ARITERM

For a sustainable future.

BIO HEATING GUIDE

- Bio Heating Design Guide
- Ariterm Bio Heating Products
- System Outline Drawings

ARITERM IS A FINNISH MANUFACTURER OF HEATING SYSTEMS

Our main products are central heating boilers used for heat production and service water heating, bio burner equipment and bio heating system solutions. Our wide range features several modern heating solutions for private homes, larger living spaces and industrial properties.

ARITERM is actively taking part in the development of the heating industry and works in close contact with various organisations and officials in the field. We also use a certified ISO 9001 quality system to ensure that the quality of our products is verified at every stage of production. Further to this we use a certified environmental system that follows the ISO 14001 standard.

All Ariterm Oy boilers are manufactured according to the H or H1 module of the Pressure Equipment Directive (PED). To prove this all the boilers have a CE 0424 stamp which has been granted by Inspecra Tarkastus Oy. Ariterm Oy also has a valid ASME pressure vessel certificate, that allows product sales into the North American market.

ARITERM

For a sustainable future.

DOMESTIC NATURAL RENEWABLE ENERGY

Modern bio heating is an easy and affordable way to take care of heating. The bio heating solutions developed and manufactured by Ariterm Oy provide an efficient and reliable way of benefiting from domestic energy sources; wood chip, pellets, briquettes, peat and field biomass.

The use of domestic energy sources as heating materials increases in Finland every year. The reasons for this are simple; e.g. forest processed wood chips, wood pellet and peat are renewable, environmentally friendly, domestic and economical energy sources which decrease the amount of sulphur and greenhouse gas emissions into the atmosphere. In other words, they correspond to the demands of sustainable development set for heating energy sources of today.

Modern bio heating is easy and largely automated, minimising the effort required for the use and maintenance of the system. This development has given rise to a new type of company, the heating enterprise, in which a local entrepreneur sells bio energy produced heat to the customers.

Wood is a traditional energy source in Finland. In its different forms, it easily fills the criteria for a good energy source. As an energy source, wood is environment friendly and renewable and also produces practically pollution-free energy. Finnish forests produce more than enough wood; over 15 million square metres of wood suitable for energy production goes unused every year.

Wood chip is made by chipping wood. The raw material for chips can be whole tree, logging waste or other waste wood. The quality of the chip is crucial to the functioning of the heating systems. Forest processed wood chip has the best properties for energy use.

Peat is the slowest renewing of the widely used bio fuels. Peat also fills the previously mentioned criteria for sustainable development. It can also be used in peat pellets, making it suitable for smaller heating systems.

Wood pellet is a domestic fuel with uniform quality and a high heat value. It is produced from sawdust and cutter chips by pressing. The raw material comes mainly from mechanical wood industry enterprises. No additives are used in wood pellet production, which makes it just as environmentally friendly as wood chip.

Wood briquettes are like wood pellets in composition, but much larger in size. Due to their larger size and higher combustion temperature, wood briquettes are mostly suitable for fairly large heating plants (>500 kW).

Grain in its various forms is readily available, especially on farms. However, the burning qualities of grain are very different from those of wood fuels. The amount of ash is up to ten times greater and the melting point of the ash is low. Using grain as fuel means a significantly greater need for cleaning and maintenance. Therefore, the suitability of grain for fuel must always be considered on a case-by-case and system-by-system basis.

Wood chip

Peat

Wood pellet

Wood briquette

DESIGNING AND SIZING THE BIO HEATING SYSTEM

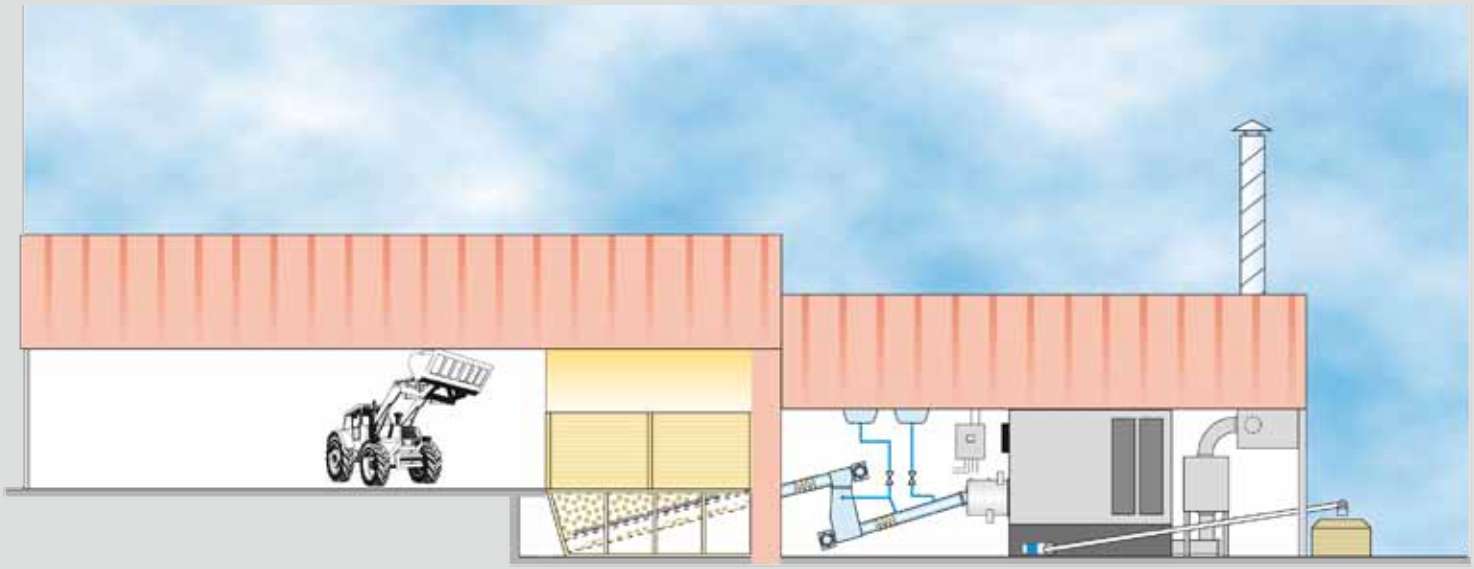
This Bio Heating Guide is intended to provide guidelines for designing and installation to customers considering and purchasing bio heating systems.

