SMART HEATING TECHNOLOGY

Purity to Nature
Savings to Clients
Comfort to Users

AUTOMATIC BIOMASS BOILERS & ACCESSORIES

SMART 100 – 525 kW

OPERATING MANUAL

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1 Brief information

Dear customer,

production and development of the biomass boilers are given intensive and constant attention in the production plant with the aim to achieve maximum quality, reliability and safety of the product.

As it is dealing with a combustion plant, it is essential that operators follow some simple but important rules.

Its reliability and safety are also given by the quality of the installation and by adherence to the standards and legal regulations applicable to the installation and operation of the equipment.
Installation and commissioning of the equipment may only be carried out by persons with appropriate ***professional competence***.
Commissioning may only be carried out by persons trained and demonstrably ***authorized by the manufacturer***.

In compliance with the applicable legislation, the plant operator is obliged to draw up the Operation rules for the boiler room.

Operation and maintenance may only be performed by a person properly and demonstrably trained by the manufacturer or installer.
Operator training should include following parts:

- safety information
- operational maintenance, service holes, lubrication points
- equipment control and standard operation
- failure conditions and their solution

Read the manual carefully and thoroughly before commissioning!

Risk analysis:
The risks involved in the installation, operation and maintenance of the boiler can be divided into the following categories

- handling of heavy loads
- danger of electric shock
- danger of wood gas explosion
- burns as a result of contact with hot parts
- poisoning by poisonous gas, especially CO

Detailed information on risk analysis can be found in the chapter 6.5.5

1.1 Advantages of our biomass boilers

Thanks to perfect technical and technological processing of the biomass combustion process they are environmentally friendly products. Moreover, biomass is a renewable source and raw material from local sources.
Advantages:

1. combustion of biomass in the form of wood shavings, sawdust, other crushed waste, wood briquettes and pellets.
2. High quality at a reasonable price
3. Variability of equipment installation according to special requirements of the customer
4. Computer-controlled combustion equipment brings a high degree of efficiency. Thanks to total combustion (with long combustion times) with precisely metered air volume, we achieve a very high degree of efficiency compared to conventional equipment.
5. Low unwanted radiation losses. These were achieved by double boiler insulation.
6. Special design of combustion chamber. Design with afterburning using secondary air supply. With this newly developed combustion chamber we have significantly increased the residence time of the exhaust gas in the hot zone and the burning time in the hot zone. In this way we achieve very low emissions.
7. A special and individually customized way of transporting fuel from the silos by means of screw conveyors (inclined screw up to 7m, horizontal screws up to 10m and 12m).

2 Safety instructions

When designing the SMART equipment, particular attention was paid to the safety of its operation. As it is dealing with a combustion plant, it is essential that operators follow some simple but important rules.

- Please read the operating instructions carefully before commissioning the machine and pay particular attention to the safety instructions. If in doubt, refer to the relevant sections in this manual.
- We would like to inform you that legal and natural persons carrying out business activities that operate a boiler are obliged by law (in the Czech Republic, Decree No. 91/93 Coll.) to issue Operation rules for the boiler room, which include also the boiler operating instructions.
- All waste generated during the maintenance of boilers and eventually their disposal after the end of their service life must be performed in accordance with the Act No. 185/2001 Coll. (or the Waste Act in the given country).
- Always close carefully all hatches, inspection openings, covers of mechanical moving parts and electrical parts.
- When opening the boiler door, make sure that no smoke and sparks get out of the boiler. Never leave the boiler door open unattended.
- Ensure sufficient supply of fresh combustion air to the boiler room and avoid low temperatures in the boiler room. The opening for air inlet and venting of the boiler room must always be free and checked periodically
- Never use liquid flammable substances or volatile substances to improve combustion.
- Perform maintenance operations regularly! Service work and repairs should only be carried out by the manufacturer or by an authorized service organization
- When servicing the boiler or when opening or removing covers, always disconnect the boiler from the power supply.
- In addition to the adequate volume of the fuel itself, no flammable or combustible substances may be stored in the boiler room.
- A functional fire extinguisher – foam or powder type – must be available on a suitable place. Powder fire extinguisher is not suitable for extinguishing electrical circuits.
- The equipment may only be operated with the fuels specified by SMART in this manual. For other types of fuel, the manufacturer's express consent must be obtained. Otherwise, it is dealing with a violation of the warranty rules.
- Do not make any sudden or unauthorized changes to the machine's settings or shutdown.
- In any case, if an emergency extinguishing device has been activated, it indicates a fault in the equipment. In your own interest, please contact our customer service or service representative immediately.
- If you have problems, you can always reach us at the phone numbers listed on the front page of this manual
- By law, in the case of automatic biomass combustion, devices are required to prevent back-fire along the transport channel to the fuel storage. The following security measures are taken in our equipment:
- The channel for screw feeding and the intermediate bin up to the back-fire damper are completely sealed. This prevents back-fire due to lack of air. Servo drive opens and closes the flap. Fuel transport begins only when the flap is fully open. In the event of a failure or power failure, the flap is closed automatically by a spring. When performing maintenance work, the flap must be closed with the exception of work directly related to it.

- The emergency extinguishing device at the fuel feeder worm channel serves as the last reserve for emergency situation. It consists of a safety thermostatic valve with an opening temperature of 95°C, a tank with water and a sensor of water level in the tank. The capillary of the safety thermostatic valve is housed in a tube that is welded to the fuel feeder screw conveyor channel on both sides. The valve is connected to the tank (with the drain valve, which must be in the open position) filled with water. If the extinguishing device is activated, the fuel in the fuel feeder channel is flooded, the hot fuel is extinguished, the contact of the float sensor measuring water level in the tank opens and the boiler shuts down.
- The temperature of the fuel channel is continuously measured and controlled at two points. As the fuel channel temperature rises, the fuel is fed to the burner in a controlled manner
- If the boiler is in a state with no demand for thermal power, the fuel is not replenished to the intermediate bin.
- Should the boiler overheat to a temperature higher than 95°C due to a fault, the equipment is shut down by a safety thermostat. If the temperature is higher than 100°C, do not open any valves or fittings, it will reduce the water pressure! This will generate steam and risk of scalding for operator.
- Never open the inspection or service doors while the boiler is in automatic ignition mode and does not burn. A sudden supply of air could cause an accumulated wood gas to explode.

3 Description of types

The SMART boilers in power series 150–500 kW are manufactured in S_V or S_IB versions

The boilers operate on the principle of combustion with bottom fuel feed, the burner furnace is self-cleaning. The system works with automatic cleaning of the heat exchanger

S_V unit with its own storage container. The fuel comes into the boiler from the storage container, the content of which is sufficient for several days.

S_IB unit with intermediate storage and indirect transport. The fuel comes from the bin to the intermediate storage container and from there to the boiler

Boiler type:

100 rated power of 100 kW, power range from 30 kW to 100 kW

150 rated power of 150 kW, power range from 40 kW to 150 kW

180 rated power of 180 kW, power range from 45 kW to 180 kW

199 rated power of 199 kW, power range from 49 kW to 199 kW

200 rated power of 200 kW, power range from 50 kW to 200 kW

220 rated power of 220 kW, power range from 55 kW to 220 kW

250 rated power of 250 kW, power range from 65 kW to 250 kW

300 rated power of 300 kW, power range from 75 kW to 300 kW

350 rated power of 350 kW, power range from 90 kW to 350 kW

400 rated power of 400 kW, power range from 100 kW to 400 kW

450 rated power of 450 kW, power range from 115 kW to 450 kW

499 rated power of 499 kW, power range from 135 kW to 499 kW

500 rated power of 500 kW, power range from 140 kW to 500 kW

525 rated power of 525 kW, power range from 142 kW to 525 kW

The manufacturer recommends Smart Boiler sizing with at least a 20% Power reserve in relation to the projected or determined heat loss of the heated object.

4 Parts of the equipment

For ease of reference, the following pages provide a schematic representation of your equipment. The boiler consists of the combustion chamber of the boiler (I), the heat exchanger (II), the central part (III), the intermediate bin and the spatial conveyor, or a storage bin (IV).

In the front part of the boiler (I, II) there is the main part of the device – combustion chamber. It consists of a circular primary burner (15), a two-piece afterburner (17), a refractory deflector (21) and an ash wheel (16) which is driven by the grate mechanism (25). All parts are made of stainless steel and heat resistant materials and can be removed through the service door of the combustion chamber (32). There is an inspection door for combustion chamber (33) above them. The fuel is fed from below to the primary burner (hence it called bottom-feed combustion system). Here, primary air is supplied so as to promote combustion. Secondary air for combustion of wood gas is supplied to the afterburner ring. Burning time is extended by a refractory deflector, which is suspended above the secondary ring of the burner. The ash falls from the rim of the ash wheel to two ash screws (26) which provide transport to the ashtray of the combustion chamber (18). In the rear part of the combustion chamber there is an exhaust damper (28) with its servo drive. This damper ensures the flowing of exhaust gas directly to flue, or in the closed position to the tubes of heat exchanger.

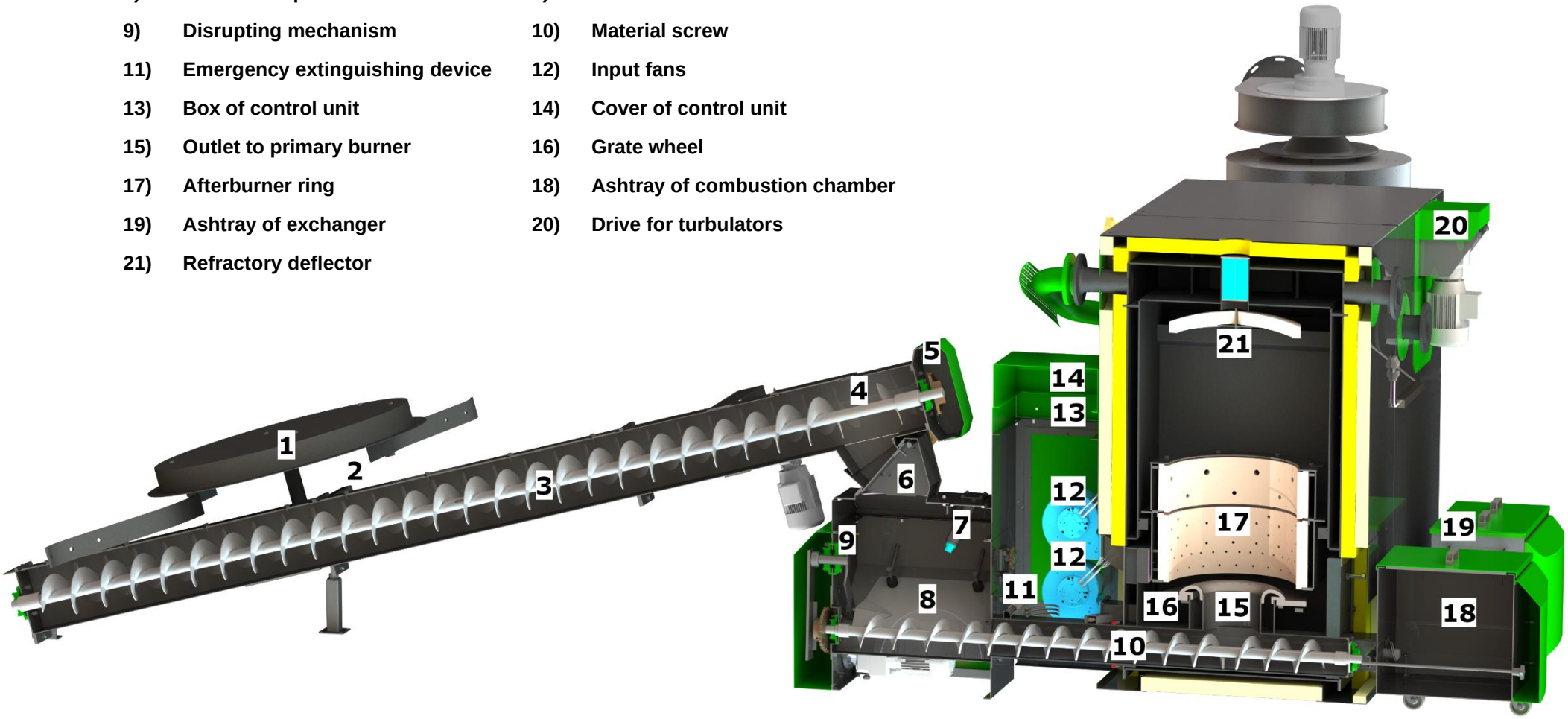
Rear part of the boiler is formed by tubular heat exchanger, in its tubes rotary turbulators (29) are installed, which ensure cleaning of the exchanger tube sheet and optimum heat transfer. From the side of the exchanger there is a drive for turbulators (20) consisting of a chain drive and a cleaning motor. At the top of the boiler there is a safety thermostat and an air bleed valve. Temperature losses are minimized by double mineral wool insulation covered by casing. On the rear side there is a smoke collector – a chimney body (31), the outlet of which is tightly connected to the inlet of the solids separator (34), on which the exhaust fan is installed to ensure the removal of exhaust gas and necessary underpressure in the boiler. At the lower part of the exchanger there is a service door for cleaning the space under the turbulators. An optional accessory is an automatic discharge of ash from the area below the exchanger, with a separate drive and ash worm (30), which transports the ash to a separate ashtray (19).

The central part (III) contains radial fans (12) with air flaps, underpressure sensor measuring underpressure in the combustion chamber, a frequency converter which continuously regulates the exhaust fan speed depending on the underpressure; a hot air gun performing the automatic ignition function and an emergency extinguishing device (11). The drive for ash screw and the drive for grate mechanism are also located here. A boiler control unit (13,14) is installed on the upper side of the central part.

The spatial conveyor (IV) transports the fuel from the external storage to the intermediate bin of the boiler. The conveyor consists of a spatial discharge mixer (1), a gearbox (2), a screw conveyor channel (4) with a conveyor screw (3) and a gearbox with drive (5). At the end of the conveyor, closer to the boiler, there is a flap with a limit switch, which opens when the conveyor is overfilled with fuel and switches off the equipment. The spatial discharge mixer consists of a cover wheel with removable bundles of leaf springs. Fuel falls from the spatial conveyor to the intermediate bin (8). An ultrasonic probe (7) is installed on the intermediate bin that senses the minimum and maximum material level in the bin. When the minimum level is reached, the airtight fire protection flap (6) opens. The conveyor motor is started and sufficient fuel is replenished, up to the maximum level. After replenishment, the flap closes, and fuel will be replenished again only when the level drops below the minimum. From there the fuel is transported by the screw feeder (10) to the combustion plate (15). Airtight fire protection flap closes automatically in the case of boiler inactivity or power failure. In the lower part there is the main drive motor, the ash worm drive motor and the gearbox with the drive for disturbing vanes (9) in the intermediate bin.

Front section of the boiler

1)	Spatial discharge mixer	2)	Gearbox
3)	Spatial discharge screw	4)	Spatial discharge channel
5)	Gearbox with drive	6)	Separation flap of channel and intermediate bin
7)	Ultrasound probe	8)	Intermediate bin
9)	Disrupting mechanism	10)	Material screw
11)	Emergency extinguishing device	12)	Input fans
13)	Box of control unit	14)	Cover of control unit
15)	Outlet to primary burner	16)	Grate wheel
17)	Afterburner ring	18)	Ashtray of combustion chamber
19)	Ashtray of exchanger	20)	Drive for turbulators
21)	Refractory deflector		



Side section of the boiler

25) **Grate mechanism**

26) **Ash screws of combustion chamber**

27) **Channel of primary air**

28) **Exchanger damper**

29) **Turbulators**

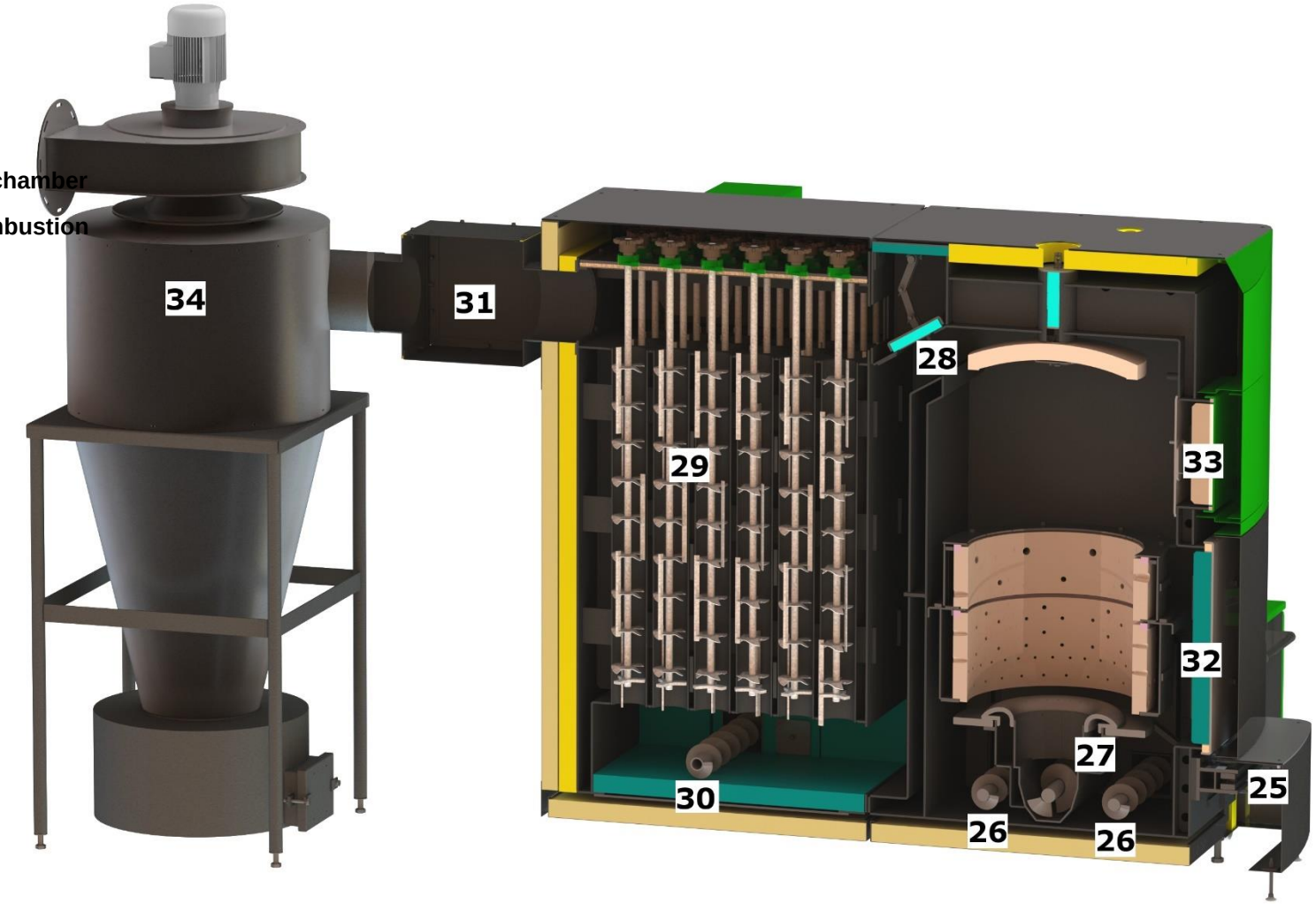
30) **Ash screw of exchanger**

31) **Chimney body**

32) **Service door of combustion chamber**

33) **Inspection door of combustion chamber**

34) **Solids separator**



5 Delivery, erection, assembly

5.1 Preparedness of boiler room

Customer or investor of the construction are responsible for ensuring preliminary work

5.1.1 Preparedness of the boiler room prior to commencing the boiler installation:

- Completion of construction work at the boiler room and fuel store. If the boiler is equipped with automatic refilling from the fuel store, the opening for the conveyor passage through the separation wall must be prepared. Ventilation of the boiler room to ensure an access of fresh air.
- All openings for transporting the boiler into the boiler room must meet the minimum dimensions for each type of boiler. For a 500kW boiler, the entire path for boiler transport to the boiler room must be at least 1400x2000mm, for boilers 150-450kW it is 1200x 2000mm.
- Hand pallet truck with minimum load capacity of 2500kg. If there are height differences of floors in the handling area, it is necessary to ensure such handling equipment that the boiler (or its individual parts) can be transported to the place of its installation.
- The boiler room must be provided with lighting and at least one 230V/16A socket near the boiler (see the boiler connection point).
- Tidy area for assembly work (boiler room and fuel store) without any obstacles for assembly

5.1.2 Readiness prior to commissioning:

- Ready “Main power supply” and its inspection (see “Boiler connection point”), which must be equipped with overvoltage protection and three-phase monitoring.
- In the vicinity of the connection point, assigned and marked terminal for connecting the boiler to the protective connection of the boiler room.
- “Main (circulation) pump", "Mixing (shunt) pump" or "Mixing (shunt) three-way valve" and lead for the switching signal from the boiler automatics, if they at a distance more than 0.7m from the boiler (see Hydraulic diagram). Also, other devices can be controlled by boiler automatics (see the Hydraulic diagram). If you require their regulation, a switchboard with marked inputs must be installed at the boiler connection point and SMART technician (trained specialist) will connect the control signals.
- Treatment of boiler water according to the manufacturer's requirements
- Flue connection between the boiler and the separator (if the boiler is equipped with a separator), separator and smoke uptake.
- If the boiler is equipped with automatic replenishing from the fuel store, the opening for the conveyor passage through the separation wall must be prepared.
- Filling the heating system with water, if this is prevented by climatic conditions, it is necessary to inform about this condition prior to starting-up the boiler.
- At least two persons responsible for maintenance and operation of the boiler, who will be acquainted with boiler operation and maintenance of during the heating test.
- If the operator requests reporting of fault conditions by means of visual or acoustic signalling, it is necessary to prepare a mark a lead at the boiler connection point and our SMART technician will connect the control signal.
- If the operator wants to report fault conditions and check the boiler status via GSM modem, it is necessary to prepare a SIM card (check the signal quality of your selected operator).
- If the operator requires remote control and monitoring, the client/investor is obliged to provide an Internet connection with adequate quality of data transmission.

5.2 Guidelines for construction

The following overview contains most important references for the planning of construction activities. Our external collaborators are ready to assist you in planning. Contact us as soon as possible to find the best solution.

The boilers can be operated in the basic environment according to ČSN 332000-3, they must be placed in a boiler room to which sufficient access of air is ensured, as necessary for combustion.

Placing boilers in residential space (including corridors) is not permitted.

C A U T I O N ! ! !

In circumstances where there is a risk of temporary formation of flammable gases or vapours and works that could create a temporary risk of fire or explosion (e.g. gluing of linoleum, PVC, use of volatile flammable substances, etc.), the boilers must be put out of operation in time before the danger arises. Do not place any objects made of flammable materials on the boilers and within a distance less than the safe distance.

5.3 Safe distances:

The equipment must be installed so that a safe distance from building materials of at least 200 mm is maintained. This distance applies to boilers and flues located in the vicinity of flammable materials with the degrees of flammability B, C and C2 (see Table 1). The safe distance (200mm) must be doubled if the boilers and flue gas ducts are located close to flammable materials of C3 degree (see Table 1). The safe distance must be doubled even if the degree of material flammability is not proved. The safe distance can be reduced by half (100 mm) when using heat-insulation non-flammable board with thickness of min. 5mm, located at the distance of 25mm from the flammable material to be protected (air insulation). The shielding plate or protective screen (on the object to be protected) must extend beyond the boiler contour, including the flues, by at least 150mm on each side and by at least 300mm above the upper surface of the boilers. The shielding plates must be provided also for room equipment made of flammable materials, if it is not possible to maintain a safe distance (e.g. in mobile devices and cottages, etc. – for more details see ČSN 061008). The safety distances must also be kept when storing objects near boilers.

Table 1

Fire classification of construction products and building elements	**Classified building elements and construction products** **(extract from ČSN 730823)**
A – non-flammable	granite, sandstone, concrete, bricks, ceramic tiles, mortars, fire plasters, etc.
B – not readily flammable	Akumin, Izoklin, Heraklith, Lignos, basalt felt boards, fiberglass boards, Novodur
C1 – hardly flammable	deciduous wood (oak, beech), planks, plywood, Sirkolit, Werzalit, hardened paper (Umakart, Ecrona)
C2 – moderately flammable	coniferous wood (pine, larch, spruce), particle and cork boards, rubber flooring (industrial, Super)

C3 – easily flammable	fibreboard (Hobra, Sololak, Sololit), cellulosic materials, polyurethane, polystyrene, polyethylene, expanded PVC

5.3.1 Approval obligation by the building authority

Any changes or extensions to the solid fuel heating system must be notified in writing to the competent building office. If the purpose of the rooms should be changed as a result of the construction of the heating system (e.g. the storage room will be used as a fuel store etc.), it is necessary to apply for a permit. You can receive the technical documentation necessary for the application (plan, technical report) from our representatives; you will pay only costs related to its delivery. The exact dimensions of the heating and storage room are required for drawing plans. For further answers to your questions about the procedure, please contact your building office (municipality or local authority) National standards and regulations must be provided by a design or installation company.

5.3.2 Design of the boiler room

The walls and ceilings must be made of fire-resistant material (12cm brick plastered on both sides, 10cm concrete, 10cm gypsum boards sealed (plastered) on both sides. The floor covering must not be of flammable material. Access to the heating room must be closed by a door opening in the direction of escape. The smallest possible door clearance width depending on the boiler type is given in the following table. The smallest width is required to install the boiler in disassembled state. The second value applies to the installation of assembled unit.

In order to erect the boiler it is necessary that the base for the boiler consists of concrete or tiled floor. Small irregularities can be compensated by the height adjustment of the boiler legs. There must be a permanently open air outlet outside the building for an air supply of 5cm^2/kW (at least 400cm^2). The opening shall be equipped with a grid with openings <5mm. Care must also be taken to prevent freezing of the heating space. No flammable substances may be stored in the heating room other than the fuel silo. A hand fire extinguisher (volume of 12kg) must be available outside the boiler room, namely in an accessible place next to the boiler room door. Each boiler room must be equipped with fixed electric lighting. For easy shutdown of the boiler, an emergency stop switch must be placed on the safe, easily accessible place. Minimum clearances should be maintained between the boiler and the room walls as specified in the appendix so as to facilitate installation and maintenance of the equipment.

5.3.3 Chimney

For chimneys that are too small or too low, the draught has to be checked or calculated by a specialist company. High boiler efficiency results in low exhaust gas temperature, therefore the chimney must be resistant to moisture. In case of serious problems, please contact our representative or your chimneysweeper. The data necessary for the chimney calculation can be found in Chapter 9.

5.3.4 Fuel storage

The following approximate rules apply to the size of the storage room at average ratios:

Fuel	Wood chips - 25% water content, 30mm, soft wood	pellets 10% water content, 6mm in diameter
Storage room per 1 year	7.7m^3 x heating power	2.8m^3 x heating power
Consumption per 1 year	6.2m^3 x heating power	2.2m^3 x heating power

The data for storage room includes the so-called dead spaces (inclined walls, incomplete filling and emptying). For equipment with a spatial conveyor, the storage room should be directly connected to the boiler room and should be rectangular if possible.

The same technical and fire protection requirements apply to the storage room as for the boiler room. In the middle of the storage room, there is a discharge device. The screw conveyor channel usually comes into the room slanted from above. The floor of the storage room should be formed by a level concrete. A slanted board made of wooden slats is recommended above

the floor, in which screw channel and drive are recessed. This creates an air cushion under the fuel, which additionally dries the fuel. The hole for clean air flow should lie under the wooden floor. A door to the storage room (with cross-section of at least 1.8 m^2 , into space) is required for the installation of the scooping equipment. This is necessary for above-ground storage rooms. In order to be able to open this door also when the storage room is fully loaded, it is necessary to choose a suitable door design, so as not to endanger the operator when it is opened. For the installation of the screw conveyor channel, an opening (50 x 50 cm) must be made to the boiler room. This opening is sealed after the equipment installation.

Indicators for biomass fuel

Indicators for biomass fuel													
Water content [%]	0	8	10	20	30	35	0	8	10	20	30	35	
Moisture [%]	0	9	11	25	43	54	0	9	11	25	43	54	
							Heating value in kWh/kg						
							5.1	4.7	4.5	4.0	3.4	3.1	
Fuel	Storage density in kg/m^3						Heating value in kWh/m^3						Proportion of ash [%]
Chopped hardwood	200	216	220	240	260	270	1024	1006	999	950	878	833	1
Chopped soft wood	140	151	154	168	182	189	717	704	699	665	614	583	1
Chopped bark	150	162	165	180	195	203	768	754	749	712	658	625	5-10
Sawdust	100	108	110	120	130	135	512	503	499	475	439	416	1
Shavings	30	32	33	36	39	41	154	151	150	142	132	125	0.2-0.5
Wood pellets	600	648	660				3073	3017	2996				0.2-0.5

5.3.5 Standards related to the design and installation of boilers

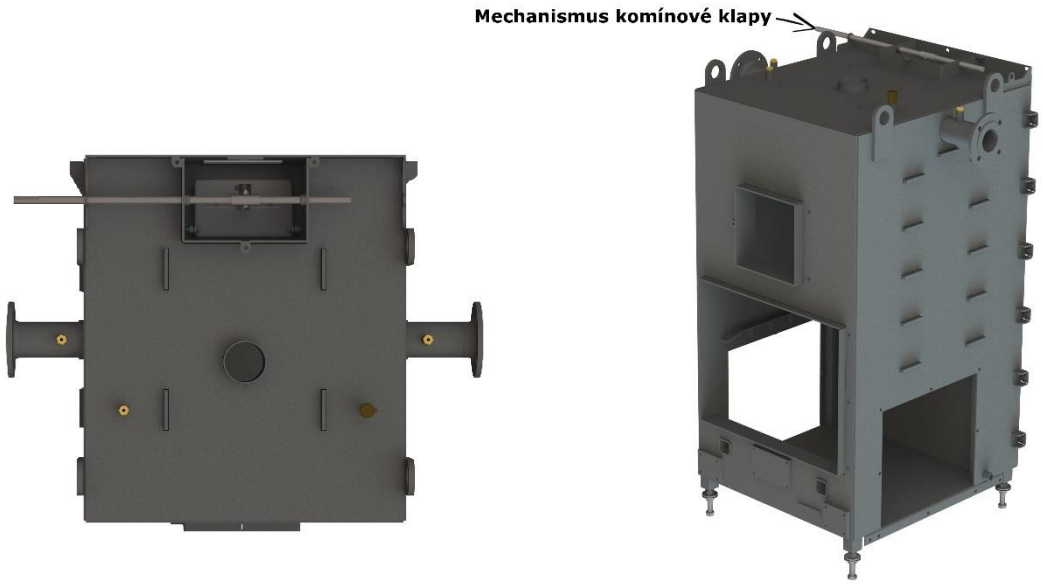
ČSN 060310/1983	Central heating, design and installation
ČSN 060830/1996	Safety installations for central heating a heating of DHW
ČSN EN 1443	Chimneys, general requirements 734200(9/2004)
ČSN 734201	Design of chimneys and flues (2/2008)
ČSN 061008/1997	Fire safety of local appliances and heat sources
ČSN 730823/1984	Degree of flammability of construction products
ČSN EN 60335-1/1997	Safety of electrical appliances for household and similar purposes
ČSN EN 50165/1999	Electrical equipment of non-electric appliances for household and similar purposes
ČSN EN 303.5+A1:2023	Central heating boilers - Part 5
ČSN 07 0240	Hot-water and low-pressure steam boilers
ČSN 07 7401	Water and steam for thermal power installations
ČSN 834611	Air protection - measurement of solid emissions from pollution sources
ČSN 061008	Fire safety of heating equipment
EN 13501-1 +A1	Fire classification of construction products and building structures

Decree No. 48/82 Coll. and Decree No. 91/93 Coll.
The installer is obliged to ensure design and assembly in accordance with the national equivalents of the cited standards

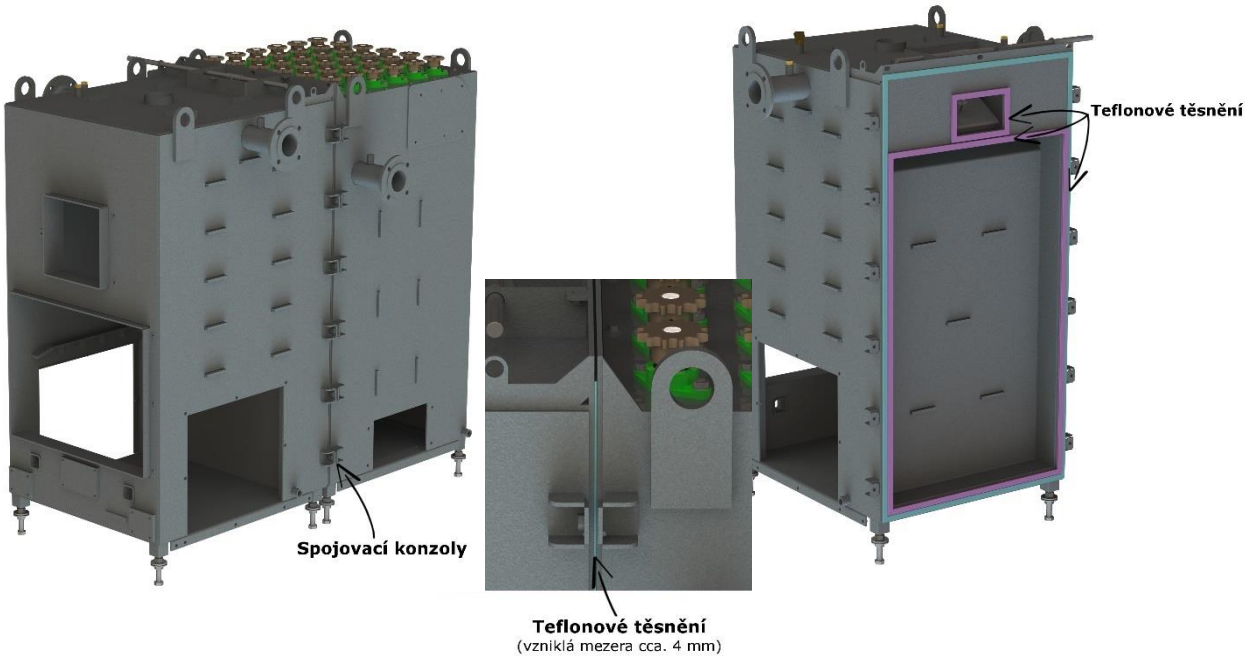
5.4 Installation of the equipment

Installation of the equipment may only be carried out by SMART technicians or demonstrably trained personnel. If the equipment can be delivered to the boiler room as a whole, it is delivered assembled. In poor spatial conditions, it is delivered disassembled and then reassembled at the installation site. Such work as connection to the chimney, the chimney itself, wiring, heating work, etc., must be carried out by specialized companies or technicians with appropriate authorization. After fulfilling these conditions and submitting valid tests and revisions, the equipment can be commissioned and set up by SMART personnel or trained personnel.
If the equipment is commissioned by personnel without an appropriate authorization, the equipment loses the warranty.
The equipment is not considered to be safe and reliable to operate.
Only technician with a valid certificate issued by the manufacturer is considered to be a demonstrably trained worker

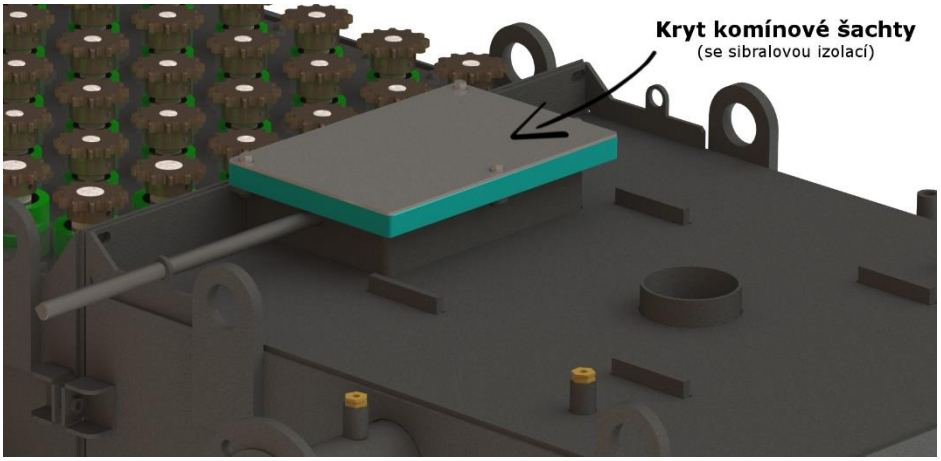
1. The combustion chamber is seated on its installation site. Using adjusting feet, the combustion chamber is levelled according to spirit level so that the bottom of the chamber is horizontal in all directions.



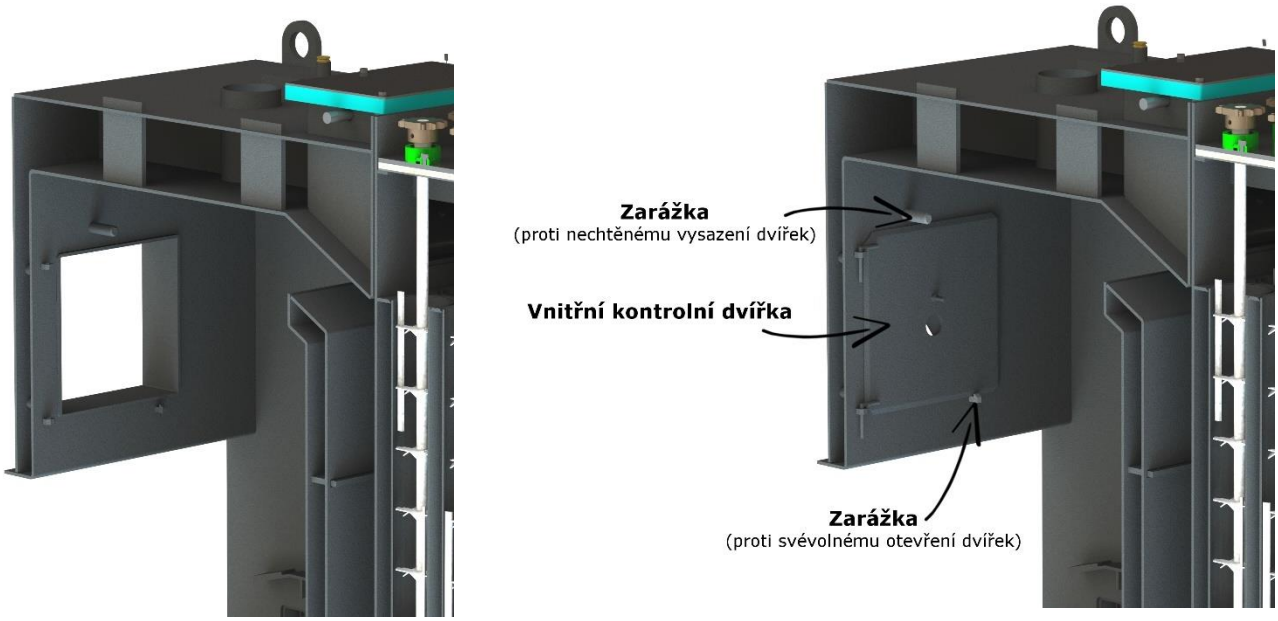
2. Connect the combustion chamber to the heat exchanger by means of screws in the upper part and also by means of connecting brackets located on the side walls of the combustion chamber and exchanger. A Teflon seal is glued between the contact surfaces of heat exchanger and combustion chamber and around the flue gas passage hole between the exchanger and the chamber to prevent leakage. In order to prevent damage to the seals, side to side movement is prohibited. The only possible movement is towards you !! A gap of approx. 4 mm is created between the metal parts of the combustion chamber and the exchanger after tightening the joints.



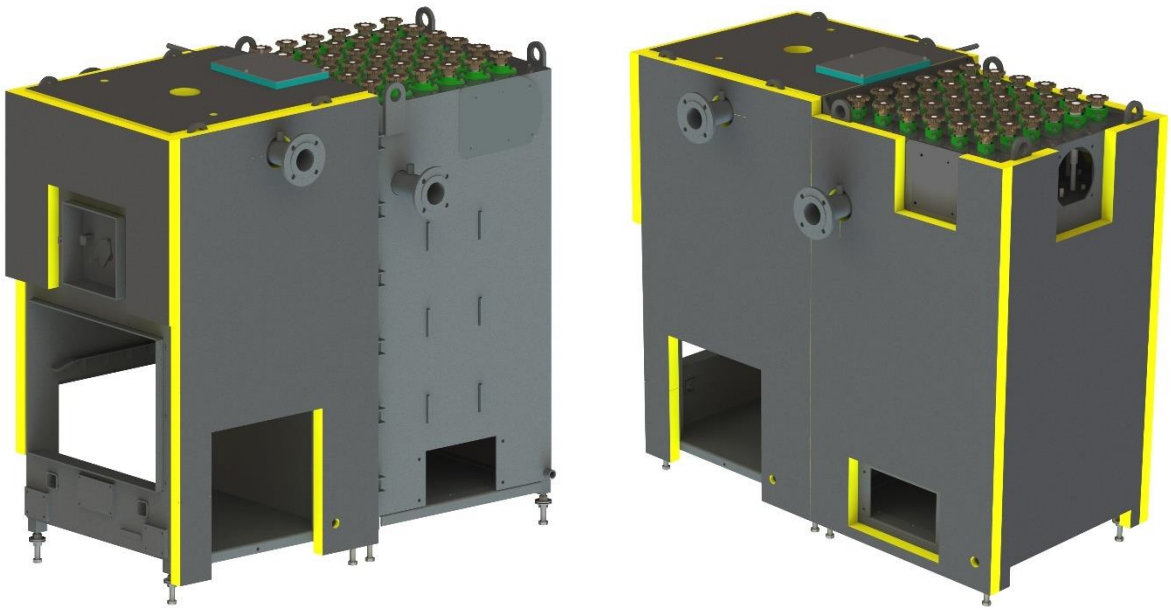
3. Screw the shaft cover onto the chimney shaft. Tighten the screws so that the thermal insulation of the insulation sits on the entire perimeter of the chimney shaft.



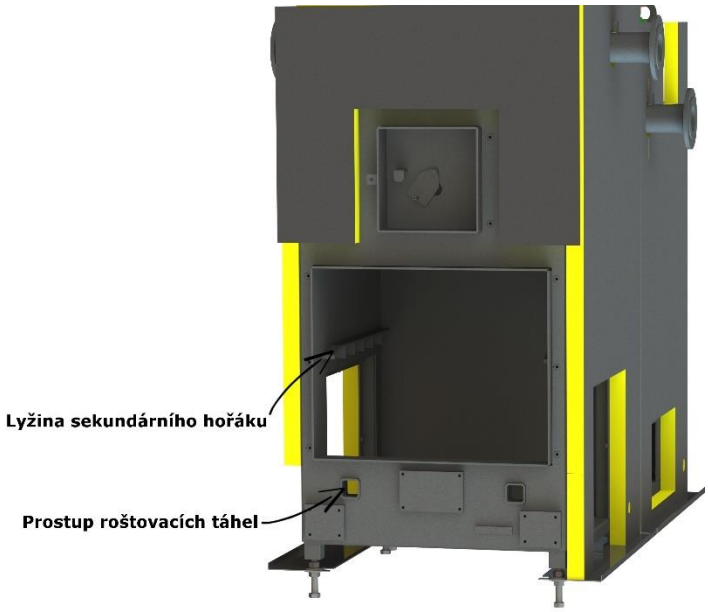
4. Insert the internal inspection door.

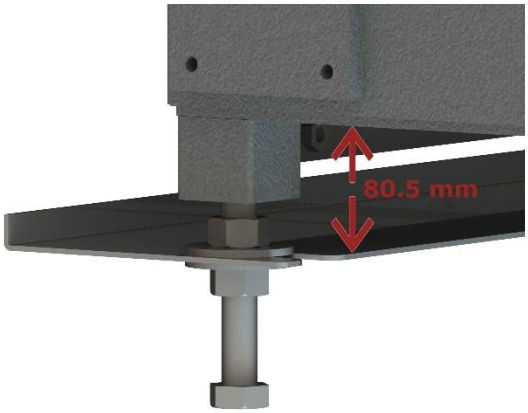


5. Insulate the combustion chamber and heat exchanger. Individual parts of the insulation are locked together by wire connectors. Do not use glue.

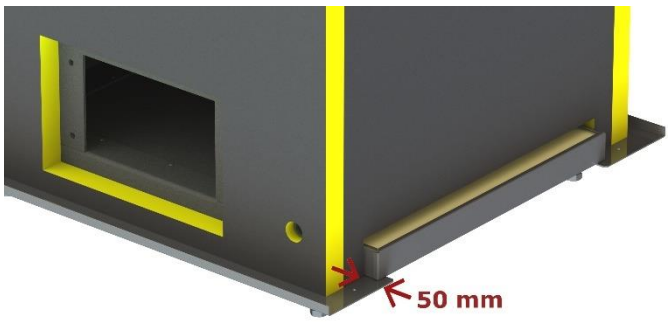


6. Nuts and fender washers are prepared on the adjusting legs, between which the skids are attached that bear the outer casing. Both skids must be at the same height and level with the boiler. The internal dimension between the boiler bottom and the skid is 80.5mm

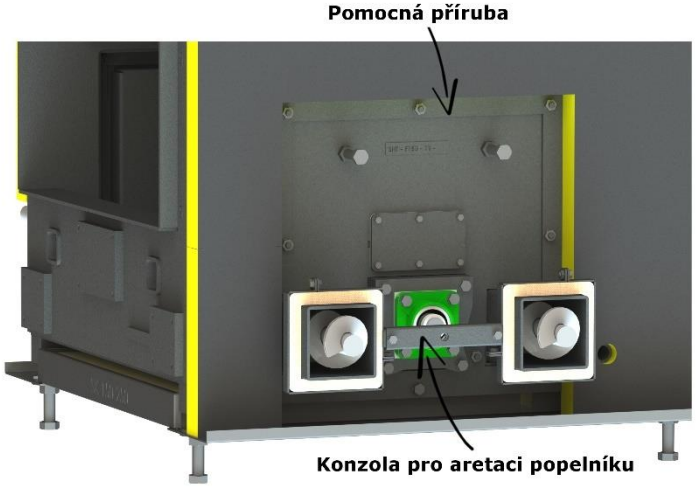




7. Insert insulated sheets under the boiler. Leave 50mm space on the rear side of the exchanger for the rear part of the outer casing.

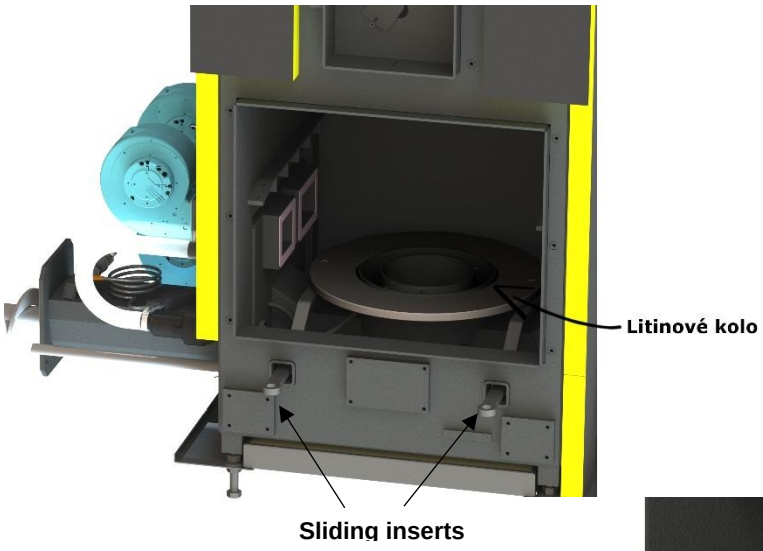


8. Insert and screw fuel feeder into the combustion chamber. The side of the inlet fans is screwed directly into the combustion chamber; an auxiliary flange must be used on side of outlet of ash worms.

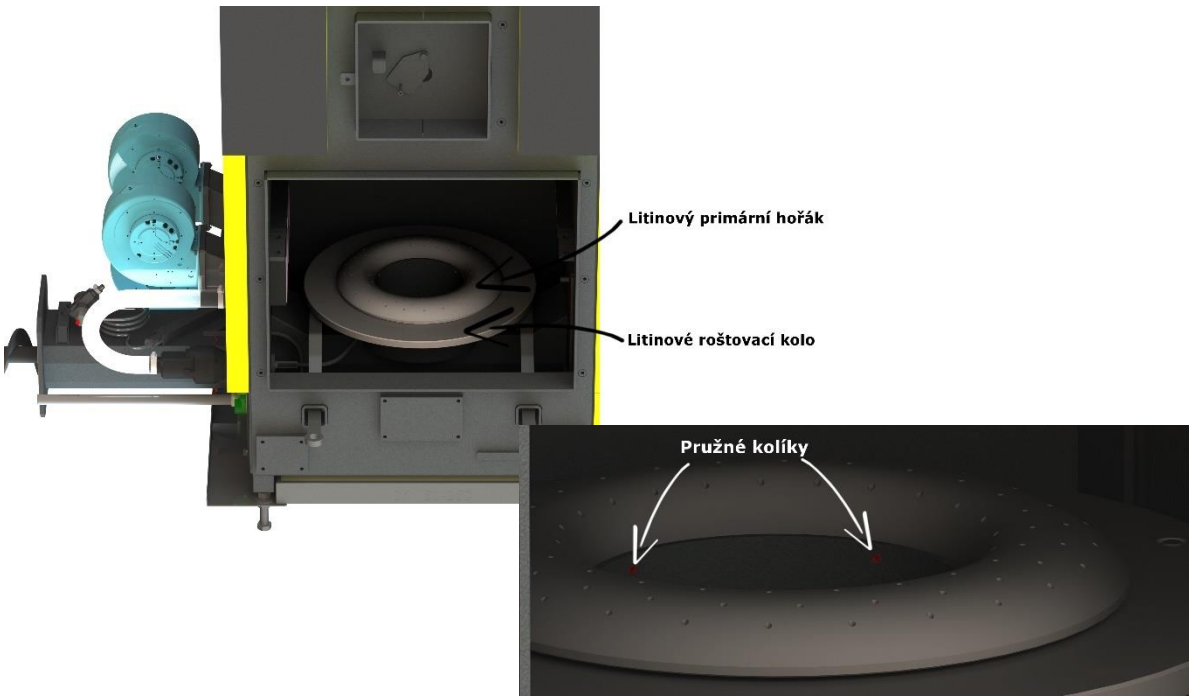


8. Install a cast iron grate wheel and grate rods on the fuel feeder. The grate rods are secured on the cast iron by cotter pins. The cast iron wheel must rotate freely back and forth.

9. Check that sliding inserts are fitted at the outer ends of the grate rods.

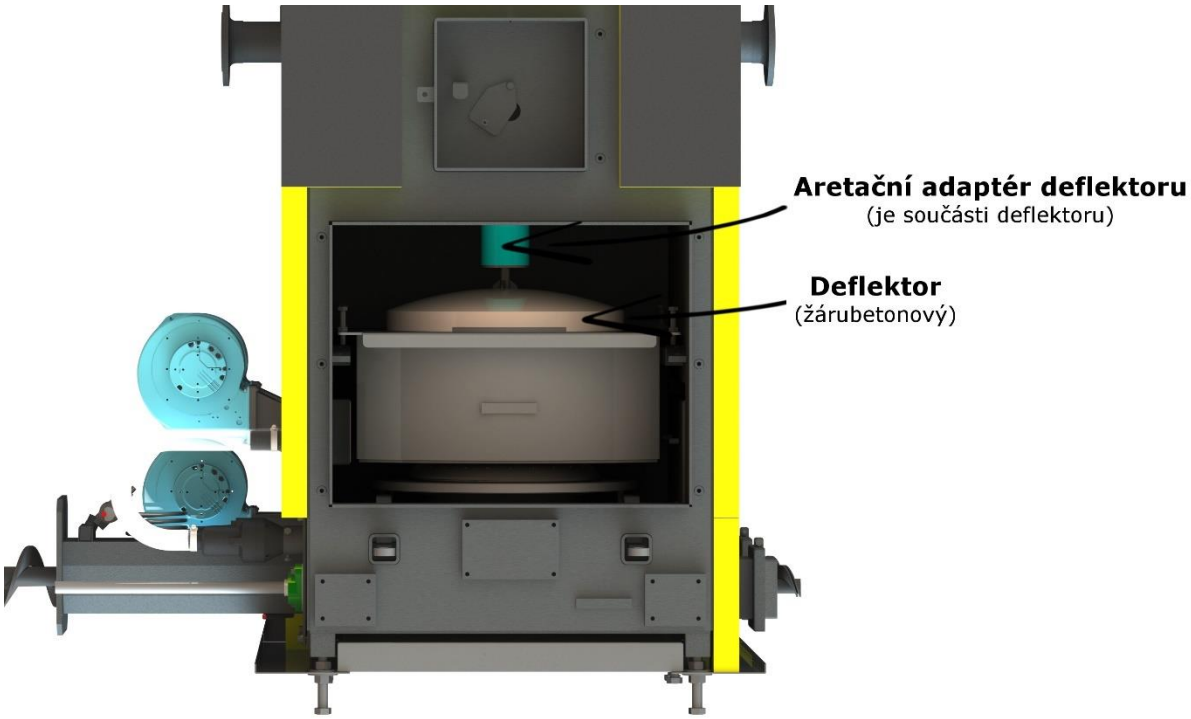


10. Insert cast iron primary burner inserted into the annular ring of the feeder and secure it with three spring pins. The primary burner must not prevent the cast iron grate wheel from moving.

