# TECHNICAL MANUAL

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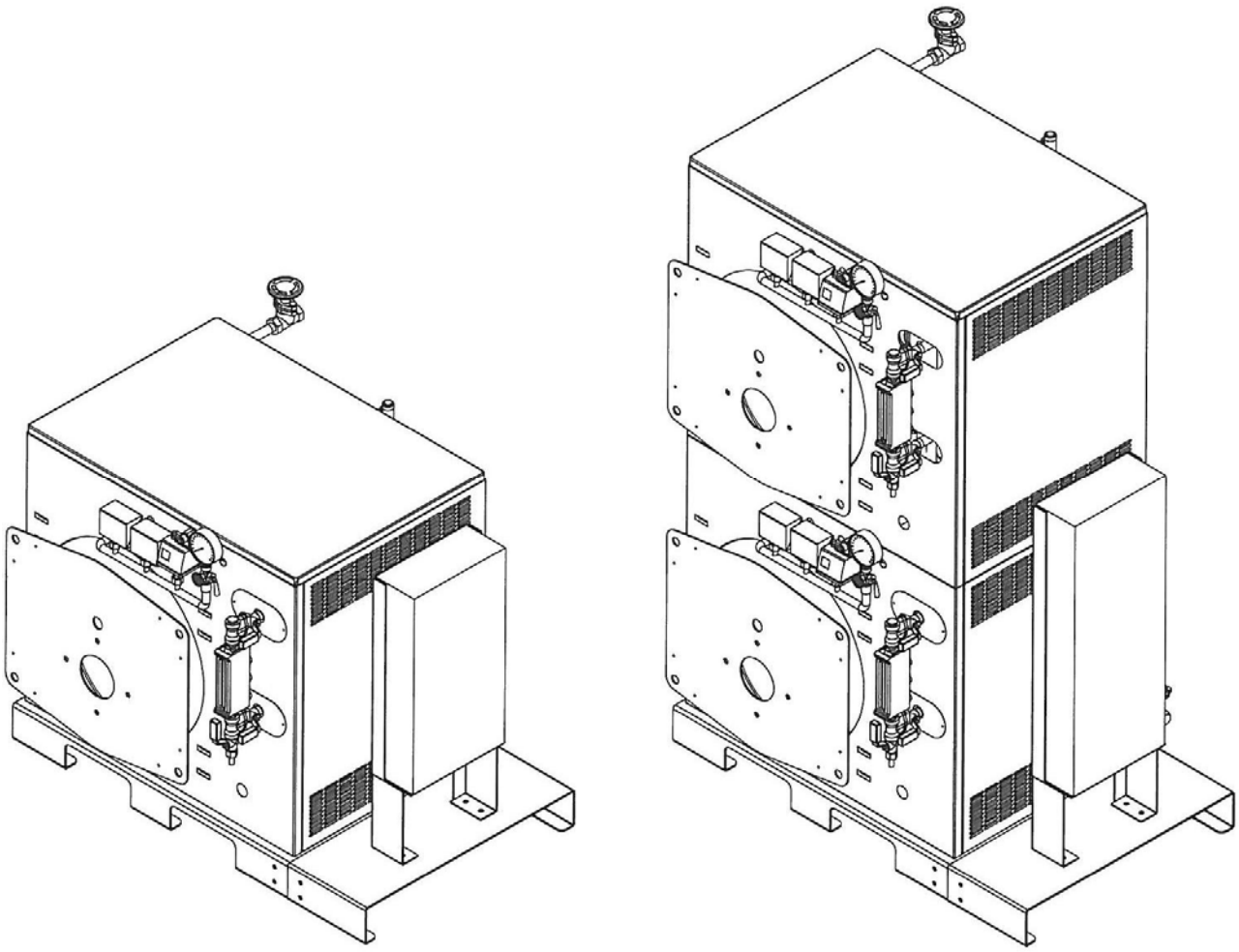


# FX

# FX DUAL

## HIGH EFFICIENCY
## STEAM GENERATOR

# 1 TECHNICAL CHARACTERISTICS

## 1.1 GENERAL

The FX model is a medium pression steam generator, 5 bar, with flame reversion in the firebox and smoke pipes.

The generator, provided in monobloc format, can be fitted with extra two-flame-stages gas or liquid fuel burners; it has a quick start-up owing to its reduced water content and provides high working efficiency even in intermittent operating conditions.

The main electrical panel enables safety and fully automatic operation by integrating two minimum water level devices independent of the regulation system and steam pressure control logic.

All devices are already connected, both hydraulically and electronically, facilitating installation and start-up of the generator.

The most critical parts of the generator, together with all included accessories, can be inspected in order to allow maintenance and cleaning operations.

The User is obliged to and responsible for ensuring that the operation of the generator is entrusted to a person who is capable of understanding the Technical Manual and information on the use of the water treatment system, who is competent in performing checks on feed water and boiler operation and in performing all the scheduled and extraordinary maintenance operations indicated in the Technical Manual, as well as satisfy the following requirements:

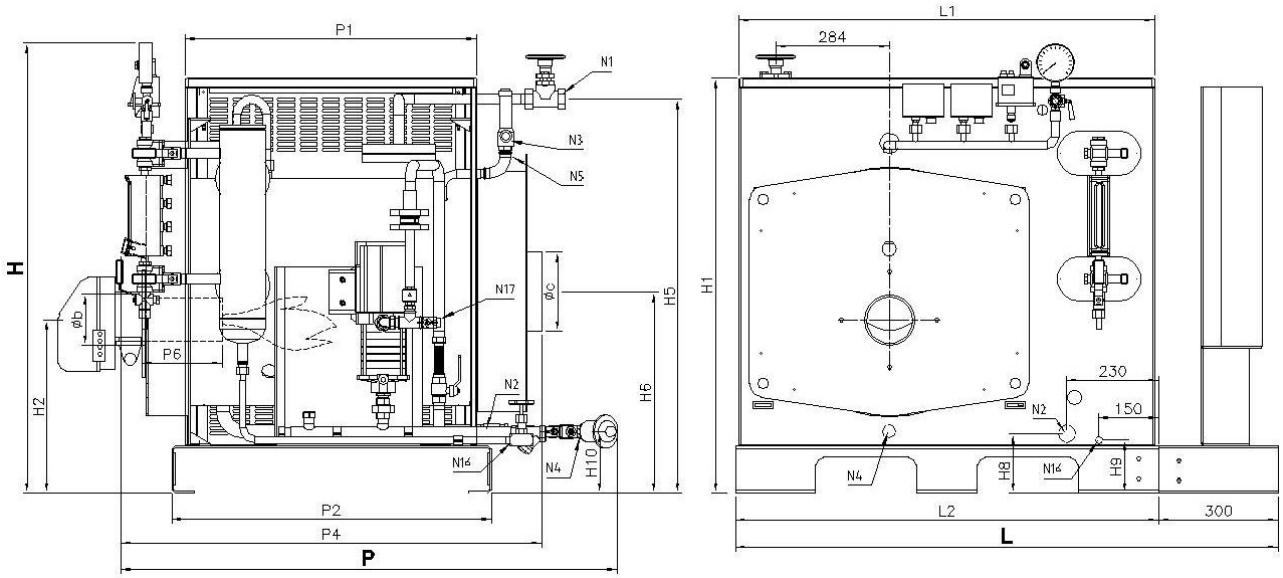
1. Physical capability
2. Competence
3. Minimum age 18 years.

### High dryness steam

Its safety and long lasting features make the FX steam generator ideal for laundries and ironing centres, and for all small to medium applications where high steam dryness and minimal thermal plant usage are required.

## 1.2 TECHNICAL DATA

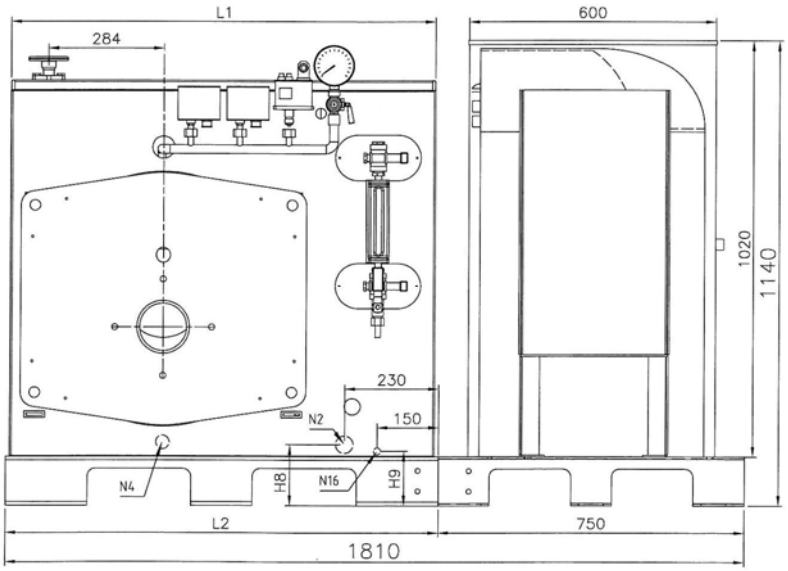
### FX 50/FX 100/FX 150




**FX 50/FX 100/FX 150** - Version with water treatment and condensate tank (optional)

N1 Steam intake
N2 Feed
N3 Safety valve exhaust
N4 Boiler exhaust
N5 Safety valve fitting
N16 Barrel exhaust
N17 Pump valve vent

