Step TRUTNOV a.s.

BIOMASS COMBUSTION BOILERS

BIOMASS COMBUSTION BOILERS

General description of the boilers

As a common feature, each type of boiler system consists of a combustion chamber placed above an overfeed stoker, underfeed stoker or a solid grate, and a vertical or horizontal exchanger. There is also a water-tube membrane combustion chamber. During instances of lower capacity, the chamber is only cooled by combustion air. The front part includes an inlet fuel neck. The fuel is forced via a hydraulic or screw feeder above the front part of the grate. The inlet neck is heated by hot water, whereby which the fuel undergoes pre-drying.

The boilers are supplied with all fittings, including insulation and metal sheeting. Ashes can be cleared from the boiler at the end of the grate either by a screw mechanism or different mechanical means. Flue gases flow out of the combustion chamber to a vertical or horizontal flue gas exchanger. The flue gas outlet from the exchanger can be tailored to the location of the boiler room according to individual plans.

1. Step KS boilers can be structurally adapted for combusting whole round bales.

2. The ideal size of a waste maize bale for combustion in Step KS boilers.

3. An example of one of the reference boiler plants for burning whole bales of straw, hay, flax, pressed paper boxes, etc., based at Step TRUTNOV. This boiler has received a „Gold Award“ from the Czech Building Academy and was rated the 2009 Best Building Product/Technology.
(Tested under continuous measurement of emissions)

Boiler description

Two basic types exist that enable whole bales of any plant product to be burnt without prior splitting and cutting: boilers with the power output of 100 to 1000 kW, which can burn bales in a vertical position, and boilers outputting 600 kW to 5000 kW, where a whole bale of straw, hay and other vegetable fuel is incinerated in a horizontal position, whilst other options include warm-water, hot-water, steam or hot-air boilers.

Boiler classification according to fuel

The catalogue describes the company's boilers by fuel type. The first part includes new and completely unique boiler designs, allowing whole bales of plant biomass to be burnt without splitting or cutting them first, which saves electricity in the order of tens of kW per hour compared to types requiring bales to be split. This new method for firing whole bales has proven useful, especially recently, when there is an increased interest in energy plants based on burning techniques. For agriculture, this chiefly involves burning hay that is harvested from permanent grasslands and pastures. Incinerating whole bales also permits the use of fuels such as bales of maize straw, flax and others that can be baled, with existing agricultural technology, whilst still in the field once the crops have been harvested. These types of fuel have yet to be exploited due to a lack of mid-capacity boiler designs that would allow such materials to be burnt while complying with emission limits.

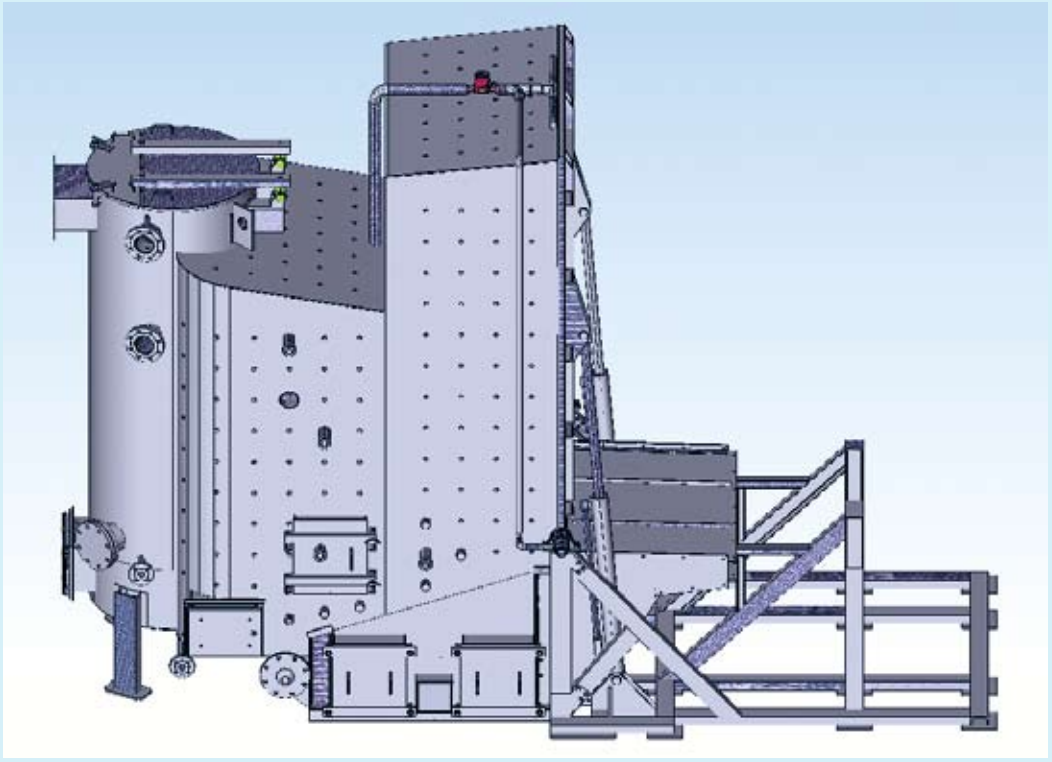
The company also offers boilers for burning wood waste, such as wood chips, mixed sawdust and wood shavings as well as grain of cereals.

