Clyde BOILERS

Natural Gas

60 kW
to
180 kW

LP Gas

60 kW
to
120 kW

Clyde CG

Wall hung condensing boilers

Contents Page

Qualified for Energy Technology List www.eca.gov.uk

Engineering Data Sheet 769/4

November 2007

Operating principles

The CG is a wall-mounted condensing boiler with stainless steel counter flow twin heat exchangers (the CG 60 has a single heat exchanger), pre-mix gas burner and integral flue products fan (refer Figs 1 and 2). When operating in condensing mode with a flow of 50°C and a return of 30°C, it will give efficiencies of up to 109.5% (ncv). Gas is supplied through a zero governor valve (2). The air intake fan (4) and venturi (3) accurately control the volumes of gas and air and mix them prior to ignition. A small flame is held on the entire surface of the burner combustion head (6). This ensures that there is optimum combustion at any point in the modulation range of the boiler.

System return water is passed through a number of tubes in the secondary (condensing) heat exchanger, and then the primary heat exchanger. An integral boiler circulation pump (11) ensures an even and constant flow through the heat exchanger - refer page 8. System circulating pumps should be hydraulically separated from the boiler(s) by a low velocity header.

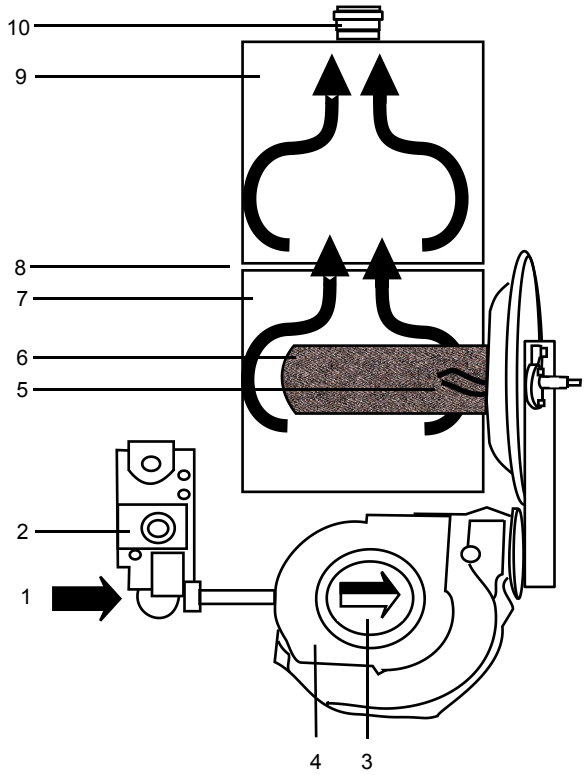


Fig 1 Diagram of operating principles

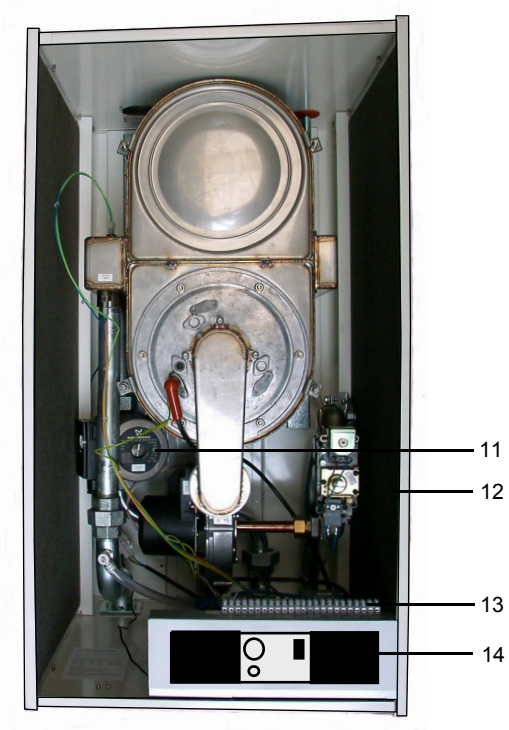


Fig 2 Cut-away CG boiler

Key to Figs 1 & 2

1 Gas supply
2 Gas valve
3 Gas and air mixing by venturi
4 Fan unit
5 Ignition and flame ionisation electrodes
6 Burner head
7 First heat exchanger
8 Baffle plate
9 Second (condensing) heat exchanger
10 Flue gas outlet
11 Boiler circulation pump
12 Sound insulation panels
13 Electrical connection strip
14 Control display

General information

Application

CG boilers are manufactured and tested in accordance with the Gas Appliances Directive 90/396/EEC, the Boiler Efficiency Directive 92/42/EEC, EN 483 and EN 677 and CE marked accordingly. They are suitable for use in LTHW heating systems with a maximum operating pressure of 6.0 bar and a maximum working temperature of 90°C (see Technical data).

CG 60, 80, 100 and 120 boilers are suitable for use with Natural gas (G20), Propane (G31) and Butane/Propane mix (G30). CG 150 and 180 boilers are only suitable for use with Natural gas (G20).

The boiler is suitable for use in pressurised (sealed) or open vented heating systems with a minimum static head of 0.5 bar. It is not suitable for use as a direct water heater. Where potable water is required, a matching calorifier or plate heat exchanger must be provided in the system. All models in the range are suitable for use with a concentric balanced flue.

Statutory requirements

The installation and commissioning of the boiler must be carried out by a qualified engineer in accordance with the instructions provided.

Gas supplies and gas burners must be installed, serviced and commissioned by a qualified person, eg. a Gas Safe registered engineer.

Handling

Offloading, dry storing and placing of equipment in the boiler room is the responsibility of the installer.

Equipment must be dry stored and protected from frost. Cartons must not be crushed or otherwise damaged.

Commissioning

Clyde undertake commissioning of boilers. Commissioning charges do not include servicing during the guarantee period, although this may be carried out under service contract or to specific order. Boilers should be commissioned in line with CIBSE Commissioning Code B.

Servicing

The importance of regular maintenance cannot be over-emphasised if maximum efficiency is to be maintained. Customers are strongly advised to place the equipment under service contract immediately commissioning is complete.

