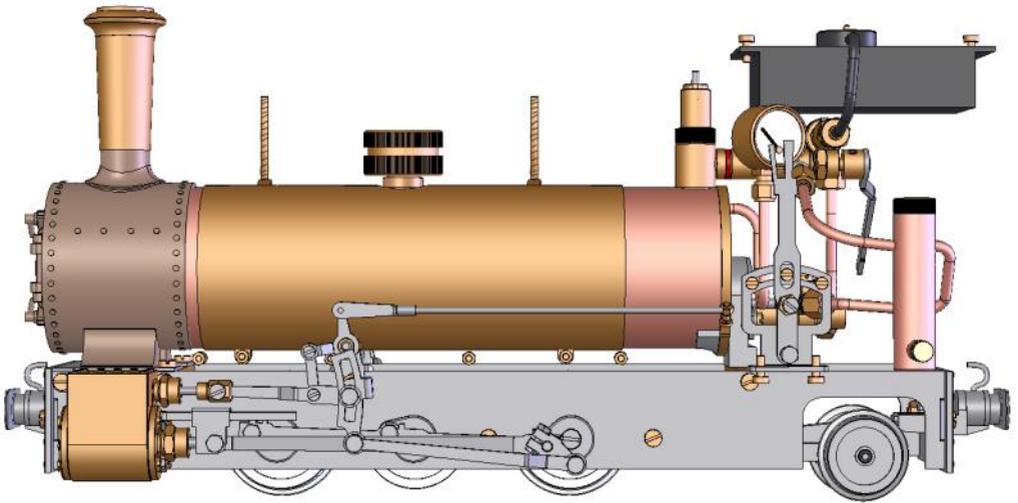




# Modular Locomotive System Instruction Manual *for* HBK21 Fowler Boiler Kit



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## HBK32 Fowler Boiler and Equipment

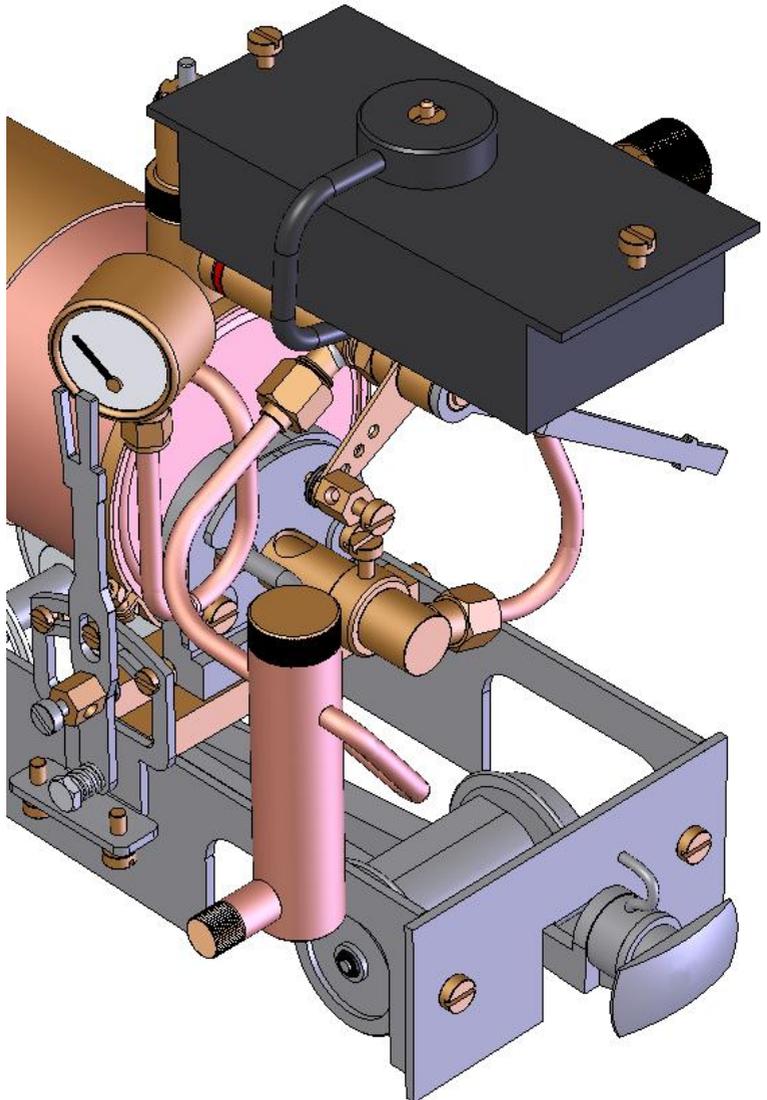
These instructions cover the installation of a gas fired boiler to the HBK31 Fowler Walschaerts valve-gearred chassis kit. Before starting to actually assemble these parts, read through these instructions fully so that you identify all parts and understand where each is fitted. Refer to diagrams at all times as these will make it clear which way round certain parts go.

