Introduction
Spring 2012
4 additional models
130kW to 199kW

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Energy
Technology
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TM

Hamworthy Herz Firematic Biomass Boilers

Pivoting Grate FM-P35, FM-P45, FM-P60
Moving Step Grate FM-M80, FM-M100

Wood Chip or Wood Pellet
Boiler Outputs 35kW to 100kW
Fully automatic, self-cleaning

CE

Hamworthy

Heating *at work.*

Herz Firematic FM-P & FM-M Series

Wood chip or Wood pellet Automatic Biomass Boilers

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

Herz Firematic 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. Firematic boilers also comply with the Clean Air Act 1993 and so may be considered for use 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 Firematic range of compact, 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.

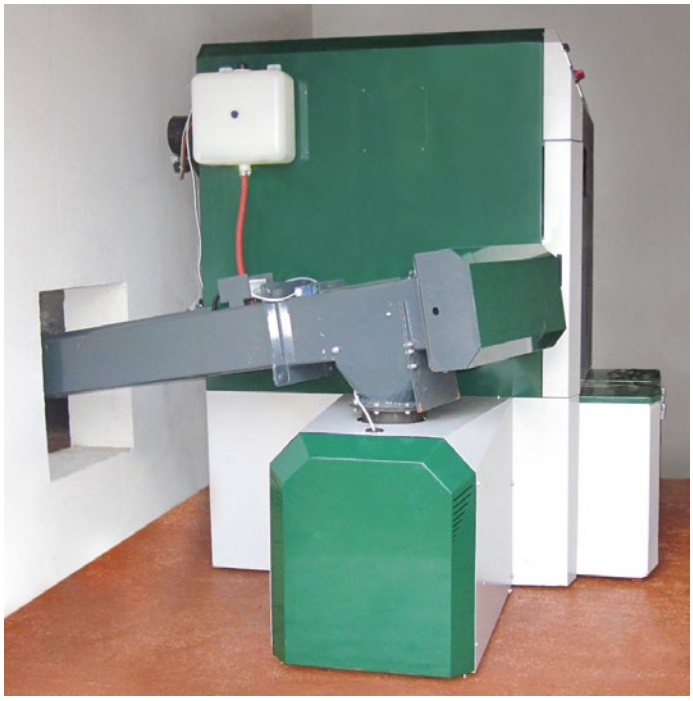
Options

- **Wood chip or wood pellet**
- **Left or right side fuel feed**
- **Auto fuel delivery system**
- **Fuel storage systems**
- **Thermal buffer vessels**
- **Additional control modules**
- **Remote monitor/alarms**
- **RHI approved heat meter**

BENEFITS

- **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**
- **Among the most compact available**
- **Energy saving auto-extinguish/ restart function**
- **Integrated fire safety systems**
- **Low headroom & small footprint**
- **Fits in existing plant room**

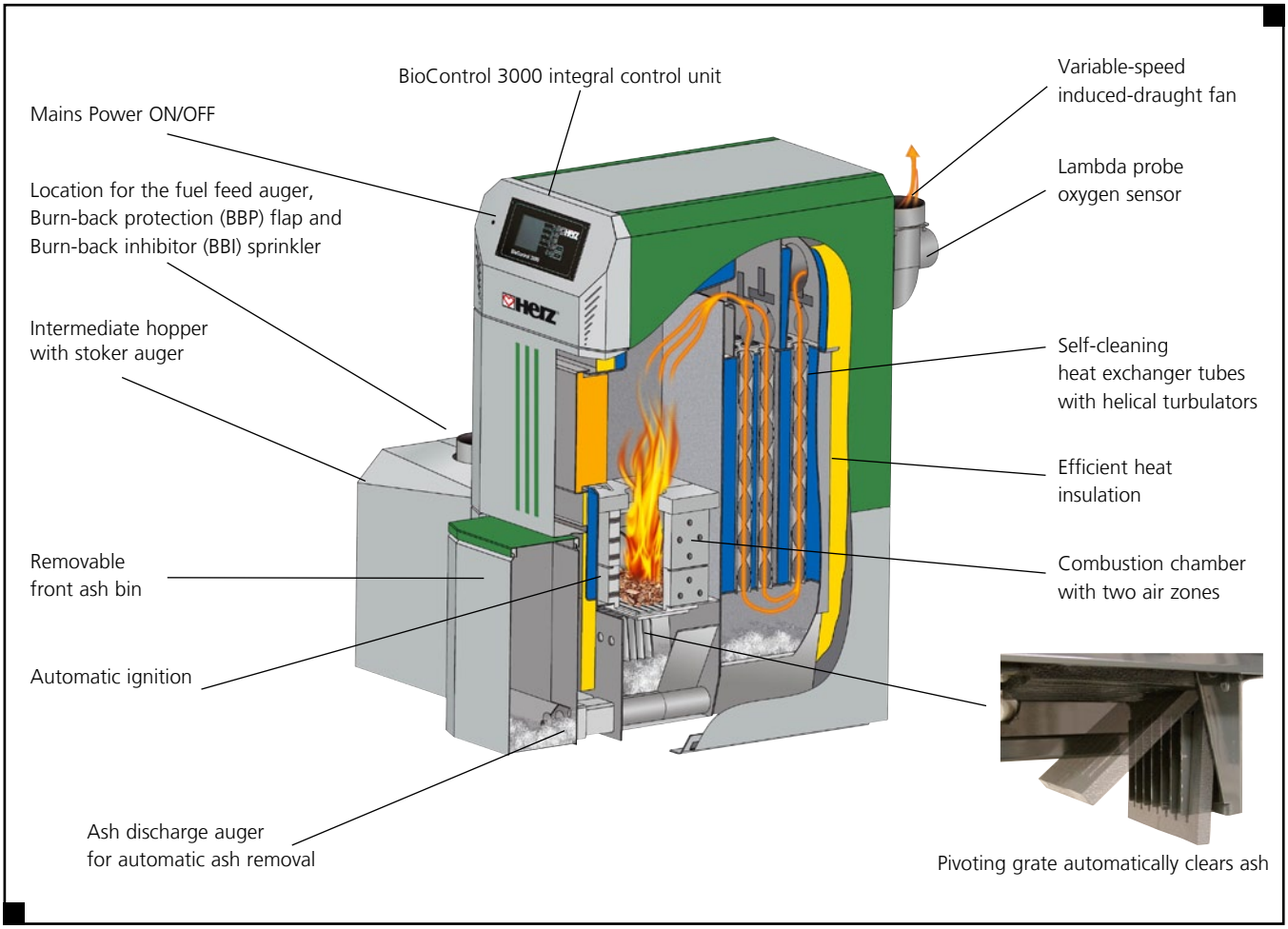
Firematic biomass boilers are a realistic proposition for many commercial buildings, and qualify for generous UK Government financial incentives.



Firematic boiler with rising fuel feed auger and drop chute above the intermediate hopper, and a water tank for the burn-back protection sprinkler.

