

SAFIRE 2000A FUEL OIL HEATER

INSTALLATION, OPERATION AND MAINTENANCE

You have selected the new generation **SAFIRE** oil heater as your heating solution. Although our goal is to take into account all problems arising from normal installation during designing the product, it is important that persons using this product familiarise themselves with these instructions. Correct installation and use ensure that the heater works flawlessly for many years to come.

1. INSTALLATION

1.2 PLACEMENT

Place the heater in a way so that warm air circulates in the best possible way in the heated space.

Flue gases can be led to a chimney, or directly out through the wall.

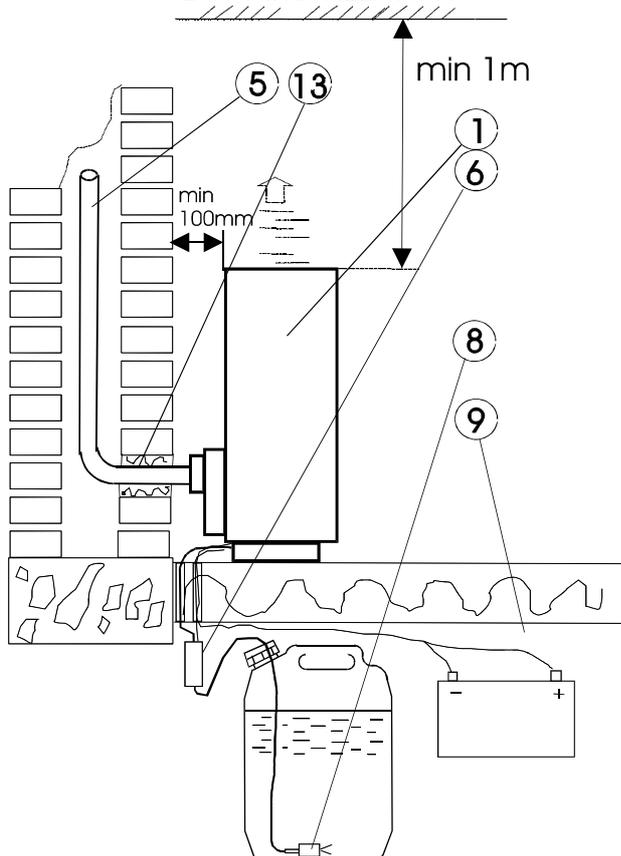
The heater should preferably be connected directly to the battery with a dedicated power cable.

The tank and pump should be placed under the heater. It is advisable to place them outside the heated space.

There should be 70-100 mm clearance behind and on the sides of the heater in order to help keep its environment clean and free from foreign objects.

There must be at least one metre of clearance above the heater.

DUCT INSTALLATION



1 HEATER
5 FLUE GAS PIPE
8 TANK

6 PUMP
9 BATTERY
13 SEALING

When using a chimney, the combustion air can be taken from the inside, because there is no danger of flue gas returning to the inside air due to the wind pressure, even in case of a power outage.

As the combustion air is taken from the heated space, the heater functions as a ventilation unit as well, which reduces the amount of moisture.

It is preferable that the tank is placed outside the heated space. However, the tank and the pump must be placed under the bottom of the heater. The lifting height must be under 2 metres.

If the fuel line is mounted inside the structures or outside the building, it must be protected with e.g. electric installation pipe or metal pipe.

A longer fuel line can be used, but the maximum length between the pump and the heater is 6 metres.

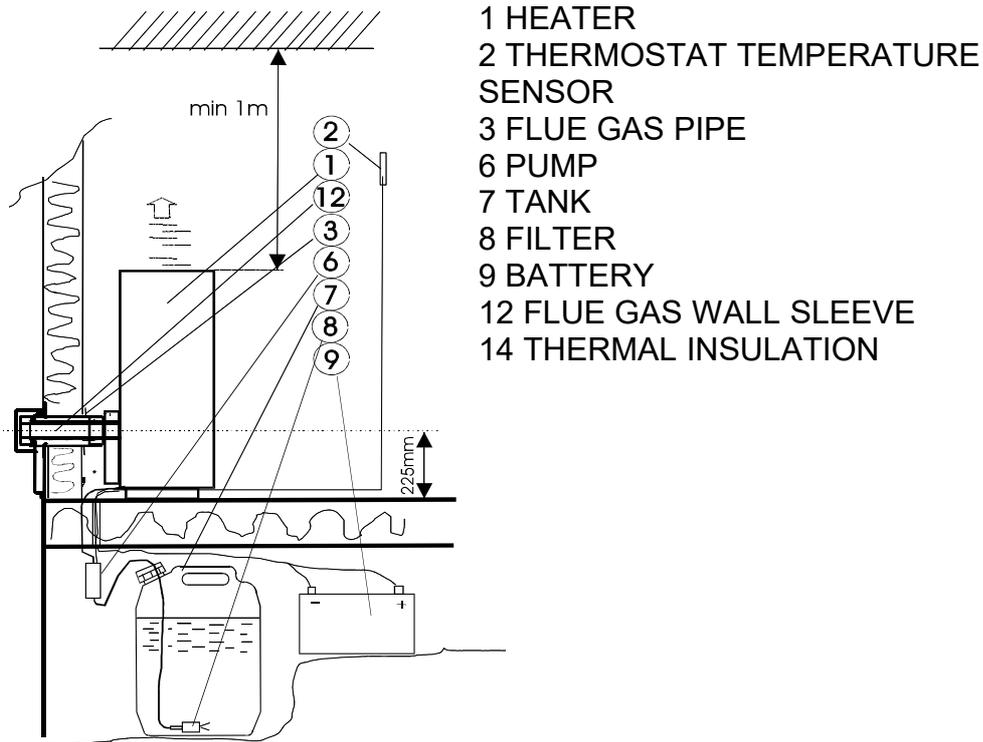
1. Cut a suitably sized hole for the flue gas pipe to the chimney. The midpoint should be at a height of 225 millimetres from the bottom of the heater.

