

## AC WhisperGen System – Product Specification 11 June 2003

### Functional Description



The WhisperGen (WG) is a cogeneration appliance for domestic installations, replacing a gas fired central heating boiler, whilst adding the functionality of generating 230V 50Hz AC electricity. The WG can be installed in combination with a thermal storage system or can be connected directly to a conventional central heating system.

The potable domestic hot water can be heated using a hot water cylinder with a coil or with a direct domestic hot water heat exchanger connected to a thermal store. For space heating a conventional radiator based central heating system can be used.

### Product Specification

#### **Regulatory Compliance**

CE compliant	
90/396/EC	Gas Appliance Directive
92/42/EEC	Hot Water Boiler Efficiency Directive (extent of application to be confirmed)
98/37/EC	Machinery Directive
89/336/EC, 92/31/EC, 98/13/EC	EMC Directive
73/23EC, 93/68/EC	Low Voltage Directive
G83	Recommendations for the Connection of small scale embedded generators (up to 16A per phase) in parallel with public low-voltage distribution

The product will be Type Approved by a notified body.

#### **Boiler Efficiency Directive Rating**

<b>Efficiency:</b>	At maximum rated power output:	96.4% (LHV) typical
	At minimum rated power output:	98.3% (LHV) typical

### WhisperGen Power Outputs

The WhisperGen's burner can run at three different fixed nominal firing rates, resulting in different electrical and thermal power outputs depending on the heat demand as assessed by the WhisperGen's heat management control software. An internally mounted and powered electrical heating element can also be activated to boost the thermal output of the WhisperGen to meet the heat demand. Also an optional externally mounted auxiliary heater can be activated if installed.

Activation of all these devices and selection of the firing rate is through the heat management control software in the Programmable Intelligent Controller (PIC).

*Power Level 1* Engine controlled to 400W gross electrical power output producing approximately 4.9 kW thermal output.

*Power Level 2* Engine controlled to 850W gross electrical power output producing approximately 6.0 kW thermal power output.

*Power Level 3* Engine run at the maximum burner firing rate, generating approximately 1200W gross electrical power output and 8.0kW thermal output.

*Power Level 4* Engine run at the maximum burner firing rate, generating approximately 1200W gross electrical power output and 8.0 kW thermal output. An additional external auxiliary heater is switched on if connected (via the WhisperGen)\*.

*Power Level 5* Engine run at the maximum firing rate, generating approximately 1200W electrical power output and 8.0 kW thermal output. An additional external auxiliary heater is switched on. Also the load dump is switched on.

#### Options:

One option is to set the maximum power level to 4, using the auxiliary heater.

Another option is to disable the auxiliary heater by switching it off and set the maximum power level to 5, thus the load dump is switched on without using the auxiliary heater.

### Load Dump

A 1.0kW resistive element (load dump) is provided to maintain control of engine speed during mains disconnect events, and to enable conversion of the electrical power output to heat under boost conditions.

The load dump element is rated at 1.0kW at 230V. When the load dump element is engaged during a mains disconnect event, the element will absorb all the electrical power output, with the alternator varying the voltage to compensate for varying electrical power outputs as the engine runs down.

### Auxiliary Heater

An external output (dry contacts) is provided to switch an external auxiliary heater running off its own power supply.

