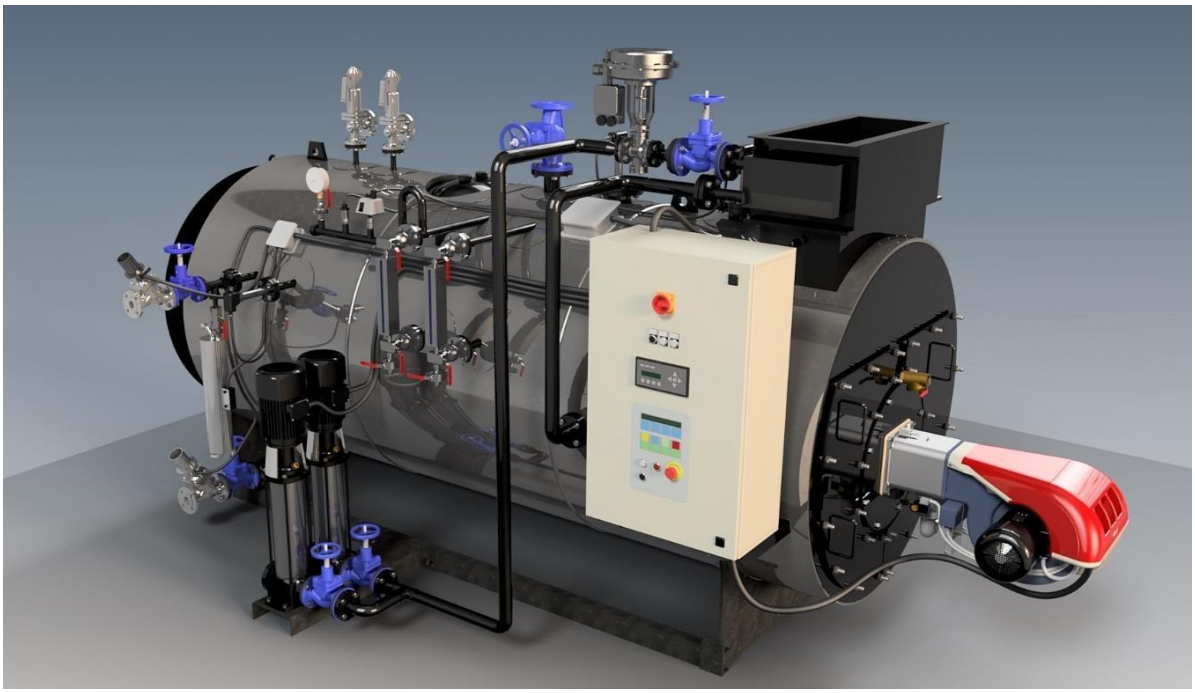

Steam boiler – FT model
n.1 x 4 ton/h @10 bar(g)

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1 TECHICAL HIGHLIGHTS AND SPECIFICATION

1.1 INTRODUCTION TO STEAM BOILER FT SERIES

The fire tube steam boiler **FT series** are an efficient and compact solution, available in different configurations, based on market demands.
These boilers are optimized for combination with any market burner.

CHARACTERISTICS	ADVANTAGES
Range 1-6 tons/h for production of saturated steam, super-heated steam and super-heated water. Optimized for matching with market technologies. Two-pass dry back type Horizontal design Large furnace. Combustion system suitable for **different fuel** (natural gas, byogas light/heavy fuel oil, LPG, Hydrogen) Fully packaged and complete with all the necessary control and safety devices. The heating surface and the fire tubes are designed to obtain high turbulence in the gaseous mass, ensuring high thermal efficiency. FT series steam generators are manufactured and certified according to the European Directive **PED** (other design codes and certifications can be applied including **ASME, SELO**, etc.). FT steam boilers are supplied in standard and container versions.	**Small footprint and compact design.** **High thermal efficiency:** High thermal efficiency due to efficient heat transfer, large exchange surfaces and optimized heat recovery systems (economizer). **Easy maintenance**: Simple and quick maintenance due to its two-pass design, with convenient access to the internal components of the boiler: furnace, inversion chamber, and tube plate.; reducing downtime for inspection, maintenance and cleaning. **Low Temperature**: Lower flue gas temperatures in the combustion chamber compared to reversed flame boilers. Lower thermal stresses in the metal structure, increasing operating life. **Low emissions**: Thanks to low temperature and thanks to the large furnace with ample diameter, combustion occurs with low NOx emissions **Control system**: FT boilers can be equipped with a multifunctional control system (OptiSpark or SMC) and dynamic monitoring of the boiler operation, ensuring optimal performance and safety even in offline mode.

