AUTOMATIC BOILERS BURNING BIOMASS

VERNER GOLEM

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General description of boilers VERNER GOLEM

The VERNER GOLEM boilers of the **rated capacity from 90 kW to 2 500 kW (in cascade up to 10 000 kW)** are designed for water heating and service water heating or for steam production. They are intended **for biomass combustion with moisture up to 60%. Suitability of particular fuels are: sawdust** with moisture up to 45%, **wood chips** or **green wood chips** with moisture up to 60%, **straw** with moisture up to 22% – these values are with usage of stabilizing fuels like **pellets**, **dry wood chips** or **brown coal**. Without using stabilizing fuel, the maximum values of the moisture are decreased of approx. 10%. The combustion of other sorts of biomass (hays, corn, plants, the rests of corn etc.) is possible to consult with manufacturer. The construction of the boilers allows to combust also fuels that make clinker, such as **bark polluted by loam** and some kinds of the **straw**. Practically we can confirm that even longtime combusting of for example rape straw has no effect to lifetime of boiler body or ceramic parts.

The boilers are equipped with an **automatic fuel feeder** out of a bin, whose size depends on working and building conditions and it can be designed for a one-day up to a few-month stock of the fuel. Boilers with rated capacity of 350 kW and higher are designed like kit, which allows big variability in space layout and the current boiler is possible to use as exchanger (for example VSB, ČKD, Slatina, Loos etc.), so you can save costs for reconstruction of current boiler-room. Our boilers are equipped by **automatic regulation of output** and the **complete combustion process is controlled by lambda sensor**. Our boilers are also equipped by automatic ignition and deashing system, so that the minimum operator attendance is demanded. It is possible to connect the automatic system of the boiler with any superior control system so there is possibility to announce the failure reports to boiler operators by mobile phone.

The boilers are **delivered as a complete set**, including mechanical parts of the bin, combustion gas cleaning equipment, control by industrial computer etc. The VERNER company supplies the boiler-room technology „with immediate entry“. It is also possible to discuss any cooperation and share of works with customer.

Function of boilers VERNER GOLEM

Intake and transport of fuel:

Crushed biomass is transported to the silo by automatic fuel feeder, in the output there extra size pieces are separated. Fuel is transported from the silo to the burner by screw conveyors. From the reason of using the screw conveyors the dimensions of the stored fuel in the silo have to be maximally 30 x 30 x 60 mm. Transport ways are equipped by water shower and by tourniguet against fire penetration of the fuel to the silo. Packaged straw is transported through separator. The fuels are possible to mix so also nonstandard fuels can be burnt.

Fuel reservoir – the silo:

The silo has movable bottom that prevents from vaulting of the fuel and ensures its equal supply. The silo can be placed at the current floor, inserted under the ground or formed like overground tower. In the output from the silo we can install the separator of extra size pieces of the fuel. Regarding boilers up to 2 Mwatts sorting is technically, energetically and for better combusting more advantageous than direct transporting of big packages to the heating chamber.

Combustion:

Combustion proceeds in place with a water-cooled bottom. Burning is regulated by computer on account of attained water temperature, data from lambda sonde, temperatures and underpressure in heating chamber. The fuels can be mixed or changed. In the burner there ash is moved by poker to ash crusher and then transported to the container or ash-bin.

Regulation:

Regulation and operation of the boiler is controlled by computer. The computer controls ignition process, shutting down of the boiler, setting outlet water temperature or steam pressure. It is also possible to control the burning process by the requested output (mainly in technologies of drying-up), on the basis of setting waste gases quality, boiler deashing and troubles signaling. At power cut there is installed a cooling system for overheating prevention. System needs intake of supply water with minimum pressure 0,2 MPa, intake 1“.

Waste gases cleaning:

Waste gases cleaning proceeds in multicyclone separator which ensures a fulfilment of emission limits at low level of power consumption for cleaning.

Emissions by the standards:

CO	650 mg/Nm^3 *
NOx	650 mg/Nm^3 *
Solid light ash	250 mg/Nm^3 * (by changing the construction 150 mg/Nm^3 is possible)

* O_2 = 11%

Transport of ash:

Ash is transported via grinder into the ash bin (or container).

Service:

Service consists of exchanger-cleaning, servicing of parts for separating and crushing, lubricating of bearings and transmission cases, controlling the water in warmwater circuit or supplementary water in steam model and controlling of inwall according to the operation and installation manual of the boiler.

Usage of boilers VERNER GOLEM

The most modern technically and also economically interesting is usage of these boilers in system called **Energetic self-contained community.** It means to install these big boilers for the centre of municipality and in connection with it to start building the system of boilers with lower outputs for family and other houses. Then it`s good to ensure producing, manipulation and selling of fuel, which is very important mainly for farmers. For example it`s possible to use corn straw for the boiler-room and grain for heating up the family houses. This system stabilizes the prices and supplies of fuel. We recommend to build boilers **in cascades up to 10 000 kW**. It is also very useful to fill in the current boiler-room for gas or fuel oil. In that case we recommend to keep 1/3 of current boiler-room output and when the boiler is also used for heating warm supply water the economic investment return will be till 2 years.

