THE HOME OF GARDEN RAILWAYS

G SCALE SOCIETY

Journal Extracts

Getting Ready for Live Steam

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An Introduction to Live Steam

by Mike Gray

G Scale draws mainly on track and battery power, and I for one have no desire to seriously stray from this path. You can sit back, mug in hand, and just watch your trains run. With DCC power, the locomotives can make all sorts of bells and whistle noises, literally in some cases. But I also have a fondness for live steam locomotives, and I have found recently that this is shared by a surprising large number of G Scale Society members.

What is the attraction, yea fascination with live steam? I must confess I have struggled to find the words to describe the 'why'. I suppose the rationale offers parallels to why there are so many preserved steam railways in the UK, plus larger gauge model ride on steam operated club tracks and so on. There is that feeling of something alive, something more than a cold machine. A bit of a challenge!

I will freely admit that live steam presents a set of specific requirements for locomotive preparation and running. I will skip some of the technicalities, but here are a few basics. Once you have a loco, you need three fundamentals: oil, water and fuel.

Oil

Steam oil, more viscous than general household oil. It thins down to the right consistency with the heat. Do not substitute 3-in-1 or similar unless you fancy a seized set of cylinders!

Water

Just like the real thing water is best pure, otherwise dissolved solids will deposit in the boiler and pipes and ultimately ruin the steaming. If you live in a soft water area good. Otherwise, I recommend distilled water or water from a dehumidifier. Filtered water off a roof is used by some, and I have tried it (it is cheap), but I have found it still leaves deposit in the boiler and pipes.

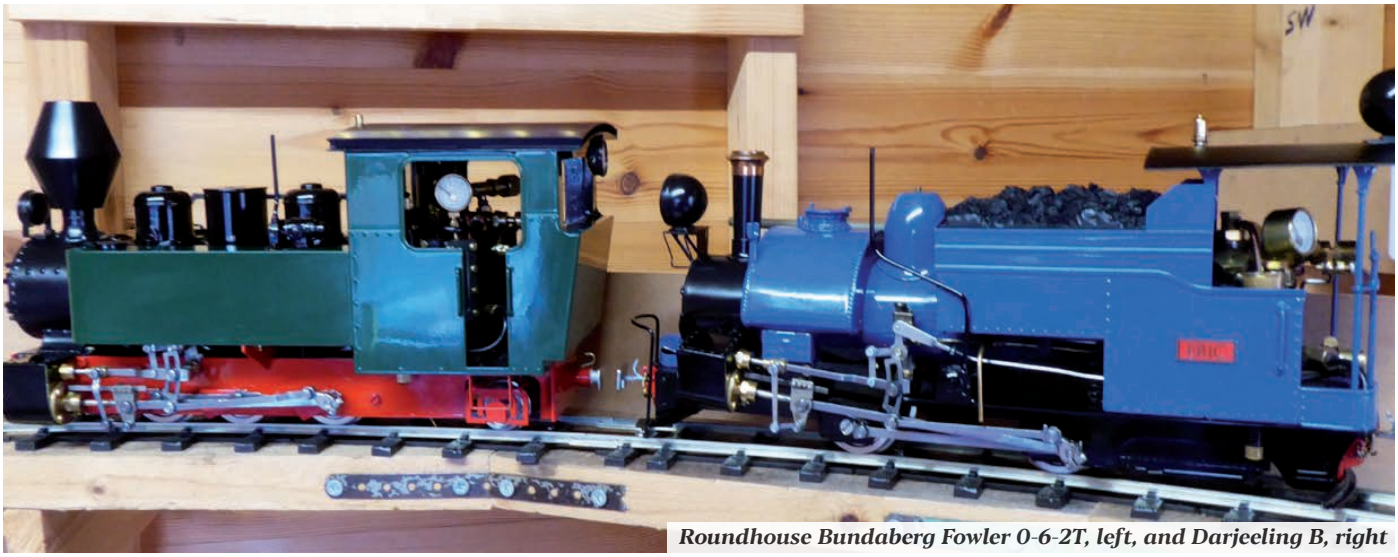
Fuel

The most common fuel these days is gas, either butane or, in cold weather, a mix of butane and propane. These are commonly available for use in camping stoves and the like, but the emphasis is on a butane rich fuel. Do not use pure propane.