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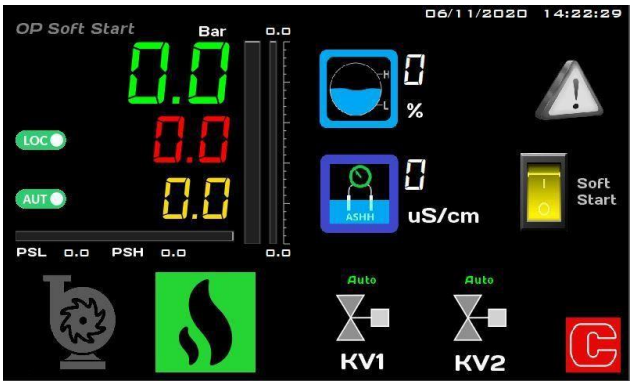
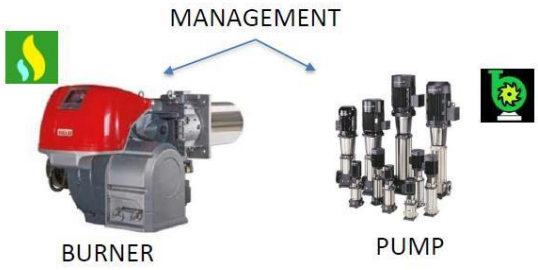
1.2 STEAM MATIC CONTROLLER

The SMC Steam Matic Controller is the innovative system developed by Cannon Bono. Based on micro-PLC technology, it allows the control and supervision of standard Bono Energia steam boilers. It is designed for the management of FT steam boilers through a simple touchscreen HMI (Human Machine Interface) installed on the electrical panel. Thanks to coloured icons, users will be able to use the controller in a simple, fast, and intuitive way.



The main functions included in the regulator are the following:

- Steam pressure control loop through burner modulation
- Feed water control loop through modulating valve and pump
- Indication of main variables of the system (Steam pressure, Water Level, Water conductivity, etc.)
- Bottom blow down valve control (if applicable)
- TDS control loop through discharge valve (if applicable)
- Ongoing alarms display
- Alarm log display
- Display of the trends of main operation parameters
- MODBUS communication for remote reading of operating variables



PROCESS VALUES TREND DISPLAY

ALARM DISPLAY

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2 INTRODUCTION

2.1 DESIGN DATA

This quotation is based on the following data:

Country of destination	Greece
Electrical data	230/400V – 50 Hz – 3 phase
Area of installation	Indoors, boiler room, free of frost, dust, and sand.
Area classification	Safe area, no classification
Elevation	< 600 m.a.s.l.
Type of fluid	Saturated Steam
Required Steam capacity	4.000 kg/h
Design pressure	11,7 bar(g)
Maximum Operating pressure	10,0 bar(g)
Main fuel	LNG Gaseous 200-250mbar stabilized
Emissions @3%O2_dry	NOx < 100 mg/Nm3 CO < 50 mg/Nm3
Feed water quality	According to EN 12953:10

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3 STANDARD AND CODES

Pressure parts design, calculation and construction	European Directive 2014/68/EU
Pressure parts certification	PED (2014/68/EU)
Electrical equipment	CEI – IEC
Ladders, walkways, supporting structure	EN 14122
Electrical protection degree	IP 54 – IP 55
Alarms sequence	ISA
Electrical protection	Standard, Non-hazardous area
Gas train and BMS	EN 676

