Pellet and Biomass boiler

BIODROP (BD)

INSTRUCTION MANUAL

ver. 1.1
THERMOSTAHL would like to thank and congratulate you on your purchasing this boiler device and ensure that you have made a good choice. BIODROP boiler is a fail-proof product made of the highest quality materials by the large, known and reliable production factory. THERMOSTAHL brand guarantees satisfaction for the customer.

Please read this Operation and Maintenance Documentation (OMD) and get familiarized with the terms and conditions of the guarantee before installing and operating the boiler.

1. GENERAL INFORMATION

   The Operation and Maintenance Documentation constitutes an integral part of the boiler and should be delivered to the user with the device.

   Installation should be carried out in accordance with the recommendations contained in this documentation as well as applicable standards and best construction practices.

   Operational use of the boiler based on this documentation shall guarantee safe and failure-free operation and shall constitute the basis for possible guarantee claims.

   The Manufacturer (Thermostahl) shall reserve the right to modify production engineering, technical data, dimensions, appearance and boiler equipment without prior notice.

   THERMOSTAHL shall not be responsible for damages resulting from improper installation of the device and for failure to comply with the terms and conditions set forth in the Operation and Maintenance Documentation.

2. SCOPE OF DELIVERY (SHIPPING CONDITION)

   BIODROP boiler shall be delivered as follows:

   1. The complete boiler body with the boiler doors,
   2. Packaging with the casing, thermal insulation with harnesses and turnbuckles for its clamping,
   3. Control panel (charged separately),
   4. Cleaning tools,

3. TECHNICAL CHARACTERISTICS, INTENDED USE OF THE BOILER, TYPES OF FUELS

   3.1. Boiler description

   The boiler of BIODROP (BD) type is a low-temperature, steel water boiler with unconstrained flow of flue gas in the combustion chamber, with a return chamber and smoke tubes installed above the combustion chamber. It is designed to be fired by solid fuel (wood, coal), as well as to be compatible with fan-assisted gas, oil and pellet burners – option available by special order. The boiler is equipped with the fuel hopper and automatic fuel feeding system by way of worm feeder.

   Boiler operation is based on the natural draught with free outflow of flue gas through chimney. During combustion the developing flame propagates through the entire combustion chamber, whose entire surface is in contact with the boiler water surface. The boiler is built with the application of the "retort" technology, which means that fuel is fed from the bottom. There are apertures supplying air through ducts from the fan located throughout the entire circumference of the retort furnace. In the front part before the retort there is a transverse
water-cooled grate, on which larger pieces of fuel can be burned. Fuel is fed from the hopper to the furnace by the help of the double-worm feeder.

This system enables a more accurate and precise fuel supply and provides a reliable protection against flame flashback. The fan supplies primary air necessary for combustion. It is controlled by means of a screw adjusting the position of the air flap. Underneath the smoke tubes there are water pipes making up the “overhead grate” ensuring more efficient heat transfer of the boiler. Flue gas is directed by smoke tubes into the smoke chamber and subsequently to the chimney. Ash is accumulated on the upper retort circumference and from there it falls into the ash bin tray.

The boiler design allows achieving high efficiency and the efficient combustion guarantees minimum exhaust emission of harmful substances and fuel economy.

According to the standard PN-EN 303-5 the boiler efficiency is classified as Class 3 [the highest]. The efficiency of BIODROP boilers is 87%. BIODROP boiler is designed to produce water of the maximum temperature of 95°C and is adapted to be operated in pump heating installations protected by the mandatory open pressure vessel. The minimum temperature of return water to the boiler is 60°C.

A boiler controller (the basic model) supplied with the boiler is required for proper operation of the boiler.

The advantages of BIODROP boiler:
- high efficiency coefficient – over 87%,
- low fuel consumption and very low level of exhaust emission of harmful substances in flue gas,
- a large combustion chamber and fuel hopper allow for loading fuel in the quantity guarantying several hours of combustion,
- independent silo for small boiler rooms and balconies, it can be placed on the left or on the right of boiler.
- automatic feeding system from central silo.
- two motors forward the fuel. At the first one pellets fall from the silo to the burner and the second motor pushes the pellet to the combustion chamber. These systems are independent and controlled by the control panel and work concurrently.
- two front doors (three for larger types) ensuring access to the smoke tubes, combustion chamber and ash bin with a tray,
- the middle front door enable loading fuel directly into the boiler (e.g., larger pieces of wood),
- simple maintenance and cleaning inside the boiler – a free access to the combustion chamber, smoke tubes, three front fully-openable doors, unscrewable smoke chamber.
- high water capacity of the boiler increasing the capacity of thermal energy accumulation, which enables a more precise temperature control and thus shortens the working cycles,
- adapted to be compatible with an oil/gas burner,
- double thermal insulation (ALU 80 mm foil mineral wool),
- modern design and aesthetic appearance,
- a large heat transfer surface,
- uniform heat load,
- option to burn furnace oil or gas.
3.2. Types of fuel

- **Solid fuels**

1. Basic fuel – automatic refuelling from the boiler-side fuel hopper fed through the feeding screw.
   - Pellets
   - “Eco-pea coal” type coal (granulation/size: from 5 mm to 25 mm)
   - Dry cereal grains, e.g. oat, corn, wheat, sunflower grain
   - Dry fruit / vegetable stones, e.g., olive, bitter cherry, sweet cherry stones of dimensions up to Ø10–15 mm.