Typical Section

Firematic FM-P Series, Pivoting Grate
FM-P35, FM-P45, FM-P60



General Description FM-P and FM-M

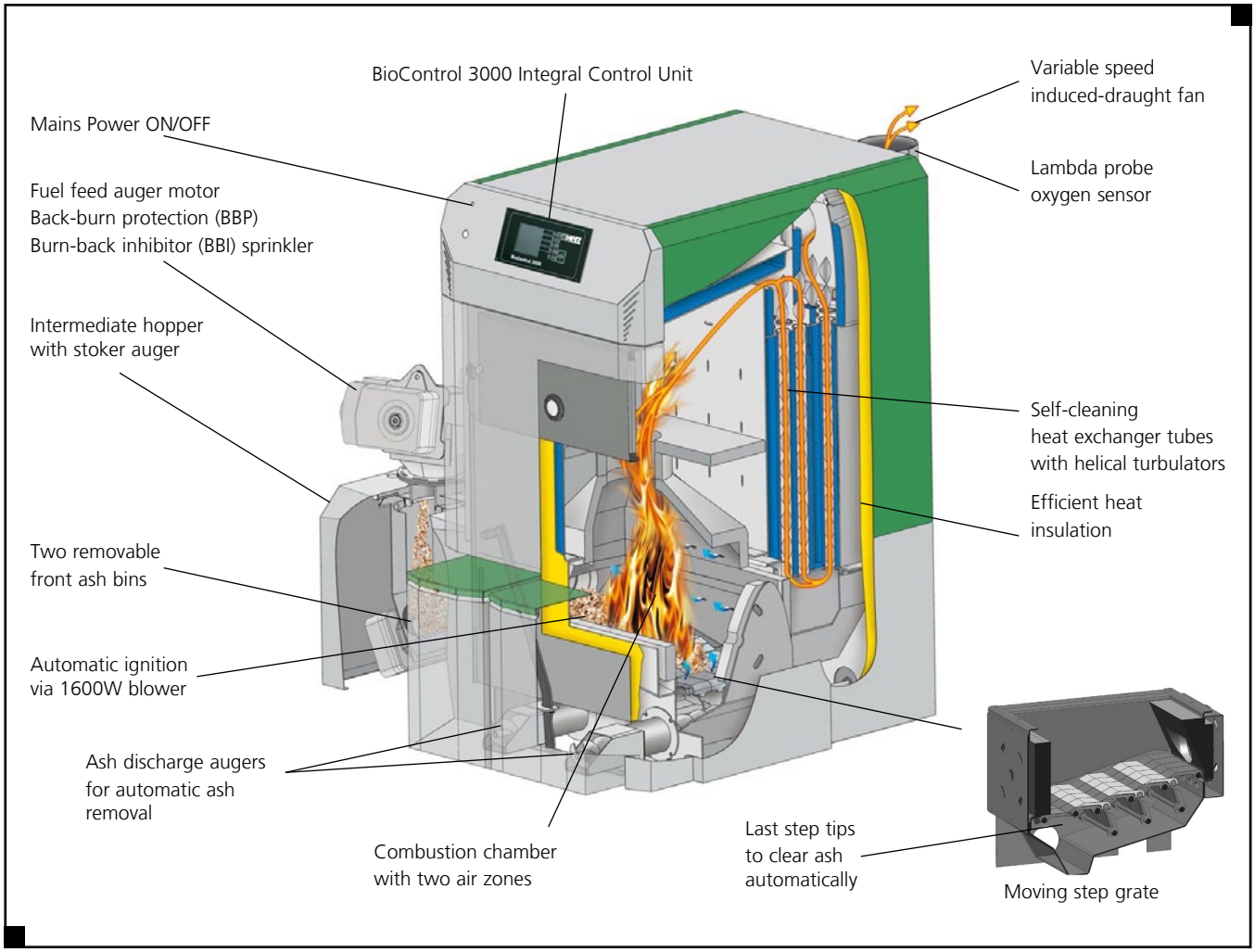
On demand, or when infra-red detectors in the intermediate hopper detect low fuel, the fuel feed auger (and integrated agitator if fitted) is powered on and supplies fuel from the main store to the intermediate hopper, via a burn-back prevention (BBP) device mounted above the hopper and continues until 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 preventing air flow back down the auger. The flap, together with a physical break between auger and intermediate hopper provided by the chute, serve to prevent any fire burning back to the main fuel store.

Fuel in the intermediate hopper is automatically stoked according to the demand cycle, via the rising stoker auger, through the stoker tube into the combustion chamber and on to a grate for burning. The FM-P models have a pivoting grate where fuel is pushed along the grate bed by auger alone, periodically pivoting 90° to drop waste ash into ash chamber below. The FM-M models have an advanced moving step grate to handle higher fuel capacities, in which several reciprocating step elements shuffle fuel along the grate as it burns. The last grate element also pivots automatically to periodically tip ash into the ash chamber below.

The fuel is lit automatically by an electric hot air gun and primary air is fan-drawn through the first combustion chamber zone to begin combustion. As the wood fuel burns, flammable gases are given off which are further burnt by fan-drawn air in a secondary combustion zone. The hot gases pass through the 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.

Typical Section

Firematic FM-M Series, Moving Step Grate
FM-M80, FM-M100



General Description FM-P and FM-M

The heat exchanger tubes contain helical turbulators in the vertical tubing which create turbulence in the gases as they pass through, improving heat transfer. The gases are drawn through the heat exchanger via a speed-controlled induced-draught fan and out through the flue to the chimney.

Periodically the cam-driven turbulators are set to a cleaning cycle, and oscillate to remove fly ash deposits automatically from the heat exchanger tubes which fall into an ash chamber below. Discharge auger(s) automatically transfer fine fly ash and coarse combustion ash to wheeled bin(s) on the front of the boiler for periodic ash disposal.

The central BioControl 3000 unit controls the safe and efficient operation of the boiler. Heat output is primarily controlled 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. This is achieved by the automatic control of the speed of induced-draught fan together with the position of the air intake flap that throttles the secondary air drawn into the combustion chamber. The primary air intake flap throttle position is manually set during commissioning for the particular fuel type used. Combustion is regulated via sensors that monitor stoker tube and combustion chamber temperatures and exhaust gas emissions (O_2 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. Additionally it can directly control up to 6 heating circuits, a solar circuit, buffer vessel and hot water tank.

Specification

Firematic FM-P, FM-M Biomass Boilers

Firematic boilers are a compact, low thermal mass, rapid response design, with a small footprint and low headroom, making them particularly suitable for plant room refurbishment projects in commercial and small industrial premises, schools and hospitals.

The boilers are designed for use on open-vented or pressurised/sealed systems, and designed to operate between 65°C and 90°C at 3 barg maximum operating pressure with a minimum return temperature of 60°C.

Model Range

The Hamworthy Herz Firematic range comprises 5 models:

Model	Power	Grate/Ash bin
FM-P35	35kW	Pivoting grate/ one ash bin
FM-P45	45kW	
FM-P60	60kW	
FM-M80	80kW	Moving step grate/ two ash bins
FM-M100	100kW	

Choice of Fuel

The Firematic 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

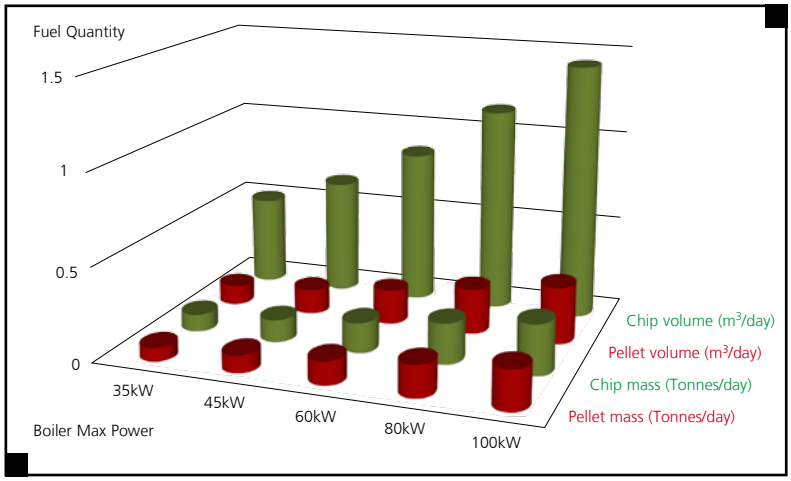
	Wood Chips	Wood Pellets
Fuel Standard	ÖNORM M7133	ÖNORM M7135
Size	G30-G50	6mm dia.
Moisture content	W10-W35 35% Max	W8-W10 10% Max

Water Quality

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

Typical Fuel Usage

A 35kW Firematic boiler will typically consume approximately 0.077 tonnes of pellets or 0.098 tonnes of chips per day. See graph below and table on page 15 for underlying data and assumptions.