There are some well-known alternative fuels. Methanol (meths) has a long history but needs careful handling to avoid spills and has a near invisible flame on a sunny day outdoors. Mamod (MSS) solid fuel tablets were a good alternative until recently banned as potential source of explosives for terrorists, a directive that has many of us head scratching! A substitute gel is now available, but I have not tried it yet. Last is coal firing. Obviously, you need the right sort of boiler and firebox. These are available but maintaining a coal fire on this small scale is demanding. One for the patient, experienced and dedicated enthusiast.

One common feature with all fuel combustion types is the need for ventilation. Outdoors is best but a through flow of air if indoors is essential. People get concerned about fuel fumes, especially butane, and certainly you should be aware of the danger. However, the most dangerous combustion product is carbon monoxide, even though most of what comes out the chimney is water vapour (steam) and carbon dioxide. You would not, or absolutely should not, light a charcoal BBQ in a closed unventilated space. The same applies to miniature steam locos even though they produce far less fumes than charcoal BBQs.

But first you need to get a live steam locomotive. Option one is simply to buy a new one. There are two main commercial sources in the UK: Roundhouse in Doncaster and Accucraft, now distributed by Maxitrax in the UK. One can buy direct from the maker or an agent, or there are



Roundhouse Bundaberg Fowler 0-6-2T, left, and Darjeeling B, right

Roundhouse 32mm gauge Taliesen as lined out by Matt Acton of Berry Hill Works

several retail stockists, many of whom advertise in our Journal. Garden Rail magazine is another useful source of information.

As a start, Roundhouse offers a range of very nice little steam locos in their Basic Series at prices around a half to a third of the cheapest locos in their Classic Series. They also offer kits at lower prices. Although MSS (Mamod) has recently closed, models are still available from many retailers. They are simpler in construction and a relatively cheap entry level way into live steam.

Option two is buying second-hand. Tag Gorton, the doyen of live steam railways, has a good deal to say about buying used locos (see Bibliography 3). Off the shelf locos from the main manufacturers retain their value well, if they have been looked after and are in good condition. Tag advises caution against snapping up too cheap a bargain unless you critically inspect the loco, and preferably see it run. If in doubt take along an experienced live steam enthusiast. The live steam world is very social, and advice and help is always forthcoming, if requested.

Most locomotives are available in either 45mm or 32mm gauge. Many live steam garden lines are to 32mm gauge. This equates to 2-foot in the common UK scale of 16mm per foot, but 45mm track is more stable and preferred by many, not least for G Scale. Many locomotives can be adjusted between the two gauges. For example, the Roundhouse Darjeeling B is adjustable simply by moving the wheels along the axles using locating screws and a back-to-back wheel gauge. Conversely, the Roundhouse Taliesen (Ffestiniog Railway 0-4-4T) is only available in 32mm gauge. You might also need a 45/32mm pony axle set as well. The same applies to tender locomotives where axle or bogie gauge change sets will be required if you want the gauge change option. The key point here is that if you are buying a

Mike's Darjeeling B on the 32mm track and a Roundhouse Katie on the 45mm track at the Grimsby and Cleethorpes MES Garden railway at Waltham Windmill

loco, whether from the maker, a retailer or privately, make sure its set to 45mm gauge if that is what you want to run, or is adjustable and comes with the necessary accessories for ponies or bogies where applicable.

You should also be aware that some longer wheelbase locomotives cannot negotiate tight curves. A limitation you may need to consider as G Scale R1 curves are only 600mm radius.

If your locomotive is fitted with Radio Control, you will also need good high-power batteries in your 'kit'. RC is fun and driver demanding on layouts that are not level. Nevertheless, I have seen and run manual throttle locos that are quite happy to run steadily round most tracks.

The next issue is boiler testing and certification. The miniature locomotive regulations (References 1 and 2) apply to boilers under 3 bar litre capacity. That is, the volume times the working pressure in the units stated. In addition, if the loco is gas fired the gas tank must be under 250 ml. None of the miniature locos I own or have tested, commercial or privately built, come anywhere near those limits, but it is important that the maker or supplier has pressure tested the relevant components to the defined levels and provides signed certification to this effect. New locos should come with this as a matter of course but if buying second hand it is best ask for the original or reputable retest certificates. If these are not available, question whether you should be buying the loco as boiler defects might not be immediately apparent.

