The Steam Umpire launch

Consuta

The Engineers Handbook

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Contents

Consuta's Engineer Training Manual

Section 1

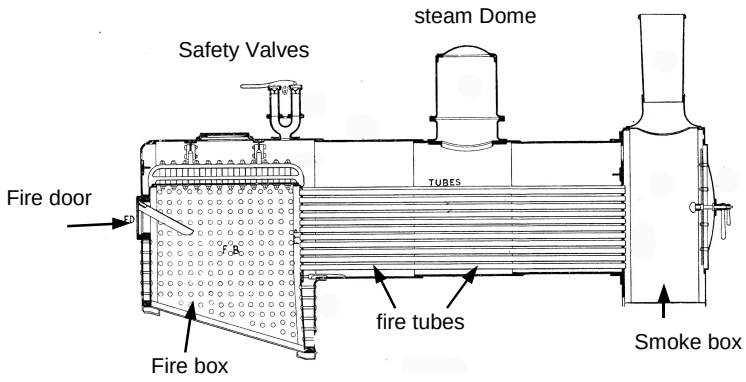
A basic description of the steam machinery used in Consuta

The elements of any steam plant can be considered in three sections: the boiler, the engine, and the auxiliaries.

Considering each in turn:-

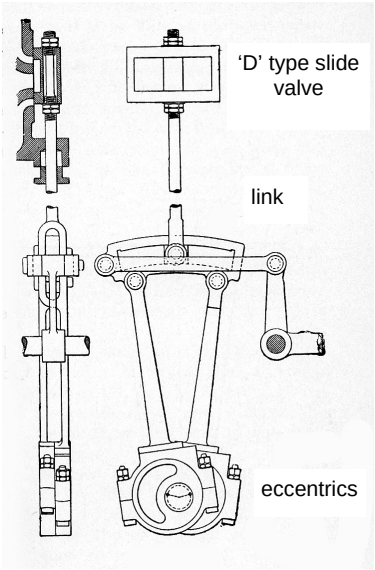
The loco boiler

Consuta is fitted with a traditional style loco boiler but is not fitted with a steam take off dome. These designs have been used on steam railway locomotives for over 100 years. See the GA below. The boiler has a firebox which is surrounded by a water wall, a number of firetubes lead out from the firebox through the water in the boiler barrel into an exit chamber called the smoke box. The smoke then exits the smokebox up the funnel. The exhaust steam from the engine is put up the funnel through a blast pipe which helps draw up the fire and increases steam output when the engine is running. The boiler on Consuta is coal fired through fire hole at the back of the boiler. Some small launches fitted with loco boilers are fired from the side.



The engine

The steam engine in Consuta was built by G.F.G. DesVignes and is the original as fitted in 1898. It has two cylinders which are double acting; this means that steam is used to push the piston in both directions, the used steam exhausts at the end of each stroke. This type of engine is referred to as a twin simple double acting. The engine is fitted with 'D' type slide valves, which slide over the cylinder valve ports to control steam admission to the cylinders. The valves are driven from a slotted link operated by two eccentrics; there are two sets of these eccentrics, driving the slide valve for each cylinder. A reversing lever controls via the link which eccentric works the slide valve, the eccentrics are so arranged to provide for the forward or reverse rotation of the engine. The valve gear on Consuta's engine is Stephenson's reverse gear after it's inventor. Each piston drives the crankshaft through a crank, the two cranks are set at 90 degrees apart, this permits the engine to start from any crank position.



The engine is lubricated by several wick fed oil boxes and a range of oil holes on the moving parts, this traditional method is known as a total oil loss system; the oil drains from the engine into the sump for collection and later removal and disposal.

The engine is also fitted with an oil pressure pump providing small amounts of oil into the steam pipe to lubricate the slide valves and pistons. The oil is pumped through a small pipe into the steam inlet manifold of each cylinder.

The steam supply to the engine is controlled by a steam throttle valve. The cylinder exhaust is taken away to a silencer which separates any water in the exhaust by centrifugal action to be drained away to the ash pan. The exhaust steam passes to the smokebox to exit through the blast pipe.

Auxiliaries **(directly on the boiler)**

The boiler has several outlet connection points to the pressure shell, these are used for various services as follows:-

- The two safety valves,
- a pressure gauge take off.
- Water gauge glass bosses,
- Two boiler water feed check valve inlets from the injectors,
- a main steam stop valve,
- a blower steam take off,
- an auxiliary steam take off,
- a blow-down shut off valve,
- steam to the whistle,
- Filling Plug

It is a requirement that all boiler connections from the pressure vessel must have a shut of valve at the connection point to the boiler; the safety valves are the only exception to this rule and cannot be shut off.

These stop valves provide a means of closing off any pipework or external fittings which may have developed a fault.