**Electrical Power Consumption (net)** Standby: 30W  
Generating: 110W (without water pump)

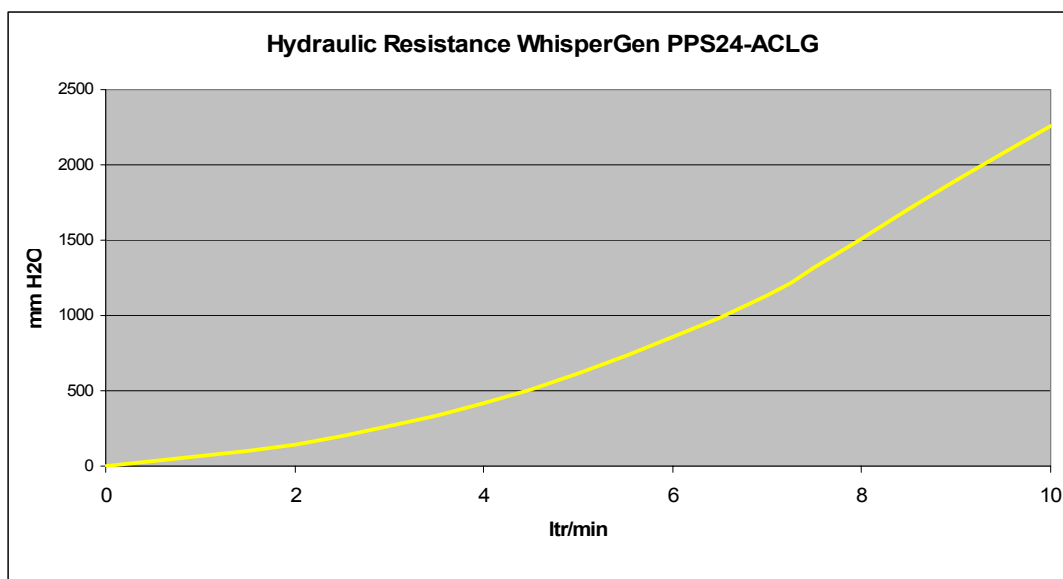
**Electrical Power Quality** Power Factor 0.95 to lag or lead at greater than 500 W generated into the mains.  
Total Harmonic Distortion compliant with EMC Directive.

**Maximum Run Time:** A maximum continuous run time of 24 hours is required for Gas Appliance Directive compliance. The WhisperGen will go through an automatic shutdown and restart sequence, assuming there is still a heat demand after 24 hours continuous running, enabling the SIT 505 burner control board to perform a self checking routine.

**Hot Water Out** PMS = Class2; 3 bar pressure rating.  
A water side pressure relief valve discharging via a separate discharge line is included to ensure the water system cannot be over-pressurised by leakage from the WhisperGen's nitrogen pressure system. The discharge line may be connected to the condensate drain by the installer, provided this meets local regulations, or plumbed separately as a safety discharge outlet.

**Hot Water Exit Temperature** User defined within the range of nominally 60°C – 75°C

**Water Flow Rate** 6 to 12 l/min.  
The hydraulic resistance of the WhisperGen is graphed below:



**Condensate** Exhaust condensate is discharged via an integral condensate syphon tank to outlet. The condensate outlet height from floor level will be about 100-130mm (subject to test).

**Maximum Flow Rate** 1.7 kg/hr max

**Acidity** pH 4

**Exhaust** Cox Geelen Coxcentric RGE 80-125 balanced flue system.

**Exhaust Exit Temperature** 85°C at 6.0 kW thermal (at 75°C coolant temperature)  
110°C max at 8.0 kW thermal (at 75°C coolant temperature)

