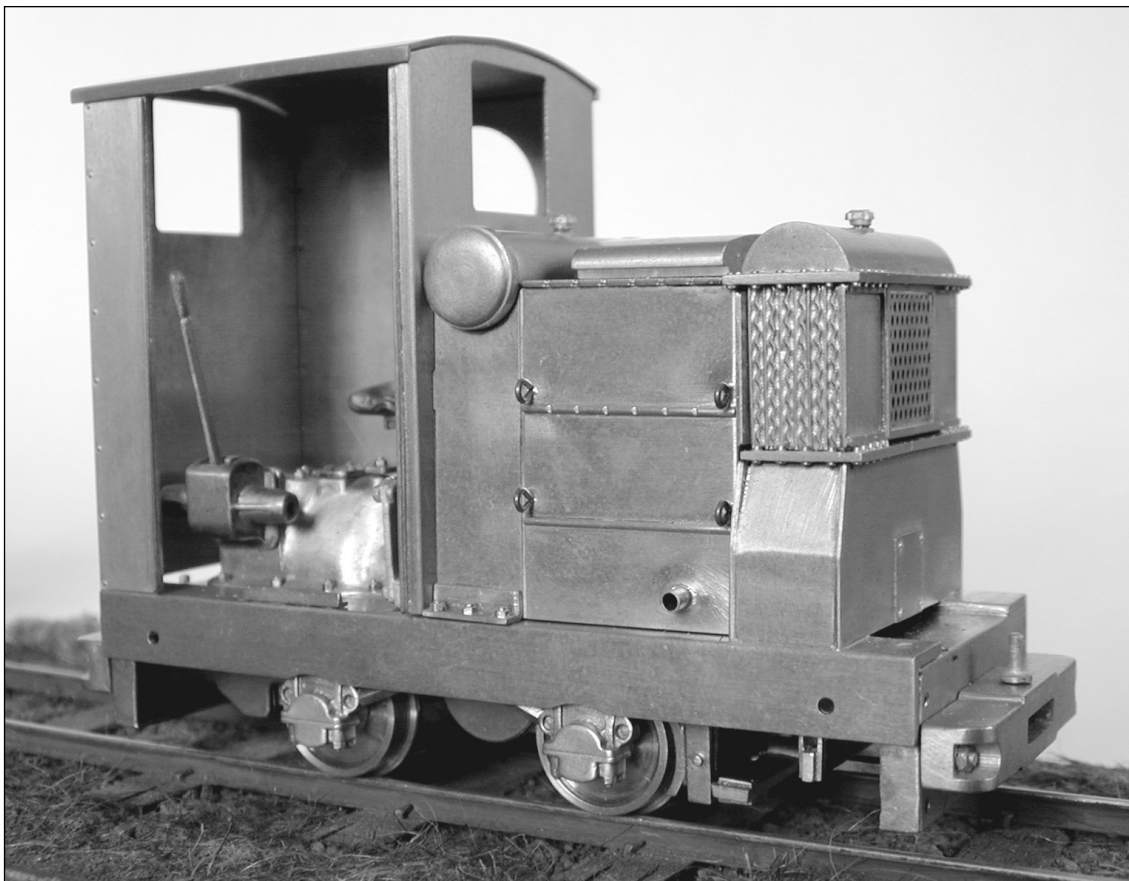


32L01 1:32 Scale Ruston & Hornsby 16/20 Diesel Locomotive



INTRODUCTION

Prototype Information

Ruston & Hornsby was formed in 1918 by the merger of Ruston, Proctor & Co of Lincoln and Richard Hornsby of Grantham. Both had been involved in the production of internal combustion locomotives, using petrol engines. The new firm, based in Lincoln were general engineers; but they decided to enter the then new field of diesel locomotive manufacture, the first one of which left the works in 1931. Their success in the field was partly due to the use of a constant mesh gearbox incorporating separate clutches for each speed. The clutches were operated by a single lever (forward and reverse being operated by second lever, with the brakes by a third), meaning that locos could be driven by relatively unskilled people, and even by somebody walking alongside, making "one-man operation" simple. Most rival products may have been mechanically simpler, but required more skill to operate successfully.

The early locomotives were fitted with Lister engines, but soon Ruston & Hornsby were building their own. The subject of this kit, the 16/20hp (hp = horsepower) loco was in production from early 1937 to 1940, and was the most popular design, a total of 188 being built. It was redesignated 20DL

in 1940, retaining the same body style at first, but by 1942 a more "streamlined" body style was introduced, but mechanically unchanged. With further cosmetic alterations and mechanical changes, the 20DL was in production until 1963, 1198 having been built.

Another aspect of Ruston & Hornsby narrow gauge designs was that 2ft gauge was regarded as the standard, other gauges were accommodated by extensions to the basic frame. Narrower gauges had to have wide frame extensions (because the drive chains had to go outside the wheels). Above about 3ft gauge, standard gauge designs were usually supplied, with the gauge suitably narrowed down.

Model Information

This kit was originally produced by **Bridge Models** and later by **Light Railway Materials**. It was intended for $\frac{3}{4}$ in gauge (true 2ft) only, and was difficult to convert to 16.5mm gauge (about 20in), as requested by some people. Now, the chassis has been extensively redesigned to accommodate both gauges, with specially made wheels and gears.

This kit will enable you to build a fully detailed model of one of the most common small narrow gauge diesel locomotives produced in the UK. There were variations, notably in the size of the combined coupling block / ballast weights. The sources quoted below will help with examples of real locomotives, showing some of these variations and inspiration for "livery" and "weathering".

Track Gauge

The kit you received has been designed to accommodate either $\frac{3}{4}$ in gauge or 16.5mm gauge. The only important differences are the length of the axle and the orientation of the functional axleboxes. Otherwise, the assembly method is identical for both gauges, unless you wish to add the frame extensions.

As already mentioned, the one major area where a real 20in gauge loco would differ from a 2ft gauge loco is that the axleboxes would be set further apart because the drive chains had to go outside the wheels (due to the width of the gearbox). The axleboxes are attached to frame extensions, which are included in the kit (they form part of the "body"). On the model, there is no need, other than historical accuracy, to fit the frame extensions, and a 16.5mm gauge model will work perfectly well without them, so the choice is yours. (We have seen 2ft gauge locos with the frame extensions, but this is usually because the loco was built for a narrower [or wider] gauge and has been altered. It is also possible that the original owner needed a loco that could be re-gauged to suit the track on different construction contracts.)

