

Heater kit contains :

- Heater, mounting bracket
- Fuel hose (3 meters), pump, a fuel tank connection to standard tanks (15, 22, 30 litres)
- Power supply cable (4 meters)
- Mounting screws, clamps
- Accessories indicated on the package: A separate control panel or GENIUS control panel with a 10 m cable, temperature sensor for the thermostat, exhaust outlet through deck or through wall

## PLACING THE HEATER

Place the heater so that at least a part of the air can be taken outside. This will allow good ventilation and drying effect.

When choosing a place for the heater remember that warm air hoses placed outside the heated space will lose plenty of heat. Minimize their length and isolate them carefully. It is more economic to place the heater close to the space to be heated and use a separate fresh air inlet. You don't have to isolate the warm air hoses inside (f. ex. under the bed); the hoses function as "radiators" for they dry the space and balance the temperature differences.

Remember also that as the heater blows warm air inside, an equivalent amount of air must be let out f. ex. through a ventilator or return to the heater as circulating air.

Maintenance is usually easiest to perform when the heater is removed from its bracket. If the heater is examined on its place, place the heater so that you can examine also the heater's own control panel led indicators and the control display. N.B.:This is important even if you are using a separate control panel.

Place the heater so that the heater is above the tank's fuel level. The heater will however not be damaged if the filler hole of the tank and thereby the fuel level temporarily rises above the heater.

The fuel hose can be lengthened between the pump and the tank.

## INSTALLATION

### Mounting bracket

The mounting bracket allows you to attach the heater in a horizontal position under or above a level or in an upright position.

Install the heater always in an upright position.

### Pump and fuel hose

Attach the fuel pump in an upright position close to the fuel tank but above the fuel level, the suction downwards. Max. suction height 2m. If you need to pass the fuel hose and the pump's power supply cable through narrow gaps, disconnect the hose connector above the pump and unplug the power supply cable from the pump's connection terminal (the polarity is insignificant). Attach the fuel hose carefully so that it won't vibrate or rub against anything. Don't attach the pump too tight; this may cause disturbing noise.

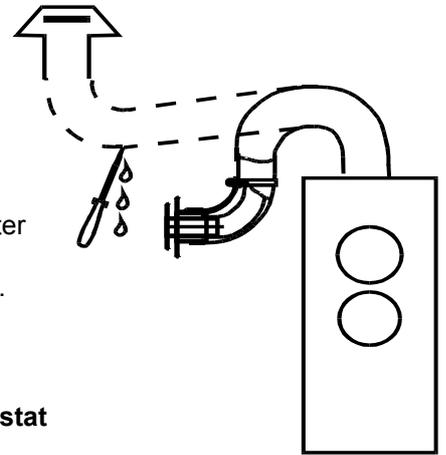
### Fuel tank connection

The fuel is conducted with a suction hose either from a separate tank (15, 22 or 30 litres) using a suitable tank connection, or from a diesel tank by using a tank connection kit. Install a shut-off to the tank connection if the fuel level in the tank or in the fuel hose can rise above the pump. Attach the fuel hoses carefully and protect them from heat or mechanical strain.

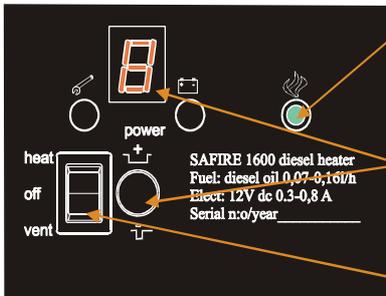
### Exhaust outlet

Exhaust is led out and combustion air taken in through hull with a coaxial exhaust outlet. For installing the outlet you need to make one  $\varnothing$  50 mm hole and four 5,5 mm holes (use the outlet end as a model).

Cut the inner pipe a bit too long, so that it can't slip from its place. Bend the exhaust outlet hose as shown in the picture and make a little hole on the outer hose, on the lowest part (also when using an outlet through hull even if the outlet is not the lowest part). This way the condensation water can trip away.



### 1600D heater's control panel:



Indicator LEDs: combustion detection, battery voltage, malfunction.

