ENTROPIE
INDUSTRIAL BOILERS

ENTROPIE HOT-WATER BOILER

TT150 up to 20000 kW

Preamble

CE

This device meets all basic requirements of relevant standards and guidelines.

Its conformity has been verified. All associated documents and the original Declaration of Conformity are available from the manufacturer.

A copy of the Declaration of Conformity is included in the installation and maintenance instructions.

Subject to technical modifications.

Constant development may lead to minor deviations of illustrations, functional steps and specifications from those described/ shown.

Updating your documentation

Please let us know if you would like to make suggestions to improve our documentation or if you have noticed any errors.

Regulations and directives

Installation:

90/396/EEC gas appliance directive
92/42/EEC boiler efficiency directive
73/23/EEC low voltage directive
89/336/EEC EMC directive
2014/98/EU pressure equipment directive

Contents

Field application TT150 boilers

ENTROPIE boiler TT150 is a three-pass gas-fired hot water boiler with a heat output of up to 20 MW.

ENTROPIE boiler TT150 is designed to supply heat to buildings and structures and provide engineering processes of various purposes.

Field of application: Stationary boiler houses used in closed and open heat supply systems.

The boilers can be transported by rail, road and water transport, in accordance with the goods transportation regulations for each type of transport. The boilers are supplied as one prefabricated transportable unit.

The warranty period, upon condition that the transportation, storage, installation and operation conditions are met, is 36 months from the start-up date, but no longer than 42 months from the shipment date.

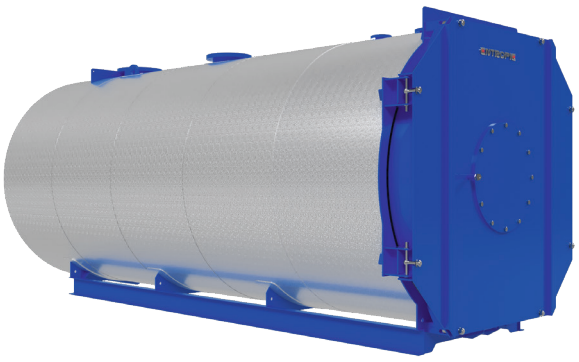


Figure 1a — General view of TT150 boiler with a heat output of up to 5000 kW. Type A

Figure 1b — General view of TT150 boiler with a heat output of up to 20000 kW. Type B

TT150 operation principle

ENTROPIE boiler TT150 with a heat output of up to 5000 kW is designed as a three-pass gas-fired boiler. See Fig. 2a for TT150 boiler operation schematic diagram.

The combustion chamber — fire tube (1) and boiler body have a cylindrical shape. The convective heating surfaces are formed by second and third pass flue tubes (2), (3) arranged axisymmetrically around the combustion chamber. Two/three-row layout of the second pass flue tubes provides high heat exchange rate, which increases the boiler efficiency level.

The fully washable first reversal chamber (4) is comprised of the rear tube sheet and the torospherical bottom (5). The second reversal chamber (6) is comprised of the front tube sheet and an indentation made specifically for the burner type used and located in the boiler front door refractory lining (7).

The front door of the boiler (8) can fully open with the burner installed (9) in any direction. Opening the front door provides easy access to the combustion chamber and flue tubes for maintenance and cleaning the boiler. The first reversal chamber is inspected and cleaned through the combustion chamber.

An inspection manhole (10) for inspection of the flue tubes and the fire tube on the coolant side is provided in the upper part of the boiler body.

The exhaust gas header is cleaned through the access manhole of the boiler exhaust gas collection chamber (11).

Water inlet and outlet nozzles (12) and (13), and emergency line nozzles (14) are located on top of the boiler. ENTROPIE boilers TT150 have two emergency line nozzles.

The design of the water inlet (12) and outlet (13) nozzles includes fittings for temperature sensors.

A water guiding element (15), which provides the most efficient distribution of coolant within the boiler, is installed under the water inlet nozzle.

The wide space between tubes and the large volume of water in the boiler ensure the optimal operation mode within the entire heat output range of the boiler.

