



## Installation & Operation Manual

**Models: 400 - 500 Series  
100 & 100 and 650 - 100  
Series 110 & 111**

**⚠ 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 water heater **MUST NOT** be installed in any location where gasoline or flammable vapors are likely to be present.

### -- WHAT TO DO IF YOU SMELL GAS

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



**Lochinvar®**  
HIGH EFFICIENCY BOILERS & WATER HEATERS

### ⚠ WARNING

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

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

Consider piping and installation when determining water heater 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 water heater **MUST NOT** be installed in any location where gasoline or flammable vapors are likely to be present.

### -- WHAT TO DO IF YOU SMELL GAS

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

### ⚠ WARNING

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

## When servicing the water heater –

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

## Water heater operation –

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

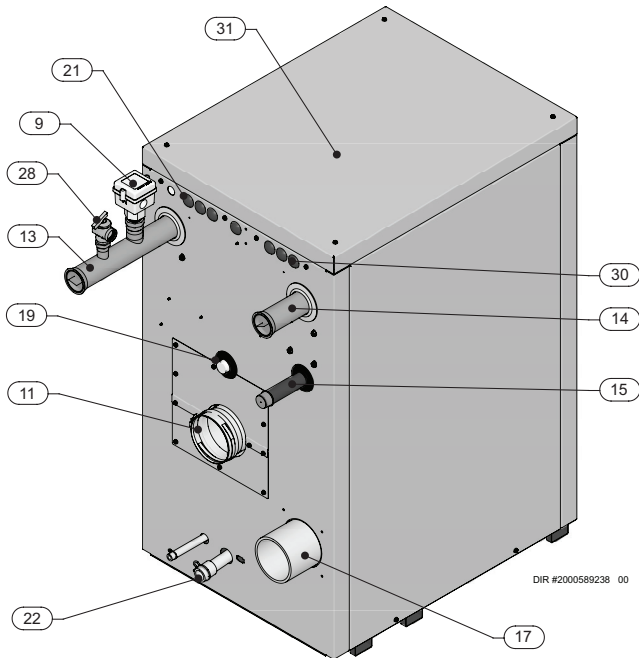
# The Armor Water Heater - How it works...

- 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**  
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 water heater if the flue gas temperature gets too hot. This protects the flue pipe from overheating.
- 7. Water heater outlet temperature sensor (housed with the high limit sensor)**  
This sensor monitors water heater outlet water temperature (system supply). If selected as the controlling sensor, the control module adjusts water heater firing rate so the outlet temperature is correct.
- 8. Water heater inlet temperature sensor**  
This sensor monitors return water temperature (system return). If selected as the controlling sensor, the control module adjusts the water heater 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 display**  
Digital controls with SMART TOUCH screen technology, full color display, and an 8" user interface screen.
- 11. Flue pipe adapter**  
Allows for the connection of the PVC vent pipe system to the water heater.
- 12. Burner (not shown)**  
Made with metal fiber and stainless steel construction, the burner uses pre-mixed air and gas and provides a wide range of firing rates.
- 13. Water outlet**  
Water connection that supplies hot water to the tank.
- 14. Water inlet**  
Water connection that returns water from the tank to the heat exchanger.
- 15. Gas connection pipe**  
Threaded pipe connection. This pipe should be connected to the incoming gas supply for the purpose of delivering gas to the water heater.
- 16. 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.
- 17. Air intake adapter**  
Allows for the connection of the PVC air intake pipe to the water heater.
- 18. High voltage junction box**  
The junction box contains the connection points for the line voltage power and the pump.
- 19. Water heater drain port**  
Location from which the heat exchanger can be drained.
- 20. Low voltage connection board**  
The connection board is used to connect external low voltage devices.
- 21. Low voltage wiring connections (knockouts)**  
Conduit connection points for the low voltage connection board.
- 22. Condensate drain connection**  
Connects the condensate drain line to a 1/2" PVC connection.
- 23. Access cover - front (not shown)**  
Provides access to the gas train and the heat exchanger.
- 24. Ignition electrode**  
Provides direct spark for igniting the burner.
- 25. Flame inspection window (not shown)**  
The quartz glass window provides a view of the burner surface and flame.
- 26. Gas shutoff valve (not shown)**  
Manual valve used to isolate the gas valve from the gas supply.
- 27. High limit sensor (housed with the outlet temperature sensor)**  
Device that monitors the outlet water temperature. If the temperature exceeds its setting, the integrated control will break the control circuit, shutting the water heater down.
- 28. Relief valve**  
Protects the heat exchanger from over pressure and temperature conditions. The relief valve is set at 150 PSI.
- 29. Flame sensor (not shown)**  
Used by the control module to detect the presence of burner flame.
- 30. Line voltage wiring connections (knockouts)**  
Conduit connection points for the high voltage junction box.
- 31. Top panel**  
Removable panel to gain access to the internal components.
- 32. Power switch**  
Turns 120 VAC ON/OFF to the water heater.
- 33. Air box**  
The air box houses the combustion air filter.
- 34. Air pressure switch**  
The air pressure switch detects blocked inlet or outlet conditions.
- 35. Pump relay**  
The pump relay is used to control the circulation pump.
- 36. Transformer**  
The transformer provides 24V power to the integrated control.
- 37. Air filter (not shown)**  
The air filter prevents dirt and debris from entering the burner.

