Seminar for Boiler Inspectors

The seminars for boiler inspectors are jointly sponsored by Federation of Model Engineering Societies and Northern Association of Model Engineers.

This document contains information collated by the speakers, which will be referred to during the seminar and it is hoped will become useful reference material to you.

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With thanks to contributions from David Vere, Nigel Thompson, Alan Reid, Alan Budd, David Mayall, and Bernard North.

Design Calculations for Copper Boilers. (as used in most published designs)

Original document by Nigel Thompson. Updated by Peter Squire and David Vere December 2017

At the present time there are no nationally agreed boiler design formula for the hobby of Model Engineering. Almost all boilers designed by or for the model engineer have followed the practices that have been used by all the major published designers in the model engineering press.

It has been suggested by many that the Australian boiler design code be adopted in the UK, but at the present time there are no formal proposals to do so or for any equivalent document produced by any of the hobby's UK umbrella organisations. Until such time as a design code is written and adopted by all parties concerned, we can only work to what is considered as 'Custom and Practice'.

Designers such as Henry Greenly, with the first published design for a passenger hauling 5" gauge coal fired locomotive the 'Halton Tank' together with his designs for Bassett Lowke all date from the first decade of the last century. L.B.S.C also used the same basic design criteria for his many published designs in Model Engineer, English Mechanics etc. Similar principles have also been followed by K N Harris, Tubal Cain, Martin Evans and Don Young.

None of the designs published in the model engineering press have failed in service through bad design. Even Martin Evans 'Simplex', much criticised for its lack of crown stay attachment to the outer wrapper has, as far as is known, never failed. He did publish a similar alternative for his LN.E.R. B1 design 'Springbok', and there are reports of problems with one boiler for a B1 where the crown came down slightly during the initial hydraulic test. On further examination it was noted that the builder had mixed the old design of a flat-topped Inner firebox with the modified round top outer wrapper without fastening them together. Fortunately, the boiler inspector spotted this very quickly and the crown was pushed back into shape. Rod stays were then fitted through both inner and outer plates and silver soldered in position.

Until such time that nationally agreed design proposals are available, we suggest that the design calculations as used in the past be applied when a hobbyist wishes to build a boiler of their own design.

The Code of Practice produced by the Model Engineering Liaison Group (MELG) on the Examination & Testing of Miniature Steam Boilers 2018 recommends in the section on design verification, that

- *The constructor of a boiler to other than a recognised design available through the model engineering trade and/or press shall produce design drawings and demonstrate to the satisfaction of the inspector, either by calculation or by well-proven example, that the design and materials used have adequate strength.*
- *If no working pressure is stated on the drawings, or published accompanying text, the boiler shall be treated as a new design and calculations shall be produced and validated.*
- *If a boiler is being made to a published or established design but is intended to be used at a higher pressure than that specified by the designer, it shall be treated as a new design. The decisions taken by boiler Inspectors shall be taken as final (see section 19).*
- *Consideration should be given to the use of a build record sheet.*

It is essential when any of your members are considering the construction of a boiler, that the club inspectors are fully involved at key stages of design and construction. This so that the boiler inspector is able to make sure that it is being made to the agreed design, using the correct materials for plates, tubes and jointing materials, and most importantly, to make sure that the correct penetration of the jointing material has occurred.

You will see on the following pages of this note that all the calculations are very simple and straightforward and answers often include rounding up to nearest available size.

Boiler Barrel

For a given thickness and diameter, a length of seamless solid-drawn tube will make the strongest barrel. When a barrel is made from flat sheet rolled to a cylindrical form with the joint lapped and riveted or brazed, the strength will depend on the type of joint used. For double riveting it is customary to take a figure of 70% of the strength of the solid drawn tube. For a single rivetted joint 50% is taken while for brazed or silver soldered joint 80% is generally accepted.

To calculate the right thickness of metal to be used for the boiler barrel, the following formulae can be recommended;

$$P = \frac{D \times F \times WP}{TS \times R \times C \times T \times 2}$$

Where P is plate thickness in inches

D is boiler diameter in inches

F is the safety factor. (this is between 6 and 10 but usually a factor of 8 is used)

WP is the working pressure in lb/in²

TS is the tensile strength of copper (a suggested figure is 25,000 lb/in²)

R is the riveting allowance (this is when a rolled and riveted barrel is used. Single row 0.5, double row 0.7, and for riveted and silver soldered 0.8. It is suggested that all copper boilers include this figure as an added safety factor.)

C is the corrosion allowance (no allowance is usually made for copper)

T is the temperature allowance (copper diminishes in strength at high temperatures. An allowance of 0.8 for pressures between 60-100 lb/in² and 0.7 for pressures from 110 to 150 lb/in²)

Consider an example of a copper boiler with a barrel diameter of 4", working pressure 90 lb/in² rolled from flat sheet and with silver soldered seam;

The barrel thickness required = $\frac{4 \times 8 \times 80}{25000 \times 0.8 \times 0.8 \times 2}$ = 0.090”, 13 S.W.G.. 3/32”, 2.5mm

To change the calculation around, barrel thickness x tensile strength x riveting allowance x temperature allowance x two, over diameter x safety factor will give the maximum working pressure

Maximum working pressure = $\frac{0.090 \times 25000 \times 0.8 \times 0.8 \times 2}{4 \times 8}$ = 90 lb/in²

Flue/Fire Tube sizes

The above formula is not appropriate for a tube subjected to external pressure.

A firetube or superheater flue must be made thicker than given by the formulae above because an externally loaded tube will collapse by buckling at a far lower load than that at which it would burst when subjected to internal pressure.

Note: Only solid drawn copper tubes should be used. Rolled and seam welded tubes must not be used for external pressure applications.

Recommended Minimum Wall Thickness of Flue Tubes
For Copper Boilers working at 80 to 120 lb/in².

The following list is for the recommended minimum wall thickness for a copper flue tube;

Tube OD	Wall Thickness	Tube OD	Wall Thickness
¼”	24 S.W.G.	5/16”	22 S.W.G.
3/8”	20 S.W.G.	7/16”	20 S.W.G.
½”	20 S.W.G.	5/8”	20 S.W.G.
¾”	18 S.W.G.	7/8”	18 S.W.G.
1”	18 S.W.G.	1-1/8”	18 S.W.G.
1-1/4”	16 S.W.G. (or 1/16")	1-3/8”	16 S.W.G. (or 1/16")
1-1/2”	16 S.W.G. (or 1/16")		

There is a definite relation between the diameter and length of a flue tube, whatever the size of the boiler. An examination of the most successful locomotive boilers shows that the length of the flue tube divided by the square of the internal diameter works out at between 50 and 70. For model boilers at all scales the following formula is recommended;

$$d = \sqrt{\frac{L}{65}}$$

Where d is the internal diameter of the tube and L is the distance between the tubeplates, both being measured in inches.

The formula cannot of course be used exactly as tubes are usually only available in increments of 1/16”

Example; for a tube of 7” length;

$$d = \sqrt{\frac{7}{65}} = 0.33”$$

The nearest standard tube to meet this would therefore be 3/8” diameter x 20 S.W.G. wall thickness

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Superheater Elements and Flue Sizes.

The size of superheater elements is governed by the considerations of the diameter which must be small enough to ensure that all the steam passing through the element is properly heated and that there is sufficient area through the elements to accommodate the required steam flow without significant pressure drop. This problem is referred to in some publications as ‘wire drawing’.

Once again, reference to successful designs is helpful with shorter barrels generally giving the least trouble as far as superheat temperature is concerned. In most cases the fraction of length divided by diameter is between 230 and 280.

For model boilers at all scales the following formula is recommended;

$$d = \sqrt{\frac{L}{275}}$$

Where d is the external diameter of the tube and L is the overall length of the element, both being measured in inches.

For practical purposes the overall length of the element may be taken as twice the distance between the tube plates

Example; for a boiler where the distance between the tube plates is 8”;

$$d = \sqrt{\frac{16}{275}} = 0.242"$$

So in this case, elements of ¼" outside diameter would be satisfactory.

To find a suitable size of superheater flue for the elements, it is only necessary to add sufficient clearance for the passage of the gases around the element while bearing in mind the need to sweep the flues.

The following table gives recommended sizes for elements and associated flues.

Element size	Flue inside diameter	Element size	Flue inside diameter
3/16"	½"	7/32"	9/16"
¼"	11/16"	9/32"	¾"
5/16"	27/32"	3/8"	1"
7/16"	1-1/8"	½"	1-1/4"

Thickness of Copper for Boiler Plates - Fireboxes and Stays

Where the outer firebox wrapper is made separately to the barrel the material should be of the same thickness or, in the case of the Belpaire type it may be a little thicker with advantage.

The inner firebox wrapper should be between $^2/_3$ and $^3/_4$ the thickness of the outer wrapper.

The firebox flanged plates, throatplate, smokebox tubeplate and backhead should all be of the same thickness as the barrel.

Plate crown stays should be at least the same gauge as the firebox wrapper covering and attached to the whole length of the inner firebox crown including the flanges of the tube and backplate.

Fitting of Firebox Side, Longitudinal Backhead, and Throatplate Stays

The general principle underlying the staying of a boiler is that all flat surfaces in the boiler must be properly supported and that all surfaces not self-supporting will require stays.

In locomotive boilers there are three principal types of stay;

Side stays – to support the flat side, front and back of the firebox

Longitudinal stays - to support the flat ends of the boiler (smokebox tubeplate and backhead)

Crown stays - to support the top or crown of the inner firebox

Side Stays.

These may be screwed, nutted, riveted and caulked with soft solder using copper, gunmetal or monel metal for the actual stays. This method, although tedious is perfectly acceptable being a mechanical fixing using the soft solder as a sealing medium. This has the advantage of being suitable for the average model engineer to successfully complete a boiler without the use of oxy-acetylene equipment.

More commonly seen is the use of round head rivets inserted from the inner firebox with a small countersink on the outer firebox wrapper to assist the brazing process.

The following table gives recommended sizes for screwed stays for Firebox Side, Throatplate and Backhead stays (based on thread root diameter)

Thickness of inner firebox	Stay diameter & thread.	Thickness of inner firebox	Stay diameter & thread.
3/64" or 18 S.W.G.	5 BA	1/16" or 16 S.W.G or 1.6mm	5 BA
3/32" or 13 S.W.G or 2.5mm	4 BA	1/8" or 10 S.W.G. or 3mm	3/16" x 40 tpi
5/32" or 8 S.W.G. or 4mm	¼" x 40 tpi	3/16"	5/16" or 3/8" x 32 tpi
1/4"	3/8" or 7/16" x 26 tpi	5/16"	½ " x 26 tpi

The pitch of side stays can be calculated by the following formula;

$$\text{Pitch} = \sqrt{\frac{D^2 \times T \times 3}{P \times F \times 4}}$$

PLEASE NOTE THAT IN SOME EDITIONS OF BOOKS BY MARTIN EVANS AND K. N. HARRIS THE SQUARE ROOT SIGN HAS BEEN OMITTED FROM THIS FORMULA

Where D is the minimum diameter of the thread in inches
P is the maximum working pressure in lb/in²
F is the safety factor. (this is between 6 and 10 but usually a factor of 8 is used)
T is the ultimate tensile strength of the stay

For copper T may be taken as 25,000 lb/in², gunmetal as 38,000 lb/in² and monel metal as 60,000 lb/in²

As an example for a 3/16" x 40 tpi Gunmetal threaded stay, and a maximum working pressure of 100 lb/in²

$$\text{Pitch} = \sqrt{\frac{5 \times 5 \times 38000 \times 3}{32 \times 32 \times 100 \times 8 \times 4}} = 0.96 \text{ inches}$$

Note: The 3/16" diameter stay is shown as 5/32" diameter in the calculation being the root diameter of the thread. Silver soldered plain rivet type stays without threads can be calculated on full diameter.

The same formula is applicable in calculations for throatplate and backhead stays.

Longitudinal stays

These are used in boiler where the firebox wrapper is separate from the barrel, the two being joined by a throatplate.

The number used is dependent on the size of the boiler, one of which can be the thick walled copper tube used to pass steam to the boiler's blower, or on locomotives with hydrostatic lubricators, a second hollow stay may be used to get the oil to the steam header in the smokebox.

Usually there is an even number of stays at around one inch pitch across the top of the firebox the centre being left clear for any girder stay in the centre of the crown and also to clear the regulator valve or rod. The stays may be silver soldered or screwed using blind nipples. They can be made from either copper or bronze and should be not less than the diameter of the side stays. The same applies to the cross staying to be found on Belpaire type outer fireboxes.

