to clear the hornguide laminations. Note that for F/S a compromise is involved. Because the chassis is narrower than it should be, the curve of the base sits higher than the curve of the rear cylinder head. This seemed a better compromise than making the frames deeper at the front than they should be.
37. It’s not easy to know the best time to fit these. Fitting now allows easier access with the benefit of no LMA castings to melt, but the wires make steadying the chassis more difficult when fitting things. They’re made from copper or annealed brass wire about 1.15mm diameter and I suggest bending them alongside the driving wheel hornguides after soldering, and bending back when the chassis is virtually finished. Soldering can be easier if the full length of wire is threaded straight across the chassis, curved after soldering, and cut out between the frames.

38. Check the profile with the scale drawings, and solder into the appropriate frame holes to project about 4mm before bending down. In the photo and diagram, the loco front is to the right. Remember that in later days some locos had an additional or alternative sandbox on top of the boiler with the pipes joined together in front of the driving wheels.

39. Finally, trim the wire inside so the motion can be fitted.

MOTION AND VALVE GEAR

40. The two photos, from above and below, show what you’re aiming for in the next steps. Before starting, read through to the end of the Motion section.

41. NOTE: The narrower frames for F/S mean that clearances are tight and some of the horizontal (or nearly so) links have to taper towards each other. It is better to create definite joggles which look as though they are meant to be. Observation of prototype practice shows that this was done, especially with the eccentric rods.

42. Choose the appropriate weigh shaft trunnions (brackets): 15 for Ashford, 16 for Kitson and Vulcan, and drill through the half-etched holes to take lill pins. Referring to the diagram at the start of the chassis section, locate the trunnions with pins and solder on the outside of the frames. Cut a length of 1/16” rod (the “weigh shaft”) and check that it will go through the trunnion holes level and at right angles to the frames.

43. Glue or solder the valve guide castings into the holes between the cylinders. The shorter one should be on the right and the slots should be vertical, to take an etched link to be trimmed and fitted later. (Here, the photo shows a later stage with the left-hand pair of slide bars fitted but from experience, it’s best to leave them until later.)

44. The etched motions parts are framed as 47. The weigh shaft lever (seen completed in the photo) is not correct and can foul the motion plate slots so use one of the pairs in the extra brass etch, straight for Ashford and crooked for Vulcan/Kitson. Remove the halves, joggle with round pliers and solder together as in the photo. For Vulcan/Kitson, it should ‘crook’ upwards. Check that it will slide onto the 1/16” weigh shaft.
45. Remove the combined eccentric rods/expansion links from the motion parts and the extra expansion links. Check with the diagram opposite which way the parts are meant to be (looking from the RHS with loco upright). Pip the lower ½ etched bolts so that the ‘bolt-heads’ will be outside, and drill through the top ½ etched circles 0.6mm. The diagram shows how to solder-laminate each expansion link to the main component.

46. Thread a straight connecting link onto a Lill pin, push through one of the holes just drilled and add a second link. Using a scrap of paper as a separator, solder the second link to the pin, parallel to the first, so that the pair of links can swivel freely. Repeat for the other expansion link.

47. Now assemble the links onto the forked weigh-shaft lever, using a Lill pin as in the photo. It’s easier if you hold the pin in a finger-vice or similar. Each pair of straight links should fit either side of each fork in the order: link1/fork/link2 - link3/fork/link4. Again using a piece of scrap paper, solder pin and final link.

48. With the weigh-shaft crank hanging down, feed the joined ends of the eccentric rods into the centre slots of the dummy motion plate between the driving wheels, finally partially feeding the bob-weight of the weigh-shaft crank through the centre slot in the motion plate. Catch the crank on the 1/16” rod between the trunnions. The arrangement will now begin to look like the underneath photo at the top of this section.

49. With the 4 links approximately vertical, and with the expansions links at a height so that they protrude roughly equally above and below the slide bars, solder the eccentric rods into the dummy motion plate. The whole floppy shebang should now be fixed. If soldered as stated, the height of the expansion links is the equivalent of the loco being in mid gear, or ‘neutral’. If I understand Stephenson’s motion correctly, then the expansion links should be lowered for forward and raised for reverse. By applying the iron to the motion plate, the expansion links can be raised or lowered to suit your preference.

50. Finally, solder or super-glue the 4 connecting links so they are neatly vertical.

51. The next job is to fit the swing links which connect to the valve guides. The etches combine both cranks and links, and the cranks are to be suspended from 1mm rod. The acute-angled link and crank should be on the driver’s left, and the (more-or-less) right-angled crank to the driver’s right. Punch the bolt-heads. On Kitson and Vulcan locos, the rod is supported in the little brackets projecting from the top of the motion plate (see earlier pic). On Ashford locos, the cranks are supported by a little upside down ‘saddle’ fitted to the underside of the boiler behind the motion plate. This makes Ashford motion a little trickier to assemble, but see solution below.

52. VULCAN/KITSON Cut a short length of 1mm rod and pass through one bracket, through the links in the correct order and into the other bracket. Work the long links between the expansion links and mark and shorten to fit neatly into the slots in the valve guides. Solder/glue in place, and solder the rod and cranks evenly between the motion plate brackets. This rod is quite important to avoid squeezing the frames and motion plate when working on them.

53. ASHFORD.

- If you haven’t already cut off the little motion plate brackets for Ashford locos, do so now. However, it’s worth considering soldering a narrow strip across the gap for strength. (When working on the chassis it’s easy to squeeze it out of shape.) Furthermore, if this strip is a T shape, the ‘leg’ of the T could be bent backwards at right angles (or more) to support the saddle. This will make fitting the various links and cranks easier, and it’s reasonably out of sight.
• Referring to the earlier photo of the ‘saddle’ Z, form it by curving to the radius of the boiler and folding down the sides to form brackets for 1mm rod. File a flat in the saddle to create clearance for the cranks. For the same reason, thin the top of the crank bearings.

• Thread the cranks + links Y in the correct order onto the 1mm rod through the bracket and temporarily solder one end of the rod so that it doesn’t all fall apart. Work the long links between the expansion links. It will help to joggle the top eccentric rods apart near the dummy support.

• Support the saddle at the correct distance behind the motion plate (see scale drawing). This is where the T-shaped strip mentioned earlier comes in. Mark and cut the long links to fit neatly into the slots in the valve guides. Then, with the saddle at the correct height (matching the curved top of the motion plate), solder/glue the links into the valve guide slots. Also solder/glue the long links to the expansion links so that everything is solid. The photo at the top of the Motion section is only to give the idea: the motion plate is fitted for Kitson/Vulcan and I’ve temporarily arranged the saddle to show what’s intended.

• You could now cut off the T-support if you wish, and fix it the saddle to the underside of the boiler after painting the model, perhaps with double-sided sticky tape.

54. I recommend continuing to assemble the other parts on the chassis, leaving the LMA motion castings to be fitted later, after painting the inside of the frames. The relevant instructions are later on.

Continued on next page…/
Section 3: Getting the chassis running

1. Most of the subsequent assembly involves soldering or gluing metal castings, so I suggest making a trial run at this stage.

2. The electrical leads should be 0.75 or 0.5mm OD. Solder them to the tags on the front pick-ups. Then thread the leads through the holes in front of the front hornblocks, arrange them along the top outside edges of the frames, and back through the holes in front of the driving wheels and terminate them in the firebox. I find it best to solder tiny strips of very thin brass (10 or 15 thou) to the chassis and curl them over to catch the leads (arrowed in photo). The leads can be held with superglue, but it doesn't stick well to the soft insulation. (In the photo the motion is wrapped in masking tape for spraying)

3. Check that there is no short-circuit between each lead and frame. Solder leads to the middle and rear pick-ups, again terminating the leads in the firebox and checking there is no short-circuit. Then solder the three leads on each side together, and add a 90mm (or so) lead to each junction for the motor or decoder.

4. To prevent the motor riding up when under load, but to allow side play, I fit an anchor made from scrap etch strip 3 or 4mm wide, bent to the profile of the diagram and soldered under the chassis top edges.

5. Cut 4 wheel springs ~7mm long from the 2.4 mm diameter phosphor-bronze spring. With tweezers, thread over the adjuster bolts to bear on the axle-boxes.

6. With the wheels off, fit the plunger pick-ups: Insert the plunger spring into one of the plunger holes and cut to barely protrude. I find a pair of nail-scissors the best tool. Be careful not to bend the end of the spring outward as it could then stick in the tube and need fishing out with a bit of bent wire. Have a small bit of sticky tape ready (masking tape is good), push a plunger in and catch with the tape. Repeat for the other five. The plungers are released after fixing the wheels. For the loco to run well, there's a fine balance between too much pressure and the need for the pick-ups to remain in contact with those wheelsets which have sideways play. If necessary, experiment with different length springs.

7. Add the wheel-sets, motor and gearbox to the chassis, then with the worm-wheel loose on its axle, trial the chassis on your track to ensure the motor runs from the pick-ups.

8. With the worm-wheel still loose on the rear axle, run the chassis backwards and forwards by hand on straight track to see if there is any binding. Next push the chassis round some sharp curves. Some gearboxes may require the lips on the axle bearings to be reduced for side-play.

9. Provided everything is OK, tighten the worm-wheel grub screw and try the loco out under its own power. Without body weight, slipping is very likely, but don’t worry, we’ll deal with that later.

10. If you intend to use a flywheel, I recommend that when assembling the loco body you don’t fit the backhead until you’ve checked the flywheel clearance by viewing from cab into boiler.

11. When you’re satisfied with the running, make a note of any washers, and remove wheels, motor and gearbox, pick-ups and springs.

Balance weights

12. These are parts 98 and should be glued across 3 of the driving wheel spokes against the inner rim. When dry, mould Milliput or other filler between the spokes.

13. If you’ve not yet done so, cut down the axles (intended for outside cranks). If you need a lot of play to get round sharp curves, then they must be almost flush to the wheels.
14. Cylinder drain cocks can be simulated with 3 medium and 1 short handrail knobs (not supplied). The cranks and links are on the additional brass etch. Using these as a guide, drill 1.3mm holes in the front corners of the cylinder base, midway across, and in the middle of the sides. Use 0.7mm brass or N/S wire, to connect as in the left-hand photo above. If wished, fit a tiny crank (redundant etch part 99) on the side of the firebox as in the right hand photo above, either soldered directly or pivoted on a lill pin. Solder linking wires, between the hornguide (14mm below top of chassis) and a diagonal one simulating the pull rod to the cab. To avoid problems with removing the wheels, I’ve cut the wire under the driving wheel bearing, and – unprototypically – bent it upwards and soldered behind the hornguides.

15. Ashpan levers can be fitted on the RHS, using wire and scrap links (spare spring hangers for example). In the prototype, the central vertical rod seen in the photo opposite goes to a handle above the footplate for pulling up and down. The ashpan flap rod goes back to the cab.

TO PAINT NOW OR NOT TO PAINT?

With all of the normal melting point solder completed, it’s worth considering whether to prime the whole chassis and paint the inside areas before fitting the motion. If you do this after fitting the rest of the valve gear, it’s hard to get a brush in, and spraying will require careful masking or much eventual scraping. BUT NOTE: if you’re going to fit the vacuum brake gear on the loco, go to the instructions at the end of the Chassis section and solder in the hanger rods now, tinning the ends for low melt. Then all you’ll need to do after priming (and painting?) is to solder the hangers on at a temperature that won’t spoil the chassis paint.

Finishing the motion

16. The photo shows the castings in ‘exploded’ layout. The valve rod guides E have been fitted earlier. The slide bar extensions D are only needed for Kitson and Vulcan batches.

17. Note that the top and bottom slide bars A are cast joined to the piston rod guides. The single slide bars A go underneath, and are tapered from middle to ends on the what is to become the lower face. (Obviously the inner faces have to be parallel for the cross-head B to slide backwards and forwards – in the prototype). Note too that the slide bars have tiny spigots on the left ends which fit into the 4-a-side square holes in the motion plate. The little cylinders on top of the top slide bars represent oil pots and should be painted ‘brass’ (gold paint) later on.

18. Saw/file slots into the ends of the con-rods F so that they can fit into the cross-heads.

19. Drill 1.6mm/No.52 into the piston rod guides in the ends of top slide bar castings but only go about 1mm deep. Cut the spigot on the right hand of each casting down to 1-1.5mm and taper almost to a point. They will fit into the holes in the cylinder backhead for Ashford locos or into the extensions D for Vulcan and Kitson batches. So the latter will need to be drilled 1.3mm about 2 or 3mm deep into the end faces (opposite the spigot).
20. Fit the top slide bars into the motion plate and cylinder backhead. For Ashford batches this is a matter of gentle forcing, and the spigots on each end should be slowly reduced until it pops in. If need be, the motion plate can be gently bent to help. Alternatively, cut the spigot off (the single spigot on the right of the previous photo), drill 1.2mm and use short lengths of 3/64 rod poked in through the backhead from the front, past the elex tags.

