CARAVAN®

WET-BASE CAST-IRON MODULAR BOILERS

STEAM / GAS
APPLICATION GUIDE

Guidelines for the design, purchase and installation of Slant/Fin gas-fired steam modular boiler systems.

CONTENTS

CODES AND STANDARDS

All Caravan installations must comply to local codes or, in the absence of local codes, to the National Fuel Gas Code, ANSI, Z223.1 latest edition.

In addition where required by the authority having jurisdiction, the installation must conform to American Society of Mechanical Engineers Safety Codes for controls and safety devices for automatically fired boilers, No. CSD-1. The installation must also conform to the additional requirements of Slant/Fin Instruction book publication No. GG-100-40 latest edition.

All electrical wiring is to be done in accordance with the National Electrical Code ANSI/NFPA No. 7 latest edition and all local electrical codes. The unit must be electrically grounded if an external power source is used.

In Canada, the installation must be in accordance with standards CGA B149.1 and B149.2, installation codes for gas burning appliances and equipment and/or local codes. All electrical connections are to be made in accordance with Standard C.S.A. C22.1 Canadian Electrical Code Part 1 and/or local codes.

Many state and local codes require intermittent ignition devices for gas boilers. Please specify if necessary.

INTRODUCTION OF FRESH WATER

Introduction of excessive amounts of fresh water into a system can cause scaling and leave deposits in the boiler and the surrounding water pipes. This will lead to inefficient boiler operation and breakdown. Fresh water will enter the system as a result of leaks such as may occur in underground piping.

Process applications that use fresh water require the use of heat exchangers. Any process application that results in introduction of fresh water into a boiler can cause scaling, with deposits forming in the boiler and surrounding piping. This will damage the boiler. Introduction of fresh water from leaks will cause similar damage.

In some areas it may be necessary to use a feed water treatment to control the corrosive makeup of the fill water. Check with the local authority to determine if the feed water will need a conditioning treatment before being supplied to the boiler.

INTRODUCTION

There are many varieties of steam heating systems. Because of the wide range of field conditions, the design of these systems is beyond the scope of this manual. However, when designing a steam Caravan boiler plant, certain guidelines should be followed that are common to all modular steam heating application.

This entire manual should be read prior to installing the Slant/Fin Caravan steam system.

Safety – each module contains a dual combination gas valve, ASME 15 lb Relief valve and pressure gauge.

Slant/Fin®

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Table 1: Ratings and dimensions

			CSA		AHRI											
Model No.	Number of Modules	Module Model Number	Input M.B.H	Gross Output M.B.H	Net Output M.B.H	Net Sq. Ft. Steam	Horsepower	Boiler Water Content (Gals)	Shipping Weight Lbs.	"A" Dim	"B" Dim	"C" Dim	Minimum Space Between Modules	Recommended Header Size	"D" Dim	"L" Dim
GXHT-600 Z	2	GXH-300	600	478	358	1492	14.78	16.8	1075	26 1/16"	59 1/8"	9"	7"	3"	11 17/32"	4' 11 1/8"
GXHT-900 Z	3	GXH-300	900	717	537	2238	21.42	25.2	1595	26 1/16"	59 1/8"	9"	7"	4"	11 17/32"	7' 8 3/16"
GXHT-1200 Z	4	GXH-300	1200	956	716	2983	28.56	33.6	2115	26 1/16"	59 1/8"	9"	7"	5"	11 17/32"	10' 5 1/4"
GXHT-1500 Z	5	GXH-300	1500	1195	895	3729	35.70	42	2635	26 1/16"	59 1/8"	9"	7"	6"	11 17/32"	13' 2 5/16"

For larger sizes, use multiple of the above

Specify gas by name, "natural" or "propane". Net ratings are based on piping and pick-up allowance of 1.33. Slant/Fin should be consulted before selecting a boiler for installation having unusual piping and/or pick-up requirements.

Ratings must be reduced by 4% at 2000 ft. elevation and an additional 4% for every additional 1000 ft. elevation over 2000 ft. **Modules in excess of 5, should be piped in banks of 5, parallel with each other.**

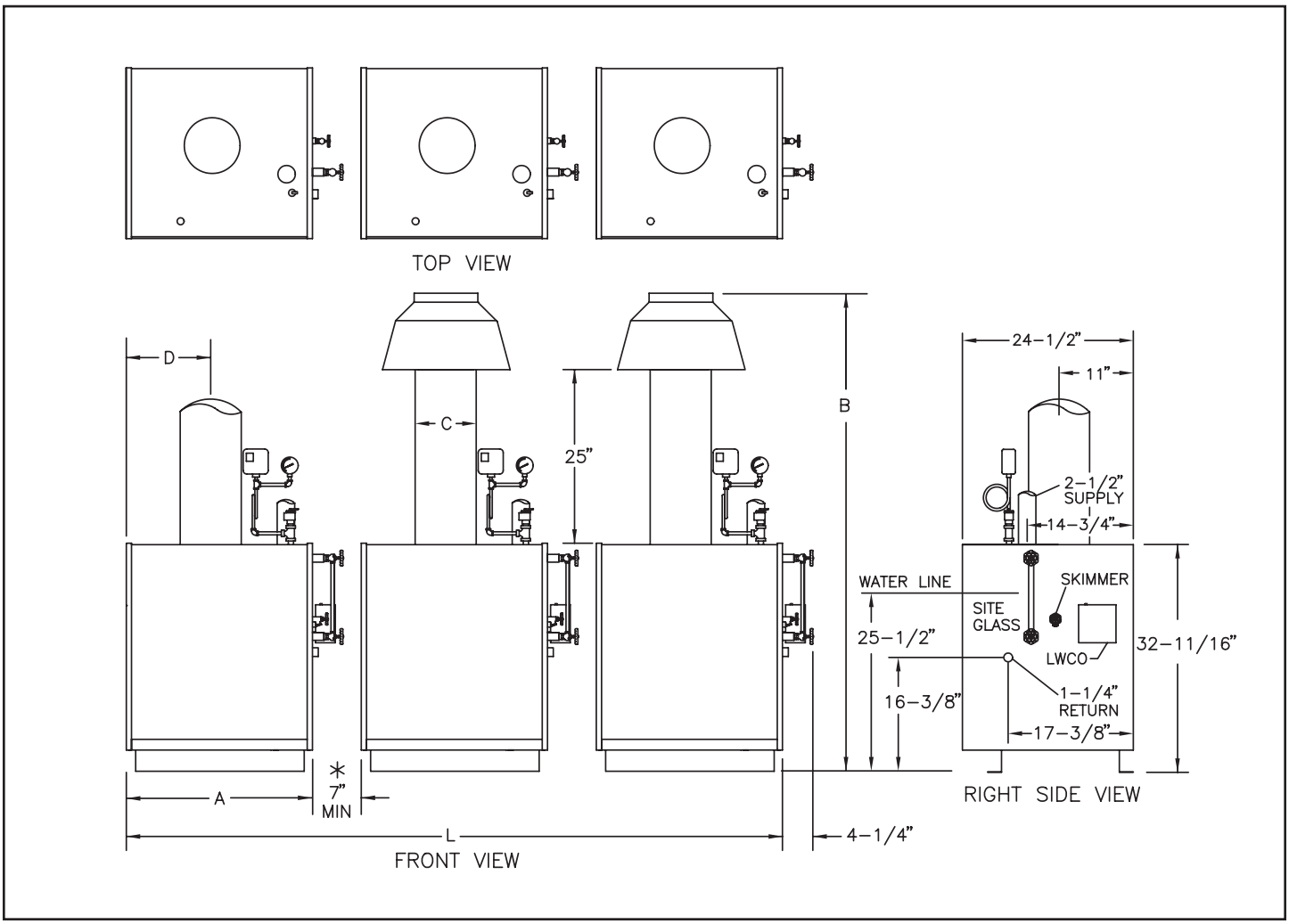

Figure 1: For McDonnel & Miller PS 801-24 L.W.C.O Min. clearance 9"

BOILER PLANT SIZING
Older buildings may have a heat loss significantly less than that of the original building. To size a replacement steam boiler plant, consider the following: Replacement steam boiler plants must be sized to match the connected radiation load. Under-sizing will prevent steam from reaching distant radiation quickly.

BOILER ROOM DESIGN
Caravan modular boiler systems allow better utilization of floor space and permit future expansion with minimum cost. The modules are hand truckable, fit through doorways and often may be installed around an existing inoperative boiler. They can be grouped in single or multiple banks. Systems consisting of five or more modules should be piped in two or more banks.

BOILER ROOM AIR SUPPLY
To ensure safe, efficient operation, the modular boiler system must be supplied with sufficient air to support complete combustion, replacing air entering draft dampers or draft hoods and ventilating the boiler room or areas.

For additional information, not listed below, see ANSI. Z223.1, section 5.3.3.

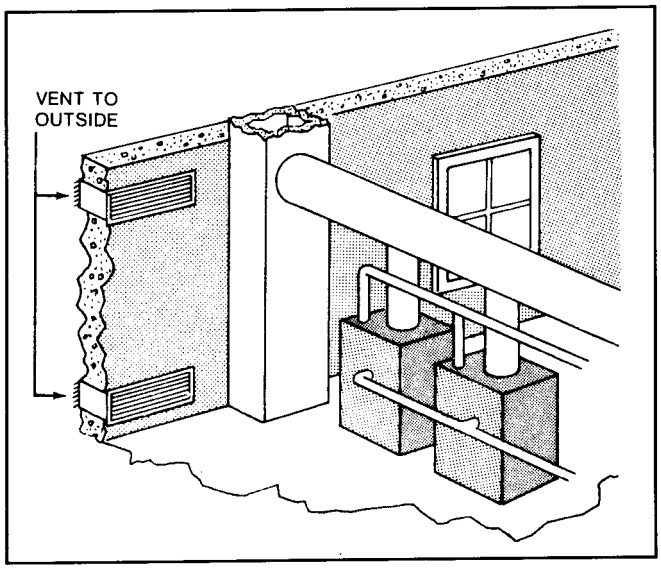

Figure 2: Correct location of combustion-air supply ducts.