*NB. We have updated the Gas Tank.*

*The drawings in this booklet are of the old tank as we have not yet updated the CAD files.*

*The difference between the old and new tanks is where the mounting screws fit.*

*This has no effect on this kit.*



## **Boiler and steam fittings**

Before mounting the boiler, remove the smokebox, brass boiler wrapper and all the steam fittings. The steam fittings are just loosely screwed on for ease of packing.

The brass wrapper can be painted the desired colour at this stage. The brass should be thoroughly cleaned and rubbed down with fine wet and dry paper before painting. Cellulose or enamel paint is readily available in spray cans for a good finish but a primer must be used first.

Etch primer and compatible top coats are available from more specialised modellers suppliers which are more suitable for use on brass and can give a more durable finish.

The Smokebox assembly also requires cleaning and painting before fitting to the chassis. Cellulose or enamel paints will stand the heat pretty well, though for a more durable finish, high temperature paint is available at motor spare shops. These come in aerosol cans and are intended for car engine and exhaust painting. Follow manufacturers instructions regarding storage and use.

The main steam pipe (superheater) passes down the single flue of the boiler on its way to the cylinders to give a certain amount of re-heating to the steam. The steam pipe to the cylinders should be installed before the boiler and smokebox, which are then threaded over the pipe. If you have already fitted your superheater, move straight on to installing the smokebox, if not read on.

The superheater has a 'T' connector silver soldered to one end, which connects the two cylinders. Carefully bend one of the steam inlet pipes up just a little. Slide one of the 2BA hexagon union nuts onto the steam inlet pipe followed by an 'O' ring. Then slide one end of the 'T' on as far as it will go and loosely screw the union nut onto it with the 'O' ring inside. The superheater should be pointing upwards for now. Put a union nut and 'O' ring onto the inlet pipe of the second cylinder and

bend the first pipe down again until the open end of the 'T' will slide back over the second inlet pipe. Loosely screw the second union nut onto the 'T' then position it centrally between the frames and tighten up both union nuts just sufficient to squeeze the 'O' rings a little. Don't over-tighten or you will crush and damage the 'O' rings.

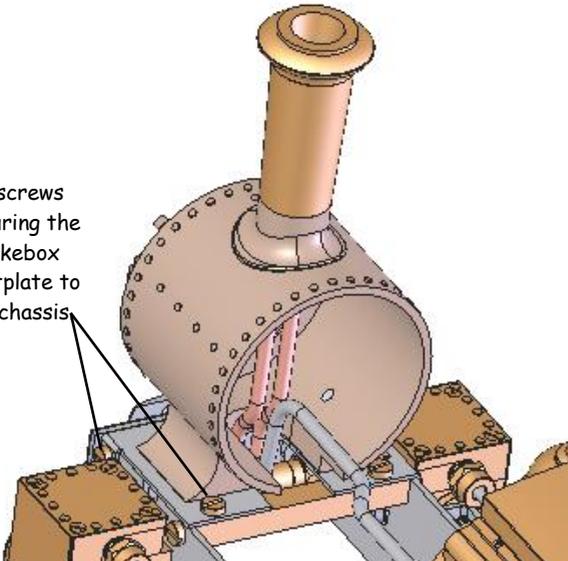
In order to line up with the centre flue of the boiler, the superheater pipe should be bent over about 20mm from the 'T' so that, when laid down, it points up from the 'T' and slightly backwards before bending and running parallel to and about 10mm above the chassis.

The two cylinder exhaust pipes can now be bent to shape. They bend up around the front of the 'T' and come together in the middle pointing upwards side by side.

The boiler is held at the front by plugging into the rear of the smokebox, which should first be screwed firmly to the chassis. Place the smoke box over the exhaust pipes so that the pipes fit up the chimney. The two lugs at the front of the smokebox footplate fit over the outside of the frames. Push 2 x M3 brass CH screws through these lugs and screw into the frames. The

rear of the steel footplate is fixed to the frame spacer, again using 2 x M3 brass CH screws. The centre hole of this frame spacer is not used.