2. Seal the flue gas pipe into place with heat-resistant material (e.g. mineral wool or mortar). The flue gas pipe must lead to the top of the chimney, and it should preferably be insulated with vermiculite.

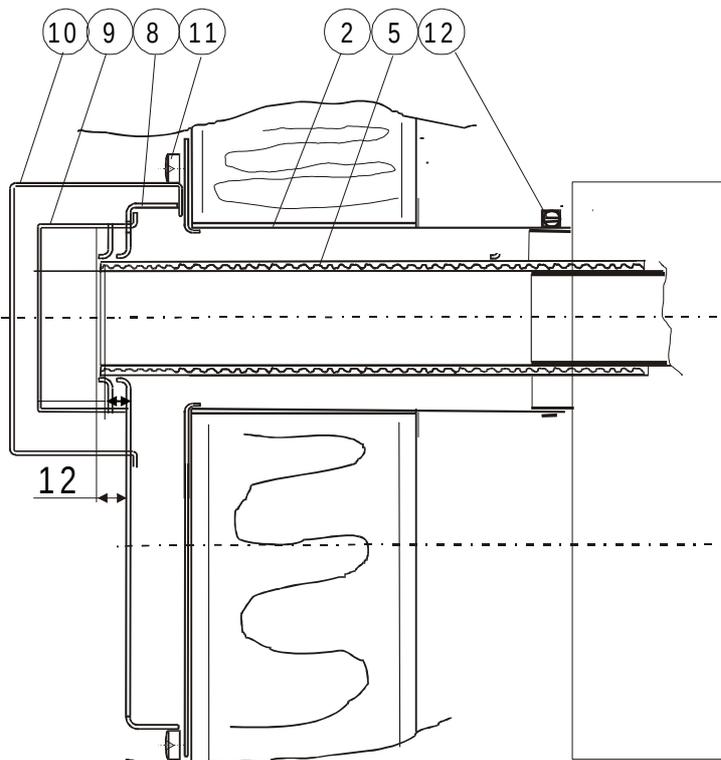
This will avoid the condensation of the flue gas in the cold chimney, as well as failures and weathering of the chimney resulting from the condensation.

3. Mount the heater and install the flue gas pipe.

1.3 WALL SLEEVE INSTALLATION



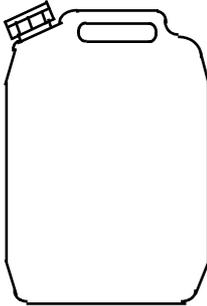
When using wall sleeves, the combustion air must be led through a wall sleeve from the outside as well.

WALL SLEEVE:

1. Make a $\varnothing 90$ mm hole to the wall, whose midpoint is at a height of 225 millimetres from the bottom of the heater.
2. Install a vent pipe (2) approx. 50 mm longer than the thickness of the wall.
3. Mount the heater.
4. Stretch the vent pipe (2) to a suitable length and fasten it with a clamp (12).
5. Install the overlong flue gas pipe (5) on top of the outlet pipe, all the way to the wall of the fan housing inside the heater.
8. Attach the frame (8) of the funnel to the wall. Ensure that the vent pipe is aligned with the extension of the frame. Seal with silicone compound in order to keep water outside the wall structures. Fasten the topmost mounting screws (11) temporarily.
9. Cut the flue gas pipe to a suitable size (see drawing: 12 mm out of the funnel frame)
10. Mount the diffuser (9) of the funnel and the housing (10). You will have to loosen the topmost mounting screws for this.

1.5 TANK, TANK CONNECTION, PUMP

1.5.1 30L TANK (475x315x295mm)



Can be used either upright or horizontally.