- **Safety Valves**

The most important fitting on any boiler is the safety valve(s), Consuta has two, the release pressure is controlled by an

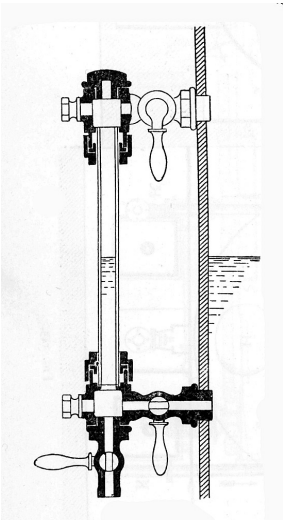
adjustable spring which should only be adjusted in the presence of a boiler inspector during the boiler inspection. These valves are set to release steam when the pressure reaches 180 psi, and they are of sufficient capacity to prevent any significant increase above this pressure. The safety valves automatically close when pressure falls below 180 psi.

- **The pressure gauge stop cock.**
  This valve must be left open at all times (lever inline with pipe) and is only used if there is damage to the pressure gauge. The boiler is fitted with a steam pressure gauge showing the boiler steam pressure. The gauge has a red line at the maximum working pressure.

- **Water Gauges**.
  There are two water gauges on Consuta showing boiler water level.

  The level in the boiler must always be kept within the range of these sight glasses.

  Each gauge has three levers which are used to check correct operation. All levers must be in the vertical position (usually hanging down) to show the correct boiler water level.



- **Boiler check valves.**
  The feed water from each steam injector is taken to a check valve on the backhead of the boiler. There are two check valves, one for each injector and these are fitted with integral shut off cocks which stop any flow in or out of the boiler. The check valves allow water into the boiler from the injectors but prevent any reverse flow.

- **Main steam stop valve**. This valve shuts off steam from the boiler to the engine throttle valve.

- **The steam blower.** This control valve provides a steam blast through small upward pointing jets on a ring fitted in the smokebox. The purpose is to increase the air draughting through the fire and make the fire burn more fiercely.
- **Auxiliary steam valve.**
  This valve shuts off steam to the auxiliary steam manifold. The manifold then distributes steam to three control valves. Two of these control valves are to regulate the steam to each injector, and the third valve shuts off steam to the bilge ejector steam valve and the windermere kettle valve.
- **Whistle stop valve.**
  This shuts off steam to the whistle and is adjusted to provide a clean voice from the whistle. Normally half a turn open.
- **Blowdown shut off valve**.
  The blowdown valve is fitted at the bottom of the firebox and is used to permit boiler water to be blown from the boiler when required. The blowdown water exit is below the river water level for safety reasons. Note this shut off valve which is a parallel slide, must not be left fully screwed down, but when shut should be backed off one turn.
- **Filling Plug**.
  A bung used to fill the boiler when cold.

The other Auxiliaries and controls

- **Steam injectors**.
  The steam to the engine is discharged to atmosphere through an exhaust silencer and the blast pipe, so the boiler needs a means of adding water to make up for this loss.

  On Consuta water is added by one of two steam injectors. These devices lift water from the river through hull skin fittings and then force it into the boiler.

  The injectors are not mechanical pumps, they work by

converting steam velocity into water pressure through specially shaped cones. The injectors on Consuta do have a couple of moving parts, needed to help start the injection process. Each injector has two operational controls, these are the steam valve and the water valve. Use in service is described later.

- **The auxiliary steam manifold**
  This is manifold takes steam from the boiler through the auxiliary steam shut off valve and is fitted with three steam valves. Two valves supply steam to each of the injectors and the third valve is used to supply steam to the Windermere kettle valve fitted behind the engine on the bulkhead near the kettle and the bilge ejector steam valve fitted on the starboard side of the engine just under the decking.
- **Water feeds to the injectors**
  The water intake is from two skin fittings on the bottom of the hull, these are fitted with shut off valves which are normally left open in service.
  The water is then passed through filters and then to a water control valve for each injector. These are located just above floor level on each side of the boiler by the coal bunkers.
- **Steam pipe water drain valve**

  This is a small valve fitted to drain the lowest point of the steam pipe between the throttle and steam stop valve. This valve is located on the starboard side of the backhead just under the engine steam and exhaust pipes.
- **Hand bilge pump**

  A hand operated bilge pump is located under the starboard (RHS) deck board; it has a “plug in” handle
- **Emergency Tiller handle**

  The emergency tiller is located under the back deck on the port side. It’s held here by clips and if needed is fitted on the top part of the rudder post over the back deck

Section II

A resume of how each component of Consuta's steam plant works and is used.