Examples of usage GOLEM boilers:

- Central heating of villages or neighbourhood
- Decentral heating of
    - schools
    - municipal offices
    - blocks of flats
    - hospitals
    - workshops
    - production plants
- Usage in production technologies, drying-plants etc.

Examples of concrete realizations (more information and complete reference list at: www.verner.cz):

Heating up of municipality: CENTRAL HEATING PLANT FOR BIOMASS ŽLUTICE – realization in 2001

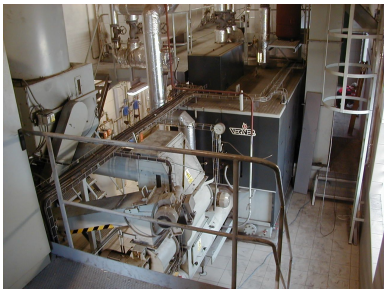
Parameters of boiler-room + technology:
Boiler: VERNER GOLEM 1x 2 500 kW
Boiler: VERNER GOLEM 3x 1 800 kW
Rated capacity: 7 900 kW
Length of caliducts: 11,6 km
Temperature gradient: 105/65 °C
Pressure area in caliducts: 0,4 Mpa, 0,9 MPa
Supply system: warm-water

Fuel:
wood chips, sawdust, pellets, straw
Rumex OK2 and other agricultural products

Boiler with producing steam: BOILER-ROOM DIBAQ a.s. HELVÍKOVICE – realization in 2004

Parameters of boiler-room + technology:
Boiler: VERNER GOLEM 1 800 kW
Rated capacity of exchanger: 1 260 kg/h
Rated warm-water capacity: 270 kW
Rated steam capacity: 1 260 kg/h
Working pressure: 8 bars
Rated temperature of solid steam: 175 °C

Fuel:
wood chips, sawdust, pellets, straw,
Rumex OK2 and other agricultural products



Heating up of school: BOILER-ROOM IN PRIMARY SCHOOL STÁRKOV – realization in 2003

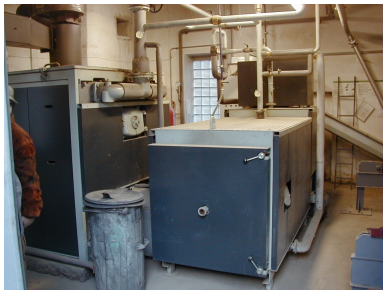
Parameters of boiler-room + technology:
Boiler: VERNER GOLEM 225 kW
Rated capacity: 225 kW

Fuel:
wood chips, sawdust

Boiler-room for wood produce: LACHMAN INTERIER DESIGN v.o.s. PROSTĚJOV – realization in 1999

Parameters of boiler-room + technology:
Boiler: VERNER GOLEM 350 kW
Rated capacity: 350 kW
Boiler VSB IV is used like exchanger

Fuel:
wood chips, sawdust



Technical parameters of boilers VERNER GOLEM

Efficiency of boiler	86 - 90 %
Adjustability of continuos operation	40 - 100 %
Adjustability of step function operation	0 - 40 %
Maximum operation overpressure of water in the burner	5 bar (0,5 Mpa)
(for usage of boiler for higher pressure exchanger is placed between the boiler and the burner)	
Temperature and pressure of medium at output	setting according to requirements
Supply electric input	3 x 400 V / 50 Hz
Temperature of flue gases at output of the boiler	180 - 260 °C
Minimum temperature of reverse water to the burner	60 °C
Maximum noise level	setting according to requirements
Fuel consumption	depends on used fuel (see chart „Oriental fuel consumption for produced energy“)

Basic dimensions and weight according to the boiler type

Dimensions and location of single parts of the boiler are very variable and they can be changed, in the chart you can see orientation dimensions.

Boiler type	Total rated capacity (kW)	Total dimensions in mm (length x width x height)	Built-up space in m (length x width x height)	Total operational weight including water filling (kg)
GOLEM 90 (compact)	90	1670 x 1430 x 1000	5,0 x 3,5 x 3,5	1 600
GOLEM 225 (compact)	225	2250 x 1380 x 1870	5,5 x 3,5 x 3,5	4 000
GOLEM 350 (burner + extension chamber + exchanger)	350	5580 x 1230 x 2100	8,5 x 4,0 x 4,5	4 800
GOLEM 600 (burner + exchanger)	600	5590 x 1980 x 2150	9,5 x 5,0 x 4,5	7 000
GOLEM 900 (burner + exchanger)	900	5990 x 2210 x 2330	11,0 x 5,0 x 4,5	12 400
GOLEM 1800 (burner + exchanger)	1 800	7980 x 2550 x 2910	12,0 x 5,5 x 5,5	32 800
GOLEM 2500 (burner + exchanger)	2 500	9925 x 2800 x 3325	14,0 x 6,5 x 6,0	40 900
GOLEM 90 and 225: The burner, extension chamber and exchanger are one non-rewirable unit, usage only as warm-water design.				
GOLEM 350: The burner, extension chamber and exchanger are independent units connected by flanges, according to used exchanger there exists possibility of warm-water, hot-water or steam design of the boiler.				
GOLEM 600 and 2500: The burner and exchanger are independent units, extension chamber is the part of exchanger, according to used exchanger there exists possibility of warm-water, hot-water or steam design. It is also possible to burn straw in boilers of these rated capacities.				