As its latest addition, the company manufactures boilers for burning relatively small bales of straw, with outputs up to 190 kW. Designed to allow manual stoking, these boilers do not include an electronic control, meaning prices can be kept low.

BOILERS FOR BURNING WHOLE BALES OF STRAW

(rape&cereal straw, hemp, Uteusha energy sorrel)

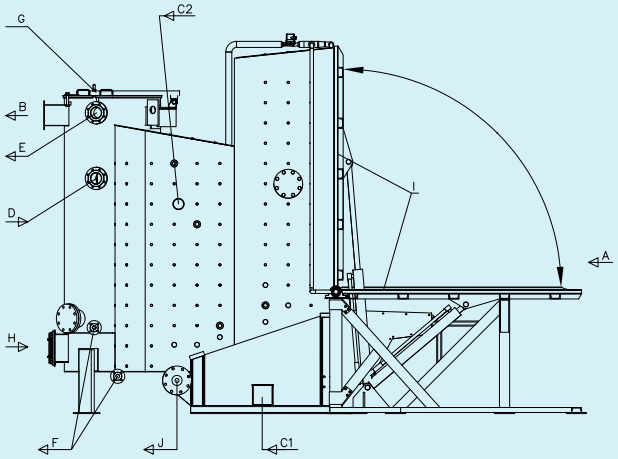
Type and capacity range: STEP-KS 100 ÷ 1000 kW



VOILERS FOR STRAW BALES, CAPACITY RANGE 100 TO 1000 kW							
STEP-KS BOILER PARAMETERS; WARM-WATER TYPE							
Boiler capacity	kW	100	175	350	600	800	1000

Legenda

A - fuel input
B - flue gas outlet
C1 - combustion air inlet (primary)
C2 - combustion air inlet (secondary)
D - heating water inlet
E - heating water outlet
F - draining
G - gate (tube cleaning)
H - inspection door
I - tilting cover
J - ashes output



Fuels

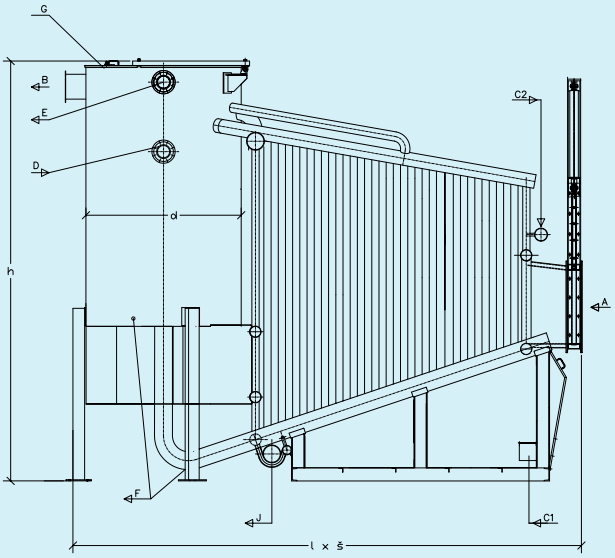
In terms of fuel utilisation, the boilers form two groups according to type of biomass:

