

**The  
EXAMINATION & TESTING  
of  
MINIATURE STEAM BOILERS  
  
(Revised Edition 2012)**

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# 1 Introduction.

- 1.1 This Test Code presumes that the model or miniature boilers are maintained and operated to at least the minimum standards as set out in Section 13 of the Code. Any failure to maintain and/or operate the boiler to those minimum standards would result in inspectors requiring more frequent or more extensive testing to be carried out.
- 1.2 Legal requirements, such as the Pressure Systems Safety Regulations 2000 (PSSR), do not normally apply to persons operating pressure equipment as a hobby activity. However the Health and Safety Executive considers it good practice for persons using such equipment to provide the same level of health and safety protection as they would if they were duty holders under the Regulations. To aid this process the principles of PSSR have been followed in drafting this document, which has been prepared after consultation with:
- Health & Safety Executive
  - Midland Federation of Model Engineers
  - Northern Association of Model Engineers
  - 7¼" Gauge Society Limited
  - Southern Federation of Model Engineering Societies
  - Royal & Sun Alliance Engineering
  - Footman James
  - Walker Midgley Insurance Brokers
- 1.3 It is considered that the procedures in this document and previous versions represent good practice for model engineering applications.
- 1.4 When operating boilers where the Health and Safety at Work etc Act 1974 applies, compliance with the requirements of PSSR shall be necessary. This requires that the Test Code is used in conjunction with the Written Scheme of Examination which accompanies this document. Steam locomotives, including model steam engines, are classed as installed systems for the purposes of the Regulations.
- 1.5 This document has been agreed and approved by the principal provider of insurance to the model engineering hobby. Individuals or organisations seeking insurance from other insurers need to check that the requirements herein are acceptable to their insurer.

- 1.6 Small boilers (i.e. boilers with a pressure-volume product below 3.0 bar litres) are not exempt from the requirements of this Test Code, see Section 14.
- 1.7 Clubs, Societies, Associations and Federations may have additional requirements and/or recommendations concerning recording and reporting of boilers and boiler tests and the like and such requirements and/or recommendations may be contained within separate publications produced by them. Such publications, where in existence, shall be used in conjunction with this Test Code and shall not be considered stand alone instructions and shall not amend or overrule any part of this Test Code.
- 1.8 Clubs, Societies and /or individuals should make reference to any insurance that is in force as it may impose additional limitations as to the size or scale of model that may be tested.

## **2 Purpose.**

- 2.1. This Boiler Test Code is for the examination, testing and certificating of steam boilers owned and/or operated, for hobby purposes only, by members of the 7¼ " Gauge Society, by members of Clubs and Societies affiliated to the Southern Federation of Model Engineering Societies and by members of Clubs and Societies affiliated to the Northern Association of Model Engineers. Steam boilers that are principally used for commercial business purposes (i.e. for the purpose of earning a living, whether total or partial, for the owner of the business, for the operator of the business or for other persons employed by the business either full time or casually or persons who are connected in any way with the business) are outside the scope of this Boiler Test Code and cannot be examined tested and certified using this Boiler Test Code.
- 2.2 That boilers are constructed to a high standard, and any repairs or modifications are similarly to a high standard of safety.
- 2.3 That the standard of safety is maintained throughout the life of the equipment.
- 2.4 That any duties and responsibilities that may be placed on the owner/user of a pressure system by the requirements of the Pressure Systems Safety Regulations 2000 are satisfied.

- 2.5 That the user of a steam powered model or a steam powered boat has proof that the boiler, not exceeding 1100 bar litres (see paragraphs 4.2, 4.3 and 4.4), has been examined, tested and duly certificated.
- 2.6 Flash steam boilers, drum boilers (as fitted to steam cars, not in association with water tubes) and coil boilers are specifically excluded from this Test Code.
- 2.7 The testing and certification of a boiler is only necessary if the boiler is to be put in to service. The validity dates of certificates issued do not have to run consecutively.

### **3 Definitions.**

- 3.1 'Shall' is mandatory, 'should' is advisory.
- 3.2 Boiler: Any pressure vessel used for the generation of steam.
- 3.3 Fittings: Devices attached to the boiler to allow the operation thereof. This includes such items as safety valves, water level gauges, pressure gauges, regulators, stop valves, feed valves, check valves, blow-down valves, superheaters, etc.
- 3.4 Mountings/bushes: Locations where fittings are attached to the boiler. Also relates to the locations for fixing the boiler to a frame or support, or for attaching other items to the boiler.
- 3.5 Working Pressure ( $P_W$ ). The pressure at which, under normal circumstances, the boiler is to be operated and to which the boiler is certificated.  
Notes:  
The working pressure shall be marked on the pressure gauge (refer to paragraph 10.2.)  
It is recommended that the range of the pressure gauge should be at least 50% beyond the working pressure.  
Safety valves shall be set to open at or below the working pressure (refer to paragraph 11.8)
- 3.6 Limit (Safe Operating) Pressure ( $P_L$ ). This is the maximum allowable pressure for the system in which a relief mechanism is fitted. For the steam pressure system this is the working pressure ( $P_W + 10\%$ ).