Crown Stays

There are four distinct types of crown stay used in model locomotive boilers;

- The direct or rod stay
- The fabricated plate girder stay
- The girder stay not connected to the outer wrapper e.g. in Simplex
- The sling girder stay

The direct rod type is probably the best to use in Belpaire fireboxes, best made from monel or drawn bronze. There are several methods of fitting involving threading and/or silver soldering, details of which are in the books recommended for further reading at the end of this note.

Rod stays although often used are not ideal for round top fireboxes as it is desirable that they be located radially so that the threaded holes in the plates are normal to the stay centre line.

The fabricated plate girder stay is often used in boilers up to 1 ½" scale where a pair of shaped plates of the same thickness as the outer wrapper are rivetted and silver soldered to both inner and outer wrappers.

When using plate crown stays it is vital to carry them along the full length of the inner firebox assembly so that they lie over the flanged edges of the inner firebox tubeplate and the firebox backplate..

Girder crown stays which are not connected to the outer wrapper have been used from time to time, but only on round top boilers and must be silver soldered along their length to the crown of the firebox.

The sling girder type are not recommended for copper boilers. Such stays are difficult to make and only suitable for large scale round top boilers where there is sufficient space between the inner and outer wrappers for easy assembly of the parts.

Boiler Test Code - Design Verification.

The subject of design verification is covered in the Boiler Test Code 2012 edition in section 4 and will become section 5 in the 2018 edition.

This section of the code has caused some concerns to boiler inspectors as to what constitutes a modification and under what circumstances are design calculations required. There have been examples where inspectors feel that verification is required for minor alterations to a published design such as the placing of feed water clacks on the front ring of the barrel because the original drawings showed backhead mounting. This of course is not the intention of this section of the test code.

When the NAME boiler sub-committee compiled and published the original Northern Association Test Code it was felt that this section should be included for those Instances when a prospective builder wished to build a boiler of non-standard construction such as the boilers designed by the Lancashire and Yorkshire Railway for their 0-8-0 goods engines which had no side firebox stays as the plates were corrugated The use of such would require the appropriate calculations as would other such as the boilers for the L.M.S. 'Fury' or the L.N.E.R. 4-6-4 'Hush Hush'.

Such conversions as the lengthening or shortening of a boiler barrel or increasing or decreasing the length of firebox, providing the stay size and pitching is no greater than that of the unmodified published design are acceptable without further assessment.

Any increases in material thickness, larger silver soldered flanges, thicker and closer pitched stays will have no detrimental effect on the safety of the boiler.

A case was brought to our attention of an inspector who requested stress calculations on the boiler for a 3 1/2" gauge Juliet because the barrel had been made from 3/32" thick copper tube instead of the specified 1/16". This clearly was not necessary a safety had not been compromised by choosing a thicker material.

Further reading and sources of information

There are many publications covering the design and manufacture of miniature boilers by well-respected model engineers such as Henry Greenly, K N Harris, Tubal Cain, Martin Evans, Alec Farmer and Don Young.

Of particular value to the authors of this note are Model Locomotive Boiler Making by Alec Farmer and Model Locomotive and Marine Boilers by Martin Evans.

Tips and Suggestions

1. Great care should be exercised if asked to increase boiler pressure above the design pressure because any such increase will reduce the factor of safety which is included to allow for any wastage or build-up of scale which can cause burning of the boiler plates.

2. Although cadmium containing filler metals were banned from sale in 2010, many model engineers retain useful stocks of such material or having used nothing other than Easy Flow No.2 and equivalent products for many years, still think about the temperature working range in terms of the Johnson Matthey materials.

   The following may be of use to you when asked which grade of silver solder should be used.

JM Brazing Alloy	Melting range °C	JM Silver-flo melting range °C	CUP Alloys melting range °C
Type 5	698 to 788		
Easy-flo	620 to 630		
Easy-flo No.2	608 to 617	JM Silver-flo 55 - 630 to 660	CUP 455 – 630 to 660
Argo-flo	605 to 651	JM Silver-flo 56 - 618 to 652	CUP 445 – 640 to 680
Argo-Bond	616 to 735	JM Silver-flo 38 - 650 to 720	CUP 438 – 650 to 720
B6	790 to 830	JM Silver-flo 40 - 650 to 710	CUP 430 – 665 to 755
D3	700 to 740	JM Silver-flo 24 - 780 to 800	CUP 424 – 740 to 780

   The above table has been constructed for comparison purposes to the original Johnson Matthey materials. It does not include all material ranges available. For further information on the ranges of materials please check;

   http://www.jm-metaljoining.com/products/silver-flo

   http://www.cupalloys.co.uk/for-model-engineers/

   Included with your seminar notes you will find a leaflet kindly supplied by CuP Alloys Ltd. which lists the appropriate ISO Standards for the various grades of silver solders with the temperature melting ranges and rod sizes available from them.

3. It is often recommended in articles on the construction of copper boilers that Johnson Matthey 'Easy-flo Flux' be used. However, if the data sheets from Johnson Matthey are consulted, we find that they do not recommend this flux for applications requiring prolonged heating. Anyone who has built a large sized copper boiler will know that the prolonged heating required will exhaust the flux often before the temperature for brazing has been reached. The Tenacity range of fluxes are suitable for extended heating and higher temperature . A large range of fluxes are available with Tenacity No.5 and its working range of 600 to 900 °C being popular with Model Engineers.

   For a complete information visit http://www.jm-metaljoining.com/products/tenacity

4. When boilers are presented for hydraulic test, the onus is on the boiler owner or operator to provide any necessary blanking plugs and also a suitable thread adaptor to fit the society's test pump. The details of the thread of the test pump fitting should be available to all boiler owners on a notice board or in the operating procedure.

5. Care should be exercised when inspecting boiler fittings. Dependent on water quality the life of some boiler fittings containing any zinc can be very short. This is caused by the dezincification of the fittings. A simple explanation is that the zinc is sacrificed to protect the copper and is caused by any acidity present in the boiler water, which can create a battery effect which etches out the zinc. Threads are particularly vulnerable to this decay. It can and has caused check valves and other fittings to blow out when the boiler is in steam. Boiler fittings ideally should be made from bronze or gunmetal and not brass.

   Some years ago the Northern Association asked the commercial manufacturers to use suitable zinc free brass for the production of boiler fittings but unfortunately there was no response from them.

Recently, some boiler fittings made from bronze have appeared on exhibition stands of some of the specialist suppliers, but in general they continue to be manufactured from brass.

The part of the fitting which always corrodes is the part which is screwed into the boiler. Accordingly it is recommended to use bronze for this part. The rest of the fitting can still be made from ordinary brass if required, as the body of a valve is not in direct contact with the copper of the boiler.

If in the future and need help or advice on boiler matters, please contact either the Secretary or Safety Officer of your affiliated body. Your club secretary will always have these contact details.

Notes on the Design and Construction of Steel Boilers

There will no doubt be discussions for evermore on whether a boiler should be made from steel or copper. Experience shows that it is difficult to design and build a steel boiler with a barrel diameter of less than 200mm (8”). It is equally increasingly difficult to make a copper boiler with satisfactory joints over this diameter. The economics also tend to favour the 200mm/8” divide as the high price of copper has to be offset with the costs of design approval and in build inspection for welded steel.
Steel is comparatively cheap and although the plates in steel boilers are stronger they are thicker to allow for corrosion. BS2790 specifies a minimum thickness of 6.5mm or ¼”. This gives useful adhesive weight.

The design and construction of welded steel boilers is covered by BS2790. There are a number of revisions of this standard the latest being 1992. If you are obtaining a copy of this standard be careful to check that the revision does not exclude locomotive boilers. When referring to this standard on drawings or specifications the part and revision date must be quoted. (Copies of British Standards are available in most university and larger public libraries.)
These notes all refer to BS2790 Part 2 1973.
The formulae in all the revisions are the same but the diagrams, formula numbers and examples change together with their number.

The Euro-norm Standard for welded steel boilers specifically excludes locomotive boilers.

BS 2790 is in metric and hence Lengths are in millimetres and Pressure, Stress and Tensile Strength are in Newtons/mm^2 (N/mm^2).

1 Newton = 0.225lb. 1 N/mm^2 = 10 Bar = 145 lb/in^2

Design calculations for a new boiler design will need to be approved by a Notified Body. They will expect your drawings and calculations to be in metric.

When using BS2790 you need to recognise that the standard is for anything from our (comparatively) tiny vessels up to the largest industrial fire tube boilers.
This can mean that it is necessary to apply the basic principles but to modify them to enable manufacture.
A typical example is stays. The smallest diameter recognised by the Standard is 19mm, however over the years the Notified Bodies have been persuaded to allow smaller diameters (typically down to 12mm) and modifying the stay to have weld preparation to facilitate welding. The Standard gives a maximum stress of 62N/mm^2 for 19mm dia. and
69N/mm^2 for 38mm dia. A maximum stress of 50N/mm^2 would be appropriate for 12mm dia and 55N/mm^2 for 16mm dia stays.

It is vital that the correct materials are specified and used in the construction of steel boilers. All materials used in a steel boiler must have certification and the serial numbers should be stamped into each plate.

The steel specifications in BS 2790 have been superseded by Euro-norm Standards but most if not all material certificates quote both standards.
BS1501 has been superseded by BS EN10028:1993. BS 1502 has been superseded by BS EN 10273:2000.

The boiler barrel should, wherever possible, be made from ASTM A106 grade B. This is hot finished seamless refinery tube as used in the oil industry and is normally easy to obtain. If the required diameter is not available the Notified Body may give approval for API 5L to be used (oil industry line pipe). Otherwise it would be necessary to have a barrel roller and welded by specialist contractor such as Deepdale Engineering. This will need to be supplied with material certificate and evidence of satisfactory x-ray examination of the seam. Current practice is to re-roll the tube after welding to minimise fatigue of the joint. It is wise to have welded longitudinal barrel seams ultrasonically examined for fatigue cracks when the boiler is stripped for through examination.

The design drawings need to specify the weld preparation to be use on each joint by referencing to the figures in BS2790.

The welding must be carried out by a welder who has current approval to BS EN287:2011 for the joints used in the boiler. The welding rods must be specified on the drawings and be suitable for the materials used. Certificates of Compliance should be supplied for the rods.

When using the normal type of locomotive boiler foundation ring (BS2790 pt2 1973 fig37a) it is necessary to have the firebox crown fully supported by stays. This means that the use of girder type crown stays is not permitted.

The steam pipe inside the boiler, after the regulator, must be made from a non-corroding material (copper or 316 Stainless steel).

If a quarter turn ball valve is used as the regulator or a control valve it must be specified for steam and have an appropriate working temperature. The cheap brass and plated quarter turn valves typically sold for compressed air and domestic water applications are not suitable.

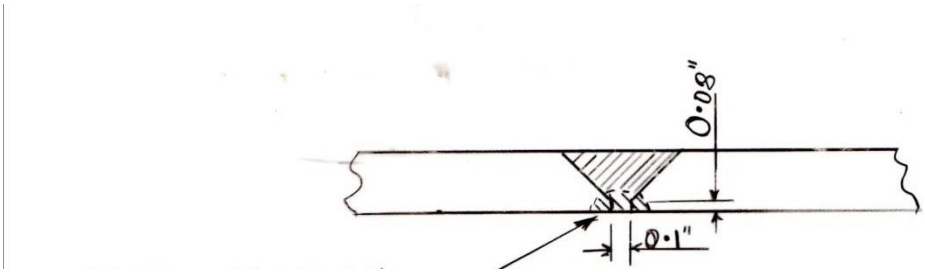
All the tappings for water gauges, feed clacks, washouts and blow-downs should be BSP threads. Fixings for flanges, domes etc. should be standard metric course threads. Wherever possible use either nut and bolt or studded fastenings. Bolts into tapped holes are not recommended. BSP Parallel threads should be sealed with soft washer not PTFE tape.

Fire tube should be expanded in and made from either cold drawn seamless tube which has been bright annealed or seamless copper tubes.