The designing of a new bio heating system may proceed as follows:

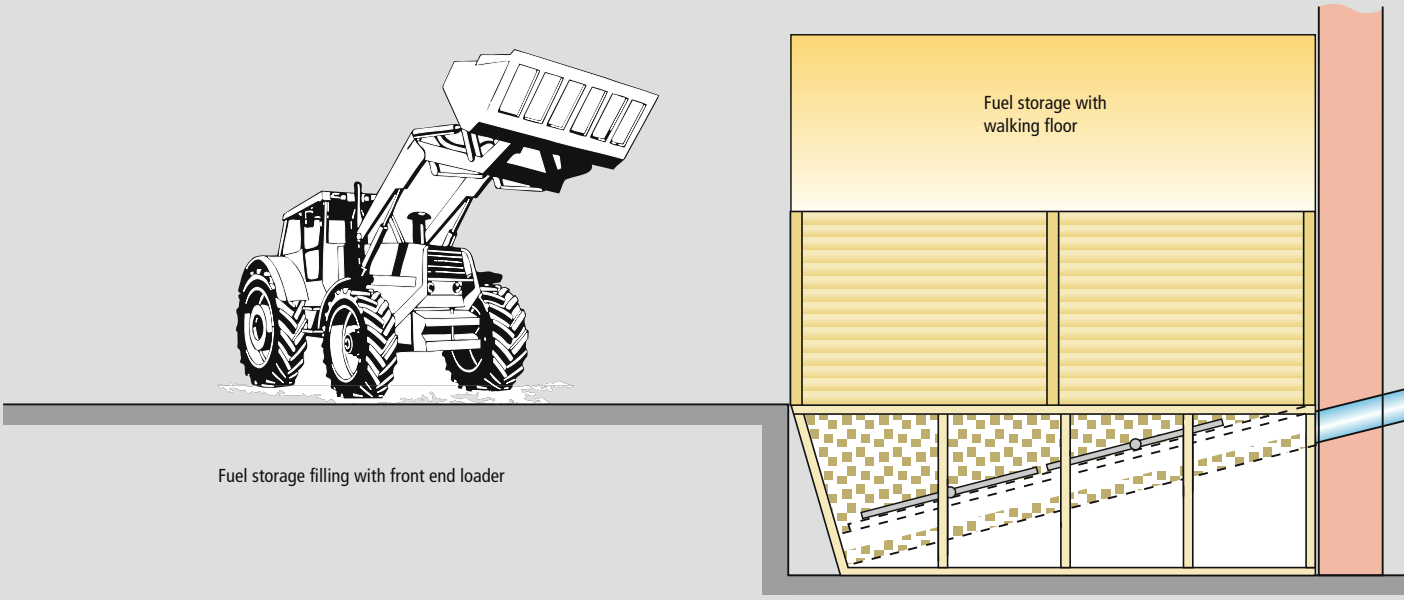
Calculate required heat power (max. power kW) → Calculate annual total energy requirement (kWh) → Choose fuels to be used (wood chip, pellet, peat, wood) → Calculate magnitude of annual fuel consumption (m^3) → Determine storing and space requirements of the fuel. → Determine space requirements of equipment (with manufacturer) → Choose suitable heating equipment (type, power, brand)

