Caley Coaches
'True Line' kits in etched brass

0141 772 5537

e-mail: jim@caley.com
url: www.caley.com

Jim Smellie,
15 Tay Crescent,
Bishopbriggs,
GLASGOW, G64 1EU,
Scotland, U.K.

General Building Notes

This booklet is designed to give an overview of etched brass kit assembly techniques and as such is not specific to any particular kit.

Tools and Techniques

Soldering Equipment

For virtually all etched brass kits soldered construction is not only recommended but a must. This puts many people off the medium but there is the advantage that it is very hard to destroy sheet brass with the kind of heat generated by a small soldering iron unlike whitemetal. We will come on the technique of soldering later but I recommend the following kit for 4mm work:-

a) 20-25W soldering iron with replaceable bits and suitable stand. For safety the stand should ideally be secured to your workbench so that it can't be knocked over. My one is made by Antex and sold in virtually all hobby/electronics shops.

b) CARR's 188° solder and Green label flux for the bulk of the assembly work.

c) CARR's 70° lowmelt solder and Red label flux if you have any whitemetal fittings to apply.

d) CARR's Solder Mask to keep solder from going where it shouldn't.

e) Heat-resistant surface to work on—I use an asbestos tile about 12" square and about ¼" thick.

f) Assorted clamps, wooden clothes-pegs, Blu-tack and the like to keep assemblies together while you work—homo-sapiens has not yet evolved into a species ideally adapted for soldering, an extra hand would often prove invaluable.

Other Tools

You will find this first list of tools invaluable :-

a) Anglepoise lamp—perhaps odd to see listed as a tool but I see it to be of prime importance, you will never do any good work if you can't see what you are doing!

b) Allied to a) is some form of magnifier.

c) Small vice with smooth cheeks for holding larger assemblies. Again ideally this will be screwed or

clamped to your workbench.

d) Stanley knife and a small offcut of wood to cut against to remove parts from the etched frets.

e) ½" fine cut file for removing tags on etched parts.

f) Needle files for gentle dressing of the parts, removing solder etc.

g) Fibre-glass brush and refills for cleaning the brass prior to soldering.

h) Small, cheap paintbrushes for applying flux (keep one for each type of flux you use).

i) Set of small 5-sided taper broaches for gently enlarging small holes.

j) Small flat nosed pliers for general gripping.

k) Small side cutters for cutting brass wire and the like.

l) 6" stainless steel ruler.

m) Small square for checking alignments.

n) Small (jeweller's type) screwdriver.

o) Pin vice and assorted small bits.

p) A map-tack for pressing out rivet detail from the rear.

q) ⅛" reamer to ease tight bearings. This may have to be augmented with a secondary size such as 2mm or 3/32" for tender and/or bogie axle bearings.

Here we come to a divergence. Users of Romford wheels will require :-

r1) Romford screwdriver

while users of other wheels will require :-

r2) Appropriate back-to-back gauge.

Compensation adds another couple of items :-

s) Small piercing saw and fine blades for removing half-etched hornblock cut-outs.

t) Set Puffer's CG003 axle/hornblock alignment jigs.

These then are our basic items. Hopefully they won't prove too expensive for you and you probably have many of them already if you have done any modelling work. But when you have to buy, buy the best you can afford. As in most of life, with tools you really do get what you pay for—today's bargain pliers won't seem quite the same bargain when the jaws fail to mate tomorrow! Good tools properly cared for last a lifetime.

Dependent on the type and amount of kit-building you intend doing there are various other but, by and large, considerably more expensive items you may wish to consider purchasing. Among these I would list :-

u) Small blowlamp for annealing the brass where forming work has to be undertaken.

v) Bending bars to ease the task of making long folds. Blacksmith Models do several sizes at a reasonable price. A much more sophisticated and thus pricy alternative is a folding press but generally this would be a case of cracking a nut with a sledgehammer.

w) Rolling mill. A few kits supply you with a flat etched sheet boiler which you need to roll into a cylinder (or perhaps even a cone depending on your tastes!). The best way to do this is via a rolling

mill—pricy but perhaps a good investment for a club or area group.

x) Riveting tool. Hopefully the kit manufacturer will have made provision for all the necessary rivets in the kit. If not, or your prototype acquired some rivets in places the rest of the class didn't, you will need to add them and a riveting tool simplifies things.

General Ground Rules

There are a couple of points which apply to kit building of any kind.