The burner will be installed on a burner plate 16 on the front door. Visual control of the flame in the combustion chamber is carried out through the sight glass 17. The exhaust gas outlet nozzle 18 is equipped with a connecting flange and located in the upper part of the rear wall of the boiler.

To ensure uniform distribution of the weight load, the boiler has two steel bearing supports 19, welded to the lower part of the boiler body, and can be installed without additional foundation on a flat, solid floor that can support the load.

The high-performance continuous thermal insulation of the boiler 20 consists of 100 mm thick laminated mineral wool mats. The corrugated aluminum clad surface of the boiler will preserve its appearance for the entire service life 21.

The drainage nozzle 22 in the lower part of the boiler allows to completely remove the coolant if necessary. A drain fitting 23 for condensate removal will be installed in the lower part.

Lifting lugs located symmetrically relative to the center of mass of the boiler are provided on the boiler body for moving the boiler during installation and loading/unloading works.

The three-pass gas path of the boiler with a low combustion intensity of the combustion chamber makes it easy to adjust boiler combustion modes and minimizes emissions of harmful combustion products.

The low aerodynamic resistance of the boiler allows to choose an optimal burner. The fastening of the first reversal chamber of the boiler on a single supporting sliding or rigid (for boilers with a heat output of over 8.0 MW) anchor on the boiler furnace structure provides compensation for cyclic thermal stresses and, therefore, a longer service life of the boilers.

Diagram of a TT150 boiler with a heat output of up to 5000 kW

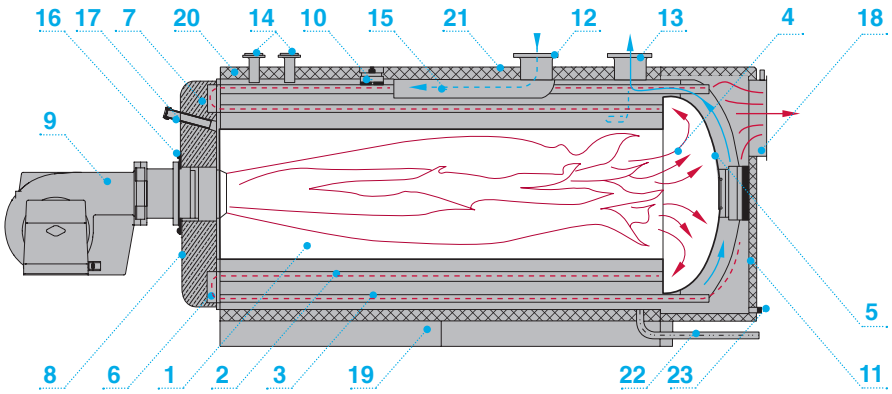


Figure 2a — Schematic operation diagram of a TT150 boiler with a heat output of up to 5000 kW. Type A

1. Fire tube
2. Second pass flue tubes
3. Third pass flue tubes
4. First reversal chamber
5. Torispherical bottom
6. Second reversal chamber
7. Front door refractory lining
8. Front door of the boiler
9. Burner
10. Inspection hole
11. Access manhole
12. Water inlet nozzle
13. Water outlet nozzle
14. Emergency line nozzle
15. Water guiding element
16. Burner plate
17. Sight glass
18. Flue gas outlet nozzle
19. Steel bearing supports
20. Thermal insulation
21. Aluminum checkered cladding
22. Drainage nozzle
23. Drain fitting

Operation principle of a TT150 boiler with a heat output of over 5100kW

ENTROPIE boiler TT150 is designed as a three-pass gas-fired boiler.

The combustion chamber — fire tube 1 — and the boiler body have a cylindrical shape. The convective heating surfaces are formed by second and third pass flue tubes 2 and 3. The multi-row layout of the second and third pass flue tubes ensures a high heat exchange rate.

The fully water-washable first reversal chamber 4 consists of a shell and two flat flanged bottoms. The second reversal chamber 5 is comprised of the front bottom of the boiler, the chamber frame and the front doors of the boiler.

The front doors of the boiler 6 provide easy access to the flue tubes during maintenance and cleaning of the boiler. The combustion chamber and the first reversal chamber are inspected and cleaned through the manhole 7 in the lower part of the boiler rear bottom; there is also a sight hole for visual control of the flame.