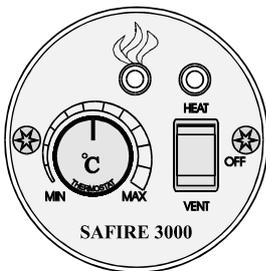
The display shows the power set with the button or the set temperature (setting = 15 + the number on the display. Positions F and L bypass the thermostat = the heater operates on max. power F or min. power L).

Start: heating, ventilation

### Thermostat

The thermostat sensor is attached to the heater's connection terminal (green connector with two empty places). Place the thermostat's sensor to a place where it can measure the temperature in the room in the best way. If you are using a GENIUS control panel, you can connect two thermostats to the heater; one to be used during the night in the sleeping cabin and one for the daytime to be used in the front cabin.

### Separate control panels 1600D, 1800D and 2100D



Place the control panel so that the display is easy to see and use, and that there's no danger of starting the heater by accident. Both control panels can be either surface or flush mounted. Attach the control panel to the connector inside the heater (remove the base of the heater). 1600D heater: the control panel cable replaces the heater's own control panel cable.

**Electric wiring**

See the wiring diagram below.

The heater's **power supply cables** should be connected straight to the battery (red +, blue -). If you need longer cables, you should change also the original cables to thicker ones so that the area of the wires (mm<sup>2</sup>) corresponds their length (m); f. ex. 6 meter long wires should be entirely at least 6 mm<sup>2</sup> thick.

**NB!** The housing of the heater is galvanic connected to the minus-pole of the battery.

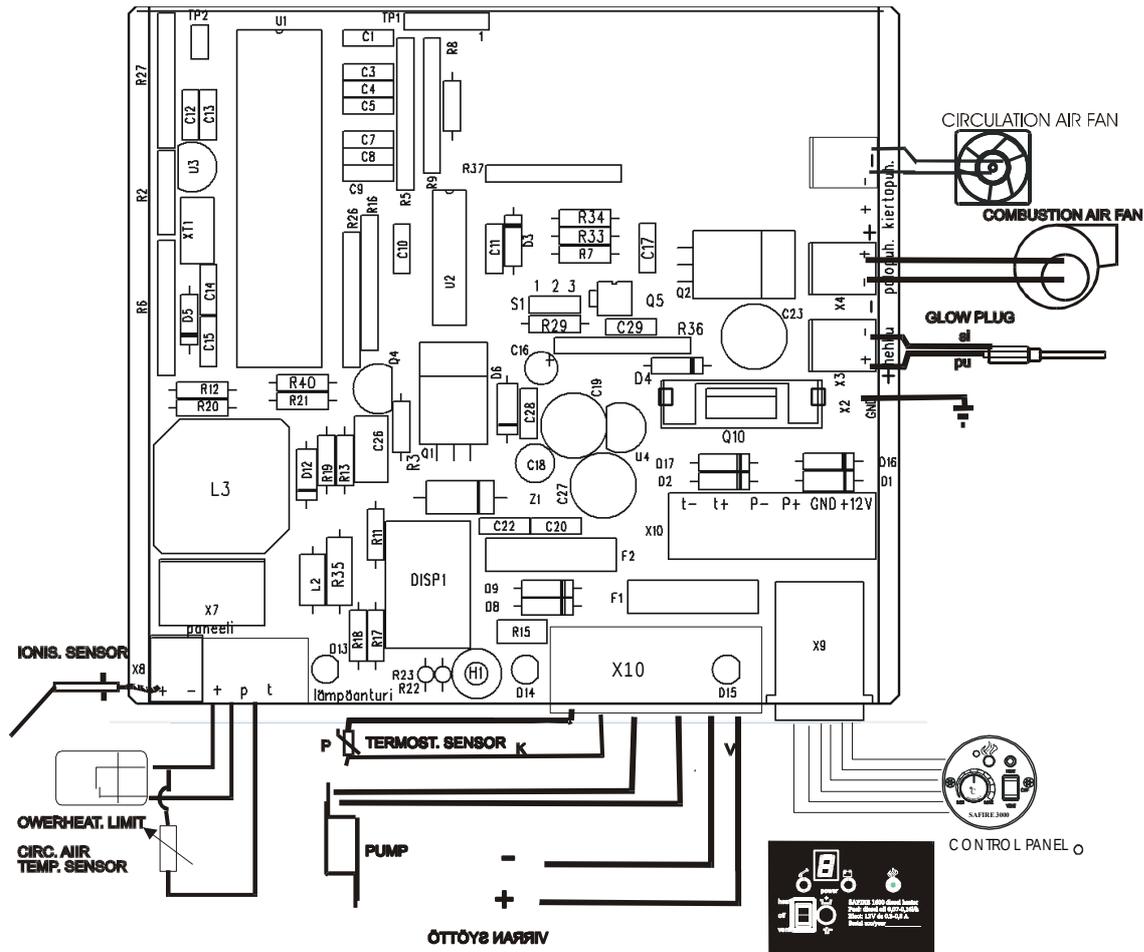
You can connect a separate main switch to the heater and a 20A time delay fuse near the battery (there is a 20A main time delay fuse F1 on the circuit board).