Design Principles

- All the parts needed to complete the model are included, except for solder, adhesive and paint. A typical "modellers" toolkit will also be needed.
- These instructions take the form of a brief description of each operation, illustrated by pictures generated by the 3D CAD system on which the model was designed. A sample model has been built to test the parts and assembly method.
- If you are a novice at soldering, the majority of the etched brass parts could be assembled with adhesive. Each part is put together with tabs and slots, designed to locate and hold them whilst soldering is done, so they will "hold themselves together" while adhesive (epoxy) sets.
- On the etched brass parts, all folds are formed with the half-etched lines on the inside, to an angle of 90°, unless specified otherwise in these instructions.
- When a reference is made to Left or Right Hand (LH or RH) (or Top, Bottom, Front or Rear), this refers to the place on the completed loco, when the right way up. Care needs to be taken at the early stages (particularly when things are upside down) to get the correct place.
- As designed, the "body" and "chassis" form two assemblies held together by screws. Furthermore, the chassis can be disassembled to remove the wheelsets and motor for maintenance and to make painting easier.

- An important aspect of the assembly of the mechanism is to try every part for free running at each stage of the assembly. That way, you will know that the most recent part is one causing problems. In other words, DON'T just assemble everything and hope it works at the end!
- On the two main sub-assemblies, all etched brass work requiring soldering can be completed before whitemetal parts are added by means of glue (epoxy or similar)
- It is suggested that the chassis should be assembled first, but if you prefer, there is no real reason why you shouldn't do the body first.
- It is also suggested that you do not remove components from the etched sheets until needed. When you do, cut through the joinings tabs with a fine saw or using a trimming ("Stanley") knife on a hard surface; use a gentle slicing action not a chopping action, or the brass will become distorted. Then remove the remains of the tab with a fine file. Reference in these instructions to "removal from etched sheet" is deemed to include removal of tabs and other cleaning up of edges, etc.
- Several parts on the etchings require "rivets" to be punched. The best tool for this is a proper rivetting press with a "female" die and a "male" punch - one of your friends or a fellow club member may have one (you will need a die of about 0.45mm). There are tiny half etched holes on the inside to provide a location for these. An alternative, advocated by some, but not really satisfactory is to use the point of a scribe pushed (very gently) from the rear. There are a few "test rivets" on the etched sheets to try out either method. If you are not satisfied with the results it is best not to form the rivets at all - on the basis that "no rivets are much better than badly formed rivets" !
- The whitemetal parts will need a bit of cleaning up (the radiator fan particularly needs it). All parts will have the remains of the feed sprue to be removed - this has been carefully located to make this job easier. Some may have some "flash" (formed along the part line in the mould), which can be removed with a combination of sharp knife and fine files.
- Most of the brass castings are attached to a sprue; the individual parts should be detached with nippers, end cutters, or a fine saw, and the sprue remains removed with fine files.

Further Information

There are a number of preserved 16/20 (and early version 20DL) locos. The principal source of reference was Ruston & Hornsby no. 187081 based at the Amberley Working Museum in West Sussex, although the cab on that is not original. Another (which by coincidence worked at the same industrial site) is at the National Railway Museum, York (although not always on display). There are other Ruston locos of the same or similar type based at a number of railway preservation sites, including the Leighton Buzzard Narrow Gauge Railway in Bedfordshire, the Moseley Railway Trust at Apedale Country Park, Newcastle-under-Lyme near Stoke-on-Trent, the Old Kiln Light Railway in Surrey, and many others. All the sites named have collections of narrow gauge diesel locomotives preserved for their own sake, and not just as incidental workhorses.

The following books and publications will be of interest:

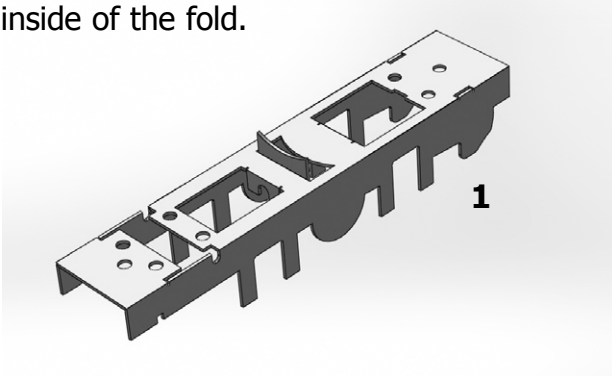
- **Ruston & Hornsby Locomotives**, Eric S Tonks, Industrial Railway Society, 1974. History of the company, with details of all locos built. Illustrated.
- **A Guide to Ruston Narrow Gauge Locomotives**, D R Hall, Moseley Railway Trust, 2000. All Ruston n.g. loco types are described, illustrated with photographs and drawings.
- **The British Internal Combustion Locomotive**, Brian Webb, David & Charles 1973.
- **Narrow Gauge & Industrial Railway Modelling Review – 41**, illustrated article on Ruston locos by Gordon Hatherill

The publications of the Narrow Gauge Railway Society and the Industrial Railway Society, as well as **Narrow Gauge & Industrial Railway Modelling Review**, regularly contain photographs and other material relating to Ruston locos.

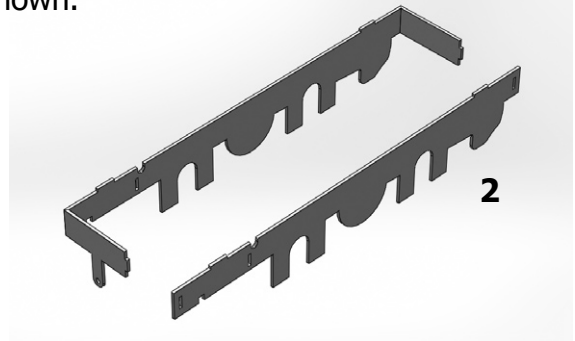
Chassis Assembly

Most of the etched chassis parts are on sheet 32L0103.