The fire tubes are inspected from the water side through the inspection hole in the upper part of the boiler body. Inspection holes 8 in the lower part of the body provide visual control across the entire length.

Water inlet and outlet nozzles 9 and 10, and emergency line nozzles 11 are located on top of the boiler. ENTROPIE boilers TT150 have two emergency line nozzles. The design of the water inlet 12 and outlet nozzles 13 includes fittings for temperature sensors.

A water guiding element 12, which provides the most efficient distribution of coolant within the boiler, is installed under the water inlet nozzle. The wide space between tubes and the large volume of water in the boiler ensure the optimal operation mode within the entire heat output range of the boiler.

The drainage pipeline 13 in the lower part of the boiler allows to completely remove the coolant, if necessary. Drain fittings 14 for condensate removal are provided in the lower part of the flue box.

The burner 15 will be installed on a mounting plate 16 in the front part of the boiler. Visual control of the flame in the combustion chamber is carried out through the sight hole located on the rear face of the boiler.

A flue gas collection chamber (flue box) with a flue gas outlet nozzle 17 and inspection holes is installed in the upper part of the rear wall of the boiler. The flue gas outlet nozzle is equipped with a connecting flange.

To ensure uniform distribution of the weight load, the boiler has two steel bearing supports 18 welded to the lower part of the boiler body, and can be installed without additional foundation on a flat, solid floor that can support the load.

The high-performance continuous thermal insulation of the boiler 19 consists of 120 mm thick laminated mineral wool mats. The boiler surface is clad with embossed aluminum 20, which preserves its appearance throughout the service life.

Slinging devices (eyebolts) located symmetrically relative to the center of mass of the boiler are provided on the boiler body for moving the boiler during installation and loading/unloading works.

The three-pass gas path of the boiler with a low combustion intensity of the combustion chamber makes it easy to adjust boiler combustion modes and minimizes emissions of harmful combustion products. The low aerodynamic resistance of the boiler allows for optimum burner selection.

The multi-row layout of the second and third pass flue tubes and the design of the flue gas reversal chambers provide a large combustion space and increase the area of heating surfaces, which increases the heat exchange rate and the boiler efficiency level.

Diagram of a TT150 boiler with a heat output of over 5100 kW

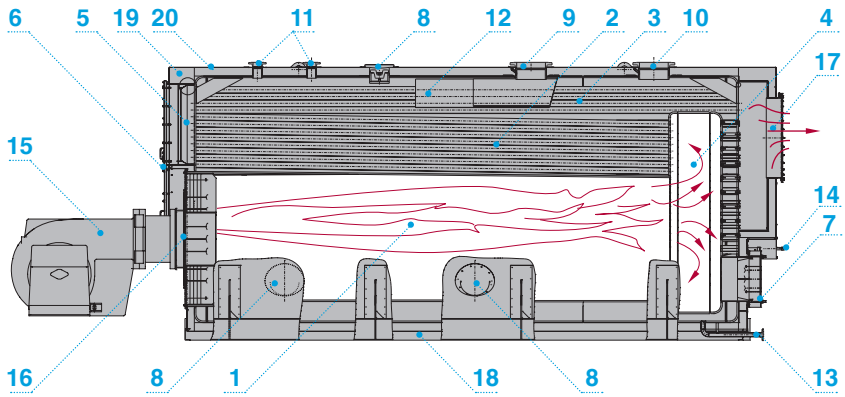


Figure 2b — Schematic operation diagram of a TT150 boiler with a capacity of up to 20000 kW. Type B

1. Fire tube
2. Second pass flue tubes
3. Third pass flue tubes
4. First reversal chamber
5. Second reversal chamber
6. Front doors of the boiler
7. Manhole
8. Inspection holes
9. Water inlet nozzle
10. Water outlet nozzle
11. Emergency line nozzle
12. Water guiding element
13. Drainage pipeline
14. Drain fitting
15. Burner
16. Burner plate
17. Flue gas outlet nozzle
18. Steel bearing supports
19. Thermal insulation
20. Embossed aluminum cladding

