„MODERATOR” Sp. z o.o.
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POLAND

Operating Instructions

Smok 30÷240kW
Automatic Biomass Burning Set

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Moderator

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Dear User,

Thank you for your purchase of our equipment. We would like to congratulate you on your good choice.

Moderator Spółka z o.o. has been manufacturing boilers utilizing proprietary technological solutions developed in late 70's in Hajnówka by engineer Kazimierz Kubacki. During last twenty years these boilers have undergone multiple technological changes and upgrades. We have also started production of automatic feeders intended for burning crumbled solid fuels, which combined with a boiler constitute complete Automatic Biomass Burning Sets (AZSB). This instruction manual is based on the latest information of the manufacturer. Due to ongoing development works on the boiler the manual is only applicable for the boiler it is delivered with.

AZSB is intended for heating water up to maximum 80 degrees Celsius in central-heating and hot household water installations as well as in process installations (wood dryers, presses, etc.).

This manual has been designed to assist users in boiler installation, operation, maintenance and servicing. It shall be read and understood before commencing with these activities.

1. Overview

1.1. Safety Instructions

The main condition of safe boiler operation is its correct connection to the central heating installation. This will only be possible after all connection and operation requirements discussed in these instructions are met and complied with. Failure to perform any action, due to involved costs of additional equipment installation will certainly affect the safety or cause the equipment operating costs to raise in future.

The equipment has been subjected to performance checks and tests, which all have been performed using carefully selected accessories (safety valves, thermal protections) and equipment. In order to guarantee preservation of declared high performance of the equipment, manufacturer-recommended equipment shall be used exclusively.

We would like to hereby advise against using substitute solutions, which have not been checked with that boiler and which do not have required approvals (Technical Supervision Office - UDT) and certificates (declaration of conformity, CE sign). We also advise against any unauthorized changes in the

equipment structure and against failing to follow safety instruction described in these instructions.

A failure to follow these recommendations may lead to serious threats and expose the operating personnel to health or life hazard.

In case of doubt, please contact our sales department or authorized servicing agent.

Safety Instructions for basic activities

Maintenance – during maintenance, the device must remain disconnected from power supply. the switch (fig. 8) must be in **0 (zero)** position. During maintenance always check tightness of connections and conditions of the cover seals.

Leaks – when filling the tank check if there are any foreign bodies under the cover, that could prevent it from being properly closed.

Head – keep in mind that the burner head stays hot long after the device has been switched off. All works on the burner head may only be performed after the temperature drops. The burner head must not be covered and must be kept clean.

Fire safety – leaving open covers or inspection holes or overfilling the container during burner operation may constitute an imminent fire threat. Too much fuel in the container will prevent tight closing of the cover:

- on each visit to the boiler room (at last once per 12 – 24 hours), it is necessary to check whether the fire water tank contains sufficient volume of water (the recommended water volume shall fit between min and max level indications),
- appropriate fire fighting equipment shall be available in the boiler room (acc. to fire brigade recommendations, appropriately sized fire extinguisher, etc.),
- do not store ashes in plastic or cardboard containers. Do not leave ashes in premises unsupervised (even if in non-combustible containers),

Protective equipment – chips, sawdust and ashes may contain carbon monoxide, dusts and allergens. When working with this material, use appropriate means of personal protection. Note that ashes may contain concealed glowing coal particles. When working with ashes, use suitable gloves.

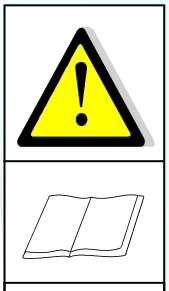
Clothing – When working in the boiler room, due to personal safety considerations, use infusible and non-combustible clothing.

Safety and Warning Signs

Please pay attention to warning and safety signs, minding their meaning and placement on the equipment. this is to avoid accidents.

Pay special attention in the boiler room keeping in mind that different parts of the boiler and systems may be hot.

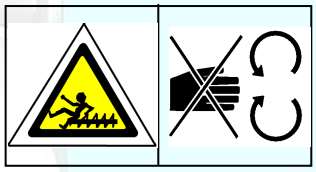
Keep a safe distance.



This boiler may only be operated by people knowledgeable with the content of this instruction manual.

Do not stand on the housing.

The device may periodically switch on without warning. Do not perform any works on a connected and switched on device.



The transport worm may start operating without warning. Switch off power supply before lifting the cover.

Rotating elements under caver, watch your fingers.

The container may contain carbon oxygen and dust. Vent the container before commencing with loading or prior to its opening.

This sign placed on pages of these instructions indicates a warning. Please read corresponding section with utmost care so as to avoid many dangerous situations in future.

Keep in that many parts and surfaces in a boiler room may have high temperatures. Pay special attention as doors may have higher temperature than other parts of the boiler. This also applies to smoke conduit and supply and return pipes. When staying in the boiler room, always stay alert.

Please note that ashes and fuel may cause allergic reactions. Also, during operation in the charging container, carbon monoxide may accumulate. We recommend wearing protective gloves and appropriate dust masks.

Remember to keep boiler room clean and in order. Leaving fuel spills on the floor may lead to a fire.

Note: The container cover must be opened carefully due to escaping combustion gases and flames from the glowing fuel, forming in result of sudden inflow of larger volume of oxygen from outside.

1.2. Warranty

1. Manufacturer grants 24-month warranty for the device, which includes workmanship and material faults.
2. Manufacturer guarantees correct operation of the Smok AZSB device, which is confirmed by the company seal.
3. Manufacturer recommends users to follow the guidelines listed below:
   - the first run of the device shall be performed by manufacturer's service representative ***** - *paid service*
   - after first year of operation, the device shall undergo ***obligatory, paid*** inspection, performed by ***Moderator service centre in Hajnówka*** ***** – this is the condition of warranty extension onto further 12 months.
4. The warranty shall not include damages caused as a consequence of incorrect use or normal wear and tear, refund of installation costs, refund of travel costs, damages caused by changes or repairs performed without manufacturer's authorization, indirect damages and losses resulting from unproductive days and any other resulting economic losses.
5. The warranty shall not include faults resulting from:
   - failure to follow installation guidelines stated in these operating instructions or resulting from regulations currently in force
   - incorrect operation and maintenance or due to the boiler use in a way, which conflicts with provisions of operating instructions (using incorrect fuel, leaving ashes after the heating season, failure caused by central heating installation freezing, inoperable or obstructed combustion gases exhaust system, shortage of water in the installation)
   - boiler application in uses other than specified in these operating instructions
   - in case of incorrect selection of the boiler output to the heat demand of the object.
6. All complaints shall be always filed to the boiler vendor. Along with the complaint, please provide the following:
   - photocopy of page 6 of the operating instructions, item 7 (with entered date and legible signature of the user)
   - fault description
   - a proof of device purchase
   - boiler output, head rated power
   - boiler and Smok device serial numbers

7. User Statement:

I hereby declare that I have acknowledged myself with the Moderator boiler operating instructions and that the device has been delivered according to order, new, complete and technically operational. Additionally a specialized company has instructed me on the device operating principles and has provided a complete set of documentation. I hereby acknowledge the recommendation of the Moderator boiler manufacturer to subject the device to regular technical inspections. In case of unjustified Moderator service team call to perform a warranty repair, I will cover full costs related thereto (man-hours and costs of transport in both directions).

***** For addresses and phone numbers see the last page of these operating instructions

* „MODERATOR" Service Department – Hajnówka, tel. 085 / 682-75-21

e-mail **:** serwis@moderator.com.pl

Date, company name or first and last name with legible signature

Declaration of Conformity

We,

Moderator Spółka z o.o.
11 Listopada 16a
17-200 Hajnówka
tel. (085) 682-75-20

hereby declare, on our own and sole responsibility that the product: Smok Automatic Biomass Burning Set, with serial number starting from 250, to which this declaration applies, meets the following requirements and standards, where applicable:

Directives	Standards
98/37/WE	EN-PN ISO 12100
97/23/WE	EN-PN 303-5

PREZES ZARZĄDU
mgr Mariusz Kubacki

Hajnówka 2007.11.15

1.3. Fuel

Only recommended fuels may be used.

AZSB is designed to burn crumbled fuels from renewable sources and wood and vegetable products, such as (chips, sawdust, bark, bricks, pellet) with humidity content of up to 25% if cast-iron head is used or 40% if ceramic head is used. As a substitute fuel for cast-iron heads for short period of time pea-coal may be used. Technical parameters of the device are specified for fuels with humidity content of up to 25% and calorific value of Q = 16.862 kJ/kg.

The higher the moisture content, the lower the calorific value. Increase of humidity causes drop of calorific value, which means that one will need twice as much fuel to achieve the same heating effect. A considerable part of thermal energy is wasted in the burning process for heating up the fuel and evaporating water (note: using wet fuel with moisture content of above 40% directly contributes to shortening of boiler's operational life and causes it to wear out prematurely). Additionally there is an increased risk of moisture condensation in the chimney. Life of a chimney exposed too condensate will be significantly shorter than in case of a dry fuel, and the draught of the chimney will also reduce.

During winter periods, increased moisture content of fuel creates the risk of fuel freezing in the container, which may lead to damage of the feeding system.

Avoid burning too fine fuels, in which dust content exceeds 5%. One shall also pay special attention when burning very dry sawdust (moisture content up to 10%), and avoid its too tight compacting. Failure to follow these requirements may lead to fuel sticking and if dusts are burned, to explosion of gases inside the container.

Chips and shall be crumbled down to particle sizes of 10-30mm. If chips are too roughly cut, there will be a risk of feeder damage.

Hygrometers are used for moisture content measurements (different types are used for sawdust and different for wood) and these are necessary equipment, which should be used when purchasing fuel (to check the actual moisture content) as well as during normal operation of the device.

Approximate data of different fuels (parameters for a 30 kW device):

Fuel type	Time of 1 c.m.* burning	weight of 1 c.m.	moisture content
	(h.)	*(kg)*	*(%)*
Bricks	**96**	**260**	**10**
Chips	**36**	**155**	**25**
Sawdust	**24**	**145**	**25**
Pellets	**168**	**700**	**10**

*c.m. – cubic meter

1.4. Technical Description

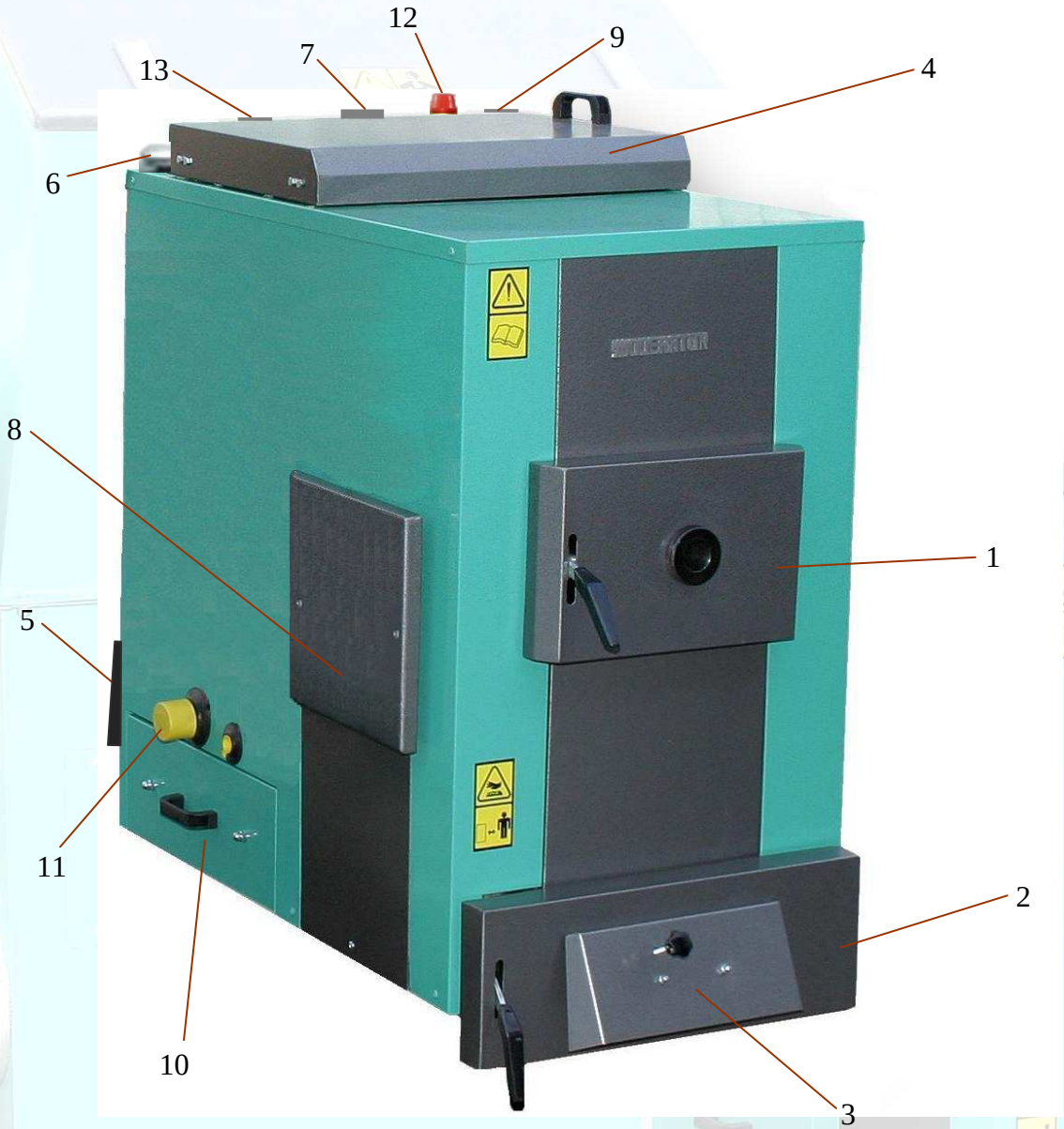
The AZSB consists of a Moderator-type boiler and Smok fuel feeder, manufactured by Moderator Sp. z o.o. in Hajnówka. The present instruction is applicable to all versions of the device, and that is to: :

- heat exchangers – 30, 60, 120, 240 kW
- cast-iron heads (40, 60, 120, 240 kW) and ceramic (30, 50, 100 kW)
- containers – 0.6, 1, 2, 6, 8, 10m^3 and other, custom-built

Boiler

The boiler (Fig. 1) is a heat exchanger operating in upper combustion system. Walls and grate are water cooled (the version supporting burners may have a cast-iron grate) and are made of quality sheet metal plates.

