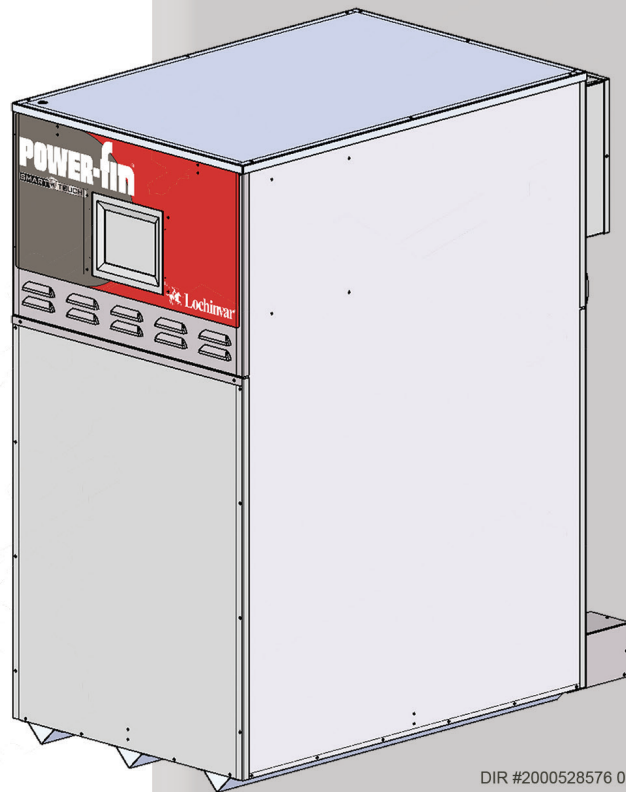


POWER-fin®

Installation & Operation Manual

Models: 502, 752, 1002, 1302,
1501, 1701, and 2001
Up To 5:1 Turndown
Beginning with
Serial #1707104971206



DIR #2000528576 00



WARNING:

This manual supplies information for the installation, operation, and servicing of the appliance. It is strongly recommended that this manual and the Power-fin Service Manual be reviewed completely before proceeding with an installation. Perform steps in the order given. Failure to comply could result in severe personal injury, death, or substantial property damage.


Save this manual for future reference.


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Hazard definitions

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

 **DANGER** DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

 **WARNING** WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

 **CAUTION** CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION CAUTION used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

NOTICE NOTICE indicates special instructions on installation, operation, or maintenance that are important but not related to personal injury or property damage.

Please read before proceeding

⚠ WARNING

Installer – Read all instructions, including this manual and the Power-fin Service Manual, before installing. Perform steps in the order given.

User – This manual is for use only by a qualified heating installer/service technician. Refer to the User's Information Manual for your reference.

Have this boiler serviced/inspected by a qualified service technician, at least annually.

Failure to comply with the above could result in severe personal injury, death or substantial property damage.

NOTICE

When calling or writing about the boiler – Please have the boiler model and serial number from the boiler rating plate.

Consider piping and installation when determining boiler location.

Any claims for damage or shortage in shipment must be filed immediately against the transportation company by the consignee.

Factory warranty (shipped with unit) does not apply to units improperly installed or improperly operated.

⚠ WARNING

Failure to adhere to the guidelines on this page can result in severe personal injury, death, or substantial property damage.

⚠ WARNING

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

This appliance **MUST NOT** be installed in any location where gasoline or flammable vapors are likely to be present.

WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
- Do not touch any electric switch; do not use any phone in your building.
- Immediately call your gas supplier from a near by phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.
- Installation and service must be performed by a qualified installer, service agency, or the gas supplier.

⚠ WARNING

DO NOT install units in rooms or environments that contain corrosive contaminants (see Table 1A on page 13). Failure to comply could result in severe personal injury, death, or substantial property damage.

⚠ WARNING

The California Safe Drinking Water and Toxic Enforcement Act requires the Governor of California to publish a list of substances known to the State of California to cause cancer, birth defects, or other reproductive harm, and requires businesses to warn of potential exposure to such substances.

This product contains a chemical known to the State of California to cause cancer, birth defects, or other reproductive harm. This boiler can cause low level exposure to some of the substances listed in the Act.

When servicing boiler –

- To avoid electric shock, disconnect electrical supply before performing maintenance.
- To avoid severe burns, allow boiler to cool before performing maintenance.

Boiler operation –

- Do not block flow of combustion or ventilation air to the boiler.
- Should overheating occur or gas supply fail to shut off, do not turn off or disconnect electrical supply to circulator. Instead, shut off the gas supply at a location external to the appliance.
- Do not use this boiler if any part has been under water. The possible damage to a flooded appliance can be extensive and present numerous safety hazards. Any appliance that has been under water must be replaced.

Boiler water –

- Thoroughly flush the system to remove debris. Use an approved pre-commissioning cleaner (see Start-Up Section), without the boiler connected, to clean the system and remove sediment. The high efficiency heat exchanger can be damaged by build-up or corrosion due to sediment.

NOTE: Cleaners are designed for either new systems or pre-existing systems. Choose accordingly.

- Do not use petroleum-based cleaning or sealing compounds in the boiler system. Gaskets and seals in the system may be damaged. This can result in substantial property damage.
- Do not use “homemade cures” or “boiler patent medicines”. Serious damage to the boiler, personnel, and/or property may result.
- Continual fresh make-up water will reduce boiler life. Mineral buildup in the heat exchanger reduces heat transfer, overheats the heat exchanger, and causes failure. Addition of oxygen carried in by makeup water can cause internal corrosion in system components. Leaks in boiler or piping must be repaired at once to prevent the need for makeup water.

Freeze protection fluids (Boiler Only) –

- NEVER use automotive antifreeze. Use only inhibited propylene glycol solutions, which are specifically formulated for hydronic systems. Ethylene glycol is toxic and can attack gaskets and seals used in hydronic systems.

Please read before proceeding

⚠ WARNING

To minimize the possibility of serious personal injury, fire, or damage to your appliance, never violate the following safety rules:

1. Boilers and water heaters are heat producing appliances. To avoid damage or injury, do not store materials against the appliance or the vent-air intake system. Use proper care to avoid unnecessary contact (especially children) with the appliance and vent-air intake components.
2. Never cover your appliance, lean anything against it, store trash or debris near it, stand on it or in any way block the flow of fresh air to your appliance.
3. UNDER NO CIRCUMSTANCES must flammable materials such as gasoline or paint thinner be used or stored in the vicinity of this appliance, vent-air intake system or any location from which fumes could reach the appliance or vent-air intake system.

Codes –

The equipment shall be installed in accordance with those installation regulations in force in the local area where the installation is to be made. These shall be carefully followed in all cases. Authorities having jurisdiction shall be consulted before installations are made. In the absence of such requirements, the installation shall conform to the latest edition of the National Fuel Gas Code, ANSI Z223.1. Where required by the authority having jurisdiction, the installation must conform to American Society of Mechanical Engineers Safety Code for Controls and Safety Devices for Automatically Fired Boilers, ASME CSD-1. All boilers conform to the latest edition of the ASME Boiler and Pressure Vessel Code, Section IV. Where required by the authority having jurisdiction, the installation must comply with the Canadian Gas Association Code, CAN/CGA-B149.1 and/or B149.2 and/or local codes. This appliance meets the safe lighting performance criteria with the gas manifold and control assembly provided, as specified in the ANSI standards for gas-fired hot water boilers, ANSI Z21.13 and gas water heaters, ANSI Z21.10.3.

The Power-fin - How it works...

- 1. Heat exchanger**

The heat exchanger allows system water to flow through specially designed tubes for maximum heat transfer. The glass lined headers and copper finned tubing are encased in a jacket that contains the combustion process.
- 2. Heat exchanger access cover**

The heat exchanger access cover is a stainless steel door which allows access for service, maintenance, and removal of the heat exchanger from inside the combustion chamber.
- 3. Blower**

The blower pulls in air and gas through the venturi (see item 5) and injects the fuel/air mixture into the burner, where they burn inside the combustion chamber.
- 4. Gas valve**

The gas valve allows the proper amount of gas to pass into the burner for combustion. The gas valve on the Power-fin works under a negative pressure (M9 models only) so gas should only be pulled through the valve when the blower is in operation.
- 5. Venturi**

The venturi attaches to the inlet (or suction) side of the blower and generates the negative pressure needed by the gas valve.
- 6. Flue sensor (not shown)**

The flue sensor is mounted in the exhaust collar of the unit and monitors the flue gas temperature. If the temperature in the stack exceeds the maximum temperature the unit will shut down to prevent a hazardous condition. In Category I models the flue sensor helps to control the amount of modulation to prevent condensation in the stack.
- 7. Outlet temperature sensor**

This sensor monitors the outlet water temperature. If selected as the controlling sensor, the appliance will maintain set point by adjusting the firing rate of the unit according to this sensor.
- 8. Inlet temperature sensor**

This sensor monitors inlet water temperature. If selected as the controlling sensor, the appliance will maintain set point by adjusting the firing rate of the unit according to this sensor.
- 9. Temperature and pressure gauge (boilers only)**

The temperature and pressure gauge monitors the outlet temperature of the appliance as well as the system water pressure.
- 10. Electronic display**

Digital controls with SMART TOUCH screen technology, full color display, and an 8" user interface screen.
- 11. Burner (not shown)**

The burner is made of a woven fabric over steel screen construction. The burner uses pre-mixed air and gas and provides a wide range of firing rates.
- 12. Water outlet (system supply)**

The water outlet is a 2 1/2" pipe connection that supplies water to the system with connections for a flow switch (see #28), a relief valve (see #24), and a temperature and pressure gauge (boilers only) (see #9).
- 13. Water inlet (system return)**

The water inlet is a 2 1/2" pipe connection that receives water from the system and delivers it to the heat exchanger.
- 14. Gas connection pipe**

The gas pipe connection on this appliance is 1", 1 1/4", or 1 1/2" NPT. To deliver the correct amount of gas volume to the appliance it may be necessary to have a larger gas line reduced at the appliance. Please reference the National Fuel Gas Code charts for more details.
- 15. SMART TOUCH Control Module**

The SMART Touch Control Module is the main control for the appliance. This module contains the programming that operates the blower, gas valve, and pumps in addition to other programmable features.
- 16. Air intake**

The air intake pipe allows fresh air to flow directly to the appliance. The air inlet is part of the filter box assembly where air filtration is accomplished with a standard filter.
- 17. Line voltage terminal strip**

The line voltage terminal strip provides a location to connect all of the line voltage (120 VAC) contact points to the unit.
- 18. Low voltage connection board**

The low voltage connection board provides a location to tie in all of the low voltage contacts to the appliance. This is where most of the external safety devices are connected to the unit such as the louver proving switch.
- 19. Condensate trap**

The condensate trap is designed to prevent flue gases from escaping the appliance through the combustion chamber drain.
- 20. Access cover - front**

The front access cover provides access to the gas train as well as the blower and other key components for service and maintenance.
- 21. Hot surface igniter (HSI)**

The hot surface igniter is a device that is used to ignite the air/gas mixture as well as monitor the performance of the flame during operation. This device acts as a flame sense electrode.
- 22. Flame inspection window (sight glass - not shown)**

The flame inspection window is a quartz glass window that allows a visual inspection of the burner and flame during operation.
- 23. High limit sensor**

Device that monitors the outlet water temperature to ensure safe operation. If the temperature exceeds its setting (field adjustable), it will break the control circuit, shutting the appliance down.
- 24. Relief valve**

The relief valve is a safety device that ensures the maximum pressure of the appliance is not exceeded. Boilers operate on pressure only and are shipped from the factory at a rating of 50 PSI. Water heaters operate on temperature and pressure and are shipped standard as 150 PSI and 210°F (98.9°C).
- 25. Power switch**

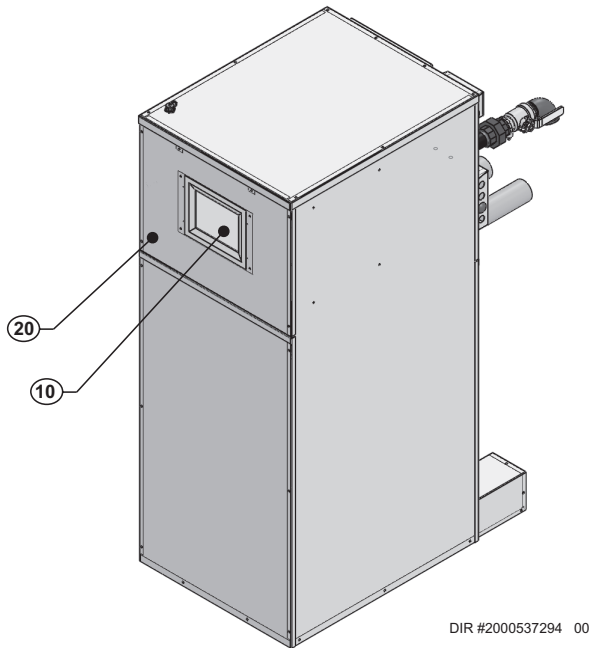
The power switch is used to engage and disengage power to the appliance on the 120 VAC circuit.
- 26. Air pressure switch**

The air pressure switch is a safety device which ensures proper blower operation. The air pressure switch is wired in series with the low voltage control circuit in such a way that if the fan does not engage or shuts down prematurely the device will break the control circuit and the unit will shut down.
- 27. Flow switch**

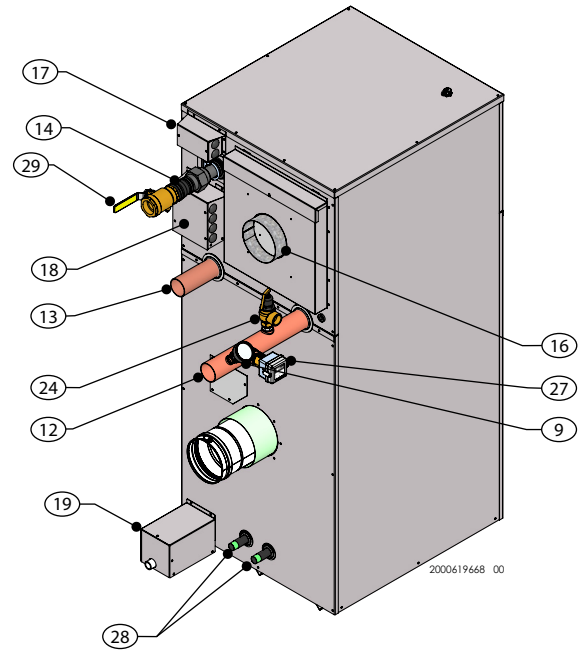
The flow switch is a safety device that ensures flow through the heat exchanger during operation. This appliance is low mass and should never be operated without flow. The flow switch makes contact when flow is detected and allows the unit to operate. If flow is discontinued during operation for any reason the flow switch will break the control circuit and the unit will shut down.

The Power-fin - How it works...

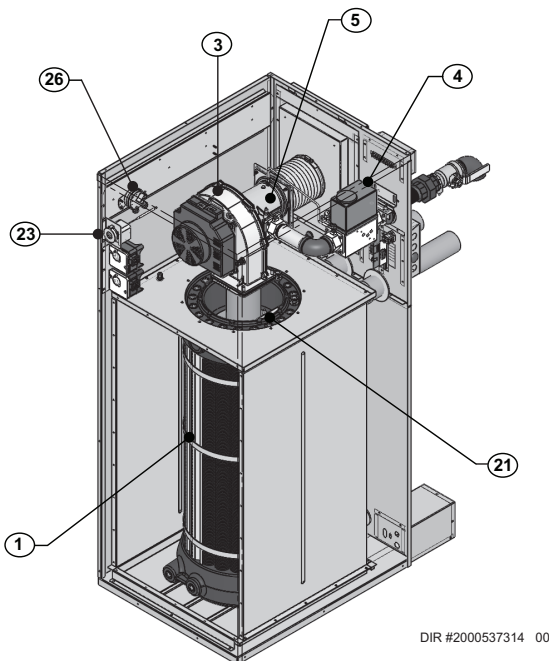
- 28. Drain port(s)
Location from which the heat exchanger can be drained.
- 29. Manual shutoff valve
Manual valve used to isolate the unit from the gas supply.



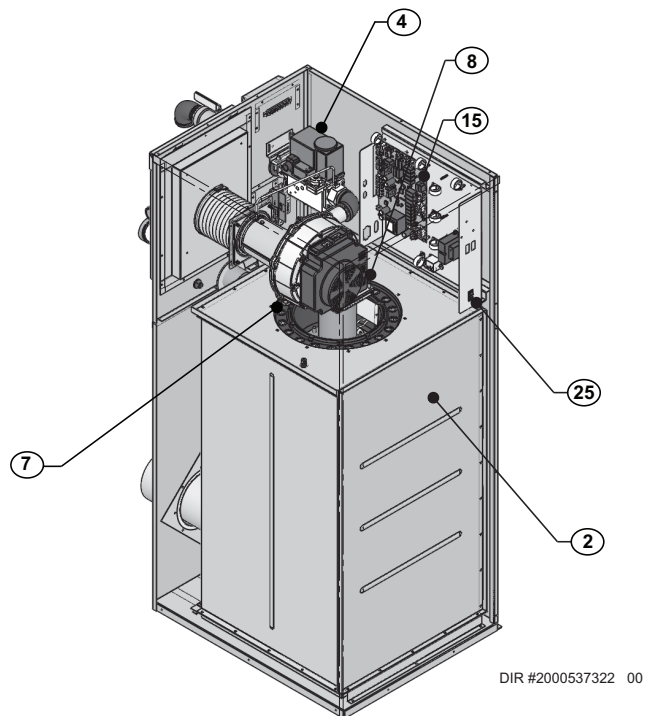
Models 502 - 1302 Front View



Models 502 - 1302 Rear View

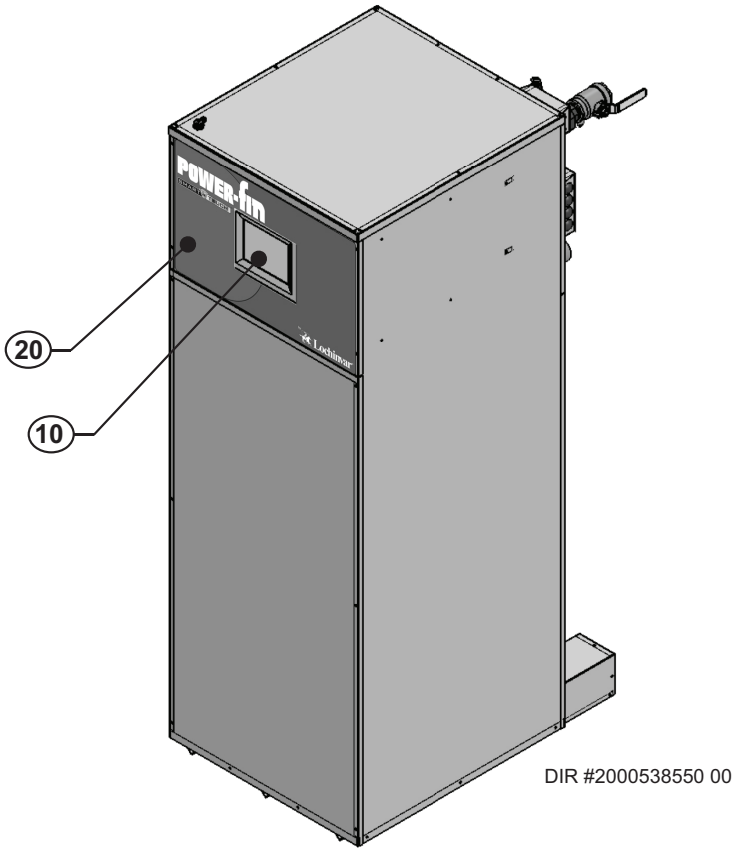


Models 502 - 1302 Right Side (inside unit) - M9



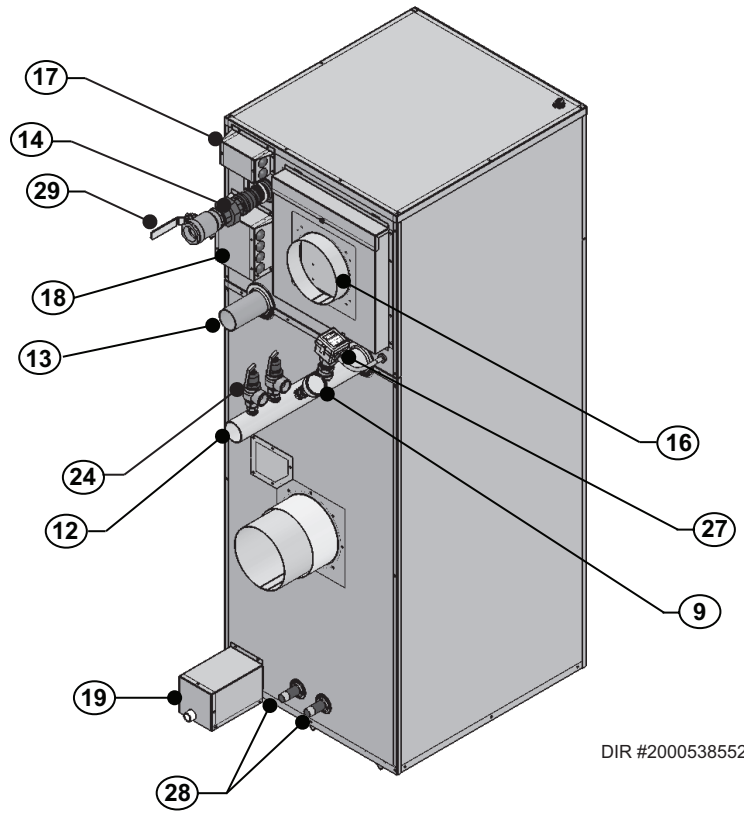
Models 502 - 1302 Left Side (inside unit) - F9

The Power-fin - How it works... (continued)



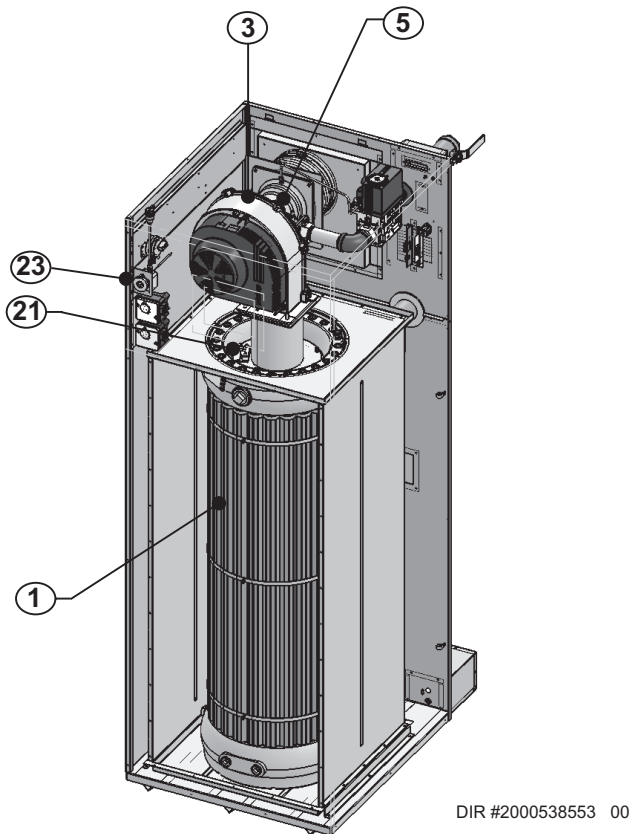
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Models 1501 - 2001 Front View



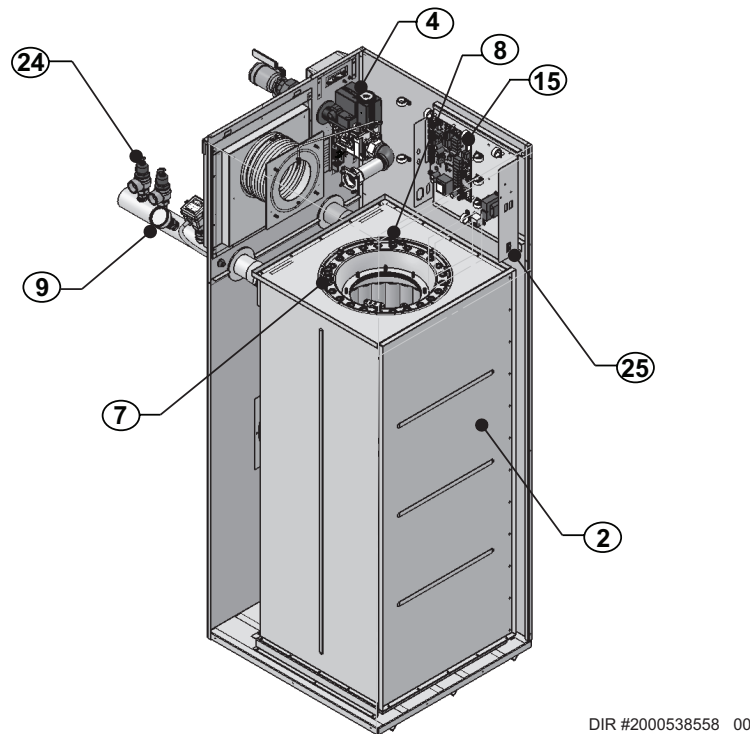
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Models 1501 - 2001 Rear View



DIR #2000538553 00

Models 1501 - 2001 Right Side (inside unit)



DIR #2000538558 00

Models 1501 - 2001 Left Side (inside unit)

Ratings



Power-Fin Water Heater Ratings			
Model Number	Input MBH (Note 4)		GPH at 100°F Rise
	Min	Max	
PFN0502-M9	100	500	515
PFN0752-M9	150	750	773
PFN1002-M9	200	999	1029
PFN1302-M9	260	1300	1339
PFN1501-M9	300	1500	1545
PFN1701-M9	340	1700	1752
PFN2001-M9	440	2000	2061
PFN0502-F9	N/A	500	515
PFN0752-F9	N/A	750	773
PFN1002-F9	N/A	999	1029
PFN1302-F9	N/A	1300	1339
PFN1501-F9	N/A	1500	1545
PFN1701-F9	N/A	1700	1752
PFN2001-F9	N/A	2000	2061

Other Specifications			
Appliance Water Content Gallons	Water Connections	Gas Connections	Air / Vent Sizes (Note 3)
3.6	2.5"	1"	5" - 4"
4.0	2.5"	1 1/4"	5" - 5"
4.3	2.5"	1 1/4"	6" - 6"
4.8	2.5"	1 1/4"	6" - 8"
5.5	2.5"	1 1/2"	6" - 6"
5.8	2.5"	1 1/2"	7" - 7"
6.2	2.5"	1 1/2"	8" - 8"
3.6	2.5"	1"	5" - 7"
4.0	2.5"	1 1/4"	5" - 9"
4.3	2.5"	1 1/4"	6" - 10"
4.8	2.5"	1 1/4"	6" - 12"
5.5	2.5"	1 1/2"	6" - 12"
5.8	2.5"	1 1/2"	7" - 14"
6.2	2.5"	1 1/2"	8" - 14"

Power-Fin AHRI Rating				
Model Number	Input MBH (Note 4)		Gross Output MBH (Note 1)	Net AHRI Ratings Water, MBH (Note 2)
	Min	Max		
PBN0502-M9	100	500	425	370
PBN0752-M9	150	750	638	554
PBN1002-M9	199.8	999	849	739
PBN1302-M9	260	1300	1105	961
PBN1501-M9	300	1500	1275	1109
PBN1701-M9	340	1700	1445	1257
PBN2001-M9	440	2000	1700	1478
PBN0502-F9	N/A	500	425	370
PBN0752-F9	N/A	750	638	554
PBN1002-F9	N/A	999	849	739
PBN1302-F9	N/A	1300	1105	961
PBN1501-B9	750	1500	1260	1096
PBN1701-B9	850	1700	1428	1242
PBN2001-B9	1000	2000	1680	1461

Other Specifications			
Appliance Water Content Gallons	Water Connections	Gas Connections	Air / Vent Sizes (Note 3)
3.6	2.5"	1"	5" - 4"
4.0	2.5"	1 1/4"	5" - 5"
4.3	2.5"	1 1/4"	6" - 6"
4.8	2.5"	1 1/4"	6" - 8"
5.5	2.5"	1 1/2"	6" - 6"
5.8	2.5"	1 1/2"	7" - 7"
6.2	2.5"	1 1/2"	8" - 8"
3.6	2.5"	1 1/4"	5" - 7"
4.0	2.5"	1 1/4"	5" - 9"
4.3	2.5"	1 1/4"	6" - 10"
4.8	2.5"	1 1/4"	6" - 12"
5.5	2.5"	2"	6" - 12"
5.8	2.5"	2"	7" - 14"
6.2	2.5"	2"	8" - 14"

Ratings *(continued)*

Notes:

1. The ratings are based on standard test procedures prescribed by the United States Department of Energy.
2. Net AHRI ratings are based on net installed radiation of sufficient quantity for the requirements of the building and nothing need be added for normal piping and pickup. Ratings are based on a piping and pickup allowance of 1.15.
3. Power-fin boilers require special gas venting. Use only the vent materials and methods specified in the Power-fin Installation and Operation Manual.
4. Standard Power-fin boilers are equipped to operate from sea level to 4,500 feet **only**. The boiler will de-rate by 4.5% for each 1,000 feet above sea level up to 4,500 feet.
5. High altitude Power-fin boilers are equipped to operate from 3,000 to 5,500 feet **only**. The boiler will de-rate by 4.0% for each 1,000 feet above sea level up to 5,500 feet. The operation given in this manual remains the same as the standard boilers. A high altitude label (as shown in FIG A.) is also affixed to the unit.

De-rate values are based on proper combustion calibration and CO₂'s adjusted to the recommended levels.

6. For Power-fin boiler installations above 5,500 feet contact the factory.
7. Ratings have been confirmed by the Hydronics Section of AHRI.

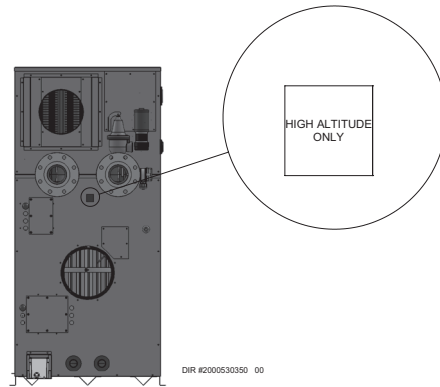


Figure A High Altitude Label Location

NOTICE

Maximum allowed working pressure is located on the rating plate.

1 Determine unit location

Installation must comply with:

- Local, state, provincial, and national codes, laws, regulations, and ordinances.
- National Fuel Gas Code, NFPA 54 / ANSI Z223.1 – latest edition.
- Standard for Controls and Safety Devices for Automatically Fired Boilers, ANSI/ASME CSD-1 – latest edition, when required.
- National Electrical Code, NFPA 70 – latest edition.
- For Canada only: CSA B149.1 Installation Code, CSA C22.1 Canadian Electrical Code Part 1 and any local codes.

NOTICE

The Power-fin gas manifold and controls met safe lighting and other performance criteria when the boiler underwent tests specified in ANSI Z21.13/CSA 4.9 – latest edition.

Before locating the appliance, check:

1. Check for nearby connection to:
 - System water piping
 - Venting connections
 - Gas supply piping
 - Electrical power
2. Locate the appliance so that if water connections should leak, water damage will not occur. When such locations cannot be avoided, it is recommended that a suitable drain pan, adequately drained, be installed under the appliance. The pan must not restrict combustion air flow. Under no circumstances is the manufacturer to be held responsible for water damage in connection with this appliance, or any of its components.
3. Check area around the boiler. Remove any combustible materials, gasoline and other flammable liquids.

WARNING

Failure to keep boiler area clear and free of combustible materials, gasoline, and other flammable liquids and vapors can result in severe personal injury, death, or substantial property damage.

4. The Power-fin must be installed so that gas control system components are protected from dripping or spraying water or rain during operation or service.
5. If a new boiler will replace an existing boiler, check for and correct system problems, such as:
 - System leaks causing oxygen corrosion or heat exchanger cracks from hard water deposits.
 - Incorrectly-sized expansion tank.
 - Lack of freeze protection in boiler water causing system and boiler to freeze and leak.
 - Debris left from existing piping, if not flushed and cleaned with an appropriate cleaner.
6. The appliance must be installed on a level floor, both front to back and side to side, for proper condensate drainage.

7. If the optional neutralizing kit is to be used, elevate the boiler at least 3" above the floor.
8. Check around the boiler for any potential air contaminants that could risk corrosion to the boiler or the boiler combustion air supply (see Table 1A on page 13). Prevent combustion air contamination. Remove any of these contaminants from the boiler area.
9. For outdoor models, you must install an optional outdoor kit. Instructions for installing the outdoor kit are included in the kit. Do not install outdoor models directly on the ground. You must install the outdoor unit on a concrete, brick, block, or other non-combustible pad. Outdoor models have additional special location and clearance requirements. A wind proof cabinet protects the unit from weather. Vent materials are field supplied.

Outdoor installation

Adequate hydronic system antifreeze must be used. A snow screen should be installed to prevent snow and ice accumulation around the unit or its venting system.

WARNING

DO NOT install units in rooms or environments that contain corrosive contaminants (see Table 1A on page 13). Failure to comply could result in severe personal injury, death, or substantial property damage.

WARNING

Do not install the appliance where the appliance will be exposed to freezing temperatures.

Do not install the appliance where condensation may form on the inside or outside of the appliance, or where condensation may fall onto the appliance.

Failure to install the appliance properly could result in severe personal injury, death, or substantial property damage.

WARNING

This appliance requires a special venting system. Use only the vent materials specified in this manual. Failure to follow all instructions can result in flue gas spillage and carbon monoxide emissions, causing severe personal injury or death.

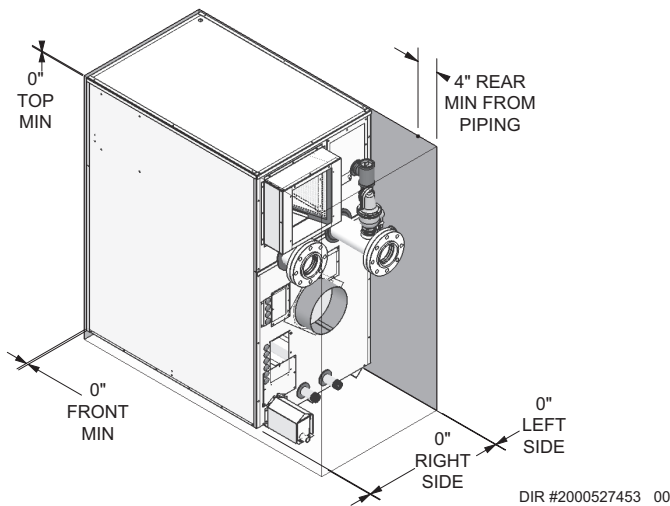
1 Determine unit location *(continued)*

Provide clearances:

Clearances from combustible materials

- Hot water pipes 1/4"
- Sides 0"
- Rear 0"
- Front 0"
- Top 0"
- Floor..... Combustible
- Vent pipe - at least 1" from combustible material

Figure 1-1 Clearances



NOTICE If you do not provide the recommended service clearances shown, it may not be possible to service the boiler without removing it from the space.

Recommended clearances for service access

- Sides 0"
- Rear 24"
- Front 24"
- Top 24"

Maintain minimum specified clearances for adequate operation. All installations must allow sufficient space for servicing the vent connections, water pipe connections, piping and other auxiliary equipment, as well as the appliance. The clearance labels on each appliance note the same service and combustible clearance requirements as shown in this manual.

Multiple boilers may be installed side by side with no clearance between adjacent boilers because this boiler is approved for zero clearance from combustible surfaces; however, service access will be limited from the sides.

Consult the *Venting* section of this manual for specific installation instructions for the appropriate type of venting system that you will be using.

Provide air openings to room:

The Power-fin alone in boiler room

1. No air ventilation openings into the boiler room are needed when clearances around the Power-fin are at least equal to the SERVICE clearances shown in FIG. 1-1. For spaces that do NOT supply this clearance, provide two openings as shown in FIG. 1-1. Each opening must provide one square inch free area per 1,000 Btu/hr of boiler input.
2. Combustion air openings are required when using the Room Air Option on 24 of this manual.

The Power-fin in the same space with other gas or oil-fired appliances

1. Follow the National Fuel Gas Code (U.S.) or CSA B149.1 (Canada) to size/verify size of the combustion/ventilation air openings into the space.

WARNING The space must be provided with combustion/ventilation air openings correctly sized for all other appliances located in the same space as the Power-fin.

Failure to comply with the above warnings could result in severe personal injury, death, or substantial property damage.

2. Size openings only on the basis of the other appliances in the space. No additional air opening free area is needed for the Power-fin when it takes its combustion air from outside (direct vent installation).

1 Determine unit location

Flooring and foundation

Flooring

The Power-fin is approved for installation on combustible flooring, but must never be installed on carpeting.

WARNING Do not install the boiler on carpeting even if foundation is used. Fire can result, causing severe personal injury, death, or substantial property damage.

If flooding is possible, elevate the boiler sufficiently to prevent water from reaching the boiler.

WARNING Assure that the floor and structure is sufficient to support the installed weight of the boiler, including the water content in the heat exchanger. If not, structural building failure will result, causing severe personal injury, death, or substantial property damage.

Vent and air piping

The Power-fin requires a special gas vent system, designed for pressurized venting.

The boiler is to be used for either direct vent installation or for installation using indoor combustion air. See page 14 of this manual when considering room air. Note prevention of combustion air contamination below when considering vent/air termination.

Vent and air must terminate near one another and may be vented vertically through the roof or out a side wall, unless otherwise specified. You may use any of the vent/air piping methods covered in this manual. Do not attempt to install the Power-fin using any other means.

Be sure to locate the boiler such that the vent and air piping can be routed through the building and properly terminated. The vent/air piping lengths, routing and termination method must all comply with the methods and limits given in this manual.

Prevent combustion air contamination

Install air inlet piping for the Power-fin as described in this manual. Do not terminate vent/air in locations that can allow contamination of combustion air. Refer to Table 1A, page 13 for products and areas which may cause contaminated combustion air.

WARNING Ensure that the combustion air will not contain any of the contaminants in Table 1A, page 13. Contaminated combustion air will damage the boiler, resulting in possible severe personal injury, death or substantial property damage. Do not pipe combustion air near a swimming pool, for example. Also, avoid areas subject to exhaust fumes from laundry facilities. These areas will always contain contaminants.

When using an existing vent system to install a new boiler:

WARNING Failure to follow all instructions can result in flue gas spillage and carbon monoxide emissions, causing severe personal injury or death.

Check the following venting components before installing:

- **Material** - For materials listed for use with this appliance, see Section 2 - Venting.
- **Size** - To ensure proper pipe size is in place, see Table 2D. Check to see that this size is used throughout the vent system.
- **Manufacturer** - Only use the listed manufacturers and their type product listed in Table 2B for CAT IV positive pressure venting with flue producing condensate.
- **Supports** - Non-combustible supports must be in place allowing a minimum 1/4" rise per foot. The supports should adequately prevent sagging and vertical slippage, by distributing the vent system weight. For additional information, consult the vent manufacturer's instructions for installation.
- **Terminations** - Carefully review Section 2 to ensure requirements for the location of the vent and air terminations are met and orientation of these fit the appropriate image from the Sidewall or Vertical options listed in the General Venting Section. ?
- **Seal** - With prior requirements met, the system should be tested to the procedure listed in parts (c) through (f) of the Removal of an Existing Boiler Section on page 13.

With stainless steel vent, seal and connect all pipe and components as specified by the vent manufacturer used.

