



Installation & Operation Manual

Models: 1250 - 4000

Series: 100 & 101

⚠ 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 nearby phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.
- Installation and service must be performed by a qualified installer, service agency, or the gas supplier.



⚠ WARNING

This manual must only be used by a qualified heating installer / service technician. Read all instructions, including this manual and the Armor Appliance Service Manual, before installing. 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 Armor Appliance Service Manual, before installing. Perform steps in the order given.

Have this appliance 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 appliance – Please have the appliance model and serial number from the appliance rating plate.

Consider piping and installation when determining appliance 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 nearby phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.
- Installation and service must be performed by a qualified installer, service agency, or the gas supplier.

WARNING

DO NOT install units in rooms or environments that contain corrosive contaminants (see Table 1A on page 10). 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 appliance can cause low level exposure to some of the substances listed in the Act.

When servicing the appliance –

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

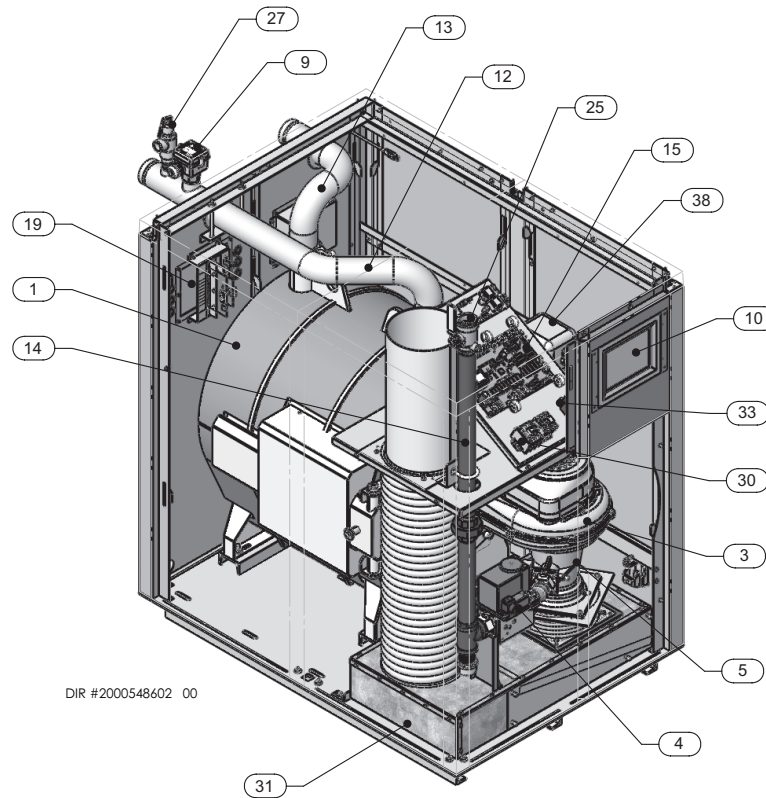
Appliance operation –

- Do not block flow of combustion or ventilation air to the appliance.
- 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 appliance 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.

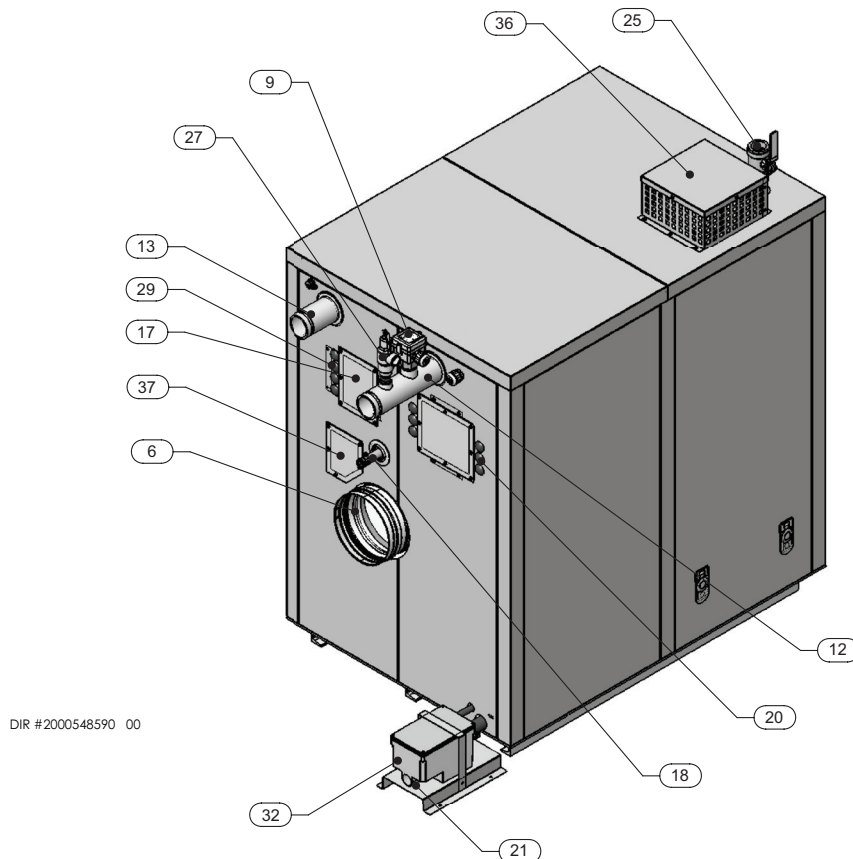
The Armor - How it works...

- 1. Stainless Steel Heat Exchanger**
Allows water to flow through specially designed coils for maximum heat transfer, while providing protection against flue gas corrosion. The coils are encased in a jacket that contains the combustion process.
- 2. Combustion Chamber Access Cover (not shown)**
Allows access to the combustion side of the heat exchanger coils.
- 3. Blower**
The blower pulls in air and gas through the venturi (item 5). Air and gas mix inside the blower and are pushed into the burner, where they burn inside the combustion chamber.
- 4. Gas Valve**
The gas valve senses the negative pressure created by the blower, allowing gas to flow only if the gas valve is powered and combustion air is flowing.
- 5. Venturi**
The venturi controls air and gas flow into the burner.
- 6. Flue Gas Sensor (limit rated, not shown)**
This sensor monitors the flue gas exit temperature. The control module will modulate and shut down the appliance if the flue gas temperature gets too hot. This protects the flue pipe from overheating.
- 7. Outlet Temperature Sensor (housed with the high limit sensor, not shown)**
This sensor monitors appliance outlet water temperature (tank supply). If selected as the controlling sensor, the control module adjusts appliance firing rate so the outlet temperature is correct.
- 8. Inlet Temperature Sensor (not shown)**
This sensor monitors return water temperature (tank return). If selected as the controlling sensor, the control module adjusts the appliance firing rate so the inlet temperature is correct.
- 9. 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.
- 10. Electronic LCD Display**
Digital controls with SMART TOUCH screen technology, full color display, and an 8" user interface screen.
- 11. Burner (not shown)**
Made with stainless steel construction, the burner uses pre-mixed air and gas and provides a wide range of firing rates.
- 12. Water Outlet**
Water connection that supplies hot water to the tank.
- 13. Water Inlet**
Water connection that returns water from the tank to the heat exchanger.
- 14. Gas Connection Pipe**
Threaded pipe connection. This pipe should be connected to the incoming gas supply for the purpose of delivering gas to the appliance.
- 15. SMART TOUCH Control Module**
The SMART TOUCH Control responds to internal and external signals and controls the blower, gas valve, and pumps to meet the demand.
- 16. Air Intake Adapter (not shown)**
Allows for the connection of the air intake pipe to the appliance.
- 17. High Voltage Junction Box**
The junction box contains the connection points for the line voltage power and the pump.
- 18. Appliance Drain Port**
Location from which the heat exchanger can be drained.
- 19. Low Voltage Connection Board**
The connection board is used to connect external low voltage devices.
- 20. Low Voltage Wiring Connections (knockouts)**
Conduit connection points for the low voltage connection board.
- 21. Condensate Drain Connection**
Connects the condensate drain line to a PVC pipe.
- 22. Access Cover - Front (not shown)**
Provides access to the gas train and the heat exchanger.
- 23. Ignition Electrode (not shown)**
Provides direct spark for igniting the burner.
- 24. Flame Inspection Window (not shown)**
The quartz glass window provides a view of the burner surface and flame.
- 25. Gas Shutoff Valve**
Manual valve used to isolate the gas valve from the gas supply.
- 26. High Limit Sensor (housed with the outlet temperature sensor, not shown)**
Device that monitors the outlet water temperature. If the temperature exceeds its setting, the integrated control will break the control circuit, shutting the appliance down.
- 27. Relief Valve**
Protects the heat exchanger from over pressure and temperature conditions. The standard relief valve is set at 150 PSI.
- 28. Flame Sensor (not shown)**
Used by the control module to detect the presence of burner flame.
- 29. Line Voltage Wiring Connections (Knockouts)**
Conduit connection points for the high voltage junction box.
- 30. Power Switch**
Turns power ON/OFF to the appliance.
- 31. Air Box**
The air shroud directs air and gas flow into the burner.
- 32. Condensate Trap**
The condensate trap is designed to prevent flue gases from escaping the appliance through the combustion chamber drain.
- 33. Transformer**
The transformer provides 24V power to the integrated control.
- 34. Low Gas Pressure Switch (not shown)**
Monitors gas supply pressure to the appliance and shuts the appliance down in the event a low gas pressure condition occurs.
- 35. High Gas Pressure Switch (not shown)**
Monitors gas supply pressure to the appliance and shuts the appliance down in the event a high gas pressure condition occurs.
- 36. Air Inlet Cover**
Used with room air for combustion and to prevent debris from entering the appliance.
- 37. Flue Sensor Access Panel**
Provides access to the flue temperature sensor.
- 38. Spark Transformer**
Provides high voltage power to the ignitor to ignite the gas/air mixture.

The Armor - How it works... (Continued)



Left Side (inside unit)



Rear View

Ratings

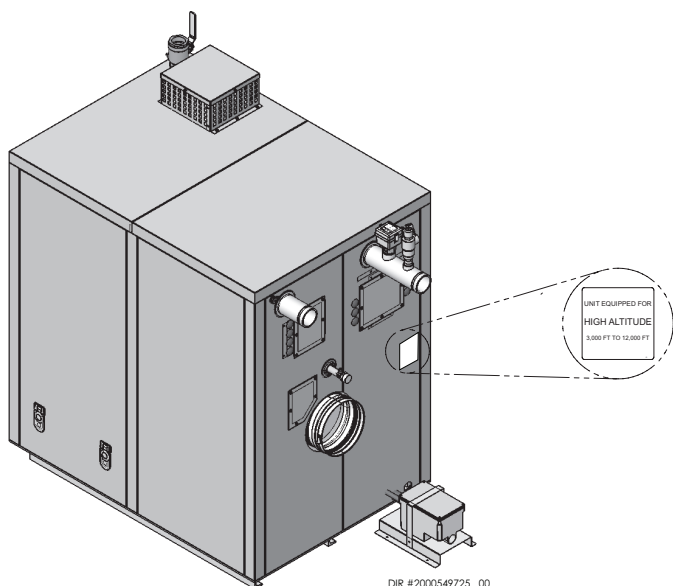


Model Number Note: Change "N" to "L" for L.P. gas models.	CSA Input Modulation Btu/hr	Water Content Gallons	Water Connections	Gas Connections	Vent/Air Size
	(Note 2, 3)				(See Note 1,5)
AWH1250N	250,000 - 1,250,000	11	2-1/2"	1-1/2"	8"/8"
AWH1500N	300,000 - 1,500,000	13	2-1/2"	1-1/2"	8"/8"
AWH2000N	400,000 - 2,000,000	17	2-1/2"	1-1/2"	8"/8"
AWH3000N	600,000 - 3,000,000	25	4"	2"	10"/10"
AWH4000N	800,000 - 4,000,000	41	4"	2-1/2"	12"/12"

NOTICE

Maximum allowed working pressure is located on the rating plate.

Figure A High Altitude Label Location



Notes:

1. Armor appliances require special gas venting. Use only the vent materials and methods specified in the Armor Installation and Operation Manual.

2. Standard Armor models are equipped for use up to 4,500 feet above sea level with no adjustments. The appliance will derate 4% for each 1,000 feet above sea level up to 4,500 feet.
3. High altitude Armor models are equipped for use from 3,000 to 12,000 feet above sea level with the following derates.

For models AWH1250 - 2000:

- 1.4% for each 1,000 feet from 3,000 feet to 5,500 feet
- 1.9% for each 1,000 feet from 5,500 feet to 9,600 feet
- Above 9,600 feet, contact the factory.

For models AWH3000 - 4000:

- 1.2% for each 1,000 feet from 3,000 feet to 5,500 feet
- Above 5,500 feet, contact the factory.

Note: Derate values for altitudes above those listed in this manual are calculated per NFPA 54 and CSA B149.1.

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

4. The manual reset high limit provided with the Armor is listed to UL353. The auto reset high limit is listed to ANSI Z21.87.
5. The Armor models 1250 and 1500 can be alternatively vented using a 6" vent/air size. If the 6" vent/air size is used, the maximum vent/air pipe lengths are limited to 70 equivalent feet each.

1 Determine appliance location

Installation must comply with:

- Local, state, provincial, and national codes, laws, regulations, and ordinances.
- National Fuel Gas Code, ANSI Z223.1 – latest edition.
- National Electrical Code.
- For Canada only: B149.1 Installation Code, CSA C22.1 Canadian Electrical Code Part 1 and any local codes.

NOTICE

All models of the Armor appliance gas manifold and controls met safe lighting and other performance under tests specified in the latest edition of ANSI Z21.10.3.

Before locating the appliance, check:

1. Check for nearby connection to:
 - 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 appliance. Remove any combustible materials, gasoline, and other flammable liquids.

WARNING

Failure to keep appliance 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 Armor appliance 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 appliance will replace an existing appliance, check for and correct system problems, such as:
 - System leaks causing oxygen corrosion or heat exchanger cracks from hard water deposits.
6. Check around the appliance for any potential air contaminants that could risk corrosion to the appliance or the appliance combustion air supply (see Table 1A on page 10). Prevent combustion air contamination. Remove any of these contaminants from the appliance area.

WARNING

DO NOT install units in rooms or environments that contain corrosive contaminants (see Table 1A on page 10). Failure to comply could result in severe personal injury, death, or substantial property damage.

WARNING

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.

WARNING

This appliance requires a special venting system. If using PVC the vent connection to the appliance must be made with the starter CPVC pipe section provided with the appliance. The field provided vent fittings must be cemented to the CPVC pipe section. Use only the vent materials, primer and cement specified in this manual to make the vent connections. Failure to follow this warning could result in fire, personal injury, or death.

WARNING

For closet and alcove installations as shown in FIG.'s 1-1 and 1-2, CPVC vent material must be used inside the structure. The ventilating air openings shown in FIG.'s 1-1 and 1-2 are required for this arrangement. Failure to follow this warning could result in fire, personal injury, or death.

Provide clearances:

Clearances from combustible materials

1. Hot water pipes—at least 1/4" from combustible materials.
2. Vent pipe – at least 1" from combustible materials.
3. See FIG.'s 1-1 and 1-2 on page 8 for other clearance minimums.

Clearances for service access

1. See FIG.'s 1-1 and 1-2 on page 8 for recommended service clearances. If you do not provide the minimum clearances shown, it may not be possible to service the appliance without removing it from the space.

Multiple appliances can be installed side by side with no clearances between adjacent appliances because the appliances are approved for zero clearances from combustible surfaces; however, service access will be limited from the sides. Consult with the local inspection authority for approval.

1 Determine appliance location

Figure 1-1 Closet Installation - Minimum Required Clearances

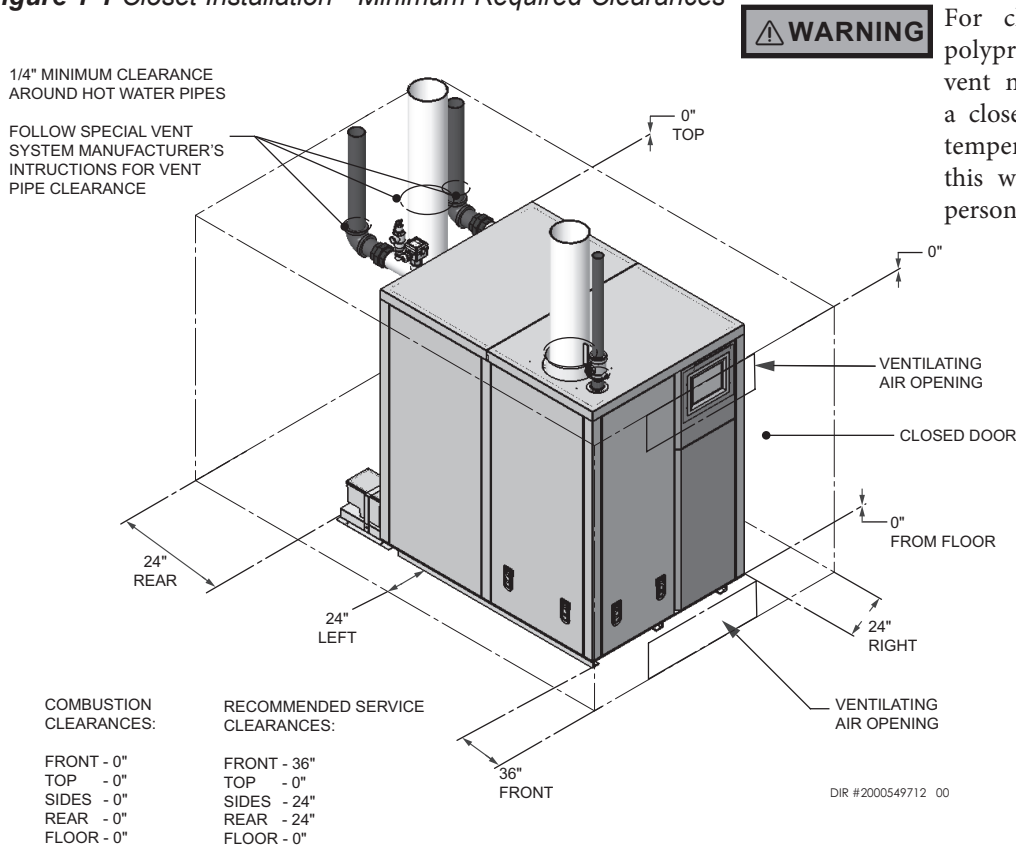
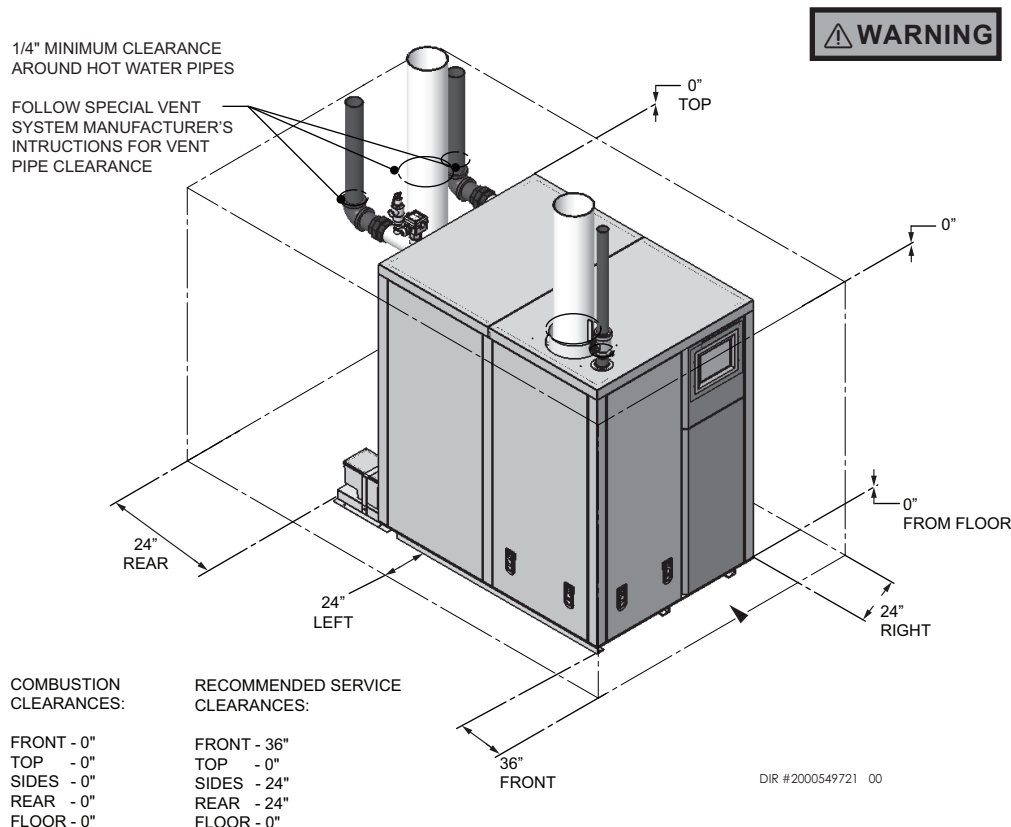


Figure 1-2 Alcove Installation - Minimum Required Clearances



1 Determine appliance location *(continued)*

Provide air openings to room:

Armor appliance alone in equipment room

1. No air ventilation openings into the equipment room are needed when clearances around the Armor appliance are at least equal to the SERVICE clearances shown in FIG.s 1-1 and 1-2. 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 appliance input.

Armor appliance in 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 Armor appliance.

Do not install the appliance in an attic.

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 Armor appliance because it takes its combustion air from outside (direct vent installation).

Flooring and foundation

Flooring

The Armor appliance is approved for installation on combustible flooring, but must never be installed on carpeting.



WARNING

Do not install the appliance 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 appliance sufficiently to prevent water from reaching the appliance.

Vent and air piping

The Armor appliance requires a special vent system, designed for pressurized venting.

The appliance is to be used for either direct vent installation or for installation using indoor combustion air. When room air is considered, see the General Venting Section. 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 Armor appliance using any other means.

Be sure to locate the appliance 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 Armor appliance as described in this manual. Do not terminate vent/air in locations that can allow contamination of combustion air. Refer to Table 1A, page 10 for products and areas which may cause contaminated combustion air.



WARNING

You must pipe combustion air to the appliance air intake. Ensure that the combustion air will not contain any of the contaminants in Table 1A, page 10. Contaminated combustion air will damage the appliance, 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.

1 Determine appliance location

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 using an existing vent system to install a new appliance:

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 3 - General Venting. For polypropylene or stainless steel venting, an adapter of the same manufacturer must be used at the flue collar connection.
- **Size** - To ensure proper pipe size is in place, see Tables 3B and 3C. Check to see that this size is used throughout the vent system.
- **Manufacturer** - For a stainless steel or polypropylene application, you must use only the listed manufacturers and their type product listed in Tables 3G and 3H for CAT IV positive pressure venting with flue producing condensate.
- **Supports** - 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.
- **Terminations** - Carefully review Sections 3 through 5 to ensure requirements for the location of the vent and air terminations are met and orientation of these fit the appropriate image from the Horizontal or Vertical options listed in the General Venting Section. For stainless steel vent, only use terminations listed in Table 3A-2 for the manufacturer of the installed vent.
- **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 Appliance Section on page 11.

With polypropylene and stainless steel vent, seal and connect all pipe and components as specified by the vent manufacturer used; with PVC/CPVC vent, see the Installing Vent or Air Piping Section on page 20.

WARNING If any of these conditions are not met, the existing system must be updated or replaced for that concern. Failure to follow all instructions can result in flue gas spillage and carbon monoxide emissions, causing severe personal injury or death.

1 Determine appliance location *(continued)*

When removing an appliance from existing common vent system:

DANGER

Do not install the Armor appliance into a common vent with any other appliance except as noted in Section 3. 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 appliance, 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 resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in Part 11 of the National Fuel Gas Code, ANSI Z223.1/NFPA and/or CAN/CSA B149.1, Natural Gas and Propane Installation Code.

1 Determine boiler location

Outdoor venting

- In order to properly install the appliance in an outdoor configuration the optional outdoor kit must be used (see Table 1B).
- Vent materials for outdoor venting are to be field supplied.
- Vent materials must be stainless steel.
- 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 1C must be used.
- See page 23 in the General Venting section for additional outdoor venting information.

Table 1B Indoor to Outdoor Conversion Kits

Model	Indoor to Outdoor Conversion Kit
1250	100297107
1500	100297108
2000	100297341
3000	100297342
4000	100297343

NOTICE

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

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

WARNING

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 indoor model is used outdoors. Properly install all covers, doors, and jacket panels to ensure proper operation and prevent a hazardous condition.

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.

Location of unit

For outdoor models, you must install a flue termination. Instructions for mounting the flue termination are included in the venting section of this manual. 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. See Outdoor Installation Venting, page 23. A wind proof cabinet protects the unit from weather.

WARNING

This product contains a condensate management and disposal system that may be subject to freezing if exposed to sustained temperatures below 32°F. Precautions should be taken to protect the condensate trap and drain lines during extended periods of outdoor temperatures below 32°F.

WARNING

The Armor is NOT suitable for installation in areas which may experience temperatures below 32°F.

CAUTION

This unit is not intended for installations where temperatures may reach below 32°F (0°C). Exposure to freezing temperatures will cause the system and appliance to freeze and leak.

Table 1C Approved Stainless Steel Adapters and Rain Caps

Model	ProTech		Z-Flex		Heat Fab		Metal Fab		Security Chimney	
	Adapter	Rain Cap	Adapter	Rain Cap	Adapter	Rain Cap	Adapter	Rain Cap	Adapter	Rain Cap
1250 - 2000	*	FSRC8	2SVDSA08	2SVSXITC08	9801MAD	CCA08EX06	8FCGLCA	8FCSEC-C60	SS8CRESTU	SS8ECU
3000	*	FSRC10	2SVDSA10	2SVSXITC10	91001MAD	CCA10EX08	10FCGLCA	10FCSEC-C60	SS10CRESTU	SS10ECU
4000	*	FSRC12	2SVDSA12	2SVSXITC12	91201MAD	CCA12EX10	12FCGLCA	12FCSEC-C60	SS12CRESTU	SS12ECU

*No adapter needed when using standard FNS length.

1 Determine appliance location *(continued)*

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.

