BHSG615EM-1 1/01

THE G-615 SERIES

CAST IRON BOILERS

FROM 1,951 TO 3,982 MBTU/hr

Thermostream BOILER DESIGN

ENGINEERING MANUAL

Buderus

BUDERUS G615 SERIES BOILERS

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INTRODUCTION

PREFACE

This engineering manual provides technical data for the Buderus G615 *Thermostream* cast iron boiler series. It is intended to supply necessary information for design and operation of the G615 Series boiler. This document includes boiler ratings and dimensional data, installation clearance and site preparation details, recommended piping layouts, control requirements, burner selection charts and venting options. In addition, the manual discusses several applications of the commercial Buderus HW3302 control panel for energy efficient operation of single and multi-boiler installations. It is the intent of Buderus Hydronic Systems, Inc. to present the available information in a clear and complete manner to assist engineers, designers and contractors.

BOILER FEATURES

Precision Casting with Flexible GL-180 M Buderus Cast Iron Material.

* Greater flexibility (40%) improves resistance to thermal and physical shock.
* Precision casting eliminates manual grinding and keeps "barrier skin" in tact.
* Precision machined beveled steel pushnipples for joining of sections.
* Tongue and groove construction with pliable strips provide positive seal for pressurized operation.

High Silicon Barrier Skin and No Refractory Material.

* Buderus cast iron contains much higher concentration of silicon for corrosion protection that allows boiler to operate safely at lower water temperatures.
* Combustion chamber design and cast iron material eliminate need for refractory.

Field-adjustable, Left or Right Swinging Door.

* Complete front access to all flue passages for easy and thorough cleaning.
* Permanent dry gasket for repeated positive sealing.

True Three Pass Design and Full Insulation.

* Three pass design yields high combustion efficiencies for forced draft oil and gas firing.
* Minimal heat losses with 4" thermal insulation on top and all sides.

Buffer Channel and *Thermostream* Casting Design.

* Buderus serpentine double water jacket casting design yields large heat transfer surfaces for efficient operation and reduced stand-by losses.
* Large flue passages allow easy and complete cleaning for continued efficient operation.
* *Thermostream* design internally preheats and mixes return water and requires no minimum return temperature for safe boiler operation.

DESCRIPTION OF THE *THERMOSTREAM* PRINCIPLE

Thermostream technology is a new development in cast iron boiler design pioneered by Buderus. Return water is preheated and mixed with boiler supply water before it is allowed to enter the main heat exchanger. The *Thermostream* principle prohibits by virtue of its design a sharp decline in temperature of the heat exchanger as a result of tempering the return water. This advanced boiler design prevents flue gas temperatures from dropping below the condensate formation level at any return water temperature. No condensation takes place in the heat exchanger under no-flow conditions. The single requirement for safe boiler operation is maintaining a minimum 122 °F-Oil fired 140 °F-Gas fired supply water temperature during burner operation. The G615 Series boilers require no minimum return water temperature.

Thermostream technology permits reliable boiler operation without a boiler bypass or shunt pump. The full three-pass and double-wall heat exchanger design features result in a compact and high efficiency boiler.

Thermostream Operation

Heated supply water flows in the top of the boiler towards the supply connection at the rear of the boiler. The return water enters the boiler through the central return distribution header pipe. This pipe has two port openings per boiler section with port sizing based on the heat generation at each section. Return water is distributed over the entire boiler length, injected into and mixed thermally with supply water before entering the main heat exchanger.
See Figure 1 for details.

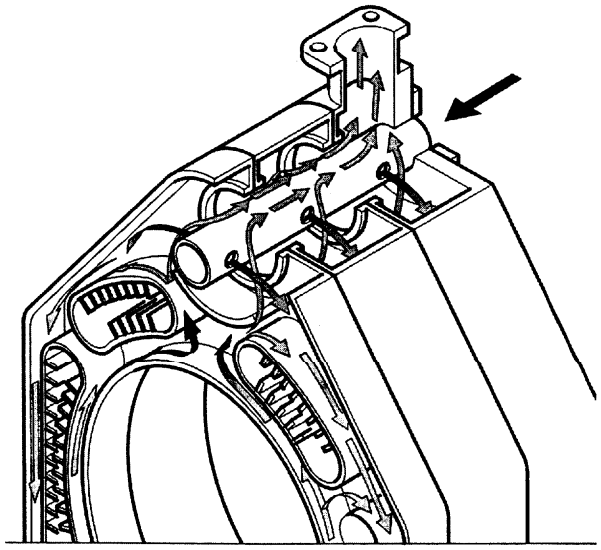


Figure 1: *Thermostream* Principle.

Heated water rises in each sectional casting along the combustion chamber wall. Preheated return water flows into the outer wall of each boiler section downward and mixes further with heated water at each cross junction. The unique boiler design capitalizes on the buoyancy enhanced water flow for optimum internal water circulation and heat transfer. Each boiler section has a water guiding plate located directly below the return header which keeps return water away from the combustion chamber at all flowrates and enhances the thermal mixing process.

The *Thermostream* principle functions for all flow rates. Internal water circulation, guiding plates and cold water injection ensure condensate free operation of the boiler under steady state operating conditions. These design features also prevent thermal shock to the boiler and substantially reduce thermal stresses.

BENEFITS OF *THERMOSTREAM* TECHNOLOGY

The benefits of the *Thermostream* boiler design can be summarized into the following four categories:

1. Long life and trouble free boiler operation.
Minimal thermal stresses develop in the boiler as a result of proportionate water distribution throughout the boiler without "dead spots" or "hot spots" occurring anywhere in the heat exchanger. The effects of rapidly varying return water temperatures are minimized and evenly dissipated throughout the boiler by preheating and proportionate distribution of return water. By design the boiler operates without condensate formation in the combustion chamber or secondary heat exchanger surfaces, provided the minimum required supply temperature is maintained. These advanced design features inherently lead to long boiler life and trouble free performance.

2. Simplified boiler system design.
The no minimum return water temperature requirement simplifies the design and lay-out of the heating plant and its necessary controls. Return water temperatures are raised internally in the boiler with minimally required control provisions. A bypass or shunt pump is not necessary as the boiler can safely operate in a no-flow condition. The G615 boiler is easily integrated into any existing system or any new heating installation can easily be designed around the G615 boiler.

3. Savings in initial equipment cost and installation time.
The elimination of return water temperature control and the minimum flow requirement results in substantial savings in required system components, initial equipment costs, installation time and reduces overall system complexity.

4. Savings in system operating costs.
Reduced electrical usage results as no bypass pump is required. Improved system reliability and reduced system down time are a result of fewer and more simplified system control components.

Cost savings are realized with the G615 boiler through:

- Simplification in system design (fewer control requirements).
- Reduction in installation time and necessary equipment.
- Reduction in operational and replacement component costs.