The boiler,

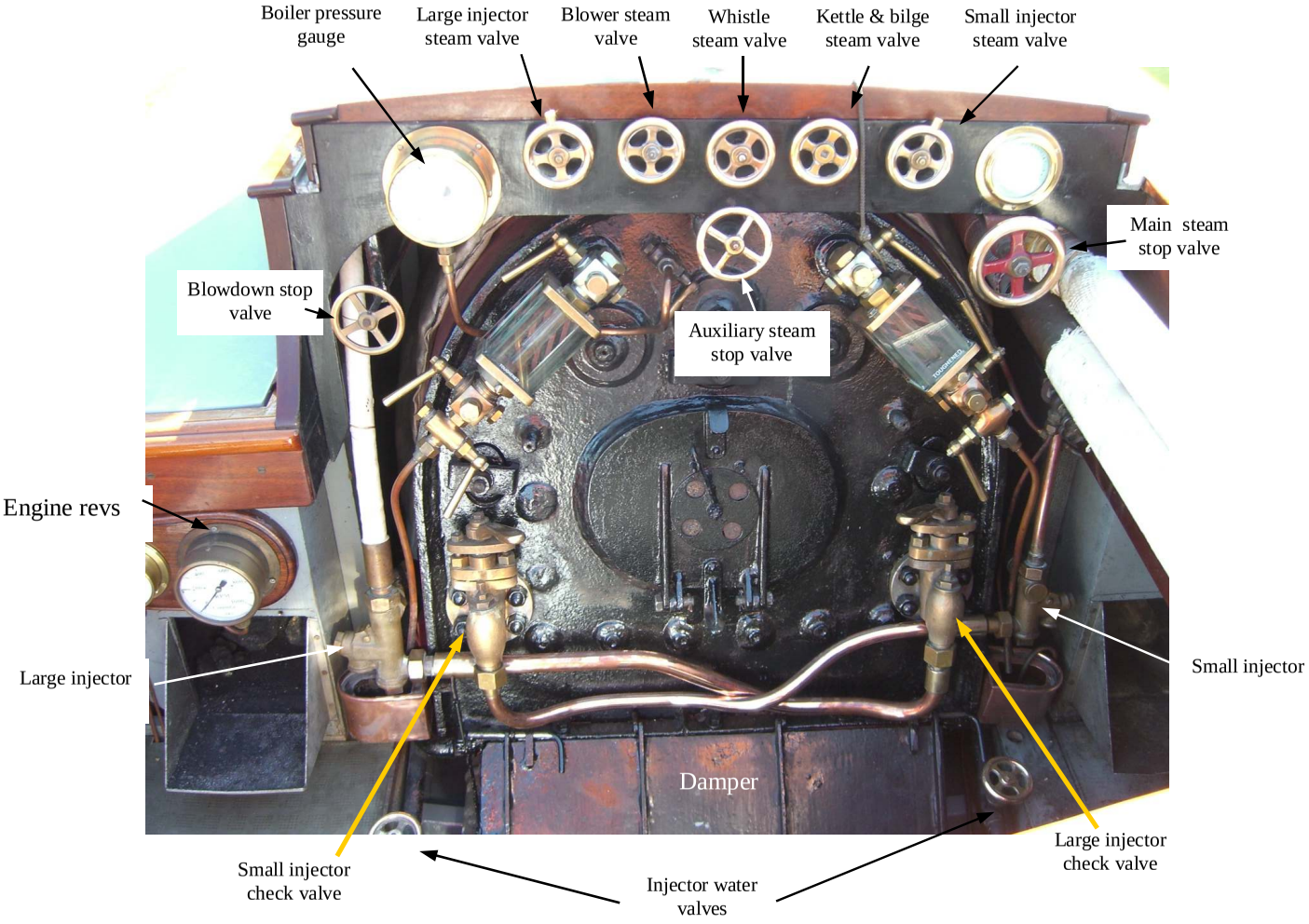
Consuta's boiler holds about 70 gallons of water, the grate is about 5 sq feet and the maximum safe working pressure is 180 psi. The grate is made up of 16 individual fire bars which are slotted into the firebox. Air to the fire is controlled by an airflap on the ashpan.

Coal qualities vary from anthracite which is mostly carbon with little gaseous volatiles and burns very clean with little or no smoke, to coals with high volatiles which are very smoky. Anthracite does not respond quickly to changing demands for heat output, and although coal high in volatiles does respond quickly it creates too much smoke and soots up the tubes.

