

Installation and Operation Instructions for

Rheos™

Modulating Boiler
Model RHCH

Modulating Water Heater
Model RHCV

U.S. Patent No. 6,644,393
Canada Patent Pending

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.

TABLE OF CONTENTS

SECTION 1.

General Information

1.1 Introduction	3
1.2 Model Identification	3
1.3 Warranty	4
1.4 Dimensions	4
1.5 Outdoor Installations	6
1.6 Locating the Appliance	6
1.7 Locating Pump-Mounted Water Heater with Respect to Storage Tank(s)	6
1.8 Locating Pump-Mounted Boiler with Respect to Return/Supply Header	6
1.9 Locating Appliance for Correct Vent Distance From Outside Wall or Roof Termination	6

SECTION 2.

Venting and Combustion Air

2.1 Combustion Air	7
2.1.1 Combustion Air From Room	7
2.1.2 Intake Combustion Air	7
2.2 Venting	9
2.3 Locating Vent & Combustion Air Terminals	9
2.3.1 Side Wall Vent Terminal	9
2.3.2 Side Wall Combustion Air Terminal	10
2.3.3 Vertical Vent Terminal	10
2.3.4 Vertical Combustion Air Terminal	10
2.4 Common Vent Test – Boilers	10

SECTION 3.

Gas Supply and Piping

3.1 Gas Supply and Piping	11
---------------------------------	----

SECTION 4A.

Water Connections – Rheos Boiler

4A.1 Heating System Piping: Hot Supply Connections – Boiler	15
4A.2 Cold Water Make-Up – Boiler	15
4A.3 Water Flow Requirements – Boiler	15
4A.4 Freeze Protection – Boiler	15

SECTION 4B.

Water Connections – Rheos Water Heater

4B.1 Water System Piping – Water Heater	18
4B.2 Hot Water Supply Piping – Water Heater	18
4B.3 Water Flow Requirements – Water Heater	18
4B.4 Combined Water (potable) Heating and Space Heating	18
4B.5 Freeze Protection — Water Heater	19

SECTION 5.

Electrical Connections

5.1 Main Power	19
5.2 Pump Connections	19
5.3 Temperature Control – Boiler	20
5.4 Temperature Control – Water Heater	20
5.4.1 Remote Water Heater Temperature Control ...	20
5.4.2 Internal Water Heater Temperature Control ...	20
5.5 Temperature Control Features	21

5.5.1 Temperature Setpoint	21
5.5.2 Differential Setting	21
5.5.3 Offset	21
5.5.4 Throttling Range	21
5.5.5 Minimum Output Setting	21
5.5.6 Integration Constant	22
5.6 External Control Connections	22
5.7 Wiring Diagrams	24

SECTION 6.

Operating Instructions

6.1 Filling the Boiler System	37
6.2 Operating the Burner and Set Up	37
6.3 Shutting Down the Rheos	39
6.4 To Restart the Rheos	39

SECTION 7.

Maintenance

7.1 System Maintenance	39
7.2 Appliance Maintenance and Component Description	39
7.2.1 Burner	40
7.2.2 Filter	40
7.2.3 Modulating Gas Valve	40
7.2.4 Safety Gas Valve	40
7.2.5 Manual Reset High Limit Control	40
7.2.6 Temperature Control	40
7.2.7 Ignition Control	40
7.2.8 Ignitor / Flame Sensor Assembly	41
7.2.9 Transformers	41
7.2.10 Blower	41
7.2.11 Flow Switch	41
7.2.12 Heat Exchanger Coil	41
7.2.13 Normally Open Vent Valve	42
7.2.14 Motorized Safety Valve	42
7.2.15 Gas Pressure Switches	43

SECTION 8.

Trouble Shooting

8.1 Sequence of Operation	44
8.2 Resolving Lockouts	44
8.3 Delayed Ignition – Possible Causes	44
8.3.1 High Lockup Pressure (LP Appliances) - Occurs on Start-up	44
8.3.2 Gas Valve Regulation	44
8.3.3 Defective Burner - Occurs on Startup or at Burner Shutdown	45
8.4 Short Cycling – Boiler	45
8.5 Short Cycling – Water Heater	45
8.6 High Gas Consumption	45

SECTION 9.

Replacement Parts

9.1 General Information	45
9.2 Parts List	46

Tables Listing	55
----------------------	----

Figures Listing	55
-----------------------	----

- (9) Fuel
 - N = Natural Gas
 - P = Liquid Propane
- (10) Altitude
 - A = Universal Altitude (0' to 10,000') (0m to 3050m)
- (11) Location
 - C = Indoor and Outdoor (for non-condensing units)
 - I = Indoor (for condensing units)
- (12) Firing Mode
 - F = Modulating
- (13) Revision
 - 1 = First version
 - 2 = Second version
- (14) Heat Exchanger
 - E = Glass-lined steel with copper tubes
 - F = Glass-lined steel with cupronickel tubes
- (15) Control Option Code
 - X = Standard, meets CSD-1 boiler standard
 - A = Control Pack A: CSD-1, CA, FM, IL, IRI, Alarm Bell
 - B = Control Pack B: CSD-1, CA, FM, IL, LDS, MN
 - C = Control Pack C: with 200°F (93°C) max. control (KY)
 - D = Control Pack A with 200°F (93°C) max. control
 - E = Control Pack B with 200°F (93°C) max. control
 - F = Non CSD-1
 - G = Non CSD-1 with 200°F (93°C) max. control
- (16) Pump Options
 - X = No Pump
 - H = Pump mounted, hard water pump
 - N = Pump mounted, normal pump

1.3 Warranty

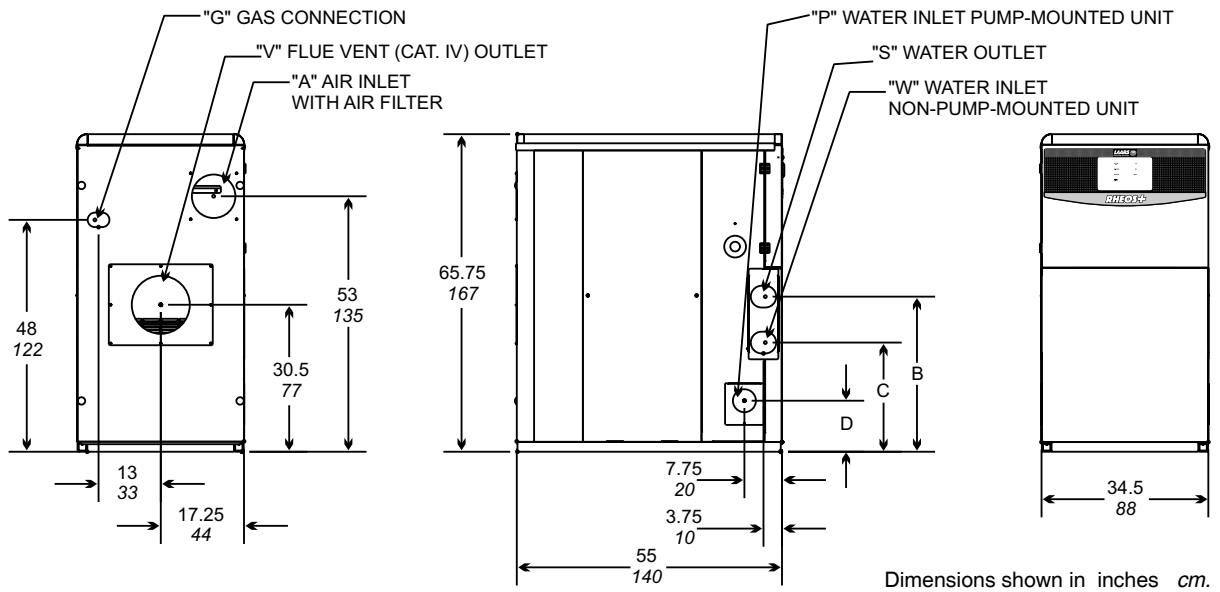
Laars Heating Systems' Rheos appliances are covered by a limited warranty. The owner should fill out the warranty registration card and return it to Laars Heating Systems.

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

The overall dimensions are 34.5" (88cm) wide, 65.75" (167cm) tall, 55" (140cm) deep. Other dimensions can be found in Figure 1.



Dimensions shown in inches *cm*.


Model	"V" Vent Outlet Connection		"A" Air Inlet Connection		"W" Inlet Water Connection Non-Pump-Mounted NPT	"P" Inlet Water Connection Pump-Mounted NPT	"S" Outlet Water Connection All Models NPT
	inches	cm	inches	cm			
1200	6	15	6	15	2-1/2"	2-1/2"	2-1/2"
1600	6	15	8	20	2-1/2"	3"	2-1/2"
2000	7	18	8	20	3"	2-1/2"	3"
2400	10	25	8	20	3"	3"	3"

Model	"G" Gas Connects. Std/Control Pk A Nat/LP NPT	Control Pk B & E Nat NPT	Control Pk B & E LP NPT	"B"		"C"		"D"	
				inches	cm	inches	cm	inches	cm
1200	1"	1-1/2"	1-1/2"	34-1/4"	87	27-3/4"	70	9-3/4"	25
1600	1-1/2"	2"	2"	34-1/4"	87	25-1/2"	65	10-1/2"	27
2000	1-1/2"	2"	1"	34-1/4"	87	24-3/4"	63	9-3/4"	25
2400	1-1/2"	2"	2"	32"	81	22-1/2"	57	10-1/2"	27

Figure 1. Dimensional Drawing.

1.5 Outdoor Installations

Attach the appropriate termination and appliance adaptor to the vent outlet (see Table 1). Units are shipped with a louvered cover over the ducted air connection. Do not remove this cover, and/or add any piping to the ducted air connection. The unit will take its combustion air through the louvers in the jacket.

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

In installations where the air temperature may go

Model (Size)	Termination	Appliance Adapter
1200	D2008300	D2008500
1600	D2008300	D2008500
2000	D2008400	D2008600
2400	D2007500	D2007600

Table 1. Terminals for Outdoor Installation.

below 15°F (-9°C), a valve heater kit, part number R2010100, must be installed on the operating gas valve. Instructions for the installation of the valve heater are included with the kit.

NOTE: Units built with control packs B and E have two actuators. Therefore, two heater kits must be used.

1.6 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. **Rheos Boilers or Water Heaters must never be installed on carpeting.** 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 Rheos must be located as close as practical to a chimney or gas vent. 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:

Appliance Surface	Clearance From Combustible Material		Suggested Service Clearance	
	inches	cm	inches	cm
Piping Side	1	2.5	18	46
Opposite Side	1	2.5	1	2.5
Top	1	2.5	24	61
Back	1	2.5	36	91
Front	1	2.5	36	91
Vent	per UL1738 venting system supplier's instructions			

Table 2. Clearances.

1.7 Locating Pump-Mounted Water Heater with Respect to Storage Tank(s)

For best results a pump-mounted Rheos water heater should be located within 15 feet (4.6m) of the storage tank(s). The pump is sized for 30 feet (9.1m) of piping.

Water heater pumps are sized for water hardness; 7.6 to 17 grains per gallon for normal water, and greater than 17 grains per gallon for hard water. If the system has soft water (1 to 7.5 grains per gallon hardness), but the Rheos has a normal water pump mounted in it, please consult the factory for assistance.

If the appliance must be installed with longer piping runs, then larger diameter pipe or tubing may be able to be used, in some instances. Consult the factory for assistance.

1.8 Locating Pump-Mounted Boiler with Respect to Return/Supply Header

For the best results a pump-mounted Rheos Boiler should be located within 15 feet (4.6m) of the supply and return headers. The pump is sized for 30 feet (9.1m) of piping, in most cases, enough for primary-secondary piping systems.

If the appliance must be installed with longer piping runs, then larger diameter tubing may be able to be used, in some instances. Consult the factory for assistance.

1.9 Locating Appliance for Correct Vent Distance From Outside Wall or Roof Termination

The forced draft combustion air blower in the appliance has sufficient power to vent properly when the guidelines in Table 3 are followed.

NOTE: When located on the same wall, the Rheos 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.

Model	Intake Size	Exhaust Size	Intake Maximum Run	Exhaust Maximum Run
1200	6" (15 cm) dia.	6" (15 cm) dia.	50 linear feet with 5 elbows	50 linear feet with 5 elbows
1600	8" (20 cm) dia.	6" (15 cm) dia.	50 linear feet with 5 elbows	50 linear feet with 5 elbows
2000	8" (20 cm) dia.	7" (18 cm) dia.	50 linear feet with 5 elbows	50 linear feet with 5 elbows
2400	8" (20 cm) dia.	10" (25 cm) dia.	50 linear feet with 5 elbows	50 linear feet with 5 elbows

Table 3. Vent / Air Pipe Sizes.

SECTION 2. Venting and Combustion Air

2.1 Combustion Air

Rheos boilers and water 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 CSA B149.1, Installation Codes, and applicable provisions of the local building codes.

A Rheos unit can take combustion air from the space in which it is installed, or the combustion air can be ducted directly to the unit. Ventilation air must be provided in either case.

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" (300mm) of the top and one commencing within 12" (300mm) 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 (550 square mm/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 (1100 square mm/kW) of total input rating of all equipment in the enclosure.

Method 2: One permanent opening, commencing within 12" (300mm) 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 (734 square mm/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

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, shown in Table 4. See Table 3 to select the appropriate diameter air pipe. 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 for the combustion air intake (see Table 5), sized per Section 1.8. 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). Up to five elbows

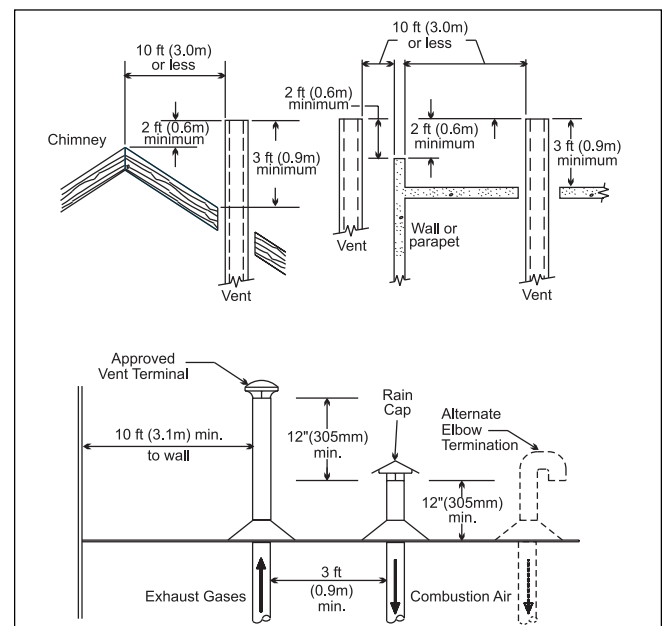


Figure 2. Combustion Air and Vent Through Roof.

	U.S. Installations (see note 1)	Canadian Installations (see note 2)
A= Clearance above grade, veranda, porch, deck, or balcony	12 inches (30 cm)	12 inches (30 cm)
B= Clearance to window or door that may be opened	4 feet (1.2 m) below or to side of opening; 1 foot (30 cm) above opening	36 inches (91 cm)
C= Clearance to permanently closed window	See note 4	See note 5
D= Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet (61cm) from the center line of the terminal	See note 4	See note 5
E= Clearance to unventilated soffit	See note 4	See note 5
F= Clearance to outside corner	See note 4	See note 5
G= Clearance to inside corner	See note 4	See note 5
H= Clearance to each side of center line extended above meter/regulator assembly	See note 4	3 feet (91 cm) within a height 15 feet above the meter/regulator assembly
I= Clearance to service regulator vent outlet	See note 4	3 feet (91 cm)
J= Clearance to nonmechanical air supply inlet to building or the combustion air inlet to any other appliance	4 feet (1.2 m) below or to side of opening; 1 foot (30 cm) above opening	36 inches (91 cm)
K= Clearance to a mechanical air supply inlet	3 feet (91 cm) above if within 10 feet (3 m) horizontally	6 feet (1.83 m)
L= Clearance above paved sidewalk or paved driveway located on public property	Vent termination not allowed in this location for category IV appliances. For Category III appliances, vent must terminate at least 7 feet (2.13m) above the sidewalk or driveway.	Vent termination not allowed in this location for category IV appliances. A vent shall not terminate directly above a sidewalk or paved driveway that is located between two single family dwellings and serves both dwellings. For Category III appliances that do not violate the previous condition, vent must terminate at least 7 feet (2.13m) above the sidewalk or driveway.
M= Clearance under veranda, porch, deck, or balcony	See note 4	12 inches (30 cm) (see note 3)

Notes:

1. In accordance with the current ANSI Z223.1 / NFPA 54 National Fuel Gas Code.
2. In accordance with the current CAN/CGA-B149 Installation Codes.
3. Permitted only if veranda, porch, deck, or balcony is fully open on a minimum of two sides beneath the floor.
4. For clearances not specified in ANSI Z223.1 / NFPA 54, clearance is in accordance with local installation codes and the requirements of the gas supplier.
5. For clearances not specified in CAN/CGA-B149, clearance is in accordance with local installation codes and the requirements of the gas supplier.

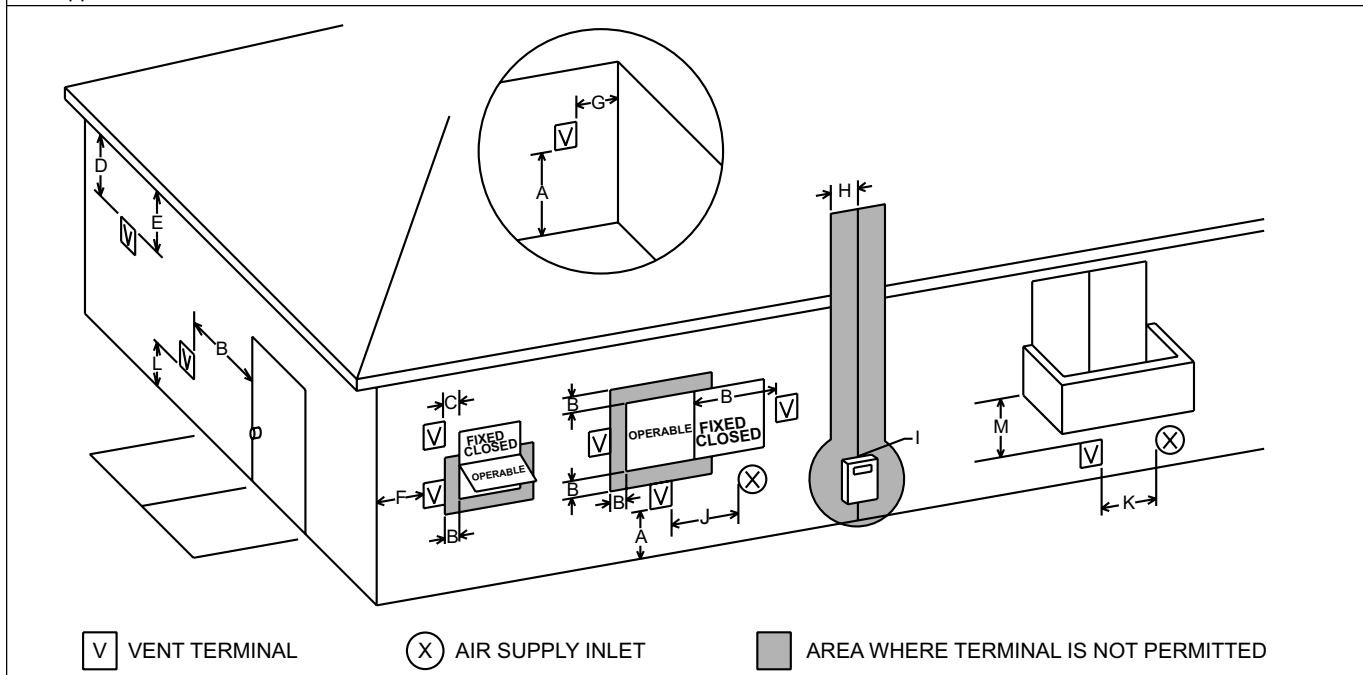


Figure 3. Combustion Air and Vent Through Side Wall.

can be used with the 50 feet of pipe. Subtract 10 allowable linear feet for every additional elbow used.

Model	Horizontal Combustion Air Terminal	Horizontal Vent Terminal
1200	20260701	D2004500
1600	20260703	D2004500
2000	20260703	D2004600
2400	20260703	D2006200

Table 4. Horizontal Vent and Air Terminals For Indoor Installations.

Term	Description
Pipe	Single-wall galvanized steel pipe, 24 gauge minimum (sized per section 1.9)
Joint Sealing	Permanent duct tape or aluminum tape
Insulation	Not required, but recommended R5 insulation for cold installations (consult American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) handbook)

Table 5. Required Combustion Air Piping Material.

The connection for the intake air pipe is in the back of the unit. Take the plate off the back to reveal the collar on the filter box. 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 Rheos loses less than 1 percent of its input rating to the room, but other heat sources may be present.

2.2 Venting

The Rheos is a Category IV appliance and must be installed with a stainless steel venting system that complies with the UL 1738 Standard (see Table 6). It must be installed per this installation manual and the venting system manufacturer’s Installation Instructions. The unit’s vent can terminate through the roof, or through an outside wall. It can be installed through walls that are from 3" (7.6cm) to 12" (30cm) in thickness.

See Table 3 to select the appropriate vent pipe diameter. The first section of venting attached to the boiler must include a condensate drain fitting and condensate trap. 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 upwards not less than ¼ inch per foot (21mm/m)

from the unit to the vent terminal. Up to five elbows can be used with the 50 feet (15.2m) of pipe. Subtract 10 allowable linear feet for every additional elbow used.

IMPORTANT NOTE ABOUT COMMON VENTING: A single vent that is shared by multiple Rheos units **MUST** be engineered by a competent venting specialist, and involves the selection of draft inducing equipment, hardware and controls to properly balance flue gas pressures. Do not common vent Rheos units unless the vent system meets this requirement. Rheos units are never permitted to share a vent with Category I appliances.

For outdoor applications, see Section 1.5.

Condensate Drain Connection: A condensate drain connection shall be provided on the first section of venting attached to the boiler. Connect a clear plastic tube between that drain connection on the vent and a floor drain (or optional condensate pump if a floor drain is not accessible). The plastic tube shall be formed into a loop (trap) to drain condensate that collects in the vent system without permitting flue gases to escape. The condensate drain must be installed so as to prevent accumulation of condensate. Consult local codes for disposal method.

Term	Description
Venting System	Heat-Fab®, Inc. Saf-T Vent®GC or CI, Metal-Fab®, Inc. Corr/Guard, or equivalent sealed stainless steel system certified to UL1738.
Insulation	Not required, but recommended R5 insulation with protective cover for cold installations (consult American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) handbook)

Table 6. Required Venting Material.

2.3 Locating Vent & Combustion Air Terminals

2.3.1 Side Wall Vent Terminal

The appropriate Laars side wall vent hood must be used, and is listed in the installation and operation manual. The terminal provides a means of installing the 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 CSA B149.1 or .2 and local applicable codes. Consider the following when installing the terminal:

1. The figure in this addendum shows the requirements for mechanical vent terminal clearances for the U.S. and Canada.
2. Vent terminals for condensing appliances or appliances with condensing vents are **not** permitted to terminate above a public walkway, or over an area where condensate or vapor could create a nuisance or hazard.

3. Locate the vent terminal so that vent gases cannot be drawn into air conditioning system inlets.
4. Locate the vent terminal so that vent gases cannot enter the building through doors, windows, gravity inlets or other openings. Whenever possible, locations under windows or near doors should be avoided.
5. Locate the vent terminal so that it cannot be blocked by snow. The installer may determine that a vent terminal must be higher than the minimum shown in codes, depending upon local conditions.
6. Locate the terminal so the vent exhaust does not settle on building surfaces or other nearby objects. Vent products may damage such surfaces or objects.
7. If the boiler or water heater 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.

2.3.2 Side Wall Combustion Air Terminal

The Laars side wall combustion air terminal (see Table 4) must be used when the heater takes air from a side wall. Consider the following when installing the terminal:

1. Do not locate the air inlet terminal near a source of corrosive chemical fumes (e.g., cleaning fluid, chlorine compounds, etc.)
2. Locate the terminal so that it will not be subject to damage by accident or vandalism. It must be at least 7 feet (2.1m) above a public walkway.
3. 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 (30cm) above grade, but the installer may determine it should be higher, depending upon local conditions.
4. If the Rheos 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 Common Vent Test — Boilers

NOTE: This section does not describe a method for common venting Rheos units. It describes what must be done when a unit is removed from a common vent system. Rheos units require special vent systems and fan for common vent. Contact the factory if you have questions about common venting Rheos units.

When an existing boiler is removed from a common venting system, the common venting system is likely to be too large for proper venting of the appliances remaining connected to it.

At the time of removal of an existing boiler, the following steps shall be followed with each appliance remaining connected to the common venting system placed in operation, while the other appliances remaining connected to the common venting system are not in operation.

Model and Gas Type	Distance from Gas Meter or Last Stage Regulator							
	0-50 feet	0-15m	50-100 feet	15-31m	100-200 feet	31-61m	200-300 feet	61-91m
1200 natural	2"	5.1cm	2-1/2"	6.4cm	2-1/2"	6.4cm	3"	7.6cm
1200 propane	1-1/2"	3.8cm	2"	5.1cm	2"	5.1cm	2-1/2"	6.4cm
1600 natural	2-1/2"	6.4cm	2-1/2"	6.4cm	3"	7.6cm	3"	7.6cm
1600 propane	2"	5.1cm	2"	5.1cm	2-1/2"	6.4cm	2-1/2"	6.4cm
2000 natural	3"	7.6cm	3"	7.6cm	3"	7.6cm	3-1/2"	8.9cm
2000 propane	2-1/2"	6.4cm	2-1/2"	6.4cm	2-1/2"	6.4cm	3"	7.6cm
2400 natural	2-1/2"	6.4cm	3"	7.6cm	3"	7.6cm	3-1/2"	8.9cm
2400 propane	2"	5.1cm	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 Sizes.

