



**Steam boiler – FT model
n.1 x 3 ton/h @10 bar(g)**

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1 TECHICAL HIGHLIGHTS AND SPECIFICATION

1.1 INTRODUCTION TO STEAM BOILER - FT SERIES

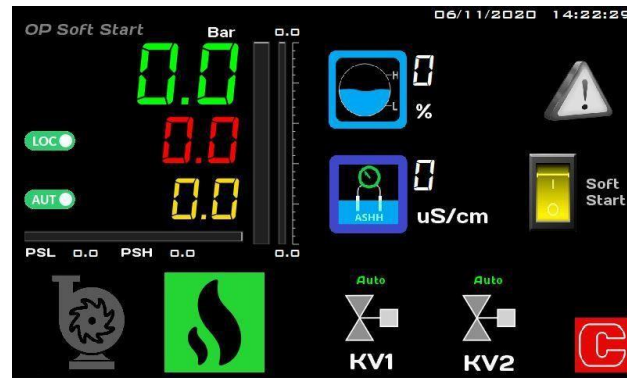
The fire tube steam boiler **FT series** are an efficient and compact solution, available in different configurations, based on market demands. These boilers are optimized for combination with any market burner.



<u>CHARACTERISTICS</u>	<u>ADVANTAGES</u>
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, biogas 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.

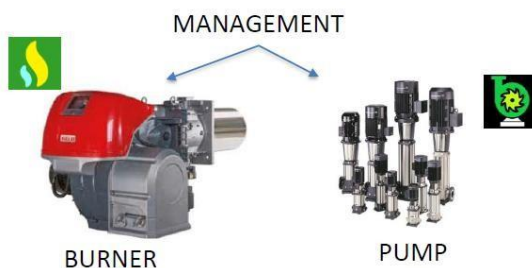
1.2 STEAM MATIC CONTROLLER

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



2 INTRODUCTION

2.1 DESIGN DATA

This offer has been prepared based on the following design data:

Project 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	3.000 kg/h
Design pressure	12,0 bar(g)
Maximum Operating pressure	10,0 bar(g)
Main fuel	LPG Gaseous 200-250mbar stabilized
Emissions @3%O ₂ _dry	NO _x < 200 mg/Nm ³ CO < 50 mg/Nm ³
Boiler feed water quality	According to EN 12953:10
Boiler feed water temperature	90 °C

3 CODES AND STANDARDS

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

4 TECHNICAL SPECIFICATION

4.1 TECHNICAL DATASHEET

DIMENSIONAL DATA

		FT 300
Length (with burner)	mm	4.900
Width (with accessories)	mm	2.250
Height (ECO version)	mm	2.500
Flue gas outlet flange (i)	mm	294 x 980
Empty weight	ton	4,9

FUNCTIONAL DATA

Design pressure	bar _g	12,0
Maximum operating pressure	bar _g	10,0
Steam quality	%	> 99,5
Boiler feed water temperature (± 5°C)	°C	90
Steam production capacity	kg/h	3.000
Heat transferred to steam	MW	2,0
Thermal Efficiency (basic version) @100%	%	89,0 ± 1
Thermal Efficiency (ECO version) @100%	%	92,0 ± 1
Pump flow rate (each)	m ³ /h	3,5
Pump static pressure (each)	mcl	140
Pump installed power	kW	4,0

Thermal efficiency, steam capacity and fuel consumption are calculated according to EN 12553-11 "indirect method".

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.

Table 4-2

Parameter	Unit	Boiler water for steam boilers using			Boiler water for hot water boilers
		Feedwater direct conductivity > 30 $\mu\text{S/cm}$	Feedwater direct conductivity $\leq 30 \mu\text{S/cm}$		
Operating pressure	bar (= 0,1MPa)	> 0,5 to 20	> 20	> 0,5	total range
Appearance	—	clear, no stable foam			
Direct conductivity at 25 °C	$\mu\text{S/cm}$	< 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 Na₃PO₄, additional NaOH injection only if the pH value is < 10.
^c If the acid conductivity of the boiler feedwater is < 0,2 $\mu\text{S/cm}$, and its Na + K concentration is < 0,010 mg/l, phosphate injection is not necessary. Under the conditions AVT (all volatile treatment, feedwater pH $\geq 9,2$ and boiler water pH $\geq 8,0$) can be applied, in this case the acid conductivity of the boiler water is < 5 $\mu\text{S/cm}$.
^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 PO₄-concentrations are acceptable (see also clause 4).
^f See ^e in table 5-1.