**Be careful** not to connect the wires wrong. This would melt the 7,5A fuse F2, which protects the electronics. Connect the thermostat's sensor to the connector X10.

The system detects automatically the installed **thermostat** and changes the Power control on the control panel to Temperature control (temperature setting: 1600D heater = 15 + the number on the display; 1800D and 2100D heater = use the adjustment knob: to obtain a normal room temperature turn the knob to point upwards, one stroke = ca. 2°C).

Connect the pump's power supply cables to the connector X10.

In case you want to remove the heater from it's place, **the connector X10** can be pulled off from the heater so that you don't have to remove the pump's, thermostat's or the battery's connectors. **Fix** the cables so that water does not get into the heater among them.



**USAGE**

**BEFORE USING THE HEATER**

Before using the heater make sure that

- the tank and the fuel hose are properly installed
- the heater is properly attached to the mounting bracket
- the combustion air, circulation air and exhaust can flow freely
- there aren't any foreign objects inside or near the heater or in its exhaust outlet, or substances which are flammable or can produce smells.

**Fuel**

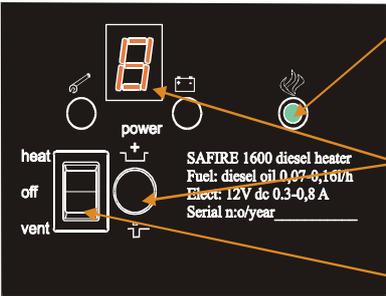
The best fuel is winter grade light fuel oil, or off-road gas oil. If you can't find winter grade fuel during the summer, you can use summer grade light fuel oil or paraffin oil.

To remove condensation water, add about 2% isopropanol-based antifreeze for gasoline engines (not antifreeze for diesel engines!) to the fuel.

If you don't use the heater in the winter and store it in a cold place, use paraffin oil the last time you use the heater, and leave the fuel hoses full (paraffin oil has a low cloud point). Paraffin oil will protect the hose from freeze.

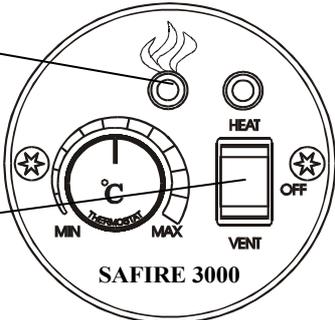
**CONTROLLING THE HEATER AND INDICATOR LEDS**

**1600D**



Indicator LEDs: combustion detection, battery voltage, malfunction.  
 The display shows the power set with the button or the set temperature (setting = 15 + the number on the display).  
 Positions F and L bypass the thermostat = the heater operates on max. power F or min. power L).  
 Start: heating, ventilation

**1800D, 2100D**



**SAFIRE 3000**

**Basic control panel**

Start: turn the switch to position "HEAT/ON".

Ventilation: turn the switch to position "VENT".

Turn off: turn the switch to position "OFF".

Adjust heating or ventilation power with the button: a short push diminishes the power and a long push increases it. At the first push the number display activates and shows the set power or temperature.

If you are using a separate control panel (1800D and 2100D heaters), adjust heating power, temperature (heaters with thermostat) or ventilation power (if the ventilating mode is active) with the adjustment knob.

**GENIUS control panel**

Turn the heater on or off according to the instructions on the display.

Return to the main menu with "BACK"-button.

Scroll the main menu with arrow keys, choose an item with "OK"-button.



## INDICATOR LEDS

### INDICATOR LEDS ON THE REAR END:

When the heater is started, the number display activates and shows the set power level. The dot on the display blinks = the pump operates.