1. Seal any unused openings in the common venting system.
 2. Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion and other deficiencies which could cause an unsafe condition.
 3. Insofar as it is practical, close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliance not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.
 4. Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.
 5. Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar or pipe.
 6. After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas burning appliance to their previous conditions of use.
 7. Any improper operation of the common venting system should be corrected so that the installation conforms to the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and/or CSA B149.1, Installation Codes. When resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in Part II of the National Fuel Gas Code, ANSI Z223.1 NFPA 54 and/or CSA B149.1, Installation Codes.
- However, the appliance will function properly without the use of high altitude modification at elevations up to 10,000 feet (3050 m).
2. The maximum inlet gas pressure must not exceed 13" W.C. (3.2kPa). The minimum inlet natural gas pressure is 4" W.C. (1.0kPa) and minimum inlet propane gas pressure is 6" (1.5kPa).
 3. Refer to Table 7, size supply.
 4. Run gas supply line in accordance with all applicable codes.
Note: If you have a boiler/water heater with a normally open vent valve, install a vent line from the vent valve to an outside location as required by your installation code or IRI requirement. **Do not remove 3/4 inch pipe plug from the vent valve if venting from the normally open vent valve is not required by your installation code.**
 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.

⚠ WARNING:

Open flame can cause gas to ignite and result in property damage, severe injury, or loss of life.

SECTION 3. Gas Supply and Piping

3.1 Gas Supply and Piping

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

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).

NOTE: The Rheos 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. A bleed line from the diaphragm-type automatic valve shall be vented per local code requirements. Rheos units are equipped with low and high gas pressure switches that are integrally vent limited. These types of devices do not require venting to atmosphere.

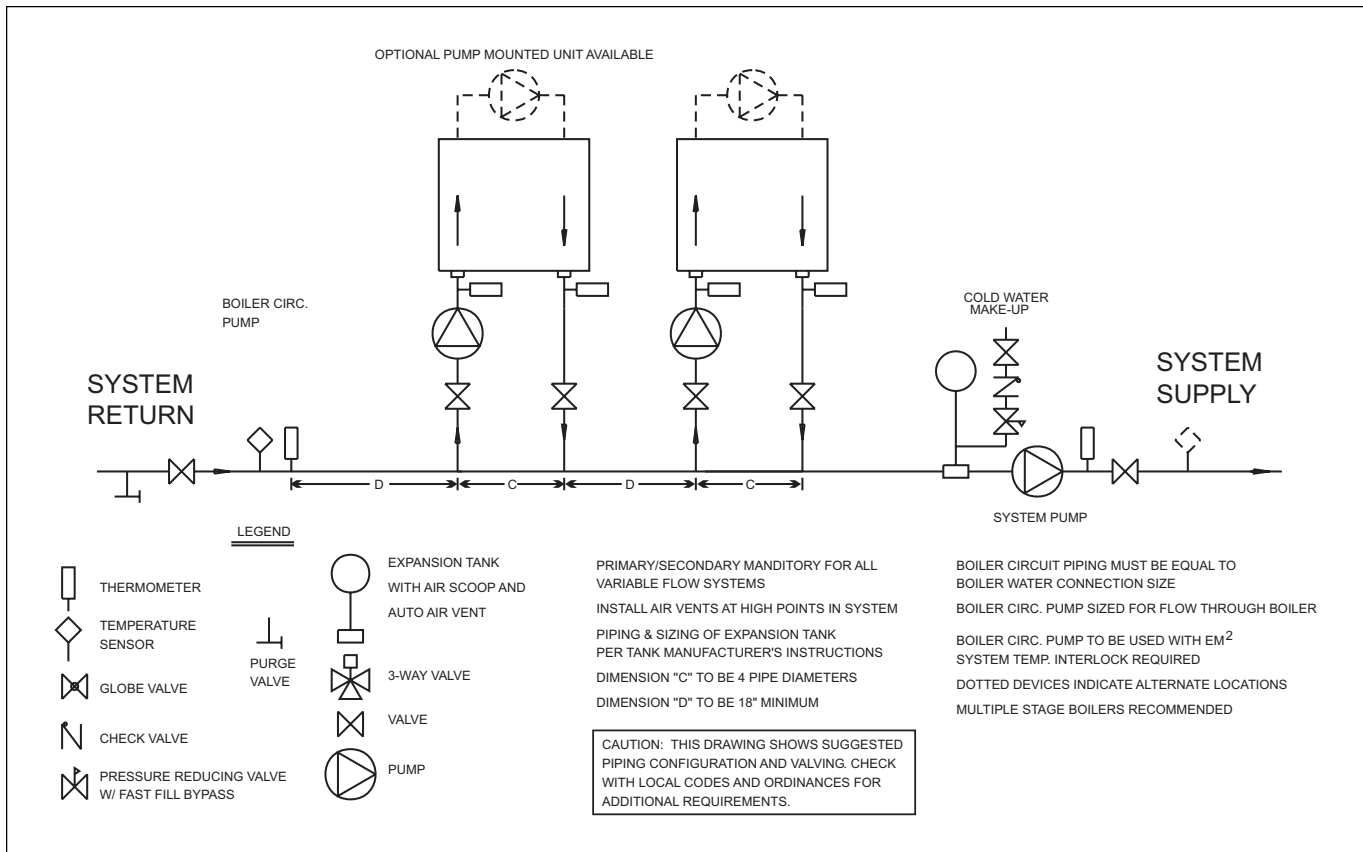


Figure 4. Hydronic Piping — Multiple Boilers, Primary Secondary System.

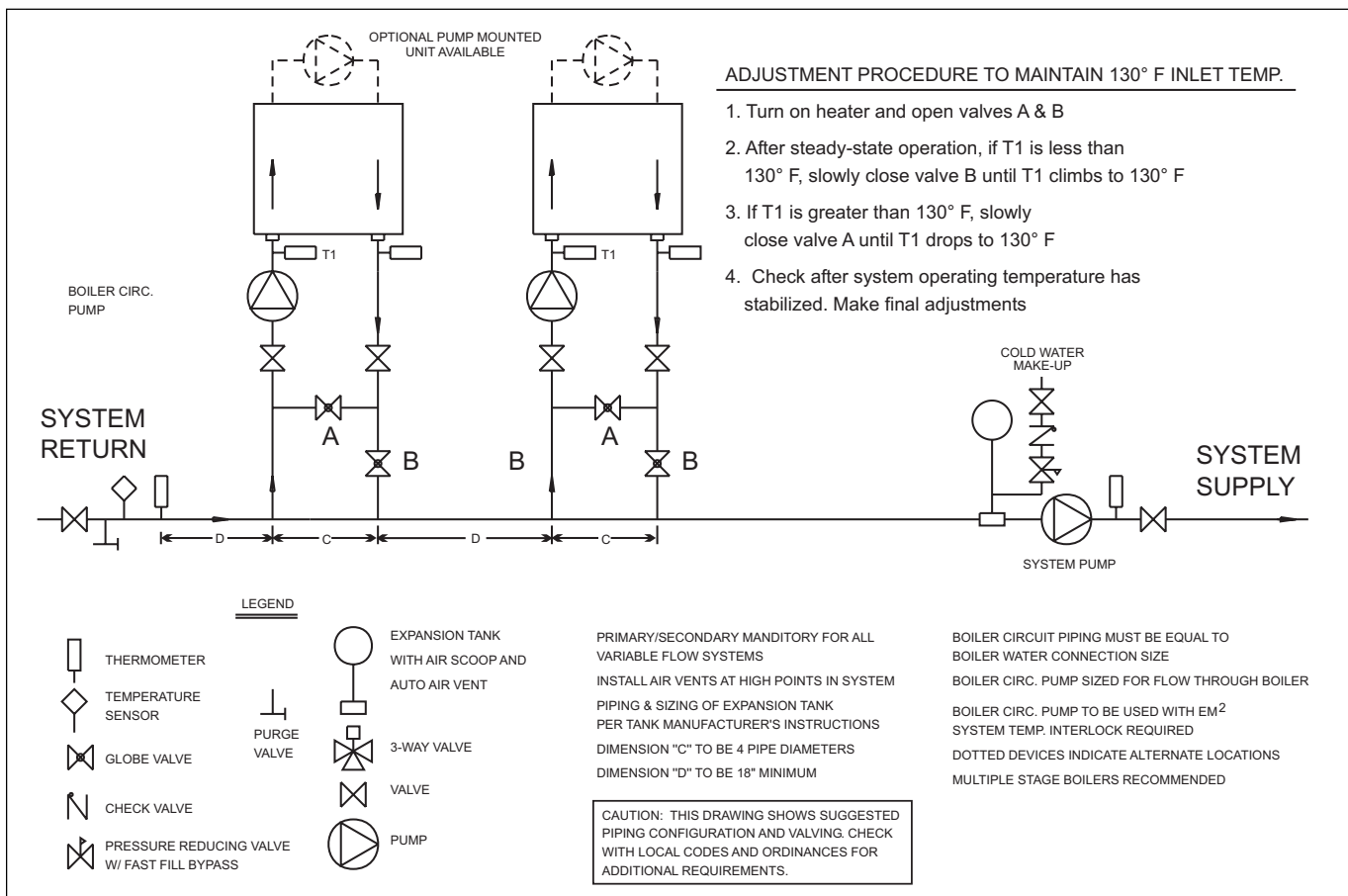


Figure 5. Hydronic Piping — Multiple Boilers, Low Temperature System.

Model (Size)	Temperature Rise in Degrees (°F/°C)											
	20°F		11°C		25°F		14°C		30°F		17°C	
	Flow gpm	H/L feet	Flow lpm	H/L m	Flow gpm	H/L feet	Flow lpm	H/L m	Flow gpm	H/L feet	Flow lpm	H/L m
1200	104	18	395	5.5	84	12	316	3.7	70	8	264	2.4
1600	139	22	527	6.7	111	14	422	4.3	93	10	351	3.0
2000	174	20	659	6.1	139	13	527	4.0	116	9	439	2.7
2400	209	18	791	5.5	167	12	632	3.7	139	8	527	2.4

NOTE: Maximum temperature rise is 30°F (17°C), as shown. Headloss is for boiler's heat exchanger only.

Table 8. Water Flow Requirements, RHCH (Boiler).

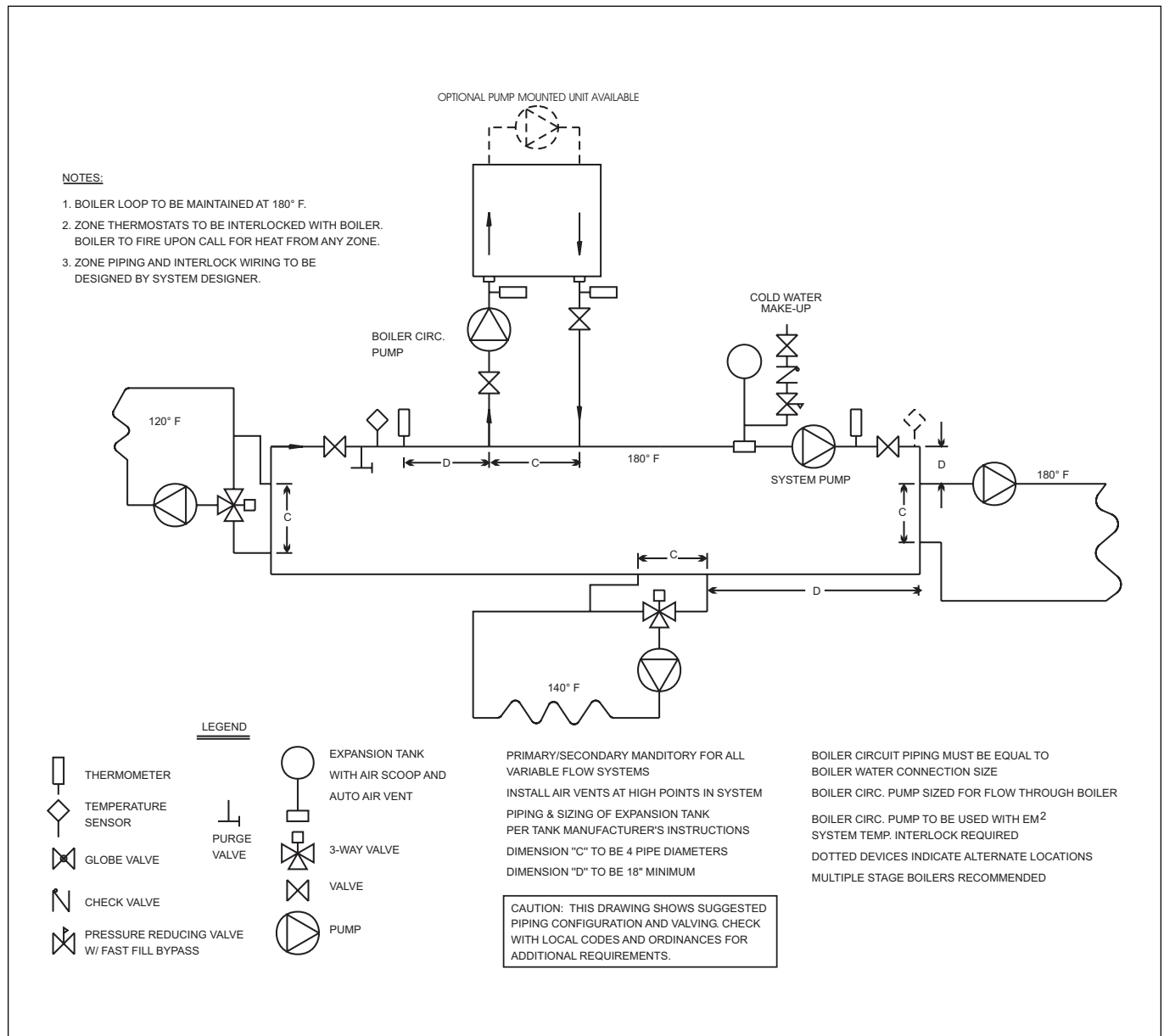


Figure 6. Hydronic Piping — One Boiler, Multi-Temperature System.

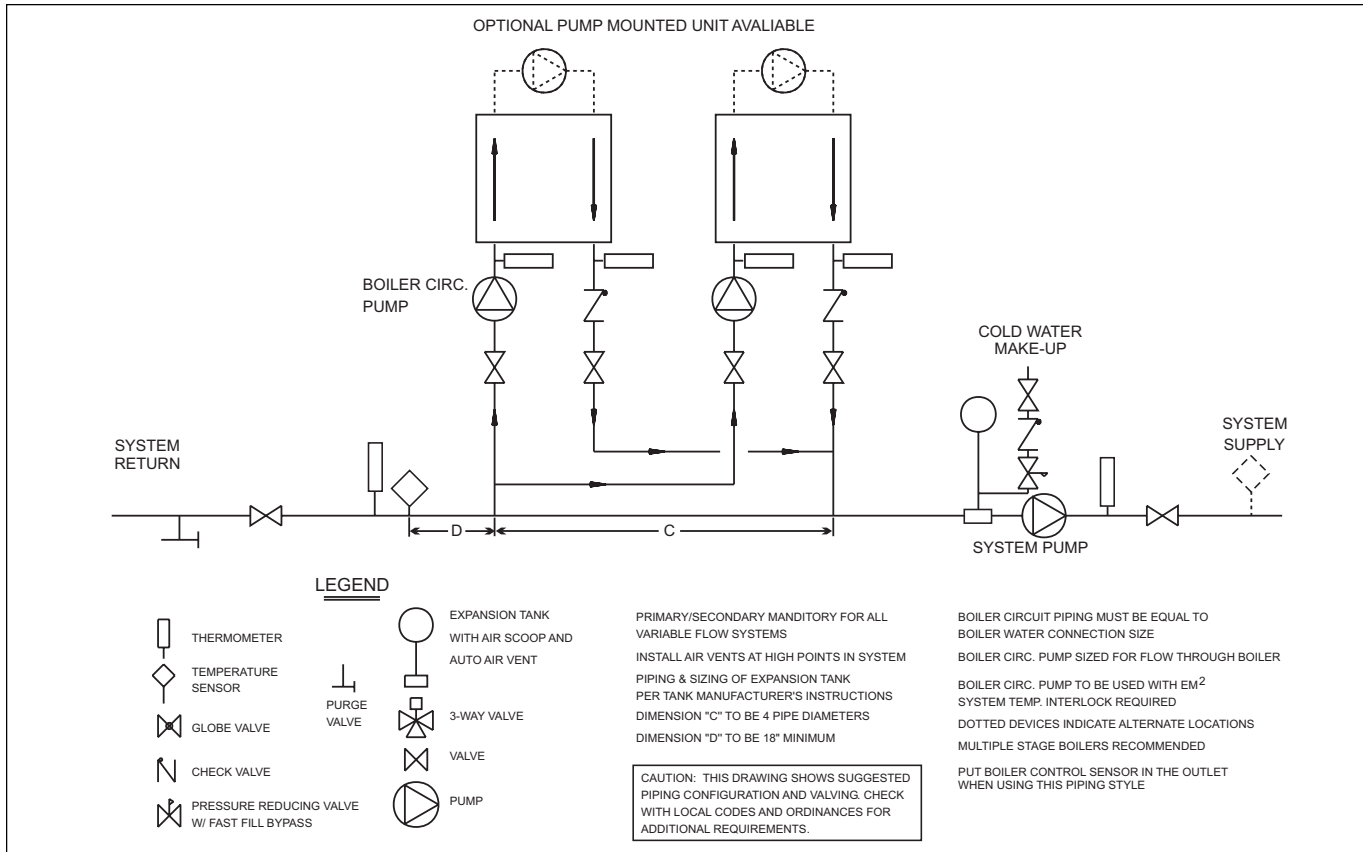


Figure 7. Hydronic Piping - Alternate System.

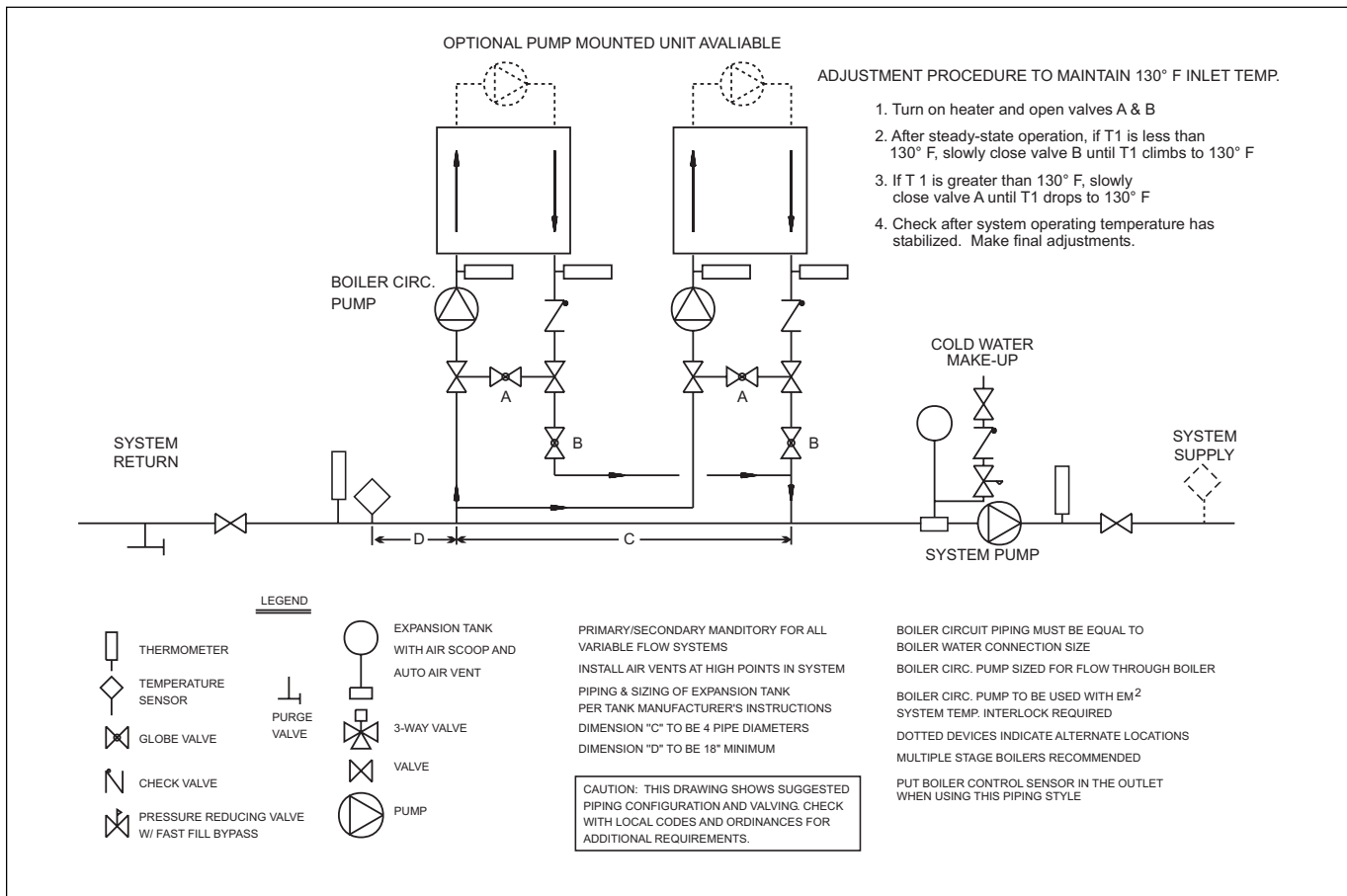


Figure 8. Hydronic Piping - Alternate Low Temperature System.

SECTION 4A. Water Connections — Rheos Boiler

4A.1 Heating System Piping: Hot Supply Connections — Boiler

NOTE: This appliance must be installed in a closed pressure system with a minimum of 12 psi (82.7kPa) static pressure at the boiler.

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" (2.5cm) 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 an air purger, an air vent, a diaphragm-type expansion tank, and a hydronic flow check in the system supply loop. Minimum fill pressure must be 12psig (82.7kPa). Install shutoff valves where required by code.

Suggested piping diagrams are shown in Figures 4, 5, 6, 7 and 8. These diagrams are meant only as a guide. Components required by local codes must be properly installed.

4A.2 Cold Water Make-Up — Boiler

1. Connect the cold water supply to the inlet connection of an automatic fill valve.
2. Install a suitable back flow preventer between the automatic fill valve and the cold water supply.
3. Install shut off valves where required.

NOTE: The boiler, when used in connection with a refrigeration system, must be installed so the chilled medium is piped in parallel with the boiler with appropriate valves to prevent the chilled medium from entering the boiler.

The boiler piping system of a hot water heating boiler connected to heating coils located in air handling appliances where they may be exposed to

refrigerated air circulation must be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle.

A boiler installed above radiation level, or as required by the authority having jurisdiction, must be provided with a low water cutoff device either as a part of the boiler or at the time of boiler installation.

4A.3 Water Flow Requirements — Boiler

A hydronic heating (closed loop) application recirculates the same fluid in the piping system. As a result, no new minerals or oxygen is introduced into the system. To ensure a proper operating temperature leading to long boiler life, a flow rate has been established based on the fluid temperature rise for this specific size boiler.

Pump-mounted boilers can be ordered for use in primary secondary piping systems. The pumps used are sized for the headloss through the heater, plus 30 feet (9.1m) of full-sized piping and a normal number of fittings.

Table 8 specifies water flow rates for boilers, which will enable the user to size a pump. The headloss shown is for the heater only, and the user will need to add the headloss of the system piping to properly size the pump.

The minimum inlet water temperature for the Rheos is 130°F (54°C) to avoid condensing on the copper coils.

4A.4 Freeze Protection – Boiler

Proper precautions for freeze protection are recommended for boiler installations in areas where the danger of freezing exists.

Power outage, interruption of gas supply, failure of system components, activation of safety devices, etc., may prevent a boiler from firing. **Any time a boiler is subjected to freezing conditions, and the boiler is not able to fire, and/or the water is not able to circulate, there is a risk of freezing in the boiler or in the pipes in the system.** When water freezes, it expands. This can result in bursting of pipes in the system, or damage to the boiler, which could result in leaking or flooding conditions.

Model (Size)	Hard Water						Normal Water						Soft Water					
	Flow gpm	H/L feet	Temp Rise (°F)	Flow lpm	H/L m	Temp Rise (°C)	Flow gpm	H/L feet	Temp Rise (°F)	Flow lpm	H/L m	Temp Rise (°C)	Flow gpm	H/L feet	Temp Rise (°F)	Flow lpm	H/L m	Temp Rise (°C)
1200	119	20	18	449	6.1	10	93	12	23	351	3.7	13	65	6.0	32	246	1.8	18
1600	161	29	17	609	8.8	10	132	20	21	500	6.1	12	89	8.9	31	336	2.7	17
2000	182	22	19	690	6.7	11	149	15	23	565	4.6	13	100	6.6	35	379	2.0	19
2400	237	23	18	898	7.0	10	186	14	23	703	4.3	13	129	6.9	32	488	2.1	18

Note: Soft Water: 1 to 7.5 grains per gallon
Normal Water: 7.6 to 17 grains per gallon
Hard Water: More than 17 grains per gallon

Note: Headloss is for heater's heat exchanger only.

Table 9. Water Flow Requirements, RHCV (Water Heater).

