



# Hamworthy Herz BioFire Biomass Boilers

Moving Step Grate: BF-M500,  
BF-M600, BF-M800 and BF-M1000

Wood Chip or Wood Pellet  
Boiler Outputs 500kW to 1MW  
Fully automatic, self-cleaning



Heating *at work.*

# Herz BioFire BF-M Series

## Wood chip or Wood pellet Automatic Biomass Boilers

The Herz BioFire biomass boilers from Hamworthy provide practical and highly efficient heating and hot water generation using wood chips or wood pellets.

Herz BioFire biomass boilers are suited for those wishing to reduce their heating costs and reliance on fossil fuels whilst at the same time reduce their carbon emissions. The boilers qualify for a range of generous UK government financial incentives for installing and running biomass "carbon neutral" technology, which means a rapid return on investment and, with applicable Renewable Heat Incentive (RHI) biomass tariff payments, a way to generate income. BioFire boilers are also exempt from the requirements of the Clean Air Act 1993 and so may be used in smokeless zone areas.

Biomass is an attractive all-year-round alternative to traditional oil and gas fuels, particularly as consistent quality standardised wood pellets and wood chips are now readily available throughout the UK.

Hamworthy present here the BioFire range of high power-to-mass ratio, high-specification, automatic biomass boilers; the product of decades of research and development by leading Austrian biomass developers Herz. Simple to operate, efficient and highly cost-effective, they are the environmentally friendly way to provide reliable heating and hot water for commercial/industrial premises.

- **Consistent high efficiency >90%**
- **Smokeless zone exempt**
- **Self-cleaning for low maintenance**
- **Comprehensive controls and monitoring**
- **Reliable low-carbon heating**
- **Automatic fuel feed and ash removal**
- **Energy saving auto-extinguish/restart function**
- **Fast install with fully pre-assembled modules**
- **Cascadable for up to 2 Megawatt projects**
- **Extremely compact high power solution**

BENEFITS

**BioFire biomass boilers are a realistic proposition for larger buildings, hotels, hospitals, housing estate projects and timber processing plants, and qualify for generous UK Government financial incentives.**

## Options

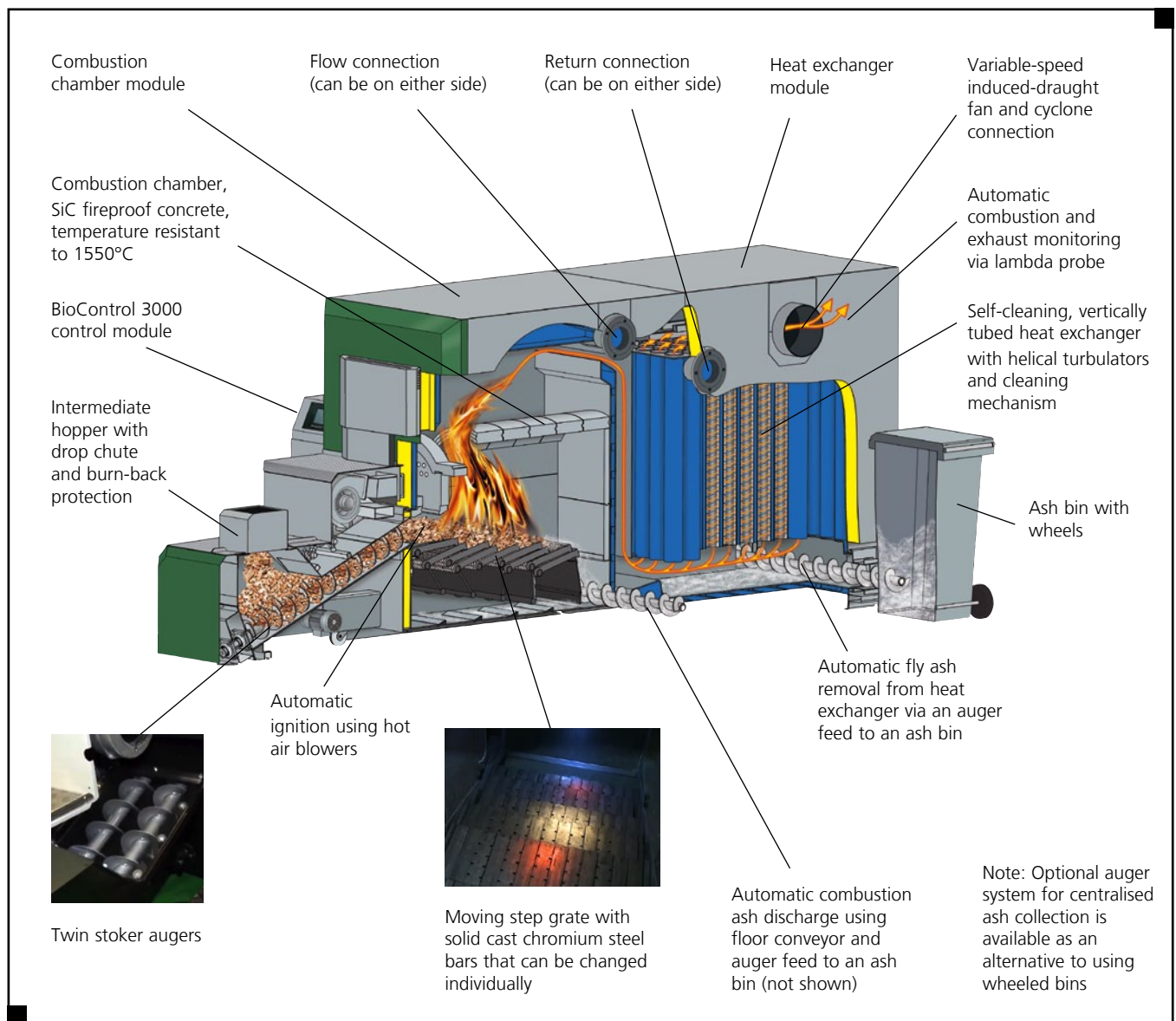
- **Wood chip or wood pellet**
- **Auto fuel delivery system**
- **Left or right module mountings**
- **Fuel storage systems**
- **Thermal buffer vessels**
- **Additional control modules**
- **Remote monitor/control options**
- **External ash disposal system**
- **RHI approved heat meter**



Typical plant room with 800 kW BioFire biomass boiler and vertical fuel feed.

# Typical Section

BioFire BF-M Biomass Boilers, Moving Step Grate  
BF-M500, BF-M600, BF-M800, BF-M1000



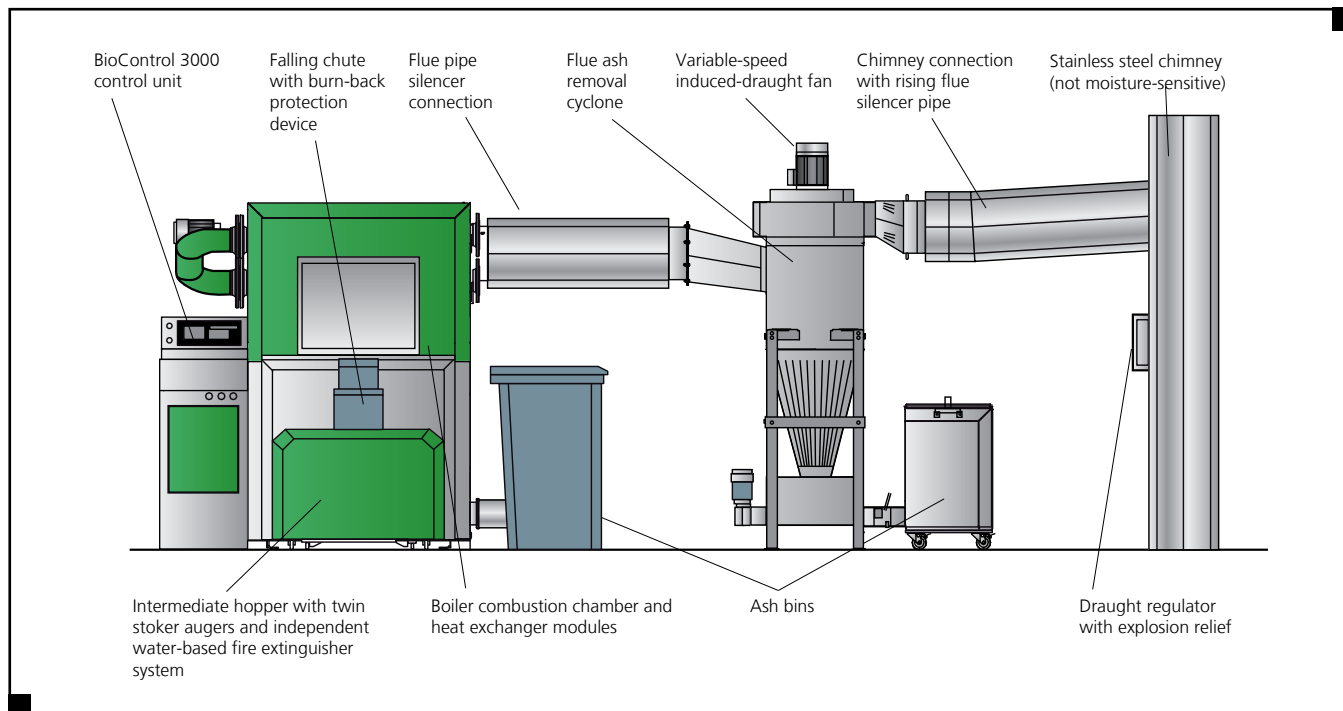
## General Description

On demand, or when infra-red detectors in the intermediate hopper detect low fuel, the fuel feed auger to the store, and integrated agitator if fitted, is powered on and supplies fuel from the main store to the intermediate hopper, via a back-burn prevention (BBP) device mounted above the hopper and continues until full. The BBP device comprises a drop chute and a motor-driven air backflow prevention valve: a flap, which only opens when fuel is being supplied, and is otherwise sprung closed creating an airtight seal to prevent air flow back down the auger. The flap, together with physical break between auger and intermediate hopper provided by the chute, serve to prevent any risk of fire burning back to the main fuel store.

Fuel in the intermediate hopper is stoked automatically into the combustion chamber according to the demand cycle, via two removable stoker augers. Fuel rises up through the stoker tube into the combustion module, and is dropped onto a moving step grate. Each grate step, made of a row of solid cast chromium steel bar elements, reciprocates to shuffle fuel along the grate as it burns, the last row of grate elements tip combustion ash periodically onto a pushrod conveyor and auger arrangement in the ash chamber below for automatic disposal to a wheeled ash bin. During the automatic cleaning cycle, the grate vibrates to assist the ash removal process.