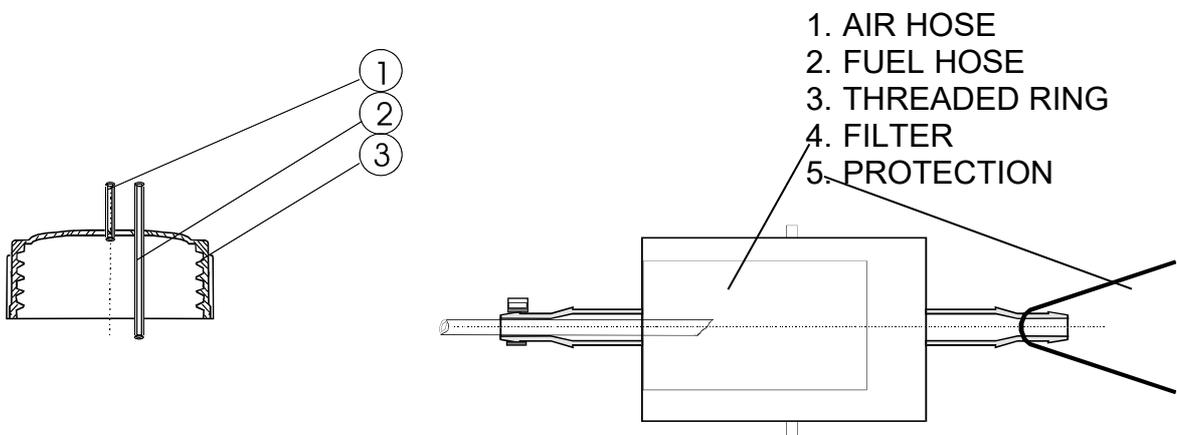
The heater comes with tank connection parts (filter, vacuum hose, air hose and threaded ring).

The tank must be placed under the heater, e.g. in the basement of the house.

If the fuel line and wiring of the pump have to be led through the structures, they must be protected with e.g. electric plastic installation pipe. For trough the floor or wall, drill approx. 10 mm hole for fuel line and wiring.

If you want to install the tank and pump inside, select a place where filling the tank or exchanging tanks does not cause inconvenience.

1.5.3 TANK CONNECTION



1.5.4 PUMP

The pump is installed close to the tank above the liquid surface in an upright position with the suction side down. The maximum vertical drop from the bottom of the heater to the tank is approx. 2 metres.

1.6 ELECTRICAL INSTALLATION (see wiring diagram on the back cover)

1. The electricity should preferably be input directly from the battery (**+ red, - yellow**). Protect the wiring with a 20 A fuse (the electronics of the heater are protected by a 15 A fuse).

If you need to use longer wires, remember to replace the original wiring with thicker ones so that the cross-sectional area of the wires in mm² corresponds with the length of the wires in metres, e.g. the area of two 10 metre wires should be at least 10 mm².

In this case, cut the original wires at a suitable length behind the heater and attach thicker wires with a suitable connecting piece.

Be careful not to connect the wires to the battery with reverse polarity (in this case, the fuse of the electronics will blow).

2. The wires of the pump are connected to the middle pins of the X10 connector. The wires cannot be connected the wrong way round.

3. In thermostat installations the sensor is connected to the empty pins of the X10 connector (see wiring diagram). The wires can be extended and they cannot be connected the wrong way round.

4. A Gsm-remote start-up device is connected behind the control panel to the X9 connector of the heater circuit board.

When using automatic start-up, the heater switch should be in the AUTO position.

The circuit board of the heater has a selection connector (S1) for the input voltage of the RJ connector. It should be in the position 2-3 when a 1287 remote control device is used (this is the factory default setting).

4 SAFIRE HEATERS USAGE

2. USAGE

2.1 COMMISSIONING

Make sure before commissioning that:

- the tank is properly installed
- the heater is attached so that all safety distances are taken into account and there is no risk of fire
- all connections are attached
- there are no foreign objects or materials, which could cause a fire hazard or unpleasant smells nearby or inside the heater or the funnel.

2.1.1 FUEL

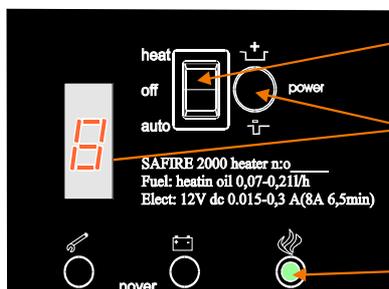
Use winter-quality light fuel oil with the heater. In very cold weather it is appropriate to use fuel oil for Arctic climates or kerosene, especially when using automatic start-up. It can be difficult to find winter-quality light fuel oil in the summer. Summer-quality fuel oil can be used temporarily.

Approx. 2% isopropanol-based gasoline engine antifreeze can be mixed with the fuel in order to remove water from it (ethanol-based antifreeze for diesel engines **MUST NOT** be used).

If the heater remains unused in a cold cabin for the **winter**, it is recommended to run the heater with **NESTE** kerosene before leaving it unused so that the fuel pump and fuel lines remain filled with **NESTE** kerosene, which withstands even colder temperatures.