A WELL-DESIGNED BIO HEATING SYSTEM

A model of a functioning bio heating system



Components of the bio heating system



Fuel storage filling with front end loader

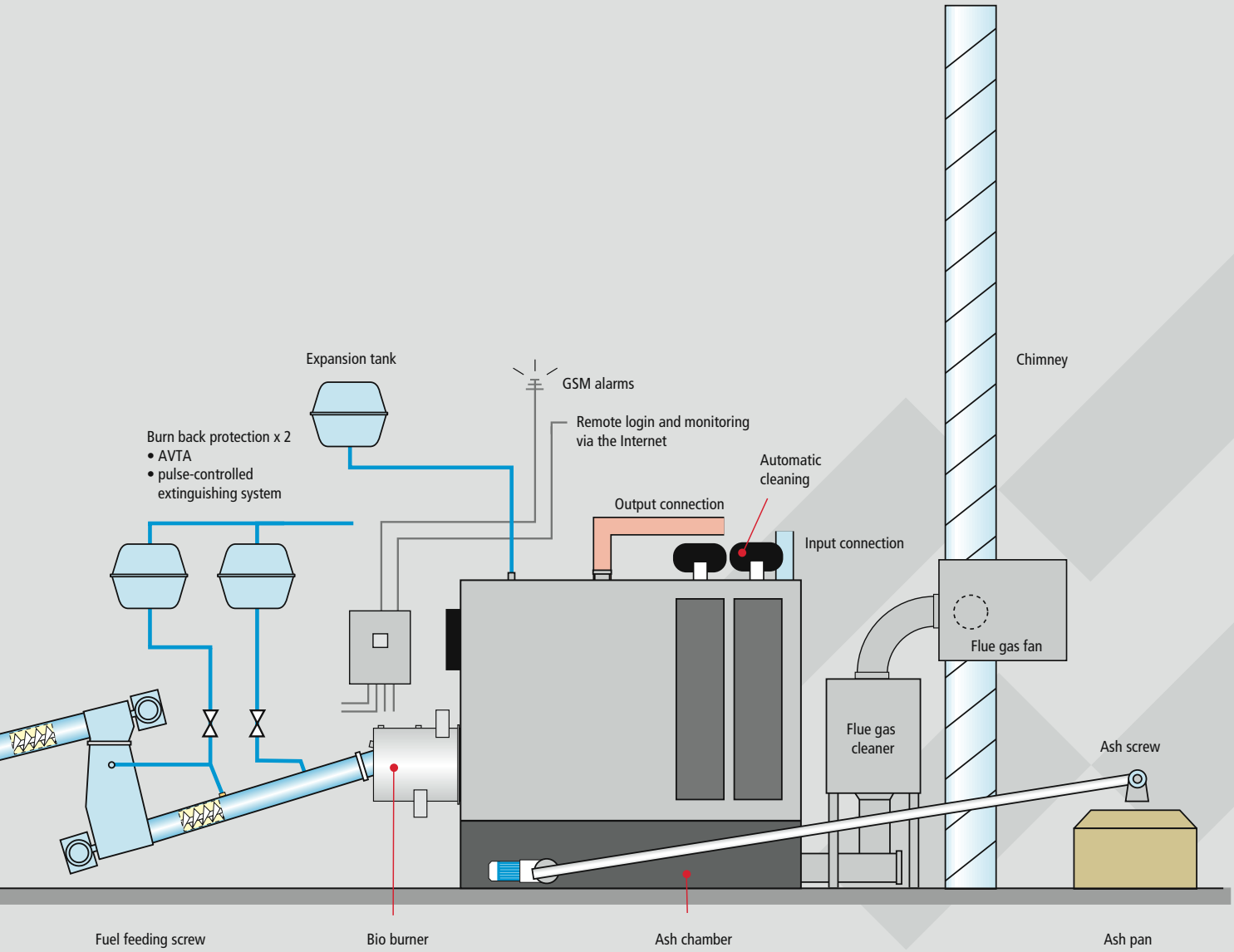
Careful planning leads to good results

Careful planning forms the basis of a functional, economical and easily maintained bio heating system. Before starting the construction work, it is necessary to go through the power requirement measurement, choice of equipment and storage solutions based on the choice of fuel, the functionality of maintenance and upkeep, the level of automation and fire safety. It is recommended to get the assistance of a professional for the planning.

As for fire safety, it is worthwhile to contact the local fire authorities as soon as possible. This way an official approval of the fire safety measures is obtained already at the design stage. Heating devices are often installed in an existing building, but a separate boiler house or a ready-made heating container solution is worth considering.

Some of the key factors in designing are:

- plant output sizing, maximum and reserve power production
- ease of maintenance (access to soot hatch, etc.)
- placement of doors and burner for left or right-handed access
- size and filling method of the storage
- types and measurements of the storage discharger and the fuel conveyors
- level of burn back protection
- level of automation and possibility of remote control and monitoring
- automatic ash removal
- flue gas fan and/or cleaner



Storage solutions for pellets

Pellet, unlike wood chip, peat and briquettes, is a slippery fuel of uniform quality. The pellet storage does not need dischargers to function. Vertical steel silos, familiar from farming, are suitable for storage. V-bottomed horizontal silos are also common, especially in use in private homes. The important thing is that the inclination of the silo walls is not under 50°; otherwise the risk of arching is great and the system may be extinguished due to the lack of fuel. In determining the size of the pellet storage, it is advisable to take into account the minimum delivery amounts of the pellet suppliers. Pellets are not affected by cold air, and air humidity is not a problem. However, it does have to be protected from water. The high density pellet will swell many times its normal size in water, thus obstructing the feeding devices.

Determining the capacity of the fuel storage

Decide on a suitable refill interval - in other words, how often you want to take care of the fuel refill. Choose the capacity of the storage according to the desired fuel storage refill interval and the calculated daily consumption (calculated by power requirement and fuel, see the adjacent chart).

Storage capacity = refill interval x daily consumption

The chart emphasises the maximum daily fuel consumption (consumption on the highest continuous power). In other words, the storage capacity calculated by this value is sufficient for the desired refill interval in the coldest period in the winter. At other times, the fuel storage refill interval will be longer.

Power kW	Daily consumption pellet m³	Daily consumption wood chip m³
40	0,3	1,1
60	0,5	1,6
80	0,6	2,1
120	1,0	3,2
150	1,2	3,6
200	1,6	4,8
250	2,0	6,0
300	2,4	8,0
400	3,2	10,7
500	4,0	13,3
700	5,6	18,7
1000	8,0	26,6

	Example 1. FARM	Example 2. TERRACED HOUSE + SCHOOL
Maximum power	60 kW	200 kW
Fuel	wood chip	pellet
Suitable burner	HakeJet	BioJet
Daily consumption at max. power m³	1,6	1,6
Desired refill interval	4 days	1 week
Silo capacity	4x1,6 = 6,4 m³	7x1,6 = 11 m³

30 m³ vertical steel silo

3 x 34 m³ vertical steel silo

9 m³ horizontal silo with a V-shaped bottom

BURN BACK PROTECTION

Fire is an essential part of any bio heating system. When working with fire, it is always necessary to take great care and remember that the system is as safe as its weakest link. Nevertheless, a well designed, built and maintained bio heating system is safe to use. In screw-conveyed solid fuel devices the danger is caused when the fire in the burning head starts to crawl backwards to the direction of the fuel storage. The Ariterm bio burning systems have been designed with burn back protection in mind, and the extinguishing systems will extinguish a possible back fire as it starts.

The right measuring of the chimney is very important for burn back prevention. Make sure the seam between the boiler and chimney is airtight. The user must make sure that there is a low pressure in the boiler's fire chamber at all times (draft from the boiler to the chimney). If this is not the case, the risk of burn back will increase significantly. Low pressure can be induced by a sufficiently long chimney with a correctly measured inner diameter. The surest way to take care of a sufficient low pressure in all circumstances is to equip the boiler with a flue gas fan. A low pressure gauge, installed in the fire chamber of the boiler, is a good accessory for ensuring the functioning and adjustments of the system. It controls the flue gas fan keeping the fire chamber pressure constant.
Equipment delivered by Ariterm has been manufactured to meet the instructions of the Federation of Finnish Insurance Companies (2006) concerning fire protection/burn back protection safety of solid fuels.