Lower-power versions of the boiler (30÷60kW) are additionally equipped with a ceramic barrier in the combustion chamber, which ensures better after-burning of exhaust gases. All versions of the boiler may be equipped with automatic ash removal system.



1. Ignition doors
2. Ash pan doors
3. Air throttle
4. Upper washout holes cover
5. Smoke conduit
6. Thermometer
7. Supply pipe
8. Head plug
9. Thermal protection sensor G1/2 muff
10. Ash pan washout
11. Return pipe
12. Safety valve
13. G 1/2 muff for thermostat

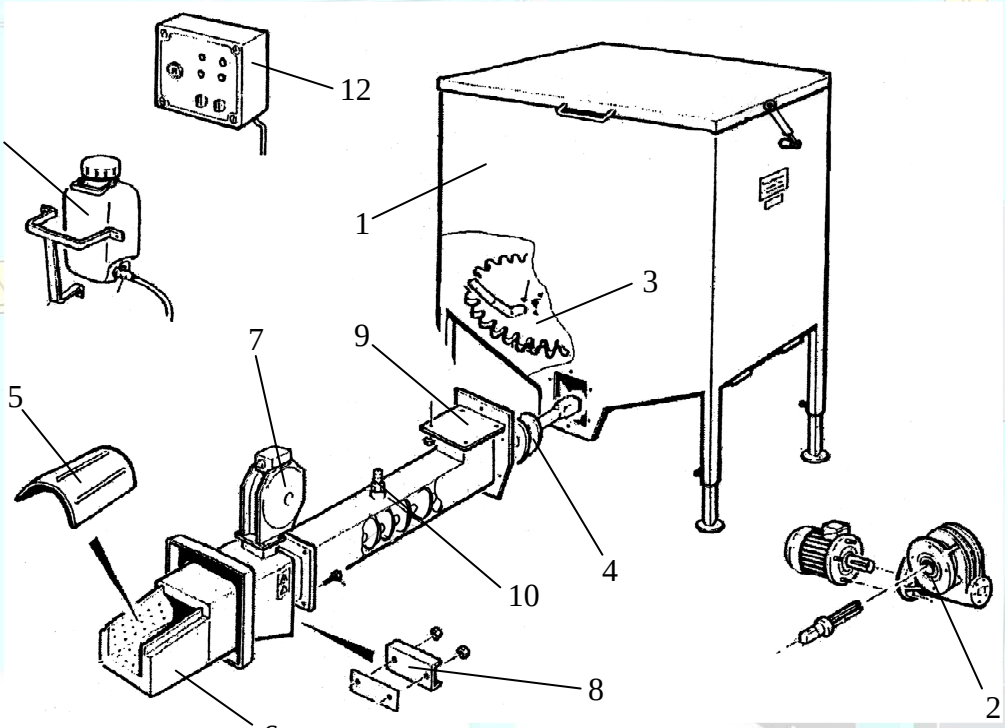
Fig. 1. Moderator-type boiler (version designed for use in ABB set) – main parts.

After the burner is disconnected, the boiler may be used for burning solid fuels in traditional system, with manual charging of the combustion chamber. Such burning shall be however treated as a substitute method to be used in special situations (e.g. power supply failures, damages to the feeder, etc.) and one shall aim at restoring the automated operation mode as soon as possible. In the emergency mode, manual charging is performed through ignition doors (1, Fig. 1). Bottom (ash pit) doors are equipped with an automatic gate (3. Fig. 1) ensuring flow of air in case of a power failure.

Head

Depending on the used fuel, two types of heads may be used: cast-iron head (for humidity of up to 25%) or ceramic head (20÷40%).

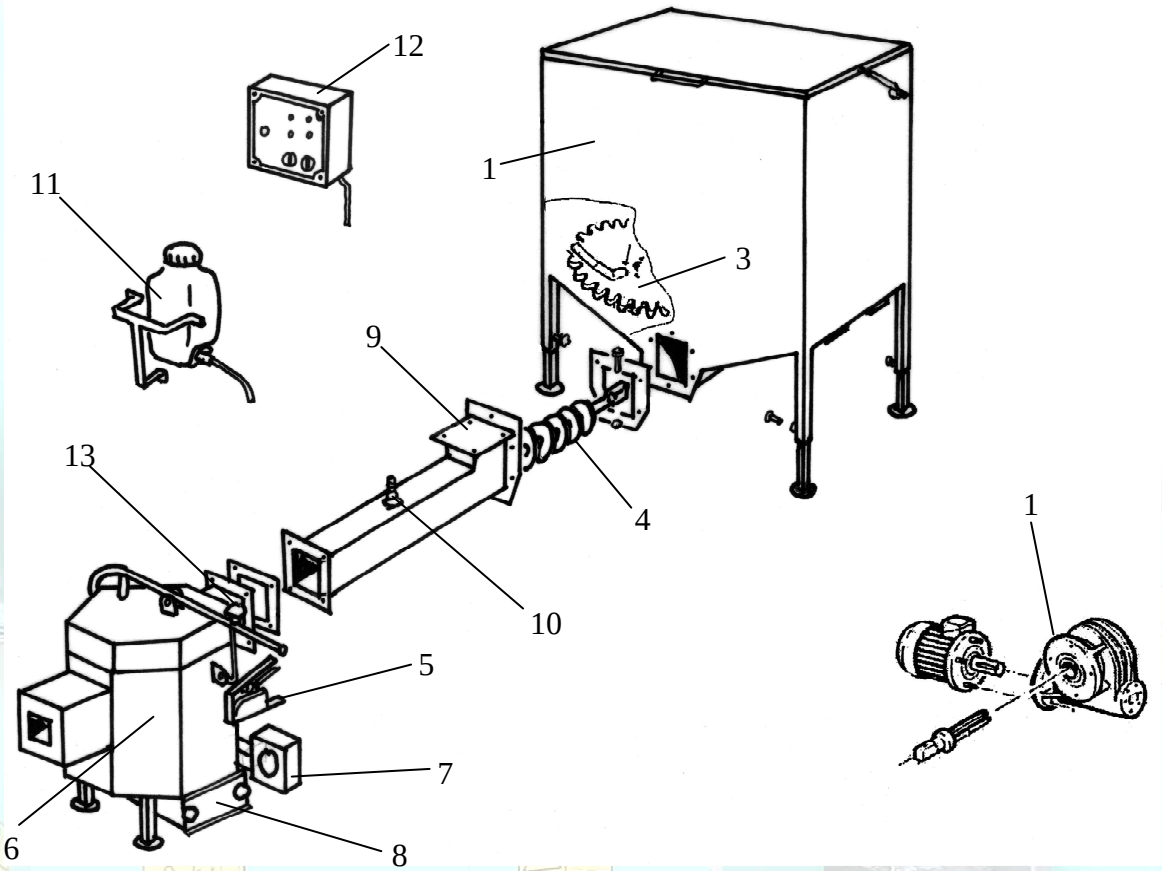
Cast-iron head (Fig. 2) is located inside the boiler combustion chamber. The head operating principle is the following. Fuel from the container (1) is transported to the head by a worm shaft meshed with mixers (toothed wheels). Fuel is fed to the head grate where in very high temperature, using air supplied by the blower, combustion process takes place. Fresh fuel supplied by the worm shaft pushes remaining ashes to the ash pan of the boiler. Flame, which heats up the boiler is automatically controlled by the head, according to the main control box settings.



1. Fuel container
2. Electric motor, gears, shaft
3. Toothed wheel
4. Worm shaft
5. Head cover
6. Head
7. Blower
8. Head washout
9. Maintenance peephole
10. Supply pipe
11. Fire water tank
12. Main control box

13.Fig. 2 Cast-iron head set.

Ceramic head (Fig. 3) is located near the boiler and thus only the flame enters the combustion chamber. The operating principle of this head is the same as of the cast-iron head, with the difference that ashes are removed to a special washout located under the head and may be removed by emptying a special cassette located there.



1. Fuel container
2. Electric motor, gears, shaft
3. Toothed wheel
4. Worm shaft
5. Limit switch
6. Ceramic head
7. Blower
8. Head washout
9. Maintenance peephole
10. Supply pipe with bee wax plug
11. Fire water tank
12. Main control box
13. Fixing screw

Fig. 3 Ceramic head set.

Containers

AZSB may include containers with varying volume between 0.6m^3 and 10m^3. The container is made of stainless steel sheet metal plates, and on its bottom a set of mixing wheels coupled with the worm shaft is installed. The shaft movement drives the toothed wheel (or wheels) which makes the fuel to move downwards. Different containers may be connected to the system. Available connections ensure equipment compatibility.

1.5. Equipment

The boiler is being delivered in completed state. Its basic equipment include: a thermometer, a G½(G¾) drain valve, a G¾(G1)safety valve, complete cleaning set, a drawer, cast-iron grate (only in AZSB30).

The feeder is provided partially assembled. Some parts of the feeder, after workshop tests are disassembled and packed inside the container. This is meant to facilitate transport and device handling to the boiler room. The feeder is equipped with all necessary elements permitting its installation outside the electric installation.

2. Assembly

2.1. General parameters

Maximum supply temperature – 80˚C
Maximum return temperature – 70˚C
Minimum recommended return temperature – 55˚C
Operating pressure - 1.5 bar (for versions above 50kW – 2.5 bar)
Thermal efficiency 84%
Combustion gases minimum temperature – 150ºC

2.2. Boiler Room

The boiler room shall meet requirements of the PN-87/B-02411 standard. Here are some of the most important of them:

- waterproof flooring
- steel or wooden doors lined with sheet metal, opening outwards
- 21x21 cm air supply hole in the bottom part of the boiler room
- at least 14x14 cm exhaust hole in the upper part of the boiler room

Equipment:

- tap
- sewage well
- sink

Forced ventilation must not be used.

2.2.1. Boiler Installation

Boiler installation shall be performed by installer with appropriate qualifications and experience (we advice to seek help from representative centres, whose installers have undergone training in Moderator Sp. z o.o.). A

faulty installation may cause premature wear of the boiler and threatens fire or may cause an explosion.

Moderator boilers are delivered assembled. During boiler installation, it is necessary to ensure its accessibility in such a way, so that boiler room walls do not render fuel charging, grate cleaning and access to the side washout and fan difficult.

2.2.2. Feeder positioning

Installation is the same for ceramic and cast-iron head versions.

Preparation:

1. Remove from the container all loose parts, remove the grate from the boiler (if equipped) and tightly close all air inlets to the device.
2. Make sure to leave 15÷20 cm in front of the burner head so that ashes could freely fall into the ash pan (this can be achieved by sliding the head into the boiler opening, prepared by the boiler manufacturer).
3. Find a place for the fire water tank and prepare a hose section of appropriate length for installation (included in the package). In order to ensure safe work, the water tank shall be fixed to a wall, rather to the side panel of the fuel container. Bottom of the water tank shall be at least 50 cm above the upper surface of the supply pipe. Check that water hose is not bent or twisted.
4. Make sure you have appropriate tools necessary to commence with installation (a complete set of keys).

Installation (identification of parts according to fig. 2 or 3):

1. Bolt the work shaft casing on to do the container.
2. Slide in worm shaft (4) into the inside of the guide and fix it using a M12x65 screw, fitted on the end of the worm shaft.
3. Attach the head (6) and fix it with screws (pay attention to careful installation of the seal).
4. Screw the blower (7) to the burner head.
5. Slide in the head (or smoke conduit) to the assembly opening in the boiler. After installation and tightening screws, in case of cast-iron head, install head cover. Install all seals with care.
6. Install the fire water tank (11), open the tap and make sure that the tank cover (nut) has an air suction hole.
7. Before filling the tank, fix tank's legs by tightening counter screws located on inner surface of legs. The tank must be levelled.
8. Connect electric installation and detectors (see description in the Installation of the control system and electric connections, par. 2.7).

2.3. Connecting to the Chimney

Boiler's smoke conduit shall be seated directly in the chimney, and after installation sealed along the contact line of: smoke conduit sheet metal – chimney brick. Chimney outlet shall be located 1 meter above the roof ridge. Square or rectangular chimneys shall be made of burnt brick; round chimneys (usually steel ones)shall be insulated over the whole height with at least 5-cm mineral wool layer.