INSTALLATION IN ENCLOSED BOILER ROOM REQUIRES TWO UNOBSTRUCTED OPENINGS FOR PASSAGE OF AIR INTO THE BOILER ROOM:

1. **Air drawn horizontally from outdoors DIRECTLY through an outside wall;** one louvered opening near the floor (below burner air inlet) and one louvered opening near the ceiling (above the highest draft regulator), each opening with a minimum FREE air passage area of **1 square inch per 4000 BTUH** of total system input.

2. **Air drawn horizontally through HORIZONTAL DUCTS;** one opening near the floor (below burner inlet) and one opening near the ceiling (above the highest draft regulator), each opening with a minimum FREE air passage area of **1 square inch per 2000 BTUH.**

3. **Air drawn VERTICALLY from outdoors;** one opening at the floor and one opening at the ceiling, each opening with a minimum FREE air passage area of **1 square inch per 4000 BTUH** of total system input.

4. **Air drawn from inside the building;** one opening near the floor (below burner inlet) and one opening near the ceiling (above the highest draft regulator), each opening with a minimum FREE air passage area of **1 square inch per 1000 BTUH** of total system input.

IF BOILERS ARE INSTALLED ADJACENT TO OTHER FUEL BURNING EQUIPMENT, THE AREA OF FREE OPENINGS MUST BE APPROPRIATELY INCREASSED TO ACCOMMODATE THE ADDITIONAL LOAD.

UNLESS PROPERLY CONTROLLED, AVOID THE USE OF FORCED VENTILATION, SINCE IT CAN CREATE AN UNDESIRABLE PRESSURE DIFFERENTIAL BETWEEN BOILER ROOM AND AIR SOURCE.

VENTING A GAS-FIRED SYSTEM

A boiler venting system provides an escape path for the products of combustion. There are three major components for venting a gas-fired Caravan: a draft hood for each module, a breeching manifold and a chimney.

Draft Hood

The draft hood is part of each boiler module, although shipped in a separate carton. It compensates for excessive draft. The dimensional relationships between the draft hood, the boiler and surface on which the boiler is mounted, are critical. These factors are all interdependent in allowing the draft hood to function without moving parts. Attempts to alter these dimensions will result in unsafe operating conditions.

Breeching

Breeching is a term used to describe a manifold(s) that connects individual boiler modules to a chimney. Breeching is usually constructed of sheet metal having a smooth interior surface with all joints made tight against leakage. Pitch breeching up toward chimney. Horizontal breeching size should be maintained for the total length. Connections from the modules into the breeching are best made at 45˚ angles in the direction of the chimney. See figure 3.

Table 2: Breeching dimensions: gas fired systems

Model No.	Consist of		Chimney Height*			
	No. of Modules	Module No.	20 Feet	25 Feet	30 Feet	50 Feet
GXHT600Z	2	GXH300	12”	10”	10”	9”
GXHT900Z	3	GXH300	14”	12”	12”	12”
GXHT1200Z	4	GXH300	16”	14”	14”	12”
GXHT1500Z	5	GXH300	16”	16”	16”	14”

Based on single row of modules with no elbows.
• Height measured from the top of draft hood to top of chimney

Note: For conditions other than those shown, consult factory, or National fuel gas code NFPA 54.

The bottom portion of the breeching should be installed at least 3 feet above the top of modules' draft hoods. If this height cannot be obtained, install the breeching as high as possible. **See Page 5, Table 3 for heights less than 3 feet.** The portion of chimney height rising directly above each draft hood is most effective in preventing flue gas spillage. When the boiler room is in an unheated space, insulate vent pipe and breeching to maintain flue gas temperature and good chimney operation. **Do not lower draft hoods' skirt height.** For some combinations of low chimneys, low ceilings and long breeching, a draft inducer may be needed. Inducers, when required, are locally specified and warrantied. The breeching should extend into but not beyond the chimney liner.

Chimney

Caravan gas-fired modular boilers operate efficiently with masonry or prefabricated chimneys as well as with “Type B” or double-walled metal vent pipe. The latter type of chimney construction is generally the least expensive. Chimney height is usually governed by the building height and the size of the boilers (See Table 1). However, the chimney should be high enough to minimize the effects of turbulent winds and pressure common near rooftop obstructions. A vent cap should be used where permitted for additional protection against adverse wind conditions and precipitation. The National Board of Fire Underwriters recommends that the chimney should extend at least 3 feet above the roof and be 2 feet higher than any obstruction within 10 feet.

Sizing horizontal breeching connectors and chimneys for gas-fired systems

Horizontal breeching connectors shall be constant sized. The chimney and the horizontal breeching connector are sized using Table 2. When there are multiple banks of boilers, the horizontal breeching connector for each bank is sized using Table 2. To size the common horizontal breeching connector, add up the total input and refer to Table 2A.
The minimum chimney opening will be equal to the size of the largest horizontal breeching section connected to it.

Table 2A: Chimney and breeching sizing for multiple banks **

BTU Input	Chimney Height*			
	20 Feet	25 Feet	30 Feet	50 Feet
1,800,000	18”	18”	18”	16”
2,100,000	20”	18”	18”	16”
2,400,000	20”	20”	20”	18”
2,700,000	22”	22”	20”	18’
3,000,000	24”	22”	22”	20”
3,300,000	24”	24”	22”	20”
3,600,000	26”	24”	24”	20”
3,900,000	26”	26”	24”	22”
4,200,000	26”	26”	24”	22”
4,500,000	28”	26”	26”	24”

•• Based upon system total BTU input

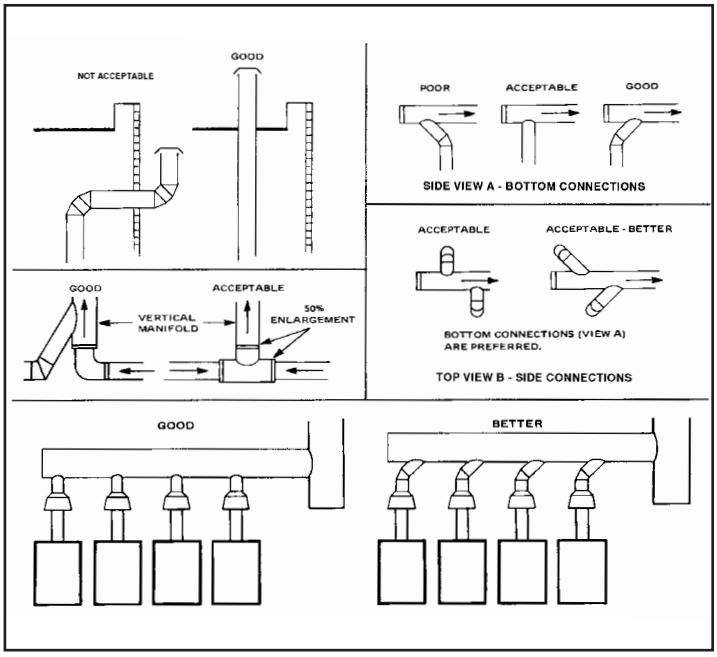

Figure 3: Suggested venting system constructions.

CONNECTOR RISE:

Connector rise is the length of the pipe connecting the top of the draft hood to the system breeching above. The diameter of this pipe varies depending upon BTU input, chimney height and the length of the connector. Fig.4 (Dim. “B”) shows the location of this pipe in a typical application. Table 3 depicts the proper diameter (Dim. ”C”) of the connector rise depending upon its total length (top of the draft hoods to the breeching above).

HORIZONTAL BREECHING CONNECTOR LENGTH:

The maximum length of the horizontal breeching connector length between the chimney and the closest boiler shall not be longer than one foot per inch of horizontal breeching connector diameter, **i.e. if the horizontal breeching connector is 16” D., the maximum length from the chimney to the first boiler would be 16 X 1 FT. or 16 feet.** The minimum length shall be one foot regardless of the horizontal breeching connector diameter. See figure 4.

Table 3

Vent connector diameters (20Ft. Chimney “F” Dim.)

Model	Flue Outlet	Connector Rise “B”		
	Size”A”	3’ High	2’ High	1’ High
		“C”	“C”	“C”
GXH300	9”	9”	10”	10”

Based on single row of modules with no elbows.
Note: For conditions other than those shown, consult factory, or National fuel gas code NFPA 54.

