



The Steam Boat Association of Great Britain

Keeping Your Feet Dry

An Introduction to Steam Boating, Friday 13 September 2024

Programme:

The session will start at about 1000 and finish at about 1530.

Activities:

1. Introduction and Safety Briefing (30 minutes)
 2. Familiarisation: The group will split into several smaller groups, and be introduced to a steamboat ashore, then look over several more boats, ashore and afloat, to show variations and answer questions. (1 hour).
 3. Launching and mooring: groups will monitor and assist in launching, mooring and hauling out a boat. (1¼ hours).
- (Probably pause for lunch about now (20 min))
4. Raising steam and cruising: 2 people per boat + trainer/skipper (1½ hours).
 5. Discussion, tea, Q&A, feedback and de-briefing. (¾ hour).

Clothing

Wear suitable clothes for the expected weather, and bring spares in case of bad weather/falling in the lake. You are likely to get your hands (maybe more) oily or dirty, but waders, overalls or a boiler suit are not needed. Work or oven gloves are desirable. You must wear soft shoes on board boats.

Buoyancy Aids/Life Jackets

All persons on board a moving boat must wear a buoyancy aid or life jacket. If you have one, please bring it. We will try to have a variety available to borrow, but you are responsible for making sure you are wearing one of the right fit. If we cannot suit you, you will not be able to participate in the steaming session.

Please familiarise yourself with the risk assessment at the end of this booklet before attending the event.

An introduction to Steam(boating)

Steam is water vapour. It is an invisible gas: the white plumes generally considered as steam are actually water droplets formed when steam meets cold air. Because steam is invisible and hot, steam leaks are dangerous, and extreme care must be taken to contain it.

It takes a lot of energy to create steam from water. This makes steam an excellent way of moving energy from one place to another. It is also possible to convert some (but not very much) of the energy of the steam to useful work, for example driving an engine to propel a boat.

1. Water is turned into steam in the *boiler*. This requires a heat source: in small steam boats this is usually a coal fire or an oil burner, sometimes a wood fire or gas burner. In submarines a nuclear reactor is used. Figures 1 and 2 below show two common types of boiler used in steam boats.