If you are running in the privacy of your own garden (or shed with the door open) you may do what you please but making sure that pressure vessels, even small ones, are sound through hydraulic and steam testing is good engineering practice. Just one notch above common sense. Plus, an increasing number of clubs and societies require production of certificates prior to running, especially when the general public is admitted to shows, open days, and meetings. It is best to have certificates and keep them up to date. Facilities exist within the G Scale Society to do this.

One more detail. Flange depth on miniature steam locomotives are usually 2mm, in contrast to the approximate 3mm of G Scale wheels. Strictly speaking they are designed to run on finer rail than the heavy-duty brass rail of most G Scale layouts, or on Peco G45 track. However, I have never found a problem running on G track, even over pointwork. Having stated this, I would nonetheless urge caution the first few circuits. Even a poor rail joint on any track type can put your loco 'on the ground'.

Finally, remember that steam locomotives get very hot. You should have handy a pair of insulated gloves with a decent grip, and post signs to warn spectators not to touch the locos while under steam. This may sound very complicated, and yes it does take a bit of effort. But it is very satisfying once you have mastered the art and figured out the characteristics of a loco and how to make it run at its best. They all behave differently, just like the real thing!

References and Select Bibliography

1. The Boiler Test Code 2018, Volume 2 – Boilers under 3 bar litres, effective from 1 May 2018.
2. The Boiler Test Code 2018, Volume 3 – LPG tanks under 250 ml, effective from 1 May 2018

If you wish to read further on this topic I recommends the following publications (all out of print books are readily available second-hand):

3. Tag Gorton, *Steaming in Your Garden*, Atlantic Publishers, Southend-on-Sea, 2006 (ISBN 1 902827 13 9). A comprehensive general survey, Part of a Garden Rail Magazine series, with information on the history of miniature live steam, and very helpful advice how to operate miniature locos (including coal firing for the adventurous) and what to look out for when buying, both new and second hand.
4. Marc Horovitz, *A Passion for Steam*, Calpac Trading Company, Union City CA, USA, 2014 (ISBN 978-0-692-23826-4). By the founding Editor of the US Garden Railways magazine. Like Tag Gorton's book this is very useful survey of miniature steam locomotive technology including numerous diagrams and photographs. The second half of the book is devoted to descriptions of the many different types of locomotive in his collection from many different commercial and hand built sources. The majority of the latter from the UK, but some built by Marc himself. A fascinating read.
5. Peter Angus, *Peter Angus – Locomotive Builder*, Camden Miniature Steam Services, Frome, Somerset, 2015 (ISBN 978-1-909358-20-1). A remarkable book from the doyen of individual UK makers. With some 300 locos listed at the time of publication of this book, Peter and his associate Mike Lax could scarcely be described as minor custom builders. Chapters on early days and techniques are followed by well-illustrated descriptions of individual locomotives, many to unusual designs and layouts. Peter seems to have liked a challenge. Mouthwatering, but you would need especially deep pockets and patience if you wish to obtain a locomotive from this stable.
6. Brian Wilson, *Steam Trains in Your Garden: Building Your Own Live Steam Locomotives and Rolling Stock*, Camden Miniature Team Services, Frome, Somerset, 2015 (ISBN 978-1-909358-12-6). This is originally an Australian book (Australian Model Engineering Magazine, 2007). The book focuses more on scratch building than the others and has a lot of constructional drawings and diagrams, including making your own boiler. I have a corresponding friend in Brisbane with a garden railway who tells me that commercial items are difficult to obtain there and expensive, so scratch building is more usual than perhaps in the UK where it is common for builders to at least purchase components commercially, such as cylinders and boilers from Roundhouse for example. Even if you are not intent on building a locomotive yourself, there are lots of interesting detail that would be useful when adjusting or maintaining commercial models, or just to better understand how a miniature steam locomotive is put together. There are short chapters on operating techniques, and the book finishes with instructions for making rolling stock, again from scratch.
7. Peter Dobson, *Live Steam Model Locomotives Vol. 1 – 16mm Narrow Gauge*, Nelson & Saunders Publishers, Olney, 1985 (ISBN 0 947750 01 0). A survey of around 70 locomotives from pioneer builders, such as Archangel (Stewart Browne) and current makers, such as Peter Angus. A few early Roundhouse models feature: a Lady Anne (then an 0-4-0T) and a very recognisable 0-4-0T Dylan, recently reissued as a limited production run. Its apparent that later and current makers took forward designs from several of these pioneers. Inspiring, though some prices will make you weep! There is no Volume 2.