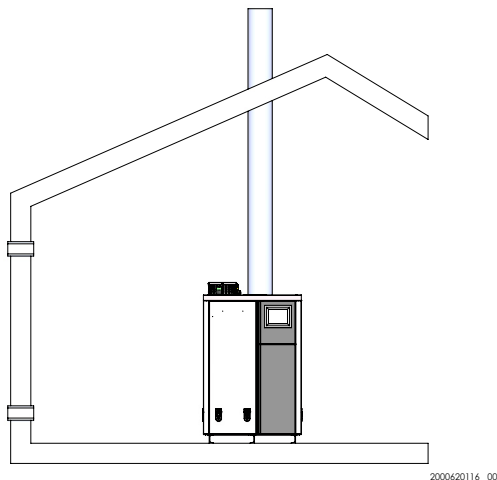
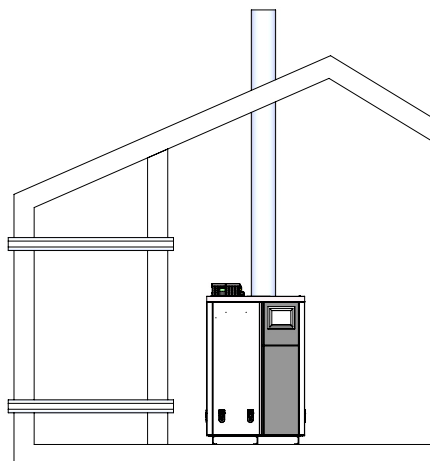


Figure 1-3_ *Combustion Air Direct from Outside*

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. 1-3).

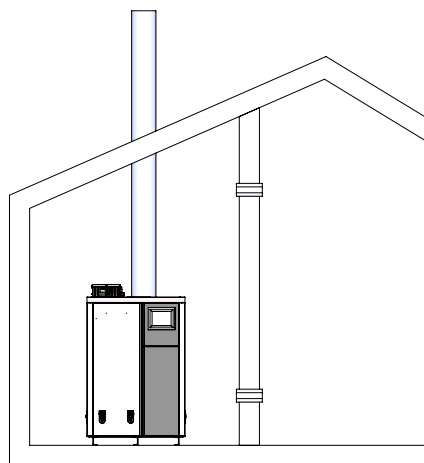
1 Determine appliance location



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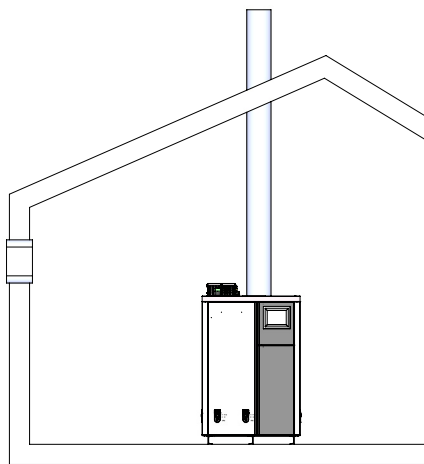
Figure 1-4_Combustion Air Through Ducts

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. 1-4).



2000620116 00

Figure 1-5_Combustion Air from Interior Space



2000620116 00

Figure 1-6_Combustion Air from Outside - Single Opening

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. 1-5).
 - (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).
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. 1-6).

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 stainless steel 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 corrected immediately.

1 Determine appliance location

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

Model Number	FIG. 1-4		FIG. 1-5		FIG. 1-6			FIG. 1-7
	*Outside Air from 2 Openings Directly from Outdoors ¹		*Outside Air from 2 Ducts Delivered from Outdoors ¹		Inside Air from 2 Ducts Delivered from Interior Space ²			*Outside Air from 1 Opening Directly from Outdoors, in ² (cm ²) ¹
					Same Story		Different Stories	
	Top Opening, in ² (cm ²)	Bottom Opening, in ² (cm ²)	Top Opening, in ² (cm ²)	Bottom Opening, in ² (cm ²)	Top Opening, in ² (cm ²)	Bottom Opening, in ² (cm ²)	Total Openings, in ² (cm ²)	
AWH1250	313 (2020)	313 (2020)	625 (4033)	625 (4033)	1250 (8065)	1250 (8065)	2500 (16192)	417 (2691)
AWH1500	375 (2420)	375 (2420)	750 (4839)	750 (4839)	1500 (9678)	1500 (9678)	3000 (19355)	500 (3226)
AWH2000	500 (3226)	500 (3226)	1000 (6452)	1000 (6452)	2000 (12904)	2000 (12904)	4000 (25807)	667 (4304)
AWH3000	750 (4839)	750 (4839)	1500 (9678)	1500 (9678)	3000 (19355)	3000 (19355)	6000 (38710)	1000 (6452)
AWH4000	1000 (6450)	1000 (6450)	2000 (12900)	2000 (12900)	4000 (25800)	4000 (25800)	8000 (51600)	1333 (8600)

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**³.

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.

Combustion air filter

This unit has a standard air filter located at the combustion air inlet. 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. You can find these commercially available filters at any home center or HVAC supply store.

Filters by model sizes:

AWH1250 - AWH2000 / 1 x 16 x 20 filter

AWH3000 - AWH4000 / 1 x 24 x 30 filter

Note: Replacement filter should have a MERV rating no greater than 4.

Follow the steps below when replacing the combustion air filter:

1. Locate the combustion air filter box.
2. Remove the air filter cover from the bottom of the air filter box to gain access to the air filter.
3. Slide the air filter out of the bottom of the air filter box.
4. Inspect the air filter for dirt and debris, replace if necessary.
5. Replace the air filter and the air filter box cover.

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.

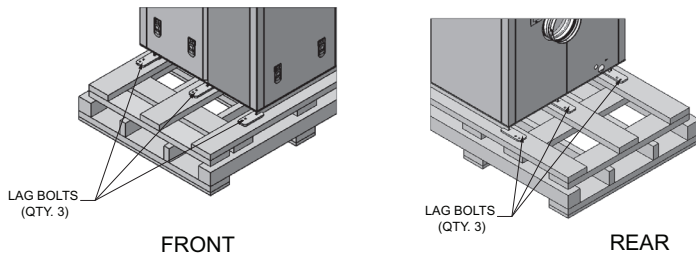
2 Prepare appliance

Remove appliance from wood pallet

1. After removing the outer shipping carton from the appliance, remove the parts box.
2. To remove the appliance from the pallet:
 - a. Remove the six (6) shipping bolts that fasten the tie-down brackets securing the legs to the front and rear of the pallet (FIG. 2-1).
 - b. The appliance can now be removed from the pallet using a lift truck lifting from the front or rear of the appliance. If lifting from the front, the lift truck forks must extend at least half way under the appliance heat exchanger to assure proper lifting technique with no damage to the appliance.

WARNING Failure to assure the truck forks are long enough to extend at least halfway under the appliance heat exchanger will result in the appliance tipping off the lift truck, and potentially falling. This will result in severe personal injury, death, or substantial property damage.

Figure 2-1 Appliance Mounted on Shipping Pallet



Gas conversions

WARNING

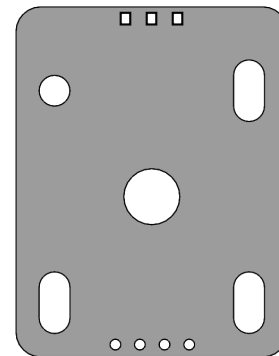
For an appliance already installed, you must turn off gas supply, turn off power, and allow the appliance to cool before proceeding. You must also completely test the appliance after conversion to verify performance as described under Start-up, Section 10 of this manual. Failure to comply could result in severe personal injury, death, or substantial property damage.

You must install a propane orifice to operate the Armor appliance on propane gas. Verify when installing that the orifice size marking matches appliance size.

Table 2A LP Conversion Table

LP Conversion Table	
Model	LP Orifice Stamping
1250	4 Circles, 3 Squares
1500	4 Circles, 3 Squares
2000	5 Circles, 4 Squares
3000	1 Circle, 1 Square
4000	1 Circle, 2 Squares

Figure 2-2 LP Orifice Stamping



DIR #2000551053 00

NOTE: Model 1250 shown for illustration purposes only.

2 Prepare appliance

Procedure

1. Remove the front access cover from the unit.
2. Remove the four (4) screws securing the gas train to the venturi (FIG. 2-3).
3. Locate the propane orifice disk from the conversion kit bag. Verify that the stamping on the orifice disk matches the appliance size (see Table 2A).

Place the orifice with gasket between the flange and venturi.

4. Reposition the gas train against the venturi and replace the screws (FIG. 2-3) securing the valve to the venturi.
5. After installation is complete, attach the propane conversion label (in the conversion kit bag) next to the appliance rating plate. Attach the LP caution label (in the conversion kit bag) to the left side of the unit in the lower left corner.

For Models 3000 and 4000: Locate the air orifice plate from the conversion kit bag. Place the plate with gasket between the flex duct flange and air box as shown in Figure 2-4.

6. Replace the front access covers.



WARNING

After converting to LP, check combustion per the Start-up procedure in Section 10 of this manual. Failure to check and verify combustion could result in severe personal injury, death, or substantial property damage.

Air Filter Replacement Procedure

1. Remove the front access cover from the unit.
2. Remove the four (4) thumb screws securing the air filter access panel (FIG. 2-4).
3. Remove the air filter.
4. Install the new air filter. See Table 3D for filter sizes. When installing, take note of the arrow on the filter and ensure that it points in the direction of the air flow.
5. Replace the air filter access panel.
6. Replace the front access cover.

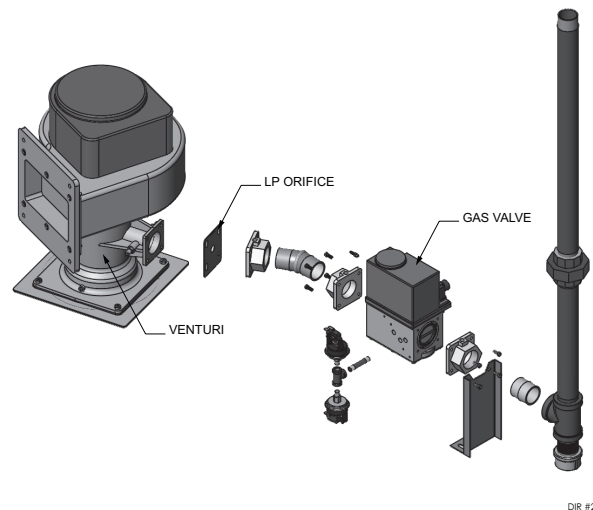
Filters by model sizes:

AWH1250-2000 / 16 x 20 x 1 filter

AWH3000-4000 / 24 x 30 x 1 filter

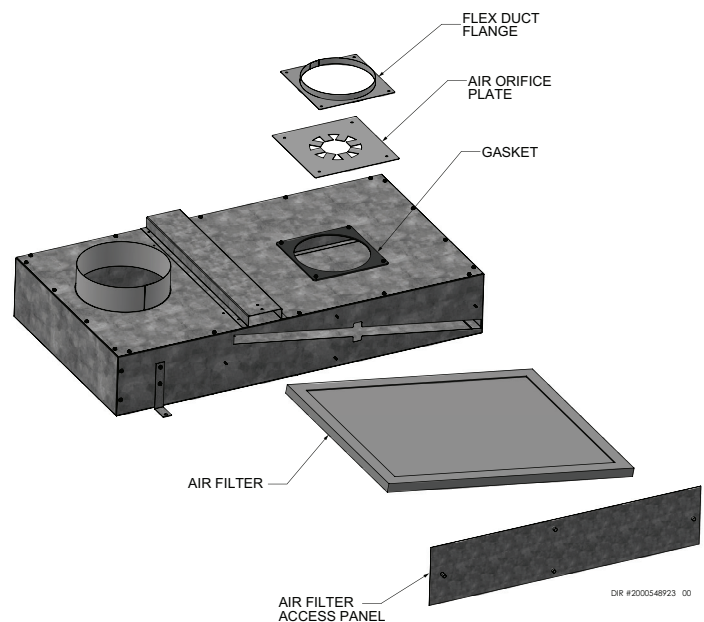
Note: Replacement filter should have a MERV rating no greater than 4.

Figure 2-3 Installing Propane Orifice - Models 1250 - 4000



DIR #2000548918 00

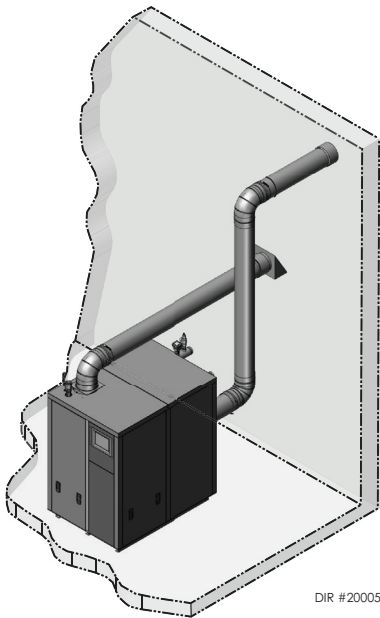
Figure 2-4 Installing Air Orifice Plate - Models 3000 & 4000



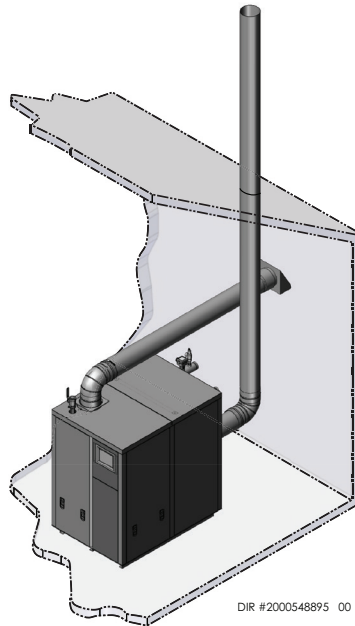
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3 General venting

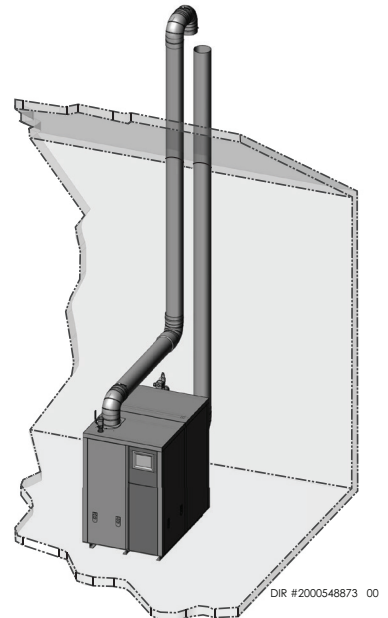
Direct venting



Sidewall

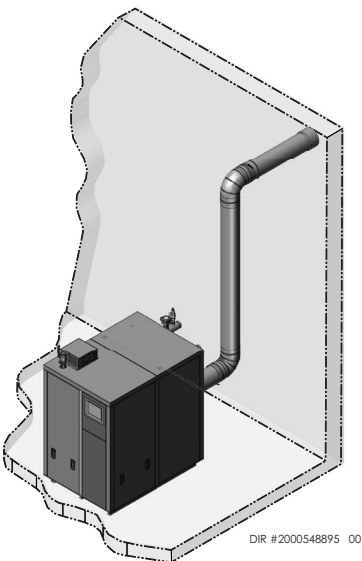


Vertical Vent, Sidewall Air

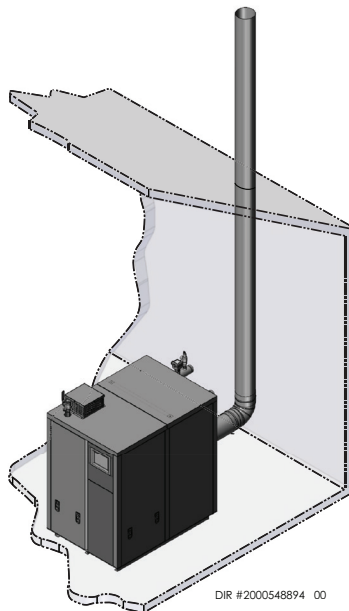


Vertical

Optional room air

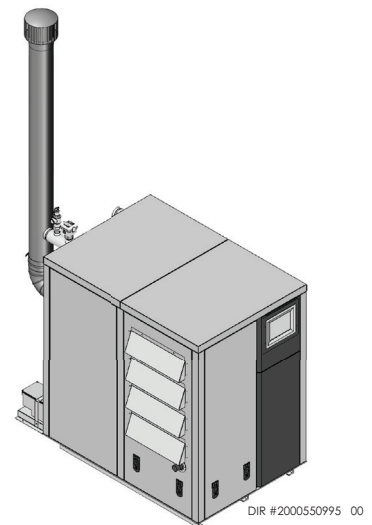


Sidewall



Vertical

Outdoor



Outdoor

3 General venting

Install vent and combustion air piping

DANGER

The Armor must be vented and supplied with combustion and ventilation air as described in this section. Ensure the vent and air piping and the combustion air supply comply with these instructions regarding vent system, air system, and combustion air quality. See also Section 1 of this manual.

Inspect finished vent and air piping thoroughly to ensure all are airtight and comply with the instructions provided and with all requirements of applicable codes.

Failure to provide a properly installed vent and air system will cause severe personal injury or death.

Air inlet pipe materials:

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

ABS, PVC, or CPVC

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.

AL29-4C, stainless steel material to be sealed to specification of its manufacturer.

*Plastic pipe may require an adapter, such as a Fernco coupling (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 air intake 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. The ABS, PVC, CPVC, 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.

Follow the polypropylene manufacturer's instructions when using polypropylene material as an inlet pipe.

Supports

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.

3 General venting *(continued)*

Vent and air piping

The Armor is certified as a Category II/IV appliance. This product has been approved for use with stainless steel vent systems. All venting systems used with an Armor appliance must be suitable for Category IV operation except for factory approved common vent systems operating as allowed in the Common Venting Section on page 20.

⚠ WARNING

Use only the materials, vent systems, and terminations listed in Table 3A-1. DO NOT mix vent systems of different types or manufacturers unless listed in this manual. Failure to comply could result in severe personal injury, death, or substantial property damage.

NOTICE

Installations must comply with applicable national, state, and local codes. Stainless steel vent systems must be listed as a UL-1738 approved system for the United States and a ULC-S636 approved system for Canada.

NOTICE

Installation of a stainless steel vent system should adhere to the stainless steel vent manufacturer's installation instructions supplied with the vent system.

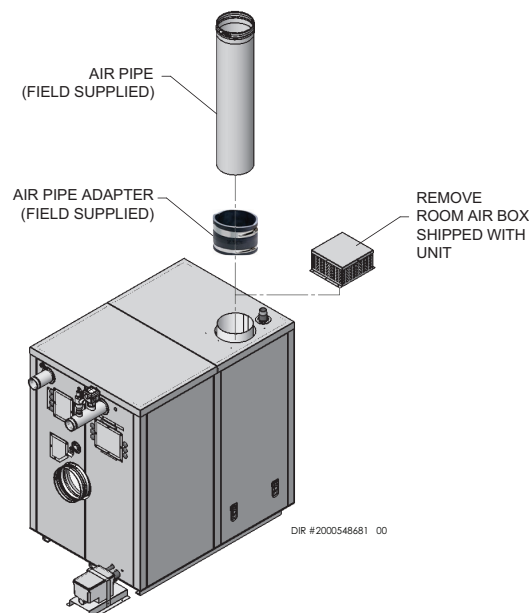
NOTICE

The Armor is supplied with an integral FasNSeal vent connector (FIG. 3-1). The installer must use a specific vent starter adapter supplied by the vent manufacturer to adapt to different vent systems.

Air intake/vent connections

1. **Combustion Air Intake Connector** (FIG. 3-1) - Used to provide combustion air directly to the unit from outdoors. A fitting is provided with the unit for final connection. Combustion air piping must be supported per guidelines listed in the National Mechanical Code, Section 305, Table 305.4 or as local codes dictate.
2. **Vent Connector** (FIG. 3-1) - Used to provide a passageway for conveying combustion gases to the outside. A pipe stub is provided on the unit for final connection. Vent piping must be supported per the National Building Code, Section 305, Table 305.4 or as local codes dictate.

Figure 3-1 Combustion Air Adapter



The Armor uses model specific combustion air intake and vent piping sizes as detailed in Tables 3B and 3C on page 18.

NOTICE

Increasing or decreasing combustion air or vent piping to sizes not specified in this manual is not authorized.

Table 3A-1 Approved Stainless Steel Vent Manufacturers

Approved Stainless Steel Vent Manufacturers		
Make	Model	Standard
ProTech Systems (Dura-Vent Co.)	FasNSeal Vent	UL1738 / ULC-S636
Z-Flex (Nova Flex Group)	Z-Vent	UL1738 / ULC-S636
Heat Fab (Selkirk Corporation)	Saf-T Vent	UL1738 / ULC-S636 / UL641 / ULC68
Metal Fab	Corr/Guard	UL1738 / ULC-S636
Securities Chimneys International	Secure Seal SS	UL1738 / ULC-S636
DuraVent	DuraSeal DS	--
Schebler Chimney Systems	eVent	UL1738 / ULC-S636
ICC	VIC	UL1738 / ULC-S636
Jeremias	--	UL1738 / ULC-S636
Enervex	Powerstack	--
Van Packer	--	--

3 General venting

Table 3A-2 Approved Stainless Steel Terminations and Adapters - Category IV

Model	DuraVent			Z Flex			Heat Fab		
	Adapter	Intake		Adapter	Intake		Adapter	Flue	Intake
1250-2000	*See note	810003357 810003369		2SVDSA08	2SVEE0890		9801MAD	CCK08TM	9890 9892
3000	*See note	810003435 810003447		2SVDSA10	2SVEE1090		91001MAD	CCK10TM	91090 91092
4000	*See note	810003476 810003488		2SVDSA12	2SVEE1290		91201MAD	CCK12TM	91290 91292
Model	Metal-Fab			Security Chimney			ICC		
	Adapter	Flue	Intake	Adapter	Flue	Intake	Adapter	Flue	Intake
1250-2000	8FCGLCA	MC 6" - 36"	8FCGSW90	SS8CRESTU	SS0MCU 4" - 24"	SSE8E90U SD0STAU 4" - 10"	HE-8DSA-F	HE-8SCR-F HE-8MC-F	HE-8E90-F HE-8SCR-F
3000	10FCGLCA	MC 6" - 36"	10FCGSW90	SS10CRESTU	SS0MCU 4" - 24"	SSE10E90U SD0ST9OAU 4" - 10"	HE-10DSA-F	HE-10SCR-F HE-10MC-F	HE-10E90-F HE-10SCR-F
4000	12FCGLCA	MC 6" - 36"	12FCGSW90	SS12CRESTU	SS0MCU 4" - 24"	SSE12E90U	HE-12DSA-F	HE-12SCR-F HE-12MC-F	HE-12E90-F HE-12SCR-F
Model	Jeremias			*No adapter needed when using Standard FNS Vent Length. **Models 1250 - 1500: For installations using a 6 inch vent, use the adapter from Table 3A-2 for the appropriate vent system manufacturer, then use the manufacturer's tapered reducing adapter from 8 inch to 6 inch diameter to continue the system. If using a DuraVent vent system, factory KIT #100295900 is available.					
	Adapter	Flue	Intake						
1250-2000	SWKL8-KLC	SWKL8-WRC	SWKL8-90ET						
3000	SWKL10-KLC	SWKL10-WRC	SWKL10-90ET						
4000	SWKL12-KLC	SWKL12-WRC	SWKL12-90ET						
Model	Enervex				Van Packer				
	Adapter		Flue	Intake	Adapter		Intake		
1250-2000	801.0676.4708		801.0679.XX08	801.0676.0408	MM08MOAB		M0890EB & M06SCTB		
3000	801.0676.4710		801.0679.XX10	801.0676.0410	MM10MOAB		M1090EB & M06SCTB		
4000	801.0676.4712		801.0679.XX12	801.0676.0412	MM12MOAB		M1290EB & M06SCTB		
Model	DuraVent								
	Adapter		Flue	Intake					
1250-2000	DS8CRESTU		DS0MCU 4" - 24"	DSE8E90U DSD0STAU 4" - 24"					
3000	DS10CRESTU		DS0MCU 4" - 24"	DSE10E90U DS0ST90AU 4" - 10"					
4000	DS12CRESTU		DS0MCU 4" - 24"	DSE12E90U					

3 General venting

Table 3B Direct Vent Minimum / Maximum Allowable Air / Vent Lengths

Model	AIR INLET			VENT			Input Derate per 25 feet of Vent
	Air Intake Diameter	Air Intake Min. Length	Air Intake Max. Length	Vent Diameter	Vent Min. Length	Vent Max. Length	
1250	8"	10'	150'	8"	10'	150'	0%
1250	6"	10'	70'	6"	10'	70'	1.5%
1500	8"	10'	150'	8"	10'	150'	0%
1500	6"	10'	70'	6"	10'	70'	2.4%
2000	8"	10'	150'	8"	10'	150'	0.7%
3000	10"	10'	100'	10"	10'	100'	0.5%
4000	12"	10'	150'	12"	10'	150'	0%

Table 3C Room Air Minimum / Maximum Allowable Air / Vent Lengths

Model	Vent Diameter	Vent Min. Length	Vent Max. Length	Input Derate per 25 feet of Vent
1250	8"	10'	150'	0%
1250	6"	10'	70'	1.0%
1500	8"	10'	150'	0%
1500	6"	10'	70'	1.7%
2000	8"	10'	150'	0%
3000	10"	10'	100'	0%
4000	12"	10'	150'	0%

Table 3D Air Filter Sizes

Model	Air Filter Size
1250 - 2000	16" x 20" x 1"
3000 - 4000	24" x 30" x 1"

3 General venting *(continued)*

When determining equivalent combustion air and vent length, add 5 feet (1.5m) for each 90° elbow and 3 feet (.9 m) for each 45° elbow.

EXAMPLE: 20 feet (6 m) of pipe + (4) 90° elbows + (3) 45° elbows = 49 equivalent feet (15 m) of piping.

Removing from existing vent

Follow the instructions in Section 1, page 11 of this manual when removing an appliance from an existing vent system.

Vent and air piping

Vent and air system:

NOTICE

Installation must comply with local requirements and with the National Fuel Gas Code, NFPA 54 / ANSI Z223.1 for U.S. installations or CSA B149.1 for Canadian installations.

You must also install air piping from outside to the appliance air intake adapter. The resultant installation is direct vent (sealed combustion).

You may use any of the vent/air piping methods covered in this manual. Do not attempt to install the Armor using any other means.

WARNING

DO NOT mix components from different systems. The vent system could fail, causing leakage of flue products into the living space. Use only approved stainless steel pipe and fittings.