Technical characteristics of TT150 boilers

Table 1

Main operating parameters of the boiler

Rated heat output, kW	1000	2000	2500	3000	3500	4200	5000	6000	6500	8000	10000	12000	15000	16500	20000
Maximum excess water pressure, bar, max	10														
Maximum water temperature, °C	150														
Minimum water temperature at the boiler inlet, °C	70														
Specified service life, years, min	20														
Specified operation time, h, min	150000														
Maximum temperature in the furnace, °C	1893														
Safety device set pressure, bar	10														
Test pressure, bar	14.7	14.7	14.9	14.9	14.9	15.1	15.1	15.1	15.1	15.3	15.3	15.3	15.3	15.3	
Efficiency level for natural-gas-fired boiler, %	90.6	89.8	89.3	89.6	90.4	91.8	91.5	91.7	90.5	90.8	91.0	89.9	90.9	90.6	92
Hydraulic resistance of water path, kPa	1.91	3.73	6.24	2.28	3.11	4.31	6.11	4.64	6.00	5.20	6.69	6.11	5.84	7.03	
Flue gas flow rate, kg/s	0.45	0.91	1.14	1.37	1.58	1.87	2.23	2.67	2.93	3.60	4.49	5.45	6.74	7.43	8.9
Aerodynamic resistance of gas path for maximum capacity*, Pa	0.27	0.86	1.05	0.93	1.30	1.31	1.92	2.58	1.17	1.32	1.53	1.54	1.89	2.35	1.80
Temperature of exhaust gas, °C	220	236	246	240	224	194	202	196	221	216	212	233	215	220	192.5
Rated water flow rate through the boiler, m^3/h	60.6	121.2	151.4	181.7	212.0	254.4	302.9	363.5	393.7	484.6	605.8	726.9	908.6	999.5	
Boiler water volume, m^3	1.8	2.6	2.7	3.8	4.3	5.1	5.1	5.9	6.8	8.7	10.9	13.5	17.6	17.6	35
Dry boiler weight (weight tolerance 4.5%), kg	3547	5078	5571	7575	8246	10431	10431	11589	15007	18089	21119	25498	31482	31482	42190
Boiler weight with water, kg	5367	7672	8268	11375	12535	15563	15563	17477	21855	26787	31996	38968	49064	49064	

Overall and connecting dimensions of TT150 boiler

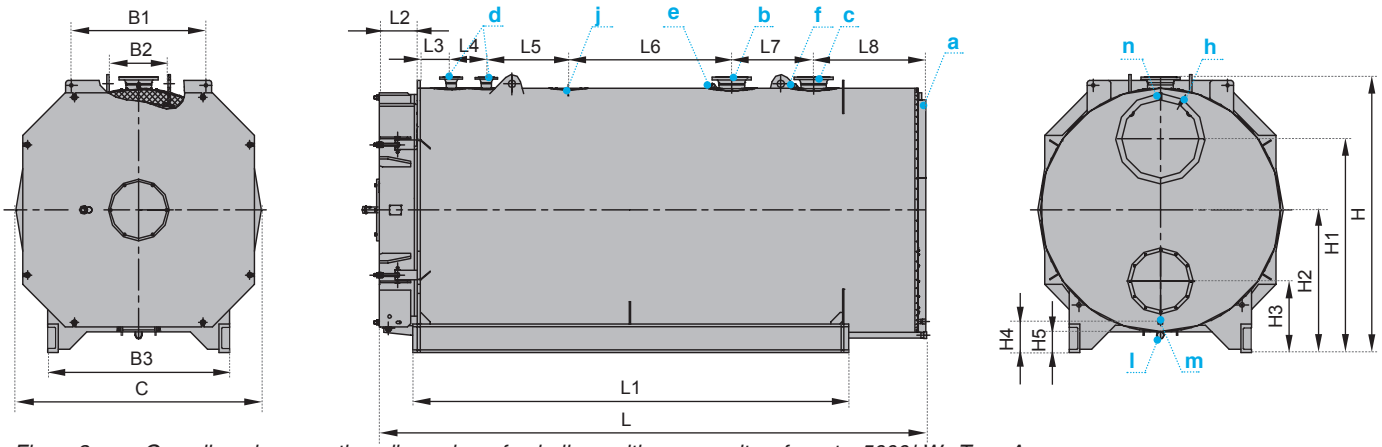


Figure 3a — Overall and connecting dimensions for boilers with a capacity of up to 5000 kW. Type A