1) Read the instructions and identify all the parts. Hopefully the manufacturer will have had the foresight to include identification numbers on the etch which are cross-referenced in the instructions. If not you are on your own but one tip here is to photocopy the etch and work out everything on paper before touching the fret again. This is perhaps only feasible if you have access to a photocopier, I don't think your local copy shop would take too kindly to being asked to copy metal although in truth it wouldn't harm either the machine or the etch—assuming they don't try to use the sheet feed that is!

2) Assemble as much data on your actual chosen prototype as possible and by prototype I mean the actual loco you are building, not the class in general. Small differences nearly always exist between members of a class even when new, as they get older the differences, and thus the pitfalls for the modeller, tend to multiply. With coaches data tends to be sparser and you will probably have to settle for modelling the generic diagram.

   Ideally you will be able to find two photographs showing the opposite elevations around the same time. It is also a good idea to take a copy of a drawing of the class (Supplied with the kit? If not find one!) and mark up on it any differences between it and your prototype. Refer to this drawing and your photographs at all times as you build your model from the kit.

Techniques

There really are only two basic techniques required in etched kit construction—FORMING and SOLDERING. This is of course once you have the fret separated into the various components.

Often there will be half etched rivet points which require pressed put to form a raised rivet on the outside of the work. This is often easiest to do with the pieces still firmly (!) held in the main etch and a slightly blunt large, headed map-tack is my favourite weapon here. Simply press the point of the map-tack into the dimple while the work is resting on a firmish surface (such as a pile of newspapers resting on top of the workbench.) A little trial and error on the less visible rivets should teach you the right pressure. Don't press to hard or you risk piercing the metal—you can always go back and try again on under-formed rivets.

Let us then deal with cutting-up the fret. Opinion varies on this one, some say "Only cut-out the parts as you need them—it stops you losing anything". Others, including me, prefer to cut-out everything at once storing the various bits (in my case) in little, clearly labelled(!), snap-top poly bags within a largish "project" box. (I find it very useful to keep everything concerned with building a kit in one box, preferably with a lid.)

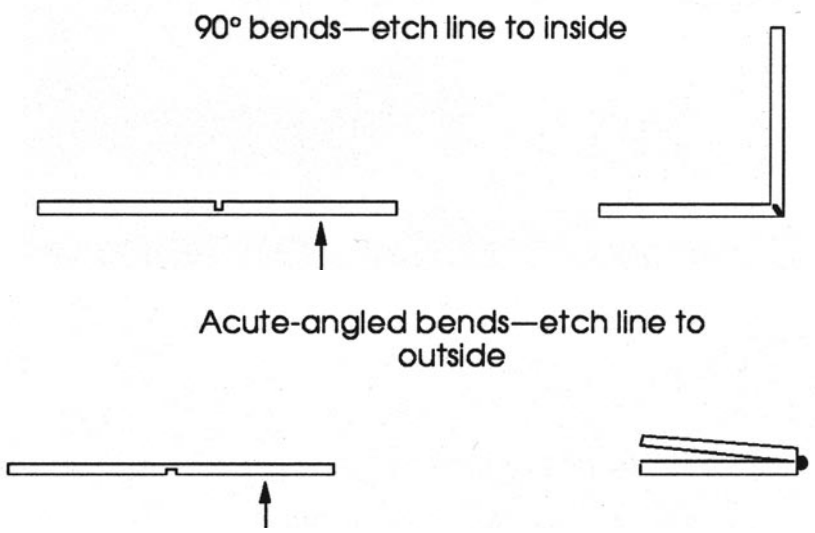
The cutting out can be done with a variety of tools but my preferred method is a Stanley knife against either a non-slip cutting mat or an offcut of fine grained wood. Where, as should be the case, the tags are small it is a simple matter to cut through the tags by scoring them in several passes. Don't try to cut them in one pass—the pressure required will almost certainly distort the etch. Sometimes larger tags or those of a heavier gauge etch will defeat this method and it then becomes necessary to resort to a piercing saw. Piercing saw blades are delicate things and need to be well supported while you work. Work close to the edge of your work bench (aka. offcut of wood) using

only an inch or so of the blade near the saw handle where it has least flex.

Once you have the part(s) separated you will need to dress the tags. The ½" file is the tool here—use it by drawing it along the tag not across it. Again the part should be well supported while you do this, perhaps in the vice, to avoid distortion.

