

The Boiler Test Code 2018

VOLUME 1 - Boilers 3 bar litres to 1100 bar litres

Effective from 1st May 2018

Prepared by:

10¼" Gauge Railway Society, 7¼" Gauge Society,
Association of 16mm Narrow Gauge Modellers,
Gauge 1 Model Railway Association, Midland Federation of Model Engineers,
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1 Introduction

- 1.1 This Test Code has been prepared by:
- 10¼" Gauge Railway Society
 - 7¼" Gauge Society
 - Association of 16mm Narrow Gauge Modellers
 - Gauge 1 Model Railway Association
 - Midland Federation of Model Engineers
 - Model Power Boat Association
 - Northern Association of Model Engineers
 - Southern Federation of Model Engineering Societies
 - Walker Midgley Insurance Brokers
- 1.2 This Code presumes that the model or miniature boilers are maintained and operated to at least the minimum standards as set out in Appendix B 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.
- 1.3 The Health and Safety Executive considers it good practice for persons using pressure equipment to provide the same level of health and safety protection as they would if they were duty holders under the Pressure Systems Safety Regulations 2000 (PSSR). To aid this process, this Code has therefore been prepared using the principles of the PSSR. Where applicable this Code complies with PSSR 2000.
- 1.4 It is considered that the procedures in this document represent good practice for model engineering applications.
- 1.5 This document shall be considered as the Written Scheme of Examination as described in the PSSR, when used in conjunction with the test certificate associated with an individual boiler.
- 1.6 When operating boilers where the Health and Safety at Work etc. Act 1974 applies, compliance with the requirements of PSSR shall be necessary. The PSSR require that the Test Code is used in conjunction with the applicable Written Scheme of Examination certificate. Steam locomotives, including model steam engines, are classed as installed systems for the purposes of the Regulations.

- 1.7 Individuals or organisations seeking insurance need to check that the requirements herein are acceptable to their insurer.
- 1.8 The provisions of this Test Code shall come into effect on 1st May 2018 and shall not be retrospective.

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. 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 or certificated 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 Following this code will enable the owner/user of a pressure system to fulfil duties and responsibilities that may be placed upon them by the requirements of the Pressure Systems Safety Regulations 2000 are satisfied (where applicable).
- 2.5 That the Owner/User of a steam powered model or a steam powered boat has proof that the boiler, of 3 bar litres or above but not exceeding 1100 bar litres (see paragraphs 4.2, 4.3 and 4.4), has been examined, tested and duly certificated.
- 2.6 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 operation thereof. Including 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 maximum 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 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 steam pressure systems this is the Working Pressure (P_W) plus 10%. This value is used for testing the correct operation of the relief mechanism only.
- 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 System 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 system hydraulic pressure test shall be carried out at intervals prescribed in paragraph 12.5b. 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 inspect either equipment in their ownership or their own work unless that work has already been tested and passed by another Inspector. 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 or where there is not another Inspector within the club prepared to undertake such a test or where a club does not have any boiler Inspectors, 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. The certificate used shall be that of the Inspector's club. 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 4.2, 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 and shall not be the Owner/User of the boiler.
- 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 (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. 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. The WSE comprises the WSE certificate and a copy of this Test Code. 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 defined as a relevant fluid.
- b. Effective from the 1st 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/User 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/User 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.

3.15 Commercially Made or Built Commercially: A boiler which will be placed on the market for sale.

4 Application

4.1 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 of Volume 2 of this Test Code.

4.2 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 his/her name notified to the relevant national body. 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.

4.3 Boilers in excess of 1100 bar litres shall not be tested using this Test Code.

4.4 Due to the specific requirements and difficulties associated with examination the following shall not be tested under this Code:

- stainless steel boilers
- flash steam boilers
- drum boilers as fitted to steam cars

- coil boilers

Owners or Users of such boilers should seek the services of professional or commercial testing organisations.

- 4.5 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 clause 3.9d).
- 4.6 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.
- 4.7 In addition to clause 4.6, an Inspector may, if 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/User.
- 4.8 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/User 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.
- 4.9 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 in 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. The decisions taken by boiler Inspectors shall be taken as final.
- 5.4 Consideration should be given to the use of a build record sheet.

