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 CO_2 at the outlet of the unit. The CO_2 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 CO_2 or O_2 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 CO_2 in the "as installed" condition. Adjust the air shutter(s) so that the CO_2 is about 8% or the O_2 is about 6.8% for appliances operating on Natural Gas. For appliances operating on LP Gas adjust the air shutter(s) so that the CO_2 is about 9.2% or the O_2 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 CO_2 or O_2 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 CO_2 or O_2 must be reset. CO_2 or O_2 will have changed when the manifold pressure was adjusted. Open the air shutter(s) to reduce the CO_2 or O_2 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 CO_2 is adjusted to 8.0% for Natural Gas appliances or 9.2% for LP appliances. When using an O_2 analyzer, the correct O_2 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 O_2 or CO_2). Pennant appliances operate best with 45% excess air (8% CO_2 on natural gas, 9.2% CO_2 on LP). Check the CO_2 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 CO_2 is high (or O_2 is low), appliances operating with low CO_2 or high O_2 (especially LP appliances) consume more gas. Adjust the CO_2 or O_2 for optimum efficiency. If no combustion analyzing equipment (CO_2 or O_2) is available then a proper adjustment of the air/fuel ratio (CO_2 or O_2) cannot be accomplished. However, by briefly sniffing the flue gases it is possible to determine if the CO_2 or O_2 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 CO_2 or high O_2. The CO_2 should be 8% (natural gas, 9.2% LP) at high fire. To check the CO_2, 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 CO_2, and adjust the air shutters if further adjustment to the CO_2 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