When installing the smoke conduit in the chimney, one shall pay attention to the chimney damper lever (it is necessary to provide a space needed for its easy opening and closing).

Remember that combustion gases entering the chimney are hot, therefore the chimney damper lever will heat up. To operate the chimney damper, always wear protective gloves.

Boiler Power kW	Square Chimney cm x cm	Rectangular Chimney cm x cm	Round Chimney cm
up to 30	15 x 15	14 x 20	15
32-60	20 x 20	15 x 27	18
62-120	25 x 25		25

2.4. Boiler Connection to the System

The Boiler will operate correctly if the temperature inside the combustion chamber will be sufficiently high, which means that the supply water (on the boiler output) shall have the temperature in the range of 70 to 80^0 C, and that the water on return, not less than 55^0 C. Such operating parameters will protect the boiler against low-temperature material corrosion. In order to ensure correct operation of the boiler, the manufacturer recommends installation of a mixing valve.

Boilers rated 30kW have connections in the form of threaded G1½ stub pipes, and boilers rated 32÷60kW G2 stub pipes. Boilers rated above 60kW – have DN80 flange connections. Connecting stub pipes with the installation shall be performed using appropriate connectors. Identification of boiler parts according to the numbering on Fig. 1.

If a boiler is fitted with thermal safety valve (SYR 5067), install valve sensor in the G½ (9) muff (Fig. 1). Install the safety valve according to provided valve installation instructions (p. 17). The method of valve connection is presented on the diagram (Fig. 5).

Connect network water supply through the G½ (11) valve with a flexible hose, which shall be disconnected after water charge is filled. During filling, oven all venting along the installation and gradually close them after water

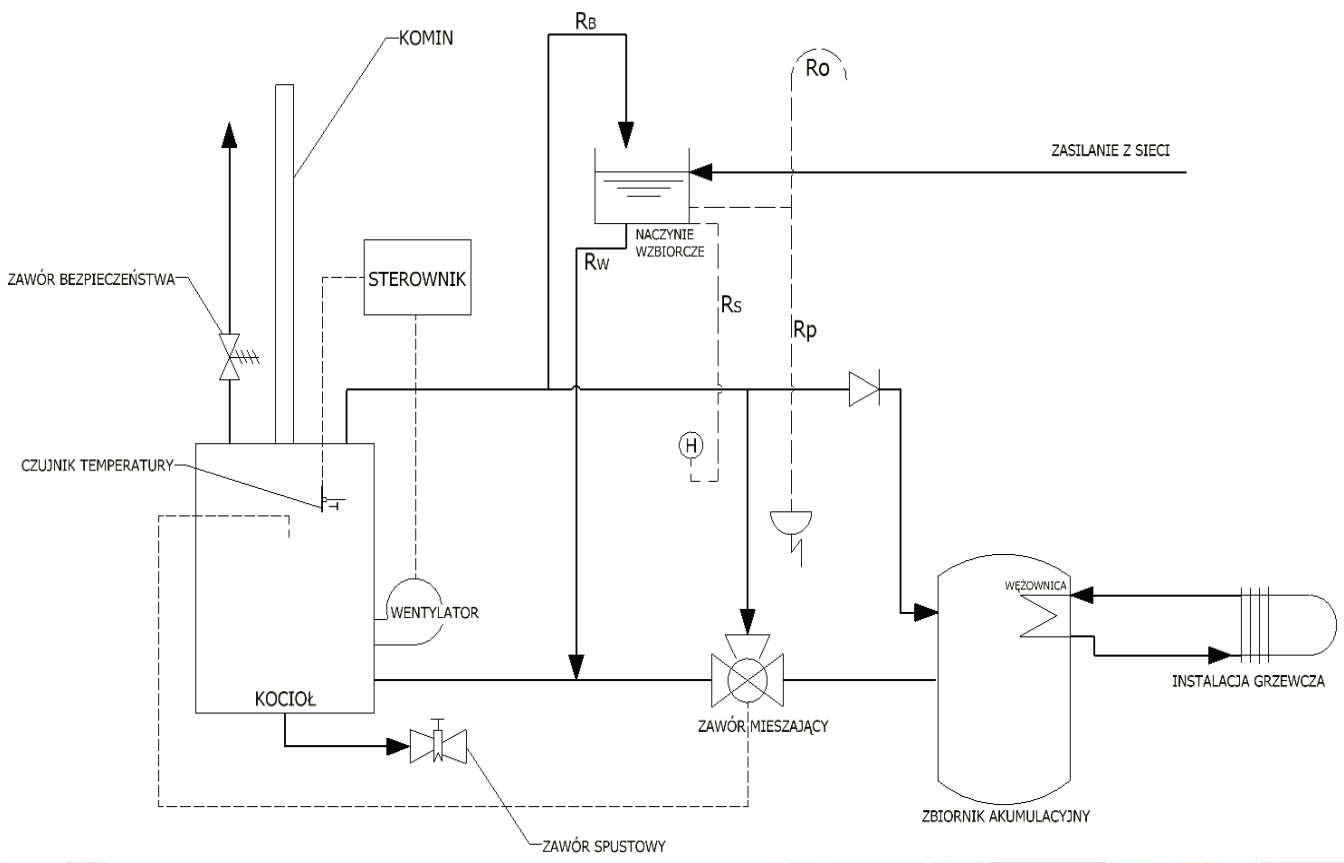
overflows in the overflow pipe of the pressure vessel. Installations operating without losses may be supplied with raw water, provided that its hardness does not exceed 10n. Otherwise water shall be pre-treated.

Install boiler accessories (handles and Bakelite knobs).

2.5. Protection of the installation

2.5.1. An open system

Moderator boilers operating in open central heating systems must be connected according to requirements of the PN-91/B-02413 standard, so that excess heat in the form of steam shall be removed through an open connection (RP overflow pipe) to atmosphere.



KOMIN – CHIMNEY
CZUJNIK TEMPERATURY – TEMPERATURE SENSOR
STEROWNIK – CONTROLLER
ZAWÓR SPUSTOWY – DRAINAGE VALVE
ZAWÓR MIESZAJĄCY– MIXING VALVE
WĘŻOWNICA - COIL
ZASILANIE Z SIECI - WATER PIPE SUPPLY
ZAWÓR BEZPIECZEŃSTWA - SAFETY VALVE
KOCIOŁ – BOILER
WENTYLATOR – BLOWER
NACZYNIE WZBIORCZE – PRESSURE VESSEL
ZBIORNIK AKUMULACYJNY – HEAT ACCUMULATION TANK
INSTALACJA GRZEWCZA – HEATING INSTALLATION

Fig. 4 Diagram of installation protection for boilers operated in open central-heating installations.

Installation requirements:

- pressure vessel with the volume of at least 4% of the total water charge

shape: cylindrical, type A. acc. to PN-91/B-02413-1-2
rectangular, type B, acc. to PN-91/B-02413-1-3

- safety riser tube (RB) with inner diameter of:

25 mm for 30 kW boilers
32 mm for 60 kW boilers
40 mm for 120kW boilers
60 mm for 240kW boilers

- riser pipe (RW) with inner diameter of:

25 mm for boilers up to 100kW
32 mm for boilers up to 300kW

- overflow pipe (RP)

inner diameters as RW and RB

- circulation pipe (RC) with inner diameter of 20 mm
- venting pipe (RO) and signalling pipe (RS) with inner diameter of 15 mm

No fittings permitting complete or partial closure of flow may be installed on RB, RW and RO pipes. The protective equipment and pipes shall be protected against freezing.

2.5.2. Closed Systems

Moderator boilers operating in closed systems must be equipped with air supply system (designed by Moderator Sp. z o.o. for Moderator boilers - we advise against installation of other air supply systems) safety valve and additionally thermal protection permitting safe discharge of excessive thermal power. Muffs welded in the upper jacket of the boiler are designed to facilitate installation of this equipment(items 9 and 12 on Fig. 1).

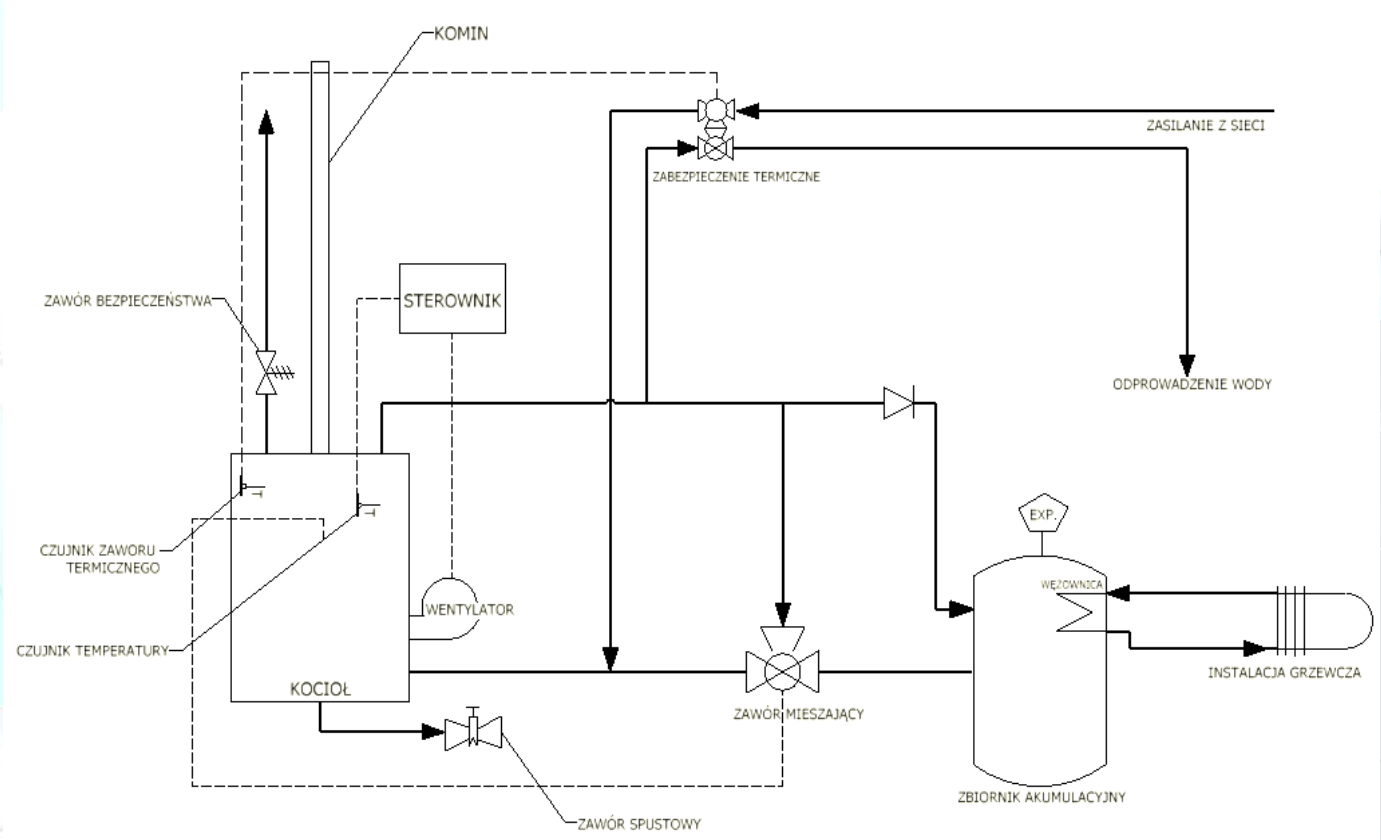
Moderator-type boilers are manufactured according to the EN-PN 303-5, standard, which permits boiler operation in closed systems, provided that specific requirements are complied with.

Special attention shall be paid in case of boiler versions designed for manual charging. The manufacturer's recommended SYR 5067 thermal protection is only and exclusively effective if pressure in water pipe network can be guaranteed at the min. level of 2.3 bar and if safety valve is installed.

This means that the system may not operate if water from in-house water intake is used (e.g. if power supply outage prevents hydrophore switching on), or in places where water supply outages are frequent.

In such situations, the boiler shall not be installed in a closed system or only its automatic version should be used (which can not burn solid fuels with manual charging). The automatic version is equipped with a thermostatic valve, which shuts off the device at the temperature of 95ºC.