Consumption of energy and fuel according to the boiler type

Boiler type	Installed electric input (kW)	Normal electric input (kW)	Maximum consumption of low-quality fuel with higher moisture (kg/h)	Consumption of combustion air at nominal output (m^3/h)	Quantity of flue gases (real) with moisture of fuel 35% and temperature of flue gases 220 °C (m^3/h)	Quantity of flue gases (re-counted) with temp. 0 °C and normal atmospheric pressure (Nm^3/h)
GOLEM 90	8	4,8	45	270	355	270
GOLEM 225	14	8,4	115	690	855	675
GOLEM 350	16	9,7	175	1050	1375	1050
GOLEM 600	19	11,4	300	1800	2355	1801
GOLEM 900	21	12,3	450	2700	3535	2701
GOLEM 1800	33	19,7	900	5400	7070	5402
GOLEM 2500	44	26,3	1250	7500	9820	7503

Orientation consumption of fuel for produced energy

This chart is used for calculation of needed fuel quantity for required amount of energy. The data are used from practice and include efficiency of the boiler and combustion – produced energy is measured in the boiler output.

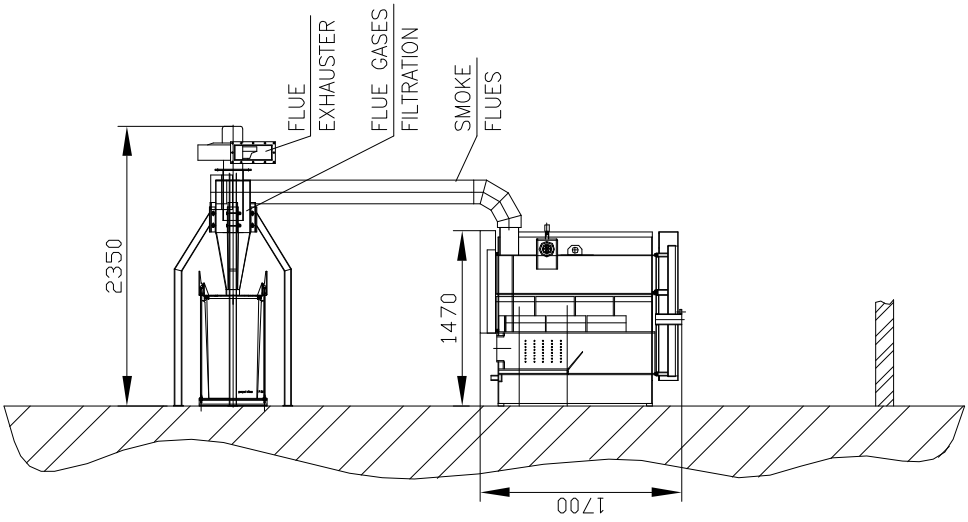
Fuel	Fuel size (mm)	Maximum (absolute) moisture (%)	With (absolute) moisture (%) ...	... the fuel consumption is (in kg for 1 kWh of produced energy):	Notice
Wood chips (also green forest chips)	30 x 30 x 60	50	up to 25	0,28	It is possible to increase maximal useful fuel moisture by using of stabilizing fuel, solution has to be consulted with producer
			up to 45	0,35	
			up to 55	0,45	
Sawdust	up to 5	35	up to 20	0,28	
			up to 35	0,35	
			up to 40	0,45	
Straw	packages	22	up to 18	0,45	Its useful to mix straw with wood chips
			up to 22	0,60	
Alternative fuel (plants)	up to 50	28	up to 19	0,45	Gathered by cutter
			up to 28	0,60	
	packages	21	up to 19	0,45	Angular packages; intake of rounded is in progress
			up to 23	0,60	