1 Determine unit location *(continued)*

Table 1A Corrosive Contaminants and Sources

Products to avoid:
Spray cans containing chloro/fluorocarbons
Permanent wave solutions
Chlorinated waxes/cleaners
Chlorine-based swimming pool chemicals
Calcium chloride used for thawing
Sodium chloride used for water softening
Refrigerant leaks
Paint or varnish removers
Hydrochloric acid/muriatic acid
Cements and glues
Antistatic fabric softeners used in clothes dryers
Chlorine-type bleaches, detergents, and cleaning solvents found in household laundry rooms
Adhesives used to fasten building products and other similar products
Areas likely to have contaminants
Dry cleaning/laundry areas and establishments
Swimming pools
Metal fabrication plants
Beauty shops
Refrigeration repair shops
Photo processing plants
Auto body shops
Plastic manufacturing plants
Furniture refinishing areas and establishments
New building construction
Remodeling areas
Garages with workshops

When removing a boiler from existing common vent system:

DANGER

Do not install the Power-fin into a common vent with any other appliance except as noted in Section 2 on page 22 or 25. This will cause flue gas spillage or appliance malfunction, resulting in possible severe personal injury, death, or substantial property damage.

WARNING

Failure to follow all instructions can result in flue gas spillage and carbon monoxide emissions, causing severe personal injury or death.

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

- a. Seal any unused openings in the common venting system.
- b. Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion, or other deficiencies, which could cause an unsafe condition.
- c. Test vent system – Insofar as is practical, close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliance not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.
- d. Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.
- e. Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar, or pipe.
- f. After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined herein, return doors, windows, exhaust fans, fireplace dampers, and any other gas-burning appliance to their previous conditions of use.
- g. Any improper operation of the common venting system should be corrected so the installation conforms with the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and/or CAN/CSA B149.1, Natural Gas and Propane Installation Code. When re-sizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in Part 11 of the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and/or CAN/CSA B149.1, Natural Gas and Propane Installation Code.

1 Determine unit location

Remove boiler from wood pallet

1. To remove the boiler from the pallet:
 - a. Remove the four (4) shipping brackets securing the unit to the right and left sides of the pallet.
 - b. The boiler can now be removed from the pallet using a lift truck lifting from the front or rear of the boiler. The lift truck forks must extend at least half way under the boiler heat exchanger to assure proper lifting technique with no damage to the boiler.

NOTICE

Do not drop the boiler or bump the jacket on the floor or pallet. Damage to the boiler can result.

Combustion and ventilation air requirements for appliances drawing air from the equipment room

Provisions for combustion and ventilation air must be in accordance with Air for Combustion and Ventilation, of the latest edition of the National Fuel Gas Code, NFPA 54 / ANSI Z223.1, in Canada, the latest edition of CGA Standard B149 Installation Code for Gas Burning Appliances and Equipment, or applicable provisions of the local building codes.

The equipment room **MUST** be provided with properly sized openings and/or be of sufficient volume to assure adequate combustion air and proper ventilation for all gas fired appliances in the equipment room to assure adequate combustion air and proper ventilation.

The requirements shown are for the **appliance only**; additional gas fired appliances in the equipment room will require an increase in the net free area and/or volume to supply adequate combustion air for all appliances.

No combustion air openings are needed when the appliance is installed in a space with a volume **NO LESS** than 50 cubic feet per 1,000 Btu/hr of all installed gas fired appliances and the building **MUST NOT** be of “Tight Construction”³.

A combination of indoor and outdoor combustion air may be utilized by applying a ratio of available volume to required volume times the required outdoor air opening(s) size(s). This must be done in accordance with the National Fuel Gas Code, NFPA 54 / ANSI Z223.1.

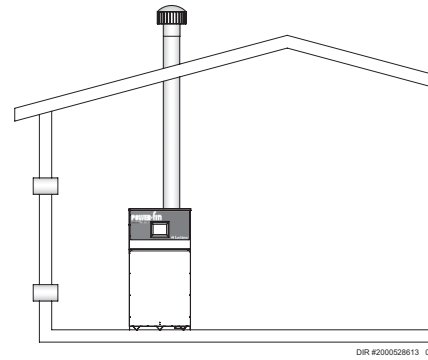


Figure 1-2_Combustion Air Direct from Outside

1. If air is taken directly from outside the building with no duct, provide two permanent openings to the equipment room each with a net free area of one square inch per 4000 Btu/hr input (5.5 cm² per kW) (see FIG. 1-2).

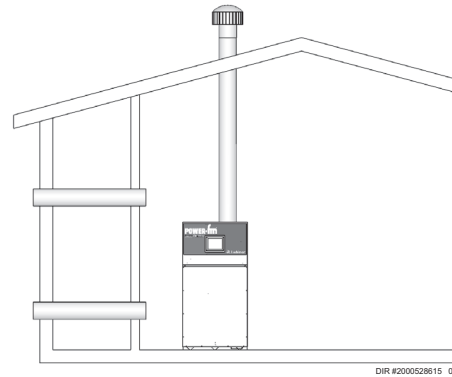


Figure 1-3_Combustion Air Through Ducts

2. If combustion and ventilation air is taken from the outdoors using a duct to deliver the air to the equipment room, each of the two openings should be sized based on a minimum free area of one square inch per 2000 Btu/hr (11 cm² per kW) of input (see FIG. 1-3).

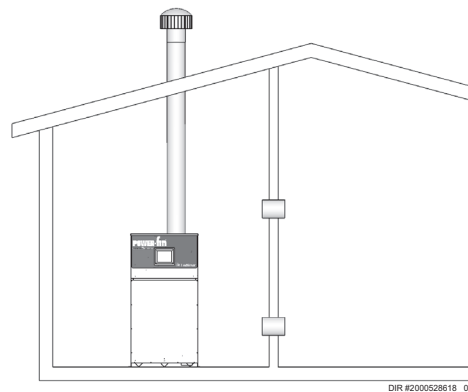


Figure 1-4_Combustion Air from Interior Space

1 Determine unit location *(continued)*

3. If air is taken from another interior space combined with the equipment room:
 - (a) Two spaces on same story: Each of the two openings specified above should have a net free area of one square inch for each 1000 Btu/hr (22 cm² per kW) of input, but not less than 100 square inches (645 cm²) (see FIG. 1-4).
 - (b) Two spaces on different stories: One or more openings should have a net free area of two square inches per 1000 Btu/hr (44 cm² per kW).

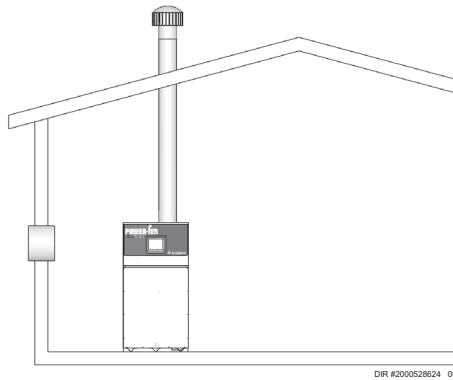


Figure 1-5 Combustion Air from Outside - Single Opening

4. If a single combustion air opening is provided to bring combustion air in directly from the outdoors, the opening must be sized based on a minimum free area of one square inch per 3000 Btu/hr (7 cm² per kW). This opening must be located within 12" (30 cm) of the top of the enclosure (see FIG. 1-5).

Combustion air requirements are based on the latest edition of the National Fuel Gas Code, NFPA 54 / ANSI Z223.1; in Canada refer to the latest edition of CGA Standard CAN/CSA B149.1. Check all local code requirements for combustion air. All dimensions based on net free area in square inches. Metal louvers or screens reduce the free area of a combustion air opening a minimum of approximately 25%. Check with louver manufacturers for exact net free area of louvers.

Where two openings are provided, one must be within 12" (30 cm) of the ceiling and one must be within 12" (30 cm) of the floor of the equipment room. Each opening must have a net free area as specified in Table 1B. Single openings shall commence within 12" (30 cm) of the ceiling. The minimum dimension of air openings shall not be less than 3" (80 mm).

CAUTION

Under no circumstances should the equipment room ever be under negative pressure. Particular care should be taken where exhaust fans, attic fans, clothes dryers, compressors, air handling units, etc., may take away air from the unit.

The combustion air supply must be completely free of any flammable vapors that may ignite or chemical fumes which may be corrosive to the appliance. Common corrosive chemical fumes which must be avoided are fluorocarbons and other halogenated compounds, most commonly present as refrigerants or solvents, such as Freon, trichlorethylene, perchlorethylene, chlorine, etc. These chemicals, when burned, form acids which quickly attack the heat exchanger, headers, flue collectors, and the vent system.

The result is improper combustion and a non-warrantable, premature appliance failure.

EXHAUST FANS: Any fan or equipment which exhausts air from the equipment room may deplete the combustion air supply and/or cause a downdraft in the venting system. Spillage of flue products from the venting system into an occupied living space can cause a very hazardous condition that must be immediately corrected. If a fan is used to supply combustion air to the equipment room, the installer must make sure that it does not cause drafts which could lead to nuisance operational problems with the appliance.

1 Determine unit location

TABLE - 1B
MINIMUM RECOMMENDED COMBUSTION
AIR SUPPLY TO EQUIPMENT ROOM

Model Number	*Outside Air from 2 Openings Directly from Outdoors		*Outside Air from 1 Opening Directly from Outdoors, in ²	Inside Air from 2 Ducts Delivered from Outdoors		Inside Air from 2 Ducts Delivered from Interior Space	
	Top Opening, in ²	Bottom Opening, in ²		Top Opening, in ²	Bottom Opening, in ²	Top Opening, in ²	Bottom Opening, in ²
502	125 (807 cm ²)	125 (807 cm ²)	167 (1077 cm ²)	250 (1613 cm ²)	250 (1613 cm ²)	500 (3226 cm ²)	500 (3226 cm ²)
752	188 (1213 cm ²)	188 (1213 cm ²)	250 (1613 cm ²)	375 (2420 cm ²)	375 (2420 cm ²)	750 (4839 cm ²)	750 (4839 cm ²)
1002	250 (1613 cm ²)	250 (1613 cm ²)	333 (2149 cm ²)	500 (3226 cm ²)	500 (3226 cm ²)	1000 (6452 cm ²)	1000 (6452 cm ²)
1302	325 (2097 cm ²)	325 (2097 cm ²)	433 (2794 cm ²)	650 (4194 cm ²)	650 (4194 cm ²)	1300 (8388 cm ²)	1300 (8388 cm ²)
1501	375 (2420 cm ²)	375 (2420 cm ²)	500 (3226 cm ²)	750 (4839 cm ²)	750 (4839 cm ²)	1500 (9678 cm ²)	1500 (9678 cm ²)
1701	425 (2742 cm ²)	425 (2742 cm ²)	567 (3658 cm ²)	850 (5484 cm ²)	850 (5484 cm ²)	1700 (10968 cm ²)	1700 (10968 cm ²)
2001	500 (3226 cm ²)	500 (3226 cm ²)	667 (4303 cm ²)	1000 (6452 cm ²)	1000 (6452 cm ²)	2000 (12904 cm ²)	2000 (12904 cm ²)

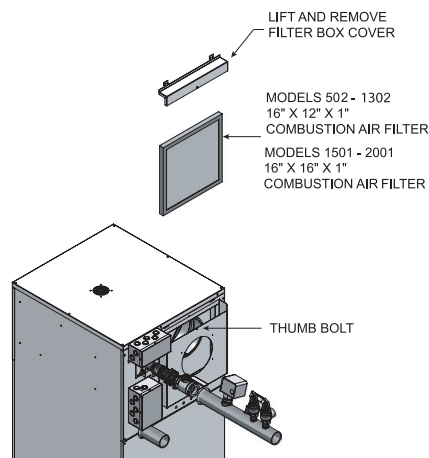
The above requirements are for the **appliance only**; additional gas fired appliances in the equipment room will require an increase in the net free area and/or volume to supply adequate combustion air for all appliances.

No combustion air openings are needed when the appliance is installed in a space with a volume NO LESS than 50 cubic feet per 1,000 Btu/hr of all installed gas fired appliances. **Buildings MUST NOT be of **Tight Construction**.**

¹Outside air openings shall directly communicate with the outdoors.

²Combined interior space must be 50 cubic feet per 1,000 Btu/hr input. **Buildings MUST NOT be of **Tight Construction**.**

³**"Tight Construction"** is defined as a building with less than 0.40 ACH (air changes per hour). For buildings of **"Tight Construction"**, provide air openings into the building from outside.



1. Locate the combustion air filter box mounted on the rear of the appliance.
2. Locate the flat thumb bolt at the top of the air filter box and turn it a 1/4 turn counterclockwise to align it with the slot in the air filter box.
3. Lift and remove the air filter box cover to gain access to the air filter.
4. Slide the air filter out the top of the air filter box.
5. Inspect the air filter for dirt and debris, replace if necessary.
6. Replace the air filter and the air filter box cover. Turn the thumb bolt clockwise a 1/4 turn to secure the air filter box cover to the air filter box.

Figure 1-7_Filter Access

Combustion air filter

This unit has a standard air filter located at the combustion air inlet as shown above in FIG. 1-7. This air filter is provided to help ensure clean air is used for the combustion process. Check this filter every month and replace when it becomes dirty. The filter size on Models 502 -1302 is 16" x 12" x 1" (40.6cm x 30.5cm x 2.5cm) and for Models 1501 - 2001 it is 16" x 16" x 1" (40.6cm x 40.6cm x 2.5cm). You can find these commercially available filters at any home center or HVAC supply store. Follow the steps below when replacing the combustion air filter:

NOTICE

During construction the air filter should be checked more frequently to ensure it does not become clogged with combustion dirt and debris.

CAUTION

Sustained operation of an appliance with a clogged burner may result in nuisance operational problems, bad combustion, and non-warrantable component failures.

2 Venting

BEFORE YOU BEGIN

Identify your appliance's vent system:

This manual covers venting requirements for CAT II/IV and CAT I models. Be sure to correctly identify the type of vent system your appliance requires before proceeding.

Category II/IV Models: See page 19

- Water Heaters**
 - PFN0502PM-M9
 - PFN0752PM-M9
 - PFN1002PM-M9
 - PFN1302PM-M9
 - PFN1501PM-M9
 - PFN1701PM-M9
 - PFN2001PM-M9
- Boilers**
 - PBN0502-M9
 - PBN0752-M9
 - PBN1002-M9
 - PBN1302-M9
 - PBN1501-M9
 - PBN1701-M9
 - PBN2001-M9

Venting options:



CAT II requires vent increaser kit.



NOTICE

Category II venting is required when common venting multiple M9 models.

Category I (Fan Assisted) Models: See page 24

- Water Heaters**
 - PFN0502PM-F9
 - PFN0752PM-F9
 - PFN1002PM-F9
 - PFN1302PM-F9
 - PFN1501PM-F9(*)
 - PFN1701PM-F9(*)
 - PFN2001PM-F9(*)
- Boilers**
 - PBN0502-F9
 - PBN0752-F9
 - PBN1002-F9
 - PBN1302-F9
 - PBN1501-B9(*)
 - PBN1701-B9(*)
 - PBN2001-B9(*)

Venting options:



NOTICE

PB/PF 0502 - 1302 - F9 Models (Only) with a CAT I sized vent connection can be sidewall vented per the requirements from the D, E, and F vent sections of this manual.

*CAT I "B9" models require field supplied barometric dampers.



Failure to use correct venting materials can result in loss of life from flue gas spillage into working or living space.

Venting Category Definitions: (Reference National Fuel Gas Code ANSI Z223.1)

CAT IV: Positive pressure condensing

An appliance that operates with a positive vent static pressure with a vent gas temperature that may cause excessive condensate production in the vent.

CAT II: Negative pressure condensing

An appliance that operates with a non-positive vent static pressure with a vent gas temperature that may cause excessive condensate production in the vent.

CAT I: Negative pressure non-condensing

An appliance that operates with a non-positive vent static pressure with a vent gas temperature that avoids excessive condensate production in the vent.

2 Venting

Vent Materials:

NOTICE The Power-Fin M9 models are supplied with an integral FasNSeal vent connector. The installer must use a specific vent starter adapter supplied by the vent manufacturer to adapt to different vent systems.

Category II/IV Vent Material Suppliers:

Category II/IV flue pipe materials and vent adapters can be obtained from the following manufacturers:

TABLE - 2A APPROVED STAINLESS STEEL VENT MANUFACTURERS		
Make	Model	Standard
ProTech Systems	FasNSeal Vent	UL1738 / ULC-S636
Z-Flex	Z-Vent	UL1738 / ULC-S636
Heat Fab	Saf-T CI Vent	UL1738 / ULC-S636
Metal Fab	Corr/Guard Vent	UL1738 / ULC-S636
Flex-L International	StaR 34 Vent	UL1738 / ULC-S636

*with AL29-4C Stainless Steel

Or other listed Category IV vent systems suitable for a condensing, positive pressure, gas fired appliance.

A Category IV flue **MUST** have all vent joints and seams sealed gastight and have provisions for a drain to properly collect and dispose of condensate that may occur in the venting system.

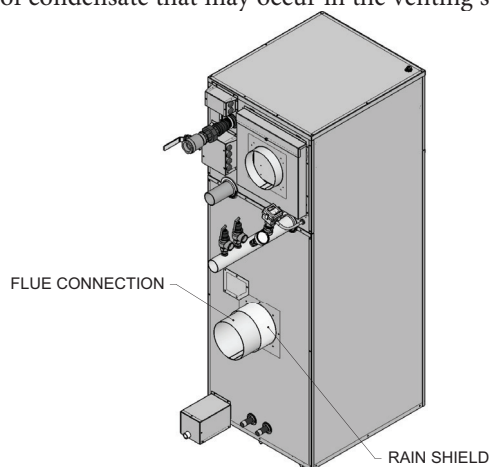


Figure 2-1_Flue vs. Rain Shield Connection

CAUTION DO NOT attach vent pipe to rain shield. Vent pipe should be connected directly to the flue pipe (see FIG. 2-1).

TABLE - 2B FLUE ADAPTER SIZES	
MODEL	FLUE ADAPTER SIZE
PB/FN0502-M9	4"
PB/FN0752-M9	5"
PB/FN1002-M9	6"
PB/FN1302-M9	8"
PB/FN1501-M9	6"
PB/FN1701-M9	7"
PB/FN2001-M9	8"

*Note: The manufacturer of the selected vent material can also provide a vent adapter to connect the vent material to the Power-fin's vent connection.

Common venting CAT II:

Flues of multiple appliances may be combined by incorporating a vent increaser to change the Category IV appliance to a Category II vent system which can be common vented using an engineered vent system. An increaser must be used and the combined engineered vent system must be designed to ensure that flue products will be properly exhausted from the building at all times. **Failure to use the correct vent increaser or a properly sized vent system may result in a hazardous condition where flue gases spill into an occupied living space.** Consult a vent designer to determine the diameter of the common vent pipe required for combined vent installation. It is recommended that all vent joints and seams are sealed gastight. This vent system has specific vent material and installation requirements. The negative draft in a conventional vent installation must be within the range of 0.02 to 0.08 inches w.c. to ensure proper operation. Make all draft readings while the unit is in stable operation (approximately 2 to 5 minutes).

Category II Increaser Kit

"Must be purchased from manufacturer"

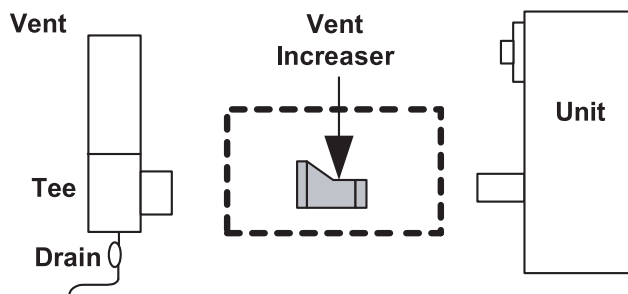


Figure 2-2_Category IV to II Conversion Chart

TABLE - 2C CATEGORY IV TO CATEGORY II CONVERSION KITS		
MODEL	FLUE SIZE	KIT NUMBERS
PB/FN0502-M9	4" to 7"	100338293
PB/FN0752-M9	5" to 9"	100338294
PB/FN1002-M9	6" to 10"	100338295
PB/FN1302-M9	8" to 12"	100338296
PB/FN1501-M9	6" to 8"	100338297
PB/FN1701-M9	7" to 9"	100338298
PB/FN2001-M9	8" to 10"	100338299

Category I Vent Material Suppliers:

Category I venting materials are readily available from your local plumbing/HVAC supply houses.

2 Venting *(continued)*

Condensing Vent Options: CAT II & IV

(CAT II vent options A, B, & C requires an adapter kit - see page 18)

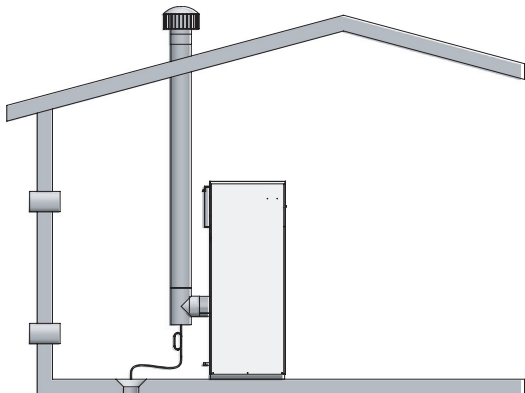
A

Vertical vent with combustion air from equipment room - see page 20.

CAT II/
IV

CAT II
requires an
adapter kit.

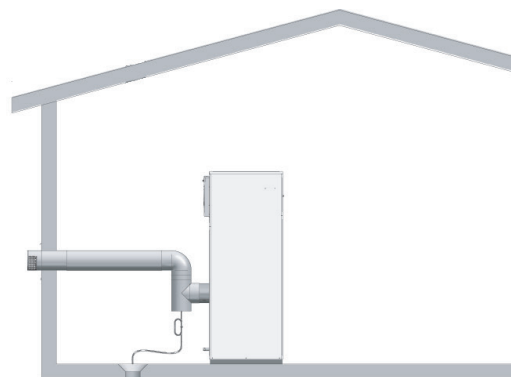
See page 18.



D

Sidewall termination with combustion air from equipment room - see page 21.

CAT IV



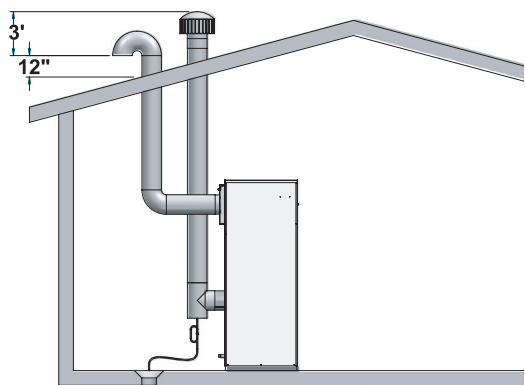
B

Vertical Direct Vent installation with rooftop combustion air inlet - see page 20.

CAT II/
IV

CAT II
requires an
adapter kit.

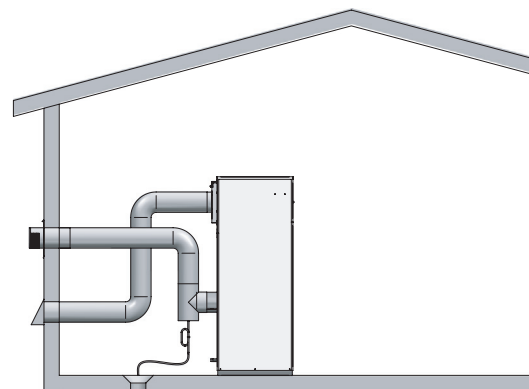
See page 18.



E

Horizontal Direct Vent installation with sidewall combustion air inlet - see page 22.

CAT IV



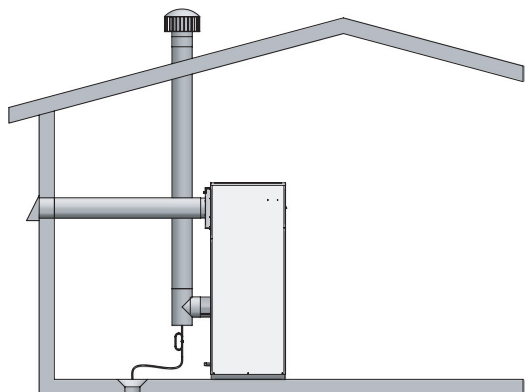
C

Vertical DirectAire installation with sidewall combustion air inlet - see page 21.

CAT II/
IV

CAT II
requires an
adapter kit.

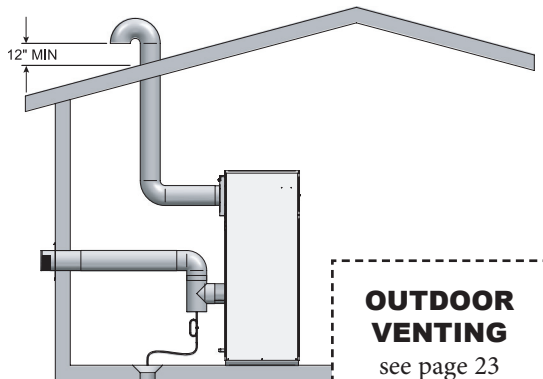
See page 18.



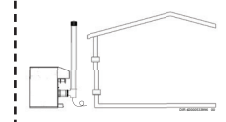
F

Horizontal DirectAire installation with vertical combustion air inlet - see page 22.

CAT IV



**OUTDOOR
VENTING**
see page 23



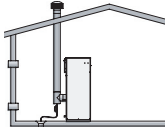
2 Venting

Condensing vent options: CAT II & IV

(CAT II vent options A, B, & C requires an adapter kit - see page 18)



CAT II/IV



CAT II requires an adapter kit.

See page 18.

Vertical vent with combustion air from equipment room - see page 19.

The flue outlet terminates on the rooftop.

The termination point for the flue products must follow the vertical vent termination clearance requirements on pages 32 and 33. These units can be identified by the Category IV and the control number M9 as noted on the unit's rating plate.

The flue from this Category IV appliance must have all vent joints and seams sealed gastight. A Category IV vent system has specific vent material and installation requirements.

The flue products in the vent system may be cooled below their dew point and form condensate in the flue. The materials used for a Category IV vent must be resistant to any corrosive damage from flue gas condensate. The flue from a Category IV vent system must have a condensate drain with provisions to properly collect and dispose of any condensate that may occur in the venting system.

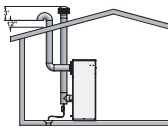
Follow all requirements in the *General Venting* and *Category IV General Venting* sections for proper installation and for venting flue products to the outdoors with a vertical termination (see pages 27 and 28).

**TABLE - 2D
VENT TERMINATION SIZES**

MODEL	CAT II VENT SIZE	CAT IV VENT SIZE	MODEL	CAT II VENT SIZE	CAT IV VENT SIZE
PB/FN0502-M9	7"	4"	PB/FN1501-M9	8"	6"
PB/FN0752-M9	9"	5"	PB/FN1701-M9	9"	7"
PB/FN1002-M9	10"	6"	PB/FN2001-M9	10"	8"
PB/FN1302-M9	12"	8"	--	--	--



CAT II/IV



CAT II requires an adapter kit.

See page 18.

Vertical direct vent installation with rooftop combustion air inlet - see page 19.

The Vertical Direct Vent system is installed with a Category IV flue and a separate combustion air pipe to the outdoors. The flue outlet and combustion air intake must both terminate on the rooftop.

The termination point for the flue products must follow the vertical vent termination clearance requirements on pages 32 and 33. These units can be identified by the Category IV and the control number M9 as noted on the unit's rating plate.

The optional Direct Vent system requires the installation of specific venting materials that are purchased locally.

Follow all requirements in the *General Venting* and *Category IV General Venting* sections for proper installation and for venting flue products to the outdoors with a vertical termination (see pages 27 and 28).

The Vertical Direct Vent system requires the installation of an additional pipe to supply combustion air from outdoors directly to the appliance. Follow all requirements under the *Combustion Air Inlet* section on pages 30 and 31.

**TABLE - 2E
AIR & VENT TERMINATION SIZES**

MODEL	CAT II		CAT IV		MODEL	CAT II		CAT IV	
	AIR SIZE	VENT SIZE	AIR SIZE	VENT SIZE		AIR SIZE	VENT SIZE	AIR SIZE	VENT SIZE
PB/FN0502-M9	5"	7"	5"	4"	PB/FN1501-M9	6"	8"	6"	6"
PB/FN0752-M9	5"	9"	5"	5"	PB/FN1701-M9	7"	9"	7"	7"
PB/FN1002-M9	6"	10"	6"	6"	PB/FN2001-M9	8"	10"	8"	8"
PB/FN1302-M9	6"	12"	6"	8"	--	--	--	--	--

2 Venting *(continued)*

Condensing vent options: CAT II & IV

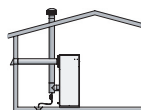
(CAT II vent options A, B, & C requires an adapter kit - see page 18)



DirectAire Vertical installation with sidewall combustion air inlet - see page 19.

CAT II/IV

The DirectAire Vertical with a Sidewall Combustion Air Vent system terminates the flue at the rooftop and air inlet at the sidewall. The flue outlet and combustion air intake terminate in different pressure zones.



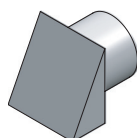
The optional DirectAire vent system requires the installation of specific venting materials that are purchased locally.

CAT II requires an adapter kit.

The termination point for the flue products must follow the vertical vent termination clearance requirements on pages 32 and 33. These units can be identified by the Category IV and the control number M9 as noted on the unit's rating plate.

See page 18.

Follow all requirements in the *General Venting* and *Category IV General Venting* sections for proper installation and for venting flue products to the outdoors with a vertical termination (see pages 27 and 28).



Air Inlet Cap

The DirectAire Vertical system requires the installation of an additional pipe to supply combustion air from outdoors directly to the appliance. Follow all requirements under the *Combustion Air Inlet* section on pages 30 and 31.

Sidewall combustion air inlet: The air inlet cap for the sidewall air inlet must be purchased from the appliance manufacturer.

The part numbers for the required sidewall air inlet cap kit are listed by model. Each kit includes the special combustion air inlet cap for installation on an exterior sidewall. The sidewall air inlet cap supplied in the kit is sized to provide combustion air for a single appliance only.

TABLE - 2F AIR INLET CAP TERMINATIONS												
MODEL	CAT II		CAT IV		CAT IV KIT NUMBER	MODEL	CAT II		CAT IV		CAT IV KIT NUMBER	
	AIR SIZE	VENT SIZE	AIR SIZE	VENT SIZE			AIR SIZE	VENT SIZE	AIR SIZE	VENT SIZE		
PB/FN0502-M9	5"	7"	5"	4"	100168088	PB/FN1501-M9	6"	8"	6"	6"	100168089	
PB/FN0752-M9	5"	9"	5"	5"	100168088	PB/FN1701-M9	7"	9"	7"	7"	100168090	
PB/FN1002-M9	6"	10"	6"	6"	100168089	PB/FN2001-M9	8"	10"	8"	8"	100168091	
PB/FN1302-M9	6"	12"	6"	8"	100168089	--	--	--	--	--	--	



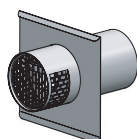
CAT IV

Sidewall termination with combustion air from equipment room - see page 19.

The connection from the appliance flue outlet to the sidewall vent cap MUST be made with listed Category IV vent materials and accessories. The installer must supply suitable vent pipe material. The sidewall vent cap must be purchased from the appliance manufacturer.



The sidewall vent cap kit includes the wall penetration assembly and the discharge screen assembly. All required Category IV vent pipe and fittings must be purchased locally.



Vent Cap

The termination point for the flue products must follow the sidewall vent termination clearance requirements on pages 33 - 36. These units can be identified by the Category IV and the control number M9 as noted on the unit's rating plate. **Note:** PB/FN0502 - 1302 - F9 models with Category I sized vent connection can be sidewall vented with Category IV vent material using the vent reducer included in the kit listed in Table 2G. This venting technique with corresponding vent reducers is not available on the larger PB/FN1501 - 2001 models.

Follow all requirements in the *General Venting* and *Category IV General Venting* sections for proper installation and for venting flue products to the outdoors with a sidewall termination (see pages 27 and 28).

TABLE - 2G FLUE VENT TERMINATION SIZES								
MODEL	CAT IV VENT SIZE	CAT IV KIT	MODEL	CAT IV VENT SIZE	CAT IV KIT	MODEL	CAT IV VENT SIZE	CAT IV KIT
PB/FN0502-M9	4"	100169247	PB/FN0502-F9	4"	100169234	PB/FN1501-M9	6"	100169201
PB/FN0752-M9	5"	100169248	PB/FN0752-F9	5"	100169235	PB/FN1701-M9	7"	100169202
PB/FN1002-M9	6"	100169201	PB/FN1002-F9	6"	100169236	PB/FN2001-M9	8"	100169246
PB/FN1302-M9	8"	100169246	PB/FN1302-F9	8"	100169237	--	--	--

2 Venting

Condensing vent options: CAT IV



CAT IV

Horizontal direct vent installation with sidewall combustion air inlet - see page 19.

The horizontal direct vent system is installed with a Category IV flue and a separate combustion air pipe to the outdoors. The flue outlet and combustion air intake must both terminate on the same sidewall.

The connection from the appliance flue outlet to the sidewall vent cap MUST be made with listed Category IV vent materials and accessories. The installer must supply suitable vent pipe material. The horizontal direct vent must be purchased from the appliance manufacturer.

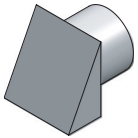
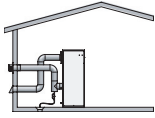
The termination point for the flue products must follow the sidewall vent termination clearance requirements on pages 33 - 36. These units can be identified by the Category IV and the control number M9 as noted on the unit's rating plate.

Note: PB/FN0502 - 1302 - F9 models with Category I sized vent connection can be sidewall vented with Category IV vent material using the vent deceiver included in the kit listed in Table 2H. This venting technique with corresponding vent deceivers is not available on the larger PB/FN1501 - 2001 models.

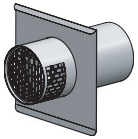
The horizontal direct vent kit includes the wall penetration assembly and the discharge screen assembly for the flue and a combustion air inlet cap. All required vent pipe and fittings must be purchased locally.

Follow all requirements in the *General Venting* and *Category IV General Venting* sections for proper installation and for venting flue products to the outdoors with a sidewall termination (see pages 27 and 28).

The horizontal direct vent system requires the installation of an additional pipe to supply combustion air from outdoors directly to the appliance. Follow all requirements under the *Combustion Air Inlet* section on pages 30 and 31.



Air Inlet Cap



Vent Cap

TABLE - 2H SIDEWALL AIR AND VENT TERMINATION SIZES											
MODEL	CAT IV		CAT IV KIT	MODEL	CAT IV		CAT IV KIT	MODEL	CAT IV		CAT IV KIT
	AIR SIZE	VENT SIZE			AIR SIZE	VENT SIZE			AIR SIZE	VENT SIZE	
PB/FN0502-M9	5"	4"	100147172	PB/FN0502-F9	5"	4"	100147161	PB/FN1501-M9	6"	6"	100147169
PB/FN0752-M9	5"	5"	100147173	PB/FN0752-F9	5"	5"	100147162	PB/FN1701-M9	7"	7"	100147170
PB/FN1002-M9	6"	6"	100147169	PB/FN1002-F9	6"	6"	100147163	PB/FN2001-M9	8"	8"	100147171
PB/FN1302-M9	6"	8"	100147174	PB/FN1302-F9	6"	8"	100147164	--	--	--	--



CAT IV

Horizontal DirectAire installation with vertical or sidewall combustion air - see page 19.

The Horizontal DirectAire vent system terminates the flue at the sidewall and air inlet at either the rooftop or a sidewall opposite the vent termination. The flue outlet and combustion air intake terminate in different pressure zones.

The connection from the appliance flue outlet to the sidewall vent cap MUST be made with listed Category IV vent materials and accessories. The installer must supply suitable vent pipe material. The Horizontal DirectAire vent cap must be purchased from the appliance manufacturer.

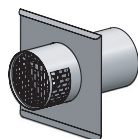
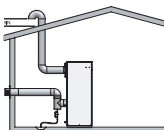
The termination point for the flue products must follow the sidewall vent termination clearance requirements on pages 33 - 36. These units can be identified by the Category IV and the control number M9 as noted on the unit's rating plate.

Note: PB/FN0502 - 1302 - F9 models with Category I sized vent connection can be sidewall vented with Category IV vent material using the vent deceiver included in the kit listed in Table 2I. This venting technique with corresponding vent deceivers is not available on the larger PB/FN1501 - 2001 models.

The Horizontal DirectAire vent system with a vertical air inlet requires a sidewall vent kit. The Horizontal DirectAire vent system with a sidewall air inlet requires a horizontal direct vent kit. All required vent pipe and fittings must be purchased locally.

Follow all requirements in the *General Venting* and *Category IV General Venting* sections for proper installation and for venting flue products to the outdoors with a sidewall termination (see pages 27 and 28).

The Horizontal DirectAire vent system requires the installation of an additional pipe to supply combustion air from outdoors directly to the appliance. Follow all requirements under the *Combustion Air Inlet* section on pages 29 and 30.



Vent Cap

TABLE - 2I SIDEWALL VENT TERMINATION SIZES											
MODEL	CAT IV		CAT IV KIT	MODEL	CAT IV		CAT IV KIT	MODEL	CAT IV		CAT IV KIT
	AIR SIZE	VENT SIZE			AIR SIZE	VENT SIZE			AIR SIZE	VENT SIZE	
PB/FN0502-M9	5"	4"	100169247	PB/FN0502-F9	5"	4"	100169234	PB/FN1501-M9	6"	6"	100169201
PB/FN0752-M9	5"	5"	100169248	PB/FN0752-F9	5"	5"	100169235	PB/FN1701-M9	7"	7"	100169202
PB/FN1002-M9	6"	6"	100169201	PB/FN1002-F9	6"	6"	100169236	PB/FN2001-M9	8"	8"	100169246
PB/FN1302-M9	6"	8"	100169246	PB/FN1302-F9	6"	8"	100169237	--	--	--	--

2 Venting *(continued)*

Outdoor venting

- In order to properly vent the appliance in an outdoor configuration the optional outdoor vent kit must be used (see Table 2I).
- Vent materials for outdoor venting are to be field supplied.
- The vent must terminate at least 36 inches above the top of the unit.
- All vent materials must be supported as recommended by the vent manufacturer.
- The terminations in Table 2K must be used.

Units are self-venting and can be used outdoors when installed with the optional outdoor kit. All vent materials must be field supplied and supported per the vent manufacturer's instructions.



Only install outdoor models outdoors, and only use the vent caps specified in this manual. Personal injury or product damage may result if any other cap is used, or if an outdoor model is used indoors. Properly install all covers, doors, and jacket panels to ensure proper operation and prevent a hazardous condition.

Table 2J Outdoor Vent Kits

Model	Outdoor Kit No.	Description
502 - 1302	100280318	M/B Series
1501 - 2001	100280319	M Series
1501 - 2001	100280320	B Series



Before installing a venting system, follow all requirements found in the General Venting section of this manual.

Combustion air supply must be free of contaminants (see the Combustion and Ventilation Air Requirements section of this manual). To prevent recirculation of the flue products into the combustion air inlet, follow all instructions in this section.

Outdoor vent / air inlet location

Keep venting areas free of obstructions. Keep area clean and free of combustible and flammable materials. Maintain minimum clearances to combustibles as stated in this manual.

Do not install outdoor models directly on the ground. You must install the outdoor unit on a concrete, brick, block, or pressure-treated wood platform.