Vent, air piping, and termination:

The Armor vent and air piping can be installed through the roof or through a sidewall. Follow the procedures in this manual for the method chosen. Refer to the information in this manual to determine acceptable vent and air piping length.

Air contamination

Pool and laundry products and common household and hobby products often contain fluorine or chlorine compounds. When these chemicals pass through the appliance, they can form strong acids. The acid can eat through the appliance wall, causing serious damage and presenting a possible threat of flue gas spillage or appliance water leakage into the building.

Please read the information given in Table 1A, page 10, listing contaminants and areas likely to contain them. If contaminating chemicals will be present near the location of the appliance combustion air inlet, have your installer pipe the appliance combustion air and vent to another location, per this manual.

WARNING

If the appliance combustion air inlet is located in a laundry room or pool facility, for example, these areas will always contain hazardous contaminants.

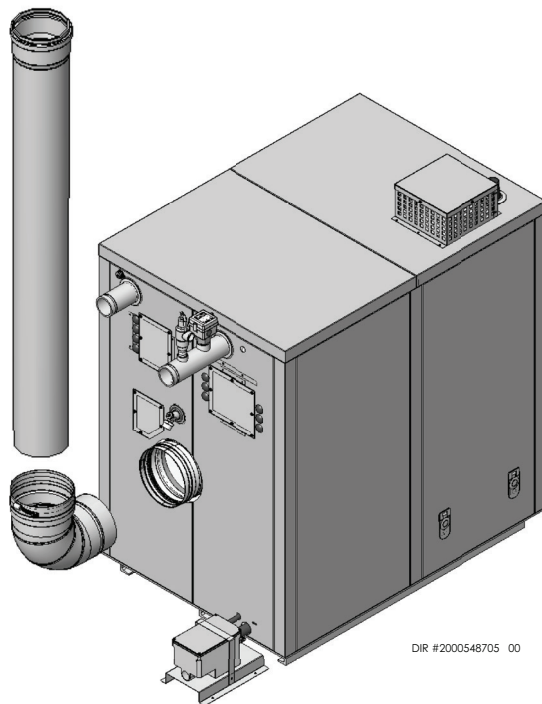
WARNING

To prevent the potential of severe personal injury or death, check for areas and products listed in Table 1A, page 10 before installing the appliance or air inlet piping.

If contaminants are found, you MUST:

- Remove products permanently.
- OR—
- Relocate air inlet and vent terminations to other areas.

Figure 3-2 Near Appliance Stainless Steel Venting



DIR #2000548705 00

3 General venting

Common venting

Armor 1250 - 4000 appliances may be common vented; however, the following criteria MUST BE followed:

1. Only Armor appliances may be connected to common flue applications. DO NOT mix other manufacturer's appliances or other Lochinvar models. Common air intake is not allowed.
2. Armor appliances connected to the common vent must all be of the same size.
3. Each Armor appliance must have a Lochinvar supplied flue damper installed (see Table 3E).
4. A condensate drain must be installed above the flue damper.
5. Only vertical direct vent, positive pressure, Category IV or vertical/chimney vent, negative pressure, Category II may be used when common venting Armor appliances. Sidewall venting is not allowed.
6. Armor appliances in a common vent must be connected and controlled with the integral Armor SMART TOUCH Cascade.
 - a. The Leader may be controlled through the Armor SMART TOUCH control through BMS (external 0 - 10V signal), ModBus, or its own internally calculated set point.
 - b. The Cascade (Members) must be controlled by the Armor Leader appliance using the Lead/Lag Cascade option.

For approved common vent sizing, contact the factory.

⚠ WARNING

When Armor appliances are common vented, the criteria above MUST BE followed. Failure to follow all these requirements will result in severe personal injury, death, or substantial property damage.

NOTICE

A field supplied inline condensate collection section MUST BE installed directly above the backflow preventer.

NOTICE

When using polypropylene common vent, a field supplied polypropylene to stainless steel adapter MUST BE installed between the backflow preventer and the unit connection.

Table 3E Flue Damper Kits

Flue Damper Kits		
Model	Damper Size	Kit Number
1250	8"	100303788
1500	8"	100303788
2000	8"	100303788
3000	10"	100303790
4000	12"	100303811

NOTE: Connection for flue damper is inside the low voltage connection box on appliance.

PVC/CPVC

This product has been approved for use with the PVC/CPVC vent materials listed in Table 3F on page 21.

NOTICE

Factory installed vent connections are sized for stainless steel venting.

Installing vent and air piping

⚠ WARNING

The vent connection to the appliance must be made with the starter CPVC pipe section if PVC/CPVC vent is to be used. The field provided vent fittings must be cemented to the CPVC pipe section using an "All Purpose Cement" suitable for PVC and CPVC pipe. Use only the vent materials, primer, and cement specified in Table 3F to make the vent connections. Failure to follow this warning could result in fire, personal injury, or death.

NOTICE

Use only cleaners, primers, and solvents that are approved for the materials which are joined together.

NOTICE

All PVC vent pipes must be glued, properly supported, and the exhaust must be pitched a minimum of a 1/4 inch per foot back to the appliance (to allow drainage of condensate).

⚠ WARNING

Insulation should not be used on PVC or CPVC venting materials. The use of insulation will cause increased vent wall temperatures, which could result in vent pipe failure.

3 General venting *(continued)*

Table 3F PVC/CPVC Vent Pipe and Fittings

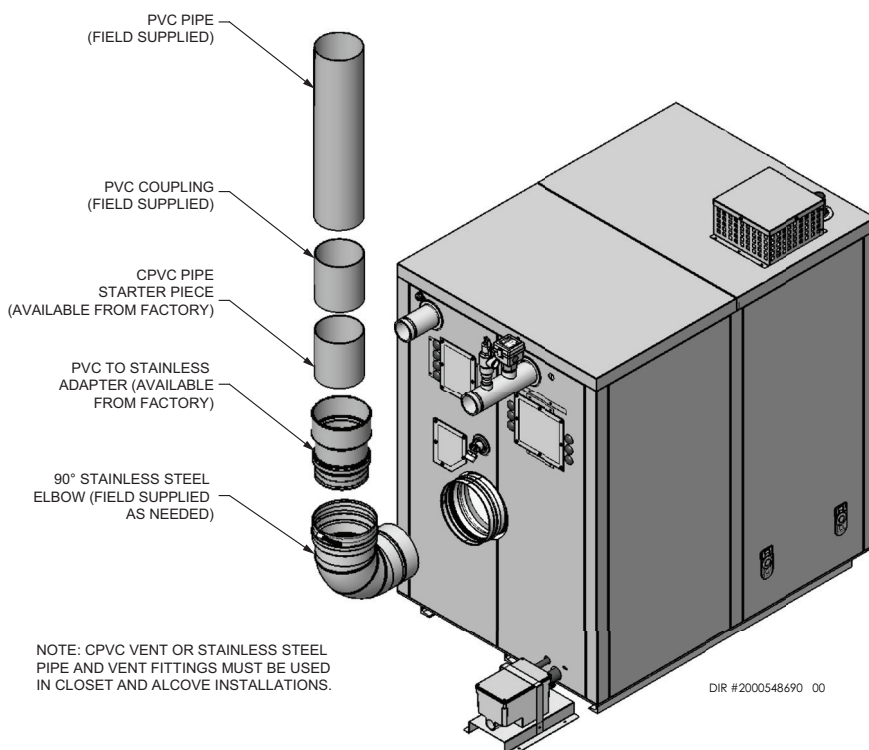
Approved PVC/CPVC Vent Pipe and Fittings		
Item	Material	Standard
Vent pipe	PVC Schedule 40, 80	ANSI/ASTM D1785
	PVC - DWV	ANSI/ASTM D2665
	CPVC Schedule 40, 80	ANSI/ASTM F441
Vent fittings	PVC Schedule 40	ANSI/ASTM D2466
	PVC Schedule 80	ANSI/ASTM D2467
	CPVC Schedule 80	ANSI/ASTM F439
	PVC - DWV	ANSI/ASTM D2665
Pipe Cement / Primer	PVC	ANSI/ASTM D2564
	CPVC	ANSI/ASTM F493
NOTICE: DO NOT USE CELLULAR (FOAM) CORE PIPE		

NOTE: In Canada, CPVC and PVC vent pipe, fittings, and cement/primer must be ULC-S636 certified.

1. Work from the appliance to vent or air termination. Do not exceed the lengths given in this manual for the air or vent piping.
2. Cut pipe to the required lengths and deburr the inside and outside of the pipe ends.
3. Chamfer outside of each pipe end to ensure even cement distribution when joining.
4. Clean all pipe ends and fittings using a clean dry rag. (Moisture will retard curing and dirt or grease will prevent adhesion.)

5. Dry fit vent or air piping to ensure proper fit up before assembling any joint. The pipe should go one-third to two-thirds into the fitting to ensure proper sealing after cement is applied.
6. Priming and Cementing:
 - a. Handle fittings and pipes carefully to prevent contamination of surfaces.
 - b. Apply a liberal even coat of primer to the fitting socket and to the pipe end to approximately 1/2" beyond the socket depth.
 - c. Apply a second primer coat to the fitting socket.
 - d. While primer is still wet, apply an even coat of approved cement to the pipe equal to the depth of the fitting socket along with an even coat of approved cement to the fitting socket.
 - e. Apply a second coat of cement to the pipe.
 - f. While the cement is still wet, insert the pipe into the fitting. If possible twist the pipe a 1/4 turn as you insert it. **NOTE:** If voids are present, sufficient cement was not applied and joint could be defective.
 - g. Wipe excess cement from the joint removing ring or beads as it will needlessly soften the pipe.

Figure 3-3 Near Appliance PVC/CPVC Venting (Flue connections from the factory are sized for stainless steel venting.)



PVC Adapter Kits		
Model	Vent Size	Kit Number
1250	8"	100267012
	6"	100289537
1500	8"	100267012
	6"	100289537
2000	8"	100267012
3000	10"	100314852
4000	12"	Field Supplied

3 General venting

Polypropylene

This product has been approved for use with polypropylene vent with the manufacturers listed in Table 3G.

NOTICE

Factory installed vent connections are sized for stainless steel venting.

All terminations must comply with listed options in this manual and be a single-wall vent offering.

For support and special connections required, see the manufacturer's instructions. All vent is to conform to standard diameter and equivalent length requirements established.

When determining equivalent combustion air and vent length for polypropylene single-wall piping, contact the manufacturer.

WARNING

Use only the adapters and vent system listed in Tables 3G and 3H. DO NOT mix vent systems of different types or manufacturers. Failure to comply could result in severe personal injury, death, or substantial property damage.

NOTICE

Installations must comply with applicable national, state, and local codes. For Canadian installation, polypropylene vent must be listed as a ULC-S636 approved system.

NOTICE

Installation of a polypropylene vent system should adhere to the vent manufacturer's installation instructions supplied with the vent system.

Table 3G Polypropylene Vent Pipe and Fittings

Approved Polypropylene Vent Manufacturers	
Make	Model
Centrotherm Eco Systems	InnoFlue SW/Flex
DuraVent (M & G Group)	PolyPro Single-Wall / PolyPro Flex

NOTICE

The installer must use a specific vent starter adapter at the flue collar connection. The adapter is supplied by the vent manufacturer to adapt to its vent system. See Table 3G for approved vent adapters. Discard CPVC starter piece.

NOTICE

All vent connections MUST be secured by the vent manufacturer's joint connector (FIG. 3-4).

WARNING

Insulation should not be used on polypropylene venting materials. The use of insulation will cause increased vent wall temperatures, which could result in vent pipe failure.

Figure 3-4 Near Appliance Polypropylene Venting

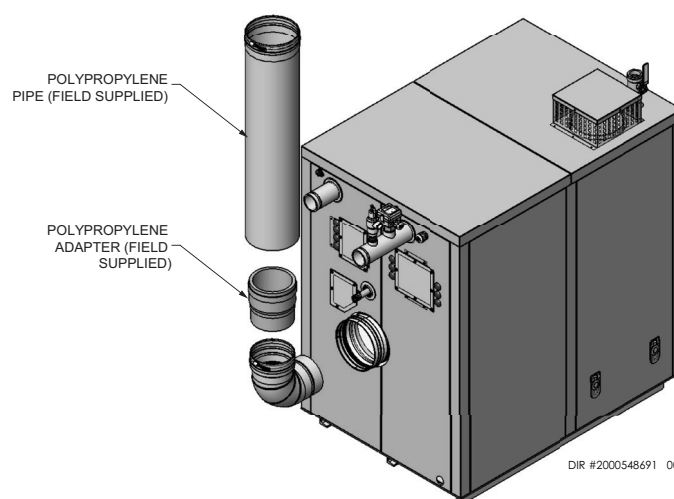


Table 3H Approved Polypropylene Terminations

Model	Manufacturer	Vent Model	Vent Type	Adapter Number	Joint Connector	Sidewall Kit*	Retaining Bracket / Adapter*
1250-2000	Centrotherm Eco Systems	Innoflue	Single-Wall	ISSA0808	--	--	--
	DuraVent (M & G)	PolyPro	Single-Wall	FSA-08M-8PPF	--	8PPS-HSTL	--
* These parts are only needed if the sidewall termination assembly is used (see FIG. 5-1C on page 27).							

3 General venting *(continued)*

Outdoor installation - see pages 12 and 15.

NOTICE

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

Units are self-venting and can be used outdoors when installed with the optional outdoor kit or purchased as outdoor ready from the factory.

Combustion air supply must be free of contaminants (see Combustion and Ventilation Air, page 10). 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 a minimum clearance of 3" (76 mm) to combustible surfaces and a minimum of 36" (915 mm) clearance to the air inlet. To avoid a blocked air inlet or blocked flue condition, keep the louvered air inlet, flue outlet, and condensate trap clear of leaves, debris, etc.

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.

Do not locate unit so that high winds can deflect off of adjacent walls, buildings, or shrubbery causing recirculation. Recirculation of flue products may cause operational problems, bad combustion, or damage to controls.

Multiple unit outdoor installations require 48" (1.22 m) clearance between each vent cap. Locate outdoor cap at least 48" (1.22m) below and 48" (1.22 m) horizontally from any window, door, walkway, or gravity air intake.

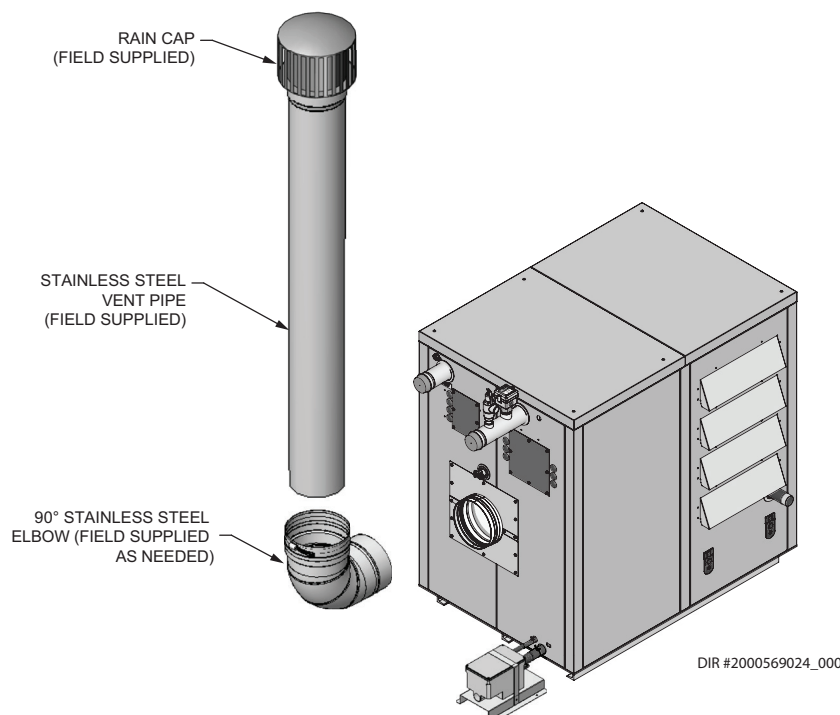
Locate unit at least 10 feet (3.05 m) away from any forced air inlet.

Locate unit at least 3 feet (0.91 m) outside any overhang.

Clearances around outdoor installations can change with time. Do not allow the growth of trees, shrubs, or other plants to obstruct the proper operation of the outdoor vent system.

Do not install in locations where rain from building runoff drains will spill onto the unit.

Figure 3-5 Outdoor Venting - Stainless Steel



NOTE: See Table 1C for approved stainless steel adapters and rain caps.

4 Vertical direct venting

Vent/air termination – vertical

WARNING Follow instructions below when determining vent location to avoid possibility of severe personal injury, death, or substantial property damage.

WARNING Do not connect any other appliance to the vent pipe or multiple appliances to a common vent pipe except as noted in Section 3 on page 20. Failure to comply could result in severe personal injury, death, or substantial property damage.

NOTICE Installation must comply with local requirements and with the National Fuel Gas Code, NFPA 54 / ANSI Z223.1 - latest edition for U.S. installations or CSA B149.1 Installation Code for Canadian installations.

Determine location

Locate the vent/air terminations using the following guidelines:

1. The total length of piping for vent or air must not exceed the limits given in the General Venting Section on page 15 of this manual.
2. The vent must terminate at least 3 feet above the highest place in which the vent penetrates the roof, and at least 2 feet above any part of a building within 10 horizontal feet.
3. The air piping must terminate in a down-turned 180° return pipe no further than 2 feet (.6 m) from the center of the vent pipe. This placement avoids recirculation of flue products into the combustion air stream.
4. The vent piping must terminate in an up-turned coupling as shown in FIG. 4-1. The top of the coupling or the rain cap must be at least 36" (914 mm) above the air intake. The air inlet pipe and vent pipe can be located in any desired position on the roof, but must always be no further than 2 feet (.6 m) apart and with the vent termination at least 36" (914 mm) above the air intake.

WARNING Rooftop vent and air inlet terminations must terminate in the same pressure zone, unless vertical vent sidewall air is set up as shown in the General Venting - Vertical Vent, Sidewall Air Section.

Figure 4-1 Vertical Termination of Air and Vent

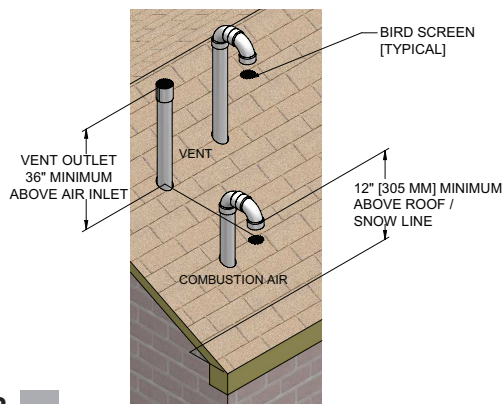
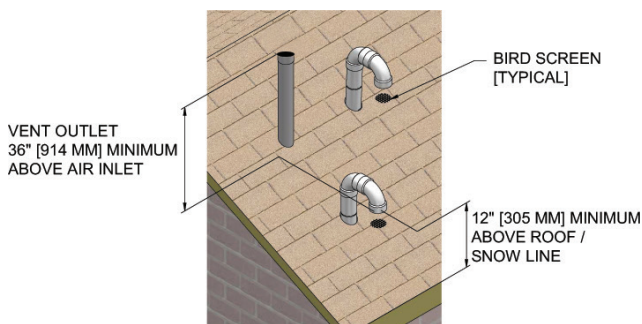


Figure 4-2 Vertical Termination of Air and Vent w/Rain Cap



5. Locate terminations so they are not likely to be damaged by foreign objects, such as stones or balls, or subject to build-up of leaves or sediment.

Prepare roof penetrations

1. Air pipe penetration:
 - a. Cut a hole for the air pipe. Size the air pipe hole as close as desired to the air pipe outside diameter.
2. Vent pipe penetration:
 - a. Cut a hole for the vent pipe. For either combustible or noncombustible construction, size the vent pipe hole per the vent manufacturer's instructions.
 - b. Insert a galvanized metal thimble in the vent pipe hole (when required by local codes).
3. Space the air and vent holes to provide the minimum spacing shown in FIG. 4-1.
4. Follow all local codes for isolation of vent pipe when passing through floors, ceilings, and roofs.
5. Provide flashing and sealing boots sized for the vent pipe and air pipe.

Termination and fittings

1. Prepare the vent termination coupling and the air termination elbow (FIG. 4-1) by inserting bird screens.
2. The air piping must terminate in a down-turned 180° return bend as shown in FIG. 4-1. Locate the air inlet pipe no further than 2 feet (.6 m) from the center of the vent pipe. This placement avoids recirculation of flue products into the combustion air stream.

4 Vertical direct venting *(continued)*

- The vent piping must terminate in an up-turned coupling as shown in FIG. 4-1. The top of the coupling or the rain cap must be at least 36" (914 mm) above the air intake. The air inlet pipe and vent pipe can be located in any desired position on the roof, but must always be no further than 2 feet (.6 m) apart and with the vent termination at least 36" (914 mm) above the air intake.
- Maintain the required dimensions of the finished termination piping as shown in FIG. 4-1.
- Do not extend exposed vent pipe outside of the building more than shown in this document. Condensate could freeze and block vent pipe.

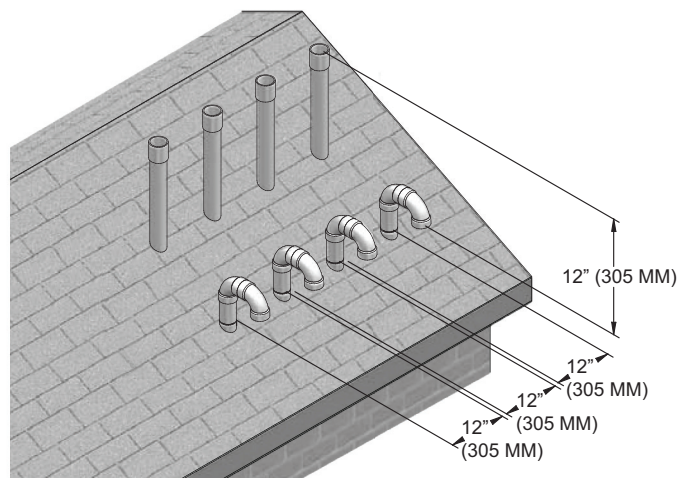
Multiple vent/air terminations

- When terminating multiple Armor appliances, terminate each vent/air connection as described in this manual (FIG. 4-3).

WARNING Terminate all vent pipes at the same height and all air pipes at the same height to avoid recirculation of flue products and the possibility of severe personal injury, death, or substantial property damage.

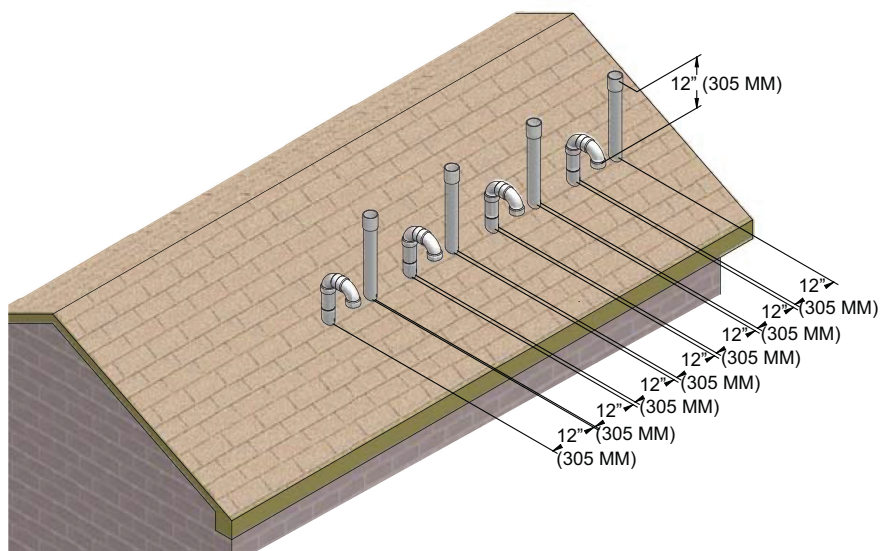
- Place roof penetrations to obtain minimum clearance of 12 inches (305 mm) between edge of air intake elbow and adjacent vent pipe of another appliance for U.S. installations (see FIG. 4-3). For Canadian installations, provide clearances required by CSA B149.1 Installation Code.
- The air inlet of an Armor appliance is part of a direct vent connection. It is not classified as a forced air intake with regard to spacing from adjacent appliance vents.

Figure 4-4 Alternate Vertical Terminations with Multiple Appliances



DIR# 2000539526

Figure 4-3 Vertical Terminations with Multiple Appliances



DIR# 2000539525

5 Sidewall direct venting

Vent/air termination – sidewall

⚠ WARNING

Follow instructions below when determining vent location to avoid possibility of severe personal injury, death, or substantial property damage.

⚠ WARNING

A gas vent extending through an exterior wall shall not terminate adjacent to a wall or below building extensions such as eaves, parapets, balconies, or decks. Failure to comply could result in severe personal injury, death, or substantial property damage.

⚠ WARNING

Do not connect any other appliance to the vent pipe or multiple appliances to a common vent pipe except as noted in Section 3 on page 20. Failure to comply could result in severe personal injury, death, or substantial property damage.

⚠ CAUTION

Sidewall venting commercial products will result in large exhaust plumes in cold climates. Consideration should be taken when locating in proximity to windows, doors, walkways, etc.

NOTICE

Installation must comply with local requirements and with the National Fuel Gas Code, NFPA 54 / ANSI Z223.1 for U.S. installations or CSA B149.1 for Canadian installations.

Determine location

Locate the vent/air terminations using the following guidelines:

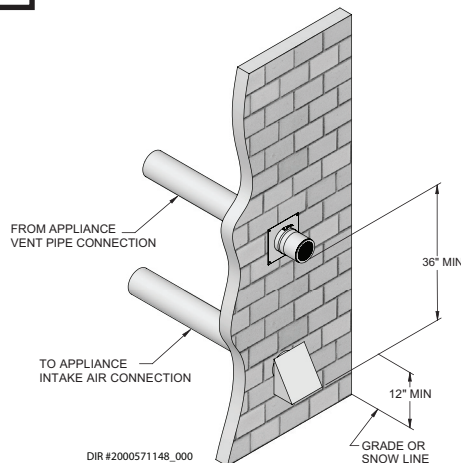
1. The total length of piping for vent or air must not exceed the limits given in the General Venting Section on page 15 of this manual.
2. You must consider the surroundings when terminating the vent and air:
 - a. Position the vent termination where vapors will not damage nearby shrubs, plants, or air conditioning equipment or be objectionable.
 - b. The flue products will form a noticeable plume as they condense in cold air. Avoid areas where the plume could obstruct window views.
 - c. Prevailing winds could cause freezing of condensate and water/ice buildup where flue products impinge on building surfaces or plants.
 - d. Avoid possibility of accidental contact of flue products with people or pets.
 - e. Do not locate the terminations where wind eddies could affect performance or cause recirculation, such as inside building corners, near adjacent buildings or surfaces, window wells, stairwells, alcoves, courtyards, or other recessed areas.

