



# CNMES Boiler Testing Notes

## Background

CNMES events often involve members using pressure vessels (i.e. steam boilers) to power railway locomotives, traction engines and other steam-powered engines when the public and other members are present. There is a significant risk of mechanical and heat injury associated with using steam boilers in close proximity to people.

Both the Health and Safety at Work Act 1974 and the terms of our club insurance policy require us to take all reasonable precautions to minimise this risk. Two main activities are required to comply with these requirements. These are:

- Ensuring that anyone operating steam engines on club property or under club auspices are competent to minimise risks associated with steam during normal operations. The club test recording scheme for achieving this is covered elsewhere.
- Minimising the risk of boiler failure by instituting a strict boiler testing regime.

This document is concerned with minimising the risk of steam boilers failing to contain steam pressure during operation by applying an appropriate CNMES boiler testing regime.

## Miniature Steam Boiler Testing

Commercial pressure vessels are subject to frequent, rigorous testing under the Pressure Systems Safety Regulations, 2000 (PSSR). Fortunately, both the Health and Safety Executive (HSE) and the Insurance industry have recognised that these very rigorous tests are not appropriate for miniature steam boilers used by non-commercial hobbyists.

A more appropriate alternative to the PSSR, specifically designed for model engineering societies, has been accepted by the HSE and the insurance industry. This is:

***“The Examination and Testing of Miniature Steam Boilers” (Rev Edn 2012).***

Unless members choose to demonstrate compliance with the PSSR, compliance with this test code is a condition of operating *any*<sup>1</sup> steam engine on CNMES premises or by club members operating elsewhere under club auspices.

The notes following this section are designed to provide helpful guidance to CNMES members on preparing for club boiler tests. These notes are informal and, in the case of dispute<sup>2</sup>, the reference above shall be considered the over-riding authority.

Another type of pressure vessel commonly used by model engineers involves fuel, typically butane or propane. Regulations covering testing of these fuel tanks are contained in:

***“Supplement to the Examination & Testing of Miniature Steam Boilers” (Rev Edn 2012).***

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<sup>1</sup> This code now also includes provision for testing and certifying small boilers under 3 bar/litres.

<sup>2</sup> In any case of dispute, a CMES boiler inspector’s decision shall be sought and shall be final.

## Arranging for a Boiler Test

CNMES has a number of members qualified to carry out boiler inspection tests on behalf of the club. These members (inspectors, witnesses and registrar) are unpaid volunteers and members should be sensitive to this when arranging for the timing and location of tests.

Members should always ask what preparation work is required by the inspector before the test and complete this work before testing. For example, for a hydraulic test the inspector will require a standard means of attaching a pressure pump hose to the boiler (see below).

## Preparing for a Boiler Test

The tests described here apply to boilers rated between 3 bar/litres (e.g. 1 litre at 45 psi) and 1100 bar/litres (e.g. 100 litres at 165 psi). Different test procedures apply to smaller boilers.

There are two discrete stages to testing a miniature boiler. In summary, these are:

- A hydraulic test, applied at intervals of up to 4 years at the discretion of the inspector. This starts with a physical boiler examination and check of markings (where appropriate). The boiler is then filled with cold water and pumped up to at least 1½ times<sup>3</sup> the normal operating pressure. The boiler should be capable of holding this pressure for at least 10 minutes with no significant leaks. The pressure gauge accuracy will also be checked, including the maximum working pressure mark.
- An annual steam test. With the heat source is set to maximum steam production, the safety valves must operate to keep boiler pressure at or below maximum pressure plus 10%. The water gauge must read accurately and at least two methods must be demonstrated of injecting water into the boiler while in steam.

## Hydraulic Test Preparation

Preparing a steam boiler for the hydraulic test involves the following:

- Find previous hydraulic test certificates and/or boiler manufacturing documents.
- Identify the boiler's capacity (in litres) and maximum working pressure (psi or bar).
- Identify where the boiler markings are.
- Removing boiler cladding to reveal the boiler surface (if required by the inspector).
- Find a torch and any mirrors needed to inspect internal surfaces.
- Clean the boiler, firebox, tubes, smokebox and grate.
- Check location and condition of fusible plug (if fitted).
- Remove and blank off safety valves.
- Devise a method of preventing leakage through the regulator during the test.
- Check that clack valves, injector feed pipes, whistle and any other boiler fittings do not leak and, if they do, repair them or blank them off.
- If the pressure gauge does not read up to the maximum test pressure, prepare a blank to replace the pressure gauge after accuracy testing.
- Provide a 5/16", 32 tpi (male) connection to the boiler for the test pressure pump.

If possible, members should conduct their own hydraulic test before presenting the engine to the inspector. This helps identify unacceptable leakages which could lead to test failures.

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<sup>3</sup> New boilers are hydraulically tested at twice the normal operating pressure.

## Steam Test Preparation

Preparing a boiler for the annual steam test involves the following:

- Find the current hydraulic test certificate.
- Find a torch and any mirrors needed to inspect internal surfaces.
- Identify where the boiler markings are.
- Conduct a preliminary test. With the engine in full steam (e.g. blower full on):
  - Check the correct operation of the pressure and water gauges.
  - Check blow-down operation of the water gauge.
  - Check that the safety valves lift at maximum working pressure and limit any pressure over-run to maximum plus 10%.
  - Check the correct operation of at least two methods of injecting water (especially injectors, which are prone to be difficult).
  - Check that the fire can be dropped quickly in an emergency.
- Ensure you have access to sufficient fire-starting materials, water, fuel and any ancillary equipment (e.g. electric blower and battery) needed to complete the test.

## Testing

Boiler tests will normally involve an inspector and a qualified witness. For all boiler tests, the inspector has the right to decide how he is going to conduct the test. Do not argue, the inspector's decision is final.

The results of all club boiler tests will be recorded by the CNMES Registrar. These records will be available for up to 10 years. A certificate of the results will be issued to the owner and pass certificates must be produced on demand whenever the boiler is steamed.

## Conclusion

The strict requirement for boiler testing can seem overly cautious, since boiler failures involving miniature steam engines are rare. The work and potential damage involved in stripping cladding and boiler fittings from superbly finished models can be a disincentive to people who may have spent hundreds of hours on the appearance of their engines.

However, apart from the distress and injury of those involved, the adverse publicity of even a single serious incident involving steam safety must be avoided. The aim of CNMES boiler testing is minimise the chances of this happening, while making test procedures as simple and non-destructive as possible.

## References

- The Examination and Testing of Miniature Steam Boilers (the "Green Book"), Rev Edn 2012.
- Supplement to the Examination & Testing of Miniature Steam Boilers, Rev Edn 2012.