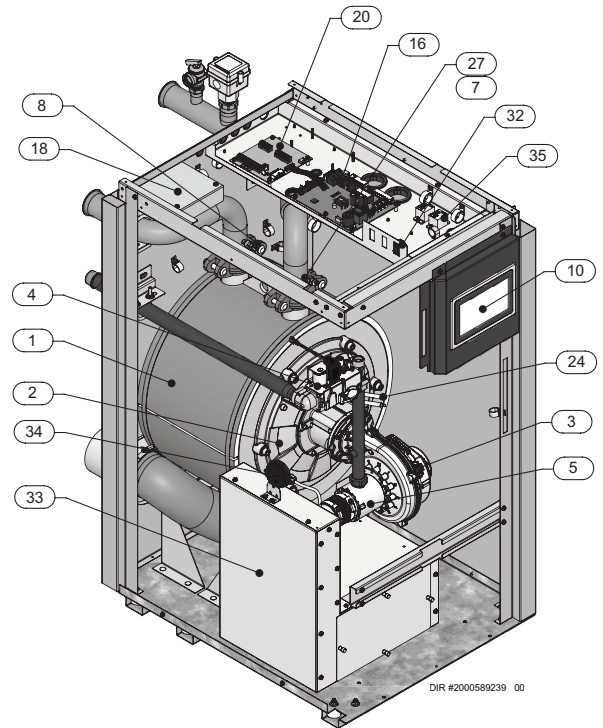


# The Armor Water Heater - How it works... (continued)

## Models 400 - 500

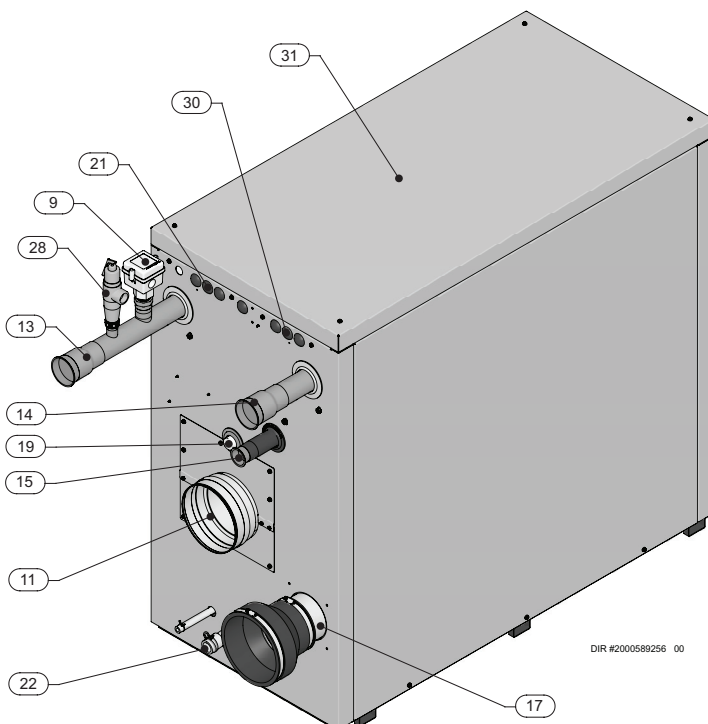


Rear View - Models 400 - 500

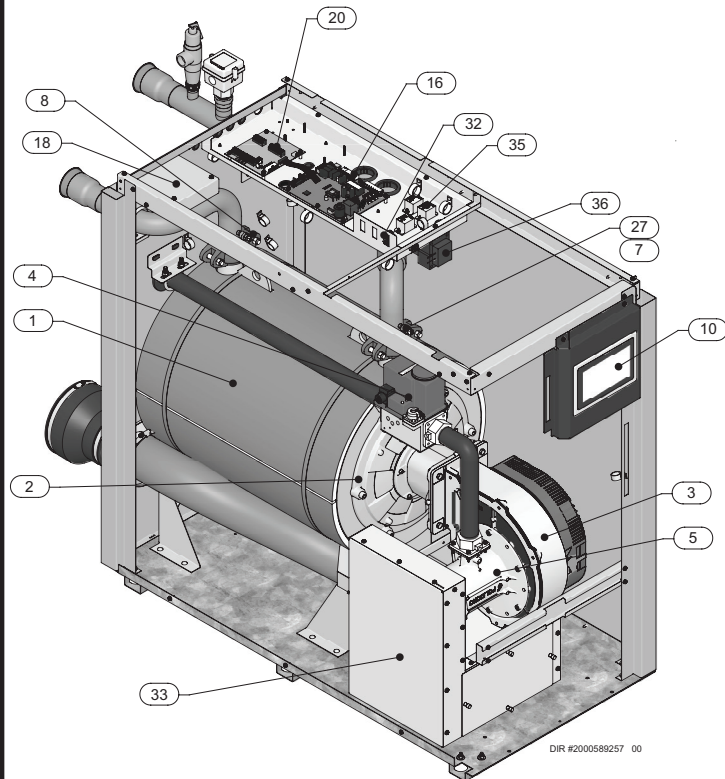


Left Side (inside unit) - Models 400 - 500

## Models 650 - 1000



Rear View - Models 650 - 1000



Left Side (inside unit) - Models 650 - 1000

## Ratings



Model Number Note: Change "N" to "L" for L.P. gas models.	CSA Input Modulation MBtu/hr		Water Content Gallons	Water Connection	Gas Connection	Vent/Air Size
	Min	Max				
AWH0400(N,L)	39.9	399	4.4	2"	1"	4"/4"
AWH0500(N,L)	50	500	4.9	2"	1"	4"/4"
AWH0650(N,L)	65	650	6.2	2"	1-1/4"	6"/4"
AWH0800(N,L)	80	800	7.3	2"	1-1/4"	6"/4"
AWH1000(N,L)	99.9	999	8.8	2-1/2"	1-1/4"	6"/6"

### NOTICE

Maximum allowed working pressure is located on the rating plate.

### Notes:

- Armor water heaters require special gas venting. Use only the vent materials and methods specified in the Armor Installation and Operation Manual.
- Standard Armor water heaters are equipped to operate from sea level to 4,500 feet only with no adjustments. Above 2,000 feet elevation, the water heater will de-rate by 4% for each 1,000 feet above sea level up to 4,500 feet. De-rate values are based on proper combustion calibration and CO<sub>2</sub> adjusted to the recommended levels.
- High altitude Armor water heaters are equipped to operate from 3,000 to 9,600 feet only. See chart for de-rates. High altitude models are manufactured with a different control module for altitude operation, but the operation given in this manual remains the same as the standard models. A high altitude label is also affixed to the unit. De-rate values are based on proper combustion calibration and CO<sub>2</sub>s adjusted to the recommended levels.
- For Canadian installations above 2,000 feet elevation, follow all applicable local codes and regulations.
- The manual reset high limit provided with the Armor is listed to UL353 or UL60730-2-9. The auto reset high limit is listed to ANSI Z21.87.

Model	Derate per 1,000 feet	
	Derate up to 5,200 feet	Derate 5,200 feet to 9,600 feet
0400	0.00%	1.70%
0500	0.50%	1.80%
0650	1.20%	1.90%
0800	2.00%	2.10%
1000	3.00%	2.30%

# 1 Determine water heater 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

The Armor water heater gas manifold and controls met safe lighting and other performance under tests specified in ANSI Z21.10.3 – latest edition.

## Before locating the water heater, 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 water heater. Remove any combustible materials, gasoline and other flammable liquids.

### WARNING

Failure to keep water heater 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 water heater 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 water heater will replace an existing water heater, 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 water heater for any potential air contaminants that could risk corrosion to the water heater or the water heater combustion air supply (see Table 1A). Prevent combustion air contamination. Remove any of these contaminants from the water heater area.

### WARNING

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

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

### WARNING

Unless specified as an outdoor appliance, this product is certified as an indoor appliance.

Do not install the appliance outdoors or locate where the appliance will be exposed to freezing temperatures

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

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

### WARNING

This appliance requires a special venting system. If using PVC the vent connection

to the appliance must be made with a CPVC pipe section. 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.

## Closet and alcove installations

A closet is any room the water heater is installed in which is less than 26 cubic feet for AWH400-500 models, 35 cubic feet for AWH650-800 models, and 39 cubic feet for AWH1000 models.

An alcove is any room which meets the criteria for a closet with the exception that it does not have a door.

**Example:** Room dimensions = 5 feet long, 4 feet wide, and 8 foot ceiling = 5 x 4 x 8 = 160 cubic feet. This would be considered a closet for a Armor water heater.

### WARNING

For closet and alcove installations as shown in FIG. 1-1 and 1-2, CPVC vent material must be used inside the structure. The ventilating air openings shown in FIG. 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" (6 mm) from combustible materials.
2. Vent pipe – Follow special vent system manufacturer's instructions.
3. See FIG. 1-1 and 1-2 for other clearance minimums.

### Recommended clearances for service access

- Front / Top / Rear..... 24"

### NOTICE

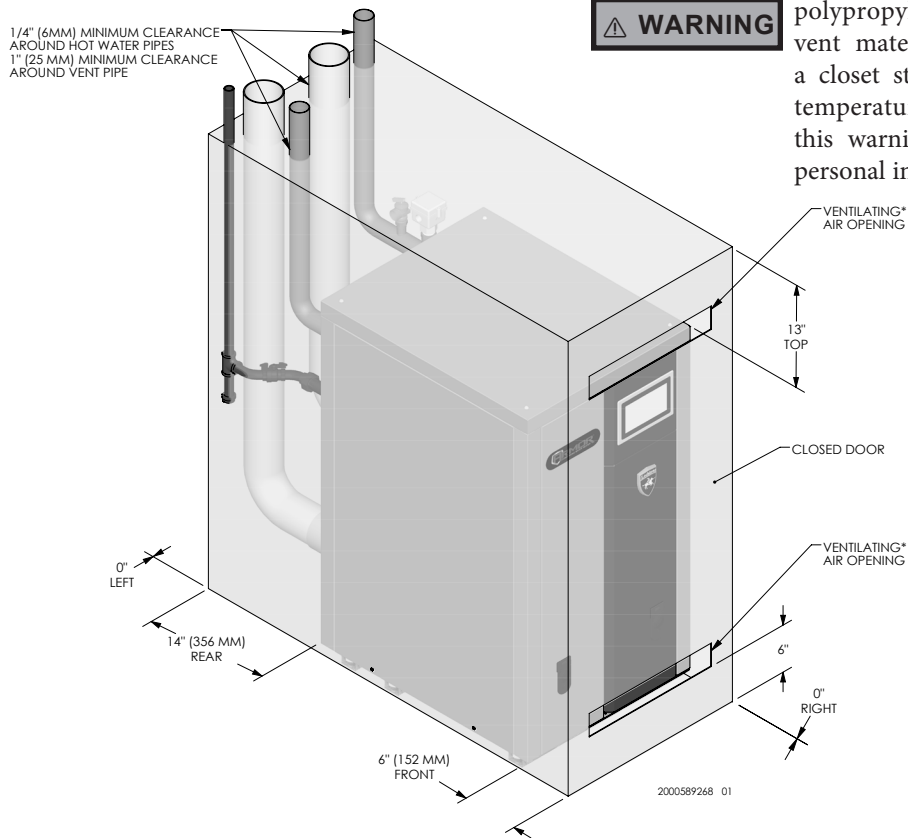
Multiple appliances can be installed side by side with no clearances between adjacent appliances because the appliances are approved for zero clearances from combustible surfaces; however, service access will be limited from the sides. Consult with the local inspection authority for approval.