6 Preliminary Requirements and Preparation for Test

Before any testing is carried out on a boiler it must satisfy the following conditions:

- 6.1 An Inspector shall require a boiler to be examined in order to be satisfied that the requirements of clauses 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.
- 6.2 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.
- 6.3 The Inspector shall check that in the case of Commercially Made boilers these are CE marked (where required by The Pressure Equipment (Safety) Regulations 2016 No 1105). Boilers Built Commercially after 30 May 2002 above 2 litres capacity which do not bear the appropriate CE marking shall not be tested.
- 6.4 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.

- 6.5 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
- 6.6 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
- 6.7 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.
- 6.8 It is the responsibility of the Owner/User 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.

6.9 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 to within $\pm 2\%$ 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. The test gauge shall be checked at every use for sticking movement and correct zero indication.

6.10 Boiler pressure gauge:

All boilers shall be fitted with a pressure gauge that is functional at all times whilst the boiler is being steamed. The boiler's own pressure gauge shall be checked against the calibrated pressure

test gauge (paragraph 6.9) and indelibly 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.

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 might 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 silver soldered 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 stress is applied to the tube glass on assembly.
 - h. Check that there is no collapse of fire tubes or super heater flues.
 - i. For welded 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 hydraulic shell pressure test ($2xP_w$) 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 adequate thickness and the correct 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 the initial hydraulic shell pressure test as described in Section 10 below. The test pressure shall be TWICE the Working Pressure ($2xP_w$) for both copper and steel boilers. Any structural modifications shall invalidate the initial shell test and necessitate a re-examination and re-test at TWICE Working Pressure ($2xP_w$) for both copper and steel boilers.

- 7.7 It is the Owner/User's responsibility 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 a steam test. The Working Pressure shall be marked on the pressure gauge.

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 (Safety) Regulations 2016 No. 1105 (PER) and where necessary 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 boiler maker can only be regarded as evidence of a satisfactory hydraulic shell test. Before the boiler can be operated it must undergo a repeat 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 subsequent to delivery of a new boiler which may affect the structural integrity of the boiler shall invalidate the manufacturer's certificate. This will necessitate a re-examination and re-test at TWICE Working Pressure ($2xP_w$).

9 Examination – Previously Tested Boilers

- 9.1 Periodic examination and re-test of COPPER boilers of any capacity 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 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 event 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 superheater 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. Particular attention should be paid to the possibility of de-zincification in brass fittings.
- 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 system hydraulic test as described in Section 10 below. The test pressure shall be ONE and ONE-HALF times the Working Pressure ($1.5 \times P_w$).
- 9.10 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 6.9.
- 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 6.10.
- 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 it is also recommended that a safety relief valve which has been set to a value just above the required test pressure be fitted immediately after the pump. This is to prevent damage to the item under test due to accidental 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)
 - 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 applied 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 ($2xP_W$) 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 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 of the boiler fittings. The safety valve(s) shall be removed and, unless the safety valve bush is to be used for connection to the boiler test pump, replaced with blanking plugs. In the case of safety valves with springs retained by vertical columns (e.g. G.W.R type) it is permitted to leave the valves in place but they shall be clipped to prevent any lift during the hydraulic test. If the pressure gauge cannot accommodate the full pressure range of the test it shall be removed and tested separately. If the pressure gauge is removed and the siphon is not removed the siphon shall be tested for any blockage by applying low hydraulic pressure to see that water is ejected freely before it is blanked off for the hydraulic test.
- 10.9 If practical, the superheater should be included in the system hydraulic 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 ($2xP_w$) for the initial hydraulic shell test and ONE and ONE-HALF times Working Pressure ($1.5xP_w$) for system hydraulic tests. The pressure shall be applied gradually and increased in steps of not more than 10% once the pressure exceeds the Working Pressure. For an initial hydraulic shell test on a soldered or welded copper boiler, the pressure should be increased in small steps from zero, with intermediate relaxations, to allow stress redistribution and work-hardening of the very soft annealed metal.
- 10.11 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.
- 10.12 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 reduce the risk of subsequent detachment.
- 10.13 Pressure loss which cannot be accounted for or which is at an unacceptable level shall lead to the test being declared a failure.
- 10.14 A boiler which shows signs of any form of failure shall be removed from service and if repaired retested - see 12.5f.