1/ Boilers for a mixture of sawdust, edgings, bark, wood chips, shavings, grains, peat and others
2/ Boilers for burning bales of rapeseed, cereal and maize straw, hemp, hay, Uteusha energy crop and others

BOILERS FOR BURNING WHOLE BALES OF STRAW

(rape&cereal straw, hemp, Uteusha energy sorrel)

Type and capacity range: STEP-KS 600 ÷ 5000 kW



Key

A - fuel input

B - flue gas outlet

C1 - combustion air inlet (primary)

C2 - combustion air inlet (secondary)

D - heating water inlet

E - heating water outlet

F - draining

G - gate (tube cleaning)

J - ashes output

Transport of fuel

1/ For biomass boilers that combust bales, there are several fuel transport design options, one of which is using a conveyor belt and overfeed stoker, both located in the fuel depot. The operator puts each bale of straw on the conveyor belt, for example, by fork lift truck. The conveyor belt carries the bales, placing them on the overfeed stoker, which is fitted with a device monitoring the presence of a straw bale, which in turn gives a command to stop the feeding motion of the conveyor belt once filling has been completed. Each time before the bale is inserted into the boiler, a water-cooled closure is automatically first opened and then closed immediately once the bale has been inserted. The whole process of inserting the fuel into the boiler, as well as its subsequent feeding into the furnace, is fully automated and based on the requirements of custom-built boiler operating systems. This method of feeding a whole bale into the boiler chamber can save a considerable amount of electricity, making it unnecessary to cut or split straw bales, an operation required by recent boiler technologies that used to amount to dozens of kW per hour.

BOILERS FOR BURNING WOOD CHIPS

(mixtures of sawdust, strips, bark, shavings, forest or industrial wood chips, et.)

Type and capacity range: STEP-KB 600 ÷ 5000 kW

BOILERS OF 600 TO 5000 kW CAPACITY									
STEP-KS + STEP-KB BOILERS PARAMETERS; WARM-WATER TYPE									
Capacity	kW	600	1000	1500	2000	2500	3000	4000	5000
Length	m	4,9	5,4	5,8	6,2	6,5	6,8	7,2	7,6
Width	m	2,1	2,1	2,1	2,1	2,5	2,5	3,0	3,0
Height	m	4,5	4,5	4,7	5,1	5,4	5,7	6,1	6,5
Weight	kg	12400	13200	14000	14800	16500	18400	20900	24100

Boiler options and use

Boilers are manufactured depending on the capacity required and form of fuel/biomass requested by clients; the basic types include warm-water boilers, hot-water boilers and steam boilers, which may or may not feature steam super heaters. In addition, a hot-air type can be designed for combustion chambers. The types of biomass boilers listed above are principally used for heating buildings with large heating demands, like industrial facilities, district heating, municipal heat plants, agricultural buildings, hotels, premises, etc. The compact hand-stoked boilers are preferred by small farms.

Clearing ash and cleaning

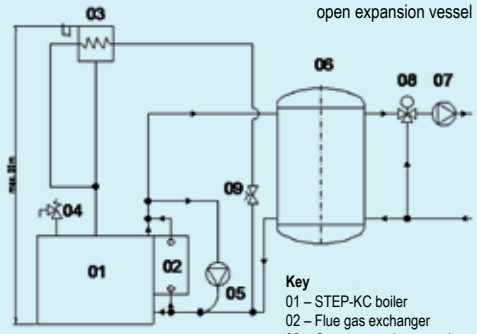
Ash is collected from the furnace manually via the open front door using an ash scraper and loaded into a container and put aside. When burning straw, ash removal from the furnace is recommended every 7-10 days; cleaning the heating surfaces of the heat exchanger should be done every 10-20 days.

Instructions for installation

The boiler comes with instructions for installation, operation and maintenance, describing everything in detail. The manufacturer recommends installing a storage reservoir as part of the heating system (see Recommended boiler mounting diagram).