### NOTICE

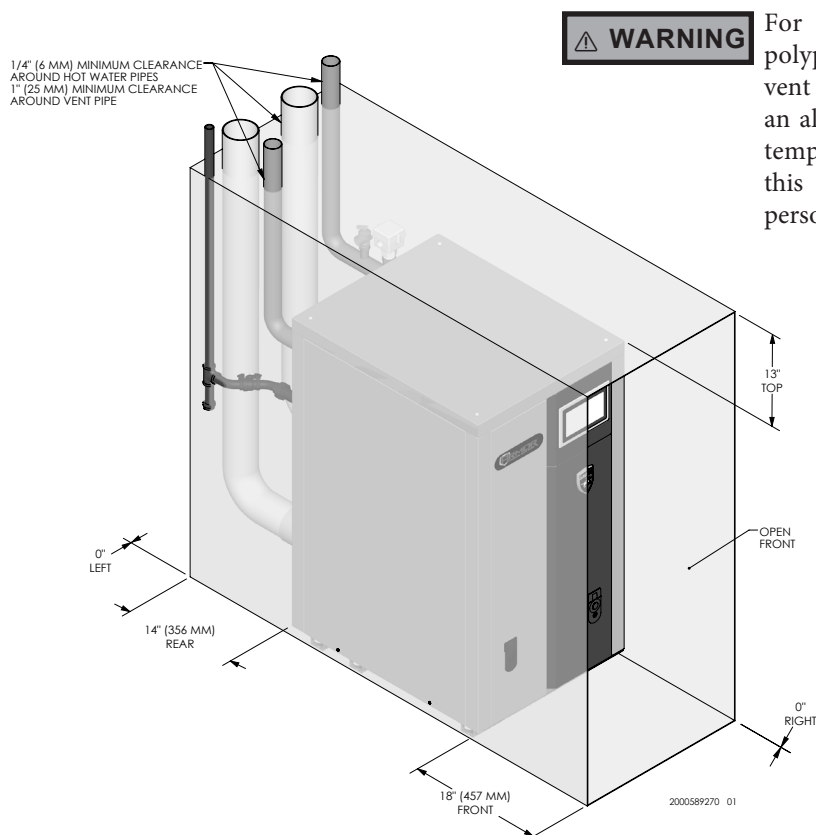
If you do not provide the recommended service clearances shown, it may not be possible to service the appliance without removing it from the space.

# 1 Determine water heater location

**Figure 1-1 Closet Installation - Minimum Required Clearances**



**Figure 1-2 Alcove Installation - Minimum Required Clearances**



# 1 Determine water heater location *(continued)*

## Provide air openings to room:

### Armor water heater alone in equipment room

1. No air ventilation openings into the equipment room are needed when clearances around the Armor water heater are at least equal to the SERVICE clearances shown in this manual. 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 water heater input.

### Armor water heater 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 water heater.

Do not install the water heater 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 water heater because it takes its combustion air from outside (direct vent installation).

## Flooring and foundation

### Flooring

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



#### **WARNING**

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

### Seismic bracing

For installations requiring seismic bracing, the base legs of the appliance are designed to allow for the use of unistrut channel to meet seismic requirements.

## Residential garage installation

### Precautions

Take the following precautions when installing the appliance in a residential garage. If the appliance is located in a residential garage, it should be installed in compliance with the latest edition of the National Fuel Gas Code, ANSI Z223.1 and/or CAN/CGA-B149 Installation Code.

- Appliances located in residential garages and in adjacent spaces that open to the garage and are not part of the living space of a dwelling shall be installed so that all burners and burner ignition devices are located not less than 18 inches (46 cm) above the floor.
- The appliance shall be located or protected so that it is not subject to physical damage by a moving vehicle.

## Vent and air piping

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

The water heater 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 water heater using any other means.

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



#### **WARNING**

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

**⚠ 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 Table 3A. 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 3I and 3K for CAT IV positive pressure venting with flue producing condensate.
- **Supports** - Non-combustible supports must be in place allowing a minimum 1/4" rise per foot. The supports should adequately prevent sagging and vertical slippage, by distributing the vent system weight. For additional information, consult the vent manufacturer's instructions for installation.
- **Terminations** - Carefully review 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 3L 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 Water Heater Section.

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.

**⚠ 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 water heater location *(continued)*

## When removing a water heater from existing common vent system:

### DANGER

Do not install the Armor water heater into a common vent with any other appliance. 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 water heater, 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.

## 2 Prepare water heater

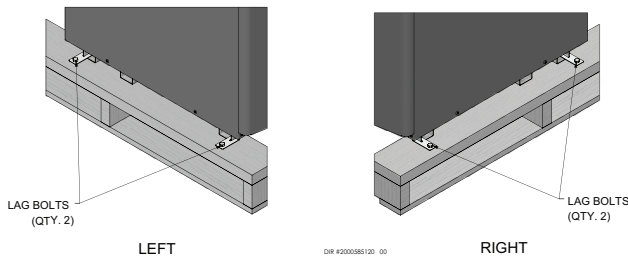
### Remove water heater from wood pallet

1. After removing the outer shipping carton from the water heater, remove the parts box.
2. To remove the water heater from the pallet remove the four (4) lag bolts located at the front and rear of the unit (FIG. 2-1).

#### NOTICE

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

Figure 2-1 Water heater Mounted on Shipping Pallet



### Gas conversions

#### WARNING

For a water heater already installed, you must turn off gas supply, turn off power and allow the water heater to cool before proceeding. You must also completely test the water heater after conversion to verify performance as described under Start-up, Section 11 of this manual. Failure to comply could result in severe personal injury, death, or substantial property damage.

#### DANGER

Inspect the O-ring when the blower is disassembled. The O-ring must be in good condition and must be installed. Failure to comply will cause a gas leak, resulting in severe personal injury or death.

### Models 400-1000 (Venturi w/ LP Orifices)

1. Remove the front access panel from the unit (no tools required for removal).
2. **For Models 400-500:** Disconnect the air inlet piping from the venturi by loosening the band clamp around the rubber boot coupling. Slide the rubber boot off of the venturi.  
**For Models 650-1000:** Disconnect the venturi from the air box by removing the four (4) bolts securing it to the air box.
3. **For Models 400-500:** Disconnect the gas piping from the venturi by loosening the threaded nut on the venturi. Replace gasket if damaged.  
**For Models 650-1000:** Disconnect the gas piping from the venturi by removing the four (4) bolts securing the pipe to the venturi.
4. Remove the bolts connecting the venturi to the fan. Remove the natural venturi from the unit (FIG. 2-2a and 2-2b).
5. Install the LP venturi onto the fan taking note of the following:
  - a. The UP arrow on the plastic housing is indeed pointing up.
  - b. The connection for the gas piping is facing towards the top of the unit. Reinstall the bolts connecting the venturi to the fan.
6. Reassemble the gas pipe to the venturi. Install the new gasket provided in the kit and ensure it is seated properly before tightening.
7. **For Models 400-500:** Reconnect the rubber boot on the air inlet to the venturi inlet and tighten the band clamp at this connection.  
**For Models 650-1000:** Reinstall the four (4) bolts connecting the venturi to the air box and tighten.
8. After installation is complete, attach the propane conversion label (in the conversion kit) next to the appliance rating plate. Attach the LP caution label (in the conversion kit) to the rear of the appliance underneath the gas supply piping.
9. Replace the front access panel removed in Step 1 and resume operation.

Figure 2-2a Installing Propane Orifice - Models 400-500

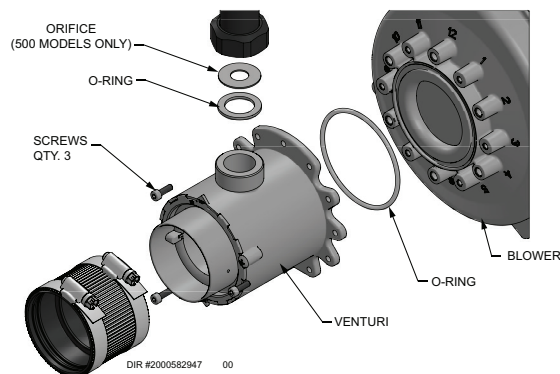
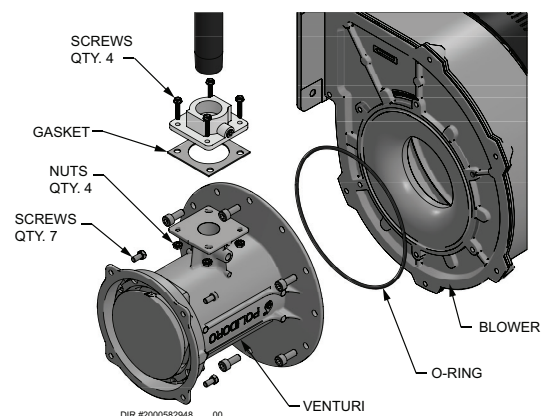


Figure 2-2b Installing Propane Orifice - Models 650-1000



## 2 Prepare water heater *(continued)*

10. **For Models 400-500:** Remove the front panel from the unit (no tools required for removal).