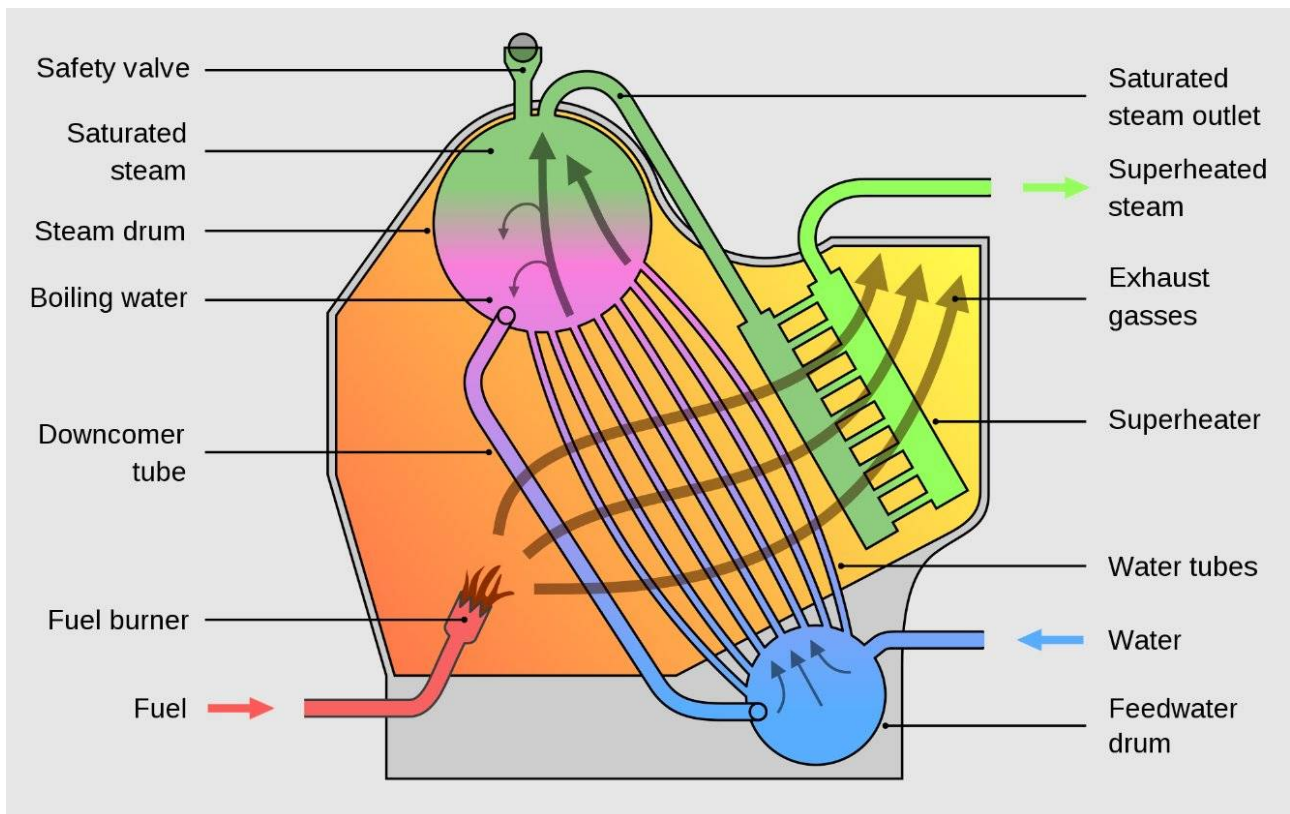


Figure 1: A Water Tube Boiler (Wikimedia Creative Commons Image)

The Launch Boiler

The boiler uses heat from burning fuel (e.g. coal or wood) to boil water to make steam. For good efficiency, a large surface area between the fire and water sides is needed. The boiler must withstand high temperatures around the fire and high pressures in the steam container.

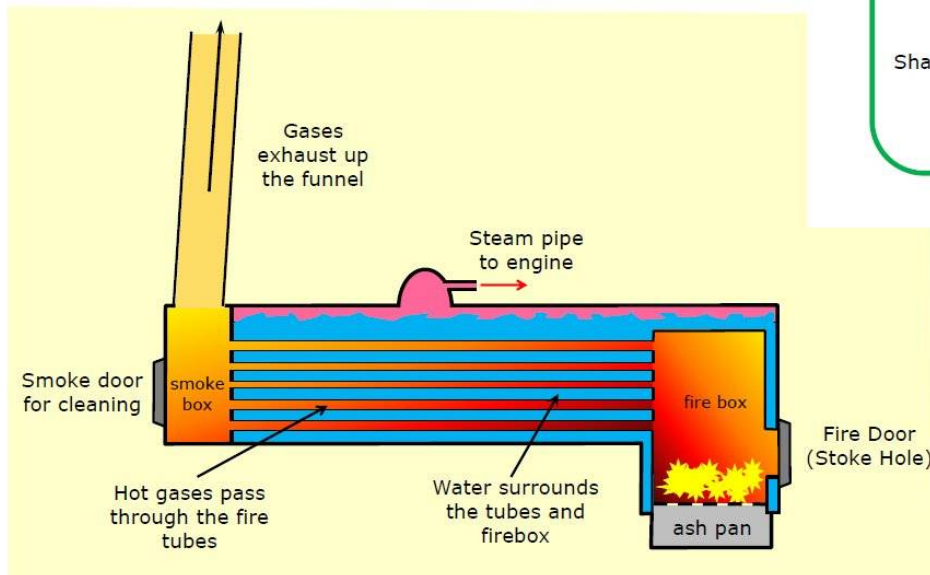
In the early nineteenth century, the design principles for boilers were not well understood, and there were many accidents.