TECHNICAL AND DIMENSIONAL BOILER DATA

Table 1: Technical Data

Boiler Model	9	10	11	12	13	14	15	16
Gross Output * MBtu/h	1951	2242	2532	2822	3112	3402	3692	3982
Boiler HP	58.3	66.9	75.6	84.3	92.9	101.6	110.3	118.9
Net IBR Rating MBtu/h	1697	1950	2202	2454	2706	2958	3210	3463
Max Input Oil GPH	16.0	18.5	21.0	23.5	26.0	28.5	31.0	33.5
Max Input Gas MBtu/h	2309	2670	3031	3392	3753	4113	4474	4835
Fire side heating surface sq.ft.	253.5	284.3	314.9	345.7	376.5	407.2	437.9	486.6
Gross Stack Temp* low fire, °F	280	240	230	230	210	210	200	215
high fire,°F	340	330	345	345	350	340	340	375
Oil Firing: CO2 content	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
Gas Firing: CO2 content	10	10	10	10	10	10	10	10
Fire Box Pressure In. WC	.85	1.07	1.3	1.6	1.4	1.4	1.4	1.5
Req'd Vent Conn. Press In. WC	+.1	+.1	+.1	+.1	+.1	+.1	+.1	+.1
Max. Boiler TemperaturE°F	240	240	240	240	240	240	240	240
Max. Operating Pressure psi	58/88	58/88	58/88	58/88	58/88	58/88	58/88	58/88

* Output ratings are based on 13% CO2 for oil firing, 10% CO2 for gas firing

Table 2: Boiler Dimensions and Specifications (See Fig. 2 for details)

Boiler Model	9	10	11	12	13	14	15	16
Boiler Block Length (LK)In.	71	77 3/4	84 1/2	91	97 3/4	104 1/4	111 1/4	117 3/4
Boiler Length* (LG) In.	75 3/4	82 1/2	89 1/4	96	102 1/2	109 1/4	116	122 3/4
Width In.	50 1/2	50 1/2	50 1/2	50 1/2	50 1/2	50 1/2	50 1/2	50 1/2
Height** In.	62 3/4	62 3/4	62 3/4	62 3/4	62 3/4	62 3/4	62 3/4	62 3/4
Dry Weight Lbs	5510	6045	6580	7110	7645	8160	8700	9125
Water Content Gal.	144	160	176	192	208	224	240	256
Operating Weight Lbs	6740	7390	8050	8720	9390	10040	10720	11280
Fire Box Depth In.	60	66 3/4	73 1/2	80	86 3/4	93 1/2	100 1/4	107
Fire Box Diameter In.	26 3/4	26 3/4	26 3/4	26 3/4	26 3/4	26 3/4	26 3/4	26 3/4
Fire Box Volume cu.ft.	23.56	26.21	29.07	31.46	34.08	36.72	39.34	41.97
Vent Conn. Size In.	14	14	14	14	14	14	14	14
Door Thickness In.	5 3/4	5 3/4	5 3/4	5 3/4	5 3/4	5 3/4	5 3/4	5 3/4
Vent Size In	14	14	14	16	16	18	18	18

* Distance from burner mounting plate to end of vent connection.

** Boiler height does not include supply manifold height

Table 3: Operational Requirements

Boiler Control	Minimum Flow GPM	Minimum Return Water Temp.		Minimum Supply Water Temp.		Minimum Low-fire For LHL Burner
		Oil Firing °F	Gas Firing °F	Oil Firing °F	Gas Firing °F	
Conventional	None	None	None	122	140	None
Ecomatic	None	None	None	122	140	None

* Boiler and Heating Systems controlled by Buderus HW3302 control.

Ecomatic module 148 controls supply Temperature for single Boiler System.

Multiple boilers each require a 122 °F minimum supply water temperature during oil operation, and a 140 °F minimum supply water temperature during gas burner operation.

BOILER WATER CONNECTIONS AND TAPPINGS

Figures 2 and 3 show boiler dimensions, location and size of water connections and control tappings. Each boiler is furnished with gaskets, a 10" long supply and a 10" long return header. Both headers are supplied with 6" 125 lbs ANSI bolt-on flanges for connection to system piping. The location of tappings are detailed in Figure 3. The supply header extends 13 3/4" above the top boiler jacket; the return header extends 5" back from the rear boiler jacket.

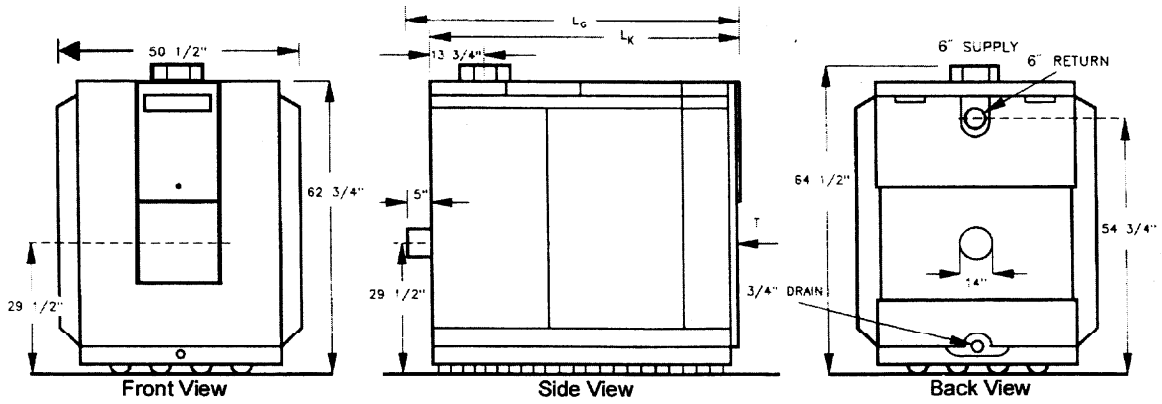


Figure 2: Boiler Dimensions.

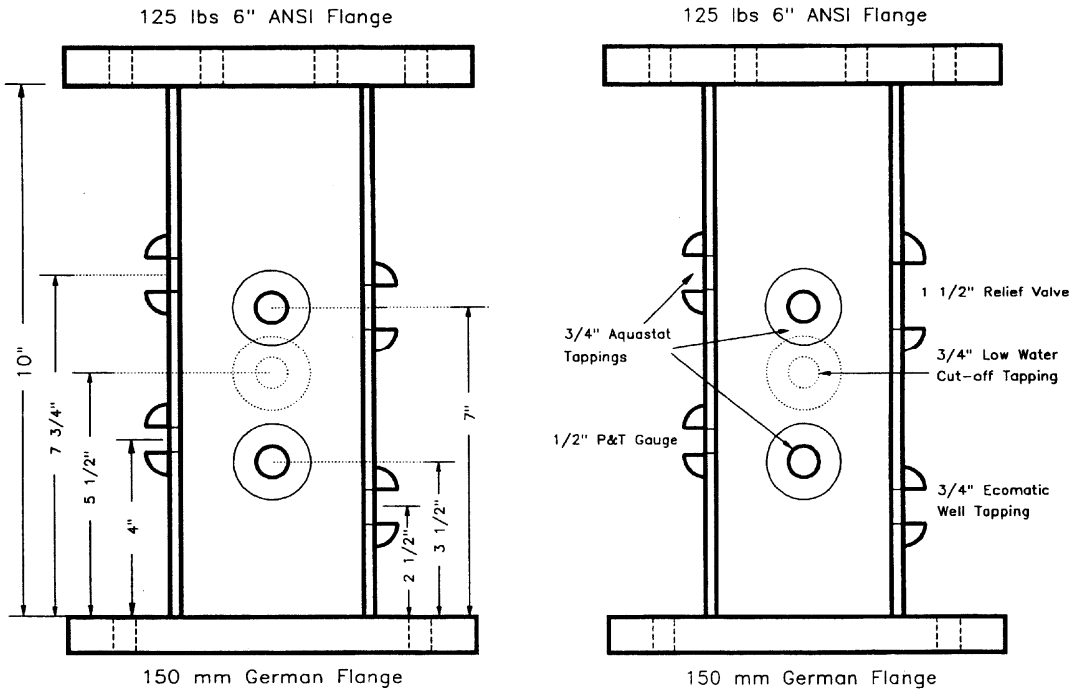


Figure 3: Supply Manifold Details.

