Integrated Professional Cleaning

IPC
BY TENNANT COMPANY

Service Manual

Rev.1.0 Jan 2025

PW-H21 I1408P M VALUE
PW-H21 I1611P T VALUE

PW-H21 outer layout

Boiler chimney

Lance holder

Control Panel

Front door

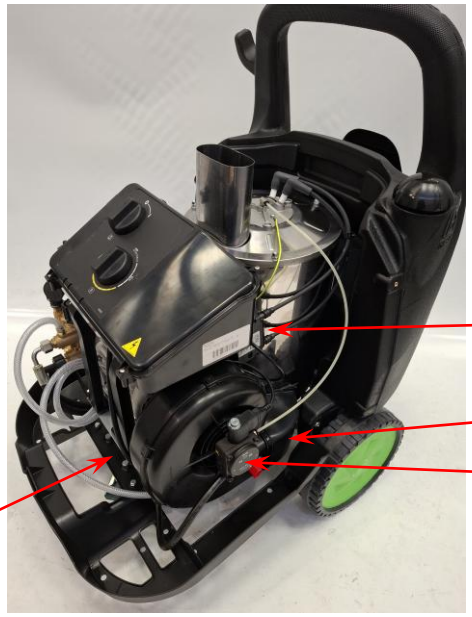
Standard equipment

Data plate

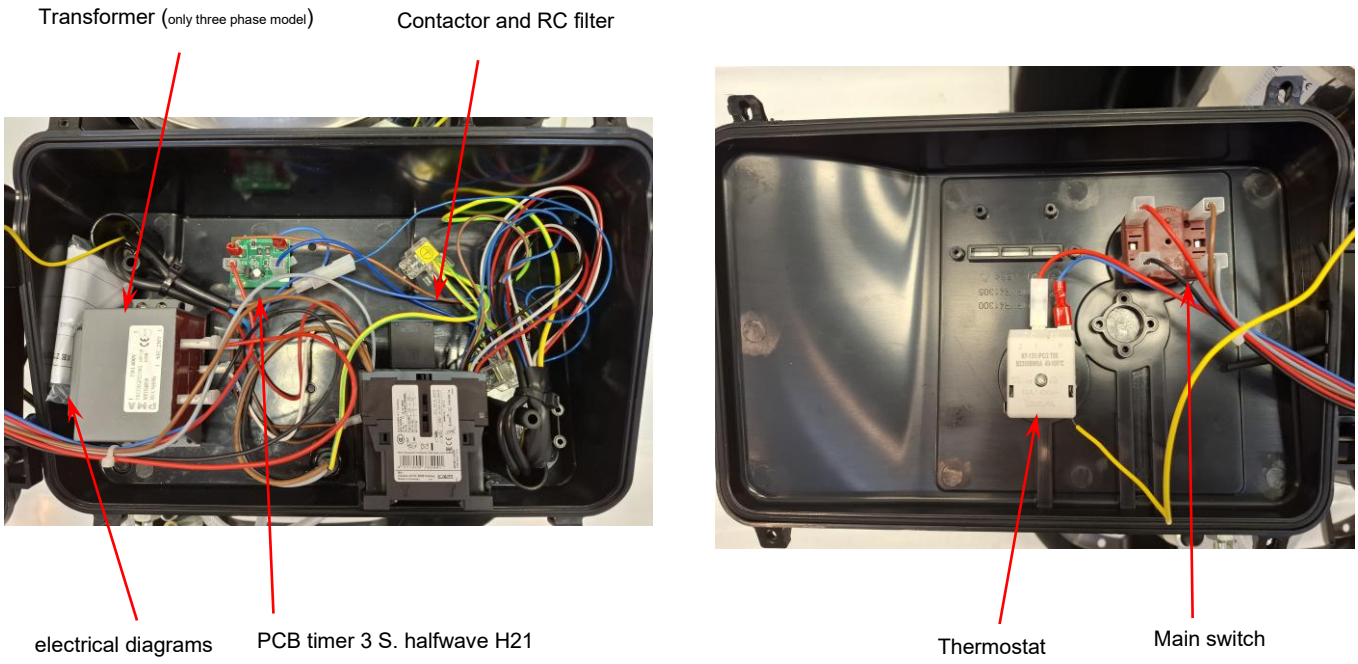
High pressure outlet

Water inlet

PW-H21 inner layout



PW- H21 (value model)
electric box components layout



Service Manual

Ip Cleaning S.r.l.
Viale Treviso, 63 – 30026 Summaga di Portogruaro – VENICE – ITALY
Tel. +39 0421 205511 (r.a.) – Fax +39 0421 204227
Internet address: www.ipcworldwide.com
e-mail address: info@ipcworldwide.com

INDEX

Topics

1. The machine doesn't starts

1) ***TROUBLE:*** Rotating the main switch "0 - I - Hot" (A) the high-pressure cleaner doesn't start or suddenly stops after a while.

Pic. 1

CAUSES:

1a No electrical connection.
1b Electric motor overload, thermal sensor tripping or burnt fuses.
1c Main switch not working.
1d Pressure switch at the unloader valve not working

REMEDIES:

1a Check the power supply voltage using a "multimeter". The machine power supply characteristics are indicated on the machine data plate placed on the rear of its chassis. For single-phase models, the allowed voltage tolerance is +/- 5%.

If the voltage is over or lower than the above-mentioned tolerance, the machine electric components may become damaged.
Pay maximum attention while checking electric components **danger of electric shocks**.

1b Pay maximum attention: **danger of electric shocks.**
Disconnect the machine from the power supply before opening the electric box, hence:
- check using a multimeter, the conductivity of the main switch contacts, rotate the switch knob to position "I" and in case of problems, replace the switch with a new component.
To open the electric box, proceed as following described:

Opening:

1. Remove the screws that hold the machine cover

2./3. Unscrew the screws that hold the electric box cover and open the electric box cover

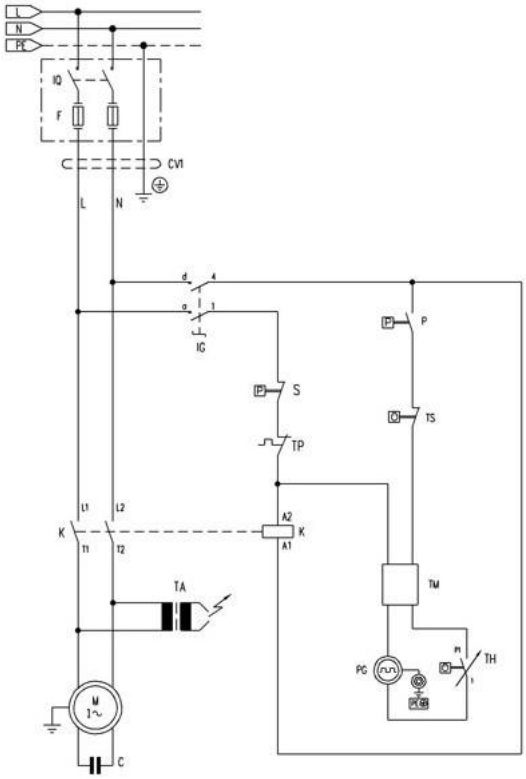
4. Check the main switch contacts continuity using a multimeter.

If the electric motor overload protection intervenes, means that the electric motor is overloaded, and its windings temperature is over 155°C. The thermal sensors are built-into the motor winding and they self-reset when the windings cool down and accordingly the electric motor restarts.

Check the A consumption of the electric motor that should not be over than the Amperage indicated to the machine data plate.
If the Amperage is much higher than normal, is necessary to discover the root cause of the electric motor overload in order to restore the correct Amperage.
Accordingly repair or replace the part failed and cause of the electric motor overload.

