Servicing Manual

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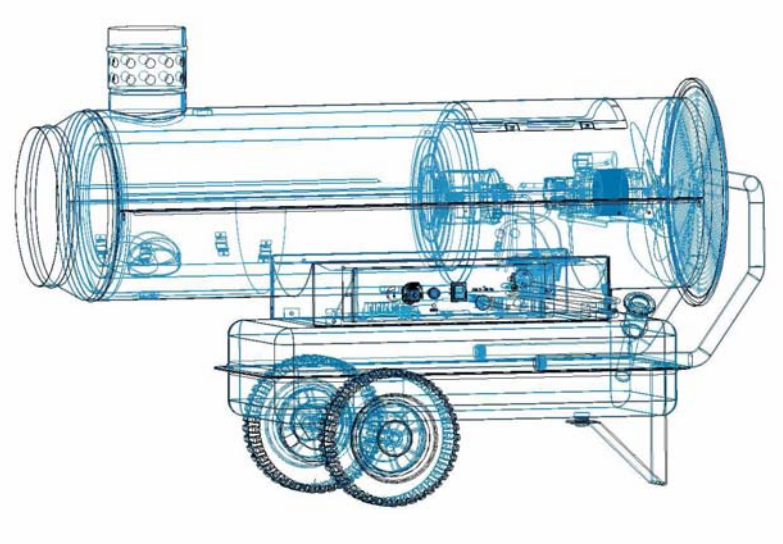
Item Nr	

MOBILE (OIL- OR KEROSENE-FIRED) EMERGENCY AIR HEATERS

MIRAGE - TORNADO



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Technical changes

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FOREWORD

Thank you for choosing the SIAL MIRAGE-TORNADO heaters. We would like to remind you that, as for any machine, you can get good operation and performance only if the heaters are correctly used and always kept in perfect efficiency. If required, the SIAL Technical Service can give you suggestions and assistance.

The SIAL MIRAGE-TORNADO heaters are especially intended for the professional heating of civil, industrial and agricultural premises.

Read and follow carefully the instructions contained in this manual before starting any servicing or maintenance operation.

SIAL S.p.A. will not accept any responsibility for damages to persons, goods, properties or to the machine itself that may result from non-compliance with the instructions contained in this manual and with the Laws and safety rules in force in the Country of destination.

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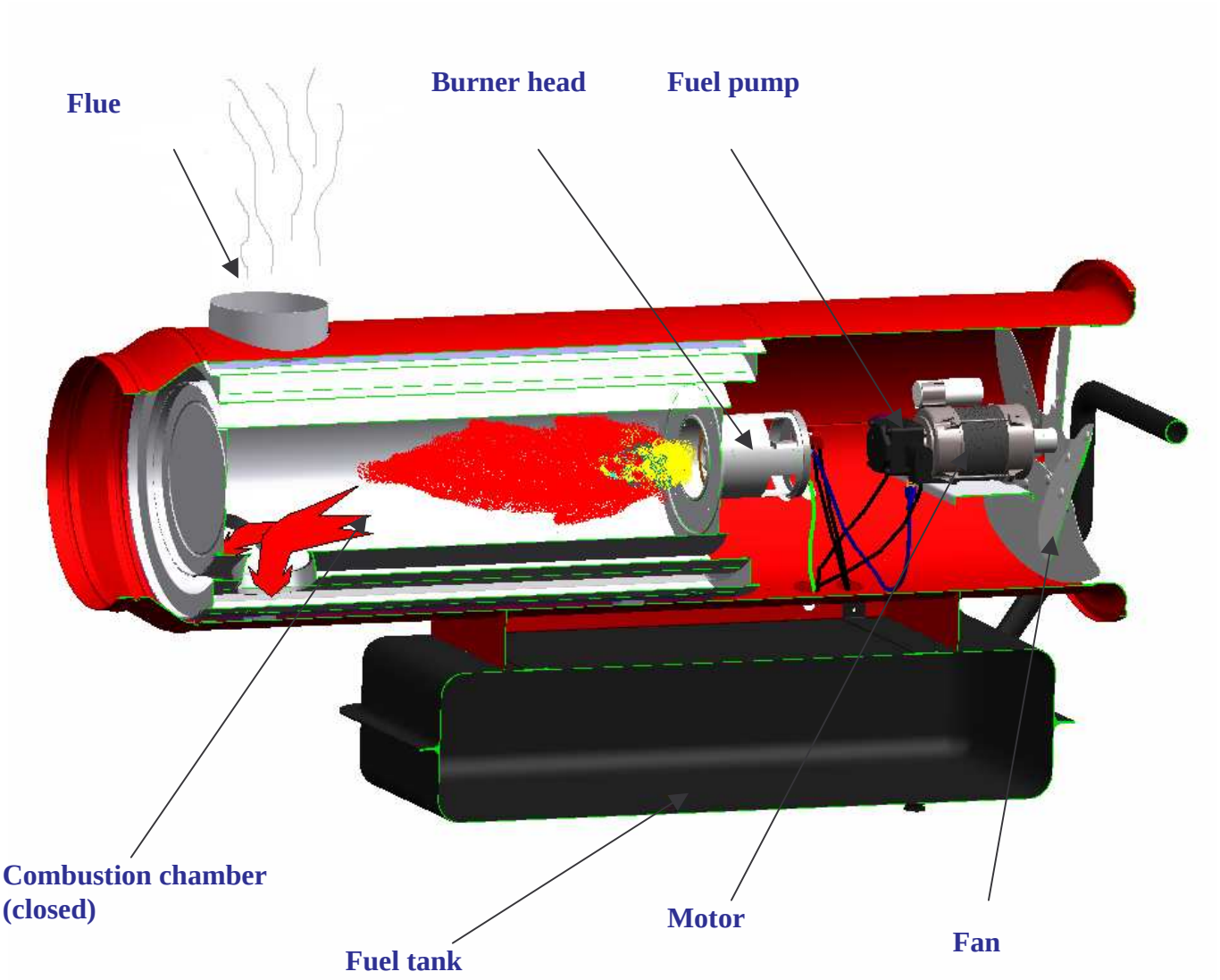
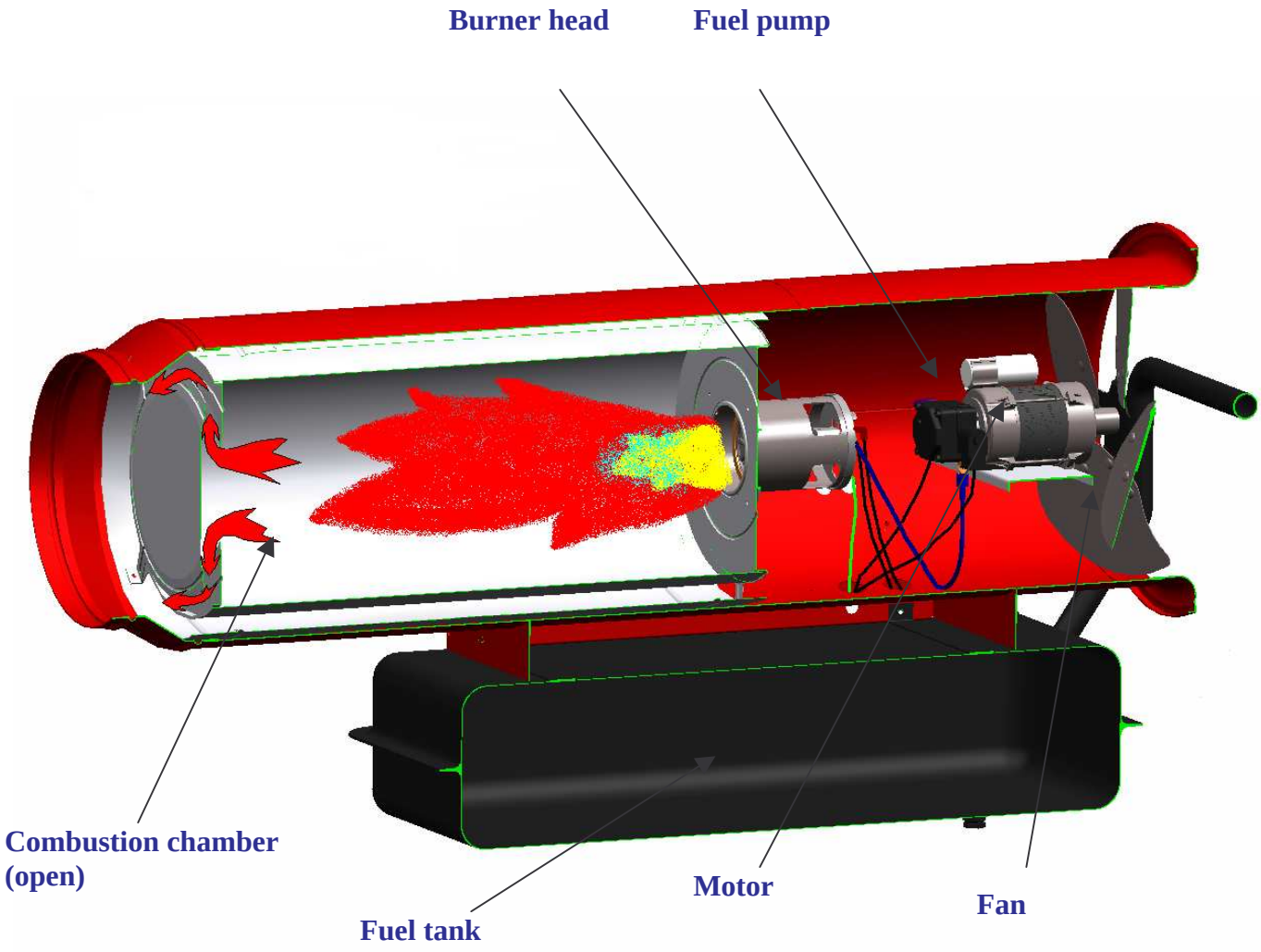
1. OPERATIONAL DIAGRAMS AND SEQUENCES

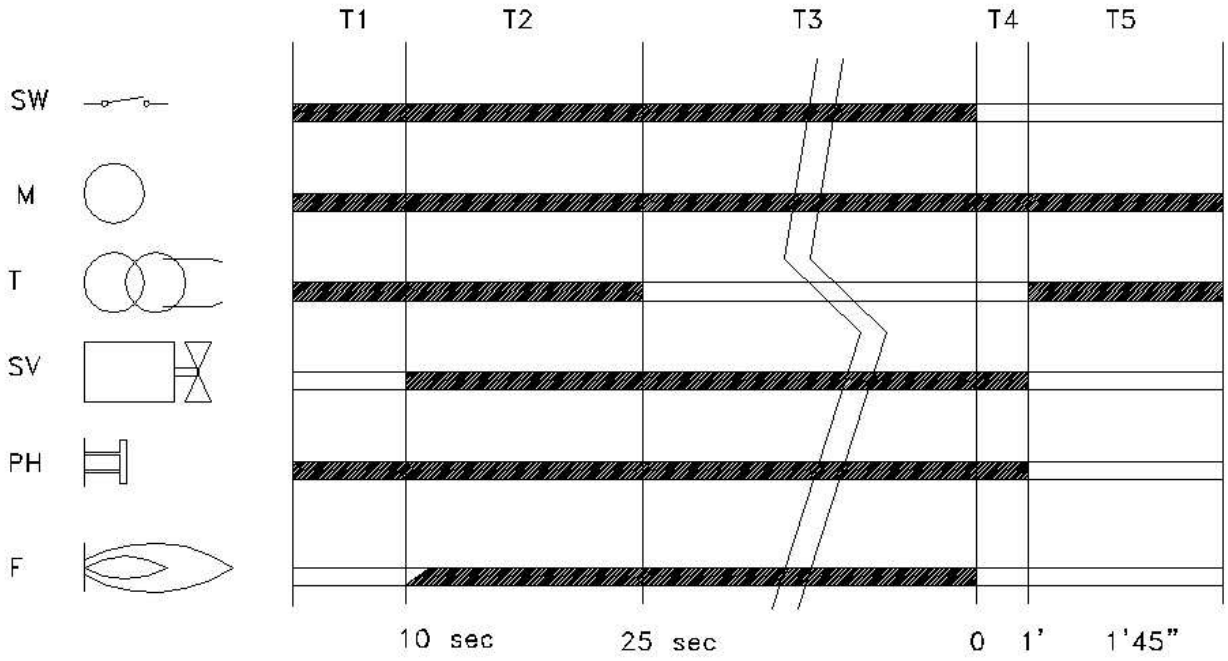
1.1 INDIRECT-FIRED HEATERS WITH FLUE



1.2 DIRECT-FIRED HEATERS WITHOUT FLUE



1.3 HEATERS WITH AND WITHOUT FLUE: OPERATIONAL SEQUENCE



T1	Prepurge time
T2	Ignition time
T3	Operation time
T4	Safety time at flame failure
T5	Aftercooling time

SW	Switch
M	Motor
T	Ignition transformer
SV	Fuel solenoid valve
PH	Flame sensor
F	Flame

Prepurge sequence

During the prepurge time (about 10 s) the fan blows air into the combustion chamber to expell any residual exhaust gases. The ignition transformer T produces a spark so that any small fuel residuals coming from the solenoid valve through the nozzle are completely burnt. At the same time the flame control unit checks for presence of flame or spurious light inside the combustion chamber: should this occur, the ignition sequence is interrupted and the heater locks out, that is all the electrical components are immediately unpowered.

Ignition sequence

During the ignition time, after the prepurge time, the fuel solenoid valve EV opens and the spark produced by the electrode ignites the fuel mist sprayed by the nozzle. The flame sensor (photoresistor) PH must feel the presence of flame within 1 s (safety time), otherwise the flame control unit locks out and the motor is stopped. If the flame sensor only feels a small flash and not a continuous flame, the whole prepurge and ignition sequence is repeated and then, if ignition is still unsuccessful, the unit goes to lock-out and stops.

Operational sequence
15 s after a regular flame ignition, the flame control unit de-energizes the ignition transformer and the electrodes stop sparking. The heater goes on operating with self-sustained combustion. The flame control unit monitors the regular presence of flame by means of the flame sensor. Any abnormal condition, such as lack of fuel, blockage of air inlet/outlet, dirty or clogged nozzle, that impairs regular combustion has the effect to close the fuel solenoid valve SV and to interrupt the fuel flow to the burner within the safety time. The flame control unit will then start a new complete prepurge/ignition sequence, and, should the problem repeat, the unit will lock out and the aftercooling sequence will start.