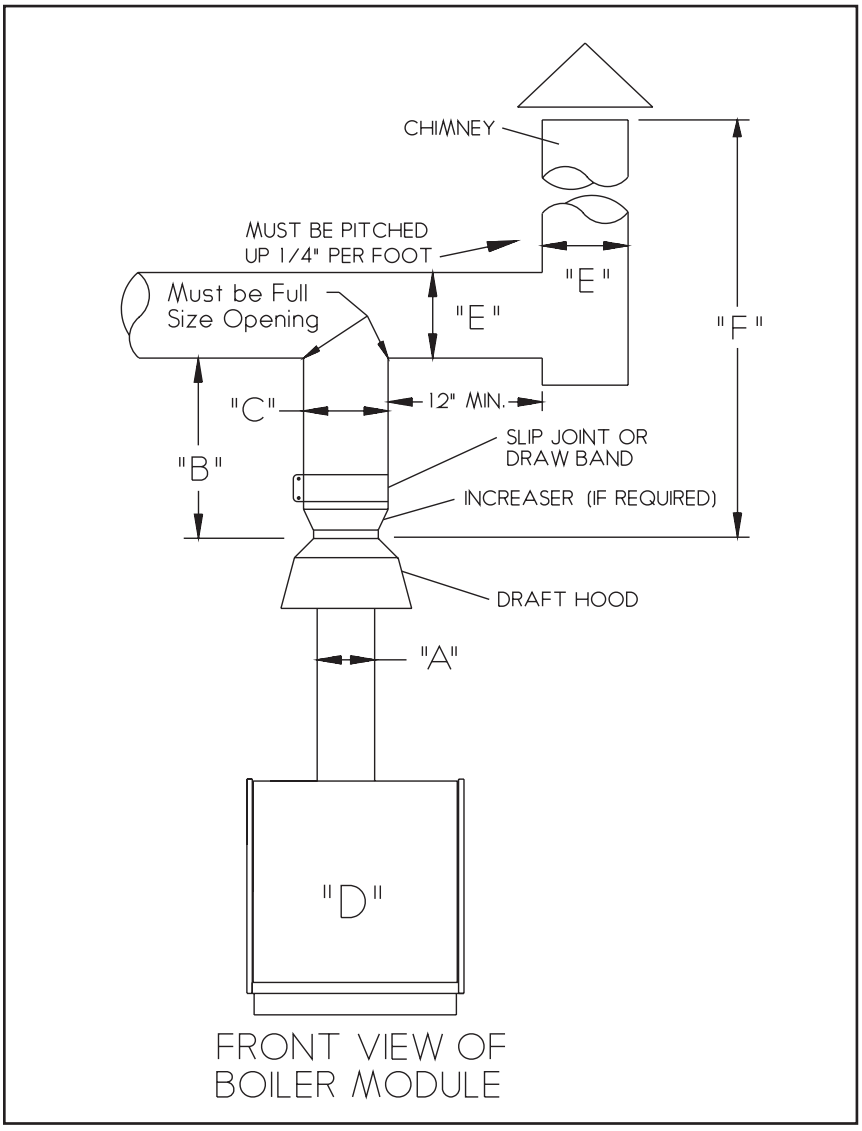

Figure 4: Connector Rise “B”

GAS PIPING

This section contains sizing and construction recommendations for fuel supply piping to Caravan gas-fired modular boiler systems. Gas-fired equipment must conform not only to codes of the local regulatory agencies, but also to additional specifications that may be imposed by the utility or gas supplier. Therefore, the following information should be considered only as a guideline.

Figure 5 illustrates a typical gas supply line installation. It consists of a main between the utility's meter box and the boiler system, a main shut-off valve, sediment trap, gas header pipe and drip legs on individual boilers.

Individual gas lines to individual boiler modules should be ¾-inch diameter. Size of gas main header pipes depends on volume of gas required and acceptable pressure drop between meter and modules' gas regulator valves. Minimum pressure required at each valve is 5-inches of water column for natural gas and 11-inches for propane gas, measured while all boilers and other gas-fired equipment on the same meter are firing. Small variations in gas flow can be compensated for by adjusting gas regulator valves. However, final pressure of gas header must vary no more than + 0.3-inches of water column.

GAS MAIN SIZING

To determine the correct pipe diameter for the gas main serving a specific Caravan system, proceed as follows:

a. Follow the building plans, find total length of straight pipe between supply from gas meter and boiler gas header.
b. Using data in Table 5, calculate equivalent linear length of screw pipe fittings used in fabrications of main. Add this to figure from step (a) to obtain equivalent total length.
c. Find Caravan gas consumption in cubic feet per hour from Table 4.
d. Multiply the system total hourly gas consumption by flow correction value from Table 6, page 7.
e. Locate system's total equivalent pipe length in right column of Table 7.
f. Move vertically to the system's corrected flow rate calculated in step (c). If this value falls between two of those listed, select larger value.
g. From this point, move horizontally to the left column and read suggested pipe diameter for gas main.

Table 4: Gas Consumption Rate

Model No.	Gas Consumption in CFH
GXHT600Z	600
GXHT900Z	900
GXHT1200Z	1200
GXHT1500Z	1500

Table 5: Equivalent linear length in feet of standard iron pipe fittings for natural gas

Pipe Size Inches	Elbow			Valve			Return Bend	Side Outlet Tee
	Standard	Medium Sweep	Long Sweep	Gate	Globe	Angle		
½	0.84	0.52	0.41	0.031	2.50	1.12	1.25	1.66
¾	1.17	0.73	0.57	0.044	3.50	1.84	1.75	2.33
1	1.57	0.98	0.77	0.057	4.68	2.11	2.34	3.11
1¼	2.19	1.37	1.07	0.082	6.54	2.94	3.27	4.35
1½	2.63	1.64	1.29	0.098	7.84	3.52	3.92	5.21
2	3.55	2.23	1.74	1.320	10.60	4.77	5.30	7.05
3	5.72	3.59	2.81	2.130	17.08	7.69	8.84	11.40

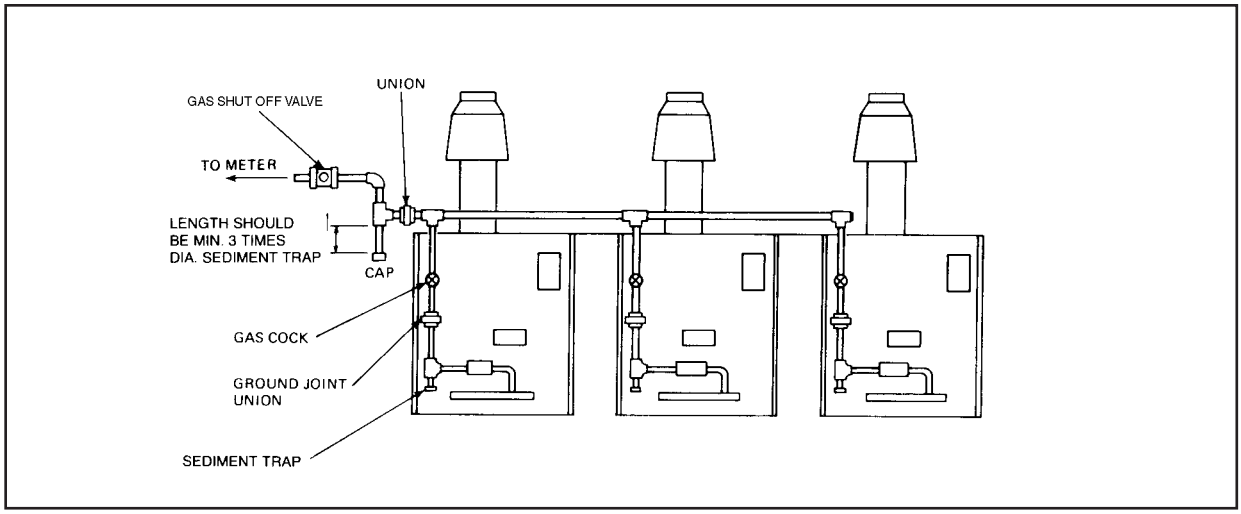

Figure 5: Typical gas supply line installation

Table 6: Characteristics of various fuel gases

Type of Gas	Heating Valve †	Flow Correction Factor
Natural	1000 Btu	1.00
Propane	2500 Btu	1.10

* per cubic foot
† Consult fuel supplier for actual BTU value.

Table 7: Gas main sizing guide

Nominal Iron Pipe Size Inches	Internal Diameter Inches	Equivalent Length of Pipe, Feet						
		10	**20**	**30**	**40**	**50**	**60**	**70**
¼	.364	32	22	18	15	14	12	11
⅜	.493	72	49	40	34	30	27	25
½	.622	132	92	73	63	56	50	46
¾	.824	278	190	152	130	115	105	96
1	1.049	520	350	285	245	215	195	180
1¼	1.380	1050	730	590	500	440	400	370
1½	1.610	1600	1100	890	760	670	610	560
2	2.067	3050	2100	1650	1450	1270	1150	1050
2½	2.469	4800	3300	2700	2300	2000	1850	1700
3	3.068	8500	5900	4700	4100	3600	3250	3000
4	4.026	17,500	12,000	9700	8300	7400	6800	6200
		80	**90**	**100**	**125**	**150**	**175**	**200**
¼	.364	11	10	9	8	8	7	6
⅜	.493	23	22	21	18	17	15	14
½	.622	43	40	38	34	31	28	26
¾	.824	90	84	79	72	64	59	55
1	1.049	170	160	150	130	120	110	100
1¼	1.380	350	320	305	275	250	225	210
1½	1.610	530	490	460	410	380	350	320
2	2.067	990	930	870	780	710	650	610
2½	2.469	1600	1500	1400	1250	1130	1050	980
3	3.068	2800	2600	2500	2200	2000	1850	1700
4	4.026	5800	5400	5100	4500	4100	3800	3500

Maximum capacity of pipe in cubic feet of gas per hour for gas pressures of 0.5 psig or less and a pressure drop of 0.3 inch water column (based on a 0.60 specific gravity gas).