Clean Air Act Exemption

The Firematic range of biomass boilers meet class 3 of EN303-5 and to comply with the requirements of the Clean Air Act 1993 for Smoke Control Zones, must not be used with wood chips or wood pellets containing 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 in the flue. The signal from the sensor is 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_2 emissions.

Burner Control

The boilers have horizontally-fed 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 which stops the combustion fan 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 boilers are welded and pressure tested to 6.5bar, over twice the operating pressure. They have a fully insulated boiler casing. The boiler body and water jacket have a low thermal mass which enables a very fast response to demand for heat. It includes a vertically-tubed, self-cleaning main heat exchanger, and a safety cooling heat exchanger.

Safety and Convenience

Firematic FM-P, FM-M Biomass Boilers

Three-Stage Burn-Back Protection:

- **Air back-flow prevention valve**

  This is a burn-back protection system between the fuel store feed auger and the rising stoker auger. 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 air-tight 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 comprises an electrical temperature sensor connected to the BioControl 3000 unit which, on over-temperature detection, turns the stoker auger fully on to convey any burning fuel back into the combustion chamber.

- **Stoker tube water sprinkler**

  The third protection system comprises a thermostatic valve and sprinkler located in the stoker tube connected to a 50 litre water tank mounted externally. In the unlikely event of other measures failing to prevent the stoker tube temperature rising, then, when the thermostat setting 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 92°C the heating circuit pumps, if not already on, can be configured to switch on to dissipate heat to the system. If the boiler temperature approaches 95°C, a thermostatically controlled, mains-fed capillary 2-port valve opens and supplies cold mains water to an additional thermal cooling heat exchanger within the boiler, and mains water cools the boiler until the boiler temperature has fallen to around 90°C. 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.

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 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.

Helical turbulators in the heat exchanger

Ash and clinker build-up on the combustion grate is automatically removed by tipping grate mechanisms and conveyed to the ash bin (FM-P) or bins (FM-M) via independent auger(s).

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 the ash.

Ash bin

Automatic Fuel Management

Fuel is fed automatically, via a fixed or flexible feed auger, or vacuum feed system, 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 low level fuel monitoring, which detects the fuel levels, and if low, starts the feed system (e.g. auger motor) to refill the hopper and stops 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 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

Firematic FM-P, FM-M Biomass Boilers

Mains Switch

The red mains on/off switch on the front of the boiler enables/disables power supplies for the boiler, control panel, auger motors and control circuits connected to external pumps/motors.

Control Panel

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

- 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
- CO and O_2 monitoring
- 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 6 independent heating circuits
- Single solar hot water circuit
- Single DHW calorifier/water tank
- Buffer tank temperature
- GSM-based remote alarms

BioControl 3000 user-interface

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, fuel and air supply, with lambda probe sensing, motorised control of secondary air supply, and speed controlled draught fan. Offering integrated hot water supply, frost protection monitoring and holiday operation, the controls can be extended to cover options for up to 6 heating zones, buffer management, domestic hot water and solar circuit control using up to four plug-in extension modules.

Building Management System Control

The Firematic 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.

Electrical Services

Power to the boiler and all controls is provided by a 16A rated 230 volt, 50Hz, single phase supply. This also powers the fuel feed auger motor. If a larger torque three-phase motor is required, i.e. to drive the combined auger and agitator system in a large woodchip store, then the boiler is provided with an additional power unit, fed by a separate 230 volt, 50Hz, single-phase supply, containing an inverter to generate the 400 volt, 50Hz three-phase supply for this motor only. On multiple auger systems, typically transporting fuel over distances greater than 6m, separate power supplies and controls will be needed for any additional auger motors. 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 to the boiler.

Controls

Firematic FM-P, FM-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 mixing valve and motor to ensure return temperatures are maintained. The temperature limit thermostat setting is factory set at 95°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.

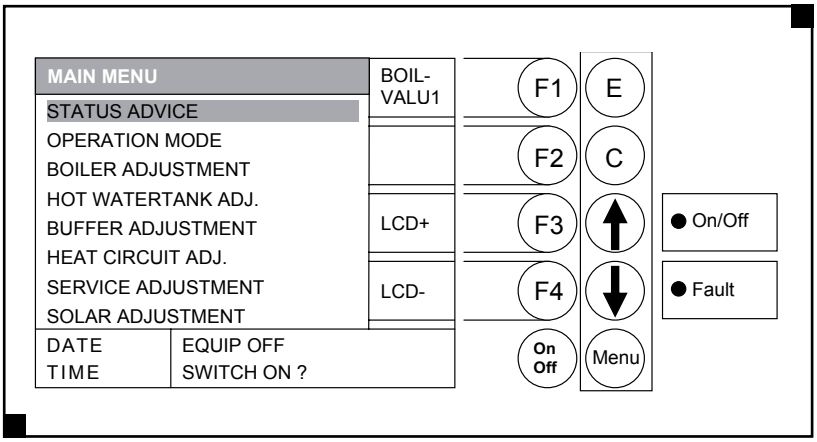
Cold Start: When the combustion chamber temperature is under 150°C, fuel is fed in at short intervals. At the same time the fuel is ignited by the hot air blower. Successful ignition is succeeded by the Scorch Phase/ Burning Phase.

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 tips through 90° allowing ash to fall to an ash chamber below for removal by ash augers to the ash bin(s) at the front of the boiler. After cleaning is completed, the grate returns to the horizontal position and the 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 ash augers to ash bin(s) at the front 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.