2. Substitute fuel – of larger dimensions, burnt on the grate, direct hand-feeding to the combustion chamber through the boiler front door.
   - wood chunks (diameter up to 40 cm), wood briquettes
   - hard coal, coal briquettes
   - sawdust briquettes

**NOTE:** The Manufactures shall not be liable for any problems resulting from use of improper fuel.

- **General conditions for all solid fuels**

The following recommendations with regard to fuels must be strictly complied with under pain of the guarantee becoming null and void:

1. The basic (point 1) fuels fed through the worm feeder:
   - should not contain any foreign matter (e.g., stones, pieces of metal, plastic, rubber, string, clothing materials, fabrics, etc.) that may cause blockage, damage of the feeding screw;
   - should be of dimensions from 5 mm to 25 mm and moisture content up to 20%.

Use of fuels with higher moisture content causes excessive exudation of water from fuel and the resultant corrosion of the boiler and loss of the guarantee.

2. The substitute fuel – (point 2) hand-feeding to the combustion chamber
   - should have moisture content up to 20% and should not contain substance harmful to the boiler and health (e.g., chemicals), which during combustion produce discharges and contaminants that may make combustion difficult and reduce the boiler lifecycle.

**Pellets**

It is a dry biomass, e.g. sawdust, wood waste in the form of a cylinder of 6 – 8 mm diameter (length up to 25 mm), highly pressed.

Strong forces acting during the pressing process cause that within the small volume of the resultant product a large quantity of fuel can be contained.

**Pellet advantages:**

- high density[energy concentration]
- low content of sulphur dioxide as well as other harmful substance in flue gas,
- low content of ash – produced without any binding agent they do not contain any harmful substances.
- renewable waste fuel
- profitable alternative to coal, oil or gas
The equivalent of 8 m\(^3\) of pellets is 3,500 litres of furnace oil [equivalent calorific values] – 2 kg of pellets ≈ 1 ltr of oil

**Main parameters of pellets:**
- diameter 6 – 8 mm, length 10 – 30 mm
- pressing density 1.1 kg/dm\(^3\)
- weight 650 – 700 kg/m\(^3\)
- heating value ~ 5 kWh/kg i.e. 18-19 MJ/kg
- water content max. 10%
- ash content max. 1%

**“Eco pea” type coal – pea coal**
- type 31 non-caking, volatile part content over 30%
- type 32 weakly caking coals, volatile part content over 30%

Calorific value c. 26 MJ/kg

Maximum allowable ash content up to 4-8%.
Slack content up to 10%, moisture content up to 15%

**Oats**
Calorific value c. 18.5 MJ/kg
Moisture content 10 – 13%
ash content c. 0.6%

3 tons of oats is equivalent to 1,000 litres of furnace oil.

Oats is suitable for cultivation throughout the whole country; its soil requirements are minimal. It is easy to burn, is characterized by thermal stability, during combustion minimal quantities of ash are produced (0.6%), which makes a perfect fertilizer.

Around 10% of lime is added to the burning oats, which prevents ash from caking.

- Liquid and gas fuels

BIO DROP boiler can also be fired with furnace oil or gas. There is an opening in the boiler door designed for that purpose, in which (with the help of a flange) a gas, oil or multi-oil burner should be installed.

Gas and oil burners should be secured in accordance with the requirements applicable to these devices.

In case of firing the boiler with furnace oil or gas, the outflow of flue gas should be decelerate through the installation of swirl vanes of flue gas to the smoke tubes.

**4. BOILER DESIGN (STRUCTURAL MATERIALS)**
- Boiler body – steel St 37/2 (acc. DIN 17100)
- Smoke tubes – steel St 35 (acc. DIN 1629) without seam
- Flue gas swirl vanes – INOX AIS 304
- Front door insulation – ceramic material ASFIL
- Boiler casing – steel sheet mm (DKP) powder coated
- Boiler casing insulation – mineral wool 80 mm with aluminum foil

A) BOILER BODY

The boiler is designed so that the components covered by flames are in contact with the boiler water space. The diameter, quantity and length of smoke tubes are selected in such a way as to make it possible to take advantage of the maximum heating power of the flue gas. Four water pipes underneath the smoke tubes and additional transverse water pipes at the height of the retort are installed to ensure more efficient water circulation in the boiler. Individual components are cut by means of laser. The boiler component parts (smoke tubes) are welded on automatic welding machines (MIG-MAG) by impulse method; the remaining components and boiler assembly is done by hand. The control of welds is subject to the DIN 8563 standard.