From the middle of the century, experience and better engineering understanding (and new regulations) led to boiler designs which were safe and economical. These are essentially the same as those used today

Boiler types have names which indicate where or for what they were developed:

- *Cornish* boilers for mine pumping;
- *Lancashire* for cotton milling;
- *Scotch* for steamships;
- *Locomotive* for railways and traction engines.

Shamrock's boiler is a *Launch* boiler, a variant on the Locomotive boiler.



The Stoke Hole is at the back for a Locomotive boiler, or at one side for a Launch boiler.

Launch and Locomotive boilers have a large cylindrical drum containing water, with a number of fire tubes running through it from end to end.

At one end is the firebox, which is double-walled with water in between. The hot gases pass from the fire box through the fire tubes to the smoke box and thence up the funnel. Heat is transferred to the water through the walls of the firebox and the fire tubes.

Shamrock's boiler has 32 fire tubes each 32 mm (1¼ inches) in diameter. The drum is 560 mm (1 ft 10 in) diameter and 1470 mm (5 ft 8 in) long.

Figure 2: A Locomotive-style Steam Boat Boiler

2. The steam is transferred to the engine via a control valve – the throttle or regulator. In the engine, the steam pressure moves a piston which, via a crank, turns the propeller shaft. At the end of the stroke, a valve system transfers the steam to the other side of the piston and it comes back.

3. Figure 3 shows the workings of a *simple* engine. More powerful engines may have two or more piston/crank units on the same crankshaft. In some engines (*compound* engines), the two are of different sizes, and the same steam acts first on the smaller one, then on the larger.