# Typical Assembly

BioFire BF-M Biomass Boilers,  
BF-M500, BF-M600, BF-M800, BF-M1000



The fuel is lit automatically in the combustion chamber by electric hot air blowers and primary air is fan-driven through holes in the grate bars (in two independently controlled zones) to begin combustion. As the wood fuel burns, flammable gases are given off and these are further burnt with controlled secondary air blown into the main combustion area, into two separate zones, each controlled by its own variable-speed fan.

The hot gases pass from the combustion chamber module to the heat exchanger module and through the vertical heat exchanger tubes, transferring heat to the water that is pumped through adjacent channels in the heat exchanger. The heated water is piped to an external buffer vessel and/or low loss header, and fed on to the building's heating circuits to distribute heat, returning via the header/buffer and pump, back to the heat exchanger for reheating.

The heat exchanger tubes contain helical turbulators in the vertical tubes that create turbulence in the gases as they pass through, improving heat transfer. Periodically the heat exchanger is set to an automatic cleaning cycle, in which the cam-driven turbulators oscillate to dislodge any fly ash deposits from the heat exchanger tubes, which fall into an ash chamber below.

The gases are drawn through the heat exchanger via a variable-speed induced-draught fan in the flue ash removal cyclone, and through to the flue/chimney, while removing fly ash and soot by rapidly rotating the flue gases in a cyclone column. Centrifugal forces push the ash and soot particles radially outwards to gather on the internal walls of the cyclone which then fall into an ash bin below, leaving a much cleaner exhaust gas efflux to exhaust to atmosphere

via a naturally ventilated flue/chimney.

Discharge augers automatically transfer fine fly ash from the heat exchanger and cyclone, and coarse ash from the combustion chamber, to wheeled bins on the side of the boiler for periodic ash disposal. Optional suction lance or auger systems are available to remove ash automatically to an external store, in place of the wheeled ash bins.

The central BioControl 3000 unit controls the safe and efficient operation of the boiler. Heat output is controlled primarily by the boiler water temperature setting, and power is adjusted automatically by the control of the primary and secondary air drawn through two separate areas of the combustion chamber. Combustion is regulated via sensors that monitor stoker tube and combustion chamber temperatures and via a lambda sensor monitoring exhaust gas emissions (O<sub>2</sub> levels). The fuel/air supply rates adjust automatically to maintain the most efficient and cleanest burn.

The controller also responds to overheat/overpressure settings, external temperature, on/off timing schemes and other locally programmed or event-driven parameters. It includes buffer vessel temperature management using predictive control, preventing rapid boiler cycling during low load (less than 30% peak output) conditions with two temperature sensors. The standard BioControl 3000 unit can control two heating circuits, a buffer vessel, a hot water tank, a solar circuit and a back-end protection kit comprising 3-port motorised valve and single or double pumps. The controls can be extended using optional plug-in heating control extension modules allowing a maximum of 4 heating circuits to be controlled; up to three of which can be solar water circuits.

# Specification

## BioFire BF-M Biomass Boilers

BioFire biomass boilers are a compact, low thermal mass, rapid response design, making them particularly suitable for commercial and small industrial premises, schools, hospitals and small housing estate projects. The boilers are designed for use on open-vented or pressurised/sealed systems, and designed to operate between 70°C and 90°C at 6 barg maximum operating pressure with a minimum return temperature of 60°C. Efficiency is not less than 90.5% under normal or part load.

### Model Range

The Hamworthy Herz BioFire series comprises 4 models:

Model	Power
BF-M500	500kW
BF-M600	600kW
BF-M800	800kW
BF-M1000	1000kW

### Choice of Fuel

The BioFire boilers offer a choice in fuel, either wood chips or wood pellets, and the boilers are optimised on commissioning for use with one type. However, if the ability to switch fuel types at a later stage is required, then the fuel storage and handling system will need to be designed to accommodate both types of fuel. Wood chips require a greater storage volume than wood pellets, whereas pellets flow much better than chips so appropriate augers, feed systems, agitators and stores will need to be specified. Other factors to consider include availability of fuel type, access for delivery vehicles to the main fuel store and any local authority planning regulations. Hamworthy can advise and supply all the necessary automatic fuel feed and storage equipment for a fully integrated installation.

### Permitted Fuels

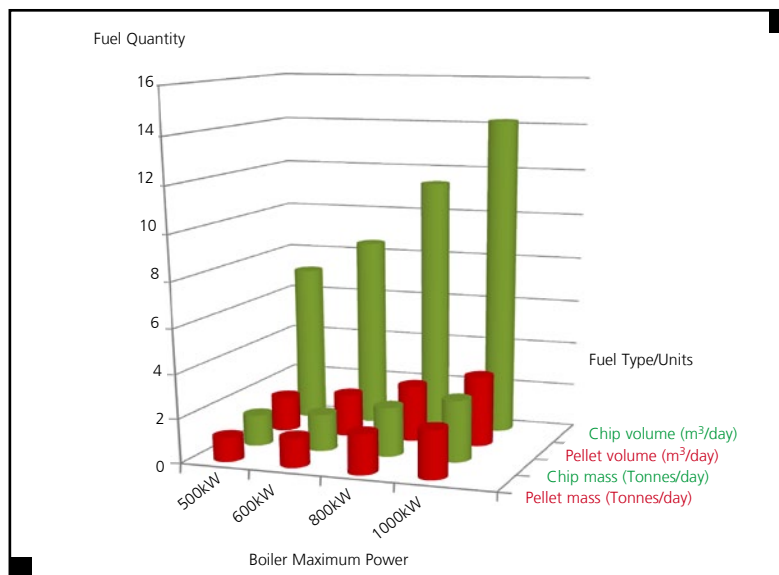
	Wood Chips	Wood Pellets
Fuel Standard	ÖNORM M7133	ÖNORM M7135 DINplus seal of approval or Swisspellet
Size	G30-G50	6mm or 8mm dia.
Moisture content	W10-W40 40% Max	W8-W10 10% Max

### Water Quality

Heating water quality must be in accordance with BS EN 12828:2003.

### Typical Daily Fuel Usage

A 500kW BioFire boiler will typically consume approximately 1.1 tonnes of pellets or 1.4 tonnes of chips per day. See graph below and table on page 16 for underlying data and assumptions.



### Clean Air Act Exemption

The BioFire range of biomass boilers meet class 3 of EN303-5 and are exempt from the requirements of section 20 the Clean Air Act 1993 for Smoke Control Zones, if they are used with wood chips or wood pellets that do not contain halogenated organic compounds or heavy metals as a result of treatment with wood preservatives or coatings.

### Combustion Performance

The boilers feature automatic exhaust and combustion monitoring via lambda probe oxygen sensors and temperature sensors in the flue. The signals from the sensors are used by the integral boiler controller to continually adjust combustion parameters (fuel feed rate, primary and secondary air flows) to deliver the cleanest and most efficient combustion performance possible, even at part load. This results in lower fuel consumption and lower CO<sub>2</sub> emissions.

### Burner Control

The boilers have moving step grate combustion chambers with full modulation control to match output with demand, saving fuel and achieving high levels of efficiency. Modulating from 100% to 30% output with no loss of performance, these boilers also feature a self-extinguish function that stops the combustion fans when there is no demand, and an automatic restart function with automatic ignition via a 1600W hot air gun to re-light the boiler when demand returns. This eliminates the need for low burn or kindling periods, which are wasteful of fuel.

### Boiler Construction

The steel fabricated modular construction boilers are welded and pressure tested to 7.5 bar. They have a fully insulated boiler casing. The combustion chamber is made of SiC fireproof concrete designed to withstand temperatures up to 1550°C, and the moving step grate is made of chromium steel elements that can be individually replaced if worn. The boiler body and water jacket have a low thermal mass that enables a very fast response to demand for heat. It includes a vertically-tubed, self-cleaning heat exchanger, protected by a high limit thermostat.

# Safety and Convenience

## BioFire BF-M Biomass Boilers

### Three-Stage Burn-Back Protection:

#### ■ Air back-flow prevention valve

This is a burn-back protection system between the fuel feed auger and the rising stoker augers. It is fitted above the intermediate hopper and has a drop chute and burn-back flap, driven by a spring-return motor. When the fuel feed auger is not running, or in the event of electrical power cut, it springs closed mechanically, creating an airtight seal to prevent reverse air flow and any risk of fire entering the feed auger and store.

#### ■ Stoker tube temperature monitor

The second protection system is two electrical temperature sensors in the stoker tube connected to the BioControl 3000 unit, which, on over-temperature detection, turn the stoker augers fully on to convey any burning fuel back into the combustion chamber.

#### ■ Stoker tube water sprinkler

The third protection system comprises a thermostatic valve located in the stoker tube connecting to a water tank mounted externally. In the unlikely event of other measures failing to prevent the stoker tube temperature rising, then, when the thermostat setting, 90°C, is reached, the valve opens activating the internal sprinkler system to extinguish any fire in the stoker tube.

### Boiler Safety Cooling Systems

If the boiler begins to overheat above its maximum normal operating temperature of 90°C, a sequence of safety measures is enabled as the temperature rises. At a predetermined temperature approaching 92°C the heating circuit pumps, if not already on, can be configured to switch on to dissipate heat to the system.

However if 95°C is reached or exceeded then the Safety Temperature Limiter in the BioControl 3000 is activated, shutting down the boiler. The boiler then cannot be restarted until the boiler temperature has fallen to below 75°C, after which it must be reset and restarted manually. Additionally, if the temperature reaches 105°C, two

thermostatically controlled, mains-fed capillary 2-port valves open and supply cold mains water to thermal cooling heat exchangers to cool down the boiler.

### Fault Indicator

On detection of a malfunction, the fault indicator on the control panel illuminates red and any warning or fault code is displayed in the status area of the BioControl 3000 control screen. Optionally, faults and alarms may be transmitted to remote equipment.

### Automatic Cleaning

The heat exchanger surfaces are automatically cleaned periodically during boiler operation using cam-driven helical turbulators to remove debris from the tubes. This ensures that the boiler maintains high efficiency performance. Ash and clinker build-up on the combustion grate is automatically removed by a vibrating grate mechanism and conveyed by augers to the ash bins.

The ash bins have wheels to aid disposal of ash. The combustion process is so efficient that the ash produced is only around 1% by mass of the fuel burnt and therefore requires a minimum of user interventions to empty ash. An optional suction lance system is available to further automate the removal of ash. Alternatively an additional auger system, or suction system, can be employed to transfer the ash to an external store.



Helical turbulators

### Automatic Fuel Management

Fuel is fed automatically, via a fixed or flexible feed auger, to the intermediate fuel hopper on the boiler, via the back-burn device and a drop chute. The intermediate hopper is equipped with infra-red fuel monitoring, which detects when the fuel level is low, and starts the feed system (e.g. auger motor) to refill the hopper, and then stops it when full.

