

# INSTALLATION, OPERATING AND SERVICE INSTRUCTIONS EVA SERIES BOILER ON/OFF, 2 STAGE, MODULATION



File Number MH25585



For Service and repairs to the heating plant, call your heating contractor. When seeking information on the boiler from the manufacturer, provide boiler model and serial number as shown on rating label.

<b>Boiler Model</b> EVA -	<b>Installation Date</b>	<b>Serial Number</b>	<b>Type System</b>
<b>Heating Contractor</b>			
<b>Address</b>			<b>Phone Number</b>

Your Local Thermal Solutions Representative:



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## IMPORTANT INFORMATION - READ CAREFULLY

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NOTE: Post these instructions and maintain in legible condition.

NOTE: The equipment shall be installed in accordance with those installation regulations required in the area where the installation is to be made. These regulations shall be carefully followed in all cases. Authorities having jurisdiction shall be consulted before installations are made.

All wiring on boilers installed in the USA shall be in accordance with the National Electrical Code and/or local regulations.

All wiring on boilers installed in Canada shall be in accordance with the Canadian Electrical Code and/or local regulations.

The following terms are used throughout this manual to bring attention to the presence of hazards of various risk levels, or to important information concerning product life.

### DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death, serious injury or substantial property damage.

### CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in moderate or minor injury or property damage.

### WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death, serious injury or substantial property damage.

### NOTICE

Indicates special instructions on installation, operation, or maintenance which are important but not related to personal injury hazards.

### DANGER

**DO NOT** store or use gasoline or other flammable vapors or liquids in the vicinity of this or any other appliance.  
If you smell gas vapors, **DO NOT** try to operate any appliance - **DO NOT** touch any electrical switch or use any phone in the building. Immediately, call the gas supplier from a remotely located phone. Follow the gas supplier's instructions or if the supplier is unavailable, contact the fire department.

## WARNING

This boiler requires regular maintenance and service to operate safely. Follow the instructions contained in this manual.

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Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury or loss of life. Read and understand the entire manual before attempting installation, start-up operation, or service. Installation and service must be performed only by an experienced, skilled installer or service agency.

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This boiler must be properly vented.

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This boiler needs fresh air for safe operation and must be installed so there are provisions for adequate combustion and ventilation air.

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The interior of the venting and air intake systems must be inspected and cleaned before the start of the heating season and should be inspected periodically throughout the heating season for any obstructions. Clean and unobstructed venting and air intake systems are necessary to allow noxious fumes that could cause injury or loss of life to vent safely and will contribute toward maintaining the boiler's efficiency.

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Installation is not complete unless a factory supplied pressure relief valve is installed on the boiler - See Installation Section of this manual for details.

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This boiler is supplied with safety devices which may cause the boiler to shut down and not re-start without service - If damage due to frozen pipes is a possibility, the heating system should not be left unattended in cold weather; or appropriate safeguards and alarms should be installed on the heating system to prevent damage if the boiler is inoperative.

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This boiler contains very hot water under high pressure. Do not unscrew any pipe fittings nor attempt to disconnect any components of this boiler without positively assuring the water is cool and has no pressure. Always wear protective clothing and equipment when installing, starting up or servicing this boiler to prevent scald injuries. Do not rely on the pressure and temperature gauges to determine the temperature and pressure of the boiler. This boiler contains components which become very hot when the boiler is operating. Do not touch any components unless they are cool.

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Boiler materials of construction, products of combustion and the fuel contain alumina, silica, heavy metals, carbon monoxide, nitrogen oxides, aldehydes and/or other toxic or harmful substances which can cause death or serious injury and which are known to the state of California to cause cancer, birth defects and other reproductive harm. Always use proper safety clothing, respirators and equipment when servicing or working nearby the appliance.

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Failure to follow all instructions in the proper order can cause personal injury or death. Read all instructions, including all those contained in component manufacturers manuals which are provided with the boiler before installing, starting up, operating, maintaining or servicing.

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Keep boiler area clear and free from combustible materials, gasoline and other flammable vapors or liquids.

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All cover plates, enclosures and guards must be in place at all times.

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This product must be installed by a licensed plumber or gas fitter when installed within the Commonwealths of Massachusetts.

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## NOTICE

This boiler has a limited warranty, a copy of which is printed on the back of this manual. It is the responsibility of the installing contractor to see that all controls are correctly installed and are operating properly when the installation is complete.

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### NOTICE

**Modular systems (two or more EVA Series boilers) may be installed with zero (0) side clearances between the boilers**

#### Minimum Clearance to Combustible Materials

<u>Left Side</u>	<u>Right Side</u>	<u>Front</u>	<u>Rear</u>	<u>Top</u>	<u>Flue Connector</u>
6"	6"	24"	6"	6"	18"

#### \*Recommended Clearance for Service\*

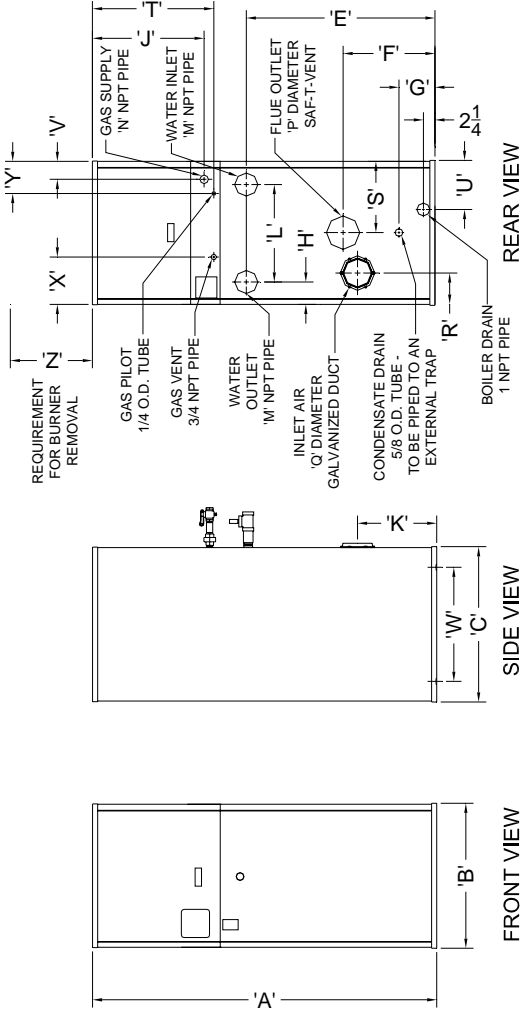
	<u>Left Side or Right Side</u>	<u>Front</u>	<u>Rear</u>	<u>Top</u>
250	24"	24"	24"	14"
500	24"	24"	24"	16"
750	24"	24"	24"	16"
1000	24"	24"	24"	16"
1500	24"	24"	24"	19"
2000	24"	24"	24"	31"
2000S	24"	36"	36"	13"
2500	24"	36"	36"	20"
3000	24"	36"	36"	26.5"

\* When 3 or more units are mounted side-by-side, front service clearance increases by 12" and the rear service clearance increases by 24".

**NOTE: Verify clearance with local codes.**

The electrical data in Figure 1: Dimensions and Capacities was updated to reflect the existing current draw for the Evolution boilers. In addition to updating the current draw, the table was modified to present the information in a more suitable format. This revised information should be used in place of that on page 5 of the Installation, Operating and Service Instructions for EVA Series Boilers, 81456001R8-3/07.

BOILER MODEL	DIMENSION																									
	'A'	'B'	'C'	'E'	'F'	'G'	'H'	'J'	'K'	'L'	'M'	'N'	'P'	'Q'	'R'	'S'	'T'	'U'	'V'	'W'	'X'	'Y'	'Z'			
EVA-250	56½	28½	30½	27½	17½	6½	4½	21½	14½	11½	2	1	3	3	5½	14½	23½	13½	3½	19½	9½	6½	14			
EVA-500	71½	28½	30½	41½	17½	6½	4½	21½	14½	11½	2	1½	4	4	5½	14½	23½	13½	3½	19½	9½	6½	16			
EVA-750	61	28½	30½	30½	17½	7	4½	21½	14½	19	3	1½	4	6	6½	13½	23½	9½	3½	19½	9½	6½	16			
EVA-1000	67½	28½	30½	36½	17½	7	4½	21½	14½	19	3	1½	6	6	6½	13½	23½	9½	3½	19½	9½	6½	16			
EVA-1500	79½	28½	30½	49	17½	7	4½	21½	27½	19	3	1½	6	8	6½	13½	23½	9½	3½	19½	9½	6½	19			
EVA-2000S	91½	28½	30½	61½	17½	7	4½	21½	27½	19	3	1½	6	8	6½	13½	23½	9½	3½	19½	9½	6½	31			
EVA-2000S	70½	38½	40½	39½	18½	6½	5½	21	19½	26½	4	1½	6	8	7	19	23½	14½	5	N/A	4	8½	13			
EVA-2500	77½	38½	40½	46½	18½	6½	5½	21	19½	26½	4	2	8	8	7	19	23½	14½	5	N/A	4	8½	20			
EVA-3000	84½	38½	40½	53½	18½	6½	5½	21	19½	26½	4	2	8	8	7	19	23½	14½	5	N/A	4	8½	26½			



BOILER MODEL RANGE	MOTOR (HP)	ELECTRICAL	
		STANDARD ELECTRICAL SUPPLY (V/DLTS/HERTZ/PHASE)	TOTAL CURRENT DRAW (N/DIFF (AMPS))
250/500	1½	120/60/1	8.1
		208/60/1	4.4
		230/60/1	4.4
		208/60/3	2.6
750/2000S	1½	230/60/3	2.52
		460/60/3	1.61
		120/60/1	17.7
		208/60/1	9.2
2500/3000	2	230/60/1	9.2
		208/60/3	5.2
		230/60/3	4.96
		480/60/3	2.83
2500/3000	2	120/60/1	N/A
		208/60/1	N/A
		230/60/1	N/A
		208/60/3	N/A
2500/3000	2	230/60/3	N/A
		460/60/3	N/A

BOILER MODEL	CAPACITIES					
	BTU INPUT	BTU OUTPUT	WATER VOLUME (GALLONS)	HEAT TRANSFER AREA (SQ. FT.)	DRY WEIGHT (LBS.)	WET WEIGHT (LBS.)
EVA-250	250,000	220,000	5.4	65	500	545
EVA-500	500,000	440,000	6.1	123	552	603
EVA-750	750,000	660,000	15.9	131	955	1088
EVA-1000	1,000,000	880,000	16.4	175	1100	1237
EVA-1500	1,500,000	1,320,000	17.4	264	1215	1360
EVA-2000	2,000,000	1,760,000	18.5	352	1350	1504
EVA-2000S	2,000,000	1,760,000	40.1	411	1902	2237
EVA-2500	2,500,000	2,200,000	41.6	518	2135	2482
EVA-3000	3,000,000	2,640,000	43.1	625	2500	2860

Figure 1: Dimensions and Capacities

## I. Pre-Installation

### WARNING

**Carefully read all instructions before installing boiler. Failure to follow all instructions in proper order can cause personal injury or death.**

- A. Installation must conform to the requirements of the authority having jurisdiction. In the absence of such requirements, installation must conform to the *National Fuel Gas Code*, NFPA 54/ANSI Z223.1, and/or CAN/CGA B149 Installation Codes. Where required by the authority having jurisdiction, the installation must conform to the *Standard for Controls and Safety Devices for Automatically Fired Boilers*, ANSI/ASME CSD-1.
- B. The boiler is not design certified for installation on combustible flooring. The boiler must not be installed on carpeting.
- C. Provide clearance between boiler jacket and combustible material in accordance with local fire ordinance. Refer to page 4 of this manual for minimum listed clearance from combustible material.
- D. Install on level floor. For basement installation provide concrete base if floor is not perfectly level or if water may be encountered on floor around boiler. Floor must be able to support weight of boiler, water and all additional system components.
- E. Protect gas ignition system components from water (dripping, spraying, rain, etc.) during boiler operation and service (circulator replacement, condensate trap service, control replacement, etc.).
- F. Provide combustion and ventilation air in accordance with applicable provisions of local building codes or: USA - *National Fuel Gas Code*, NFPA 54/ANSI Z223.1, Section 5.3, Air for Combustion and Ventilation; Canada - *Natural Gas Installation Code*, CAN/CGA - B149.1, or *Propane Installation Code*, CAN/CGA - B.149.2, Part 5, Venting Systems and Air Supply for Appliances.

### WARNING

**Adequate combustion and ventilation air must be provided to assure proper combustion.**

The following guideline is based on the *National Fuel Gas Code*, NFPA 54/ANSI Z223.1.

1. Determine volume of space (boiler room). Rooms communicating directly with space (through openings not furnished with doors) are considered part of space.  
$$\text{Volume [ft}^3\text{]} = \text{Length [ft]} \times \text{Width [ft]} \times \text{Height [ft]}$$
2. Determine Total Input of all appliances in space. Round result to nearest 1,000 Btu per hour (Btuh).
3. Determine type of space. Divide Volume by Total Input.
  - a. If result is greater than or equal to 50 ft<sup>3</sup> per 1,000 Btuh, space is considered an *unconfined space*.
  - b. If result is less than 50 ft<sup>3</sup> per 1,000 Btuh, space is considered a *confined space*.
4. Determine building type. A building of *unusually tight construction* has the following characteristics:
  - a. Walls and ceiling exposed to outside atmosphere have a continuous water vapor retarder with a rating of 1 perm or less with openings gasketed and sealed, and;
  - b. Weather-stripping has been added on openable windows and doors, and;
  - c. Caulking or sealants applied in joints around window and door frames, between sole plates and floors, between wall-ceiling joints, between wall panels, at plumbing and electrical penetrations, and at other openings.
5. For boiler located in an *unconfined space in a building of other than unusually tight construction*, adequate combustion and ventilation air is normally provided by fresh air infiltration through cracks around windows and doors.

### NOTICE

**Boilers operated with sealed combustion are exempt from needing provisions for combustion air from the room, provided air intake piping is installed per code and the instructions in this manual.**

6. For boiler located within *unconfined space in building of unusually tight construction* or within *confined space*, provide outdoor air through two permanent openings which communicate directly or by duct with the outdoors or spaces (crawl or attic) freely communicating with the outdoors. Locate one opening within 12 inches of top of space. Locate remaining opening within 12 inches of bottom of space. Minimum dimension of air opening is 3 inches. Size each opening per the following:

- a. Direct communication with outdoors. Minimum free area of 1 square inch per 4,000 Btu per hour input of all equipment in space.
- b. Vertical ducts. Minimum free area of 1 square inch per 4,000 Btu per hour input of all equipment in space. Duct cross-sectional area shall be same as opening free area.
- c. Horizontal ducts. Minimum free area of 1 square inch per 2,000 Btu per hour input of all equipment in space. Duct cross-sectional area shall be same as opening free area.

Alternate method for boiler located within confined space. Use indoor air if two permanent openings communicate directly with additional space(s) of sufficient volume such that combined volume of all spaces meet criteria for unconfined space. Size each opening for minimum free area of 1 square inch per 1,000 Btu per hour input of all equipment in spaces, but not less than 100 square inches.

- 7. Ventilation Duct Louvers and Grilles. Equip outside openings with louvers to prevent entrance of rain and snow, and screens to prevent entrance of insects and rodents. Louvers and grilles must be fixed in open position or interlocked with equipment to open automatically before burner operation. Screens must not be smaller than 1/4 inch mesh.

Consider the blocking effect of louvers, grilles and screens when calculating the opening size to provide the required free area. If free area of louver or grille is not known, assume wood louvers have 20-25 percent free area and metal louvers and grilles have 60-75 percent free area.

### DANGER

**Do not install boiler where gasoline or other flammable vapors or liquids, or sources of hydrocarbons (i.e. bleaches, cleaners, chemicals, sprays, paint removers, fabric softeners, etc.) are used or stored.**

### NOTICE

**Due to the low water content of the boiler, incorrect sizing of the boiler with regard to the heating system load will result in excessive boiler cycling and accelerated component failure. Thermal Solutions DOES NOT warrant failures caused by incorrectly sized boiler applications. DO NOT oversize the boiler to the system. Modular boilers greatly reduce the likelihood of boiler oversizing.**

## II. Unpacking the Boiler

### NOTICE

**Boiler crate is equipped with a tip & tell label. If label indicates boiler has been tipped over during shipping, remove crate and inspect before trucker leaves.**

### CAUTION

**Do not drop boiler. Do not bump boiler jacket against floor.**

- A. Move boiler to approximate installed position.
- B. Remove all crate fasteners.
- C. Open outside container and remove all inside protective spacers and bracing.
- D. Remove all boiler hold-down fasteners.

### WARNING

**Installation of this boiler should be undertaken only by trained and skilled personnel from a qualified service agency.**

- E. Tilt the boiler to one side and slide a small roller under the raised base.
- F. Tilt the boiler to the other side and slide another roller under the base.  
Place a larger pipe roller on floor behind the skid.
- G. Roll the boiler forward or backward off the skid and onto the pipe roller.
- H. Move boiler to its permanent location.



## III. Installation

### A. VENTING

#### 1. General Guidelines

- a. The vent system must be in accordance with the National Fuel Gas Code/NFPA 54 ANSI Z222.3, Part 7, Venting of Equipment or Applicable provisions of Local Building Codes.
- b. All vent pipe must be adequately supported with vent supports no less than five (5) feet apart. The completed vent system must be rigid and able to withstand impacts without collapse.
- c. This boiler requires AL29-4C® venting. Boiler is certified for use of single wall AL29-4C® venting. Consult factory for any other venting materials.

### WARNING

**Do not use this boiler with galvanized based vent systems.**

- d. This boiler may be operated with conventional, sidewall or vertical venting. Conventional vented appliances operate with negative pressure in the vent pipe. Sidewall and vertically vented boilers operate with positive pressure in the vent pipe. Positive pressure vent pipe can be mated to the boiler without any adapters.
- e. Consult vent pipe manufacturer's instructions for minimum clearance to combustible material for vent components. In the absence of instructions, the minimum clearance to combustible material is six (6) inches.
- f. Consult vent pipe manufacturer's instructions for proper method of sealing vent pipe sections and fittings. In the absence of instructions, make sure pipe and fittings are clean by swabbing with alcohol. Use Dow Corning 736 or 732 RTV, Polybar #500 RTV or Sil-bond 4500 or 6500 to seal vent pipe. Do not use other adhesives or sealants except as expressly permitted by the vent pipe manufacturer's instructions.
- g. Refer to the appropriate drawings in this section of this manual to determine the proper configuration of venting system.
- h. Consult vent pipe manufacturer's instructions for vent system assembly. Follow vent pipe manufacturer's instructions if those instructions conflict with this section.
- i. Install vent system before installing air intake, water, gas or electrical connections.

### WARNING

**DO NOT USE vent dampers with this boiler unless authorized by factory.**

#### 2. IMPORTANT

The Commonwealth of Massachusetts requires compliance with regulation 248 CMR 4.00 and 5.00 for installation of side-wall vented gas appliances as follows:

- (a) For all side wall horizontally vented gas fueled equipment installed in every dwelling, building or structure used in whole or in part for residential purposes, including those owned or operated by the Commonwealth and where the side wall exhaust vent termination is less than seven (7) feet above finished grade in the area of the venting, including but not limited to decks and porches, the following requirements shall be satisfied:

**INSTALLATION OF CARBON MONOXIDE DETECTORS.** At the time of installation of the side wall horizontal vented gas fueled equipment, the installing plumber or gas fitter shall observe that a hard wired carbon monoxide detector with an alarm and battery back-up is installed on the floor level where the gas equipment is to be installed. In addition, the installing plumber or gas fitter shall observe that a battery operated or hard wired carbon monoxide detector with an alarm is installed on each additional level of the dwelling, building or structure served by the side wall horizontal vented gas fueled equipment. It shall be the responsibility of the property owner to secure the services of qualified licensed professionals for the installation of hard wired carbon monoxide detectors.

In the event that the side wall horizontally vented gas fueled equipment is installed in a crawl space or an attic, the hard wired carbon monoxide detector with alarm and battery back-up may be installed on the next adjacent floor level.

In the event that the requirements of this subdivision can not be met at the time of completion of installation, the owner shall have a period of thirty (30) days to comply with the above requirements; provided, however, that during said thirty (30) day period, a battery operated carbon monoxide detector with an alarm shall be installed.

**APPROVED CARBON MONOXIDE DETECTORS.** Each carbon monoxide detector as required in accordance with the above provisions shall comply with NFPA 720 and be ANSI/UL 2034 listed and IAS certified.

**SIGNAGE.** A metal or plastic identification plate shall be permanently mounted to the exterior of the

building at a minimum height of eight (8) feet above grade directly in line with the exhaust vent terminal for the horizontally vented gas fueled heating appliance or equipment. The sign shall read, in print size no less than one-half (1/2) inch in size, “**GAS VENT DIRECTLY BELOW. KEEP CLEAR OF ALL OBSTRUCTIONS**”.

INSPECTION. The state or local gas inspector of the side wall horizontally vented gas fueled equipment shall not approve the installation unless, upon inspection, the inspector observes carbon monoxide detectors and signage installed in accordance with the provisions of 248 CMR 5.08(2)(a)1 through 4.

- (b) EXEMPTIONS: The following equipment is exempt from 248 CMR 5.08(2)(a)1 through 4: The equipment listed in Chapter 10 entitled “Equipment Not Required To Be Vented” in the most current edition of NFPA 54 as adopted by the Board; and Product Approved side wall horizontally vented gas fueled equipment installed in a room or structure separate from the dwelling, building or structure used in whole or in part for residential purposes.
- (c) MANUFACTURER REQUIREMENTS - GAS EQUIPMENT VENTING SYSTEM PROVIDED. When the manufacturer of Product Approved side wall horizontally vented gas equipment provides a venting system design or venting system components with the equipment, the instructions provided by the manufacturer for installation of the equipment and the venting system shall include: Detailed instructions for the installation of the venting system design or the venting system components; and A complete parts list for the venting system design or venting system.
- (d) MANUFACTURER REQUIREMENTS - GAS EQUIPMENT VENTING SYSTEM NOT PROVIDED. When the manufacturer of a Product Approved side wall horizontally vented gas fueled equipment does not provide the parts for venting the flue gases, but identifies “special venting systems”, the following requirements shall be satisfied by the manufacturer: The referenced “special venting system” instructions shall be included with the appliance or equipment installation instructions; and The “special venting systems” shall be Product Approved by the Board, and the instructions for that system shall include a parts list and detailed installation instructions.
- (e) A copy of all installation instructions for all Product Approved side wall horizontally vented gas fueled equipment, all venting instructions, all parts lists

for venting instructions, and/or all venting design instructions shall remain with the appliance or equipment at the completion of the installation.

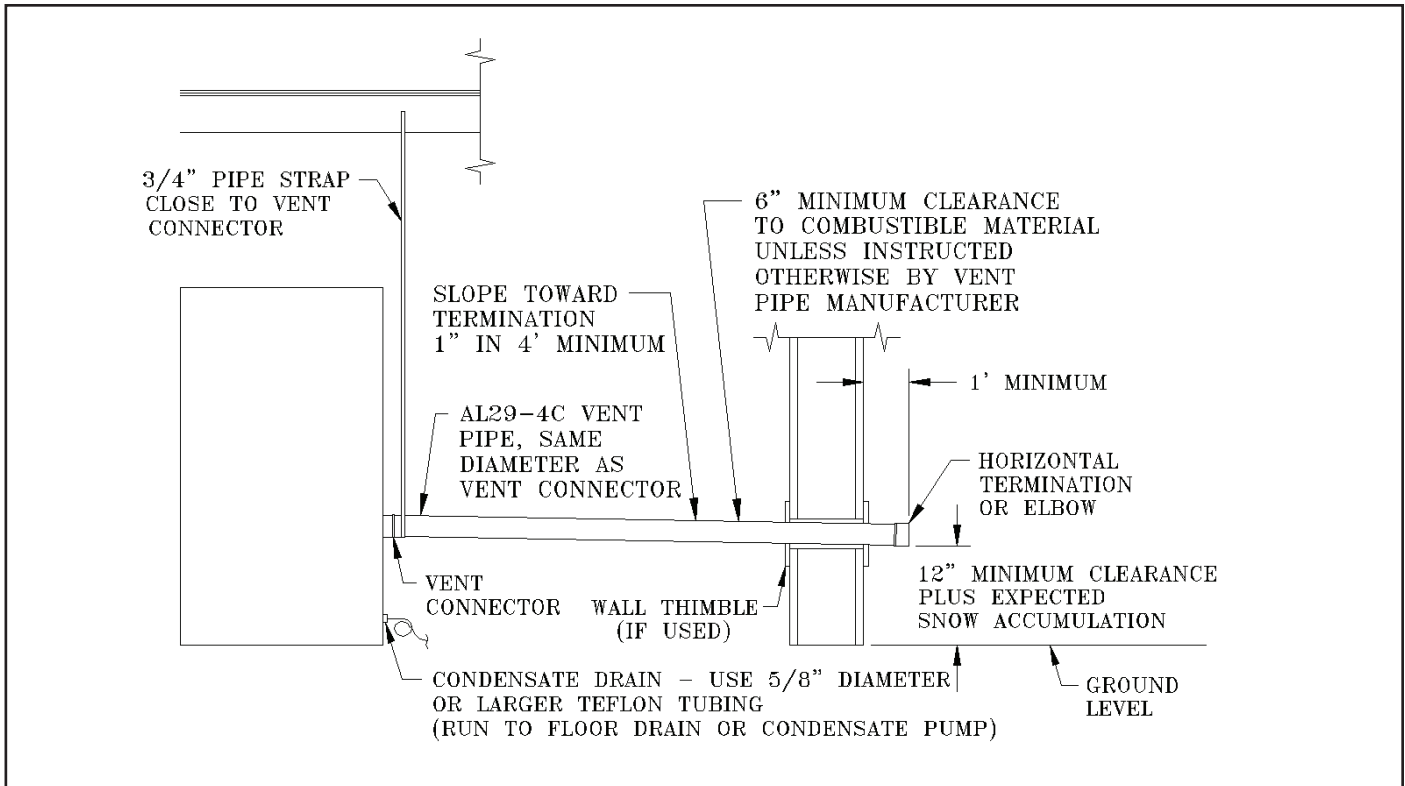
## WARNING

**Do not use a barometric damper with sidewall or vertical venting.**

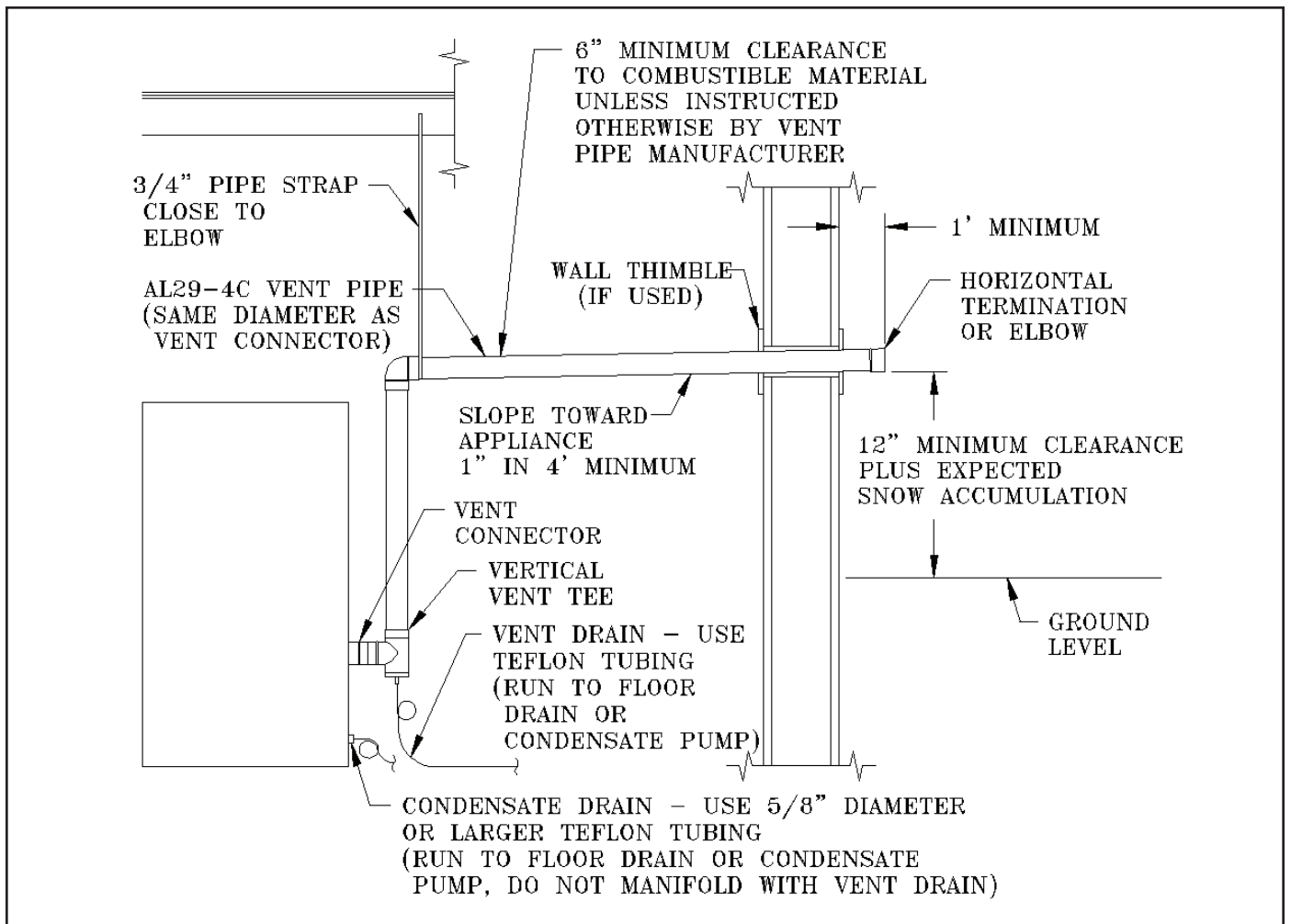
## CAUTION

**Moisture and ice may form on surfaces around vent termination. To prevent deterioration, surfaces should be in good repair (sealed, painted, etc.)**

3. **Sidewall and Vertical Venting** (positive pressure stack) - See Figures 2, 3 and 4.
- The maximum vent length is 50 equivalent feet. The vent length is equal to the total length of straight pipe plus the equivalent length of all the vent fittings. Consult the vent pipe manufacturer for equivalent length of fittings. Consult factory for lengths in excess of 50 feet.
  - It is permissible to run vent pipe through a vertical or horizontal chase provided minimum clearance to combustibles are maintained.
  - Horizontal vent pipe must slope no less than one (1) inch in four (4) feet of run. For sidewall venting, slope pipe toward vent termination if possible.
  - The vent termination location is restricted as follows:
    - Minimum twelve (12) inches above grade plus normally expected snow accumulation or seven (7) feet above grade if located adjacent to public walkways. **DO NOT INSTALL** over public walkway where local experience indicates condensation or vapor from the boiler creates a nuisance or hazard.
    - Minimum three (3) feet above any forced air inlet located within ten (10) feet of the vent termination.
    - Minimum four (4) feet below, four (4) feet horizontally or one (1) foot above any door, window or gravity air inlet.
    - Minimum four (4) feet horizontally from electric meters, gas meters, regulators and relief valves. This distance may be reduced if equipment is protected from damage due to condensation or vapor by enclosure, overhangs, etc.
    - Minimum twelve (12) inches from corners of building.