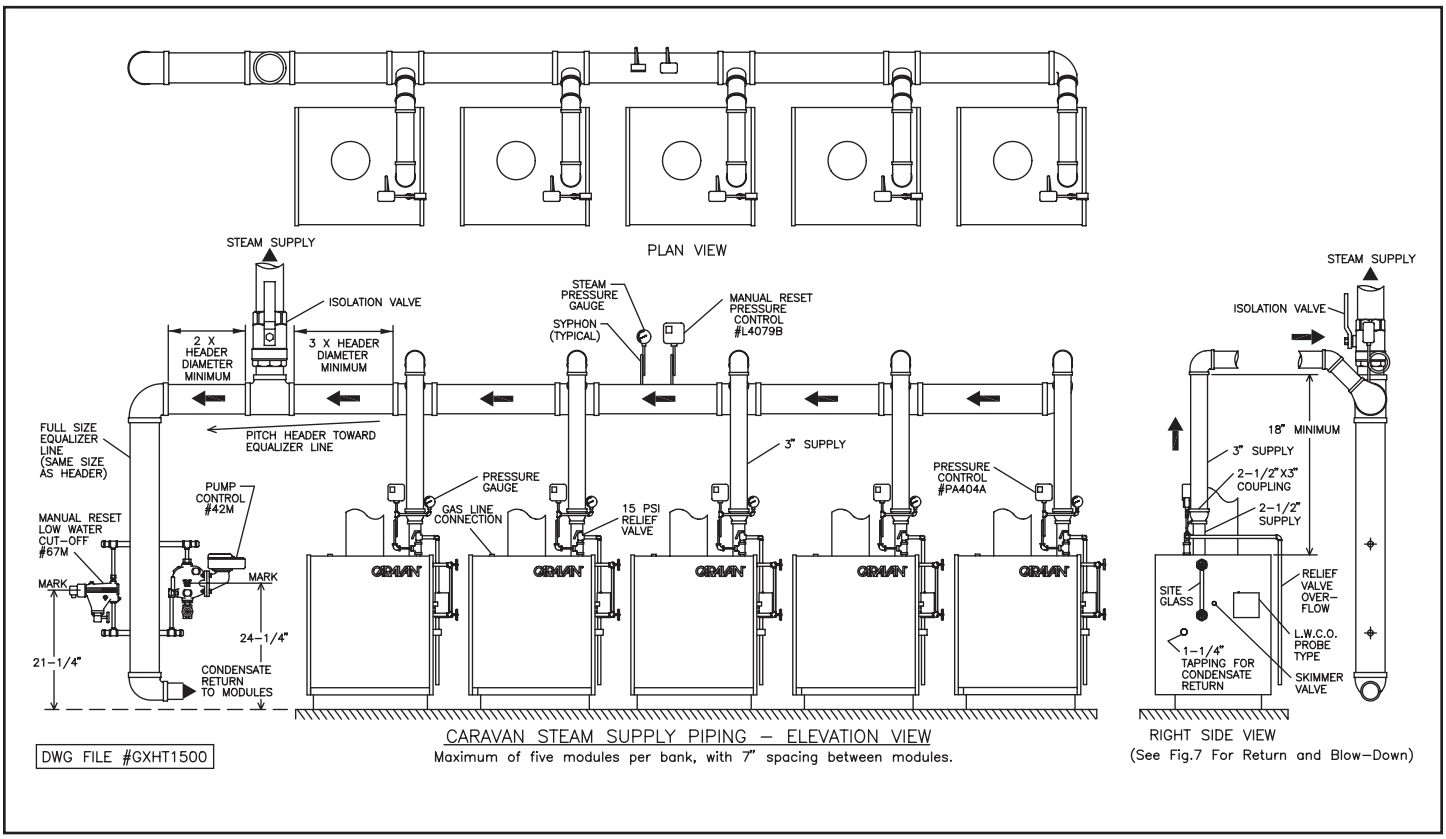

Figure 6: Typical Caravan GXHT-1500 steam heating system supply piping

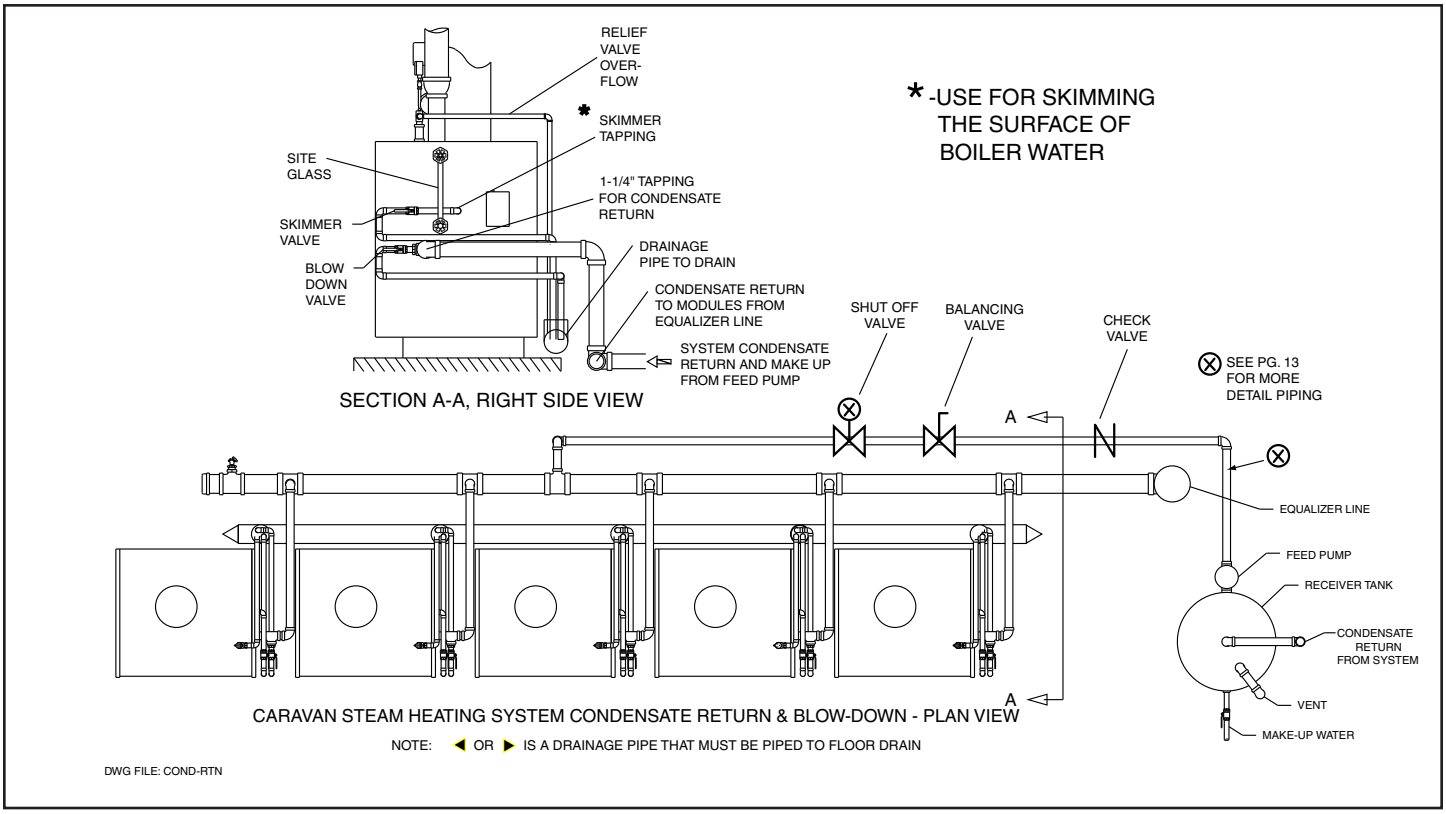

Figure 7: Typical Caravan GXHT-1500 steam return piping, elevation view

STEAM SUPPLY AND RETURN PIPING

Modular steam boilers must be piped in a way that provides nearly equal steam pressure at all modules. Supply and return pipes and fittings should be identical on each module. The pressure drop in the supply header, between the connection to the building and the supply tapping on each module must be kept to a minimum. When installed properly, this will result in minimal variance in water levels between modules. Figure 8 shows the take off to the system after the last module and before the equalizer/drain line. Header size shown on this page (Table 8) is based on this piping arrangement. Figure 9 shows the piping arrangement between the module and header connections. In this area, try to keep the number of elbows to a minimum (maximum 3). It is important to note that a pressure difference of as little as one ounce (1/16 PSI) between modules will result in a water level difference of almost 2 inches.

Table 8: Modular steam boiler plant header pipe sizing

No. of Modules	Capacity Steam EDR Gas	Header Pipe Sizes Supply Gas	Return
2	1492	3”	1 ½”
3	2238	4”	2”
4	2983	5”	2”
5	3729	6”	2”

Maximum 5 modules per bank.