2.1.2 CONTROLS AND INDICATORS

2.1.2.1 CONTROLS



Start-up: heating/automatic start-up

The numeric display shows the power set with the push buttons or thermostat setting (value = 15 C + displayed value). Functions F and L bypass the thermostat, and the heater is run in either full power (F) or minimum power (L).

Indicators: combustion, battery voltage, fault

The heater is started by turning the switch to the HEAT position

Automatic control with a control device or timer by turning the switch to the AUTO position

The heater is shut off by turning the switch to the OFF position

The heating power is adjusted with the push buttons: Short pushes decrease the power setting and long pushes increase it. The first push of the button turns on the display, which indicates the power setting or thermostat.

2.1.2.2 INDICATORS

When the heater is started, the power setting is shown on the control panel. The decimal point flashes with the strokes of the pump.



Indicator lights on the heater's control panel:

Green indicator D15 indicates that the flame sensor has detected that the combustion has started.



Yellow indicator D14 indicates a low voltage.

A low voltage can be caused by too low battery voltage, too thin power wires or a bad contact in a connector.

The heater works with low voltage when starting up, but if the low voltage is present after the preheating stage, the aftercooling phase is started, the pump is stopped and the device is turned off (error code 7 is shown on the display).



Red indicator D13 indicates that there is a malfunction in the heater. The pump stops and the error code is shown on the display (see part 3, malfunctions and errors)

2.1.3

START-UP

The heater is started by using the switch **ON-OFF-AUTO**.

The **numeric display** is turned on.

The pump starts running (a knocking sound can be heard and the decimal on the display starts blinking), the fan starts running.



The **green indicator** in the heater's base lights up approx. 1.5-3 minutes after start-up, when the flame sensor has detected a sufficient combustion.

The ignition process is ended approx. 6.5 minutes later, and the heater is set to the power setting of the thermostat.

2.1.3.1

START-UP WITH Gsm-REMOTE START-UP DEVICE

When enabling the start-up device, make sure that the heater is ready for use and that air circulation is possible in the heated space. Turn the heater's switch to the position **AUTO**.

PLEASE NOTE! Never cover a heater that is set to automatic start-up, even if the switch is not in the AUTO position.

If the device is started remotely, it can be kept on by turning the switch to the ON position before the selected heating time ends.

2.1.4

POWER SELECTION

Check that the thermostat temperature setting or power setting meets your needs.

2.1.5

POWER ADJUSTMENT

The power is adjusted with push buttons.

The digital display indicates the set temperature (15 °C + displayed value (e.g. 3 = 18 °C).

Positions F (max) and L (min) will take precedence over the thermostat, and the heater runs at maximum or minimum power. The heater recalls the previous setting.

2.2

TURNING OFF

The device is turned off by turning the switch to the OFF position. The pump stops and the device enters the aftercooling phase. The fan keeps running.

The power supply of the heater must not be cut off before the aftercooling phase has ended (approx. 6.5 minutes) e.g. by using the main switch.

ERRORS, FAILURES

(Identification of indicators: see wiring diagram)

NORMAL OPERATION:

If the control panel is lit upon start-up, it is an indication that the device is turned on and powered.



The **green indicator** in the heater's control panel indicates that the flame sensor has detected a flame in the burner.

A flashing decimal point in the display indicates that power pulses are sent to the pump.

POSSIBLE ISSUES:

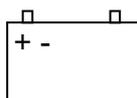
If the **digital control panel** is not lit within 40 seconds from start-up, it is an indication that the heater is not powered.



If the **green indicator** is not lit after the start-up process (approx. 6.5 minutes), the device enters the aftercooling phase and turns off.

The reason for this could be air in the fuel system. A new start-up attempt can be made if other problems are not found.

As the heater is running, if the **green flame indicator** dims, the **red indicator** is lit, fault code 3 shows up on the display and the heater shuts off, it is usually a sign of an empty fuel tank or a disruption in the fuel supply. Check the device for issues.

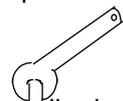


The **yellow indicator** on the heater's base indicates that the input power is too low (<10.8V, or 10.2V at start-up).

During the start-up process the heater accepts a lower current. The occurrence of under-voltage during start-up is usually a sign of too thin or long power wires to the heater, oxidation in a connector or poor connection.

First check the battery status, then the wiring and connections.

If the under-voltage indicator lights up during use and the device shuts down, the battery is probably almost depleted.



If the red indicator is lit, the device usually shuts down due to a malfunction indicated by the electronics (see next chapter).

The most common error is the lack of a flame, which leads to error code 3 being shown on the display.

Please note! If you have turned off the heater after the malfunction was shown, you can bring up the error code again by turning the switch to the AUTO position. WHEN THE AUTO POSITION IS SELECTED, THE DISPLAY SHOWS THE LAST ERROR CODE THAT HAS LED TO THE SHUTTING DOWN OF THE HEATER.