**Figure 2: Sidewall Pressurized Venting**



**Figure 3: Sidewall Pressurized Venting (Optional)**

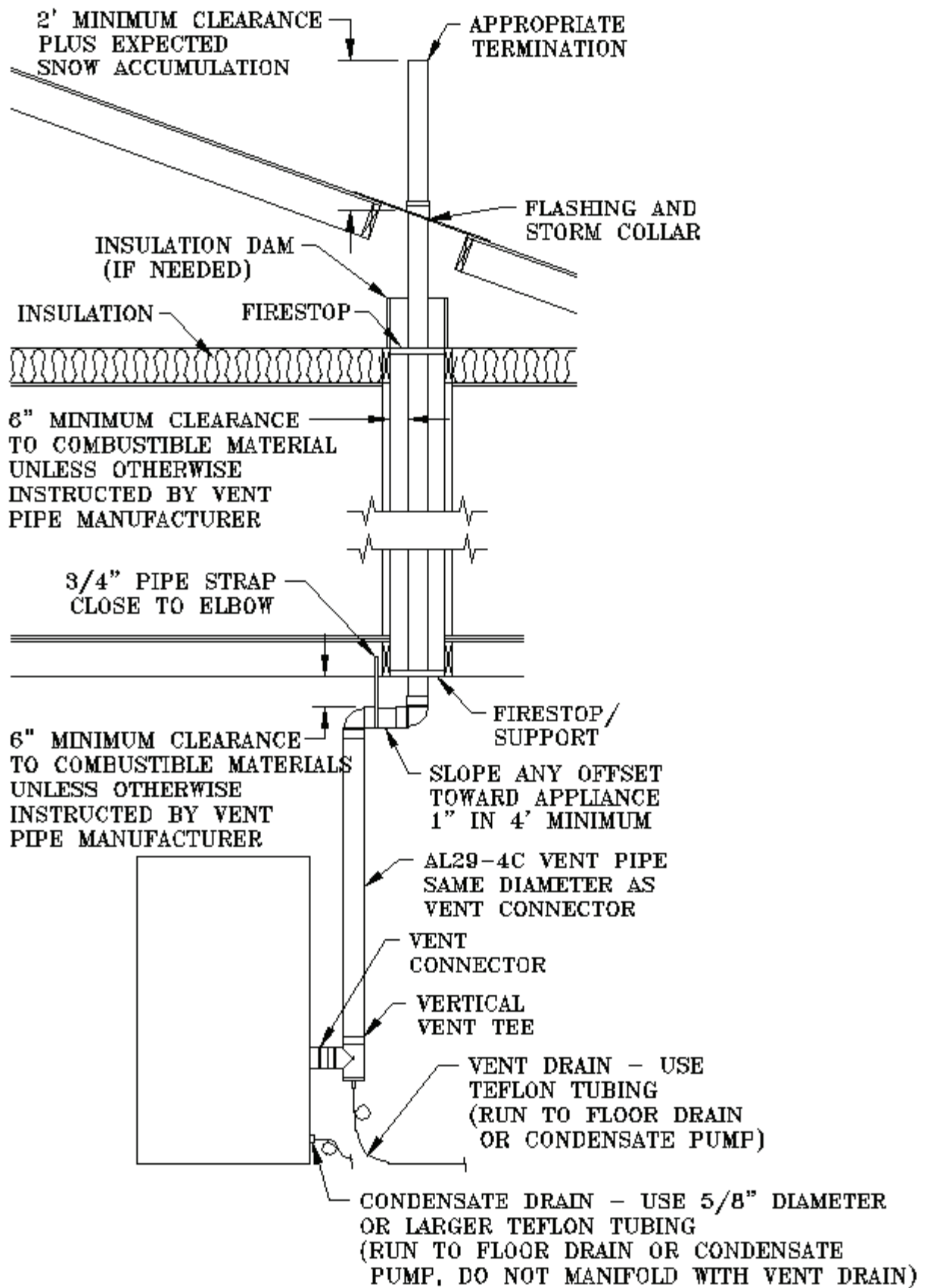
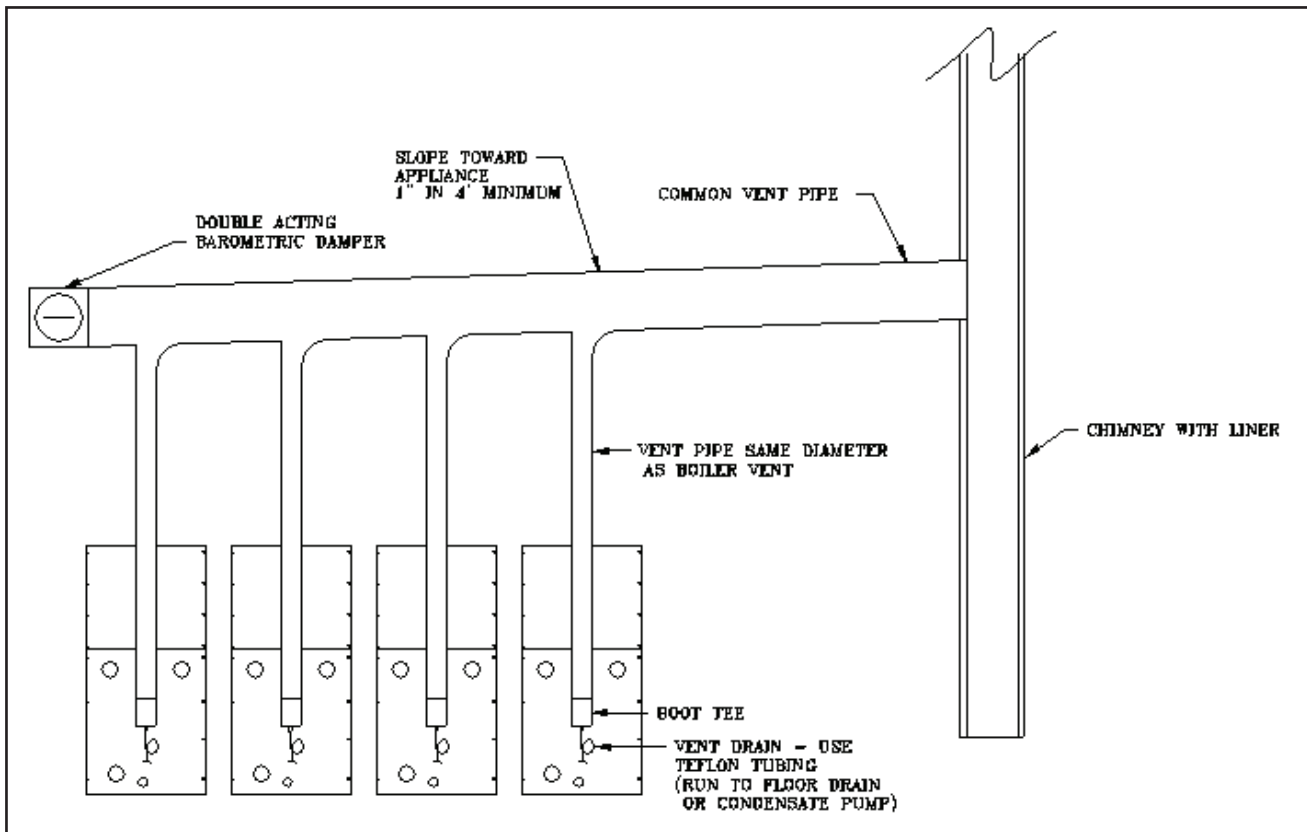


Figure 4: Vertical Pressurized Venting

- e. Use appropriately designed thimbles when passing through combustible walls or roofs.
  - f. Install firestops where vent passes through floors, ceilings or framed walls. The firestop must close the opening between the vent pipe and the structure.
  - g. Enclose vent passing through occupied or unoccupied spaces above the boiler with materials having a fire resistance rating at least equal to the rating of the adjoining floor or ceiling. Maintain minimum clearance to combustible materials.
  - h. Locate vent terminal above combustion air intake terminal (if used) and no closer than one (1) foot horizontally.
  - i. Install vent terminal and work towards the boiler.
  - j. Vertical venting requires flashing and a storm collar to prevent moisture from entering the structure.
  - k. Vertical vent termination must be at least two (2) feet plus the expected snow accumulation above roof penetration height.
4. **Conventional Venting** (Negative Draft) - See Figure 5.
- a. The minimum chimney height is 15 feet.
  - b. The chimney must be protected from down drafts, rain and debris by using a chimney cap or star.
  - c. Start installing vent at vent cap and continue installation toward the boiler.
  - d. The flue connector and chimney flue diameter may need to be increased or decreased depending on the dimensions of the boiler. Consult the National Fuel Gas Code or Local Codes for sizing. Boiler input, flue connector lateral distance and chimney height affect the flue connector or chimney flue diameters.
  - e. A double acting barometric damper with integral flue spillage interlock switch must be used when the boiler is vented conventionally.
  - f. The chimney and flue connector must be sized and configured to provide a minimum - 0.04 inch w.c. draft at the vent outlet of the boiler.
  - g. Maintain a minimum vertical pitch of one (1) inch in four (4) feet of vent connector run.



**Figure 5: Conventional Venting (Negative Draft)**

**B. COMBUSTION AIR** - See Figures 6 and 7.

1. The boiler may be operated with inside or outside air.
2. Refer to combustion air piping drawings in this section of this manual for proper outside air installation details.
3. Combustion air conduit can be galvanized smoke pipe, PVC, CPVC, or flexible aluminum conduit.
4. The maximum air inlet length is fifty (50) equivalent feet. Air inlet length is equal to the total length of straight pipe plus the equivalent length of fittings. Consult conduit manufacturer for equivalent length of fittings and pipe.  
Consult factory for inlet lengths in excess of 50 feet.
5. All joints and seams of the air intake pipe must be sealed using Silicone caulk, such as RTV 732 or equivalent.

8. The air intake pipe must be adequately supported with straps or supports no less than five (5) feet apart. The completed air intake pipe system must be rigid and able to withstand impacts without collapse.

**WARNING**

**Do not reduce size of air intake pipe.**

**Read, understand and follow combustion air instruction restrictions contained in the Pre-Installation instructions of this manual.**

6. Air intake termination must be located at least twelve (12) inches above grade plus the expected snow accumulation.
7. Boiler may be installed with vertical venting and sidewall combustion air inlet or visa versa.

**CAUTION**

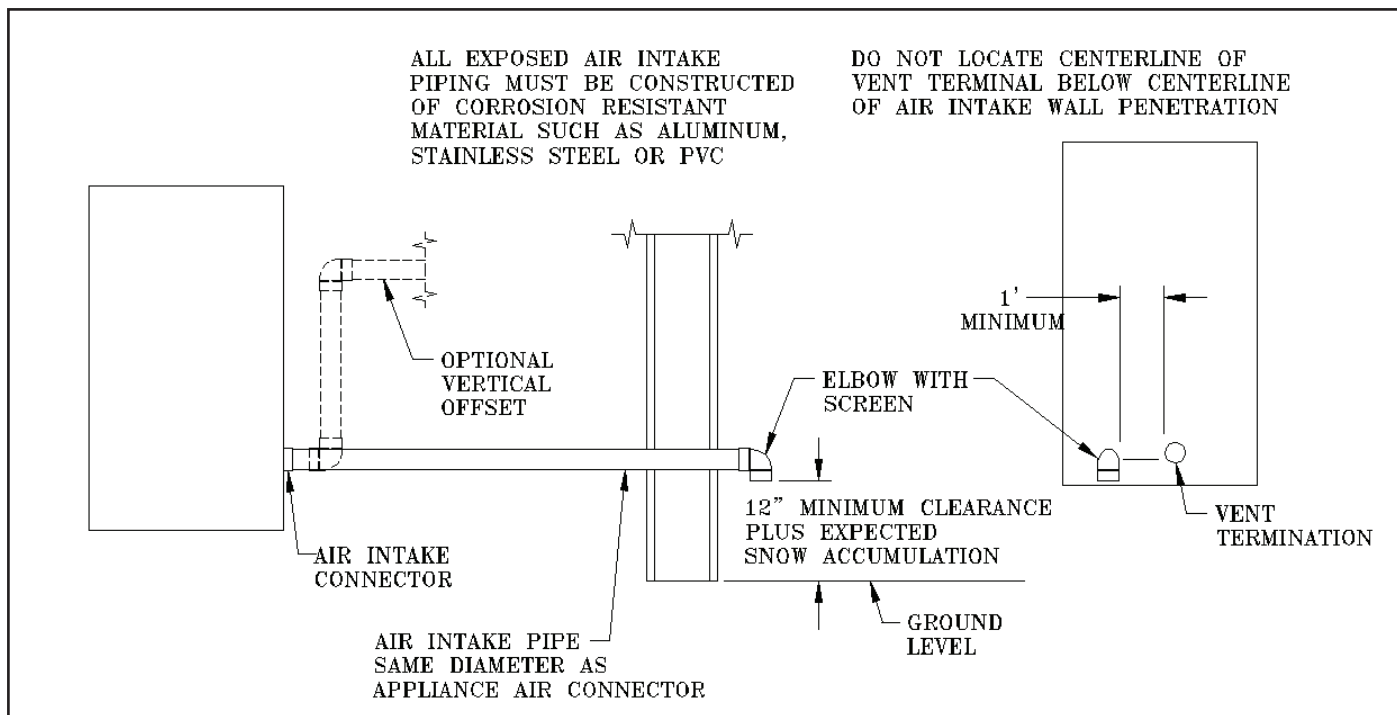
**Dirty, contaminated or dusty air used for combustion will decrease the useful life of the boiler air filter. Use outside air if inside air quality is questionable. Use outside air if the boiler is installed in manufacturing plants, laundries, dry cleaners or other locations with heavy particulates in the air.**

**WARNING**

**Do not locate air intake where petroleum distillates, CFC's, detergents, volatile vapors or any other chemicals are present. Severe boiler corrosion and failure will result. Thermal Solutions does not warrant failures caused by contaminated air.**

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**Do not locate air intake termination where natural convection or wind conditions may cause the boiler exhaust gases to be drawn into the air intake.**



**Figure 6: Horizontal Air Intake Piping**

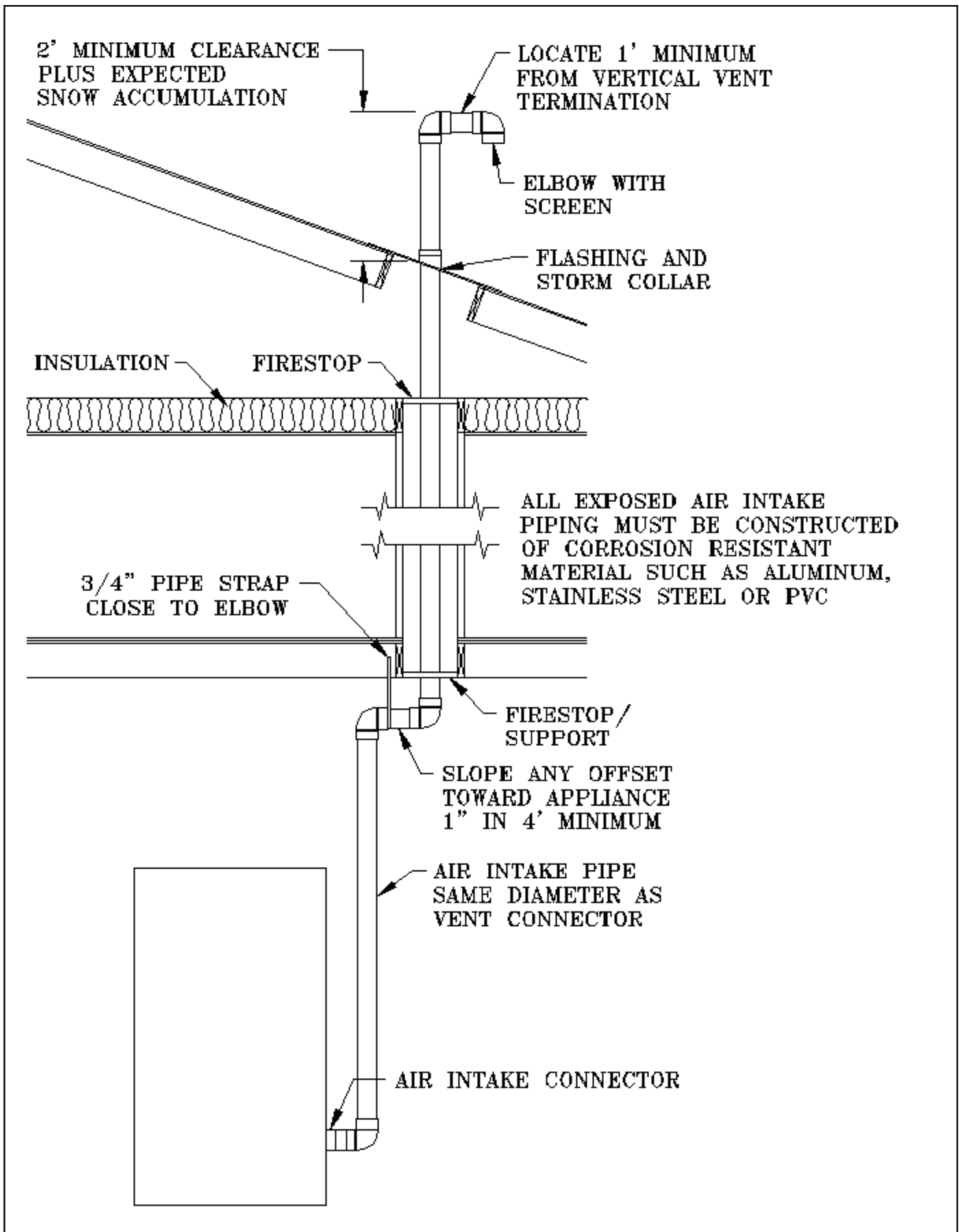


Figure 7: Vertical Air Intake Piping

### C. WATER PIPING AND TRIM

#### CAUTION

Failure to properly pipe boiler may result in improper operation and damage to boiler or structure.

#### CAUTION

Proper water treatment is required. The water shall have a maximum water hardness of 8.5 grains or 150 ppm. The recommended pH range is 8.8 to 9.2.

#### CAUTION

Oxygen contamination of boiler water will cause corrosion of iron and steel boiler components, and can lead to boiler failure. Thermal Solutions Standard Warranty does not cover problems caused by oxygen contamination of boiler water or scale (lime) build-up caused by frequent addition of water.

#### CAUTION

All piping either new or existing must be cleaned with a tri sodium phosphate (TSP) solution to remove mill scale and oils from the system. Failure to do so could result in premature failure of the heat exchanger (not covered by Thermal Solutions warranty).

#### CAUTION

On an existing or retrofit system, a filter or strainer must be installed on the system return prior to the boilers.

#### CAUTION

When using Glycol products, all Glycol manufactures' requirements, including rust inhibitors, must be adhered. Max 50% Glycol.

1. Design and install boiler and system piping to prevent oxygen contamination of boiler water and frequent water additions.
  - a. There are many possible causes of oxygen contamination such as:

- i. Addition of excessive make-up water as a result of system leaks.
    - ii. Absorption through open tanks and fittings.
    - iii. Oxygen permeable materials in the distribution system.
  - b. In order to insure long product life, oxygen sources must be eliminated. This can be accomplished by taking the following measures:
    - i. Repairing system leaks to eliminate the need for addition of make-up water.
    - ii. Eliminating and/or repairing fittings which allow oxygen absorption.
    - iii. Using of non-permeable materials in the distribution system.
    - iv. Isolating the boiler from the system water by installing a heat exchanger.
    - vi. Using properly designed and operating air elimination devices in water piping.
2. Design and install system piping to prevent return water temperatures below 120°F. Refer to Table 1 for boiler flow and pressure drop requirements.
3. Connect system supply and return piping to boiler. Refer to Figure 8. Also consult I=B=R Installation and Piping Guides. Maintain 1/2" minimum distance between water piping and combustible material. Consult Thermal Solutions for unusual system requirements.

#### CAUTION

Return water temperature below 120°F will cause flue gas condensation inside the boiler. Flue gas condensate can lead to boiler failure. Thermal Solutions Standard Warranty does not cover problems caused by flue gas condensation.

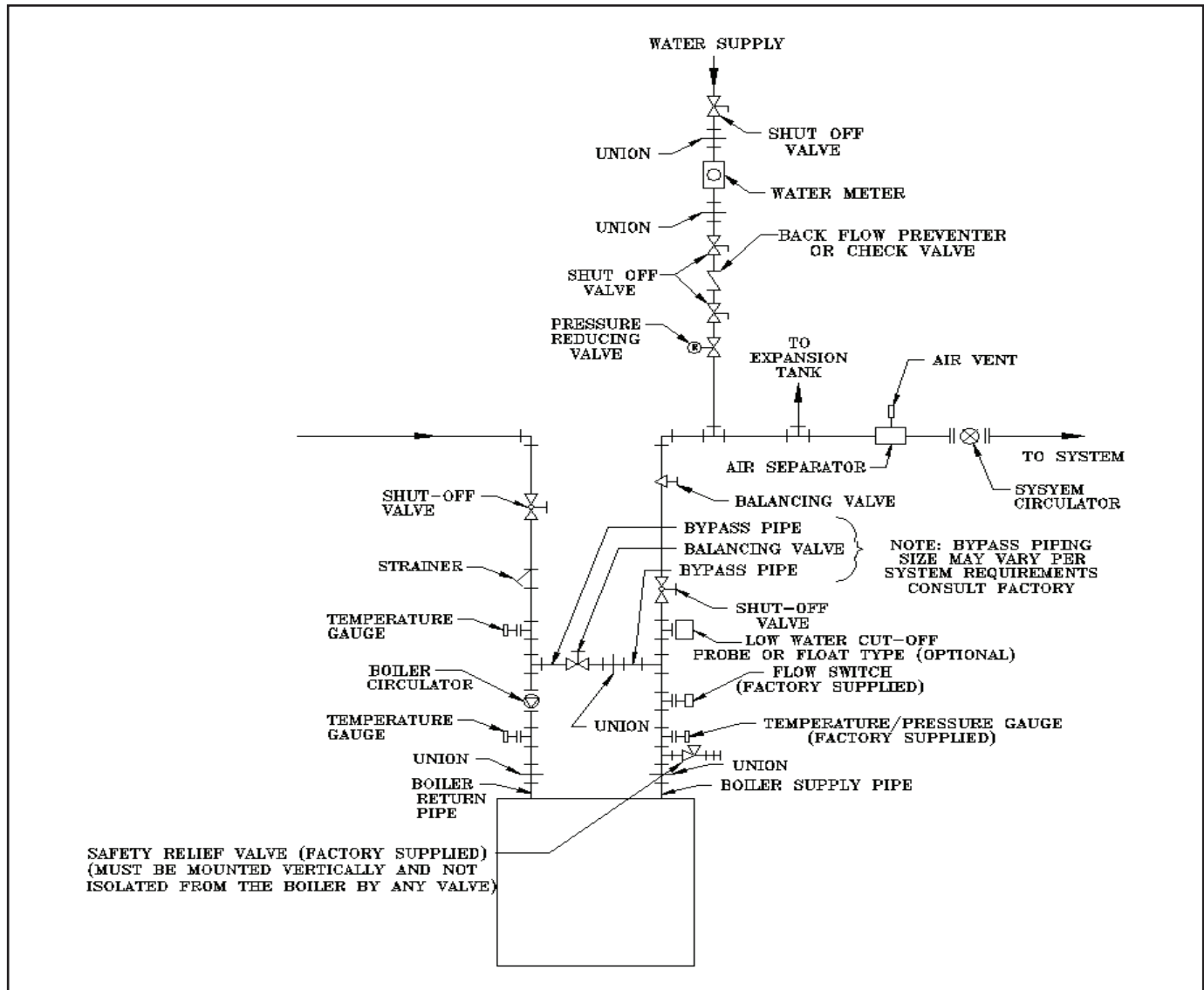
#### WARNING

Supply and return water temperature differences greater than 40°F at high fire can lead to boiler failure. Thermal Solutions Standard Warranty does not cover problems caused by temperature difference greater than 40°F at high fire.



**TABLE 1 - EVA BOILER FLOW AND PRESSURE DROP**

BOILER MODEL	20°ΔT (at high fire)		40°ΔT (at high fire)		Minimum Flow Rate (gpm)	Maximum Flow Rate (gpm)	Supply/Return Pipe (inch dia.)
	ΔP (Ft.)	Flow (GPM)	ΔP (Ft.)	Flow (GPM)			
EVA-250	0.73	22	0.19	11	11	22	2
EVA-500	2.93	44	0.74	22	22	44	2
EVA-750	1.81	66	0.46	33	33	66	3
EVA-1000	3.24	88	0.81	44	44	88	3
EVA-1500	7.37	132	1.85	66	66	132	3
EVA-2000	13.27	176	3.32	88	88	176	3
EVA-2000S	4.27	172	1.36	86	86	172	4
EVA-2500	4.34	215	1.43	108	108	215	4
EVA-3000	4.41	258	1.73	129	129	258	4



**Figure 8: Water Piping (Single Boiler)**

4. Install drain valve in fitting provided at bottom rear of the boiler.
5. If this boiler is used in connection with refrigeration systems, the boiler must be installed so that the chilled medium is piped in parallel with the boiler using appropriate valves to prevent the chilled medium from entering the boiler. Also consult I=B=R Installation and Piping Guides. If this boiler is connected to heating coils located in air handling units where they may be exposed to refrigerated air, the boiler piping must be equipped with flow control valves to prevent gravity circulation of boiler water during operation of the cooling system.
6. Install optional low water cut-off such as McDonnell & Miller Model PS851-M-120 or equal in system

## WARNING

**Do not install valves, plugs or caps in safety relief valve piping.**

**Safety relief valve piping must be terminated such that in the event the safety relief valve opens, the discharge will not cause personal injury or damage.**

7. There must be a minimum of five pipe diameters of straight horizontal run downstream of the flow switch. Otherwise, premature failure of flow switch paddle may occur. See flow switch instruction manual (MM-601) included with boiler.

## WARNING

**Failure to operate the unit with the proper water flow rate can lead to appliance failure. Always verify proper water flow switch operation so that the unit stops operating if improper water flow is present.**

## WARNING

**Failure to operate the unit with the proper water flow rate can lead to appliance failure. Always install water flow switch so that the unit stops operating if improper water flow is present.**

**Safety relief valve discharge piping must be piped such that the potential of severe burns is eliminated. DO NOT pipe in any area where freezing could occur. DO NOT install any shut-off valves, plugs or caps. Consult Local Codes for proper discharge piping arrangement.**

**Do not operate boiler with flow rates in excess of the maximum flow rates listed in Table 3. Boiler tube erosion and pitting will occur. Thermal Solutions Standard Warranty does not cover problems caused by excessive water flow rates.**

**If a high head system pump is installed, assure that the boiler relief valve and system piping are capable of operating properly at the combined pressure of the system fill pressure plus the pump static head pressure.**

## D. GAS PIPING

### WARNING

**Failure to properly pipe gas supply to boiler may result in improper operation and damage to the boiler or structure. Always assure gas piping is absolutely leak free and of the proper size and type for the connected load.**

**An additional gas pressure regulator may be needed. Consult gas supplier.**

1. Size gas piping. Design system to provide adequate gas supply to boiler. Consider these factors.
  - a. Allowable pressure drop from point of delivery to boiler. Refer to Table 2 for minimum and maximum boiler gas train inlet pressure. If gas supply pressure is higher than maximum as listed in Table 2, an additional field supplied pressure regulator will be required.
  - b. Maximum gas demand. Table 7 lists boiler input rate. Also consider existing and expected future gas utilization equipment (i.e., water heater, cooking equipment).
  - c. Length of piping and number of fittings. Refer to Table 3 for maximum capacity of schedule 40 pipe. Table 6 lists equivalent pipe length for standard fittings. Table 4 lists correction factors for pressure drops other than 0.3 in w.c.
  - d. Specific Gravity of Gas. Gas piping systems for gas with a specific gravity of 0.70 or less can be sized directly from Table 3 unless an authority having jurisdiction, specifies a specific gravity factor be applied. For specific gravity greater than 0.70, apply gravity factor from Table 5. If exact specific gravity is not shown choose next higher value.

For gas piping material other than schedule 40 pipe, refer to National Fuel Gas Code, NFPA 54/ANSI Z223.1 and/or CAN/CGA B149 Installation Codes.

### WARNING

**Failure to use proper thread compounds on all gas connectors may result in leaks of flammable gas.**

2. If step down regulator is required, it must be used in conjunction with the factory supplied regulator and be located as far away from the boiler as possible to prevent nuisance shutdowns.
3. Install field supplied sediment trap, ground-joint union and manual non-displacable shut-off valve upstream of factory supplied shut-off valve outside the boiler jacket. Use methods and materials in accordance with Local Codes and requirements of gas supplier. In absence of such requirements, follow National Fuel Gas Code, NFPA 54/ANSI Z223.1 and/or CAN/CGA B149 Installation Codes.
4. Use thread joint compound resistant to the action of liquefied petroleum gas.
5. All above ground gas piping upstream from field supplied manual gas valve must be electrically continuous and bonded to a grounding electrode. Do not use gas piping as grounding electrode. Refer to National Electrical Code, ANSI/NFPA 70 and /or CSA C22.1 Electrical Codes.

### WARNING

**Gas supply to boiler and system must be absolutely shut off prior to installing or servicing boiler gas piping.**

**Table 2 - Boiler Gas Train Inlet Pressure**

BOILER MODEL	ON/OFF		2-STAGE		MODULATION	
	MIN ("w.c.)	MAX ("w.c.)	MIN ("w.c.)	MAX (psig)	MIN ("w.c.)	MAX (psig)
EVA-250	5.0	14.0	N/A	N/A	4.0	5 psi
EVA-500	5.0	14.0	N/A	N/A	5.0	5 psi
EVA-750	5.0	14.0	7.0	5 psi	7.0	5 psi
EVA-1000	6.0	14.0	7.0	5 psi	7.0	5 psi
EVA-1500	6.0	14.0	7.0	5 psi	7.0	5 psi
EVA-2000	7.5	14.0	9.0	5 psi	9.0	5 psi
EVA-2000S	N/A	N/A	N/A	N/A	7.0	5 psi
EVA-2500	N/A	N/A	N/A	N/A	6.0	5 psi
EVA-3000	N/A	N/A	N/A	N/A	6.0	5 psi

\* Available with optional gas train with min 4" w.c. inlet gas pressure.

6. Pressure test. The boiler and its gas connection must be leak tested before placing boiler in operation.
- a. Protect boiler gas control valve. For all testing over ½ psig, boiler and its individual shutoff valve must be disconnected from gas supply piping. For testing at ½ psig or less, isolate boiler from gas supply piping by closing boiler's individual manual shutoff valve.

- b. Locate leaks using approved combustible gas detector, soap and water, or similar nonflammable solution.

**DANGER**

**Do not use matches, candles, open flames or other ignition source to check for leaks.**

**TABLE 3: MAXIMUM GAS CAPACITY OF SCHEDULE 40 PIPE.**  
(Based on pressure drop of 0.3in. w.c. and 0.6 specific gravity)  
Nominal schedule 40 pipe size inch.