- f. Do not terminate above any door or above or below any window. Condensate can freeze, causing ice formations.
- g. Locate or guard vent to prevent condensate damage to exterior finishes.

Figure 5-1A Sidewall Termination of Air and Vent

NOTICE

PVC/CPVC or ABS is acceptable air inlet pipe material.

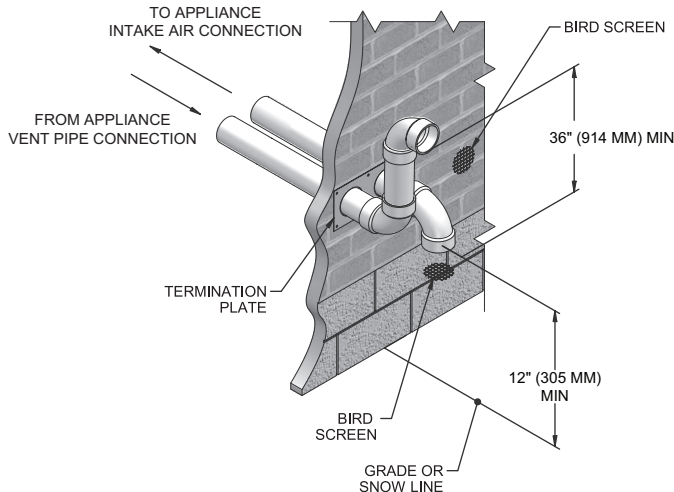


3. Maintain clearances as shown in FIG.'s 5-1A thru 5-4, pages 26 thru 28. The vent termination should not be located in traffic areas such as walkways, adjacent buildings, operable windows, or doors. Also maintain the following:
 - a. Vent must terminate:
 - At least 6 feet (1.8 m) from adjacent walls.
 - Not less than 7 feet (2.1 m) above grade where located adjacent to public walkways.
 - No closer than 12 inches (305 mm) below roof overhang.
 - At least 3 feet (.9 m) above any forced air intake within 10 feet (3 m).
 - No closer than 4 feet (1.2 m) horizontally from any door or window or any other gravity air inlet.
 - b. Air inlet must terminate at least 12 inches (305 mm) above grade or snow line; at least 36 inches (914 mm) below the vent termination.
 - c. Do not terminate closer than 4 feet (1.2 m) horizontally from any electric meter, gas meter, regulator, relief valve, or other equipment. Never terminate above or below any of these within 4 feet (1.2 m) horizontally.
4. Locate terminations so they are not likely to be damaged by foreign objects, such as stones or balls, or subject to build-up of leaves or sediment.

5 Sidewall direct venting *(continued)*

Vent/air termination – sidewall

Figure 5-1B PVC / CPVC / Polypropylene Sidewall Termination of Air and Vent w/Field Supplied Fittings



- The air piping must terminate in a down-turned elbow as shown in FIG. 5-1B. This arrangement avoids recirculation of flue products into the combustion air stream.
- The vent piping must terminate in an elbow pointed outward or away from the air inlet, as shown in FIG. 5-1B.

WARNING

Do not exceed the maximum lengths of the outside vent piping shown in FIG. 5-1C. Excessive length exposed to the outside could cause freezing of condensate in the vent pipe, resulting in potential appliance shutdown.

Figure 5-1C PVC / CPVC / Polypropylene Sidewall Termination of Air and Vent

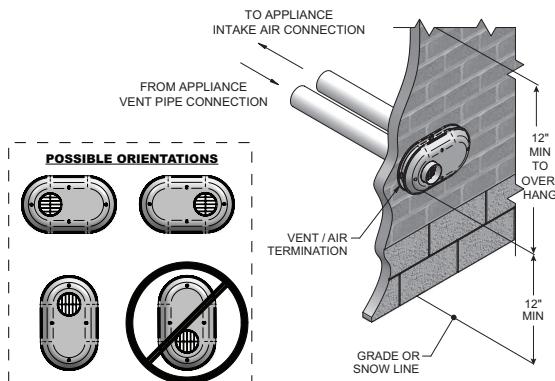


Table 5A Sidewall Vent Kits

Model	Kit #	Air	Vent	Centerline Width
1250 - 1500	100157612	6" (152 mm)	6" (152 mm)	7 3/4" (197 mm)

Figure 5-2A PVC / CPVC / Polypropylene Sidewall Termination w/Field Supplied Fittings

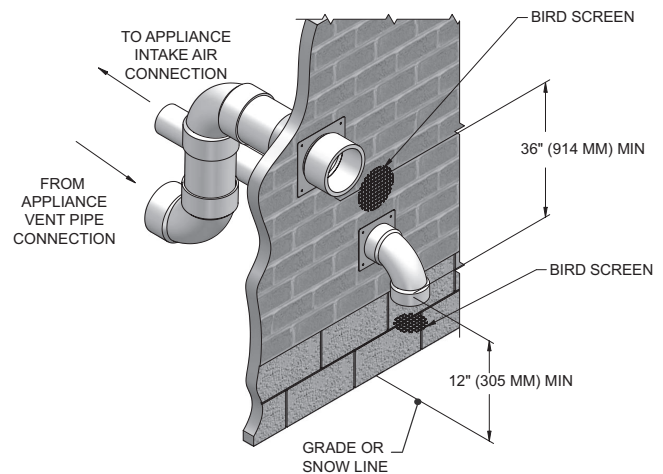
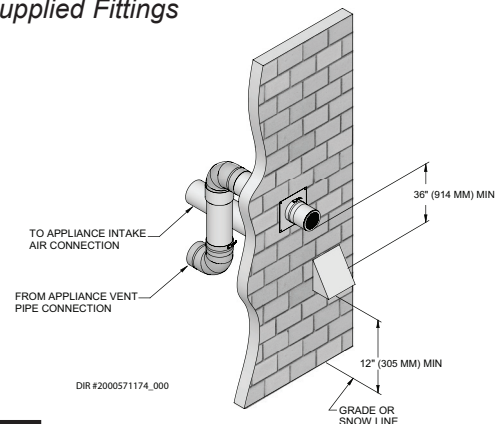


Figure 5-2B Stainless Steel Sidewall Termination with Field Supplied Fittings



NOTICE

PVC/CPVC or ABS is acceptable air inlet pipe material.

- Maintain clearances as shown in FIG's 5-1A thru 5-4, pages 26 thru 28. Also maintain the following:
 - Vent must terminate:
 - At least 6 feet (1.8 m) from adjacent walls.
 - No closer than 12 inches (305 mm) below roof overhang.
 - At least 7 feet (2.1 m) above any public walkway.
 - At least 3 feet (.9 m) above any forced air intake within 10 feet (3 m).
 - No closer than 4 feet (1.2 m) below or horizontally from any door or window or any other gravity air inlet.
 - Air inlet must terminate at least 12 inches (305 mm) above grade or snow line; at least 3 feet (.9 m) below the vent termination (FIG. 5-1B); and the vent pipe must not extend more than 24 inches (610 mm) vertically outside the building.
 - Do not terminate closer than 4 feet (1.2 m) horizontally from any electric meter, gas meter, regulator, relief valve, or other equipment. Never terminate above or below any of these within 4 feet (1.2 m) horizontally.

5 Sidewall direct venting

Vent/air termination – sidewall

8. Locate terminations so they are not likely to be damaged by foreign objects, such as stones or balls, or subject to buildup of leaves or sediment.

Figure 5-3 Clearance to Doors and Windows

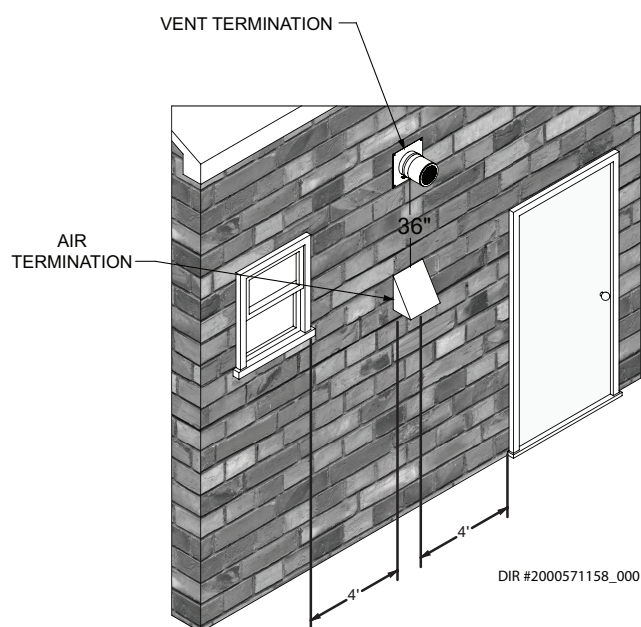
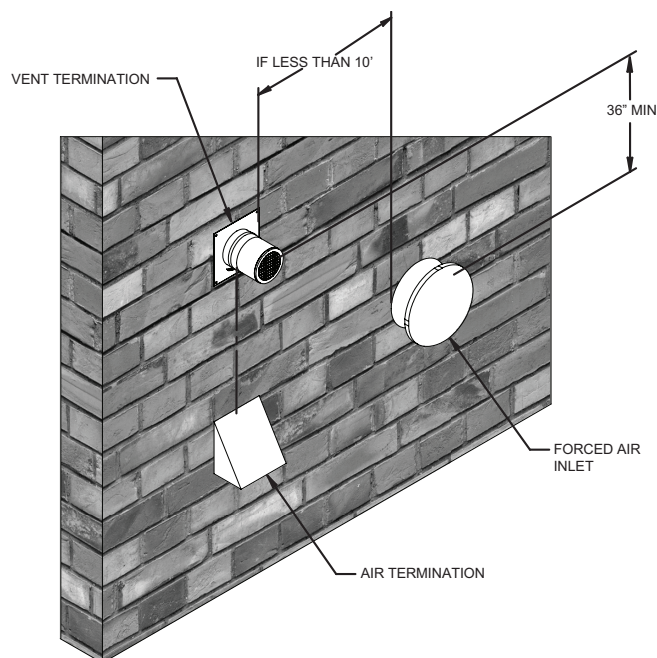


Figure 5-4 Clearance to Forced Air Inlets



CAUTION

Sidewall venting commercial products will result in large exhaust plumes in cold climates. Consideration should be taken when locating in proximity to windows, doors, walkways, etc.

Prepare wall penetrations

1. Air pipe penetration:
 - a. Cut a hole for the air pipe. Size the air pipe hole as close as desired to the air pipe outside diameter.

Vent pipe penetration:

- a. Cut a hole for the vent pipe. For either combustible or noncombustible construction, size the vent pipe hole per the vent manufacturer's instructions.
2. Install the vent and air intake piping. Seal all gaps between the pipes and wall with RTV silicone sealant.
3. Seal all wall cavities.

Termination and fittings

1. The air termination must be oriented at least 12 inches above grade or snow line as shown in FIG. 5-1A, page 26.
2. Maintain the required dimensions of the finished termination piping as shown in FIG. 5-1A, page 26.
3. Do not extend exposed vent pipe outside of the building more than what is shown in this document. Condensate could freeze and block vent pipe.
4. Stainless steel terminations are designed to penetrate walls with a thickness up to 9.25 inches of standard construction.

Multiple vent/air terminations

1. When terminating multiple Armor appliances, terminate each vent/air connection as described in this manual (FIG. 5-5).

WARNING

All vent pipes and air inlets must terminate at the same height to avoid possibility of severe personal injury, death, or substantial property damage.

5 Sidewall direct venting *(continued)*

- Place wall penetrations to obtain minimum clearance of 12 inches (305 mm) between vent pipe and adjacent air inlet, as shown in FIG. 5-5 for U.S. installations. For Canadian installations, provide clearances required by CSA B149.1 Installation Code.
- The air inlet of an Armor is part of a direct vent connection. It is not classified as a forced air intake with regard to spacing from adjacent appliance vents.

Figure 5-5 Multiple Vent Terminations (must also comply with **Figure 5-1A**)

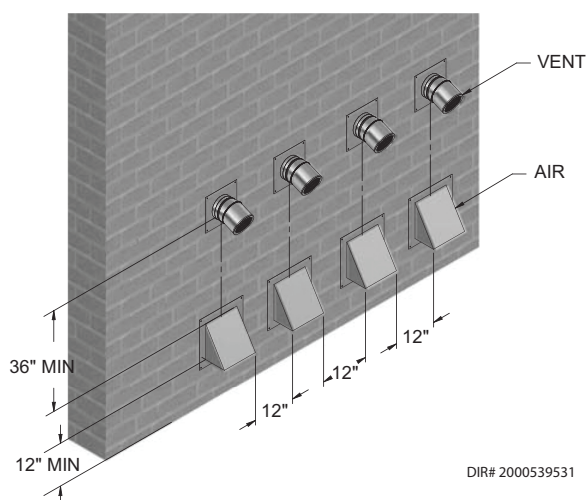


Figure 5-6 Direct Vent Terminations

DIRECT VENT TERMINATIONS			
Air Inlet		Vent Termination	
Dryer Inlet		Straight	
90° Elbow		Mitered	
		23° Elbow	

Figure 5-7 Room Air (Direct Exhaust Terminations)

ROOM AIR (DIRECT EXHAUST TERMINATIONS)	
Vent Termination	
23° Elbow	
45° Elbow	
90° Elbow	

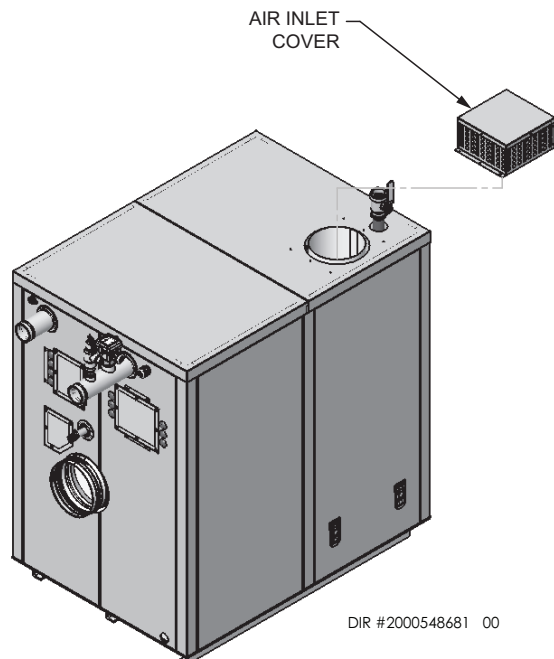
Room air

The Armor appliance may be installed with a single pipe carrying the flue products to the outside while using combustion air from the equipment room.

Follow the requirements in the General Venting section for vent material specifications, vent length requirements, and vent termination requirements.

The air inlet cover is supplied on the unit. Combustion and ventilation air must be supplied to the equipment room per the requirements on pages 16 and 17 of this manual for proper operation of the Armor appliance when utilizing the single pipe method.

Figure 5-8 Room Air Installation



5 Sidewall direct venting

Figure 5-9 Direct Vent Terminal Clearances

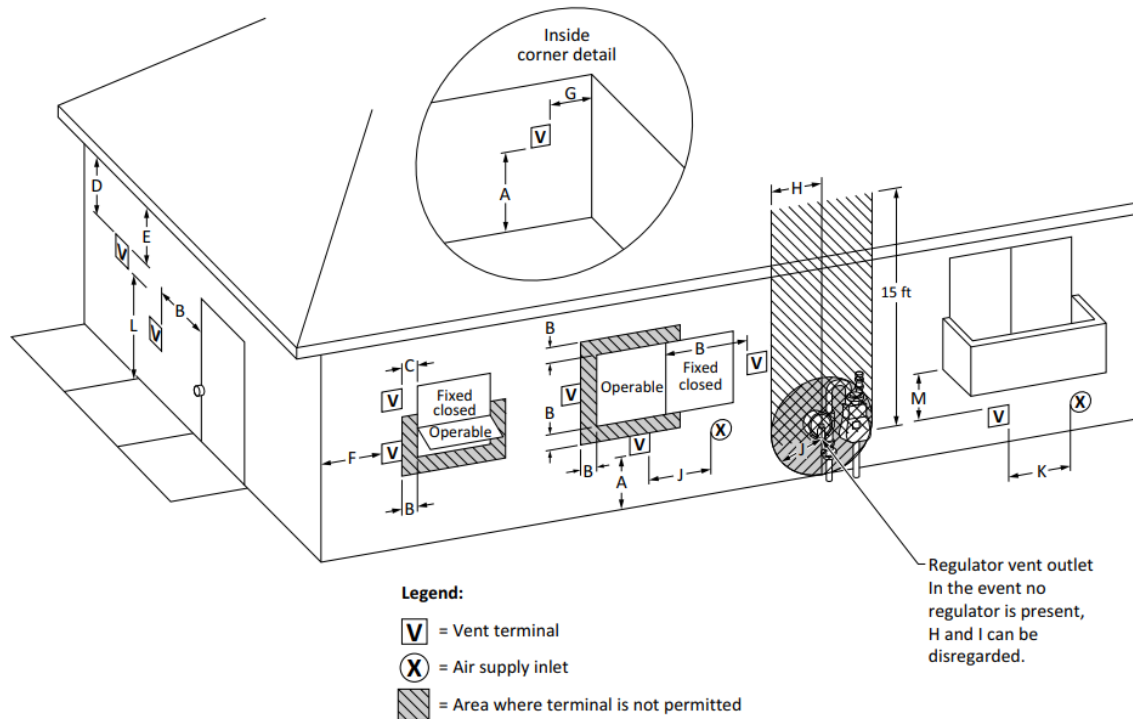


Table 5B Direct Vent Terminal Clearances

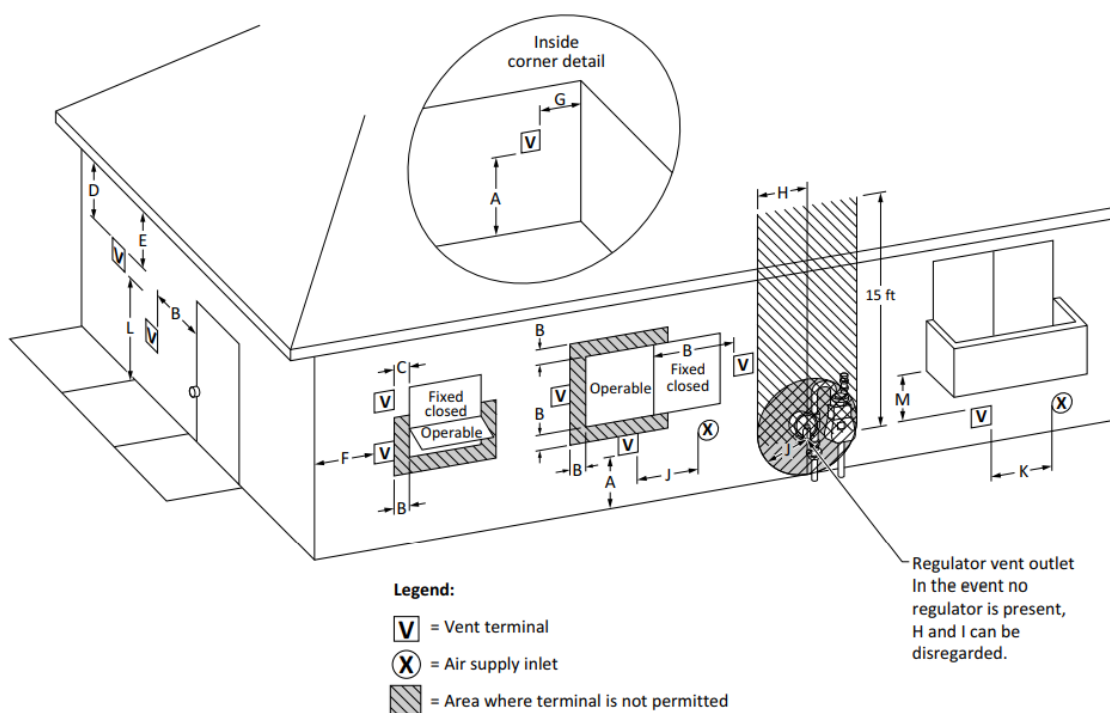
		Canadian Installations¹	US Installations²
A =	Clearance above grade, veranda, porch, deck, or balcony	12 in (30 cm)	12 in (30 cm)
B =	Clearance to window or door that may be opened	6 in (15 cm) for appliances ≤ 10,000 Btuh (3 kW), 12 in (30 cm) for appliances > 10,000 Btuh (3 kW) and ≤ 100,000 Btuh (30 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)	*

5 Sidewall direct venting *(continued)*

Table 5B 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)‡	*
* 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			

Figure 5-10 Other than Direct Vent Terminal Clearances



5 Sidewall direct venting

Table 5C Other than Direct Vent Terminal Clearances

		Canadian Installations¹	US Installations²
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

6 System piping

System water piping methods

Observe a minimum of 1/4 inch clearance around all un-insulated hot water pipes when openings around the pipes are not protected by non-combustible materials.

General piping information

Basic steps are listed below along with illustrations on the following pages (FIG.'s 6-2 thru 6-6), which will guide you through the installation of the Armor appliance.

1. Connect the cold water supply to the inlet side of the appliance.
2. Connect the hot water supply to the outlet side of the appliance.
3. Install a backflow preventer on the cold feed makeup water line.
4. Install the factory supplied pump as shown in FIG.'s 6-2 thru 6-6.
5. Install an expansion tank on the system supply. Consult the tank manufacturer's instruction for specific information relating to tank installation. Size the expansion tank for the required system volume and capacity.
6. Install a drain valve at the lowest point of the system.
7. This appliance is supplied with a relief valve sized in accordance with ASME Boiler and Pressure Vessel Code, Section IV ("Heating Boilers"). Pipe the discharge of the safety relief valve to a suitable drain to prevent injury in the event of pressure relief. Pipe the discharge to a drain. Provide piping that is the same size as the safety relief valve outlet. Never block the outlet of the safety relief valve.

See the *piping illustrations included in this section, FIG.'s 6-2 thru 6-6 for suggested guidelines in piping the Armor appliance.

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

When connecting the unit to piping made of a different material, use of a dielectric fitting or a dielectric union conforming to ASSE 1079 is recommended to prevent corrosion and potential subsequent water leaks at or near the connection. Dielectric fittings may be required by local plumbing codes.

Water flow switch

A water flow switch is factory installed in the outlet piping on all appliances. 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 appliances 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.

Water connections

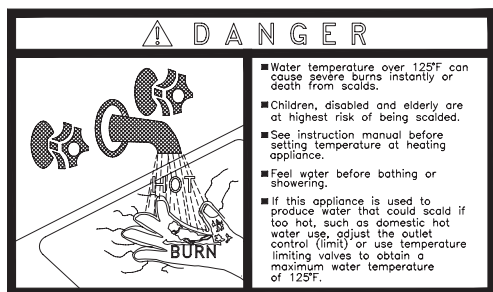
The inlet and outlet water connections on the appliance are grooved pipe connections. A grooved coupling or fitting is required to connect the appliance to the system piping. Victaulic style 107N QuikVic rigid coupling is recommended.

6 System piping

Scalding

This appliance can deliver scalding temperature water at any faucet in the system. Be careful whenever using hot water to avoid scalding injury. Certain appliances such as dishwashers and automatic clothes washers may require increased temperature water. By setting the thermostat on this appliance to obtain the increased temperature water required by these appliances, you may create the potential for scald injury. To protect against injury, you should install a mixing valve in the water system. This valve will reduce point of discharge temperature by mixing cold and hot water in branch supply lines. Such valves are available from the local plumbing supplier.

Figure 6-1 Scald Warning Label Located on the Appliance



The following chart (Table 6A) 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.

Table 6A Approximate Time / Temperature Scald Chart

APPROXIMATE TIME / TEMPERATURE RELATIONSHIPS IN SCALDS	
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

Water chemistry

NOTICE

The temperature rises and circulating pumps shown in Table 6B are selected based on the heating of potable water with a specified water chemistry. See Table 10A in Start-Up Section for recommendations.

Heating of high hardness and/or high total dissolved solids water may require a larger circulating pump and a revised temperature rise specification based on the water chemistry of the water to be heated. See Table 10A in Start-Up Section for recommendations.

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 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.

Piping components

Appliance system piping:

Appliance system piping **MUST** be sized per the pipe requirements listed in Table 6B. Reducing the pipe size can restrict the flow rate through the appliance, causing inadvertent high limit shutdowns and poor system performance.

Check valves:

Field supplied. Check valves are recommended for installation as shown in FIG's 6-2 thru 6-6.

Appliance isolation valves:

Field supplied. Full port ball valves are required. Failure to use full port ball valves could result in a restricted flow rate through the appliance.

Anti-scald mixing valve:

Field supplied. An anti-scald mixing valve is recommended when storing domestic hot water above 115°F.

Unions:

Field supplied. Recommended for unit serviceability.

Temperature and pressure relief valve:

Factory supplied. The temperature and pressure relief valve is sized to ASME specifications. Storage tanks may require additional valves depending on local codes.

Tank sensor:

Lochinvar supplies a tank sensor. 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.

Strainer:

Field supplied. Required to help eliminate debris from causing damage to the heat exchanger. When installing in a pre-existing system, it is recommended to install a filter in the recirculation line capable of removing debris left in the system.

Building Recirculation Filter:

Field supplied as required (see Table 10A). When required, helps to eliminate debris from causing damage to the heat exchanger.

CAUTION

Check recirculation pump size to verify it is sized for filter addition and upsize if necessary.