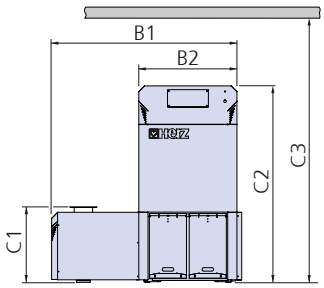
Technical Data

Firematic FM-P, FM-M Biomass Boilers

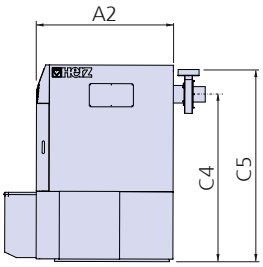
	Boiler Model			FM–P35	FM–P45	FM–P60	FM–M80	FM–M100
Energy	Boiler operating efficiency – Minimum		(%) gross	>93	>96		>94	
	Boiler output Nominal Maximum at 80/60°C		kW	35	45	60	80	100
			Btu/h x 1000	119	154	205	273	341
	Turn down ratio		%	20	29	20	30	26
	Boiler output range Minimum – Maximum, W25 chips		kW	7–35	13–45	13–65	25–82	25–96
	Boiler output range Minimum – Maximum, W10 pellets		kW	10–40	13–48	16–72	30–90	30–107
Water	Water capacity		litres	80	116		175	
	System design flow rate at 20°C Δt rise, @80°, p=0.9718		l/s	0.43	0.55	0.74	0.98	1.23
	Waterside pressure loss at 20°C Δt rise		mbar	10.80	2.20	4.10	5.70	8.80
	System design flow rate at 10°C Δt rise		l/s	0.86	1.10	1.47	1.96	2.45
	Waterside pressure loss at 10°C Δt rise		mbar	39.90	7.50	15.30	22.40	34.60
	Water pressure – Maximum		barg	3				
	Water flow temperature – Maximum		°C	90				
	Water return temperature – Minimum		°C	60				
Fuel	Wood pellet size / moisture content – Maximum		mm / %	6 – 8 / 10				
	Wood chip size / moisture content – Maximum		mm / %	G50 / 35				
	Fuel rate, Maximum, W10 pellets		kg/hr	8.79	11.30	15.07	19.97	25.00
	Fuel rate, Maximum, W30 chips		kg/hr	11.76	15.18	20.21	26.94	33.68
Flue	Flue gas mass flow – full load		kg/s	0.0235	0.0285	0.0366	0.0485	0.052
	Flue gas mass flow – part load		kg/s	0.0063	0.0084		0.0165	0.017
	Flue gas temperature at 80/60°C full load – Approximate		°C	~140	~110	~140	~110	~115
	Flue gas temperature at 80/60°C part load (30%) – Approximate		°C	~60				
	Flue draught required at boiler Minimum/Maximum		mbar	0.05/0.10				
	NO_x emissions @ full output, 0°C, 13% O_2, dry gas 1013 mbar	Wood pellet, Minimum – Maximum	mg/MJ	N/A – 72	N/A	N/A	48 – 60	48 – 72
		Wood chip, Minimum – Maximum	mg/MJ	N/A – 107	77 – 94	77 – 99	75 – 97	75 – 101
Connections	Water flow connection (Internal diameter)		Inch	1″	1½″		2″	
	Water return connection (Internal diameter)		Inch	1″	1½″		2″	
	Safety heat exchanger connection, input and outputs (ID)		Inch	½″				
	Drain connection (Internal diameter)		Inch	½″				
	Flue diameter (O/D) – Nominal		mm	150		180		
	Shipping weight boiler without controller/stoker – Approximate		kg	517	620		750	
	Electrical supply			230V 1Ph 50Hz 16A, 2.6 kW (Inverter used if auger motor requires 400V 3PH 50Hz 32A).				

Dimensional Details

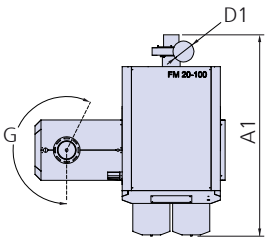
Firematic FM-P, FM-M Biomass Boilers



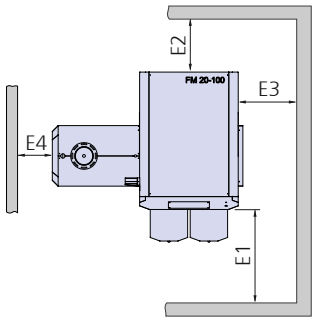
Front view



Side view



Plan view



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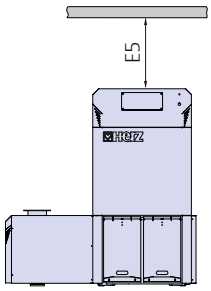
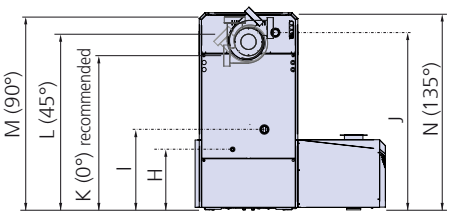


Front view



Rear view

All dimensions in mm.

Dimensions/mm	Firematic Boiler Model				
	FM-P35	FM-P45	FM-P60	FM-M80	FM-M100
A1 Length (total)	1450	1480	1490	1442	
A2 Length (boiler body)	960	1070		1177	
B1 Width (total)	1300	1410		1636	
B2 Width (boiler body)	600	710		846	
C1 Height (fuel drop cell)	650			647	
C2 Height (total)	1490	1590		1692	
C3 Height (inc. min. clearance)	2100	2300			
C4 Height (flue spigot centreline)	1200	1300		1442	
C5 Height (flue exit if fan is vertical)	1372	1475	1515	1654	
D1 Flue spigot diameter	150		180		
E1 Clearance to front of boiler	600	700			
E2 Clearance behind boiler	500	530		450	
E3 Clearance to boiler side	300			500	
E4 Clearance to stoker side	300			500	
E5 Clearance above boiler	610	710		608	
G Range of Feed auger installation angle	205°				
H Fill/drain port height	395			493	
I Return port height	440	500		690	
J Flow port height	1280	1375		1520	
K Flue exit height with fan at 0°	1082	1180		1323	
L Flue exit height with fan at 45°	1238	1340	1370	1508	
M Flue exit height with fan at 90°	1372	1475	1515	1654	
N Flue exit height with fan at 135°	1405	1510	1535	1675	
Minimum clear access to bring in (W/H mm)	600 x 1490	710 x 1590		846 x 1692	
Minimum floor area inc. clearance (L/W mm)	2060 x 1900	2300 x 2010		2327 x 2636	