Guarantee

Subject to correct handling, installation and operation, all equipment is guaranteed for twelve months from the date of despatch. Boiler heat exchangers are guaranteed for a period of two years from the date of manufacture.

The guarantee is not valid if the boiler is not installed in accordance with these instructions (please refer to page 5), becomes blocked with debris and/or carbonate deposits from the system water and/or there is no documented evidence of commissioning by Clyde or their appointed engineer.

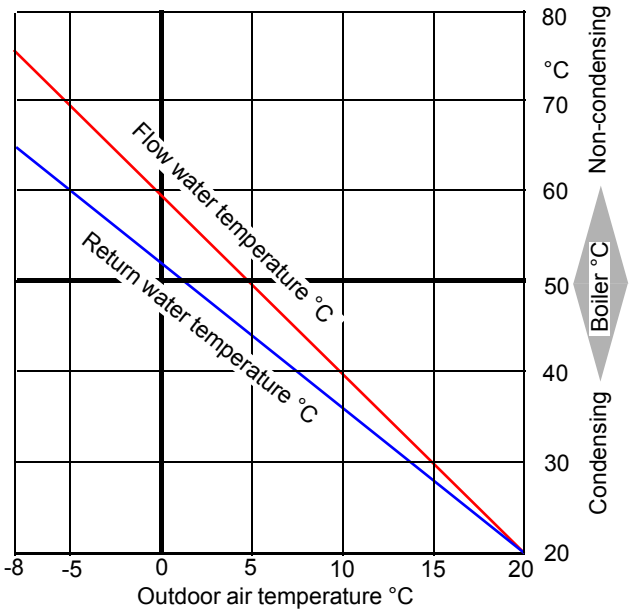
Boiler Log book

A boiler log book that provides a permanent record of commissioning and servicing data and measurements is supplied with every boiler. It is recommended that the owner ensures that this log book is kept safe and brought up to date on every occasion that routine or emergency work is carried out on the boiler.

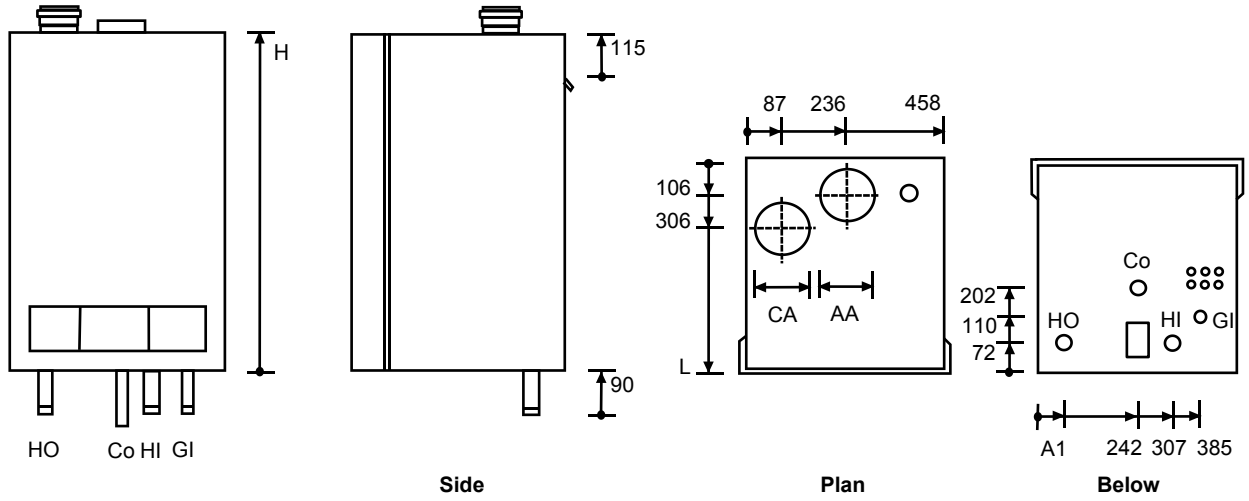
Emitter sizing (radiators)

The boiler will operate in condensing mode whenever the return water is below 50°C and will reach its full potential if the flow water temperature is also below 50°C. However, the latter condition will mainly occur when the boiler is heating an underfloor heating scheme or transiently when recharging a DHW storage tank from cold. By careful design of a traditional heating system with radiators, and with weather compensating control in operation, the return water temperature can be held below 50°C for most of the heating season, only rising above this figure when outdoor temperatures are below zero.

For optimum performance, calculate heat losses on the basis of a 20°C internal temperature and a -8°C outdoor air temperature. With no added factors, size the radiators on the basis of published EN 442 data (ΔT50) and size the system pump for a 10°C temperature drop. In most cases this will ensure that the boiler begins to operate in condensing mode when the outdoor air temperature rises above 1°C and becomes fully condensing when the temperature is above 5°C. For heating schemes in buildings where the occupants have special needs, different environmental conditions may apply and further advice must be sought.



Dimensions and Technical data



Dimensions

Boiler model / output		kW	60	80	100	120	150	180
Boiler flow connection	HO		R1½	R1½	R1½	R1½	NW50	NW50
Boiler return connection	HI		R1½	R1½	R1½	R1½	NW50	NW50
Condensate outlet	Co	mm	25					
Gas Inlet	GI		R¾	R¾	R¾	R¾	R1	R1
Flue connection	AA	mm	80	100	100	130	130	130
Combustion air inlet	CA	mm	80	100	100	130	130	130
Boiler depth	L	mm	485	485	485	485	670	670
Boiler height	H	mm	835	835	835	835	890	890
Position of HO	A1	mm	72	72	72	72	122	122

Technical data

Flow 50°C / Return 30°C

Heat output (ncv)	Max	kW	58	77	96	116	150	180
Heat input (ncv)	Max	kW	55.6	74.3	92.2	111.2	138.8	166
Efficiency (ncv)		%	109	109.5	109.5	109.5	109.5	109.5

