

Installation and Operation Instructions for **Pennant™** Pool Heater Model PNCP

U.S. Reg. 2,765,423

FOR YOUR SAFETY: This product must be installed and serviced by a professional service technician, qualified in hot water boiler installation and maintenance. Improper installation and/or operation could create carbon monoxide gas in flue gases which could cause serious injury, property damage, or death. Improper installation and/or operation will void the warranty.

⚠ WARNING

If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
- Do not touch any electrical switch; do not use any phone in your building.
- Immediately call your gas supplier from a nearby phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

Installation and service must be performed by a qualified installer, service agency, or gas supplier.

⚠ AVERTISSEMENT

Assurez-vous de bien suivre les instructions données dans cette notice pour réduire au minimum le risque d'incendie ou d'explosion ou pour éviter tout dommage matériel, toute blessure ou la mort.

Ne pas entreposer ni utiliser d'essence ni d'autres vapeurs ou liquides inflammables dans le voisinage de cet appareil ou de tout autre appareil.

QUE FAIRE SI VOUS SENTEZ UNE ODEUR DE GAZ:

- Ne pas tenter d'allumer d'appareils.
- Ne touchez à aucun interrupteur. Ne pas vous servir des téléphones dans le bâtiment où vous vous trouvez.
- Appelez immédiatement votre fournisseur de gaz depuis un voisin. Suivez les instructions du fournisseur.
- Si vous ne pouvez rejoindre le fournisseur de gaz, appelez le service des incendies.

L'installation et l'entretien doivent être assurés par un installateur ou un service d'entretien qualifié ou par le fournisseur de gaz.

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SECTION 1. General Information

In the Commonwealth of Massachusetts, this appliance must be installed by a licensed plumber or gas fitter.

⚠ WARNING

The Pennant pool heater **must** be installed in accordance with the procedures detailed in this manual, or the Laars Heating Systems warranty may be voided. The installation must conform to the requirements of the local jurisdiction having authority, and, in the United States, to the latest edition of the National Fuel Gas Code, ANSI Z223.1/NFPA54. In Canada, the installation must conform to the latest edition of CAN/CGA-B149.1, Natural Gas Installation Code or CAN/CGA-B149.2, Propane Gas Installation Code, and/or local codes. Where required by the authority having jurisdiction, the installation of Pennant appliances must conform to the Standard for Controls and Safety Devices for Automatically Fired Boilers, ANSI/ASME CSD-1. Any modifications to the boiler, its gas controls, or wiring may void the warranty. If field conditions require modifications, consult the factory representative before initiating such modifications.

1.1 Introduction

This manual provides information necessary for the installation, operation, and maintenance of Laars Heating Systems Pennant copper tube pool heaters. Read it carefully before installation.

All application and installation procedures should be reviewed completely before proceeding with the installation. Consult the Laars Heating Systems factory, or local factory representative, with any issues or questions regarding this equipment. Experience has shown that most operating issues are caused by improper installation.

The Pennant appliance is protected against over pressurization. A pressure relief valve is fitted to all appliances. It is installed on the outlet header, at the water outlet of the appliance.

IMPORTANT: The inlet gas pressure to the appliance must not exceed 13" W.C. (3.2kPa).

All installations must be made in accordance with the 1). American National Standard Z223.1/NFPA54-Latest Edition "National Fuel Gas Code" or 2). CAN/CGA 1-B149 "Installation Codes for Gas Burning Appliances and Equipment" and with the requirement of the local utility or other authorities having jurisdiction. Such applicable requirements take precedence over the general instructions contained herein.

All electrical wiring is to be done in accordance with the local codes, or in the absence of local codes, with: 1). The National Electrical Code ANSI/NFPA No. 70-latest Edition, or 2). CSA STD. C22.1 "Canadian Electrical Code - Part 1". This appliance must be electrically grounded in accordance with these codes.

1.2 Model Identification

Consult the rating plate on the unit. The following information describes the model number structure.

Model Character Designation

1-3 Model Series Designation

P N C = Pennant

4 Usage

P = Pool Heater

5-8 Size

0 5 0 0 = 500,000 BTU/h input
0 7 5 0 = 750,000 BTU/h input
1 0 0 0 = 999,000 BTU/h input
1 2 5 0 = 1,250,000 BTU/h input
1 5 0 0 = 1,500,000 BTU/h input
1 7 5 0 = 1,750,000 BTU/h input
2 0 0 0 = 1,999,000 BTU/h input

9 Fuel

N = Natural Gas
P = Liquid Propane

10 Altitude

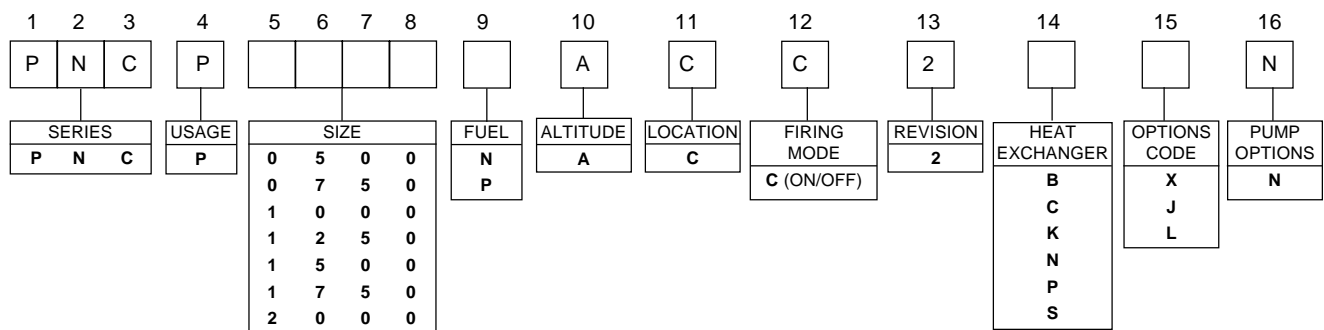
A = 0-10,000 feet

11 Location

C = Indoor and Outdoor

12 Firing Mode

C = On-off



13 Revision

2 = Second version

14 Heat Exchanger

B = Glass-lined CI / copper / brz trim (std. PNCP)

K = Bronze / copper

P = Glass-lined cast iron / cu-nickel / brz trim

S = Bronze / cu-nickel

15 Option Code

X = Standard unit

J = CSD-1, FM, IRI, IL

L = MN and LDS (Indoor units only)

16 Pump Options

N = Pump mounted, normal pump

1.3 Warranty

Laars Heating Systems' Pennant appliances are covered by a limited warranty. The owner should fill out the warranty registration card and return it to Laars Heating Systems.

All warranty claims must be made to an authorized Laars Heating Systems representative or directly to the factory. Claims must include the serial number and model (this information can be found on the rating plate), installation date, and name of the installer. Shipping costs are not included in the warranty coverage.

Some accessory items are shipped in separate packages. Verify receipt of all packages listed on the packing slip. Inspect everything for damage immediately upon delivery, and advise the carrier of any shortages or damage. Any such claims should be filed with the carrier. The carrier, not the shipper, is responsible for shortages and damage to the shipment whether visible or concealed.

1.4 Dimensions

(See Figure 1.)

1.5 Locating the Appliance

The appliance should be located to provide clearances on all sides for maintenance and inspection. It should not be located in an area where leakage of any connections will result in damage to the area adjacent to the appliance or to lower floors of the structure.

When such a location is not available, it is recommended that a suitable drain pan, adequately drained, be installed under the appliance.

The appliance is design certified by CSA-International for installation on combustible flooring; in basements; in closets, utility rooms or alcoves. The location for the appliance should be chosen with regard to the vent pipe lengths and external plumbing. The unit shall be installed such that the gas ignition system components are protected from water (dripping, spraying, rain, etc.) during operation and service (circulator replacement, control replacement, etc.). When vented vertically, the Pennant must be located as close as practical to a chimney or outside wall. If the vent terminal and/or combustion air terminal terminate through a wall, and there is potential for snow accumulation in the local area, both terminals should be installed at an appropriate level above grade.

The dimensions and requirements that are shown in Table 2 should be met when choosing the locations for the appliance.

HEATER SIZE	VENT COLLAR SIZE		HORIZONTAL VENT PIPE DIAMETER*		AIR COLLAR & PIPE DIAMETER		MAX. PIPE LENGTH		MAX. NO. OF ELBOWS	SIDE WALL VENT TERMINAL		SIDE WALL COMBUSTION AIR TERMINAL	
	IN.	CM	IN.	CM	IN.	CM	FT.	M		PART NUMBER	PART NUMBER	PART NUMBER	PART NUMBER
500	8	20	6	15	6	15	50	15	3	CA001401	20260701	20260701	20260701
750	10	25	8	20	6	15	50	15	3	CA001402	20260701	20260701	20260701
1000	10	25	8	20	8	20	50	15	3	CA001402	20260703	20260703	20260703
1250	12	30	8	20	8	20	50	15	3	CA001403	20260703	20260703	20260703
1500	12	30	8	20	8	20	50	15	3	CA001403	20260703	20260703	20260703
1750	14	36	8	20	8	20	50	15	3	CA001405	20260703	20260703	20260703
2000	14	36	12	30	12	30	50	15	3	CA001404	20260706	20260706	20260706

*Horizontal venting requires stainless vent pipe. See Table 5.

Table 1. Horizontal Vent / Combustion Air Parameters.

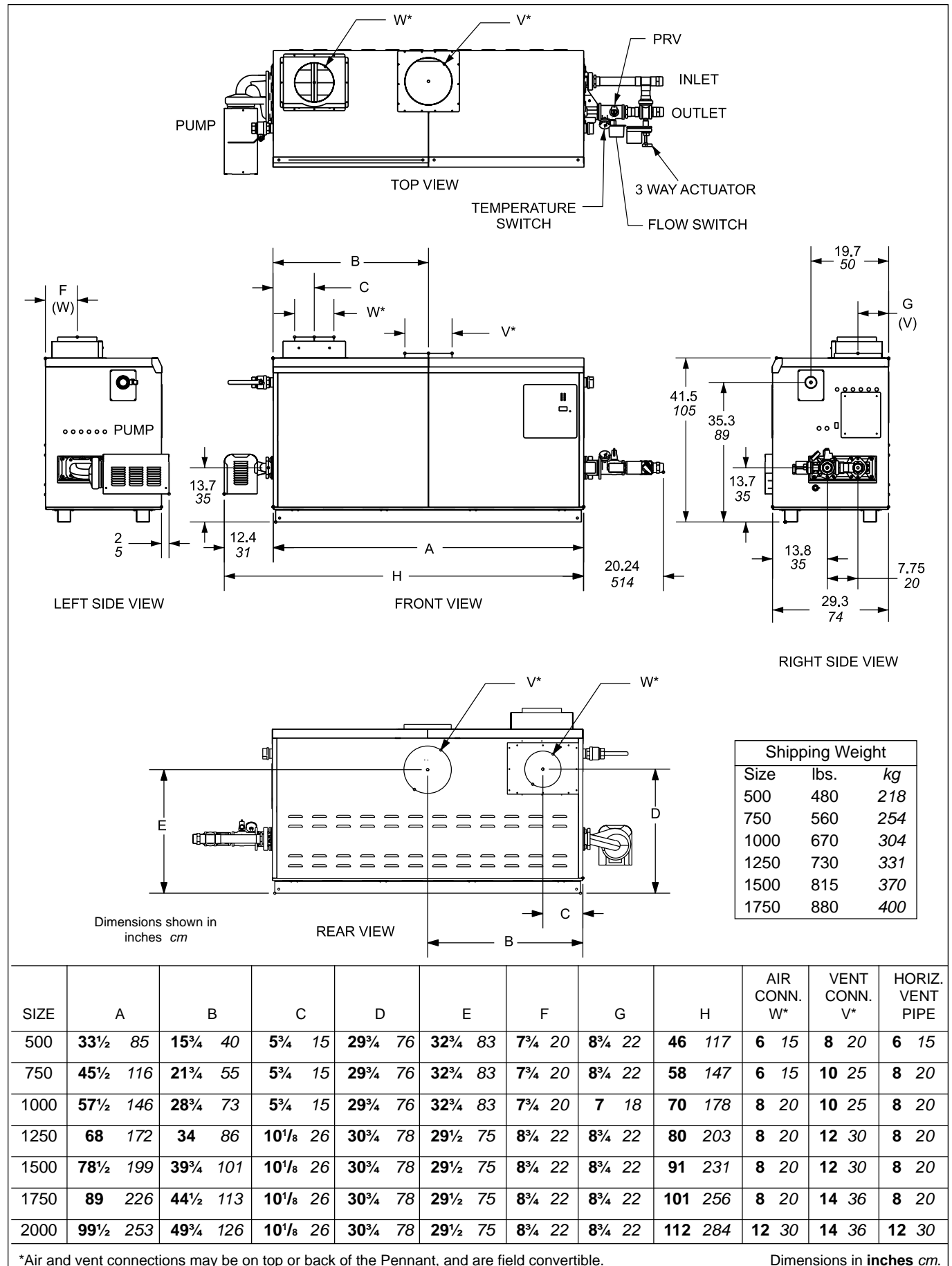


Figure 1. Dimensional Data.

1.6 Locating Heater with Respect to Pool System Loop

For the best results, the Pennant should be located within 15 feet (4.6m) of the pool system loop. The pump is sized for 30 feet (9.1m) of piping.

If the appliance must be installed with longer piping runs, then larger diameter piping shall be used. Consult the factory for assistance.

1.7 Locating Appliance for Correct Horizontal Vent/Ducted Air Distance From Outside Wall

The forced draft combustion air blower/blowers in the appliance has/have sufficient power to pull air and vent properly when the following guidelines for horizontal air and vent are followed (see Table 1).

NOTE: On all model sizes, the vent collar size is larger than the size of the vent pipe that can be used. Vent collar size and horizontal pipe diameters can be found in Table 1. The larger vent collar size is to accommodate Category I (vertical) vent systems.

NOTE: When located on the same wall, the Pennant combustion air intake terminal must be installed a minimum of 12" (30cm) below the exhaust vent terminal and separated by a minimum of 36 inches (91cm) horizontally.

The air intake terminal must be installed high enough to avoid blockage from snow, leaves and other debris. Never obtain combustion air from the pool area. Corrosion of and/or damage to the pool heater may result.

APPLIANCE SURFACE	REQUIRED CLEARANCE FROM COMBUSTIBLE MATERIAL		RECOMMENDED SERVICE ACCESS CLEARANCE	
	inches	cm	inches	cm
Left Side	1	2.5	24	61
Right Side	1	2.5	24	61
Top	1	2.5	12	30
Back	1	2.5	12**	30**
Front	1	2.5	36	91
Vertical (Category 1) Vent	6*	15.2*		
Horizontal (Category 3) Vent	per UL1738 venting system supplier's instructions			

*1" (2.5cm) when b-vent is used.

**When vent and/or combustion air connects to the back, recommended clearance is 36" (91cm).

Table 2. Clearances.

SECTION 2. Venting and Combustion Air

2.1 Combustion Air

Pennant pool heaters must have provisions for combustion and ventilation air in accordance with section 5.3, Air for Combustion and Ventilation, of the National Fuel Gas Code, ANSI Z223.1, or Sections 7.2, 7.3 or 7.4 of CAN/CGA B149, Installation Codes, or applicable provisions of the local building codes.

A Pennant appliance may receive combustion air from the space in which it is installed, or it can be ducted directly to the unit from the outside.

Ventilation air must be provided in either case. Never obtain combustion air from the pool area. Corrosion of and/or damage to the pool heater may result.

2.1.1 Combustion Air From Room

In the United States, the most common requirements specify that the space shall communicate with the outdoors in accordance with method 1 or 2, which follow. Where ducts are used, they shall be of the same cross-sectional area as the free area of the openings to which they connect.

Method 1: Two permanent openings, one commencing within 12 inches (30 cm) of the top and one commencing within 12 inches (30 cm) of the bottom, of the enclosure shall be provided. The openings shall communicate directly, or by ducts, with the outdoors or spaces that freely communicate with the outdoors. When directly communicating with the outdoors, or when communicating to the outdoors through vertical ducts, each opening shall have a minimum free area of 1 square inch per 4000 Btu/hr

BOILER SIZE	EACH OPENING*	
	SQUARE INCHES	SQUARE CM
500	125	807
750	188	1213
1000	250	1613
1250	313	2020
1500	375	2420
1750	438	2826
2000	500	3226

*Net Free Area in Square Inches / Square cm

Area indicated is for one of two openings; one at floor level and one at the ceiling, so the total net free area could be double the figures indicated.

This chart is for use when communicating directly with the outdoors. For special conditions and alternate methods, refer to the latest edition of ANSI Z223.1.

Note: Check with louver manufacturers for net free area of louvers. Correct for screen resistance to the net free area if a screen is installed. Check all local codes applicable to combustion air.