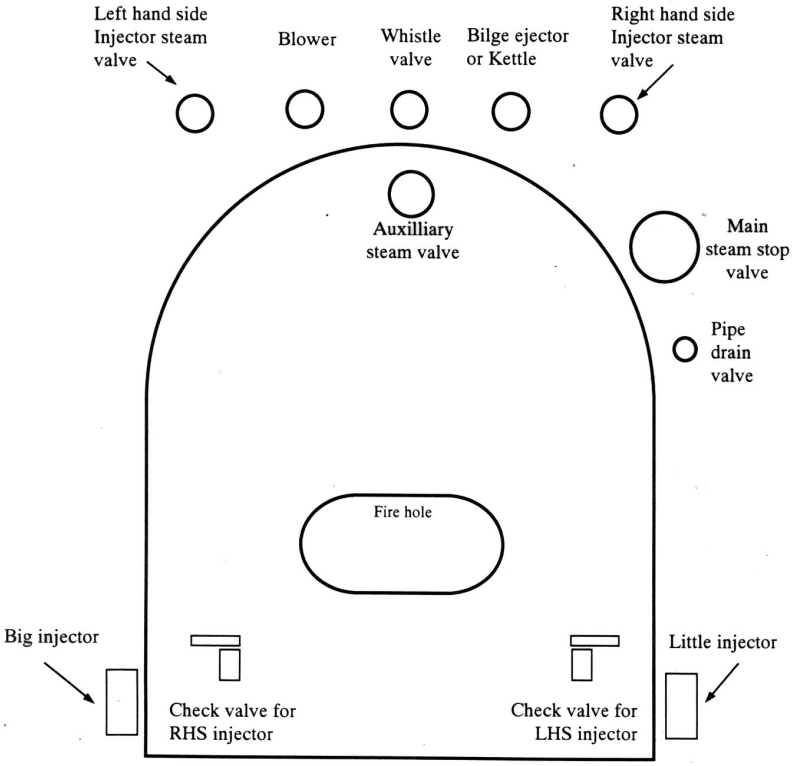
The best coal for loco boilers is known as steam coal, this has a limited amount of volatiles so burns with only a little smoke, but allows the fire to respond well for varying steam requirements.

Firing technique is very important. It is necessary for the whole fire grate to be covered by fuel at all times, any hole will allow cool air to pass through the grate, not through the coals and then into the boiler tubes so significantly reducing the boiler steam output. The fire should not be too deep, this will just block the air flow through the hot coals and make more smoke. When coal is first put on there will be a little smoke but this should clear fairly quickly as the volatiles burn off.

The steaming rate depends on how hard the fire burns. The engineer has an air control damper, this is a flap on the


Boiler pressure gauge
Large injector steam valve
Blower steam valve
Whistle steam valve
Kettle & bilge steam valve
Small injector steam valve
Main steam stop valve
Blowdown stop valve
Auxiliary steam stop valve
Engine revs
Large injector
Small injector
Damper
Small injector check valve
Injector water valves
Large injector check valve

Consuta valve layout



ashpan which regulates the amount of air passing up through the grate and the fire. It is normally closed when the engine is stopped and opened as required when steaming, this controls the amount of oxygen available for the fire.

The engine exhaust blast has a major effect on the fire and steaming of the boiler, because extra air is pulled through the fire when the engine is run due to the creation of a vacuum in the smokebox by the blast nozzle. The steam blower can be used independent of the engine, and is used to help draw the fire up when the engine is stopped or is running slowing.

Engine:

- reversing, oiling, warming up, handling
- Other general services such as skin fittings, bilge ejector, kettle etc.
- The physical layout of the controls.
- Identify the location of each component with the aid of diagrams.
- Note the engine can be turned when cold by use of a barring bar. This must never be used when in steam.

The responsibilities of the engineer.

Steam plant unlike modern machinery depends on continuous monitoring of all parts of the machinery by the engineer. And for best result the engineer requires experience and a good understanding of the physical principles involved in steam machinery.

The engineer has to manage the fire to provide the steam required for the type of duty the boat is expected to provide. Constant attention needs to be kept on the boiler water level, the condition of the fire, and the boiler steam pressure. The engineer has to ensure that the engine is kept clear of condensate and that the engine is kept well oiled during service. The engineer obeys instructions given by the skipper (helmsman) to manoeuvre the engine as requested.

Because boiler steam output does not respond instantly to changing requirements, the engineer has to anticipate steam demand that may be required. The engineer needs to be aware when the boat speed is to be significantly increased, ie more steam output required, or if the boat is to be stopped for a period, ie no steam required. This anticipation of steam demand will dictate the boiler firing requirements. For example when coming to a lock steam demand drops, and a secondary concern is not to make excessive smoke while in the lock, so coal should not be added prior or during passage through a lock.

The fittings,

The Injectors and how they work on Consuta.

Injectors are very reliable; faulty performance is not too difficult to diagnose once the basic working principles are understood.

The injector has two modes; the first (starting mode) is to lift water up from the river into the injector body. When this is achieved the working mode changes automatically to then put water into the boiler. 100 years ago such injectors were called automatic starting injectors.

The injector overflow gives a good indication of how it is

working and if there are any faults. When working there should be no water or steam from the overflow and the injector plus its pipework makes a gurgling noise. At boiler pressures above 100 psi the water supply valve should be fully open, and the steam valve opened wide to put water into the boiler without dribbling from the overflow. If boiler pressure drops below 100 psi the injector will start to dribble water from the over flow, and at this point the water valve needs to be closed a little until this spillage stops. By controlling the water valve the injector can be made to work below 50 psi.

Injector faults in service can be due to a blockage in the water filter/water feed, or if the water in the water pipe becomes too hot, or if the check valve has stuck or is not opening, or if the check shut off valve has not been opened.