Flow 80°C / Return 60°C

Heat output (ncv)	Max	kW	55	73	90	109	136	163
Heat input (ncv)	Max	kW	55.6	74.3	92.2	111.2	138.8	166
Efficiency (ncv)		%	97	98	98	98	98	98
Flue gas temperature at full load		°C	85					
Flue gas mass flow		kg/s	0.028	0.038	0.046	0.056	0.069	0.084
CO_2 in flue gas (1)		%	9					
CO in flue gas	Max	mg/kWh	20					
PH of condensate produced			4 to 5.5					
Natural gas consumption (gross cv) (2)		m³/h	5.74	7.66	9.5	11.5	14.3	17.1
N0x Emissions		mg/kWh	15					
Boiler seasonal efficiency (3)		%	95	95	95	95	95	95
Dry weight		kg	46	73	78	83	92	101
Water volume		l	3.9	5	6.5	8.3	10.4	12.9
Maximum allowable temperature		°C	90					
Maximum hydraulic working pressure		bar	6					
CE Registration number			CE 0063 BP3254					
Max electrical power consumption		W	355	355	355	375	460	460
Electrical protection			IP40					

Notes : (1) Measured at the flue gas adaptor (2) Based on GCV 38.76 MJ/m³

(3) Calculated from the non-domestic heating and cooling compliance guide for conformance with ADL2A and ADL2B 2006 using the formula η **seasonal = 0.81** $\eta_{30\%}$ **+ 0.19** $\eta_{100\%}$

Water flow rates and hydraulic resistances

Water flow rate at 20°C temp. rise	l/s	0.71	0.95	1.19	1.43	1.79	2.14
Hydraulic resistance at 20°C temp. rise	kPa	22.4	45.8	38.2	35.6	44.8	33.6

Regulations governing installation

CG boilers should be installed in accordance with all prevailing regulations and codes of practice, including the Building Regulations, Health and Safety Regulations PM5, Water Bylaws and the current Gas Safety (Installation and Use) Regulations. Detailed relevant guidance will also be found in;

BS 6644 :2005	Installation of appliances exceeding 70 kW net input
BS 5440-2	Ventilation for appliances not exceeding 70 kW net input
BS 6891	Low pressure gas installation pipework of up to 28mm (R1)
BS 5449	Forced circulation hot water central heating systems for domestic premises
BS 6880	Code of practice for installation of low temperature hot water heating systems of output exceeding 45 kW

CIBSE Guides B and C and Commissioning Code B
Institution of Gas Engineers Utilization Procedures 1, 1A, 2, 4, 7 and 10.

Water treatment

CG boilers have a stainless steel heat exchanger and care must be exercised to ensure that the system water and any water treatment is compatible.
Whenever a new boiler is connected to an existing system, the pipework must be thoroughly cleaned and flushed. This is to remove debris, rust particles, carbonate deposits and any existing water treatment that might be incompatible with the heat exchanger. New systems must also be thoroughly flushed to remove debris and flux deposits. Clyde recommend that a permanent means of filtration be fitted into the return pipework, such as a sludge trap, hydrocyclone or full flow duplex filters. The boiler guarantee will be invalid if waterways are blocked by debris or carbonate deposits.
The pH value of the system water should be measured to ensure that it is between 5 and 10.5. If system water is in contact with aluminium, the pH value must be less than 8.5. Temporary hardness (calcium carbonate and magnesium carbonate) can be removed by boiling and its effects limited by preventing ingress of fresh, untreated water. Permanent hardness (eg sulphates and chlorides) must not exceed 50 mg/litre. The boiler guarantee will be invalidated by the use of incorrect or incompatible water treatment. Specialist advice should be obtained, eg from;

Fernox Tel. 01483 793200

For full information on cleaning, flushing and protecting hot water systems, refer to BSRIA Application Guide AG 1/2001.

Deaeration

It is a condition of warranty that there is effective air separation and removal from the system. The air separator should be fitted at the hottest part of the system.

Boiler condensate

CG boilers have a 25mm flexible condensate drain that is compatible with standard plastic waste pipe. Do not use other materials, as they will corrode. The pipe size must not be reduced and there must be a continuous fall to drain. As a further precaution against freezing, condensate pipes should be run internally whenever possible and lagged when run externally.

Pressurisation of systems

CG boilers should be installed as part of a pressurised (sealed) or open vented system with a minimum pressure of 0.5 bar. The maximum allowable pressure for the boilers is 6 bar. They are not to be used with a gravity system.

Boiler location

CG boilers must not be installed external to a building. The boiler must be mounted on a sound internal wall, capable of supporting its weight. The boiler location must be frost-free and adequately ventilated (see below). Contamination of the combustion air by inflammable vapours, high dust levels or halogenated hydrocarbons will constitute a safety hazard and will damage the boiler. The following minimum clearances around the boiler should be observed;

Front	500 mm
Sides	20 mm
Below	100 mm
Above	300 mm (subject to flue installation requirements)

Air supply and ventilation

Adequate air for combustion and ventilation is essential to the safe operation of a boiler. If the boiler is installed with a Type C balanced flue, BS 6644:2005 calls for minimum ventilation of 2 cm^2 free area per kW net input at both high and low level unless the ambient temperature of the plant room ceiling exceeds 40°C.
For a single 60 kW boiler with a Type B powered flue, the ventilation requirements of BS 5440-2 apply, and they are partly summarised in Table 1. For ventilation direct to outside air, the requirement is for 5 cm^2 per kW net rated heat input above 7 kW.

Appliance	Ventilation direct to outside air
CG 60	248 cm^2

Table 1 Ventilation for single boiler installations complying with BS 5440-2

When the installation comprises multiple boilers or single boilers above 70 kW net input with Type B flues, the ventilation requirements of either BS 6644:2005 or IGEM/UP/10 must be met. Table 2 shows the requirements of BS 6644:2005. This standard requires natural ventilation at both high and low levels to the outside air, and is based on the net input of the boilers.