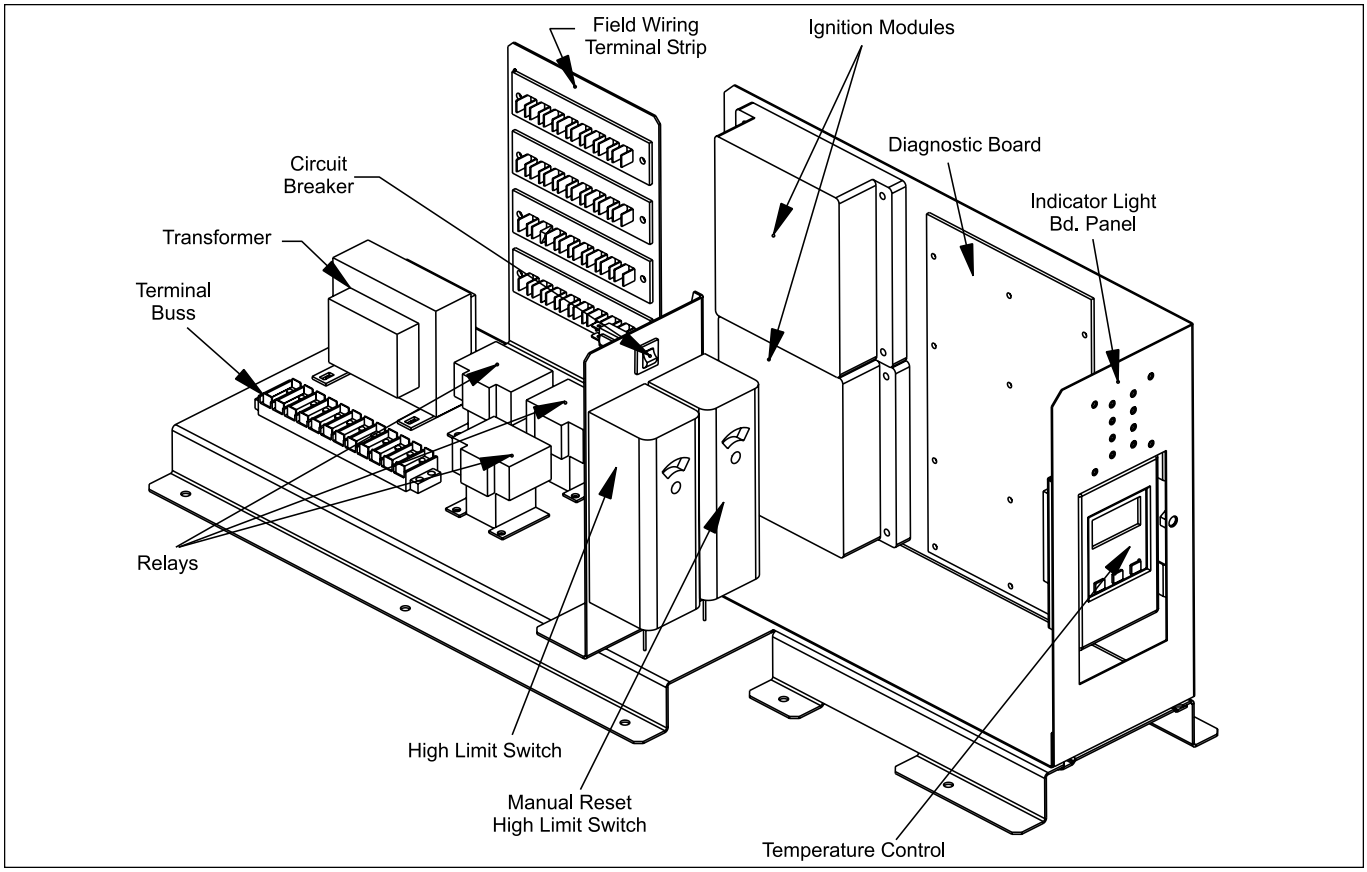

Figure 8. Typical Control Panel.

models with two ignition modules (1250, 1500, 1750 and 2000).

A diagnostic panel, that includes test points, as well as diagnostic lights, is provided in the control module. It is located on the right side of the module, behind the display. To access, remove the retaining screws from the display cover panel and remove it. Grasp the control module at its base and pull it outward. Ladder diagrams are shown in Figures 12 and 13.

Figure 12 shows the diagram for the 500, 750 & 1000. These have one blower and one ignition module. The blower is energized directly through the "inducer" terminals F1 and F2 of the (Fenwal) ignition module. The 24V power to the T'STAT terminal of the ignition module(s) are routed through the safety interlocks.

The ladder diagram for models 1250, 1500, 1750 and 2000 is shown in Figure 13. These models have two ignition modules, each with its own blower, and each controlling part of the input so that startup at reduced input is provided. The blowers are energized by the ignition modules indirectly via switching relays. When either ignition module receives a call for heat, it switches its blower to high speed and the blower of the idle ignition module to low speed.

The wiring schematic for the Pennant 500 – 1000 is shown in Figure 14, and the schematic for the 1250 – 2000 models is shown in Figure 15. All 24V wiring is routed through the diagnostic PC board. Wiring harnesses connect between the diagnostic PC board and the control components, indicator board, or field wiring terminal strip. The diagnostic board contains LEDs that indicate open status of the safety interlocks, and quick-connect terminals that provide tests points for checking voltage/continuity at various points in the control circuit.

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.