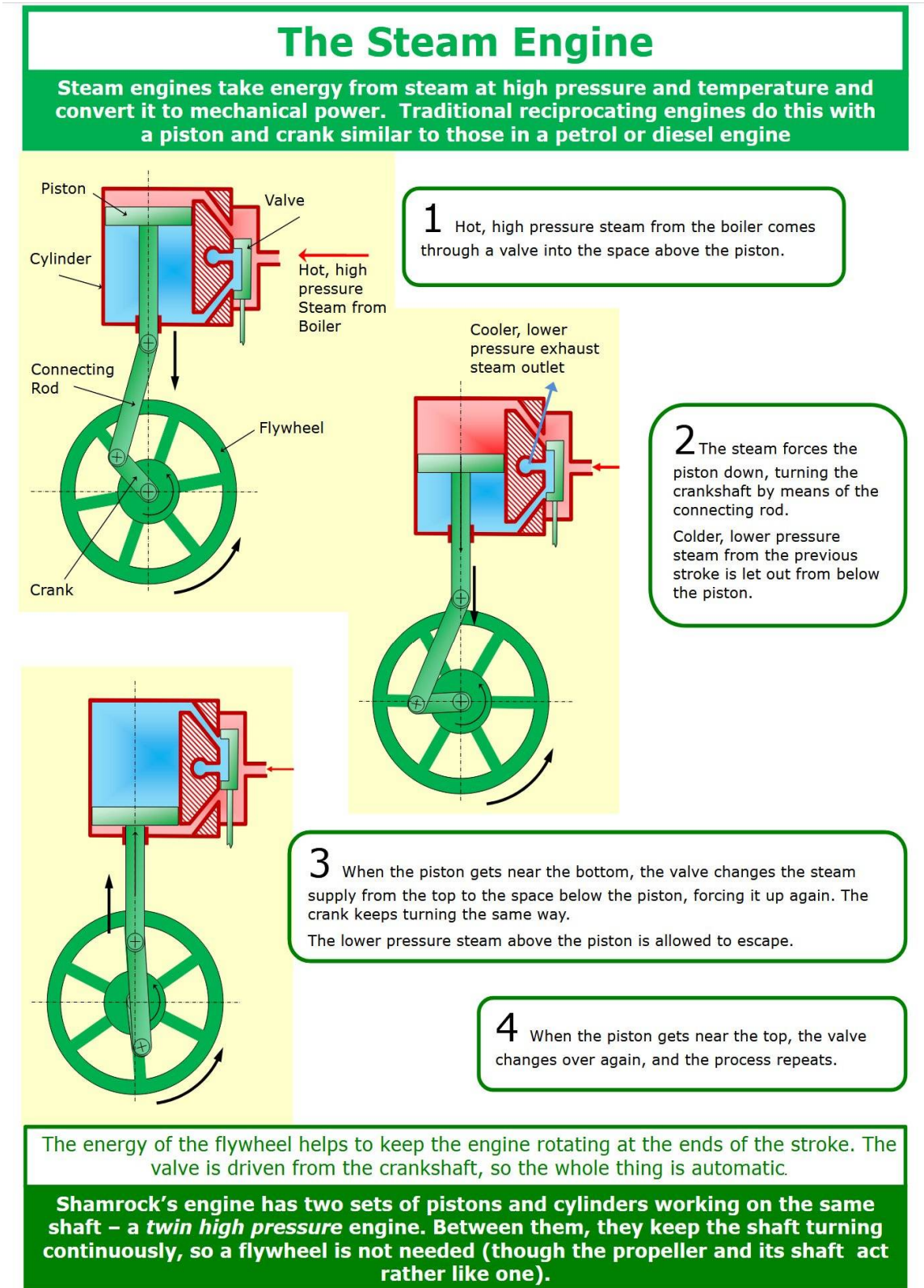


Figure 3: A simple Steam Engine

4. To keep running, we have to add more water to the boiler, and get rid of the steam which has done its work. There are two main set-ups for doing this: *open circuit* and *closed circuit*. If you have a good supply of clean fresh water (like a locomotive tender or a lake) you can keep pumping water in and letting the exhaust steam escape. This is open circuit. The exhaust steam is often directed up the funnel to help draw the fire, so this is also known as a 'puffing' configuration. A typical open circuit arrangement is shown in Figure 4.