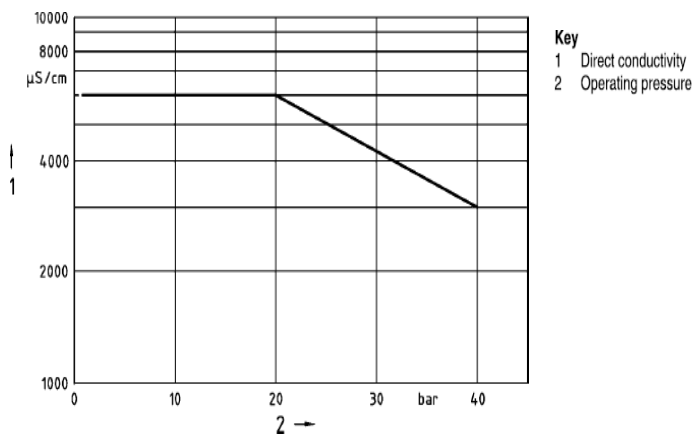


Figure 4-1: Maximum acceptable direct conductivity of the boiler water depending on pressure; feed water direct conductivity >

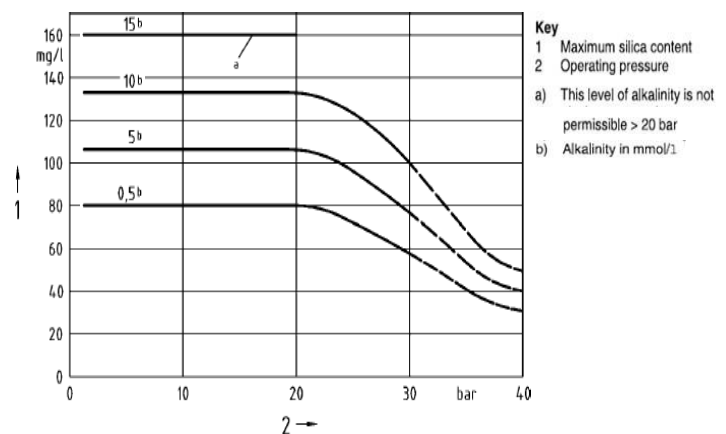


Figure 4-2: Maximum acceptable silica content (SiO₂) of the boiler water depending on pressure.

4.3 TECHNICAL SPECIFICATION – FT BOILER

BOILER BODY

Dry-back two-passes boiler structure. Horizontal cylindrical furnace. Shell equipped with a manhole for internal cleaning and inspection, N.1 handhole (n.2 from FT 400), flanged connections: steam outlet, safety valve/s, drain/s, internal distribution, instruments and probes, surface drain. N.2 lifting eyebolts. Internal steam trap, to ensure high steam dryness. Tube sheets fully welded to the shell and furnace. Smoke tubes expanded and welded to the tube sheets.

Materials:

- Furnace, shell and gussets: rolled steel P355 EN10028 or equivalent, tube sheets P295 EN10028 or equivalent
- Smoke tubes: rolled steel ASTM A 210 Gr.A1 or equivalent (seamless tubes) - Flanges: Forged steel ASTM A105
- Pipes: Rolled steel ASTM A 106 Gr.B.

All materials with a 3.1 certificate of conformity according to EN10204.

Flanged connections according to PN16 EN1092-1 (water supply is always PN40).

CE PED certification as equipment; Risk Class IV, verification module B+F (CE), hydraulic test, and calculation standard EN12953.