FORMING to my mind encompasses anything concerned with turning the 2-D etch into a 3-D shape that doesn't actually involve joining parts together.

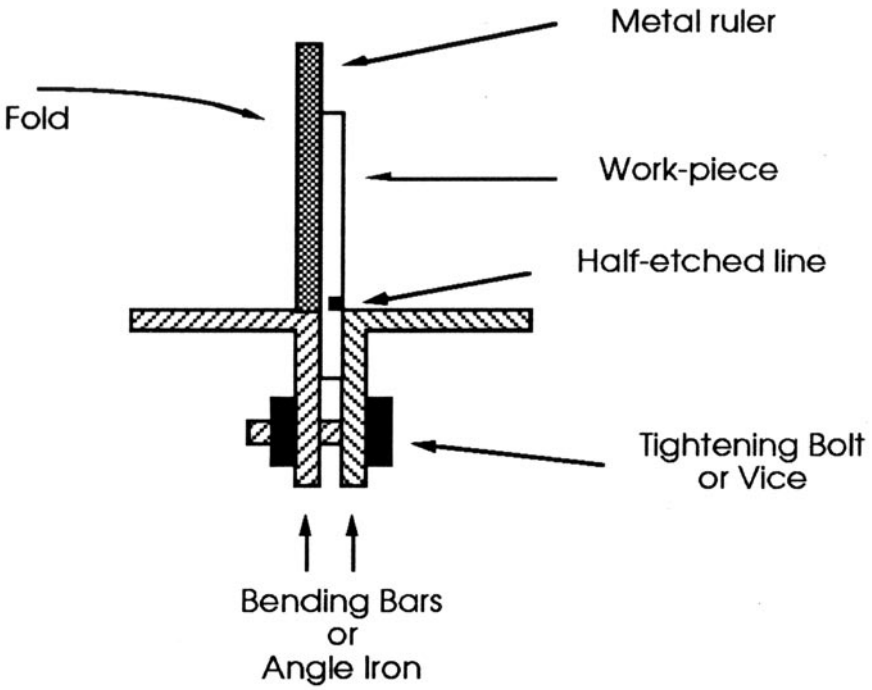
Box-like structures are often formed by folding-up from the flat along half-etched lines. The de facto standard used by most kit producers is that these line go to the inside of the fold when the bend required is 90° or less ("etch-closed") and to the outside where the bend is greater than this ("etch-open"). The sketch should make this clear.



Actually as drawn the upper example, if encountered on a kit, would cause you no end of problems. This is because the etched line is too narrow and the upper edges would meet before the 90° fold is achieved causing distortion. Unfortunately this situation is encountered all too often in kits either through poor design or sloppy quality control during the etch process. The remedy is however simple—due to the mechanics of the etching process the half-etched line is more of a "V" in nature then the box drawn and it can be easily widened with a few strokes of a 60° needle-file used flat in the groove.

Nearly all folds will be short enough (in 4mm scale anyway) not to cause any major headaches—gripping one end with pliers (or even fingers) and bending will suffice. Longer folds can be trickier and here bending bars are useful. Clamp-up the piece to be folded in the bars (or between two lengths of angle-iron in the vice) with the half-etched line just showing and, using a metal ruler or similar, fold over the free end to the required angle. Again the sketch should clarify things.