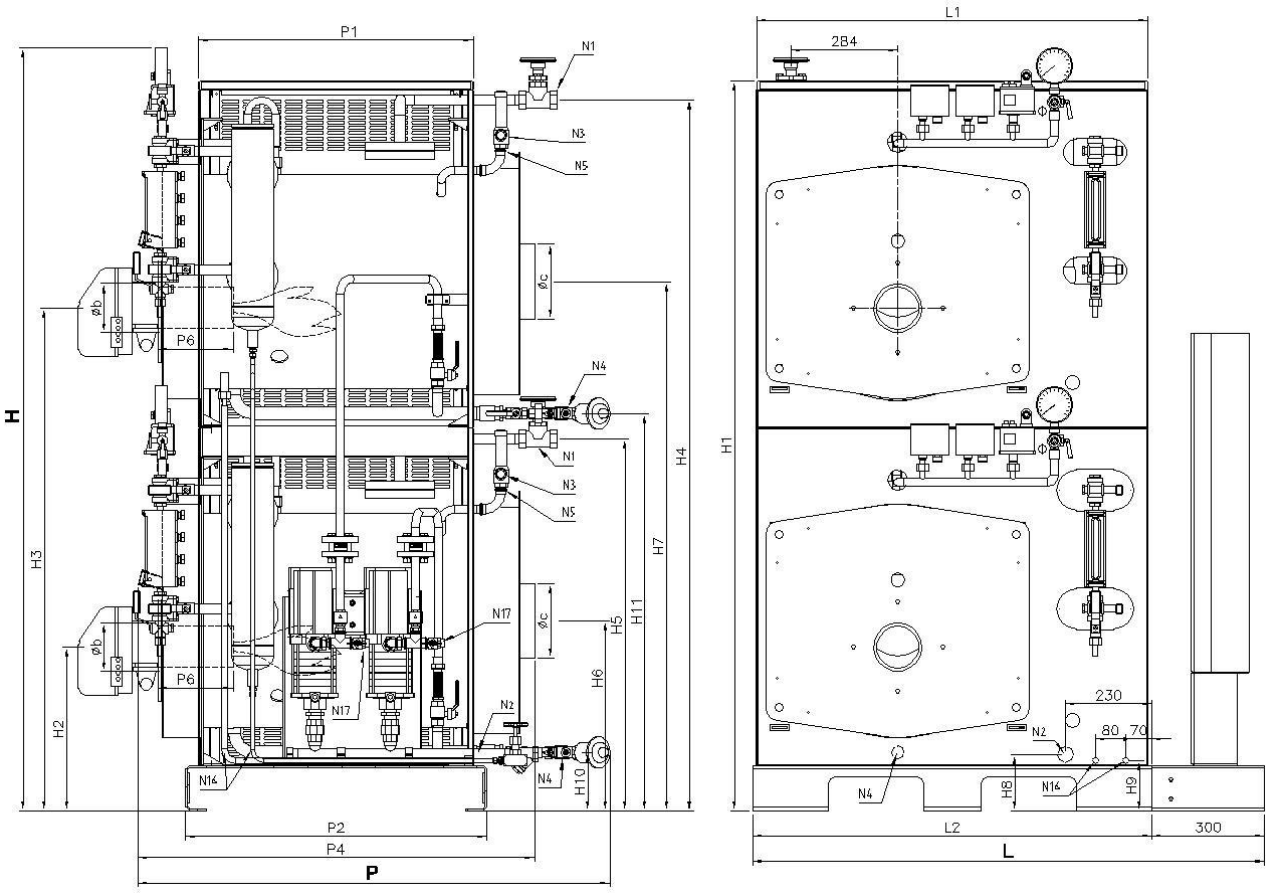
2nd pump, optional




| Characteristics | Heat output | | Pressure losses flue gas side | Design Pressure | Total capacity | Steam capacity* | Total weight | Electric supply | Frequency | Insulation class | Electric power | Fuel | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | kW | kcal/h | mbar | bar | l | kg/h | kg | Volt ~ | Hz | IP | W | | | |
| | | | | | | | | | | | | Nat. gas | Lpg | Gasoil |
| FX 50 | **31,7** | 27.300 | 0,4 | 5 | 59 | 50 | 430 | 1/N~ 230 | 50 | IP55 | 2000 | X | X | X |
| FX 100 | **70,5** | 61.000 | 1,5 | 5 | 59 | 100 | 430 | 1/N~ 230 | 50 | IP55 | 2000 | X | X | X |
| FX 150 | **104,6** | 90.000 | 3,2 | 5 | 59 | 150 | 430 | 1/N~ 230 | 50 | IP55 | 2000 | X | X | X |
| FX 100 DUAL | **63,4** | 55.000 | 0,4 | 5 | 59x2 | 100 | 830 | 1/N~ 230 | 50 | IP55 | 2000 | X | X | X |
| FX 200 DUAL | **141,0** | 121.000 | 1,5 | 5 | 59x2 | 200 | 830 | 1/N~ 230 | 50 | IP55 | 2000 | X | X | X |
| FX 300 DUAL | **209,2** | 180.000 | 3,2 | 5 | 59x2 | 300 | 830 | 1/N~ 230 | 50 | IP55 | 2000 | X | X | X |

| Dimensions | H | H1 | H2 | H3 | H4 | H5 | H6 | H7 | H10 | H11 | L | L1 | L2 | P | P1 | P2 | P6 | Øb | Øc | N1 | N2 | N3 | N4 | N5 | N16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | DN/in | DN/in | DN/in | DN/in | DN/in | in |
| FX 50 | **1130** | 1040 | 435 | - | - | 990 | 505 | - | 155 | - | **1360** | 1040 | 1060 | **1280** | 730 | 800 | 150-200 | 130 | 200 | 3/4" | 3/4" | 1" | 1/2" | 1/2" | 3/8" |
| FX 100 | **1130** | 1040 | 435 | - | - | 990 | 505 | - | 155 | - | **1360** | 1040 | 1060 | **1280** | 730 | 800 | 150-200 | 130 | 200 | 3/4" | 3/4" | 1" | 1/2" | 1/2" | 3/8" |
| FX 150 | **1130** | 1040 | 435 | - | - | 990 | 505 | - | 155 | - | **1360** | 1040 | 1060 | **1280** | 730 | 800 | 150-200 | 130 | 200 | 3/4" | 3/4" | 1" | 1/2" | 1/2" | 3/8" |
| FX 100 DUAL | **2030** | 1940 | 435 | 1335 | 1890 | 990 | 505 | 1405 | 155 | 1055 | **1360** | 1040 | 1060 | **1280** | 730 | 800 | 150-200 | 130 | 200 | 3/4" | 3/4" | 1" | 1/2" | 1/2" | 3/8" |
| FX 200 DUAL | **2030** | 1940 | 435 | 1335 | 1890 | 990 | 505 | 1405 | 155 | 1055 | **1360** | 1040 | 1060 | **1280** | 730 | 800 | 150-200 | 130 | 200 | 3/4" | 3/4" | 1" | 1/2" | 1/2" | 3/8" |
| FX 300 DUAL | **2030** | 1940 | 435 | 1335 | 1890 | 990 | 505 | 1405 | 155 | 1055 | **1360** | 1040 | 1060 | **1280** | 730 | 800 | 150-200 | 130 | 200 | 3/4" | 3/4" | 1" | 1/2" | 1/2" | 3/8" |

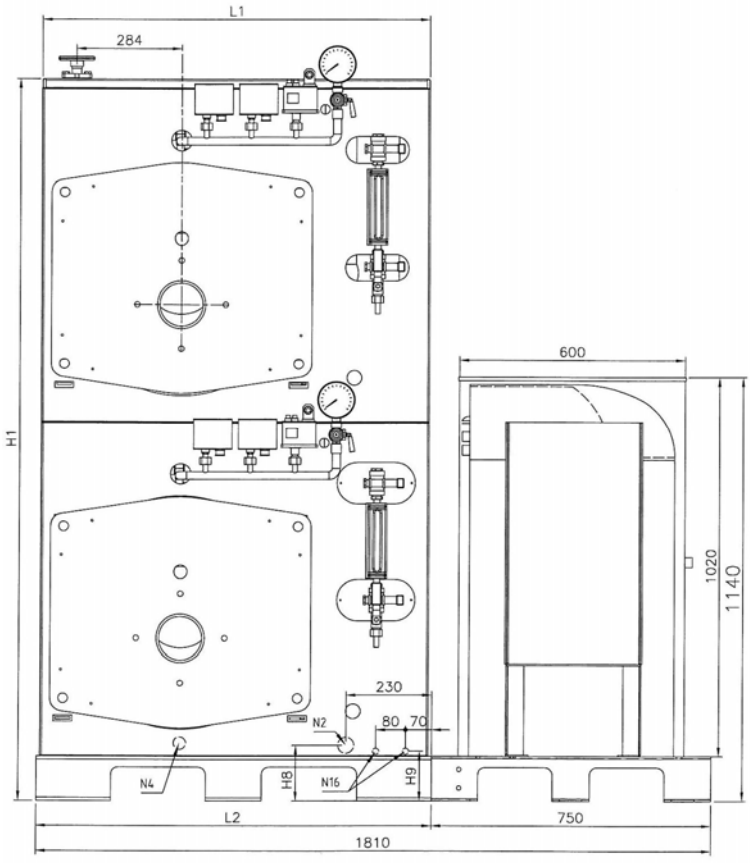
**FX 100 DUAL/FX 200 DUAL/FX 300 DUAL**




**FX 100 DUAL/FX 200 DUAL/FX 300 DUAL** - Version with water treatment and condensate tank (optional)

N1 Steam intake
N2 Feed
N3 Safety valve exhaust
N4 Boiler exhaust
N5 Safety valve fitting
N16 Barrels exhaust
N17 Pump valve vent

3rd pump, optional



MAIN COMPONENTS (Fig. 1)