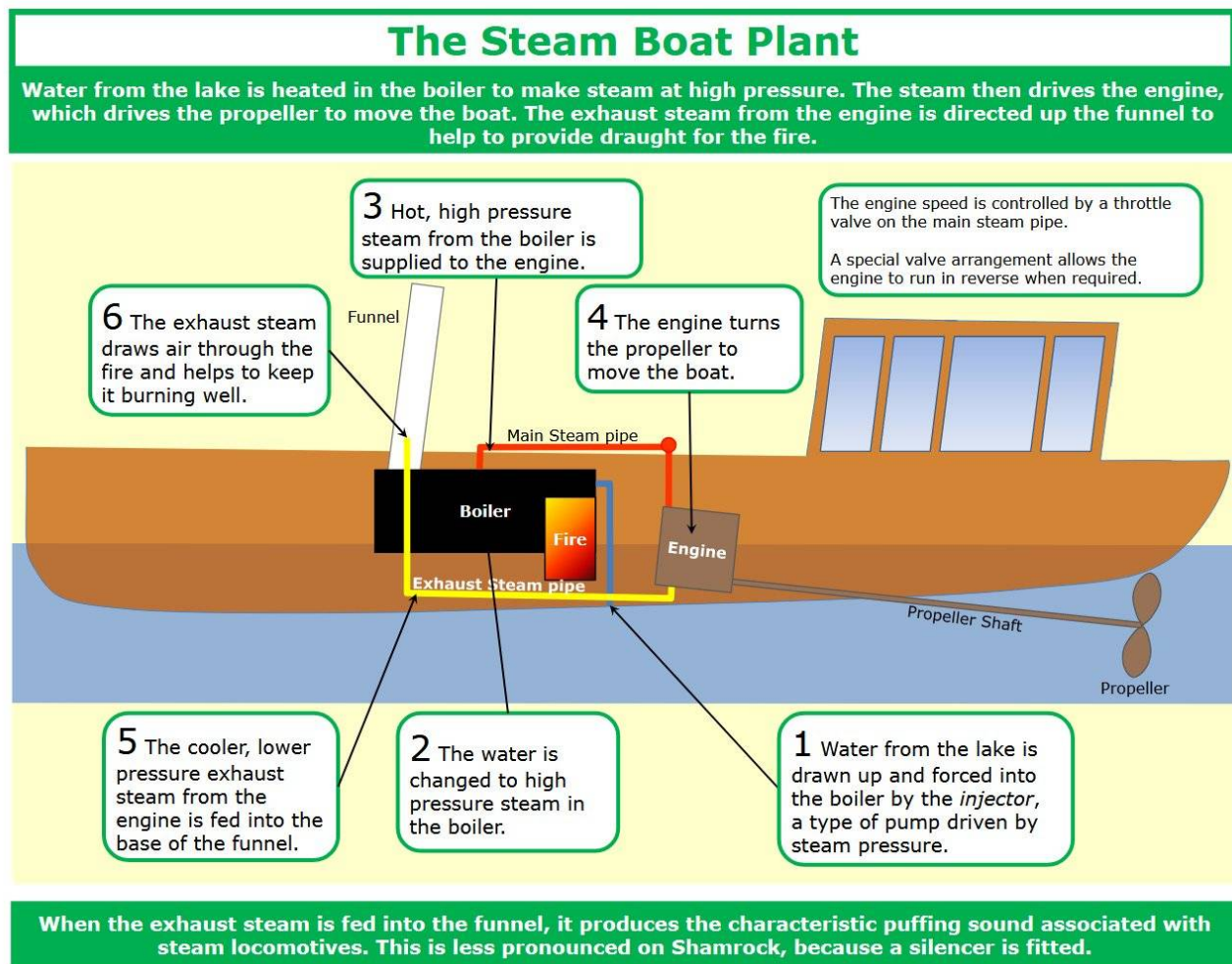


Figure 4: An Open Circuit (Puffing) Configuration

On the other hand if you only have access to dirty or salt water, you can condense the exhaust steam back to water and pump it back into the boiler to re-use. This is closed circuit or *condensing*. A typical condensing plant is shown (rather diagrammatically) in Figure 5.

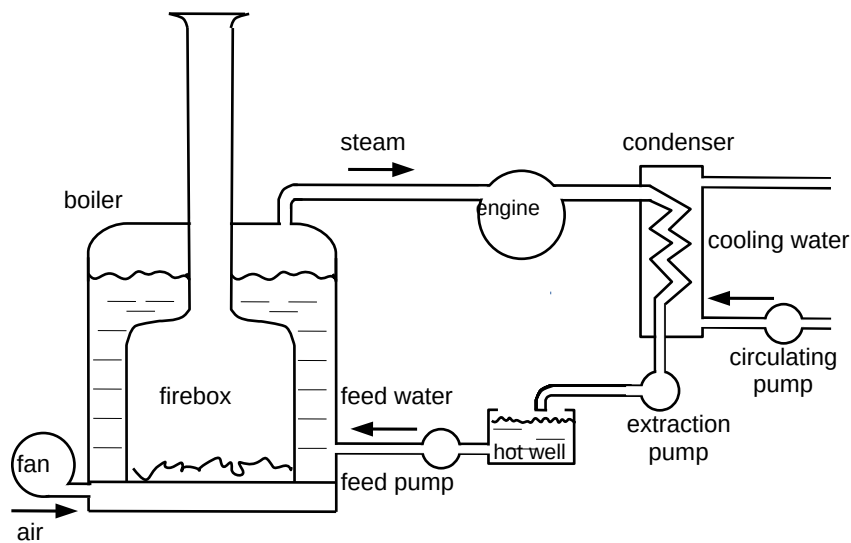


Figure 5: A Condensing Steam Plant

Condensing has the advantage that the pressure in the condenser may be below atmospheric pressure, so you effectively get more pressure difference across the engine, so increasing power. But you cannot puff, and may need an alternative way of blowing the fire.

