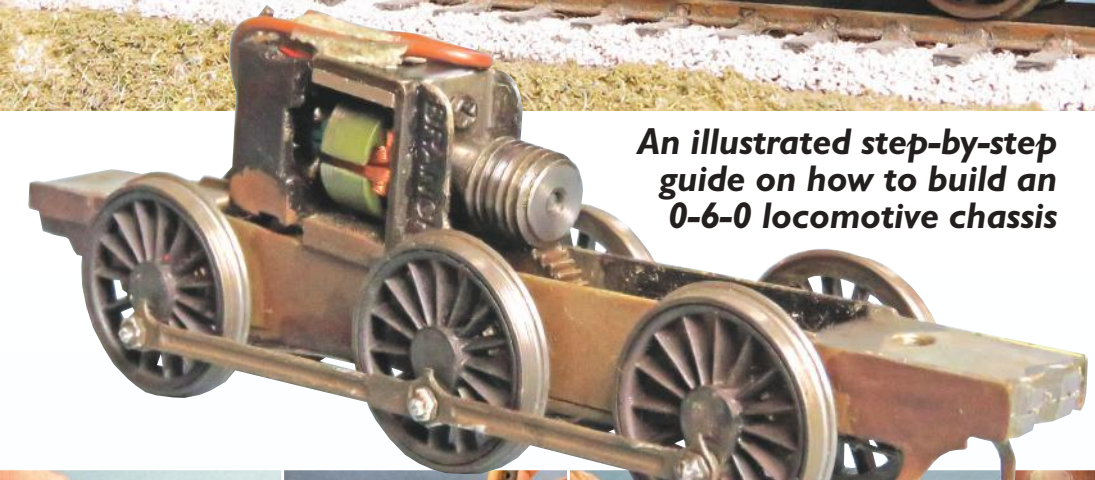
Building a Locomotive Chassis in 3mm Scale



An illustrated step-by-step guide on how to build an 0-6-0 locomotive chassis

THE 3mm SOCIETY
www.3mmsociety.org.uk

£5 where sold. Free to 3mm Society members

Acknowledgements

John Sutton wrote and illustrated these notes. They could not have been completed without the support and encouragement of Committee colleagues and especially the invaluable and unstinting work of former Society New Products Officer Graham Shirley, who designed and saw into production the Chassis Assembly Jigs and etched L-spacers shown throughout. He also provided the sideplay diagram, the 3D gearbox instructions and two of the Photos 5 and 28. Alan Gee contributed Photos 23 and 24.

Martin Olley brought professional graphic design expertise to the production of this publication.

I must also thank the many past and present Society members, including contributors to Mixed Traffic, who gave so freely of their knowledge and from whom I have learned almost all of what I know about modelling in 3mm scale – which as we all know, has its own peculiarities and idiosyncrasies.

John Sutton, Cambridge, November 2023

Introduction

There are probably as many ways to make a working locomotive chassis in 3mm scale as there are proficient 3mm modellers to make them. These notes set out a straightforward, proven method of making a free-running 12mm-gauge mechanism, using a small number of tools and readily-available components. We hope they will be of use to all 3mm modellers, from the least to the most experienced. Most of the techniques described here are equally applicable to locos for 13.5mm or 14.2mm gauges, or for Irish or GWR broad gauges. Once they have been mastered, more complex chassis for 3mm fine-scale could be attempted.

Experienced builders of 3mm-scale locos will probably agree that for a mechanism to be free-running at all speeds, it needs to have:

- *Frames which are foursquare and true.*
- *Axle holes and bearings which are correctly aligned to allow driving-wheel axles to spin freely.*
- *Coupling rods and axle holes whose centres match exactly.*
- *Driving wheels which run truly and are quartered exactly (Society SQ, Markits and Romford driving wheels are recommended for those building their first 3mm chassis).*
- *Sideplay for driving wheels and coupling rods, to assist passage round curves and through pointwork.*
- *No tightness in any moving parts - a small amount of slop is your friend.*
- *Weight low down to improve pulling-power and help current pick-up (3mm-scale models are small, and if too light may not run well.*
- *Gearbox and motor which fit the chassis and, ideally, can be concealed in the loco body.*
- *Electrical pick-ups which work efficiently and can be adjusted easily if damaged.*

Etched chassis are found in many kits and frames in a variety of common wheelbases are available in the 3SMR and Brynkits ranges. These notes principally show the building of a typical 060 chassis with 3SMR frames, but also show how fold-up chassis in the Brynkits and Worsley Works ranges are assembled. Once the principles have been grasped and mastered in building a simple chassis, more complex ones – perhaps from kits – for Pacifics, 460s, eight-coupled engines and others can be tackled with confidence.

Tools and Components

Joining an Area Group and getting to know fellow Society members is probably the best thing you can do to find out how to go about 3mm modelling. Challenges that seem daunting to you may well have been overcome by someone else, whose brains you can pick. The number of special tools you might need to start on a particular project might also seem daunting (and expensive), but you can bet someone in the Group will have the necessary and be happy to lend you what you need. Some groups, I believe, have collectively acquired tools and equipment for members to share. Many specialist tools are available from online suppliers or traders at model railway exhibitions. A list of suppliers, regularly updated, is to be found on the 3mm Society website:

https://sites.google.com/site/3mmpublic/tools-suppliers

Tools

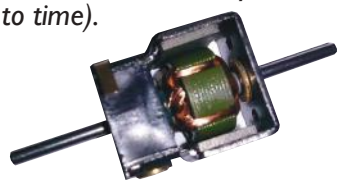
- *A piece of flat board to work on (a shelf offcut will do nicely)*
- *Emery cloth glued to a board a few inches square for cleaning up parts ahead of soldering*
- *Files - 4 inch flat and a selection of needle files (a tapered "rat-tail" needle file is especially useful)*
- *A good pair of fine-nosed pliers*
- *1/8in twist drill (or 1/8in parallel reamer)*
- *Set of small 0.3-1.6mm metric (or number) drills*
- *Set of small (say 0.6-2.0mm) tapered cutting broaches*
- *Set of small blade and Phillips screwdrivers for very small screws*
- *No 26/3.7mm 5-sided cutting broach to enlarge the axle holes to accept 1/8in top hat axle bearings*
- *Electric soldering iron and a reel of solder (such as Carrs 183)*
- *Flux (liquid or paste such as Fluxite)*
- *10BA and 12BA tap and pin vice to hold tap (a tap wrench is not necessary for these small sizes)*
- *Tweezers, wooden cocktail sticks and coffee stirrers (for applying flux and holding down parts being soldered) Small crocodile clips or spring hair-clips for holding wires in place and acting as heat sinks while soldering*
- *Small engineer's square to check for right angles*
- *A razor saw*

Components

- *Etched frames and coupling rods: 3SMR, Brynkits or ones supplied in particular kits*
- *Society Loco Chassis Assembly Jigs* ***(ref SD162)***
- *Society 1/8in top-hat axle bushes* ***(ref SD063)***
- *Society Etched L-spacers* ***(ref SD168 for 12mm gauge, SD169 for 13.5mm gauge, SD170 for 14.2mm gauge)***
- *Society SQ driving wheels (Markits/Romford RP25 driving wheels are also popular)*
- *Romford, KM or other 1/8in inside-diameter axle washers of various thicknesses*
- *Society 1mm-ID 0.2mm-thick crankpin washers* ***(ref SD110)***
- *Motor such as High Level 1015 Iron Core from:*

www.highlevelkits.co.uk

(The Mashima 9mm-wide open-frame types shown here are no longer made but equivalents are stocked by 3mm Scale Model Railways – www.3smr.co.uk . Many 3mm modellers will have one or two appropriate motors in stock and Society Secondhand Sales may have Mashima types from time to time).



- *Gearbox such as Branchlines RSL, Society 3D print* ***(ref SD146)*** *or High Level Slimliner Plus.*
- *BA screws (12BA and 10BA are the most useful)*
- *Fine stranded wire*
- *Sheet lead for weighting (a begged scrap of builder's flashing could last a lifetime)*
- *1 or 1.5mm printed circuit board – a small piece from a radio spares shop or eBay will last a long time*
- *0.3 or 0.4mm hard straight wire for pick-ups. The type of metal is immaterial - nickel silver is as good as any.*

A Note on Soldering

Soldering is nothing like as difficult as those who have never tried will tell you. If you are a member of an Area Group, or are friends with other Society members, it is likely that one of them will have experience of soldering (and perhaps chassis construction) and be happy to offer advice and show you how to go about it.

You need to make sure you

- *allow the soldering iron time to heat up to working temperature*
- *clean the metal to be soldered thoroughly by rubbing with emery cloth or wet-or-dry paper*
- *apply flux sparingly where the solder is to go*

- *hold the parts to be soldered together firmly, using a bit of stripwood, a small screwdriver, the point of an old needle file or finger pressure*
- *don't dab with the soldering iron – instead, hold the bit firmly to the metal for a few seconds till the flux fizzes and the solder flashes along the joint*
- *clean off flux residue thoroughly by scrubbing with an old toothbrush and household cream cleaner, rinse and then allow to dry; do this after each soldering session*

(All that said, if you remain resistant to the idea of soldering, nearly all of the soldered joints shown here could be made with tiny amounts of Araldite. Construction of a simple loco chassis would, though, take far, far longer).