Electric diagrams

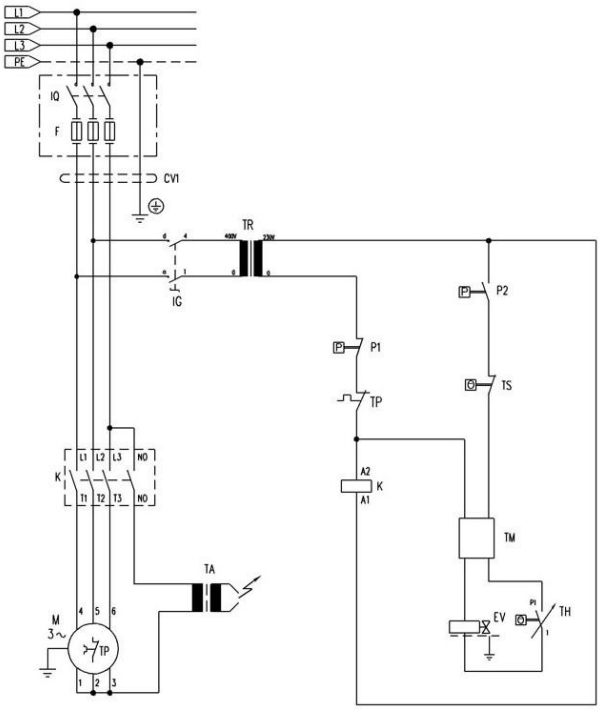
PW-H21 I1408P M VALUE 230/50hz



On which:

- IG = Main switch
- M = Electric motor
- K = Contactor
- TA = High voltage ignition transformer
- S = Total stop switch (total stop system)
- P = Burner control
- TM = Timer 3”
- PG = Solenoid fuel pump.
- TP = thermal overload protector
- TH = adjustable thermostat
- TS = Safety thermostat
- C = capacitor

PW-H21 I1611P T VALUE 400V/50hz



On which :

- IG = Main switch
- M = Electric motor
- K = Contactor
- TA = High voltage ignition transformer
- P_1 = Total stop switch (total stop system)
- P_2 = Burner control
- TM = Timer 3”
- EV = Solenoid of fuel pump.
- TP = thermal overload protector
- TH = adjustable thermostat
- TS = Safety thermostat
- TR = Trasformer

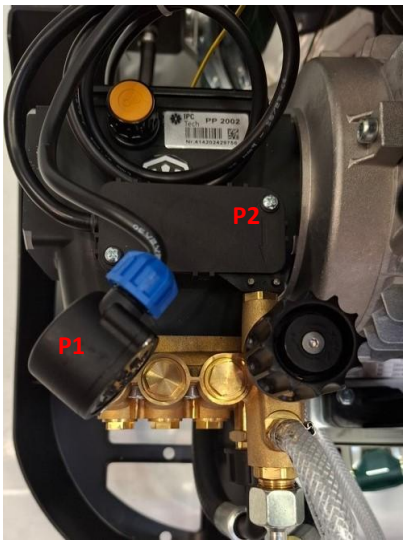
In order to check the electric motor Amperage, set the machine pressure at maximum, switch on the machine and discharge the high-pressure water from the lance, hence check using a “multimeter” the Amperage following the above instruction:

Check the Amperage with a A clamp meter on the power wires of the contactor.

Compare the measurement with the A on electric machine data plate; the data plate is visible from the window as shown in the picture.

We recommend checking the proper functioning of safety electric components, at least once a year.

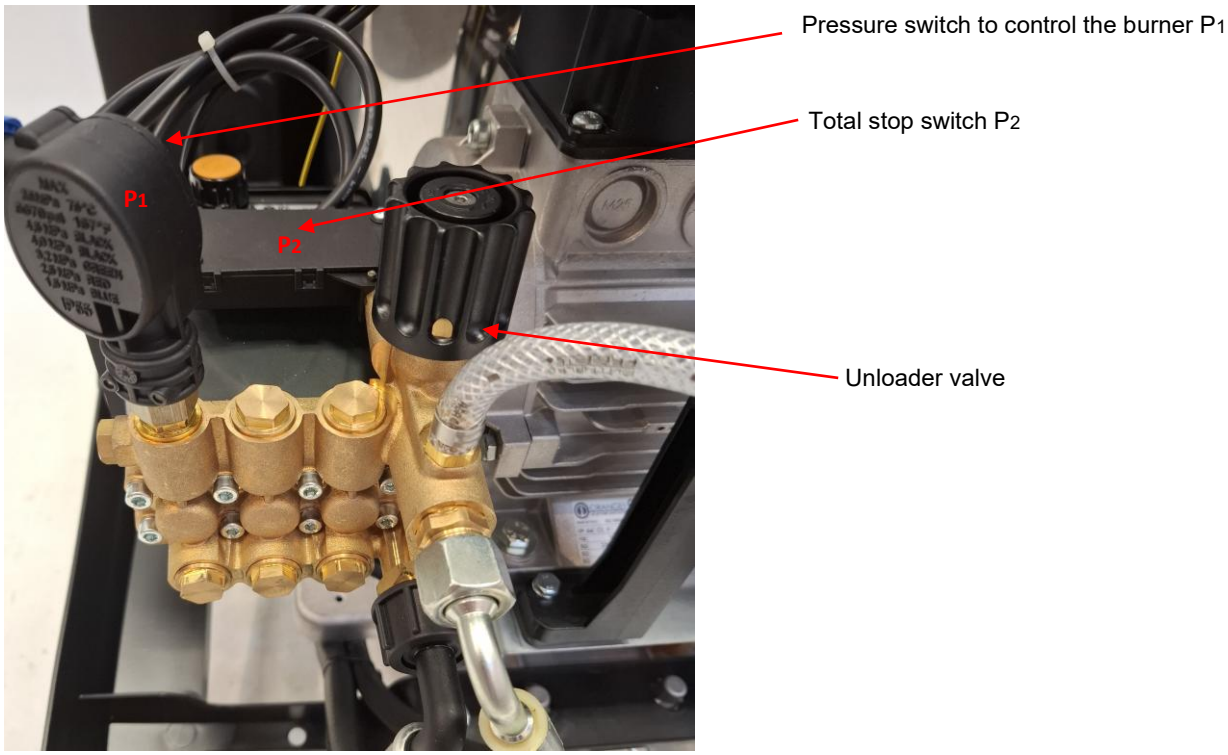
1c Check the continuity of switch (P_2) its contacts should be N.C. .



The total stop switch

1. Starting phase

Here following the functioning diagram for this machine model:



The switch P2 is ON (contact closed); in this situation, when the main switch is turned to “I” position, the machine starts.

2. High pressure phase

When pressure into the pump increases, the switch P2 remains closed (on) this allows the machine functioning.

3. Stopping phase

When the spray gun trigger is released, the lance stops to spray water, the switch P2 will be open (off) and accordingly the electric motor is not power supplied and stops in “total stop mode”.

The machine outlet hydraulic circuit, is kept under pressure by the spray gun and the check valve, placed at the unloader valve outlet.

The machine is now in “stand-by”, until the spray gun trigger is reactivated in order to discharge the outlet pressure and make switch P_2 to change from opened (OFF) to closed (ON); hence the machine restarts from the phase “1” (starting phase).

In case all the above-mentioned checks don’t evidence any functioning mistake, the failure is probably caused by the electric motor failure or contactor. Check and if necessary, replace them with new ones.

2. No water jet at the lance nozzle

2) ***TROUBLE:*** No water jet sprayed from the lance nozzle.

CAUSES: **2a** Bad or missing water feeding connection
2b Inlet water filter clogged
2c Air intake from the water feeding circuit
2d Pump head valves ceased
2e High pressure nozzle clogged

REMEDIES:

2a Check the supply water flow (l/min), in order to ensure that supply water available is sufficiently high compared with the machine characteristics.
The supply water flow (l/min) must exceed at least 10%, then the water flow characteristics declared in the machine data plate.
Check the fittings to the water inlet circuit and particularly ensure they are not damaged or not properly sealed, causing flow obstruction or air intakes.