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4 TECHNICAL SPECIFICATION

4.1 STEAM BOILER DATASHEET

DIMENSIONAL DATA

		FT 400
Length (with burner)	mm	5.650
Width (with accessories)	mm	2.450
Height	mm	2.550
Flue gas outlet flange (i)	mm	316 x 1.100
Stack diameter (optional)	mm	500
Empty weight	ton	10,0

FUNCTIONAL DATA

Design pressure	bar_g	12,0
Maximum operating pressure	bar_g	10,5
Steam quality	%	> 99,5
Boiler feed water temperature (± 5°C)	°C	80
Steam production capacity (NG)	kg/h	4.000
Heat transferred to steam (NG)	MW	2,7
Thermal Efficiency (basic version) @100%	%	89,0 ± 1
Pump flow rate (each)	m3/h	5,0
Pump static pressure (each)	mcl	140
Pump installed power	kW	4,0

Thermal efficiency, steam capacity and fuel consumption are calculated according to EN 12953-11 "indirect method".

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4.2 FEED WATER QUALITY SPECIFICATION

A proper feed water treatment system is mandatory for the issuing and validity of the manufacturer's guarantee. Therefore, it is necessary to carry out a complete analysis of the raw feed water, to select the correct water treatment system. Equally important is the periodic analysis of feed water and boiler water.

If the water treatment is not carried out properly, elements dissolved in the water such as calcium, magnesium or silica can deposit on the iron surfaces of the coil at higher temperatures, causing incrustations and blocking the pipes. In addition, if the feed water is rich in oxygen, the iron in contact with the water will suffer corrosion, leading to holes in the coil. The table below shows the limits values for boiler feed water according to EN 12952-12 and EN 12953-10. In order to maintain the values shown, it is necessary to use water conditioners in addition to water treatment units.

Table 4-1

Parameter	Unit	Feedwater for steam boilers		Make-up water for hot water boilers
Operating pressure	bar (= 0,1 MPa)	> 0,5 to 20	> 20	total range
Appearance	—	clear, free from suspended solids		
Direct conductivity at 25 °C	µS/cm	not specified, only guide values relevant for boiler water see table 5-2		
pH value at 25 °C [a]	—	> 9,2 [b]	> 9,2 [b]	> 7,0
Total hardness (Ca + Mg)	mmol/l	< 0,01 [c]	< 0,01	< 0,05
Iron (Fe) concentration	mg/l	< 0,3	< 0,1	< 0,2
Copper (Cu) concentration	mg/l	< 0,05	< 0,03	< 0,1
Silica (SiO_2) concentration	mg/l	not specified, only guide values for boiler water relevant, see table 5-2		—
Oxygen (O_2) concentration	mg/l	< 0,05 [d]	< 0,02	—
Oil/grease concentration (see EN 12953-6)	mg/l	< 1	< 1	< 1
Organic substances (as TOC) concentration	—	see footnote [e]		

[a] With copper alloys in the system the pH value shall be maintained in the range 8,7 to 9,2.

[b] With softened water pH value > 7,0 the pH value of boiler water according to table 5-2 should be considered.

[c] At operating pressure < 1 bar total hardness max. 0,05 mmol/l shall be acceptable.

[d] Instead of observing this value at intermittent operation or operation without deaerator if film forming agents and/or excess of oxygen scavenger shall be used.

[e] Organic substances are generally a mixture of several different compounds. The composition of such mixtures and the behaviour of their individual components under the conditions of boiler operation are difficult to predict. Organic substances may be decomposed to form carbonic acid or other acidic decomposition products which increase the acid conductivity and cause corrosion or deposits. They also may lead to foaming and/or priming which shall be kept as low as possible.

