



**Scratchbuilding  
GWR Bulldog 3343 CAMELOT  
by Tony White**

Published by G1MRA

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The Gauge 1 Model Railway Association's principle objectives are to promote railway modelling in any scale which will involve a rail gauge of approximately 1.75 inches or 45 millimetres, and to bring together persons interested in the construction of Gauge One models, tools and apparatus of all kinds.

Information on G1MRA can be obtained from their web site at [www.g1mra.com](http://www.g1mra.com).

Other books available from G1MRA are:-

### Three books on the construction of G1 locomotives:-

#### The Project Book edition 5 created in 2013

This new version offers improved help to beginners who want to build from scratch. The latest edition of a book which has stood the test of time over 40 years contains almost 100 pages, more colour, up-to-date drawings and more accurate descriptions based on feedback from users of the original editions. Those who want to build this meths fired single cylinder LMS 4F 0-6-0 tender engine will be able to buy some parts from G1MRA suppliers if they wish.

#### The Dee Book

Members who already possess loco constructional skills could move on to the Dee book. This Book contains 96 pages, including full drawings and constructional descriptions to build a live steam SR D class twin inside cylinder tender engine. The loco design can run on meths or gas. A separate book of metric drawings can be purchased, but you will still need the Dee book.

#### The ARM1G Book

Those who may not have the time to work from scratch may wish to choose the gas fired ARM1G, for which most parts are available off the shelf. It is a scale live steam working model that involves very little engineering skill from the builder and is simple to run. The book contains 70 pages including full drawings and constructional descriptions to build a twin cylinder 0-4-4 tank engine.

### Five books drawn from G1MRA Newsletters in the series Modelling in Gauge 1

#### Book 1 - Electric Propulsion

The first book in the Modelling in Gauge 1 series. Draws on articles from 200 Newsletters to bring you the collective experience and wisdom of G1MRA members on the subject of Electric Propulsion. Motors, gears, locos, bogies, controllers, batteries, tracks and much more.

#### Book 2 - JVR's Contribution to Gauge 1

This book draws on the many articles and letters written by John van Riemsdijk that have been published in more than 200 Newsletters over a 50 year period. John's work is legendary. Many of us will know of his input into the design of the many Aster locomotives running throughout the world. His work is published in this volume of over one hundred pages, including photographs and drawings.

#### Book 3 - Freight Stock

A compilation of articles on Freight Stock that have appeared in Newsletters since 1963.

#### Book 4 - Coaching Stock

A compilation of articles on Coaching Stock that have appeared in Newsletters since 1963.

#### Book 5 - Coal Firing

A review of Coal firing in G1 edited by Charles Simon and with input from across Europe.

Printed by North East Surrey College of Technology (Nescot)

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## Introduction

In this book Tony White explains the way he translates extensive research on full size build variations into a finely detailed scratch built model.

When the Gauge 1 Model Railway Association (G1MRA) was founded in 1947 most locomotives were scratch built, because there were very few commercial engineering companies producing G1 models. The early G1MRA Newsletter & Journals (NL&Js) had many articles from members about aspects of scratch building.

G1MRA has published three previous books on building a G1 locomotives. The PROJECT and DEE books provide an proven design that requires workshop tools. ARMIG took a different approach, as explained in the introduction "In recent years the model trade has made available components for Project, DEE and other published designs that allow the builder to make only what they are equipped and skilled to create, and buy the rest. ....which means the lathe and mill in the workshop might not be needed by everyone who would like to build their own Gauge 1 locomotive. ARMIG aims to build on these changes by providing a design that is intended to be assembled from components you can buy.....Which is why ARMIG is the other way round to build a Gauge 1 locomotive."

Today you can use these available components as short cuts in the scratch building process where they save time, as you will discover Tony has done. However, as you will read, there are no short cuts to the research needed to create your special locomotive.

Editing these books always gives me an 'ahah' moment when I suddenly realise why something so simple works, Tony provided one with the three point suspension diagram in Chapter 3 on page 20. It reminded me of JvR's Type J bogie [Modelling in G1 - Book 2 page 63], which also uses a 3 point geometry approach to avoid springing individual axleboxes.

