



Chiltern Model Steam Engines

Installation and Operating Instructions Horizontal 3.5" Boiler v1.1

PLEASE CONTACT US IF YOU HAVE ANY QUESTIONS OR COMMENTS ON IMPROVEMENTS

NOTE: PLEASE CLOSELY FOLLOW THE FOLLOWING INSTRUCTIONS AS INCORRECT OPERATION OF THE BOILER CAN CAUSE DAMAGE AND INJURY TO YOURSELF AND OTHERS.

The boiler specification as supplied is as follows:

- Type: Horizontal Centre Flue
- Diameter: 3.5" (89mm)
- Overall Length (including burner): 7.5" (190mm)
- Length of pressure vessel: 6" (150mm)
- Flue tube diameter: 1.5" (37mm)
- Number of cross tubes: 9
- Number of longitudinal stays: 2
- Outer shell thickness: 10G (2.5mm)
- Approximate capacity: 800ml
- Max working pressure: 60psi (4bar)
- Test pressure: 120psi (8 bar)
- Weight including burner: 1.9kg
- Burner head diameter: 1.125" (28mm)
- Fuel: Butane or butane/propane mix
- Bushes in backhead for the water gauge: 2 off 1/4"x40tpi
- Bush for pressure gauge: 1 off 3/16"x40tpi
- Bush for safety valve: 1 off 5/16"x26tpi
- Bush for steam outlet: 1 off 1/4"x40tpi
- Bush for Fill plug or additional outlet: 1 off 5/16"x32tpi
- Bushes tapped M4 fitted on boiler base to allow mounting on cradles: 2 (blind)
- Estimated steam output: 600 cu ins/min (9832ml/min) at 50psi using 65/35 mix gas

Optional items if ordered:

- Gas Canister Regulator and Pipe
- Oak Mounting Plinth and Cradles
- Copper Steam Pipe (made up with connectors to engine)

Boiler General

THE BOILER MUST BE OPERATED IN A WELL VENTILLATED AREA TO PREVENT THE BUILD UP OF CARBON MONOXIDE.

The boiler is a single flue type, of copper construction, fully silver soldered and pressure tested. It is designed to operate at a pressure not exceeding 60 psi.

Being copper the exterior surface can be polished or lagged with for example wood strips or brass sheet (which is easier to paint). If left unprotected the boiler surface is vulnerable to dints, scratches and tarnishing.

Boiler Mounting

An oak plinth, including cradles, can be purchased from Chiltern Model Steam. If however you are fabricating your own, it must be substantial enough to withstand the temperatures generated by the gas burner.

The boiler has 2 blind bushes threaded M4 on its base for mounting purposes. Care must be taken when inserting the mounting bolts not to subject these bushes to lateral force as this may crack the silver solder. For the same reason make sure the M4 bolts are not too long and are not over tightened.

Gas Burner

The gas burner ceramic is totally enclosed in the boiler flue and requires ventilation around the burner end of the boiler and chimney (for exhaust) to operate correctly and safely. ***This is clearly very important if installing the boiler in an enclosed space such as a boat or if the boiler is being operated indoors.***

No forced draft from either blowers or exhaust is required and indeed could have a detrimental effect on the burner. Steam engine exhaust pipes can be taken up into the base of the chimney if needed.

The gas burner can be taken off the boiler by removing the 2 M2 screws and the gas jet carrier removed by loosening the M2 grub screw in the burner mixer tube using the 0.9mm Allen key (provided). Take care not to damage the ceramic burner element or gas jet.

On refitting, check that the jet carrier is tight and pushed right into the mixer tube then nip up the grub screw. Push the burner body on to the flue and nip up the retaining screws.

Pressure Gauge

The pressure gauge and its syphon pipe are easily damaged and can if needed be removed. The cone fitting does not require sealing but be careful not to overtighten when replacing. If required, the syphon pipe can be bent to a more convenient position but this must be done with care.

Safety Pressure Valve

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The safety valve if removed and then replaced should be screwed into its boiler bush until little more than finger tight. The valve will start to blow off as the pre-set pressure is reached. It is factory set to start lifting and venting steam pressure between 60 and 70 psi (Pressure Gauge needle at mid-point). The normal working pressure of this boiler is 60 psi and during the first steaming, check that the safety valve is not allowing the pressure to rise much above this pressure – the boiler has been tested to 120psi.

The pressure at which the safety valve operates can be reduced if you want to limit the pressure to the connected steam engine or in exceptional cases increased (max. 60psi).

This is done by screwing in or out the fitting in the top of the valve that the stainless steel rod protrudes through. Using a pair of tweezers or fine nosed pliers, screw clockwise (down), to compress the internal spring and increase the boiler pressure. If screwed anti-clockwise the pressure on the internal spring is reduced and the operational boiler pressure will effectively be lowered - usually no more than half a turn is needed either way.

Be aware that whilst you are adjusting the safety valve, hot steam will be released by the safety valve. So wear gloves and take precautions.

Steam Connection to Engine

The boiler should be securely connected to the steam engine by a pipe specifically designed to withstand the operating temperature and pressure of the boiler - preferably a copper pipe with silver soldered connections.

The boiler's steam outlet valve is situated on top of the boiler and has a 1/4"x40tpi ME connector which takes 5/32" pipe nipples. This is the same as the inlet/outlet on Chiltern Model Steam engines.

Boiler Filling

The boiler fill plug screws into the threaded bush on top of the boiler and uses a red fibre washer to seal. It is used to fill the boiler with water whilst the boiler is inactive, i.e. the burner is not ignited.