Pipe Length in Equivalent Feet	NOMINAL IRON PIPE SIZE IPS INCHES							
	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4
10	278	520	1050	1600	3050	4800	8500	17500
20	190	350	730	1100	2100	3300	5900	12000
30	152	285	590	890	1650	2700	4700	9700
40	130	245	500	760	1450	2300	4100	8300
50	115	215	440	670	1270	2000	3600	7400
60	105	195	400	610	1150	1850	3250	6800
70	96	180	370	560	1050	1700	3000	6200
80	90	170	350	530	990	1600	2800	5800
90	84	160	320	490	930	1500	2600	5400
100	79	150	305	460	870	1400	2500	5100
125	72	130	275	410	780	1250	2200	4500
150	64	120	250	380	710	1130	2000	4100
175	59	110	225	350	650	1050	1850	3800
200	55	100	210	320	610	980	1700	3500

**TABLE 4 - CORRECTION FACTORS FOR GAS PIPE PRESSURE DROP OTHER THAN 0.3 IN W.C.**

Pressure Drop	Correction Factor
0.1	0.577
0.2	0.815
0.3	1.00
0.5	1.29
1.0	1.83

**TABLE 5 - SPECIFIC GRAVITY CORRECTION FACTORS**

Specific Gravity	Correction Factor	Specific Gravity	Correction Factor
0.50	1.10	1.30	1.07
0.55	1.04	1.40	1.04
0.60	1.00	1.50	1.00
0.65	0.96	1.60	0.97
0.70	0.93	1.70	0.94
0.75	0.90		
0.80	0.87		

**TABLE 6 - EQUIVALENT OF STANDARD PIPE FITTING & VALVES**

**VALVES FULLY OPEN**

Pipe Size	I.D. Inches	Gate	Globe	Angle	Swing Check	90° Elbow	45° Elbow	90° Tee, Flow through Run	90° Tee, Flow through Branch
1/2"	0.622	0.35	18.6	9.3	4.3	1.6	0.78	1.0	3.1
3/4"	0.824	0.44	23.1	11.5	5.3	2.1	0.97	1.4	4.1
1"	1.049	0.56	29.4	14.7	6.8	2.6	1.23	1.8	5.3
1-1/4"	1.380	0.74	38.6	19.3	8.9	3.5	1.6	2.3	6.9
1-1/2"	1.610	0.83	45.2	22.6	10.4	4.0	1.9	2.7	8.0
2"	2.067	1.10	58	29	13.4	5.2	2.4	3.5	10.4
2-1/2"	2.469	1.32	69	35	15.9	6.2	2.9	4.1	12.4
3"	3.068	1.60	86	43	19.8	7.7	3.6	5.1	15.3
4"	4.026	2.1	112	56	26.8	10.1	5.4	6.7	20.1
6"	6.065	2.6	140	70	40.4	15.2	8.1	10.1	30.3

Equivalent lengths are for standard screwed fittings and for screwed, flanged, or welded valves relative to schedule 40 steel pipe.

**WARNING**

Table 7 lists gas inputs at sea level to 2000 feet altitude. Reduce gas input four percent (4%) for each additional 1000 feet above sea level.

**TABLE 7: RATED INPUT**

Boiler Model	Rated Capacity (CFH)		Gas Connection Size (inc dia.)
	Natural	LP/Propane	
EVA-250	250	100	1
EVA-500	500	200	1-1/4
EVA-750	750	300	1-1/2
EVA-1000	1000	400	1-1/2
EVA-1500	1500	600	1-1/2
EVA-2000	2000	800	1-1/2
EVA-2000S	2000	800	1-1/2
EVA-2500	2500	1000	2
EVA-3000	3000	1200	2

## E. ELECTRICAL

1. General. Install wiring and ground boiler in accordance with authority having jurisdiction or in absence of such requirements National Electrical Code, ANSI/NFPA 70 and/or CSA C22.1 Electrical Code.

### WARNING

**Failure to properly wire electrical connections to the boiler may result in serious physical harm. DO NOT ATTACH ADDITIONAL J-Box to back or top of boiler jacket.**

### DANGER

**Positively assure all electrical connections are unpowered before attempting installation or service of electrical components or connections of the boiler or building. Lock out all electrical boxes with padlock once power is turned off.**

2. Connect the main power supply and ground from fused disconnect to proper boiler electrical leads located in the junction box at the rear of the boiler. Refer to electrical consumption plate on boiler jacket.
3. Remove factory supplied jumper wire from terminals 4 and 5. Connect field supplied safety limits or devices (low water cut-off, temperature limit etc.) in series using proper terminals provided in boiler electrical cabinet. Refer to wiring diagram supplied with boiler for wiring information. Refer to Figures 9a, 9b, and 9c, for typical wiring diagrams. Refer to Figure 1, for electrical requirements for

### CAUTION

**Each boiler must be protected with a dedicated properly sized fused disconnect.**

### WARNING

**Electrical power may be supplied from more than one service. Make sure all power is off before attempting any electrical work.**

### WARNING

**The wiring diagrams contained in this manual are for reference purposes only. Each boiler may be wired differently according to the specifications given to Thermal Solutions at the time the boiler was purchased. Always use the wiring diagram provided with the boiler. If the wiring diagram provided with the boiler is unavailable, STOP all wiring work and contact Thermal Solutions for a replacement diagram.**

### WARNING

**Do not directly connect low voltage (24 volt, milliamp etc.) controls to this boiler. If low voltage controls are desired, isolating relays must be used.**

### WARNING

**Never jump out any safety controls.**

5. Following pages have sample wiring diagrams. Contact Thermal Solutions Representative or visit website ([www.thermalsolutions.com](http://www.thermalsolutions.com)) for current wiring options.
6. An as-built wiring diagram is included with every boiler when it ships.

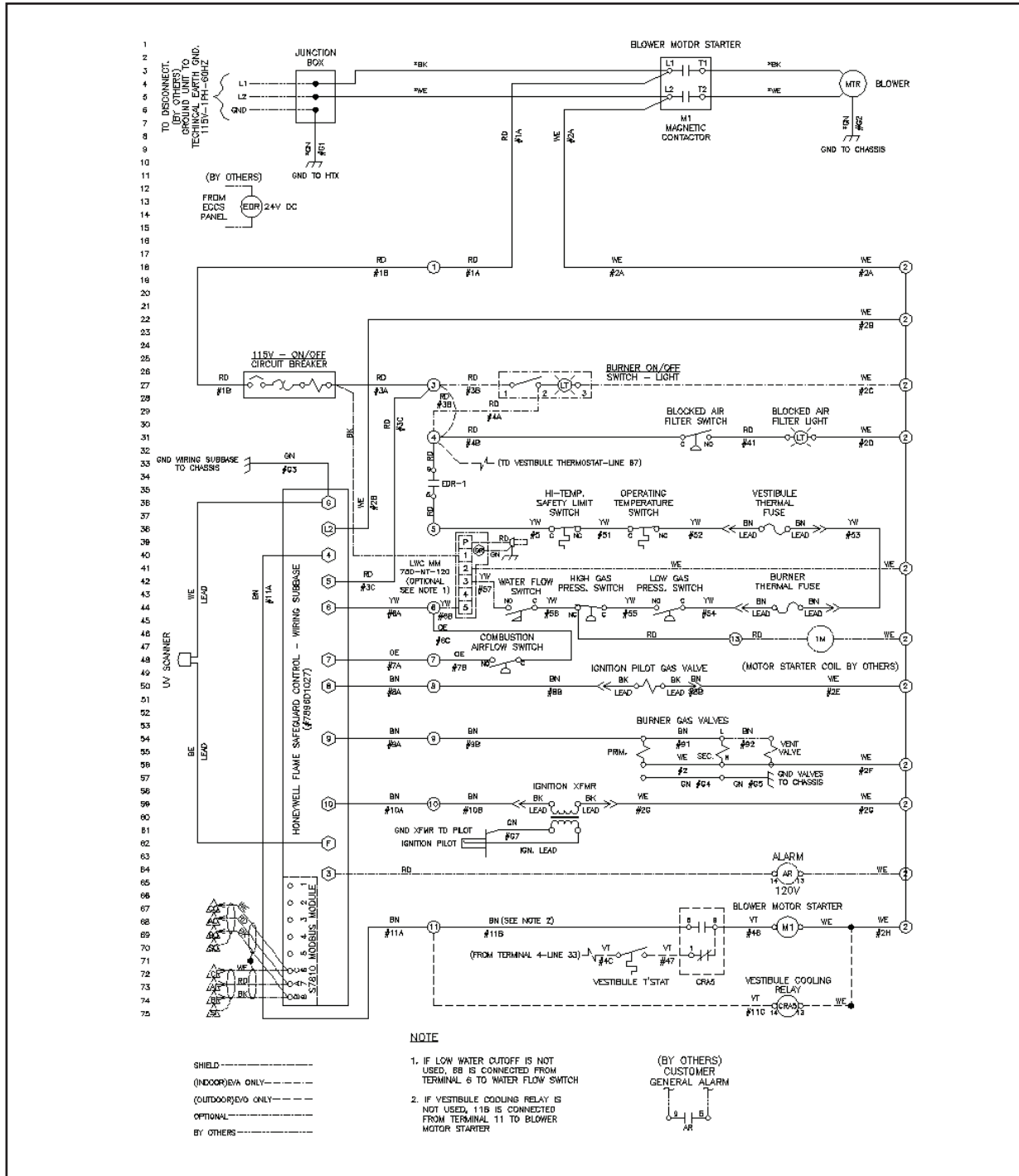


Figure 9a: Standard UL/FM/CSD-1 Wiring Diagram (On/Off)

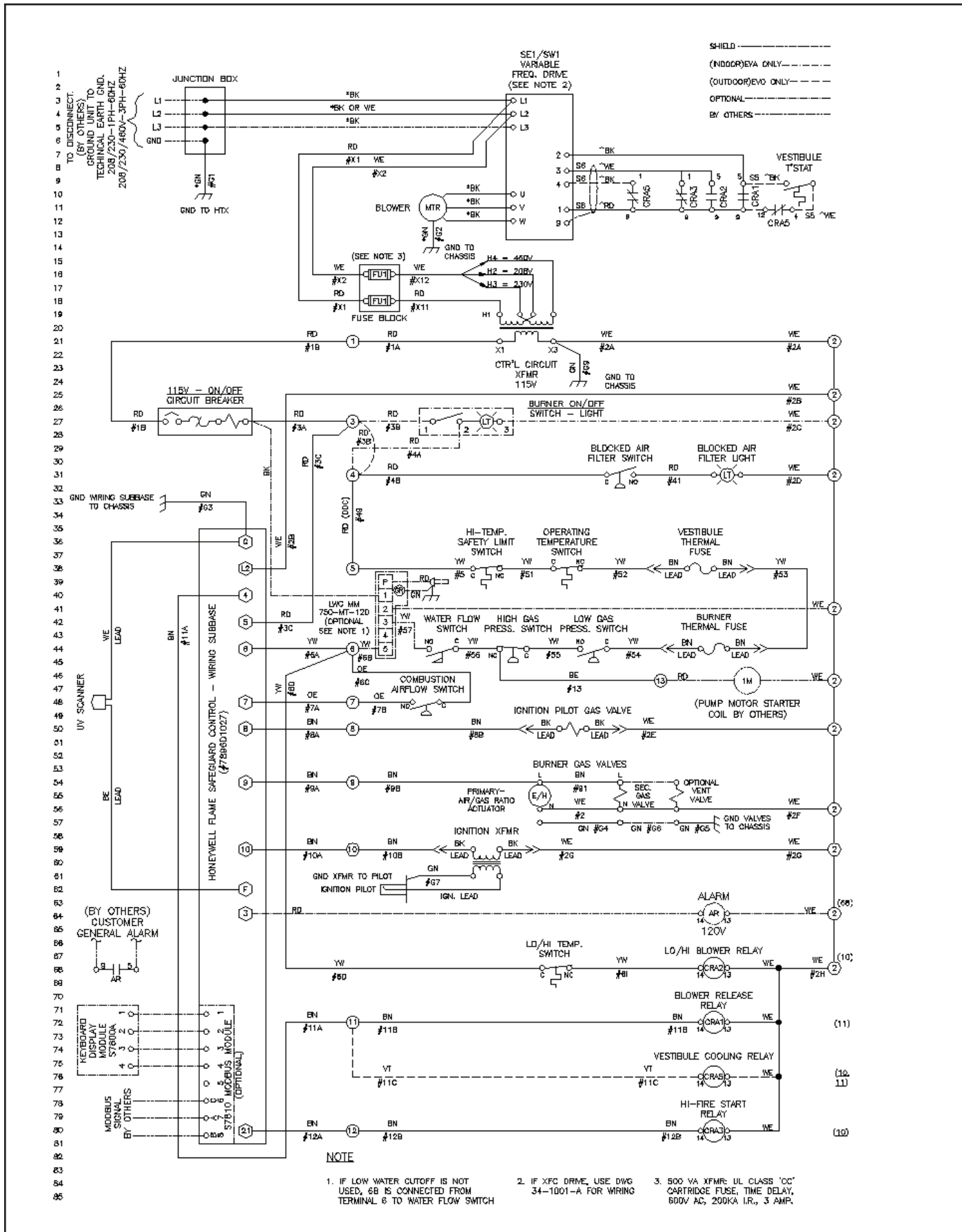
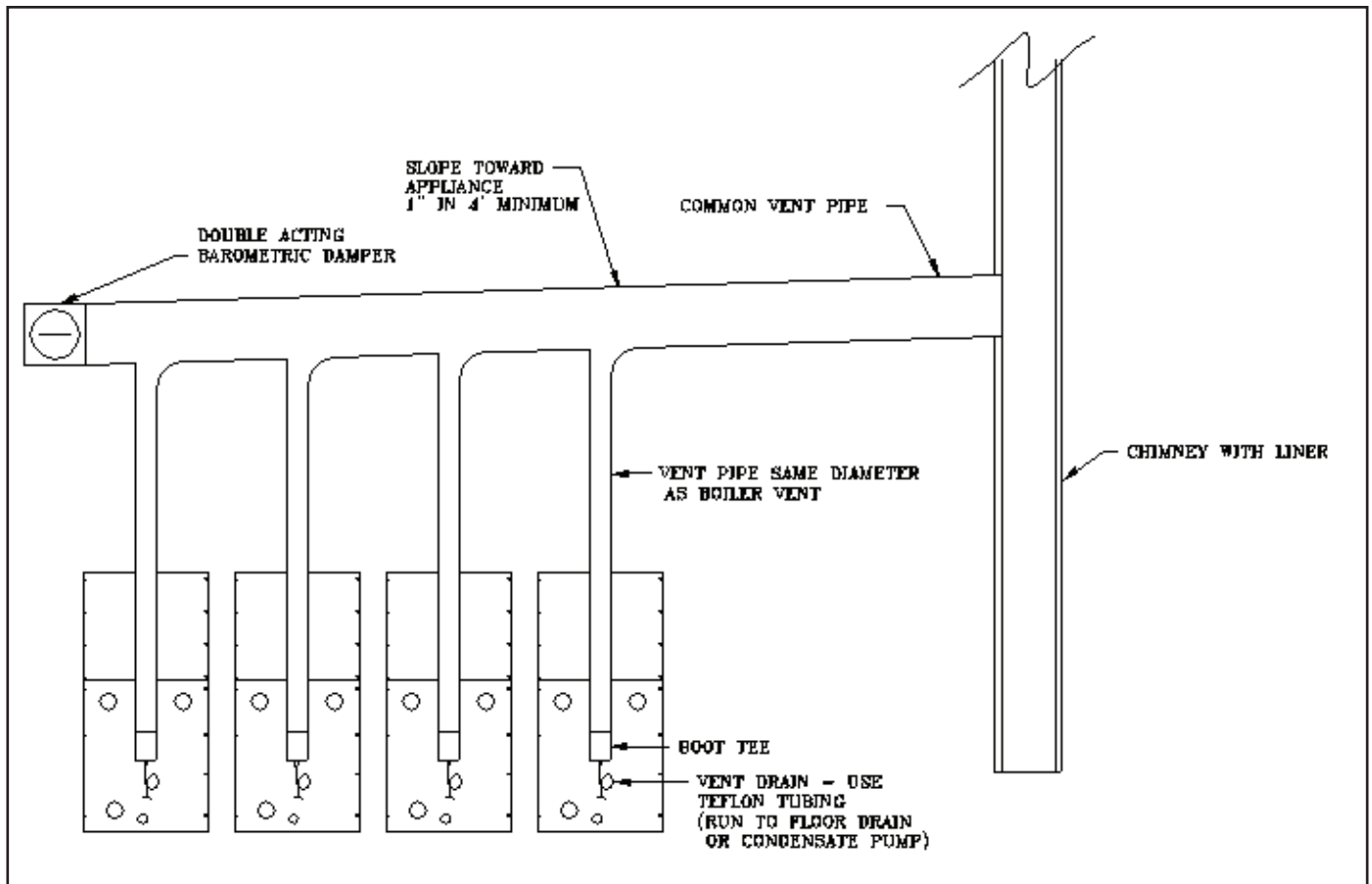


Figure 9b: Standard UL/FM/CSD-1 Wiring Diagram (2-Stage)







**Figure 10: Modular System: Conventional Venting (negative draft)**

## F. MODULAR SYSTEMS

### 1. General Guidelines

- a. Read and follow all venting, combustion air, water piping, gas piping and electrical instructions contained in this manual unless otherwise instructed in this section.
- b. Modular systems are complex. Design and installation of modular systems should only be undertaken by skilled and knowledgeable engineers and contractors.
- c. Consult Local Building Codes, National Fuel Gas Code, or NFPA 54/ANSI Z222.3 for restrictions and instructions on modular boiler

### 2. Module Sizing

- a. Consult factory for recommended number and size of boilers for a given input.

### 3. Venting

- a. Sidewall/Vertical Venting(positive pressure stack)
  - i. Refer to Figures 2 and 3 for sidewall venting guidelines for venting of modular boiler individually.
  - ii. Refer to Figure 4 for vertical venting guidelines for venting of modular boilers individually.

## WARNING

**DO NOT manifold vent components of boiler without converting to negative draft.**

- iii. The maximum vent length for each boiler is fifty (50) equivalent feet. (Note: Consult factory for lengths in excess of 50 feet)
- iv. Each boiler requires an individual vent pipe.
- v. The minimum horizontal distance between vent terminations is one (1) foot. Additional horizontal distance is desirable to avoid frost damage to the building. Vent terminations must be at least twelve (12) inches above the ground plus the expected snow accumulation.
- vi. Multiple vertical vent pipes may be piped through a common vertical conduit so that one roof penetration may be made. Each vent termination must be one (1) foot from other terminations. A minimum of at least six (6) inches from the common conduit to combustible material must be maintained unless otherwise instructed by the conduit manufacturer.

## CAUTION

**Installing multiple vent terminations close together promotes frost build up on buildings. To minimize this possibility, extend the distance from the building to the end of the vent termination and increase the horizontal distance between vent terminations.**

- b. Conventional Venting (Negative Draft)
  - i. Refer to Figure 10 for conventional venting guideline for modular boilers.
  - ii. Use only AL29-4C or 316 L and 304 L stainless steel vent components.
  - iii. Refer to National Fuel Gas Code to determine required chimney diameter and common venting diameter. Note that combined input, lateral length and chimney height affect vent diameter.
  - iv. A single double acting barometric damper can be utilized on the common venting when venting according to Figure 10.
  - v. Slope common venting a minimum of one (1) inch in four feet of run towards boilers.
  - vi. Locate boiler(s) with lowest input closest to chimney.

#### 4. Air Intake Piping

- a. Consult factory for common air intake pipe sizing.
- b. Refer to Figures 11 and 12 for common air intake guidelines for modular boilers.
- c. Individual air intake pipes may be used in lieu of common air intake piping.
- d. The maximum air intake length is fifty (50) equivalent feet. Common air intake straight lengths and fittings should be assumed to have the equivalent length the same as an individual air intake pipe, used for a given boiler intake pipe diameter. (Note: Consult factory for lengths in excess of 50 feet)
- e. Position horizontal air intake termination center line below horizontal vent termination's center line.
- f. Vertical air intake pipe must terminate at least

## NOTICE

**Consult factory for common air intake sizing.**

#### 5. Water Piping

- a. Refer to Figures 13 thru 18 for typical water piping for modular boilers.
- b. Installing a low water cut-off in the system piping is highly recommended and may be required by Code.
- c. Refer to Table 1 for pressure drop and flow requirements for each boiler.

#### 6. Gas Piping

- a. Refer to National Fuel Gas Code, Local Codes and Tables 2 through 7 for gas pipe sizing.

## CAUTION

**Proper water treatment is required. The water shall have a maximum water hardness of 8.5 grains or 150 ppm. The recommended pH range is 8.8 to 9.2.**

## NOTICE

**The pressure drop given in Table 1 is for the boiler only. The pressure drop of each system fitting and component must be added to the boiler pressure drop to determine the system pressure head requirement. See Table 6 for fitting and component equivalent lengths.**

## WARNING

**If gas pressure in the building is above ½psig, for ON/OFF boilers, an additional gas pressure regulator is required. Use an additional gas pressure regulator for 2 Stage & modulating boilers, where the gas pressure is greater than 5 psig. Using one additional regulator for multiple boilers may result in unsafe boiler operation. The additional regulator must be able to properly regulate gas pressure flow at the lowest input of a single boiler. If the regulator cannot do this, two or more additional regulators are required. Consult regulator manufacturer's instructions for minimum gas flow rate.**

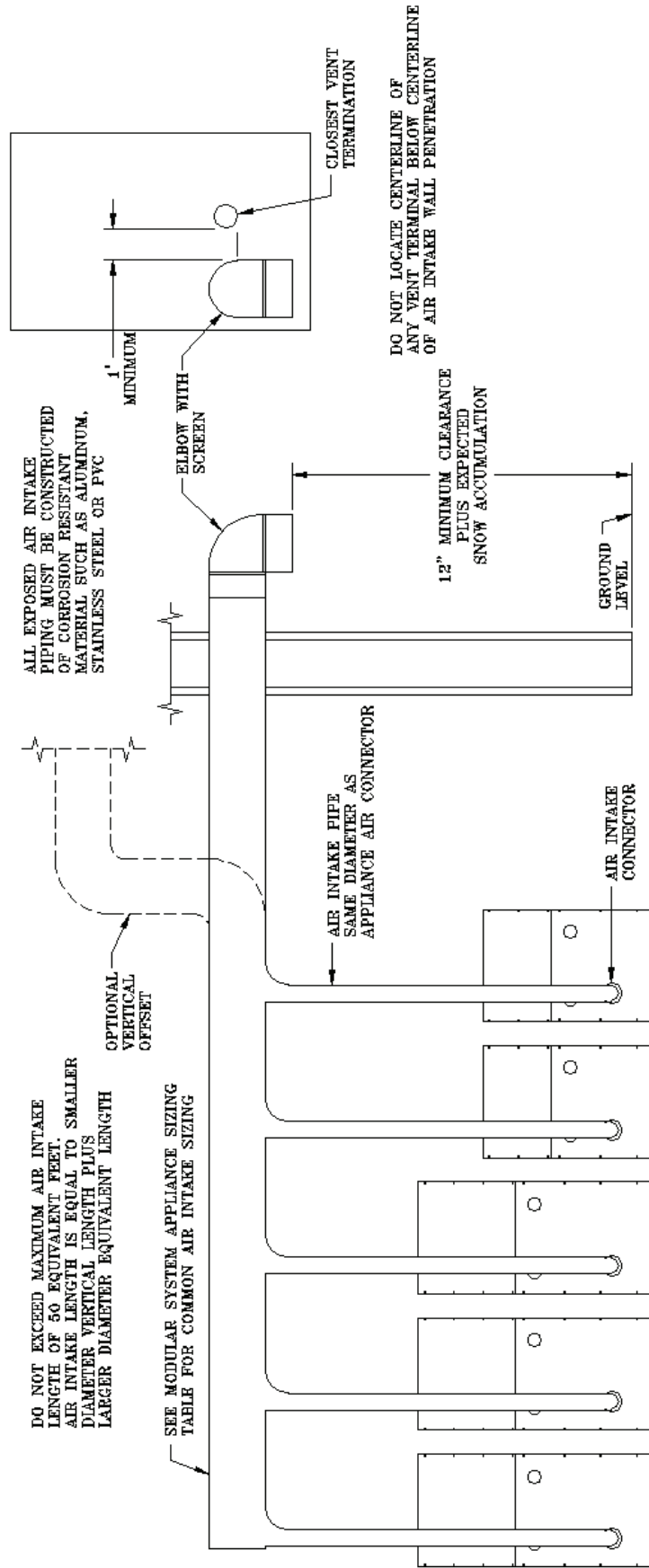


Figure 11: Modular System Horizontal Air Intake Piping

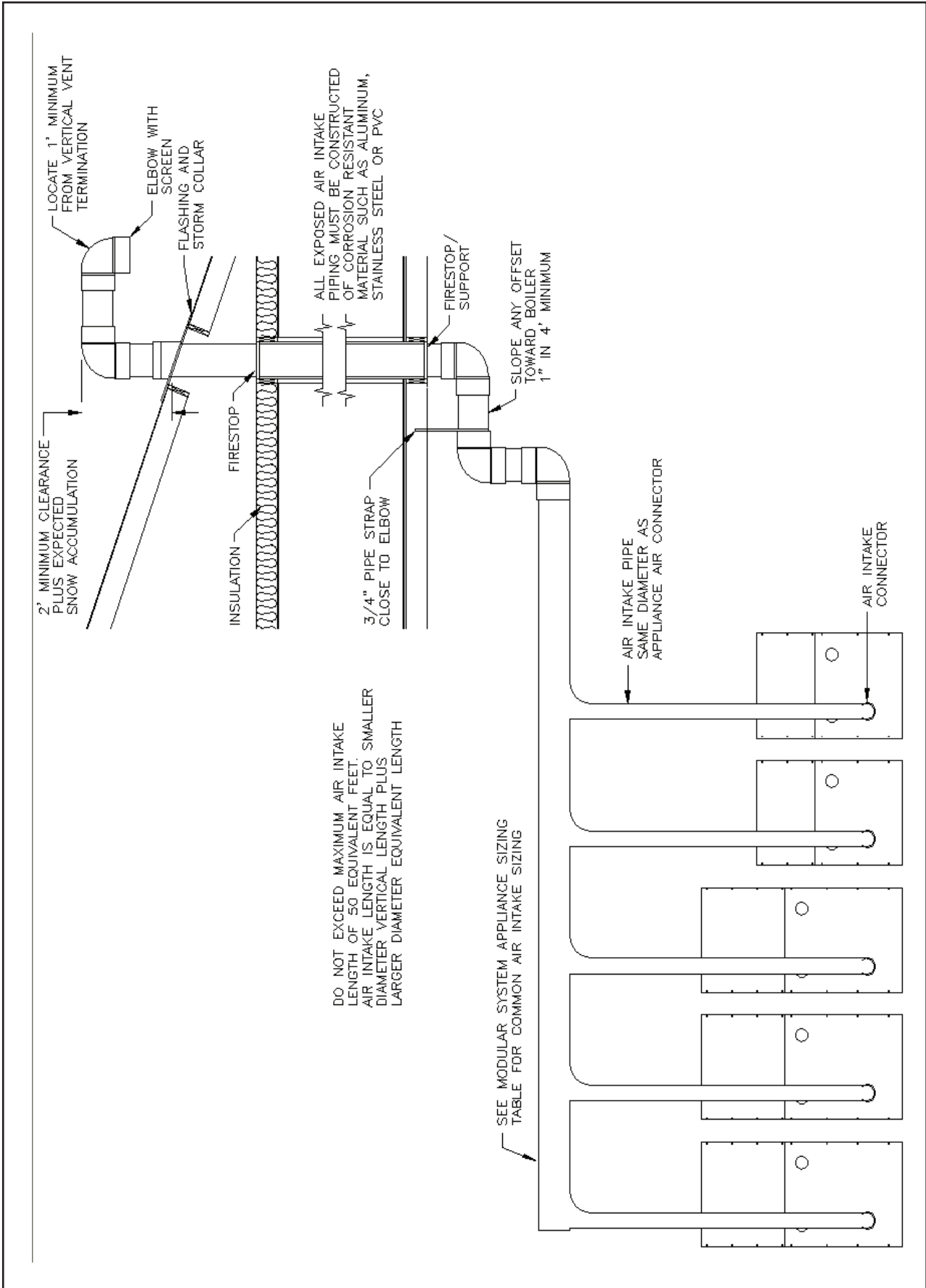
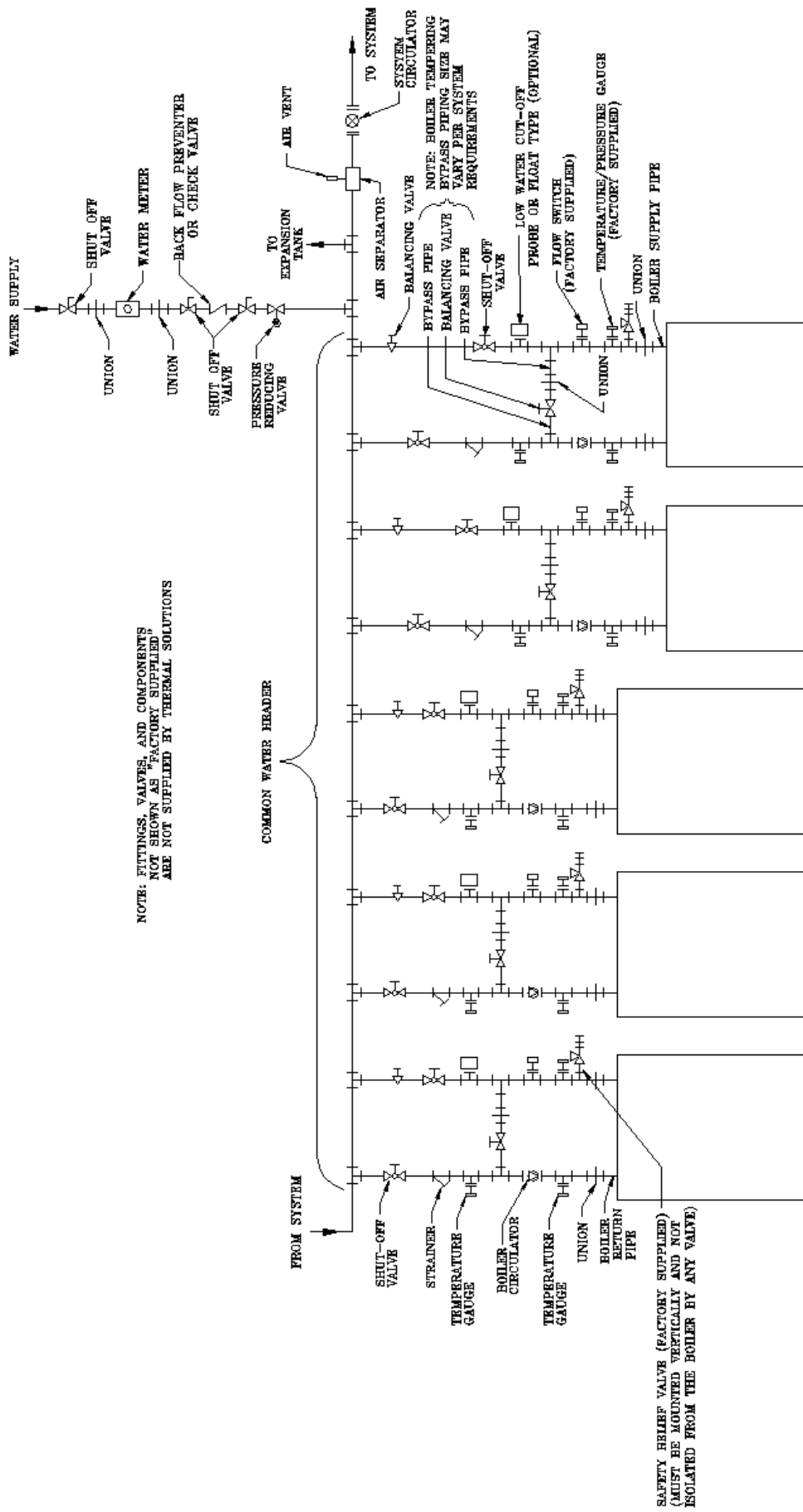
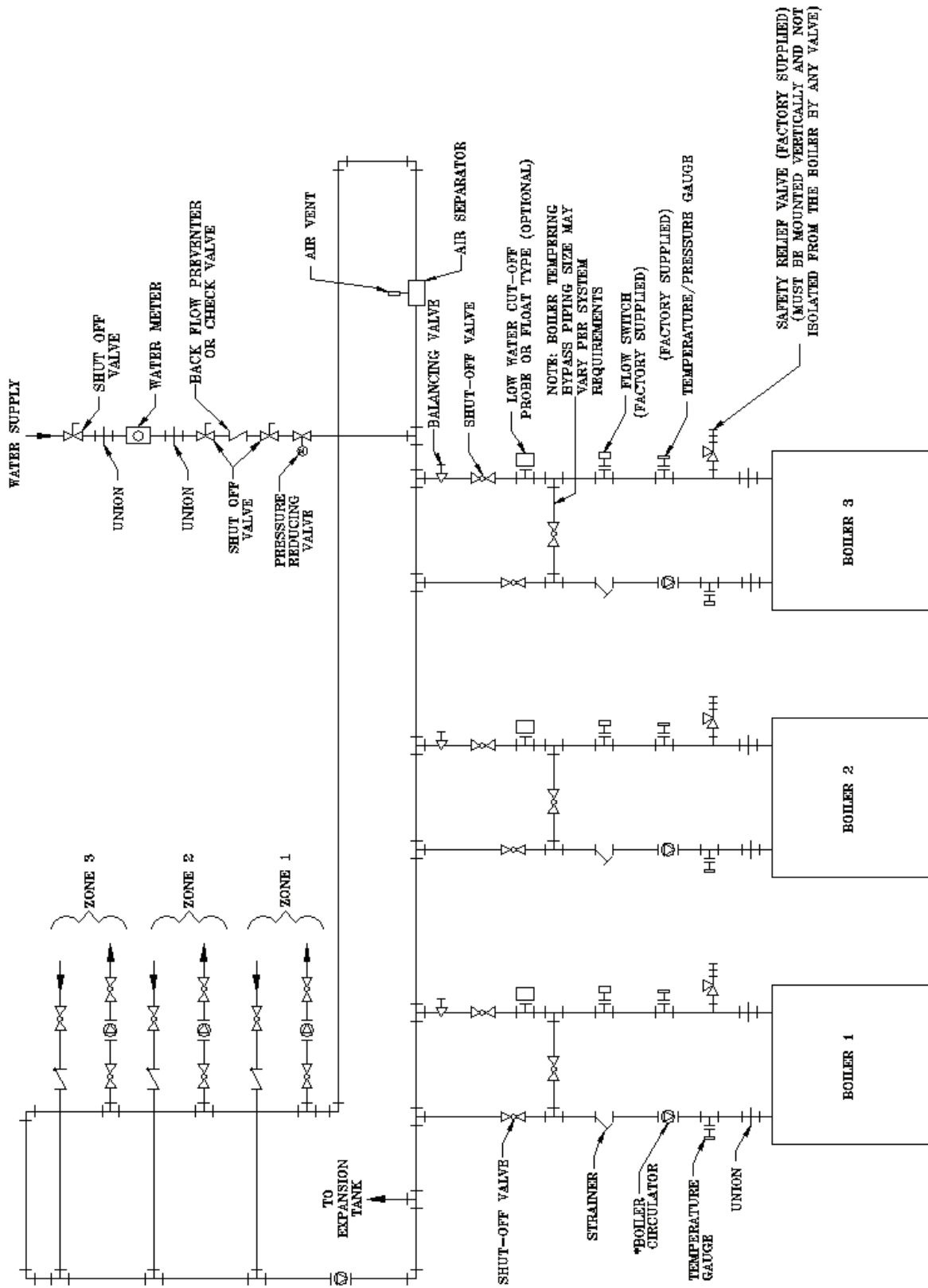


