

# West Wiltshire Society of Model Engineers Newsletter

Issue No. 13

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All the open day events for 2020 are now cancelled with the exception of the Santa Specials where we will take a decision nearer the time.

The good news is we can look forward to our events next year. The Wiltshire Model Steam Gala will take place on 18<sup>th</sup> September 2021 and will everybody's help will be our best show yet.

## **Knitted Train Bunting**

*'This is a call for all you knitters, aspiring knitters or maybe you have a 'better half' who is a knitter'.*

Michelle Richardson has asked if we have any knitters in our club who might like the challenge of producing a pattern, or helping us to make some knitted train bunting for future events to decorate the club house.

Even if we can't drive trains at the club at the moment we can still knit trains at home!



## **News**

### **Wiltshire Model Steam Gala & 2020 Events**

It is with deep sadness, that we would like to let you all know that we have decided to cancel the Wiltshire Model Steam Gala show this year.

With the pandemic restrictions likely to last in some format for the foreseeable future, we wanted to let our traders and exhibitors know as early as possible. I am pleased to report that we are already forwarding their bookings to 2021.



# Cylinders From Solid

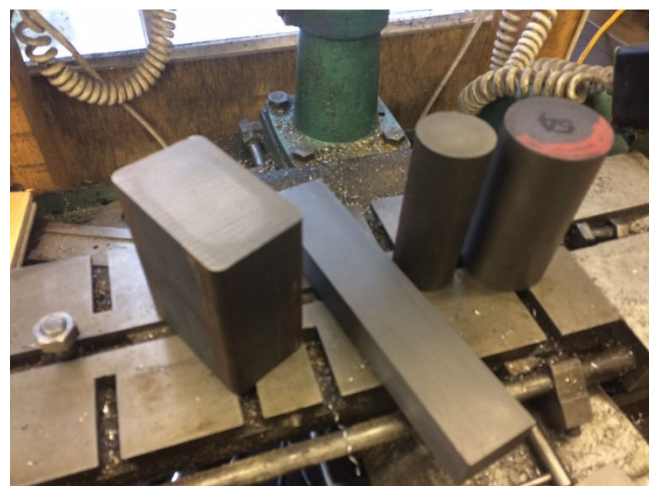
By Julian Haines

One of my many current projects is a 3 ½" narrow gauge style locomotive, essentially to the Martin Evans Conway design but taking in some cues from Ross Harrison's Lilla, the two designs being uncannily similar allowing mix and match of much of the construction.

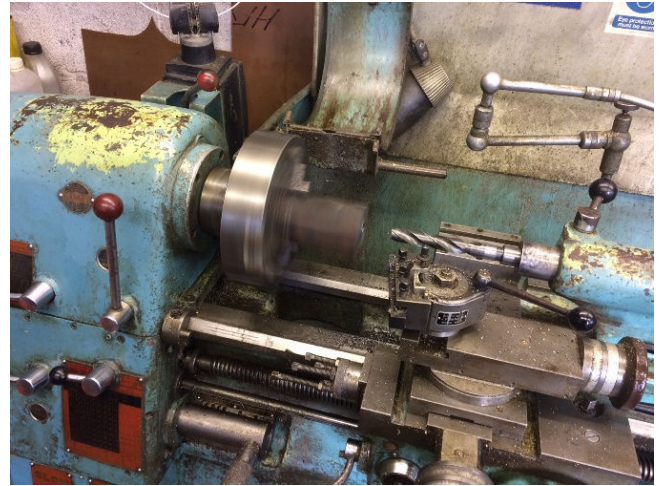
On coming to the cylinders I decided to have a go machining from solid, the cost of the cast iron came to about £70 rather than £200 plus for the castings. From start to finish the two cylinders took 5 evenings to complete so a little slower than working from castings but not much.

One clear benefit was the consistency and very high quality of the cast iron which machined beautifully all the way through. I'm fortunate in having medium size machinery, a Colchester Chipmaster and Tom Senior Mill which with sharp tools made light work of reducing what was initially a 2.9kg block of cast iron down to an 850g cylinder.

One of the cylinder blocks, round bar for the end covers, pistons and rings and rectangular bar for the valve chests. The cylinder blocks supplied as 40 x 80 section 100mm long.