BIODROP boilers are adapted to be operated at the operating pressure of 2-3 bar (depending on the boiler power rating). At the production plant each boiler is subjected to pressure testing to pressure of 4-5 bar (depending on the boiler power rating).

B) BOILER DOOR

The boiler has two doors enabling separate access to the smoke tubes and to combustion chamber, the upper door and to ash bin the second one. In case of large size boilers there are three doors enabling separate access to the smoke tubes, combustion chamber and ash bin. The doors are filled in with the fireproof insulation. Special packing cord was used to seal them.

A sight-glass to the combustion chamber is installed in the boiler upper door (middle door for large size boilers) and the opening for mounting the oil or gas burner (plugged) is provided.

C) COMBUSTION CHAMBER, FURNACE, WATER CAPACITY, CASING

The oval-shaped combustion chamber is of large volume. The retort furnace has apertures arranged about its circumference (for better air access), which enables precise burning of fuel.

The retort is a replaceable component of the boiler. It is screwed down to the boiler body by means of 8 bolts.

The application of an upper and lower water grate (before the retort) enables better heat exchange in the boiler ensuring its stable operation.

Owing to its considerable water chamber capacity, HL-BIOPLEX boiler can accumulate a large quantity of thermal energy and transfer it to the central heating system for a long time.

The boiler body’s casing is made up of metal components that are electrostatically painted and clamped together.

D) BOILER CONTROLLER

Each BIODROP boiler is fitted with a basic control panel.

Please carefully read the Instruction Manual and get familiarized with the terms and conditions of the guarantee before installing the controller. There is a possibility to use other controllers with extended functions as an additional option. The information pertaining to this matter is contained in the separate manual for these controllers.
5. TECHNICAL DATA - DIMENSIONS

5.1. Technical data

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</table>

6. DESIGN AND INSTALLATION RECOMMENDATIONS

The boiler (boilers) should be installed in the boiler room specially designated and adapted for that purpose.

6.1. Boiler installation recommendations

- The boiler should be placed in the vertical position.
- The boiler should be installed as close to the chimney as possible.

All distances of the boiler (boilers) from the boiler room’s walls and the distances between the boilers should ensure easy access to the boiler (boilers). The distance of the boiler front from the wall should ensure assembly and disassembly of the burner and cleaning of the smoke tubes.

6.2. Boiler room recommendations

- The boiler room should comply with the requirements set forth in the PN87/B-02411 standard “Built-in solid fuel boiler rooms”.

Moreover, it should comply with requirements of “Technical conditions relating to buildings” provided for in the Building Code (Official Journal No. 75 of 2000, item 690).

- The dimensions of the boiler room should comply with the requirements relating to heat loads, fire protection regulations and allow for them to be fitted out, operated and maintained in compliance with the OHS regulations.
- The minimum height of the boiler room:
  - for boilers to 100 kW - 2.5 m
  - for boilers from 100 to 230 kW - 3.0 m
  - for boilers from 230 to 400 kW - 3.5 m
  - for boilers over 400 kW - 4.0 m
- The minimum distances of the boiler from the front wall:
  - for boilers to 100 kW - 1.5 m
  - for boilers over 100 kW - 2.0 m
- The distance of the boiler from the rear wall should ensure proper access to the boiler.
- The minimum distances of the boiler from the side wall:
  - for boilers to 300 kW - 0.6 m
  - for boilers over 300 kW - 1.0 m
These distances should be twice as long from the side of the feeder.
- The boiler room’s floor should be:
  - dust-free and non-flammable (paved with terracotta tiles or painted),
  - laid out with an inclination to the floor drain or cooling well.
- The boiler room should have natural exhaust ventilation carrying off the air outside and supply of combustion air (the so-called “Z-shaped” ventilation duct) with the outlet placed 0.3 m above the floor level.
- The section area of the exhaust opening should be calculated making allowance for the ventilation air flow to be at least 0.5 m$^3$/h per 1 kW of the installed nominated power.
- The section area of the air supply duct should be calculated on the basis of the quantity of air required for combustion, which should be 1.6 m$^3$/h per 1 kW of the installed nominated power and additional air required for the needs of the natural ventilation (0.5 m$^3$/h per 1 kW), which in total gives at least 2.1 m$^3$/h per 1 kW of the installed nominated power in the boiler room.
- Use of mechanical ventilation is not allowed.
- No flammable materials may be stored in the boiler room.
- The boiler room should have window openings of the total area not less than 1/15th of the floor area.
- The boiler room’s door should be made of metal, without door lock, opening outside under pressure, with the clear width of min. 0.9 m.