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Table 4-2

Parameter	Unit	Boiler water for steam boilers using			Boiler water for hot water boilers
		Feedwater direct conductivity > 30 µS/cm		Feedwater direct conductivity ≤ 30 µS/cm	
Operating pressure	bar (= 0,1MPa)	> 0,5 to 20	> 20	> 0,5	total range
Appearance	—	clear, no stable foam			
Direct conductivity at 25 °C	µS/cm	< 6 000 [a]	see Figure 5-1 [a]	< 1 500	< 1 500
pH value at 25 °C	—	10,5 to 12,0	10,5 to 11,8	10,0 to 11,0 [b, c]	9,0 to 11,5 [d]
Composite alkalinity	mmol/l	1 to 15 [a]	1 to 10 [a]	0,1 to 1,0 [c]	< 5
Silica (SiO_2) concentration	mg/l	pressure dependent, according to figure 5-2			—
Phosphate (PO_4) [e]	mg/l	10 to 30	10 to 30	6 to 15	—
Organic substances	—	see footnote [f]			—

[a] With superheater consider 50 % of the indicated upper value as maximum value.

[b] Basic pH adjustment by injecting Na_3PO_4, additional NaOH injection only if the pH value is < 10.

[c] If the acid conductivity of the boiler feedwater is < 0,2 µS/cm, and its Na + K concentration is < 0,010 mg/l, phosphate injection is not necessary. Under the conditions AVT (all volatile treatment, feedwater pH ≥ 9,2 and boiler water pH ≥ 8,0) can be applied, in this case the acid conductivity of the boiler water is < 5 µS/cm.

[d] If non-ferrous materials are present in the system, e. g. aluminium, they may require lower pH value and direct conductivity, however, the protection of the boiler has priority.

[e] If coordinated phosphate treatment is used; considering all other values higher PO_4-concentrations are acceptable (see also clause 4).

[f] See [e] in table 5-1.

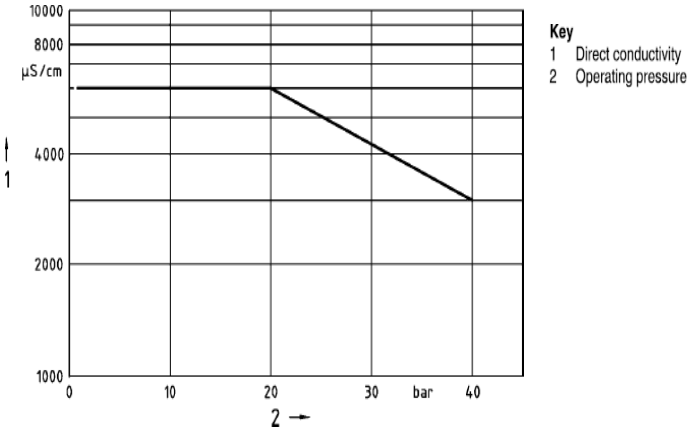

Figure 4-1: Maximum acceptable direct conductivity of the boiler water depending on pressure; feed water direct conductivity >

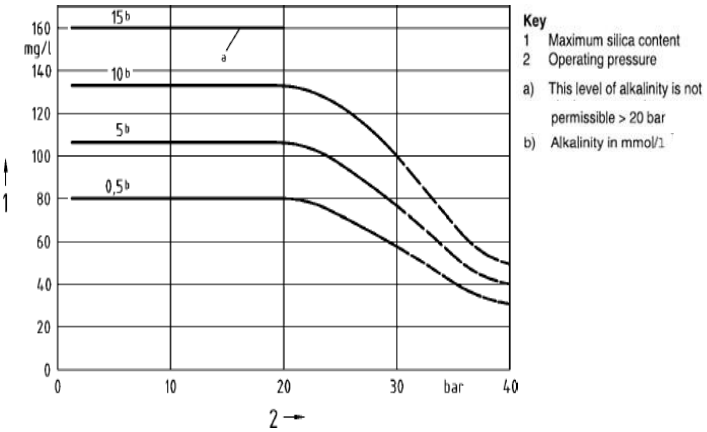

Figure 4-2: Maximum acceptable silica content (SiO_2) of the boiler water depending on pressure.