- 3.7 Initial hydraulic shell pressure test. The hydraulic pressure test carried out on the boiler shell on the initial completion of manufacture. The boiler shell shall be fitted with blanking plugs as appropriate. The test pressure shall be twice the working pressure ( $2x P_w$ ).
- 3.8 Repeat hydraulic pressure test. The hydraulic pressure test carried out on the boiler once all the boiler fittings except the safety valves have been attached to the boiler shell. The repeat hydraulic pressure test shall be carried out at intervals prescribed in paragraph 12.5(b). The test pressure shall be one and one half times the working pressure ( $1.5x P_w$ ).
- 3.9 Inspector:
- a. This is a person who is competent to examine and report on all parts of the system as covered by the Test Code. An inspector shall not be permitted to examine or test either his own work or equipment in his ownership but he is permitted to test a boiler which is owned by his Club or Society provided that he did not participate in the building or repairing of the boiler. An inspector shall be a member and appointed by the Committee of the Club or Society under whose name the boiler is examined and/or tested after such persons have satisfied the Committee that they have the appropriate level of experience and/or qualifications.
  - b. An inspector acting as a competent person who carries out an examination under the Written Scheme of Examination shall have such sound practical and theoretical knowledge and actual experience of the type of system which is to be examined as will enable defects or weaknesses to be detected which is the purpose of the examination to discover and their importance in relation to the integrity and safety of the system to be assessed.
  - c. The individual should know his own limitations and should not act outside his level of qualification or knowledge.
  - d. In order to provide for the situation of a boiler inspector not wishing to test a certain boiler because of lack of experience and where there is not another inspector within the club prepared to undertake such a test, arrangements can be made for the boiler inspector of one club to test a boiler in the ownership of a member of another club. Such an arrangement shall be made between clubs on behalf of the member(s) concerned and not directly between the member and the boiler inspector. It shall be a matter for the clubs to check that such an arrangement is covered within the insurance cover available to them.

- e. See also Section 2 and Section 4 paragraphs 4.3 and 4.4 for limitations of test.
- f. A Club or Society can agree that a boiler inspector be authorised to undertake examinations, hydraulic tests and steam tests without the presence of a witness. If such an agreement is made the boiler inspector shall be formally authorised to do so by the management of the Club or Society and the name of the boiler inspector shall be registered with the appropriate Federation or Association.

3.10 Witness: A person who observes the examination and test of a completed boiler and signs the certificate in such capacity. The witness shall be a member of the Club or Society, shall not be the owner of the boiler, and preferably also have a sound knowledge of the design and construction of boilers.

3.11 The pressure-volume product (bar litres). A measure of the stored energy of a boiler, i.e. the working pressure  $P_w$  (in bar) multiplied by the total internal water volume  $V$  (in litres).

Note: 1 bar = 14.5038 psi      10 psi = 0.689 bar  
1 litre = 0.22 gallons/1.76 pints  
1 pint = 0.568 litre  
1 gallon = 4.544 litres

3.12 Owner/User. As defined in the Pressure Systems Safety Regulations 2000 Regulation 2 paragraph 48. Steam locomotives, including model steam engines, are classed as installed systems for the purposes of the Regulations.

3.13 Written Scheme of Examination.

- a. A Written Scheme of Examination (WSE) is a document containing information about selected items of equipment which form a pressure system, operate under pressure and contain a relevant fluid. For the purposes of this document, the pressure system is a boiler shell including the attached fittings and pipework with steam as the relevant fluid. Steam at any pressure is regarded to be a relevant fluid.
- b. Effective from the 1<sup>st</sup> January 2013 a Written Scheme of Examination will be prepared by a competent person, and issued to the owner/user, for the periodic examination of the system in accordance with the requirements of the Pressure Systems Safety Regulations 2000, Regulation 8.
- c. The boiler inspector shall carry out the examination in accordance with the Written Scheme of Examination and in accordance with the requirements of the Pressure Systems Safety Regulations 2000, Regulation 9.

- d. The Written Scheme of Examination needs completing only once, unless: -
  - i) the boiler changes hands when a new Written Scheme in the name of the new owner is needed
  - ii) the boiler has undergone major repairs or the working pressure ( $P_w$ ) has been altered when a new Written Scheme is needed
- e. The boiler owner should safely keep the Written Scheme of Examination with the other boiler paperwork.

3.14. Controlling Engineer. For the purposes of the Written Scheme of Examination the controlling engineer is the boiler inspector.