Boilers:

One or Two Points to Note

by Janet T Royston

There has been quite a bit said about live steam recently and I do not intend going over the same ground that has already been published in the Journal. However, I attended a 'Seminar for Boiler Inspectors' at the request of the Society, and I think there are one or two little bits of information that I picked up that are worth passing on.

Most of us buy professional/commercially made model steam engines in G Scale, so this is where I shall begin. When a new boiler is first made it undergoes a test known as a 'Shell Test'. This is for a completed boiler without any fittings. All the fitting holes are blanked off and a hydraulic test is applied up to twice the intended steam working pressure and left for ten minutes. This test is **NEVER** repeated after the boiler has been in steam. Once the boiler has been fitted into a loco and steamed, any future hydraulic test would be carried at one and a half times the working steam pressure on the system, not just the boiler shell but with as many of the fittings as possible being tested. This is a 'System Hydraulic Pressure Test'.

When a boiler is in steam, it is important that the safety valve, or in some cases valves, are adequate in releasing any excess pressure. To do this the boiler is heated as hard as possible continually. This is the 'Safety Inspection and Steam Accumulation Test'. The system is checked for any sign of leakage or problems but most importantly that the safety valves have the capacity to prevent the steam pressure going above 10% of the working pressure. While we are talking about the pressure, it is important that the pressure gauge is functioning correctly. Some cheap ¾-inch diameter gauges have been found to be almost 50% out. If in any doubt, it is a good idea to have it tested against a calibrated pressure gauge. Most model engineering clubs will be able to assist in this respect.

In addition, in gas fired locos, the fuel reservoir is a pressure vessel as well and this also will have been tested when it was built. The testing is somewhat different, but this will be recorded along with the boiler information in the documentation provided by the manufacturer of the model. It is important that all the documentation is kept from the original purchase together with any further testing that has been done during the life of the engine. If you are buying a second-hand locomotive, the paperwork should be present, usually found at the back of the operating manual. If the paperwork is not available... 'BUYER BEWARE'. Without this history of the locomotive, you could be entering a minefield!

Attached is an example certification page, which came with my own Roundhouse Sandy River & Rangely Lakes steam locomotive. It clearly shows you all the information on the construction and testing, before it left the factory.

I hope this has been of use to the membership.
Live steam is nothing to fear. All that is needed is an understanding of these simple rules and the enjoyment of driving a real engine is readily at hand. Enjoy your models and keep safe.

ROUNDHOUSE

ROUNDHOUSE ENGINEERING CO. LTD.
Units 6-9 Churchill Business Park. Churchill Road.
Wheatley. Doncaster. DN1 2TF. England
Telephone 01302 328035 Fax 01302 761312
Email:- mail@roundhouse-eng.com
www.roundhouse-eng.com

EC Declaration Of Conformity

I hereby declare that the model described:

Model: **S.R. & R.L. #24** Serial No.: Bec 13121

Conforms to the Pressure Equipment Directive 97/23/EC
All components and assemblies have been designed and manufactured according to sound engineering practice (SEP)

Description and specification of equipment covered

Steam Generator and associated pipe work and fittings

Model: **Type 10 boiler** Serial No.: 080421 I

Boiler Material: **Copper** Test date: 08.04.21
Test pressure: **5.4 bar**
Volume: **350 ml**
Max working pressure: **2.7 bar**
Safety valve set pressure: **2.7 bar**
Maximum filling volume: **317 ml**
Year of manufacture: **Same as 'Test Date'.**

Vessel for Group 1 gasses and associated pipe work and fittings.