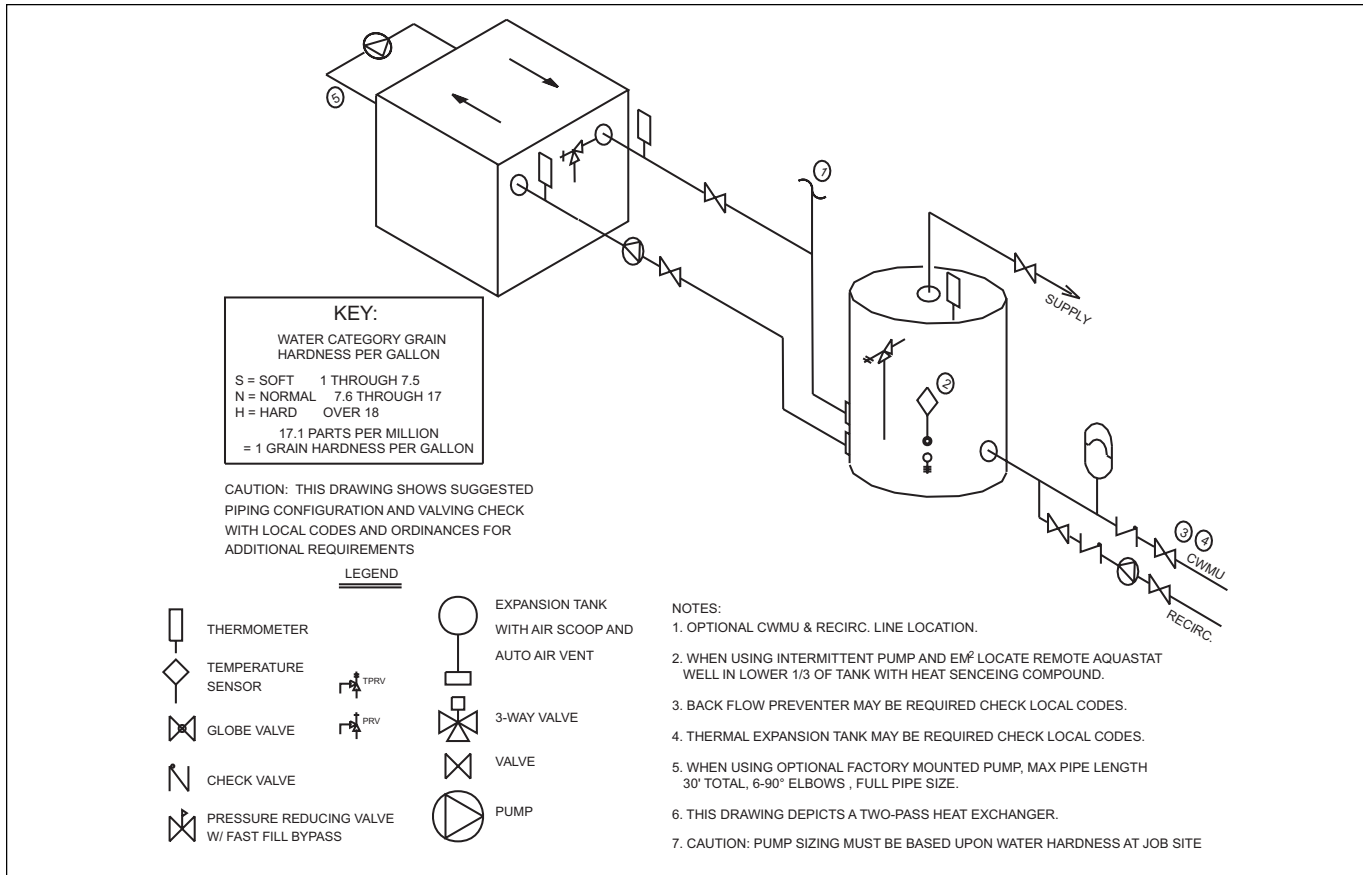


Figure 9. Water Heater Piping — One Heater, One Tank.

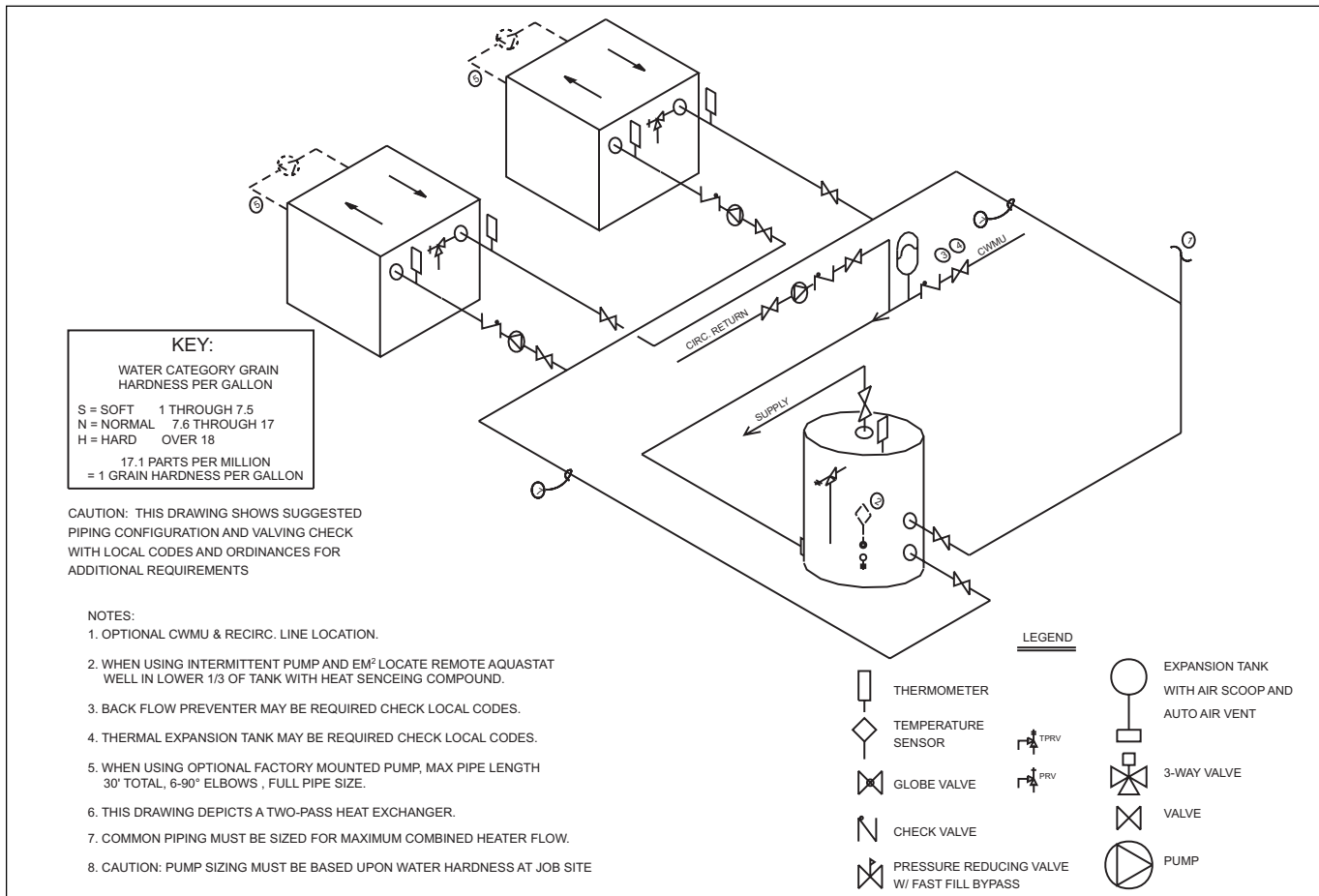


Figure 10. Water Heater Piping — Multiple Heaters, One Tank.

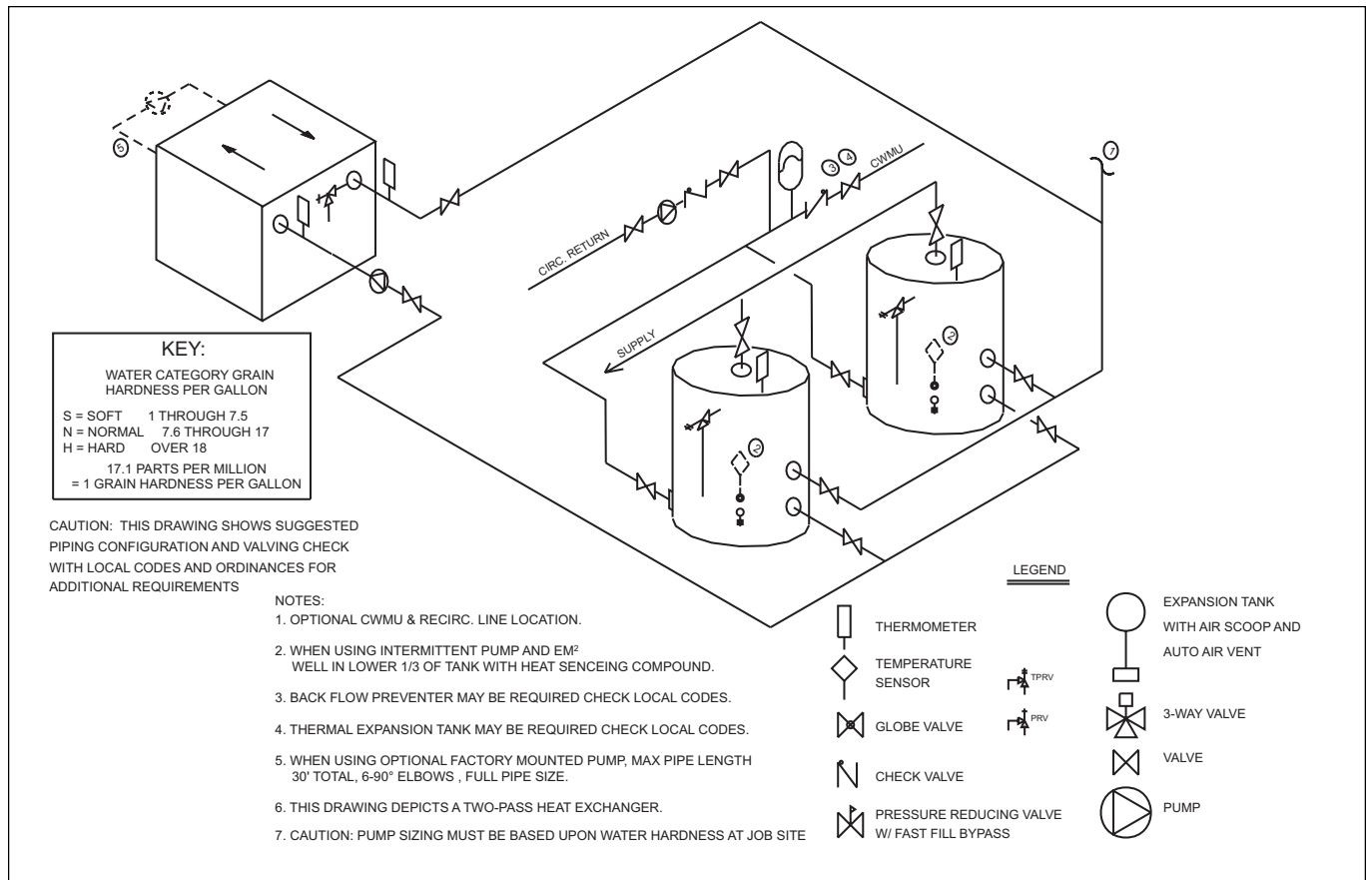


Figure 11. Water Heater Piping — One Heater, Multiple Tanks.

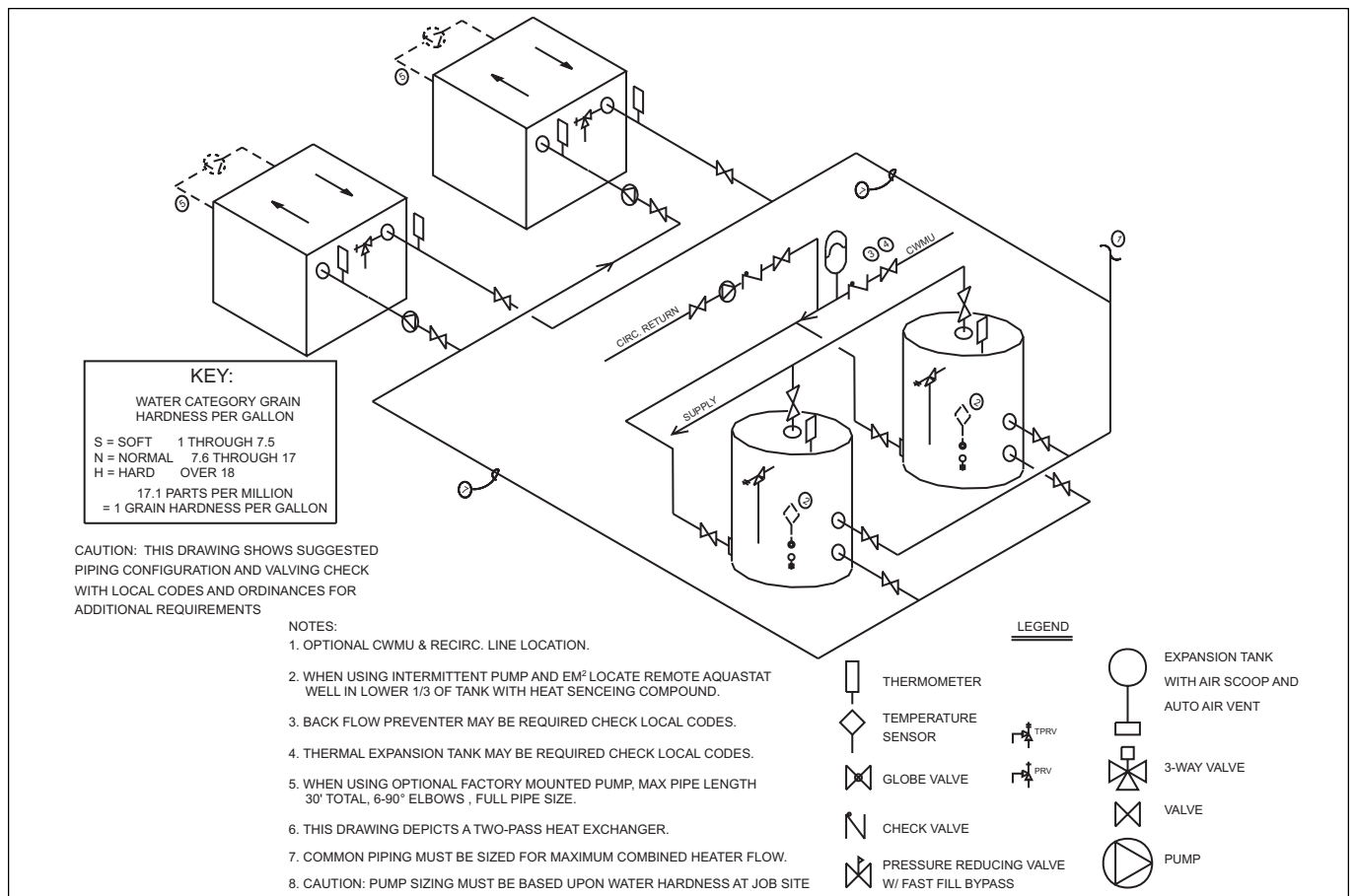


Figure 12. Water Heater Piping — Multiple Heaters, Multiple Tanks.

Do not use automotive anti-freeze. Maintaining a mixture of minimum 50% water and maximum 50% properly inhibited HVAC glycol, which contains an antifoamant, is the preferred method of freeze protection for Rheos boilers. **Percentage of glycol used in the Rheos boiler must not exceed 50%.** Typically, this mixture will serve as burst protection for temperatures down to approximately -35°F (-30°C). To get the desired temperature rise across the boiler when this mixture is used, increase the water flow by 15% above the original recommendation. Increase the head loss requirement by 20%.

IMPORTANT NOTES: Different glycol products may provide varying degrees of protection. Glycol products must be maintained properly in a heating system, or they may become ineffective. Consult the glycol specifications, or the glycol manufacturer, for information about specific products, maintenance of solutions, and set up according to your particular conditions.

SECTION 4B. Water Connections — Rheos Water Heater

4B.1 Water System Piping — Water Heater

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.

The Rheos can be used with several different types of readily available storage tanks. A pump draws water from the storage tank and pumps the water through the heater and back into the tank. Pump-mounted units have a circulating pump built into the water heater.

Pipe the outlet from the heater's relief valve such that any discharge from the relief valve will be conducted to a suitable place for disposal when relief occurs. Do not reduce line size or install any valves in this line. The line must be installed to allow complete drainage of both the valve and the line.

Suggested piping diagrams are shown in Figures 9, 10, 11 and 12. These diagrams are meant only as a guide. Components required by local codes must be properly installed.

The minimum inlet water temperature for the Rheos is 130°F (54°C) to avoid condensing on the copper coils.

4B.2 Hot Water Supply Piping — Water Heater

Follow the tank manufacturer's guidelines for completion of the hot water system connections.

NOTE: A listed temperature and pressure relief valve listed as complying with the Standard for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems, 1). ANSI Z21.22 latest edition, or 2). CSA 4.4, of suitable discharge capacity must be installed in the separate storage tank system.

If the Rheos water heater is installed in a closed water supply system, such as one having a backflow preventer in the cold water supply line, the relief valve may discharge periodically, due to thermal expansion. Means (such as a properly-sized expansion tank) shall be provided to control thermal expansion. Contact the water supplier or local plumbing inspector on how to control this situation.

4B.3 Water Flow Requirements — Water Heater

In a water heating application (an open system), new water is constantly being introduced. With the new water comes a fresh supply of minerals that can be deposited on the unit's heat exchanger. This is commonly known as scaling. The amount of minerals will depend upon the hardness of the water. Water can also be aggressive, and can erode metals, including copper, if the water is moved too quickly. The water flow requirements for the Rheos water heater are based upon the hardness of the water. The water flow is kept high enough to prevent scaling, but low enough to prevent tube erosion. For extremely soft or hard water, cupro-nickel tubes are available. Contact a Laars Representative if you have questions or concerns about water quality.

Pump-mounted water heaters can be ordered with standard pumps for soft or normal water or with pumps for hard water. The pumps used are sized for the headloss through the heater, plus 30 feet (9.1m) of full-sized piping and a normal number of fittings.

Table 9 specifies water flow rates for water heaters, which will enable the user to size a pump. The headloss shown is for the heater only, and the user will need to add the headloss of the piping system to properly size the pump.

4B.4 Combined Water (potable) Heating and Space Heating

NOTE: These systems are not allowed in the Commonwealth of Massachusetts.

Piping and components connected to this water heater for the space heating application shall be suitable for use with potable water.

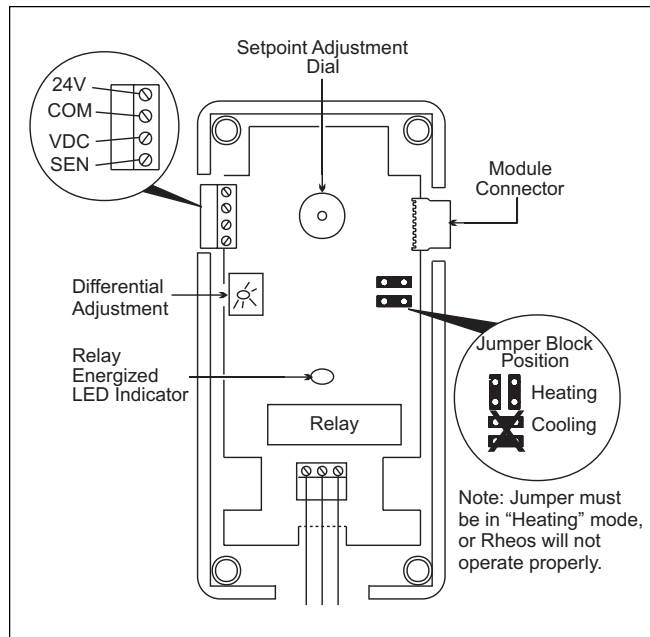


Figure 13. Temperature Control.

Toxic chemicals, such as used for boiler treatment, shall not be introduced into the potable water used for space heating.

This water heater when used to supply potable water shall not be connected to any heating system or component(s) previously used with a non-potable water heating appliance.

When the system requires water for heating at temperatures higher than required for other uses, an anti-scald mixing or tempering valve shall be installed to temper the water for those uses in order to reduce scald hazard potential.

4B.5 Freeze Protection – Water Heater

Although Rheos water heaters are design-certified for outdoor installations, such installations are not recommended in areas subject to freezing temperatures unless proper precautions are taken.

Power outage, interruption of gas supply, failure of system components, activation of safety devices, etc., may prevent a heater from firing. **Any time a heater is subjected to freezing conditions, and the heater is not able to fire, and/or the water is not able to circulate, there is a risk of freezing in the heater or in the pipes in the system.** When water freezes, it expands. This can result in bursting of pipes in the system, or damage to the heater, which could result in leaking or flooding conditions.

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. Electrocution can result in severe injury or death.

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 box that is located inside 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 wiring box.

Wiring connections are shown in Figures 18 through 33.

5.1 Main Power

Connect a properly sized and fused, 120-volt supply to the main power switch (hot leg is connected directly to switch). Neutral leg is connected directly to the white wire. Ground wire can be connected to the grounding screw in the box or on the switch.

5.2 Pump Connections

The pump time delay relay will call the pump to be energized upon a call for heat, and will keep the pump energized for a delay period after the call for heat has ended. The delay period is adjustable from 0.1 to 10 minutes.

Pump-mounted Rheos units have pumps that are wired at the factory to the pump time delay through a relay. Wiring to a separate 120V single phase circuit, per the wiring diagrams in Figures 18 through 33 is necessary.

Rheos units without the factory-mounted pump also have the pump time delay relay. A 120V single phase pump, which is no larger than 1hP, can be wired directly to pump time delay relay, as shown in the unit's wiring diagram (120V hot connection on the pump to terminal 2 on the pump delay relay, and 120V neutral to the 120V neutral circuit of the unit.)

If the pump is 3-phase, higher voltage than 120V, or higher horsepower than 1hp, the pump's starter or a separate relay can be connected to the unit's pump time delay relay, and the pump can be driven indirectly.

Contact the factory if there are questions about connecting a pump to the Rheos' pump time delay relay.

5.3 Temperature Control — Boiler

Connect boiler T-T wires to isolated contacts on zone valves, circulator relays, sequencing controls (multiple appliance applications) or other temperature controlled devices. The Rheos boiler temperature control measures temperature on the boiler inlet. Set the temperature control such that the setpoint plus the boiler temperature rise equals the desired boiler outlet temperature. Also set the manual reset high limit 20°F above the outlet temperature to avoid nuisance lockouts.

Example, Imperial units: If the desired outlet temperature is 180°F, and the boiler temperature rise is 25°F, then set the boiler temperature at 155°F (180°F – 25°F). Lastly, set the manual reset high limit to 200°F (180°F + 20°F).

Example, Metric units: If the desired outlet temperature is 82°C, and the boiler temperature rise is 14°C, then set the boiler temperature at 68°C (82°C-14°C). Lastly, set the manual reset high limit to 93°C (82°C+11°C).

5.4 Temperature Control — Water Heater

5.4.1 Remote Water Heater Temperature Control

The Rheos water heater can be used with a field-supplied tank aquastat, sequencing control, or other temperature control device, which will call the unit for heat when the temperature goes below the controller's setpoint. For the most efficient setting, set the tank temperature at the lowest possible setting for adequate hot water in the application.

Caution

If the tank temperature control is set too high, a potential for hot water scalding may exist.

After a setting has been chosen for the tank temperature control, set the heater temperature control 10°F (6°C) higher. The heater's temperature control senses the inlet water temperature to the heater. The heater's manual reset high limit senses heater outlet temperature, and should be set 20°F (11°C) above the outlet temperature to avoid nuisance lockouts.

Example, Imperial units: If the tank temperature is set to 140°F, set the heater's temperature control to 150°F (140°F+10°F). Further, if the temperature rise

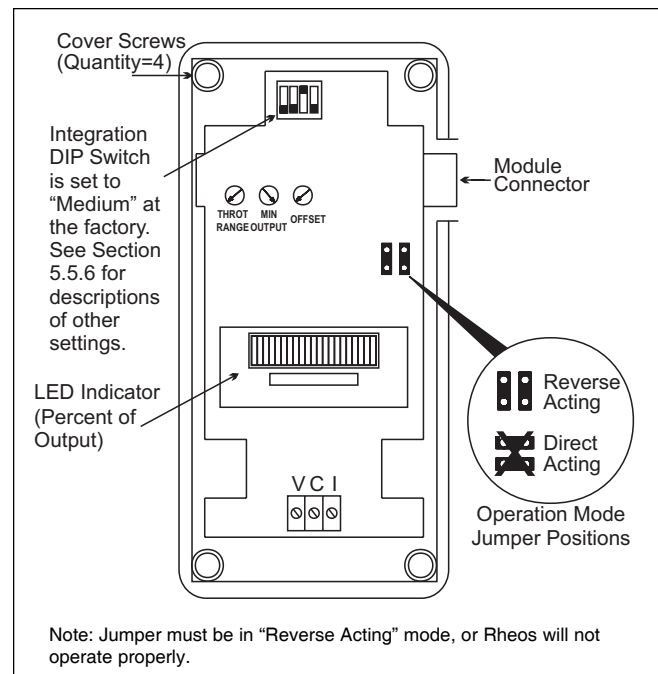


Figure 14. Proportional Control.

through the heater is 25°F, the outlet temperature will be 175°F (150°F+25°F). Therefore, set the manual reset high limit to 195°F (175°F + 20°F).

Example, Metric units: If the tank temperature is set to 60°C, set the heater's temperature control to 66°C (60°C+6°C). Further, if the temperature rise through the heater is 15°C, the outlet temperature will be 81°C (66°C+15°C). Therefore, set the manual reset high limit to 92°C (81°C+11°C).

5.4.2 Internal Water Heater Temperature Control

When an external control is not used, the circulator between the heater and the storage tank must run continuously, so that the heater's temperature control can detect and control the water temperature in the storage tank. The Rheos water heater's temperature control is adjusted to its lowest temperature position when shipped from the factory. This is the preferred starting point for setting the temperature control. Set the manual reset high limit 20°F (11°C) plus heater temperature rise above the temperature control's setting.

Example, Imperial units: If the heater's temperature control is set to 130°F, and the temperature rise through the heater is 25°F, the outlet temperature will be 155°F. Set the manual reset high limit to 175°F.

Example, Metric units: If the heater's temperature control is set to 55°C, and the temperature rise through the heater is 14°C, the outlet temperature will be 69°C. Set the manual reset high limit to 80°C.

**Caution**

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

5.5 Temperature Control Features

The Rheos temperature control is versatile and will allow the user to better match the modulating control to the application. Settings that can be changed are temperature setpoint, differential, offset, throttling range, and minimum output.

The temperature setpoint is the setting at which the unit will shut off, having satisfied the controller's call for heat.

The differential determines how far the temperature in the Rheos can fall before energizing again.

The offset determines where the throttling range begins.

The throttling range is the temperature range through which the unit will modulate from minimum to maximum firing rate.

Important Note: These control parameters work together. Therefore, setting one parameter may have an affect on another. Figures 15, 16 and 17 show the relationships between these settings. Figure 15 follows the examples that are shown in the following sections, and Figures 16 and 17 are examples of how the parameters can interfere with each other.

5.5.1 Temperature Setpoint

The temperature setpoint is the point at which the temperature control relay will be de-energized and the unit's call for heat will end. The temperature setpoint is adjusted with the setpoint dial on the A350 control (see Figure 13). The temperature control's sensor is in the inlet of the unit.

5.5.2 Differential Setting

The differential is the difference in temperature settings when the temperature control's relay is energized and de-energized. For instance, if the temperature setpoint is 180°F (82°C) and the differential is 20°F (11°C), the temperature control will call the unit to energize at 160°F (71°C). (The differential is the setpoint minus the differential setting) The call for heat will end when the unit reaches its setpoint of 180°F (82°C). The Rheos differential is adjustable from 1°F to 30°F (1°C to 17°C). In general, the differential setting for a water heater system will be low, so that when a storage tank is drawing down, the heater will react to sustain a minimum tank temperature. Boilers generally have higher differentials than water heaters, to minimize short cycling (see throttling range). The differential is set by removing the cover of the A350 control and

adjusting the potentiometer marked "DIFF" (see Figure 13).