2b Check and clean the water supply inlet filter and if necessary, replace it.

Check the filter at the machine water inlet fitting.

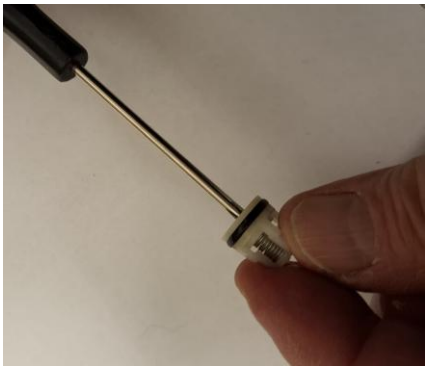
We recommend to check the water filter every 50 hours (or every week)

2c Check the water circuit that connects the water tank to the high pressure pump inlet, particularly check that fittings are properly tightened and are not leaking water.
The pressure of the feeding water, will put in evidence any area not properly sealed by leaking water; in the case proceed with their repair.

2d Check the inlet and outlet valves placed into the pump head; if the valves are sticky, unstick the valve from its seat manually pressing gently the valve disk until released. If the valves are dirty, disassemble them and clean.

Unscrew the inlet and outlet valve caps

Strip out the valves.



Unstuck the valve from its seat pressing gently with a pin.

Reassemble the caps using sealing glue type Loctite 542.

We recommend the replacement of inlet and outlet valves every 500 hours or one a year.

2e Clean the high pressure nozzle and if necessary, replace it with a new genuine part. Check the spare part book in order to identify the nozzle size.

Replacement and cleaning of the high pressure nozzle

We recommend the high pressure nozzle replacement every 200 hours or any time the machine working pressure become 20% lower than rated pressure.

3. No pressure to the lance

3) ***TROUBLE:*** The high-pressure pump rotates but doesn't achieve the rated pressure or the pressure is not stable and fluctuates.

CAUSES:
3a Defective water feeding connection
3b Inlet water filter clogged
3c Air intake from the water feeding circuit
3d Pump head valves ceased or worn
3e High pressure nozzle worn or deformed/or clogged
3f Seat of unloader valve damaged
3g Pump gaskets worn or water leaks from the pump head

REMEDIES:

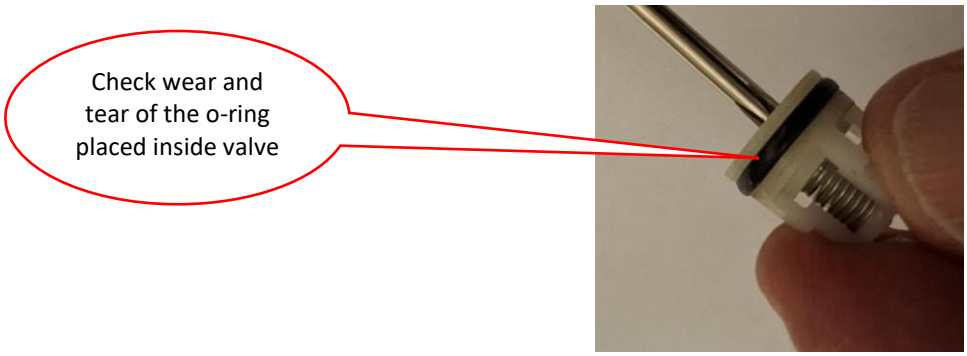
3a Check the feeding water flow (l/min), in order to ensure that feeding water available is sufficiently high compared with the machine characteristics.
The feeding water flow (l/min) must exceed at least 10%, then the water flow characteristics declared in the machine data plate.
Check the fittings to the water inlet circuit and particularly ensure they are not damaged or not properly sealed, causing flow obstruction or air intakes.

3b Check and clean the water inlet filters and if necessary, replace them **(see 2b)**.

We recommend to check the water filter every 50 hours (or every week)

3c Check the water circuit that connects the machine inlet, particularly check that fittings are properly tightened and are not leaking water.
The pressure of the feeding water will highlight any areas that are not properly sealed and are leaking. In this case, proceed with their repair.

3d Check the inlet and outlet valves placed into the pump head; if the valves are stuck, unstick the valve from its seat manually pressing gently the valve disk until released. If the valves are dirty, disassemble them and clean.
If the valves are worn or deformed, replace them **(see 2d)**.



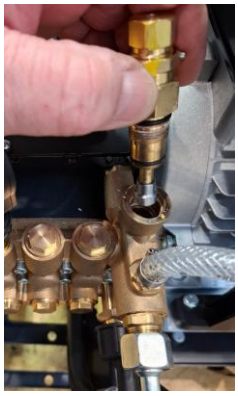
We recommend the replacement of inlet and outlet valves every 500 hours or one a year.

3e Replace the high-pressure nozzle with a new genuine part.

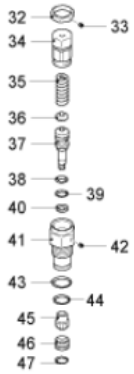
We recommend the high pressure nozzle replacement every 200 hours or any time the machine working pressure become 20% lower than rated pressure.

3f Repair the unloader valve (bypass valve) by replacing its cartridge that is part of the dedicated repairing kit.

Remove the knob by loosening its fixing screw

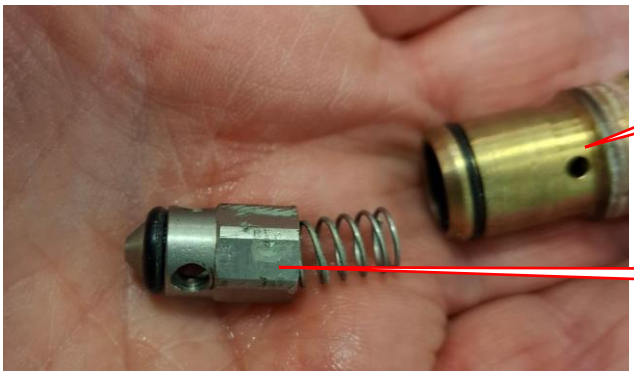


Unscrew the complete unloader valve piston and remove it from the valve housing also its seat.



Replace the unloader valve by genuine spare parts. See its reference on spare parts book available on IPC business area

Unscrew the high-pressure hose and unscrew the outlet fitting to strip out the check valve.

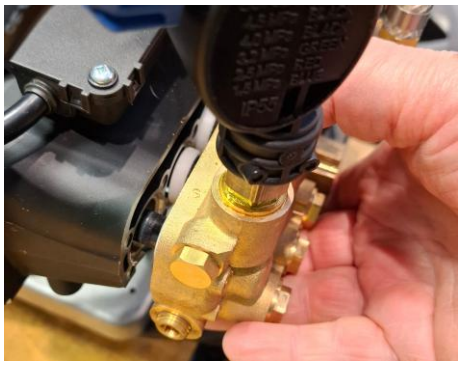


The check valve failures, causes pressure leaks or the unloader valve not functioning.

After replacing the valve kit, it will be necessary to replace the lance nozzle.

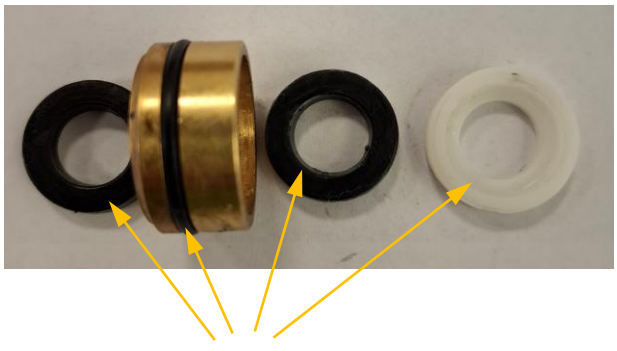
3g Replace the high-pressure pump gaskets kit and ensure that the pistons are not scraped. If pistons are scraped, replace them following the instructions described in the paragraph **8c**.