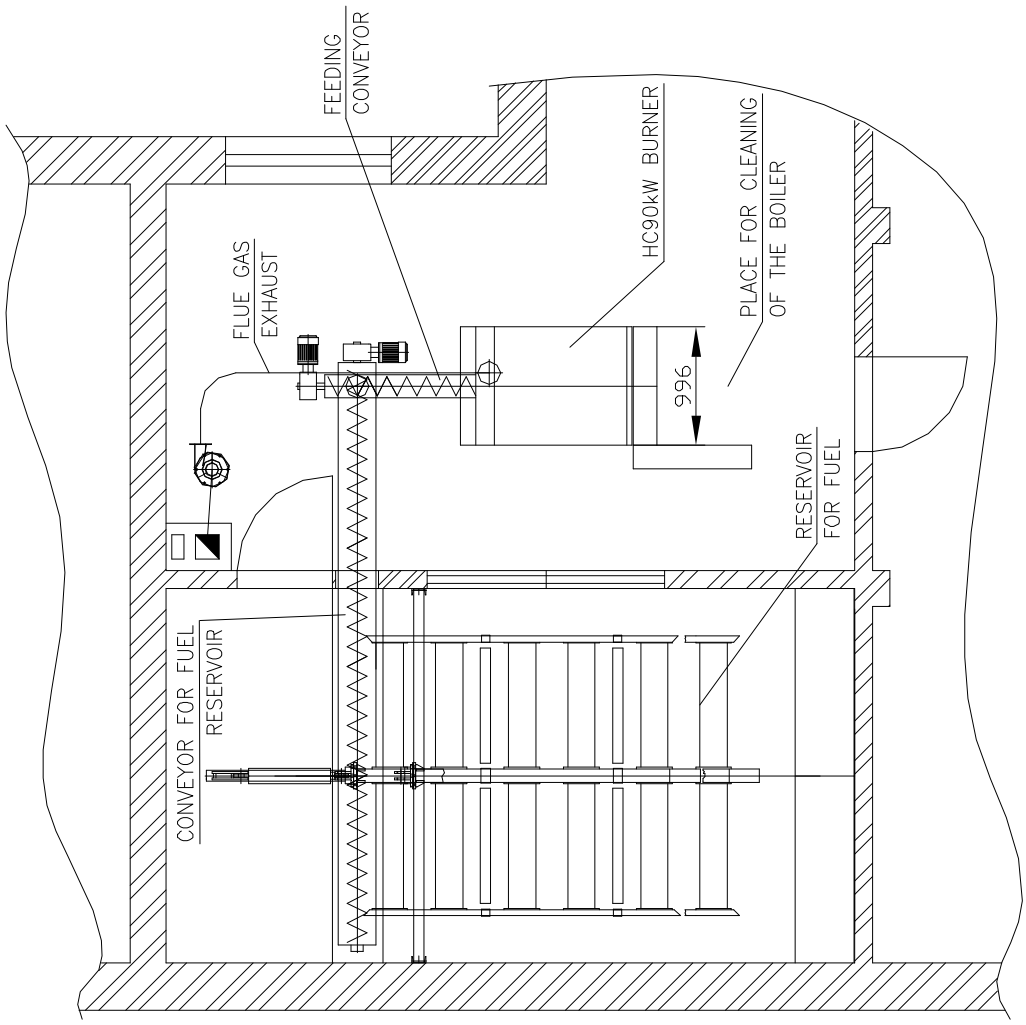
Orientation specific density of fuel

This chart is used for calculation of the silo or storage of fuel capacity.

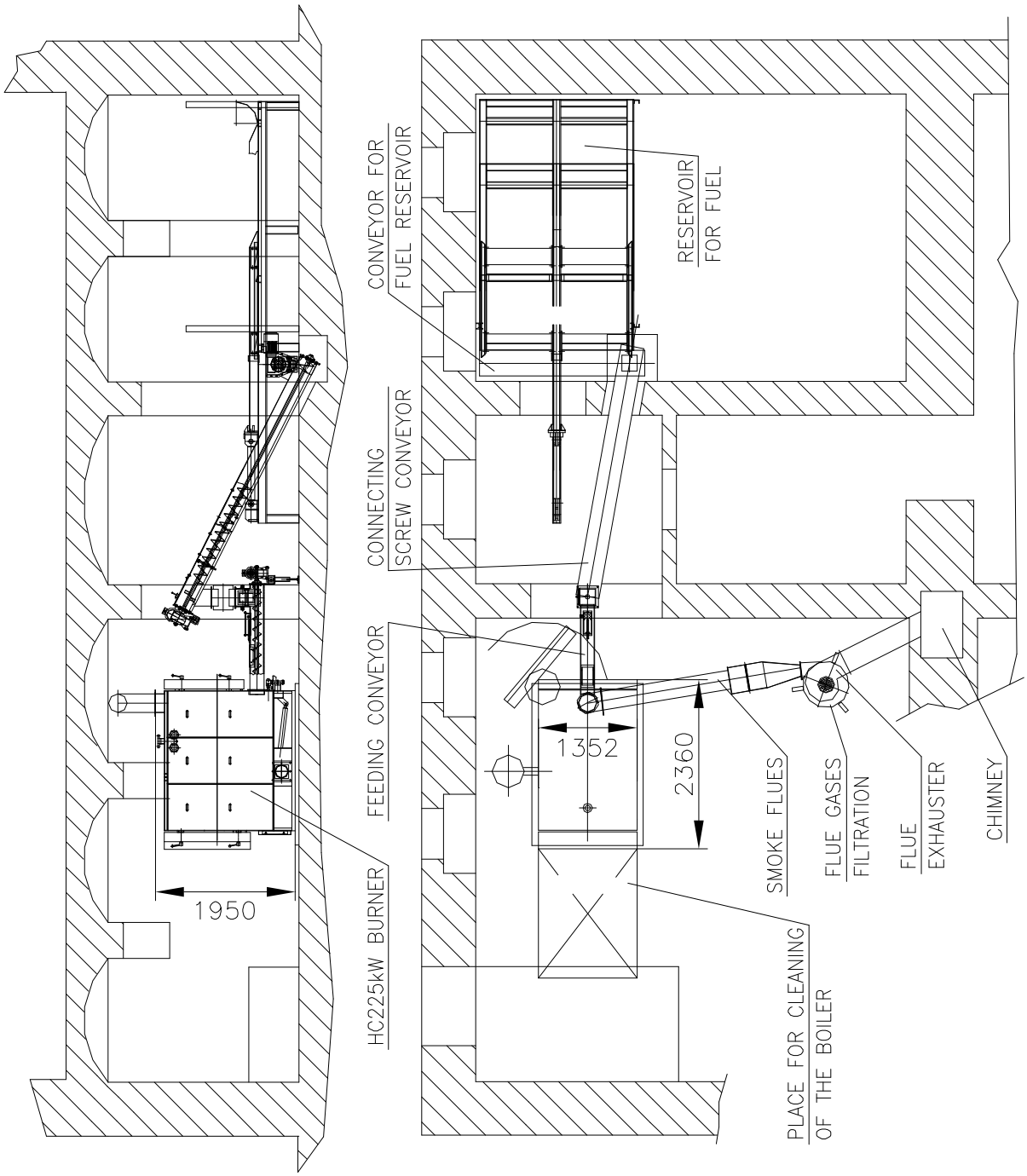
Fuel	At (absolute) moisture (%) ...	... the weight of fuel is (kg / m^3)	Notice
Soft wood chips	up to 25	180 - 220	Wood chips up to 50 mm
	up to 45	200 - 250	
	up to 50	200 - 280	
Soft sawdust	up to 20	120 - 160	According to size, soft sawdust have higher specific density
	up to 35	130 - 180	
	up to 40	140 - 190	
Tough wood chips	up to 25	200 - 280	Wood chips up to 50 mm
	up to 50	220 - 300	
Tough sawdust	up to 25	140 - 220	According to size, soft sawdust have higher specific density
	up to 45	160 - 250	
Wood shavings	up to 15	50 - 120	According to its size
Straw in angular packages	up to 20	350 / package	Dimensions 0,8 x 1,2 x 3,5 m
Straw in rounded packages	up to 20	250 / package	Diameter 1,5 m
		400 / package	Diameter 1,8 m
Alternative fuel (plants)	up to 20	180	Gathered by cutter