### Agitator

If wood chips are used, then it is recommended to use an agitator to aid fuel movement to the feed auger. Hamworthy wood chip storage/feed solutions include a rotary agitator driven from the fuel feed auger via a reduction gearbox. The agitator, which can be angled and sized to suit the store, features two horizontally-opposed flexible arms that bow and sweep through the woodchips to help guide the fuel onto the auger. An agitator may not be necessary for wood pellets as they have much better flow characteristics, although the storage system should have a sloping floor to guide pellets to the feed auger.



Auger-driven agitator

# Controls

## BioFire BF-M Biomass Boiler

### Control Panel



BioControl 3000 user interface

Control of the boiler is via the BioControl 3000 module, a microprocessor-based controller with LCD screen, 10-key keypad and menu-driven user interface. With power on, the boiler is started or stopped by pressing the On/Off button for 3 seconds and releasing.

### Control Features

- Weather compensating flow temperatures
- Flow temperature control with room temperature influence
- Sensors for flow and return temperatures
- Low boiler pressure control
- Temperature limit stat
- Overheat protection system
- Comprehensive 7-day program timers
- Holiday programme
- Frost protection
- Data logging
- Fault code analysis
- Auxiliary boiler management
- Integrated back-end protection
- Control of two heating circuits
- CAN bus, RS232 and Volt-free connections for remote control and monitoring

### Control Options

- Up to 4 independent heating circuits
- Single solar hot water circuit
- Single DHW calorifier/water tank
- Buffer tank temperature
- GSM-based remote alarms
- Remote PC monitor/control software

### Remote Signalling

Volt-free relay contacts are provided for the following operating conditions:

- Fuel store temperature monitor
- Boiler general alarm
- Release for external control

On power-up, the screen displays the main menu and navigation to sub-menus and data entry is made via the keypad. This interface is used to manage the various phases of boiler operation and to set or observe operating parameters. Current date and time, and current boiler operating status are displayed at the bottom of the screen.

The controller provides full combustion control, including fuel stoking rate and primary and secondary air flow control, with lambda probe sensing. Offering frost protection monitoring, holiday operation, solar circuit control, buffer management and integrated domestic hot water supply, the controls can be extended, via plug-in modules, to cover options for up to four heating zones if no solar circuit, or maximum of three heating zones and one solar circuit.

### Building Management System Control

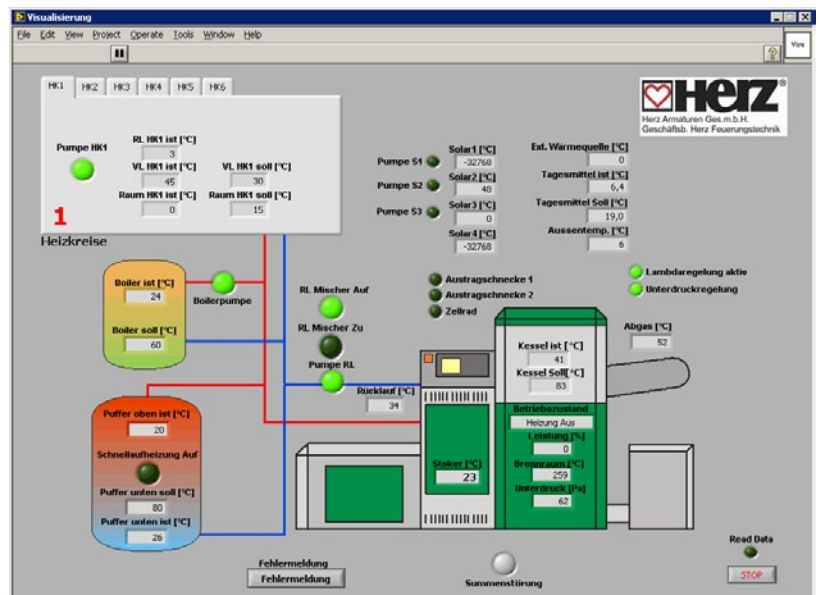
The BioFire boiler can be controlled and monitored by a Building Management System (BMS), via RS232, Controller Area Network (CAN) bus digital interface, 24V and volt-free contacts.

### Optional Remote Alarm

A GSM mobile SMS messaging system is available to send alarm texts automatically to predefined telephone numbers in the event of faults.

### Optional Remote Monitoring and System Control Software

Options are available for Graphical User Interface (GUI)-based software packages to remotely monitor and/or control various system parameters via a networked PC. These options require appropriate network/modem connections to the BioControl 3000 and appropriate PC hardware and network connections at the point of use. Typically, the software presents a visual representation of the system, including boiler, auxiliary boiler, buffer vessel, heating and solar circuits, and pumps, together with current temperature, pressure and on/off status at various points in the system.



Typical BioFire boiler GUI software display (optional) showing system parameters

### Remote On/Off

Facilitating control from an external source, the remote on/off circuit is at 24V DC and requires a volt-free contact device to enable/disable operation. The boiler will operate using its own internal temperature regulation controls in remote on/off mode, i.e. will start up if frost protection conditions prevail.

# Controls

## BioFire BF-M Biomass Boilers

### Pressure and Temperatures

The boilers are suitable for a maximum flow temperature of 90°C and a minimum return temperature of 60°C. The back-end protection function uses a 3-port motorised mixing valve and single double pump arrangement to ensure return temperatures are maintained. The temperature limit stat setting is factory set at 110°C.

### Boiler Operating Status

The BioControl 3000 reports the following boiler operating states:

#### Heating Off

The boiler is switched off.

#### Ready

The boiler and/or buffer vessel temperature is sufficient to supply hot water to the heating circuits.

#### Ignition Preparation

The burner plate has been cleaned and lambda probe preheated.

#### Pre-ventilation

Combustion chamber and flue is purged with air.

#### Cold Start

When the combustion chamber temperature is under 150°C, fuel is fed in at short intervals. At the same time the fuel is ignited by the hot air blower. Successful ignition is succeeded by the *Scorch Phase/Burning Phase*.

#### Warm Start

When the combustion chamber temperature is over 150°C a warm start is carried out. There is an attempt at starting without blower ignition. If no ignition is apparent within the maximum ignition period, then the equipment transfers to cold start.

#### Scorch Phase/Burning Phase

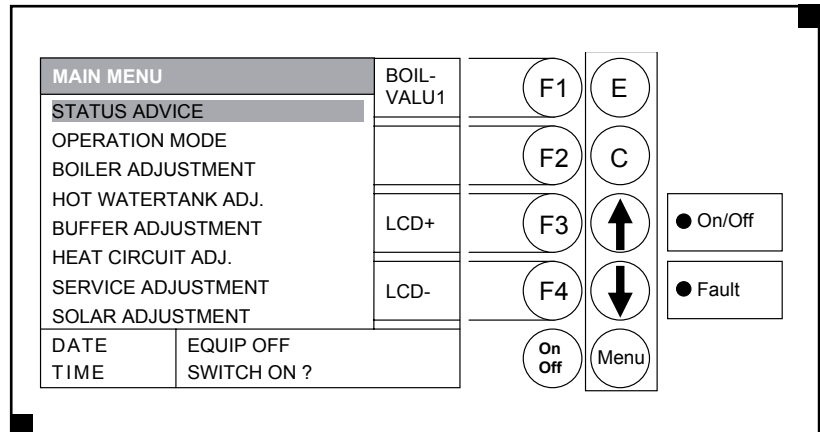
Period allowed to achieve an even fire bed. The length of the phase should not be set for longer than 3 minutes.

#### High Running Phase

The boiler runs at the rated output. When the boiler temperature is reached it then goes over to the regulation phase.

#### Regulation Phase/Control Phase

Boiler is modulated between rated load and part load- it switches to Ready condition if the target temperature plus regulation hysteresis setting is exceeded.



BioControl 3000 main menu screen, keypad and indicators

#### Burn-Out Phase

When the boiler switches off, the fuel remaining in the combustion chamber is allowed to burn out for a preset time period. If the period is set too short, unburned fuel will be discarded and so more fuel will be used than necessary.

#### Burner Cleaning

During the burner cleaning phase the grate ring shakes allowing ash to fall to an ash chamber below for removal by an ash auger to the combustion ash bin at the side of the boiler. After cleaning is completed, the grate and boiler returns to normal operation. The cleaning interval is proportional to the running time of the stoker auger.

#### Heat Exchanger Cleaning

During the heat exchanger cleaning cycle, the helical turbulators oscillate to remove fly ash and clinker deposits which fall down to the ash chamber for removal by the ash auger to the fly ash bin at the side of the boiler. The cleaning interval is proportional to the running time of the stoker auger.

#### Exhaust Temperature Regulation

If the maximum exhaust temperature is exceeded, the boiler modulates to part load conditions.

#### Flame Monitoring

If combustion parameters fluctuate excessively, the boiler switches off.

#### Frost Protection

With the boiler set to "heating off" and not operating, if frost conditions are detected the frost protection system fires the boiler to maintain a minimum water temperature and prevent freezing.

#### Low Water Pressure Alarm

There are no internal water pressure switches in the biomass boiler, however the BioControl 3000 unit can accept a 0V contact from an external controller, such as can be found in a Chesil pressurisation unit, which will stop the boiler under low pressure conditions.