6.3. Hydraulic system installation
- The system should be installed in accordance with the applicable regulations and best construction practices.
- The boiler can only be operated in the open system heating installations.
- The open pressure vessel should be placed 2-3 m above the highest point of the central heating system and protected against frost.
- No cut-off valves should be installed between the boiler and pressure vessel.
- The boiler room’s hydraulic system should ensure minimum temperature of return water to the boiler (for solid fuel and gas – 60°C, for furnace oil – 50°C*).
- To this end, a mixing valve with the boiler pump must be installed of the capacity of c. 40% of the nominal flow of water through the boiler.
- A desludger or strainer should be installed in the return water system before the boiler.
- The temperature sensors of the systems protecting against exceeding the allowable temperature should be installed directly on the boiler at its highest point.

Symbols

- T1 Hot water outlet
- T2 Return water inlet
- T3 Safety kit 1"
- T4 Overheating safety valve
- T5 Inlet of cold water from the network in case of overheating
- T6 Drain ½"
Installation of boiler with open type expansion tank

**Symbols**

1,2,3,4,5,6,7,8,9  Ball valve
10,11  Radiator switch
12  Radiator
13,14,15  Safety valve
16  Automatic water fill valve
17  Drain tap
18  Cold water supply valve
19, 20, 21, 22, 23, 24  Check valve
B  Buffer tank
VE  Open type expansion tank
PCI  Circulator of heating system
PRC  Recirculation pump
PB  Circulator for buffer tank
RP  Pressure reducer
F  Y-type strainer
A  Automatic air vent
FD  Water filter
Installation of boiler with closed type expansion tank

Symbols
1,2,3,4,5,6,7,8,9 Ball valve
10,11 Radiator switch
12 Radiator
13,14,15 Safety valve
16 Automatic water fill valve
17 Drain tap
18 Cold water supply valve
19, 20, 21, 22, 23, 24 Check valve
B Buffer tank
VE Closed type expansion tank
PCI Circulator for heating system
PRC Recirculation pump
PB Buffer tank circulator
RP Pressure reducer
F Y-type strainer
A Automatic air vent
FD Water filter

6.4. Installation safety

- **3 bar safety kit**

It consists of a collector, manometer, safety valve and automatic air vent. It is fixed to the input of hot water. For safety reasons, if not installed any of the following protective systems must be installed and the second valve.

Regularly check the correct operation of safety valves. In case of wear or damage, replace them immediately with new ones.

3 bar safety kit.
• **By-pass system with load units**

Boiler has to operate for a temperature difference 10 to 15°C and to ensure that the temperature of the return water is over 50°C. This insures the smooth operation of the boiler and generally the right operation, the constant performance and the long lifetime.

To ensure that the temperature difference will be between 10 and 15°C the installation needs a recirculation pump and a 3-way thermostatic valve. This system insures the right temperature of return water and also the right temperature of water at the radiators.

The ESBE series LTC100 is a load unit designed to protect the boiler from return temperatures that are too low. Maintaining a high and stable return temperature enables a higher level of boiler efficiency, reduced tarring and increased life span of the boiler. The integrated pump offers boiler protection and optimal tank loading.

The LTC100 is used in heating applications where solid fuel boilers are used to feed storage tanks.

The load unit consists of an integrated pump and thermic valve, designed to make both assembly and handling easy. The load unit is protected by an insulation shell and is fitted with easily readable thermometers.

The valve regulates on two ports, which makes it easy to install and does not require any balancing valve in the bypass pipe.

The LTC100 has an integrated auto-circulation function which makes the unit operational even during power failure or pump failure. The circulation function is blocked at delivery, but can easily be activated if required.

The valve contains a thermostat which begins to open connection A at an outgoing mixed water temperature in connection AB of 50°C, 55°C, 60°C, 65°C, 70°C or 75°C. Connection B is fully closed when the temperature in connection A exceeds the nominal opening temperature with 10°C.

![ESBE LTC 100, load unit.](image)

• **Overheating protection system**

This thermostatic recooling two-way valve is designed to protect central-heating heat sources against overheating. The fill and drain valves in its brass body are controlled by a thermostatic element. When the limit temperature is reached, the drain valve opens, enabling the overheated water escape from the heat source into the sewer system. At the same time, the filling valve opens to let cold water in from the mains. As soon as the water temperature drops below the limit, both the valves close.

If the pressure in the mains could be above 6 bar, it is necessary to install a pressure reducer at the inlet of cooling water. It should be installed as well if the pressure in the heating system is too high after recooling. In such cases the pressure of the reducing valve should be set approximately to a double value of the pressure required in the heating system, not less than 2 bar.
Warning: This valve is NO substitution for a safety valve.