M3 screws  
securing the  
Smokebox  
Footplate to  
the chassis

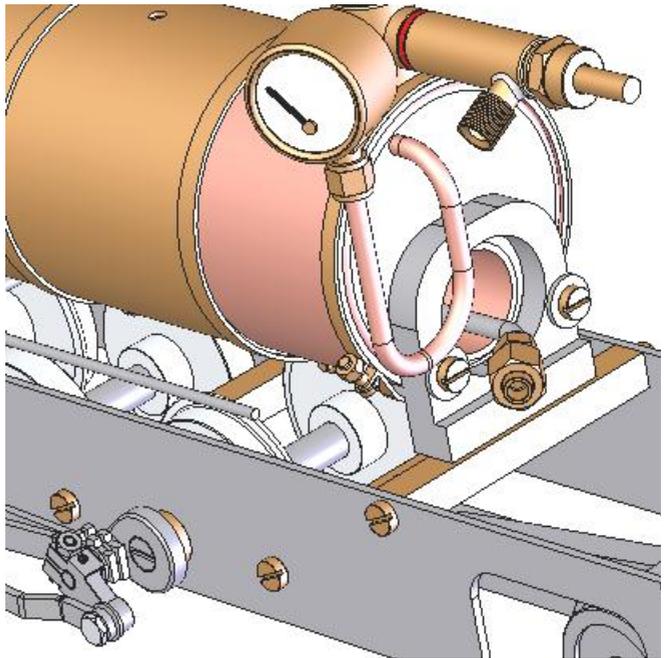


The exhaust pipes should now be pointing up inside the chimney side by side.

If not, gently bend to final shape.

The 4BA Brass screws need to be  $\frac{7}{8}$ " long. If they are longer than this, reduce the length using a small hacksaw. Fit the screws into the brass boiler wrapper and slide it back over the boiler, making sure that the hole in the centre of the wrapper fits over the filler plug bush in the centre of the boiler. The wrapper is not symmetrical so ensure that it is fitted to the boiler the correct way around. If fitted correctly approximately  $\frac{1}{4}$ " of the boiler will be showing at the front of the wrapper. Do not tighten it on yet.

The boiler mounting foot (which is a stainless steel casting), can now be fitted to the back of the boiler. First, remove the bottom, countersunk screw from the casting. The large hole in the casting fits over the flue tube, and the curved platform points forward and sits under the boiler barrel. The brass boiler band should be fitted around the rear of the boiler



passing over the curved platform, so that when tightened, it clamps the mounting foot to the boiler. Ensure that the boiler band is flush with the back edge of the boiler, and position the long brass screw at about 7 o'clock, so that it will not foul the footplate or any other items. Before tightening the boiler band fully, ensure that the mounting foot is pushed up against the boiler backhead. Also, when the mounting foot is stood on a flat surface, the steam turret and boiler filler plug are standing vertical on top of the boiler. If not, simply rotate the boiler on the mounting foot until all looks OK.

The boiler is now slid over the superheater so that it passes right down the centre flue and out of the back. The front end of the boiler pushes into the smoke box until the threaded hole in the rear mounting foot lines up with the hole in the rear frame spacer. The superheater should be tight against the top left hand side of the boiler flue tube. It needs to be in this position so that when the burner is fitted, there is enough space around the burner to allow the gas to burn efficiently. If the superheater is not at the top left of the flue tube, remove the boiler and gently bend the superheater in the smokebox until it is in the correct position.

A brass spacer plate is provided to keep the boiler level and is placed between the mounting foot and the frame spacer. Using the screw that was removed earlier, fix the mounting foot firmly to the frame spacer.

Now slide the boiler wrapper forward to meet the rear edge of the smoke box and tighten up the two clamp screws on the underneath. Fit the Long Steam Regulator to the rear of the steam turret on top of the boiler. It needs to finish up with the steam outlet on the side at about the 7 to 8 mark on a clock face when viewed from the rear and should screw on finger tight until it is about 45 degrees from the desired position. If it does not, the fibre washer can be reduced in thickness by rubbing it on a flat file until this is achieved. Now the regulator can be fixed in place using a little plumbers thread seal or PTFE tape, with the final 45 degree of rotation compressing the fibre washer a little to give a good firm seal. Do not force things - this goes for all fittings, remember the threads are quite fine.

If you later fit Radio Control using the HBK23 R/C Fittings Kit, the long steam regulator will be replaced by a Short Steam Regulator, to enable the R/C linkages to fit easily.

The pressure gauge does not require sealing as the cone fitting takes care of this. It should be on the left hand side but final positioning can be done to suit the body when that is fitted. The copper siphon pipe to which it is attached is easily bent with the

fingers, but this should be done with care. You will need two 4BA open ended spanners to tighten up the union nut.

The Safety valve has an 'O' ring seal on its thread, and is simply screwed into the top of the steam turret until finger tight. It is set to lift at approximately 40 psi. The Filler plug also has an 'O' ring seal. This is screwed into the filler bush in the middle of the boiler. Again, it only needs to be finger tight.