## **4 Application.**

- 4.1 The provisions of this revision shall come into effect on 1st January 2013 and are not retrospective.
- 4.2 The Boiler Test Code shall be applied to the testing and inspection of copper and steel boilers from 3 bar litres up to and including 1100 bar litres. Small boilers below 3 bar litres shall be tested in accordance with the requirements indicated in Section 14.
- 4.3 Boilers above 500 bar litres up to a maximum of 1100 bar litres may be tested under this code subject to the boiler inspector concerned having been approved by his/her Club or Society and notified to the relevant organisation. This shall not be read as implying that an individual inspector has to test boilers at these limits. Inspectors shall only test boilers appropriate to their range of competency and the facilities available to them.
- 4.4 Boilers in excess of the above limits shall not be tested using this Test Code.
- 4.5 Due to the specific requirements and difficulties associated with the examination of stainless steel boilers they shall not be tested under this Code. It is suggested that owners or users of such boilers should seek the services of professional or commercial testing organisations.
- 4.6 Persons presenting boilers for test under these arrangements shall be members of the Club or Society under whose name the boiler is to be examined and/or tested (but see provisions of paragraph 3.7).
- 4.7 Boiler inspectors undertake this duty on a voluntary non-commercial basis. They or their Club or Society shall not charge

for examination, testing or certification. All examinations and tests are carried out entirely at the discretion of the inspector. Inspectors are not under any obligation to test every boiler presented for certification, with particular regard to the principle that boiler inspectors certify boilers that they feel competent to test by virtue of their own experience.

- 4.8 In addition to paragraph 4.7, an inspector may, if he is not satisfied that a boiler and/or its associated equipment and fittings are fit for service, refuse to undertake an examination and/or test. The reason for refusal shall be given in writing to the owner.
- 4.9 Once a boiler has been accepted for test and it then does not pass any stage of the examination or test procedures or it is considered to be in imminent danger (other than when a postponement of the test has been made to effect an adjustment which it is anticipated would subsequently provide a satisfactory test), the boiler inspector shall issue a 'Fail' certificate to the owner which indicates the reason for failure. The copy intended for the Club or Society records shall also be endorsed to record that the boiler has failed. This information shall also be passed on to the Boiler Registrar of the Association or Federation supplying the boiler certificate.
- 4.10 The decisions taken by boiler inspectors shall be taken as final.

## **5 Design Verification.**

- 5.1 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.
- 5.2 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.
- 5.3 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.
- 5.4 Consideration should be given to the use of a build record sheet.

## **6. Preliminary Requirements and Preparation for Test.**



- 6.1 Before any testing is carried out on a boiler it must satisfy the following conditions.
- 6.2 An inspector shall require a boiler to be examined in order to be satisfied that the requirements of paragraphs 7.4 and 7.5 are fulfilled, particularly where a boiler is already constructed and presented for examination. All prospective constructors should discuss such possible requirements with the inspector before commencing construction and the boiler should be examined at least twice during construction.
- 6.3 If welding is undertaken by a person who is not a coded welder the inspector shall require that weld samples be made available for inspection and testing prior to the commencement of the welding of the boiler, or that the welder shall have proof of test pieces being satisfactorily tested within the 12 months prior to the jointing being undertaken. Weld samples shall be tested by appropriate testing laboratories.
- 6.4 The inspector shall check that in the case of commercially made boilers these are CE marked (where required by The Pressure Equipment Regulations 1999 No 2001 and The Pressure Equipment (Amendment) Regulations 2002 No 1267). Boilers built commercially after 30 May 2002 which do not bear the appropriate CE marking shall not be tested.
- 6.5 It is recommended that screw operated valves fitted on the back head of the boiler should be of the type where the spindle cannot be screwed out. The use of non captive valve spindles or fittings should not be a reason to fail a boiler. Also check that all levers and hand-wheels are securely fitted to their respective spindles.
- 6.6 Boiler water feed arrangements shall be by at least two independent means (two of each, or a combination of, hand pump, injector, mechanical pump, etc.). A single boiler inlet with two check valves is acceptable
- 6.7 Boilers shall be fitted with at least one water level gauge which where practicable is to be fitted to the boiler independently of all other fittings, including the manifold. Where practicable the fitting of gauge glass protectors is recommended.
- 6.8 Water level gauges shall be so constructed, mounted, or adapted such that the lowest water level visible in the gauge glass indicates that the level of water is above the firebox crown sheet.
- 6.9 It is the responsibility of the owner to prepare the boiler for testing.

- a. If not already recorded the water volume (litres) shall be measured (the boiler inspector may wish to check this measurement).
- b. For boilers which require an internal examination all washout plugs and inspection doors shall be removed.
- c. Where boilers have been steamed, the smokebox, combustion spaces and surfaces shall be thoroughly cleaned and all fire tubes or flues brushed through.

6.10 Pressure test gauge:

The hydraulic pressure test indicated in Section 10 shall be carried out using a test gauge which has, within the previous two years, been checked and calibrated either against a currently validated dead weight test apparatus or against other traceable equipment. The test gauge may also be calibrated by a commercial test facility that shall provide a calibration test certificate. The calibration record shall be available for examination. Any errors identified on the calibration record shall be taken in to account when subsequently using the gauge for test or calibration purposes.