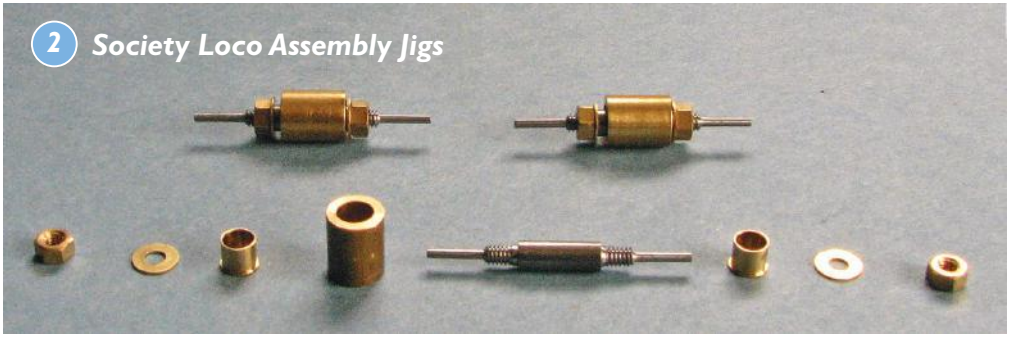
Aligning Frames

There are several chassis assembly jigs on the market, some complex, some expensive, some popular with 3mm modellers. This pamphlet recommends the Society Loco Chassis

1 Reaming axle holes out to take the bearings

Assembly Jigs (available for 12, 13.5 and 14.2mm gauges) shown throughout as a simple, reliable and inexpensive way to assemble a foursquare chassis with axle holes in exact alignment. These jigs, sold in a pack of three, can be used again and again. (Three, by the way, are quite enough to ensure accurate frame alignment when building eight- and ten-coupled mechanisms.) The jigs align the frames and 1/8in top-hat axle bushes and hold them in place while L-spacers are soldered in place. When soldering is complete the jigs and bushes are removed and the jigs set aside for future use.
The axle bushes are then soldered in place as shown later.

Before going any further, check that the axle bearings will fit in the etched axle holes. Although some kits have frames whose axle holes are etched to accept top-hat bearings, the 3SMR etched frames shown in most of these pictures are etched slightly under size and need to be carefully reamed to accept the bearings. This can be done by twisting a pointed file in the holes, but a No 26 cutting broach, shown in ***Photo 1*** *on page 5, held in a tap wrench, will do the job more quickly and accurately. Check the fit of the bearing - it should be a tight push fit - as you go and stop reaming as soon as each bearing fits its hole. Finish by filing off the remains any tags left on the frames when they were removed from the etched fret.*



2 *Society Loco Assembly Jigs*

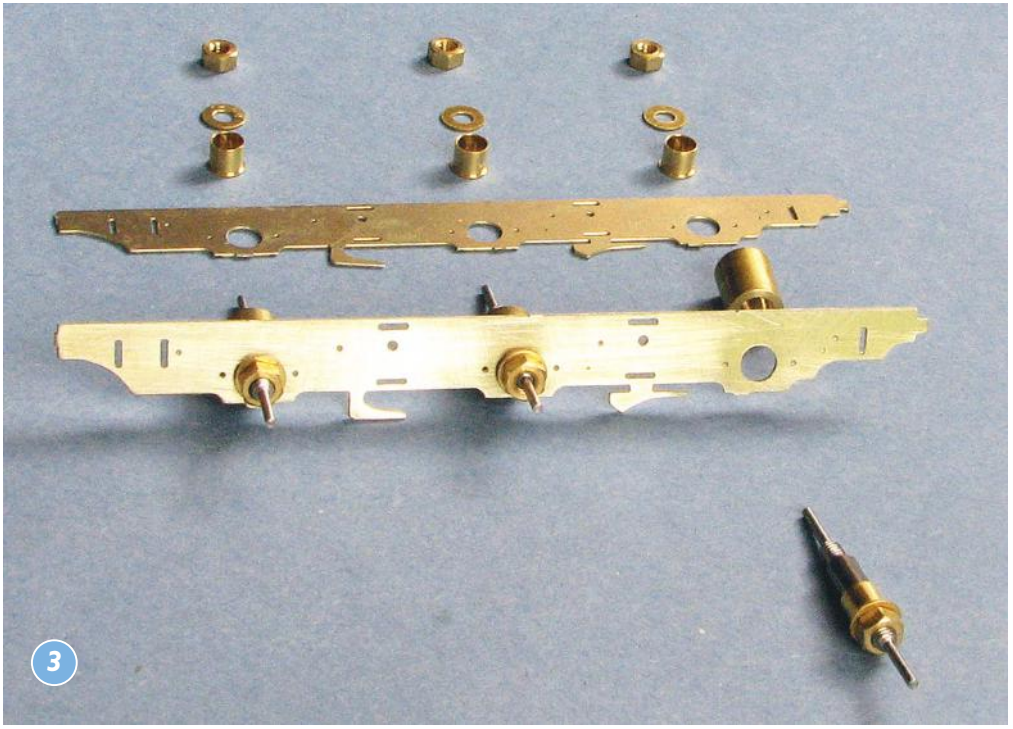


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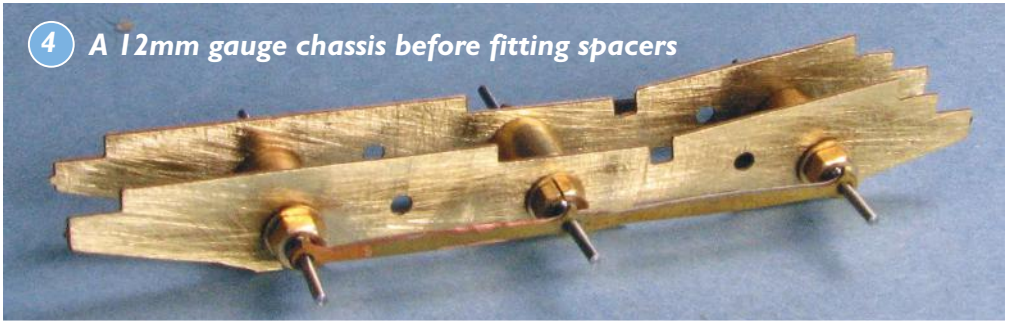
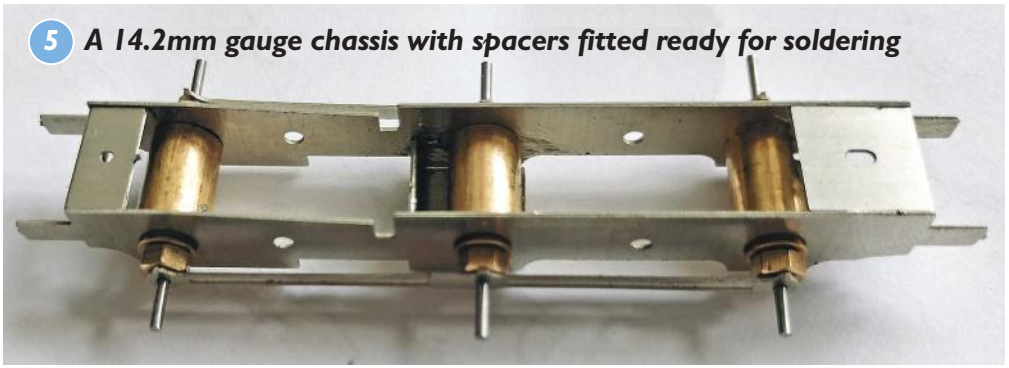
Photo 3 *(opposite page) shows etched frames from a kit and the alignment jigs and axle bushes set out in the order in which they are used. Begin by placing a bush over one end of the steel central core, followed by a washer and nut (bottom right in the photograph). Then place in the axle hole and put the tube over the central core (left and centre axles above). Repeat for the other two axles, then put the second frame over the other end of the core and, for each axle in turn, add the axle bush, washer and nut, then tighten the nuts so that the frames are held firmly in alignment, as in the photograph below. It is essential that this stage is carried out correctly as an out-of-square chassis will never run truly. Note that the etched coupling rods can be placed over the spigots at the ends of the jigs to check that they too are in perfect alignment, as in* ***Photo 4*** *below. Now the frames are aligned truly, spacers can be soldered in place.*



4 ***A 12mm gauge chassis before fitting spacers***

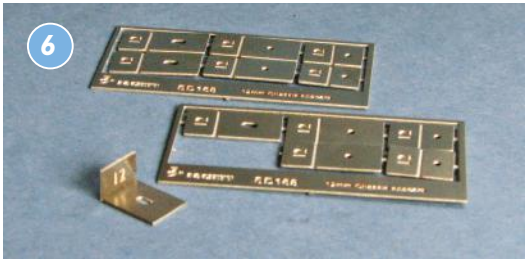


5 ***A 14.2mm gauge chassis with spacers fitted ready for soldering***

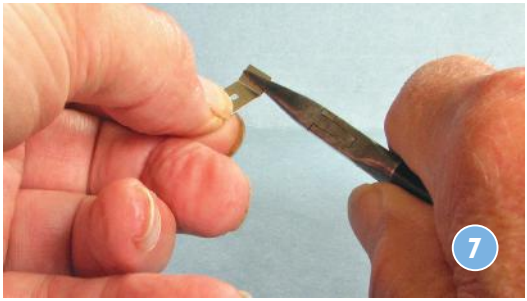
● *Two alternative frame-assembly and alignment methods are shown in Appendix 1 on page 22*