- **Temperature and pressure relief valve**

The T&P valve has a temperature sensor and provides double safety against temperature (90°C) and pressure (3 bar). The output of the valve should be connected with the drain for the disposal of the overheated water. The T&P valve should be connected nearby to the boiler and necessary at the outlet. It provides safety in case of closed type expansion tank installation but it is not replace the overheating safety system.

Technical data:
- Temperature (limit): 90°C
- Pressure (limit): 3 bar
- Connection: ½"
- Discharge rating: 10 kW

**Dimensions**

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<th>B</th>
<th>C</th>
<th>D</th>
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<td>40</td>
<td>102</td>
<td>88</td>
<td>39</td>
</tr>
</tbody>
</table>

**6.5. Thermal protection of the boiler**

- The boiler should be operated within the supply and return water temperature differences in the range of 10 – 15°C.

  Because of the lifecycle of the boiler, it should be operated with the return water temperature not lower than 60°C.

  In practice, it is difficult to meet this condition because the average atmospheric conditions during the entire heating season “require” lower settings.

**In order to ensure the required return water temperature the following solutions are suggested:**

- Higher settings on the boiler (possible only with low external temperatures).
Recommended

- use of a mixing system based on the application of a three-way mixing valve with a boiler circulator (the solution ensuring the proper temperature of both the return water and the central heating system)

Boiler water requirements:

- water for filling up boilers and heating installations should comply with the requirements of the PN-93/C-04607 standard,
- the boiler water should have the following parameters:
  - pH value > 8.5
  - total hardness < 20 of
  - free oxygen content < 0.05 mg/l
  - chlorides content < 60 mg/l.
- the used water treatment technology for filling up the heating installation should comply with the requirements referred to above,
- In the event of failing to comply with the above-mentioned requirements, THERMOSTAHL may withdraw the guarantee for the installed boiler (boilers).

6.6. Chimney system

- It should be installed as an acid-proof, double-wall, insulated chimney, or in the case of chimneys made of brick, comply with the requirements of the PN89/B-10425 standard; the technical parameters of the chimney should ensure its protection against the effects of the condensate resulting from cooling of the flue gas. Use of acid-proof chimney inserts (tin, stoneware, etc.) is recommended.
- The section of the chimney can be calculated following the formula provided below:
  \[ D = 20(3+P)^{1/2} \text{[m]}^2 \]; where: \( D \)-diameter in mm, \( P \)-boiler power rating in kW.
- The chimney diameter may not be less than the diameter of the flue.
- Connecting several boilers to one common chimney flue is not recommended.
- The connection of the boiler to the chimney should be thermally insulated and run the shortest possible way with the least possible number of pipe elbows, with the appropriate height of the flue towards the chimney.
- The chimney should be freely open towards the top and built at least 1 m above the roof,
- The diameter of the flue gas duct should be selected (calculated) in accordance with the recommendations of the manufacturers of the chimney inserts, however it should not be less than the diameter of the boiler flue.
- Installation of an inspection door for removing combustion residues should be envisaged,
- The entire length of the chimney should be maintained clean,
- Before connection the boiler to the chimney the user should obtain a positive opinion of the chimney cleaners’ specialist.
A graph for selecting the chimney diameter in relation to the boiler power rating and the chimney height, including the provided values of the chimney draught.