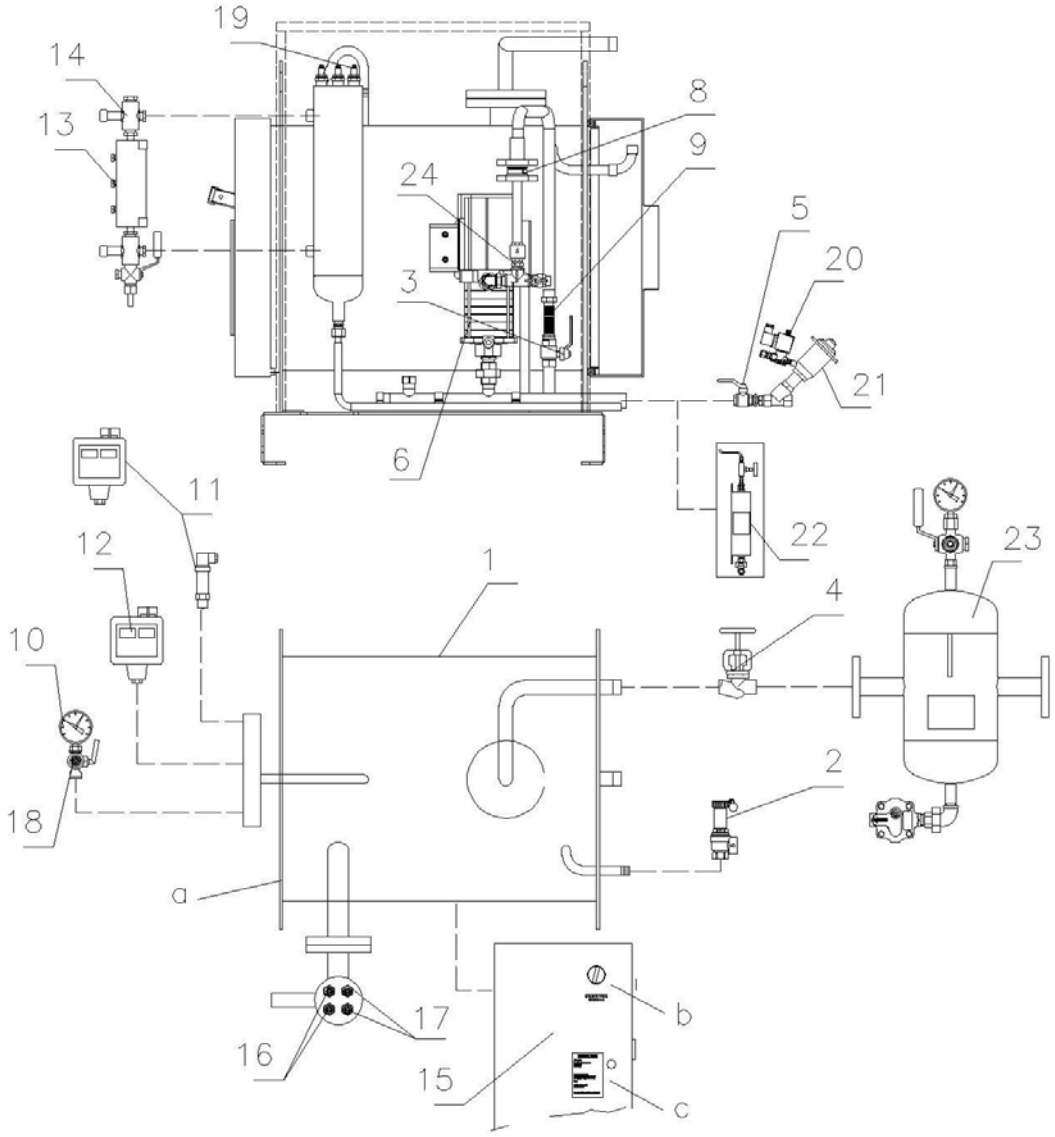



Fig. 1

LEGEND

1. Generator body
2. Spring safety valve
3. Pump ball valve
4. Steam intake ball valve
5. Exhaust ball valve
6. Electropump (2nd optional)
7. Water filter
8. Check valve
9. Adapter joint
10. Manometer
11. 1st-2nd Flame reg. pressure switch
11. Pressure transmitter (option)
12. Safety pressure switch
13. Reflection level gauge
14. Bleeding unit tap
15. Switchboard
16. Water level limits
17. Water level regulation
17. Working level probe (optional)
18. Manometer tap
19. Maximum level probe (optional)
20. Electrovalve
21. Quick discharge valve
22. Chill (optional)
23. Condensate separator kit (optional)
24. Pump valve vent

a Body identification plate position inside or outside the plate

b Level limit identification plate position inside switchboard.

c Ensemble identification plate position

# 2 ACCESSORIES

**FX** steam boilers are fitted with a series of accessories that can be subdivided as follows:
- Safety accessories (safety valves, water level limits, safety pressure switches).
- Observation accessories (level gauge, pressure gauge, flame inspection).
- Control accessories (level, pressure switches, transmitters).
- Feed water accessories.
- Manual operation accessories (stop valves, purge valve).

In the following description the accessories are subdivided as to the physical parameter they control (pressure and level).

## 2.1 PRESSURE

### 2.1.1 PRESSURE GAUGE (Fig. 2)

The pressure gauge is Bourdon type consisting of a flat elliptical section metal tube, bent to an arc. One end of the tube is open and communicates with the boiler where the pressure is to be measured; the other end, closed and free to move is connected by a lever system to a toothed arc and to the gauge indicator hand.
**The gauge shows in red the design pressure.**

The gauge is carried on a three-way valve to allow the following operations:
- Communication between boiler and gauge (normal operation position).
- Communication between gauge and the atmosphere (position necessary to purge the siphon).
- Communication between the boiler, the gauge and a test gauge (position necessary to verify the gauge).

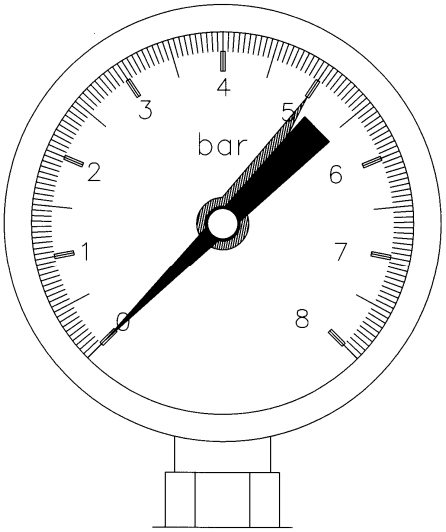



Fig. 2

### 2.1.2 OPERATING PRESSURE SWITCH (Fig. 3-4)

This device controls the pressure in the generator and keeps it within the preset maximum and minimum values.

Following are the instructions for calibrating mod. DANFOSS KP 35 with 0-7.5 bar calibration field.

Undo the screws of the protection box and remove the cover to have access to the pressure switch.

Operating pressure and differential pressure are set via top screws, as shown in Fig. 4, and may be displayed on the two scales.


Fig. 3

1. Regulation screws
2. Differential regulation screws
3. Main arm
4. Main spring
5. Differential spring
6. Bellows
7. Connector
8. Contact system
9. Contact terminals
10. Earth terminal
11. Cable gland
12. Inverter
13. Locking plate

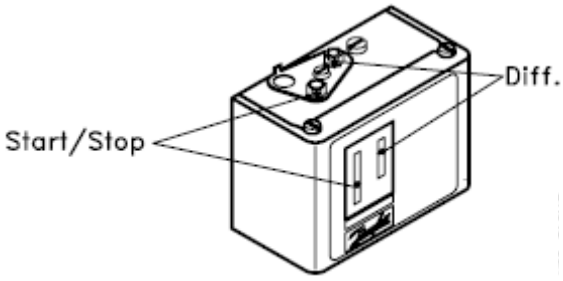



Fig. 4

### 2.1.3 SAFETY PRESSURE SWITCH (Fig. 5)

The pressure switch is equipped with a unipolar switch whose contact position depends on the set value and the current connection pressure.
The device is calibrated at a higher pressure than the transmitter maximum pressure, but always lower than the safety valve opening pressure.
While the pressure switch can be mounted in any position, it should be installed with the cable gland downward in systems subject to strong vibrations.
The safety pressure switch operates in the event of a fault in pressure transmitter, cutting out the burner permanently.

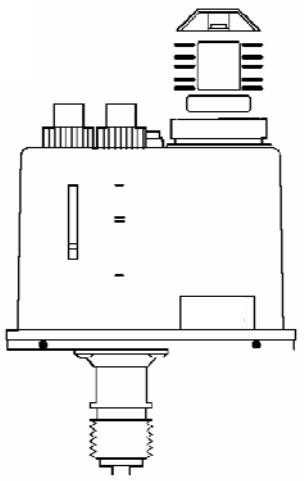


Fig. 5

### 2.1.4 OPERATION PLAN (Fig. 6)

LEGEND
1. Main shaft
2. Main spring
3. Differential shaft
4. Differential spring
6. Activation lever
7. Bellows
8. Pressure port
10. Differential handle
11. DIN pin
12. Microswitch
13. Microswitch bracket
14. Regulation handle

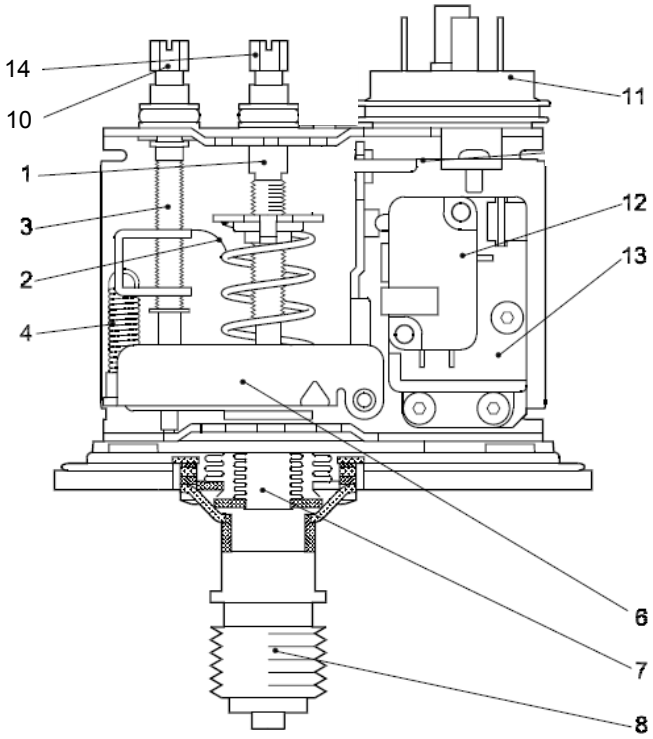



Fig. 6

***Microswitch***
The pressure switch operates independently from the environment temperature changes.
Therefore, the settings of the operating pressure and differential remain constant as long as the allowed environment temperature is not exceeded.
When the system pressure exceeds the set value, the pressure switch stops the machine automatically.
The reset of the pressure switch, once the boiler pressure is reestablished, is via switch in the control panel.
Rupture of internal bellows leads to reduced operating pressure of the pressure switch, about 3 times lower than the set value, causing machine arrest.
Rupture of external bellows leads to reduced operating pressure of the pressure switch, about 3 bars lower than the set value, ensuring an intrinsically safe operation.