5.5.3 Offset

The offset determines the temperature below the controller's setpoint where the throttling range begins. It offsets the throttling range.

For instance, if the setpoint is 180°F (82°C) and the offset is 5°F (3°C), then the unit's throttling range will begin at 175°F (79°C). Between 175°F (79°C) and 180°F (82°C), the Rheos will be in low fire.

The offset can be adjusted between 0°F and 30°F (0°C and 17°C) by removing the cover of the S350P control and adjusting the Offset dial (see Figure 14).

5.5.4 Throttling Range

The throttling range allows the Rheos to match the BTU demands of varying systems, by allowing the user to choose the temperature range through which the unit will modulate. This will tell the controller how fast to respond to a change in temperature. A small throttling range keeps the unit in high fire more, and quickens the response of the system. A larger throttling range allows the Rheos to spread its modulating range over a larger temperature range.

Example, Imperial units: Using a temperature setpoint of 180°F, with a 20°F differential, a 5°F offset, and a throttling range of 10°F, the unit will come on at 160°F and shut off at 180°F. The offset will set the top of the throttling range 5°F under the setpoint, which is 175°F in this example. Therefore, the throttling range will cause the Rheos to modulate between 50% and 100% of full fire between 175°F and 165°F. Between 175°F and 180°F, the unit will remain at low fire. Between 160°F and 165°F, the unit will be at full fire.

Example, Metric units: Using a temperature setpoint of 82°C, with a 11°C differential, a 3°C offset, and a throttling range of 5°C, the unit will come on at 71°C and shut off at 82°C. The offset will set the top of the throttling range 3°C under the setpoint, which is 79°C in this example. Therefore, the throttling range will cause the Rheos to modulate between 50% and 100% of full fire between 79°C and 74°C. Between 79°C and 82°C, the unit will remain at low fire. Between 71°C and 74°C, the unit will be at full fire.

The throttling range is adjustable between 2°F and 30°F (1°C to 17°C). The range can be set by removing the cover of the S350P control and adjusting the "THROT RANGE" dial (see Figure 14).

5.5.5 Minimum Output Setting

The minimum output setting of the controller is 0% of full fire. However, the minimum output of the Rheos is limited to 50% of full fire by the fan speed controller, to ensure proper operation of the Rheos. If a minimum desired output is higher than 50%, the

setting can be adjusted up by removing the cover of the S350P control and adjusting the Min Output dial (see Figure 14). Turning the dial clockwise increases the minimum output. In most cases, this setting should be left as shipped from the factory, with the arrow pointing to the 5 o'clock position.

5.5.6 Integration Constant

The proportional control used on the Rheos has internal circuitry that helps to minimize overshoot that can sometimes be associated with proportional plus integral (PI) controls. There are three field-selectable integration constants (slow, medium and fast), and an off position on the proportional control, which are selected with the dials on the control (see Figure 14). In most cases, this setting will not need to be changed

Off: Switch 1 to ON position and all others to OFF. Setting the control to the “Off” position puts the control into proportional only operation. This is not a recommended setting for the Rheos.

Slow: Switch 2 to ON position and all others to OFF. This is the slowest integration constant. It allows the Rheos the most time to reach its setpoint. In most cases, this is too slow for Rheos installations.

Medium: Switch 3 to ON position and all others to OFF. The integration constant is set to “Medium” at the factory, and in most cases, will not need to be changed. This setting will be the best suited to most Rheos installations.

Fast: Switch 4 to ON position and all others to OFF. If the rate of system recovery to setpoint is sluggish with the control set to medium, the “Fast” setting may be an improvement. The “Fast” setting

will only be used when the rate of change at the sensor is very rapid. In most cases, this setting is too fast for the Rheos.

5.6 External Control Connections

Rheos units are built with a selector switch and a terminal strip to allow the Rheos to receive a 0-10VDC signal from an external controller (such as a building automation system or multiple boiler control).

When the selector switch is in the “Rheos Control” position, the Rheos will be modulated by the unit’s factory-mounted modulating control.

When the switch is in the “External Control” position, the unit look for a 0-10VDC signal from an external (field-supplied) controller.

To interlock the external boiler control with the Rheos, the call for heat signal **MUST** be connected to the field interlock terminal strip on the Rheos (shown in Figure 18). Be sure to remove the factory-installed jumper between the field interlock terminals. The 0-10VDC modulating signal **MUST** be connected to external control terminal strip, located to the right of, and behind the front panel. The terminal strip is labeled “0-10VDC +” and 0-10VDC -” to indicate which terminal received the hot signal (+) and which terminal receives the common signal (-) from the controller.

The Rheos unit will modulate between 4.7V and 10V (for 50% and 100%, respectively). Anything less than 4.7 volts will result in 50% of full fire.

For the external control to modulate the Rheos, the selector switch on the front panel must be in the “External Control” position.

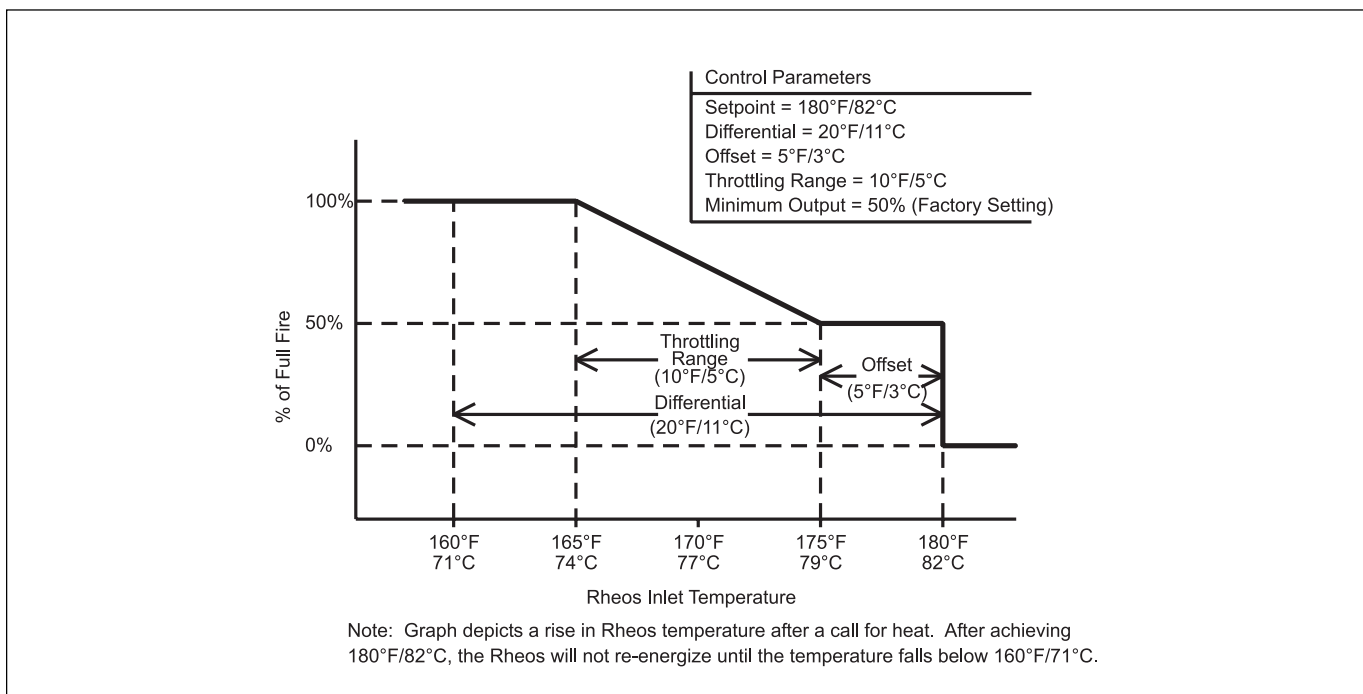


Figure 15. Control Parameter Graph.

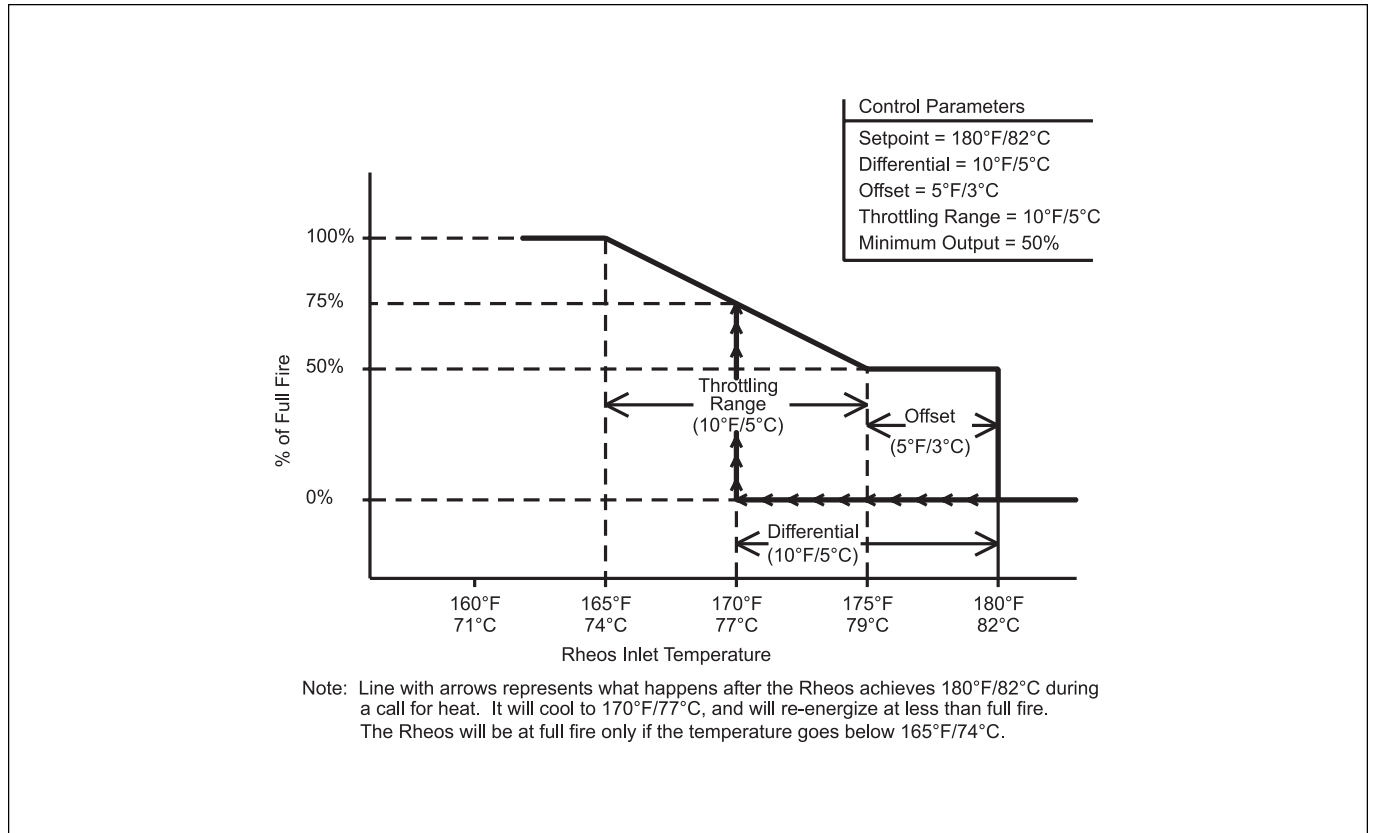


Figure 16. Control Parameter Possible Interference.

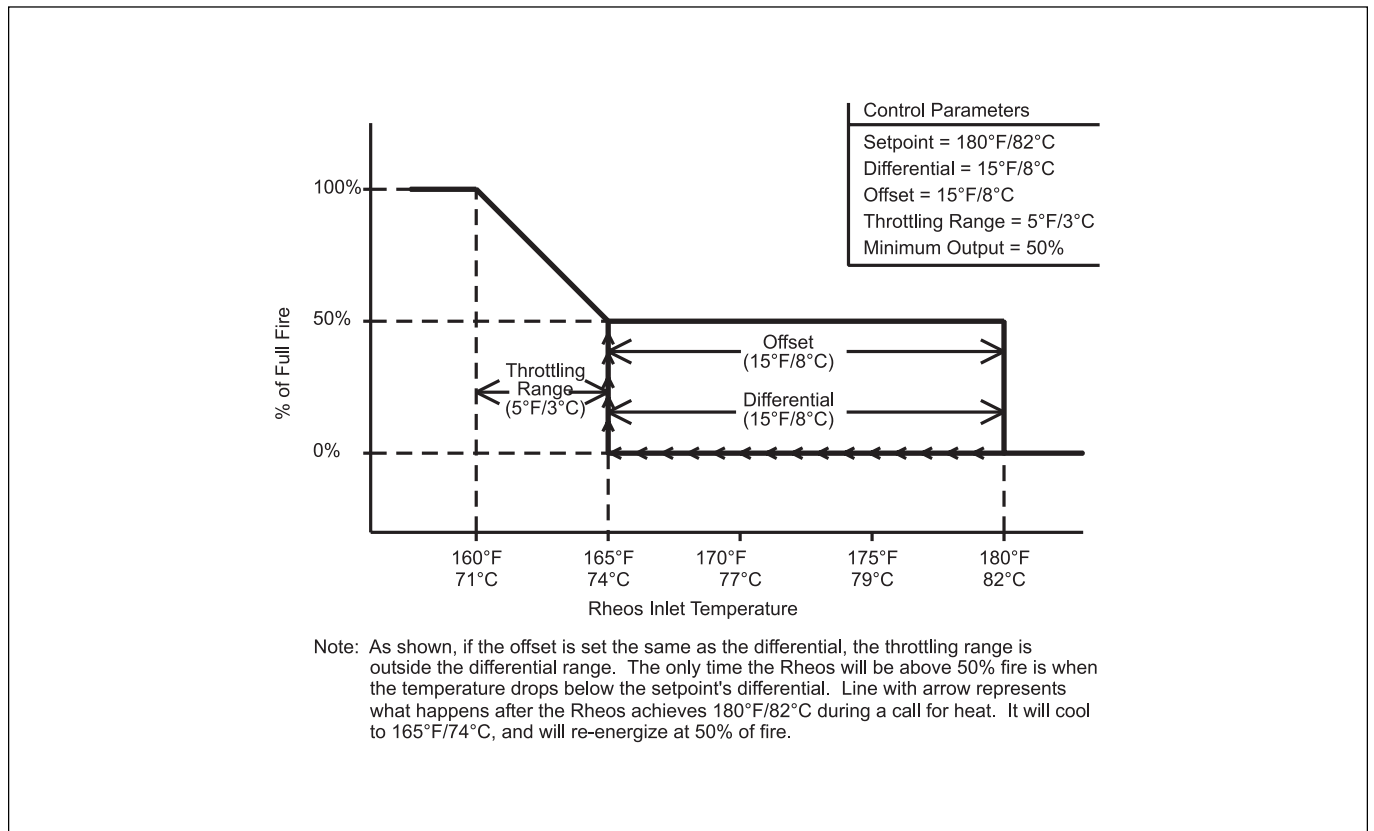


Figure 17. Control Parameter Possible Interference.

Important Note: DO NOT MAKE/BREAK RHEOS LINE VOLTAGE TO SIGNAL CALL FOR HEAT. A “call for heat / end call for heat” MUST be connected to the field interlock terminals. The Rheos does not recognize 0 volts as a signal to shut off. If the call for heat is not connected between the field interlock terminals, the Rheos will remain in low fire when it sees 0 volts as a modulating signal.

 **Caution**

Rheos supply voltage must not be disengaged, except for service or isolation, or unless otherwise instructed by procedures outlined in this manual. To signal a call for heat, use the 24V field-interlock, as shown in the wiring diagram(s).

Some Rheos components are designed to have constant voltage during normal operation. If Rheos supply voltage is toggled as a call for heat signal, premature failure of these components may result.

5.7 Wiring Diagrams

 **Caution**

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

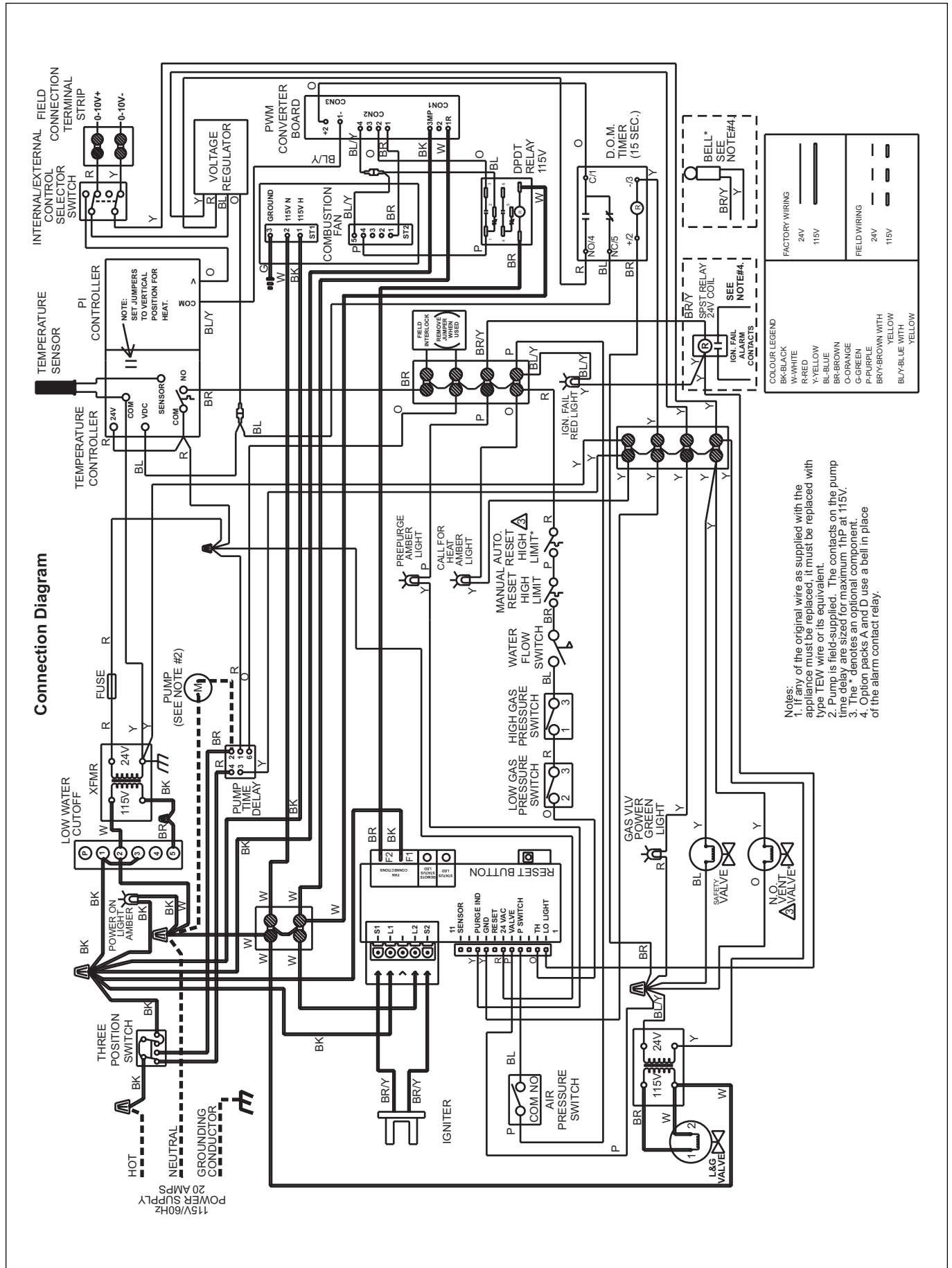


Figure 18. Wiring Diagram, Model 1200, Standard and Codes A, C, D, F and G.

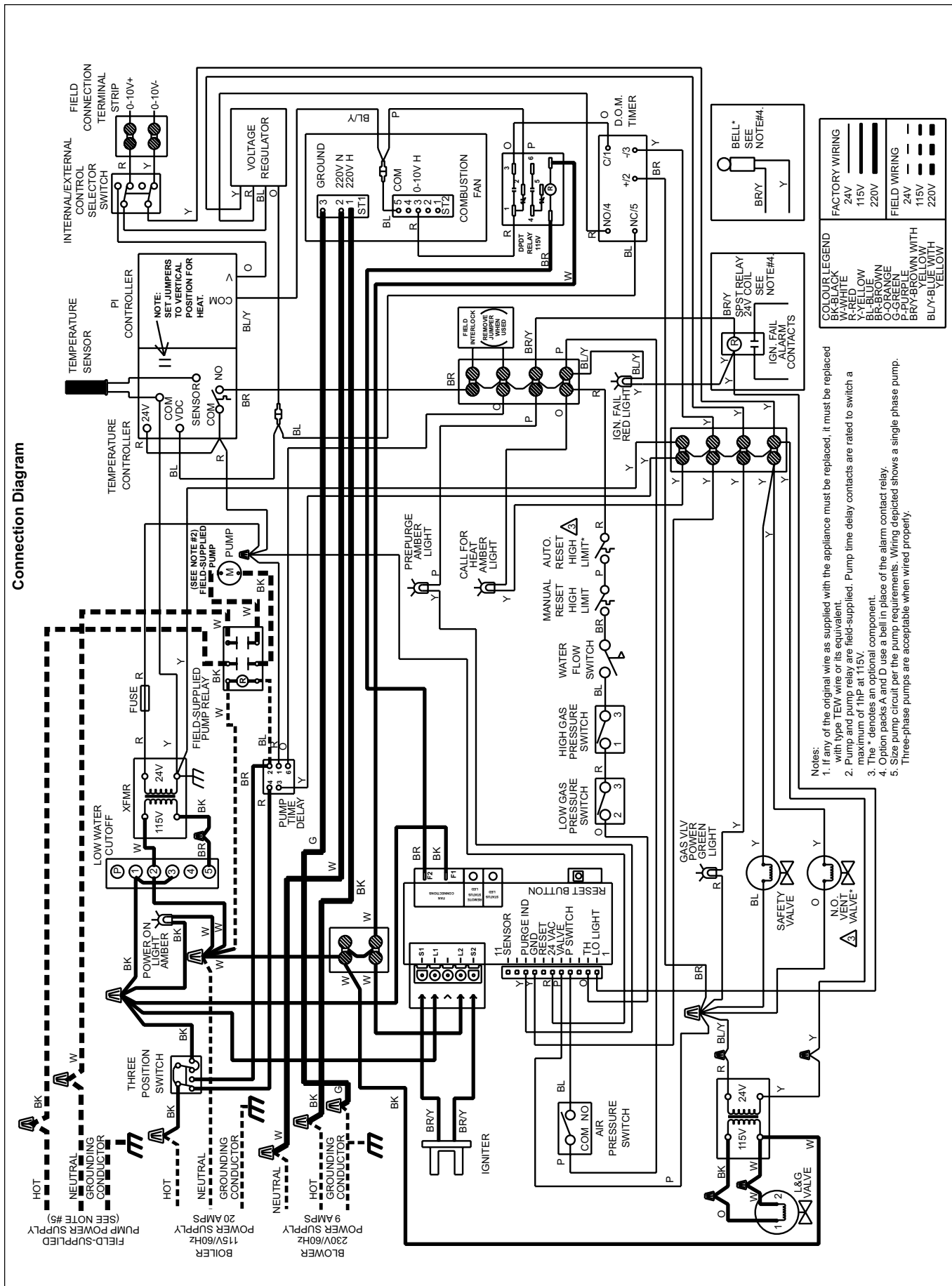


Figure 19. Wiring Diagram, Models 1600, 2000 and 2400, Standard and Codes A, C, D, F and G.

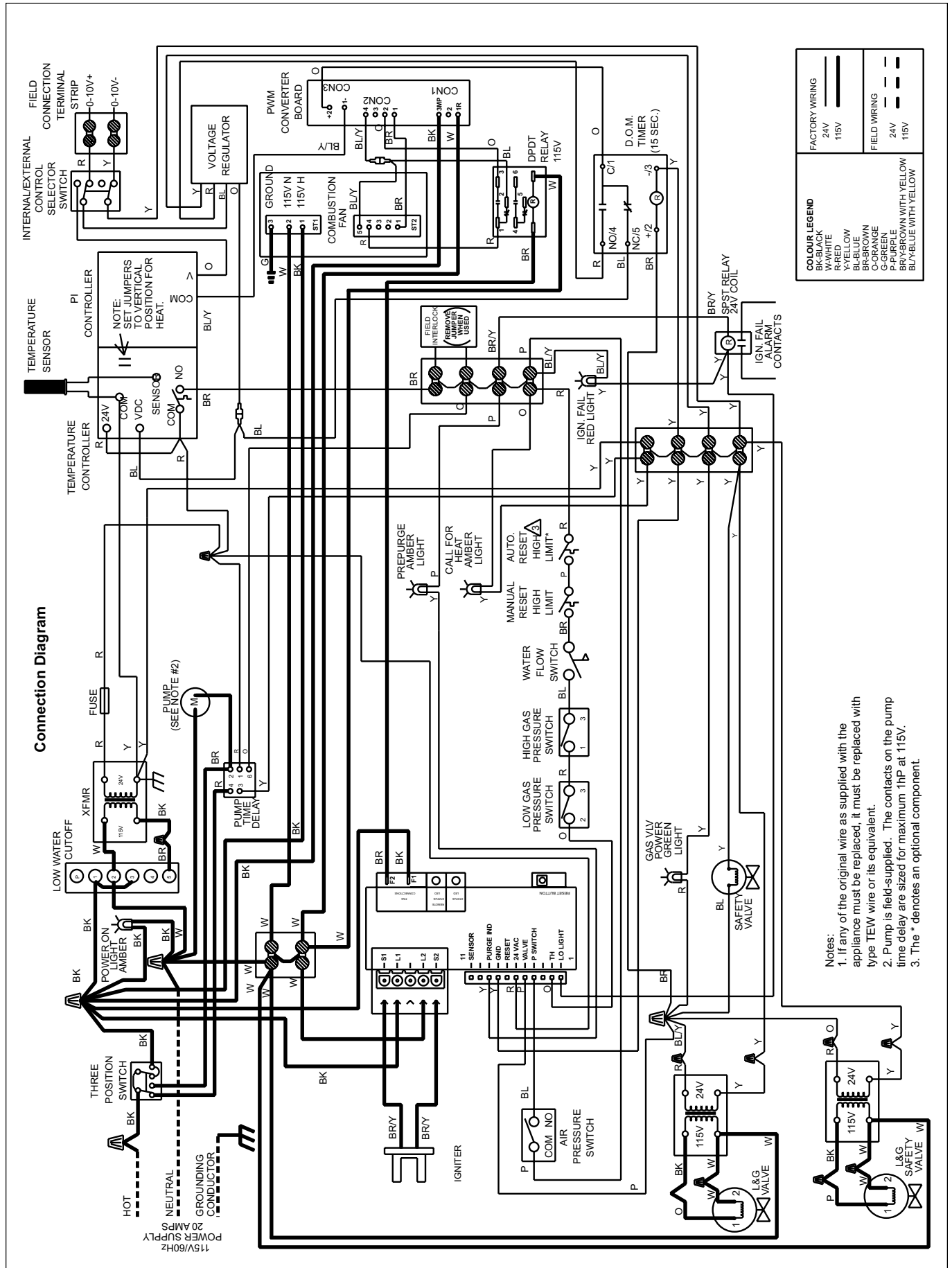


Figure 20. Wiring Diagram, Model 1200, Codes B and E.