Figure 12: Modular System Vertical Air Intake Piping



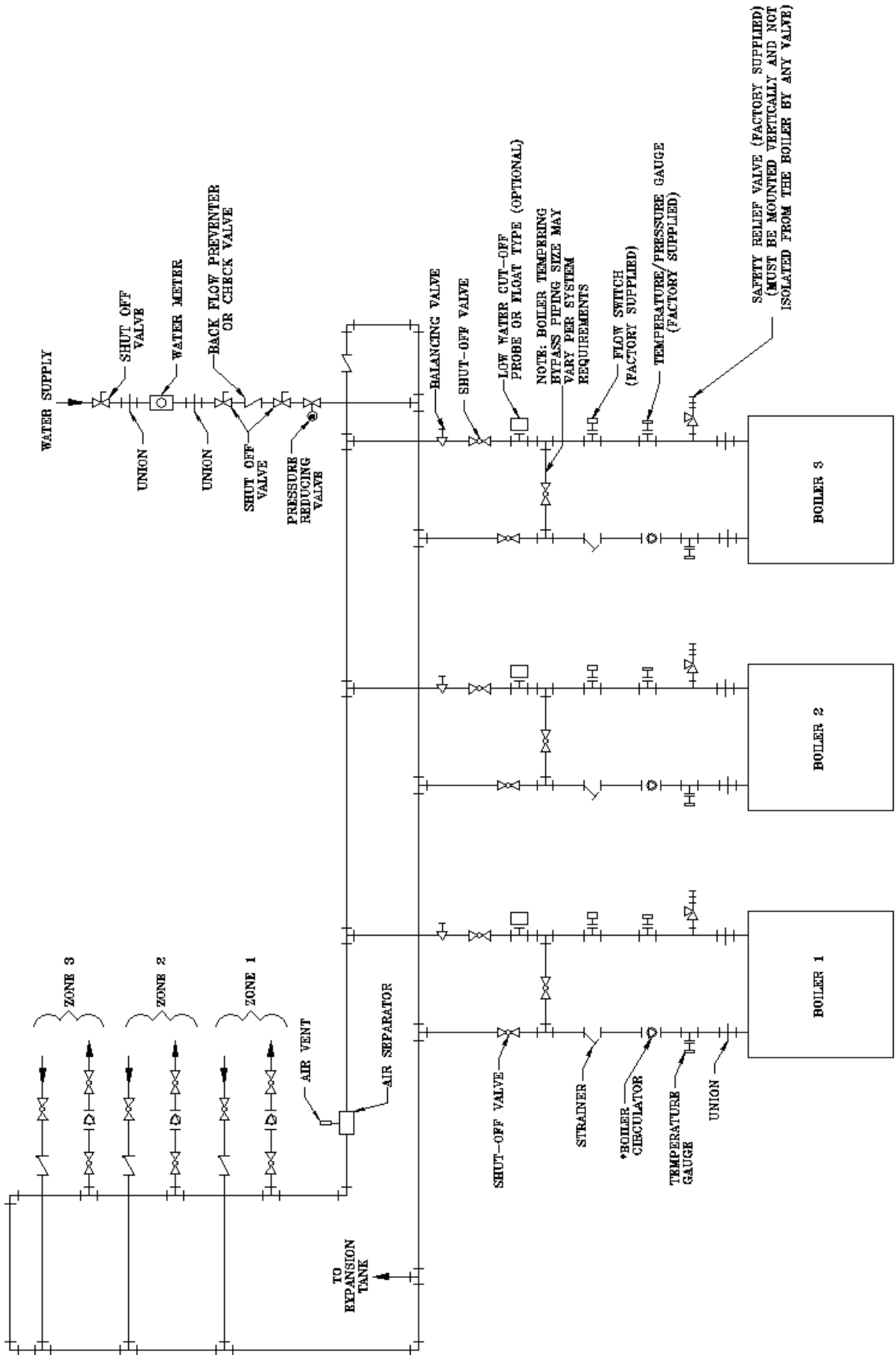
NOTE: FITTINGS, VALVES, AND COMPONENTS NOT SHOWN AS "FACTORY SUPPLIED" ARE NOT SUPPLIED BY THERMAL SOLUTIONS

Figure 13: Modular System: Typ One Pipe Water Piping



\*BOILER PUMP MUST BE SIZED TO OVERCOME PRESSURE DROP ACROSS ENTIRE BOILER LOOP

Figure 14: Modular System: Typ Primary/Secondary Water Piping



\*BOILER PUMP MUST BE SIZED TO OVERCOME PRESSURE DROP ACROSS ENTIRE BOILER LOOP

Figure 15: Modular System: Typ Primary/Secondary without System Pump



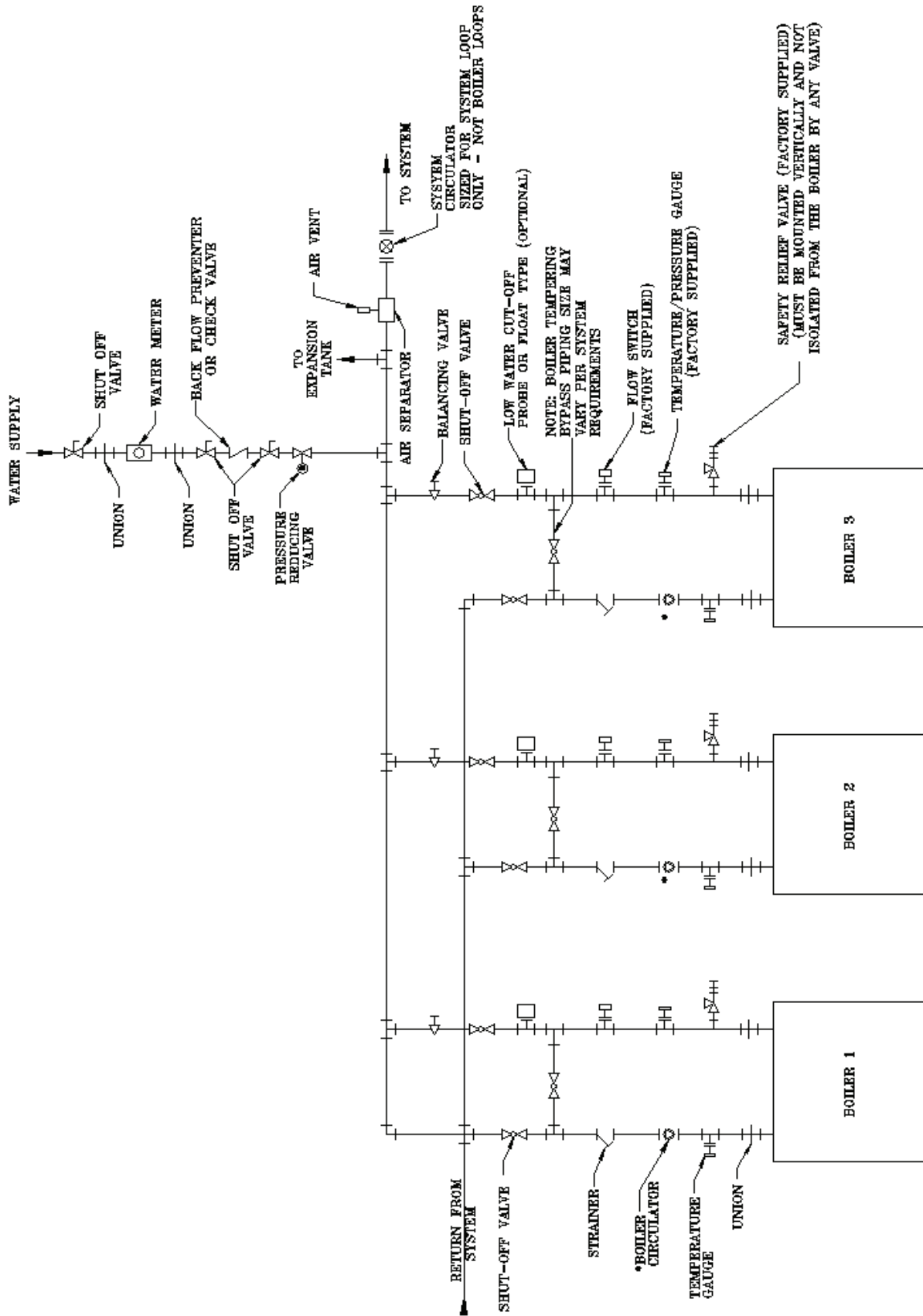


Figure 16: Modular System: Typ Reverse - Return Water Piping

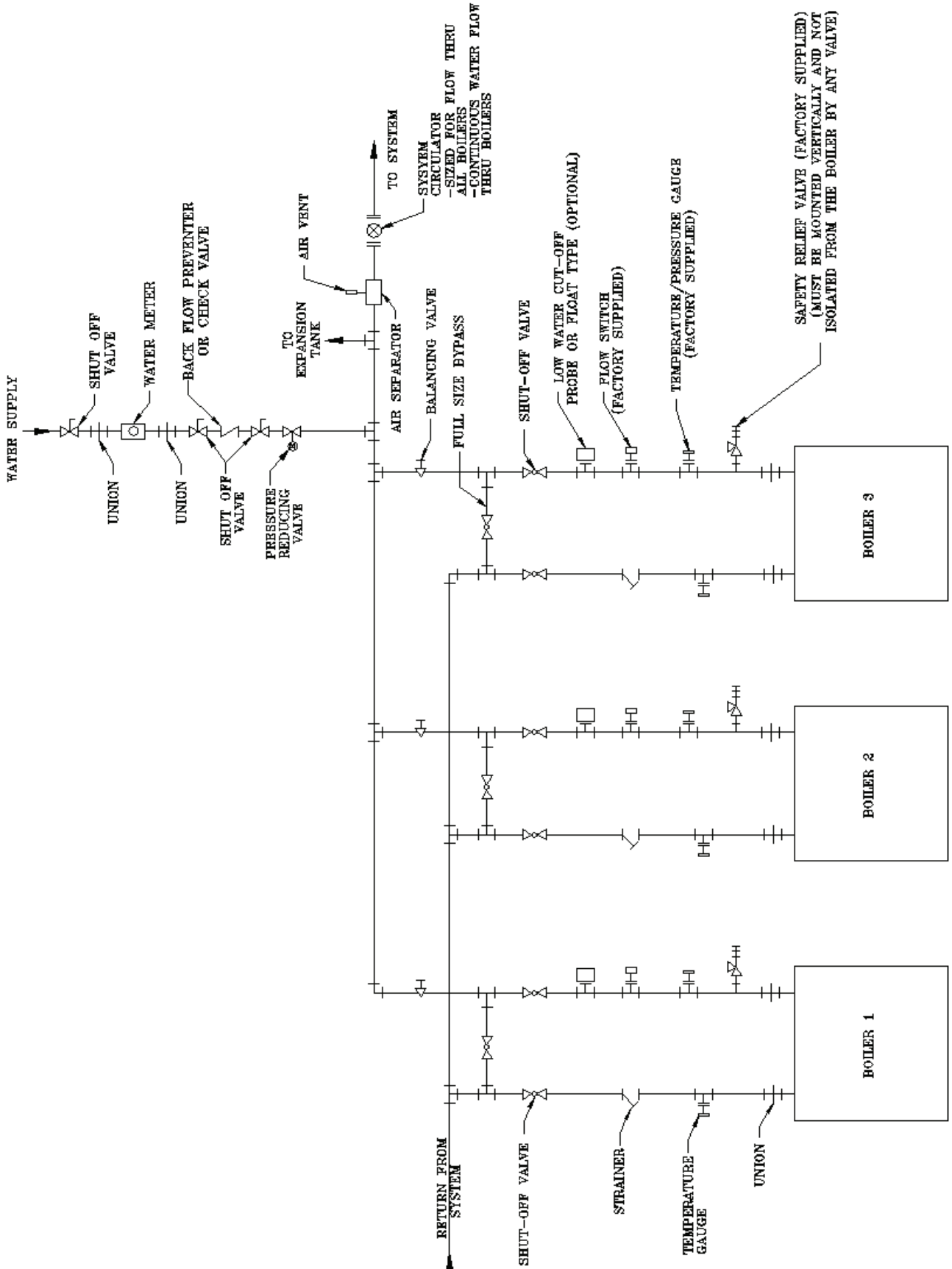
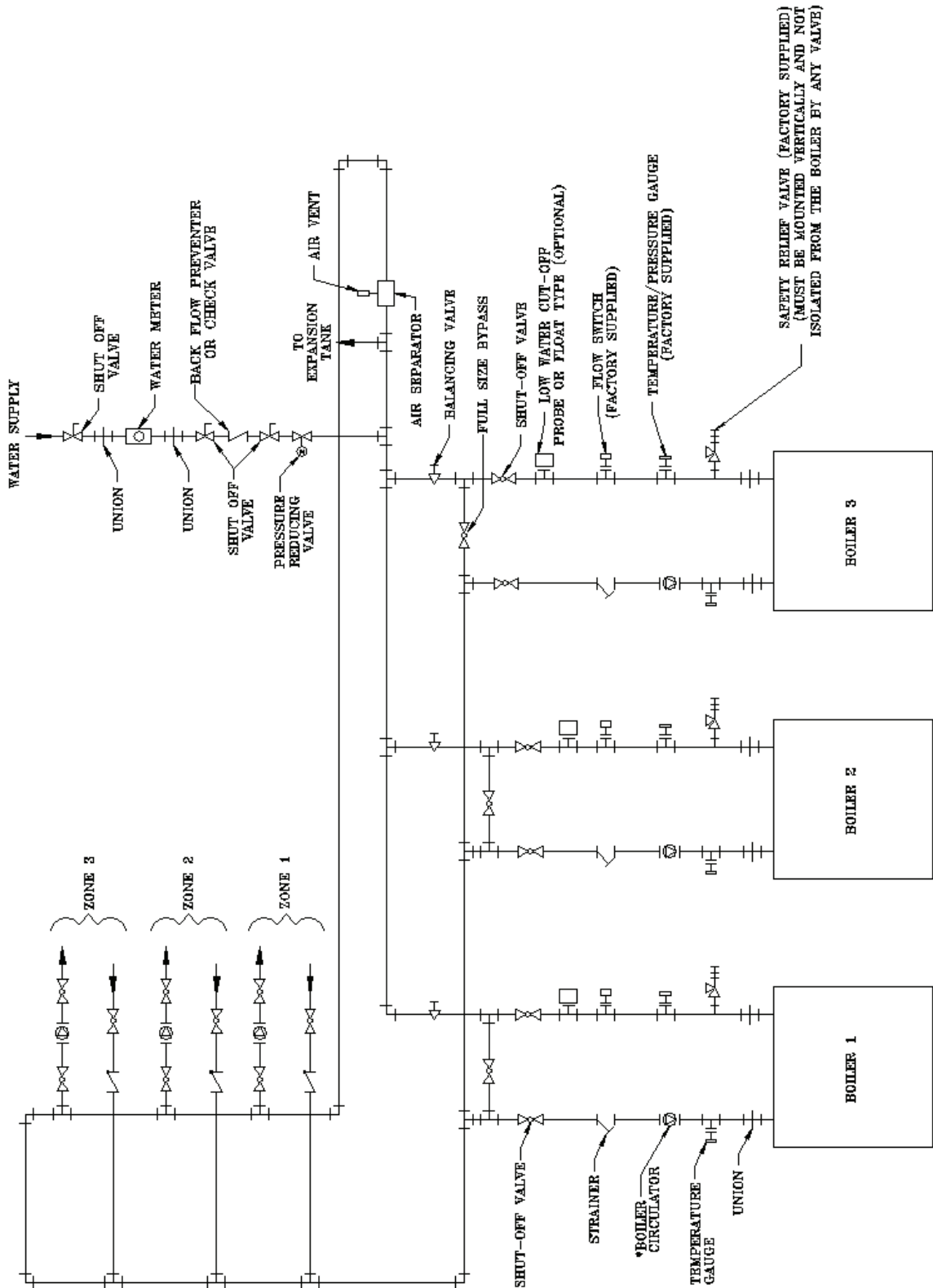


Figure 17: Modular System Reverse - Return with System Pump Only



\*BOILER PUMP MUST BE SIZED TO OVERCOME PRESSURE DROP ACROSS ENTIRE BOILER LOOP

Figure 18: Modular System: Typ Primary/Secondary with Reverse-Return

## 7. Electrical

- a. Each boiler must be provided with a dedicated fused disconnect.
- b. Install wiring and ground boiler in accordance with requirements of authority having jurisdiction. In absence of such requirements, the National Electrical Code, ANSI/NFPA 70 and/or CSA C22.1 Electrical Code.
- c. Install each circulator with a separate fused disconnect switch. Refer to circulator manufacturer's data for electrical requirements.
- d. Refer to Figure 1 for electrical data for each size boiler.

### NOTICE

**Do not install boiler and circulator pump on the same fused disconnect.**

## 8. Condensate Piping

- a. Each boiler requires separate condensate drains. In addition, most venting configurations require separate condensate drains in the vent system. Do not manifold boiler drains or vent drains together.
- b. Refer to Section G for condensate removal system.

## G. CONDENSATE DRAINS

1. Each boiler contains a condensate drain. In addition, most vent configurations require a drain tee located in the vent piping. Pipe each condensate drain separately to a floor drain or condensate pump/sump.
2. Use continuous Teflon or high temperature resistant silicone tubing for condensate piping. Do not install fittings on condensate lines.

### CAUTION

**Failure to properly pipe condensate system will greatly reduce boiler life. Do not install plugs, caps or valves on condensate piping. Do not connect condensate drains together. Do not reduce size of condensate piping.**

3. Each condensate drain must contain a siphon/pigtail to prevent flue gas flow through the condensate piping.

4. A common condensate pump/sump may be used. Run separate piping from each condensate drain to the sump. A common drain may be used to discharge condensate from the sump. Consult pump/sump manufacturer for compatibility of pump/sump materials of construction. If a common sump is used, individual drain lines should be connected such that one drain cannot back feed into another drain.
5. Consult local authorities regarding disposal of flue gas condensate into public waste water system. Some jurisdictions require that the condensate be buffered before discharge. This buffering is commonly achieved by draining the condensate through a limestone bed. Consult a chemical treatment company for buffering systems.

### CAUTION

**Do not use PVC, CPVC or any other non Teflon or non high temperature resistant silicone based material for condensate piping.**

## IV. System Start-up

### CAUTION

Failure to properly pipe boiler may result in improper operation and damage to boiler or structure.

### CAUTION

Oxygen contamination of boiler water will cause corrosion of iron and steel boiler components, and can lead to boiler failure. Thermal Solutions Standard Warranty does not cover problems caused by oxygen contamination of boiler water or scale (lime) build-up caused by frequent addition of water.

### CAUTION

All piping either new or existing must be cleaned with a tri sodium phosphate (TSP) solution to remove mill scale and oils from the system. Failure to do so could result in premature failure of the heat exchanger (not covered by Thermal Solutions warranty).

### CAUTION

On an existing or retrofit system, a filter or strainer must be installed on the system return prior to the boilers.

### CAUTION

When using Glycol products, all Glycol manufactures' requirements, including rust inhibitors, must be adhered. Max 50% Glycol.

- A. Verify that the venting, water piping, gas piping and electrical system are installed properly. Refer to installation instructions contained in this manual.

### WARNING

Completely read, understand and follow all instructions in this manual, Honeywell flame safeguard, and all other component manuals supplied with this boiler before attempting start up.

- B. Confirm all electrical, water and gas supplies are turned off at the source and that chimney/vent is clear of obstructions. If boiler is controlled by an external control system, this system must be temporarily disconnected. The local boiler controls should be allowed to operate the boiler.
- C. Remove the upper front jacket panel.
- D. Confirm that all manual shut-off gas valves between the boiler and gas supply are closed.

### CAUTION

This boiler contains a manual gas shut-off valve inside of the upper front jacket panel.

- E. Fill boiler and system with water to desired cold fill pressure. Fully open supply and return water valves and fully close bypass balancing valve. See Figure 8.

### WARNING

The maximum operating pressure of this boiler is 160 psig. Never exceed this pressure. This boiler was supplied with a safety relief valve with a pressure relief setting specified at the time of purchase. The relief valve setting must be above the maximum operating pressure of the system. Consult Thermal Solutions if the desired system operating pressure is above the safety relief valve pressure setting. Do not plug or change safety relief valve.

- F. Confirm that the boiler and system have no water leaks.
- G. Turn on electrical supply to the boiler and circulation system at fused disconnect switches. Note that there is electrical power at certain components even with the power switch off. See wiring diagrams in Figures 9a, 9b, and 9c.
- H. Turn system circulators on and purge air from the boiler and system piping.
- I. Confirm that water flow switch is operating properly.
- J. Turn on gas supply to the boiler gas piping.
- K. Confirm that the supply pressure to the gas regulator supplied with the boiler conforms to Table 2 for maximum and minimum supply pressures.

- L. Open the manual gas shut-off valves located upstream of the gas regulator supplied with the boiler. Do not open manual gas valve inside of boiler jacket.

## DANGER

**Do not use matches, candles, open flames or other ignition source to check for leaks.**

- M. Using soap solution, or similar non-combustible solution, electronic leak detector or other approved method, check that boiler gas piping valves, regulators and all other components are leak free. Eliminate any leaks.
- N. Purge gas line of air.
- O. Reset low gas pressure safety switch.
- P. Turn on control circuit breaker inside front jacket panel. Note that the flame safeguard is powered even with the power switch off.
- Q. Turn boiler operating switch to the on position.
- R. Allow boiler to complete prepurge and trial for ignition period. Once pilot flame is recognized by controller, position flame control switch to test position.
- S. Look through the boiler sight glass and confirm that pilot flame is blue and steady and that the flame signal is between 1.5 and 5.0 volts DC. Adjust pilot gas regulator until proper pilot manifold gas pressure is achieved per firetest report label. Pilot flame should be blue with very little yellow.
- T. Turn the boiler off, place flame control switch in "run" position, and repeat Steps R., and S. at least five times until reliable pilot ignition and signal is achieved and confirmed.
- U. With the pilot operating properly, allow boiler to continue to trial for main flame. Confirm that the flame control locks out on main flame failure.
- V. Open the manual main gas shut-off valve located inside the boiler jacket.
- W. Using the procedure detailed in Step M, leak test gas piping and valves inside of jacket. Eliminate any leaks.
- X. Reset flame safeguard and allow boiler to run through prepurge, trial for pilot and trial for main flame.

- Y. Confirm that main flame ignites smoothly. Observe main flame and confirm that burner element is evenly orange without flickering. Observe flame signal and confirm signal is between 1.5 and 5.0 volts DC.

- Z. Turn boiler off and repeat Steps X and Y at least five times to confirm proper main burner operation.

- AA. With main flame on, at high fire, measure gas pressure downstream of the main gas valves and adjust to the manifold pressure indicated on the factory firetest label.

## WARNING

**Failure to properly adjust gas input rate will result in over firing or under firing of the appliance. Improper and unsafe boiler operation may result.**

- BB. Confirm that high and low gas pressure switches are functioning and are adjusted to prevent over firing or under firing of the boiler.
- CC. Adjust setting of air filter flow switch by rotating knob on switch counter clockwise until change filter light switch is illuminated. Turn switch knob clockwise  $\frac{1}{4}$  turn past the point where the change filter light goes out. Replace upper front jacket panel.
- DD. With boiler running and all panels attached, measure oxygen ( $O_2$ ) and carbon monoxide (CO) concentrations in the flue gas and flue gas temperature. Compare results with values given on factory firetest report supplied with the boiler.

## DANGER

**Failure to properly adjust excess air will result in unsafe levels of carbon monoxide. Variations in venting or combustion air pressure and temperature will change excess air. Adjust excess air levels so that variation in venting or combustion air pressures and temperatures caused by change of seasons, wind conditions, opening or closing of boiler room doors or windows do not cause the boiler to operate with carbon monoxide concentrations above 400 parts per million.**

**EE.** Verify that all safety and operating limits and flame controls are operating properly. These controls and limits include combustion air switch, water temperature operating control, manual reset water temperature safety limit, vestibule fuseable link, mixer fuseable link, high and low gas pressure switches. Refer to manuals for these components for proper start-up and operating instructions. Follow all instructions contained in these manuals. This manual was provided with the boiler.

**FF.** Set Operating Limits - To set the operating boiler water temperature for on/off and 2-Stage boiler, rotate the dial of the "operating" aquastat to the appropriate temperature setting.

2-Stage boiler operation—set the "firing rate" aquastat at 20°F below the "operating" aquastat at initial start-up. Adjust "firing rate" set point to accommodate field requirements.

To set the operating boiler water temperature for modulating boilers refer to Appendix A - Digital Temperature Controller for Modulating Boilers.

**GG.** Replace access panels and turn boiler off. Allow system and boiler water to cool.

**HH.** After boiler and system water has cooled to less than 80°F, turn boiler on and observe the return water temperature from the system. If the return water temperature rises to above 120°F in less than five (5) minutes, leave the bypass balancing valve fully closed. If return water temperature is not above 120°F or it takes a longer period than five (5) minutes to rise above 120°F, slowly open bypass balancing valve. See Figure 8. Continue to open bypass balancing valve so that return water temperature to the boiler is above 140°F. Note that if the temperature does not rise above 140°F with the bypass valve fully open, slowly begin to close balancing valve in the system and return piping until boiler water return temperature is above 140°F. Turn boiler off and allow boiler and system water to cool to less than 80°F. Turn boiler on and note return water temperature to the boiler. Confirm

that water temperature rises above 120°F in less than five (5) minutes. If not, continue to open bypass balancing valve.

Modulating boilers utilize a PID digital temperature control, where the set point cannot be set lower than 140°F, using a 5°F lower differential setting, for 20°F  $\Delta T$ .

**II.** When water adjustment is complete, allow boiler to operate and confirm proper operation. Place system control back in normal operation.

**JJ.** Contact reputable chemical treatment company for recommendations on proper water treatment for the installation. Each installation is different and must be analyzed based on local water conditions and boiler operating schedule. The treatment chemicals must be compatible with copper, bronze, steel and cast iron materials of construction.

## NOTICE

**A proper water treatment is required and a monitoring program will extend the life of the boiler. The water shall have a maximum water hardness of 8.5 grains or 150ppm. The recommended pH range is 8.8 to 9.2.**

## WARNING

**Chemicals used in treating boiler water are toxic and/or harmful. Always use protective clothing and equipment when working with/near chemicals. Contact local authorities to determine if treated boiler water can be discharged into local waste water system.**

## V. Operation and User Maintenance

### FOR YOUR SAFETY, READ BEFORE OPERATING

#### WARNING

**If you do not follow these instructions exactly, a fire or explosion may result causing property damage or personal injury.**

- A. This boiler is equipped with an ignition device which automatically lights the pilot. Do not try to light the pilot by hand.
- B. BEFORE OPERATING smell all around the boiler area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.

#### WHAT TO DO IF YOU SMELL GAS

- Do not try to light any boiler or other appliance.
  - Do not touch any electric switch; do not use any phone in your building.
  - Immediately call your gas supplier from a remotely located phone. Follow the gas supplier's instructions.
  - If you cannot reach your gas supplier, call the fire department.
- C. Do not use this boiler if any part has been in contact with water. Immediately call a qualified service technician to inspect the boiler and to replace any part of the control system and any gas control which has been in contact with water.

### LIGHTING INSTRUCTIONS

1. STOP! Read all the safety information (warnings, cautions etc.) in this manual.
2. Set system control so that there is no call for heat to the boiler.
3. This boiler is equipped with an ignition device which automatically lights the pilot and main burner. Do not try to light the pilot or main flame by hand.
4. Locate the operating switch located on the front of the boiler.
5. Move the switch to the "on" position.
6. Set system control so that there is a call for heat from the system.
7. Observe prepurge, pilot ignition and main flame ignition.