Restart sequence
If the flame shuts down for any reason, the flame control unit repeats the whole start sequence, consisting of the prepurge and the ignition sequences. If there is no flame signal within the safety time T4, the control unit goes to lock-out and the red lamp on the control panel lights up. If, on the contrary, a small flame signal is detected within the safety time, the control unit repeats the start sequence. The whole sequence will be repeated 3 times maximum and then the unit will definitely lock out. A maximum number of 3 ignition tries has been fixed to avoid that excessive smoke is produced during the repeated starting sequences. This effect could occur when the fuel tank is almost empty and the suction hose contains fuel and air mixed, or when the nozzle is partially blocked or damaged, and therefore the pressurized fuel is incorrectly sprayed.

Aftercooling sequence
During this time the heater is subjected to a cooling cycle to avoid excessive overheating of materials and components that could occur if the motor/fan suddenly stopped. This sequence is also very important from the point of view of efficiency, as all the residual heat that accumulates in the combustion chamber can be recovered and sent in the space to be heated.
For safety reasons, it has been established that the high voltage ignition transformer must be energized during the aftercooling time. By doing this, any small fuel residuals coming from the solenoid valve SV will burn completely and will not accumulate inside the combustion chamber. Any explosion risk or abnormal heat release during future ignition sequences is therefore prevented.
The aftercooling time is factory set and independent of the action of a limit control or similar devices on the combustion chamber. The aftercooling time lasts about 1 minute and 45 seconds.

Lock-out sequence
In the event of flame shut down due to lack of fuel or to another reason (see also the par. “SAFETY OPTIONS IN CASE OF ABNORMAL OPERATION”) the flame control unit will put the heater in a safety condition starting the lock-out sequence. During this sequence the fuel solenoid valve SV is immediately closed within the safety time T4 (< 1s) and then an aftercooling cycle will start to cool the surfaces of the combustion chamber. The ignition transformer is powered, and therefore a spark is produced by the electrodes, during the aftercooling cycle as described above.

Reset sequence
The unit can be reset by pushing the red reset pushbutton with integral warning lamp on the control panel. For safety reasons, reset will only be possible after about 30 s from lock-out. Also in the event of electrical supply failure/restoration, reset will only be possible after 30 s approximately.

1.4. SAFETY OPTIONS IN CASE OF ABNORMAL OPERATION

- **Spurious (external) light or anticipated ignition**

During the prepurge time no flame signal must come to the flame control unit. A flame signal with no flame could be due to external lights, short-circuit in the flame sensor or in the flame sensor leads, fault in the flame signal amplifier, fire on board of the unit, or, should the solenoid valve SV not properly interrupt the fuel flow to the nozzle, to anticipated ignition of the fuel/air mist during the prepurge time. In this case after the prepurge time and the safety time, the unit goes to lock-out.
Special attention is required in the event that the heater is directly exposed to sunlight (e.g. when used outdoors). It may happen that sunrays come into the combustion chamber and give a false flame signal, especially when the heater is new and the inner surfaces are bright and reflect light.

- **Flame failure at ignition**

If there is no flame signal at the end of the safety time T4, the flame control unit goes to lock-out condition.

- **Flame failure during operation**

If the flame signal fails during operation, the flame control unit closes the fuel solenoid valve, the fuel flow to the nozzle is interrupted and a new prepurge/ignition cycle is started. In case of lock-out, the unit can be manually reset after 30 s approx.

- **Overheat thermostat activation**

In the event of combustion chamber overheating, the overhat thermostat interrupts the electrical supply to the flame control unit and to all components. The heater is immediately stopped.
The possible causes of overheating are described in par. 3 “TROUBLESHOOTING GUIDE”

2. FUNCTIONAL DESCRIPTION OF COMPONENTS

2.1 CASING/FRAME

Description
The heater casing consists of :

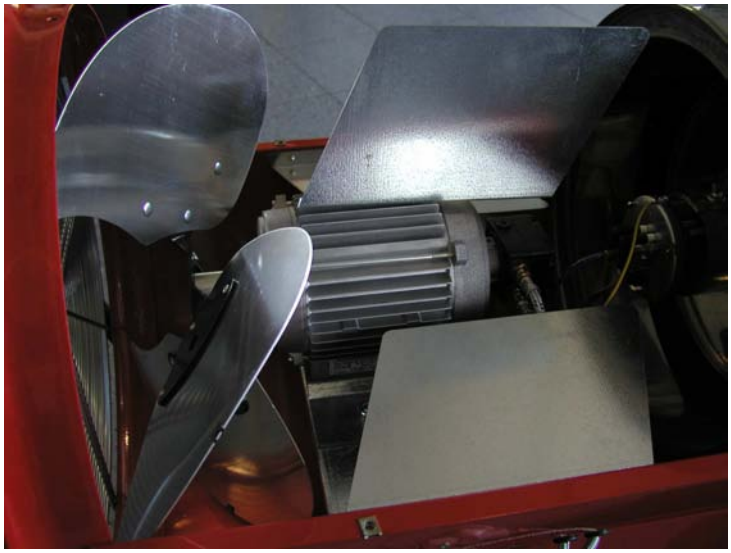
- a tank made of galvanized steel which also acts as a support for the whole machine.
- a support fixed on the tank to which the lower half-shell of the heater is connected. This support also contains the electrical board.
- a lower half-shell which, together with the upper half-shell, forms the air duct where heat is transferred to the flowing air. All main components are directly fixed onto the lower shell.
- an upper half-shell that completes the air duct and can be disassembled by unscrewing 6 screws for servicing and maintenance. On the indirect-fired heaters with flue the upper shell includes a circular hole for the flue collar.
- on the upper shell you can also find an inspection door that allows operators to reach the components inside the heater and to carry out most of the repair and maintenance operations.
- on the rear, a protection guard is fitted on the air inlet to prevent any contact with the rotating parts of fan/motor.
- on the front, a half cylindrical protection shield if fitted between the combustion chamber and the lower shell, to limit the temperature of such part, that is directly accessible and can be touched by the operators.

- On the front a diffuser outlet cone allows the warm air (on indirect-fired heaters) or the mixture of warm air and exhaust gases (on direct fired heaters) to be released into the heated room. The axle with wheels and the support foot are connected below the tank.

2.2 FAN/MOTOR ASSEMBLY

Description

An electrical motor drives both the fan and the oil pump. A helicoidal fan provides a constant air flow in the axial direction, a part of which is used for the combustion ; the remaining part flows along the surfaces of the combustion chamber and of the heat exchanger, and it is consequently heated. The fan is connected to the motor shaft by means of a threaded pin.
The oil pump has the function to suck fuel from the tank and to drive it to the nozzle at the rated pressure : the pump is connected to the motor shaft by a resin joint and fixed to the motor casing by means of 3 threaded pins. Single-phase, 2- or 4-poles motors with rotational speeds of 2800 rpm or 1400 rpm are used according to the heater model. See technical data sheet for detailed motor specifications.



ILL. 1: particolare gruppo motore MIRAGE 85H – TORNADO 115

2.3 FUEL CIRCUIT

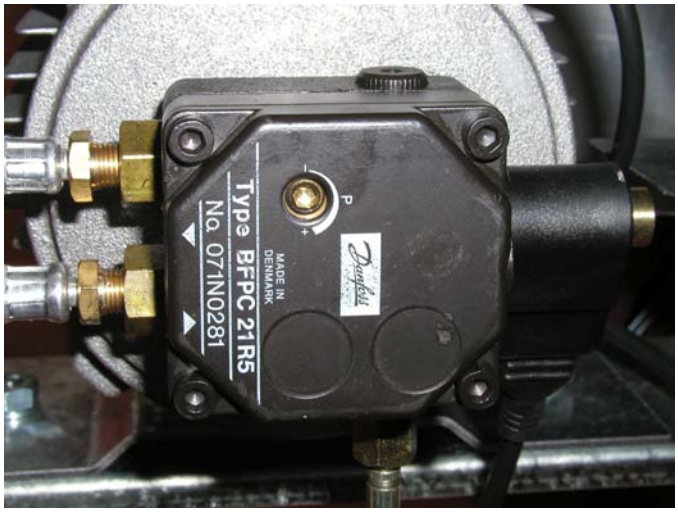
Description

The fuel circuit is basically composed of :

- tank
- suction and return hoses
- fuel filter,
- fuel pump,
- fuel solenoid valve,
- high pressure microhose
- combustion head
- nozzle

The gear pump, driven by the motor, sucks fuel from the tank and increases its pressure to the rated value. At the pump outlet a fuel cut-out solenoid valve SV is fitted. The pump is controlled by the flame control unit. During normal operation the valve is open and the pressurized fuel flows to the nozzle, where it is atomized, mixed with primary combustion air and ignited by the electrode spark. The flow of primary air to the burner is adjusted by an air lock on the combustion head.
Under abnormal operating conditions (see also flow-chart) the flame control unit closes the solenoid valve SV, fuel does not come to the nozzle but goes back to the tank through the return hose. An adjustment screw is fitted on the front of the pump ; it allows to adjust the pressure and consequently the fuel flow.

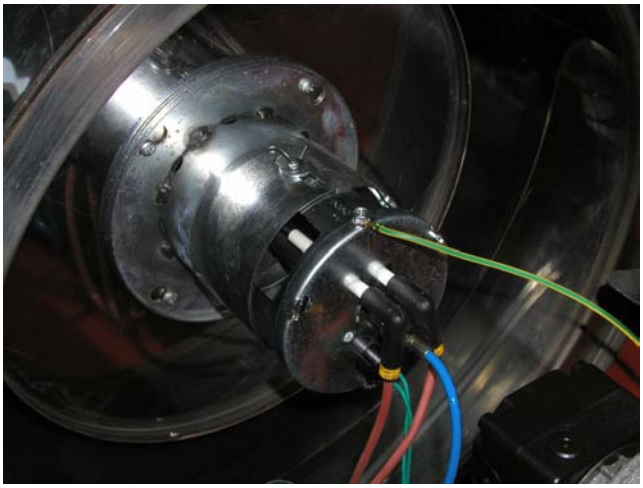
ILL. 2: particolare gruppo filtro gasolio



ILL. 3: particolare pompa gasolio

2.4 BURNER HEAD/COMBUSTION CHAMBER

Description



ILL. 4: particolare testa di combustione

A certain amount of air coming from the fan flows around the combustion head, and, depending on the air lock setting, a part of it - the so-called primary air - flows inside the burner head. The primary air is distributed and mixed with the atomized fuel jet exiting the nozzle by means of a baffle disc. To get good combustion and therefore high efficiency, the adjustment of the primary air/fuel ratio must be very accurate. For this purpose, please carefully follow the setting specifications and instructions contained in this manual.

The burner head includes :

- nozzle holder
- air lock
- baffle disc (whirl disc)
- fuel nozzle
- ignition electrode
- flame sensor (photoresistor)

The fuel coming out of the nozzle is atomized and mixed with primary air. Additional circumferential openings on the burner head allow another amount of air, called secondary air, to flow into the chamber. That is an additional air delivery that completes combustion.
During the whole ignition sequence the electrodes are powered by the high voltage transformer and produce a spark that ignites the fuel-air mixture.
The function of the whirl disc is to induce a rotational component in the primary air flow and therefore to decelerate it : this way the mixing of fuel and air is increased and the combustion improved.

The combustion chamber is made of stainless steel. It includes :

- a rear end on which the combustion head is fitted
- a front end with hole on direct heaters, without hole on indirect heaters
- a front flame shield on direct heaters
- the heat exchanger with gas passageways
- the exhaust gas flue collar
- the protection shield around the chamber
- a manually resettable overheat thermostat