**For Models 650-1000:** Remove the top access cover from the unit (no tools required for removal)..

11. Use a combustion analyzer to verify CO<sub>2</sub> is within the range shown in Table 2A. If not, adjust the screw **clockwise** incrementally to raise CO<sub>2</sub> and **counterclockwise** to lower CO<sub>2</sub> (FIG. 2-3 and 2-4).

12. Replace the front access panel removed in Step 1 and resume operation.

**Table 2A Flue Products Chart**

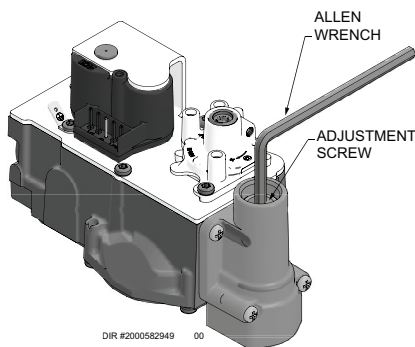
Natural Gas		Propane	
CO <sub>2</sub>	O <sub>2</sub>	CO <sub>2</sub>	O <sub>2</sub>
8.4% - 9.4%	4.8% - 6.5%	9.4% - 10.4%	5.4% - 6.9%



### WARNING

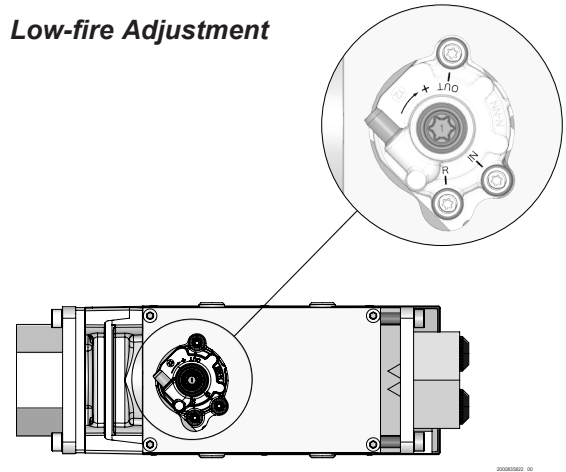
After converting to LP, check combustion per the Start-up procedure in Section 11 of this manual. Failure to check and verify combustion could result in severe personal injury, death, or substantial property damage.

**Figure 2-3 Gas Valve Adjustment - Models 400 - 500**

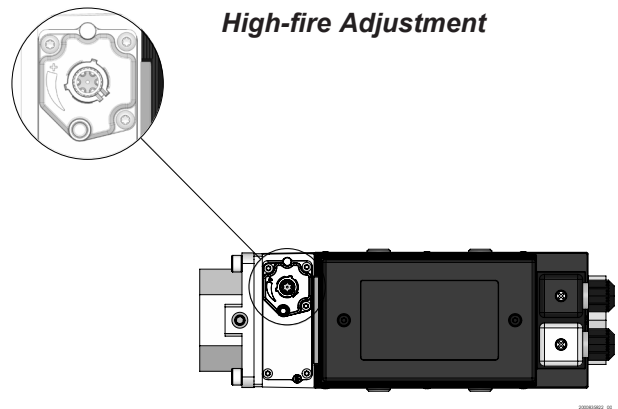


**Figure 2-4 Gas Valve Adjustment - Models 650 - 1000 Series 110 - 111**

### Low-fire Adjustment



### High-fire Adjustment



## 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:

AWH0400-1000 / 12 x 12 x 1 filter

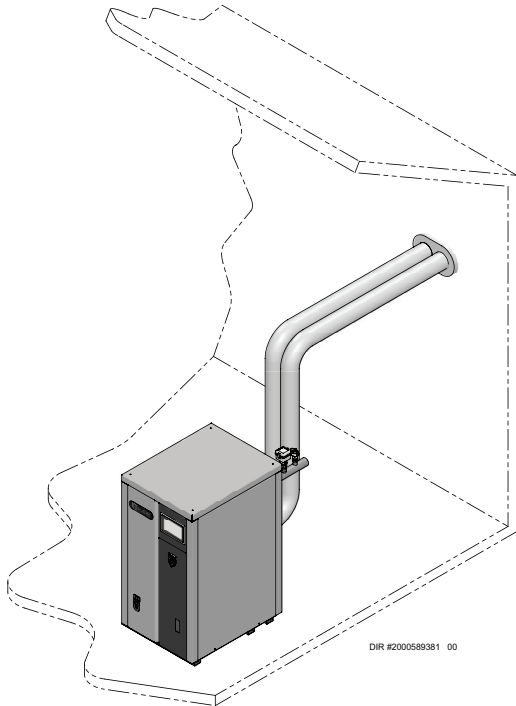
Note: Replacement filter should have a MERV rating no greater than 4.

Follow the steps below when replacing the combustion air filter:

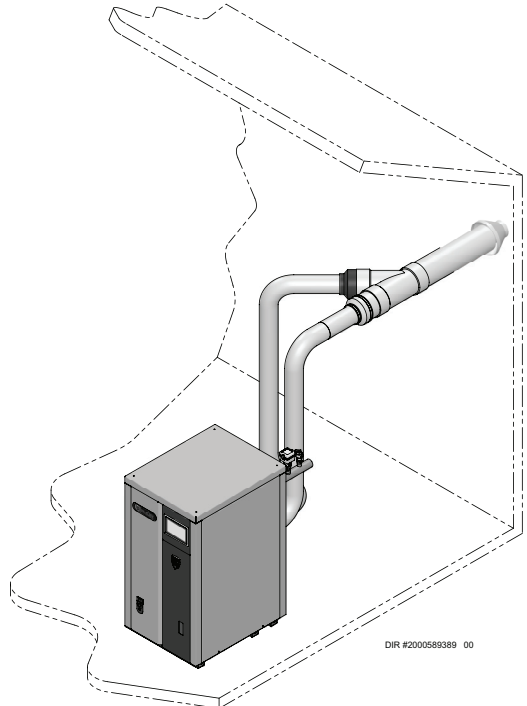
1. Locate the combustion air filter box.
2. Lift and remove the air filter box cover to gain access to the air filter.
3. Slide the air filter out the top of the air filter box.
4. Inspect the air filter for dirt and debris, replace if necessary.
5. Replace the air filter and the air filter box cover.

### 3 General venting

#### Direct venting options - Sidewall Vent

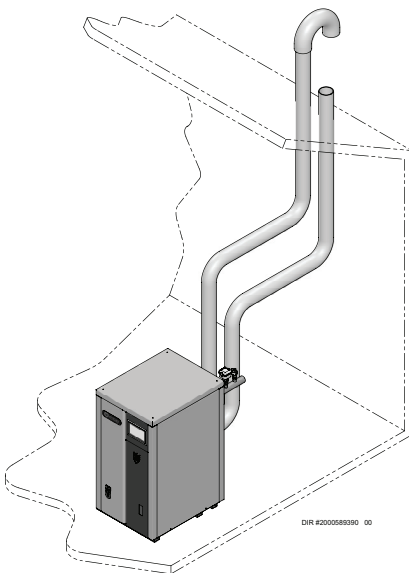


**Figure 3-1** Two-Pipe Sidewall Termination

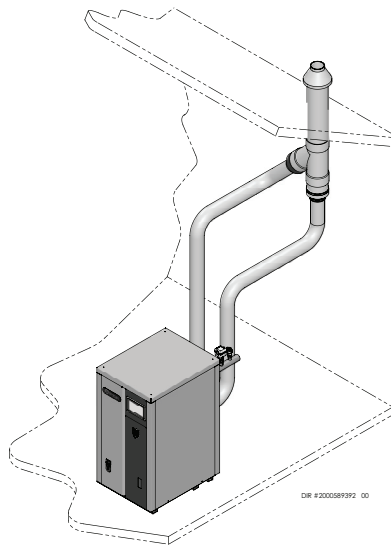


**Figure 3-2** PVC/CPVC Concentric Sidewall Termination

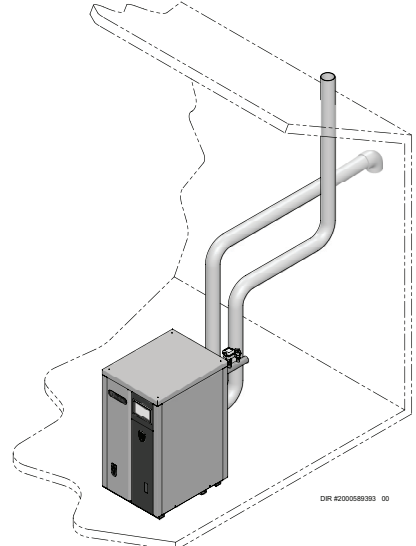
#### Direct venting options - Vertical Vent