Unscrew the screws that hold the pump head

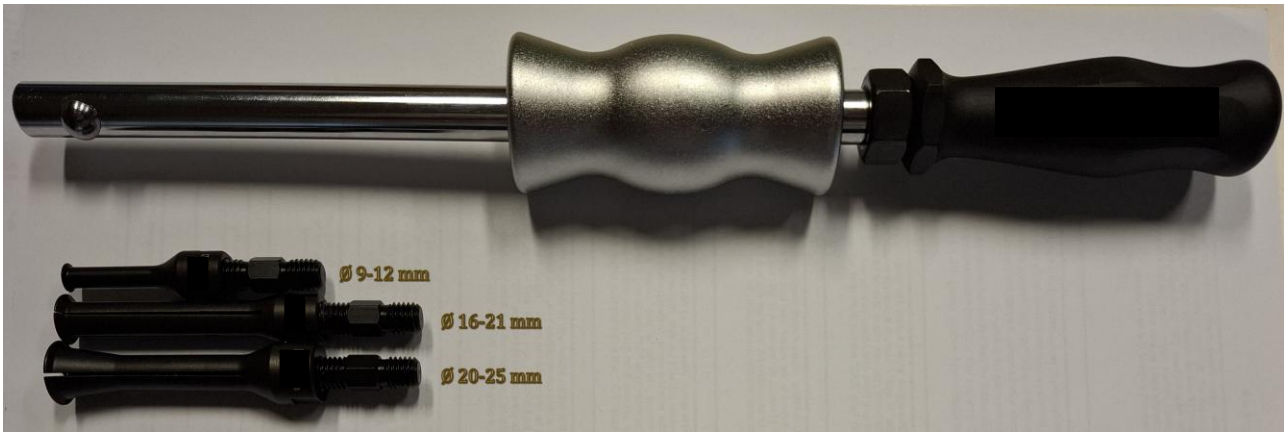


Pull out the pump head

Remove the pump gasket kit using the dedicated puller



Gaskets that may wear and tear.



AZMC40034 complete set

Strip out the pump gasket packages using the proper extractor according to piston diameters

4. The boiler doesn't ignite

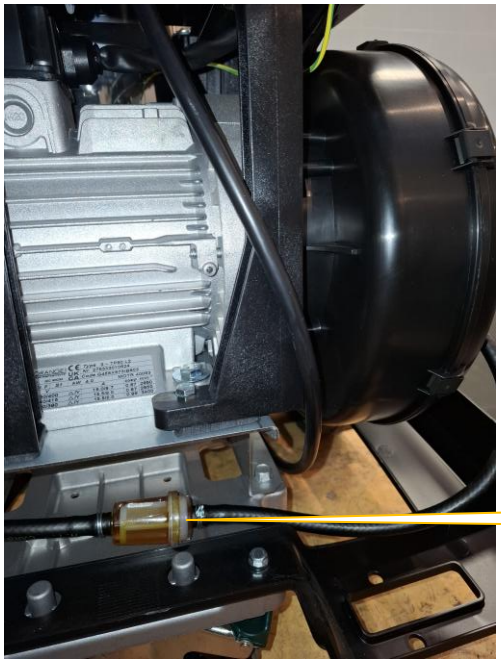
4) ***TROUBLE:*** Switching on the burner by setting the switch at the boiler on, but the burner doesn't ignite.

CAUSES: **4a** Missing fuel
4b Suction pipe and/or, fuel filers clogged
4c Fuel pump faulty
4d Fuel solenoid not powered or defective or damaged
4e Fuel nozzle clogged or spraying irregularly
4f High voltage ignition transformer not functioning
4g Sparking plugs are dirt or worn

REMEDIES:

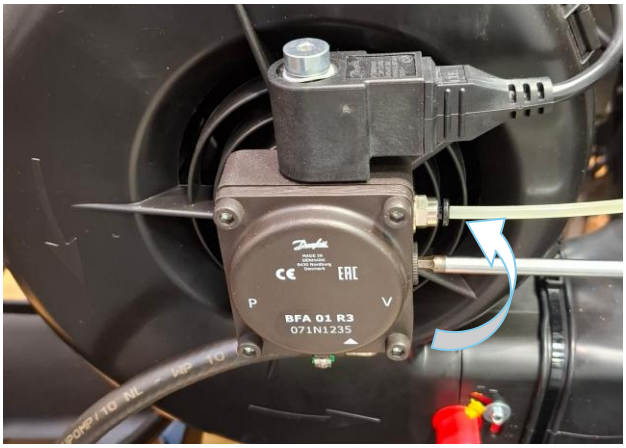
4a Check the fuel level inside of the fuel tank, if it is empty, refill the tank with fuel till max. level.

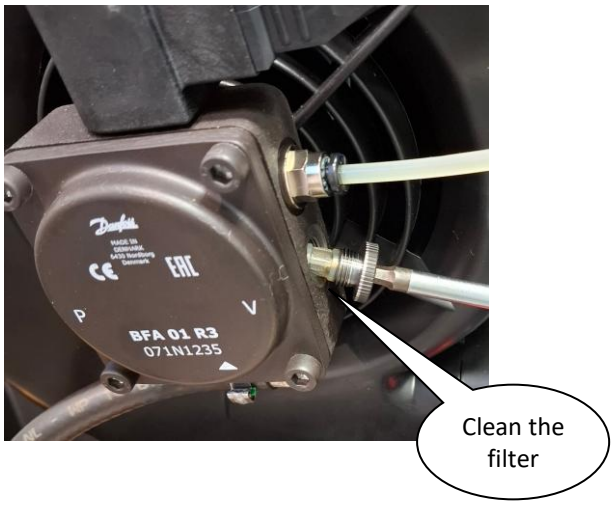
4b Check if fuel flows into the fuel circuit, check and remove any possible obstruction to the suction pipe.



Check the fuel cartridge filter, if it is dark / clogged replace it.

Check and clean the fuel filter inside of the fuel pump.





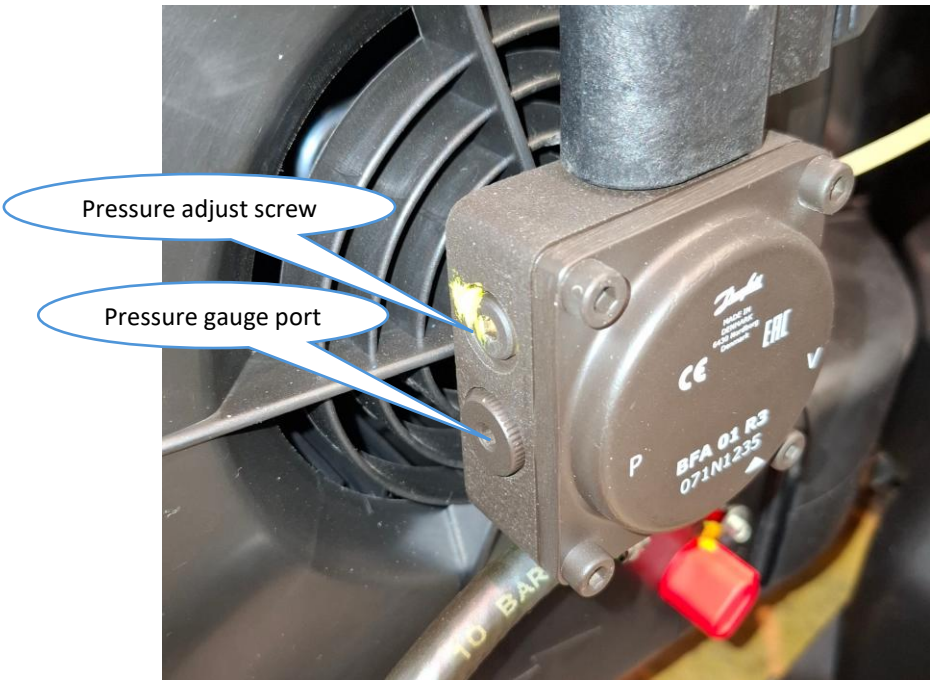
We recommend to check the fuel filter every 100 hours

4c Check with a pressure gauge (p/n **AZMC27323**) the fuel pump setting pressure that should be between 9,5 - 10bar.