2.5 ELECTRICAL BOARD

Description

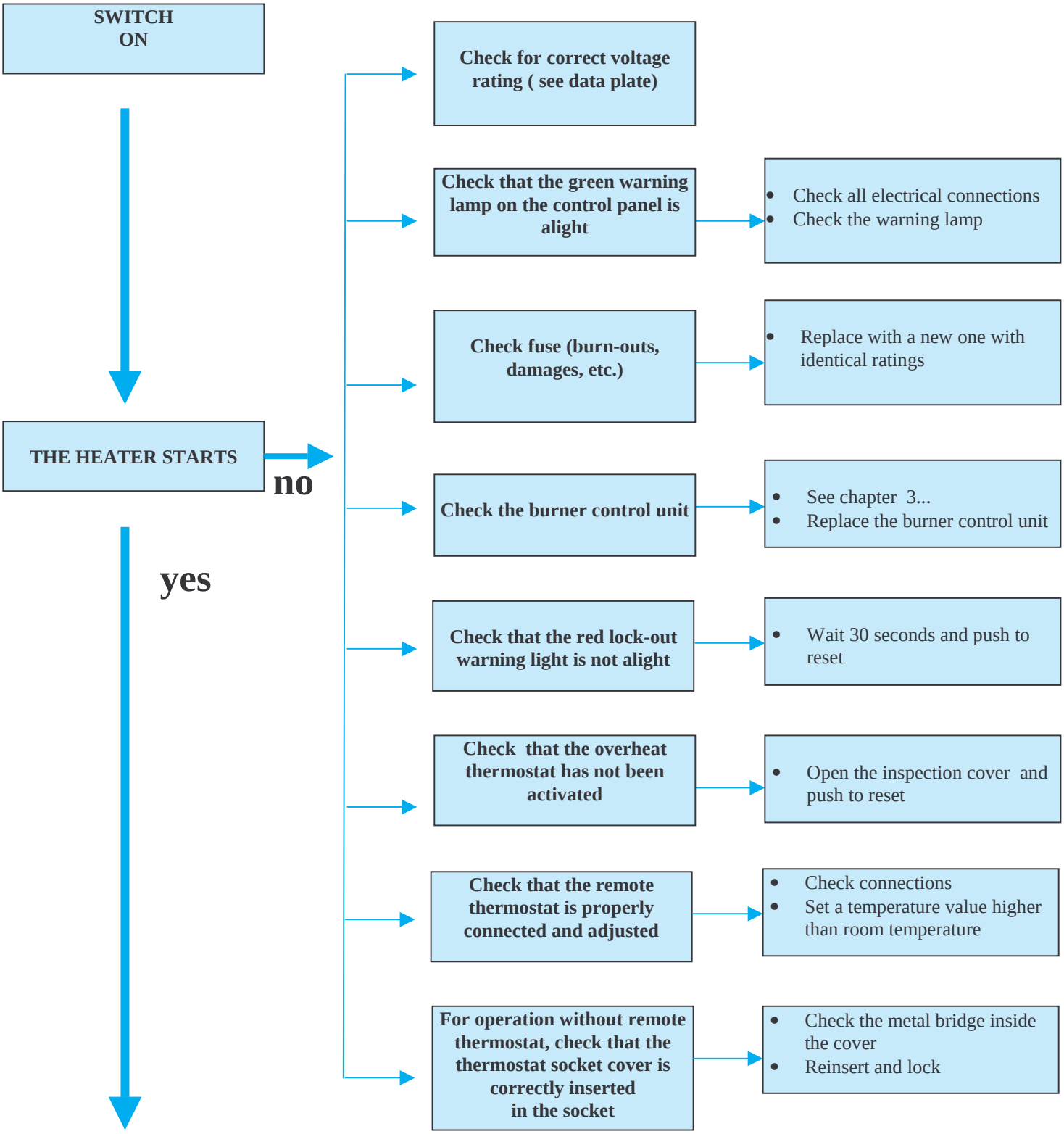
ILL. 5: particolare cruscotto

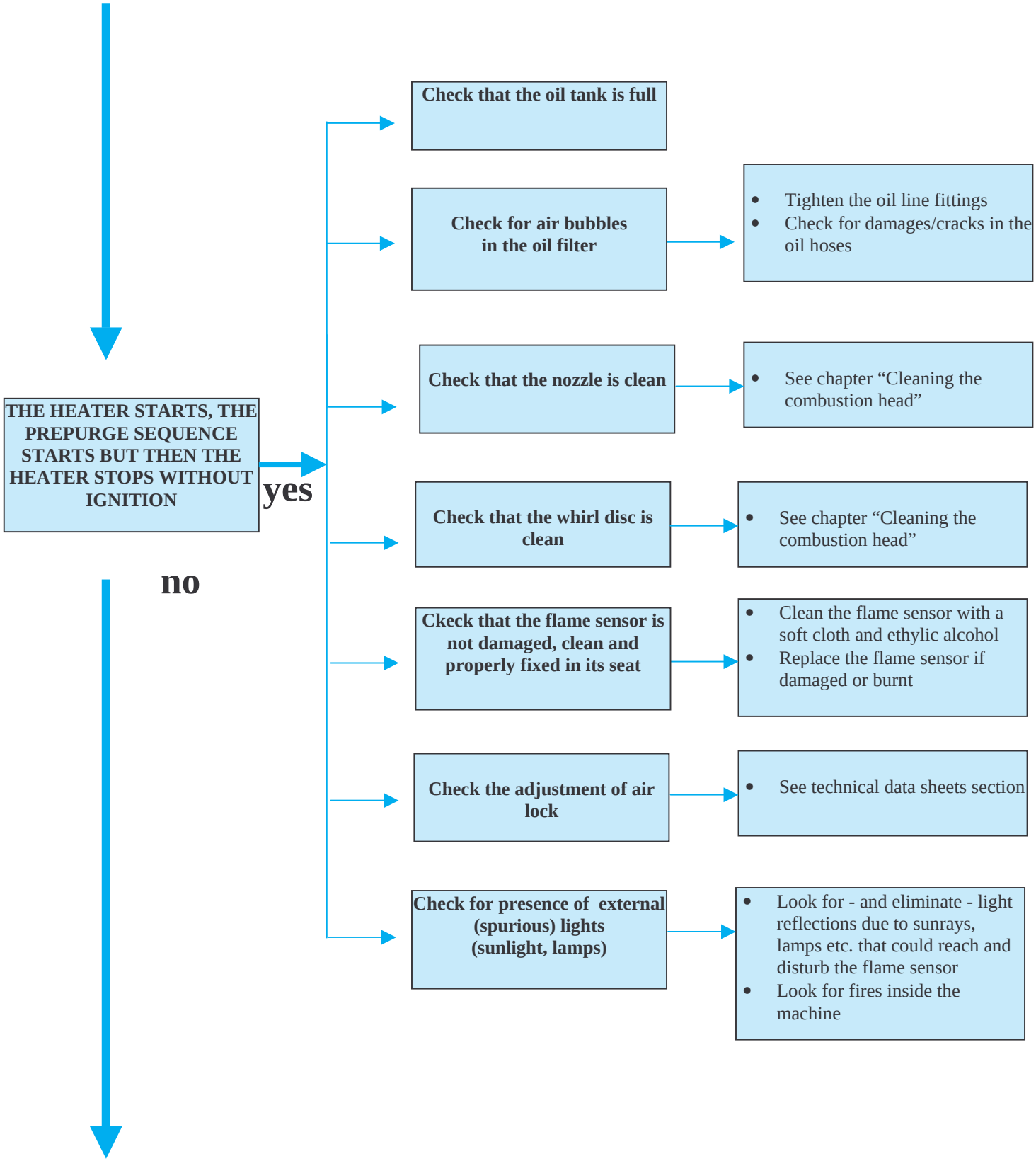
The electrical board has the function to broadcast the electrical supply coming from the electrical system through the power cord to all components, by means of a control/command electronic device, called burner (flame) control unit. This part has also the task to monitor flame and to ensure safe operation of the heater during all its operational sequences.

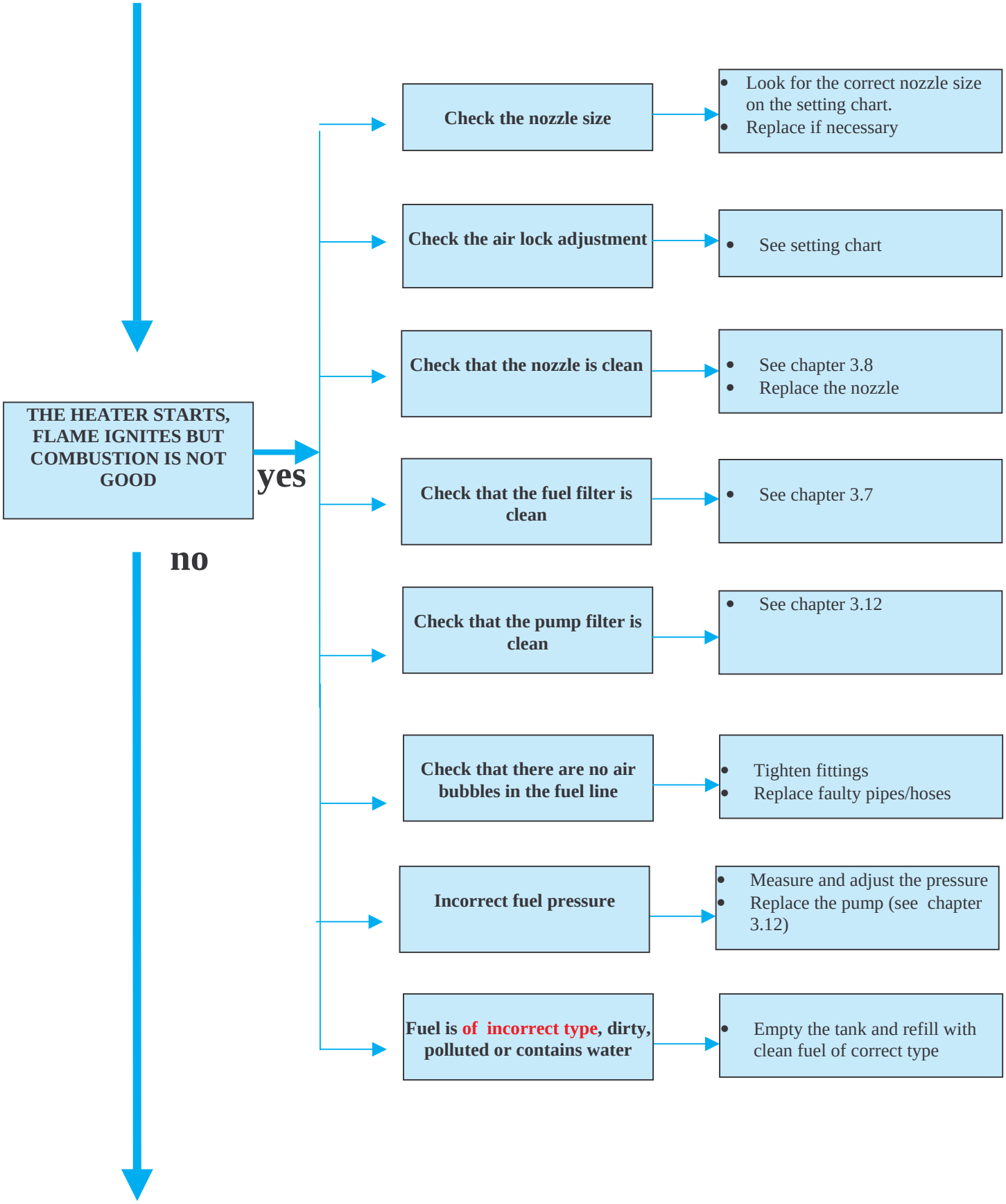
The electrical board consists of the following parts :

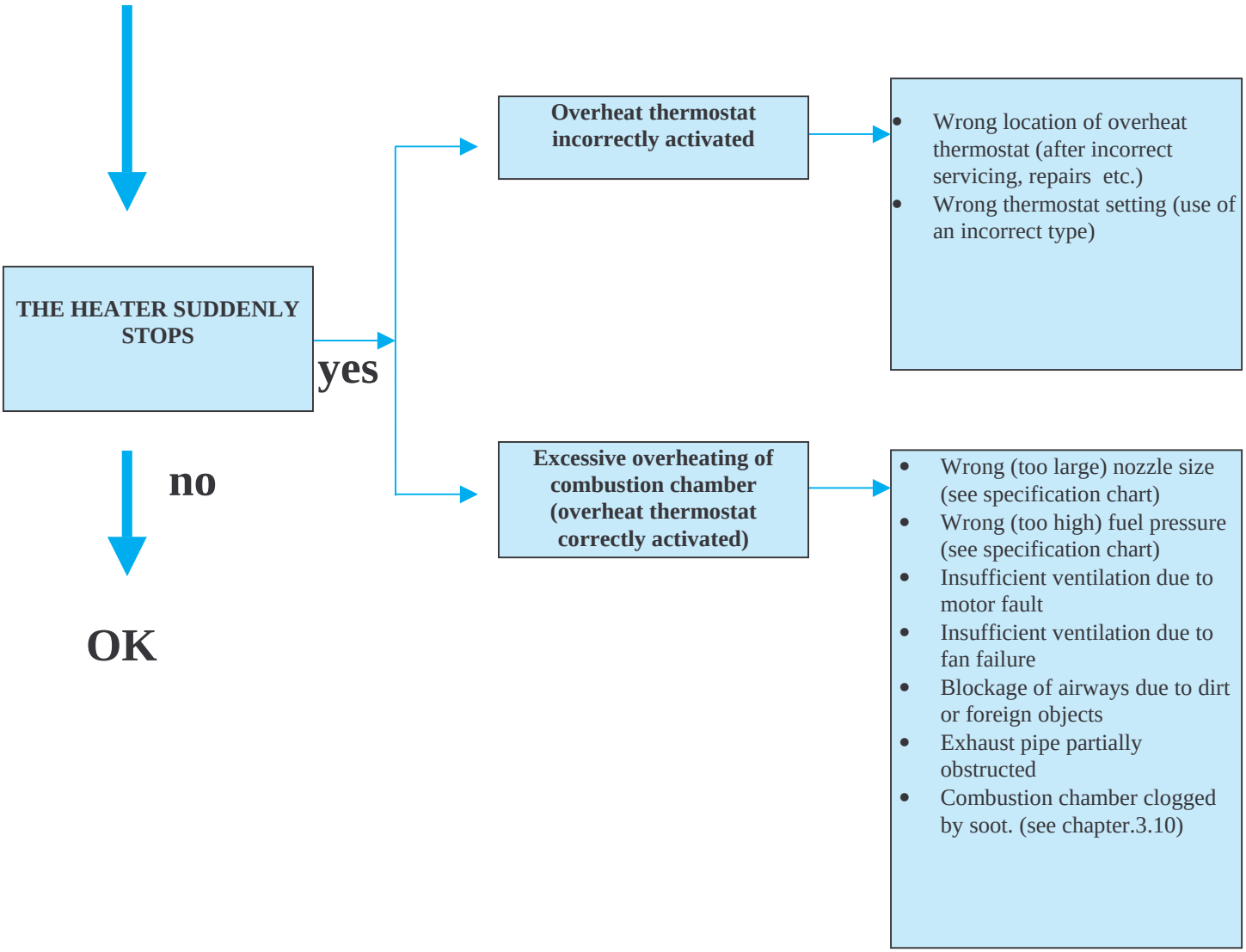
- Control panel
- Protecting cover (against water/dust)
- Power cable with strain relief and plug
- ON/OFF switch
- Remote room thermostat socket with plastic cover and inner electrical bridge (closing circuit for operation without thermostat)
- Reset pushbutton with built-in warning lamp
- high voltage ignition transformer
- fuse with fuseholder
- electronic burner (flame) control unit

3. TROUBLESHOOTING


SWITCH ON
THE HEATER STARTS
no
yes
Check for correct voltage rating (see data plate)
Check that the green warning lamp on the control panel is alight
Check all electrical connections
Check the warning lamp
Check fuse (burn-outs, damages, etc.)
Replace with a new one with identical ratings
Check the burner control unit
See chapter 3...
Replace the burner control unit
Check that the red lock-out warning light is not alight
Wait 30 seconds and push to reset
Check that the overheat thermostat has not been activated
Open the inspection cover and push to reset
Check that the remote thermostat is properly connected and adjusted
Check connections
Set a temperature value higher than room temperature
For operation without remote thermostat, check that the thermostat socket cover is correctly inserted in the socket
Check the metal bridge inside the cover
Reinsert and lock


THE HEATER STARTS, THE PREPURGE SEQUENCE STARTS BUT THEN THE HEATER STOPS WITHOUT IGNITION
yes
no
Check that the oil tank is full
Check for air bubbles in the oil filter
Tighten the oil line fittings
Check for damages/cracks in the oil hoses
Check that the nozzle is clean
See chapter “Cleaning the combustion head”
Check that the whirl disc is clean
See chapter “Cleaning the combustion head”
Ckeck that the flame sensor is not damaged, clean and properly fixed in its seat
Clean the flame sensor with a soft cloth and ethylic alcohol
Replace the flame sensor if damaged or burnt
Check the adjustment of air lock
See technical data sheets section
Check for presence of external (spurious) lights (sunlight, lamps)
Look for - and eliminate - light reflections due to sunrays, lamps etc. that could reach and disturb the flame sensor
Look for fires inside the machine


THE HEATER STARTS, FLAME IGNITES BUT COMBUSTION IS NOT GOOD
yes
no
Check the nozzle size
Look for the correct nozzle size on the setting chart.
Replace if necessary
Check the air lock adjustment
See setting chart
Check that the nozzle is clean
See chapter 3.8
Replace the nozzle
Check that the fuel filter is clean
See chapter 3.7
Check that the pump filter is clean
See chapter 3.12
Check that there are no air bubbles in the fuel line
Tighten fittings
Replace faulty pipes/hoses
Incorrect fuel pressure
Measure and adjust the pressure
Replace the pump (see chapter 3.12)
Fuel is of incorrect type, dirty, polluted or contains water
Empty the tank and refill with clean fuel of correct type


THE HEATER SUDDENLY STOPS
yes
no
OK
Overheat thermostat incorrectly activated
Wrong location of overheat thermostat (after incorrect servicing, repairs etc.)
Wrong thermostat setting (use of an incorrect type)
Excessive overheating of combustion chamber (overheat thermostat correctly activated)
Wrong (too large) nozzle size (see specification chart)
Wrong (too high) fuel pressure (see specification chart)
Insufficient ventilation due to motor fault
Insufficient ventilation due to fan failure
Blockage of airways due to dirt or foreign objects
Exhaust pipe partially obstructed
Combustion chamber clogged by soot. (see chapter.3.10)

THE MAINTENANCE OPERATIONS DESCRIBED IN THIS MANUAL MUST BE CARRIED OUT BY QUALIFIED PERSONNEL ONLY, IN COMPLIANCE WITH THE ELECTRICAL SAFETY STANDARDS IN FORCE.
ONLY USE ORIGINAL OR RECOMMENDED SPARE PARTS.