**Figure 3-3** Two-Pipe Vertical Termination



**Figure 3-4** PVC/CPVC Concentric Vertical Termination



**Figure 3-5** Vertical Vent, Sidewall Air Termination



### 3 General venting *(continued)*

#### Install vent and combustion air piping

##### **⚠ DANGER**

The Armor water heater 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.

##### **⚠ WARNING**

This appliance requires a special venting system. Use only approved stainless steel, PVC, CPVC or polypropylene pipe and fittings listed in Tables 3H, 3I, and 3K for vent pipe, and fittings. Failure to comply could result in severe personal injury, death, or substantial property damage.

##### **⚠ WARNING**

DO NOT mix components from different systems. The vent system could fail, causing leakage of flue products into the living space. Mixing of venting materials will void the warranty and certification of the appliance.

##### **NOTICE**

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

##### **⚠ WARNING**

For closet and alcove installations, CPVC, polypropylene or stainless steel material **MUST BE** used in a closet/alcove structure. Failure to follow this warning could result in fire, personal injury, or death.

##### **⚠ CAUTION**

Improper installation of venting systems may result in injury or death.

##### **NOTICE**

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

##### **NOTICE**

Vent system must be pitched 1/4" minimum per foot back to the appliance to allow drainage of condensate.

The Armor water heater 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.

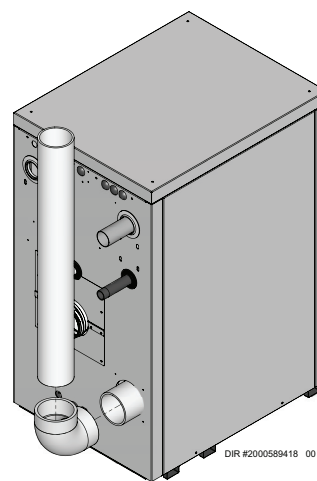
You may use any of the vent/air piping methods covered in this manual. Do not attempt to install the Armor water heater using any other means.

You must also install air piping from outside to the water heater air intake adapter unless following the Optional Room Air instructions in this manual. The resultant installation is direct vent (sealed combustion).

#### Air intake/vent connections

1. **Combustion Air Intake Connector** (FIG. 3-6) - Used to provide combustion air directly to the unit from outdoors. A fitting is provided on 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. 3-7 thru 3-10) - Used to provide a passageway for conveying combustion gases to the outside. A transition fitting 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 3-6 Near Water Heater Air Piping Models 400 - 500**



### 3 General venting

#### Requirements for installation in Canada

- Installations must be made with a vent pipe system certified to ULC-S636.  
IPEX is an approved vent manufacturer in Canada supplying vent material listed to ULC-S636.
- The first three (3) feet of plastic vent pipe from the appliance flue outlet must be readily accessible for visual inspection.
- The components of the certified vent system must not be interchanged with other vent systems or unlisted pipe/fittings. For concentric vent installations, the inner vent tube must be replaced with field supplied certified vent material to comply with this requirement.
- The 3 and 4" Concentric Vent Kit available from Lochinvar (see Section 4 – *Sidewall Termination – Optional Concentric Vent*) and the 3 and 4" Concentric Vent Kit available from IPEX are both approved for use on the Armor water heater. Both kits are listed to the ULC-S636 standard for use in Canada.

#### Sizing

The Armor water heater uses model specific combustion air intake and vent piping sizes as detailed in Table 3A below.

**Table 3A Air Intake/Vent Piping Sizes**

Model	Air Intake	Vent
400 - 500	4 inches (102 mm)	4 inches (102 mm)
650 - 800	4 inches (102 mm)	6 inches (152 mm)
1000	6 inches (152 mm)	6 inches (152 mm)

#### NOTICE

Increasing or decreasing combustion air or vent piping sizes is not authorized, unless referenced in manual..

**Table 3B Concentric Vent Kit Equivalent Vent Lengths**

Model	Kit Number	Equivalent Vent Length
400 - 500	100140484	30 feet

#### Minimum / Maximum allowable combustion air and vent piping lengths are as follows:

**Combustion Air** = 12 equivalent feet minimum / 150 equivalent feet maximum

**Vent** = 12 equivalent feet minimum / 150 equivalent feet maximum

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

**EXAMPLE:** 20 feet of PVC pipe + (4) 90° elbows + (2) 45° elbows + (1) concentric vent kit (100140484) = 49 equivalent feet of piping.

#### 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.

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

Model	Vent			Input De-Rate per 25 Feet of Vent
	Vent Diameter	Vent Min. Length	Vent Max. Length	
400	4"	12'	150'	0.56%
500	4"	12'	150'	0.50%
650N*	4"	12'	80'	0.30%
650L*	4"	12'	30'	0.82%
650	6"	12'	150'	0.10%
800	6"	12'	150'	0.50%
1000	6"	12'	150'	0.66%

\*When using 4" vent for the 650 model, the allowable vent length for propane models is different from the allowable vent length for natural gas models.

**Table 3D Direct Vent Minimum/Maximum Allowable Air/Vent Lengths**

Model	Air Inlet			Vent			Input De-Rate per 25 Feet of Vent
	Air Intake Diameter	Air Intake Min. Length	Air Intake Max. Length	Vent Diameter	Vent Min. Length	Vent Max. Length	
400	4"	12'	150'	4"	12'	150'	0.78%
500	4"	12'	150'	4"	12'	150'	0.83%
650N*	4"	12'	80'	4"	12'	80'	0.29%
650L*	4"	12'	30'	4"	12'	30'	0.81%
650	4"	12'	150'	6"	12'	150'	2.00%
650	6"	12'	150'	6"	12'	150'	0.60%
800	4"	12'	100'	6"	12'	100'	0.63%
800	6"	12'	150'	6"	12'	150'	0.38%
1000	6"	12'	150'	6"	12'	150'	1.00%

\*When using 4" vent for the 650 model, the allowable vent length for propane models is different from the allowable vent length for natural gas models.

### 3 General venting *(continued)*

#### Air inlet pipe materials:

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

- PVC, CPVC, Polypropylene or ABS
- Dryer Vent or Sealed Flexible Duct (not recommended for rooftop air inlet)
- Galvanized steel vent pipe with joints and seams sealed as specified in this section.
- Type "B" double-wall vent with joints and seams sealed as specified in this section.
- AL29-4C, stainless steel material to be sealed to specification of its manufacturer.

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

**⚠ WARNING** Using air intake materials other than those specified can result in personal injury, death or property damage.

**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:

- a. 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.
- b. Do not install seams of vent pipe on the bottom of horizontal runs.
- c. Secure all joints with a minimum of three (3) sheet metal screws or pop rivets. Apply Aluminum Foil Duct Tape or silicone sealant to all screws or rivets installed in the vent pipe.
- d. 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 PVC, CPVC, ABS, Dryer Vent or Flex Duct air inlet pipe should use a silicone sealant to ensure a proper seal at the appliance connection and the air inlet cap connection. Dryer vent or flex duct should use a screw type clamp to seal the vent to the appliance air inlet and the air inlet cap. Proper sealing of the air inlet pipe ensures that combustion air will be free of contaminants and supplied in proper volume.

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

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.

#### Vent, air piping, and termination:

The Armor water heater vent and air piping can be installed through the roof or through a sidewall. Follow the procedures in this manual for the method chosen. This unit requires Category IV venting. Refer to the information in this manual to determine acceptable vent and air piping length.