Table 2K Approved Outdoor Terminations

Model	Category IV (AL29-4C)			
	Diameter	Heat Fab	Z-Flex	Metal-Fab
PB/PF 502	4	CCA04RC/5400CI	2SVSRFC04	4CGSWC
PB/PF 752	5	CCA05RC/5500CI	2SVSRC05	5CGSWC
PB/PF 1002	6	CCA06RC/5600CI	2SVSRC06	6FCSSWCB
PB/PF 1302	8	CCA08RC/5800CI	2SVSRC08	8FCSSWCB
PB/PF 1501	6	CCA06RC/5600CI	2SVSRC06	6FCSSWCB
PB/PF 1701	7	CCA07RC/5700CI	2SVSRC07	7FCSSWCB
PB/PF 2001	8	CCA08RC/5800CI	2SVSRC08	8FCSSWCB

Model	Category I			
	Diameter	Heat Fab	Z-Flex	Metal-Fab
PB/PF 502	7	CCA07RC/5700CI	2SVDRC07	7MC
PB/PF 752	9	CCA09RC/5900CI	2SVDRC09	10MC*
PB/PF 1002	10	CCA10RC/51000CI	2SVDRC10	10MC
PB/PF 1302	12	CCA12RC/51200CI	2SVDRC12	12MC
PB/PF 1501	12	CCA12RC/51200CI	2SVDRC12	12MC
PB/PF 1701	14	CCA14RC/51400CI	2SVDRC14	14MC
PB/PF 2001	14	CCA14RC/51400CI	2SVDRC14	14MC

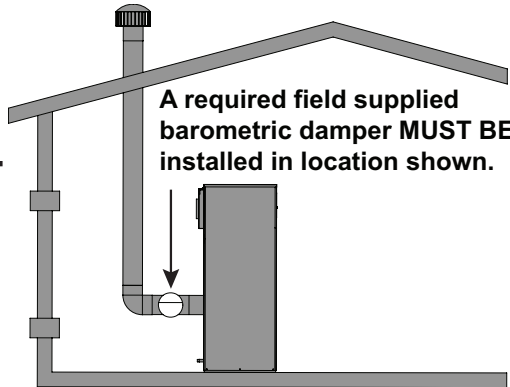
*Requires increaser for diameter of termination.

Note: The terminations listed above can be used on indoor installations, but are required on all outdoor installations.

2 Venting

Non-Condensing Vent Options: CAT I

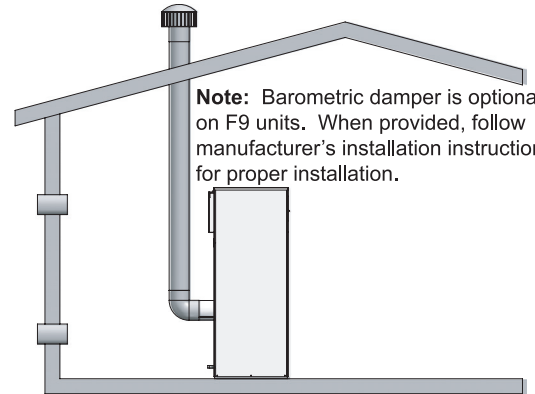
G



A required field supplied barometric damper **MUST BE** installed in location shown.

CAT I - B9

Vertical negative draft venting system - see pages 25 and 26.



Note: Barometric damper is optional on F9 units. When provided, follow manufacturer's installation instructions for proper installation.

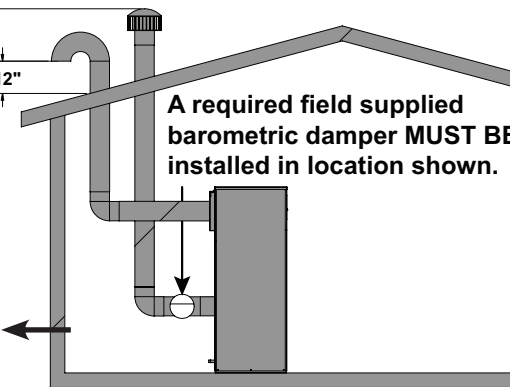
CAT I - F9

Vertical negative draft venting system - see page 25.

H

INCORRECT INSTALLATIONS

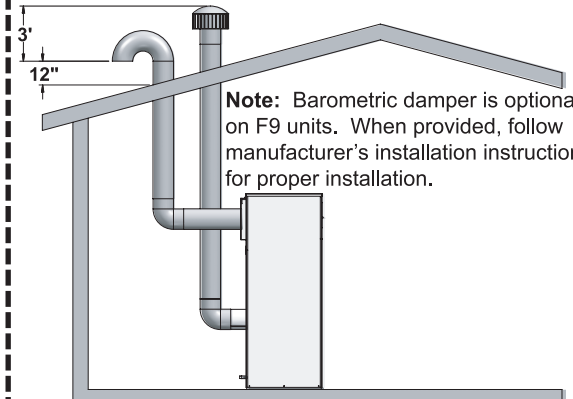
On B9 Models DO NOT install barometric damper in either of these locations.



A required field supplied barometric damper **MUST BE** installed in location shown.

CAT I - B9

DirectAir vertical venting with vertical air inlet - see pages 25 and 26.

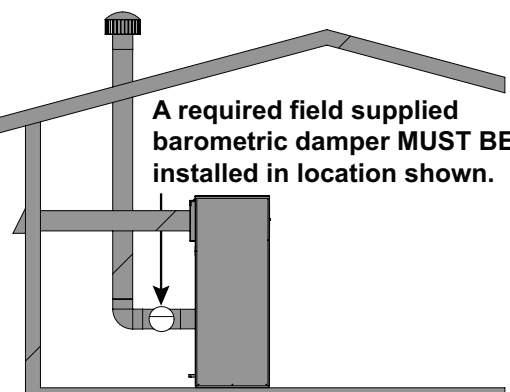


Note: Barometric damper is optional on F9 units. When provided, follow manufacturer's installation instructions for proper installation.

CAT I - F9

DirectAir vertical venting with vertical air inlet - see page 25.

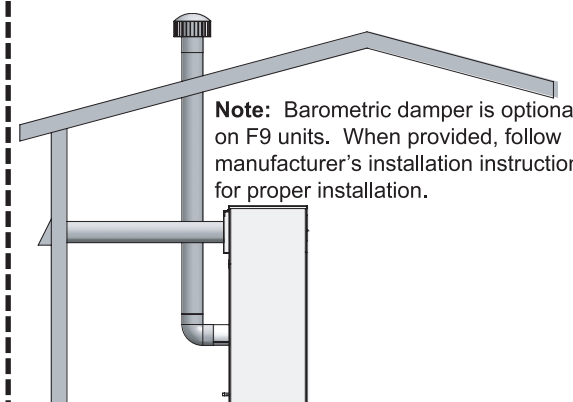
I



A required field supplied barometric damper **MUST BE** installed in location shown.

CAT I - B9

DirectAir vertical venting with sidewall inlet - see pages 25 and 26.



Note: Barometric damper is optional on F9 units. When provided, follow manufacturer's installation instructions for proper installation.

CAT I - F9

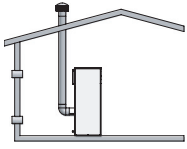
DirectAir vertical venting with sidewall inlet - see page 25.

2 Venting *(continued)*

Non-Condensing vent options: CAT I



CAT I



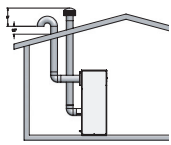
Vertical negative draft venting system - see page 24.

Units that may be vented with a Category I, Type “B” vent material operate with limited burner modulation. These units can be identified by the Category I and the control number F9 or B9 as noted on the unit’s rating plate. These are the only units that can be vented with standard double-wall vent material. See the *General Venting* and the *Negative Draft General Venting* on pages 26 and 27. The flue must terminate at the rooftop and follow the clearance requirements on pages 32 and 33. Combustion air is supplied from the equipment room. The installation of the vent must conform to the latest edition of the National Fuel Gas Code, ANSI Z223.1, in Canada, the latest edition of CGA Standard B149 Installation Code for Gas Burning Appliances and Equipment. The negative draft in a conventional vent installation must be within the range of 0.02 to 0.08 inches w.c. to ensure proper operation. Make all draft readings while the unit is in stable operation (approximately 2 to 5 minutes).

TABLE - 2L FIELD PROVIDED TERMINATIONS			
MODEL	VENT SIZES	MODEL	VENT SIZES
PB/FN0502-F9	7"	PB/FN1501-F9	12"
PB/FN0752-F9	9"	PB/FN1701-F9	14"
PB/FN1002-F9	10"	PB/FN2001-F9	14"
PB/FN1302-F9	12"	--	--



CAT I



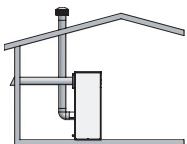
DirectAire vertical venting with vertical air inlet - see page 24.

Units that may be vented with a Category I, Type “B” vent material operate with limited burner modulation. These units can be identified by the Category I and the control number F9 or B9 as noted on the unit’s rating plate. These are the only units that can be vented with standard double-wall vent material. See the *General Venting* and the *Negative Draft General Venting* sections on pages 26 and 27. The flue must terminate at the rooftop and follow the clearance requirements on pages 32 and 33. Combustion air is supplied vertically from the rooftop. The installation of the vent must conform to the latest edition of the National Fuel Gas Code, ANSI Z223.1, in Canada, the latest edition of CGA Standard B149 Installation Code for Gas Burning Appliances and Equipment. The negative draft in a conventional vent installation must be within the range of 0.02 to 0.08 inches w.c. to ensure proper operation. Make all draft readings while the unit is in stable operation (approximately 2 to 5 minutes).

TABLE - 2M FIELD PROVIDED TERMINATIONS					
MODEL	AIR SIZES	VENT SIZES	MODEL	AIR SIZES	VENT SIZES
PB/FN0502-F9	5"	7"	PB/FN1501-F9	6"	12"
PB/FN0752-F9	5"	9"	PB/FN1701-F9	7"	14"
PB/FN1002-F9	6"	10"	PB/FN2001-F9	8"	14"
PB/FN1302-F9	6"	12"	--	--	--

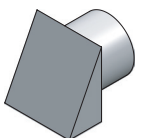


CAT I



DirectAire vertical with sidewall air inlet - see page 24.

Units that may be vented with a Category I, Type “B” vent material operate with limited burner modulation. These units can be identified by the Category I and the control number F9 or B9 as noted on the unit’s rating plate. These are the only units that can be vented with standard double-wall vent material. See the *General Venting* and the *Negative Draft General Venting* sections on pages 26 and 27. The flue must terminate at the rooftop and follow the clearance requirements on pages 32 and 33. Combustion air is supplied horizontally from the outside. The installation of the vent must conform to the latest edition of the National Fuel Gas Code, ANSI Z223.1, in Canada, the latest edition of CGA Standard B149 Installation Code for Gas Burning Appliances and Equipment. The negative draft in a conventional vent installation must be within the range of 0.02 to 0.08 inches w.c. to ensure proper operation. Make all draft readings while the unit is in stable operation (approximately 2 to 5 minutes).



Air Inlet Cap

TABLE - 2N AIR INLET CAP							
MODEL	AIR SIZES	VENT SIZES	KIT NUMBER	MODEL	AIR SIZES	VENT SIZES	KIT NUMBER
PB/FN0502-F9	5"	7"	100168088	PB/FN1501-F9	6"	12"	100168089
PB/FN0752-F9	5"	9"	100168088	PB/FN1701-F9	7"	14"	100168090
PB/FN1002-F9	6"	10"	100168089	PB/FN2001-F9	8"	14"	100168091
PB/FN1302-F9	6"	12"	100168089	--	--	--	--

2 Venting

Common Venting CAT II:

Flues of multiple Power-fins may be combined by incorporating a vent increaser to change the Category IV appliance to a Category II vent system which can be common vented using an engineered vent system. The increaser kit must be provided by the manufacturer and the combined engineered vent system must be designed to ensure that flue products will be properly exhausted from the building at all times. **Failure to use the correct vent increaser or a properly sized vent system may result in a hazardous condition where flue gases spill into an occupied living space.** Consult a vent designer to determine the diameter of the common vent pipe required for combined vent installation. It is recommended that all vent joints and seams are sealed gastight. This vent system has specific vent material and installation requirements. The negative draft in a conventional vent installation must be within the range of 0.02 to 0.08 inches w.c. to ensure proper operation. Make all draft readings while the unit is in stable operation (approximately 2 to 5 minutes).

Common Venting CAT I - Venting options: G, H, & I (F9 / B9)

The negative draft in a conventional vent installation must be within the range of 0.02 to 0.08 inches w.c. to ensure proper operation. Make all draft readings while the unit is in stable operation (approximately 2 to 5 minutes).

As noted in the diagrams on page 24, F9 models do not require a barometric damper in a single stack installation as illustrated. However, common venting of multiple negative draft appliances requires that you **MUST** install a barometric damper on each unit to regulate draft. Install per the requirements of the latest edition of the National Fuel Gas Code, ANSI Z223.1 and/or CAN/CGA-B149 Installation Code. A field supplied inline condensate collection section **MUST BE** installed above the vent connector of each unit.

Common Venting systems may be too large when an existing unit is removed. At the time of removal of an existing appliance, follow the steps below with each appliance remaining connected to the common venting system placed in operation, while other appliances remaining connected to the common venting system are not in operation:

- a. Seal any unused opening in the common venting system.
- b. Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion, and other unsafe condition.
- c. Insofar as is practical, close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any other appliances not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.
- d. Place in operation the appliance being inspected. Follow the lighting (operating) instructions in this manual (see page 59). Adjust thermostat so appliance will operate continuously.
- e. Test for spillage at the draft hood / relief opening after five (5) minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar, or pipe.
- f. After it has been determined that each appliance remaining connected to the common venting system vents properly when tested as above, return doors, windows, exhaust fans, fireplace dampers, and other gas burning appliances to their previous conditions of use.
- g. Any improper operation of the common venting system should be corrected so that the installation conforms to the latest edition of the National Fuel Gas Code, ANSI Z223.1, in Canada, the latest edition of CGA Standard B149 Installation Code for Gas Burning Appliances and Equipment.

When resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in the latest edition of the National Fuel Gas Code, ANSI Z223.1, in Canada, the edition of CGA Standard B149 Installation Code for Gas Burning Appliances and Equipment.

B9 Barometric Damper CAT I - Venting options: G, H, & I (Required for B9)

Category I B9 units require a field supplied barometric damper to be installed at the rear of the unit. The damper should be installed directly after the flue collar prior to going vertical with the flue pipe as shown in the figures on page 24. The damper position indicator should be visible after its installation. The damper should be sized appropriately for the flue pipe. 1501 B9 models require a 12" damper. 1701 and 2001 B9 models require a 14" damper. When using barometric dampers, make-up air must be supplied to the room in order for them to function. This location is important and specifically required for the B9 appliance and may not match suggested locations found in the damper manufacturer's installation manual. Otherwise follow the manufacturer's recommendations on damper installation and operation. The negative draft in a conventional vent installation must be within the range of 0.02 to 0.08 inches w.c. to ensure proper operation. Make all draft readings while the unit is in stable operation (approximately 2 to 5 minutes).

Note: Barometric dampers may also be required on 502, 752, 1002, and 1302 "F9" models for use in high draft areas and are required when common venting multiple negative draft Category I appliances (see *Common Venting CAT I* section).

2 Venting *(continued)*

CAT I, II, & IV General venting information - Vent options: All Categories

Vent installation for connection to gas vents or chimneys must be in accordance with “Venting of Equipment”, of the latest edition of the National Fuel Gas Code, ANSI Z223.1, in Canada, the latest edition of CAN/CGA Standard B149 Installation Code for Gas Burning Appliances and Equipment or applicable provisions of the local building codes.

All venting applications where combustion air is drawn from the equipment room must have adequate combustion and ventilation air supplied to the equipment room in accordance with the latest edition of CAN/CGA Standard B149 Installation Code for Gas Burning Appliances and Equipment or applicable provisions of the local building codes.

The distance of the vent terminal from adjacent buildings, windows that open and building openings MUST comply with the minimum clearances stated in this manual and the latest edition of the National Fuel Gas Code, ANSI Z223.1, in Canada, the latest edition of CAN/CGA Standard B149 Installation Code for Gas Burning Appliances and Equipment.

The vent connection is made directly to the flue outlet opening on the rear of the unit. The connection from the appliance vent to the stack must be made as direct as possible with no reduction in diameter.

Vent system must be supported horizontally to prevent sagging. Methods and intervals for support vary by vent manufacturer and vent material. Vent support methods and intervals shall adhere to vent manufacturer’s instructions, where applicable. Vent piping must be supported per the National Building Code, Section 305, Table 305.4 or as local codes dictate.

When CAT II/IV venting is used, the vent for this appliance shall not terminate:

1. over public walkways; or
2. near soffit vents or crawl space vents or other areas where condensate or vapor could create a nuisance or hazard or cause property damage; or
3. where condensate vapor could cause damage or could be detrimental to the operation of regulators, relief valves, or other equipment.

A water heater shall not be connected to a chimney flue serving a separate appliance designed to burn solid fuel.

NOTICE

Examine the venting system at least once a year. Check all joints and vent pipe connections for tightness. Also check for corrosion or deterioration. Immediately correct any problems observed in the venting system.

CAT IV Specific venting information: Vent Options A, B, C, D, E, & F

A Category IV venting system operates with a positive pressure in the vent. This positive pressure is generated by the internal combustion air blower which operates the combustion process and also exhausts the flue products from the building. The Category IV flue from this appliance cannot be combined with the vent from any other appliance. **The Category IV flue from this appliance must be a dedicated stack, there is one exception however. The Category IV flues from multiple Power-fin appliances may only be combined when using an engineered vent system incorporating an induced draft fan to ensure that flue products will be properly exhausted from the building at all times. Failure to use a properly sized induced draft fan on a combined Category IV vent installation may result in a hazardous condition where flue gases spill into an occupied living space.** Consult the induced draft fan manufacturer to size the induced draft fan and to determine the diameter of the common vent pipe required for a combined vent installation. The flue from this Category IV appliance must have all vent joints and seams sealed gastight. A Category IV vent system has specific vent material and installation requirements.

The flue products in the vent system may be cooled below their dew point and form condensate in the flue. The flue materials used for a Category IV vent must be resistant to any corrosive damage from flue gas condensate. The flue from a Category IV vent system must have a condensate drain with provisions to properly collect and dispose of any condensate that may occur in the venting system.

The connection from the appliance vent to the stack or vent termination outside the building must be made with listed Category IV vent material and must be as direct as possible. The Category IV vent and accessories such as firestop spacers, thimbles, caps, etc., must be installed in accordance with the vent manufacturer’s instructions. The vent connector and firestop must provide correct spacing to combustible surfaces and seal to the vent connector on the upper and lower sides of each floor or ceiling through which the vent connector passes.

Any vent materials specified must be listed by a nationally recognized test agency for use as a Category IV vent material.

The venting system must be planned so as to avoid possible contact with concealed plumbing or electrical wiring inside walls, floors, or ceilings. Locate the appliance as close as possible to a chimney or gas vent.

2 Venting

CAT IV Specific venting information (continued): Vent options A, B, C, D, E, & F

Horizontal portions of the venting system shall be supported to prevent sagging. Horizontal runs should slope upwards not less than a 1/4 inch per foot from the drain tee installed in the flue to the vertical portion of the flue or to the vent terminal on sidewall venting installations. This ensures proper removal of any condensate that may form in the flue. Follow the installation instructions from the vent material manufacturer.

Do not use an existing chimney as a raceway if another appliance or fireplace is vented through the chimney. The weight of the venting system must not rest on the unit. Adequate support of the venting system must be provided in compliance with local codes and other applicable codes. All connections should be secured and sealed per the vent manufacturer's specifications.

Vent connectors serving appliances vented by natural draft shall not be connected to any portion of the Category IV positive pressure vent system used by this appliance. Connection of a negative draft flue into the positive pressure stack from this appliance may cause flue products to be discharged into an occupied living space causing serious health injury.

When a Category IV vent system is disconnected for any reason, the flue must be reassembled and resealed according to the vent manufacturer's instructions.

The flue may terminate either vertically at the rooftop or horizontally on a sidewall. Refer to the specific vent termination sections for information about recommended vent termination location and clearances.

Length of flue pipe

The installed length of the Category IV flue from the appliance to the point of termination, outside of the building, must not exceed a maximum of 50 equivalent feet (15.2m) in length. Subtract 5 feet (1.5m) of equivalent length for each 90° elbow installed in the vent. Subtract 2 1/2 feet (0.7m) of equivalent length for each 45° elbow installed in the vent.

CAT II/IV Drain Tee Requirements: Vent options A, B, C, D, E, & F

Drain tee installation

A drain tee must be installed in the Category II & IV vent pipe to collect and dispose of any condensate that may occur in the vent system. The drain tee should be installed at the point where the flue turns vertical for a rooftop termination or as one of the first fittings in a horizontal flue connector that will terminate on a sidewall. Ensure that horizontal portions of the vent are properly sloped to allow condensate to be evacuated at the drain tee. Plastic drain tubing, sized per the vent manufacturer's instructions, shall be provided as a drain line from the tee. The drain tubing must have a trap provided by a 10" (25.4cm) diameter circular trap loop in the drain tubing. Prime the trap loop by pouring a small quantity of water into the drain hose before assembly to the vent. Secure the trap loop in position with nylon wire ties. Use caution not to collapse or restrict the condensate neutralization system or a suitable drain for disposal of condensate that may occur in the Category IV vent system. Ensure that the drain from the condensate tee is not exposed to freezing temperatures. See Section 7, *Startup - Freeze Protection* for more information.

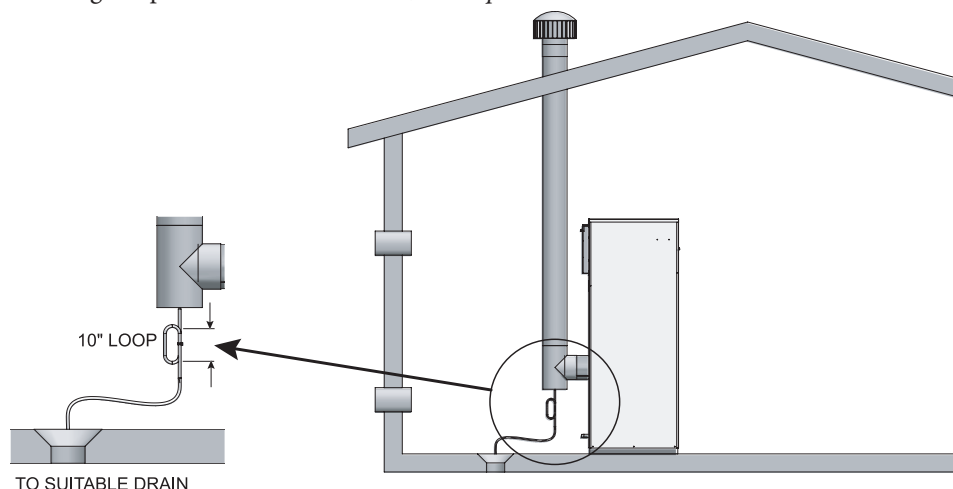


Figure 2-3_Drain Tee Installation

CAT I Specific venting information:

Follow all requirements set forth in the latest edition of the National Fuel Gas Code, ANSI Z223.1, in Canada, the latest edition of the CAN/CGA Standard B149 Installation Code for Gas Burning Appliances and Equipment or applicable provisions of the local building codes.

2 Venting *(continued)*

Vertical Air Inlet: Vent options B, F, & H

Vertical combustion air inlet

The air inlet cap for the vertical rooftop air inlet is assembled from components purchased locally. The air inlet cap consists of two 90° elbows installed at the point of termination for the air inlet pipe. The first 90° elbow is installed on the rooftop at the highest vertical point of the air inlet pipe and turned horizontal, the second 90° elbow is installed on the horizontal outlet of the first elbow and turned down.

A 90° elbow and a 90° street elbow may be used to make this assembly. If a straight piece of pipe is used between the two elbows, it should not exceed 6 inches (152mm) in length. The termination elbow on the air inlet must be located a minimum of 12 inches (0.30m) above the roof or above normal levels of snow accumulation.

Location of a vertical air inlet cap

Incorrect installation and/or location of the air inlet cap can allow the discharge of flue products to be drawn into the combustion process on the heater. This can result in incomplete combustion and potentially hazardous levels of carbon monoxide in the flue products. This will cause operational problems with the heater and possible spillage of flue products that can cause personal injury, death, or property damage.

The point of termination for the combustion air inlet cap **MUST** be at least 3 feet (0.91m) below the point of flue gas termination (vent cap) if it is located within a 10 foot (3.05m) radius of the flue outlet. Use care to ensure that the 90° elbow assembly is properly installed on the air inlet pipe.

The combustion air inlet cap must not be installed closer than 10 feet (3.05m) from an inside corner of an L-shaped structure.

The termination point of the combustion air inlet cap must be installed at least one foot (0.30m) above the rooftop and above normal snow levels.

The combustion air cap assembly used **MUST** adequately protect the combustion air inlet from wind and weather.

Combustion air supplied from outdoors must be free of contaminants (see *Combustion and Ventilation Air*, page 14). To prevent recirculation of flue products into the combustion air inlet, follow all instructions in this section.

The combustion air inlet caps for multiple appliance installations must maintain the minimum 3 foot (0.91m) clearance below the closest vertical flue outlet if within 10 feet (3.05m).

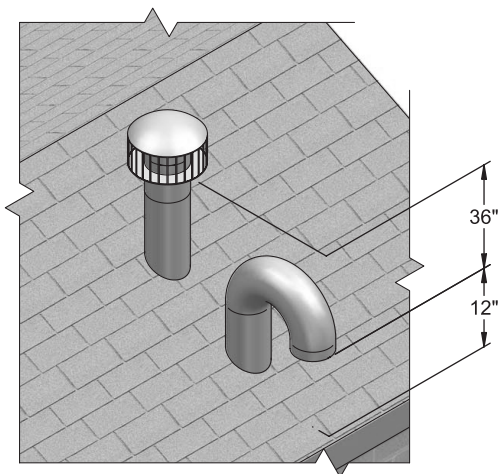


Figure 2-4_Vertical Air Inlet Clearances

2 Venting

Horizontal Air Inlet: Vent options C, E, F, & I

Sidewall combustion air inlet

The sidewall termination caps for both the flue products and combustion air must be purchased from the appliance manufacturer.

The part numbers for the required sidewall termination kit are listed under each designated table. Each kit includes both the special combustion air inlet cap and the sidewall flue cap for installation on an exterior sidewall. The sidewall air inlet cap supplied in the kit is sized to provide combustion air for a single appliance only.

Location of a sidewall air inlet cap

Incorrect installation and/or location of the air inlet cap can allow the discharge of flue products to be drawn into the combustion process on the heater. This can result in incomplete combustion and potentially hazardous levels of carbon monoxide in the flue products. This will cause operational problems with the heater and possible spillage of flue products that can cause personal injury, death, or property damage.

The termination point of the sidewall air inlet must be installed a minimum of 12 inches (0.30m) above ground level and above normal levels of snow accumulation.

The point of termination for the sidewall combustion air inlet cap **MUST** be located a minimum of 3 feet (0.91m) horizontally and 12 inches (0.30m) below the point of flue gas termination (vent cap) if it is located within a 10 foot (3.05m) radius of the flue outlet.

The combustion air inlet caps for multiple appliance installations must maintain the same minimum clearance from the closest vent cap installed within a 10 foot radius of the point of flue gas termination as specified in single appliance installations.

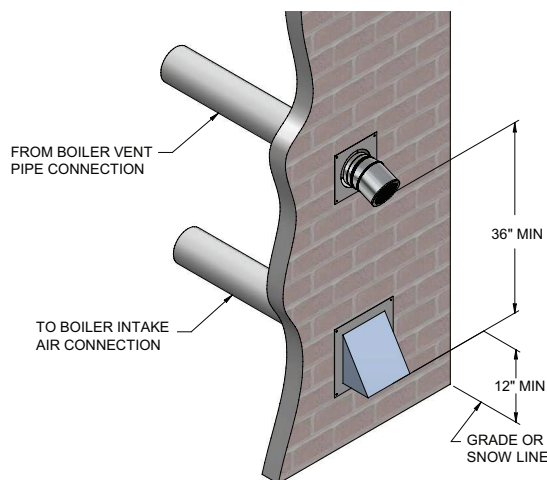


Figure 2-5_Horizontal Air Inlet Clearances

Multiple horizontal or vertical direct vent installations

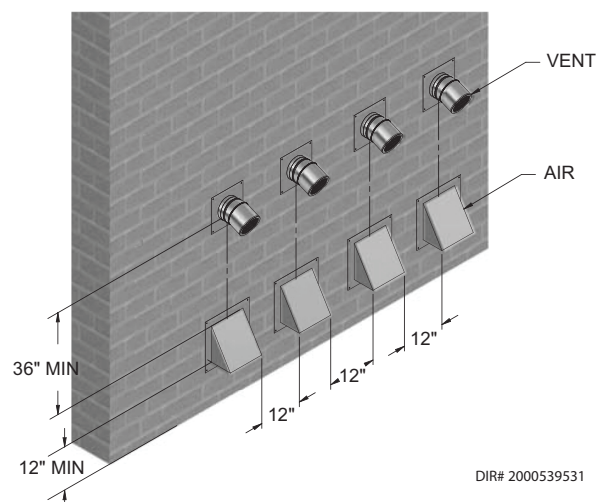
The combustion air inlet caps for multiple appliance installations must maintain the same minimum clearance from the closest vent cap installed within a 10 foot radius of the point of flue gas termination as specified in single appliance installations. Multiple flue outlet caps may be installed side by side and multiple air inlet caps may be installed side by side, but the minimum clearance of a 3 foot (0.91m) horizontal radius and 12 inches (0.30m) below the closest flue outlet to the air inlet cap must be maintained. All clearance and installation requirements in this section and the applicable portions of the *Category IV General Venting* section must be maintained on multiple appliance installations.

The combustion air inlet cap must not be installed closer than 10 feet (3.05m) from an inside corner of an L-shaped structure.

The combustion air cap assembly used **MUST** adequately protect the combustion air inlet from wind and weather.

Combustion air supplied from outdoors must be free of contaminants (see *Combustion and Ventilation Air*, page 14). To prevent recirculation of flue products into the combustion air inlet, follow all instructions in this section.

Figure 2-6 Multiple Vent Terminations (must also comply with Figure 2-6)



2 Venting *(continued)*

Length of air inlet pipe for both vertical and horizontal - Vent options: All Categories

The maximum installed length of the air inlet pipe from the appliance to the air inlet cap is 50 equivalent feet (15.2m) in length. Subtract 5 feet (1.52m) of equivalent length for each 90° elbow installed in the air inlet pipe. Subtract 2 1/2 feet (0.7m) of equivalent length for each 45° elbow installed in the air inlet pipe.

Air inlet pipe materials:

The air inlet pipe(s) must be sealed. Choose acceptable combustion air inlet pipe materials from the following list:

PVC, CPVC or ABS

Dryer Vent or Sealed Flexible Duct (not recommended for rooftop air inlet)

Galvanized steel vent pipe with joints and seams sealed as specified in this section.

Type “B” double-wall vent with joints and seams sealed as specified in this section.

*Plastic pipe may require an adapter (not provided) to transition between the air inlet connection on the appliance and the plastic air inlet pipe.

WARNING Using vent or air intake materials other than those specified, failure to properly seal all seams and joints or failure to follow vent pipe manufacturer’s instructions can result in personal injury, death or property damage. Mixing of venting materials will void the warranty and certification of the appliance.

NOTICE The use of double-wall vent or insulated material for the combustion air inlet pipe is recommended in cold climates to prevent the condensation of airborne moisture in the incoming combustion air.

Sealing of Type “B” double-wall vent material or galvanized vent pipe material used for air inlet piping on a sidewall or vertical rooftop Combustion Air Supply System:

- Seal all joints and seams of the air inlet pipe using either Aluminum Foil Duct Tape meeting UL Standard 723 or 181A-P or a high quality UL Listed silicone sealant such as those manufactured by Dow Corning or General Electric.
- Do not install seams of vent pipe on the bottom of horizontal runs.
- Secure all joints with a minimum of three sheet metal screws or pop rivets. Apply Aluminum Foil Duct Tape or silicone sealant to all screws or rivets installed in the vent pipe.
- Ensure that the air inlet pipes are properly supported.

The PVC, CPVC, or ABS air inlet pipe should be cleaned and sealed with the pipe manufacturer’s recommended solvents and standard commercial pipe cement for the material used. Use only cleaners, primers, and solvents that are approved for the materials which are joined. Horizontal runs shall have supports suitable for non-metallic vent piping that do not clamp tightly onto vent, allowing for vent expansion or contraction. Supports shall be as close to joints and fittings as practical and no more than 5 feet apart. The PVC, CPVC, ABS, Dryer Vent or Flex Duct air inlet pipe should use a silicone sealant to ensure a proper seal at the appliance connection and the air inlet cap connection. Dryer vent or flex duct should use a screw type clamp to seal the vent to the appliance air inlet and the air inlet cap. Proper sealing of the air inlet pipe ensures that combustion air will be free of contaminants and supplied in proper volume.

When a sidewall or vertical rooftop combustion air supply system is disconnected for any reason, the air inlet pipe must be resealed to ensure that combustion air will be free of contaminants and supplied in proper volume.

DANGER Failure to properly seal all joints and seams as required in the air inlet piping may result in flue gas recirculation, spillage of flue products and carbon monoxide emissions causing severe personal injury or death.

Combined combustion air inlet points - Category I, II, & IV

The air inlet pipes from multiple appliances can be combined to a single common connection if the common air inlet pipe has a cross sectional area equal to or larger than the total area of all air inlet pipes connected to the common air inlet pipe. [Example: two 8" (20.3cm) air inlet pipes (50.3 in²(324.5cm²) area each) have a total area of 100.6 in² (645.2cm²) requires a 12 inch (30.5cm) (113.1in²area) (729.7cm²) common air inlet pipe.] The air inlet point for multiple boiler air inlets must be provided with an exterior opening which has a free area equal to or greater than the total area of all air inlet pipes connected to the common air inlet. This exterior opening for combustion air must connect directly to the outdoors. The total length of the combined air inlet pipe must not exceed a maximum of 50 equivalent feet (15.2m). You must deduct the restriction in area provided by any screens, grills, or louvers installed in the common air inlet point. These (screens, grills, or louvers) are common on the sidewall air inlet openings and some rooftop terminations. Screens, grills, or louvers installed in the common air inlet can reduce the free area of the opening from 25% to 75% based on the materials used.

2 Venting

Vertical Vent Termination Clearances - Venting options: A, B, C, G, H & I

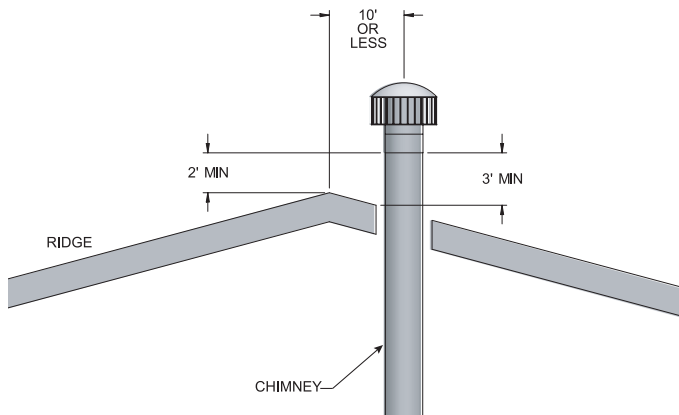


Figure 2-7_Vent Termination from Peaked Roof - 10 ft. or Less From Ridge

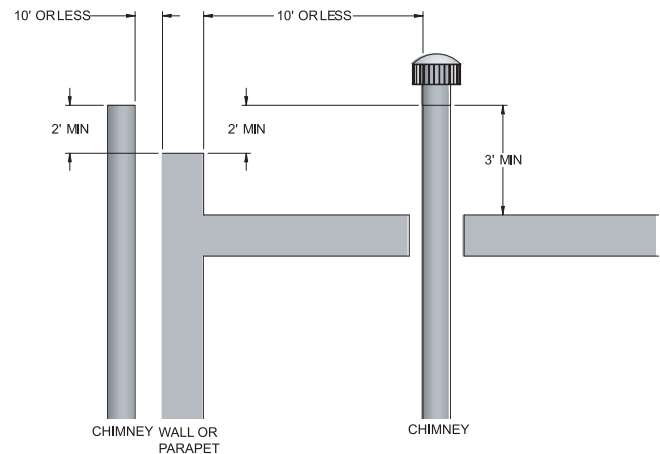


Figure 2-9_Vent Termination from Flat Roof - 10 ft. or Less From Parapet Wall

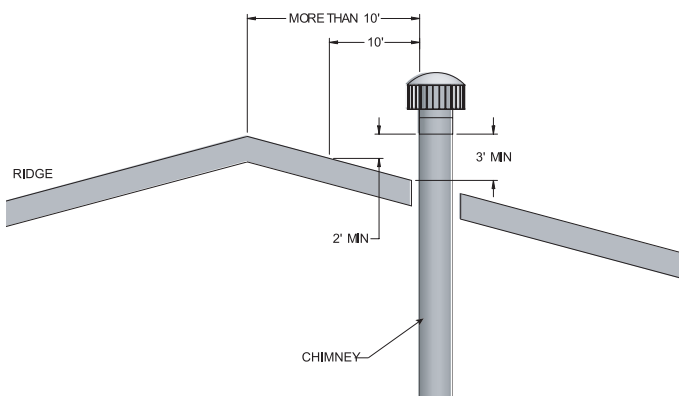


Figure 2-8_Vent Termination from Peaked Roof - 10 ft. or More From Ridge

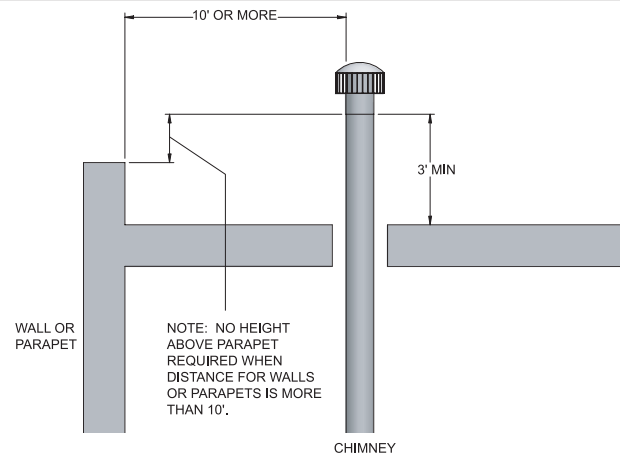


Figure 2-10_Vent Termination from Flat Roof - 10 ft. or More From Parapet Wall

The vent terminal should be vertical and exhaust outside the building at least 2 feet (0.61m) above the highest point of the roof within a 10 foot (3.05m) radius of the termination.

The vertical termination must be a minimum of 3 feet (0.91m) above the point of exit.

A vertical termination less than 10 feet (3.05m) from a parapet wall must be a minimum of 2 feet (0.61m) higher than the parapet wall.

The vent cap should have a minimum clearance of 4 feet (1.22m) horizontally from and in no case above or below, unless a 4 foot (1.22m) horizontal distance is maintained from electric meters, gas meters, regulators, and relief equipment.

The venting system shall terminate at least 3 feet (0.9m) above any forced air inlet within 10 feet (3.05m).

The venting system shall terminate at least 4 feet (1.2m) below, 4 feet (1.2m) horizontally from, or 1 foot (30cm) above any door, window, or gravity air inlet into any building.

Do not terminate the vent in a window well, stairwell, alcove, courtyard, or other recessed area. The vent cannot terminate below grade. The bottom of the vent terminal shall be located at least 12 inches (30cm) above the roof or above normal snow levels.

To avoid a blocked flue condition, keep the vent cap clear of snow, ice, leaves, debris, etc.

Vertical Vent Termination Clearances - Venting options: A, B, C, G, H & I

Flue gases from this appliance may contain large amounts of water vapor that will form a white plume in winter. Plume could obstruct window view.

