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**The Steam Boat Association**

**Boiler Installation  
and  
Boiler Operation**

**STEAMBOATING PRACTICE**

**SBA GUIDE No.2**



# The Steam Boat Association of GB

## Introduction

This guidance note sets out to expand on the contents of THE STEAMBOATER's GUIDE, and should be read in conjunction with that publication.

## Installation

- *proper mounting-rigid,*
- *support whilst on trailer,*
- *insulation from hull, lagging,*
- *wet ashpan,*
- *avoiding personal burns*
- *positioning of controls*
- *several methods of feeding water*
- *protection from exhausts, funnel and safety valve,*
- *drain on discharge,*
- *positioning of blow-downs, on water gauge and main vessel*

The boiler is likely to be the heaviest component of the boat contents, and should be mounted on substantial bearers. These are often substantial timbers running along the length of the hull, which also carry the engine mountings and the thrust bearing.

If the boat is to be trailed, it is worth considering the way in which the weight of the boiler is supported when the boat is on the trailer, and the bearers mentioned above may be bonded into an egg box type lattice, cross-braced with floors. In this way the load may be transferred to the keel, which is likely to be supported on rollers when on the trailer.

Heat rises, but when the boiler is in operation there is likely to be heat transfer downwards, by conduction, by ash falling into the ashpan, and by radiation from the underside of the grate. Insulation may be arranged to deal with this and a so called wet ashpan can be very helpful. This latter is arranged to hold water, absorbing heat by gradual evaporation, and quenching any hot ash falling into it.

In the event of a rapid loss of water feed the boiler to lower the pressure & preserve the water level, also, prepare to remove the fire to avoid overheating. In any case turn off the blower, close the air intake damper and open the fire door. If no leak is visible confirm the blow down is not leaking.

Clinker is formed when the fire is driven hard, resulting in the ash at the base of the fire melting, this effectively cuts off air supply to the fire, and clogs the grate, slows the fire and may damage the fire bars.

A hole in the fire, sometimes makes a noise but has the effect of limiting combustion as all the air flow is focussed through that section of the grate. Always ensure that the whole grate is adequately covered by the fire.

In the event of a gauge glass breaking, isolate it immediately by closing both cocks and opening the gauge glass blow down. **Assess navigational safety**, delegate tasks such as organising another vessel to come alongside to crew members. Feed the boiler to lower the pressure and preserve an estimated safe water level. Turn the fire down by closing the air intake damper and opening the firehole door. the blower or fuel valves. Gas and liquid fuelled boilers are readily stabilised by shutting off the fire.

## Gauge Glass Replacement and Test

Attempt to establish the reason for the glass failure, fittings may for example have become misaligned, and your spare could sustain the same damage. Having replaced the glass replace the water gauge protector and confirm all passages are clear by

- 1 open the drain and gently open the top valve, steam should escape from the blow down
- 2 close the top valve and open the bottom valve steam should escape from the blow down
- 3 close the blow down the glass should fill with water
- 4 open the bottom (water) valve
- 5 open the top valve the actual water level will be displayed

give any dispersed oil the best chance of coalescing and being separated from the water. Any organic component in the hotwell will attract the oil droplets, hair, plastic drinking straws, plastic turnings and special prepared fabrics have all been used for this purpose.

If puffing, more sediment and previously dissolved material is likely to be deposited in your boiler.

You should recognise that the orifices and seats in many injectors, pumps and non-return valves are small and need to be protected from suspended material. Filters should be provided in lines drawing water from rivers, canals, and lakes with a sea cock facility to dismantle for cleaning whilst the boat is in the water, in use.

### **Water tube vs Fire tube**

Water tube are principally of light weight & offer faster & more responsive steam production. Fire tube boilers of comparable steam production rate are generally heavier because of the thickness of material required for the larger diameter of the components used in their construction. They are lethargic docile steamers providing useful weight to ballast a 'full' hull profile.

### **Problems etc**

- *Spare*

Worthwhile spares to carry include, a gauge glass prepared to the correct dimension, including spare rubber washers, PTFE tape. A selection of nuts and bolts, and also a spanner to fit each.

### **Emergency procedures**

In the event of leakage from a fitting as pressure builds avoid tightening fittings to contain it. It is very likely to "take up". It must be remembered that a leak may be due to a crack which may fracture if overstressed. Should the water gauge leak, the nuts may be tightened only after isolating the gauge with both cocks and opening the gauge blow down.

Proper lagging and insulation of the boiler itself minimises heat loss, and at the same time prevents burns to both the operator and passengers in the proximity. Particular attention should be paid to any item which may be grasped in emergency, such as if the boat were to rock. Many fire tube boilers are lagged with hardwood strips which really just contain a mineral fibre mat, which is the principal insulant. Water tube boilers often have refractory lining of the outer casing complemented by mineral materials.