AZMC27323

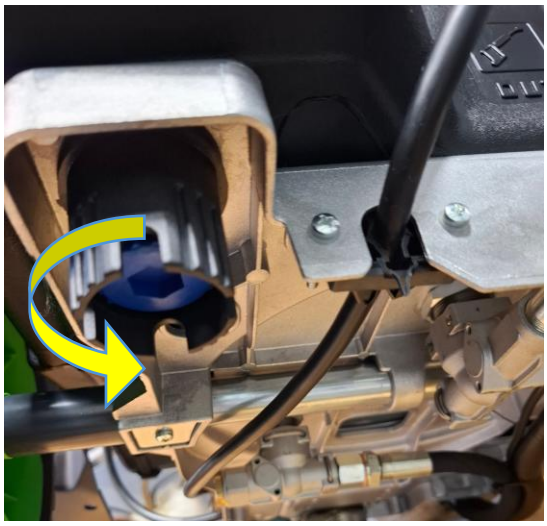
HOT WATER CLEANERS

FUEL PRESSURE GAUGE KIT



If after all the above-mentioned checks, still missing the pressure to the fuel circuit, replace the complete fuel pump, hence adjust its operating pressure that should be 10 bar.

We recommend cleaning the fuel tank by opening the tank drain caps and the fuel replacement.



Tank drain caps placed
under the machine chassis.

We recommend to check and clean the fuel pump and the fuel tank every 200 hours.

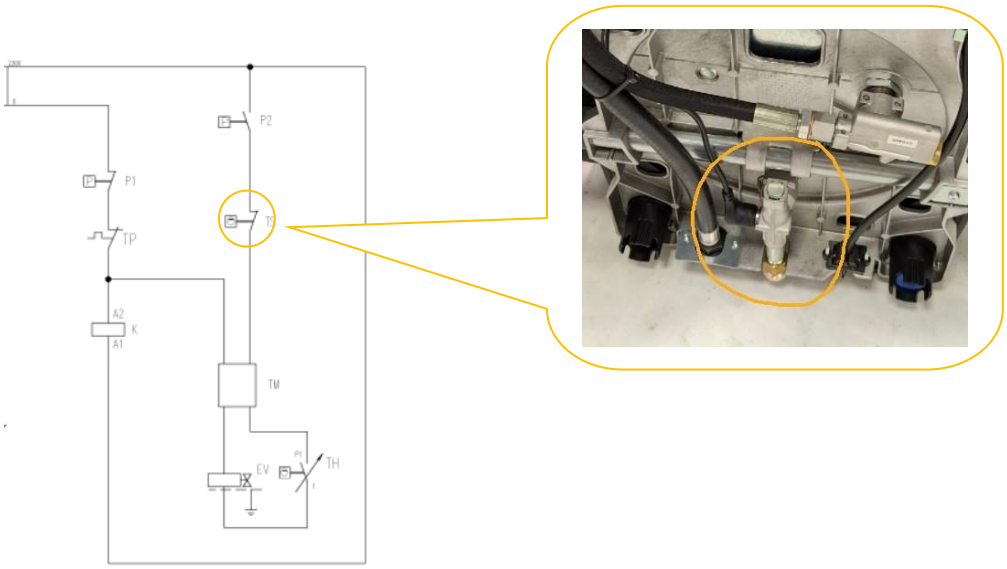
4d Check first the voltage to the fuel solenoid using a multimeter, the voltage to EV, if no voltage, check.

- Check the proper functioning of the pressure-switch P_2 placed on the high pressure pump head. Check if the pressure-switch piston slides regularly (switch should be ON when under pressure and OFF during by-pass phase), then check if the switch inside of the pressure-switch functions correctly. If not working properly replace the whole pressure-switch.

Check the voltage to the fuel solenoid

Check the pressure switch

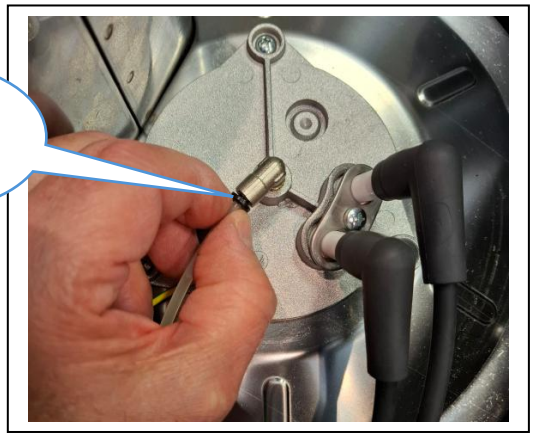
- Check the continuity of the contact of the thermostat (TS). If the contact is opened, replace the thermostat with a new one.

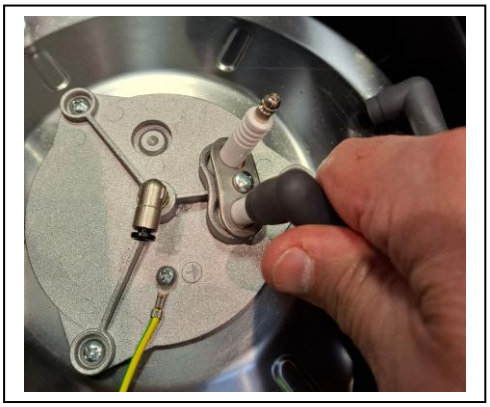


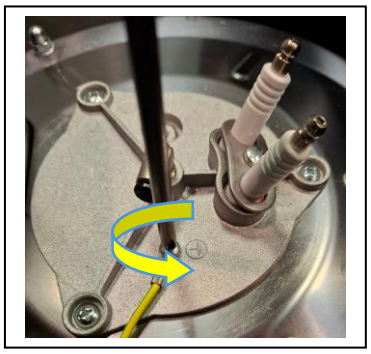
If all the above-mentioned component are functioning properly, replace the fuel solenoid “EV”.

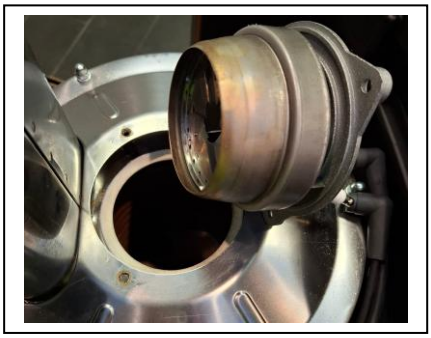
4e Replace the burner nozzle with a brand new nozzle:

Disassembling instruction for boiler PW H21.