### 2.1.5 SAFETY VALVE

It is devised for steam discharge, when the generator maximum designed pressure is achieved. The boilers are equipped with a spring type valve (Fig. 7).
The operator must pay particular attention to the safety valve and ensure highly careful maintenance. The safety valve is the generator's most important and sensitive item, representing the most effective guarantee that the pressure inside the generator will not exceed the allowed value.
As during normal operation of a boiler, the safety valve never acts, it is **good practice to check that the valve is free, i.e. that the valve plug is not stuck to the seat,** by acting on the side lever (spring valves) or on the horizontal lever carrying the weight (lever and weight valves) until the valve starts to discharge steam.

WARNING
On first start-up, you must verify that safety valve adjustment is made to the boiler design pressure. Generally the spring safety valve is supplied already adjusted. The safety valve installed on steam boilers must have the discharge piped to outside the boiler room. Particular care must be taken in designing the discharge line; we show some here.

- The discharge line should e of diameter at least equal to that of the discharge flange on the safety valve.
- Only wide radius curves must be used in the discharge line.
- The entire discharge line must be built to avoid the formation of condensation locks. There must be therefore adequate slopes to ensure complete drainage.

Particular care must be taken if the valve seat and plug are to be ground; if this operation becomes necessary due to leaks, use abrasives based on silicon carbide or oil based carborundum. Carry out the first grinding operation using fine grain abrasive, finishing with a very fine grain abrasive.

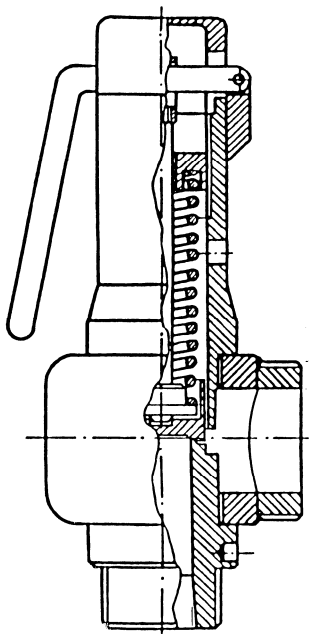


Fig. 7

## 2.2 LEVEL

### 2.2.1 LEVEL INDICATOR GAUGE

The level indicator consists of a pair of valves connected to a sight glass box containing a prismatic glass. This device is connected to the boiler both above and below the normal water level, while the lower part is fitted with a purge valve so that any sludge can be removed, to keep the glass clean. Using these valves, the efficiency of the level control system can be verified periodically by carrying out the following operations:
Open for a few seconds and then close the purge valve. If the water disappears from the sight glass and then appears again with ample level oscillation, then it can be considered that the level operates correctly. If on the other hand the water returns slowly or stops at a level differing form the preceding level, then on of the communications may be obstructed. To make sure which of the two is obstructed, and to attempt a purge, close the steam valve leaving the water valve open, then open the purge valve. This valve must release water taking with it any sludge formed in the pipes. Then close the water valve and open the steam valve: steam should be released from the purge valve. Closing the purge valve and leaving the two water and steam valves open, the water should return to the initial level. If this does not occur, the communication pipes between the level and the boiler must be cleaned.
Make sure that the vent and the outlet are closed during the operation. The interception valves must be completely open during the operation.
The gauges should be isolated periodically to check that the bolt tightening torque moment is at least circa 30 Nm, in order to reduce the possibility of leakage.
Do not proceed to the maintenance operation without first checking that:

- the pressure inside the generator is not equal to the atmospheric pressure.
- The gauge temperature is equal to the environmental temperature.

The maintenance operation should be performed when:

- The crystal loses a degree of transparency, becoming partially opaque, signs of internal roughness due to erosion or corrosion processes which leads to loss of geometry, making reading very difficult. Minimum leakage is still detected from the gaskets or interception units.

### 2.2.2 AUTOMATIC LEVEL REGULATOR

This is an electrical conduction type with electronic relays located in the electrical panel, and operates in water pump start-stop and ensures low level maintenance: (Fig. 8)

**Barrel probes:**

6 Pump stop
7 Pump start
8 1st safety burner stop and alarm on.
9 2nd safety burner stop and alarm on.

**N.B.: we suggest that as well as the acoustic alarm in the boiler room, a further acoustic alarm be provided in an area where personnel is normally present.**

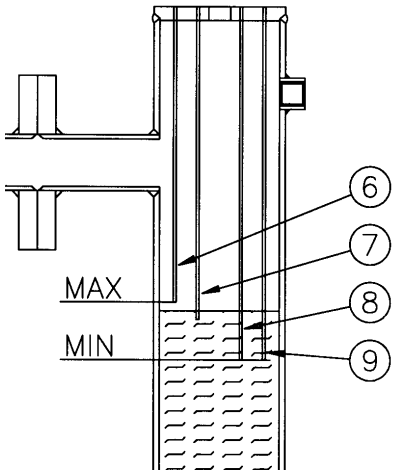



Fig. 8

# 3 FEED WATER

An electric centrifugal pump supplies the water. The inlet side of the pump must never be under suction pressure, but always under positive pressure due to the difference in height between the pump itself and the feed water tank. While a pump can operate under suction head from a cold water tank (up to 5-6 m), if the water is hot the pump cannot operate and indeed needs the water to be delivered under a certain pressure. The height of the feed water tank varies with the temperature, as shown in the following table:

| **Feed water temperature** (Celsius) | **Positive water head** (metres) |
|---|---|
| 60 | 0.5 |
| 70 | 1 |
| 80* | 2 |
| 90* | 3 |

* unsuitable temperature for the collection vessel on the boiler adjacent base

**ATTENTION**

- **Avoid use of feed water at a temperature lower than 60°C as its high oxygen concentration has a potential corrosive action.**

## 3.1 FEED UNIT VERSION (optional)

The generator can be equipped with a condensate collect Water-softener/Vessel, which is placed together with the electrical panel on the special boiler side base.

### 3.1.1 WATER-SOFTENER

The water-softener is cabin type with automatic regeneration control. The resin storage cylinder and the brine tank are cased in a sole device together with the mixing valve that adjusts the residual hardness.

***For all information regarding to the water-softener, please see the specific manual supplied with the unit.***

### 3.1.2 CONDENSATE TANK (Fig. 9)

The condensate tank is made of AISI 304L stainless steel and consists of:

- n° 3 level probes;
- regulation thermostat;
- thermometer;
- heating steam port with steam ejector;
- exhaust valve;
- overflow/vent access;
- condensate return access.

Condensate tank hook ports

1. Pre-heating steam input 1" (optional kit)
2. Water input 1/2”
3. Pumps outlet 3/4”
4. Exhaust 1/2”
5. Condensate recovery 1"
6. Minimum level probe 1/2”
7. Thermometer 1/2”
8. Overflow/vent 1"
9. Maximum level probe 1/2”
10. Thermostat (optional kit)
11. Load startup probe 1/2"

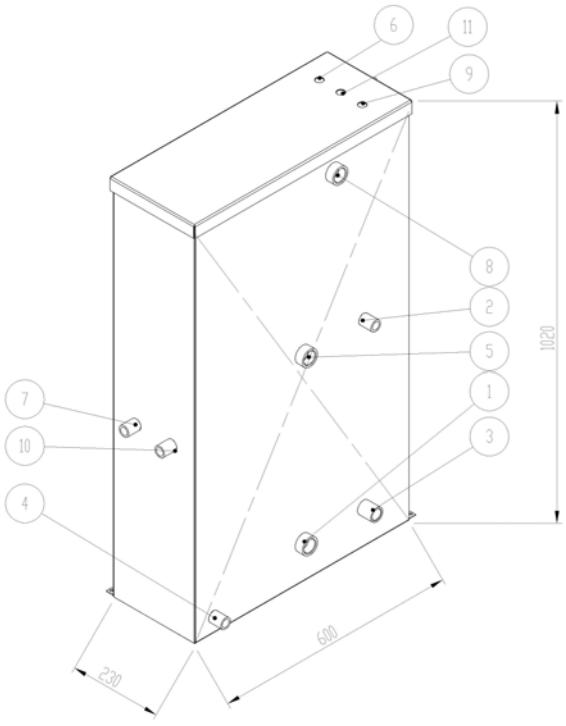



Fig. 9

# 4 INSTALLATION

## 4.1 HEATING UNIT

**The user must verify that the heating unit is designed in compliance with the specific local standards in force in the country of use.**

## 4.2 SITING

Our generators must be placed on a horizontal support base able to support the weight of the boiler when completely full of water.

## 4.3 WATER CONNECTIONS

The steam boilers once positioned are connected to the system as follows (Fig. 10):

**Water**

From the condensate collection tank (10) (if existing; otherwise from the treated water tank) to the suction side of the feed water pump (9).

**Steam**

From the main steam take-off valve (3) to the user services (distributor or others), from the safety valve outlets (6) to outside the boiler room in a safe position.

**Drains**

From the level indicator drains and barrel (16), the boiler drain (17) to the drainage network.

**Fuel**

Connection to the burner foreseen for fuel oil or natural gas/lpg.

**Compressed air**

Air pressure should range from 4 to 10 bar.