SECTION 10.
Wiring Diagrams

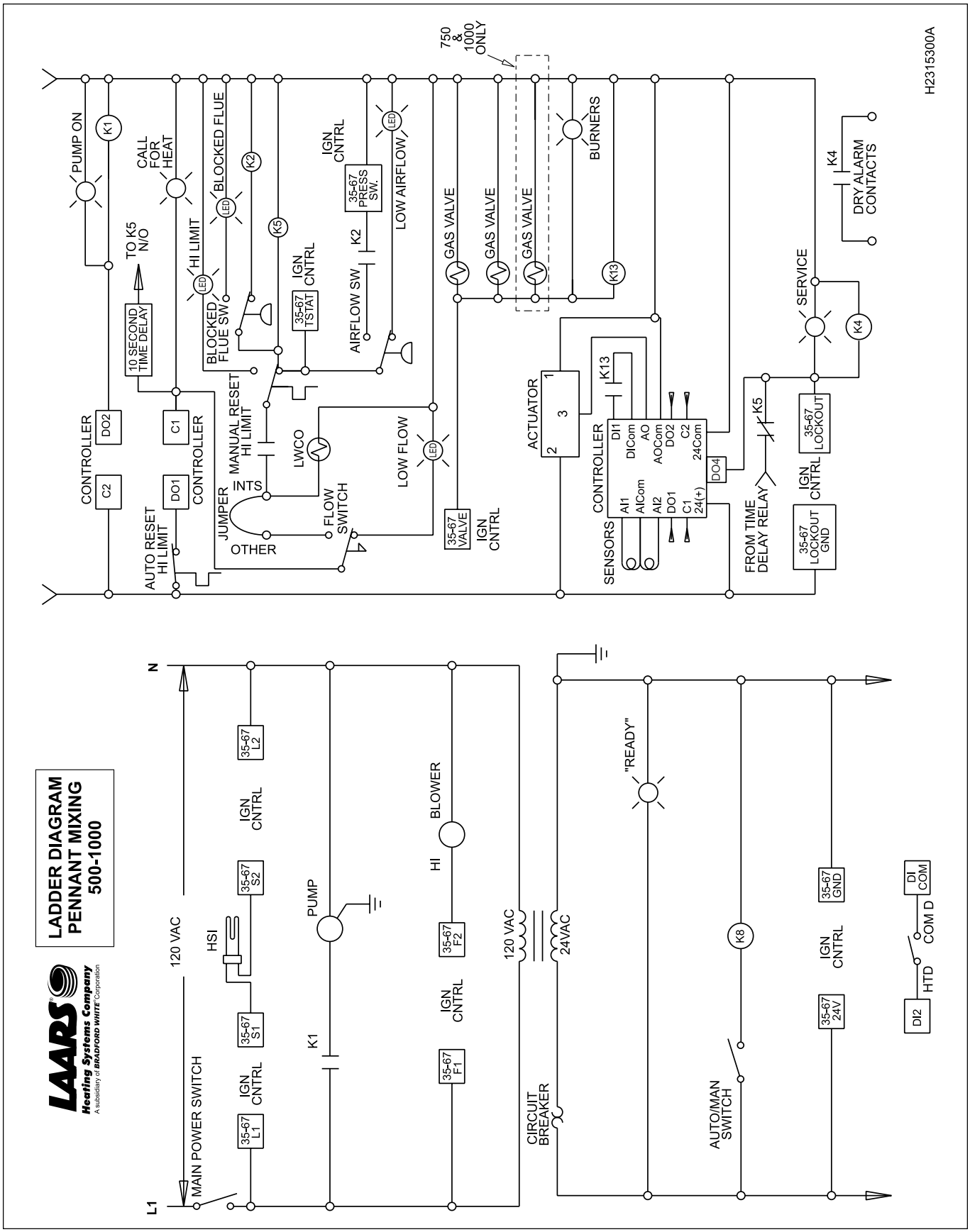

Figure 12. Pennant 500 - 1000 Ladder Diagram.