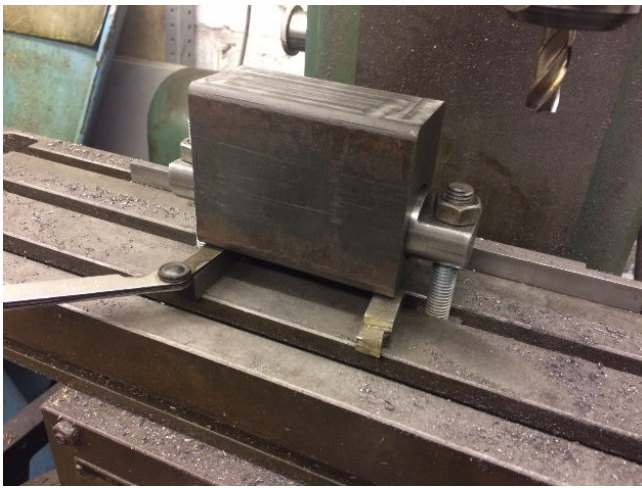
These were roughly marked out, set up in the lathe, drilled and then bored to size for the finished cylinder.



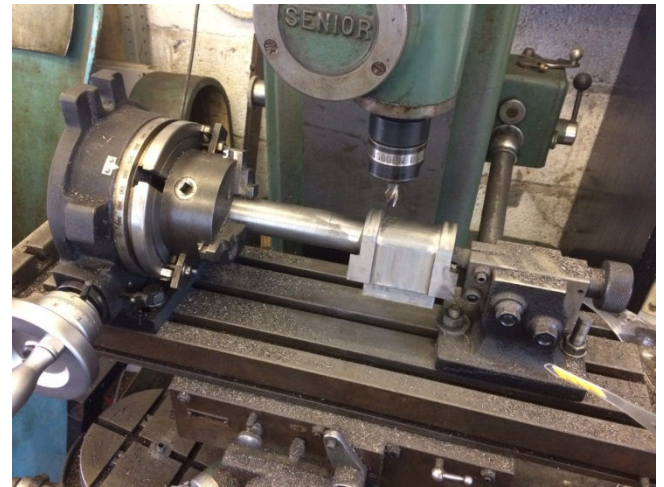
A decent clamping bar was then made a snug sliding fit and the blocks transferred to the mill to square up the four main faces with the bore.



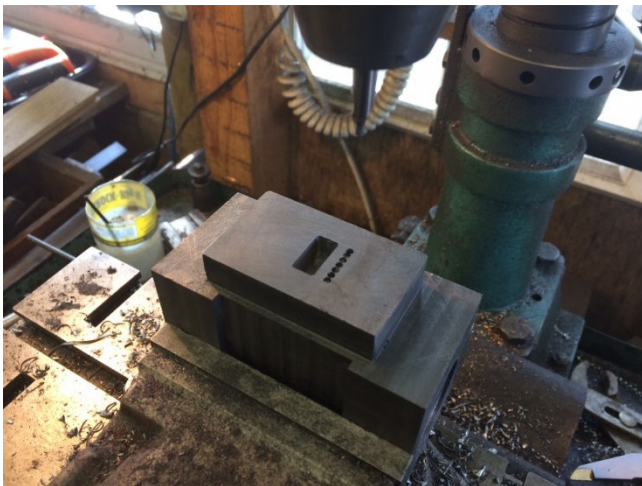




Transferred back to the milling machine, still on the mandrel to machine the outsides to shape, this being dimensionally less critical as ordinarily these surfaces would be left as cast.



Once square some of the waste was machined away prior to marking and drilling the valve ports. The ports were initially cut by drilling undersize then squaring up with a 1/8<sup>th</sup> milling cutter a few thou at a time.



Next job was to square up the bolting flanges to and hey presto two almost finished cylinder blocks.



The cylinders were then driven on to a mandrel to face off the two ends to length whilst ensuring the cover flanges were square to the bore.





Next job was to drill the passages, I cheated here and used round holes of the same cross sectional area as the rectangular ones specified, I couldn't see any benefit in hand cutting eight small rectangular holes almost an inch deep through cast iron.



The cylinders were then finish honed with a small car brake cylinder hone and the port face flatted back with fine wet and dry paper on a sheet of glass. Final job is to drill and tap for all the fixing studs, fingers crossed I have no disasters here.

## Switch Gear for the 5" Ground Level Track

By Terry Neary

Terry has been busy in his workshop during the lockdown, producing these parts for points for the 5" ground level track.

These five sets of switch gear will be used to operate the points either end of the passing loops down both sides of the raised 3 ½" & 5" elevated track circuit and also the points for a branch line to the carriage shed.