Table 3. Combustion Air Openings.

(5.5 square cm/kW) of total input rating of all equipment in the enclosure. When communicating to the outdoors through horizontal ducts, each opening shall have a minimum free area of not less than 1 square inch per 2000 Btu/hr (11 square cm/kW) of total input rating of all equipment in the enclosure. Table 3 shows data for this sizing method, for each Pennant model.

Method 2: One permanent opening, commencing within 12 inches (30 cm) of the top of the enclosure, shall be permitted. The opening shall directly communicate with the outdoors or shall communicate through a vertical or horizontal duct to the outdoors or spaces that directly communicate with the outdoors and shall have a minimum free area of 1 square inch per 3000 Btu/hr (7 square cm/kW) of the total input rating of all equipment located in the enclosure. This opening must not be less than the sum of the areas of all vent connectors in the confined space.

Other methods of introducing combustion and ventilation air are acceptable, providing they conform to the requirements in the applicable codes listed above.

In Canada, consult local building and safety codes or, in absence of such requirements, follow CAN/CGA B149.

2.1.2 Intake Combustion Air

Never obtain combustion air from the pool area. Corrosion of and/or damage to the pool heater may result. The combustion air can be taken through the wall, or through the roof. When taken from the wall, it must be taken from out-of-doors by means of the Laars horizontal wall terminal (see Table 2). When taken from the roof, a field-supplied rain cap or an elbow arrangement must be used to prevent entry of rain water (see Figure 2).

Use single-wall galvanized pipe, per table 4, for the combustion air intake (see Table 1 for appropriate size). Route the intake to the heater as directly as possible. Seal all joints with tape. Provide adequate hangers. The unit must not support the weight of the combustion air intake pipe. Maximum linear pipe length allowed is 50 feet (15.2m). Three elbows have been calculated into the 50-foot (15.2m) linear run. Subtract 10 allowable linear feet (3.0m) for every additional elbow used (see Table 1). When fewer than 3 elbows are used, the maximum linear pipe length allowed is still 50 feet (15.2m).

TERM	DESCRIPTION
Pipe	Single-wall galvanized steel pipe, 24 gauge minimum (either insulated or non-insulated)
Joint Sealing	Permanent duct tape or aluminum tape

Table 4. Required Combustion Air Piping Material.

The connection for the intake air pipe is on the filter box. The Pennant appliances may have venting and combustion air ducting attached to the top or the back. They are shipped with the connections at the top. For attaching either or both pipes to the back, the mounting flanges are reversible by removing the mounting screws and orienting the flanges in the desired position. Replace the screws after positioning flanges. Run a bead of silicone around the collar and slide the pipe over the collar. Secure with sheet metal screws.

In addition to air needed for combustion, air shall also be supplied for ventilation, including all air required for comfort and proper working conditions for personnel. The Pennant loses less than 1 percent of its input rating to the room, but other heat sources may be present.

2.2 Venting

2.2.1 Vent Categories

Depending upon desired Pennant venting, it may be considered a Category I or a Category III appliance. In general, a vertical vent system will be a Category I system. However, in rare instances, a Pennant's vertical vent system may be considered Category III. In the U.S., the National Fuel Gas Code (American National Standard Z223.1-Latest Edition), or in Canada the CSA B149.1 (latest edition), defines a Category I vent system, and includes rules and tables to size these vent systems. If the Pennant's vertical vent system does not satisfy the criteria for Category I venting, it must be vented as a Category III system.

All Pennant vent systems which discharge horizontally (without the use of a power venter) are considered Category III vent systems.

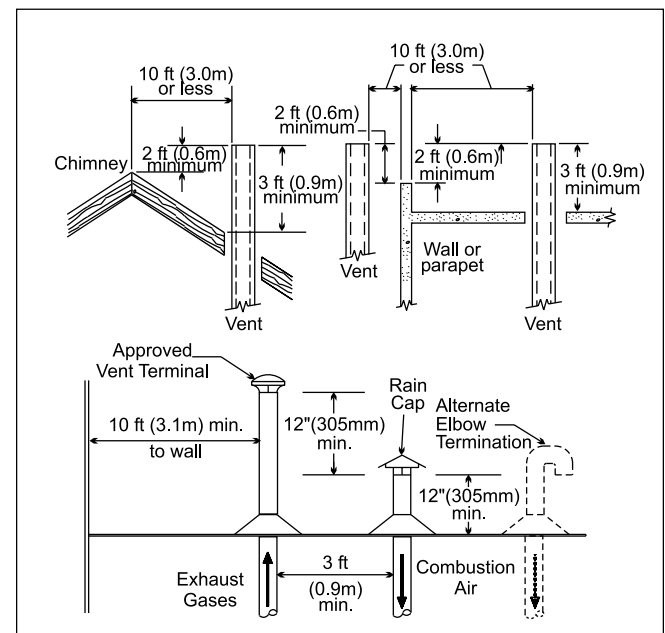


Figure 2. Combustion Air and Vent Through Roof.

2.2.2 Category I Vent

When vented as a category I appliance, the vent system must conform to the National Fuel Gas Code (American National Standard Z223.1-Latest Edition) in the U.S., or in Canada, to CSA B149.1 (latest edition). The vent system must be sized and installed for a Category I Fan-Assisted Appliance.

If chimney height is greater than 25 feet, or if multiple units are vented into the same vertical vent, a barometric damper must be installed on each appliance, such that the flue draft does not exceed (negative) 0.1" w.c.

If using a power venter for any type of Category I venting, the draft should be set between (negative) 0.01 and 0.10" w.c.

2.2.3 Common Venting Systems

Pennant units are Category I fan-assisted when vented vertically and adhering to all applicable codes. Pennant units are not allowed to be vented into a common horizontal vent system, unless a properly-sized vent fan is used, and the common vent system is properly designed by the vent fan manufacturer or a qualified engineer. When common venting Pennant fan-assisted heaters with other appliances through one shared vertical duct called a "common vent", special care must be taken by the installer to ensure safe operation. In the event that the common vent is blocked, it is possible, especially for fan-assisted devices, to vent backwards through non-operating appliances sharing the vent, allowing combustion products to infiltrate occupied spaces. **If the appliances are allowed to operate in this condition, serious injury or death may occur.**

⚠ WARNING

Operation of appliances with a blocked common vent may lead to serious injury or death. Safety devices must be implemented to prevent blocked common vent operation. If safe operation of all appliances connected to a common vent cannot be assured, including prevention of spillage of flue gasses into living spaces, common venting should not be applied, and appliances should each be vented separately.

It is for this reason that, in addition to following proper vent sizing, construction and safety requirements from the National Fuel Gas Code, ANSI Z223.1 or in Canada, from CSA B149.1 as well as all applicable local codes, it is required that installers provide some means to prevent operation with a blocked common vent. It is suggested that a blocked vent safety system be employed such that if the switch from one appliance trips due to excessive stack spill or backpressure indicating a blocked vent condition, that all appliances attached to the vent be locked out and prevented from operating. (Note that the Pennant Pool

Heater is equipped with a blocked vent safety (pressure) switch, as shipped.) As an additional precaution, it is recommended that a Carbon Monoxide (CO) alarm be installed in all enclosed spaces containing combustion appliances. If assistance is required in determining how a blocked vent safety system should be connected to a LAARS product, please call Applications Engineering at (603) 335-6300.

Refer to the installation and operating instructions on all appliances to be common vented for instructions, warnings, restrictions and safety requirements. If safe operation of all appliances connected to a common vent cannot be assured, including prevention of spillage of flue gasses into living spaces, common venting should not be applied, and appliances should each be vented separately.

2.2.4 Category III Vent

When the Pennant is vented with horizontal discharge, it must be installed per this installation manual and the venting system manufacturer's installation instructions. The vent system must be sealed stainless steel, per Table 5.

Route the vent pipe to the heater as directly as possible. Seal all joints and provide adequate hangers as required in the venting system manufacturer's Installation Instructions. Horizontal portions of the venting system must be supported to prevent sagging and may not have any low sections that could trap condensate. The unit must not support the weight of the vent pipe. Horizontal runs must slope downwards not less than ¼ inch per foot (2 cm/m) from the unit to the vent terminal. Reference Table 2 for the size of the Category III vent system. Up to three elbows can be used with 50 linear feet (15.2m) of pipe. Subtract 10 allowable linear feet (3.0m) for every additional elbow used.

TERM	DESCRIPTION
Pipe	Must comply with UL Standard 1738 such as Type 29-4C Stainless Steel (either insulated or non-insulated).
Joint Sealing	Follow vent manufacturer's instructions

Table 5. Required Horizontal Venting Material.

2.3 Locating Vent & Combustion Air Terminals

2.3.1 Side Wall Vent Terminal

The Laars side wall vent hood (listed in Table 1) must be used when the heater is vented through a side wall. It provides a means of installing vent piping through the building wall, and must be located in accordance with ANSI Z223.1/NFPA 54 and applicable local codes. In Canada the installation must be in accordance with CAN/CGA B149.1 or .2 and

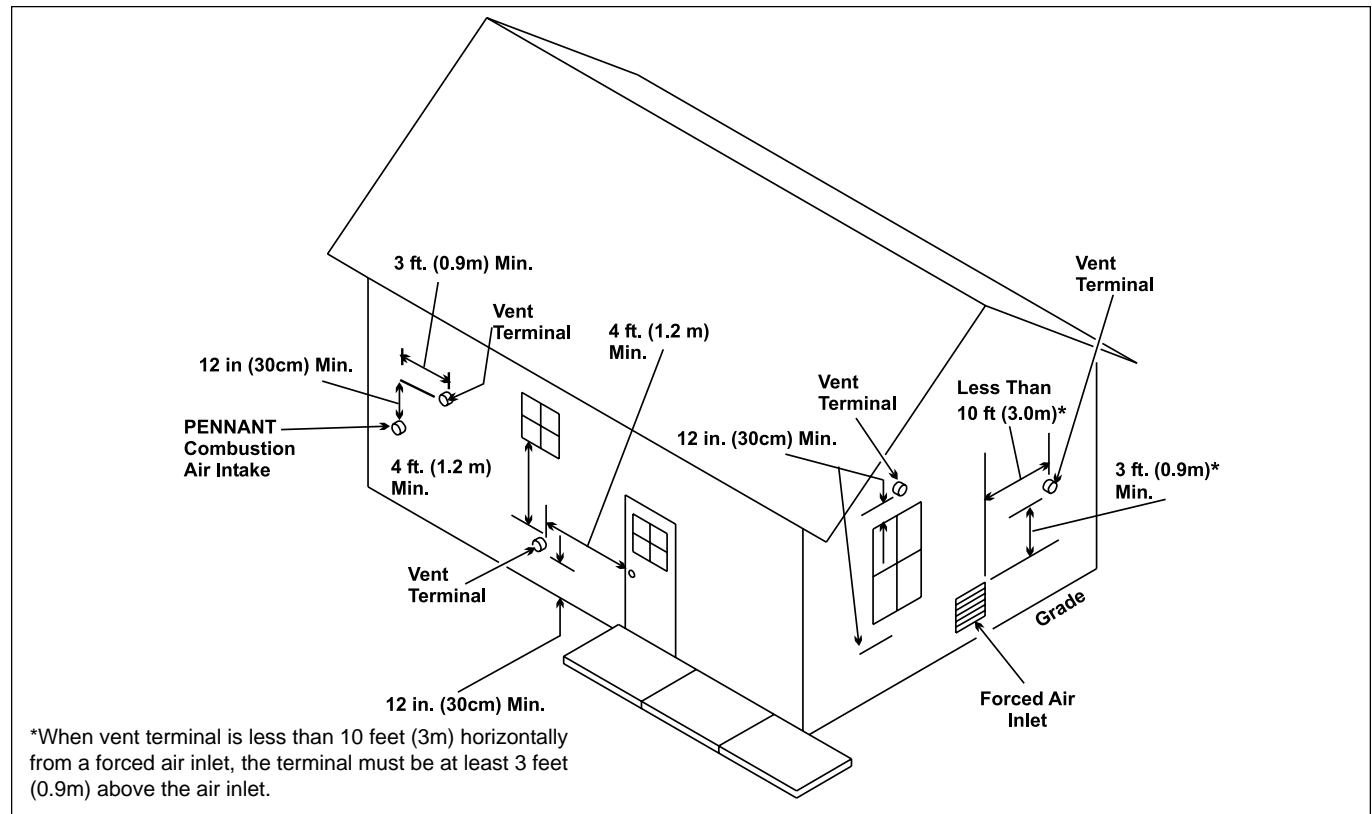


Figure 3. Combustion Air and Vent Through Side Wall.

local applicable codes (see Figure 3). Consider the following when installing the terminal:

- Through-the-wall vent terminals must terminate at least 7-feet above a public walkway.
- Locate the vent terminal so that vent gases cannot be drawn into air conditioning system inlets. The National Fuel Gas Code requires that it be at least 3 feet (0.9m) above any such inlet that is within a horizontal distance of 10 feet (3m).
- Locate the vent terminal so that vent gases cannot enter the building through doors, windows, gravity inlets or other openings. The National Fuel Gas Code requires that it be located at least 4 feet (1.2m) below, 4 feet (1.2m) horizontally from, or 1 foot (0.3m) above such openings. Whenever possible, locations under windows or near doors should be avoided.
- Locate the vent terminal so that it cannot be blocked by snow. The National Fuel Gas Code requires that it be at least 12 inches (30 cm) above grade, but the installer may determine it should be higher, depending upon local conditions.
- Locate the terminal so the vent exhaust does not settle on building surfaces and other nearby objects. Vent products may damage such surfaces or objects.
- Locate the terminal at least 6 feet (1.8m) horizontally from any gas or electric metering, regulating, or relief equipment.
- If the Pennant uses ducted combustion air from an intake terminal located on the same wall, locate the vent terminal at least 3 feet (0.9m) horizontally from the combustion air terminal, and locate the vent terminal at least 1 foot (0.3m) above the combustion air terminal.
- Note that side wall vent terminals for models 750-2000 are shipped with reducers for the vent collars, to accommodate horizontal vent sizes, shown in Table 1.

⚠ WARNING

The outdoor vent terminal gets hot. Unit must be installed in such a way as to reduce the risk of burns from contact with the vent terminal.

2.3.2 Side Wall Combustion Air Terminal

Never obtain combustion air from the pool area. Corrosion of and/or damage to the pool heater may result. The Laars side wall combustion air terminal (listed in Table 1) must be used when the unit takes its combustion air through a duct from a side wall.

Consider the following when installing the terminal:

- Do not locate the air inlet terminal near a source of corrosive chemical fumes (e.g., cleaning fluid, chlorinated compounds, etc.)
- Locate the terminal so that it will not be subject to damage by accident or vandalism.
- Locate the combustion air terminal so that it cannot be blocked by snow. The National Fuel

Gas Code requires that it be at least 12 inches (30 cm) above grade, but the installer may determine it should be higher, depending upon local conditions.

4. If the Pennant is side-wall vented to the same wall, locate the vent terminal at least 3 feet (0.9m) horizontally from the combustion air terminal, and locate the vent terminal at least 1 foot (0.3m) above the combustion air terminal (see Figure 3).

2.3.3 Vertical Vent Terminal

When the unit is vented through the roof, the vent must extend at least 3 feet (0.9m) above the point at which it penetrates the roof. It must extend at least 2 feet (0.6m) higher than any portion of a building within a horizontal distance of 10 feet (3.0m), and high enough above the roof line to prevent blockage from snow. When the combustion air is taken from the roof, the combustion air must terminate at least 12" (30cm) below the vent terminal (see Figure 2).

2.3.4 Vertical Combustion Air Terminal

When combustion air is taken from the roof, a field-supplied rain cap or an elbow arrangement must be used to prevent entry of rain water (see Figure 2). The opening on the end of the terminal must be at least 12" (30cm) above the point at which it penetrates the roof, and high enough above the roof line to prevent blockage from snow. When the vent terminates on the roof, the combustion air must terminate at least 12" (30cm) below the vent terminal.

2.4 Vent Terminals for Outdoor Units

For outdoor applications, the vent and combustion air openings must be covered with proper terminals to prevent rain, snow and other objects from falling into the Pennant.

Part numbers for the terminals to cover the vent and combustion air openings are shown in Table 6. Vent opening must be on top of the unit, and the combustion air opening must be on the back of the unit. The terminals are connected directly to the unit. No vent piping is used.