21. For Vulcan and Kitson, the same method is used with a little difference. First, hold with tweezers one set of top slide-bars with the spigots fitted into motion plate. (I took the photo as an after-thought having already fitted one set.) Then, fit the slide-bar extension against it, as in the second photo. (Not being three-handed my left hand is missing and on the camera button.) Slide the extension down, taking the slide bars with it until its spigot locates in the cylinder backhead. Press down where the castings meet and hey presto it all fits. Well probably not. A little taper helps on the bottoms of the two castings where they press together, and the spigots need to be reduced little by little until they do press in. Alternatively, you could remove the spigots all together, glue the extension into the cylinder backhead and when the glue has set, glue the slide bar casting in place.

22. Glue the top slide bars and piston-rod guide into the backhead and motion plate. Then turn turn the chassis over ready for the next stage.

23. Cut down one piston rod to 1mm and the other to 5-5.5mm. Lay the cross-heads on the slide bars and fit the piston rods into the holes drilled in the guides. One by one add the lower slide bars and glue in place. The photo, taken from underneath, shows the right hand set with the crosshead close up to the slide bar support. The left-hand crosshead is roughly halfway through its throw and the lower slide bars have yet to be fitted.

24. The con rods should be trial-fitted by threading through the motion plate from the firebox side and pulling back to fit in the dummy motion plate. They’re deliberately too long, and should be cut back; the ends will need filing thinner and tapering a little to go in the dummy plate slots. When finished mine looked like this:

25. When satisfied, glue into cross-head and dummy motion plate. For some gearboxes, you’ll need to file the projecting ends flush against the plate.

26. The photo shows the end result from the rear.

27. Re-assemble the chassis and check it runs under its own power. It’s fairly light without the body and may not negotiate curves and points without derailing. Don’t worry at this stage.
Vacuum brake (Smith’s non-auto)

28. This was fitted from c1878 and by this time, the trailing wheel had probably been moved further back. The parts are boxed as 59. Parts A, B and C are hung from 1mm rod through chassis holes as shown in scale drawing and photo. There are two holes for hanging A depending on the wheelbase, and similarly there are two lengths of the link E. Part D is for laminating to part B to give the impression of a fork at the bottom and also so that the edges can be bevelled to look like round rod. Cut it short at the top, or bend it over and solder into the hole instead of using 1mm rod. The B and D laminate goes up into the vacuum cylinder in the prototype, and its casting should be centred over them on the footplate.

29. The brake block castings fit the wheel diameters: check which is which before fitting.

30. Since etching, I have discovered that Link E should be fitted as shown, to the upper of the two holes. (Originally I had interpreted photos as showing it linked to the lowest hole of the driving hanger C). As a result, the photo shows it how it will be angled when it should in fact be horizontal, so correct this by joggling the 1mm hanger rod for C down and the one for A up. (The joggle won’t show behind the outside frames.)

31. Existing photos show that there was no vacuum cylinder on the fireman’s side, and therefore no part B on this side. I’ve provided it, though, in case new evidence comes to light.

32. The brake linkage is joined across under the firebox by tie rods. The forward rod has to be in the brake hanger extension to clear the ashpan. Tie rods should be cut from 3/64in tube and threaded and soldered onto the lill pins in the holes shown. All the other lill pins should be cut short.
INSTRUCTIONS: MAIL BODY

The suggested sequence is:

- Soldering the outer frames, footplate, smokebox wing-plate, cab plates etc
- Preparing and fitting the resin boiler assembly, followed by running trials and adding lead weight.
- Further soldering of small parts to body, followed by adding detail castings. Fragile or vulnerable fittings may be left off until after painting and lining. Note that if you plan to line the inside of the cab this is next to impossible after adding certain fittings such as the reverser quadrant. I also recommend lining the inside of the cab before the boiler is finally fixed in position. More on these points later.

Modelling choice

If you are intending to model a loco pre-c1869, then it should have a feed-water heating pipe running on the right hand side of the loco from the smokebox back to the tender tank. It is highly visible at 22in or so above the footplate. (See historical notes and photos.) However, you may choose to omit it because of difficulty in the cab area.

The point is that – as can be seen in the scale drawings – the pipe is continuous between loco and tender and must have had a flexible coupling or two in the footplate area. The pipe can be represented by 1.6mm diameter rod with early version kits, but how to allow the loco to traverse curves?

Assuming two fixed pipes terminating at the gap between loco and tender, the pipes will be close together on RH curves and further apart on LH curves. The difference on 4ft curves is around 8 or 9mm.

If anyone knows of a supply of narrow rubber tube this would be the obvious solution, but does it exist?

Various solutions occur to me:

1) Terminate the smokebox ‘pipe’ behind the cab side-plate, and extend the tender ‘pipe’ towards the loco, cutting it short by the side of the firebox, and joggling it a little according to trials on opposite curves and reverse curves. The absence of a join is in the least visible area and could be hidden even more by a suitable fireman casting.

2) If you can source close-coiled spring (narrow versions are used by some for vacuum pipes) this could be soldered to, say, the tender pipe and allowed to slide in and out over the loco pipe. It would need to be a minimum 1.6mm diameter, and the rods for the pipes would need to be filed down to fit inside. If anyone knows of a source, please let me know.

3) Use heat-shrink insulating tube of suitable diameter shrunk on to one pipe and free on the other.

4) A sliding tube as suggested in the instructions near the end of this section.

The suggested order of assembly should help you avoid some difficulties I got into…

1. These two photos show the footplate assembly you’re aiming for in the first body stage.

2. Remove footplate 19, cut out parts from the central hole and put carefully by. Remove ½-etched rectangles 28b and keep safely as they are needed soon. Note that the pieces for the front frames are intended to be bent down to form the frames at the prototype distance apart. The fold is on the ‘wrong’ side so that when bent down there is a sharp edge and the lower half of the line looks like the join between frames and footplate. The rivet holes line up with the front guard irons, and can be drilled for cosmetic bolt-heads (not supplied) to be fitted later.
3. Note that the $\frac{1}{2}$-etched positions for the securing nuts should be on top, and the name, Cudworth Mail, underneath. Punch the rivets in the front frame.

4. Lay the footplate on a flat heatproof surface and anneal it where it has to be curved over the driver axleboxes. This is done on a heat-proof surface heating in turn both sides with a blowtorch (to reduce distortion until reheat has just been achieved. (Place the footplate on a heat-proof surface and use a blow-torch. Annealing is not absolutely necessary but makes curving much easier. Allow to cool slowly and while waiting, read and trial the following.

5. The outer frames are intended to be triple laminates to reproduce the prototype ‘sandwich’, where a gap can be seen between inner and outer hornguides in photos when viewed at an angle. Cut out the relevant parts listed below and note how they are to be assembled, but don’t solder yet. Make a trial assembly using lill pins through the holes. Note the holes numbered 1, 2 & 3 which enable the trailing wheel hornguides to be accurately positioned according to the version of the loco you are building. Take your time over the following stages so as not to have to unsolder mistakes.

- Middle laminate 20
- Inner laminate 21. Solder to 20 so that numbering cannot be seen.
- Inner laminate, rear hornguides 22. Choose one of three fixing positions depending on loco version modelled – 1 for Vulcan and Kitson in original state; 2 for Ashford; 3 for Vulcan and Kitson after modification to longer wheelbase. When you’ve made your choice, note that inner laminate 21 may need cutting back on the $\frac{1}{2}$-etched lines. NOTE: The profile of 22 may need adjusting (filing) to match outer hornguide laminate which differs according to the type of loco. Do this before proceeding.
- Outer laminate, front hornguides 23. Solder to 20 so that the $\frac{1}{2}$ etched face looks outwards (and therefore the thicker parts for the steps can be seen)
- Outer laminate, centre hornguides; 24a, keeper plates
- Outer laminate, rear hornguides 25. Original Kitson and Vulcan locos (Nos197-204)
- Outer laminate, rear hornguides 26. Kitson and Vulcan locos (Nos197-204) modified with longer wheelbase
- Outer laminate, rear hornguides 27. Ashford locos.

6. Before assembly, the axlebox guides have to be bent out. Fit in the vice with 0.5mm between the guide and the vice. Use a piece of scrap etch as a spacer. Part-fold the guide outwards with long nose pliers. Finish off by hammering down with a length of scrap metal, say 1.6mm thick. The distance between the guides should be 4.5mm, but as the axleboxes are cosmetic, this is not critical and the castings can be filed to fit.

7. There are three ways of proceeding. One is to laminate now, the second is to laminate 20, 21 and 22, curve the footplate as described below and solder in place, followed by the outer hornguides; the third is to curve the footplate around the middle laminate 20 and solder the inner and outer laminates afterwards. I followed the third, but I think the second is probably the best. Note that in all cases, the laminates are located by lill pins. Have lill pins in the keeper plate holes as well. The lill pins must be removed after soldering, as they will be re-inserted in order to fit the spring hangers.

8. Referring to the drawing, mark on the footplate where the centre curves are to start, and form over rod, tube or dowel about 30mm or so in diameter. Form the centre curve in three parts avoiding the pairs of holes where kinking can occur. Offer up the outer frames and work at the curves with finger and thumb to a close fit. There is side-play in the tags and slots to aid the fitting. Provided a snug fit
is reached, there is exactly room to fit the buffer beams in the slots. Without a snug fit, the outer frames will seem too long. Make sure you’re very satisfied with the fit before proceeding!

9. One by one, clamp the frames to the footplate and solder-tack the rear flat portion. Then, pressing the frame down on to the footplate, solder to the centre point of the upper curve (the two holes). Pass a piece of wire down through the outer hole to check that it lines up vertically with the centre of the axlebox cutout. If not, unsolder, clean off and re-shape the curve. It’s not the end of the world if you don’t get this quite right, because the outer axleboxes are cosmetic, but you don’t want the axleboxes to be noticeably off the wheel centres.

10. Finally, sight along the edges to check the front and rear flat sections of the footplate are in the same straight line. Clean off excess solder. As construction continues, keep checking that they retain the straight line as pressing down when fitting parts on top can cause distortion.

11. On the original Kitson and Vulcans, the top rear steps fit into slots. They should be folded and fitted now, otherwise the hornguides are vulnerable. Insert from the rear, soldering at the rear also. There are various width steps, parts 39 and 40. After fitting, I recommend soldering wire or strip strengtheners behind the steps and the valances.

12. The prototype front buffer beam is a ‘sandwich’ – outer iron flitch plates on a baulk of wood. A piece of wood is supplied. For those who want an all-metal loco, Part 31 was intended to be folded and soldered for thickness, but has turned out too short, so fold it to allow small ends cut from scrap etch to be fitted to it.

13. Punch rivets in the buffer beam flitch plates 29 and 30. The holes for the buffers should be correct for Ashford buffers but need opening out to 3.8mm or so for Vulcan/Kitson type. Drill through the rear plate for the buffers to work as supplied. (The buffer spindles and nuts are barely visible even when pushed in.) Solder both plates in place. Solder the washer plate 30a centrally on the front plate, lining up the hook hole with a matchstick.

14. Before fitting the rear drawbar 32, the profile needs adjusting. File off 1mm from the lower slanting edges. (The original Ashford drawing seems to be in error with the rear elevation not matching the side elevation, and I only picked this up when making the model.)

15. Fill around the tags with solder and file flush to make a nice job. Do the same for the un-needed spring-hanger slots provided for the different wheelbases. I find a plumber’s solder containing lead is good for this, and after putting flux around the slot, I carry a blob of solder on the iron and use the tip to wipe it over the slot. If the iron is switched off and cooling down it helps as the solder then becomes ‘pasty’.

16. If you haven’t already done so, bend down the front part of the frames behind the buffer beam. Fit the smokebox/cylinder front 8, with the cylinder covers already soldered (see Chassis instructions). Use the little rectangles 29b to cover gaps.

17. Fit wooden buffer beam and buffers later on.

TRAILING WHEEL CLEARANCE

18. At this stage, trial the footplate on the chassis and check the clearance between the top of the rear wheels and the footplate. For the longer wheelbase versions, there’s a slot in the footplate for clearance, but for the shorter versions, the slot must usually be extended forward by cutting and drilling. Check with APPENDIX A on weighting and springing, instruction 12.

The Splashes

19. The brass outer trim was usually polished, and so separate brass splasher sides are provided. Careful examination will show there is a half-etched flange around the curved edges to locate the half-etched tops. The tops are designed to project approximately 1mm under the footplate.

For S7, the driver splasher tops can be narrowed along their entire length to about 4.5mm.

For F/S reduce the centre 25mm to 5.5mm width, and then taper out to the full width at the ends. This compromise means that wheel flanges will not be visible, and the taper is hardly noticeable. The
driver splashers will still need shaping to allow the boiler and firebox to sit in. I find this reduction impossible to calculate so I suggest doing this when trial fitting the boiler.

20. If you have bending rollers, running the splasher tops through until you obtain the exact radius will make the job more manageable. The leading wheel splasher clearance against F/S treads is quite tight. Bevel the front and rear of the slots in the footplate to improve clearance.