### **Gas System**

In line with all our locomotives, this boiler is now fitted with the ROUNDHOUSE "FG" type gas burner, which requires no adjustment other than initial positioning. The screw holes on the mounting flange are slotted to allow for this. The superheater pipe should pass down the centre flue to the left hand side and, on emerging from the back, should be bent over slightly to the left. A wedge shaped notch is cut out of the gas burner mounting flange to allow the superheater to pass through it. Ensure that the superheater is well over to the left hand side of the flue tube for its full length. Fix the burner to the mounting foot using the two brass screws already fitted to the mounting foot. Fix the burner to the mounting foot using the two screws and washers already fitted to the mounting foot. The washers are placed between the head of the screw and the face of the gas burner mounting flange. The burner should be set to the bottom of the flue tube and the right hand fixing screw is slotted vertically to enable this. This allows the maximum space above the burner for the gas to burn correctly. Do not over tighten these screws.

Push the jet block into the burner body as far as it will go (up to the step in the jet block) before nipping up the retaining screw.

The rectangular gas tank is designed to fit under the roof. There **must** be a clear airspace between it and the boiler and under no circumstances should it be in contact with the boiler or other steam pipes and fittings. The gas regulator is a needle valve and is mounted horizontally under the gas tank.

The gas connecting pipe can be bent to shape by hand as shown

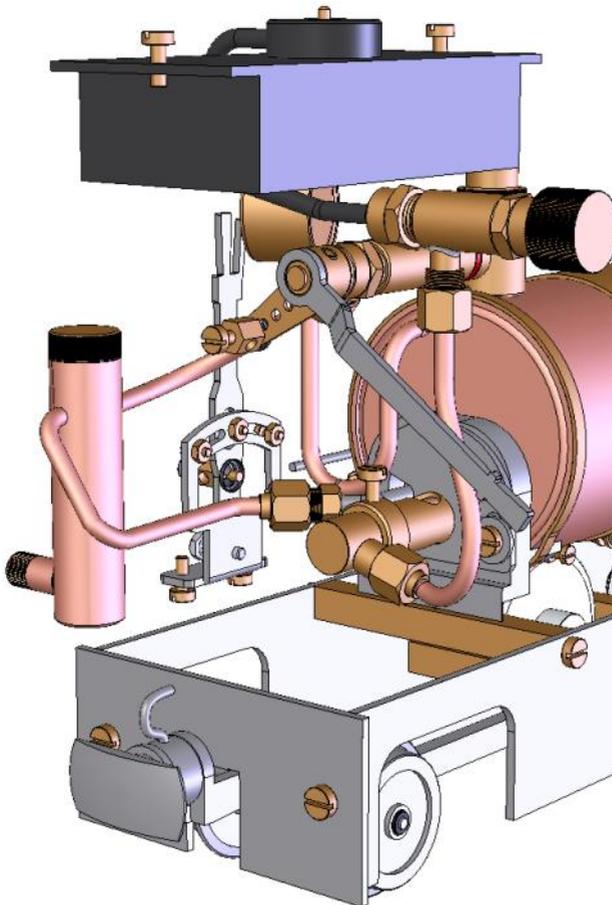
in the following drawing. It drops down from the gas tank and connects to the Gas Jet Block. Until the rest of the body work is fitted the gas tank will only be supported by this pipe, so care must be taken here.

### **Displacement Lubricator (Cylinder Lubricator)**

The displacement lubricator delivers steam oil to the cylinders, providing internal lubrication. We can now fit the displacement lubricator to complete the steam fittings. This sits over to the left hand side of the cab as far back as possible, in the doorway. Final positioning is left until the body is fitted so for now, just bend the pipes by hand to place it roughly in position as shown.

Looking at the left hand side of the chassis with the lubricator drain facing you, the

left hand pipe bends up and inwards to connect to the regulator and the right hand pipe bends down and round the back of the lubricator to connect to the end of the superheater pipe where it emerges from the flue tube.



### **Preparing the chassis for running**

You should now be in a position to test run your chassis and make any adjustments or final fixings to the valve-gear as detailed in

the chassis instructions (e.g. pinning the return cranks on Walschaerts valve-gear).

### **Lubrication**

Regular lubrication of all working parts is important and should be carried out before each operating session. There are two types of lubrication required: The external moving linkages and bearings are lubricated with a medium oil such as motor engine oil, and the internal steam mechanisms such as cylinders, pistons and valves are lubricated with a special steam oil that is mixed with the steam. Infrequent external lubrication will allow parts to run dry, and over oiling can form pools around operating parts that attract dirt and grit. If too thin an oil is used it will evaporate very quickly as the loco gets hot – leading to dry running. We recommend the use of a 20-50 motor oil for external lubrication.