Typical Layout

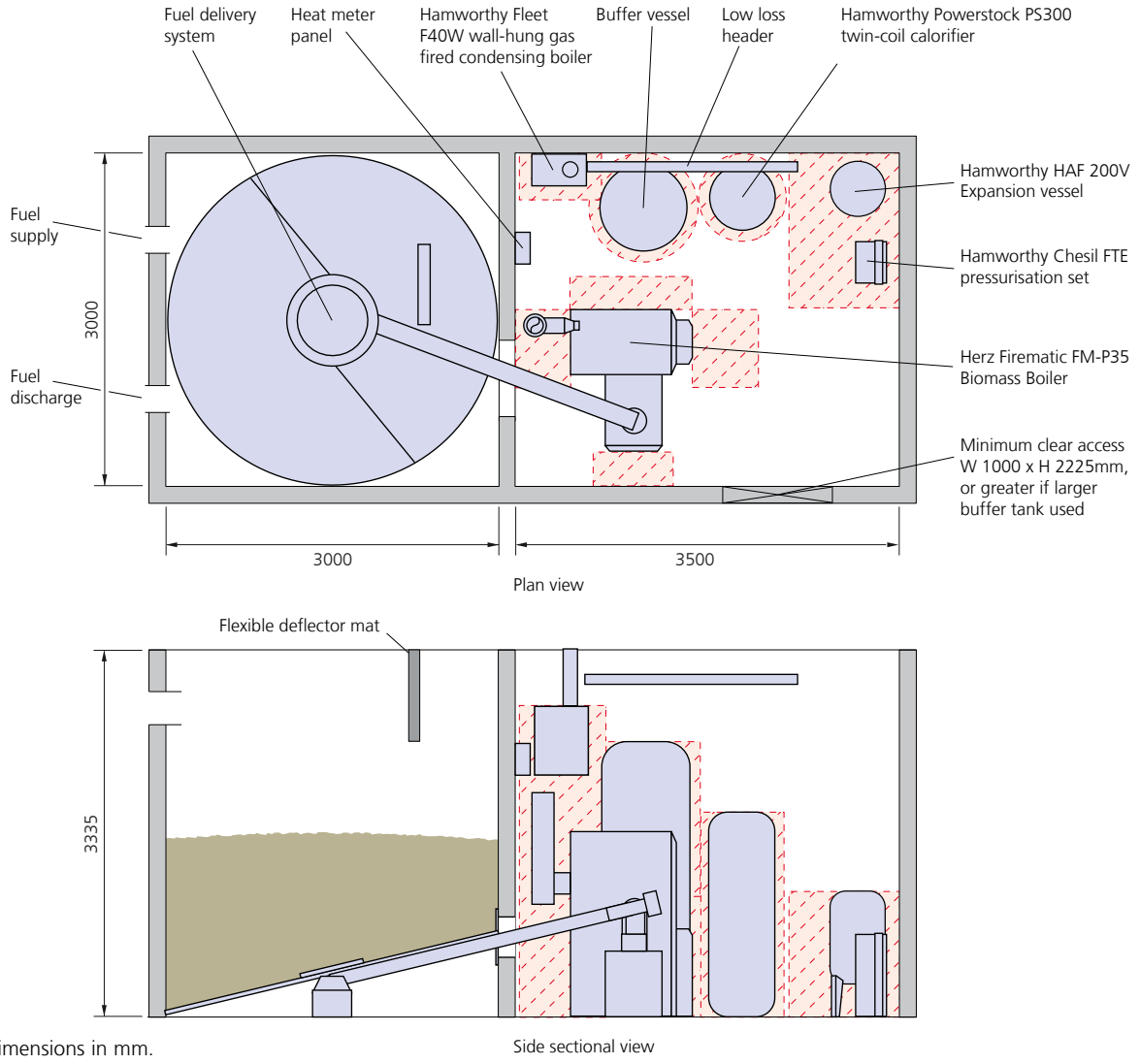
Firematic FM-P, FM-M Biomass Boilers

The layout below shows a Firematic FM-P35, 35kW biomass boiler in a plant room with an adjacent wood chip fuel store. Fuel feed is via a 3 metre diameter spring agitator and 3 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 BioMatic 3000 controller.

This design uses a 1500 litre capacity thermal buffer vessel and is combined with a Hamworthy Fleet F40W 40kW gas-fired, pre-mix, wall-mounted condensing boiler, complete with Chesil FTE pressurisation unit and HAF 200V expansion vessel, and a Hamworthy Powerstock PS300 twin-coil calorifier for domestic hot water, offering connections for an optional solar water circuit.

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 blown method, in which case a rubber deflection 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.

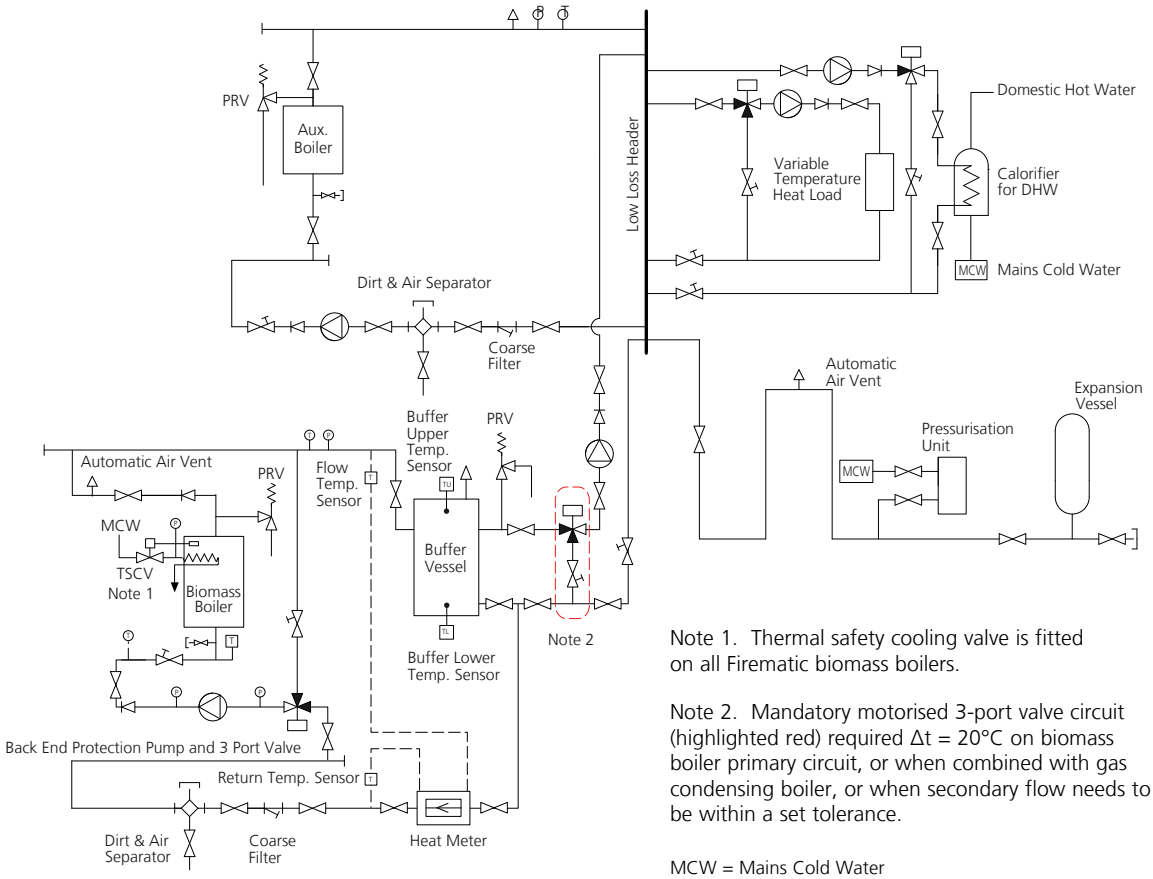


General arrangement of typical Firematic boiler plant room and fuel store

System Schematics

Firematic FM-P, FM-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. Thermal safety cooling valve is fitted on all Firematic biomass boilers.

Note 2. Mandatory motorised 3-port valve circuit (highlighted red) required Δt = 20°C on biomass boiler primary circuit, 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 3bar. The Firematic 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.