Model: **Type 'B' gas tank** Serial No.: 070421 I

Test pressure: **34 bar** Test date: 07.04.21
Volume: **30.35 ml**
Maximum permissible working pressure: **17 bar**
Maximum working temperature: **65 degrees C**
Intended use: **storage of Liquefied Petroleum Gas (LPG)**
Year of manufacture: **Same as 'Test Date'.**

Signed

R. Loxley (director) Dated 07.05.21....

Roundhouse Live Steam 'Sandy River & Rangely Lakes' No 24

Boiler Testing: *Awkward Exceptions*

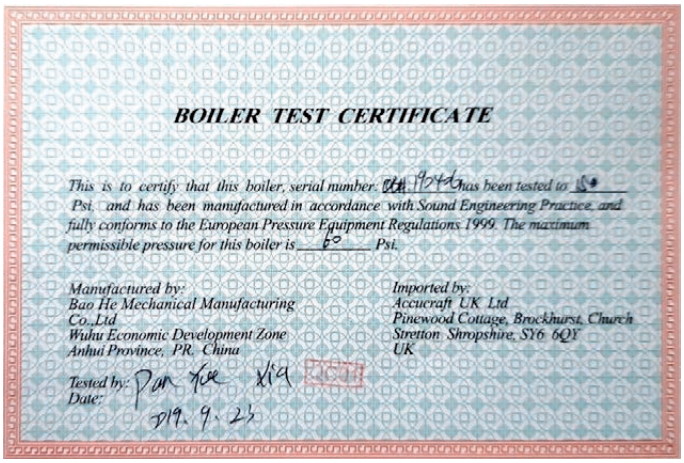
by Mike Gray

Janet Royston, in her article on boilers in the Summer Journal, p.34, raised several good points about miniature steam locomotive boiler testing, from the initial twice working pressure hydraulic proof test to the regular periodic steam testing. That the two-times test is required only once, as part of the locomotive certification, is true most of the time but there are circumstances, mercifully rare, when this twice working pressure test needs to be repeated. These are:

1. If a boiler is modified.
2. If a boiler is damaged and repaired.
3. If the original boiler certificate has been lost and needs reissuing.

This last exception adds weight to Janet's caution about buying a locomotive without accompanying paperwork. For public running, it will be necessary to repeat the full boiler hydraulic test, and the full test for the gas tank too if one is fitted.

Janet illustrates a loco certificate using a Roundhouse Sandy River example (for boiler and gas tank). The Sandy River is a joy to run as its boiler is large relative to the gas tank capacity, and it can be operated with only sporadic water level checks and top up. The Roundhouse documentation is complete and contains all the information required in the steam test form as specified in Volumes 2 & 3 of the Boiler Test Codes 2018 (see 'An Introduction to Live Steam', Journal Spring 2025, pp.10-12). Page 2 of the associated steam test form is shown below. This form, for boilers under 3 bar litre and gas tanks less than 250ml



BOILER TEST CERTIFICATE

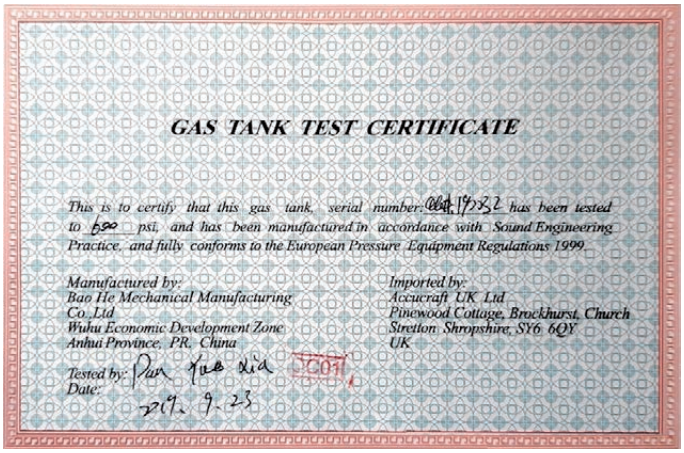
This is to certify that this boiler, serial number: [illegible] has been tested to 150 Psi. and has been manufactured in accordance with Sound Engineering Practice, and fully conforms to the European Pressure Equipment Regulations 1999. The maximum permissible pressure for this boiler is 60 Psi.