6 System piping (continued)

Table 6B Appliance Pump Applications / Typical Temperature Rise

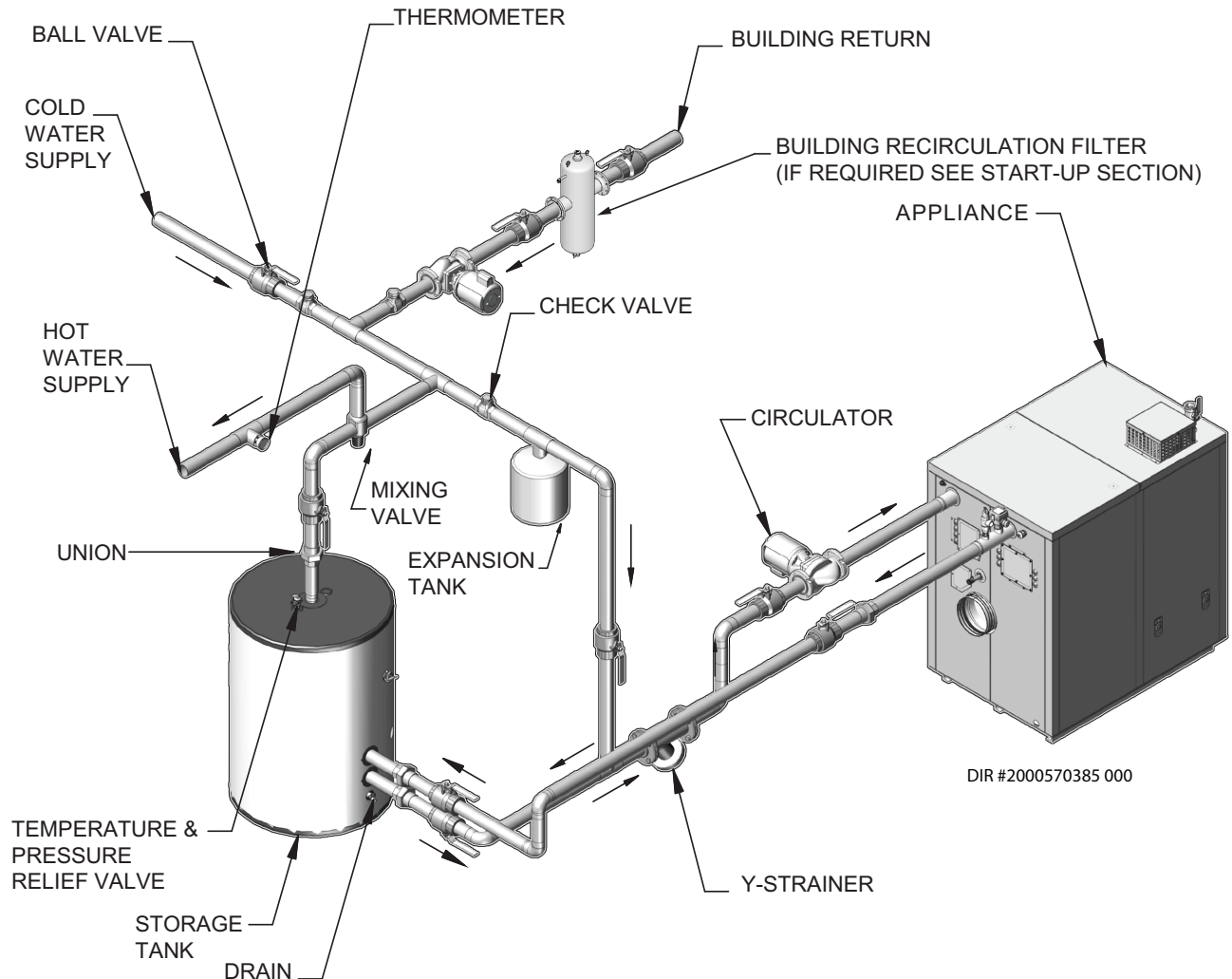
Appliance Pump Applications							
Model	Pipe Size	Water Hardness	B&G Pump	Alternate Grundfos Pump	Flow Rate (GPM)	Loss (FT/HD)	Temp. Rise
1250	2-1/2"	5 to 12 gpg	*100297119	TP50-160	112	23	22°F
	3"	12 to 15 gpg	100297116	N/A	145	35	17°F
1500	2-1/2"	5 to 12 gpg	*100297119	TP50-160	115	22	26°F
	3"	12 to 15 gpg	100297116	N/A	148	31	20°F
2000	3"	5 to 12 gpg	*100297118	TP50-160	145	27	27°F
	4"	12 to 15 gpg	100297115	N/A	180	39	22°F
3000	4"	5 to 15 gpg	*100297117	TP100-80	270	24	22°F
4000	4"	5 to 12 gpg	*100297117	TP100-80	290	19	27°F
		12 to 15 gpg	Contact Factory	N/A	Contact Factory		

*Denotes standard pump supplied with unit.

NOTICE

Pump selections and flow shown above are based on 45 feet of piping, 4 - 90° elbows, and 2 - fully ported ball valves.

Figure 6-2 Single Appliance - Single Tank



CAUTION

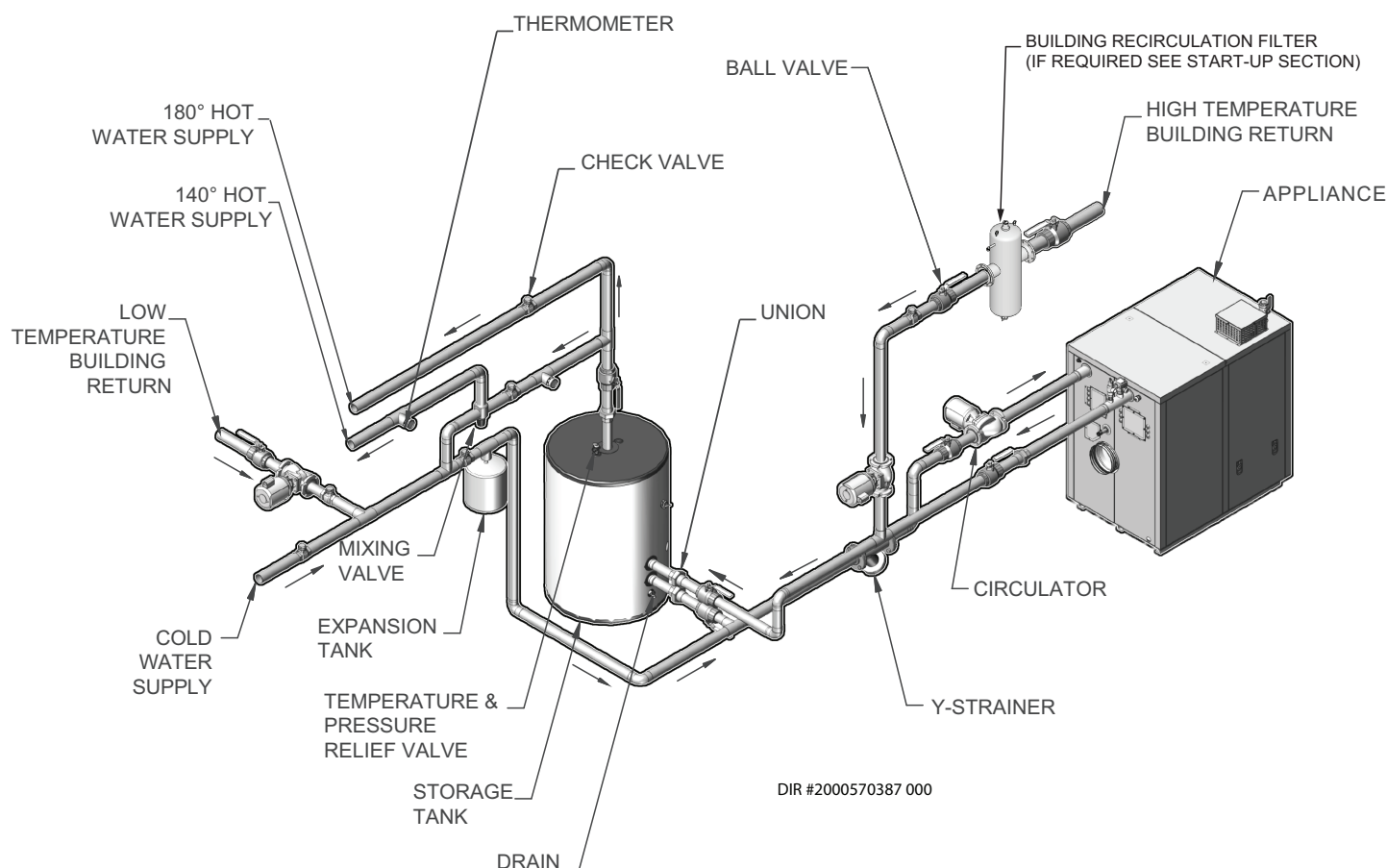
The piping will not support the weight of the appliance circulator pump. Do not attempt to support the weight of the appliance circulator pump with the piping or its accessories. Refer to the pump manufacturer's installation instructions. Failure to comply could result in severe personal injury, death, or substantial property damage.

NOTICE

Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment. The installer must follow all manufacturer's instructions for each system component. The installer is responsible for compliance with local codes.

6 System piping

Figure 6-3 Single Appliance - Single Tank (2 Temperature)



CAUTION

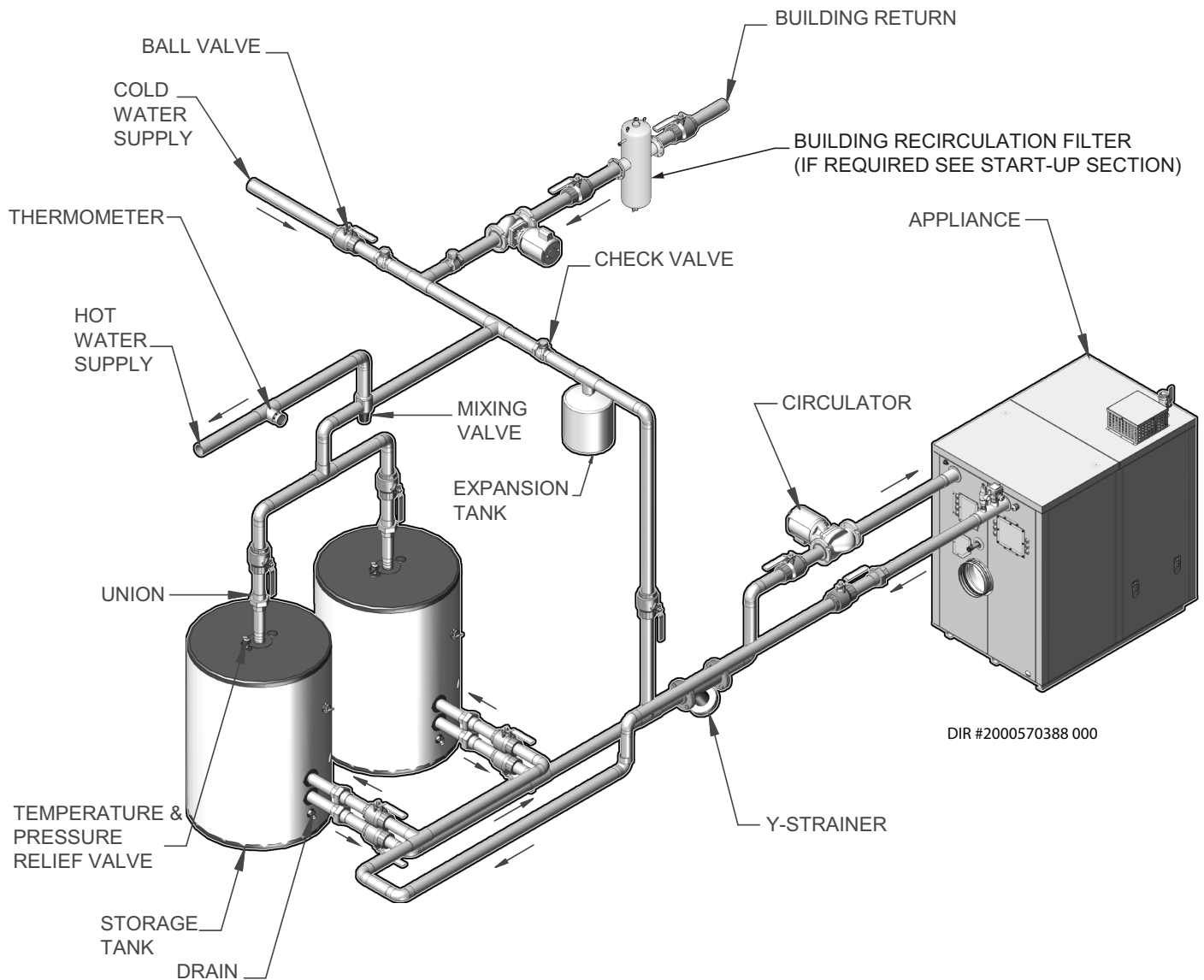
The piping will not support the weight of the appliance circulator pump. Do not attempt to support the weight of the appliance circulator pump with the piping or its accessories. Refer to the pump manufacturer's installation instructions. Failure to comply could result in severe personal injury, death, or substantial property damage.

NOTICE

Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment. The installer must follow all manufacturer's instructions for each system component. The installer is responsible for compliance with local codes.

6 System piping *(continued)*

Figure 6-4 Single Appliance - Double Tank



CAUTION

The piping will not support the weight of the appliance circulator pump. Do not attempt to support the weight of the appliance circulator pump with the piping or its accessories. Refer to the pump manufacturer's installation instructions. Failure to comply could result in severe personal injury, death, or substantial property damage.

NOTICE

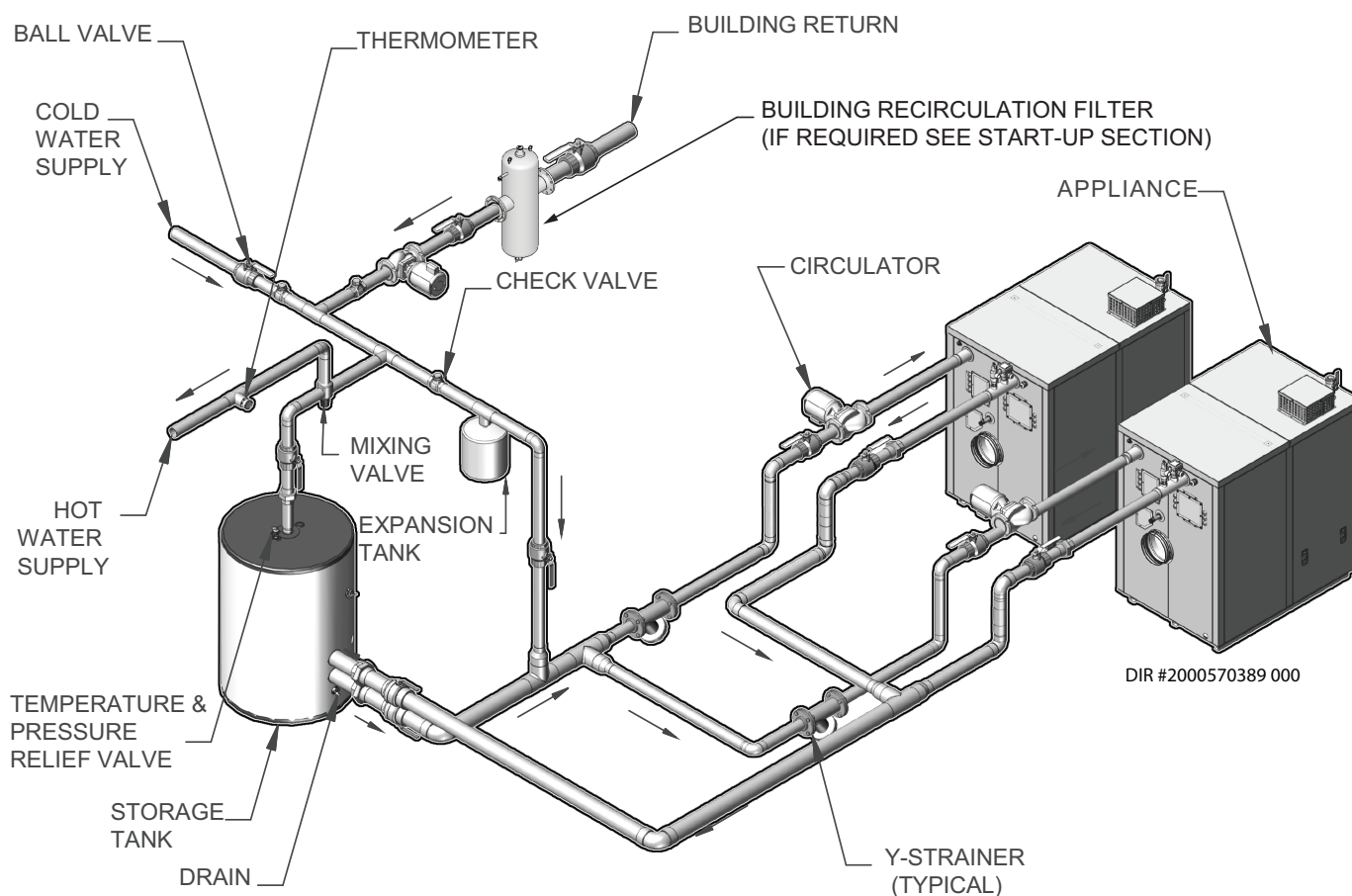
Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment. The installer must follow all manufacturer's instructions for each system component. The installer is responsible for compliance with local codes.

6 System piping

Figure 6-5 Double Appliance - Single Tank

Model	Standard Pump						
	Number of Units						
	2	3	4	5	6	7	8
Required Pipe Sizes in NPT with Standard Pump							
1250	4"	5"	6"	6"	7"	7"	8"
1500	4"	5"	6"	6"	7"	7"	8"
2000	5"	6"	7"	7"	8"	9"	9"
3000	6"	8"	9"	10"	11"	12"	12"
4000	7"	8"	9"	10"	11"	12"	13"

Model	Upsized Pump						
	Number of Units						
	2	3	4	5	6	7	8
Required Pipe Sizes in NPT with Upsized Pump							
1250	5"	6"	7"	7"	8"	9"	9"
1500	5"	6"	7"	7"	8"	9"	9"
2000	5"	6"	7"	8"	9"	10"	10"
3000	6"	8"	9"	10"	11"	12"	12"
4000	Contact Factory						



CAUTION

The piping will not support the weight of the appliance circulator pump. Do not attempt to support the weight of the appliance circulator pump with the piping or its accessories. Refer to the pump manufacturer's installation instructions. Failure to comply could result in severe personal injury, death, or substantial property damage.

NOTICE

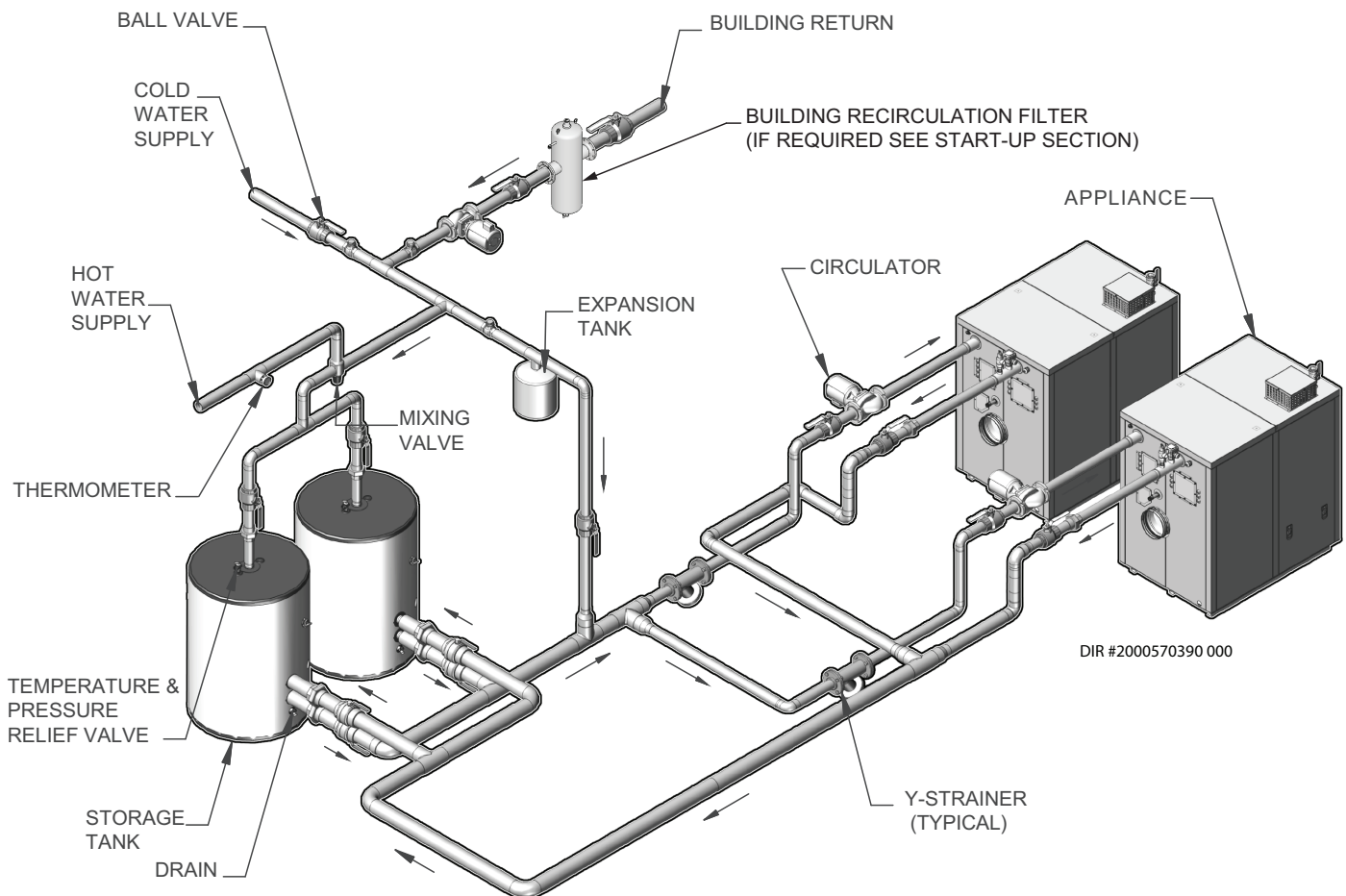
Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment. The installer must follow all manufacturer's instructions for each system component. The installer is responsible for compliance with local codes.

6 System piping (continued)

Figure 6-6 Double Appliance - Double Tank

Model	Standard Pump						
	Number of Units						
	2	3	4	5	6	7	8
Required Pipe Sizes in NPT with Standard Pump							
1250	4"	5"	6"	6"	7"	7"	8"
1500	4"	5"	6"	6"	7"	7"	8"
2000	5"	6"	7"	7"	8"	9"	9"
3000	6"	8"	9"	10"	11"	12"	12"
4000	7"	8"	9"	10"	11"	12"	13"

Model	Upsized Pump						
	Number of Units						
	2	3	4	5	6	7	8
Required Pipe Sizes in NPT with Upsized Pump							
1250	5"	6"	7"	7"	8"	9"	9"
1500	5"	6"	7"	7"	8"	9"	9"
2000	5"	6"	7"	8"	9"	10"	10"
3000	6"	8"	9"	10"	11"	12"	12"
4000	Contact Factory						



CAUTION

The piping will not support the weight of the appliance circulator pump. Do not attempt to support the weight of the appliance circulator pump with the piping or its accessories. Refer to the pump manufacturer's installation instructions. Failure to comply could result in severe personal injury, death, or substantial property damage.

NOTICE

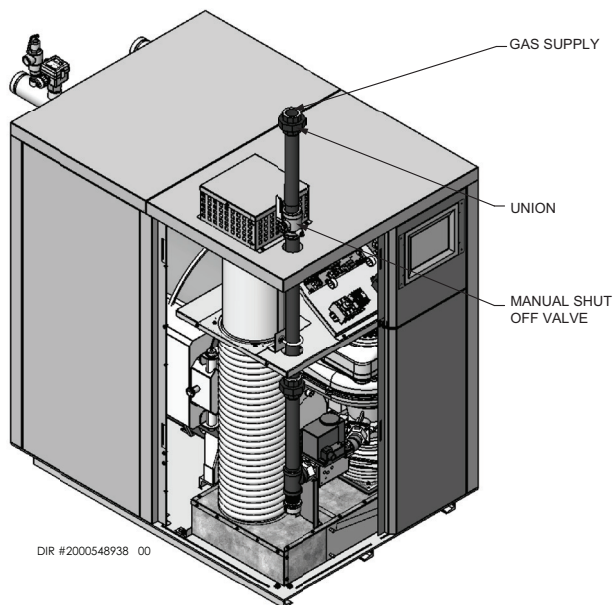
Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment. The installer must follow all manufacturer's instructions for each system component. The installer is responsible for compliance with local codes.

7 Gas connections

Connecting gas supply piping

1. Install ground union for servicing, when required. In Canada – When using manual main shutoff valves, it must be identified by the installer.

Figure 7-1 Gas Supply Piping



2. Support piping with hangers, not by the appliance or its accessories.

WARNING The gas valve and blower will not support the weight of the piping. Do not attempt to support the weight of the piping with the appliance or its accessories. Failure to comply could result in severe personal injury, death, or substantial property damage.

3. Purge all air from the gas supply piping.
4. Before placing the appliance in operation, check the appliance and its gas connection for leaks.
 - a. 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).
 - b. 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).
 - c. The appliance and its gas connection must be leak tested before placing it in operation.

WARNING Do not check for gas leaks with an open flame – use the bubble test. Failure to use the bubble test or check for gas leaks can cause severe personal injury, death, or substantial property damage.

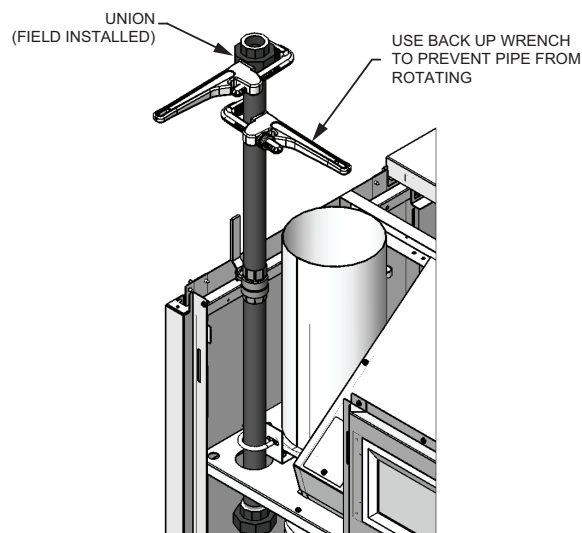
5. Use pipe sealing compound compatible with propane gases. Apply sparingly only to male threads of the pipe joints so that pipe dope does not block gas flow.