6.11 Boiler pressure gauge:

The boiler's own pressure gauge shall be checked against the calibrated pressure test gauge (paragraph 6.10) and marked with the working pressure of the boiler as a red line on the dial of the gauge (or an immoveable point on the bezel if access to the dial is not possible) at the point indicated by the test gauge using indelible marking. Pressure gauges for small models with a link and lever mechanism are only claimed to be accurate to  $\pm 10\%$  full range output (fro) and pressure gauges with a gear and quadrant mechanism should be better than  $\pm 5\%$  (fro) accurate. Gauges which cannot be red lined within these limits, even after adjustment, shall be replaced.

## 7 Examination – Non-Commercially Built New Boilers.

7.1 During construction of a new boiler the following items, where applicable, shall be taken in to consideration by the inspector to determine, as far as reasonably practical, that the boiler is sound.

- a. Owing to the ductility of annealed copper in a newly constructed boiler some minor distortion/bulging may take place and this should be allowed for.
- b. Screw threads in mounting bushes can be burnt or scorched. Check that screw threads of fittings and their mounts are of adequate depth to maintain sufficient strength.
- c. Check that copper fireboxes with girder stay arrangements have adequate penetration of silver solder to all joints.

- d. Check that hollow stays (e.g. for blower) that are fitted by mechanical means have adequate strength and integrity of joints.
- e. Butt strap joints in copper boiler barrels shall be examined to indicate that full penetration of silver solder has been achieved before other jointing is progressed.
- f. In small copper boilers check that there has been sufficient heat penetration to produce an adequate joint around all stays.
- g. Check that the faces of mounts for water gauges remain parallel to one another during construction so that no undue pressure is applied to the tube glass on assembly.
- h. Check that there is no collapse of fire tubes or super heater flues.
- i. Specifically for steel boilers the inspector may request to examine the preparation of joints before welding. Checks may also be made during construction for distortion that may occur during the welding process.

7.2 The initial examination and hydraulic shell test shall be carried out without any cladding present on the boiler. Boilers shall also be presented in such a way as to provide full access and visibility of all boiler surfaces.

7.3 As much of the boiler as possible (internally and externally) shall be examined to determine the general condition of the boiler.

7.4 The inspector shall satisfy himself:-

- a. That the materials used are of the correct thickness and specification.
- b. That, where required by the build procedure, the relevant material certificates are provided.
- c. That the boiler is constructed in accordance with the design drawings.
- d. That the requirements of Paragraphs 5.1 to 5.4 have been met.
- e. That all joining procedures have been satisfactorily undertaken and that the joints are sound. Particular attention should be paid to the penetration of silver solder and the adequacy of any welds.

7.5 The boiler shall be fitted with suitable blanking plugs or plates for the duration of the test to provide pressure tight integrity of the boiler shell. The inspector shall satisfy himself that the boiler, blanks and mountings are suitable to allow the subsequent hydraulic tests to be safely undertaken.

7.6 The boiler shall then be subject to a hydraulic shell test as described in Section 10 below. The test pressure shall be TWICE

the working pressure ( $2 \times P_W$ ) for both copper and steel boilers. Any structural modifications undertaken by the owner before first use, which may affect the structural integrity of the boiler shall invalidate the initial shell test and necessitate a re-examination and re-test at TWICE working pressure ( $2 \times P_W$ ) for both copper and steel boilers.

- 7.7 It is the owner's responsibility to ensure that the boiler is indelibly marked with a unique identification number in a suitable place so located as to be readily visible when the boiler is installed. The form and position of the marking shall not damage or compromise the structure of the boiler. Once allocated and indelibly marked on the boiler the identification number shall not be added to or amended and all certification shall use that number. Identification numbers for non-commercially built boilers are allocated by the builder. However, before allocating a permanent number it is recommended that the builder contacts his/her Federation or Association as they may have a preferred method of boiler numbering.
- 7.8 Before the boiler can be operated it must undergo a further hydraulic test at 1.5 times working pressure ( $1.5 \times P_W$ ) and steam test to be carried out by the inspector.

## **8 Commercially built boilers and their certificates.**

- 8.1 Purchasers of commercially built boilers should make sure that their order states that the boiler is to be tested under this Code and that the boiler has been built in accordance with the Pressure Equipment Regulations 1999 (PER) and carries the appropriate CE marking and that the documentation has been endorsed by the manufacturers Notified Body.  
Note: Commercial boiler makers should note that their products are likely to be tested under this Code and should therefore be constructed in such a way that they can safely withstand an Initial test at TWICE working pressure ( $2 \times P_W$ ).
- 8.2 The certificates supplied by a commercial boilermaker can only be regarded as evidence of a satisfactory hydraulic shell test. Before the boiler can be operated it must undergo a further hydraulic test at 1.5 times working pressure ( $1.5 \times P_W$ ) and steam test to be carried out by the inspector.
- 8.3 Boiler numbers allocated by commercial boiler makers shall not be added to or amended and all certification shall use that number
- 8.4 Any modifications undertaken by the owner subsequent to delivery of a new boiler, and before first use, which may affect the structural

integrity of the boiler shall invalidate the manufacturer's certificate and necessitate a re-examination and re-test at TWICE working pressure ( $2 \times P_W$ ) for both copper and steel boilers.