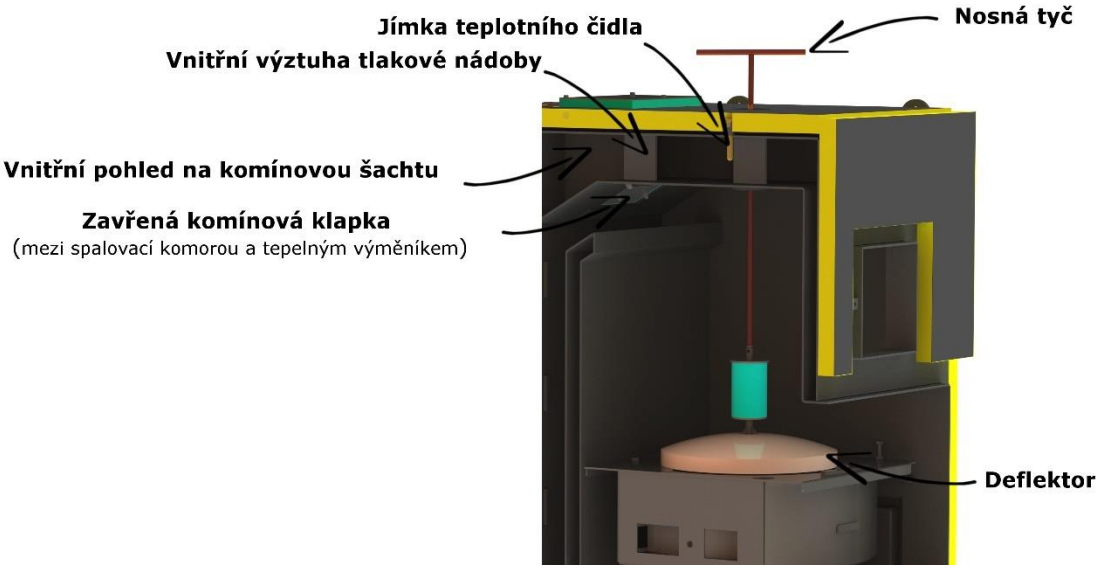


11. Insert the lower part of the secondary burner. Use the adjusting screws to position the burner horizontally so that the air ducts from the fuel feeder precisely match the air ducts in the secondary burner. When inserting, be careful not to damage the primary burner. Then press the secondary burner against the sealing cords on the fuel feeder. This is done using pressure bolts on the right side of the fuel feeder. These screws are loosened again after completion of the furnace to prevent the burner from deforming during thermal expansion. The gap between the bolts and the burner is now 1mm

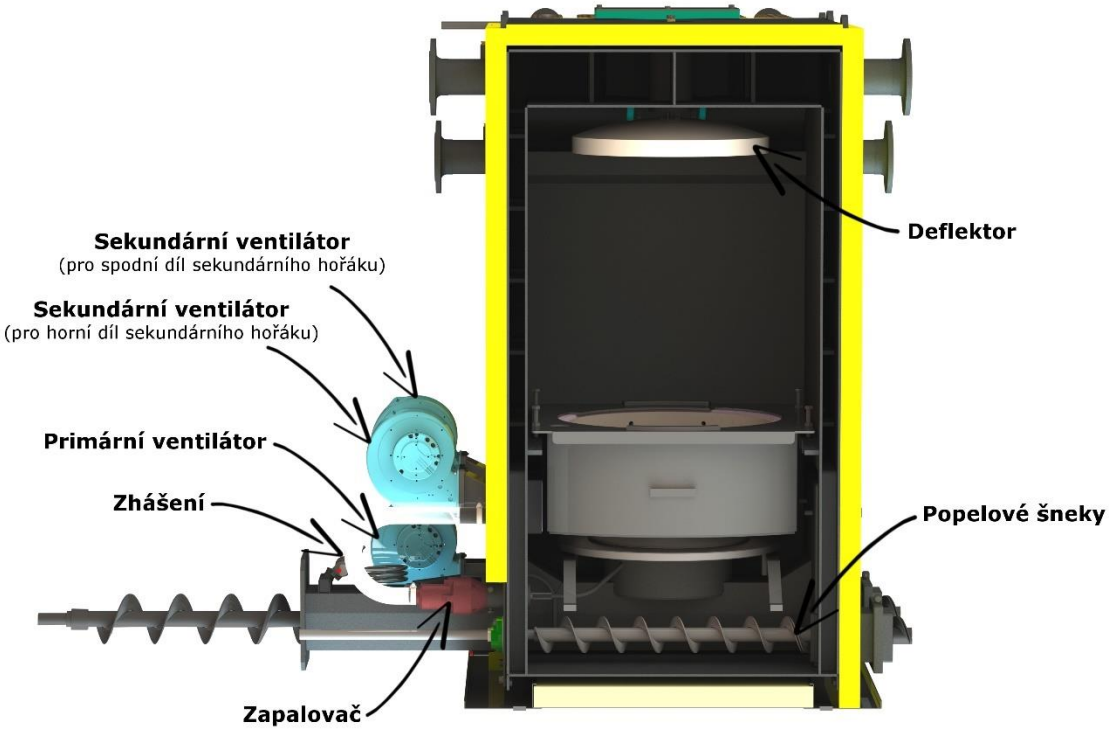
12. Put a refractory deflector on the secondary burner in the combustion chamber. Handle the ceramic deflector very carefully.



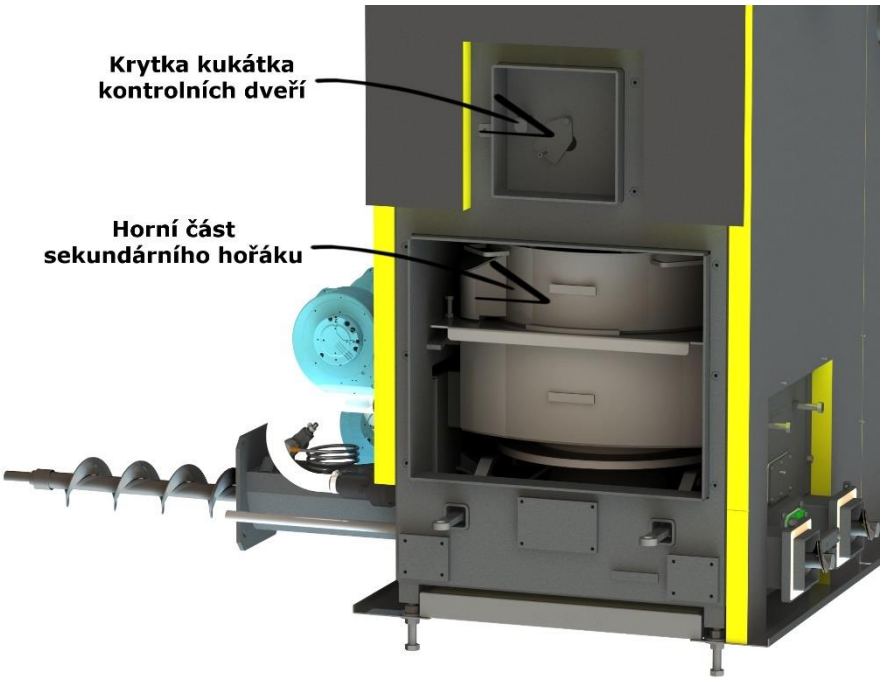
13. Lower the deflector support rod through the upper Sibral grommet and secure it with two stainless steel bolts and nuts.



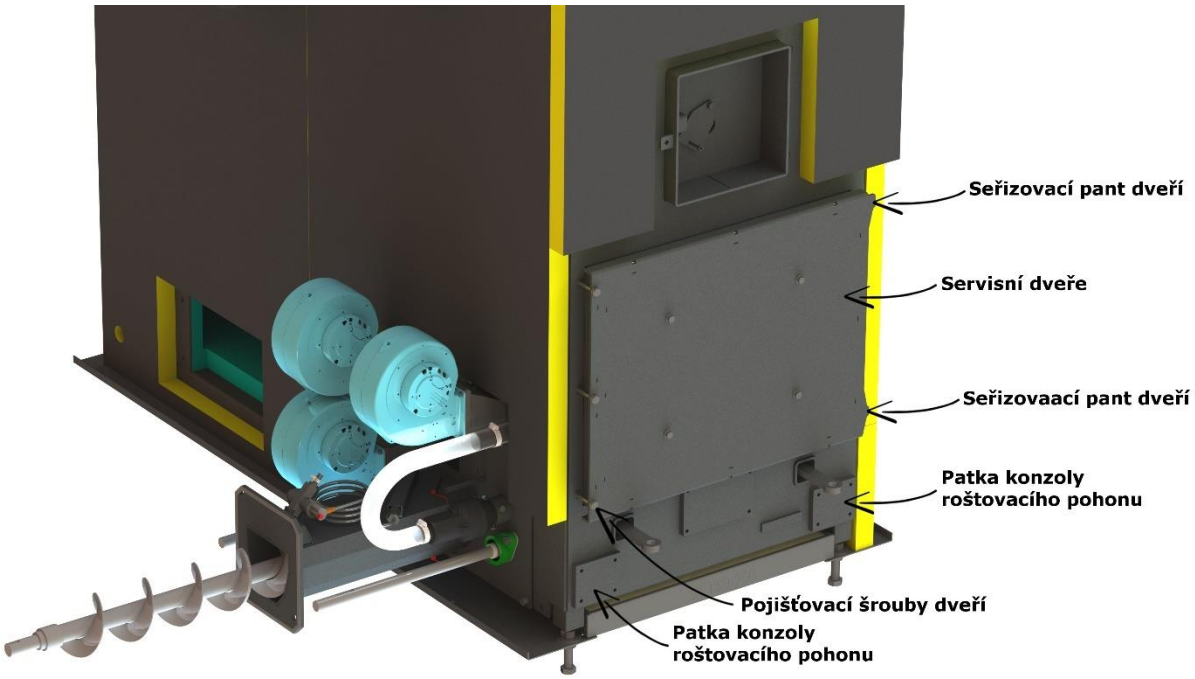
14. After securing the deflector, pull it to the prescribed height (height may vary depending on the fuel being combusted). Secure the rod above the Sibral grommet of the combustion chamber. The support rod consists of two parts. Both parts are threaded together. The upper part of the support rod can be unscrewed.



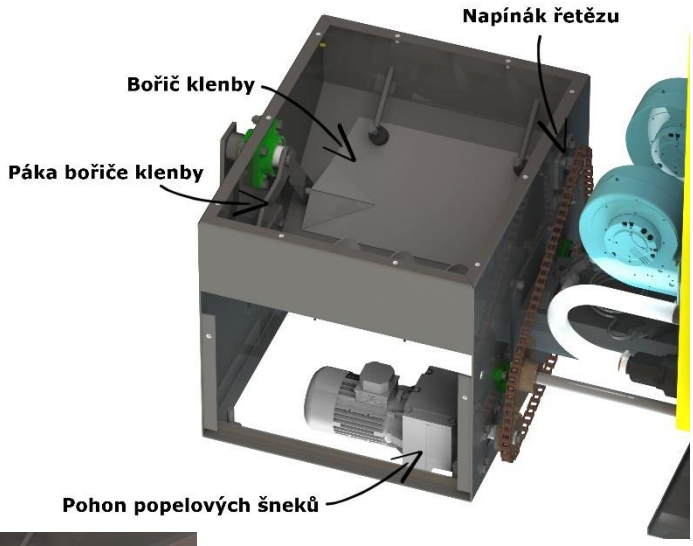
15. Insert upper secondary burner. Support the upper part into the annular ring at the lower part of the burner. There must be sealing glass-ceramic cords in the annular rings. Also, the passageways between the two parts of the burner must be sealed. Correct mutual position of the burners is indicated on the outer casings of the burners.

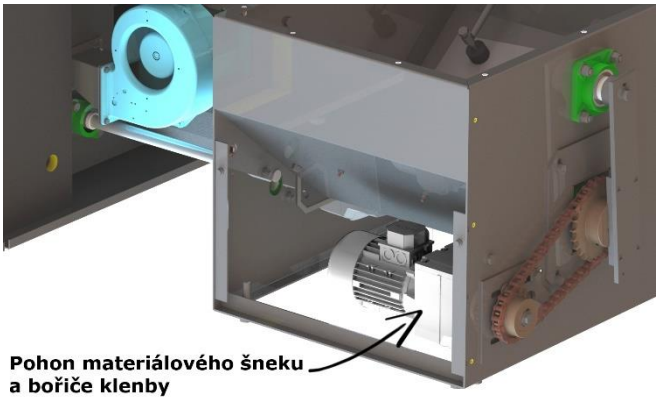


16. Install the service door and secure it with three screws. Tighten the screws evenly so that to prevent the door deforming. The door hinges are adjustable. The door must be opened without force and, at the same time seal evenly around the glass-ceramic sealing cord.

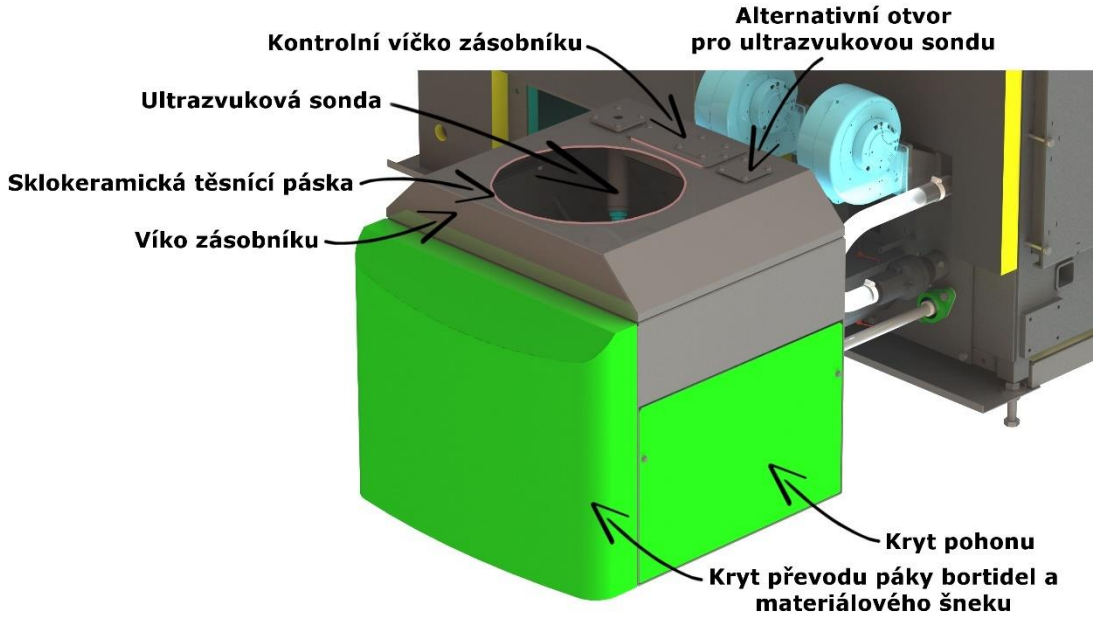


17. Pull up the fuel bin and screw it to the assembly. Within this step, the shafts are fitted with sprockets, bearings and chains. A Teflon seal must be glued between the bin and the feeder.

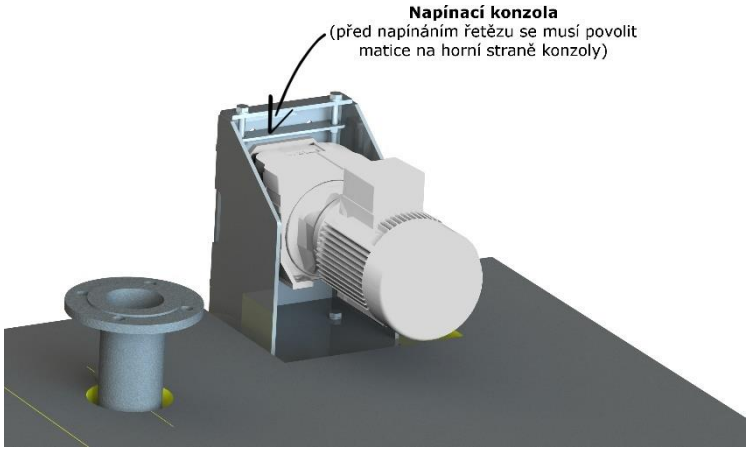


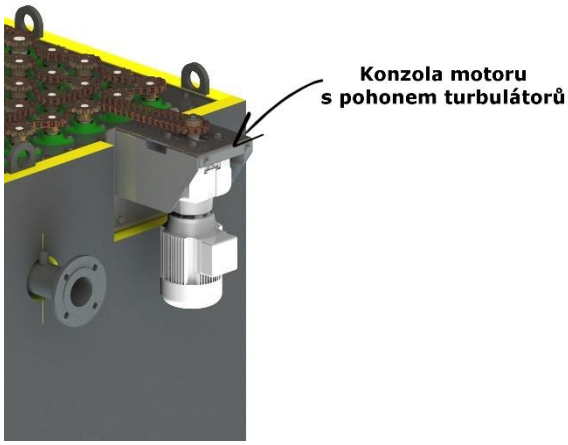


18. Install drive covers and bin lid on the bin. Glue the glass-ceramic sealing tape onto the contact surfaces of the upper lid, inspection lid of the bin, alternative opening for the ultrasonic probe and the tube for ultrasonic probe.

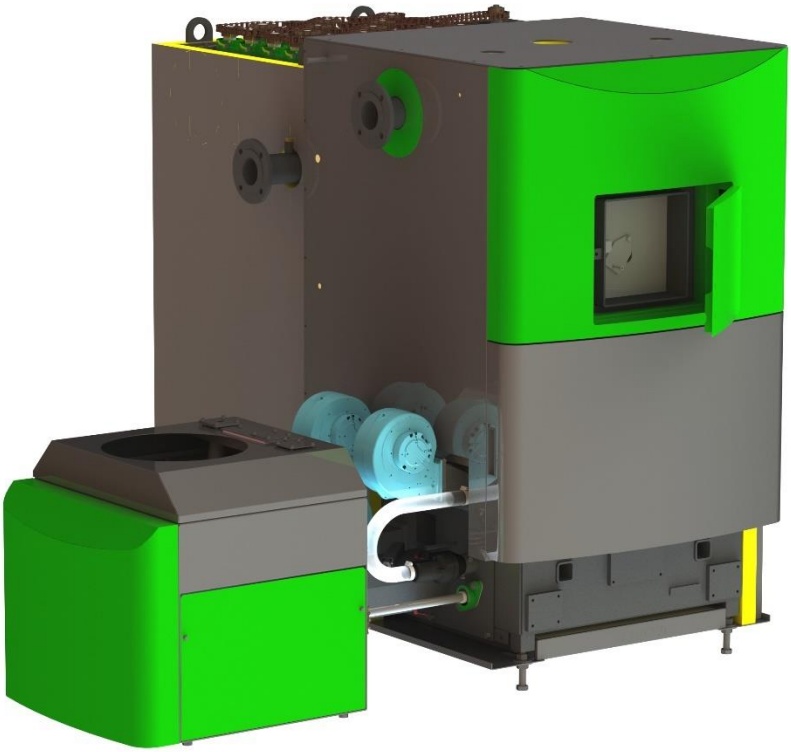


19. Screw the motor bracket with drive to the exchanger. In this step you can thread the chain(s). The chains are tensioned by tensioning screws using a flange on the motor bracket.

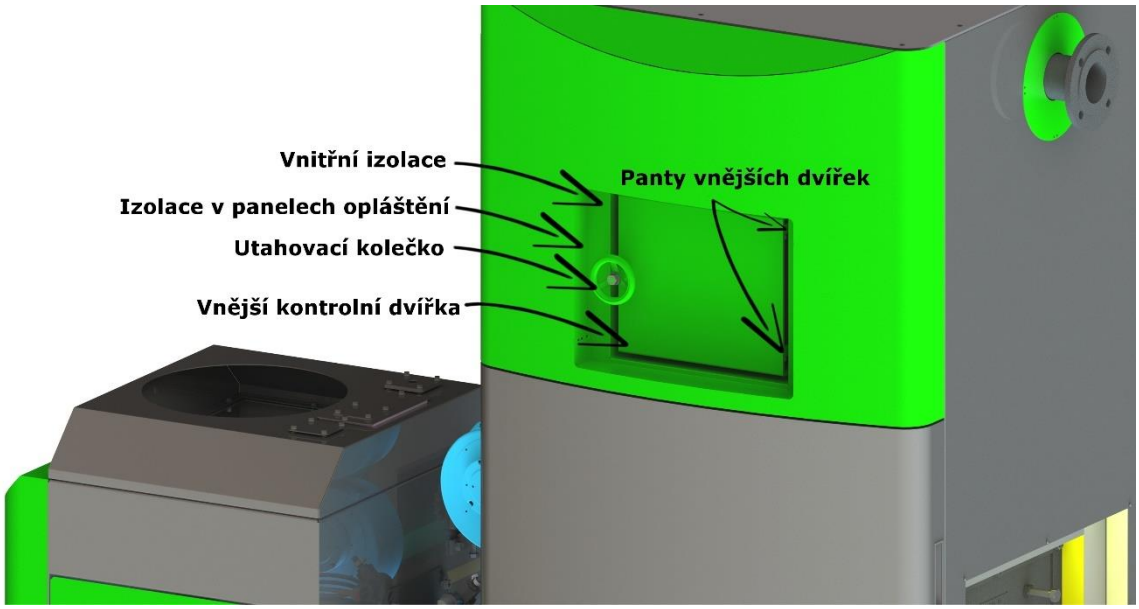




20. Fit the combustion chamber with casing. Insulation must be glued to sheet metal panels. Remove the plug for actuator shaft of chimney damper, namely on the side on which you want to install the actuator.

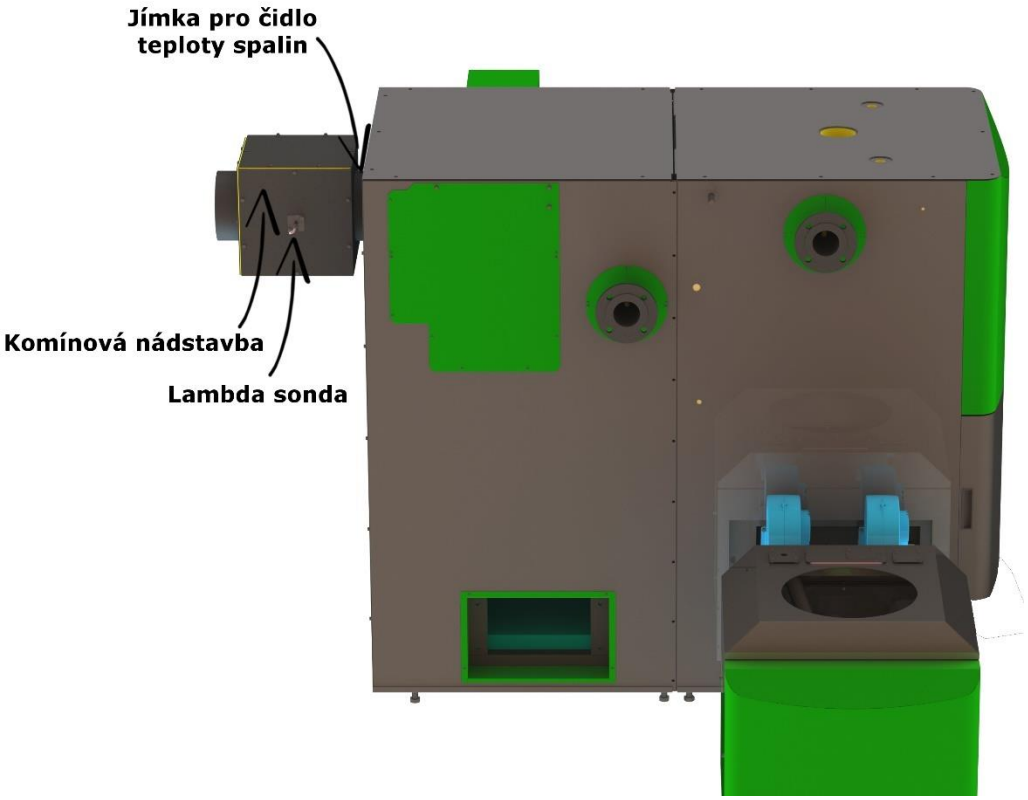


21. Install external inspection door. The door hinges are adjustable. It is necessary to adjust them so that the sealing glass-ceramic cord sits along the whole perimeter of the penetration frame.

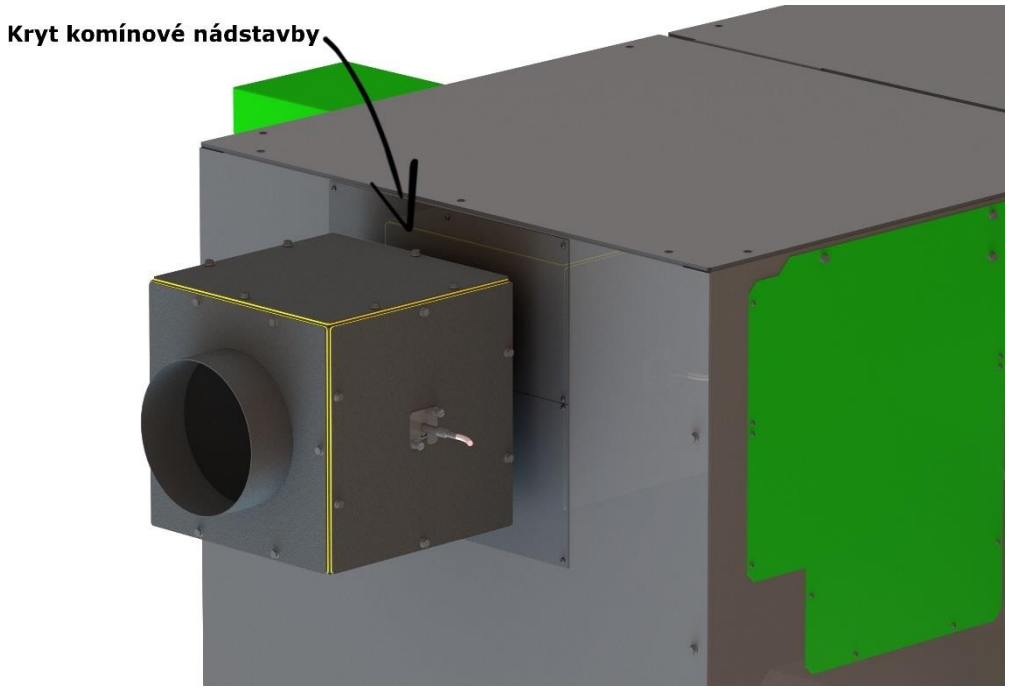


22. Install heat exchanger and put casing on it. Insulation must be installed to sheet metal panels. Rear part must be aligned with the support rails.

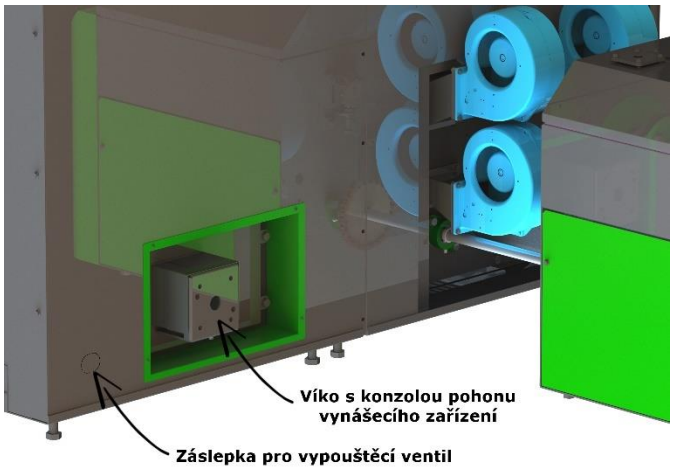
23. Screw the chimney body on. The chimney body is fitted with a well for the sensor of exhaust gas temperature and lambda probe. A Teflon seal must be glued between the heat exchanger and the chimney body. The chimney body can be fitted from the rear, left or right. For this variability of installation, the manufacturer has prepared mounting holes and cover sheets for boiler casing.



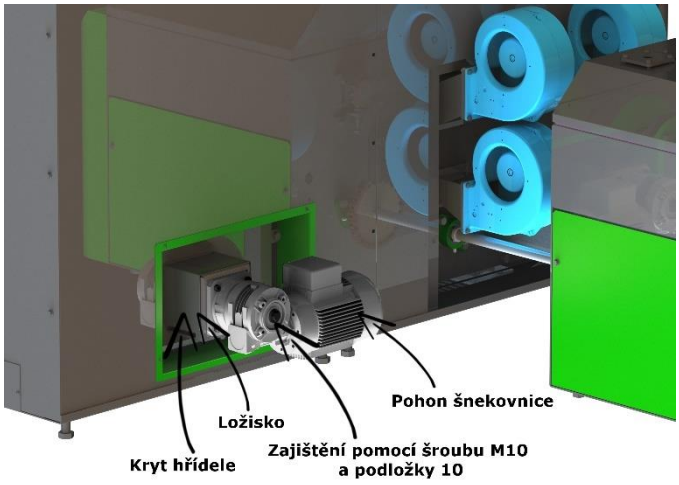
24. Screw on the cover plates around the chimney body

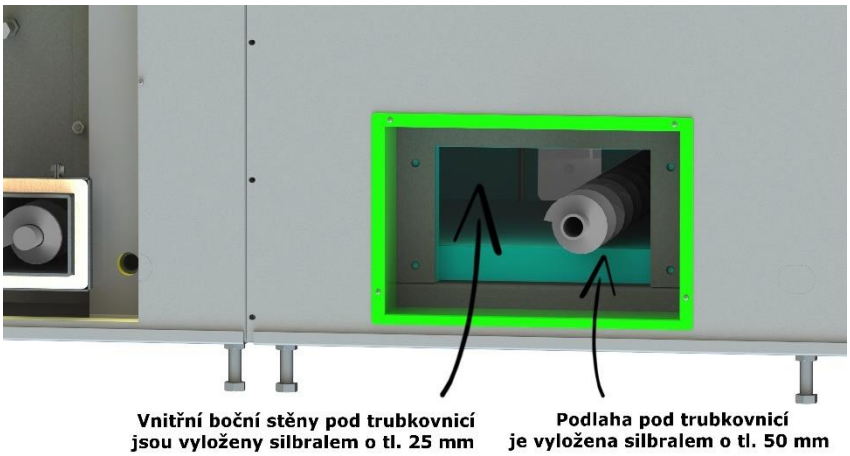


25. Screw the lid to the heat exchanger, which bears a bracket for drive of the deashing device (or the inspection lid of exchanger).

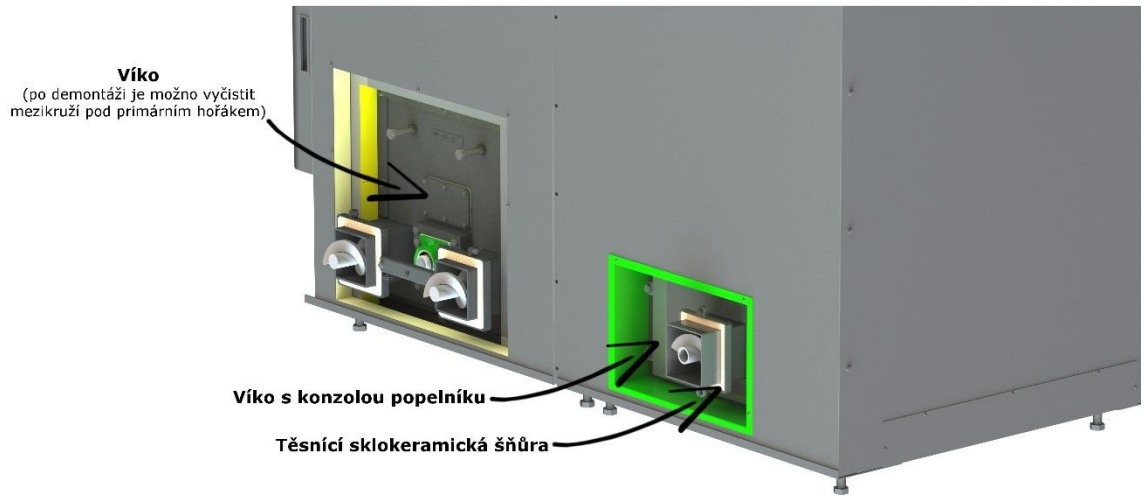


26. Insert the worm with electric gearbox and screw them to the bracket. The worm shaft is secured against sliding by an M10x25 screw and washer 10.
If automatic deashing is not used, the opening is closed by an inspection lid

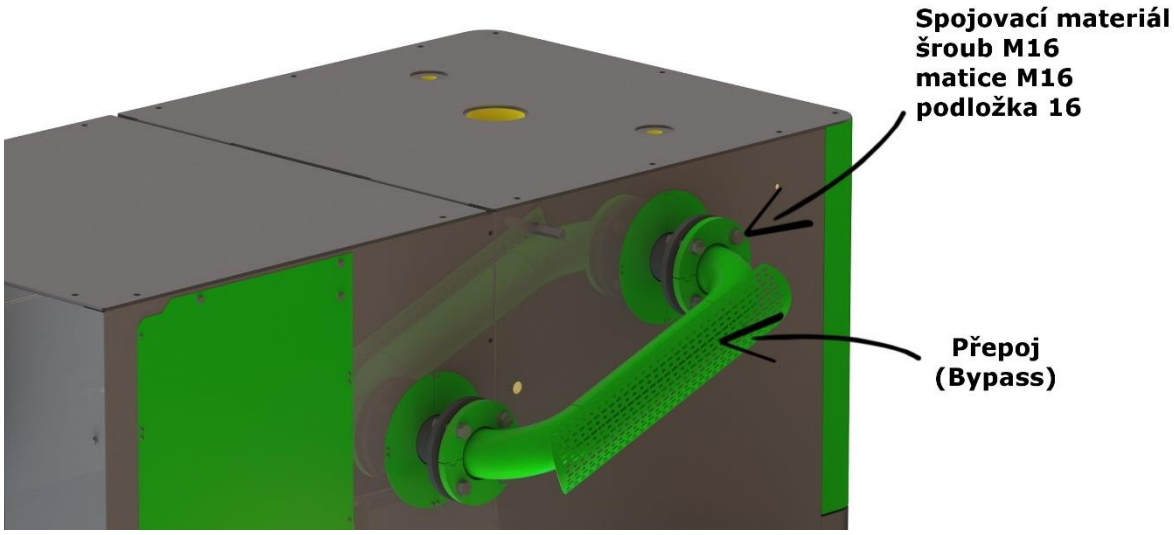




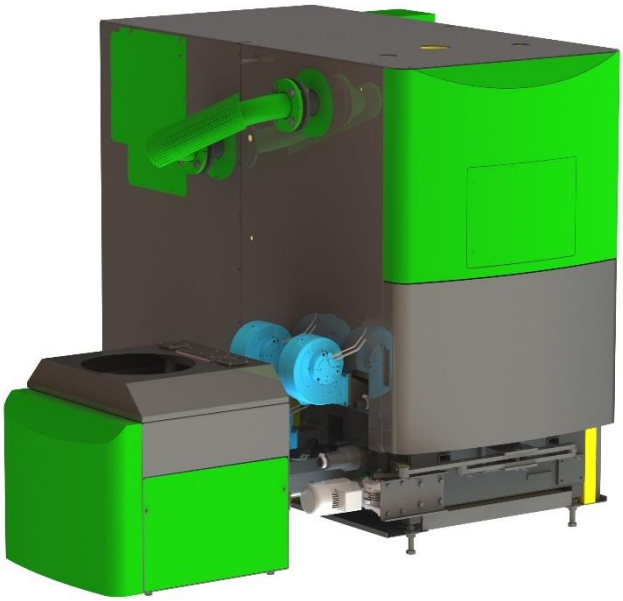
27. Screw on the lid with bracket for exchanger ashtray (or exchanger lid)

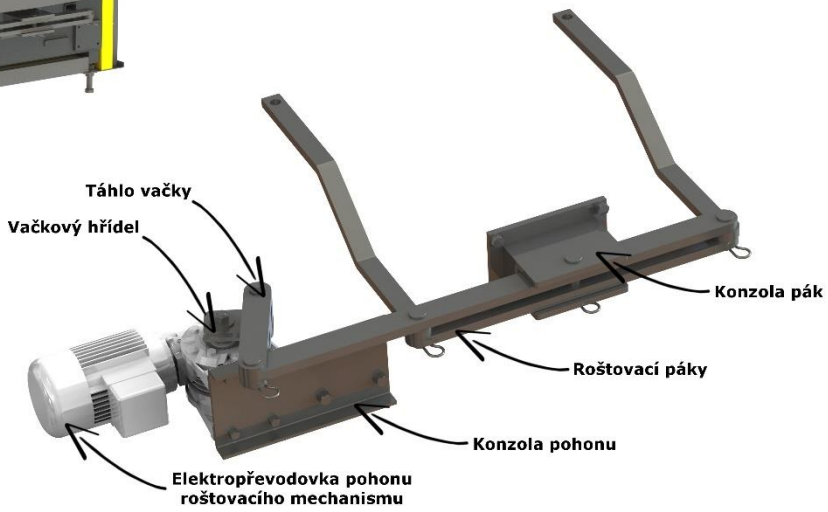


28. Screw on the interconnection for hot water flow (bypass) between the combustion chamber and the exchanger. The bypass can be installed from the left or right side of the boiler. The side is defined in hydraulic diagram so that the pipe from the boiler is as simple as possible.
Insert a Klingerit seal between the flanges of the pressure vessels and the interconnection.

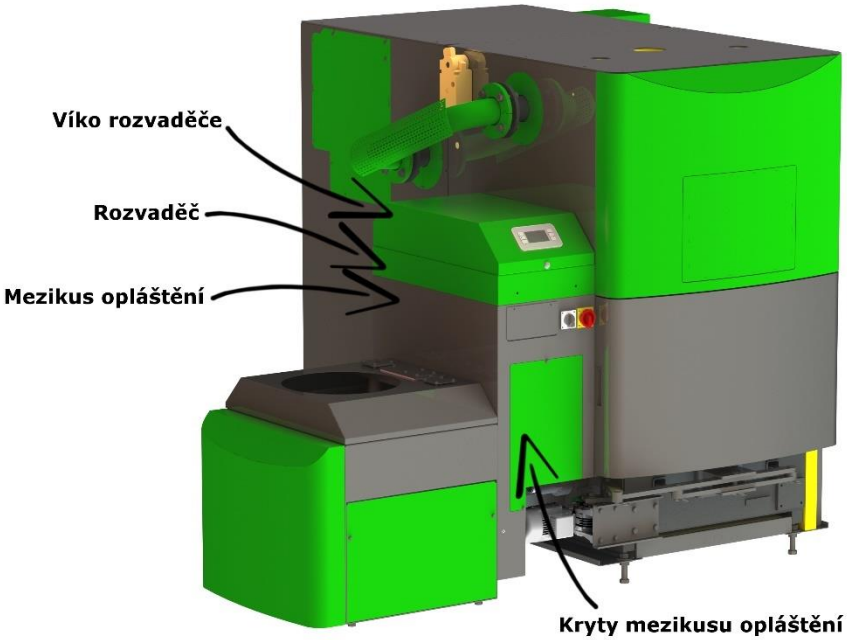


29. Screw on the bracket for grate drive mechanism. The electric gearbox, camshaft, and cam rod are mounted on the drive bracket. Then attach the grate levers and connect them with the cam rod, the grate linkage and the grate lever bracket.



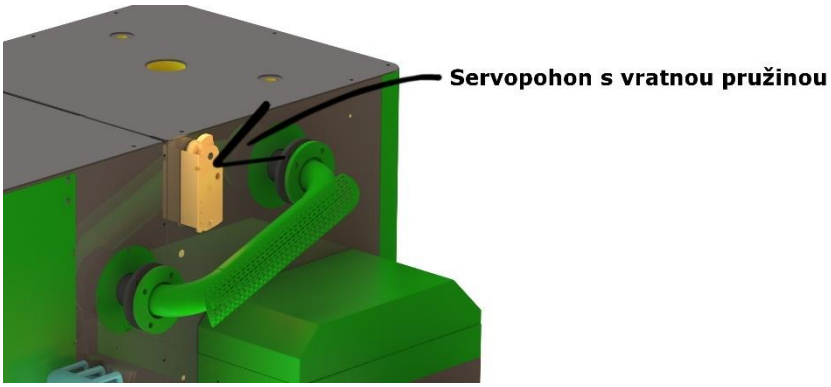


30. Insert the intermediate piece of casing between the combustion chamber casing and the fuel bin and screw it on from the inside.
The control unit with a switchboard cover is installed on the intermediate piece of casing.

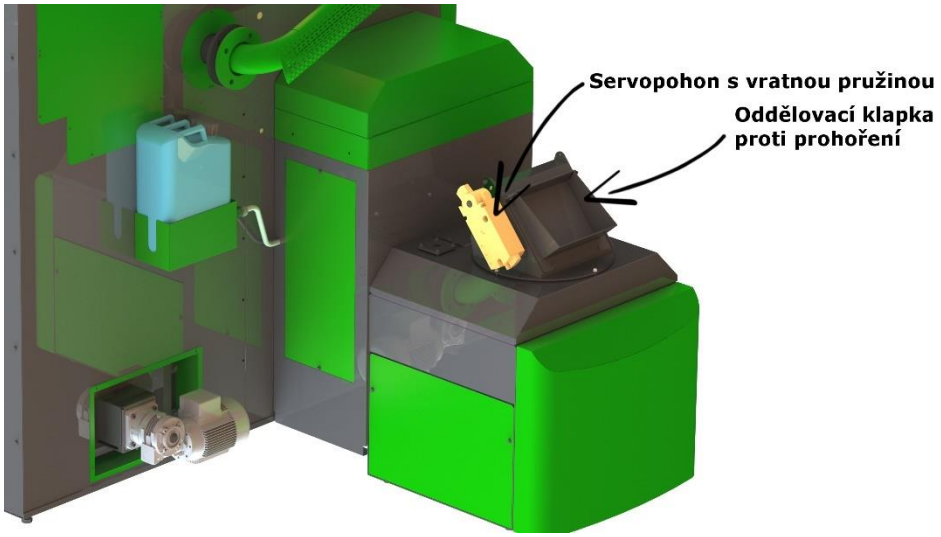


31. Install remaining parts of the casing on the combustion chamber

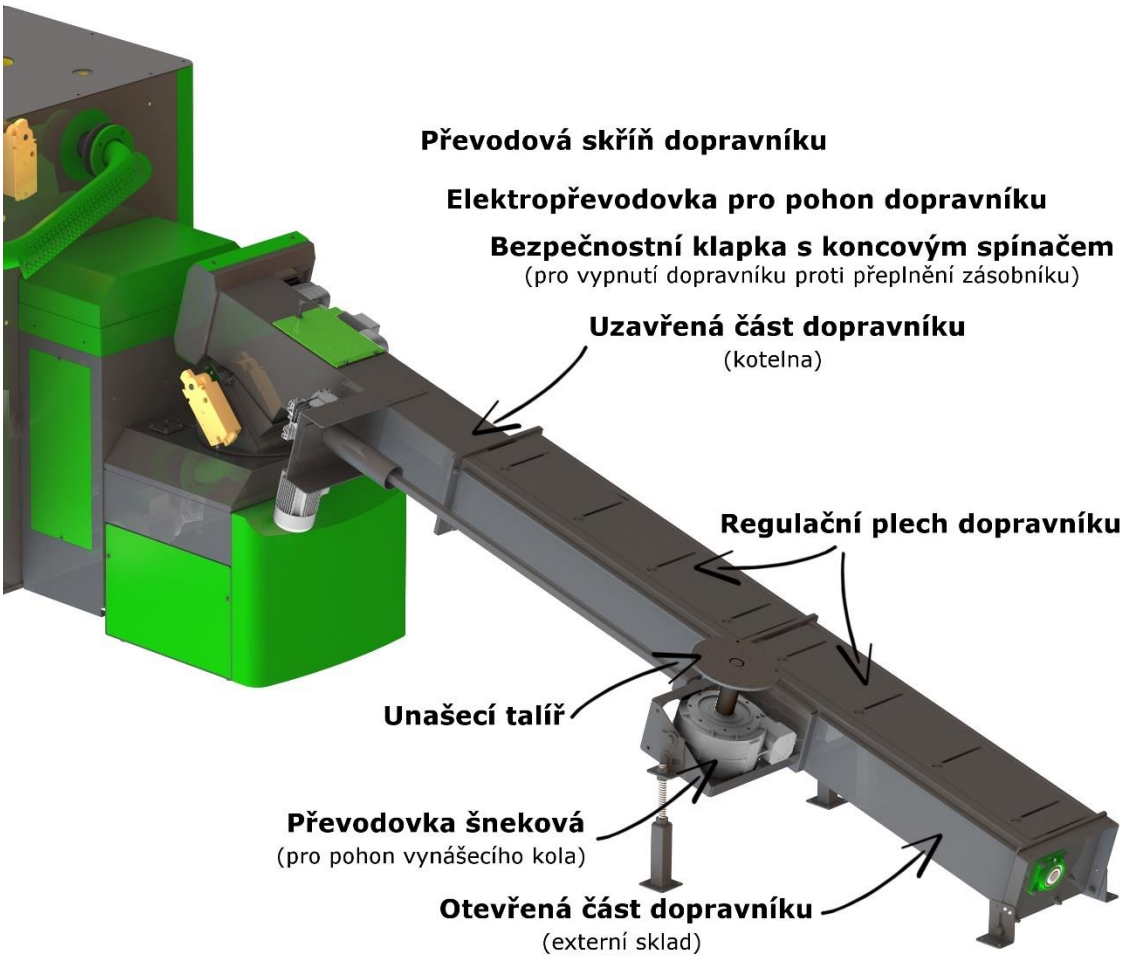
32. Install and lock actuator of chimney flap. The positioning of the actuator must ensure safe opening when it is de-energized

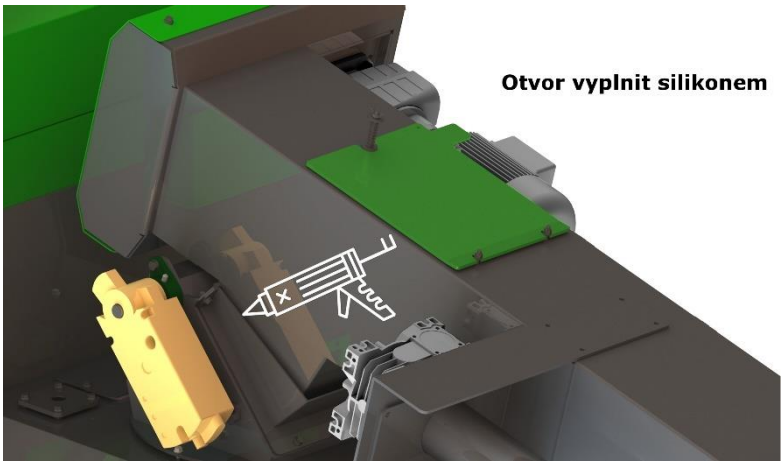


33. Install and screw the separation fire flap together with actuator fitted with a return spring on the fuel bin. Screw the flap to the top of the intermediate bin after the channel of discharge equipment is seated.
Assembly of the actuator with the flap axis must ensure that the flap securely closes when the actuator is without control voltage.

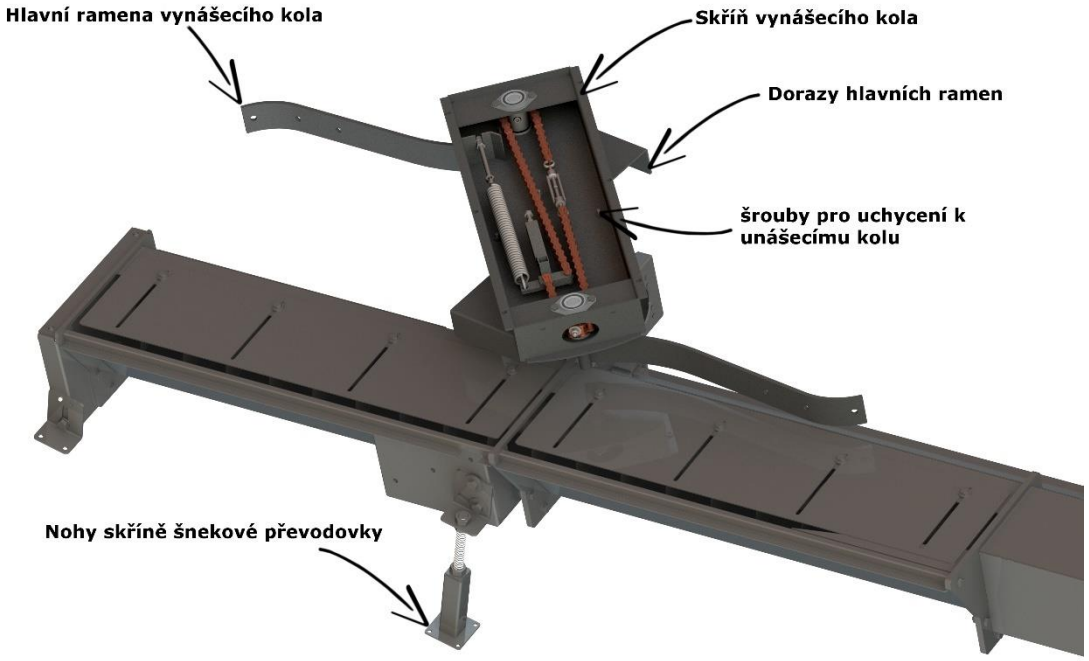


34. Set up the fuel conveyor according to the drawings for the deployment of the technology and lock it together with the separation fire flap. Fill the opening between channel end and the separator flap with silicone.
An airtight connection is necessary so as to prevent back fire

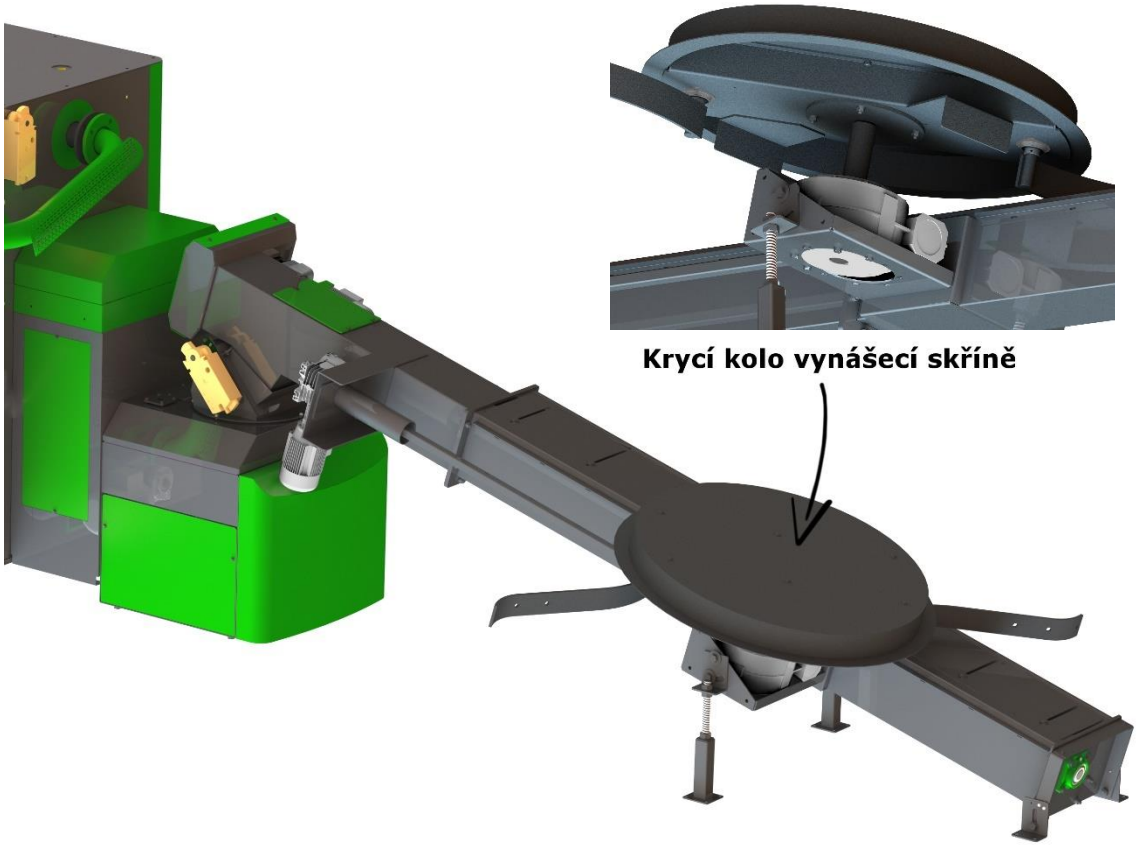




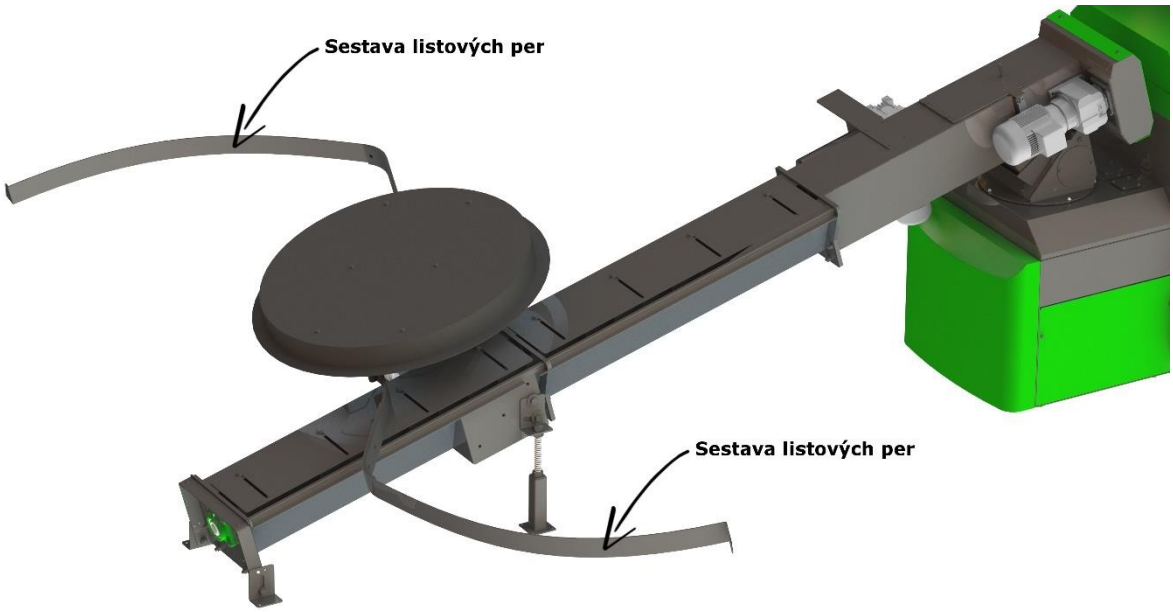
35. Screw the discharge wheel housing onto the discharge plate



36. Screw the cover wheel of the discharge box to the discharge wheel housing

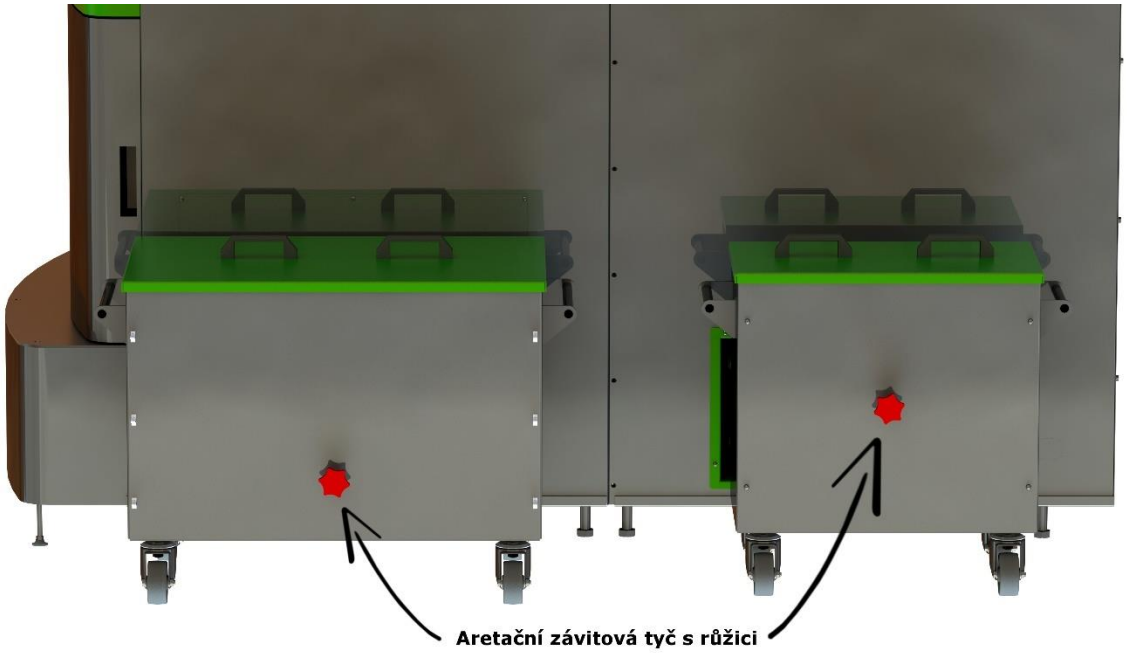


37. Screw the leaf springs assembly onto the main fixed arms of the discharge device. Never shorten leaf springs according to the size of the external fuel store. All bolts shall be loose and shall allow for the sliding movement of the individual spring leaves. This does not apply to the screws securing the leaves to the fixed arms of the discharge wheel.