*Note: It is not sufficient to remove the BMS enable signal under low pressure or other emergency stop conditions. Once enabled, the boiler will continue to run even if the enable is removed.*





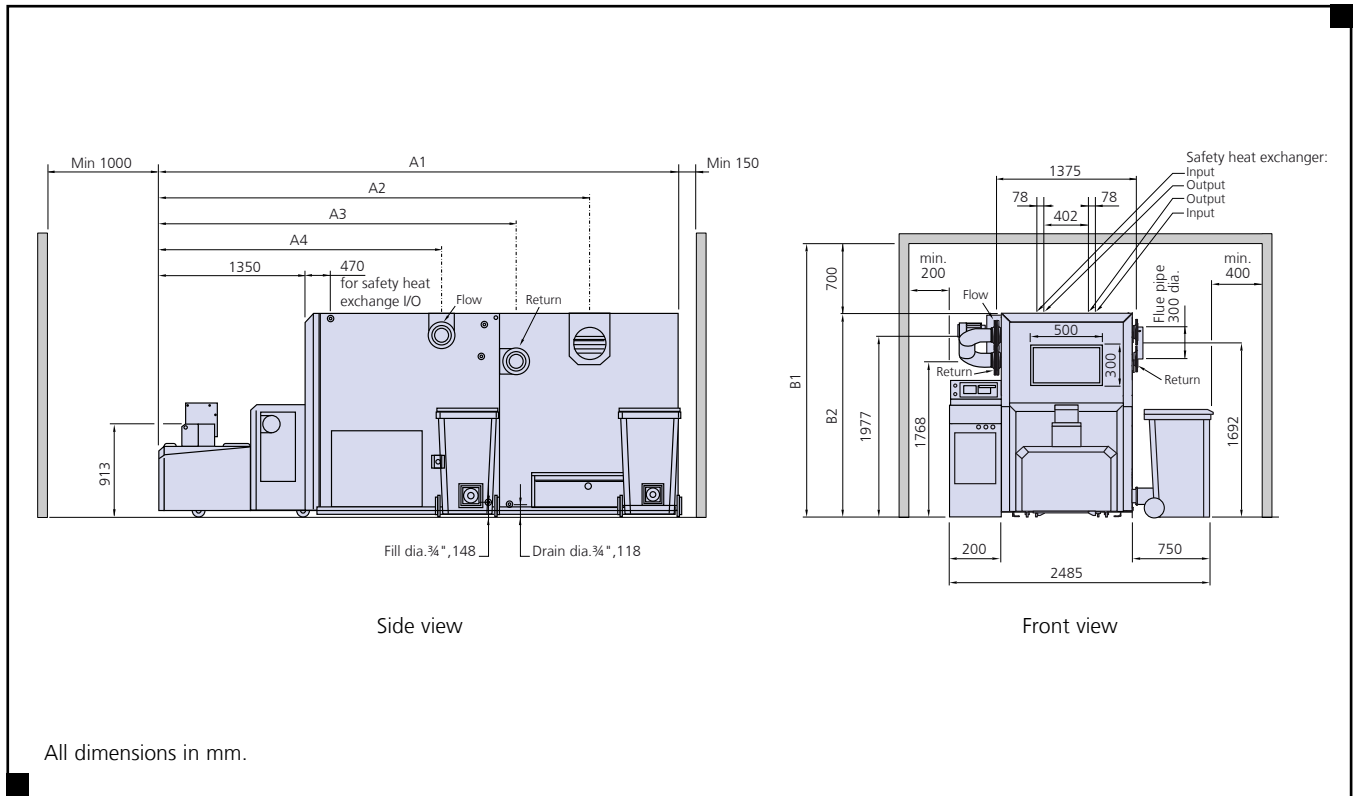
# Technical Data

## BioFire BF-M Biomass Boilers

Boiler Model		BF-M500	BF-M600	BF-M800	BF-M1000	
Energy	Boiler operating efficiency – Maximum (full/part load) (%) gross	91.5/90.5		91.7/90.5	91.6/90.5	
	Boiler output – Nominal Maximum at 80/60°C	kW	500	600	800	1000
		Btu/h x 1000	1,706.0	2,047.2	2,729.6	3,412.0
	Turn down ratio	%	30	40		
Boiler output range, Minimum – Maximum		kW	150–500	240–600	320–800	400–1000
Water	Water capacity	litres	1,146	1,660		1,950
	Waterside pressure loss at 35°C Δt rise	mbar	36	28	31	-
	System design flow rate at 20°C Δt rise @80°, p=0.9718	l/s	6.13	7.36	9.81	12.26
	Waterside pressure loss at 20°C Δt rise	mbar	47	37	41	-
	System design flow rate at 10°C Δt rise @80°, p=0.9718	l/s	12.26	14.72	19.62	24.52
	Waterside pressure loss at 10°C Δt rise	mbar	88	61	-	185
	Water pressure – Maximum	barg	6			
	Water flow temperature – Maximum/Minimum	°C	<90/70 (note 100°C max option on request)			
	Water return temperature – Minimum (at 10°C Δt)	°C	60			
Fuel	Wood pellet size	mm	6 or 8 (10 with rigid auger)			
	Wood pellet moisture content – Maximum	%	10			
	Wood chip size – Maximum		G50			
	Wood chip moisture content – Maximum	%	40			
	Fuel rate, Maximum – Approximate, W10 pellets	kg/hr	125.1	150.2	200.2	250.3
	Fuel rate, Maximum – Approximate, W30 chips	kg/hr	168.4	202.1	269.4	336.8
Flue	Flue gas mass flow – Full load	kg/s	0.400	0.479	0.614	0.798
	Flue gas mass flow – Full load	Nm³/h	~1100	~1327	~1700	~2200
	Flue gas mass flow – Part load	kg/s	0.17	0.27	0.36	0.44
	Flue gas mass flow – Part load	Nm³/h	~470	~740	~990	~1200
	Flue gas temperature at 80/60°C full load – Approximate	°C	~120		~130	~150
	Flue gas temperature at 80/60°C part load (30%) – Approximate	°C	~80			
	Flue draught required at boiler Minimum/Maximum	mbar	0.05/ 0.15			
	NO <sub>x</sub> emissions @full output, 0°C, 13% O <sub>2</sub> , dry gas. 1013mbar	Wood chip, Minimum – Maximum @ output power Mg/Nm <sup>3</sup>	116@214kW–133@553kW	201@246kW–228@600kW	111@351kW–117@794kW	-
	Connections	Water flow connection (Internal diameter)	DN	DN 125 (5")		
Water return connection (Internal diameter)		DN	DN 125 (5")			
Drain/fill and safety heat exchanger input/output connections (Internal diameter)		Inch	1"			
Flue diameter (O/D) – Nominal		mm	300			
Weight	Boiler combustion chamber module – Approximate	kg	1800		2550	
	Burner (trough, grate elements, handler etc.) – Approximate	kg	750		825	
	Feed (stoking augers and intermediate hopper)	kg	180			
	Casing BioControl 3000	kg	85		105	
	Heat exchanger module	kg	2430		2650	
	Fly ash removal cyclone and accessories	kg	205		250	
	Fan weight	kg	65		-	
Electrical supply		400V 3Ph 50Hz 20A				

# Dimensional Details

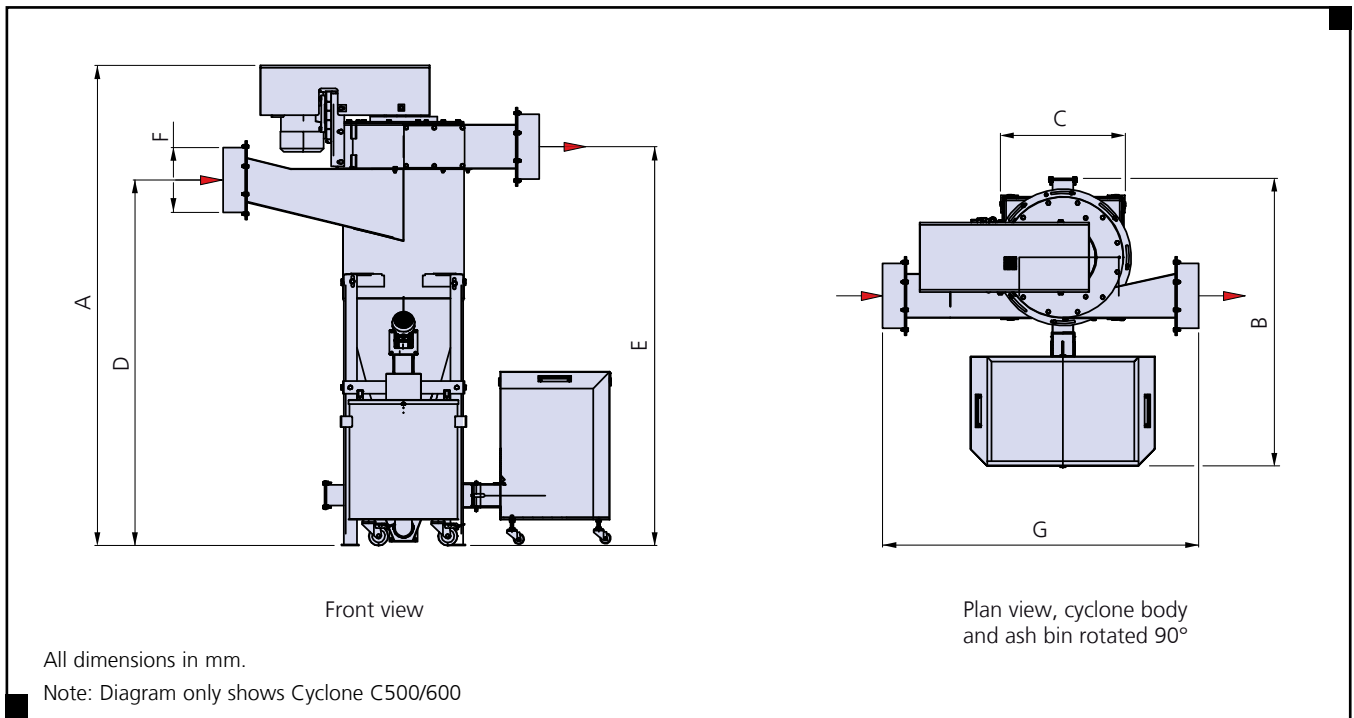
## BioFire BF-M Biomass Boilers



Dimensions/mm	BioFire Boiler Model			
	BF-M500	BF-M600	BF-M800	BF-M1000
A1 Length (total)	4,245	4,735	5,240	
A2 Length to flue port centre	3,590	3,950	4,425	
A3 Length to return input port centre	3,050	3,250	3,755	
A4 Length to flow output port centre	2,365	2,595	3,100	
B1 Height including clearance	2,650		2,865	
B2 Height	1,977		2,180	
<b>Carry-in dimensions, Heat exchanger module/mm</b>	<b>BF-M500</b>	<b>BF-M600</b>	<b>BF-M800</b>	<b>BF-M1000</b>
Length	1,400	1,600		
Width	1,400			
Height	2,100			2,400
<b>Carry-in dimensions, Heat exchanger module/mm</b>	<b>BF-M500</b>	<b>BF-M600</b>	<b>BF-M800</b>	<b>BF-M1000</b>
Length	2,200	2,400		
Width	1,400			
Height	2,100			2,400

# Dimensional Details

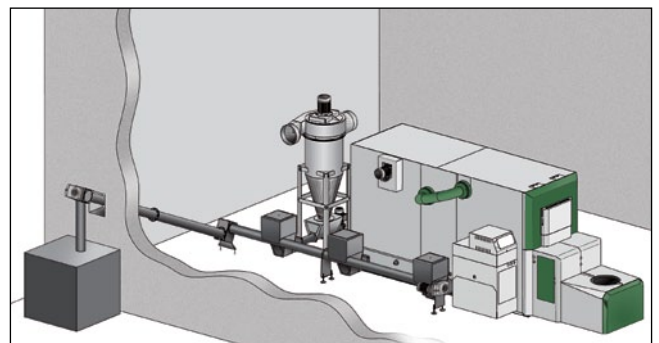
BioFire BF-M Biomass Boilers  
Fly Ash Removal Cyclone  
C500/C600 and C800/C1000



Dimensions/mm	BioFire Boiler Model			
	BF-M500	BF-M600	BF-M800	BF-M1000
	Cyclone C500/600		Cyclone C800/C1000	
A Height	2325		For double rotor cyclone dimensions please contact our technical team. Tel: 01202 662500	
B Length	1485			
C Body width	705			
D Height to axis of flue inlet	1690			
E Height to axis of flue discharge	1845			
F Flue outside diameter	300			
G Width total	1400			

## Fly Ash Removal Cyclone

The C500/C600 cyclone is matched to the BF-M500 and BF-M600 BioFire boilers and the larger C800/C1000 double rotor cyclone is matched to the BF-M800 and BF-M1000 BioFire boilers. Integrated with the control system, the fully insulated cyclone flue gas dust extractor is fitted with a variable-speed induced-draught fan and frequency inverter control unit, and supplied with 300 mm anti-vibration flexible connections and silencer pipes connecting to the boiler and flue system. Fly ash, soot and dust particles captured by the cyclone are automatically auger-driven into an ash bin, or to a bespoke central discharge system, for periodic disposal.