WARNING Failure to apply pipe sealing compound as detailed in this manual can result in severe personal injury, death, or substantial property damage.

WARNING Armor appliances are typically shipped ready to fire on natural gas. Check the appliance rating plate to determine which fuel the appliance is set for. If set to natural gas, it may be converted to LP by installing an orifice or by making a gas valve adjustment (see pages 13 thru 14). In order to operate on LP gas, an orifice **MUST BE** installed or a gas valve adjustment **MUST BE** made. Failure to comply could result in severe personal injury, death, or substantial property damage.

WARNING Use two wrenches when tightening gas piping at appliance (FIG. 7-2), using one wrench to prevent the appliance gas line connection from turning. Failure to support the appliance gas connection pipe to prevent it from turning could damage gas line components.

Figure 7-2 Inlet Pipe with Backup Wrench



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

7 Gas connections *(continued)*

Natural gas:

Pipe sizing for natural gas

1. Refer to Table 7A for pipe length and diameter. Based on rated appliance input (divide by 1,000 to obtain cubic feet per hour).
 - a. Table 7A is only for natural gas with specific gravity 0.60 inches, with a pressure drop through the gas piping of 0.30 inches w.c.
 - b. For additional gas pipe sizing information, refer to ANSI Z223.1 (or B149.1 for Canadian installations).

Natural gas supply pressure requirements

1. Pressure required at the gas valve inlet pressure port:
 - Maximum 14 inches w.c. with no flow (lockup) or with appliance on.
 - Minimum 4 inches w.c. with gas flowing (verify during appliance startup).
2. Install 100% lockup gas pressure regulator in supply line if inlet pressure can exceed 14 inches w.c. at any time. Adjust lockup regulator for 14 inches w.c. maximum.

Propane gas:



WARNING Armor appliances are typically shipped ready to fire on natural gas. Check appliance rating plate to determine which fuel the appliance is set for. If set to natural gas, it may be converted to LP by installing an orifice (see pages 13 thru 14). In order to operate on LP gas, an orifice **MUST BE** installed or a gas valve adjustment **MUST BE** made. Failure to comply could result in severe personal injury, death, or substantial property damage.

Pipe sizing for propane gas

1. Contact gas supplier to size pipes, tanks, and 100% lockup gas pressure regulator.

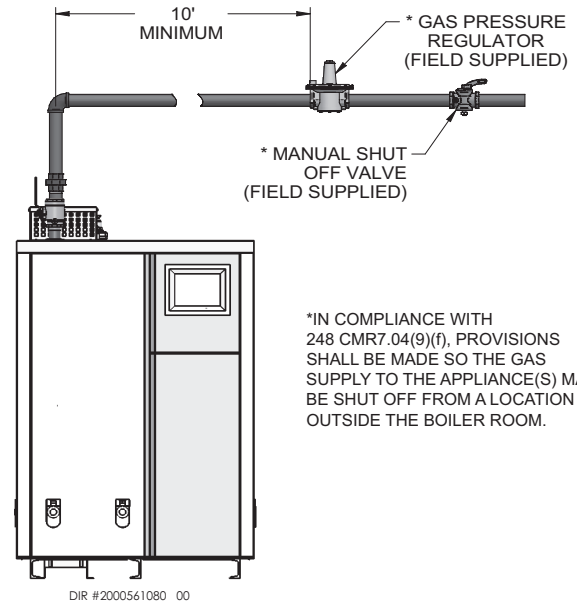
Propane supply pressure requirements

1. Pressure required at gas valve inlet pressure port:
 - Maximum 14 inches w.c. with no flow (lockup) or with appliance on.
 - Minimum 8 inches w.c. with gas flowing (verify during appliance startup).



WARNING Ensure that the high gas pressure regulator is at least 10 feet upstream of the appliance.

Figure 7-3 Gas Supply Piping to Regulator



7 Gas connections

Table 7A Natural Gas Pipe Size Chart

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

⚠ WARNING

Armor appliances are typically shipped ready to fire on natural gas. Check the appliance rating plate to determine which fuel the appliance is set for. If set to natural gas, it may be converted to LP by installing an orifice (see pages 13 thru 14). In order to operate on LP gas, an orifice **MUST BE** installed. Failure to comply could result in severe personal injury, death, or substantial property damage.

Check inlet gas supply

NOTICE

CSA or UL listed flexible gas connections are acceptable, but you must exercise caution to ensure that the line has adequate capacity to allow your appliance to fire at full rate. Consult with local codes for proper installation or service procedures.

⚠ WARNING

DO NOT adjust or attempt to measure gas valve outlet pressure. The gas valve is factory-set for the correct outlet pressure. This setting is suitable for natural gas and propane, requiring no field adjustment. Attempting to alter or measure the gas valve outlet pressure could result in damage to the valve, causing potential severe personal injury, death, or substantial property damage.

The gas piping must be sized for the proper flow and length of pipe to avoid excessive pressure drop. Both the gas meter and the gas regulator must be properly sized for the total gas load.

If you experience a pressure drop greater than 1 inch w.c., the meter, regulator, or gas line is undersized or in need of service. Perform the steps below when checking inlet gas supply:

1. Turn the main power switch to the "OFF" position.
2. Shut off gas supply at the manual gas valve in the gas piping to the appliance.
3. Remove the 1/8" (3 mm) pipe plug on the inlet flange to the valve and install a suitable 1/8" (3 mm) fitting (field supplied) for the manometer tubing. Place the tubing of the manometer over the tap once the set screw is loosened or the 1/8" (3 mm) fitting is installed (depending on model) as shown in FIG. 7-4 on page 43.
4. Slowly turn on the gas supply at the field installed manual gas valve.

5. Turn the power switch to the "ON" position.
6. Adjust the temperature set point on the control display of the SMART TOUCH control module 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 displayed on the control panel.
8. Ensure inlet pressure is within specified range. Minimum and maximum gas supply pressures are specified in this section of the manual.
9. If gas supply pressure is within normal range and no adjustments are needed, proceed on to Step 11.
10. If the gas pressure is out of range, contact the gas utility, gas supplier, qualified installer, or service agency to determine the necessary steps to provide proper gas pressure to the control.
11. Turn the power switch to the "OFF" position.
12. Shut off the gas supply at the manual gas valve in the gas piping to the appliance.
13. Remove the manometer from the pressure tap on top of the gas valve. Remove the 1/8" (3 mm) field supplied fitting and reinstall the pipe plug removed in Step 3.

⚠ WARNING

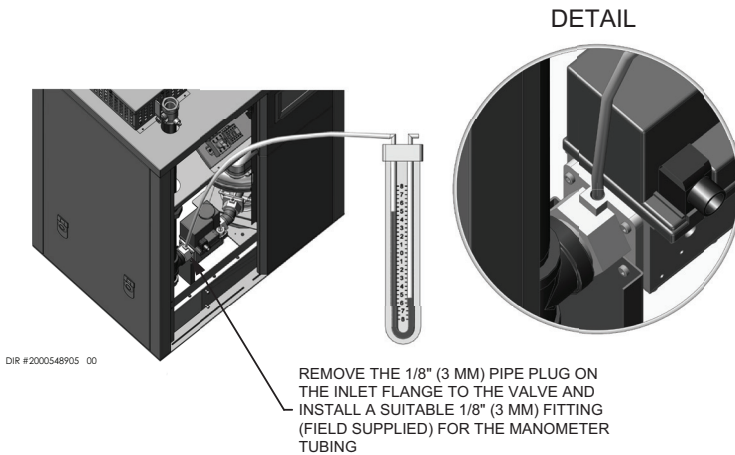
Do not check for gas leaks with an open flame -- use the bubble test. Failure to use the bubble test or check for gas leaks can cause severe personal injury, death, or substantial property damage.

14. Turn on the gas supply at the manual gas valve.
15. Turn the power switch to the "ON" position.
16. Adjust the temperature set point on the control display of the SMART TOUCH control module to the desired water temperature so the appliance will call for heat.

7 Gas connections *(continued)*

17. Check burner performance by cycling the system while you observe burner response. The burner should ignite promptly. Flame pattern should be stable. Turn system off and allow burner to cool, then cycle burner again to ensure proper ignition and flame characteristics.

Figure 7-4 Inlet Gas Supply Check



Gas pressure

The gas pressure must remain between 4 inches w.c. (natural), 8 inches w.c. (LP) minimum, and 14 inches w.c. (natural and LP) maximum during stand-by (static) mode and while in operating (dynamic) mode. If an inline regulator is used, it must be a minimum of 10 feet from the Armor appliance. It is very important that the gas line is properly purged by the gas supplier or utility company. Failure to properly purge the lines or improper line sizing, will result in ignition failure.

The problem is especially noticeable in NEW LP installations and also in empty tank situations. This can also occur when a utility company shuts off service to an area to provide maintenance to their lines.

Gas valve replacement

The gas valve **MUST NOT** be replaced with a conventional gas valve under any circumstances. As an additional safety feature, this gas valve has a flanged connection to the venturi and blower.



WARNING

Failure to follow all precautions could result in fire, explosion, or death!



WARNING

DO NOT adjust gas valve outlet pressure. The gas valve is factory-set for the correct outlet pressure. This setting is suitable for natural gas and propane, requiring no field adjustment. Attempting to alter the gas valve outlet pressure could result in damage to the valve, causing potential severe personal injury, death, or substantial property damage.

8 Field wiring

⚠ 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.

NOTICE

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

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

The appliance 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, or local codes or regulations.
2. In Canada, CSA C22.1 Canadian Electrical Code Part 1, and any local codes.

Line voltage connections

1. **For 1250 - 1500 Models:** Connect 120V power wiring to the line voltage terminal strip in the junction box, as shown in FIG. 8-1A.
- For 2000 - 3000 Models:** Connect 208V power, 3 phase wiring to the line voltage terminal strip in the junction box, as shown in FIG. 8-1B.
- For 4000 Models:** Connect 480V power, 3 phase wiring to the line voltage terminal strip in the junction box, as shown in FIG. 8-1C.
2. Provide and install a fused disconnect or service switch (25 amp recommended) as required by the code (see FIG. 8-1A thru 8-1C).
3. The DHW pump is shipped loose on all Armor models. Wire the pump as shown in FIG. 8-1A thru 8-1C.
4. The Armor appliance is capable of controlling a building recirculation pump (field supplied). Wire the building recirculation pump as shown in FIG. 8-1A thru 8-1C.
5. A field supplied contactor is required between the appliance and pumps.

Figure 8-1A Line Voltage Field Wiring Connections - 120V

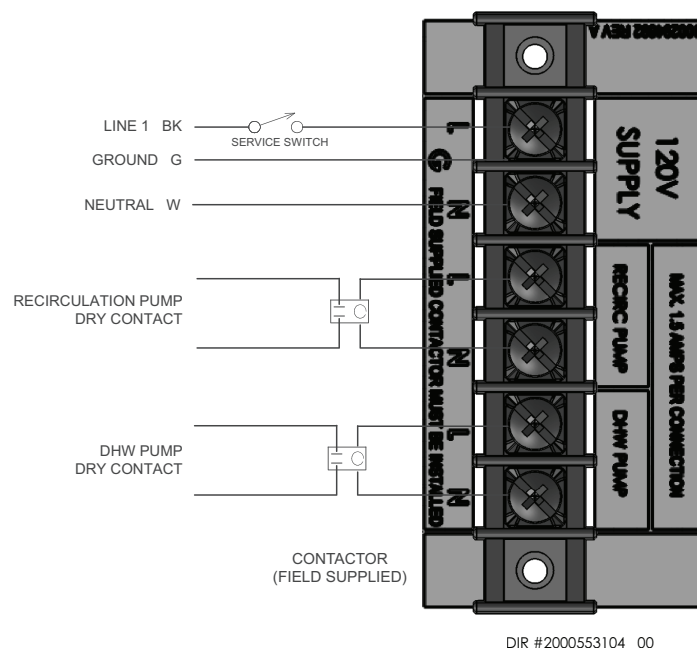
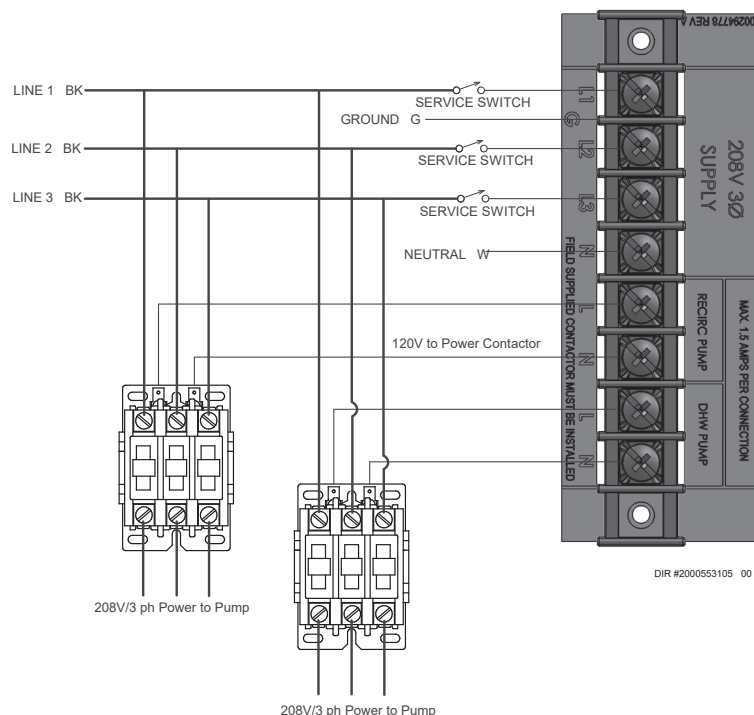
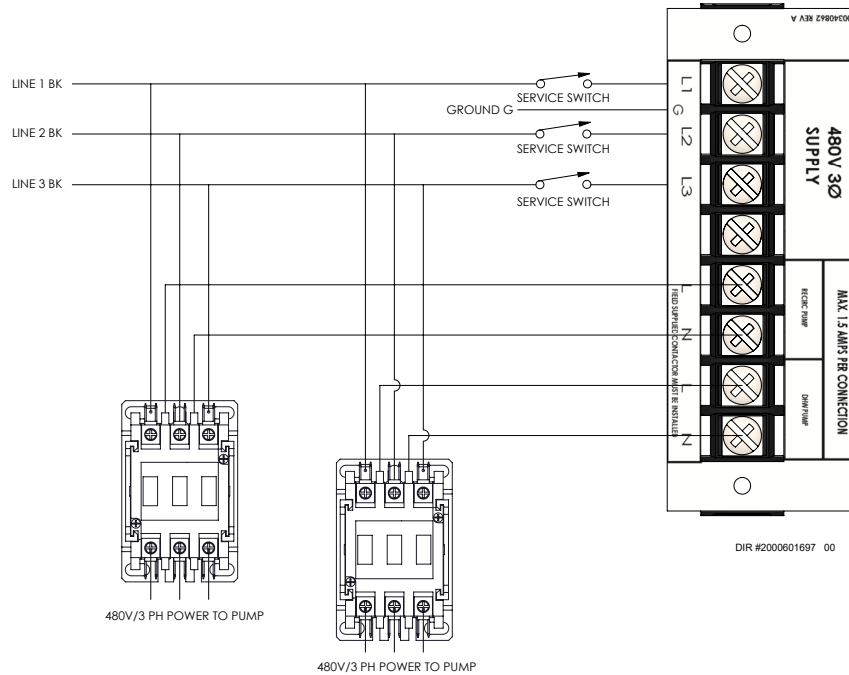


Figure 8-1B Line Voltage Field Wiring Connections - 208V



8 Field wiring *(continued)*

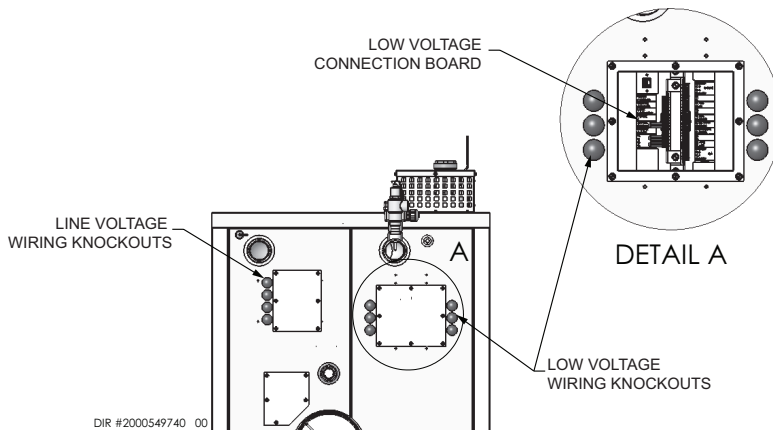
Figure 8-1C Line Voltage Field Wiring Connections - 480V



Low voltage connections

1. Route all low voltage wires through the knockouts in the rear of the appliance, as shown in FIG. 8-2.
2. Connect low voltage wiring to low voltage connection board as shown in FIG. 8-3 on page 47 of this manual and the appliance wiring diagram.

Figure 8-2 Routing Field Wiring



Tank thermostat

1. Connect the tank thermostats (isolated contact only) to the tank thermostat contacts as shown in FIG. 8-3.

Tank sensor

1. By installing a tank sensor, the SMART TOUCH control can perform the tank thermostat function. The SMART TOUCH control automatically detects the presence of this sensor and generates a DHW call for heat when the tank temperature drops below the programmed differential and finishes the call for heat when the tank temperature reaches above the programmed offset.
2. The tank sensor is the only sensor suitable for use with the SMART TOUCH control. Connect the sensor leads to the Tank Sensor terminals on the Low Voltage Connection Board (FIG. 8-3).

Louver relay

If louvers need to operate when the appliance fires, they can be controlled by this output. Connect these terminals to a 24 VAC relay coil, which is wired to operate the louvers (FIG. 8-3).

Louver proving switch

When the operation of the louvers needs to be verified before the appliance fires, remove the jumper wire from these terminals and connect them to the normally open contacts on its proving switch (FIG. 8-3).

8 Field wiring

Flow switch

A flow switch is used to guarantee flow through the appliance before allowing it to fire. The flow switch is installed at the appliance outlet.

Rate output

This output provides a 0 - 10V signal that is proportional to the firing rate of the appliance. This may be used by a BMS system to monitor the actual rate of the appliance.

ModBus

When the optional ModBus interface module is installed, the RS-485 ModBus cable is connected to these terminals. Use shielded, 2-wire twisted pair cable. If desired, the shield can be connected to ground by installing a jumper wire between terminals 1 and 3 on connector X5 on the optional ModBus interface module.

Appliance Building Management System (BMS)

1. An external control may be connected to control either the firing rate or the set point of the appliance. If the external control uses a set of contacts to enable the appliance, connect the contacts to the Tank Thermostat terminals. Otherwise, the SMART TOUCH control will be enabled by the 0-10V signal.
2. Make sure the (-) terminal is connected to the (-) or common output terminal of the external control, and the (+) terminal is connected to the (+) or 0 - 10 VDC terminal of the external control. Make sure the (-) voltage is not below ground.

Enable

When there is a need to override a call for heat, remove the jumper wire from these terminals and connect them to the normally closed enable switch.

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 appliance is responding to a call for heat.

Alarm contacts

The SMART TOUCH control closes another set of contacts whenever the appliance 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 appliance is down.

Wiring of the cascade

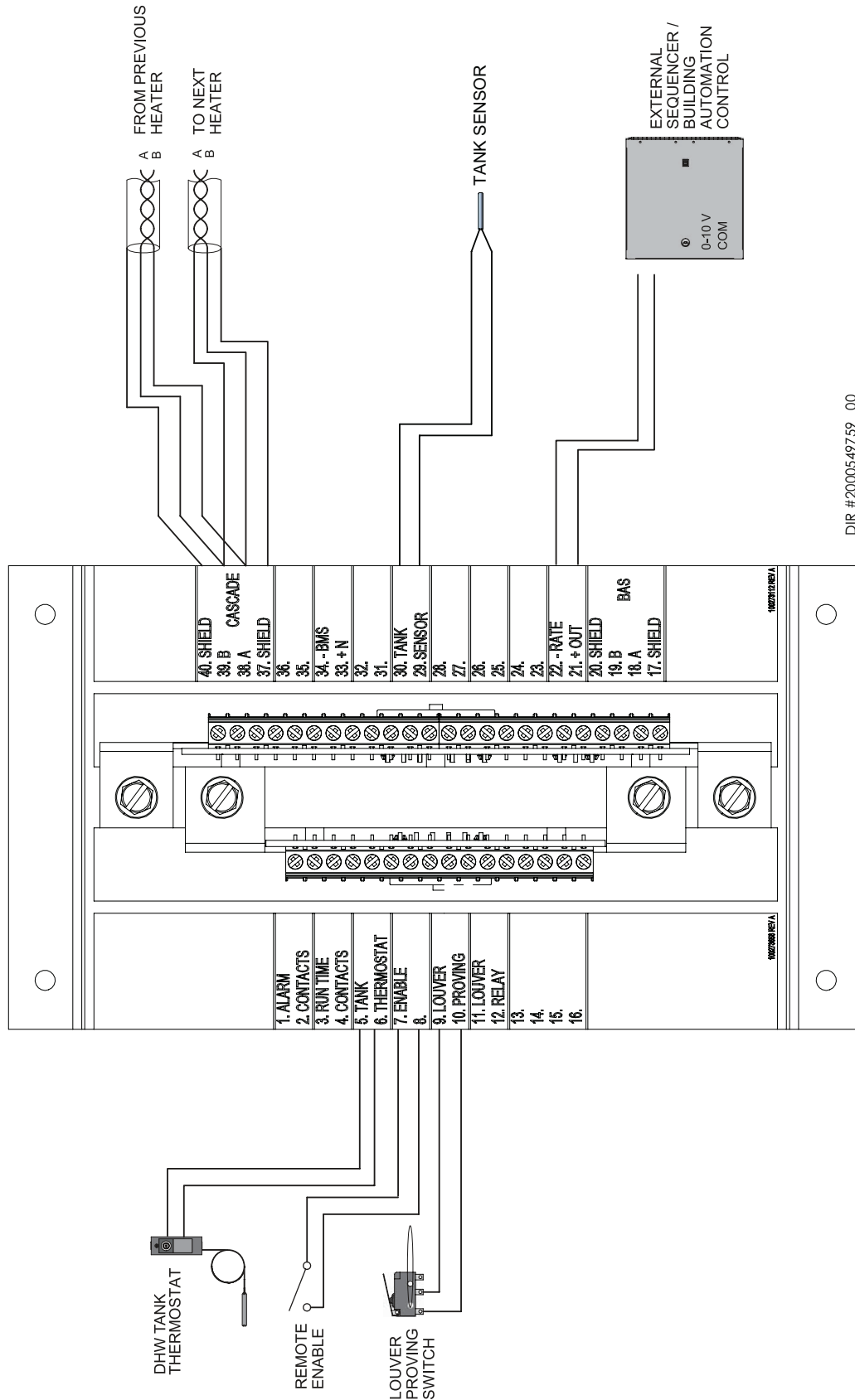
When wiring the appliances for Cascade operation, select one appliance as the Leader appliance. The remaining appliances will be designated as Members. See page 54 "Configuration of the Cascade" for a detailed explanation of this procedure.

Connect the tank sensor to the Leader appliance. For the Cascade system to work properly the tank sensor must be installed. The tank sensor should be wired to the low voltage connection board at the terminals marked for the tank sensor (see FIG. 8-3). The Leader control will use the water temperature at the tank sensor to control the operation of the Cascade.

Communication between the Leader appliance and the Member appliances is accomplished by using shielded, 2-wire twisted pair communication cable. Connect one of the twisted pair wires to Cascade terminal A on each of the Low Voltage Connection boards, and the other wire of the twisted pair to Cascade terminal B on each of the Low Voltage Connection Boards. Connect the shield wires to one of the shield terminals on the Low Voltage Connection Boards (FIG. 8-3). If more than two appliances are on the Cascade, daisy chain the wiring from the Cascade terminals on the second appliance to the Cascade terminals on the third appliance, then from the third to the fourth, and so on. The connections between appliances can be made in any order, regardless of the addresses of the appliances. Try to keep each cable as short as possible.

8 Field wiring *(continued)*

Figure 8-3 Low Voltage Field Wiring Connections



DIR #2000549759 00

9 Condensate disposal

Condensate drain

1. The Armor is a high efficiency appliance that produces condensate.
2. The rear of the appliance has a 1 inch (25.4 mm) hose and a 3/8 inch (9.8 mm) hose for connection to the condensate trap.
3. Connect the two (2) condensate hoses to the condensate trap.
4. The condensate trap must be installed at the same level or below the appliance base.
5. The condensate trap is sized for a 1" PVC outlet connection pipe.
6. Plug the wiring connection from the condensate trap into the connector located on the back of the unit.
7. Slope condensate tubing down and away from the appliance into a drain or condensate neutralizing filter. Condensate from the Armor will be slightly acidic (typically with a pH from 3 to 5). Install a neutralizing filter if required by local codes.

A neutralizer kit (FIG. 9-1) is available from the factory. The neutralizer kit must be placed on a surface that is a minimum of 3 inches lower than the condensate trap with field supplied piping (vacuum break) installed between the condensate trap and the neutralizer kit.

8. Do not expose condensate line to freezing temperatures.

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.

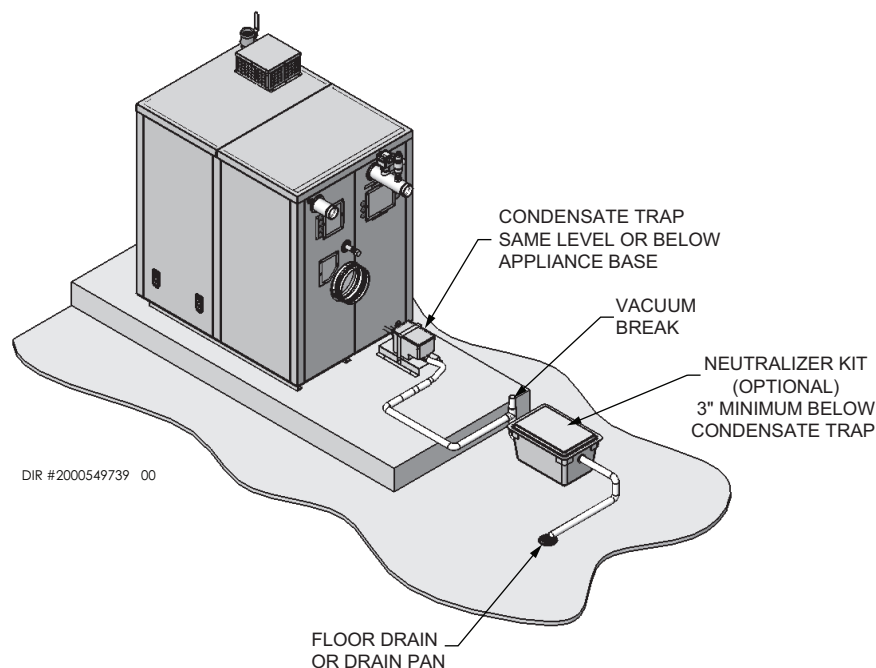
NOTICE

To allow for proper drainage on large horizontal runs, a second line vent may be required and tubing size may need to increase to 1 inch (25 mm).