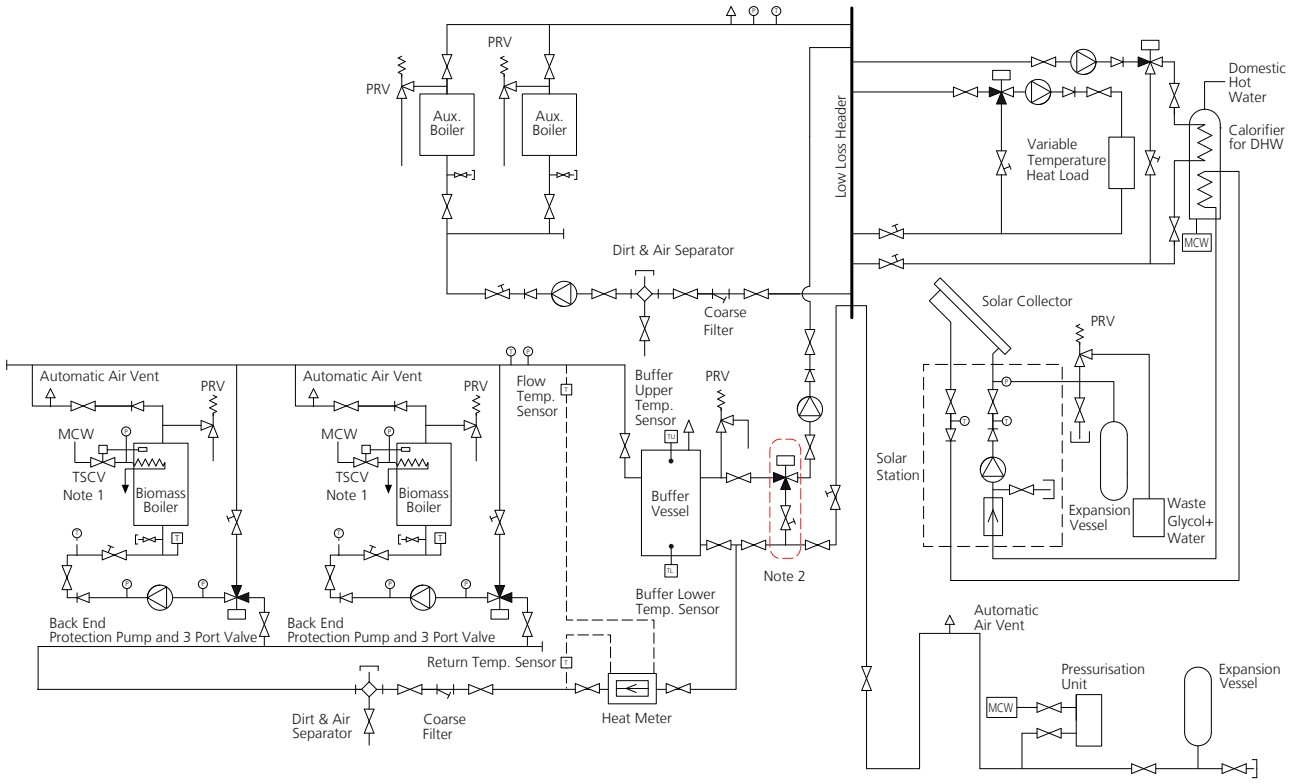
Pressurisation and expansion vessels are shown although dosing pots and additional safety valves have been omitted for clarity.

The heat meter is shown as it is necessary to have an accurate measure of heat generated by biomass to claim the Renewable Heat Incentive (RHI) and other such benefits.

System Schematics

Firematic FM-P, FM-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 solar circuit



Note 1. Thermal safety cooling valve is fitted on all Firematic biomass boilers.

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MCW = Mains Cold Water
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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.

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

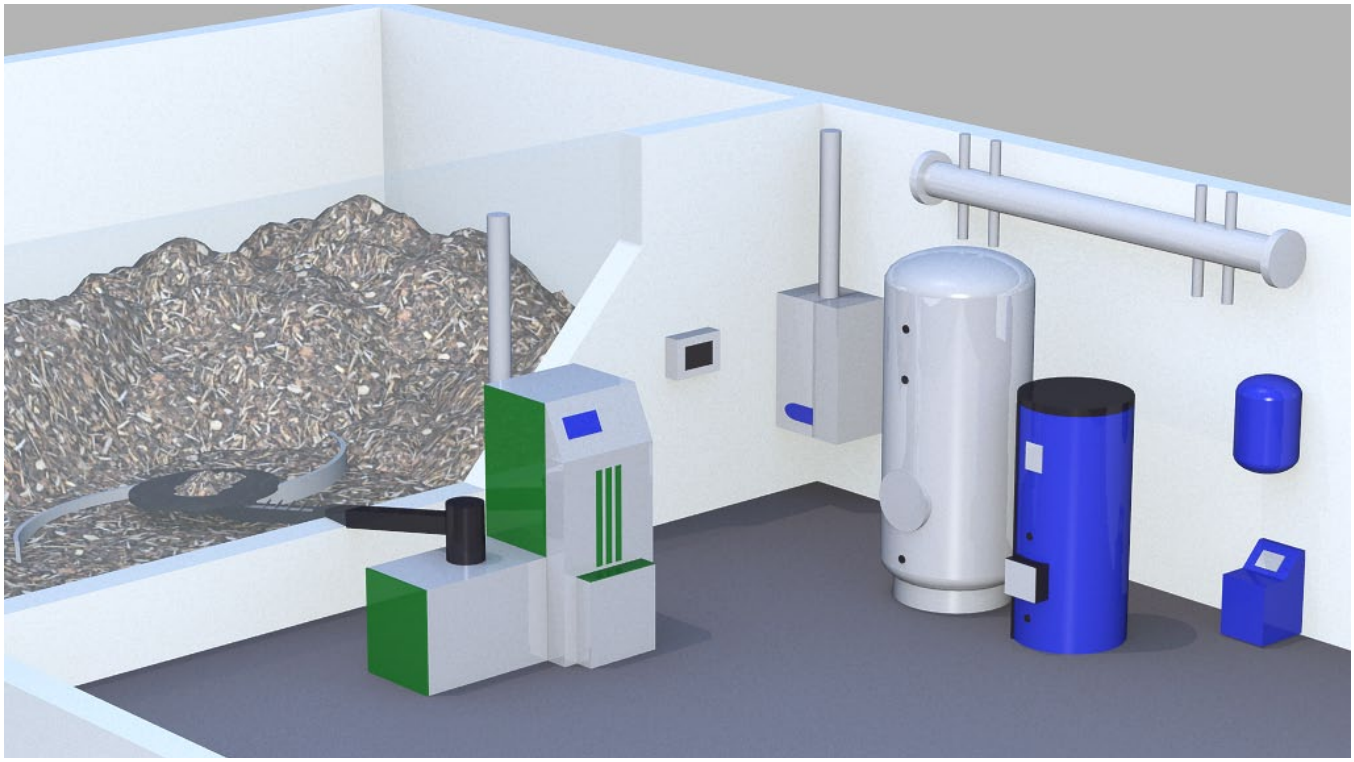
A pressure relief valve must be fitted in line with BS 6644 either directly to each boiler, or fitted to the shortest possible straight length of pipe rising from each boiler, or if not fitted directly to each boiler, then fitted on the flow output side of each boiler ensuring that there is no other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

Typical Plant and Fuel Store

Firematic FM-P, FM-M Biomass Boilers



Typical plant room with Firematic boiler with adjoining fuel store, automatic feed system and heat meter, wall-mounted Fleet boiler, 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 compliant heat meter option.

Auxiliary Boiler

In an installation that combines biomass, gas, oil, solar or 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 absolutely necessary, is recommended on all Firematic biomass boiler installations to use a thermal buffer vessel as an energy store, 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, and as Firematic boilers are of a small thermal mass design, smaller buffer vessels can be used. Typically for up to 60kW Firematic boiler the minimum recommended buffer size is 1500 litres, and for 80kW and 100kW Firematic boilers, the minimum size is 2000 litres. 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 is recommended for corrosion inhibitors to be introduced to protect the system and plant.

Fuel Storage and Automatic Fuel Feed Systems

Firematic FM-P, FM-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 store rooms, 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.

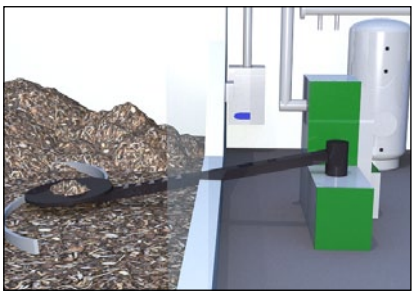
As every biomass installation is different, please contact a Hamworthy sales representative who can advise on the complete range of fuel storage options, fuel delivery systems and ancillary equipment from Hamworthy.