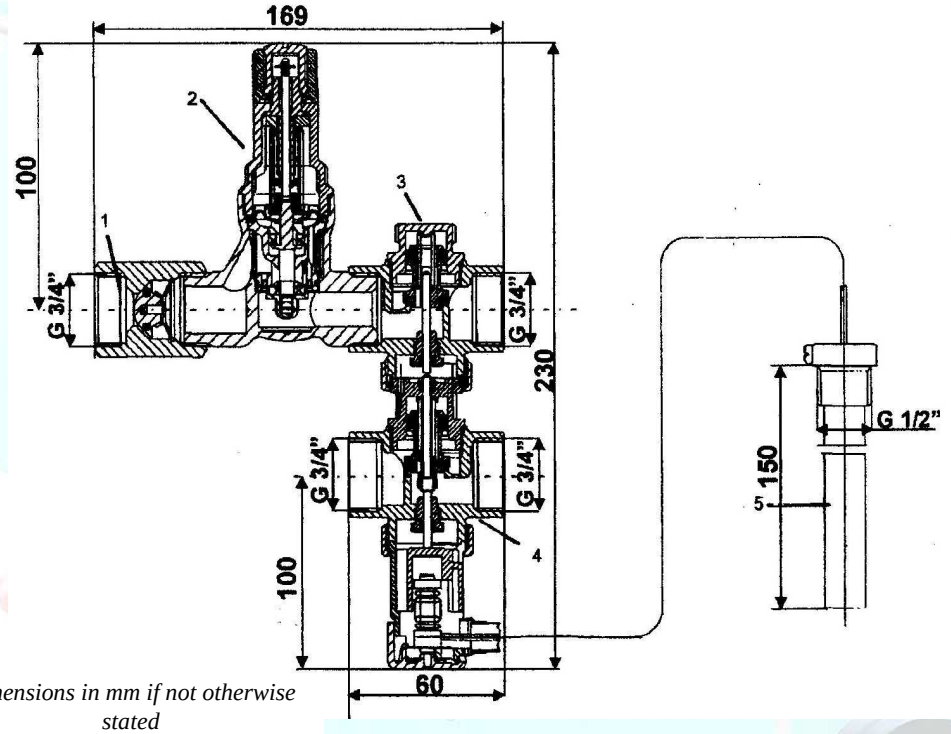
<u>Boiler installation without a reliable device to discharge the excessive thermal power is forbidden.</u>



KOMIN – CHIMNEY
ZAWÓR BEZPIECZEŃSTWA - SAFETY VALVE
CZUJNIK ZAWORU TERMICZNEGO – THERMAL PROTECTION VALVE SENSOR
CZUJNIK TEMPERATURY - TEMPERATURE SENSOR
KOCIOŁ - BOILER
STEROWNIK – CONTROLLER
WENTYLATOR – BLOWER
ZAWÓR SPUSTOWY – DRAINAGE VALVE
ZABEZPIECZENIE TERMICZNE – THERMAL PROTECTION
ZAWÓR MIESZAJĄCY– MIXING VALVE
ZBIORNIK AKUMULACYJNY – HEAT ACCUMULATION TANK
WĘŻOWNICA - COIL
INSTALACJA GRZEWCZA – HEATING INSTALLATION
ZASILANIE Z SIECI - WATER PIPE SUPPLY
ODPROWADZENIE WODY – WATER DRAINAGE

Fig. 5 Diagram of installation protection for boilers operated in closed central heating systems

2.5.3. Thermal protection



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dimensions in mm if not otherwise stated

Applications:

5067 thermal protection is designed to protect solid fuel boilers in heating installations fitted with thermostatic valves conforming to the PN-EN303-5 Polish Standard. It is particularly recommended for boilers, which are not equipped with cooling exchanger. Figure 1 presents installation principle, at a close distance from the boiler, with special consideration for such guiding and sizing of pipes so that no pressure losses occur.

Installation and operating principle: The 5067 thermal protection valve consists of the following elements: non-return valve (1), pressure reducer (2), thermally-controlled filling valve (3) and ejection valve (4), pressure sensor with a capillary tube(5).

The pressure reduction valve (2) is connected to the water pipe network. The output of the thermally-controlled filling valve (3) is connected to boiler's return line. The supply line to the input of thermally controlled ejection valve (4), which output side leads to the outlet. The pressure sensor is installed in the warmest part, optimally in the upper part of the boiler. The pressure reduction valve is firmly set to 1.2 bar, thus the operating pressure in the heating device shall be by 0.2 to 0.3 bar higher. This prevents opening of the safety valve in the installation. It is recommended to use a safety valve with settings of at least 2 bars.

If the preset opening temperature of ca. 90^{O}C is exceeded, the filling valve (3) starts to open. In order to maintain stable pressure in the heating installation, the ejection valve opens at 97^{O}C. After the ejection valve opens, hot water flows out of the installation and cold water may flow in from the supply line, this cools down the boiler. When boiler temperature drops to 94^{O}C, the ejection valve closes. Thermally controlled filling valve and temperature sensor help to restore the correct flow pressure in the heating installation.

When the temperature reaches 88°C, also the filling valve closes.

Build:

The thermal protecting device is controlled by two independent valves: the filling valve and the ejection valve. The body of the device is a die stamped brass element whilst other parts that contact water are made of stainless steel and temperature resistant plastic. All sealing elements are made of resilient and high-temperature resistant, heavy duty elastomeric rubber material. Springs are made of stainless spring steel. The sensor and capillary tube are made of copper, whereas the sleeve is additionally nickel-plated.

Valve opening is controlled by doubled temperature sensor. The fittings are self-venting. Elements of the valve, the valve seat and seal may be removed and cleaned without any change to pre-set opening temperature. Compact head of the temperature sensor may be conveniently disassembled during the valve body installation. The capillary tube from the sensor to actuator is protected by a special, metal flexible hose.

Pressure reducer operating pressure:	1.2 bar (factory-fixed)		
Maximum water inlet pressure:	16 bar		
Minimum required inlet water pressure :	2.3 bar		
Temperature		of opening::	of closing:
filling valve		90°C +0/-2°C	88°C +0/-2°C
ejection valve		97°C +0/-2°C	94°C +0/-2°C
Maximum operating temperature	135°C		
Capillary tube	1300 mm – standard length		
Weight	1.5kg		

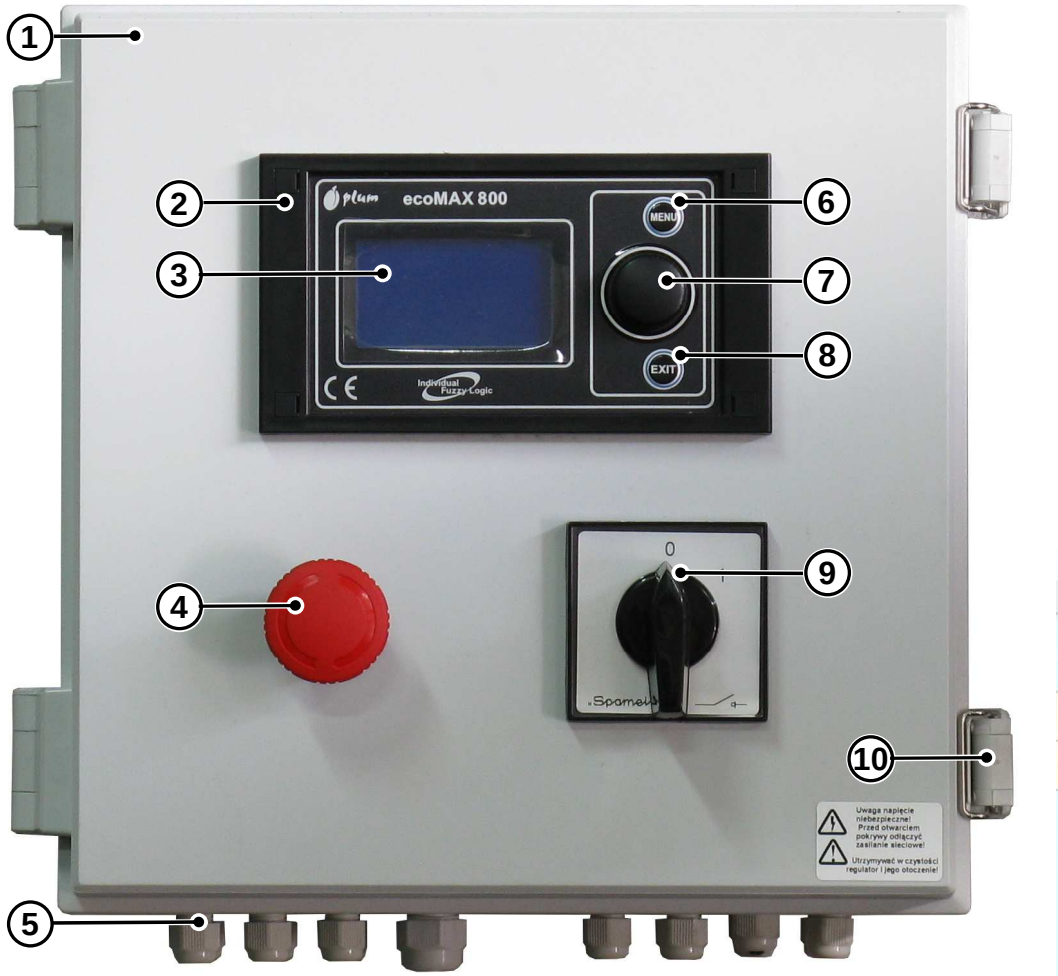
2.6. Installation of the control system and electric connections

Safety Guidelines

1. Before connecting the device, it is necessary to read boiler and controller operating instructions.
2. Before commencing with installation, repairs or maintenance or when performing any connecting works, it is absolutely necessary to disconnect the power supply and to make sure that there is no live supply on any of terminals or cabling.
3. the boiler room shall be equipped with 400V/50Hz electric power system, compliant with applicable regulations.
4. The electric system (regardless of its type) shall be terminated with power supply receptacle with a protective terminal. **Use of power receptacles without connected protective terminal may cause electric shock hazard!!!**
5. The boiler shall be connected to a separate power supply line, protected with 3-phase C10A/400V fuse set and a residual circuit breaker (for shock-protection).
6. The cabined, where electrical accessories are installed may only be opened by a qualified electric engineer knowledgeable with the device operation.
7. Location of power receptacle used for the controller connection shall be chosen in such a way, so that the power plug is readily accessible for quick disconnection in case of an emergency.
8. Electric cables shall be well fixed on their whole length. Wires shall be guided away from heating parts of the boiler and in particular away from hot elements of the head, flue conduit and chimney.
9. The control box must be installed and operated according to electric equipment handling principles.
10. The controller may not be exposed to water and to conditions causing water condensation, e.g..: sudden changes of the ambient temperature.
11. The controller shall be installed in a location preventing its heating to fuse temperatures above 50°C. It must not be installed on the fuel container wall.
12. The controller must not be operated if its enclosure is broken or damaged.
13. The controller shall be installed in a place inaccessible for children.
14. During thunderstorms the controller shall be plugged off the power supply network.

2.6.1. Description of control box

Figure 6 presents the AZSB or APSB control box cabinet.



1. Controler front panel
2. ecoMAX800 controller panel
3. Display
4. Emergency stop pushbutton
5. Cable glands
6. MENU button
7. Select / change / accept button
8. EXIT button
9. Controller power switch
10. Enclosure lid hook

Fig. 6. Front view of the control cabinet.

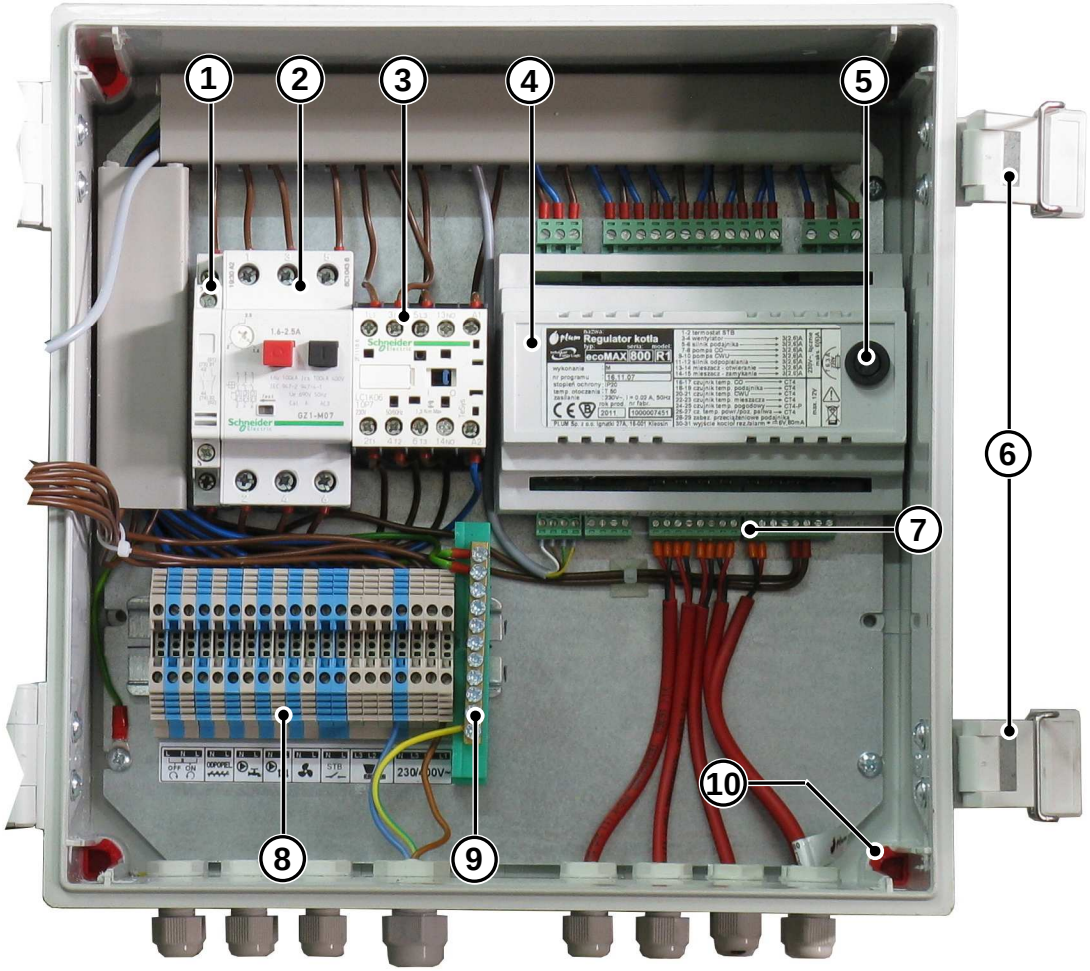
Details regarding ecoMAX 800 R controller operation and settings are provided in the controller's operating manual, enclosed with the set.