The following solutions tell of the thorough fire safety planning of the Ariterm burners:

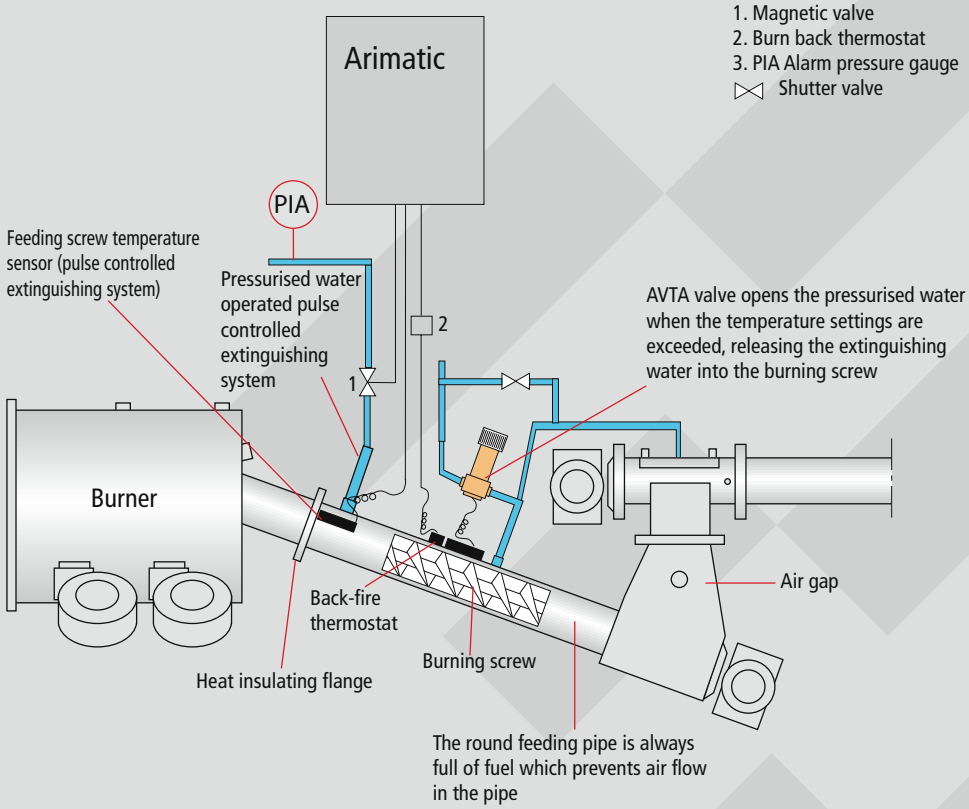
- a round screw in a round feeding pipe: the pipe is always full of fuel
- two-screw feeding system: air gap between the screws and a rising burning screw
- a flange between the burning head and the fuel feeding pipe hinders the transmission of heat
- AVTA valve, a thermostatic extinguishing system functioning by pressurised water, backed up by an expansion tank in case of network pressure loss. Nozzles for the burning screw and the free fall funnel. The AVTA valve is self-powered and needs no electricity etc. to function. (AVTA is a standard equipment in T1, T2 and K2, and K4.)
- automatics, pulse controlled extinguishing system, functioning by pressurised water. A nozzle at the front end of the burning screw will extinguish a starting fire (accessory). Its functioning in case of power failure can be ensured with a UPS device
- automatics, thermostat-controlled burn back protection (if the temperature in the feeding screw rises over the set value, the blowers will stop and the automatic system will drive the screw for a set time to empty it of the overheated fuel)
- limit switches in the burner and the lid of the silo
- automatic dry powder extinguishing system for pellet
- alarm connection to a GSM phone

The burn back protection of a wood chip heating system

1. Directed by the temperature sensor, the pulse controlled extinguishing system sprays water into the feeding screw to increase fuel moisture and lower the temperature. This takes away the conditions the fire needs to spread. The system does not turn the machinery off or make an alarm.
2. Directed by the temperature sensor, the automation turns the screw for a set time to drive the seat of fire out of it. The system turns the machinery off and makes an alarm.
3. Directed by the temperature sensor, the AVTA valve sprays water into the feeding system, thus extinguishing the fire.

The abovementioned active fire safety systems, combined with structural fire safety solutions, guarantee a safe and functional bio heating system. For the best possible result, we recommend contacting the local fire authorities already in the designing phase.

In pellet devices the water extinguishing system should be replaced by a powder extinguishing system.



BURN BACK PROTECTION CONNECTIONS

Wood chip systems

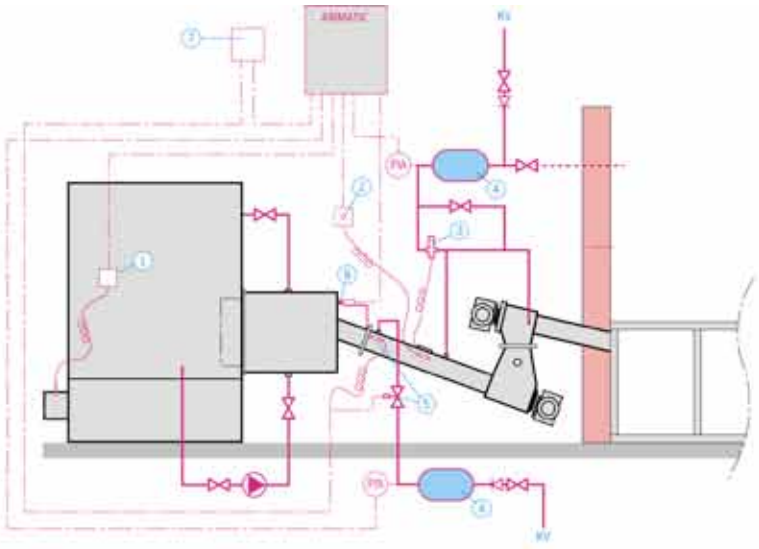
1. Flame control thermostat
2. Burn back thermostat
3. AVTA valve, self-operated DN 25
4. Expansion tank 35-50 l, prepressure 100 kPa
5. Pulse controlled burn back protection:temperature control for magnetic valve and feeding screw
6. UPS device
7. Dislocation limit switch for burner head

PIA Alarm pressure gauge, 0-600 kPa

Shutter valve

Non-return valve

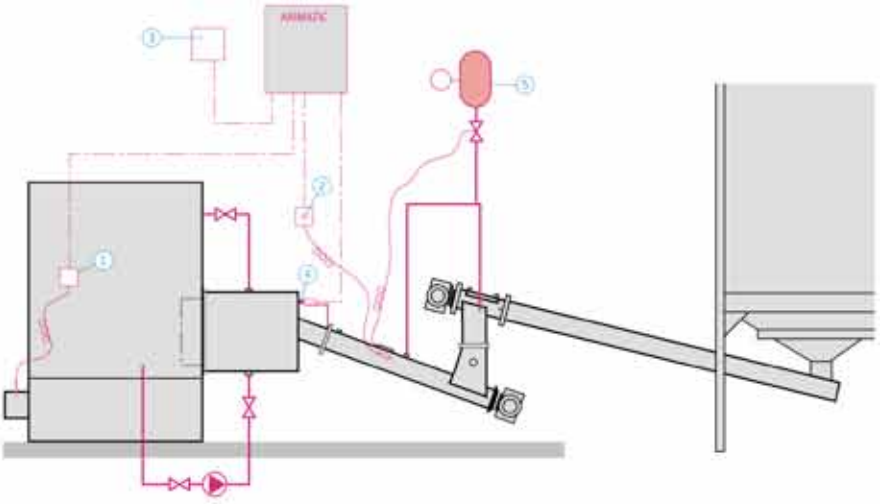
KV Cold water



Pellet systems

1. Flame control thermostat
2. Burn back thermostat
3. UPS device
4. Dislocation limit switch for burner head
5. Powder extinguishing system with two hoses and alarming pressure gauge