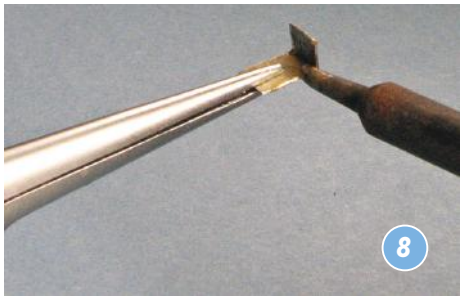
Fitting L Spacers

Photo 6 *overleaf shows* ***Society SD168 L spacers for 12mm gauge*** *(SD169 for 13.5mm and SD170 for 14.2mm gauges are also available), which have been designed to create a loco chassis whose width will allow enough sideplay in the driving wheels for locos to take curves and negotiate crossings and complex pointwork easily. The slots are clearance for 12BA screws (for body fixing, say) and the holes tapping size for 12BA (so pick-ups can be screwed in place – and removed later, if necessary, for maintenance or adjustment. A tapped spacer could also be positioned to accept the pivot screw of a pony truck).*

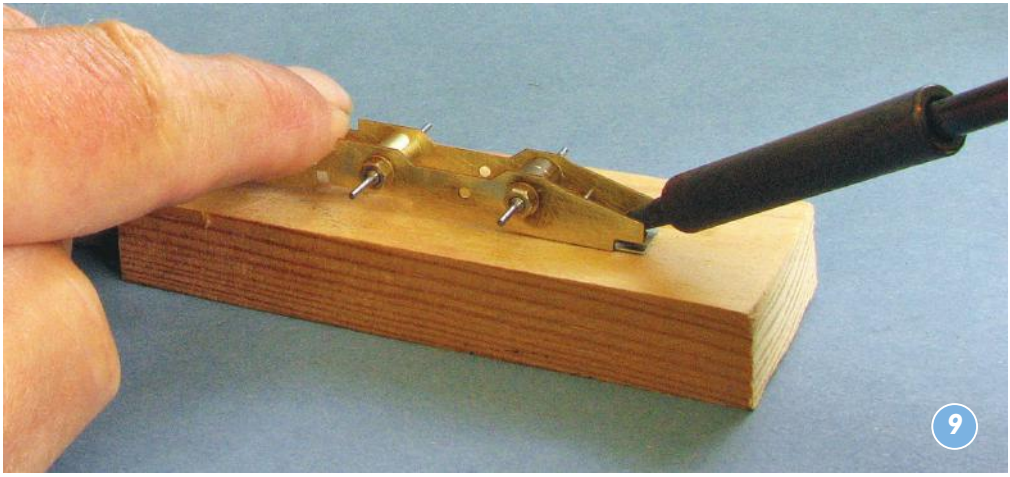


Fold each spacer at right angles with fine-nosed pliers as shown in ***Photo 7****. Etched fold lines make this simple and accurate. The fold line is always on the inside of the bend. Clean the metal by rubbing with emery cloth or wet-or-dry paper to prepare it for soldering. Flux the edges of the spacers with paste or liquid flux and tin with a small amount of solder as shown in* ***Photo 8****.*

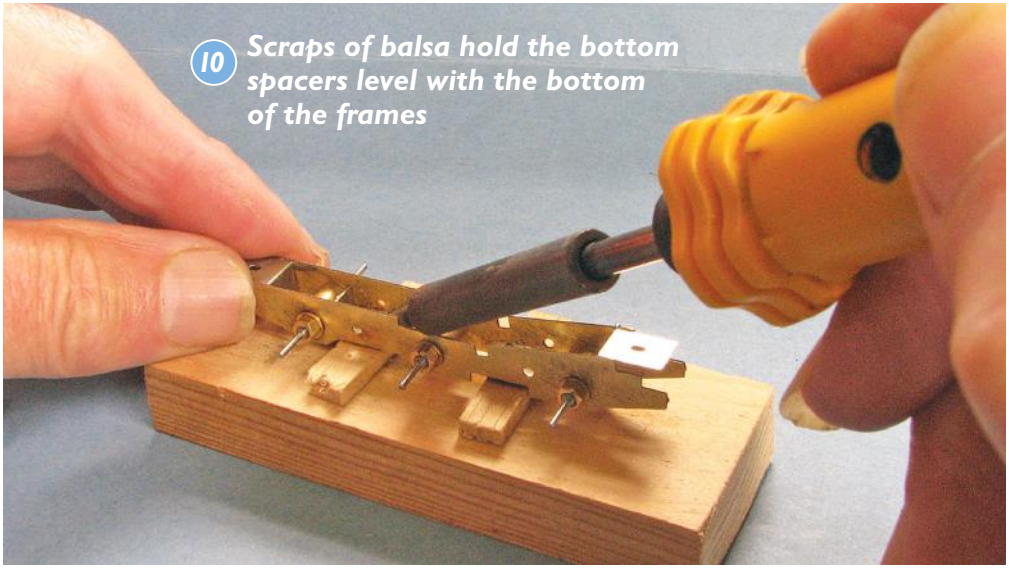




Hold the spacers in place firmly as shown in ***Photos 9 and 10****. Flux joints carefully and solder them. Pick up a small blob of solder on the bit of the soldering iron and hold the bit to the joint for several seconds, watching the solder melt and flash along the joint.*



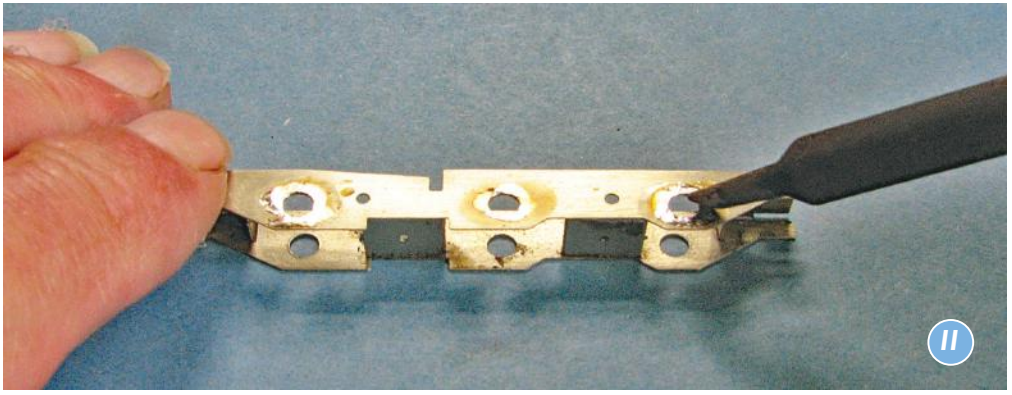
Don't dab or take the iron away too soon. Don't try to solder a joint until the iron is hot enough. A scrap of wood, as shown here, will protect the surface of whatever table or bench you work on.



10 Scraps of balsa hold the bottom spacers level with the bottom of the frames

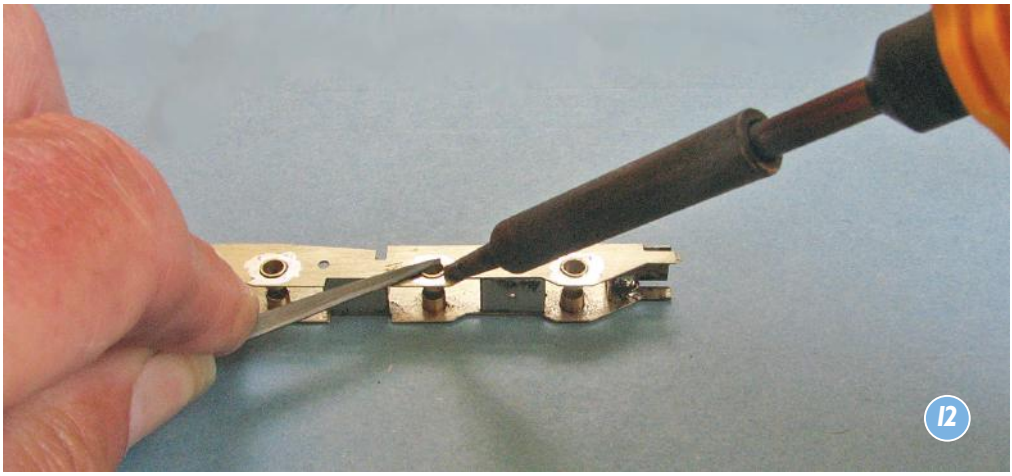
Fitting Axle Bearings

Once the chassis is soldered strongly together, the jigs are removed for future use and the 1/8in axle bearings can be soldered in place as shown here. First tin the frames round the axle holes. Make sure the surface is well fluxed but only use a small amount of solder or solder paint - see ***Photo 11****.*