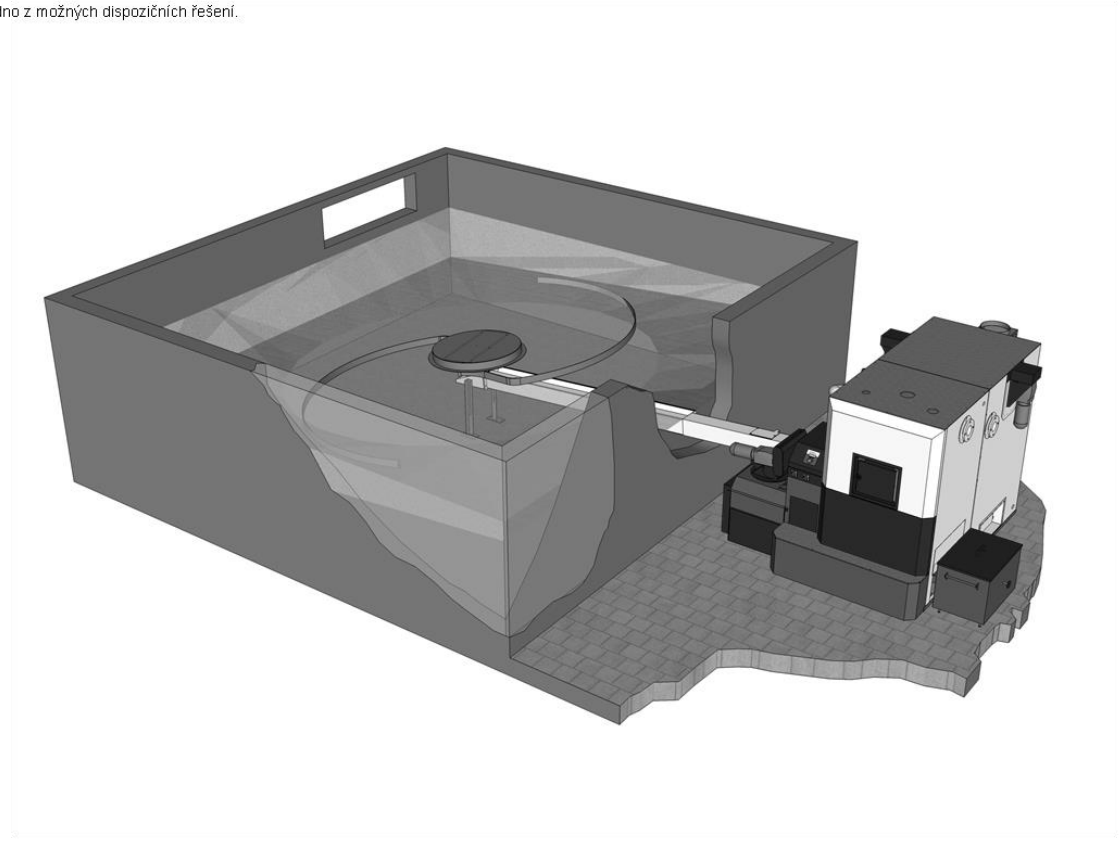


38. Install cover plate of the fuel feeder. First of all be sure to loosen the pressure screws of secondary burner.

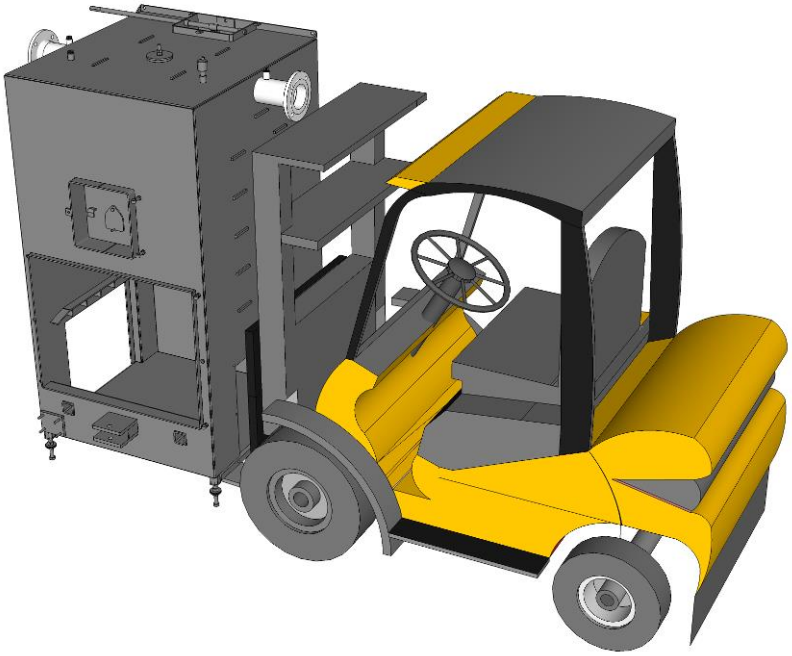
39. Pull up the ashtrays, adjust the ashtray legs so that they fit into the glass-ceramic cords with their throats and tighten them by means of the locking threaded rods.

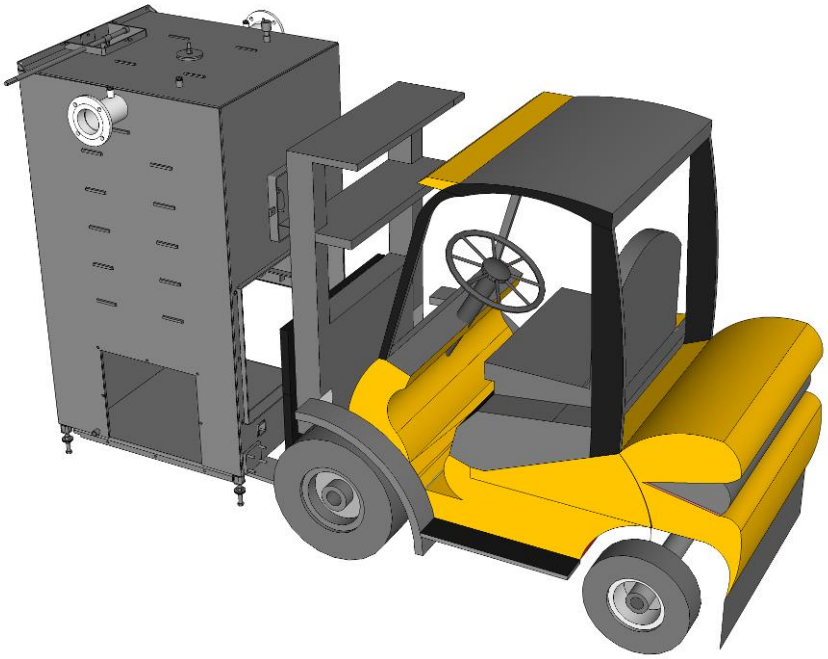


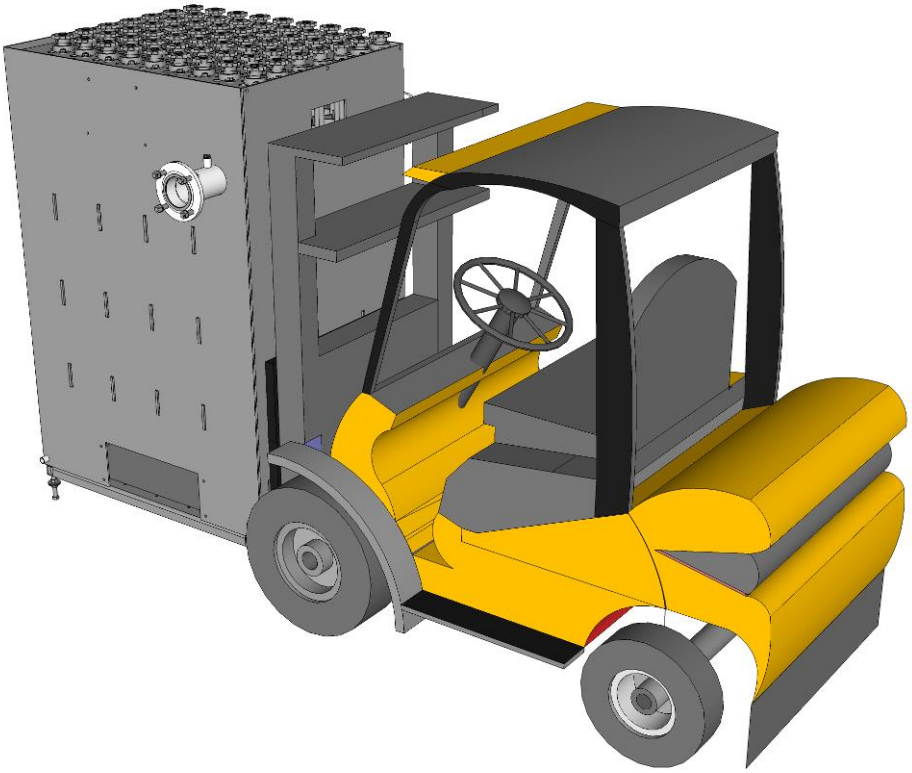
Jedno z možných dispozičních řešení.

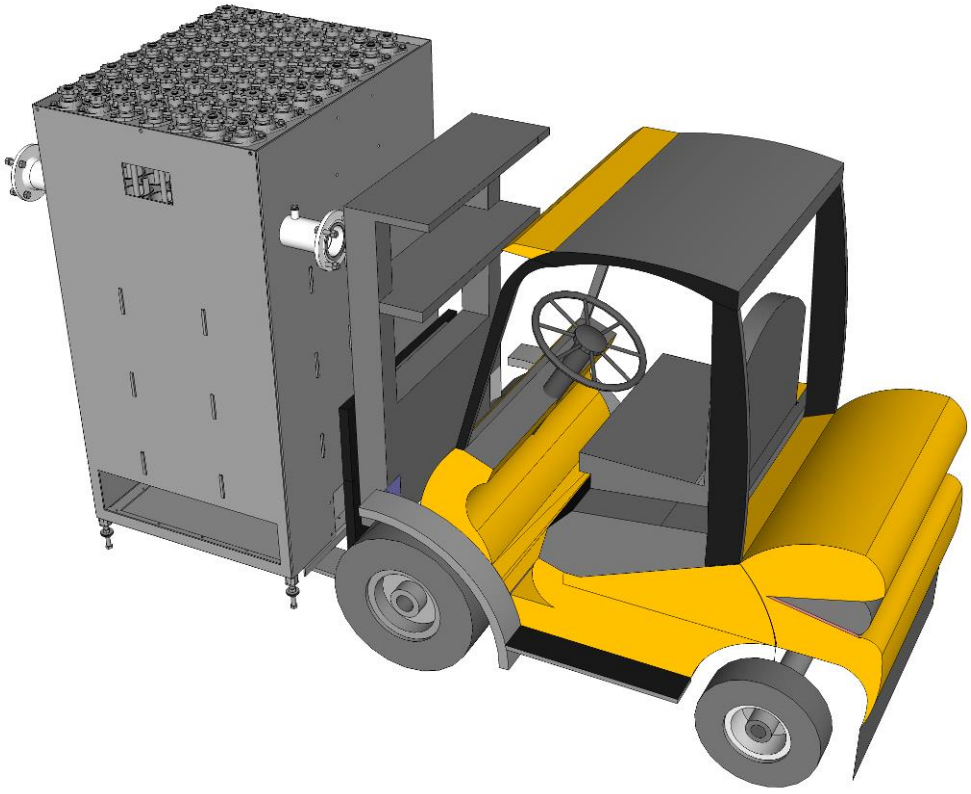


Handling of the boiler is permitted only by a forklift or pallet truck with a load capacity of min 2500kg.



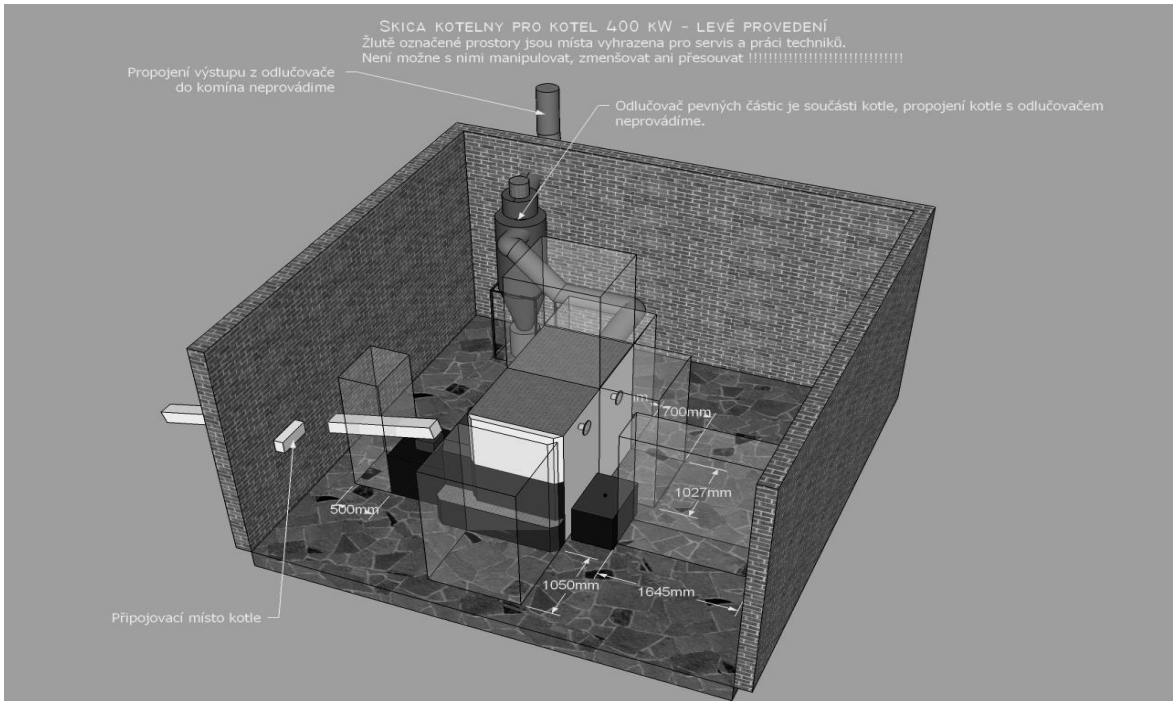






5.4.1 Power supply connection

When designing the wiring and control system of the boiler room, it is advisable to proceed from the below given recommendations, conditions and requirements for the connection of individual input or output elements.



5.4.2 Connection point of the boiler:

The most convenient location is on a wall adjacent to the side of the control box from the direction of the fuel intermediate bin position, accessible for easy operation.

5.4.3 Main power supply:

At the connection point, terminate the wiring with a suitable **main boiler switch** (cam, press type etc.). Label this switch appropriately (e.g. “BOILER” or in other suitable way). The switch must be designed for rated current of at least I_j = 20A, three- or four-pole type.

The switch can be replaced with three-phase five-pin **socket with plug** for rated current of at least I_j = 20A (e.g. IZS 1653).

Boiler equipment requires connection to 3 x 400/230V 50Hz mains, in **TNC-S design (boiler connection 5x2.5C)**. Boiler supply must be protected by three, resp. four-pole circuit breaker with rated current I_j = 20A and tripping characteristic B.

Main power supply must be equipped with overvoltage protection and three-phase monitoring.

Installation of RCD is not required. If installed, RCD with 100mA tripping current is recommended

In the vicinity of the connection point, the responsible designer will identify and mark the terminal for connecting the boiler to the protective interconnection of the boiler room.

5.4.4 Main (circulation) pump:

The main circulation pump must ensure the boiler cooling and removal of sufficient power at delta T=10°C. The pump must be of single-phase type and be connected directly to the control unit at terminals X1.22 and X1.23

The output is single-phase designed for contactor control, event. when the maximum allowed current (6 A) is not exceeded, the pump can be connected directly from the boiler control part.
Types of pumps recommended by the manufacturer:

Power output of the Boiler		Q[m3/h] ΔT=10°C	Catalogue No.	Pump
100	**kW**	8.213	**GTP00414**	Pump Magna1 32-60 F 220 1x230V PN6/10
150	**kW**	12.920	**GTP00415**	Pump Magna3 50-60 F 240 1x230V PN6/10
180	**kW**	15.504	**GTP00415**	Pump Magna3 50-60 F 240 1x230V PN6/10
199	**kW**	17.140	**GTP00415**	Pump Magna3 50-60 F 240 1x230V PN6/10
200	**kW**	17.140	**GTP00415**	Pump Magna3 50-60 F 240 1x230V PN6/10
220	**kW**	18.949	**GTP00415**	Pump Magna3 50-60 F 240 1x230V PN6/10
250	**kW**	21.533	**GTP00415**	Pump Magna3 50-60 F 240 1x230V PN6/10
300	**kW**	25.840	**GTP00409**	Pump Magna3 65-60 F 340 1x230V PN6/10
350	**kW**	30.146	**GTP00416**	Pump Magna3 50-120 F 280 1x230V PN6/10
400	**kW**	34.453	**GTP00416**	Pump Magna3 50-120 F 280 1x230V PN6/10
450	**kW**	38.760	**GTP00417**	Pump Magna3 80-120 F 360 1x230V PN6
499	**kW**	43.066	**GTP00417**	Pump Magna3 80-120 F 360 1x230V PN6
500	**kW**	43.066	**GTP00417**	Pump Magna3 80-120 F 360 1x230V PN6
525	**kW**	46.82	**GTP00417**	Pump Magna3 80-120 F 360 1x230V PN6

5.4.5 Mixing (shunt) pump:

Not used.

5.4.6 Mixing (shunt) three-way valve:

The manufacturer prefers mixing valve actuator with 24V= power supply and 0-10V control voltage.

It is also possible to use a variant with a supply voltage of 230V and 0-10V control voltage
Connect the actuator to terminals X1.100 and X1.101
Connect the 0-10V control to terminals X1.89
Connect the 230V actuator with three-point control to terminals X1.33, X1.34 and X1.35

5.4.7 Pump for TO1:

Type of the circulation pump for Heating circuit 1 is selected by the designer of the heating system

The pump control output is of single-phase type. If the maximum allowed pump current of 3.0A is not exceeded, it is possible to connect the pump directly from the boiler control part after the pump connection.
If, due to the required power, it is necessary to use the three-phase pump, the relay output is used to control the three-phase contactor.
Connect pump or contactor to terminals L-X1.26, N-X1.27, PE

5.4.8 Three-way valve of output heating circuit 1 (VO1):

The output is single-phase 230V type designed for control of three-point servo-drive. If the maximum allowed current of 0.5A is not exceeded, it is possible to connect the three-way valve directly from the boiler control part after the pump connection.
Connect the actuator to terminals + X1.30 - X1.32 and the neutral conductor to terminal X1.31

5.4.9 Failure conditions of the boiler:

The boiler control unit also provides information on failure conditions of the boiler. This message is conveyed via one potential-free changeover contact with permitted load of 230V/6A. The fault contact can be connected to the GSM modem or directly to the signalling circuit. The signal is output to A1/T9/Q11-Q12 - NC or A1/T9/Q11-Q12 - NO

5.4.10 Fault messages:

There are two types of failure conditions:
- the failure conditions that disappear spontaneously when the cause of the failure ceases to exist
- fault conditions requiring the assistance of an operator (service technician) that are cleared only after the fault has been rectified and the confirmed (acknowledged) by operator on the control panel

5.4.11 External boiler shutdown:

In case of external request for standard or emergency shutdown of the boiler, it is possible to use dedicated digital inputs of the control system. For their proper function, a potential-free normally close contact (NC) is required

Ext ON/OFF – Boiler shutdown – after disconnection of the signal on terminals X1.96 - X1.97 the boiler is SW shut down; the boiler functions are the same as if the boiler reaches the required temperature. The boiler display shows the text message “No demand” in the last line. When the boiler is shut down, only the function of holding fire is in operation and if the boiler temperature is higher than the switching temperature for circulating pump, the pump is also in operation. When the fault is removed or the heating demand from the superior control is changed, the boiler evaluates its own current state and continues operation without the need for further intervention.

If the boiler is switched off by disconnecting the main power supply of the boiler, for example by a contactor in the boiler protection switchboard, the boiler will return into operation automatically according to the set program after the supply voltage of the control unit is restored. However, it must be taken into account that the control voltage for pump operation will also unavailable and so the boiler may overheat! However, if the pumps need to be running, this must be done in the control system of the heating circuit. If the pumps are connected directly from the boiler control unit, this should be discussed with the company responsible for boiler electrical installation.

The method of shutting down the boiler by switching off the supply voltage is unsuitable and is forbidden by the manufacturer.

5.4.12 Other recommendations, conditions and requirements:

- Any connection of controls other than those mentioned above must be consulted with the manufacturer! All requests for atypical connections or changes must be made in writing, delivered to Smart Heating Technology s. r. o. and to the company responsible for electrical installation in the boiler room

- The type, protection, location and design of individual elements or wiring at the connection point are not specified exactly, these are usually based on the project documentation, but they must comply with all applicable local standards!

- The wiring between the main connection point and the control unit is usually made by the company supplying the boiler wiring, but on request it can be prepared by the company responsible for the electrical installation in the boiler room. Based on agreement it is also possible to omit the wiring box from the connection point and lead the individual lines up to the control unit. In both cases it is necessary to ask the boiler manufacturer for approval of the design, types of individual cables and their length reserve for connection to the boiler control unit!

- Any interventions in the boiler system (cable connection, program setting) can only be performed by a worker authorized by Smart Heating Technology s. r. o. Changes and modifications to the internal wiring of the control unit are not permitted!

- For the purposes of service work, it is recommended to place a simple or double 230V 50Hz socket close to the connection point with the current value of the protection element of 16A. The service socket of the European type can be found in the boiler control unit after removing the top cover

Any questions, specifications or requirements regarding the connection of the boiler to the electrical installation can be consulted with the manufacturer's service and design department

5.4.13 Connection to flue and exhaust fan

The size of the flue connection between the boiler and the chimney must be chosen according to the boiler power. The flue is led horizontally (left, back, right) or upwards (viewed from the front of the boiler) from the chimney body. Selected connection is given by the project according to the specific situation in the boiler room. The exhaust fan delivered together with the boiler is located on the cyclone. The design of the flue should be as short as possible and must rise at an angle of at least 10° towards the chimney.
For cleaning the flue, easily accessible service openings must be available. The flue must be completely airtight so as to prevent any unwanted air inlet (cooling of flue gas, condensation, loss of draught).
The detonation door must be designed in such a way as to avoid danger to persons.
In order to improve the draught, it is advisable to insulate the flue to prevent loss of exhaust gas temperature. Flues must not be led through foreign housing or utility units.
The internal cross-section of the flue must not be larger than the internal cross-section of the uptake and must not taper towards the chimney. The use of flue elbows is not suitable.
The methods of making flue passages through structures made of combustible materials are described in ČSN 061008/97
The design of the flue gas ducts is governed by the relevant national standards, which the installer is obliged to follow.

5.4.14 Connection of heating water

For all SMART boilers, the lowest return water temperature higher than 55°C must be maintained so as to prevent damage to the boiler by low-temperature corrosion. Increasing the return flow temperature is therefore essential for all boilers. The return water temperature is increased by means of a three-way mixing valve with actuator.
The heating system (boiler) must be equipped with a boiler pump. The connection to the heating system is made via the manifold and collector. Other methods of connection must be consulted with our technicians (because of the relation to boiler regulation, etc.) already at the project preparation stage.

Heating water is connected to the boiler by means of fittings. Boilers with 100kW power with 2 pcs of G2“

Heating water is connected to the boiler by means of flanges. Boilers with 150-250kW power with 2 pieces of flanges DN80/PN6 and 300-525kW boilers with 2 pieces of flanges DN100/PN6.

Power output of the boiler (kW)	Flange size Flow and Return	Boiler circuit pump, flow rate (m3/h)	
		∆t=10K	∆t=20K
100	G2“	8.2	4.5
150	DN 80/PN6	13.4	6.7
180	DN 80/PN6	16.1	8.0
199	DN 80/PN6	17.2	8.6
200	DN 80/PN6	17.2	8.6
220	DN 80/PN6	19.6	9.8
250	DN 80/PN6	22.3	11.2
300	DN 100/PN6	26.8	13.4
350	DN 100/PN6	31.3	15.6
400	DN 100/PN6	35.7	17.9
450	DN 100/PN6	40.2	20.1
499	DN 100/PN6	44.6	22.3
500	DN 100/PN6	44.6	22.3
525	DN 100/PN6	46.8	23.4

5.4.15 Quality of feed and boiler water

The quality of feed and boiler water is prescribed by ČSN 07 7401. Analyses and dosing of chemicals into the system shall be carried out in such a way that the requirements of this standard are reliably ensured during the whole period of operation of the heating system. Observing the specified values will prevent deposits build-up on heat exchange surfaces and system corrosion. If the quality of the feed and boiler water does not meet ČSN 07 7401, the heating system must be equipped with a device for the treatment of feed water (for the treatment of replenished water e. g. cation-exchange water softener of KZV100 type; in order to maintain the required quality, all water supplied to the heating system must pass through this device).

5.4.16 Water replenishment.

For filling and replenishment of heating systems, treated water according to ČSN 07 7401 or ČSN 38 3350 is used. It is allowed to use tap water as long as the water quality meets these standards, but the water main must be secured against the ingress of water from the heating system to the water main, even if the water pressure in the water main line drops when compared with the overpressure in the heating system. For systems up to 100kW, it is recommended to use a removable hose, which is only connected for the duration of system refilling under constant supervision of the operator. At the point of connection to the heating system, the water mains must be equipped with a shut-off, return and aeration fitting. Automatic replenishment must be of limited duration and its extent must be under control.

5.4.17 Control and measurement equipment

Heat sources and measurement and control systems shall be equipped with a device to indicate malfunction and to shut down the equipment at following conditions:
a) power failure;
b) exceeding the maximum or minimum operating overpressure in the system;
c) exceeding the maximum working temperature of the heat-carrying or heated substance;
d) presence of harmful substances above the permissible concentrations;
(e) flooding the area (especially for installations below ground level);
(f) exceeding the temperature of 40°C in the area;
(g) exceeding the time limit for water replenishment to the system.

After the conditions a), b), c) have passed, the equipment may be put back into operation automatically and only when the failure repeats, it is it put out of operation. Returning to operation is only carried out by conscious intervention by the operator.

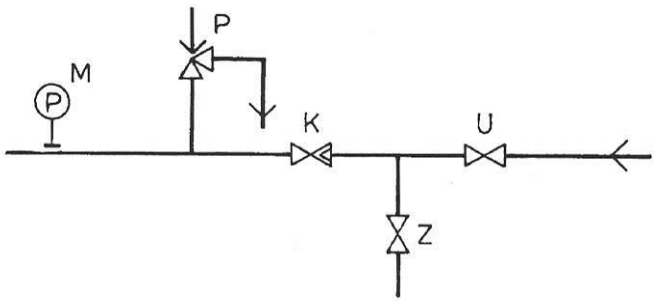
The conditions d) to g) shut down the equipment and its restart is only possible by conscious intervention of the operator.

Signalling of failure conditions is connected to the permanent residence or dispatching centre or is signalled remotely by sending an SMS, e-mail message

5.4.18 Safety equipment for hot water heating systems.

The safety equipment must be connected at a defined safety point. In addition, a thermometer and pressure gauge must be installed in the safety point and also pressure and temperature sensor and possibly also water shortage sensor.

Each self-closable domestic water heater shall be provided with following devices at the cold pressure water supply: shut-off (U), test valve (Z), non-return valve or non-return flap (K), safety valve (P) and a pressure gauge (M). The safety valve and pressure gauge may be installed anywhere within the safety section. It is also permitted to use a combination fitting consisting of a safety and non-return valve. See Figure 3 for an example of solution.



Obrázek 3 – Příklad zabezpečovacího zařízení na přívodu studené vody do ohřívače

5.4.19 Protection against exceeding the maximum working overpressure.

It can be carried out either hydrostatically, e. g. by a water column in the safety pipe and vessel or by a safety valve.

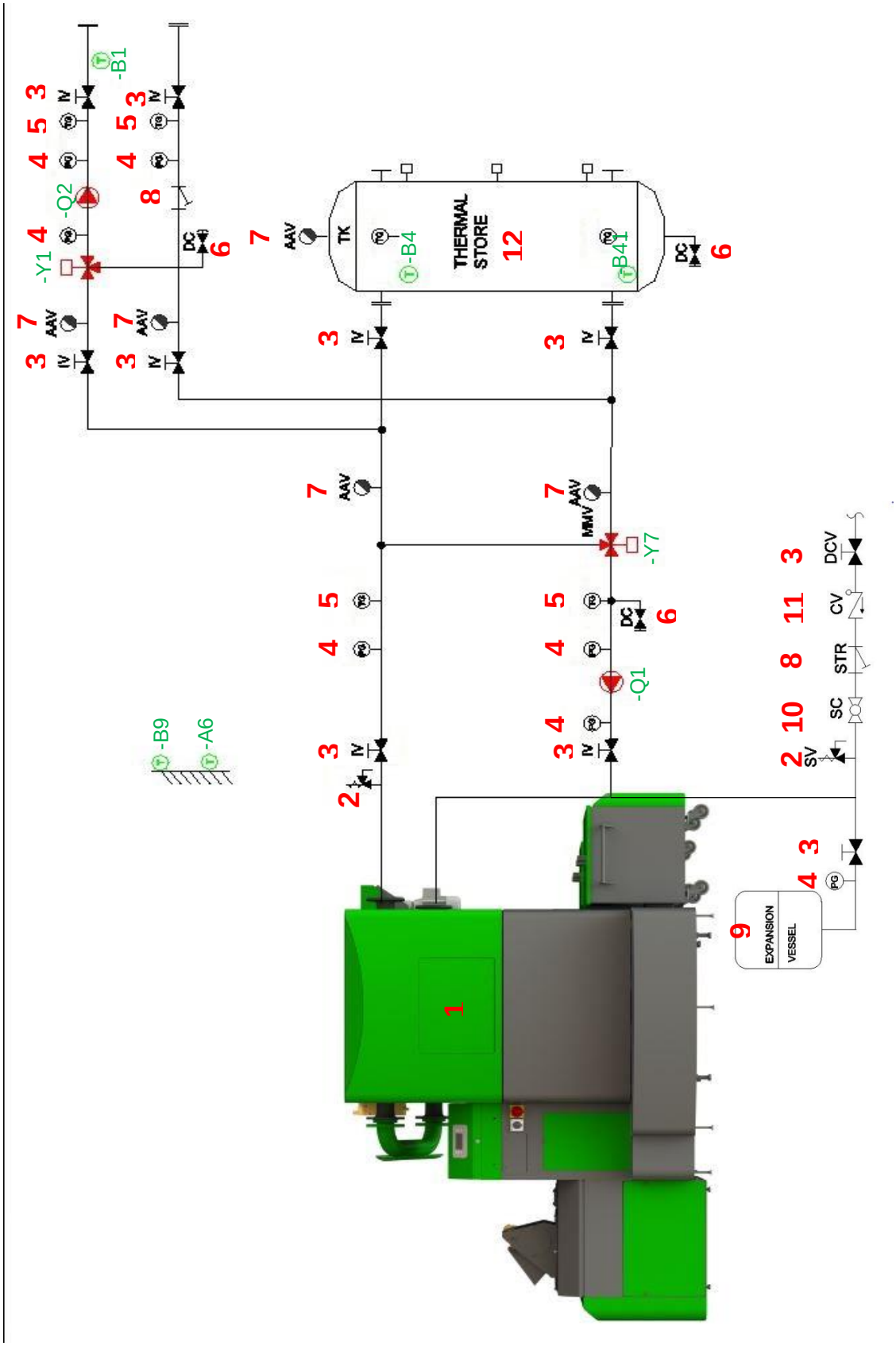
Boiler type	Pot	Qn	So min	Valve type (DUCO MEIBES)	So	d1	d2
SMART 150	250	150	196	1" x 1.1/4" KD	380	32	32
SMART 150	350	150	156	1" x 1.1/4" KD	380	32	32
SMART 180	250	180	235	1" x 1.1/4" KD	380	34	34
SMART 180	350	180	187	1" x 1.1/4" KD	380	34	34
SMART 199	250	180	235	1" x 1.1/4" KD	380	34	34
SMART 199	350	180	187	1" x 1.1/4" KD	380	34	34
SMART 200	250	180	235	1" x 1.1/4" KD	380	34	34
SMART 200	350	180	187	1" x 1.1/4" KD	380	34	34
SMART 220	250	220	287	1" x 1.1/4" KD	380	36	36
SMART 220	350	220	228	1" x 1.1/4" KD	380	36	36
SMART 250	250	250	326	1" x 1.1/4" KD	380	37	37
SMART 250	350	250	259	1" x 1.1/4" KD	380	37	37
SMART 300	250	300	387	1.1/4" x 1.1/2" KD	804	39	39
SMART 300	350	300	311	1" x 1.1/4" KD	380	39	39
SMART 350	250	350	451	1.1/4" x 1.1/2" KD	804	41	41
SMART 350	350	350	363	1" x 1.1/4" KD	380	41	41
SMART 400	250	400	451	1.1/4" x 1.1/2" KD	804	43	43
SMART 400	350	450	409	1.1/4" x 1.1/2" KD	804	43	43
SMART 450	250	450	580	1.1/4" x 1.1/2" KD	804	45	45
SMART 450	350	450	461	1.1/4" x 1.1/2" KD	804	45	45
SMART 499	250	500	644	1.1/4" x 1.1/2" KD	804	46	46
SMART 499	350	500	512	1.1/4" x 1.1/2" KD	804	46	46
SMART 500	250	500	644	1.1/4" x 1.1/2" KD	804	46	46
SMART 500	350	500	512	1.1/4" x 1.1/2" KD	804	46	46
SMART 525	250	500	644	1.1/4" x 1.1/2" KD	804	46	46
SMART 525	350	500	512	1.1/4" x 1.1/2" KD	804	46	46

p_{ot} = kPa ... opening overpressure of the safety valve
Q_n = kW ... rated power of heat source
$S_{o\ min}$ = mm2 ... calculated minimum cross-section of seat of safety valve
S_o = mm2... real cross-section of seat of designed safety valve
d_1 = mm... minimum inside diameter of the inlet safety pipe
d_2 = mm... minimum inside diameter of the outlet safety pipe

Note: The calculated internal diameter of the safety pipeline is considered only as a reference. Pipe dimensions must meet the condition that the pressure loss of the safety pipe upstream the safety valve does not exceed $0.03.p_{ot}$ and the total loss of the safety pipe does not exceed the value of $0.10.p_{ot}$

5.5 Connecting diagram

5.5.1 Hydraulic diagram (recommended)



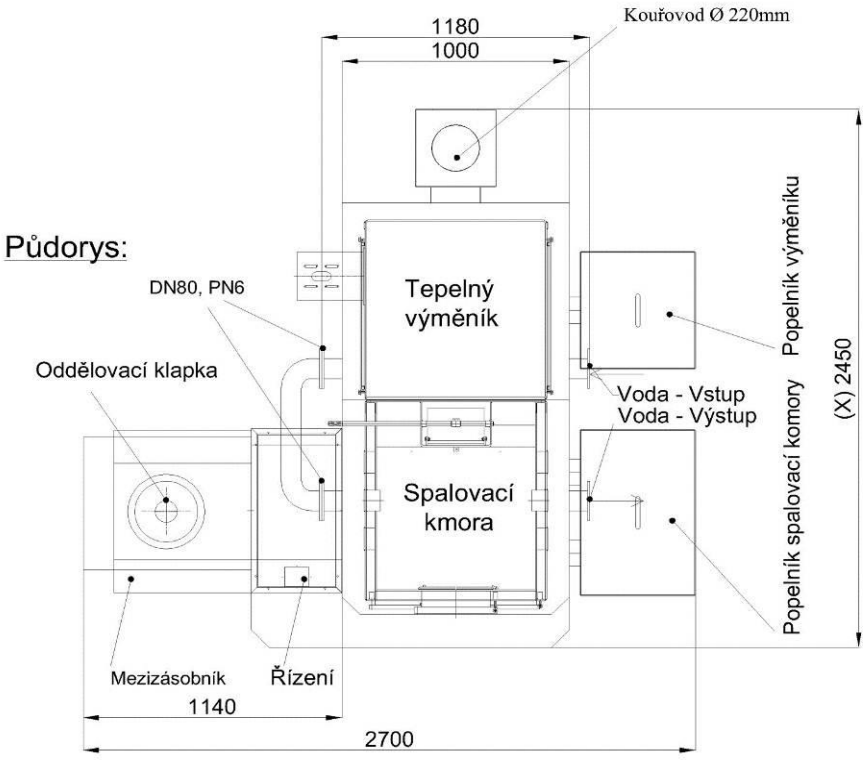
1	Biomass boiler
2	Safety valve
3	Valve
4	Visual pressure sensor
5	Visual temperature sensor
6	Discharge valve
7	Automatic air bleed valve
8	Water filter
9	Expansion vessel
10	Closing cock
11	Back-flow valve
12	Buffer

B1	Flow temperature of heating water for TO1
B9	Sensor of outside temperature
B4	Top buffer temperature
B41	Bottom buffer temperature
A6	Sensor of temperature in boiler room
Y1	Mixing valve TO1
Y7	Mixing valve of boiler circuit
Q1	Boiler pump
Q2	Export pump

5.5.2 Boiler dimensions

Technical parameters of boilers: 155 - 250kW S_IB							
SMART type:	150	180	199	200	220	250	kW
Length (x)	2090	2210	2330	2330	2330	2450	mm
Width	2700	2700	2700	2700	2700	2700	mm
Height	1825	1825	1825	1825	1825	1825	mm

Půdorys:



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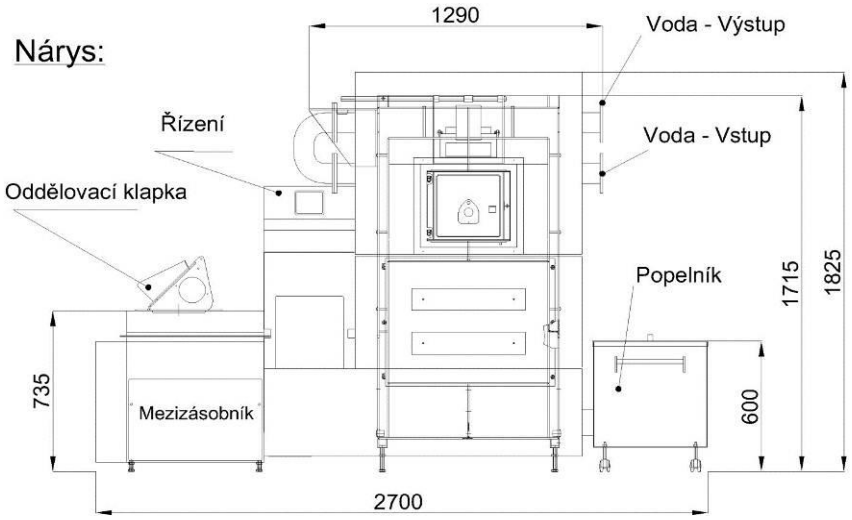
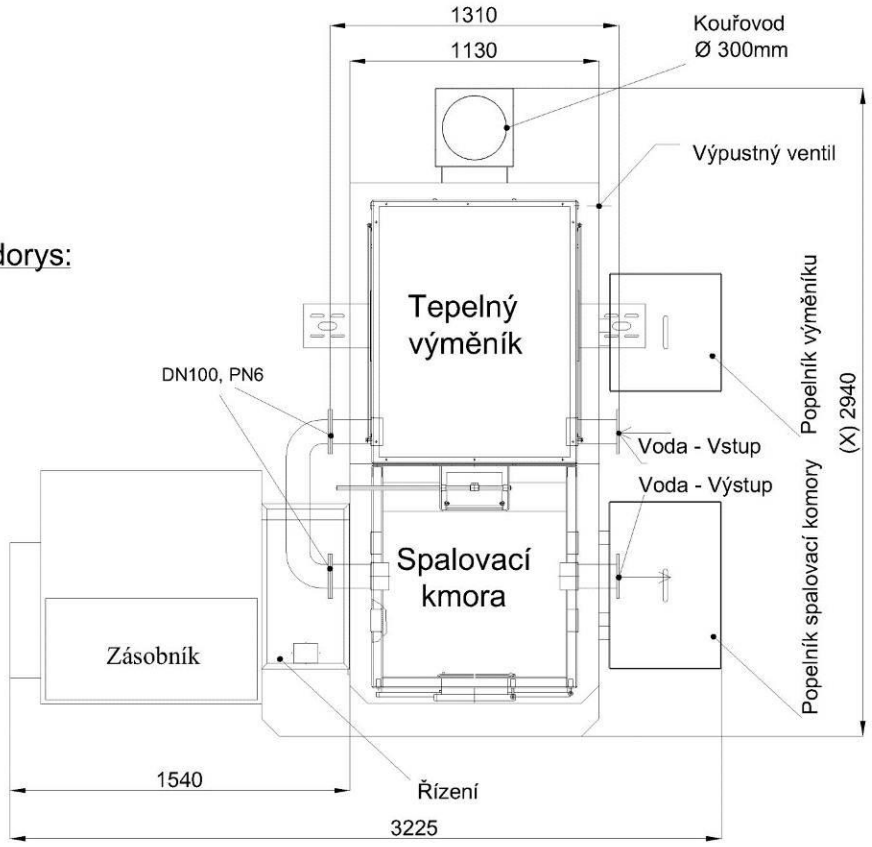


Max. teplota:	**90 °C**
Max. provozní tlak:	**3,5 bar**
El. přípoj 400 V, s nulovým vodičem	
Max. celkový přípojný příkon:	**4.03 kW**
Max. zrnitost paliva:	**30 mm**
Max. vlhkost paliva:	**30 %**

Technical parameters of boilers: 155 - 250kW S_V								
SMART type:	300	350	400	450	499	500	525	kW
Length (x)	2460	2580	2700	2820	2940	2940	2940	mm
Width	3225	3225	3225	3225	3225	3225	3225	mm
Height	1980	1980	1980	1980	1980	1980	1980	mm

Půdorys:



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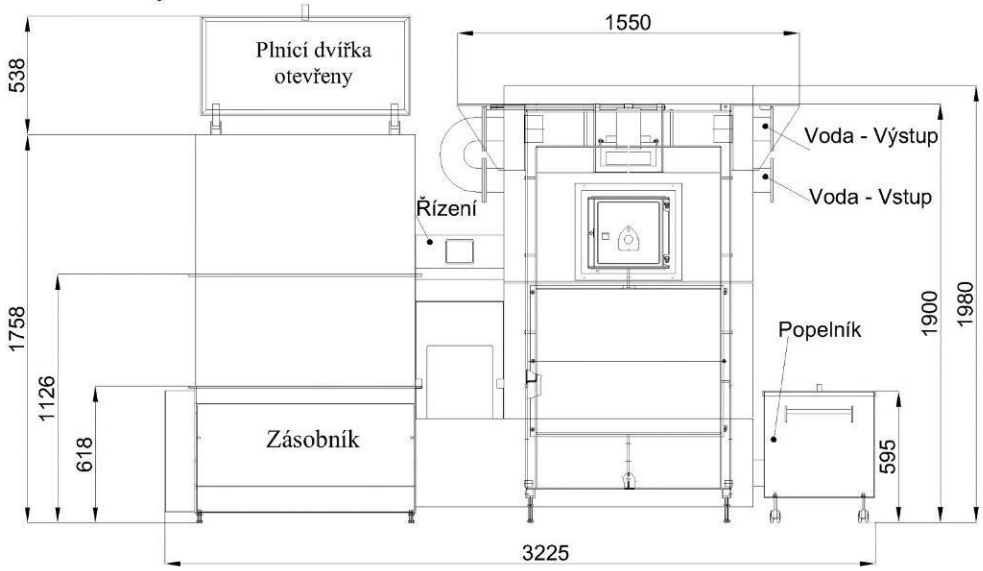
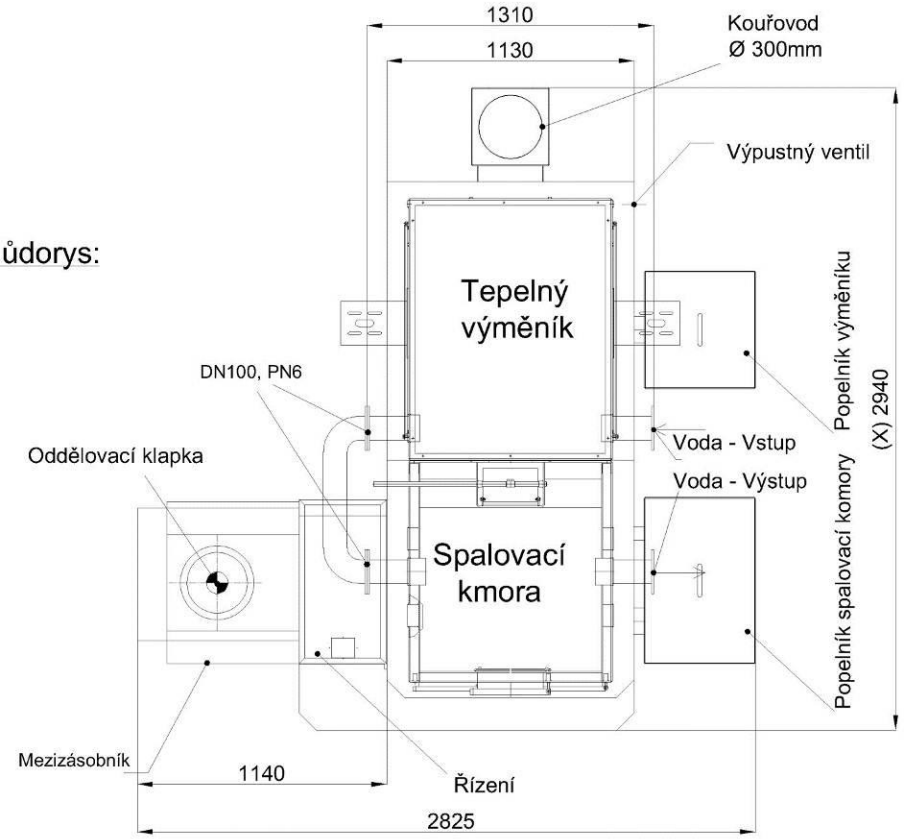


Max. teplota:	**90 °C**
Max. provozní tlak:	**3,5 bar**
El. přípoj 400 V, s nulovým vodičem	
Max. celkový přípojný příkon:	**4,88 - 5,43 kW**
Max. zrnitost paliva:	**30 mm**
Max. vlhkost paliva:	**30 %**

Technical parameters of boilers: 300 - -525kW I_B								
SMART type:	300	350	400	450	499	500	525	kW
Length (x)	2460	2580	2700	2820	2940	2940	2940	mm
Width	2825	2825	2825	2825	2825	2825	2825	mm
Height	1980	1980	1980	1980	1980	1980	1980	mm

Půdorys:



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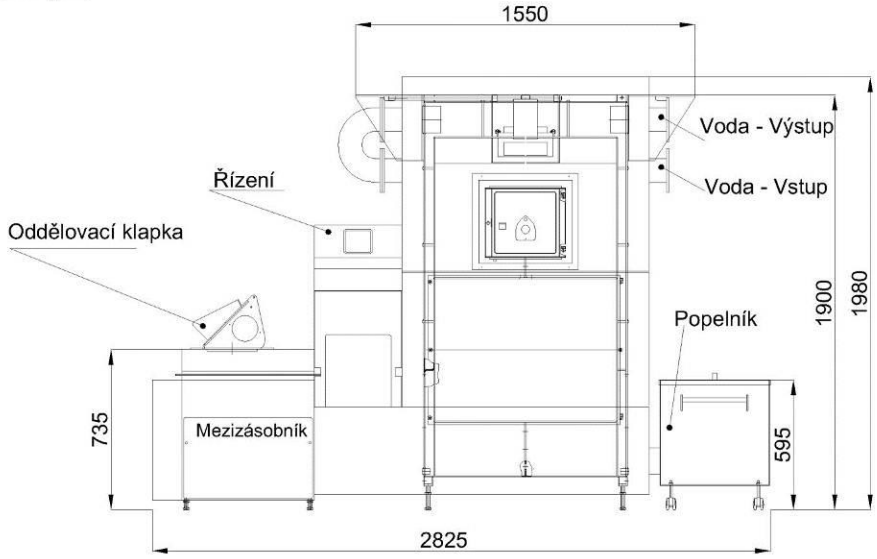
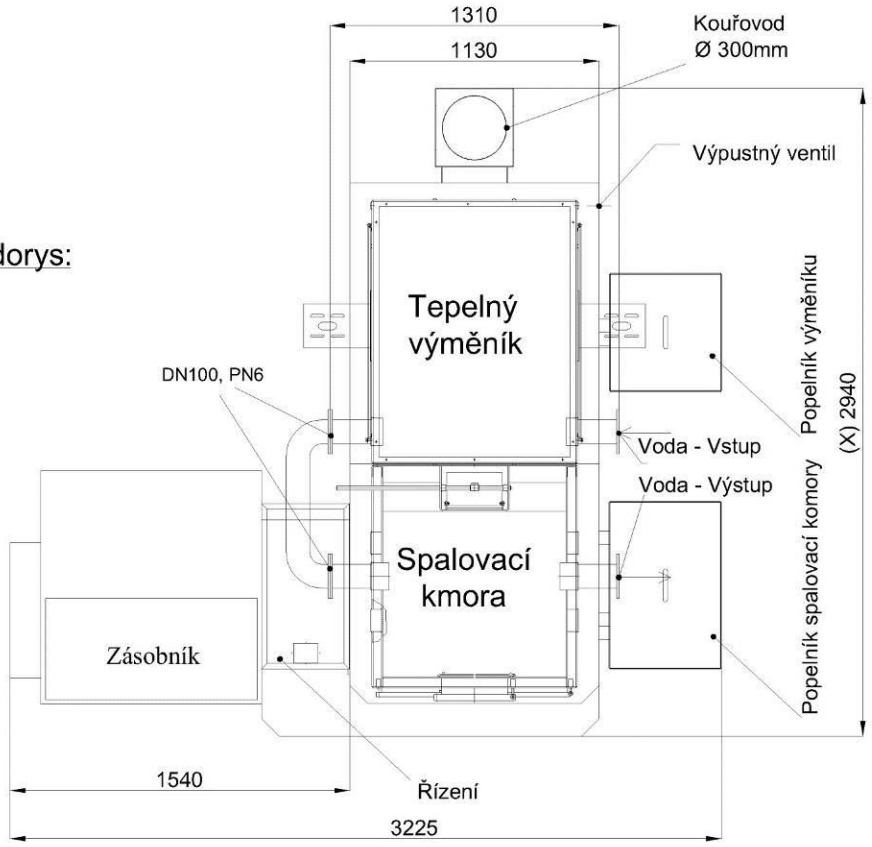


Max. teplota:	**90 °C**
Max. provozní tlak:	**3,5 bar**
El. přípoj 400 V, s nulovým vodičem	
Max. celkový přípojný příkon:	**5,44 - 5,99 kW**
Max. zrnitost paliva:	**30 mm**
Max. vlhkost paliva:	**30 %**

Technical parameters of boilers: 300 - 525kW S_V								
SMART type:	300	350	400	450	499	500	525	kW
Length (x)	2460	2580	2700	2820	2940	2940	2940	mm
Width	3225	3225	3225	3225	3225	3225	3225	mm
Height	1980	1980	1980	1980	1980	1980	1980	mm

Půdorys:



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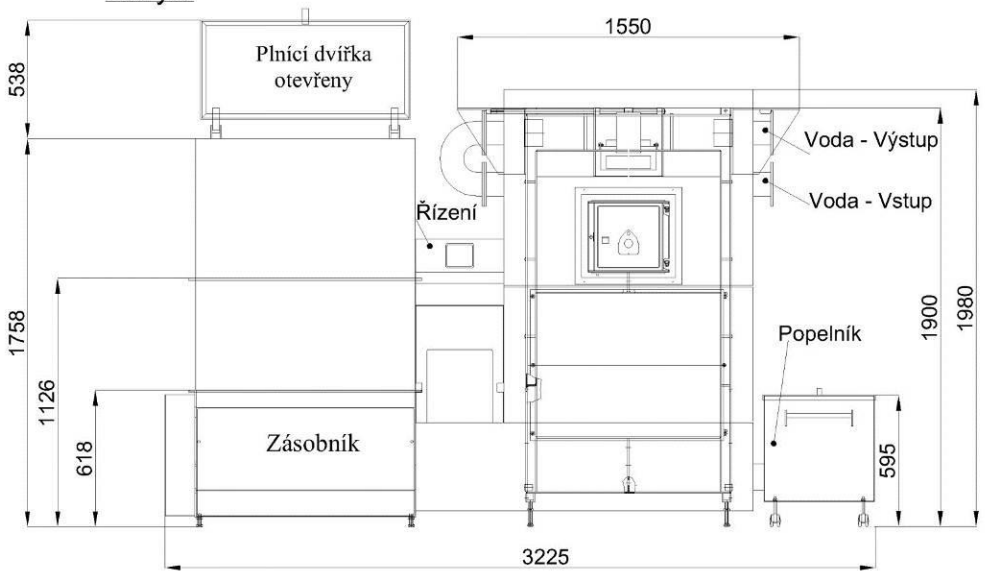


Max. teplota:	**90 °C**
Max. provozní tlak:	**3,5 bar**
El. přípoj 400 V, s nulovým vodičem	
Max. celkový přípojný příkon:	**4,88 - 5,43 kW**
Max. zrnitost paliva:	**30 mm**
Max. vlhkost paliva:	**30 %**

5.6 Electrical scheme

Electrical scheme is provided in Appendix A

5.6.1 Description of function

1 The boiler is activated by switching the main switch Q1 to position I with reverse switch in position II. From now on, the boiler operation is controlled automatically by the SMART CLIMATICS control unit according to the set program. In the case of power failure, the boiler shuts down. When the power supply is restored, the current status is detected and the boiler starts operation automatically according to the set program.

2 The SMART CLIMATICS control unit is powered directly from HV Q1 and its operation is independent of the position of the SA1 switch and the status of contactors KM1 and KM2. The SMART CLIMATICS control unit is protected by fuse FU1 (1A), which forms a part of the control unit. The control unit ensures automatic boiler operation based on continuous reading of input data, it evaluates them and controls the boiler operation according to the set program via outputs.