I hope you enjoy this book and it encourages you to explore your way into the world of G1. People often think G1MRA is just about live steam, but there are many electric G1 locos around nowadays, with an increasing number of commercial models available. These provide an easy route into G1. I use mine to provide instant interest to visitors who are surprised to find a railway in my back garden. Wheelsets and motor/gearbox assemblies are available commercially. So if you are inspired by this book to try G1 scratchbuilding you will find, as Tony comments overleaf, a wide group of G1MRA friends and suppliers to help you solve any problems that arise.



Martin Hulse (G1MRA member 584)  
G1MRA Vice President

# Acknowledgements

It is important to recognise the contribution made to the writing of this book by people who influenced and taught me the skills and techniques that I describe. Without their help none of this would have happened.

It began over sixty years ago when I was at university and met Stewart Hine. He introduced to me to finescale 2mm at a time when to build a locomotive you made everything including the spoked wheels and motor, and you had to do it without a workshop full of machine tools. It was the lessons learned then that enabled me to make things in a very small scale. One of my later Gauge 1 locomotive tenders has opening tool boxes with working hinges and clasps! Once when visiting him I saw his Gauge 1 Bulldog under construction and was intrigued although it was then way beyond my skill level.

Later when I moved to Bristol he asked me to take something destined for Pendon to Guy Williams who lived in the same village. We subsequently spent many a happy session in his workshop, and he showed me how he made locomotives in 4mm scale for Pendon and how he used a very basic lathe. During this time, he once had in his workshop a Gauge 1 model that a museum had asked him to repair. I was tempted to try the scale but had no money or time although I felt I had enough knowledge to maybe try when the time was right. When I later moved away Guy very kindly gave me a finescale scratchbuilt 4mm GWR 4-4-0 'St Anthony' and for the second time I was inspired by this class of locomotive.

Some twenty years ago when I retired and finally had time I joined G1MRA and took my first steps in this larger gauge, although I also dabbled in 2½in, 3½in and 5in gauges. G1 was a scale that lent itself to really finescale models that could run alone without the need to build a matching piece of finescale countryside. And it had the potential to combine all that I had learned about model engineering and making detailed fittings that required a magnifying glass to appreciate.

I built from scratch and rebuilt some old live steamers, coal and spirit fired, adding detail and gaining experience. Several were GWR 4-4-0s, but I had never previously considered making an electric powered loco in this scale using all the techniques I had been shown in smaller scales. Later I needed to show grandson Isaac, who visited every few days, how things in my workshop worked as he was fascinated by watching me repair his toys when broken. He was too young to be near the lathe or milling machine in action, but he could sit on my knee and help solder things.

Hence the birth of the idea for this locomotive. I had a lot of parts suitable for a Bulldog in 1/32 scale, even a suitable spare tender, but what should it be called? There was no GWR 4-4-0 called 'Isaac' so reading through the names when I came to 'Camelot' it was obvious. Isaac had been my lucky lottery winner in life.

So together we began construction but I realised that when he inherited it, if it went wrong, he would never remember how we made it. I made copious notes and took many photographs and even wrote a leaflet on taking it apart. From those notes a few articles appeared in the model railway and model engineering press, but it was suggested that the whole thing might be published as a book.

The idea instantly appealed. Here was the definitive guide to go with Isaac's engine so that it could always be maintained or repaired. I had no idea how to pursue these suggestions and here I have to thank David Halfpenny and Martin Hulse for their contribution and encouragement in helping convert notes to book. Thanks also to all the members of G1MRA. When I asked about some incomprehensible detail or query someone always came up with the required answer or a rare close up photograph. Some contributors who are separately acknowledged have provided such abundant material without which neither the book nor the model would have been completed. In addition named friends have successfully made parts after I have repeatedly failed to get it just right.

I am also indebted to a most valuable contribution made by Martin Evans, Editor of the Model Engineer, who kindly gave permission for some of the drawings that appeared in the series of constructional articles on a 5inch Bulldog/Dukedog by the late Keith Wilson between 1978-1982 to be used, as although my notes were extensive, I made few proper drawings, only quick sketches.

This locomotive and this book are truly a team effort and whether you scratchbuild an outside frame engine or a simpler inside framed class, maybe you will be inspired to have a go and perhaps find ideas that you can use. If so our efforts will not have been wasted.

Tony White (G1MRA member 1865)

# GWR Bulldog 3343 Camelot

## The finished engine.



Number or mark the axle boxes and their respective slots and check that they all fit and slide smoothly to the top of the slot. A cross piece will need to be added at the bottom of the slot to stop it falling out, but I will explain that later.