Ventilation direct to outside air	Total kW input (net)
Low level	4 cm^2 per kW of total rated net input
High level	2 cm^2 per kW of total rated net input

Table 2 Ventilation for multiple boiler installations in a boiler room complying with BS 6644:2005

Heat exchanger hydraulic resistance

The CG boiler has a high resistance heat exchanger. A Grundfos or DAB pump is supplied as an integral part of the boiler to overcome this resistance and ensure a constant water flow through the boiler. This is not a system circulating pump. The boilers are designed to work at ΔT 20K or higher (refer Technical data on page 4). When operating at full load at ΔT 20, the CG60 has a pump head of 3m available for system circulation, but there is no significant pump head available for the other models. At a higher ΔT (eg ΔT 25K), there is some available head with all models, and reference should be made to the charts in the Installation Instructions. If operation at a reduced load is acceptable, there may be adequate head for a small heating circuit or DHW calorifier.

Although there may be adequate head for primary circulation through a DHW calorifier, in all cases additional circulating pump(s) will be required for the heating distribution. These should be hydraulically separated from the boiler(s) by a low velocity header - see below.

Low velocity headers

Low velocity headers are used to separate hydraulically the boilers from the rest of the system. They should be used whenever a circulating pump is installed in addition to the boiler pump. Used in conjunction with a system filter and air separator (refer page 5), they are invaluable when connecting a new boiler to an existing system.

Low velocity headers should always be vertical and sized for a maximum water velocity of 0.5 m/s. Fig 3 proposes dimensions for the design of a low velocity header, and Table 3 sizes dimension D for a ΔT 20 system.

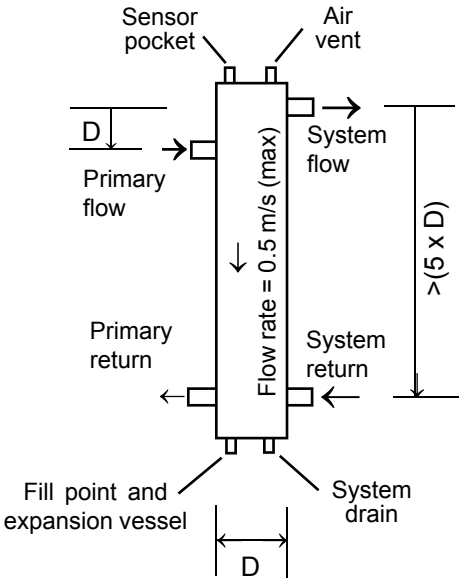
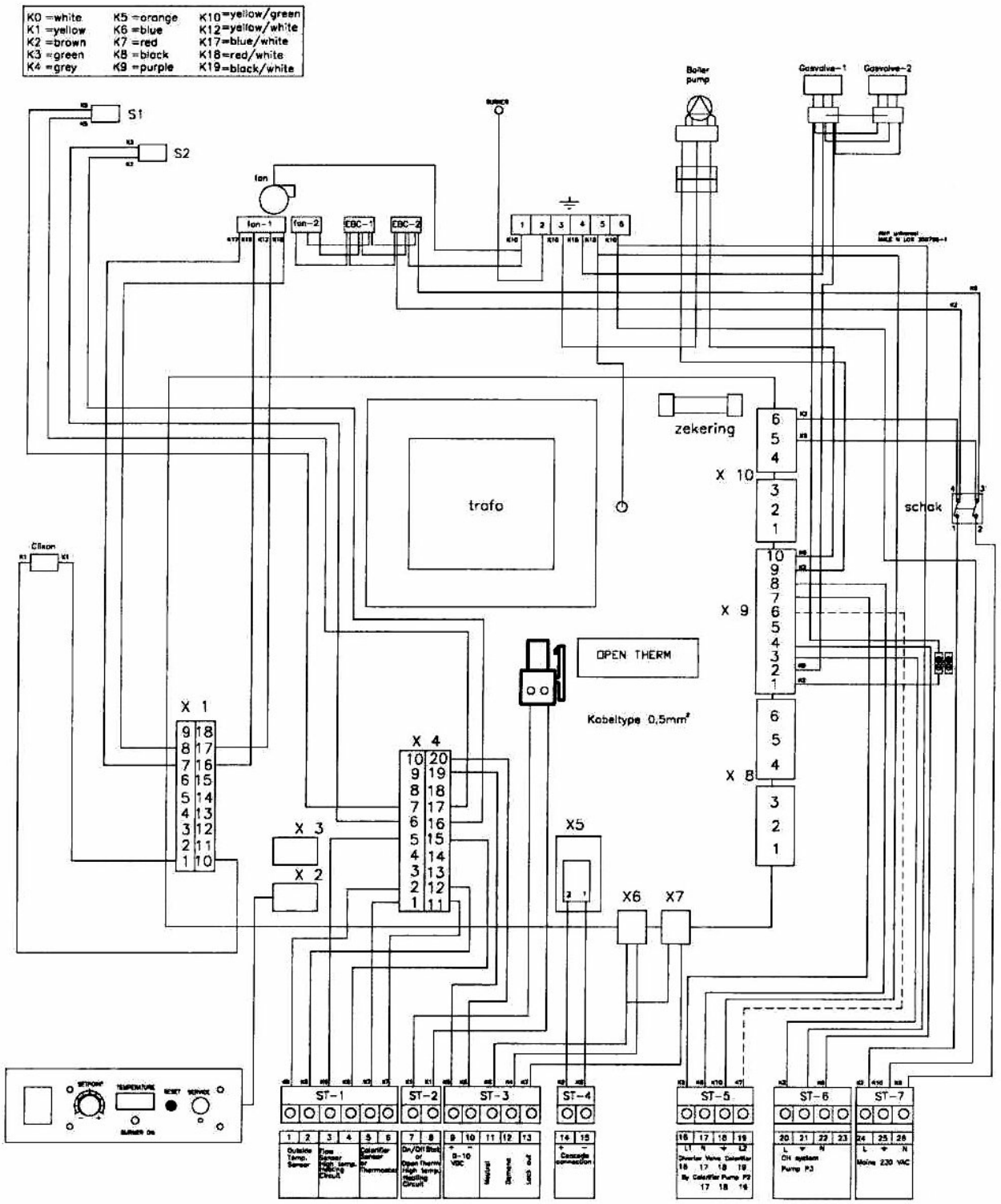