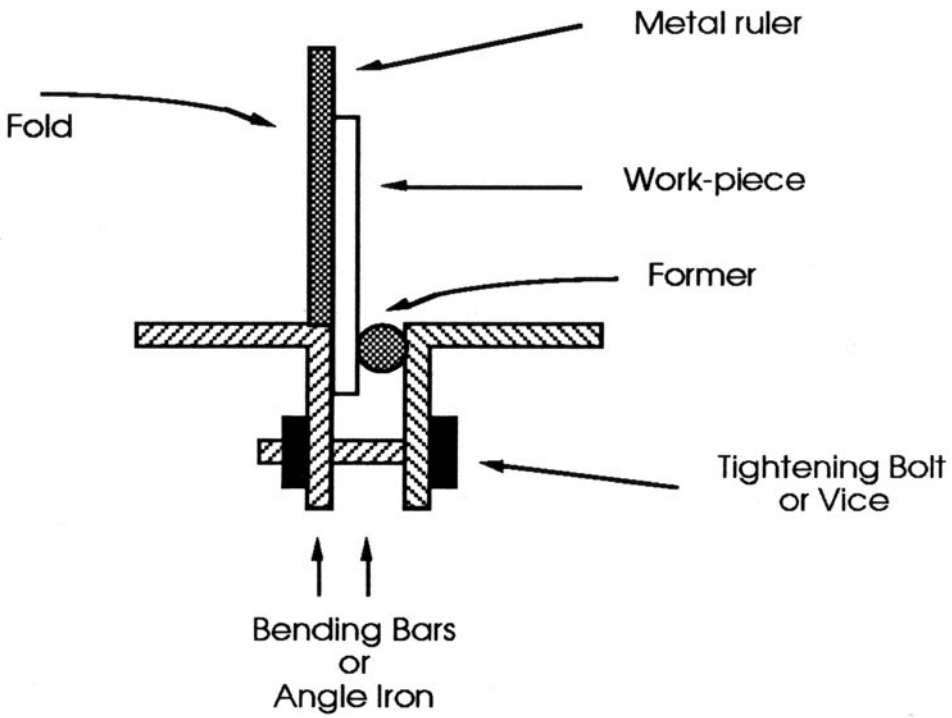
It pays to think about the bending order. Generally do the trickier folds first while it is still possible to clamp the piece in your bars and then fold down (or up) all the little gubins.



The other side to forming is when curves are involved. Examples of what I mean are roofs and loco side tanks. Often these kinds of bends come easier if the metal is first annealed. In annealing the metal is heated with a small blowlamp until it reaches a mauve colour. There is no need to heat the brass to "red hot" and you are in danger of melting the sheet if you do! Allow to cool slowly. Working the metal, by bending or filing etc. makes it hard again. It is important to clean the surface oxide off any annealed parts before you come to solder them as we shall see later.

The actual process of forming tight curves and bends uses a variation of the bending bars described above. Clamp the piece up in the bars (or vice) with a former of a suitable radius and fold over as before. A variation on this technique for bends of a small radius (such as Caley side tank tops) is to clamp the work-piece into the bars along with a length of scrap brass from the etch in place of the former. When you fold the sandwich the scrap will form a near 90° bend but the work-piece will have a nice small radius curve—the exact radius will depend on the thickness of the etch and on the thickness of the scrap piece. Some trial and error on scrap is perhaps called for before using the method in earnest.

Gentle curves, such as cab roof tops, call for a different technique and no tools for once other than those God gave you, in this case your fingers. Support the roof or whatever in the first three fingers of your hand and gently press down in the centre with the thumb on the same hand. Keeping the same pressure, "roll" your thumb back and forth along the piece. Check regularly against your drawing and continue until you have the correct radius. This is one of those techniques which is much easier to do than describe—have a go on a piece of scrap if you don't believe me! Once you have the basic curve any reverse curves can be executed by bending (by hand) against a suitable former.



SOLDERING is the process by which nearly all of an etched kit should be assembled. The only real exception to this in my mind are either where a screw assembly is used (most obviously body to chassis) and the occasional small detail parts which can be glued on. In the latter case either an Epoxy type or "super-glue" can be used.

In any soldering, the old maxim "Cleanliness is next to Godliness" should be uppermost in your mind. It is none too difficult to solder brass to brass but impossible to solder brass to dirt (or dirt to dirt for that matter). Cleanliness is also important after the soldering process as we shall see.

Any part should be cleaned before you attempt to solder it, even if it looks clean there is liable to be a layer of surface oxide. This is especially true of castings and annealed parts which have gone through a high temperature process during their formation. At higher temperatures oxides form more easily. Cleanliness can be achieved either mechanically or chemically—perhaps a combination of both is best. The worst of the gunge should be removed by polishing the parts with a fibre-glass brush and the parts then wiped with a solvent such as MEK-PAK or one of Mr. Carr's brews to kill the rest. Wipe it on with a piece of kitchen roll or the like in a well ventilated place.

It is also important to keep the bit of the soldering iron clean and well tinned—by which I mean coated in solder. To tin a new bit, dip it briefly in flux as it warms for the first time and apply some of the solder directly to it. After that it should be simple matter of wiping the bit on the damp sponge of your iron's stand to keep the bit clean but if it comes really gunged up you may have to scrape it clean. This should only be done when absolutely vital since most bits are nickel plated and you are liable to scrape the plating off thus considerably shortening the life of the bit. Because of this your iron must have a replaceable bit and you should have a ready source of replacements—it is no good buying a bargain iron mail order if you can't get replacement bits locally.