It is important to note that when an injector is used this will probably reduce the boiler steam pressure for two reasons. First the injector is using some of the steam generated in the boiler, and second that it is putting in water which is cooler than the water in the boiler so has to be heated up. This feature can be usefully used to keep boiler pressure under control when passing through locks.

Checking the water gauge passageways.

Each gauge has three valves and in working position all levers will be vertical, usually pointing down. In this position the top and bottom gauge valves are open to the boiler, the lowest valve is closed.

To check that ways are clear close the two valves to the boiler and open the bottom blow down valve. Now open the top valve and steam should come out of the blowdown pipe. Close this valve and open the lower gauge valve, steam and water will come out. Close this valve and close the blow

down valve. The two gauge valves can now be opened slowly and the water should rise to the correct level in the glass.

Repeat this procedure for the other water gauge.

Section III

Operational

Raising steam and getting the machinery ready for use

Procedure for lighting up.

- Check that the ashpan is empty of ash then add about half an inch depth of water. There must always be some water present in the ashpan while there is a fire in the boiler, this is to prevent the possibility of heat damage to the hull.
- Clean out the grate if not already clean.
- Check that there is water showing in the gauge glasses; water should been visible in both.
- Remove funnel cap and open the damper.
- Fit the safety escape pipe but don't fit the funnel brass band until the fire has stopped smoking.
- Fully open the ashpan damper.

There are various methods of starting the fire:-

1 Newspaper, with a wood covering

2 Oily rags with a wood covering.

3 Fire lighters with a wood covering.

It is important to have enough dry wood to get a really good wood fire going before adding any coal. It is also important that there are no gaps or empty parts on the grate.

When the wood is burning well, start adding coal to give an even cover over the whole area of the grate.

Keep the fire door closed. In the early stages of the lighting

up there will be a tendency for flames to come out of the fire door, this is quite normal with loco type boilers. The coal will burn smoky at first but this should clear when using good steam coal.

Check the fire during steam raising and add further coal to keep the whole grate covered, but do not overfill, because too much coal will create excessive smoke and choke the fire.

It takes about an hour before the boiler comes to the boil. Once the fire has been lit, open the auxiliary steam valve and one of the injector steam valves to release expanding air from the boiler. These valves can be closed down when steam starts to come through as the boiler reaches boiling point. When the pressure rises to about 20 psi the steam blower can be used to encourage the fire if required.

Preparing the engine while raising steam

The engine has several oil boxes which need filling up to about 2/3 with bearing oil. There are three boxes on the crankshaft and one long box on the side of the cylinders. You will need to prime the wick feeds, best done by giving an oil can squirt down the wick tubes before inserting the oil impregnated wick. The wick box on the side of the engine feeds the connecting rod little and big ends through oil drip pipes. There are two other wicks which feed oil which drips onto the two Stephenson valve links. When the flow starts these tubes should be checked to see if they are dripping, and that the drips are falling correctly into the oil holes on the engine motion work.

Getting the engine ready for operation

Warming the engine and checking the injectors
When the pressure reaches 100 psi a start can be made to

warm the engine. Open all engine drains and slightly open the steam pipe drain. Make sure that the engine throttle is closed, then open the main steam stop valve a very small amount. Condensed water will come out of the pipe drain, this flows into the ashpan. When this stops the pipe drain valve can be closed and the main steam valve fully opened. The engine throttle can then be opened a very small bit. Warn the skipper that you are about to warm up the engine.
The engine has two drains on each cylinder, one of these valve clears water from the valve chest, the other drains water from the bottom of the cylinder. Water from the top of the cylinder will automatically run out of the slide valve port into the valve chest so a drain valve on the cylinder top is not needed.

With these valves open, condensate will flow from a combined drain pipe into the ashpan as the engine block is warmed up. The condensed water can easily be seen flowing into the ashpan.

Occasionally move the reversing lever from ahead to astern during this warming up. The engine can be allowed to turn over very slow provided the boat is securely tied up. When water stops flowing from the engine drains the engine is ready for service, and if the pressure is above 100 psi inform the skipper that the engine is ready.

Checking the injectors for proper operation

Once the pressure has reached 100psi or more both injectors must be tested for proper service.

First fully open the water valve on each injector. Note that there are also hull skin shut off valves which are normally left open and only need be closed if the filters are to be checked or the pipework is to be disconnected.

Open both the boiler check valve shut off cocks, note that these levers are set at 45 degrees to the boiler backhead for fully open or fully shut. The open position is as marked by a small pointer on the top of the lever.

Open the injector steam valve about one turn. On first use there will be steam/air blown out of the injector overflow while air is removed and water being lifted to the injector. When this has cleared the injector should now begin to work. Open the steam valve another turn if there is any water dribbling from the overflow. For correct operation there should be nothing from the injector overflow port

At pressures below 100 psi it may be necessary to close the injector water valve if there is water flowing from the injector overflow, adjust the water valve until this flow stops.

Both injectors must be tested working before the boat is confirmed as ready for service.

The whistle valve needs to be opened by no more than about a half turn to be ready for service. Warn people if you wish to check the whistle.