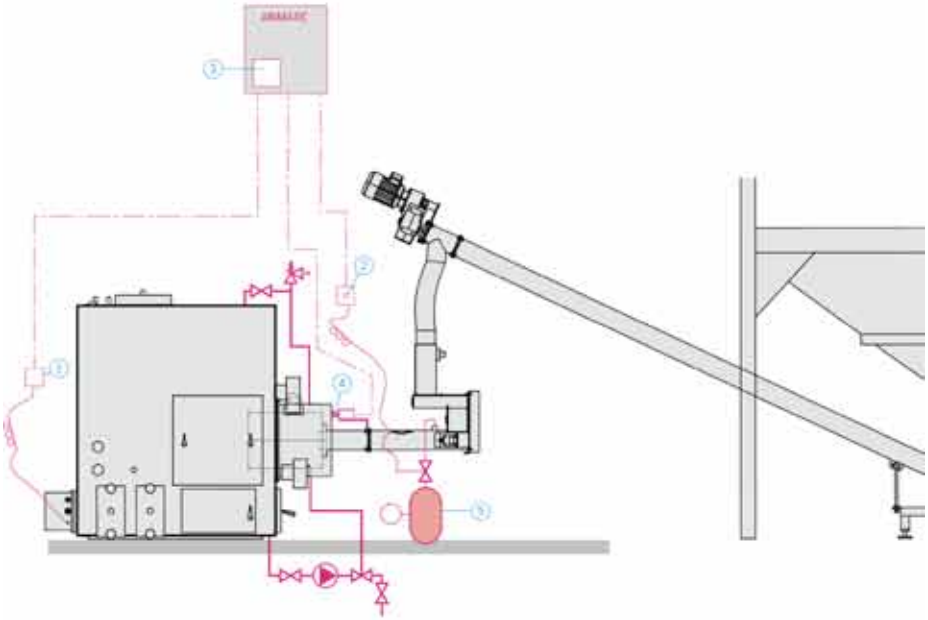
Shutter valve



Pellet systems PS-10

1. Flame control thermostat
2. Burn back thermostat
3. UPS device
4. Dislocation limit switch for burner head
5. Powder extinguishing system and alarming pressure gauge

Shutter valve



ARIMAX 300 BIO BOILER SERIES

Powerful 1.5 bar Bio Boilers 40-150 kW

The bio boilers in the Arimax 300 series are efficient and easy to use. All boilers are available as right/left models, with burner openings always in the front and on either side. An ash chamber comes with all boilers as a standard feature.

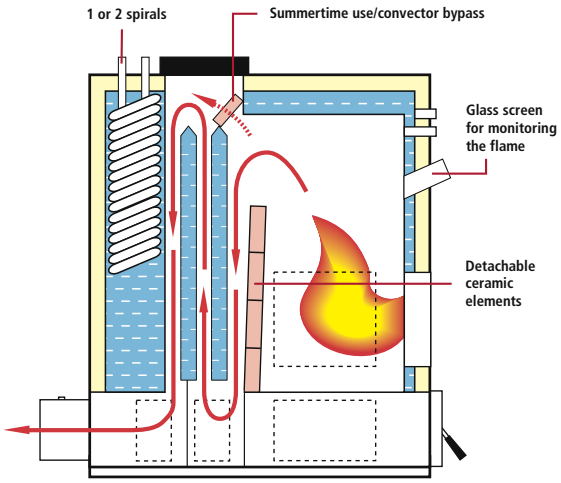
The boiler is compatible with e.g. HakeJet, BioJet and MultiJet burners. The square burner opening enables the use of other burner solutions as well. The boilers are easy to clean through the large maintenance and cleaning hatches.

The chimney duct can be installed from behind or on either side. The ceramic back wall of the fire chamber adds efficiency and maintains clean burning, especially with moister fuels.

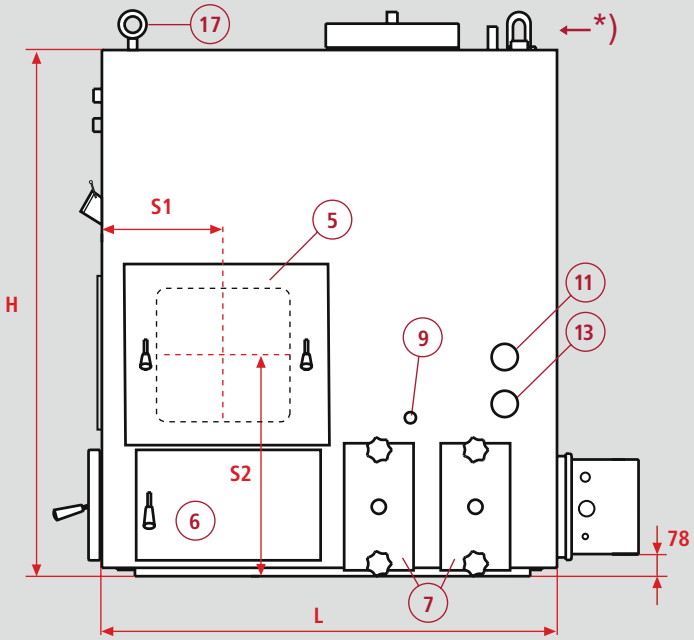
Boiler	340	360	380	3120	3150
Power kW	40	60	80	120	150
Weight kg	522	670	830	1070	1278
Capacity l	210	280	370	460	550
Max. operating pressure bar	1,5	1,5	1,5	1,5	1,5
Max. operating temperature °C	120	120	120	120	120
Fire chamber measurements					
Fire Chamber Height mm	780	920	1080	1150	1200
Fire Chamber Width mm	400	480	550	650	750
Fire Chamber Depth mm	400	480	550	650	750
Fire Chamber Capacity m³	0,125	0,212	0,327	0,486	0,675
Fire surface m²	3,7	5,5	7,4	11,2	14,7
Fire surface loading kW/m²	10,8	10,8	10,8	10,7	10,2
Burner opening size mm x mm	250 x 250	360 x 360	400 x 400	440 x 440	480 x 480
Other measurements					
Chimney duct size mm	138 x 226	138 x 226	138 x 226	218 x 226	218 x 226
Chimney duct, min. Ø mm	150	180	200	220	250
Chimney duct length min. m	4	6	8	9	10
Flow/return connection DN	50	50	50	50	50
Expansion connection DN	25	25	25	25	25
Thermostat connection DN	20	20	20	20	20
Warm water spiral 56 kW	yes	yes	yes	yes	yes
Additional spiral possibility 56+56 kW	no	yes	yes	yes	yes