3 By turning the SA1 switch to 0 position all motors and fans are deactivated (because of interrupting power supply of contactors KM4 to KM8 and relay KA1), except for circulation pump, which is supplied independently via QF circuit breaker so that correct boiler cooling-down is ensured even after possible power failure. Power supply 24V = (A2) is supplied via fuse FU.1 and independent power supply of the control unit is ensured, again independently of the position of Q2. The switch Q2 in the 0 position also disconnects the contacts of the relay outputs of the control unit and thus the power supply for the coils of contactors, relays and all equipment powered by the SL1 branch.

4 The position 1 of Q2 switch is used for FORWARD movement of all 3-phase motors. This position is locked

Position 2 of Q2 switch is used for a short-time reversal of the 3-phase boiler motors **exclusively for service and maintenance purposes. In 2 position it is necessary to hold the arrow of the reversing switch, otherwise it will return to position 0 by spring action.**

Running longer than 5s in this mode can damage the mechanical parts, especially of the M1 motor, of all worm drives.

5 The safety relay function is formed by serial connection of contactors KM1, KM2 and provides the function of emergency thermostat, which disconnects power supply of coils of these contactors. In case of boiler overheating (extraordinary emergency state) it interrupts, by disconnecting the working contacts of contactors KM1 and KM2, the supply of phase voltage to the motors – QF1 and QF2 circuit breakers, A5, A6 and A7 combustion fans – QF5 circuit disconnects the power supply of the FLAP CONVEYOR, which opens automatically and prevents boiler overheating. The safety contactors KM1, KM2 thus ensure the safety of the system in case of boiler overheating, irrespective of the status of control unit. So, they act as an additional safety feature. The fault condition of these contactors is monitored by the control unit and indicated on the control unit display.

6 In addition to the function of safety contactors, the power supply for the pumps – relays KA2, KA4 – provides for heat removal from the boiler, as well as the power supply for the actuators that should open in case of overheating or failure. Furthermore, the exhaust fan M8, converter A8 – QF4 circuit breaker remain active, which must ensure the removal of exhaust gas and dangerous gases.

7 The M8 SINAMICS G 110 frequency converter converts a 1-phase supply voltage (230V/50Hz) to 3-phase voltage (3 x 230 V) with variable frequency 0-50Hz to supply the 3-phase M8 motor of exhaust fan. The converter is powered directly from output (Q1) of HV, circuit breaker QF4, its operation is independent of the position of Q2 switch. It is controlled by an analogue 0-10V output signal from the SMART CLIMATICS control unit - POL687 T2 X1 to the terminals 9-10 of the converter. By varying the output voltage frequency, the converter controls the speed of the 3-phase asynchronous M8 motor of the exhaust fan, maintaining the prescribed underpressure in the area of boiler burner. M8 motor is connected to following terminals: X2.1, X2.2, X2.3, X2.GND

ATTENTION! When replacing the motor, make sure that the motor terminal box is connected to D (delta)! Output voltage of the converter is 3 x 230 V.

8 The underpressure in the furnace area is continuously measured by the underpressure sensor QBE66, whose 0-10V output is connected to the analogue input of the control unit A1A POL985 T3 X8 and evaluated by the control unit according to the set program. Insufficient underpressure is indicated by a fault message on the display of control terminal.

9 The frequency converter is a source of higher harmonic frequencies, which can propagate on the mains and into the space as an undesirable interference. In order to suppress this interference to an acceptable level defined by standards, FK4-25-400 mains filter is connected to the supply voltage input upstream HV.

10 At the appropriate moment when the boiler is started, the exchanger cleaning cycle is started by starting the M4 (or M5) motors through KM6 contactor, namely for the time specified by the program. The cleaning is then repeated at specified intervals for a specified period of time according to the settings of the CU program. The parameter for starting the exchanger cleaning is the number of dosed supplied to burner (typically 200 doses). The thermal protections of these motors are connected in series, so the activation of any of these protections will disable all motors. M4 motor is connected to following terminals: X1.10, X1.11, X1.12, X1GND3. M5 motor is connected to following terminals: X1.13, X1.14, X1.15, X1.GND3. Thermal switches are connected to terminals X1.65, X1.66 and are monitored at CU by A3 POL687 T3 X6 **Error messages on terminal display do not distinguish between M4 and M5 motors. The fault must be localized by measurement!**

11 For boilers of type I_B equipped with a conveyor from an external fuel store, the M1 motor is switched by contactor KM3 – controlled from the output of SMART CLIMATICS control unit – A1 POL687 T12 DO2. The motor is blocked by a limit switch under the lid of transport channel. (When the lid is opened manually or by pressure from the inside when the channel is blocked – fault is reported.) Fuel delivery to the boiler intermediate bin is controlled by the fuel level in the intermediate bin via a capacitive sensor. Motor start is further conditioned by opening the FlapConveyor – A1 POL687 T11 Q84. The contacts of flap limit switch contacts are connected to inputs A1 POL687 T5 DU2 – flap closed, actuator contact A and A1 POL687 T5 DU1 – flap open, actuator contact B. If the flap is not fully open, motor M1 will not operate. If the flap is not fully closed after filling the intermediate bin, a fault condition is reported. M1 motor is connected through following terminals: X1.1, X1.2, X1.3, X1.GND1

12 SICK _1, level capacitance sensor, controls by its state the switching on or off of the KA3 relay. The relay contact gives a signal when the intermediate bin is full. If the relay is tripped – the level is at the desired level. If the fuel level is below the setpoint, both the level sensor and the relay are closed. SICK_1 level sensor is connected to following terminals: X1.25, X1.36. The relay contact is connected to A3A POL985 T3 X7. After

replenishing the fuel up to required level, the motor is disconnected and the flap is closed by spring action. The flap always closes when the boiler is shut down for any reason, e.g. in the case of power failure. For adjustment and maintenance purposes, the flap can be opened manually using the handle on Siemens GCA326 actuator – FlapConveyor. The software executes a delayed start of the M1 motor when the fuel level drops. This delay (typically 30sec -5min) is dependent on current boiler power

13 The exhaust gas passage through the boiler heat exchanger is opened after reaching the prescribed temperature, through the exchanger flap. The flap is opened by the Siemens GCA326 actuator – FlapExch. The actuator is controlled by relay output SMART CLIMATIX control unit - A3 POL687 T10 Q24. In its basic position at the start of the boiler, the flap is opened and the exhaust gas flows directly to the chimney. When the required temperature is reached, the flap closes and the exhaust gas is routed through the exchanger. When the exhaust gas temperature drops, the flap opens again, so that the exhaust gas is directed to the chimney. It is protection against low-temperature corrosion. The control unit checks the flap position, when the exhaust gas is led through the exchanger – contact B of the actuator – this is connected to the binary input A1 POL687 T3 X8 through terminals X1.66, X1.68

14 The control unit evaluates the state of the boiler and according to the current state of the boiler it starts the ignition cycle or normal operation (after reaching the minimum required temperature of the combustion gas and the O_2 content in the exhaust gas). Ignition hot-air gun is switched by output A1 POL687 T10 Q34 as an IGNITION signal. If an ignition fault is detected, the control unit shuts down the boiler. The ignition process is not started unless there is sufficient – required – underpressure in the boiler. Usually – 25Pa. Ignition gun is connected to following terminals: X1.44 –L, X1.45-N.

15 The M2 motor switched by the KM4 contactor supplies fuel to the boiler burner according to the boiler program. KM4 contactor is switched by output A1 POL687 T12 DO1. The timing of M2 motor switching determines the boiler power. The boiler power is modulated and controlled by a PID controller. The fuel dose is constant, the delay between doses is controlled. The PID controller controls the dosing within the range of 30-100% of the rated boiler power, taking into account the current and required boiler water temperature. Thermal switch of M2 motor is connected via terminals X1.69, X1.71 and is checked at input A3 POL687 T4 D1

16 The M6 motor, switched by the KM7 contactor, drives the grate and cleans the burner according to the boiler program. The motor is connected to following terminals: X1.16, X1.17, X1.18, X1.DND4. KM7 contactor is switched by CU output A1 POL687 T11 Q64. The movement of the grate ensures the removal of the burnt material from the space of the primary burner and its falling off to the ash worms. Thermal switch of M6 motor is connected to terminals X1.67, X1.66, then connected to binary input A3 PL687 T3 X7 and its status is checked here

17 M3, deashing motor, is switched by KM5 contactor, controlled from output A1 POL687 T11 Q54. The motor is connected to following terminals: X1.7, X1.8, X1.9, X1.GND2. The motor drives ash worms, which remove the spent fuel from the space under the burner to the ashtray, namely at the intervals specified by the program. The switching interval is related to the amount of fuel burned, e.g. the number of fuel doses delivered to the burner (typically 150). Thermal switch of M3 motor is connected via terminals X1.63, X1.65 and checked by control unit at input A3 POL687 T3 X5

18 A5, A6, A7, combustion air fans, are electronically controlled, highly efficient fans. They are controlled by 0-10V control signals, they are supplied by single-phase 230V voltage. The output of the primary fan A6 is controlled according to the table values set in the program in relation to the current boiler power. The secondary fans A6, A7 are also controlled according to the table values set in the program. Moreover, their performance and air volume are controlled according to data from Lambda probe data and O_2 content in the exhaust gas. Combustion fans are protected by QF5 circuit breaker.

Connection of fan A5: X1.38-L, X1.39-N, X1.50 - 0-10V control, X.51-GND

A6: X1.40-L, X1.41-N, X1.52 - 0-10V control, X.53-GND

A7: X1.42-L, X1.43-N, X1.54 - 0-10V control, X.55-GND

19 The contents of O_2 in exhaust gas is continuously sensed by the lambda sensor LS. The Lambda probe is connected via an electronic converter and communicates with the control unit via a MODBus converter.

The converter power supply is 24V DC – terminals X1.81 + 24V, X1.82 GND.

Communication takes place via the RS485 bus – X1.91 A+, X1.92 B-. For correct communication, it is necessary to observe the polarity and marking of the wires on the control unit side and on the MODBus side of the converter!

20 M13, the shunt pump, ensures the minimum required temperature of water returning to the boiler according to the program setting (55°C). It is switched via KA2 relay or by an external contactor switched by the output of this relay.

Pump motor is connected to following terminals: X1.22-L, X1.23-N, X.1GND5.

KA2 relay is switched by output A1A POL985 T5 Q14

21 The temperature of return water (B7) is measured by the NTR10k QAL36.225 temperature sensor connected to the analogue input A3A POL687 T1 B3 – terminals X1.79, X1.80

22 Circulation pump M11 of heating circuit TO1 is switched via relay KA4 or by an external contactor switched by the output of this relay. Pump motor is connected to following terminals: X1.26-L, X1.27-N, X.1GND6. KA4 relay is switched by output A3A POL985 T6 Q74. The temperature of water in heating circuit is measured by the NTR10k QAL36.225 temperature sensor connected to the analogue input A3A POL687 T1 B1 – terminals X1.76, X1.78

23 Temperature sensors:

T_HC1	temperature of heating circuit 1	NTR10k	X1.76, X1.78 A1A POL985 T1 B1
T_Outwater	boiler temperature, outlet	NTR10k	X1.77, X1.78 A1A POL985 T1 B2
T_Retwater	boiler temperature, inlet	NTR10k	X1.79, X1.80 A1A POL985 T1 B3
T_ExhGas	exhaust gas temperature	NTR10k	X1.85, X1.84 A1A POL985 T2 X3
T_Feeder2	back-fire temperature 2	NTR10k	X1.84, X1.86 A1A POL985 T2 X4
T_Feeder	back-fire temperature	NTR10k	X1.59, X1.60 A1A POL687 T1 B2
T_B4AkuUp	top buffer temperature	NTR10k	X1.58, X1.60 A1A POL687 T1 B1
T_B4AkuDown	top buffer temperature	NTR10k	X1.59, X1.60 A1A POL687 T1 B2

The use of other output units and input sensors according to the boiler room design is not excluded, see the diagrams and the relevant tables.
Replacing fuse ratings with higher rating fuses is not permitted. Always use T-fuses with max. rating of 1.0A.

All electric motors used for drives are equipped with built-in thermal protections.

Checks and revisions of el. equipment
Boilers according to ČSN 331500
In accordance with ČSN 331500 (5), we recommend regular inspections at least within the intervals set for the revisions of the premises in which the boiler is installed and always after any major repairs. If no intervals are set, we recommend 3 years. (private residential buildings, family houses, etc.)
Minimum scope of inspections:

1. measurement of insulation state between working conductors of power circuits themselves and MN circuits
2. between power circuits and MN circuits and ground
3. measuring the continuity of protective circuit
4. measurement of leakage currents

Follow the procedure in accordance with the provisions of ČSN 331610, Article 6.3.2, 6.4, 6.5.4, 6.6

Caution:
When measuring the insulation state, disconnect the circuits of the electrical part of the device, including the inputs and outputs of the control unit, preferably by pulling it out of the connectors.

X1.1	L1 Conv	M1		X1.50	O-10V Fan Prin	A5
X1.2	L2 Conv	M1		X1.51	M	A5
X1.3	L3 Conv	M1		X1.52	M	A6
GND1	PE			X1.53	O-10V Fan Sec1	A6
GND1	PE			X1.54	O-10V Fan Sec2	A7
X1.4	L1 Feeder	M2		X1.55	M	A7
X1.5	L2 Feeder	M2		X1.56	M	
X1.6	L3 Feeder	M2		X1.57	Input 0-10V	
X1.7	L1 Deashing	M3		X1.58	TB4_Aku_Up	
X1.8	L2 Deashing	M3		X1.59	T_Feeder_Up	
X1.9	L3 Deashing	M3		X1.60	M	
GND2	PE			X1.61	M	
GND2	PE			X1.62	TB41_Aku_Dwn	
X1.10	L1 Exch_cleaning	M4		X1.63	TKDeash	
X1.11	L2 Exch_cleaning	M4		X1.64	TK_Exch_Clean	
X1.12	L3 Exch_cleaning	M4		X1.65	M	
X1.13	L1 Exch_cleaning	M5		X1.66	M	
X1.14	L2 Exch_cleaning	M5		X1.67	TK_Burner_Cl	
X1.15	L3 Exch_cleaning	M5		X1.68	KS_Flap_Exch	
GND3	PE			X1.69	TK_Feeder	
GND3	PE			X1.70	KS_Conv	
X1.16	L1-Burner_Clean	M6		X1.71	M	
X1.17	L2-Burner_Clean	M6		X1.72	KS_Conv+TK_Conv	
X1.18	L3-Burner_Clean	M6		X1.73	LS_B_Flap_Conv	
X1.19	L1_Ex_deash	M7		X1.74	+24V	
X1.20	L2_Ex_deash	M7		X1.75	LS_A_Flap_Conv	
X1.21	L3_Ex_deash	M7		X1.76	THC1	
X1.22	L1-Shunt Pump	M9		X1.77	T_OutW	
X1.23	N_Shunt Pump	M13		X1.78	M	
X1.24	N			X1.79	M	
X1.25	Sick - contact			X1.80	T_RetW	
X1.26	HC1 Pump	M11		X1.81	+24V MOD_BUS	
GND4	PE			X1.82	GND_MOD_BUS	
GND4	PE			X1.83	M	
X1.27	N_HC1_Pump	M11		X1.84	M	
X1.28	N			X1.85	T_Exhg	
X1.29	Ignition Fan			X1.86	T_Feeder2	
X1.30	L+ HC1 Servo	M15+		X1.87	Kanystr_Level	
X1.31	N			X1.88	M_Kanystr_Level	
X1.32	L- HC1 Servo	M15-		X1.89	Shut Servo 0-10V	
GND5	PE			X1.90	Level Saugh	
GND5	PE			X1.91	A+ RS485	
X1.33	L+ Shunt Servo	M14+		X1.92	B- RS485	
X1.34	N			X1.93	Silo 50%	
X1.35	L- Shunt Servo	M14-		X1.94	Silo 100%	
X1.36	Sick L1			X1.95	N	
X1.37	N			X1.96	M_Ext ON/Off	
X1.38	N			X1.97	Ext ON/Off	
GND6	PE			X1.98	L Sec_Thermostat	
GND6	PE			X1.99	SW_Sec_Thermostat	
X1.39	L Fan Primar	A5		X1.100	GND_24	
X1.40	L Fan Sec1	A6		X1.101	+24V	
X1.41	N			X1.102	Boiler 55°C OUT	
X1.42	**N**			X1.103	Boiler 55°C OUT	
X1.43	L Fan Sec2	A7		X1.104	Water_Presure	
X1.44	L Ignition	KA1		X1.105	M	
X1.45	N Ignition			X1.106	T3_X5	
X1.46	N					
GND7	PE			X2.1	W	M8
GND7	PE			X2.2	V	M8
X1.47	L Flap Exchanger	FLAP Exch		X2.3	U	M8
X1.48	L Flap Conv	FLAP Conv		X2.GND		
X1.49						

5.6.2 Risk analysis

The risks related to the delivery of the boiler and its accessories.		
Source of risk.	**Effect of risk.**	**Elimination of danger.**
Means of transport – truck, technician's car.	Restrictions on the movement of employees (neighbours, family members) and machinery in the place where the equipment will be unloaded from a truck, passenger car.	Define the unloading area in advance and demonstrably notify the employees (neighbours, family members) of this fact
A trolley, forklift, lorry arm or other means used for equipment unloading.	There is a risk of injury or damage by the moving parts of the machine being moved.	Thoroughly think over the strategy of unloading and moving of individual parts of the equipment to the place where it will be temporarily stored or directly assembled.
Storage of the equipment, either assembled or disassembled.	Collision of persons, machines, vehicles etc. with stored parts of the equipment. Condensation of water in the electrical installation and subsequent injury to the technician, eventually damage to the equipment.	Mark the storage area appropriately, protect, if necessary, and mark. The area must be dry to prevent moisture from reaching the electrical installation.

The risks related to setting up the boiler and its assembly.		
Source of danger.	**Effect of risk.**	**Elimination of danger.**
A trolley, forklift or other means used for equipment installation.	There is a risk of injury or damage by the parts of the machine being moved.	Exercise caution in the event that employees of different companies participate in the completion, supervisor must be determined
The assembly itself.	Injuries caused by the drill, angle grinder and common tools that technicians use. E.g. hammer, screwdriver, file, etc. Dropping any part of the equipment.	All workers must wear personal protective equipment. E.g. protective goggles, work gloves, etc. Be careful and cautious throughout your work.

The risks related to normal operation of the boiler and its accessories.		
Source of danger.	**Effect of risk.**	**Elimination of danger.**
Boiler body.	Burns on the inner inspection door, if the outer door is open, the hand or face is burned when the inspection door is opened.	Wear protective gloves when opening the door; internal door is in direct contact with the exhaust gas and can reach temperatures of up to 400°C. When opening the inspection door, stand in such a way that any escape of hot exhaust gas does not affect any part of your body. The danger lasts for a few seconds until the underpressure in the combustion chamber is automatically equalized.
Ashtray.	Hand injury, burn on ashtray. Removing ash from the ashtray.	Use handles designed for this purpose while handling the cover and ashtray. Empty the ash only at the designated locations. The ash may still be hot, so store the ash only in the designated areas.
Bin.	Injuries to hands by dropping the lid of the bin, pinching the fingers into the securing clip.	Always open the lid to the extreme position; if this is not possible for an unspecified reason, the lid must be securely locked. Be careful when blocking the lid.

Discharge channel and discharge wheel.	Serious injuries to limbs by leaf springs while working in fuel silo.	If you shovel the fuel in the silo for any reason, remember that the leaf springs are retracted around the discharge wheel. So, when the fuel is removed, leaf springs unfold as a result of relieving their load. Therefore, do not do this work alone, use long enough tools, **the boiler must be switched off! ! !**
Low voltage	Electric shock, voltage 3x230/400V	Do not remove protective covers. Do not use the equipment when its insulation is damaged Make regular checks and inspections

The risks related to the maintenance of the boiler and its accessories.		
Source of danger.	**Effect of risk.**	**Elimination of danger.**
Always carry out maintenance with the equipment switched off. Switch off the boiler by the main switch on the boiler switchboard. Caution – the interference voltage filter remains permanently energized		
Chain gears, lubrication of bearings.	Scratching, cutting, falling off ladder when lubricating turbulator bearings. Slip on grease. Falling tools.	Wear protective gloves. Handle the safety covers carefully. Store in a safe place so that they do not restrict your work. Do not place tools on sloping surfaces of boiler edges, between turbulators, etc.
Combustion chamber.	Burns, inhalation of dust, dust in eyes.	If the boiler is not shut down for sufficiently long time, the burner parts may still be hot, so wear protective gloves. Wear safety goggles and a respirator when cleaning the combustion chamber. The recommended downtime is 4 hours.
Wiring.	Electric shock.	Intervention in the wiring is only possible after the device has been switched off by the main switch for more than 2 minutes.
After maintenance work has been completed, check that all covers are correctly positioned and secured before putting the boiler back into operation. Make sure you have all the tools you started working with so as to avoid unpredictable collisions.		

6 Operation of heating equipment SMART

6.1 Safety instructions

Before opening the control box, motor or fan connection boxes, fan or other connection boxes, the unit must be switched off using the main switch.

The design of the boiler enables the boiler to operate without usual interventions of the operator, depending on the volumes of fuel store and ashtrays. The boilers are equipped with the automatics allowing the operation with occasional attendance and control of boiler heat power by programmable control unit. The operating states of the boiler are evaluated and clearly displayed on the display. The specific time intervals of supervision on the boiler operation depend on the way of signalling and the extent of automation of the regulation used. It is recommended to check the boiler condition at least once a day.

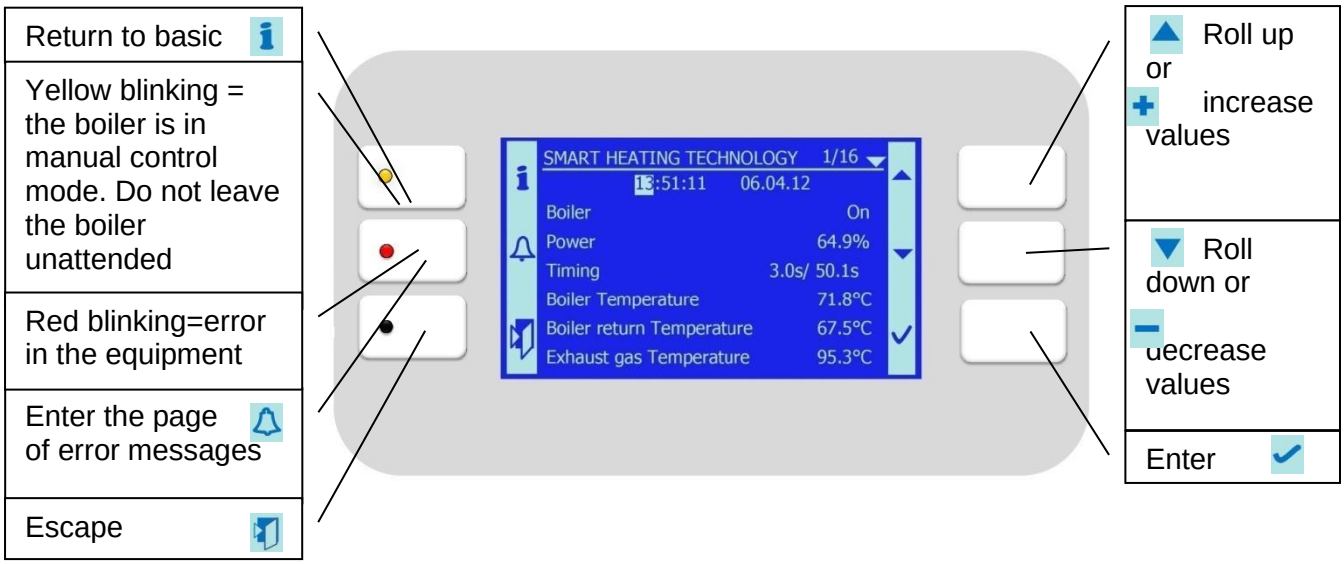
Operator intervention is required in following cases:

- change of material to be burnt (density (kg/m3) of wood chips, sawdust and pellets varies, therefore it is necessary to change operating values for different type of combustion).
- boiler maintenance, where weekly, monthly and half-yearly inspections are prescribed
- in the event of a fault on boiler technology, when the fault is displayed on the control unit display, which is equipped with a potential-free fault condition contact. The boiler is equipped with a GSM modem, so in the event of a fault, an SMS message with the fault description is sent. By sending an SMS in the form STAV (accents must be respected) to the phone number of the SIM card inserted in the GSM modem it is possible to find out the current status of the boiler. The boiler sends back SMS containing information on exhaust gas temperature and inlet and outlet temperatures.

7 Description of control unit

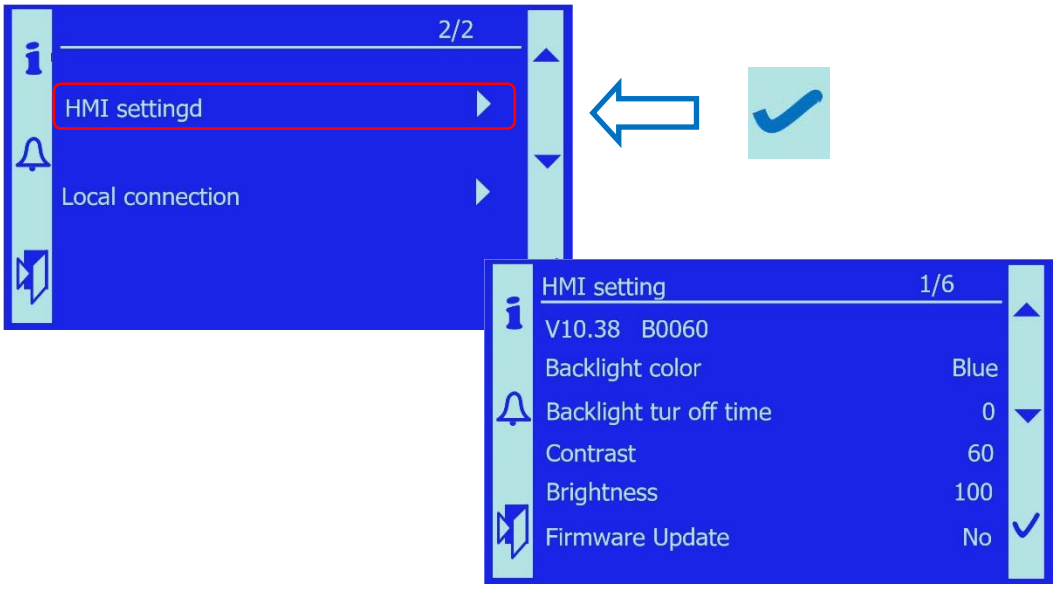
7.1 HMI terminal

The HMI terminal functions as the control and information panel of the SMART control unit
It allows to:
- check the boiler function
- identify the status of individual boiler peripherals
- identify fault conditions
- control the boiler elements in manual mode
- set operating values for the boiler



7.2 HMI setting

If you keep the ESC §§ button pressed for about 5 seconds, you will enter the terminal setting mode.



Now you change the parameters of the HMI Terminal.

- **Backlight colour**

The backlight colour can be set to either blue or white:
The HMI terminal will display in inverse colours with white background and blue characters.

- **Backlight turn off time**

You can set the time after which the display goes out within the HMI power saving mode
The display lights up again when you press any button.
Important notice: If you set the time delay to 0, the display will be lit permanently.

- **Contrast**

HMI display contrast.
An optimum setting is chosen by the user.

- **Brightness**

Brightness of HMI display.
An optimum setting is chosen by the user depending on the ambient light intensity.

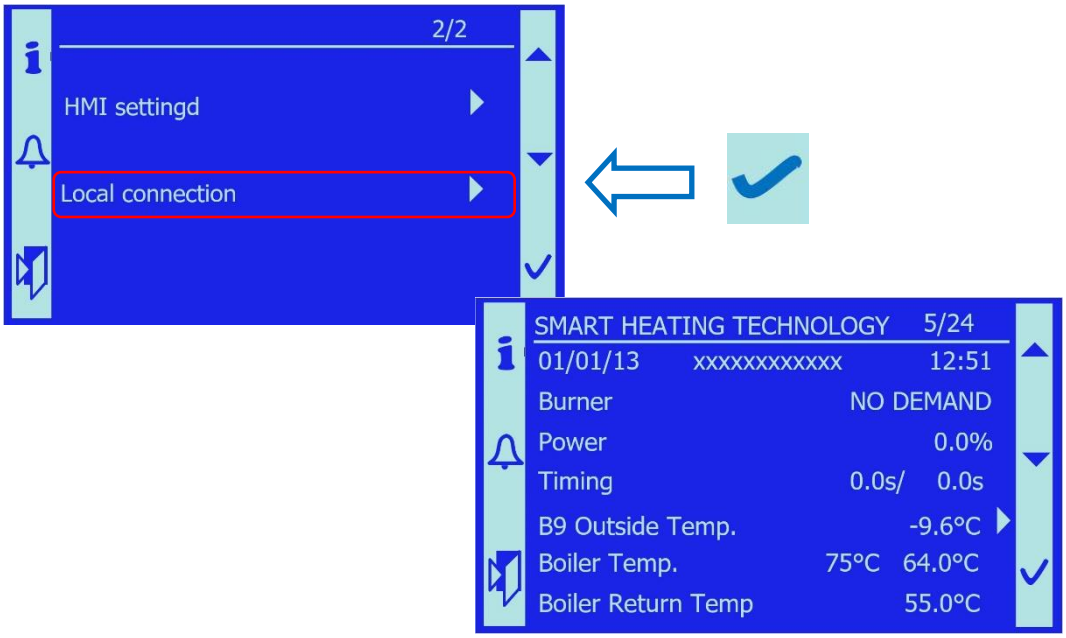
- **Firmware Update**

Used to upload firmware to the HMI, see Update of HMI Firmware 7.2.1

Return to standard mode

After setting the necessary functions of the HMI display it is necessary to return it to the standard functioning within the application used.

Press ESC then  move to the Local Connection item and confirm it.

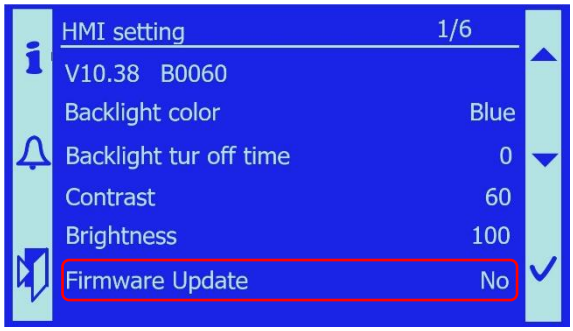


7.2.1 Update of HMI firmware

You need the POL12291.bin file to update the firmware.

1. Insert the SD card into the PLC, on which the POL12291.bin file is saved
2. Enter the HMI setting

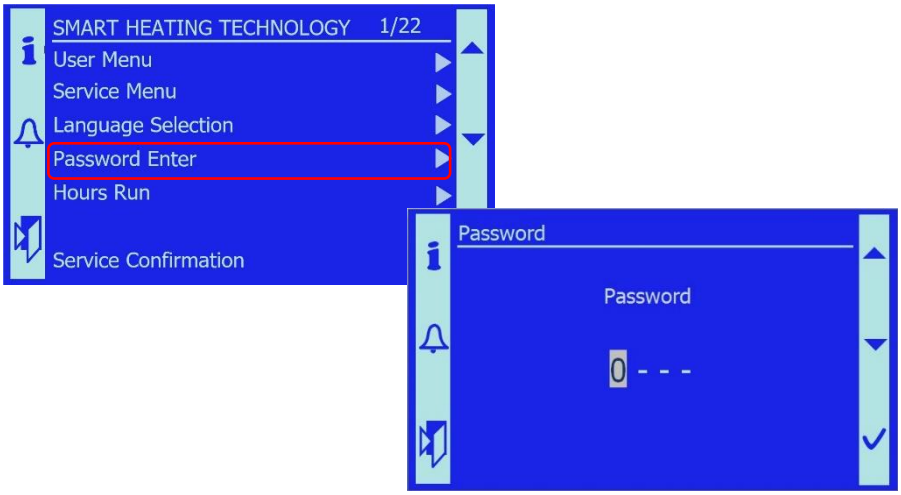
3. Set “Yes” for the “Firmware Update” item and wait.



4. The recording status indicator appears on the screen.
5. Then the HMI restarts itself and the start screen is displayed.
6. Remove the SD card from the PLC.

7.3 Access levels

Some items and settings are blocked for security reasons and can only be changed when a user logs on appropriate access level.



On the start screen, use the arrow keys § §§ to move to the **Password Entry** tab, then use §§§ and §§§§ buttons to set all 4 numbers of the access password and confirm them.

The login level is indicated by the key symbols in the upper right corner of the screen. If the user is not logged in, the keys are not displayed and his user rights are kept to a minimum.

Level 4 – user not logged in, the rights are limited to a minimum.
Level 3 – password: 1000 – basic functions and settings are enabled for the user.
Level 2 – password: 2000 – service level, most functions and settings are on.
Level 1 – password: xxxx – the level for manufacturer without any restrictions.

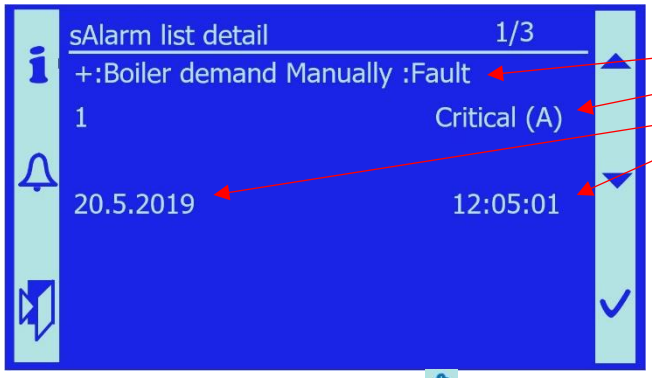
- **Enter**

If you hold the Enter button pressed for about 5 seconds, you will enter the **Password Entry** mode. This is the same function as the password entry menu.

7.4 Error messages

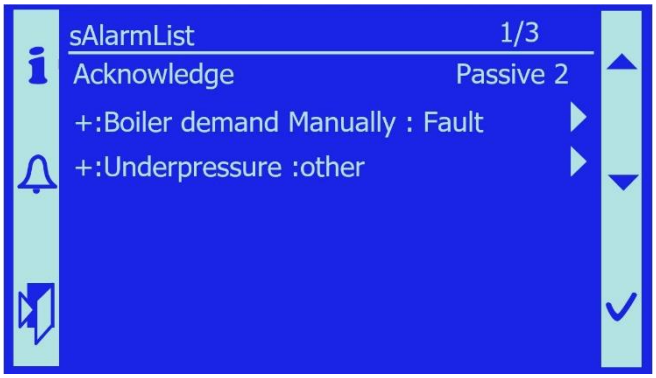
In the case of fault, red indicator starts to blink on the HMI.

When you press §§ button, the error is displayed together with its details.



- Name of error
- Alarm class
- The date of error occurrence
- The time of error occurrence

If you press the §§ button again, the list of all current error messages is displayed with maximum of 50 entries.



- **Acknowledge** – used to acknowledge the errors with memory.

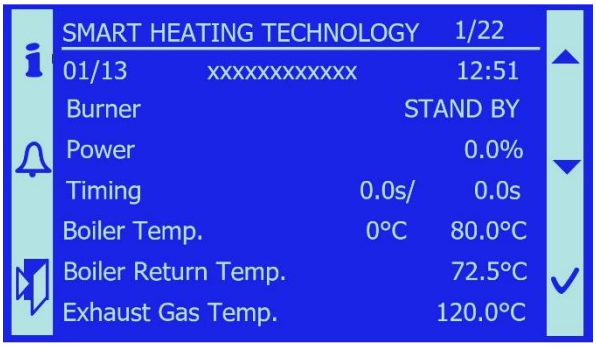
If you press the §§ button again, the history of error messages is displayed with maximum of 50 entries.

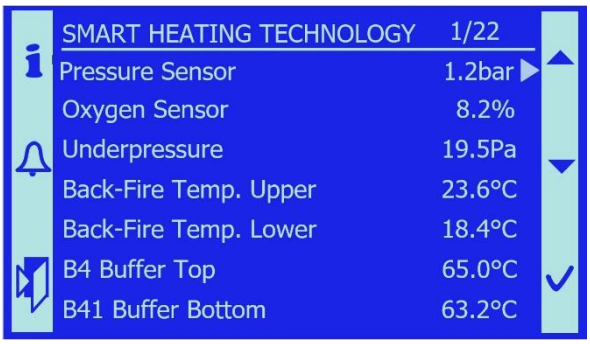
- **Acknowledge** – used to clear the history of error messages

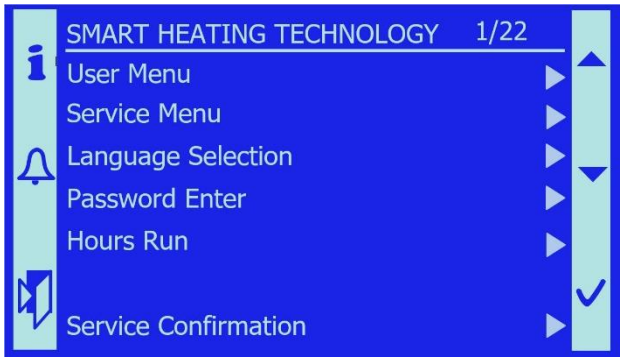
For the list of all errors see the chapter called List of error messages

7.5 Main screen

After switching on the boiler, the HMI displays the basic screen. Some data are always displayed. Some data are displayed according to the system configuration when the selected peripherals are turned on.







- **Burner** – A – information of the request for heat supply. Following operating statuses may be displayed: NO DEMAND/ON/STANDBY/UP-KEEP/IGNITION

- **Power [%]** – A –information about the current boiler power. The power value is calculated based on the fuel dosing. The value is informative and may not correspond to actual power. The correct dosing, which corresponds to the fuel used, will be set by the technician when commissioning the boiler.

- **Timing [s/s]** – A – information on current timing of fuel dosing. The batch timing is controlled continuously by the boiler controller in accordance with required the burner output.

- **Boiler Temp. [°C]** – A **–** information on current temperature of outlet water.

- **Boiler Return Temp. [°C]** – A – information on current temperature of water returning to the boiler.

- **Exhaust Gas Temp. [°C]** – A – information on current temperature of exhaust gas.

- **Pressure Sensor [Pa]** – C – information on current pressure of water in the system.

- **Oxygen Sensor [%]** – C – information on current oxygen content in exhaust gas.

- **Underpressure [Pa]** – A – information on current underpressure in the combustion chamber.

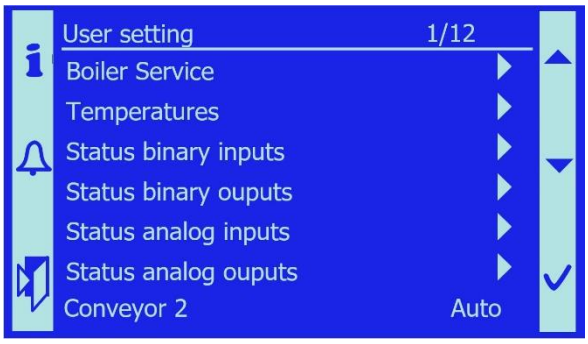
- **Back-Fire Temp. Upper [°C]** – A – information on current temperature at upper side of the fuel channel.

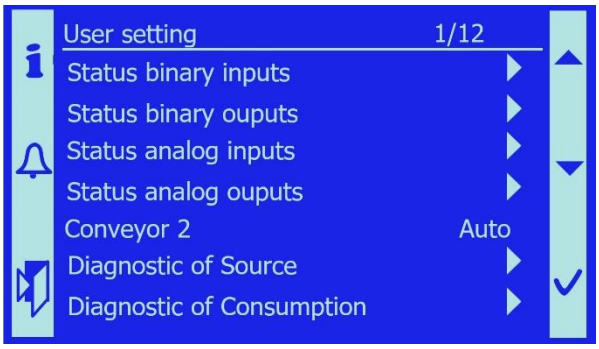
- **Back-Fire Temp. Lower [°C]** – A – information on current temperature at lower side of the fuel channel.
- **B4 Buffer Top [°C]** – C – information on current temperature in the buffer, top temperature.
- **B41 Buffer Bottom [°C]** – C – information on current temperature in the buffer, bottom temperature.
- **User Menu** – A – used to enter the User Menu
- **Service Menu** – A – used to enter the Service Menu, password is required, see 7.3
- **Language Selection** – A – used to enter the menu to select the desired language
- **Password Enter** – A – insert the password to enter the Service Menu
- **Hours Run** – A – access to menu with information about operating hours of boiler parts
- **Service Confirmation** – A – used to enter the menu to confirm the required service actions

Note: A the value is always displayed (Always)
C value is displayed after system configuration (Config)

7.6 User Menu

User setting menu allows the trained operator (user) to set some function parameters. The current status of individual pieces of equipment can also be checked in this menu. The Menu is accessed from the main screen. Password is not required.





7.6.1 Boiler Service

In this menu it is possible, based on operating requirement or required setting for boiler service, to set the boiler into Automatic control mode, or to permanently On or permanently Off modes

- If **Auto** mode is selected – the boiler operates in an automatic mode controlled according to the requirement of the superior control system (M&R), either by means of External ON/Off contact or KNX communication, ...
- If **On** mode is selected – there is a permanent demand for heat production in the boiler. This setting has higher priority than the requirements of the superior control system.
- If **Off** mode is selected – the boiler is permanently shut down. This SW input has a higher priority than the binary input External On/Off

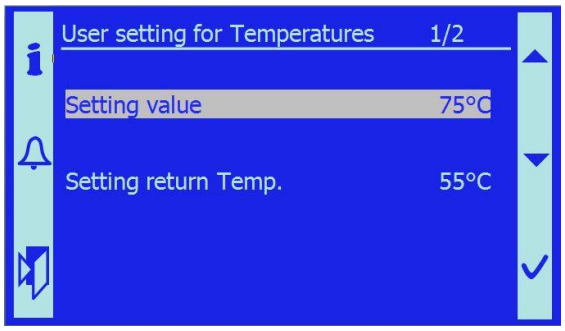
- *Note*: In On/Off mode, the control panel indicates the status of manual control. The red indicator light turns on and the orange indicator light flashes.

- *Note*: The error messages include a record of the manual shutdown of the boiler or activation of its manual control.

7.6.2 Temperatures

In this menu, the boiler operating (required) temperature and return water temperature can be set.
Both values may only be changed in the range set by the service technician or at the factory.

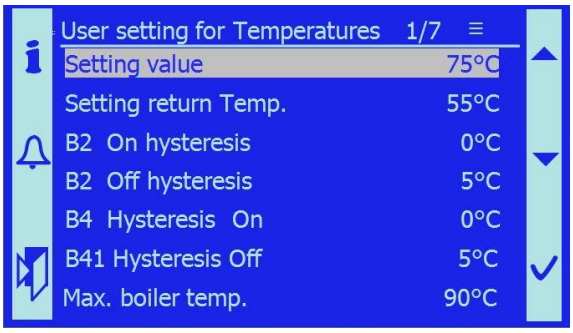
If the user is not logged in1, he can set following parameters:



- **Setting value** – required temperature of water at boiler outlet. If higher temperature is reached in the boiler, it switches to Standby condition.

- **Setting return Temp.** – required temperature of return water for the boiler. Based on this temperature, the mixing valve in short boiler circuit is controlled.
- *Note:* It is forbidden to reduce the set return temperature below 55°C because of the danger of low-temperature condensation and subsequent damage to the boiler.

If the user is logged-in on level 2, service level, he can also set following parameters:



- **B2 On hysteresis** – when boiler temperature drops below the setpoint temperature by the value of this hysteresis, the boiler switches from Standby to Operation mode.
Example: Required temperature = 75°C, B2 On hysteresis = 2°C. The boiler starts working at 75-2=73°C

- **B2 Off hysteresis** –when boiler temperature exceeds the setpoint temperature by the value of this hysteresis, the boiler switches to Standby condition
Example: Required temperature = 75°C, B2 Off hysteresis = 5°C. The boiler switches to Standby at 75+5=80°C
- *Note:* This is a very advantageous feature of boiler behaviour, because the temperature of outlet water can be kept slightly above the required temperature and the control elements so have a reserve for regulation. With a suitably selected hysteresis, the boiler operation is optimized with a minimum of transitions to STANDBY.

- **B4 Hysteresis On** – Hysteresis for temperatures B4 and B41 is used when the boiler operation is also controlled based on the temperatures of buffer in the Buffer On mode; for details see Configuration 7.10.18. (not used in Buffer Off or Capacity only modes) when the top temperature in the buffer drops below temperature setpoint by the value of this hysteresis, the boiler switches from Standby to Operation mode
Example: Required temperature = 75°C, B4 Hysteresis On = 0°C. The boiler starts working at 75-0=75°C
- *Note:* It is used, when the boiler is controlled based of the temperatures of the buffer. This is a very advantageous feature of boiler behaviour, because the boiler can be started well in advance before the water temperature in the buffer falls below an acceptable limit. This reduces temperature fluctuations in the buffer

1 If no access password is entered, the key symbol is not displayed in the upper right corner.

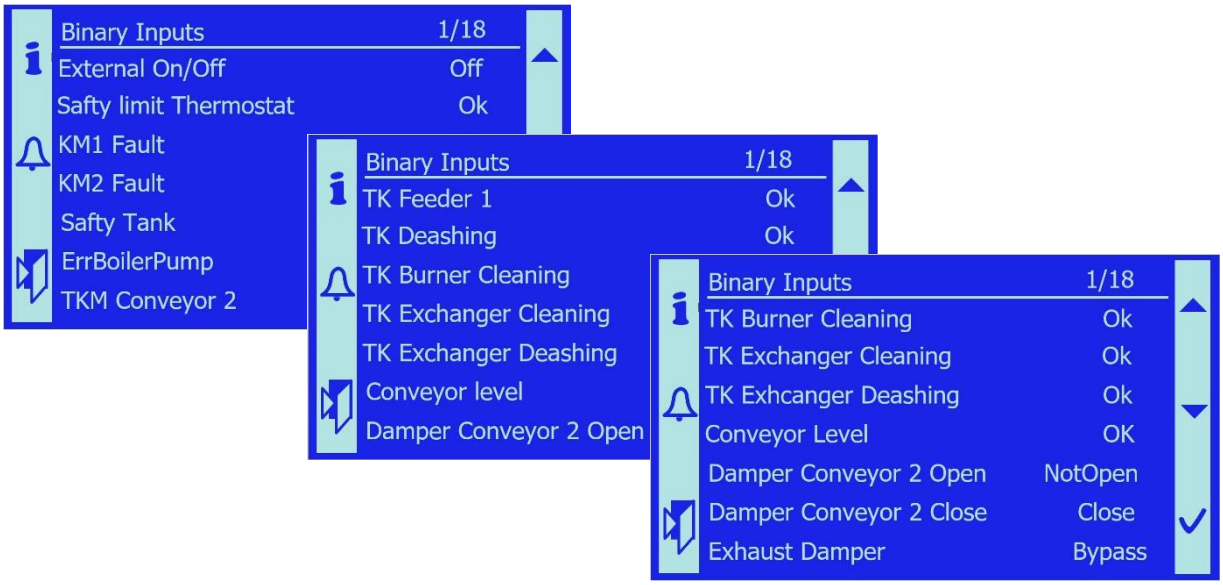
- *Note*: It is compared permanently with B2 on hysteresis and the boiler starts working, whichever comes first.

- **B41 Hysteresis Off** – when the bottom temperature in the buffer exceeds temperature setpoint by the value of this hysteresis, the boiler switches to Standby condition
- *Note:* It is compared permanently with B2 off hysteresis and the boiler switches to Standby condition, whichever comes first.

- **Max. boiler temp.** - this is the maximum value at which the desired boiler temperature can be set by the user. Boiler will never exceed this temperature. The value is set by the service technician or the manufacturer.
- *Note*: this function is used as a safety feature so as to prevent boiler overheating.

7.6.3 Status binary inputs

The menu is used to check the momentary operating states of all binary inputs introduced into the control system. It serves for service and analysis of possible operating and fault conditions.



- **External On/Off** – information on the request for heat supply. If On and boiler temperature is lower than the setpoint, the boiler runs. If OFF, the boiler is in Standby condition

- **Safty limit Thermostat** – information on the current status of the thermostat contact
  OK – emergency thermostat is OK
  Error – the boiler reached a temperature higher than 95°C and the contact opened. A fault is reported: Safety thermostat: Error.

- **KM1 Fault** – information on the current status of the safety contactor. The contactor is controlled by emergency thermostat. KM1 and KM2 must always be in the same operating position.
  OK – contactor is OK
  Error – contactor was disconnected by emergency thermostat or operating positions of KM1 and KM2 do not match
  A fault is reported: KM1 Fault: Error.

- **KM2 Fault** – information on the current status of the safety contactor. The contactor is controlled by emergency thermostat. KM1 and KM2 must always be in the same operating position.
  OK – contactor is OK
  Error – contactor was disconnected by emergency thermostat or operating positions of KM1 and KM2 do not match
  A fault is reported: KM2 Fault: Error.

- **Safety Tank** – information on the water level in the tank
  Full – water level is OK
  Empty – the water level is low or the tank has been emptied to extinguish the channel.
  A fault is reported: Safety tank: Empty.

- **TKM Conveyor 2** – information on the current status of thermal switch of M1 motor, conveyor 2
  OK – motor temperature is low, thermal switch is OK
  Error – thermal switch is open, motor is overheated
  A fault is reported: TK conveyor 2: Error.

- **TK Feeder 1**– information on the current status of thermal switch of M2 motor, Feeder 1.
  OK – motor temperature is low, thermal switch is OK
  Error – thermal switch is open, motor is overheated
  A fault is reported: TK feeder 1: Error.

- **TK Deashing** – information on the current status of thermal switch of M3 motor, Deashing.
  OK – motor temperature is low, thermal switch is OK
  Error – thermal switch is open, motor is overheated
  A fault is reported: TK deashing: Error.

- **TK Exchanger Cleaning** – information on the current status of thermal switch of M4, M5 motor, Exchanger Cleaning.
  OK – motor temperature is low, thermal switch is OK
  Error – thermal switch is open, motor is overheated
  A fault is reported: TK exchanger cleaning: Error.

- **TK Burner Cleaning** – information on the current status of thermal switch of M6 motor, Burner Cleaning.
  OK – motor temperature is low, thermal switch is OK
  Error – thermal switch is open, motor is overheated
  A fault is reported: TK burner cleaning: Error.

- **TK Exchanger Deashing**– information on the current status of thermal switch of M7 motor, Exchanger Deashing.
  OK – motor temperature is low, thermal switch is OK
  Error – thermal switch is open, motor is overheated
  A fault is reported: TK exch. deashing: Error.

- **Conveyor level** – information on current fuel level in the intermediate bin.
  OK – fuel level is sufficient
  Low – fuel consumed, should be replenished.

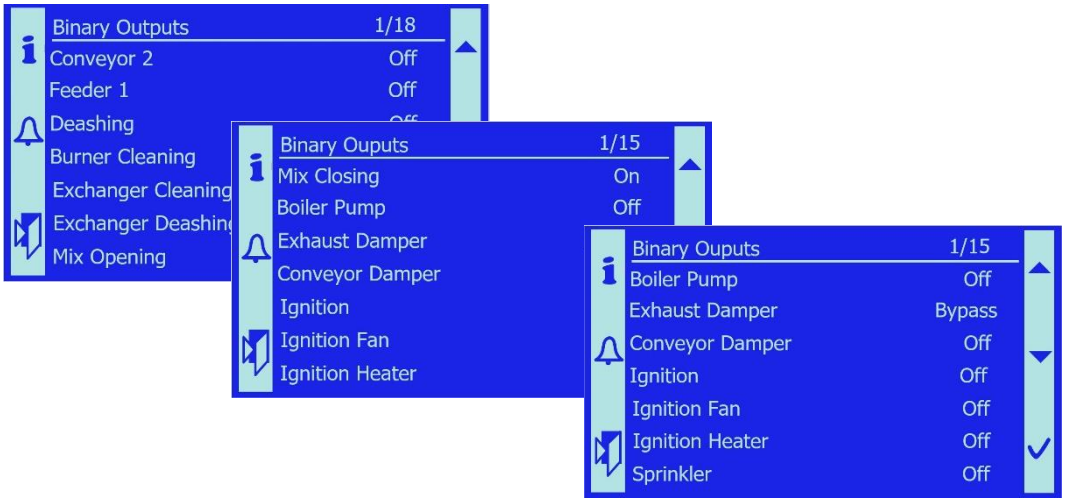
- **Damper Conveyor 2 Open** – information on current position of damper of intermediate bin.
  Not open – The damper is either closed or is opening. It has not reached its end position
  Open – damper is fully open, B limit switch is closed (opening angle is greater than 70°)
  Note: the information on the opposite position of the damper should be considered

- **Damper Conveyor 2 Close** – information on current rest position of safety damper of intermediate bin
  Not open – damper is in an intermediate position, limit switch is not closed
  Closed – damper is safely closed, A limit switch is closed (opening angle is less than 5°)
- *Note:* the information on the opposite position of the damper should be considered
- *Note:* if neither of the inputs of damper limit switches is in active condition, the damper is in an intermediate position between fully close and fully open positions

- **Exhaust Damper** – information on current position of safety damper of exchanger
  Bypass – The damper is in the position where the exhaust gas goes directly to the chimney
  Exchanger – The damper is in the position where the exhaust gas passes through the exchanger.

7.6.4 Status binary outputs

The menu is used to check the momentary operating states of all binary inputs lead out of the control system.



- **Conveyor 2** – information on current control status of M1, motor for conveyor 2.
  Displayed operating statuses.
  On – M1 motor is activated and conveyor 2 is running.
  Off – M1 motor is stopped.

- **Feeder 1** – information on current state of M2, motor of fuel screw.
  On – M2 motor is activated and the fuel is supplied.
  Off – M2 motor is stopped.

- **Deashing** – information on current state of M3, motor for deashing.
  On – M3 motor is activated and removes ash from the combustion chamber.
  Off – M3 motor is stopped.

- **Burner Cleaning** – information on current state of M6, motor for burner cleaning.
  On – M6 motor is activated and burner cleaning is in progress.
  Off – M6 motor is stopped.

- **Exchanger Cleaning –** information on current state of M4, M5, motors for exchanger cleaning.
  On – M4 and M5 motors are activated and exchanger cleaning is in progress.
  Off – M4 and M5 motors are stopped.

- **Exchanger Deashing** – information on current state of M7, motor for exchanger deashing.
  On – M7 motor is activated and removes ash from the exchanger.
  Off – M7 motor is stopped
- **Mix Opening** – information on current state of servomotor for three-way valve Y7 Y8
  On – servomotor is activated and three-way valve is opening.
  Off – servomotor is deactivated and the valve is stopped at its position.

- **Mix Closing** – information on current state of servomotor for three-way valve Y7 Y8
  On – servomotor is activated and three-way valve is closing
  Off – servomotor is deactivated and the valve is stopped at its position
- *Note:* these outputs are used for servo drive with three-point control. In parallel with these outputs, also the analogue 0-10V output “Return Valve” functions for a continuously controlled servo drive.

- **Boiler Pump** – information on current state of Q1, boiler pump.
  On – the pump is activated and runs.
  Off – the pump is stopped.