3.1 CHECKING THE SUPPLY VOLTAGE

The supply voltage must match with the rated voltage indicated on the data plate. The actual input voltage must be within -15% and + 10% of the rated voltage for good and safe operation.

- Measure the mains voltage, inserting the multimeter tips into the electrical socket and compare it with the rated voltage written on the data plate.

If no voltage is found :

- Check the electrical system fuse(s) and the main distribution board.
- Check the electrical socket.

Note : Only carry out maintenance/repairs on the heater and not on the electrical system, for which servicing by authorized personnel is required.

3.2 CHECKING AND REPLACING THE POWER CORD

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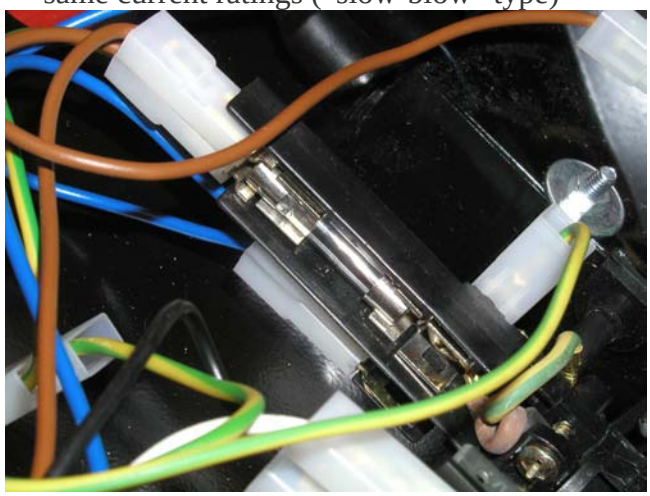
- Check that the green warning lamp lights up. If it does not, this means the heater is not powered.
- Check the conditions of cable and plug and look for damages and failures.
- Unscrew the fixing screws of the control panel and extract the electrical board.

Ill. 6

- Unscrew the fixing screw of the resin board cover and remove the cover.

Ill. 7

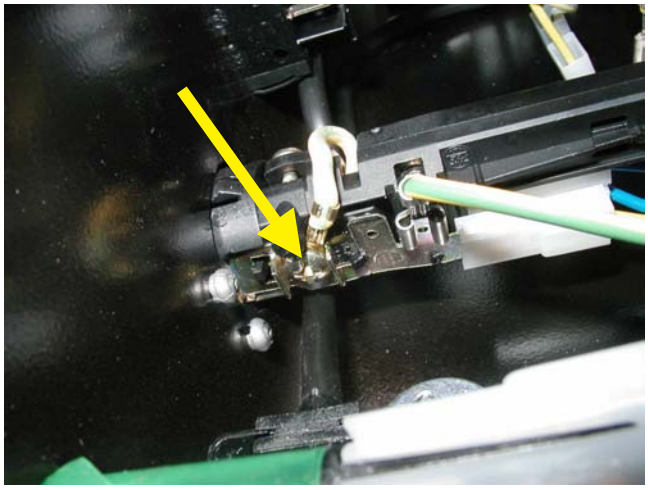
- Check voltage between mains terminals (live and neutral) on the cable strain relief. If no voltage is found, check the fuse. If it is damaged or burnt, replace it with one with same current ratings (“slow-blow” type)



Ill. 8

To replace the power cord

- Only use H07RN-F power cords (Europe) or SJT power cords (USA) with watersplash-proof plug.
- Disconnect the line leads and earth leads from terminals

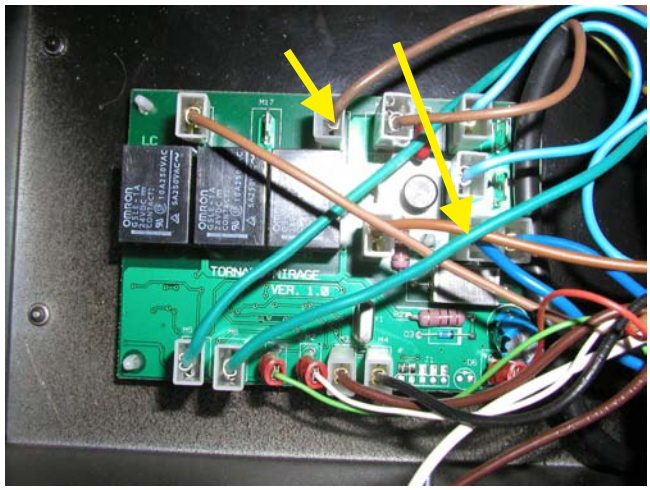


Ill. 9

- Remove the defective cable.
- Insert the replacement cable into the strain relief (inner lenght : about 5 cm).
- Fix the strain relief into its seat.
- Connect the line and earth leads to terminals.
- Check for proper operation.
- Reassemble the electrical panel.

3.3 CHECKING AND REPLACING THE MOTOR

- Extract the electrical board (see picture)
- Check voltage at the motor terminals using a multimeter.

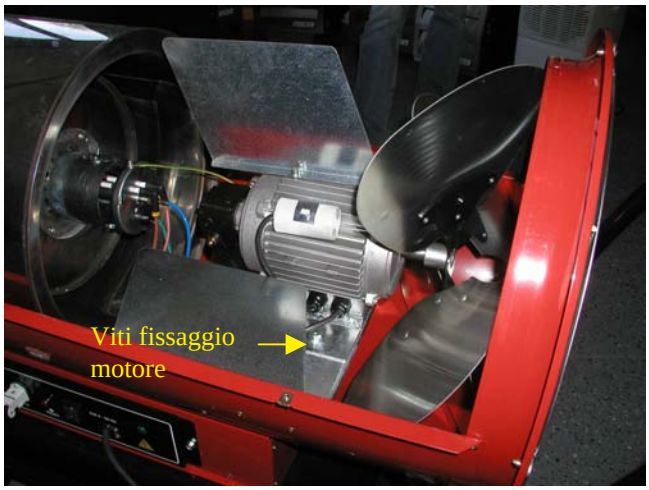


Ill. 10

- Check the capacitor.
- To replace the motor:
- Unpower the machine by unplugging it.
- Disconnect the motor leads on the burner control unit (see picture #10).
- Remove the upper shell by unscrewing its 6 fixing screws.

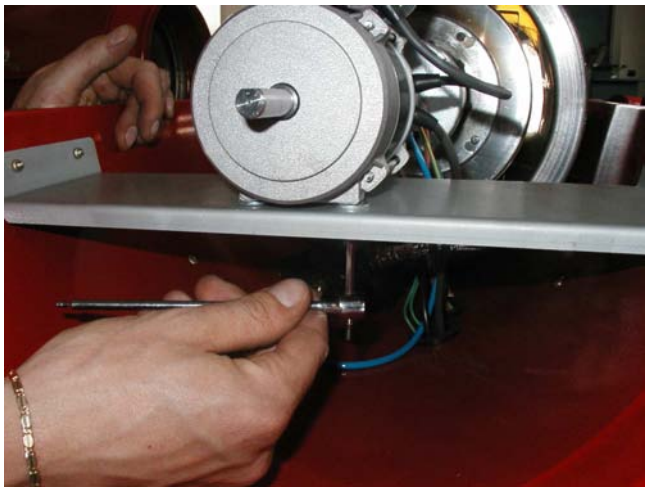
Ill. 11

- Disassemble the fan. *(see chapter 3.4)*
- Loosen the fuel pump fixing screws and disconnect the pump *(see chapter 3.12)*.
- Unscrew the fixing screws of the motor bracket on the lower support.



Ill. 12

- Unscrew the fixing screws of the motor on the bracket.



Ill. 13

- Replace motor and fix it on the bracket. Connect bracket to lower support. Connect motor leads on the terminal board following the wiring diagram.
- Check operation.
- Reassemble fan, fuel pump, rear guard, upper shell and electrical board.

To replace the capacitor :

- Remove the inspection cover.
- Extract the capacitor from its support.
- Disconnect leads on the capacitor.

Ill. 14

- Replace the capacitor with one with same capacity (µF rating).
- Connect, check operation and reassemble.

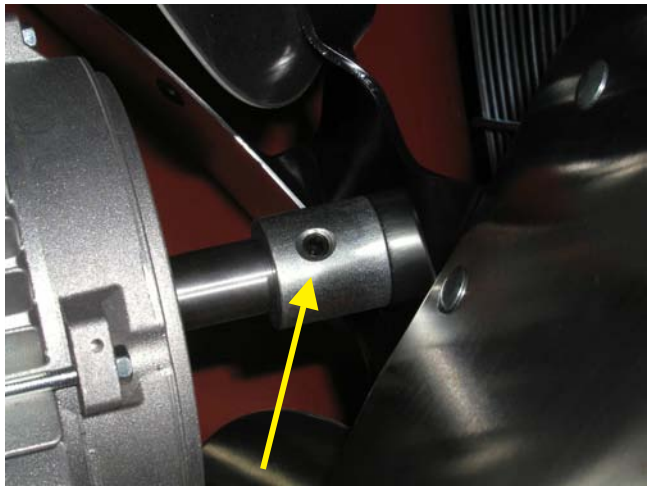
3.4 CHECKING AND REPLACING THE FAN

WARNING : MAKE SURE THAT THE HEATER IS NOT POWERED BEFORE OPERATING ON MOVING PARTS WITHOUT GUARDS IN PLACE. BODY INJURY DANGER!

- Remove the rear guard and look for possible damages or obstructions not allowing the fan to rotate.

To replace a damaged fan:

- Unscrew the fixing screw on the fan hub.



Ill. 15

- Extract the damaged fan and replace it.
- Check by hand that the fan can rotate freely without interference.
- Check operation after reassembling guards.

3.5 EXHAUST GAS ANALYSIS (for heater with flue only). COMBUSTION AIR ADJUSTMENT

Perform an exhaust gas analysis with the Shell-Bacharach method to check the quality of combustion.

- Use a standard smokemeter (Shell-Bacharach pump) .

Ill. 16

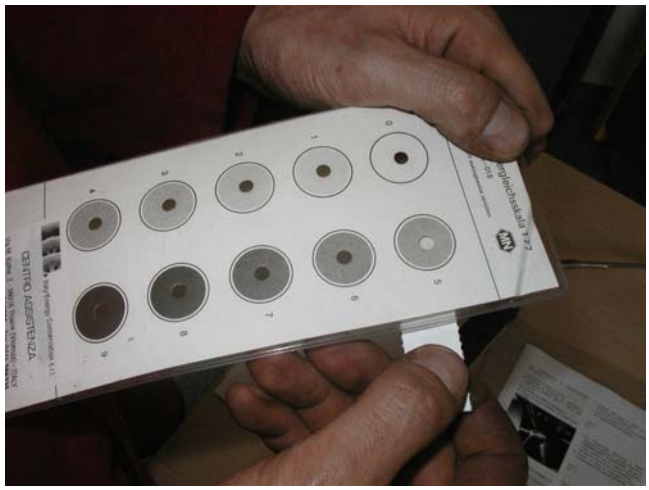
- Insert a test strip into the pump slot .

Ill. 17

- Connect an extension for exhaust gas analysis to the flue adapter.
- Insert the pump end into the flue extension.

Ill. 18

- With the heater operating in normal conditions, draw in the exhaust gases for 10 times (**IMPORTANT : 10 TIMES EXACTLY**), taking care to carry out all movements slowly and using the complete piston stroke.
- Extract the paper strip, check the colour and compare it with the reference scale to assign a smoke number.

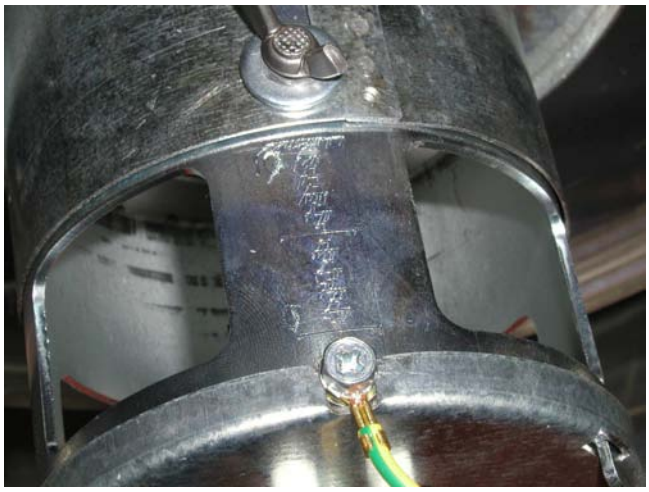


Ill. 19

Oil-fired heaters are factory set by the manufacturer to give a smoke number equal to 0 (zero) of the Shell-Bacharach scale. A smoke number greater than 1 indicates bad combustion. Should this occur, the causes of the problem should be detected and eliminated.

The most important factors that can cause high smoke numbers are :

- Clogged combustion chamber due to incorrect installation (exhaust flue obstructed or badly designed, see chapter 3.10 and user instruction manual)
- Operation without flue adapter
- Dirty combustion head, fuel lines and/or nozzle (see chapter 3.9)
- "Too closed" adjustment of air lock (see chapter 3.9.



Ill. 20

- Lack of combustion air due to installation too close to a wall or in a small room without openings towards outside.

AIR LOCK ADJUSTMENT

- Remove the inspection cover.
- Unscrew the fin screw on the combustion head.
- Move the air lock in the axial direction to reach the position shown on the setting chart supplied by the manufacturer (see setting chart at the end of this manual)

Ill. 21

3.6 CLEANING THE FUEL TANK

To clean the fuel tank:

- Lift the heater at about 1 m height using a fork truck or other suitable means.
- Place a proper container under the heater tank.
- Unscrew the drainage cap on the tank bottom to discharge the fuel completely.

Ill. 22

To clean the fuel filler filter, extract the filter from the tank filler cap, clean it and reassemble.