Flue gas condensate can freeze on exterior surfaces or on the vent cap. Frozen condensate on the vent cap can result in a blocked flue condition. Flue gas condensate can cause discoloration of exterior building surfaces. Adjacent brick or masonry surfaces should be protected with a rust resistant sheet metal plate.

The manufacturer shall NOT be held liable for any personal injury or property damage due to ice formation or dislodging of ice from the vent system or vent termination.

2 Venting *(continued)*

Vertical Vent Termination Clearances - Venting options: A, B, C, G, H & I Masonry chimney installations

A masonry chimney must be properly sized for the installation of a high efficiency gas-fired appliance. Venting of a high efficiency appliance into a cold or oversized masonry chimney can result in operational and safety problems. Exterior masonry chimneys, with one or more sides exposed to cold outdoor temperatures, are more likely to have venting problems. The temperature of the flue products from a high efficiency appliance may not be able to sufficiently heat the masonry structure of the chimney to generate proper draft. This will result in condensing of flue products, damage to the masonry flue/tile, insufficient draft and possible spillage of flue products into an occupied living space. Carefully inspect all chimney systems before installation.

A standard masonry chimney must NOT be used to vent the products of combustion from the flue of a Category IV, positive pressure appliance. If a masonry chimney is to be used, the chimney MUST use a sealed, metallic, corrosion resistant liner system to vent flue products from this high efficiency appliance. Sealed, metallic, corrosion resistant liner systems (single-wall, double-wall, flexible or rigid metallic lines) must be rated for use with a high efficiency, Category IV, positive pressure vent system. Corrosion resistant chimney liner systems are typically made from a high grade of corrosion resistant stainless steel such as AL29-4C. The corrosion resistant liner must be properly sized and fully sealed throughout the entire length if the flue is contained within the masonry chimney. Both the top and the bottom of the masonry chimney must be capped and sealed to provide a dead air space around the sealed corrosion resistant metallic liner. Consult with local code officials to determine code requirements or the advisability of using a masonry chimney with a sealed corrosion resistant liner system.

WARNING Do not vent this unit into a masonry chimney without a sealed stainless steel liner system. Any breaks, leaks or damage to the masonry flue/tile will allow the flue products to leak from the chimney and into occupied living spaces. This could cause serious injury or death due to carbon monoxide poisoning and other harmful flue products.

CAUTION Venting of a high efficiency Category IV appliance into a masonry chimney without a sealed stainless steel liner can result in operational and safety problems. Any breaks, leaks, or damage to the masonry flue/tile will allow spillage of the positive pressure flue products from the chimney. These flue products can easily escape into an occupied living space causing a health hazard. If there is any doubt about the condition of a masonry chimney, or its acceptability for use after insertion of a corrosion resistant liner system, consult with local code officials.

NOTICE Check with local code officials to determine code requirements or advisability of a masonry chimney with a sealed corrosion-resistant liner system.

Inspection of a masonry chimney

A masonry chimney must be carefully inspected to determine its suitability for the venting of flue products. A clay-tile-lined chimney must be structurally sound, straight and free of misaligned tile, gaps between liner sections, missing sections of liner or any signs of condensate drainage at the breaching or clean out. If there is any doubt about the condition of a masonry chimney, it must be relined with a properly-sized and approved chimney liner system. An unlined masonry chimney must not be used to vent flue products from this high-efficiency unit. An unlined chimney must be relined with an approved chimney liner system when a new appliance is being attached to it. Metallic liner systems (Type-B double-wall or flexible or rigid metallic liners) are recommended. Consult with local code officials to determine code requirements or the advisability of using or relining a masonry chimney.

Location of a sidewall vent termination - Venting options: D, E, & F

The vent cap shall terminate at least 3 feet (0.91m) above any forced air inlet within 10 feet (3.05m).

The vent shall terminate at least 4 feet (1.22m) below, 4 feet (1.22m) horizontally from or 1 foot (0.30m) above and 2 feet (0.60m) horizontally from any door, window, or gravity air inlet to the building.

The sidewall vent termination must be at least 8 feet (2.4m) horizontally from any combustion air intake located above the sidewall termination cap.

Do not terminate the vent in a window well, stairwell, alcove, courtyard, or other recessed area. The vent cap cannot terminate below grade.

The vent shall not terminate directly above a public walkway due to the normal formation of water vapor in the combustion process. Horizontal terminations must not be located over areas of pedestrian or vehicular traffic.

The vent system shall terminate at least 1 foot (0.30m) above grade, above normal snow levels and at least 7 feet (2.13m) above grade when located adjacent to public walkways.

The vent terminal shall not be installed closer than 3 feet (0.91m) from an inside corner of an L-shaped structure.

The vent cap should have a minimum clearance of 4 feet (1.22m) horizontally from and in no case above or below, unless a 4 foot (1.22m) horizontal distance is maintained from electric meters, gas meters, regulators, and relief equipment.

Flue gas condensate can freeze on exterior walls or on the vent cap. Frozen condensate on the vent cap can result in a blocked flue condition. Some discoloration to exterior building surfaces can be expected. Adjacent brick or masonry surfaces should be protected with a rust resistant sheet metal plate.

The sidewall vent system MUST use the sidewall vent cap kit provided by the appliance manufacturer for installation on a sidewall termination.

The sidewall vent cap MUST be purchased as a kit from the appliance manufacturer to ensure proper operation. Locally purchased or fabricated sidewall vent caps should not be used.

2 Venting

Sidewall Vent Termination Clearances - Venting options: D, E, & F

Figure 2-11A Direct Vent Terminal Clearances

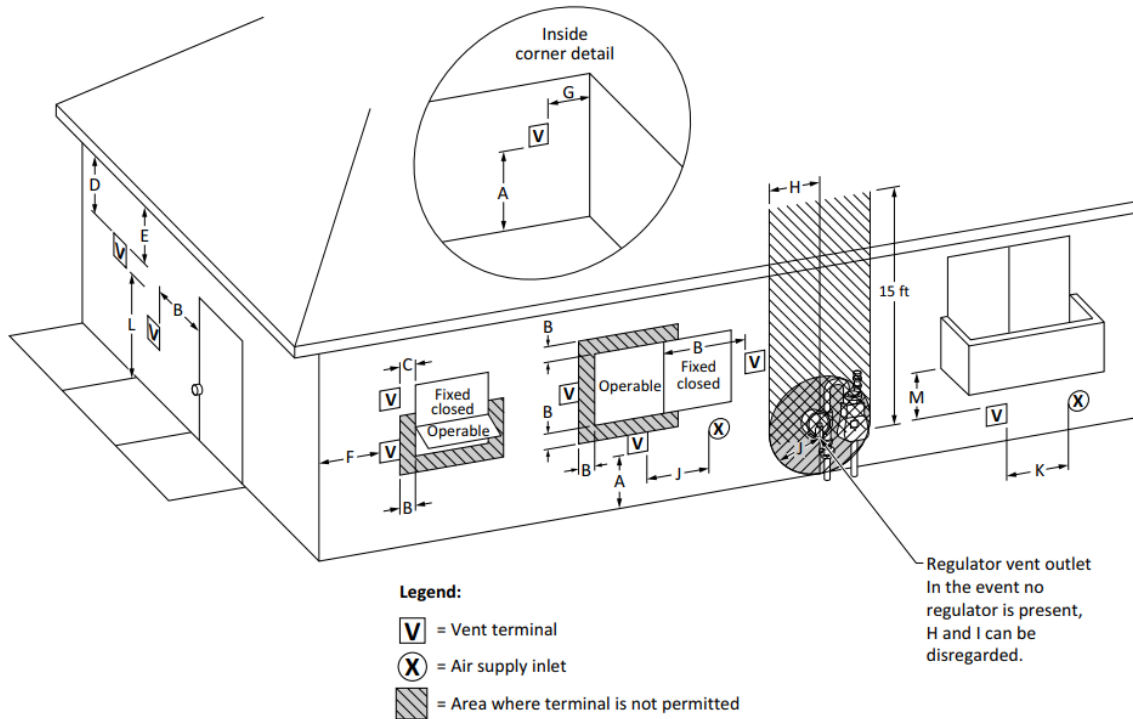


Table 20 Direct Vent Terminal Clearances

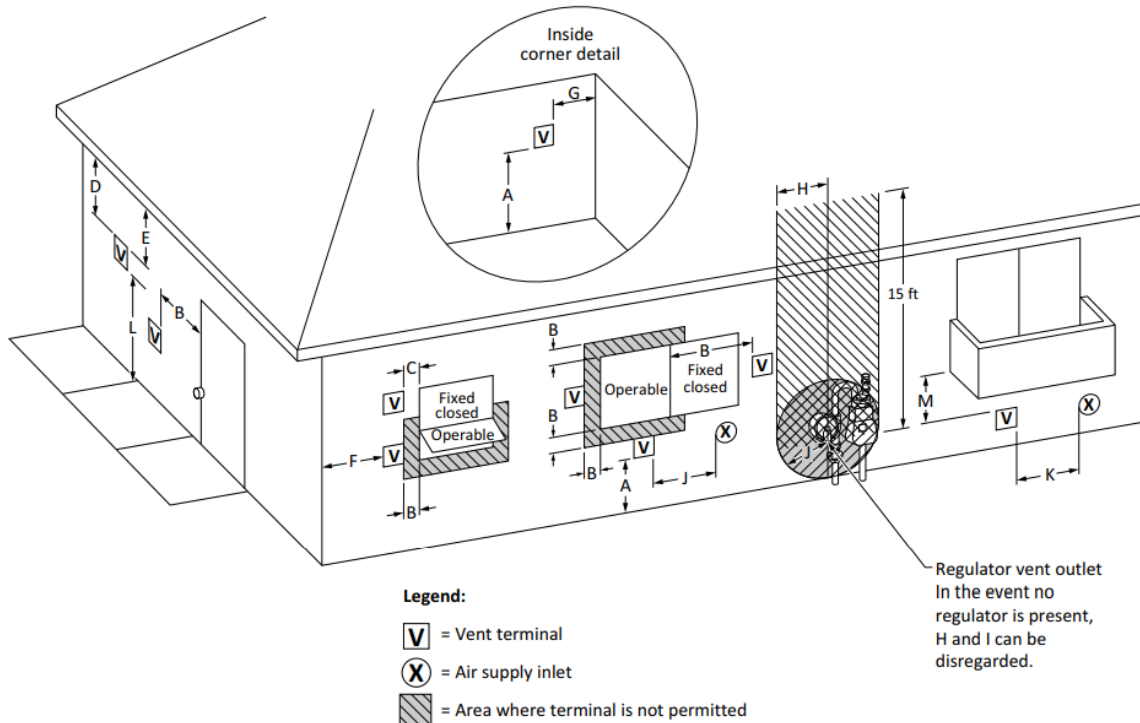
		Canadian Installations ¹	US Installations ²
A =	Clearance above grade, veranda, porch, deck, or balcony	12 in (30 cm)	12 in (30 cm)
B =	Clearance to window or door that may be opened	6 in (15 cm) for appliances ≤ 10,000 Btuh (3 kW), 12 in (30 cm) for appliances > 10,000 Btuh (3 kW) and ≤ 100,000 Btuh (30 kW), 36 in (91 cm) for appliances > 100,000 Btuh (30 kW)	6 in (15 cm) for appliances ≤ 10,000 Btuh (3 kW), 9 in (23 cm) for appliances > 10,000 Btuh (3 kW) and ≤ 50,000 Btuh (15 kW), 12 in (30 cm) for appliances > 50,000 Btuh (15 kW)
C =	Clearance to permanently closed window	*	*
D =	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 ft (61 cm) from the center line of the terminal.	*	*
E =	Clearance to unventilated soffit	*	*
F =	Clearance to outside corner	*	*
G =	Clearance to inside corner	*	*
H =	Clearance to each side of center line extended above meter / regulator assembly	3 ft (91 cm) within a height 15 ft (4.6 m)	*
I =	Clearance to service regulator vent outlet	3 ft (91 cm)	*

2 Venting *(continued)*

Table 20 Direct Vent Terminal Clearances (continued)

J =	Clearance to nonmechanical air supply inlet to building or the combustion air inlet to any other appliance	6 in (15 cm) for appliances ≤ 10,000 Btuh (3kW), 12 in (30 cm) for appliances > 10,000 Btuh (3 kW) and ≤ 100,000 Btuh (30 kW), 36 in (91 cm) for appliances > 100,000 Btuh (30 kW)	6 in (15 cm) for appliances ≤ 10,000 Btuh (3kW), 9 in (23 cm) for appliances > 10,000 Btuh (3 kW) and ≤ 50,000 Btuh (15 kW), 12 in (30 cm) for appliances > 50,000 Btuh (15 kW)
K =	Clearance to a mechanical air supply inlet	6 ft (1.83 m)	3 ft (91 cm) above if within 10 ft (3 m) horizontally
L =	Clearance above paved sidewalk or paved driveway located on public property	7 ft (2.13 m)†	7 ft (2.13 m) for mechanical draft systems (Category I appliances). Vents for Category II and IV appliances cannot be located above public walkways or other areas where condensate or vapor can cause a nuisance or hazard
M =	Clearance under veranda, porch, deck, or balcony	12 in (30 cm)‡	*
<p>* Clearance in accordance with local installation codes and the requirements of the gas supplier.</p> <p>† A vent shall not terminate directly above a sidewalk or paved driveway that is located between two single family dwellings and serves both dwellings.</p> <p>‡ Permitted only if veranda, porch, deck, or balcony is fully open on a minimum of two sides beneath the floor.</p> <p>NOTES:</p> <p>1) In accordance with the current CSA B149.1, Natural Gas and Propane Installation Code</p> <p>2) In accordance with the current ANSI Z223.1/NFPA 54, National Fuel Gas Code</p>			

Figure 2-11B Other than Direct Vent Terminal Clearances



2 Venting

Table 2P Other than Direct Vent Terminal Clearances

		Canadian Installations ¹	US Installations ²
A =	Clearance above grade, veranda, porch, deck, or balcony	12 in (30 cm)	12 in (30 cm)
B =	Clearance to window or door that may be opened	6 in (15 cm) for appliances ≤ 10,000 Btuh (3 kW), 12 in (30 cm) for appliances > 10,000 Btuh (3 kW) and ≤ 100,000 Btuh (30 kW), 36 in (91 cm) for appliances > 100,000 Btuh (30 kW)	4 ft (1.2 m) below or to side of opening; 1 ft (300 mm) above opening
C =	Clearance to permanently closed window	*	*
D =	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 ft (61 cm) from the center line of the terminal.	*	*
E =	Clearance to unventilated soffit	*	*
F =	Clearance to outside corner	*	*
G =	Clearance to inside corner	*	*
H =	Clearance to each side of center line extended above meter / regulator assembly	3 ft (91 cm) within a height 15 ft (4.6 m)	*
I =	Clearance to service regulator vent outlet	3 ft (91 cm)	*
J =	Clearance to nonmechanical air supply inlet to building or the combustion air inlet to any other appliance	6 in (15 cm) for appliances ≤ 10,000 Btuh (3kW), 12 in (30 cm) for appliances > 10,000 Btuh (3 kW) and ≤ 100,000 Btuh (30 kW), 36 in (91 cm) for appliances > 100,000 Btuh (30 kW)	4 ft (1.2 m) below or to side of opening; 1 ft (300 mm) above opening
K =	Clearance to a mechanical air supply inlet	6 ft (1.83 m)	3 ft (91 cm) above if within 10 ft (3 m) horizontally
L =	Clearance above paved sidewalk or paved driveway located on public property	7 ft (2.13 m)†	7 ft (2.13 m) for mechanical draft systems (Category I appliances). Vents for Category II and IV appliances cannot be located above public walkways or other areas where condensate or vapor can cause a nuisance or hazard
M =	Clearance under veranda, porch, deck, or balcony	12 in (30 cm)‡	*
*	Clearance in accordance with local installation codes and the requirements of the gas supplier.		
†	A vent shall not terminate directly above a sidewalk or paved driveway that is located between two single family dwellings and serves both dwellings.		
‡	Permitted only if veranda, porch, deck, or balcony is fully open on a minimum of two sides beneath the floor.		
NOTES:			
1)	In accordance with the current CSA B149.1, Natural Gas and Propane Installation Code		
2)	In accordance with the current ANSI Z223.1/NFPA 54, National Fuel Gas Code		

3 Water connections

Inlet and outlet connections

For ease of service, install unions on the inlet and outlet of the appliance. The connection to the appliance marked “Water Inlet” on the header should be used for return from the system. The connection on the header marked “Hot Water Outlet” is to be connected to the supply side of the system. Minimum water pipe connections to this appliance are 2 1/2 inches (63.5mm) pipe. See the piping requirements in the heating boiler or water heater section of this manual for multiple appliance installations.

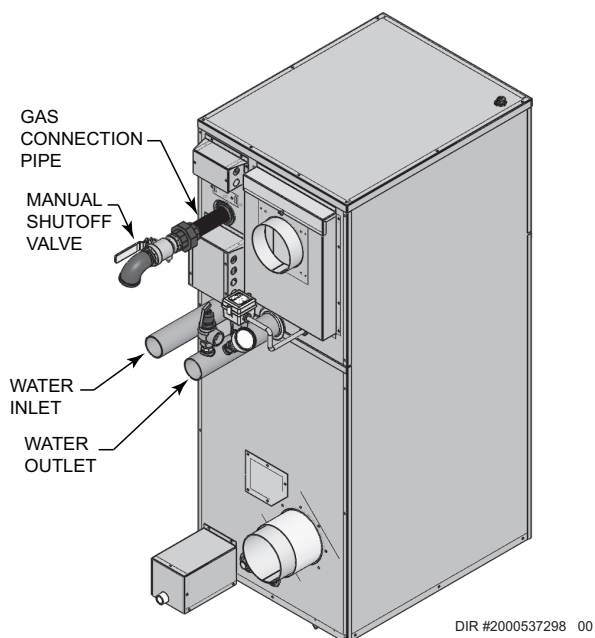


Figure 3-1_Water Connections

Heat exchanger

This appliance uses a finned copper tube heat exchanger to maximize the heat transfer process. The heat exchanger is mounted in the inner jacket on the front side of the appliance. The heat exchanger is composed of two circular, glass lined, and cast iron headers with either 20 or 24 (depending on the model) vertical finned copper tubes (FIG. 3-2). A series of “V” shaped baffles are installed between the individual tubes to control the movement of the flue products over the finned copper surface and increase heat transfer. Water enters the heat exchanger and makes four passes over the area exposed to direct heat from the burner. A circulating pump **MUST** be installed to ensure proper water flow over the heat transfer surfaces during burner operation. Water temperatures in the heat exchanger are determined by water flow.

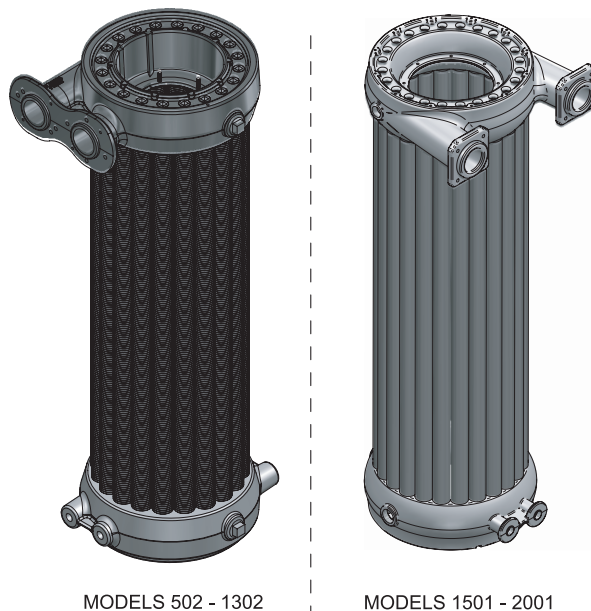


Figure 3-2_Heat Exchanger(s)

Initial set-up of maximum water flow

On initial start-up of the Power-fin, the maximum water flow to the heat exchanger must be checked and manually limited with a valve or bypass before normal operation begins.

Minimum water temperatures

A minimum return water temperature of 140°F (60°C) has been established to control condensate formation based on the Btu/hr output at rated burner input. Maintaining inlet water temperatures to the appliance equal to or higher than the specified minimum temperature ensures proper operation of the appliance and prevents condensate formation on the heat exchanger. An appliance allowed to sustain operation at water temperatures lower than the specified minimum temperature may not provide enough heat from the burner to maintain water temperature in the heat exchanger above the 140°F (60°C) dew point of flue products. Operation of the appliance at a temperature below the specified minimum set point will result in non-warrantable operational problems from the condensate formation on the primary heat exchanger (see the *Low Temperature Bypass Requirements* section on page 45 of this manual).

⚠ CAUTION

An appliance allowed to operate at return temperatures below the specified minimum setting may experience problems with the operating controls, safety switches, obstruction of the flue gas passages on the heat exchanger, incomplete combustion and possible flue gas spillage. Sustained operation at lower than specified water temperatures may cause hazardous conditions that may result in personal injury or non-warrantable damage to the appliance.

3 Water connections

Water flow switch

A water flow switch is factory installed in the outlet piping on all heating boilers and water heaters. The flow switch must prove water flow before a trial for ignition can begin. The flow switch requires a minimum flow of 26 GPM to make the flow switch and start burner operation. A water flow switch meets most code requirements for a low water cutoff device on boilers requiring forced circulation for operation. A fault message, **Flow Sw/LWCO** will be indicated in the Operator Interface on a low water flow condition as sensed by the flow switch.

Low water cutoff

If this boiler is installed above radiation level, a low water cutoff device must be installed at the time of boiler installation. An electronic low water cutoff is available as a factory supplied option on all models. The low water cutoff should be inspected every 6 months. A fault message, **Flow Sw/LWCO** will be indicated in the Operator Interface on a low water condition as sensed by the low water cutoff.

Relief valve

This unit is supplied with a relief valve(s) sized in accordance with ASME Boiler and Pressure Vessel Code, Section IV (“Heating Boilers”). The relief valve(s) is installed in the vertical position and mounted in the hot water outlet. No valve is to be placed between the relief valve and the unit. To prevent water damage, the discharge from the relief valve shall be piped to a suitable floor drain for disposal when relief occurs. No reducing couplings or other restrictions shall be installed in the discharge line. The discharge line shall allow complete drainage of the valve and line. Relief valves should be manually operated at least once a year.

CAUTION Avoid contact with hot discharge water.

Heating boiler installations

Piping of the boiler system

The drawings in this section show typical boiler piping installations, see FIG.’s 3-3 through 3-6. Before beginning the installation, consult local codes for specific plumbing requirements. The installation should provide unions and valves at the inlet and outlet of the boiler so it can be isolated for service. An air separation device must be supplied in the installation piping to eliminate trapped air in the system. Locate a system air vent at the highest point in the system. The system must also have a properly sized expansion tank installed. Typically, an air charged diaphragm-type expansion tank is used. The expansion tank must be installed close to the boiler and on the suction side of the system pump to ensure proper operation. A water meter to monitor makeup water is recommended. Makeup water volume should not exceed 5% of total system per year. Install a Y-strainer or equivalent multi-purpose strainer just before the boiler pump at the inlet of the heat exchanger. This item is used to remove system debris from older hydronic systems and to protect newer systems.

NOTICE

*Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment and detailing required by local codes.

IMPORTANT

All boiler piping must contain an oxygen barrier. This will help prevent any excess oxygen from entering the system.

CAUTION

The boiler system should not be operated at less than 12 PSIG (Non-metallic system piping must have an oxygen barrier to be considered a closed loop).

Hot water piping must be supported by suitable hangers or floor stands, **NOT** by the boiler. Copper pipe systems will be subject to considerable expansion and contraction. Rigid pipe hangers could allow the pipe to slide in the hanger resulting in noise transmitted into the system. Padding is recommended on rigid hangers installed with a copper system. The boiler pressure relief valve must be piped to a suitable floor drain. See the *Relief Valve* section on this page.

CAUTION

A leak in a boiler “system” will cause the “system” to intake fresh water constantly, which will cause the tubes to accumulate a lime/scale build up. This will cause a non-warrantable failure.

Water connections (heating boilers only)

All boilers have 2 1/2 inch copper pipe inlet and outlet connections. Installed piping to and from the boiler must be a minimum of 2 1/2 inch diameter.

CAUTION

Field installed reducing bushings must not be used.

Any reduction in pipe size may decrease flow resulting in high water temperatures, boiler noise, flashing to steam, and non-warrantable heat exchanger damage.

The boiler may be installed with a primary/secondary piping system provided to the boiler. It is important to guarantee that adequate flow is provided to properly dissipate heat from the boiler and also ensure that flow through the boiler does not exceed the maximum recommended flow rate of 75 GPM for Models 502 - 1302 and 90 GPM for Models 1501 - 2001 for a boiler equipped with a copper heat exchanger.

NOTICE

It is recommended to install an inlet water strainer to prevent debris from entering the heat exchanger or system.

Boiler circulator requirements

This is a low mass, high efficiency hot water boiler which must have adequate flow for quiet, efficient operation. Pump selection is critical to achieve proper operation. A pump should be selected to achieve proper system design water temperature rise. A separate pump may be installed in a secondary loop to the boiler. Pipe diameter and length are critical to ensure proper flow through the boiler. A System Temperature Rise Chart (Table 3A on page 44) is provided to assist in proper pump selection. This table provides GPM and boiler head-loss at various temperature rises for each model based on Btu/hr input. Temperature rise is the difference in boiler inlet temperature and boiler outlet temperature while the boiler is firing at full rate.

Example: The boiler inlet temperature is 160°F (71.1°C) and the boiler outlet temperature is 180°F (82.2°C). This means that there is a 20°F (11.1°C) temperature rise across the boiler. The boiler temperature rise is visible in the Operator Interface on the boiler’s front control panel.

3 Water connections *(continued)*

Circulator pump specifications

1. Maximum operating pressure for the pump must exceed system operating pressure.
2. Maximum water temperature should not exceed the nameplate rating.
3. Cast iron circulators may be used for closed loop systems.
4. A properly sized expansion tank must be installed near the boiler and on the suction side of the pump.

Circulator pump operation (heating boilers only)

The boiler pump must run when the boiler is firing. Separate supply circuits can be provided or the two circuits (pump and controls) can be combined for connection to one circuit, properly sized for both.

Intermittent pump operation

An intermittent pump operation feature is provided. The boiler's circulating pump will cycle on at each call for heat, before the burner fires. The pump will continue to operate while the burner is firing. The pump will run for a minimum 30 second period after the temperature set point is satisfied. This timing is selectable from the Operator Interface. This timing will remove any of the residual heat from the combustion chamber before turning the pump off. See the wiring diagram in *Section 11* of this manual.

Pump Maintenance: Inspect the pump every six (6) months and oil as necessary. Use SAE 30 non-detergent oil or lubricant specified by the pump manufacturer.

The boiler is recommended for installation in a primary/secondary piping system. This type of system uses a separate boiler circulating pump to supply flow to and from the boiler only. The secondary pump is sized based on the head loss of the boiler and related pipe and fittings in the secondary loop only.

A properly sized primary system pump provides adequate flow to carry the heated boiler water to radiation, air over coils, etc. The fittings that connect the boiler to the primary system should be installed a maximum of 12 inches (0.30m) (or 4 pipe diameters) apart to ensure connection at a point of zero pressure drop in the primary system. There should be a minimum of 10 pipe diameters of straight pipe before and after the boiler secondary loop connections to prevent turbulent flow at the secondary loop connections. The secondary loop piping to and from the boiler must have a fully ported ball valve installed in both the supply and return side piping. The ball valves must be fully ported having the same inside diameter as the installed piping. The ball valve in the piping supplying water to the boiler will only be used as a service valve. The ball valve installed in the discharge from the boiler back to the primary system will be used to adjust boiler flow and temperature rise to ensure proper performance.

The boiler primary piping system must have a circulator installed in the main system loop to carry the heated boiler water to the point of use in the main system.

Multiple boilers may also be installed with a primary/secondary manifold system. Multiple boilers should be connected to the common manifold in reverse return to assist in balancing flow to multiple boilers.

The installer must ensure that the boiler has adequate flow without excessive temperature rise. Low system flow can result in overheating of the boiler water which can cause short burner cycles, system noise, relief valve discharge and in extreme cases, a knocking flash to steam. These conditions indicate the need to increase boiler flow to and from the boiler. This is generally accomplished by either increasing the size of the boiler pump or by increasing the diameter of the piping that connects the boiler to the primary system. A larger diameter pipe reduces head loss and increases flow.



CAUTION At no time should the system pressure be less than 12 PSIG.

Low system water volume

System run time is very important to the overall operating efficiency of the boiler. Short cycling of the boiler creates problems with condensation in the vent stack, condensation on the heat exchanger, system temperature spikes, and mechanical component failures. To prevent short cycling of the boiler, it is important to limit the boiler cycles to six or fewer per hour.

A buffer tank is an effective way to enhance a small system load and increase heating system efficiency (see FIG. 3-6 on page 43 of this manual). Buffer tanks add water volume to the system and act as a flywheel to absorb the additional Btu's provided by the boiler when only a single zone of a large system is calling for heat.

To calculate the proper buffer tank size for a multiple zone system:

$$\frac{(\text{Run Cycle}) (\text{Output} - \text{Minimum System Load})}{$$

$$(\text{Temp. Rise}) (8.33) (60 \text{ Min.})$$

PBN2001-B9 (1.7:1 Turndown)

Min. Load = 100,000 Btu/Hr

Min. Boiler Output = 850,000 Btu/Hr

Cycle Time = 10 Min

Temp. Rise = 38

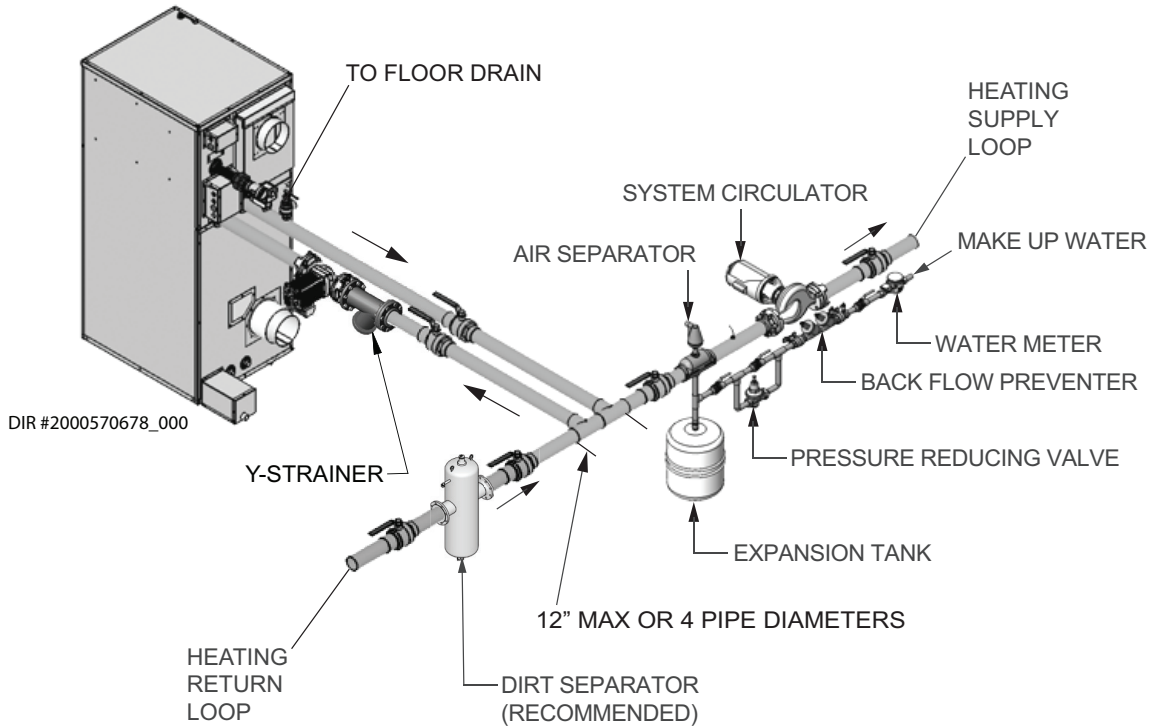
$$(10)(850,000 - 100,000) / (38)(8.33)(60) = 395 \text{ Gallons}$$

3 Water connections

Figure 3-3_Primary/Secondary Piping of a Single Boiler

COMMON MANIFOLD SIZE (Min.) Models: 502, 752, 1002, & 1302		
Number of Units	GPM	Diameter (in.)
1	75	2 1/2

COMMON MANIFOLD SIZE (Min.) Models: 1501, 1701, & 2001		
Number of Units	GPM	Diameter (in.)
1	90	2 1/2



NOTICE

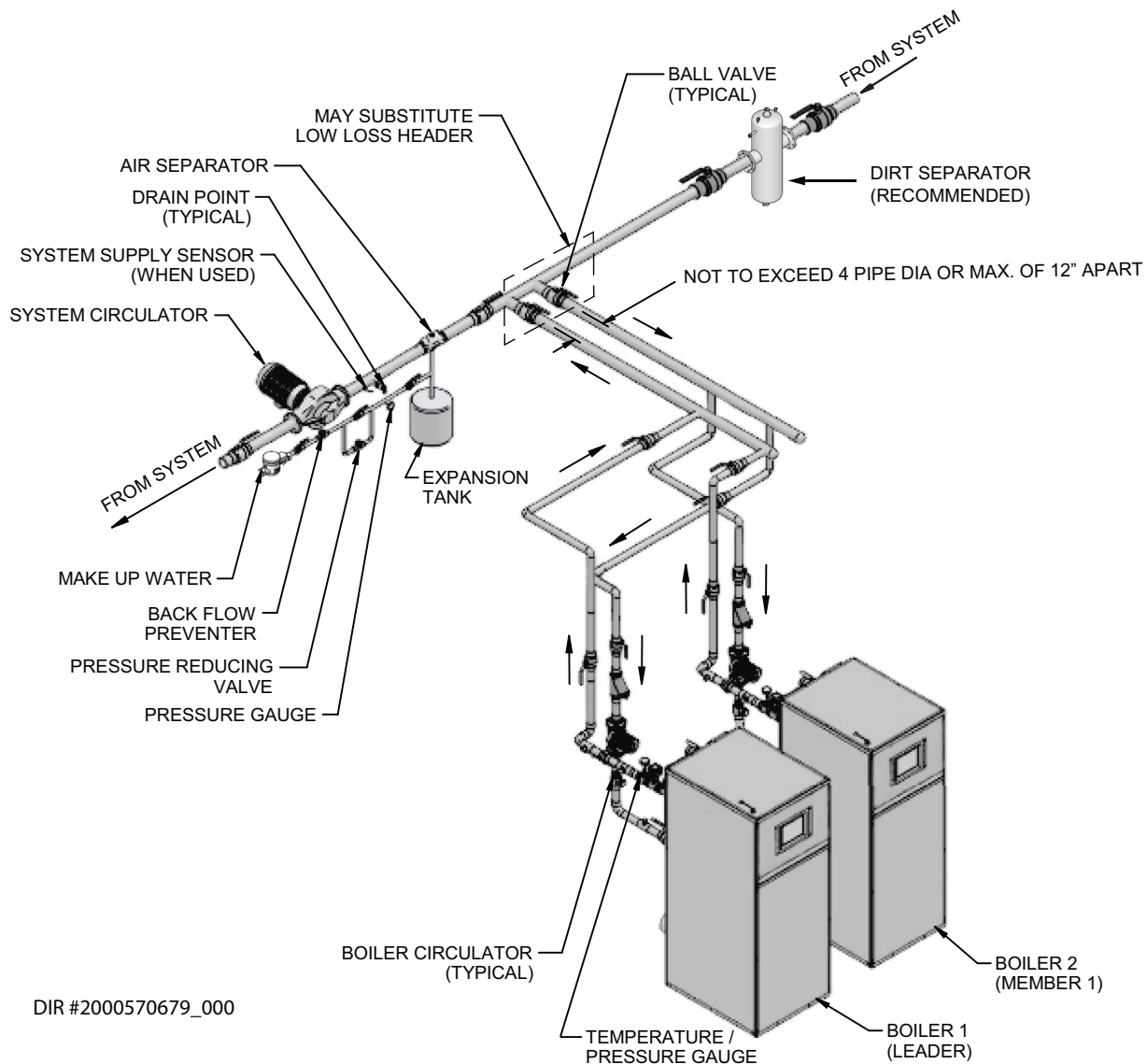
*Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment and detailing required by local codes.

3 Water connections *(continued)*

Figure 3-4 Primary/Secondary Piping of Multiple Boilers

COMMON MANIFOLD SIZE (Min.) Models: 502, 752, 1002, & 1302		
Number of Units	GPM	Diameter (in.)
2	150	3 1/2
3	225	4
4	300	5
5	375	6
6	450	6
7	525	6
8	600	8

COMMON MANIFOLD SIZE (Min.) Models: 1501, 1701, & 2001		
Number of Units	GPM	Diameter (in.)
2	180	4
3	270	5
4	360	6
5	450	6
6	540	6
7	630	8
8	720	8



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NOTICE

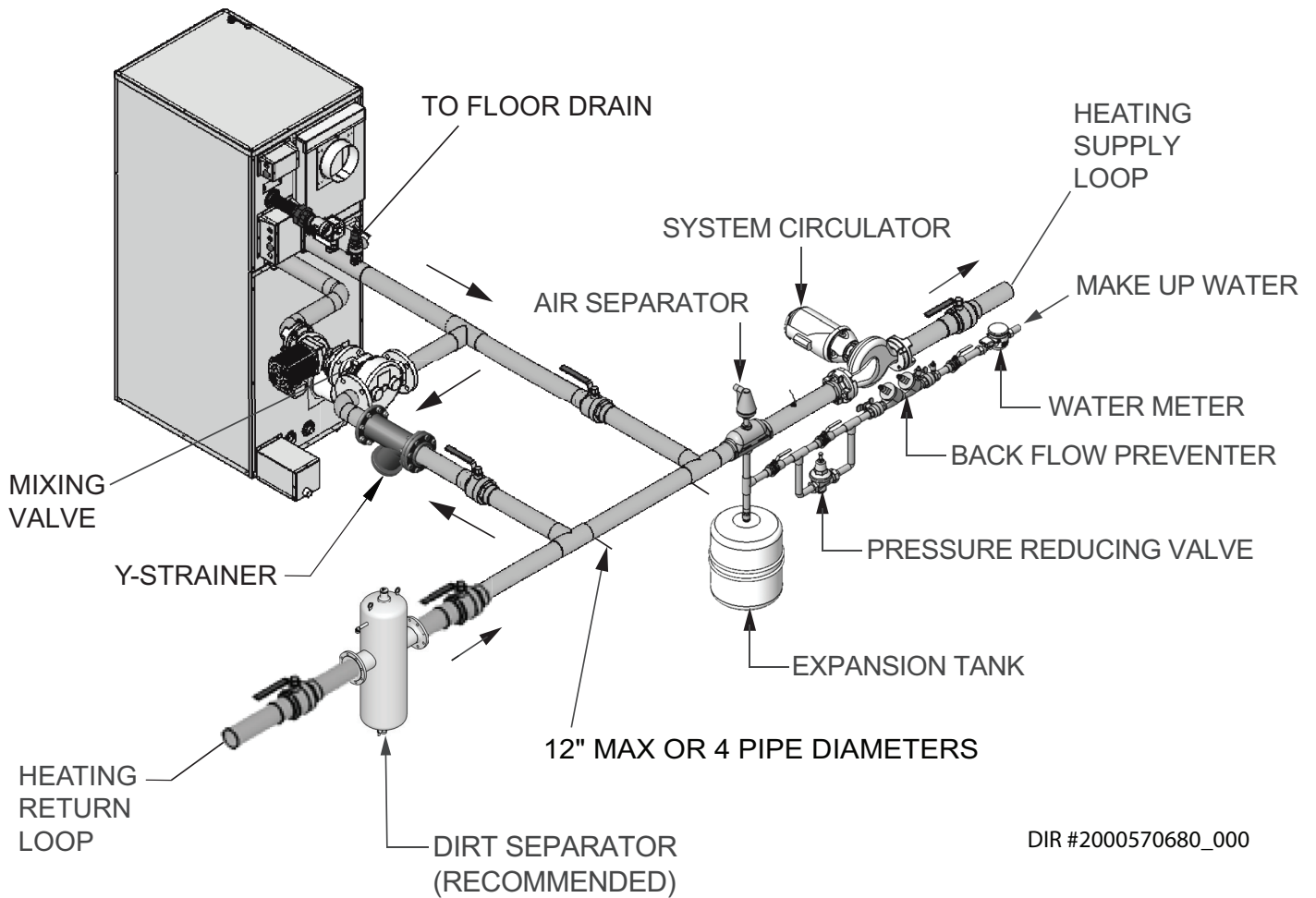
*Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment and detailing required by local codes.