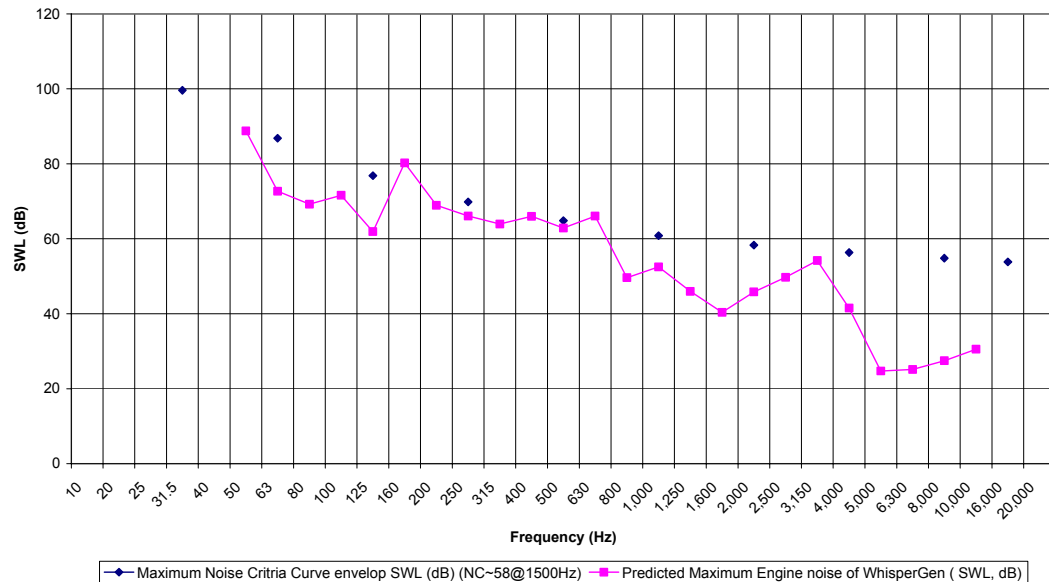
## Noise

The sound power level is measured according to BS EN ISO 9614-2:1997.

A graph with noise curve for the WhisperGen enclosure, running in normal firing rate (power level 2), is given below. The dotted curve is the maximum noise intensity.

The lined curve is a typical maximum WhisperGen noise curve.

Noise Specification of WhisperGen



Noise level at flue exit:

noise curve t.b.a.

## Fuel

Gas Type: 2H – 2<sup>nd</sup> family natural gas

Supply conditions: 2H-G20-20mbar

(Note: this implies a supply pressure between 17 and 25 mbar in accordance with EN483)

Consumption: 1.1 m<sup>3</sup>/hr at 10.5 kW firing rate

## Water

Central Heating water to be treated with a corrosion inhibitor such as Sentinel X100 or equivalent. If freezing temperatures could be experienced by the central heating system, an anti freeze such as Sentinel X500 should be added to the system. Corrosion inhibitors and other water treatment additives (e.g. scale inhibitors) must be compatible with aluminium and brass metals used in the WhisperGen cooling system.

## Air

Intake air via balanced flue

Air temperature min: -15 deg C

max: +40 deg C

## Electrical Connection

Voltage nominal: 230 V 50 Hz

Voltage and frequency limits, grid disconnection and reconnection behaviour in accordance with Engineering Recommendation G83.

Sub circuit current capacity: 16 amps

Note: Electrical connections to the WhisperGen are made via IEC plug and socket connections on the WhisperGen electronics module located behind the front panel.

**Mains Loss Protection:**

Primary disconnection protection to G83 provided by Mains Sense Unit (MSU), Voltage and Frequency limit control systems incorporated in the WhisperGen electronics enclosure. The MSU disconnects the WhisperGen from the mains after any out of limit condition and prevents reconnection until stable mains is present for 3 minutes. Both phase and neutral are disconnected from the grid. The WhisperGen will be ready for restart 10 minutes after disconnection, provided there has not been another mains disconnection during that period.

The power supply for the WhisperGen is to be supplied from a lockable isolation switch, required in G83.

**External Control Interface:**

Inputs/outputs:

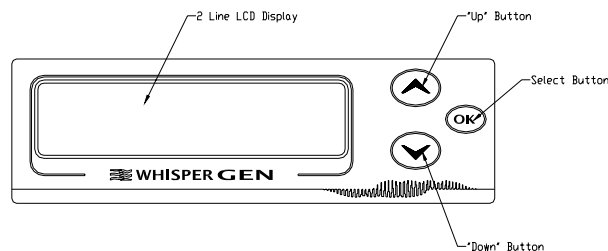
- Heat demand On/Off	Input impedance	142 k $\Omega$
	Threshold On	90V, 50 Hz
	Off	20V, 50 Hz
- Boost mode On/Off (thermal store)	Input impedance	142 k $\Omega$
	Threshold On	90V, 50 Hz
	Off	20V, 50 Hz
- Pump On/Off	Input impedance	142 k $\Omega$
	Threshold On	90V, 50 Hz
	Off	20V, 50 Hz
- Pump On/Off		230V, 50Hz
- Aux Heater On/Off		dry contacts

**Communications Interfaces:**

- RS-232 port with female DB9 connector for connection to a Programmable Intelligent Controller (PIC).
- RS-232 port with male DB9 connector for connection to a modem.
- RJ45 port for Ethernet connection.