Bespoke automated ash discharge system using augers to transport ash to centralised external store

# Typical Layout

## BioFire BF-M Biomass Boilers

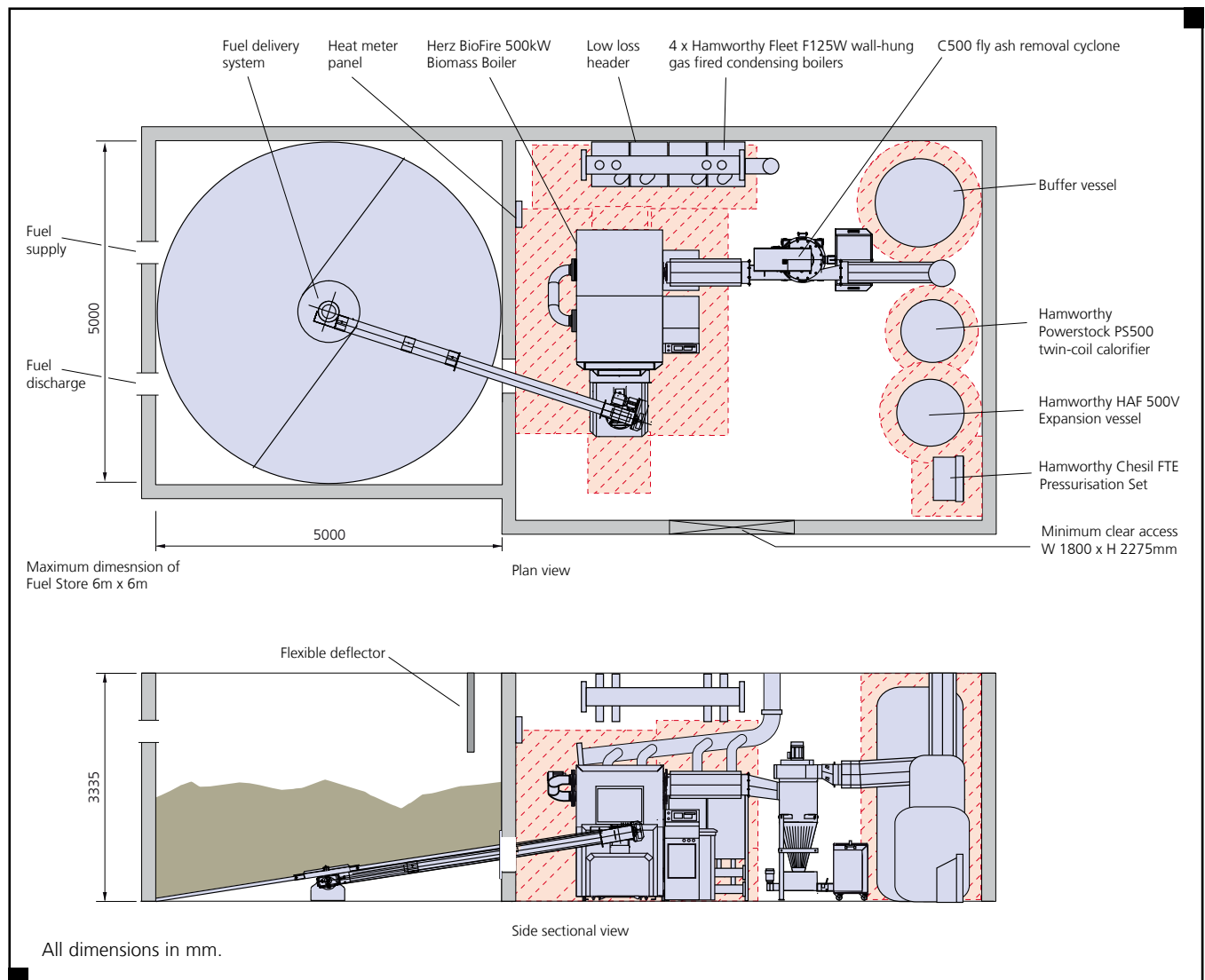
The layout below is an example of how plant can be arranged for effective use of space, and shows a BioFire BF-M500 (500kW) biomass boiler and C500/C600 fly ash removal cyclone in a plant room with an adjacent wood chip fuel store. Fuel feed is via a 5 metre diameter spring agitator and 5 metre (approx.) rising auger. The fuel drops into the intermediate hopper, via a burn-back protection (BBP) device and chute which is then fed into the boiler by its stoker screw at a rate determined by the BioControl 3000 controller.

This design uses a 5000 litre capacity thermal buffer vessel and is combined with a set of four Hamworthy Fleet W125kW gas-fired pre-mix condensing boilers in a frame kit with pipe kit and flue header, a Powerstock PS500 twin-coil calorifier, a Chesil FTE pressurisation unit and HAF 500V expansion vessel.

Wood chip fuel delivery may be via a tipping truck directly tipping wood chips into the store from above. If wood pellets are used, they may be delivered using a blown method, in which case a flexible shock absorption mat should be used to protect the wall when filling the store.

A heat meter (display shown wall-mounted) is necessary for recording the power produced solely by the Biomass boiler—a condition for eligibility for the Renewable Heat Incentive. The heat meter includes a flow meter and two temperature sensors. One sensor must be positioned in the flow pipework as close as possible to the boiler, the other sensor and the flow meter must be positioned in the return pipework as close to the biomass boiler as possible, but upstream of the back end protection circuit.

Wheeled ash bins facilitate the removal of ash from the boiler and cyclone.

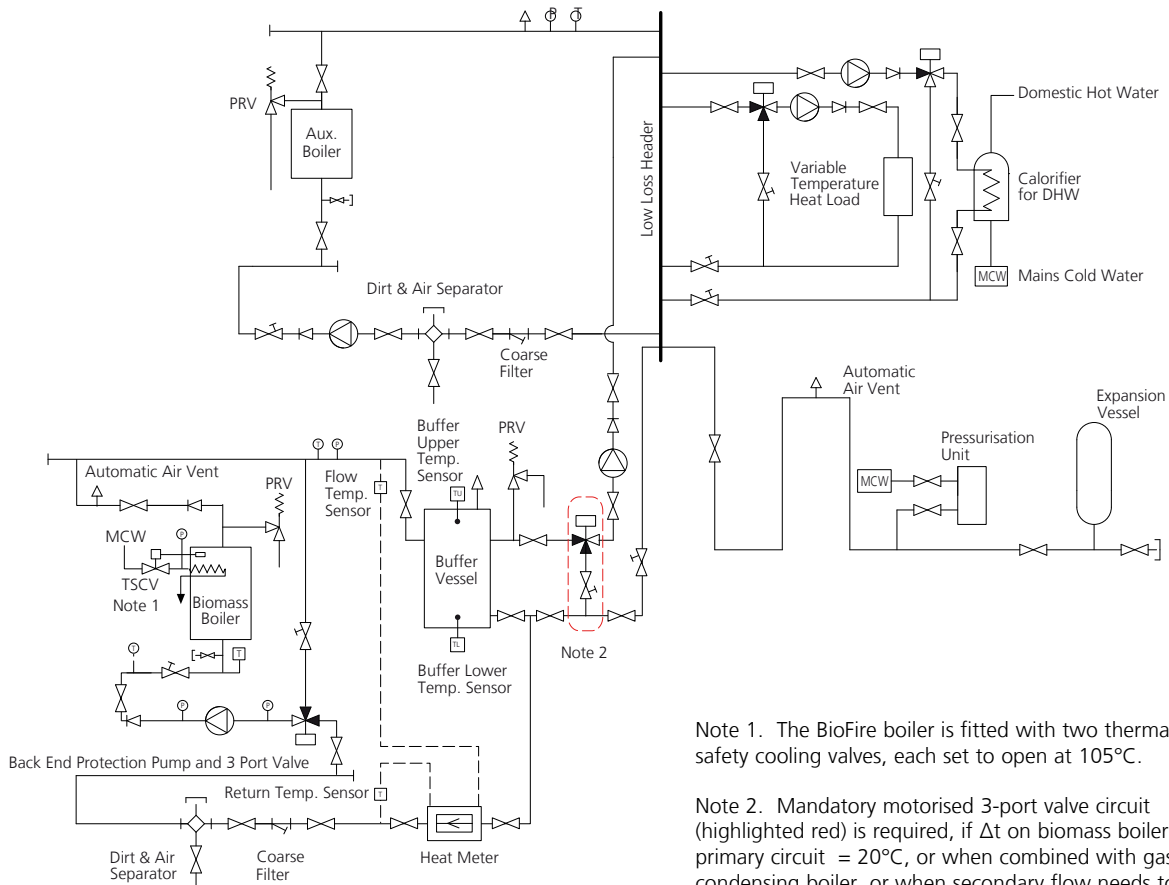


General arrangement of typical BioFire boiler plant room and fuel store.

# System Schematics

BioFire BF-M Biomass Boilers

**Schematic A: Basic pressurised hydraulic circuit, with single biomass boiler and auxiliary gas boiler, 1 x heating and 1 x hot water circuits**



Note 1. The BioFire boiler is fitted with two thermal safety cooling valves, each set to open at 105°C.

Note 2. Mandatory motorised 3-port valve circuit (highlighted red) is required, if  $\Delta t$  on biomass boiler primary circuit = 20°C, or when combined with gas condensing boiler, or when secondary flow needs to be within a set tolerance.

MCW = Mains Cold Water  
 PRV = Pressure Relief Valve  
 TSCV = Thermal Safety Cooling Valve

In a typical arrangement shown in Schematic A, the pressurised circuit may operate up to a maximum pressure of 6bar. The BioFire boiler might be sized to supply the base load and an auxiliary gas- or oil-fired boiler, such as a Hamworthy Fleet wall-hung boiler, sized to provide peak winter loading. The boilers could be sized to share proportions of the load and work together, or both sized to provide all seasonal loading with one being able to completely back-up the other if one needs to be isolated for servicing.