Manufactured by:
Bao He Mechanical Manufacturing Co. Ltd
Wuhu Economic Development Zone
Anhui Province, PR. China

Imported by:
Accucraft UK Ltd
Pinewood Cottage, Brockhurst, Church Stretton, Shropshire, SY6 6QY
UK

Tested by: Pan Yue Xia
Date: 19.9.23

Accucraft Sabrina's Boiler Test Certificate



GAS TANK TEST CERTIFICATE

This is to certify that this gas tank, serial number: [illegible]2332 has been tested to 600 psi, and has been manufactured in accordance with Sound Engineering Practice, and fully conforms to the European Pressure Equipment Regulations 1999.

Manufactured by:
Bao He Mechanical Manufacturing Co. Ltd
Wuhu Economic Development Zone
Anhui Province, PR. China

Imported by:
Accucraft UK Ltd
Pinewood Cottage, Brockhurst, Church Stretton, Shropshire, SY6 6QY
UK

Tested by: Pan Yue Xia
Date: 19.9.23

Accucraft Sabrina's Gas Test Certificate

Certificate of Hydraulic Test

Small boilers with a pressure-volume product below 3.0 bar litre
Liquefied Petroleum Gas (LPG) gas tanks below 250 ml capacity

Certificate Number
.....

Model Details							
Description of model		Date of manufacture if known.		Builder/ Manufacturer		Owner/ User	

Boiler Technical Details			
Boiler Identification		Working Pressure (P_W), bar	
Boiler Volume (litres)		Bar litre product	
Materials used, e.g. copper, brass		Boiler type	
Maker (if known)		Construction date (if known)	

Gas Tank Technical Details			
Gas Tank Identification			
Gas Tank Volume (litres)		Fuel: butane only / butane propane mix	
Materials used, e.g. copper, brass			
Maker (if known)		Construction date (if known)	

Initial Hydraulic Test (2xP_W)					Second Hydraulic (System) Test (1.5xP_W)					Gas Tank Hydraulic Test (400 psi)				
Test result	Pass		Fail		Test result	Pass		Fail		Test result	Pass		Fail	
Date					Date					Date				
Inspector (Name)					Inspector (Name)					Inspector (Name)				
Inspector (Sign)					Inspector (Sign)					Inspector (Sign)				
Witness (Name)					Witness (Name)					Witness (Name)				
Witness (Sign)					Witness (Sign)					Witness (Sign)				
Expiry date (if applicable)					Expiry date (if applicable)					Expiry date (if applicable)				
Test location					Test location					Test location				
Comments					Comments					Comments				

Gas Tank Test Pressure: 400 psi regardless of whether butane or a mix with a maximum propane content of 40%

Conversions: 14.5 psi = 1 Bar, to be used to when calculating the bar litre product

Issuing Club/Society and Organisation (strike through those not applicable)					
16mm NGM	G1MRA	Midland Federation	MPBA	Northern Association	Southern Federation

Small Boiler/Gas Tank Certificate 2018	Page 2 of 2	

capacity, is used widely by model engineering societies and by the G Scale Society.

As could be seen, the comprehensive Roundhouse documentation contains all the data required. Not all makers' certificates are so comprehensive. The Boiler Test and Gas Test certificates for an Accucraft Sabrina are shown left. This loco is owned by a friend, and I have performed steam tests on it several times. From observation and experience, these locos are professionally made and run well. The manufacturer's boiler and gas tank hydraulic tests exceed the 2018 Code requirements (twice working pressure: 120 psi, and 400 psi respectively). But neither the boiler nor the gas tank volumes are stated. As both are required on page 2 of the Steam Test Form, what to do?

The boiler volume is relatively simple. I carefully empty the boiler then fill it using a graduated syringe. Once the volume 'injected' is recorded the same syringe is used to empty the boiler and the volume noted again, thus forming a cross check. With care, I have never experienced more than a few ml difference.

The gas tank is a bit more difficult as obviously it is not practical to fill and empty it with water. But the 2018 Test Code requires only that the gas tank be less than 250ml capacity. The absolute volume is not strictly required (unlike with the boiler where the volume and working pressure are used to calculate the confirmatory bar litre figure). Accordingly, I measure the outside dimensions and calculate that volume. The inside capacity will obviously be less than this figure.