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4.3 TECHNICAL SPECIFICATIONS

BOILER BODY

- Shell made in P 355 GH EN10028-2 or equivalent. Furnace tube, made in P 355 GH EN10028 or equivalent. Front and back tube plates, made in P355 GH EN10028-2 or equivalent. Smoke pipes, seamless type, made in P 235 GH or equivalent, expanded and welded to the tube plates. Turbulators installed inside the smoke pipes.
- Internal steam trap, to ensure high steam dryness.
- Front smoke chamber made in carbon steel S 235 JR, lined with high temperature insulation material, and welded to the pressure body, complete with: n. 2 doors, bolted, for pipes connections; burner supporting plate; connection for stack.
- Back smoke chamber made in carbon steel S 235 JR, lined with high temperature insulation material, bolted to the pressure body. The sealing is made with ceramic fiber ropes. The chamber can be easily removed, for maintenance purpose, using a lifting lugs located above.
- Insulation in mineral wool panels, thickness: 100 mm; density: 100 mg/m3.
- External finishing in stainless steel.
- Black, high temperature paint for front and back smoke chambers.
- Base-frame integrated to the pressure body, made in structural carbon steel. The boiler shall be installed on a concrete or steel base, able to support its weight.
- Accessories installed on left side referred to burner front (as standard)
- Boiler body certificated according to 2014/68/EU PED, Design code EN12953.

VALVES AND ACCESSORIES

- N. 1 steam outlet stop valve, globe type, PN16.
- N. 2 spring safety valves, PN16
- N. 1 blow-down valve, PN16.
- N. 1 tap for external manifold.
- N. 1 valve for pressure gauge.
- Water line composed of N. 1 globe valve and N. 1 check valve.
- N. 1 feed water pumps, in vertical arrangement, with motor

INSTRUMENTATION

- N. 1 pressure gauge for steam pressure indication
- N. 1 pressure transmitter for burner modulation
- N. 1 safety pressure switch for high steam pressure alarm and interlock.
- N. 3 level probes for level control (pump start, pump stop, ground)
- N. 2 low level probes and switches for low level alarms and interlocks.
- N. 1 visual level indicators.

72H UNMANNED OPERATION (in option)

It includes:
Sample cooler in SS and valve
TDS control system (TDS conductivity probe, Touch screen regulator on control panel, Superficial pneumatic valve)
Pneumatic valve with temporized opening control for automatic blow down, DN40
Burner suitable for 72h operation, manual tests (not electric)

BURNER

Monobloc burner, suitable for LNG with modulating combustion regulation.
Complete with Gas train, Burner Management System, air fan complete.
O2 probe for combustion optimization in option.

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CONTROL PANEL

Cabinet for monitoring and control, manufactured according to CE standards, enclosure IP 54, complete with: Main switch; Safety relays for safety chains; Burner motor protection; Pump motor protection; Control module for burner modulation, management of pump(s) and alarms; Alarm reset; Emergency stop.
Boiler control system SMC with HMI installed in the boiler control panel.
Control panel supplied loose. Junction box supplied on boiler board.

TECHNICAL DOCUMENTATION

- Equipment drawing with foundation loads (ENGLISH – digital)
- Transport drawing with dimensions, weights and indications on handling (ENGLISH – digital)
- P&ID for water/steam and combustion (ENGLISH – digital)
- Electrical diagrams (ENGLISH – digital and paper)
- Boiler Instruction and maintenance manual (ENGLISH and GREEK – digital and paper)
  Note: instruction manual of instruments and accessories in English only.
- Boiler management system “SMC” manual (ENGLISH – digital)
- Boiler control panel HMI language: ENGLISH
- Boiler and Control Panel CE Certification (ENGLISH – digital)
- Boiler main components documentation and CE Certification (ENGLISH – digital)
- Signals serial list (ENGLISH – digital)

Standard of documentation: BONO STANDAR

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