- **Exhaust Damper** – information on current state of safety exhaust damper.
  On – exhaust damper is energized and exhaust gas flows to exchanger (normal condition during standard operation of the boiler).
  Off – exhaust damper is deenergized and exhaust gas flows directly to chimney (condition during cold start of the boiler or emergency condition because of boiler overheating).

- **Conveyor Damper** – information on current state of safety fire damper in fuel channel located on the intermediate bin.
  On – damper is energized and open (condition during fuel replenishing).
  Off – damper is deenergized and fuel transport path is tightly sealed (when the boiler is in operation and the fuel is not supplied).
- *Note:* The damper position determined by On or Off of the control voltage can be controlled by means of the binary inputs “Conveyor Damper open/Conveyor Damper close”

- **Ignition** – information on current state of hot-air ignition gun.
  On – ignition gun is activated and blows hot air (about 400°C)
  Off – ignition gun is deactivated.

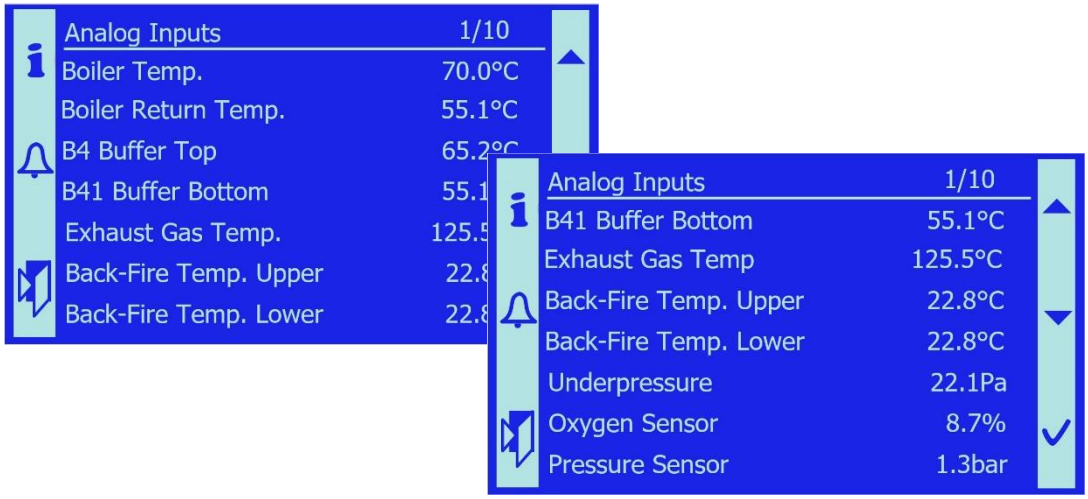
- **Ignition Fan** – information on current state of fan for ignition gun.
  On – fan of ignition gun is activated and blows.
  Off – fan of ignition gun is deactivated.

- **Ignition Heater** – information on current state of heating spiral for ignition gun.
  On – heating spiral of ignition gun is activated.
  Off – heating spiral of ignition gun is deactivated.

- **Sprinkler** – information on current state of sprinkler.
  On – sprinkler is activated and extinguishing
  Off – sprinkler is deactivated

7.7 Status analog inputs

The menu is used to check the momentary operating states of all analogue inputs introduced into the control system. These are mainly thermometers, lambda sensor.



- **Boiler Temp.** – current temperature of boiler outlet water
  sensor B2

- **Boiler Return Temp.** – current temperature of water returning to the boiler
  sensor B7

- **B4 Buffer Top** – current value of top temperature in the buffer
  sensor B4

- **B41 Buffer Bottom** – current value of bottom temperature in the buffer
  sensor B41
  Note: B4 and B41 temperatures are only displayed when the boiler operation with Buffer is selected – see 7.17

- **Exhaust Gas Temp.** – current temperature of exhaust gas downstream the boiler
  sensor B8

- **Back-Fire Temp Upper** – current value of temperature at the top of the fuel channel, protection against back-fire
  sensor B5

- **Back-Fire Temp Lower** – current value of temperature at lower side of the fuel channel, protection against back-fire
  sensor B5.1

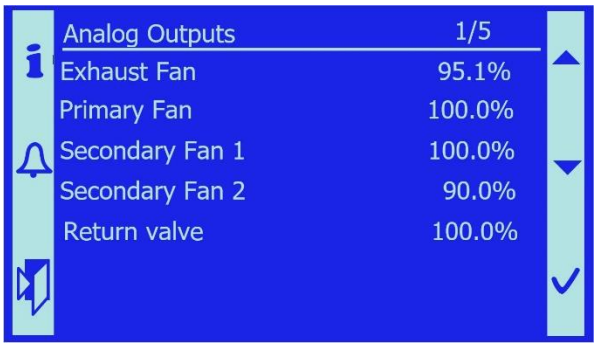
- **Underpressure** – current value of the underpressure in the combustion chamber

- **Oxygen Sensor** – current content of residual oxygen in the exhaust gas

- **Pressure Sensor** – current value of water pressure in the heating system

7.8 Status analog outputs

The menu is used to check the momentary operating states of all analogue outputs lead out of the control system. They are especially fans and servo drives



- **Exhaust Fan** – current output of exhaust fan in [%]
- **Primary Fan** – current output of primary fan in [%]
- **Secondary Fan 1** – current output of secondary fan 1 in [%]
- **Secondary Fan 2** – current output of secondary fan 2 in [%]
- **Return valve** – current position of servo drive to control return water in [%]

7.9 Conveyor 2

It is used for simple control of feeder supplying the fuel from silo to intermediate bin (conveyor 2). After the silo has been emptied, the disturbing mechanism (folding arms and spring system) is in the deployed position. If we fill the silo with a high layer of fuel in this state, these arms can be blocked in the fuel. After filling the fuel to the defined level – see chapter 6.2 Filling the silo with fuel, the mechanism must be started up for a short time. Folding arms and springs retract under the protective plate and so system jamming is prevented.

Auto – the conveyor 2 is controlled by software in the control unit.

On – fire damper above intermediate bin is opened automatically. When opened, motor is started for pre-set period of time. This time is set by the technician in Motors menu 7.10.5. After the time has elapsed – typically 30-90 seconds, the motor stops and damper closes. The time is set so that the arms of the disturbing mechanism reliably hide under the protective plate.

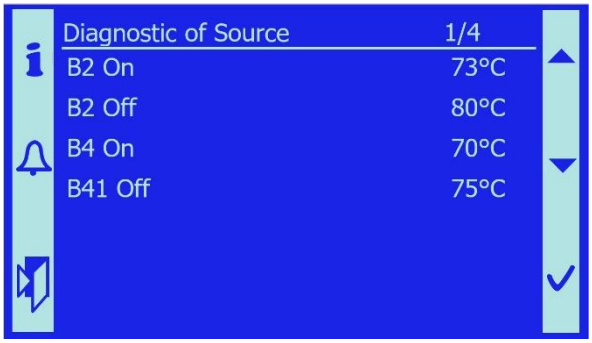
Off – conveyor 2 can be stopped anytime

- *Important notice:* The operator is obliged to use this function when filling the silo. The result is the rotation of the mechanism and the retracting of the leaf springs. It is necessary to use this function in order to prevent the springs from jamming under the fuel.

7.9.1 Diagnostics of Source

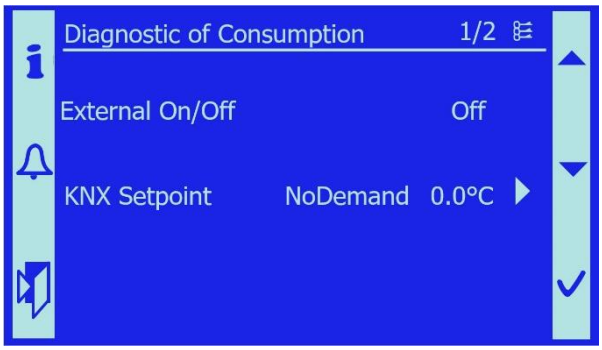
Auxiliary information menu in which the operator can easily find out what the boiler start and stop conditions are in relation to the control temperatures.

The displayed values reflect the currently set values of temperatures with hysteresis for switching the boiler on and off



7.9.2 Diagnostics of consumption

Auxiliary information menu in which the operator can easily find out, what are the current conditions for the heating circuit in the terms of time control, required temperatures, outside

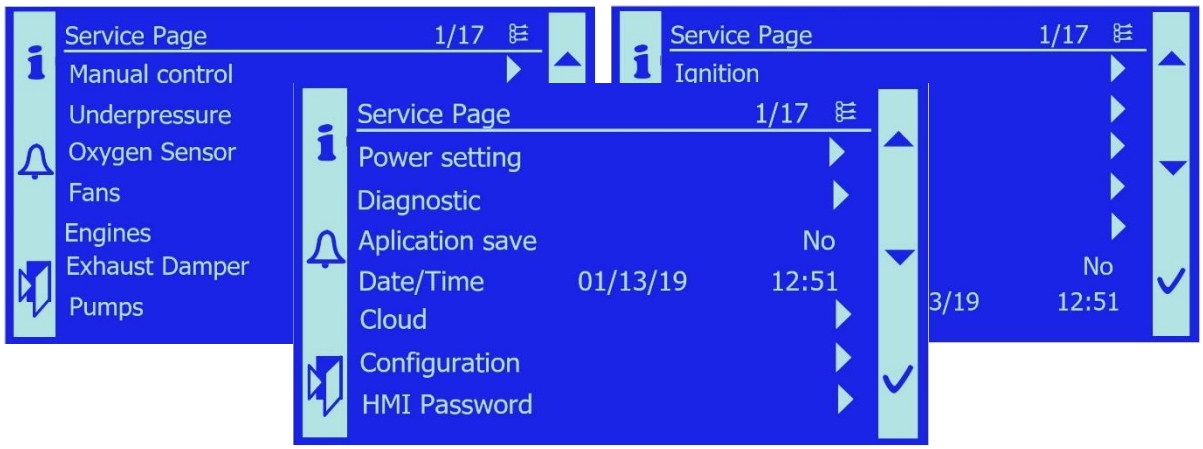


temperature, etc...

- **KNX Setpoint** – displays the setpoints sent from the superior control system

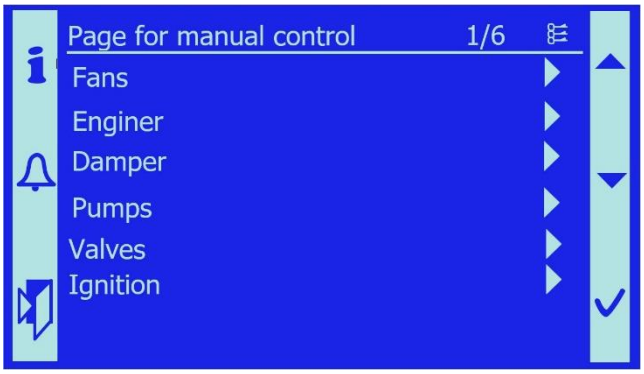
7.10 Service Menu

In the service menu, the qualified operator can set all boiler operating and performance parameters, and optimize the settings according to the required operating conditions, the fuel used and the required operating mode. It is also possible to manually control the boiler equipment (motors, fans, ...)

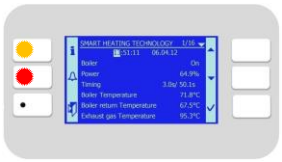


7.10.1 Manual control

It is used for manual control of boiler equipment[2].



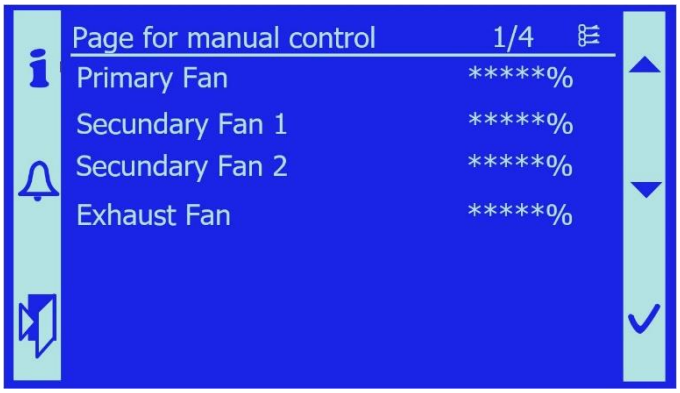
- If manual control is activated, e.g. exchanger cleaning, the status of manual control is indicated on the control panel. The red indicator light turns on and the orange indicator light flashes.



- The error messages include the identification which boiler element is in manual control.
- This condition continues until repeated intervention of the user and until the value is returned to automatic mode (Auto, ***).

7.10.1.1 Fans

On this tab it is possible to set manually a fixed value of the speed, both for air supply and exhaust fans.



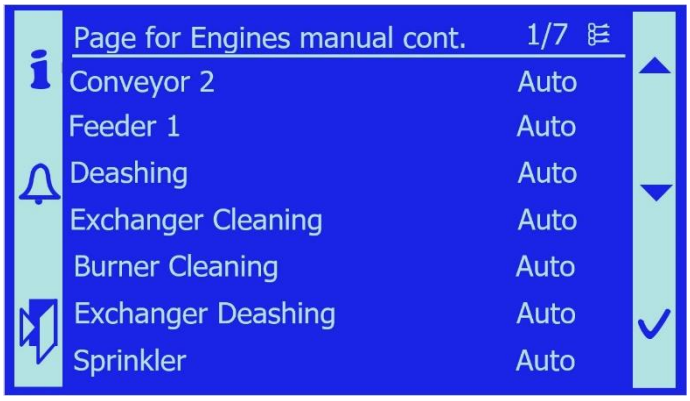
- **Primary Fan**– it is possible to set a fixed speed of the primary fan that blows air into the primary burner.
- **Secondary Fan 1** – it is possible to set a fixed speed of the secondary fan 1 that blows air into the secondary burner 1.
- **Secondary Fan 2** – it is possible to set a fixed speed of the secondary fan 2 that blows air into the secondary burner 2.
- **Exhaust Fan**– it is possible to set a fixed speed of exhaust fan which creates an underpressure and draws the exhaust gas off the combustion chamber

Note: for automatic mode, the value is again set to ***

2 Electrical actuators on the boiler.

7.10.1.2 Motors

On the Motors tab it is possible to manually control (switch on and off) all motors on the boiler.

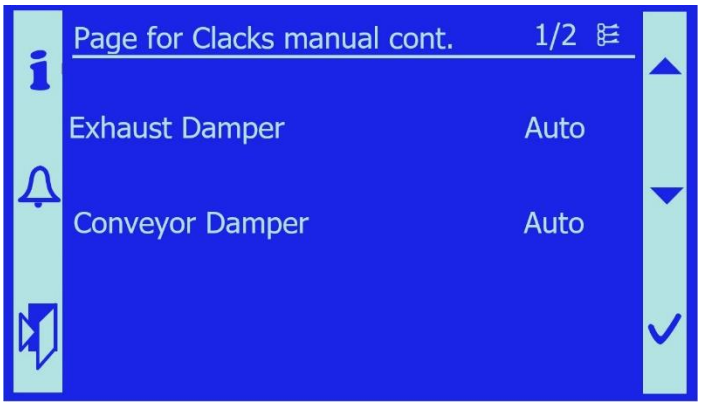


- *Note*: If you set the Feeder 1 to manual mode, the motor returns back to Auto mode after 10 times the feed time to prevent the burner being overfilled with fuel. The Off position is permanent, independent of time; in order to operate the motor in automatic mode again, an operator intervention is required and AUTO mode has to be set.
- *Note*: When the Sprinkler function is activated, one sprinkler extinguishing cycle is performed.

Warning: when performing service tasks and working on the device, SW shutdown of the motor is not sufficient for safe work. It is necessary to use Emergency OFF.

7.10.1.3 Dampers

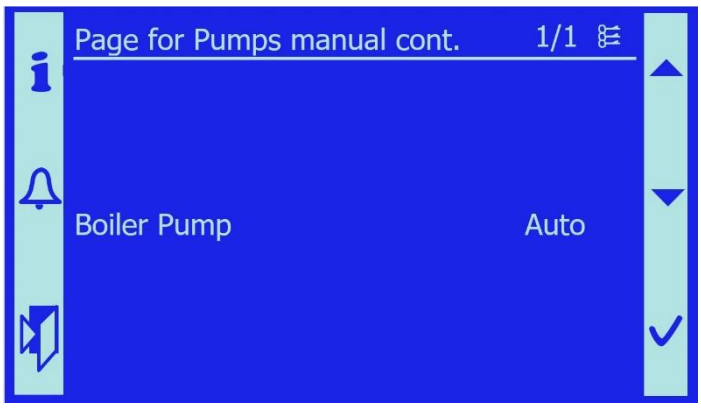
This tab enables to control all dampers on the boiler manually.



- *Note*: Damper of intermediate bin has a fire-prevention function and opens in automatic mode only for the time necessary to replenish the fuel. If the damper is opened manually, the risk of back-fire is increased.
- *Note: I*f the exhaust damper is opened manually, there is a risk of dangerous increase of exhaust gas temperature

7.10.1.4 Pumps

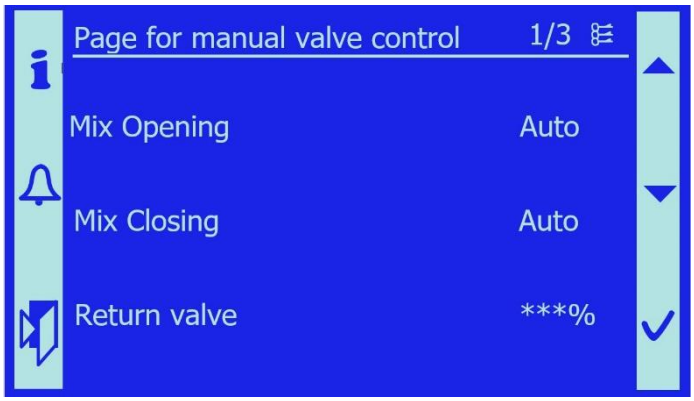
This tab enables to control the boiler pump manually.



- *Note*: If the heating circuit is enabled in the configuration, this tab displays the option of manually controlling export pump of the heating circuit.

7.10.1.5 Valves

This tab enables to control manually the mixing valve of the boiler.



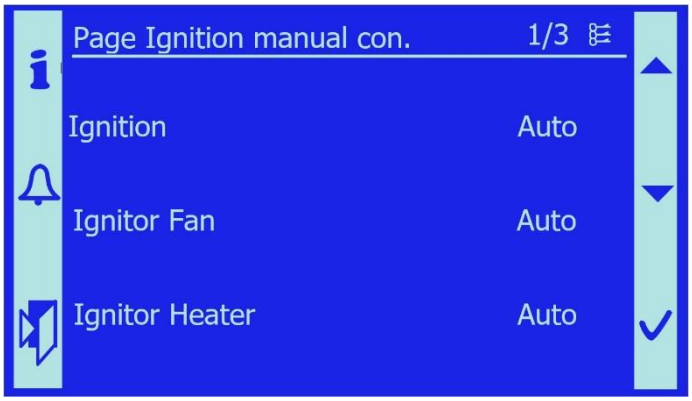
- *Note*: If the installed three-way valve is actuated by a three-point 230 V AC actuator, it is controlled by the Mix opening and Mix closing items. Return valve item is used for the valves with 0..10V control.

If the heating circuit is enabled in the configuration, this tab displays the option of manually control of mixing valve for the heating circuit.

7.10.1.6 Ignition

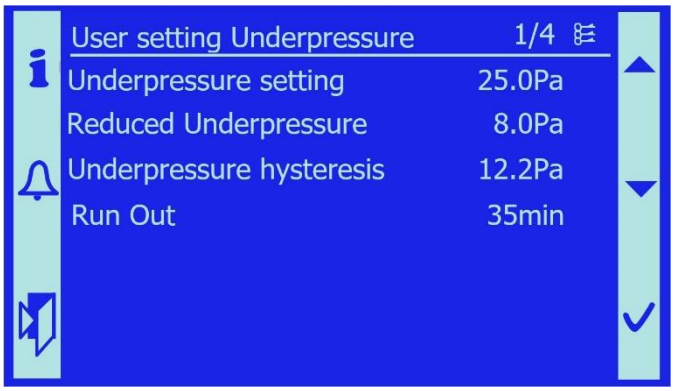
This tab enables to control manually the ignition system of the boiler.

- *Note***:** When the Ignition is started, firstly Ignition Fan is activated and later also Ignition Heater. When the Ignition is deactivated, fan continues to run for 30s so that the heating spiral cools down. Fan and heater can be controlled also independently. Heating spiral turns off automatically after 1 minute.



7.10.2 Underpressure

For correct functioning of the boiler it is important that the boiler maintains a certain level of underpressure. The primary purpose of maintaining the underpressure is to force the exhaust gas to flow through the heat exchanger where heat exchange takes place. The secondary purpose is to prevent a leakage of exhaust gas into the boiler room, increasing the risk of fire



and poisoning of the operator by toxic gases.

- **Underpressure setting**: Required underpressure for boiler operation. Standard value is 25Pa.

- **Reduced Underpressure**: When the boiler is in Standby mode, lower value of underpressure is maintained. This condition provides for the removal of exhaustion gas from residual fuel.

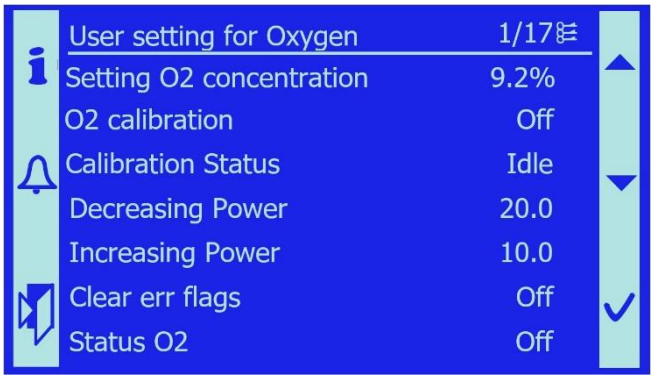
- **Underpressure hysteresis**: Permitted pressure drop. If the underpressure drops below the allowable difference, underpressure fault is reported with a small delay and the boiler is shut down.

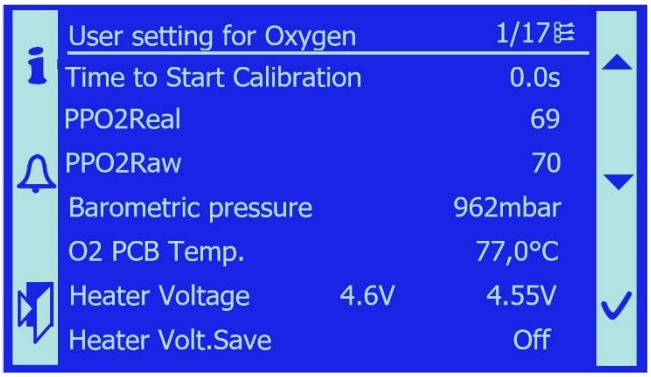
Example: Underpressure setting is 25.0Pa and Underpressure hysteresis is 12.2Pa: if underpressure lower than 12.8Pa is measured in the combustion chamber, the fault is reported.

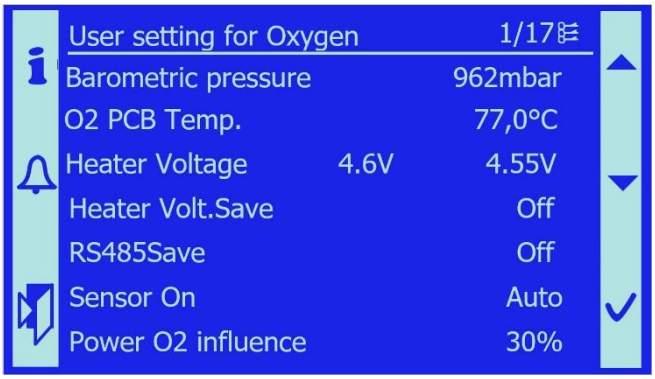
- **Run Out**: Reduced underpressure is maintained in the combustion chamber for the period of time set in this parameter. When this expires, exhaust fan is stopped and underpressure in the combustion chamber is no more controlled. Only natural draught is active.

7.10.3 Oxygen sensor

In order to ensure high-quality fuel combustion, the concentration of O2 in the exhaust gas is measured. Depending on the O2 concentration required, the output of the fans blowing air into the burner, where the fuel is burned, is adjusted. The O2 concentration is measured by a lambda probe, which is connected to the control unit via a ModBus converter.







- **Setting O2 concentration** – Required concentration of oxygen in exhaust gas.

- **O2 calibration** – It is used to calibrate the lambda probe that measures oxygen in the exhaust gas. There are two types of calibration:
  - **First Cal.** – it is used before the boiler is started and when the sensor is replaced, the calibration takes 360s
  - **Standard Cal.** - During boiler operation it is good to calibrate the sensor – perform Standard calibration that takes 120s

- **Calibration Status** – Calibration status is displayed: Idle / Active / Completed.
  - **Idle** – calibration is performed
  - **Active** – calibration is in progress
  - **Completed** – calibration has been completed

- **Decreasing Power** – It is dealing with a reduction in the speed of supply fans in the case of exceeding the required oxygen content in exhaust gas.

- **Increasing Power** – It is a dealing with an increase in the speed of supply fans in the case of drop below the required oxygen content in exhaust gas.

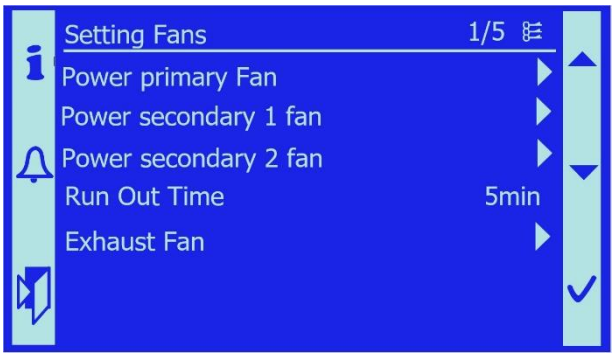
- **Clear err flags** – Confirmation of the errors related to lambda sensor and converter.

- **Status O2** – Information on the operating condition of lambda sensor Off/Heating/Operation/Operation termination/Stand by
  - **Off** – sensor is off
  - **Heating** – sensor is being heated up before operation
  - **Operation termination** – sensor switches off and lambda cools down
  - **Stand-by** – the sensor is operated in stand-by mode.

- **Time to Start Calibration** – countdown of the time for the calibration start, the sensor is heated up and being prepared for calibration.
- **PPO2Real** – information on communication status
- **PPO2Raw** – information on communication status
- **Barometric pressure** – Current barometric pressure measured by lambda probe.
- **O2 PCB Temp.** - It displays the temperature of the communication module of lambda (the printed circuit inside the box).
- **Heater Voltage** – It is used to set the required voltage for the lambda probe.
- **Heater Volt.Save** – It saves the value set for Heater Voltage.
- **RS485Save**– It saves the set values for O_2 inverter.
- **Power O2 Influence** – boiler power, at which the lambda sensor starts to influence the speed of fans.

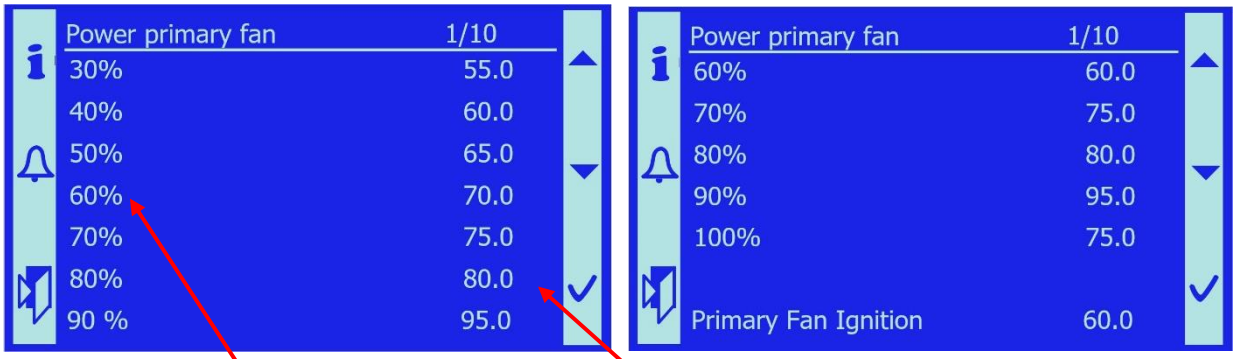
7.10.4 Fans

The fans blow the combustion air into the burner, which is divided into three sections. Each section has its own fan. The output of each fan depends on the actual boiler power. Each fan has its own settings.



- **Power primary Fan**– it blows air under the fuel, aerates the fuel and initiates combustion.
- **Power secondary 1 fan** – it blows air from the secondary burner 1 into the flame and ensures optimum combustion.
- **Power secondary 2 fan** – it blows air to the secondary burner 2, above the flame and ensures complete burning of combustion products

Each fan has its own settings.



For given boiler power defined fan output is set. For primary fan and the secondary fan also the desired output during ignition is set.

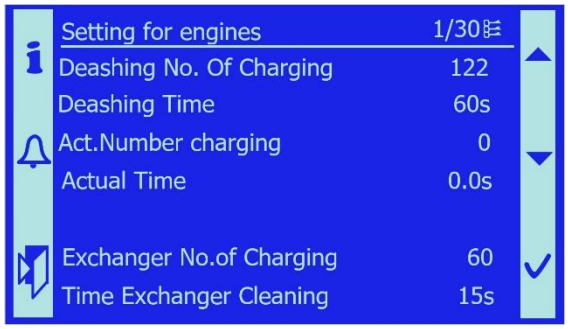
- **Exhaust Fan** – required underpressure in the combustion chamber is created by exhaust fan which is regulated according to the PID characteristics. Here it is possible to change PID control parameters (proportional factor, integration factor and derivative factor)

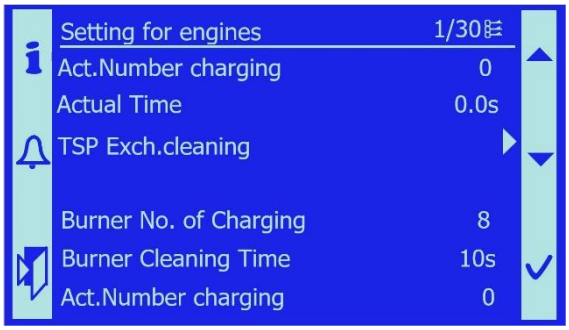
- **Run Out Time** – When the boiler switches to Standby mode, their output linearly decreases and they stop when the set time elapses.

- *Note*: current speed of secondary 1 and secondary 2 fans is influenced by lambda probe, see Oxygen sensor 7.10.3

7.10.5 Motors

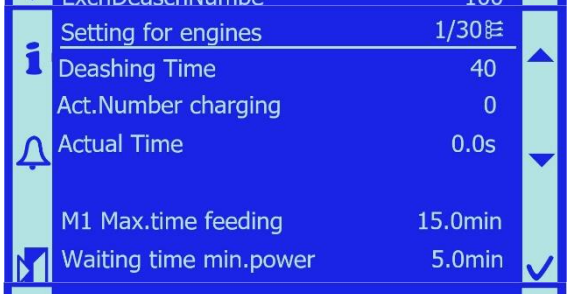
Setting the operating parameters for motors. Setting the conditions for their start and the time period for their operation.

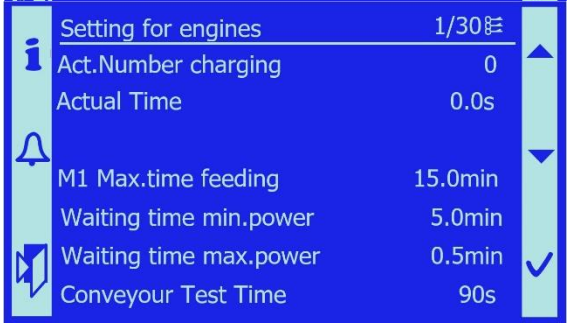




- The settings for the motors depend on the number of stokings, e.g. when the feeder 1 is started (and the number of stokings is increased by one), the motor operates for the set running time.
For each motor the current number of stokings and the current runtime are displayed; these counters are reset after each cycle.
- **Exchanger cleaning** has special function of time schedule TSP Exch. cleaning, which allows to set the time, when the exchanger should be cleaned. Because of noisiness, it is possible, for example, to turn off the cleaning at night.
- **Burner cleaning** has an added cleaning function in Standby mode to prevent fuel from caking upon the burner.
- **StandbyOn** – how long after the boiler goes into Standby the cleaning cycle is activated and the time between individual cleaning cycles.
- **StandbyOff** – cleaning time in Standby mode
- **NrCycles** – number of cycles repeated

- Level sensor installed in intermediate bin controls the operation of **Conveyor 2**, its functions are based on that.





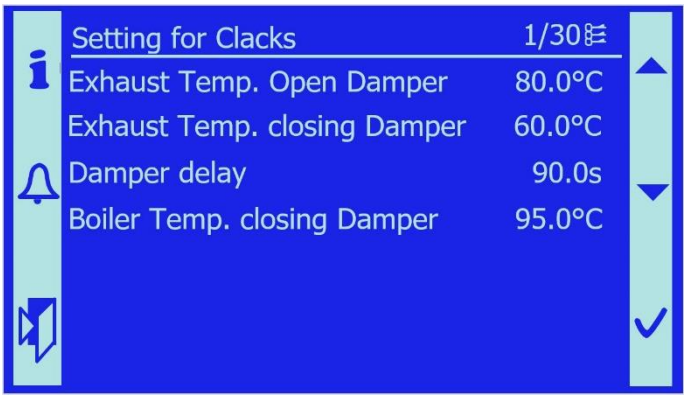
- **M1 Max.time feeding** – when the feeder starts, the time in which the feeder has to replenish the fuel level in intermediate bin starts to count down; if not, an error is reported. This may be due to lack of fuel or feeder failure.
- **Waiting time min.power** – time before fuel replenishment is started at minimum boiler power.
- **Waiting time max.power** – time before fuel replenishment is started at maximum boiler power.
- **Conveyor Test Time** – in order to start the conveyor 2, the feeder damper must first be opened and must be opened no later than in the set time. If not, the error is reported. Damper closing is monitored in the same way.

7.10.6 Exhaust damper

The exhaust damper serves as a safety feature and also prevents low-temperature corrosion. The exhaust damper controls the flow direction of the hot exhaust gas by opening the inlet to the exchanger while closing the outlet to the chimney and vice versa.

In the event of a power failure, the damper automatically opens towards the chimney and at the same time shuts off the exhaust gas supply to the exchanger so as to prevent possible damage to the technology and boiler overheating.

- *Note*: if there is a request to close the exhaust damper, it has to be completed within 120 seconds, otherwise a fault is reported.



- **Exhaust Temp. Open Damper** – the exhaust gas temperature must reach a certain value to open the damper towards the exchanger where the heat exchange takes place. Typical value is 90°C

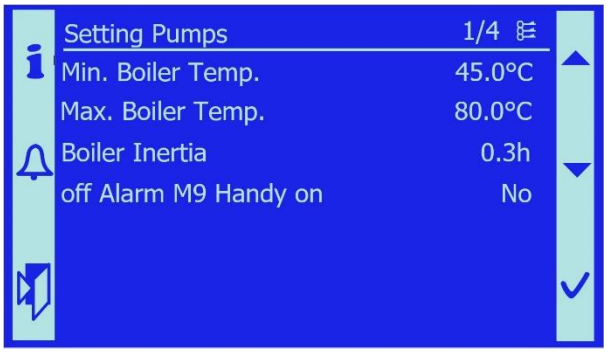
- **Exhaust Temp. closing Damper** – if the exhaust gas temperature drops below the set limit, the damper to exchanger is closed and exhaust gas flows directly into the chimney. In order to prevent low-temperature corrosion and exhaust gas taring on exchanger walls (deterioration of heat transfer). Typical value is 60°C

- **Damper delay** – when the limit values are reached, the damper waits for the set time and then it starts opening or closing.

- **Boiler Temp. closing Damper** – when the boiler temperature reaches the set limit value, the damper starts to open towards the chimney. In order to prevent boiler overheating.

7.10.7 Pumps

It is used to set the boiler pump.



- **Min. Boiler Temp.** – temperature, at which the boiler pump is started

- **Max. Boiler Temp.** - if the boiler goes to Standby mode and the boiler pump stops (see Boiler inertia), the boiler temperature may rise. In order to prevent boiler overheating, the boiler pump starts when the boiler temperature reaches the set temperature.

- **Boiler Inertia** –If the boiler goes into standby mode or is shut down, the boiler pump stops after the set value has passed

- **Off Alarm M9 Handy on** – if the boiler pump needs to operate continuously in manual control, it is switched to the On position so that the information message that the boiler pump is operated in manual control is not displayed. This function allows to deactivate this message and therefore no manual control fault is reported.

7.10.8 Ignition

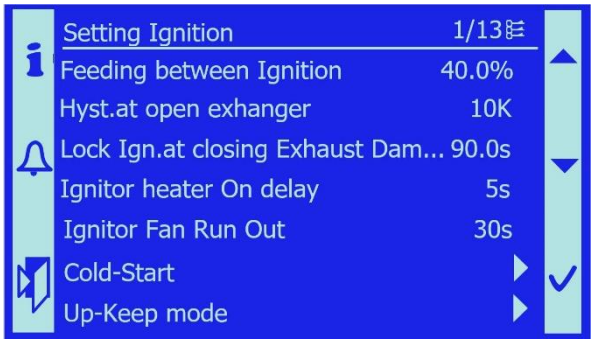
In order for the boiler to operate fully automatically, the automatic ignition device and functions are implemented. After a successful ignition routine, the boiler starts with minimum power (30% of its nominal power) and then the power is gradually increased. For this to happen, following requirements must be met:

1. Exhaust Temp. Ignition – for this condition to be met, the temperature of exhaust gas must at least reach the set value.

2. Exhaust against Boiler Temp. – the exhaust gas must reach a value higher by the set value.

3. Hyst.Exhaustgas_Water – temperature of exhaust gas must be higher when compared with boiler temperature by the set value.

If these conditions are met, the control system evaluates that the boiler burns safely and starts refuelling according to power.

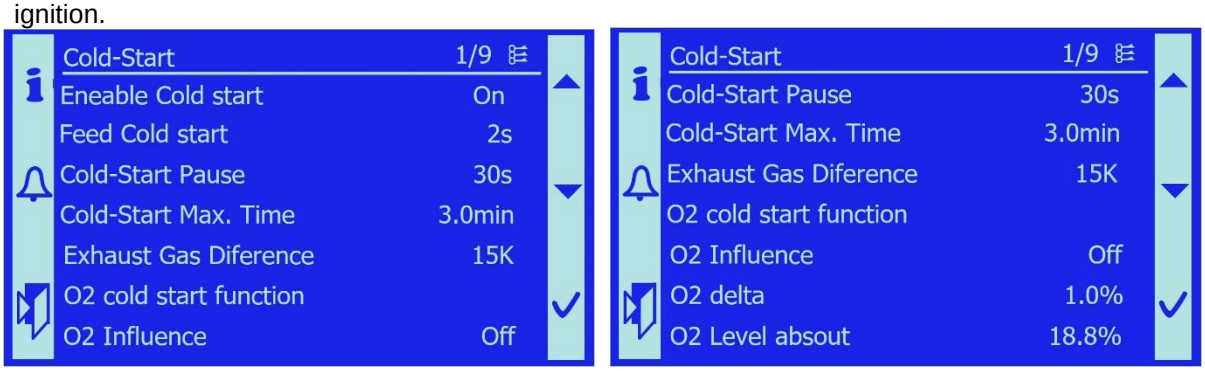


- **Ignition Time** – period of ignition gun activation

- **Space between Ignition** – pause between repetitions of ignition cycle
- **Ignition repetition** – number of pause repetitions of ignition cycle
- **Feeding between Ignition** – if there is no ignition, the amount of fuel in the burner will be increased in each repetition when compared with the first feeding, namely by this percentage.
- **Hyst.at open exchanger** – If the exhaust damper to exchanger is opened (see 7.10.6), this value is subtracted from required difference. It compensates for the exhaust gas temperature, which decreases as the exhaust gas passes through the exchanger
- **Lock Ign.at closing Exhaust Damper** – at the moment when the ignition occurs and the exhaust damper begins to close, the exhaust gas begins to flow through the exchanger and is cooled down. As soon as it falls below the ignition temperature, ignition can occur. The ignition is repeated if the exhaust gas temperature does not rise to the desired value within the set time.
- **Ignitor heater On delay** – an ignition gun is used for ignition. In order to protect the heater, the fan of ignition gun is first turned on and after the set time has elapsed, the heater is switched on.
- **Ignitor Fan Run Out** – in order to protect the heater, the fan of ignition gun has certain run-out after heating. So, desired cooling down of heater is achieved.

7.10.9 Cold start

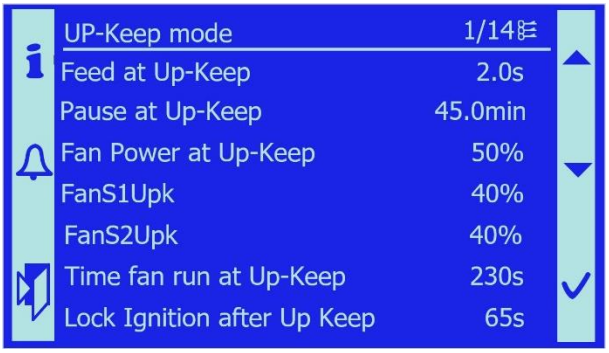
If the boiler is put into operation at low boiler temperature and combustion in a conventional way would take a long time and it would not be possible to ignite successfully when the set conditions are met. If cold start is enabled, it assists ignition by adding fuel during ignition.



- **Enable Cold start** – enable/disable the function of cold start
- **Feed Cold start** – Feeder 1 is started for the time set and stokes the burner with fuel.
- **Cold-Start Pause** – pause between individual stokings.
- **Cold-Start Max. Time** – maximum time of cold start activation.
- **Exhaust Gas Diference** – in order to activate the cold start routine, the exhaust gas must rise by the set value.
- **O2 cold start function** – in order to activate the cold start routine, this function can be conditioned by the desired level of residual O2 in the exhaust gas.
- **O2 influence** – switching on/off the influence of residual O2 on the cold start function
- **O2 delta** – concentration of oxygen in the exhaust gas must drop by the set value
- **O2 Level absolut** – concentration of oxygen in the exhaust gas must drop to set value.

7.10.10 Up Keep mode

In order to prevent the boiler from repeatedly igniting it is possible to keep the flame in

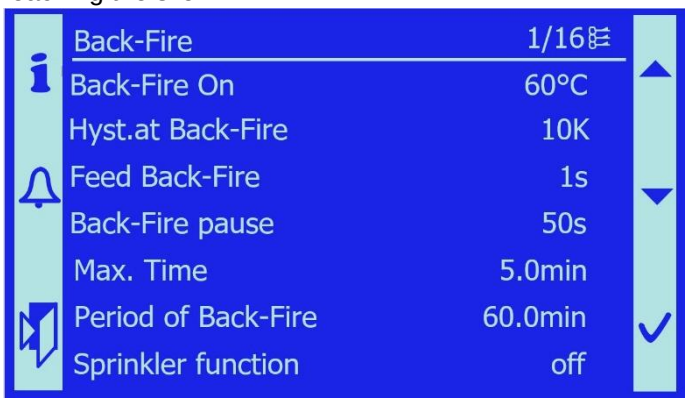


the boiler permanently.

- **Eneable UPkeep** – switching on/off the Up Keep function.
- **Exhaust in Up-Keep** – required exhaust gas temperature for Up Keep function
- **EXh.hyst.Up keep** – difference for exhaust gas temperature.
- **B2UpKeep** – required boiler temperature for Up Keep function.
- **B2UpHys** – exhaust gas temperature should by higher than boiler temperature by this value.
- **ExhHystUp2** – difference for exhaust gas temperature
- **O2 level Up-Keep** – required concentration of oxygen in exhaust gas.
- **Feed at Up-Keep** – stoking time in one cycle of UpKeep mode.
- **Pause at Up-Keep** – pause between individual activations of Feeder 1
- **Fan Power at Up-Keep** – power of primary fan during Up Keep mode
- **FanS1Upk** – power of secondary fan 1 during Up Keep mode
- **FanS2Upk** – power of secondary fan 2 during Up Keep mode
- **Time fan run at Up-Keep** – for how long the fans will blow air into the combustion chamber
- **Lock Ignition after Up Keep** – when switching from Up Keep mode to operation, the ignition gun is blocked for the set time. If the boiler fails to reach its power by this time, the ignition mode is started.

7.10.11 Back-fire

The boiler is equipped with several protection measures against boiler damage. They include the system of protection against back-fire or backdraught. The system serves to protect the intermediate bin against back-fire and to prevent the flame from spreading into the fuel paths, possibly reaching the silo.



- **Back-Fire On** – two temperature sensors are installed on the fuel channel, which measure the temperature continuously. If the set temperature is exceeded, the back-fire protection system is activated. Fault condition “High back-fire temperature” is reported.

- **Hyst.at Back-Fire** – back-fire protection system is deactivated only when the temperature decreases from “Back-Fire On” temperature by the value set in this parameter.

- **Feed Back-Fire** – for how long the fuel Feeder 1 is activated so as to force the flame back into the burner.

Note: If operator sets the value of this parameter too high, the burner can be overfilled within back-fire protection with undesired effect, not preventing the back-fire

- **Back-Fire pause** – pause between individual stokings within back-fire protection.

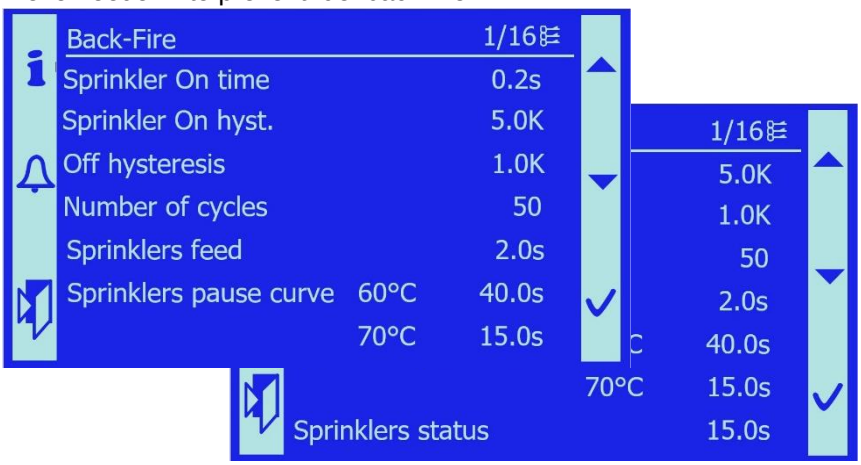
- **Max. Time** – period of time, for which the back-fire protection system is activated.

- **Period of Back-Fire** – Back-fire protection system will only be reactivated after the set time.

Note: If the temperature on fuel conveyor rises to 90°C, the safety valve (Caleffi) opens and the fuel channel is flooded with water. After emptying the tank, the “empty tank” fault is reported

7.10.11.1 Sprinkler function

It is an additional fire extinguishing system that injects water under pressure into the fuel channel of feeder 1 to prevent fuel back-fire.

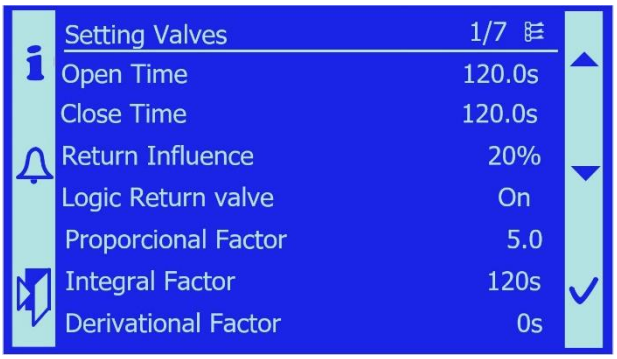


- **Sprinkler On time** – duration of one water injection
- **Sprinkler On hyst.** - In order to activate the back-fire protection mode with the sprinkler function, specific temperature must be reached on the fuel channel – see “Back-Fire On” temperature 7.10.11 – reduced by the value given in Sprinkler On hyst.
- **Off hysteresis** – extinguishing with sprinkler is stopped, when the temperature on the fuel channel drops below Back-Fire On temperature, reduced by this value.
- **Number of cycles** – maximum number of sprinkler activations
- **Sprinklers feed** – when sprinkler is activated, also fuel feeder is activated for the set time
- **Sprinklers pause curve** – this is the time delay between water injections depending on the temperature. E.g. as the temperature rises, the time delay between water injection decreases.
- **Sprinklers status** – status of sprinkler

7.10.12 Valves

It is used to set the parameters for three-way valve of boiler. The boiler control unit can to control two types of valve:

- Three-point valve, 230V AC
- Valve with control signal 0..10V, 24V DC



- **Open Time** – it used only when a three-point valve is installed, the maximum run time of the valve to open from closed to open positions

- **Close Time** – it used only when a three-point valve is installed, the maximum run time of the valve to close from open to closed positions

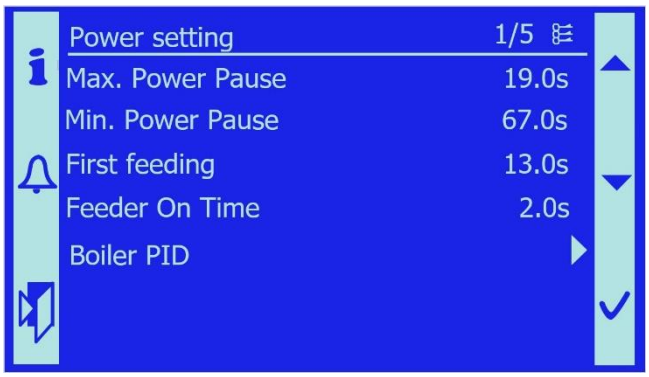
- **Return Influence** – influencing the valve operation by the return temperature

- **Logic Return valve** – inverts the logic of operation of the three-way valve on the boiler.

- **Proporcional Factor, Integral Factor, Derivational Factor** – these are PID control parameters of the three-way valve. These parameters determine the speed and extent of the control

7.10.13 Power Setting

Here, the parameters for fuel supply are set that determine the boiler power.



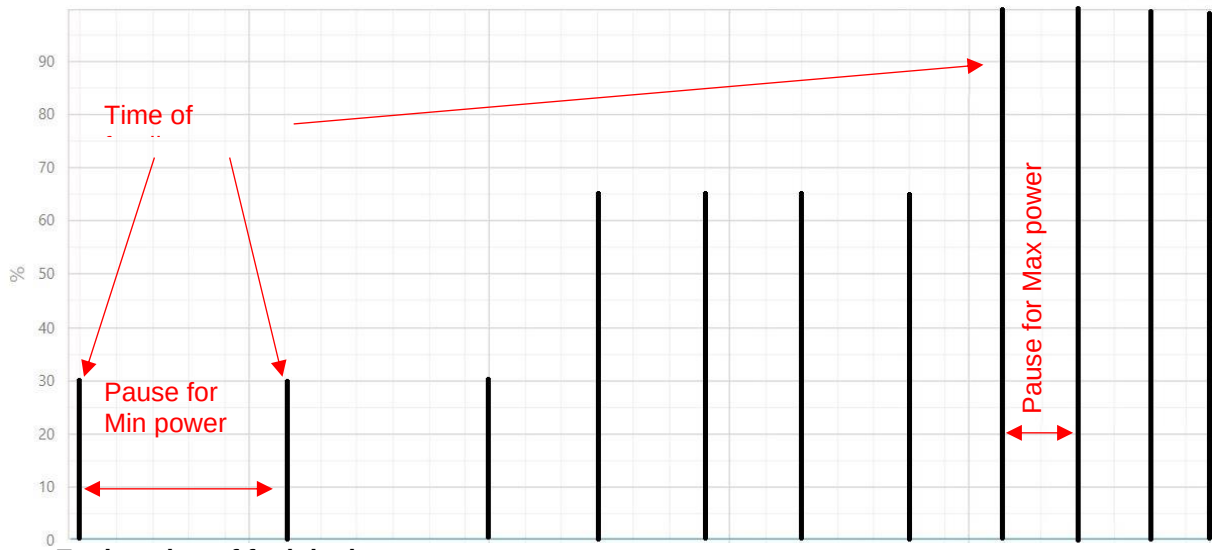
- **Max. Power Pause** – if the boiler is at its maximum power (100%), the delay between stokings is equal to the set value.

- **Min. Power Pause** – if the boiler is at its minimum power (30%), the delay between stokings is equal to the set value.

- **First feeding** – during ignition, predefined larger amount of fuel is supplied to the burner as needed for ignition. This is a Feeder 1 on time.

- **Feeder On Time** – it is a duration of one cycle of Feeder 1 during normal operation

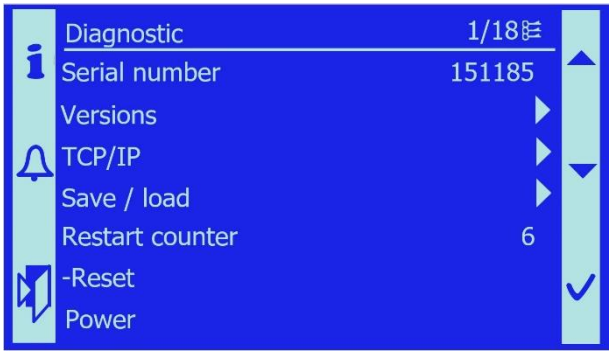
- **Boiler PID** – here proportional factor, integration factor and derivative factor are set – they are the parameters for PID regulation of boiler power.



Explanation of fuel dosing

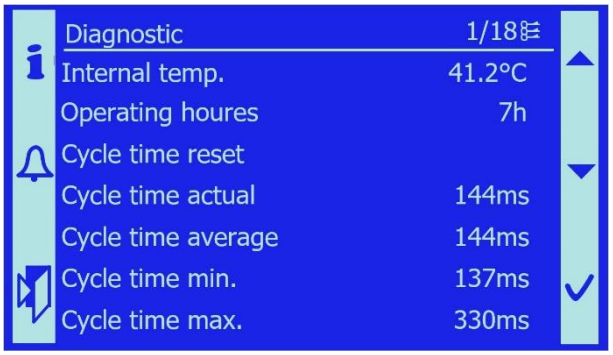
7.10.14 Diagnostics

It displays useful information for the diagnostics of control unit.