Instruments and Auxiliaries

To get the water into the boiler, you need a *feed pump*. This may be a mechanical pump driven by the engine or another engine, or a hand pump, or a steam driven pump with no moving parts, known as an *injector*. It is normal, for safety reasons, to have two independent pumps.

If you are condensing, you need a pump to extract the water from the condenser (which will be below atmospheric pressure) and put it into the feed tank or *hot well*. This is called the extraction or *air pump* (because it also pumps a lot of dissolved air out of the condenser).

If you have an 'inboard' condenser, as in the diagram, you also need a circulating pump to pump cold water through it. The alternative is a *keel condenser*, a pipe underneath the boat which uses the lake as cooling water.

If your plant is condensing, you may need a *stack blower* which sends a jet of steam up the chimney to help the fire draw.

Two monitoring instruments are essential:

1. A gauge showing the level of water in the boiler. It is essential to keep this within safe limits. If the boiler runs out of water, serious or catastrophic damage can occur. If the boiler is too full, water may carry over with the steam and damage the engine.



2. A gauge showing the pressure in the boiler. This will be marked with a red line showing the maximum allowable pressure, at which the *safety valve* will lift and release excess steam.

Most boats have extra instruments to help with management. For example additional pressure gauges on the engine, between the engine cylinders, on the condenser, on the feed pump. Oil or gas fired boats will also have controls and instruments for the particular fuel system.

Non-steam instruments might include a revolution counter (tachometer), a GPS/Satnav, a compass, a depth gauge, a clock – all sometimes installed in polished brass cases for uniformity of appearance.

Other extras might include a whistle and/or siren, a steam ejector bilge pump, a 'Windermere Kettle'.

Completion procedure of standard and bespoke Risk Assessment sections 1 to 4:

1. Fill in your details and the event name at the top of the RA (please print the document and fill it in by hand, legibly, using black pen);
2. Using the “**Likelihood of Harm Guidance**” chart assess the “Likelihood of Harm” in relation to the event you plan to hold, do this for all the risks in Sections 1 to 3;
3. Multiply the value you have given for “Likelihood of Harm” by the pre-defined “Severity of Harm” and write the score in the box;
4. If the “Score AxB” is greater or equal to 15 then you must write in the box what action you have taken to reduce the likelihood of this risk and its rating;
5. If there are risks particular to your event not mentioned in Sections 1 to 3 please carry out a bespoke Risk Assessment in Section 4; and
6. Use the Check Sheet in Section 5 to identify additional risks specific to your event that might be present but are not included in Sections 1 to 3.

Severity of Harm Comparisons Guidance

Score	Example
1	A small cut requiring a plaster
2	A twist or sprain causing difficulty and pain or a larger cut that might need a stitch or tetanus jab
3	A painful injury such as a broken finger or arm but from which a full mend will be possible
4	A severe injury that causes permanent change such as a broken hip or neck or scarring.
5	A Fatality or severe permanent disability like blinding or spinal damage

Likelihood of Harm Guidance

Score	Category	Example
1	Very Unlikely	Something that will happen once in a blue moon under exceptional circumstances like being hit by lightning
2	Unlikely	Something that shouldn't happen under normal circumstances like a tyre blow out
3	Likely	Something that is likely to happen if simple precautions are not taken to prevent it like getting something in your eye if grinding metal without goggles
4	Very Likely	Something that is likely to happen under normal circumstances like not spotting a pot hole in the road
5	Difficult to Avoid	Something that is likely to happen as matter of course like hitting the kerb when parking

Steamboat Association Event Risk Assessment (To be conducted by the Event Organiser)