**Important: the air should be filtered through a mesh of 25 µm.**

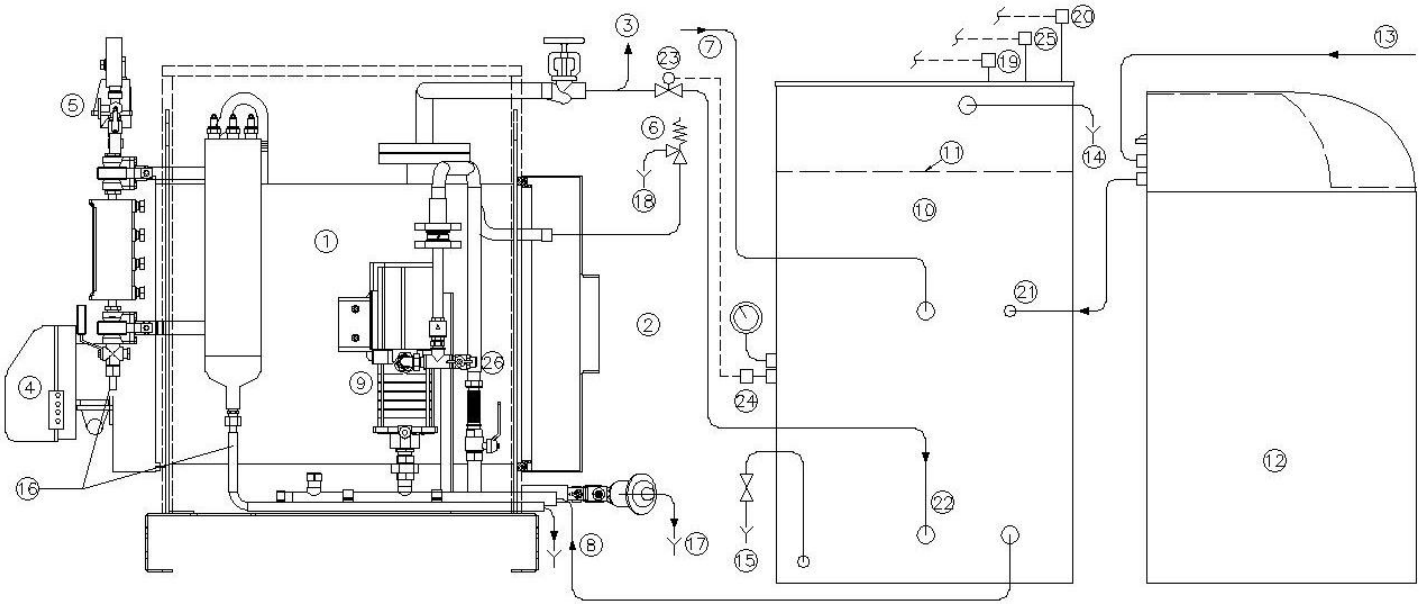


Fig. 10 – System diagram

**LEGEND**

1. Boiler
2. Smokestack
3. Steam take-off
4. Burner
5. Instrumentals
6. Safety valves
7. Condensate return
8. Feed
9. Electric pump supply
10. Condensate tank
11. Water level
12. Water treatment
13. Water supply
14. Breather/too full
15. Condensate tank drain
16. Leve indicator and barel drain
17. Boiler drain
18. Safety valves drain
19. Maximum level probe
20. Minimum level probe
21. Water input
22. Pre-heating steam input (optional kit)
23. Solenoid (optional kit)
24. Thermostat (optional kit)
25. Load startup probe
26. Pump valve vent

## 4.4 SINGLE MODULE OPERATION

If only one of the two modules operates permanently, it is recommended to intercept the non-operating module both electrically and hydraulically by activating the electric selectors (except the burner, pump and sludge exhaust) on the front panel and the ball valves that intercept the pump and the relative steam intake valve.

## 4.5 ELECTRIC CONNECTIONS

The boilers are provided with a switchboard (protection level IP 55) completely assembled to the various boiler accessories. Before connecting the switchboard, make sure that the electric system has been correctly installed, checking in particular the efficiency of the earthing system.

**Wiring diagram**

*Refer to the diagram supplied with the specific switchboard.*

## 4.6 SMOKESTACK

**The smokestack must be dimensioned as to applicable regulations.**

## 4.7 BURNER

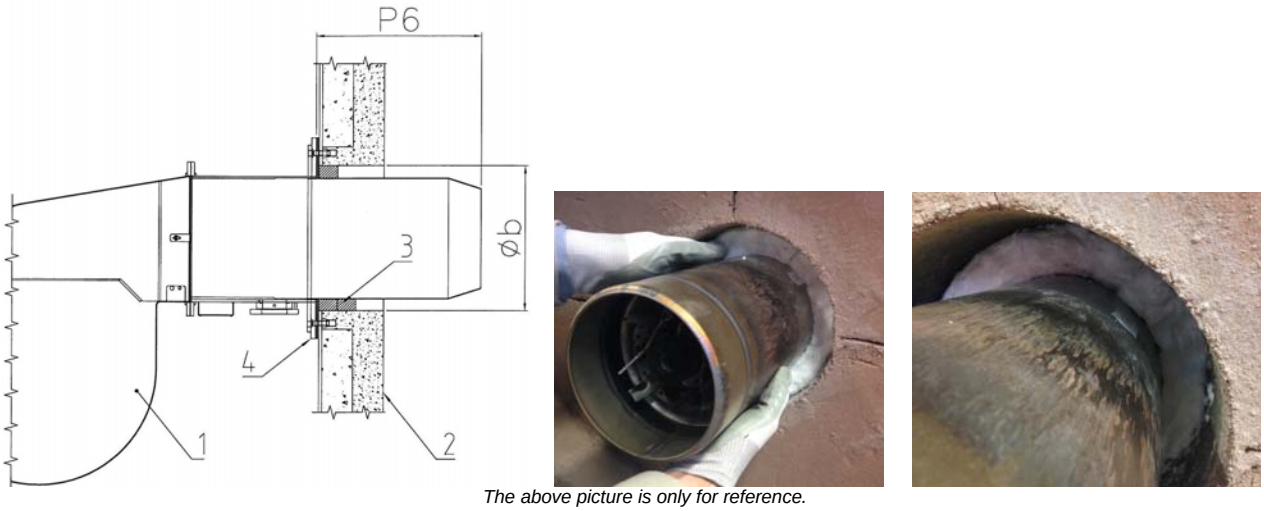
This is a low water content generator suitable for applications that require constant steam withdrawal. To better answer to steam demand, it is advisable to install a **two-stage burner** or **a modulating burner;** this avoids large pressure variations consequent on sudden stream demands that might cause irregular operation of the generator.

Moreover, especially in natural gas fuel burners, at each restart, a long "prewash" in the combustion chamber is performed, cooling the small mass of water in the boiler which determines quick pressure fall: therefore it is recommended to reduce the burner stops to minimum, using one of the aforementioned type.

### 4.7.1 BOILER - BURNER COUPLING

Verify that the spaces between the burner sleeve and the boiler door are suitable filled with flame-resistant ceramic insulation (Fig. 11).

The thermoinsulating strip provided with the boiler must be wrapped around the mouthpiece for at least an entire circumference of the flame radiation to protect the flange of the burner. Not that the ceramic insulation is necessary to fill the gap until the insulation inside surface of the door.




*The above picture is only for reference.*

Fig. 11

KEY:
1. Burner
2. Manhole
3. Thermoinsulating material
4. Flange

All details on the draught tube lenght (**P6**), the diameter of the burner hole (**Øb**) and the pressurization are included in the par. Technical Specifications.

# 5 BOILER OPERATION

## 5.1 FIRST START-UP (Electromechanical panel)

**WARNING: Before start up, open the door and insert wholly turbolators into the front end sections of the smoke tubes, ensuring that they have been pushed inside for at least 100 mm.**

*The above picture is only for reference.*

- Verify that all fittings are tight.
- Verify that the feed water pipes are clean, carrying out a series of washing operations with drainage to waste before final boiler filling.
- Close the drain valves, the steam take-off valve and the level drains/barrel.
- Open the level control valves and the feed water valve (upstream of the feed water pump).
- Check that the man-way is correctly closed.
- Start the boiler as follows:

1) Prime the pumps by coupling a water pipe under pressure in the rear low part of the boiler;
2) Supply voltage to the boiler framework, controlling the burner main switch opening;
3) Check that the drive shaft of the feed water pump is free to turn and check that the shaft turns in the correct direction.
4) Check that the pump stops when the maximum level is reached by observing the level indicators and checking the positions of the indicator valves.
5) Press and keep pressed the safety water level reset button for at least 10 seconds, the conductivity relay being of the delayed type.
6) Press and keep pressed the safety water level reset button for at least 10 seconds, the conductivity relay being of the delayed type.
7) Open the boiler drain and check on the level indicator at what level the pump-start probe acts (7 Fig. 9);
8) Set the pump switch to “0” leaving the drain open and check the actuation level of the safety probes (8 e 9 Fig. 9) with respect to the minimum level reference plate.
9) Close the drain and set the pump switch to AUT
10) Switch on the burner and bring the boiler up to pressure adjusting the operation pressure.

## 5.2 FIRST START-UP (Electronic panel)

See the specific OPERATING PANEL technical manual.

# 6 MAINTENANCE

## 6.1 ORDINARY

- Purge the level gauges and the boiler;
- Check the efficiency of the control and regulation instruments, examining carefully the electrical parts (connections included) and the mechanical parts; it is advisable to replace every year the ceramic probe-holders;
- Carry out burner maintenance (as to the specific instructions);
- Check the tightness of flange bolts and the state of the gaskets;
- Clean the flue-gas tube bundle and the turbolators.