Ill. 23

3.7 CHECKING/CLEANING/REPLACING THE OIL FILTER

Ill. 24

- Unscrew the lower filter body (glass).
- Pour out the fuel contained in the filter.
- Open the filter and extract the filter cartridge.

Ill. 25

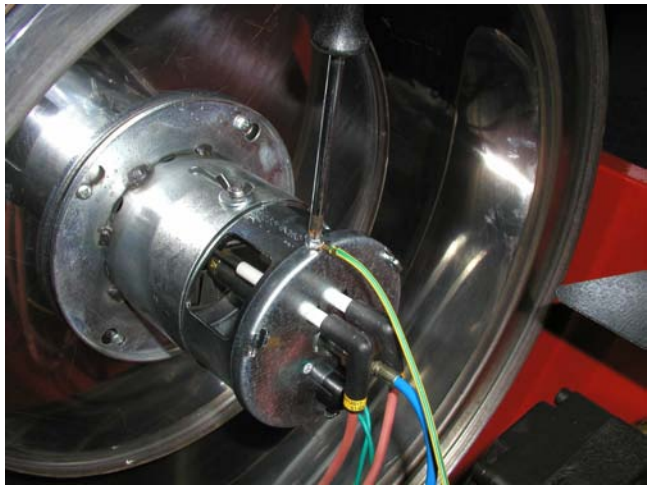
- Clean the filter cartridge using a soft brush and then blow compressed air.

To replace the complete filter:

- Loosen the filter fittings and unscrew the filter/bracket fixing nut .
- Reassemble and connect fuel hoses.

3.8 CHECKING/CLEANING/ REPLACING THE OIL FILTER

- Remove the inspection panel.
- Remove the fixing screw on the burner head (nozzle-holder)



Ill. 26

- Extract the nozzle holder by rotating it clockwise to release it from the fixing hooks.

Ill. 27

Ill. 28

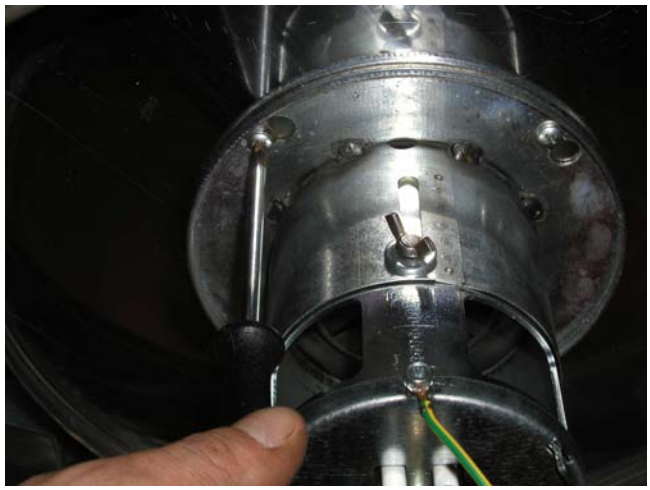
- Unscrew the nozzle taking care not to touch the electrode, as impacts could damage the electrode ceramic insulators and impair good ignition.

Ill. 29

- Clean the nozzle blowing compressed air inside it.
- If cleaning is not sufficient, replace the nozzle. Only use the nozzle sizes and types recommended by the manufacturer (see setting chart).
- Reassemble the nozzle.
- Reassemble the burner head and the inspection cover.

3.9 CHECKING/CLEANING/REPLACING THE BURNER HEAD AND THE WHIRL DISC.

- Remove the inspection cover.
- Loosen (do not unscrew completely) the fixing screws of the end disc on the combustion head.

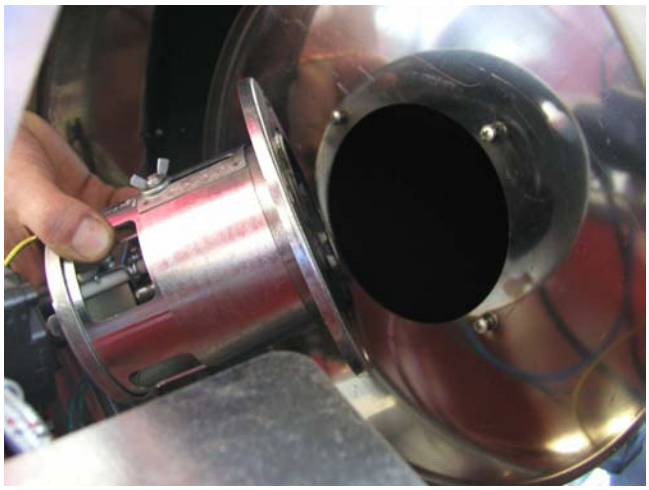


Ill. 30

- Slightly rotate the combustion head clockwise so that the screw heads match with the big holes on end disc. This will be helpful when reassembling, as the screws will act as supporting and centering means for the combustion head.

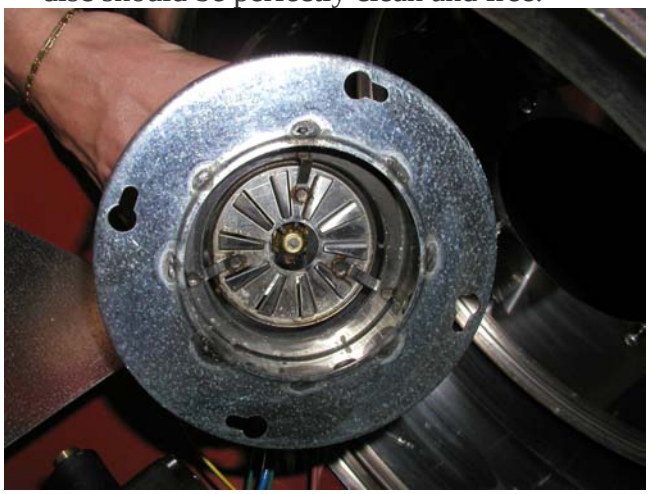
Ill. 31

- Extract the combustion head.



Ill. 32

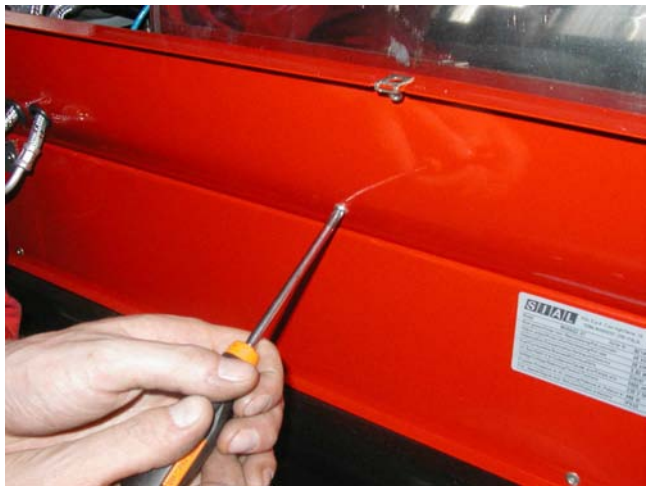
- Clean the whirl disc using a brush and then blow compressed air on it. To get good combustion the air flow openings in the whirl disc should be perfectly clean and free.



Ill. 33

3.10 CLEANING THE COMBUSTION CHAMBER

- Remove the upper shell.
- Disassemble the burner head (see chapter 3.8).
- Disassemble the combustion head (see chapter 3.9).
- Unscrew the fixing screws on the combustion head.

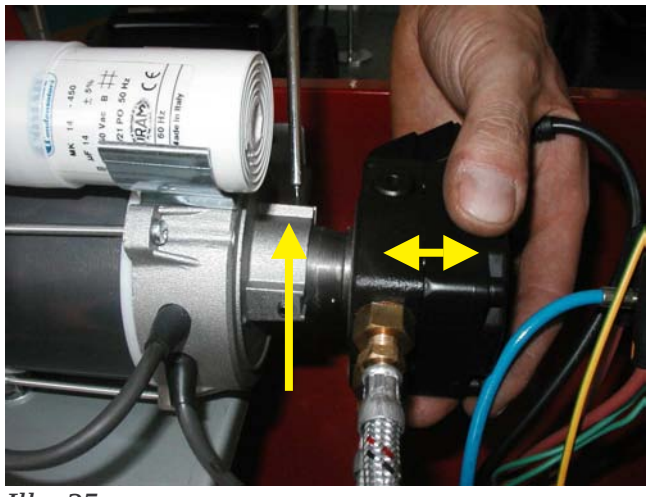


Ill. 34

- Extract the combustion chamber and if required clean using Diesel oil
- Eliminate any Diesel residuals, carefully dry and reassemble the combustion head, the burner head and the upper shell.

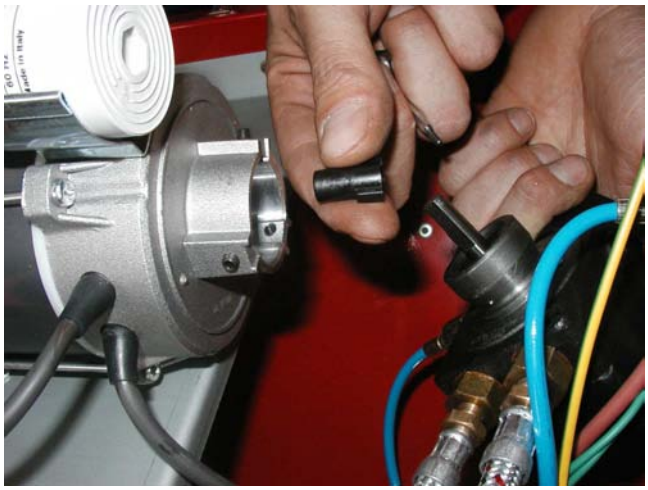
3.11 REPLACING THE MOTOR/PUMP JOINT

- Loosen (do not unscrew completely) the 3 fixing screws on the fuel pump



Ill. 35

- Extract the pump sliding it in the axial direction.



Ill. 36

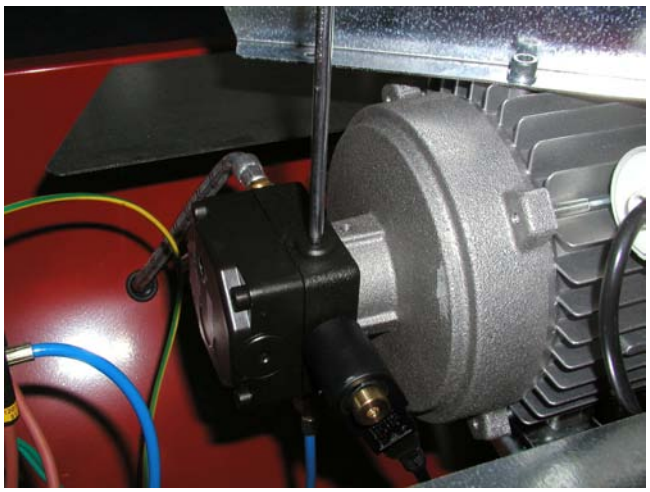
- Check the conditions of the coupling and replace it if required.
- Make sure that the motor shaft can rotate freely (move the fan by hand to check)
- Reassemble.

3.12 CHECKING/CLEANING/ADJUSTING /REPLACING THE FUEL PUMP

- Remove the inspection cover.

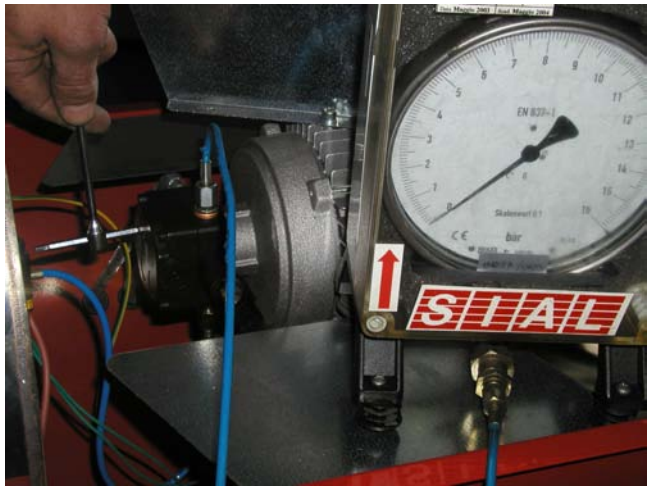
To measure the delivery pressure:

- Unscrew the screw on the upper part of the pump



Ill. 37

- Connect a pressure gauge with a suitable measuring range.
- Close the inspection panel and start a short ignition cycle (10 s prepurge followed by 3 s first ignition)
- Shut down the heater turning the ON/OFF switch to 0 so that the aftercooling cycle starts and the motor continues to rotate.
- Open the inspection cover and turn the screw on the pump head clock- ot anticlockwise (reading at the same time the pressure gauge) until the correct pressure setting is reached.



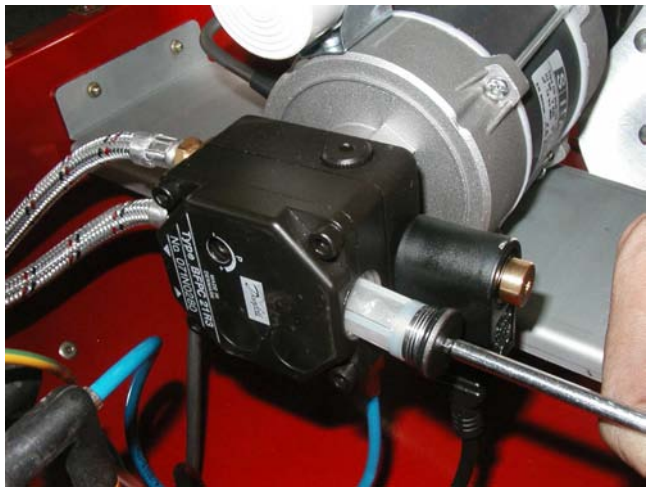
Ill. 38

To measure the suction vacuum:

- Unscrew the screw marked with “V”.
- Connect a vacuum-meter to the port “V”.

To clean the pump filter:

- Unscrew the filter fixing screw on the pump carter and extract the filter.