Alternately, the installer may use a short piece of

SIZE	OUTDOOR VENT TERMINAL	OUTDOOR COMBUSTION AIR TERMINAL
500	20254703	D2007900
750	20254705	D2007900
1000	20254705	D2008000
1250	D2007700	D2008000
1500	D2007700	D2008000
1750	D2007800	D2008000
2000	D2007800	D2008200

Table 6. Vent Terminals for Outdoor Units

galvanized single wall or B-vent and an approved rain cap for the vent termination. A minimum 12" of vent height is acceptable. In addition, a properly sized single wall galvanized 90° ell can be used for the intake air terminal, with the open end of the ell facing down to prevent rain infiltration. The combustion air inlet opening must still be high enough to prevent blockage by snow (see Section 2.3.2).

SECTION 3. Gas Supply and Piping

3.1 Gas Supply and Piping

Gas piping should be supported by suitable hangers or floor stands, not by the appliance.

The Pennant's gas train allows the user to pipe the gas from either the right side or the left side of the unit. As shipped, the right side of the gas train is capped off, and there is a manual valve on the left side. If desired, the manual valve on the left side of the gas train may be moved to the right side, and the cap on the right side may be moved to the left.

Review the following instructions before proceeding with the installation.

1. Verify that the appliance is fitted for the proper type of gas by checking the rating plate. Laars Heating Systems appliances are normally equipped to operate at elevations up to 2000 feet (610m). Pennant appliances may be adjusted to operate properly at higher elevations; however, input will be reduced if the heating value of the gas supply is below sea level values.
2. The maximum inlet gas pressure must not exceed

SIZE AND GAS TYPE	DISTANCE FROM GAS METER OR LAST STAGE REGULATOR					
	0-100'	0-31m	100-200'	31-61m	200-300'	61-91m
500 natural	1-1/2"	3.8cm	2"	5.1cm	2"	5.1cm
500 propane	1"	2.5cm	1-1/2"	3.8cm	1-1/2"	3.8cm
750 natural	2"	5.1cm	2"	5.1cm	2-1/2"	6.4cm
750 propane	1-1/2"	3.8cm	1-1/2"	3.8cm	2"	5.1cm
1000 natural	2"	5.1cm	2-1/2"	6.4cm	3"	7.6cm
1000 propane	1-1/2"	3.8cm	2"	5.1cm	2-1/2"	6.4cm
1250 natural	2-1/2"	6.4cm	2-1/2"	6.4cm	3"	7.6cm
1250 propane	2"	5.1cm	2"	5.1cm	2-1/2"	6.4cm
1500 natural	2-1/2"	6.4cm	3"	7.6cm	3"	7.6cm
1500 propane	2"	5.1cm	2-1/2"	6.4cm	2-1/2"	6.4cm
1750 natural	2-1/2"	6.4cm	3"	7.6cm	3"	7.6cm
1750 propane	2"	5.1cm	2-1/2"	6.4cm	2-1/2"	6.4cm
2000 natural	3"	7.6cm	3"	7.6cm	3-1/2"	8.9cm
2000 propane	2-1/2"	6.4cm	2-1/2"	6.4cm	3"	7.6cm

Notes:

1. These figures are based on 1/2" (0.12kPa) water column pressure drop.
2. Check supply pressure and local code requirements before proceeding with work.
3. Pipe fittings must be considered when determining gas pipe sizing.

Table 7. Gas Piping Size.

- 13" W.C (3.2kPa). The minimum inlet gas pressure is 5" W.C. (1.2kPa).
3. Refer to Table 7, size supply.
 4. Run gas supply line in accordance with all applicable codes.
 5. Locate and install manual shutoff valves in accordance with state and local requirements.
 6. A sediment trap must be provided upstream of the gas controls.
 7. All threaded joints should be coated with piping compound resistant to action of liquefied petroleum gas.
 8. The appliance and its individual shutoff valve must be disconnected from the gas supply piping during any pressure testing of that system at test pressures in excess of 1/2 PSIG (3.45kpa).
 9. The unit must be isolated from the gas supply system by closing its individual manual shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 PSIG (3.45kpa).
 10. The appliance and its gas connection must be leak tested before placing it in operation.
 11. Purge all air from gas lines.

⚠ Caution

Do not use open flame to check for leaks.

NOTE: The Pennant appliance and all other gas appliances sharing the gas supply line must be firing at maximum capacity to properly measure the inlet supply pressure. The pressure can be measured at the supply pressure port on the gas valve. Low gas pressure could be an indication of an undersized gas meter, undersized gas supply lines and/or an obstructed gas supply line. The Pennant may not fire if the gas pressure lower than 5" w.c.

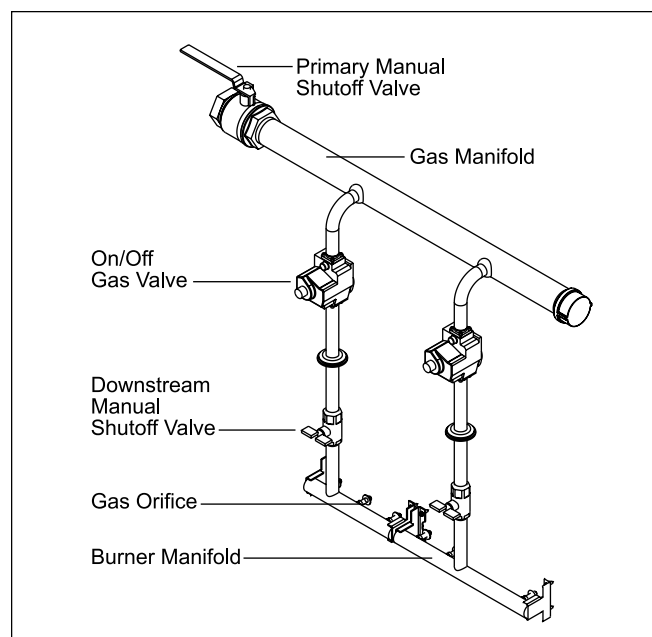


Figure 4. Typical Gas Train Configuration.

SECTION 4. Water Connections

4.1 Piping

Hot water piping should be supported by suitable hangers or floor stands. Do not support piping with this appliance. Due to expansion and contraction of copper pipe, consideration should be given to the type of hangers used. Rigid hangers may transmit noise through the system resulting from the piping sliding in the hangers. It is recommended that padding be used when rigid hangers are installed. Maintain 1" clearance to combustibles for hot water pipes.

Pipe the discharge of the relief valve (full size) to a drain or in a manner to prevent injury in the event of pressure relief. Install shutoff valves where required by code.

Pennant Pool Heaters are equipped with mounted pumps, which serve the heater plus 30 feet of full-sized piping with a normal number of fittings. If the pool's loop is more than 15 feet away from the heater, please contact the factory.

A mixing system is mounted on the heater. The system consists of a three-way valve, temperature control and piping. The temperature sensor for the control is in the heater inlet. When the control detects water temperature that is below 120°F (49°C), it will direct the three-way valve to actuate, which sends water from the outlet of the heater back to the inlet. The outlet water that is diverted to the inlet mixes with the return water from the pool, and keeps the inlet temperature at or above 120°F (49°C) (see Figure 5). This keeps cold return water from causing condensing on the outside of the Pennant heat exchanger.

IMPORTANT NOTE: Since heater outlet temperatures can reach 150°F (66°C) in some cases, copper or CPVC are recommended materials for heater connection piping. PVC material may be used for the inlet valve and the piping upstream of it.

When pipe, fittings, grids or any other element of the filter system are made of plastic materials, they may be damaged by the momentary "back siphoning"

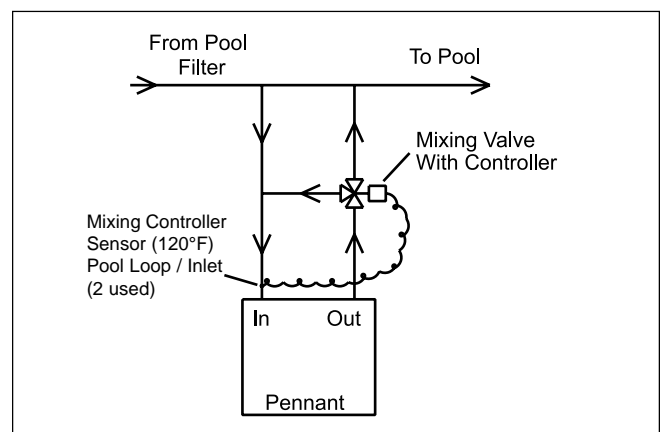


Figure 5. Mixing System.

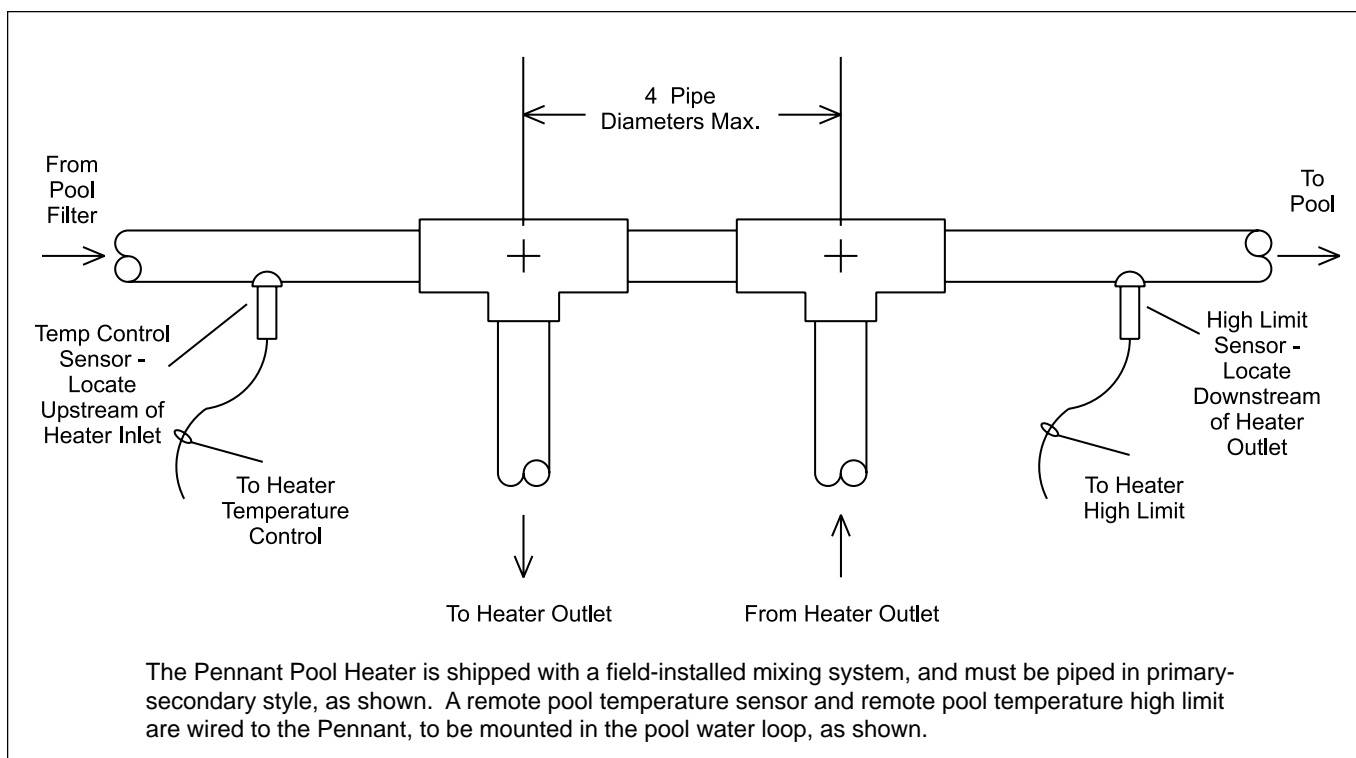


Figure 6. Pool Heater Piping.

of hot water from the heater when the filter pump stops running.

See Figure 6 for proper connection of the Pennant heater to the pool loop.

4.2 Automatic Chlorinators

A concentration of chlorine in the heater can be very destructive; therefore the following rules about the installation and operation of such devices must be followed:

1. The chlorinator should be installed so it introduces the gas or solution downstream of the heater.
2. The chlorinator should be wired so it cannot operate unless the filter pump is operating.
3. The chlorinator should be provided with an anti-siphon device so that the draining of the piping after the pump shuts off will not siphon chlorine solution into the heater.
4. When the operation of a chlorinator is such that it must be installed in the pump suction, or some other place where the chlorine solution flows through the heater, corrosion of the heater can occur. Excessive concentrations of chlorine resulting from improper adjustment or chlorinator equipment failure are responsible for this corrosion. The heater warranty does not cover the resulting damage to the heat exchanger.

4.3 Sensor Locations

Two sensors must be installed in the pool loop, as shown in Figure 5. The inlet sensor for the temperature control must be installed in the pool loop

within 12" (30 cm) of the inlet to the heater. This sensor is **not** installed in a well. For sensitivity, it must be installed in direct contact with the pool water flow. The second sensor, the high limit sensor, must be installed in the pool loop within 12" (30 cm) downstream of the heater outlet. This sensor is a capillary and bulb. It shall be used with the immersion well that is provided.

SECTION 5. Electrical Connections

⚠ WARNING

The appliance must be electrically grounded in accordance with the requirements of the authority having jurisdiction or, in the absence of such requirements, with the latest edition of the National Electrical Code, ANSI/NFPA 70, in the U.S. and with latest edition of CSA C22.1 Canadian Electrical Code, Part 1, in Canada. Do not rely on the gas or water piping to ground the metal parts of the boiler. Plastic pipe or dielectric unions may isolate the boiler electrically. Service and maintenance personnel, who work on or around the boiler, may be standing on wet floors and could be electrocuted by an ungrounded boiler.

Single pole switches, including those of safety controls and protective devices must not be wired in a grounded line.

All electrical connections are made in the field

wiring terminal strip, which is located at the right side of the appliance.

NOTE: All internal electrical components have been prewired. No attempt should be made to connect electrical wires to any other location except the field wiring strip.

5.1 Main Power

Pennant appliances are fitted with pigtail leads for main power connection. Connect a fused 15-ampere, 120-volt supply to the black wire. Neutral leg is connected directly to the white wire. Ground wire is connected to the green wire. Pump-mounted units, sizes 1250 to 2000, have separate electrical connections for the pump. Either connect these to a separate 15A circuit or increase the circuit size for the main boiler to accommodate the additional pump load.

Wiring diagrams are shown in Section 10 in Figures 12 through 15. Field wiring is shown in Section 10 in Figures 17 and 18.

IMPORTANT NOTE: If the backwash operation is manual the heater must be shut off manually during backwashing.

Auxiliary Time Clock Wiring:

If a time clock is used to control the pool filter pump operation, a separate switch or relay must be used to shut off the heater at least 15 Minutes before the filter pump is shut off. A remote switch or relay, if installed, should be connected across the “Other Ints” terminals on the field-wiring terminal board after removing the factory-installed jumper. For manual shut off, a switch is provided and identified with a label on the right side of the heater.

All field-installed electrical safety devices and controllers may also be connected across the Pennant’s “Other Ints” terminals after the factory-installed jumper is removed. If a remote switch or

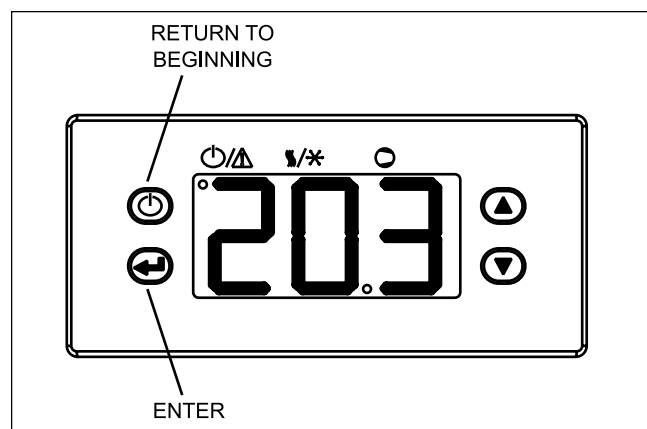


Figure 7. Pool Heater Controller.

relay (mentioned above) is installed, the other field-installed electrical safety devices and controllers should be wired in series with that switch or relay.

5.2 Temperature (Operating) Control

The Pennant temperature control operates by measuring the pool loop return temperature, before the heater inlet piping. It is adjustable to a maximum of 104° F and will prevent heater operation at return temperatures above 104° F. It also controls the pool heater pump and the temperature of the water entering the heat exchanger. It also controls the Pennant pump operation and the mixing system, which tempers the water entering the heat exchanger to prevent damage from condensation. The sensors for the control are installed as shown in Figure 6 and Section 4.3, Sensor Locations. The automatic mixing system sensor, already installed, is shown in Figure 5. During operation, the automatic mixing system diverts water from the outlet to the inlet to “pre warm” the water to a minimum inlet temperature of 120°F. This prevents condensation from forming, which can damage the heater.