3 Water connections

Figure 3-5_Boiler with Low Temperature Bypass Piping - Using a Thermostatic Mixing Valve Required for Systems Operating at less than 140°F (60°C) Return Water Temperatures from the Heating Return Loop

COMMON MANIFOLD SIZE (Min.) Models: 502, 752, 1002, & 1302		
Number of Units	GPM	Diameter (in.)
1	75	2 1/2

COMMON MANIFOLD SIZE (Min.) Models: 1501, 1701, & 2001		
Number of Units	GPM	Diameter (in.)
1	90	2 1/2



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NOTICE

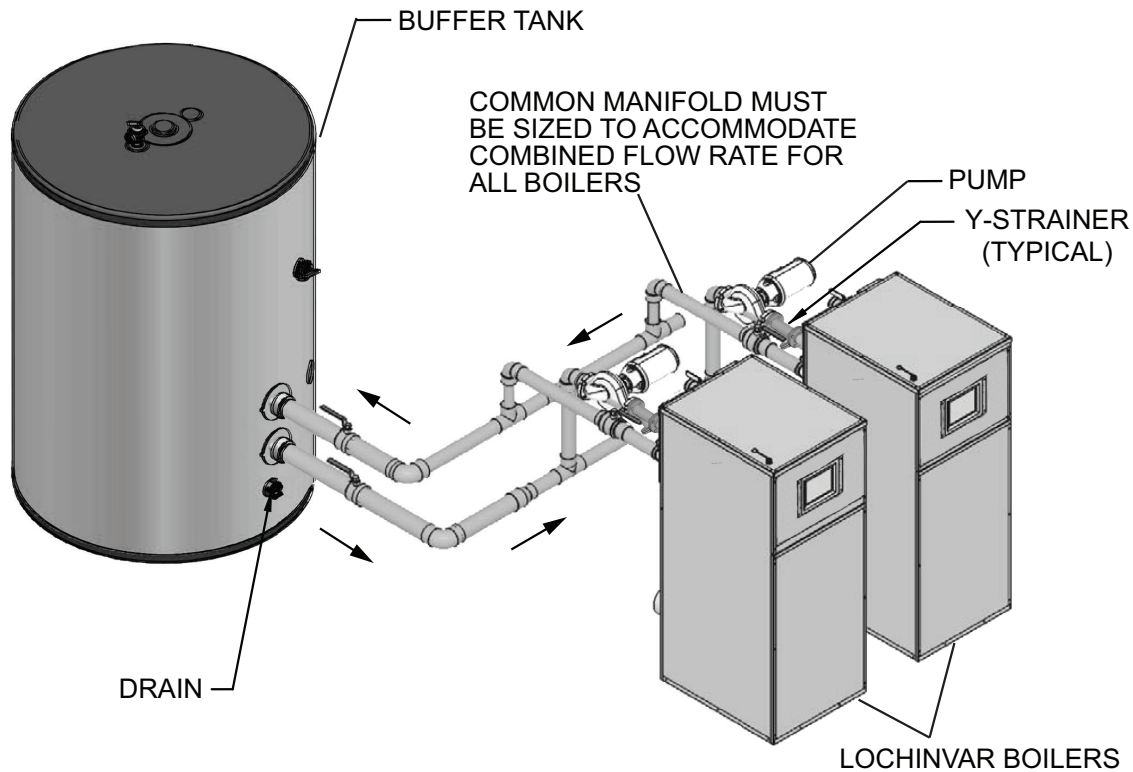
*Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment and detailing required by local codes.

3 Water connections *(continued)*

Figure 3-6 Primary/Secondary Piping with Buffer Tank

COMMON MANIFOLD SIZE (Min.) Models: 502, 752, 1002, & 1302		
Number of Units	GPM	Diameter (in.)
2	150	3 1/2
3	225	4
4	300	5
5	375	6
6	450	6
7	525	6
8	600	8

COMMON MANIFOLD SIZE (Min.) Models: 1501, 1701, & 2001		
Number of Units	GPM	Diameter (in.)
2	180	4
3	270	5
4	360	6
5	450	6
6	540	6
7	630	8
8	720	8



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NOTICE

*Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment and detailing required by local codes.

NOTICE

The Inlet/Outlet System tapings are shown in the optional location on the side of the tank for pictorial purposes. The standard location for the system tapings is 180° from the recirculation tapings.

3 Water connections

TABLE - 3A
SYSTEM TEMPERATURE RISE CHART
 Temperature Rise and Head Loss Based on Boiler Output in Btu/hr

Btu/hr		30°F ΔT		35°F ΔT		40°F ΔT		45°F ΔT		50°F ΔT		55°F ΔT		60°F ΔT	
Input	Output	GPM	Ft/hd	GPM	Ft/hd	GPM	Ft/hd	GPM	Ft/hd	GPM	Ft/hd	GPM	Ft/hd	GPM	Ft/hd
500,000	425,000	29.0	0.9	24.9	0.7	21.8	0.5	19.3	0.4	17.4	0.3	15.8	0.2	14.5	0.1
750,000	638,000	43.5	2.1	37.3	1.8	32.6	1.3	29.0	1.0	26.1	0.8	23.7	0.7	21.8	0.6
1,000,000	849,000	58.0	4.8	49.7	3.3	43.5	2.4	38.7	2.0	34.8	1.6	31.6	1.2	29.0	1.1
1,300,000	1,105,000	75.4	9.8	64.7	6.9	56.6	4.6	50.3	3.6	45.3	2.9	41.1	2.2	37.7	1.9
1,500,000	1,275,000	87.9	9.8	75.3	7.7	65.9	6.3	58.6	5.2	52.9	4.2	47.9	3.3	43.9	2.7
1,700,000	1,445,000	99.6*	14.1	85.4	10.2	74.7	7.9	66.4	6.5	59.8	5.3	54.3	4.6	49.8	3.9
2,000,000	1,700,000	N/A	20.2	100.4*	14.9	87.9	11.9	78.1	9.2	70.3	7.2	63.9	6.4	58.6	5.2

*Cupro-Nickel Heat Exchanger Required at Flows Above 75 GPM on Models 502 - 1302 and above 90 GPM on Models 1501 - 2001.

TABLE - 3B	
BOILER TEMPERATURE RISE AT MAXIMUM FLOW	
Temperature Rise at Full Rate Fire, 75 and 90 GPM Maximum Flow	
Model	Temperature Rise
502	11°F (6.1°C)
752	17°F (9.4°C)
1002	23°F (12.8°C)
1302	30°F (16.7°C)
1501	28°F (15.6°C)
1701	32°F (17.8°C)
2001	38°F (21.1°C)

Boiler bypass requirements

The installer must ensure that the boiler is supplied with adequate flow without excessive temperature rise. It is recommended that this boiler be installed with a bypass in the piping if the maximum recommended flow rate is exceeded. The bypass will help to ensure that the boiler can be supplied with adequate water flow. Flow rates exceeding the maximum recommended flow will result in erosion of the boiler tubes. A typical bypass with a valve as shown in FIG. 3-5 will allow control of boiler flow.

Temperature / pressure gauge

This boiler is equipped with a dial type temperature / pressure gauge. This gauge is factory installed in the outlet side of the boiler piping. The gauge has one scale to read system pressure and a separate scale to read water temperature in degrees Fahrenheit. The temperature / pressure gauge is provided to meet code requirements. Water temperatures can be more accurately monitored from the data provided in the digital display in the Operator Interface.

Typical heating boiler installations

General plumbing rules:

1. Check all local codes.
2. For serviceability of boiler, always install unions.
3. Always pipe pressure relief valve to an open drain.
4. Locate system air vents at highest point of system.
5. Expansion tank must be installed near the boiler and on the suction side of the system pump.
6. Support all water piping.

Installation with a chilled water system

Pipe refrigeration systems in parallel. Install duct coil downstream at cooling coil. Where the hot water heating boiler is connected to a heating coil located in the air handling units which may be exposed to refrigeration air circulation, the boiler piping system must be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle.

The coil must be vented at the high point and hot water from the boiler must enter the coil at this point. Due to the fast heating capacity of the boiler, it is not necessary to provide a ductstat to delay circulator operation. Also, omit thermostat flow checks as the boiler is cold when heating thermostat is satisfied. This provides greater economy over maintaining standby heat.

3 Water connections *(continued)*

Minimum boiler water temperatures

Inlet water temperatures below the specified minimum of 140°F (60°C) can excessively cool the products of combustion resulting in condensation on the heat exchanger. Condensation on the heat exchanger can cause operational problems, bad combustion, sooting, flue gas spillage and reduced service life of the related components. See the *Low Temperature Bypass Requirements* section for boiler system applications below the minimum specified temperature.

Low temperature bypass requirements

To prevent condensation problems, a boiler **MUST NOT** be operated (other than for brief periods during initial system startup) with an inlet water temperature of less than 140°F (60°C). If normal system return temperatures are less than the required 140°F (60°C) boiler inlet requirement, a method of low return water temperature protection **MUST BE** provided to protect the boiler.

For Example: *Night Setback* of the system loop water temperature, *Night Shutdown* and *Weekend Shutdown* of the entire boiler / heating system, and *Indoor / Outdoor Air Reset* of the system loop water temperature. If any of these Building Management System control functions are being utilized on the hydronic heating system, some type of low return water protection **MUST BE** provided.

If the boiler heating system will be used on a Water Source Heat Pump System, Radiant Floor Heating System, Snow Melting Heating System, etc., some type of low return water protection must be provided.

Condensation can cause operational problems, bad combustion, sooting, flue gas spillage and reduced service life of the vent system and related components.

To prevent the system return water temperature below 140°F (60°C) from entering the boiler inlet, an electrically actuated 3-way mixing valve is available, consult manufacturer for kit availability (see FIG. 3-5 on page 42). By using this valve, the SMART TOUCH control will bypass outlet water back into the inlet of the boiler to maintain the inlet temperature above 140°F (60°C).

A fast acting, self contained mixing valve, set to 140°F (60°C), may also be used. The installation of this valve must be done as shown in FIG. 3-5. This arrangement will maintain the required flow through the boiler.

When a mixing valve is used, an optional system return sensor should be installed into the system return piping. This will allow the display of the actual system return temperature, and will also allow control of the system return temperature when the SMART TOUCH control is programmed for inlet temperature control. As always, installation of the system supply sensor is strongly recommended as well. This will reduce the potential for short cycling of the boiler, and provide more responsive temperature regulation, even when the SMART TOUCH control is programmed for inlet temperature control.

CAUTION

A boiler allowed to operate at set point temperatures below the specified minimum settings may experience operational problems with the operating controls and safety switches, obstruction of the flue gas passages on the heat exchanger, incomplete combustion and possible flue gas spillage. Operation at lower than specified water temperatures may cause hazardous conditions that result in non-warrantable damage to the appliance.

Three way valves in system

The installation of a three way valve on this boiler is **not generally recommended** because most piping methods allow the three way valve to vary flow to the boiler. This boiler is a low mass, high efficiency appliance which **requires a constant water flow rate for proper operation**. Low flow rates can result in overheating of the boiler water which can cause short burner cycles, system noise, relief valve discharge and in extreme cases, a knocking flash to steam. These conditions can cause operational problems and non-warrantable failures of the boiler.

Radiant floor and snow melt heating systems

This type of heating boiler application operates in a low temperature range which requires a boiler bypass as described under the *Low Temperature Bypass Requirements* section. A non-metallic rubber or plastic tubing installed in a radiant (in floor) system must have an oxygen barrier to prevent oxygen from entering the system through the walls of the installed tubing. Excessive oxygen absorption into the system will result in an accelerated rate of corrosion causing a sludge buildup. This excessive corrosion will also damage the boiler and system components. Sludge formed as the result of excessive oxygen in the system can restrict water flow resulting in a premature boiler failure. Any boiler damage due to excessive oxygenation is non-warrantable.

TABLE - 3C
MAXIMUM WATER FLOW

CAUTION: The maximum flow rate through Power-fin models with a copper heat exchanger must be set to provide and not exceed the following flow:

Model	Maximum Flow	Maximum Flow for CuNi Heat Exchanger
502, 752, 1002, and 1302	75 GPM	95 GPM
1501, 1701, and 2001	90 GPM	115 GPM

If higher flow rates are required through the boiler, an optional Cupro-Nickel heat exchanger is available. Consult the factory for specific application requirements.

4 Gas connections

Gas supply

Verify that the appliance is supplied with the type of gas specified on the rating plate. This appliance is configured for operation up to 4000 feet altitude. Consult factory for installations above 4000 feet elevation.

Inlet gas pressure: Measured at the inlet pressure tap on the appliance gas manifold. The pressure tap is located upstream of the redundant gas valve and downstream of the field installed gas cock.

MODEL	CODE	NATURAL		LP	
		Max. w.c.	Min. w.c.	Max. w.c.	Min. w.c.
502 - 1302	F9	14.0	4.2	14.0	11.0
502 - 1302	M9	14.0	4.0	14.0	11.0
1501 - 2001	B9/F9	14.0	4.0	14.0	8.0
1501 - 2001	M9	14.0	4.0	14.0	8.0

Maximum inlet gas pressure must not exceed the value specified. Minimum value listed is for the purposes of input adjustment.

Gas pressure test

1. The appliance must be disconnected from the gas supply piping system during any pressure testing of that system at a test pressure in excess of 1/2 PSIG (3.5 kPa).
2. The appliance must be isolated from the gas supply piping system by closing a manual shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 PSIG (3.5 kPa).
3. The appliance and its gas connection must be leak tested before placing it in operation.

Checking manifold gas pressure

Reference the Power-fin Service Manual for information regarding manifold gas pressure.

Gas connection

Safe operation of the appliance requires properly sized gas supply piping. See gas line sizing data:

1. Gas pipe size may be larger than appliance connection.
2. Installation of a union at the appliance gas line connection is required for ease of service and removal of the gas train.
3. If an additional manual shutoff valve is required by local codes, install the valve on the outside at the gas supply to the appliance as shown in FIG. 3-1.
4. A sediment trap (drip leg) **MUST** be provided in the inlet of the gas connection to the appliance, see FIG. 3-1.
5. Optional gas controls may require routing of bleeds and vents to the atmosphere, outside the building when required by local codes.

Diameter Pipe (inches)	1 1/2	2	3	4	5
Equivalent length of Straight Pipe (feet)	4	5	10	14	20

NOTICE

If an inline high gas pressure regulator is used, it **MUST BE** of the lockup type and be located a minimum of 10 feet from the appliance. Failure to do so may result in insufficient gas volume supplied to the appliance.

4 Gas connections *(continued)*

TABLE - 4C Capacity of Schedule 40 Metallic Pipe in Cubic Feet of Natural Gas Per Hour (based on .60 specific gravity, 0.30" w.c. pressure drop)														
Pipe Size (Inches)	Length of Pipe in Straight Feet													
	10	20	30	40	50	60	70	80	90	100	125	150	175	200
1/2	131	90	72	62	55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/4	273	188	151	129	114	104	95	89	83	79	70	63	58	N/A
1	514	353	284	243	215	195	179	167	157	148	131	119	109	102
1 1/4	1,060	726	583	499	442	400	368	343	322	304	269	244	224	209
1 1/2	1,580	1,090	873	747	662	600	552	514	482	455	403	366	336	313
2	3,050	2,090	1,680	1,440	1,280	1,160	1,060	989	928	877	777	704	648	602
2 1/2	4,860	3,340	2,680	2,290	2,030	1,840	1,690	1,580	1,480	1,400	1,240	1,120	1,030	960
3	8,580	5,900	4,740	4,050	3,590	3,260	3,000	2,790	2,610	2,470	2,190	1,980	1,820	1,700
4	17,500	12,000	9,660	8,270	7,330	6,640	6,110	5,680	5,330	5,040	4,460	4,050	3,720	3,460

Gas piping

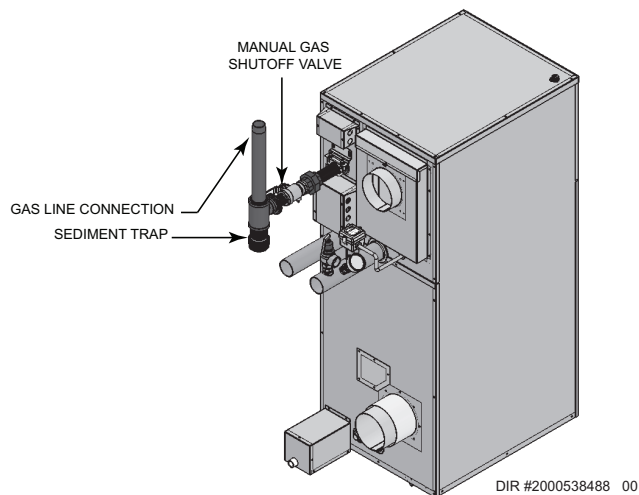


Figure 4-1 Gas Line Connection with Sediment Trap (Drip Leg) and Manual Main Gas Shutoff Valve

All gas connections must be made with pipe joint compound resistant to the action of liquefied petroleum and natural gas. All piping must comply with local codes and ordinances. Tubing installations must comply with approved standards and practices.

Install piping to control

1. The gas line should be a separate line direct from the meter unless the existing gas line is of sufficient capacity. Verify pipe size with your gas supplier.
2. Use new, properly threaded black iron pipe free from chips. If tubing is used, make sure the ends are square, deburred and clean. All tubing bends must be smooth and without deformation. Avoid flexible gas connections. Internal diameter of flexible gas lines may not provide appliance with proper volume of gas.
3. Run pipe or tubing to the unit's gas inlet. If tubing is used, obtain a tube to pipe coupling in order to connect the tubing to the unit's gas inlet.
4. Install a sediment trap in the supply line to the unit's gas inlet (see FIG. 3-1).
5. Remove seal over gas inlet to the appliance.
6. Apply a moderate amount of good quality pipe compound (DO NOT use Teflon tape) to pipe only, leaving two end threads bare.
7. Connect gas pipe to inlet of appliance. Use a wrench to support the gas manifold on the appliance.
8. For LP gas, consult your LP gas supplier for expert installation.

4 Gas connections

Checking gas supply pressure

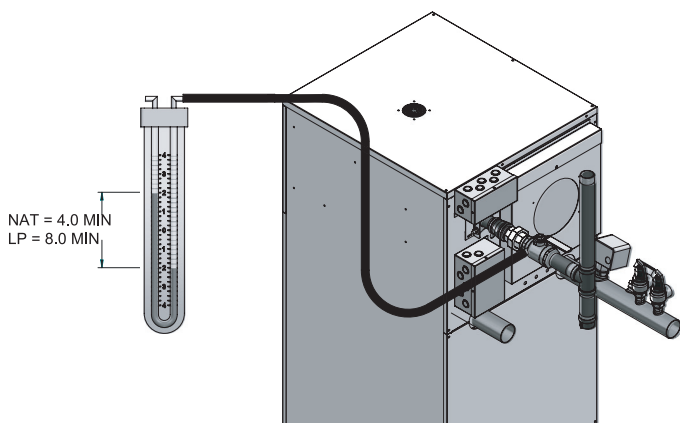


Figure 4-2_Gas Supply Pressure Measurement

1. Turn the main power switch to the “OFF” position.
2. Shut off the gas supply at the manual gas cock in the gas piping to the appliance. If fuel supply is LP gas, shut off gas supply at the tank.
3. Remove the 1/8" hex plug from the gas pressure test port located on the manual shutoff valve at the rear of the appliance. Install a fitting in the inlet pressure tapping suitable to connect to a manometer or magnahelic gauge. Range of scale should be 14 inches water column or greater to check inlet pressure.
4. Turn on gas supply at the field installed manual gas cock, turn on LP gas at tank if required.
5. Turn the power switch to the “ON” position.
6. Adjust the temperature set point on the display to call for heat.
7. Observe the gas supply pressure as the burner fires at 100% of rated input. Percent of burner input will be shown on the display of the SMART TOUCH control module.
8. Ensure inlet pressure is within specified range. Minimum and maximum gas supply pressures are specified in the *Gas Supply* section of this manual.
9. If gas pressure is out of range, contact the gas utility, gas supplier, qualified installer or service agency to determine necessary steps to provide proper gas pressure to the control.
10. If gas supply pressure is within normal range, proceed to remove gas manometer and replace pressure tap fittings in the gas piping to the appliance.
11. Turn the power switch to the “OFF” position.
12. Shut off gas supply at the manual gas cock in the gas piping to the appliance. If fuel supply is LP gas, shut off gas supply at the tank.
13. Remove the manometer and related fittings from the gas pressure test port at the inlet gas supply connection to the appliance. Replace the 1/8" plug in the gas pressure test port and tighten.
14. Turn on the gas supply at the manual valve, turn on LP gas at the tank if required.
15. Turn the power switch to the “ON” position.
16. Adjust the temperature set point on the display of the SMART TOUCH control module to the desired water temperature so the appliance will call for heat.
17. Check burner performance by cycling the system while you observe burner response. The burner should ignite promptly. Flame pattern should be stable, see “*Maintenance - Normal Flame Pattern*” in the Power-fin Service Manual. Turn system off and allow burner to cool, then cycle burner again to ensure proper ignition and flame characteristics.

NOTICE

If a pressure drop of more than 2" w.c. occurs between Standby (Static) Mode and Operating (Dynamic) Mode, a gas volume problem exists. Contact the gas utility, gas supplier, qualified installer, or service agency to determine the necessary steps to provide the proper gas volume to the appliance.

High and low gas pressure switches

1. Manual reset high and low gas pressure switches are supplied to meet M13 firing code for Factory Mutual, GE GAP, and CSD-1.
 2. In the Commonwealth of Massachusetts, gas appliances over 1,000,000 BTU must be equipped with manual reset high and low gas pressure switches when required to meet the Massachusetts requirements.
- NOTE:** Massachusetts code requires a pressure regulator to be installed upstream of the low gas pressure switch. Lochinvar requires any inline regulator used **MUST BE** of the lockup type and be located a minimum of 10 feet from the appliance. Failure to do so may result in insufficient gas volume supplied to the appliance. Massachusetts also requires a shutoff valve be installed ahead of the regulator for replacement or service. When required, both regulator and shutoff valve are to be “field provided”.
3. Figures 4-3A, B, and C on page 49 show piping connections for high and low gas pressure switches for respective Power-fin models.

4 Gas connections *(continued)*

High and low gas pressure switches *(continued)*

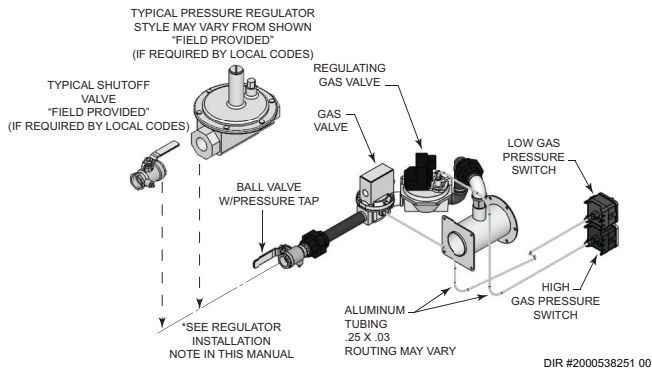


Figure 4-3A_PB/PF 502 - 1302 F9 High & Low Gas Pressure Switches

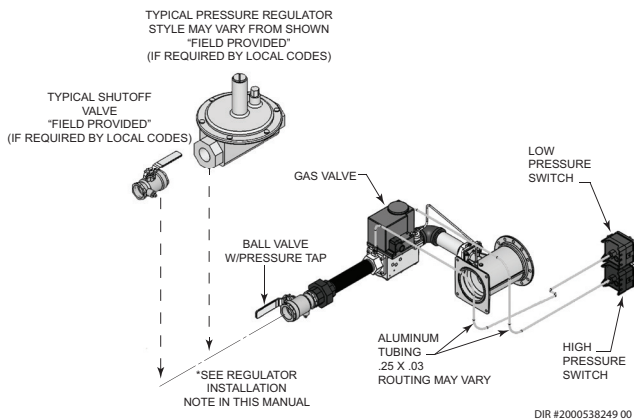


Figure 4-3B_PB/PF 502 - 1302 M9 High & Low Gas Pressure Switches

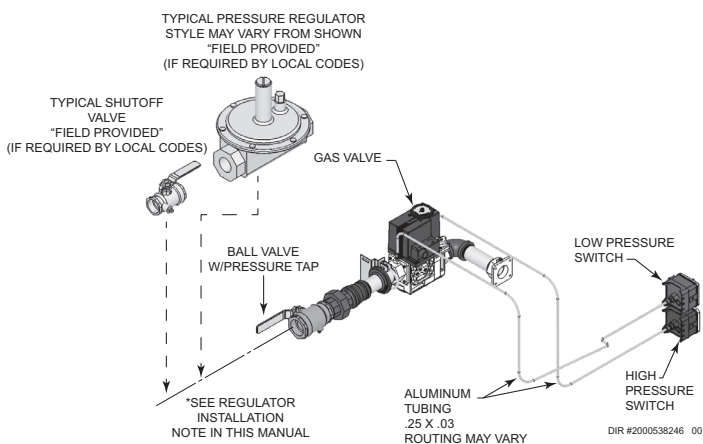


Figure 4-3C_PB/PF 1501 - 2001 M9, B9, & F9 High & Low Gas Pressure Switches

NOTICE

The gas train and controls assembly provided on this unit have been tested under the applicable American National Standard to meet minimum safety and performance criteria such as safe lighting, combustion, and safety shutdown operation.

502 - 1302 F9 gas train

The combination gas valve on this appliance uses line (120 VAC) voltage for operation. These two valves satisfy the requirement for the safety shutoff and operating valves required on boilers and water heaters. The combination valve also regulates the amount of gas mixed with the air delivered to the burner for proper combustion. Both the combination valve and diaphragm valve have threaded vents - see the *Venting of Gas Train Components* section, this page.

There are no serviceable parts on the combination gas valve.

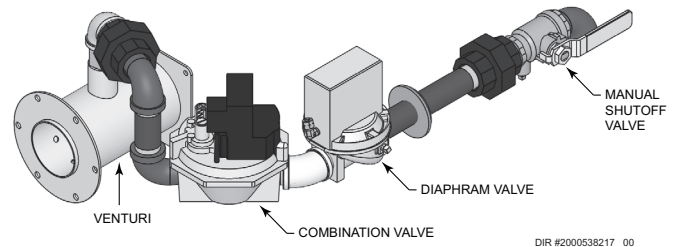


Figure 4-4_Gas Train Assembly F9 - Models 502 - 1302 M9, B9, & 1501 - 2001 F9 gas train

The ratio gas valve on this appliance uses line (120 VAC) voltage for operation. The valve contains the safety shutoff and operating valves required on boilers and water heaters. The ratio valve uses the negative pressure signal generated by the venturi to modulate the amount of gas, so that the proper mixture of air and gas is delivered to the burner throughout the full range of burner operation. The ratio gas valve does not require installation of a vent line - see the *Venting of Gas Train Components* section below.

There are no serviceable parts on the combination gas valve.

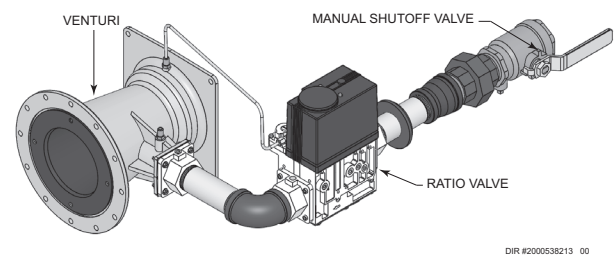


Figure 4-5_Gas Train Assembly M9/B9 - Models 1501 - 2001

Venting of gas train components - F9/B9/M9 and optional gas train components

Local codes may require the routing component bleeds and vents to the atmosphere outside the building. Components (valves, pressure switches) having vents which would require external vent lines are provided with threaded vent line connections. These vent line connection points may be accessed by removing the top jacket panels. Proper routing of vent lines to the atmosphere from the factory supplied termination points is the responsibility of the installing contractor.

5 Electrical connections

Boiler operating control module

The operating temperature control for the appliance is the SMART TOUCH control module. It is located on the inside of the control panel, behind the front access door. Access to adjust the temperature set point and other user adjustable points is made through the Operator Interface located on the right front access door. The outlet sensor is placed in a bulbwell installed in the outlet side of the heat exchanger top header. The inlet sensor is located in a bulbwell on the inlet side of the heat exchanger top header.

The operating sensor, inlet or outlet, is selectable from the screen in the Operator Interface.

The exact temperature set point is based on your system's requirements. Set the control set point(s) to the desired operating water temperature.

The maximum temperature set point that can be programmed into the standard control module from the Operator Interface on a heating boiler is 215°F (101.7°C). The manual reset high limit control for a heating boiler is adjustable up to a fixed maximum setting of 230°F (110°C).

The maximum temperature set point for a water heater is 190°F (88°C). The auto reset high limit is fixed at 200°F (93°C), and the adjustable manual reset high limit has a maximum setting of 230°F (110°C).

A 120 VAC, 15 Amp, 1 ph, 60 Hz circuit is required for operation of the appliance controls.

The appliance, when installed, must be electrically grounded in accordance with the requirements of the authority having jurisdiction or in the absence of such requirements, with the latest edition of the National Electrical Code ANSI/NFPA No. 70. When the unit is installed in Canada, it must conform to the CAE C22.1, Canadian Electrical Code, Part I and/or local Electrical Codes. Multiple units connected in a Cascade must be grounded to the same ground connection.

1. All wiring between the appliance and field installed devices shall be made with type T wire [63°F (35°C) rise].
2. All line voltage wire exterior to the appliance must be enclosed in approved conduit or approved metal clad cable.
3. The circulating pump must run continuously when the appliance is being fired.
4. To avoid serious damage, DO NOT energize the appliance until the system is full of water. Ensure that all air is removed from the heat exchanger and piping before beginning initial operation. Serious damage may result if the appliance is operated without proper flow.
5. Provide the appliance with proper overload protection.



WARNING

ELECTRICAL SHOCK HAZARD – For your safety, turn off electrical power supply before making any electrical connections to avoid possible electric shock hazard. Failure to do so can cause severe personal injury or death.

TABLE - 5A
AMP DRAW DATA

Model	Unit Blower & Controls	Pump FLA*
502	6.7	8.8
752	6.7	8.8
1002	6.7	8.8
1302	6.7	8.8
1501	6.5	8.8
1701	6.5	8.8
2001	6.5	8.8
*Standard Pump Supplied with Water Heaters Only		

NOTICE

Wiring must be N.E.C. Class 1.

If original wiring as supplied with the boiler must be replaced, use only type 105°C wire or equivalent.

Boiler must be electrically grounded as required by National Electrical Code ANSI/NFPA 70 – latest edition.



CAUTION

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

Installation must comply with:

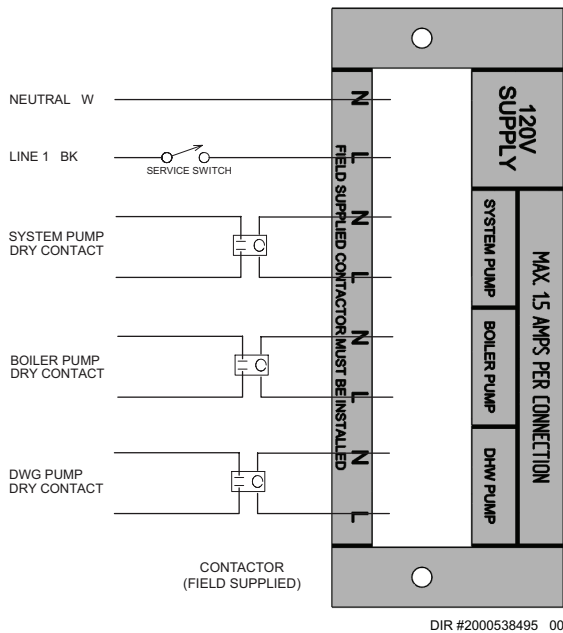
1. National Electrical Code and any other national, state, provincial, local codes, or regulations.
2. In Canada, CSA C22.1 Canadian Electrical Code Part 1, and any local codes.

Line voltage connections

1. Connect 120 VAC power wiring to the line voltage terminal strip in the junction box, as shown in FIG. 5-1.
2. Provide and install a fused disconnect or service switch (15 AMP recommended) as required by the code (see FIG. 5-1).
3. To activate a system pump, wire as shown in FIG. 5-1. If the motor is larger than 1.5 AMP, you must install a contactor.
4. When connecting power to units which are to be cascaded, each unit must be connected to the same ground connection.

5 Electrical connections *(continued)*

Figure 5-1_Line Voltage Field Wiring Connections

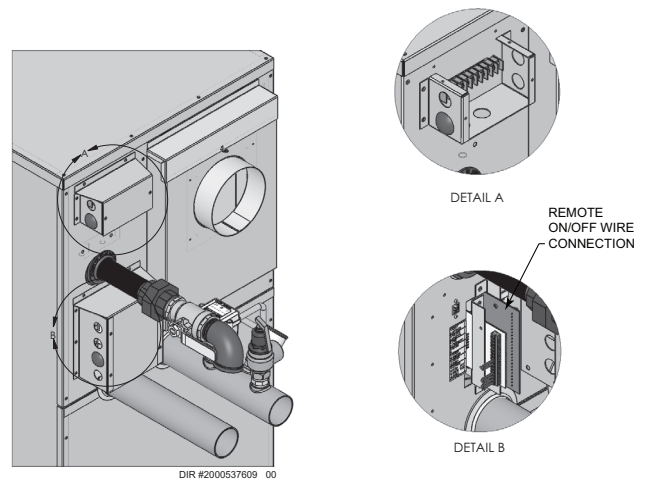


EMS or remote thermostat connection

An EMS, remote thermostat or other remote temperature control may be connected to the boiler (see FIG. 5-3). Follow the manufacturer’s instructions supplied with the remote temperature control for proper installation and adjustment. Connection of a set of dry switching contacts or a remote on/off thermostat to the low voltage connection board will allow the unit to be switched on and off by making or breaking a 24 VAC control circuit. Remove the factory jumper between the enable terminals on the low voltage connection board and connect the remote temperature control in its place, see FIG. 5-4 on page 53.

Ensure that all wiring used to connect the switching contacts of the remote temperature controller to the connection board are a minimum of 18 gauge and have a maximum installed length of 300 feet (91.4m). Set the SMART TOUCH control to a set point temperature slightly higher than the setting of the remote temperature control. This will ensure that the remote temperature controller functions as the operating control for the heater.

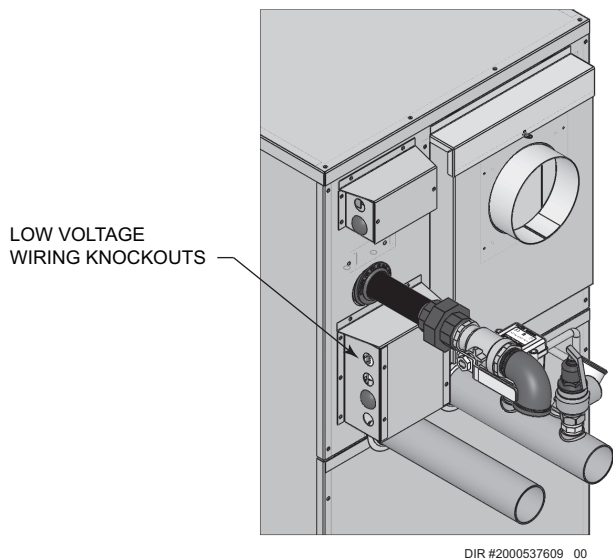
Figure 5-3_Remote ON/OFF Wire Connection



Low voltage connections

1. Route all low voltage wires through the knockouts in the rear of the heater, as shown in FIG. 5-2.
2. Connect low voltage wiring to the low voltage connection board as shown in FIG. 5-4 on page 53 of this manual and the heater wiring diagram.

Figure 5-2_Routing Field Wiring



5 Electrical connections

Louver proving switch

1. When the operation of a louver proving switch needs to be verified before the boiler fires, remove the jumper wire from these terminals and connect them to the normally open contacts on its proving switch (FIG. 5-4).

System supply sensor

1. By installing the system supply sensor into the supply of the primary loop, the temperature of the primary supply can be controlled. The SMART TOUCH control automatically detects the presence of this sensor, and controls the boiler firing rate to maintain the system supply temperature to the set point (if the outlet sensor control is currently selected).
2. Connect these terminals to the system supply sensor (FIG. 5-4).

System return sensor

1. By installing the system return sensor into the return of the primary loop, the temperature of the primary return can be sensed when a 3-way valve or other device is installed ahead of the heater inlet. The SMART TOUCH control automatically senses the presence of this sensor. If the inlet sensor is selected as the controlling sensor, the SMART TOUCH control will adjust the firing rate to hold the system return temperature to the set point. It is strongly recommended that the system supply sensor be installed as well.
2. Connect these terminals to the system return sensor (FIG. 5-4).

Boiler Management System (BMS)

1. An external control may be connected to control either the firing rate or the set point of the appliance. Connect the 0 - 10 VDC terminals to the 0 - 10 VDC output of the external control. The SMART TOUCH control can be programmed to use the enable output of the Boiler Management System, or use the voltage signal to enable the heater. Connect the enable terminals to the enable output of the BMS, when used.
2. Make sure the ground terminal is connected to the ground output terminal of the external control, and the 0 - 10 VDC terminal is connected to the 0 - 10 VDC terminal of the external control.

Runtime contacts

The SMART TOUCH control closes a set of dry contacts whenever the burner is running. This is typically used by Building Management Systems to verify that the boiler is responding to a call for heat.

Alarm contacts

The SMART TOUCH control closes another set of contacts whenever the heater is locked out or the power is turned off. This can be used to turn on an alarm, or signal a Building Management System that the boiler is down.

Wiring of the cascade

When wiring the heaters for Cascade operation, select one heater as the Leader heater. The remaining heaters will be designated as Members. See page 62 *Configuration of the Cascade* for a detailed explanation of this procedure.

On boilers, connect the system supply sensor and outdoor air sensor (if used) to the Leader boiler. The location of the system supply sensor should be downstream of the boiler connections in the main system loop. The system supply sensor should be wired to the low voltage connection board at the terminals marked for the system supply sensor (see FIG. 5-4). The Leader control will use the water temperature at the system supply sensor to control the operation of the Cascade.

If outdoor air reset is desired, the outdoor air sensor should be wired to the low voltage connection board at the terminals marked for the outdoor air sensor (FIG. 5-4). If the outdoor air sensor is connected, the Leader control will calculate the water temperature set point based on the programmed reset curve parameters. If the outdoor air sensor is not connected, the Leader control will maintain the space heating (SH) set point that is programmed into the control.