2.6.2. Control Box Installation.

The control box shall be installed on the boiler room wall in a place, which will ensure easy access for maintenance purposes. Below is the description of the control box installation procedure:

1) Remove the ecoMAX800R control box from its packaging.
2) Undo hooks (10) (fig. 6) and the front lid (1) (fig. 6).
3) Using a flat screwdriver, pry and remove 4 red plugs (10) (fig. 7) located in inner corners of the enclosure.
4) Using a Ø8 mm drill bit, drill holes in the plastic under removed plugs.

5) Place the control box against the wall in the place intended for its installation and mark 4 holes (e.g. using the drill bit)
6) Using Ø8 drill bit, drill at least 80mm-deep holes in the wall .
7) Attach the box to the wall using expansion plugs.
8) Having performed all of the activities listed above, proceed with electric connections of the device.



1. Motor switch aux. connector
2. Motor switch
3. Feeder contactor
4. Controller output module
5. Fuse
6. Lid closing hook
7. Sensors terminal strips
8. Terminal strip (high-voltage side)
9. PE protective line terminal strip
10. Plug

Fig. *7. Control box - inside view.*

Cables must not be guided through the control box enclosure without using cable glands.

The controller must not be installed on the boiler, on the worm shaft pipe, on flue ducts, on the chimney nor on the fuel container or on any surfaces that may heat up above 50°C.

2.6.3. Electric connections

Before commencing with electric connection, it is necessary to install the wiring (not included) in the boiler room, according to applicable regulations. Cables shall be guided inside casing pipes or dedicated cable trays. This work shall be performed by a licensed electric engineer. It is recommended to use cables with cross sections stated in Table 1 for wiring of respective circuits.

Cross-sections of cables to be used for wiring:

Table 1. Minimum required cable cross sections

Circuit	Identification	Cable type	Cable cross-section
Power supply	N L3 L2 L1 230/400V~	H05VV-F 300/500V	5x1.5 mm^2
Feeder (feder motor)		H05VV-F 300/500V	4x1.5 mm^2
STB	STB	H03VV-F 300/300V	3x0.75 mm^2
Blower		H03VV-F 300/300V	3x0.75 mm^2
Central-Heating Pump		H03VV-F 300/300V	3x0.75 mm^2
Hot Water Pump		H03VV-F 300/300V	3x0.75 mm^2
Ash removal (option)		H03VV-F 300/300V	3x0.75 mm^2
Mixing valve actuator	OFF ON	H03VV-F 300/300V	4x0.75 mm^2
Connections to outputs no. 16 – 31 shall be made using the H03VV-F 300/300V cable, with cross-section of 2X0.75MM^2.			

APSB or AZSB devices cooperating with the controller are connected to terminal strips (7) and (8) (see fig. 7). These terminals can be accessed after the front cover of the controller (1) is opened (fig. 6).

Under terminal strip (8) (fig. 7) there is a label sticker located, which is shown on fig. 8.

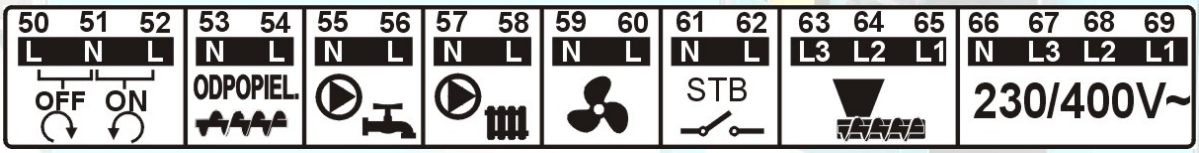


Fig. 8. The label under the (high-voltage) terminal strip.

Terminals (7) (fig. 7) are identified on the label (fig. 9) located on the controller output module, above the following terminals.

Fig. 9. Description of the sensors terminal strip.

When connecting cables to the controller, remember to use cable ferrules, which will prevent cable frying. On end sections of cables with removed insulation, on the feeder motor side eyelet terminals shall be crimped.

Tin-plating of cable ends connected to terminal strips is not permitted.

POWER SUPPLY

For controller's power supply, use a cable with the minimum cross-section as specified in table 1. Cables shall be connected to terminals no. 66, 67, 68, 69 of the terminal strip no. (8) (fig. 7), identified with the symbol shown on the figure 10. The protective wire shall be connected to a terminal of the PE terminal strip (9) (fig. 7).

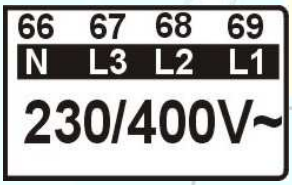


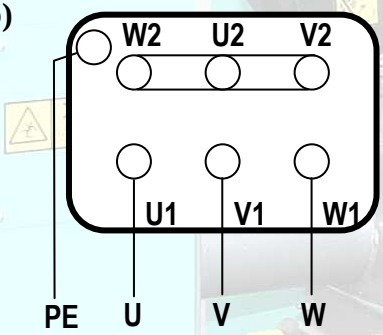
Fig. 10. Identification of terminals – power supply.

FEEDER

AZSB and APSB are equipped with 3-phase ~400V/50Hz (fig. 11a) motors. To connect the motor use a cable with the minimum cross-section as specified in the table 1. Winding of the motor shall be connected in star to (fig. 11b). The motor is supplied from the terminals of the (8) terminal strip (fig. 7) identified with the symbol shown on fig. 11c. The protective wire shall be connected to a terminal of the PE terminal strip (9) (fig. 7).

a)

b)



c)

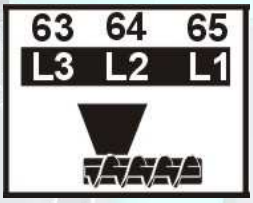


Fig. 11. a) gear-motor, b) motor connection terminals with cover removed, c) controller terminals used for connecting the gear-motor.

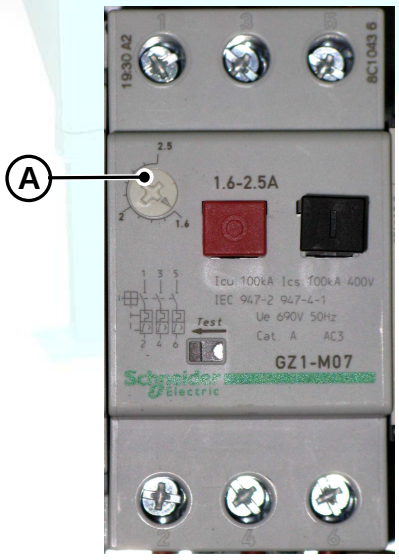


Fig. 12. Motor switch.

Having connected the motor, it is necessary to check worm shaft rotation direction. In order to do this, it is necessary to set the LIGHT mode on the ecoMAX800 controller (see ecoMAX800 controller operating instructions) and then switch on the feeder. the The worm shaft shall rotate in the direction causing the fuel to be pushed into the head. If that is not the case, it is necessary to switch phases on POWER SUPPLY terminals.

Setting the motor thermal protection switch

The purpose of the motor thermal protection switch (fig. 12) is to protect the feeder motor against fuel feeding system overloading consequences. The motor thermal protection switch shall be pre-set with the A knob (the arrow on fig. 12) to appropriate current, according to the table 2. The current setting depends on the power of used motor driving the fuel feeding system. Motor rated current is indicated on the feeder motor rating plate.

Values of motor protection switch currents are specified in the table 2:

Table 2. Current values.

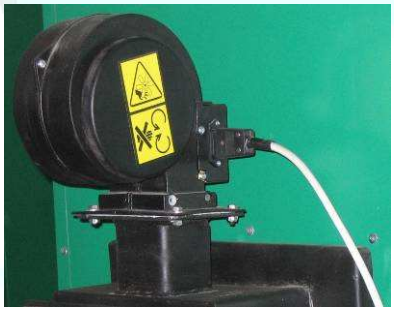
Motor power [kW]	Motor rated current [A]	Current to be set on the protection switch [A]
0.55	1.5	1.7
0.75	2	2.2
1.1	2.8	3.1
1.5	3.4	3.8

If the protection switch is set incorrectly (e.g. too high value), then the device may "get stuck", which in turn may lead to motor overheating and burning or breaking the gear-motor fixing. Too low current may cause frequent trips of the switch.

Rated current values specified in the table 2 may actually slightly differ from those stated on the rating plate.

BLOWER

The line that feeds the blower shall be connected to a plug (fig. 13b), which is delivered with the device. The blower shall be supplied off terminal strip (8) terminals (fig. 7) identified with the symbol presented on figure 13c. The protective wire shall be connected to a terminal of the PE terminal strip (9) (fig. 7). The recommended cross-section of the cable used to connect the blower is specified in the table no. 1.

a) 

b) 

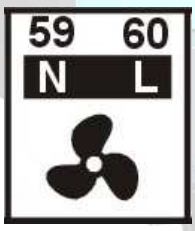
c) 

Fig.13. a) view of the blower (cast-iron type), b) blower plug, c) identification of connection terminals.

SAFETY TEMPERATURE BREAKER – STB

a) b)

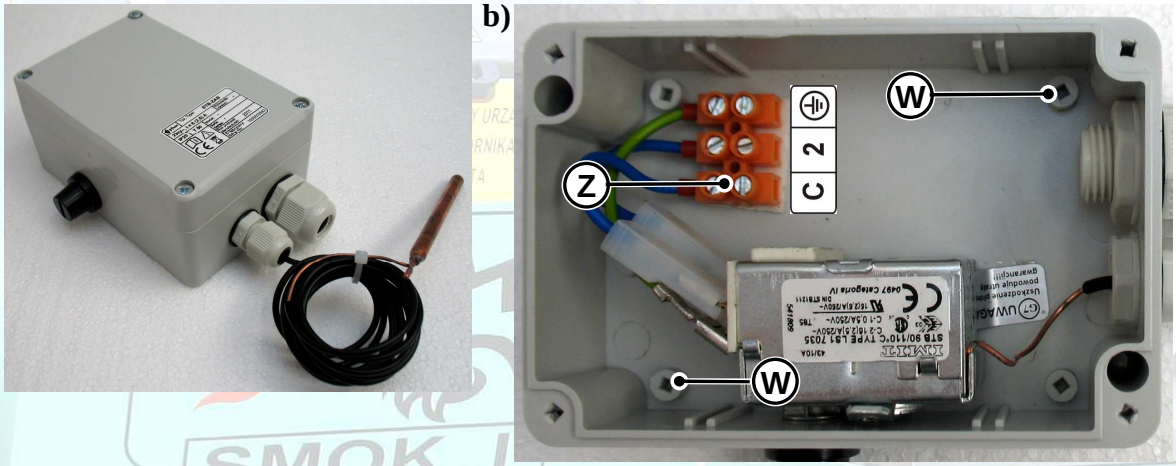


Fig.14. a) STB temperature limiter, b) STB with cover removed

The role of the safety temperature limiter STB (fig. 14a) is to disconnect blower and feeder power supply when the temperature exceeds 95°C on the central heating system supply pipe. The limiter is installed directly on the boiler, close to the power supply pipe, as shown on fig. 15a. Having undone 4 screws, the enclosure lid shall be removed. Next the limiter box shall be installed on the boiler using 2 screws in openings (W) (fig. 14b). Cables are attached to the connector (Z) (fig. 14b). the protective line is connected to the terminal identified as PE. Remaining two lines are connected to terminals C and 2. If cables connected to terminals C and 2 are exchanged, this will not affect the controller nor STB operation. On the side of the controller, the cable shall be connected to terminal strip (8) (fig. 7) terminals identified with the symbol shown on figure 15b. The protective wire shall be connected to a terminal of the PE terminal strip (9) (fig. 7). The recommended cross-section of the STB connection cable is shown in table 1. The STB capillary and the boiler temperature sensor shall be attached to the supply pipe with the fixing clip (delivered in the kit) within 10÷15 cm away from the stub pipe or the connecting flange (fig. 15a). Having performed all of the above tasks, the sensor shall be thermally sealed with the pipe.