5.3 Programming the Temperature Control

5.3.1 Temperature Control Overview

The digital display on the control has the following uses:

- To display the actual pool loop temperature during normal operating mode.
- To allow the user to view and adjust the control settings.

Figure 6 identifies the control buttons.

The Pool Heater Temperature Control face contains an LCD screen and four (4) buttons (see Figure 7). The LCD screen will display the pool loop return temperature during normal operation. When the control is first powered up, it displays $\square\square\square$. It then displays the temperature at the pool loop sensor. After the temperature is displayed, the current settings (parameters) may be viewed. To scroll through the parameters, press the down arrow button to advance to the next parameter.

Pump-Mounted 500–1000		
BOILERS / WATER HEATERS		
VOLTS	PHASE	AMPS
115	Single	Less than 12
PUMP		
Included in Pennant Connection		
BLOWER(S)		
Included in Pennant Connection		
Pump-Mounted 1250–2000		
BOILERS / WATER HEATERS		
VOLTS	PHASE	AMPS
115	Single	Less than 12
PUMP		
VOLTS	PHASE	AMPS
115	Single	Less than 12
BLOWER(S)		
Included in Pennant Connection		
Table 8. Electrical Data.		

Table 8. Electrical Data.

5.3.2 Programming Control Parameters

There are four (4) control parameters that may be set. They are the Pool Loop Temperature (LSP), the Pool Loop Temperature Differential (dLS), the Boiler Temperature (bsp) and the Pump Off Delay (Pd).

The pool loop temperature (desired pool temperature) is set by changing the LSP parameter. After scrolling through the parameters until LSP is displayed, press the enter button. The setpoint will be displayed. Press the up arrow or down arrow buttons until the desired setpoint is displayed. Press the enter button and the setpoint will be activated. The display will return to indicating the present pool loop temperature.

In addition to the ability to set the pool loop temperature, the differential associated with that setting may also be adjusted. The differential is set by changing the dLS parameter. After scrolling through the parameters until dLS is displayed, press the enter button. The setpoint will be displayed. Press the up arrow or down arrow buttons until the desired setpoint is displayed. Press the enter button and the setpoint will be activated. The display will return to indicating the present pool loop temperature.

The boiler operating temperature is set by changing the bsp parameter. After scrolling through the parameters until bsp is displayed, press the enter button. The setpoint will be displayed. Press the up arrow or down arrow buttons until the desired setpoint is displayed. Press the enter button and the setpoint will be activated. The display will then return to indicating the pool loop temperature.

The last parameter that may be adjusted is Pd, the pump off delay. After again scrolling through the parameters until Pd is displayed, press the enter button. The pump delay time will be displayed. The pump off delay may be set between 0.1 and 10 minutes. Press the up arrow or down arrow buttons until the desired setpoint is displayed. Press the enter button and the setpoint will be activated. The display will again return to indicating the present pool loop temperature.

By depressing the upper left hand button at any time during the programming, the menu may be returned to the beginning.

5.3.3 Setpoint - LSP

The setpoint is the desired temperature around which the heater will control (desired pool temperature). It is adjustable between 60° F and 104° F.

5.3.4 Differential - dLS

The differential (dLS) is the number of degrees between the temperature at which the heater turns off and the temperature at which the heater restarts. It is adjustable from 1° F to 10° F.

5.3.5 Pump Operation

The pump energizes when there is a heat demand.

5.3.6 Heater Purge (Pump Delay) - Pd

After a demand is satisfied, the pump will continue to run for a preset length of time. That length of time is adjustable from 0.1 to 10 minutes and is programmed by the parameter Pd.

Caution

Should overheating occur or the gas supply fail to shut off, turn off the manual gas control valve to the appliance.

5.4 Limit Controls

In addition to the pool heater temperature control, Pennant appliances are fitted with a Pool Loop high limit set at 135° F and an automatic reset heater high limit with a maximum setting of 190° F.

The Pool Loop high-limit sensing bulb is to be installed in the sensor well (supplied), downstream of the heater (see Figure 6). If sufficient capillary length exists to reach the sensor location, the control may remain in its location near the rear of the cabinet on the right side, behind the slide out drawer (see Figure 9). If the sensor location is farther from the heater than the capillary will reach to, then the control should be moved to the remote location and the wires extended to the new location of the control. If the controller needs to be moved, and it is being moved to an outdoor location, the control will need to be put in a weather-tight enclosure to protect it from rain, snow, etc.

The other limit control limits the temperature of the discharge from the heat exchanger to a maximum of 190° F. This limit should be set to a minimum of 175° F. To set the limit controls, remove the control panel cover and pull the control panel out to gain access. Appliances with reversed heat exchangers have the limit controls relocated to the left side of the appliance. The left access door must be removed to gain access to the limit controls on these appliances.

SECTION 6. Operating Instructions

6.1 Sequence of Operation

The amber "Ready" light on the front panel indicates that the control system is energized. Upon a call for heat from the pool temperature control, the green "Heat" indicator on the front panel will light.

The green "Pump" indicator on the front panel will light.

Once the water flow switch makes, and if all of the safety interlocks are closed, the ignition module(s) will energize the blower(s) for a 15-second pre-purge, followed by a 20-second period to allow the ignitor(s) to heat.

Energizing the blower pressurizes the air box (which supplies air to the burners) and closes the

normally-open contact(s) of the airflow pressure switch(es). This allows the ignition module to proceed with the ignition sequence.

The blocked flue pressure switch senses the pressure difference between the exhaust plenum and the blower inlet plenum. It will interrupt the airflow sensing circuit if this pressure exceeds a maximum value. If airflow is not proven, the ignition module will either attempt ignition again (up to three times) or will lockout (if the optional lockout ignition module is used).

The ignition module checks that the ignitor current has reached a minimum value and energizes the gas valves at the end of the ignitor-heating period. The green indicators on the front panel will light, indicating that the gas valves are open.

After a 4-second trial for ignition, the ignitor switches off, and unless the flame sensor detects a flame, the gas valves will close and the ignition module will either attempt ignition again (up to three times) or will lockout (if the optional lockout ignition module is used). *Note: at this point, if gas pressure is below the required 5" w.c. minimum, the pool heater will lock out.*

If flame is sensed, the burner will continue to fire as long as there is a call for heat. Pennant 1250, 1500, 1750 and 2000 models start at part load. When the gas valves controlled by the first ignition module are energized, the second ignition module is energized and enters the same ignition sequence just described. If there is a subsequent loss of flame signal, the burner will attempt re-ignition up to three times (only once if optional lockout ignition module is used.) Loss of flame signal from the first ignition module will cause shutdown of the heater.

When the call for heat is satisfied, the gas valves close and the blower(s) continues to run for 30 seconds. The pump will continue to run for the length of time selected at startup by the adjustment of the pump time delay (Pd).

If a call for heat is prevented from being satisfied either by a safety interlock or due to an ignition lockout, the red "Service" indicator on the front panel will light. To reset the standard ignition module, toggle the Pennant power switch off, and then on again. (To reset the optional single try lockout ignition module, the reset button on the module must be pressed. Interrupting power to this module will not reset the lockout.)

The Pennant 1250, 1500, 1750 and 2000 models have two ignition modules that control different burners.

6.2 Filling the Heater System

1. Ensure the system is fully connected, filled with water and all valves are open.
2. Start up heater according to the procedure in this manual. Operate the entire system for one (1) hour.

3. After placing the unit in operation, the ignition system safety shutoff device must be tested. First, shut off the manual gas valve, and call the unit for heat. After the pre-purge and ignitor heat-up time, the main gas terminals will be energized, attempting to light, for four (4) seconds, and then will de-energize. The unit will go into lockout mode. Second, turn the power off and then on again, push the reset button (optional Ignition Module only), open the manual gas valve and allow the unit to light. While the unit is operating, close the manual gas valve and ensure that power to the main gas valve no longer exists.
4. Check the entire system for leaks.

Caution

Protect the heater from low pH water if an "acid start up" or similar technique is used. Corrosion of the heater and heat exchanger due to low pH water is not covered under the limited warranty. The water must be neutralized to normal pH levels before filling the heater and starting up the system.

Important: The installer is responsible for identifying to the owner/operator the location of all emergency shutoff devices.

WARNING

Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control that may have been under water.

6.3 Operating the Burner and Set Up

6.3.1 Set Up for 0 to 2500 Feet Altitude

The setup must be checked before the unit is put in operation. Problems such as failure to start, rough ignition, strong exhaust odors, etc. can be due to improper setup. Damage to the heater resulting from improper setup is not covered by the limited warranty.

1. Using this manual, make sure the installation is complete and fully in compliance with the instructions.
2. Determine that the appliance and system are filled with water and all air has been bled from both. Open all valves.
3. Observe all warnings on the Operating Instructions label and turn on gas and electrical power to appliance.
4. Switch on the appliance power switch located on the right side of the unit.
5. The Pennant will enter the start sequence, as long as the unit is being called for heat. The blower and pump come on for pre-purge, then the ignitor warm-up sequence starts and after the ignitor

warm-up is complete and all safety devices are verified, the gas valves open. If ignition doesn't occur, check that there is proper gas supply. Wait 5 minutes and start the unit again. During initial start up, air in the gas line may cause the Pennant to "lock out" during the first few trials for ignition. Depending on the ignition modules installed, the manual reset button on the ignition module(s) may need to be depressed to restart the heater.

6. When the unit is running, the supply gas pressure must be checked. Inlet gas pressure must not exceed 13" W.C. (3.2kPa). The minimum inlet gas pressure is 5" W.C. (1.2kPa).
7. Once the inlet gas pressure is verified, the outlet gas pressure from each valve (manifold gas pressure) must be checked, and adjusted, if necessary. The manifold gas pressure must be 2.5" W.C. (0.62kPa).
8. Complete the setup by checking the CO₂ at the outlet of the unit. The CO₂ should be 8% for natural gas, or 9.2% for propane.
9. **After placing the appliance in operation, the Burner Safety Shutoff Device must be tested.** To test:
 - (a) Close gas shutoff valve with burner operating.
 - (b) The flame will go out and blower will continue to run for the post purge cycle. Three (3) additional attempts to light will follow (only one (1) attempt for optional module). Ignition will not occur as the gas is off. The ignition control will lockout, and will have to be reset before the unit will operate. The ignition control reset button is located on each ignition control, in the lower right corner, and can be reset by depressing. It is not marked on the ignition control label.
 - (c) Open gas shutoff valve. Restart the appliance. The ignition sequence will start again and the burner will start. The appliance will return to its previous mode of operation.

NOTE: Models 1250, 1500, 1750 and 2000 have two ignition controls and two ignitors.

6.3.2 High Altitude Adjustment and Set Up

Pennant appliances may be operated at high altitude (7700 ft., 2347 m) with a reduction in output of approximately 10%. At elevations higher than 7700 ft. (2347 m) the reduction in output will exceed 10% and at elevations below 7700 ft. (2347 m) it will be less than 10%. When adjusted properly, the appliance will perform properly at any altitude. High altitude adjustment must not be made on appliances operating at elevations below 2500 ft. (762 m).

No orifice changes are required to adjust the

Pennant appliances for high altitude. High altitude adjustment is accomplished by adjustment of the gas valve manifold pressure and the air shutter(s). The required instruments used to assist in these adjustments are a CO₂ or O₂ Analyzer and a U-Tube Manometer or other device capable of reading a pressure of 2.5-3.0 inches W.C. (0.62-0.75 kPa).

Start the adjustment process by checking the CO₂ in the "as installed" condition. Adjust the air shutter(s) so that the CO₂ is about 8% or the O₂ is about 6.8% for appliances operating on Natural Gas. For appliances operating on LP Gas adjust the air shutter(s) so that the CO₂ is about 9.2% or the O₂ is about 6.8%. Appliances with two blowers should be adjusted so that the air shutters below each blower are open the same amount.

Once the CO₂ or O₂ has been set, the manifold pressure may be adjusted. Remove the 1/8 NPT plug from the lower side of the gas valve that is to be set and install a fitting, hose and manometer. Start the appliance and observe the manifold pressure. Manifold pressure must be adjusted to 3.0 in. W.C. (0.75 kPa) (for high altitude only, standard operating pressure is 2.5 in. W.C. (0.62 kPa)). It is adjusted by removing the slotted cap on the gas valve and turning the adjustment screw (beneath the cap) clockwise to increase pressure. After the adjustments have been completed, the fitting, hose and manometer have been removed and the 1/8" plug has been replaced, replace the cap. Repeat this process until all gas valves have been set. Note: The pressure can be set only when the appliance is operating and only when the particular gas valve being adjusted is energized by a call for heat.

After all of the gas valve manifold pressures have been set, the CO₂ or O₂ must be reset. CO₂ or O₂ will have changed when the manifold pressure was adjusted. Open the air shutter(s) to reduce the CO₂ or O₂ to the values achieved previously.

The procedure is complete when all gas valves are adjusted to a manifold pressure of 3.0 in. W.C. (0.75 kPa) and the CO₂ is adjusted to 8.0% for Natural Gas appliances or 9.2% for LP appliances. When using an O₂ analyzer, the correct O₂ is 6.8% for both Natural Gas and LP appliances.

Caution

Should any odor of gas be detected, or if the gas burner does not appear to be functioning in a normal manner, close main shutoff valve, do not shut off switch, and contact your heating contractor, gas company, or factory representative.

6.4 Shutting Down the Pennant

1. Switch off the shutdown switch (located above the Main Power Switch).
2. Wait until the "pump" light (located on the front panel) goes out.

3. Switch off the main electrical disconnect switch.
4. Close all manual gas valves.
5. If freezing is anticipated, drain the Pennant and be sure to also protect piping connected to the Pennant from freezing.

This step to be performed by a qualified service person.

6.5 Backwash Switch Operation

Pennant Pool Heaters are equipped with a filter backwash switch, which is located above the main power switch. The switch is intended to provide a means by which the heater can be safely shut down for pool filter service, without causing nuisance tripping of the heater high limit.

This switch is internally wired in series with the Other Interlocks terminals, and will interrupt the call for heat signal when open. Please note that when the backwash switch is active the heater “Service” light will be illuminated.

To place the heater into backwash mode proceed as follows:

1. Turn the backwash switch down to the “Filter Backwash Mode” position.
2. Wait for the heater outlet temperature to drop down to a temperature equal to the pool water return temperature.
3. Turn the main power switch off.

Pool filter servicing may now proceed normally. After completion of the filter servicing, place the heater back into service as follows:

1. Turn the main power switch on.
2. Allow time for the pump to turn on, and purge air from the heater.
3. Turn the backwash switch up to the “Normal” position.

The service light will turn out, and the heater will resume normal operation. Please note that if the heater is equipped with a low water cut off there will be a brief delay while the LWCO completes a self-check.

6.6 Spring and Fall Operation Stand-by Service

Turn the thermostat down to approximately 70°F (21°C). This will prevent the pool and surrounding ground from becoming chilled and permit the pool to be raised to swimming temperature in a shorter length of time. **Do Not Operate** below 60°F (16°C).

6.7 Winter Operation

HEATER MODEL	MINIMUM FILTER PUMP FLOW RATE
PNCP 500	240 GPM
PNCP 750	360 GPM

Table 9. Minimum Filter Pump Flow Rates For Spas.

Complete Shutdown

1. See Section 6.4
2. If the heater is not protected from freezing temperatures, it should be **completely drained before the first frost**. Drain the heater by removing the plug at the end of the inlet/outlet header casting. Also, remove the small plug at the bottom of the pump housing. Do not replace either plug until the time that refilling is desired. The heater must be level for complete draining. When compressed air is used to blow out lines, it is still necessary to follow these directions. Because of the potential for electrical power failure or pump failure, freeze protection should never be accomplished by operating the pool heater and the filter pump. Either of those failures will potentially allow a freeze up and cause damage to the heater and the attached system.
3. **Improper use of the heater:** The Laars PNCP pool heater is not designed for continuous use as a “anti-freezing” device for pools. Operating the heater at low water temperatures will damage the heat exchanger.

6.8 To Restart the Pennant

If drained, follow Section 6.2 in this manual for proper filling and purging.

1. Switch off the main electrical disconnect switch.
2. Close all manual gas valves.
3. **WAIT FIVE (5) MINUTES.**
4. Set the pool aquastat to its lowest setting.
5. Open all manual gas valves.
6. Reset all safety switches.
7. Set the temperature controller to the desired temperature setting and switch on electrical power.
8. Burner will go through a prepurge period and ignitor warm-up period, followed by ignition.

6.9 Therapeutic Pools (Spas)

Therapeutic pools or “spa” pools are usually piped and controlled so that very warm or hot water, often with air injection, is forced at high velocity into a confined area of a swimming pool or into a small separate pool. For the purposes of this manual, any application in which the water temperature is maintained above 85°F (30°C) is considered a *spa*.

SPECIAL SET-UP AND OPERATING PROCEDURES APPLY TO SPAS.