Welded Joints for Steel Boilers

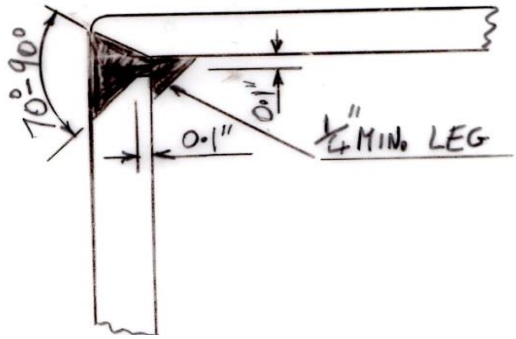
Figures refer to BS26790 Part 2 1973

Butt Welds to Fig 27c



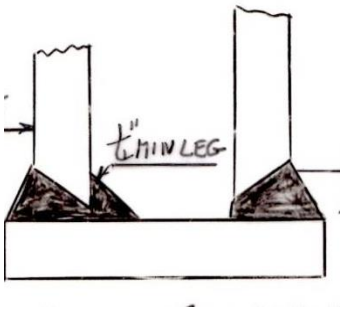
Grind out and dye penetration test
before welding second side

Corner Joint to Fig 30e



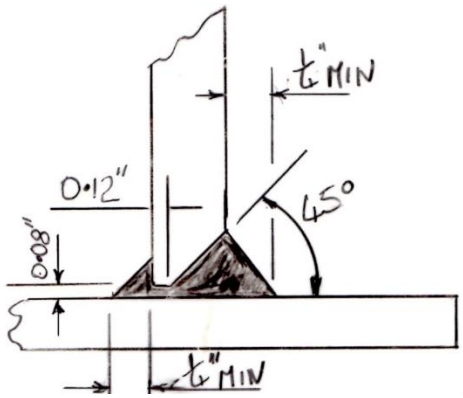
Firehole Ring to Fig 11b

Fireside



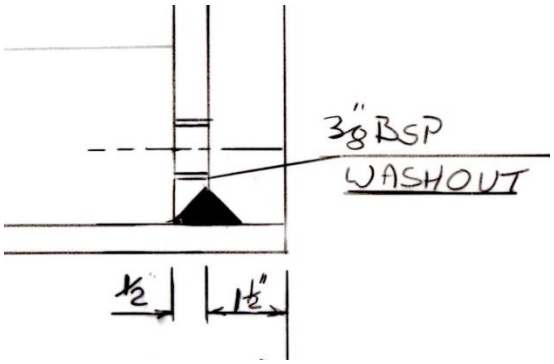
Single Sided weld
Full Penetration required

Front Tube Plate to Fig 11b



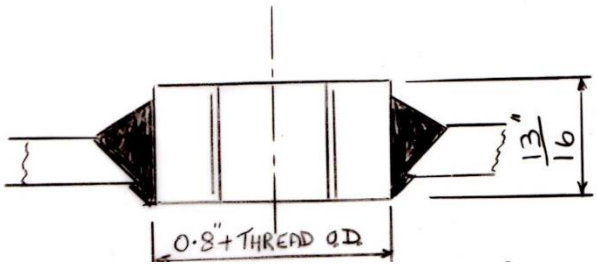
Preferred method

Front Tube Plate based on Fg 11a



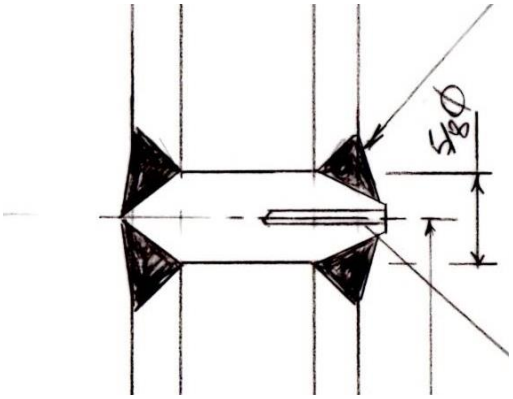
Only to be used where there is no access to weld at the rear of the tube-plate.
Full penetration weld required

Threaded Nozzles to Fig11b



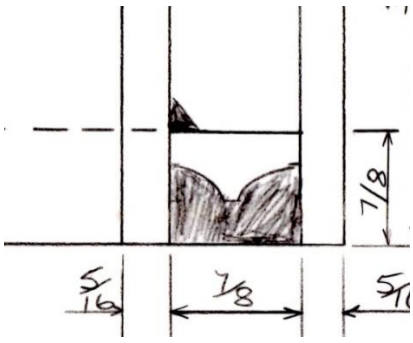
Stays based on fig 15b

Full penetration welds



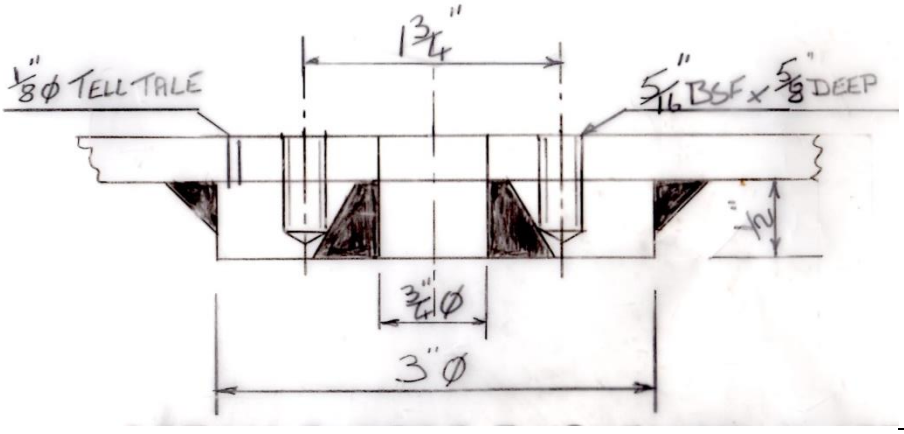
0.1” dia. tell-tale hole

Foundation Ring based on fig37a



This type of foundation ring may only be used if the firebox crown is fully supported by stays

Thickening plate for flanged connections



GDR Vere 31st December 2017

Boiler & LPG tank Certification

Alan Reid – NAME
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INTRODUCTION

Any pressure vessel, typically a locomotive boiler for road or rail, brought into the model engineering hobby requires pressure testing on a regular basis to ensure it is safe to use. Guidance on testing is given in the Boiler Test Code 2018 which should be regarded as the 'Bible' for club boiler inspectors. Although the BTC title implies it is just for boilers it does also cover the testing of **refillable** LPG tanks. The BTC 2018 replaces the 'Green', 'Blue' and 'Red Books' used by the hobby in previous years. It is now in three volumes which cover all sizes of boiler, used by the hobby, and LPG tanks. The sub-titles of the three volumes are:

(a. VOLUME 1 – Boilers 3 bar-litres to 1100 bar-litres.

(b. VOLUME 2 – Boilers under 3 bar-litres.

(c. VOLUME 3 – LPG tanks under 250 ml.

Clubs appoint their own inspector(s) who should be well versed in boiler and/or LPG tank construction and familiar with the Boiler Test Code. Witnesses (apprentice boiler inspectors?) should be familiar with the testing requirements and are there to check the inspector does not miss anything pertinent. Boiler inspectors can refuse to test a pressure vessel if they believe they do not have sufficient experience or knowledge to do the test.

TESTING OF BOILERS 3 TO 1100 BAR-LITRES

The tests are in three parts:

(a. An initial test checks the newly made boiler is sound in all joints and where necessary that any flat surfaces have been adequately stayed to prevent bulging. This test is called the ***'initial hydraulic shell pressure test'*** and is carried out on a bare boiler with the holes plugged to allow pressurisation at twice the design working pressure (2 x Pw). A new boiler bought from a commercial supplier should come with a certificate shewing a shell test has been done satisfactorily; this certificate is acceptable to the hobby. A shell test certificate lasts for the life of the boiler unless the boiler is structurally altered when another shell test should be done and new certificate issued. If the boiler changes hands a new certificate is needed. A boiler made by a club member requires the club boiler inspector to do a shell test and certify it accordingly.

(b. Periodically a boiler in use requires a ***'system hydraulic pressure test'*** at 1.5 x Pw. As many fittings as possible, attached to the boiler, are tested at this pressure, thus it is a test of the boiler system not just the boiler shell. This test is also carried out on a new boiler before the boiler is brought into use even though it is commonly called a retest or repeat test.

(c. The third test is the ***'safety inspection and steam accumulation test'*** which checks that there are no significant leaks or other visible problems and that the safety valves allow excess steam to escape, when the boiler is working hard, thereby preventing the boiler pressure from exceeding the Pw + 10% This test is commonly called the steam test.

The boiler owner cannot test his/her own boiler nor be a witness to such any of the above tests.

See appendices for illustrations of a sequence of certification for a boiler from the shell test onwards.

TESTING OF BOILERS UNDER 3 BAR-LITRES

The tests are in three parts:

(a. An ***'initial hydraulic shell pressure test'*** at twice the design working pressure is done on the bare boiler as for the larger boilers.

(b. Next a ***'system hydraulic pressure test'*** at 1.5 x Pw. With as many fittings as possible, attached to the boiler, is carried. This it is a test of the boiler system not just the boiler shell.

(c. After completing the hydraulic tests a ***'safety check and steam test'*** is required as (c above.

Note that the specified hydraulic tests are not repeated unless the boiler is structurally altered in any way.

The boiler owner may be the witness to the tests if the inspector agrees.

An example of a small boiler certificate is shewn in the appendices.

An exception to the above exists for low pressure boilers:

These boilers are in two classes as defined in BTC Vol. 2, 3.14.1 (Class LO) and 3.14.2 (Class LS) – they have a working pressure of less than 2 bar (29 psi.).

Class LO does not require a hydraulic test but the safety valve must be tested to shew it releases at or below the working pressure.

Class LS requires an initial hydraulic test at twice the working pressure and that the safety valve releases at the working pressure or less.

TESTING OF REFILLABLE LPG TANKS

The tests are in three parts:

(a. An initial test checks the newly made tank is sound at a test pressure of 400 psi. no matter what the ratio of propane to butane is (propane up to a maximum of 40% is allowed). No leaks are allowed and this test is called the ***'hydraulic test'***.

(b. The next test is with the tank filled with LPG, as specified in the design, with the filler valve and gas control valve in place. This ***'safeguard test'*** looks for leaks from the fittings – any leak is regarded as a failure.

(c. A ***'safety check'*** in the form of a leak test is required every five years (see BTC 2018, vol.3, section 13).

The tank owner may be the witness to the tests if the inspector agrees. The tank owner may also inspect their own tank providing it has previously been inspected by another inspector.

CERTIFICATION

Note. Boiler certificates have, inside the front cover of the pad, guidance describing how the certificate should be filled in. Correctly filled-in certificates shew that the boiler has been examined according to the Boiler Test Code. This is important, to the club and the owner, in case at a later date a problem arises which causes the authorities to take notice. Certificates come in pads which do not need carbons for the copies. They are pre-printed with serial numbers and have a security feature to shew such a certificate is genuine.

What follows describes the paper work required at each stage of the life of a boiler.

Boilers of 3 bar-litres up to 1100 bar-litres.

The written scheme of examination certificate (Pxx) spells out the physical details of a boiler which require checking at a testing stage. It is prepared by a competent person who is normally the boiler inspector within the club. Section 2 is self-explanatory in that the boiler is described noting its owner, boiler identity (as stamped on the boiler), type of model etc. Section 3 is an exercise in ticking the relevant boxes, each to shew that a particular facility is present on the boiler, eg. if there are two safety valves the SV1 and SV2 boxes are ticked. Similarly if there is only one injector fitted then INJ1 is ticked. The remaining sections of the WSoE are straightforward. The serial number of the WSoE is quoted on every examination certificate for the boiler in question. Each certificate has white, pink and yellow copies, which do not require carbon paper. The top white copy is given to the owner of the boiler. The pink and yellow copies are retained by the boiler inspector and club, if that club is within NAME, whereas for **FMES clubs only**, the pink copy is sent to their boiler registrar.

NOTE. The WSoE certificate explains what is to be tested but the testing methods are described in Volume 1 of the Boiler Test Code. The certificate and the BTC form together the complete Written Scheme of Examination.

If a boiler changes hands or is structurally altered in any way, eg. another clack valve bush is installed, then a new WSoE certificate must be prepared.

The examination certificate of a pressure system (Pyy) is a multi-purpose form to be used for all hydraulic and annual steam tests. At first glance this certificate is somewhat daunting but if it is tackled carefully, section by section, it should become clearer.

Sections 1,2 and 3 just require the details of the boiler to be entered. One important entry is that the serial number of the WSoE certificate, eg. W123456 must be entered below the printed serial number of the examination certificate (top right box).