Section IV

Boiler and engine management underway

It is the engineer's responsibility to keep the boiler and fire suitable and ready for the service required.

Firing

The secret of good firing is anticipation of the steam demand likely to be required While under way coal should be added to the fire in small amounts to make up areas which looked burnt through. A useful guide to the condition of the fire is to look at the funnel exhaust. If there is no smoke this could mean it is time to consider adding coal, if very smoky then this may mean too much coal or a lack of air through the fire. Dependant on coal the fire may need extra airholes made by use of the pricker iron, or possibly extra top air, warning use the pricker sparingly only if necessary and do not damage the performance of the fire. Some steam coal cake together and need to be loosened up a small amount.

Because the fire takes time to respond the engineer needs to anticipate requirements. For example if coming to a lock the fire needs to be allowed to die down just prior to stopping. Also it is very inconsiderate to make smoke while passing through a lock. The general rule here is that no coal should be added to the fire when approaching a lock or while in the lock. Coal should only be added when leaving the lock.

The fire automatically responds to the amount of steam through the engine, by virtue of the exhausts blast, but it is important to make use of the damper. The general rule is that when running the damper should be open wide and when stopped the damper should be fully closed.

The firing technique should be aimed at avoiding the safety valves blowing off when moored up or in a lock.

Boiler water level

The level of water in the boiler must be continuously monitored whenever the engine is running. Note that the water level will rise in the gauge glasses when the engine is running due to steam bubbles in the boiler water. This effect increases as the boiler water gains more solids in suspension (ie dirty river water).

When the throttle is closed the water level will drop, so it is good practice to put the injector on when the engine is slowed down or is about to be stopped.

The injector is used to ensure that there is always water in the gauge glass. If water is very low and the injectors cannot be started then the engine must be stopped and the fire damped down immediately.

It is also important not to have too much water in the boiler because of the risk of water pickup in the steam take off which will go into the engine. Normally there should not be more than three quarters of water in then gauges. If the level is high then it may be necessary to open the engine drain valves to clear the water carried over. This is a known problem with the present boiler.

Water carryover in the engine is distinguished as a metallic clicking noise in the engine, cause by water hammer momentarily lifting the slide valve to release the water, open the drains to help get rid of this water.

Operation of the engine throttle and reverser.

The engineer operates the throttle and reverser as instructed by the skipper (helmsman). Normal maximum boat speed allowed on the river equates to approximately 180/200 rpm engine revs. The engine can be taken up to 280 to 300 max but only if instructed to do so by the skipper in special circumstances. The engine should never be run above 300 rpm unless on umpire duty.

While manouvering the engine reverser must be held by hand, and at all other times it should be locked off in full gear. Note ‘Ahead’ is

when the lever is fully down and ‘Astern’ is when it is fully up.

Under no circumstances should the engine reversing lever be placed in mid gear at any time. If the engine is not moving then steam pressure will hold the engine valves firmly on the valve faces making it difficult or even impossible to move the reversing lever. If this lockup occurs then the throttle must be fully closed and the valve chest pressure relieved by opening the valve chest drain valves. Pressure on the valves can be seen on the valve chest pressure gauge. The reverser **must not** be left in mid gear when the engine is stopped.

When the boat is underway, the engine drains should be closed and only opened if there is any water carry over in the cylinders, heard by a light metallic clicking noise.

When running astern do not run the engine above 180 rpm to avoid excessive strain on the rudder mechanism.

Note that there is a hull resonance at engine revs between 230 to 260 rpm and this range of engine speed should be avoided.

Procedure for stopping the engine for a while

When a stop of more than 15 minutes is expected try to arrange that the fire is dying back but still covering the whole grate.

When the skipper has finished with engines for a long stop over then this is a good time to fill the boiler and make sure there is sufficient coal added to the fire to keep it alight across the whole grate during the stop time. Do not add too much coal which will result in unwelcome smoke The ashpan damper must be shut and the firedoor closed.

All engine drains must be opened and if the boat is to be left unattended then it is a wise precaution to close the main steam stop valve.

Section V

Shutting down at the end of an outing

The fire should be arranged to be dying down for the very last part of the trip, but it is still important that it covers the whole grate.

Boiler blowdown and water level

The boiler should be blown down from normal working level to the bottom of the gauge glass, then filled right up past the top of the glass. The blowdown cock is operated by a square key fitted onto the valve through a hole in the floor plate; this valve only requires a 90 degree turn to move from fully closed to fully open.

Important before filling up with the injector, make sure that any muddy water disturbed by the blow down has cleared away. The purpose of this blowdown and refill is to get rid of some of the accumulated solids that build up in the boiler water.

It is important to fill the boiler up to the very top of the gauge at the end of the day, otherwise there could be insufficient water in the boiler for the next steaming. There will a drop in water level when the boiler is out of steam and there can be losses due to minor leaks while cooling.