Ill. 39

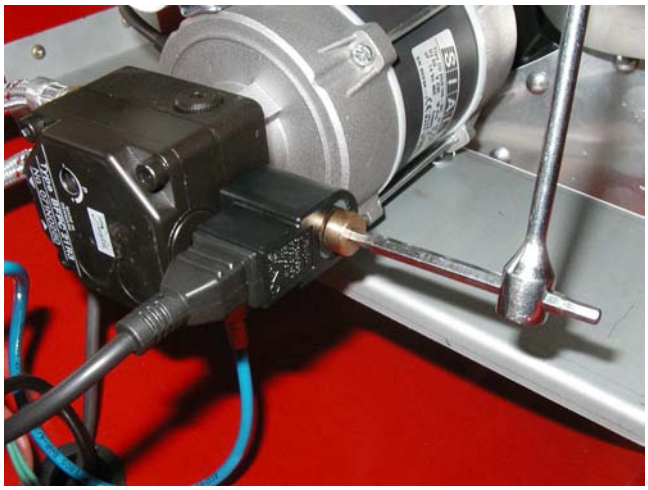
- Clean the filter with compressed air or wash it with clean Diesel oil.
- Reassemble

To replace the pump:

- Loosen the pump fixing screws.
- Make sure that the motor/pump resin joint is correctly fitted.
- Replace the pump and reassemble the whole unit

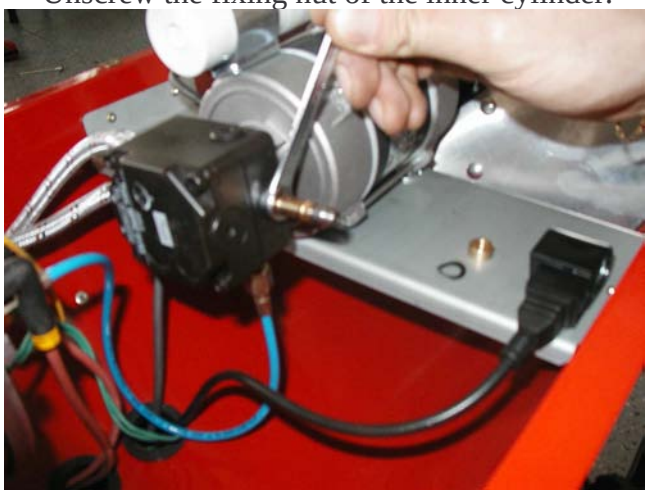
3.13 CHECKING AND REPLACING THE FUEL SOLENOID VALVE

- Unscrew the solenoid valve fixing nut.



Ill. 40

- Extract the valve casing.
- Unscrew the fixing nut of the inner cylinder.



Ill. 41

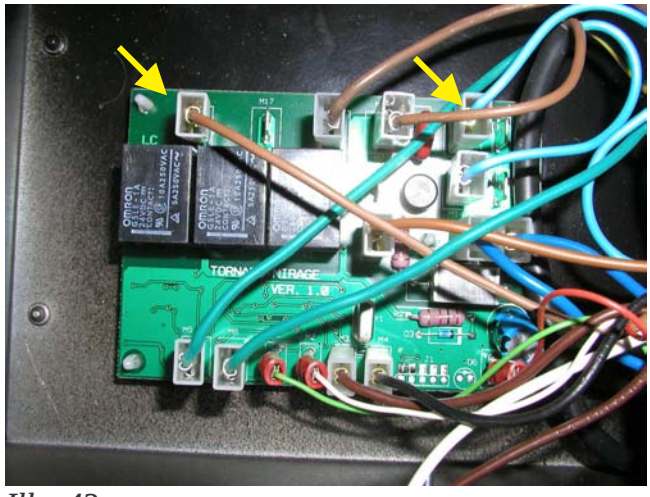
- Extract the inner cylinder and clean it with Diesel oil.

Ill. 42

Check that the inner cylinder can slide freely. If required clean the piston.

To replace the solenoid valve:

- Open the electrical board.
- Check voltage at the solenoid valve terminals.



Ill. 43

If a voltage can be measured on the terminals shown in the picture but the solenoid valve does not work :

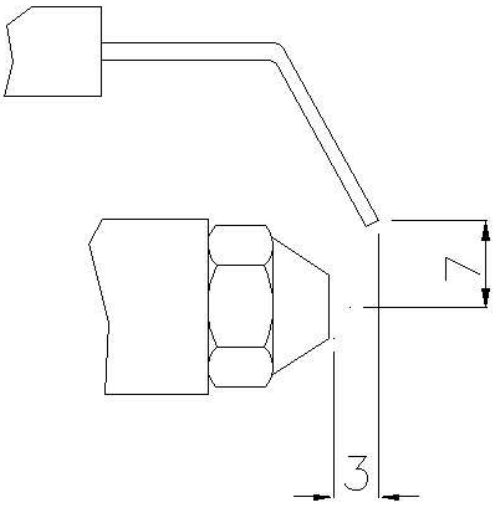
- Disconnect the valve leads from the burner control unit.
- Replace the solenoid valve.
- Reconnect and check operation.

3.14 CHECKING/CLEANING/ADJUSTING/ REPLACING ELECTRODES

- Extract the burner head.

Ill. 44

- Check that the electrode tips are clean.
- If not, clean them with a soft brush and then with compressed air.
- Check the clearances between electrode tips and between electrode tips and nozzle.
- Adjust the clearances according to the diagram below :



To check that ignition spark is regular:

- Insert the nozzle holder into the burner head and fix it wih a proper screw.
- Completely open the air lock.
- Disconnect the solenoid fuel valve from mains.
- Give power to the heater and allow a start cycle to take place turning the ON/OFF switch to I (ON).
- Visually check that the ignition electrodes produce a regular spark .

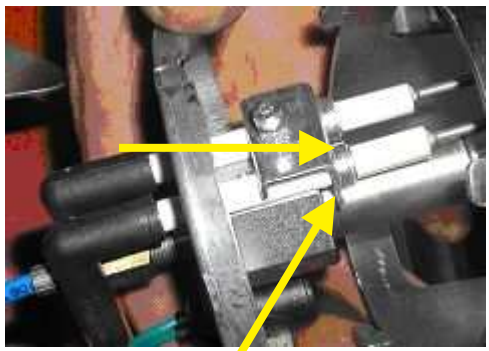
Warning

At ignition, an 11 kW high voltage is produced between the electrode tips. Carefully follow the electrical safety regulations during all servicing and maintenance operations.

- Reconnect the solenoid valve leads after checking spark.

To replace the electrodes:

- Disconnect the high voltage leads from electrodes.
- Unscrew the electrode fixing screws.



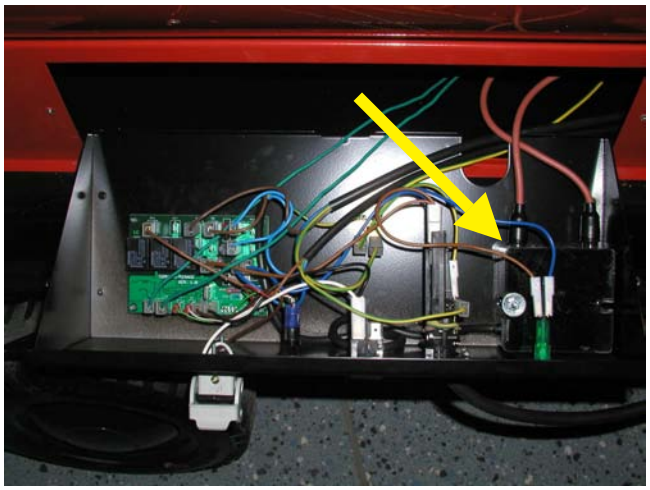
Ill. 45

- Replace the electrodes and reconnect the high voltage leads.
- Reassemble the burner head.

3.15 CHECKING AND REPLACING HIGH VOLTAGE CABLES

- Check that the high voltage cables are properly connected.
- Check the conditions of high voltage cables and look for possible damages.

Disconnect the high voltage cables from electrodes and from the ignition transformer in the electrical board.



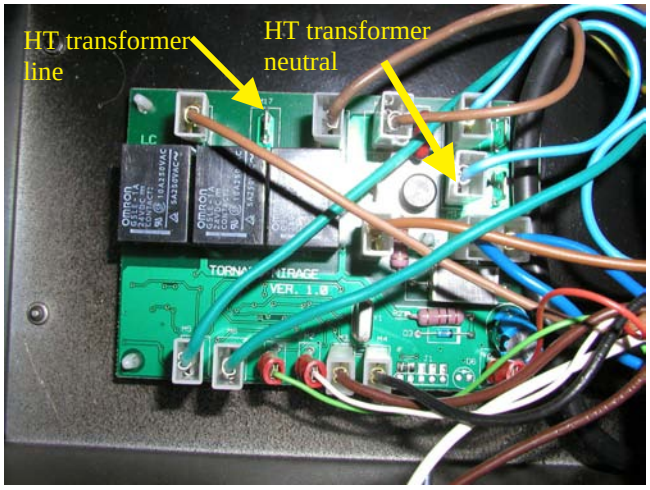
Ill. 46

- Connect the new cables and check operation.

3.16 CHECKING/REPLACING THE IGNITION TRANSFORMER

To replace the transformer:

- Unscrew the transformer fixing screw and nut on the electrical board.
- Disconnect the high voltage cables from the transformer.
- Disconnect the high voltage cables from the burner control unit.

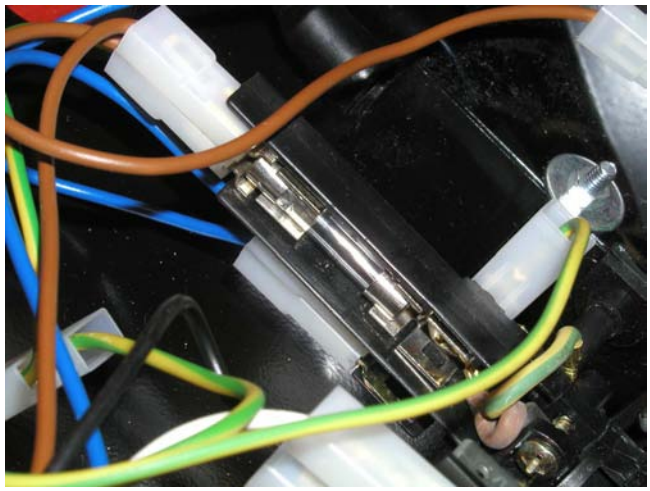


Ill. 47

- Replace the transformer, reconnect cables to transformer and burner control unit following the wiring diagram shown on the label placed on the electrical board cover.

3.17 REPLACING THE FUSE

- Open the electrical board.
- Extract the fuse from the fuse holder in the electrical board.

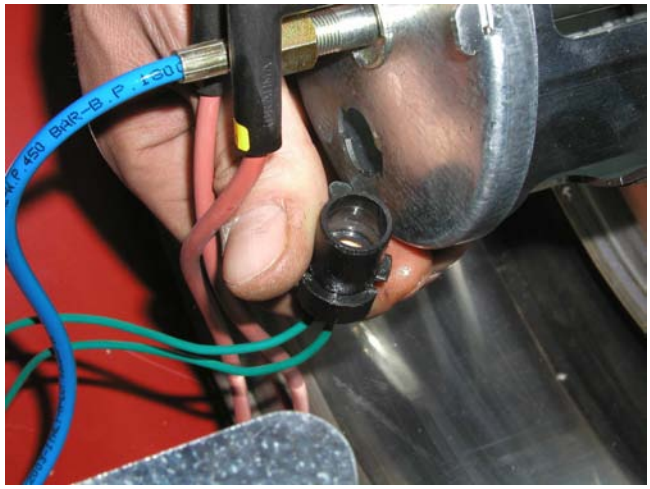


Ill. 48

- Check the conditions of fuse.
- Replace the faulty fuse with one with identical current ratings. See technical specifications.

3.18 CHECKING, CLEANING AND REPLACING THE FLAME SENSOR

- Extract the flame sensor from its seat in the burner head disc, by turning it about ¼ turn to loosen the fixing feet of flame sensor support.



Ill. 49

- Gently push the sensor leads to extract the flame sensor. Clean the sensor glass with a cloth soaked with ethylic alcohol to eliminate any soot or dust residuals.

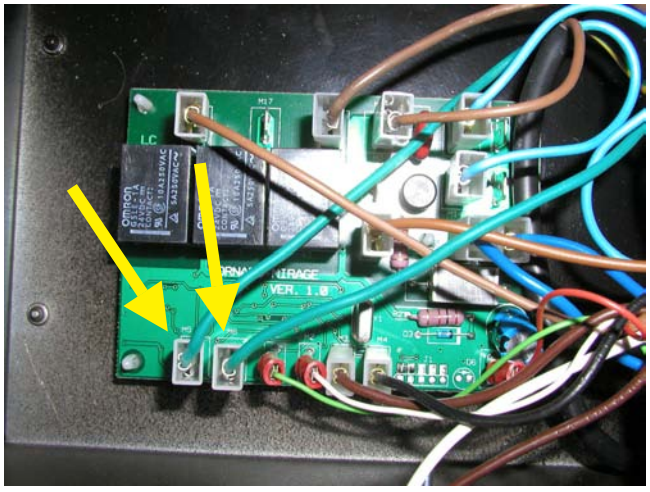
Ill. 50

It is possible to check the proper operation of the flame sensor simply using a multimeter.
Connect the multimeter terminals to the sensor leads and proceed as follows:

- Set the multimeter to measure resistance
- Expose the flame sensor to light.
- Under normal conditions, the tester should show ohmic resistance quickly decreasing as illumination increases.

To replace the flame sensor:

- Disconnect the flame sensor leads from the burner control unit (see wiring diagram).



Ill. 51

- Replace the faulty sensor.
- Reconnect, reassmble and check operation.

3.19 CHECKING/REPLACING THE OVERHEAT THERMOSTAT

- Remove the inspection cover and/or the upper shell.
- Check that the thermostat is properly fixed and connected.

To replace the thermostat:

- Disconnect the thermostat cables.
- Replace the thermostat.
- Reconnect and reassemble.

To reset the overheat thermostat:

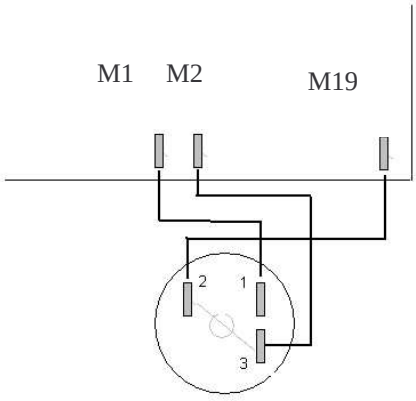
- Unplug the heater
- Remove the inspection door
- Push the reset button

Ill. 52

3.20 CHECKING OPERATION OF BURNER (FLAME) CONTROL UNIT

Perform the following tests to check operation of the burner control unit.
Check reset pushbutton/ lock-out warning lamp

- ➢ Ensure that the lock-out warning lamp is correctly connected (see diagram)



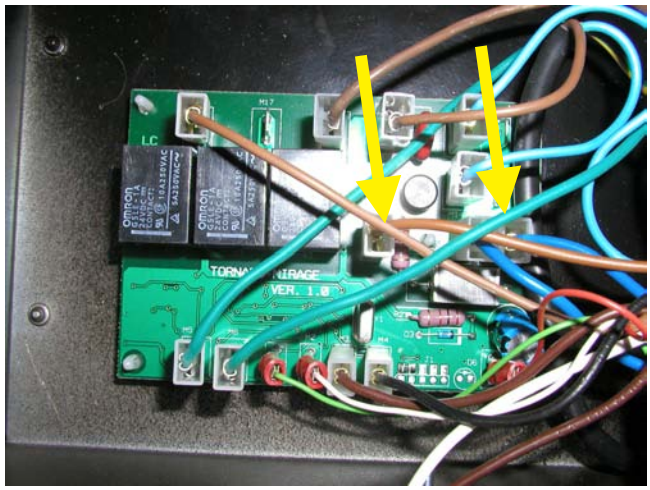
- Check that there is electrical continuity between the terminals 1 and 3 of the reset pushbutton.
- Check that there is a 18-20V voltage between the terminals M2 and M19 of the burner control unit when the unit is in lock out condition (the lamp is alight).