**Insulation** is only effective if adequate air circulation removes any heat migrating through the insulation. Similarly air circulation around a wet or dry ashpan is vital.

Ceramic insulating materials are not required as general purpose insulation only when such materials are exposed to direct flame radiant heat. Cheaper alternatives are available with equal 'Q' values. See Funnel 97 p62.

### **The Blow Down**

The pressure vessel will require a means of emptying, known as blow down. (*Blowdown penetrations through the hull attract interest by Boat Safety Scheme examiners*).

As blowing down is normally carried out with the boiler under pressure, there will be a discharge of boiling water and high temperature steam. For this reason the blow down exhaust from the hull is often arranged to be below the water line. The valve used to control the blowdown should be as large as practicable, preferably a plug cock of bore comparable to the discharge pipe. This will allow a vigorous discharge producing the maximum agitation to any sediment in the boiler. The point of take off should ensure that the pressure vessel may be drained completely e.g. level with the foundation ring, or separate provision for all drums of a water tube boiler.

### **Water Gauge Blow down**

The blowdown from the water gauge should also be disposed of with due consideration to safety. It is often directed into the ashpan. If this is the case ensure there is no possibility of stirring up of ash, but preferably discharged overboard.

### **Boiler isolation fittings**

Means of isolation local to the boiler should be provided to all main

and peripheral systems; for example, each water feed clack should have an isolating cock on the boiler side.

The engine is likely to have a main stop valve and a regulator valve in series with it. The engine stop valve should be in place of the steering position in case of emergency.

All fitting should be selected to be appropriate for their duty in respect of temperature and pressure rating. If these last are unknown, it may be better to discard.

All joints in pipework subject to pressure should be silver soldered and of appropriate wall thickness. If compression fittings are used, olives should be silver soldered. You should be alert to the possibility of work hardening or fatigue in any pipework subject to vibration, e.g the main steampipe.

Pressure gauges should be thermally isolated from steam by use of a siphon arrangement.

Control valves should be arranged in such positions as to be easily reached by the operator, both for convenience and also in emergency, without risk of burning. Unfortunately many steamboaters seem to collect a burn or two during each season.

### **Steam exhausting to atmosphere**

If you intend to puff then you will need to have a separator to ensure condensed exhausts are not emitted from the chimney, could be both hot and dirty.

Safety valve exhausts should also be made safely and efficiently secured to restrain reaction forces, and should have a low level drain to ensure no build up of condense in the discharge tube.

### **The fire grate**

The fire grate should be arranged so that the bars may be easily cleaned, (bars in line with the fire door), and the fire may be dropped in emergency. The fire door and ashpan damper should be fitted with a catch to ensure that it stays closed in the event of firebox pressurisation e.g a tube failure or fusible plug release.

When specifying requirements for a new boiler it is advisable to

### **Fuel**

Central heating oils, diesel, paraffin and Lpg's are all used as fuels in various types of specialist burners.

Coal is more widely used, and the use of "Welsh steam coal" is the most popular. This is to a large extent smokeless when burnt properly, has something of a flame, and burns without the requirement of large forced draught for moderate output. Housecoals are used but can generate a smoke nuisance without very careful handling, and do not generally have such high heat output potential. Anthracites will generally require a more vigorous draught. Homefire has been found to be steady but slow to respond, Coalite is bulky and peat makes a different smell.

### **Water**

- *source soft/hard*
- *filtration to remove oil and suspended solids*
- *condensing and hardness*

When water contains a low level of dissolved salts it is said to be soft, conversely hard water contains a higher level of salts, soft water is likely to have a lower pH, that is be more acidic due to dissolved CO<sub>2</sub>, whilst the salts of hard water may be deposited as the water is boiled and evaporated. An ideal pH for the water of a boiler is about 9-11, that is mildly alkaline, this inhibits corrosion of steel, pH is less significant for copper boilers.

If your installation is condensing, clearly the same quantity of water is circulated with only a modest top up, this will keep down hardness salt concentrations/deposits, and any sludge which you import from external sources. On the other hand, measures will be required to remove cylinder lubricants from the condensate before it is returned to the boiler.

Oily residues are to be discouraged in boilers as they may decompose in the boiler and generate corrosive situations, and also inhibit heat transfer giving rise to overheating.

Hotwells are designed to provide a reasonably long dwell time to

## Storage

- *temperature*
- *humidity*
- *full or empty*
- *externally clean*
- *internally clean*

The boiler should be stored in a location where it is not subject to large or rapid fluctuations in temperature. If any of the system is left containing water, it must clearly be frost free. It is easy to overlook the condenser or the Bourdon tube within the pressure gauge for example.

If the boiler is stored empty with plugs out then large variations in humidity should be avoided both from an internal point of view and also from external consideration. As well as the grate, accumulations in the smoke box should be removed, and tubes should be clean.