**Making up splashers**

This is never the easiest job. Here’s my method: tin along the flange and also on the edge of each splasher top with very little solder. Press a little plasticine onto a heat-resistant surface such as plywood and press the splasher side into it. This will create a low plasticine ‘wall’ which will help hold the splasher top in place while the iron is applied. A little acid flux will speed up the process. Do not use too big an iron: the idea is to catch the top centre to the side with only a mm. or two of solder. If you don’t get it right first time, try again. You’ll need to clean the plasticine off with white spirit, but dry it before applying heat again. (Yes, I know it’s obvious, but if someone can take a coffee shop to court over burning themselves on the cup…) Once caught, hold the iron to one side of the tack and join a little bit more. Check that the top is fitting snugly into the flange and work outwards until the whole splasher is formed.

21. Notch the splasher tops at the bottom corners so that the splasher fits snugly onto the chassis and solder only at the tags to begin with. Check that the sides of the splashers are absolutely at right angles to the footplate. Then catch the splasher tops to the footplate where they stick out underneath. Run a thin line of solder on the rear join between splasher sides and footplate. File/burr off excess solder and the tag slots.

**The Cab**

**Spectacle plate variations**

The original versions had a simple spectacle plate perched on the firebox. Later on to give the crew more weather protection, low side extensions were added. While a loco still had the long Cudworth firebox, the spectacle plate remained in the same position, and the ends of the extensions matched the rear ends of the side plates.

When shorter fireboxes were fitted, the spectacle plate was moved forward, and maybe the front plates either side of the firebox were too. (If not, the cab would have been very draughty.) The spectacle plate then seems to be level with the leading edges of the side plates. Check with photos. In the forward position, the cab front plates can be solid, but with the original versions, there must have been a cutout to accommodate the springs.

22. Solder the top rails 37a to the cab side plates 37, and solder the side plates to the footplate.

23. According to which version you’re building, adjust the cutout in the cab front plates 38 to clear the springs (check against drawing).

24. Depending on the level of detail you plan to fit, drill holes in the RHS front plate as in the diagram. The 0.6mm lower hole is for the rod coming back from the sanding lever linkage. The 1.8mm upper hole is only needed if you’re going to fit it the feed-water heater pipe (see box at start of Body section).

25. File a tiny notch in the top outer corners to clear the top rails, and solder the parts in place, making sure they’re upright. Trial the resin firebox casting, and check that it isn’t forcing the side plates off the vertical. If necessary remove a little from the front plates 38 where they touch the firebox to give a snug fit.

26. The holes either side of the firebox allow clearance for the rear wheel flanges as they move up and down against the springs. If you’re building a short wheel-base loco (original Vulcans and Kitsons) the hole needs to be extended by drilling and filing forward by 5 or 6mm. Whether or how you cover the holes depends on how much the trailing wheels travel up-and-down on your track. See Appendix 1 for a discussion of possibilities.
27. The photo shows what you’re aiming for in the next stages. For earlier locos, the extension side-plates will be removed. The little holes below each spectacle are for the control rods coming back from the boiler sandbox on later locos. If not fitting these, fill with solder when fixing spectacle rims. The central hole is for the whistle handle. If you are fitting Smith’s vacuum, a hole needs to be drilled for the control rod on the left-hand side, close to the boiler, to be 28mm above the footplate.

28. Although I’ve fitted the reverser quadrant, I recommend doing this much later, because of painting and lining problems.

29. Before removing the spectacle plate 53 from the etch, note that the half-etched tags (as in the prototype) are to be left on – they locate in the corresponding grooves of the cab front plates and are not etch holding tags. (In the next photo, the tags are there but merge with the background.)

30. Cut out the etched beading around the boxed etch 57 and the side extension beading 54. Bevel off the inner/lower edges. Original locos: solder the beading along the edge of the spectacle plate and cut off the side extensions.

31. Later locos: Anneal the corners to be bent, and when cool, bend around 3mm rod so that the etched beading is inside. The curves must start immediately next to the vertical beading. Trial fit so that the extension plates sit in the middle of the top rails. If necessary, file back the rear edges to match the rear edges of the side plate. Solder the side extension beading and then curve round to meet the spectacle plate. The photo shows this.

32. Solder the front spectacle rims 55 in place, with the $\frac{1}{2}$ etch inside: this forms a circular recess to take the glazing. If you leave the rims attached to the number tag, this is convenient for locating the rim with a croc clip. The rear rims are to trap glazing, and may be glued after painting the cab.

33. On the prototype there are little angle-brackets that fix the cab to the firebox. They can be seen on photos and are fairly prominent. I haven’t provide an etched part, but they can be made from narrow scrap etch. Although a bit fiddly, I recommend fitting them particularly if you’re modelling a loco without spectacle plate side extensions. If you drill two holes in each of the ends that sit on the firebox, then later on you can drill 0.55mm into the firebox and pin the brackets to it. This gives the plate much needed support and without them it’s all too easy to twist the plate off when handling.

34. Read the Painting Note below before soldering the spectacle plate.

Boiler assembly continues on next page...
BOILER ASSEMBLY (including smokebox and firebox)

Historical note: cladding (sometimes called cleading – probably Midlands dialect)

After joining firebox, boiler and smokebox in the boiler shop and fitting to the frames in the loco shop, something like asbestos cement was trowelled over and held in place with thin iron or steel sheets. These and the ‘boiler bands’ holding them in place are what we paint and see in a model. To hold everything in place at stepped joints, the flat bands are replaced with a ‘cladding ring’ of curved profile, usually beaten out of thin brass and often polished. These can be seen around the backhead in preserved locos. In the early years, when fireboxes were stepped out from the boiler, they were also used here, as in the Mail. Such a cladding ring is also used between boiler and smokebox to hide all the rivets and is usually painted black – it may be of soft wrought iron. It’s an open question as to whether the smokebox ring was brass on early locos.

NOTE: The rings for the model are provided as cast discs. They are of different thicknesses representing the prototype: the thicker one (with the square-ish hole) goes against the firebox.

The idea is to work on each of the three castings separately as instructed before fitting all three together (thus sandwiching the cladding rings) before attempting to remove clearance areas for the wheels and motor. The boiler assembly is intended to be removable for painting and maintenance using 10BA bolts up from the footplate. These means that all five items can be be kept separate which should make painting easier – no masking needed. The brass should be gently polished and lacquered or varnished.

Working with resin

Resin castings are relatively soft compared with metal, so take any filing and smoothing slowly to avoid taking off too much. The resin used by SER-Kits is high quality and will not snap under normal handling. A useful tool for sanding flat faces is a piece of emery cloth/sandpaper glued to a piece of flat plywood or MDF about 75 or 100mm square.

Smokebox

1. This is as good a time as any to trial-fit the smokebox door casting in the etched smokebox plate. File the edge to taper inwards slightly, offer up and hold against the light to see where more needs to be filed off. Thin the back of the hinges with the edge of the file, but not the vertical ‘pivot’. When fitted properly, the door should be ¼ mm or so proud of the wing plate. (In the prototype it sits on it). Leave as a push fit at this stage, but drill for the central darts (handles) 0.9mm and possibly 0.55mm for edge handles (see some photos) to be made from wire.

   (In the final assembly either hold the spigot in the resin cross-piece with UHU or similar as in the photo so it can be pushed out from the rear. Alternatively, thin styrene packing is glued to the resin crosspiece, and the spigot removed. A tiny drop of superglue will be run round the door.)

2. Rub the resin smokebox casting on glasspaper to ensure the front face A is flat. Check floor at right angles to front (B). Most castings need a little taken off rear of floor. When seen from the side or the top, the casting has a slight ‘saddle’ shape (C and C), so file/sand edges to lie flat

3. The smokebox wingplate should be just proud of the casting all the way round (~3/8in, 0.25mm). First check the snugness of fit over the wheel splasher (D). If gap too large on one side, sand floor more on that side. If not enough gap, scrape away with tip of a craft knife, maintaining the curve. (Take more off away from the edge, and then gently at the edge.) Only then remove the floor evenly to get the height right. Not much need be removed, if any.

4. Hold the smokebox casting in place on the body and mark the screw holes underneath. Drill No.57, 1.1mm, and tap 10BA. (This is a narrower hole than for metal as there’s a danger the tap will open out the resin too much to hold the bolts. But use commonsense and don’t
force the tap) Alternatively, file ledges inside and glue 10BA nuts over clearance holes. If you’re not bothered about removing the smokebox for painting etc (especially as it’s black and unlined), then later on it can be glued in place with epoxy resin glue. The photo was taken at a later stage but shows what you’re aiming for.

5. Before fitting the casting, it’s worth slightly bending the smokebox wing-plate back. This will ensure it fits snugly against the whole boiler assembly.

6. The thinner cladding ring fits against the smokebox. Mine was slightly sloppy and I superglued a small piece of 10 thou (1/4 mm) styrene across the bottom of aperture so that the same amount of resin casting showed all the way round.

**Boiler**

NOTE 1: The bands are not symmetrically spaced: the gaps between the outer bands are 20.5 and 21mm. The longer gap goes to the rear.

7. With a fine flat file, clean up the casting, especially any slight flash or mismatch arising from where the mould halves join. Carefully run the file round against the boiler bands. There should be few imperfections but if there are any, use a standard model filler.

8. Both cladding rings are a tight fit into the boiler, and the inside should be filed with a ½ round file for a fit. Note that the mould plug is not always concentric in the mould so file the thicker parts of the wall first. Note too that the end boiler bands are intended to be slightly proud of the cladding rings: in the prototype the thin beaten brass would have been caught under the boiler bands. The photo shows the cladding ring modified to clear motor and wheels, but don’t do this yet.

**Firebox**

9. The photo shows what you’re aiming for in the next few stages. The firebox casting is slightly narrower than it should be at the base because the resin seems to clench a little as it sets. Cut a spacer from (say) ¼ in x 1/8 in wood, styrene or metal, so that when wedged and glued in place, the firebox is about 28mm wide (or even a little more because we’re seeing the cladding). The rear edge of the casting is bevelled to fit inside the firebox rear brass casting but may need filing more for a snug fit. There are two holes in the footplate etch so that the firebox can be bolted down.

10. The firebox rear casting is intended for any Cudworth loco, and for the Mail needs about 2mm removed from the bottom. File or saw from the visible side (rear to front) to avoid lifting the electroplating. This shouldn’t happen, but if it does, the footboards will hide small imperfections.

**Trial assembly and wheel/motor fit**

11. Temporarily glue the thin cladding ring to the smokebox and the thick one to the firebox. Use something like UHU which can be peeled off. With the smokebox in place, slide the firebox between the cab sideplates and catch the boiler. For S7 and the (correct) thinner splasher, the firebox should fit, but for F/S and it’s thicker splasher, you will instantly see where they need filing away to allow the firebox and its cladding ring to move forward and catch the boiler.

12. With the splasher filed, check the boiler assembly for snug fitting and – holding the backhead in place - measure against the scale drawing. If the backhead is too close to the rear of the footplate, file a little off (retaining the bevel), but generally this is not necessary. Note that the centre-line of the boiler is below the top of the splasher and there was probably a narrow gap on the prototype.

13. Turn the body over and mark the firebox sides for drilling and tapping as for the
smokebox. Alternatively, to avoid tapping, drill a hole through the footplate and into the firebox spacer you fitted earlier to take a countersunk bolt and nut.

14. Wheel Clearance (F/S) With the boiler assembly fixed, draw round the splasher with a pencil, disassemble and draw a parallel pencil line about ¾ mm inside. Fix in the vice – without overtightening and using a wooden block for the firebox as shown. File or sand into the boiler and firebox: this is where a mini sanding disc is useful, but be careful not to go beyond the inner line or filler will be needed… Obviously where the firebox narrows, thinning is not needed. Note that there’s roughly a couple of mm clearance between the top of the wheels and the splasher (these locos must have had a bouncy ride!) so you need to pay most attention to the exact position of the cutaway at the sides. Note also that the boiler may become quite thin at the cutaway, particularly if you need to give your wheels lot of sideplay. In the worst-case scenario, glue styrene card inside and make good with filler. When painted and lined, the wheels will hide any problems.

15. You will need to remove a rectangle from the bottom of the boiler. Drill a series of holes across the front of the slot before using any type of craft saw. A 24mm wide slot is barely visible through the wheels.

**The Cladding Rings**

16. Choose the best side of the plated casting to be uppermost. Assuming your motor will drive the driving wheels (some prefer motors in the tender), saw through the thick cladding ring with the rectangular hole to extend the hole downwards. Then file into the sides to match the thinned part of the resin firebox. NOTE: hold the casting in the vice with cardboard or similar to avoid cracking off the electroplating, and saw and file gently for the same reason. (The photo was taken later and shows where I’ve packed above the motor with layers of lead.) If it occurs to you to simply cut across the casting on a level with the splasher, note that the lower brass can be seen through the driving wheels, particularly when the loco is moving.