Section 4 specifies which type of examination is to be done, ie. shell test, system hydraulic test or steam test. If a steam test is being done and a repeat hydraulic test is not yet due, section 4c is filled in with the serial number of the current hydraulic test certificate, its expiry date plus the working pressure of the boiler. This then allows the certificate recording the steam test to replace the previous examination certificate which can be filed thus only one certificate is in use at any one time.

Sections 5 and 6 only need entries if appropriate.

Section 7 is where the result of the relevant test(s) is recorded with the reason for a failure recorded in Section 8. Those tests not undertaken should be so marked in Section 7.

The remaining sections just require club details and signatures of those inspecting the boiler.

A commercially manufactured boiler should come with documents shewing that is has passed a shell test thus there is no need to do another one. Note that such a boiler should be stamped with a CE or UKCA mark put there by the manufacturer and have accompanying paperwork shewing CE or UKCA conformity.

It is wise to hydraulically test a boiler immediately on completion, or after purchase, to check its integrity. Thereafter it is not necessary to do a repeat hydraulic test until the boiler is ready to be put into service.

The first validity period of the certificate for a boiler must not exceed four years. The starting date is that of the first system hydraulic pressure test (at 1½ x Pw, ie. not the shell test) for both copper and steel boilers. For subsequent system hydraulic tests the validity period must not exceed four years for copper boilers, whereas for a steel boiler it must not exceed **two** years.

A steam test is required annually, but the certificate has a validity period of fourteen months maximum. If the hydraulic examination certificate expires before the end of the fourteen month period, then the steam test expires with it. The reason 14 months is allowed is historical; mill owners were very reluctant to stop working to test the boilers of the steam engines used to power looms etc. Easter was a convenient time for the test as the mill workers were on holiday then but Easter is a moveable date (it is set as the Sunday which follows the first new moon after the Spring equinox). It was decided by the hobby to follow this convention for the annual steam test. Note that there is no requirement to send details of a steam test to the Boiler Registrar.

Remember that an examination certificate shewing that the boiler has passed its hydraulic and steam tests, and that both tests are within date, is needed to allow it to be used in public.

The validity periods, as laid down in the BTC, are the maximum allowed. There is no minimum period recommended as it is up to the boiler inspector to decide, given the condition of the boiler, whether a shorter period before the next test is appropriate. NOTE. Although the validity period of a steam test can be a maximum of 14 months, if 12 months are specified then there is NO grace period, of a further 2 months, as the date recorded on the certificate is the date the steam test expires.

,The certificates can be accompanied by a blue record card which charts the tests carried out on the boiler (the use of this card is optional but it is recommended that it is still filled in for completeness). Note that this blue record card is **not** a substitute for an examination certificate and cannot be used to prove a boiler is certified fit for use.

Boilers below 3 bar-litres.

Simplified arrangements have been agreed for boilers with below 3 bar-litres pressure-capacity and there is a small boiler certificate (Pzz) which combines a WSoE (top part of the certificate) and an examination section (bottom part of the certificate):

The written scheme of examination certificate requires the basic details of the boiler to be specified. Unlike larger boilers these small boilers may be made from brass (see 3.17 in Vol.2 of the BTC) as an alternative to copper. Cross out which does not apply in para 3 of the certificate. Para 4 – delete those facilities not present on the boiler. To

complete the WSoE section the boiler inspector signs and dates the section.

The hydraulic examination starts in the same way as that for a large boiler in that it is given a shell test to check the integrity of the boiler. Thereafter it is given a system hydraulic pressure test once; following this it never again needs another hydraulic test unless structurally altered. Exceptionally, brass boilers need a retest every three years (BTC 2018, vol. 2, para. 14.2). The results of the hydraulic tests are recorded in **Box A** of the combined certificate. It does need an annual steam test to complete and maintain it's certification. The results of the steam test are noted in **Box B.**

The combined certificate reflects the testing requirements and Volume 2 of the Boiler Test Code gives the details of how the testing should be carried out. *It is recommended that this certificate is always used if the locomotive is capable of hauling at least the driver.* For smaller locomotives and stationary boilers alternative certificates are available as indicated below.

Refillable LPG tanks.

The Federation uses the small boiler certificate for LPG tanks. The tank serial number is entered in Box B. NAME uses an examination form plus a card certificate which have been coloured red in the past but nowadays they are orange (they are illustrated below).

Refillable LPG tanks need a Safety test every 5 years maximum (BTC Vol 3, para. 8.2)

NOTE: the Gauge 1 society has produced a boiler/LPG tank test certificate as an alternative to the above. It is particularly suitable for boilers of less than 2 bar working pressure. It can be downloaded from the Web at:

www.g1mra.com/resources-links/standard-guidance/ (click New Boiler Certificate)

---oooOooo---

The present recommendaton is that all certificates (and the blue record card) pertaining to a particular boiler (or refillable LPG tank) should remain with that boiler until it is scrapped, thus when a boiler changes ownership the paperwork should go with the boiler to the new owner. The society doing a test of any kind is responsible for keeping the copies of any certificate issued in its name.

BOILER IDENTITY

All new boilers made within the hobby, ie. not bought commercially, require a unique identity. NAME laid down the following format many years ago and recently the Federation have adopted it.

The format is as follows:

N123-80-345-S	NAME boilers
F123-80-345-S	FMES boilers

N123	Number of the NAME society which first tests the boiler
F123	Number of the Federation society which first tests the boiler
80	Safe working pressure as designed - a boiler can be used at a lower pressure if desired but not at a higher pressure unless shewn to be safe by calculation.
345	A unique identity within the issuing society
S	This suffix is only required for a steel boiler

The identity should be stamped, or etched, on the boiler in a position where it will not affect the integrity of the boiler and ideally in a place where it can be seen with the boiler in the frames – typically somewhere on the backhead or perhaps on the dome foundation ring. Note that the hyphens, in the identity, are not required when stamping the boiler, as a gap will suffice. It is not a good idea to run all the letters/numbers together because confusion can arise, eg. N1475513 can easily be mistaken for N14 75 513 rather than N147 55 13 as intended. This identity system for a new boiler made by a club member is not optional.

The year of manufacture may also be appended to the boiler identity and this information will be noted within the records.

A boiler identity stays with that boiler for ever, and **never** changes even if the safety valves are adjusted to release at a lower pressure.

Boilers coming into the hobby from without may have an identity already, in which case that identity should be used. If for some reason such a boiler has never been given an identity then one to the above format should be created and stamped on the boiler.

REPORTING THE RESULTS OF AN HYDRAULIC TEST BY NAME CLUBS.

Hydraulic tests are not recorded by the Federation, instead the pink WSoE form is sent to their registrar to record the existence of a boiler.

NAME has had, for many years, a requirement for clubs to report the basic details of each and every hydraulic test to the NAME Boiler Registrar for recording on the central database. Boiler inspectors can report test results as an **attachment** to an e-mail sent to the Boiler Registrar. To this end an .xls or .ods spreadsheet is available and will be sent to anyone who would like to report via an e-mail. Anyone not wishing, or not able, to use this method can report by form through the postal service, again just ask the Boiler Registrar for the blank form. The blank spreadsheet or postal form as supplied should be kept as a master sheet. When wishing to make a report, a copy is made from the master sheet, the details filled in on the copy which is then sent to the Boiler Registrar by post or as an email attachment. Hydraulic test results can be reported singly or several at a time whichever is convenient to the boiler inspector. An example of the spreadsheet is shewn here:

Boiler hydraulic test results for NAME society number : N

Issue 22 June 2014

Name of sender : Telephone number of sender :

Name of owner	Material Copper/ Steel/ LPG	Boiler identity eg. N123-80-456	Hydraulic Test date eg. 13/5/07	Expiry Date eg. 12/5/11	Hydraulic Certificate Number eg. C123456	Bar-litres **NOT** Volume	Model gauge and description Please mark with * if this is the first time this Boiler has been tested in this club.

Also recorded is whether a boiler has been scrapped or stolen, PROVIDED THIS INFORMATION IS GIVEN to the registrar. Knowledge that a boiler has been stolen can be useful in case that boiler ever gets tested again within NAME It is also helpful if clubs would inform the registrar when a boiler leaves the club, e.g. when the owner dies. If a boiler is scrapped its identity must NOT be re-used. LPG tank hydraulic tests are also reported using the above form, leaving those boxes which are not applicable blank.

It is sufficient to quote the bar-litres figure to the nearest whole number because the methods available to societies when measuring the volume do not warrant a more precise result. A ready-reckoner is shewn below. Remember that if a society has a boiler of greater than 500 bar-litres then the relevant boiler inspector must have been registered with NAME (usually this is done on the annual affiliation form). Boilers of greater than 1100 bar-litres cannot be tested within the hobby.

Historical data are not normally retained, ie. only the results of the last reported test are stored.

Problems noted with reported tests:

Unclear writing – very often interpretation is required and that can lead to mistakes.
Missing boiler identity – this has happened and it means that nothing can be recorded.

Other problems found:

Boiler identity written without gaps or other indications to separate the sections of the identity.
Expiry date BEFORE the examination date.
Expiry date making the validity period longer that that allowed in the BTC.
No suffix of S on a steel boiler which when stated should be written clearly so that it is not read as **5**.
Boiler pressure (seen in the identity) greater than that of the published design – this is allowed PROVIDED that the boiler has the required strength and the necessary calculations have been done to prove it is safe to use.

This fact should always be noted on the report.

Boiler pressure different to that previously recorded (if the working pressure is lowered, for whatever reason, the boiler identity DOES NOT CHANGE).

Boiler pressure transposed with the unique society identity.

Boiler volume quoted instead of bar-litres (pressure x volume) – this is a common mistake.

CALCULATING THE BAR-LITRES FOR A BOILER

It is difficult to measure the volume of a boiler with any great accuracy therefore quoting the bar-litres to an accuracy of fractions of a whole unit cannot be justified. The table below is provided to assist boiler testers when testing a boiler for the first time.

	Pressure in psi.													
Volume in litres	30	40	50	60	70	75	80	85	90	100	110	120	150	175
1.5	3	4	5	6	7	7	8	8	9	10	11	12	15	17
2	4	5	6	8	9	10	10	11	12	13	14	16	20	23
2.5	5	6	8	10	11	12	13	14	15	17	18	20	25	29
3	6	8	10	12	14	15	16	17	18	20	22	24	30	35
3.5	7	9	11	14	16	17	19	20	21	23	26	28	35	41
4	8	10	13	16	19	20	21	23	24	27	29	32	40	47
4.5	9	12	15	18	21	22	24	26	27	30	33	36	45	53
5	10	13	17	20	23	25	27	28	30	34	37	40	51	59
6	12	16	20	24	28	30	32	34	36	40	44	48	61	71
7	14	19	23	28	33	35	38	40	42	47	52	57	71	83
8	16	21	27	32	38	40	43	46	48	54	59	65	81	95
9	18	24	30	36	42	45	48	52	55	61	67	73	91	107
10	20	27	34	40	47	51	54	57	61	68	74	81	102	119
12	24	32	40	48	57	61	65	69	73	81	89	97	122	142
14	28	38	47	57	66	71	76	80	85	95	104	114	142	166
16	32	43	54	65	76	81	87	92	97	108	119	130	163	190
18	36	48	61	73	85	91	97	104	110	122	134	146	183	214
20	40	54	68	81	95	102	108	115	122	136	149	163	204	238
25	51	68	85	102	119	127	136	144	153	170	187	204	255	297
30	61	81	102	122	142	153	163	173	183	204	224	244	306	357
35	71	95	119	142	166	178	190	202	214	238	261	285	357	416
40	81	108	136	163	190	204	217	231	244	272	299	326	408	476
45	91	122	153	183	214	229	244	260	275	306	336	367	459	535
50	102	136	170	204	238	255	272	289	306	340	374	408	510	595
60	122	163	204	244	285	306	326	346	367	408	448	489	612	714
70	142	190	238	285	333	357	380	404	428	476	523	571	714	833
80	163	217	272	326	380	408	435	462	489	544	598	653	816	952
90	183	244	306	367	428	459	489	520	551	612	673	734	918	1071
100	204	272	340	408	476	510	544	578	612	680	748	816	1020	1190