## **9 Examination – Previously Tested Boilers.**

- 9.1 Periodic examination and re-test of COPPER boilers of any capacity and STEEL boilers not exceeding 500 bar litres may be carried out with the boiler mounted and clad for as long as the inspector considers that he can properly examine and test it. Where this is not the case the inspector may require the boiler cladding to be removed, although this would not normally be necessary at less than 10 year intervals.
- 9.2 For STEEL boilers of 500 bar litres and above the inspector shall require that the cladding be removed at 7 year intervals, which may be extended to 10 years at the discretion of the inspector who is required to state the reason to justify the extension beyond 7 years. The inspector may require the boiler to be dismantled in order to carry out a thorough inspection.
- 9.3 If all surfaces of the boiler can be examined, at the discretion of the boiler inspector, the examination can be conducted with the cladding removed but without dismantling the boiler.
- 9.4 After any mishap to a boiler which may have caused distortion to any tubes or plates, the inspector may require the boiler to be dismantled to allow a thorough examination of the boiler to be undertaken prior to a retest.
- 9.5 For any retest or examination carried out after structural repair or alteration to any boiler, the retest or examination shall be undertaken before the boiler is remounted and clad.
- 9.6 As much of the boiler as possible (internally and externally) shall be examined to determine the general condition of the system. Particular emphasis shall be paid to internal corrosion and/or wasting. The examination shall include all fittings and mountings.
  - a. Visually check for the possibility of bulging or collapse of the firebox due to broken stays, or overheating caused by low water level or scale formation.
  - b. Visually check for signs of verdigris (green stains) for a copper boiler and rust marks for a steel boiler in the smoke box, inside the firebox or on the back head which may indicate locations of possible leaks.
  - c. Visually check for signs of leaks at the foundation ring caused by overheating due to excessive scale formation.

- d. Visually check there are no leaks or collapse of firetubes or super heater flues caused by the tubes becoming thin due to the scouring of ash and chemical action of flue gases.
- e. Visually check radiant superheater tips for corrosion caused by heat, gases and abrasion.
- f. During examinations or tests at extended intervals (say ten years), check adequacy of screw threads to all fittings and mounts.
- g. The inspector may require fusible plugs, where fitted, to be removed and inspected or replaced at the periodic test intervals so that the formation of scale does not impede their operation.
- h. If any washout plugs or inspection plates have been removed for internal inspection of the boiler they shall be refitted in the correct manner so that their integrity is maintained. They should be checked by the inspector before the boiler is tested.

9.7 STEEL boilers require a more rigorous visual examination than copper boilers.

- a. Check for internal corrosion and wasting. Consider that this may require the use of equipment not normally available to the average club inspector, e.g. ultrasonic testing, x-ray, dye penetration, magnetic particle inspection. Such testing needs to be carried out by persons suitably qualified or experienced in the processes.
- b. Check for evidence of corrosion beneath the lagging, particularly at the bottom of the boiler barrel where moisture may accumulate.
- c. On traction engine boilers, check for stress cracking caused by road shocks, e.g. between the smoke box and boiler barrel, at the joint between the barrel and the lower outer firebox plate and at any stays to which the horn plates are attached.
- d. During examinations and tests at extended intervals (e.g. 7 - 10 years), check adequacy of screw threads to all fittings and mounts.

9.8 The inspector shall satisfy himself that the boiler, fittings and mountings are in suitable condition to allow the subsequent hydraulic tests to be safely undertaken.

9.9 The boiler shall then be subjected to a hydraulic test as described in Section 10 below.

9.10 The test pressure shall be ONE and ONE HALF times the working pressure ( $1.5 \times P_w$ ) for both copper and steel boilers.

9.11 If not already marked the boiler shall be indelibly marked with a unique identification number (see paragraph 7.7)

## **10 Hydraulic Test Procedure.**

- 10.1 The test shall be carried out using the test gauge indicated in paragraph 6.10.
- 10.2 If not already marked the boiler's own pressure gauge shall be checked against the test gauge and marked with the working pressure of the boiler as indicated in paragraph 6.11.
- 10.3 It is recommended that a stop valve be positioned between the test pump and the boiler under test so that the pump can be isolated from the boiler and test gauge. In situations where the test pump is of a large capacity and to be used on a small boiler or equipment it is also recommended that a safety relief valve be fitted immediately after the pump which has been set to a value just above the required test pressure. This is to prevent damage to the item under test due to inadvertent over pressurisation from the test pump or axle pump.
- 10.4 It is recommended that:-
  - a. The test is carried out in quiet conditions such that the failure of any internal component (e.g. a stay) may be audibly detected.
  - b. The water used for the test is at a temperature not lower than 7°C (45°F) and not higher than 21°C (70°F) and as near as possible to the air ambient temperature.
  - c. The test is carried out in an area where no significant change in the temperature of the boiler could occur for the duration of the test. In particular it is recommended that any test undertaken out-of-doors is carried out in a shaded location away from direct sunlight.
  - d. The test is carried out away from personnel who are not directly involved with the test.
- 10.5 Safety precautions shall be observed as follows:-
  - a. The boiler shall be fully filled with water and vented to exclude all air pockets.
  - b. No hammer testing or shock loading shall be carried out whilst the boiler is under pressure.
- 10.6 For the initial hydraulic shell pressure test ( $2xP_W$ ) the boiler shall be fitted with blanks as indicated in paragraph 7.5 above to prove the pressure integrity of the boiler shell.
- 10.7 It is recommended that if a superheater is to be subsequently fitted it is given an initial ( $2 \times P_W$ ) pressure test after fitting appropriate