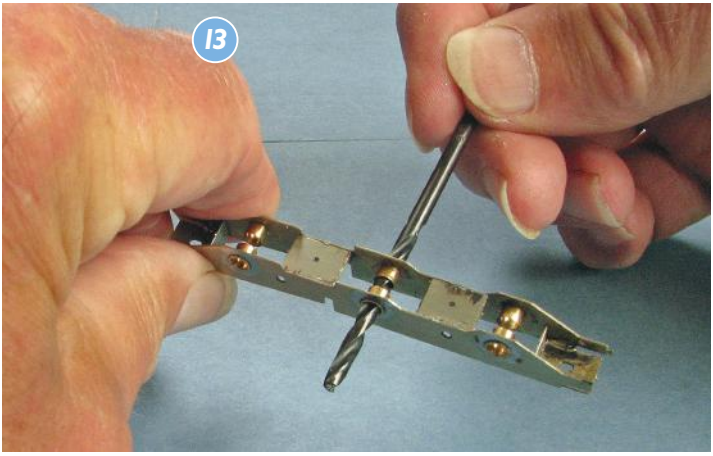


11

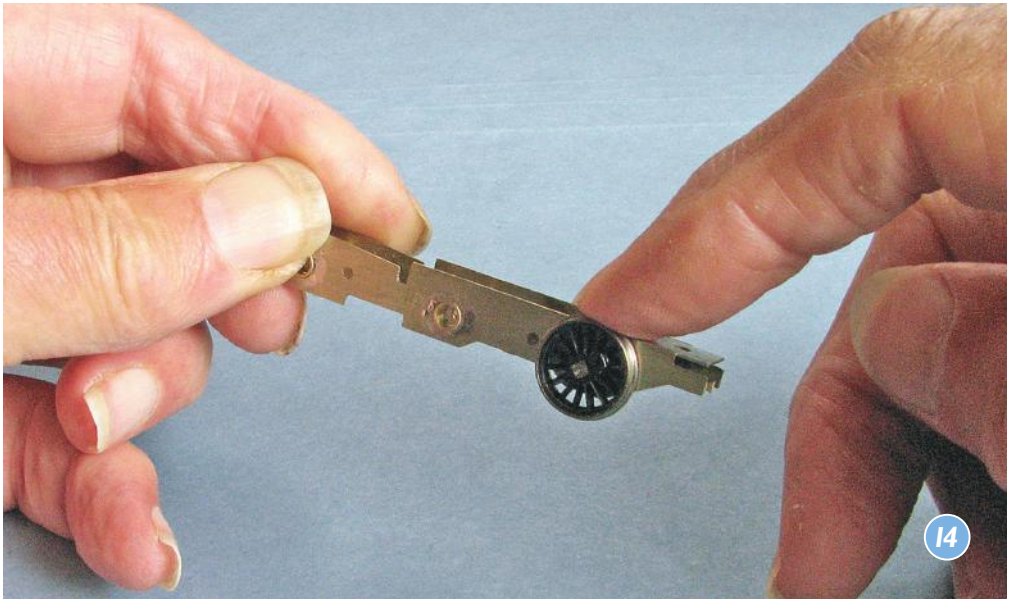
Next fit the bearings. A small amount more flux will help the solder attach the rims to the frames. Make sure the bearings are held firmly in place while soldering. ***Photo 12*** *shows the point of an old needle file being used. Allow each join to cool before moving on to the next. Double check that the rim of each axle bush is flush with the frame, as shown below. Any excess solder can be cleaned off with a file or emery board, but if you have been careful there shouldn't be much.*



When all six bearings are in place, run a 1/8in drill (or a 1/8in parallel reamer) though the holes, turning it with your fingers as shown in ***Photo 13****. If the drill sticks, a bearing may not have been soldered accurately, so apply a hot soldering iron to it, then try again. The drill or reamer should rotate freely.*



Next, mount one driving wheel on an axle and spin it in the axle holes, as shown in ***Photo 14****. It should spin freely. Proceed no further if it doesn't. Tight spots do not mysteriously disappear with running-in. Instead, ease the bearings a touch more, with drill, reamer or a little roll of wet-or-dry paper. Now is the time to fit all six wheels to the chassis, just temporarily, and push/flick it along a length of track, perhaps with a lump of lead on top to weigh it down. It should run freely, and very probably will. If it doesn't, try a spot of oil in the bearings. When you're happy that the wheels spin freely, put them somewhere safe and go on to the next stage. (Even if finally intending to use Society SQ or Fine-scale driving wheels in the finished chassis, many experienced 3mm modellers like to use a set Romford/Markits drivers during these testing processes. Their screw fixing means that they can be taken on and off their axles quickly and as many times as necessary, something less advisable with plastic-centred wheels.)*



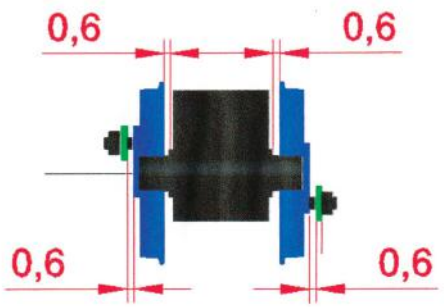
Paint the Chassis

Clean the chassis thoroughly with kitchen cream cleaner to remove grease and flux residue, then spray it with acrylic primer and matt black, masking the axle bushes and axle holes, perhaps with little blobs of Blu-Tack or the ends of cotton buds. Allow each coat to dry properly. Then, to taste, finish with a dark grey-brown frame-dirt colour, a commercial one or one of your own mixing. It is now time to fit driving wheels, motor and gear cradle and to add weight to the chassis.

Sideplay and Minimum Radii

Society member Chris Ketley explained the need for sideplay very clearly in an article in the Society magazine (see the ***Bibliography on page 23****). "When a loco goes round a curve the chassis forms a straight line cutting the corner," he wrote, "so there should be enough clearance between the backs of the wheels and the chassis to allow for sideways displacement of the wheels." He went on to explain that even if the wheelsets are able to move very easily from side to side, coupling rods which are too tight can restrict sideplay. There should always be something in the region of 0.5mm play between the crankpin nuts or washers and the coupling rods – "So never fully tighten the crankpin nuts," he concluded.*

How much sideplay you need will be dictated by the sharpness of your curves. Unless you are using very sharp radii, you won't need a vast amount and won't need flangeless drivers, which are as unnecessary as they are ugly (though of course 9F 2-10-0s and LNWR 0-8-0s each had one flangeless wheelset). A 2-8-0 illustrates the general principles (which apply to all wheel arrangements) well. It will probably be driven through a gear cradle on the third axle, so its motor can be concealed in the firebox, and the driven axle must have no sideplay in order to keep the gear wheel central and in mesh. There isn't room for sideplay on the leading axle of an outside-cylindered loco as it is usually behind the slidebars and clearance must be left for the crosshead, connecting rod and coupling rod to miss each other as they rotate – which leaves the second and fourth axles free to shimmy as the engine negotiates reverse curves. My all-flanged 2-8-0s take 2ft radius curves with ease, as of course do six-coupled inside-cylinder locos, and Chris Ketley's 9F 2-10-0 can run through Peco H0m curved points. This diagram, by Graham Shirley, shows the amount of sideplay needed.



Sideplay is eliminated, limited or permitted by whatever thicknesses of 1/8in washers are interposed between axle bush and driving wheel. An 0-6-0 driven on the centre axle can have a lot of side-to-side movement on the leading and trailing axles (splasher clearance permitting). In contrast, a four-coupled chassis needs no sideplay. In practice, about 0.6mm clearance between the axle bearing and the rear of the driving wheel on each side of the chassis will be enough for each axle with sideplay.

(Note that a chassis will run just as effectively with the front or rear axle driven - see the photograph of a BR Class 4 2-6-0 chassis in ***Appendix 2****).*

Coupling Rods

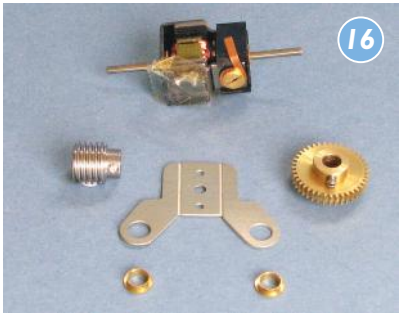
Ensure the coupling rod holes are not tight on the driving wheel crankpins. If they are, use a broach or a triangular needle file to open the holes up slightly, to a little over 1mm diameter. Do this by hand: never use a drill in a power tool. As ever, a very small amount of slop is your friend. Don't overdo it. You can test how freely chassis, wheels and coupling rods run before fitting the motor and gearbox. Use short lengths of plastic sleeving from domestic wiring on the centre crankpins to hold the rods in place while you test, by pushing the wheeled chassis backwards and forwards on some track and through some pointwork. Should the coupling rods still seem tight, open up any tight holes a fraction more and test again. As soon as the chassis runs freely and all seems well, remove the wheels and move on to fitting the motor and gearbox before fitting all of the driving wheels and the coupling rods permanently. Never proceed further until you've achieved a free-running unpowered chassis. Pick up possible faults at each stage.