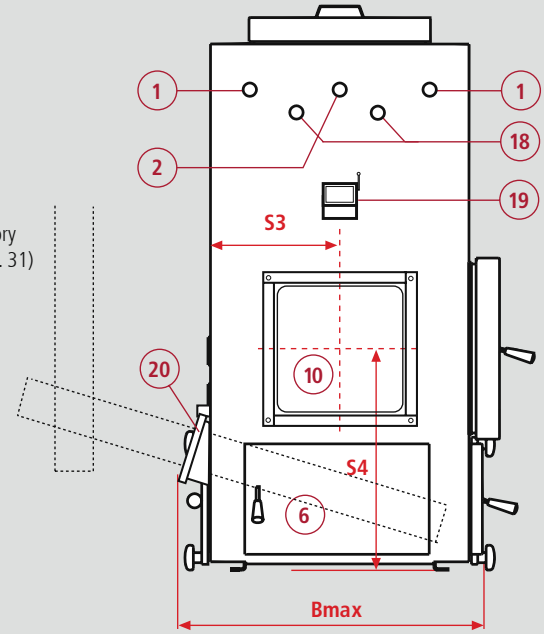
The bio boilers in the Arimax 300 series use authentic vertical convection, which extends the period between cleanings significantly. The large fire chamber in the boiler has been designed specifically for bio fuels. Versatile hatches and connections enable several different assembly options.

It is also possible to install several electric resistances into the boiler as emergency heat sources. The boiler convector is equipped with a detachable ceramic bypass plate. During summertime, when heat requirements are very small, the bypass plate can be removed. This makes the burner more steady and safe. The spacious ash chamber, included as a standard feature, is insulated from the outside.

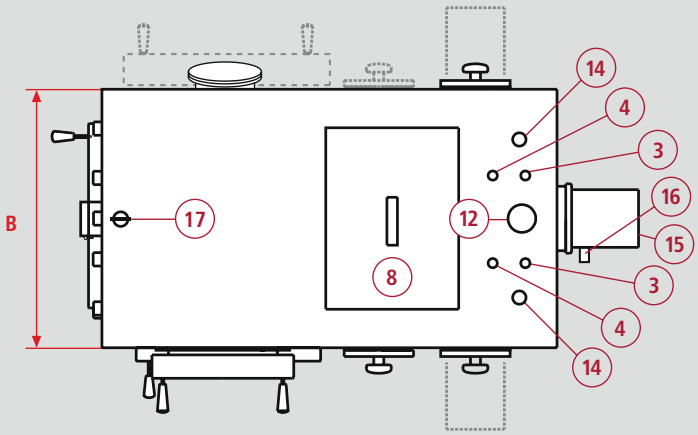


Boiler	340	360	380	3120	3150
Boiler height H mm	1285	1425	1585	1655	1705
Boiler width B mm	620	700	770	870	970
KBoiler depth L mm	1090	1192	1300	1440	1590
Maintenance/burner hatch measurements mm	250 x 250	360 x 360	400 x 400	440 x 440	480 x 480
Max. transportation width B max. mm	740	820	890	990	1090
Locations of the midpoint of the hatches					
- side hatch, from front S1 mm	290	350	364	415	483
- side hatch, from floor S2 mm	555	616	650	650	660
- front hatch, from side S3 mm	310	350	385	435	485
- front hatch, from floor S4 mm	555	616	650	650	660





Optional accessory
ash screw (see p. 31)



STANDARD EQUIPMENT:

- cleaning tools
- pressure gauge/thermometer
- combustion gas thermometer
- warm water spiral

ACCESSORIES:

- additional spiral (for warm service water, not for Arimax 340 Bio)
- underpressure controlled flue gas fan
- ash screw kit
- equipment set for burning wood, contains hatch and grates (not for 3120, 3150)
- safety valve
- electric resistance with a thermostat 6 kW
- oil burner equipment (hatch set)
- pellet burning equipment
- *) lifting eye (detachable)

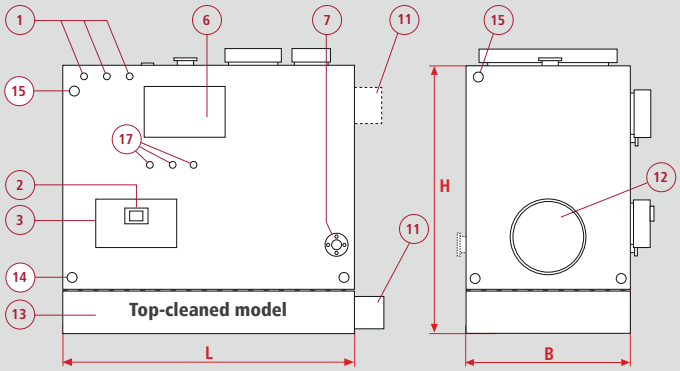
1. Damper/thermostat connection DN 20
2. Thermometer connection DN 20
3. Cold water Ø 22
4. Warm water Ø 22
5. Maintenance/oil burner hatch
6. Ash hatch
7. Cleaning hatch
8. Sooting hatch
9. Drain connection DN 15
10. Burner opening, can also be **on the side** of the boiler
11. Electric resistance connection DN 50
12. Output to network DN 50
13. Return from network DN 50
14. Expansion/safety valve DN 25
15. Chimney duct, also sides 138x226 mm
16. Combustion gas measurements
17. Lifting eye
18. Measuring connection for the fire chamber (2) DN 20
19. Viewing screen
20. Ash screw connection