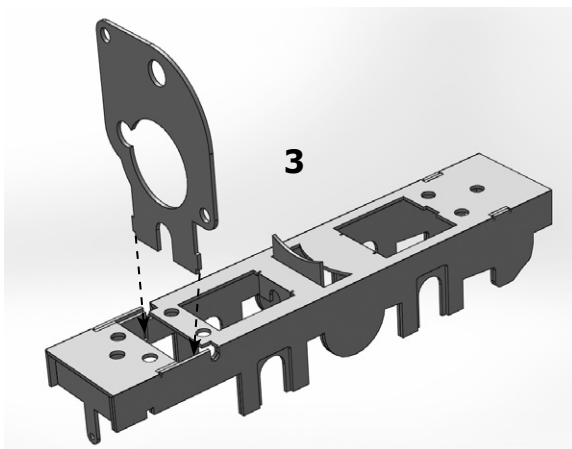
- 1 Take the outer chassis section and bend as shown, noting that all fold lines are on the inside of the fold.



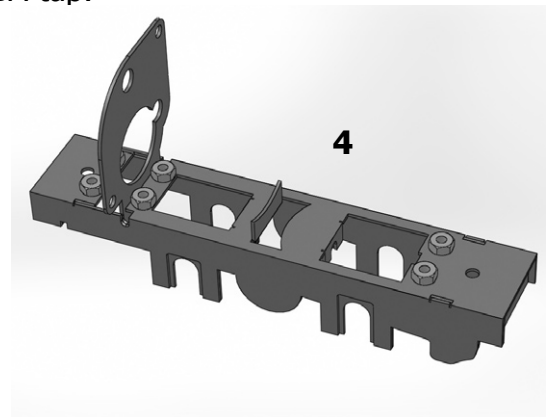
- 2 Take the inner chassis parts and bend as shown.



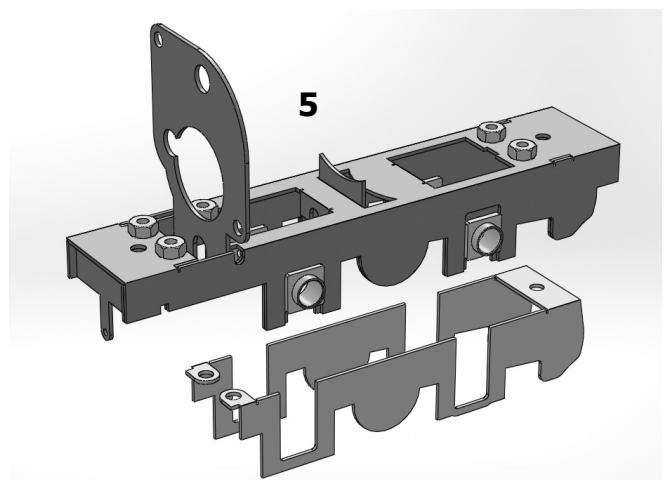
- 3 Slot the inner sections into the outer section; there are tabs and slot to aid location. Then "click" into place the motor mount; there are tabs on the latter and slots inside the chassis. Note carefully the correct orientation.



- 4 Now solder all these components together, by applying lots of liquid flux and letting the solder draw into the edges by capillary action. At the same time solder 6 x 10BA nuts above the holes as shown. These must be located centrally over the relevant hole - it will be found that once the solder is liquid the nut will tend to "float" into the right place - but check afterwards. If any solder flows into the threads of the nuts, this can probably be cleared by "forcing" a bolt through, or by means of a 10BA tap.



- 5 Try the 4 functional axleboxes in place; you might need to scrape a bit of solder from the etched slots to achieve axleboxes which slide in freely, but without any slop. For $\frac{3}{4}$ " gauge, the round protruding section of the axlebox goes to the outside (as shown on the illustrations), whilst for 16.5mm gauge they go to the inside. Now fold up the keeper plate etching as shown and trial fit in place, securing with two screws at the front and one at the rear; the nut for the rear screw will be soldered to the body, so at this stage, put a nut on temporarily to hold everything together.



- 6 At this stage assemble the wheelsets into the chassis to check that they roll freely. The wheels fit onto square ended axle and are retained by countersunk socket cap screws tightened with the supplied allen key. (If you've ever used Slater's wheels before, you will know the system). Then dismantle the wheelsets, axleboxes and keeper plate and keep them safe until the gearboxes are assembled.
- 7 **IMPORTANT:** All gears and bearings must be well lubricated with light clock oil before running and kept well lubricated throughout their working life.