To communicate with a network using PC or modem an optional Tini Card has to be installed on the electronics board.

For adjusting WhisperGen software parameters a "service" version of the Engine Management System software can be installed on a stand alone PC. This PC can communicate with the WhisperGen using the RS-232 port and does not need the optional Tini Card.

**User Interface:**

The user interface enables:

- 1) Enabling/Disabling the alarm buzzer
- 2) Silencing the alarm buzzer if a fault occurs
- 3) Clearing a fault, allowing the WhisperGen to restart
- 4) Viewing engine operating parameters
- 5) Viewing engine software version.
- 6) Access to hidden installation menu

The LCD display reports the actual water temperature on the first line of the display, and either a "standby" ,"starting" ,"stopping" message or the electrical power output on the second line. The alarm buzzer is only turned on when the WhisperGen is in a lockout state, requiring user intervention to resume operation. The user may optionally disable the buzzer under all conditions.

### Fault Behaviour

The WhisperGen's control system objective is to keep the WhisperGen operational if at all possible. The control system can detect a number of possible fault conditions, and in most cases (i.e. volatile fault) will automatically go through a shutdown and restart sequence to try and recover from the fault condition. During this process, the fault symbol on the LCD will remain lit, but no alarm will sound. The fault symbol is turned off when the WhisperGen recovers from the fault condition. If the fault cannot be corrected, or if a non-volatile fault requiring shutdown and lockout occurs, the WhisperGen will go through a controlled shutdown into the lockout mode. At this point, the fault code is shown on the display, the display backlight is flashing and the alarm buzzer is turned on. The display also instructs the user to call for service, and displays the instruction to silence the alarm. Once the alarm is silenced, after the minimum lockout time the user may clear the fault, enabling the WhisperGen to attempt a restart.

## System configurations

The WhisperGen can be run direct with a conventional system which consists of space heating radiators and a domestic hot water cylinder or with a system that has a thermal storage tank between the WhisperGen and the central heating system.

### Conventional system configuration

If the WhisperGen is running with a conventional system the Programmable Intelligent Controller (PIC) will replace the conventional controller. The PIC is a controller which will give the WhisperGen not only an On/Off heat demand signal but will communicate with the WhisperGen and call for the power level that is needed to meet the heat demand. To achieve this, the PIC has several extra inputs to have more information on actual temperatures and set points. Thus the heat management software in the PIC will call for a particular power level to improve engine performance.

The heat management control algorithm selects the appropriate power level in response to:

- 1) the presence of a heat demand signal (set in the heating period schedules), and
- 2) the difference between the actual room or tank temperature and the set point.

Having more information on temperatures the WhisperGen is able to:

- maximize efficiency by running in more efficient power levels for longer periods
- calculate the optimal start time, using the more efficient power levels, and
- reduce cycling through having information on actual heat load and heat output.

The control logic to reduce power levels is based on the following heat demand signal states and temperature thresholds (T is the actual central heating flow temperature at the WhisperGen outlet; t is the temperature set point):

Mode	Switch Point	Action
A	Heat Demand ON	WhisperGen and central heating pump turned ON.
B	$T = t$	Power Levels set to maintain constant temperature rise of 0.66 deg C per minute Auxiliary external heater switched OFF if operating (power reduced to P3)
C	$T = t+2$	Temperature T evaluated every 2 minutes, if T remains greater than $t+2$ then power reduced by 1 level (e.g. P3 to P2)
D	$T = t+4$	Power level reduced to P1 immediately
E	$T = t+8$	WhisperGen shutdown immediately. WhisperGen will automatically start after 30 minutes if:
G	$T = t-3$	Temperature T is below $t-3$ AND Heat Demand Signal is ON Temperature T evaluated every 9 minutes; if T remains less than $t-3$ then power level increased by 1 step (e.g. P2 to P3) Max. power level is 3
H	$T = t-12$	If temperature T is below $t-12$ the power level is set to 4. If after 9 minutes T remains less than $t-12$ , the power level is set to 5