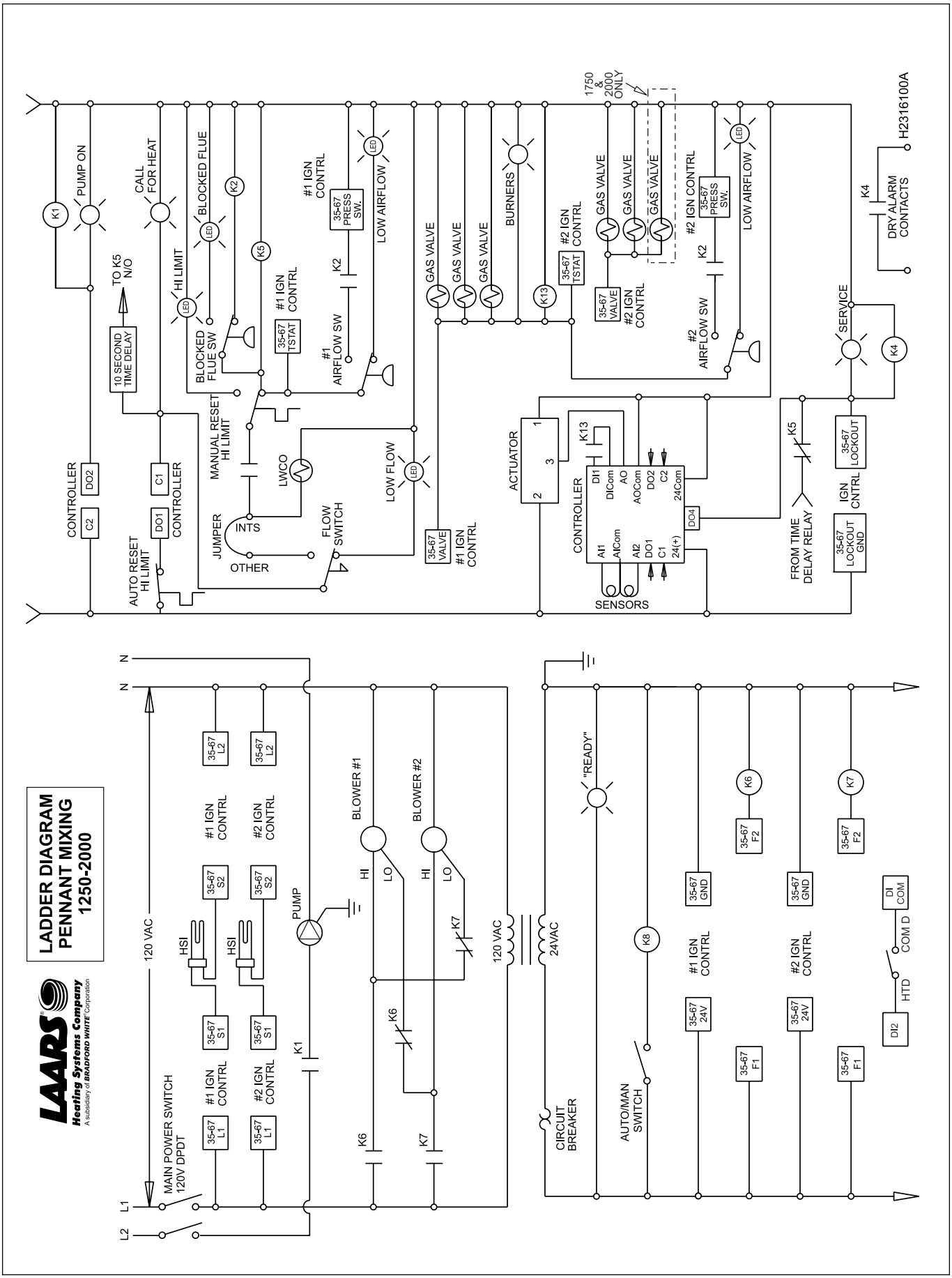

Figure 13. Pennant 1250 - 2000 Ladder Diagram.