17. Place the firebox in position and check there’s enough sideplay for the motor on your sharpest curve. For the ABC gearbox I had to remove extra semicircles at the sides to clear the bolts holding it together.

**Note for painting**

It will become obvious that the resin firebox will be trapped by the spectacle plate when fitted. The reason to avoid this is to allow the boiler, firebox and cladding rings to be removed for painting and possible maintenance. There are various solutions – your choice.

1. File a slight bevel as to the bottom rear of the firebox, as in the side-view diagram (exaggerated for clarity). This allows the firebox to be slid down and in from front to rear after the spectacle plate has been soldered in place. But leave soldering the spectacle plate and bevelling until after working on the boiler castings. Note too that once you’ve fitted the firebox rear, water gauge and top whistles, sliding can’t happen.

2. Alternatively, tin the points where the cab fits (tags and side extensions) and then tin again with low melt (70deg.) solder. Complete the loco, including fitting castings on the firebox and painting. Scrape the paint off the solder points and touch with the iron. If you’re reasonably quick, the solder will melt before the heat spoils the surrounding paint. Of course a little touching up will be needed.

3. A third solution is to solder little tags to the front bottom corners of the spectacle plate making forks with the existing tags so that the plate can simply be lifted off. Combined with angle brackets pinned to the firebox (see previous instruction) this is the most flexible solution.
18. Re-assemble the smokebox, boiler and firebox, fit to the chassis and check there's enough sideplay to go round your sharpest curve.

19. There's room to fit a flywheel, especially if you remove slots in the footplate as marked in the photo. But there's a trade-off between lead weight for adhesion and the space taken by the flywheel. See next section

**LEAD WEIGHTS AND RUNNING:** Now is the time to read Appendix A thoroughly, add weight and get the loco running as you would wish. Please don't leave this, since any cutting and soldering, and the general handling involved is best done now, not after painting and lining!

**Boiler Fittings: Handrail Knobs**

20. Bolt the smokebox, boiler and firebox in place, sandwiching the cladding rings. Check the boiler is correctly rotated for gearbox sideplay and hold the spectacle plate in place with tape or croc clips. Mark a top pencil centre-line. Then mark horizontal guide-lines 22mm above the footplate. Referring to the scale drawing, mark verticals for the handrail knob positions. Check the diameter hole needed (depending on the supplier, it's usually 1.3 or 1mm) and drill for the short knobs (sandbox and firebox) on the horizontal line, and for the long knobs on the boiler ½ mm below the line. It's good if the knobs can be a push fit. Also drill through the smokebox plate knob holes into the resin.

21. Thread the side knobs onto a length of straight wire, check it's not curved and the same distance above the footplate all the way along, and superglue the knobs in place. Note that the knobs are supplied drilled 0.7mm, but 0.9mm rails look more prototypical, and the holes can be drilled out by hand-holding the knobs with pliers and letting the drill find its own way. Only go half-way and turn the knob over before going through. Remove the wire to be replaced after painting.

22. If you're satisfied with the smokebox, the front handrail knobs can be trialled. To get the angle right, it's best to bend wire to the correct curve against the scale elevation. Although the handrail is one long length of wire, I find it easier to curve the front handrail round the edges of the smokebox so that its ends half-fit into the smokebox knobs. Later on, after painting and lining, the side rails can be fitted, and pulled back into the forward knobs. This method also means that the boiler and firebox can be removed from the footplate if necessary in the future.

**Further drilling for other boiler fittings**

As the idea is to leave fixing the various fittings until the last possible moment, you may find it helpful to identify them by reading the end of the body section, and also referring to the scale drawings.

23. Drill a pilot hole for the chimney and open out to 6.5mm/1/4in. Drill for the dome 4.5mm/No.16 or 3/16in midway between the boiler bands. (This is unnecessary if your model is to have the later boiler mounted sandbox.) Measure off the drawing from the front of the firebox casting for the rear safety valve and drill 3.5/No28 or 9/64in for Ashford/Vulcan. Mark 8.5mm behind the safety-valve centre, and draw a vertical round and down the side of the firebox. Mark across it 19mm above the footplate. This is the side position for the safety-valve balance fixing. Drill 1mm No.60.

24. All on the top centre-line: drill for the front whistle 1.2mm diameter, 1.5mm ahead of the spectacle plate. Drill 0.6mm diam 1mm behind the spectacle plate for wire 'pipe' from the pressure gauge. Drill for the rear whistle and multiple union 2mm diam, 5mm behind the spectacle plate.

25. On the RHS of the firebox there are three try-cocks (for the water level if the glass fails) on a diagonal. Mark these off the scale drawing and drill 0.8mm.

26. Water gauge casting: drill the lower hole 1mm diam, 20.5mm above the footplate. Insert the casting and use the top 'pipe' to locate a 12BA washer on the firebox. Glue the washer in place.

27. Clack valves: There are two varieties, and you must check with a photo of your chosen loco to know which to use. One type is at the height of the boiler centre-line, but the other is well below, hence the angled washer-plate. Additionally, their position along the boiler depends on the loco version. Check with photos and drawings, and mark and drill into the boiler 1/16in/1.6mm.
28. If you’re planning to fit the feed-water heater pipe (pre c1870), drill a 1/16in/1.6mm hole in the RHS of the smokebox casting 13.5mm above the footplate and 5.5mm behind the smokebox wingplate. The pipe runs horizontally back to the hole drilled in the RHS lower cab front. I suggest reading the whole of this sub-section before doing anything.

29. The pipe is a tight fit between the driver spring and splasher, and it’s best to prepare it at this stage. Anneal a 160mm length of 1/16 in brass rod at one end and curve it sharply round about 10mm from the end to go into the smokebox. Solder one of the six circular unions from the brass etch on the pipe where it fits into the boiler. (The unions look like washers with 4 1/2-etched holes to pip for ‘nuts’ and they’re easier to pip while still in the etch.)

30. Left as it is, the rod will force the driver springs outwards at the top. The diagram (plan view) shows a solution: file flats where the rod is against the front of the splasher arc, and joggle the pipe in behind the spring. It’s easier if the rod is painted separately and fitted when you fit the springs.

31. The solutions to getting the loco round curves with a joiner between the pipes has been discussed at the start of the body section. This is Solution 4 in detail, and it uses a sliding tube which has a degree of flexibility. It’s best to finalise this at the time of fitting the tender pipe. While still in the etch, pip four of the pipe unions and drill them 1.8mm, then tin their rears. Remove from etch and sweat in pairs. (The remaining union is to fit on the tender pipe where it enters the water tank.) Cut a piece of the supplied aluminium foil 15mm long and 6mm wide. Roll it on the long edge along a piece of 1/16” rod so that it just overlaps itself, then superglue it into the unions to form the coupling shown in the diagram. The ends of the heater pipe on loco and tender should be tapered with a file over about 4mm so they can dip in and out as the loco goes round curves, but the end of the taper stops the coupling sliding fully onto one or the other leaving a gap. Assuming the tube would have been made of india-rubber I suggest the unions should be painted green along with the pipes and the aluminium tube painted black. It’s not surprising the water heater was removed after a few years!

32. Now continue with soldering operations on the footplate.
Reverser lever and linkage.

33. The driver’s lever and quadrant. (For positioning, see earlier photos.) When the bottom of the quadrant is folded over, this will locate into the ½-etched slot on the footplate floor in the correct place. However, the backhead rim is slightly overscale in order to fit on to the boiler casting and can push the quadrant out of the vertical. To avoid this, remove about ½ - ¾ mm from the flap’s outer edge so that it can be fitted further away from the backhead.

34. Solder lill pins pointing outwards into the two top holes and file down the heads to avoid fouling the backhead. Take the lever casting and drill out the two holes 0.6mm. Trial the casting (with a pin as pivot) with the notched quadrant on the outside. The lever also exists as an etch, but this is too long. If you prefer to use it for strength, re-drill the holes as matched against the casting. However, if the lever gets bent it’s not brittle and can be bent back.)

35. I discovered the hard way that the quadrant makes inside lining impossible and had to bend it out of the way. It’s best to fit it after painting either by gluing, or by drilling the quadrant base and footplate to take a couple of tiny nuts and bolts.

36. The long link from the reverser lever to the weigh shaft crank comes as three etches, 50, 51 and 52. If you wish to make the complete link, solder the halves together, overlapping at the half-etches. The photo shows how it was arranged on the prototype. However, if the whole link is fitted (to the body), there are various difficulties. But a trial fitting as in the first photo allows marking it and the body for a suggested solution shown in the following two photos.

37. The forward end of the link is cut down, and fitted to the chassis as shown opposite, soldering the right-hand end behind the frame and catching the left hand end onto the weigh-shaft lever with a pin. A small recess is filed in the motion plate to avoid the link standing proud and fouling the footplate when fitting the body onto the chassis.

38. The rear end of the cut down link is threaded through the cab front plate slot and the end soldered to a tiny recess filed in the splasher. The fussy may notice the missing link behind the driving wheel spokes, so you may wish to glue a piece of the link into a slot in the firebox casting.

39. Firebox supports. With the firebox in position, fit the triangular support plates 45, soldering to the footplate. The tags may need to be reduced for snug fitting, and a slot must be filed in the LH one for the reverser link.
40. **Sandboxes and linkage.** The holes for the sandboxes are in the correct position for Ashford locos, but need opening out to about 2.8mm/No.34. For Vulcan/Kitson, drill new holes about 2 ¾mm behind the Ashford holes. The sandboxes are best made removable because they are lined as well as painted. The casting sprue is a 6BA bolt, so run a die down this to remove flash. If you don’t have a die, file flash down and clear the threads with a saw.

41. Decide whether you want to fit the tiny castings for the sandbox operating linkage as in the photo. The little uprights for the pivots have a spigot to fit in the levers, but the prototype would have had a rod across from one side to the other, curved to fit under the boiler. If you wish to fit this rod, drill the pivots 0.55mm and use 0.5mm rod. There’s quite a lot of room for these on Ashford locos, but they’re a tight fit on Vulcan/Kitson, arising from the position of the motion plate wings and the slight increased width of the driver splashers to give wheel clearance.

42. If you decide you’re going to fit the castings, drill a 1.2 mm hole in the RHS wing plate as in the top diagram seen from the front (note that there are F/S and S7 versions of 44), and drill 1.2mm holes in both sides of the footplate as in the lower diagram. Solder both 44s in place. However, note that judging from photos, at least No.201 of the Kitsons had the motion wing plates removed, perhaps when the boiler-top sandbox was added.

43. With the tight Kitson/Vulcan fitting, getting the rocker levers in requires a bit of juggling: curve the link to the sandboxes in order to thread them in an arc through the hole in the wing plate. Alternatively cut off, and fix a short length of scrap etch through the hole. In the late stages of assembly, run a wire rod back from the top of the rocking lever, behind the driver springs and into the cab.

44. **The lamp irons.** These are boxed on the etch as 100. Six are identical, three for the tender, two for the loco smokebox wing-plate and one for the front buffer beam. The latter appears originally not to have been fitted; it can be seen on some later photos, centrally on the front buffer beam, either in front of it or behind. Cut these six with no ½-etch tags left on. The one at the far end has a single tag for cutting; the unfixed end is ½ -etched for curling into a hook to hold a Special oval board. This iron is for the top of the smokebox and should only be soldered after the smokebox door casting has been trial fitted. Joggle and fit the irons.
COSMETIC SPRINGING

These notes also apply to the tender and I suggest making all the springs (but not axleboxes) ready at the same time. The right-hand photo shows how the axleboxes are connected to the springs by two rods, one outside the frames and one behind. On the prototype the rods are prevented from distorting by guides directly below the footplate overhang and above the axlebox. The weight of the loco and tender is transmitted to the each spring by four hangers (strips). In the model loco, the wheel axles are located only by the inner bearings, and so the outer axleboxes are purely cosmetic. The tender is different and should be built with sliding axleboxes – see later.

Axlebox castings

55. The kit has two types of axlebox: the driver boxes have no axlehole and are slightly different – as with the prototype; the other type of box is for leading and trailing wheels. It is also used for the tender, and Slaters top-hat wagon wheel bearings are a push fit for extended axles if used.

56. Drill the loco castings 0.6mm to take the rods which will be made from 0.5mm N/S wire. Be careful not to force the drill and remove frequently, or it may bind and break. The hole need only be 2 or 3mm deep. Don’t drill the tender axleboxes at this stage.

57. Cut off the sprues and file flush against the rear of the axlebox. Trial the castings in the hornguides, running a file down the side slots. As they are cosmetic, it’s actually helpful in the next stages if they’re tight enough not to fall out.

Rod guides and springs

58. So that the rods can be threaded through the holes in the footplate, clear them with a 0.6 mm drill.

59. There are several boxes of the rod guides for the springing, parts 58 with spares to replace ones that go wrong or get lost. A total of 48 are needed for both loco and tender, and they can all be made now. The guides have to be shaped to look roughly like opened out omegas (Ω) in profile and it’s best to form the parts in strips as follows.