Internal lubrication is achieved by steam oil that is mixed with the steam in the displacement lubricator, housed in the left-hand side of the cab. Remove the knurled cap from the top and slacken the drain screw two or three turns at the bottom but do not remove it. Any water in the lubricator will run out through the drain screw. Tighten the drain screw and refill with the steam oil supplied, then replace the cap. Take time filling the lubricator, especially when cold, as the oil takes time to run down and may trap an air bubble. Both cap and drain screws are fitted with 'O' rings and need only be closed finger tight.

**NOTE:** Only special steam oil as supplied should be used in the lubricator and under no circumstances should ordinary oil be substituted, or damage may result.

The gas and steam regulators will require periodic lubrication – see the troubleshooting section for details.

### **Filling The Gas Tank**

The filling of the gas tank should only be carried out in a well-ventilated area, where there are no naked lights or other lighted locomotives close by. Ordinary Butane or Iso-butane gas (as

used in gas cigarette lighters) is the preferred fuel, though for economy, the larger canisters as used for blowlamps or camping stoves etc. are better. The larger canisters have an EN417 threaded self sealing valve on top and require a special adapter to couple up to the filler valve on the locomotive. A special brass gas filler adapter is obtainable from your local garden railway supplier or direct from **ROUNDHOUSE**.

Mixed gasses are also available and may be used if ordinary butane or iso-butane are not available, but see 'Gas System' section under 'Troubleshooting' later on, for more information on this subject.

Before attempting to fill the gas tank, make sure that the gas control valve is closed by turning it clockwise.

The filler valve for the gas tank is on top of the tank. The gas tank must be firmly supported here as it is only held by the connecting gas pipe. Invert the gas canister and place its nozzle over the gas filler valve. Support the tank and press the canister down. The gas will be heard hissing as it enters the tank and a small amount will escape around the valve. This is quite normal and is due to the gas tank venting as the liquid enters. After about 20 to 30 seconds, liquid gas will emerge from the valve showing that the tank is full. Remove the canister immediately.

### **Filling The Boiler**

A syringe and plastic pipe are supplied for filling of the boiler. Distilled water is recommended if available. As an alternative to distilled water if this is unavailable, clean tap water can be used in soft water areas. Also, rain water or water from a dehumidifier can be used provided that it is adequately filtered - pass the water through a paper wine filter or similar to remove any small particles that may have found their way into the water. Do not use deionised water as this type of water may cause damage to the boiler and fittings over the long term .

The boiler is filled with water through the filler plug in the

middle of the boiler. Unscrew this and fill the boiler right to the top with clean water. There has to be a space above the water to allow steam to be raised so, insert the end of the plastic pipe into the boiler and withdraw 30ml of water with the syringe. Replace the filler plug finger tight.

### **Lighting the Burner**

**WARNING:** Before lighting read the 'Gas System' section under 'Troubleshooting' and be aware of potential problems. If the gas system is not operating correctly, **shut it off immediately** or damage may result. Move the locomotive to another location before lighting. Butane is heavier than air and small pockets of gas can collect around the locomotive during filling.

To light the burner, hold a lighted match or cigarette lighter over the top of the chimney and **slowly** open the gas regulator by turning it anti-clockwise. The gas should ignite almost immediately with a pop as the flame travels down the chimney and into the boiler tube. The burner should be audible but not too loud.

**NOTE** as stated above, the gas regulator should be opened slowly until the burner ignites. If opened too quickly, particularly when the engine is cold or if the gas tank has just been filled, it is possible that the flame may not travel back into the boiler flue but stay in the smokebox. If this should happen, the burner will sound quite different to normal and the blue flame will be visible in the smokebox if viewed down the chimney from a safe height. Should this happen, turn off the gas immediately or damage may result, and then re-light it. If the problem persists and it is not possible to ignite the burner correctly, then a dirty jet should be suspected and cleaned as detailed in the trouble shooting section.

For the first couple of minutes keep the burner on low. This is important, as until it warms up, the flame will be a little unstable and turning it up too much could cause it to go out. Also, with a completely full tank, liquid gas could be drawn off

instead of vaporised gas, which can also extinguish the flame.

After a couple of minutes, the gas control valve can be opened a little more to speed up steam raising. Open the gas regulator slowly to about one full turn. The full range of adjustment (closed to fully open) is achieved within the **first full rotation** of the gas regulator knob any more is unnecessary.