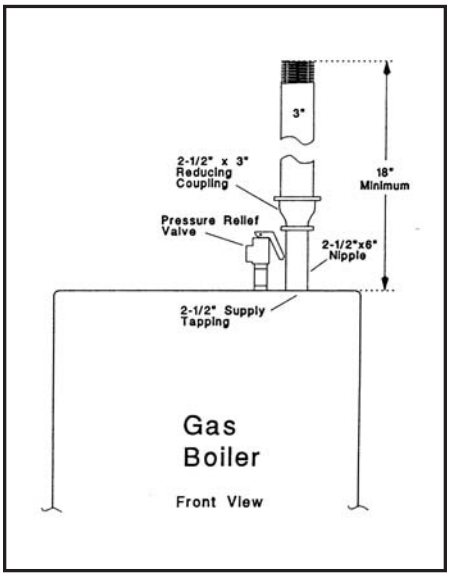

Figure 10: Steam supply header at gas modules

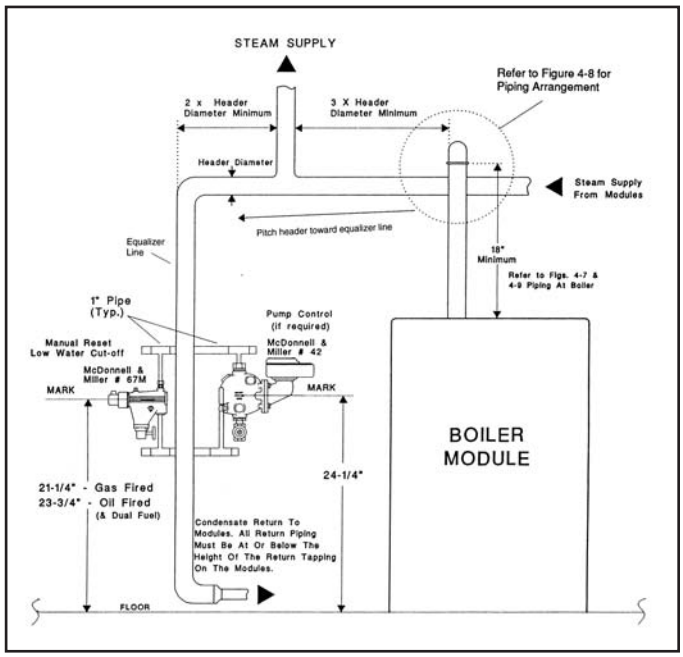

Figure 8: Piping details

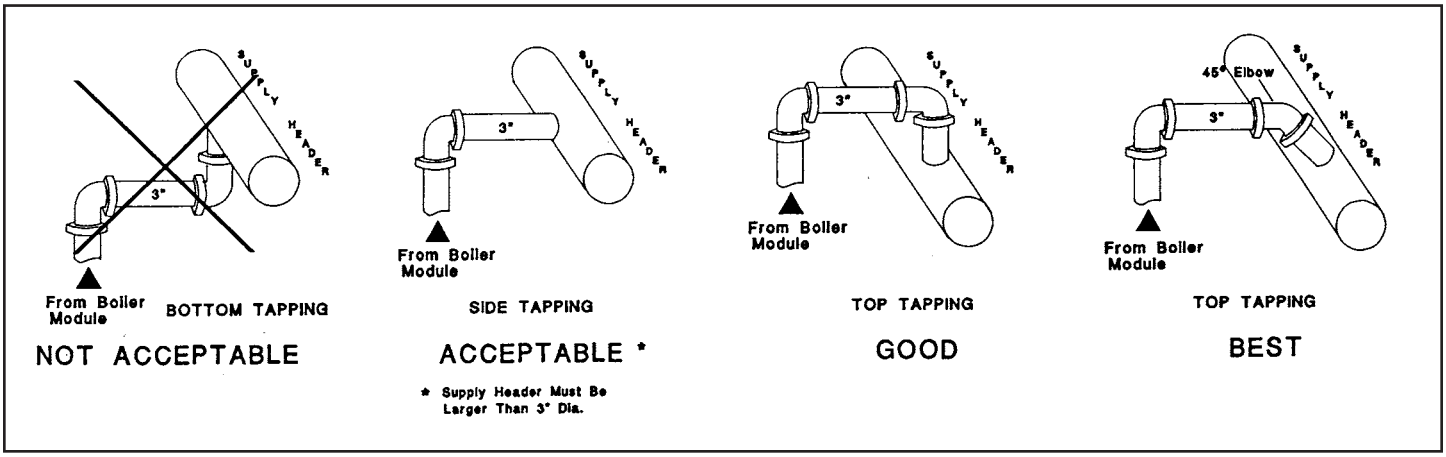

Figure 9: Steam supply header piping

INSTALLATION AND PIPING RECOMMENDATIONS

When one or more steam boilers are replaced with a new Caravan modular boiler system, there are certain conditions that must be considered.

1. All modules must be set on a level surface, and individually leveled.
2. When setting gas fired Caravan systems on a raised base, at least 3 inches of the base must extend beyond the front and sides of the bank of modules. This will ensure a smooth pattern of combustion air entering the combustion chamber.
3. Leave a minimum of 7 inches between gas steam modules to accommodate return piping, skimmer tapping, gauge glass and low water cut off.
4. The module supply pipe must be increased from 2½" x 6" to at least 3" (see figure 10, page 9). As shown, a 2½" x 6" nipple is installed in the module supply tapping followed by 3" x 2½" reducing coupling and a 3" supply pipe. The 2½" x 6" nipple is necessary to provide the needed clearances to remove the pressure relief valve for servicing and replacement. To minimize pressure drop, no more than three 90 elbows should be installed between the module supply tapping and the steam header (see figure 9, page 9).
5. All banks of modules must have an equalizer/drain line from the supply header to the return header. This equalizer/drain should be located at the end of the header that the system steam supply is taken from. The equalizer/drain should be the same size as the supply header (see figure 8, page 9). The supply & return header for each bank should be sized according to Table 8, page 9.
6. To prevent accumulation of condensate, steam headers should be pitched down in the direction of steam flow and toward the equalizer/drain with no reduction in size. Module connections must be on the side of the header (horizontal) or at any angle between the side and top of header, never between the side and bottom. To prevent condensate in the header from re-entering the boiler supply pipe, side connections must enter a header that is at least one size larger than the boiler supply connections. Top or 45˚ top-angle connections are preferred and can enter a header of the same size or larger. See Figure 9.The supply header for each module should be sized according to Figure 10, page 9.
7. The supply connection between the building steam main and the module steam header should be located between the last boiler on the header and the equalizer/drain. Connection must be at least 2 header diameters from the last module (see Figure 8, Page 9).
8. Piping should provide a means for both surface and bottom blow-down and flushing sediment from the system for clean, safe and efficient operation (see Figures 11 and 12, Page 11 and Fig. 7 page 8).
9. The use of a pump control is recommended to regulate the water level in a bank of boilers and prevent the bank from operating with an unsafe low water condition. For protection of banks with 2 to 5 modules, the control should be located on the equalizer line. All applications require a low water cut-off on each module and one cut off for each bank.
10. Supply and/or return shut-off valves on individual modules are not recommended. However, if valves on individual modules are unavoidable, additional safety controls are required on each module. Full-port valves should be used to minimize pressure drop and should be the same diameter as the pipe.
11. Impurities and oxygen in fresh water cause scaling and leave deposits in the boiler and surrounding pipes. This leads to inefficient operation and other system problems. The older the system, the greater the probable accumulation of scale. Therefore, it is necessary to check the piping for blockage or restriction and clean or replace the piping as required. Applications such as process systems can result in excessive introduction of fresh water into a steam boiler. This will damage the boilers and void any warranty. Caravan modular boiler systems are not recommended for applications involving the use or discharge of raw steam or condensate. In all cases, boiler water should be tested periodically to determine if conditioning treatment is needed. Consult a local boiler water treatment expert.

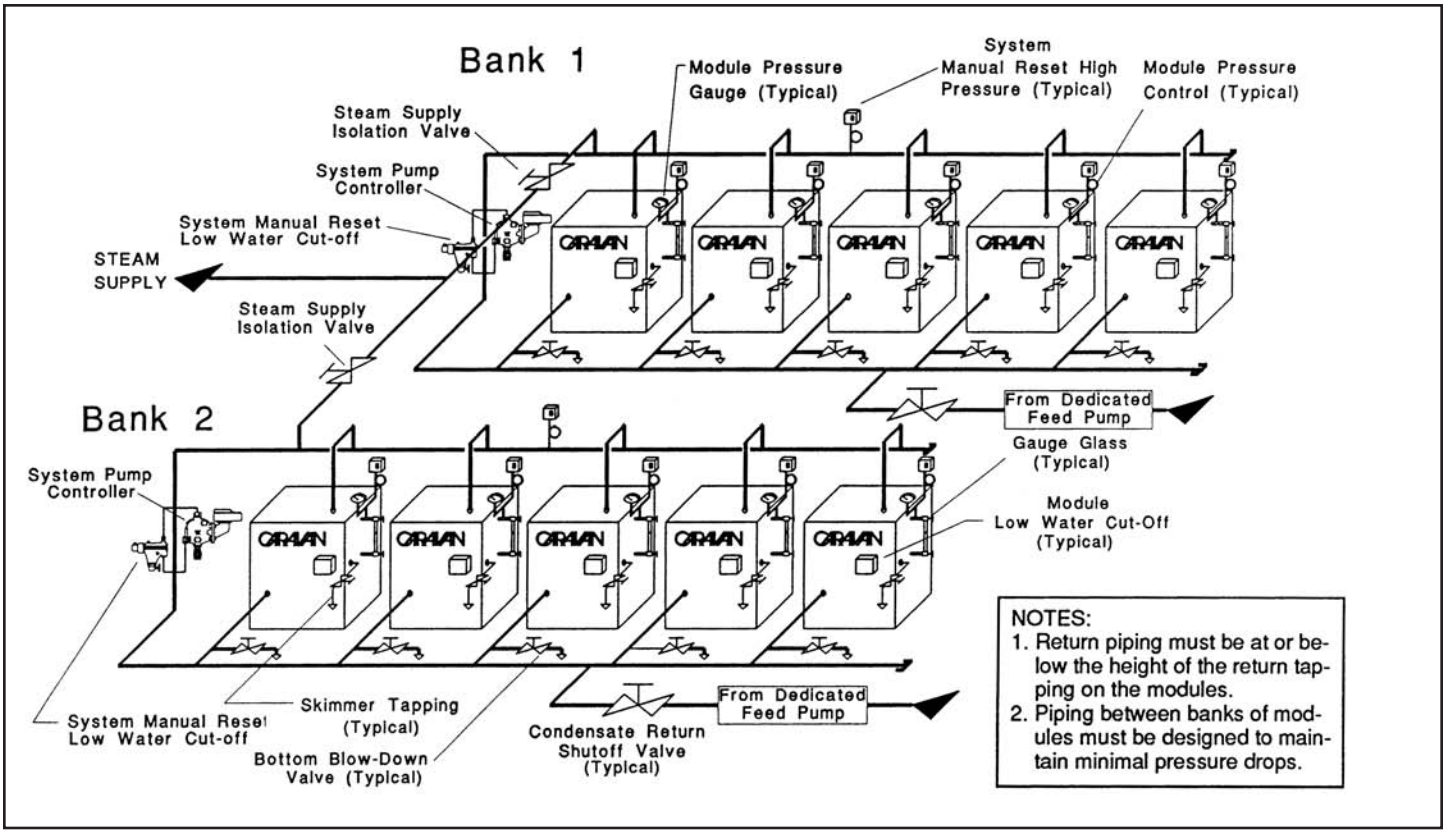

Figure 11: Steam modules, isolated banks (Note: For detail piping refer to pages 8 & 9)