#### WARNING

**If prepurge does not occur and/or pilot ignition or main flame ignition is excessively noisy or rough, immediately turn off gas supply and electrical power to the boiler. Call qualified service technician.**

8. If pilot or main flame ignition does not occur during initial attempt, remove the upper front jacket panel of the boiler. If the boiler pilot and main flame light, go to Step 10.

#### WARNING

**The control cabinet of the boiler contains electrical connections which can cause physical harm. Do not touch any part of the boiler controls and/or connections unless instructed by this manual.**

9. Reset the burner control by pressing the reset button located on the burner control. If you do not know where the control reset button is, do not touch any part of the control system or wiring. Turn all gas and electrical power off to the boiler and call a qualified service technician.

#### WARNING

**Do not reset the burner control more than three (3) consecutive times. If pilot ignition or main flame ignition does not occur in three (3) attempts, turn all gas and electrical power off and call a qualified service technician.**

10. Replace the upper front jacket panel.
11. Observe several on and off cycles of the boiler. If any light offs are excessively noisy or rough, or any questionable boiler operation is noticed, immediately turn off all gas and electrical power and call qualified service technician.



## **DANGER**

**This boiler requires periodic service and maintenance for safe operation. Instructions for proper maintenance and service are contained in the boiler manual. Only qualified and skilled technician should perform maintenance or service on this boiler.**

### **TO TURN OFF GAS TO BOILER**

- Set control system so there is **no** call for heat to the boiler.
  - Turn off all electrical power to the boiler if service is to be performed.
  - Locate the operating switch on the front of the boiler.
  - Move the operating switch to the “off” position.
12. The following maintenance must be performed by the boiler operator on a daily basis when the boiler is operating.

- a. Observe burner color.
- b. Check flame control for proper operation and shutdown.
- c. Check vent and air intake piping for any obstructions.
- d. Check for any water leaks.
- e. Check for any gas leaks.
- f. Check condensate drains for any obstructions.
- g. Clean any debris or trash from boiler area.
- h. Log that the above maintenance was completed in a boiler log. Maintain log near boiler location.

## **WARNING**

**If any unusual or improper operation or site conditions are observed, turn the boiler off and contact an experienced and skilled service agency.**

## **WARNING**

**Do not operate boiler without air filter in place and securely fastened and sealed. Replacement air filters must be purchased from authorized Thermal Solutions Representatives. Part numbers are listed in Figure 20.**

**Do not readjust gas regulator, bypass water valve, system return water valve, system supply water valve, pressure switch or water flow switch from setting determined during system start-up. Do not tamper with any other boiler components.**

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## VI. Service

### DANGER

This boiler uses flammable gas, high voltage electricity, moving parts, and very hot water under high pressure. Assure that all gas and electric power supplies are off and that the water temperature is cool before attempting any disassembly or service.

More than one gas shut-off valve and electrical disconnect switch are used on the boiler. Assure that all gas valves and electrical disconnect switches are off before attempting any disassembly or service.

Do not attempt any service work if gas is present in the air in the vicinity of the boiler. Never modify, remove or tamper with any control device.

### WARNING

This boiler must only be serviced and repaired by skilled and experienced service technicians.

If any controls are replaced, they must be replaced with identical models.

Read, understand and follow all the instructions and warnings contained in all the sections of this manual.

If any electrical wires are disconnected during service, clearly label the wires and assure that the wires are reconnected properly.

Never jump out or bypass any safety or operating control or component of this boiler.

Read, understand and follow all the instructions and warnings contained in ALL of the component instruction manuals.

Assure that all safety and operating controls and components are operating properly before placing the boiler back in service.

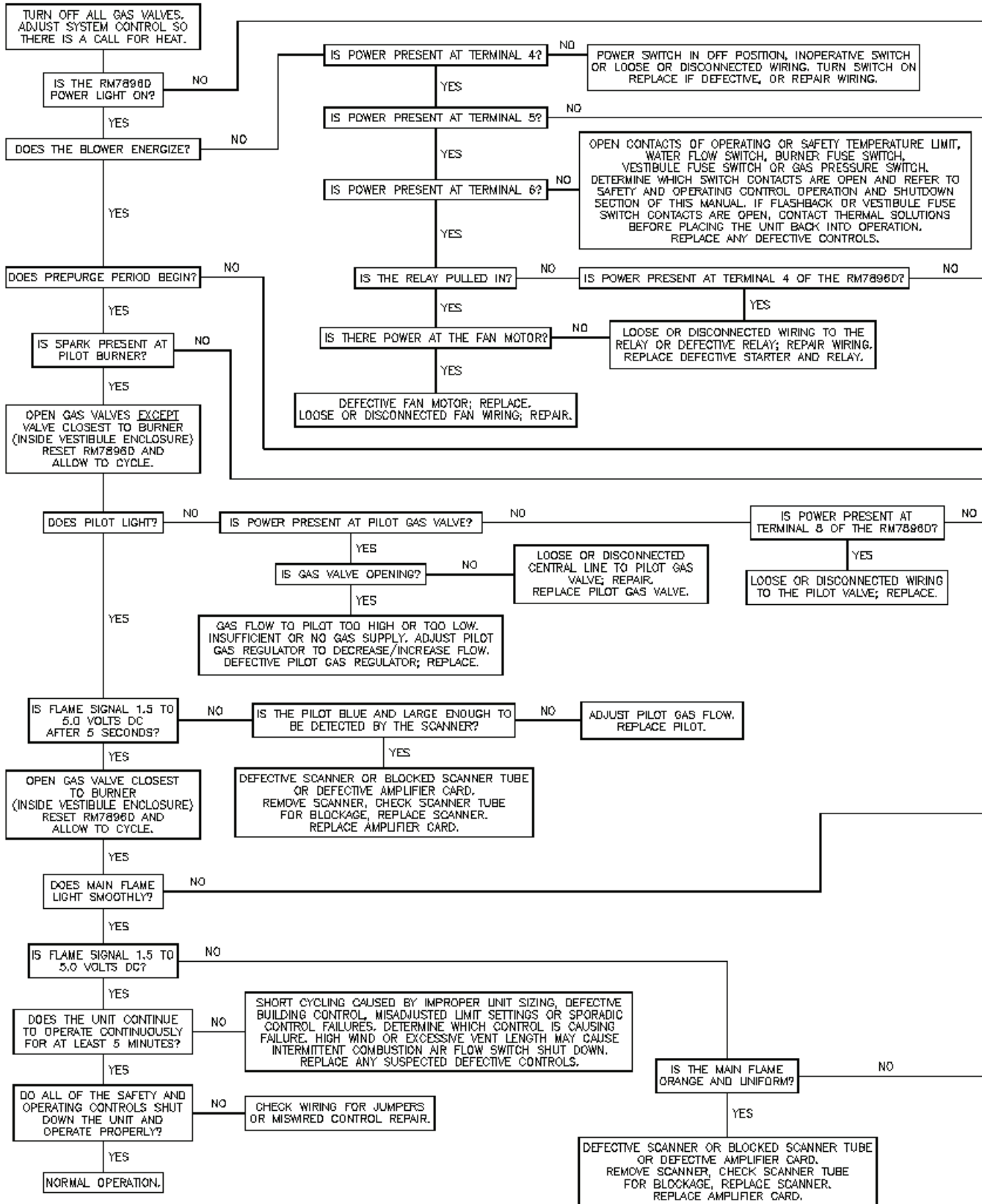
### CAUTION

USE caution when servicing components behind upper front jacket panel. Filter/mounting bracket may cause head injury.

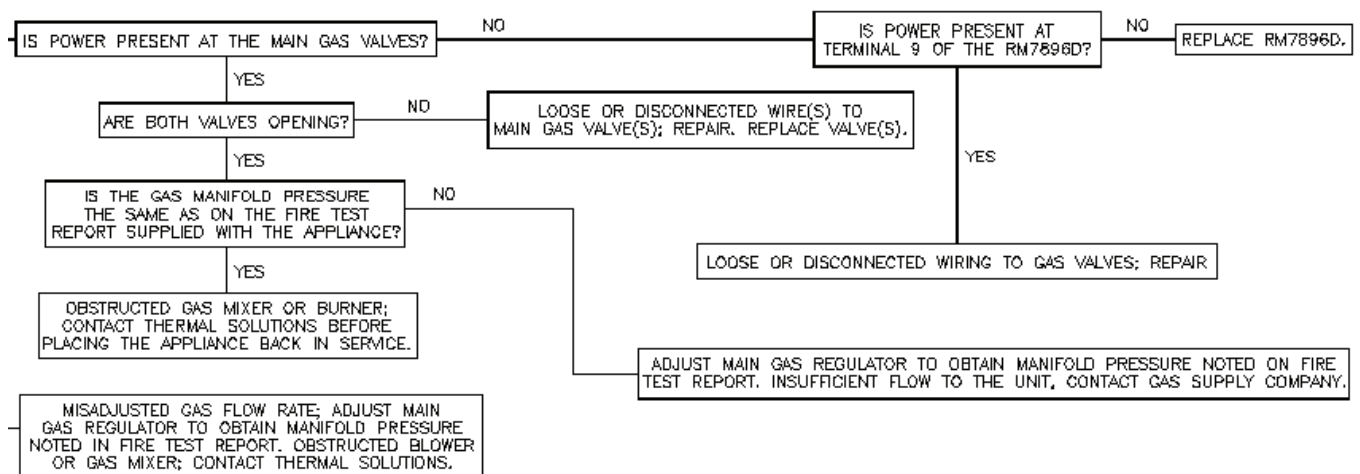
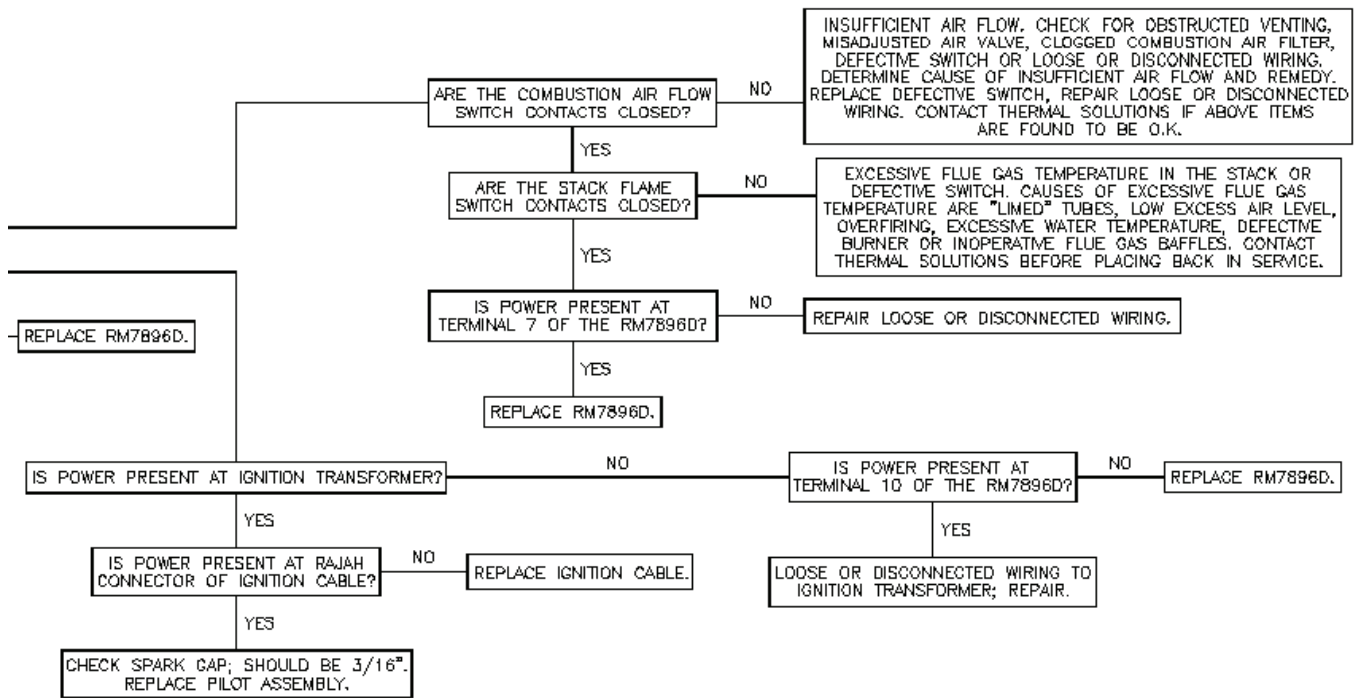
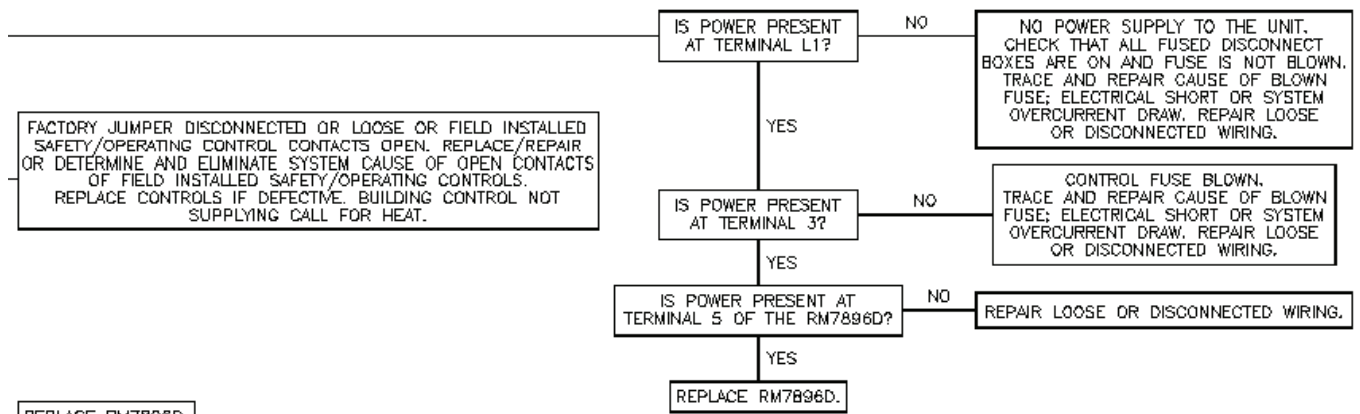
### WARNING

The service instructions contained in this manual are in addition to the instructions provided by the manufacturer of the boiler components. Follow component manufacturer's instructions. Component manufacturer's instructions were provided with the boiler. Contact component manufacturer for replacement if instructions are missing. Do not install, start up, operate, maintain or service this boiler without reading and understanding all of the component instructions. Do not allow the boiler to operate with altered, disconnected or jumpered components. Only use replacement components identical to those originally supplied by Thermal Solutions.

SAFETY AND OPERATING CONTROLS. OPERATION AND SHUT DOWN	
Component	Function
Control Circuit Breaker	If the power draw of the control circuit exceeds approximately 5 amps, the circuit breaker trips and prevents the boiler from operating until circuit breaker is reset.
Power Switch	If this switch is in the off position, power is interrupted to the control circuit of the boiler which prevents the boiler from operating. If the switch is in the on position, power is supplied to the control circuit.
Operating Aquastat	If the boiler water temperature exceeds the adjustable set point, power is interrupted to the control circuit of the boiler which prevents the boiler from operating. When the boiler water temperature drops below the set point minus the adjustable differential setting, power is again supplied to the control circuit.
Manual Reset High Limit Aquastat	If the boiler water temperature exceeds the adjustable set point, power is interrupted to the control circuit of the boiler which prevents the boiler from operating. Power is interrupted until the control is manually reset by pressing the control's reset button. When the button is depressed, power will again be supplied to the control circuit.
Flow Switch	If the water flow through the boiler drops below the fixed flow rate required to move the control's paddle enough to close the control's contacts, power is interrupted to the control circuit, which prevents the boiler from operating. When the water flow rate is increased, the paddle closes the control's contacts and power is supplied to the control circuit.
Pressure (Safety) Relief Valve	If the pressure inside the appliance exceeds the fixed set point, the valve opens mechanically and discharges water. The valve remains open until the pressure inside the appliance drops below the set point.
Mixer Fuseable Link	If the temperature in the interior of the burner exceeds the fixed set point, the contacts of the switch open and power is interrupted to the control circuit which prevents the boiler from operating. Power is interrupted until the switch is replaced.
Vestibule Fuseable Link	If the temperature in the interior of the vestibule enclosure exceeds the fixed set point, the contacts of the switch open and power is interrupted to the control circuit which prevents the boiler from operating. Power is interrupted until the switch is replaced.
High and Low Gas Pressure Switches	If the gas pressure reaches a point below the adjustable set point, or above the adjustable set point, the contacts of the switch open and power is interrupted to the control circuit which prevents the boiler from operating. Power is interrupted until gas pressure is between the high and low set points and the control is manually reset by moving the switch to the reset position. The switches will not reset until the gas pressure is within the set point parameters.
Combustion Air Flow Switch	If the differential air pressure drops below the fixed set point, the contacts of the switch open and power is interrupted to the control circuit, which prevents the boiler from operating. Power is interrupted until air flow increases so that the contacts close.
Flame Safeguard Control	Refer to the manual supplied with the boiler.
Variable Frequency Drive (VFD)	The variable frequency drive's primary function is to vary the rotational speed of the blower fan based on the air requirements of the boiler combustion process. The VFD is used for both 2-Stage and Modulating boilers. The speed of the fan for 2-Stage boiler is triggered through relays. The VFD on Modulating boilers responds to a 4-20 ma signal from the Digital Temperature Controller.
Digital Temperature Controller	The microprocessor based temperature controller is used on all modulating boilers. The controller's basic function is to control the firing rate of the boiler based on the difference between the bulk boiler water temperature and the controller's set-point. The controller also has the ability to change the operating set-point based on an external signal (contact closure for reduced demand setting or outdoor reset)



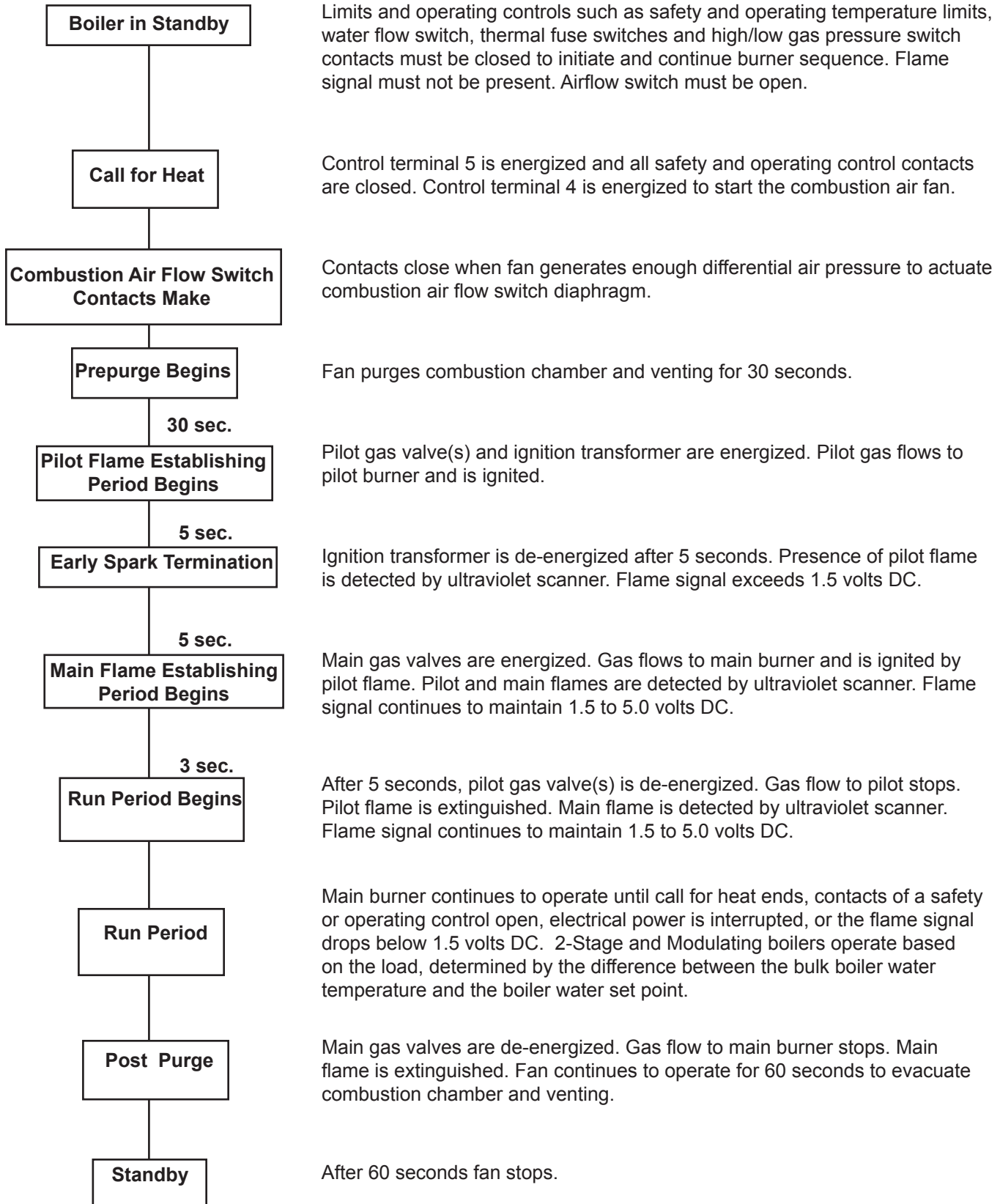
## Troubleshooting Guide



**NOTICE**

BEFORE REPLACING RM7896D, CONFIRM THAT ALL THE WIRING TO THE SUB-BASE IS SECURE AND THAT THE SUB-BASE CONTROLS ARE NOT BENT TO THE REAR.

## NORMAL SEQUENCE OF OPERATION



<b>PERIODIC MAINTENANCE RECOMMENDED CHECK LIST</b>		
<b>Frequency</b>	<b>Component/Item</b>	<b>Recommended Test</b>
<b>Daily Maintenance</b>	Gauges, monitors, and indicators	Make visual inspection and record readings.
	Gauges, monitors, and indicators	Check operation of boiler is as shown on page (46) of this manual.
	Burner flame	Make visual inspection of burner flame.
	Low Draft, fan air pressure, and damper position interlocks	Test low draft, fan, air pressure, and damper position interlocks according to instructions if so equipped
<b>Weekly Maintenance</b>	Igniter	Make visual inspection, check flame signal strength; log
	Flame signal strength	Read and log flame signal meter, read for both pilot and main flames
	Flame failure detection system	Close manual fuel supply for (1) pilot, (2) main fuel cock, and/or valve(s); check safety shutdown timing
	Firing rate control	Check firing rate control, place RWF40 in manual mode and check high and low firing settings for proper operation
	Pilot and/or main fuel valves	Open limit switch and make aural and visual check; check valve position indicators and check fuel meters if so fitted
	Low-water fuel cutoff	Test low-water fuel cutoff device and alarm according to manufacturer's instructions
<b>Monthly Maintenance</b>	Flue, vent, stack, or outlet dampers	Check components
	Gas pressure interlocks	Test high and low gas pressure interlocks
<b>Semi-Annual Maintenance</b>	Gauges, monitors, and indicators	Recalibrate all indicating and recording gauges
	Flame failure detection system	Check components
	Condensate drain tubes	Check drain tubes have liquid in trap and condensate is properly directed
	Air filter	Check air filter
	Interlocks and valves	Check piping and wiring of all interlocks and shut off valves if so equipped
<b>Annual Maintenance</b>	Flue, vent, stack, or outlet dampers	Measure carbon monoxide and oxygen levels and temperature in flue products
	Flame failure detection system	Conduct pilot turndown test according to manufacturer's instructions. This test is required annually and after any adjustments to flame scanner mount or pilot burner
	Pilot and/or main fuel valves	Check all coils and diaphragms; test other operating parts of all safety shutoff and control valves
	Pilot and/or main fuel valves	Perform leakage test on pilot and main gas and/or oil fuel valves, in accordance with instructions
	Flame safeguard	Test purge timing according to manufacturer's instructions
	Air Filter	Replace (recommended)
	Boiler trim	Remove lower front jacket panel and check for any signs of corrosion and leaks
High limit and operating temp. controls	Test proper operation	
<b>As-Required</b>	Low-water fuel cutoff	Recondition or replace
	Safety relief valves	Test safety relief valves in accordance with ASME Boiler and Pressure Vessel Code, Sections VI and VII



**Air Filter:**

- A. Perform a visual inspection of air filter and replace as necessary
  1. Remove upper front fanel
  2. Remove red tube from nipple on filter assembly
  3. Remove wing nut
  4. Remove filter assembly from boiler
  5. Remove foam pre-filter and wash with soap and water
  6. Replace primary filter as necessary

**Burner:**

- A. No maintenance or inspection is required.

**Pilot and Main Flame:**

- A. Perform a visual inspection of pilot burner flame.
  1. Refer to the flame safeguard instruction manual and conduct a pilot turndown test.
  2. Observe pilot operation and record pilot signal. Flame should be steady medium hard blue clearly visible through sight glass.
- B. Pilot Cleaning and Maintenance
  1. Shut off gas supply and disconnect electrical service.
  2. Disconnect scanner, ignition electrode, loosen and remove pilot gas line and combustion air line from fan.
  3. Remove mounting fasteners and pull pilot assembly from heat exchanger.
  4. Examine pilot electrode and set gap to 1/8" if needed. Clean as required.
  5. Reassemble in reverse order using a new gasket available from Thermal Solutions.
- C. Perform a visual inspection of main burner flame.
  1. Observe main flame and record flame signal. Flame should be steady deep orange in color with dark blue checkerboard pattern throughout.
  2. Main burner requires no cleaning or annual maintenance

**Check Combustion and Safety Controls:**

- A. Check flame failure detection system with system operating.
  1. Pilot
    - a. Refer to the flame safeguard instruction manual
    - b. Manually close pilot fuel supply and verify lock out of primary control.
  2. Main Flame
    - a. Refer to the flame safeguard instruction
    - b. Close manual main fuel shut off valve and verify lockout of primary control.

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## VII. Repair Parts

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EVA Series repair parts can be ordered through your nearest Thermal Solutions Representative for delivery from Lancaster, PA.

The Representatives can also advise as to the availability of product and repair parts from local sources.

Contact Thermal Solutions for your Representative at:

Thermal Solutions Products LLC  
1175 Manheim Pike  
Lancaster, Pennsylvania 17601  
Telephone (717) 239-7642  
Fax (877) 501-5212 (toll free)  
[www.thermalsolutions.com](http://www.thermalsolutions.com)

### **WARNING**

**The repair parts noted in this section are for a standard EVA Series boiler. Different contents and components may have been supplied due to the request of the equipment end user. Consult Thermal Solutions for repair parts on non-standard controls and components.**

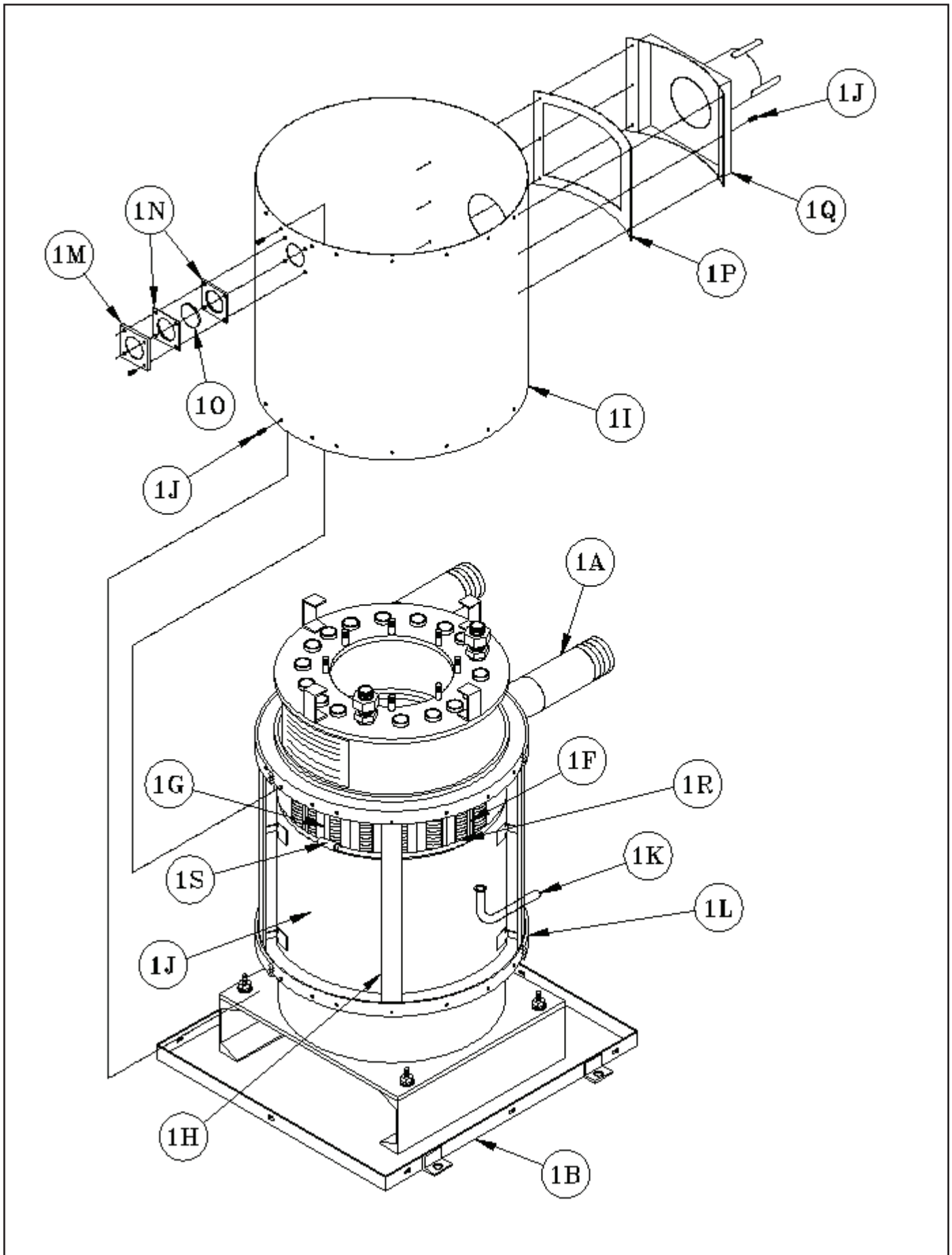


Figure 19: Combustion Chamber Assembly

BOILER COMBUSTION CHAMBER											
Key No.	Description	(Quantity) Part Number									
		EVA-250	EVA-500	EVA-750	EVA-1000	EVA-1500	EVA-2000	EVA-2000S	EVA-2500	EVA-3000	
<b>1. COMBUSTION CHAMBER ASSEMBLY</b>											
1A	Heat Exchanger	(1) 603563001	(1) 603563002	(1) 6035630031	(1) 6035630041	(1) 6035630051	(1) 6035630061	(1) 603563013	(1) 603563014	(1) 603563015	
1B	Base	(1) 61556042		(1) 61556024				(1) 61856501			
1F	Tube Baffle	(17) 70356115	(17) 70356116	(31) 70356215	(31) 70356216	(31) 70356217	(31) 70356218	(41) 70356315	(41) 70356316	(41) 70356317	
1G	Sight Tube Baffle	(1) 70356121	(1) 70356122	(1) 70356223	(1) 70356224	(1) 70356225	(1) 70356226	(1) 70356318	(1) 70356319	(1) 70356320	
1H	Combustion Pan Support	(4) 603561051	(4) 603561061	(4) 603562041	(4) 603562051	(4) 603562061	(4) 603562071	(6) 60356208	(6) 60356209	(6) 60356210	
1I	Heat Exchanger Wrapper	(1) 70356118	(1) 70356119	(1) 70356219	(1) 70356220	(1) 70356221	(1) 70356222	(1) 70356246	(1) 70356247	(1) 70356248	
1J	Heat Exchanger Baffle	(1) 70356234	(1) 70356235	(1) 70356236	(1) 70356237	(1) 70356238	(1) 70356239	(1) 70356240	(1) 70356241	(1) 70356242	
1K	Condensate Drain Tube	(1) 8065603			(1) 8065601						
1L	1" Fiber Gasket	(9 LF) 9206032			(14 LF) 9206032				(19.5 LF) 9206032		
1M	Sight Glass Lens Retainer	(1) 7186019									
1N	Sight Glass Gaskets	(2) 8206039									
1O	Sight Glass Lens	(1) 8026082									
1P	Vent Connector Gasket	(1) 8205623		(1) 8205624				(1) 82056601			
1Q	Vent Connector	(1) 81156026	(1) 81156027	(1) 81156016	(1) 81156017			(1) 81156028	(1) 81156029		
1R	Wrapper Banding	(12LF) 92466028			(24LF) 92466028				(25.5 LF) 92466028		
1S	Banding Buckle	(3) 80860946			(4) 80860946				(3) 80860946		