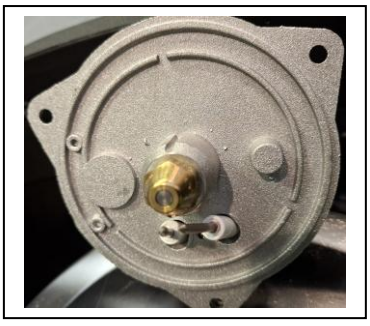


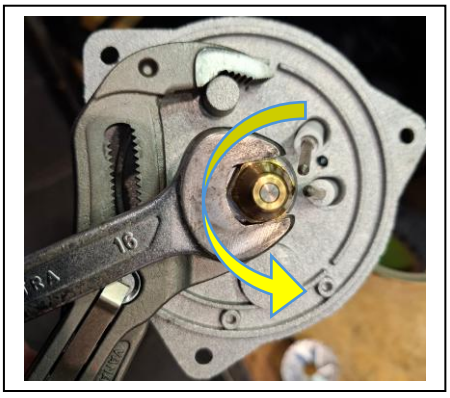






Check the status of boiler basket. In case replace it

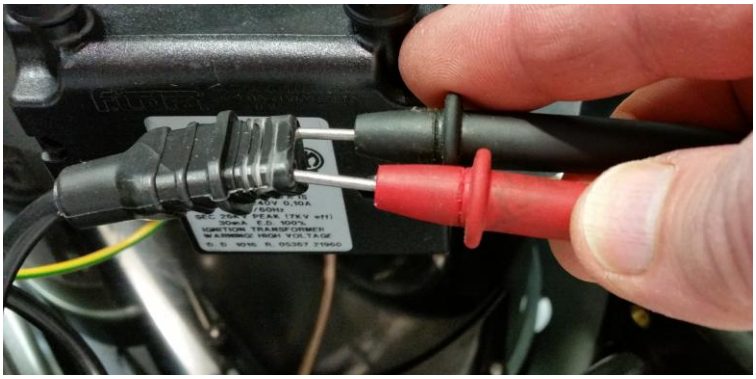




Note: While replacing the burner nozzle, do not touch the nozzle orifice with fingers to avoid its oxidation hence modify its characteristics.

We recommend to replace the burner nozzle every 200 hours.

4f Check the power supply voltage to the high voltage ignition transformer: it should be (+/- 5%) indicated to the machine data plate.



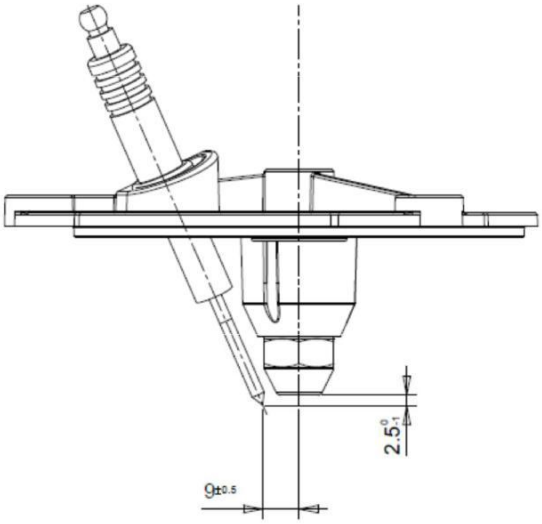
If the voltage is lower than the above mentioned, check the voltage at the main power supply line and in case there is no voltage, check the following:

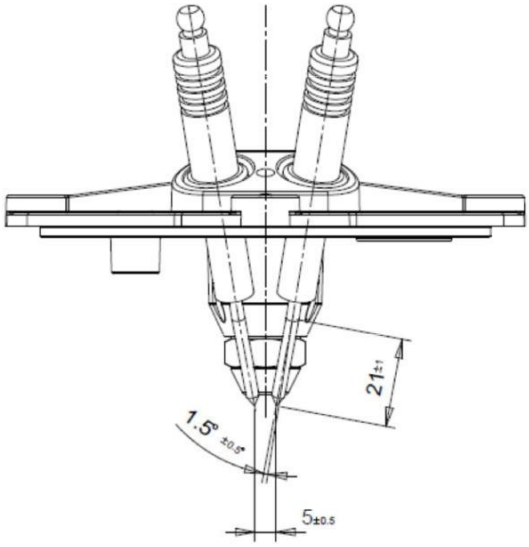
- proper electrical connection and tightening, of the high voltage transformer power wires, connected to connection board in the electric box.
- proper functioning of the aux contact of the contactor (see the electric diagram placed inside of the machine's electric box, or the electric diagram at the section ***1b***.

If the voltage to the high voltage transformer is correct, check the high voltage wires AT, that are connected to the transformer outlet and particularly check if they are properly plugged in to the transformer and to the electrodes.

Check that AT wires are not damaged or cracked, if necessary replace them.
Strip out the whole combustion head and check if electrodes make a spark arch (electrodes must be clean and adjusted at proper distance from each other); if there is no spark between the electrodes, replace the High Voltage Transformer.

4g Strip out the whole combustion head and check if electrodes make a spark arch between their top edges. If there is no spark between the electrodes, check the High Voltage Transformer functioning as described in chapter ***4g***, clean the electrodes and check they are not damaged or cracked, check and if necessary, adjust the gap between the electrodes accordingly with the following drawing choosing the one that represent the model under maintenance:





If the ceramic insulation of the electrodes is cracked, replace them and check also the gap between the electrodes as per above scheme.

We recommend to check and adjust the electrodes position every 200 hours and replace them every 500 hours.

5. Bad fuel combustion

5) ***TROUBLE:*** Excessive smoke from the chimney

CAUSES:

5a Suction pipes and/or, fuel filers clogged
5b Fuel pump pressure setting not properly adjusted
5c Contaminated fuel
5d Combustion adjustment incorrect
5e Burner coil clogged by dirt or soot
5f Fuel nozzle partially clogged

REMEDIES:

5a Check and clean as indicated in the section ***4c***

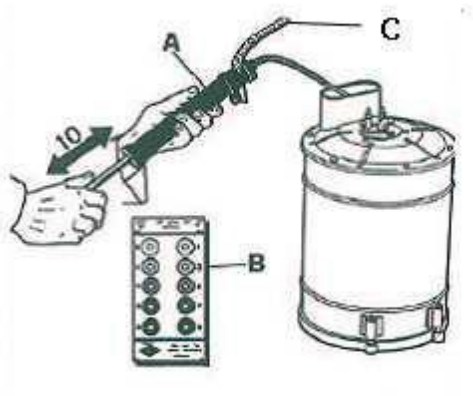
5b Check by using the pressure gauge (p/n **AZMC27323**), the Fuel Pump pressure that should be adjusted between 9,5 and 10 bar max., if necessary, proceed as described in the section ***4d***.

5c Drain out the fuel from the fuel tank by opening the drain caps, clean carefully the fuel tank, clean or replace if necessary, the fuel filters as described in the section ***4c***

5d Check and adjust the combustion, using the smoke tester tool (p/n **AZMC20915**); The combustion test, is performed comparing the smoke color and the smoke color scale, belonging to Bacharach Shell scale.
The color of the smoke should be between points 0 and 2 of the Bacharach scale.