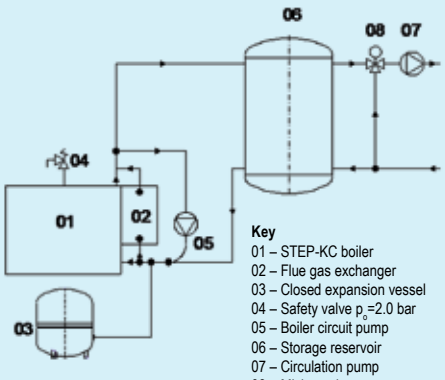
Recommended boiler mounting diagram:

STEP-KC BOILER MOUNTING DIAGRAM
open expansion vessel



Key
01 – STEP-KC boiler
02 – Flue gas exchanger
03 – Open expansion vessel
04 – Safety valve p_c=2.0 bar
05 – Boiler circuit pump
06 – Storage reservoir
07 – Circulation pump
08 – Mixing valve
09 – Control valve

STEP-KC BOILER MOUNTING DIAGRAM
closed expansion vessel



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07 – Circulation pump
08 – Mixing valve

BOILERS FOR BURNING BALES OF STRAW, OUTPUT 50-190 kW						
STEP-KC BOILER PARAMETERS; WARM-WATER OPTION						
Boiler output		kW	50	75	150	190
Standard bale parameters	Number	-	2	1	1	1
	Diameter	m	0,60	0,80	1,20	1,50
	Depth	m	0,65	1,20	1,20	1,20
	Weight	kg	39	64	144	225
	Heat supplied	kWh	92	151	339	530
Average output supplied; typical heating method	Stoking once per day	kW	11	19	37	51
	Stoking twice per day	kW	22	35	69	98
	Maximum	kW	49	75	150	190
Boiler length		m	2,20	2,30	2,95	2,98
Boiler width		m	1,10	1,45	1,85	2,25
Boiler height		m	1,20	1,50	2,30	2,65
Combustion chamber diameter		m	0,95	1,15	1,50	1,90
Combustion chamber length		m	1,40	1,45	1,90	1,90
Minimum cross-section of the chimney		m	0,30	0,30	0,35	0,35
Minimum effective length of the chimney		m	8,00	10,00	8,00	8,00
Dimensions; heating water input/output			2"/2"	2"/2"	3"/3"	3"/3"
Boiler weight		kg	635	974	3550	4120
Boiler water volume		L	230	477	1600	1900
Minimum volume of the storage reservoir		L	2400	3500	7000	9000

Container bi

BIOMASS COMBUSTION BOILERS

Additional technical information

The thermal efficiency of automatic boilers is 85-90 % at a flue gas temperature of 175 to 180 °C. In warm-water boilers, the output temperature ranges up to 110 °C at a normal pressure of 6 bar, while in hot-water and steam boilers it is based on the specifications for the same. Fuel consumption is generally 45 kg per 100 kW for wood chips with a moisture of up to 40 %; the fuel consumption for straw is 29 kg per 100 kW and a water content of up to 20 %.

Boilers with an electricity generation option

For all types of biomass listed above the output parameters of steam or hot water produced by industrial boilers can be adapted for combined generation of heat and electricity. These can be project specific, according to local operating conditions, but only projects with year-round use of heat can be effective. The sale and use of electricity from renewable sources has been increasingly promoted in a number of countries around the globe.

omass boiler

COMPANY HEADQUARTERS

Transport of fuel

2/ In mixtures containing sawdust, strips, bark, wood chips, shavings etc., the fuel is transported from a silo via the alternating motion of an axial feeding bar fitted with a large number of conveyance wedges. The feeding bar is driven by a hydraulic cylinder. Within hydraulic feeders, i.e. transporting fuel using pistons, the machinery operates on the same principle as that carrying the fuel out of the silo, which is incorporated into the control circuit of the boiler. This means that the feeder is turned off or on depending on the rate of extracting heat from the boiler (depending on the outlet boiler's water temperature). This type of system has benefits in that the flow of the fuel can be totally separated at two points, i.e. in the wall between the silo and boiler areas as well as between refuelling and furnace areas.

Not only does this provide for the safest level of protection from any back burning, but larger logs or pieces of bark contained in the fuel are cut and easily transported into the fire chamber.