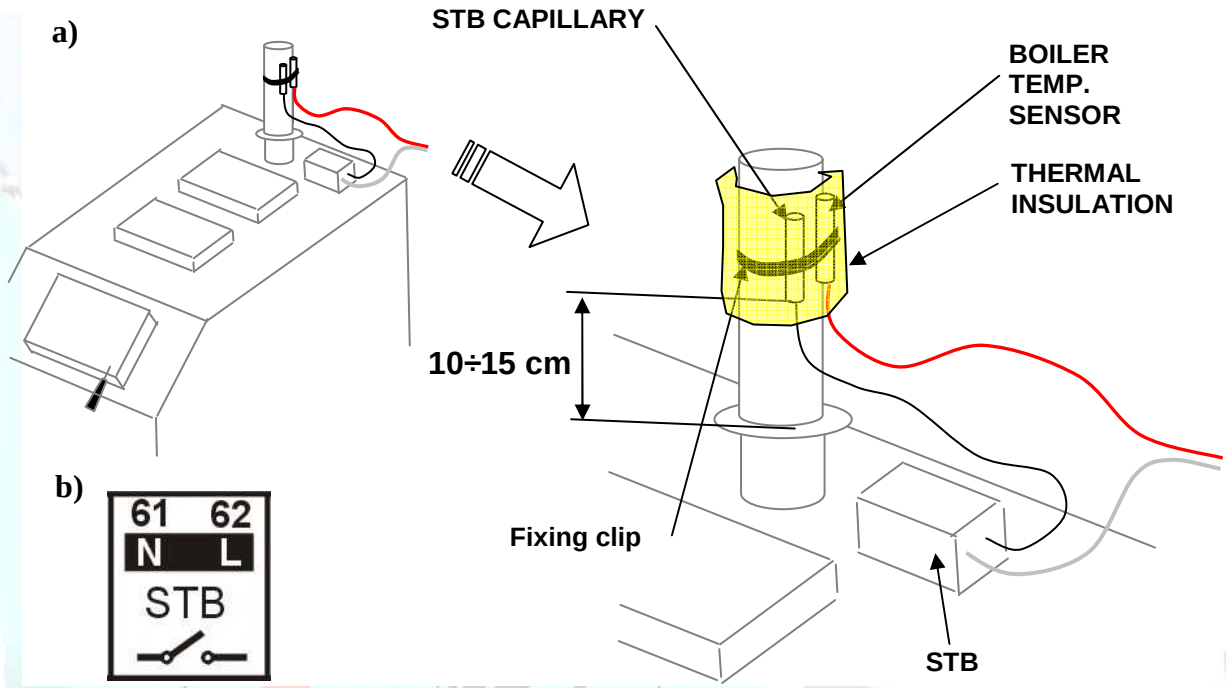


Fig.15. a) STB installation, b) identification of controller terminals

Regulations in force require safety time limiter installation.

CENTRAL HEATING PUMP

The circulating pump shall be connected to terminal strip (8) (fig. 7) terminals identified with the symbol shown on figure 16. The protective wire shall be connected to a terminal of the PE terminal strip (9) (fig. 7). The recommended cross-section of the wire used for pump connection is presented in table 1. Connection on the side of the pump shall be made according to the pump manufacturer's technical documentation.

Fig.16. Identification of connecting terminals.

HOT WATER PUMP

Hot water container pump shall be connected to terminal strip (8) (fig. 7) identified with the symbol shown on figure 17. The protective wire shall be connected to a terminal of the PE terminal strip (9) (fig. 7). The recommended cross-section of the wire used for pump connection is presented in table 1. Connection on the side of the pump shall be made according to the pump manufacturer's technical documentation.

Fig.17. Identification of connecting terminals.

ASH REMOVAL

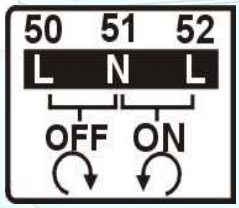
The cable used to connect the ash removal system motor shall have the cross-section specified in table 1. Ash-removal motor winding shall be connected according to the diagram located inside the connection box.

Fig.18. Identification of connecting terminals.

Power supply of the ash removal motor shall be connected to terminals shown on figure 18. The protective wire shall be connected to a terminal of the PE terminal strip (9) (fig. 7). After the motor is connected, it is necessary to check form worm shaft rotation direction. The worm shaft shall rotate in the direction causing ash to be pushed off into the container. If this is not the case, then it is necessary to change motor wiring connections.

The ash removal system is standard feature in AZSB 100 GC, AZSB 120 GŻ, AZSB 240 GC and GŻ units.

MIXING VALVE ACTUATOR



The mixing valve actuator shall be connected to the terminal strip (8) (fig. 7) terminals identified with the symbol shown on figure 19. The protective wire shall be connected to a terminal of the PE terminal strip (9) (fig. 7). The recommended cross-section of the actuator's connecting cable is stated in table 1.

Fig.19. Identification of connecting terminals.

The actuator supports only mixing valve servos equipped with limit switches. Use of other mixing valve servos is not allowed. One may use actuators with the full rotation time between 30 and 255s.

Detailed information regarding connection and configuration of the controller to support the mixing valve actuator can be found in the controller operating instructions, enclosed with the boiler.

BOILER TEMPERATURE SENSOR

The boiler temperature sensor shall be connected to the supply pipe as shown on fig. 15a and connected to terminals no. 16 and 17 of the controller, which are identified with the symbol shown on figure (fig. 20). In order to extend the sensor cable, one may use a cable with cross-section stated in table 1, which does not exceed 10 m in length, as this may adversely affect temperature readouts accuracy. Installation of sensor cable along power supply lines shall be avoided. It is necessary to maintain at least 10 cm spacing.

Fig.20. Identification of connecting terminals czujnika temp. kotła.

The sensor shall be installed dry.
Do not prime with oil or other liquids!!!

FUEL FEEDER TEMPERATURE SENSOR

The measuring sensor (C) (fig. 22) shall be installed in the (T) sleeve and fixed by tightening the (S) screw. In order to prevent sensor's metal enclosure against damage, the screw shall be tightened by hand rather than using a key or a wrench. Connect the sensor to terminals no. 18 and 19 of the controller, which are identified with the symbol, as shown on fig. 21. In order to extend the sensor cable, one may use a cable with cross-section stated in table 1, which does not exceed 10 m in length, as this may adversely affect temperature readouts accuracy. Installation of sensor cable along power supply lines shall be avoided. It is necessary to maintain at least 10 cm spacing.

Fig.21. Identification of connecting terminals.

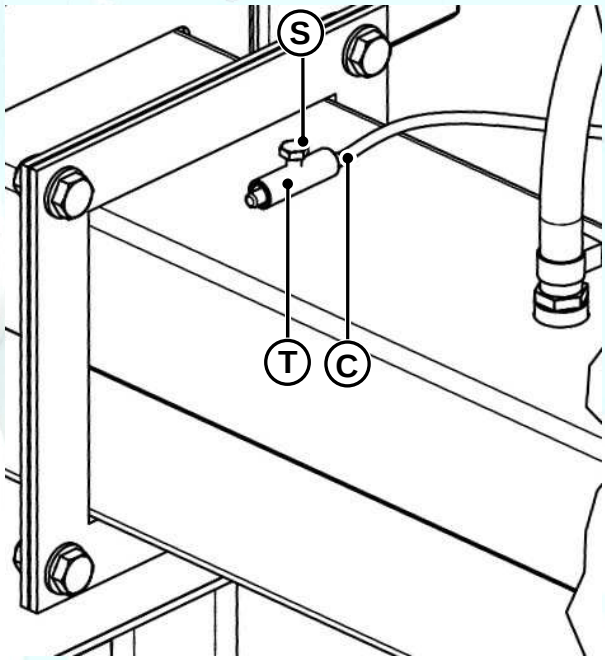


Fig.22. Feeder temperature sensor installation.

HOT WATER TEMPERATURE SENSOR

The sensor shall be installed in the hot water contained in a dedicated place. Connect the sensor to terminals 20 and 21 of the controller identified with the symbol as shown on fig. 23. In order to extend the sensor cable, one may use a cable with cross-section stated in table 1, which does not exceed 10 m in length, as this may adversely affect temperature readouts accuracy. Installation of sensor cable along power supply lines shall be avoided. It is necessary to maintain at least 10 cm spacing.

Fig.23. Identification of hot water sensor connecting terminals.

FIRST MIXER TEMPERATURE SENSOR

If a mixing valve with an actuator is used, the actuator shall be connected with a mixer sensor. Connect the sensor to terminals no. 22 and 23 of the controller, identified with the symbol as shown on fig. 24. In order to extend the sensor cable, one may use a cable with cross-section stated in table 1, which does not exceed 10 m in length, as this may adversely affect temperature readouts accuracy. Installation of sensor cable along power supply lines shall be avoided. It is necessary to maintain at least 10 cm spacing.

Fig.24. Identification of mixing valve temperature sensor connecting terminals.

In case of extended central heating systems with more than one mixing valve actuators, it is possible to expand the controller with additional expansion module MX.01, which supports two mixing systems.

WEATHER SENSOR

This sensor shall be installed on the coldest wall of the building (usually this will be the northern face), under a hood or an awning. The sensor must not be exposed to direct sunlight nor rain. The sensor shall be installed at least 2m above the ground level, far from windows, chimneys and other sources of heat that could affect temperature readings (at least 1.5m away). The sensor shall be connected to terminals 24,25 of the controller, identified with the symbol as shown on fig. 25. To connect the sensor, one may use a cable with cross-section stated in table 1, which does not exceed 10 m in length, as this may adversely affect temperature readouts accuracy. Installation of sensor cable along power supply lines shall be avoided. It is necessary to maintain at least 10 cm spacing.

Fig.25. Identification of weather sensor connecting terminals .

FUEL LEVEL SENSOR (applicable to versions with a ceramic head)

Te limit switch of the head fuel level sensor is accessible after the yellow cover (O) is removed (fig. 27). Cables shall be connected to COM, NO terminals of the (W) limit switch. Normally-open (NO) terminal. When the „tongue" located in the combustion is lifted, the circuit shall be closed. The limit switch cable shall be guided through the cable gland (D) located on the bottom of the yellow cover. On the controller side, the cable shall be connected to terminals no. 26 and 27 (fig. 26).

Fig.26. Identification of the fuel level sensor connecting terminals.

If the fuel level is exceeded, the limit switch will trip. The controller will stop feeding fuel to the burner head. The fan will continue to operate. The fuel will burn off and the fuel level will drop, the limit switch will open and feeding will restart. If the limit switch does not re-close within 30 minutes, a warning message "HEAD FULL" will be displayed. The controller will switch to STOP mode and pumps will continue to operate.

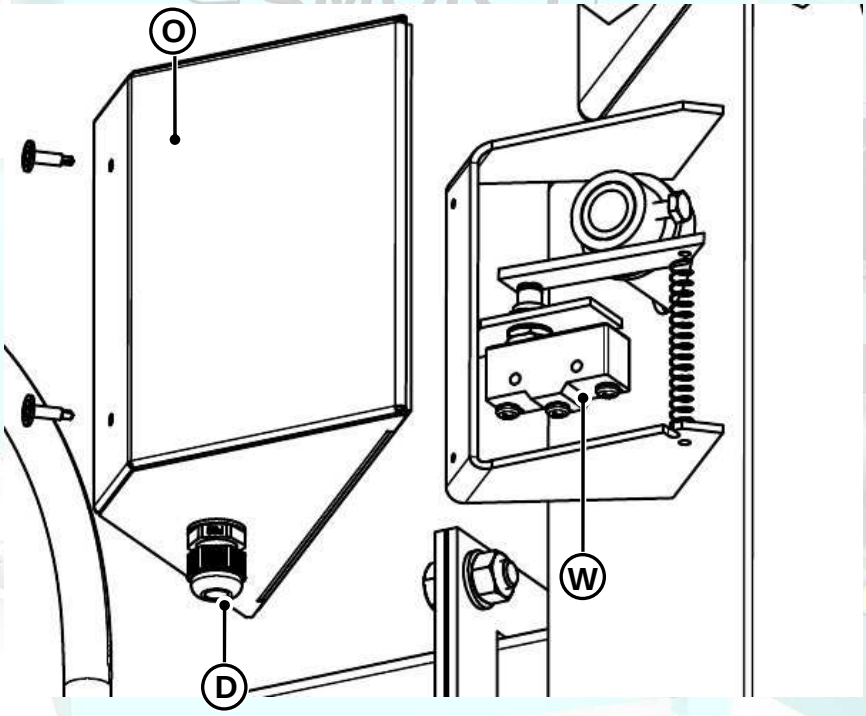


Fig.27. Location of the limit switch

If outputs 26 and 27 are not used (this is the case in cast-iron head versions of the unit) then after the temperature sensor is connected, one may enable the return protection function in the controller.

The following table presents maximum loads of respective outputs.

Table 3. Maximum output loadings.

Circuit	Identification	Maximum current [A]	Remarks
Feeder (Feeder motor)		1.7 (0.55kW)	depending on the rated power of the motor used
		2.2 (0.75 kW)	
		3.1 (1.1 kW)	
		3.8 (1.5 kW)	
Blower		2.6	
Central Heating Pump		2.6	
Hot Water Pump		2.6	
Ash Removal (optional)		2.6	
Mixing Valve Actuator		2.6	
KEEP IN MIND THAT THE TOTAL CURRENT OF ALL DEVICES CONNECTED TO THE CONTROLLER (BLOWER, CENTRAL HEATING PUMP, HOT WATER PUMP, ASH REMOVAL, MIXING VALVE ACTUATOR) MUST NOT EXCEED 6A.			

3. Device Operation

3.1. Technical Description

The worm shaft feeds the fuel to the burner at a pre-programmed rate. The device is designed to work in such a way so that the flame in the grate does not go out. This is ensured by flame suspension function, which remains active when the water in the central heating system meets preset values. In the Run mode <OPERATION> the feed parameter („feeding time - operation") sets the duration of the worm shaft feeder operation and the pause parameter („feeding stop - operation") sets the duration of pauses between its activation. When the water in the boiler achieves the temperature set on the controller, the device will automatically switch to the <CONTROL> mode. In this mode the feed and the pause parameters have the same meaning, whereas the pause parameter is scaled in minutes. Additionally the device operation is assisted by thermostatic sensors responsible for maintaining the preset temperature of supply water from the boiler and for control of head correct temperature and overall safety.

3.2. Working Settings

Duration of the „feeding time - operation" and „feeding stop - operation" periods must be set according to the actual type of fuel used. The following table presents approximate pres-et times for various devices, depending on the type of fuel used.