Fig 3 Dimensions for design of low velocity header

Boiler Output (kW)	ΔT 20
60	50 mm
80 / 100 / 120	65 mm
150 / 160 / 180 / 200	80 mm
240	90 mm
300	100 mm
360	125 mm

Table 3 Sizing guide for low velocity header
Data taken from CIBSE Guide C4 2000

Boiler wiring diagram



For strip connector details, refer to Fig 4 on page 8

Boiler wiring diagram

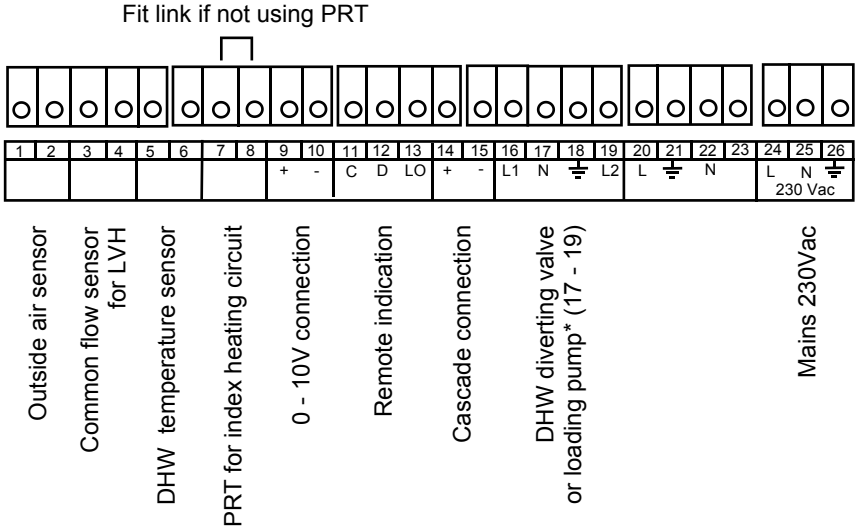


Fig 4 Termination of external control components to the strip connector

Note

Remote indication
LO = Lock out lamp connection
D = Demand (run) lamp connection

When driving external controls directly from the Furimat 914 controller without using a relay, the following maximum loads must not be exceeded;
Models CG 60 to 120 = 1.45A, 230V
Models CG 150 and 180 = 1.1A, 230V

*All circulating pumps should be connected via a relay, not directly

General

CG boilers can be supplied with a range of purpose made stainless steel and plastic flue systems.
Standard items available from Clyde are;
Type C concentric balanced flue for horizontal termination.
Type C concentric flue for vertical termination through a flat or pitched roof.
Also available to special order are;
Type C twin tube flue for horizontal or vertical termination.
Type B powered flue for vertical termination (ie combustion air is taken from within the boiler room, so ventilation must comply with either BS 5440-2:, BS 6644:2005 or IGEM/UP/10 as appropriate - refer page 5).
Type B powered flue common headers for multiple boilers - contact Clyde for information on these.

Type C concentric flues

The standard horizontal and vertical flue kits are 80/125 mm for the CG 60 and 80 and 100/150 mm for the CG 100, 120, 150 and 180 models - refer Figs 5 and 6.
Additional straight lengths of 1m and 2m, plus 45° and 90° bends are available to complete the system. All additional lengths and fittings are supplied with the necessary sealing collars. The straight lengths can be cut with a hacksaw at the plain end.
A separate condensate drain tee should be installed for long horizontal or vertical flue runs. For this reason, horizontal flues should have a slight fall (3°) back to the boiler.
The 80/125 concentric flue is adequate for short runs and ideal for horizontal termination through an adjacent wall. However, the smaller size increases the resistance of the flue and longer runs may require 100/150 concentric flue or twin pipe.
The EL (Equivalent Length) pressure drop of the straight flue lengths, fittings and terminals must not exceed 250Pa for the CG60 to 120 models or 350 Pa for the CG150 and 180. Table 4 gives the resistances of flue components.