The Pressure Systems Safety Regulations 2000

Statutory Instrument 2000 No 128 - Regulation 8

Written Scheme of Examination for a Boiler

1. Introduction:
1.1. This Written Scheme of Examination has been written in order to comply with the requirements of the Pressure Systems Safety Regulations 2000 (Regulation 8)
1.2. All examination and testing shall be carried out in accordance with the requirements of the formally issued Boiler Test Code entitled The Examination and Testing of Miniature Steam Boilers, Boiler Test Code BTC 2012 or the latest edition relevant at the time of the test. The pressure test values and the periodicity of test shall be in accordance with the Code

Scheme No. W 005789

2. Description of the System:

a) Serial / Boiler (System) Number: SF 007 ABC
b) Name of Owner: Albert Hall
c) Year of Manufacture 2018
d) Name of Manufacturer Albert Hall
e) Boiler Material and Method of Jointing (eg welded, silver soldered, riveted etc) Copper/Silver Soldered
f) Boiler Type Fire Tube / ~~Water Tube~~ (delete as applicable)
g) Type of Model: Railway Locomotive ~~or Vehicle~~ / ~~Road Vehicle~~ / ~~Boat / Stationary~~ ~~Plant / Other~~ (please specify) (delete those not applicable)
h) Description: (e.g. Romulus loco, Burrell traction engine etc) "Simplex" 0-6-0
i) Gauge or Scale: 5 inch gauge
j) Working Pressure (P_w): 100 psi
k) Limit (Safe Operating) Pressure (P_L): 110 psi ($P_L = P_w + 10\%$)

3. Items to be Examined and Tested: - tick box to confirm item/s fitted ☑ leave blank if not fitted

Safety Valve	SV1 ✓	SV2 ✓	SV3 ☐	SV4 ☐	Boiler Feed Check Valve	CV1 ✓	CV2 ✓	CV3 ✓	CV4 ☐	
Fusible Plug	FP1 ☐	FP2 ☐			Blow Down Valve	BDV1 ✓	BDV2 ☐			
Pressure Gauge	PG1 ✓				Boiler Water Feed Injector	INJ1 ✓	INJ2 ☐	INJ3 ☐		
Water Level Gauge	WLG1 ✓	WLG2 ☐			Boiler Water Feed Mechanical Pump	MP1 ✓	MP2 ☐			
Try Cock	TC1 ☐	TC2 ☐			Boiler Water Feed Hand Pump	HP1 ✓	HP2 ☐			
Superheater	SH1 ✓				Boiler Water Feed Steam/Electric Pump	FP1 ☐	FP2 ☐			

4. Special Requirements: – Identify any special requirements applicable to this system

5. Examinations:
5.1 A new boiler shall be examined in accordance with Sections 7 and 8 indicated in the Code. The new boiler shall comply with the requirements of the Pressure Equipment Regulations 1999 and subsequent Amendments where necessary.
5.2 A previously tested boiler shall be examined in accordance with Section 9 indicated in the Code.

6. Preparation for Test:
The boiler shall be prepared for test by the owner in accordance with Section 6 indicated in the Code

7. Initial Hydraulic Pressure Test: (Shell Test)
7.1 A new privately built boiler shall be subject to an Initial hydraulic pressure test in accordance with Section 10 indicated in the Code. The test pressure and duration of test shall be as indicated in the Code.
7.2 A commercially built boiler shall have been tested to the same Initial hydraulic pressure test values as indicated in the Code. A certificate of Hydraulic test shall have been provided by the manufacturer and will be accepted provided that it is accompanied by a CE Declaration of Conformity in accordance with the requirements of the Pressure Equipment Regulations 1999 where appropriate.
7.3 This test is valid for the life of the boiler unless the boiler is subject to repair or modification which would affect the structural integrity of the boiler. In this case the boiler shall be subject to a retest to the values indicated as the Initial hydraulic pressure test.

8. Subsequent Hydraulic Pressure Tests: (Repeat Tests)
Subsequent Hydraulic pressure tests shall be carried out after the completion of the Initial hydraulic pressure test and once all the relevant fittings have been attached to the boiler, in accordance with Section 10 indicated in the Code. The pressure test values, duration and periodicity shall be as indicated in the Code.

9. Steam Tests:
Steam tests shall be carried out in accordance with Section 11 indicated in the Code. The tests shall be carried out after the subsequent Hydraulic pressure test at the specified intervals indicated in the Code.

10. Records:
10.1 Record of Reviews and Modifications to the Written Scheme of Examination shall be undertaken by the Model Engineering Liaison Group only.
10.2 Record of Modifications to the System shall be recorded on a replacement Written Scheme of Examination.

11. Certification:
11.1 This unique Written Scheme of Examination (WSE) shall be used in conjunction with the formally approved Hydraulic and Steam Test Certificate issued by the relevant Federations, Associations and Societies identified in the Code.
11.2 All relevant information required by the Pressure Systems Safety Regulations 2000 shall be recorded on the appropriate certificates and supporting documentation.
11.3 This Written Scheme of Examination forms part of the package of documentation that shall be retained by the owner of the boiler and subsequently passed on to the new owner if the boiler is sold.
11.4 This Written Scheme of Examination and certification shall be retained in accordance with the requirements of the Pressure Systems Safety Regulations 2000, Regulation 14.

Name of Club/Society: Camberley MES **Affiliation Number of Club/Society:** 007

This Written Scheme of Examination is controlled by the Model Engineering Liaison Group whose Chartered Engineer is Mr W C Pearson CEng MIMechE.
The Controlling Engineer (as described in Pressure Systems Safety Regulations 2000 Regulation 8 Paragraph 106) for this scheme is: -

Controlling Engineer (Boiler Inspector) Name: Mick Sterbs **Signature:** M Sterbs

Date Written Scheme of Examination prepared: 1st September 2018

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Examination Certificate of a Pressure System

Pressure Systems Safety Regulations 2000

1. Relevant Organisation: (delete those not applicable)
7¼" Gauge Society / Northern Association of Model Engineers / Southern Federation of Model Engineering Societies

Certificate No.
C 167051
Written Scheme No.

2a) Owner's Name:

2b) Location of System: (i.e. location where examined)

3. Item/System Details: **A boiler built commercially after 30 May 2002 shall not be tested unless it carries appropriate CE marking (see BTC para 6.4)**

a) Serial/Boiler (System) Number:

b) Year Boiler Built:

c) Name of Boilermaker:

d) Boiler Material:

e) Type of Model: Railway Locomotive or Vehicle / Road Vehicle / Boat / Stationary Plant / Other (please specify)
(delete those not applicable)

f) Description:
(e.g. Romulus loco, Burrell traction engine etc)

g) Gauge or Scale:

h) Boiler volume in litres:

i) Bar litres of boiler:

j) Registration No:
(if Road Vehicle and one allocated by DVLA)

4. Examination Undertaken:

4a) Cold Examination and Hydraulic (Shell) Test Yes / No Note: Test Pressure is 2 times working pressure - see BTC Sections 7 & 8

Test Pressure Applied _____ psi for a Working Pressure (P_W) of _____ psi

4b) Cold Examination and Hydraulic (Repeat) Test Yes / No Note: Test Pressure is 1½ times working pressure - see BTC Section 9

Test Pressure Applied _____ psi for a Working Pressure (P_W) of _____ psi

4c) Cold Examination and Hydraulic Test carried forward from Certificate Number _____

Working Pressure (P_W) of _____ psi showing a Date next Cold Examination and Hydraulic Test due (i.e. hydraulic test expiry date) | DD | MM | YY | Strike through if no carried forward certificate

4d) Cold Examination and Steam Test Yes / No

5. System parts not Examined: (e.g. because cladding not removed)

(continue overleaf if necessary)

6. Repairs Needed and Timescale for Completion:

(continue overleaf if necessary)

7. Result of Examination:

7a) Cold Examination and Hydraulic (Shell) Test: .Pass / Fail / Not Undertaken .If 'Pass' valid for life of boiler & subject to Repeat Tests. .If 'Fail' complete Section 8 below

7b) Cold Examination and Hydraulic (Repeat) Test: .Pass / Fail / Not Undertaken .if 'Pass' complete 7c below .if 'Fail' complete Section 8 below

7c) Date next Cold Examination and Hydraulic Test due: (i.e. hydraulic test expiry date) | DD | MM | YY | Strike through If Repeat Hydraulic Test not undertaken

7d) Cold Examination and Steam Test: .Pass / Fail / Not Undertaken . if 'Pass' complete 7e and 7f below, if 'Fail' complete Section 8 below

7e) The safety valve/s were seen to blow freely at a pressure not greater than the stipulated Safe Operating Limit (P_W + 10%). It is my considered opinion that the System may be returned to service and operated at a Working Pressure (P_W) of: - **Working Pressure** psi Strike through if Steam Test not undertaken

7f) Date next Cold Examination and Steam Test is due: (i.e. steam test expiry date strike through if not undertaken) | DD | MM | YY | Note: The date of the next Cold Examination and Steam Test cannot be later than the date of the next Cold Examination and Hydraulic Test as shown in either 4c or 7c above

8. Notes: (eg 'Cladding Removed' including 'Other Observations', 'Reason for Fail' or 'Defects which may give rise to Imminent Danger')

(continue overleaf if necessary)

Name of Club/Society:

Affiliation Number of Club/Society:

Declaration: - I have concluded my examination of the System detailed above in the manner and to the extent described in the Examination and Testing of Miniature Steam Boilers Revised Edition 2012 and any subsequent revisions and in the Written Scheme of Examination and in any related report(s) and this is a true statement of the result of the examination. The record of the Examination and Test consists of this certificate and the related documentation.

Inspector Name:

Inspector Signature:

Witness Name:

Witness Signature:

Note: If the Inspector is authorised by his Club/Society to conduct tests without a witness write 'Not Required' (see Boiler Test Code paragraph 3.9f)

Date the Examination took place:

Date of this Certificate:

121122

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Hydraulic (Shell) Test

Examination Certificate of a Pressure System

Pressure Systems Safety Regulations 2000

1. Relevant Organisation: (delete those not applicable)
~~7¼" Gauge Society~~ / ~~Northern Association of Model Engineers~~ / Southern Federation of Model Engineering Societies

Certificate No. C 202881

Written Scheme No.

2a) Owner's Name: Albert Hall

2b) Location of System: (i.e. location where examined) Camberley MES

3. Item/System Details: **A boiler built commercially after 30 May 2002 shall not be tested unless it carries appropriate CE marking (see BTC para 6.4)**

a) Serial/Boiler (System) Number: SF 007 ABC

b) Year Boiler Built: 2018

c) Name of Boilermaker: Albert Hall

d) Boiler Material: Copper

e) Type of Model: (delete those not applicable) Railway Locomotive or ~~Vehicle / Road Vehicle / Boat / Stationary Plant / Other (please specify)~~

f) Description: (e.g. Romulus loco, Burrell traction engine etc) "Simplex" 0-6-0T

g) Gauge or Scale: 5"

h) Boiler volume in litres: 3

i) Bar litres of boiler: 21

j) Registration No: (if Road Vehicle and one allocated by DVLA)

4. Examination Undertaken:

4a) Cold Examination and Hydraulic (Shell) Test Yes / ~~No~~ Note: Test Pressure is 2 times working pressure - see BTC Sections 7 & 8
Test Pressure Applied 200 psi for a Working Pressure (P_W) of 100 psi

4b) Cold Examination and Hydraulic (Repeat) Test ~~Yes /~~ No Note: Test Pressure is 1½ times working pressure - see BTC Section 9
Test Pressure Applied _____ psi for a Working Pressure (P_W) of _____ psi

4c) Cold Examination and Hydraulic Test carried forward from Certificate Number _____

Working Pressure (P_W) of _____ psi showing a Date next Cold Examination and Hydraulic Test due (i.e. hydraulic test expiry date) DD MM YY Strike through if no carried forward certificate

4d) Cold Examination and Steam Test ~~Yes /~~ No

5. System parts not Examined: (e.g. because cladding not removed)

(continue overleaf if necessary)

6. Repairs Needed and Timescale for Completion:

(continue overleaf if necessary)

7. Result of Examination:

7a) Cold Examination and Hydraulic (Shell) Test: .Pass / ~~Fail / Not Undertaken~~ .If 'Pass' valid for life of boiler & subject to Repeat Tests. .If 'Fail' complete Section 8 below

7b) Cold Examination and Hydraulic (Repeat) Test: .~~Pass / Fail~~ / Not Undertaken .if 'Pass' complete 7c below .if 'Fail' complete Section 8 below

7c) Date next Cold Examination and Hydraulic Test due: (i.e. hydraulic test expiry date) DD MM YY Strike through If Repeat Hydraulic Test not undertaken

7d) Cold Examination and Steam Test: ~~.Pass / Fail~~ / Not Undertaken . if 'Pass' complete 7e and 7f below, if 'Fail' complete Section 8 below

7e) The safety valve/s were seen to blow freely at a pressure not greater than the stipulated Safe Operating Limit (P_W + 10%). It is my considered opinion that the System may be returned to service and operated at a Working Pressure (P_W) of: - Working Pressure _____ psi Strike through if Steam Test not undertaken

7f) Date next Cold Examination and Steam Test is due: (i.e. steam test expiry date strike through if not undertaken) DD MM YY Note: The date of the next Cold Examination and Steam Test cannot be later than the date of the next Cold Examination and Hydraulic Test as shown in either 4c or 7c above

8. Notes: (eg 'Cladding Removed' including 'Other Observations', 'Reason for Fail' or 'Defects which may give rise to Imminent Danger')

BARE SHELL

(continue overleaf if necessary)

Name of Club/Society: Camberley MES **Affiliation Number of Club/Society:** 007

Declaration: - I have concluded my examination of the System detailed above in the manner and to the extent described in the Examination and Testing of Miniature Steam Boilers Revised Edition 2012 and any subsequent revisions and in the Written Scheme of Examination and in any related report(s) and this is a true statement of the result of the examination. The record of the Examination and Test consists of this certificate and the related documentation.