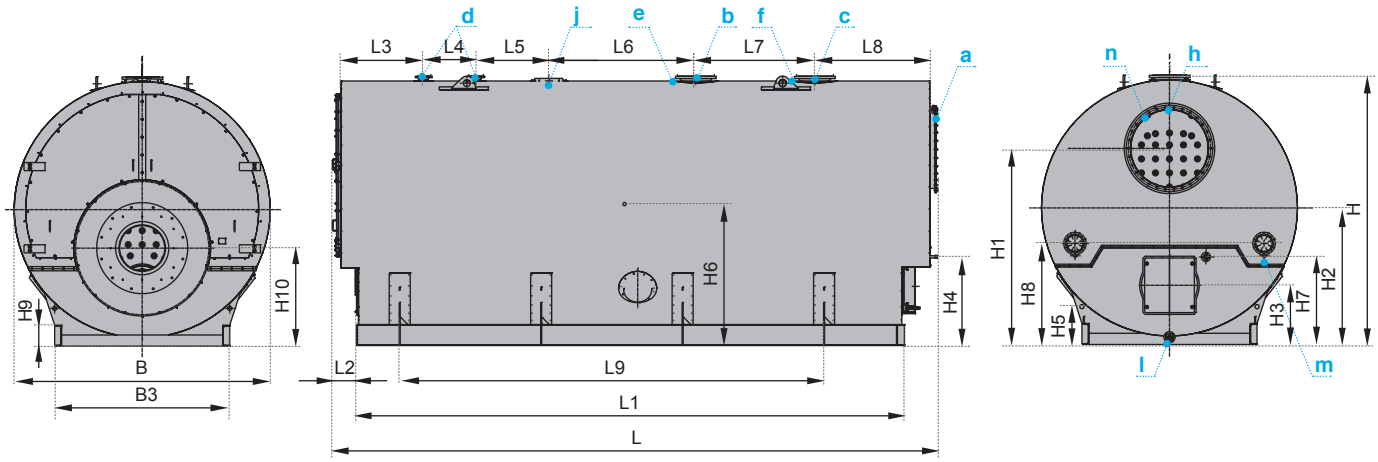


Figure 3b — Overall and connecting dimensions for boilers with a capacity of over 5100 kW. Type B

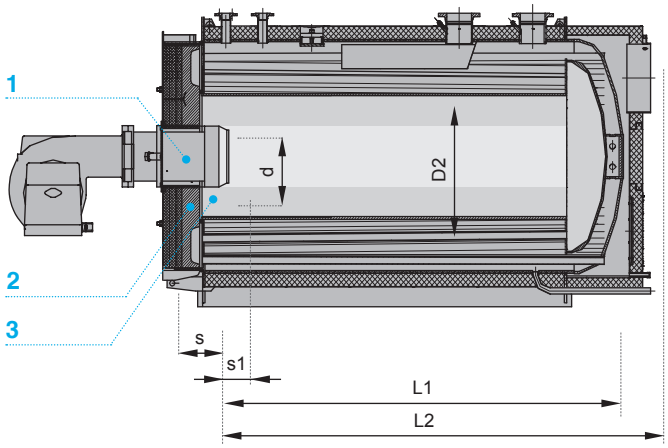
Table 2
Overall and connecting dimensions

Standard size of the boiler		5000	20000
Exhaust gas outlet, DN, mm	a	650	1100
Water inlet, DN, mm	b	200	400
Water outlet, DN, mm	c	200	400
Safety valve, DN, mm	d	80	125
Temperature sensor (inlet), DN, mm	e	G 1/2-B	G 1/2-B
Temperature sensor (outlet), DN, mm	f	G 1/2-B	G 1/2-B
Flue gas temperature sensor, DN, mm	h	G 1/2-B	G 1/2-B
Inspection hole, DN, mm	j	252 x 190	230 x 330
Boiler water drain, DN, mm	l	G 1/2-B	50
Condensate removal, DN, mm	m	G 1-B	G 1-B
Draft and head gauge, DN, mm	n	G 1/2-B	G 1/2-B
Length, mm	L	4830	8629
Width, mm	B	2100	3647
Height, mm	H	2326	3843
Support frame length, mm	L1	3730	7825
Distance, mm	L2	325	286
Distance, mm	L3	276	1174

