



Chiltern Model Steam Engines

Installation and Operating Instructions Horizontal 3" Electric Boiler v1.0

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

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

THE ELECTRICAL WIRING SHOULD BE DONE OR CHECKED BY A SUITABLY COMPETENT PERSON.

The boiler specification as standard, is as follows:

- Cylinder Water Vol. Capacity: 450ml
- Cylinder Dimensions: 78mm(dia.) x 176mm(L)
- Overall Dimensions: 210(L) X 80(W) X 150(H)
- Cylinder Sidewall thickness: 3.5mm
- Safety Valve Release: 20psi
- Steam outlet valve: 1/4" x 40tpi ME
- Brass Fill Plug: 1/4" x 40tpi ME
- Materials: Brass, Aluminium Alloy, Steel
- Type: Unibody
- Weight including Heating Element: 1.5kg
- Electric Heating Element: 700w, 220v AC or 110v AC

The standard kit includes:

- Aluminium boiler body/cylinder
- Safety valve
- Steel support base sides and ends
- 12 M3 stainless steel screws
- Steam outlet valve
- Brass water fill plug
- Electric Heating Element, securing nuts and seals/washers
- Black Enclosure Box (49x24x16mm)

Optional items if ordered:

- 220v AC Voltage Regulator (UK Plug)
- Pressure Gauge (0-30psi) and Pipe
- Water Level Gauge with draw down valve
- Copper Steam Pipe (made up with connectors to engine)

Customer Supplied:

- Mains Power Lead, 3 core, min. 0.75mm² for equipment up to 10A.
- Mains Plug (5A)
- Unfused Plug-in Active (non-latching) RCD (Residual Current Device) Plug

- Variable mains AC voltage controller, 1Kw (available as an option)
- Mounting board

Tools/Materials:

- Slot/flat screw driver (medium)
- Small cross head screwdriver
- Small pliers or M3 socket wrench (5.5mm)
- M5 allen key (4mm)
- Silicon Sealant

Boiler General

ALWAYS CHECK WIRING PRIOR TO USE AND CONNECT TO MAINS POWER SUPPLY USING AN ACTIVE RCD SAFETY DEVICE. NEVER LEAVE THE BOILER UNATTENDED WHEN UNDER POWER - ALWAYS TURN OFF THE ELECTRICITY. NOT SUITABLE FOR CHILDREN UNDER 16 YEARS OLD.

The 3 inch Horizontal Model Steam Engine Boiler Kit is suitable for driving our single cylinder engines under light load or other similar size model steam engines.

See the demonstration YouTube videos of the boiler (gas version) driving our Beam engine

<https://www.youtube.com/watch?v=-ZET-58BWwA> and Mill Single engine

<https://www.youtube.com/watch?v=XBPHYm4m3XQ>

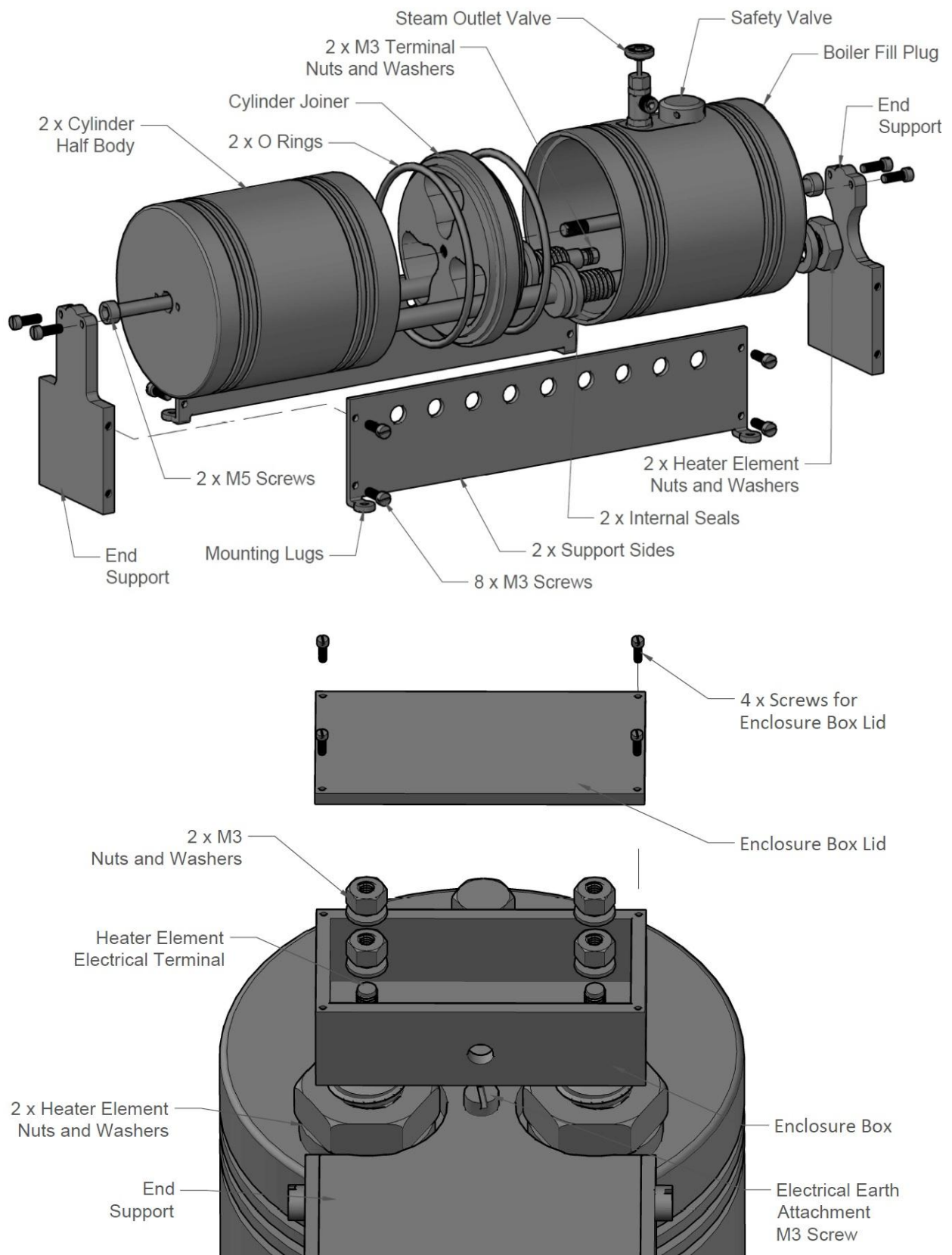
The boiler has a simple cylinder design made of 3.5mm thick aluminium alloy, heated from inside by an electrical heating element. There are no cross tubes, flue or chimney unlike our other boilers which have higher output.