Inspector Name: Bill Stickers **Inspector Signature:** W Stickers

Witness Name: Max Headroom **Witness Signature:** Max Headroom
Note: If the Inspector is authorised by his Club/Society to conduct tests without a witness write 'Not Required' (see Boiler Test Code paragraph 3.9f)

Date the Examination took place: 1/3/18 **Date of this Certificate:** 1/3/18

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System (Fittings) and 1st Steam Test

Examination Certificate of a Pressure System

Pressure Systems Safety Regulations 2000

1. Relevant Organisation: (delete those not applicable)
~~7¼" Gauge Society~~ / ~~Northern Association of Model Engineers~~ / Southern Federation of Model Engineering Societies

Certificate No. C 202884

2a) Owner's Name: Albert Hall

2b) Location of System: (i.e. location where examined) Camberley MES

Written Scheme No. WOO5789

3. Item/System Details: **A boiler built commercially after 30 May 2002 shall not be tested unless it carries appropriate CE marking (see BTC para 6.4)**

a) Serial/Boiler (System) Number: SF 007 ABC **b) Year Boiler Built:** 2018

c) Name of Boilermaker: Albert Hall **d) Boiler Material:** Copper

e) Type of Model: (delete those not applicable) Railway Locomotive or ~~Vehicle / Road Vehicle / Boat / Stationary Plant / Other (please specify)~~

f) Description: (e.g. Romulus loco, Burrell traction engine etc) "Simplex" 0-6-0T **g) Gauge or Scale:** 5"

h) Boiler volume in litres: 3 **i) Bar litres of boiler:** 21 **j) Registration No:** (if Road Vehicle and one allocated by DVLA)

4. Examination Undertaken:

4a) Cold Examination and Hydraulic (Shell) Test ~~Yes~~ / No Note: Test Pressure is 2 times working pressure - see BTC Sections 7 & 8
Test Pressure Applied _____ psi for a Working Pressure (P_W) of _____ psi

4b) Cold Examination and Hydraulic (Repeat) Test Yes / ~~No~~ Note: Test Pressure is 1½ times working pressure - see BTC Section 9
Test Pressure Applied 150 psi for a Working Pressure (P_W) of 100 psi

4c) Cold Examination and Hydraulic Test carried forward from Certificate Number _____

Working Pressure (P_W) of _____ psi showing a Date next Cold Examination and Hydraulic Test due (i.e. hydraulic test expiry date) DD MM YY Strike through if no carried forward certificate

4d) Cold Examination and Steam Test Yes / ~~No~~

5. System parts not Examined: (e.g. because cladding not removed)

(continue overleaf if necessary)

6. Repairs Needed and Timescale for Completion:

(continue overleaf if necessary)

7. Result of Examination:

7a) Cold Examination and Hydraulic (Shell) Test: ~~Pass / Fail~~ / Not Undertaken .If 'Pass' valid for life of boiler & subject to Repeat Tests. .If 'Fail' complete Section 8 below

7b) Cold Examination and Hydraulic (Repeat) Test: .Pass / ~~Fail / Not Undertaken~~ .if 'Pass' complete 7c below .if 'Fail' complete Section 8 below

7c) Date next Cold Examination and Hydraulic Test due: (i.e. hydraulic test expiry date) 01 (DD) 09 (MM) 22 (YY) Strike through If Repeat Hydraulic Test not undertaken

7d) Cold Examination and Steam Test: .Pass / ~~Fail / Not Undertaken~~ . if 'Pass' complete 7e and 7f below, if 'Fail' complete Section 8 below

7e) The safety valve/s were seen to blow freely at a pressure not greater than the stipulated Safe Operating Limit (P_W + 10%). It is my considered opinion that the System may be returned to service and operated at a Working Pressure (P_W) of: - Working Pressure 100 psi Strike through if Steam Test not undertaken

7f) Date next Cold Examination and Steam Test is due: (i.e. steam test expiry date strike through if not undertaken) 01 (DD) 09 (MM) 19 (YY) Note: The date of the next Cold Examination and Steam Test cannot be later than the date of the next Cold Examination and Hydraulic Test as shown in either 4c or 7c above

8. Notes: (eg 'Cladding Removed' including 'Other Observations', 'Reason for Fail' or 'Defects which may give rise to Imminent Danger')

R Jones

(continue overleaf if necessary)

Name of Club/Society: Camberley MES **Affiliation Number of Club/Society:** 007

Declaration: - I have concluded my examination of the System detailed above in the manner and to the extent described in the Examination and Testing of Miniature Steam Boilers Revised Edition 2012 and any subsequent revisions and in the Written Scheme of Examination and in any related report(s) and this is a true statement of the result of the examination. The record of the Examination and Test consists of this certificate and the related documentation.

Inspector Name: Bill Stickers **Inspector Signature:** W Stickers

Witness Name: Max Headroom **Witness Signature:** Max Headroom
Note: If the Inspector is authorised by his Club/Society to conduct tests without a witness write 'Not Required' (see Boiler Test Code paragraph 3.9f)

Date the Examination took place: 1/9/18 **Date of this Certificate:** 1/9/18

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2nd Steam Test

Examination Certificate of a Pressure System

Pressure Systems Safety Regulations 2000

1. Relevant Organisation: (delete those not applicable)
~~7¼" Gauge Society~~ / ~~Northern Association of Model Engineers~~ / Southern Federation of Model Engineering Societies

Certificate No. C 202888

2a) Owner's Name: Albert Hall

2b) Location of System: (i.e. location where examined) Camberley MES

Written Scheme No. W005789

3. Item/System Details: A boiler built commercially after 30 May 2002 shall not be tested unless it carries appropriate CE marking (see BTC para 6.4)

a) Serial/Boiler (System) Number: SF 007 ABC

b) Year Boiler Built: 2018

c) Name of Boilermaker: Albert Hall

d) Boiler Material: Copper

e) Type of Model: Railway Locomotive or ~~Vehicle / Road Vehicle / Boat / Stationary Plant / Other (please specify)~~
(delete those not applicable)

f) Description: "Simplex" 0-6-0T
(e.g. Romulus loco, Burrell traction engine etc)

g) Gauge or Scale: 5"

h) Boiler volume in litres: 3

i) Bar litres of boiler: 21

j) Registration No:
(if Road Vehicle and one allocated by DVLA)

4. Examination Undertaken:

4a) Cold Examination and **Hydraulic (Shell) Test** ~~Yes~~ / No Note: Test Pressure is 2 times working pressure - see BTC Sections 7 & 8
Test Pressure Applied _____ psi for a Working Pressure (P_W) of _____ psi

4b) Cold Examination and **Hydraulic (Repeat) Test** ~~Yes~~ / No Note: Test Pressure is 1½ times working pressure - see BTC Section 9
Test Pressure Applied _____ psi for a Working Pressure (P_W) of _____ psi

4c) Cold Examination and Hydraulic Test carried forward from Certificate Number C202884

Working Pressure (P_W) of 100 psi showing a Date next Cold Examination and Hydraulic Test due (i.e. hydraulic test expiry date) 01 (DD) 09 (MM) 22 (YY) Strike through if no carried forward certificate

4d) Cold Examination and **Steam Test** Yes / ~~No~~

5. System parts not Examined: (e.g. because cladding not removed)

(continue overleaf if necessary)

6. Repairs Needed and Timescale for Completion:

(continue overleaf if necessary)

7. Result of Examination:

7a) Cold Examination and **Hydraulic (Shell) Test:** ~~Pass / Fail~~ / Not Undertaken .If 'Pass' valid for life of boiler & subject to Repeat Tests. .If 'Fail' complete Section 8 below

7b) Cold Examination and **Hydraulic (Repeat) Test:** ~~Pass / Fail~~ / Not Undertaken .if 'Pass' complete 7c below .if 'Fail' complete Section 8 below

7c) Date next Cold Examination and **Hydraulic Test due**: (i.e. hydraulic test expiry date) ___ (DD) ___ (MM) ___ (YY) Strike through If Repeat Hydraulic Test not undertaken

7d) Cold Examination and **Steam Test:** .Pass / ~~Fail / Not Undertaken~~ . if 'Pass' complete 7e and 7f below, if 'Fail' complete Section 8 below

7e) The safety valve/s were seen to blow freely at a pressure not greater than the stipulated Safe Operating Limit (P_W + 10%). It is my considered opinion that the System may be returned to service and operated at a Working Pressure (P_W) of: - **Working Pressure** 100 psi Strike through if Steam Test not undertaken

7f) Date next Cold Examination and **Steam Test is due**: (i.e. steam test expiry date strike through if not undertaken) 01 (DD) 09 (MM) 20 (YY) Note: The date of the next Cold Examination and Steam Test cannot be later than the date of the next Cold Examination and Hydraulic Test as shown in either 4c or 7c above

8. Notes: (eg 'Cladding Removed' including 'Other Observations', 'Reason for Fail' or 'Defects which may give rise to Imminent Danger')

(continue overleaf if necessary)

Name of Club/Society: Camberley MES **Affiliation Number of Club/Society:** 007

Declaration: - I have concluded my examination of the System detailed above in the manner and to the extent described in the Examination and Testing of Miniature Steam Boilers Revised Edition 2012 and any subsequent revisions and in the Written Scheme of Examination and in any related report(s) and this is a true statement of the result of the examination. The record of the Examination and Test consists of this certificate and the related documentation.