In order to check the combustion according to Bacharach Shell method, proceed as following described:

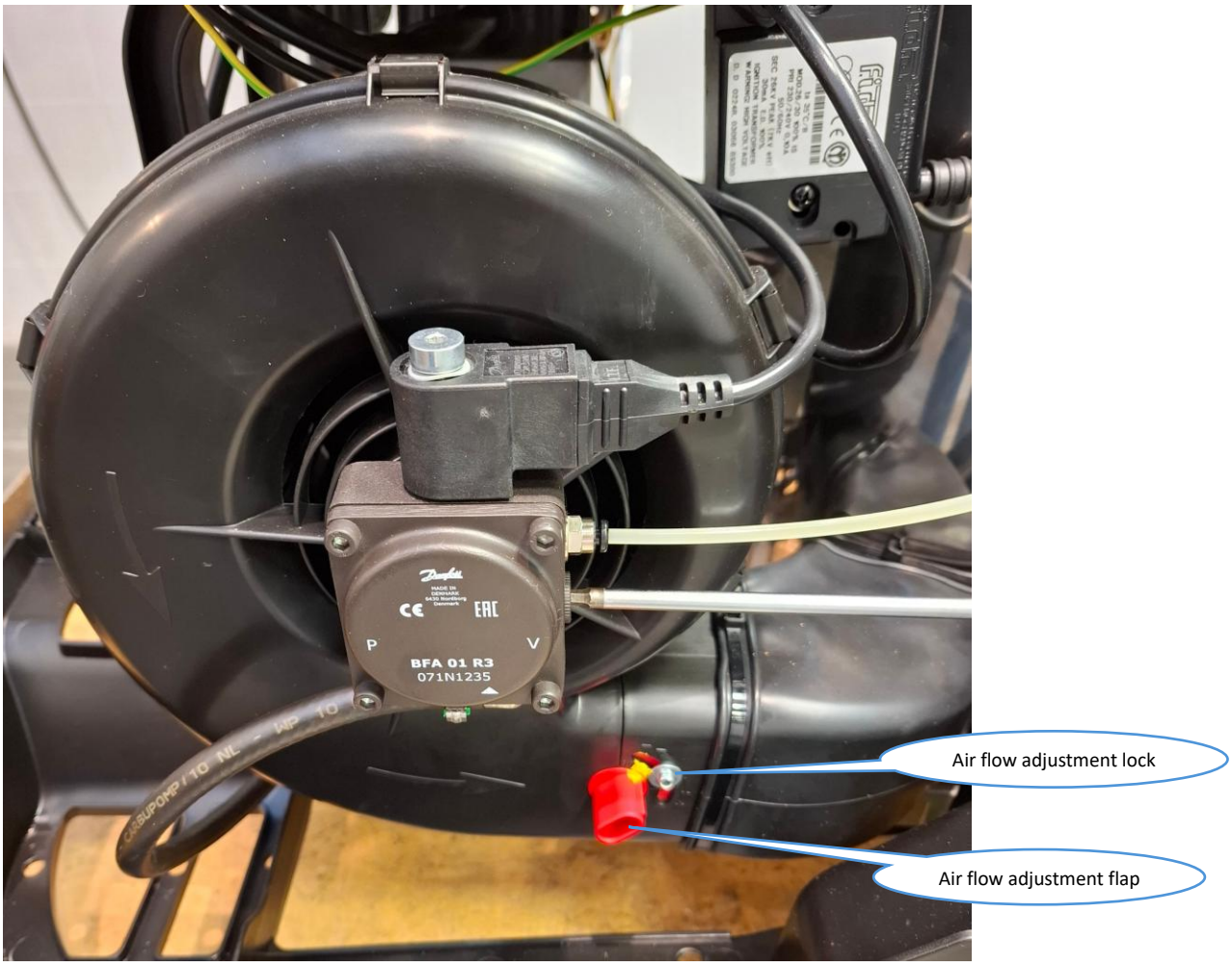
- Switch on the machine and also the machine boiler, fit to the tester the paper filter (C) and use the smoke pump (A) in order to make 10 pump actions, hence obtain a gray colored spot, to the filter paper.



- If the grey color spot is darker, than the point "2" of the Bacharach Shell scale (B), increase the air flow to the boiler by adjusting the blower valve and finally repeat the smoke test as before explained.

- If the spot looks a little yellow colored, the air flow at the boiler is too much and should be reduced. Reduce the air flow at the boiler from the blower valve and repeat the smoke test as before explained.

In order to achieve the best combustion and proper adjustment, we recommend to use clean and good quality fuel (Cetane, should be not less than 51)

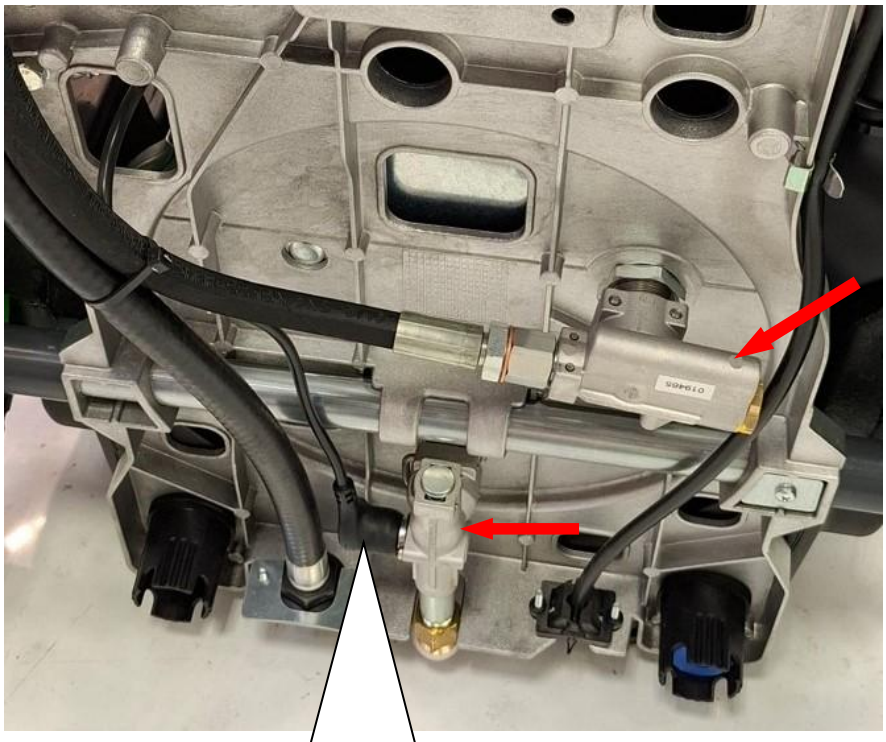


The smoke test, let the boiler functioning continually for 1 minute at least.

5e Disassembling of the boiler and cleaning of the boiler coil:

Disassembling instruction for boiler PH H21.

Disconnect all electric cables and pipes, dismount the boiler covers.



Disconnect the inlet and outlet fittings from the boiler.

Strip out completely the boiler from the machine, then proceed with the cleaning of the coil that can be done with the help of a metal brush and a vacuum cleaner to remove the soot.
The coil cleaning, can be done also by washing the part with high pressure and in combination with proper detergents.

5f Replace the burner nozzle and check the gap between the electrodes as indicated into the drawing at the paragraph ***4h***

6. Poor hot water at the machine outlet

6) ***TROUBLE :*** The water is not warm enough

CAUSES: **6a** Temperature sensor not working ,always off
6b Fuel filters clogged or dirty
6c Fuel pump pressure setting not properly adjusted
6d Contaminated fuel
6e Fuel nozzle partially clogged
6f Burner coil pipe internally clogged by limestone

REMEDIES:

6a Set the thermostat at the desired temperature, if the boiler doesn't work, means that the sensor could be broken.

6b Check and clean as described in the section ***4c***

6c Check and clean as described in the section ***4d***

6d Check and clean as described in the section ***5c***

6e Check and clean as described in the section ***5f***

6f Clean internally the coil pipe, in order to remove the limestone, using the chemical product M402 (ask to IPC HPW export dept. hpw.export@tennantco.com). **Warning**: M402 is an acid chemical, wear the individual protection devices to prevent accidents and injuries.
Follow the instruction written on M402 product label, in order to prepare the acid solution; to make circulating the acid into the coil and remove the limestone, use the pumping tool designed for this operation.
When limestone removal operation with acid, has been completed, repeat the operation by using an alkaline chemical, in order to neutralize the acid effects that may slowly corrode the pipe (i.e. using the chemical type U102).

WARNING!! Follow the rules in force for chemicals waste, DO NOT waste in the environment.