Table 2
Continued

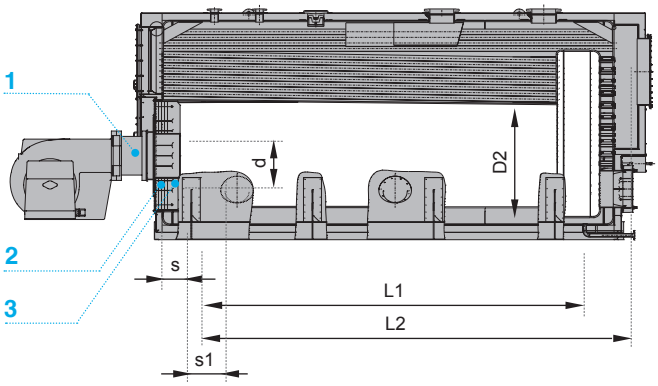
Standard size of the boiler		5000	20000
Distance, mm	L4	300	750
Distance, mm	L5	700	1024
Distance, mm	L6	1400	2100
Distance, mm	L7	700	1700
Distance, mm	L8	960	1641
Support frame width, mm	B3	1556	2500
Distance, mm	H1	1805	2800
Distance, mm	H2	1205	1950
Distance, mm	H3	605	845
Distance, mm	H4	266	1267
Distance, mm	H5	118	540
Distance, mm	H6	—	2021
Distance, mm	H7	—	1250
Distance, mm	H8	—	1443
Distance, mm	H9	—	300
Distance, mm	H10	—	1337
Distance, mm	L9	—	6060

Furnace dimensions of TT150 boiler



1. Burner flame head
2. Door refractory lining
3. Elastic heat-resistant thermal insulation material

Figure 4a — Burner installation. Type A



1. Burner flame head
2. Door refractory lining
3. Elastic heat-resistant thermal insulation material

Figure 4b — Burner installation. Type B

Table 3
Burner installation dimensions

Standard size of the boiler	5000	20000
Diameter of mounting hole, d, mm	450	650
Cover thickness including the transition plate, s, mm	320	472
Installation size of the burner s1, mm	20-60	20-60
Furnace chamber diameter, D2, mm	1000	1700
Fire tube length, L1, mm	3650	6250
Furnace chamber length, L2, mm	3990	6950

Burner selection and installation

The aerodynamic characteristics and arrangement of burners shall ensure that the flame is distributed evenly within the furnace, without affecting the walls, and prevent the formation of stagnant or poorly ventilated areas within the furnace.

Burners used with ENTROPIE boilers TT150 shall be of forced air draft type with adjustable excess air factor. The start-up of the burners, the purging of the combustion chamber, and operation and shutdown shall be automatic.

ENTROPIE boilers TT150 require excess pressure in the furnace chamber to operate. Burners shall be selected taking into account the length and diameter of the furnace, and the aerodynamic resistance of the boiler. It is permitted to use automatic multi-stage and modulated (gas, liquid-fuel or combined) burners.

When ordering a burner, ensure that its connecting dimensions and the dimensions of its flame head meet the technical requirements for the boiler and this technical description. An additional extension and/or intermediate flange shall be ordered if the burner is equipped with a short or long flame head.

The burner gas line shall include a compensator. This will facilitate the removal of mechanical loads on the gas pipeline both during operation of the boiler and in case of accidental changes in the position of the boiler front door after opening/closing during maintenance and cleaning.

The burner flame head shall be installed in accordance with the manufacturer's requirements. The burner flame head shall completely fit in the furnace chamber.

The space between the burner flame head and the rigid thermal insulation of the boiler shall be packed with an elastic thermal insulation material supplied together with the boiler (it shall be installed around the burner hole of the flange).