SECTION ASSEMBLY OPTIONS

1) All G615 Series boilers can be ordered in unassembled version for on-site installation. Returnable Buderus G615 assembly tools must be ordered with the boiler.

Detailed instructions for boiler assembly and installation are available in the G615 Assembly and Maintenance Instructions Manual (Publication no. 63004041-10/99 USA).

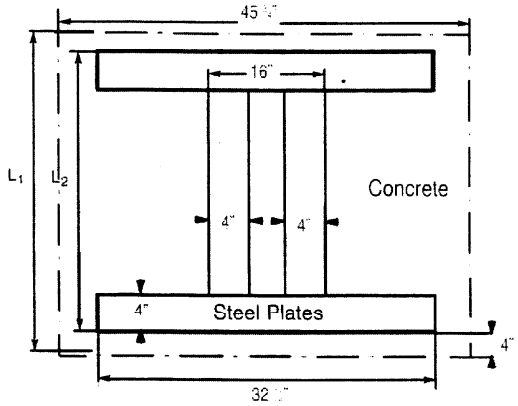
BOILER FOUNDATION PREPARATIONS

The boiler must be placed on a level, sufficiently strong, smooth concrete base, 4" high. The minimum width of the platform must be 45 3/4". The platform length for each boiler model is listed per Foundation Length L1 specification in Table 4.

When designing the foundation, it is required to make provisions for a 4"x3/16" flat steel plate or a 4"x2"x1/4" angle iron, of Length L2 as shown in Table 4 and Figure 4. These plates will distribute the weight of the boiler, allow for the sections to slide together during assembly and allow for thermal expansion and contraction of the boiler during operation.

Table 4: Foundation dimensions and length of supporting steel strip

Boiler Model	/9	/10	/11	/12	/13	/14	/15	/16
Foundation Length L1 In.	65 3/4	72 1/2	79 1/4	86	93 3/4	99 1/4	106	112 1/2
Strip Spacing L2 In.	58	64 1/2	71 1/4	78	84 1/2	91 1/4	98	104 3/4



Plan View of Boiler Foundation:

Figure 4: Boiler Foundation Details.

BOILER CLEARANCE REQUIREMENTS

The standard full size boiler door can be hinged left or right as needed for the application. This door permits easy and complete access to all flueway passages for inspection and cleaning purposes. Figures 5, 6 and 7 show recommended clearances around the boiler.

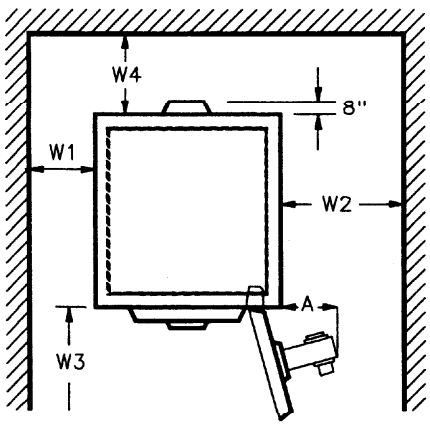


Figure 5: Single Boiler Layout.

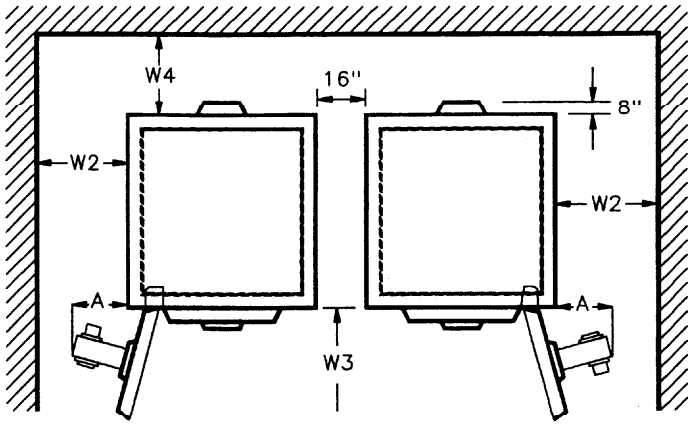


Figure 6: Multiple Boiler Layout.

Recommended clearances around the boiler:
Distance to wall: W1= 32"
Distance to wall on burner side: W2= Burner Projection "A" + 4"
Distance in front of boiler: W3= Boiler Length L + 40"
Distance behind boiler: W4= 1/2 Boiler Length L + 20"
Distance above boiler: W5= 24"

The above recommended clearances are based on maintaining ample access to all sides of the boiler. All local, state and federal codes and ordinances must be complied with and may require different dimensions than those stated above.

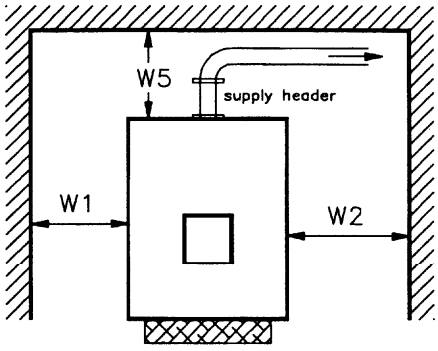


Figure 7: Front View Clearances.

If needed, the following absolute minimum dimensions must be maintained under all circumstances. These minimum clearances are based on practical hands-on installation experience; however, local, state and federal codes and regulations take precedent over these absolute minimum clearances.

1. The W1 dimension must not be less than 12" to allow boiler jacket installation.

2. Care must be observed with respect to the hinging direction of the burner door for cleaning purposes. The indicated minimum dimension W2 must be maintained, or in case of insufficient space next to the boiler, it will be necessary to dismount the burner before fully opening the burner door. The W2 dimension must be at least 12" for jacket installation.

3. For field assembled boilers, the W3 dimension must not be less than 60". This minimum length is required for assembly tool removal and to insert the return distribution pipe into the front of the boiler. Please notify Buderus Hydronic Systems, Inc. of space constraints when ordering unassembled boilers in order to get sectional assembly tools.

4. A 32" clearance (W4) behind the boiler is required to permit access to the clean-out covers. Covers are located on the flue gas collector, and two near the bottom of the boiler. Flue collector covers allows removal of residues from the upper portion of the heat exchanger; the lower covers must be removed for cleaning of the lower flueway passages.

5. The top clearance (W5) is limited by the required access to the supply header and subsequent boiler piping. Boiler jacket installation does not require clearance beyond the height of the supply header.

6. Stand-by losses are very low because of the full 4" thermal insulation. Close boiler proximity to combustible surfaces is of no importance as the surface temperature of any portion of the boiler jacket panel will not exceed the ambient room temperature by more than 36 °F. A 2" clearance to combustibles is acceptable for the G615 boiler jacket panels.

BURNER SELECTION CHARTS

G615 Series boilers have undergone application testing at the noted burner companies with burners available for oil, gas and dual-fuel firing. Contact your Buderus representative or Buderus Hydronic Systems directly for burner pricing and availability.