ERROR MESSAGES

No. 1 indicates overheating.

Overheating is often caused by the heater airways being blocked or too much fuel, see page 7 "Inspections".

No. 2 indicates that the ionisation electrode is faulty or sooty (occasionally). In most cases, the error code is shown when the tip of the electrode is too close to the burner "hat", or is shorted by the burner frame. See page 8.

No. 3 indicates that the heater has stopped due to no flame. This is usually due to the fuel running out or a blockage in the fuel system.

No. 4 indicates that the glow plug is at fault: the connector is disconnected, the plug is broken or its wire is faulty.

No. 5 indicates that there is a fault in the combustion air fan or its wiring.

No. 7 indicates under-voltage. See section about indicator lights on the heater's base.

No. 8 indicates that the circuit of the pump is not closed.

The letter b (number 11 in SMS'es) indicates that the **overflow sensor** has detected oil in the collection space under the circuit board. It must be cleaned and the fault **must definitely** be repaired before the next start-up.

The **decimal on the display** blinks with the pulses of the pump.

The pump is not powered if the decimal does not blink and the pump does not make a clicking sound. The fault is either in the wiring of the pump, the coil or the circuit board.

If the decimal blinks while the pump does not make a clicking sound, and the wires are not in a short circuit, the pump is faulty; usually due to fuel thickening or impurities in the fuel.

4 INSPECTIONS, MAINTENANCE AND SERVICE

4.1 INSPECTIONS

Check from time to time, especially if the flame in the burner has changed, that:

1. the heater is supplied with enough power
2. combustion air enters the heater freely. Blockages can be caused by e.g. spiders, mosquitoes, snow, water, ice etc.
3. flue gases can leave the heater freely
4. there are no leaks in the fuel lines (air bubbles)
5. there are no impurities or water in the bottom of the fuel tank
6. the fuel filter in the fuel tank is not clogged
7. the vent pipe of the fuel tank is not clogged
8. Also make sure that dust has not built up inside the heater, which may cause a smell and a fire hazard.

If there is reason to believe that the heater does not get enough fuel (power reduced, change in combustion), check the amount of fuel going to the heater.

The easiest way to measure the fuel feed is to put the fuel line in a measuring cylinder filled with fuel while the heater is running on full power setting (the fuel filter should be removed before starting, as it may cause measurement errors). Let the heater suck fuel from the measuring cylinder for e.g. 6 minutes. Multiply the measured value by ten in order to calculate the fuel consumption per hour. A model **2000** heater consumes 190-210 ml/h on full power setting. If the measured result is different from this, the reason for the difference has to be investigated upon. If the fuel consumption is too high, it is usually caused by: erroneous placement of the fuel tank (or measuring cylinder) above the heater, increase in the basic frequency of the pump. The normal frequency for a model **2000** heater is 100 strokes/min on full power setting, and 35 strokes/min on minimum power setting.

4.2 MAINTENANCE

If abnormal symptoms appear during operation: a smell, loss of power or ignition problems, the reason for the symptom has to be eliminated.

Too much fuel supply may cause impure burning and overheating.

If the overheating is caused by a defect in the electronics or pump, **always** contact product service.

The formation of a smell is usually caused by a fuel leak or accumulation of soot in the burner.

The reason for reduced power is usually a reduction in the pumping volume or a blockage, or impurities in the pump.

A low fuel consumption may be caused by a blockage in the fuel system. If the filter has been found clean, the fuel line is worth checking. The most common reason for a fuel line blockage is paraffin formation, which occurs when the fuel is in cold temperatures. If the fuel line is not completely blocked, the blockage can be removed by adding isopropanol to the fuel (gasoline car antifreeze, **ethanol-based liquids** must not be used), which dissolves the paraffin blockage rapidly. Isopropanol can also be forced through the lines by using a syringe or e.g. a bicycle pump while the heater is on (start-up phase).

A small air leak in the suction line (before the pump) can cause low fuel consumption as well. Check whether there is a significant amount of air bubbles in the lines.

Blockages can also occur at the fuel inlet line near the burner when the heater is used for a prolonged time. In this case it should be replaced or cleaned. The cleaning

can be performed with a 1.5 mm drill or by heating the end of the line with a gas flame and by using a needle etc.

If the mixture of the combustion is too lean e.g. due to paraffin formation, soot is formed in the inlet line quickly.