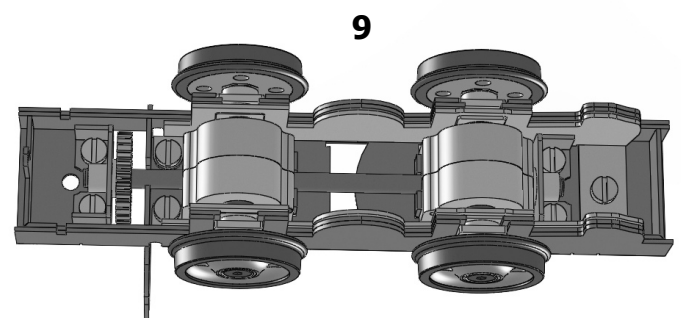
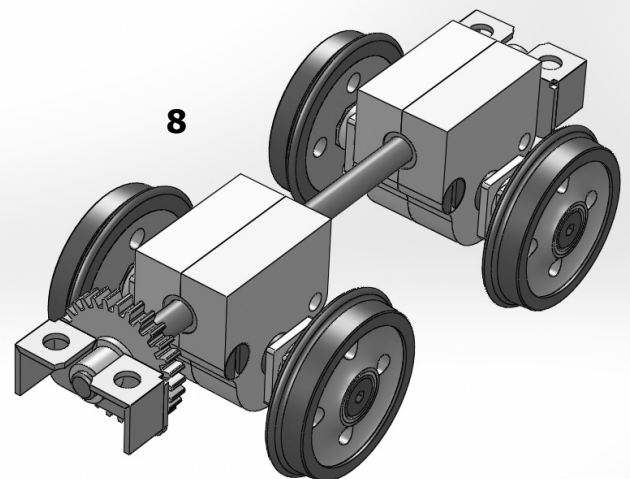
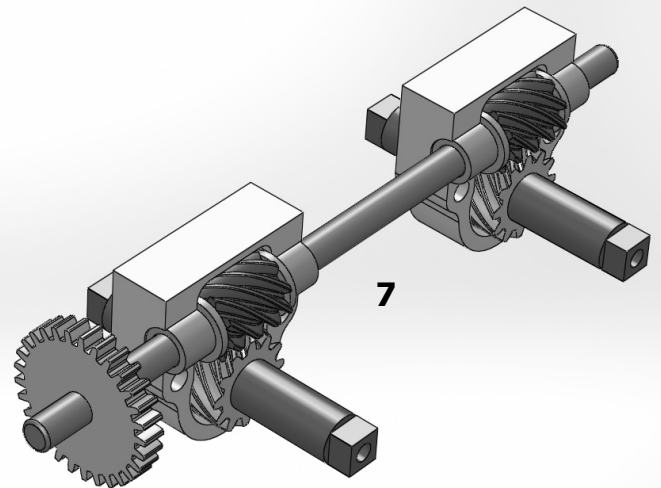
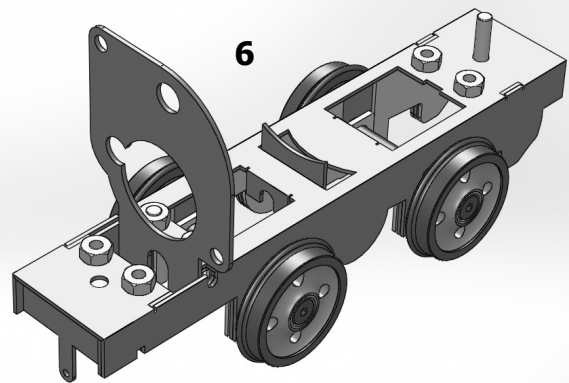
Now assemble the gearboxes onto the layshaft. This comes assembled with the two smaller helical gears and a spur gear in place, as well as 3 bearings which are trapped by the gears. The first job is to fix the two larger helical gears, one on to each axle. Use Loctite retainer (Type 603) or similar, not "Superglue" (Cyano/ACC) even if it is made by Loctite. Make sure that the gear is exactly in the middle of the axle. The retainer should set enough to proceed in about 10 minutes, but make sure you remove all traces of liquid before going any further.

The gearcases are done next; one half is shown in picture 7, the other in picture 8. As with all stages, check by rotating the spur gear that the helical gears revolve without any binding

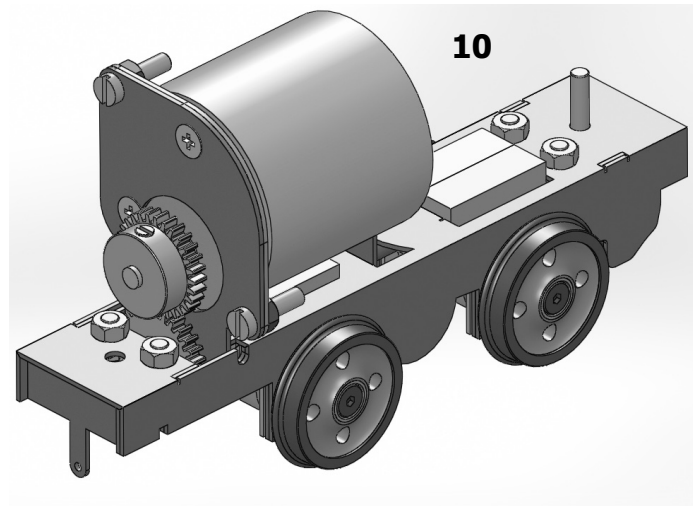
- 8 Now replace the functional bearings and wheels and do a test assembly into the chassis. You will probably find that the rectangular holes into which gearboxes locate will need slight easing with a file so that they slide in easily. Similarly, the axleboxes must slide up and down easily - if they did at stages 5 and 6, they should now. If they don't, try to establish where they are binding and ease SLIGHTLY with a file.

Now fold up the layshaft end bearing retainers and solder a bearing in place (both end are identical).

- 9 Now put the the layshaft/gearbox assembly back in the chassis and this time screw the shaft retainers into the previously soldered nuts. Check that the assembly still revolves freely and without binding. If it did at the end of stage 8, but doesn't now, then the retainers are the problem. Try to ascertain where it's tight, and as with previous stages, ease SLIGHTLY with a file.

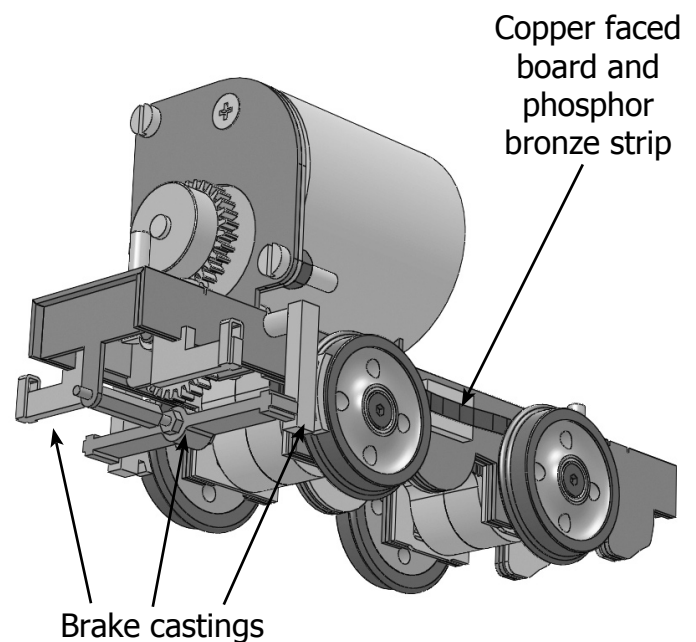


10 Fit the motor. The motor comes with an etched plate already fitted; this goes on the protruding plate on the chassis as shown, with the two screw heads on the motor being the means of accurately location. Fit two 10BA screws and nuts as shown. The second spur gear (with boss and grub screw) goes as shown. The whole mechanism should revolve smoothly and without binding by turning this gear by hand. If it doesn't then go back and try all the previous stages until you find the problem. If you try to solve the problem by applying power to the motor, you will probably burn it out - and they are quite expensive!