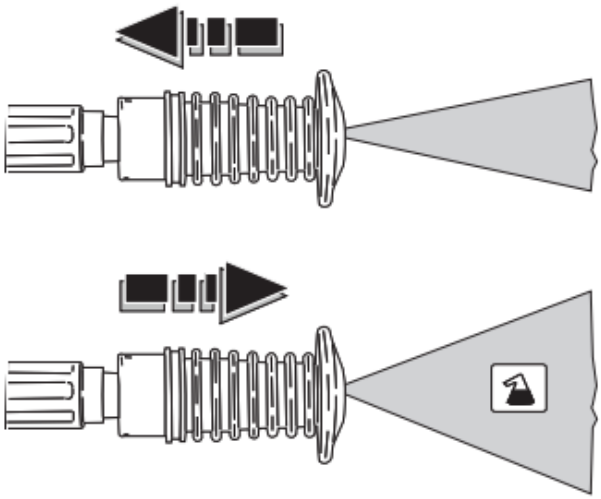
7. Poor detergent delivery

7) ***TRUBLE:*** Poor detergent delivery

CAUSES:
- **7a** Low pressure at the lance is not activates
- **7b** Empty detergent tank
- **7c** The injector of the detergent is dirty
- **7d** Burner coil or high-pressure outlet pipes clogged

REMEDIES:

7a Open the low pressure device at the lance



7b Refill with detergent the chemical tank if it is empty; we recommend to use only the detergents listed in the catalogue.

7c Dismantle and clean the detergent injector.

7d Clean the detergent circuit hoses, replace them if are damaged, clean the coil as described in the section ***6f***

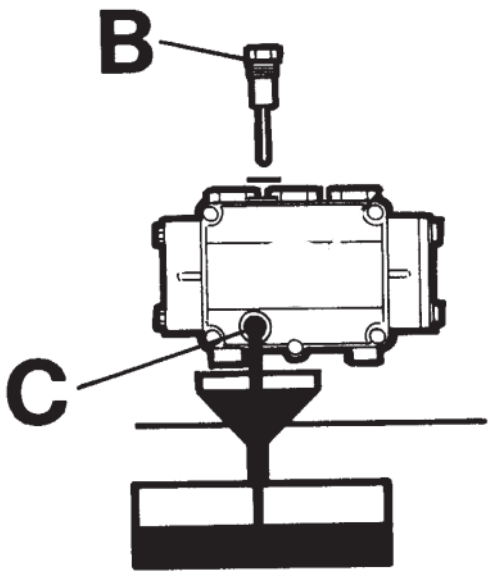
8. Oil and water emulsion phenomena to the high-pressure pump oil

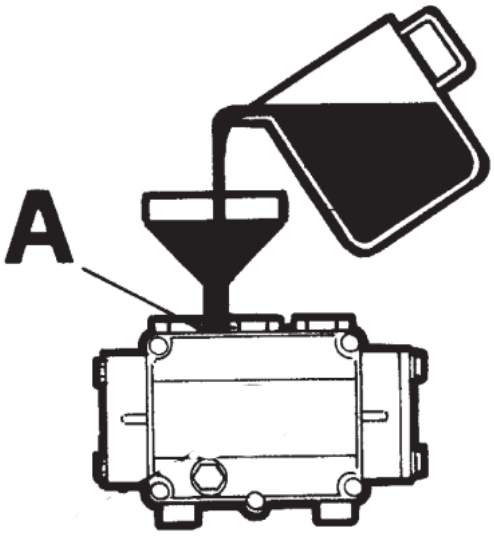
8) ***TROUBLE:*** The oil, inside of the high-pressure pump looks white color (oil and water emulsion phenomena)

CAUSES: **8a** Extremely high environment humidity percentage
8b High pressure pump gaskets worn
8c High pressure pump pistons damaged

REMEDIES:

8a Replace the pump oil using about 150 gr. of oil quality SAE 30 15W40:
Oil, must be wasted in compliance with the country's rules in force for oils, refill the oil into the pump about 150 gr.

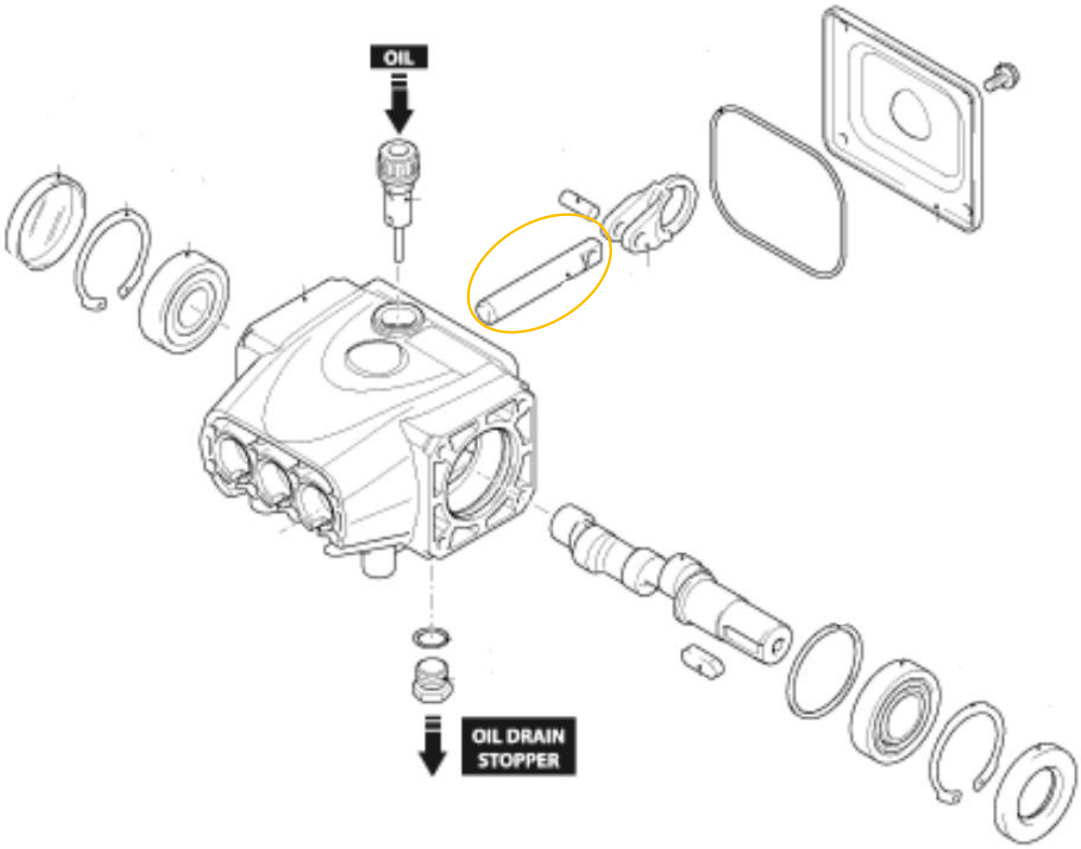




We recommend proper ventilation of the place where the machine operates, in order to reduce as much as possible the environment humidity percentage.

8b Replace the pump water gaskets as described in section ***3i***

8c Replacement of the pump pistons:



Check if pistons are scraped, replace if necessary with genuine spare parts.

Periodic maintenance

	Every day	Every 50h	Every 100h	Every 200h	Every 300h	Every 500h	Every year		
Check the power cord and the high pressure quick couplings.	♦								
First pump oil replacement		♦							
Pump oil replacement						♦			
Fuel filters cleaning and replacement			♦						
Fuel tank cleaning			♦						
Water feeding filters cleaning		♦							
Boiler and coil cleaning from soot				♦					
Boiler coil limestone cleaning					♦				
Fuel pump filter cleaning				♦					
Burner nozzle replacement				♦					
Sparking electrodes gap adjustment				♦					
Sparking electrodes replacement						♦			
Pump's water gaskets replacement						♦			
High pressure nozzle replacement				♦					
Check and adjust of the safety devices or components							♦		