WINTER

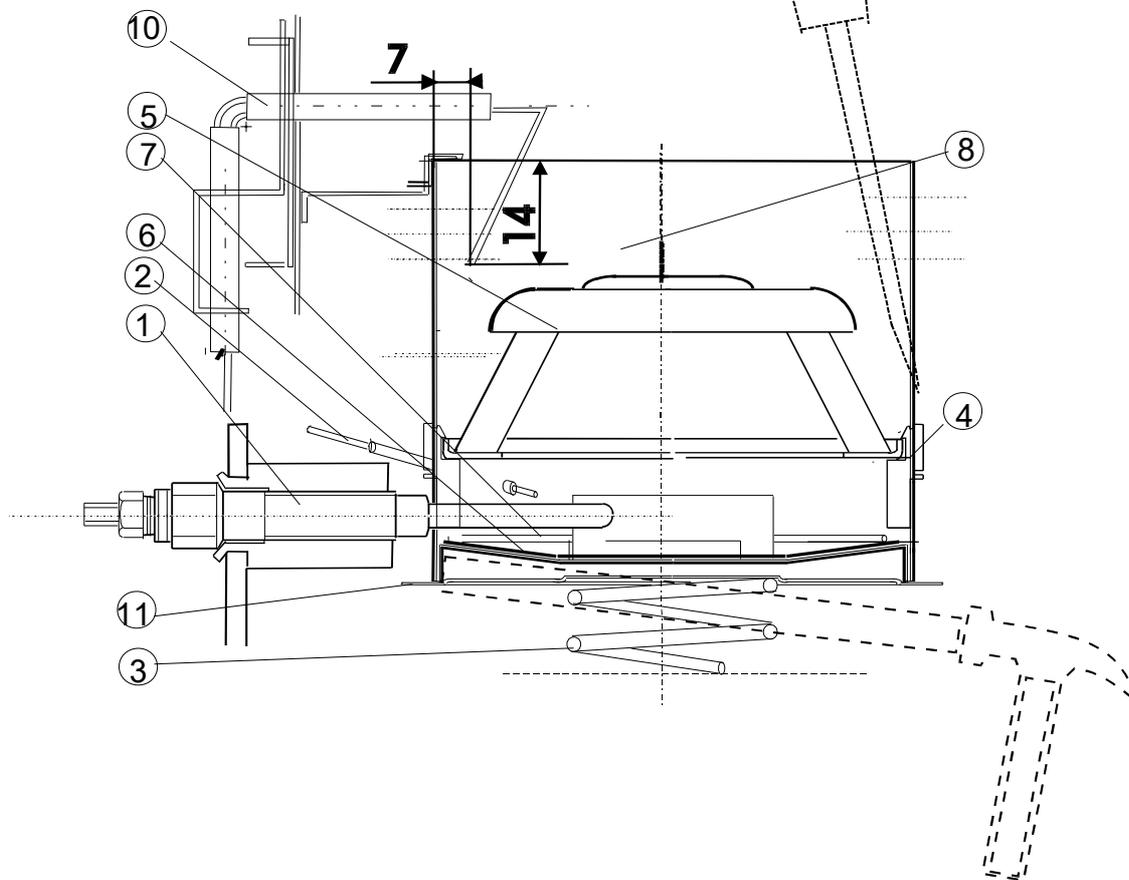
If the heater is left unused for a long period in the cold, there is a risk that the lines and the fuel in the tank form paraffin (this is a risk in very cold weather conditions, even when using winter-quality light fuel oil, and especially if using summer-quality light fuel oil). In order to avoid starting problems in the spring **NESTE** kerosene should be used when using the heater for the last time before the pause so that kerosene is left in the lines, pump and filter.

The fuel should be replaced in the spring.

Battery connectors should be disconnected for the winter.

4.21 BURNER MAINTENANCE

1. Loosen the base plate of the heater, disconnect the circuit board wires so that you can turn the base to the side.
2. Disconnect the fuel inlet line (2).
4. Remove the glow plug (1) and its fastening plate. At the same time the circuit board protective plate and its support come off.
3. Open the burner compartment cover.
5. Remove the burner support spring (3) and the burner (8). If you are unable to remove the burner, use a hammer and a suitable piece of wood, see picture.
Remove the topmost centering plate of the spring (11) first in order to remove the burner cylinder without damaging the ionisation sensor (10).
6. Open the burner cap (5) locking (4) e.g. with a screwdriver. Push the screwdriver between the cylinder and the lower ring so that the lower ring can pass the locking claw. Turn the screwdriver and lift the cap at the same time in order to lift the lower ring of the cap over the locking.
7. Clean the burner e.g. with an old toothbrush. The soot at the bottom can be removed with a screwdriver.
8. If required, replace the base fabric (6), which is held in place by the locking spring (7).
9. Assemble the burner in the reverse order. Ensure that the burner is in the right position. Use a glow plug to centre the burner during assembly. Before closing the burner compartment cover, make sure that the burner is in the correct position (hole of glow plug directly ahead).



4.3 CLEANING THE IONISATION SENSOR ELECTRODE

Fault No. 2 indicates that the ionisation electrode is sooty, faulty or shorted. Soot build-up on the sensor is, without exception, the result of poor combustion, and always requires cleaning the burner as well. The electrode can be cleaned without removing it after the burner is removed. If needed, the electrode can be removed from the front surface of the heater by removing the outer cover of the heater and opening the locking spring from its claws. For cleaning you can use e.g. rubbing alcohol-based cleaning products (car windshield washer fluid, etc.). It is important that the insulation of the electrode is clean so that current does not leak, which disrupts the functioning of the heater. Also, the electrode wire should not touch the burner.