Destroying the fire

The fire can now be broken up with the rake, or if rather deep then make a large hole in the fire on the grate. Use a little amount of blower while raking the fire this will reduce the risk of flyash coming out of the firedoor.

Engine details

The engine oil wicks can all be lifted out of the oil pipes and

hooked on the side of the oil box, open up all engine drains.

Shutting boiler valves

The following valves must be closed:-

Main engine stop valve, auxiliary steam valve, whistle valve blower, and very important the two injector check valves must be shut, and the injector water valves also closed.

If the fire is out or nearly out then the ash can be carefully removed from the ashpan, this must not be done if the fire is still burning strongly, and it's important to avoid dropping the ash into the bilges. Do not try to remove the fire until it has cooled down, this may mean leaving for the next steaming day.

Capping the funnel

Remove the funnel brass band and the copper safety escape pipe. If there is time polish up while still warm when the tarnish is easily removed.

Place the funnel cap on the funnel.

Tidy up the engine compartment

Sweep up any spilt ash or coal on the floor plates.

Tidy away any tools.

Check the contents of the engine drip tray, and if this is high, pump out into the used oil container store behind the engine.

Service aids

A First Aid set is carried under the engineers seat.

Hand cleaner (yellow colour) is available in a dispenser bottle, can be washed off with water.

Cleaning rags and paper towling is carried in the engine compartment. Polishing aids are carried under the aft cockpit deck.

Two powder fire extinguishers are carried, one in the forward compartment and one in the engine compartment.

Operational checklist

Please read this carefully to ensure safe operation of the steam machinery

Raising steam check list

- ❑ Clean grate.
- ❑ Check water level in boiler.
- ❑ Put water in cleared ashpan.
- ❑ Remove funnel cap.
- ❑ Fit safety escape pipe.
- ❑ Open damper fully.
- ❑ Prepare fire and light up.
- ❑ Check oil boxes and insert wicks.
- ❑ Check level in steam oil box.
- ❑ Oil around the engine while raising steam.
- ❑ Open injector check valves.
- ❑ Open injector water valves.
- ❑ Open main stop valve to warm up and drain the steam pipe with pipe drain.
- ❑ Open all engine drains and start warming the engine.
- ❑ Test that both injectors are in working order when pressure reaches 100psi.
- ❑ Fit brass funnel band.

Shutting down check list

- ❑ Knock a hole in the fire on the grate.
- ❑ Riddle fire thoroughly.
- ❑ Make sure that boiler water level is at or above the top gauge glass nut.
- ❑ Shut off the two injector check valves.
- ❑ Shut off the two injector water valves.
- ❑ Shut off auxiliary steam valve.
- ❑ Shut off main steam stop valve.
- ❑ Shut off whistle steam valve.
- ❑ Make sure blower valve is closed.
- ❑ Open all engine drains.
- ❑ Fully close fire door and damper.
- ❑ Remove oil wicks from the oil tubes.
- ❑ Remove steam safety escape pipe.
- ❑ Removed funnel brass band.
- ❑ Fit funnel cap..

Safety

Risks

The engine compartment presents hazards for the unwary, so you need to be aware of the risks. Only competent persons are allowed in the engine area.

The boiler backhead is hot enough to cause burns. Some of the steam fittings and pipes are very hot and will also cause burns.

The engine cylinders and steam pipework in this area also presents a burn hazard.

The engine has open motion work so hands and feet should be kept clear at all times, even when the engine is stationary. Do not try to oil parts of the engine while running. Oiling should only be done when engine is at rest.

Clothing

The engineers clothing should provide good cover for arms and legs. ie no short sleeve shirts or short trousers.

Shoes

Barefeet and open shoes must not be used. Shoes should however have soft soles and must not be capped or have steel studded bottoms to avoid damage to boat varnish/paintwork.

Gloves

Heat resistant gloves are provided and bare hands must not be used on any of the boiler controls or the firedoor handle. The engine throttle and reversing lever do run cool so can be managed by bare hands.

First Aid

If you do suffer a skin burn the best treatment is to keep it as cold as possible by dousing in cold water. Consuta carries a first aid kit, ask the skipper. Located under the engineers seat.

Fire extinguishers

Two are carried, one under the seat front compartment, one in the engine compartment. Use water to dowse small fires, only use the extinguisher if the fire is severe

Regular Maintenance

Reporting Problems and faults

It is important that any operational or mechanical problems are reported to the skipper and a note is made in the operational log book.

Operating hints and tips

Good Oiling Practice on Consuta

The engine used in Consuta needs constant attention from the engineer.

The crankshaft just needs the oil boxes fill 2/3 with oil and wicks placed in the tubes. No further attention is needed during the day.

However more attention is required for the Big end and little oiling. These are fed from the oil box on the side of the cylinder block. It is good practice to put extra oil into the oil holes of the Xhead and big end from the oil can while in a lock.

It is also a good idea while in a lock to put a small squirt of oil in the various oil holes on the valve gear ie eccentrics and Stephenson link, and also the small cups at the back of the crosshead slide bar.