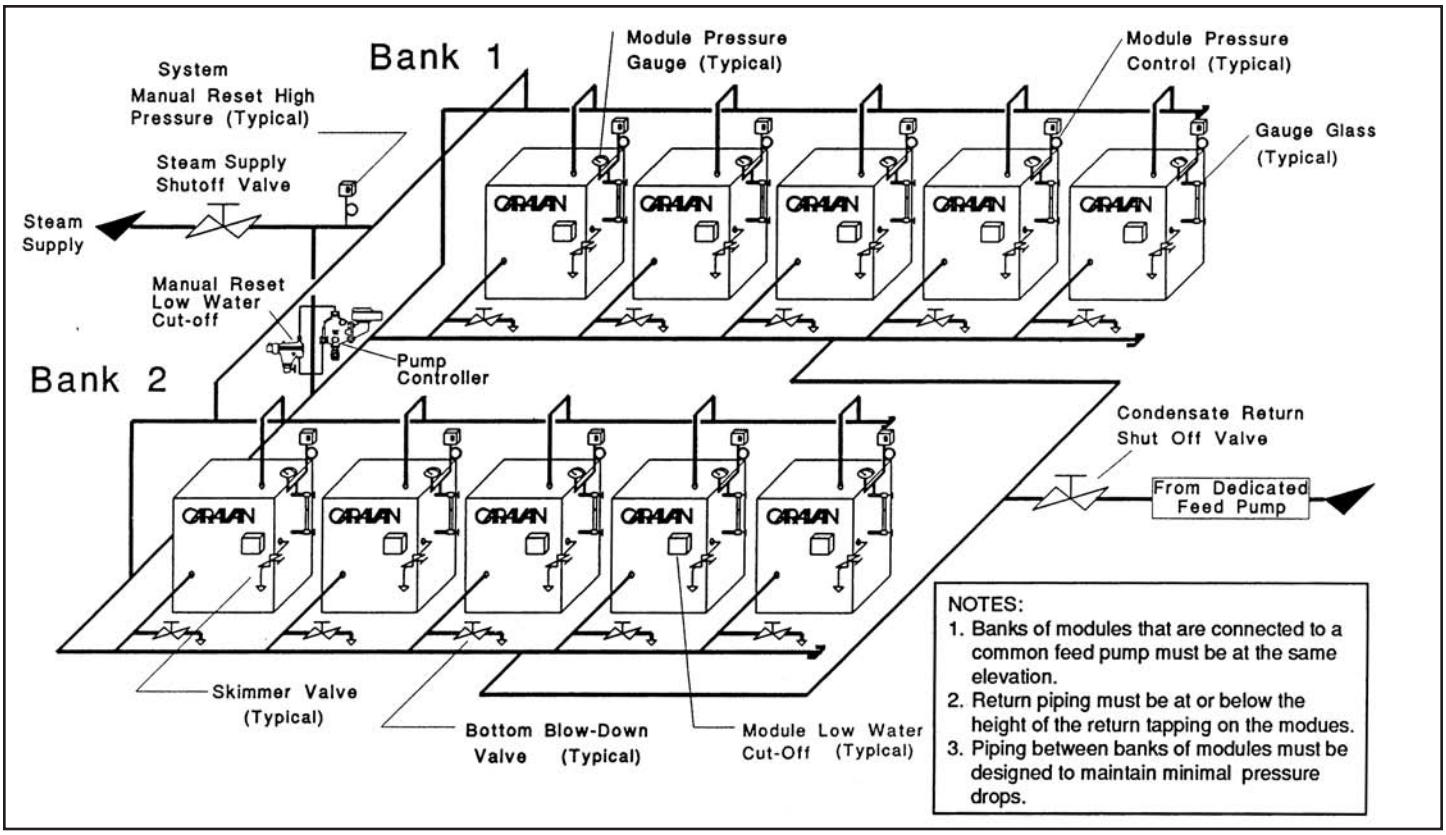

Figure 12: Steam modules, integrated banks (Note: For detail piping refer to pages 8 & 9)

12. Caravan modular boiler systems are often used as a replacement for old, large, inefficient boilers. Compared with older boilers, modern steam boilers have a relatively small water volume in the operating range. The result can be that a normal volume of condensate return water could create high water levels in the new modules. In most systems, the use of a combination feed-pump and receiver will prevent flooding. The recommended storage capacity for the receiver is shown in Table 9. This table is based on condensate returned to the receiver within twenty minutes of start-up. If the time required for returning condensate is greater, a larger receiver would be needed. Check with the fee pump manufacturer for the correct size. The feed-pump/receiver is used to store condensate returned from the system, provide feed-water to the boilers, as regulated by the pump control and add makeup water to the system.
    A balancing valve MUST be provided on the feed-pump discharge line. This valve is used to adjust water volume to prevent feed-water from entering the boilers too quickly, which can cause water levels to "bounce". The pump discharge pressure must be slightly higher than the steam operating pressure. A rate of 1 GPM per module is more than sufficient to feed a steam Caravan system (see Table 9).
    The feed pump is activated by a pump control mounted on the equalizer drain line, (see Figure 8, page 9). When the boiler water level drops, the pump control energizes the feed-water pump, transferring feed-water from the receiver to the bank of modules. On systems with more than one bank of boilers that are isolated (valved), each bank must have a dedicated feed-pump with a dedicated power supply, (see Figure 11, page 11). This will prevent the operation of one bank of boilers from interfering with another.
    During operation, condensate from the heating system is constantly being returned to the receiver. It is natural that some steam / condensate will be lost through venting and small, undetected leaks in the system. When the receiver water level drops below a predetermined low level, a float mechanism allows make-up (fresh) water to enter the receiver and replace any water lost in the system. However, if this is occurring frequently, the system should be checked for leaks. The use of a water meter in the make-up line is recommended.
    Certain local codes may require a Hartford Loop. However, the use of a Hartford Loop is otherwise not recommended when using a feed-pump. Consult your local authorities.
    WARNING: The description in this manual is for a boiler feed-pump only. Do not use a "condensate pump" in place of a feed-pump on a Caravan system. Unlike a feed-pump, a condensate pump will pump water into the boilers regardless of the boiler water level. Some systems may require the use of condensate return pumps in distant parts of the system. These condensate pumps must discharge into the boiler feed-pump/receiver, not into the boilers.
13. All equipment such as steam traps and air vents in the steam heating system should be checked for proper operation and replaced or repaired as needed. All piping should be checked for proper pitch.
14. It is good practice to re-pack and/or tighten the packing nuts on all valves in the system.

Definitions of terms

• **Make-up water:** Fresh water introduced into the system to compensate for evaporation, leaks, blow-down and other use of steam or condensate.

• **Condensate water:** Water that has been condensed from steam in the system.

• **Feed-water:** Any mixture water, both condensate and make-up, that enters the boilers to maintain water level.

• **Header:** The pitched horizontal pipe connecting the modules where steam or condensate flows to or from a bank of modules.

Table 9: Boiler feed pump and receiver sizing

No. of Modules	Gas		Oil	
	Min. GPM	Net Storage	Min. GPM	Net Storage
1	.65	13	.75	15
2	1.30	26	1.50	30
3	1.95	39	2.25	45
4	2.60	52	3.00	60
5	3.25	65	3.75	75
6*	3.90	78	4.50	90
7*	4.55	91	5.25	105
8*	5.20	104	6.00	120
9*	5.85	117	6.75	135
10*	6.50	130	7.50	150
11*	7.15	143	8.25	165
12*	7.80	156	9.00	180
13*	8.45	169	9.75	195
14*	9.10	182	10.50	210
15*	9.75	195	11.25	225

* Maximum 5 modules per bank.
On systems with more than one bank of boilers, each bank must have a dedicated feed-pump with its own power supply. This will prevent the operation of the one bank of boilers from interfering with another.