The tip of the ionisation sensor should be placed according to the dimensions in the figure. You can cut a piece of cardboard for measuring, for example. If necessary, you can bend the sensor wire. However, be careful not to break the insulation. Small cracks will not cause the electrode to malfunction.

November 2012

SF-LÄMMITIN OY Tilhenkatu 1 20610 Turku Finland Tel./Fax 02-2443282

INSPECTING AND CLEANING THE PUMP

The functioning of the pump can be inspected by letting air bubbles inside the hose. The fuel progresses 18-20 mm per pump stroke. Slow movement is a sign of a blockage and air bubbles show that there is an air leak in the suction side or pump.

If it is found that the pump does not operate even though the decimal point flashes, or measurements show that the pumped volume does not correspond with the pulse frequency, and there is not any blockages, the pump may be faulty. The most common defects of the pump are:

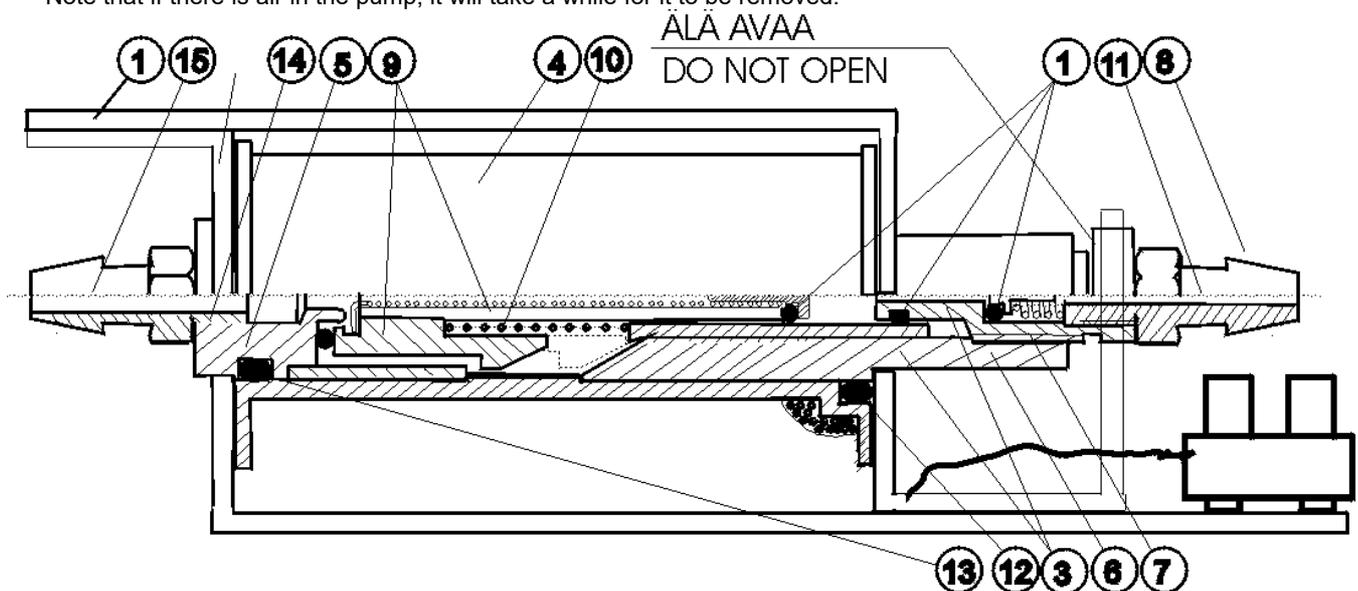
1. Clogging, or the movement of the pump piston is restricted or hindered altogether due to external impurities or paraffin.
2. Water-induced corrosion (the water must have been affecting for several months).
3. A leaking non-return valve in the suction cycle due to impurities or corrosion.

REMOVING SMALL IMPURITIES AND PARAFFIN FROM THE PUMP

1. Remove the pump from the hose connectors.
2. Now you can force isopropanol through the pump with e.g. an injection syringe.