11 Safety Inspection and Steam Accumulation Test

- 11.1 An examination under steam pressure shall be undertaken;
- Before first placing the boiler in to service
 - After every system hydraulic test.
 - A steam (accumulation) test can only be undertaken during the validity period of a hydraulic test certificate.
- 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. The vehicle should be restrained so that it 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 verify free passage of steam from the top valve and water from the bottom valve.
 - c. The water level gauge and pressure gauge should be clearly visible.
- 11.7 On smaller boilers 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 such boilers 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 fitted. 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 exceed the Limit (Safe Operating) Pressure during safety valve operation.
- 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/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/User of the boiler. Commercial Initial Hydraulic test certificates are also acceptable. Certificates will also be issued on the successful completion of subsequent system hydraulic tests and subsequent steam tests as appropriate.
- 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/User
 - c. The location where the test was carried out

- d. Identification of the system that the certificate relates to, e.g. boiler number
- e. Maker
- f. Type of boiler
- g. Boiler volume in litres
- h. Material(s) used in construction
- i. Date of construction, if known
- j. Date of examination and hydraulic test, if applicable
- k. Date of examination and steam test, if applicable
- l. Result of the examination
- m. Expiry date of the certificate
- n. Working Pressure of the boiler
- o. Test pressure applied
- p. Parts not examined
- q. Any repairs needed and timescale for completion
- r. Confirmation of safety valve(s) operation
- s. Date of the report
- t. 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 Owner/User within 28 days of the date of examination. Records should be retained by the boiler Inspector and/or the Club or Society.

12.5 The validity period of test certificates are as follows:

- a. The Initial Hydraulic 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. System hydraulic pressure tests are valid for the following periods:
Copper boilers: FOUR (4) years from the date of test.
Steel boilers: FOUR (4) years from the date of the first $1.5xP_w$ hydraulic test and thereafter for TWO (2) years.
- c. 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.

- d. The steam certificate shall be effective from the date of the steam test, for a maximum period of 14 months (see 11.1) but not beyond the expiry date of the hydraulic certificate.
 - e. Certificates are not valid until both the hydraulic and steam tests have been satisfactorily undertaken.
 - f. Any structural alteration or repair of the boiler shall invalidate all current certificates. This will necessitate a new initial shell test followed by a $1.5P_w$ system hydraulic test and a steam test.
- 12.6 Test Certificates which include repeat hydraulic test and steam test results issued by professional or commercial organisations are acceptable. It is not acceptable to mix a commercial hydraulic repeat 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 system tests, modifications, repairs, ownership, etc.) shall be kept by the Owner/User as required by PSSR 2000, Regulation 14.
- 12.8 All certificates and records (including material certification, drawings, calculations, etc. where appropriate) shall be retained by the Owner/User and shall be passed to the new Owner/User should the model or boiler change hands. A certificate issued under this Test Code remains valid if a boiler changes hands providing the new Owner/User of the boiler complies with Boiler Test Code 2018 Volume 1, paragraph 2.1.
- 12.9 If the certificates are lost, and if the current certificate issuer cannot be traced and duplicate certificates issued, the boiler shall be submitted for retest which shall include an examination and initial hydraulic shell test ($2P_w$). This test may be carried out with the fittings attached provided that the Inspector is confident that they will withstand the test pressure.

Appendix A: Reference documentation

The following documentation has been taken in to account when producing this Boiler Test Code:

- a. Pressure Equipment (Safety) Regulations 2016. No 1105
- b. The Pressure Systems Safety Regulations 2000. SI 2000 No 128
- c. Pressure Systems Safety Regulations 2000. Approved Code of Practice L122 (PSSR2000)

Further information can be obtained from the technical representatives of the clubs and societies listed in 1.1.

Appendix B: Regular or Routine Inspections & Maintenance

This guidance is not part of the Boiler Test Code.

Safe operation of boilers requires that they, and their associated fittings, be subject to regular or routine inspection & maintenance in service. The need for routine inspection and test in service should not be confused with the requirements for periodic examination. (Sections 7 to 11 refer).

Whilst not comprehensive, the following checks should be undertaken by the Owner/User 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.

Certification is not required for regular/routine maintenance and checks, but it is recommended that Owners/Users keep a log of steamings and inspections.

If the boiler will be out of use for a prolonged period of time:

- 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 be laid up dry to minimise 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.

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