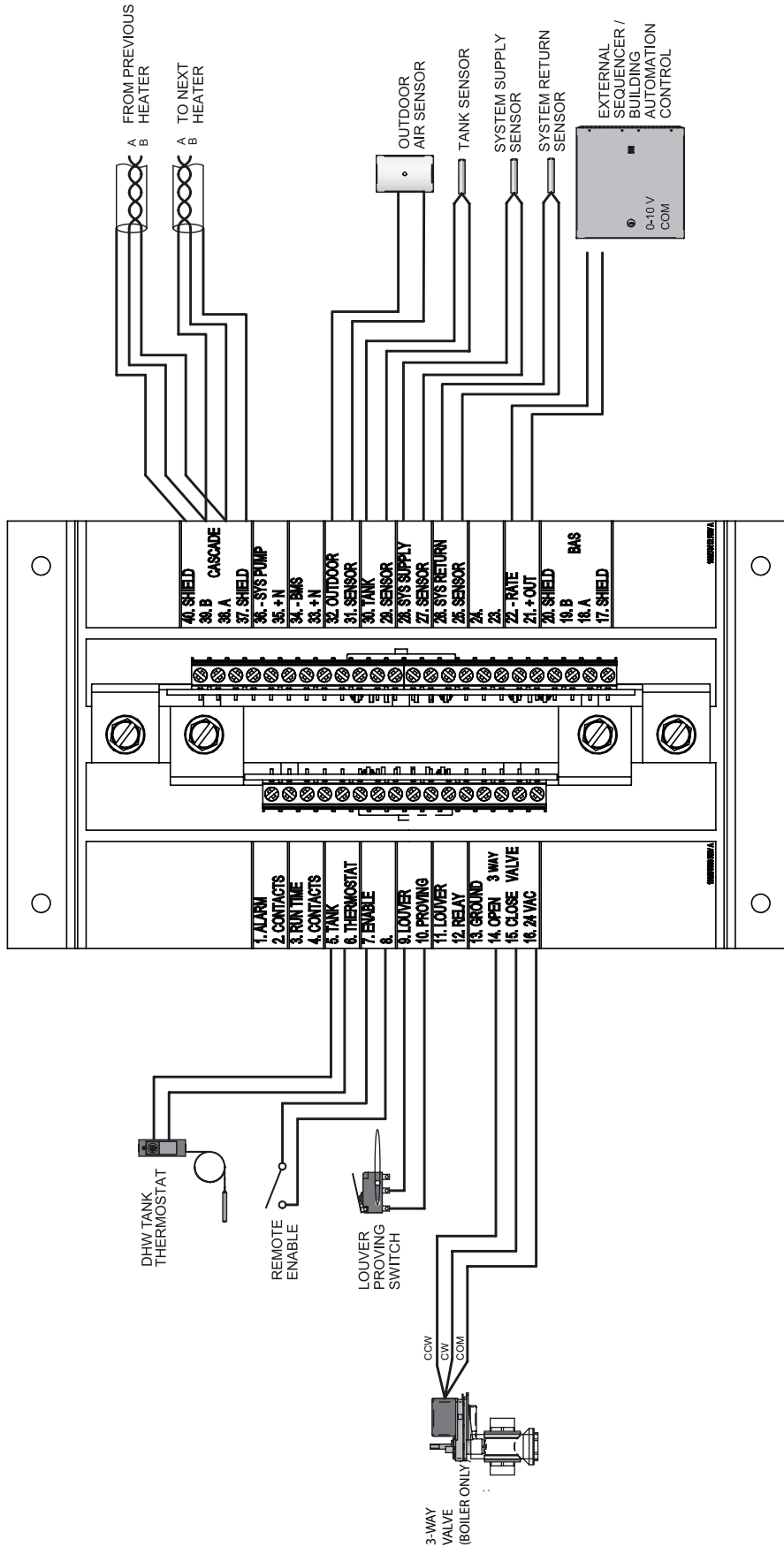
If a Thermostat, Zone Control enable output, or Building Management System enable output are available, it should be wired to the low voltage connection board on the Leader boiler at the enable terminals. If the boilers are to run continuously, leave the jumper wire between the enable terminals. This will initiate a call for heat on the Cascade. Also, leave the jumpers on the enable terminals of all the Member heaters. This will allow them to run independently should the Leader heater fail.

Communication between the Leader heater and the Member heaters is accomplished by using shielded, 2-wire twisted pair communication cable. Connect one of the twisted pair wires to terminal A on each of the low voltage connection boards, and the other wire of the twisted pair to terminal B on each of the low voltage connection boards. Connect the shield wire to the shield ground terminal on all of the heaters. If more than two heaters are on the Cascade, daisy chain the wiring from the Cascade terminals on the second heater to the Cascade terminals on the third heater, then from the third to the fourth, and so on. The connections can be made in any order, regardless of the addresses of the heaters. Try to keep each cable as short as possible.

When the Member 1 boiler is programmed as a Redundant Leader, it allows the Member 1 boiler to automatically assume control of the Cascade should it lose communication with the Leader boiler. When this option is selected, it is **required** that the Member 1 boiler have duplicate connections to the installed external sensors (such as the system supply sensor), control voltages, and heat demand settings of the Leader boiler.

5 Electrical connections *(continued)*

Figure 5-4_Low Voltage Field Wiring Connections



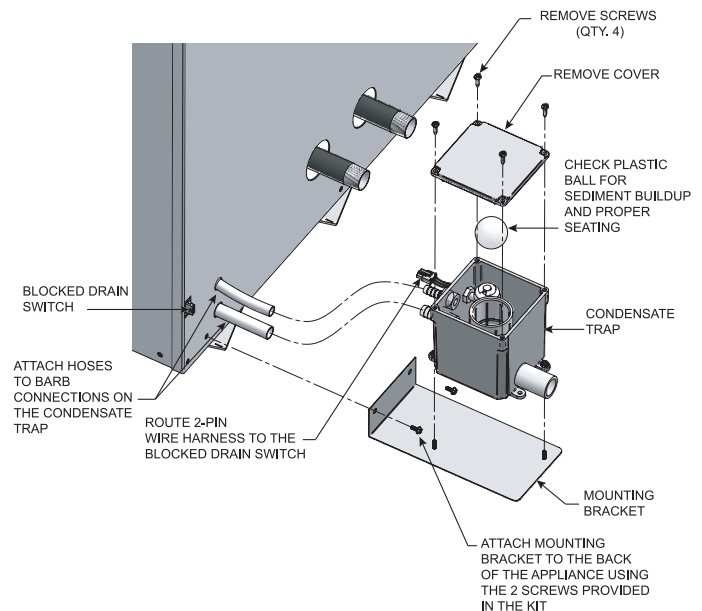
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6 Condensate disposal

Condensate trap installation

1. Locate the condensate trap kit shipped loose with the appliance. The kit includes a sheet metal mounting base, two (2) nuts and the condensate trap.
2. Install the condensate trap mounting base on the rear of the appliance in the lower left-hand corner as depicted in FIG. 6-1. Use the pre-drilled holes on the appliance to secure the mounting base to the appliance.
3. Secure the condensate trap to the base using the two (2) nuts supplied with the kit. The trap should be oriented so that the barb connections are pointing toward the appliance (FIG. 6-1).
4. Use a level to ensure that the condensate trap is level on its base. Failure to keep the condensate trap level can result in the spillage of flue products from the condensate trap.
5. Locate the two hoses exiting the back of the appliance. Attach the larger hose on the appliance to the lower barb connection on the condensate trap. Secure the hose to the barb with a field supplied hose clamp (FIG. 6-1).
6. Attach the smaller hose on the unit to the upper barb connection on the condensate trap. Secure the hose to the barb connection with a field supplied hose clamp (FIG. 6-1).
7. Route the 3-pin wiring harness from the condensate trap to the matching connector on the lower back of the appliance as shown in FIG. 6-1. This is the blocked drain safety switch. This switch will shut the appliance off if the condensate trap becomes too full of liquid.
8. Remove the four (4) screws securing the top cover to the condensate trap and remove the cover (FIG. 6-1).
9. Locate the plastic ball inside the float tube. Verify there is nothing under the ball causing it to not seat properly (FIG. 6-1).
10. Replace the cover.
11. Replace the four (4) screws removed in Step 8.
12. A 1/2" pipe connection is supplied on the condensate trap. Connect a suitable pipe or tube to this connection (see FIG. 6-1).

Figure 6-1_Install Condensate Trap



WARNING

Use a level to ensure that the condensate trap is level on its base. Failure to keep the condensate trap level can result in the spillage of flue products from the condensate trap.

Failure to follow this warning could result in product damage or improper operation, personal injury, or death.

NOTICE

Use materials approved by the authority having jurisdiction. In the absence of other authority, PVC and CPVC pipe must comply with ASTM D1785 or D2845. Cement and primer must comply with ASME D2564 or F493. For Canada use CSA or ULC certified PVC or CPVC pipe, fittings, and cement.

13. Slope the condensate line down and away from the appliance into a drain or condensate neutralizing filter. Do not expose the condensate line to freezing temperatures.

NOTICE

The condensate line must remain unobstructed, allowing free flow of condensate. If condensate is allowed to freeze in the line or if the line is obstructed in any other manner, the blocked drain safety switch will prevent the appliance from firing.

7 Start-up

Pre-Commissioning Cleaning

1. Prior to fill and start-up, flush the entire heating system.
2. Clean the entire heating system with an approved pre-commissioning cleaner (comparable to Sentinel X300 and Fernox F3) in accordance with the manufacturer's recommendation to remove debris and prolong the life of the heat exchanger.
3. Clean all water filtering devices in the system.
4. Flush the cleaning solution out of the entire system and refill.

Fill water

Check/control fill water chemistry

IMPORTANT

Conduct water quality testing prior to installing the appliance. Various solutions are available to adjust water quality.

The manufacturer recommends the following for properly filling your boiler with the appropriate water chemistry for closed loop boilers. Good fill water quality will help extend the life of the appliance by reducing the effects of lime scale buildup and corrosion in closed loop systems.

Hardness between 5 and 15 grains per gallon

1. Consult local water treatment companies for hard water areas (above 15 grains per gallon hardness).
2. Hardness levels that are above 15 grains/gallon can lead to lime scale buildup throughout the boiler system. If the fill water is below 5 grains/gallons, usually due to use of a water softener, it is recommended to mix in some potable water at the inlet to increase the hardness of the water to above 5 grains/gallons.

pH between 6.5 and 8.5

1. pH levels below 6.5 can cause an increase in the rate of corrosion. pH of 8.5 or higher can potentially cause lime scale buildup.

Total Dissolved Solids (TDS) less than 350 ppm

1. Total dissolved solids are all minerals, salts, metals, and charged particles that are dissolved in water.
2. The greater the amounts of TDS present, the higher the corrosion potential due to increased conductivity in the water.

Chloride concentration less than 150 ppm

1. Do not fill boiler or operate with water containing chlorine in excess of 150 ppm.
2. Filling with fresh drinking water should be acceptable.
3. Do not use the boiler to directly heat swimming pool or spa water.

Boiler water

CAUTION

Do not use petroleum based cleaning or sealing compounds in the boiler system. Gaskets and seals in the system may be damaged. This can result in substantial property damage.

CAUTION

DO NOT use "homemade cures" or "boiler patent medicines". Serious damage to boiler, personnel, and/or property may result.

Table 7A Boiler Water Chemistry

BOILER WATER CHEMISTRY	
Specification	Range
Dissolved Solids	< 2000 ppm
pH Level	6.5 to 9.5
Chloride	< 150 ppm

- Monitoring pH, chlorides, TDS, and hardness levels can prolong the life of the appliance by reducing lime scale buildup, corrosion, and erosion. Check for leaks to ensure that fresh water is not entering the system.
- Continual fresh makeup water will reduce boiler life.
- Mineral buildup in the heat exchanger reduces heat transfer, overheats the stainless steel heat exchanger, and causes failure.
- The addition of oxygen carried in by makeup water can cause internal corrosion in system components.
- Leaks in the boiler or piping must be repaired at once to prevent excessive makeup water. For this purpose, it is recommended to install a water meter to easily check the amount of makeup water entering the system. Makeup water volume should not exceed 5% of the total system volume per year. **NOTE:** When makeup water is added, make sure the chemical additives are added to maintain the correct level.
- An approved multi-metal corrosion inhibitor (comparable to Sentinel X100 or Fernox F1) is recommended at the correct concentration and in the manner recommended by the manufacturer.

Freeze protection

WARNING

Ethylene glycol is toxic, DO NOT use as your freeze protection. Ethylene glycol has a sweet aroma which children and pets could mistake as food and ingest; leading to death.

1. Use glycol only if needed for freeze protection.
2. Propylene glycol is the recommended freeze protection.
3. Make sure to flush the boiler system before adding glycol.
4. Determine the freeze protection fluid quantity using system water content, following the fluid manufacturer's instructions. Boiler water content is listed on page 3. Remember to include expansion tank water content.

7 Start-up

5. Local codes may require a backflow preventer or actual disconnect from city water supply.
6. When using freeze protection fluid with automatic fill, it is suggested to install a water meter to monitor water makeup. Freeze protection fluid may leak before the water begins to leak, causing the concentration to drop, which reduces the freeze protection level.
7. The freeze protection set points may be lowered when freeze protection fluid is used (see the Power-Fin Service Manual).
8. Consult the glycol manufacturer for details on the suggested mix of glycol and water for the desired freeze protection level and the de-rate effect it will have on the boiler output.

Test / replace freeze protection fluid

1. For systems using freeze protection fluids, follow the fluid manufacturer's instructions.
2. Freeze protection fluid must be replaced periodically due to degradation of inhibitors over time.
3. It is recommended to test the glycol concentration annually and adjust within the desired set points.

Oxygen prevention

CAUTION

Eliminate all system leaks. Continual fresh makeup water will reduce boiler life. Minerals can build up in the heat exchanger, reducing heat transfer, overheating the heat exchanger, and causing heat exchanger failure.

Dissolved oxygen can have a negative effect on the boiler system. Oxygen can cause iron oxide to generate iron deposits. Oxygen may also increase the rate of corrosion on non-stainless steel parts of the system. A low pH level combined with oxygen further enhances its corrosive effects. After boiler installation, check for air leaks in the following areas:

- Suction gasket
- Pump
- Air valve
- O-ring gaskets

Precautions include installing a water meter to evaluate the fresh water volume entering the system (should be no more than 5% system volume). Additional volumes of fresh water could indicate that a leak is present.

Fill and test water system

1. Fill system only after ensuring the water meets the requirements of this manual.
2. Close automatic and manual air vents and boiler drain valve.
3. Fill to correct system pressure. Correct pressure will vary with each application.
 - a. The minimum cold water fill pressure for a system is 12 psi.
 - b. Pressure will rise when the boiler is turned ON and system water temperature increases.
4. At initial fill and during boiler startup and testing, check the system thoroughly for any leaks. Repair all leaks before proceeding further.

Purge air from water system

1. Purge air from system:
 - a. Connect a hose to the purge valve (see purge/drain valve in the piping diagrams on pages 40 through 43). Route the hose to an area where water can drain and be seen.
 - b. Close the boiler or system isolation valve between the purge valve and fill connection to the system.
 - c. Close zone isolation valves.
 - d. Open the quick-fill valve on the cold water makeup line.
 - e. Open purge valve.
 - f. Open the isolation valves one zone at a time. Allow water to run through the zone, pushing out the air. Run until no noticeable air flow is present. Close the zone isolation valves and proceed with the next zone. Follow this procedure until all zones are purged.
 - g. Close the quick-fill water valve and purge valve and remove the hose. Open all isolation valves. Watch that system pressure rises to correct cold-fill pressure.
 - h. After the system has operated for a while, eliminate any residual air by using the manual air vents located throughout the system.
 - i. If purge valves are not installed in the system, open the manual air vents in the system one at a time, beginning with the lowest floor. Close the vent when water squirts out. Repeat with remaining vents.
2. Open the automatic air vent (diaphragm-type or bladder type expansion tank systems only) one turn.
3. Open other vents:
 - a. Starting on the lowest floor, open air vents one at a time until water squirts out.
 - b. Repeat with remaining vents.
4. Refill to correct pressure.

7 Start-up *(continued)*

Check for gas leaks

WARNING Before starting the boiler, and during initial operation, smell near the floor and around the boiler for gas odorant or any unusual odor. Remove the front access panel and smell the interior of the boiler enclosure. Do not proceed with startup if there is any indication of a gas leak. Use an approved leak detection solution. Repair any leaks at once.

WARNING Propane boilers only – Your propane supplier mixes an odorant with the propane to make its presence detectable. In some instances, the odorant can fade, and the gas may no longer have an odor. Before startup (and periodically thereafter), have the propane supplier verify the correct odorant level in the gas.

Check thermostat circuit(s)

1. Disconnect the two external wires connected to the enable terminals on the connection board.
2. Connect a voltmeter across these two incoming wires. Close each thermostat, zone valve, and relay in the external circuit one at a time and check the voltmeter reading across the incoming wires.
3. There should NEVER be a voltage reading.
4. If a voltage does occur under any condition, check and correct the external wiring. (This is a common problem when using 3-wire zone valves.)
5. Once the external thermostat circuit wiring is checked and corrected if necessary, reconnect the external thermostat circuit wires to the connection board. Allow the boiler to cycle.

Inspect/fill condensate system

Inspect/check condensate lines and fittings

1. Inspect the condensate drain line, condensate PVC fittings and condensate trap.

Fill condensate trap with water

1. Remove the four (4) screws securing the top cover to the condensate trap and remove the cover (FIG. 7-1).
2. Locate the plastic ball inside the float tube. Verify there is nothing under the ball causing it to not seat properly.
3. Fill with fresh water until the water begins to pour out of the drain.
4. Replace the cover.
5. Replace the four (4) screws removed in Step 1.

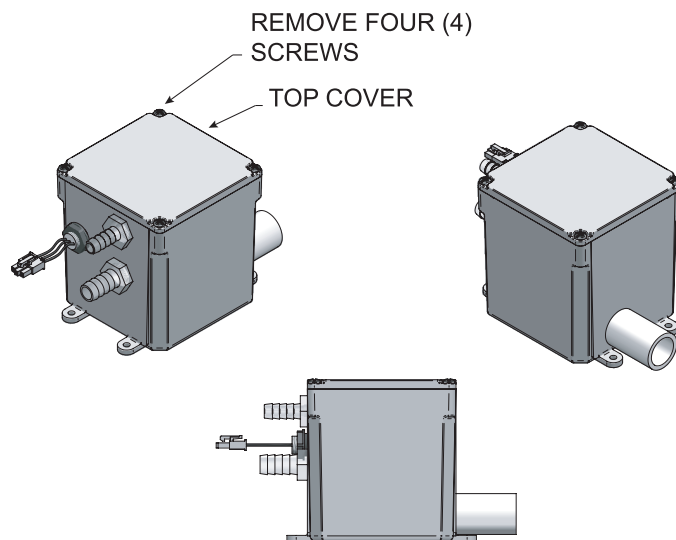


Figure 7-1_ Condensate Trap

Check vent and air piping

1. Inspect vent piping and air piping for signs of deterioration from corrosion, physical damage or sagging. Verify air piping and vent piping are intact and correctly installed per this manual.

Placing the boiler in operation

Boiler operational checks

2. Turn the boiler main power switch to the “ON” position.
3. Verify operation of the SMART TOUCH control module and Operator Interface.
4. Program the adjustable points from the Operator Interface.
5. Push the reset for the low water cutoff (if equipped).
6. Ensure that maximum flow to the boiler does not exceed 75 GPM on Models 502 - 1302 and 90 GPM on Models 1501- 2001. Verify by checking temperature rise while burner is firing at 100% of rated input.
7. Install a manometer on the gas supply to the boiler and verify minimum gas supply pressure as the burner fires at 100% of rated input.
8. Verify operation of safeties as necessary (low water cutoff, high limit, gas pressure, etc.,).
9. Verify that all adjustable points in the Operator Interface are set as required.

7 Start-up

Final checks before starting the boiler

- ❑ Read the Power-fin Service Manual to familiarize yourself with SMART TOUCH control module operation. Read this manual, page 59 for proper steps to start boiler.
- ❑ Verify the boiler and system are full of water and all system components are correctly set for operation.
- ❑ Verify the preparation procedures of Section 7, pages 55 and 56 have been completed.
- ❑ Verify electrical connections are correct and securely attached.
- ❑ Inspect vent piping and air piping for signs of deterioration from corrosion, physical damage or sagging. Verify air piping and vent piping are intact and correctly installed per this manual.

Start the boiler

1. Read and follow the Operating instructions in FIG. 7-2, page 59.

If boiler does not start correctly

1. Check for loose connections, blown fuse or service switch off?
2. Is external limit control (if used) open? Is boiler water temperature above 200°F (93°C)?
3. Is the boiler receiving a call for heat?
4. Is gas turned on at meter and boiler?
5. Is incoming gas pressure less than 4 inches w.c. (.99 kPa)?

If none of the above corrects the problem, refer to the Troubleshooting Section of the Power-fin Service Manual.

Check system and boiler

❑ Check water piping

1. Check system piping for leaks. If found, shut down the boiler and repair immediately. (See WARNINGS on pages 56 and 57 (startup) regarding failure to repair leaks.)
2. Vent any remaining air from the system using manual vents. Air in the system will interfere with circulation and cause heat distribution problems and noise.

❑ Check vent piping and air piping

1. Check for gastight seal at every connection, seam of air piping, and vent piping.

⚠ WARNING Venting system must be sealed gastight to prevent flue gas spillage and carbon monoxide emissions, which will result in severe personal injury or death.

❑ Check gas piping

1. Check around the boiler for gas odor following the procedure on page 46 of this manual (connecting gas supply piping).

⚠ WARNING If you discover evidence of any gas leak, shut down the boiler at once. Find the leak source with a bubble test and repair immediately. Do not start the boiler again until corrected. Failure to comply could result in severe personal injury, death, or substantial property damage.

Check flame and combustion

1. Turn the main power off to the boiler by placing the “On/Off” switch in the OFF position.
2. Remove the flue temperature sensor from the flue collector. **Note:** Combustion measurements will be made at this point.
3. Insert the probe from a combustion analyzer into the hole left by the removal of the flue temperature sensor.
4. Turn the main power on to the boiler by placing the “On/Off” switch in the ON position.
5. Navigate to the Setup Screen from the Home Screen by pressing the SETUP button along the left side of the screen. Enter the installer password.
6. Select the Service Maintenance Screen. The tabs will scroll (up and down) to reveal more options. See the Power-Fin Service Manual for more detailed information.
7. Once the heat exchanger has modulated up to rate, measure the combustion. The values should be in the range listed in *Table 9A* of the Power-fin Service Manual. CO levels should be less than 200 ppm for a properly installed unit. If the combustion is not within range reference the *Troubleshooting* Section in the Power-fin Service Manual for possible causes and corrective actions.
8. Once the heater analysis is complete, test the safety shutoff device by turning the manual shutoff valve to the OFF position and ensuring that the heater shuts down and registers an alarm. Open the manual shutoff valve and reset the control.

7 Start-up *(continued)*

Figure 7-2_Operating Instructions

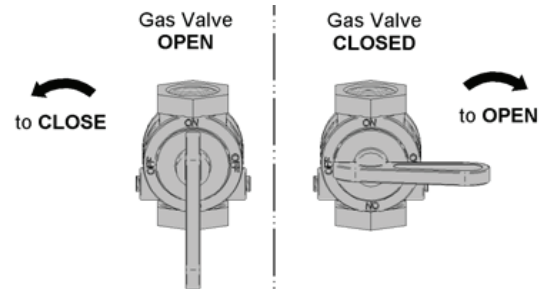
FOR YOUR SAFETY READ BEFORE OPERATING

WARNING: If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury, or loss of life.

- A. This appliance does not have a pilot. It is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.
 - B. BEFORE OPERATING smell all around the appliance 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 appliance.
 - Do not touch any electric switch; do not use any phone in your building.
 - Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
 - If you cannot reach your gas supplier, call the fire department.
- C. Use only your hand to turn the gas control knob. Never use tools. If the handle will not turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.
 - D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

OPERATING INSTRUCTIONS

1. **STOP!** Read the safety information above on this label.
2. Set the thermostat to lowest setting.
3. Turn off all electric power to the appliance.
4. This appliance is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.
5. Remove front door.
6. Turn gas shutoff valve counterclockwise to "OFF". Handle will be perpendicular to pipe. Do not force.
7. Wait five (5) minutes to clear out any gas. If you then smell gas, **STOP!** Follow "B" in the safety information above this label. If you don't smell gas, go to next step.
8. Turn gas shutoff valve clockwise to "ON". Handle will be parallel to pipe.
9. Install front door.
10. Turn on all electric power to appliance.
11. Set thermostat to desired setting.
12. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier.



TO TURN OFF GAS TO APPLIANCE

1. Set the thermostat to lowest setting.
2. Turn off all electric power to the appliance if service is to be performed.
3. Remove front door.
4. Turn gas shut off valve counterclockwise to "OFF". Handle will be perpendicular to pipe. Do not force.
5. Install front door.

LBL20053 REV B

7 Start-up

Set space heating operation

Verify space heat circulator mode

The system pump output can be programmed to never run (OFF), run only when a space heating demand is present (ON), or run continuously except during warm weather shutdown (WWSD). If the boiler is not heating an indirect HW (Hot Water Generator) tank, it also turns on the boiler pump. After the space heating call for heat ends, and the system pump is programmed as ON, the system pump continues to run for a short period of time. If the boiler pump was running, it continues to run for a short period of time as well. These pump delays are factory set to 30 seconds. If different delays are desired, the appropriate parameters in the control must be changed. See the Power-fin Service Manual for a detailed explanation of this procedure.

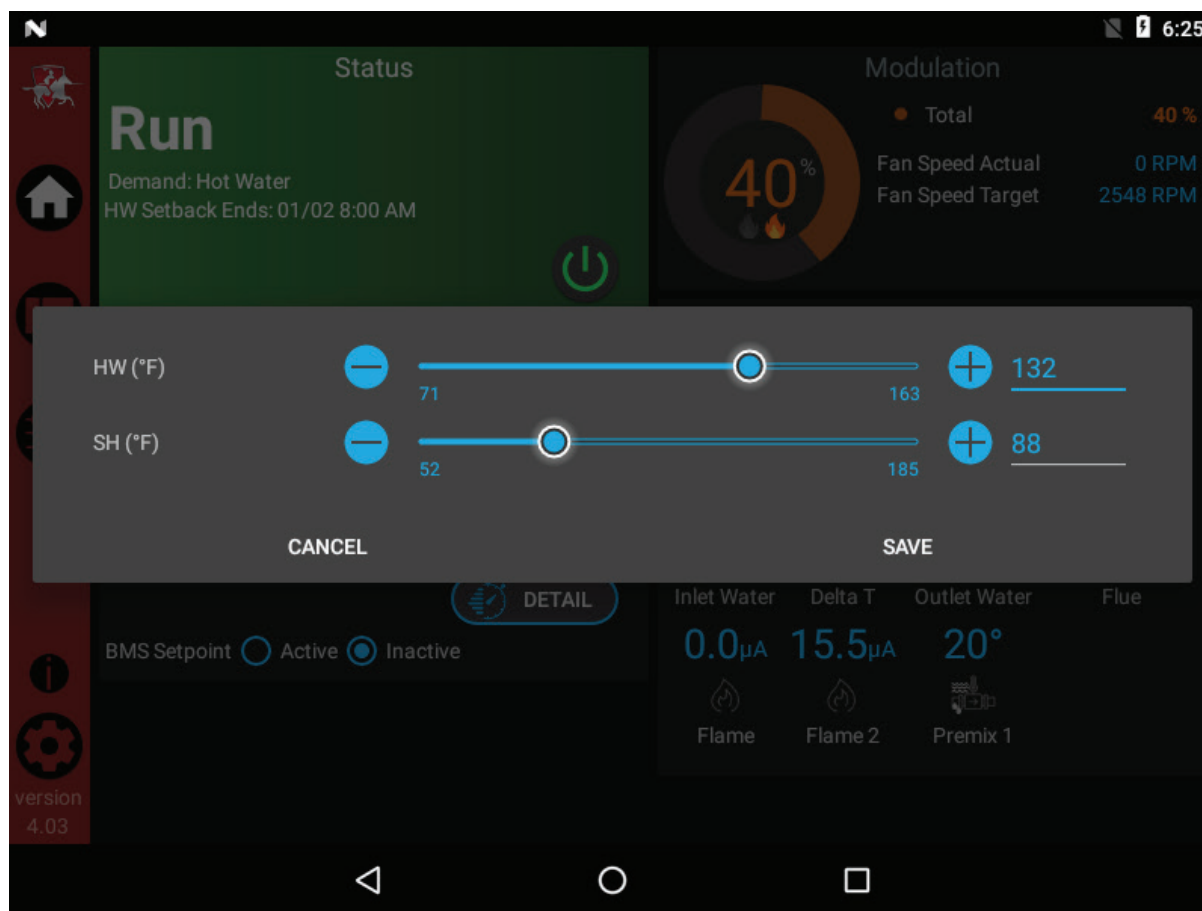
Set space heating set point temperature

During normal operation, set point temperatures can be adjusted from the Home Screen by pressing the DETAILS button on the bottom of the screen (see FIG. 7-3).

1. To change a set point, use the set point slider feature or the PLUS (+) and MINUS (-) buttons to adjust the set points as shown in FIG. 7-3.
2. Once the set point has been adjusted to the desired setting, press the Door Menu slider (top left) or the Setup button.
3. Press the APPLY CHANGES button on the top of the screen.

NOTE: The APPLY CHANGES button must be pressed to complete programming of the controls. Failure to press the APPLY CHANGES button will result in an unprogrammed control. The Door Menu button will become highlighted when there are changes that can be applied.

Figure 7-3 User Set Point Screen



8 Operating information

Set Hot Water Generator (HW) operation

Note: For more detailed instructions, please refer to the Power-fin Service Manual.

Verify HW mode

There are two (2) modes of operation for HW. In Normal Mode, when a HW demand begins, the control will start the HW pump, turn off the boiler pump (if running), and modulate to bring the outlet temperature to the HW boiler set point. The maximum firing rate may be limited in this mode if desired.

In Zone Mode it is assumed that the indirect HW tank is piped as a zone on the primary loop. When a HW demand begins, the control will turn on the HW pump output, and raise the system temperature set point to the HW boiler set point (if higher). The boiler pump will be turned on. The system pump may be forced on, forced off, or not changed, depending on the System Pump Mode selected (reference the Power-fin Service Manual for details). In this mode, any low temperature zones (such as radiant heating) may need additional controls to limit the water temperature sent to those zones.

Set HW boiler target temperature

When in the HW Mode, the control will modulate to maintain the boiler outlet temperature or system supply temperature to a set point. This set point is set at the factory to 180°F. If a different set point is desired, the appropriate parameter in the control must be changed. See the Power-fin Service Manual for a detailed explanation of this procedure.

Set maximum HW fan speed

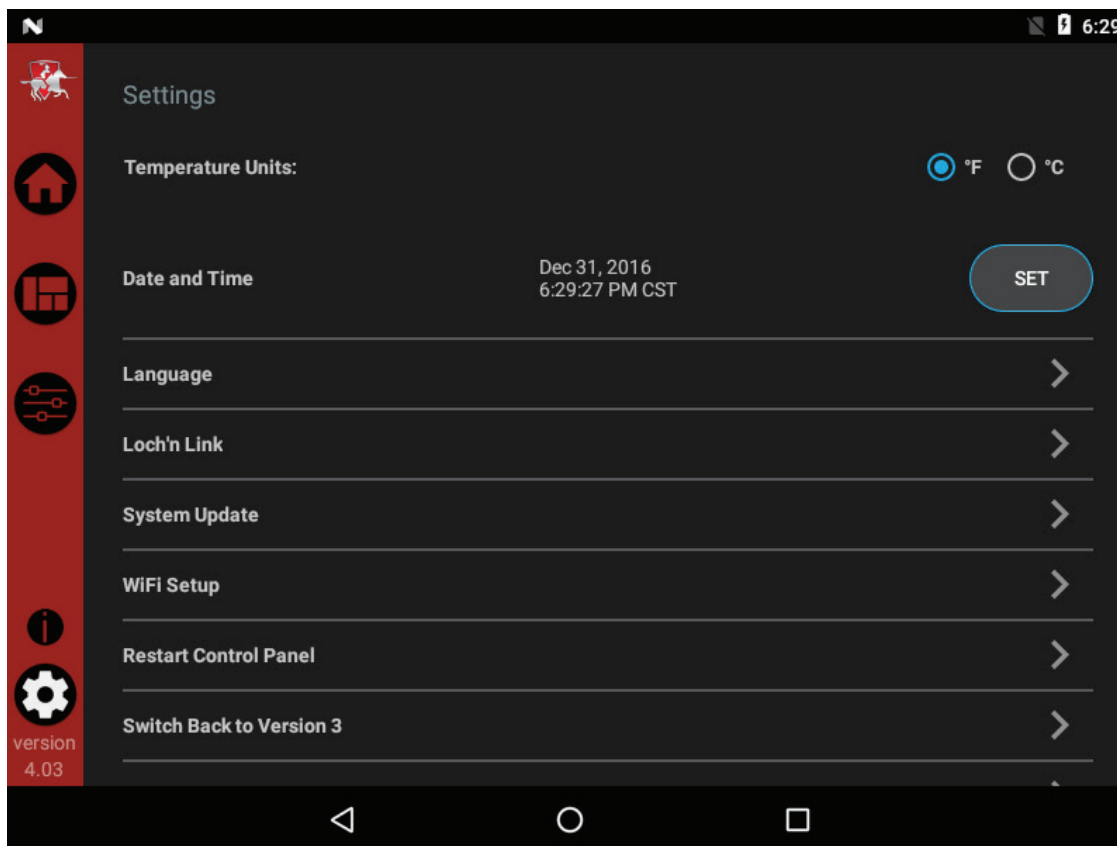
If the rated input of the indirect tank is less than the maximum output of the boiler, change the maximum HW fan speed setting to limit the boiler output accordingly, see the Power-fin Service Manual for a detailed explanation of this procedure.

Set clock

The SMART TOUCH control has a built-in clock that it uses for its night setback feature and for logging events. This clock must be set when the appliance is installed and anytime the appliance has been powered off for more than one day. Use the following procedure to set the clock:

1. Press the SETTINGS button under the Lochinvar logo (see FIG. 8-1).
2. Press the SET button across from the date and time.
3. Proceed to set the date, time, and time zone.
NOTE: Automatic Time Zone will not work.
4. Temperature units and WiFi may also be set here. These items may be used to automatically sync the time.
5. Press the Home, View, or Back button to exit.

Figure 8-1 Rapid Setup Screen



8 Operating information

Configuration of the cascade

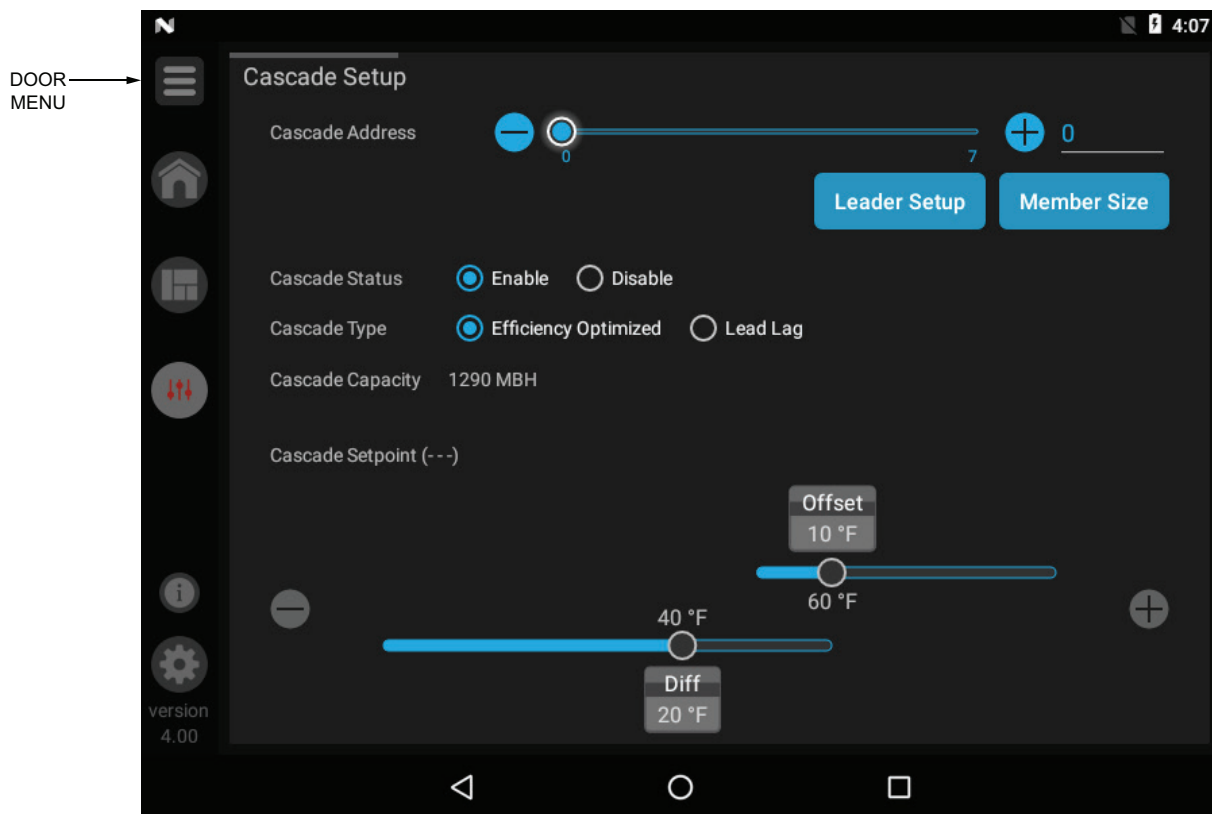
NOTE: For more detailed instructions, please refer to the Power-Fin Service Manual.

When installing a Cascade system, all units must be programmed for Cascade to operate. Access the Cascade Setup options as follows:

1. Press the SETUP button on the left side of the display screen.
2. Enter the installer password.
3. Select the Cascade option as shown in FIG. 8-2.
4. Each unit must have a unique address set. The leader has more options which are described in the Power-Fin Service Manual.
5. Once all the updates are complete, press the Door Menu slider (top left) or the Setup button.
6. Press the APPLY CHANGES button on the top of the screen.

NOTE: The APPLY CHANGES button must be pressed to complete programming of the controls. Failure to press the APPLY CHANGES button will result in an unprogrammed control. The Door Menu button will become highlighted when there are changes that can be applied.

Figure 8-2 Cascade Screen



8 Operating information *(continued)*

General

How the appliance operates

The Power-fin uses a copper finned tube heat exchanger to transfer heat from the flue products to the water. An electronic control module monitors various inputs to initiate a call for heat. The blower provides air to the burner and forces the flue products out of the combustion chamber and into the vent system. The control module regulates the blower speed to control the firing rate of the unit. The modulating gas valve monitors the amount of combustion air being pulled into the blower and regulates the amount of gas supplied, which then mixes with the combustion air and is supplied to the burner.

How the control modules operate

The Power-fin boiler is equipped with a SMART TOUCH control module. The SMART TOUCH control module receives inputs from boiler sensors and external devices. The control module activates and controls the blowers and gas valves to regulate heat input and switches the boiler, Hot Water Generator (HW), and system pumps on and off as needed. The user programs the control module to meet system needs by adjusting control parameters. These parameters set operating temperatures and boiler operating modes.

Control inputs and outputs

Enable

This input tells the boiler to provide water for space heating.

Hot Water Generator (HW) tank thermostat

This input tells the boiler to provide water for heating an indirect HW tank.