Inspector Name: Bill Stickers **Inspector Signature:** W Stickers

Witness Name: Max Headroom **Witness Signature:** Max Headroom
Note: If the Inspector is authorised by his Club/Society to conduct tests without a witness write 'Not Required' (see Boiler Test Code paragraph 3.9f)

Date the Examination took place: 1/9/19 **Date of this Certificate:** 1/9/19

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3rd Steam Test

Examination Certificate of a Pressure System

Pressure Systems Safety Regulations 2000

1. Relevant Organisation: (delete those not applicable)
~~7¼" Gauge Society~~ / ~~Northern Association of Model Engineers~~ / Southern Federation of Model Engineering Societies

Certificate No. C 202894

2a) Owner's Name: Albert Hall

2b) Location of System: (i.e. location where examined) Camberley MES

Written Scheme No. WOO5789

3. Item/System Details: **A boiler built commercially after 30 May 2002 shall not be tested unless it carries appropriate CE marking (see BTC para 6.4)**

a) Serial/Boiler (System) Number: SF 007 ABC

b) Year Boiler Built: 2018

c) Name of Boilermaker: Albert Hall

d) Boiler Material: Copper

e) Type of Model: (delete those not applicable) Railway Locomotive or ~~Vehicle / Road Vehicle / Boat / Stationary Plant / Other (please specify)~~

f) Description: (e.g. Romulus loco, Burrell traction engine etc) "Simplex" 0-6-0T

g) Gauge or Scale: 5"

h) Boiler volume in litres: 3

i) Bar litres of boiler: 21

j) Registration No: (if Road Vehicle and one allocated by DVLA)

4. Examination Undertaken:

4a) Cold Examination and Hydraulic (Shell) Test ~~Yes~~ / No Note: Test Pressure is 2 times working pressure - see BTC Sections 7 & 8

Test Pressure Applied _____ psi for a Working Pressure (P_W) of _____ psi

4b) Cold Examination and Hydraulic (Repeat) Test ~~Yes~~ / No Note: Test Pressure is 1½ times working pressure - see BTC Section 9

Test Pressure Applied _____ psi for a Working Pressure (P_W) of _____ psi

4c) Cold Examination and Hydraulic Test carried forward from Certificate Number C202884

Working Pressure (P_W) of 100 psi showing a Date next Cold Examination and Hydraulic Test due (i.e. hydraulic test expiry date) 01 (DD) 09 (MM) 22 (YY) Strike through if no carried forward certificate

4d) Cold Examination and Steam Test Yes / ~~No~~

5. System parts not Examined: (e.g. because cladding not removed)

(continue overleaf if necessary)

6. Repairs Needed and Timescale for Completion:

(continue overleaf if necessary)

7. Result of Examination:

7a) Cold Examination and Hydraulic (Shell) Test: ~~Pass / Fail~~ / Not Undertaken .If 'Pass' valid for life of boiler & subject to Repeat Tests. .If 'Fail' complete Section 8 below

7b) Cold Examination and Hydraulic (Repeat) Test: ~~Pass / Fail~~ / Not Undertaken .if 'Pass' complete 7c below .if 'Fail' complete Section 8 below

7c) Date next Cold Examination and Hydraulic Test due: (i.e. hydraulic test expiry date) ___ (DD) ___ (MM) ___ (YY) Strike through If Repeat Hydraulic Test not undertaken

7d) Cold Examination and Steam Test: .Pass / ~~Fail / Not Undertaken~~ . if 'Pass' complete 7e and 7f below, if 'Fail' complete Section 8 below

7e) The safety valve/s were seen to blow freely at a pressure not greater than the stipulated Safe Operating Limit (P_W + 10%). It is my considered opinion that the System may be returned to service and operated at a Working Pressure (P_W) of: - Working Pressure 100 psi Strike through if Steam Test not undertaken

7f) Date next Cold Examination and Steam Test is due: (i.e. steam test expiry date strike through if not undertaken) 01 (DD) 09 (MM) 21 (YY) Note: The date of the next Cold Examination and Steam Test cannot be later than the date of the next Cold Examination and Hydraulic Test as shown in either 4c or 7c above

8. Notes: (eg 'Cladding Removed' including 'Other Observations', 'Reason for Fail' or 'Defects which may give rise to Imminent Danger')

(continue overleaf if necessary)

Name of Club/Society: Camberley MES **Affiliation Number of Club/Society:** 007

Declaration: - I have concluded my examination of the System detailed above in the manner and to the extent described in the Examination and Testing of Miniature Steam Boilers Revised Edition 2012 and any subsequent revisions and in the Written Scheme of Examination and in any related report(s) and this is a true statement of the result of the examination. The record of the Examination and Test consists of this certificate and the related documentation.

Inspector Name: Bill Stickers **Inspector Signature:** W Stickers

Witness Name: Max Headroom **Witness Signature:** Max Headroom

Note: If the Inspector is authorised by his Club/Society to conduct tests without a witness write 'Not Required' (see Boiler Test Code paragraph 3.9f)

Date the Examination took place: 1/9/20 **Date of this Certificate:** 1/9/20

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4th Steam Test

Examination Certificate of a Pressure System

Pressure Systems Safety Regulations 2000

1. Relevant Organisation: (delete those not applicable)
~~7¼" Gauge Society~~ / ~~Northern Association of Model Engineers~~ / Southern Federation of Model Engineering Societies

Certificate No. C 202900

2a) Owner's Name: Albert Hall

2b) Location of System: (i.e. location where examined) Camberley MES

Written Scheme No. W005789

3. Item/System Details: A boiler built commercially after 30 May 2002 shall not be tested unless it carries appropriate CE marking (see BTC para 6.4)

a) Serial/Boiler (System) Number: SF 007 ABC

b) Year Boiler Built: 2018

c) Name of Boilermaker: Albert Hall

d) Boiler Material: Copper

e) Type of Model: (delete those not applicable) Railway Locomotive ~~or Vehicle / Road Vehicle / Boat / Stationary Plant / Other (please specify)~~

f) Description: (e.g. Romulus loco, Burrell traction engine etc) "Simplex" 0-6-0T

g) Gauge or Scale: 5"

h) Boiler volume in litres: 3

i) Bar litres of boiler: 21

j) Registration No: (If Road Vehicle and one allocated by DVLA)

4. Examination Undertaken:

4a) Cold Examination and Hydraulic (Shell) Test ~~Yes~~ / No Note: Test Pressure is 2 times working pressure - see BTC Sections 7 & 8

Test Pressure Applied _____ psi for a Working Pressure (P_W) of _____ psi

4b) Cold Examination and Hydraulic (Repeat) Test ~~Yes~~ / No Note: Test Pressure is 1½ times working pressure - see BTC Section 9

Test Pressure Applied _____ psi for a Working Pressure (P_W) of _____ psi

4c) Cold Examination and Hydraulic Test carried forward from Certificate Number C202884

Working Pressure (P_W) of 100 psi showing a Date next Cold Examination and Hydraulic Test due (i.e. hydraulic test expiry date) 01 (DD) 09 (MM) 22 (YY) Strike through if no carried forward certificate

4d) Cold Examination and Steam Test Yes / ~~No~~

5. System parts not Examined: (e.g. because cladding not removed)

(continue overleaf if necessary)

6. Repairs Needed and Timescale for Completion:

(continue overleaf if necessary)

7. Result of Examination:

7a) Cold Examination and Hydraulic (Shell) Test: ~~Pass / Fail~~ / Not Undertaken .If 'Pass' valid for life of boiler & subject to Repeat Tests. .If 'Fail' complete Section 8 below

7b) Cold Examination and Hydraulic (Repeat) Test: ~~Pass / Fail~~ / Not Undertaken .if 'Pass' complete 7c below .if 'Fail' complete Section 8 below

7c) Date next Cold Examination and Hydraulic Test due: (i.e. hydraulic test expiry date) ___ (DD) ___ (MM) ___ (YY) Strike through If Repeat Hydraulic Test not undertaken

7d) Cold Examination and Steam Test: .Pass / ~~Fail / Not Undertaken~~ . if 'Pass' complete 7e and 7f below, if 'Fail' complete Section 8 below

7e) The safety valve/s were seen to blow freely at a pressure not greater than the stipulated Safe Operating Limit (P_W + 10%). It is my considered opinion that the System may be returned to service and operated at a Working Pressure (P_W) of: - Working Pressure 100 psi Strike through if Steam Test not undertaken

7f) Date next Cold Examination and Steam Test is due: (i.e. steam test expiry date strike through if not undertaken) 01 (DD) 09 (MM) 22 (YY) Note: The date of the next Cold Examination and Steam Test cannot be later than the date of the next Cold Examination and Hydraulic Test as shown in either 4c or 7c above

8. Notes: (eg 'Cladding Removed' including 'Other Observations', 'Reason for Fail' or 'Defects which may give rise to Imminent Danger')

(continue overleaf if necessary)

Name of Club/Society: Camberley MES **Affiliation Number of Club/Society:** 007

Declaration: - I have concluded my examination of the System detailed above in the manner and to the extent described in the Examination and Testing of Miniature Steam Boilers Revised Edition 2012 and any subsequent revisions and in the Written Scheme of Examination and in any related report(s) and this is a true statement of the result of the examination. The record of the Examination and Test consists of this certificate and the related documentation.

Inspector Name: Bill Stickers **Inspector Signature:** W Stickers

Witness Name: Max Headroom **Witness Signature:** Max Headroom

Note: If the Inspector is authorised by his Club/Society to conduct tests without a witness write 'Not Required' (see Boiler Test Code paragraph 3.9f)

Date the Examination took place: 1/9/21 **Date of this Certificate:** 1/9/21

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Repeat Hydraulic Test (Start of Next Cycle)

Examination Certificate of a Pressure System

Pressure Systems Safety Regulations 2000

1. Relevant Organisation: (delete those not applicable)
~~7¼" Gauge Society~~ / ~~Northern Association of Model Engineers~~ / Southern Federation of Model Engineering Societies

Certificate No. C 202908

2a) Owner's Name: Albert Hall

2b) Location of System: (i.e. location where examined) Camberley MES

Written Scheme No. W005789

3. Item/System Details: A boiler built commercially after 30 May 2002 shall not be tested unless it carries appropriate CE marking (see BTC para 6.4)

a) Serial/Boiler (System) Number: SF 007 ABC

b) Year Boiler Built: 2018

c) Name of Boilermaker: Albert Hall

d) Boiler Material: Copper

e) Type of Model: (delete those not applicable) Railway Locomotive or ~~Vehicle / Road Vehicle / Boat / Stationary Plant / Other (please specify)~~

f) Description: (e.g. Romulus loco, Burrell traction engine etc) "Simplex" 0-6-0T

g) Gauge or Scale: 5"

h) Boiler volume in litres: 3

i) Bar litres of boiler: 21

j) Registration No: (if Road Vehicle and one allocated by DVLA)

4. Examination Undertaken:

4a) Cold Examination and Hydraulic (Shell) Test ~~Yes~~ / No Note: Test Pressure is 2 times working pressure - see BTC Sections 7 & 8

Test Pressure Applied _____ psi for a Working Pressure (P_W) of _____ psi

4b) Cold Examination and Hydraulic (Repeat) Test Yes / ~~No~~ Note: Test Pressure is 1½ times working pressure - see BTC Section 9

Test Pressure Applied 150 psi for a Working Pressure (P_W) of 100 psi

4c) Cold Examination and Hydraulic Test carried forward from Certificate Number _____

Working Pressure (P_W) of _____ psi showing a Date next Cold Examination and Hydraulic Test due (i.e. hydraulic test expiry date) DD ___ MM ___ YY ___ Strike through if no carried forward certificate

4d) Cold Examination and Steam Test Yes / ~~No~~

5. System parts not Examined: (e.g. because cladding not removed)

(continue overleaf if necessary)

6. Repairs Needed and Timescale for Completion:

(continue overleaf if necessary)

7. Result of Examination:

7a) Cold Examination and Hydraulic (Shell) Test: ~~Pass / Fail~~ / Not Undertaken .If 'Pass' valid for life of boiler & subject to Repeat Tests. .If 'Fail' complete Section 8 below

7b) Cold Examination and Hydraulic (Repeat) Test: .Pass / ~~Fail / Not Undertaken~~ .if 'Pass' complete 7c below .if 'Fail' complete Section 8 below

7c) Date next Cold Examination and Hydraulic Test due: (i.e. hydraulic test expiry date) DD 01 MM 09 YY 26 Strike through If Repeat Hydraulic Test not undertaken

7d) Cold Examination and Steam Test: .Pass / ~~Fail / Not Undertaken~~ . if 'Pass' complete 7e and 7f below, if 'Fail' complete Section 8 below

7e) The safety valve/s were seen to blow freely at a pressure not greater than the stipulated Safe Operating Limit (P_W + 10%). It is my considered opinion that the System may be returned to service and operated at a Working Pressure (P_W) of: - Working Pressure 100 psi Strike through if Steam Test not undertaken

7f) Date next Cold Examination and Steam Test is due: (i.e. steam test expiry date strike through if not undertaken) DD 01 MM 09 YY 23 Note: The date of the next Cold Examination and Steam Test cannot be later than the date of the next Cold Examination and Hydraulic Test as shown in either 4c or 7c above

8. Notes: (eg 'Cladding Removed' including 'Other Observations', 'Reason for Fail' or 'Defects which may give rise to Imminent Danger')

(continue overleaf if necessary)

Name of Club/Society: Camberley MES **Affiliation Number of Club/Society:** 007

Declaration: - I have concluded my examination of the System detailed above in the manner and to the extent described in the Examination and Testing of Miniature Steam Boilers Revised Edition 2012 and any subsequent revisions and in the Written Scheme of Examination and in any related report(s) and this is a true statement of the result of the examination. The record of the Examination and Test consists of this certificate and the related documentation.