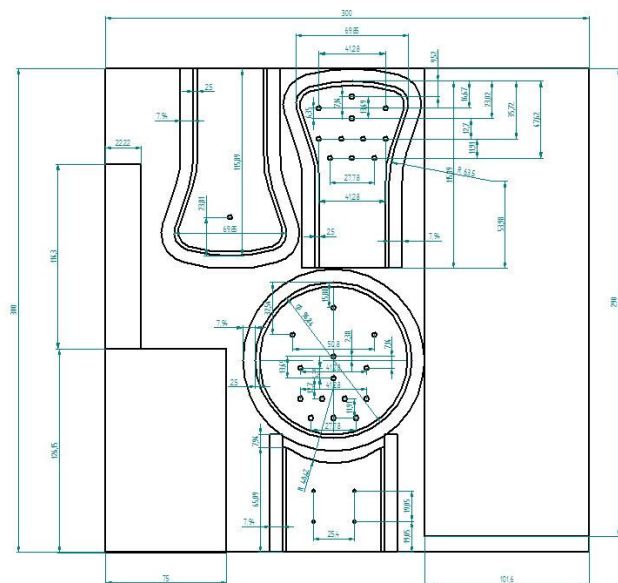
# Plastic Boiler Plate

## Formers?

### Don't Be Soft! Part 2

By David Adams

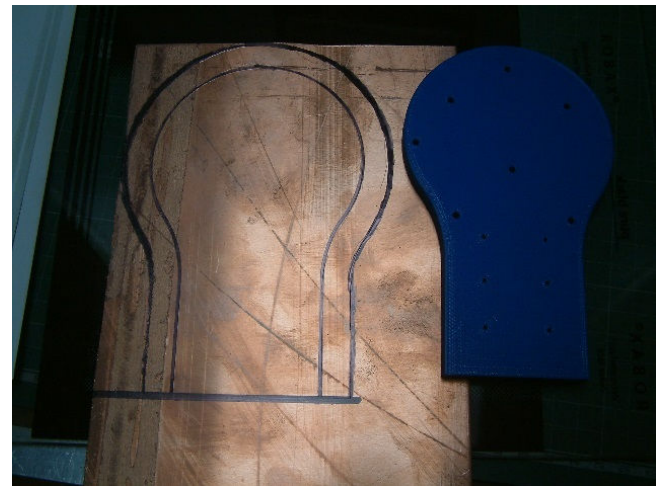
The 3D printed plastic formers described in Part 1 are placed on the copper sheet and a set of dividers used to mark out the extra material that forms the boiler plate flanges. It is always better to allow for a generous amount of material for the flanges as any extra can be trimmed off but it's not so easy to add material if you find you haven't allowed enough! Having extra material also makes it easier to form the flanges with the rubber mallet as the edge of the material you are striking with the mallet is further away from the radius of the former you are bending the copper around but don't go too mad because copper is expensive. Whilst on this subject it is a good plan to use the CAD system and the former plates you have drawn to work out the most efficient way to cut the copper sheet. Copper is expensive and you want to waste as little as possible, I cut all the boiler plates, inner firebox wrapper and outer firebox extension and strap from a single sheet of 2.5mm thick 300mm x 300mm copper. The backhead was cut from a smaller piece of copper plate as it is 3mm thick.



**Figure 1 - Cutting plan for 300mm x 300mm x 2.5mm thick copper sheet. Dimensions used to**

**double check CAD models against the plans for the locomotive boiler.**

Once everything is marked out on the copper sheet and you are absolutely happy after having checked and double checked your work it is time to cut everything out. I found the best results were with an electric jigsaw fitted with a metal cutting blade. The blade needs to be a shallow one to allow you to cut around the curved edges at the top of the boiler plates. I held the copper sheet onto a stout workbench with a G-clamp or two with some wood to protect the surface of the sheet. This is noisy & slow work as copper is horrible stuff to cut or machine but the jigsaw method works for me and I have now produced sets of boiler plates for two boilers with one pack of three metal cutting jigsaw blades.



**Figure 2 - Backhead plate marked out onto 3mm copper sheet ready to be cut out next to its 3D printed former.**

Your persistence should have now paid off and you have a complete set of copper boiler plate material cut out and ready to begin creating the flanges using the 3D printed formers. As supplied, the bright shiny copper sheet is in a half-hard state created by the metal being passed through rollers during manufacture. This half-hard state has helped so far with cutting the material as it resists bending but now we want to bend the copper over the formers so the copper is annealed which removes the internal stresses in the material caused by rolling which has the effect of making the copper soft and surprisingly easy to work.





**Figure 3 - Backhead plate cut out in the firebrick forge ready to be annealed.**

Heat the copper plates to bright cherry red with something like a Sievert propane torch or a plumber's blow torch. Some fire bricks arranged around the plates to reflect the heat back towards the copper makes this process much quicker and uses less gas. Let the plates cool slowly in the firebrick forge for a few minutes and then if you want to speed up the process drop them into water as they need to be completely cold before they get anywhere near the plastic 3D printed formers.



**Figure 4 - Backhead plate being annealed.**

Your boiler plates will now look black and really sorry for themselves as the heating brings the oxides to the surface of the copper and combines with the soot from the propane flame but don't worry the citric acid pickle will clean them up at the end before silver soldering the boiler.