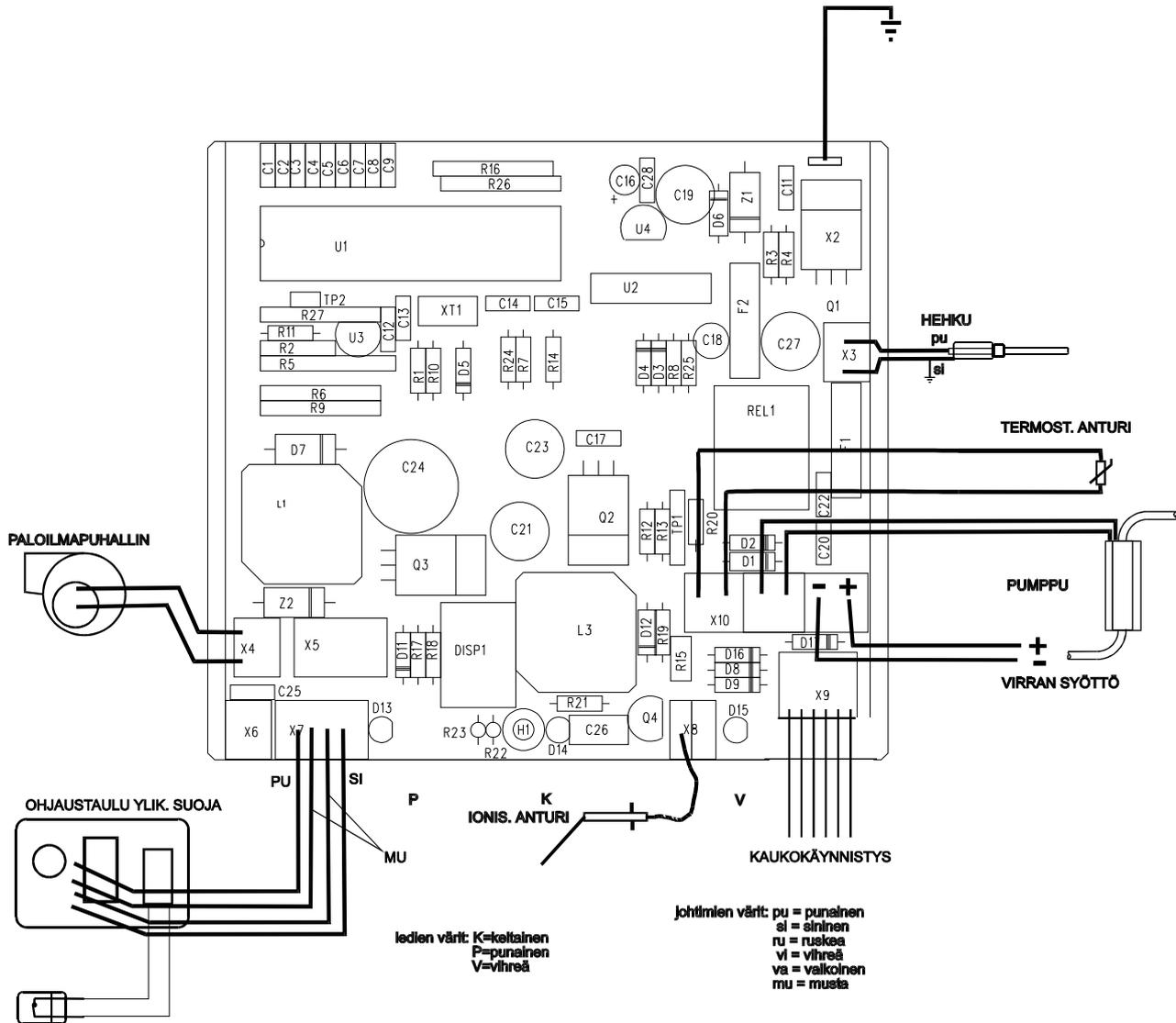
OPENING AND CLEANING THE PUMP (only in case of emergency)

1. Remove the pump and remove the hoses from the connectors.
 2. Remove the wiring of the pump.
 3. Disconnect the wiring connector strip (8) so that it remains attached to the coil wires.
 4. Remove the iron shell (1) of the pump by opening its screws.
 5. Pull the upper part (3) of the pump out of the coil (4). The piston (9) and spring (10) come loose at the same time.
 6. The lower end of the pump (5) can be removed by pulling as well.
 7. Now you can wash the insides of the pump with e.g. isopropanol. There should not be any stiffness between the piston and the cylinder.
 8. Check the functioning of the non-return valve by attaching a piece of hose to pump outlet socket (11) and blowing under the liquid surface. The valve should not leak. If necessary, you can try to clean by forcing a powerful flow through the valve downstream.
 9. **DO NOT OPEN** the sealed connection (7) between the pump body (6) and the valve body, as it is adjusted to the correct stroke length.
 10. Assemble in the reverse order. Be sure to check the O-rings (12 and 13), as well as the condition and cleanliness of their grooves.
- In order to ensure the tightness of the hoses, check the clamps when installing the pump. Potential leaks on the suction side are seen as air bubbles downstream of the pump, even if they cannot be seen on the suction side. Note that if there is air in the pump, it will take a while for it to be removed.



4.21 BURNER MAINTENANCE

4.4 ELECTRICAL CONNECTIONS



November 2012

SF-LÄMMITIN OY Tilhenkatu 1 20610 Turku Finland Tel./Fax 02-2443282