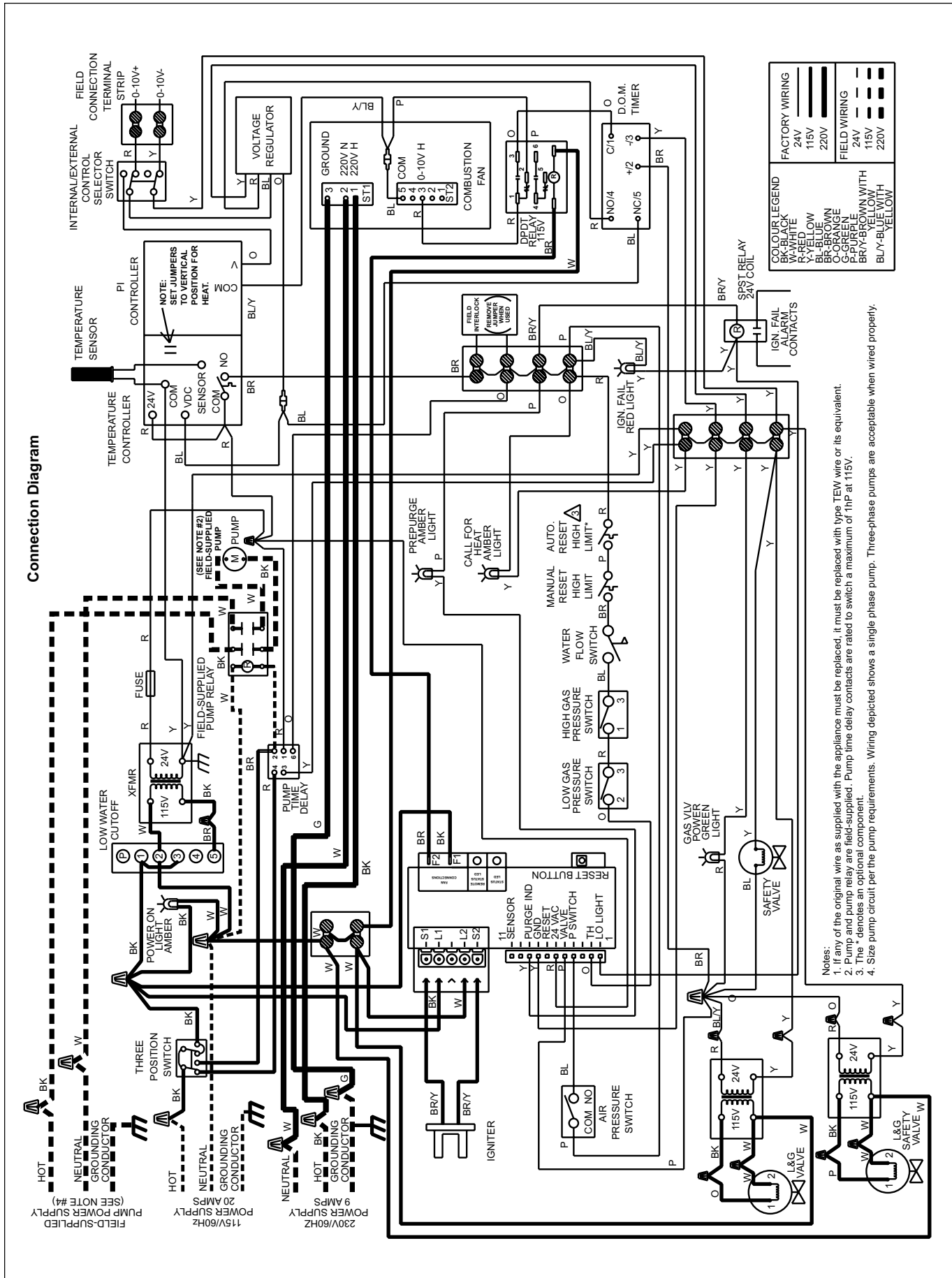


Figure 21. Wiring Diagram, Models 1600, 2000 and 2400, Codes B and E.

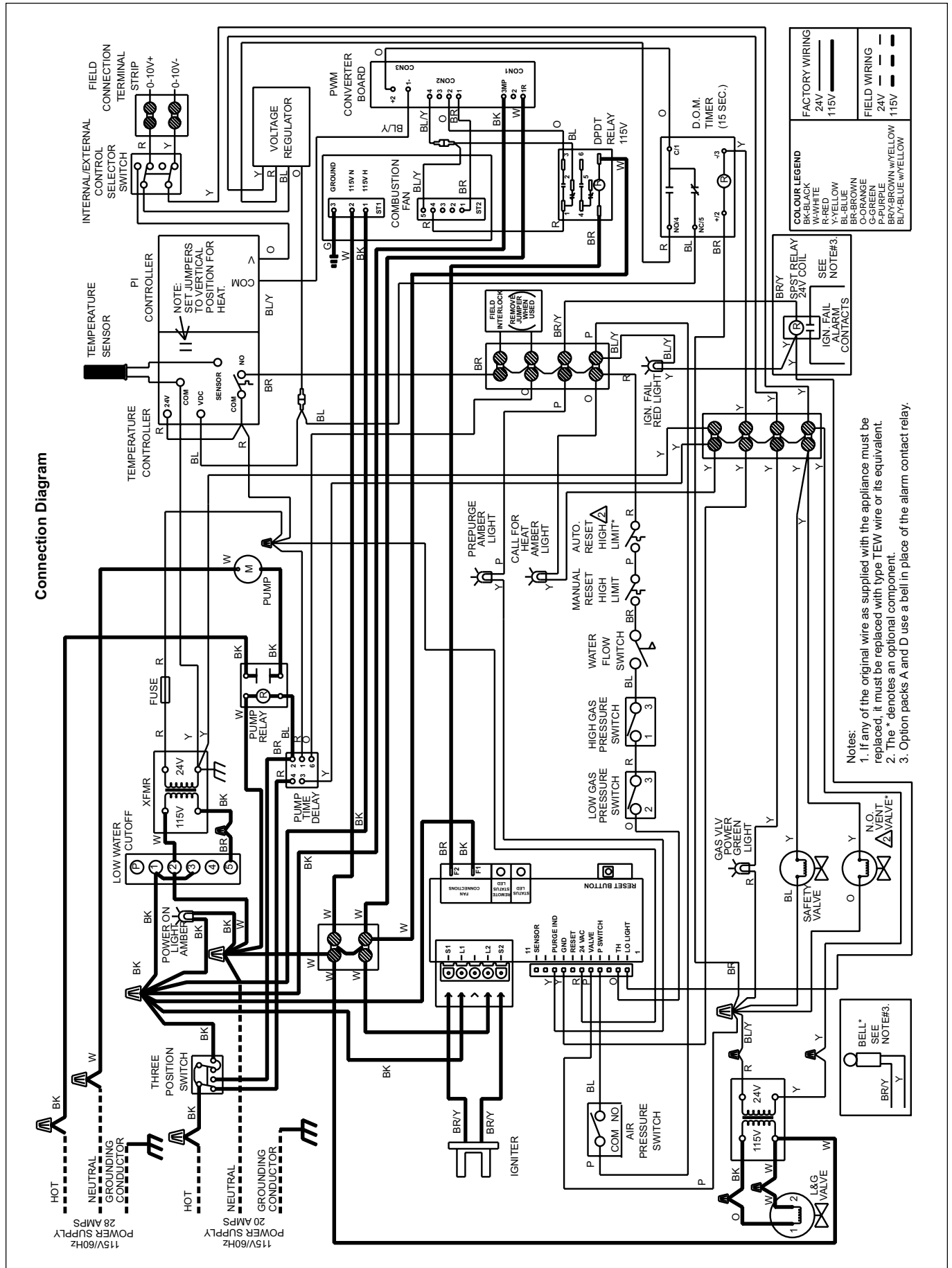


Figure 22. Wiring Diagram, Model 1200, Pump-Mounted, Standard and Codes A, C, D, F and G.

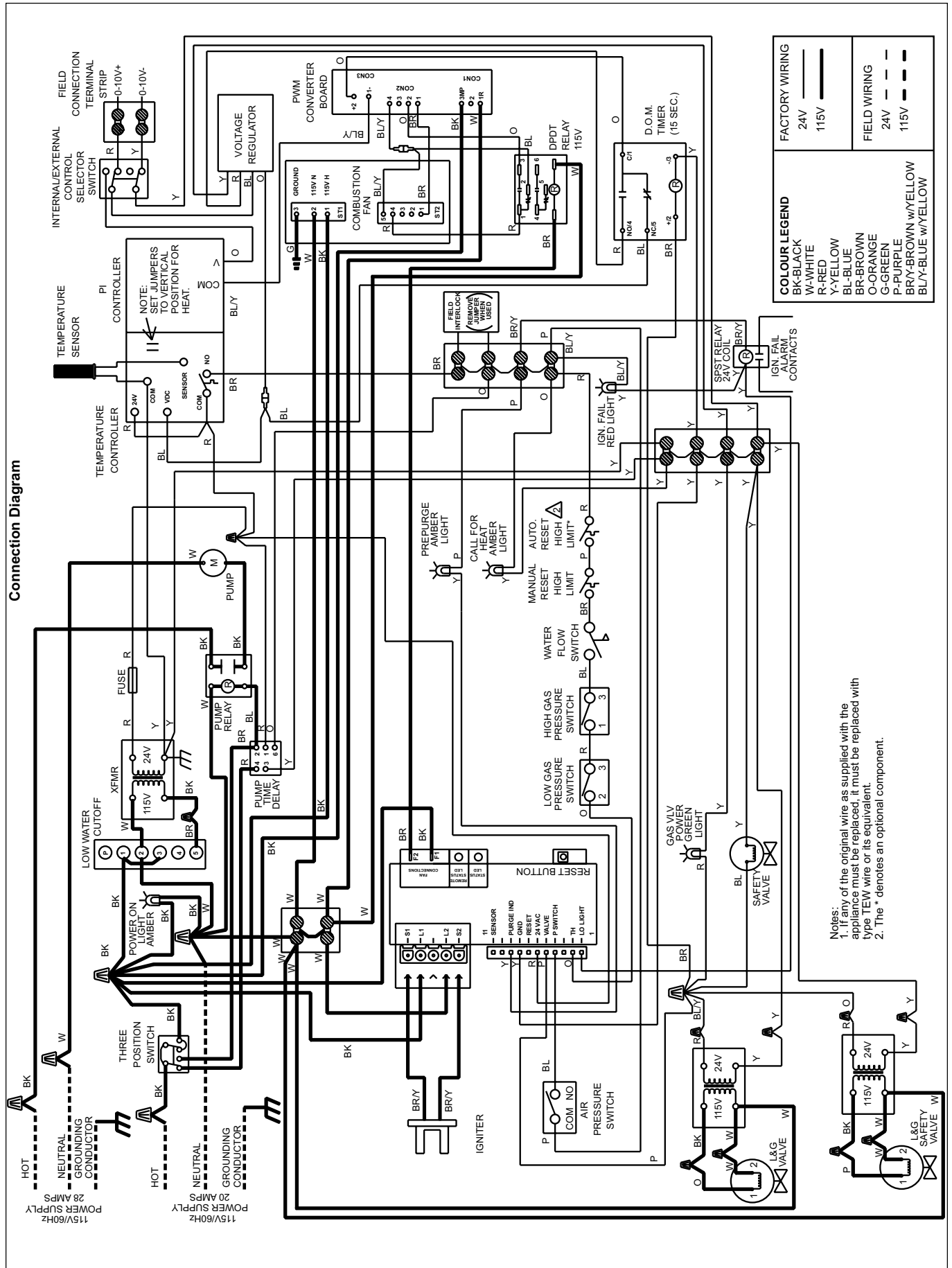


Figure 24. Wiring Diagram, Model 1200, Pump-Mounted, Codes B and E.

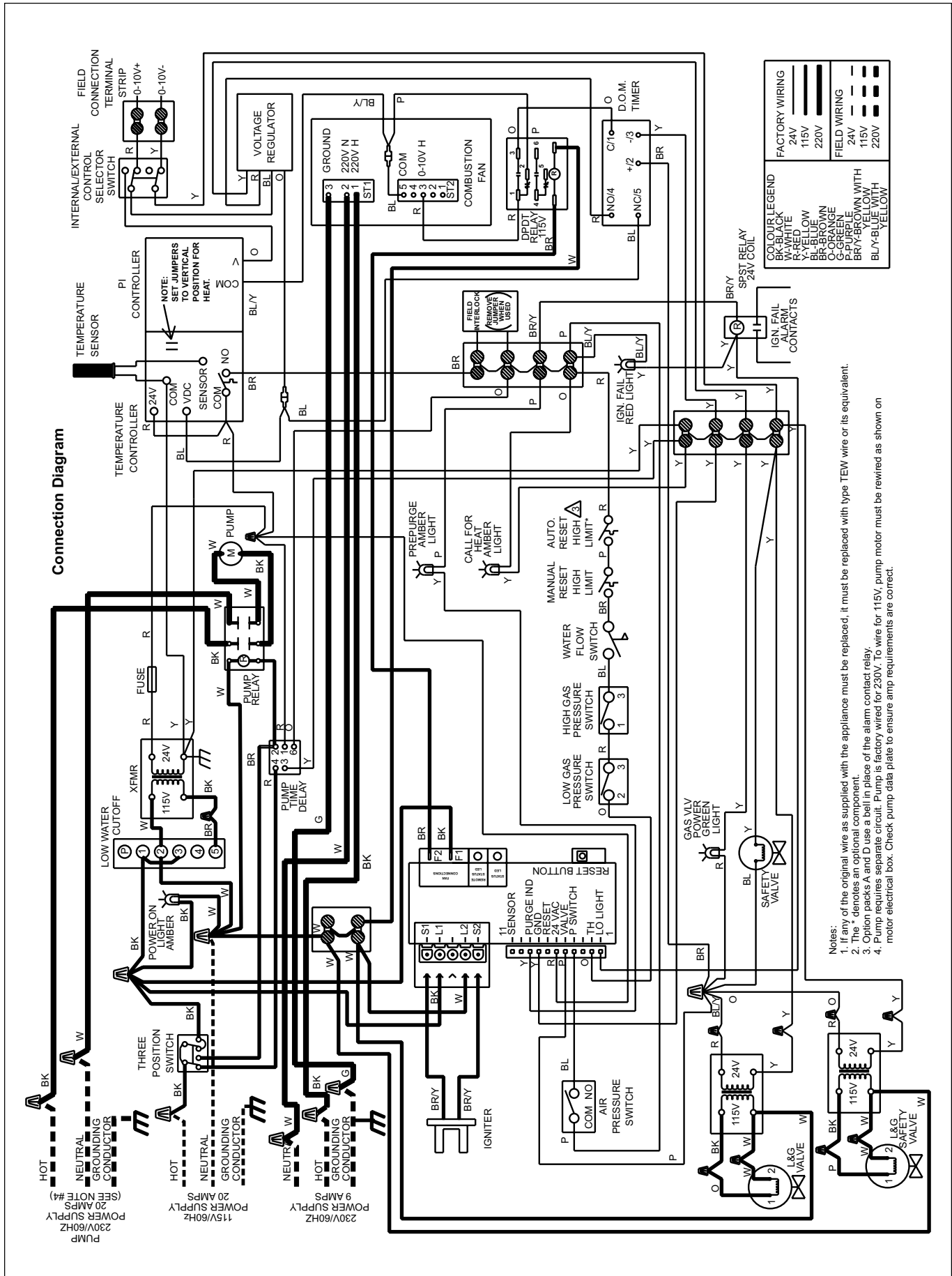
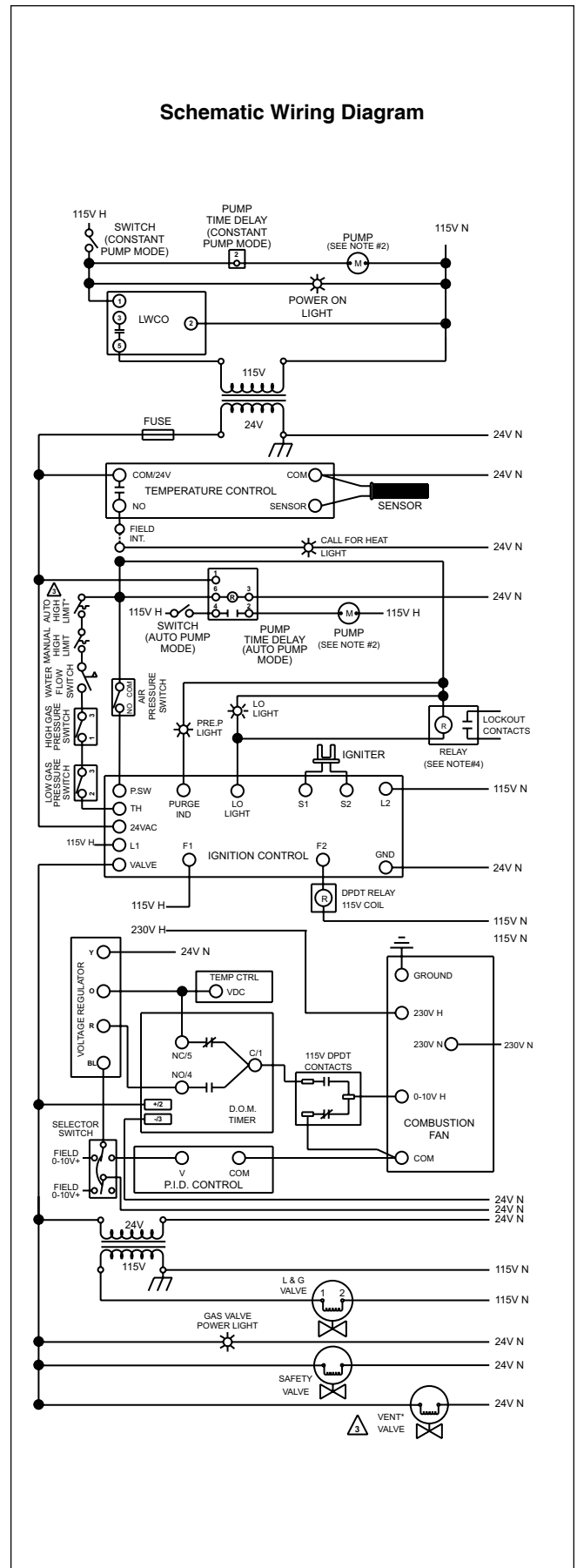
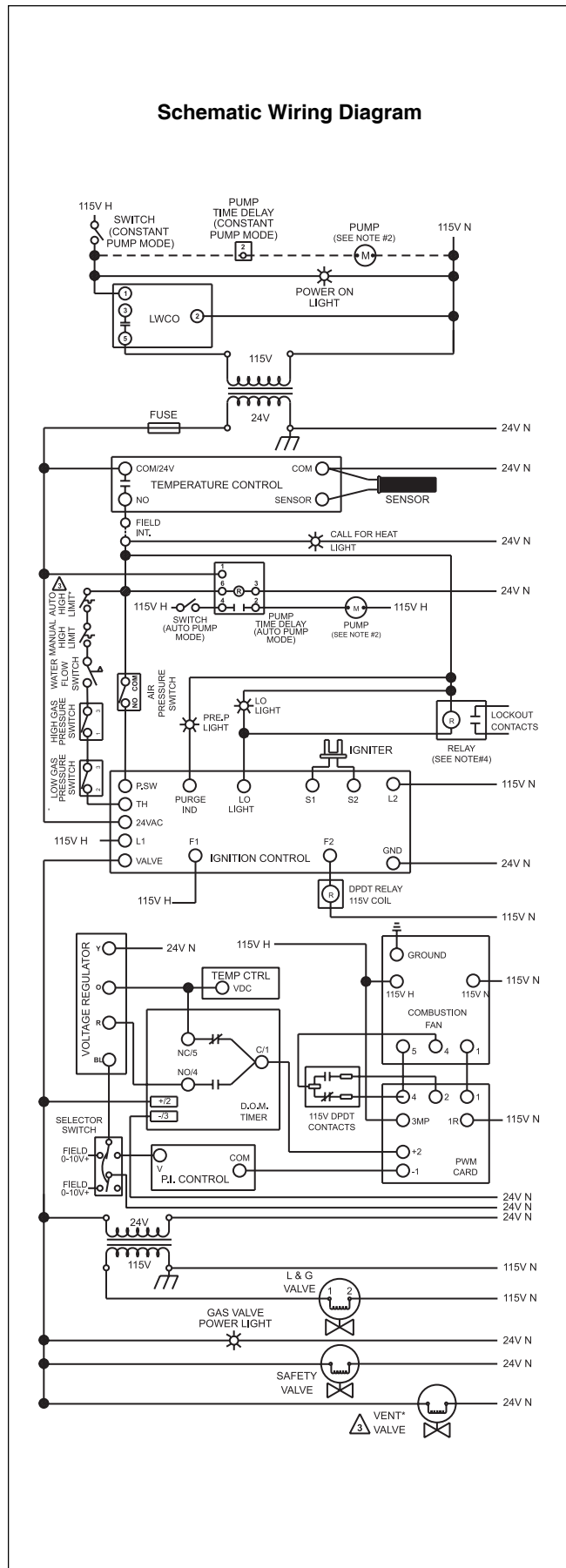


Figure 25. Wiring Diagram, Models 1600, 2000 and 2400, Pump-Mounted, Codes B and E.



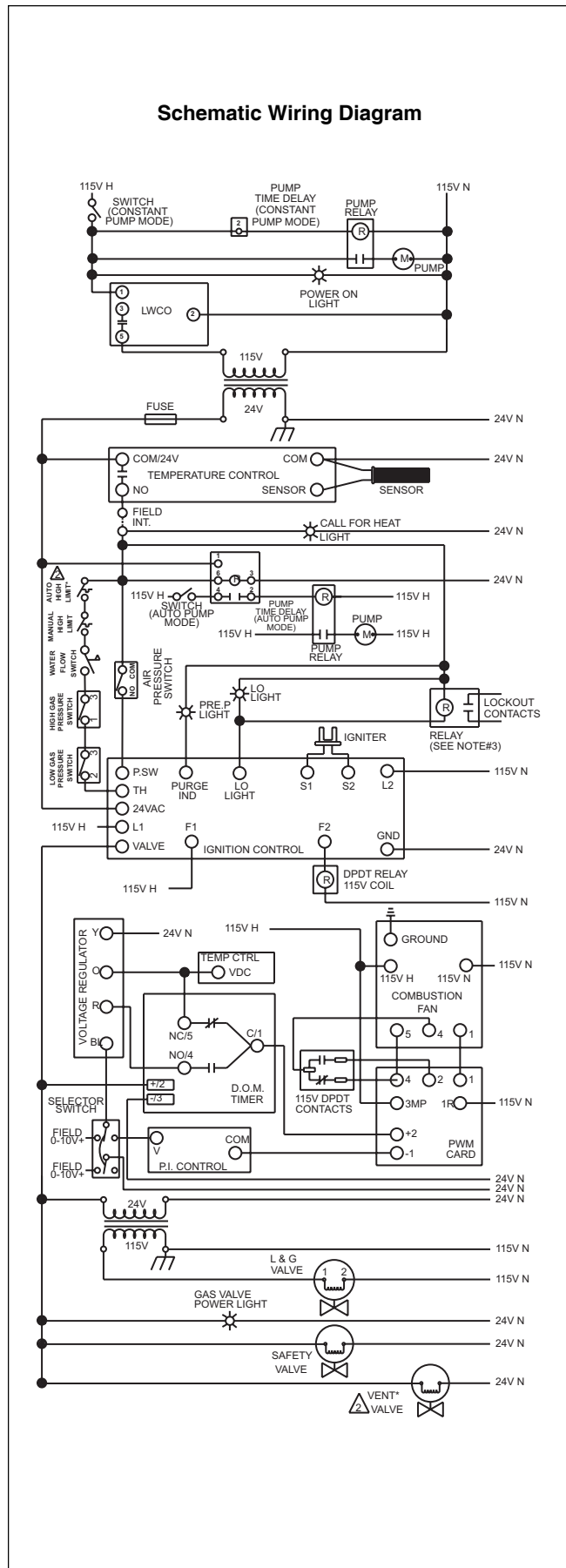


Figure 30. Wiring Schematic, Model 1200, Pump-Mounted, Standard and Codes A, C, D, F and G.