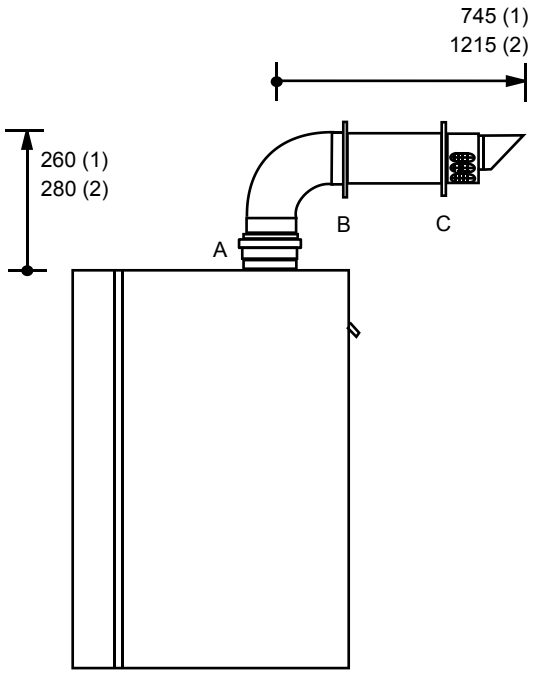


Fig 5 80/125 and 100/150 concentric horizontal flue arrangement

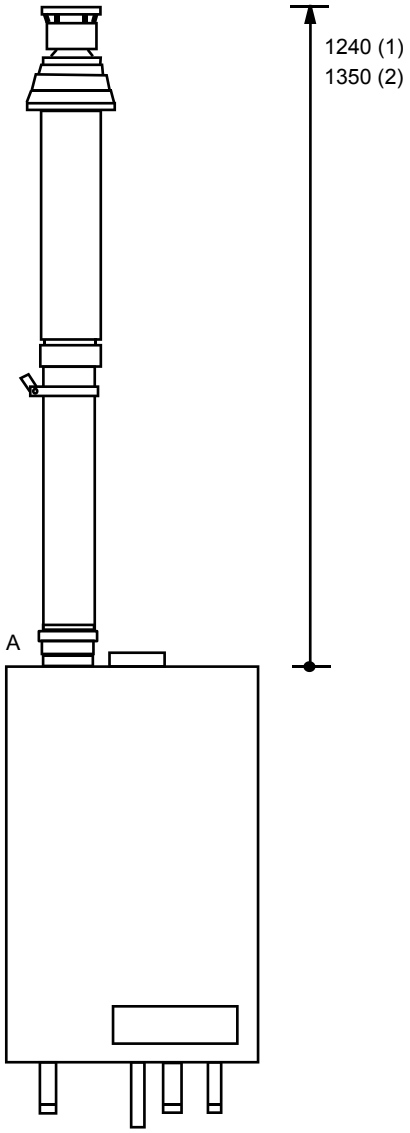


Fig 6 80/125 and 100/150 concentric vertical flue arrangement

Key to Figs 5 and 6

A	Flue gas sampling point
B	Interior wall cover plate
C	Exterior wall cover plate

Notes;
(1) Dimensions for 80/125 concentric flue
(2) Dimensions for 100/150 concentric flue

Flue component	Resistance (Pa) CG60	Resistance (Pa) CG80	Resistance (Pa) CG100	Resistance (Pa) CG120	Resistance (Pa) CG150	Resistance (Pa) CG180
80/125 concentric wall terminal	20	27	N/R	N/R	N/R	N/R
100/150 concentric wall terminal	N/R	6	10	18	40	66
80/125 concentric roof terminal	25	32	N/R	N/R	N/R	N/R
100/150 concentric roof terminal	N/R	8	14	25	43	77
80/125 concentric pipe (per m)	14	18	N/R	N/R	N/R	N/R
100/150 concentric pipe (per m)	2.5	4.5	7	12	26	44
80/125 concentric 45° bend	8.5	11.5	N/R	N/R	N/R	N/R
100/150 concentric 45° bend	2.5	4.5	5	12	26	44
80/125 concentric 90° bend	14	18	N/R	N/R	N/R	N/R
100/150 concentric 90° bend	5	4	7	12	26	44
80 mm flue gas duct (per m)	5	8	13	N/R	N/R	N/R
100 mm flue gas duct (per m)	2	3.5	4	6.5	N/R	N/R
130 mm flue gas duct (per m)	0.45	0.8	1.2	1.8	3.8	6
150 mm flue gas duct (per m)	N/R	N/R	0.5	0.8	1.7	3
80 mm flue gas 45° bend	2.5	4	6.5	N/R	N/R	N/R
100 mm flue gas 45° bend	1	1.7	2	3.2	N/R	N/R
130 mm flue gas 45° bend	0.2	0.4	0.6	0.8	1.9	3
150 mm flue gas 45º bend	N/R	N/R	0.2	0.4	0.8	1.5
80 mm flue gas 90° bend	5	8	13	N/R	N/R	N/R
100 mm flue gas 90° bend	2	3.5	4	6.5	N/R	N/R
130 mm flue gas 90° bend	0.4	0.8	1.2	1.8	3.8	6
150 mm flue gas 90º bend	N/R	N/R	0.5	0.7	1.7	3
80 mm air supply duct (per m)	4	7.5	10	N/R	N/R	N/R
100 mm air supply duct (per m)	1.2	3	3.5	4	N/R	N/R
130 mm air supply duct (per m)	0.35	0.75	0.8	1.1	1.2	2
150 mm air supply duct (per m)	N/R	N/R	0.3	0.4	0.6	1.2
80 mm air supply 45° bend	2	3.5	5	N/R	N/R	N/R
100 mm air supply 45° bend	0.6	1.5	1.7	2	2.2	N/R
130 mm air supply 45° bend	0.2	0.4	0.4	0.5	0.6	1
150 mm air supply 45º bend	N/R	N/R	0.15	0.2	0.3	0.6
80 mm air supply 90° bend	4	7	10	N/R	N/R	N/R
100 mm air supply 90° bend	1.2	3	3.5	4	10	9
130 mm air supply 90° bend	0.3	0.7	0.8	1.1	1.2	2
150 mm air supply 90º bend	N/R	N/R	0.3	0.4	0.6	1.2