Estimated Fuel Mass/Volume Requirements

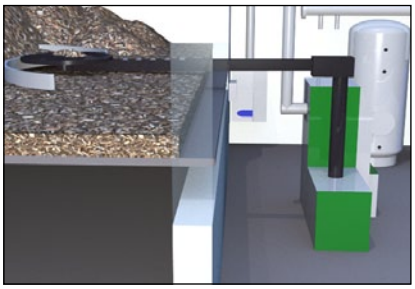
See also associated graph on page 5

Fuel Usage	Firematic Boiler Model				
	FM-P35	FM-P45	FM-P60	FM-M80	FM-M100
Pellet mass Tonnes/day	0.077	0.099	0.132	0.176	0.22
Pellet volume m^3/day	0.112	0.144	0.192	0.256	0.32
Pellet mass Tonnes/week	0.378	0.486	0.648	0.864	1.08
Pellet volume m^3/week	0.56	0.72	0.96	1.28	1.6
Chip mass Tonnes/day	0.098	0.126	0.168	0.224	0.28
Chip volume m^3/day	0.497	0.639	0.852	1.136	1.42
Chip mass Tonnes/week	0.497	0.639	0.852	1.136	1.42
Chip volume m^3/week	2.471	3.177	4.236	5.648	7.06

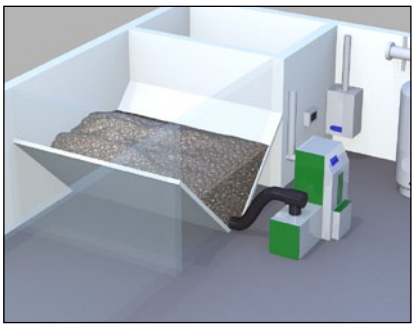
Duty data: 12 hours/day operation, 5 days/week, 70% duty cycle, 85% average boiler efficiency
Moisture content: wood chips 30% /wood pellets 10%.



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



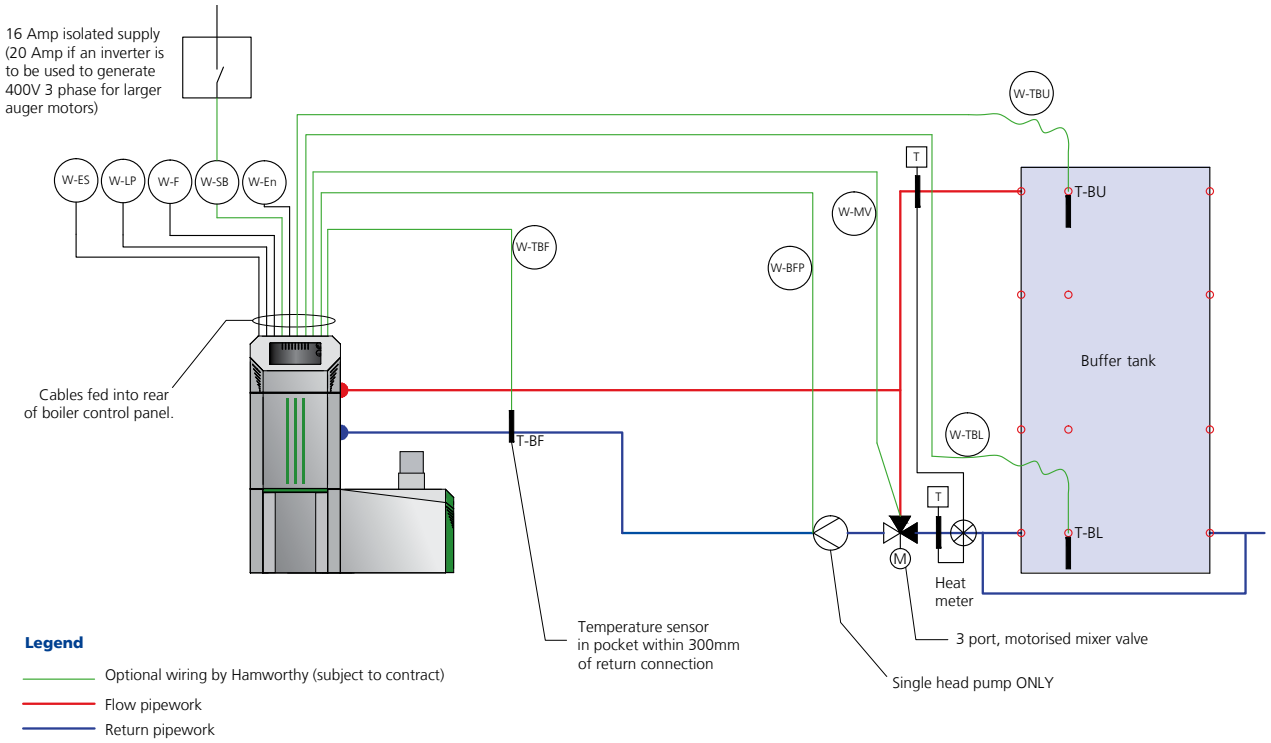
Rigid horizontal auger; and drop chute; store at higher level



Rigid auger in sloping-floor store with flexible rising auger

Electrical Details

Field Wiring Diagram
Firematic FM-P, FM-M Biomass Boilers

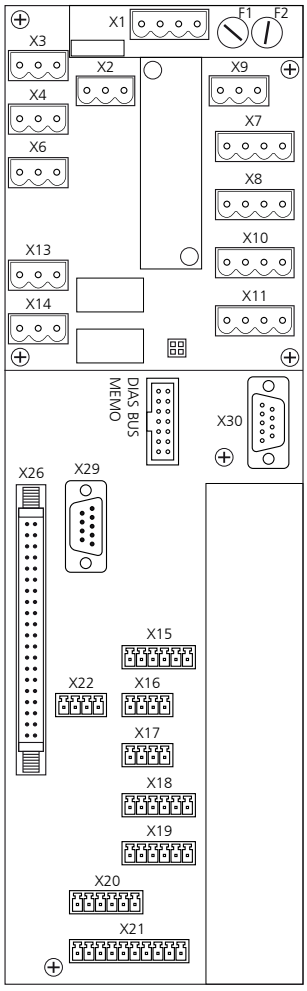


Note: Only single-head primary pumps (one pump at maximum 3A, multiple pumps at total maximum 5A) can be powered directly from the BioControl 3000. For twin-head pumps, power using an external controller, and use 0V signal control from the BioControl 3000.