11 The remaining job is to fit the electrical pickups. Using epoxy, fix a piece of copper faced board to each side of the chassis, mid-way between the axles. Take two pieces of phosphor bronze strip, about 32mm long, and solder the middle of each to the copper pads. Bend the strip as necessary to wipe on the back of each wheel tyre. Now solder a length of insulated wire from each copper pad to the terminals of the motor. Left hand side to "+" terminal should result in movement in the conventional direction, but you may need to try both combinations to ensure it matches your other locomotives.

12 Now fit the chassis castings. The two brake block / hanger castings and the cross beam / pull rod casting assemble to form a unit, which can be made removeable for chassis maintenance. The two brake block units fit into slots in the etched chassis. The brake block cross beam fits into holes in the front (i.e. away from the wheels) of the blocks, and the front of the pull rod fits into the small hole in the etched tongue at the front of the chassis; make sure that all holes are opened up sufficiently. Assemble this unit in the chassis, either assemble "dry" and then apply superglue (ACC) to each joint (on the point of a cocktail stick), or apply epoxy and allow to harden thoroughly. Make sure that the brake blocks are not touching the wheels (or an electrical short circuit will result!). The unit is held in place by the body, once complete, and can be removed by careful manoeuvring.



The final piece is the second cross beam, which was made for the original kit, but for this version needs to be cut into two, also removing about 3mm from each half. The two halves are glued into the slot in the chassis as shown. This way, it does not interfere with the chassis-to-body fixing screw; which can be manoeuvred around the hexagonal turnbuckle, or if you prefer, just omit the turnbuckle!

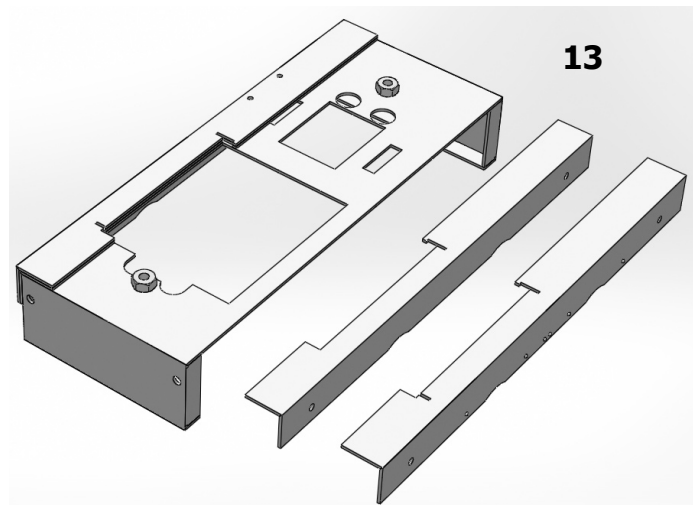
A ballast weight, which also represents the bottom of the gearbox, is glued across the rear of the keeper plate, aligned with the fixing hole (so that the fixing screw passes through the casting).

You have now completed the difficult part of construction!

Body Assembly

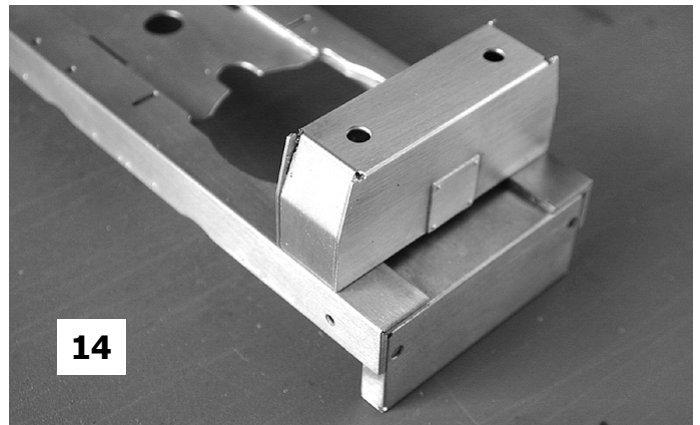
The etched parts are mostly on sheet 32L0101 and 32L0102; see facsimile of the sheets on page 12.

- 13 The floor folds up as shown; note that all fold lines are on the inside. Add the side frames, formed from two layers. In the drawing, one side is shown assembled and the other side with the side frame parts separate. Solder two 10BA brass nuts over the holes as shown (see notes in section 4).

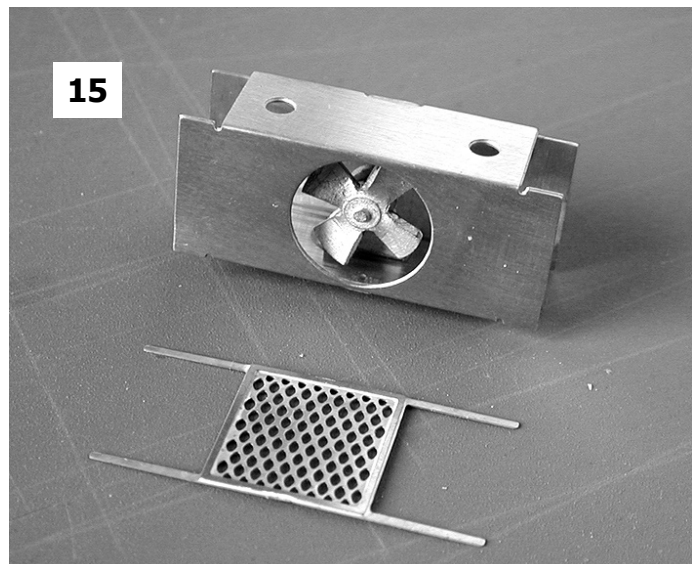


The remaining illustrations are taken from the original Bridge Models/Light Railway Materials instructions and in some, the original chassis design will be visible. However, this does not affect the assembly of the body. If you want to add the frame extensions (see introduction) there are notes at the end of this section, but read them first, before starting any work.

- 14 The radiator bottom comes next. Fold down the front and rear at 90°; there is a small cover plate (with four "rivets") which folds to 180°, so that the rivets are visible. The side pieces fold down so the the upper part is at an angle and the lower part is vertical. Attach to underframe with cover plate to the front, as shown



- 15 Form the centre section of the radiator next. This forms, in effect, a piece of square tube. The grille and rivets strips (in the form of an "H") can be attached over the circular hole. Fit the fan to its bracket, and with tweezers, fit into the centre hole on the etching, with the fan facing forwards (photo 11 shows the fan in place but the grille still loose). At this stage you will need to paint the inside of the radiator centre section (because it will be inaccessible later), then fit the radiator element castings to the outer ends of the "tube". Set aside until until all the soldering is completed.