Distilled water is recommended, as sold for battery topping up, but clean soft water can be used if this is not available. Rain water is also an acceptable alternative, provided that it is adequately filtered for example with paper wine filters. Do not use demineralised or de-ionised water, as this is not the same as distilled water and could cause long term damage.

Remove the boiler filling plug and, if using a syringe, 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 around 30ml of water with the syringe.

Replace the boiler filling plug finger tight.

Boiler Water Level and Gauge

Care should be taken to always ensure that there is sufficient water in the boiler whilst the burner is lit. The boiler could otherwise be damaged.

The minimum water level is just above the horizontal centre flue (into which the gas burner is inserted), hence ensuring hottest part of the boiler is always covered by water - this is approximately halfway up the water gauge. ***So whilst in steam with the burner lit, closely monitor the water level gauge and turn off the burner gas when the water level drops below halfway.***

If bubbles get trapped in the water gauge's tube making it difficult to get an accurate reading, use the draw down valve on the base of the water gauge to vent a little air/steam. Take precautions as this will be scolding hot.

The water gauge has a replaceable glass tube which can be accessed by removing the blanking nut on top of the gauge. Replacement tubes are available from multiple model engineering suppliers.

Gas Regulator/Valve and Pipe

If the optional Chiltern Model Steam Gas Canister Regulator and Pipe is not being used, ensure that there is a valve connected directly to the gas canister or tank which can be used to turn off the gas supply. The gas regulator/valve should also be capable of reducing supply to the gas burner once the boiler is up to steam.

The supply pipe from the canister/tank must be connected securely to the burner's gas jet carrier. Check this if the optional regulator/pipe is purchased from Chiltern Model Steam. Also check the connection of the regulator to the canister/tank is secure.

Gas Canister/Tank

For safety reasons ensure the gas canister or tank is located away from the burner in a secure location.

NOTE: After extended use the pipe, gas canister or tank's surface can, in exceptional circumstances, become cold enough to stick to your skin, so use gloves.

If a gas tank is purchased elsewhere please follow the supplier's installation and operational instructions.

Positioning of the canister/tank is very important for both safety and good operation. Propane/Butane gas is stored as a liquid, but changes to a gas as it mixes with air. As gas from the top of the canister/tank is drawn off, more of the liquid below it turns to gas and this process causes a drop in temperature which also lowers the pressure within the canister/tank. If allowed to get too cold, then the pressure of gas can drop until it is insufficient to maintain steam production.

To offset this temperature drop turn off the gas and let the canister/tank warm up naturally. It is also possible to make use of the conducted and radiated heat from the boiler to maintain a good working pressure within the canister/tank.

If however, it is allowed to get too hot, the pressure of the gas inside the canister/tank can become dangerously high and this must never be allowed to happen. It is important therefore that there is plenty of air space between it and any hot items such as boiler or steam pipes. Under normal operating conditions, the temperature of the canister/tank should not be allowed to get higher than 30 degrees Celsius.

Lighting the Burner

WARNING: Before lighting read the section on troubleshooting and be aware of potential problems. If the gas system is not operating correctly, shut it off immediately or damage may result.

Be aware that Butane is heavier than air and small pockets of gas can collect around the canister/tank during connection/filling. So always use a well ventilated location.

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 flue. The burner should be audible.

NOTE as stated above, the gas regulator should be opened slowly until the burner ignites. If opened too quickly, it is possible that the flame may not travel back into the boiler flue but stay in the flue and/or chimney. If this should happen, the burner will sound quite different to normal and the blue flame will be visible in the flue if viewed down the chimney from a safe height.

Should this happen, turn off the gas immediately or damage may result and then relight 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 troubleshooting 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 canister/tank, liquid gas could be drawn off instead of vaporized gas, which can also extinguish the flame.

After a couple of minutes, the gas control regulator can be opened slowly if needed to speed up steam raising.

Troubleshooting

This system is designed for use with butane or a butane/propane mix. There are a variety of mixes ranging from 90/10 to 60/40 with one of the most common being 70/30 (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 lowering the calorific value. This can make the burner a little more difficult to light in the cold and/or maintain high steam pressure/volume (if that is needed) – use trial and error to find the best gas for your application.

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 gas jet hole can become blocked by small particles of dirt making the burner difficult to light, burn weakly at normal operating temperatures*, burn in the flue/chimney 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 boiler warms up. This is quite normal).

1. Carefully, disconnect the gas pipe from the jet carrier. Note when connecting or disconnecting the gas pipe, do not use excessive force as it is possible to cause damage by bending the pipe.
2. Slacken the grub screw retaining the jet carrier in the mixer tube and slide it out.

3. Remove the jet from the jet carrier using a 4BA spanner. Wash out the jet in fast evaporating thinners (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 - they can be purchased from model engineering suppliers – the boiler is fitted with a No. 8 Gas Jet. 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, ensuring all connections are tight. When re-positioning the jet carrier in the burner mixer tube, ensure that it is pushed in as far as it will go.

Pressure Vessel Care and Maintenance

The boiler is fitted with a safety valve to prevent the steam pressure rising above the maximum allowable working pressure and is pre-set to open at between 60 and 70 psi. It must not be adjusted to increase this value.

If the safety valve becomes defective in any way do not use the boiler and repair or replace the valve.

The connection of the gas supply should be checked before every use.

It is recommended that the boiler be drained after use.

Boilers do have a finite life so it is recommended that if the boiler is used regularly or operated in public it 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.
3. Steam pressure test to check the correct functioning of all steam controls, gauge and safety valve.