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 Details

Boiler PCB Connections
Firematic FM-P, FM-M Biomass Boilers



X1	Supply
X2	Relay output pump for additional heat source
X3	Relay output for reverse flow pump
X4	Relay output for boiler pump
X5	Relay output for admixer pump
X6	Relay output pump for HC1
X7	Relay outputs for reverse mixer ON OFF
X8	Relay outputs for rapid heating up ON OFF
X9	Relay output pump for HC 2
X10	Relay outputs for HC1 mixer ON OFF
X11	Relay outputs for HC2 mixer ON OFF
X12	Potential-free relay output for the storeroom temperature monitor
X13	Potential-free relay output release for external control
X14	Potential-free relay output alarm
X15	Digital inputs
	1/2/3 Input release for external control
	4/5/6 Input Heat exchanger cleaning control
X16	Analogue outputs 0 – 10V DC
	1/2 Analogue outputs– Secondary air injection flap
	3/4 Analogue outputs– Primary air injection flap
X17	Boiler temperature inputs
	1/2 Flue gas temperature PT1000
	3/4 Combustion room temperature Thermoelement
	5/6 Terminal connection compensation KTY
X18	Temperature inputs heating circuit 2
	1/2 Advance flow temperature
	3/4 Target temperature
	5/6 Actual temperature

X19	Temperature inputs heating circuit 1
	1/2 Advance flow temperature
	3/4 Target temperature
	5/6 Actual temperature
X20	Temperature inputs
	1/2 External temperature
	3/4 Stoker channel temperature
	5/6 Ext. temperature / rotation temperature
	7/8 Return flow temperature HK1
	9/10 Return flow temperature HK2
X21	Temperature inputs
	1/2 Boiler temperature
	3/4 Hot water tank temperature
	5/6 Buffer temperature lower
	7/8 Buffer temperature upper
	9/10 Return flow temperature
X22	Lambda sensor
X23	CO probe (not used)
X24	Connection to SECONDARY air volume sensor (not used)
	1/2 Secondary fan
	3/4 Secondary air
X25	Connection to PRIMARY / low pressure box air volume sensor (not used)
	1/2 Primary fan
	3/4 Primary air / actual low pressure
X26	Connection to the active component 50 pin
X27	Connection to the active component 20 pin
X28	CAN Bus interface (galvanically isolated)
X29	CAN Bus interface (galvanically isolated)
X30	RS232 interface
	DIAS Bus Memo
F1	Fuse 1 0.63A, for BioControl 3000
F2	Fuse 2 5A, for switched devices

Electrical Supply

An independent 16A isolator and fused electrical supply is recommended for each boiler module.

Supply is 230 volt, 50Hz, single phase. An additional single phase supply is recommended to supply the fuel feed auger motor which is wired via the boiler.

Alternatively, an inverter unit option is available to provide a 400 volt, 50Hz, three phase supply if required for larger torque auger motors, in which case a 20A isolator is recommended. This option includes a 32A D-Type rated circuit breaker for the supply to the inverter, and wiring for the single phase supply to the electric ignition requires a 10A motor rated circuit breaker, with minimum cable size of 2.5mm.

Wiring must be in accordance with IEE Regulations and any local regulations which apply. Wiring must be completed in heat resistant 3 core cable (size 4.0mm^2 c.s.a.). To prevent excessive current (> 1 amp) through the boiler control panel, it is recommended that external pumps are connected via a contactor.

Remote Signalling

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

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

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.

Biomass Solutions

Firematic FM-P, FM-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 and discharged by means of a fan at high level.

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 6cm^2 per kW heat input low level and 3cm^2 per kW heat input high level (approximately 8cm^2/kW low level and 4cm^2/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 0.10mbar 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 Guide 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 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.**

Explosion Relief

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 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

Firematic 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 a sample of fuel is tested and the boiler combustion parameters are set-up for a single commissioned fuel type. It is imperative 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 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. Firematic) and power output (e.g. 100=100kW). 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 BioMatic BM-U220, refer to Herz BioMatic 220 (220kW) in the MCS approved products list.

Sustainable Heating and Hot Water

Firematic FM-P, FM-M Biomass Boilers

Why Choose Hamworthy?

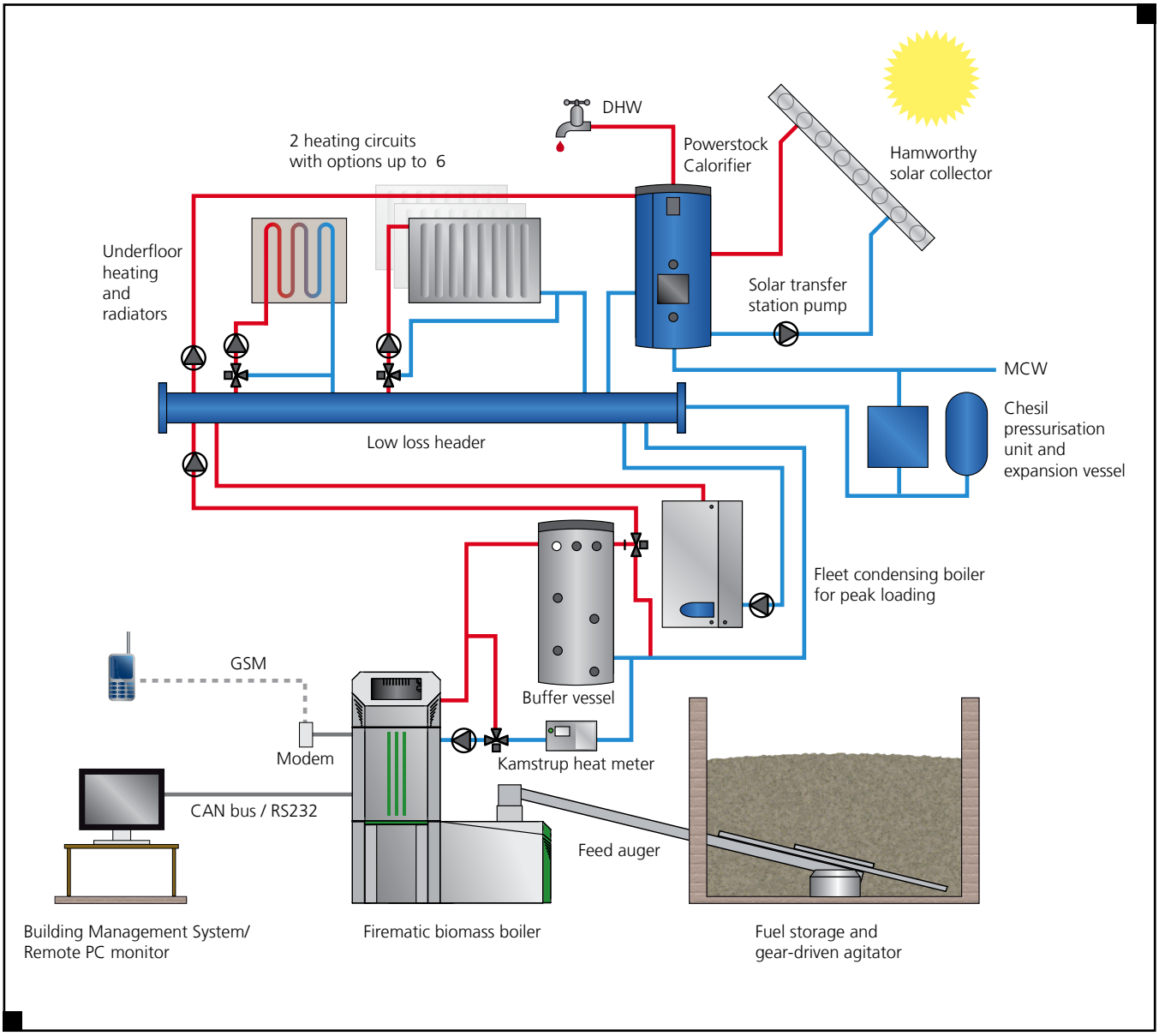
Hamworthy has extensive knowledge and over 40 years of experience of heating and hot water systems for commercial buildings, including supply of gas fired boilers for peak-load delivery alongside biomass boiler and solar hot water systems. We can advise on the optimum boiler selection for each project.

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 completed 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



Typical Hamworthy renewable solution comprising: Firematic 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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Email: **sales@hamworthy-heating.com**
Web: **www.hamworthy-heating.com**

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Hamworthy Heating Accreditations

ISO 9001 Quality Management System
ISO 14001 Environmental Management System
OHSAS 18001 Health & Safety Management System