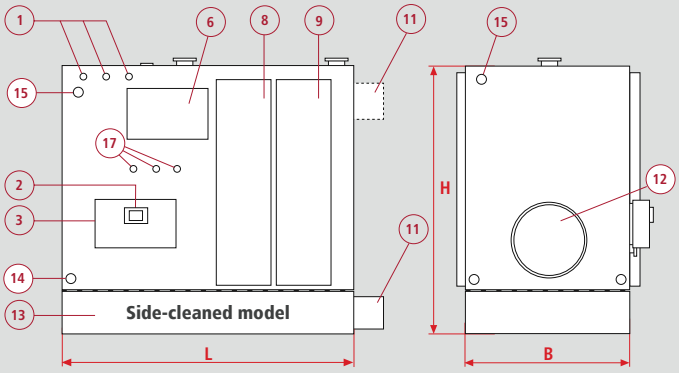
- nominal output 120-3000 kW
- compatible with Ariterm's bio burners
- max. working pressure 4-10 bar
- can be equipped with a domestic hot water heat exchanger
- the boiler has the necessary hatches for cleaning and fire maintenance. Depending on the model, the convection part is cleaned from the top or from the side of the boiler. The position of the fire chamber hatches can be determined separately while ordering.
- the structure is open at the bottom; insulated ash chamber and screw system for ash removal available as accessories

Accessories

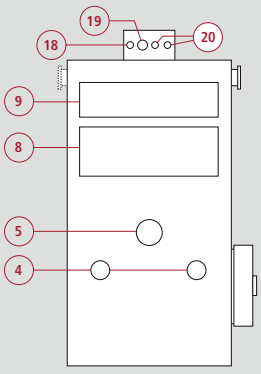
- Insulated steel ash chamber
- Ash screws
- Compressed air operated automatic convector cleaning
- Vacuum-controlled flue gas fan
- Flue gas cleaner
- Oil burner hatch

Pictured here is a side-cleaned model with the back convector cleaning hatch opened. The ash chamber seen on the bottom of the boiler is an accessory.





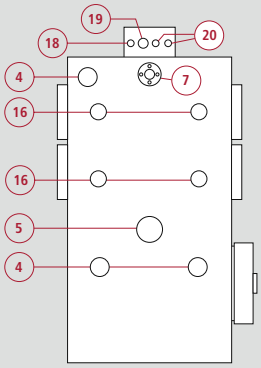
1. Thermostat connections (both sides)
2. Flame monitoring screen
3. Burning head/fire chamber maintenance hatch (back or side)
4. Expansion/relief valve connection
5. Flow connection
6. Maintenance hatch
7. Return connection
8. Front convector cleaning
9. Back convector cleaning
10. Damper plate
11. Chimney duct (in 120-150 kW models on top)
12. Burner hatch (front or side)
13. Ash chamber (accessory)
14. Connection to water-space (lower corners)
15. Burning head cooling circulation connection



Side-cleaned models:

- 120 - 1000 kW, cleaning from the side chosen by the customer
- Accessory: 120 - 1000 kW, cleaning from both sides
- Recommendation: 500 - 1000 kW boilers, cleaning from both sides

16. Automatic cleaning connections
17. Measuring connections for the fire chamber
18. Heat/analysis connection for combustion gas
19. Connection for lambda sensor
20. Combustion gas measuring connections (2)



							5-draught bio boilers						
Power kW	**120**	**150**	**200**	**250**	**300**	**400**	**500**	**700**	**1000**	**1500**	**2000**	**2500**	**3000**
Width B mm	980	980	980	1030	1080	1180	1285	1485	1685	1885	1985	1985	1985
SP-model extra w. +mm	+340	+340	+340	+340	+340	+340	+340	+340	+340	+340	+340	+340	+340
Depth L mm	1690	1790	1990	2090	2270	2370	2615	2915	3315	3615	4360	4960	5560
Height H mm	1540	1740	1540	1590	1640	1840	1845	2145	2345	2645	2745	3045	3295
Weight kg	1250	1450	1650	1800	2200	2700	2920	3850	6100	8650	11300	12700	13960
Capacity dm³	500	600	710	800	860	1100	1750	2410	2850	4250	5400	6390	7330
Max. working P bar	4	4	4	4	4	4	4	4	4	4	4	4	4
Max. working T °C	120	120	120	120	120	120	135	135	135	135	135	135	135
Fire chamber width mm	700	700	700	750	800	900	1000	1200	1400	1600	1700	1700	1700
Fire chamber depth mm	800	900	900	1000	1100	1200	1300	1600	1700	2000	2300	2900	3500
Fire chamber height mm	1400	1600	1400	1450	1500	1700	1700	2000	2200	2500	2600	2900	3150
Fire chamber capacity m³	0,7	1,0	0,8	1,1	1,3	1,8	2,2	3,8	5,5	8,1	10,2	14,3	18,7
Fire surface m²	19,0	22,0	25,9	30,8	33,7	43,9	54,3	75,2	105,2	161,2	212,7	268,8	315,8
Fire surface load kW/m²	6,3	6,8	7,7	8,1	8,9	9,1	9,2	9,3	9,5	9,3	9,4	9,3	9,5
Chimney duct location D mm	1230 (1	1430 (1	50	50	50	50	-	-	-	-	-	-	-
Chimney duct height E mm	250	250	250	250	250	250	-	-	-	-	-	-	-
Chimney duct width F mm	300	300	400	400	500	500	-	-	-	-	-	-	-
Flow/return connection DN	50	50	65	65	65	80	80	100	100	125	150	200	200
Expansion connection DN	50	50	50	50	50	50	50	50	50	65	80	80	100
Thermostat connections DN	20	20	20	20	20	20	20	20	20	20	20	20	20

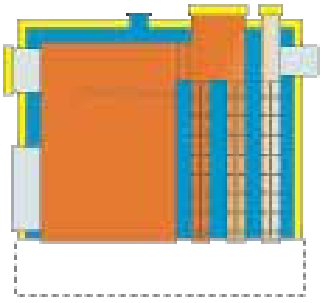
(1 Measurement for the top-cleaned model; the side-cleaned model is 100 mm shorter.