**Green LED D10:** the flame sensor has detected a flame and combustion is in process.



**Yellow LED D2:** the voltage is low, under 10,8V (or under 10,2V during the ignition).

The battery voltage may be too low, the power supply cables too thin or some connection in the wiring loose.

During the start the voltage can be lower, because the voltage drop caused by the filament current in the power supply cables can be up to 0,5V. If the voltage drops below the limits mentioned above, the aftercooling mode activates and the heater turns off.



**Red LED D9:** malfunction detected, the combustion stops.

The display indicates the type of malfunction (see Malfunctions) If you have turned the heater off, you can see the latest malfunction type on the display again by turning the switch to "VENT": the latest error code shows on the display.

### INDICATOR LEDS ON THE SEPARATE CONTROL PANEL:

**Green LED** above the switch of the basic control panel: the heater is on. If the LED is not on when starting the heater, the heater's power supply is probably disconnected.



**Green LED (flame)** on the control panel: the flame sensor has detected a flame and combustion is in process.

### GENIUS CONTROL PANEL

Control the heater according to the instructions indicated on the GENIUS control panel.

The normal start: Push BACK, the text HEATER CONTROL appears on the display; push OK, the text START appears on the display, push OK and the heater starts.

The menu ADJUST POWER allows you to adjust either the power or the temperature. Choose menu items with arrow keys, accept with OK.

If you desire extra strong ventilation, choose DRYING VENTILATE. On this mode the heater takes more fresh air; this improves the drying effect while the heating power is low (practical f. ex. in the summer when the air is damp but not very cold).

Return to the main menu with BACK.

NB! All selections are not allowed in every mode.

## STARTING THE HEATER

Start the heater with **ON/HEAT-OFF-VENT**-switch.

**The number display** (1600D) activates.

The pump operates (you can hear tapping, the dot on the display blinks), the fans are operating..



**Green LED (flame)** on the end of the heater and on the separate basic control panel lights about 1 1/2–3 minutes after the start when the flame sensor has detected a sufficient flame.

The ignition process ends in about 6 1/2 minutes. The heater operates on the power set with the thermostat or with the button; the main fan measures the temperature of the room and operates on sufficient power.

### HEATING POWER

Make sure that the temperature set on the thermostat or the chosen power settings correspond to your needs.

### ADJUSTING THE HEATING POWER

If your heater has a thermostat, it will adjust the power automatically. If you want to change the heating power temporarily, adjust the temperature settings; the power level will change to correspond to the set limit.

If your heater doesn't have a thermostat, adjust the power manually with the button.  
NB! The main fan doesn't operate on the new power level until the temperature of the air requires it.

### TURNING OFF THE HEATER

Turn the heater off by turning the switch into OFF position; the pump stops, the heater goes into aftercooling mode and turns off.

**Do not cut the power supply off f. ex. from the main switch when the aftercooling is on process (about 6 1/2 minutes)!**

**MALFUNCTION**

(To identify the LEDs: see wiring diagram)

**NORMAL FUNCTION**

The number display activates on start: the heater is on and gets current.



**Green LED (flame)** on the control panel and on the end of the heater: the flame sensor has detected a flame in the burner.

A blinking dot on the power level display: the pump is operating.

**MALFUNCTIONS:**

The **number display** doesn't activate or the **green LED** above the switch is not on when starting the heater: the heater's power supply is off.

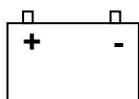
**The fuse** may be melted (f. ex. if the + and – connectors are connected wrong). Remove the base of the heater and the name plate. The spare fuse is in the bag with the manual.



If the LED is not on after the start process (about 6 1/2 min.) the heater goes into aftercooling mode and turns off.

This will happen f. ex. if the fuel system is empty during the start. If you don't notice anything unusual, you may try to restart the heater.

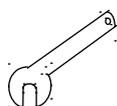
The **green LED (flame)** turns off when the heater is operating, the red LED on the end of the heater is on, and the heater turns off: the fuel tank may be empty or the fuel inlet is defective. Check the situation.



The **yellow LED** on the end of the heater: The voltage is too low (less than 10,8 V or 10,2 V during the start).