7. BOILER REGULATOR
<p>| | | |</p>
<table>
<thead>
<tr>
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</table>
| 1 | FUEL SELECTION | Selection of type of fuel.  
<p>|   |   | BIOMASS - WOOD - WOOD TO BIOMASS (auto transition) |
| 2 | WATER TEMP. Max | Maximum water temperature. |
| 3 | FEEDER VALUE | Feeder duty cycle (%) in the full burning process. |
| 4 | AIR VALUE | Power amount of the fan (%) in the full burning process. |
| 5 | MANUAL FEEDING | Manual activation of the feeder. When button A1 or A2 is pressed the feeder is working manually and message appears on the screen. |
| 6 | FEEDER VALUE | Feeder duty cycle (%) in the reduced burning process. |
| 7 | AIR VALUE | Power amount of the fan (%) in the reduced burning process. |
| 8 | TEMP. WATER DT | Temperature difference below the maximum water temperature that the &quot;reduced burning&quot; process is activated. |
| 9 | TEMP. EXHAUST | Exhaust temperature above which the &quot;reduced burning&quot; process is activated. |
| 10 | ACTICATE | Activation of the process &quot;Repeat Air Blow&quot;. In this process the fan is working on a selected power level (usually 100%) and it helps cleaning the remaining ashes in the burning area. |
| 11 | REPEAT TIME | Repeating time of the process &quot;Repeat Air Blow&quot;. |
| 12 | DURATION TIME | Duration time of the process &quot;Repeat Air Blow&quot;. |
| 13 | AIR VALUE | Power amount of the fan (%) in the &quot;Repeat Air Blow&quot; process. |
| 14 | ACTICATE | Activation of the process &quot;Conservation&quot;. In case of high water temperature, or absence of thermostat command, the process activates the feeder periodically so that there is always a small amount of fuel burning slowly. |
| 15 | FEEDER Off TIME | Time that the feeder is not working in the &quot;conservation&quot; process. |
| 16 | FEEDER On TIME | Time that the feeder is working in the &quot;conservation&quot; process. |
| 17 | ACTICATE | Activation of the process &quot;feeder overheat&quot;. When this option is activated and the &quot;feeder overheat input&quot; is triggered (normally closed contact) the process activates the feeder periodically so that burning fuel is pushed back inside. |
| 18 | FEEDER Off TIME | Time that the feeder is not working in the &quot;feeder overheat&quot; process. |
| 19 | FEEDER On TIME | Time that the feeder is working in the &quot;feeder overheat&quot; process. |</p>
<table>
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<tr>
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<th>Description</th>
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<td><strong>21</strong></td>
<td>AIR VALUE Max</td>
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<tr>
<td></td>
<td><strong>22</strong></td>
<td>TEMP. WATER DT</td>
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<td><strong>23</strong></td>
<td>TEMP. EXHAUST DT</td>
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<td></td>
<td><strong>24</strong></td>
<td>TEMP. EXHAUST Off</td>
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<tr>
<td></td>
<td><strong>25</strong></td>
<td>TIME EXHAUST Off</td>
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<tr>
<td><strong>AUTO IGNITION</strong></td>
<td><strong>26</strong></td>
<td>ACTICATE</td>
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<tr>
<td></td>
<td><strong>27</strong></td>
<td>INITIAL FEEDING</td>
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<td><strong>28</strong></td>
<td>AIR VALUE</td>
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<td><strong>29</strong></td>
<td>TIME Max</td>
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<td><strong>30</strong></td>
<td>TEMP. EXHAUST On</td>
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<td><strong>OTHER SETTINGS</strong></td>
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<td>DT HYSTERESIS</td>
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<td><strong>32</strong></td>
<td>TEMP. CIRCULATOR</td>
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<td><strong>33</strong></td>
<td>FEEDER PERIOD</td>
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<td>SILO SENSOR</td>
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<td>DT COMPENSATION</td>
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<td><strong>36</strong></td>
<td>BLOWER TYPE</td>
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<td></td>
<td><strong>37</strong></td>
<td>AUXILIARY OUTPUT</td>
</tr>
</tbody>
</table>
8. OPERATION AND MAINTENANCE

8.1. Start of boiler

Before firing the boiler ensure the following:

- The installation is complete and correct and there is any problem at the hydraulic network.
- The electrical installation is complete and correct.
- The connection of flue gas tube is correct without problems and with the suitable insulation.
- The sensors are well positioned to the boiler.
- The hydraulic network is complete and there is the correct pressure.
- The circulator is connected and working properly.
- The expansion tank is connected properly and ensures enough expansion of the water.
- The boiler valves are open.
- There is sufficient ventilation of the installation.
- No flammable or explosive materials around the boiler.

If you notice any damage or malfunction at the boiler contact your installer or the company.

8.2. Combustion settings

The air flow is adjusted by a dumber and the dimmer of regulator (the dumber should be always open and every setting should be by the regulator). When the dumber is open the air flow is maximum and when the dumber closes the air flow falling. Set the air flow according the next pictures of flame.

![Very high air flow. The flame has not enough time to develop properly, many unburned particles thrown over the cone. There is large production of soot and many unburned residues.](image1)

![Low air flow. Small flame with a mat red color. Large amount of products of imperfect combustion, mainly CO.](image2)
When the combustion is right then the ash should be granular without big size residues of unburned material. **Large amount of unburned residues cause damage to the feeding screw.**

Check the draught of exhaust and set the dumber of the gas flue tube. For pellet or other biomass it is suggested to set it at the second position left or right. For woods it is suggested to set it in the horizontal position (completely opened) and for oil in the vertical position (completely closed).

In case that the draught is large close the dumber one position (decrease of chimney diameter). In case that the draught is low open the dumber one position (increase of chimney diameter).

### 8.3. Maintenance

**Warning:** The boiler should be switched off by the main switch at least one hour before its cleaning.

- **Daily maintenance**

  When performing the daily, standard servicing of the boiler room the following tasks should be carried out:
  
  - ensure that the boiler room is clean and tidy,
  - check the correctness of the burner operation and boiler controller (or the heat circulation system controller),
  - in the case of boilers fed with furnace oil, check the fuel level in the tanks,
  - check the pressure of water in the heating system, and replenish the water volume, if necessary,
  - check the leakproofness of the hydraulic connections in the boiler room and, in case of leaks, rectify them immediately,
- in the event of any abnormalities in the operation of the burner or the boiler controller, the Approved Service centre should be contacted in order to carry out necessary repairs.