Check with a scribed line on the back of the frame for the axle box centreline. The angle iron (brass in this case) can be added either side of the box and the result can be seen in the Fig 2-9. Once happy with this, it's just a case of tidying up all the parts for the remaining three assemblies and adding them to the frames. But do complete one frame before starting on the second.



Fig 2-9 Angle iron for bearing surfaces of axle boxes



Fig 2-10 Basic assembly up and running with bearings all fitted and temporary stretchers

### Bogie Frame Tests

Before proceeding to the cross members, I made plain but temporary rectangular stretchers for the front and rear, just tack soldered to ends of the frames in order to test clearances between the fronts of the wheels and the backs of the frames, see Fig 2-10. As a result discovered that I didn't have anywhere nearly enough width within the bogie to accommodate the wheel sets, although the problem was easily solved as I shouldn't have left the shoulder on the axle ends (see Fig 2.5) and by turning off this shoulder and deepening the bearing holes in the axle boxes suddenly the bogie width was correct. When completed and fitted this now left a 0.5mm clearance or side play on the wheels that could if it proved a problem be filled with a thin washer, although this has never been done.

There remained just a couple of jobs to do: make and fit the earlier mentioned cross pieces to go at the bottom of axle box slots, and design some hidden means to prevent the axle boxes dropping to the bottom of the slot when the locomotive is lifted off the track. The first is pretty obvious and cosmetic: the second proved something of a problem. Although there are a number of options, the main difficulty with them all was moving the cross piece to one side allowing the axle box to slide into the slot.

In the end I settled for a strip of 1mm x 1mm N/S flat behind each frame that fitted across the bottom edge of each axle box soldered at the centre as in Fig 2-11 that prevents the boxes dropping out. However, when the ends of this beam are prised centrally (at the arrow point) away from the frame, the axle box can drop down and out of the frame because there is very little of the box protruding on the inside of the frame. But don't make the bar so long it doesn't clear the axle itself.

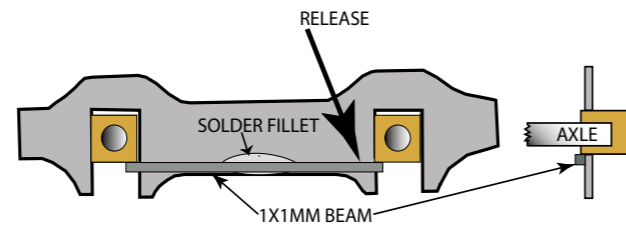


Fig 2-11 1mm N/S bar soldered at centre of inside of frame to stop axle box dropping out

To prise the beam out in this way is difficult to access even with a small screwdriver so I made a tool shown in Fig 2-12, a strip of steel glued in a wooden handle that is just thin and strong enough to move the end of that beam clear of the axle box and this makes maintenance so much easier. It was at this point that I decided the loco should have its own special tool box.



Fig 2-12 Tool to aid removal of bogie wheel set

After fitting this holding strip, the actual gap for movement between the spring central block and top of axle box is about 1mm. This can be filled with a tiny coil spring, but you'll need to drill a small recess in top of each axle box to hold it in position. The alternative is a small disc of soft rubber glued to the top of the box, although for a long time I ran the loco without anything in the gap and the bogie gave no problems.

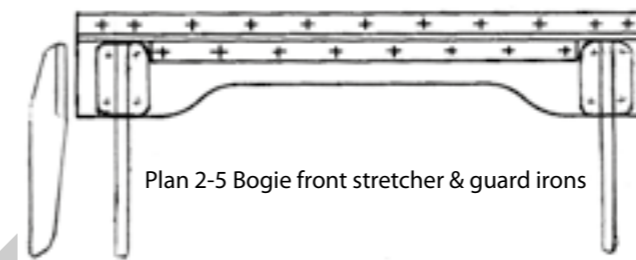
### The Bogie Cross Members (Fore and Aft)

We can now move onto constructing the cross members that hold the bogie sides together or apart! It is probably helpful at this point to explain that there were two types of bogie interior design: an older type characterised by the appearance of the two suspension springs below the central member of the frames and a more modern type copied from the French Atlantic's bogie. I wasn't sure which to go for as I hadn't yet decided on the name and number of my prototype, but I ended up making an approximation of the later type.