Inspector Name: Bill Stickers **Inspector Signature:** W Stickers

Witness Name: Max Headroom **Witness Signature:** Max Headroom

Note: If the Inspector is authorised by his Club/Society to conduct tests without a witness write 'Not Required' (see Boiler Test Code paragraph 3.9f)

Date the Examination took place: 1/9/22 **Date of this Certificate:** 1/9/22

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The Pressure Systems Safety Regulations 2000

Statutory Instrument 2000 No 128 Regulation 8

Written Scheme of Examination for a Boiler below 3 bar litres

Certificate No. SC 270168

1. Introduction

1.1 This Written Scheme of Examination has been written in order to comply wit the requirements of the Pressure Systems Safety Regulations 2000 Regulation 8

1.2 All examination and testing shall be carried out in accordance with the requirements of the formally issued Boiler Test Code Entitled The Examination and Testing of Miniature Steam Boilers, Boiler Test Code BTC 2012 or the latest edition relevant at the time of the test. The pressure test values and the periodicity of test shall be in accordance with the Code and with the requirements indicated in paragraph 1.6 of the Boiler Test Code BTC2012

2. Test Requirements

2.1 Examination and Testing shall be carried out in accordance with the requirements indicated in Section 14 of the Boiler Test Code BTC2012

3. Boiler Material (Boiler Inspector to delete material not used) **Copper** ~~**Brass**~~

4. Items to be examined and tested. (Boiler Inspector to delete items not fitted)

Safety Valve **SV1** Pressure Gauge **PG1** Water Level Gauge **WLG1** Boiler Water Feed Pump ~~**MP1**~~

5. Certification

5.1 This unique Written Scheme of Examination (WSE) shall be used in conjunction with the formally approved Hydraulic and Steam Test Certificate issued by the relevant Federations and Associations identified in the Code

5.2. All relevant information required by the Pressure Systems Safety Regulations 2000 shall be recorded on the appropriate certificate and supporting documentation.

5.3 This Written Scheme of Examination forms part of the package of documentation that shall be retained by the owner of the boiler and subsequently passed to the new owner if the boiler is sold.

5.4 This Written Scheme of Examination and certification shall be retained in accordance with the requirements of the Pressure Systems Safety Regulations 2000 Regulation 14.

This Written Scheme of Examination is controlled by the Model Engineering Liaison Group whose Chartered Engineer is Mr W C Pearson CEng MIMechE. The controlling engineer (Boiler Inspector) as described in Pressure Systems Safety Regulations 2000 Regulation 8 Paragraph 106 for the scheme is: -

Boiler Inspector Name: Albert Hall **Signature:** *A Hall* **Date Prepared:** 13 Sept 2013

CERTIFICATE OF ANNUAL INSPECTION AND STEAM TEST FOR BOILERS BELOW 3.00 bar litres

Name of Club/Society Camberley MES Number 007

Box A

Boiler Identity No. ME 1243
Date of Construction 3 Dec 2002
Description of model Delilah "Lord Raglan"
Manufacturer Mendip Engineering
Hydraulic (Shell Test) 120 psi/~~bar~~
Test Date 6 Feb 2003
Hydraulic (Repeat Test) 90 psi
Test Date 13 Sept 2003
Working Pressure 60 psi/~~bar~~
Volume of boiler 0.3 litres 1.24 bar litres

Box B

Previous Certificate No. SC 271023
Date of test 27 May 2017
Date of expiry 26 May 2018
Pressure gauge confirmed working YES/~~NO~~
Marked working pressure 60 psi/~~bar~~
Safety valves seen to operate 60 psi/~~bar~~
Repairs (if any) and the date by which they should be carried out (note on the reverse)
Gas Tank Serial Number GT 1843
Safeguard Test 15 Jul 2001

Boiler Inspector (Block capitals) Albert Hall Signature *A Hall*

Witness (Block capitals) Bill Stickers Signature *B Stickers*

Owner (Block capitals) Terry Bull Signature *T Bull*

In signing this certificate the owner accepts that it is his/her responsibility to maintain the boiler in a safe working condition at all times. The boiler may only be used if the owner is in possession of a valid steam test certificate. THE BOILER INSPECTOR ACCEPTS NO LIABILITY IN REGARD TO THE USE AND MAINTENANCE OF THE BOILER. After its expiry, this certificate should be retained as a record.

2012 issue 05

130730

THE NORTHERN ASSOCIATION OF MODEL ENGINEERS

REPORT OF EXAMINATION / TEST OF A REFILLABLE LPG TANK

This form is to be completed and **retained** by the boiler inspector on examination / test of an LPG tank. Please **print** clearly in the relevant boxes.

Part 1 LPG tank details

1. Name of owner.	2. LPG tank identity.
3. N.A.M.E. Society Number.	4. Material used to construct tank.
5. Examination Form Number. (eg. N123-12345, ie. the Society number followed by a serial number)	6. Builder (if known).
7. Fuel to be used. BUTANE % / PROPANE %	8. Date of construction (if known).

Part 2 Hydraulic Test (see section 7. in the BTC 2018, Vol. 3))

9. Date of visual inspection before hydraulic test.	10. Declared working pressure.
11. The test pressure is to be 400psi as specified in the Boiler Test Code 2018, Volume 3, para. 7.3.	12. Date of hydraulic test.
13. Inspector's comments, if any.	14. A repeat hydraulic test is not required unless the LPG tank is altered or repaired in any way when it must be treated as if it were a new tank (BTC 2018 Vol. 3. para. 6.2).
	15. Signature of Inspector.
	16. Signature of Witness.

Please report this hydraulic test of a refillable LPG tank to the N.A.M.E. Boiler Registrar using either the postal reporting form or its equivalent email form. Fill in only those boxes which apply to the above hydraulic test (Name of owner, Society number, LPG tank identity and hydraulic test date).

Part 3 Safeguard Test (see section 8 in the BTC 2018, Vol. 3)

17. Date of Safeguard Test	18. We the undersigned certify that on the above dates the LPG tank, including fittings and attachments was examined and tested according to N.A.M.E.'s relevant Boiler Test Code. The above is an accurate and true record of the results.
19. Signature of Inspector.	20. Signature of Witness.

NAME LPG CERTIFICATE

THE NORTHERN ASSOCIATION OF MODEL ENGINEERS
LPG TANK TEST CERTIFICATE

Issuing Society		
Name of Owner	N.A.M.E. Society No. **N**	Date of Issue
Address of Owner	Certificate No.	Continued from Cert. No.
	Tank Material	Working Pressure
Signature of Owner	Date Built	Initial Test Pressure
LPG Tank Identity No. Identity No.	Builder	Retest Pressure
NOTES. The Inspectors accept no liability on the grounds of this pressure test certificate. The Owner and / or User of this LPG Tank remain solely responsible for its safe use in all circumstances.		

Certificate front.

DETAILS OF TESTS

Test No.	Hydraulic Test Date	Working Pressure	Test Pressure	VALID UNTIL	Inspectors Signatures
Initial Test					.....
Retest No. 1					.....
Retest No. 2					.....
Retest No. 3					.....
Retest No. 4					.....
Retest No. 5					.....
Retest No. 6					.....
Retest No. 7					.....

Certificate back.

CERTIFICATE OF TEST AND INSPECTION OF A LIQUID PETROLEUM GAS TANK Serial Number SFLPG- . . . . . .

Name of Club/Society . . . . . Number . . . . . .

LPG TANK DETAILS

Gas tank identity number . . . . . .
Material of construction . . . . . .
Date of construction . . . . . .
Manufacturer. . . . . .

FUEL MIXTURE

BUTANE . . . . . % PROPANE . . . . . %
Working pressure at 20°C . . . . . psi/bar
Volume of gas tank . . . . . ml

INITIAL HYDRAULIC TEST

(Copy from original initial certificate for annual safeguard tests)

Initial hydraulic test pressure . . . . . psi/bar
(Test pressure shall be 400 psi / 27.6 bar. Maximum propane content 40%)

Date of test . . . . . .

INITIAL / ANNUAL SAFEGUARD TEST

(Strike out as appropriate)

Date of test . . . . . .
Result of test . . . . . .
Date of expiry . . . . . .

Inspector	(Block capitals)	Signature . . . . .
Witness	(Block capitals)	Signature . . . . .
Owner	(Block capitals)	Signature . . . . .

In signing this certificate the owner accepts that it is his/her responsibility to maintain the LPG tank in a safe working condition at all times. The LPG Tank may only be used if the owner is in possession of a valid test certificate. NOTE THAT THE INSPECTOR ACCEPTS NO LIABILITY IN REGARD TO THE USE AND MAINTENANCE OF THE LPG TANK. This certificate should be retained as a record.

2018 Issue 04

FEDERATION OF MODEL ENGINEERING SOCIETIES

gastank_4.doc

This certificate is available to download from www.fmes.org.uk and will be found in the section on pressure vessel testing.

A proposal for a common certificate based on that above has been made; it will need to be assessed by the MELG. If accepted it will then be used by both the FMES and NAME thus the certificates in use at present will no longer needed but will still be valid until the expiry dates.

G1MRA and 16mm NGM have opted to use an un-numbered certificate which can be downloaded from their websites on the internet. This certificate is shewn on the next two pages:

Record of Inspection and Safety Checks

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

Certificate Number
.....

This document is used to record the annual check for boilers below the 3.0 bar litre limit and/or LPG gas tanks below 250 ml capacity. All examination and testing shall be carried out in accordance with the requirements of The Boiler Test Code 2018, Volume 2 (small boilers) and/or Volume 3 (gas tanks), which along with this document constitute the **Written Scheme of Examination**. This Written Scheme of Examination complies with the requirements of the Pressure Systems Safety Regulations 2000, Regulation 8. This Written Scheme is controlled by the Model Engineering Liaison Group whose Chartered Engineer is Mr W C Pearson CEng MIMechE. This certificate applies to the boiler and/or gas tank at the time of test only.

Certification; This document may be used in conjunction with any pressure test certificate/documentation issued by a boiler/tank manufacturer. This document along with the certification from the manufacturer shall be retained by the owner of the boiler/tank/model and subsequently passed on to any new owner of the boiler/tank/model. Inspector(s) will retain a record of the Test and Examination in their personal record system. Their record will establish the Certificate Number, boiler/tank identity mark, Owner, model and the date of inspection.

Certificate applies to a Boiler only ☐ **Certificate applies to a Gas Tank only** ☐ **Certificate applies to both a Boiler and Gas Tank within the same model** ☐

Record of Annual Inspection and Safety Check

Items to be Examined Annually (check applicable boxes)

Safety Valve ☐ Pressure Gauge ☐ Water Level Gauge ☐ Boiler Water Feed pump ☐

Is pressure gauge fitted **YES/NO**	Range (if fitted) 0 -	**Safety Valve set to lift at.....psi** **Pressure Gauge redlined at.....psi**	

Date of inspection	Location	General Condition of boiler, pipework and fittings	Safety Valve lifts at	Gas Tank Safety Check if fitted	Inspected by: Signature	Witnessed by: Signature	Expiry Date	Comments, advice to owner, areas of concern, etc.

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

The table below provides a summary of the tests required by the various types of small boilers below 3 bar-litres. The clauses refer to those found in the BTC, Vol.2.

2018 Boiler Test Code - Vol 2 - Summary

Type of test / Boiler type	Clause 6 - Init ial Test New Boilers Init ial Test	 Repeat Hyd	Safety / Steam test
Copper	2 x Pw	1.5 x Pw	Yes
Clause	5.6 \ 6.5	6.6	13.1.2
Validity	Lifet ime	See note	14 months
Clause	6.5		13.2.1
Class LO (< 2 bar)	Not Required	Not Required	Yes
Clause	14.1.1	14.1.1	13.1.2
Validity	-	-	14 months
Clause			13.2.1
Class LS (< 2 bar)	2 x Pw	1.5 x Pw	Yes
Clause	5.6 \ 6.5	6.6	13.1.2
Validity	Lifet ime	See note	14 months
Clause	6.5		13.2.1
High Pressure	2 x Pw	1.5 x Pw	Yes
Clause	5.6 \ 6.5	6.6	13.1.2 \14.1.3
Validity	Lifet ime	See note	14 months
Clause	6.5		13.2.1
		1.5 x Pw	
Brass	2 x Pw		Yes
Clause	5.6 \ 6.5	6.6	13.1.2
Validity	Lifet ime	3 years	14 months
Clause	6.5	14.2	13.2.1
Be aware - 13.1.5 b and 13.2.2.2 but see 13.2.2			Note: Clause 13.2 - 1st Steam test by boiler inspector, subsequent steam tests by owner!
Note:	The term "Init ial Test" refers to both 2 x Pw and 1.5 x Pw test ing being undertaken See Clauses 6.5 & 6.6. The cert f icate is valid for the lifet ime of the boiler. See Clause 6.5		

Revised Dec 2022