1. Models PNCP1000 and larger should **not** be used for spas due to their higher temperature rises.
2. To ensure that the spa inlet does not exceed 104°F (40°C), the spa filter pump must circulate water at the minimum flow rates shown in Table 9.

NOTE: Maximum Spa Temperature Is Assumed To Be 100°F (38°C).

3. Spas are excellent for relaxation, body-conditioning and for arthritic and rheumatic problems, but can be hazardous.

WARNING

The U. S. Consumer Product Safety Commission has warned that elevated temperatures in spas and hot tubs can be hazardous. Follow these "Safety Rules for Hot Tubs:"

- Spa or hot tub water temperatures should never exceed 104°F (40°C). A temperature of 100°F (38°C) is considered safe for a healthy adult. Special caution is suggested for young children.
- Drinking of alcoholic beverages before or during hot tub use can cause drowsiness, which could lead to unconsciousness and subsequently lead to drowning.
- Pregnant women beware! Soaking in water above 102°F (39°C) can cause fetal damage during the first three months of pregnancy (resulting in the birth of a brain-damaged or deformed child). Pregnant women should stick to the 100°F (38°C) maximum rule.
- Before entering the spa or hot tub, users should check the water temperature with an accurate thermometer; spa or hot tub thermostats may err in regulating water temperatures by as much as 4°F (2°C).
- Persons with a medical history of heart disease, circulatory problems, diabetes or blood pressure problems should obtain their physician's advice before using spas or hot tubs.
- Persons taking medications which induce drowsiness, such as tranquilizers, antihistamines or anticoagulants, should not use spas or hot tubs.

SECTION 7. Maintenance

7.1 System Maintenance

1. Lubricate the system water-circulating pump, if required, per the instructions on the pump.
2. Inspect the venting system for obstruction or leakage at least once a year. Periodically clean the inlet air filter and the screens in the vent terminal and combustion air terminal (when used).
3. Keep the appliance area clear and free from combustible materials, gasoline, and other flammable vapors and liquids.
4. If the appliance is not going to be used for extended periods in locations where freezing normally occurs, it should be isolated from the system and completely drained of all water. All systems connected to it should also be drained or protected from freezing.
5. Low water cutoffs, if installed, should be

checked every 6 months. Float type low water cutoff should be flushed periodically.

6. Inspect flue passages, and clean with brushes/vacuums, if necessary. Sooting in flue passages indicates improper combustion. Determine the cause and correct.
7. Inspect the vent system and air intake system, and ensure that all joints are sealed properly. If joints need to be resealed, completely remove existing sealing material, and clean with alcohol. Apply new sealing material, and re-assemble.

7.2 Appliance Maintenance and Component Description

Only genuine Laars replacement parts should be used.

Caution

Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation. Verify proper operation after servicing.

See Figures 7 through 11 for location of gas train and control components.

The gas and electric controls on the appliance are engineered for long life and dependable operation, but the safety of the equipment depends on their proper functioning. It is strongly recommended that a qualified service technician inspect the basic items listed below every year.

- a. Ignition controls
- b. Ignitors
- c. Water temperature control
- d. Automatic gas valve
- e. Pressure switches
- f. Blowers

7.2.1 Burners

Close main manual gas valve before proceeding. Checking the burners for debris - Remove the ignitor inspection panels(s) and ignitor(s) and inspect the burners through the ignitor hole(s) using a flashlight to illuminate. If there is any indication of debris on the burners that are visible, all the burners will need to be inspected more thoroughly. Remove the screws from around the front of the air box (large panel from which the ignitor inspection panel(s) were removed), and remove the large panel. Remove the gas manifold assemblies and the burner panels. Inspect the burners. Clean burners, if necessary, by blowing compressed air from the outside of the burners into the center of the burner. A dirty burner may be an indication of improper combustion or dirty combustion air. Determine the cause, and correct. Replace the burners in the reverse order.

7.2.2 Filter

The filter used in the Pennant is washable with an 83% arrestance. Since the filter is washable, it will

only need replacement in very rare cases. If filter replacement is needed, it should only be replaced with a factory part. Inspect the air filter. If there is debris on the air filter, remove it from the filter box, and wash it with mild soap and water. Ensure that the filter is completely dry before re-installing, in reverse order.

7.2.3 Gas Valves

The gas valves are designed to operate with supply pressures of 4-13 inches w.c. (1.0 to 3.2 kPa).

To remove a valve, shut off 120-volt power and the manual gas shutoff valve. Remove the top front panel from the unit. Disconnect the wires to the valve. Disengage the flanged fitting before and after the valve, and remove the valve. Re-install in reverse order. Ensure o-rings are properly installed for both inlet and outlet. Turn on manual gas shutoff valve and 120 volt power and check appliance operation and tightness of gas valve connections.

7.2.4 Pool Loop High Limit Control

The high limit switch is an automatic reset switch with an adjustable set point, up to 135°F (57°C). To replace the switch, shut off the 120-volt power to the appliance. Remove the cover from the switch to access the mounting screws. Remove the screws, and pull the switch off the control panel. Remove the capillary and bulb from the thermal well located in the pool loop adjacent to the heater outlet. Replace in reverse order.

7.2.5 Automatic Reset High Limit Control

An automatic reset high limit is used to limit heater water from exceeding 200°F. The high limit switch has an adjustable set point, up to 190°F (88°C). To replace the switch, shut off the 120-volt power to the appliance. Remove the cover from the switch to access the mounting screws. Remove the screws, and pull the switch off the control panel. Remove the capillary and bulb from the thermal well located in the header. Replace in reverse order.

7.2.6 Temperature Control

The temperature control is a single stage control. To replace the control, shut off the 120-volt power to the appliance. Unplug all of the electrical connectors, remove the retainer clip and the control. Replace in reverse order.

7.2.7 Ignition Controls


The ignition controls ensure the proved interrupted-type ignition system. They control the hot surface ignitor(s) and prove that the flame signal is appropriate for powering the gas valves. It also controls the blower's pre-purge and post-purge. Pennant models 500, 750 and 1000 have one ignition control. Models 1250, 1500, 1750 and 2000 have two ignition controls. On these models, one ignition

control provides for part-load start-up and the second control brings the heater to full rate, after the first control has started the part-load burners.

To replace a control, shut off the 120-volt power to the appliance. Remove the cover from the control panel. Remove the electrical connectors from the ignition control. Take out the controller's mounting screws, and pull the controller out. Replace in reverse order.

7.2.8 Ignitors

The ignitors used are 120v "Hot Surface" type. They are energized whenever there is a call for heat and switched off when ignition is established and the flame has been sensed. Pennant models 500, 750 and 1000 have one ignitor. Models 1250, 1500, 1750 and 2000 have two ignitors. To replace the ignitor, shut off the 120-volt power to the appliance, remove the ignitor access panel, disconnect the Molex connector, remove the two mounting screws on the ignitor flange, and pull the ignitor out. Install in reverse order, always using a new ignitor gasket with the replacement ignitor.

 **Caution**
Ignitor gets hot.

7.2.9 Ignition Sensors

The ignition sensors ensure that the main flame is ignited, so that raw gas is not allowed to fill the combustion chamber. The ignitors are the ignition sensors on Pennant appliances. There are no separate ignition sensors.

7.2.10 Transformer

The Pennant's transformer is not capable of supplying control voltage for external devices. Should a transformer need replacing, shut off the 120-volt power. Unplug the transformer wires, remove the mounting screws and remove the transformer. Replace transformer in the reverse order.

7.2.11 Blowers

The combustion air blowers bring the combustion air for the Pennant from the upper chamber to the lower chamber. Mixing of the gas and air occurs in the burners. If a blower change is required, turn off the 120-volt power and gas supply to the unit. Remove the front panel. Disconnect the blower's wire harness. Remove the screws at the blower flange, and pull the blower out. Replace blower in reverse order, ensuring that all joints are made correctly. After replacement, ensure that the unit operates properly, by following the set-up procedure in this manual. Use caution in handling the blower, ensuring you do not put pressure on the blower wheel.

7.2.12 Flow Switch

The unit uses a paddle-type flow switch to ensure the unit has water flow before ignition is allowed.

7.2.13 Heat Exchanger Coil

Caution

Black carbon soot buildup on a dirty heat exchanger can be ignited by a random spark or flame. To prevent this from happening, dampen the soot deposits with a wet brush or fine water spray before servicing the heat exchanger.

The Pennant has a pre-mixed burner system. These systems provide the burners with sufficient air for complete combustion, and black carbon sooting is seldom experienced. If sooting is suspected, view ports for inspection of the heat exchanger are provided on both sides of the heater. They are located below the headers, and are accessed by opening the small round cover that is attached by one screw. In the unlikely event that there is a buildup of black carbon soot or other debris on the heat exchanger, clean per the following:

1. Disconnect the electrical supply to the unit.
2. Turn off the gas supply by closing the manual gas valve on the heater.
3. Disconnect and remove the wires, conduit and sensors from all components that are attached to the inlet/outlet header.
4. Isolate the heat exchanger from the water supply.
5. Disconnect the header flanges from the inlet and outlet.
6. Allow the heat exchanger to drain. Remove the front cover(s). Remove the venting and remove the top, by removing the screws that attach the top to the side panels. Remove the side panels. Remove the front lower panels sealing the combustion area. To remove the gas train, disconnect the unions located above the intermediate pan and the field installed union located outside the cabinet, and pull up, bringing the union end connectors through the grommets in the intermediate pan. To remove the intermediate pan, remove the slide out control assembly and blower(s) to reveal the screws. Remove the screws holding the intermediate pan, and lift up to remove it. The heat exchanger has integral metal sections attached, which connect to the frame of the boiler. Locate and remove the screws along the front, rear and bottom of the integral metal sections, and remove the heat exchanger and metal sections by lifting up. On the larger appliances, a center heat exchanger support must be unbolted before it can be removed.
7. Remove the heat exchanger from the unit.

NOTE: The heat exchangers are heavy and will require two people to remove to avoid personal injury.

8. Clean the heat exchanger: A light accumulation of soot or corrosion on the outside of the heat exchanger can be easily removed. Use a wire brush to remove loose soot and scale from the heat exchanger. Do not use water or compressed air for cleaning.

9. **NOTE:** While the heat exchanger is out of the unit, inspect the firewall refractory insulation. Replace if necessary.
10. Inspect the inside of the copper tubes for scale buildup. Scale can build up on the inner surface of the heat exchanger tubes, which can restrict water flow. If the tubes show signs of scaling, clean the internal surface. Laars offers a tube cleaning kit part number R0010000.
11. Reassemble in the reverse order, and check appliance operation after start-up.

NOTE: The Warranty does not cover damage caused by lack of required maintenance, lack of water flow, or improper operating practices.

SECTION 8. Trouble Shooting

8.1 Resolving Lockouts

There are many causes of lockouts. The three most common causes are: (1) inadequate gas supply, (2) poor combustion, (3) ignitor failure.

1. **Inadequate gas supply:** Before proceeding, ensure that the gas supply has not been shutoff or the LP tank (LP boilers) is not empty. Then, restart the boiler and observe the operational cycle. After a 15-second fan pre-purge, the ignitor will heat up for 20 seconds, and then the unit will light. If it does not, check the gas supply pressure to the appliance, after resetting the appliance and attempting another start-up. The gas pressure to the appliance must be above 5" W.C. (1.2kPa) throughout the entire start-up cycle. If it is not, correct the supply problem (check gas valves or supply piping). If the supply pressure is adequate, consult the factory for assistance.
2. **Poor Combustion:** Poor combustion should be suspected if there is a strong flue gas odor. The odor may result from an improper gas/air ratio (high or low O₂ or CO₂). Pennant appliances operate best with 45% excess air (8% CO₂ on natural gas, 9.2% CO₂ on LP). Check the CO₂ of the appliance and adjust if necessary.
3. **Ignitor failure:** If the boiler goes through a normal start cycle but combustion does not occur, and the gas pressure is at least 5" w.c., ignitor failure may be the cause. Check the ignitor by unplugging it, allowing it to cool to room temperature, and measuring the ignitor resistance. It should be 50-80 ohms. If the resistance is not 50-80 ohms, replace the ignitor. If the resistance is correct, reset the boiler and check for 120 VAC at the ignitor plug during the start cycle. If there is no voltage, replace the faulty ignitor wire harness or the ignition control.

8.2 Delayed Ignition - Possible Causes

A defective burner can cause a delayed ignition. If the gas supply pressure is proper and the gas valves are functioning properly, then burners should be inspected. There should be no distortion or perforations in the burners outside of the active burner port area. Replace if indicated.

8.3 Short Cycling

Because of the large mass of pool systems, short cycling should not exist. If it does, it will be caused by insufficient flow in the pool loop. Check that there is no blockage in the pool loop such as a plugged or partially plugged pool filter.

8.4 High Gas Consumption

Appliances operating with an improper air/fuel ratio are very inefficient and consequently, have very high gas consumption. Because efficiency is high when the CO₂ is high (or O₂ is low), appliances operating with low CO₂ or high O₂ (especially LP appliances) consume more gas. Adjust the CO₂ or O₂ for optimum efficiency. If no combustion analyzing equipment (CO₂ or O₂) is available then a proper adjustment of the air/fuel ratio (CO₂ or O₂) cannot be accomplished. However, by briefly sniffing the flue gases it is possible to determine if the CO₂ or O₂ is within the proper range. No significant flue gas odor should be detected when combustion is proper. A

strong piercing smell indicates poor combustion and generally a lean mixture - low CO₂ or high O₂. The CO₂ should be 8% (natural gas, 9.2% LP) at high fire. To check the CO₂, first verify that the supply gas pressure is within 5" to 13" w.c. (1.2 to 3.2 kPa) With the Pennant running with both stages firing, set the air box pressure to 1.5" w.c. (0.37 kPa) (as a starting point), by adjusting the air shutter(s) at the bottom of the fan(s). Check the CO₂, and adjust the air shutters if further adjustment to the CO₂ is needed. Models 1250, 1500, 1750 and 2000 have two blowers and two air chambers (boxes). The pressure of each air box must be equal when the final adjustment is made.

8.5 Troubleshooting the Pool Heater Temperature Control

With a Voltmeter, test for 24 VAC between terminals 1 & 2 on the 10 pin connector. Check that the sensor temperature is lower than the setpoint temperature by at least the differential setting. If this is true, check that there is 24 VAC at the yellow wire on the 4 pin connector. If there is not 24 VAC, check that the high limit is not open. If there is 24 VAC at the yellow wire on the 4 pin connector and not at the light blue wire on that connector, replace the control.

8.6 Troubleshooting Pennant Controls

The Pennant series consists of three models with one ignition module (500, 750 & 1000) and four

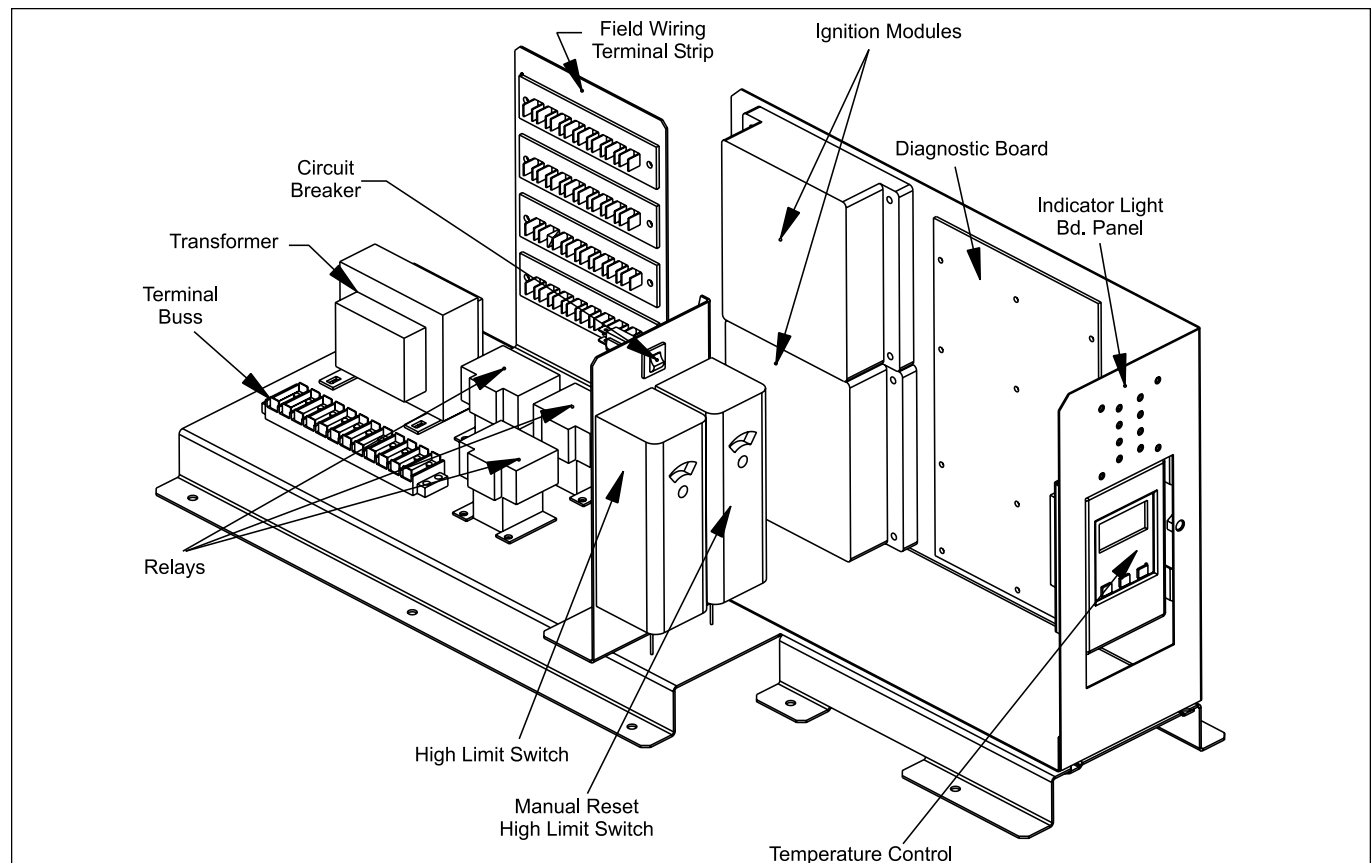


Figure 8. Typical Control Panel.