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, condensate can exit from the appliance tee, resulting in potential water damage to property.

9. A condensate removal pump is required if appliance is below the drain. When installing a condensate pump, select one approved for use with condensing appliances and furnaces. The pump should have an overflow switch to prevent property damage from condensate spillage. The switch should be wired to the auxiliary device proving switch terminals on the low voltage connection board.

Figure 9-1 Condensate Disposal



NOTE: Neutralizer shown for illustrative purposes only. Actual neutralizer may vary.

10 Start-up

Check/control water chemistry

NOTICE

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

See the following table for properly operating the appliance with the appropriate water chemistry. Good water quality will help extend the life of the appliance by reducing the effects of scale buildup and corrosion.

Table 10A Water Chemistry

WATER CHEMISTRY		
Specification	Range	Requirement
Hardness	< 5 gpg	Follow recommendations detailed below (See Notice 3)
	5 to 12 gpg	Use Table 6B for pump recommendation
	12 to 15 gpg	Use Table 6B for pump recommendation
	> 15 gpg	Water softening system required (See Notice 4)
Dissolved Solids	< 350 ppm	Hardness level must be met
pH Level	6.5 to 8.5	Acceptable range
Chloride	< 150 ppm	Acceptable range

NOTICE

- Do not use the appliance to directly heat swimming pool or spa water.
- At initial fill and during water heater start-up and testing, check system thoroughly for any leaks. Repair all leaks before proceeding further.
- When water hardness levels are less than 5 gpg or 85.5 mg/l, the following is recommended:
 - Flush and clean existing water heating system prior to installation.
 - Inspect and, if necessary, replace the anodes in any existing tanks.
 - Install a Y-strainer on the inlet of each water heater as detailed in Section 6.
 - Limit the run time of the hot water recirculation loop.
 - 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.
- When water softener is required, a Template Assisted Crystallization system is recommended.

Check for gas leaks

WARNING

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

WARNING

DO NOT adjust gas valve outlet pressure. The gas valve is factory set for the correct outlet pressure. This setting is suitable for natural gas and propane, requiring no field adjustment. Attempting to alter the gas valve outlet pressure could result in damage to the valve, causing potential severe personal injury, death, or substantial property damage.

WARNING

Propane appliances 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 start-up (and periodically thereafter), have the propane supplier verify the correct odorant level in the gas.

10 Start-up

Final checks before starting the appliance

- ❑ Read the Armor Service Manual to familiarize yourself with SMART TOUCH control module operation. Read this manual, page 51 for proper steps to start the appliance.
- ❑ Verify the appliance and system are full of water and all system components are correctly set for operation.
- ❑ Verify the preparation procedures of Section 10, pages 49 and 50 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 appliance

1. Read and follow the operating instructions in FIG. 10-1, page 51.

If appliance does not start correctly

1. Check for loose connections, blown fuse, or service switch off.
2. Is appliance water temperature above 200°F?
3. Is tank thermostat or tank set point set below room temperature?
4. Is gas turned on at meter or appliance?
5. Is incoming gas pressure less than 4 inches w.c.?

If none of the above corrects the problem, refer to the Troubleshooting Section of the Armor Service Manual.

Check system and appliance

❑ Check water piping

1. Check system piping for leaks. If found, shut down the appliance and repair immediately. (See WARNINGS on pages 49 and 50 (Start-up) regarding failure to repair leaks.)
2. Check Delta T. Reference Section 6 - *System Piping* on page 34 for more information regarding Delta T.
3. 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 appliance for gas odor following the procedure on page 40 of this manual (*Connecting Gas Supply Piping*).

WARNING

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

❑ Propane appliances – verify conversion

1. Verify propane conversion has been completed per the Propane Conversion instructions.

WARNING

DO NOT adjust gas valve outlet pressure. The gas valve is factory-set for the correct outlet pressure. This setting is suitable for natural gas and propane, requiring no field adjustment. Attempting to alter the gas valve outlet pressure could result in damage to the valve, causing potential severe personal injury, death, or substantial property damage.

WARNING

Armor appliances are typically shipped ready to fire on natural gas. Check appliance rating plate to determine which fuel the appliance is set for. If set to natural gas, it may be converted to LP by installing an orifice or by making a gas valve adjustment (see pages 13 and 14). In order to operate on LP gas, an orifice MUST BE installed or a gas valve adjustment MUST BE made. 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 appliance 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 appliance 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.

10 Start-up *(continued)*

Figure 10-1 Operating Instructions

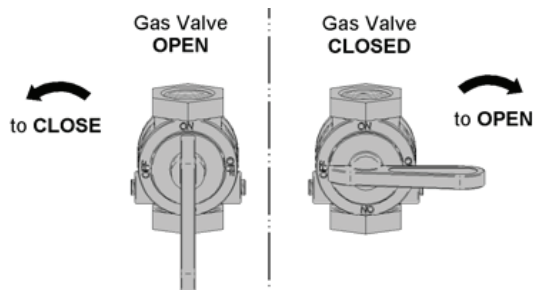
FOR YOUR SAFETY READ BEFORE OPERATING

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.

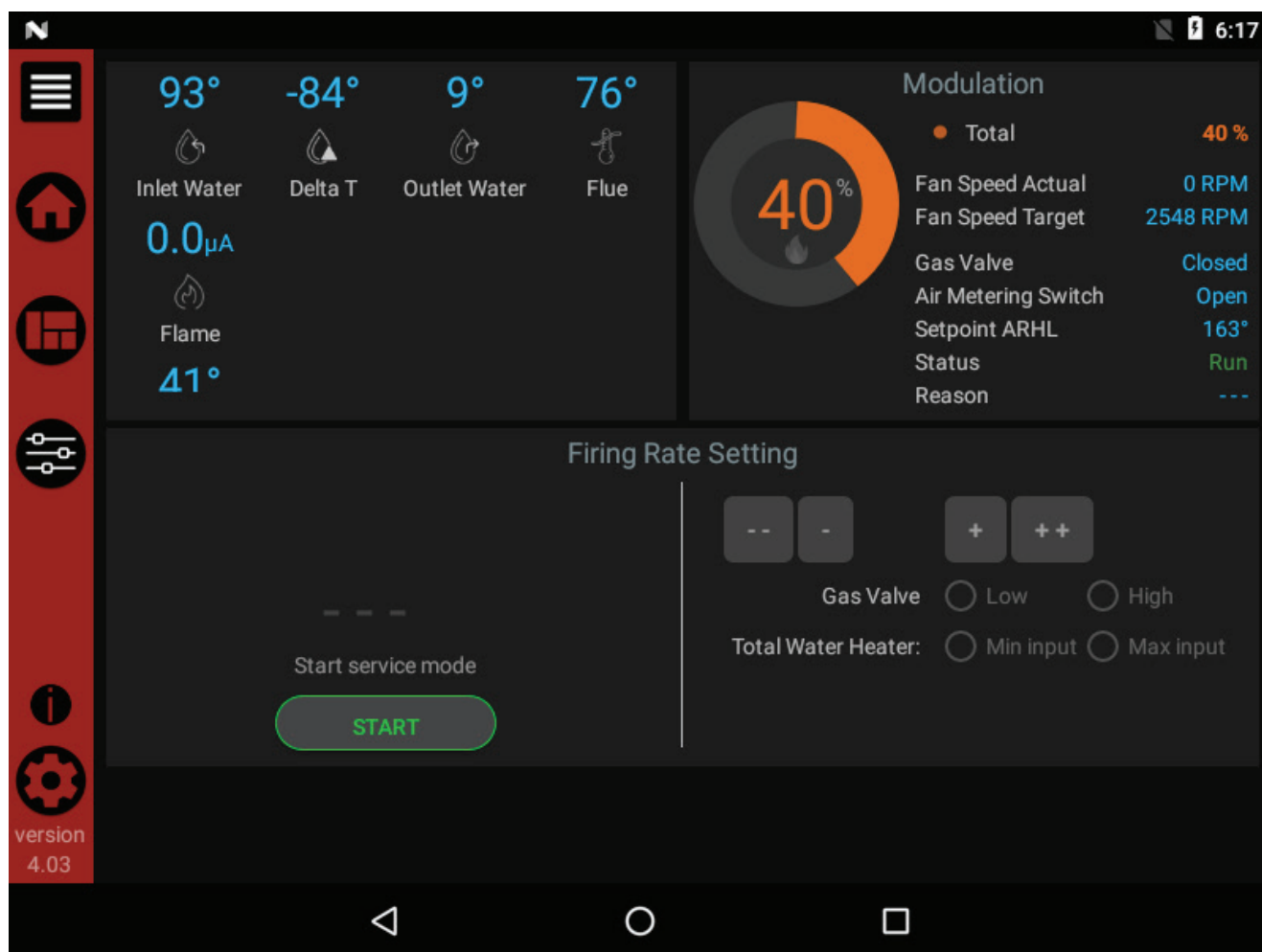
LBL20053 REV B

10 Start-up

Check flame and combustion *(continued)*

6. Select the Service Maintenance Screen. The tabs will scroll (up and down) to reveal more options. See FIG. 10-2.
7. Once the heat exchanger has modulated up to rate, measure the combustion. The values should be in the range listed in Table 3H of the Armor 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 Armor Service Manual for possible causes and corrective actions.
8. Once the combustion analysis is complete, test the safety shutoff device by turning the manual shutoff valve to the OFF position and ensuring that the appliance shuts down and registers an alarm. Open the manual shutoff valve and reset the control.

Figure 10-2 Service Maintenance Screen



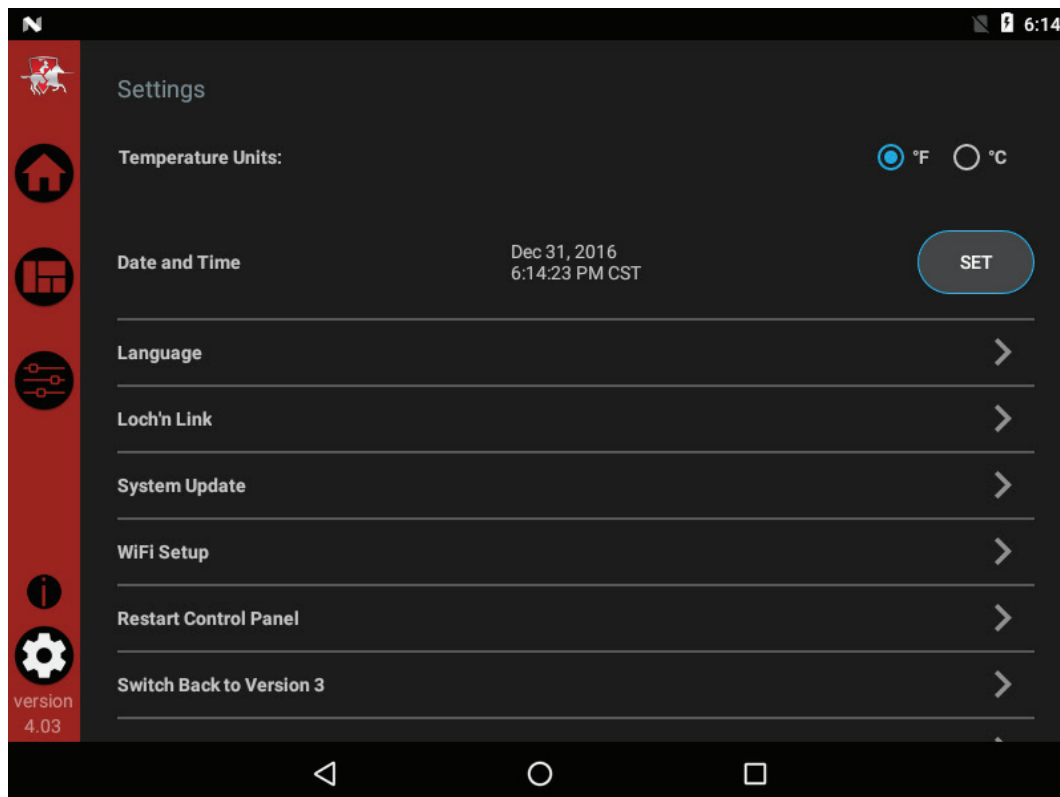
10 Start-up *(continued)*

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. 11-1).
 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 10-3 Settings



10 Start-up

Configuration of the cascade

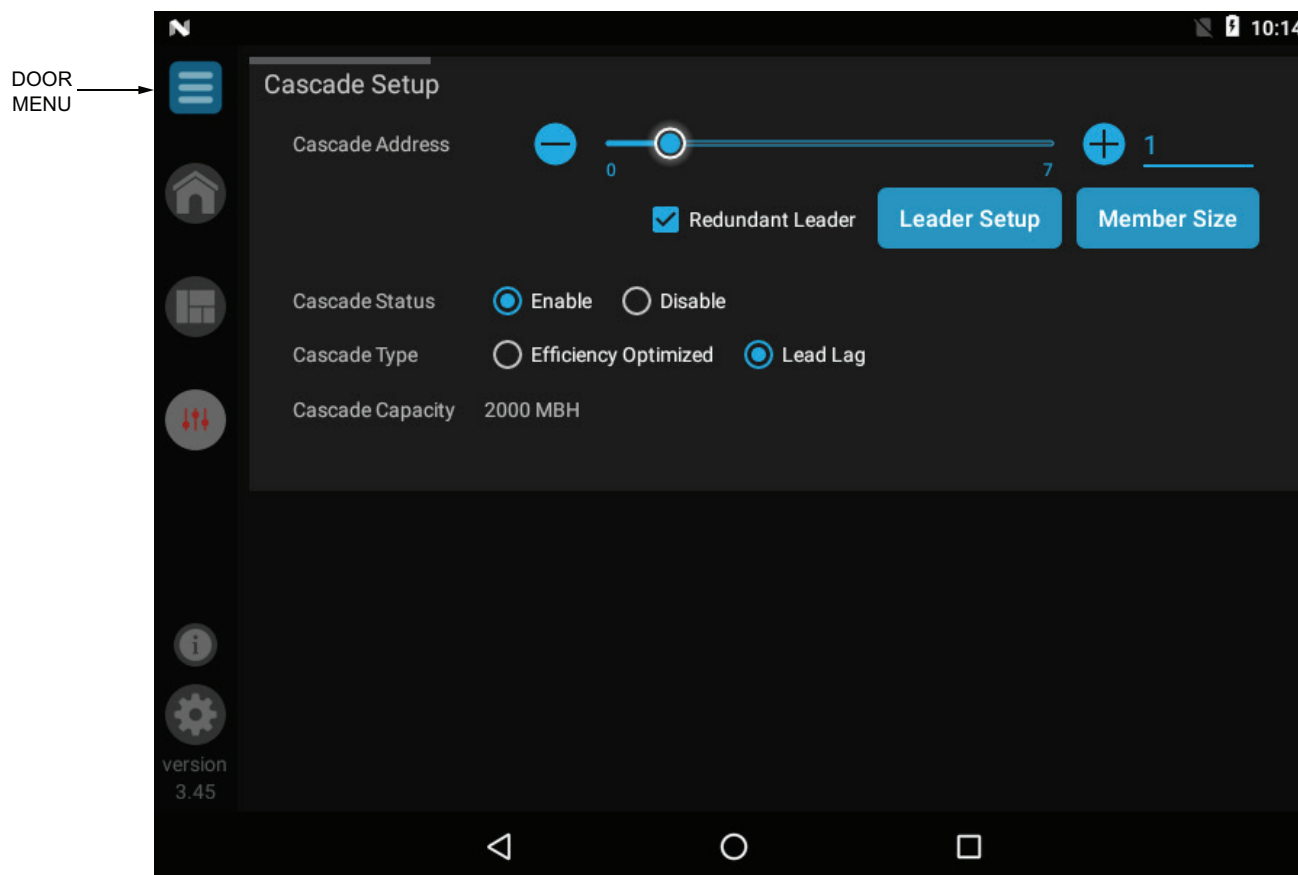
NOTE: For more detailed instructions, please refer to the Armor Service Manual.

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. 10-4.
4. Each unit must have a unique address set. The leader has more options which are described in the Armor 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 10-4 Cascade Screen



11 Operating information

General

How the appliance operates

The Armor uses an advanced stainless steel 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 Armor appliance is equipped with a SMART TOUCH control module. The SMART TOUCH control module receives inputs from appliance sensors and external devices. The control module activates and controls the blowers and gas valves to regulate heat input and switches the appliance, DHW, and building recirculation 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 appliance operating modes.

Control inputs and outputs

Enable

This input overrides a call for heat from the tank sensor.

Tank Thermostat

This input tells the appliance to provide water for heating a storage tank.

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

The Armor 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.

Tank Thermostat / Tank Sensor

The SMART TOUCH control allows the connection of a tank thermostat or tank sensor to the low voltage connection board. When a tank sensor is connected, the tank thermostat input is ignored.

Anti-cycling

After a heating demand has been satisfied, the control will delay the next 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.

DHW pump control

When a call for heat starts, the pump is turned on. After the call for heat ends, the pump will run for an additional period of time.

Louver

When the appliance 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 Armor 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, the heating load, and various other temperature limitations.

11 Operating information

Gradient limiting

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

Night setback

The controller may be programmed to reduce the tank set point 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. 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 appliance is firing at minimum rates, the control will increase the firing rate when the flame signal drops too low.

ModBus

The Armor appliance 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 appliance, 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 appliance 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.

Protection features

Outlet temperature, flue temperature, and temperature rise limiting

The outlet water temperature is monitored by the appliance outlet temperature sensor. When the outlet temperature exceeds 195°F (91°C), the unit will reduce the fan speed. If the outlet water temperature exceeds 205°F (96°C) the control will shut the unit down until the minimum off time has expired and the outlet drops 10°F (-12°C).

The control module monitors the flue temperature by a sensor located in the flue exhaust. If the flue temperature exceeds 215°F (102°C) the control will reduce the maximum fan speed. If the flue temperature exceeds 250°F (121°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 the control determines the temperature rise is too high, it will either reduce the firing rate or shut down the unit as appropriate. The unit will restart automatically once the temperature difference has dropped below the allowable rise and the minimum off time has expired.

Freeze protection

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

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

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



CAUTION

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 appliance and system.

11 Operating information *(continued)*

Sequence of operation

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 appliance provides dry contacts for indicating when the appliance 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 appliance 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.

Appliance temperature regulation

Operating temperature (target)

The SMART TOUCH control module senses water temperature and regulates appliance firing and firing rate to achieve a target temperature. The target temperature can be set between 32°F (0°C) and 185°F.

High limit operations

The Armor SMART TOUCH control has two (2) integral limits, one auto reset and one manual reset. The integral high limits are UL353 certified.

If the outlet temperature exceeds 205°F, integral manual reset high limit action occurs. The appliance will shut down until the outlet water cools down and the appliance is reset through the user interface.

Low water cutoff protection

A low water cutoff device with test and reset functionality is provided in the appliance as optional 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 temperature is too high, the control module modulates down and will shut the appliance off. This ensures appliance shutdown in the event of low flow conditions.

11 Operating information

Cascade

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

Once the Leader appliance 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. 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 Armor Service Manual for an explanation of the offset and differential). The Leader will energize the lead appliance on the Cascade. For a new start-up this will be the Leader appliance.

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 appliances in a way that is the most efficient. This allows more appliances 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 appliances at a time as possible. This method will not bring on another appliance until the current number of appliances cannot meet the demand.

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

Sequence of the cascade

To equalize the run time of all appliances 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.

Night Setback operations with Cascade

Night Setback operation of the appliances within the Cascade are available. Programming will be done through the Leader appliance. Refer to the Armor Service Manual for information regarding Night Setback.

11 Operating information *(continued)*

Sequence of operation

1.	Upon a call for heat, the control turns on the DHW pump.
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.
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.	Once the DHW call for heat is satisfied, the control will turn off the gas valve and begin the Post-Purge cycle. Any pumps that are running will begin their respective Pump Delay cycles.
10.	At the end of the Post-Purge cycle, the louver relay contacts will de-energize.
11.	At the end of the Pump Delay cycle(s), the pump(s) will be turned off.

11 Operating information

SMART TOUCH™ w/Armor CON•X•US Interface

The Home Screen displays basic information on how the unit is running. It is divided into the following sections: Status, Demand, Modulation, Sensors, and Navigation.

Figure 11-1 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: Inlet Water Temperature, Delta T Water Temperature, Outlet Water Temperature, Flue Temperature, and HW Tank Temperature.
- 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, 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 appliance 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.

12 Maintenance

Maintenance and annual startup

Table 12A Service and Maintenance Schedules

Service technician (see the following pages for instructions)		Owner maintenance (see the Armor User's Information Manual for instructions)	
ANNUAL START-UP	General: • 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 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 10. • 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 Armor Service Manual). If combustion or performance indicate need: • Clean heat exchanger • Remove and clean burner using compressed air only • Clean the blower wheels		
		Daily	• Check appliance area • Check pressure/temperature gauge
		Monthly	• Check vent piping • Check air piping • Check air and vent termination screens • Check relief valve • Check condensate drain system • Check Delta T • Remove debris from Y-strainer • Check building recirculation filter (if filter required)
		Every 6 months	• Test low water cutoff • Reset button (low water cutoff) • Check appliance piping (gas and water) for leaks • Operate relief valve • Check water chemistry

12 Maintenance

⚠ 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 by a qualified service technician. In addition, the maintenance and care of the appliance designated in Table 12A 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 appliance area

1. Verify that appliance 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 - Determine Appliance Location. If any of these are present in the appliance intake air vicinity, they must be removed. If they cannot be removed, reinstall the air and vent lines per this manual and the Armor Service Manual.

Inspect appliance interior

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

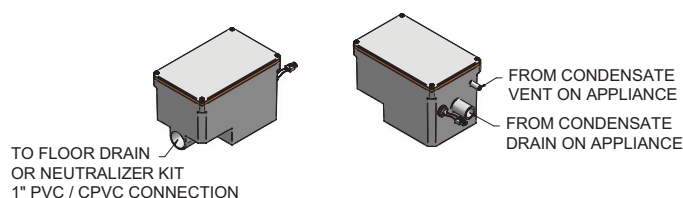
Clean condensate trap

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. 12-1).
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 top cover and the screws removed in Step 1.

Figure 12-1 Condensate Trap



⚠ WARNING

The condensate trap must be filled with water during all times of appliance operation to avoid flue gas emission from the condensate drain line. Failure to fill the trap could result in severe personal injury or death.

Check all piping for leaks

⚠ WARNING

Eliminate all system or appliance leaks. Leaking water may 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 7 - 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 appliance vent discharge and air intake are clean and free of obstructions.

12 Maintenance *(continued)*

⚠ 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).
3. Watch the system pressure as the appliance 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 push valve to flush vent. Replace caps. Make sure vents do not leak. Replace any leaking vents.

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 6 - System Piping for suggested best location of expansion tanks and air eliminators.

Check appliance 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 6 - System Piping 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 appliance relief valve as directed could result in unsafe pressure build-up, 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 appliance 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 electrodes

1. Remove the ignition and flame sense electrodes from the appliance heat exchanger access cover.
2. Remove any deposits accumulated on the ignition/flame sense electrode using sandpaper. If the electrodes cannot be cleaned satisfactorily, replace with new ones.
3. Replace ignition/flame sense electrode, making sure gasket is in good condition and correctly positioned.

Check ignition ground wiring

1. Inspect appliance 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 appliance wiring

1. Inspect all appliance 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 Armor Service Manual. Adjust settings if necessary. See Section 1 of the Armor Service Manual for adjustment procedures.
2. Check settings of external limit controls (if any) and adjust if necessary.

12 Maintenance

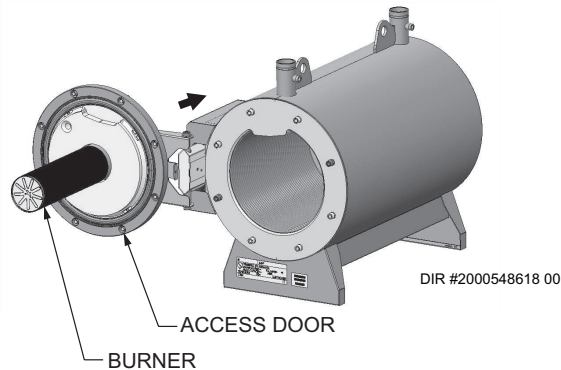
Perform start-up and checks

1. Start appliance and perform checks and tests specified in Section 10 - Start-up.
2. Verify cold fill pressure is correct and that operating pressure does not go too high.

Check burner flame

1. Inspect flame through observation window.
2. If the flame is unsatisfactory at either high fire or low fire, turn off appliance and allow it to cool down. Remove the burner and clean it thoroughly using a vacuum cleaner or compressed air. Do not use compressed air to clean burner if performed inside a building.
3. Remove the burner, reference FIG. 12-2 below.
4. When replacing the burner, ensure gasket is in good condition and positioned correctly.

Figure 12-2 Burner Assembly



Check flame signal

1. At high fire the flame signal shown on the display should be at least 8 microamps.
2. A lower flame signal may indicate a fouled or damaged flame sense electrode. If cleaning the flame sense electrode does not improve, ground wiring is in good condition, and ground continuity is satisfactory, replace the flame sense electrode.
3. See Section 3 - Troubleshooting in the Armor Service Manual for other procedures to deal with low flame signal.

Review with owner

1. Emphasize the need to perform the maintenance schedule specified in this manual.
2. Remind the owner of the need to call a licensed contractor should the appliance or system exhibit any unusual behavior.
3. Remind the owner to follow the proper shutdown procedure and to schedule an annual start-up.

Cleaning heat exchanger

For recommended materials; including brush, appropriate extension(s), refractory cover, and detailed instructions see Table 12B - Heat Exchanger Cleaning Kit.