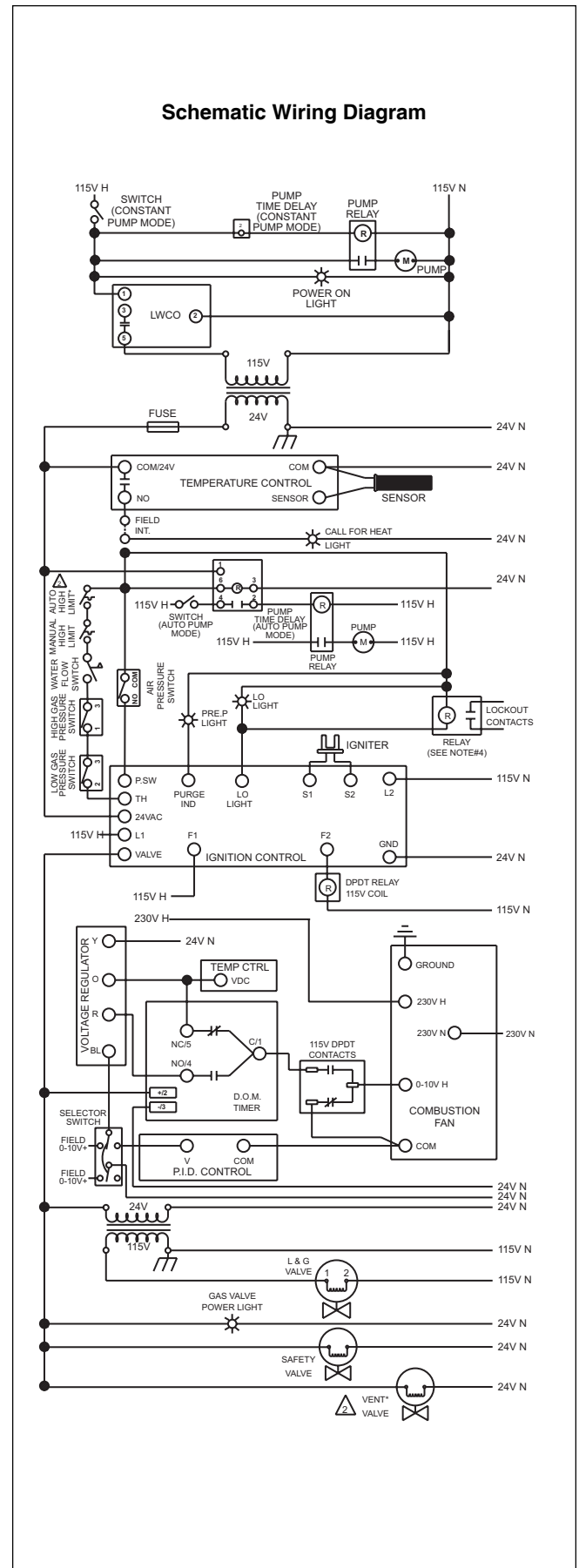


Figure 31. Wiring Schematic, Models 1600, 2000 and 2400, Pump-Mounted Standard and Codes A, C, D, F and G.

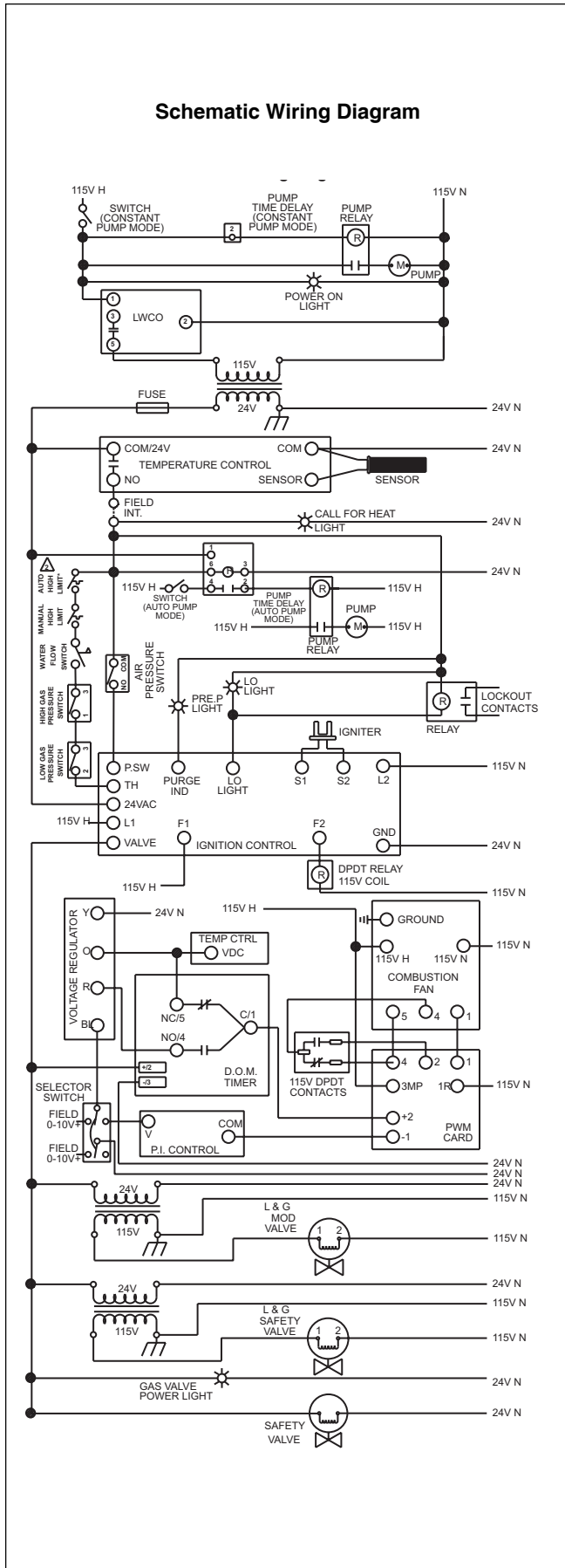


Figure 32. Wiring Schematic, Model 1200, Pump-Mounted, Codes B and E.

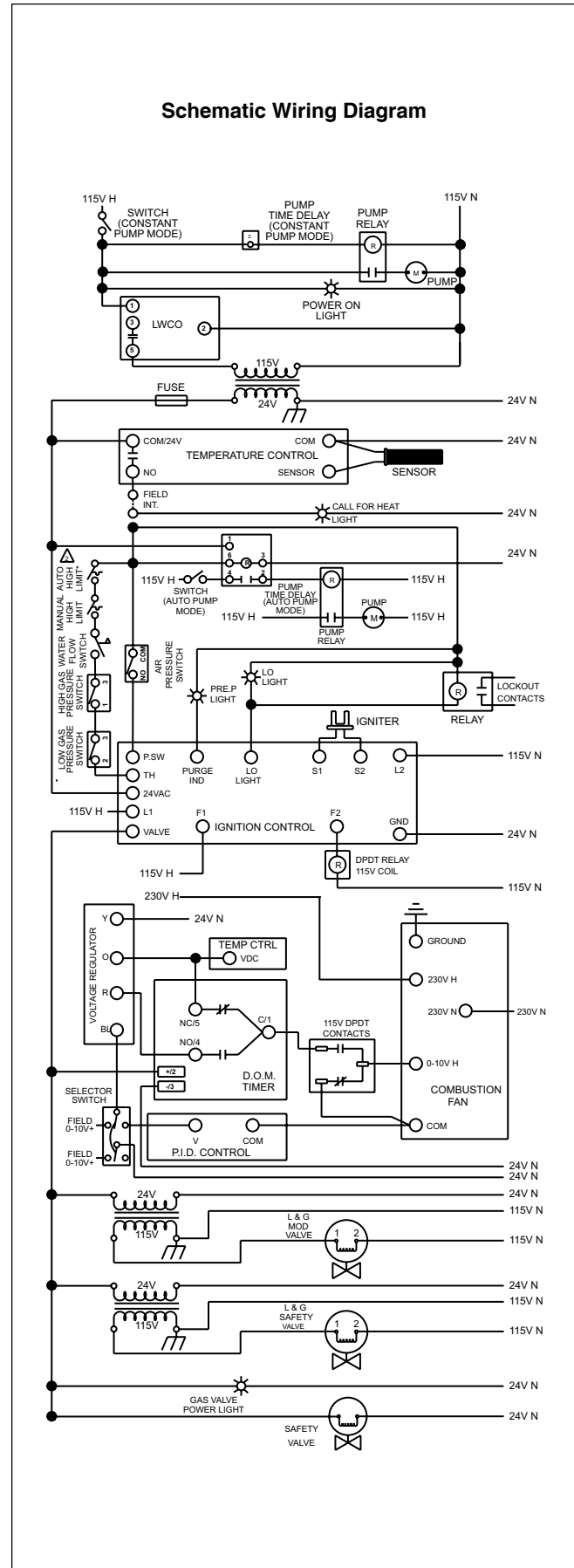


Figure 33. Wiring Schematic, Models 1600, 2000 and 2400, Pump-Mounted Codes B and E.

SECTION 6.

Operating Instructions

6.1 Filling the Boiler System

1. Ensure the system is fully connected. Close all bleeding devices and open make-up water valve. Allow system to fill slowly.
2. If make-up water pump is employed, adjust pressure switch on pumping system to provide a minimum of 12 psi (81.8 kPa) at the highest point in the heating loop.
3. If a water pressure regulator is provided on the make-up water line, adjust the pressure regulator to provide at least 12 psi (81.8 kPa) at the highest point in the heating loop.
4. Open bleeding devices on all radiation units at the high points in the piping throughout the system, unless automatic air bleeders are provided at such points.
5. Run system circulating pump for a minimum of 30 minutes with the boiler shut off.
6. Open all strainers in the circulating system, check flow switch operation, and check for debris. If debris is present, clean out to ensure proper circulation.
7. Recheck all air bleeders as described in Step 4.
8. Check liquid level in expansion tank. With the system full of water and under normal operating pressure, the level of water in the expansion tank should not exceed $\frac{1}{4}$ of the total, with the balance filled with air.
9. Start up boiler according the procedure in this manual. Operate the entire system, including the pump, boiler, and radiation units for one (1) hour.
10. Recheck the water level in the expansion tank. If the water level exceeds $\frac{1}{4}$ of the volume of the expansion tank, open the tank drain, and drain to that level.
11. Shut down the entire system and vent all radiation units and high points in the system piping, as described in Step 4.
12. Close make-up water valve and check strainer in pressure reducing valve for sediment or debris from the make-up water line. Reopen make-up water valve.
13. Check gauge for correct water pressure and also check water level in the system. If the height indicated above the boiler insures that water is at the highest point in the circulating loop, then the system is ready for operation.
14. Refer to local codes and the make-up water valve manufacturer's instructions as to whether the make-up water valve should be left open or closed.
15. 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. Main gas terminals will be energized, attempting to light, for seven (7) seconds, and then will de-energize. The unit will go into lockout mode. Second, turn the power off, press the manual reset button shown in detail A of Figure 30, 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 has been cut.

16. Within three (3) days of start-up, recheck all air bleeders and the expansion tank as described in Steps 4 and 8 above.

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.

6.2 Operating the Burner and Set Up

The Rheos modulating appliance utilizes an advanced, state-of-the-art design. 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 boiler resulting from improper setup is not covered by the limited warranty.

REQUIRED TOOLS:

Differential pressure gauge capable of reading negative 0.01 inches W.C. (0.002kPa).

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. There is a gas/air test panel to the left of the control panel, at the front of the unit (see Figure 34). Ensure that all four valves on the test panel are closed (see Figure 35).
5. Remove the two plugs from the + and – ports of the air orifice taps, thread hose barbs into the 1/8" NPT connections, and attach the manometer pressure lines to the barbs. Be sure all connections are gas tight.

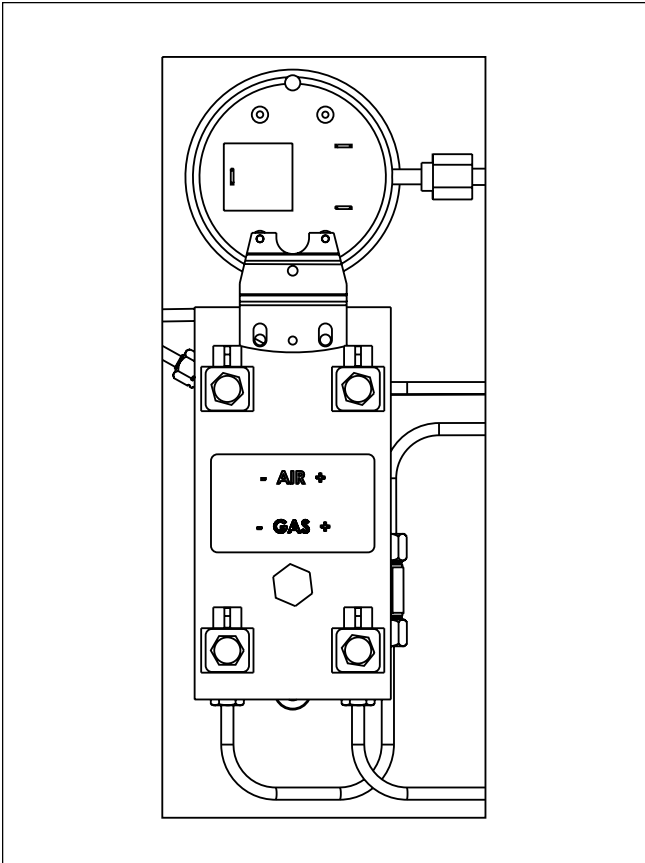


Figure 34. Gas/Air Test Panel.

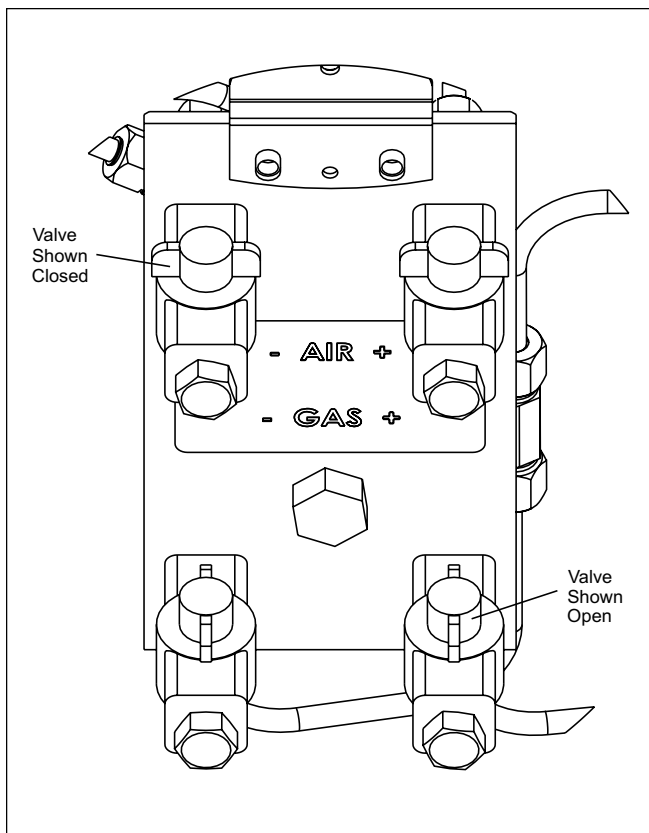


Figure 35. Test Panel Valves.

6. Switch on the appliance power switch located on the front of the unit.
7. The Rheos will enter the start sequence. The blower and pump come on for pre-purge, then the ignitor warm-up sequence starts and after all safety devices are verified, the gas valve opens. If ignition doesn't occur, check that there is proper gas supply. Wait 5 minutes and start the unit again.
8. Open air orifice test port valves. Check air orifice differential at full fire, and make note of the differential.
9. Switch the Rheos off.
10. Close air orifice valves, remove the barbs and replace the plugs. Make sure the connections are gas tight.
11. Remove the two plugs from the + and - ports of the gas orifice taps, thread hose barbs into the 1/8" NPT connections, and attach the manometer pressure lines to the barbs. Be sure all connections are gas tight.
12. Switch on the appliance power switch located on the front of the unit.
13. The Rheos will enter the start sequence. The blower and pump come on for pre-purge, then the ignitor warm-up sequence starts and after all safety devices are verified, the gas valve opens.
14. Open gas orifice test port valves. Check gas orifice differential at full fire, and make note of the differential.
15. Close gas orifice valves, remove the barbs and replace the plugs. Make sure the connections are gas tight.
16. If gas and air orifice differentials match what is shown in Table 10, and do not differ from each other by more than 0.1" w.c., the unit is properly set up. If not, consult the factory.
17. **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. One additional attempt to light will follow including pre-purge, ignitor on, valve/flame on and post purge. 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.
 - (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.

⚠ 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.

Gas Type	Air Orifice Differential	Gas Orifice Differential
Natural	4.0 to 4.5" W.C. (1.0 to 1.1kPa)	4.0 to 4.5" W.C. (1.0 to 1.1kPa)
Propane	4.5 to 5.0" W.C. (1.1 to 1.2kPa)	4.5 to 5.0" W.C. (1.1 to 1.2kPa)

Note: Long runs of vent or combustion air piping may reduce the air and gas differential pressures. This is acceptable, as long as the pressures are within 0.1" (0.025kPa) w.c. of each other.

Table 10. Air and Gas Orifice Differentials at Full Fire.

6.3 Shutting Down the Rheos

1. Switch off the main electrical disconnect switch.
2. Close all manual gas valves.
3. If freezing is anticipated, drain the Rheos and be sure to also protect building piping from freezing.

This step to be performed by a qualified service person.

6.4 To Restart the Rheos

If drained, follow Section 6.1 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 aquastat or thermostat to its lowest setting.
5. Open all manual gas valves.
6. Reset all safety switches (pressure switch, manual reset high limit, etc).
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.

SECTION 7. Maintenance

⚠ WARNING

Disconnect all power to the appliance before attempting any service to the appliance. Contact with electricity can result in severe injury or death.

7.1 System Maintenance

1. Lubricate the system water-circulating pump, if required, per the instructions on the pump.
2. If a strainer is employed in a pressure reducing valve or the piping, clean it every six months.
3. Inspect the venting system for obstruction or leakage at least once a year. Periodically clean the screens in the vent terminal and combustion air terminal (when used).
4. Keep the appliance area clear and free from combustible materials, gasoline, and other flammable vapors and liquids.
5. 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.
6. Low water cutoffs, if installed, should be checked every 6 months. Float type low water cutoff should be flushed periodically.
7. Inspect and clean the condensate collection and disposal system yearly.
8. When a means is provided to neutralize condensate, ensure that the condensate is being neutralized properly.
9. Inspect flue passages, and clean with brushes/vacuums, if necessary. Sooting in flue passages indicates improper combustion. Determine the cause and correct.
10. 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 36, 37 and 38 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 control
- b. Water temperature control
- c. Automatic gas valve
- d. Pressure switches
- e. Blower

7.2.1 Burner

Check the burner for debris. Remove the fan assembly to access the burner. Remove the 6 nuts, which hold the burner in place. Pull burner up and out. Clean burner, if necessary, by blowing compressed air from the outside of the burner into the center of the burner, and wipe the inside of the burner clean with glass cleaner. A dirty burner may be an indication of improper combustion or dirty combustion air. Determine the cause, and correct. Always replace the burner gasket when replacing the burner.

7.2.2 Filter

The filter used in the Rheos 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 factory parts. To access the filter, remove the unit's front panel. Disengage latch on top of filter box and remove the filter box cover. 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 Modulating Gas Valve

The modulating gas valve consists of a valve body and a pressure regulating electro-hydraulic actuator. It provides the air/gas ratio control for the unit. It is designed to operate with supply pressures of 4-13 inches w.c. (1.0 to 3.2 kPa).

To remove the valve actuator, shut off 120-volt power and the gas shutoff valve. Remove the front panel from the unit. **Label the four pressure tubes that are connected to the valve actuator, to ensure that they will be replaced correctly.** Remove the four tubes from the barb connectors. Disconnect the 110-volt wires from the actuator. Remove the valve actuator by taking out the four screws, and pulling the actuator out. Re-install in reverse order. Turn on gas shutoff valve and 120 volt power and check appliance operation and tightness of gas valve connections.

The gas valve body will rarely have to be removed. If there is a valve problem, and it has been

determined the actuator is working properly, the gas valve body may need to be replaced. To remove the gas valve body, shut off 120-volt power and the gas shutoff valve. Remove the front and right-side panels from the unit. Disconnect the union between the valve body and the blower. **Label the four pressure tubes that are connected to the valve actuator, to ensure that they will be replaced correctly.** Remove the valve actuator, per the instructions above. Unscrew the valve body from the gas train. After the valve has been removed, replace with a new valve in the reverse order. Turn on gas shutoff valve and 120 volt power and check appliance operation and tightness of gas valve connections.

7.2.4 Safety Gas Valve

The safety gas valve is a 24-volt diaphragm valve. It is designed to operate with supply pressures of 4-14 inches w.c. (1.0 to 3.4 kPa). To remove the gas valve, shut off 120-volt power. Shut off the main gas supply to the unit. Disconnect the gas supply piping from the back of the unit. Disconnect the electrical wires from the valve, and unscrew the gas valve from the gas train. Re-assemble in reverse order. A bleed line from the diaphragm type automatic valve shall be vented per local code requirements.

7.2.5 Manual Reset High Limit Control

The high limit switch is manual reset switch with an adjustable set point, up to 240°F (116°C) on boiler models and 200°F (93°C) water heater models. 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. Replace in reverse order.

7.2.6 Temperature Control

The temperature control consists of an adjustable electronic control and digital display module. To replace the control or the display, shut off the 120-volt power to the appliance. Remove the cover from the control panel, and remove the screws from the DIN rail clip, to which the controls are mounted. Pull the electrical connector from the controller. Slide the controllers from the DIN rail clip. Replace in reverse order.

7.2.7 Ignition Control

The ignition control ensures the proved interrupted-type ignition system. It controls the hot surface ignitor and proves that the flame signal is appropriate for powering the gas valves. It also controls the blower's pre-purge and post-purge. To replace the 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 Ignitor / Flame Sensor Assembly

The ignitor is a 110v “Hot Surface” type. It is energized whenever there is a call for heat and switched off when ignition is established and the flame has been sensed. To replace the ignitor, shut off the 120-volt power to the appliance, disconnect the Molex connector, remove the two mounting screws on the ignitor flange, and pull the ignitor out. Always install a new ignitor gasket with the replacement ignitor.

 **Caution**
Ignitor gets hot.

7.2.9 Transformers

There are three transformers in the Rheos unit. One is 24v to 110v, the second is 110v to 24v, and the third is 110v to 220v. Be sure to replace the transformers with factory parts. These transformers are not capable of supplying control voltage for external devices such as zone valves, which must have their own separate power supply. 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.

7.2.10 Blower

The combustion air blower is a high-pressure centrifugal blower with a variable speed motor. The speed of the motor is determined by the control logic. If a blower change is required, turn off the 120-volt power and gas supply to the unit. Take the front panel, the two side access panels, and the top jacket panel off. (If there is enough clearance on the side, the top may not have to be removed.) Disconnect the gas union between the blower and gas valves. Disconnect the filter box assembly (at the air transition) from the blower (six 8 mm bolts). Disconnect the two Molex electrical connectors from the top right of the blower. Remove the four nuts from the blower flange, and pull the blower out. Replace blower in reverse order, ensuring that all joints are made correctly and sealed. After replacement, ensure that the unit operates properly, by following the set-up procedure in this manual.

7.2.11 Flow Switch

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

7.2.12 Heat Exchanger Coil

Black carbon soot buildup on the external surfaces of the heat exchanger is caused by one or more of the following; incomplete combustion, combustion air problems, venting problems and heater

short cycling. Soot buildup or other debris on the heat exchanger may restrict the flue passages.

If black carbon soot buildup is suspected, disconnect electrical supply to the unit, and turn off the gas supply by closing the manual gas valve on the unit. Access the heat exchanger through the side access panels, and inspect the finned copper tubing using a flashlight. If there is a buildup of black carbon soot or other debris on the heat exchanger, clean per the following:

 **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.

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. Drain the heat exchanger from the drain located on the bottom of the heat exchanger.
6. Disconnect the header flanges from the inlet and outlet.
7. Remove the heat exchanger from the unit.
NOTE: The heat exchangers are heavy and may 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 blocks for cracks, wear and breakage. 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 R2000700.
11. Reassemble in the reverse order.

If heat exchanger removal is necessary, consult the factory for instructions.

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

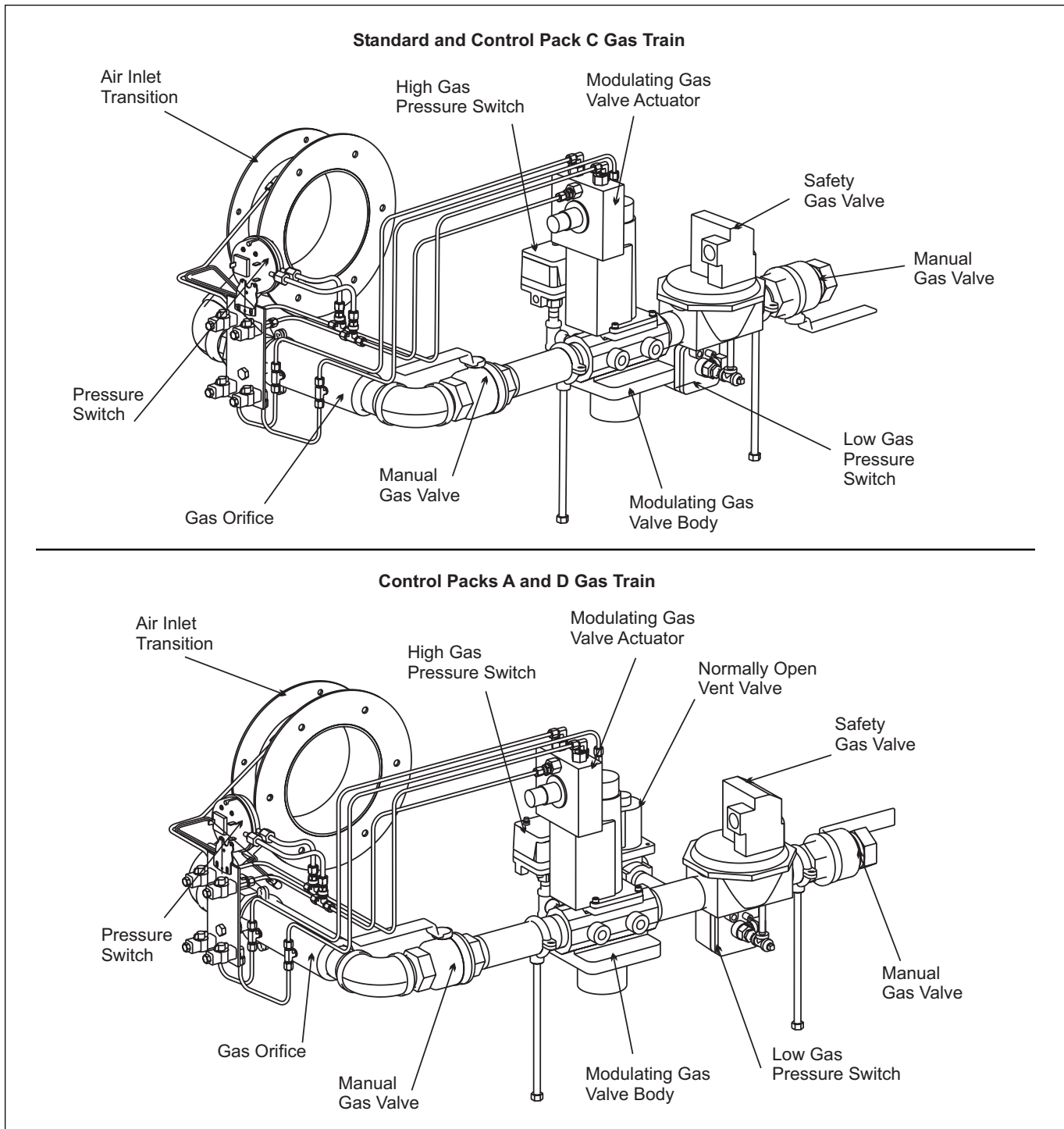


Figure 36. Gas Trains.