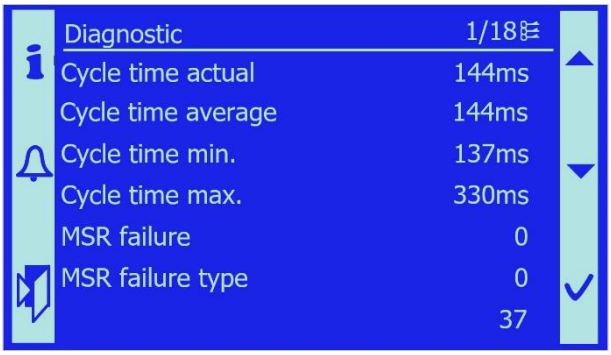
- **Serial number** – serial number of PLC
- **Versions** – this tab contains detailed information on version of software in PLC
- **TCP/IP** – on this tab it is possible to set the parameters of Ethernet connection (DHCP, IP address,…)

Note: it is necessary to reset PLC after any change



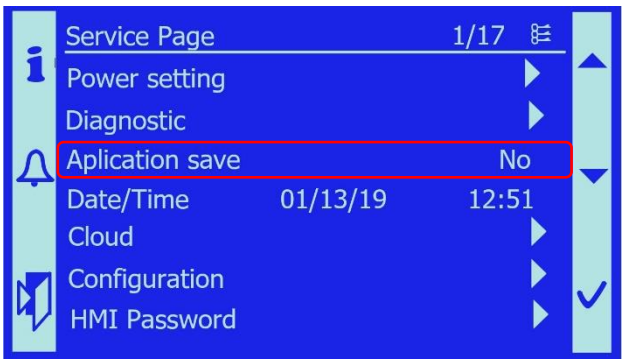
- **Save/load** – on this tab it is possible to back-up the settings of all parameters and also to load them.
- **Restart counter** – number of PLC restarts.
- **-Reset** – allows the software to restart the PLC without turning off the power.
- **Internal temp.** – it displays the temperature of PLC

Other items in this tab are used for the analysis of PLC status.



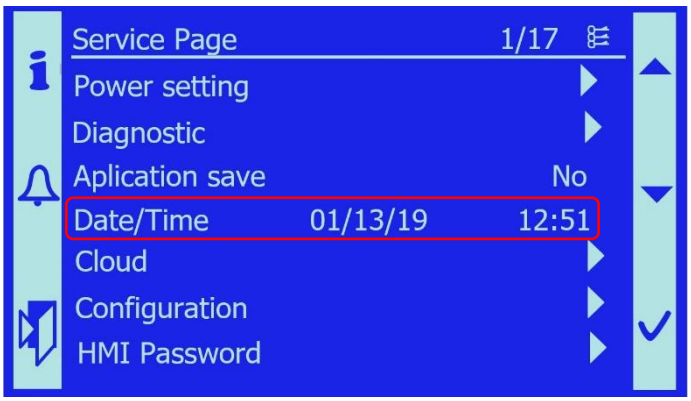
7.10.15 Application save

If the operator makes changes to the boiler settings, these changes must be stored in internal memory of PLC. If not, in case of automatic reset of the PLC the original settings will be loaded!



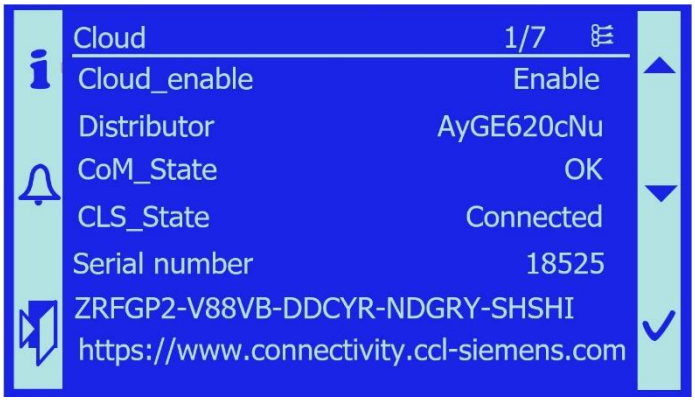
7.10.16 Date/Time

It allows to set the date and time.



7.10.17 Cloud

It allows remote access and administration of boiler control. If the boiler has access to the Internet, the system will automatically log in to the Cloud Storage provided by Siemens, where data on the boiler operation are backed up. Also, remote access is provided and other benefits, such as automatic sending of error messages to e-mail, faster service interventions, data analysis, also with the possibility to use mobile application.

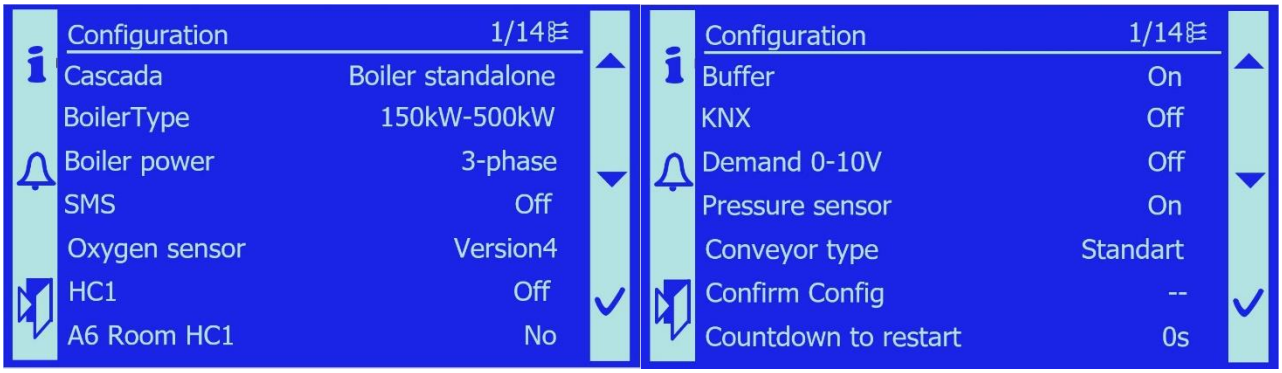


- **Cloud_enable** – switch this function on/off
- **Distributor** – Identification of the account to which the PLC is logging in
- **CoM_State** – information whether the PLC is communicating correctly with Icloud application
- **CLS_State** – information whether the PLC is connected to the Cloud Server
- **Serial number** – serial number of PLC
- **Activation number** – this is an atypical name of the PLC under which the PLC logs in to the Cloud profile
- **ServerIP** – web address, to which PLC is connected

7.10.18 Configuration

The boiler and its control unit may:
- work in various connections to the hydraulic system depending on the installation
- use optional peripheral devices
- use several types of boiler control and communication with adjacent equipment.
- use two means of transporting fuel to the intermediate bin.

Depending on the specific installation of the boiler and the peripheral equipment used, the service technician sets the specific system configuration. Depending on the set configuration, the control unit then operates and use the manufactured and connected devices.



The configuration menu is called up by pressing the §§§ button; the displayed values cannot be changed on the home screen. In order to change them, the service technician must be logged in and enter the configuration mode via the Service menu.

- **Cascada** – If two boilers are installed to work together so as to increase power, the so-called cascade control must be enabled, see chapter Cascade

- **BoilerType** – determines which control unit it is dealing with and for what type of boiler it is used. This is set at the factory and then it is forbidden to change this parameter.

- **Boiler power** – displays whether the boiler operates in a single-phase or three-phase version. This is set at the factory and then it is forbidden to change this parameter.

- **SMS** – enables sending SMSs with error messages, for more information see the chapter SMS

- **Oxygen sensor** – lambda sensor communicating with the control unit via a converter is used to measure the oxygen concentration in exhaust gas. Here, it is possible to change the converter version. Converter version can be found on its back side.

- **HC1** – The software and technical equipment of the boiler enables the control of one controlled heating circuit. The heating circuit control is described in chapter 7.16

- **A6 Room HC1** – Activates the room sensor in the reference room that is heated by the heating circuit TO1. The heating circuit can operate without the room sensor in the equithermal control mode without the influence of the heated space or use a passive temperature sensor or a room unit.

- **Buffer** – The boiler operates on the basis of the set temperature and the temperatures of the top and bottom temperature sensors in the buffer. For this mode, suitable hysteresis can be set for individual sensors so that the boiler operation is smooth and optimum. The hysteresis is set by the service technician, see chapter Buffer 7.17. If the

Capacity only function is on, the display shows the temperatures in the buffer but the measured temperatures are not considered by the control system

- **KNX** – The control unit can be connected via KNX-TP bus. The boiler control unit can thus communicate either with the superior control system or with other boilers, e. g. in cascade connection. For more information, see KNX communication 7.18

- **Demand 0-10V** – The control signal comes from superior system and the boiler outlet temperature depends on its size. For more information on output temperature range depending on 0-10V signal, see the chapter Demand 0-10V 7.19

- **Pressure sensor** – Sensor of water pressure in the system has been a standard boiler equipment since 2014 and it protects the boiler against operation without the necessary water pressure in the system **Chyba! Nenalezen zdroj odkazů.**

- **Conveyor Config** – Depending on the boiler equipment, it is possible to choose standard refuelling by means of a screw conveyor or in exceptional cases refuelling by pneumatic conveying.

When the configuration is changed, it is necessary to use Confirm Config!

Configuration is confirmed by activating the reconfiguration signal, or Confirmation of configuration takes place automatically after 30 seconds after the configuration change.

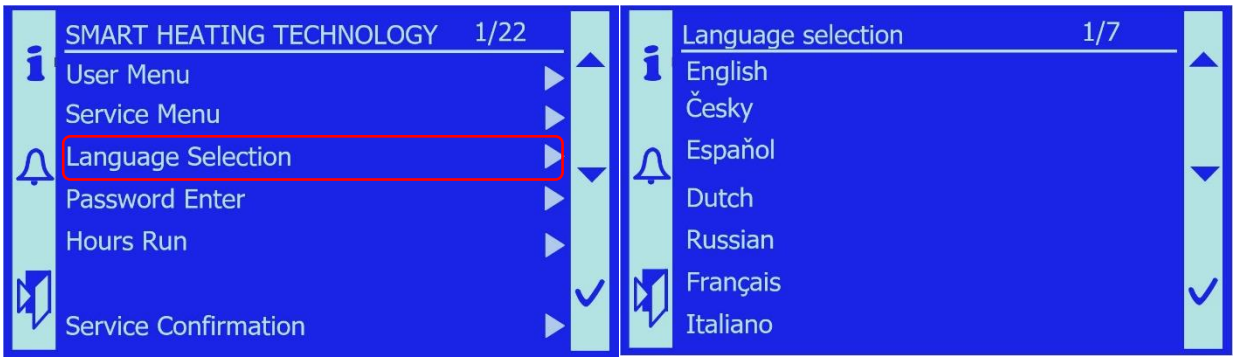
7.10.19 HMI password

It allows to change user passwords. In order to change your password, you need to be logged on the top level – Manufacturer.

Note: If you change the password for the Manufacturer level and then forget it, you must ask the service department for password recovery.

7.11 Language selection

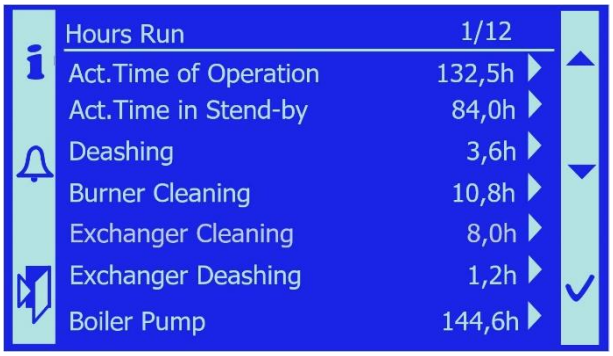
In accordance with the applicable legislation, communication with the operator of the equipment must be in the official language valid at the installation site.
The Language selection menu allows you to set the national version of the software.



After confirming the set language, HMI communication will take place in the selected language.

7.12 Hours run

Statistics of machine operating hours is an informative service for customer or service technician and is available after entering this menu. The actual operating times of selected boiler parts are displayed here.



After entering the Hours run menu, the actual time data for which the monitored boiler elements were in operation are displayed:

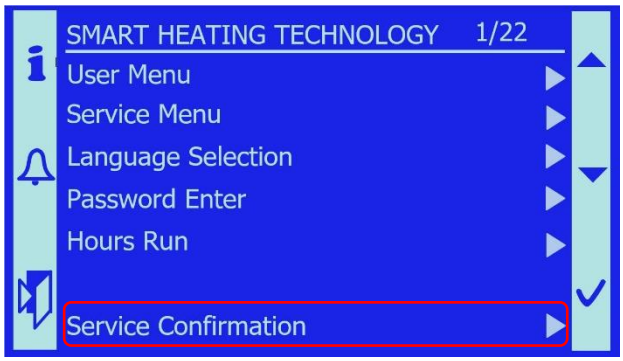
- **Act.Time of Operation** - total time during which the boiler was in operational mode (power 30-100%)
- **Act.Time in Stend-by** - total time that the boiler was in Standby mode, without power demand
- **Deashing -** total time for which deashing screws were active (M3)
- **Burner Cleaning** - total time for which burner cleaning was active (M6)
- **Exchanger Cleaning** - total time for which the cleaning process was active (M4, M5)
- **Exchanger Deashing** - total time for which the deashing under exchanger was active (M4, M7)
- **Boiler Pump** - total run time of the boiler pump, including the run-out times
- **Conveyor 2** - total time for which fuel has been fed from silo to intermediate bin (M1)
- **Feeder 1** - total time for which fuel has been fed to burner (M2)

- **Ignition** - total time for which the hot-air gun was active
- **Exhaust Damper** - total time for which the damper was in Exchanger position
- **Oxygen Sensor** - total time for which the sensor was active and measured residual O2

Important notice: When updating the software version and uploading the SW application, the counters of operating hours are reset. Prior to uploading a new program version, record all the data carefully and re-enter them in the counters after uploading!

7.13 Service confirmation

SMART boilers require repeated and regular service so as to ensure their operational reliability as well as to meet the conditions for the product warranty. As an aid, the **Service Confirmation** menu can be used. The service technician sets the service period in hours. When the set operating time has elapsed and the machine is required to be serviced, the following message appears on the main screen: **Service required.**



When this message appears, operator of the equipment is obliged to perform the prescribed inspection tasks and the maintenance of the equipment. Service is confirmed by the

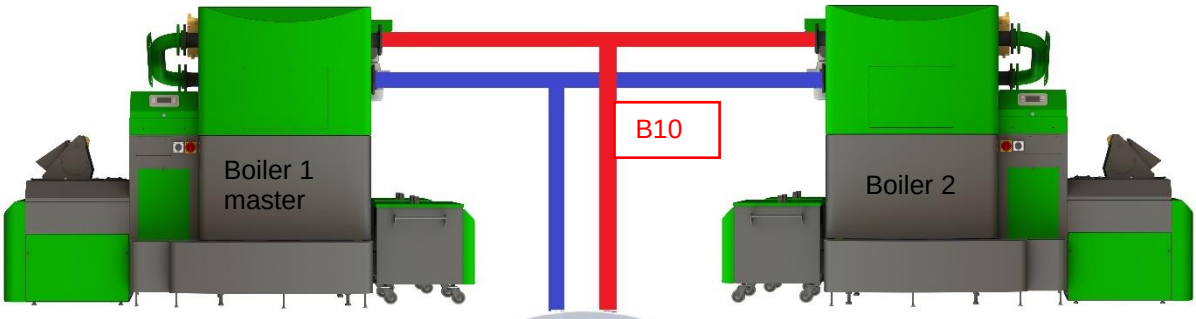
operator in the Service confirmation menu.

- *Note:* The flashing warning message “Service required” will not disappear from the main page until all operations have been completed and confirmed by the operator
- *Note*: The **Service required** is only an informative message not limiting the boiler operation. However, if maintenance is neglected repeatedly, the customer loses the warranty.

7.14 Cascade

It is a connection of up to four boilers together instead of one boiler with a high power, which works as one whole even at low heat consumption. We can use a cascade source composed of multiple boilers, which can also be described as intelligent one, because individual boilers cooperate and communicate with each other. Previously, the boiler rooms were controlled by a cascade controller. Now, the boilers are equipped with a communication interface, enabling the transmission of information between the boilers and continuous modulation of the power of all boilers in the cascade simultaneously. The result is not only the achievement of optimum power at a given moment, economic operation, but also an access to information about the current activity or problem of the cascade boiler room.
Advantages of cascade boiler room:

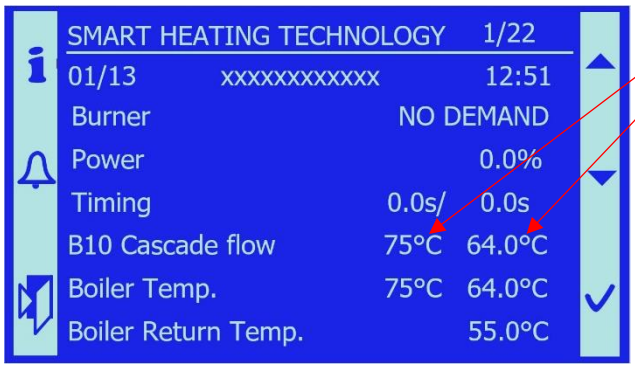
- simple operation and setting
- simple assembly
- operational reliability
- economically available
- wide power modulation
- fully automated operation
- environmental friendliness



In order for the cascade to function properly, the temperature sensor B10 must be installed in the place of the common pipe after connecting the boilers. Sensor B10 is connected to boiler 1, master, at terminals X1.76 and X1.78. Furthermore, Cascade (see 7.10.18) must be enabled in the configuration menu of boilers. In configuration menu of master boiler, the item Boiler 1 master is selected. For other boilers, Boiler 2 or Boiler 3 or Boiler 4 is selected according to their order. For communication between the main boiler and the auxiliary boilers, it is necessary to connect them to the ProcessBus communication. Terminals for the connection of communication cable connection are located on POL687 CE+ and CE-

- *Note:* Two boilers must not have the same designation.
- *Note:* The polarity of the CE + and CE- conductors must be observed

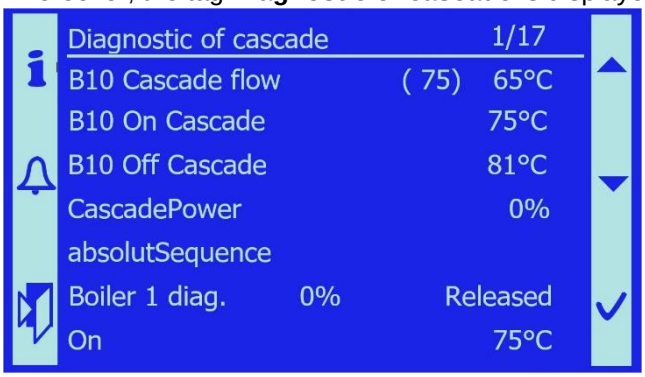
Then, after the boiler restart, following is displayed:
Start screen:



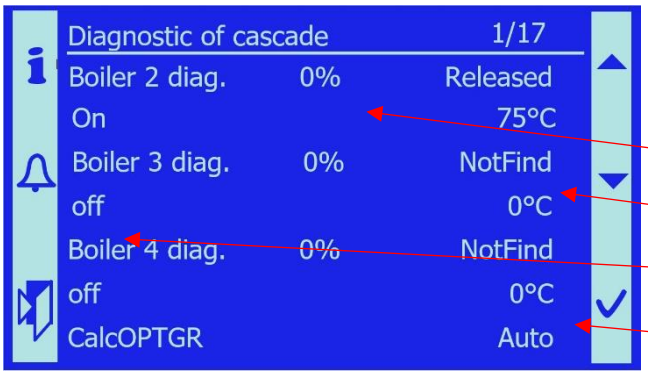
- **B10 Cascade flow**

Displays required temperature of cascade
Displays current temperature of cascade

Moreover, the tag **Diagnostic of cascade** is displayed in User menu:

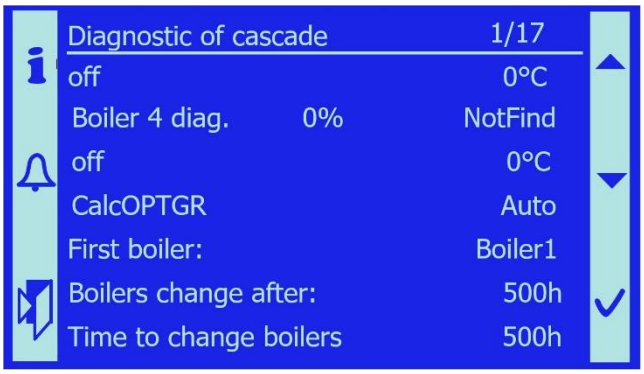


- **B10 Cascade flow** – It displays required and real temperature of cascade
- **B10 On Cascade** – temperature, at which the cascade, resp. boilers, is activated
- **B10 Off Cascade** – temperature, at which the boilers are deactivated.
- **CascadePower** – current power of cascade.



- **Boiler 1 diag. (2,3,4)** – Information on the condition of individual boilers.
- **Current power of given boiler**
- **Demand for boilers**
- **Boiler condition**
- **Current temperature of boiler**

- **CalcOPTGR**



- **First boiler:** - Shows, which boiler is currently master
- **Boilers change after:** - time, at which the boilers alternate
- **Time to change boilers** – it counts down the time to alternate boilers

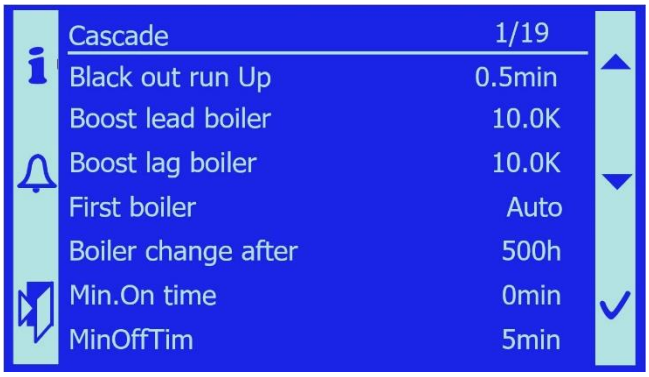
All cascade settings are carried out on **boiler No. 1** on Service Menu tab – Cascade

The temperature to which the cascade should heat is set on boiler 1 in the User Menu – Temperatures – Setting value or the heating request is sent from the superior system.

- **B10 On hysteresis** – by how much the B10 temperature must fall below the cascade setpoint to start the boilers in the cascade.

- **B10 Off hysteresis** – by how much the B10 temperature must rise above the cascade setpoint to stop the boilers and switch them to standby mode.

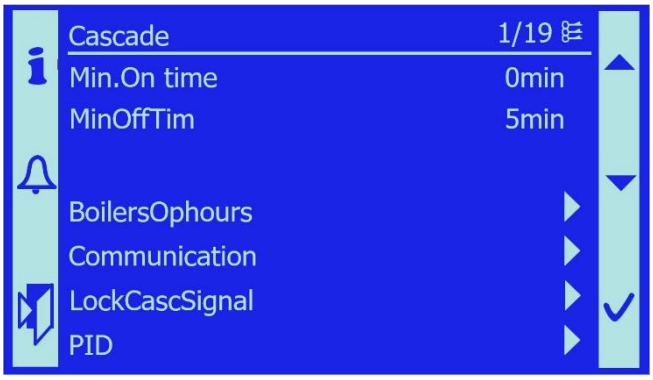
- **Max.temp.cascade** – maximum temperature of cascade which is never exceeded.



- **Min.temp.cascade** – minimum temperature of cascade, temperature is never lower.

- **Release integral** – allows to set the integration factor for the PID control of the cascade

- **Run Up Time** – this is proportional factor for the PID control of the cascade



- **Backward integral** – this is derivative factor for the PID control of the cascade

- **Black out run Up** – in the event of a power failure, the cascade will be started after its restoration when the set time elapses.

- **Boost lead boiler** – by how much the boiler temperature should be increased on the master boiler 1 compared to the desired temperature in the cascade

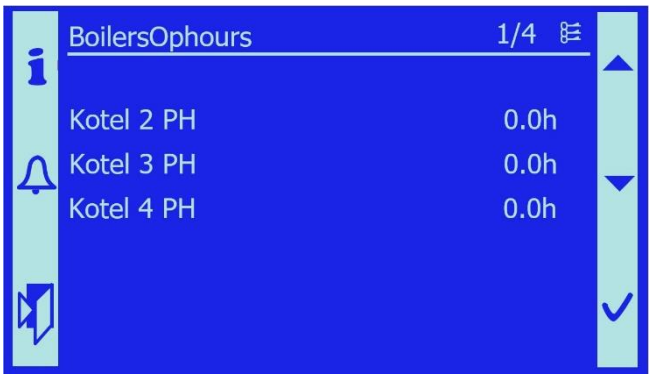
- **Boost lag boiler** – by how much the temperature in other boilers connected to the cascade should be increased compared to its boiler temperature.

- **First boiler** – it determines whether the boilers will alternate (Master / Slave) or one boiler will always be a Master.

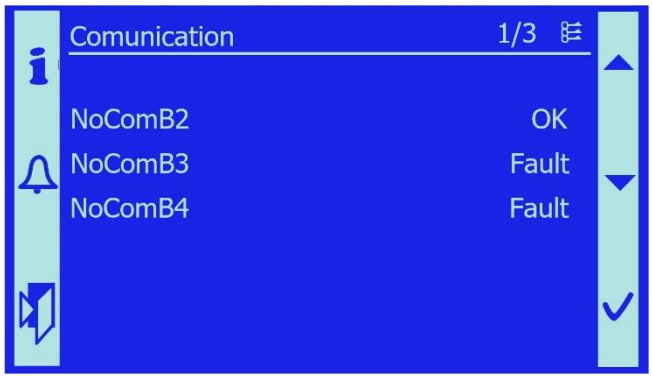
- **Boiler change after** – determines, when the boilers will alternate if the First boiler item is set to Auto.

- **Min.On time** – minimal time of cascade operation

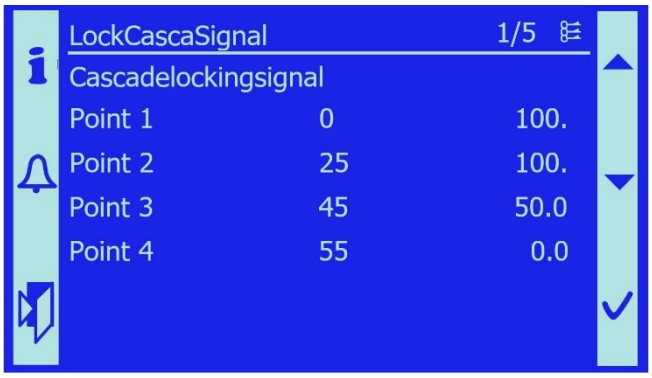
- **MinOffTim** – minimal time of cascade deactivation



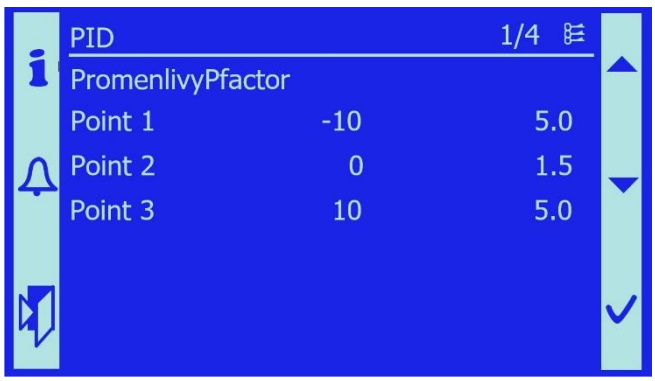
➢ **BoilersOphours** – On this tab the operating hours of individual boilers connected in cascade are displayed



➢ **Comunication** – this tab shows the status of communication between the slave boilers and the master boiler



➢ **LockCascSignal** – Locking of cascade signal for individual boilers. This setting affects the control of the mixing valve of the boiler in order to achieve the fastest possible heating of the boilers.
Example: Mixing valves are completely closed up to 25°C!
Only after reaching the temperature of 55°C, the control of mixing valve is allowed without restriction



➢ **PID** – It allows to set cascade PID control for individual boilers

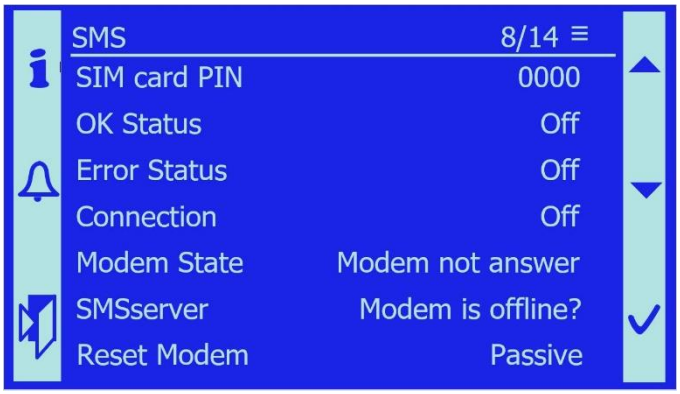
7.15 SMS

It is used for sending the fault conditions of the boiler. In order to use this function actively, it is necessary to install the GSM Modem and enable the function in the configuration,

see 7.10.18

- *Important notice:* This equipment is connected by the manufacturer on the basis of a special order directly in the production or can be added by a service technician for the already operated equipment.
- *Important notice:* The local operator's SIM card is inserted into the modem. There must be a sufficiently strong signal.

Then, after the boiler restart, following is displayed:
In User Menu – tab **SMS**:



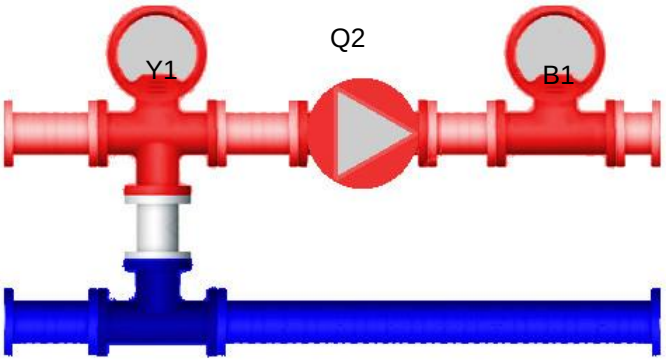
- **Act.tel number** – the current phone number to which the SMS will be sent
- **Tel1 - 4** – memory for telephone numbers, defined by user including national prefix
  Not all numbers have to be entered
- **ENGO** – it will send SMS even after returning to normal state after the fault
- **PIN Incoming SMS** – each SMS must contain this PIN (1234). Without the PIN the message will not be accepted.
- **SIM Card PIN** – PIN code for the SIM card inserted in the GSM modem. Using the PIN code can also be turned off before inserting the SIM card into the modem using a telephone
- **OK Status** – indicates whether the modem is working
  - Operating states: *OK* – modem is ready / *Not functional* – modem is not eligible for SMS transmission
- **Error Status** – errors of modem
  - Operating states: OFF – no fault / ON – error
- **Connection** – shows the connection of the modem to the transmission network
  - Network Type: GSM / Analog / Off (no signal)
- **Modem State** – shows current activity of modem
  - Operating states: Modem not answer/Initializing/Ok
- **SMSserver** – shows the status of signal, whether it is suitable for SMS transmission.

- Operating states: Modem is online/Modem is off-line

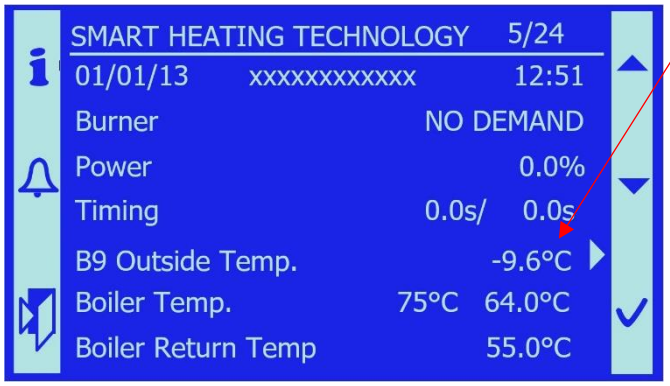
- **Reset Modem** – allows to restart the modem.

7.16 Heating circuit 1

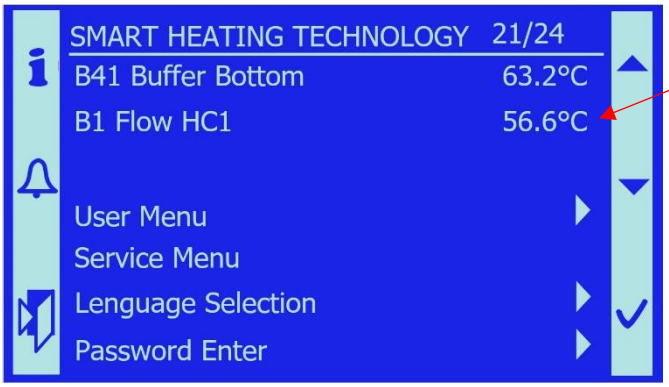
The boiler control system provides for the regulation of one heating circuit. In order to use this function, it is necessary to connect the three-way valve, pump, temperature sensor for measurement heating water for heating circuit B1 and outdoor temperature sensor to the boiler control unit and enable TO1 in Configuration. Due to high power of boilers and the type of their use, more heating circuits than 1 are used in practice. In most cases, a superior measurement and control system is used to control the heating circuits, namely in the form of a separate switchboard.



When the control unit is reset, following is displayed
Start screen:

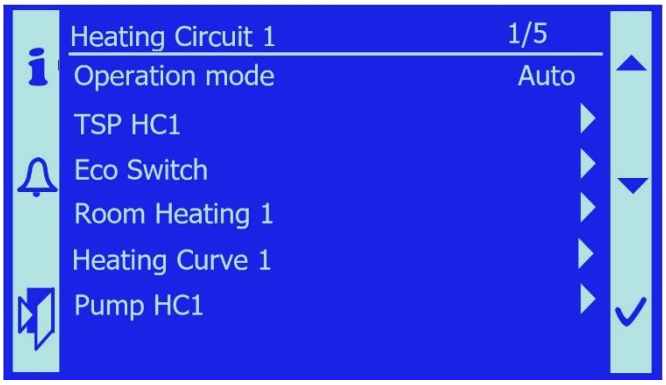


- **B9 Outside Temp.** - displays the current outdoor temperature. On the tab it is possible to simulate the outside temperature for service purposes.



- **B1 Flow HC1 –** temperature of the water downstream the three-way valve towards the heating system thus the temperature of the heating water

In order to set the parameters for heating circuit, the Heating circuit 1 tab is displayed in the User

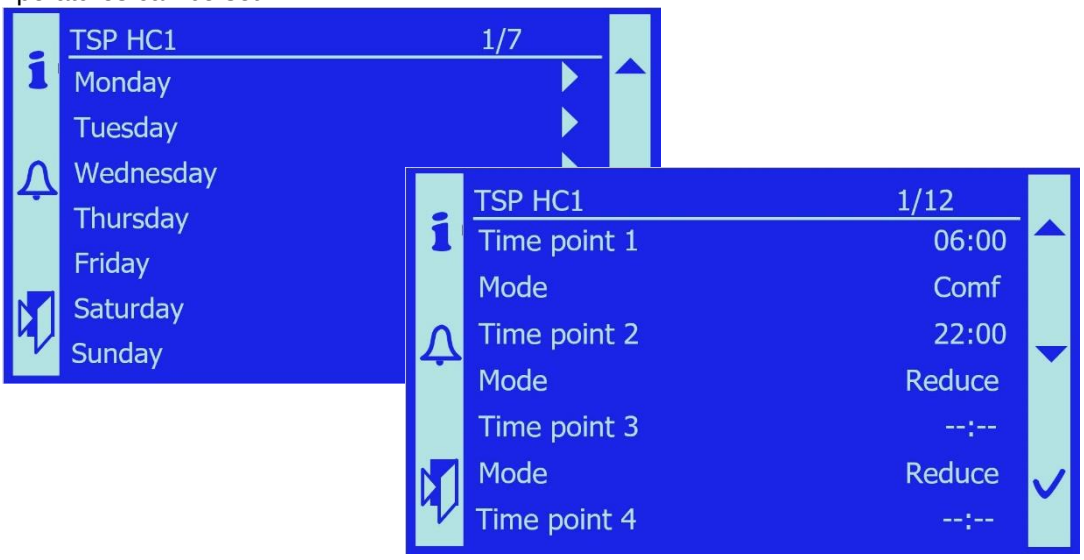


Menu

- **Operation mode** – determines the function of the heating circuit
  - **Auto** – the heating circuit is controlled by the program according to the time schedule, required temperatures (Comfort/Reduce/Frost protection).
  - **Frost protection** – the heating circuit will constantly maintain a temperature in the system that will prevent the system and the heated object from freezing, typically +5°C.
  - **Reduce** – the heating circuit is permanently set to heat to reduced temperature. The reduced temperature is usually by 3-5°C lower than the Comfort temperature and is used for example for night heating or heating on Saturdays, Sundays, holidays when the building is not used
  - **Comfort** - the heating circuit is permanently set to heat to Comfort temperature. Comfort temperature is usually the highest temperature used for space heating.

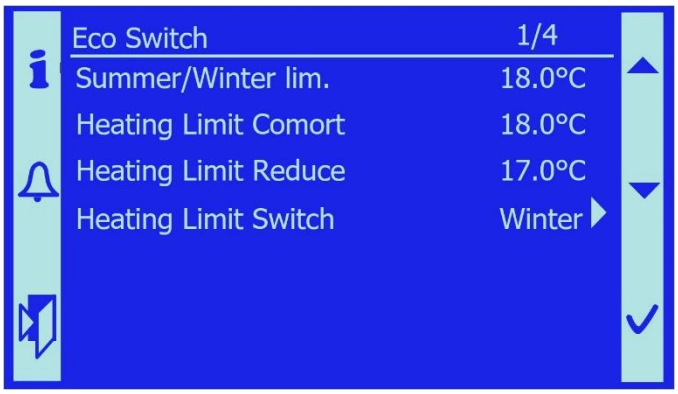
7.16.1 TSP HC1

Allows you to set required temperatures on individual days of the week. Up to 6 time zones with different temperatures in the heated space can be set for each day. Comfort/Reduce temperatures can be set



7.16.2 ECO Switch

in this menu, the user sets



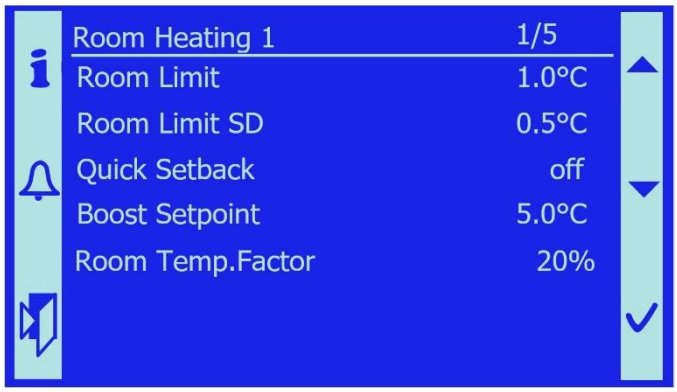
- **Summer/Winter lim**. - The temperature at which the system switches from winter heating to summer operation. The set temperature is the integrated outdoor temperature over a period of about 72 hours. Switching the Summer/Winter modes takes effect when the integrated outdoor temperature value exceeds the set value

- **Heating Limit Comfort** – The set value represents the desired Comfort temperature in the heated room, e.g. 21°C. The system will apply this temperature whenever the comfort temperature is required

- **Heating Limit Reduce** – The set value represents the desired Reduced temperature in the heated room, e.g. 17°C. The system will apply this temperature whenever the reduced temperature is required

- **Heating Limit Switch** – It allows the operator to manually switch the heating mode from Auto mode, which is controlled according to the set temperature parameters, to Winter or Summer mode. Until the mode is switched back to Auto mode, the selected mode (Winter or Summer) is applied

7.16.3 Room Heating 1



- **Room Limit** – This is the temperature loss of the room.

- **Room Limit SD** – ??? The set value represents the desired Comfort temperature in the heated room, e.g. 21°C. The system will apply this temperature whenever the comfort temperature is required

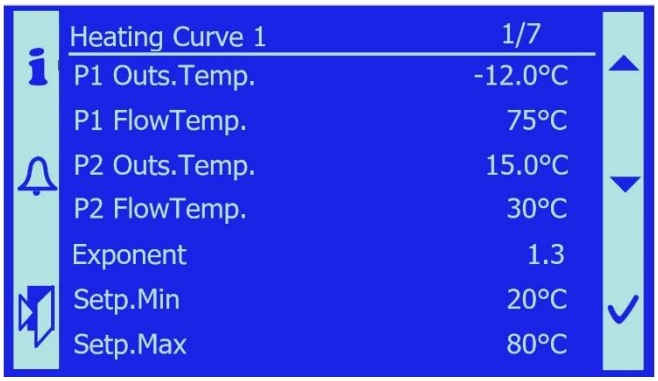
- **Quick Setback** – Allows the operator to enable or disable the quick setback mode in the room.

This mode is off by default

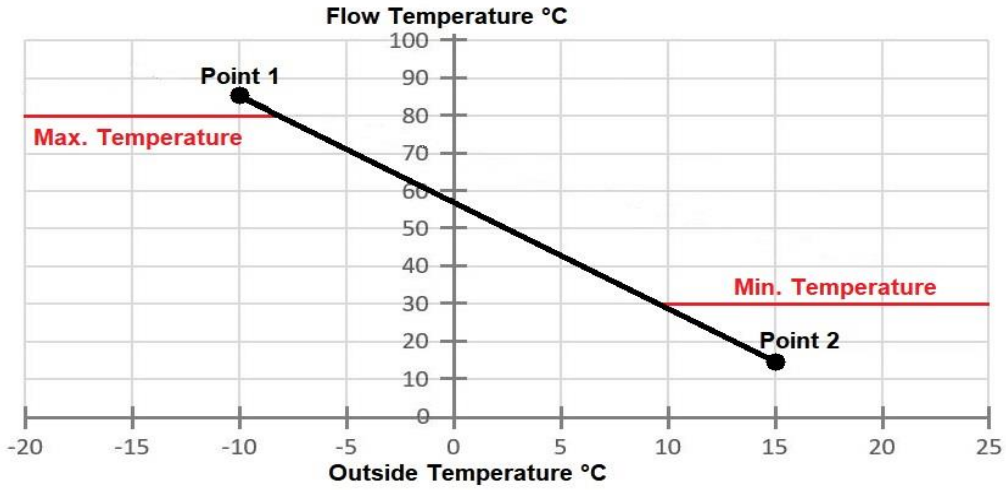
- **Boost Setpoint** – Allows the operator to set the dynamics of transition from Reduced room temperature to Comfort temperature. The dynamics is set by the temperature value [°C]. In practice it is so that in the period of time when the room heating mode changes from Reduced to Comfort, the value set as the Boost Setpoint is added to the set comfort temperature
  - *Note*: If we set Boost Setpoint = 0°C, boost is deactivated

- **Room Temp.Factor** – Allows the operator to adjust the effect of room temperature to the correction of equithermal control. The limit values are as follows:
  - Room influence 0% - pure equithermal control
  - Room influence 100% - full room temperature control without equithermal control

7.16.4 Heating Curve 1

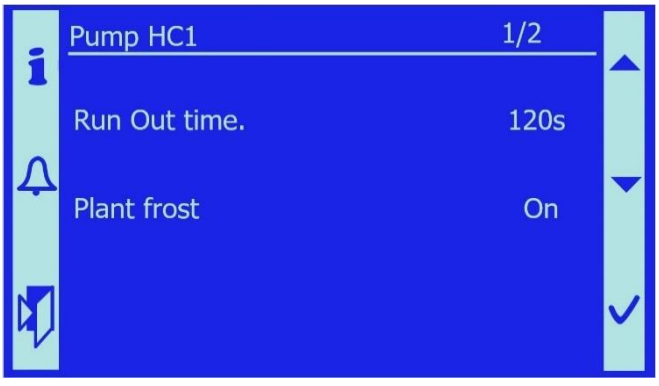


The heating curve is used to set the temperature of heating water entering the heating circuit. Heating water depends on the outside temperature. The curve is determined using two points and the exponent.



- **Determining the first point**: if the outdoor temperature is B9-point1 (-10°C), it will heat to the flow temperature B1-point1 (85°C).
- **Determining the second point**: if the outdoor temperature is B9-point2 (15°C), it will heat to the flow temperature B1-point2 (15°C).
- **Setp.Min** and **Setp.Max** – these are the limits of the heating curve, the heating water does not exceed the given limits.
- **Exponent** – it is the shift of the heating curve along the y axis.

7.16.5 Pump HC1

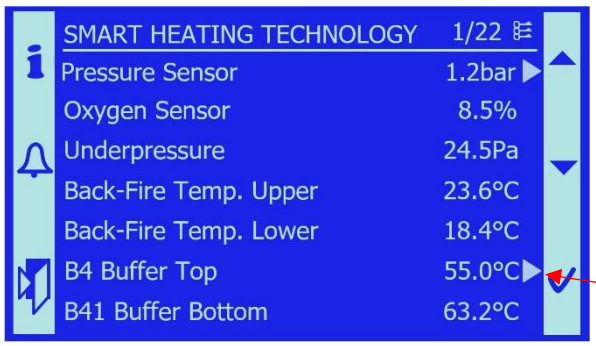


- **Run Out time** – Sets the pump run time when the demand for TO1 heating ceased. It is because of removal of excess heat from the source and increasing the operational stability of the system, range [0-1200s]
- **Plant frost** – If frost protection is enabled, the pump will start when the water temperature drops below 4°C. This function can be turned on and off.

7.17 Buffer

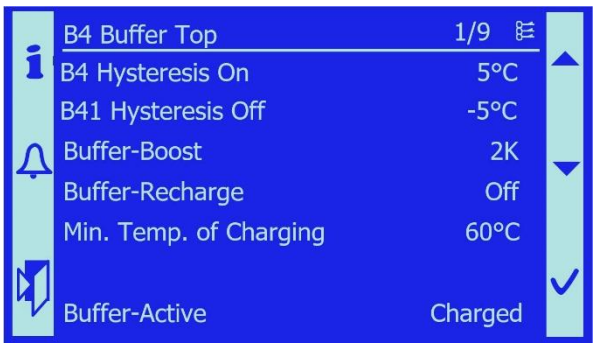
By enabling this function, see 7.10.18, and connecting the sensors measuring temperature in the buffer, the boiler operation can be controlled according to the current temperatures of water in the buffer.

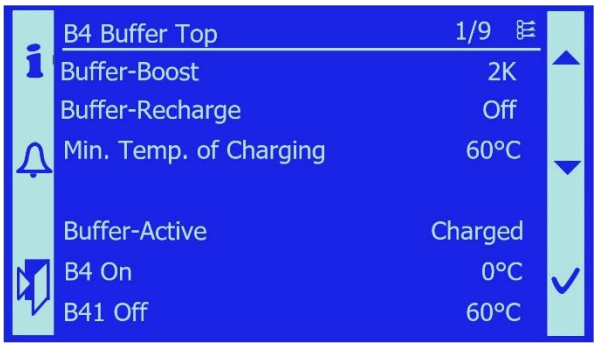
When the control unit is reset, B4 a B41, the temperatures in buffer, are displayed on start screen.



- The primary setting is made in the Temperature tab 7.6.2, items B4 Hysteresis On and B41 Hysteresis Off.

- Secondary setting is made directly on B4 Buffer Top tab





- **B4 Hysteresis On** – This is the same value as displayed on Temperatures tab
- **B41 Hysteresis Off** – This is the same value as displayed on Temperatures tab
- **Buffer-Boost** – Increases the required temperature in buffer by the set value.
- **Buffer-Recharge** – Shows when the buffer recharging is on or off. If the function is switched on, the boiler will continue to operate even when the heating demand ceased, until the buffer is fully charged
- **Min.Temp.of Charging** – this is a minimum temperature in the buffer, the temperature is never lower. The boiler always keeps the temperature above this value
- **Buffer-Active** – it shows the state of buffer:
  - Charged – The buffer is heated up
  - Charging activ – The buffer is being heated
  - FullCharged – The buffer is fully heated
- **B4 On** – It displays information at what temperature the boiler will start to operate and heat up the buffer and the heating system.
- **B41 Off** – It displays information at what temperature the buffer charging is deactivated and boiler switches to Standby mode.

7.18 KNX communication

It enables boiler control from an external control system via peer- to-peer communication KNX. After connecting the boiler to superior control system and enabling the KNX function, see Configuration 7.10.18, boiler control system is reset and the **KNX info** tab is displayed in the Diagnostics of consumption (7.9.2) tab.

- **KNX Setpoint** – information on requested values sent via communication
  - No request – value whether the boiler should heat or not
  - 0°C – current required boiler temperature sent via communication

- **Excess heat 1** – information on the current status of demand for heat removal from the boiler. Protection against boiler overheating

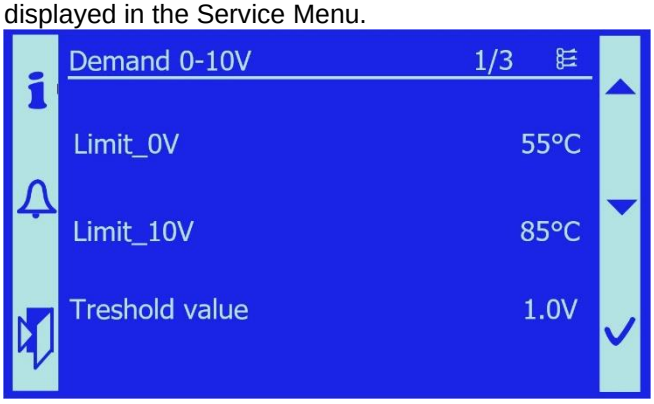
- **Excess heat 2** – information on the current status of demand for heat removal from the boiler. Protection against boiler overheating

- **KNX Comm.** - information on the current status of the communication channel of the heating zone 1

Note: Communication table can be sent on request.

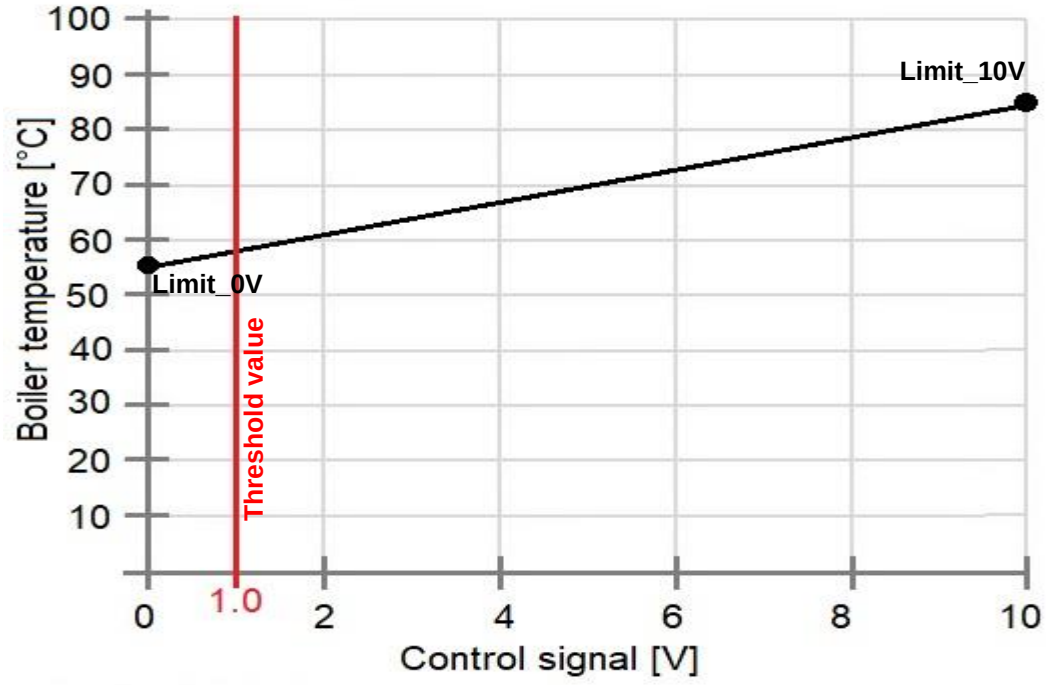
7.19 Demand 0-10V

This function allows to set the desired boiler temperature via an analogue 0-10V signal. After connecting the control signal to the boiler control system and activating this function in Configuration (see 7.10.18), the control system restarts and the **Demand 0-10V** tab is displayed in the Service Menu.



- **Limit_0V** – If zero voltage is sent via analogue signal, the boiler will heat to the value set as minimum (55°C).
- **Limit_10V** – If 10V voltage is sent via analogue signal, the boiler will heat to the value set as maximum (85°C).
- **Treshold value** – this is value of input sensitivity, e. g. above which voltage value the required boiler temperature starts to change. Voltage lower than this value is taken as zero voltage

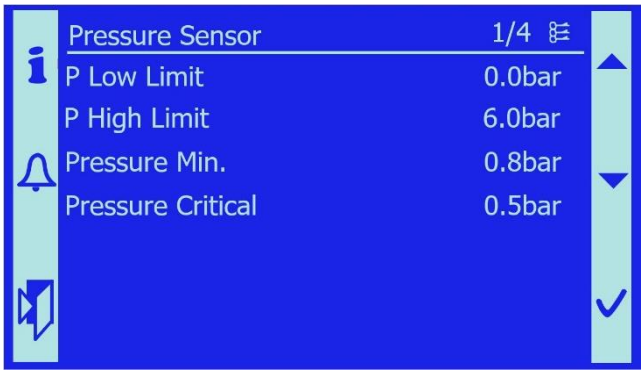
- *Note* – 0 and 10V limits define curve used to set boiler temperature.



7.20 Pressure Sensor

This is a safety feature of the boiler, which measures the pressure in the water heating system. This function is enabled by default, see Configuration 7.10.18

The parameters can be changed within the Pressure Sensor tab on the start screen.



- **P Low Limit** – This is the measuring range of the pressure sensor. This is set at the factory – it is forbidden to change it.
- **P High Limit** – This is the measuring range of the pressure sensor. This is set at the factory – it is forbidden to change it.
- **Pressure Min.** - If the water pressure drops below the Pressure low limit (0.8 bar), the boiler control system signals the pressure drop via an error message.
- **Pressure Critical** – When the pressure of system water drops below the critical pressure, the boiler operation is shut down so as to prevent damage to the system.

The values are set by the authorized person when commissioning the equipment according to the pressure conditions of particular installation.

7.21 List of error messages

For the sake of safe boiler operation, the error messages are divided into Alarm classes with automatic or manual reset.