The valve gear does wear because the loads on the various parts of the linkage are fairly high, so attention to oiling here is important because of the very rudimentary arrangements provided.

Summarising there are four wick feed oil boxes. Three are used on the main crankshaft bearings, the other box has eight wick oil pipes. At the end of the day remove the wicks from the oil pipes if there is much oil remaining in the boxes otherwise this oil will run away through the wicks.

When placing the wicks into the oil pipes, first put a good shot of oil down the pipe and fully insert the wick after dipping into the oil. Wick feeds work by capillary action, and please note, will take a little while before oil starts coming through the long pipes.

More about the art of Firing Consuta

The boiler fitted to Consuta unfortunately is not a good design. It is too heavy and because of the way the steam is taken off, it has a small steam space and a small water operating range, so it can be difficult to supply enough steam for the engine unless the fire is maintained in good condition..

The boiler has an adequate sized grate of 5.5 sqft but only has a small combustion chamber. Nevertheless with the good coal it can work quite well but needs good constant management.

So what is this thing about wet steam and why should boiler pressure effect steam usage

It is important to try and keep Consuta's boiler pressure high during any steaming, because if the pressure is allowed to drop lower than about 120 psi a lot more steam will be used by the engine at any specific speed compared with steam consumption if pressure is kept higher say at 160 psi or more.

So why should the engine use more steam when boiler pressure is low? Suppose Consuta is running at 300 rpm the pressure on the engine is only 25psi. The steam at the engine, when the boiler pressure is low, will be wetter here than when the boiler pressure is high, this is because of the saturation temperatures of steam at the different pressures. Dampness in high pressure steam will mostly evaporate when pressure is reduced at the engine throttle by the effect of wire drawing. Any water (ie condensate) with the steam passing through the engine represents heat from the boiler doing no work; so the fire has to work harder to replace this lost heat.
Is there an answer apart from installing a better boiler to supply drier steam? perhaps a superheater. NO the only practical option with the present installation is to try and keep boiler pressure high at all times when running.

The fire condition

The engine blast is the main method of forcing the fire, the faster the engine runs the more fierce is the draft; and except at low engine revs the blower will not have much effect. The blower is not needed with a well managed fire, and is only necessary with poor firing or for raising steam.

Keeping the fire in good condition is a key objective to achieving good results. A good fire when running hard will look bright red/ orange all over. So what does this entail.

The whole of the grate area must have a good base of burning coals. Any parts which are burnt through or nearly burnt out will let cold air pass through with dire results on steam output, so make sure that coal is added in good time to avoid any dead spots or holes on the grate. It's particularly important to ensure that all around the sides of the firebox has enough coal, so it is better to keep the fire thicker here than in the middle.

Sometimes the fire can be thick and black if too much coal has been added. When this happens the air cannot easily pass through the coals and the fire becomes choked. This state can be recognised by lots of black/dark smoke from the funnel and the red parts of the fire will look dull. Usually caused by adding too much coal over a short time, or sometimes the coal itself has caked up. The situation can usually be improved by careful use of the pricker to make small holes right through to the grate.

Clinker can also be a serious problem, however the present coal is very good and does not have any serious clinkering problems.

The ideal Firing technique is quoted as "little and often" and this is the basis of a good firing technique on Consuta. Don't add large quantities of coal in one firing, this will just damp the fire down and create a lot of unpleasant smoke.

When firing try to keep the fire door closed except when putting a shovel full on. It's bad practice to open the fire door before getting a

shovel full of coal ready. Large quantities of coal air sucked in will drop steam generation dramatically and also can be detrimental to boiler tube sealing due to the cooling effect of the cold air.

The colour of the funnel exhaust

Slight dark smoke would indicate fire OK, a totally clean exhaust would indicates volatiles have burnt off so the fire may need more coal. Thick black smoke means that too much coal has been put on at one time or the fire is choked. If the exhaust is very black allowed extra air in through a slightly open fire door. This extra air allows unburnt gases to burn off on top of the fire. This method of reducing smoke is especially important if coal has been added when the damper remains shut; just hold the fire door open a little using a piece of coal to hold it open at the top.

Use of engine drains

There are two drains on each cylinder. There is an installation fault on Consuta because if all drains are opened it allows valve chest condensate to partially blow into the cylinder drains, so don't open both at the same time.

Use of the reversing lever. – Important instructions

The reversing ever should always be used in either the full ahead or full astern positions. Linking up is not necessary nor desirable on Consuta's engine.

It is important on Consuta that the lever is **never put in the mid gear position** this can allow the steam pressure to build up in the valve chests and jamb the valves hard onto the valve ports making it impossible to move the reversing lever – **if this happens shut throttle and open valve chest drains to relieve pressure**. Don't do it – several engineers have been caught out with the engine locked up at critical points during manouvering.

While manoeuvring don't lock off the reversing lever but keep one hand on the lever at all times, however once under way the lever must be locked.

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