Certain control elements that may need to be rewired in the field are connected via the field wiring terminal strip rather than to the diagnostic PC board. These include the low-water cutoff (LWCO), external alarm, and water flow switch.

Only genuine Laars replacement parts should be used.

To order or purchase parts for the Laars Pennant, contact your nearest Laars dealer or distributor. If they cannot supply you with what you need, contact Customer Service (see back cover for address, telephone and fax numbers).

9.2 Parts List

Item	Description	Size	Size	Size	Size	Size	Size
		500	750	1000	1250	1500	1750
		500	750	1000	1250	1500	2000
Sheet Metal Components							
See Figure 32							
1	Panel, Jacket, Side Left	5C3420	5C3420	5C3420	5C3420	5C3420	5C3420
2	Panel, Jacket, Side Right	5C3525	5C3525	5C3525	5C3525	5C3525	5C3525
3	Panel, Jacket, Front	5C3320	7C3320	10C3320	12C3320		
3	Panel, Jacket, Front, Left					15C3320	17C3320
4	Panel, Jacket, Front, Right					15C3320	17C3320
5	Panel, Jacket, Rear	5C3220	7C3220	10C3220	12C3220	15C3220	17C3220
5A	Panel, Jacket, Rear, Filter Enclosure					15C3026	15C3026
6	Panel, Jacket, Top	5C3021	7C3021	10C3021	12C3021		
	Panel, Jacket, Top, Left					15C3021	17C3021
7	Panel, Jacket, Top Right					15C3025	17C3025
8	Control Door, Access	5C3011	5C3011	5C3011	5C3011	5C3011	5C3011
9	Plate, Gas Pipe Seal	5C3304	5C3304	10C3304	20C3304	20C3304	20C3304
		(2)	(2)	(2)	(2)	(2)	(2)
10	Plate, Cover, Wiring	5C3502	5C3502	5C3502	5C3502	5C3502	5C3502

Item	Description	Size 500	Size 750	Size 1000	Size 1250	Size 1500	Size 1750	Size 2000
11	Plate, Vent	5C3004	10C3004	10C3004	20C3004	20C3004	20C3004	20C3004
12	Cover, Vent Plate				20C3006	20C3006	20C3006	20C3006
13	Plate, Cover, Filter	5C3002	5C3002	5C3002	15C3002	15C3002	15C3002	15C3002
14	Collar, Vent	5C3106	10C3100	10C3100	15C3100	15C3100	20C3100	20C3100
15	Air Filter Assembly	5C3700	5C3700	10C3700	15C3700	15C3700	15C3700	20C3700
16	Air Filter	R2014700	R2014700	R2014700	R2014700	R2014700	R2014700	R2014700
		(1)	(1)	(1)	(2)	(2)	(2)	(2)
16A	Trim, Jacket, Front	5C3019	7C3019	10C3019	12C3019	15C3019	17C3019	20C3019
16B	Housing, Rain Shield, Pump	5F3015	5F3015	5F3015	5F3015	5F3015	5F3015	5F3015
16C	Cover, Housing, Pump	5F3016	5F3016	5F3016	5F3016	5F3016	5F3016	5F3016
16D	Bracket, Support, Pump Cover	5F3017	5F3017	5F3017	5F3017	5F3017	5F3017	5F3017
Internal Components								
See Figures 33 and 34								
17	Base Assembly	5C1020	7C1020	10C1020	12C1020	15C1020	17C1020	20C1020
18	Chamber, Front	5C2003	7C2003	10C2003	12C2003	15C2003	17C2003	20C2003
18A	Chamber, Left Side, Front	5C2015	5C2015	5C2015	5C2015	5C2015	5C2015	5C2015
18B	Chamber, Right Side, Front	5C2016	5C2016	5C2016	5C2016	5C2016	5C2016	5C2016
Item	Description	Model 500	Model 750	Model 1000	Model 1250	Model 1500	Model 1750	Model 2000
19	Chamber, Rear	5C2006	7C2006	10C2006	12C2006	15C2006	17C2006	20C2006
20	Chamber Assembly, Left, Bottom	5C2601	5C2601	5C2601	5C2601	5C2601	5C2601	5C2601
21	Chamber Assembly, Right, Bottom	5C2201	5C2201	5C2201	5C2201	5C2201	5C2201	5C2201
22	Chamber, Top	5C2001	7C2001	10C2001	12C2001	15C2001	17C2001	20C2001
23	Chamber, Side, Top	5C2002	5C2002	5C2002	5C2002	5C2002	5C2002	5C2002
24	Exhaust Plenum	5C2007	10C2007	10C2007	20C2007	20C2007	20C2007	20C2007
25	Bracket, Chamber, Front	5C2009	7C2009	10C2009				
	Bracket, Chamber, Front Left				12C2011	15C2011	17C2011	20C2011
26	Bracket, Chamber, Front Right				12C2009	15C2009	17C2009	20C2009
27	Divider, Chamber, Front						15C2010	20C2002
27A	Divider, Upper, Chamber, Front				15C2005	15C2005		
27B	Divider, Lower, Chamber, Front				15C2002	15C2002		
28	Cover, Chamber	5C2004	7C2004					
	Cover, Chamber, Front Left			10C2004	12C2010	15C2004	17C2010	20C2010

Item	Description	Size 500	Size 750	Size 1000	Size 1250	Size 1500	Size 1750	Size 2000
29	Door, Chamber Access	5C2005 (1)	5C2005 (1)	5C2005 (1)	5C2005 (2)	5C2005 (2)	5C2005 (2)	5C2005 (2)
30	Cover, Chamber, Front Right				12C2008	15C2004	17C2008	20C2008
	Gasket Tape, Rear, Base (43')	R2014500	R2014500	R2014500	R2014500	R2014500	R2014500	R2014500
	Gasket Tape, Front, Base (63')	R2014600	R2014600	R2014600	R2014600	R2014600	R2014600	R2014600
32	Ignitor, Hot Surface, with Gasket	2400-286 (1)	2400-286 (1)	2400-286 (2)	2400-286 (2)	2400-286 (2)	2400-286 (2)	2400-286 (2)
33	Tile, Side (Right and Left)	T2015601 (2)	T2015601 (2)	T2015601 (2)	T2015601 (2)	T2015601 (2)	T2015601 (2)	T2015601 (2)
34	Tile, Front	T2017300 (1)						
35	Tile, Front, Left Side		T2016200 (1)	T2016800 (1)	T2016800 (1)	T2016800 (1)	T2016800 (1)	T2016800 (1)
35A	Tile, Front, Right Side		T2016300 (1)	T2017100 (1)	T2017900 (1)	T2017100 (1)	T2017900 (1)	T2017100 (1)
35B	Tile, Front, Center				T2016900 (1)	T2016900 (1)	T2016900 (2)	T2016900 (2)
36	Tile, Rear	T2015700 (1)						
37	Tile, Rear, Left Side		T2017500 (1)	T2016600 (1)	T2016600 (1)	T2016600 (1)	T2016600 (1)	T2016600 (1)
37A	Tile, Rear, Right Side		T2016600 (1)	T2016600 (1)	T2018100 (1)	T2016600 (1)	T2018100 (1)	T2016600 (1)
37B	Tile, Rear, Center				T2017200 (1)	T2017200 (1)	T2017200 (2)	T2017200 (2)
38	Tile, Bottom	T2015500 (1)						
39	Tile, Bottom, Left Side		T2017400 (1)	T2017400 (1)	T2017400 (1)	T2017400 (1)	T2017400 (1)	T2017400 (1)
39A	Tile, Bottom, Right Side		T2016500 (1)	T2017400 (1)	T2018000 (1)	T2017400 (1)	T2018000 (1)	T2017400 (1)
39B	Tile, Bottom, Center				T2015900 (1)	T2015900 (1)	T2015900 (2)	T2015900 (2)
41	Heat Exchanger, Copper	R2014901	R2014902	R2014903	R2026701	R2014904	R2026702	R2014905
	Heat Exchanger, Cupro-Nickel	R2027801	R2027802	R2027803	R2027804	R2027805	R2027806	R2027807

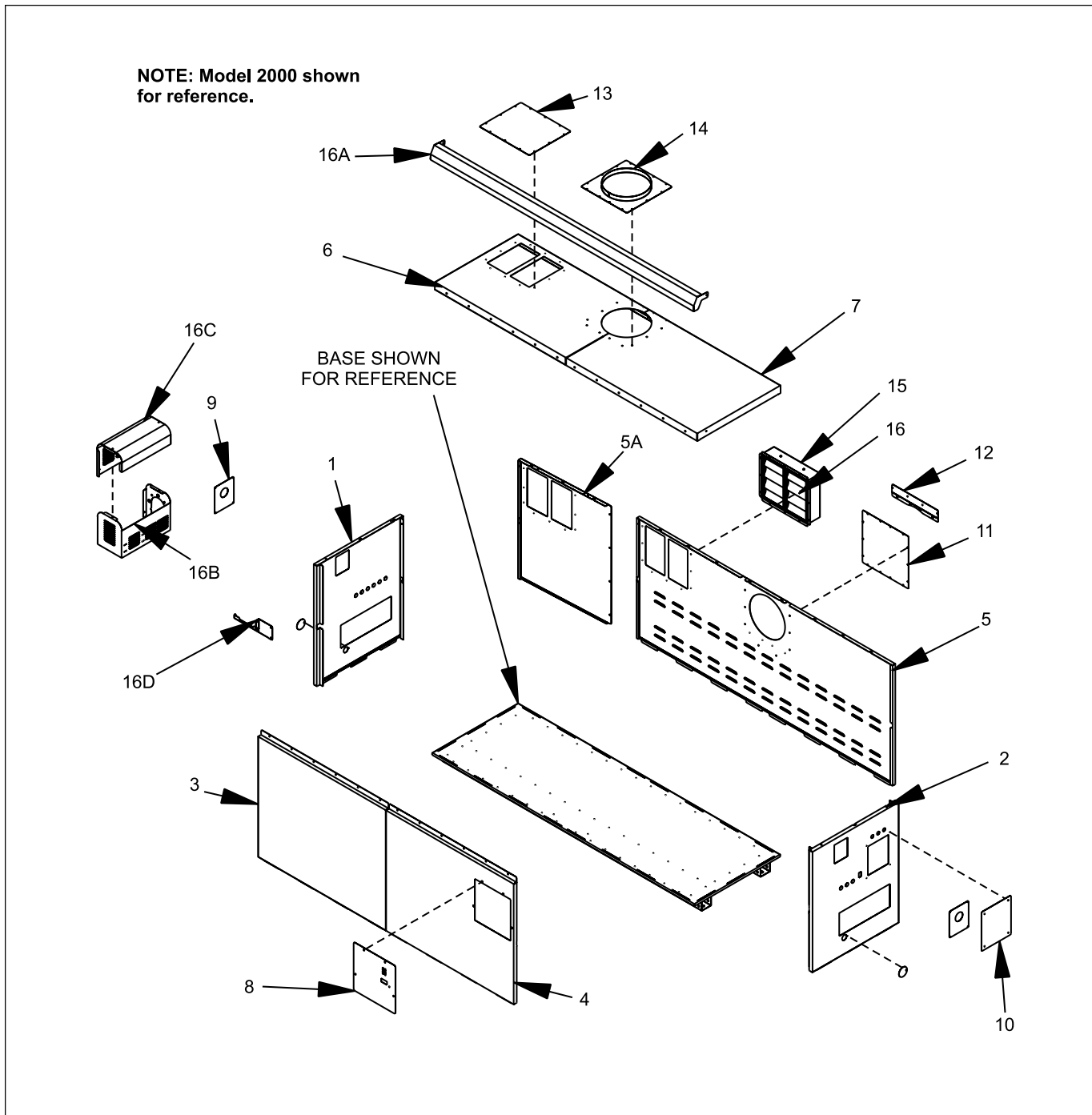
Item	Description	Size 500	Size 750	Size 1000	Size 1250	Size 1500	Size 1750	Size 2000
42	Water Barrier, Inlet/outlet	20230103	20230103	20230103	20230103	20230103	20230103	20230103
43	Water Barrier, Inlet	10338300	10338300	10338300	10338300	10338300	10338300	10338300
44	Gasket, Header	S0095100 (2)	S0095100 (2)	S0095100 (2)	S0095100 (2)	S0095100 (2)	S0095100 (2)	S0095100 (2)
45	Cover, In/Out, Glass-Lined Cast Iron	10364504	10364504	10364504	10364504	10364504	10364504	10364504
	Cover, In/Out, Bronze	10364501	10364501	10364501	10364501	10364501	10364501	10364501
46	Well, Temperature Control	RE2058300	RE2058300	RE2058300	RE2058300	RE2058300	RE2058300	RE2058300
47	Gasket, Flange	S0063700 (2)	S0063700 (2)	S0063700 (2)	S0063700 (2)	S0063700 (2)	S0063700 (2)	S0063700 (2)
48	Flange, Cast Iron	10391302	10391302	10391302	10391302	10391302	10391302	10391302
	Flange, Bronze	20255401	20255401	20255401	20255401	20255401	20255401	20255401
49	Relief Valve, PNCH, 75 PSI	A0063300	A0063600	A0063600	A0063600	A0063600	A0002700	A0002700
	Relief Valve, PNCV, 125 PSI	RA0001200	RA0001200	RA0001200	RA0001200	A0064400	A0064400	A0066400
50	Tee, Adapter, Outlet, Cast Iron	20150302	20150302	20150302	20150302	20150302	20150313	20150313
	Tee, Adapter, Outlet, Bronze	20150301	20150301	20150301	20150301	20150301	20150301	20150303
51	Flow Switch	RE0013000	RE0013000	RE0013000	RE0013000	RE0013000	RE0013000	RE0013000
52	Gauge, Temperature/Pressure	RA0079000	RA0079000	RA0079000	RA0079000	RA0079000	RA0079000	RA0079000
54	Low Water Cutoff	E2076500	E2076500	E2076500	E2076500	E2076500	E2076500	E2076500
55	Pump Housing, Glass-lined, Cast Iron	R20607600	R20607600	R20607600	R20607600	R20607600	R20607600	R20607600
	Pump Housing, Bronze	10483300	10483300	10483300	10483300	10483300	10483300	10483300
56	Gasket, Pump Adapter	not used on current production (was S0024600)						
57	Pump Adapter, Glass-lined Cast Iron	not used on current production (was 10364200)						
	Pump Adapter, Bronze	10364201	10364201	10364201	10364201	10364201	10364201	10364201
58	Baffle, Diffuser, Pump Inlet	10338400	10338400	10338400	10338400	10338400	10338400	10338400
59	Pressure Switch	RE0240900 (2)	RE0240900 (2)	RE0240900 (2)	RE0240900 (3)	RE0240900 (3)	RE0240900 (3)	RE0240900 (3)
60	Blower	R2060900 (1)	R2060900 (1)	R2060900 (1)	R2060900 (2)	R2060900 (2)	R2060900 (2)	R2060900 (2)
61	Weldment, Blower Mount	5C5300 (1)	5C5300 (1)	5C5300 (1)	5C5300 (2)	5C5300 (2)	5C5300 (2)	5C5300 (2)
62	Damper, Duct Assembly, Blower	15C5400 (2)	15C5400 (2)	15C5400 (2)	15C5400 (2)	15C5400 (2)	15C5400 (2)	15C5400 (2)