So much for the prelude now we actually come to soldering and in this I always go against conventional wisdom. Most books tell you that solder should never be applied directly to the iron except when tinning, instead they say both heat and solder should be applied directly to the job. This might be the best way for electronics work but not, I find anyway, for sheet metal work. What I do is to set up the job using assorted clamps, Blu-tack etc., apply a generous dose of flux to the joint using a cheap (children's) paintbrush, pick up some solder on the iron and apply the iron to the joint. All being well, the flux will boil off and the solder run into the seam. If you didn't have enough solder on the iron—and it's always better to err on the side of caution since it makes cleaning up

easier—repeat the process (including more flux) until happy. In a few seconds the joint will cool and you are ready to move onto the next job.

Sometimes you don't want the solder to flow along a joint but instead to tack two items together—perhaps during the initial stage of an assembly where you wish to check the alignment. In this case apply onto a drop of flux in the appropriate place and use only the merest drop of solder on the iron. If it is really important that solder be excluded from an area try some smearing it with Carr's solder mask. This is, I think, a graphite based paste which will halt the flow of solder and act as a lubricant to boot so it is very useful on bearings and the like.

The third and final technique is that of "tinning and sweating". Here the aim is to join two pieces of sheet together—perhaps applying an overlay to the main assembly. Flux the areas to be joined and run a thin coat of solder into each face. Re-flux the area and place the overlay in the correct position. Now apply heat to the job preferably from behind or from an adjacent area. Again the flux should boil off, the solder coatings melt and mingle leaving everything nice and solid when it cools.

Fixing white metal castings calls for a little lateral thinking. Our problem is this :-

1) Whitemetal melts around 130°—well below the melting point of our solder, and

2) Low metal solder as sold for the assembly of white metal kits does not bond to brass.

The solution is simple once it is appreciated that low melt solder does bond to 188° solder. Simply tin the brass in the area where the casting is to be fixed with 188° solder, position the casting, apply the appropriate flux for the low melt solder (such as Carr's Red label), pick up a small amount of the low melt solder on a clean iron and apply to the job. In a trice the flux should boil and the job is done. It is important to stress that your iron should be thoroughly cleaned when switching between different type of solder—some people even keep an iron specifically for each type—since if the different types of solder are allowed to mix you will end up with a bastard alloy which will bond to neither whitemetal nor brass.

Thoroughly clean each sub-assembly using an old toothbrush and warm soapy water as you go and clean the model after EVERY work session. The principal reason behind this is that flux is an acid, any excess flux left on a model is, at best, liable to ruin you paint job and, at worst, turn your precious creation into a heap of corroded brass! Cautious people might even like to use an alkaline bath to neutralise any left over flux before cleaning—a mild solution of washing soda has the desired properties.

Motor and gears

I will start this section by stating that, with only one exception, I do not like open framed motors—I find them bulky, noisy and inefficient, very often being poor starters. They were perhaps fine a few years ago when little else was available but today we have a wide range of "can" style motors available from such sources as Branchlines (see useful addresses section) that normally one can be found to fit our chosen prototype whatever that may be. My rule of thumb when choosing a motor is "Which is the biggest one that will fit with encroaching on the cab and/or daylight under the boiler etc.?".

Branchlines have a nice range of 1:38, 1:60 and 1:80 gearboxes which can be recommended as can the various gearboxes from High Level.

Honourable mention goes to the Anchoridge DS10 and its clones. It is the only "open frame" motor which I would use but then its design is more akin to a "can-less can" than a conventional open-frame motor. It has the advantage of being a bit cheaper than most cans and of being able to fit into most spaces, axle hung using a mounting bracket and Romford 1:40 gears. It has a drawback in being a little frail but treat it kindly and it will serve you well.

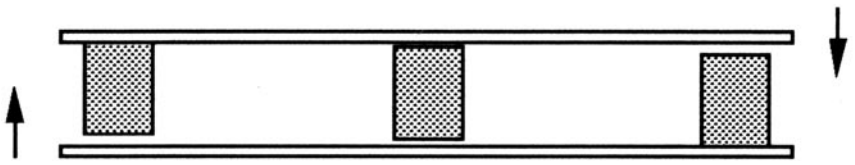
Whatever combination you choose, choose at the outset before building any of your kit. Often some aspects of the construction may require modification for a particular motor or gearbox and it is far easier to do this as you go, referring to the parts concerned, than trying to shovel everything in after construction.