Ask the factory for an alternative order form.

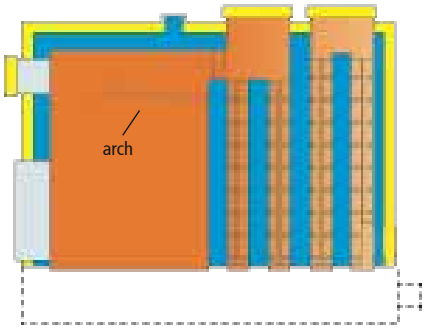
6 and 10 bar boilers, 500 -3000 kW

Power kW	**500**	**700**	**1000**	**1500**	**2000**	**2500**	**3000**
Working pressure 6 bar, max working temperature 150 °C, Weight kg	3050	3990	6320	8960	11650	13170	14400
Working pressure 10 bar, max working temperature 175 °C, Weight kg	3450	4550	7270	10100	13200	14950	16950

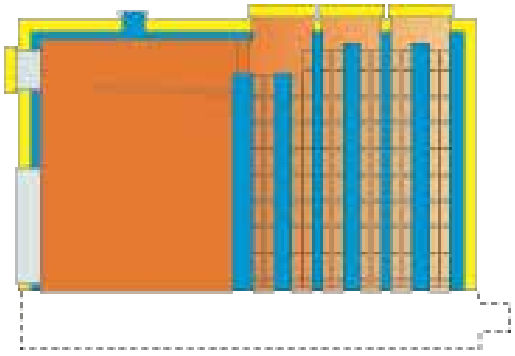
Draft of boiler cross sections



Arimax Bio 120-150 kW



Arimax Bio 200-400 kW



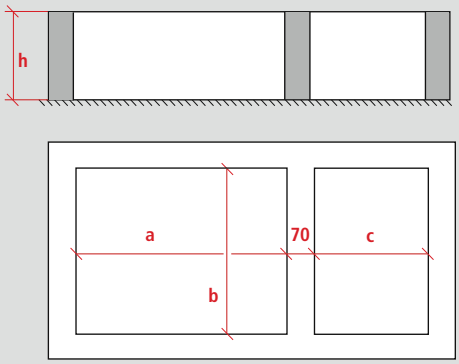
Arimax Bio 500-3000 kW

For top-cleaned models, the boiler room height needs to be 2 x the height of the boiler. The arch is standard only in those 200-400 kW boilers equipped with an Ariterm burner.

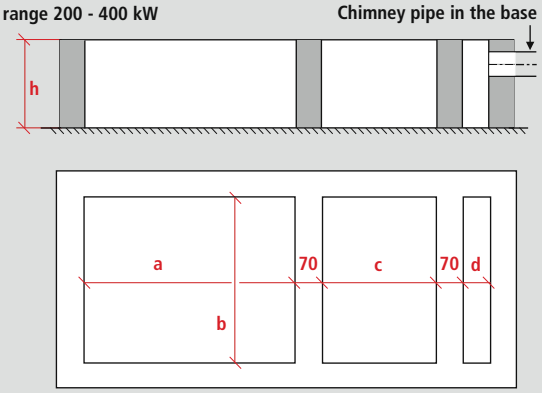
Bricked ash chamber measuring guide

The ash chamber can be made from bricks by scale on the spot. Boilers equipped with steel bases are also available. The measurements are in millimetres. Measurement h is the minimum height.

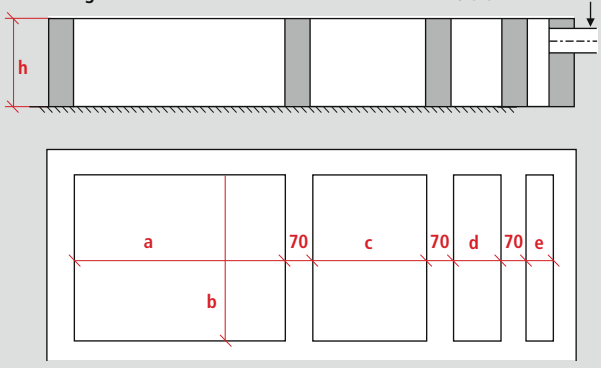
Power range 120 - 150 kW



Power range 200 - 400 kW **Chimney pipe in the base**



Power range 500 - 3 000 kW **Chimney pipe in the base**



							Factory-built steel ash chambers	
Power	**a**	**b**	**c**	**d**	**e**	**h**	**Ash chamber weight (kg)**	**Ash chamber weight with grate blocks (kg)**
120	825	730	540	-	-	350	225	-
150	925	730	540	-	-	350	235	-
200	925	730	536	135	-	350	270	-
250	1025	780	536	135	-	350	290	-
300	1125	830	596	155	-	500	465	-
400	1225	930	596	155	-	500	510	-
500	1325	1030	354	334	135	500	585	-
700	1625	1230	354	334	135	800	980	1622
1000	1725	1430	596	374	155	800	1145	2505
1500	2025	1630	596	374	155	800	-	3145
2000	2325	1730	1040	374	155	1000	-	3761
2500	2925	1730	1040	374	155	1000	-	4488
3000	3525	1730	1040	374	155	1000	-	5266

When using the flue gas fan the flue duct connection from the chamber must be made according to table on page 27.

Domestic hot water

The need for domestic hot water varies by building. That is why the Arimax Bio 120-3000 kW boilers can be equipped with domestic hot water heat exchanger most suitable for the customer's property. It is advisable to have the dimensioning of the exchanger carried out by HVAC designer. The advantage of the heat exchanger over the traditional hot water spiral is its significantly better heat transmission capacity and the possibility to assemble it afterwards. It is easier to determine the right heat exchanger power if the following things are known of the hot water consumption:

- maximum consumption (litre per second or litre per minute)
- duration of maximum consumption (e.g. 15 minutes)
- max temperature of water (e.g. +65 °C)

If accurate information is not available, the magnitude of the measurements can be determined if it is known how many warm water taps there are for the boiler (e.g. 2 showers, 2 kitchen taps and 3 wash basin taps). A little oversizing of the domestic hot water heat exchanger does no harm.

ARITERM

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