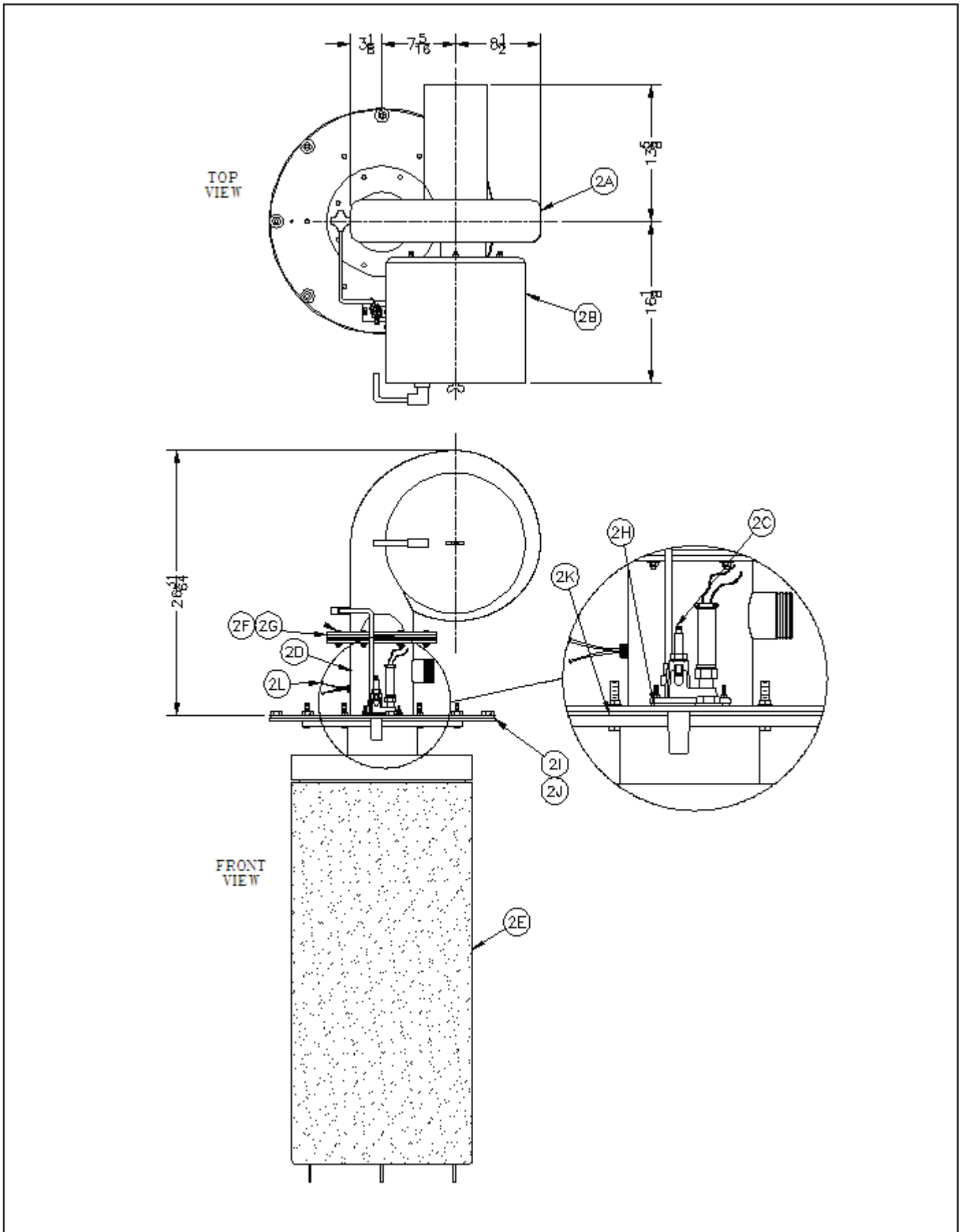


Figure 20: Burner Assembly

BURNER ASSEMBLIES										
Key No.	Description	(Quantity) Part Number								
		EVA-250	EVA-500	EVA-750	EVA-1000	EVA-1500	EVA-2000	EVA-2000S	EVA-2500	EVA-3000
<b>2. BURNER/FAN ASSEMBLIES</b>										
2A	Fan (120v/1ph)	(1) 811560022	(1) 81156001				N/A			
	Fan (three phase)	(1) 811560021	(1) 81156018					(1) 81156300		
2B	Air Filter	(1) 81156013	(1) 81156009	(1) 81156011		(1) 81156012		(1) 81156101		
2C	Pilot Assembly - Natural -OR- Pilot Assembly - LP	See Pages 69 and 71								
2D	Mixer Assembly - Natural	(1) 602561021	(1) 602561031	(1) 60256209	(1) 60256210	(1) 60256211	(1) 60256212	(1) 62156300		
	Mixer Assembly - LP	(1) 602561051	(1) 602561061	(1) 60256213	(1) 60256214	(1) 60256215	(1) 60256216	(1) 62156300		
2E	Burner Element	(1) TS250CF	(1) TS500CF	(1) TS750CF	(1) TS1000CF	(1) TS1500CF	(1) TS2000CF	(1) TS2000SCF	(1) TS2500CF	(1) TS3000CF
2F	Air Orifice Gasket	(2) 82056061		(2) 8205603				(2) 8205666		
2G	Air Orifice/On/Off	(1) 802561031	(1) 802561041	(1) 80256234	(1) 80256235	(1) 80256236	(1) 80256237	N/A		
	Air Orifice (2-Stage)	N/A	N/A	(1) 80256235	(1) 80256235	(1) 80256236	(1) 80256237	N/A		
	Air Orifice (Modulation)	—	(1) 802561041	(1) 80256235	(1) 80256253	(1) 80256236	(1) 80256237	(1) 82156307	—	
2H	Pilot Gasket	(1) 8205608								
2I	Gas Mixing Orifice	(1) 80256134	N/A							
2J	Burner Gasket	(1) 82056071	(1) 82056041				(1) 82056501			
2K	Burner Mounting Flange Gasket	(1) 8205609	(1) 8205605				(1) 8205665			
2L	Burner Thermal Fuse Assembly	(1) 6025601					N/A			

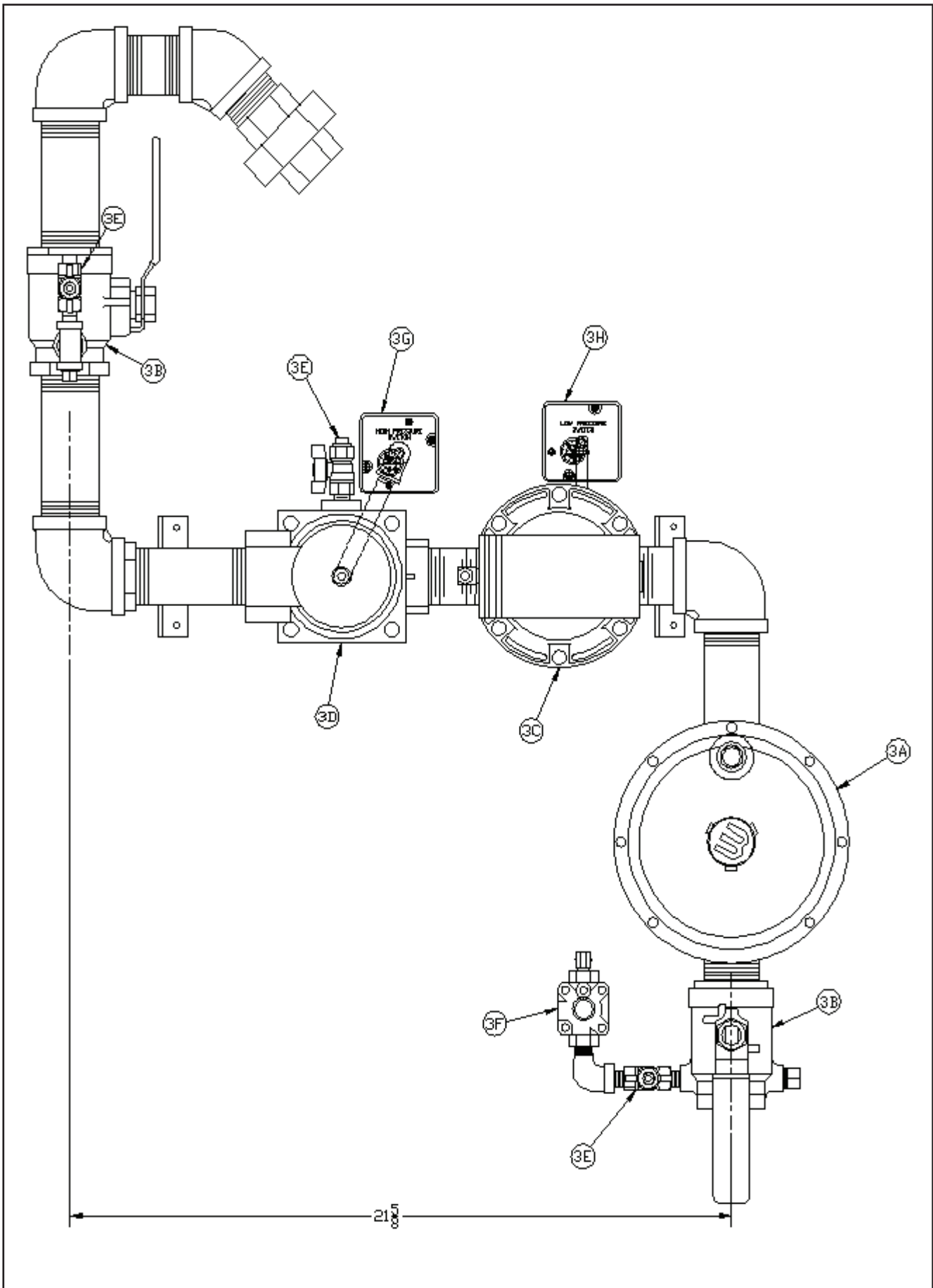


Figure 21a: UL/FM/CSD-1 Main Gas Train Assembly (On/Off)

UL/FM/CSD-1 GAS TRAIN (2-STAGE) - MAIN AND PILOT							
Key No.	Description	(Quantity) Part Number					
		EVA-250	EVA-500	EVA-750	EVA-1000	EVA-1500	EVA-2000
<b>3. Main and Pilot Gas Train (UL/FM/CSD-1)</b>							
3A	Main Gas Valve Body 1" NPT	N/A	N/A	(1) 816634041	—	—	—
	Main Gas Valve Body 1-1/2" NPT	N/A	N/A	—	(1) 81663404		
3B	Manual Gas Valve with Pilot Tapping, 1" NPT	N/A	N/A	(2) 806603055	—	—	—
	Manual Gas Valve with Pilot Tapping, 1-1/2" NPT	N/A	N/A	—	(2) 806603053		
3C	Air/Gas Ratio Controller Siemens SKP70	N/A	N/A	(1) 81663408			
3D	Solenoid Valve V4295A1031 1" NPT	N/A	N/A	(1) 81660207	—	—	—
	Solenoid Valve V4295A1056 1-1/2" NPT	N/A	N/A	—	(2) 81660205		
3E	Manual Gas Cock 1/4"	N/A	N/A	(3) 822758			
3F	325-3 Pilot Gas Regulator	N/A	N/A	(1) 822702			
3G	High Gas Pressure Switch	N/A	N/A	(1) 80160333			
3H	Low Gas Pressure Switch	N/A	N/A	(1) 80160332			



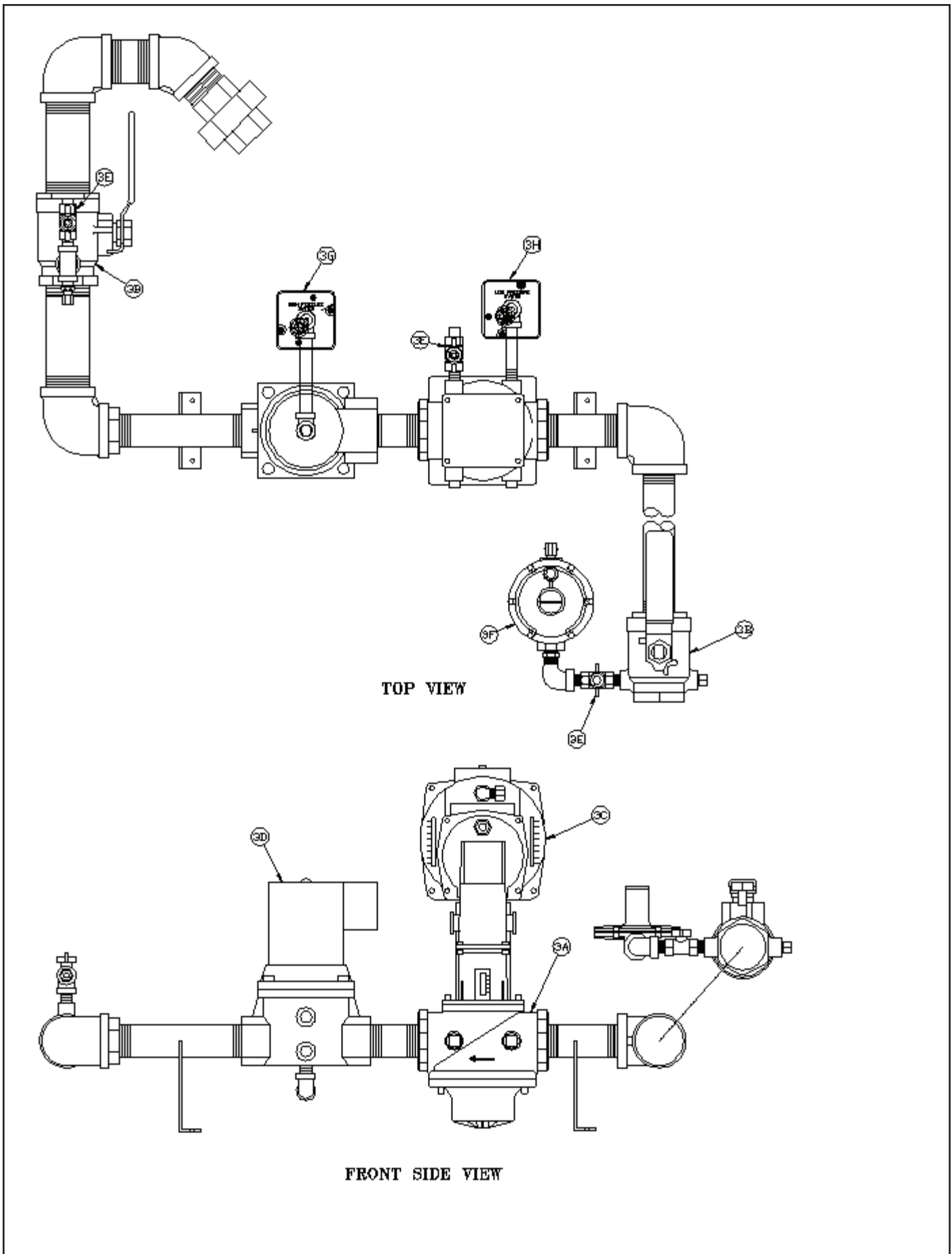


Figure 21b: UL/FM/CSD-1 Main Gas Train Assembly (2-Stage)

UL/FM/CSD-1 GAS TRAIN (2-STAGE) - MAIN AND PILOT							
Key No.	Description	(Quantity) Part Number					
		EVA-250	EVA-500	EVA-750	EVA-1000	EVA-1500	EVA-2000
<b>3. Main and Pilot Gas Train (UL/FM/CSD-1)</b>							
3A	Main Gas Valve Body 1" NPT	N/A	N/A	(1) 816634041	—	—	—
	Main Gas Valve Body 1-1/2" NPT	N/A	N/A	—	(1) 81663404		
3B	Manual Gas Valve with Pilot Tapping, 1" NPT	N/A	N/A	(2) 806603055	—	—	—
	Manual Gas Valve with Pilot Tapping, 1-1/2" NPT	N/A	N/A	—	(2) 806603053		
3C	Air/Gas Ratio Controller Siemens SKP70	N/A	N/A	(1) 81663408			
3D	Solenoid Valve V4295A1031 1" NPT	N/A	N/A	(1) 81660207	—	—	—
	Solenoid Valve V4295A1056 1-1/2" NPT	N/A	N/A	—	(2) 81660205		
3E	Manual Gas Cock 1/4"	N/A	N/A	(3) 822758			
3F	325-3 Pilot Gas Regulator	N/A	N/A	(1) 822702			
3G	High Gas Pressure Switch	N/A	N/A	(1) 80160333			
3H	Low Gas Pressure Switch	N/A	N/A	(1) 80160332			

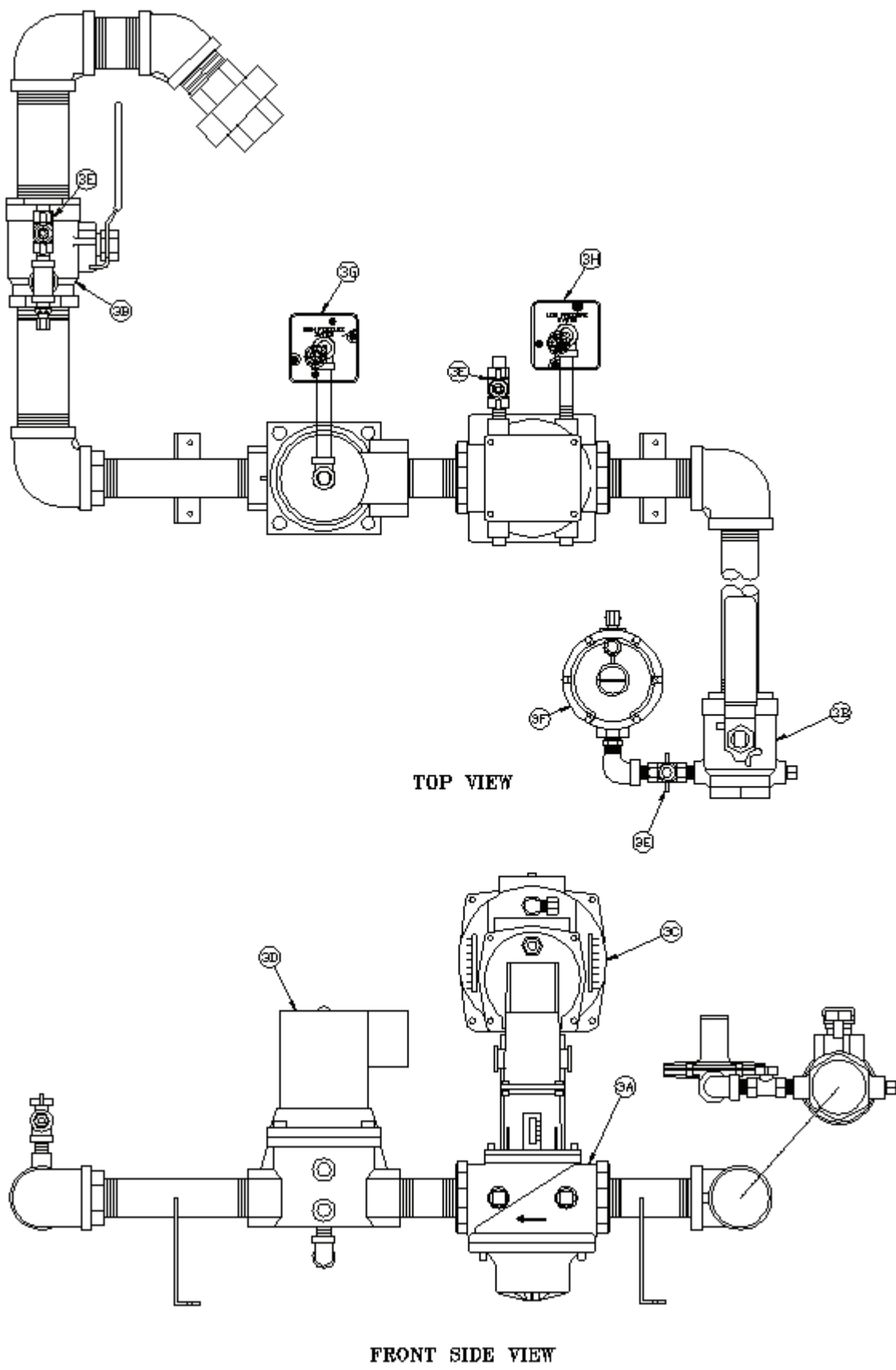


Figure 21c: UL/FM/CSD-1 Main Gas Train Assembly (Modulation)

UL/FM/CSD-1 GAS TRAIN (MODULATION) - MAIN AND PILOT										
Key No.	Description	(Quantity) Part Number								
		EVA-250	EVA-500	EVA-750	EVA-1000	EVA-1500	EVA-2000	EVA-2000S	EVA-2500	EVA-3000
3. Main and Pilot Gas Train (UL/FM/CSD-1)										
3A	Main Gas Valve Body 1" NPT	(1) 816634041			—	—	—	—	—	—
	Main Gas Valve Body 1-1/2" NPT	—	—	—	(1) 81663404			—	—	
	Main Gas Valve Body 2" NPT	—	—	—	—	—	—	(1) 816634043		
3B	Manual Gas Valve with Pilot Tapping, 1" NPT	(2) 806603055			—	—	—	—	—	—
	Manual Gas Valve with Pilot Tapping, 1-1/2" NPT	—	—	—	(2) 806603053			—	—	
	Manual Gas Valve with Pilot Tapping, 2" NPT	—	—	—	—	—	—	(2) 806604691		
3C	Air/Gas Ratio Controller Siemens SKP70	(1) 81663408								
3D	Solenoid Valve V4295A1031 1" NPT	(1) 81660207			—	—	—	—	—	—
	Solenoid Valve V4295A1056 1-1/2"	—	—	—	(2) 81660205			—	—	
	Solenoid Valve V4295A1064 2"	—	—	—	—	—	—	(1) 816602051		
3E	Manual Gas Cock 1/4"	(3) 822758								
3F	RV20L Pilot Gas Regulator	(1) 822702								
3G	High Gas Pressure Switch	(1) 80160333								
3H	Low Gas Pressure Switch	(1) 80160332								

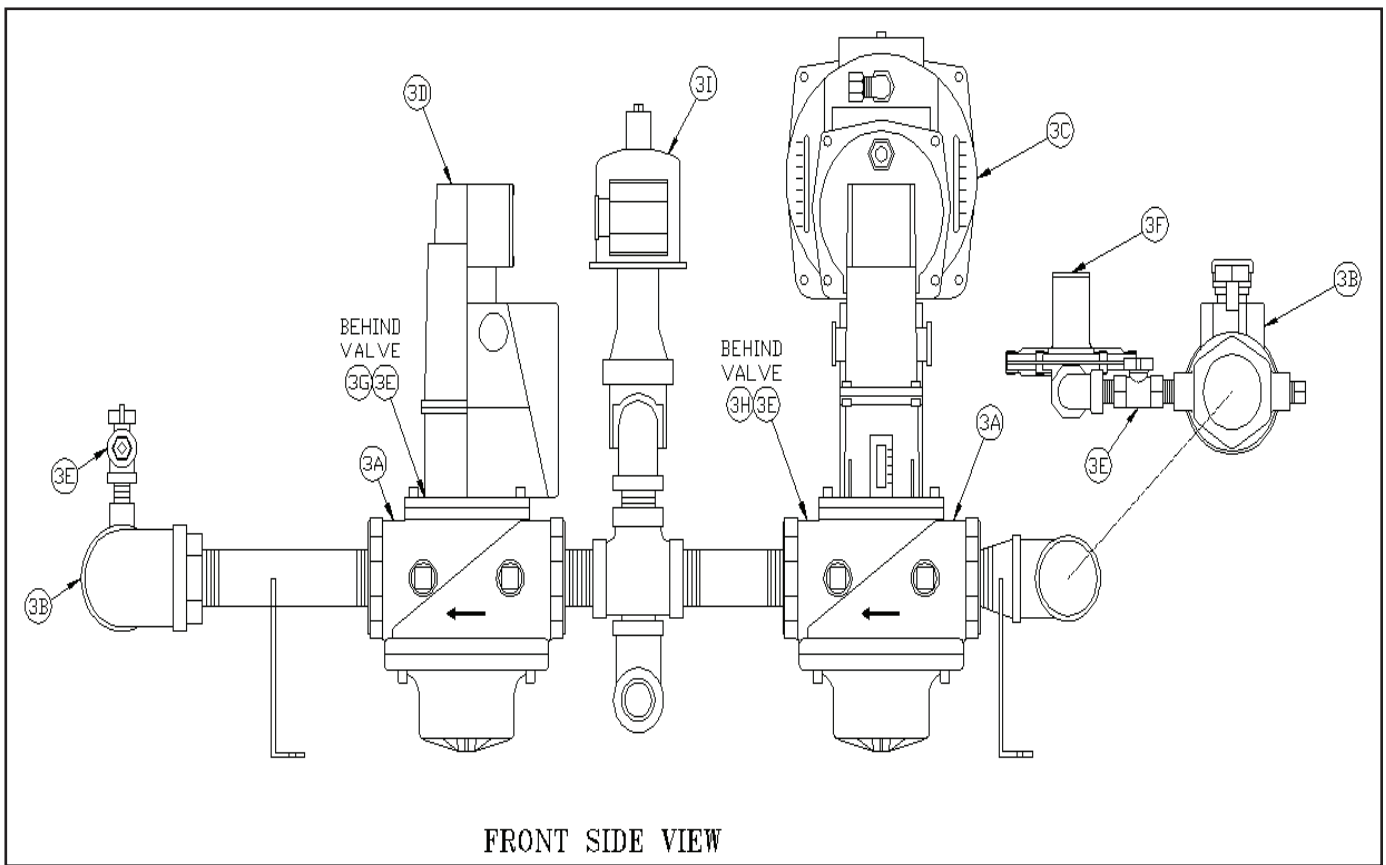


Figure 22a: DB&B/IRI w/POC Gas Train (On-Off, 250-750)