Chassis

I feel it is well worth the effort to compensated all loco chassis and anyone interested in the subject is recommended to Mike Sharman's little booklet on the subject which covers all the basics, goes through the common 0-6-0 chassis in detail and suggests layouts for just about every other conceivable wheel arrangement.

Most etched kit chassis make provision for compensation by providing half-etched cut-outs around each axle hole—if you don't want compensation you simply insert axle bearings in the holes as usual otherwise you remove the half etched sections which gives you the required cut-out for just about any compensation or springing system on the market. A piercing saw is the best tool for this removal, cut up each side of the cut-out to the top and then, using a pair of pliers, push the sawn part back (folding it on the top half etched line) and waggle it until it breaks off cleanly. Remember when using a piercing saw that it helps to keep the saw edge close to the end of the work bench at all times, and press down hard on the frame with your fingers. Keep the saw vertical and let the blade do the work on every down stroke. Don't remove the cut-outs for the driven axle.

When assembling the chassis take care not to end up with a banana. If all the spacers are soldered to one sideframe and then to the other, expansion caused by the heat is liable to warp everything when it cools so that it never runs true. It is far better to solder the front spacer to the left hand frame and the rear spacer to the right and then solder the two sub-assembles together, trapping any other spacers in place when you do so. Solder the center spacers in place. Once again the diagram should help explain.



Setting up sub-hornblocks is not a difficult matter if you use a set of jigs and the coupling rods from the kit. Start at the driven axle by locating the top-hat bearings opening up the holes slightly if necessary. Take care to keep the holes circular. Use a Puffer's axle/hornblock alignment jig to check the alignment of the bearings and when satisfied solder the bearings to the sideframes. Leave the jig in place.

Now, using the coupling rods and a set of Puffer's axle/hornblock alignment jigs, fit the hornblocks and bearings as follows :-

a) Locate the hornblocks and bearings for the centre axle, using the spring of the jig to hold them in place,

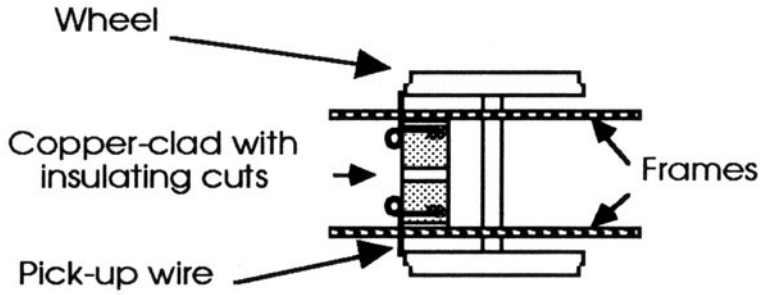
b) For each side, slip the appropriate section of the coupling rod over the spigot of the jig in the fixed axle bearings and over the spigot of the jig in the centre axle bearings adjusting as required,

c) Once happy with the alignment of both sides, solder the hornblocks to the sideframes,

d) Repeat from a) using the other sections of the coupling rods and the centre axle as the reference point for the next and subsequent axles.

Remove the coupling rods and jigs and solder a keeper wire across the bottom of the slot in each sub-hornblock.

Pickups come in many shapes and forms. My current favourite uses copper clad printed circuit board and phosphor bronze wire. Cut a piece of circuit board to be a tight fit between the frames and cut insulating gaps along the center and at each edge so as to keep the frames electrically dead. Glue this in place on the chassis. Make up two small "springs" from phosphor bronze wire as shown in the diagram and solder them to the circuit board. Adjust until they contact with the edge of the wheel rim—picking up from the wheel rim ensures that pick-up is never effected by dirty wheel tyres. The spring in the phosphor bronze can take many forms to suit the circumstances but is necessary to keep the pick-up in good contact with the wheel at all times.



Pick-up arrangement

Wheel quartering is another area which seems to cause problems but the method I use is as follows :-

a) Starting with the driven axle adjust all the wheels to approximately the correct quarter aligning by eye to the nearest spoke,

b) Fit the coupling rods and bushes to the driven and centre wheels,

c) Freewheel the chassis up and down and feel for binding,

d) If binding occurs, adjust only one wheel on the centre axle $\frac{1}{8}$ of a spoke clockwise,

e) Again freewheel the chassis up and down, repeatedly adjusting the quartering anti-clockwise on the same wheel until no binding occurs,

f) Fit the coupling rods between the centre and rear axle and repeat the process from c), adjusting only the quarter of one of the rear wheels.