Scheme of boiler-room VERNER GOLEM 90 (practical example)

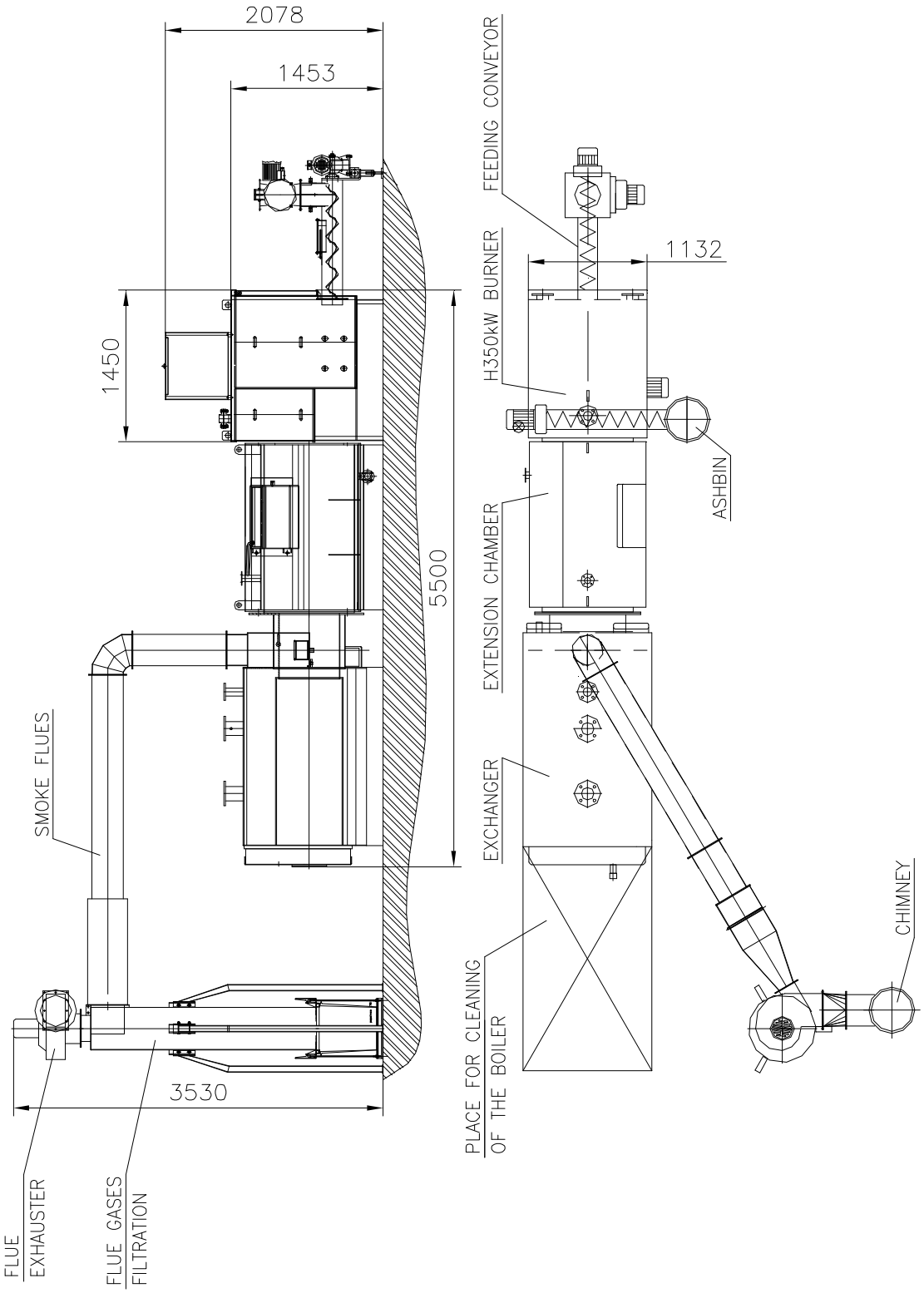




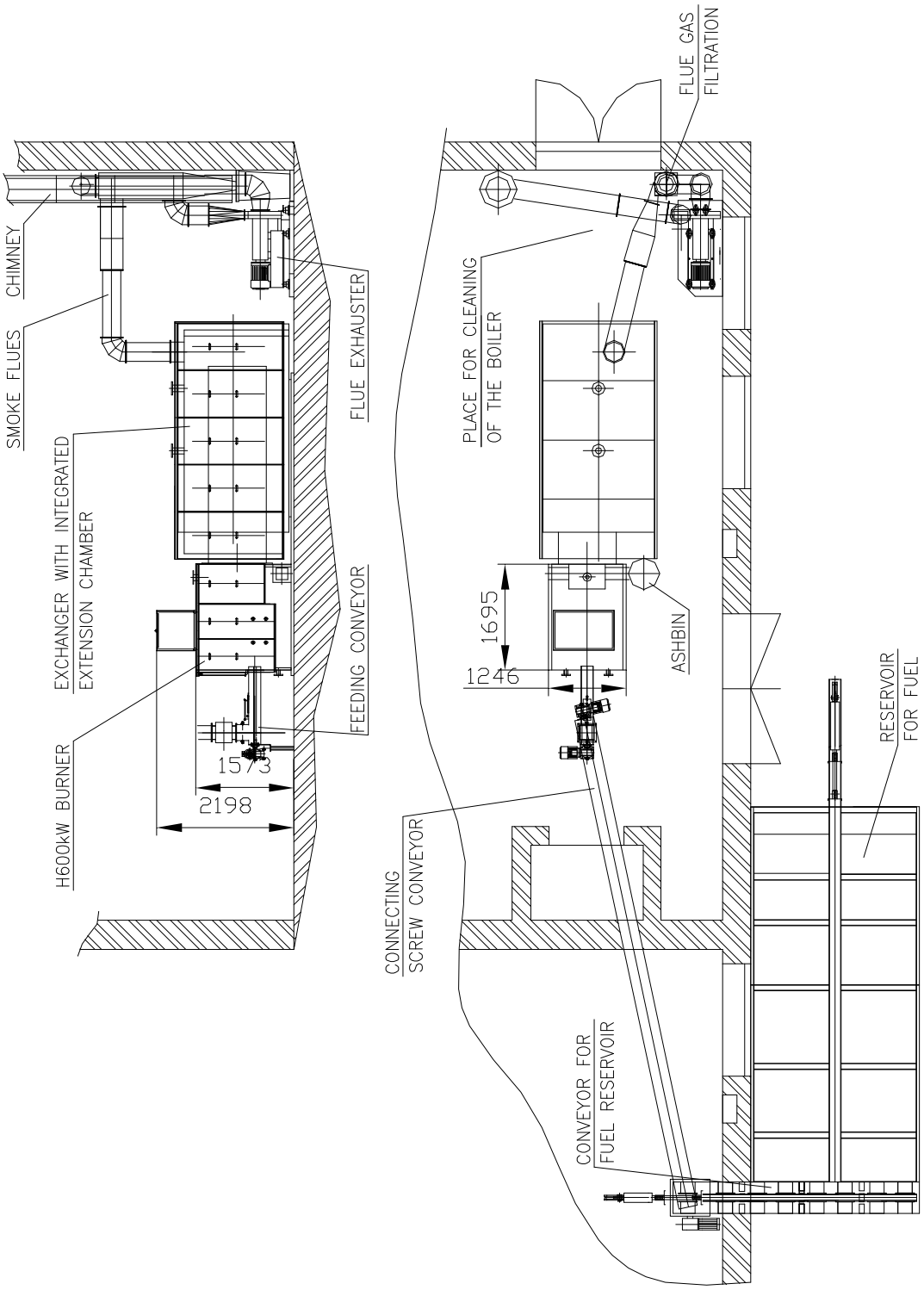
Scheme of boiler-room VERNER GOLEM 225 (practical example)