Steam output can be regulated using a variable mains AC voltage controller. A 220v version suitable for UK/Europe is available as an option. Similar 110v versions are widely available for North American customers.

The boiler is provided as a kit of fully machined, unpainted parts that can be easily assembled with simple tools. It is designed to operate at a pressure not exceeding 20 psi.

Boiler Assembly

The basic boiler (no options) consists of the parts shown in the following diagrams:



Boiler assembly instructions:

1. Remove the 2 long M5 screws from the boiler cylinder to separate it into its 3 parts plus 2 O ring seals.
2. Take the nuts, seals and washers off the heating element and push the threaded ends through the holes in the Cylinder Joiner – keep the O rings in place on the Cylinder Joiner.
3. Put the 2 Inner Seals on the threaded ends of the element
4. Insert the threaded ends of the element through the large holes in the Cylinder Half Body (the half with the valves).
5. From the outside of the Cylinder Half Body place the washers on the threaded ends of the element, then screw on the nuts to hold the element in place – do not over tighten the nuts.
6. Making sure the O Ring seal is correctly in place re-attach the Cylinder Half Body with the valves to the Cylinder Joiner using a long M5 screw – make sure the tube part of the heater element does not touch the Cylinder Joiner where it goes through the holes.
7. Similarly making sure the O Ring seal is correctly in place re-attach the other Cylinder Half Body to the Cylinder Joiner using a long M5 screw - leave this screw slightly loose for later alignment.
8. Attach the End Supports (one shaped to accommodate the heater element fixing nuts) to the Cylinder Half Bodies using the 4 slightly longer M3 screws.
9. Check the boiler sits square on the End Supports on a flat surface and twist the non-valve Cylinder Half Body as needed. Take off the End Support, tighten the M5 screw and reattach the End Support.
10. Attach each of the Support Sides to the End Supports with the slightly shorter M3 screws, as shown in the diagram. Gradually tighten each screw ensuring the supports are not twisted and sits flat on a mounting board (customer supplied).
11. Screw the boiler securely to a mounting board using the lugs on the Support Sides.

NOTE: The next steps involve wiring up the electric heater element and should be done by or checked by a suitably competent person before the boiler is connected to the mains power supply.

12. Separate the 3 cores of the customer supplied mains cable – min. 0.75mm² for equipment up to 10A. The earth wire should be connected securely to the End Support using the short M3 screw in the tapped hole between the heater element terminals, see assembly diagram – it is recommended to fit an electrical crimped ring connector to the wire.
13. Remove the 2 M3 nuts, washers and white plastic spacer from each of the heater element terminals.
14. If not already drilled, drill 2 3mm holes for the heater element terminals in the back of the Black Enclosure Box so that it can be inserted onto the heater terminals. Also drill a hole through which the electrical wires enter the box, see assembly diagram.
15. Use some silicon sealant to seal around the heater element terminals, push the white plastic spacers on the terminals and then place the Enclosure Box on to the terminals – the aim is for the box and terminals to be electrically sealed from the outside for safety purposes.
16. Screw on an M3 nut and washer on each of the heater terminals to hold the enclosure box in place.