All burners listed in the selection charts are UL approved and most can be equipped to meet ULC, CGA, FM, IRI and CSD-1 standards. Commercial burners for price quotation are available with the following list of features:

Type of Fuel:	**Mode of Operation:**
- No. 2 Fuel Oil	- Low - High - Off
- Natural Gas	- Low - High - Off
- Propane	- Low - High – Off
- Dual Fuel Operation	- Full Modulation

Approval Requirements: UL, ULC, CGA, IRI, FM, CSD-1, applicable local/state codes.

Available Options:- Type of Flame Sensing, Dry Contact Relays for DDC Interface.
- Low NOx Add-on Equipment.
- Remotely Mounted Control Panels, Alarm Bell, Others.

Table 5: Power Flame Burner Selection Chart

OIL BURNERS: C MODELS

Boiler Model	/9	/10	/11	/12	/13	/14	/15	/16
Oil Burner Model	C2-OB	C3-O	C3-O	C3-O	C3-OB	C3-OB	C4-OB	C4-OB
Min. Operating Mode	LHO	LHO	LHO	LHO	LHO	LHO	MOD	MOD
Blower Motor HP	1 1/2	2	2	2	3	3	5	5
Oil Burner Length "A"	40	44	44	44	44	44	50	50
Fuel Line Conn. Size In.	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4

GAS and DUAL FUEL BURNERS: C MODELS

Boiler Model	/9	/10	/11	/12	/13	/14	/15	/16
Gas Burner Model	C2-G-20B	C3-G-20	C3-G-25	C3-G-25	C3-G-25B	C3-G-25B	C4-G-30	C4-G-30
Min. Operating Mode	LHO	LHO	LHO	LHO	LHO	LHO	MOD	MOD
Manifold Gas Press.In.WC	4.2	2.2	2.5	2.8	3.1	3.5	3.0	3.4
Std. Gas Train Size	2"	2"	2"	2 1/2"	2 1/2"	2 1/2"	2 1/2"	2 1/2"
Blower Motor HP	1 1/2	2	2	2	3	3	5	5
Gas Burner Length "A"	40"	44"	44"	44"	44"	44"	50"	50"
Dual Fuel Burner Model	C2-GO-20B	C3-GO-20	C3-GO-25	C3-GO-25	C3-GO-25B	C3-GO-25B	C4-GO-30	C4-GO-30
Min. Operating Mode	LHO	LHO	LHO	LHO	LHO	LHO	MOD	MOD
Blower Motor HP	1 1/2	2	2	2	3	3	5	5
Fuel Line Conn. Size In.	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
Dual Fuel Burner Lgth In.	40	44	44	44	44	44	50	50

Table 6: Gordon-Piatt Burner Selection Chart.

Oil Burners

Boiler Model	/9	/10	/11	/12	/13	/14	/15	/16
Oil Burner Model	S8.3-O-20	S8.3-O-20	S10.1-O-30	S10.1-O-30	S10.1-O-30	S10.2-O-50	S10.2-O-50	S10.2-O-50
Min. Operating Mode	LHO	LHO	LHO	LHO	LHO	MOD	MOD	MOD
Blower Motor HP	2	2	3	3	3	5	5	5
Oil Burner Length In.	30 5/8	30 5/8	30 5/8	30 5/8	30 5/8	33 5/8	33 5/8	33 5/8
Fuel Line Conn. Size In.	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4

Gas and Dual Fuel Burners

Boiler Model	/9	/10	/11	/12	/13	/14	/15	/16
Gas Burner Model	S8.3-G-20	S8.3-G-20	S10.1-G-30	S10.1-G-30	S10.1-G-30	S10.2G-50	S10.2G-50	S10.2G-50
Min. Operating Mode	LHO	LHO	LHO	LHO	LHO	MOD	MOD	MOD
Min Gas Sup. Press.- In.WC	7-14	7-14	7-14	7-14	7-14	7-14	7-14	7-14
Std. Gas Train Size In.	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	2	2	2
Blower Motor HP	2	2	3	3	3	5	5	5
Gas Burner Length In.	30 5/8	30 5/8	30 5/8	30 5/8	30 5/8	33 1/2	33 1/2	33 1/2
Duel Fuel Burner Model	S8.3-GO-20	S8.3-GO-20	S10.1-GO-30	S10.1-GO-30	S10.1-GO-30	S10.2-GO-50	S10.2-GO-50	S10.2-GO-50
Min. Operating Mode	LHO	LHO	LHO	LHO	LHO	MOD	MOD	MOD
Blower Motor HP	2	2	3	3	3	5	5	5
Fuel Line Conn. Size In.	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Dual Fuel Burner Length In.	30 5/8	30 5/8	30 5/8	30 5/8	30 5/8	33 1/2	33 1/2	33 1/2

Table 7: Beckett Oil Burner Selection Chart

Boiler Model	/9	/10	/11	/12	/13	/14
Oil Burner Model	CF 2300	CF 2500	CF 2500	CF 3500	CF3500	CF 3500
Min. Operating Mode	LHO	LHO	LHO	LHO	LHO	LHO
Blower Motor HP	3/4	2	2	2	2	2
Oil Burner Length "A" In.	20 1/2	22	22	22	22	22
Fuel Line Conn. Size In.	3/8	3/8	3/8	3/8	3/8	3/8

Table 8: Industrial Combustion Burner Selection Chart (Untested Application)

Boiler Model	/9	/10	/11	/12	/13	/14	/15	/16
Gas Input Mbtu/hr	2309	2670	3031	3392	3753	4113	4474	4835
Gas Train in.	1 1/2	1 1/2	1 1/2	1 1/2	2	2	2	2
Gas Burner Model	FPG-25	FPG-28	FPG-36	FPG-36	FPG-42	FPG-42	FPG-42	MPG-54
Burner Motor H.P.	1	1	2	2	3	3	3	3
Oil Input GPH	16.0	18.5	21.0	23.5	26.0	28.5	31.0	33.5
Fuel Line Size in.	1/2	1/2	1/2	1/2	1/2	1/2	1/2	3/4
Oil Burner Model	FPL-25	FPL-28	FPL-36	FPL-36	FPL-42	FPL-42	FPL-42	MPL-54
Dual Fuel Burner Model	FPLG-25	FPLG-28	FPLG-36	FPLG-36	FPLG-42	FPLG-42	FPLG-42	MPLG-54
Burner Length in.	38	38	38	38	38	38	38	45

Table 9: Webster Burner Selection Chart (Untested Application)

Boiler Model	/9	/10	/11	/12	/13	/14	/15	/16
Gas Input Mbtu/hr	2309	2670	3031	3392	3753	4113	4474	4835
Oil Input GPH	16.0	18.5	21.0	23.5	26.0	28.5	31.0	33.5
Gas Train in.	2	2	2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2
Gas Burner Model	JB1G-07	JB2G-10	JB2G-10	JB2G-15	JB2G-20	JB2G-30	JB2G-30	JB2G-50
Oil Burner Model	JB1O-07	JB2O-10	JB2O-10	JB2O-15	JB2O-20	JB2O-30	JB2O-30	JB2O-50
Dual Fuel Burner Model	JB1C-07	JB2C-10	JB2C-10	JB2C-15	JB2C-20	JB2C-30	JB2C-30	JB2C-50
Fuel Line Size in.	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
Burner Motor H.P.	3/4	1	1	1 1/2	2	3	3	5
Burner Length in. *	34	38	38	38	38	38	38	45

* Burner length reduced by 9", when control cabinet mounted on top of burner.