During the start process the voltage can be lower. Usually undervoltage during the start is caused by too thin and/or too long power supply cables, oxidation in some connection or otherwise bad contact. Check the battery first, then the wires and connections.

If the yellow LED is on during operation and the heater turns off, the battery is probably about to drain.



The **red LED** on the end of the heater: the heater is turned off because of a malfunction displayed on the circuit board.

Usually this is caused by lack of fuel, which stops the combustion; the error code on the circuit board display is 3.

**NB!** If you have turned off the heater after some malfunction, you can see the latest error code on the display again by turning the switch to the position "VENT": the number of the latest malfunction which caused the heater to turn off shows on the display.

**ERROR CODE NUMBERS**

**Number 1:** Overheating. Overheating is usually caused by a blockage on the normal warm air circulation (f. ex. too much restriction on the warm air grilles or too much fuel. See p. 7, Examination).

**Number 2:** The flame sensor electrode is sooty or defective. Clean the electrode (see p. 8). A short circuit may have occurred on the housing.

**Number 3:** The heater has turned off because the combustion has stopped. Usually this is caused by lack of fuel or a block in the fuel system.

**Number 4:** The glow plug is defective, the connection might be loose, or either the connector or the wire might be defective.

**Number 5:** The flame fan or its wires are defective.

**Number 6:** The main fan or its wires are defective.

**Number 7:** Undervoltage (see p. 5, Indicator LEDs).

**Number 8:** The pump's electric circuit is broken.

**Number 9:** The temperature sensor of the circulating air or its wires are defective.

**A:** Last stop has been illegal ( voltage break or main switch).

Just put the heater on "vent" for a while, after that start normally.

**The dot on the display** is supposed to blink according the pump pulses.

If this does not happen and the pump does not make a tapping noise, the pump doesn't get current. The problem is either on the pumps wires, in the spool or on the circuit board.

If the dot on the display blinks but the pump does not make a tapping noise and the wires are ok, the problem is in the pump usually because of clouded fuel.

## EXAMINATION, MAINTENANCE AND SERVICE

### EXAMINATION

Check regularly especially, if the combustion in the burner is different, that

1. the heater gets current.
2. the combustion air access is clear; f. ex. spiders, mosquitoes, snow, water or ice can block the air flow.
3. the exhaust outlet is clear.
4. the fuel hose does not leak.
5. there aren't any impurities or water on the bottom of the fuel tank.
6. the fuel filter is clean.
7. the air hose of the tank is clear.
8. there isn't any dust inside the heater; it may cause smells and risk of fire.

If the heater doesn't seem to get enough fuel (the power is lower, the combustion is different), measure the fuel inlet: Remove the fuel filter (it may cause measurement errors). When the heater operates normally on maximum power, put the fuel hose into a measuring glass with a certain amount of fuel in it. Let the heater operate for 6 minutes. Multiply the amount of fuel consumed by 10, and you will get the fuel inlet/hour.

On maximum power the **1600D** heater consumes normally 150–170 ml/h the **1800D** heater 170–190 ml/h. and **2100D** heater 200-220ml/h If the measured fuel consumption is above these limits, check the cause: the tank (or the measuring glass) may be placed above the heater.

If the heater gets too much fuel, the combustion may be impure and cause risk of overheating. If the overheating is caused by defective electronics or pump, always contact your nearest maintenance service.

If the fuel consumption is too low, there might be a blockage in the fuel system. If the filter is clean, check the fuel hose: the fuel in it may be clouded, if the hose has been in a cold place for a long time. If the blockage is not thorough, you can dissolve it rather quickly with isopropanol (= common anti-freeze for gasoline engines). You may also force isopropanol into the hose when the pump operates (during start) f. ex. with a hypodermic syringe or bicycle pump.

Also a little leak in the suction hose (before the pump) may cause the low fuel consumption. Check if there is a significant amount of bubbles in the hose. With extensive usage also the fuel inlet pipe near the burner may be blocked. If this happens, change the pipe or clean it f. ex. by heating it with a gas flame, drilling and blowing it empty.

If the fuel mixture is too weak, the fuel feed pipe may get a carbon deposit and may block. Clean the pipe and find out, why the fuel mixture is weakened.