Table 4 flue gas component resistances

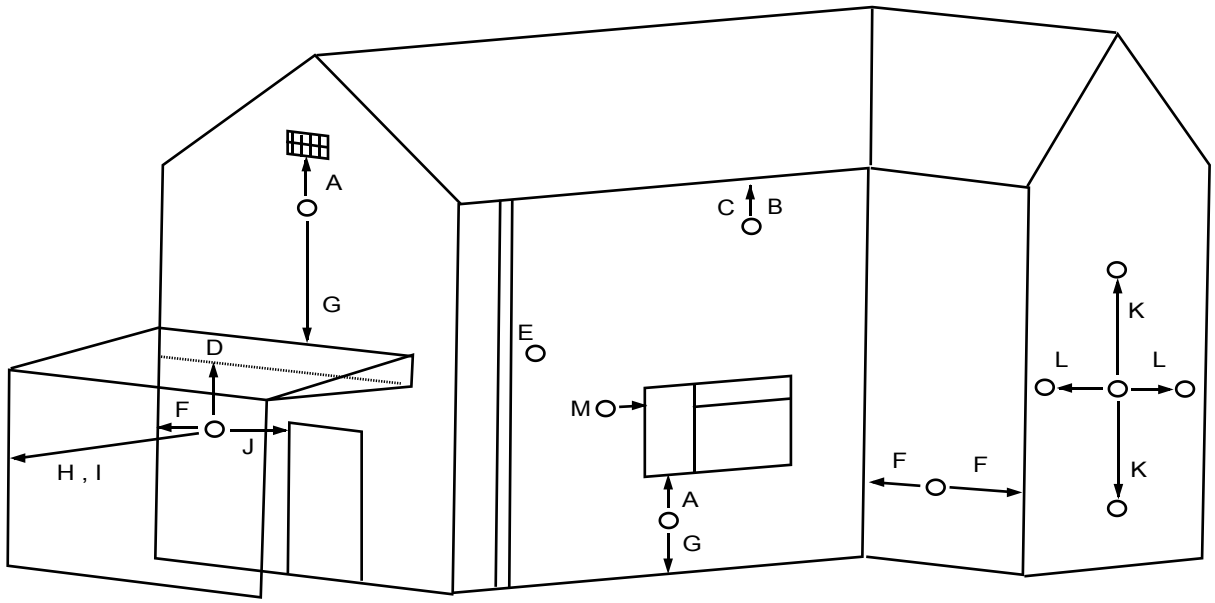


Fig 7 Location of concentric balanced flue terminals

Key to Fig 7

A	Directly below an opening	300 mm
B	Below gutters, soil pipes or drain pipes	75 mm
C	Below soffit / eaves	200 mm
D	Below balconies or car port roof	200 mm
E	From a vertical soil pipe or drain pipe	75 mm
F	From an internal or external corner	300 mm
G	Above ground, roof or balcony level	300 mm
H	From a surface facing the terminal	600 mm
I	From a terminal facing the terminal	1200 mm
J	From an opening in the car port	1200 mm
K	Vertically from a terminal on the same wall	1500 mm
L *	Horizontally from a terminal on the same wall	300 mm
M	Horizontally from an opening	300 mm

For further information, refer to BS 5440-2

* BS 5440-2 is concerned with boilers with a net input of up to 70 kW (ie CG 60). IGEM UP/10 gives guidance for boilers of greater out put. To conform with this Utilisation Procedure, dimension L should be increased to 600 mm.

Where boilers with a total output of 150 kW or more are to have horizontal terminals on the same wall, reference should be made to the Clean Air Act to determine whether dispensation should be sought.

Hydraulic system design and control

General

The Furimat 914 controller built into each boiler can provide cascade control of up to eight boilers without the need for external controls. A 230 Vac permanent supply must be provided for each boiler. One boiler is designated as the master, and the others connected in series by a two wire bus (RS 485 serial communication system). A full weather compensation program is included in the Furimat 914, and this is activated by connecting an Outside Air Sensor to the master controller. A time clock or programmable room thermostat (PRT) can also be connected to the master, or an open therm modulating controller (RC).

Individual heating circuits can be controlled by the inclusion of EBC controllers. Each EBC can control 2 heating circuits via 2 no. 3-port mixing valves and 2 no. circulating pumps. Up to 2 EBC units can be fitted in each boiler, giving a maximum of 32 heating zones with 8 boilers. Additional EBC units can be wall-mounted if more than 4 heating circuits x the number of boilers are required. Additionally, a modulating zone controller (RCO) is required for local control of each heating circuit. Note that the maximum electrical current that can be switched by each EBC is 2A, so additional relays (not supplied by Clyde) may be needed.

The arrangement shown in Fig 8 will heat a single heating circuit, directly compensated on the common boiler flow temperature. A second heating circuit can be controlled by a 3-port mixing valve, connected to the master boiler. However, the flow temperature of this secondary circuit cannot exceed the compensated flow temperature of the index circuit. Alternatively, an EBC contoller can be incorporated. The boilers should be hydraulically separated from the system by a Low Velocity Header (LVH). Although the boilers each have a circulating pump, there is no facility to control additional circulating pumps from the Furimat 914 other than via an EBC.

DHW calorifiers can be connected either side of the LVH, controlled from the master boiler or EBC by an immersion sensor and either a loading pump or 3-port diverting valve.

0 - 10 Volt connections are also provided with the Furimat 914.

If plastic pipework is used in the heating system (either proprietary push-fit for conventional radiator circuits or underfloor heating), this must be hydraulically separated from the boiler eg by a plate heat exchanger. This is to prevent magnetite fouling the boiler heat exchanger and is particularly important if the plastic pipework does not have an oxygen barrier.

Key to figs 8 to 10

Items supplied as part of optional controls packs

EBC	Boiler-mounted controller
FA	Outside Air Sensor
FB	DHW calorifier sensor
FK	Common flow temperature sensor
FV	Flow temperature sensor
PRT	Programmable Room Thermostat / Timeclock
RC	Modulating Room Controller
RCO	Local heating circuit controller
CGCPU	Pressurisation unit

Items not supplied as standard by Clyde;

AS	Air Separator
DV	3-port diverting or control valve valve
EV	Expansion vessel
F	Filter
KR	Non-return valve
PH	Heating circuit pump
PS	DHW primary pump
SH	Mixing valve

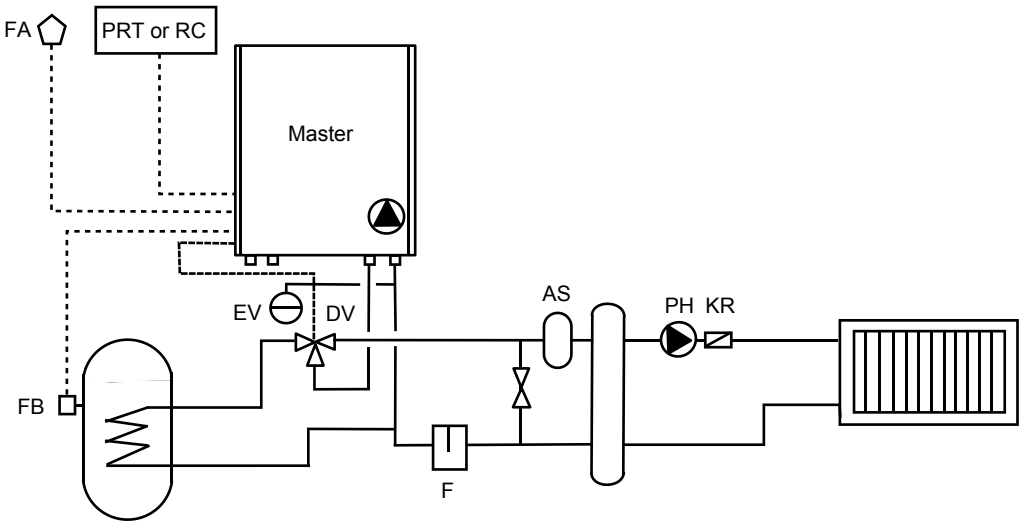


Fig 8 Single boiler with one heating zone and optional DHW calorifier connected to the "High" temperature side of the LVH
The DHW calorifier is directly controlled from the boiler via the 3-port diverting valve (DV) and DHW sensor (FB). The PRT or RC (Programmable Room Thermostat/ modulating control) gives time control of the heating circuit (the RC also gives time control of the DHW). The addition of the Outside Air Sensor (FA) will provide direct weather compensation of the boiler flow temperature.
An optional differential pressure bypass valve has been included to guarantee a minimum flow through the boiler.