Table 10a: Weishaupt Burner Selection Chart (Untested Application)

Boiler Model	/9	/10	/11	/12	/13	/14	/15	/16
Gas Input Mbtu/hr	2309	2670	3031	3392	3753	4113	4474	4835
Oil Input GPH	16.0	18.5	21.0	23.5	26.0	28.5	31.0	33.5
Gas Burner Model	G5/1-D	G5/1-D	G5/1-D	G7/1-D	G7/1-D	G7/1-D	G77/1-D	G7/1-D
Oil Burner Model	L5Z	L5Z	L5T	L5T	L5T	L7T	L7T	L7T
Dual Fuel Burner Model	GL5/1-D	GL5/1-D	GL7/1-D	GL7/1-D	GL7/1-D	GL8/1-D	GL8/1-D	GL8/1-D
Fuel Line Size in.	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Burner Motor H.P. **	2/2/2	2/2/2	2/2/4 1/2	2/2/4 1/2	2/2/4 1/2	4 1/2/4 1/2/6 1/2	4 1/2/4 1/2/6 1/2	4 1/2/4 1/2/6 1/2
Burner Length in. **	31 1/4/27/31 1/4	31 1/4/27/31 1/4	31 1/4/27/37 1/2	31 1/4/27/37 1/2	31 1/4/27/37 1/2	37 1/2/27/37 1/2	37 1/2/27/37 1/2	37 1/2/27/37 1/2

* Burner motor HP's and Burner length are listed in order of Gas, Oil, and Dual Fuel Burners.

Table 10b: Gas Train Details for Weishaupt Burners

Burner Model	Size 5	Size 7	Size 8
High Pressure Gas Train in.	1 1/2	2	2
Low Pressure Gas Train in.	2	2 1/2	n/a

*Disclaimer: Weishaupt burners have not fired Buderus Boilers in US Facilities. However Weishaupt Burners have been tested and successfully fired in G615 Series Boilers in Germany and are CSA certified.

BOILER SAFETY AND OPERATING CONTROLS

Available Hydronic Accessories

50/80 psi ASME Relief Valve.
3 1/4" Pressure & Temperature Gauge.
Honeywell L4006A1058 Adjustable High Limit Aquastat (Need 2 for LHL burner).
Honeywell L4006E1109 Manual Reset High Limit Aquastat.
Hydrolevel Model 550 probe type Low Water Cut-Off (LWCO).
Aquastat for supply water temperature control.

Place the L4006E1109 Manual Reset in the 3/4" long shank immersion well in the rear of the boiler.

The P & T gauge, Low Water Cut-Off, Relief Valve and aquastat controls must be installed per Figure 3. Plug unused tappings.

For control of the boiler supply temperature, an "open-on-rise" Honeywell aquastat can be furnished with each boiler to prevent the supply water temperature from dropping below 122 °F during burner operation. The aquastat temporarily interrupts power to the main system pump (or individual boiler pump for multiple boiler systems). Figure 8 shows a typical electrical wiring schematic for a single boiler using the hydronic control accessories with supply temperature control. (Relay coil is not provided).

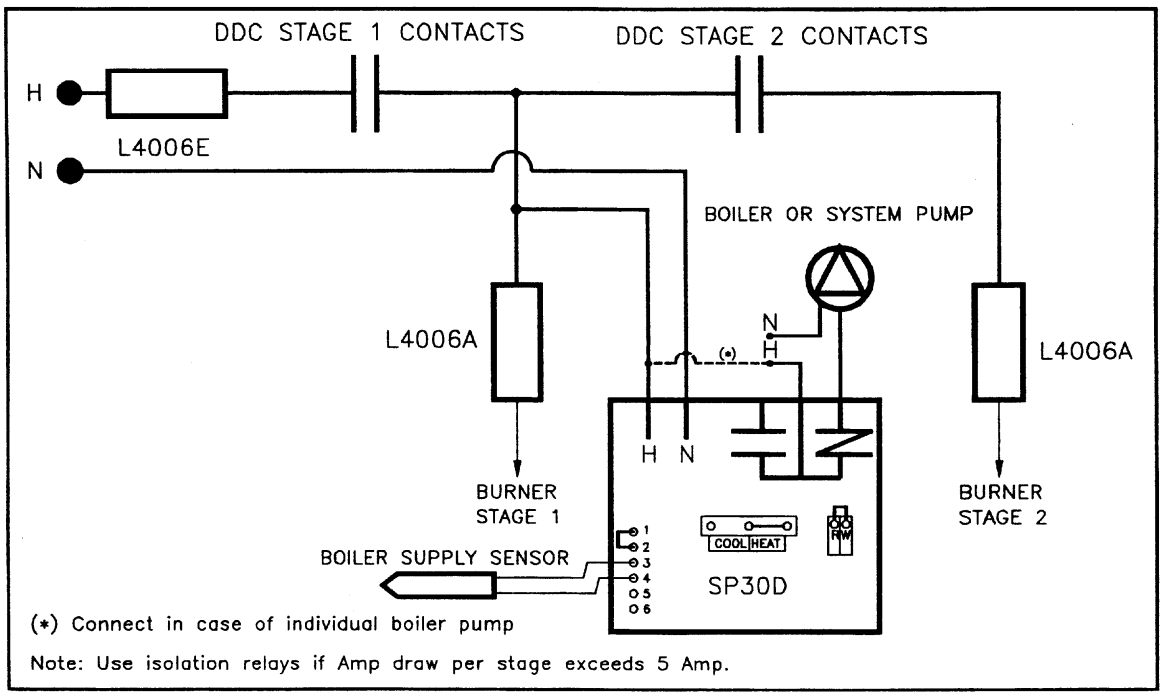


Figure 8: Electrical control schematic with supply temperature control.

Buderus Ecomatic HW3302 Operating Control Panel

Buderus Hydronic Systems, Inc. offers the multi-purpose, modular Ecomatic HW3302 wall mounted panel for modulating control of the heating system based on indoor and outdoor temperature. The control operates on the principle of constant water circulation with system water temperature based on indoor and outdoor conditions to perfectly balance supply of heat and demand requirements.

The panel can control multiple boiler systems with up to four independent firing stages, domestic hot water (DHW) production, one high temperature zone and up to four mixing valve controlled lower temperature zones. Each temperature zone operates on its own heating curve with adjustable night setbacks. Four time channels are individually programmed over a 24 hour, 7 day period with manual overrides for each channel. The control safeguards single boiler installations against low supply water temperatures.

Manual reset and adjustable high limit aquastats must be used on each boiler as standard safety controls when using the HW3302. The Ecomatic HW3302 controls the firing of the burner stages by means of relay closures according to the listed modules.

No. of Firing Stages	1	2	3	4
Required Modules	004	004,010	004, 174	004, 174

Operational Sequence

Burner stages are engaged with adjustable time delays with load dependent override based on the deviation between actual and desired system temperature. Once this deviation or other system requirements are satisfied, the stages are shut down time and load dependent.

The Ecomatic HW3302 panel has a modular configuration where modules are inserted depending on system requirements. Standard modules are:
Module 004: System water temperature controller based on outdoor air sensing.
Module 136: Channel designation card for programmable clock module 171.
Module 171: Four channel, programmable 24 hour, 7 day clock.