Event Name: Keeping Your Feet Dry III

Event Date: 13th September 2024

Organiser Name: R Calvert, M Duckket, D Bullough

Signed: 15/02/2024 - R Calvert

Date of Assessment: 15/02/2024

1. Hazards Specific to Steam Boats

Hazard	Nature of Risk	Potential Harm	Current Actions or Advice to Control Risk	Likelihood of Harm (1-5) A	Severity of Harm (1-5) B	Score A X B	Notes/Further Action (if score 15 or greater)
1.1 Burn on hot machinery	Any exposed steam pipes, engine parts or metal adjacent to boiler may cause an injury	Scalding or burns to parts which come into contact	Hot surfaces to be insulated where possible. All passengers and crew especially children to be briefed about dangerous surfaces.	3	2	6	RC initial steamboating safety brief SBA skippers to brief trainees in situ and supervise. Risk greater in smaller boats
1.2 Contact with moving machinery	Impact or crush injury may result from contact with moving components	Laceration or crush injury	Where possible moving parts should be guarded. Passengers and crew especially children to be briefed about potential risks	3	3	9	Risk greater in smaller boats RC initial safety briefing. Skippers to brief in situ and supervise.
1.3 Sudden release of steam	Rapid expulsion of steam from boiler or plant could cause a burn injury	Scalding or burns	All steam plant to possess a valid boiler certificate. Passengers and crew to be briefed about potential risks, pay attention to the dangers of whistles, blowers, blow-down outlets and pressure relief valves.	2	5	10	All boats to have completed an SBA Declaration Form. RC to organise. Safety Briefing, whistles, Windermere Kettles an Safety Release Valves.
1.4 Liquid fuel or gas Fire	From the use of volatile fuels such as paraffin or gas which could cause a fire on board	Burns and possible compromise of the integrity of the hull and evacuation of vessel	All boats have a competent operator who understands the maintenance, storage and use of such fuels in accordance with the Boat Safety Scheme specification. Always carry a fire extinguisher.	2	5	10	MD to brief those going on Betur to specific risks.
1.5 Whistle use	Damage to hearing could be a consequence of careless whistle use	Temporary or permanent hearing damage	Warn people when the whistle is about to be blown, understand the characteristics for your own whistle volume and size.	2	4	8	See 1.4

2. Boating Hazards

Hazard	Nature of Risk	Potential Harm	Current Actions and Advice to Control Risk	Likelihood of Harm (1-5)A	Severity of Harm (1-5)B	Score A X B	Notes/Further Action (If score is 15 or greater)
2.1 Falling in water	Could affect any person attending an event, particularly inexperienced, young or people with limited movement	Infection, Hypothermia, Drowning	Care when passengers embarking or disembarking. Vigilance for trip hazards adjacent to water. Suitable footwear recommended, life jackets or buoyancy aids should be made available to crew and passengers.	2	5	10	JR, initial safety briefing. All trainees required to wear Buoyancy Aid. BA to be made available for those without own. NT to be approached re loan of BAS See also 4.1
2.2 Finger crushing	Boats could squeeze together at moorings or in locks or when manoeuvring	Laceration or broken / dislocated bone	All passengers advised to keep fingers in board when near other boats or mooring. Special vigilance with children.	3	3	9	JR initial safety briefing.
2.3 Launching	Boats and trailers being manoeuvred whilst on a slipway being launched or recovered	Laceration, broken bone, dislocation	Ensure the launch or recovery is organised and supervised by one person, do not allow it to become chaotic and try to keep young children at a distance. Ensure the launch site and it's approach is fit for purpose and free from obstruction.	3	3	9	SBA skippers will launch and retrieve boat(s) with assistance of trainees under their direct supervision.
2.4 Fire	Fire as a result of fuel spill or cooking equipment	Burns or loss of boat	All boats should carry a suitable fire extinguisher and fire blanket.	1	4	4	No cooking involved.
2.5 Propellers	Person overboard, or if weed clearing might suffer injury from contact	Laceration, broken bone, dislocation	Steam isolated from engine before anyone approaches propeller.	2	4	8	Covered in safety briefings
2.6 Cuts	Wound may be contaminated with river water	Well's disease or other infection	Cover cuts with a sterile waterproof dressing, if in doubt seek professional medical attention.	2	5	10	
2.7 Locks	Falling in, Lock-keys (windlasses) spinning	Bruising As above for Immersion in water potential drowning	Skippers asked to keep 'helpers' at bay .	3	5	10	N/A - no locks on lake
2.8 Currents	Losing control of the boat caused by currents or changing water level	Drowning, sinking, collision with other boats or structures, grounding, stranding and capsizing	Study waterway information available on the relevant authority, use life jackets, carry a suitable anchor and lines, oars and paddles and a mobile phone or radio.	2	5	10	Wash from Ferries and Power Boats Specific dangers to be identified.