0 - 10V BMS input (set point or power)

The Power-fin can be controlled by a Building Management System (BMS) using a 0 - 10 VDC signal. The control can be configured by the installer to use this signal to either control set point or firing rate.

0 - 10V System Pump speed input

When a variable speed system pump is used, and there is a 0 - 10V signal available from the pump speed control, this signal may be connected to the boiler. Doing so will allow the boiler to anticipate changes in the BTU's needed by the system as the system flow changes, and therefore, help the boiler to maintain the desired system temperature. Connect the - input terminal to the COM or - output terminal on the pump speed control, and the + input terminal to the 0 - 10V or + output terminal on the pump speed control. Note that the voltage on these inputs must never go below ground.

HW priority

The SMART TOUCH control allows the connection of a HW thermostat or tank sensor to the low voltage connection board. When a tank sensor is connected, the HW thermostat input is ignored. When a boiler is programmed for HW Normal Mode, the maximum firing rate can be limited to match the input rating of the indirect tank coil.

HW / space heating (SH) cycling

If a HW call for heat is received while a space heating call is in progress, and the HW is in Normal Mode, the control will start the HW pump and shut the boiler pump off. The system pump will remain on. For stand-alone boilers, if the space heating call is still active while the HW call is in operation, the control will wait for 30 minutes (time adjustable by installer) then it will switch back to the space heating demand. There is a timer to switch from space heating to HW and a timer to switch from HW to space heating. The control will switch back and forth until one of the heat demands end. This function does not apply to cascade systems.

Controlling sensor

The control module is programmed to use the outlet sensor as the control sensor by default. If a system supply sensor is connected, the control automatically uses it as the control sensor. The control module may be programmed to use the inlet sensor as the control sensor instead. In this case, the control will use the system return sensor if it is connected.

Anti-cycling

After a space heating demand has been satisfied, the control will delay the next space heating call for a set time period (time is adjustable by the installer). The time delay will be bypassed if the inlet water temperature drops too far during the delay.

Boiler, system, and HW pump control

When a space heating call for heat starts and no HW call is on, the boiler pump is turned on. The system pump will turn on also if it is programmed to do so. If a HW call for heat is on, the boiler pump will wait to turn on until just before the HW pump turns off. After the space heating call for heat ends, the boiler pump will run for an additional period of time.

When a HW call for heat starts, the HW pump is turned on. If a space heating call for heat is on, the boiler pump will turn off a few seconds after the HW pump turns on.

Louver

When the boiler needs to control combustion air louvers, connect a 24 VAC louver relay to the two (2) Louver Relay terminals. Connect the Louver End Switch to the Louver Proving Switch input on the Low Voltage Connection Board.

Temperature control

Modulation

The Power-fin is capable of modulating its firing rate from a minimum of 20% to a maximum of 100%. The firing rate is dictated by the call for heat (i.e., space heating or hot water generation), the heating load, ramp delay (if enabled), and various other temperature limitations.

8 Operating information

Gradient limiting

If during operation of the boiler the outlet water temperature is rising too quickly, the control will reduce the firing rate to its lowest setting.

Outdoor air reset

If an outdoor air sensor is connected, the control module will calculate the set point based on the programmed reset curve. The installer can change the slope of the reset curve by several adjustable parameters. The user can limit the maximum set point for the system using the space heating set point.

Boost function

If outdoor air reset is active, the boost temperature is not 0, a space heating demand has been active continuously for a set period of time (time adjustable by installer) and there has been no HW demands, the control will increase the set point by a fixed number of degrees (adjustable by installer). This process will continue until the space heating demand ends, the set point reaches the programmed set point or a maximum of 20 increases has occurred. Once the system heat demand is satisfied, the set point will revert to the value determined by the reset curve.

Night setback

The controller may be programmed to reduce the space heating set point and/or Hot Water Generator set point for each demand during a certain time each day. A start and stop time for each demand can be programmed for each day of the week. The controller can be programmed to reduce the tank set point as well. A different set of start and stop times can be programmed each day of the week.

Flame current support

To prevent nuisance shutdowns when the boiler is firing at minimum rates, the control will increase the firing rate when the flame signal drops too low.

ModBus

The Power-fin boiler can be connected to and controlled by a Building Automation System through the ModBus interface. Connect the A and B wires to the A and B terminals. If connecting another cable (in a daisy chain), connect the shield wire of the first cable to one of the shield terminals, and the shield wire of the second cable to the other shield terminal. If it is desired to ground the cable shield at the heater, connect the shield wire to one of the shield terminals, and install a jumper across the two (2) terminals in connector X5 on the ModBus interface board.

0-10V Rate output

A 0-10V signal which indicates the firing rate of the heater is available. This output may be connected to a Building Management System (BMS) to allow it to monitor the actual firing rate. Connect the - terminal to the COM or - terminal on the BMS, and connect the + terminal to the 0 - 10V or + terminal on the BMS.

Ramp Delay

For systems with lower flow, the SMART TOUCH can limit the firing rate (when enabled) when a space heating call for heat starts, or when switching from a DHW call for heat to a space heating call for heat. There are six (6) limits that can be programmed, as well as six (6) time intervals corresponding to each limit. The sixth limit will also limit the firing rate for the rest of the call for heat.

Protection features

Outlet temperature, flue temperature, and temperature rise limiting

The outlet water temperature is monitored by the boiler outlet temperature sensor. When the outlet temperature exceeds 215°F (102°C), the unit will reduce the fan speed. If the outlet water temperature exceeds 220°F (104.4°C) the control will shut the unit down until the minimum off time has expired and the outlet drops 10°F (5.5°C).

The control module monitors the flue temperature by a sensor located in the flue exhaust. If the flue temperature exceeds 400°F (204.4°C) the control will reduce the maximum fan speed. If the flue temperature exceeds 450°F (232.2°C) the control will shut the unit down. The unit will restart automatically once the flue temperature drops 50°F (10°C) and the minimum off time has expired.

The control monitors the temperature difference between the inlet and the outlet sensor. If this difference exceeds 55°F (12.8°C) the control will reduce the fan speed. If the temperature difference exceeds 65°F (18.3°C) the control will shut the unit down. The unit will restart automatically once the temperature difference has dropped below 50°F (10°C) and the minimum off time has expired.

Freeze protection

DO NOT install the boiler in a room likely to freeze.

The following integral feature of the SMART TOUCH control module provides some protection for the boiler only -- not for the system.

- The SMART TOUCH control module provides freeze-up protection as follows when the boiler water temperature drops below 45°F (7°C):
- Below 45°F (7°C), the boiler and system pumps (if enabled) operate constantly.
- Below 37°F (3°C), the boiler turns on.
- Boiler and pumps turn off if boiler water temperature rises above 43°F (6°C).



This feature of the SMART TOUCH control module does not eliminate the possibility of freezing. The installation must still use recognized design, installation and maintenance practice to prevent freeze potential for the boiler and system.

8 Operating information *(continued)*

Monitor external limits

Connections are provided on the connection board for external limits such as an additional high limit. The SMART TOUCH control will shut off the burner and inhibit relighting whenever any of these external limits open.

Run-time and alarm outputs

The boiler provides dry contacts for indicating when the boiler is running, and when it is unable to operate.

Run-time and cycle counting

The control uses four timers to monitor the total hours of burner operation:

75 - 100%	50 - 75%
25 - 50%	<25%

The control uses four (4) ignition counters to monitor the amount of boiler cycles. The first counter counts all ignitions of the control. The second counter counts only ignition attempts that have failed. The third and fourth counters are the same as the first and second respectively, but can be reset by the installer.

Service reminder

The control can be programmed for service reminder notification. This notification will become active when either a set amount of time has expired, or a set amount of running hours or cycles has expired (all adjustable by the installer). The service reminder notification can be reset by the installer. The service company's name and phone number can be programmed to display when service is due.

Error logging

The control will hold in memory the last 10 blocking faults as well as the last 10 lockout faults. The date and time of the occurrence will be recorded as well. Only the 10 most recent occurrences will be held in memory.

Boiler temperature regulation

Operating temperature (target)

The SMART TOUCH control module senses water temperature and regulates boiler firing and firing rate to achieve a target temperature. The target temperature can be set between 32°F (0°C) and 215°F (101.7°C).

- Target temperature is fixed when the outdoor sensor is not installed.
- Target temperature is calculated as described under "Outdoor Reset Operation" and "Target Temperature Boost" when the outdoor sensor is connected.

High limit operations

The Power-fin SMART TOUCH control has two (2) integral limits, one auto reset and one manual reset. The Power-fin also has one auxiliary manual reset high limit. The integral and auxiliary high limits are UL353 certified.

When the outlet temperature exceeds 225°F (107.2°C) (Installer Adjustable Parameter), integral auto reset high limit action occurs. The boiler will shut down until the outlet water cools down and the timer expires.

If the outlet temperature exceeds 230°F (110°C) (User Adjustable Dial), auxiliary manual reset high limit action occurs. The boiler will shut down until the outlet water cools down and the boiler is reset through the user interface.

If the outlet temperature exceeds 230°F (110°C) (Installer Adjustable Parameter), integral manual reset high limit action occurs. The boiler will shut down until the outlet water cools down and the boiler is reset through the user interface.

Low water cutoff protection

A low water cutoff device with test and reset functionality is provided in the boiler as standard equipment.

Flow sensing device

The SMART TOUCH control module uses temperature sensing of both supply and return temperatures of the heat exchanger. If the flow rate is too low or the outlet temperatures too high, the control module modulates down and will shut the boiler off. This ensures boiler shutdown in the event of low flow conditions.

NOTICE

If a mechanical flow switch is required to meet local code requirements the Power-fin boiler can be equipped with a field supplied outlet flow switch. Please wire to the Louver Proving Switch terminals.

Outdoor reset operation, if used

Target temperature with outdoor reset

This feature improves the system's efficiency as the outdoor temperature warms up.

See the Power-fin Service Manual to change the settings.

Reset curve

The reset curve looks at outdoor air temperature and adjusts the set point.

8 Operating information

Cascade

When multiple boilers are installed, they can be wired together in a cascade sequence. A maximum of eight boilers can be controlled from a single control. In this application one boiler would be designated as the Leader control and all others would be designated as Member controls.

Once the Leader boiler receives a call for heat from the Enable input, the 0 - 10 VDC input, or ModBus, the control will determine what the set point will be. If outdoor air reset is desired, connect the outdoor air sensor to the terminals on the Low Voltage Connection Board on the Leader boiler. The set point will be calculated based on the programmed reset curve parameters. See the Power-fin Service Manual to program the reset curve. If outdoor air reset is not desired, do not connect the outdoor air sensor. A fixed temperature set point can be programmed into the control, or provided through the ModBus interface.

If the water temperature at the controlling sensor is less than the set point + the turn-off offset - the off-on differential, the control will initiate a call for heat on the Cascade (see the Power-fin Service Manual for an explanation of the offset and differential). The Leader will energize the lead boiler on the Cascade. For a new startup this will be the Leader boiler.

The two (2) types of Cascade control are listed below:

Efficiency optimization

Efficiency optimization is chosen when the application is such that overall heating efficiency is most important. The Cascade will fire the boilers in a way that is the most efficient. This allows more boilers to fire at one time, at a lower rate, thus more efficient.

Lead/Lag

The Lead/Lag method is chosen when the application requires firing as few boilers at a time as possible. This method will not bring on another boiler until the current number of boilers cannot meet the demand.

The parameters for both types of Cascade are adjustable. Reference the Power-fin Service Manual for a more detailed description of these adjustments.

Sequence of the cascade

To equalize the run time of all boilers on the Cascade, the firing sequence will automatically be changed at set intervals.

For the first 24 hours after initializing the Cascade, the sequence will be changed every hour. After that the sequence will be changed once every 24 hours.

HW operation with cascade

For normal mode HW operation any boiler(s) in the Cascade can be selected to provide heat for a HW call. Select a boiler to be designated as the HW boiler. Connect the HW thermostat or sensor to the terminals on the Low Voltage Connection Board marked for the corresponding device. When the boiler receives a HW call, the Leader control will take that boiler out of the Cascade sequence. If another boiler is available, the Leader will start it up to take its place.

The HW boiler will adjust its set point to the programmed HW boiler set point and will adjust its firing rate to maintain this. Once the HW call has been satisfied, the Leader control will place that boiler back into the Cascade sequence.

Switching of the boiler between HW operation and SH operation when there is a call for both does not occur in Cascade Mode.

When HW is programmed for Zone Mode, connect the HW thermostat or tank sensor to the Leader boiler. When a HW call is received, the Leader will modulate the entire Cascade to bring the system supply temperature up to the HW boiler set point (if higher).

Night Setback and Ramp Delay operations with cascade

Night Setback and Ramp Delay operation of the boilers within the Cascade are available. Programming will be done through the Leader boiler. Refer to the Power-fin Service Manual for information regarding Night Setback and Ramp Delay.

8 Operating information *(continued)*

Sequence of operation

1.	Upon a call for heat, the control turns on the appropriate pumps (system and boiler pumps for a space heating call, HW pump for a hot water generator call).
2.	The control confirms that the low water cutoff contacts are closed and energizes the louvers (optional).
3.	The control confirms that the gas pressure switch, blocked drain switch, limits, louver proving switch (optional) and contacts close. The Pre-Purge cycle begins.
4.	The control confirms the blower comes up to the desired speed, and the air pressure switch is closed.
5.	Once the Pre-Purge cycle is complete, the control lowers the blower speeds, initiates sparking of the ignition electrode, and opens the gas valve.
6.	After a short wait, the control stops sparking and checks for the presence of flame current through the flame sense electrode.
7.	If the control does not detect flame current, the control will lockout indefinitely, until the RESET button on the touch screen LCD is pressed.
8.	If the control detects flame current, the control will hold the blower speed constant for a few seconds to allow the flame to stabilize, then begin modulating the firing rate in order to maintain the controlling sensor to the desired set point temperature.
9.	If the current call for heat is for space heating and a HW call for heat becomes active, the control will turn on the HW pump relay output, then turn off the boiler pump. It will then modulate the blower speed in order to maintain the outlet temperature to the desired HW outlet set point temperature.
10.	Once both the space heating and HW calls for heat are satisfied, the control will turn off the gas valve(s) and begin the Post-Purge cycle. Any pumps that are running will begin their respective Pump Delay cycles.
11.	At the end of the Post-Purge cycle, the louver relay contacts will de-energize.
12.	At the end of the Pump Delay cycle(s), the pump(s) will be turned off.

8 Operating information



w/Power-fin CON·X·US Interface

The Home Screen displays the available basic system information. It is divided into the following sections: Status, Demand, Modulation, Sensors, and Navigation.

Figure 8-3 Home Screen



- The **Status** Section is located on the top left of the screen and displays how the unit is currently running (i.e. Off, Stand-by, Blocking, and Lockout) including: current driving demand, the next Hot Water Setback scheduled, the reason for any blocking or lockout, and a power button.
- The **Demand** Section is located on the bottom left of the screen and displays information about the targets and limits of the current demand being serviced.
- The **Modulation** Section is located on the top right of the screen and displays the target modulation of the unit. This section also includes target and actual fan speeds.
- The **Sensor** Section is located on the bottom right of the screen and displays both factory installed and field installed sensor including: Outdoor Air, Hot Water Temperature, System Supply, System Return, Inlet Water, Delta T, Outlet Water, Flue Temperature, and Flame Current.
- The **Navigation** Section is located down the left side of the screen. There are five (5) sections located below the Lochinvar icon: Home, View, Setup, Information (About), and Settings. The Home Section is the screen shown above. The View Section provides more detailed information including subsections for: History, Cascade, Graphing, and a complete list of current Sensor Values. The Setup Section has several screens to aid in setting up the appliance. The Setup Section includes screens for adjusting: Set Points, Pump Settings, Cascade, BMS, Ramp Delay, and Night Setback. The Information Section provides information about the hardware and software including the current software version of the interface, the version of the boiler control, and the CON·X·US device serial number. The Setting Section enables several interface setup features including: Time Setup, Temperature Unit Select, Loch'n Link, System Update, and WiFi Setup.

9 Domestic water heaters

This section applies only to those appliances used to supply domestic hot water, installed with a storage tank(s). A circulating pump **MUST** be installed in the piping assembly to the storage tank and valves used to control water velocity through the appliance. Proper water velocity is important for correct operation of your water heater.

This section contains specific instructions for those appliances used to supply domestic hot water. All warnings, cautions, notes and instructions in the general installation and operation sections apply to these instructions. Water heaters are designed for installation with a storage tank. The operation of the circulating pump, proper sizing of the piping between the tank and heater and the control of water velocity, as explained in this section, are important for correct operation of your water heater.

NOTICE

To ensure proper velocity through the heat exchanger, it is necessary to regulate the temperature rise across the heat exchanger from inlet to outlet. This must be done on initial installation and periodically rechecked. With the correct temperature rise across the heat exchanger when the water heater is firing at 100% of rated input, you may be assured of the proper velocity in the tubes. This will yield long life and economical operation from your water heater.

Excessive lime/scale build-up in the heat exchanger tubes is a result of restricted flow and too little velocity in the tubes. Excessive pitting or erosion in the tube is caused by high water flow and too much velocity through the tubes. Care should be taken to measure temperature rise and maintain velocity as follows:

Initial set-up of maximum water flow

On initial start-up of the Power-fin the maximum water flow through the heat exchanger must be manually set before normal operation begins.

TABLE - 9A
MAXIMUM WATER FLOW

⚠ CAUTION: The maximum flow rate through Power-fin models with a copper heat exchanger must be set to provide and not exceed the following flow:

Model	Maximum Flow	Maximum Flow for CuNi Heat Exchanger
502, 752, 1002, and 1302	75 GPM	95 GPM
1501, 1701, and 2001	90 GPM	115 GPM

The heat exchanger is capable of operating within the design flow rates required for the water heater, storage tank(s), and connecting piping. Erosion of the finned copper tubes may occur if the flow rate exceeds the maximum allowable flow rate through the water heater. The maximum flow rate through the water heater must be adjusted. Maximum flow on Models 502 - 1302 is 75 GPM and 90 GPM on Models 1501 - 2001. Flow rate can be determined by measuring the temperature rise through the water heater when it is firing at full rate input.

TABLE - 9B
TEMPERATURE RISE AT FULL RATE FIRE
75 AND 90 GPM FLOW

Model	Temperature Rise
502	11°F (6.1°C)
752	17°F (9.4°C)
1002	23°F (12.8°C)
1302	30°F (16.7°C)
1501	28°F (15.6°C)
1701	32°F (17.8°C)
2001	38°F (21.1°C)

1. The pump must run continuously when the burner is firing.
2. With the pump running and the burner in the water heater in the off cycle, the inlet water temperature and outlet water temperature readings on the Operator Interface should read approximately the same temperatures. Water Temperature Rise on the Operator Interface should read near zero.
3. Turn the water heater on and allow time for the temperature to stabilize. The Service Mode can be used to force the water heater to run at full fire. See the Power-fin Service Manual for a detailed explanation of the Service Mode. Check the water temperature rise in the Operator Interface when the burner is firing at 100% of rated input.
4. Compare the water temperature rise in the Operator Interface with the required temperature rise. Should adjustment be needed, proceed as follows.

9 Domestic water heaters

If the temperature rise is too high, the water velocity is too low, adjust as follows:

1. Check for restrictions in the outlet of the water heater.
2. Be sure all valves are open between the water heater and the storage tank. Ensure that all ball valves are fully ported.
3. Check the pump to be sure it is running properly and that the pump motor is running in the proper direction.
4. Check diameter and length of the piping between the storage tank and water heater against the head capacity of the circulating pump.
5. Be sure the pipes between the water heater and storage tank are not less than 2 1/2 inch (63.5mm) diameter. To increase flow and decrease temperature rise, increase the piping to 3 inch (76.2mm) diameter to decrease head loss in the piping to the storage tank.
6. Common manifold piping for multiple unit installations will require larger minimum pipe sizes and tank circulating tappings to ensure proper flow.

If the temperature rise is too low, the water velocity is too high, adjust as follows:

1. Temperature rise can be increased by slowly closing the field-installed ball valve in the outlet piping from the water heater to the storage tank to achieve the proper temperature rise.
2. Sustained high water velocity and low temperature rise may result in pitting or erosion of the copper tubes in the heat exchanger. This is a non-warrantable failure. Temperature rise must be properly adjusted to achieve the specified flow rate.
3. Once temperature rise has been properly set, return to normal operation.

CAUTION

Temperature rise cannot be adjusted when the burner is firing at less than 100% of rated input.

Water chemistry

NOTICE

Water temperature rise and maximum flow data is based on heating potable water with a hardness of 5 to 20 grains per gallon and total dissolved solids not exceeding 350 ppm.

The required temperature rise and the standard circulating pump are sized based on the heating of potable water with a hardness of 5 to 20 grains per gallon and a total dissolved solids not exceeding 350 ppm. Consult the manufacturer when heating potable water exceeding these specifications. Heating of high hardness and/or high total dissolved solids water may require a larger circulating pump, an optional Cupro Nickel heat exchanger and a revised temperature rise specification based on the water chemistry of the water to be heated. Water with a hardness of less than 5 grains per gallon will usually have a pH which can be aggressive and corrosive causing non-warrantable damage to the heater, pump, and associated piping. Corrosion due to water chemistry generally shows up first in the hot water system because heated water increases the rate of corrosive chemical reactions.

NOTICE

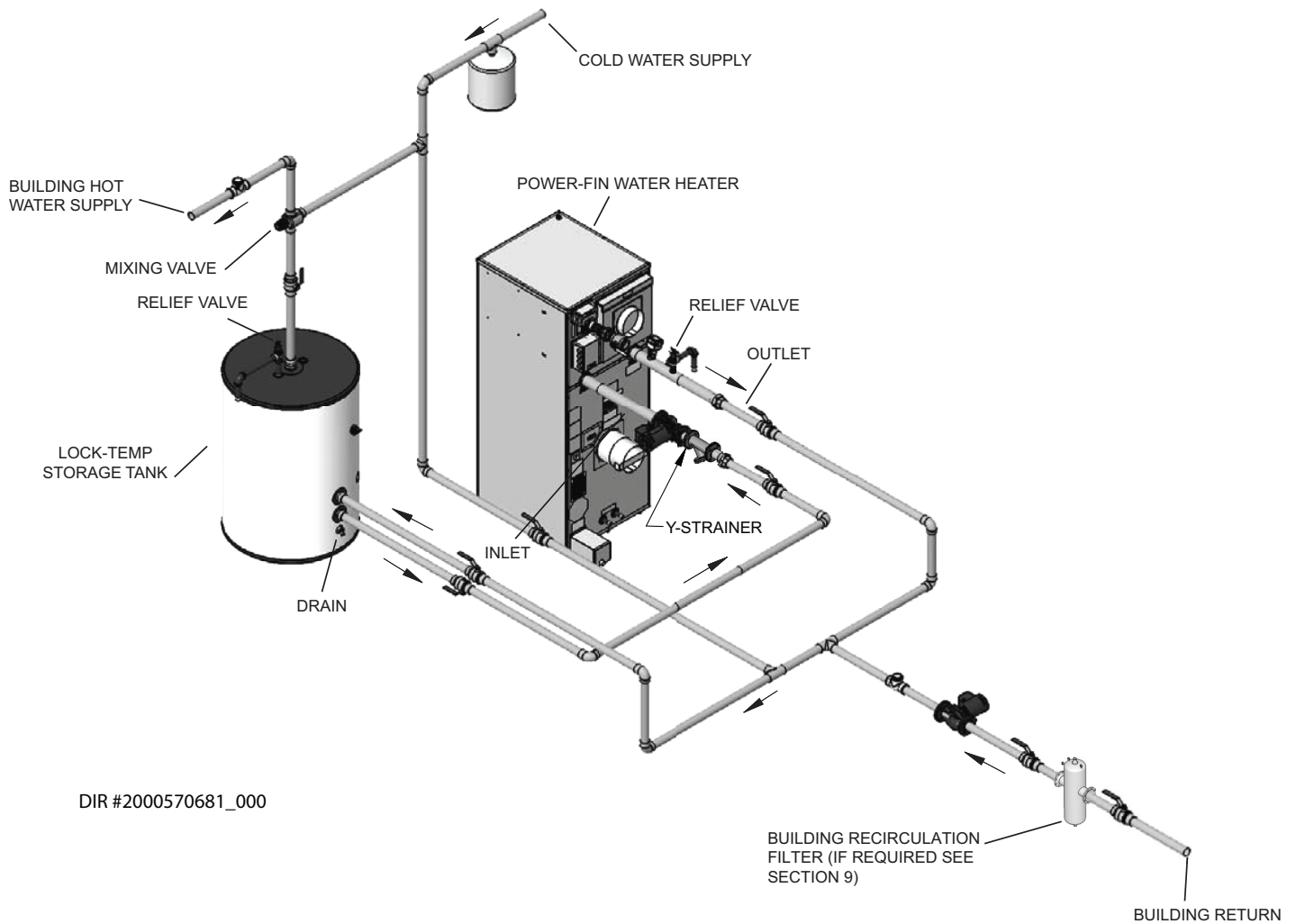
1. Do not use the appliance to directly heat swimming pool or spa water.
2. At initial fill and during water heater start-up and testing, check system thoroughly for any leaks. Repair all leaks before proceeding further.
3. When water hardness levels are less than 5 gpg or 85.5 mg/l, the following is recommended:
 - a. Flush and clean existing water heating system prior to installation.
 - b. Inspect and, if necessary, replace the anodes in any existing tanks.
 - c. Install a Y-strainer on the inlet of each water heater as detailed in this section.
 - d. Limit the run time of the hot water recirculation loop.
 - e. Filter the hot water recirculation loop to a level of 10 microns. CAUTION: Check recirculation pump size to verify it is sized for filter addition and upsize if necessary.
4. When water softener is required, a Template Assisted Crystallization system is recommended.

9 Domestic water heaters *(continued)*

Figure 9-1_Typical Water Heater Piping with Storage Tank

COMMON MANIFOLD SIZE (Min.) Models: 502, 752, 1002, & 1302		
Number of Units	GPM	Diameter (in.)
1	75	2 1/2

COMMON MANIFOLD SIZE (Min.) Models: 1501, 1701, & 2001		
Number of Units	GPM	Diameter (in.)
1	90	2 1/2



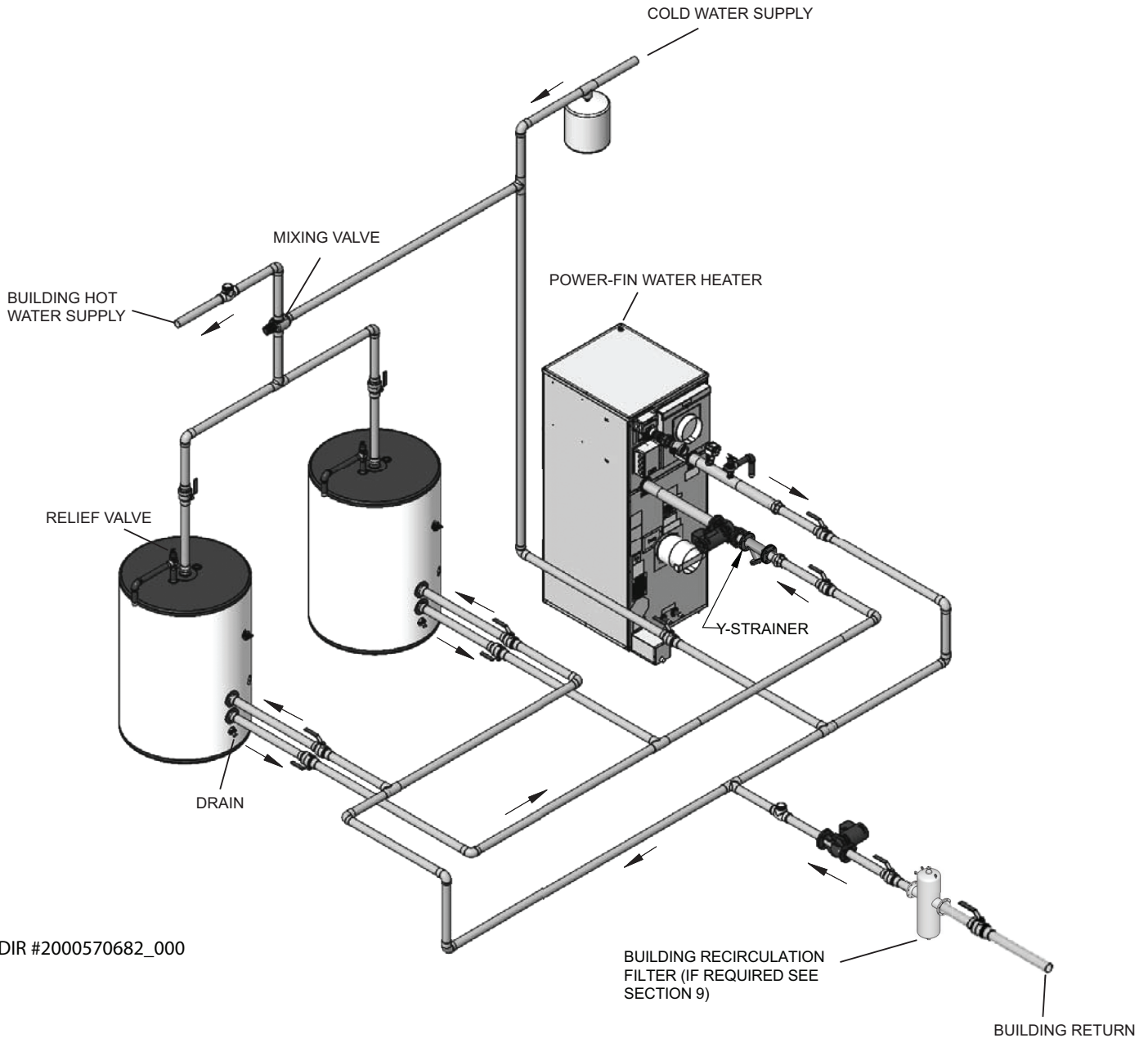
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9 Domestic water heaters

Figure 9-2_Single Water Heater Piping with Two Storage Tanks

COMMON MANIFOLD SIZE (Min.) Models: 502, 752, 1002, & 1302		
Number of Units	GPM	Diameter (in.)
1	75	2 1/2

COMMON MANIFOLD SIZE (Min.) Models: 1501, 1701, & 2001		
Number of Units	GPM	Diameter (in.)
1	90	2 1/2



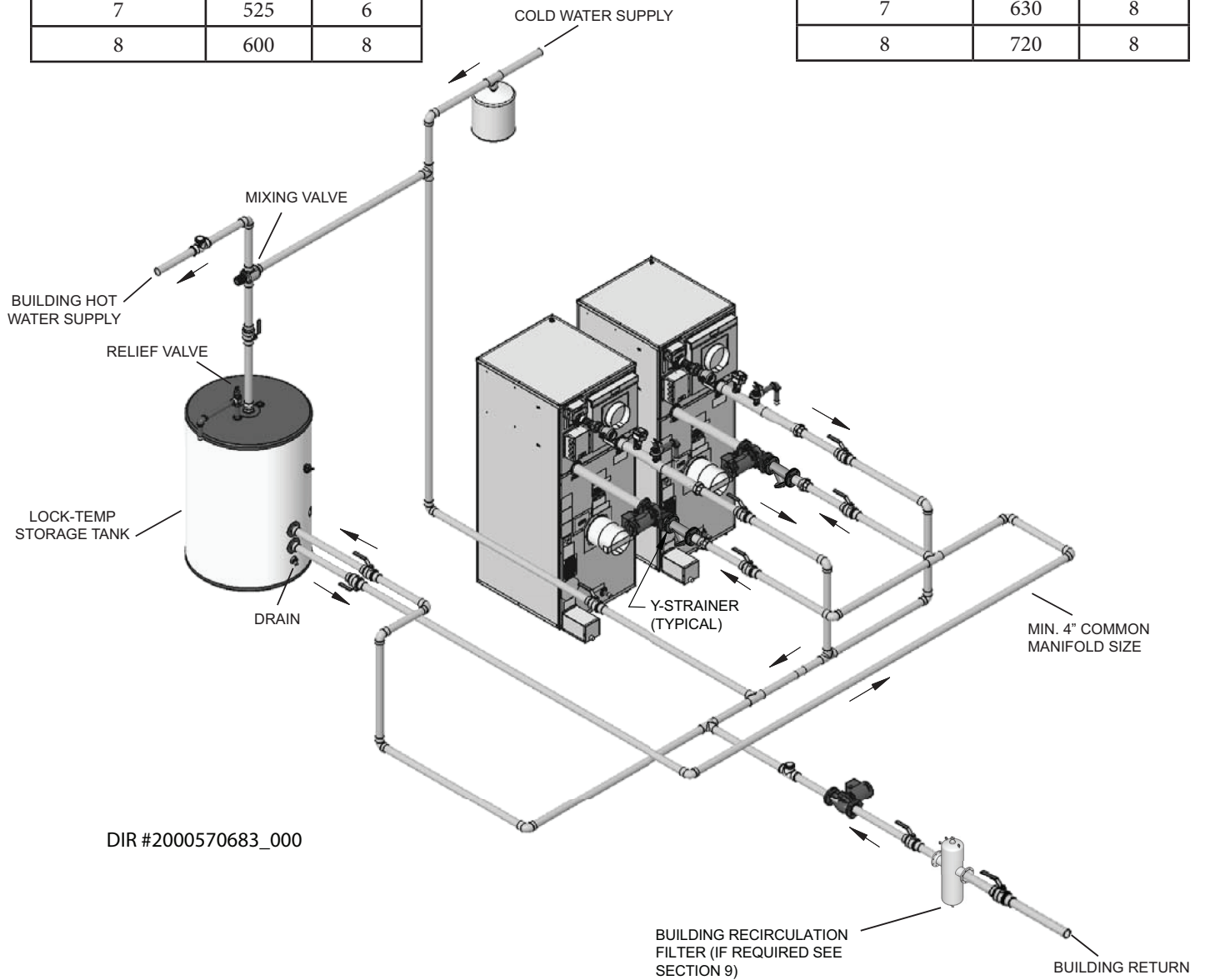
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9 Domestic water heaters *(continued)*

Figure 9-3_Multiple Water Heater Piping with a Single Storage Tank

COMMON MANIFOLD SIZE (Min.) Models: 502, 752, 1002, & 1302		
Number of Units	GPM	Diameter (in.)
2	150	3 1/2
3	225	4
4	300	5
5	375	6
6	450	6
7	525	6
8	600	8

COMMON MANIFOLD SIZE (Min.) Models: 1501, 1701, & 2001		
Number of Units	GPM	Diameter (in.)
2	180	4
3	270	5
4	360	6
5	450	6
6	540	6
7	630	8
8	720	8



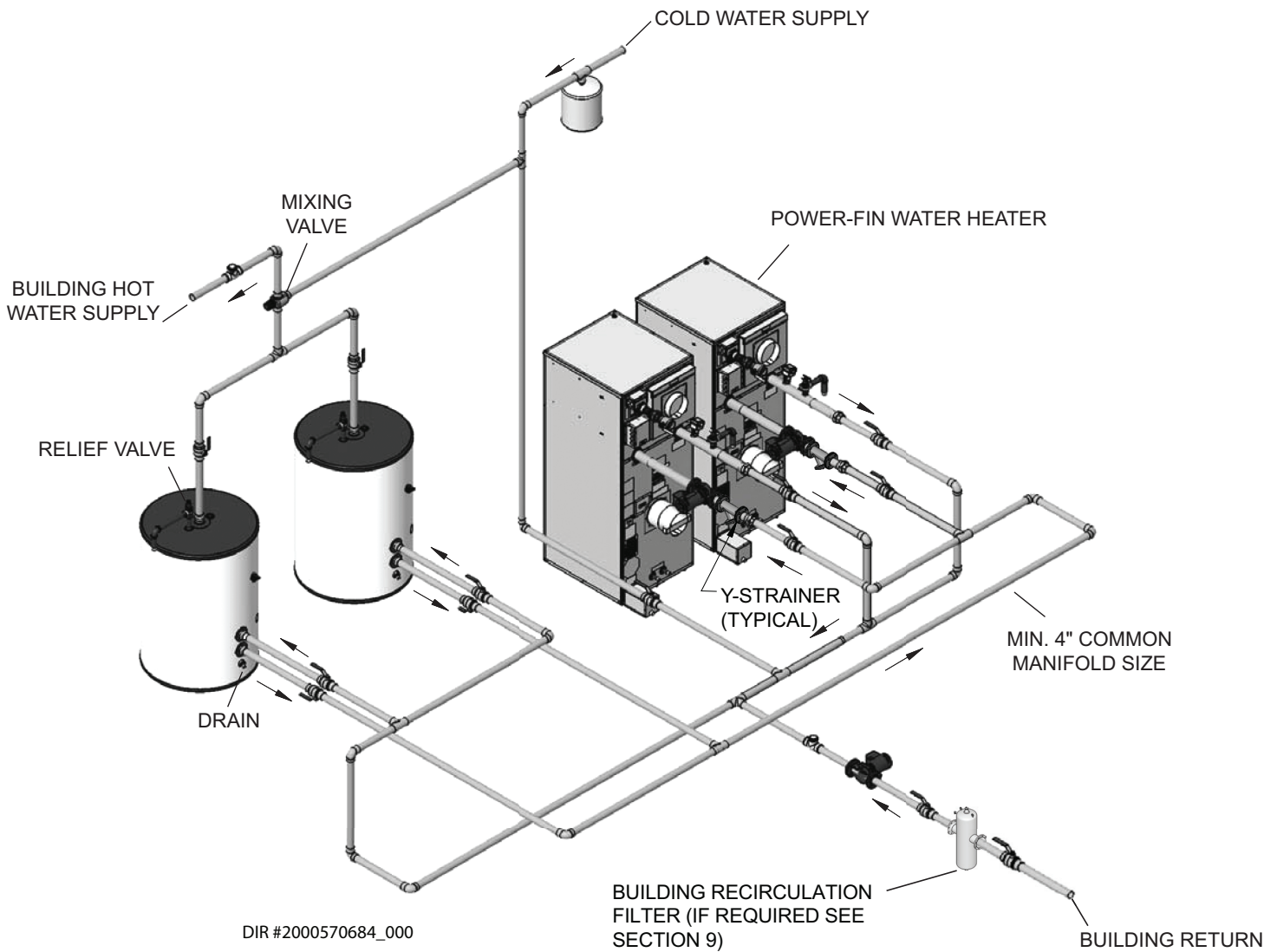
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9 Domestic water heaters

Figure 9-4 Multiple Water Heater Piping with Multiple Storage Tanks

COMMON MANIFOLD SIZE (Min.) Models: 502, 752, 1002, & 1302		
Number of Units	GPM	Diameter (in.)
2	150	3 1/2
3	225	4
4	300	5
5	375	6
6	450	6
7	525	6
8	600	8

COMMON MANIFOLD SIZE (Min.) Models: 1501, 1701, & 2001		
Number of Units	GPM	Diameter (in.)
2	180	4
3	270	5
4	360	6
5	450	6
6	540	6
7	630	8
8	720	8



9 Domestic water heaters *(continued)*

TABLE 9C COMMON WATER MANIFOLD SIZE FOR MULTIPLE WATER HEATER INSTALLATIONS		
Pipe sizing chart provides minimum pipe size for common manifold piping to ensure adequate flow.		
Number of Water Heaters	Common Manifold Size (Min.) Models	
	502 - 1302	1501 - 2001
1	2 1/2"	2 1/2"
2	3 1/2"	4"
3	4"	5"
4	5"	6"
5	6"	6"
6	6"	6"
7	6"	8"
8	8"	8"

Pump operation

1. The water heater must have a properly sized circulating pump. This pump is sized to circulate water between the heater and the storage tank only.
2. The pump is sized to the heater input and water chemistry specifications noted in the *Water Chemistry* section on page 70.
3. The diameter and length of the piping installed between the storage tank(s) and water heater must be properly sized based on the capacity of the circulating pump.
4. The pump must run continuously when the water heater is energized. This is the standard operating system for a water heater.