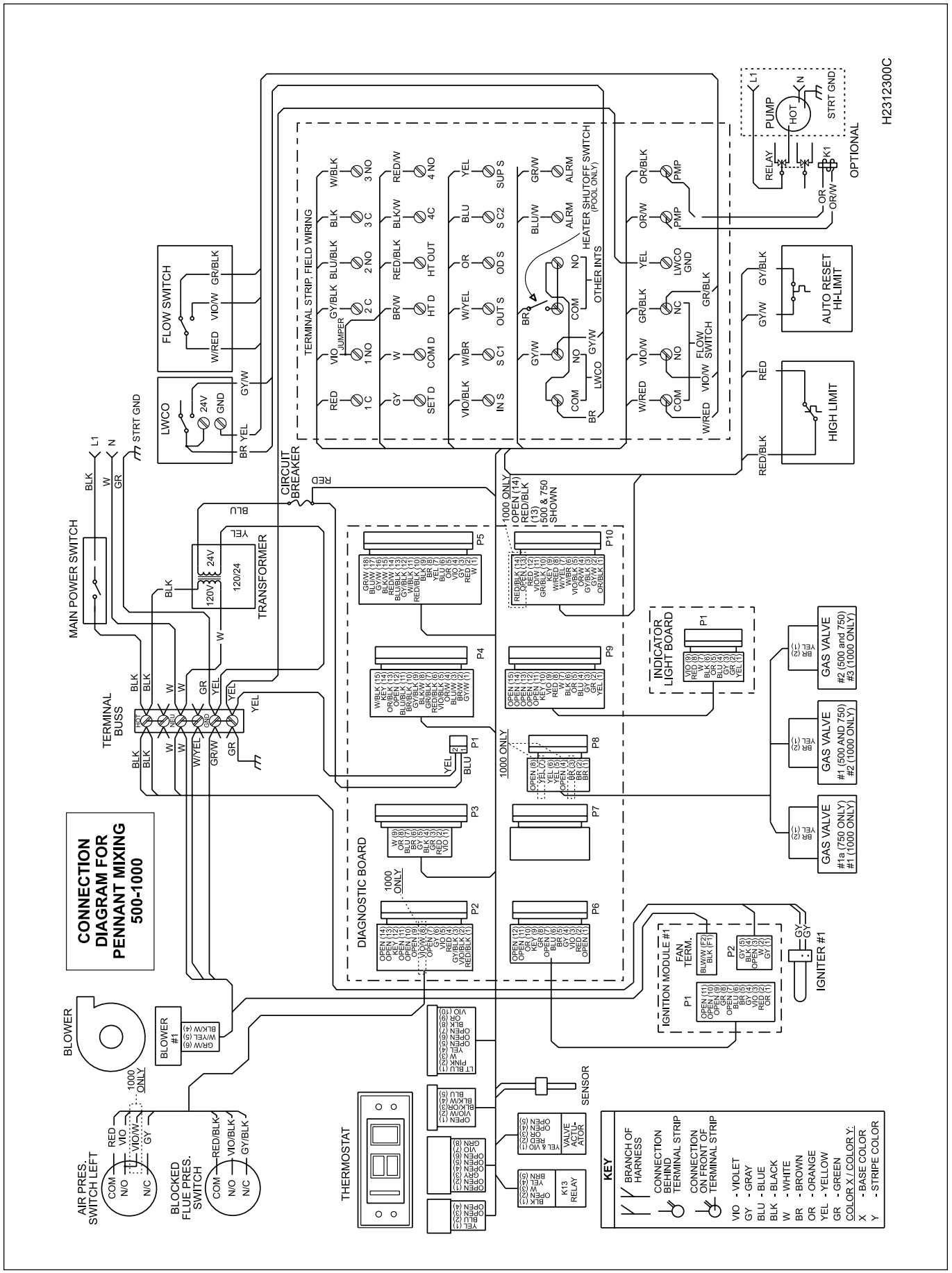

Figure 14. Pennant 500 - 1000 Wiring Schematic.

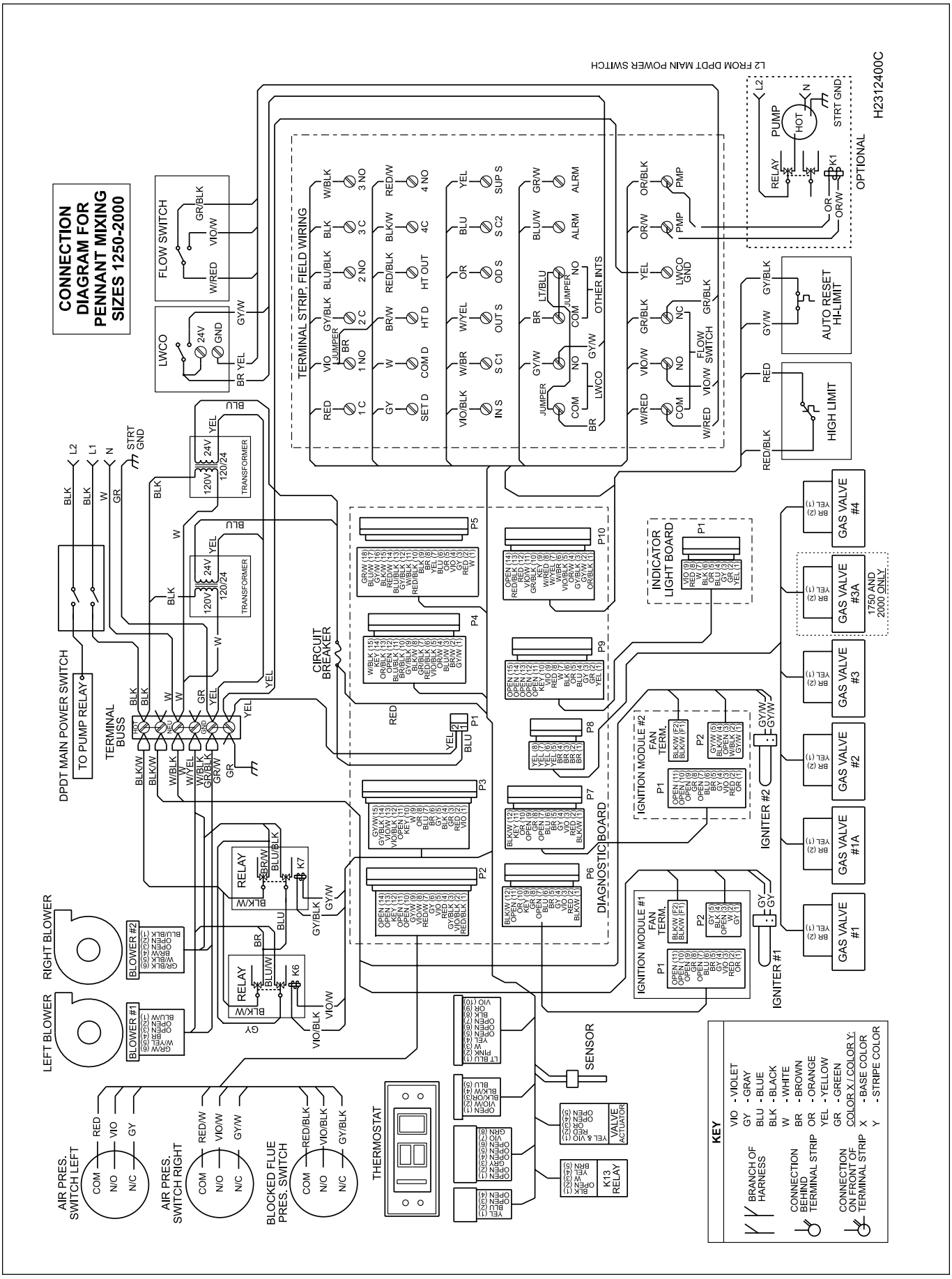

Figure 15. Pennant 1250 - 2000 Wiring Schematic.