- 16 Form the bonnet section next. The unit folds up as in photo 12, which also shows the additional pieces described next. Once the top is firmly soldered to the sides, the two small strips which located it whilst folding need to be carefully removed to clear the top section of the radiator. On each side take two pieces of the 0.5mm wire and fix in the two horizontal half-etched lines. The top one on each side needs a series of small notches to represent the hinge sections – these should line up with

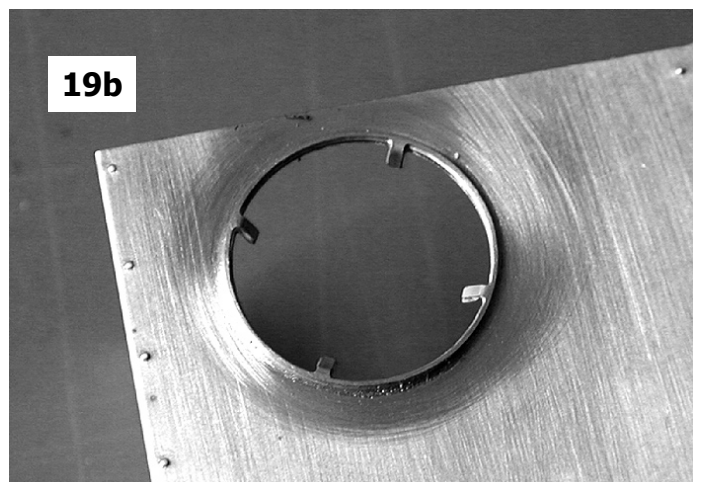
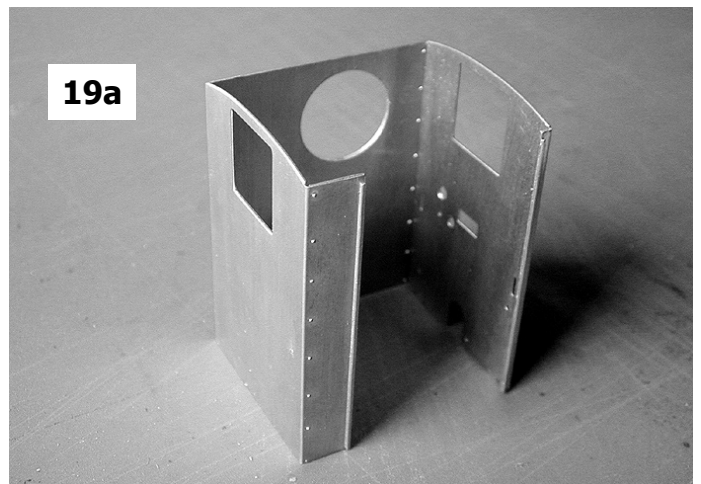
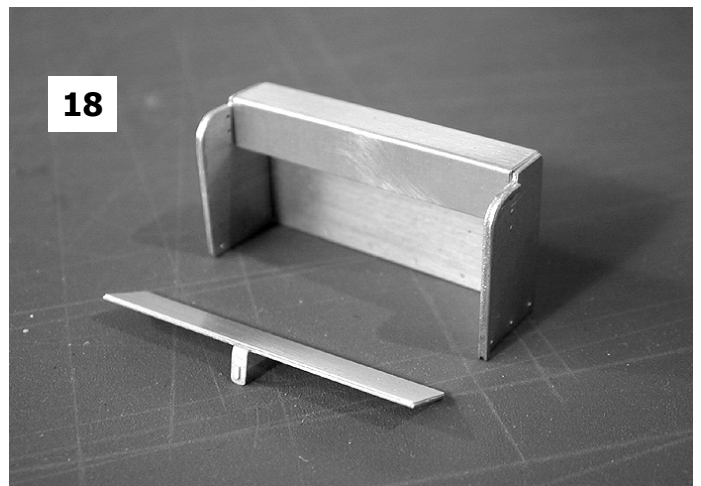
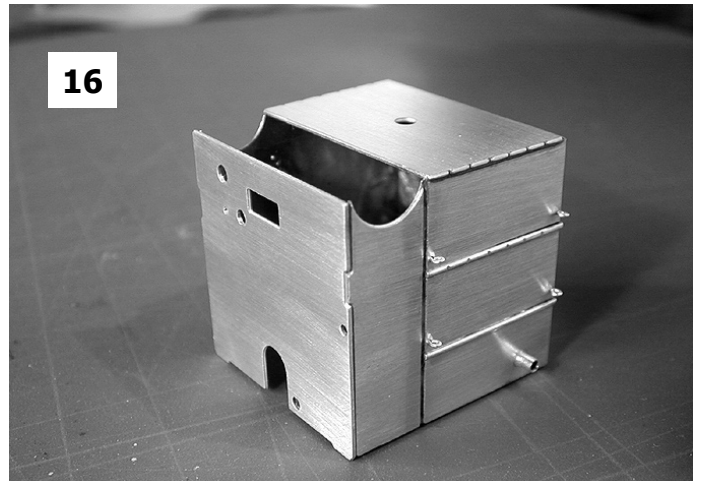
the equivalent notches etched in the edge of the top. A short length of small diameter tube is fitted to the hole in the right side to represent the exhaust outlet (this is the "as built" location, but many were altered later in life). Now attach four of the tiny eyelets (per side) onto the etched holes - these may need to be drilled through with a 0.3 or 0.4mm drill. These are bonnet catches on the real thing, they are horizontal when holding the bonnet sides closed. The left side rear lower eyelet has to be cut off flush on the inside (to clear a casting fitted later) but the others can be left - although check clearances with the chassis and motor in place.

17 There is now a choice, depending on whether you want a cab or not. The fold-up cab forms the back of the bonnet/fuel tank upstand, so if you want a cabless loco, the separate bonnet rear needs to be fitted (noting the correct orientation in picture 16). Attach the (cabless) bonnet to the frames.