## 6.2 PERIODIC

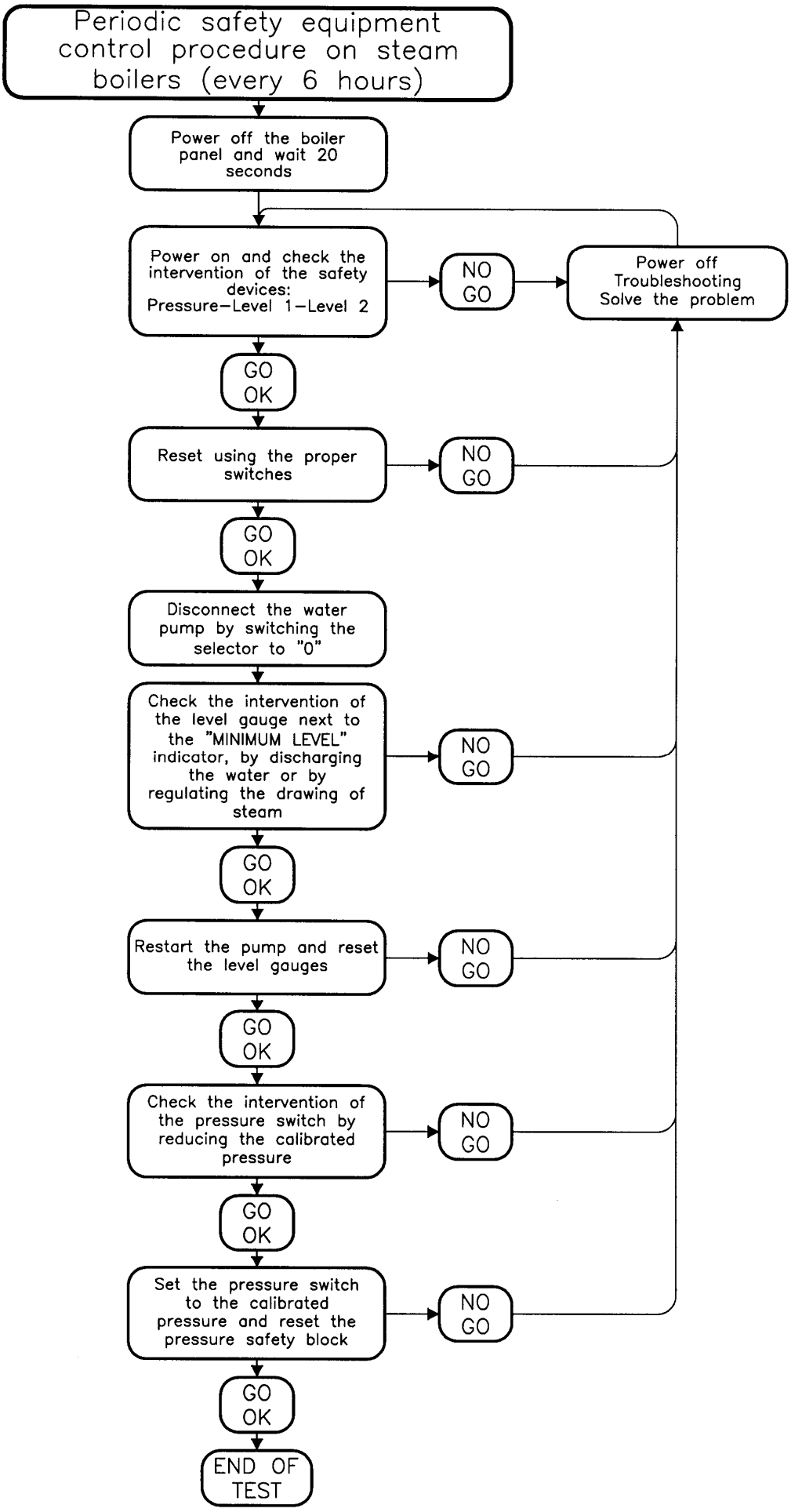
### 6.2.1 PERIODIC CONTROL EVERY 6 HOURS OF USE (Electromechanical panel)

From time to time (every 6 hours of use) the thermal plant must be inspected by operator to check the efficiency of all safety accessories:

- Safety pressure switch
- Water level limits

The system can be reset if no anomalies have been encountered: power off the panel for approx. 20 seconds, power on the main switch and press the reset buttons.

For further details follow the flow chart below:


Periodic safety equipment control procedure on steam boilers (every 6 hours)
Power off the boiler panel and wait 20 seconds
Power on and check the intervention of the safety devices: Pressure–Level 1–Level 2
NO GO
Power off Troubleshooting Solve the problem
GO OK
Reset using the proper switches
NO GO
GO OK
Disconnect the water pump by switching the selector to "0"
Check the intervention of the level gauge next to the "MINIMUM LEVEL" indicator, by discharging the water or by regulating the drawing of steam
NO GO
GO OK
Restart the pump and reset the level gauges
NO GO
GO OK
Check the intervention of the pressure switch by reducing the calibrated pressure
NO GO
GO OK
Set the pressure switch to the calibrated pressure and reset the pressure safety block
NO GO
GO OK
END OF TEST

## 6.3 SCHEDULED

All boilers must be periodically stopped for careful inspection and maintenance: the time interval between stops is established by experience, by the operating conditions, by the quality of the feed water and by the type of fuel used.

Before starting for inspection or for cleaning, check carefully that there is no possibility of entry of water or steam via the pipework to which the boiler is connected. Every valve must be locked and if necessary isolated by removing a piece of pipework or by inserting a blind flange.

During inspection also verify all the accessories, with priority to safety valves, level probes and pressure switches.

### 6.3.1 WATER LEVEL LIMITS SUBSTITUTION

To replace the water level limits or parts of it, follow strictly the instructions below:
1) Ensure that the new ceramic plug is intact
2) Check the length of the rod
3) Ensure that the rod is coaxial to the plug axis
4) Inspect the electrical system and, in particular, ensure that the resistance of the electric circuit linking the ceramic plug to the electrical panel is intact (resistance must be over 10 MOhm)
5) Ensure that the automatic level control consisting of the two ceramic plugs and their conductivity-relays, work well

**The replaced components must have the same features as the originals. For calibration, it is necessary to refer to Technical Manual and, if not provided, please contact the manufacturer.**

## 6.4 CONSERVATION DURING WHEN OUT OF SERVICE

Often during periods of disuse the worst cases of corrosion appear. The operations to be carried out to guarantee correct conservation of the boiler depend essentially on the duration of the stop.
The boiler can be subjected to dry conservation if the period of disuse is long, or to a wet conservation for short stops or if the boiler has a back-up function and must be ready to come on-line in a short time.
In both cases, the necessary operations tend to eliminate the causes of possible corrosion.

### 6.4.1 DRY CONSERVATION

The boiler must be drained and dried carefully, then placing in the boiler shell a hygroscopic substance (for example lime or silica gel etc)

### 6.4.2 WET CONSERVATION

Drain the water and clean the generator completely. Fill the body up to the normal operation level and after a brief evaporation period it is essential to purge into the atmosphere to eliminate all dissolved gases. Then fill the generator completely, dosing a sufficient amount of DEHA (diethyl hydroxyl amine) to develop a residue concentration of more than 100 ppm that prevents attacks of oxygen dissolved in the water. Also add trisodium phosphate, until the total alkalinity reaches over 400 ppm. Now close all the connections.
Control all the connections to make sure that there are no leaks and take water specimens at regular intervals noticing that the alkalinity value has not had alterations.
A “wet” conservation” is always advisable because there are greater guarantees of perfect conservation and a smaller interval to reach operation conditions.

# 7 WATER CHARACTERISTICS

All the values listed as follow are taken by tables 5.1 and 5.2 contained in the EN 12953-10 (rules related to quality features of feeding and working of boiler water).
For steam generators **there are some regulations that require limit values for water characteristics.** However, limits should be adopted for all generators as stated by qualified companies that recommend the type of treatment to be carried out basing on careful analysis of the available water. **Many faults and sometimes serious accidents are caused by the use of water with non-conforming features.**

FEEDWATER - LIMIT VALUES (entering the boiler)
**Tab. 1**

| **Specifications** | **Measurement unit** | **Feedwater for steam boilers with pressure ≤ 20 bar** | **Integrating water for hot water boilers** (total operating range) |
|---|---|---|---|
| Appearance | Transparent, void of suspended solids | | |
| Direct conductivity at 25 °C | μS/cm | See values in chart 2 | |
| pH at 25°C [a)] | --- | > 9.2 [b)] | > 7 |
| Total hardness (Ca+Mg) | mmol/l | < 0.01 [b)] | < 0.05 |
| Iron (Fe) | mg/l | < 0.3 | < 0.2 |
| Copper (Cu) | mg/l | < 0.05 | < 0.1 |
| Silica ($SiO_2$) | mg/l | See chart 1.1 | |
| Oxygen ($O_2$) | mg/l | < 0.05 [d)] | - |
| Oil-based substances | mg/l | < 1 | < 1 |
| Concentration of organic substances | ------ | See footnote [e)] | |

a) With copper alloys in the system, the value of the PH must be maintained in the interval between 8.7 and 9.2.
b) With a PH value of the water softened to > 7.0, the PH value of the boiler water should be foreseen as per prospect 5-2.
c) With an operating pressure <1 bar, a total maximum hardness of 0.05 mmol/l should be acceptable.
d) Instead of complying with this value with an intermittent operation or operation without deaerator, in case of agents which form the film and/or excess of oxygen, the additive must be used.
e) The organic substances are usually a mixture of numerous different compounds. The composition of these mixtures and the behavior of their single components to the operating conditions of the boiler are difficult to predict. The organic substances can be decomposed to form carbonic acid or other acidic decomposition products, which increase the acidic conductivity and cause rust and deposits. They can also lead to the formation of foam and/or to the production of steam with suspended water, which must be maintained as low as possible.

**Chart 1.1 maximum acceptable content of silica in the boiler water up to pressures of 20 bar**

| **Alkalinity** | **Silicate** |
|---|---|
| 0,5 mmol/l | **80** mg/l |
| 5 mmol/l | **105** mg/l |
| 10 mmol/l | **135** mg/l |
| 15 mmol/l | **160** mg/l |

Note: these values are to be accepted when a thermal deaerator is installed. If not so, it is good practice to heat the water in the tank at least to 80°C to reduce the content of dissolved gasses ($O_2$ e $CO_2$). Be sure to use chemical conditioners to deoxygenate feed water and to reduce $CO_2$ corrosion.