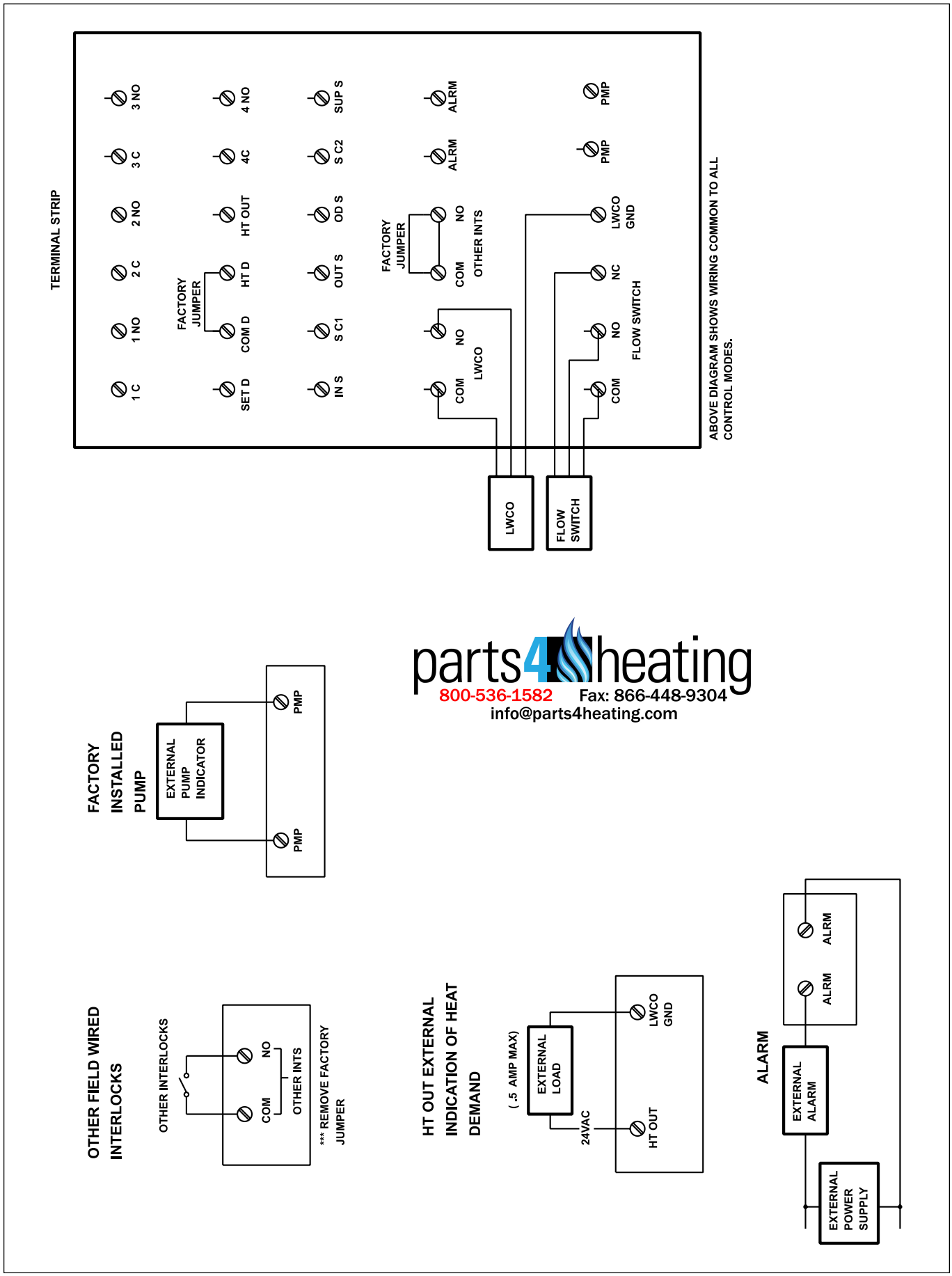

Figure 16. Field Wiring, PNCP 500-1000.