Coach Painting by Peter Tatlow

(Note that while this section deals with L.M.S. livery many of the points covered can be applied to any livery—Jim Smellie).

I would suggest that the kit is completed except for the door handles, grab irons, plastic interior fittings and glazing. Thoroughly clean the metal work to remove all trace of soldering flux and grease, and dry off.

To achieve a satisfactory crimson lake it is important to apply a brown base coat. I have used a red oxide car spray, but something browner might be more appropriate. Follow this with crimson lake. Spraying is obviously the preferred method and , if adopted, 'little and often' is the motto to avoid runs. On completion of the lake a coat of gloss varnish should be applied.

Before commencing the lining, it is necessary to lay the coach body on its side and fix it, perhaps with masking tape, to prevent any tendency to move during the delicate operation of lining out. Top and bottom of the coach should be laid blocks of wood or books upon which to rest a straight edge just clear of the coach side. Better still, if you intend lining out a number of coaches, is to have a purpose made open topped box just large enough to accommodate any of your intended coaches.

The gold or yellow is applied by means of a draughtsman bow pen to the full width of the actual or painted panelling. You will not achieve this in one stroke and several side by side should be put down until the desired width is arrived at. The full width of gold or yellow line is suggested because it is easier to achieve and subsequently one can concentrate on fitting the black line down the middle of the broad line. For the gold colour I have used Humbrol's 'Metal Coat' satin gold, which, once thoroughly stirred, is a suitable consistency straight out of the tin. Alternatively Precision Paints produce a brass paint recommended for gold lining. The yellow and black lining can be a suitable modeller's paint or artist's goash let down, if necessary, to a consistency found to be satisfactory by

experience applied by bow pen again. This consistency needs to be as thick as possible so long as it will still flow on a test piece from the pen. Another method for black is to use draughting ink in an appropriate size of stylus-type of drawing pen. Minor errors can be corrected by the delicate use of a fine brush, OO or less, afterwards. If the process becomes a complete disaster, the beauty of a metal kit is that you can remove all the paint with paint stripper and start again ! That is why I omitted the plastic interior parts. Hopefully you will be satisfied when another quick coat of gloss varnish is advisable before painting the underframe and ends/end details black. Apply the transfers and fix with another coat of varnish.

After this one is free to complete the coach the final assembly instructions

Useful Addresses

When writing to any of the following (or any other supplier for that matter) please remember the courtesy of enclosing an S.A.E.

Branchlines, PO Box 31, Exeter, Devon, EX4 6NY.	Gearboxes and Mashima motors.
Eileen's Emporium, PO Box 14753, London, Kent, SE19 2ZH.	Supplier of brass rod, wire, sheet etc.
High Level 14 Tudor Road, Chester-le-Street, Co. Durham, DH3 3RY	Some rather innovative gearboxes
Sharman Wheels, PO Box 8238 Chelmsford Essex CM1 7WY. www.sharmanwheels.com	Wheels for just about any loco imaginable. P4, EM & OO.
MJT Scale Components, Dart Castings, 17 Hurst Close, Staplehurst, Tonbridge, Kent, TN 12 0BX. www.dartcastings.co.uk	Portascap conversion kits; Hornblocks etc.
Shesto, (Nathan Shestopal Ltd.), Unit 2, Sapcote Trading Centre,	Tools and workshop sundries.

374 High Road,
Willesden,
London,
NW10 2DH.

Sylbert Clocks,
2a St Mary's Road,
Eastbourne,
East Sussex,
BN21 1QD

Rolling bars, folding press and riveting tools

Ultrascale
Gear Services (Letchworth) Ltd.
Unit 25
Such Close II Industrial Estate
Letchworth Garden City
Hertfordshire
SG6 1JF

Wheels and gears

Acknowledgements

"To copy from one book is plagiarism, to copy from two is research".

Most of my ideas aren't new and it is only proper to pay tribute to those whose writings have pointed me in the right direction over the years. In no particular order they are :-

Guy Williams, Allan Sibley, Mike Sharman, Rod Neep, Iain Rice, MRJ No. 1 Shop team and Wild Swan publications in general.

Special thanks is due to Peter Tatlow for the section on coach painting.

Jim Smellie