An intermittent pump control function with an all bronze pump is installed as standard equipment on all water heater systems. The pump will operate only while there is a "Call for Heat" and for a timed period after the water temperature set point is satisfied to remove any residual heat from the combustion chamber.

5. Lubricate pump to manufacturer's recommendations. Pump damage due to inadequate lubrication is non-warrantable.

The tank sensor must be installed in the tapping provided in the lower 25% of the storage tank to achieve proper operation. As shipped from the factory, the tank sensor is in the literature package shipped with the unit. Placing the sensor in the tapping provided on the storage tank will improve temperature response and prevent short cycles of operation.

The standard circulating pump on this water heater is sized based on installation of a single storage tank and heater in close proximity. If the number of fittings and straight pipe exceeds the specified maximum equivalent number of straight feet for a specified diameter of pipe, non-warrantable operational problems may be experienced.

500,001 - 1,300,000 Btu/hr Models
1/2 HP, 120 VAC, 9.8 Amps

1,500,000 - 2,000,000 Btu/hr Models
3/4 HP, 120 VAC, 8.8 Amp

The standard pump selection is based on the following pipe and fittings from the water heater to the storage tank:

6 - 90° elbows 2 - ball valves
2 - unions 1 - cold water tee

Not more than 45 feet of straight pipe.

For every elbow and tee in excess of those shown above, DEDUCT 6.5 FEET from the maximum allowable straight pipe in the heater to tank circulating loop.

TABLE 9D WATER HEATER PUMP APPLICATIONS						
Model	Pipe Size	Water Hardness	Pump	Flow Rate (GPM)	Head Loss (FT)	Temp. Rise
502	2-1/2"	5 to 15 gpg	Armstrong 114109-957	75	15	11°F
		15 to 20 gpg	Grundfos TP 50-160/2B	95	15	9°F
752	2-1/2"	5 to 15 gpg	Armstrong 114109-957	75	15	17°F
		15 to 20 gpg	Grundfos TP 50-160/2B	95	15	14°F
1002	2-1/2"	5 to 15 gpg	Armstrong 114109-957	75	15	23°F
		15 to 20 gpg	Grundfos TP 50-160/2B	95	15	18°F
1302	2-1/2"	5 to 15 gpg	Armstrong 114109-957	75	15	30°F
		15 to 20 gpg	Grundfos TP 50-160/2B	95	15	24°F
1501	2-1/2"	5 to 15 gpg	Grundfos TP77PAB	90	15	28°F
		15 to 20 gpg	Grundfos TP 50-160/2B	115	15	22°F
1701	2-1/2"	5 to 15 gpg	Grundfos - TP77PAB	90	15	32°F
		15 to 20 gpg	Grundfos TP 50-160/2B	115	15	25°F
2001	2-1/2"	5 to 15 gpg	Grundfos TP77PAB	90	15	38°F
		15 to 20 gpg	Grundfos TP 50-160/2B	115	15	29°F

When installing multiple water heaters and/or multiple storage tanks, the diameter of the inter-connecting pipe and all fittings must be increased. An increase in pipe diameter will decrease head loss in the system piping and ensure proper flow. Proper pipe size between the heater and storage tank **MUST** be maintained to ensure that the standard pump supplied on the water heater will maintain desired flow.

Heat exchanger

On all models, header inspection plugs in the heat exchanger can be removed for field inspection and cleaning of copper tubes. The heat exchanger may be removed from the unit.

9 Domestic water heaters

Thermostat adjustment procedure

During normal operation, set point temperatures can be adjusted from the Home Screen by pressing the DETAILS button on the bottom of the screen (see FIG. 7-3 on page 60).

1. To change a set point, use the set point slider feature or the PLUS (+) and MINUS (-) buttons to adjust the set points as shown in FIG. 7-3.
2. Once the set point has been adjusted to the desired setting, press the SAVE button to save changes to the set point and return to the Home Screen.

Note: The SAVE button must be pressed to ensure proper programming of the controls. Failure to press the SAVE button will require all changes to be reprogrammed.

Minimum water temperatures (domestic hot water use)

Domestic water temperatures:

This high efficiency water heater should be operated at a temperature setting high enough to prevent condensing of the products of combustion on the unit's heat exchanger or in the attached venting system. Use extreme caution when storing water at elevated temperatures. A water temperature setting maintained above the dew point of the products of gas combustion should prevent condensate formation and ensure proper performance of the venting system. The manufacturer recommends the use of a properly sized thermostatic mixing valve to supply domestic hot water at temperatures less than 140°F (60°C). Storing the water at a higher temperature and thermostatically mixing the water will increase the available quantity of mixed hot water, greatly reducing the possibility of condensate formation on the heat exchanger or in the venting system and help prevent the growth of water borne bacteria.

NOTICE

Adequate care **MUST** be taken to prevent a potential scald injury when storing water at elevated temperatures for domestic use.

Inlet water temperatures below the specified minimum recommendations can excessively cool the products of combustion resulting in condensation on the heat exchanger. Condensation on the heat exchanger can cause operational problems, bad combustion, sooting, flue gas spillage and reduced service life of the related components.

CAUTION

An appliance allowed to operate at return temperatures below the specified minimum setting may experience problems with the operating controls, safety switches, obstruction of the flue gas passages on the heat exchanger, incomplete combustion, and possible flue gas spillage. Sustained operation at lower than specified water temperatures may cause hazardous conditions that may result in personal injury or non-warrantable damage to the appliance.

The maximum temperature set point that can be programmed into the control module from the Operator Interface for water heater operation is 190°F (88°C). The control is factory pre-set at approximately 120°F (49°C). Facilities with small children or invalids may require 120°F (49°C) or a lower temperature setting to reduce risk of scald injury. Some states may require a lower temperature setting. Check with your gas supplier for local requirements governing the temperature setting. Remember, no water heating system will provide exact temperature at all times. Allow a few days of operation at this setting to determine the correct temperature setting consistent with your needs.

NOTICE

1. This water heater, when set at the lower temperature setting, is not capable of producing hot water of sufficient temperature for sanitizing purposes.
2. Higher stored water temperature increases the ability of the water heater to supply desired quantities of hot water, however remember --

CAUTION

Hotter water increases the risk of scald injury.

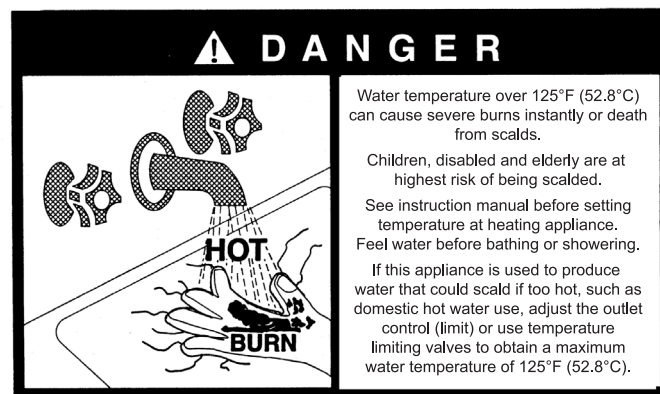


Figure 9-5_Danger Warning

9 Domestic water heaters *(continued)*

The following chart (Table 9E) details the relationship of water temperature and time with regard to scald injury and may be used as a guide in determining the safest water temperature for your applications.

120°F	More than 5 minutes
125°F	1 1/2 to 2 minutes
130°F	About 30 seconds
135°F	About 10 seconds
140°F	Less than 5 seconds
145°F	Less than 3 seconds
150°F	About 1 1/2 seconds
155°F	About 1 second

CAUTION Setting the temperature selector to higher settings provides hotter water, which increases the risk of scald injury.

Location of Cold Water Supply Piping Connections

Incorrect piping of the cold water supply to the system may result in excessive low temperature operation causing condensate formation on the primary heat exchanger and operational problems. The cold water supply piping must be installed in the discharge piping from the heater to the storage tank. This allows the cold water to be tempered in the storage tank before entering the heater. See typical installation drawings provided in this manual for correct piping (FIG.'s 9-1 thru 9-4). Higher water temperatures reduce the volume of condensate formed.

WARNING Should overheating occur or the gas supply fail to shut off, do not turn off or disconnect the electrical supply to the pump. Instead, shut off the gas supply at a location external to the appliance.

Adjustable high water temperature limit control

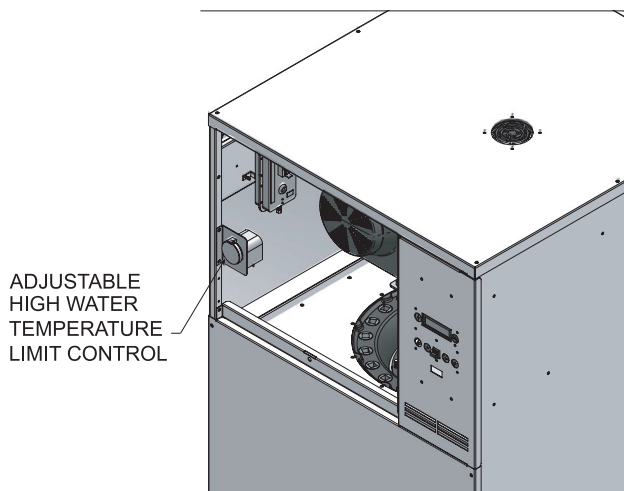


Figure 9-6_Adjustable High Water Temperature Limit Control

A high limit control is located on the inside of the left front panel, as shown in FIG. 9-6. The setting of this control knob limits maximum discharge water temperature. The water heater temperature limit control is adjustable up to a maximum setting of 210°F (99°C). This water heater also includes a fixed high water temperature limit control set to 200° (93.3°C). The RESET key on the display must be pushed whenever water temperature has exceeded the set point of the limit. The temperature of the water in the heat exchanger must drop a minimum of 15°F (8.3°C) below the setting of the high limit control before the reset function can be activated. A high limit message will be shown in the Operator Interface when water temperature exceeds the high water temperature limit control set point.

NOTICE

The high limit control will not reset until the water temperature has dropped below the set point of the high limit.

Optional relief valve

This water heater is normally supplied with a temperature and pressure relief valve sized in accordance with applicable codes. Units may be supplied with an optional pressure only relief valve. When a water heater is equipped with this optional relief valve and is piped to a separate storage vessel, the storage vessel must have a properly installed temperature and pressure relief valve which complies with local codes.

Thermal expansion

A relief valve that discharges periodically may be due to thermal expansion in a closed system. A water heater installed in a closed system, such as one with a backflow preventer or check valve installed in the cold water supply, shall be provided with means to control expansion. Contact the water supplier or local plumbing inspector on how to correct this situation. Do not plug or cap the relief valve discharge.

Cathodic protection

Hydrogen gas can be produced in a hot water system that has not been used for a long period of time (generally two weeks or more). Hydrogen gas is extremely flammable. To prevent the possibility of injury under these conditions, we recommend the hot water faucet be open for several minutes at the kitchen sink before you use any electrical appliance which is connected to the hot water system. If hydrogen is present, there will be an unusual sound such as air escaping through the pipe as the hot water begins to flow. There should be no smoking or open flames near the faucet at the time it is open.

10 Maintenance

Maintenance and annual start-up

Table 10A_Service and Maintenance Schedules

Service technician (see the following pages for instructions)		Owner maintenance (see the Power-fin User's Information Manual for instructions)	
ANNUAL START-UP	General:	Daily	<ul style="list-style-type: none"> • Check boiler area • Check pressure/temperature gauge
	<ul style="list-style-type: none"> • Address reported problems, if any • Inspect interior; clean and vacuum if necessary; • Clean condensate trap and fill with fresh water • Check for leaks (water, gas, flue, condensate) • Verify flue and air lines in good condition and sealed tight • Check system water pressure/system piping/expansion tank • Check fill water meter • Test boiler water. When test indicates, clean system water with approved system restorer following manufacturer's information. • Check control settings • Check the ignition and both flame sense electrodes (sand off any deposits; clean and reposition) • Check wiring and connections • Perform start-up checkout and performance verification per Section 7. • Flame inspection (stable, uniform) • Check both flame signals (at least 10 microamps at high fire) • Clean the heat exchanger • Test low water cutoff (reference the Power-fin Service Manual). 	Monthly	<ul style="list-style-type: none"> • Check vent piping • Check air piping • Check air and vent termination screens • Check relief valve • Check condensate drain system • Check building recirculation filter (if filter required)
	<p>If combustion or performance indicate need:</p> <ul style="list-style-type: none"> • Clean heat exchanger • Remove and clean burner using compressed air only • Clean the blower wheels 	Every 6 months	<ul style="list-style-type: none"> • Test low water cutoff • Reset button (low water cutoff) • Check boiler piping (gas and water) for leaks • Operate relief valve
		End of season months	<ul style="list-style-type: none"> • Shut boiler down (unless boiler used for domestic hot water)

10 Maintenance *(continued)*



WARNING

Follow the service and maintenance procedures given throughout this manual and in component literature shipped with the appliance. Failure to perform the service and maintenance could result in damage to the appliance or system. Failure to follow the directions in this manual and component literature could result in severe personal injury, death, or substantial property damage.



WARNING

The appliance should be inspected annually only by a qualified service technician. In addition, the maintenance and care of the appliance designated in Table 10A and explained on the following pages must be performed to assure maximum appliance efficiency and reliability. Failure to service and maintain the appliance and system could result in equipment failure.



WARNING

Electrical shock hazard – Turn off power to the appliance before any service operation on the appliance except as noted otherwise in this instruction manual. Failure to turn off electrical power could result in electrical shock, causing severe personal injury or death.

Address reported problems

1. Inspect any problems reported by the owner and correct before proceeding.

Inspect boiler area

1. Verify that boiler area is free of any combustible materials, gasoline and other flammable vapors and liquids.
2. Verify that air intake area is free of any of the contaminants listed in Section 1 of this manual. If any of these are present in the boiler intake air vicinity, they must be removed. If they cannot be removed, reinstall the air and vent lines per this manual.

Inspect boiler interior

1. Remove the front access covers and inspect the interior of the boiler.
2. Vacuum any sediment from inside the boiler and components. Remove any obstructions.

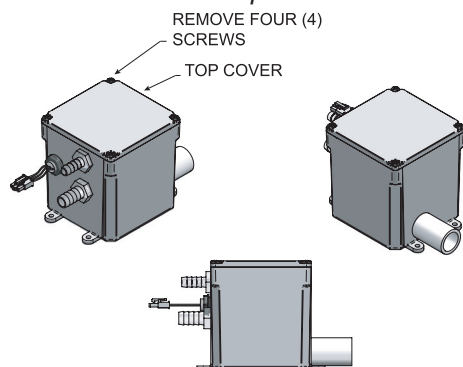
Clean condensate trap

1. Inspect the condensate drain line, vent line, condensate PVC fittings, and condensate trap.

Flush condensate trap with water

1. Remove the four (4) screws securing the top cover to the condensate trap and remove the cover (FIG. 10-1).
2. Locate the plastic ball inside the float tube. Verify there is nothing under the ball causing it to not seat properly.
3. Replace the top cover and the screws removed in Step 1.

Figure 10-1 Condensate Trap



Check all piping for leaks



WARNING

Eliminate all system or boiler leaks. Continual fresh makeup water will reduce boiler life. Minerals can build up, reducing heat transfer, overheating heat exchanger, and causing heat exchanger failure. Leaking water may also cause severe property damage.

1. Inspect all water and gas piping and verify to be leak free.
2. Look for signs of leaking lines and correct any problems found.
3. Check gas line using the procedure found in Section 4 - *Gas Connections*.

Flue vent system and air piping

1. Visually inspect the entire flue gas venting system and air piping for blockage, deterioration or leakage. Repair any joints that show signs of leakage. Verify that air inlet pipe is connected and properly sealed.
2. Verify that boiler vent discharge and air intake are clean and free of obstructions.



WARNING

Failure to inspect for the above conditions and have them repaired can result in severe personal injury or death.

Check water system

1. Verify all system components are correctly installed and operational.
2. Check the cold fill pressure for the system. Verify it is correct (must be a minimum of 12 psi (82.7 kPa)).
3. Watch the system pressure as the boiler heats up (during testing) to ensure pressure does not rise too high. Excessive pressure rise indicates expansion tank sizing or performance problem.
4. Inspect automatic air vents and air separators. Remove air vent caps and briefly press push valve to flush vent. Replace caps. Make sure vents do not leak. Replace any leaking vents.

10 Maintenance

Check expansion tank

1. Expansion tanks provide space for water to move in and out as the heating system water expands due to temperature increase or contracts as the water cools. Tanks may be open, closed or diaphragm or bladder type. See Section 3 - *Water Connections* for suggested best location of expansion tanks and air eliminators.

Check fill water meter

1. Check fill water meter for water usage. If the amount exceeds 5% of your system volume, you could have a leak. Have the system checked for leaks and fixed by a qualified service technician.

Test boiler water

1. Test boiler water. Reference the Power-Fin Installation and Operation Manual for guidelines. When test indicates, clean system water with approved system restorer following the manufacturer's information.

Check boiler relief valve

1. Inspect the relief valve and lift the lever to verify flow. Before operating any relief valve, ensure that it is piped with its discharge in a safe area to avoid severe scald potential. Read Section 3 - *Water Connections* before proceeding further.



WARNING Safety relief valves should be re-inspected **AT LEAST ONCE EVERY THREE YEARS**, by a licensed plumbing contractor or authorized inspection agency, to ensure that the product has not been affected by corrosive water conditions and to ensure that the valve and discharge line have not been altered or tampered with illegally. Certain naturally occurring conditions may corrode the valve or its components over time, rendering the valve inoperative. Such conditions are not detectable unless the valve and its components are physically removed and inspected. This inspection must only be conducted by a plumbing contractor or authorized inspection agency – not by the owner. Failure to re-inspect the boiler relief valve as directed could result in unsafe pressure buildup, which can result in severe personal injury, death, or substantial property damage.



WARNING Following installation, the valve lever must be operated **AT LEAST ONCE A YEAR** to ensure that waterways are clear. Certain naturally occurring mineral deposits may adhere to the valve, rendering it inoperative. When manually operating the lever, water will discharge and precautions must be taken to avoid contact with hot water and to avoid water damage. Before operating lever, check to see that a discharge line is connected to this valve directing the flow of hot water from the valve to a proper place of disposal. Otherwise severe personal injury may result. If no water flows, valve is inoperative. Shut down the boiler until a new relief valve has been installed.

2. After following the above warning directions, if the relief valve weeps or will not seat properly, replace the relief valve. Ensure that the reason for relief valve weeping is the valve and not over-pressurization of the system due to expansion tank waterlogging or undersizing.

Inspect ignition and flame sense electrode

1. Remove the ignition and flame sense electrode from the burner plate.
2. Remove any deposits accumulated on the ignition/flame sense electrode using sandpaper. If the electrode cannot be cleaned satisfactorily, replace with a new one.
3. Replace ignition/flame sense electrode, making sure the gasket(s) is in good condition and correctly positioned.

Check ignition ground wiring

1. Inspect boiler ground wire from the heat exchanger access cover to ground terminal strip.
2. Verify all wiring is in good condition and securely attached.
3. Check ground continuity of wiring using continuity meter.
4. Replace ground wires if ground continuity is not satisfactory.

Check all boiler wiring

1. Inspect all boiler wiring, making sure wires are in good condition and securely attached.

Check control settings

1. Navigate to the Setup Screen and check all settings. See Section 1 of the Power-fin Service Manual. Adjust settings if necessary. See Section 1 of the Power-fin Service Manual for adjustment procedures.
2. Check settings of external limit controls (if any) and adjust if necessary.

Perform start-up and checks

1. Start boiler and perform checks and tests specified in Section 7 - *Start-up*.
2. Verify cold fill pressure is correct and that operating pressure does not go too high.

10 Maintenance *(continued)*

Check all wiring

1. Inspect all wiring, making sure wires are in good condition and securely attached.

Check control settings

1. Set the SMART TOUCH control module display to Parameter Mode and check all settings. See *Section 1* of the Power-fin Service Manual. Adjust settings if necessary. See *Section 1* of the Power-fin Service Manual for adjustment procedures.
2. Check settings of external limit controls (if any) and adjust if necessary.

Perform start-up and checks

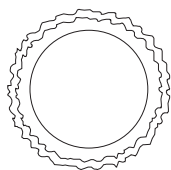
1. Start appliance and perform checks and tests specified in *Section 7 - Start-up*.
2. Verify cold fill pressure is correct and that operating pressure does not go too high.

Check burner flame

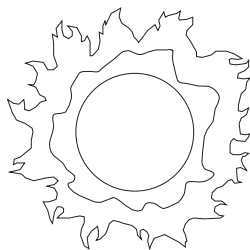
Visually check main burner flames at each start-up after long shutdown periods or at least every six months. A burner viewport is located on the burner mounting flange.

WARNING The area around the burner viewport is hot and direct contact could result in burns.

Figure 10-2_Flame Pattern Illustration



NORMAL BURNER FLAME



ABNORMAL BURNER FLAME

Normal Flame: A normal flame at 100% of burner input is blue, with slight yellow tips, a well defined flame and no flame lifting.

Yellow Tip: Yellow tipping can be caused by blockage or partial obstruction of air flow to the burner.

Yellow Flames: Yellow flames can be caused by blockage of primary air flow to the burner or excessive gas input. This condition **MUST** be corrected immediately.

Lifting Flames: Lifting flames can be caused by over firing the burner, excessive primary air or high draft.

If improper flame is observed, examine the venting system, ensure proper gas supply and adequate supply of combustion and ventilation air.

Check flue gas passageways

Any sign of soot around the inner jacket, outer jacket, flue pipe connections, burner or in the areas between the fins on the copper heat exchanger indicates a need for cleaning. The following cleaning procedure must only be performed by a qualified serviceman or installer. Proper service is required to maintain safe operation. Properly installed and adjusted units seldom need flue cleaning.

NOTICE

All gaskets/sealants on disassembled components or jacket panels must be replaced with new gaskets/sealants on reassembly. Gasket and sealant kits are available from your distributor.

CAUTION

When a Category IV vent system is disconnected for any reason, the flue must be reassembled and resealed according to the vent manufacturer's instructions.

10 Maintenance

Inspect and clean burner

The burner should be removed for inspection and cleaned on an annual basis. An appliance installed in a dust or dirt contaminated environment may require cleaning of the burner on a 3 to 6 month schedule or more often, based on severity of the contamination. The fan assisted combustion process may force airborne dust and dirt contaminants, contained in the combustion air, into the burner. With sustained operation, non-combustible contaminants may reduce burner port area, reduce burner input or cause non-warrantable damage to the burner.

Use extreme care when operating an appliance for temporary heat during new construction. Airborne contaminants such as dust, dirt, concrete dust or drywall dust can be drawn into the burner with the combustion air and block the burner port area. External combustion air filters are provided with the appliance. These filters help ensure clean air is used for the combustion process. Check filters every month and replace when necessary. The burner of an appliance used for temporary heat without combustion air filters installed will probably require a thorough cleaning before the unit is placed into normal service.

Access to the burner will require the following steps:

1. Turn off main electrical power to the appliance.
2. Turn off main manual gas shutoff to the appliance.
3. Remove the front outer control panel covers. Slide out the inner control panel to increase service clearances and carefully remove the multi-pin wiring connectors on the back of the control panel. Remove the screws along the front and rear edge of the top outer jacket panel to remove top. Remove the control panel to allow access to the components in the top of the appliance.
4. Remove the sensing tubes from the low air pressure switch to the combustion air blower.
5. Disconnect the wiring connections on the top of the combustion air blower.
6. Remove the six (6) hex head bolts attaching the gas/air venturi to the inlet of the combustion air blower.
7. Remove the four (4) nuts holding the combustion air blower to the top of the burner and remove the combustion air blower assembly.
8. Use care when removing the combustion air blower assembly to prevent damage to the venturi and burner gaskets.
9. Disconnect the power wires to the hot surface igniter.
10. Remove the hot surface igniter. The hot surface igniter is fragile. Use care to prevent impact damage to the silicone carbide igniter surface when removing the igniter.

11. Remove the eight (8) nuts holding the burner to the heat exchanger.
12. The burner can now be lifted vertically out of the heat exchanger chamber.
13. Use care when removing the burner to prevent damage to the woven burner port surface or gaskets on removal.
14. Remove any visible dust or dirt blockage from the surface of the burner with a vacuum. Compressed air may also be blown across the burner surface to clean the “pores” of the woven burner port material.
15. Reassemble in reverse order.

Inspect and clean the heat exchanger

1. Turn off all power to the appliance.
2. Turn off main gas to appliance.
3. Remove the front outer jacket panel.
4. Remove the front inner jacket panel (see FIG. 10-3).
5. Check the heat exchanger surface for soot. If soot is present, the heat exchanger must be cleaned and the problem corrected.
6. Remove the burner as described in the *Inspect and Clean Burner* section of this manual.
7. Check the “V” baffles on the heat exchanger. Remove and clean if necessary.
8. Remove soot from the heat exchanger with a stiff bristle brush. Use a vacuum to remove loose soot from surfaces and inner chamber.
9. The heat exchanger can be removed by disconnecting all water piping to the heat exchanger, removing the screws holding the heat exchanger to the top of the inner jacket and sliding the heat exchanger towards the front of the appliance. Once the heat exchanger is removed, a garden hose can be used to wash the tubes to ensure that all soot is removed from the heat exchanger surfaces. *Note: Do not wet the insulation blankets on the inside of the outer jacket panels.*
10. Ensure that any soot present on the burner is removed. See *Inspect and Clean Burner* section, this page.

10 Maintenance *(continued)*

11. Carefully reinstall the heat exchanger and “V” baffles if removed from the appliance.
12. Reinstall the inner jacket panel, burner, manifolds, wires, and hoses. Use new gasket material to ensure a proper air seal.
13. Reassemble all gas and water piping. Test for gas leaks.

NOTICE

Upon completion of any testing on the gas system, leak test all gas connections with a soap and water solution while main burners are operating. Do not spray soap and water solution on the SMART TOUCH control module housing. The use of an excessive amount of soap and water solution can damage the control. Immediately repair any leak found in the gas train or related components. Do not operate an appliance with a leak in the gas train, valves, or related piping.

14. Reassemble outer jacket panels.
15. Cycle unit and check for proper operation.

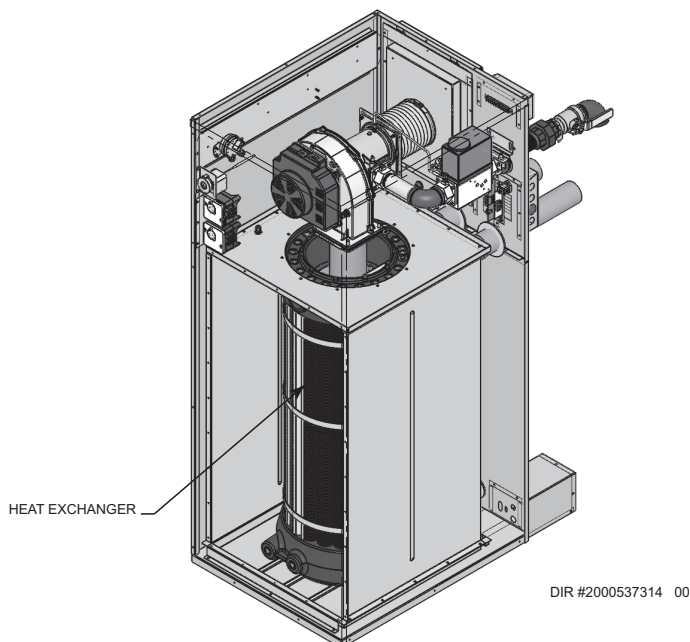
Review with owner

1. Review the Power-fin User's Information Manual with the owner.
2. Emphasize the need to perform the maintenance schedule specified in the Power-fin User's Information Manual (and in this manual as well).
3. Remind the owner of the need to call a licensed contractor should the appliance or system exhibit any unusual behavior.
4. Remind the owner to follow the proper shutdown procedure and to schedule an annual start-up at the beginning of the next heating season.

Oiled bearing circulators

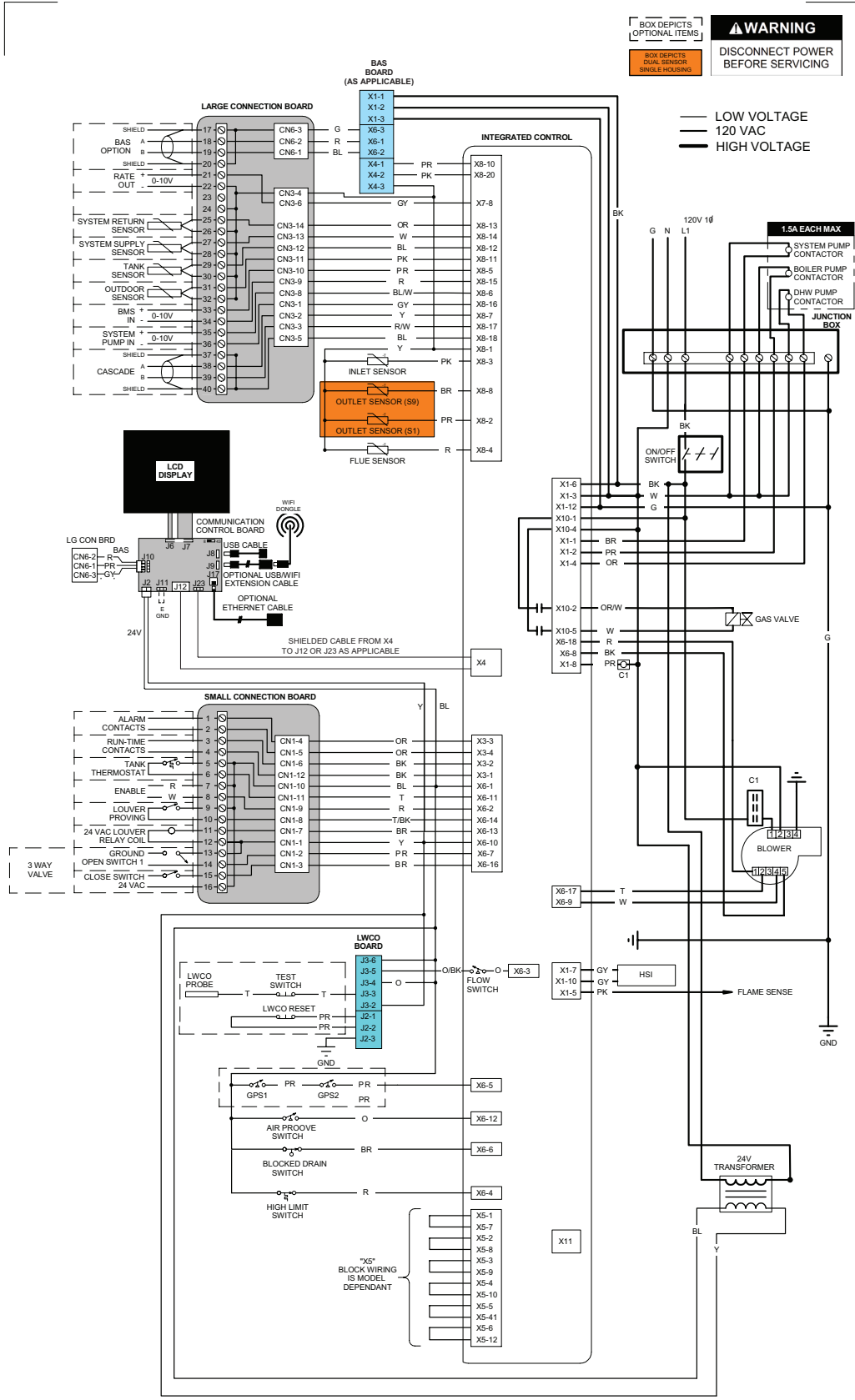
Inspect the pump every six (6) months and oil as necessary. Use SAE 30 non-detergent oil or lubricant specified by the pump manufacturer.

Figure 10-3 Location of the Heat Exchanger Inside Jacket



11 Diagrams

Figure 11-1 Wiring Diagram



BOX DEPICTS OPTIONAL ITEMS
BOX DEPICTS DUAL SENSOR SINGLE HOUSING

WARNING
DISCONNECT POWER BEFORE SERVICING

— LOW VOLTAGE
 — 120 VAC
 — HIGH VOLTAGE

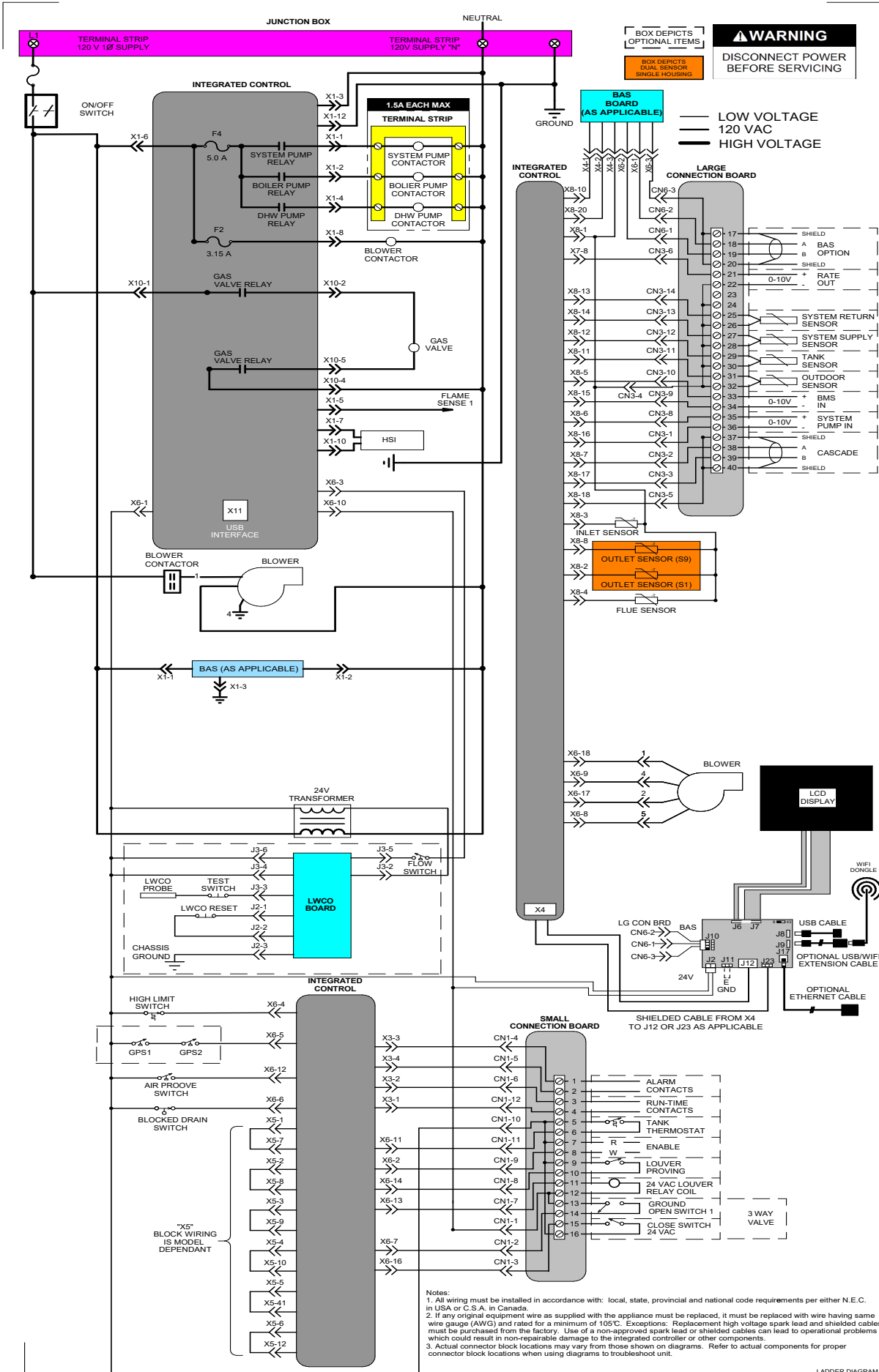
1.5A EACH MAX

Notes:
 1. All wiring must be installed in accordance with local, state, provincial and national code requirements per either N.E.C. in USA or C.S.A. in Canada.
 2. If any original equipment wire as supplied with the appliance must be replaced, it must be replaced with wire having same wire gauge (AWG) and rated for a minimum of 105°C. Exceptions: Replacement high voltage spark lead and shielded cables must be purchased from the factory. Use of a non-approved spark lead or shielded cables can lead to operational problems which could result in non-repairable damage to the integrated controller or other components.
 3. Actual connector block locations may vary from those shown on diagrams. Refer to actual components for proper connector block locations when using diagrams to troubleshoot unit.

WIRING DIAGRAM
 100279760 REV B

11 Diagrams (continued)

Figure 11-2 Ladder Diagram



Notes

Notes

Revision D (PCP# 300009248 / CN# 50009030) reflects limit changes on pages 64-65 of the Operating Information section.

Revision E (PCP# 300010217 / CN# 50009885) reflects an update to the pump motor size in number 3 under "Line Voltage Connections."

Revision F (PCP # 300022655 / CN # 500012544) reflects an update to the water chemistry and pump information on pages 3, 10, 38, 40-45, 55-56, 69-75, 78, and 80 along with the addition of the flue vs rain shield image and caution on page 18.

Revision G (PCP # 300021634 / CN # 500011858) reflects an update to the piping diagrams on pages 40-43 and 71-74.

Revision H (PCP #300024224 / CN #500014583) reflects an update to the ratings chart on page 8 as well as all of the piping diagrams.

Revision J (PCP #300028200 / CN #500017830) reflects an update to the user interface display screens as well as updates to the ladder and wiring diagrams.

Revision K (TLA #300029494 / CN #500018868) reflects the addition of the FasNSeal Notice on page 18.

Revision L (TLA #300030320 / CN #500019614) reflects an update to the text in Tables 3C and 9A.

Revision M (TLA #300030852 / CN #500020656) reflects an update to all of the piping diagrams, Table 10A, and the addition of the second Notice on page 70.

Revision N (TLA #300031557 / CN #500020650) reflects an update to Figure 5-4.

Revision P (TLA #300033465 / CN # 500022172) reflects edits made to the CAT II increaser and Amp Draw table.

Revision R (TLA #300034032 / CN #500022819) reflects an update to the ratings table and Table 3A.

Revision T (TLA #300034853 / CN #500023423) reflects the addition of the Notice on page 17.

Revision U (TLA #300035559 / CN #500024192) reflects an update to the Ratings Table.

Revision V (TLA #300039487 / CN #500027540) reflects an update to the water connections in the ratings table.

Revision W (TLA #300041765 / CN #500029717) reflects an update to FIG. 2-2 and Table 2B.

Revision X (TLA #300041734 / CN #500029765) reflects an update to the "Wiring of the Cascade" section, Figure 2-5, and the addition of Figure 2-6.

Revision Y (TLA #300044691 / CN #500032481) reflects a general update to 2021 water heater standards.

Revision AA (PCP #300047308 / CN #500035365) reflects the addition of Cat I masonry chimney language to Venting on page 33.

Revision AB (PCP #300053436 / CN #500040055) reflects an image update on page 6.

Revision AC (PCP #300054410 / CN #500041125) reflects an update to the warnings on page 10.

Revision AD (PCP #300055885 / CN #500042300) reflects an updated ladder diagram on page 85.

Revision Notes: Revision A (PCP #300005813 / CN #500005966) initial release.

Revision B (PCP# 300006581 / CN# 500006679) reflects an update to venting category information on pages 34-36.

Revision C (PCP# 300008544 / CN# 500008642) reflects an update to the PF 502 input to 500,001 on page 75 along with edits made to the piping diagrams on pages 71 - 74.