Fitting Gears and Motors

Most experienced loco builders will agree that the foolproof way to fit motor and gears is to use a gearbox (sometimes called a gear-cradle). This section shows two straightforward ones in use, the tried-and-tested ***Branchlines Romford Slimline (RSL)*** *and the more recent* ***Society SD146 3D-print Gearbox.*** *The* ***High Level Slimliner Plus*** *is also popular with 3mm modellers and it too is illustrated in this section.*

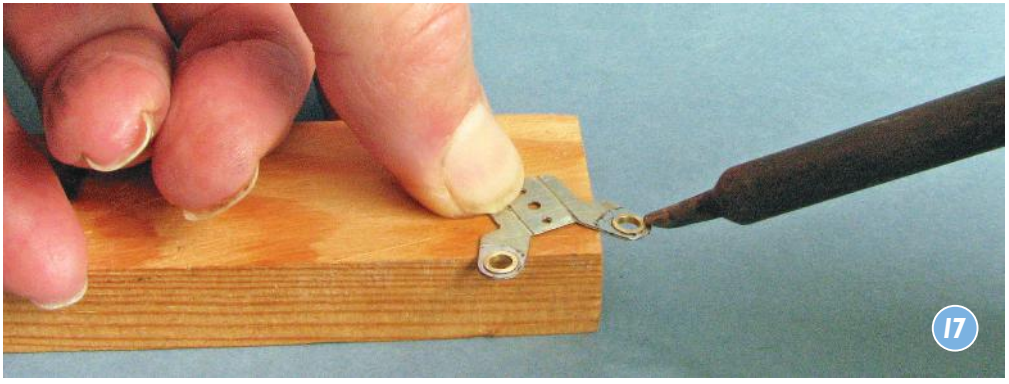
The Branchlines™ RSL

For many years the combination of a small motor such as the Mashima M16K shown here (or a small flat-can type) and a Branchlines RSL has been the go-to combination for a great many 3mm modellers. Gearboxes with grubscrew fixing of gear wheel and worm are more forgiving than those with press- or-glue-fixed gears as they can be taken apart easily, both during construction and, later, for maintenance or repair. The RSL's suitability for a wide range of loco types, its smallness, simplicity, ease of use and screw-fixed gears account for its popularity – and make it a good one to recommend to first-time loco builders. Assembled carefully and used with a good controller a loco powered by this gearbox and a small motor will run smoothly and haul surprisingly large numbers of coaches or wagons at scale speeds. In our small scale it is powerful enough.

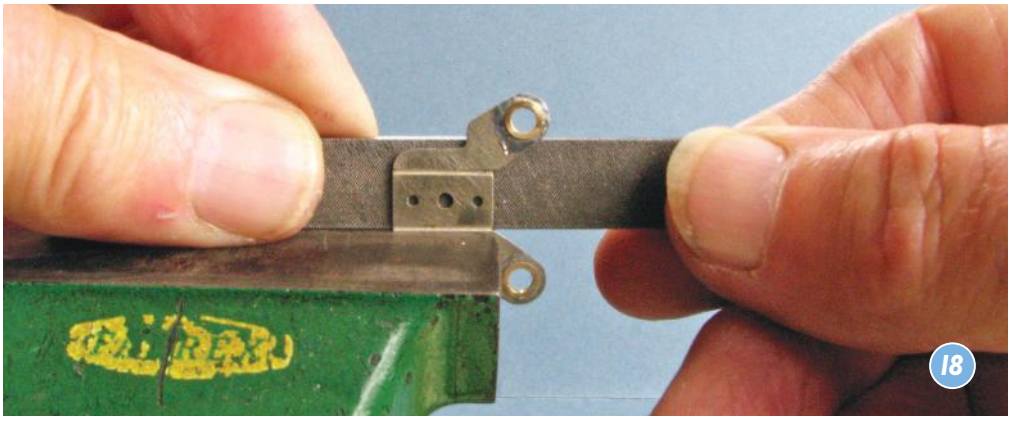


Follow the instructions which come with whatever gearbox you are using. The RSL's are simple, and the procedures are shown in the sequence of photographs which follows on the next page.

The motor's fixing screws are Sellotaped to it. Look after them, they are easy to drop and lose!



Begin by checking that the straw-hat bearings fit the axle holes, easing the holes very slightly if necessary, with a reamer or triangular needle file. Flux and tin the area round the axle holes with a small amount of solder, insert the bearings, add a trace of flux and use a hot soldering iron to fix the bearings, as shown in ***Photo 17****. Clean off any flux residue before continuing.*

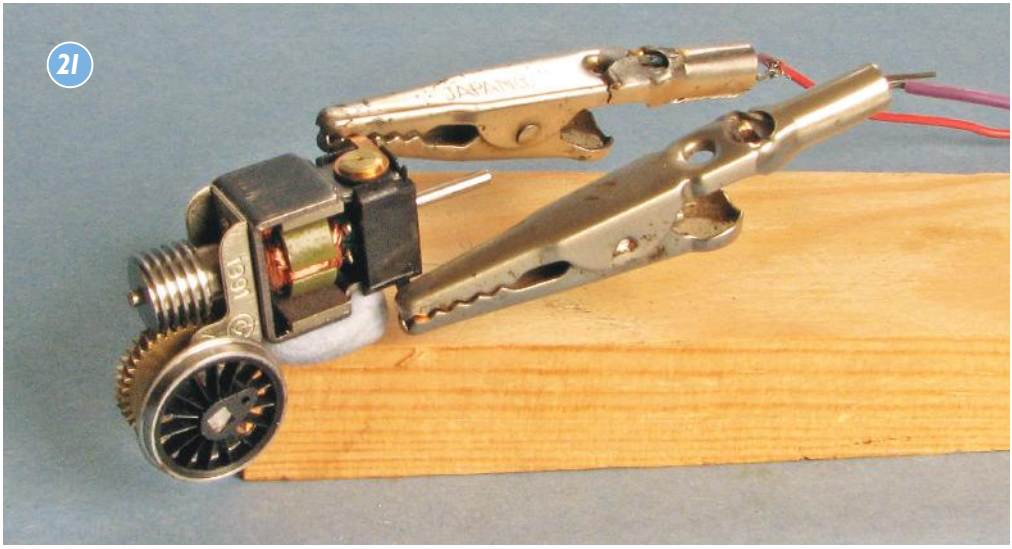


The RSL has half-etched fold lines, making the unit extremely easy to fold to shape. Confident, experienced or insouciant modellers might do it with their fingers, pressing the etching against a workbench, but to be on the safe side it is better to do it as shown here. The first fold is done in a vice as shown in ***Photo 18****. A four-inch flat file is about to be used to fold the etching forward. The second fold can easily be done with finger pressure as the cradle is held in a pair of fine-nosed pliers -* ***Photo 19****.*

At this point it is worth checking that both folds of the nickel-silver fret are at right-

angles to the spine of the cradle and parallel with each other. In ***Photo 20*** *a piece of 1/4in brass bar is being used – but a scrap of 1/4in wood would do just as well. (Note that the straw-hat bearings need to be filed flush with the outside of the cradle to fit in a 12mm-gauge chassis. This is not necessary for 13.5mm, 14.2mm and other wider gauges).*

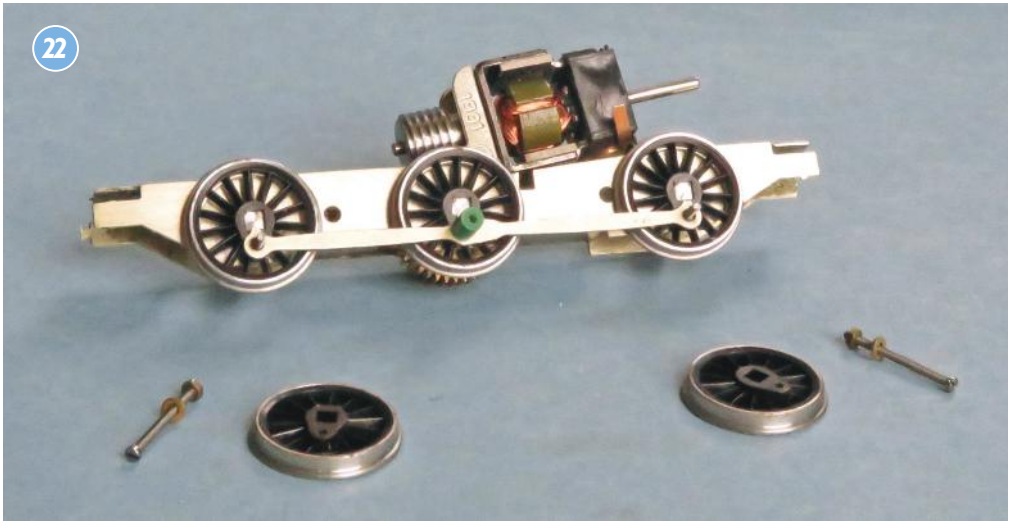
Finally, test fit a 1/8in-diameter driving-wheel axle, and if it is tight, ease the bearings slightly with a 1/8in drill or a broach. Add a tiny drop of oil good-quality light oil to the axle and test again, with a wheel and axle, as shown in Section 3. Do not proceed until the axle spins freely.



Next screw the nickel-silver gear-cradle to the motor. You may find it helpful to stick the tiny screw to the screwdriver point with a smear of Blu-Tack, then put it in place and screw home. Next fit an axle, the gear wheel and the worm. The centre of the worm should be exactly aligned with the top centre of the gear wheel for optimum meshing. Put a drop of oil on the gears, then Blu-Tack the motor to the edge of a table or your layout (for clarity ***Photo 21*** *shows it on a piece of wood against a plain background).*

Attach jump leads, connected to a controller, switch on the power and if the unit runs as smoothly as it should, let it run slowly for a while, then increase the speed progressively. After a few minutes the unit should run sweetly and quietly. If, as shown here, you attacha wheel to the axle and the jump leads to the track of your layout, you will be able to see if the mechanism runs in the direction the controller indicates. If it doesn't, reverse the crocodile clips. Make a note of which tag should be connected to the left- or right-hand rail so that when you wire the pick-ups to the motor tags your mechanism will have the same polarity as your other locos.