I decided to complete the basic box structure before worrying about the central parts that would contain the mechanism for pivoting the bogie under the loco for the reasons shortly discussed. The front stretcher is basically the trial one I already had fitted but shallower and shaped at the lower edge, although detail needed adding using strips of T or L brass strip and of course the guard irons. See Plan

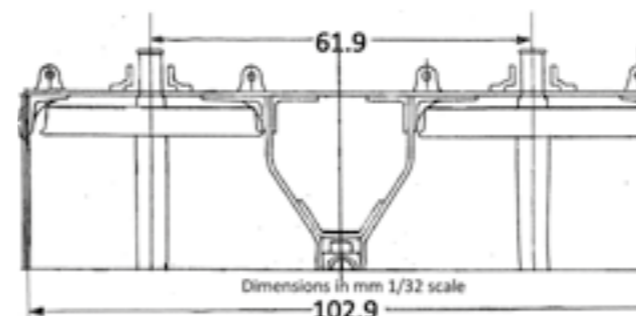
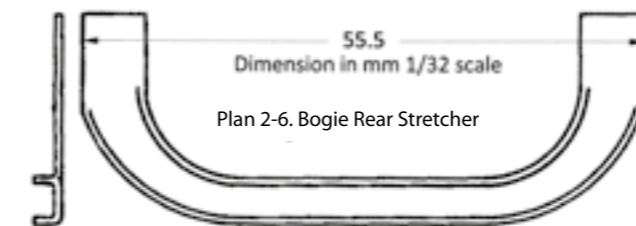


Fig 2-13 Bogie showing U shaped rear stretcher and plainer front stretcher



2-5. Do put the guard irons on if possible while the cross piece is in the flat. I forgot and ended up having to add them when everything was up and running. It's then a real pain to hold them accurately for soldering, and do check they line up with the rails.

The rear is a flattened U shape, so designed to allow clearance in the prototype for the connecting rods and valve gear as well as part of the frames, and is shown in Fig 2-13. It was made by cutting an outline shape from 0.5mm N/S (see Plan 2-6) and then soldering on two strips of 2mm x 0.5mm N/S as shown in loco drawings and photographs I have of a prototype. These later were available to view on the Bluebell Railway website, but no longer seem to be accessible. There are some nice external photographs of the bogie at [www.gwr.org.uk/no440s.html](http://www.gwr.org.uk/no440s.html) as well as other photographs of GWR 4-4-0s.



Plan 2-7 Bogie half plan

Both front and rear stretchers can have angle soldered into all four corners to match the prototype, but to be honest you just cannot see them even if you remove the bogie, as the wheels totally obscure the view into the corners. See Plan 2-7.

### The Pivot Mechanism (Centre) of Bogie

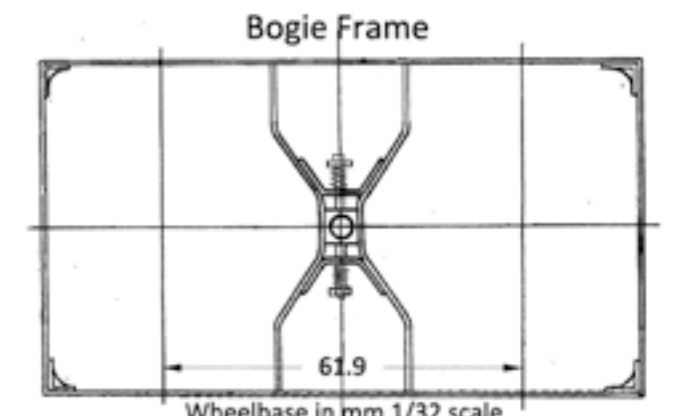
The central arrangement in the prototype Fig 2-14 and Plan 2-7, traced from a massive Swindon drawing, shows just the essential features that require modelling. The central cross arrangement for the model bogie I made is shown in Fig 2-15 and Plan 2-8, being made from pieces of 0.5mm N/S cut and bent to size from your drawing and soldered in position as shown. It is basically two long transverse pieces bent to shape with two inner pieces that have a hole drilled in them for the springing



Fig 2-14 Bogie centre arrangement in prototype



Fig 2-15 Construction of the central cross pieces of the bogie



Plan 2-8. Plan of model bogie Frames and Central Pivot Mechanism



Fig 5-6 Spring subassembly with parts below running plate shown



Fig 5-7 The same spring subassembly in position showing the position of rods from spring shackles, dampers not yet fitted at lower ends

were made more easily by turning down a length of 1/4in nickel silver to 5.6mm diameter and then parting off 3.4mm lengths. I chucked each one in a watchmaker's 7/32 in collet and centre drilled them, cut the outer face down to 5.0mm diameter for 0.7mm. Then angled the face for the outer half of its diameter, before turning the piece in the collet to round the top edge see Fig 5-8.