60. Tape a short length of 0.5mm N/S rod to a hard surface. In the photo, I’m using the anvil of the vice. A punch is to be made using a piece of (say) 1/4in x 1/8in metal strip. Saw/file a slot along the end about 1mm-1.2mm wide. The punch is then gently hammered down to press the little guides over the rod a couple at a time. Note that the thin half-etch centre is to be forced up between the sticking out bits.

61. When formed, punch the rivets, tin the rear of the guides with solder and cut them out as needed.
62. Clean up the various spring castings and drill each of them with two 0.55mm holes 2mm apart, centred on the underside of the spring. A little jig made from a straight U of thin strip makes this job much easier. There’s not much room for error, but it will make fitting easier if you open out the holes to 0.7mm. Next drill the holes at the ends of the springs 0.7mm working from both sides so that the drill doesn’t wander. For the hangers to fit snugly, I suggest using a wider drill bit held in the fingers and rotated to form a slight countersink to the holes.

Assembly

63. First, fit all the inner rods, working from behind the outer frames. Temporarily slide an axlebox into a hornblock. Thread a length of 0.5mm rod through the footplate into the axlebox casting and solder it to the frame. Cut it to project about 4mm above the footplate. Repeat for the other rods.

64. Next, fit the outer rods. Again, thread 0.5mm rod down through the footplate into the axlebox and solder two guides across it, one up under the footplate, the other above the hole in the frame for the axlebox. Fine aluminium tweezers are very helpful here. Trim the rod and repeat for all the other axleboxes.

Spring Hangers

65. There are three types of spring hangers held in etch box 57. Although some of them look similar to the hangers for the tender they are a slightly different length. They are:

66. Two-hole type, no folds: for leading and trailing springs

67. Three-hole type, ½ etched for folding either side of centre hole, long: outer driver springs

68. Three-hole type, ditto, short: inner driver springs. These are also represented by the flat etched spring & hangers sticking up above the chassis. I expect many modellers will prefer not to bother with making up the inner springs because of the very limited clearance between these and the boiler cladding. Note that there seem to be no inner hangers on the Vulcan and Kitson batches, although they may have been retrofitted.

Driver spring hangers

69. The photo shows how these are to be assembled. Because of the cost, many will prefer to use wire soldered into the holes, but separate packs of brass 16BA bolts and nuts can be supplied either when ordering, or later (Send an SAE with the cheque and avoid p&p). If using bolts, open out the centre holes with a 0.8mm drill.

70. Fold the hangers tight across the ½ etch so that they won’t taper when inserted into the footplate slots. Join each pair (of the same length) using 0.7mm wire, or thread 3 nuts onto a bolt so that the the hangers will be 3mm apart and saw it off to leave around 1.5mm overlapping. Fix the hangers: with 16BA bolts I prefer thin superglue as it’s hard to stop solder getting into the threads and spoiling the look of them.

Fitting springs

71. Looking ahead, once you’ve fitted the loco springs and hangers, painting the splashers and polishing the brass trim will be difficult. I suggest trialling them, removing, painting them separately, and then fitting after painting the loco.

72. Assemble springs and hangers using a temporary ‘jig’ as in the photo. A pin is pressed into a flat piece of wood and cut short – the ‘fixed pin’. Lill pins are soldered using normal solder into one end of each of two hangers, allowing the solder to flow and tin about 3mm of the pin. The pins are threaded through the spring with its ‘worst’ side uppermost. Working on one end at a time, thread on the rear hanger and catch both on the fixed pin, with a space to keep them apart. The strip of metal in the photo is another spacer to compensate for the pin-heads. The rear hanger is then fixed with low MP solder, and the process repeated for the other end. NOTE: for the cab springs, have the best side uppermost – their reverse side is the one that’s seen.
73. With the better side of the spring casting outwards, feed the front spring hangers through the footplate slots until the spring is seated on the rods and catch with lill pins.

74. Before fitting the rear springs and hangers, file down the face of the pin and the low melt solder blob so they clear the rectangular holes in the cab front plate extensions. Have the best side of the spring casting facing inwards where it will be seen. Feed the spring and hangers through the cab front hole, locate one pair of hangers in the footplate slots and rock the casting to feed in the other pair and again catch the bottoms of the hangers temporarily with two more pins. Do this even if you’re going to do the final fixing after painting, to check everything fits.

75. The driver spring hangers should be threaded with pins and low melt soldered at the rear before threading through the footplate slots. The loco should now look like the photo at the top of this section.

76. If you’re going to paint the springs and hangers separately, remove them now, (maybe bagging or tagging them so they go back correctly).

77. When the springs, hangers and axleboxes are finally fitted, add the keeper plates 24a, pinning and superglueing.

78. Guard irons

79. These are parts 17 and on the prototype were joined by a cross-stay. If you wish to fit this, then drill 0.55mm holes so that they are 20mm above the bottom point of the irons and make the stay from 0.5mm N/S rod.

80. The irons can now be folded out below the rivets and then gently curved back to match the rail width. Solder them direct after punching rivets, or after drilling out the rivet holes and locating with pins. When trialled with the wheels, they need a little shortening, by about 1mm and the position for the stay holes allows for this.

81. Buffers and buffer beams

82. Wash and degrease the whole body before fitting the wood.

83. The wooden front buffer beam should be approximately 10.5mm wide and 2.7mm deep. Sand to fit between the flitch plates, bevelling the top edges to clear your soldering. Drill holes for the buffers and draw-hook.

84. Either glue the buffers and hook in place with superglue or alternatively remove the wood and solder them with low-melt. (There’s just room to get a tapered thin iron in between the plates.) For this method you need to open out the holes in the wood to form slots, being careful not to split the wood, so that it can be pushed in from below.

85. Make the coupling chain out of 1 long link (through the drawhook) and 4 medium links. The chain is usually hooked up.

Angle iron...

A close examination of original drawings and photos shows a strip of what was probably angle iron rivetted at the top of the outside frames and intended for joining the footplate. Although rivets are shown on the drawings, they are barely visible in photos and may have been ground flat. I have provided thin strip for the tender on the main etch. The equivalent for the loco is on the extra brass etch, with a suitable reverse curve to go around the driving axle. Although on the prototype it probably went behind the spring rod guides, it makes fitting difficult and I suggest cutting the beading to butt up against the spring rod guides.

Further curved strip is provided on the brass etch to go along the bottom of the driver splashers.
Boiler Fittings: Castings

All boiler fitting castings are to be glued into the resin and it's up to you whether to do this after painting and lining. I find painting, lining and varnishing much easier without the fittings and a further advantage is that you avoid damaging them. The fittings can all be mounted into holes in a piece of board along with the round sandboxes, tender rear sandbox etc. and painted and varnished at the same time. (Separate them into green and black and varnish/lacquer only.)

In the final assembly, I glued the cladding rings to the smokebox and firebox, leaving the boiler free to ‘float’ wedged between them and stopped from rotating by the handrails. This will allow for future disassembly, although motor maintenance only requires separating body and chassis.

It should go without saying that the chimney must be vertical when seen from both front and side. Dome, safety valve and whistle should be sighted from the rear against a central mark on the top of the spectacle plate and the chimney.

86. Fit chimney, checking with set square from side and front.

87. Boiler top sandbox. The box that the domes sit on in later versions is to do with sanding. It may contain sand, but I cannot see any filler caps in photos. It may cover take-off valves for an early form of steam sanding. The box is represented by part 46. Fold down the sides and solder. File the sides where they touch the boiler for a snug fit. The holes in the rear are for 0.5mm N/S rod for the controls, while the holes in the sides are for the sand (or steam) pipes. I suggest soldering the pipes in at this stage, and trial bending to fit into the footplate holes. When you fix sandbox and dome depends on your painting preferences. The rods go back into the cab through the holes beneath the spectacles and are bent at right angles to make handles.

88. Before fitting the rear safety valve, drill two holes 1.6mm diam about 1.5mm deep where the casting is pipped for two more safety valve levers, the ones that look like little spanners. Before fitting the dome, drill two 1.6mm holes inside the top ring across the dome (at right-angles to the boiler centre line). These are for the spigots on the safety valve levers. Trial both dome and rear safety valve with the valve levers and balances as in the next instructions before final fitting.

89. Safety Valves: Each pair of Salter spring balances is connected by a U-fork to a spigot. The longer spigot goes behind the dome. The shorter spigot should be curved at right angles and the lower ridge filed off so that it will fit close to the firebox.

90. Glue the dome levers into the two holes (it’s difficult to solder because of heating the whole dome) so they are parallel. When dry, trial fit the top ‘bobbins’ of the balances and mark a hole to drill for the spigot. On the prototype the boiler band must have been cut to fit round it.

91. Trial fit the rear safety valve and the spring balances into the hole drilled in the firebox earlier. Check the length of the ‘spanners’: the diagram above shows the dimensions that worked for me. The idea is that when properly fitted the spring balances are vertical seen from both side and front (and of course that the safety valve cover remains in line with the cab centre mark and chimney).

92. Note that there are different types of clack valves and it’s best to check with photos before fitting. Drill into the underside of the castings 1mm for the copper supply pipe. Some clack valves have a shut-down valve on top. For these, drill the top 0.5mm and make up handwheels as in instruction 101.

93. Fit smokebox darts into the smokebox door.
Firebox rear fittings

The photos show the parts and where they fit in the finished model. Note that once the firebox casting is in place and side fittings added, you can no longer slide the firebox sufficiently to release the boiler casting without removing the spectacle plate.

94. The rear and its fittings should eventually be painted (dirty) black, except for the cladding ring which should probably be polished (brass). The shovelling door catches can be made of 0.5mm wire superglued or low-melt soldered across as shown in the photo. These would get hot, and as far as I can make out, chains were attached and anchored on the tray or regulator so that the fireman can pull the chain to lift the catch without burning his hand. To be to scale, these would need to be very fine and I don't supply them in the kit. If you fit them, do so before fixing the firebox rear in place, when it can be laid flat.

95. The rest of the castings can be glued in place. Fit the tray through the three holes. Drill the regulator bearing 0.6mm to take the cast spigot on the regulator (the 'shepherd's crook' lever). You may wish to cut off the 'crook' and replace it with 0.5mm wire threaded into a hole carefully drilled in the end. I suggest leaving off the reg. itself until the loco is almost complete. The two cocks on either side of the regulator (A and B) should be drilled 1mm, to take 0.9mm copper wire which goes down to the footplate as in the scale drawing. If you’re not sure of your drilling ability, drill in 0.7mm or so for just 1/2mm and taper the end of the wire.

96. Drill the front loco whistle (hidden behind the spectacle plate in the above photos) 0.6mm horizontally through the base. After fitting to the firebox, a short length of 0.5mm N/S wire is passed through the central hole in the spectacle plate into this hole for the handle. This will need to be bent or joggled to get round the safety whistle. It can just be seen in the top RH photo.

97. The rear whistle was for safety and would have been activated by a chain running back through the train to the guard’s van. The two cocks either side of it are for the feedwater supply from the footplate-mounted Gifford injectors. These were fitted later (in probably in the early 1860s) and replaced the feedwater pumps worked off the crossheads. Drill for 0.9mm wire as for cocks A and B. For locos in original condition, cut off the cocks to leave the safety whistle only or even leave off the whole fitting. (Refer to the scale drawing of the cab rear elevation.)

98. Water gauge (seen on plain firebox for clarity): Drill 0.55mm for 0.5mm wire handles bent at right angles as in the scale drawing. Drill the bottom for a thin pipe of 0.5mm copper wire though this is pretty much out of sight and can be omitted. A small washer is packed with the castings to glue against the firebox where the water gauge top pipe enters it.

99. Fit the three try cocks into the holes in the side of the firebox on the right hand side in front of the cab.
100. The Gifford injectors: Drill a 0.55 hole in the top of each injector, for the handwheel shown in the scale drawing. Drill a 1mm hole into each of the rear unions (hex nuts). Curve 0.9mm wire to the shapes shown in the cab elevation drawing leaving the tops over length, and bend at 90deg. to go into the holes. I found it best to solder them in with low-melt. The bottom spigot of each casting should be filed to a rectangle to fit at the rear of the slots in the footplate where the locating tabs have been bent down. Each injector is then trialled in the slot while you adjust the wires to fit into cocks at the top of the firebox. These ‘pipes’ are very prominent, so take time to match the curves on each side.

101. When fitted, make up hand-wheels: best done before removing from etch: drill the handwheel centres 0.5mm. Hold ~15mm of 26SWG/0.5mm in the vice, and - holding the complete handwheel etch - solder the handwheel to the wire. Snip from etch, clean up and insert in top holes with superglue. When painting, leave the rims shiny, but paint the centres red (or use a fine felt-tip pen).