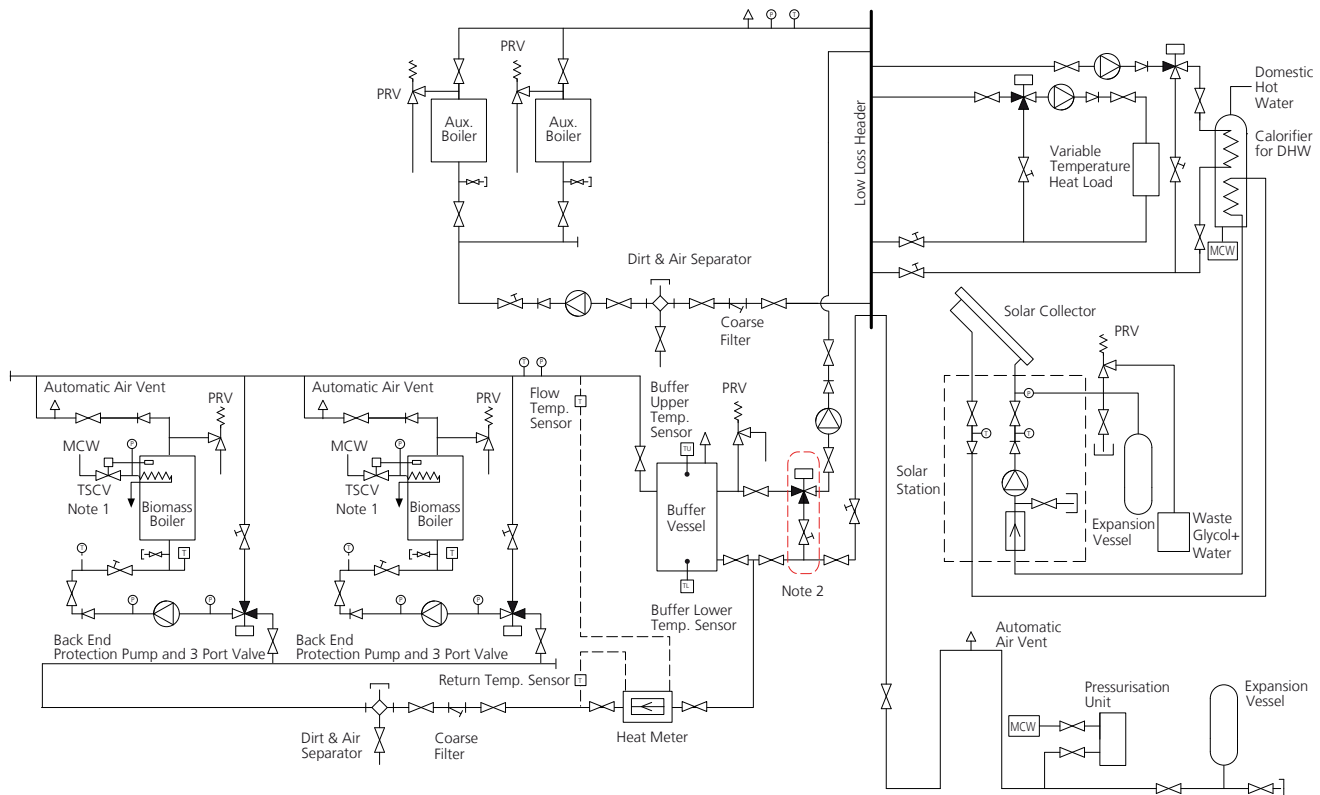
The BioControl 3000 unit allows two biomass boilers to be used (master/slave) as shown in Schematic B and cascade control is possible to sequence correctly the firing and modulation of one biomass boiler after the other, in line with demand and timer settings. Similarly, multiple gas/oil boilers may be used, and cascade operation is possible using an external cascade controller.

A buffer tank may be chosen to be a large thermal store or just be of adequate size to allow the boiler to dissipate residual heat once the boiler is switched off. A low-loss header provides hot water to a single heating circuit in Schematic A and also to a calorifier such as a Hamworthy Powerstock, to provide domestic hot water (DHW). Here perhaps, only one boiler is used to provide the DHW in the summer, whilst the other is switched off. In Schematic B additional heating circuits (maximum 6) and a solar hot water circuit have been shown as these can all be controlled by the BioControl 3000 unit if fitted with the appropriate optional expansion modules and software. Pressurisation and expansion vessels are shown although dosing pots and additional safety valves have been omitted for clarity. The heat meter is shown as it is necessary to have an accurate measure of heat generated solely by the biomass boiler to claim Renewable Heat Incentive (RHI) and other such benefits.

# System Schematics

## BioFire BF-M Biomass Boilers

**Schematic B: Option for 2nd biomass boiler, 2 x auxiliary boilers, 1 x heating circuit and 1 x hot water circuit, with calorifier also fed by 1 x solar circuit**



Note 1. Each BioFire boiler is fitted with two thermal safety cooling valves, each set to open at 105°C

Note 2. Mandatory motorised 3-port valve circuit (highlighted red) is required, if  $\Delta t$  on biomass boiler primary circuit = 20°C, or when combined with gas condensing boiler, or when secondary flow needs to be within a set tolerance.

MCW = Mains Cold Water  
 PRV = Pressure Relief Valve  
 TSCV = Thermal Safety Cooling Valve

### Back-end Protection

The BioControl 3000 includes an option to integrate back-end boiler protection, in which it controls a 3-port mixing valve to blend the return water with the supply hot water until the main system return water temperature is above the flue gas dew point (60°C), protecting against corrosion damage by preventing the formation of condensation.

Mixing valve control requires a temperature sensor to be installed in the return pipe between the boiler and the mixing valve, to measure return water temperature entering the boiler. Hamworthy can provide 3-way motorised mixing valves, or integrated back-flow units comprising a thermal 3-way motorised mixing valve and integrated single or double pump set, non-return and isolation valves as required.

*Note: If a 3-port mixer valve is specified then the primary pump must be located between the 3-port valve and the boiler return port.*

*Note: If adequate provision to maintain the return water temp at or above 60°C is not made then the boiler warranty will be void.*

### Pressure Relief Valve

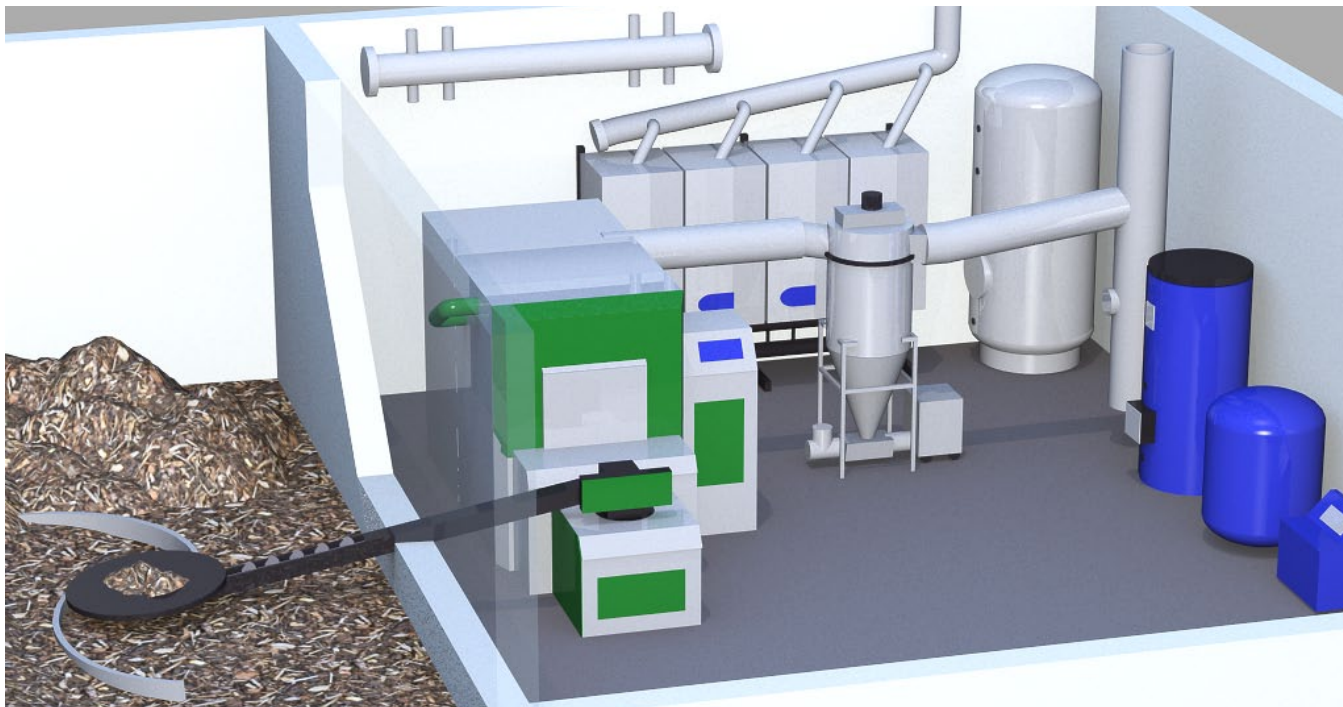
A pressure relief valve must be fitted in line with BS 6644 either directly to the boiler, or fitted to the shortest possible straight length of pipe rising from the boiler, or if not fitted directly to the boiler, then fitted on the flow output side of the boiler ensuring that there is no other valve or isolator between the safety valve and the boiler.

### Solar Integration

The BioControl 3000 includes an option to integrate the control of a solar heating circuit. Hamworthy, as part of their renewable solutions offer, can provide a complete integrated solar hot water solution to complement the biomass heating system. In this example, when appropriate outdoor conditions prevail, the solar system is configured to be able to provide a proportion of the energy for the DHW system, via one coil of the Powerstock calorifiers.

# Typical Plant and Fuel Store

## BioFire BF-M Biomass Boilers



Typical plant room with BioFire boiler and fly ash cyclone with adjoining fuel store, automatic feed system and heat meter (not in view), 4 x wall-mounted Fleet boilers, buffer vessel, low loss header, Powerstock calorifier, Chesil pressurisation unit and expansion vessel (piping and valves removed for clarity)

### Heat Meter

To comply with the Renewable Heat Incentive (RHI) requirements, a heat meter compliant with Class 2 of Annex MI-004 of EU Measuring Instruments Directive (MID) 2004 must be installed. The heat meter includes a flow meter and two temperature sensors. One sensor must be positioned in the flow pipework as close as possible to the boiler, the other sensor and the flow meter must be positioned in the return pipework as close to the biomass boiler as possible, but upstream of the back end protection circuit. The heat meter must be capable of measuring instantaneous power (kW) and total energy generated (kWh) solely by the biomass boiler. The Hamworthy biomass package includes a RHI-compliant heat meter option.