Unscrew the gears and go on to fit motor and gearbox to the chassis. ***Photo 22*** *shows Society SQ drivers, with crankpins, fitted to their axles and placed in the chassis. (Note that it is worth carefully cleaning any flash or burrs which could be present in the square holes in the plastic centres of the driving wheels before fitting the axles).*



The coupling rod is temporarily held in place by a piece of plastic sleeving from domestic wiring. The centre – driven – axle should have no side-to-side movement and this can be achieved by placing 1/8in washers over the axle between the wheels and the frames on each side. The front and rear wheelsets can have as much sideplay as you like (see ***Section 5: Sideplay,*** *earlier). Two of the wheels for the other side of the locomotive are shown in the foreground, with the 14BA steel crankpins, the washers which are fitted between the wheel face and the coupling rods and the 14BA nuts used to secure the rods once you are certain that the chassis runs smoothly.*

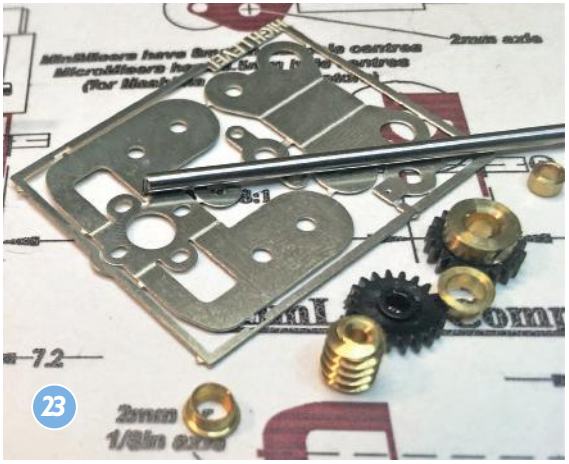
With all six wheels in place, the gears and axle bearings lightly oiled and the coupling rods still attached temporarily with plastic sheathing on the centre crankpins, jump leads can again be attached and the chassis tested under power, slowly at first, stopping immediately if there is any stiffness. (If there is binding, open out the holes in the coupling rods very slightly and try again.) Increase the speed little by little and let the chassis run in for a short while.

The 0-6-0 chassis illustrated here has the drive on the centre axle, which has been the norm for many years. However, in some cases it may be preferable to drive on the rear or, more rarely, the front axle. The driven axle will have no sideplay, the centre one the most and the other outer axle may be allowed a little. Appendix 2 has photos of a number of arrangements.

This initial testing can be done off the layout at first, with one end of the chassis held in a vice or between finger and thumb. If the chassis runs freely – and there is no reason to believe it won't – you can move on to run it round curves and through pointwork on your layout. As the loco body has yet to be fitted, it may be helpful to Blu-Tack some lead weight to the chassis temporarily during this testing process. When the loco body is eventually fitted, ensure that it has enough weight, probably in the boiler of a tender engine and in the boiler and tanks of a tank locomotive. Etched or 3D-printed loco bodies will need more weight than already heavy white-metal locos.

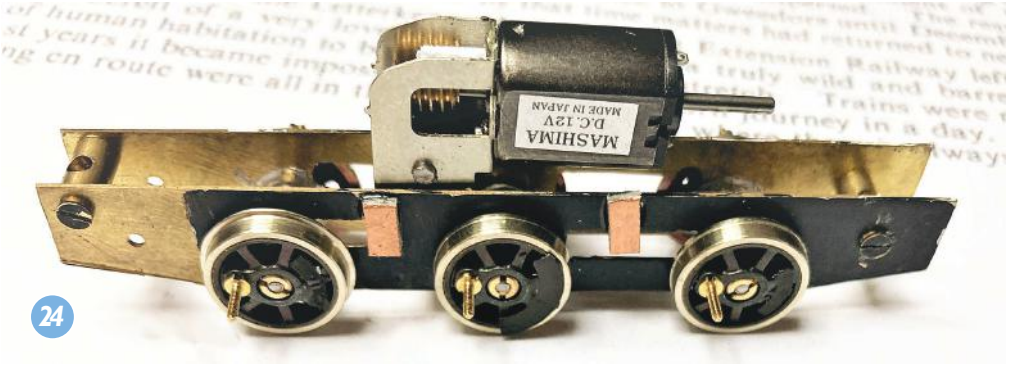
For clarity's sake, ***Photo 22*** *shows the chassis and wheels unpainted. In practice it is sensible to paint both before final assembly of the chassis.*

The High Level Slimliner Plus Gearbox



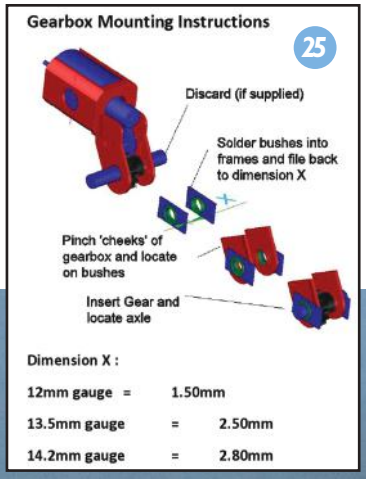
23

The parts of the Slimliner Plus gearbox, which can be arranged in different ways, are shown in ***Photo 23*** *and in a 12mm-gauge chassis in* ***Photo 24****. This is one of many built by Society member Alan Gee for 4mm-scale Irish narrow-gauge locomotives. In size and construction methods it is very similar to chassis built for 3mm-scale locomotives.*



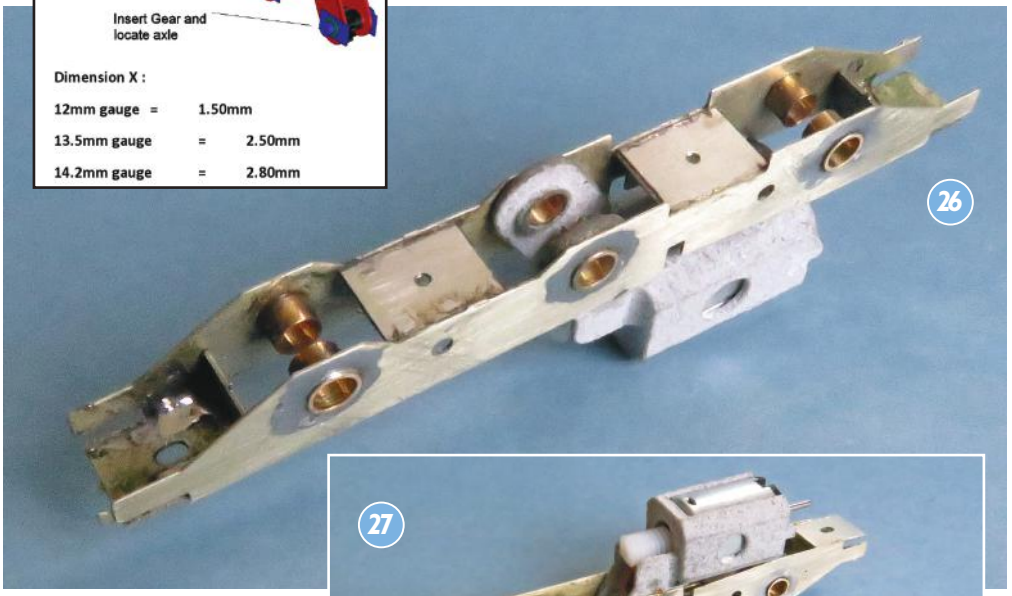
24

The high level Slimliner Plus gearbox shown on a 12mm chassis



This gearbox clips on to the top-hat axle bushes of the driven axle, which need to be filed back to the dimension shown below, which will depend on the track gauge you are building the chassis for.

***Photo 26** shows the filed-back bearings and the motor and gearbox clipped in place over them.*



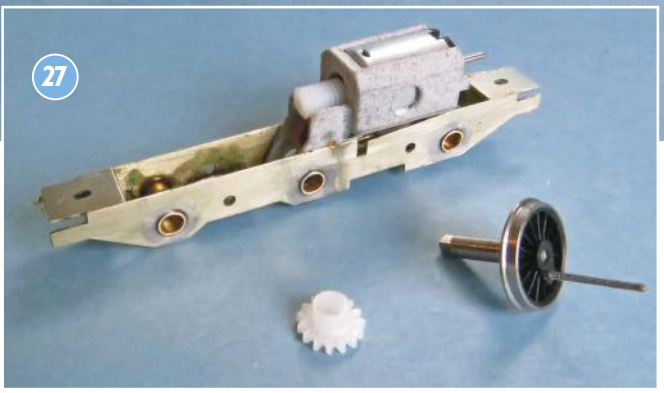
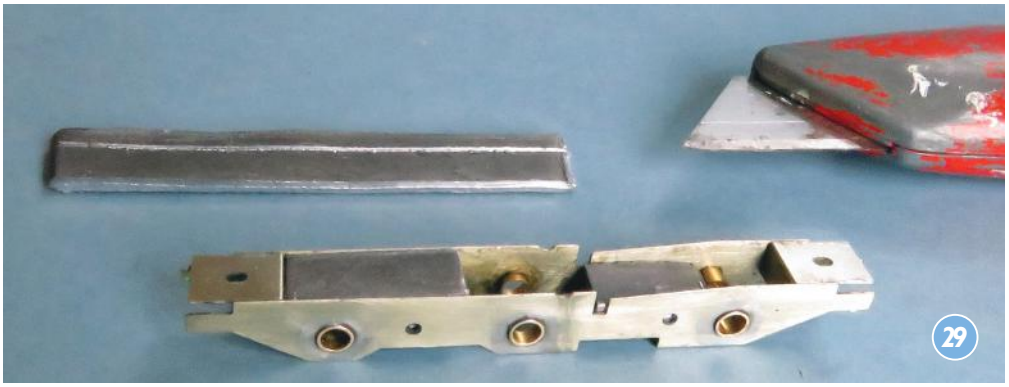