Design and manufacturing supervised by a Notified Third Party Body.

QCP Bono standard (quality control supervised by an NB); Radiographic inspections (RT): 10% butt joints, 100% crossovers; Ultrasonic inspections: 25% welds on tube sheets, manholes, lifting lugs, and flat bottoms; magnetic particle or dye penetrant inspections: nozzles, flanges, and flue pipes. Metal plate bearing the factory number, CE marking, and technical data.

Front smokebox carbon steel made sheet with ribbed profiles; N.2 bolted and thermally insulated doors for complete access to the front tube sheet for cleaning and inspection. Rectangular upper flue gas flange, also suitable for economizer placing (optional). 1/2" connection for flue gas temperature measurement. Burner mounting connection with refractory concrete. Sight glass with high-temperature glass and protective gate; combustion chamber pressure measurement connection. Back smoke chamber made in carbon steel S 235 JR, lined with high temperature insulation material, bolted to the pressure body; internally with a double layer of refractory concrete. The chamber can be easily removed for maintenance having full access to the rear tube sheet, using a lifting lugs located above.

Base frame made of metal sections consisting of: fixed front saddle, movable rear saddle with sliding devices; metal ground support profiles, supports for mounting the feed pumps. Stainless steel plate for the ground connection.

Set of removable turbulators inserted in the smoke tubes to intensify heat exchange.

Mineral wool insulation, thickness 100 mm, density 100 kg/m³; stainless steel or Aluzinc® sheet metal finish with galvanized steel screws.

Painting of non-insulated parts: cleaning, two coats of silicone paint at high temperature for a total thickness of 50-70 microns, black color.

Accessories installed on left side referred to burner front (as standard).

COMBUSTION SYSTEM

Monoblock burner, fully automatic, modulating version with low-emission, consisting of:

- full external casing
- metal casing with heat generator connection flange and sight glass
- stainless steel combustion head with diffuser disc and fuel nozzles
- combustion air-side safety pressure switch to shut off the burner (air fan failure or malfunction)
- fuel flow regulating valve
- servomotor(s) to operate the air damper and fuel valve
- combustion air damper with full closure to minimize energy losses related to boiler cooling
- flame detection probe

- digital BMS control system with remote unlocking and self-diagnostics function to identify any malfunctions (from burner supplier)
 - low-noise centrifugal combustion air fan coupled with motor managed by frequency converter.
 - air/fuel ratio control devices to ensure optimal flame combustion parameters
 - fuel train with control pressure switches and shut-off valves (for gas burners, train compliant with EN676, excluding the filter, anti-vibration mount, manual valve, and stabilizer, including a leak detection system for power capacities over than 1.200 kW)
 - devices for internal burner accessibility for inspection and maintenance.
- The electrical power supply is provided through the boiler control panel; the burner is supplied assembled, connected to the boiler, and functionally tested.
- O2 probe for combustion optimization (option).
- The burner is CE certified in compliance with applicable European directives and product standards.

ACCESSORIES CE-24H

- Manual steam outlet and drain valves, flow-through type, with packing seals, flanged according to PN16 EN1092-1. Valve body in ductile iron GGG40 for PN16, carbon steel for PN40. Manual ball valves PN40 steel made for the water supply.
- Valve connections:
- N.1 Steam outlet valve
 - N.2 boiler body drain valves (one with quick release)
 - N.1 Manual boiler water inlet valve
 - N.1 check valve for boiler water inlet
 - N.2 stilling wells inside the boiler body for level probes placing
- N.2 pressure safety valves, factory-calibrated, with flanged inlet and drain connections. The valves are sized to discharge the maximum steam capacity produced by the boiler with a maximum overpressure of 3% compared to the set value. The maximum backpressure considered downstream of the valve is equal to 10% of the trip pressure. The valves are supplied with a PED certificate of conformity and a manufacturer's calibration certificate.
 - Pressure gauge with stainless steel case for local boiler pressure indication.
 - PED Class IV certified safety pressure switch as a limiter with manual reset high-pressure cut-out.
 - Steam pressure transmitter with 4-20 mA signal and digital regulator with boiler pressure indication mounted on the front of the control panel, equipped with a modulating burner load control output and standby threshold.
 - N.1 level gauges with reflective glass and metal armor. Flanged connections with drain and shut-off valves. (Note: A second indicator is available as an option for the FT200.)
 - N.3 conductive probes for boiler level regulation. Relay on the back of the panel for pump start/stop.
 - (For version with modulating water level regulation, these are replaced by start/stop thresholds on the level regulator.)
 - N.3 conductive probes for redundant stopping of the feed pumps. Relay on the back of the panel.
 - N.2 self-monitoring conductive safety probes for very low boiler level. Relay on the back of the panel for very low water level with manual reset boiler shutdown. The safety chain is certified as PED Class IV and has a SIL2 safety level according to IEC61508-2.