Electrical Components

See Figure 34

Item	Description	Size 500	Size 750	Size 1000	Size 1250	Size 1500	Size 1750	Size 2000
64	Bracket, Control Panel Mounting	5C7103	5C7103	5C7103	5C7103	5C7103	5C7103	5C7103
65	Terminal Board, Field Wiring	E2307400	E2307400	E2307400	E2307400	E2307400	E2307400	E2307400
66	Ignition Control, Single Try, CSD-1	E2107300	E2107300	E2107300	E2107300	E2107300	E2107300	E2107300
		(1)	(1)	(2)	(2)	(2)	(2)	(2)
66A	Ignition Control, 3-Try, non-CSD-1	E2313900	E2313900	E2313900	E2313900	E2313900	E2313900	E2313900
		(1)	(1)	(2)	(2)	(2)	(2)	(2)
67	Diagnostic Board	E2105500	E2105500	E2105500	E2105500	E2105500	E2105500	E2105500
68	Indicator Light Panel Board	E2105600	E2105600	E2105600	E2105600	E2105600	E2105600	E2105600
69	Temperature Control	E2106900	E2106900	E2106800	E2106800	E2106800	E2106800	E2106800
70	High Limit, Auto Reset, 200°F	E2217700	E2217700	E2217700	E2217700	E2217700	E2217700	E2217700
71	High Limit, Auto Reset, 135°F	E2104800	E2104800	E2104800	E2104800	E2104800	E2104800	E2104800
72	Relay, Pump (SPST)	E0098300	E0098300	E0098300	E0098300	E0098300	E0098300	E0098300
72A	Relay, Fan (DPDT)				E0076600	E0076600	E0076600	E0076600
					(2)	(2)	(2)	(2)
74	Transformer	E2310400	E2310400	E2310400	E2312800	E2312800	E2312800	E2312800
					(2)	(2)	(2)	(2)
75	Switch, Rocker	E2322700	E2322700	E2322700	E2322700	E2322700	E2322700	E2322700
	Sensor, Universal (shipped loose)	R2014800	R2014800	R2014800	R2014800	R2014800	R2014800	R2014800
Gas Train Components								
See Figure 33								
76	Manifold, Gas Supply	5C6700	7C6700	10C6700	12C6700	15C6700	17C6700	20C6700
77	Valve, Ball	V2003100	V2003100	R2003700	R2011600	R2011600	R2011600	R2011600
Burner Trays								
Note: Burner Tray Assemblies contain item numbers 78 through 81.								
	Burner Manifold Assy, 3 Burners, Right, Nat	5C6600	5C6600		5C6600	5C6600	5C6600	
		(1)	(1)		(2)	(1)	(1)	
	Burner Manifold Assy, 3 Burners, Left, Nat	5C6500	5C6500		5C6500	5C6500	5C6500	
		(1)	(2)		(3)	(1)	(2)	
	Burner Manifold Assy, 4 Burners, Right, Nat			10C6600		10C6600	10C6600	10C6600
				(1)		(1)	(1)	(2)
	Burner Manifold Assy, 4 Burners, Left, Nat			10C6500		10C6500	10C6500	10C6500
				(2)		(2)	(2)	(4)

Item	Description	Size 500	Size 750	Size 1000	Size 1250	Size 1500	Size 1750	Size 2000
	Burner Manifold Assy, 3 Burners, Right, LP	5C6620 (1)	5C6620 (1)		5C6620 (2)	5C6620 (1)	5C6620 (1)	
	Burner Manifold Assy, 3 Burners, Left, LP	5C6520 (1)	5C6520 (1)		5C6520 (3)	5C6520 (1)	5C6500 (2)	
	Burner Manifold Assy, 4 Burners, Right, LP			10C6620 (1)		10C6620 (1)	10C6620 (1)	10C6620 (2)
	Burner Manifold Assy, 4 Burners, Left, LP			10C6520 (2)		10C6520 (2)	10C6520 (2)	10C6520 (4)
78	Valve, Gas, Combination	V2017600 (2)	V2017600 (3)	V2017600 (3)	V2017600 (5)	V2017600 (5)	V2017600 (6)	V2017600 (6)
79	Valve, Manual Shutoff	V2000200 (2)	V2000200 (3)	V2000200 (3)	V2000200 (5)	V2000200 (5)	V2000200 (6)	V2000200 (6)
80	Orifice, Gas, Natural	L2013000 (6)	L2013000 (9)	L2013000 (12)	L2013000 (15)	L2013000 (18)	L2013000 (21)	L2013000 (24)
81	Orifice, Gas, Propane	L2012400 (6)	L2012400 (9)	L2012400 (12)	L2012400 (15)	L2012400 (18)	L2012400 (21)	L2012400 (24)
	Burner Manifold, 3 Burners, Right	L2012900 (1)	L2012900 (1)		L2012900 (2)	L2012900 (1)	L2012900 (1)	
	Burner Manifold, 3 Burners, Left	L2012800 (1)	L2012800 (2)		L2012800 (3)	L2012800 (1)	L2012800 (2)	
	Burner Manifold, 4 Burners, Right			L2012700 (1)	L2012700	L2012700 (1)	L2012700 (1)	L2012700 (2)
82	Burner Manifold, 4 Burners, Left			L2012600 (2)		L2012600 (2)	L2012600 (2)	L2012600 (4)
	Burner Tray, 3 Burners	L2012200 (2)	L2012200 (3)		L2012200 (5)	L2012200 (2)	L2012200 (3)	
	Burner Tray, 4 Burners			L2012500 (3)		L2012500 (3)	L2012500 (3)	L2012500 (6)
	Gasket, Burner Tray, 3 Burner	S2012700 (2)	S2012700 (3)		S2012700 (5)	S2012700 (2)	S2012700 (3)	
82A	Gasket, Burner Tray, 4 Burner			S2012500 (3)		S2012500 (3)	S2012500 (3)	S2012500 (6)

**Figure 9. Sheet Metal Components.**

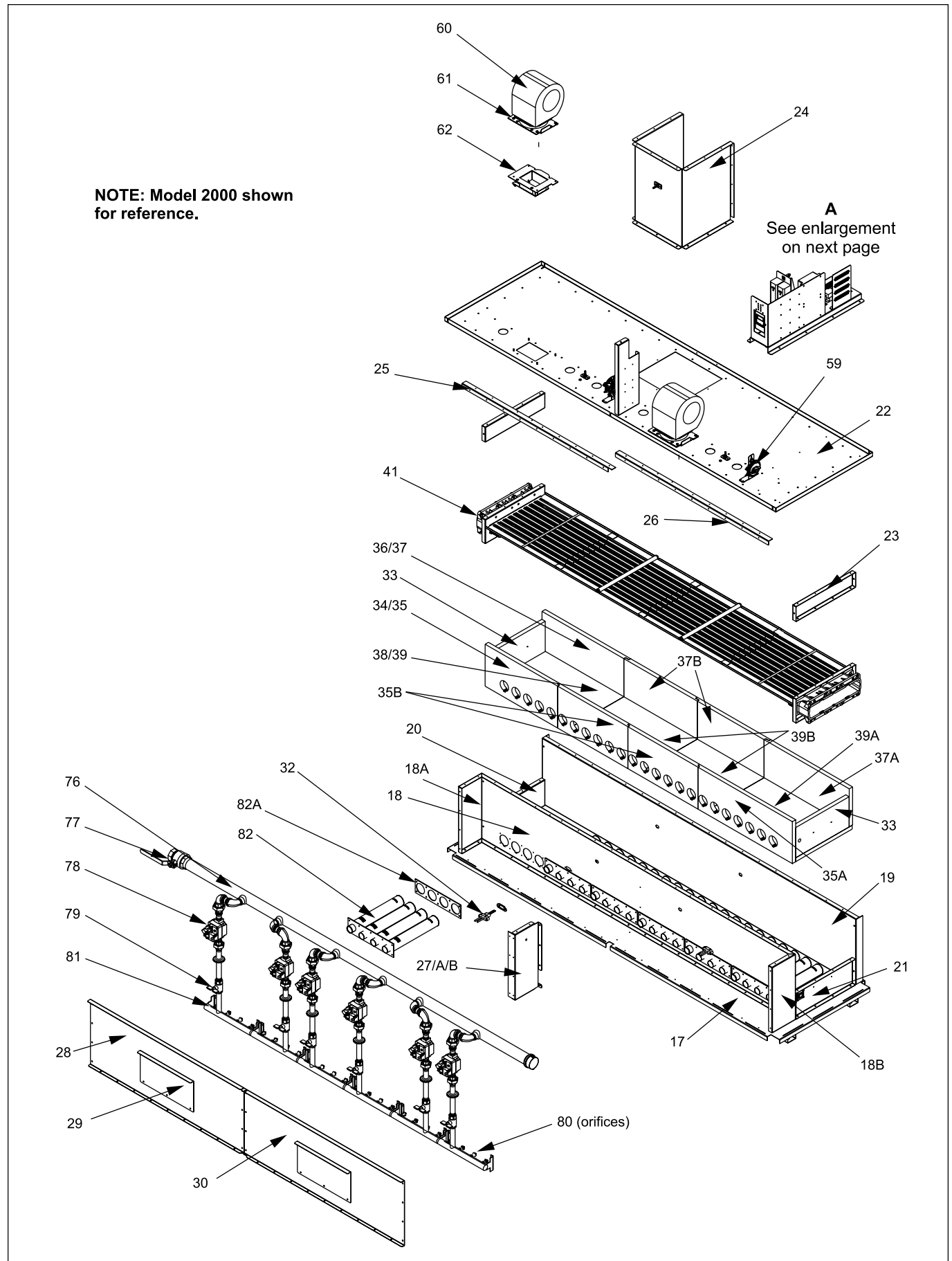


Figure 10. Internal Components.

See pump chart below
for pump numbers.

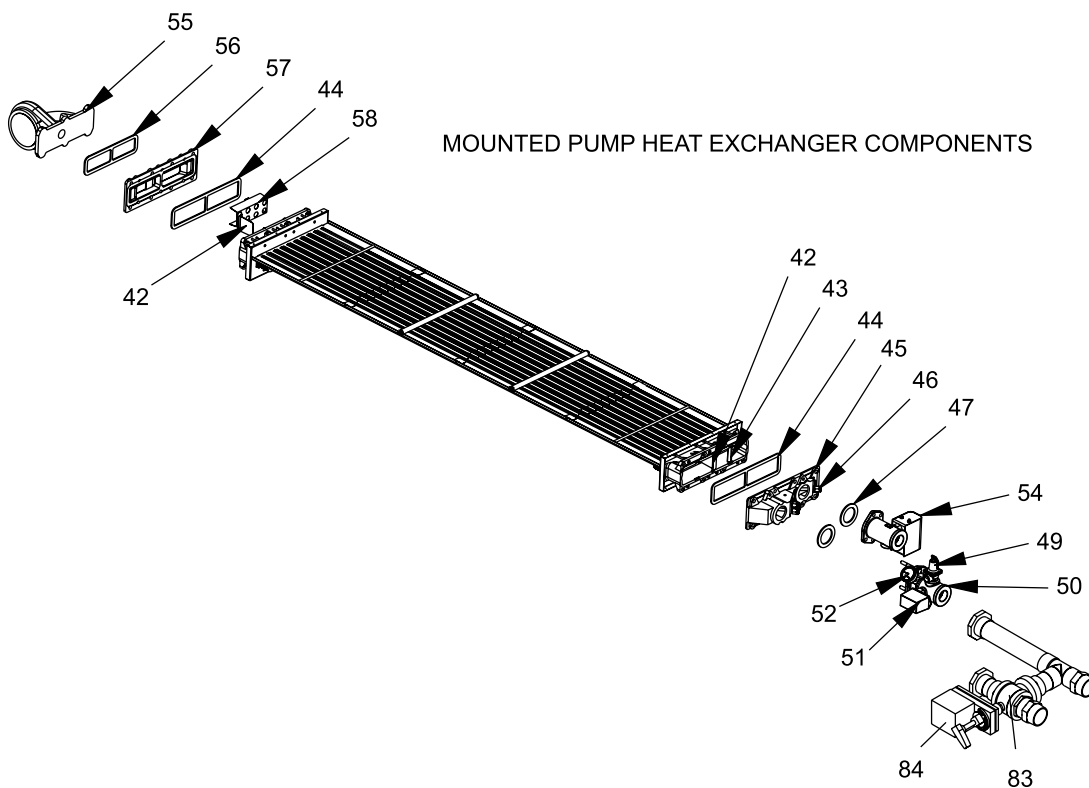
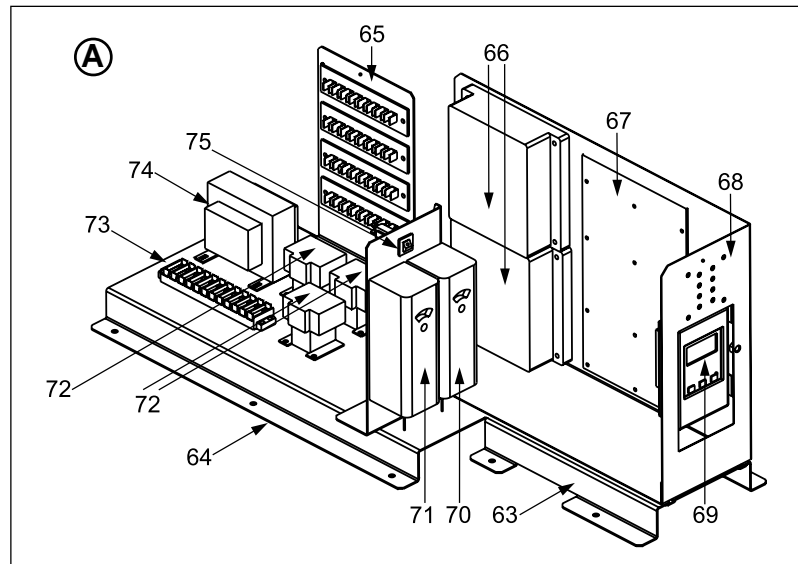


Figure 11. Heat Exchanger Components.

SECTION 10.

Wiring Diagrams

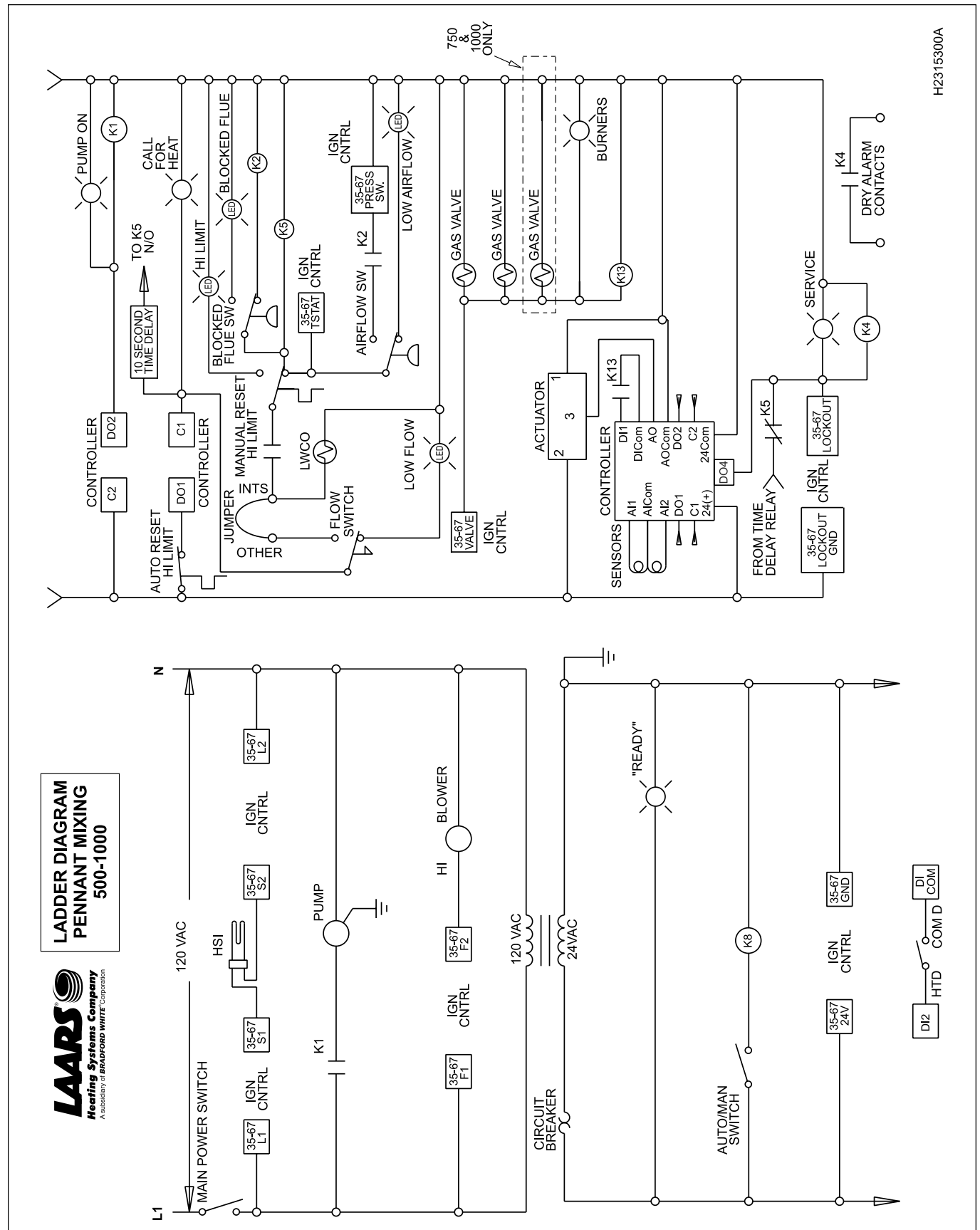


Figure 12. Pennant 500 - 1000 Ladder Diagram.