***Photo 27** shows the motor and gearbox in place.The final gear is fitted at the same time as the centre wheelset. (Note that the long 14BA crankpin of the Society SQ wheel has yet to be shortened.The other wheels and axles have been omitted to produce an uncluttered picture).*

***Photo 28** shows a 14.2mm-gauge chassis with an SD146 gearbox driving the front axle, built by Graham Shirley.The nickel-silver wiper pick-ups show clearly behind the driving wheels and the chassis has been weighted with lead strips.*

Weight

In a small-scale locomotive, it helps to have as much weight as possible low down in the model. This is easily achieved by gluing strips of lead in appropriate spaces, avoiding the gears and axles. An offcut of roofing lead is easily cut with a Stanley knife. Cut the strips about 7mm wide and remove burrs from the cut edges, either with a file or, more quickly, by squeezing in the jaws of a vice.



*Contact adhesives such as Evo-Stik or 5-minute epoxy resin will keep the lead in place. Liquid Lead could come in usual for packing nooks and crannies. Note the open space behind the rear axle (on the right in **Photo 29**) to give room for the two wires from the pick-ups to the motor tags.*

Fitting Coupling Rods

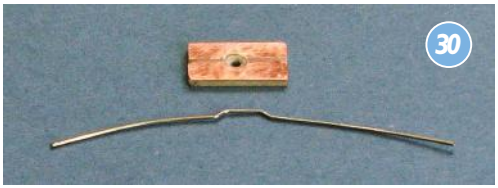
*Prime and paint the coupling rods at the same time you paint the assembled chassis. Place the rods over the crankpins and hold them in place with the 14BA nuts supplied with Society SQ wheels, Romford crankpin washers or **Society 1mm-ID 0.2mm-thick washers** (ref SD110), all of which can be held in place with a tiny spot of cyanoacrylate Superglue or 5-minute epoxy adhesive, carefully applied with a pin or a length of wire. Ensure that you allow adequate (0.5-0.6mm) sideplay on each crankpin as shown in the diagram in **Section 5**.*

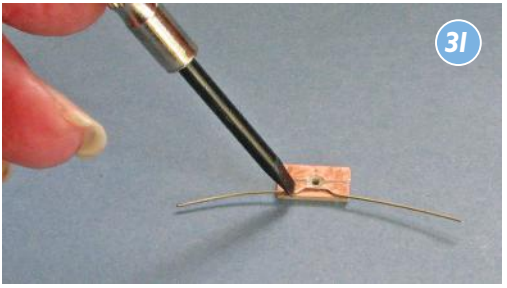
For better appearance you may choose to thin 14BA nuts or Romford washers before fitting them. Paint the crankpin nuts or washers with the same sort of oily-looking colour you used for the coupling rods.

Pick-Ups

Pick-ups made from 1.5mm-thick printed circuit board (PCB) and springy wire convey power from the track to the motor. For preference the PCB is screwed to the bottom chassis spacers, as if glued it cannot be removed for adjustment or servicing. The kind of wire used is really immaterial. Experienced 3mm modellers have used steel, phosphor-bronze, beryllium copper, brass and nickel-silver successfully. The important thing is for the wires to kiss and not scrape the driving wheels. The longer the wire the more it will flex and press gently and constantly against the driving wheel.

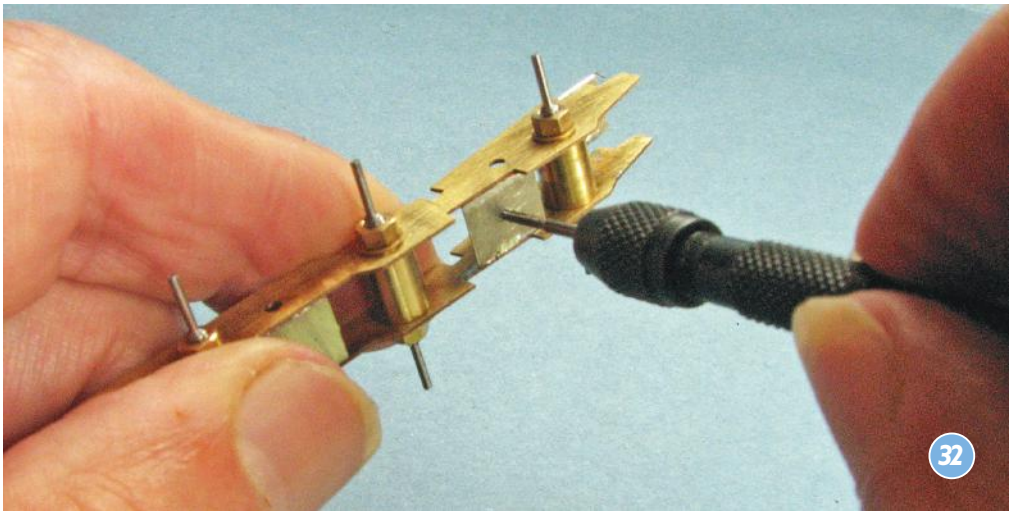
If using Society SQ or other plastic-centred driving wheels, the PCB will need to be gapped along its centreline, as shown in the photograph below, as pick-up wires will be needed on each side of the locomotive. If you are using Romford/Markits wheels, pick-up is from the insulated wheels on one side of the locomotive only and only that side has pick-up wires, which need to be connected to the relevant motor tag. Note that the screw hole is countersunk to clear the 12BA countersunk screwhead.





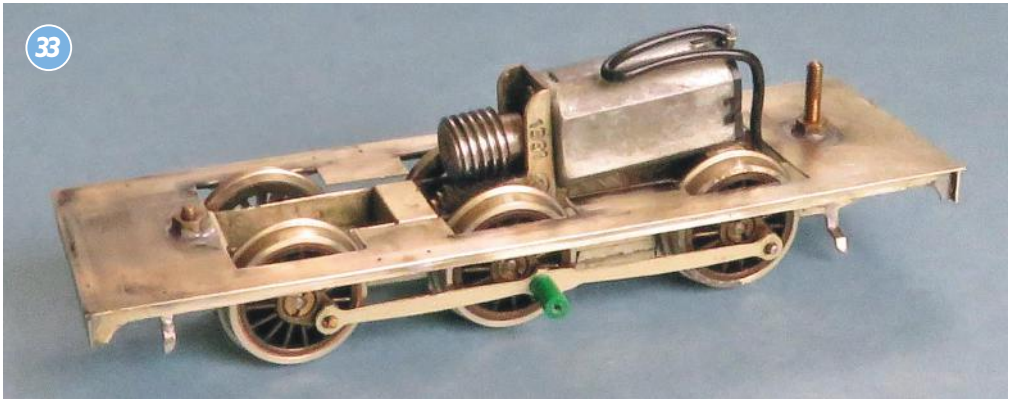
A length of 0.3mm wire is run between finger and thumb to curve it, then shaped as shown in ***Photo 30*** *so that it will lie flat on the PCB for soldering. Tin the flat bend in the pick-up wire and flux the PCB, then solder the wire to the PCB with a small blob of solder.* ***Photo 31*** *shows the wire being held in place with a small screwdriver, but for clarity the soldering iron is not shown. The wires are made overlength for easy handling and trimmed to size when the driving wheels are fitted to the chassis. You are aiming for pick-up wires which combine stiffness and flexibility – hence the single blob of solder to allow maximum movement of the wires as the loco chassis runs and its wheels make maximum use of sideplay on curves.*

Photo 32 *shows a 12BA taper tap, held in a pin vice, being used to tap a thread in one of the bottom spacers. Go carefully. Insert the tap, ensure it is perpendicular, and turn it clockwise for half a turn, then anti-clockwise for a quarter of a turn, removing the tiny amount of swarf that may appear. The spacer is thin so you will only need to repeat this process once or twice to create a screw thread.*



Test by screwing a 12BA brass screw into the threaded hole – if it is tight, so much the better. If it won't go into the hole, tap gently for another half or quarter turn. The completed pick-up plates are screwed to the chassis and wired to the motor once the wheels, coupling rods, motor and gearbox have been fitted. At this stage the wiper wires can be trimmed to length. ***Appendix 2*** *shows different pick-up arrangements in a number of locomotives and how the wires can be bent and positioned to achieve maximum flexibility.*

Fixing the Loco Body to the Chassis



The body for the GWR 94XX 0-6-0PT in ***Photo 33*** *will be attached to the chassis by 10BA screws (which suit the slots in the Brynkits chassis fret) positioned under the smokebox and the cab. The screws engage with 10BA nuts soldered to the nickel-silver footplate. (A thicker white-metal or 3D-printed footplate could simply be tapped 12 or 10BA, with no nuts needed.) For clarity a longer rear screw than is necessary has used for this photograph.*

Photo 34 *shows an alternative method. On this scratchbuilt LNER O4/8 2-8-0 a long L-spacer at the front of the chassis forms a tongue which engages with a bent strip soldered to the footplate behind the front buffer beam. At the rear of the engine the cab floor is drilled and tapped to accept a 10BA screw.*

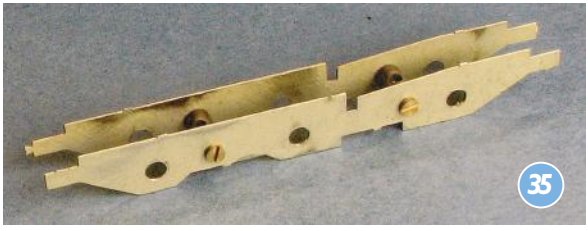
Some final advice...