Head Power (kW) (min.)	**Fuel type**	**Container Volume** (m3)	**"Run" mode** feeding time - operation (s) feeding stop - operation (s)	**"Suspend mode"** feeding time - operation (s) feeding stop - operation (min)
40	sawdust	0.6	5 20	6 9
40	bricks	0.6	3 40	4 12
50	chips	1	5 25	4 10
100	sawdust	6	15 35	10 6
120	pellet	10	5 40	4 6

The pause duration in the <CONTROL> mode may not bee too short and too long in the <OPERATION> mode, as water in the boiler is already hot, and if overheated may cause the overheat protection system (STB) to trip and automatically switch off the device.

This problem may be particularly visible in spring, when user forgets to change the control box settings despite the increase of the outdoor temperature.

The device must operate using both these modes. The <CONTROL> mode must be initiated and last significantly longer than the <OPERATION> mode. This will ensure appropriate head cooling. If during operation user connects additional heat loads, then the thermal power may be insufficient and in such case the system will only work in the <OPERATION> mode. This may lead to the head overheating and cause it to wear prematurely.

Supply water temperature setting

Temperature of supply water is measured by a thermostatic sensor installed close to the boiler supply pipe or directly on the pipe. The temperature shall be set to ca. 80^0 C, which will allow to ensure its optimum performance. Appropriately selected parameters will affect combustion parameters, including the temperature of combustion gases. The temperature of gases in the chimney may not be too low, as it will cause condensation, which will damage the chimney and the boiler. On the other hand, too high combustion gases temperature will result with unnecessary heat losses.

Blower air volume control

The correct volume of air needed for combustion can be determined by watching the colour of the flame: optimum colour is yellow. A smoking, dying down flame requires more air. Sharp, short flame, some times lightly bluish or transparent indicates too much air. The air volume can be modified via the control box menu. Additionally the blower has mechanic throttle to control air flow. The throttle is equipped with a spring preventing complete shut-off of air supply.

Feeder maximum temperature adjustment

The flame sensor measures the temperature on the feeder. The upper threshold of the feeder anti-overheat protection is set from the main control box. If the feeder temperature exceeds the preset value, then the controller will stard the feeder for a pre-programmed time of 8min. During this time air supply will be shut off and pumps will be on. After the fuel is “pushed out”, the controller will switch off the feeder and will no longer switch it on, even if the feeder temperature is still high.

3.3 Burning

3.3.1. Ignition

For ignition, use dry duel with humidity content of up to 20%. Firelighters may be used, paper (except from newspapers) or cardboard. A batch of fuel shall be fed into the head’s combustion chamber manually, after the mode is switched to LIGHT, on the controller, with the feeding being switched on. When the fuel appears on the burner grate, it shall be ignited and the blower shall be started using the blower fan switch.

After about 5 minutes the flame should stabilize. Then, one shall press EXIT and the controller will resume operation in automatic OPERATION mode. If the fuel batch fed puts out the flame, the procedure shall be repeated. The activities are the same for both head types: the cast-iron head requires no further maintenance and after ca. 1 hour may be left unattended.

In case of ceramic heads, first ignition of the boiler involves also drying and burning-in the combustion chamber (use dry fuel with humidity content of up to 20%). The process shall last ca. 3 days. The combustion chamber burning-in shall be performed in such a way, so that the brick colour lightens. Having completed with the boiler drying, it is necessary to stop and cool it down naturally by some 12 hours. Before the next (and each successive) start of the feeder, in order to prepare it for continuous operation under full load, it is necessary to warm up the ceramic chamber first, then switch to continuous burning. For burning, use fuel with moisture content of 20 to 40% (provided that the burning process runs continuously, in appropriately preheated chamber). Please keep in mind that if the chamber is not sufficiently heated up, wet fuel

may simply put down the flame. It is necessary to pay attention to correctness of the <CONTROL> mode settings as too much fuel may cause the limit switch to trip (protecting against head combustion chamber overloading) and stop the device, which will require it to be re-ignited.

Do not use oil, gas, solvents nor any other flammable material constituting an explosion threat for igniting the boiler.

3.3.2. Continuous operation mode

During operation, BOILERS with cast-iron heads do not require monitoring in between fuel charging into the fuel container. Boiler cleaning and ash removal may be performed once per week and ash removal from the boiler's rear chamber, once per month. After at least 3 months of operation, it is necessary to remove burnt impurities (e.g. sand) from the head washout. Ash removal may be performed after the power supply switch is set to "0" (zero).

Do not charge the fuel directly to the boiler combustion chamber. This may cause damage to the head. When burning fuels (mainly sawdust) with high dust concentrations, boiler doors must not be opened during burner operation under no circumstances. Sudden inflow of air may cause explosion. Do not permit the head to work partially immersed in ash. Poor cooling of the head may quickly lead to damage of its steel casing or cracking of grate plates.

During ceramic head operation, washout under the head may require cleaning even as much as once per 2 days. As the head is installed by the boiler the fuel may be periodically charged to the boiler's combustion chamber (e.g. fragmented wood). However this may only be performed assuming max care, after the power supply switch is set to "0" (zero).

The ceramic head consists of a metal external casing and a ceramic heat-proof chamber located inside it. The external casing has the form of a double coat ensuring head cooling and guiding the combustion air flow (air, before it reaches the grate is pre-heated). The heat-proof chamber acts as a thermal accumulator, with its three-part cast-iron grate installed in its lower part, on which burning process takes place.

During operation, the grate must be tightly closed (a hold down screw is used for this purpose).

Inside the chamber, on a special heat-resistant pipe a dosing diaphragm is installed. Swing-mount plate prevents excessive filling of the head's combustion chamber with fuel (when the plate is lifted, limit switch is activated and feeding stops).

The dosing diaphragm is activated in emergency situations only (e.g. when the flame is suppressed with insufficiently preheated chamber, charged with wet fuel) and it requires operating personnel intervention and boiler re-ignition.

The fire protection system is consist of a container and a line connecting it with the stub pipe (10) located on the worm shaft guide casing. The stub pipe is filled with beeswax. When the casing temperature increases, the beeswax melts and fire is extinguished.

The fire protection system is activated in emergency situations only. After activation of the system, the operating personnel intervention and boiler re-ignition are required. Before start-up, it is necessary to replenish the beeswax at the stub pipe, if necessary. Unscrew the stub pipe, fill it with wax and after cooling down, screw in onto its place again.

3.3.3. Emergency operation of the boiler

This function shall be used in emergency situations only. In case of cast-iron heads, the feeder shall be disconnected and the assembly opening sealed with heat-resistant brick and protected by means of bolted steel flap. In case of the ceramic head, is not necessary to disconnect the feeder, one however needs to protect the inlet to the head smoke conduit (e.g. by covering it with a steel flap).

In case when the boiler is connected in a closed system, it must not be used without manufacturer-recommended protections (see chapter 2.5.2).

When igniting, do not fill the whole combustion chamber (wood - 50% of filling, coal – not more than 20%). Fuel should not have moisture content higher than 30%. Do not use fine coal.

In any case do not burn PVC products: food products packaging (butter or margarine boxes), toys, plastic building materials; PA products, e.g. textiles. Some types of plastics, such as PE, PP, PET may be burned if their volume relative to the volume of charged fuel does not exceed 5% and their burning temperature exceeds 85ºC.

During normal operation of the boiler, it is necessary to periodically monitor and supplement the fuel reserve. In order to achieve possibly the most stable temperature of supply water, it is necessary to:

- use fuel with humidity content of up to 30%
- In case of higher moisture contents, fuel shall be dried or mixed with dry one, keeping in mind that the more wet is the mix, the less dose and the more surplus air must be used

- when using fuel with different granulation, it shall be charged alternatively (large granulation fuel already glowing in the combustion chamber shall be supplemented with finer grained fuel, e.g. from sawmills – as in other way they will spill through the grate)
- if possible avoid opening the charging flap during ignition and during boiler temperature increase phase.

Note: avoid burning fine fuels, in which dusts concentration exceeds 5%. Pay attention when burning very dry sawdust (moisture content up to 10%), do not compact them tightly in the combustion chamber. Having charged sawdust, leave free space in the rear part of the chamber to ensure air access. Failure to meet these requirements may result with gases from combustion chamber backdrafting during sudden opening of the charging flap. When the charging flap is opened, this may cause sudden growth of the air volume in the combustion chamber and explosive combustion of dusts.

When operating a boiler with air supply system, do not open the charging flap during fan operation. Before supplementing the fuel, switch off the controller.

- adjustment of the boiler performance, and thus the supply water temperature shall be performed by changing the setting of the throttle (or the ash pan doors adjustment slot) or by changing the cross-section of the combustion gases outlet in the smoke conduit. When operating a boiler with air supply system, the ash pan flap shall remain closed.

3.4. Cleaning, Ashes

Boiler

Grate cleaning is performed when water temperature starts to drop and when the ash pan illumination reduces. Ash shall be removed while the flame is reduced.

In order to ensure fuel economy, keep internal chambers of the boiler and spaces between water tubes clean. An indication suggesting that cleaning is required is reduced chimney draught. Insufficient air will cause the boiler to excessively smoke.

Cleaning is performed on extinguished boilers.

In case of heavy contamination of the boiler, chemical agents removing boiler deposits may be used, but only such, which are allowed on the marked (i.e. with CE mark and instructions of use).

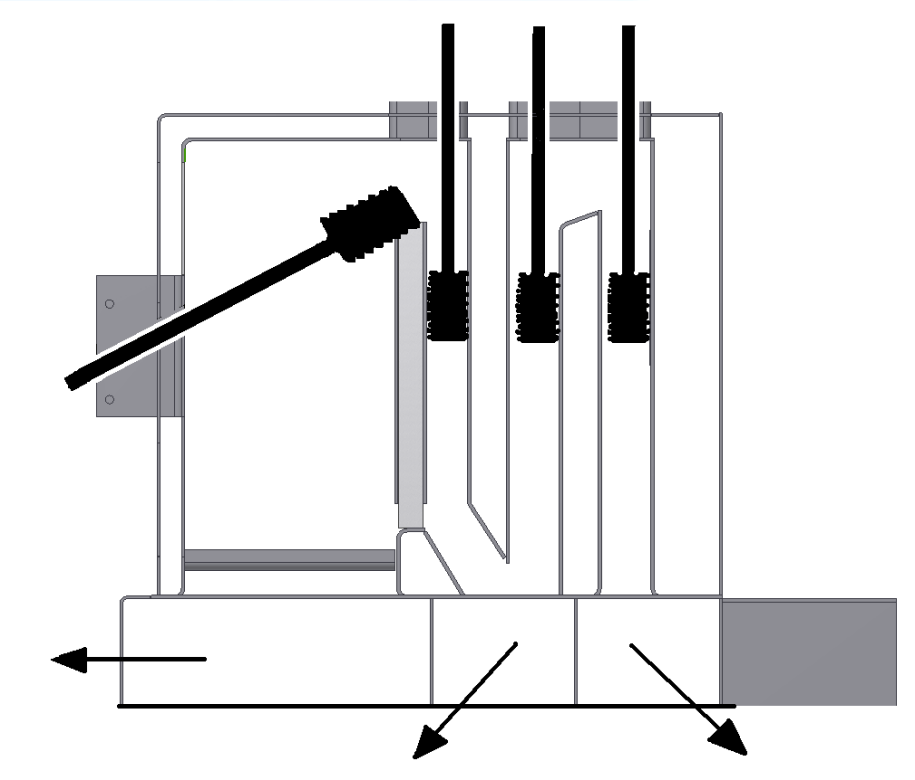


Fig. 23 Boiler cleaning diagram (the figure presents 30 kW exchanger cleaning (120 and 240kW models have different cross-section, yet the cleaning approach remains the same).

Combustion gases leaving blocked chimney are dangerous.

The chimney and the conduit shall be kept clean; they shall be cleaned before each heating season.

The Feeder

For description of head cleaning, see item 3.4.2.. In case of the container, it requires no maintenance during the heating season. After the heating season's end, it is necessary to disconnect the head from the boiler and to inspect the grate. Remove deposit from cast-iron elements, check cast-iron surfaces (for cracks), clean air inlet holes. After cleaning, reinstall the head. If seals are damaged during maintenance work, replace them with new ones.

Inspect the feeder container, remove the toothed wheel(s), remove compressed fuel from under the plate, check straightness of the worm shaft and reliability of threaded connections.

Ashes

Ashes shall be removed with the device switched off. In case of cast-iron heads it is sufficient to remove ashes once every 2 weeks. In case of ceramic heads, the washout under the head needs to be emptied once every 2 days.

Ash handling procedure is described in p.1 “Safety Instructions”

3.5. Program-Initiated Shutdown of AZSB

Boiler

After the fuel burns out, open all doors and maximally open the damper in the smoke conduit. Remove ash, clean the boiler. Do not drain the circulating water. Cool down time is equal to the ignition time.

Feeder

If the fuel in the container is supplemented on ongoing basis, the feeder will work continuously. In order to stop the device, e.g. to prepare it for ash removal, place the power supply switch in „0” (zero) position.