**N.B.:** All the maintenance operations that require opening the heater (except changing the fans) are performed as followed:

Open the base of the heater (it is not necessary to totally remove the screws) and remove the name plate. To remove the circuit board take off the glow plug and it's fasteners; now you can slide the circuit board. To remove the fans take first off the circuit board and it's fasteners; now you can remove the heat exchanger by pulling downwards after you have unscrewed the screws on the base of the heater.

### WINTER

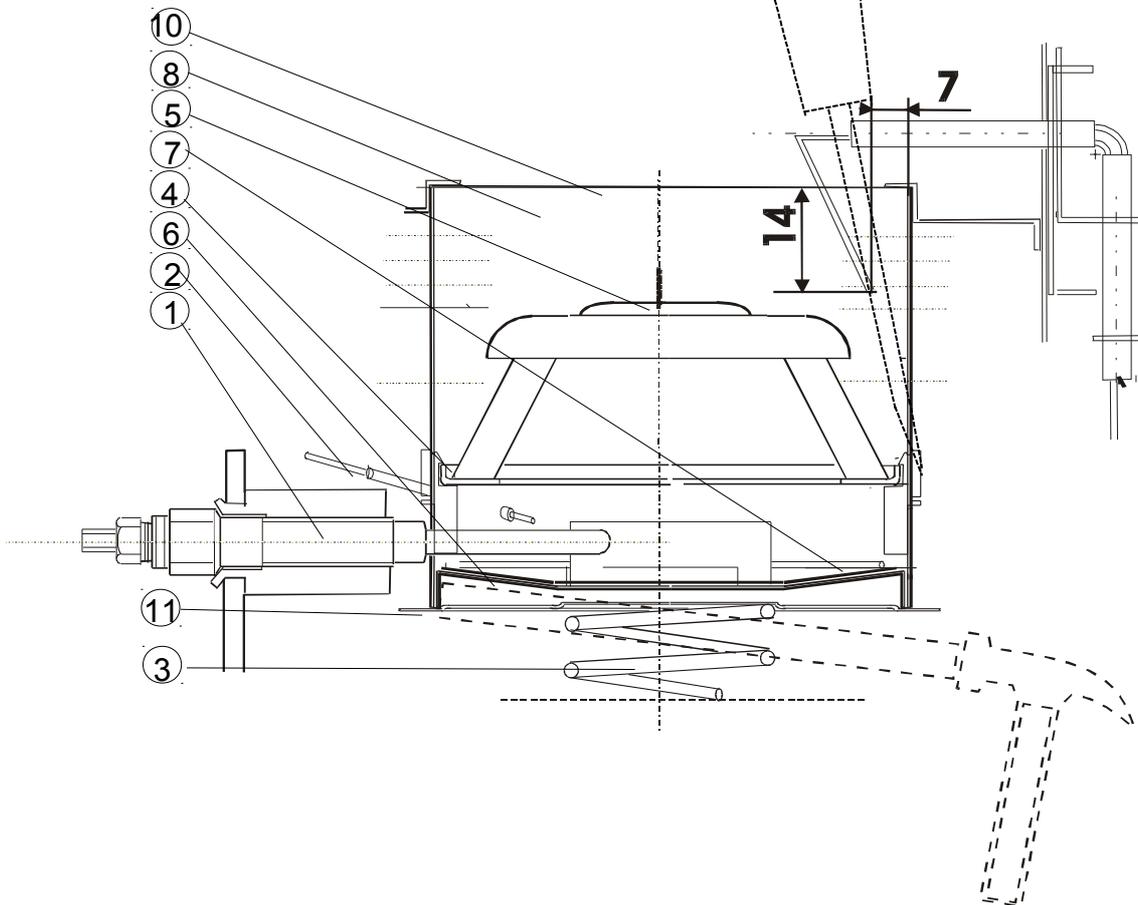
Remove the battery wire for winter.

If the heater is unused in a cold place for a long time, the fuel in the hoses and in the tank may become clouded (this may happen also with winter grade fuel oil).

The last time you use the heater before the winter, use paraffin oil to avoid starting problems in the spring. Make sure that paraffin oil fills the fuel hose, the pump and the fuel filter. In the spring it's best to acquire new fuel.