7.2.13 Normally Open Vent Valve

Some Rheos models provide a normally open vent valve for installations with IRI code requirements. The valve opens when power is removed from the safety valves. And the valve closes when the safety valves are powered. See sections 3.1 Item #4 for installation instructions.

7.2.14 Motorized Safety Valve

Control packs B and E have an additional motorized safety valve. This valve is powered open at

the same time as the safety valve. To remove the valve actuator, shut off the 120V power and the gas shutoff valve. Remove the right side, or front panel. Disconnect the 120V wires from the actuator. Remove the valve actuator by taking out the four screws, and pulling the actuator out. Re-install in reverse order. Turn on gas shutoff valve and 120V power and check appliance operation and tightness of gas valve connections.

The gas valve body will rarely have to be removed. If there is a valve problem, and it has been

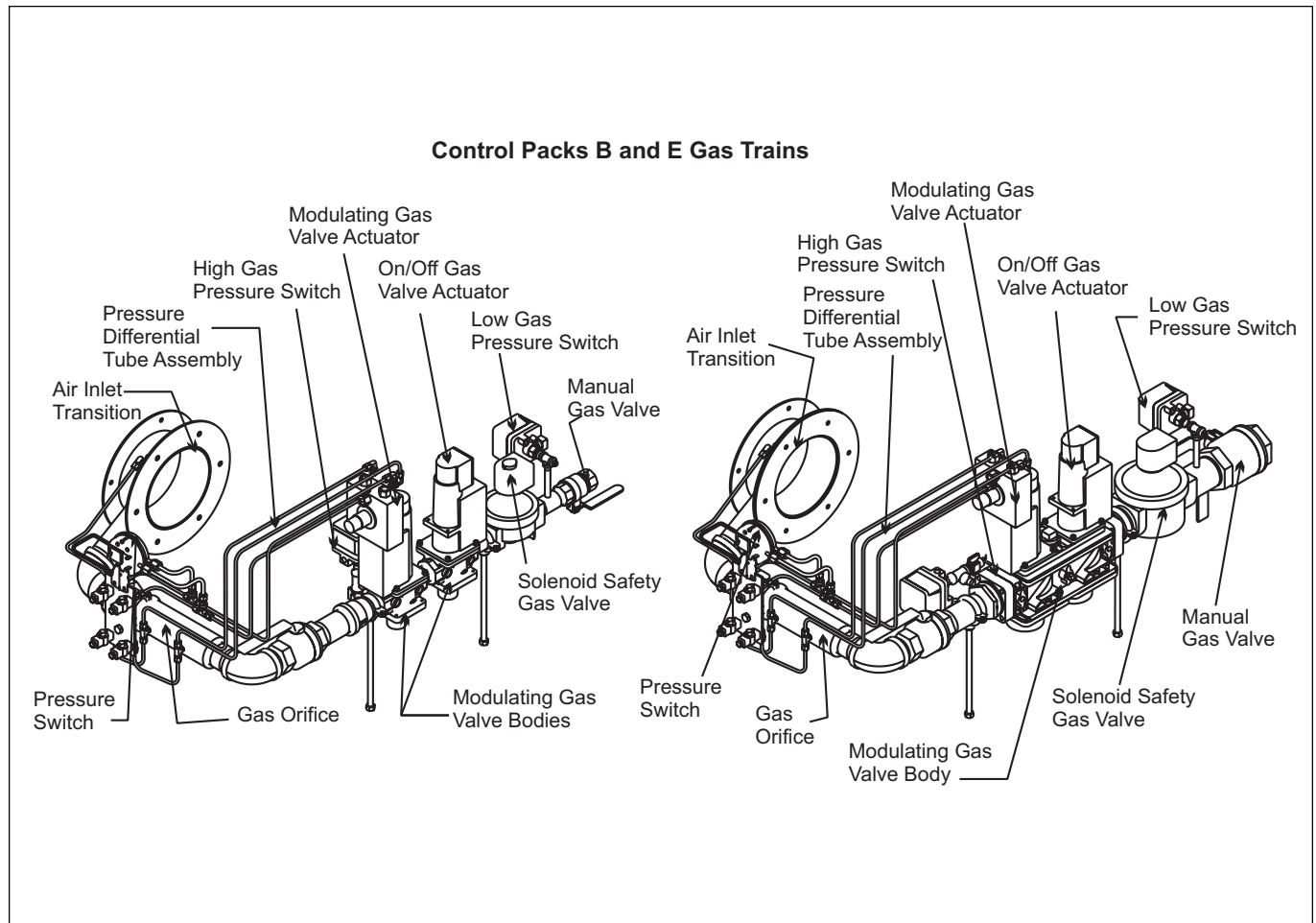


Figure 37. Gas Train.

determined the actuator is working properly, the gas valve body may need to be replaced. To remove the gas valve body, shut off 120V power and the gas shutoff valve. Remove the right side and front panels. Remove the valve actuator. Unscrew the valve body from the gas train. After the valve has been removed, replace with a new valve in reverse order. Turn on gas shutoff valve and 120V power and check appliance operation and tightness of gas valve connections.

7.2.15 Gas Pressure Switches

The high and low gas pressure switches are 24V manual reset switches that act to cut power to the gas valves if the gas pressure is too low or too high for proper operation. The gas pressure switches used are integrally vent limited, and do not require venting to atmosphere. To remove a switch, remove the screw on the plastic housing and pull the clear cover off. Disconnect the two wires from the screw terminals. Twist the switch off the pipe nipple. Reassemble in reverse order. For natural gas, set the low gas pressure switch to 3" w.c. For propane, set the low gas pressure switch to 5" w.c. For natural and propane, set the high gas pressure switch to 14".

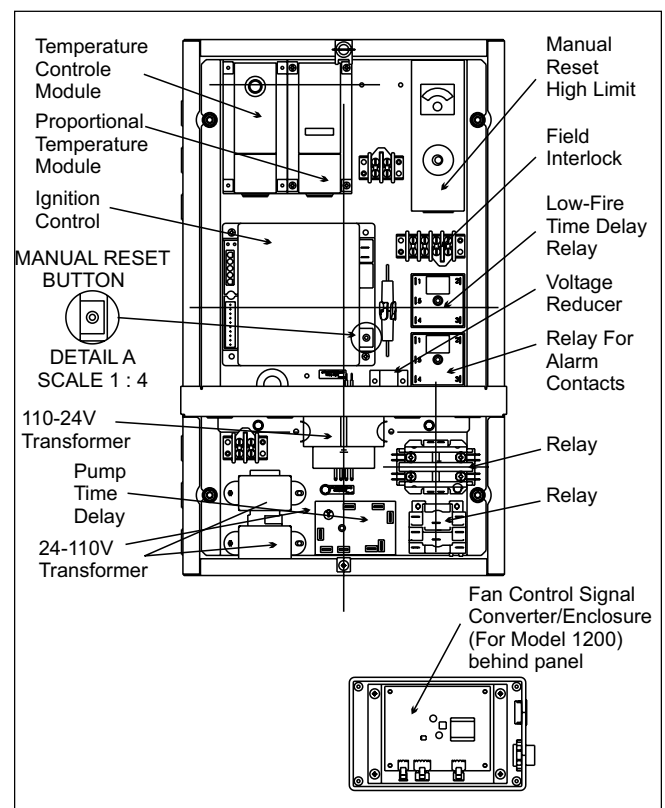


Figure 38. Control Panel.

SECTION 8. Trouble Shooting

8.1 Sequence of Operation

The Rheos appliance is a cold start appliance that should start only on a call for heat from a tank aquastat, room thermostat, zone valve end switch or other space temperature control device.

1. Upon a call for heat,
 - (a) The internal pump will start. (Pump is optionally mounted on unit.)
 - (b) The blower will begin a 15 second pre-purge.
2. Following the prepurge cycle the hot surface ignitor will heat and will begin a 7 second trial for ignition. The unit is allowed three attempts for ignition.
3. The gas valve will then be energized and low-fire (50% of full fire) ignition will occur. The unit will remain in a low-fire start-up period for 15 seconds.
4. After the low-fire start time is over, the unit will be in normal operation firing rate and will modulate based on the heating load via the temperature controller settings and readings.
5. When the call for heat is complete, or the unit reaches its setpoint temperature, the gas valve will close, and the fan will continue to run for its 30 second post-purge. If a pump time delay is used, the pump will continue to run for the specified amount of time (adjustable from 0.1 to 10 minutes).

8.2 Resolving Lockouts

There are many causes of lockouts. The three most common causes are: (1) inadequate gas supply, (2) poor combustion, (3) ignitor failure (4) combustion air.

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 the pre-purge time, the unit should light. If it does not, consult the factory.
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). If an improper gas/air ratio is suspected, consult the factory.
3. Ignitor failure: If the boiler goes through a normal start cycle but combustion does not occur, ignitor failure should be suspected. Check the ignitor by unplugging the ignitor plug and measuring the ignitor resistance. It should be 50-80 (Ω) ohms. If the resistance is not 50-80 ohms

(Ω), 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.

4. Inadequate combustion air: If the boiler goes through a normal ignition cycle, and shuts off after the blower ramps up to full speed, an abnormal restriction in the air intake or exhaust system should be suspected. Check the air filter for buildup of debris and clean filter if necessary. Inspect all exhaust venting and intake venting for blockages. Remove any blockages and inspect and replace any damaged vent sections. If the unit still continues to lockout after igniting, consult the factory.

Once the reason for the lockout has been identified and resolved you can reset the unit by pressing the manual reset button (see Detail A in Figure 30. Control Panel).

8.3 Delayed Ignition - Possible Causes

8.3.1 High Lockup Pressure (LP Appliances) - Occurs on Start-up

High lock up pressure is the most common cause of delayed ignitions on LP fueled appliances. It may result from an improper second stage regulator selection or from a faulty regulator.

Lock up can be detected by measuring the gas supply pressure to the appliance at the inlet pressure port on the gas valve. The gas supply to the appliance must be shut off before making any connections. To check: use a water manometer or pressure gauge with a scale reading of at least 25 in. W.C. or 15 oz/in². (6.2kPa). Attach the manometer to the gas valve inlet pressure port. Turn on the gas supply. The Rheos appliance is designed to operate with supply pressures of 4-13 in. W.C. (2.3 - 7.5 oz/ in²) (0.1-3.2kPa). If the supply pressure exceeds 13 in. W.C. (7.5 oz/ in²) (3.2kPa) (with the appliance off) it is possible that this may be the cause of the delayed ignitions and the inlet pressure must be reset to between 4-13 in. W.C. (2.3 – 7.5 oz/in²) (0.1-3.2kPa). Restart the appliance and then switch it off. If the inlet gas pressure exceeds 13 in. W.C. (7.5 oz/ in²) (3.2kPa) after the appliance is switched off, correct the lock up problem.

8.3.2 Gas Valve Regulation

Gas valve regulation problems can also cause delayed ignitions. If gas valve regulation problems are suspected, consult the factory. Do not attempt field adjustment or repair.

8.3.3 Defective Burner - Occurs on Startup or at Burner Shutdown

A defective burner can cause a delayed ignition. If the gas supply pressure is proper, the gas valve is functioning properly, the burner should be inspected. There should be no distortion or perforations in the burner. Replace if indicated.

8.4 Short Cycling — Boiler

Because the Rheos is a modulating boiler, and its input will decrease when there is a reduction in heating load, short cycling is greatly reduced. If the heating load drops below the minimum input of the boiler for an extended period, the boiler will have a tendency to short cycle. This can be a symptom of improper control strategy or setpoints, or a load distribution problem. See Section 5.5 regarding controller setup. Contact your Laars representative to discuss possible remedies.

8.5 Short Cycling — Water Heater

Short cycling will generally occur only in combination space heating and water heating applications when the water heater is operating in the space-heating mode. Because the Rheos is a modulating water heater and its input will reduce when there is a reduction in heating load, short cycling is greatly reduced. If the heating load drops below the minimum input of the water heater for an extended period, the water heater will have a tendency to short cycle. If short cycling is frequently experienced, regardless of the control's attempt to limit it, the heating load should be redistributed to control it. See Section 5.5 regarding controller setup.

If short cycling occurs in a water heater application, it is probably caused by undersized piping between the water heater and the storage tank or by some other factor that restricts proper water flow through the water heater. The cause should be determined and corrected.

8.6 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) can not 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 to 9% at all firing rates. Do not attempt to correct combustion. Contact factory if the CO₂ is not within this range.

SECTION 9.

Replacement Parts

Only genuine Laars replacement parts should be used.

9.1 General Information

To order or purchase parts for the Laars Rheos, 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

COMBUSTION COMPONENTS

See Figure 39

	1200	1600	2000	2400
1 Combustion chamber assembly	R2010800	R2016300	R2016400	R2001000
2 Base assembly	R2001100	R2001100	R2001100	R2001100
3 Panel, front cover, base frame	R2001200	R2001200	R2001200	R2001200
4 Panel, top, combustion chamber (with insulation)	R2001300	R2001300	R2001300	R2001300
5 Panel, bottom, combustion chamber	R2001400	R2001400	R2001400	R2001400
6 Panel, left, combustion chamber	R2001500	R2001500	R2001500	R2001500
7 Panel, right, combustion chamber	R2001600	R2001600	R2001600	R2001600
8 Panel, access, combustion chamber	R2001700	R2001700	R2001700	R2001700
9 Support, front, fan transition	R2010200	R2010200	R2010200	R2010200
10 Support, rear, fan transition	R2010300	R2010300	R2010300	R2010300
11 Hardware kit, combustion chamber	R2002200	R2002200	R2002200	R2002200
12 Burner, with gaskets	R2013200	R2016500	R2016600	R2002300
13 Gasket kit, burner	R2002400	R2002400	R2002400	R2002400
14 Tile kit (top & bottom of heat exchanger w/top insulation)	R2002500	R2002500	R2002500	R2002500
15 Tile support w/rods	R2010900	R2016700	R2016800	R2002600
16 Tile support protective liner	R2016900	R2016900	R2016900	R2002700
17 Flue collector kit (with gaskets)	R2011000	R2011000	R2017000	R2002800
18 Gasket kit, flue collector	R2002900	R2002900	R2002900	R2002900
19 Gasket kit, combustion chamber	R2003000	R2003000	R2003000	R2003000
20 Heat exchanger assembly, copper	R2013300	R2017100	R2017200	R2003100
20 Heat exchanger assembly, cupro-nickel	R2013301	R2017101	R2017201	R2003101
21 Baffle, flue	R2017300	not used	not used	not used

GAS TRAIN / COMBUSTION AIR COMPONENTS

See Figures 40 and 41

25 Gas train assembly, standard, Nat	R2011100	R2017400	R2017500	R2003200
25 Gas train assembly, standard, LP Nat	R2011200	R2017600	R2017700	R2010400
25 Gas train assembly, control pack A, Nat	R2017800	R2017900	R2018000	R2018100
25 Gas train assembly, control pack A, LP Nat	R2018200	R2018300	R2018400	R2018500
25 Gas train assembly, control pack B and E, Nat	R2018600	R2018700	R2018800	R2018900
25 Gas train assembly, control pack B and E, LP Nat	R2019000	R2019100	R2019200	R2019300
26 Gas valve, safety	R2011300	R2003300	R2003300	R2003300
27 Gas valve, solenoid safety, for control packs B & E	R2019400	R2019500	R2019500	R2019500
28 Gas valve, mod valve actuator	R2003400	R2003400	R2003400	R2003400
29 Gas valve, mod valve body	R2011400	R2011400	not used	R2003500
29 Gas valve, mod valve body, size 2000, Nat	not used	not used	R2003500	not used
29 Gas valve, mod valve body, size 2000, LP	not used	not used	R2011400	not used
30 Gas valve, mod complete (body and actuator)	R2011500	R2011500	not used	R2003600
30 Gas valve, mod complete (body and actuator) size 2000, Nat	not used	not used	R2003600	not used
30 Gas valve, mod complete (body and actuator) LP gas size 2000, LP	not used	not used	R2011500	not used
31 Gas valve, manual	R2011600	R2003700	R2003700	R2003700
32 Double valve body / Actuator	not used	not used	R2019600	R2019600
33 Double valve body	not used	not used	R2019700	R2019700
34 On/Off Actuator	R2019800	R2019800	R2019800	R2019800
35 Normally open vent valve	R2014400	R2014400	R2014400	R2014400
36 Gas orifice kit (orifice in holder), Nat	R2011700	R2019900	R2020000	R2003800
36 Gas orifice kit (orifice in holder), LP	R2011800	R2020100	R2020200	R2010500
37 Gas orifice, Nat	R2011900	R2020300	R2020400	R2003900
37 Gas orifice, LP	R2012000	R2020500	R2020600	R2010600
38 Pressure switch, high gas	R2004000	R2004000	R2004000	R2004000

	1200	1600	2000	2400
39 Pressure switch, low gas	R2004100	R2004100	R2004100	R2004100
40 Tubing/Fittings (gas train repair kit)	R2020700	R2020700	R2020700	R2020700
41 Air filter box assembly (with gasket and hardware) Nat	R2020800	R2020900	R2004400	R2004400
41 Air filter box assembly (with gasket and hardware) LP	R2020800	R2021000	R2021100	R2021200
42 Air filter	R2004500	R2004500	R2004500	R2004500
43 Gasket kit, air filter	R2004600	R2004600	R2004600	R2004600
44 Air filter box cover	R2004700	R2004700	R2004700	R2004700
45 Air filter felt gasket	R2004800	R2004800	R2004800	R2004800
46 Air filter air inlet vent w / gasket	R2021300	R2021400	R2021400	R2021400
47 Blower	R2012100	R2004900	R2004900	R2004900
48 Blower gasket kit	R2012200	R2005000	R2005000	R2005000
49 Air orifice, Nat	R2012300	R2021500	R2021700	R2005100
50 Air orifice strip, LP	not used	not used	R2022000	R2022000
51 Air orifice, LP	R2026400	R2021600	R2021700	R2005100
52 Air restrictor, LP	R2026500	R2022100	R2022200	not used
53 Air transition (filter box to blower)	R2012500	R2005200	R2005200	R2005200
54 Blower adapter transition	R2022300	not used	not used	not used
55 Ignitor kit (with gasket)	RW2002300	RW2002300	RW2002300	RW2002300
56 Sight glass	R2005300	R2005300	R2005300	R2005300
57 Pressure switch, air	R2022400	R2022400	R2022400	R2022400

ELECTRICAL COMPONENTS*See Figure 42*

	1200	1600	2000	2400
60 Transformer, 115/24V, 40VA step down	R0021300	R0021300	R0021300	R0021300
60 Transformer, 115/24V, 80VA step down, for control pack B & E only	R2022500	R2022500	R2022500	R2022500
62 Transformer, 24/115 step up	R2005500	R2005500	R2005500	R2005500
63 Fuse kit, 2 Amp, 5 pack (not shown)	RE2043600	RE2043600	RE2043600	RE2043600
63 Fuse kit, 5 Amp, 5 pack (Control packs B and E) (not shown)	RE2043500	RE2043500	RE2043500	RE2043500
64 Fuse holder (qty of 5)	RE2000300	RE2000300	RE2000300	RE2000300
65 Diagnostic lights kit	R2005600	R2005600	R2005600	R2005600
66 Ignition control (Single Trial)	R2014100	R2014100	R2014100	R2014100
66 Ignition control (Three Trial, Control packs F and G)	R2022600	R2022600	R2022600	R2022600
67 High limit, manual reset, RHCH boiler	RE0015900	RE0015900	RE0015900	RE0015900
67 High limit, manual reset, RHCV water heater	RE2217800	RE2217800	RE2217800	RE2217800
68 Temperature control, RHCH boiler	R2005800	R2005800	R2005800	R2005800
69 Module, proportional control	R2005900	R2005900	R2005900	R2005900
70 Timer, delay on make	R2006000	R2006000	R2006000	R2006000
71 Relay, DPDT, 24V coil	R2006100	R2006100	R2006100	R2006100
72 Relay, DPDT, 120V coil	R2006200	R2006200	R2006200	R2006200
73 Relay, EM2 kit	RE2077700	RE2077700	RE2077700	RE2077700
74 Relay, 115VAC SPST	R2014200	R2014200	R2014200	R2014200
75 Voltage regulator	R2006300	R2006300	R2006300	R2006300
76 Terminal block, 2 position	R2006400	R2006400	R2006400	R2006400
77 Terminal block, 4 position	R2006500	R2006500	R2006500	R2006500
78 Sensor, temperature control (not shown)	R2006600	R2006600	R2006600	R2006600
79 Switch, toggle, 3-way SPDT	R2007700	R2007700	R2007700	R2007700
80 Switch, toggle, DPDT	R2015000	R2015000	R2015000	R2015000
81 Control signal converter	R2012700	not used	not used	not used
82 Bell, alarm, 24V	R2014200	R2014200	R2014200	R2014200
83 Cover, control panel top	R2006700	R2006700	R2006700	R2006700
84 Cover, control panel bottom	R2007000	R2007000	R2007000	R2007000
85 Enclosure, control panel	R2006800	R2006800	R2006800	R2006800
86 Voltage divider panel, Std and control pack options A, C, and D	R2006900	R2006900	R2006900	R2006900
86 Voltage divider panel, control pack options B and E	R2015200	R2015200	R2015200	R2015200
87 Support, control panel bottom	R2007100	R2007100	R2007100	R2007100

	1200	1600	2000	2400
88 Panel, diagnostic lights	R2007300	R2007300	R2007300	R2007300
89 Bracket, mounting, diagnostic panel	R2007400	R2007400	R2007400	R2007400
90 Standoff	R2007500	R2007500	R2007500	R2007500
91 Hardware kit, control panel	R2007600	R2007600	R2007600	R2007600
92 Bracket, support, control panel top	R2007800	R2007800	R2007800	R2007800

HEAT EXCHANGER / WATER PATH*See Figure 43*

	1200	1600	2000	2400
93 Header cover	R2012800	R2022700	R2022800	R2007900
93 Header cover, pump mount	R2022900	R2023000	R2023100	R2023200
94 Water barrier assembly	R2012900	R2023300	R2023400	R2008000
95 Gasket kit, heat exchanger cover	R2013000	R2023500	R2023600	R2008200
96 Hardware kit, heat exchanger cover	R2013100	R2023700	R2023800	R2008300
97 Gauge, temperature/pressure	RA0079000	RA0079000	RA0079000	RA0079000
98 Pressure relief valve, RHCH boiler	A0063600	A0063600	A0002700	A0002700
98 Pressure relief valve, RHCV boiler	A0001200	A0064400	A0000400	A0000400
100 Immersion well, high limit	RE2058300	RE2058300	RE2058300	RE2058300
101 Immersion well, temperature control	RE2074000	RE2074000	RE2074000	RE2074000
102 Tube cleaning kit (not shown)	R2000700	R2000700	R2000700	R2000700
103 Flow switch (with paddle)	R2008400	R2008400	R2008400	R2008400
104 Low water cutoff, manual reset	RE2075100	RE2075100	RE2075100	RE2075100
105 Pump, circulator (normal water)	R2023900	R2024100	R2024300	R2024100
105 Pump, circulator (hard water)	R2024000	R2024200	R2024400	R2024200
106 Bracket, pump mounting (normal water)	R2024600	R2024500	R2024500	R2024500
106 Bracket, pump mounting (hard water)	R2024600	R2024600	R2024600	R2024600
107 Flange, pump, gaskets / hardware	R2024700	R2024800	R2024700	R2024800
108 Shims, pump bracket (10 ea)	R2013600	R2013600	R2013600	R2013600
109 Gaskets (10 pk)	R2013800	R2013800	R2013800	R2013800
110 Temperature switch, bi-metal disc	R2024900	R2024900	R2024900	R2024900

JACKET*See Figure 44*

	1200	1600	2000	2400
115 Panel, upper front access	R2015101	R2015101	R2015101	R2015101
116 Panel, lower front access	R2015102	R2015102	R2015102	R2015102
117 Panel, waterway access	R2025000	R2025100	R2025200	R2025300
117 Panel, waterway access, pump	R2025400	R2025400	R2025400	R2025500
118 Panel, waterway cover	R2025600	R2025600	R2025600	R2025600
119 Panel, pump access	R2025700	R2025800	R2025800	R2025800
120 Panel, PRV access	R2025900	R2025900	R2025900	R2025900
121 Panel, rear access	R2008600	R2008600	R2008600	R2008600
122 Panel, front left	R2008700	R2008700	R2008700	R2008700
123 Panel, front right	R2008800	R2008800	R2008800	R2008800
124 Panel, rear left	R2008900	R2008900	R2008900	R2008900
125 Panel, rear right	R2009000	R2009000	R2009000	R2009000
126 Panel, common access	R2009100	R2009100	R2009100	R2009100
127 Panel, top	R2009200	R2009200	R2009200	R2009200
128 Panel, support	R2009300	R2009300	R2009300	R2009300
129 Panel, flue vent access	R2026000	R2026000	R2026100	R2026300
130 Panel, ducted air cover	R2009500	R2009500	R2009500	R2009500
131 Jacket trim kit	R2009600	R2009600	R2009600	R2009600
132 Hardware kit, jacket	R2009700	R2009700	R2009700	R2009700
133 Window, control / display	R2009800	R2009800	R2009800	R2009800
134 Window guide	R2009900	R2009900	R2009900	R2009900
135 Window latch	R2010000	R2010000	R2010000	R2010000
136 Jacket retro-fit kit (standard)	R2026400	R2026500	R2026600	R2026700
137 Jacket retro-fit kit (mounted pump)	R2026800	R2026900	R2027000	R2027100

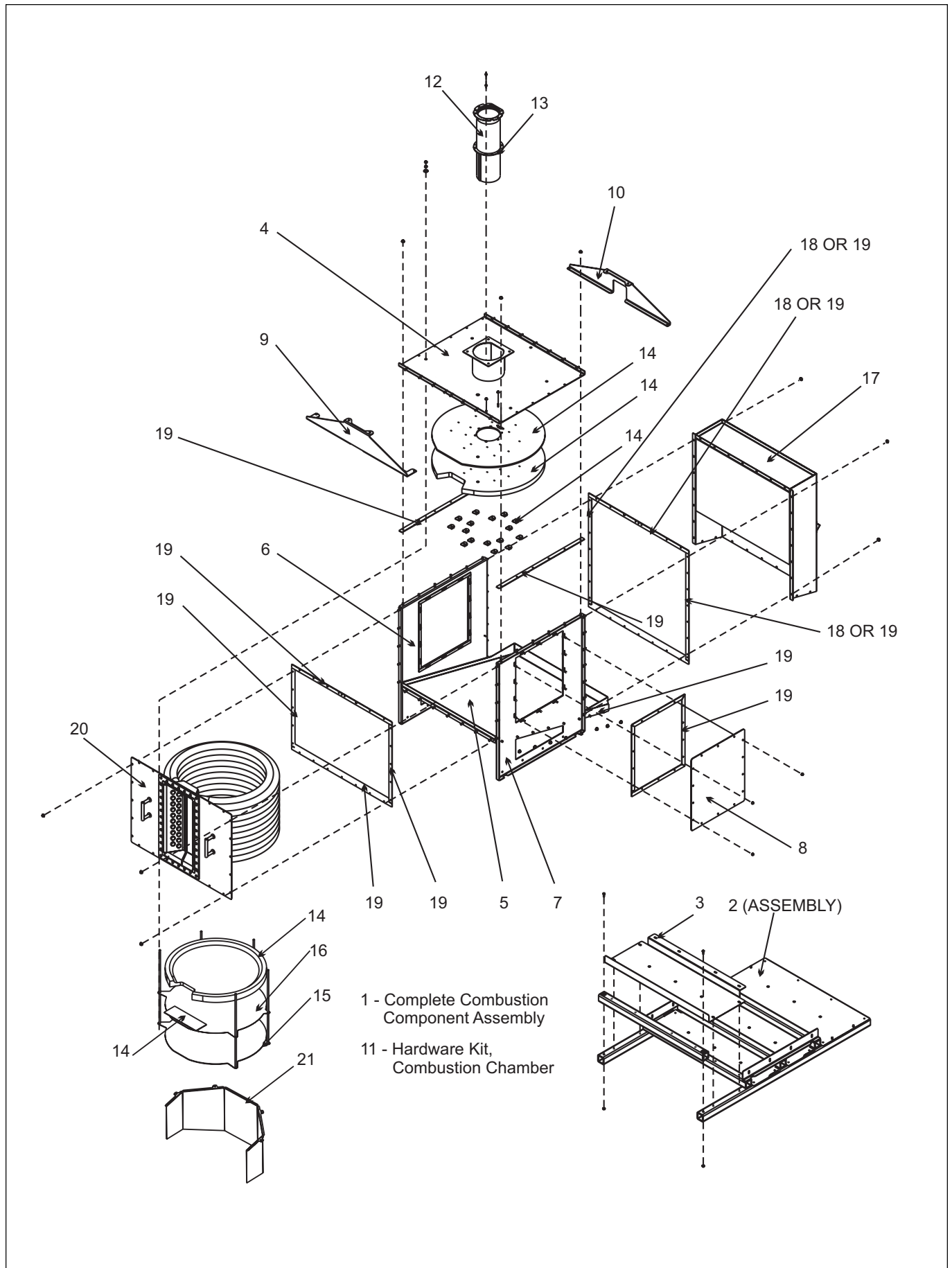


Figure 39. Combustion Components.