### Programmable intelligent controller (PIC)

The controller will consist of a base station located behind the WhisperGen front panel and a wall mounted user interface to be installed in the living room.

With the user interface the customer can add or change the time and temperature settings for the heating periods. The interface will also display the WhisperGen status.

The basic functions for the PIC are essentially the same as for a standard central heating controller. That is, it should provide for:

- entry of daily heating period schedules, for hot water and space heating
- setting temperature targets for hot water and space heating
- allowing temporary override for extra heating, or suspension of the heating programme
- sensing and displaying hot water, room, and an optionally outside temperature
- controlling diversion valves for coolant flow, and
- displaying of WhisperGen and controller lockout situations and fault codes.

### **Dimensions**

The size of the wall mounted user interface is size 130x120x25 mm (BxHxD).

### **Base station in/outputs**

- The PIC will have five temperature inputs, for room, outdoor and hot water cylinder temperatures.  
The room temperature sensor will be inside the user interface, but an external temperature sensor can be connected as an option.
- Drive outputs for a single 3-way valve or other dual 2-port valve configurations
- Other spare digital outputs (3x).

### **PIC comms channels**

- Serial link at 9600 bps to the WG RS-232 port. Note: the maximum length of the cable between user interface and WhisperGen can be 15 metres.
- Serial link to a Tini card and cellphone, for remote EMS.

### **Remote monitoring and logging**

The WhisperGen itself will not be connected to the remote Engine Management System (EMS). The WhisperGen serial port will be occupied talking to the PIC but the PIC will have capability to relay to the EMS information data relating to its own heat management decisions, and information extracted from the WhisperGen (A second comms port on the PIC will be required for this).

### **Compliance**

The Programmable Intelligent Controller will be Type approved by a notified body.

### **Thermal store configuration**

The thermal store controller will supply an ON/OFF heat demand signal to the WhisperGen typically either in response to the thermal storage temperature sensor and water heating timetable.

The WhisperGen's water temperature set point is set to 80°C maximum. The water temperature of the thermal storage tank can be set to a value desired, with a maximum of 75°C.

The heat management control algorithm selects the appropriate power level in response to:

- 1) the presence of a heat demand signal from the thermal storage controller, and
- 2) the presence of a "boost" signal from the thermal storage controller.

The control logic is based on the following heat demand signal states and temperature thresholds (T is the actual central heating flow temperature at the WhisperGen outlet; t is the temperature set point):

Mode	Switch Point	Action
A	Heat Demand ON	WhisperGen and central heating pump turned ON. Power Levels set to 850W
B	Boost demand ON	Power level set to 1200W
C	T= t+8	WhisperGen shutdown immediately. WhisperGen will automatically start when Temperature T is below t-3 AND Heat Demand Signal is ON

The WhisperGen has priority over control of the water pump. It will receive, and in most cases pass on, signals from the external controller to switch the pump on or off (e.g. for frost protection circulation, pump exercise etc) but in some situations the WhisperGen may require the pump to run for an extended period of time, e.g. in cool down.

There is a connection provided that will enable the pump to be powered directly from the WhisperGen in the event of loss of mains supply to the WhisperGen, so that the pump will remain running, thus preventing boiling of the water during the engine shutdown phase. In this situation, the WhisperGen is isolated from the grid.