## Boiler treatment

- *what they are and purpose*
- *which to use*
- *how much*

Water treatment is often used in steamboat boilers, if of steel, the desirable parameters are a pH of about 11, a suspending agent to keep sediment mobile and some antioxidant agent.

Many treatments are tannin based and a correct concentration is said to have a colour similar to tea.

If of copper, the treatment should deal with sediment and any hardness that may be present

## Boiler Log

Your boiler inspector may ask you to keep a log, in which you record the number of hours the boiler is in use, and also any relevant additional information. This will enable him to determine the specific testing regime to be applied at subsequent test time.

check with the inspection authority if a fusible plug is required. Consensus deems that the ability to preserve steam pressure to provide engine power & hence navigational safety is preferred. A fusible plug is then not fitted.

## Checks before filling

- *water treatment*
- *clean grate and tubes*
- *means of lighting up*
- *fuel*
- *checks before casting off*

Before starting to fill the boiler ensure all bottom run offs are securely closed, and any shut off valves on water gauge or pressure gauge are open. When filling the boiler, recognise that the water will expand as its temperature rises, and check all valves and fittings to confirm correct functioning, eg blow down is clear but securely closed and water gauge reads correctly. Procedure for doing this is described below under gauge glass replacement and test.

A new fire is usually made more readily on a clean grate, and clean tubes have obvious advantages. Wood has been traditionally used for lighting up, quick lighting barbecue charcoal has advantage in making a good hot fire quickly and produces less smoke and fly ash.

Prior to casting off ensure you are adequately prepared, do you have enough fuel, some kindling, do all your means of water feed function reliably, is the safety valve operating correctly, water gauge operating correctly under pressure.

Do not set off until you have enough pressure with an adequate water level, subsequent recovery will be much more difficult than just waiting a few more minutes.

Check the correlation between safety valve operating pressure and the pressure gauge reading. Unusual results may indicate the onset of a defective pressure gauge or safety valve. Always assume the worst until proven otherwise.

### **In Use**

- *Water level*
- *firing*
- *clean feed*
- *anticipation*
- *lunch time stop*

With experience you will recognise the best level for water in the boiler, initially you may find advantage in keeping the water some little way above the mid point of the water gauge. This will be of benefit should you suffer water loss and gives more time to recover. Bear in mind that if water level should be too high the steam space is reduced in volume, and pressure may drop rapidly on steam take off. There will also be a risk of water carry over into the engine, which will interfere with its performance, and may also cause damage by hydraulic pressure. In addition if the safety valve should lift, there is the possibility of the discharge of volumes of boiling water at high level.

With liquid and gaseous fuels, steam is produced almost instantaneously whereas with solid fuel, some little time will elapse before additions of fuel produce more steam. you will accordingly, need to anticipate the requirement to add more fuel. It is also necessary to ensure that the grate is completely covered by fuel. Excessive use of the blower will create clinker, in which the ash is made so hot that it melts and clogs the air passages through the grate.

The water, which you put into the boiler may either be carried with you or drawn from that which you steam upon. If you draw from the river/ canal you should consider its suitability as feedwater & the need for filtration to ensure no large particles or vegetation are drawn into pumps/injectors or undesirable chemical impurities into the boiler. If condensing and reusing water you will need to remove all or most of any oil you may be adding to the steam. Any steam oil used in this situation should be non compounded, that is straight hydrocarbon. This will have much better separation properties in the hotwell. Many steamboaters experience difficulty in steam production after the lunchtime stop. The fire may have become

“lazy”. This may be mitigated to some extent by adding some fuel and leaving the fire door open with dampers closed, whilst taking refreshment. Prior to setting off do not be in too great a hurry, ensure that the fire is made up well and burning through with the grate having been cleaned to remove much of the ash. Recognise that solid fuel needs to be warmed up before it begins to produce heat itself.

Liquid and gas fuels will very likely produce steam more or less instantaneously, and the approach to a lock, for example will be accompanied by a turn down in the flame. With solid fuel firing such situations must be anticipated, the fire may be controlled to some extent by closing the damper and opening the door, firing may be necessary to anticipate the departure, little and often is the order of the day which allows fuel to warm up to burning temperature steadily.

### **Disposal**

- *clean grate*
- *blow down?*
- *Plugs out?*

After a period of use the manner of disposal can have a marked affect on the life of the boiler, much more corrosion damage may be done on storage rather than in use.

Ash has the ability to absorb and retain moisture, so any residues of ash should be carefully removed and not left in contact with boiler plates The ashpan should also be cleaned to improve the dryness of the storage atmosphere.

For corrosion to take place oxygen and moisture are necessarily present. If the boiler is blown down hot and plugs are removed at top and bottom to allow a circulation of air, then moisture will be removed.

If the boiler is filled to the top with treated water then oxygen is removed, other than any which may be dissolved in the water which will be absorbed by the water treatment chemicals.