**Figure 5 - Backhead plate and former held in vice with flange beginning to be formed with rubber mallet.**

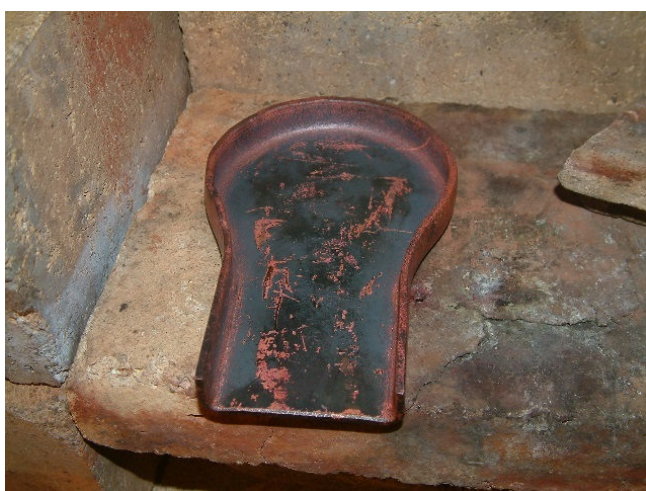
Place the 3D printed former and cut out copper plate in the jaws of a large vice fitted with soft jaws so as not to damage the former or the surface of the copper boiler plate being flanged.

In Alec Farmer's invaluable book he describes a whole range of sheet metalworking hammers which I don't have. I just use a large hard rubber mallet which cost a few pounds from the local DIY shop. Using the rubber mallet, work your way around the edge of the flange being formed on your boiler plate. You will soon notice that after working around the flange with the mallet the copper becomes harder to work. It's time to stop using the mallet as this is an indication that the copper is work hardening due to the material being cold worked and internal stresses are being set up by the dislocations to the crystal lattice structure of the copper atoms you have caused by using nothing more than the force of your mallet! If you continue to force the copper you run the risk of cracking the material which is definitely not what you want for a successful steam locomotive boiler.



**Figure 6 - Backhead plate flange partly formed being returned to the forge for further annealing.**

Remove the boiler plate from the vice and former and anneal it again using exactly the same process as before. Once annealed, refit the former and return to the vice and you will find the copper has become easy to form again using very little effort from your mallet. This process is repeated maybe half a dozen times to get the copper to gradually drape itself around the former. For plates such as the firebox tube plate and firebox back plate there are internal corners where the edge of the rubber mallet can be used to good effect to create the flanges whilst for the external radiiuses the centre of the mallet is used. The rubber mallet does not mark the surface of the soft copper in any way.



**Figure 7 - Backhead plate with flange nearing completion.**

As I was using 3D printed formers for the first time the first plate I flanged was the backhead which was made out of 3mm thick copper, my

thinking was that if the 3D printed soft plastic former withstood forming the 3mm thick backhead then all the other formers would be fine as all the other boiler plates are made from thinner 2.5mm thick copper. All the 3D printed formers worked without a problem, nothing broke and I was very pleased with the flanged copper boiler plates produced. When you look at the finished copper boiler plates in 2.5mm and 3mm thick copper and look at the soft 3D printed plastic formers they were made over it almost looks almost impossible but goes to show what a wonderful material copper is and how it can be worked into intricate shapes with ease if it is kept soft and annealed.



**Figure 8 - Smokebox tube plate, fire box tube plate, firebox back plate & boiler shell work in progress.**

Before the 3D printed formers are removed from the flanged copper plates run a drill down the pilot holes in the 3D printed formers for the positions of the fire tubes and threaded bushes etc. transferring the hole positions as holes through the copper. This is a two minute job and a major advantage of using 3D printed formers as the holes in the copper plates are in exactly the right position without the need for any marking out of hole positions.





**Figure 9 - Backhead plate and former after pilot hole positions have been transferred to the copper plate.**

After removing the formers the copper plates can then have the flanges trimmed to the correct length trimming away the excess material we added when the plates were cut out. This I did using a hack saw with cutting oil to remove the larger amounts of material which was hard work through 2.5mm and 3mm copper followed by a bench grinder to get the flanges to almost the correct depth and then finishing by bolting the plates onto the face plate of the lathe and skimming the flanges down to size and giving them a perfectly flat machined finish.



**Figure 10 - Backhead plate flange excess material being trimmed away with hacksaw and cutting oil.**

The plates were bolted to the lathe face plate to have the various pilot hole drill positions opened up and reamed for the fire tubes and threaded bush positions.



**Figure 11 - Firebox tube plate bolted to lathe faceplate having firetube holes reamed to size.**

Next time I form the inner and outer firebox wrappers using the 3D printed bucks in Part 3.