7.21.1 Motors:

<table>
<tr><td colspan="3">Error message:
TK conveyor 2: Error - (TKM Conveyor 2: Fault)</td></tr>
<tr><td colspan="2">Element:
Thermal switch of motor for conveyor 2,
Thermal switch of motor for disturbing device in the silo
Limit switch of conveyor 2</td><td>Alarm class: 1 critical
Reset: Automatic</td></tr>
<tr><td>Cause:
• Motor temperature higher than 95°C
• Disconnected connector - TkM1 or KsM1
• Disconnected limit switch of conveyor 2</td><td>Analysis:
• Jammed screw or heavy running
• Inspection of TkM1 and KsM1 connectors
• Inspection of thermal switch for M1
• Inspection of KsM1 limit switch
• Inspection of cover
• Inspection of fuel quality, if it causes the cover opening</td><td>Remedy:
• Release obstacle in the screw conveyor
• Release obstacle in disturbing device in the silo
• Reconnect connectors
• Replace motor - M1
• Replace KsM1 limit switch
• Clean the area under the cover
• Retighten the spring above the cover
• Use standard fuel</td></tr>
<tr><td colspan="3">Error message:
TK feeder 1: Error - (TK Feeder 1: Fault)</td></tr>
<tr><td colspan="2">Element:
Thermal switch of motor for feeder 1</td><td>Alarm class: 1 critical
Reset: Automatic</td></tr>
<tr><td>Cause:
• Disconnected safety thermostat because of boiler overheating above 95°C.</td><td>Analysis:
• Jammed screw or heavy running
• Inspection of thermal switch for M2</td><td>Remedy:
• Remove obstacle in the screw mechanism
• Replace motor - M2</td></tr>
</table>

Error message:
TK deashing: Error - (TK Deashing: Fault)

Element: Thermal switch for deashing of combustion chamber
Alarm class: 1 critical
Reset: Automatic

Cause:	*Analysis:*	*Remedy:*
• Motor temperature higher than 95°C	• Jammed screw or heavy running • Inspection of thermal switch for TkM3	• Remove obstacle in the screw mechanism • Reconnect connector - TkM3 • Replace motor - M3
• Disconnected connector - TkM3	• See TK Exch.deasching: Fault	
• Together with message TK Exch.deasching: Fault		

Error message:
TK exchanger cleaning: Error - (Tk Exchanger Cleaning: Fault)

Element: Thermal switch of motor for exchanger cleaning
Alarm class: 1 critical
Reset: Automatic

Cause:	*Analysis:*	*Remedy:*
• Disconnected safety thermostat because of boiler overheating above 95°C.	• Jammed turbulators or heavy running • Inspection of thermal switch for M4 • Inspection of thermal switch for M5 • Inspection of TkM4 connector • Inspection of TkM5 connector	• Release obstacle in driving mechanism of turbulators • Replace motor - M4 • Replace motor - M5 • Reconnect connector - TkM4 • Reconnect connector - TkM5
• Disconnected connector - TkM4 • Disconnected connector - TkM5		

Error message:
TK burner cleaning: Error - (TK Burner Cleaning: Fault)

Element: Thermal switch for burner cleaning
Alarm class: 1 critical
Reset: Automatic

Cause:	*Analysis:*	*Remedy:*
• Motor temperature higher than 95°C	• Blocked burner cleaning or heavy running • Inspection of thermal switch for M6	• Remove obstacle in the grate mechanism • Replace motor - M6

Error message: **TK exch. deashing: Error** - (TK Exch.deasching: Fault)		
Element: Thermal switch for exchanger deashing		*Alarm class:* 1 critical *Reset:* Automatic
Cause: • Motor temperature higher than 95°C • Disconnected connector - TkM7 • Together with message Tkdeasching: Fault	*Analysis:* • Jammed screw or heavy running • Inspection of thermal switch for M7 • Inspection of TkM7 connector • See TkDeasching: Fault	*Remedy:* • Remove obstacle in the screw mechanism • Replace motor - M7 • Reconnect connector - TkM7

7.21.2 Dampers**:**

Error message: **Damper closed: On** - (Damper Off:On)		
Element: Feeder damper		*Alarm class:* 1 critical *Reset:* Manual
Cause: • Fuel damper is in incorrect position in open state	*Analysis:* • Inspection of damper position through inspection holes • Checking the operation of the damper by means of manual control	*Remedy:* • Release obstacle from the area of fuel damper • Reset end position

Error message: **Damper closed: Off** - (Damper Off:Off)		
Element: Feeder damper		*Alarm class:* 1 critical *Reset:* Manual
Cause: • Fuel damper is in incorrect position in close state • Failure of servo-drive • Disconnected connector for feeder damper	*Analysis:* • Inspection of damper position through inspection holes • Inspection of reverse switch • Checking the operation of the fuel damper, including measuring the voltage at terminals X1.48 and X1.49 • Inspection of QF6 circuit breaker • Inspection of connector - feeder damper	*Remedy:* • Release obstacle from the area of fuel damper • Turn the switch to position 1 • If there is voltage at the terminals and the damper does not move, replace its actuator • Reset QF6 circuit breaker • If there is no voltage at the terminals, the PLC must be replaced • Reconnect the connector
Error message: **Exhaust damper: Bypass** - (ExhClack: Bypass)		
Element: Exhaust damper		*Alarm class:* 1 critical *Reset:* Automatic
Cause: • Exhaust damper remains open to exchanger • Disconnected connector of exhaust damper • Failure of servo-drive	*Analysis:* • Inspection of damper position through inspection holes • Inspection of connector for exhaust damper • Inspection of reverse switch • Checking the operation of the exhaust damper, including measuring the voltage at terminals X1.46 and X1.47	*Remedy:* • Remove the cause of exhaust damper jamming • Reconnect the connector • Turn the switch to position 1 • If there is voltage at the terminals and the damper does not move, replace its actuator

		• If there is no voltage at the terminals, the PLC must be replaced

7.21.3 Pumps:

Error message: **Boiler Pump: Fault** - (BoilerPump: Fault)		
Element: Boiler pump		*Alarm class:* 1 critical *Reset:* Automatic
Cause: • Fault of boiler pump	*Analysis:* • Examination of boiler pump function • Inspection of QF6 circuit breaker • Examination of error messages on the boiler pump	*Remedy:* • Find the cause of the boiler pump fault • Reset QF6 circuit breaker • Confirm the faults on pump • Contact service technician

7.21.4 Ignition:

Error message: **Ignition error: Error** - (Ignition Error: Fault)		
Element: Maximum number		*Alarm class:* 1 critical *Reset:* Manual
Cause: • Maximum number of ignition attempts • Unfunctional ignition gun	*Analysis:* • Examination of fuel level in burner • Inspection of fuel quality • Inspection of QF6 circuit breaker • Examination of ignition gun function • Measure the voltage at the connector of ignition gun	*Remedy:* • Adjust the parameters for ignition • Confirm the fault • Reset QF6 circuit breaker • Does not heat up – replace heater • Replace ignition gun

7.21.5 Oxygen sensor:

Error message: **Temperature of O2 sensor inverter: 86°C** - (O2 PCB Temp.: 86°C)		
Element: Converter of lambda probe		*Alarm class:* 1 critical *Reset:* Automatic
Cause: • Converter of lambda probe is overheating	*Analysis:* • Examination of converter temperature	*Remedy:* • Cool the inverter down • Replace converter of lambda probe
Error message: **Modbus error: Error** - (Modbus Error: Fault)		
Element: Converter of lambda probe		*Alarm class:* 1 critical *Reset:* Automatic
Cause: • Loss of communication with the converter of Lambda sensor	*Analysis:* • Inspection of fuse - FU2 • Check the power supply of inverter at its connectors	*Remedy:* • Replace fuse - FU2 • Restart PLC • Replace converter of lambda probe • Replace PLC
Error message: **Incorrect asymmetry: Error** - (Modbus Error: Fault)		
Element: Lambda probe		*Alarm class:* 1 critical *Reset:* Automatic
Cause: • Error in communication with Lambda probe	*Analysis:* • Confirm the fault, see Oxygen sensor 7.10.3	*Remedy:* • Confirm the fault, see Oxygen sensor 7.10.3 • Replace lambda probe
Error message: **Oxygen sensor: 0.1** - (Oxygen Sensor: 0.1)		
Element: Lambda probe		*Alarm class:* 1 critical *Reset:* Automatic
Cause:	*Analysis:* • Inspection of lambda probe	*Remedy:* • Calibrate the lambda probe

• The sensor measured the oxygen value below the range	ATTENTION! Temperature up to 300°C!	• Replace lambda probe

7.21.6 Sensors:

Error message:
Boiler temperature: Open - (Boiler Temp: openLoop)

Element: Boiler temperature sensor
Alarm class: 1 critical
Reset: Automatic

Cause:	*Analysis:*	*Remedy:*
• Temperature sensor is broken	• Inspect the sensor connector - boiler temperature • Measure the resistance of the temperature sensor	• Reconnect temperature sensor • Replace temperature sensor ATTENTION! The sensor must be securely placed in the well!

Error message:
Boiler temperature: Short circuit - (Boiler Temp: shortedLoop)

Element: Boiler temperature sensor
Alarm class: 1 critical
Reset: Automatic

Cause:	*Analysis:*	*Remedy:*
• Temperature sensor is shorted	• Measure the resistance of the temperature sensor	• Replace temperature sensor ATTENTION! The sensor must be placed in the well!

Error message:
Boiler temperature: 131°C - (Boiler Temp: 131°C)

Element: Boiler temperature sensor
Alarm class: 1 critical
Reset: Automatic

Cause:	*Analysis:*	*Remedy:*
• The temperature sensor measured the value outside the allowed range	• Examination of boiler temperature • Measure the resistance of the temperature sensor	• Replace temperature sensor ATTENTION! The sensor must be placed in the well!

Error message: **Boiler temperature: Over range** - (Boiler Temp: overRange)		
Element: Boiler temperature sensor	*Alarm class:* 1 critical	*Reset:* Automatic
Cause: • The PLC measured infinite resistance at the input	*Analysis:* • Measure the resistance of the temperature sensor	*Remedy:* • Replace temperature sensor ATTENTION! The sensor must be placed in the well!
Error message: **Boiler return temperature: Open** - (Boiler Return Temp.: openLoop)		
Element: Boiler return temperature sensor	*Alarm class:* 1 critical	*Reset:* Automatic
Cause: • Temperature sensor is broken	*Analysis:* • Inspect the sensor connector - boiler temperature • Measure the resistance of the temperature sensor	*Remedy:* • Reconnect temperature sensor • Replace temperature sensor ATTENTION! The sensor must be placed in the well!
Error message: **Boiler return temperature: Short circuit** - (Boiler Return Temp.: shortedLoop)		
Element: Boiler return temperature sensor	*Alarm class:* 1 critical	*Reset:* Automatic
Cause: • Temperature sensor is shorted	*Analysis:* • Measure the resistance of the temperature sensor	*Remedy:* • Replace temperature sensor ATTENTION! The sensor must be placed in the well!

Error message: **Boiler return temperature: 131°C** - (Boiler Return Temp.: 131°C)		
Element: Boiler return temperature sensor		*Alarm class:* 1 critical *Reset:* Automatic
Cause: • The temperature sensor measured the value outside the allowed range	*Analysis:* • Examination of real boiler temperature • Measure the resistance of the temperature sensor • Examination of pump running	*Remedy:* • Replace temperature sensor ATTENTION! The sensor must be placed in the well!
Error message: **Boiler return temperature: Over range** - (Boiler Return Temp: overRange)		
Element: Boiler return temperature sensor		*Alarm class:* 1 critical *Reset:* Automatic
Cause: • The PLC measured infinite resistance at the input	*Analysis:* • Measure the resistance of the temperature sensor	*Remedy:* • Replace temperature sensor ATTENTION! The sensor must be placed in the well!
Error message: **Exhaust gas temperature: Open** - (Exhaust Gas Temp.: openLoop)		
Element: Exhaust gas temperature sensor		*Alarm class:* 1 critical *Reset:* Automatic
Cause: • Temperature sensor is broken	*Analysis:* • Measure the resistance of the temperature sensor	*Remedy:* • Replace temperature sensor ATTENTION! The sensor must be placed in the well!
Error message: **Exhaust gas temperature: Short circuit** - (Exhaust Gas Temp.: shortedLoop)		
Element: Exhaust gas temperature sensor		*Alarm class:* 1 critical *Reset:* Automatic
Cause: • Temperature sensor is shorted	*Analysis:* • Measure the resistance of the temperature sensor	*Remedy:* • Replace temperature sensor

		ATTENTION! The sensor must be placed in the well!
Error message: **Exhaust gas temperature: 351°C** - (Exhaust Gas Temp.: 351°C)		
Element: Exhaust gas temperature sensor		*Alarm class:* 1 critical *Reset:* Automatic
Cause: • The temperature sensor measured the value outside the allowed range	*Analysis:* • Examination of exhaust gas temperature • Measure the resistance of the temperature sensor • Inspection of exhaust damper • Inspection of exchanger cleaning	*Remedy:* • Replace temperature sensor ATTENTION! The sensor must be placed in the well! • Use the same procedure as in the case of fault of exhaust damper • Use the same procedure as in the case of TK exchanger cleaning
Error message: **Exhaust gas temperature: Over range** - (Exhaust Gas Temp: overRange)		
Element: Exhaust gas temperature sensor		*Alarm class:* 1 critical *Reset:* Automatic
Cause: • The PLC measured infinite resistance at the input	*Analysis:* • Measure the resistance of the temperature sensor	*Remedy:* • Replace temperature sensor ATTENTION! The sensor must be placed in the well!
Error message: **Back-fire temperature upper: Open** - (Back-Fire Temp. Upper: openLoop)		
Element: Upper sensor of back-fire temperature		*Alarm class:* 1 critical *Reset:* Automatic
Cause: • Temperature sensor is broken	*Analysis:* • Measure the resistance of the temperature sensor	*Remedy:* • Replace temperature sensor ATTENTION! The sensor must be placed in the well!

Error message: **Back-fire temperature upper: Short** - (Back-Fire Temp. Upper: shortedLoop)		
Element: Upper sensor of back-fire temperature	*Alarm class:* 1 critical	*Reset:* Automatic
Cause: • Temperature sensor is shorted	*Analysis:* • Measure the resistance of the temperature sensor	*Remedy:* • Replace temperature sensor ATTENTION! The sensor must be placed in the well!
Error message: **Back-fire temperature upper: 131°C** - (Back-Fire Temp. Upper: 131°C)		
Element: Upper sensor of back-fire temperature	*Alarm class:* 1 critical	*Reset:* Automatic
Cause: • The temperature sensor measured the value outside the allowed range	*Analysis:* • Examination of boiler temperature • Measure the resistance of the temperature sensor	*Remedy:* • Replace temperature sensor ATTENTION! The sensor must be placed in the well!
Error message: **Back-fire temperature upper: Over range** - (Back-Fire Temp. Upper: overRange)		
Element: Upper sensor of back-fire temperature	*Alarm class:* 1 critical	*Reset:* Automatic
Cause: • The PLC measured infinite resistance at the input	*Analysis:* • Measure the resistance of the temperature sensor	*Remedy:* • Replace temperature sensor ATTENTION! The sensor must be placed in the well!
Error message: **Back-fire temperature, lower: Open** - (Back-Fire Temp. Lower.: openLoop)		
Element: Lower sensor of back-fire temperature	*Alarm class:* 1 critical	*Reset:* Automatic
Cause: • Temperature sensor is broken	*Analysis:* • Measure the resistance of the temperature sensor	*Remedy:* • Replace temperature sensor

		ATTENTION! The sensor must be placed in the well!
Error message: **Back-fire temperature, lower: Short** - (Back-Fire Temp. Lower.: shortedLoop)		
Element: Lower sensor of back-fire temperature		*Alarm class:* 1 critical / *Reset:* Automatic
Cause: • Temperature sensor is shorted	*Analysis:* • Measure the resistance of the temperature sensor	*Remedy:* • Replace temperature sensor ATTENTION! The sensor must be placed in the well!
Error message: **Back-fire temperature, lower: 131°C** - (Back-Fire Temp. Lower.: 131°C)		
Element: Lower sensor of back-fire temperature		*Alarm class:* 1 critical / *Reset:* Automatic
Cause: • The temperature sensor measured the value outside the allowed range	*Analysis:* • Examination of boiler temperature • Measure the resistance of the temperature sensor	*Remedy:* • Replace temperature sensor ATTENTION! The sensor must be placed in the well!
Error message: **Back-fire temperature, lower: Over range** - (Back-Fire Temp. Lower: overRange)		
Element: Lower sensor of back-fire temperature		*Alarm class:* 1 critical / *Reset:* Automatic
Cause: • The PLC measured infinite resistance at the input	*Analysis:* • Measure the resistance of the temperature sensor	*Remedy:* • Replace temperature sensor ATTENTION! The sensor must be placed in the well!
Error message: **Pressure sensor: Open** - (Pressure sensor: openLoop)		
Element: Water pressure sensor		*Alarm class:* 1 critical / *Reset:* Automatic
Cause: • Pressure sensor is broken	*Analysis:* • Inspection of pressure sensor connector	*Remedy:* • Connect the connector of pressure sensor

Error message: **Pressure sensor: 6bar** - (Pressure sensor: 6bar)		
Element: Water pressure sensor	*Alarm class:* 1 critical	*Reset:* Automatic
Cause: • The pressure sensor measured the value outside the allowed range	*Analysis:* • Inspection of water pressure in the boiler • Examination of the working range defined for the sensor	*Remedy:* • Replace temperature sensor ATTENTION! The sensor must be placed in the well!
Error message: **Underpressure: 100Pa** - (Underpressure: 100Pa)		
Element: Boiler underpressure sensor	*Alarm class:* 1 critical	*Reset:* Automatic
Cause: • The underpressure sensor measured the value outside the allowed range	*Analysis:* • Inspection of underpressure sensor	*Remedy:* • Replace underpressure sensor
Error message: **B4 Buffer top: Open** - (B4 Buffer Top: openLoop)		
Element: Top sensor of buffer temperature	*Alarm class:* 1 critical	*Reset:* Automatic
Cause: • Temperature sensor is broken	*Analysis:* • Examination of connection - temperature sensor • Measure the resistance of the temperature sensor	*Remedy:* • Reconnect temperature sensor • Replace temperature sensor ATTENTION! The sensor must be placed in the well!

Error message: **B4 Buffer top: Short circuit** - (B4 Buffer Top: shortedLoop)		
Element: Top sensor of buffer temperature	*Alarm class:* 1 critical	*Reset:* Automatic
Cause: • Temperature sensor is shorted	*Analysis:* • Measure the resistance of the temperature sensor	*Remedy:* • Replace temperature sensor ATTENTION! The sensor must be placed in the well!
Error message: **B4 Buffer top: 131°C** - (B4 Buffer Top: 131°C)		
Element: Top sensor of buffer temperature	*Alarm class:* 1 critical	*Reset:* Automatic
Cause: • The temperature sensor measured the value outside the allowed range	*Analysis:* • Examination of buffer temperature • Measure the resistance of the temperature sensor	*Remedy:* • Replace temperature sensor ATTENTION! The sensor must be placed in the well!
Error message: **B4 Buffer top: Over range** - (B4 Buffer Top: overRange)		
Element: Top sensor of buffer temperature	*Alarm class:* 1 critical	*Reset:* Automatic
Cause: • The PLC measured infinite resistance at the input	*Analysis:* • Measure the resistance of the temperature sensor	*Remedy:* • Replace temperature sensor ATTENTION! The sensor must be placed in the well!

Error message: **B41 Buffer bottom: Open** - (B41 Buffer Bottom: openLoop)		
Element: Bottom sensor of buffer temperature		*Alarm class:* 1 critical *Reset:* Automatic
Cause: • Temperature sensor is broken	*Analysis:* • Examination of connection - temperature sensor • Measure the resistance of the temperature sensor	*Remedy:* • Reconnect temperature sensor • Replace temperature sensor ATTENTION! The sensor must be placed in the well!
Error message: **B41 Buffer bottom: Short circuit** - (B41 Buffer Bottom: shortedLoop)		
Element: Bottom sensor of buffer temperature		*Alarm class:* 1 critical *Reset:* Automatic
Cause: • Temperature sensor is shorted	*Analysis:* • Measure the resistance of the temperature sensor	*Remedy:* • Replace temperature sensor ATTENTION! The sensor must be placed in the well!
Error message: **B41 Buffer bottom: 131°C** - (B41 Buffer Bottom: 131°C)		
Element: Bottom sensor of buffer temperature		*Alarm class:* 1 critical *Reset:* Automatic
Cause: • The temperature sensor measured the value outside the allowed range	*Analysis:* • Examination of buffer temperature • Measure the resistance of the temperature sensor	*Remedy:* • Replace temperature sensor ATTENTION! The sensor must be placed in the well!

Error message: **B41 Buffer bottom: Over range** - (B41 Buffer Bottom: overRange)		
Element: Bottom sensor of buffer temperature	*Alarm class:* 1 critical	*Reset:* Automatic
Cause: • The PLC measured infinite resistance at the input	*Analysis:* • Measure the resistance of the temperature sensor	*Remedy:* • Replace temperature sensor ATTENTION! The sensor must be placed in the well!
Error message: **B10 cascade output: Open** - (B10 Cascade flow: openLoop)		
Element: Cascade temperature sensor	*Alarm class:* 1 critical	*Reset:* Automatic
Cause: • Temperature sensor is broken	*Analysis:* • Examination of connection - temperature sensor • Measure the resistance of the temperature sensor	*Remedy:* • Reconnect temperature sensor • Replace temperature sensor
Error message: **B10 cascade output: Short circuit** -(B10 Cascade flow: shortedLoop)		
Element: Cascade temperature sensor	*Alarm class:* 1 critical	*Reset:* Automatic
Cause: • Temperature sensor is shorted	*Analysis:* • Measure the resistance of the temperature sensor	*Remedy:* • Replace temperature sensor
Error message: **B10 cascade output: 131°C** - (B10 Cascade flow: 131°C)		
Element: Cascade temperature sensor	*Alarm class:* 1 critical	*Reset:* Automatic
Cause: • The temperature sensor measured the value outside the allowed range	*Analysis:* • Examination of cascade temperature • Measure the resistance of the temperature sensor	*Remedy:* • Replace temperature sensor

Error message: **B10 cascade output: Over range** -(B10 Cascade flow: overRange)		
Element: Cascade temperature sensor		*Alarm class:* 1 critical *Reset:* Automatic
Cause: • The PLC measured infinite resistance at the input	*Analysis:* • Measure the resistance of the temperature sensor	*Remedy:* • Replace temperature sensor

7.21.7 Operational faults:

Error message: **Safety thermostat: Error** - (Safety limit thermostat: Fault)		
Element: Safety thermostat		*Alarm class:* 1 critical *Reset:* Manual
Cause: • Disconnected safety thermostat because of boiler overheating above 95°C. • KM1 Fault and KM2 Fault are displayed simultaneously	*Analysis:* • Inspection of boiler temperature • Inspection of QF3 circuit breaker	*Remedy:* • Find the cause of boiler overheating • Remove excess heat • After cooling below 65°C activate the safety thermostat • Find the cause of circuit breaker tripping • Reset QF3 circuit breaker
Error message: **KM1 Fault: Error** - (KM1 Fault: Fault)		
Element: KM1 contactor		*Alarm class:* 1 critical *Reset:* Manual
Cause: • Different position of contactors KM1 and KM2	*Analysis:* • Examination of correct position of KM1	*Remedy:* • Replace contactor

• Together with message: Sefty limit termostat: Fault	• Inspection of QF3 circuit breaker	• Find the cause of circuit breaker tripping • Reset QF3 circuit breaker

Error message:
KM2 Fault: Error - (KM2 Fault: Fault)

Element: KM2 contactor | *Alarm class:* 1 critical | *Reset:* Manual

Cause:	*Analysis:*	*Remedy:*
• Different position of contactors KM1 and KM2 • Together with message: Sefty limit termostat: Fault	• Examination of correct position of KM2 • Inspection of QF3 circuit breaker	• Replace contactor • Find the cause of circuit breaker tripping • Reset QF3 circuit breaker

Error message:
Safety tank: Empty - (Safe Tank: Empty)

Element: Safety tank | *Alarm class:* 1 critical | *Reset:* Manual

Cause:	*Analysis:*	*Remedy:*
• Low water level in the tank • Connector disconnected • Failure of level sensor	• Inspection of water in the tank • Examination of connector connection • Examination of correct position of sensor • Examination of correct function of sensor	• Add extinguishing water • Reconnect the connector • Fasten in correct position • Replace level sensor

Error message:
Minimal pressure: Error - (Minimal pressure: Fault)

Element: Water pressure sensor | *Alarm class:* 1 critical | *Reset:* Automatic

Cause:	*Analysis:*	*Remedy:*
• Water pressure has fallen below the set value, see **Chyba! Nenalezen zdroj odkazů.** 7.1	• Inspection of water pressure in the system	• Add water to system • Adjust pressure setting

Error message: **Critical pressure: Error** - (Critical Pressure: Fault)		
Element: Water pressure sensor		*Alarm class:* 1 critical *Reset:* Manual
Cause: • Water pressure has fallen below the critical value, see **Chyba! Nenalezen zdroj odkazů.** REF _Ref9926492 \r \h * MERGEFORMAT 7.1	*Analysis:* • Inspection of water pressure in the system • Examination of set range	*Remedy:* • Find the cause of water loss • Add water to system
Error message: **ErrBoilerPump: Fault** - (ErrBoilerPump: Fault)		
Element: Boiler pump		*Alarm class:* 1 critical *Reset:* Automatic
Cause: • Fault of boiler pump	*Analysis:* • Examination of boiler pump function • Inspection of QF6 circuit breaker • Examination of error messages on the boiler pump • Inspection of input: X1.88 and X1.90	*Remedy:* • Find the cause of the boiler pump fault • Reset QF6 circuit breaker • Confirm the faults on pump • Contact service technician
Error message: **Back-fire fault: Error** - (Back-Fire Error: Fault)		
Element: Back-fire temperature sensors		*Alarm class:* 1 critical *Reset:* Manual
Cause: • There is a back-fire in the boiler	*Analysis:* • Check the status of intermediate bin • Check the intermediate bin for leaks • Inspection of actuator for fuel damper	*Remedy:* • Find the cause of back-fire • Seal the intermediate bin • Replace actuator of the fuel damper

Error message: **FireMaR: Fault** - (FireMaR: Fault)		
Element: Fire sensor in the boiler room		*Alarm class:* 1 critical *Reset:* Manual
Cause: • There is a fire in the boiler room	*Analysis:* • Finding the real situation	*Remedy:* • Extinguish a fire or call firefighters • Contact your service technician
Error message: **Flooding: Error** - (Flooding: Fault)		
Element: Flooding sensor		*Alarm class:* 1 critical *Reset:* Automatic
Cause: • The boiler is flooded with water	*Analysis:* • Inspection of flooding sensor • Inspection of water pressure in the system	*Remedy:* • Find the cause of boiler room flooding
Error message: **CO concentration: Error** - (CO Concentration: Fault)		
Element: CO sensor		*Alarm class:* 1 critical *Reset:* Automatic
Cause: • Carbon monoxide (CO) has accumulated in the boiler room	*Analysis:* • Ventilate the boiler room, do not enter it while the alarm is active	*Remedy:* • Find the cause of CO accumulation
Error message: **Simulation of outside temperature: Error** - (Outside Temp. simulation: Fault)		
Element:		*Alarm class:* 1 critical *Reset:* Manual
Cause: • Simulation of outside temperature	*Analysis:* • Check the settings of outdoor sensor, see Heating circuit 1 7.16	*Remedy:* • Set the simulated temperature to Auto

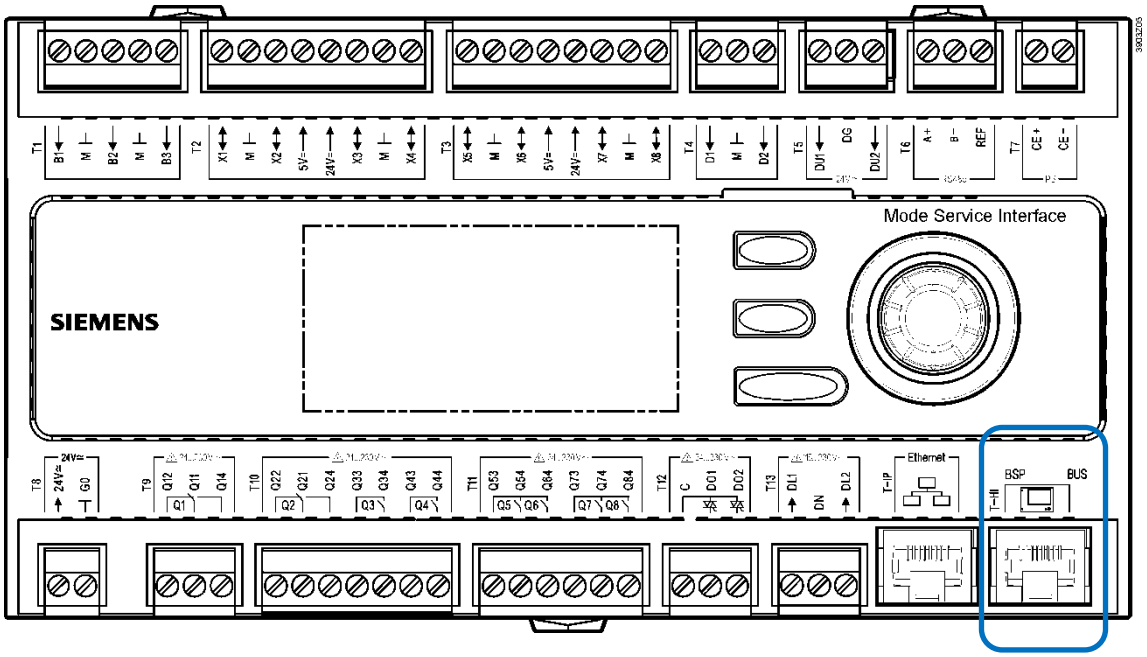
Error message: **Service required: Error** - (Request for Service: Fault)		
Element:	*Alarm class:* 1 critical	*Reset:* Manual
Cause: • Boiler maintenance is required	*Analysis:* • Make boiler maintenance	*Remedy:* • Make boiler maintenance • Confirm boiler maintenance in Service confirmation 7.13
Error message: **Underpressure fault: Error** - (Underpressure Fault: Fault)		
Element: Boiler underpressure sensor	*Alarm class:* 1 critical	*Reset:* Automatic
Cause: • It was not possible to maintain the set underpressure in burner area	*Analysis:* • Examination that all service openings are closed • Amount of ash in cyclone • Check of flue for clearness • Inspection of function of exchanger cleaning • Determination at which boiler power the fault occurred and fan speed • Check of underpressure hose for clearness • Inspection of function of underpressure sensor	*Remedy:* • Close all service openings • Remove ash of the cyclone • Clean the flue • Start-up exchanger cleaning • Adjust PID for exhaust fan • Adjust fan settings • Clean underpressure hose • Replace underpressure sensor

Error message: **Maximum temperature of exhaust gas: Error** - (Max. Temp. Exhaust Gas: Fault)		
Element: Exhaust gas temperature sensor		*Alarm class:* 1 critical *Reset:* Manual
Cause: • Exhaust gas temperature exceeded critical temperature	*Analysis:* • Verification of exhaust damper functionality • Inspection of function of exchanger cleaning • Verification of boiler power setting	*Remedy:* • Start-up the exhaust damper • Start-up the exchanger cleaning • Reduce boiler power
Error message: **Maximum time for conveyor 2: Error** - (Max. Time Conveyor 2: Fault)		
Element: Sensor of level in intermediate bin		*Alarm class:* 1 critical *Reset:* Manual
Cause: • The conveyor was unable to replenish fuel to the intermediate bin at the specified period of time	*Analysis:* • Sufficient volume of fuel in silo • Functioning of disturbing device in the silo • Correct running of conveyor 2 • Examination of function of KA4 relay • State of QF3 circuit breaker • Inspection of function of level sensor	*Remedy:* • Add fuel to silo • Start-up the disturbing device • Check the motor of disturbing device • See TK conveyor 2 • Enlarge the gap at conveyor 2 • Replace KA4 relay • Reset QF3 circuit breaker • Replace level sensor
Error message: **O2 calibration fault: Error** - (O2 Calibration Error: Fault)		
Element: Lambda sensor		*Alarm class:* 1 critical *Reset:* Manual
Cause: • The lambda probe has not been calibrated	*Analysis:* • Inspection of power supply for Lambda probe	*Remedy:* • Replace Lambda probe • Replace the converter for lambda probe

7.22 Preparation and connection of the boiler to the Internet

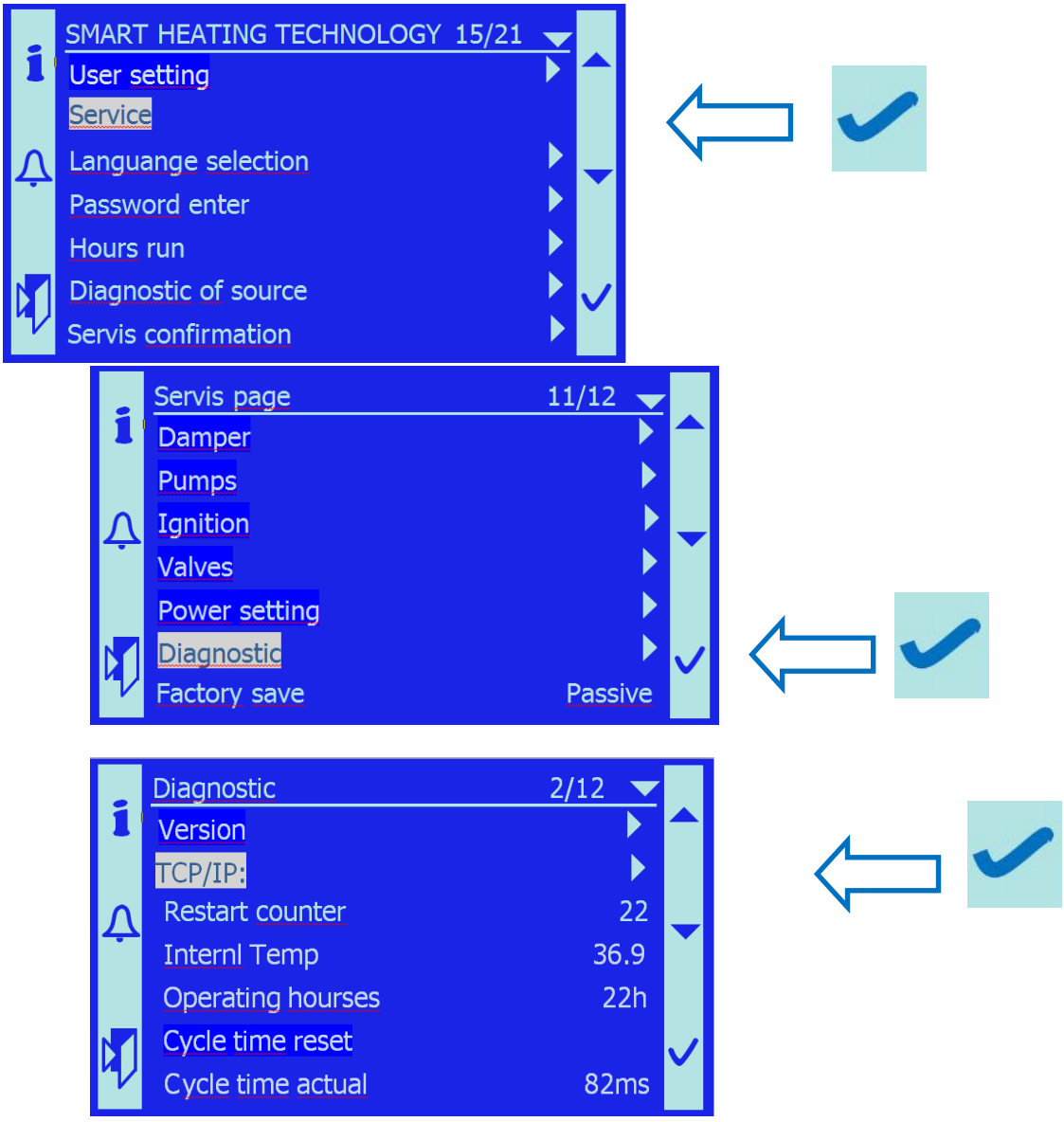
Setting up an Internet connection is a job for an IT technician.
POL 687 acts as a **web server on port 80**.

1. Connect the cable to the Ethernet terminal on POL687. A standard RJ45 connector is used for connection

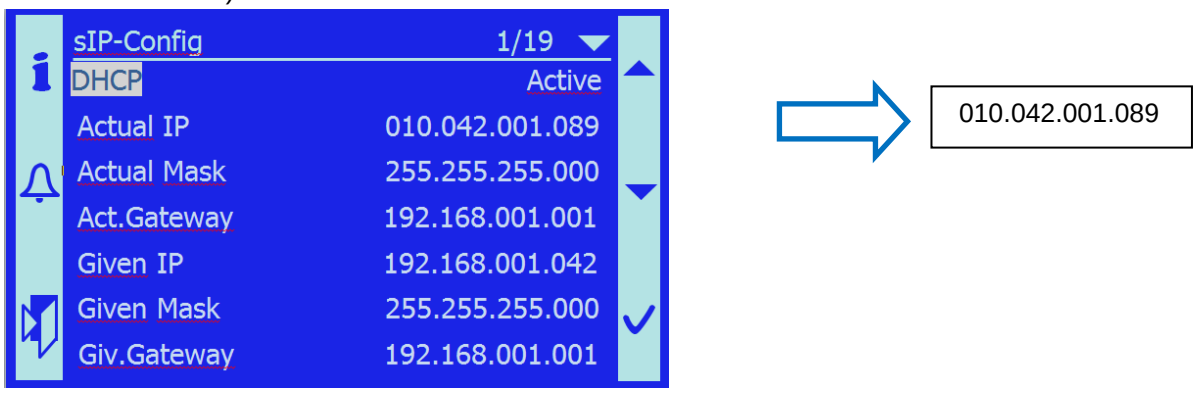


2. The controller has a factory default IP address of **192.168.1.42**
   In order to change the IP address and its settings according to the requirements of the local data network, make the following settings.

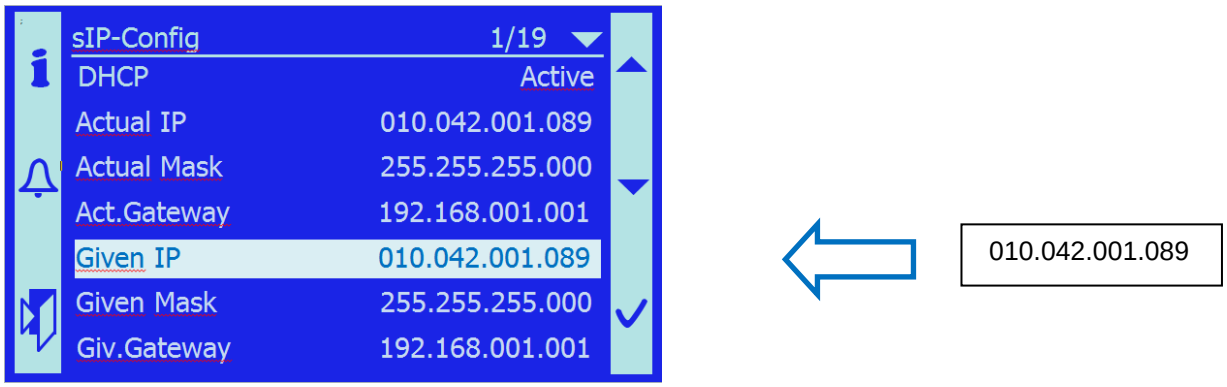
3. Enter SERVICE menu (password Level 3) /Diagnostic/TCP_IP



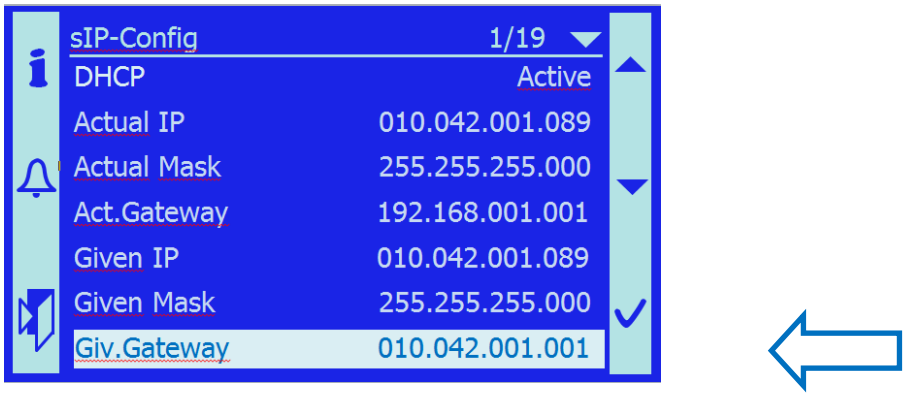
4. Use Actual IP item to find out what address the router provides in the local network (e. g. 10.42.1.89)



5. Enter this address to Given IP item (10.042.1.89)



6. Set Given Gateway to the range (family) of provided addresses (10.042.1.1)



7. Set DHCP – passive. This will disable dynamic assignment of addresses to the boiler control unit

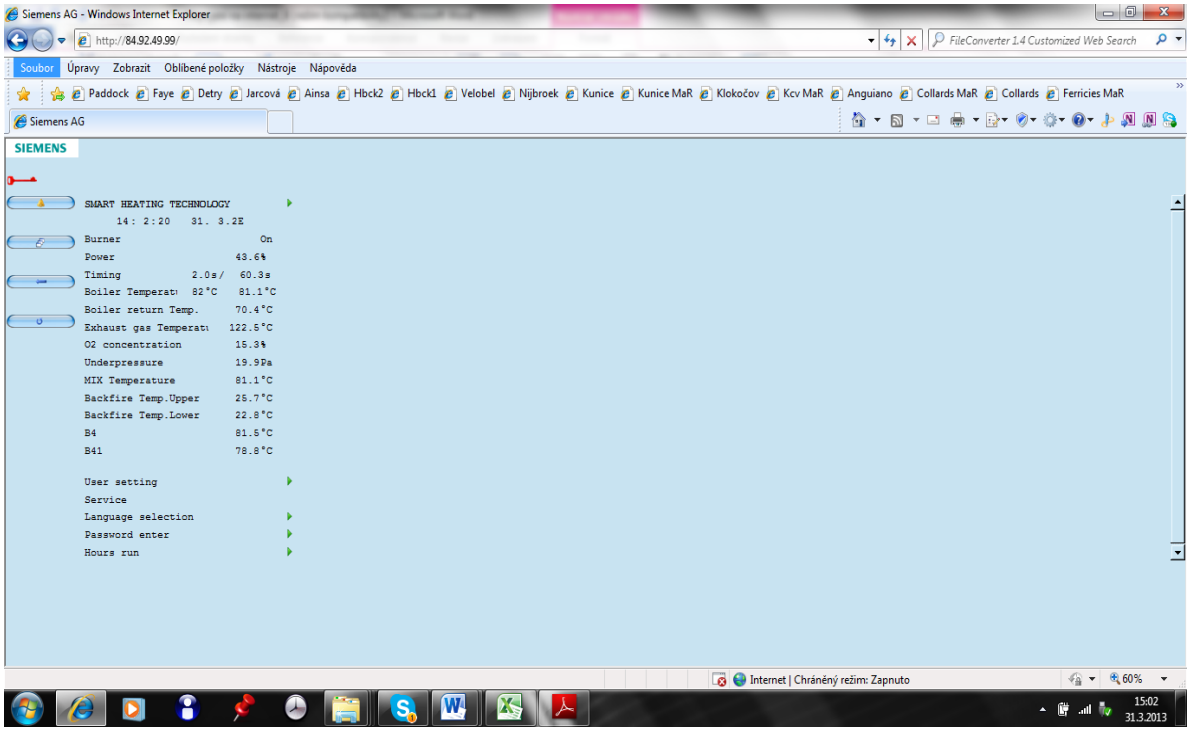
8. Ensure that the router reserves the address (10.42.1.89) for the boiler and does not assign it to another device

9. Now the device must be accessible on the local network by entering the address (actual IP) in the address bar of the Internet browser (Mozzila, Seemonkey)

10. In order to enable the access from external INTERNET, set the router and its “portforwarding” so that after entering the router's address and port 80 (or 8080) it connects directly to the actual IP address

11. The changes will take effect after the device is RESET. It is necessary to switch the controller off and on!
    Perform a RESET of the device.

12. Try the connection at the newly set IP address



8 Operation

8.1.1 Firing the boiler

The boiler is equipped with automatic ignition. After being programmed for specific fuel at the factory or by an authorized technician, boiler is ready for automatic ignition. Before starting the boiler for the first time, open the inspection door and observe the furnace to see if there is enough fuel (approx. 5-8 cm in the centre of the burner). If the exhaust gas temperature does not exceed the set ignition switch-off temperature and the O2 value is not less than 18%, ignition mode is activated. Bulk density (kg/m3) of the material to be burned (wood chips x sawdust) varies, so it is necessary to change the combustion program to burn another type of material. The exhaust, primary, secondary1, secondary2 fans start. When the underpressure in the combustion chamber reaches the prescribed value (typically 25Pa), the hot air gun is activated and the first dose of fuel is supplied to the combustion chamber. Under no circumstances you should open the combustion chamber during ignition mode. There is a risk of wood gas explosion because of changing the O2 concentration in the combustion chamber. Fuel will ignite and the boiler will remain in ignition mode until the exhaust gas temperature reaches the ignition off temperature and the O2 value is less than 18%. After reaching this temperature and O2 content, the boiler switches to the mode: “Normal operation”.

The boiler can also be fired manually using paper (newspapers, cardboard, etc.), do not use any flammable substances (petrol, thinners, etc.). Go to “Manual operation” (individual parts of the boiler are switched off), switch on the feeder motor (MANUAL MODE / MOTOR CONTROLS / FEEDER MOTOR1) and refill the fuel into the furnace. Light up the paper, place it on the fuel and close the furnace door. Return from the manual mode back to the start page of the menu. The boiler evaluates the condition and starts the automatic "Ignition mode". Fuel will ignite and the boiler will remain in ignition mode until the exhaust gas temperature reaches the ignition off temperature or the O2 value is less than 18%. After reaching this temperature or O2 content, the boiler switches to the mode: “Normal operation”.

If the material is too damp or the fuel is missing for some reason, ignition will not occur and the display will show “Ignition Fault”.

The user or service technician must determine the cause of this condition. There must not be excessive fuel from previous ignition in the combustion chamber of the burner.

8.1.2 Normal operation

After ignition of the boiler, the control unit regulates the boiler power. By adjusting the parameters for individual types of fuel, the amount of stoking material, amount of combustion air, etc. is changed automatically. These settings are made by a technician of our company during the heating test. Bulk density (kg/m3) of the material to be burned (wood chips, sawdust) varies, therefore it is necessary to change the parameters of the program to burn different types of material. Normal operation is based on the set program values. The output of the primary fan is controlled by the boiler power and the maximum power setting in normal operation. The output of the secondary fan depends on the current O2 value, the required O2 value is set to 8%. The output of the secondary fan is controlled according to the interpolation table (if O2 is greater than or equal to 15.1% secondary fan output is 0%, if O2 is 15% secondary fan output is 20%, then it is controlled by interpolation curve up to 8% O2) , and is continuously filtered. If O2 value is less than 8%, the secondary fan output is 100%. The output of the secondary fan 2 at O2 value higher than 12.5% is 0%, after reaching 12.5% O2 the output of the secondary fan 2 is 20%, further it depends on the actual O2 value. The regulation starts after reaching 8.5% O2 and in step at 10% of power, until then the output of the secondary fan 2 is 20%. If the O2 value is lower than 5.75%, the boiler stoking is stopped and re-started only when the O2 value is higher than 6.25%. The lambda sensor control is inactive during ignition, ignition failure, thermostat off, exceeded exhaust gas temperature. Boiler power is decreased (min. 25%) according to the difference between the required and actual boiler outlet temperature depending on the PID controller. After exceeding the required temperature by a maximum of 2°C, the boiler switches to the mode: “Stop heating wait” and the primary fan starts at 100% and the secondary fan at 80%; run-out times for fans are set on the display menu. These run-out times are valid also in the case of fault. The desired water temperature is calculated from the desired temperature of DHW

+5°C when the desired water temperature is lower than the desired temperature of DHW. As soon as the temperature drops, the boiler will automatically return to normal operation. As soon as one of the faults occurs, the boiler shuts down, the air-tight fire protection damper closes and the control unit signals the fault condition on the home screen instead of the date and time or replaces “Normal operation”” on the other screens.

When the lambda sensor control is off, the output of the input fans is stable as set by the display.

In case of any differences from the program, please contact the service department.

8.1.3 Manual operation

After pressing appropriate icon on the main page of the control unit display, the individual parts of the boiler can be started manually, without any relation to regulation. Manual operation is used for inspection and service, as individual motors can be started separately. This section is intended only for experienced operators and service personnel. The individual motors and signals are started by the up arrow and switched off by pressing this key again.

8.1.4 Reverse run

The boiler is equipped with reverse switch for the purposes of maintenance. This switch reverses the direction of rotation motors for conveyors, exchanger cleaning and deashing grate. It can be used to release the conveyors stuck because of jammed screw, jamming of any foreign bodies in the conveyor, etc. This function can only be used in "Manual mode".

Use this reverse run only during maintenance and only for a few seconds (5 seconds). Prolonged use of the conveyor screw could result in the damage leaf springs and vanes of discharge equipment.

Use the reverse run only in "Manual operation” mode.

8.1.5 Boiler shutdown

The boiler must be shut down prior to maintenance work on the equipment. When carrying out work in the furnace area, the boiler must be shut down for four hours before the work is commenced.

8.1.6 Faults

In the event of a fault in any part of the boiler, a description of the fault appears on the Status line. After the fault has been rectified, this must be acknowledged on the control display by pressing the fault acknowledgment icon. After this confirmation, the boiler resumes normal operation.

If you have any problems, please contact our service department.

8.1.7 Restart of control unit

The control unit is restarted by switching off the main switch on the boiler. Switch the boiler on at the main switch again after 30 seconds.

9 Boiler maintenance

9.1.1 Inspection book – Operational logbook in the boiler room

This is a checklist for automatic biomass combustion equipment – SMART boilers

Operator of the equipment:

Manufacturer: Smart Heating Technology s.r.o

Heating equipment: Automatic hot water boiler

Supplier:
Type:

Year of manufacture:

Boiler power:

The operator of the system must periodically carry out the following checks on the automatic heating system and regularly record the inspection results in the checklist. The operator must observe the safety rules given in this manual throughout the period of use and during servicing. The device may be operated and maintained only in accordance with the operating instructions

9.1.2 Important phone numbers

Police:	112,	local phone number:
Fire brigade:	112,	local phone number:
Hospital:	112,	local phone number:
Service:		Smart Heating Technology +420 777 258 491, +420 734 751 681

9.1.3 Safety and protection of health

- During operation and maintenance of boilers it is necessary to observe the principles of safety and health protection at work.
- Follow the manufacturer's instructions
- Use personal protective equipment
- **Never open the combustion chamber or any part of the boiler while the boiler is in ignition mode.**
  There is a danger of explosion of wood gas
- Always turn off the power when handling the equipment - Emergency Switch. The CU remains energized
- When modifying the control unit, turn off the main switch or disconnect the main power supply

The risks related to normal operation of the boiler and its accessories.		
Source of danger.	**Effect of risk.**	**Elimination of danger.**
Boiler body.	Burns on the inner inspection door, if the outer door is open, the hand or face is burned when the inspection door is opened.	Wear protective gloves and goggles when opening the door. Internal door is in direct contact with the exhaust gas and can reach temperatures of up to 400 ° C. When opening the inspection door, stand in such a way that any escape of hot exhaust gas does not affect any part of the body, especially the eyes. The danger lasts for a few seconds until the underpressure in the combustion chamber is automatically equalized.
Ashtray.	Hand injury, burn on ashtray. Removing ash from the ashtray.	Use handles designed for this purpose while handling the cover and ashtray. Empty the ash only at the designated locations. The ash may still be hot, so store the ash only in the designated areas.
Rotating parts of the boiler	Injury to hands or other parts of the body due to moving or rotating parts of the boiler	Always open the lid or protective cover only when the moving parts and their actuators are disconnected from the power supply
Discharge channel and discharge wheel.	Serious injuries to limbs by leaf springs while working in fuel silo.	If you shovel the fuel in the silo for any reason, remember that the leaf springs are retracted around the discharge wheel. So, when the fuel is removed, leaf springs unfold as a result of relieving their load. Therefore, do not do this work alone, use long enough tools, **the boiler must be switched off! ! !**

The risks related to the maintenance of the boiler and its accessories.		
Source of danger.	**Effect of risk.**	**Elimination of danger.**
Always carry out maintenance with the equipment switched off. Switch off the boiler by the main switch on the boiler switchboard.		
Chain gears, lubrication of bearings.	Scratching, cutting, falling off ladder when lubricating turbulator bearings. Slip on grease. Falling tools. Unintended starting of drive	Wear protective gloves. Handle the safety covers carefully. Store in a safe place so that they do not restrict your work. Do not place tools on sloping surfaces of boiler edges, between turbulators, etc. Disconnect el. power supply
Combustion chamber.	Burns, inhalation of dust, dust in eyes.	If the boiler is not shut down for sufficiently long time, the burner parts may still be hot, so wear protective gloves. Wear safety goggles and a respirator when cleaning the combustion chamber. The recommended downtime is 4 hours.
Ignition mode	Explosion of wood gas	Never open the combustion chamber or other parts of the boiler if the boiler ignites and obviously does not burn
Wiring.	Electric shock.	Intervention in the wiring is only possible after the device has been switched off by the main switch for more than 2 minutes.
Insufficient removal of exhaust gas	Low underpressure or blocked flue Risk of CO poisoning	Check underpressure on display Inspect and clean the chimney systematically and regularly
After maintenance work has been completed, check that all covers are correctly positioned and secured before putting the boiler back into operation. Make sure you have all the tools you started working with so as to avoid unpredictable collisions.		

9.2 Weekly inspections

At least once a week, preferably daily, a visual inspection should be performed by an authorized operational employee. If any defects or non-conformities are found, they must be rectified immediately

After installation of a new boiler, fuel change or other significant change in boiler operation, we recommend that the user perform this inspection more frequently, preferably daily, for a limited/required time. Until you are sure that the change does not adversely affect the boiler operation

- Write the values regularly into the Daily report form. These are then used to analyse possible problem
- Visual inspection of the boiler
  - checking the system for leaks, check water pressure
  - check the combustion chamber
    - the flame must be bright yellow
    - there must be no black spots of soot anywhere
    - burner must be clean without ash layer
  - check the ash layer at the bottom of the burner. If the ash layer is thick or slag is formed, call service organization
  - under normal operation of the boiler, no visible dark smoke should come out of the chimney. At low temperatures the smoke has white colour (water vapour)
  - check ashtray. The ash shall be of light grey colour. The ash is normally loose without slag
  - check the ash condition under the exchanger or in the second ashtray
- If the Alarm is on, press the red LED flashing button to find out the reason for the fault. Enter the fault and time of the fault occurrence in the Daily record. Call the service organization if you cannot safely remedy the fault yourself
- Checking the condition and quality of fuel in silo
- During the operation of the boiler, no strong or undesirable sound can be heard from the moving parts. However, the sound level is higher when cleaning the exchanger.

Note: When you open the inspection door, ashtray or cyclone ashtray, the underpressure in the boiler drops. If the required underpressure is not restored within 2 minutes, the boiler will be shut down

9.3 Monthly inspections

It is obligatory to carry out monthly inspection and maintenance operations and record their results in the inspection book

- It fully includes the tasks from 1.3 Weekly inspections
- Check the function of back-fire damper. Use mechanical handle and also SW control
- Check the safety damper for safety function and also leaks
- Check the functionality of extinguishing mechanism, add water to safety tank. Press the red inspection button on the flooding valve – press for max. 10 sec.
- Check the evaluation of fault conditions by the control unit. Simulate fault of tank, exhaust fan, motor

- Examine correct functioning of all motors
- Examine functionality of equipment providing fault messages via GSM/Internet
- Examine correct functioning of all fans
- Make overall inspection of combustion chamber and burner
- Make overall inspection of exchanger
- Make overall inspection and cleaning of flue
- Check perfect condition of flue and exhaust fan
- Make visual inspection of the combustion chamber,
- Check carefully the burner, its integrity, clearness and cleanliness of the air vents
- Inspect combustion chamber with opened front service door, correctness of secondary air supply
- Check ashtray and ash quality
- Check the boiler room for cleanliness and the absence of flammable substances
- Inspect and lubricate bearings and moving parts
- Lubricate the moving floor in the intermediate bin
- Check the exchanger and the space under the turbulators, clean of the combustion residues
- Check cyclone, remove combustion residues

See Appendix M - Smart 150-500 kW Monthly maintenance, draft.