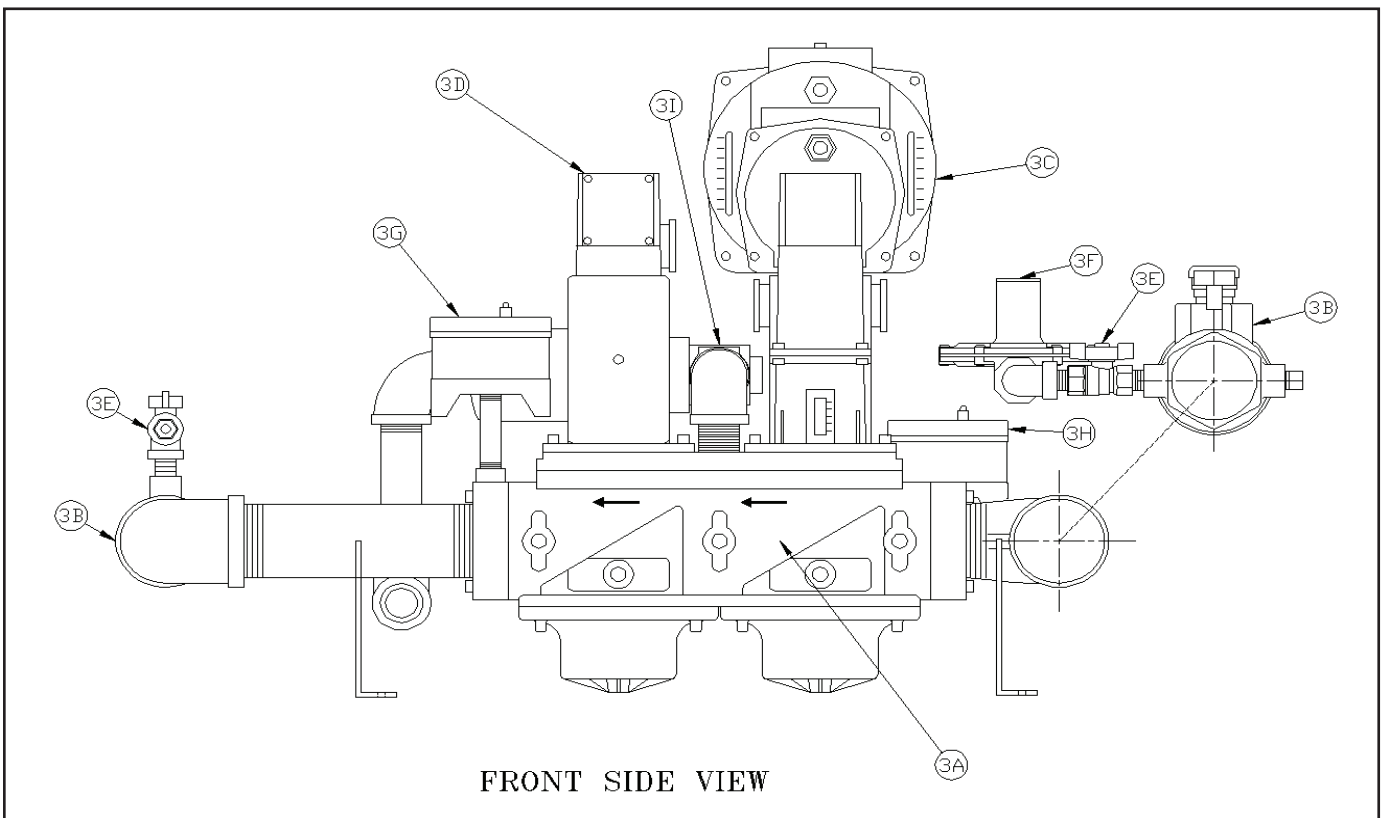
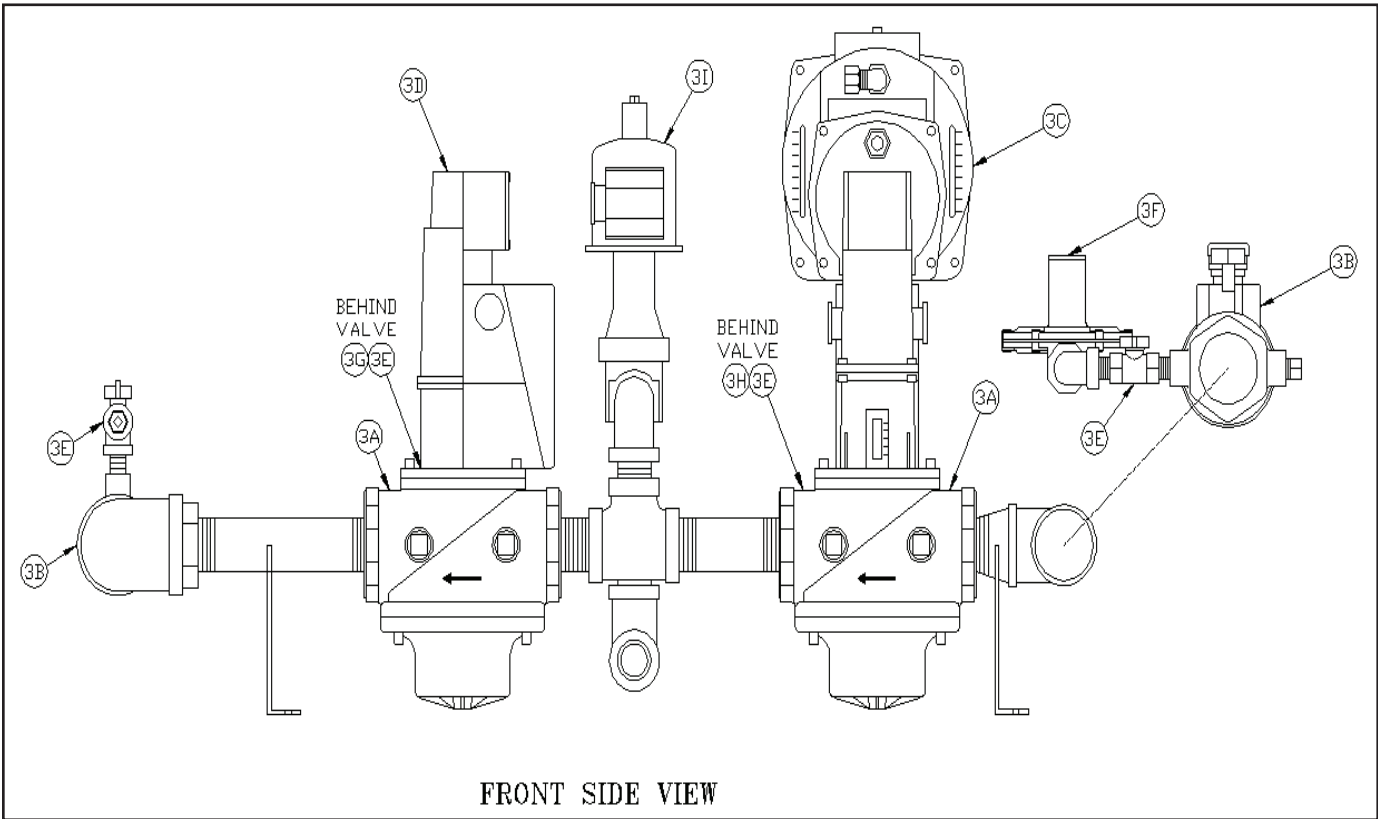
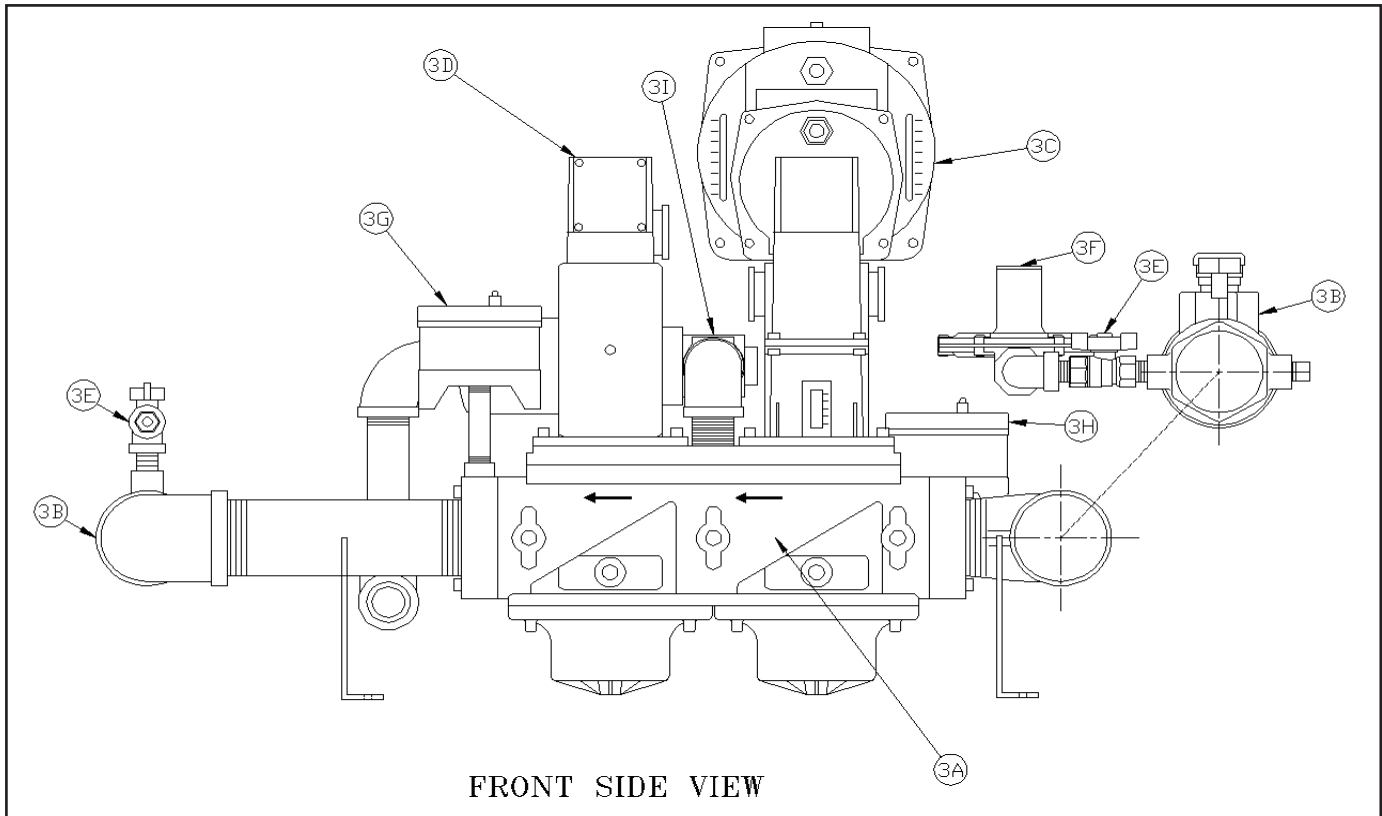


Figure 22b: DB&B/IRI w/POC Gas Train (On-Off, 1000-2000)

DB&B AND IRI W/POC (ON/OFF) - MAIN AND PILOT							
Key No.	Description	(Quantity) Part Number					
		EVA-250	EVA-500	EVA-750	EVA-1000	EVA-1500	EVA-2000
<b>3. Main and Pilot Gas Train</b>							
3A	Main Gas Valve Body 1" NPT	(2) 816634041			—	—	—
	Main Gas Valve Body, DBL 1-1/2" NPT	—	—	—	(1) 81663405		
3B	Manual Gas Valve with Pilot Tapping, 1" NPT	(2) 806603055			—	—	—
	Manual Gas Valve with Pilot Tapping, 1-1/2" NPT	—	—	—	(2) 806603053		
3C	DB&B Actuator/Regulator Siemens SKP20 (max 5psi)	(1) 81663410					
	IRI w/POC Actuator/Regulator Siemens SKP20 (max 5psi)	(1) 81663411					
3D	DB&B Actuator Siemens SKP10	(1) 81663406					
	IRI w/POC Actuator Siemens SKP10	(1) 81663407					
3E	Manual Gas Cock 1/4"	(3) 822758					
3F	325-3 Pilot Gas Regulator	(1) 822702					
3G	High Gas Pressure Switch	(1) 80160333					
3H	Low Gas Pressure Switch	(1) 80160332					
3I	Normally Open Vent Valve	(1) 81660262					



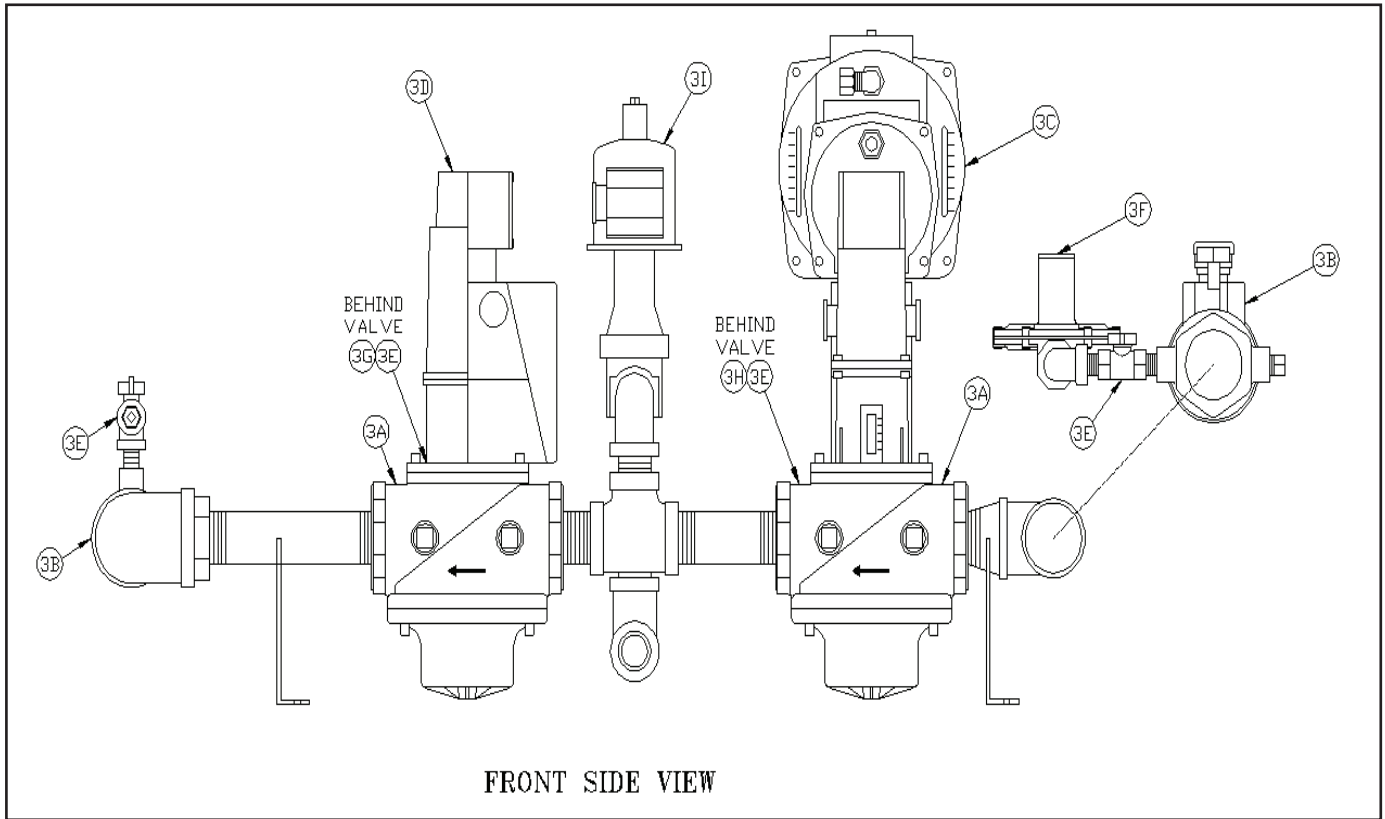
**Figure 23a: DB&B/IRI w/POC Gas Train (2-Stage, 750)**



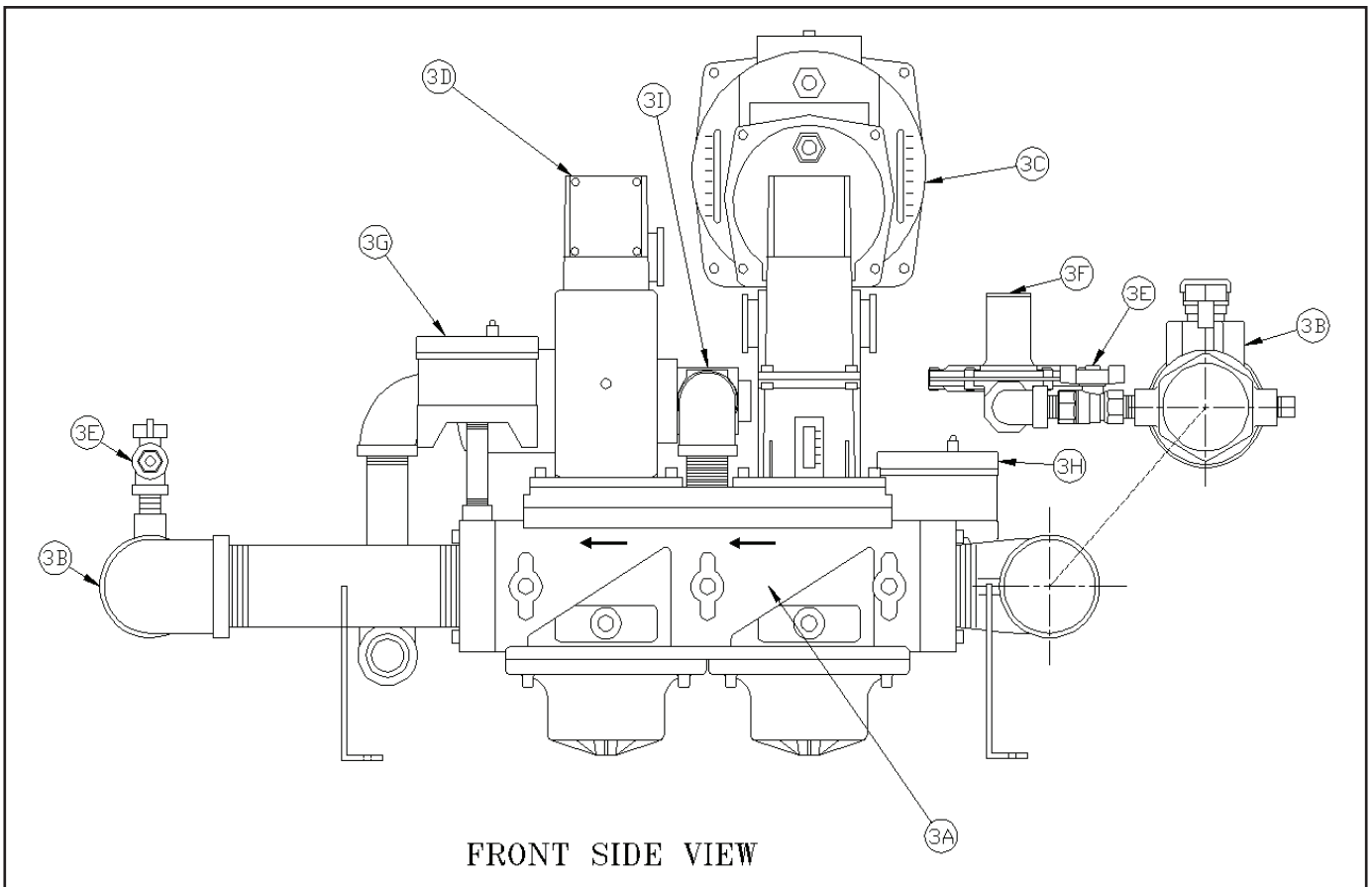
**Figure 23b: DB&B/IRI w/POC Gas Train (2-Stage, 1000-2000)**

DB&B AND IRI W/POC (2-STAGE) - MAIN AND PILOT							
Key No.	Description	(Quantity) Part Number					
		EVA-250	EVA-500	EVA-750	EVA-1000	EVA-1500	EVA-2000
<b>3. Main and Pilot Gas Train</b>							
3A	Main Gas Valve Body 1" NPT	N/A	N/A	(2) 816634041	—	—	—
	Main Gas Valve Body, DBL 1-1/2" NPT	N/A	N/A	—	(1) 81663405		
3B	Manual Gas Valve with Pilot Tapping, 1" NPT	N/A	N/A	(2) 806603055	—	—	—
	Manual Gas Valve with Pilot Tapping, 1-1/2" NPT	N/A	N/A	—	(2) 806603053		
3C	DB&B Actuator/Regulator/Ratio Valve Siemens SKP70 (max 5psi)	N/A	N/A	(1) 81663408			
	IRI w/POC Actuator/Regulator/Ratio Valve Siemens SKP70 (max 5psi)	N/A	N/A	(1) 81663409			
3D	DB&B Actuator Siemens SKP10	N/A	N/A	(1) 81663406			
	IRI w/POC Actuator Siemens SKP10	N/A	N/A	(1) 81663407			
3E	Manual Gas Cock 1/4"	N/A	N/A	(3) 822758			
3F	325-3 Pilot Gas Regulator	N/A	N/A	(1) 822702			
3G	High Gas Pressure Switch	N/A	N/A	(1) 80160333			
3H	Low Gas Pressure Switch	N/A	N/A	(1) 80160332			
3I	Normally Open Vent Valve	N/A	N/A	(1) 81660262			





**Figure 24a: DB&B/IRI w/POC Gas Train (Modulation, 250-750)**



**Figure 24b: DB&B/IRI w/POC Gas Train (Modulation, 1000-3000)**

DB&B AND IRI W/POC (Modulating) - MAIN AND PILOT										
Key No.	Description	(Quantity) Part Number								
		EVA-250	EVA-500	EVA-750	EVA-1000	EVA-1500	EVA-2000	EVA-2000S	EVA-2500	EVA-3000
<b>3. Main and Pilot Gas Train</b>										
3A	Main Gas Valve Body 1" NPT	(2) 816634041			—	—	—	—	—	—
	Main Gas Valve Body, DBL 1-1/2" NPT	—	—	—	(1) 81663405			—	—	
	Main Gas Valve Body, DBL 2" NPT	—	—	—	—	—	—	(1) 816634051		
3B	Manual Gas Valve with Pilot Tapping, 1" NPT	(2) 806603055			—	—	—	—	—	—
	Manual Gas Valve with Pilot Tapping, 1-1/2" NPT	—	—	—	(2) 806603053			—	—	
	Manual Gas Valve with Pilot Tapping, 2" NPT	—	—	—	—	—	—	(1) 806604691		
3C	DB&B Actuator/Regulator Ratio Valve Siemens SKP70 (max 5psi)	(1) 81663408								
	IRI w/POC Actuator/Regulator Ratio Valve Siemens SKP70 (max 5psi)	(1) 81663409								
3D	DB&B Actuator Siemens SKP10	(1) 81663406								
	IRI w/POC Actuator Siemens SKP10	(1) 81663407								
3E	Manual Gas Cock 1/4"	(3) 822758								
3F	325-3 Pilot Gas Regulator	(1) 822702								
3G	High Gas Pressure Switch	(1) 80160333								
3H	Low Gas Pressure Switch	(1) 80160332								
3I	Normally Open Vent Valve	(1) 81660262								

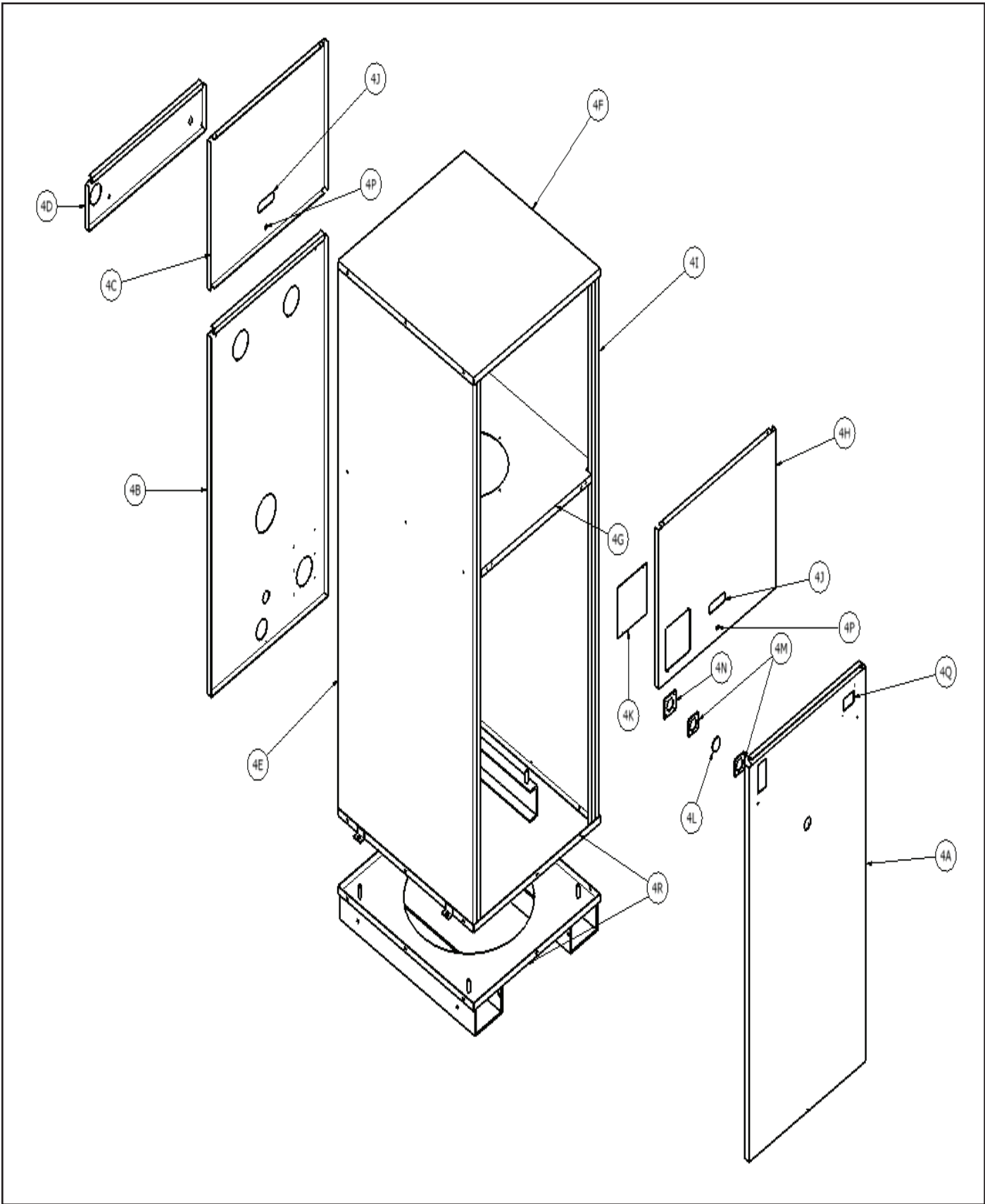


Figure 25: Jacket Panels Indoor Units

JACKET - INDOOR										
Key No.	Description	(Quantity) Part Number								
		EVA-250	EVA-500	EVA-750	EVA-1000	EVA-1500	EVA-2000	EVA-2000S	EVA-2500	EVA-3000
<b>4. Jacket Assembly</b>										
4A	Jacket Lower Front Panel (On/Off) & (2-Stage)	(1) 604563151	(1) 604563161	(1) 604563171	(1) 604563181	(1) 604563191	(1) 604563201	N/A	N/A	N/A
	Jacket Lower Front Panel (Modulation)	(1) 60456315	(1) 60456316	(1) 60456317	(1) 60456318	(1) 60456319	(1) 60456320	(1) 6045612030	(1) 6045602530	(1) 6045603030
4B	Jacket Lower Rear Panel	(1) 604563031	(1) 604563041	(1) 604563051	(1) 604563061	(1) 604563071	(1) 604563081	(1) 6045612040	(1) 6045602540	(1) 6045603040
4C	Jacket Upper Rear Panel	(1) 70456279						(1) 704563002		
4D	Jacket Center Rear Panel	(1) 704562471						(1) 704563004		
4E	Jacket Panel Left Side	(1) 604563271	(1) 604563281	(1) 604563291	(1) 604563301	(1) 604563311	(1) 604563321	(1) 6045612010	(1) 6045602510	(1) 6045603010
4F	Jacket Top Panel	(1) 704562541						(1) 704563000		
4G	Jacket Vestibule Panel	(1) 604563011		(1) 604563021				(1) 604563000		
4H	Jacket Upper Front Panel	(1) 70456278						(1) 704563001		
4I	Jacket Panel Right Side	(1) 604563211	(1) 604563221	(1) 604563231	(1) 604563241	(1) 604563251	(1) 604563261	(1) 6045612020	(1) 6045602520	(1) 6045603020
4J	Handle	(2) 8056256								
4K	View Port Cover for Flame Safeguard	(1) 81356007								
4L	Observation Port Lens	(1) 8026082								
4M	Observation Port Gasket	(2) 8206039								
4N	Observation Port Lens Retainer	(1) 7186019								
4P	Latch	(2) 80861722								
4Q	Power Switch w/Filter Light	(1) 6136363								

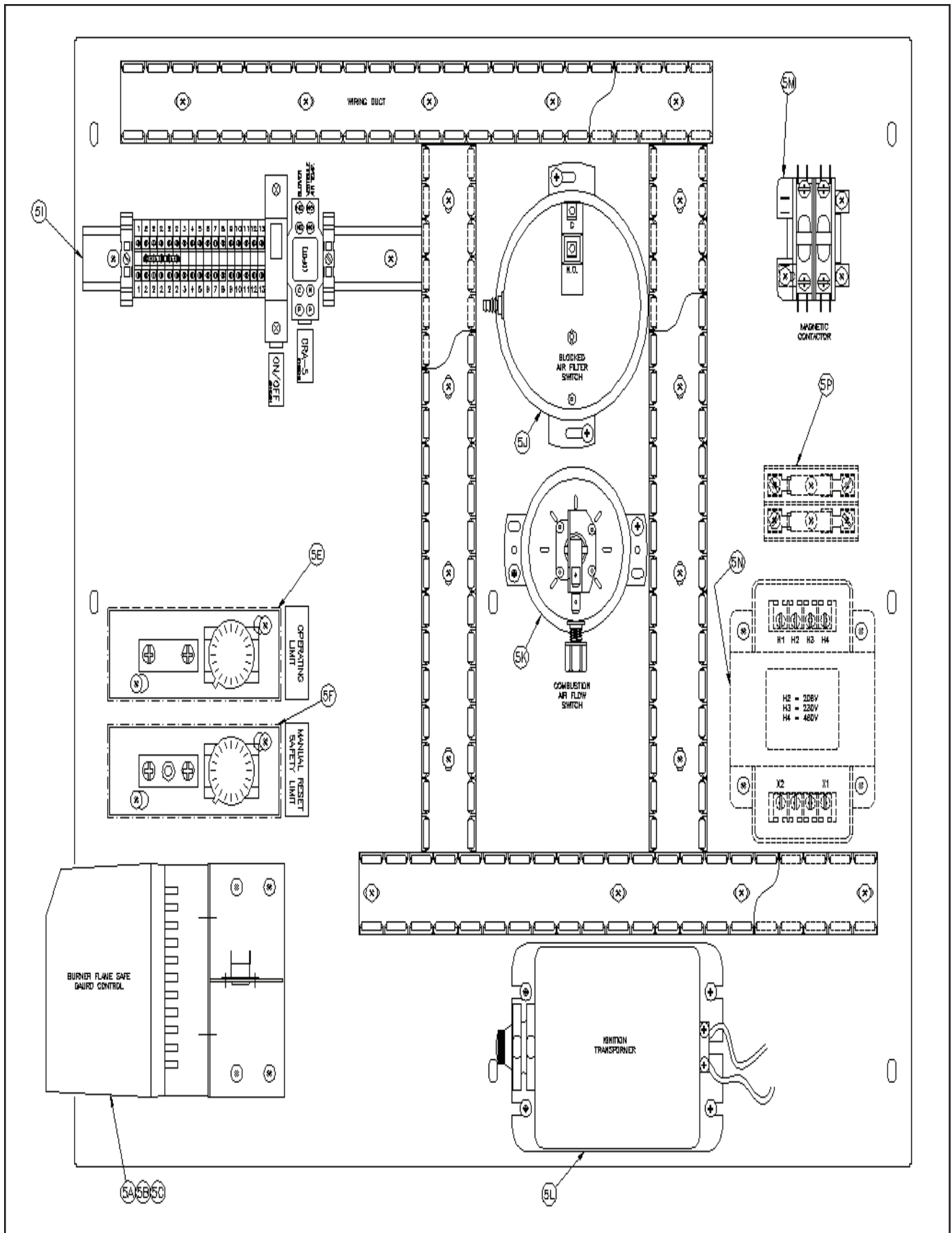


Figure 26a: Control Panel Assembly (On/Off)

CONTROLS (ON/OFF)							
Key No.	Description	(Quantity) Part Number					
		EVA-250	EVA-500	EVA-750	EVA-1000	EVA-1500	EVA-2000
<b>5. Controls and Components</b>							
5A	RM7896D1027 Flame Safeguard Control for UL/FM/CSD-1/DB&B				(1) 80160212		
	RM7800M1011 Flame Safeguard Control for IRI/POC				(1) 80160230		
	Modbus Module for 5A (optional - not shown)				(1) 80160909		
	Display Module for 5A (optional - not shown)				(1) 80160640		
5B	Amplifier Card (not shown) R7849A1023				(1) 80160243		
5C	Purge Card (not shown) ST7800A1039				(1) 8136362		
5D	Power Switch with Filter Light (not shown)				(1) 8136363		
5E	Operating Limit L4008A1015 (Auto Reset - max 240F)				(1) 80160626		
	Operating Limit L4008A1242 (Auto Reset - max 200F(wh))				(1) 80160659		
5F	High Limit L4008E1305 (Manual Reset - max 240F)				(1) 80160667		
	High Limit L4008E1313 (Manual Reset - max 200F (wh))				(1) 80160660		
5G	Water Flow Switch FS4-3 (not shown)				(1) 80160175		
5H	Vestibule Fuse Switch (not shown)				(1) 80160209		
5I	Terminal Block/Circuit Breaker Assembly				(1) 8136498		
5J	Blocked Filter Switch				(1) 80160295		
5K	Combustion Air Flow Switch (On/Off & 2-Stage)				(1) 80160903		
5L	Ignition Transformer				(1) 80160018		
5M	Motor Starter 115v/1ph (shown)				(1) 80160843		
	Motor Starter 208/230/460v-1/3ph (not shown)				(1) 80160415		
5N	Control Transformer (High Voltage Option)				(1) 80160820		
5P	Fuses and Fuse Block (High Voltage Option)				(2) & (2) 8136426 8136427		