OPERATING WATER - LIMITING VALUES

**Chart. 2**

| **Specifications** | **Measurement unit** | **Water for steam boilers with pressure ≤ 20 bar** | | **Boiler water for hot water boilers** (total operating range) |
|---|---|---|---|---|
| | | Direct conductivity of the feedwater > 30 µS/cm | Direct conductivity of the feedwater ≤30 µS/cm | |
| Appearance | Transparent, without the formation of permanent foam | | | |
| Direct conductivity at 25 °C | µS/cm | < 6000 [a)] | < 1500 | < 1500 |
| pH at 25 °C | ------ | 10,5 ÷ 12 | 10 ÷ 11 [b) c)] | 9 ÷ 11.5 [d)] |
| Composite alkalinity | mmol/l | 1 ÷ 15 [a)] | 0.1 ÷ 1 [c)] | < 5 |
| Silica ($SiO_2$) | mg/l | See chart 1.1 | | |
| Phosphates ($PO_4$) [e)] | mg/l | 10 ÷ 30 | 6 ÷ 15 | - |
| Organic substances | ------ | See footnote [f)] | | |

a) With a super-heater, consider 50% of the value normally indicated as the maximum to be the maximum value.
b) Adjustment of the basic pH by means of an injection of $NaPO_4$, further injection of NaOH only if the pH value is < 10.
c) If the acidic conductivity of the feedwater of the boiler is < 0.2 µS/cm, and its concentration of Na + K is <0.01 mg/l, the injection of phosphate is not necessary . It can be applied in AVT conditions (All-volatile treatment with volatile chemical agents, feedwater pH ≥ 9.2 and boiler water pH ≥ 8), in such case, the conductivity of the boiler water is < 5 µS/cm.
d) If there are non-iron materials in the system, i.e. aluminum, these may require a lower pH value and a direct conductivity, however, the priority is to protect the boiler.
e) If a coordinated phosphate treatment is used, considering all the other values, higher concentrations of $PO_4$ are acceptable.
f) The organic substances are usually a mixture of numerous different compounds. The composition of these mixtures and the behavior of their single components to the operating conditions of the boiler are difficult to predict. The organic substances can be decomposed to form carbonic acid or other acidic decomposition products, which increase the acidic conductivity and cause rust and deposits. They can also lead to the formation of foam and/or to the production of steam with suspended water, which must be maintained as low as possible.

FREQUENCY OF THE ANALYSES

The frequency of analysis is determined evidently as a function of the use of the boiler and of the quality of the water used; it is advisable in any case to check the pH, the total hardness and the alkalinity of the feed and boiler waters at least every two days. Once a month, especially under conditions of variable operation, it is advisable to subject meaningful samples of the boiler and feed waters to complete analysis.
It is also advisable to inspect the return condensate for traces of any highly contaminating oily substances (reduction of evaporation from the water surface in the boiler caused by a layer of oil).

# 8 TROUBLESHOOTING

| FAULT | PROBABLE CAUSE | SUGGESTED REMEDY |
|---|---|---|
| **Safety valve/s opening** | Maximum pressure exceeded, as set on the valve. Must be equal to the boiler design pressure. | Adjust the safety pressure switches and / or limit switches. |
| | Loss of the adjustment of the safety valve | Check and then adjust the valve using a reference gauge |
| **Small leaks from the safety valve/s** | Dirt on the valve seat | Clean the seat by opening the valve manually a few times |
| | Marks on the valve seat | Dismantle the valve and regrind the valve seat with very fine abrasive. |
| **Pump stopped** | Pump overload relay has acted | Check the motor current |
| | | Check the relay setting |
| | Pump shaft seized | Maintenance to the pump |
| **Pressure safety switch operates** | Pressure limit switch set too high | Adjust the pressure limit switch |
| | Pressure limit switch faulty | Replace the pressure limit switch |
| | Pressure switch pipe coil blocked | Clean or replace the pipe coil |
| **Safety level 1 or 2 operates** | Water level detection interrupted | Steel probe encrusted<br>Connection cable interrupted |
| | Safety level relay faulty | Temporary replacement of the safety electronic relay with one of the two relays in the panel.<br>If the problem disappears, replace the faulty relay. |
| | No water feed | See faults "feed water" |
| **Feed water insufficient** | Pump seized | See faults "Pump stopped" |
| | Pump suction filter blocked | Clean the filter |
| | Level control faulty | Temporary replacement of the electronic control relay with one of those present in the panel.<br>If the problem disappears, replace the faulty relay. |
| | Level probes short circuited | Dismantle the control probes for inspection of the ceramic insulation |
| | Pump cavitation | Suction head (difference in height between supply tank and pump) insufficient in relation to the water temperature |
| | | Clean the pump suction filter |
| | | Reduce the head loss in the pipe between collector tank and the pump by increasing the pipe section |
| | Pump rotation direction | Invert two phases (three-phase pump) |
| **Burner always ON** | Erroneous electrical connection to the panel | Consult the wiring diagram |
| | Safety level relays faulty | See “Intervention safety level 1 or 2” |
| | Control and/or safety pressure switches inactive | Check the adjustment of the pressure switches |
| | | Check the pressure switch connections to the control panel |
| **Burner always OFF** | Problems with the burner | See the specific burner Manual |
| | Burner fuses interrupted | Replace the fuses |
| | No consent to the burner from the control pressure switch | Replace the control pressure switch |
| | No consent to the burner from the safety level relay | See “Intervention safety level 1 or 2” |
| | Erroneous connection to the control panel | Consult the wiring diagram |

# 9 PAPERWORK

**CHECK THE LOCAL STANDARDS IN FORCE IN THE COUNTRY OF USE FOR PRESSURE EQUIPMENT INSTALLATION AND RUNNING.**

# 10 WATER LEVEL LIMITS

## 10.1 GENERAL

The water level limits consists in: n. 2 level rods, n. 2 probes, electrical cables, n. 2 electronic relays. The device prevents the lowering of the level of water in the steam generators and the consequent overheating of the membrature.

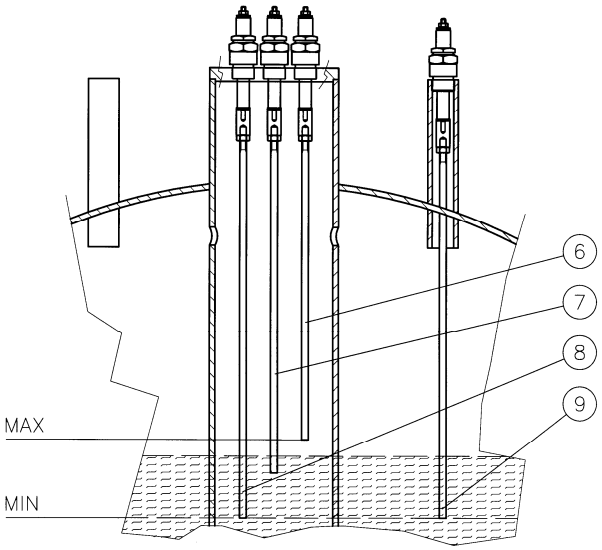
**The principle of survey and control of the level is based on water conductivity. In order to guarantee the correct operation of the device, following conditions must be fulfilled:**

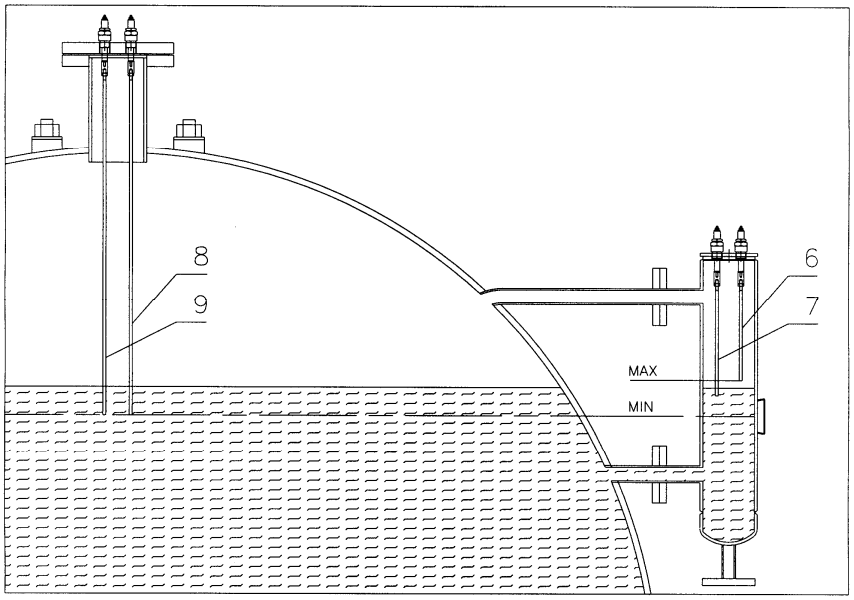
- **Water conductivity > 250 S/cm**
- **Water temperature < 210°C**
- **Pressure < 20 bar**

(See. " Operating water ").

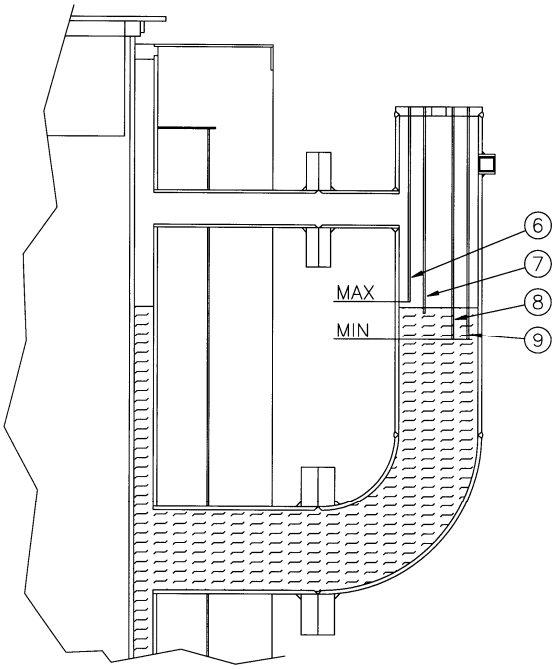
## 10.2 TYPICAL APPLICATIONS

**Boiler probes:**
6 Pump stop
7 Pump starting
**8 1st burner cut-out safety device and alarm ON.**
**9 2nd burner cut-out safety device and alarm ON**




NOTE: it is recommended that an alarm bell is installed in the boiler room as well as a sound or visual alarm in highly visited rooms.