### Auxiliary Boiler

In an installation that combines biomass, gas, oil, solar and other sources, the energy mix at any time will depend on customer requirements.

One approach is to use the biomass boiler as the heat generator for the base load requirements and to use modular high efficiency gas boilers as auxiliaries for peak loads and back-up.

### Buffer Vessels/Low Loss Headers

Although not an absolute necessity, it is recommended on all BioFire biomass boiler installations to use a thermal buffer vessel as an energy store and as an energy dump, particularly

on systems where the load will fluctuate or there is a smaller system water volume (thermal mass). This will help to reduce boiler cycling, improve seasonal efficiency and reduce wear and tear on the plant.

The buffer tank size should be adequate to allow the boiler to dissipate residual heat once the boiler is switched off. Typically the minimum recommended buffer size is calculated using 10 litres/kW for boilers above 250kW. However, a much larger buffer vessel, or multiple vessels, may be appropriate depending on the hot water storage volume requirements of the application. A low loss header ensures adequate boiler flow rates regardless of the operating conditions of the heating circuits.

### Calorifier and Solar Systems

Solar systems and calorifiers can be added for the domestic hot water circuits, saving energy, particularly in the summer months where only domestic hot water may be required.

### Pressurisation Units, Expansion Vessels and Dosing Pots

Most biomass solutions operate on a sealed water system, and so require a pressurisation unit such as a Chesil from Hamworthy and a matching expansion vessel to provide the system head, and the automatic replacement of any water losses from the system. A dosing pot may be required for the introduction of corrosion inhibitors to protect the system and plant.

BioFire boiler	BF-M500	BF-M600	BF-M800	BF-M1000
Minimum recommended standard buffer vessel size/litres	5,000	6,000	8,000	10,000

# Fuel Storage and Automatic Fuel Feed Systems

## BioFire BF-M Biomass Boilers

Hamworthy supply storage equipment and bespoke fuel feed systems tailored to suit almost any biomass installation.

### Fuel Storage

Hamworthy have solutions from the smallest to the largest fuel storage requirement, ranging from flexible plastic sack stores and hoppers for internal plant room use, up to multi-tonne bespoke storerooms, bunkers, hoppers, silos and hook bin stations for external storage together with hydraulic bunker covers and fuel lifts.

### Fuel Delivery Systems

The biomass package includes the fuel delivery system suitable for wood chip or wood pellet transport from the fuel store to the intermediate hopper on the boiler and is bespoke for every application. Flexible or fixed augers are built to suit fuel type and storage unit type and height/distance from the boiler. Delivery systems can be gravity fed, blown or shaken, and can include spring agitators or walking floors where applicable. Pellet-only stores should be made with a 40° to 45° smooth sloping floor to enable gravity-feed flow to the augers.

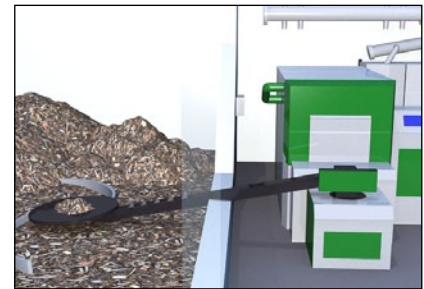
As every biomass installation is different, please contact a Hamworthy sales representative who can advise on the complete range of fuel storage options, fuel delivery systems and ancillary equipment from Hamworthy.

### Estimated Fuel Mass/Volume Requirements

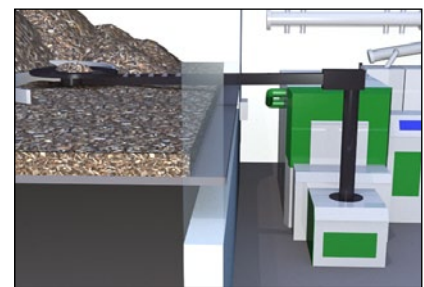
See also associated graph on page 5

Fuel Usage		BioFire Boiler Model			
		BF-M500	BF-M600	BF-M800	BF-M1000
Pellet mass	Tonnes/day	1.10	1.32	1.76	2.20
Pellet volume	m <sup>3</sup> /day	1.60	1.92	2.56	3.20
Pellet mass	Tonnes/week	5.40	6.48	8.64	10.8
Pellet volume	m <sup>3</sup> /week	8.00	9.60	12.8	16.0
Chip mass	Tonnes/day	1.40	1.68	2.24	2.80
Chip volume	m <sup>3</sup> /day	7.10	8.52	11.36	14.20
Chip mass	Tonnes/week	7.10	8.52	11.36	14.20
Chip volume	m <sup>3</sup> /week	35.30	42.36	56.48	70.60

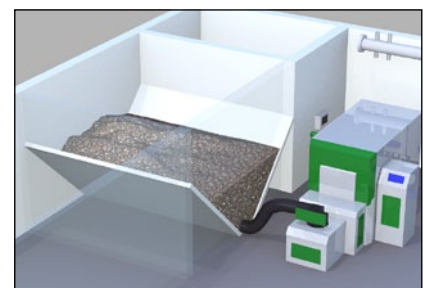
Duty data: 12 hours/day operation, 5 days/week, 70% duty cycle, 85% average boiler efficiency. Moisture content: wood chips 30%/wood pellets 10%.



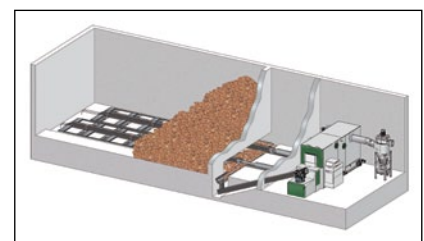
Agitator and rising rigid auger, store and plant room on same level



Rigid horizontal auger; and drop chute; store at higher level



Rigid auger in sloping-floor store with flexible rising auger

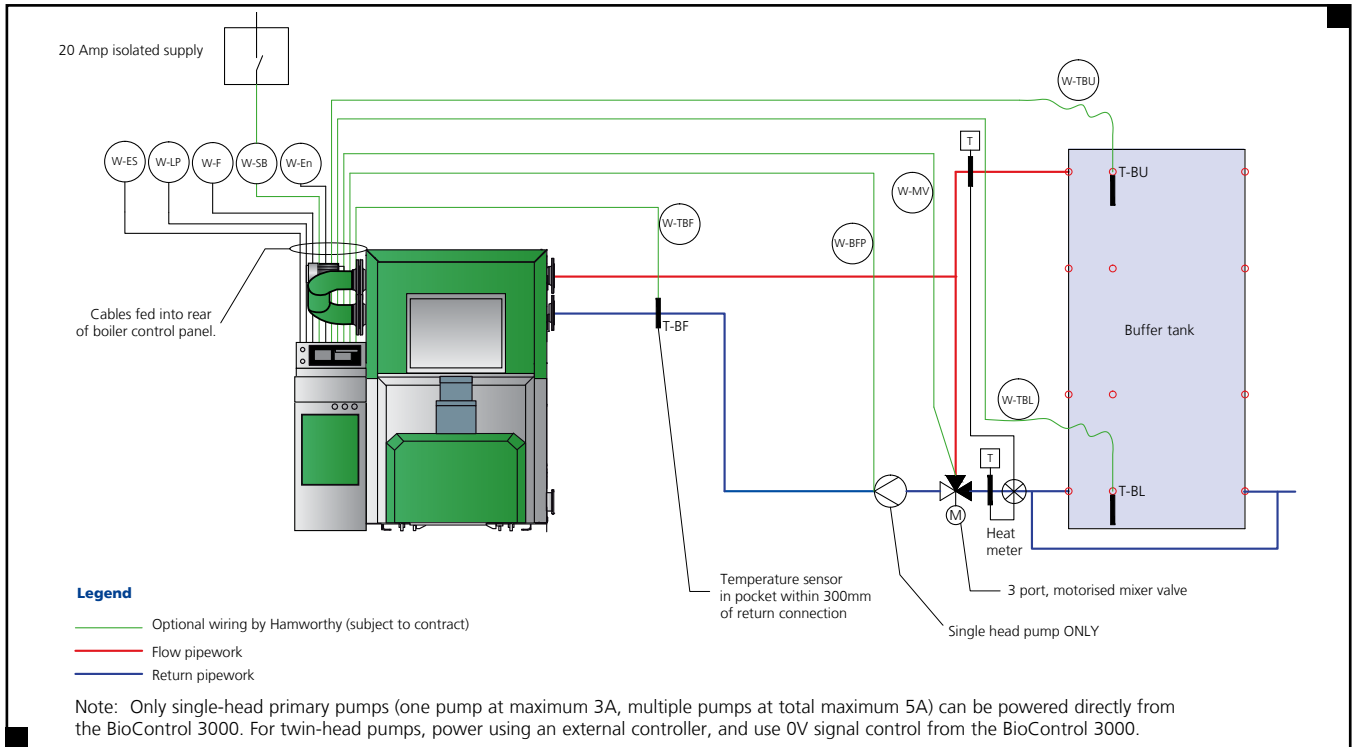


Dual-ladder walking floor and auger feed system



# Electrical Details

## Field Wiring Diagram BioFire BF-M Biomass Boilers



Ref	Field Wiring	Voltage supplied from Biomass boiler
W-SB	Boiler Supply	N/A
W-TBU	Buffer: Upper temperature sensor. Screened cable	24V
W-TBL	Buffer: Lower temperature sensor. Screened cable	24V
W-MV	3-port mixer actuator, 230V	230V
W-En	BMS-enable input	24V DC
W-F	BMS-fault output	0V relay contact, NO/NC
W-LP	BMS: Water pressure fault input	24V DC (open to fault)
W-ES	BMS: Emergency stop input	24V DC (closed to fault)
W-BFP	Primary shunt pump	230V single head pump only
W-TBF	Return pipe: temperature sensor. Screened cable	24V

### Electrical Supply

An independent 20A isolator and fused electrical supply is recommended for each boiler. A single, 400 volt, 50Hz, three phase supply is required to provide power for the boiler and to generate all subsequent derived voltages to power internal augers, fan motors, grate vibrator, automatic ignition blower and the BioControl 3000 controller unit. This single supply also provides power, via terminals in the boiler, to the external fuel feed auger motor, water return pump and the induced draft fan in the cyclone. The total electrical power requirement, excluding auger feed systems, is approximately 8.33kW for BF-M500/BF-M600 models, and approximately 11.45kW for BF-M800/BF-M1000 models. For a basic feed system, with agitator and one motor drive only, allow 1.5kW for a basic wood chip augers system or 1.1kW for a basic

wood pellet auger. Larger, multiple motor-driven systems will require additional power.