#### Common venting

Armor water heaters may be common vented; however, the following criteria **MUST BE** followed:

1. Only Armor water heaters may be connected to the common vent. **DO NOT** mix other manufacturer's appliances or other Lochinvar models.
2. Armor water heaters connected to the common vent must all be of the same size.
3. Each Armor water heater must have a Lochinvar supplied flue damper installed (see Table 3F).
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 water heaters. Sidewall common venting is not allowed.
6. Armor water heaters 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, BACnet, or its own internally calculated set point.
  - b. The Cascade (Members) must be controlled by the Armor Leader water heater using the Lead/Lag Cascade option.

For approved common vent sizing, contact the factory.

Armor water heaters cannot be connected using a common air system.

**⚠ WARNING** When Armor water heaters 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.

### 3 General venting

**Table 3E** Flue damper kits

Flue Damper Kits		
Model	Damper Size	Kit Number
400	4"	100056141
500	4"	100056141
650	4" or 6"	100056141
800	6"	100056142
1000	6"	100056142

#### Common venting CAT II:

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

**Table 3F** Category IV to Category II Conversion Chart

Model	Category IV Standard Vent Size	Category II Increaser Size
400	4"	6"
500	4"	6"
650	6"	8"
800	6"	8"
1000	6"	8"

#### Optional room air

##### NOTICE

Optional room air is intended for commercial applications. Combustion air piping to the outside is recommended for residential applications.

Commercial applications utilizing the Armor water heater may be installed with a single pipe carrying the flue products to the outside while using combustion air from the equipment room. In order to use the room air venting option the following conditions and considerations must be followed.

- The unit MUST be installed with the appropriate room air kit (Table 3G).

- The equipment room MUST be provided with properly sized openings to assure adequate combustion air. Refer to the instructions provided with the room air kit.
- There will be a noticeable increase in the noise level during normal operation from the inlet air opening.
- Using the room air kit makes the unit vulnerable to combustion air contamination from within the building. Please review Section 1, Prevent Combustion Air Contamination, to ensure proper installation.
- Vent system and terminations must comply with the standard venting instructions set forth in this manual.

##### WARNING

When utilizing the single pipe method, 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, 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.

**Table 3G** Optional Room Air Kit

Model	Kit Number	Description
400 - 800	100157616	Room Air Kit
1000	100344020	Room Air Kit

#### Air contamination

Pool and laundry products and common household and hobby products often contain fluorine or chlorine compounds. When these chemicals pass through the water heater, they can form strong acids. The acid can eat through the water heater 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 listing contaminants and areas likely to contain them. If contaminating chemicals will be present near the location of the water heater combustion air inlet, have your installer pipe the water heater combustion air and vent to another location, per this manual.

##### WARNING

If the water heater 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 before installing the water heater or air inlet piping.

If contaminants are found, you MUST:

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



## 3 General venting *(continued)*

### PVC/CPVC

This product has been approved for use with the PVC/CPVC vent materials listed in Table 3H.

#### Installing vent and air piping

**WARNING** The vent connection to the appliance must be made with 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 3H 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 CPVC and 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 water heater (to allow drainage of condensate). Horizontal runs shall have supports suitable for non-metallic vent piping that do not clamp tightly onto vent, allowing for vent expansion or contraction. Supports shall be as close to the joints and fittings as practical and no more than 5 feet apart.

**NOTICE** When available, follow all vent manufacturer's installation instructions.

**WARNING** Insulation shall 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.

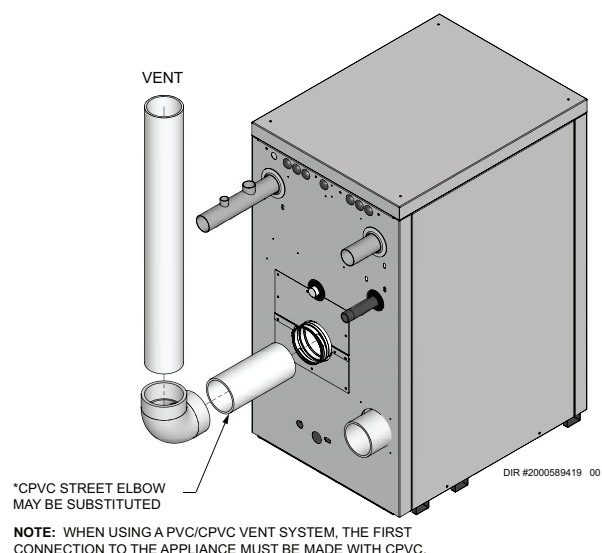
**Table 3H PVC/CPVC Vent Pipe, and Fittings**

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 40	ANSI/ASTM F438
	CPVC Schedule 80	ANSI/ASTM F439
	PVC - DWV	ANSI/ASTM D2665
Pipe Cement / Primer	PVC	ANSI/ASTM D2564
	CPVC	ANSI/ASTM F493
<b>NOTICE: DO NOT USE CELLULAR (FOAM) CORE PIPE</b>		

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

1. Work from the water heater 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 a 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 3-7 Near Water Heater PVC/CPVC Venting - Models 400 - 1000**





## 3 General venting

### Polypropylene

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

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:

- 1 foot of Duravent 4 inch single-wall pipe is equivalent to 1.6 feet of piping

### Flexible polypropylene

For use of flex pipe, it is recommended to have the vent material in 32°F or higher ambient space before bending at installation. No bends should be made to greater than 45° and ONLY installed in vertical or near vertical installations (FIG. 3-8).

#### NOTICE

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

#### NOTICE

All vent connections MUST be secured by the vent manufacturer's joint connector (FIG. 3-9).

#### 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.

#### WARNING

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

Table 3I Polypropylene Vent Pipe and Fittings

Approved Polypropylene Vent Manufacturers		
Make	Model	Standard
Centrotherm Eco Systems	InnoFlue SW/Flex	UL-1738/ULC-S636
Duravent (M & G Group)	PolyPro Single-Wall / PolyPro Flex	ULC-S636

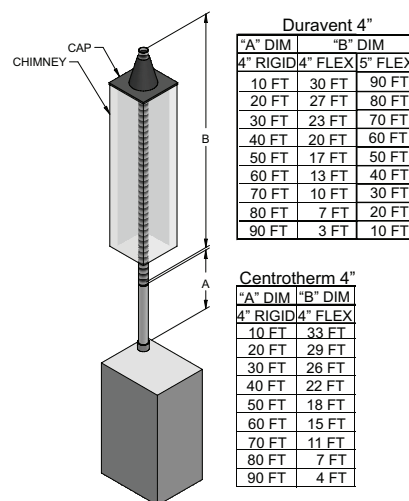
#### NOTICE

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.

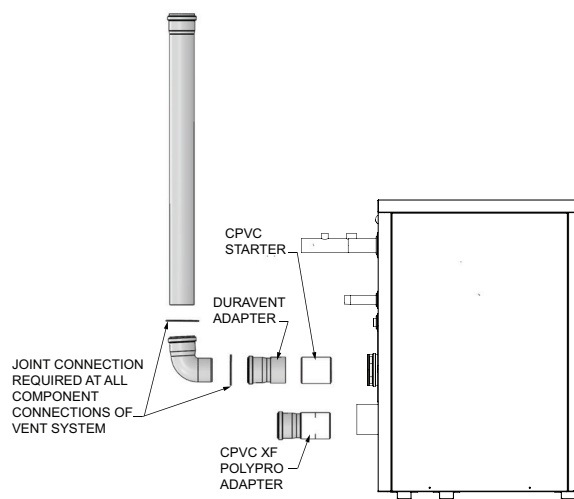
Figure 3-8 Near Water Heater Flexible Polypropylene Venting



- \*NOTES: 1) FLEX PIPE MAY ONLY BE RUN IN A VERTICAL ORIENTATION  
 2) ALL VENT LENGTHS REPRESENTED IN ABOVE CHARTS ARE EQUIVALENT LENGTHS.  
 3) SECTION A IS EQUIVALENT FEET OF RIGID PIPE, WHICH MAY INCLUDE 45 AND 90° ELBOWS. PLEASE SEE SIZING SECTION FOR DETERMINING EQUIVALENT FEET.