The burners shall ensure safe and cost-effective operation of the boilers.

The burners shall have manufacturer datasheets containing the basic information (name and address of the manufacturer, serial number, manufacture date, design/structural solutions, main dimensions, parameters of working fluids, type, capacity, adjustment range, main technical characteristics, etc.).

Boiler arrangement

Spacial planning and design/structural solutions for burners shall comply with the applicable local rules and regulations, while meeting the manufacturer's requirements for the minimum distances.

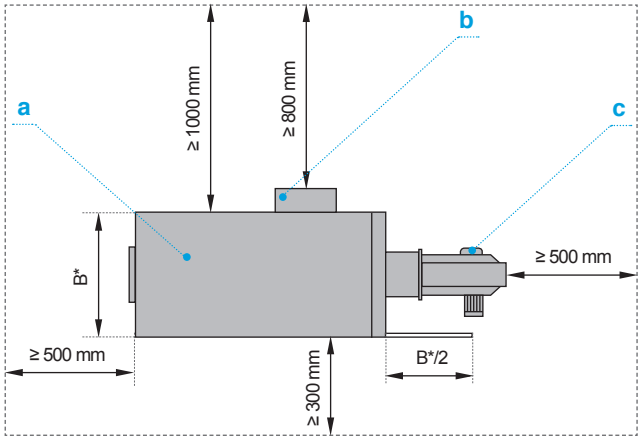


Figure 5 — Burner installation. Minimum distances

Table 4

Name	5000	20000
Minimum width of the opening, mm	2200	4065
Minimum height of the opening, mm	2426	4119
Platform length, mm	3730	7835
Platform width, mm	1556	2540

a Boiler

b Boiler automation

c Burner apparatus

* See the boiler technical data for dimension "B"

Flue gas temperature and flow rate

With the correctly controlled combustion conditions and clean heat exchange surfaces of the boiler, the exhaust gas temperature depends on the heat capacity of the boiler and the presence of intraboiler water.

The exhaust gas flow rate (Table 5) depends on the boiler heat output and the type of fuel used for the boiler. It is necessary to control the temperature of flue gases and temperature changes at various boiler loads.

If the flue gas temperature rises by 30 °C above the temperature established in the process flow chart, it is necessary to clean the heat exchange surfaces both on the flue gas side and on the coolant side. The flue gas temperature shall prevent condensate formation for all operating modes. The temperature shall not exceed +250 °C.

Table 5

Flue gas flow rate

Name	Numerical value	
Rated heat output, kW	5000	20000
Exhaust gas flow rate when operating on natural gas, kg/s, max	1.87/2.23	9.00

Transportation

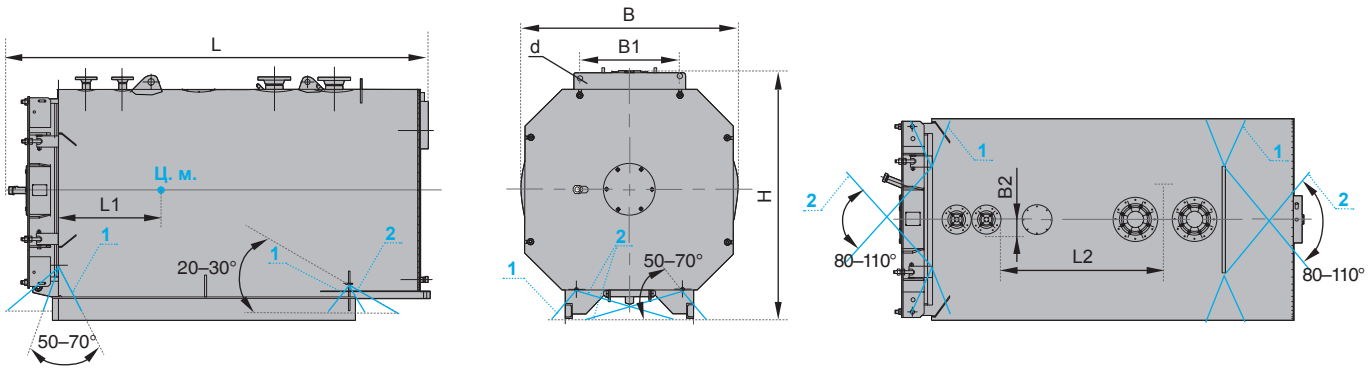
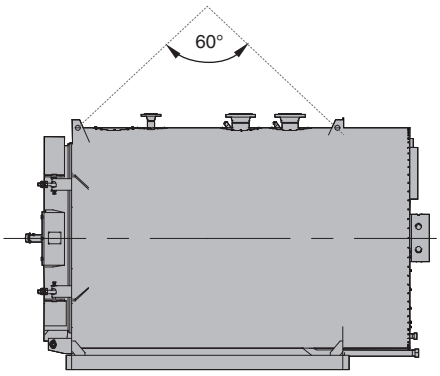