Burner and accessory assembly and blank functional testing.

CONTROL PANEL CE-24H

Electrical panel compliant with EN 60204 and EN 61439 standards installed on the machine. IP54 metal carpentry powder-coated RAL 7035 (grey) with front door. CE identification data plate. Safety hatch disconnect switch. Start, stop, and reset buttons. Mushroom-head lock button compliant with ISO 13850. Safety chains for limiters with SIL relays. Front panel regulators/indicators for process variables. Visual status and alarm signals. Acoustic lock signal (SMC and Optispark versions).

Cumulative alarm and cumulative lock signal contacts in the terminal block. 230V auxiliary section (230V and 24V for SMC and OPTISPARK versions) for managing safety and regulation logic. Signal wiring carried out with 1.5 mm² cables terminated with cable lugs and marked with the numbering shown in the diagram. Ground terminal or bar for equipotential connection of field electrical equipment. Power section with devices for controlling and protecting the burner and field equipment (when included). Numbered terminal block for connecting the panel to the field. Remote lockout contact provision. Single-line wiring diagram with multiple pages for immediate consultation. Forced ventilation (IP23) is provided for Optispark panels (optional). TN-S power supply system with ground cable. Power supply voltage: 400V, 3-phase + N. Frequency: 50Hz. Environmental conditions: installation protected from weather and direct sunlight, minimum temperature 10°C, maximum temperature 40°C. Safety testing and CE certificate of electrical conformity. Housing for safety relay of probe and control logic.

72 H UNMANNED OPERATION KIT (option)

TDS boiler water salt concentration monitoring system consisting of:

- conductivity probe mounted inside the boiler body for conductivity measurement
- regulator/limiter mounted on the QE with process variable indication
- DN15 stainless steel automatic surface blowdown valve with electro-pneumatic control

Automatic blowdown system consisting of

- DN32 stainless steel automatic bottom drain valve (DN40 for sizes 500 and 600) with electro-pneumatic control
- timer device mounted on the QE

Boiler water sampling system consisting of:

- sampling tank with stainless steel coil and water-cooled containment jacket
- sampling valve

On boiler control panel:

- SIL safety chain for shutdown in the event of very high feedwater conductivity.
- SIL safety chain for shutdown in the event of a feedwater system fault (signal supplied by the installer).
- Conductivity regulator housing and control logic.

Note. The customer is responsible for a condensate and water treatment analysis and monitoring system. A risk analysis must determine if polluted condensate return (with oils, acids, organic substances, etc.) or feed water treatment fault is possible. If so, a monitoring system must be in place to divert polluted condensate or feedwater to a drain and trigger an immediate boiler lockout if contaminant limits are exceeded.

BOILER CONTROL SYSTEM SMC

PLC for regulation and control of the boiler functionalities, including rear panel CPU and front panel 7" touch screen HMI.