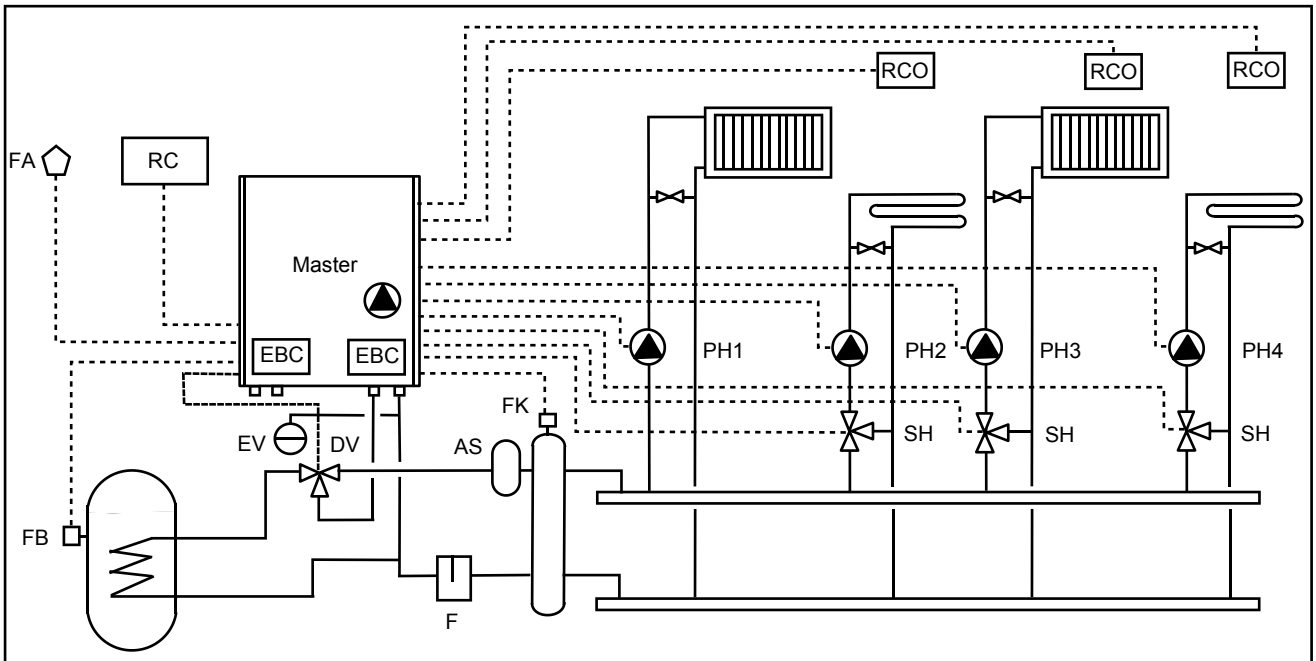


Fig 9 Single boiler with up to 4 heating zones
This arrangement has a secondary heating circuit and mixing valve, with a maximum flow temperature that cannot exceed the compensated flow temperature of the index circuit. The DHW calorifier is still controlled from the boiler via the 3-port diverting valve (DV) and DHW sensor (FB).

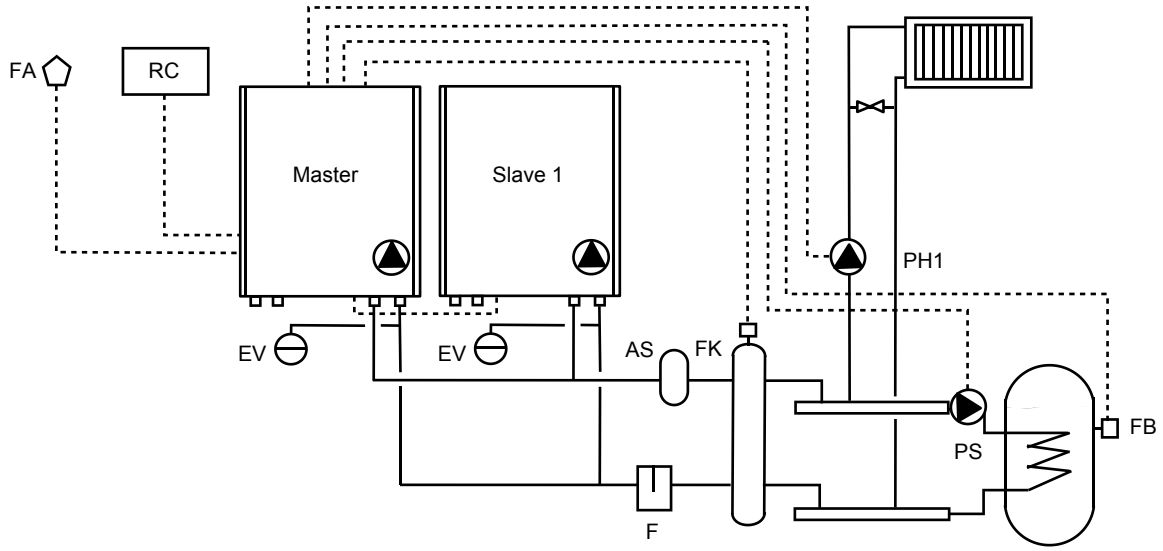


Fig 10 Up to 8 boilers in cascade with optional DHW on "Low"temperature side of LVH.
The DHW calorifier is directly controlled by the master boiler via the sensor (FB) and loading pump (PS). The boilers are connected together by a cascade bus.

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