Figure 6a — Boiler transportation diagram. Type A



Symbol legend:

- • — Center of mass;
- —— — Fastener;
- 1 — Roll-over protection;
- 2 — Diagonal fastening.

Figure 7a — Boiler slinging schematic diagram. Type A

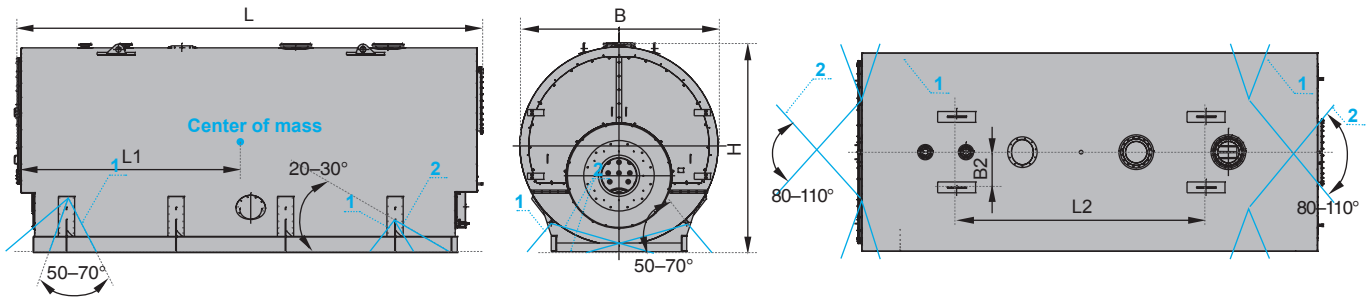


Figure 6b — Boiler transportation diagram. Type B

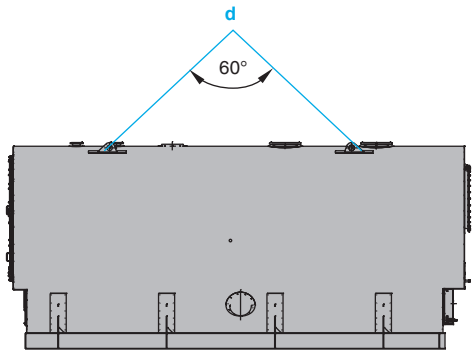


Figure 7b — Boiler slinging schematic diagram. Type B

Symbol legend:

● — Center of mass,

—— — Fastener;

1 — Roll-over protection;

2 — Diagonal fastening,

d — Slinging eyebolts.

Table 6

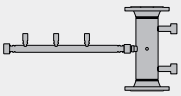
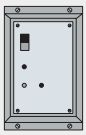
Boiler transportation dimensions

Name	Numerical value	
Rated heat output, kW	**5000**	**20000**
Length, L, mm	4830	8629
Width, B, mm	2100	3647
Height, H, mm	2326	3843
Distance, B2, mm	375	650
Center of mass, L1, mm	1842	4049
Distance, L2, mm	2300	4510
Mass, m, kg	10431	42190

Boiler accessories

At the customer's request, ENTROPIE can supply the following optional boiler accessories:

Table 7

	Burner plate
	Burner flange
	Safety group header for connection of sensors and instrumentation
	Minimum and maximum pressure limiters
	Safety valves
	Temperature sensors
	Three-way valve
	Boil-off protection sensor
Other boiler installation and maintenance accessories	

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