I prefer to make these small parts in the watchmaker's lathe as you can sit down and see and control what you are doing more easily. I put them in the box of made parts ready to place on the rods. When I am at the stage of final details I will place each one on its rod and finish it off with two 12BA nuts (a sliding fit on the rod), and will either glue or solder them in position. Photographs Fig 5-9 a & b taken later show the idea.



Fig 5-8 Shock absorber fitted but two retaining nuts not yet added



Fig 5-9 a & b Two nuts below spring dampers and close up below



## Chapter 6 Cab and Firebox

### Cab

We now start some quite simple sheet metal work. Initially this is just cutting two sides and a front to size and using a drill and piercing saw to create windows and front lookouts, finally filing to shape and size.

I perhaps should stress that at this stage we are not building the complete cab, just the outside in order to enable us to line up the firebox and boiler assembly but we can add a few more features than just rivet embossed detail. I added the scaled 3/4in split brass tubing over front and rear of edges to form the beading. This would mean splitting brass tube 0.6mm diam in the middle so I cheated and used 0.6mm brass rod soldered directly to the edges, having reduced the dimensions of the side to allow for this. The preliminary results for the sides are shown in Fig 6-1. I left enough spare at the lower edge to reach the top of the cab handrail.



Fig 6-1 Two cab sides not yet finished

Do make sure that you add as much detail to both the sides and front while you can still work on the metal in the flat because it makes that work so much easier. By those features I mean the beading around the cab sides, holes in sides for the short handrail, the frames around the front lookouts, (assuming your modelled prototype still has them, although if not they would still be visible plated over), and I always think it's worth adding the number plates now.

You can measure, position and solder the plates on so much more easily while the sides can be laid flat although many will delay that until just before or after the model is painted. If doing the latter use glue, but I do like everything to be serviceable so I bolt mine on. It also provides a means should you later decide to change the identity of the loco. But more relevant, you have plates that go on after painting, the brass edges thus remain free of paint and you can take them off occasionally for a quick polish.

It's not difficult to do the bolt on method using a 12BA brass C/S screw soldered to the centre of the back of the plate,

that fits into the hole in the cab side with the nut holding it in position. You then have no worry about gluing it in the wrong position, or out of alignment, can put it on after painting, and can even, as previously suggested, change the name and number.

Mark a circle at the centre on the rear of plate, stand the brass C/S screw in the centre and setting up something to hold it firmly in position just solder it. Soft solder will do but silver solder using a small amount of SS paste is a lot securer. Make sure the area surrounding the screw is clear of solder or debris, countersink the hole in the cab side and it will sit nicely flush when tightened up. If it doesn't, sort it now, not later when the cab side cannot be laid flat.

We can now turn to the front. Don't forget that part of the outer lower edge needs to be removed so that there is a gap for the splashers and springs. See Plan 6-1 and Fig 6-6. I found it difficult to measure accurately from any of the available drawings, so I made the openings under size and opened them out later with needle files when I was able to try it over the splashers and springs. The outside part at the bottom ends up very thin, and so it is a lot safer finishing this part when the cab sides are in position to stop the thin 'limb' bending.

Much the same applies to the cab lookout holes if still present at your model's date. Drawings tend to be a bit vague as to position but they require an insert 6.1mm internal diameter and 7.8mm external diameter turned from brass rod. Their external diameter is given as 9.75 inches and their centres are 17 inches off centreline. These are measurements that can be read on the Swindon Bulldog drawings. I'm not sure of the other dimensions but I made mine proud of the front of the cab by 0.5mm. The cab spectacles have a frame but it's mounted on the inside, so if you want to model it, now is the time to add it, although I have to confess that when all is finished it is almost impossible to see. The most important thing to watch is that at the front they clear the angle running all around the firebox.

Once you're certain all the rivet and other details on cab sides and front are sorted the sides can be soldered to the front. This presents a slight problem as all photographs show that the side sits slightly ahead of the cab front, but by how