Optional Modules:
Module 010: Two stage firing control with adjustable staging times with load override.
Module 174: Four stage firing control with adjustable, energy dependent setpoints.
Module 005: Three or four way mixing valve and pump control with own heating curve.
Module 006: Prioritized DHW control with optional thermal disinfection.
Module 148: Boiler supply water temperature controller with pump control.

Operational Description of Module 148

Module 148 is specifically designed to control the supply temperature for the G615 boiler during burner operation. This supply temperature is controlled by regulating the flowrate through the boiler. Module 148 implements this requirement in the following ways:

Single Boiler Implementation

1) Operate a 3-way mixing valve between boiler supply and return. See Fig. 9.

2) Temporarily overtake control of mixing valves from 005 modules to raise the supply temperature. (Only possible if all heating zones controlled by 005 modules). See Fig. 10.

Module 148 can control a boiler pump, set up for continuous operation or with an adjustable run time from 1 to 60 minutes after burner shut-down. Module 148 automatically raises the set-point of the system water temperature to a minimum of 135 °F at burner start-up. This feature lengthens burner run times and reduces burner cycles.

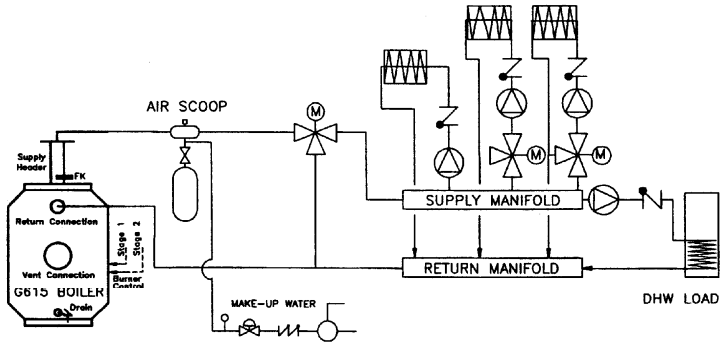


Figure 9: Module 148 operates 3 way mixing valve between boiler supply and return during burner operation based on temperature measured by the FK sensor.

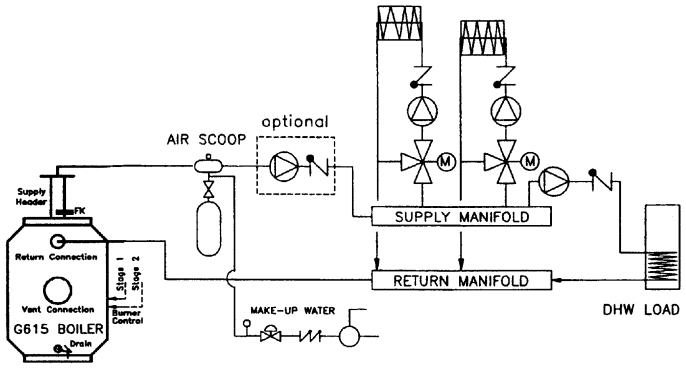


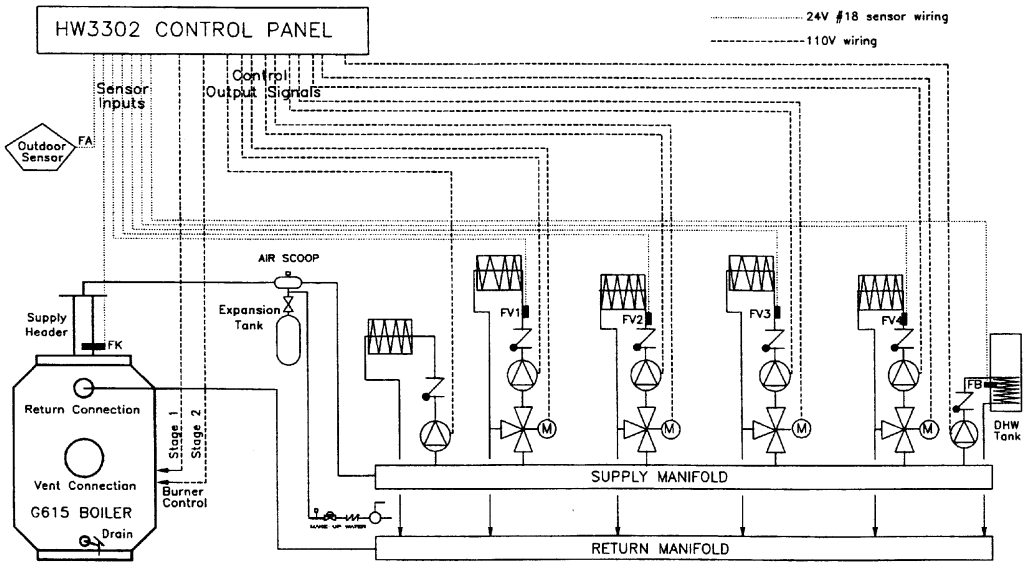
Figure 10: Module 148 controls the position of the heating zone mixing valves for supply temperature control. A boiler pump can also be controlled.

Multiple Boiler Implementation with HW3302 control

Each boiler must be safeguarded through its own supply temperature aquastat as discussed on page 13. Module 148 is not used in multiple boiler applications. Refer to Figures 12 and 13 for typical installation schematics. Note that only a single high limit aquastat per boiler is required when using the HW3302 panel and two stage (LHL) burners.

PIPING ARRANGEMENTS

This section outlines suggested piping arrangements for different heating installations. Its aim is to provide solutions and assist in the layout of heating systems without imposing restrictions. These piping schematics illustrate how G615 boilers with conventional supply temperature control and/or with the Ecomatic HW3302 control panel can be applied to various piping arrangements for optimum system control. These layouts are by no means all-encompassing but aim to provide guidance in understanding the usefullness and wide applicability of the Ecomatic HW3302 control panel. Buderus G615 boilers have been specifically designed for highly efficient, low temperature operation with HW3302 control.



Single Boiler Arrangement: Ecomatic Control.

Figure 11: Single boiler piping schematic with Ecomatic HW3302 control.

System Features:

- Outdoor temperature modulation of entire heating system.
- Supply temperature control through Module 148.
- Lower temperature zones controlled by Modules 005 (total of 4 zones).
- Priority DHW production with Module 006.
- Two-stage burner control with Module 010.
- Room temperature compensation for each heating zone with BFM room sensors.
- Four channel, 7 day program with adjustable setback on each heating zone.

Dual Boiler Arrangement: Conventional Controls.