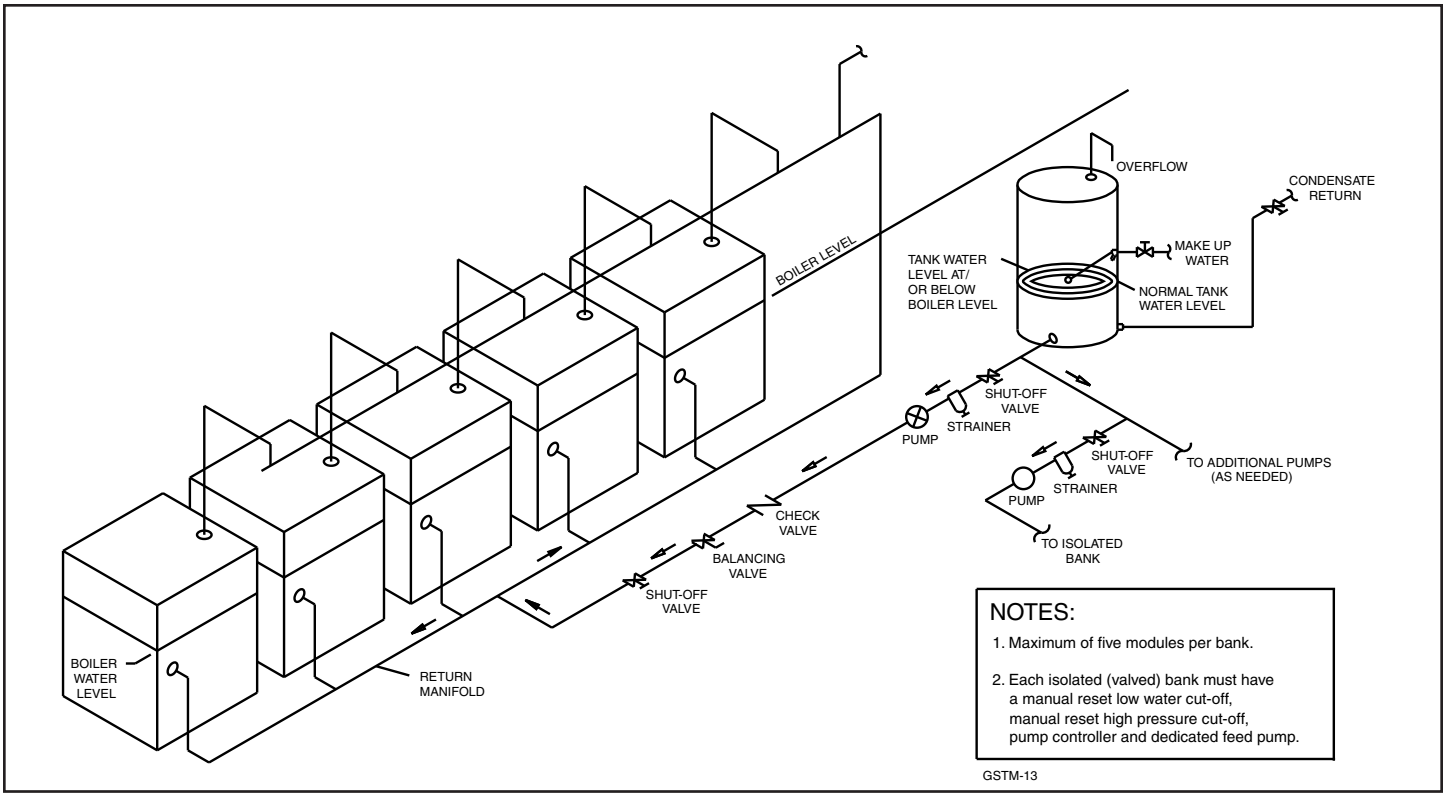

Figure 13: Installation with receiver tank water level at or below modules normal water levels

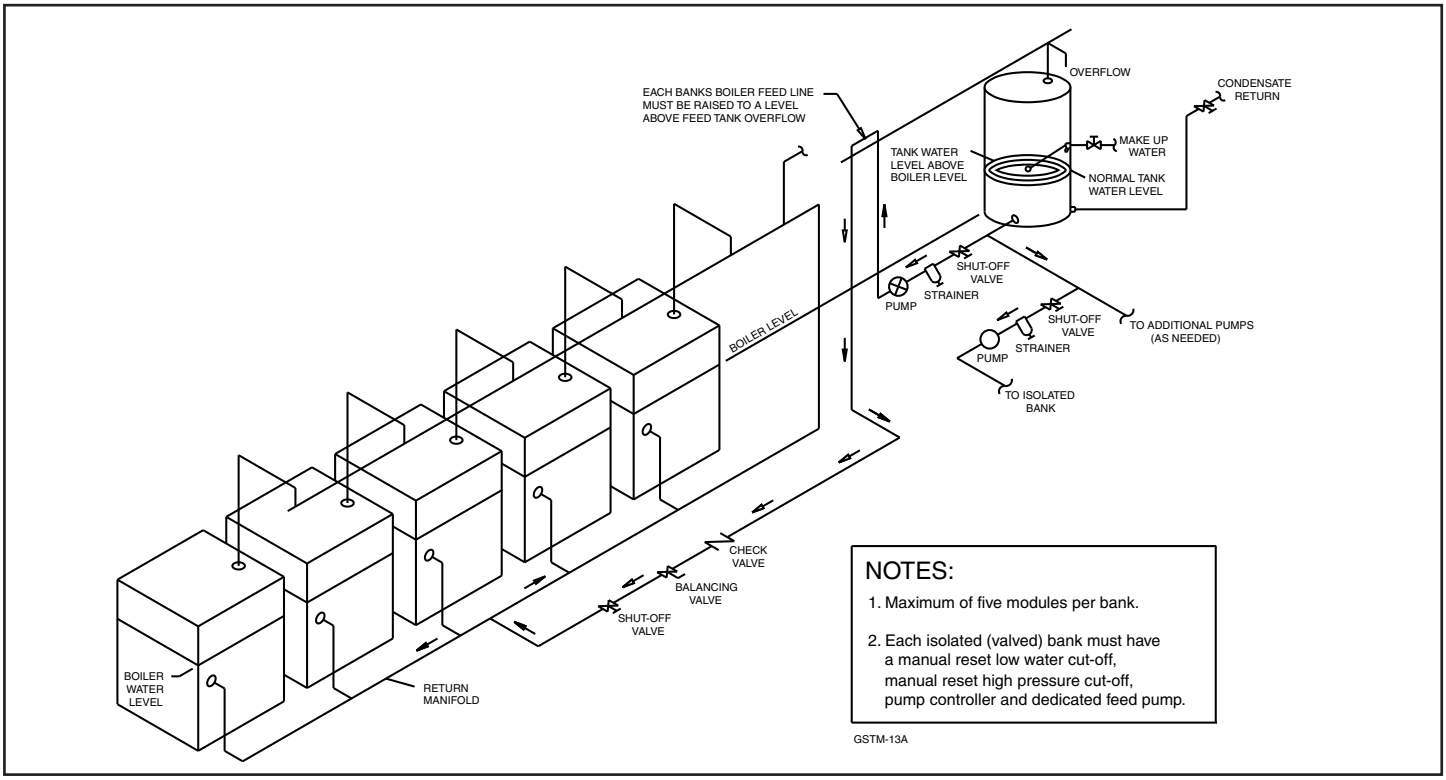

Figure 13A: Installation with receiver tank water level above modules normal water levels

MODULAR STEAM WITH SPACE TEMPERATURE CONTROL WIRING DIAGRAM

Sequence of operation

When the building thermostat calls for heat, contacts (RC) of the R8285B control closes. This energizes the coils of R1 and R2 relays. With these contacts closed all the modules are energized to fire. This will bring the system pressure up quickly. The P404A pressure controls on each module (not shown in diagram, see fig. 16) are set to the pressure required to heat the building. This will stage the number of modules firing to meet the demands of the building load. The required modules will continue to fire until the thermostat is satisfied.

There are several manufacturers that provide more sophisticated controls for modular steam systems.