102. One of the final jobs is to cut out circles of glazing and trap with the remaining brass spectacle rims. I found it best to do this after painting, supergluing the rims in place and then varnishing them, but you will have your own preferred method.
INSTRUCTIONS MAIL TENDER

‘Chassis’

Fitting and removing wheels, springing and compensation – design choices

Sub-frame method. This is probably the easier option but you the non-prototype bearing guides spoil the ‘emptiness’ under the frames on these early locos. This option uses the Slaters 3/16in round bearings at front and rear, with the centre axle on a square Slaters bearing sprung to cope with track irregularities. The brake gear is fitted on 3/64in rods through the etched holes in the subframe so removing it is relatively easy for painting. Use ordinary Slaters axles so that the outer cast axleboxes are purely cosmetic.

The option closest to the prototype is to use Martin Finney wheels with extended axles in top-hat bearings pushed into slots in the cast axleboxes. The front two axles can move up and down, controlled by compensation beams; the rear axleboxes are to be fixed. This method is a little more work and so read through the instructions first. Removing wheels is also more difficult to after fitting the brake gear, so paint them first.
4. Before folding, you need to drill 1.6mm holes on both sides of the cut down sub-frame for the comp. beam pivot, 33.5mm behind front edge of front spacer (approx 56mm from frame front edge) and 6mm above the bottom edge.

5. Fold, including the spacer 65 as in the earlier photo.

6. Cut two 6.5mm lengths of 3/32” tube. Place the comp. beams 101 in turn on a cocktail stick held in the vice and solder on the tube. The second photo shows how the beams are to be fitted when the chassis is in place on the footplate. The pivot is made with 41mm of 1/16” rod which should be left loose so that it can be fed through pivots and beams after the subframe has been added but before it’s bolted down. NOTE that the the comp beams must be as close as possible to the outer frames or they can short circuit on the wheels.

7. Solder 65 into the slots at the front of the inner frames with the part number uppermost. The vac cyl. support is then that bit further below the tender body and closer to the track.

Guard irons

8. These can now be joggled below the fitting Solder them direct after punching rivets, or after drilling out the rivet holes and locating with pins. When trialled with the wheels, they may need to be shortened. These are parts 66 and on the prototype were joined by a cross-stay. If you wish to fit this, then drill 0.55mm holes so that they are 6mm above the bottom point of the irons and make the stay from 0.5mm N/S rod.

9. The irons can now be joggled below the rivets to a gentle reverse curve to match the rail width. Solder them direct after punching rivets, or after drilling out the rivet holes and locating with pins. When trialled with the wheels, they need a little shortening, by about 1mm and the position for the stay holes allows for this.

Footplate and outer frames

10. On the footplate open out the hole for the hand brake casting to 2.4mm diam.

11. The outer frames should made up, laminating them (as follows) in the same way as the loco. Fortunately all the tenders seem to have been the same, unlike the locos.

12. Before you start, check parts 70 and 71 (seen in the photo below) which are the outermost laminates. Parts 71 are the front hornguides and framing for the footsteps. Near the bottom step is a hole to take
the brake spindle. The bearing will be formed from the little parts 71a laminated on to the step frame to cover the hole. They can be seen in the photo below, RH top, where part 71 is facing outwards, while the bearing hole can be seen from the inside, RH bottom. Originally, I had planned for the ovals to stand out from the half-etch and save some soldering but it proved impossible to punch the rivets. In revising the etch I left one of the ovals in place on the left-hand steps. This should be filed off flat.

13. Fold up the hornguide edges as for the loco and check that the axleboxes can move up and down freely but without too much play. The rear ones can be quite stiff as these will be fixed. If you’re building with subframe and inner bearings then all can be stiff.

14. LAMINATION. (See diagram below) Line up 68 against 69 so that the lettering on both is hidden inside the sandwich. On 69, (the one with the hornguides) the top strip is intentionally narrower, so that the bottom edge is invisible even on a viaduct. (Otherwise the frame would appear a ridiculous 2 scale inches wide.) Now temporarily pin the end hornguides in position. The top edges of hornguides and parts 68 and 69 should line up with only the fixing tabs on 68 sticking up and the gap between the inner and outer hornguides should be only the thickness of the etch (0.5mm). When building, I found that the top of 69 needs filing down about ¼ mm all the way along so that the tabs can do their job. This is best done before soldering.

15. The half-etched circles in parts 68 should be punched to make large ‘rivets’. These represent the ends of the brake hanger pivots. (The brake castings fit into holes in the footplate, but if you’re the sort of person who wants working brakes, then drill the pivot holes 1.4mm and use 3/32in rod as pivots, cutting of the tops of the brake castings. Work from the outside, as the inner holes do not quite line up as they should. Good luck with avoiding electrical shorts…)

16. Tin the lettered sides of 68 and 69 and the rear tops of the hornguides. Clear the holes with a 0.55mm drill. The exact order of soldering everything together is up to you, but my method was first to pin the rear hornguide through the top two holes and the two keeper plate holes as a guide, then clamp with croc clips, and apply heat. The pins should be removed with a quick touch of heat; later on the top holes will be used for the spring hangers. Then I pinned the front hornguide/steps in place and soldered. Finally the centre hornguides.

17. Check that the hornguides are positioned correctly by trial-fitting the combined keeper plates and stays 87 and 88. They have ½-etched ends to create an overlap without increasing the thickness. Once matched and soldered together, they are interchangeable. Set aside the stays/keeper plates for later on.

18. Solder the laminates to the footplate 67 making sure to get them the right way round (!)

19. Punch the rivets in the rear buffer beam and solder in place. Add the square washer plate 72a over the hole for the drawhook, locating with a cocktail stick cut to a rectangular chisel end. Slightly fold the front buffer beam 73 into a very shallow V to match the footplate and solder in place.

20. Add wire strengtheners to the rear of the steps and tin around where the steps will be fixed (See earlier diagram)
21. Each brake spindle bearing is made with the little ovals and circles 71a. Pip the rivets and tin the rear while still attached to the etch box. Remove each item as needed (they're easily lost). Put a cocktail stick through the hole above the lower step, thread the oval on, and with a hot low wattage iron briefly touch the hornguide above the oval until the solder flows. Remove the stick, hold the little circle (bearing cover) with a croc clip and sweat on to the oval. This whole process might be a candidate for resistance soldering where the heat is very localised.

22. Remove the steps, 68a and fold. The upstand will go behind the hornguide/step hanger. square steps go at the bottom and the rectangular at the top, through the etched slits. Hold the bearing laminates 71 in place with a small croc clip and solder the steps in place.

23. Solder a countersunk 6BA bolt into the front hole. This will fix body to chassis and also form the coupling pin. It helps coupling if you file the end to a point. The head of the bolt will be hidden by the footboards. Solder a 6BA nut on top of the rear fixing hole in the ½ etched hex recess.

### Tender Body

At this stage I recommend moving onto the body. The intention is for it to be removable for painting, and especially for lining behind the springs.

#### Removable body

It’s best if the body is removable mainly because, if not, lining is almost impossible around the springs. The etch is designed for spacers at front and back carrying 8BA nuts lining up with holes in the footplate. With a removable subframe this works well. With the working axleboxes method, I discovered after assembly that getting the bolts in when the wheels are in place can be quite fiddly.

There are two solutions. The simple one is to go ahead anyway and cut down the bolts, the rear to ~8mm long and the front to 5mm, bevelling the cut ends with a file to give a lead into the nuts. The longer ones should be mounted in drill or lathe and the head filed down to ~3mm diam. They can then be worked into place with tweezers and screwed home with a narrow watchmaker’s screwdriver on the angle.

The ‘better’ solution which will take longer is to re-drill the rear holes in the footplate closer to the centre line so that they are 20mm apart inside the subframe. The rear spacer 85 in the tender body should be drilled to correspond before fitting. The front spacer 78 can be omitted and cut into two pieces to fit inside the sandboxes, with corresponding holes drilled in the footplate.

24. The tender footplate is part 67. Remove from the etch carefully so as not to distort the ½ etched edges. Open out the hole for the handbrake casting to 1.3mm. Because the footplate is not very high above the track on these early locos, there is a danger the overscale treads of F/S wheels could short on the footplate. There’s about ½ - ¾ mm clearance. Wheels that can move up and down may short-circuit onto the footplate over bumps in your trackwork (well, not yours, but someone else’s…). Consider marking where the tops of the wheel flanges might touch the footplate and drilling holes to be opened out into slots. Use the slots for the body tabs as an indication of how near the edge (not) to go.

25. Start with the bunker front/cab sideplates 74 which is to end up as in the photo. It was only after building the loco that I noticed that the Kitson batch does not have the oval holes for a small grab handle. Anyone modelling this batch will have to file small ovals from scrap etch to fill in the holes. If you are building a loco pre c1869, then you need to drill a 1.7mm hole for the feed-water heater pipe as shown.

26. Anneal where the sideplates are to be curved, and along the top fold. When cool, fit in the slots and note how ½ etched lines in the footplate are intended to locate the sideplates. Mark the start of the bends, and then put the side-plates in their intended slots and mark the end of the curves.

27. There are probably folding devices for a job such as this, but I bent the curves by holding 74 between fingers and thumbs and starting to curve over 1/8” rod sticking out of the vice and then 3/32”. Keep offering up to the footplate to check the curving, and use pliers to straighten up the curve if it goes too far into what should be straight. I found it helpful to overbend and use pliers to open the bend out. Not only does the curve have to be the correct radius, but it must remain at right angles to the bottom edge, otherwise the side plates will not be vertical viewed from the front. It takes a while and shouldn’t be rushed. If need be, re-anneal and have a
break! Make sure the side plates fit exactly in their ½ etched slots. I found that they were about 1/4mm too long, and filed them back. (If others confirm this, I’ll note an amendment for any future etch revisions.)

28. Finally, make the reverse fold of the top. To get the correct height, it’s important that the curved top should be snug against the horizontal shelf, and (being a barbarian) I clamped it against a steel bar and used a gentle hammer… The rectangular hole appears to be for the coal rake and fire pricker.

29. 9 or 10mm lengths of 0.5mm N/S rod should be soldered inside the oval sideplate holes: there’s a ½ etched slot to locate the top.

30. Remove the tender sides 77 from the etch. For locos running pre c1869, refer to the scale drawing and, mark the hole for the feedwater pipe. Drill 1.7mm on the right-hand side only.

31. THE TOP FLARES. I started by catching the flare in the vice between two lengths of hardwood, one slightly bevelled, so that bending the side down starts to create the radius. Removing from the vice, I finished off by gripping the thick top of the flare with wide pliers and bending down. The side ‘follows’, curving a little more. You need to work bit by bit along the flare and back again, not trying to do too much at once. Try the flares against the top of the bunker front to get the profile right. By the time the pliers are about 45deg. to the sides you’re about there.

32. Solder the rear flare 82 to the tender rear 81, matching along the ½ etches. If you leave the flare attached to parts 58 and 97, they form a useful handle while soldering. The ½ etched slots on rear and flare are to locate the lamp-irons later on. Note that the flare should lie flat with the rear as with the sides: it does not overlap as Stirling flares do. Curve the flare as for the sides, and trial against them. The fit can be helped by very slightly bevelling the inner face of the flare beading.

33. The sides are intended to be strengthened inside by laminating parts 83 against them. They also form a ledge to support the tank top and the front curve. Clamp the 83s against the sides, mark through the middle two handrail knob holes, unclamp, and drill for clearance, say 2mm. If you try and drill after assembling the tender there’s a good chance the drill will wander in the thin half-etch and spoil the side. (Yes, I know, I should have etched the holes…)

34. The tank top 84 should be curved before the 83s are soldered so that they can be used as templates. This job is made easier if you have rolling bars.

35. Tin the 83s and clamp to the sides. Note that the tender rear 81 has ½ etched edges to fit between the sides, so there must be 1/4mm gap between the back of the 83s and the sides to allow for this. Tack the 83s in a couple of places and check the alignment before sweating into position all the way round. It’s worth strengthening the middle gap with scrap etch along the floor edge.

36. Place the sides and end in their footplate slots. If they don’t fit nicely together, you may need to increase the flares. Clamping them together is not easy, and I hold them with fingers and touch a hot well-tinned soldering iron to the corners of the flares to catch them and similarly catch the insides of the corners nearer the floor. The iron can then be run down inside each corner to complete the join. Done well, the result should be a sharp corner rather than the rounded corner of a folded box.

37. The rear spacer 85 should then be added, in the slot on the inside of the rear. Two 8BA nuts are sweated over the holes. 8BA bolts will hold the rear down via the holes in the footplate.

38. Re-fit the body into the footplate slots, and check the fit of the tank top 84. Catch the rear corners with solder. Remove and complete the soldering from the inside, working from the rear, then down the curve. Refit to check all is square.

39. Solder the bunker front 74 to the bunker, adding the front spacer 78. Add two 8BA nuts.

40. Bolt the body to the footplate with four 8BA bolts. Curve the ½ etched sandbox fronts 76 and solder into the slots in the bunker front and side plates but not to the footplate.