### **Running the chassis**

When full working pressure has been reached (about 40psi), the safety valve will start to blow off steam. Steam generation can be controlled by the gas valve in the cab. If the safety valve blows off frequently during running, then too much steam is being produced, which wastes water and gas. Turning down the burner will decrease the amount of steam created. Conversely, if steam pressure is not maintained during a run, then the burner should be turned up. After a few minutes of running it may be noticed that the gas pressure through the burner has increased. This is due to the gas tank becoming warmer and so increasing the gas pressure. Simply turn the gas down – this may need to be performed several times during a run. The art of balancing steam generation to the operational requirement by the adjustment of the gas control valve will quickly be learned.

The gas tank has a duration of about 25 minutes, though this will vary a little depending on the gas valve setting. The boiler should not be allowed to run dry, and the gas tank capacity is such that the gas should run out before the water. When the gas is fully used up, the steam pressure in the boiler will be seen to gradually drop until the loco comes to a halt. Should the water expire before the gas is fully used, the pressure will drop rapidly and the loco will stop. Check the pressure gauge – if this is zero turn off the gas. No damage will result if the gas is turned off immediately. When full working pressure has been reached (about 40psi), the safety valve will start to blow off steam. Steam generation can be controlled by the gas valve. If the safety valve blows off frequently during running, then too much steam is being produced, which wastes water and gas.

Turning down the burner will decrease the amount of steam made. Conversely, if steam pressure is not maintained during a run, then the burner should be turned up. The gas tank has a duration of about 25 minutes, though this will vary a little depending on gas valve setting.

On a manually controlled locomotive, there are three main controls.

- 1) **The gas regulator**, which should be used to control steam generation as described earlier.
- 2) **The reversing lever**. This is moved fully forward for running in a forward direction and fully back to run in the reverse direction. It should be parked in the centre (mid gear) when the locomotive is stationary for any length of time. When in mid gear position, the valve gear is effectively in neutral and the engine will not move under steam power.
- 3) **The steam regulator**. This is the main steam control valve and regulates the speed at which the engine will run and is moved anti-clockwise to open and clockwise to close.

Using the reversing lever, select the desired direction of travel then open the regulator a little. Initially, there will be a certain amount of water in the pipes and cylinders, which will exhaust through the chimney and, after a few moments, the engine will move jerkily as this clears. Once the parts have warmed up, the engine will move off steadily and it's speed can be controlled with the regulator. Subsequent starts will be quite smooth once the cylinders etc. have reached their normal operating temperature. To reverse the locomotive, close the regulator to bring it to a halt, move the reversing lever over and open the regulator again.

The art of fine control will soon be learnt with a little practice.

## Trouble Shooting

### Gas System

This system is designed for use with Butane or Iso-Butane gas. Mixed gasses, i.e. Butane with a proportion of Propane mixed in, are available, and may be used if straight Butane is unavailable.

These come in a variety of mixes ranging from 90/10 to 60/40 with one of the most common being 70/30. The figures refer to the proportions of the mix i.e. 70/30 contains 70% butane and 30% propane. If using mixed gasses, always choose the one with the largest proportion of butane.

The addition of propane slightly alters the gasses properties. This can make the burner a little more difficult to light when cold or after filling the gas tank. Always open the regulator very slowly when lighting, and only just sufficient for ignition to take place. Opening too much too soon may extinguish the flame until the burner reaches normal operating temperature.

The tiny jet in these units can become blocked by small particles of dirt making the burner difficult to light, burn weakly at normal operating temperatures\*, burn in the smokebox or fail completely. If any of these should happen, clean out the jet as follows.

(\* On very cold days, a burner may start off burning weakly due to the temperature of the gas but should increase to its normal level as the engine warms up. This is quite normal)

Carefully, disconnect the gas pipe from the jet block using a 2BA spanner.

**Note** when connecting or disconnecting the gas pipe and jet block, do not use excessive force. Always hold the end of the gas burner near the air holes to support it otherwise it is possible to cause damage by bending the body. Slacken the screw retaining the jet block and slide it out to the rear. Remove the jet from the jet block using a 4BA spanner. Wash

out the jet in fast evaporating thinner (Cellulose or similar). Blow through the jet from the front, which should clear most blockages. Although the hole through the jet is tiny, if you hold it up to the light you should be able to see quite clearly if it is blocked or not. If in doubt, fit a new jet. A spare gas jet is included with the toolkit.

Do not use wire to clean the jet as this can damage the precision hole and may upset the delicate balance of the gas system. Reassemble in the reverse order, putting a small amount of PTFE tape round the thread of the jet. Ensure all connections are tight. When re-positioning the jet block in the burner, ensure that it is pushed in as far as it will go.

The gas regulator has a spindle 'O' ring housed inside the body which may need lubrication from time to time if the control becomes 'spongy' in operation, making precise gas control difficult.