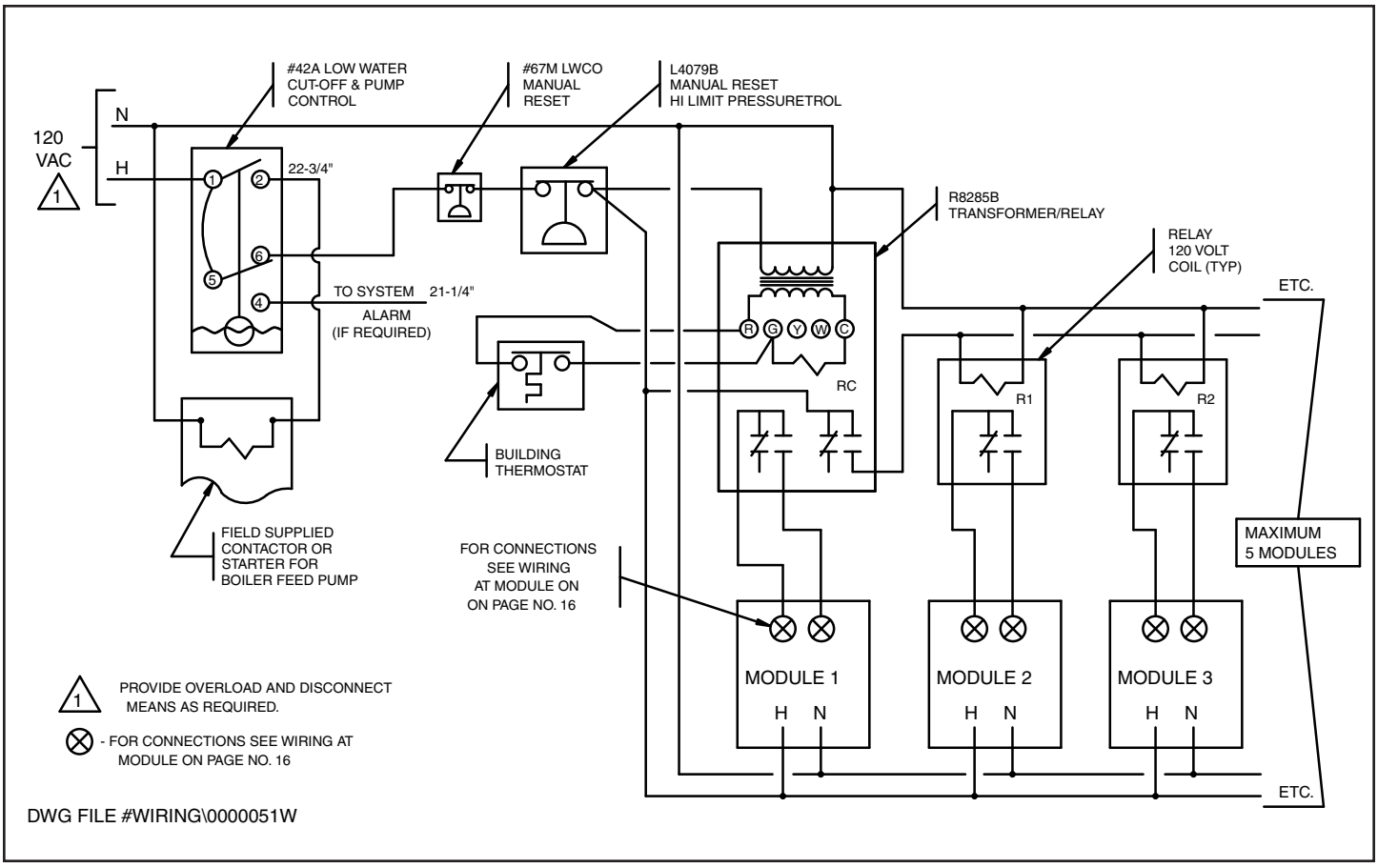

Figure 14: Space temperature control wiring diagram

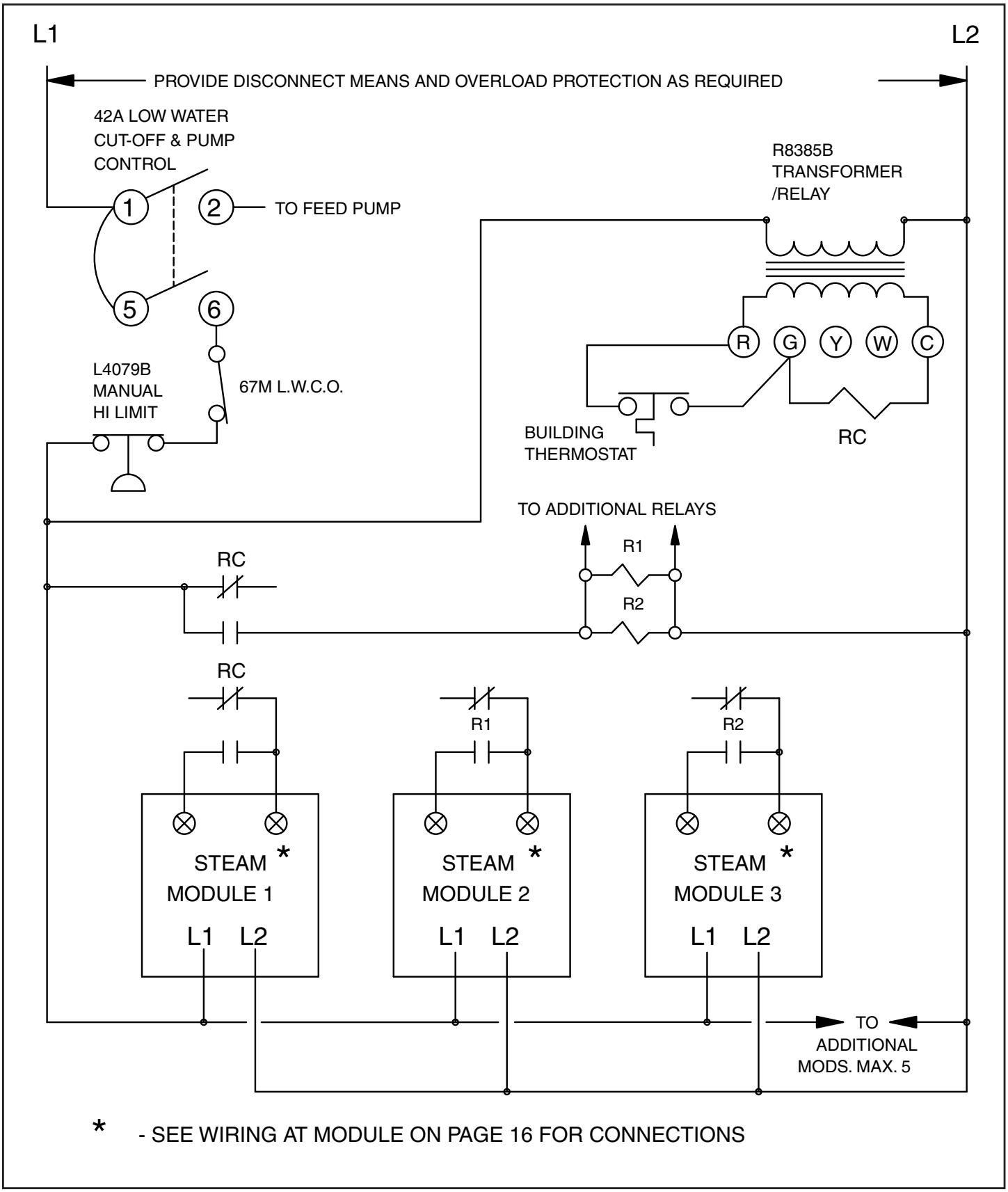

Figure 15: Space temperature control ladder diagram

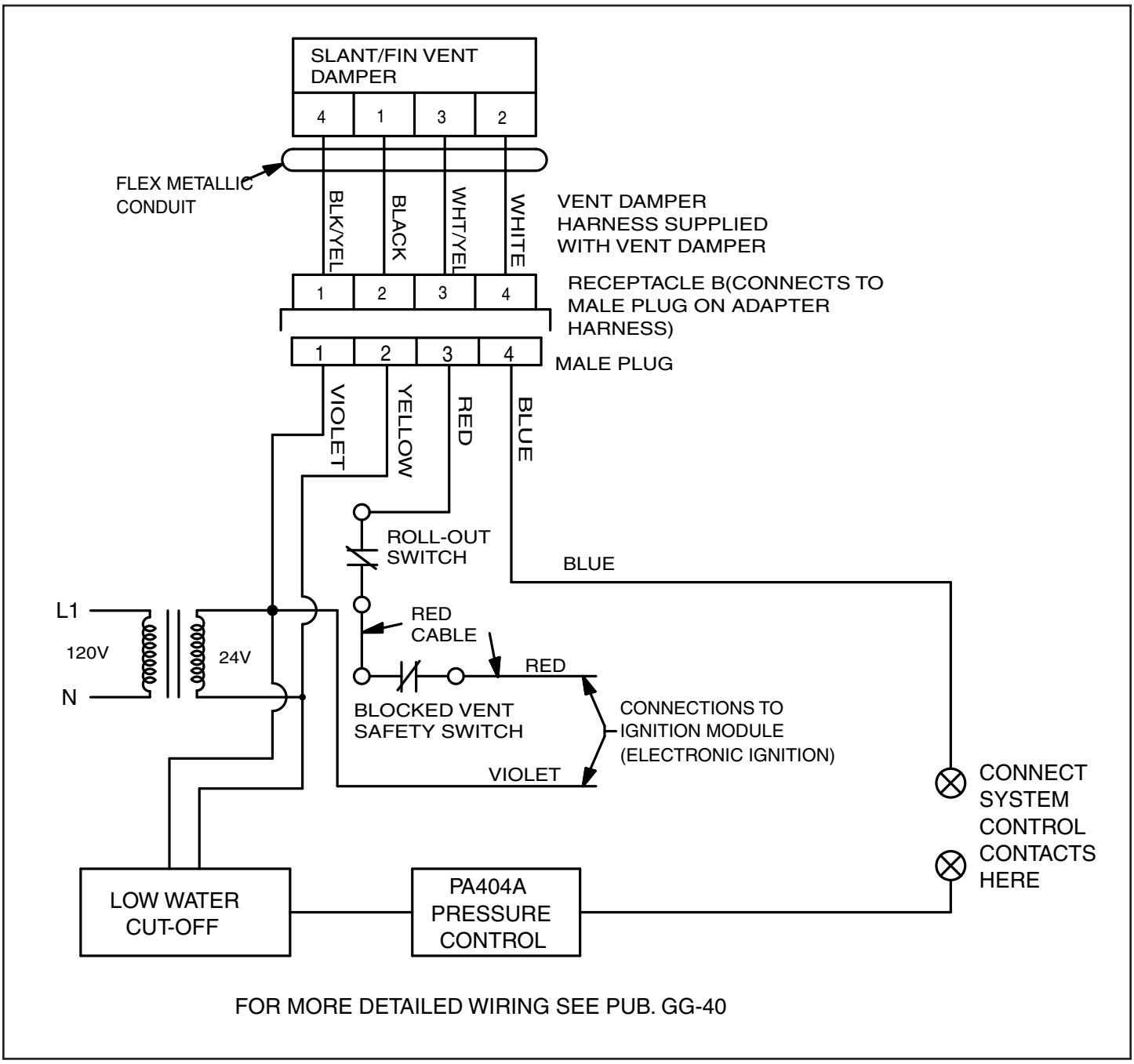

Figure 16: Wiring at module