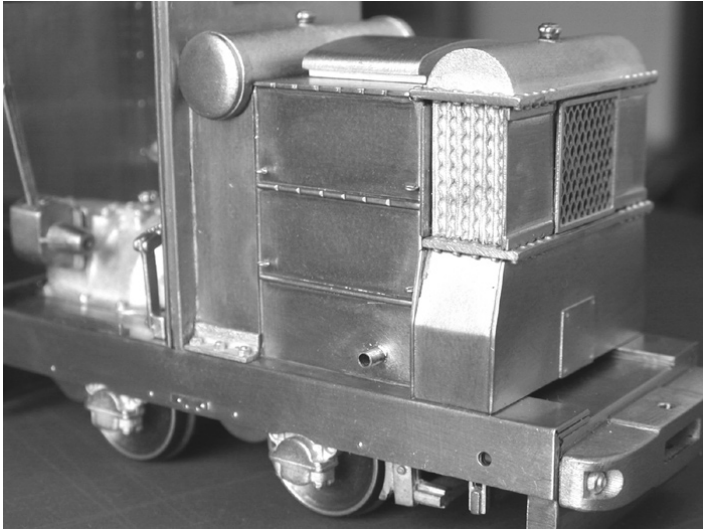
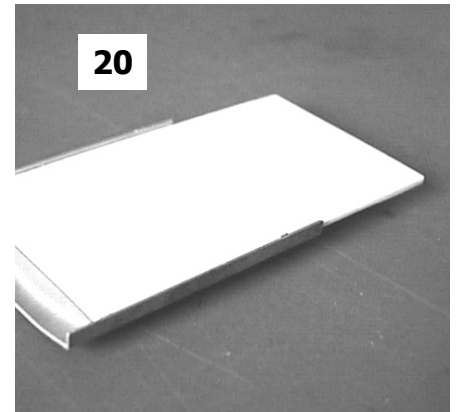
18 Some cabless locos had a toolbox at the rear. This is shown folded up in photo 13, but with the lid still separate - this goes centrally on the top. Note that the "J" shaped beading folds back through 180° before soldering.

19 If you want a cabbed loco, the first job is to form the three lines of rivets, see note in the introduction for advice on this. Form the front and sides of the cab by folding the inside half etched lines to 90° (photo 14). The beading either side of the cab entrance is formed by folding the (very fragile) strips to 180° outside, and then soldering, removing the remains of the tab afterwards. The (even more fragile - until soldered) beading for the circular window is formed by folding the four tiny location strips to 90° and inserting in the hole (photo 15). Once the beading is soldered, the location strips are removed with a fine rounded file. There are two riveted strips which go inside the cab, on the face with the round window, covering up the previously embossed dimples, representing the internal angles.

20 Locate the tabs on the rear of the bonnet sides into the slots in the front of the cab and attach both to the frames, locating the tabs in the bottom of the cab front into the slots in the frames.

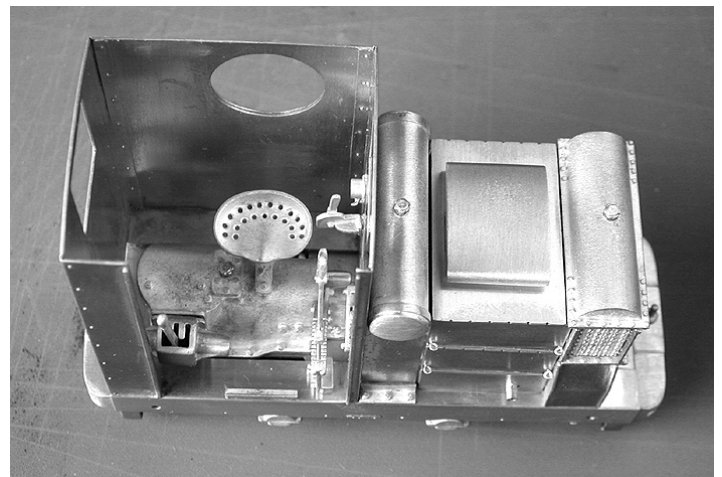
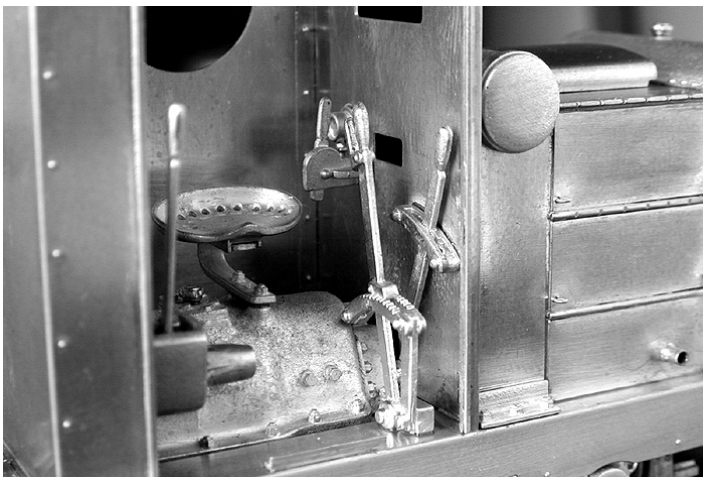


21 Take the cab roof and gently roll to a curve to suit front and rear of the cab. One way of doing this is to use a piece of round bar or wooden dowelling (of about 1/2in or 3/4in diameter) as a "rolling pin" (like rolling pastry for baking) on a slightly yielding surface (say hard rubber). The correct curve will gradually form, but check frequently. Now fold down the side pieces - these are deeper than needed to make folding easier, so they need to be filed to size after folding. Use a piece of 1mm (40thou) Plastikard cut to be a close fit inside the roof, and holding the roof upside down, file down to the plastic. This will leave a neat 1mm edge to the roof. Fit to the top of the cab after all the interior castings are fitted.