blanks and pressure adaptors with a record of the test result being kept on the hydraulic shell test certificate. A test certificate supplied by a manufacturer is acceptable if it meets the pressure test value requirement.

- 10.8 For all further hydraulic repeat tests, i.e. subsequent to the initial hydraulic shell test, the boiler shall be fitted with the working components attached to the boiler shell to prove the pressure and structural integrity of the interface and the boiler fittings. This includes the pressure gauge. If the gauge is not of the full range required by the test ( $1.5 \times P_W$ ) it shall be disconnected and a blank fitted. The pressure gauge shall be checked against the test gauge – see paragraph 6.11. Check that the siphon is not blocked by applying low hydraulic pressure to see that water is ejected from the siphon before the blank joint is closed.
- 10.9 If practical, the superheater should be included in the hydraulic repeat pressure test. This requires a blank to be fitted on the outlet of the superheater. It shall be removed on completion of the test and the pipe reconnected. The regulator shall be in the 'Open' position for the test. For superheaters the Boiler Inspector shall assess the testing requirement on an individual basis and annotate the Written Scheme of Examination accordingly.
- 10.10 The applied pressure shall be TWICE working pressure ( $2 \times P_W$ ) for the initial hydraulic shell test and ONE and ONE HALF times working pressure ( $1.5 \times P_W$ ) for repeat hydraulic tests.
- 10.11 The pressure shall be applied gradually and increased in steps of not more than 10% once the pressure exceeds the working pressure.
- 10.12 The test pressure shall be held for as long as necessary to allow the boiler to be thoroughly examined throughout for signs of distortion, damage or leakage and evidence of joint failure. The boiler shall be subject to a minimum test period of TEN minutes at full test pressure.
- 10.13 Any loss of pressure shall be fully investigated. Slight loss from blanking plugs and fittings may be allowed. The boiler fittings should be examined for integrity, thread quality and dezincification to eliminate any risk of subsequent detachment.
- 10.14 Pressure loss which cannot be accounted for or which is at an unacceptable level shall lead to the test being declared a failure.
- 10.15 A boiler which shows signs of any form of failure shall be removed from service and repaired. After repair the boiler shall be subject to



a repeat hydraulic test of  $(2 \times P_W)$  or  $(1.5 \times P_W)$  as appropriate with a pass certificate or fail certificate being issued.

## **11 Steam (Accumulation) Test - Annual.**

- 11.1 An examination under steam pressure shall be undertaken;
  - a. Before first placing the boiler into service. A steam (accumulation) test can only be undertaken after carrying out and during the validity period of a satisfactory hydraulic test.
  - b. After every repeat hydraulic test.
  - c. Annually or at intervals not exceeding fourteen months.
- 11.2 A thorough visual examination of the cold boiler shall be carried out as indicated in paragraphs 9.6 and 9.7 before commencing the steam test.
- 11.3 The boiler pressure gauge shall be checked for accuracy against the calibrated test gauge, particularly the red line, prior to conducting the steam test.
- 11.4 Consideration may be given to the protection of the superheater (where fitted) during the steam accumulation test by allowing a small amount of steam to pass through the superheater during the test. Check that the locomotive cannot move during this test.
- 11.5 The boiler shall be steamed using the appropriate fuel and further examinations carried out as the pressure is rising and whilst the boiler is at working pressure.
- 11.6 Correct operation of the following items shall be verified:
  - a. Boiler water feeding arrangements by at least two independent means (hand pump, injectors, mechanical pump, etc.)
  - b. The water level gauge(s) shall be blown down and the water levels shall be seen to recover without delay. Where fitted, the top and bottom water level gauge valves shall be operated independently in turn to ensure free passage of steam from the top valve and water from the bottom valve.
- 11.7 On boilers with a pressure-volume product of less than 10 bar litres and with a total internal volume not exceeding two (2) litres it is acknowledged that the provision of two independent means of water feed arrangement may not be possible. Therefore for the purpose of testing these boilers:
  - a. One (1) means of water feed arrangement is acceptable.
  - b. On model boats not capable of carrying boiler feed water, boiler feed water arrangements do not have to be provided as long as the fuel shall be exhausted before the water level in the boiler reaches a critical level.