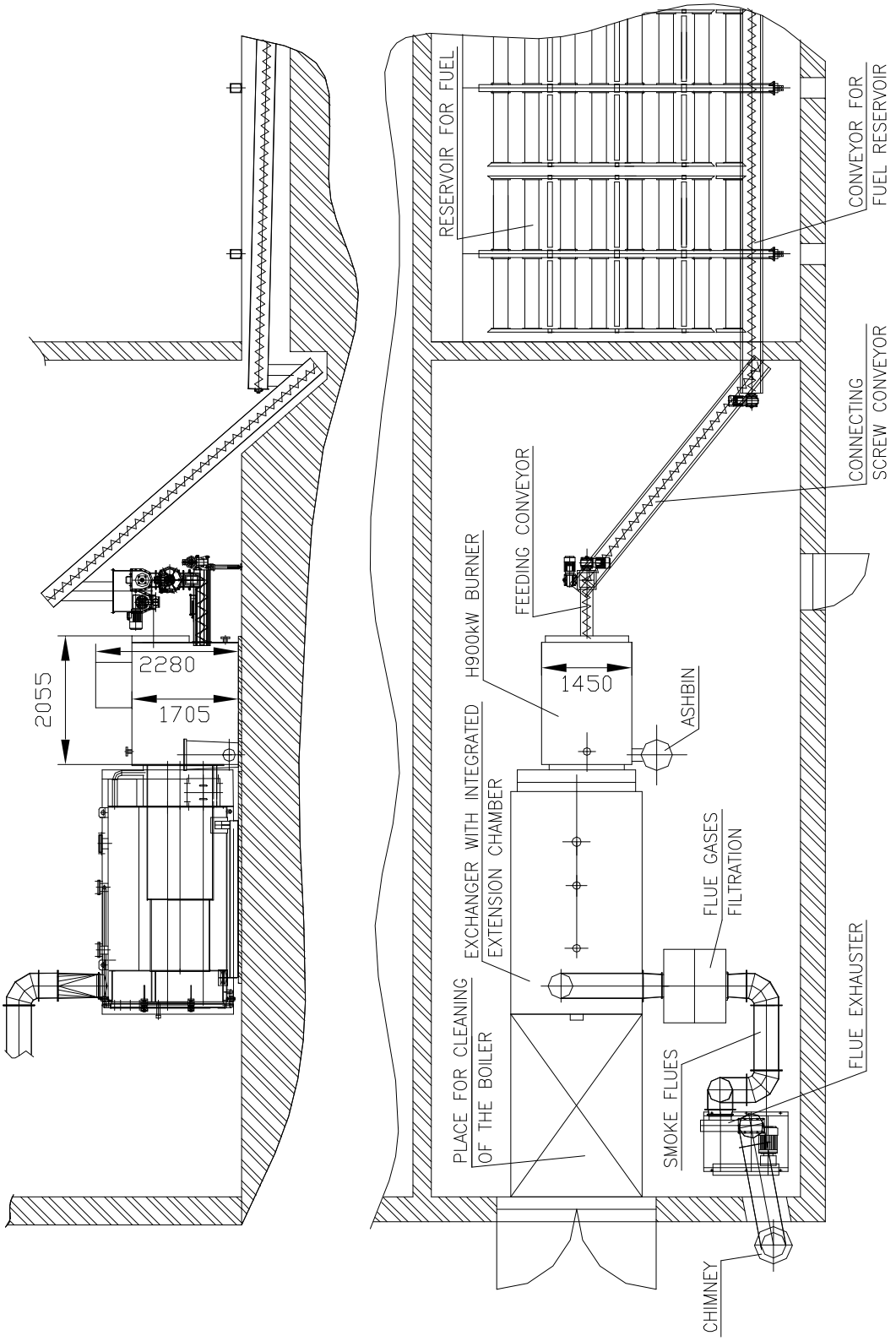
Scheme of boiler-room VERNER GOLEM 350 (practical example)