22 Now fit all the remaining whitemetal and lost wax brass castings. Reference to the photographs should provide most of the information on location and orientation of these, but note the following:

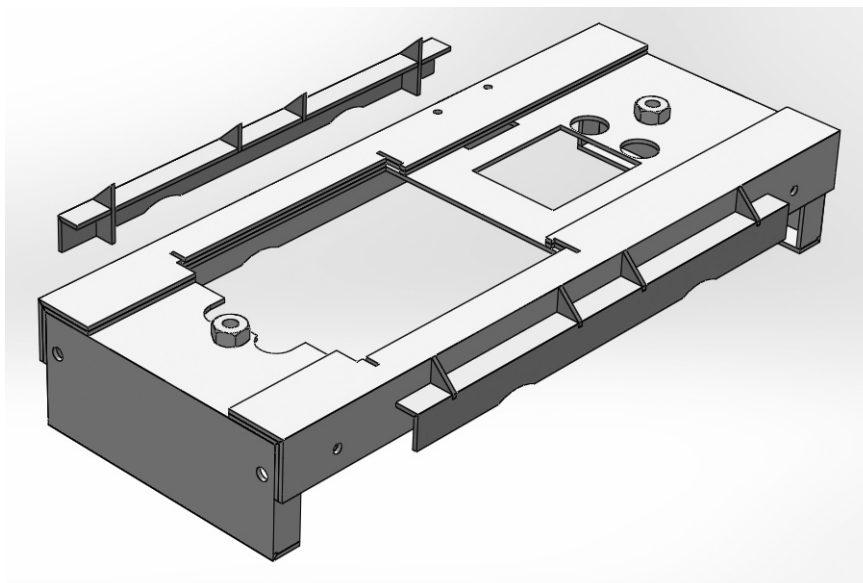
- There is representation of the starting handle mechanism; this looks like two pieces of channel inside each other, with a small round part protruding. This glues inside the bonnet behind the "egg shaped" hole on the left side.
- The speed gear lever (the one in the three-pronged "gate") can be fixed in place, or if you wish, can be made moveable by drilling the brass "gate" box horizontally through the two "tubular" extensions, and inserting a piece of wire into this and through the lever.
- The axleboxes are "handed" (two of each) with a representation of the hexagonal tensioners which go towards the centre (see pictures). Locate the axlebox by aligning its centre by eye with the centre of the small crescent shaped cut out in the side frames.
- There are three filler caps, one each on the radiator and fuel tank, both clear in the photos, but the third goes on the top of the gearbox next to the seat.



23 The model is now complete and in need of painting. Thoroughly clean with kitchen cream cleaner, then (preferably) a suitable spray paint or airbrush. The standard colour, as supplied by the manufacturers was mid olive green. You may be able to find a suitable automotive spray paint or use Southern Railway "Dark Olive Green" from one of the proprietary paint ranges. Alternatively, in industry, any shade of green, red or occasionally, blue, is likely, but note that it was rare for more than one colour to be used (e.g. no red buffer beams - that is usually an "invention" of the preservationists!). The "safety" yellow-with-black "wasp stripes" livery did not make its appearance until around 1960. However, painting the basic colour is probably the easy bit (!); most small industrial diesels like this were treated badly, so far as appearance is concerned, so you will need to apply a lot of so-called weathering; We have seen many such locomotives covered in so much dirt that it was impossible to tell what colour it had been painted! The best advice is to seek out a book on the subject, such as "The Art of Weathering" by Martyn Welch, published by Wild Swan Publications.

Frame Extensions

24 Fold the frame extension to a 90° angle and fit the triangular pieces as shown. The assembly must be attached to the main frame by eye, but this is quite simple. The top of the triangles lines up with the top of the frame; the bottom of the extension lines up with the bottom of the frame, and the "quarter moon" cut outs on the extension line up with the equivalents on the main frame. The whitmetal axleboxes now fit between the extension and the main frame (rather than inside the main frame), but might need slight trimming to get them to fit neatly.



Parts List - Ref. 32L01 - Ruston & Hornsby 16/20 Diesel Locomotive

Part Number	Description	No. Per Kit
Etchings		
X32L0101	Mainly Cab and Bonnet, etc	1
X32L0102	Mainly Floor, frames and radiator, etc	1
X32L0103	Mainly Chassis, etc.....	1
Brass Castings		
X32L0110	Gear shift Box.....	1
X32L0111	Coupling Pin	2
X32L0112	Brake Lever and Quadrant.....	1
X32L0113	Direction Gear Lever and Quadrant	1
X32L0114	Throttle Lever.....	1
X32L0115	Oil Pressure Gauge	1
X32L0116	Speed Gear Lever	1
X32L0117	Radiator Cap	3
Whitemetal Castings		
X32L0120	Radiator Top	1
X32L0121	Radiator Middle	1
X32L0122	Radiator Fan.....	1
X32L0123	Radiator Fan Bracket.....	1
X32L0124	Radiator Element	2
X32L0125	Coupling Block	2
X32L0126	Axlebox, LH	2
X32L0127	Axlebox, RH	2
X32L0128	Brake Block, LH	1
X32L0129	Brake Block, RH	1
X32L0130	Brake Block Cross Beam	1
X32L0131	Brake Cross Beam	1
X32L0132	Sand Pipe	2
X32L0133	Gearbox Case	1
X32L0134	Transmission Cover Box	1
X32L0135	Seat	1
X32L0136	Seat Bracket	1
X32L0137	"Foot Rest" Angle	1
X32L0138	Fuel Tank	1
X32L0139	Fuel Tank Base Angle Bracket	2
X32L0140	Ventilator Top	1
X32L0141	Gearbox Bottom	1
X32L0142	Starter Handle Bracket	1
Wheels and Axles		
32N16RH	Wheels.....	4
X7NG03SA	¾" gauge axle.....	2
XA35053	16.5mm gauge axle	2
—	Countersunk, socket cap, axle screw (steel).....	4
X78003	0.89mm A/F Allen Key.....	1
Other Parts		
—	Phosphor Bronze strip (for pickups), 6"	1
X32L0151	29 tooth spur gear with boss and grub screw.....	1
X32L0152	Layshaft, with 29 tooth spur gear, 2 x 9tooth helical gears, and 3 bearings.....	1
XFD0303	12tooth helical gear	2
XFD0301	Machined gear case half.....	4
—	10BA x ¼" countersunk brass screws.....	4
—	10BA brass nuts.....	10
—	10BA x ¼" cheesehead brass screws	10
X49601	⅛" square slotted bearings	4
1211	2mm ID bushes ("4mm Coach Bearings").....	3
—	20thou (0.5mm) straight brass wire, 3"	1
—	Insulated wire, 2"	2
—	1/16" Brass Tube (for exhaust pipe), ½"	1
—	Copper clad sleeper strip (for pickups), 1"	1
—	Faulhaber 2020 motor with etched brass mount.....	1
—	Small Eyelets (for bonnet catches)	8
—	Instructions.....	1