- c. Water in the gauge glass must recover its level without delay following movement of the boiler. Water gauges fitted to boats whose boilers fall within this size/category do not have to be capable of being blown down.
- d. The water level gauge and pressure gauge should be clearly visible.

11.8 The boiler shall then be steamed at the maximum firing rate of the fuel and with full blower operation where applicable. The test shall be continued for sufficient time as to allow the inspector to be satisfied that stable conditions have been attained. The operation of the safety valve(s) shall be checked to make certain that they operate at the working pressure of the boiler ( $P_W$ ) and that the pressure does not rise by more than 10% of the working pressure ( $P_W + 10\%$ ) during safety valve operation (limit pressure  $P_L$ ).

11.9 Safety valves which are found to alter their set position during operation allowing the uncontrolled release of the boiler contents shall be fitted with some form of locking device to prevent this happening.

Where safety valves have been stripped down, cleaned, readjusted or replaced in between tests the owner or user of the boiler should inform the boiler inspector who may wish to conduct a repeat steam test.

11.10 A boiler which fails to meet the above requirements (11.8 to 11.9) shall be removed from service and rectification action carried out as appropriate. The boiler shall then be subject to a repeat steam test.

## **12 Certification.**

12.1 It is essential to be able to provide evidence that a particular boiler has satisfactorily passed an examination and test by an inspector and the boiler is safe to be operated. Certificates are issued to this effect.

12.2 On a satisfactory completion of the initial shell hydraulic test, a certificate of hydraulic test shall be issued to the owner of the boiler. The further repeat hydraulic test shall be followed by a steam test and the appropriate certificates issued.

12.3 The certificates shall include the following information:-

- a. The name of the Club/Society and Organisation issuing the certificate
- b. The name of the owner
- c. The location where the test was carried out

- d. Identification of the system that the certificate relates to, e.g. boiler number
- e. Type of boiler
- f. Boiler volume in litres
- g. Material(s) used in construction
- h. Date of construction, if known
- i. Date of examination and hydraulic test, if applicable
- j. Date of examination and steam test, if applicable
- k. Result of the examination
- l. Expiry date of the certificate
- m. Working pressure of the boiler
- n. Test pressure applied
- o. Parts not examined
- p. Any repairs needed and timescale for completion
- q. Confirmation of safety valve(s) operation
- r. Date of the report
- s. Name and signature of inspector (and witness where involved)

12.4 In accordance with the requirements of the Pressure Systems Safety Regulations 2000 Regulation 9 paragraph 3(a) the completed certificate shall be handed to the user within 28 days of the date of examination. Records should be retained by the boiler inspector and/or the Club or Society and the Boiler Registrar of the appropriate Association or Federation.

12.5 The certificate of hydraulic test validation period is as follows: -

- a) The Initial Shell 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.
- b) Further repeat tests shall be valid for a period not exceeding: -  
Copper boilers: - FOUR (4) years from the date of test.  
Steel boilers: - FOUR (4) years from the date of the Initial test of a new boiler with subsequent tests at intervals of TWO (2) years.
- c) The steam certificate shall be effective from the date of the steam test, no earlier and no later. It can run for a maximum period of 14 months (see 11.1) from the date of steam test but not beyond the expiry date of the hydraulic certificate.
- d) Inspectors may, at their discretion, issue a certificate of hydraulic test with a shorter validity period where the inspector considers that the above periods are inappropriate to the age and/or condition of the boiler.
- e) Certificates are not valid for safe operation until both the hydraulic and steam tests have been undertaken.
- f) Any structural alteration or repair of the boiler shall invalidate any current certificate and necessitate a retest.

- 12.6 Test Certificates which include hydraulic and steam test results issued by professional or commercial organisations are acceptable. However, commercial certificates may not necessarily be valid for the periods outlined in paragraph 12.5. It is not acceptable to mix a commercial hydraulic test certificate with a Club or Society issued steam test certificate or vice versa.
- 12.7 A record of the boiler's history (Initial and Repeat tests, modifications, repairs, ownership, etc.) shall be kept by the owner, see PSSR 2000 Regulation 14.
- 12.8 All certificates and records (including material certification, drawings, calculations, etc. where appropriate) shall be retained by the owner and shall be passed to the new owner should the model or boiler change hands. If a boiler changes hands a certificate issued under this Test Code remains valid providing the new owner of the boiler complies with Boiler Test Code 2012 paragraph 2.1. If the certificates are lost, and if the current certificate issuer cannot be traced and duplicate certificates issued, the boiler should be submitted for retest.