41. Trial fit the bunker floor 79 – lowering the projecting ‘tongue’ into the shovelling hole. It’s a little bit wide and needs about 1/4mm filed off each side. Don’t force it in. Adjust the length until it slopes gently down to meet the curved tank front.
42. Curve the ½ etched sandbox fronts 76, tin their top edges and the underneath of the sandbox tops 75.  
Trial the tops, and file slots to accommodate the vertical rods in the oval cut-outs. Solder sides and tops 
in place. Solder the shovelling plate 80 to the ‘tongue’ of the bunker floor, where it projects between the 
sandboxes.

43. Trial the rails to the top of the sideplates – these were between the 
bunker front 74 and sandbox tops 75 on the etch. The ½ etched groove 
locates them and the top of the rails should be the same height above 
the footplate as the loco’s. Solder in place. After fitting the vertical grab- 
rails later on, the thickening at the ends around the grab-rail holes should 
be filed off if you want to be true to the prototype, but of course this will 
weaken them. You should have now reached the stage shown in the 
photo.

44. Check the historical notes concerning the toolboxes. Note that Mail No.2 
in later days had the rear box remounted in front of the top toolbox, and 
apparently with a flat lid. If you’re building a Stirling era modification loco, 
SER-Kits can supply a casting for the large tender top toolbox.

45. Fold and solder the top and rear toolbox sides, 93 and 95. Bend the lids 94 and 96 to fit. Fit the top 
toolbox in the etched rectangle on top of the tank (but see next instruction before soldering), and fit the 
rear toolbox centrally up against the rear of the tank. On Stirling locos there was a scale inch between 
the box and tank, but I cannot find evidence for this on Cudworth tenders. Perhaps the gap was to avoid 
external corrosion.

46. In Cudworth drawings and photos, there is a fixing for the top toolbox lids but it’s very unclear. My guess 
is a slot half way along the lower sides of the lids which fell over a metal ‘tongue’ projecting from the 
side. The tongue probably had a hole drilled in it for a padlock, but no padlock can be seen in any of 
the photos of Mails. If you want to fit this, do not solder the toolbox to the tank-top until you’ve done so. (See 
‘Superdetailing’ later.)

47. Joggle lamp-irons (three identical ones from etch box 100) and solder into slots on the tender rear and 
centrally on the flare. (You may wish to read the discussion on lamp-irons in the historical booklet before 
committing yourself).

48. Pass lengths of 0.5mm N/S rod through the tiny holes in the shelf of the bunker front and into the 
corresponding holes in the bunker floor. Solder in place. There are tiny cast handles – the water cocks 
themselves – but I suggest fitting these after painting and lining.

49. The rear oval number-plate was on the tank rear above the toolbox. The oval frame for the white 
pasteboard type is on the extra brass etch.

Feed-water heater pipe

50. You will have already decided whether to fit or not when building the loco body. Drill a hole in the right 
hand side of the tank/bunker, 12.3mm up, and 45.5mm behind the bunker front. Circular unions (they 
look like washers) are provided on the extra brass etch with 4 ½ etched circles for punching as rivets. 
When fixing, arrange the rivets on the diagonal.

51. Anneal a 160mm length of 1/16 in brass rod at one end and curve it sharply round about 6mm from the 
end to go into the tender side. You may wish to glue this in after painting so that it doesn’t make lining 
difficult.

52. See loco instructions for method of joining the tender pipe to the loco pipe.

Finishing

53. Solder or glue the rear buffers. Assemble and fit the Slaters sprung drawhook and screw coupling.

54. Add the two tiny water cock castings to the wire rods fitted earlier to the shelf above the shovelling hole.

55. Add the tender brake standard.
Finishing The Chassis

56. Refer back to the boxed discussion on compensation v. sub-frame at the start of the tender notes. Then modify the axleboxes as follows.

57. Drill the castings to take the rods from the springs (0.5mm N/S). For fixed axleboxes I suggest drilling 0.7mm at both pips. For sliding axleboxes I suggest a wider drill such as 1mm to ensure free movement. The front hole can go right through to the slot, the rear one about 2 ½ mm deep for the comp beam spigots. Too little and these spigots can pop out when the axleboxes bounce up and down over uneven track or when lifting the tender off. Be careful not to force the drill and lift it in and out frequently, or it can bind and break.

58. With the rod holes drilled, saw off the the casting sprues and file flush. Hold the axleboxes in the vice so the slot isn’t pinched in. Check the fit of top-hat bearings in the slots and clearing out any irregularities with a cylindrical burr in a drill. Ideally, they should be a push fit so that later on they can be held with Loctite or UHU. If this can be achieved, then they and the frames will not need to be splayed out to get the wheel sets out for painting or maintenance.

59. Trial the axleboxes. If your wheels are going to be in sub-frame bearings, then the axleboxes are cosmetic and should be a push fit (slightly squeeze the bent-out hornguide sides) and you can remove them and go on to ‘Further Detailing’. If you’re using comp beams, then the rear axleboxes should be a push fit while those at middle and front should slide freely. I suggest marking the axleboxes L1-3, R1-3 so that they are always replaced in the corresponding slots.

60. Add the sub-frame. For later removal, it’s helpful to open the hole for the front fixing bolt forward into an open slot. Then the way to get the sub-frame in is to slide it from the rear, overshoot, and with rear touching the footplate, slide it back and over the coupling bolt.

61. Lift the sub-frame enough to push the comp beam pivot rod through the holes drilled earlier, catching the comp beams. All being well, the comp beams will have next to no sideways movement but be free to pivot. You may need to file/burr/sand off any projections from the springing pins, or very slightly joggle the comp beams. Remember they must be absolutely flush against the frames where they might short-circuit against the wheels.

62. Trial the four compensated axleboxes and check that the comp beam spigots engage in the corresponding shallow holes. Trial the wheels, pressing the top-hat bearings into the axleboxes.

63. Turn the tender over, holding the wheels in place with a ruler or strip, and place on track. Adjust the rear axlebox (use a wedge of plasticine if it’s not a tight fit) so that the footplate is level and measure the distance from the top of the track to the top of the footplate. When adjusted, it should be 30mm (actually 29.9) but at this stage it will be higher as the comp beam spigots are deliberately too long to allow for differences in the depth you’ve drilled the axlebox holes. If, say, your footplate is 31mm above the track, then you need to remove 31 – 30 = 1mm from each spigot. I suggest removing this in stages. I managed to cut a couple of the spigots too short and so cut them off completely and soldered replacement 0.5mm wire; this however fouled the wheels and to avoid short-circuits, I had to saw slots in the comp. beams for the wire to fit flush.

64. Next trial the tender on your sharpest curve. With my four foot radius curves, I had to remove the projecting centre bosses of the Slatters’ Martin Finney type wheels to allow enough side play.

65. MAINTENANCE NOTE. Later on, fitting the wheels requires springing the brake rods outwards. Without tilting the axles, work the front wheels down past the brake rods and when clear, add the top-hat bearings and press them down into the axlebox slots. As these axles are not pin-point, you might consider shortening their ends to ease fitting.
(Cosmetic) Springs
The springs and hangers can be easily deformed when the body has not been fitted and I recommend finding a strip of wood about 35mm wide so that the tender chassis can be put on it upside down when doing maintenance, painting etc. The springs will hang down either side of the wooden strip out of harm’s way.

66. Add the spring rods and guides using the same method as for the loco. If you’re using fixed axleboxes, treat them all the same. For compensated axleboxes only fit the outer rods, as the comp beam spigots form the inner rods below the footplate as far as a viewer is concerned. The important thing is for the hanger pins to project as little as you can manage inside the frames where they can foul the comp beams.

67. If you’re going to fit beading (Parts 86 – see discussion in the loco body instructions) now is the time. Although on the prototype it probably went behind the spring rod guides, it makes fitting difficult and I suggest cutting the beading to butt up against the spring rod guides.

68. Returning to the springing: the rods should be cut down to about 3.5mm above the footplate before fitting the spring castings. Drill the castings as for the loco. For compensated axleboxes, fix the rear rods into the casting and cut to project about 3mm or slightly less. The idea is that the rods will locate in the footplate holes but barely project underneath the footplate, where they could foul the comp beams.

69. Using the hangers boxed as 92, fix the spring castings as for the loco wheels. Note that where some of the pins project into the underframe space, they can foul the comp beams, so for these run the solder between inner hanger and frame so that the pin can be ground or burred flush.

The Brakes: read the historical notes in the booklet before continuing.

70. Parts are supplied for both the earlier wooden shoe brakes (90), and Stirling iron shoe brakes (91). The prototype had brake linkage either side of brake shoes and wheels, which is why there are four long links and four front adjuster rods. You may wish to omit the inner linkage because of the danger of short-circuiting the treads, but this can be avoided if you use tube spacers as suggested later. The photo opposite shows a trial assembly of wheels and wooden shoe brakes with only the outer rods. (You will have springs fitted.) The two photos below show the trial fittings of the linkage for wooden shoes (above) and iron shoes (below)

71. There are no transverse connecting rods between the wooden shoes, but the Stirling version would have had them. They are to be made from 3/64in tube threaded onto the ends of the lil pins. As you fit the brakes, have the scale drawings by you and refer to them along with the instructions.

72. Clear out the bottom holes of the appropriate brake shoe-and-hanger castings with a 0.6mm drill, and solder the top spigots into the square holes in the footplate, tinning round the holes first and then using low-melt (or glue with epoxy glue). Keep the solder or glue away from the outer edges or the blob will interfere with the tender body fit. Alternatively, if you’re using the sub-frame method with Slaters’ wheel-bearings, you may prefer to cut off the spigots and fit the castings on 3/64in rod.
73. If you’re fitting vacuum brakes, add the double crank shown in the photo by threading onto a length of 3/64in rod which is soldered into the trunnions. Leave the double crank loose. The spigot protruding from it (bottom left of the photo) will fix to the vacuum cylinder.

74. If you’re building a non-vac loco, cut off the trunnions.

75. Referring to the photo at the start of the brake section, make the main brake spindle by cutting a length of 1/16in rod exactly long enough to spring into the bearing holes behind the front steps: it’s about 46mm. Thread on the two tiny cranks and the outer crank and rod which connects to the brake handle. (There are castings for these to be drilled 1/16in and 0.6mm, or use the etchings in etch box 89. The etched brake handle crank has an etched slot appropriate for the vacuum brake.)

76. For the vacuum brake, the brake spindle must also be threaded through the large hole in the double crank (to be seen in the previous photo). The photo opposite shows what you’re aiming for. File the vacuum cylinder casting to be a snug fit on its seating, and trim the ‘piston rod’ on the etched double crank to be a push fit.

77. For both types of brake, spring the spindle into place. The cranks and rod to the brake handle can be soldered to that casting later on.

ORIGINAL WOODEN BRAKE SHOES

78. Refer to the previous trial assembly. Prepare the brake-rods (90) by soldering lill pins into the centre and end holes of two of the long rods, and into both ends of the adjuster rods. Let the solder tin 6 or 7mm along the pins ready for using low-melt later on.

79. Insert the long rods’ pins into the rear and middle brake block pivots and solder with a tiny dab of low-melt. To avoid short-circuits you will probably need to leave around a millimetre (or more) of lill pin showing between the rods and the castings. Insert the adjuster rod pins through the long rods’ front holes and into the 0.6mm holes in the tiny cranks and again catch with low-melt. This is very similar to the Stirling arrangement in the above photo.

80. Now trial the axle-boxes and wheels, and adjust the closeness of the brake shoes to the wheels. Glue or solder the tiny cranks to their spindle.

81. If you plan to fit the inner brake rods, this is probably best done after painting the chassis and wheels. Paint the rods too and scrape away where they are to be soldered onto the lill pins. I suggest fitting short lengths of 3/64" tube over the lill pins as spacers between the castings and the inner rods. For my 4ft curves, I cut 2mm for front and rear and 3mm for centre wheels.

STIRLING IRON-SHOE BRAKES

82. Drill 0.9mm through the cast ‘bolts’ holding brake shoes to hangers.

83. Refer to the previous trial assembly photo and to the scale drawing. Prepare the combined brake-rods and cranks by soldering lill pins into holes which carry the brake shoes. Let the solder tin 6 or 7mm along the pins ready for using low-melt later on. Thread into the brake shoe holes.

84. The adjusting links should have the adjuster casting soldered at the end with low melt after cutting off the sprue. The little spigots go in the end holes of the link. The photo shows both inner and outer brake rodding and links, but you may choose to omit the inner. To avoid short circuits with the wheels, you will probably need to leave at least a millimetre (or more) of lill pin between the rods and the castings for clearance.

85. If you do plan to fit the inner brake rods, this is probably best done after painting the chassis and wheels. Paint the rods too and scrape away where they are to be soldered onto the lill pins. I suggest fitting short lengths of 3/64" tube over the lill pins as spacers between the castings and the inner rods. For my 4ft curves, I cut 2mm for front and rear and 3mm for centre wheels.