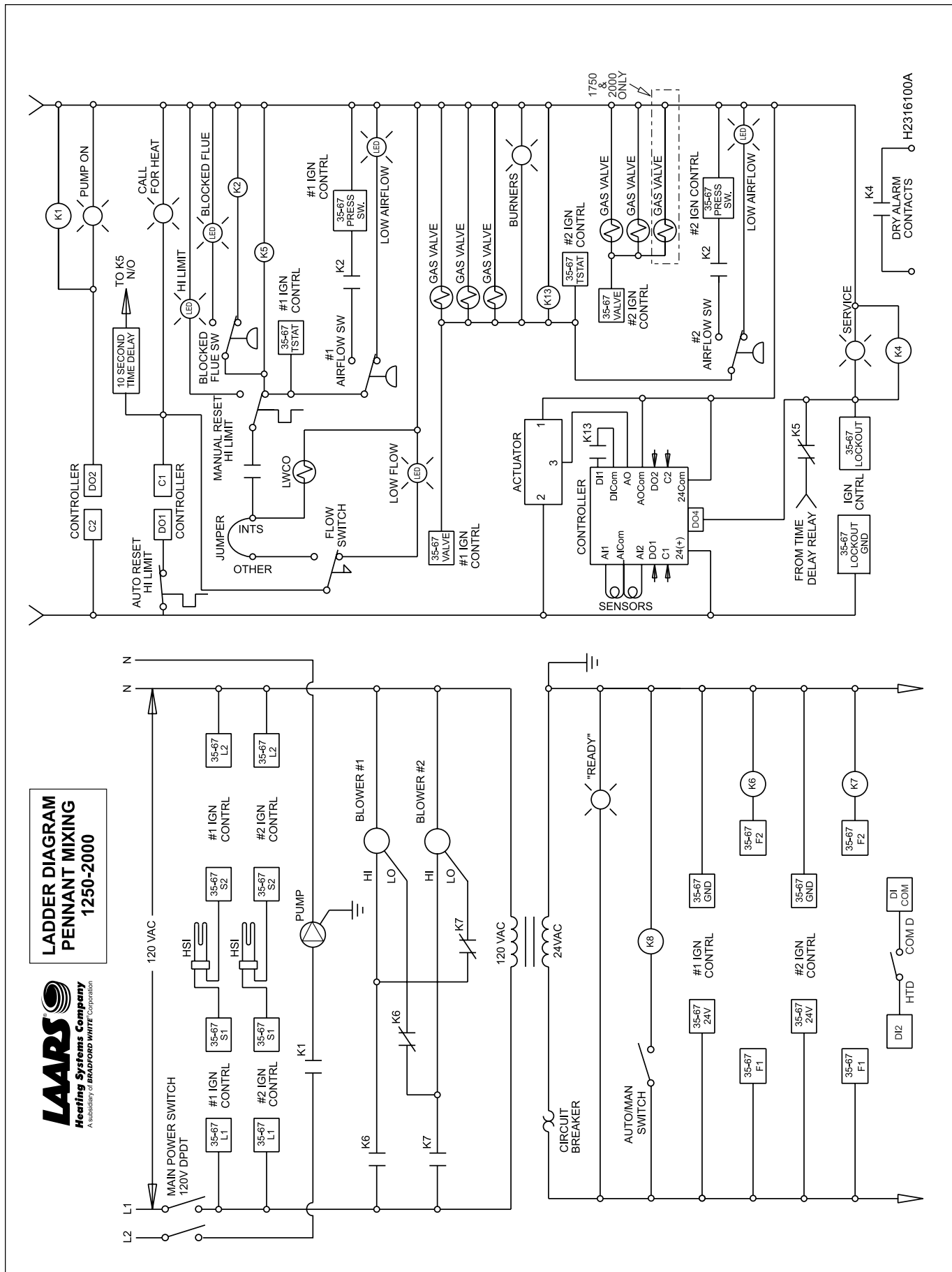


Figure 13. Pennant 1250 - 2000 Ladder Diagram.

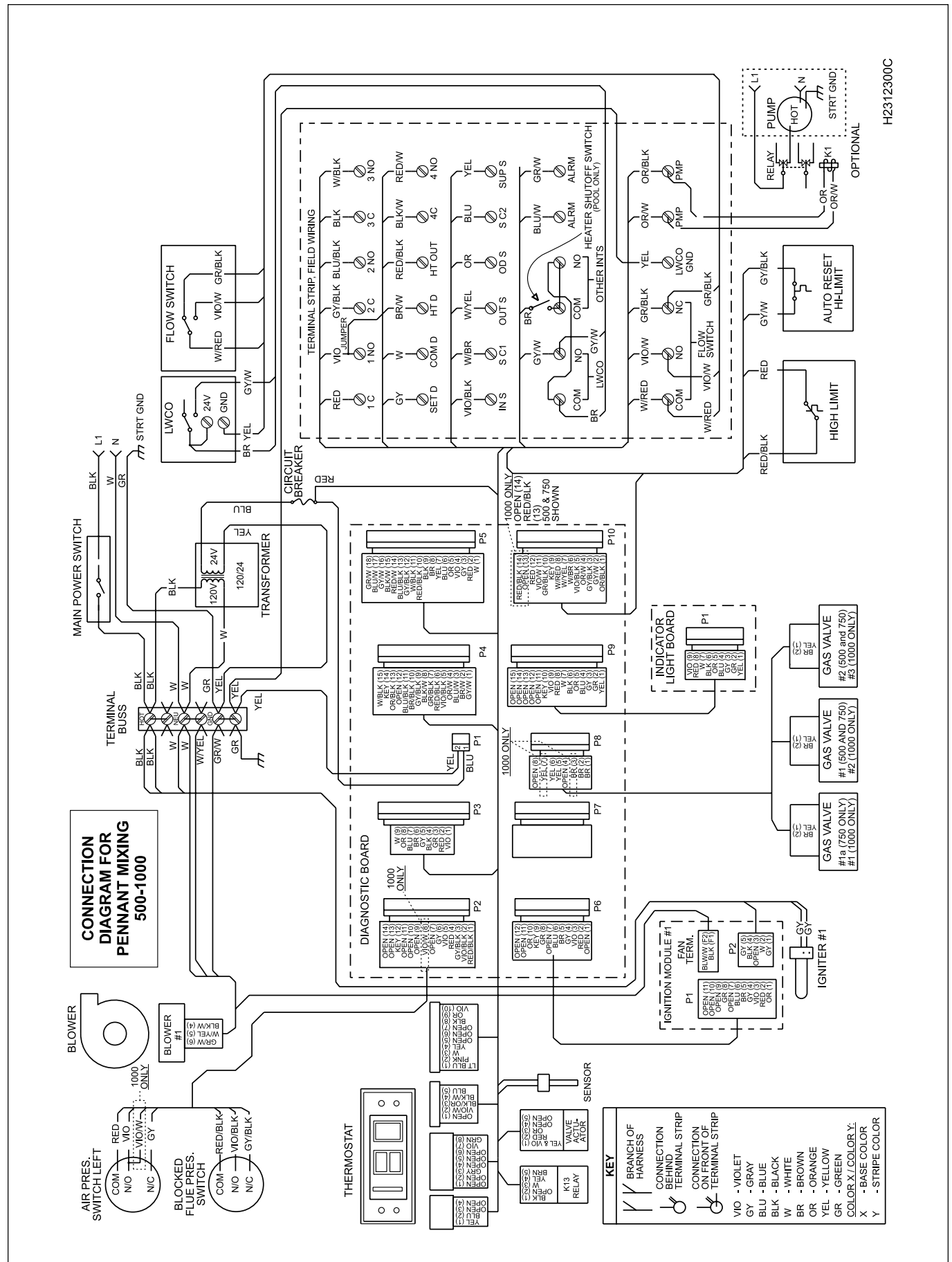


Figure 14. Pennant 500 - 1000 Wiring Schematic.

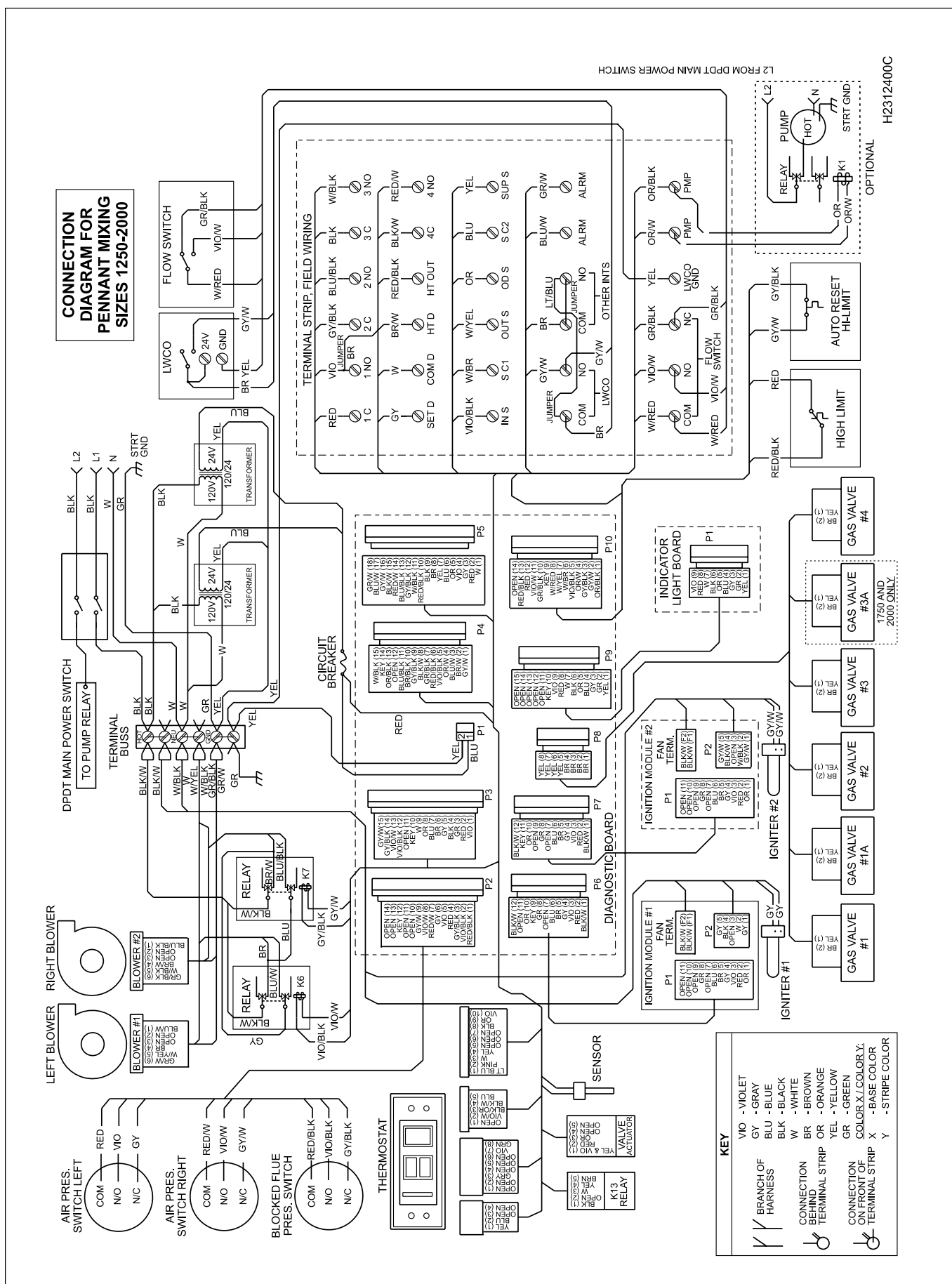


Figure 15. Pennant 1250 - 2000 Wiring Schematic.

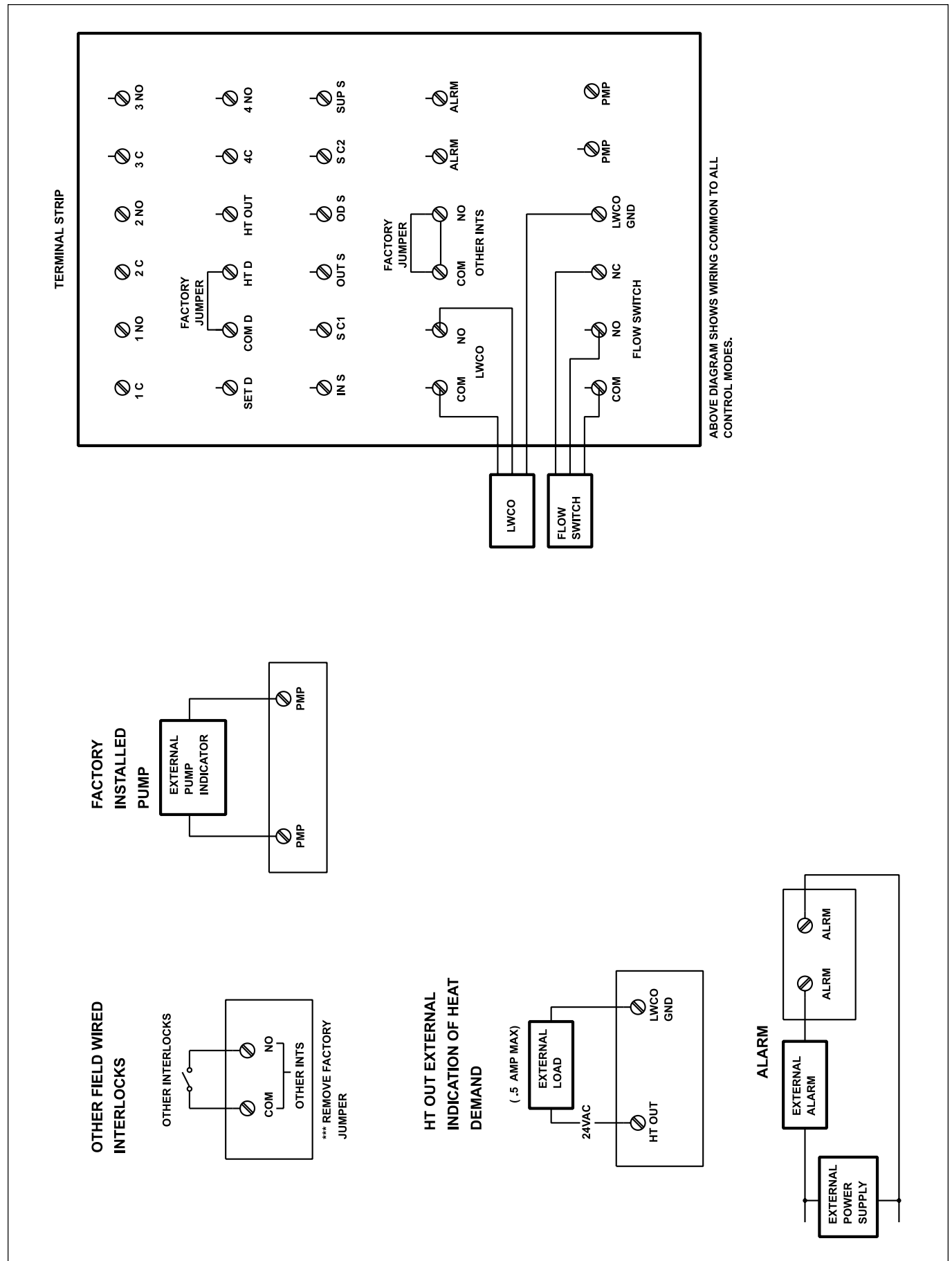


Figure 16. Field Wiring, PNCP 500-1000.

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