At every stage of building described above, check that the chassis is foursquare (used carefully as intended, the assembly jigs ensure this), that all soldered joints are firm and that wheelsets rotate freely. Cure any stiffness or binding carefully, as described, before moving on to the next stage. Keep the work clean, removing flux residue after each soldering session. Ensure that there is enough sideplay in wheelsets and coupling rods for the chassis to go through pointwork and round curves (reverse curves such as a crossover particularly). Don't rush, or work for too long without a break for rest: that's when mistakes happen. Be patient. Keep it simple.

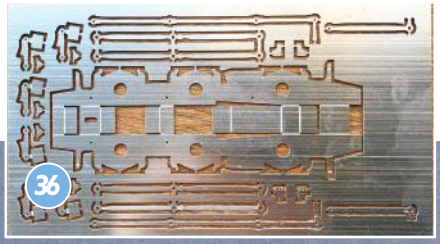
Appendix 1 - Alternative methods of assembling frames

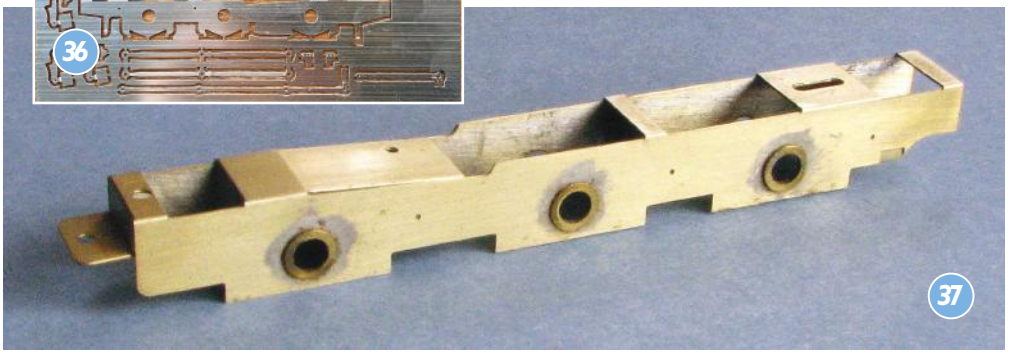
Many experienced 3mm modellers have used Society turned brass frame spacers (FS001) to hold etched frames the recommended 7.5mm apart. 3SMR loco frames have two convenient 10BA clearance holes, as shown in ***Photo 35****. They are easily soldered in place to make a rigid chassis, with etched L-spacers in addition, after which the cheesehead screws can be removed for re-use and the holes filled – with Milliput, for instance. Alternatively, the brass spacers can be used as assembly jigs and removed for re-use after L spacers have been soldered in place. The axle holes can then be reamed to accept the axle bushes and the bushes soldered in place as described earlier.*

Brynkits and some Worsley Works etched loco chassis are of the fold-up type. They are not difficult to fold and the Society Chassis Assembly



Jigs can be used to ensure that their axle holes are in proper alignment before the chassis' integral spacers are soldered. ***Photo 36*** *shows the fret for a GWR 0-6-0PT. The half-etched fold lines show clearly.* ***Photo 37*** *shows a folded fret for a GWR 2251 0-6-0, with the axle bearings soldered in place.*





Society Jigs and Spacers

For 12mm gauge:
Chassis Assembly Jig (x 3): ref SD162
L shaped Etched Chassis Spacers: SD168
7.5mm-wide turned brass spacers: FS001

For 13.5mm gauge:
Chassis Assembly Jig (x 3): SD188
L shaped Etched Chassis Spacers: SD169

For 14.2mm gauge
Chassis Assembly Jig (x 3): SD189
L shaped Etched Chassis Spacers: SD170

BA Screws

	Tapping	Clearance
14BA	0.8mm No 68	1.1mm No 60
12BA	1.05mm No 60	1.40mm No 54
10BA	1.40mm No 54	1.75mm No 49
8BA	1.8mm No 50	2.25mm No 41

Brass countersunk 12BA screws 1/4in long, which have many uses in railway modelling, can be bought in packets of 10 or 50 from online suppliers such as ***ba-bolts.co.uk*** *or* ***ekpsupplies.com***

Bibliography

Performing pick-ups
by John Sutton, Mixed Traffic 203. An illustrated approach to making effective pick-ups.

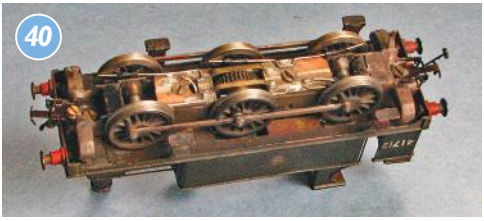
Driving round the bend
by Chris Ketley, Mixed Traffic 214. A clearly-illustrated explanation of the need for sideplay in wheels and coupling rods.

Tapping SQ wheels straight
by Phil Smith, "Quick Tips", Mixed Traffic 228.

An Irish approach to loco chassis
by Alan Gee, Mixed Traffic 230/231. A stage-by-stage account of building a 12mm-gauge mechanism.

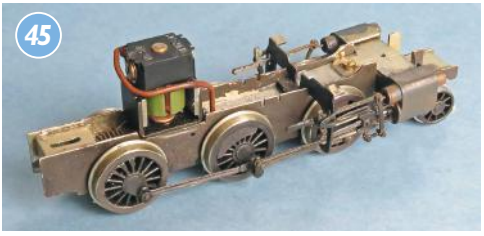
Appendix 2 - Photos of various chassis and pick-up arrangements

GCR J11 0-6-0 with SQ driving wheels
The PCB plates are gapped and the screwholes countersunk. Brass strips connect the two plates physically and electrically and wires to the two motor terminals are soldered to the plate next to the rear driving wheel.



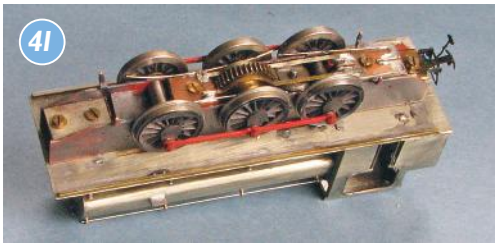
MR 1F Half-cab 0-6-0T with SQ driving wheels
This shows how the brass strips joining the pick-up plates have been bent to clear the gear wheel boss and grubscrew.

BR 9F 2-10-0 with SQ driving wheels
A motor mounted vertically in the firebox (and therefore concealed) drives the fourth axle through a Branchlines RSL gearbox. There is no sideplay on the first and fourth (driven) axles, but as much as possible on the others. The chassis takes 2ft-radius curves with ease.

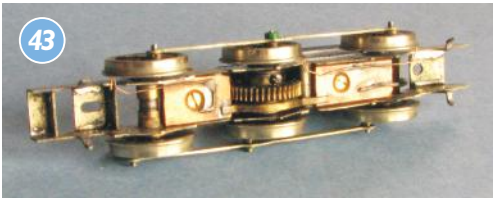


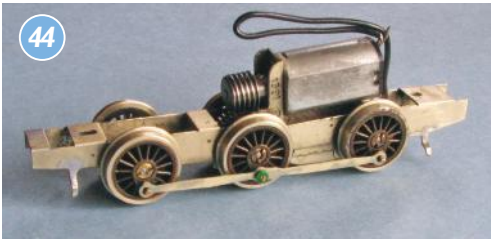
Class 4 Mogul with vertical motor
A Branchlines RSL 40:1 gearbox drives the rear axle. The motor is concealed in the loco firebox and there is daylight under the high-pitched boiler.

GNR J6 0-6-0 with SQ driving wheels
The pick-up wires are as long as possible and are bent to allow them to be soldered to the PCB easily.



LNER J94/Hunslet 0-6-0ST with SQ wheels
The motor, driving an RSL gearbox, is mounted vertically in the firebox of this Amble Junction kit. Opportunity was taken to make the rear pick-up wipers as long - and therefore springy - as possible.





GWR 94XX 0-6-0PT with Romford wheels
The wheels on the left-hand side of the locomotive are insulated and the wire pick-up wipers act upon them and are connected to one motor terminal. The PCB plates do not need to be gapped, though there must be countersunk clearance round the fixing-screw heads as usual. The right-hand drivers are uninsulated and the other motor terminal is soldered to the Brynkits fold-up chassis, which is live.

The principles shown in these photographs apply to any wheel arrangement and any motor/gearbox arrangement. It is just a question of deciding which axle will be driven, where chassis spacers are needed, what size the PCB plates need to be and how to arrange and bend the pick-up wires to allow as much flexibility as possible for the best possible contact. Arrangements for each locomotive will vary.