## Installation Requirements

### Standards & Regulations

Installation is to comply with the requirements of:

- BS6798 2000 "Specification for the installation of gas fired boilers of rated input not exceeding 70 kW net"
- BS5546 2000 "Specification for installation of hot water supplies for domestic purposes, using gas fired appliances of rated input not exceeding 70 kW net"
- BS5440 2000 "Installation and maintenance of flues and ventilators for gas appliances of rated input not exceeding 70 kW net (1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> family gases)"
- BS6891 1998 "Installation of low pressure gas pipe work of up to 28mm (R1) in domestic premises (2<sup>nd</sup> family gases)"
- BS5449 1990 "Forced circulation hot water central heating systems for domestic premises"
- Gas Safety (Installation & Use) Regulations 1998 (as amended)
- BS7671:2001 Requirements for electrical installations – IEE Wiring Regulations.
- Local building regulations
- Bylaws of the local Water Company
- Health & Safety Document #635 (Electricity at Work Regulations 1989)
- G83 Recommendations for the Connection of small scale embedded generators (up to 16A per phase) in parallel with public low-voltage distribution

### Installation Type

C<sub>12</sub> or C<sub>32</sub> - induced draught fan, for either horizontal (through wall) or vertical (through roof) flue exit. The flue exit is from the rear of the enclosure. In order to accommodate a vertical flue exit, additional cavity space is required to incorporate an elbow in the flue system external to the enclosure.

### Mounting Type

Floor Mounted, free standing  
The enclosure incorporates four wheels enabling the machine to be pushed into a tight fitting cavity. The rear of the machine can be levelled before installation in the cavity by levelling the rear wheel support, and the front of the machine can be levelled after installation by adjusting two adjustable feet from outside the enclosure.

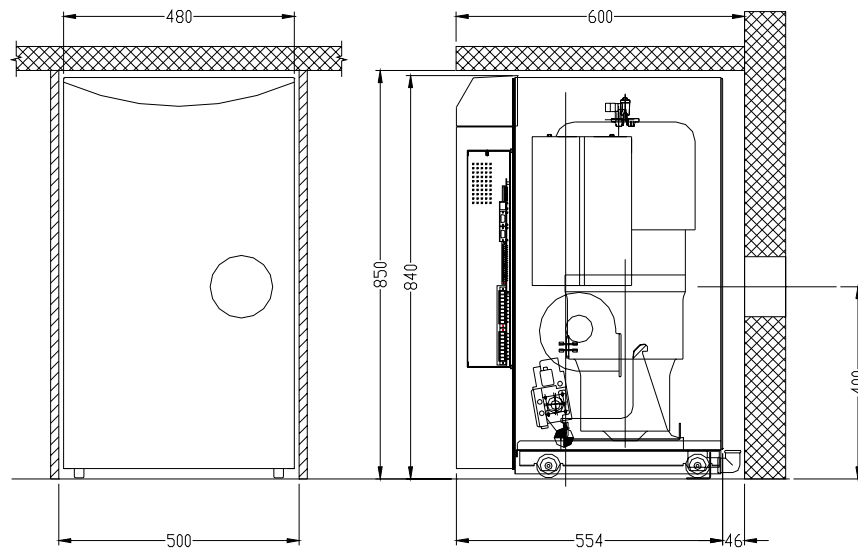
### Weight

138 kg dry weight



## Cavity Dimensions

500W x 850H x 600D (minimum)



## Environment

Ambient Temperature: 0 to 55 deg C  
Humidity: 0-95% Relative Humidity, non-condensing

Adequate ventilation is required to limit the air space temperature around the WhisperGen to 55 deg C max.