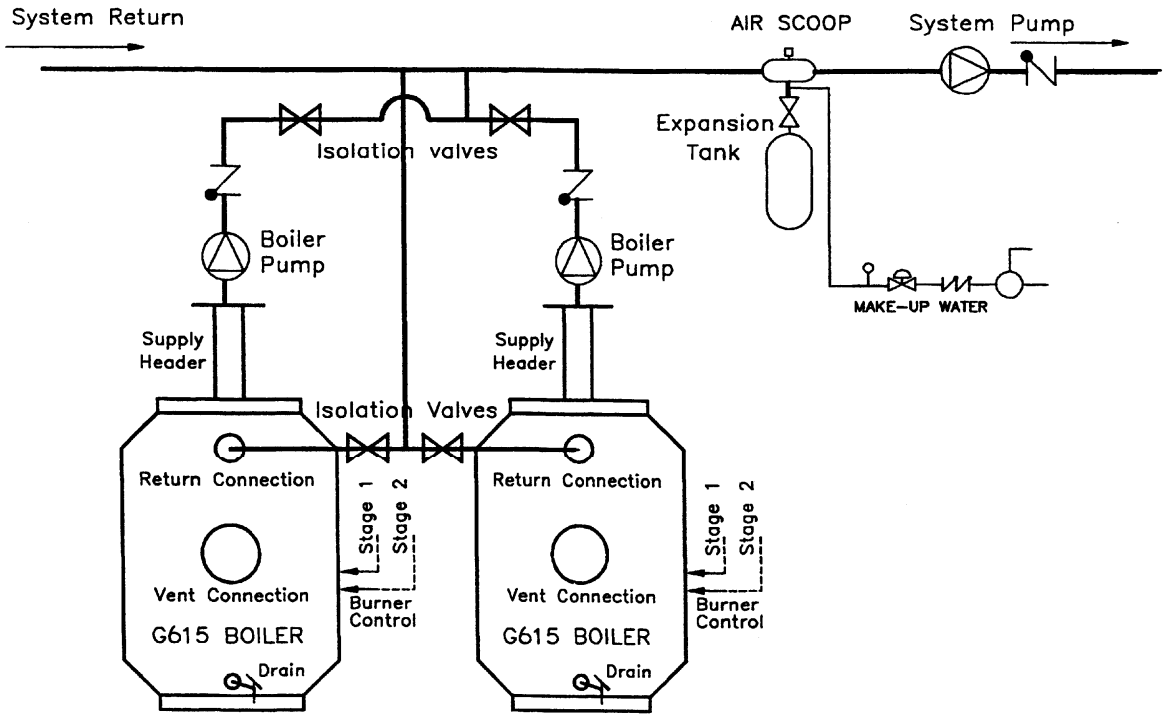


Figure 12: Two Buderus G615 boiler arrangement with individual boiler pumps.
System Features:

Parallel boiler piping, readily expandable to multiple boiler system.
Conventional, high temperature operation.
Supply temperature control of each boiler through individual boiler pumps.
Stage firing based on main loop temperature requirements.

Four Boiler System with Primary/Secondary Piping:
Conventional and Ecomatic Control.

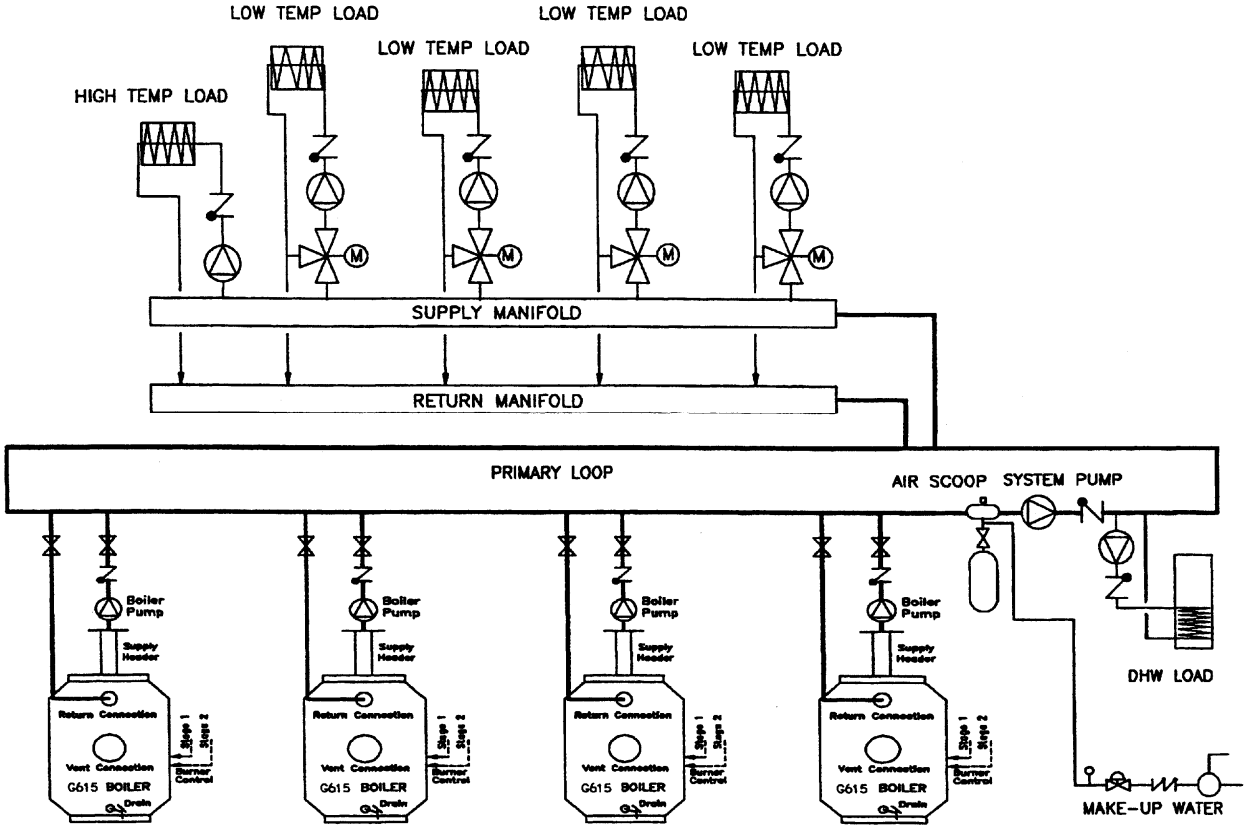


Figure 13: Schematic of four G615 Buderus boilers with individual boiler pumps for supply temperature protection in a primary/secondary piping arrangement.

Features based on conventional control:

Boiler protection with individual boiler pumps and supply aquastat.
Stage firing based on maintaining primary loop temperature.

Features based on Ecomatic HW3302 control:

Outdoor temperature modulation of entire heating system.
Boiler stage firing based on system requirements; energy weighted stage switching.
(Staging of LHL burners done in field per burner manufacturer's specifications).
Manual sequence reversal with four stage firing control.
Integrated control of (up to) five temperature zones and DHW load.
Boiler protection with individual boiler pumps and supply aquastat.
Room temperature compensation and day/night mode override with BFM's.
Individual setbacks on all heating zones; 4 channel, 7 day programmability.

PRESSURE LOSS ACROSS THE BOILER

Figure 14 shows the pressure loss on the water side for each model of the G615 Series boilers as a function of water flowrate.