86. Finally, the brake shoes are coupled in pairs by lengths of 3/64" brass tube fixed on the lill pins, checking lengths carefully to avoid short-circuits.
Superdetailing (for those who wish…)

87. Top toolbox catches. Drill 1mm holes centrally along the edges of the lids. Hammer the end of 0.9mm copper wire flat, push down through the hole until the flat jams and solder inside. Cut off and bevel.

88. Tender feed-water pipes. Notice in the side elevation drawing, the feed-water pipes run down from under the tender tank, curve round and go towards the loco firebox. These can easily be formed from 1.2mm copper wire curved to the profile in the scale drawing and soldered to the subframe. They will need non-prototype tapering inwards under the loco to allow it to traverse curves. Not so easy is to pip the union castings (they look like 4-prong tap-handles), drill 1.2mm, cut from the sprues and thread on the wire, for this reason they’re being omitted from kits. If you want to try your hand, send an SAE.

Footboards

89. The loco and tender footboards are in two parts. Some modification is needed to the loco section to fit around the Gifford injectors, if fitted, drilling two ~3mm holes and filing into them from the front edge. Originally, I thought the rear boards might have been hinged, but – as discussed in the historical booklet – they are probably a single unit of cross boarding fixed to bearers. It’s up to you if join them by short lengths of wire to allow movement.

90. In the end I decided to make the footboards out of thin ply and wood strip, to be stained and weathered. If you wish to do the same, here is a template. In case it doesn’t print quite accurately, redraw based on the measurements, cut the wood slightly oversize and sand down for a fit. You’ll see there’s an extension alongside the reversing lever quadrant (not on the etch) where I now think the driver would want to put his left foot to get purchase.

91. In order to allow fitting when there’s a steam heat pipe to the tender, I cut the plywood in half along where it starts to get narrower (below the 46mm measurement in the diagram) and hinged it with a bit of tape. The footboard is free floating to allow the loco round curves, but you could try locating pins into holes drilled in the footplate.

92. Finally, decide on how much you wish to assemble before painting. If you add the axleboxes and keeper plates at this stage, they will have to be masked. Alternatively add them after painting. The lill pins holding the keeper plates can be separately tinned with ordinary solder and then touched with a tiny blob of low-melt on the iron, or simply glued. Bear in mind that the wheels should be painted green and, ideally, have a double white line around the circumference.

Appendices follow…/
APPENDIX A: Lead Weights, Springing, Running

1. It's very important that you understand the following before finishing the body with detailing, painting and lining. It's much better to sort out running in the mid-stages as recommended in the instructions. Surgery and soldering after detailing and painting is not a recommended course of action!

2. There is a compromise between springing, weighting and the performance you can expect from this loco. Because of my 4ft radius curves and 1 in 40 gradients, I had to fill every spare ml with lead. If your track is all on the level with 6ft or more curves, you will probably need much less. But no track is perfect...

3. To understand what has to be achieved, imagine an 0-6-0 loco with no springing or compensation and with coupling rods removed. Assume the motor drives the middle wheels. If the loco is going slowly, then obviously any dip in the track will cause it to lose grip as the middle wheels spin. Any bump in the track, especially on curves, will potentially lead to derailment as front or rear wheels lose contact. For the Mail, the trick is that the driving wheels are unsprung, while the leading wheel bearings are adjusted so the loco is level when these are at the top of their travel. In other words, the function of the leading wheel springs is only to push one or other wheel down into any dips in the rails. Therefore these springs can be relatively strong. The trailing wheels, on the other hand, are very lightly sprung so as to barely reduce the weight pressing on the drivers, but to allow the whole loco to dip down into dips in the track so that the drivers don’t lose contact with the rails. The loco is therefore almost like a 2-2-0, and this is the clue to how to proceed.

4. Start by remove the trailing wheels so that the loco is in effect a 2-2-0.

5. The first step is to roll a strip of lead about 5cm wide and fill the boiler ahead of the gearbox. I used lead around 1.3mm thick, and needed 29cm for the roll. It can be left loose at this stage, but later on check that the front cladding ring can still be fitted when it’s glued in place.

6. With smokebox, boiler and firebox loosely in place, fit body on chassis and check that there’s enough forward weight for it not to tip backwards. If it does, add a roll of lead to the smokebox. Connect to a train of vehicles with a rough wire coupling and trial. If the loco slips, cut progressively wider strips of lead and fill the top of the firebox down to the motor. For my gradients, the firebox is filled over the motor and behind it all the way down to the footplate (no flywheel). If necessary fill the ashpan with strips of lead (as I had to), but leave room here or elsewhere for a decoder if needed.

7. If the leading wheels tend to jump the track at speed, then more weight is needed at the front. My smokebox is completely filled with a roll of lead.

8. You should now have an idea of the maximum possible performance on your layout with your vehicles.

9. Finally, refit the trailing wheels and springs and check performance. There is a trade-off between heavy pulling ability without slipping on gradients and the speed at which the loco can be reversed over sharp curves or complicated trackwork without the trailing wheels lifting and derailing because the springs are too weak.

10. If there is now slipping where there was none, slightly reduce the length of the rear springs. That will usually do the trick for track with no gradients. Otherwise, experiment as I did with lighter rear springs. I tried replacing the spiral springs with new ones made from the same fine spring wire as the pickups use, but this was too weak and the loco ran off the track in reverse even when going slowly. The end solution was to bend springs from 0.5mm P/B wire as in the photo, soldering one each side to a strip of metal representing the rear top of the ashpan. You can see how the free end of each spring is turned at right angles to bear on the axlebox. Painted black, the springs are reasonably invisible. No doubt spring wires of a different profile (half a swastika?) could be soldered to the chassis cross-piece if you don’t want to add the ashpan top.

11. Finally, you need to consider trailing axlebox travel and possible short-circuits. Whatever springing you use, retain the 12BA bolts which limit the trailing boxes’ top travel. I suggest screwing the bolts down, so that when the body is fitted to the chassis and the loco is level, the rear axleboxes have only about 1mm upward play. Run the loco very slowly over all your track, and if the drivers slip in places, then the rear boxes need more upward travel. (Of course if these dips are where the loco is unlikely ever to stop, they can probably be ignored because the momentum of a normally moving train will carry over them.)
12. However, the more upward travel the more likely the tops of the wheel treads could short against the footplate. This is why there are etched holes to prevent this happening. In extreme cases the extra 0.5mm provided by the thickness of the footplate may not be enough and the treads will touch any hole covers. With short wheelbase locos (Vulcan and Kitson originals) the covers can be left off, as the holes are barely visible in the dark between firebox, springs, cab sides and front. With long wheelbase locos (Ashford and modified Vulcans and Kitsons) the holes are in the cab and while a cover of scrap etch may work, if your track requires the trailing wheels to have a lot of up-and-down movement you may need to devise little splashers. For safety these might be of thin styrene.

**APPENDIX B: DIY Firebox rear with cladding ring**

The etch contains the same parts that I used for the firebox rear casting. For anyone who is interested, this was my method:

1. Use around 120mm of 3/16in brass tube – final length needed around 90mm. File along it's length to reduce to less than ½ round cross-section (around 2mm outside depth measured with calipers).

2. Anneal. While cooling, hold a length of scrap 22mm plumber's copper tube or similar vertically in a vice. The diameter is not crucial. My piece still had a compression olive near the end, and I found this helpful to the forming process.

3. Slowly work the brass round the tube with the fingers, gently bending more and more to form a horseshoe curve. **Anneal frequently**, especially if the tube starts to become difficult to work or kinks. Remove kinks with pliers as soon as they form.

4. Slowly reduce the radius using the firebox casting and rear etch as templates. Hold the brass on an angle to the former tube so that it forms a 90deg. quadrant profile.

5. Anneal and use tube and pliers to form the reverse curves either side.

6. When satisfied with the shape (and it takes a fair while to achieve; be patient, it took me an hour or more to get right), solder to the etched backhead and cut off the waste. Trial for a snug fit against the firebox. Solder the firebox doors, and add horizontal wire to represent the catch-bolt.

7. Finally use progressively finer emery cloth to remove blemishes and achieve a fine finish which can be polished.
APPENDIX B: Mail etch numbering

1. Chassis. If springing driving wheels, file out slot to rear ½ etched line; if not, file bottom keeperplate and horns to rear ½ etched line
2. Inner hornblocks, front
3. Inner hornblocks, rear
4. Outer hornblocks, rear
5. Inner hornblocks, centre (if choosing sprung drivers)
6. Rear chassis spacer, S7
7. Front chassis spacer, S7
8. Rear cylinder head and chassis spacer; 8A – cylinder heads, front, and rear with centre hole, plus valve covers. The F/S version is elliptical to fit between the frames, but seen from the side looks like the circle it should be. Use S7 valve covers with F/S heads and file to clear each other when soldered in place.
9. Motion plate, two versions for F/S and S7
10. Support for dummy motion between driving wheels, number to face to rear
11. Firebox grate and ashpan sides
12. Ashpan front. Cut to ½ etched line for F/S chassis width, and joggle at wide ½ etched line to suit side profile
13. Ashpan base
14. Cylinder base (to be curved)
15. Trunnions for weight shaft (Ashford)
16. Trunnions for weight shaft (Vulcan/Kitson)
17. Guard irons
18. Slide bars for dummy motion (top only)
19. Footplate
20. Outside frame, middle laminate
21. Outside frame, inner laminate. Solder to 15 so that ½ etched face of the hornblocks looks inwards.
22. Outside frame inner laminate, rear hornblocks. Choose one of three fixing positions depending on loco version modelled.
23. Outside frame outer laminate, front hornblocks. Solder to 15 so that the ½ etched face looks outwards (and therefore the thicker parts for the steps can be seen)
24. Outside frame outer laminate, centre hornblocks; 24a, keeper plates
25. Outside frame outer laminate, rear hornblocks. Original Kitson and Vulcan locos (Nos197-204)
26. Outside frame outer laminate, rear hornblocks. Kitson and Vulcan locos (Nos197-204) modified with longer wheelbase
27. Outside frame outer laminate, rear hornblocks. Ashford locos.
28. Smokebox front plate; 28a, smokebox rear saddle; 28b, angle iron fillers
29. Front buffer beam (outer)
30. Front buffer beam (inner); 30a, draw-hook washer plate
31. Front buffer beam ‘thickness’
32. Rear draw beam
33. Driving wheel cover sides
34. Driving wheel covers
35. Leading wheel cover sides
36. Leading wheel covers
37. ‘Cab’ side plates; 37a top rails
38. ‘Cab’ front plates
39. Steps (Vulcan and Kitson)
40. Steps (Ashford)
41. Backhead (firebox)
42. Coal doors
43. Coal door grills
44. Motion plate ‘wings’
45. Firebox ‘wings’
46. Dome base (later versions)
47. Dummy motion parts
48. Reversing lever stand
49. Reversing lever
50. Reversing link (left-hand end) and weight shaft crank, Vulcan and Kitson
51. Reversing link (left-hand end) and weight shaft crank, Ashford
52. Reversing link (right-hand end) – join overlap to 50 or 51
53. Spectacle plate (remove sides for early versions). When cutting off the number tag, leave the main
tag to match the other side. These fix to the cab front plates as per prototype.
54. Spectacle plate beading
55. Spectacle rims
56. Numberplate ovals – black on white enamel version
57. Spring hangers
58. Spring guides
59. Brake gear
60. Loco footboards
61. 'Wooden' fall plate
62. Loco tender coupling
63. Tender chassis
64. Guides for Slaters square bearings
65. Front chassis spacer and loco-tender coupling bearer
66. Tender guard irons
67. Tender footplate
68. Outside tender frame, middle laminate; 68a, tender steps
69. Outside frame, inner laminate. Solder to 68 so that ½ etched face of the hornblocks looks inwards.
70. Outside frame outer laminate, centre and rear hornblocks. Solder to 68 so that the ½ etched face
looks outwards (and therefore the thicker parts for the steps can be seen)
71. Outside frame outer laminate, front hornblocks; 71a, bearing for brake spindle
72. Rear draw bar; 72A, draw-hook washer plate
73. Front draw bar
74. Bunker front and front side plates – curve to ½-etched lines in footplate
75. Sandbox tops
76. Sandbox sides – curve to ½-etched lines in footplate
77. Tender sides
78. Front fixing for removable tank/bunker assembly
79. Bunker floor
80. Shovelling plate (between sandboxes)
81. Tender rear
82. Rear flare
83. Inner tender sides and support for tank top
84. Tank top – curve to profile of 82
85. Rear fixing for removable tank/bunker assembly
86. Outside frame beading
87. Combined keeper plates and hornblock stays (front)
88. Combined keeper plates and hornblock stays (rear)
89. Brake cranks
90. Brake rods and adjusters – original versions with wooden brakes
91. Brake rods and adjusters – later versions with iron block vac brakes
92. Tender spring hangers
93. Top tool box sides
94. Top tool box lid
95. Rear tool box sides
96. Rear tool box lid
97. 93Handwheels – may have been used on locos with short fireboxes
98. Driving wheel balance weights
99. Sandbox levers
100. Lamp-irons
101. comp beams