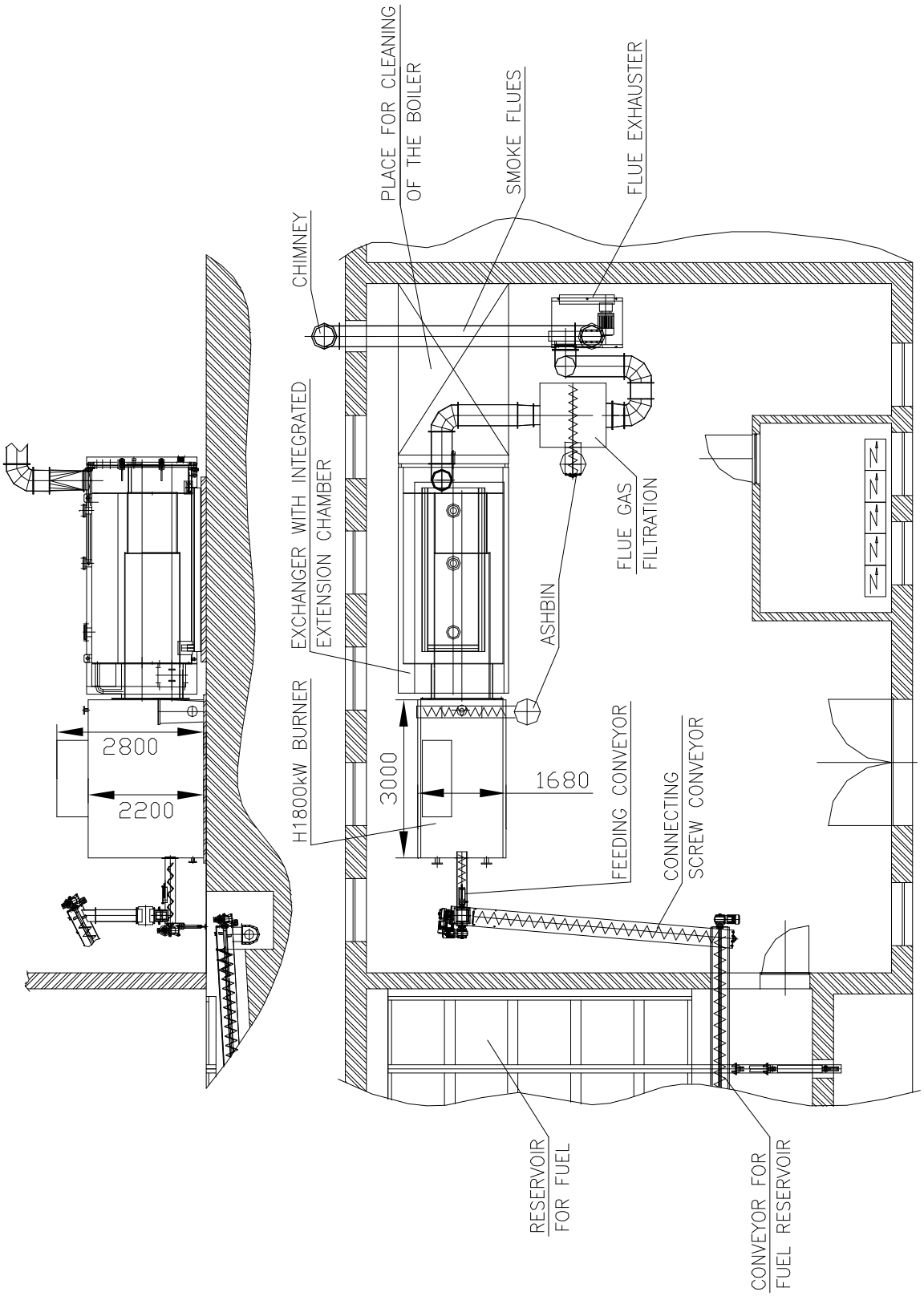
Scheme of boiler-room VERNER GOLEM 600 (practical example)



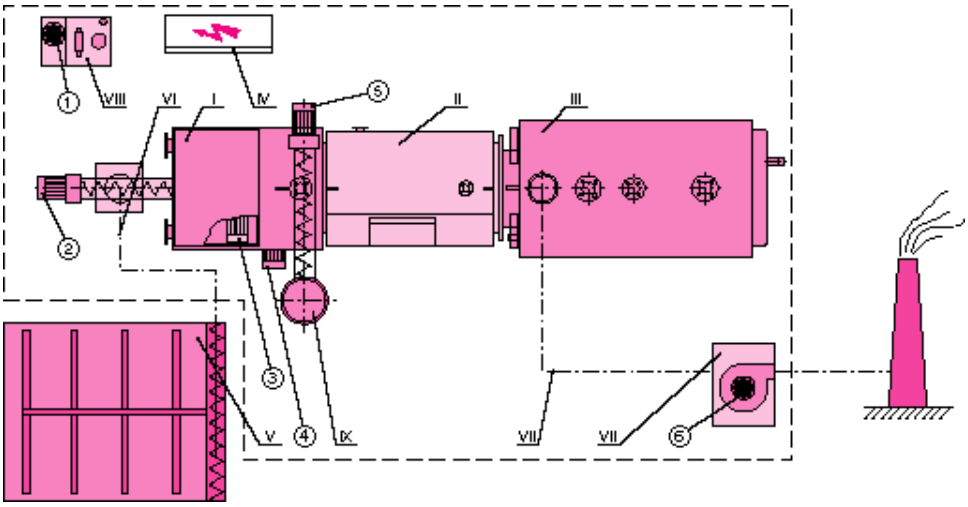
Scheme of boiler-room VERNER GOLEM 900 (practical example)



Scheme of boiler-room VERNER GOLEM 1800 (practical example)



General scheme of boiler-room VERNER GOLEM



I = burner
II = extension chamber
III = exchanger
IV = control unit
V = fuel reservoir / silo
VI = transport tracks
VII = flue ways and filtration
VIII = hydraulic unit
IX = ashbin

1 = drive for hydrogenerator
2 = drive for feeding screw
3 = drive for ventilator of combustion air
4 = drive for ash crusher
5 = drive for ash conveyor
6 = drive for flue gases conveyor

VERNER®
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