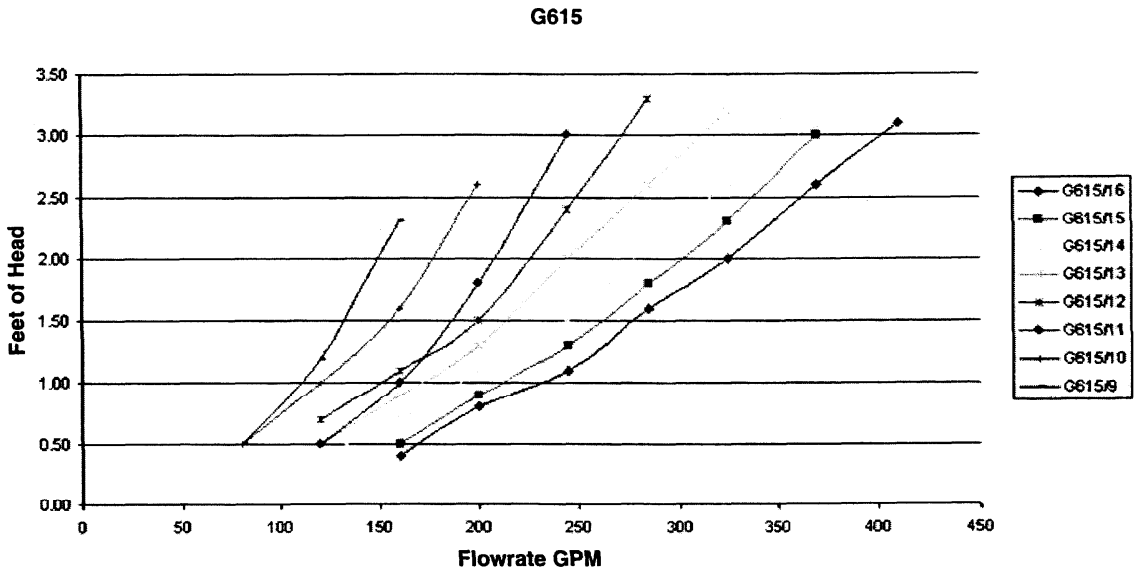


Figure 14: Pressure Loss across the G615 Series boilers.

Boiler Flow Requirements:
Minimum: None, boiler can be fired in a no flow condition.
Maximum: No maximum flow requirement across the boiler; only a minimum supply temperature of 122 °F during burner operation (140 °F for gas fired operation).

Note: This minimum supply temperature must be reached within 15 minutes after burner start, to prevent condensate formation.

VENTING REQUIREMENTS

All G615 Series boilers have a 14" vent connection and are designed to operate with a positive firebox pressure (See Table 1). Vent connection pressure should be +0.1 in W.C. For boilers set up to operate at very high efficiency levels, precautions are required with respect to the use of proper venting materials as a result of possible flue gas condensation in the venting system.

The G615 boiler can be installed for regular chimney venting provided the heating unit is set up to operate without excessive condensate formation in the venting system.

Approved venting materials under these circumstances are:
1 Type B double-wall gas vent or Type L gas or oil vents.
2 Single-wall metal pipe manufactured out of galvanized sheet steel (minimum thickness .0304 inch), or other approved, non-combustible, corrosion-resistant material.
3 Masonry, metal or factory built chimneys. Metal and masonry chimneys must be built and installed in accordance with ANSI/NFPA 211, "Standard for Chimneys, Fireplaces, Vents and Solid-Fuel Burning Appliances", or according to local building codes. Masonry chimneys must be lined with an approved clay lining, a listed chimney lining system or other approved material.

Vent connectors shall be made of Type B double-wall (gas only) or Type L material (gas or oil), factory-built chimney sections or single-wall steel pipe. An approved vent cap or roof assembly of equal or greater venting capacity shall be installed at the end of the venting system. All restrictions, specifications and exceptions concerning the use of these materials must be adhered to as described in the latest edition of the National Fuel Gas Code ANSI Z223.1 or local codes.

A listed barometric draft assembly may be required to control boiler breeching draft. This draft assembly must be single-acting on oil fired equipment, dual-acting on gas and dual-fuel fired equipment.

G615 Series boilers can operate at positive firebox pressures up to 2.0 inch WC by proper adjustment of burner operating settings. Please consult with burner manufacturer's specifications concerning required adjustments.

G615 COMMERCIAL BOILER SPECIFICATIONS

1 There shall be provided and installed a quantity of ____ G615 Buderus sectional cast iron hot water boiler(s) with a total gross rating of _____ Mbtu/h and a net IBR rating of _____ Mbtu/h, suitable for forced draft firing with fuel oil #2, natural gas or propane.

2 Boiler(s) shall be fabricated with GL-180M high silicon cast iron. They shall be of pressurized wet base, double wall, sectional construction with precision machined steel push nipples. Boiler(s) shall have a central return distribution pipe with two drilled openings per boiler section to allow proportionate water distribution over the entire length of the boiler.

3 Boiler(s) shall be constructed, tested and labeled in accordance with ASME Section IV and shall bear IBR ratings and the ASME stamp. Sections shall be labeled for 58/88 psig maximum working pressure rating.

4 Boiler(s) shall be of full three pass design, suitable for forced draft firing and capable of achieving combustion efficiencies of 86+% for oil firing and 83/84 % for gas firing. Gross stack temperatures at full firing rate shall not exceed 375 °F.

5 Boiler(s) shall be field assembled by contractor at jobsite with tools provided by boiler manufacturer to ensure all parts are torqued properly. Individual sections shall have tongue and groove construction to accommodate permanent pliable sealing strips and provide a positive seal for pressurized operation. The seal shall occur from the inside surface outward. Sections shall incorporate cast iron integral legs for proper boiler support. Boiler shall provide rear and top access for all connections and controls.

6 The design of the boiler and the geometry of the combustion chamber shall eliminate the need for refractory material or a combustion target wall. Boiler flue collector shall be cast iron construction for long life.

7 Access to boiler firesides for inspection and maintenance shall be through a fully insulated and jacketed door, field-adjustable for left or right hinging. The seal between the door and the boiler casing shall be a permanent dry gasket for repeated positive sealing.

8 Boiler(s) shall be furnished with heavy-gauge baked enamel high quality jacket with a full 4" fiberglass insulation on top and all sides, flanged water and control connections and a customized steel plate for mounting of an oil, gas or dual fuel burner approved for use by boiler manufacturer.

9 Hydronic accessories shall include a 50/80 PSI ASME relief valve, a 3 1/4" temperature & pressure gauge, a Honeywell L4006A1058 adjustable high limit aquastat, a Honeywell L4006E1109 Manual Reset high limit aquastat and a Hydrolevel Model 550 probe type low water cutoff or equivalents provided by others.

10 The heating plant control system shall consist of the Buderus HW3302 commercial control panel furnished with supply and outdoor air sensors or equivalent controls furnished by others. The control panel shall contain indicator lights displaying status of individual burner stages, system and zone pumps and possible mixing valve(s) operation. The heating unit(s) shall operate on an adjustable heating curve, adjustable lead/lag, manual firing sequence reversal, and variable burner differential. The different heating zones shall operate on independent

heating curves with individually adjustable night setbacks, room temperature compensation and manual day/night mode overrides.

11 Boiler(s) shall have provisions on the front casing to permit flushing of the water side of the boiler for removal of any accumulated deposits inside the boiler's water passages.

12 Boiler(s) shall be furnished with removable flue passage baffles to easily alter gross stack temperatures.

13 Boiler(s) shall be capable of sustained operation at any return water temperature without any means external to the boiler to temper or preheat the return water. A single aquastat shall maintain a minimum supply water temperature of 122 °F-Oil fired (140 °F)-Gas fired at the boiler supply connection during burner operation by temporarily interrupting flow through the boiler.

DISCLAIMER

This engineering manual was prepared by Buderus Hydronic Systems, Inc. This information is in part based on the venting requirements set forth in the National Fuel Gas Code. Buderus Hydronic Systems, Inc. makes no warranty or representation, expressed or implied, with respect to the accuracy, completeness, or usefulness of this information, nor assumes any liability with respect to the use of any information contained within this document. In addition, Buderus Hydronic Systems, Inc. reserves the right to make changes without notice due to continuing engineering and technological improvements.

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