### OPENING AND CLEANING THE COMBUSTION CHAMBER

1. Remove the base of the heater by loosening the four screws on the base.
2. Remove the control panel.
3. Remove the glow plug (1).
4. Open the screws of the lid of the combustion chamber near the circuit board and remove the closing device holding the circuit board's fastening.
5. Remove the circuit board and its fastening by pulling the fastening off from behind the board. This way you don't have to remove the connectors from the circuit board.
6. Remove the fuel feed pipe (2).
7. Open the other screws of the lid of the combustion chamber and remove the support of the heater's housing. Make sure that the housing doesn't split. The blower pipes should stay in their places.
8. Remove the burner (8): use a hammer and a suitable block of wood.
9. Open the lock mechanism (4) of the burner cap (5) f. ex. with a screwdriver: push the screwdriver next to the lock mechanism between the hole cylinder and the lower ring so that the hole cylinder gives in and the lower ring has room to slide past the lock mechanism. Rotate the screwdriver and lift the burner cap simultaneously.
10. Clean the burner f. ex. with an old toothbrush. Remove the carbon deposit from the bottom f. ex. by first heating it with a gas flame or warm air fan and then scraping it off f. ex. with a screwdriver.
11. If necessary, change the backing (6). The backing stays on its place with a locking spring (7).
12. Assemble in an opposite order. Make sure that the burner is on its place in a right position. Use the glow plug to align the burner. Check also the position of the casing pipe of the fuel pipe.



### CLEANING THE FLAME SENSOR ELECTRODE

Error code number 2 in the display indicates that the flame sensor electrode is sooty, defective or that a short circuit has occurred. To clean the electrode, turn the voltage off, then remove the burner and clean the electrode's insulation. Use f. ex. alcohol-based cleaning agent (windshield washer fluid) for cleaning.

**N.B.!** Make sure that the insulation of the electrode is clean to prevent any leakage current which can cause malfunction. Don't let the filament of the electrode touch the burner!

**Place the flame sensor tip according to the measurements on the picture above.** Check the measurements f. ex. with a cardboard model. If necessary, you can bend the filament of the electrode. Be careful not to break the insulation. Small fractures however don't have an impact on the function of the electrode.

## CHECKING AND CLEANING THE PUMP

Check the pump by letting an air bubble into the hose. On one pulse the fuel pushes forward about 18 mm. If the fuel advances slowly, there might be a blockage. Air bubbles indicate an air leak on the suction or in the pump. If the pump doesn't operate properly although the dot on the error code display blinks, or if you verify by measuring that the pump's performance is not sufficient although the pulse frequency is right and there aren't any blockages, the problem might be in the pump. The most common malfunctions in the pump are:

1. Blockage in the pump, or restriction or jamming of the piston caused by external impurities or clouded fuel.
2. Corrosion caused by water during a long period of time.
3. Leakage of the check valve during the suction caused by impurities or corrosion.

## CLEANING MINOR IMPURITIES AND CLOUDED FUEL IN THE PUMP

1. Release the hose connectors from the pump.
2. Now you can press isopropanol (a common anti-freeze for gasoline engines and truck air brakes) through the pump.

## OPENING AND CLEANING THE PUMP

1. Release the hose connectors from the pump.
2. Release the wires from the pump.
3. Remove the connector strip (8) so that it rests on the filaments of the spool.
4. Unscrew the iron housing (1) of the pump by unscrewing the screws. The ends and the spool can now roll out of the housing.
5. Pull the upper end (3) of the pump out of the spool (4), the piston (9) and the spring (10) are removed at the same time.
6. Pull also the lower end (5) of the pump out.
7. Wash the inner parts of the pump f. ex. with isopropanol.
8. Test the check valve: connect a hose in the outlet connector (11) and blow air under the fluid level. The valve should not leak. Open and the clean, if necessary. Use threadlocking material (f. ex. Loctite 243) for sealing. **DO NOT OPEN** the sealed connection between the pump's housing (6) and the valve's housing (7): the connection specifies the right piston stroke.
9. Assemble in reverse order. To seal the connector threads use either thread seal tape or oil resistant sealing compound. Remember to check that the o-rings (12 and 13) and their grooves are clean.

When you assemble the pump, check the clamps to make sure that the hose connections are tight. Bubbles after the pump reveal leaks on the suction. NB! If there is air inside the pump, it may take a while before the i pump is completely empty of air.