## Flue Exit Direction

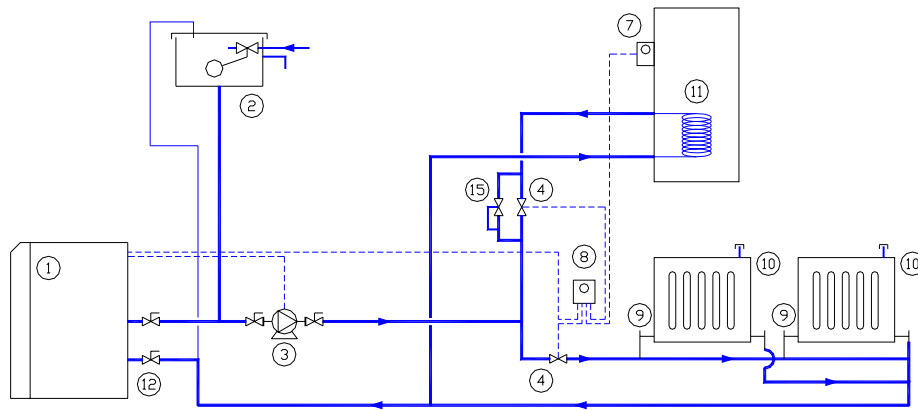
Rear exit from the enclosure.

## Installation Configurations

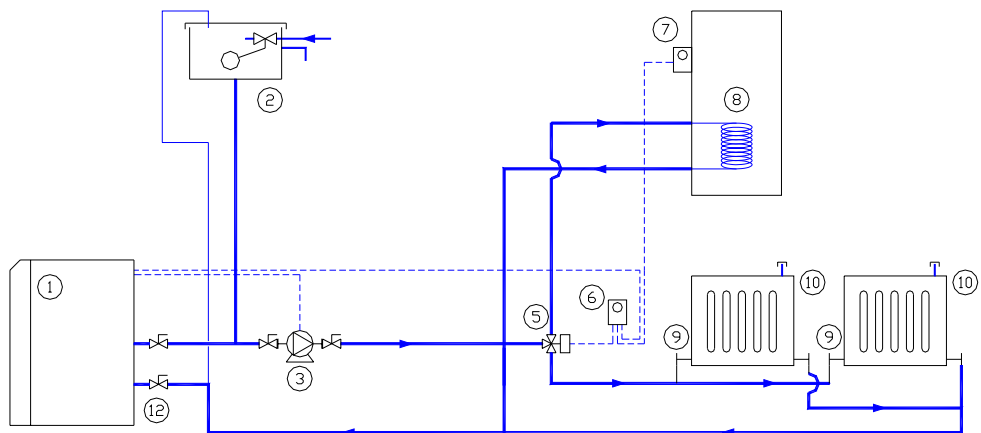
The WhisperGen can be installed in either an open vented or a sealed system. Lockable water isolation valves must be installed on the WhisperGen supply and return pipes to enable disconnection of the WhisperGen from the heating circuit. Refer to the Installation & Service Manual for valve specifications.

### 2-port valve system

In a system with a 2-port valve there must be a means of dissipating heat during WhisperGen shutdown. An automatic by-pass valve has to be installed in parallel with the valve to the hot water cylinder to keep a flow path open.

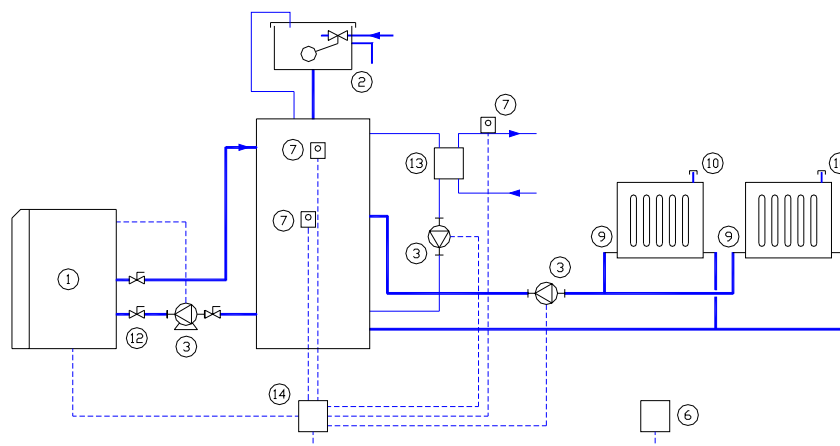


### 3-port valve system



### Thermal storage system

In situations where the WhisperGen is installed with a thermal storage system, the thermal storage controller has to provide a signal to the WhisperGen to go to maximum firing rate. Maximum water storage temperature set point 80°C.