As stated in the lighting instructions earlier, the full range of adjustment for normal burner operation is achieved within the first full rotation of the regulator knob, and it should only be unscrewed more than this for maintenance purposes and when the tank is empty, and there are no naked lights nearby.

To lubricate it, remove the knurled knob which is retained by a 4BA socket grub screw (.100" AF Allen key required) in the side. This grub screw is accessed by first removing the brass lever which is screwed into the same hole.

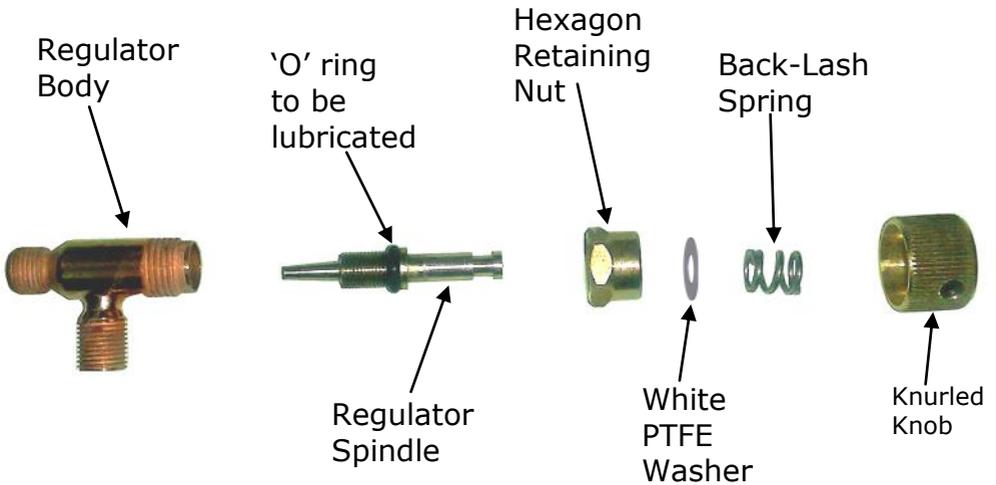
Beneath the knob is a back-lash spring which will slide off the spindle.

Unscrew the hexagon retaining nut then screw the spindle out of the body.

The 'O' ring can now be lubricated.

Replace the spindle followed by the retaining nut. Slide the backlash spring over the spindle and replace the knob. Note that the grub screw that holds the knob in place tightens into a groove near the end of the spindle and should be in a position that allows the side handle to be screwed in and operate the regulator without fouling other controls or the cab side.

### Gas Regulator (Internal Parts)





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**EC Declaration Of Conformity**

I hereby declare that the model described:

**Model: HBK21 BOILER KIT (Fowler)**

Conforms to the Pressure Equipment Directive 97/23)EC

All components and assemblies have been designed and manufactured according to sound engineering practice (SEP)

**Description and specification of equipment covered**

**Steam Generator and associated pipe work and fittings**

**Model: Type 5 boiler**

Serial No.:

Boiler Material: **Copper**

Test pressure: **5.4 bar**

Volume: **276 ml**

Max working pressure: **2.7 bar**

Safety valve set pressure: **2.7 bar**

Maximum filling volume: **246 ml**

Year of manufacture: **Same as 'Test Date'**.

Test date:

**Vessel for Group 1 gasses and associated pipe work and fittings.**

**Model: Type 'E' gas tank**

Serial No.:

Test pressure: **34 bar**

Volume: **39.90 ml**

Maximum permissible working pressure: **17 bar**

Maximum working temperature: **65 degrees C**

Intended use: **storage of Liquefied Petroleum Gas (LPG)**

Year of manufacture: **Same as 'Test Date'**.

Test date:

Signed

Dated .....

**R. Loxley (director)**

Please refer to the 'owner's handbook' for your particular model of locomotive, for details on correct use of these pressure vessels.

## **Pressure vessel care and maintenance**

### **Gas tank**

The gas tank is used for the storage of LPG (liquefied petroleum gas) in the form of butane, iso-butane or as set out in the 'owners handbook'.

The tank is fitted with a self-venting filler valve which contains no serviceable parts. Should the filler valve become defective in any way, it must be replaced with a new item.

It is recommended that the gas tank should undergo the following checks, carried out by a 'competent person', club, society or pressure vessel manufacturer, every year:-

1) thorough visual inspection.

And every five to ten years:-

1) hydrostatic pressure test to not less than 1.5 and not more than 2 times the maximum working pressure.