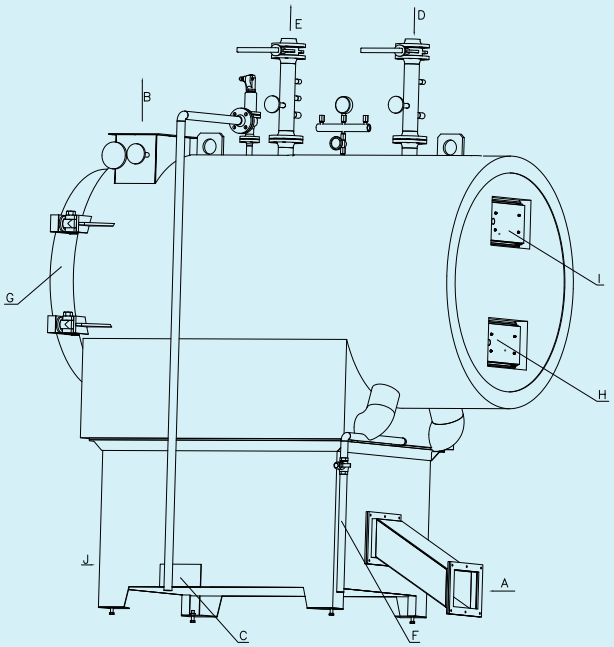
In boilers with lower outputs, bales of biomass are fed into the open boiler door by hand or a simple mechanism.

BOILERS FOR BURNING WOOD CHIPS

(mixtures of sawdust, strips, bark, shavings, forest or industrial wood chips, et.)

Type and capacity range: STEP-KB 100 ÷ 1000 kW

BOILERS FOR WOOD CHIPS, CAPACITY RANGE 100 TO 1000 kW									
STEP-KB BOILER PARAMETERS; WARM-WATER TYPE									
Boiler capacity	kW	100	190	300	400	500	600	800	1000



Legenda

A - fuel input
B - flue gas outlet
C - combustion air inlet (primary / secondary)
D - heating water inlet
E - heating water outlet
F - draining
G - gate (tube cleaning)
H - inspection door I
I - inspection door II
J - ash collection door

Control and regulation

In automated boilers, the boiler output is regulated automatically and continuously scanned. It is determined by the value of the combustion chamber vacuum, as well as by the number of batches of fuel fed into the combustion chamber depending on the temperature of the boiler output's water. The slave fan is controlled according to a frequency converter depending on the oxygen level in the flue gas (this applies to boilers with higher outputs). The exhaust fan placed on the flue gas outlet controls the vacuum set in the chamber, based on the frequency converter. In small boilers with manual stoking, the output is controlled using warm-water and flue thermostats.

HAND-STOKED BOILERS FOR BURNING WHOLE BALES OF BIOMASS

(straw, hay, flax and energy crops)

Type and capacity range: STEP-KC 50 - 190 kW

Use
This equipment for biomass combustion (burning whole round/rectangular bales of straw) is designed to heat small buildings (industrial facilities, municipal heating plants, agricultural buildings, operational premises, etc.). The furnace can also be adapted for burning pieces of wood.

Type of boiler
The boilers are available as warm-water type boilers and operate at maximum working pressure 2.0 bar, while the maximum working temperature is 100 °C.

Boiler description
The STEP-KC boiler consists of a water-cooled furnace with a cylindrical combustion chamber and a flue gas exchanger. In the front part of the boiler are circular gates that permit bales of straw to be manually stoked easily into the combustion chamber. The flue gas outlet is located at the top of the rear part. The boilers come with mandatory fittings, insulation and metal sheeting.

Fuel
The boilers can burn straw as well as wood.
Specification of straw: round/rectangular bales of straw (rapeseed straw, wheat straw, hemp straw, Uteusha energy crop), max. humidity 16 %, low to medium compression. Specification of wood: bulk wood with a moisture content of up to 20 %. Burning sawdust and shavings is not recommended, instead automatic boilers should be used for such materials.

Operation and control
1) STEP-KC 50 kW / STEP-KC 75 kW
   Combustion in the boiler is controlled by a draught controller (direct-acting thermostatic valve), which controls the valves supplying combustion air into the furnace. Inlet openings with these valves supplying combustion air are located at the top and bottom of the front door. The boiler comes with a cooling device in case of overheating.

2) STEP-KC 150 kW / STEP-KC 190 kW
   Combustion in the boiler is based on forced exhaust and/or combustion air supply. The boiler is equipped with an operating temperature controller, which, once the preset values of water temperature (90 °C) have been reached, closes the inlet openings for the combustion air supply. The boiler comes with a cooling device in case of overheating.

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