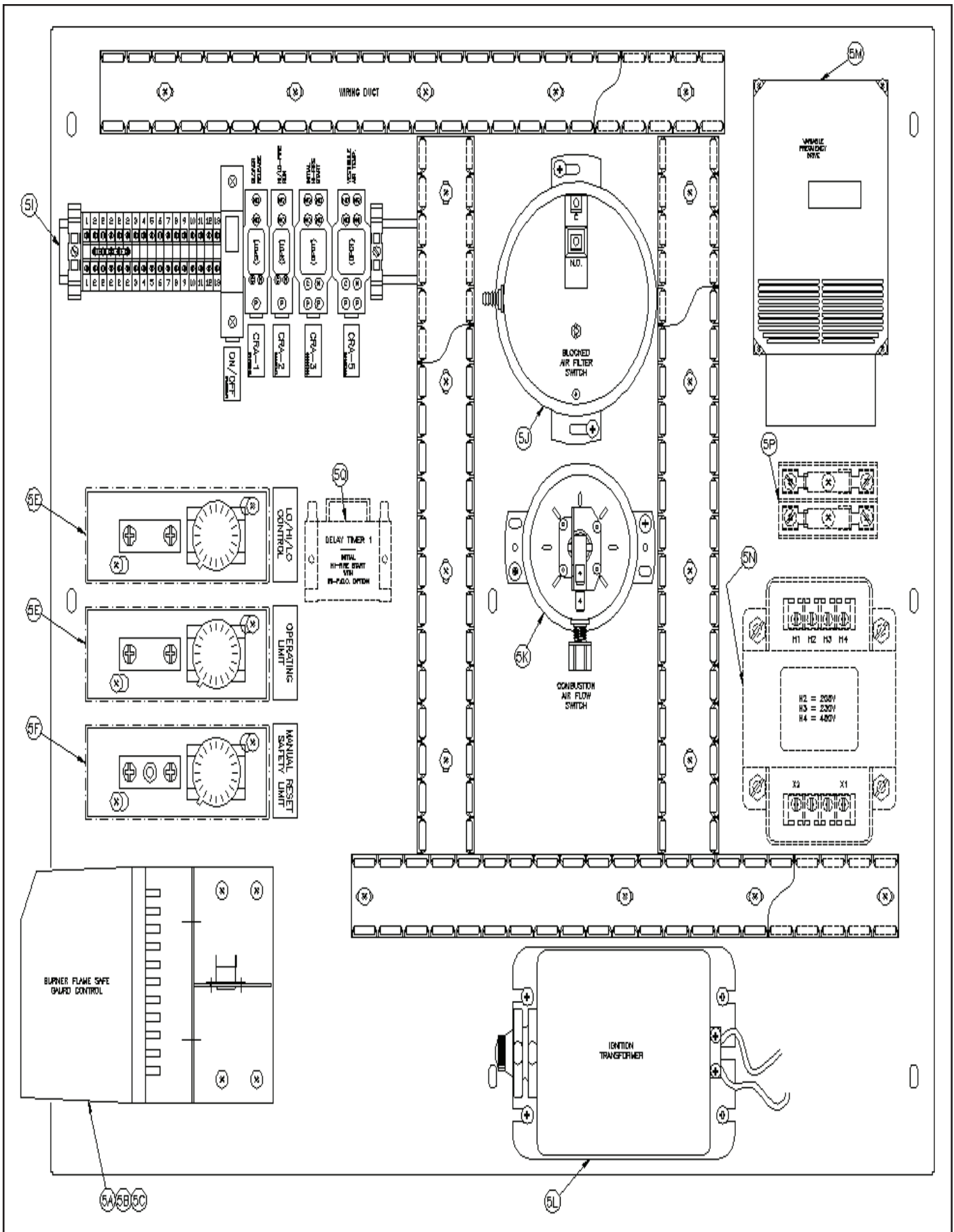


Figure 26b: Control Panel Assembly (2-Stage)

CONTROLS (2-Stage)							
Key No.	Description	(Quantity) Part Number					
		EVA-250	EVA-500	EVA-750	EVA-1000	EVA-1500	EVA-2000
<b>5. Controls and Components</b>							
5A	RM7896D1027 Flame Safeguard Control for UL/FM/CSD-1/DB&B	N/A	N/A		(1) 80160212		
	RM7800M1011 Flame Safeguard Control for IRI/POC	N/A	N/A		(1) 80160230		
	Modbus Module for 5A (optional - not shown)	N/A	N/A		(1) 80160909		
	Display Module for 5A (optional - not shown)	N/A	N/A		(1) 80160640		
5B	Amplifier Card (not shown) R7849A1023	N/A	N/A		(1) 80160243		
5C	Purge Card (not shown) ST7800A1039	N/A	N/A		(1) 8136362		
5D	Power Switch with Filter Light (not shown)	N/A	N/A		(1) 8136363		
5E	Operating Limit L4008A1015 (Auto Reset - max 240F)	N/A	N/A		(1) 80160626		
	Operating Limit L4008A1242 (Auto Reset - max 200F(wh))	N/A	N/A		(1) 80160659		
5F	High Limit L4008E1305 (Manual Reset - max 240F)	N/A	N/A		(1) 80160667		
	High Limit L4008E1313 (Manual Reset - max 200F (wh))	N/A	N/A		(1) 80160660		
5G	Water Flow Switch FS4-3 (not shown)	N/A	N/A		(1) 80160175		
5H	Vestibule Fuse Switch (not shown)	N/A	N/A		(1) 80160209		
5I	Terminal Block/Circuit Breaker Assembly	N/A	N/A		(1) 8136498		
5J	Blocked Filter Switch	N/A	N/A		(1) 80160295		
5K	Combustion Air Flow Switch (On/Off & 2-Stage)	N/A	N/A		(1) 80160903		
5L	Ignition Transformer	N/A	N/A		(1) 80160018		
5M	Variable Frequency Drive 115 volt input	N/A	N/A		(1) 80160933		
	Variable Frequency Drive 208/230 volt input	N/A	N/A		(1) 80160934		
	Variable Frequency Drive 460 volt input	N/A	N/A		(1) 80160936		
5N	Control Transformer (High Voltage Option)	N/A	N/A		(1) 80160820		
5P	Fuses and Fuse Block (High Voltage Option)	N/A	N/A		(2) & (2) 8136426 8136427		
5Q	Delay Timer (IRI/POC option only)	N/A	N/A		(1) 80160675		



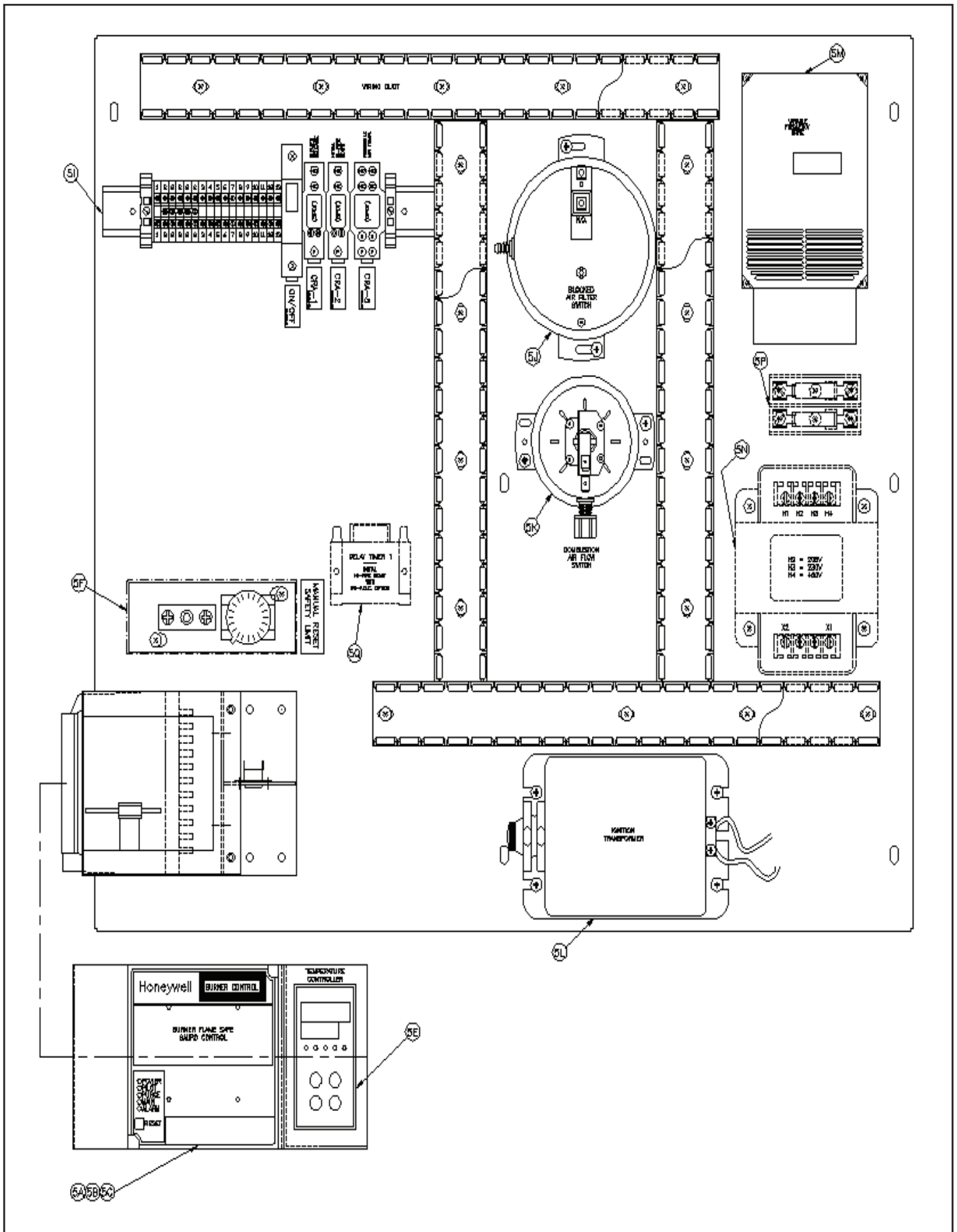
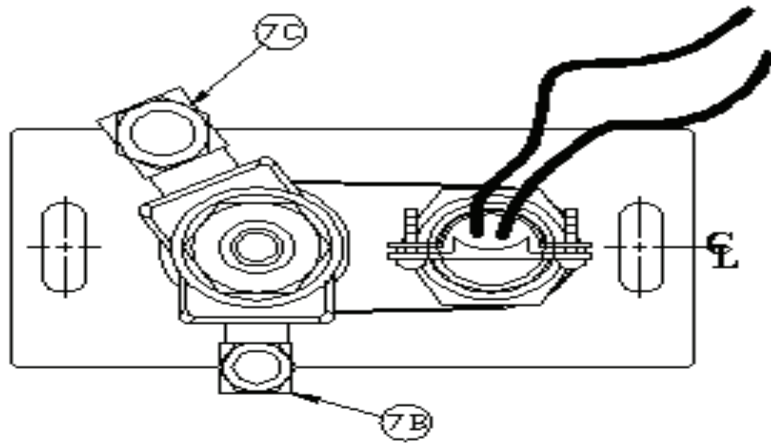
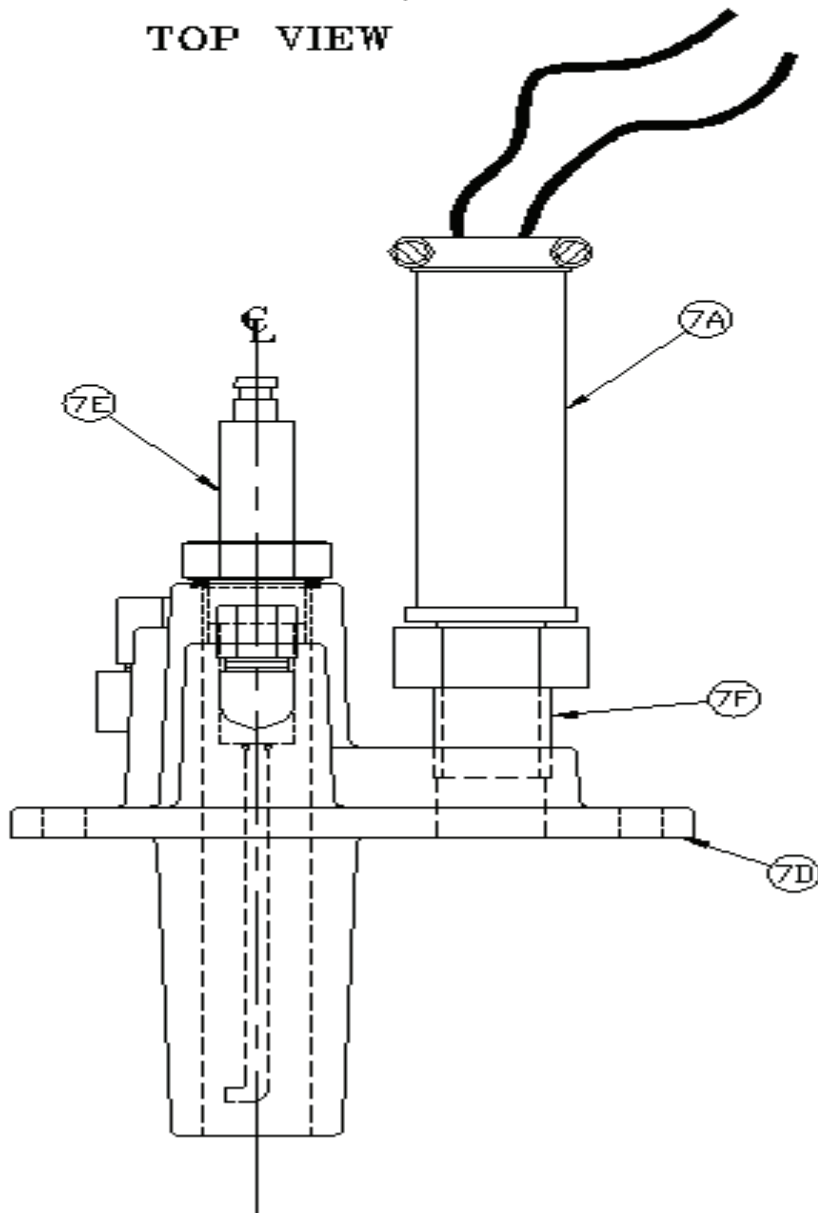


Figure 26c: Control Panel Assembly (Modulation)

CONTROLS (Modulation)											
Key No.	Description	(Quantity) Part Number									
		EVA-250	EVA-500	EVA-750	EVA-1000	EVA-1500	EVA-2000	EVA-2000S	EVA-2500	EVA-3000	
<b>5. Controls and Components</b>											
5A	RM7896D1027 Flame Safeguard Control for UL/FM/CSD-1/DB&B	(1) 80160212					—				
	RM7800M1011 Flame Safeguard Control for IRI/POC	(1) 80160230					—				
	RM7840L1018 Flame Safeguard Control	—					(1) 801602302				
	Modbus Module for 5A (optional - not shown)	(1) 80160909									
	Display Module for 5A (optional - not shown)	(1) 80160640									
5B	Amplifier Card (not shown) R7849A1023	(1) 80160243									
5C	Purge Card (not shown) ST7800A1039	(1) 8136362					—				
	Purge Card (not shown) ST7800A1005	—					(1) 81363621				
5D	Power Switch with Filter Light (not shown)	(1) 8136363									
5E	Operating Limit, Digital RWF40	(1) 80160905									
	Operating Limit, Digital Modbus, RWF40 (optional)	(1) 80160908									
5F	High Limit L4008E1305 (Manual Reset - max 240F)	(1) 80160667									
	High Limit L4008E1313 (Manual Reset - max 200F (wh))	(1) 80160660									
5G	Water Flow Switch FS4-3 (not shown)	(1) 80160175									
5H	Vestibule Fuse Switch (not shown)	(1) 80160209									
5I	Terminal Block/Circuit Breaker Assembly	(1) 8136498									
5J	Blocked Filter Switch	(1) 80160295									
5K	Combustion Air Flow Switch (Modulating)	(1) 80160914									
5L	Ignition Transformer	(1) 80160018									
5M	Variable Frequency Drive 115 volt input	(1) 80160931	(1) 80160933					N/A			
	Variable Frequency Drive 208/230 volt input	(1) 80160932	(1) 80160934								
	Variable Frequency Drive 460 volt input	(1) 80160935	(1) 80160936								
5N	Control Transformer (High Voltage Option)	(1) 80160820									
5P	Fuses and Fuse Block (High Voltage Option)	(2) & (2) 8136426 8136427									
5Q	Delay Timer (IRI/POC Option Only)	(1) 80160675					—				



TOP VIEW



FRONT VIEW

Figure 27a: ULX2 Pilot Assembly

PILOT ASSEMBLY (ULX2 Design)										
Key No.	Description	(Quantity) Part Number								
		EVA-250	EVA-500	EVA-750	EVA-1000	EVA-1500	EVA-2000	EVA-2000S	EVA-2500	EVA-3000
<b>7. Pilot Assembly, ULX2</b>										
—	Pilot Assembly Natural Gas, ULX2	(1) 62356109								
	Pilot Assembly Propane, ULX2	(1) 62356209								
7A	Ultraviolet Sensor	(1) 8026145								
7B	Pilot Orifice Natural Gas	(1) 722606								
	Pilot Orifice Propane	(1) 722605								
7C	Pilot Air Orifice	(1) 722607								
7D	Cast Iron Body, ULX2	(1) 8236158								
7E	Ignitor, ULX2 (STD) (Brass Nut)	(1) 82356009								
	Ignitor, ULX1 (OLD) (3 set screws)	(1) 82356008						N/A		
7F	Heat Block	(1) 8026217								
7G	Pilot Ignition Cable (not shown)	(1) 6135601								
7H	Pilot Solenoid Valve V4046C1047 (not shown)	(1) 81660204								
7I	O-Ring	(1) 8206054								

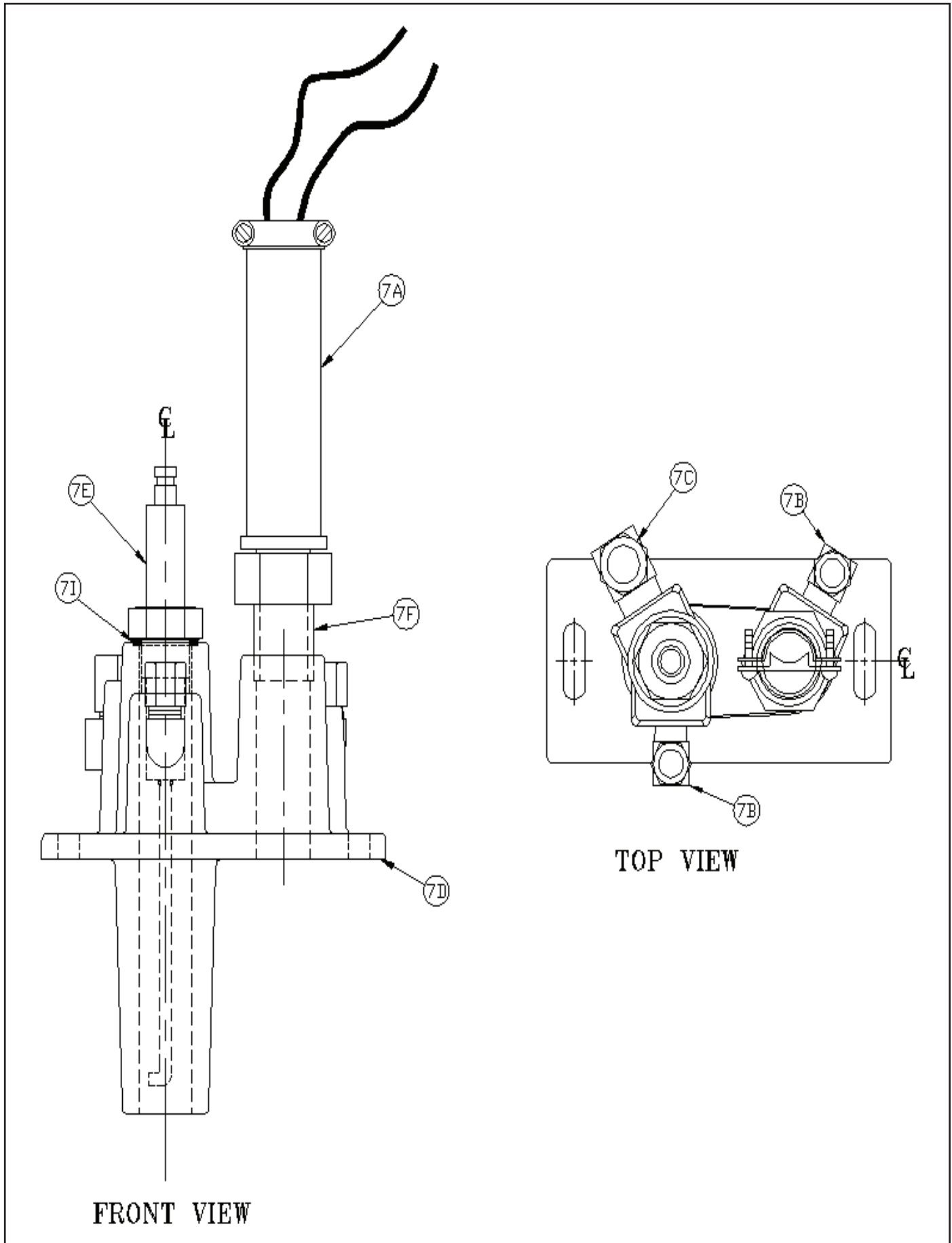


Figure 27b: "Bishop" Pilot Assembly

PILOT ASSEMBLY (Bishop Design)										
Key No.	Description	(Quantity) Part Number								
		EVA-250	EVA-500	EVA-750	EVA-1000	EVA-1500	EVA-2000	EVA-2000S	EVA-2500	EVA-3000
7. Pilot Assembly, Bishop										
—	Pilot Assembly Natural Gas, ULX2					(1) 62356110				
—	Pilot Assembly Propane, ULX2					(1) 62356210				
7A	Ultraviolet Sensor					(1) 8026145				
7B	Pilot Orifice Natural Gas					(1) 722606				
	Pilot Orifice Propane					(1) 722605				
7C	Pilot Air Orifice					(1) 722607				
7D	Cast Iron Body					(1) 82361581				
7E	Ignitor Assembly, ULX2					(1) 82356009				
7F	Nipple, 1/2 NPT x Close					(1) 806600040				
7G	Pilot Ignition Cable (not shown)					(1) 6135601				
7H	Pilot Solenoid Valve V4046C1047 (not shown)					(1) 81660204				
7I	O-Ring					(1) 8206054				

## VIII Appendix A –Temperature Controller Operation for Modulating Boilers



### A. Description

The microprocessor based temperature controller is utilized for all modulating Thermal Solutions water boilers. The basic function of the controller is to modulate the firing rate of the burner in response to the boiler heat load. The controller monitors the boiler water temperature through the use of a sensor located in the boiler pressure vessel. The controller compares the boiler water temperature to the controller’s user defined operating set-point temperature.

An output signal from the microprocessor varies the blower speed through the use of a variable frequency drive (VFD). The gas valve regulates an appropriate amount of gas flow for a given air flow or blower speed. The user may adjust the operating set-point temperature for a given application. In addition, the controller has the ability to change to an alternate set-point through an external signal for low load conditions (i.e. weekend use, night setback). Outdoor reset is another standard feature, allowing the boiler operating temperature to vary based on the outdoor ambient temperature. The typical result is a higher seasonal efficiency.

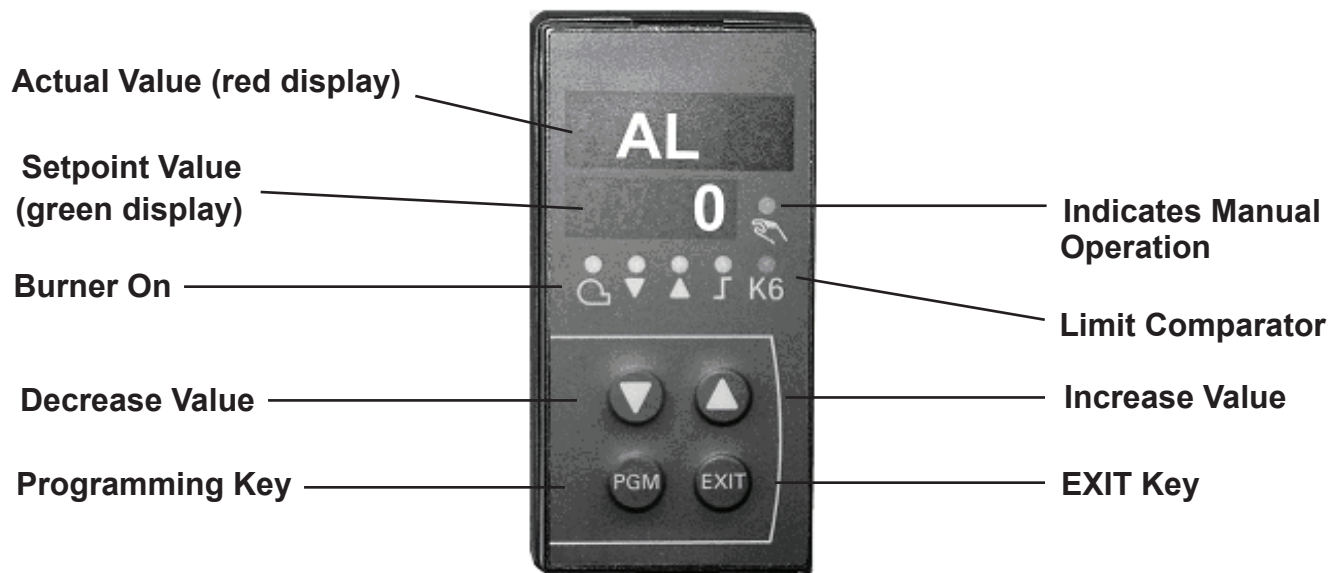
Other features include:

<b>Low Fire Hold</b>	<b>2-Stage Operation</b>
<b>Multiple Set Points</b>	<b>Multiple Analog Inputs</b>
<b>Digital Inputs</b>	<b>Mod Bus Communications</b>
<b>"AUTO TUNE" Optimization</b>	<b>Manual Override</b>

### B. Set-Up

All of the control parameters have been set at the factory. There are a few parameters called “Process Parameters” that must be defined by a qualified operator. The table below will help serve as a reference and record when making adjustments.

<b>Parameter</b>	<b>Display</b>	<b>Value Range*</b>	<b>Factory Setting</b>	<b>User Setting</b>
<b>Setpoint 1</b>	SP1	145-240	180	
<b>Setpoint 2</b>	SP2	145-240	0	
<b>Digital Setpoint Shift (optional)</b>	dSP	145-240	0	
<b>Outside Temperature (optional)</b>	TA	Consult Factory	—	
<b>Pre-definition of External setpoint (optional)</b>	SP.E	Consult Factory	—	



To alter any of these process parameters follow the following steps:

- To obtain access into the programming mode of the controller, briefly press the button “PGM”.
- You will see “SP1” displayed on the second line in green LEDs. The previously set operating temperature will be displayed on the first line in red LEDs. To increase or decrease the setpoint 1 value (SP1) use the up and down arrow keys respectively ( ▲ ▼ ).
- To set the value for “SP2”, briefly press the “PGM” key and follow the same instructions above.
- To return to the operating mode press “EXIT”, otherwise the unit will automatically return to the operating mode after 30 seconds of no activity.

To make other adjustments, contact your local representative or consult the factory.

### C. Adjustments

Often during troubleshooting conditions it may become necessary to manually adjust the firing rate. Follow the instructions below to make manual firing rate adjustments.

- Press “EXIT” button and hold for 5 -10 seconds.
- The red light above manual operation (hand) symbol illuminates.
- Press ▲ button to raise firing rate. Press ▼ button to lower firing rate.
- 0 = 50% of Maximum firing rate and 100 = 100% of Maximum firing rate
- Press “EXIT” button and hold for 5 –10 seconds to return to automatic firing rate control.
- Automatic mode has been re-activated once the red light above the manual operation symbol goes out.

### D. Other

#### System Specifications

Input voltage—100-240vac 48/63hz  
 Environmental—Nema 4 external, Internal 95%rh noncondensing  
 Transducer supply—24VDC, 30ma  
 Analog Input 1—Pt100,Ni100, Thermocouple (J, K, T or N),4-20ma and Analog 0-10v  
 Analog Input 2—1k pot,4-20ma, 0-1VDC, 0-10 VDC  
 Analog Input 3—Pt100,Ni100 Temperature sensors  
 Output 1 release to modulate-24-240VAC 2Amps max  
 Output 2 and 3 open/close—24-240VAC 2Amps max  
 Output 4 programmable—24-240VAC 2Amps max  
 Output 5 analog output—0-10 VDC (500 ohm load min), 0-20 or 4-20ma (500ohm load max)  
 Mod bus rtu port—9600 Baud, unit Address 1-99  
 Data storage—EEPROM  
 Approvals—UL, CSA, CE



# NOTES

# NOTES

# Thermal Solutions

("seller")

## LIMITED WARRANTY

### LIMITED WARRANTY

Subject to the terms and conditions herein and except as provided below with respect to products or parts not manufactured by Thermal Solutions, Seller warrants to the original owner at the original installation site that products manufactured by Seller ("Products") comply, at the time of manufacture, the heat exchanger with recognized hydronics industry regulatory agency standards and requirements then in effect and will be free from defects in materials and workmanship for a period of 3 years from date of shipment (the "Warranty Period"). The burner is also covered under the limited warranty for 10 years from date of shipment (the "Warranty" Period). SPECIAL NOTE: The warranty of any boiler found to be operating as a "Water Heater" shall revert back to Thermal Solution's standard water heater warranty.

For products or parts not manufactured by Thermal Solutions, the warranty obligations of Thermal Solutions shall, in all respects, be limited to one year.

### REMEDY

- A. The sole remedy for breach of this warranty is expressly limited to the repair or replacement of any part found to be defective under conditions of normal use within the Warranty Period. Labor for removal and/or installation is not included.
- B. Warranty - The owner must notify the original installer of the Product and Seller (Attention: Thermal Solutions, P.O. Box 3244, Lancaster, PA 17604-3244), in writing, within the Warranty Period, providing a detailed description of all claimed defects. Transportation to a factory or other designated facility for repairs of any products or items alleged defective shall, in all events, be the responsibility and at the cost of the owner.

### EXCLUSIONS

Seller shall have no liability for and this warranty does not cover:

- A. Incidental, special or consequential damages, such as loss of the use of products, facilities or production, inconvenience, loss of time or labor expense involved in repairing or replacing the alleged defective Product.
- B. The performance of any Product under conditions varying materially from those under which such Product is usually tested under industry standards as of the time of shipment.
- C. Any damage to the Product due to abrasion, erosion, corrosion, deterioration, abnormal temperatures or the influence of foreign matter or energy.
- D. The design or operation of owner's plant or equipment or of any facility or system of which any Product may be made a part.
- E. The suitability of any Product for any particular application.

- F. Any failure resulting from misuse, modification not authorized by Seller in writing, improper installation or lack of or improper maintenance.
- G. Equipment furnished by the owner, either mounted or unmounted, or when contracted for by the owner to be installed or handled.
- H. Leakage or other malfunction caused by:
  - 1. Defective installations in general and specifically, any installation which is made:
    - a. in violation of applicable state or local plumbing housing or building codes,
    - b. without a certified ASME, pressure relief valve, or
    - c. contrary to the written instructions furnished with the unit
  - 2. Adverse local conditions in general and, specifically, sediment or lime precipitation in the tubes and/or headers or corrosive elements in the atmosphere.
  - 3. Misuse in general and, specifically, operation and maintenance contrary to the written instructions furnished with the unit, disconnection, alteration or addition of components or apparatus, not approved by seller, operation with fuels or settings other than those set forth on the rating plate or accidental or exterior damage.
- I. Production of noise, odors, discoloration or rusty water.
- J. Damage to surrounding area or property caused by leakage or malfunction.
- K. Costs associated with the replacement and/or repair of the unit including: any freight, shipping or delivery charges, any removal, installation or reinstallation charges, any material and/or permits required for installation reinstallation or repair, charges to return the boiler and or components.

Seller's liability under this warranty shall not in any case exceed the amount paid for the Product found to be defective.

### THIRD-PARTY WARRANTIES

For goods or components not manufactured by Seller, the warranty obligations of Seller shall, in all respects, conform and be limited to one year from the date of shipment

### SEVERABILITY

To the extent that any provision of this warranty would be void or prohibited under applicable law, such provisions shall be limited in effect to the minimum extent necessary to render the remaining provisions hereof enforceable.