### **Boiler**

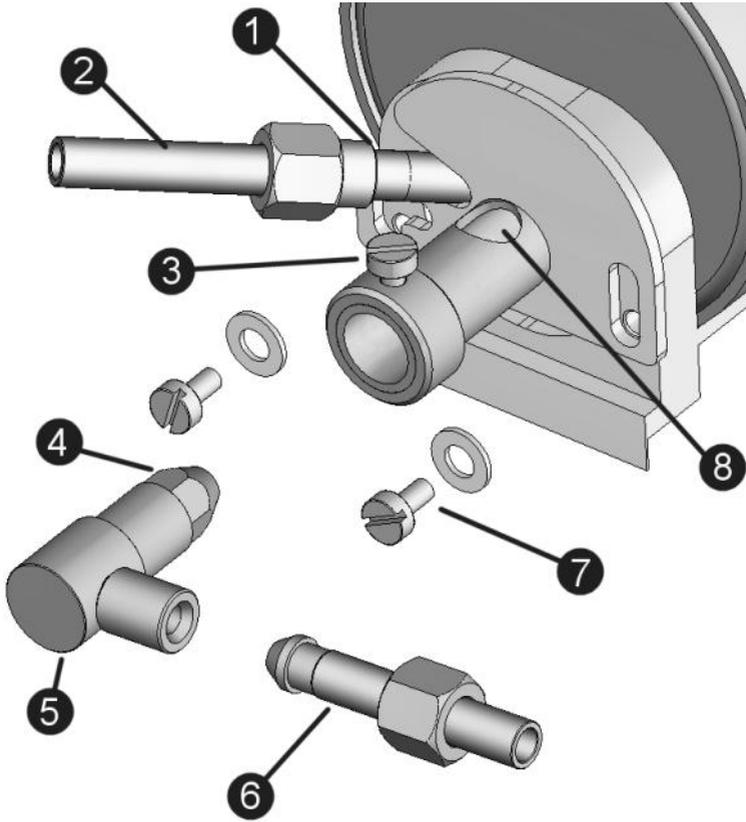
The boiler is fitted with a safety valve to prevent the steam pressure rising above the maximum allowable working pressure. This is pre-set to open at between 2.38 bar (35 psi) and 2.72 bar (40 psi) and must not be adjusted to increase this value.

If the safety valve becomes defective in any way, it should be replaced or returned to the factory for service and calibration.

It is recommended that the boiler should undergo the following checks, carried out by a 'competent person', club, society, or pressure vessel manufacturer, every one to two years:-

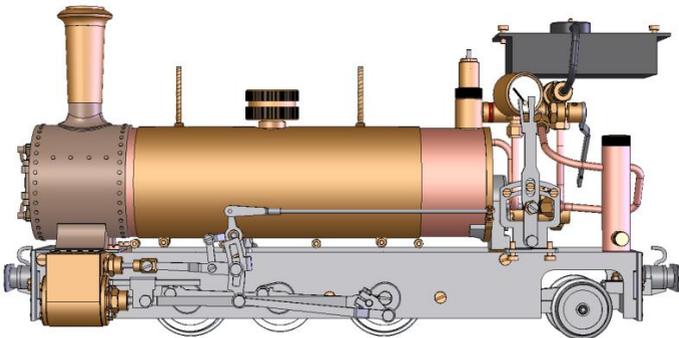
1) thorough visual inspection.

2) hydrostatic pressure test to not less than 1.5 and not more than 2 times the maximum working pressure.



### Gas Burner

- 1). Superheater Pipe. 2). Lubricator Pipe.  
 3). Gas Jet Block retaining screw. 4). Gas Jet.  
 5). Gas Jet Block. 6). Gas Pipe.  
 7). Gas Burner fixing screw. 8). Air Inlet Holes.



# Fowler Boiler Kit

## CHECKLIST

- 1 Single flue boiler
- 1 Brass Boiler Wrapper with long screws & nuts
- 1 Safety Valve assembly and 'O' ring
- 1 Pressure Gauge
- 1 Manual Steam Regulator (long), handle and Fibre washer
- 1 Boiler Filler Plug with 2 'O' rings fitted
- 1 Cast Smokebox with chimney and steel plate fitted

- 1 Gas Tank with filler valve, gas regulator, and 2½" gas pipe

- 1 Gas Burner with gas jet, jet block and retaining screw
- 1 Boiler Mounting foot (short), with 3 screws and 2 washers
- 1 Brass Spacer Plate

- 6 M3 Brass Screws
- 2 4BA CSK long Brass screws, nuts & washers (shorten to 7/8")

- 1 Stainless Steel Superheater with union nuts and 'O' rings
- 1 Boiler Band with screw and nut
- 1 Lubricator

- 1 Small bottle of steam oil
- 1 60ml Syringe and tube
- 1 Pack of spare washers, 'O' rings and gas jet



*PARTS CHECKED*



*PRESSURE VESSEL CERTIFICATE COMPLETED*