3.6. Emergency Shutdown of AZSB

Boiler (applies to the emergency operation mode after feeder disconnection)

In case of emergency states, such as exceeded 100^0 C temperature, installation elements breaks and loss of water charge, control & automatic equipment or protection equipment failure or sudden pressure increase, it is necessary to:

- remove fuel from the grate and move outside the boiler room
- lower circulating water temperature by adding cold water to the water charge, like during filling
- maximally open the smoke conduit throttle (if installed)

In case of boilers operating in closed system, an emergency condition may be any condition resulting from power outage (pumps stop) or from leaving doors of the boiler open. The central-heating installation shall be protected with a safety valve set to 2 bars, additionally the manufacturer shall protect the boiler with safety valve, factory preset to 2.5 bar, however in case of an emergency condition, such protections are insufficient. The boiler must be additionally protected with a thermal protection valve, which will remove the hot water from the boiler in case of an emergency condition, while at the same time supplementing thus caused shortage of water in the boiler with cold water from water pipe installation in order to cool down the boiler and to reduce the pressure (section 2.6).

Keep in mind that emergency conditions are likely to occur during summer, when only household hot water is heated in the boiler. Anticipating such conditions, it is worth to consider installation of a heat accumulator capable of taking over the heating power surplus unavoidable in such circumstances.

The glowing fuel must not be extinguished or cooled down with water.

Feeder

Set the fuel supply switch in “0” (zero) position. Set the blower switch in the blower (<dmuchawa>) position, switch off feeding – press the red button on the emergency switch. The blower will continue to work and burn out the fuel on the grate and then it will start to cool down the head. Open the chimney damper in the boiler. After the fuel burns out, boiler doors may be opened in order for the boiler to cool down. When the temperature starts to drop, switch off the device.

4. Troubleshooting, Safe Operation Conditions

The main precondition of boiler safe operation is construction of its installation and protections according to Polish standards.

In order to maintain safe operating conditions of the boiler, it is necessary to follow the principles listed below :

- wear protective gloves and goggles
- do not block charging flaps and ash pan doors
- grate change shall be performed using the ash pan lever
- use portable 24V lamps
- maintain order and cleanness in the boiler room
- maintain good technical condition of the boiler and its related installation
- during the winter season ensure that the heating process is continuous

If water freezing in the installation is suspected, check whether safety piping is not blocked. The water added to the water charge in the installation shall return through the overflow pipe from the pressure vessel. If safety piping is blocked, the boiler must not be ignited, and if it has been operating, proceed as in boiler emergency shutdown procedure (see p. 3.5.)

4.1. Installation of the fuel container in non-heated premises

Installation of the fuel container in unheated premises does not constitute a problem to the container operation as such. However condensation resulting from changes of atmospheric conditions, combined with the heat conducted by the worm shaft may cause the device to freeze when the outdoor temperature drops.

4.2. Anti-freeze protection

To prevent damages caused by frost, the main pipe and the bottom of the container may be thermally insulated and additional defrosting device may also be installed.

Thermal insulation of the main pipe and the tank bottom is sufficient when the fuel is dry enough and stored indoors. The main pipe shall be insulated with mineral wool on its whole length in unheated premises, and on 1 m section in heated premises. Appropriate insulation of the bottom requires supporting brackets to be bound with the gear and the main pipe and welding of wires guided through mineral wool slabs on the bottom of the container. Finally mineral wool slabs shall be protected against rain.

If the fuel has been dried and stored outdoors, the best way of protecting it against frost is to use an insulation and a resistor installed in corners of the box, e.g. using an aluminium tape, wrapped under the main pipe. The mineral wool in such case is placed above the resistor.

We recommend to use automatic, frost-proof resistors, which are available in multiple configurations.

Note: Despite this effort, in particular if wood chips are used as fuel, the fuel may jam in the worm shaft. Any remains shall be removed before the start of the heating season and at least once during the season.

If a water container is located in this premise, it will be necessary to use anti-freeze agent.

Note: Gas pressure drops when temperatures drop. due to this gas cylinders of the container flap will behave differently under such conditions.

4.3. Troubleshooting

No.	Fault	Cause	Remedy
1	Flame backdrafting to the fuel container	- no fuel in the container or too low fuel level, - fuel clogging, - container cover not fully closed	- supplement fuel in the container, - mix the fuel, - check the cover tightness
		- blocked worm shaft - power outage for a longer period - no water in the container	- determine the cause and remove the failure - empty the container of the fuel and fill the worm shaft line with water - supplement water in the

			container
		- insufficient chimney draught	- use an exhaust fan, improve the draught
2	Fuel clogging in the container	- using sawdust with dusts content of more than 5%, - too high moisture content in fuel (above 40%), the fuel freezes to container walls during the winter season	- change the fuel - add a portion of dry fuel and mix it thoroughly
3	Smoke in the container	- head contamination - blocked chimney - boiler cover and doors not fully closed	- clean ash in the head - clean the chimney - close covers and doors in the boiler
4	Worm shaft does not rotate	- power outage - worm shaft blocked - damaged worm shaft and toothed wheel	- start left rotation, then restart (see par. 4.3.1.) - replace the worm shaft, replace toothed wheels
5	Loud operation of the feeder unit	- damaged electric motor bearing , - gear-motor oil leak, - damaged toothed wheel bearing, - foreign body (e.g. metal) in the worm shaft pipe	- replace the bearing - seal any leaks, add oil, - replace the bearing - remove the worm shaft, remove the foreign body
6	**Ceramic head** Quick deposit build-up Excessively fast lining wear Incorrect gassing process in the combustion chamber Smoke in the boiler room	- excessively contaminated fuel - the head chamber has not been sufficiently pre-heated - the lining was damaged (e.g. during cleaning), too dry fuel used - too low temperature inside the chamber - to high moisture content in fuel - limit switch incorrectly set - head cover not fully closed - insufficient chimney draught - container cover not fully closed	- do not burn coal, coke, fine coal, plastics and rags, use fuels according to the instructions, - remove deposit - heat-up the chamber (par. 3.4.1) - regenerate the lining, use fire-resistant cement - incorrect ignition process (par. 3.4.1) - add dry fuel - adjust the limit switch - close the cover - use exhaust fan, improve the draught - check seal tightness, close the cover
7	**Cast-iron head** Quick deposit	- excessively contaminated	- do not burn coal, coke, fine coal, plastics and rags, use fuels

	build-up	fuel	according to the instructions, - remove deposit
8	Boiler can not reach the preset temperature	- contaminated fan - too much ash in the (cast-iron) head, blocked ventilation openings in the head - too high moisture content of fuel, - incorrect controller settings	- clean fan blades -remove ashes from the head through the washout opening - charge correct fuel - set correct feed and pause times
9	Fire water tank emptying	- flame backdrafting to the fuel container	- undo the connector, insert beeswax plug. If the container has been emptied when using sawdust, the pipe must be cleaned off the fuel as soon as possible, as sawdust expands and may permanently block the machine – immediately force feeding of the combustion chamber with fresh fuel.

4.3.1. Procedure in Case of Worm Shaft Jamming

The device has stopped: - Make sure, that the device is really switched off. If the boiler is in the flame suspend mode, the blower and the worm shaft may not rotate for longer periods.

The device has stopped *(and has cooled down)*: - Boiler may have overheated causing the device to shut down. Restart the controller.

The device has stopped *(display message „BLOKADA PODAJNIKA" - /feeder jam/)***:**

- It is likely that a stone, a root, etc. from peat or chips got into the system through the worm shaft. Re-engage the thermal protections switch.

If the feeding worm shaft does not rotate in the forced supply mode, the following procedure shall be followed:

- Open the manhole and perform an inspection,
- Sometimes it may be necessary to switch the worm shaft in backwards direction. For this purpose, having previously disconnected power supply, exchange any 2 phases and switch the controller and feeding briefly on.
- Remove scale, root etc. causing the failure through the inspection manhole.
- Make sure that the worm shaft operates correctly and tightly close the manhole.

If the engine runs and the worm shaft does not turn – that may be caused by a foreign body at the bottom of the worm shaft. To remove this failure, it will be necessary to remove the fuel from the container under the located jam spot and then clean up the worm shaft.

5. Spare Parts

5.1. Main Spare Parts List

No.	Part name	Part No.
1.	Electric motor with gear-motor	2
2.	Toothed wheel	3
3.	Worm shaft	4
4.	Limit switch	5
5.	Main electric control box	12
6.	Ceramic head (30,50,100)	6a
7	Cast-iron head (40,60,120)	6b

Part numbers are applicable to figures no. 2, 3 page 9, 10 of the instructions.

5.2. List of Wearable Parts*

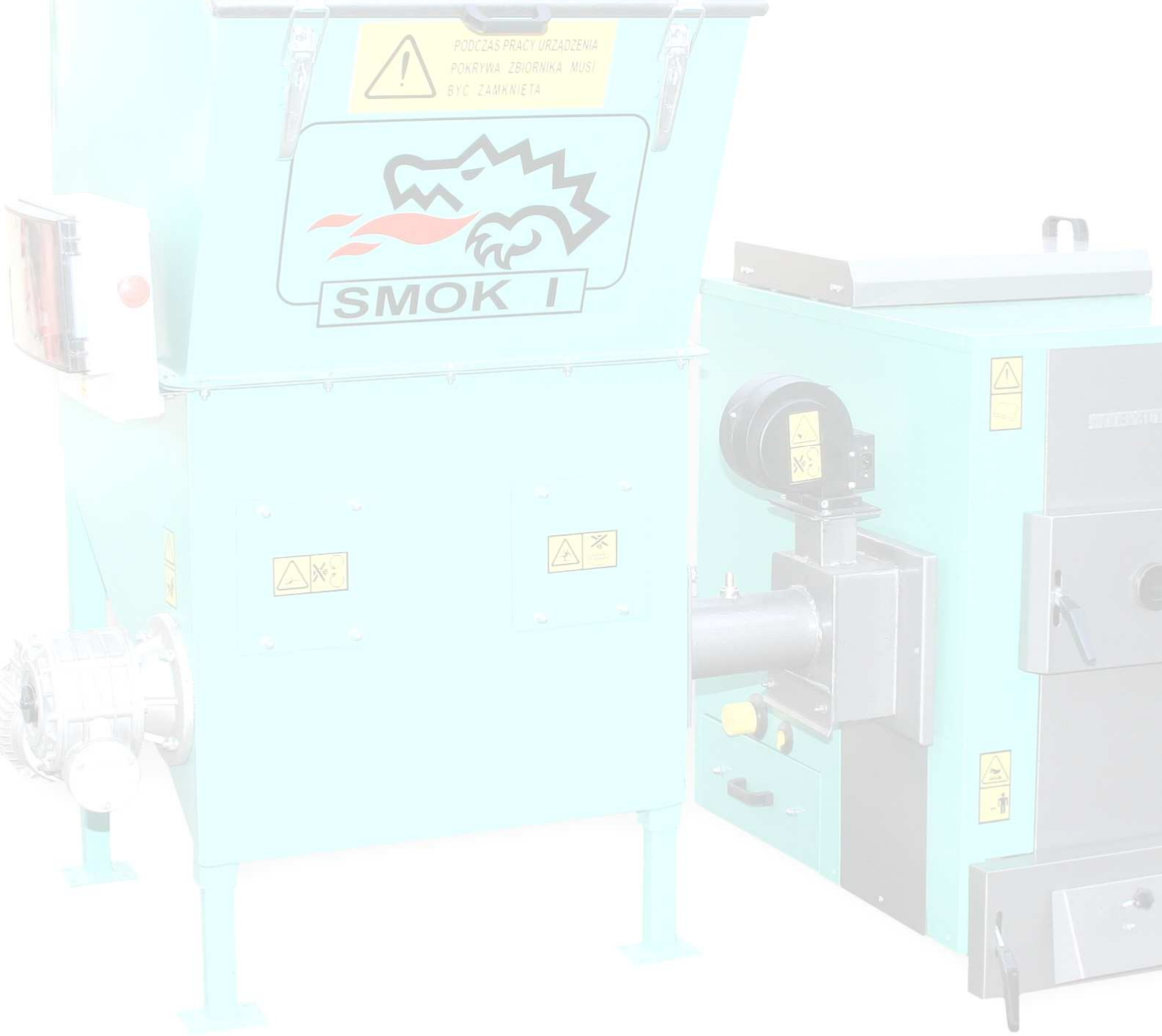
No.	Part Name	Part No.
1.	Door seals	Z1
2.	Ash container (for versions from 100kW up)	Z2
3.	Air supply control arm	Z3
4.	Ceramic head grate	Z4
6	Cast-iron head grate	Z5
7.	Safety valve- “fireman”	Z6
8.	AZSB grate side (2 pcs.)	Z7
9.	AZSB grate bottom (1 pc.)	Z8

***NOTE: The aforementioned parts are not subject to warranty replacement. If their replacement is needed, they are available for purchase from Moderator Sp. z o.o. service department.**

6. Disposal

Assuming correct operation, the boiler shall operate without problems for about 15 years. After that time its further operation may be economically unjustified. The boiler is made of materials, which are fully recyclable. It is

recommended to provide it for disposal to a specialized machine disassembly and disposal company.
In case of the feeder, the fault-free operation time of the head (provided it is maintained, operated and serviced properly) shall reach several years (7 to 9). After that time, it may be necessary to replace cast-iron grate inserts. if the repair is no longer economically reasonable, the best way will be to dispose the head. In case of the head, the simplest way of disposing it is to send it to a metal specialized scrap metal collection plant.



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* warranty and post-warranty repairs of central-heating boilers only
** warranty and post-warranty repairs of central-heating boilers and commissioning only.
*** boiler commissioning only.