<u>Electrical continuity check</u>
Unplug the heater

- Turn switch to I (ON)
- Set the room thermostat in a operating (closed) position
- Check that the overheat thermostat is closed
- Check electrical continuity between terminals M3 and M4 of the electronic control unit (with all wires connected).

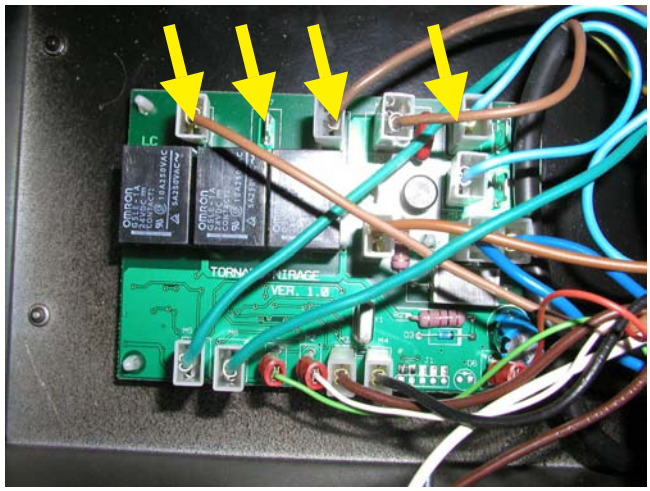
<u>Power supply to loads</u>
Plug the heater.

- Turn switch to I (ON)
- Set the room thermostat in a operating (closed) position
- Using a multimeter, check that the burner control unit is powered



Ill. 53

- Check voltage on the transformer, motor and solenoid valve terminals and that they are correctly energized according to the operational cycle.



Ill. 54

The voltage supply to components must match with the mains voltage.
Should this not occur, or should the components not be correctly energized according to the operational cycle, replace the flame control unit with a new one.

<u>Lock-out test</u>
Start the heater and wait that the ignition cycle is completed. (wait until the ignition spark stops).
Disconnect the flame sensor fast-on from terminal M5 on the burner control unit.

- The heater must immediately lock-out.
- The red warning lamp must light up.

- Reset must be possible only after at least 30 seconds.

4.1

SETTING CHART - INDIRECT-FIRED HEATERS (WITH FLUE)

	CHAMBER INLET	FAN	WHIRL (BAFFLE) DISC	FUEL PUMP	FUEL PRESSURE	BURNER NOZZLE	AIR LOCK OPENING	OVERHEAT THERMOSTAT
MIRAGE 37 H USA	# 8 holes 6 mm dia.	dia.=350mm 3 blades 18°	out. dia.=76mm in. dia.=27mm 10 blades	DANFOSS R3	12 bar	DANFOSS 0.65 60° H	3 mm lock position 1	170 °C (red markings)
MIRAGE 55 H USA	# 8 holes 6 mm dia.	dia.=350mm 3 blades 18°	out. dia.=76mm in. dia.=27mm 10 blades	DANFOSS R3	12 bar	DANFOSS 1.00 60° H	7 mm lock position 2	170 °C (red markings)
MIRAGE 85 H USA	# 8 holes 10 mm dia.	dia.=500mm 4 blades 33°	out. dia.=76mm in. dia.=22mm 10 blades	DANFOSS R5	12 bar	DELAVAN 1.50 80° W	14 mm lock position 3.5 - 4	170 °C (red markings)

SETTING CHART - DIRECT-FIRED HEATERS (WITHOUT FLUE)

	CHAMBER INLET	FAN	WHIRL (BAFFLE) DISC	FUEL PUMP	FUEL PRESSURE	BURNER NOZZLE	AIR LOCK OPENING	OVERHEAT THERMOSTAT
TORNADO 67 USA	# 8 holes dia. 6 mm	dia.=350mm 3 blades 18°	out. dia.=76mm in. dia.=27mm 10 blades	DANFOSS R3	12 bar	DANFOSS 1.25 60° H	4 mm lock position 1.5	100 °C (black markings)
TORNADO 115	# 8 holes dia. 10 mm	dia.=500mm 4 blades 33°	out. dia.=76mm in. dia.=27mm 10 blades	DANFOSS R5	12 bar	DELAVAN 2.25 80° W	13 mm lock position 3.5	100 °C (black markings)

Servicing Manual

TECHNICAL DATA SHEET FOR INDIRECT FIRED OIL HEATERS – 37 kW MODEL

Thermal Specifications

Maximum Thermal Power (Diesel Oil)		
Consumption	Kg/hr at 3°C (37F)	2,88
	U.S. gal/hr	0,90
Efficiency	%	**87,10**
Power Input	kcal/hr	31304
	kW	36,40
	BTU/hr	**125216**
Power Output	kcal/h	27266
	kW	31,70
	BTU/hr	**109063**
Fuel Pressure		
	12 bar	175 psi

Smoke Index		
		1,00
Air Lock Adjustment		
mm		3,0

Maximum Thermal Power (Kerosene)		
Consumption	Kg/hr	2,64
Efficiency	%	87,10
Power Input	kcal/hr	29106
	kW	33,84
	BTU/hr	116425
Power Output	kcal/hr	25352
	kW	29,48
	BTU/hr	101406
Fuel Pressure		
psi		12,00
Air Lock Adjustment		
mm		3,00

Airflow Specifications

Air Flow Rating		
m³/h	2000 m³/h	1180 ft³/min

Fan Diameter		
mm	350 mm	14 in
Blade #	3 sickle-shaped	
Pitch	18°	

Temperature Rise (Delta)		
at 20°C (68 F)	54°C	97 F

Noise Level	**at 1 m**	**at 2 m**
dB(A) average	77	75
with original hood		

Nozzle Type		
Manufacturer		DANFOSS
Type		60° H
Flow Rate	GPH	0,65

Air Ducting		
Hose Diameter		
	315 mm	12 in
Maximum Hose Lenght		
	8 m	25 ft

*oil gross heating value Kcal/kg	10869,44
*kerosene gross heating value Kcal/kg	11.025,08
according to standard prEN 13842:2002	

Electrical Specifications

Rated Voltage	
V/Hz	110/60

Rated Current	
A	7,0

Rated Power	
W	460

Motor Power	
W	430

Rotational Speed	
rpm	3400

Fuse	
A	15 slow-blow

Size Specifications

Weight		**Tank Capacity**	
70 kg	154 lb	51 liters	14 U.S. gal
Lenght		**Outlet Diameter**	
1188 mm	47 in	308 mm	12 in
Width		**Flue Diameter**	
620 mm	24 in	150 mm	6 in
Height			
790 mm	31 in		

Package Specifications

Lenght	1250 mm	**Height**	830 mm
Width	530 mm	**Weight**	72 Kg

TECHNICAL DATA SHEET FOR INDIRECT FIRED OIL HEATERS – 55 kW MODEL

Thermal Specifications

Maximum Thermal Power (Diesel Oil)		
Consumption	Kg/hr at 3°C (37F)	4,16
	U.S. gal/hr	1,29
Efficiency	%	**87,10**
Power Input	kcal/hr	45217
	kW	52,58
	BTU/hr	**180868**
Power Output	kcal/h	39384
	kW	45,80
	BTU/hr	**157536**
Fuel Pressure		
	12 bar	175 psi

Smoke Index		
		1,00
Air Lock Adjustment		
mm		4,0

Maximum Thermal Power (Kerosene)		
Consumption	Kg/hr	3,81
Efficiency	%	87,10
Power Input	kcal/hr	42006
	kW	48,84
	BTU/hr	168022
Power Output	kcal/hr	36587
	kW	42,54
	BTU/hr	146347
Fuel Pressure		
psi		12,00
Air Lock Adjustment		
mm		7,00

Airflow Specifications

Air Flow Rating		
m³/h	2500 m³/h	1475 ft³/min

Fan		
mm	350 mm	14 in
Blade #	3 sickle-shaped	
Pitch	18°	

Temperature Rise (Delta)		
at 20°C (68 F)	73°C	131 F

Noise Level	**at 1 m**	**at 2 m**
dB(A) average	75	73
with original hood		

Nozzle Type		
Manufacturer		DANFOSS
Type		60° H
Flow Rate	GPH	1,00

Air Ducting		
Hose Diameter		
	315 mm	12 in
Maximum Hose Lenght		
	8 m	25 ft

*oil gross heating value Kcal/kg	10869,44
*kerosene gross heating value Kcal/kg	11.025,08
according to standard prEN 13842:2002	

Electrical Specifications

Rated Voltage	
V/Hz	110/60

Rated Current	
A	7,0

Rated Power	
W	460

Motor Power	
W	430

Rotational Speed	
rpm	3400

Fuse	
A	15 slow-blow

Size Specifications

Weight		**Tank Capacity**	
76 kg	167 lb	51 liters	14 U.S. gal
Lenght		**Outlet Diameter**	
1405 mm	55 in	308 mm	12 in
Width		**Flue Diameter**	
620 mm	24 in	150 mm	6 in
Height			
790 mm	31 in		

Package Specifications

Lenght	1470 mm	**Height**	830 mm
Width	530 mm	**Weight**	80 Kg

TECHNICAL DATA SHEET FOR INDIRECT FIRED OIL HEATERS – 85 kW MODEL

Thermal Specifications

Maximum Thermal Power (Diesel Oil)		
Consumption	Kg/hr at 3°C (37F)	6,64
	U.S. gal/hr	2,06
Efficiency	%	**88,50**
Power Input	kcal/hr	72173
	kW	83,92
	BTU/hr	**288692**
Power Output	kcal/hr	63873
	kW	74,27
	BTU/hr	**255493**
Fuel Pressure		
	12 bar	175 psi

Smoke Index		
		1,00
Air Lock Adjustment		
mm		14,0

Maximum Thermal Power (Kerosene)		
Consumption	Kg/hr	4,86
Efficiency	%	88,50
Power Input	kcal/hr	53582
	kW	62,30
	BTU/hr	214328
Power Output	kcal/hr	47420
	kW	55,14
	BTU/hr	189680
Fuel Pressure		
psi		12,00
Air Lock Adjustment		
mm		14,00

Airflow Specifications

Air Flow Rating		
m³/h	4500 m³/h	2650 ft³/min

Fan		
Diameter	500 mm	20 in
Blade #	3 sickle-shaped	
Pitch	28°	

Temperature Rise (Delta)		
at 20°C (68 F)	72°C	130 F

Noise Level	**at 1 m**	**at 2 m**
dB(A) average	73	71
with original hood		

Nozzle Type		
Manufacturer		DELAVAN
Type		80° W
Flow Rate	GPH	1,50

Air Ducting		
Hose Diameter		
	450 mm	18 in
Maximum Hose Lenght		
	16 m	52 ft

*oil gross heating value Kcal/kg	10869,44
*kerosene gross heating value Kcal/kg	11.025,08
according to standard prEN 13842:2002	

Electrical Specifications

Rated Voltage	
V/Hz	110/60

Rated Current	
A	12,0

Rated Power	
W	800

Motor Power	
W	750

Rotational Speed	
rpm	1700

Fuse	
A	20 slow-blow

Size Specifications

Weight		**Tank Capacity**	
121 kg	267 lb	100 liters	26 U.S. gal
Lenght		**Outlet Diameter**	
1680 mm	66 in	443 mm	17 in
Width		**Flue Diameter**	
690 mm	27 in	150 mm	6 in
Height			
938 mm	37 in		

Package Specifications

Lenght	1760 mm	**Height**	965 mm
Width	650 mm	**Weight**	124 Kg

TECHNICAL DATA SHEET FOR DIRECT FIRED OIL HEATERS – 67 kW MODEL

Thermal Specifications

Maximum Thermal Power (Diesel Oil)		
Consumption	Kg/hr at 3°C (37F)	5,22
	U.S. gal/hr	1,62
Efficiency	%	
Power Input	kcal/hr	56739
	kW	65,98
	BTU/hr	**226954**
Power Output	kcal/hr	
	kW	
	BTU/hr	
Fuel Pressure		
	12 bar	175 psi

Smoke Index		
		1,00
Air Lock Adjustment		
mm		4,0

Maximum Thermal Power (Kerosene)		
Consumption	Kg/hr	
Efficiency	%	
Power Input	kcal/hr	0,00
	kW	0,00
	BTU/hr	0,00
Power Output	kcal/hr	0,00
	kW	0,00
	BTU/hr	0,00
Fuel Pressure		
psi		0,00
Air Lock Adjustment		
mm		0,00

Airflow Specifications

Air Flow Rating		
	2800m³/h	1650 ft³/min

Fan		
Diameter	350 mm	14 in
Blade #	3 sickle-shaped	
Pitch	18°	

Temperature Rise (Delta)		
at 20°C (68 F)		

Noise Level	**at 1 m**	**at 2 m**
dB(A) average	75	73

Nozzle Type		
Manufacturer		DELAVAN
Type		60° S
Flow Rate	GPH	1,25

Air Ducting		
Hose Diameter		
Maximum Hose Lenght		

*oil gross heating value Kcal/kg	10869,44
*kerosene gross heating value Kcal/kg	11.025,08
according to standard prEN 13842:2002	

Electrical Specifications

Rated Voltage	
V/Hz	110/60

Rated Current	
A	6,0

Rated Power	
W	460

Motor Power	
W	430

Rotational Speed	
rpm	3400

Fuse	
A	10 slow-blow

Size Specifications

Weight		**Tank Capacity**	
65 kg	143 lb	51 liters	14 U.S. gal
Lenght		**Outlet Diameter**	
1405 mm	55 in	308 mm	12 in
Width		**Flue Diameter**	
620 mm	24 in		
Height			
750 mm	30 in		

Package Specifications

Lenght	1470 mm	**Height**	830 mm
Width	530 mm	**Weight**	76 kg

Servicing Manual

TECHNICAL DATA SHEET FOR INDIRECT FIRED OIL HEATERS – 115 kW MODEL

Thermal Specifications

Maximum Thermal Power (Diesel Oil)		
Consumption	Kg/hr at 3°C (37F)	9,12
	U.S. gal/hr	2,83
Efficiency	%	
Power Input	kcal/hr	99129
	kW	115,27
	BTU/hr	**396517**
Power Output	kcal/h	0
	kW	0,00
	BTU/hr	**0**
Fuel Pressure		
	12 bar	175 psi