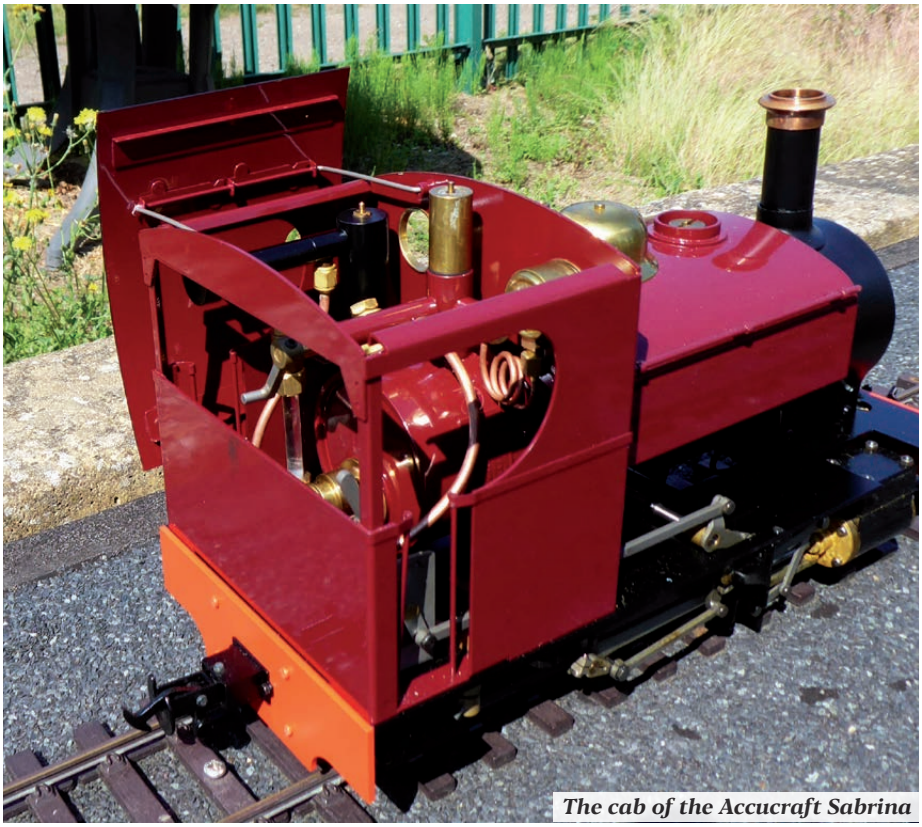
The top of the Sabrina gas tank is visible in the far corner of the cab, with the flow control valve protruding to the left. The top of the gas tank is cylindrical, but the main part below is a rectangular box. The dimensional measurements are a little tricky, but you need do them only once. For Sabrina the outside volume is about 54ml, so this comfortably satisfies the less than 250ml criterion. I enter the figure on the form with a note about the outside volume.

For such measurement purposes, I carry a test and minor adjustment kit, as shown. The kit includes a graduated syringe and tube, long enough to get to the corner of the boiler. A set of calipers (with depth gauge) and short ruler for gas tank dimensions. The mirror probe is handy for confirming boiler and gas tank identity numbers. The small pin nose pliers and miniature spanner set are for nipping up any 'loose' joints in the pipework. The pliers are also used to lift the safety valve spindle (Pressure Relief Valve) prior to starting a steam test. If a loco has not been run for a while, it is quite common for the valve to stick a little, which can elevate the initial lift pressure. Shades of the Ramsbottom type safety valve on full size locomotives where a lever extended into the cab to enable the driver to 'exercise' a sticky valve.

There is one more item in the test kit. The 2018 Boiler Test Code Volume 3 requires a check on the leak integrity of the gas tank and pipework every five years. For this I use a commercial soapy water pump spray. In a recent steam test, this very effectively showed a small gas leak in Sabrina's pipework after the control valve. The leak was sorted out straight away by nipping up the joint.

I suppose even this minor observation says something about why I maintain that a more or less annual inspection with steam and gas tank testing by an independent competent person is a good idea, whether the loco is intended for running in private (when strictly speaking no certificates are required, but at your own risk) or in public where a lot of clubs and societies now require production of a valid certificate to run.

Checks, comments and small corrections, if needs be, are preferable to problems, or poor practice, building up until one day there is a serious failure, with possible injurious consequences.



The cab of the Accucraft Sabrina

Mike's test and minor adjustment kit

Leak detector spray