## 10.3 ELECTRICAL CONNECTIONS

*Refer to the diagram supplied with the specific switchboard.*

## 10.4 STEAM GENERATOR OPERATION
(Water level limits)

### 10.4.1 FIRST START-UP

See par. 5.1

## 10.5 MAINTENANCE

### 10.5.1 ORDINARY

- Bleed periodically (level indicators, probe-holder barrel if any, boiler) to avoid mud deposits.
- Check the efficiency of the regulation and control instruments by inspecting carefully the electrical (also connections); it is also recommended that the probe-holder ceramic plugs are replaced every year

### 10.5.2 PERIODIC CONTROL EVERY 6 HOURS OF USE (Electromechanical panel)

From time to time (every 6 hours of use) the thermal plant must be inspected by qualified personnel to check the efficiency of all safety accessories:

- Water level limits
- Safety valve

The system can be reset if no anomalies have been encountered: power off the panel for approx. 20 seconds, power on the main switch and press the reset buttons.

For further details follow the flow chart to par. 6.2.1.

### 10.5.3 EXTRAORDINARY MAINTENANCE (WATER LEVEL LIMITS SUBSTITUTION)

See par. 6.3.1.

## 10.6 TROUBLESHOOTING
See Cap. 8.

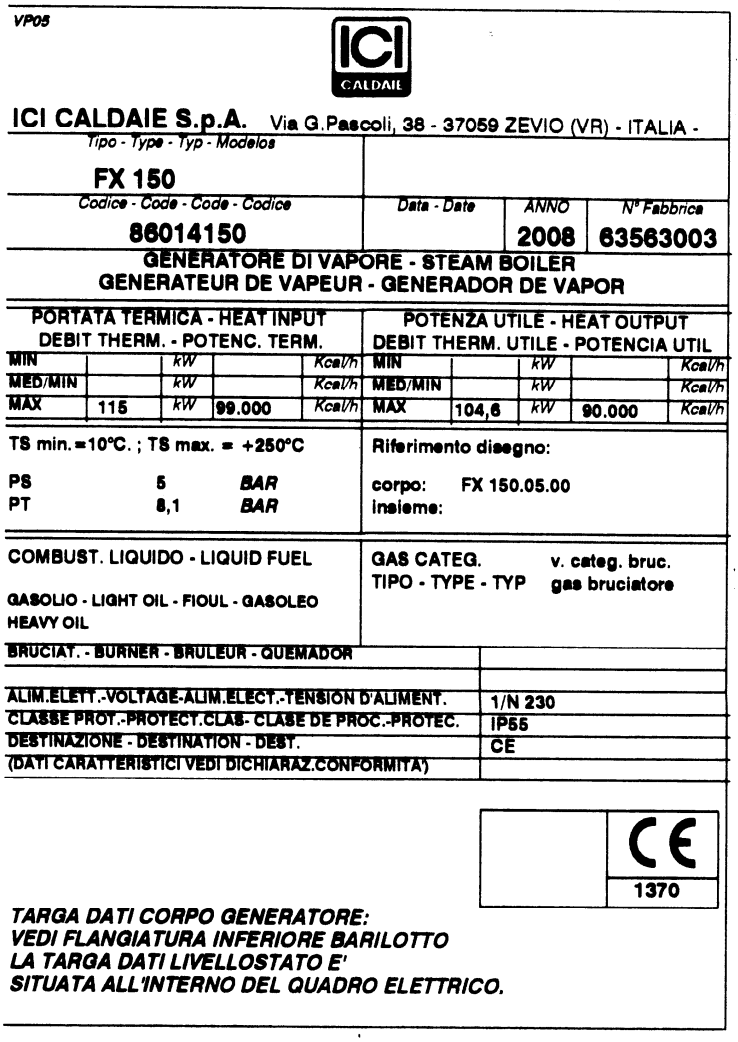
# 11 REMARKS

**This manual is an essential part of the product.**
**In case the body is sold or moved, please ensure that this manual is forwarded to the new owner.**
**This boiler body has to be used according to its own purpose.**
**Any contractual or extra-contractual responsibility is excluded when referring to damages occurred to people, animals or things caused by failure of maintenance, scheduled control or misuse.**

1. Avoid contact between the non-insulated parts of the equipment during operation. If any regulation and control maneuver must be performed during the operation, appropriate clothes should be worn for protection (D.P.I. equipment in accordance to applicable regulations).
2. Pay attention to the sharp edges that necessarily form part of the generator and its accessories.
3. the boiler body must be kept away from adverse climatic conditions, with regards to minimum temperature (-10°C) and the effect of rain.
4. Seismic intensity of the user region must be taken into consideration when designing the boiler.
5. After earthquake activity call upon technical personnel to evaluate the damages, performing CND type control (non destructive control) if necessary.
6. The manufacturer is not responsible in case of damages during boiler disconnection.
7. Observe a minimum distance of at least 5 mt from the device while moving.
8. Use appropriate tools for movement operations to avoid tipping the body over
9. In event of violent shock during movement, perform a visual check to evaluate the integrity of each part; carry out the hydraulic test again.
10. In the event of degrading, follow the specific standards in force.
11. Any welding/fixing intervention is forbidden, for any eventuality contact the manufacturer/control subject of the operation (according to applicable regulations).
12. Verify the proper status of the safety level indicator, as on the user's guide.
13. Verify the water conductivity referring to the values shown in this manual.
14. Check the correct status of the feed water pump (pump wear, suction head, feed water temperature, pump connection and disconnection according to the level probes).
15. At start-up, the intervention of the safety level switch must be checked, checking that the intervention occurs when the level (displayed on the glass level gauge) corresponds to "Minimum level" tag.
16. carry out the bleeding operations by operating the exhaust valves on the bottom of the boiler.
17. Do not consider boiler connections as a weight support for the tubes
18. Provide dilation joints and tube supports for the connection of the boiler to the plant.
19. A regular and proper maintenance of the safety valve/s must be carried out, as specified by the boiler/valve use and maintenance manual.
20. Verify the power supply of the control panel referring to the electrical diagram attached.
21. The equipment can be accessed inside by use of a special key, entrusted only to professional qualified persons.
22. Check the proper connection to ground.
23. Check the electrical system of the plant.

24. Before opening the boiler door, be sure to check that the burner is not operating and with no power supply.
25. Before closing the deviating valve, be sure to switch off both burner and pump.
26. Pump aspiration filter must be cleaned regularly.
27. The seal of all of the joins must be checked regularly and at start-up.
28. Verify the proper joins of the hydraulic connections
29. Verify the proper connection of the electrical parts
30. Carry out the proper fastening of the chimney
31. The replaced accessories must have the same features as the originals. For calibration it is necessary to refer to the Technical Manual and it is, however, recommended to contact the manufacturer.
32. No alteration of the accessories (safety valve, pressure switches, electrical panel and level probes) is allowed. The generator must be operated by qualified personnel appointed by the user. The manufacturer is not responsible in the event of damage due to alteration.
33. The boiler operators must prove adequate knowledge of the control and safety accessories, be confident with the instructions shown in this manual and in good health.

## 12 DATA LABEL



VP05

ICI CALDAIE

**ICI CALDAIE S.p.A.** Via G.Pascoli, 38 - 37059 ZEVIO (VR) - ITALIA -

| Tipo - Type - Typ - Modelos | | | |
|---|---|---|---|
| **FX 150** | | | |
| Codice - Code - Code - Codice | Data - Date | ANNO | N° Fabbrica |
| **86014150** | | **2008** | **63563003** |

**GENERATORE DI VAPORE - STEAM BOILER**
**GENERATEUR DE VAPEUR - GENERADOR DE VAPOR**

| PORTATA TERMICA - HEAT INPUT<br>DEBIT THERM. - POTENC. TERM. | | | | | POTENZA UTILE - HEAT OUTPUT<br>DEBIT THERM. UTILE - POTENCIA UTIL | | | | |
|---|---|---|---|---|---|---|---|---|---|
| MIN | | kW | | Kcal/h | MIN | | kW | | Kcal/h |
| MED/MIN | | kW | | Kcal/h | MED/MIN | | kW | | Kcal/h |
| MAX | 115 | kW | 99.000 | Kcal/h | MAX | 104,6 | kW | 90.000 | Kcal/h |

| | |
|---|---|
| TS min.=10°C. ; TS max. = +250°C | Riferimento disegno: |
| PS 5 BAR<br>PT 8,1 BAR | corpo: FX 150.05.00<br>insieme: |
| COMBUST. LIQUIDO - LIQUID FUEL<br>GASOLIO - LIGHT OIL - FIOUL - GASOLEO<br>HEAVY OIL | GAS CATEG. v. categ. bruc.<br>TIPO - TYPE - TYP gas bruciatore |
| BRUCIAT. - BURNER - BRULEUR - QUEMADOR | |
| ALIM.ELETT.-VOLTAGE-ALIM.ELECT.-TENSION D'ALIMENT. | 1/N 230 |
| CLASSE PROT.-PROTECT.CLAS- CLASE DE PROC.-PROTEC. | IP55 |
| DESTINAZIONE - DESTINATION - DEST. | CE |
| (DATI CARATTERISTICI VEDI DICHIARAZ.CONFORMITA') | |

CE 1370

***TARGA DATI CORPO GENERATORE:***
***VEDI FLANGIATURA INFERIORE BARILOTTO***
***LA TARGA DATI LIVELLOSTATO E'***
***SITUATA ALL'INTERNO DEL QUADRO ELETTRICO.***

**Appartenente al Gruppo Finluc, iscritto R.I. VR n. 02245640236**
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