Smoke Index		
		1,00
Air Lock Adjustment		
mm		13,0

Maximum Thermal Power (Kerosene)		
Consumption	Kg/hr	
Efficiency	%	
Power Input	kcal/hr	0,00
	kW	0,00
	BTU/hr	0,00
Power Output	kcal/hr	0,00
	kW	0,00
	BTU/hr	0,00
Fuel Pressure		
psi		0,00
Air Lock Adjustment		
mm		0,00

Airflow Specifications

Air Flow Rating		
m³/h	4800 m³/h	2850 ft³/min

Fan		
mm	500 mm	14 in
Blade #	3 sickle-shaped	
Pitch	28°	

Temperature Rise (Delta)		
at 20°C (68 F)		

Noise Level	**at 1 m**	**at 2 m**
dB(A) average	75	73

Nozzle Type		
Manufacturer		DANFOSS
Type		80° W
Flow Rate	GPH	2,25

Air Ducting		
Hose Diameter		
Maximum Hose Lenght		

*oil gross heating value Kcal/kg	10869,44
*kerosene gross heating value Kcal/kg	11.025,08
according to standard prEN 13842:2002	

Electrical Specifications

Rated Voltage	
V/Hz	110/60

Rated Current	
A	12,0

Rated Power	
W	800

Motor Power	
W	750

Rotational Speed	
rpm	1760

Fuse	
A	20 slow-blow

Size Specifications

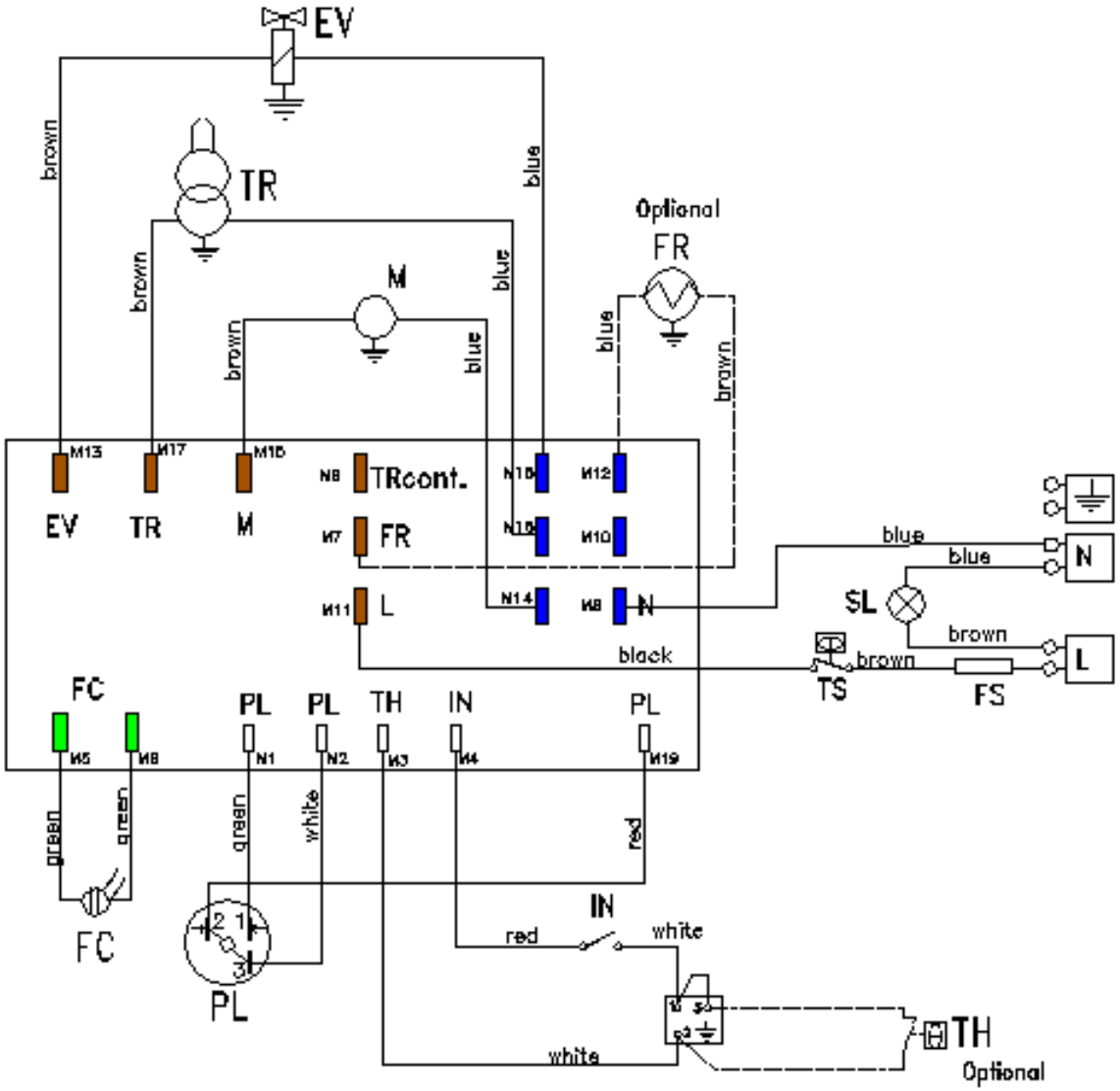
Weight		**Tank Capacity**	
101 kg	222 lb	100 liters	14 U.S. gal
Lenght		**Outlet Diameter**	
1680 mm	66 in	308 mm	12 in
Width		**Flue Diameter**	
690 mm	25 in	150 mm	6 in
Height			
898 mm	35 in		

Package Specifications

Lenght	1760 mm	**Height**	965 mm
Width	650 mm	**Weight**	116 Kg

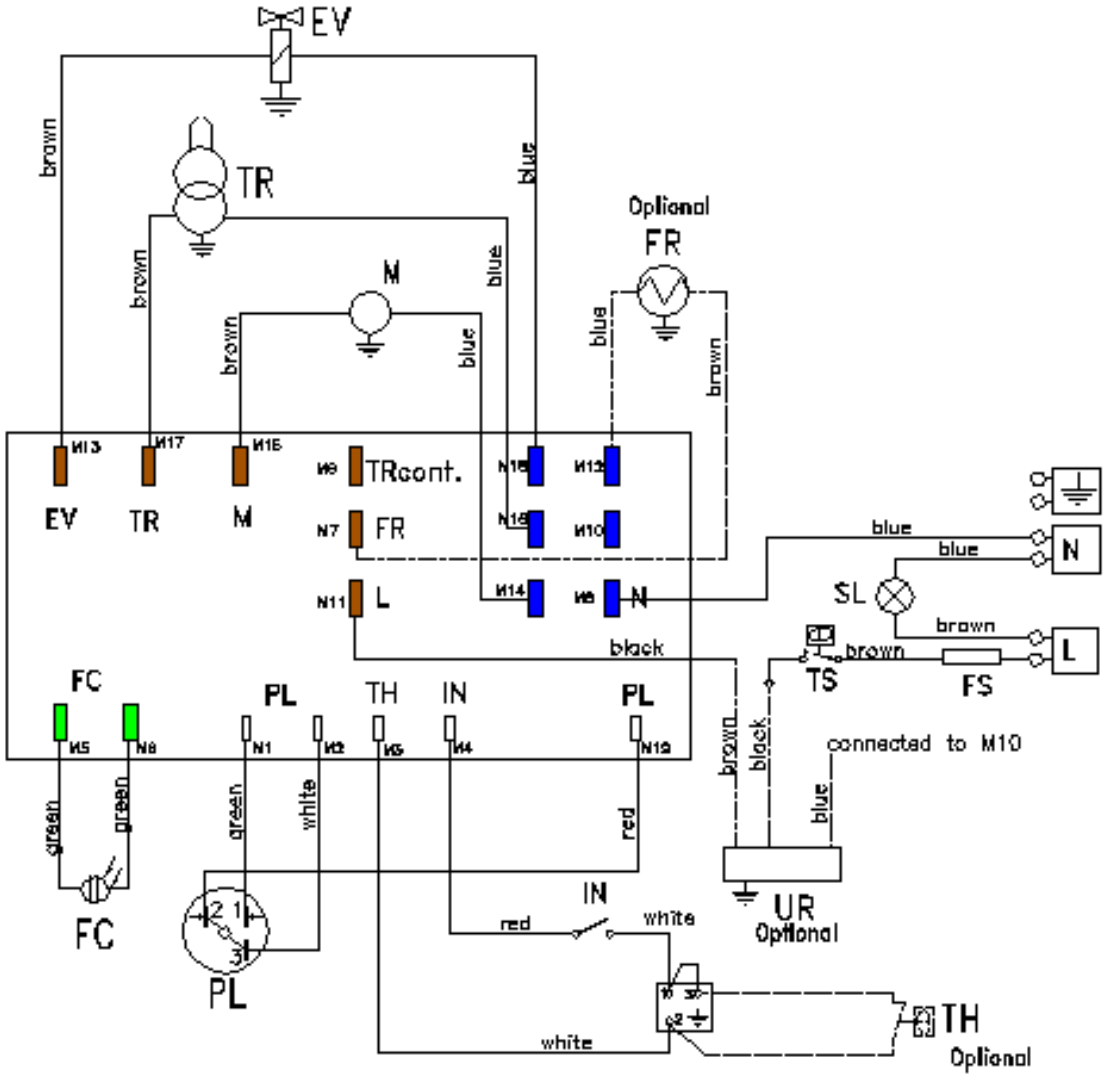
4.2 WIRING DIAGRAM

Basic version



EV	**Fuel solenoid valve**
TR	**High voltage transformer**
M	**Motor**
SL	**Warning lamp**
TS	**Overheat thermostat**
FS	**Fuse**
FC	**Flame sensor**
PL	**Reset pushbutton**
IN	**Switch**
TH	**Remote (room) thermostat**
FR	**Heated filter (optional)**

Version with heated filter and nozzle pre-heater



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PL	**Reset pushbutton**
IN	**Switch**
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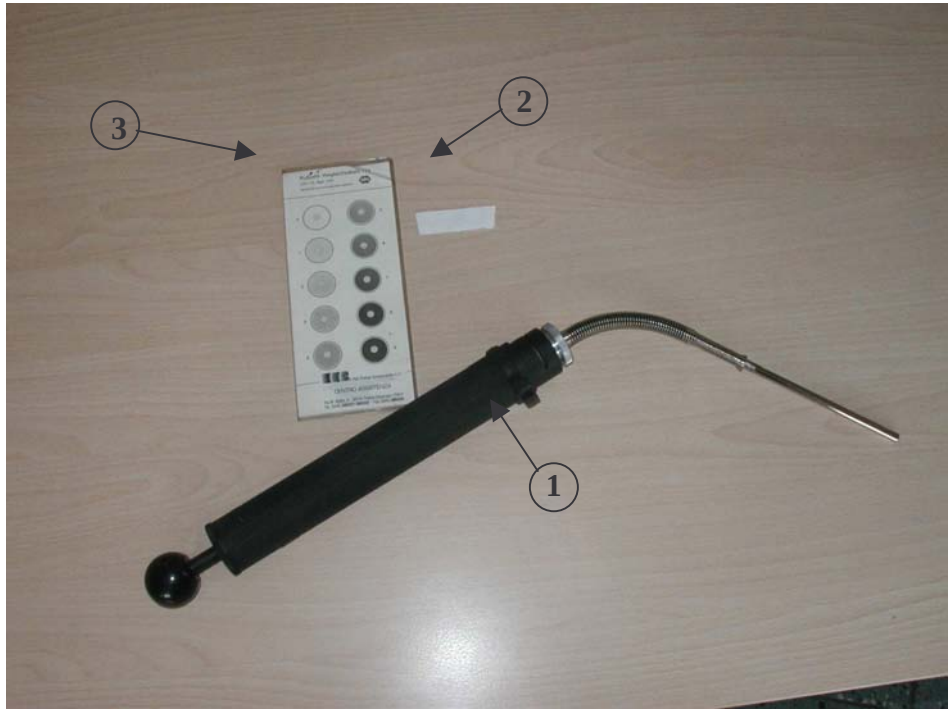
FR	**Heated filter (optional)**

4.3 SPECIAL SERVICING TOOLS

1. **Smokemeter**
2. **Strips for smokemeter**
3. **Shell-Bacharach reference scale**
4. **Pressure gauge for oil pressure measurement**
5. **Electrical multimeter**



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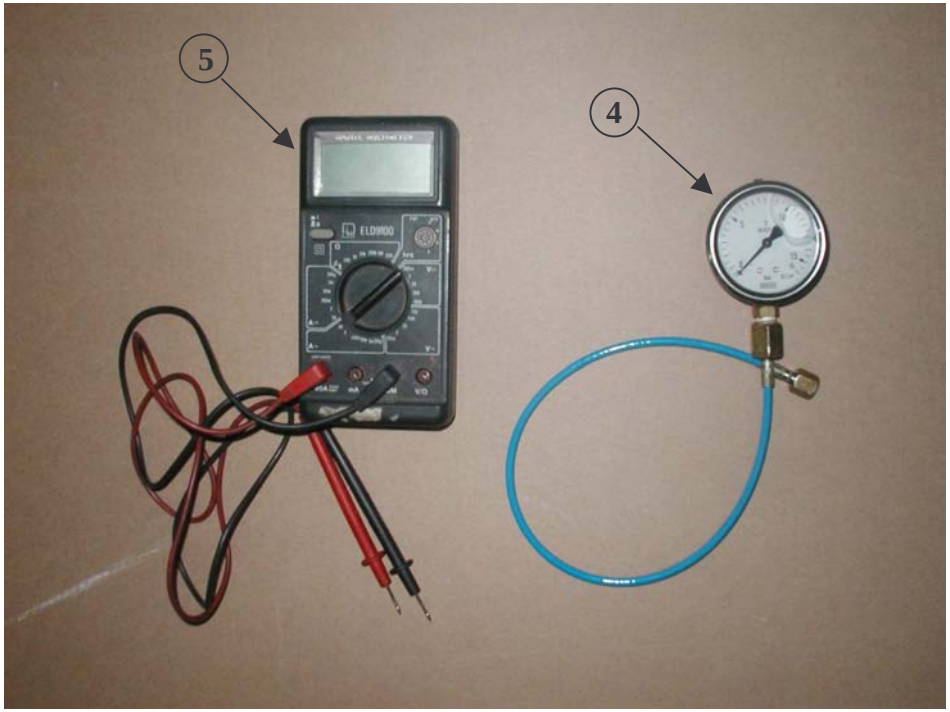

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