1	WhisperGen	9	TRV valve
2	Header tank / Expansion vessel	10	Space heating radiator
3	CH pump	11	Uncontrolled space heating radiator
4	2-way valve	12	Isolation valves
5	3-Way valve	13	DHW heat exchanger
6	Programmable Intelligent Controller (PIC)	14	Thermal storage controller
7	Temperature thermostat / sensor	15	Automatic by-pass valve
8	Indirect hot water cylinder		

## Servicing

### Service Interval:

Annual or 3000 hours, whichever is first.

### Service Access:

Service access is via the front face of the machine. Routine service tasks can be completed without disconnecting the machine from gas and water services. Non routine service tasks may require the machine to be disconnected from the gas and water services, and removed from the installation cavity to gain adequate access to internal parts.

### Service Tasks:

Refer Installation & Service Manual

## Packaging

### Crate dimensions

To be advised

### Compliance

94/62/EC Packaging & Waste Directive

### Freight Method

Suitable for international/domestic transport by road, rail, sea or air freight as a single unit or via ISO container.

### Storage Temperature

-20 to +65 deg C.

## Boundary Diagram

The boundary diagram specifies those components supplied as part of the WG, those parts fitted at the time of installation and supplied by the installer, as well as those components of the system that are assumed to be part of the existing house heating system.

### **PPS24ACLG WhisperGen Assembly** (supplied by Whisper Tech Ltd)

Services Interface Kit

Installation Kit

Warning Labels – Generator Warnings & Pump Supply Warnings  
Electrical Connection Plugs and/or flying leads

WhisperGen

Manuals

User Manual  
Installation & Service Manual

### **Installation Package** (supplied by the installer/commissioner)

Flue Kit

Cox Geelen Concentric RGE 80-125 balanced flue.

Water System

Pipe, fittings, valves and water strainer as required to connect the WG water connection interface to the household system as defined in the Installation & Service Manual.

Nitrogen System

Nitrogen bottle, regulator, filling hose and calibrated pressure gauge for charging of the WhisperGen pressure vessel. (Note: this may not be required if the engines are pressurised prior to dispatch from the distribution centre)

Gas System

Pipe, fittings and valves as required to connect the WG gas connection interface to the household system as defined in the Installation & Service Manual.

Condensate Drain

Pipe and fittings as required to connect the WG condensate drain interface to the household drainage system.

Electrical System

Power supply via a lockable isolation switch for the WhisperGen. Mains supply connection including earth as specified in the Installation & Service Manual.

Computer Interface

A Windows PC, running appropriate WhisperTech software, connected to the WG via the serial interface may be required for installation/commissioning.

**Household System (assumed to be part of the existing house central heating system)**

- Water circulation pump & header tank/expansion vessel
- Domestic Hot Water cylinder of 90 to 180 litre capacity, with suitably rated internal heat exchange coil for transfer of heat from the WG output to the potable water store **or** thermal storage system with a minimum of 190 litre primary water capacity. The thermal store controller has to provide signals to the WhisperGen to go to a specified power level.
- Space Heating Radiators fitted with TRV valves as required
- Diverter valve to distribute water between space heating and domestic water system. Note that a diverter valve is preferred over a two port zone valve system with bypass as it ensures there is sufficient thermal storage to accommodate the WhisperGen's power output during shutdown.
- DHW temperature sensor, room thermostats as required, and central heating programmer.

**Programmable Intelligent Controller (PIC) Package**

- Wall mounted user interface
- Base station to be installed behind the WhisperGen front panel
- DHW temperature sensor
- Cables between WhisperGen and user interface

*Whisper Tech Ltd reserves the right to revise and improve its products as it sees fit. This publication describes the state of this product at the time of its publication and may not reflect the product at all times in the future*

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