IMG00840

Figure 3-9 Near Water Heater Polypropylene Venting



### 3 General venting *(continued)*

**Table 3J Approved Polypropylene Terminations**

Model	Centrotherm InnoFlue SW					
	Polypropylene Adapter	Joint Connector	Sidewall Retaining Bracket*	Sidewall Adapter*	Low Profile Wall Termination	Concentric Wall Termination
400-500	ISAAL0404	IAN504	IATP0404	ISTAGL0404	ISLPT0404	ICWT462 & ICT0446
650-1000	ISAAL0606	Not Required	IATP0606	ISTAGL0606	ISLPT0606	ICWT610 & ICTC06610
Model	DuraVent Polypro			* These parts are only needed if the sidewall termination assembly is used (see FIG. 4-5B).		
	Polypropylene Adapter	Joint Connector	Sidewall Kit*			
400-500	4PPS-AD-M	4PPS-LB	4PPS-HLK			
650-1000	6PPS-06PVC-M-6PPF	Not Required	6PPS-HLK			

#### Stainless steel vent

This product has been approved for use with stainless steel using the manufacturers listed in Table 3K.

**WARNING** Use only the materials, vent systems, and terminations listed in Tables 3K and 3L. 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

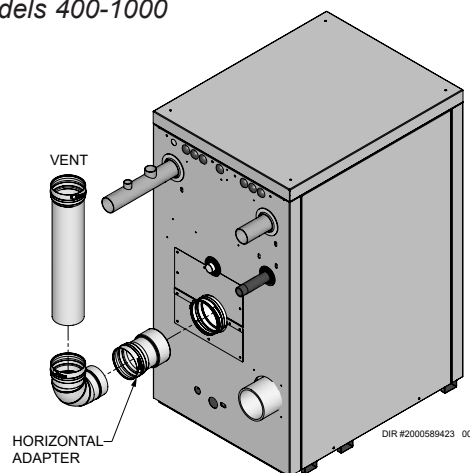
The installer must use a specific vent starter adapter at the flue collar connection, supplied by the vent manufacturer to adapt to its vent system. See Table 3L for approved vent adapters. Discard CPVC starter piece.

#### 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.

**Figure 3-10 Near Water Heater Stainless Steel Venting Models 400-1000**

**Table 3K Stainless Steel Vent Pipe and Fittings**

Approved Stainless Steel Vent Manufacturers	
Make	Model
Dura Vent (M & G Group)	FasNSeal
Dura Vent (M & G Group)	FasNSeal Flex* Vent
Z-Flex (Nova Flex Group)	Z-Vent
Heat Fab (Selkirk Corporation)	Saf-T Vent
Metal Fab	Corr/Guard
Security Chimney	Secure Seal
ICC	VIC
Van Packer	--
Energex	Powervent
Jeremias	--

\*Use of FasNSeal Flex smooth inner wall vent is to be used in vertical or near vertical sections only, taking precaution to ensure no sagging occurs of the vent system. Connect to the FasNSeal rigid vent using specially designed adapters and sealing method, see manufacturer's instructions.

### 3 General venting *(continued)*

**Table 3L Approved Stainless Steel Terminations and Adapters Continued**

Model	DuraVent			Heat Fab			Z Flex		
	FasNSeal			Saf-T Vent			Z-Vent		
	S.S. Adapter	Flue Termination	Intake Air Termination	S.S. Adapter	Flue Termination	Intake Air Termination	S.S. Adapter	Flue Termination	Intake Air Termination
400-500	FSA-4PVC-4FNS	FSBS4 FSRC4	FSAIH04	9401PVC	9492 5400CI	9414TERM	2SVSLA04	2SVSTP(F,X)04 2SVSRCX04	2SVSTEX0490
650-800	FSA-6PVC-6FNS	FSBS6 FSRC6	FSAIH04	9601PVC	9690 9692	9414TERM	2SVSTTA06	2SVSTPX06 2SVSRCX06	2SVSTEX0490
1000	FSA-6PVC-6FNS	FSBS6 FSRC6	FSAIH06	9601PVC	9690 9692	9614TERM	2SVSTTA06	2SVSTPX06 2SVSRCX06	2SVSEE0690 & 2SVSTPX06
Model	Metal Fab			Security Chimney			ICC		
	Corr/Guard			Secure Seal			VIC		
	S.S. Adapter	Flue Termination	Intake Air Termination	S.S. Adapter	Flue Termination	Intake Air Termination	S.S. Adapter	Flue Termination	Intake Air Termination
400-500	4CGPVCA	4CGSWHT 4CGSWC	4CGSW90LT	SS4PVCU	SS4STU SS4RCBU	SS4ST90AU	HO-04PA	HM-04MC HM-04SR	HE-04E90 HM-04SR
650-800	6FCGPVCA	6FCGSWMC 6FCGSWC	4CGSW90LT	SS6PVCU	SS6STU SS6RCBU	SS4ST90AU	HO-06PA	HM-06MC HM-06SR	HE-04E90 HM-04SR
1000	6FCGPVCA	6FCGSWMC 6FCGSWC	6FCGSW90L	SS6PVCU	SS6STU SS6RCBU	SS6ST90AU	HO-06PA	HM-06MC HM-06SR	HE-06E90 HM-06SR
Model	Enerflex			Van Packer					
	Powervent								
	Boiler Adapter	Flue Termination	Intake Air Termination	Boiler Adapter	Flue Termination	Intake Air Termination			
400-500	801.0676.4604	801.0679.1004	801.0676.4604	C04PVC04.38B/ C04PVC04.38B	M0490EB & M04SCTB	M0490EB & M04SCTB			
650-800	801.0676.4606	801.0679.1006	801.0676.4604	C04PVC04.38B/ C06PVC06.50B	M0690EB & M06SCTB	M0490EB & M04SCTB			
1000	801.0676.4606	801.0679.1006	801.0676.4606	C06PVC06.50B/ C06PVC06.50B	M0690EB & M06SCTB	M0690EB & M06SCTB			
Model	Jeremias								
	Boiler Adapter	Flue Termination	Intake Air Termination						
400-500	SWKL4-KLC	SWKL4-WRC	SWKL4-90ET						
650-800	SWKL6-KLC	SWKL6-WRC	SWKL4-90ET						
1000	SWKL6-KLC	SWKL6-WRC	SWKL6-90ET						

## 4 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.

#### Determine location

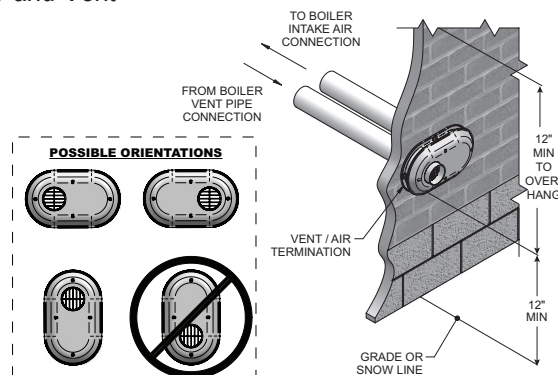
Locate the vent/air terminations using the following guidelines:

- The total length of piping for vent or air must not exceed the limits given in the General Venting Section of this manual.
- You must consider the surroundings when terminating the vent and air:
  - Position the vent termination where vapors will not damage nearby shrubs, plants, or air conditioning equipment or be objectionable.
  - The flue products will form a noticeable plume as they condense in cold air. Avoid areas where the plume could obstruct window views.
  - Prevailing winds could cause freezing of condensate and water/ice buildup where flue products impinge on building surfaces or plants.
  - Avoid possibility of accidental contact of flue products with people or pets.
  - 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.

**WARNING** Sidewall vent and air inlet terminations must terminate in the same pressure zone.

- Do not terminate above any door or window. Condensate can freeze, causing ice formations.
- Locate or guard vent to prevent condensate damage to exterior finishes.
- Do not locate the terminations over public walkways.
- Do not locate the terminations near soffit vents, crawlspace vents, or other areas where condensate or vapor could create a nuisance, hazard, or cause property damage.
- Do not locate the terminations where condensate vapor could cause damage or could be detrimental to the operation of regulators, relief valves, or other equipment.
- Terminations must be located a minimum of 12" above grade or maximum snow line.