### **13 Regular or Routine Inspections & Maintenance.**

- 13.1 Safe operation of boilers requires that they, and their associated fittings, be subject to regular or routine inspection & maintenance in service.
- 13.2 The need for routine inspection and test in service should not be confused with the requirements for periodic examination. (Sections 7 to 11 refer).
- 13.3 Whilst not comprehensive, the following checks should be undertaken by the owner or operator before everyday operation:
- a. Check that the safety valve(s) operate at the specified release pressure as indicated by the red line on the pressure gauge.
  - b. Check for any leaks or weeps from fittings, bushes and pipe work.
  - c. Check the water level gauge waterways are clear by blowing down the glass and confirm that the water level returns to its correct position without delay.
  - d. Check the correct operation of any pumps/injectors required to maintain or replenish the water level in a boiler.
  - e. Check that the hand pump (if fitted) operates correctly and can be used to put water into the boiler in an emergency.
  - f. Check that all clack valves seat properly.
  - g. Check the regulator operation that it operates smoothly and that it can be completely closed and opened.

- 13.4 Certification is not required for regular/routine maintenance and checks, but it is recommended that owners/operators keep a log of steamings and inspections.
- 13.5 Precautions:
- a. All boilers should be properly 'laid up' after steaming. This is particularly important for steel boilers where corrosion continues if the boiler interior is not dry.
  - b. Copper boilers should also be laid up dry to minimise the problem of dezincification of any brass fittings.
  - c. If the boiler may be subject to low temperatures it is recommended that the pressure gauge is disconnected to prevent damage due to freezing of water in the siphon tube.

## **14. Small Boilers**

- 14.1 For the purposes of this Test Code 'small boilers' are defined as those with a pressure-volume product below 3 bar litres. Examination and test of this type of boiler is applicable if the boiler is fitted with (as a minimum requirement) a safety valve and a pressure gauge. The boiler may also be fitted with a water level gauge and a mechanical method of pumping water in to the boiler whilst under working pressure. If no means of supplying water to the boiler whilst working is present the fuel supply shall be so arranged that it is used up before the water is completely used.
- 14.2 The information given in Section 7 of this Test Code (Examination-non commercially built new boilers) is applicable to small boilers. This includes the requirement for the boiler to be marked with a unique identification number.
- 14.3 The boiler shall be subjected to an initial hydraulic shell pressure test of TWICE working pressure ( $2 \times P_w$ ) and is valid for the life of the boiler. A repeat hydraulic pressure test shall be conducted after the appropriate working components have been attached to the boiler shell to prove the pressure and structural integrity for the interface of the boiler fittings. This includes the pressure gauge. The applied pressure shall be ONE and ONE HALF times working pressure ( $1.5 \times P_w$ ). The test method is as described in Section 10 of this Test Code.
- 14.4 The hydraulic pressure test is not repeated unless the boiler has been subject to a structural modification or repair which may affect the integrity of the pressure system.

- 14.5 Test Certificates supplied by a commercial boiler maker are acceptable as evidence of a satisfactory hydraulic test provided that the test values are equivalent to those indicated in paragraph 14.3.
- 14.6 A visual examination of the pressure system pipe work shall be conducted. The pressure gauge shall be checked for accuracy against the calibrated test gauge, particularly the red line, prior to conducting the steam test. The steam test shall be carried out immediately after the first hydraulic test ( $1.5 \times P_W$ ) and every 12 months thereafter. The boiler shall be steamed at the maximum firing rate of the fuel. The test shall be continued for sufficient time as to allow the inspector to be satisfied that stable conditions have been attained. The operation of the safety valve(s) shall be checked to make certain that they operate at the working pressure of the boiler ( $P_W$ ) (see paragraph 3.5) and that the pressure does not rise by more than 10% of the working pressure ( $P_W + 10\%$ ) during safety valve operation (limit pressure  $P_L$ ). If fitted, the correct operation of the water level gauge and the boiler water feed pump shall be verified.
- 14.7 On satisfactory completion of the test a Certificate of Examination shall be issued to the owner of the boiler.
- 14.8 Simple 'small boilers' which do not have a fitted pressure gauge or working components other than a safety valve shall be visually examined and then steamed at the maximum firing rate of the fuel. The test shall be continued for sufficient time as to allow the inspector to be satisfied that stable conditions have been attained. Normal operation of the safety valve and the absence of steam leaks or water from the boiler will indicate that the pressure system is working within its safe operating limits.

## **15 Reference Documentation**

- 15.1 The following documentation has been taken in to account when producing this Boiler Test Code: -
- a. The Pressure Systems Safety Regulations 2000. SI 2000 No 128.
  - b. The Pressure Systems Safety Regulations 2000. Approved Code of Practice L122.
  - c. The Pressure Equipment Regulations 1999. SI 1999 No 2001.
  - d. The Pressure Equipment Regulations 1999. Guidance Notes URN 05/1074.
  - e. The Pressure Equipment (Amendment) Regulations 2002. SI 2002 No 1267.

- f. Passenger Carrying Miniature Railways Guidance on Safe Practice HSG216.
- g. Further information, e.g. contact details for approved testing laboratories, can be obtained from the 7¼” Gauge Society, the Midland Federation of Model Engineers, the Northern Association of Model Engineers or the Southern Federation of Model Engineering Societies.

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