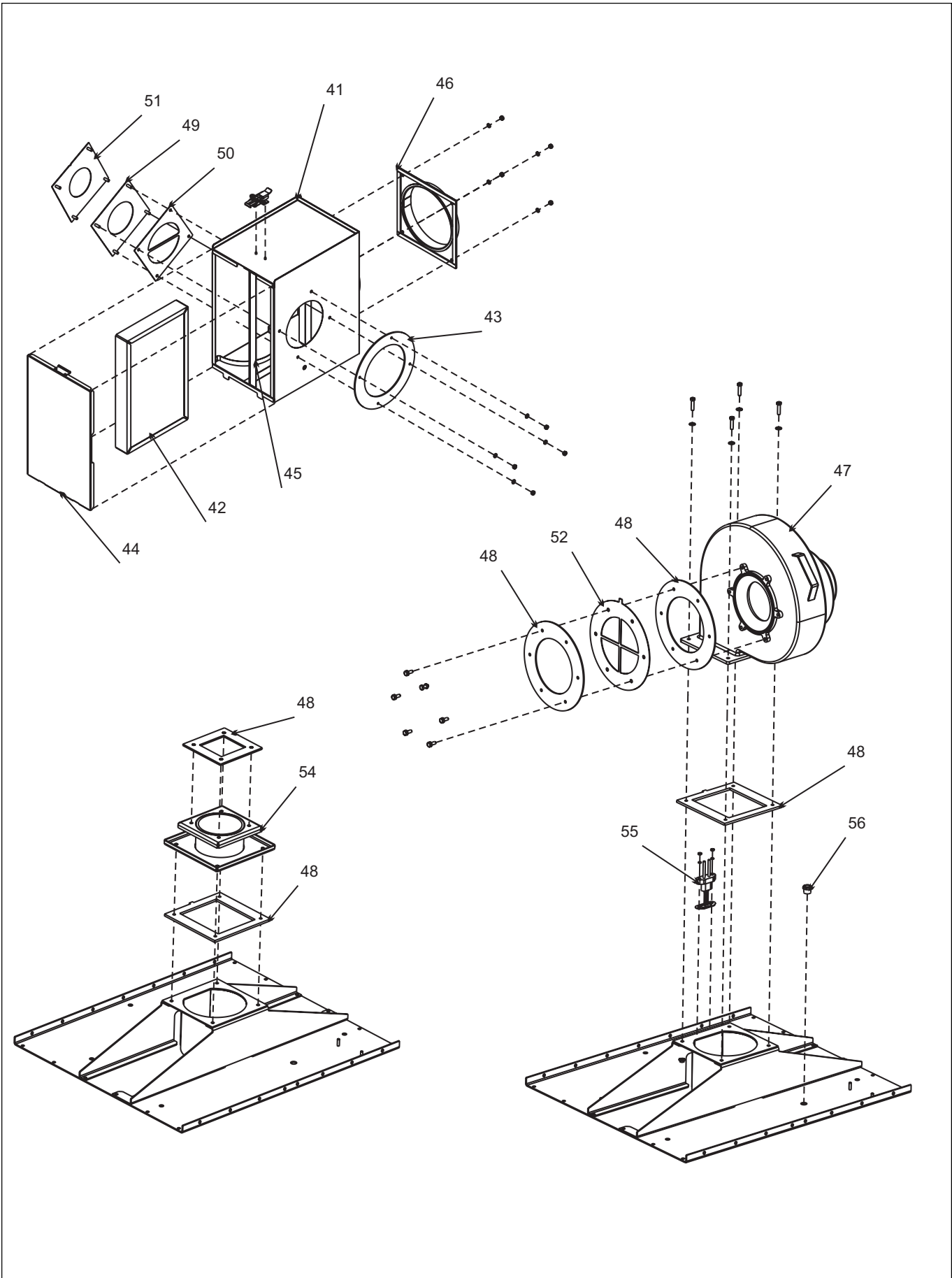


Figure 40. Gas Train/Combustion Air Components.

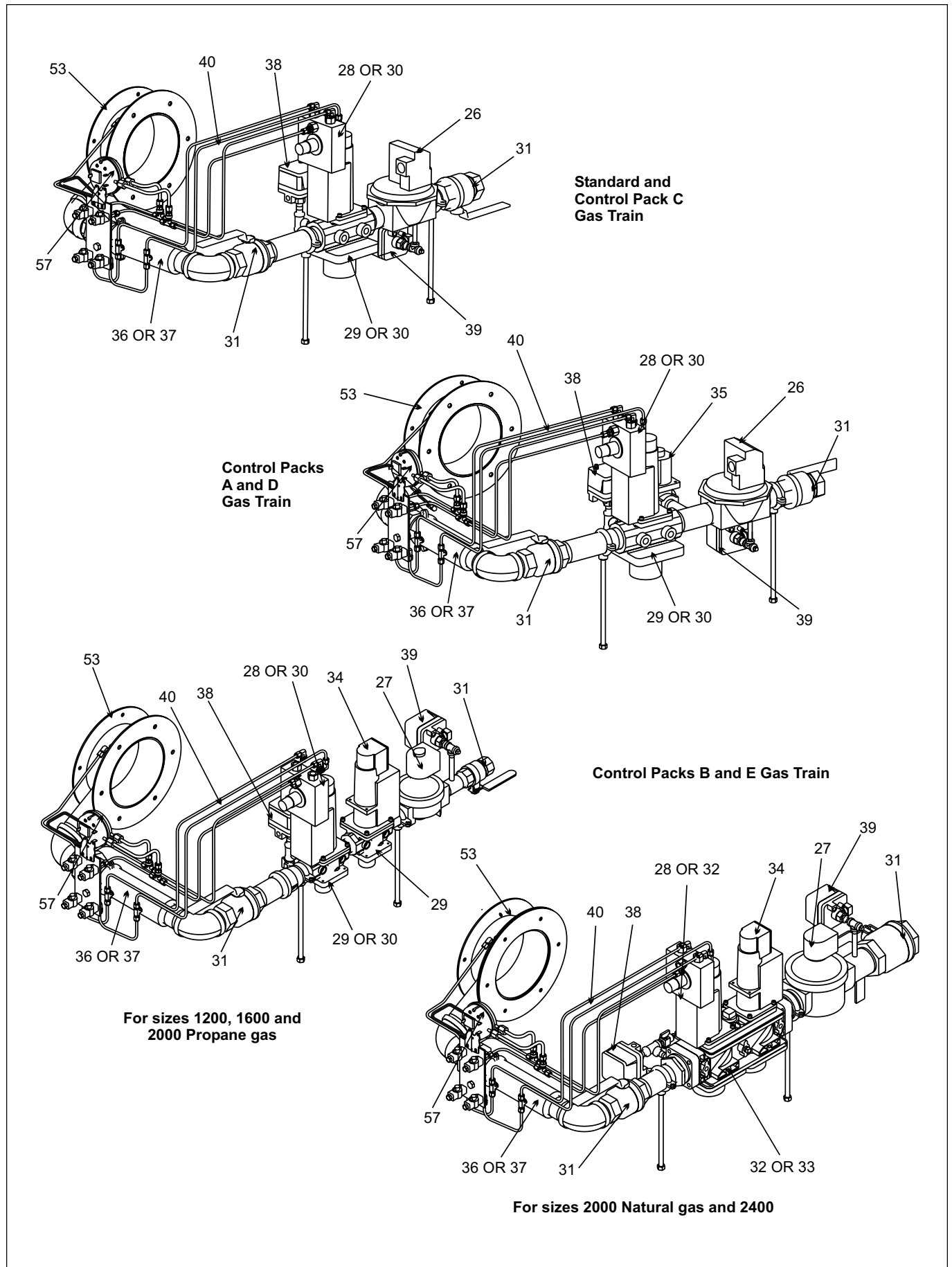


Figure 41. Gas Train Components.

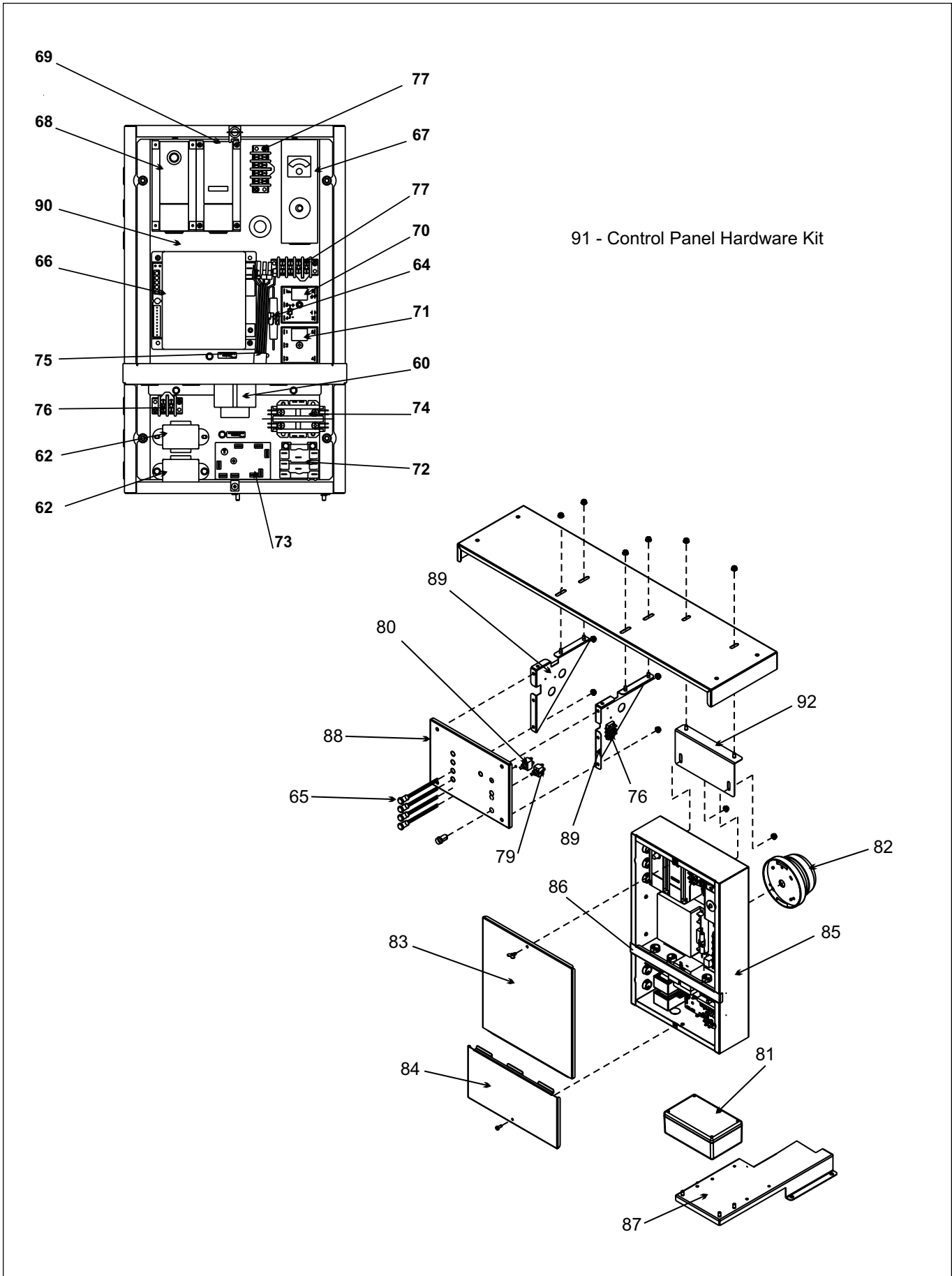


Figure 42. Electrical Components.

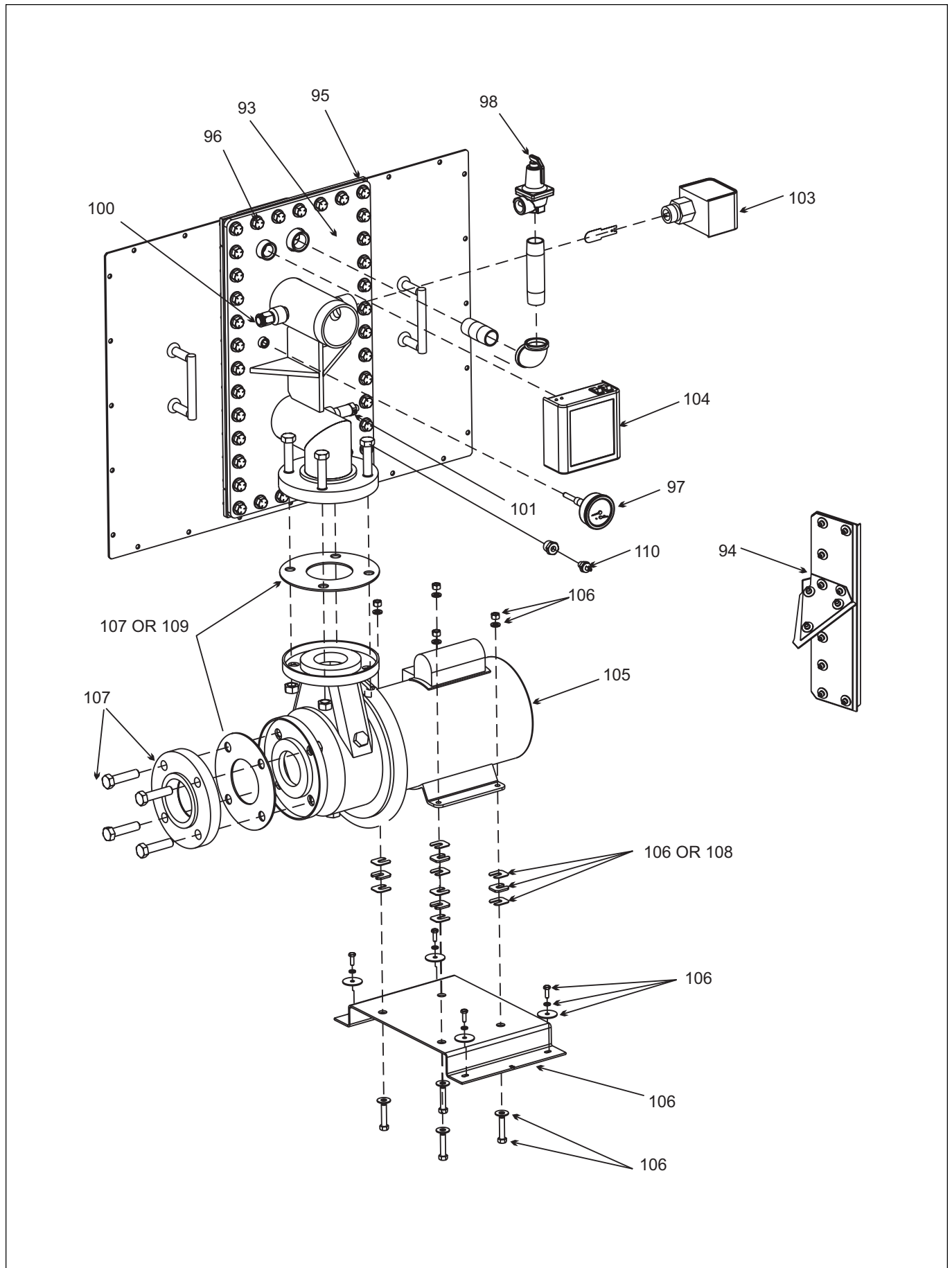


Figure 43. Heat Exchanger / Water Path Components.

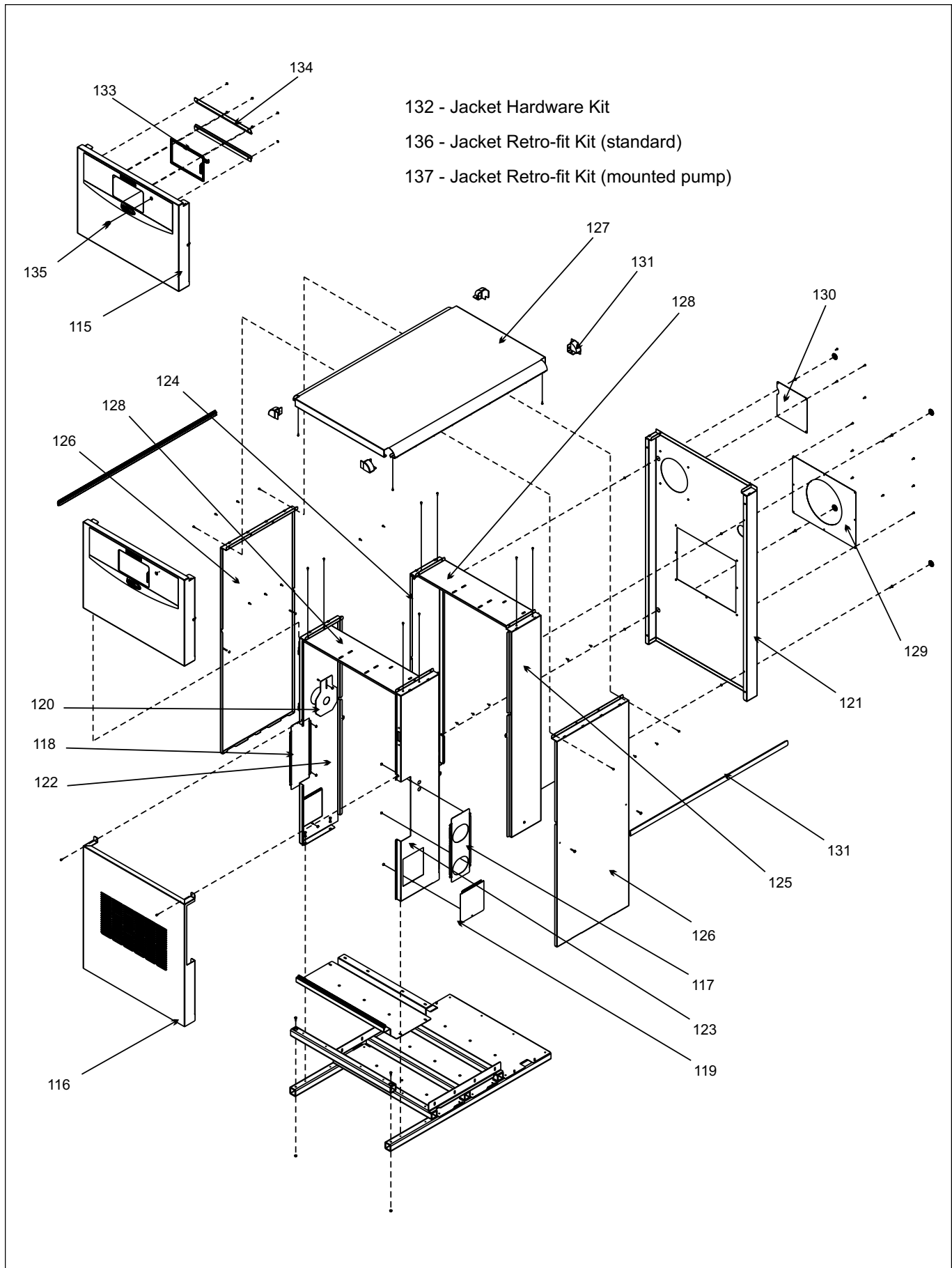


Figure 44. Jacket Components.

Tables Listing

Table 1	Terminals for Outdoor Installation	6
Table 2	Clearances	6
Table 3	Vent / Air Pipe Sizes	7
Table 4	Horizontal Vent and Air Terminals For Indoor Installations	9
Table 5	Required Combustion Air Piping Material	9
Table 6	Required Venting Material	9
Table 7	Gas Piping Sizes	10
Table 8	Water Flow Requirements – RHCH (Boiler) ...	13
Table 9	Water Flow Requirements – RHCV (Water Heater)	15
Table 10	Air & Gas Orifice Differentials at Full Fire	39

Figures Listing

Figure 1	Dimensional Drawing	5
Figure 2	Combustion Air and Vent Through Roof	7
Figure 3	Combustion Air and Vent Through Side-Wall ...	8
Figure 4	Hydronic Piping – Multiple Boilers, Primary Secondary System	12
Figure 5	Hydronic Piping – Multiple Boilers, Low Temperature System	12
Figure 6	Hydronic Piping – One Boiler, Multi-Temperature System	13
Figure 7	Hydronic Piping - Alternate System	14
Figure 8	Hydronic Piping - Alternate Low Temperature System	14
Figure 9	Water Heater Piping – One Heater, One Tank ...	16
Figure 10	Water Heater Piping – Multiple Heaters, One Tank	16
Figure 11	Water Heater Piping – One Heater, Multiple Tanks	17
Figure 12	Water Heater Piping – Multiple Heaters, Multiple Tanks	17
Figure 13	Temperature Control	19
Figure 14	Proportional Control	20
Figure 15	Control Parameter Graph	22
Figure 16	Control Parameter Possible Interference	23
Figure 17	Control Parameter Possible Interference	23
Figure 18	Wiring Diagram, Model 1200, Standard and Codes A, C, E, F and G	25

Figure 19	Wiring Diagram, Models 1600, 2000 and 2400, Standard and Codes A, C,E, F and G	26
Figure 20	Wiring Diagram Model 1200, Codes B and E	27
Figure 21	Wiring Diagram, Models 1600, 2000 and 2400, Codes B and E	28
Figure 22	Wiring Diagram, Model 1200, Pump-Mounted, Standard and Codes A, C, E, F and G	29
Figure 23	Wiring Diagram, Models 1600, 2000 and 2400, Pump-Mounted, Standard and Codes A, C, E, F and G	30
Figure 24	Wiring Diagram, Model 1200, Pump-Mounted, Codes B and E	31
Figure 25	Wiring Diagram, Models 1600, 2000 and 2400, Pump-Mounted, Codes B and E	32
Figure 26	Wiring Schematic, Model 1200, Standard and Codes A, C, E, F and G	33
Figure 27	Wiring Schematic, Models 1600, 2000 and 2400, Standard and Codes A, C,E, F and G	33
Figure 28	Wiring Schematic, Model 1200, Codes B and E	34
Figure 29	Wiring Schematic, Models 1600, 2000 and 2400, Codes B and E	34
Figure 30	Wiring Schematic, Model 1200, Pump-Mounted, Standard and Codes A, C, E, F and G	35
Figure 31	Wiring Schematic, Models 1600, 2000 and 2400, Pump-Mounted, Standard and Codes A, C, E, F and G	35
Figure 32	Wiring Schematic, Model 1200, Pump-Mounted, Codes B and E	36
Figure 33	Wiring Schematic, Models 1600, 2000 and 2400, Pump-Mounted, Codes B and E	36
Figure 34	Gas/Air Test Panel	38
Figure 35	Test Panel Valves	38
Figure 36	Gas Trains	42
Figure 37	Gas Train	43
Figure 38	Control Panel	43
Figure 39	Combustion Components	49
Figure 40	Gas Train/Combustion Air Components	50
Figure 41	Gas Train Components	51
Figure 42	Electrical Components	52
Figure 43	Heat Exchanger / Water Path	53
Figure 44	Jacket Components	54

parts4heating
800-536-1582 Fax: 866-448-9304
info@parts4heating.com



H2300300D



Waterpik Technologies
6000 Condor Drive, Moorpark, CA 93021 • 805.529.2000 • FAX 805.529.5934
20 Industrial Way, Rochester, NH 03867 • 603.335.6300 • FAX 603.335.3355
480 S. Service Road West, Oakville, Ontario, Canada L6K 2H4 • 905.844.8233 • FAX 905.844.2635
www.Laars.com

Litho in U.S.A. © Laars Heating Systems 0504 Document 1170D