3. General Event Hazards

Hazard	Nature of Risk	Potential Harm	Current Actions and Advice to Control Risk	Likelihood of Harm (1-5)A	Severity of Harm (1-5)B	Score A X B	Notes/Further Action (if score is 15 or greater)
3.1 Sun burn	Forgetting the need to protect bare skin during a full day in the sun	Sunburn and heat stroke	Advise people to keep covered and use sunblock pay particular attention to children.	3	2	6	This is not generally considered to be the responsibility of the organiser but it is within the realm of the organisers duty of care.
3.2 Cooking equipment	Fire, explosion and burns caused by faulty or poorly maintained cooking equipment especially LPG	Burns, scolding and potential fatality	Take particular care to ensure the correct use and assembly of portable cooking equipment, do not allow the cooking area to become crowded and chaotic.	2	5	10	N/A - no cooking
3.3 Use of lifting machinery	Risk to any bystanders during the launching of boats using cranes and lifting equipment	Concussion, crushing, impact fractures, entanglement in ropes and harnesses	Ensure all equipment has sufficient capacity, is certificated and operators & banksmen are competent and the area is cleared of all people not needed for the lifting operation.	N/A	5	N/A	N/A
3.4 Tripping on mooring lines	Boaters and members of the public are at risk of tripping over poorly managed mooring lines	Trips and falls	Ensure mooring lines and pins are tidy and easily visible.	3	2	6	Long ends should be coiled or returned to boat.
3.5 Slippery surfaces	Paths, walkways, jetties and towpaths etc will become slippery especially when wet, icy or muddy raising the likelihood of a fall	Cuts, bruises, broken bones, dislocations and concussion	Organisers should discourage running and encourage the use of suitable footwear depending on the conditions.	2	4	8	Covered in Initial Safety Briefing
3.6 Covid	Airborne transmission (dominant method) Transmission through touching infected surfaces Infected person (asymptotic) attends event Extremely vulnerable persons	Varies from asymptotic symptoms to flu like illness, and risk of very severe illness or long term covid	Government recommendations regarding: - Ventilation; - wearing face masks; - use of hand sanitiser, & - lateral flow tests before meeting potentially vulnerable persons etc.	4 3	3 (flu like illness) 4 (long term covid)	12 12	SBA Rally with predominantly outdoor activity so risk significantly reduced. To follow government recommendations at the time of the rally.

4. Risks specific to your event but are not included above (Print multiple sheets if needed)

Hazard	Nature of Risk	Potential Harm	Current Actions and Advice to Control Risk	Likelihood of Harm (1-5)A	Severity of Harm (1-5)B	Score A X B	Notes/Further Action (if score is 15 or greater)
Area used as trailer park, obstruction. Uneven surfaces.	Trip/fall hazard	Injuries	Site to be checked night before event	2	3	6	Site Survey on day before event
Site accessible to General Public	See 1 hazards to steamboats	See 1	Boat Area to be cordoned off from the General Public	2	3	6	Arrange in conjunction with NT
Trainees unfamiliar with hazards	As above	As above	As Above	2	3	6	Trainees directly supervised by SBA skippers. Maps of area indicating hazards to be provided