Furthermore, the daily servicing requires:
- Checking the condition of the fuel in the hopper and removing the ash.
- The ashbin tray should be emptied every 2 to 7 days depending on the boiler operating load and ash content in the fuel.

The external casing of the boiler should be cleaned with a slightly damp cloth and cleaning detergents.

**Weekly maintenance**
- Open the fire door and check the condition of the smoke tubes and clean them, if necessary. Part of the accumulated carbon deposit enters the flue box and it should be removed from there through the inspection window at the bottom of the box. Check the condition of the water pipes underneath the smoke tubes, and of the deflector. Clean them, if necessary.
- From time to time remove the slag in case it has excessively accumulated in the boiler’s retort, whilst remembering of the proper adjustment of amounts of coal and air. In the case of large quantities of slag, check whether the coal complies with the recommended characteristics.

**Monthly maintenance**
- Additionally to carrying out the daily servicing tasks, perform the following:
  - Extinguish the boiler and check for carbon deposits on the exchanger walls. If their thickness exceeds 1.5-2 mm, the carbon deposits should be removed from the walls by means of a steel brush.
  - The walls in the combustion chamber (about the retort) should be cleaned through the fire door.
  - Check for the accumulation of slag in the retort, if necessary, extinguish the boiler and clean the retort.
  - The retort’s internal space should be cleaned through the inspection window located in its side.
  - Check whether too large amount of coal dust or other waste have not accumulated in the charging hopper and remove it.
  - Check the patency of air nozzles in the retort, clean them, if necessary.
  - Check the condition of the door sealant and, if necessary, replace it with a new one.

**8.4. Maintenance of feeding screw**

In the event the boiler has not been operated for a longer period of time, the following tasks should be carried out:

- Start the feeder and keep it operating for 15 minutes once per quarter. Thanks to that blockage of the worm feeder can be avoided.
- Remove the residues of coal from the feeder screw tube, empty the hopper and clean the retort.

The feeder has been designed in such a way so as to avoid onerous maintenance. From time to time the residues of coal or ash should be removed from the feeder.

Regularly clean the engine casing. The motor is filled in with synthetic oil and, except for external cleaning, it does not require specific maintenance. No solvent should be used for cleaning as they can damage the sealing rings.

- Check the condition of the chain transmission and periodically lubricate it with graphite grease.

Check and clean the blades of the blow-in fan.

8.5. Boiler maintenance

Regular and proper maintenance of the boiler is the necessary condition for its proper and reliable operation and reduction in fuel consumption. At least once a year and after each longer shut-down of the boiler, the Approved Service’s representatives should be contacted to carry out an inspection.

Whilst carrying out the periodic maintenance the following tasks should be performed:

- thoroughly remove the combustion residues from the boiler (whilst being cleaned the boiler should have the temperature of c. 50-60°C), i.e.:
  - switch off the power supply,
  - detach the burner (if installed) and open the boiler door,
  - take out the swirl vanes of flue gas from the smoke tubes (if installed),
  - clean the combustion chamber, smoke tubes and flue gas swirl vanes,
  - empty the ash bin,
  - check the condition of the packing cord of the boiler door and boiler thermal insulation and replace it, if necessary,
  - mount the flue gas swirl vanes (if needed) in the smoke tubes,
  - close tightly the boiler door and mount the burner (if needed),
  - open the inspection door located in the rear part of the boiler underneath the flue and remove all combustion residues,
  - check whether the thermostatic switch sensors are in the sleeve and are well secured,
  - check the condition of the engine, motoreducer, upper and lower feeder screw, chain transmission and blower,
  - connect the burner (if installed) *) to the fuel system and switch on the power supply,
  - start the boiler,
  - carry out an analysis of the flue gas, and adjust the settings of the burner, if necessary (in accordance with the burner’s technical documentation), \( \pm \)[if such a burner is installed].

- Check the operation of the boiler pump.
- Check the condition of the remaining devices installed in the boiler room (pumps, filters, desludgers, valves).

All types of worm gears used in the boilers are gears operating in gear oil requiring to be replaced once every two years.
### 9. DEFECTS - TROUBLESHOOTING