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
- TDS control loop through discharge valve
- Ongoing alarms display:
 - High steam pressure alarm
 - Burner lockout alarm
 - Low water level alarm
 - High water conductivity alarm (TDS)
 - Bad feed water quality alarm (coming from the plant)
 - Bad quality signals alarm

- High water level alarm
- Alarm log display
- Trend display of:
 - Steam pressure
 - Steam pressure setpoint
 - Water level
 - Water level setpoint
 - Water conductivity
- Date and time function
- Digital signals available to the boiler user:
 - Heater lockout
 - Heater alarm
- Analog signals from/to the heater user plant (4-20mA):
 - Actual steam pressure (AO)
 - Remote steam setpoint (AI)
- MODBUS communication for remote reading of operating variables

FEED WATER PUMP SKID

N.1 Vertical stainless steel pump, multistage impeller, directly coupled to an IEC3 electric motor managed by frequency converter.

Placed connected to the boiler base frame, mechanically connected including check valve and connection piping, and electrically wired at the control panel.

Control logics provided by electrical panel.

Electrical protection with circuit breaker and start/stop contactor.

SECOND FEED WATER PUMP (option)

Additional pump with same characteristics and logics.

Supplied mounted on the boiler base frame, also including manual isolation valve.

ECONOMIZER (option)

Finned tube heat exchanger (feedwater-flue gas exchanger), placed on the boiler front smokebox structure, consisting of: rectangular-section air containment frame made of carbon steel sheet with reinforcing ribs; bolted flanging for flue gas inlet and outlet; horizontal carbon steel finned tubes welded to end manifolds; flanged water inlet/outlet connections; threaded connections for temperature and pressure gauges. Water outlet thermometer.

Non-interceptable piping for connection to the generator body and feed pump.

The economizer is PED-certified as pressure equipment.

Painting: cleaning, 2 coats of high-temperature silicone paint for a total thickness of 50-70 microns, black.

Feedwater modulation system consisting of:

- Continuous capacitive level measurement probe
- PID controller mounted on the control panel with pump start/stop thresholds and modulating valve control
- Modulating electro-pneumatic valve in carbon steel with positioner

BY-PASS ECONOMIZER (option)

Manual economizer bypass system consisting of the following components:

- N.3 PN 40 manual ball valves for shutting off and bypassing the economizer
- Superheated water/steam safety valve for economizer protection
- N.1 manual valve for draining the economizer

Hydraulic interconnection lines

CE-PED ASSEMBLY CERTIFICATION

CE PED certification for the assembly, including all equipment already certified through an independent procedure (body, economizer, etc.) and all supplied safety accessories, risk class IV, module B+F.

Safety accessories tested in the workshop under NB supervision.

Metal plate riveted to the QE bearing the factory number, CE marking, and technical data.

CE ASSEMBLIES certificate and EXEMPTION (where applicable).

FLUE GAS CHIMNEY CONNECTION (option)

Metal carpentry for adapting the rectangular flue connection to a circular chimney.

The fitting consists of a carbon steel body with flanged ends for direct mounting on the boiler's flue outlet. It allows for vertical support of the chimney up to a maximum height of 10 mt from the floor.

The fitting is supplied fully coated with high-temperature paint.

4.4 TECHNICAL DOCUMENTATION

- ✓ Equipment drawing with foundation loads (ENGLISH – digital)
- ✓ Transport drawing with dimensions, weights and indications on handling (ENGLISH – digital)
- ✓ PCID 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 (local language only if available from the supplier)
- ✓ 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 STANDARD

4.5 VENDOR LIST

COMPONENT	MANUFACTURER
Pressure parts	CANNON BONO
Insulation	CANNON BONO
External finishing	CANNON BONO
Burner	RIELLO
Feed water pump	GRUNDFOS or equivalent
Safety valves	BESA / CARRARO or equivalent
Manual valves	KSB / MIVAL / EFFEBI or equivalent
Pressure gauges	WIKA / OMET or equivalent
Pressure switches	DANFOSS or equivalent
Pressure transmitter	JUMO or equivalent
Thermometers	OMET or equivalent
Level gauges	BONETTI / DIESSE or equivalent
Level probes	MMT or equivalent
Electrical components	ABB or equivalent