17. Push the Live and Neutral wires of the mains cable through the hole drilled earlier in the enclosure box and securely connect them to the heater element terminals using 2 M3 nuts and washers (it does not matter which way around) – as mentioned earlier it is recommended to fit electrical crimped ring connectors to the wires.
18. Seal the holes in enclosure box with silicon sealant, seal and fix the enclosure lid in place with the 4 tiny screws.
19. If not already fitted, fit the appropriate mains plug with 5A fuse onto the mains lead.

The boiler cylinder is normally supplied with the Outlet and Safety Valves already fitted. These can be removed by unscrewing the long cylinder M5 socket head screws. This will allow splitting the cylinder body into two halves and the centre joining section. Remove the valve nuts which are on the inside of the cylinder and then unscrew the respective valves from the cylinder body from the outside.

Painting

It is recommended that the base sides and ends are coated with heat proof/high temperature aerosol paint such as that used on barbeques or car brake callipers. The boiler cylinder can be left or sprayed black to match.

Boiler Mounting

The boiler should be secured to a base mounting board using the 4 lugs on the sides.

Boiler Operation

Steam output can be regulated by connecting the heating element to a variable mains AC voltage controller rated for at least a 1kw heating element and compatible with the customer's local main electrical supply and plug.

A 220v AC version suitable for UK/Europe is available as an option from Chiltern Model Steam. Similar 110v AC versions are widely available for North American customers.

The voltage controller should be plugged into the mains power supply via an unfused plug-in active (non-latching) RCD (Residual Current Device) Plug.

Initially the voltage controller can be set to its highest. Once the water has boiled the voltage controller can normally be turned down to around half depending on how much steam is needed to drive the engine.

Safety Pressure Valve

The boiler is fitted with a safety valve to prevent the steam pressure rising above the maximum allowable working pressure. ***It must not be adapted to increase this value.***

The safety valve will start to release/blow off as the pre-set pressure is reached. It is factory set to start venting steam pressure around 20 psi.

During operation, check that the safety valve is releasing and not allowing the pressure to continue to rise. Do this by opening the outlet valve.

If the safety valve does not appear to be working properly it can be removed as mentioned above. The valve consists of a piston/spring which needs to move freely. Clean and lubricate as needed or replace.

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

Pressure Gauge (optional extra)

The pressure gauge and its siphon 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 siphon pipe can be bent to a more convenient position but this must be done with care.

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 - these are available ready made from Chiltern Model Steam.

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" or 1/8" pipe ferrules. This thread is the same as the inlet/outlet on all Chiltern Model Steam engines.

The valve is secured in place with a 1/4" brass nut on the inside of the boiler which needs to be removed before the valve is removed or re-orientated. So to get access to the nut the boiler first needs to be split by removing the M5 cylinder screw(s), see earlier assembly diagram. Once the nut is removed the valve can be unscrewed.

Be careful when reassembling not to over tighten and hence strip the brass threads. Also ensure the large O ring is in place when putting the boiler body back together.

Boiler Filling

The boiler fill plug screws into the end of the boiler and uses an O ring to seal.

NOTE: Only fill the boiler with water whilst the boiler is disconnected from the main power supply and unpressurised.

Distilled water is recommended, as sold for battery topping up, but clean soft water can be used if this is not available. Dehumidifier, condensing tumble dryer or even 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 fill the boiler with clean water. There has to be a space above the water to allow steam to be raised so fill with up to around 400ml of water or empty out 50ml if filled to the top.

A tube from a garden pressure sprayer or large syringe can be used to fill the boiler. To allow air to escape while water is being pumped into the boiler, disconnect the steam outlet pipe and open the outlet steam valve.

Replace the boiler filling plug - do not over tighten.

Boiler Water Level

Care should be taken to always ensure that there is sufficient water in the boiler whilst the heater element is under power. The boiler could otherwise be damaged.

The minimum water level is around one third full (150ml), hence ensuring the heating element is always covered by water.

Experience will be gained using the boiler as to how much water is consumed and therefore left in the boiler at a particular run-time. So when the boiler has cooled pour out the remaining water into a measuring container – hopefully there is at least 150ml.

From testing with Chiltern Model Steam single cylinder engines, a full boiler can be run for 30-40 minutes on light load, e.g. Beam engine ticking over gently. Around 20 minutes under heavier load, e.g. Mill single running at speed driving a dynamo – see the YouTube videos mentioned above.

Remove the mains power immediately if it is suspected the boiler is running low or if steam stops coming from the boiler.

Boiler Water Level Gauge (optional)

The optional water level gauge if fitted will provide a visual indication of the amount of water in the boiler.

If bubbles get trapped in the water gauge's glass 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 5mm 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. Only finger tighten the tube retaining nuts.

Pressure Vessel Care and Maintenance

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 the safety valve.