1. Shut down appliance:
 - Follow the "To Turn Off Gas to Appliance" instructions for the appliance in Section 10 - Start-up.
 - Do not drain the appliance unless it will be exposed to freezing temperatures.
2. Allow time for the appliance to cool to room temperature if it has been firing.
3. Remove the flex duct connecting the venturi to the air box. Remove the intake air flex duct.
4. Disconnect the gas train at the union and at the venturi. Loosen the gas train support bracket. Remove the gas train.

WARNING

The appliance contains ceramic fiber materials. Use care when handling these materials per instructions in the Service Manual. Failure to comply could result in severe personal injury.

5. Remove the bolts securing the heat exchanger access cover and set aside.
6. Slide out the heat exchanger door and blower assembly. Pull the pin to swing the door open.

NOTE: On some models, the front corner post may need to be removed in order to fully swing the heat exchanger door open. The corner post can be removed by loosening the two nuts at the base and the two screws at the top of the post.

7. Remove the condensate hose from the condensate trap. Connect a field supplied 1" diameter hose to a drain pan. Using field supplied means cover the refractory in the back of the combustion chamber of the heat exchanger.
8. Use a vacuum cleaner to remove any accumulation on the appliance heating surfaces. Do not use any solvent.
9. Brush the heat exchanger while dry using a nylon bristle brush. **Caution:** DO NOT use a metal brush. Re-vacuum the heat exchanger.
10. Finish cleaning using a clean cloth dampened with warm water. Rinse out debris with a low pressure water supply.
11. Allow the heat exchanger to thoroughly dry.
12. Remove the field supplied rear refractory cover from the back of the combustion chamber of the heat exchanger and reassemble.

12 Maintenance *(continued)*

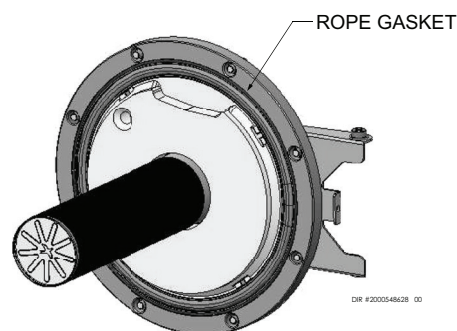
13. Close isolation valves on piping to isolate appliance from system. Attach a hose to the appliance and drain and flush appliance thoroughly with clean water by using purging valves to allow water to flow through the water makeup line to the appliance.
14. Perform start-up and check-out procedures in the Check Flame and Combustion - Section 10 - Start-up on pages 50 and 52 of this manual.
15. Replace the access cover and restore appliance to operation.

Table 12B Heat Exchanger Cleaning Kit

Model	Kit Number	Part Number	Component Description
1250 - 2000	100298563	100298574	Rear Refractory Cover
		100162565*	Nylon 4" Wheel Brush*
		100162568	1/4" x 24" Drill Extension
		100162567	1/4" x 12" Drill Extension
3000 - 4000	100298564	100298575	Rear Refractory Cover
		100162565*	Nylon 4" Wheel Brush*
		100162568	1/4" x 24" Drill Extension
		100162567	1/4" x 12" Drill Extension

CAUTION * Do NOT use a metal brush. Only use the kit-provided brush or an equivalent replacement nylon brush.

Figure 12-3 Rope Gasket - Heat Exchanger Door



CAUTION: IF GASKET IS DAMAGED DO NOT REUSE. THE ROPE GASKET MUST BE REPLACED.

NOTICE

Rope gasket is intended for sealing combustion (see FIG. 12-3). If gasket is damaged DO NOT reuse, the rope gasket must be replaced. Consult factory for replacement rope gasket.

Check Delta T

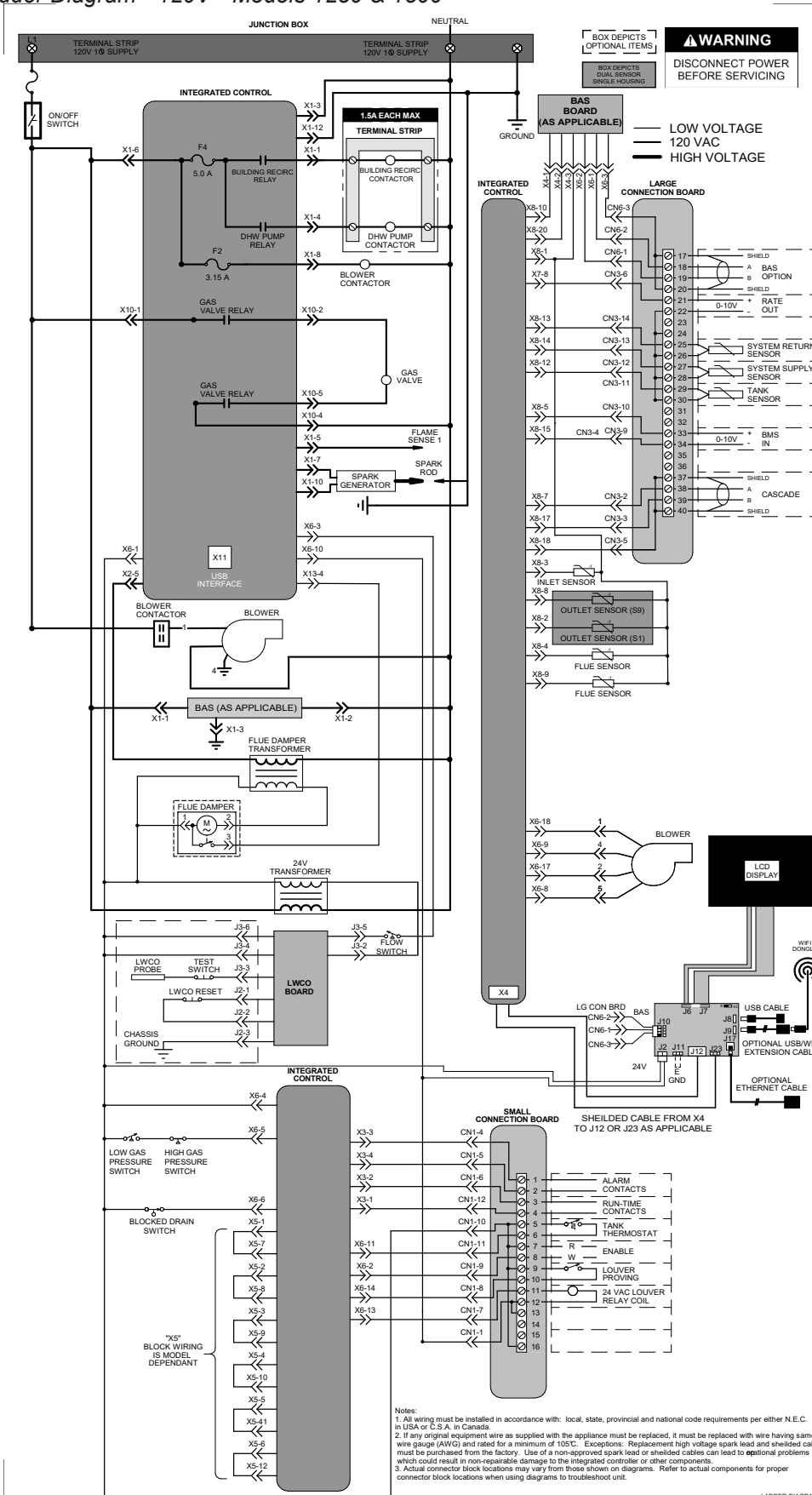
1. Check Delta T. Reference Section 6 - *System Piping* on page 34 for more information regarding Delta T.

Oiled bearing circulators

1. The circulator shipped with the Armor appliance is water-lubricated. No oiling is required.
2. Check other circulators in the system. Oil any circulators requiring oil, following circulator manufacturer's instructions. Over-oiling will damage the circulator.

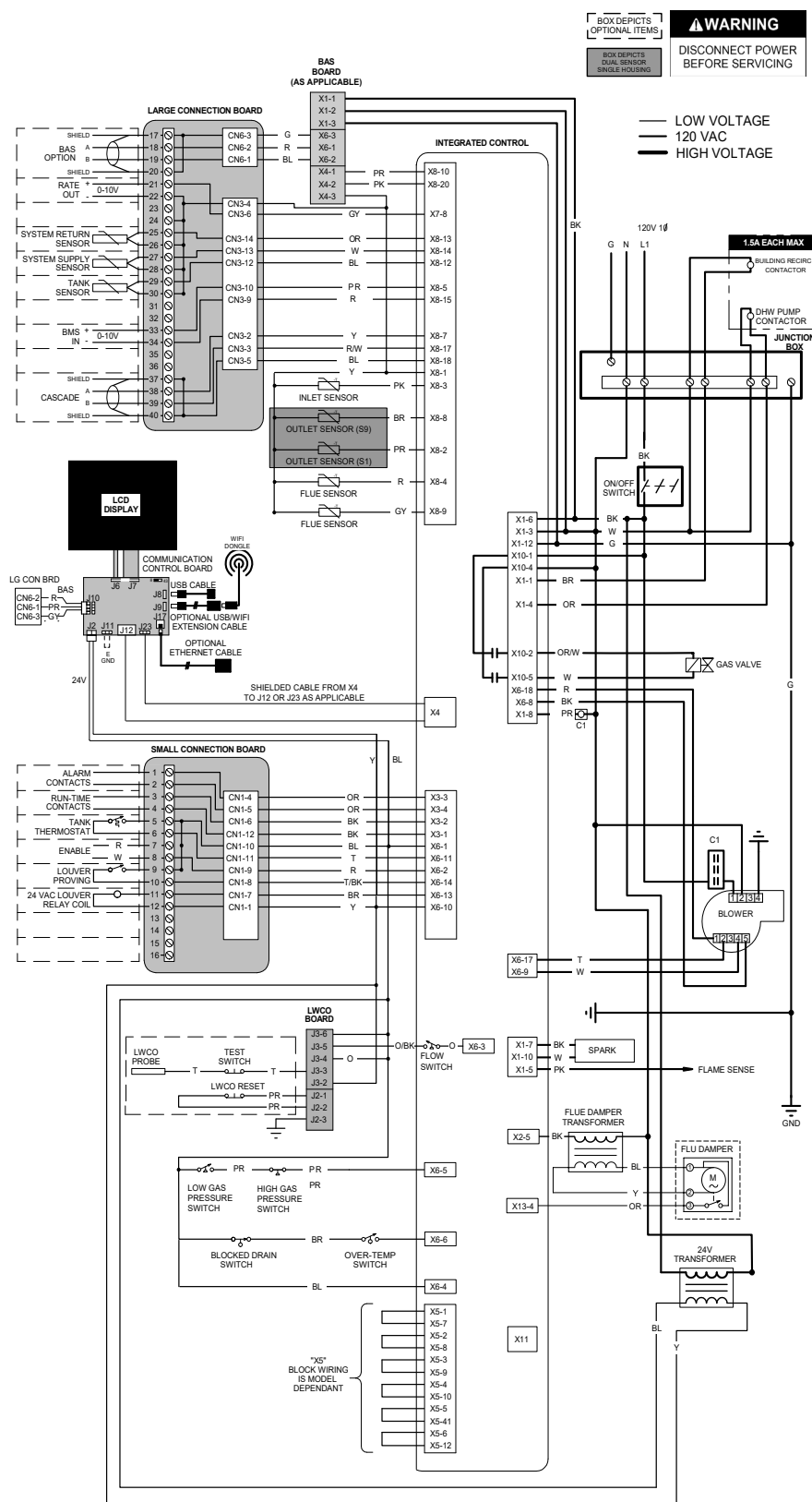
13 Diagrams

Figure 13-1 Ladder Diagram - 120V - Models 1250 & 1500



13 Diagrams (continued)

Figure 13-2 Wiring Diagram - 120V - Models 1250 & 1500



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 is 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
10203020 REV G

13 Diagrams

Figure 13-3 Ladder Diagram - 208V - Models 2000 & 3000

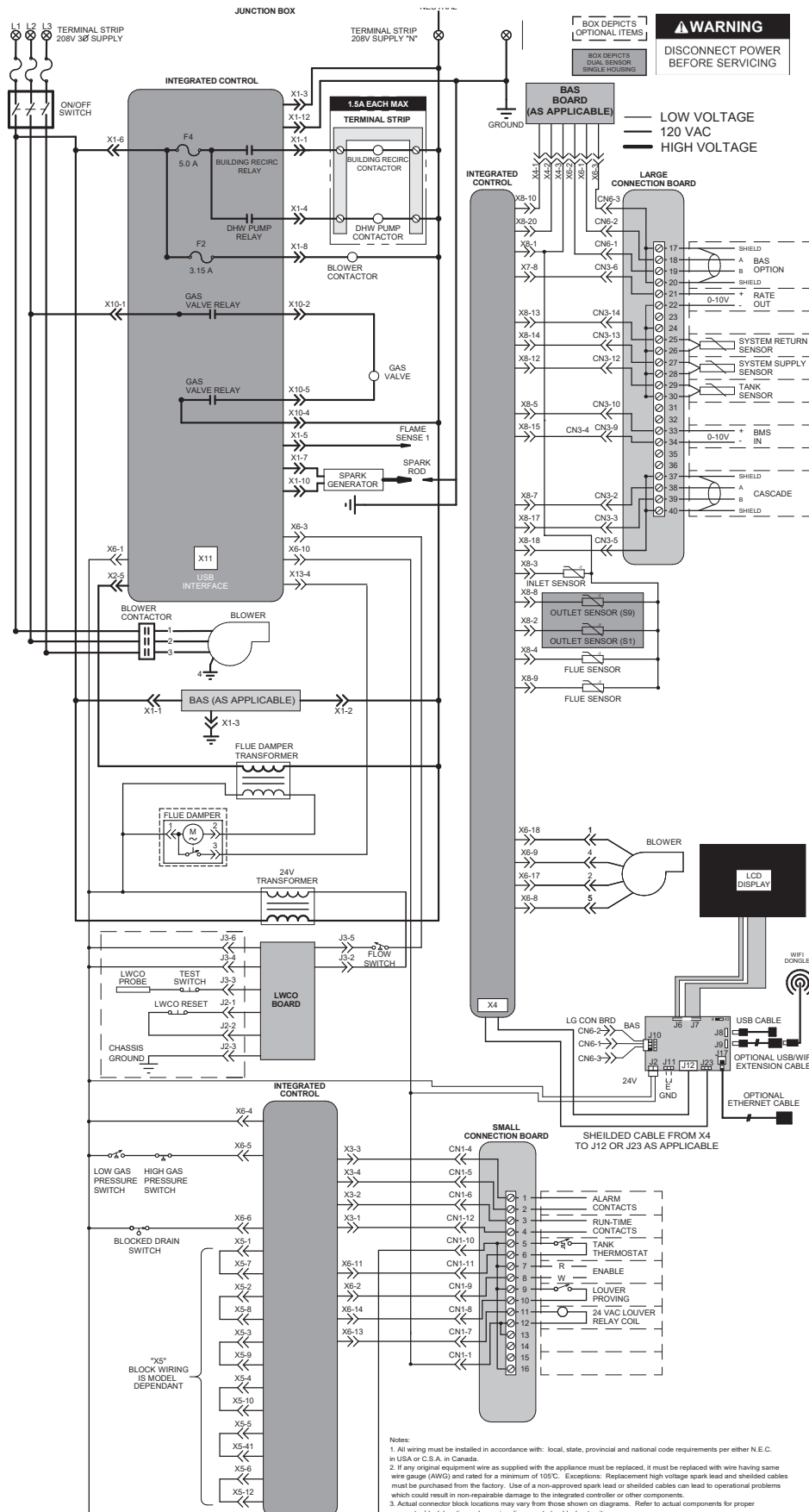
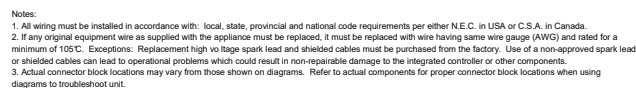
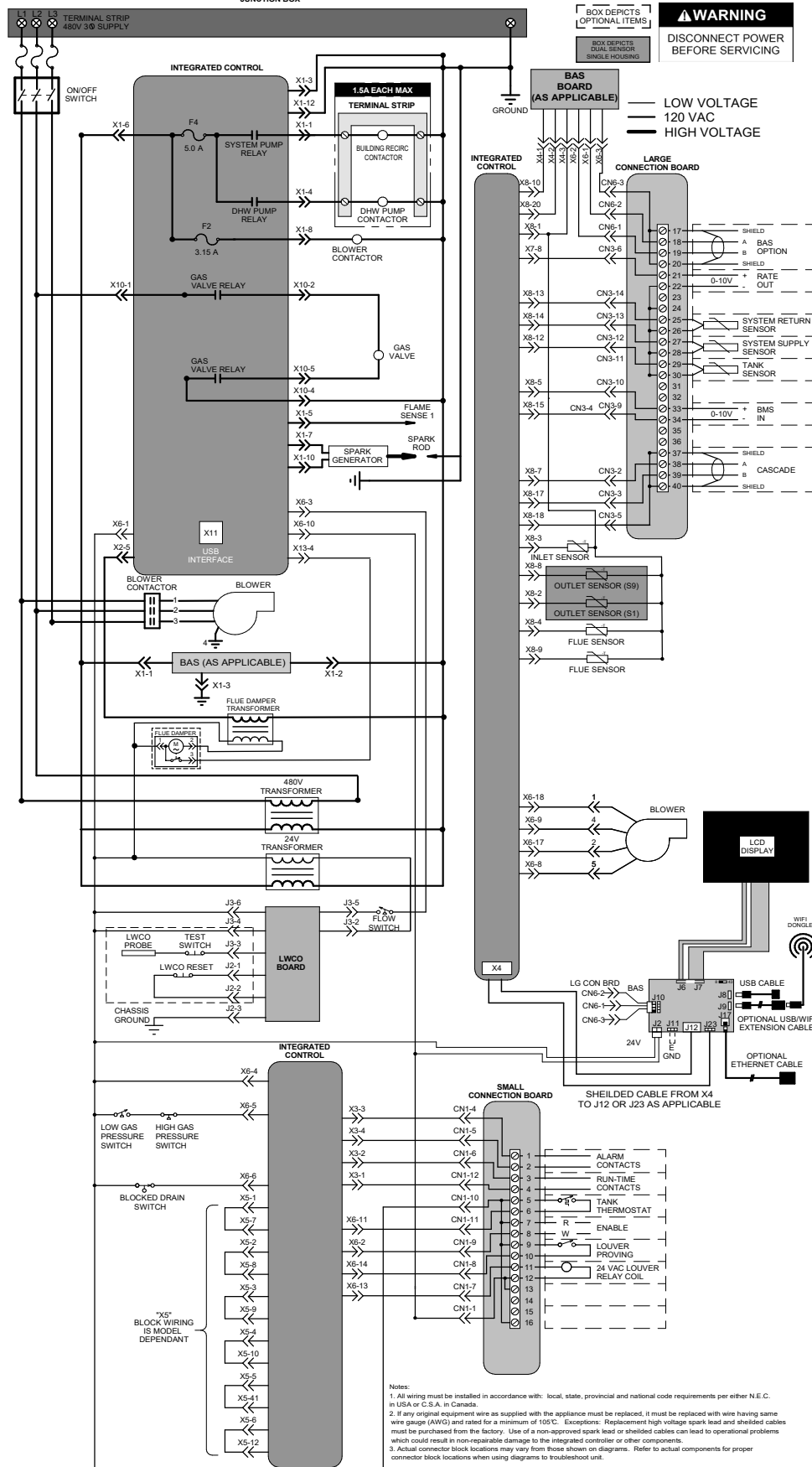


Figure 13-4 *Wiring Diagram - 208V - Models 2000 & 3000*



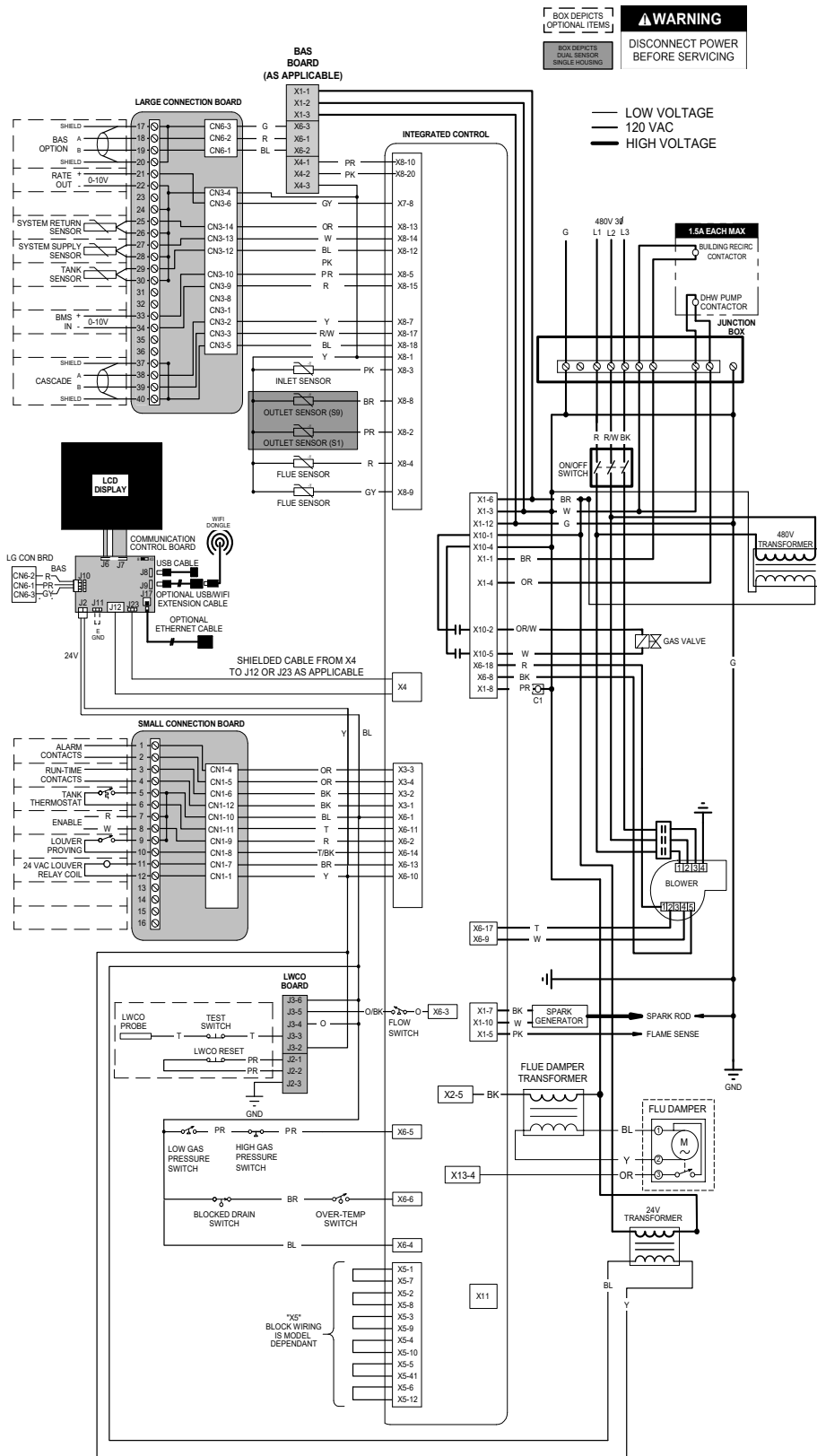
13 Diagrams

Figure 13-5 Ladder Diagram - 480V - Model 4000



13 Diagrams (continued)

Figure 13-6 Wiring Diagram - 480V - Model 4000



Revision Notes: Revision A (PCP #3000022340 / CN #500012474) initial release.

Revision B (PCP #3000024735 / CN #500014579) reflects an update to information on pages 12, 18, 20, 23, 33, 38-39, and 44.

Revision C (PCP #3000026430 / CN #500016316) reflects the addition of Figure 7-3 on page 41.

Revision D (PCP #3000028201 / CN #500017801) reflects an update to all of the user interface screens, an update to Table 6B on page 34, and an update to the ladder and wiring diagrams.

Revision E (PCP #3000030213 / CN #500019446) reflects the addition of the table of PVC adapter kits in FIG. 3-3 on page 21 as well as some updates to the outdoor installation information on pages 12 and 23.

Revision F (PCP #3000030779 / CN #500020179) reflects an update to the piping diagrams, Table 10A, Table 12A, and the addition of the building recirculation filter on page 34. The 23° vent terminations on pages 26 through 29 were also updated.

Revision G (PCP #3000033465 / CN #500022172) reflects the addition of the neutral wiring reference on page 44.

Revision H (PCP #3000033789 / CN #500022617) reflects the input rates and output rates are revised to match AHRI rounding and comply with Energy Star turndown rate requirements.

Revision J (PCP #3000035946 / CN #500024660) reflects the addition of the air filter replacement procedure.

Revision K (PCP #3000037183 / CN #500025582) reflects an update to the line voltage diagrams in Figure 8-1.

Revision L (PCP #3000038559 / CN #500026649) reflects an update to the water heater sensor material number.

Revision M (PCP #3000043460 / CN #500031150) reflects an update to the ladder and wiring diagrams, fuse amperage information, and general water heater standard updates.

Revision N (PCP #3000048432 / CN #500035749) reflects a correction about replacing the Rope Gasket in Figure 12-3 on page 65.

Revision P (PCP #3000046794 / CN #500034183) reflects an update to the verbiage in the note in Table 3A-2 Approved Stainless Steel Terminations and Adapters - Category IV on page 18.

Revision R (PCP #3000049393 / CN #500036574) reflects the combining of tables on page 6.

Revision T (PCP #3000052551 / CN #500039466) reflects an update to Table 3A-1 and Table 3A-2.

Revision U (PCP #3000053179 / CN #500039996) reflects the addition of pages 13 through 15.

Revision V (PCP #3000054410 / CN #500041125) reflects a change to the warnings on page 7.

Revision W (PCP #3000055885 / CN #500042300) reflects a change to the ladder diagrams on pages 70, 72, and 74.

Revision X (PCP #3000058272 / CN #500044398) reflects an update of the ANSI standard.

Revision Y (PCP #3000060820 / CN #500046810) reflects the addition of a dielectric notice to page 37.

Revision AA (PCP #3000068392 / CN #500053899) reflects the removal of inoperable functions.

Revision AB (PCP #3000068121 / CN #500053624) reflects updated wiring diagrams.