<table>
<thead>
<tr>
<th>Type of defect</th>
<th>Cause of defect</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Backflow of flue gas into the boiler room</strong></td>
<td>1. Blocked chimney - no or weak chimney draught 2. Blocked smoke tubes in the boiler, dirty combustion chamber 3. Blocked apertures in the furnace 4. Improper supply and exhaust ventilation of the boiler room 5. Fire, glow in the retort falls too low 6. Incorrectly adjusted boiler fan 7. Improper boiler start-up 8. Incorrect connection of the boiler with the chimney 9. Incorrectly closed, adjusted boiler door</td>
<td>1. Measure the chimney draught, check the required draught according to the manual, check the patency of the chimney and clean the chimney 2. Clean the smoke tubes and combustion chamber 3. Clean the furnace, unblock the apertures 4. Check the operation of the supply and exhaust ventilation 5. Correct setting of fuel feeding time 6. Adjust the fan 7. Fire the boiler in accordance with the manual 8. Make a proper connection of the boiler with the chimney 9. Check whether the boiler door seal adheres to the boiler on its entire length</td>
</tr>
<tr>
<td><strong>Low temperature water in the boiler despite intensive burning</strong></td>
<td>1. Improper fuel – too low calorific value or damp fuel 2. Incorrectly selected boiler in relation to the size of the building 3. No/weak chimney draught 4. Boiler scale inside the boiler 5. Incorrect adjustment of the boiler settings 6. Improper or blocked air supply installation 7. Too low quantity of primary air</td>
<td>1. Use fuel of high calorific value and moisture content in accordance with the manual 2. Check selection of the boiler and the system 3. Check whether the combustion chamber, smoke tubes and chimney are not dirty, clean them 4. Chemically clean the boiler water jacket Use conditioned boiler water 5. Adjust the boiler 6. Check the condition of the air supply installation 7. Adjust or clean the fan</td>
</tr>
<tr>
<td><strong>Boiler temperature too high</strong></td>
<td>1. Water loss in the system</td>
<td>1. Admit water – after cooling of the boiler</td>
</tr>
<tr>
<td><strong>Too high temperature of the flue</strong></td>
<td>1. Too high chimney draught 2. Incorrect heat transfer due to dirty combustion chamber 3. Incorrectly selected, too small boiler power rating</td>
<td>1. Mount the swirl vanes or adjustment of by flue damper 2. Check the chimney system whether is suitably selected 3. Clean the combustion chamber and smoke tubes 4. Check the appropriateness of boiler selection in relation to the building</td>
</tr>
<tr>
<td><strong>Too high consumption of fuel</strong></td>
<td>1. Incorrectly installed central heating system 2. Incorrect selection of the boiler in relation to the building 3. Fuel of low calorific value 4. Improper parameters of boiler operation</td>
<td>1. Check the central heating system 2. Carry out a short energy audit 3. Replace the fuel with the appropriate fuel 4. Set proper parameters for boiler operation</td>
</tr>
<tr>
<td><strong>Flame image</strong></td>
<td>1. to little air access 2. too much air</td>
<td>1. Increase the quantity of supplied air to the combustion</td>
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</tbody>
</table>
1. red, smoking  
2. light, white  
3. clean intensely yellow

| 3. sufficient quantity of air chamber and retort, e.g., by increasing revolutions of the fan or enlarging the aperture.  
2. Decrease the quantity of air flow.  
3. Decrease the quantity of air flow. Properly burned fuel should leave soft ash without sinters. Boiler fuel sinters (low quality) cause burning out of the feeding screw. |

Water leakage from the boiler

| 1. Vapour condensation from air and flue gas during firing up the boiler  
2. Too low return water temperature  
3. Too damp fuel  
4. No or weak chimney draught  
5. Too small section of the chimney  
6. The boiler incorrectly connected to the system  
7. Condensate or rain water enters the boiler  
1. When starting-up quickly fire-up the boiler to the temperature of 70-90°C and maintain it for a couple of hours.  
2. During operation the boiler should be protected against low return water temperatures by means of a mixing valve or mixing pump. The minimum return water temperature - 56°C.  
3. Use fuel with less moisture content.  
4. Check the patency of the chimney and clean it.  
5. Check dimensions of the chimney against the recommendations.  
6. Seal the boiler to system connection.  
7. Change the boiler to chimney connection method. |

Fuel is not fed – the feeding screw is not working

| 1. Blockage of the feeding screw by foreign body in the fuel  
2. Burned feeding screw tip  
3. No voltage in the motor engine  
1. Check whether the split pin is not broken or the allen screws on the chain wheel are not loose.  
- Check whether the chain is not broken.  
- Check whether the feeder has not been blocked by the thermal protection.  
2. Incorrect adjustment of combustion – the flame falls too low to the furnace – adjust.  
- Unstable chimney draught or boiler room ventilation – check and adjust.  
1. 2. In case of mechanical destruction of the feeding screw replace it with a new one.  
3. Check for voltage in the motor. |

The fan does not start

| Fan failure  
- Check the electrical connection of the fan,  
- Check the capacity of the fan engine. |

Poor combustion

| 1. The fan feeds too little air  
2. Too little chimney draught  
3. Incorrect air supply system  
1. Clean the fan, adjust the quantity of air with the feeding screw.  
2. Measure the chimney draught, check the required draught according to the manual,  
- check the chimney and clean it.  
3. Check the air supply duct. |