9.4 Semi-annual inspection

It is necessary to perform a half-yearly general inspection of the boiler, to lubricate all the bearings and to execute all the maintenance works. At least once a year this inspection should be performed by our Service Department or by a contractual service company (it is valid for the length of the guarantee period).

It is necessary to carry out a semi-annual general inspection of the equipment with mandatory burner removal, lubrication of all bearings and all maintenance work. The inspection must be carried out at least once a year by the manufacturer's service department or by a contracted service company. Without such service, the customer loses the right to apply the warranty conditions (it applies during the warranty period).

9.5 Record on the realized inspections

The manufacturer should inspect the equipment at least once a year. This inspection is reimbursed by the user of the device

Year	Operator of the equipment:				Administrator of the equipment:								
Inspection	Month:				Month:				Month:				
Week	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	Note
Back-fire damper													
Extinguishing system													
Flue-chimney													
Control unit, wiring													
Bearings lubrication													
Alarm system													
Fans													
Combustion chamber													
Hand fire extinguisher													
Ashtray													
Fuel storage													
Condition of boiler room													
Fire-fighting equipment													
Cyclone, cleaning													
Exchanger, cleaning													
Turbulators, function													
Inspection of burner													
Signature/ NOTE													

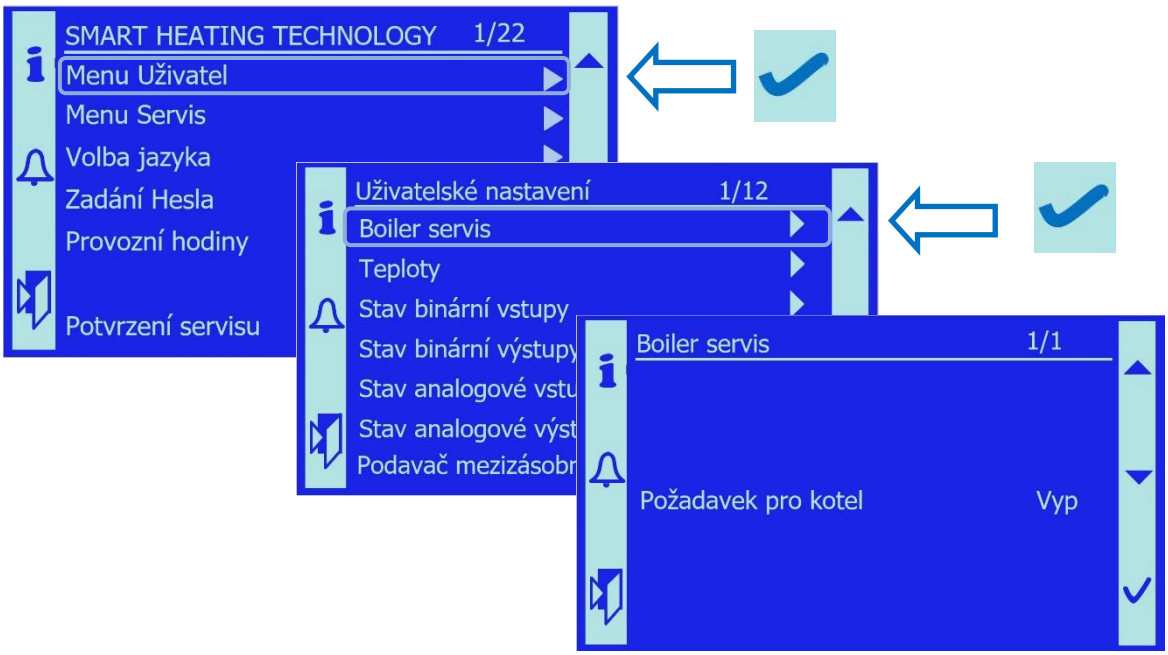
9.5.1 Inspection of combustion chamber and burner

The aim of this chapter is to describe the operations related to proper maintenance and service of the combustion chamber and especially the burner.

9.5.1.1 Preparatory operations

Prior to access to the combustion chamber

- Stop the operating power of the boiler and let it to cool down adequately
- Operating power of the boiler can be stopped in following ways:
  - By disconnecting EX_OFF in superior system (not recommended because of safety)
  - By switching off the boiler, see Boiler Service 7.6.1
    (User Menu → Boiler Service → Demand for boilers Off)



- By turning the Emergency Switch to “0” position
- In order to improve working conditions and to extract dust and combustion gas from the combustion chamber, set the output of the exhaust fan in manual mode, see Fans 7.10.1.1, to suitable level of 35%
- The space in front of the combustion chamber must be free and without any flammable objects

9.5.1.2 Safety precautions

When opening the combustion chamber and working in the combustion chamber there are following risks and dangers to the health of workers and possible property damage:
- danger of explosion of wood gas. Never open the access to the combustion chamber when the boiler is being ignited and if the chamber and the boiler are filled with grey wood gas!!

- Fire hazard – there may be unburnt fuel residues in the combustion chamber. If they fall out of the combustion chamber on combustible material, a fire may result. Check availability of fire-fighting equipment
- Risk of poisoning by poisonous gases. Ensure removal of exhaust gas and gases through the exhaust fan function. Ensure sufficient ventilation of the boiler room
- Risk of burns – all parts of the combustion chamber may have a high temperature. Therefore, wear suitable protective clothing and gloves

- Eyes and lungs can be affected by dust – always wear protective goggles and a respirator
- Risk of injury to hands from rotating and moving parts of the machine
- Always work in pair, never alone

9.5.1.3 Opening of the combustion chamber

- Firstly, check the situation in combustion chamber by opening the inspection door. There should be no high flame in the burner, no smoke visible in the combustion chamber.
- Remove the front upper casing cover – push it sideways and remove it forwards
- Remove the bottom grate cover – lift it on the left and right sides and slide it forward
- If the conditions for safe opening of the combustion chamber are met, unscrew the three M10 screws using the M17 wrench.
- When loosening the screws, stand in such a way that any sudden opening of the door cannot hit you
- Open the door slowly and carefully so that the operator is not affected by fire, hot ash, etc.

9.5.1.4 Examination of the combustion chamber

Always check the following after opening the service door of the combustion chamber:

- Quantity and quality of ash and combustion residues. The ash must be grey, light, with no visible fuel residues
- Condition of ash screws and ash level under the burner
- Condition of ceramic reflector. It should be compact, without any cracks
- Condition of coating in combustion chamber. Original colour is black. If the colour is pink in some places, it means that these parts have been extremely thermally stressed, find out the cause!!
- There must be no places with black soot in the combustion chamber. This would indicate poor combustion or leakage and the presence of foreign air in the combustion chamber

9.5.1.5 Inspection of burner

The burner itself consists of two parts – the lower secondary ring and the upper ring. For proper operation, air supply from the secondary fans A6 - secondary fan 1 and A7 - secondary fan 2 must be ensured.

- Check that the burner rests on the seals of air ducts!
- Contact of burner with the sealing cord must be firm, not overstretched.
- Check the position of the upper burner ring according to the position of arrows. The arrows must be facing towards each other (right boiler) or apart (left boiler). They must never point to one side (both up or down) as this would mean that upper ring is rotated by 180°.
- Check that the fixing screws (located on the opposite side of the burner than the air ducts) have sufficient clearance for thermal expansion. The correct distance between the screws and the burner during operation is 1.2 - 2mm.

Important notice: If the fixing screw is firmly tightened into the burner during the boiler operation, thermal expansion of the burner ring is prevented. This results in the risk of damage and deformation of the burner. It may break.
Important notice: If the boiler is in operation when the fixing screws are tightened, warranty for the equipment expires

- Check the gap between the bottom edge of the burner and the grate plate. The correct height is 15-20 mm for pellets and 30-40 mm for wooden chips.

Important notice: The optimum height can only be adjusted during operation according to the fuel used. The service organization is responsible for the correct adjustment and optimization of the required gap height!

9.5.1.6 Inspection of upper ring

- The burner body must be clean without any stuck parts of combustion residues
- Air holes of circular shape must be clean and clear throughout the diameter
- Ash and other contaminants must not remain inside the hollow burner body
- If necessary, clean the burner ring with a scraper and a steel brush
- If necessary, clean the holes using an electric drill and drill bit of appropriate diameter

9.5.1.7 Inspection of lower ring

- The burner body must be clean without any stuck parts of combustion residues
- Air holes of circular shape must be clean and clear throughout the diameter
- Ash and other contaminants must not remain inside the hollow burner body
- If necessary, clean the burner ring with a scraper and a steel brush
- If necessary, clean the holes using an electric drill and drill bit of appropriate diameter

9.5.1.8 Inspection of primary burner

- The cast-iron circular primary burner is perforated, the holes have 4 mm in diameter
- The ring body must be intact, free of deposits
- If necessary, clean the burner ring with a scraper and a steel brush
- All openings must be clean and clear
- If necessary, clean the holes using a cordless drill and drill bit with D=4mm
- Check the fuel feed channel for tar deposits
- If necessary, carefully remove any deposits with a scraper or larger screwdriver

9.5.1.9 Inspection of the grate mechanism

- Check the integrity of the lever grate mechanism
- Check the connecting pins on grate levers and the grate wheel
- All pins must be secured with cotter pins
- Start the grate mechanism
- Turn the emergency switch to position “1”
- Activate motor cleaning see Motors 7.10.1.2
- Check that it runs smoothly.
- If the grate operation is OK, return the control of grate motor to Automatic mode

9.5.1.10 Burner removal

After opening the large service door and carefully checking the current condition, you can remove the burner parts:

Important: burner parts can be very hot, so always wear protective gloves
ALSO USE FOOTWEAR WITH STRENGTHENED STEEL TOE

- Remove the cover of fixing screw that are located on casing on the side of ashtray
- Loosen the fixing screws by turning them counter-clockwise by approx. 5 mm
- Grasp the upper ring by the metal handles, raise it by about 50mm and try to move the ring to the left or right side.

- You must move the ring so that it jumps out of the sealing grooves provided with the sealing cord.
- Then the ring can be easily pulled out forwards
- Removing the lower ring is made similarly, lift it up in front part and pull firmly forward
- The cast iron ring of the primary fan prevents straight pulling forward. Therefore, you must hold the front part of the lower burner part very high
- By repeatedly moving the front part of the lower ring of the burner up and down and by strong pulling you should get the part to the edge of the combustion chamber
- Grasp the burner in pair and move it to the inspection site

Important: burner parts can be very hot, only place them on a non-flammable mat

9.5.1.11 Removal of primary burner

- The primary burner must be removed as part of the annual inspection of the boiler
- The primary burner is fixed by three spring pins located at the pitch of 120°
- Mark visibly the position of the primary ring with respect to the fixed part of the fuel channel
- Hammer out the pins using a round bar with D=6mm
- They will fall inside the burner into the space where primary air passes
- Using a pry tool (larger screwdriver, chisel) remove the primary burner
- Clean the area under the primary burner and in the air duct using a vacuum cleaner

9.5.1.12 Installation of primary burner

- Install the primary burner according to the pre-made mark
- Using a rubber mallet, tap the primary burner into correct position
- Pre-drilled holes must be in concentric position on the fixed part of the fuel channel and on the primary burner
- Secure the primary burner with spring pins
- Use new 6mm DIN pins

9.5.1.13 Installation of burner

- After careful inspection and cleaning of the combustion chamber, the burner can be installed back into the combustion chamber
- In front of the combustion chamber, rotate the bottom ring of the burner so that the air holes and air ducts are on the same side
- In pair lift the lower burner ring and fit it on the rails in the combustion chamber
- Push firmly into the rear position
- Check carefully that the lower burner ring is fitted at the correct level according to fuel to be used, see Inspection of burner 9.5.1.5
- All 4 setting screws must rest on the rails !! Check it
- The lower burner ring must be seated horizontally, the front and rear sides must have the same gap above the grate wheel
- Check the correct position of the air duct between the lower burner ring and the upper burner ring
- Fit the upper burner ring and check the correct position using the orientation arrows
- Tighten the fixing screws so that the burner contacts the air duct with the sealing
- LOOSEN the fixing screws so that the gap between the screw and the burner is 1.5-2.0mm

9.5.2 Inspection of exchanger

The aim of this chapter is to describe the operations related to proper maintenance and service of the exchanger and the group of cleaning turbulators

9.5.2.1 Preparatory operations

Prior to access to the exchanger

- Stop the operating power of the boiler and let it to cool down adequately
- Operating power of the boiler can be stopped in several ways, see Preparatory operations 9.5.1.1
- By turning the Emergency Switch to “0” position
- In order to improve working conditions and to extract dust and combustion gas from the combustion chamber, set the output of the exhaust fan in manual mode, see Fans 7.10.1.1, to suitable level of 35%
- The space in front of the cleaning holes of the exchanger must be free and without any flammable objects

9.5.2.2 Safety precautions

When opening the combustion chamber and working in the combustion chamber there are following risks and dangers to the health of workers and possible property damage:
- danger of explosion of wood gas. Never open the access to the exchanger when the boiler is being ignited and if the exchanger and the boiler are filled with grey wood gas!!

- Fire hazard – residues of hot ash may be present in the combustion chamber. If they fall out of the exchanger on combustible material, a fire may result. Check availability of fire-fighting equipment
- Risk of poisoning by poisonous gases. Ensure removal of exhaust gas and gases through the exhaust fan function. Ensure sufficient ventilation of the boiler room
- Risk of burns – all parts of the combustion chamber may have a high temperature. Therefore, wear suitable protective clothing and gloves
- Eyes and lungs can be affected by dust – always wear protective goggles and a respirator
- Always work in pair, never alone
- Safely disconnect the turbulator motor(s) from the power supply

9.5.2.3 Opening of inspection door of the exchanger

- If the conditions for safe opening of the cleaning door of exchanger are met, unscrew the four M10 screws using the M17 wrench.
- The cleaning door is on both sides of the exchanger – for easier access to the large space under the exchanger
- Open the door slowly and carefully so that the operator is not affected by fire, hot ash, etc.

9.5.2.4 Examination of area under exchanger

Always check the following after opening the cleaning door of the exchanger:

- Quantity and quality of ash and combustion residues. The ash must be grey, light
- Amount of ash
- Ash consistency – it must be powdery, free from tar particles and any moisture
- Tar and moisture can mean a serious problem – contact the manufacturer
- Condition of insulation material
- There must be no places with black soot under the exchanger. This would indicate poor combustion or leakage and the presence of foreign air in the exhaust gas paths of the exchanger

9.5.2.5 Examination of area above exchanger

The space above the exchanger can be checked through the chimney body after unscrewing one of the covers

- Above the heat exchanger (above the turbulators) some dust particles may be deposited
- Check ash quality and colour – it should be light grey
- Check the turbulators for smoot and easy run.
- Check the condition and contamination of the Lambda probe – there must be not ash or soot layer
- Check the condition and contamination of exhaust gas thermometer – there must be not ash or soot layer

9.5.2.6 Inspection of drive for turbulators

The turbulators are driven by 0.55kV drive motor(s), helical gearbox with i = 64 and also system of gears connected by chain.
The turbulators are mounted in bearings.
Turbulators that are close to the motor are most stressed and therefore have thickened shafts
The design of turbulators varies according to the direction of rotation. They therefore have suitably ground wiper blades that respect the sense of rotation

- Remove the turbulator drive cover – aluminium diamond sheet – use hexagonal key No. 6
- Remove the chain guard above the motor (s)
- Check the condition and tension of the drive chain – check the chain tension between the motor pinion and first turbulators. When pressed strongly, chain deflection should be about 1.5-2cm
- If necessary, tighten the chain by tightening the two M10 bolts on the motor bracket with a M17 wrench
- Prior to tensioning, loosen the 4 motor fixing bolts with the M17 wrench !!
- After proper tensioning, tighten the 4 fixing screws firmly in the new position
- Check all bearings for lubrication – use a lubricating nipple and Chevron grease if necessary

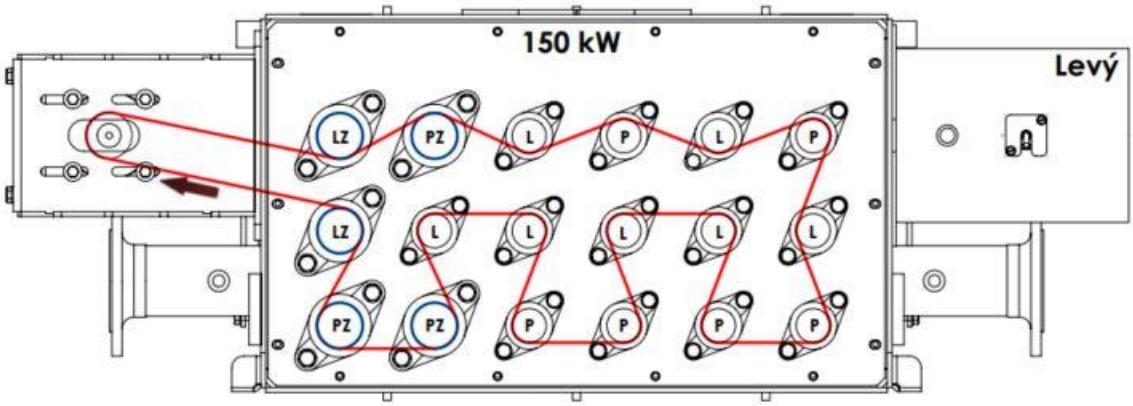
If the turbulator drive shows problems such as heavy running (manifested by a large chain deflection on the thrust side of the chain), it is necessary to centre the turbulator bearings. The axis of the turbulator must be identical with the axis of exchanger tube:

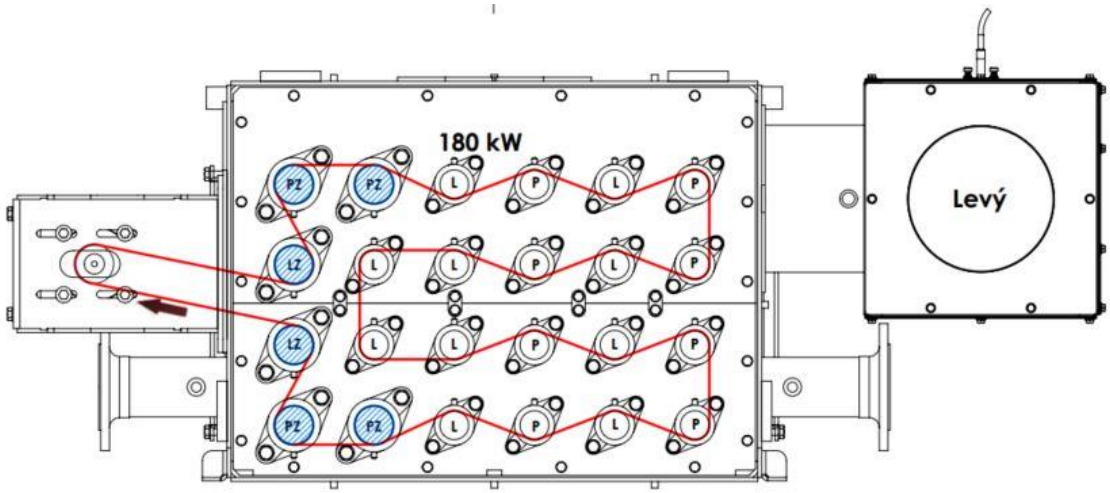
- Loosen the 4 fixing bolts on the turbulator drive motor – M17 wrench
- Loosen the 2 tensioning bolts on the motor bracket sufficiently – M17 wrench
- Disconnect the chain coupler
- Remove the chain and store it in a dust-free place. It is lubricated and could be strongly contaminated
- Rotate the turbulators to see if there is any excessive resistance to rotating motion

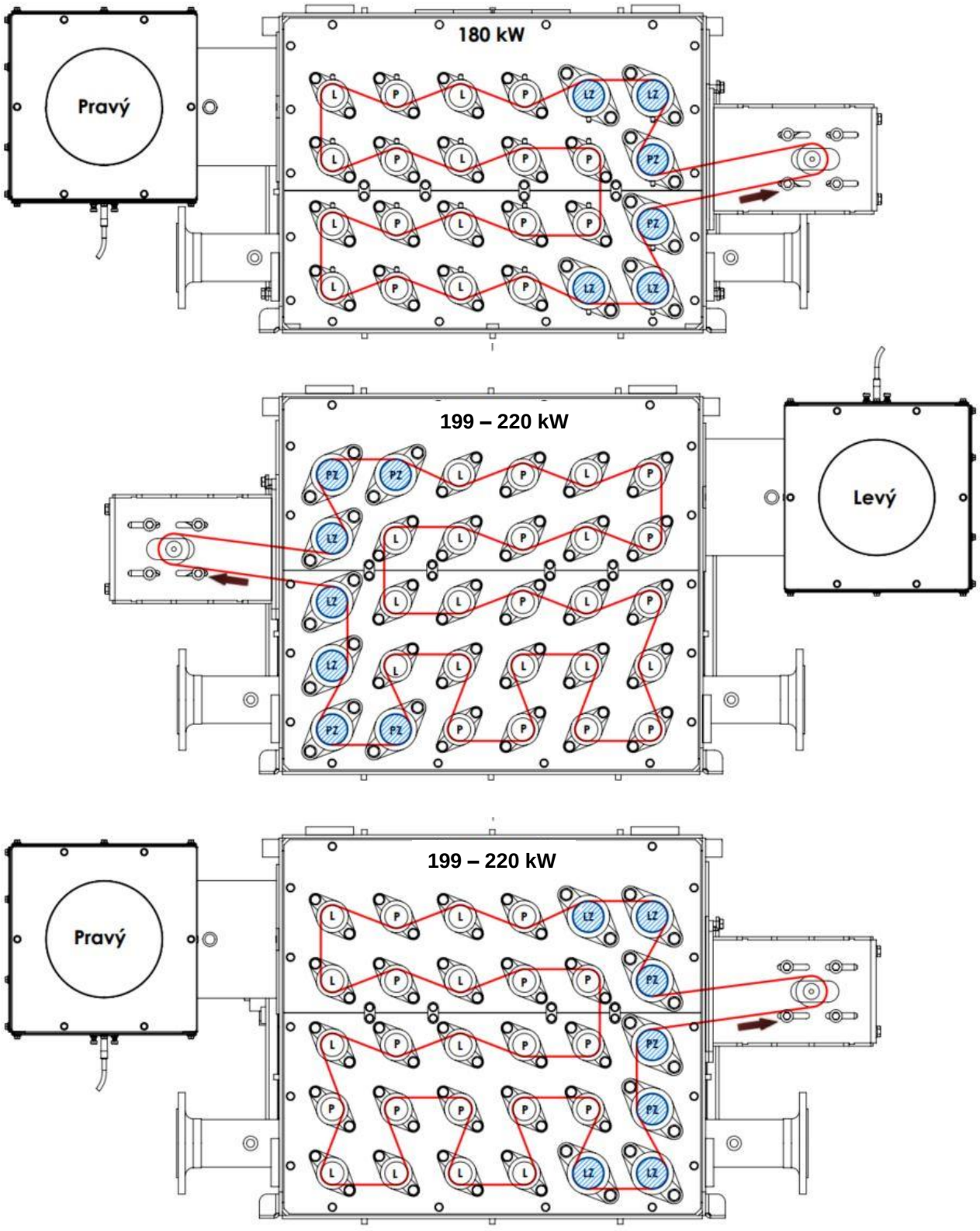
- For the turbulator that resists, loosen the screws that secure its bearing. Use M17 wrench for UCF204 bearings or M19 wrench for UCF206 bearings.
- Position the bearing so that is does not drag and rotates easily. Fix in this position by firmly tightening the screws
- Repeat for all problematic turbulators

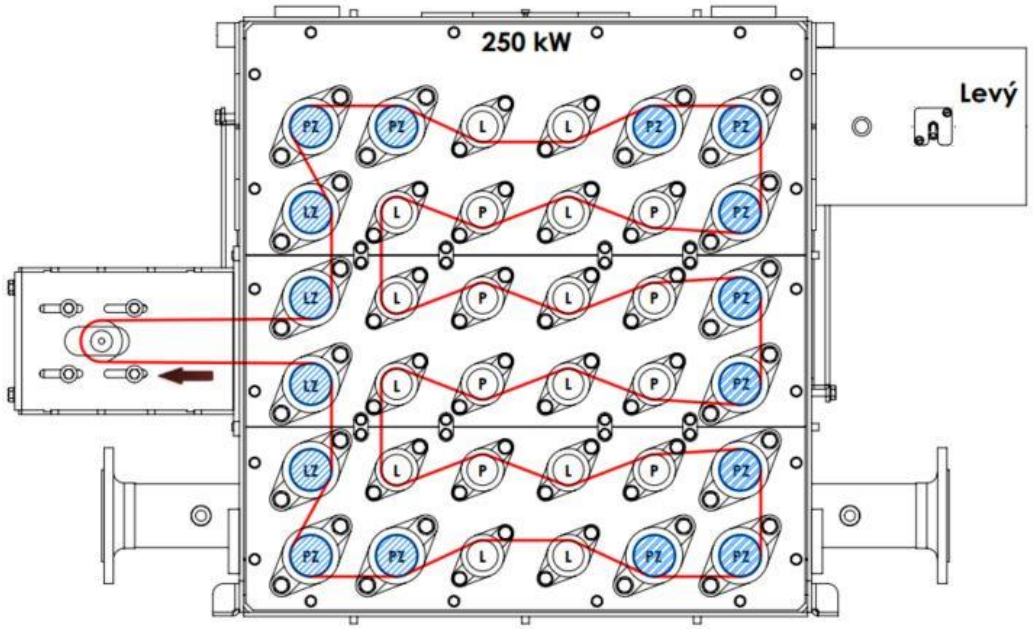
If all turbulators can easily rotate, you can thread the chain as shown. The direction of rotation of individual turbulators must be respected – see the pictures below

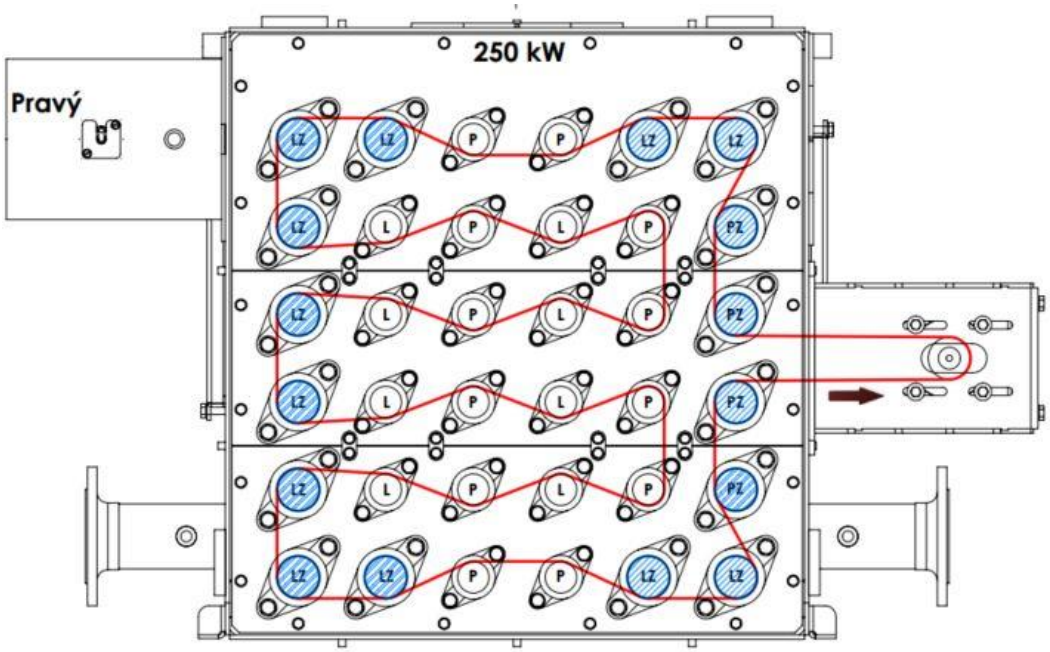
- Connect the chain with coupler
- Tighten the chain with 2 tensioning bolts on the motor bracket – gradually tighten with M17 wrench
- Tighten the 4 fixing screws of motor for chain drive – use M17 wrench

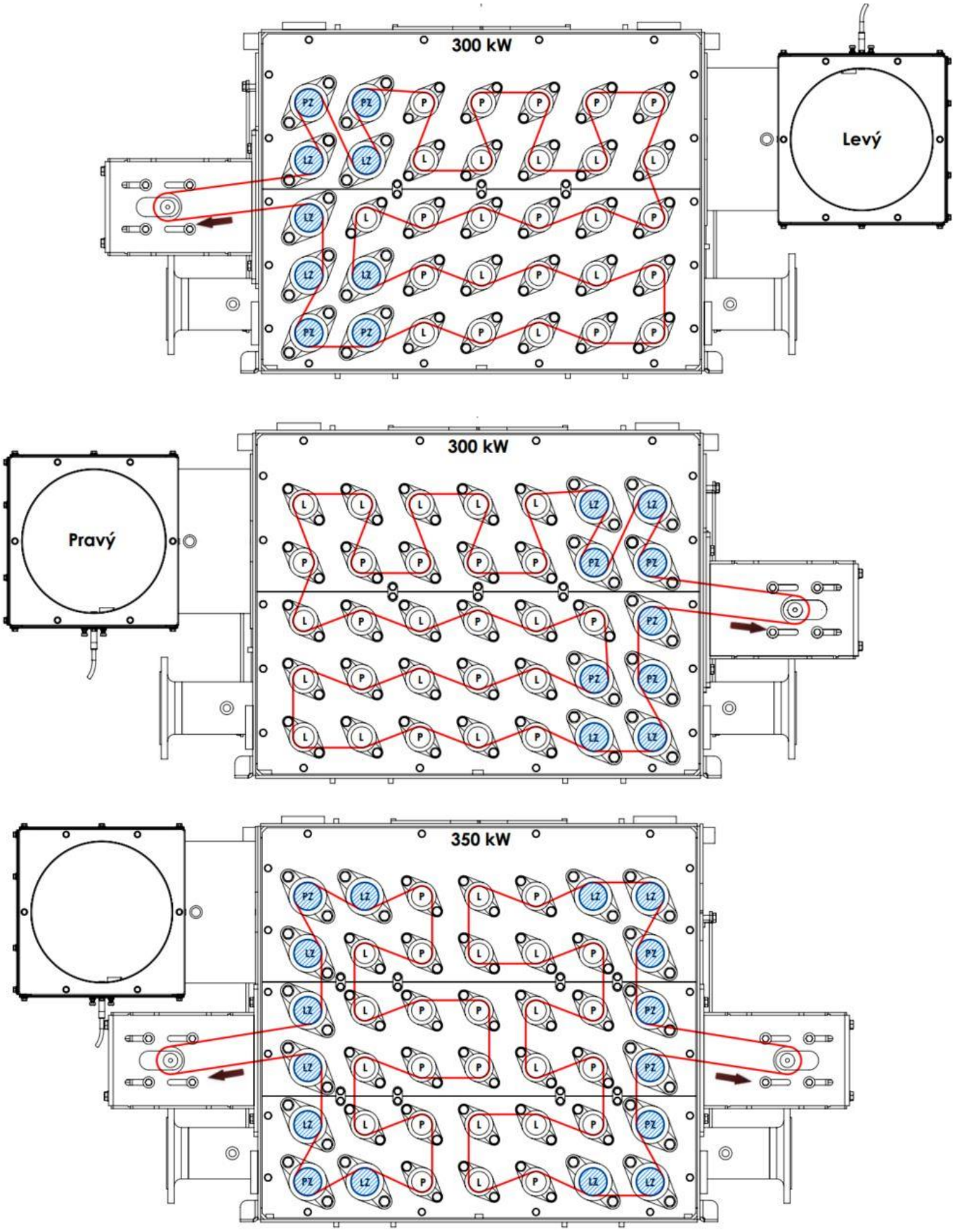


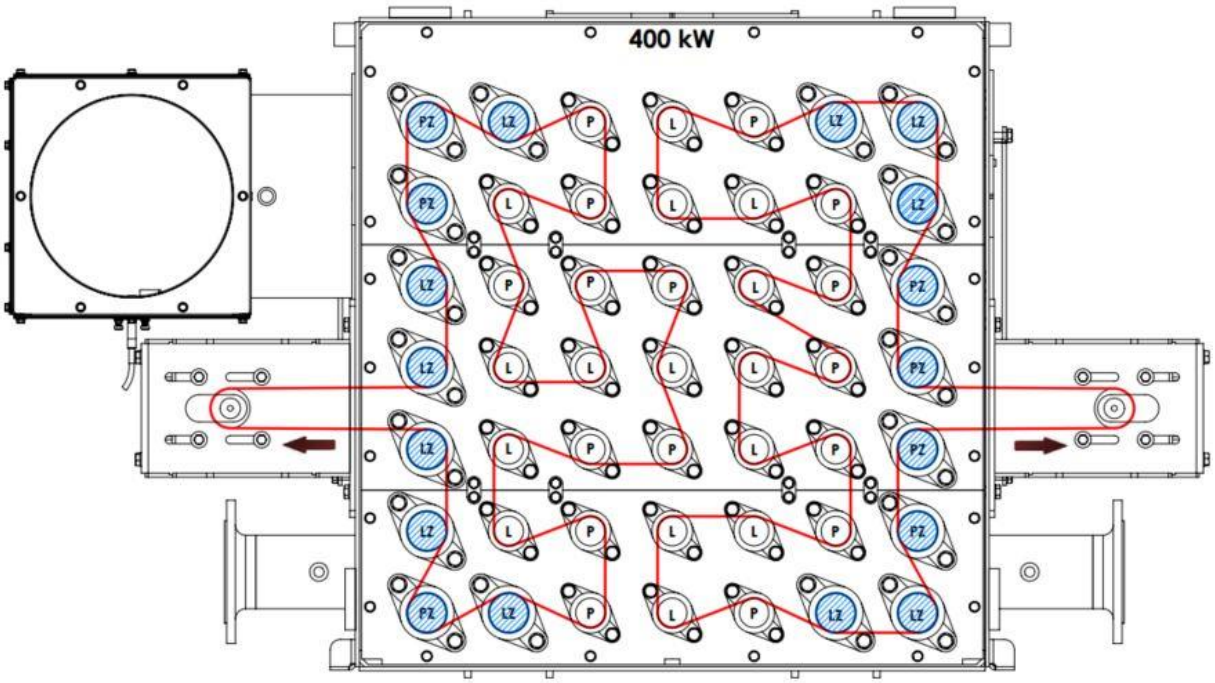


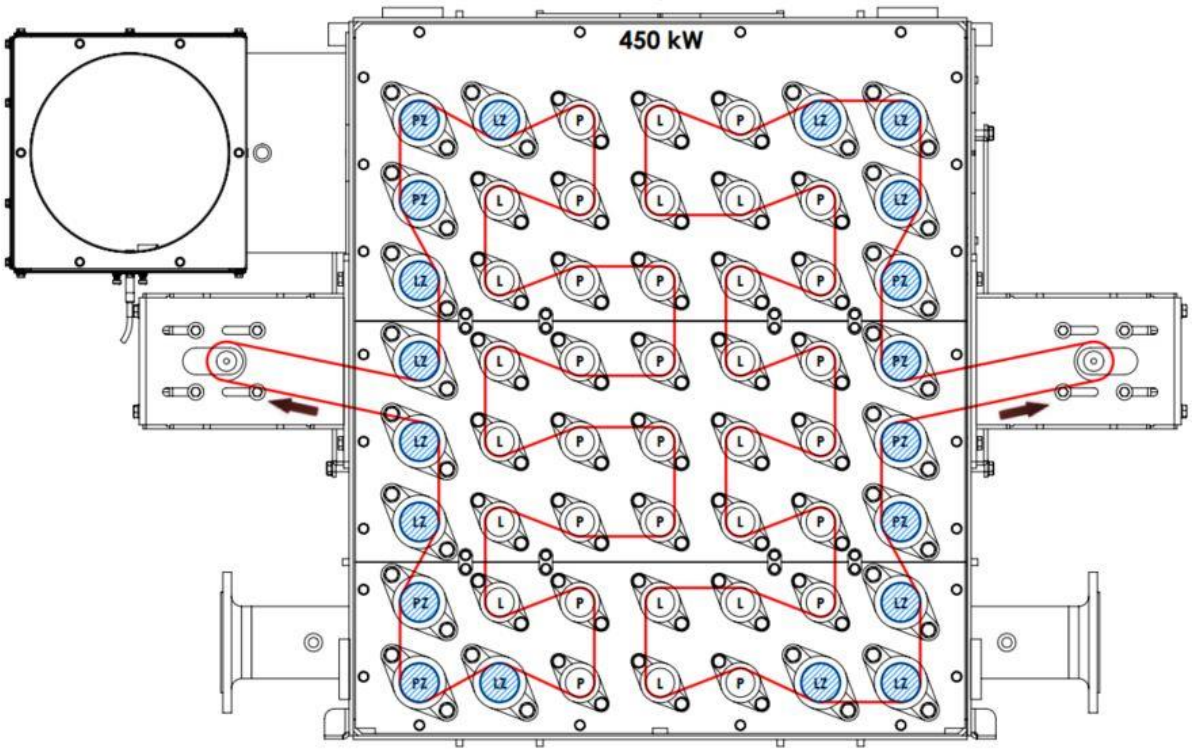

180 kW
Pravý
199 – 220 kW
Levý
199 – 220 kW
Pravý

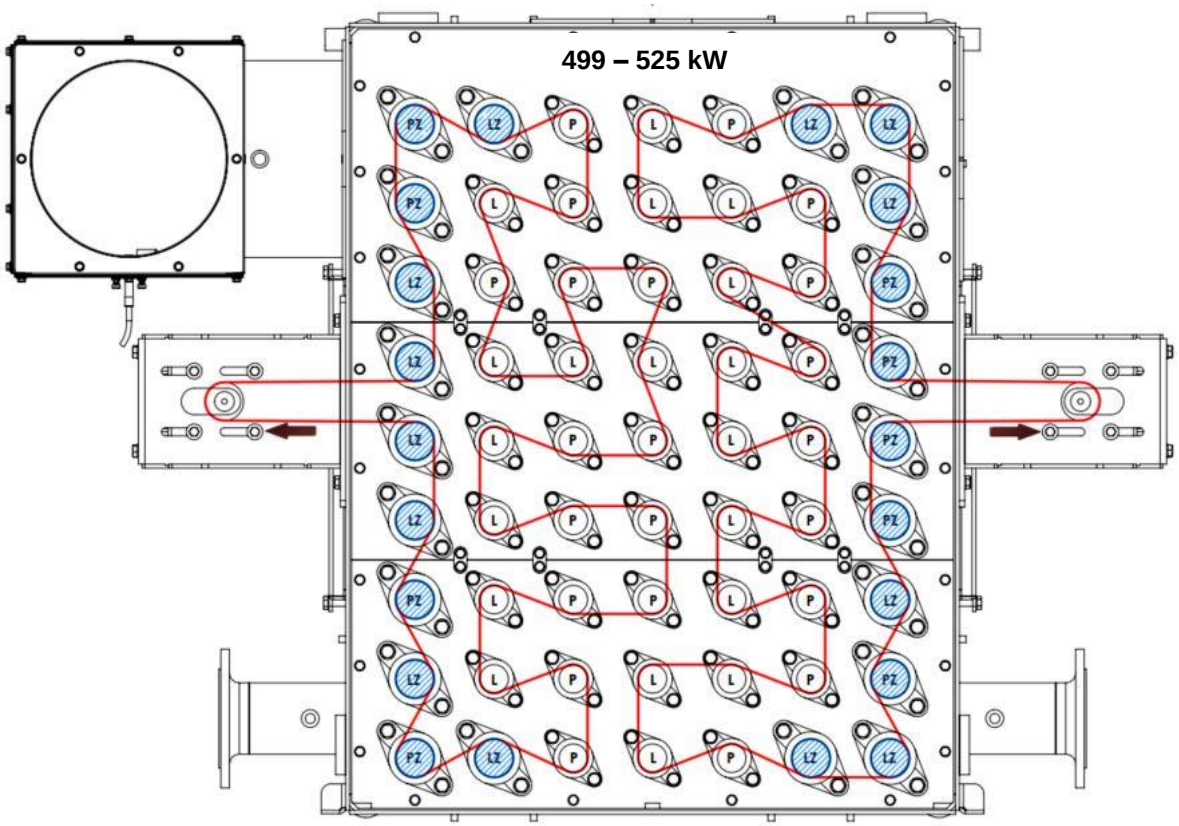

250 kW
Levý
PZ
LZ
L
P


250 kW
Pravý
LZ
P
L
PZ


300 kW
Levý
Pravý
300 kW
350 kW


400 kW
PZ
LZ
P
L


450 kW
PZ
LZ
P
L



Note: The blue colour indicates the turbulators with reinforced shaft
The arrow indicates the direction of chain movement
L – turbulators with left sense of rotation
P – turbulators with right sense of rotation

- After repair or service intervention check the function of the cleaning mechanism
- Prior to re-starting operation carefully check the observance of safety rules !!!
- Start up the cleaning mechanism
  - Turn the emergency switch to position “1”
  - For the activation of M4/M5 motor see Motors 7.10.1.2

10 Technical specifications

TECHNICAL SPECIFICATION OF SMART BOILER								
Marking		**100**	**150**	**180**	**199**	**200**	**220**	**250**
Nominal power Pn	kW	100	150	180	199	200	220	250
Partial load Pč	kW	26	40	45	49	49	55	65
Boiler efficiency at Pn	%	92	95.3	95	95	95	95	95
Boiler efficiency at Pč	%	92	95.6	95	92	92	95	95
Boiler class		5	5	5	5	5	5	5
Operating Mode		NON-CONDENSATION						
Boiler category		1	1	1	1	1	1	1
Water								
Water volume	l	180	380	420	450	450	460	500
Diameter of water connection	„	6/4	3	3	3	3	3	3
Diameter of water connection	DN	50	80	80	80	80	80	80
Hydraulic loss of the boiler at the temperature gradient of 20° C	mbar	65	65	73	78	78	80	87
Boiler temperature	°C	60-90	60-90	60-90	60-90	60-90	60-90	60-90
Min. temp. of return water	°C	55	55	55	55	55	55	55
Max. operating pressure	bar	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Testing pressure	bar	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Temperature of furnace	**°C**	**900 – 1100**						
Pressure of furnace	mbar	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04
Required chimney draught	mbar	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Induced draught required		Yes	yes	yes	yes	yes	yes	yes
Temperature of combustion gas	°C	140	140	130	125	125	125	120
Temperature of combustion gas	°C	80	80	80	75	75	75	75
Mass flow of combustion gas at	kg/h	240	360	390	425	425	475	540
Mass flow of combustion gas at	kg/h	240	125	135	145	145	165	190
Diameter of flue pipe	mm	160	220	220	220	220	220	220
Diameter of chimney	mm	200	250	250	250	250	250	250
Chimney design		**Moisture resistant**						
Fuel								
Maximum size	cm	3	3	3	3	3	3	3
Maximum moisture	%	30	30	30	30	30	30	30
Electrical equipment								
IP		**IP 41/20**						
Connection		**3x230/400V – 50 Hz 16A**						
Conveyor motor	W	550	550	550	550	550	550	550
Motor of disturbing device	W	--	550	550	550	550	550	500
Motor of fuel screw	W	550	550	550	550	550	550	550
Motor of exchanger cleaning	W	550	550	550	550	550	550	550
Motor of deashing of combustion	W	--	550	550	550	550	550	550
Motor of exchanger deashing	W	--	120	120	120	120	120	120
Motor of grating in combustion	W	120	120	120	120	120	120	120
Fan of primary air	W	83	83	83	83	83	83	83
Fan of secondary air 1	W	83	105	105	105	105	105	105
Fan of secondary air 2	W	--	83	83	83	83	83	83
Chimney fan	W	160	300	300	300	300	300	300
Electrical ignition	W	1000	1000	1000	1000	1000	1000	1000
Exchanger damper	W	--	8	8	8	8	8	8
Separation flap	W	8	8	8	8	8	8	8
Total El. Power Input	**W**	**3104**	**4577**	**4577**	**4577**	**4577**	**4577**	**4577**

TECHNICAL SPECIFICATION OF SMART BOILER								
Marking		**300**	**350**	**400**	**450**	**499**	**500**	**525**
Nominal power Pn	kW	300	350	400	450	499	500	525
Partial load Pč	kW	75	90	100	115	140	140	140
Boiler efficiency at Pn	%	95.1	95.3	95.4	95.6	95.6	95.6	95.6
Boiler efficiency at Pč	%	95	95.5	95.9	96.2	96.4	96.4	96.4
Boiler class		5	5	5	5	5	5	5
Operating Mode		NON-CONDENSATION						
Boiler Category		1	1	1	1	1	1	1
Water								
Water volume	l	690	740	790	850	900	900	900
Diameter of water connection	„	4	4	4	4	4	4	4
Diameter of water connection	DN	100	100	100	100	100	100	100
Hydraulic loss of the boiler at the temperature gradient of 20° C	mbar	95	102	110	122	130	130	130
Temperature of heating water	°C	60-90	60-90	60-90	60-90	60-90	60-90	60-90
Min. temp. of return water	°C	55	55	55	55	55	55	55
Max. operating pressure	bar	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Testing pressure	bar	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Temperature of furnace	**°C**	**900 – 1100**						
Pressure of furnace	mbar	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04
Required chimney draught	mbar	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Induced draught required		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Temperature of combustion	°C	125	125	120	120	120	120	120
Temperature of combustion	°C	80	80	80	80	80	80	80
Mass flow of combustion gas at	kg/h	725	785	850	810	970	970	970
Mass flow of combustion gas at	kg/h	230	255	270	305	320	320	320
Diameter of flue pipe	mm	300	300	300	300	300	300	300
Diameter of chimney	mm	350	350	350	350	350	350	350
Chimney design	**Moisture resistant**							
Fuel								
Maximum size	cm	3	3	3	3	3	3	3
Maximum moisture	%	30	30	30	30	30	30	30
Electrical equipment								
IP	**IP 41/20**							
Connection	**3x230/400V – 50 Hz 16A**							
Conveyor motor	W	550	550	550	550	550	550	550
Motor of disturbing device	W	550	550	550	550	500	500	500
Motor of fuel screw	W	550	550	550	550	550	550	550
Motor of exchanger cleaning 1	W	550	550	550	550	550	550	550
Motor of exchanger cleaning 2	W	--	550	550	550	550	550	550
Motor of deashing of	W	550	550	550	550	550	550	550
Motor of exchanger deashing	W	120	120	120	120	120	120	120
Motor of grating in combustion	W	120	120	120	120	120	120	120
Fan of primary air	W	83	83	83	83	83	83	83
Fan of secondary air 1	W	400	400	400	400	400	400	400
Fan of secondary air 2	W	400	400	400	400	400	400	400
Chimney fan	W	1100	1100	1100	1100	1100	1100	1100
Electrical ignition	W	1000	1000	1000	1000	1000	1000	1000
Exchanger damper	W	8	8	8	8	8	8	8
Separation flap	W	8	8	8	8	8	8	8
Total El. Power Input	**W**	**5989**	**6539**	**6539**	**6539**	**6539**	**6539**	**6539**

We reserve the right to make technical changes

11 Manufacturer's warranty

The assertion of rights resulting from the liability for defects is governed by the provisions of §422-441 and for the compensation of damages by the provisions of §373-386 of the Commercial Code. In addition to the benefits required by law, SMART HEATING TECHNOLOGY s. r. o provides you for the whole equipment:

- 2-years warranty from the moment of commissioning for material defects on all parts of the equipment
- 5-years warranty from the moment of commissioning for the boiler body.

The warranty covers the guaranteed properties and faultlessness corresponding to the state of the art. Design or execution changes that are made prior to shipment of the order are not covered by the warranty. Visible damage must be reported immediately upon receipt of the equipment, no later than 8 days thereafter. Hidden defects should be reported within 8 days after their detection. Any notification of defects must be made in writing and by telephone.

Excluded from this warranty are natural wear, especially the gaskets of all kinds, or damage due to inadequate handling of equipment and as a result of frequent use of strong detergents or chemicals. The damages caused by the water level and damage caused by a natural disaster are also excluded.

The warranty expires if the equipment supplied by us is not installed by us or by an authorized installer, or if the equipment is modified and repaired by an unqualified person, also if devices are installed in the equipment that are not intended for this purpose, when the attached installation and operating rules are not observed and when the device is not used according to the regulations. Nor does the warranty cover the damages caused by the use of fuels others than those specified. The guarantee fuel is wood chips - B1, and pellets. Also, shawings and sawdust (not small dust) with a maximum humidity of 30% and a maximum grain size of up to 30 mm are suitable fuels.

The boiler must be regularly serviced once a year for at least the duration of the five-year warranty.

The damages incurred during transport (unless included in the scope of delivery) or storage are also excluded from the warranty. We provide compensation for confirmed deficiencies, at our discretion, either in the form of free repair or by supply of a spare part. Guarantee coverage is free of charge in the first six months after commissioning. After this period, the guarantee work incurred is charged except for repairing the resulting net material costs at our indicative rates.

Withdrawal from the contract or entitlement to a discount are possible if, at our discretion, repair or replacement is not possible or the deadline set for that is not met.
Additional warranty conditions and limitations:

11.1 Warranty and complaint conditions

Automatic biomass boilers SMART 150 – 500 kW

Smart Heating Technology s. r. o. provides warranty for its products for the period of 24 months after their commissioning or trial operation, but no longer than 30 months from the date of shipment of the product from the factory or until 8,000 operating hours have been achieved at an power higher than 80% of the nominal power. Smart Heating Technology s. r. o. provides a 60-month warranty on the boiler body, combustion chamber and exchanger

The parts that are to be considered as consumables are excluded from the warranty. They are as follows:

- Ceramic deflector – catalogue No.:	MTC00001, MTC00003
- Lower and upper ceramic part of burner – catalogue No.:	MX150004A003000, MX150004A005000, MX300004A003000, MX300004A005000
- Heating spiral for ignition gun – catalogue No.:	MET00001
- The parts specified in the partial purchase contract	

Complaints against defects and requirements for the delivery or replacement of defective parts or adjustment of the equipment to the operating parameters specified in the

technical documentation of the equipment may only be considered under following conditions

- All overdue payables related to the claimed equipment are paid.
- The boiler is permanently stored and operated under the conditions specified by the manufacturer (climatic effects, mains voltage, fuel, regular maintenance, chimney body and exhaust gas removal, quality and functionality of the heating circuit, quality of heating water).
- The device was put into operation by a person or company (hereinafter referred to as the person) authorized by the equipment manufacturer.
- The person who commissioned the equipment demonstrably sent a completed table of boiler operating parameters (checklist) to the manufacturer's address upon commissioning.
- The fuel used is in full compliance with the fuel parameters for which the product has been certified.
- Maintenance and service are carried out properly and responsibly in accordance with the operating instructions, and this is regularly recorded.
- The equipment was commissioned by a person or company (hereinafter referred to as “person”) authorized by the manufacturer of the equipment and after the first year of operation, the manufacturer or authorized person performed an annual service inspection in full extent!
- A copy of records is sent to the manufacturer regularly 1 x quarterly.
- Upon request, the operator shall allow the manufacturer to inspect the equipment at any time without any restriction. Hindering the inspection may represent a reason for disclaimer of warranty or termination of warranty conditions.
- Only the person who ordered the boiler on the basis of the contractual and business conditions from the manufacturer and to whom the boiler and accessories were subsequently delivered is entitled to claim the defect.

11.2 The reasons for voiding warranty rights:

- Expiration of the warranty period.
- Improper or unauthorized installation.
- Unprofessional handling, operation or neglected care.
- Violation of protective seals or stickers if parts of the equipment are provided with them.
- Failure to follow the manufacturer's or supplier's instructions.
- Connection to incorrect voltage system or a system with instable parameters.
- Use of parts and components not supplied or use not demonstrably approved by the manufacturer.
- The warranty expires for the goods damaged by the elements – force majeure.

Complaint in the case of incomplete or damaged partial delivery:

- The complaints regarding quantity and quality of delivered goods are made according to visual inspection upon receipt of goods by the buyer, namely in writing.
- If the delivery is obviously damaged upon delivery by the transport company, or if the delivery does not agree with the information on the delivery note, the buyer shall not accept the goods from the carrier unless the damage to goods or incomplete delivery have been recorded and the necessary documentation has been prepared. The buyer shall also record the non-compliance in the international consignment note CMR. The record and documentation shall be signed by the buyer's representative and the driver. The complaints for such damaged goods shall be filed by the subject which ordered the transport.
- The complaints regarding the quantity and quality of goods may be reported within 3 (three) working days after delivery and signing of the acceptance protocol.
- Complaints regarding the subsequent findings in the area of inadequate quantity or quality of delivered goods may not be accepted by the seller without giving a reason.
- The complaints are processed for each partial delivery of goods separately.

- The complaints are sent by registered mail or e-mail along with documents and documents confirming this fact. The method of submitting a complaint by electronic mail requires confirmation of its receipt by seller's representative. Without confirmation by the seller it is considered that the complaint was not received. The seller is obliged to confirm receipt of the complaint by e-mail without delay.
- The date of filing the complaint is the date on the postmark from the buyer's country. The date of receipt of electronic complaint is the date of confirmation of receipt of electronic mail by the seller.
- The seller delivers the missing goods or exchanges poor quality goods for good quality immediately, however, no later than 15 calendar days after receipt of the complaint, if the complaint is considered justified.

11.3 How to lodge a complaint:

The buyer shall state in his complaint:

- Type and serial number of the boiler or goods.
- Date of installation and commissioning.
- Name of the installer.
- Type of defect and a detailed description of how the defect manifests itself, or photo documentation.
- A description of the cause that caused the defect, if it is obvious or known.
- A copy of the service and inspection records.

How the complaint is settled:

- The buyer sends the defective part to the manufacturer's address at his own expense so that the defective part can be further claimed, unless the parties agree that the part need not be sent.
- The defective part must be properly packed and labelled so as to prevent further damage during transport.
- If the complaint is justified, the manufacturer sends at his own expense a new perfect part.
- If the situation so requires, the manufacturer or the supplier shall, after prior agreement, send his specialist to remove the defect. The complaining entity is obliged to pay the costs associated with this trip route in full if it is proved that the defect was not remedied by the complaining entity because of its inexperience or negligence of its obligations or that the provisions for the provision and duration of the warranty conditions were breached
    - If the complaint is unjustified, the buyer shall not be entitled to a free delivery of a replacement part or a repair free of charge.
    - The costs related to the replacing the defective part during the warranty period shall be borne by the buyer.
    - Repairs or service interventions carried out after the warranty period are always performed for a consideration.

Address for sending complaints:

Smart Heating Technology s.r.o
Dukelská 125
742 42 Šenov u Nového Jičína
Czech Republic

service@smartheating.cz
info@smartheating.cz

A valid version of the "Warranty and Complaint Conditions" is published on the manufacturer's official website

12 Declaration of Conformity

The manufacturer assures the user that it has worked out the EC declaration of conformity for the product – SMART hot water boilers. It can be sent to him at his request

Smart Heating Technology s.r.o
U Statku 653/24
Ostrava – Bartovice 717 00
Czech Republic
Company ID: 28616774, Tax ID: CZ28616774