Wiring must be in accordance with IEE Regulations and any local regulations which apply. Wiring must be completed in heat resistant 5 core cable (size typically 4.0mm<sup>2</sup> c.s.a., depending on run length). To prevent excessive current (> 1 amp) through the boiler control panel, it is recommended that external pumps are connected via a contactor.

On multiple auger systems, typically transporting fuel over distances greater than 6m, separate power supplies and controls may be needed for any additional auger motors or pneumatic systems. All on-boiler peripheral wiring to the fuel feed augers, combustion fans, boiler temperature sensors and ignition hot air blowers is supplied in heat resistant conduit.

# Biomass Solutions

## BioFire BF-M Biomass Boilers

### Air Supply and Ventilation

An adequate supply of fresh air for combustion and ventilation must be provided in accordance with BS 6644. The air supply should be achieved using:

- Natural ventilation supplying air with a low-level opening, and discharge through a smaller sized high-level opening.
- A fan to supply air to a low-level opening, with natural discharge through a high-level opening.
- A fan to supply air to a low-level opening, with fan discharge through a high-level opening.

Note: Fans must be selected such that a negative pressure is not created in the boiler house relative to the outside air pressure.

In line with IGE UP10, where a biomass appliance is installed in the same space as a gas appliance, the additional natural ventilation provisions for the biomass-fuelled appliance must be at least 6 cm<sup>2</sup> per kW heat input low-level and 3 cm<sup>2</sup> per kW heat input high-level. (Approximately 8cm<sup>2</sup> per kW low level and 4cm<sup>2</sup>/kW high-level based on heat output.)

### Flues & Chimneys

The flue and chimney should be designed in compliance with IGE UP10 DIN 4075 or EN 13384 such that the flue gases are always rising and natural draught is in accordance with minimum 0.05mbar and maximum 0.15mbar draught limits, measured during full output and minimum output. Flue design will take into account the flue gas mass flow rate and temperatures specific to each boiler. *Refer to Technical Data table on page 9; additional information can be found in our flue design guidelines in the biomass overview sales brochure 500002590.*

If the natural draught of the designed flue system is greater than stipulated, draught stabilisation must be provided. If less than stipulated, either the height of the flue system should be increased or an additional pressure-compensating variable-speed fan should be used at the flue termination point, with its pressure sensor located close to the boiler flue spigot connection. Flue gases at all times should be prevented from entering the boiler room.

Access for cleaning the flue should be provided after every bend, otherwise as a minimum every 10m. Other design aspects to consider include, but are not limited to: condensate removal, provision for draught measurement/ smoke analysis, pressure tightness of joints, lining of existing chimneys, height above building and proximity influence by/ on adjacent buildings. **Under no circumstances must the biomass boiler be incorporated into a gas/oil fired flue system.**

An explosion relief device must be installed in the flue system within 1.5 metres of the boiler flue spigot (condition of boiler warranty). Hamworthy Heating can offer advice and, where necessary, a full design, manufacture, supply and installation service in partnership with Midtherm Engineering, using systems such as the Hamworthy Masterflue MF stainless steel flue system.

*For further advice and details contact Hamworthy Midtherm, Tel: 0845 450 2867, Email: hamworthy@midtherm.co.uk*

### Fire Protection Systems

Hamworthy recommend the following fire protection systems in wood stores for wood fuel storage rooms:

- Public buildings: Automatic sprinkler system
- Private buildings: Isolated MCWS terminating inside storage room above fuel feed auger.

### Delivery and Site Assembly

BioFire boilers are delivered and installed by our MCS-approved technology partners Rural Energy, and Hamworthy also work in partnership with specialists Midtherm with regards flue and chimney design and installation. All installations are built and tested to a high standard.

### Commissioning and Training

Hamworthy service department will organise commissioning and training, details of which will be given at the quotation stage. During commissioning, commission fuel is tested and the boiler combustion parameters are set-up for a single commissioned fuel type. It is important that this fuel is representative of the fuel to be used. The boiler will be initially fired and performance checked in accordance with the quotation specification, and then handed over to the building operators along with a logbook and initial training.

### Hamworthy and Herz

By combining the longstanding reputations of both Hamworthy in the UK for heating and hot water systems, Herz in Europe for research and development in biomass technology, and our other specially selected technology partners, you can be assured of the best solution whatever your economic/environmental goals.

### Microgeneration Certification Scheme (MCS) and Renewable Heat Incentive (RHI)

Hamworthy biomass solutions are provided in the UK in conjunction with our MCS-approved technology partner Rural Energy, allowing supplier, equipment and installation compliance for the requirements of the renewable heat incentive. **MCS approved certification number MCS1405.**

### Hamworthy/Herz Nomenclature

Herz nomenclature defines each boiler model by model range name (e.g. BioFire) and power output (e.g. 600=600kW). To aid categorisation within and across the Hamworthy biomass brochures, Hamworthy nomenclature for the same boilers includes additional prefixes for range name (FM= Firematic, BM= BioMatic, PS=Pelletstar and BF=BioFire), and for grate type (P =Pivoting, M=Moving step, U=Underfed ring).

For compliance purposes, the additional Hamworthy prefixes are to be ignored so that the model range names and power outputs directly correspond with those of Herz, which are those referenced in the relevant lists of approved products: the Energy Technology List for Enhanced Capital Allowances and the Microgeneration Certification Scheme (MCS) for the Renewable Heat Incentive. E.g. for Hamworthy BioFire BF-M220, refer to Herz BioFire 220 (220kW) in the MCS approved products list.

# Sustainable Heating and Hot Water

## BioFire BF-M Biomass Boilers

### Why Choose Hamworthy?

Hamworthy has extensive knowledge and over 40 years of experience of heating and hot water systems for commercial buildings, including supply of gas fired boilers for peak-load delivery alongside biomass boiler and solar hot water systems. We can advise on the optimum boiler selection for each project.

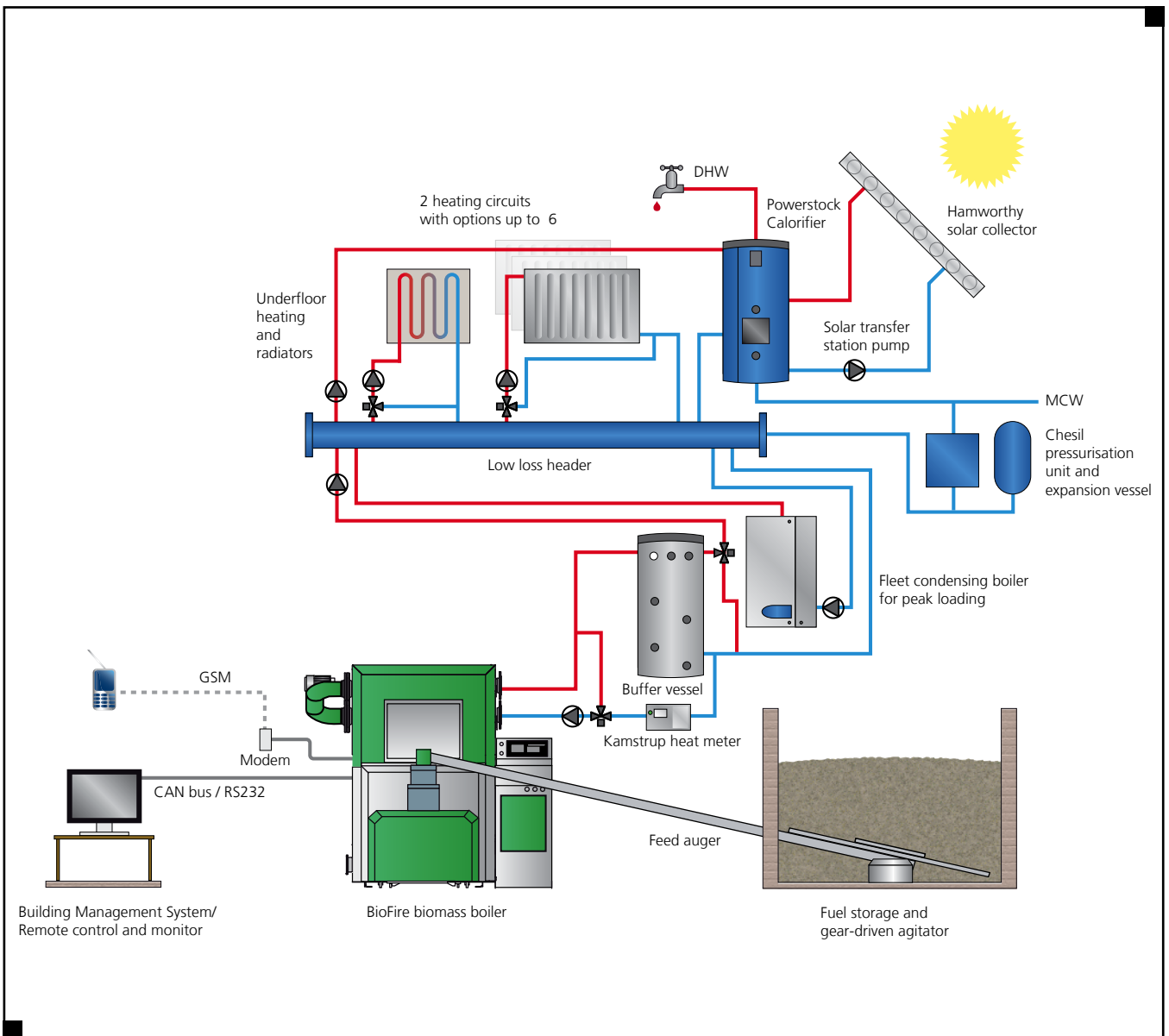
Whether it's for a new build, or for a refurbishment project, and whether it's a partial or total migration to biomass

and/or other renewable heating systems, we have the knowledge and expertise to help guide you through every stage of the process, from feasibility studies to complete installation and on-going support.

For advice on making the right choice for your heating and hot water systems talk to Hamworthy.

**Tel: 0845 450 2865**

**Email: [sales@hamworthy-heating.com](mailto:sales@hamworthy-heating.com)**



Typical Hamworthy renewable solution comprising: BioFire biomass boiler with bespoke automatic wood chip/pellet feed system and storage system; buffer vessel, Kamstrup heat meter, low loss header, back-up gas-fired Fleet condensing boiler, Powerstock calorifier, Hamworthy solar thermal system and Chesil pressurisation unit and expansion vessel. (Note flues are not shown.)



**Customer Service Centre**

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Dorset BH17 0HH

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Hamworthy reserves the right to make changes and improvements which may necessitate alteration to the specification without prior notice.

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**Hamworthy Heating Accreditations**

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ISO 14001 Environmental Management System  
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