**Figure 4-1A** PVC/CPVC/Polypropylene Sidewall Termination of Air and Vent



**Table 4A** Sidewall Vent Kits

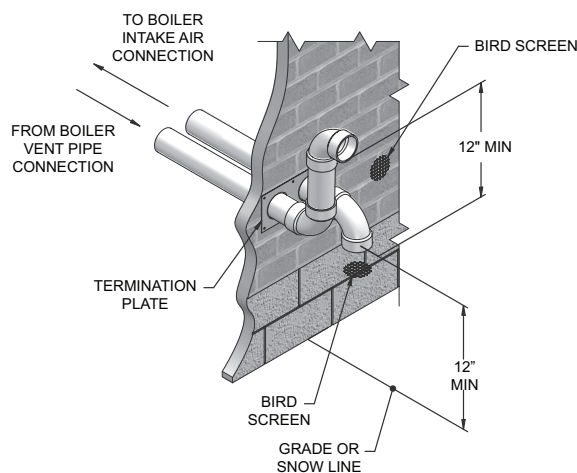
Model	Kit Number	Air Intake	Vent Size
400 - 500	100157611	4"	4" vent
650 - 800	100157613	4"	6" vent
1000	100157612	6"	6" vent

#### If using the alternate sidewall termination:

- The air piping must terminate in a down-turned elbow as shown in FIG. 4-1B. 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. 4-1B.

**WARNING** Do not exceed the maximum lengths of the outside vent piping shown in FIG. 4-1B. Excessive length exposed to the outside could cause freezing of condensate in the vent pipe, resulting in potential water heater shutdown.

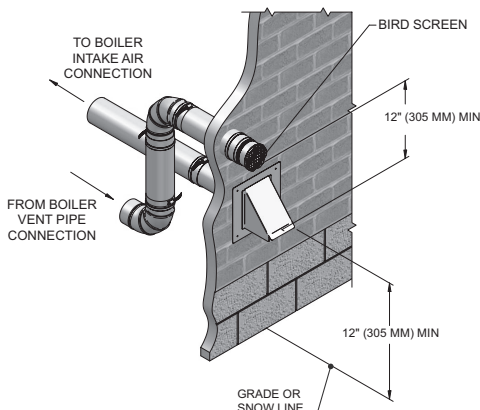
**Figure 4-1B** Alternate PVC/CPVC Sidewall Termination of Air and Vent w/Field Supplied Fittings



## 4 Sidewall direct venting *(continued)*

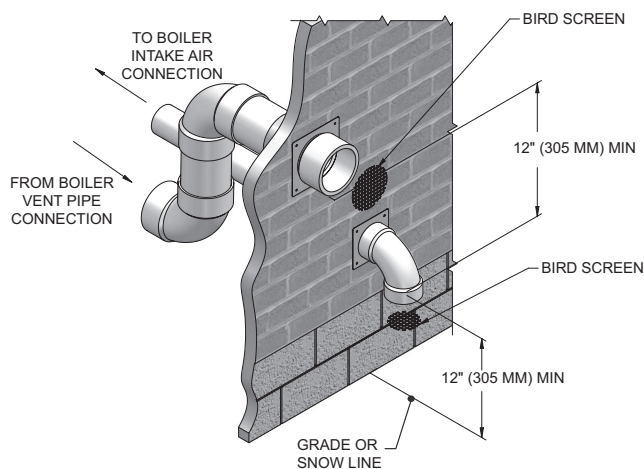
### Vent/air termination – sidewall

**Figure 4-1C** Alternate PVC/CPVC/SS Vent Termination - Typical Stainless Steel Sidewall Termination of Air and Vent w/Field Supplied Fittings



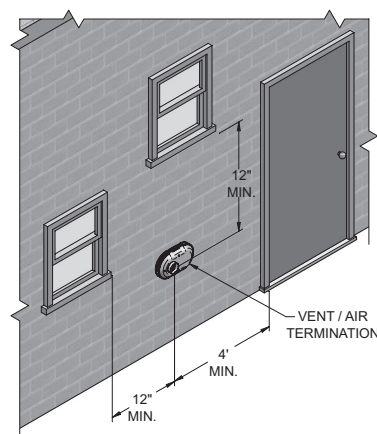
**NOTICE** PVC/CPVC or ABS is acceptable air inlet pipe material.

**Figure 4-2** Alternate PVC/CPVC/SS/ Polypropylene Sidewall Termination w/Field Supplied Fittings

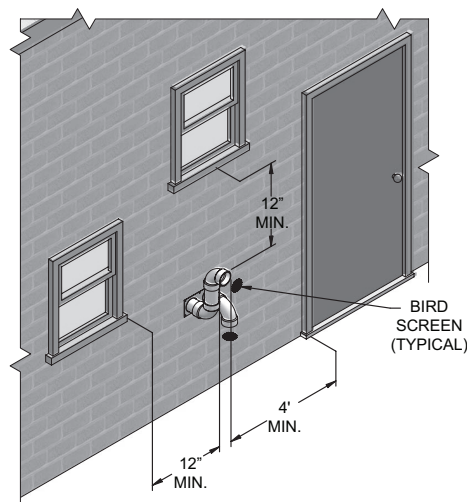


5. Maintain clearances as shown in FIG. 4-1A thru 4-5B. Also maintain the following:
  - a. Vent must terminate:
    - At least 6 feet from adjacent walls.
    - No closer than 12 inches below roof overhang.
  - b. Air inlet must terminate at least 12 inches above grade or snow line; at least 12 inches below the vent termination; and the vent pipe must not extend more than 24 inches vertically outside the building as shown in FIG. 4-1B.
  - c. Do not terminate closer than 4 feet horizontally from any electric meter, gas meter, regulator, relief valve, or other equipment. Never terminate above or below any of these within 4 feet horizontally.
6. 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 4-3A** Clearance to Gravity Air Inlets



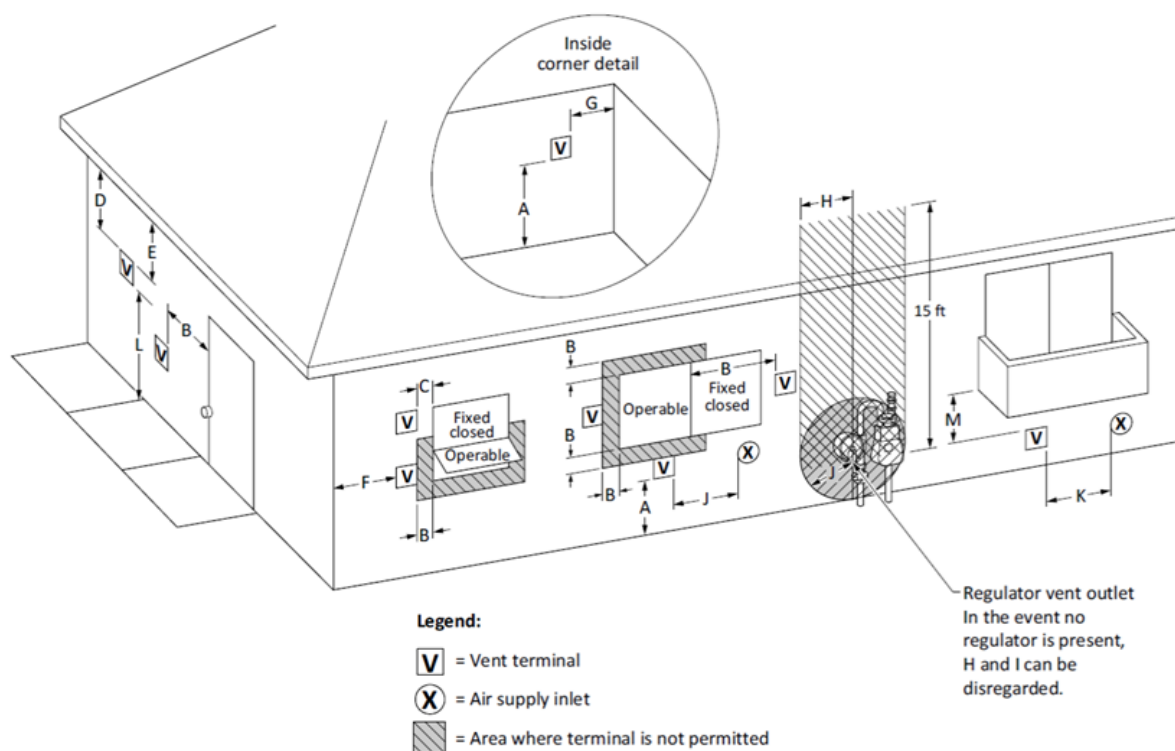
**Figure 4-3B** Alternate Clearance to Gravity Air Inlets w/ Field Supplied Fittings





## 4 Sidewall direct venting

**Figure 4-4A** Direct Vent Terminal Clearances



**Table 4B** Direct Vent Terminal Clearances

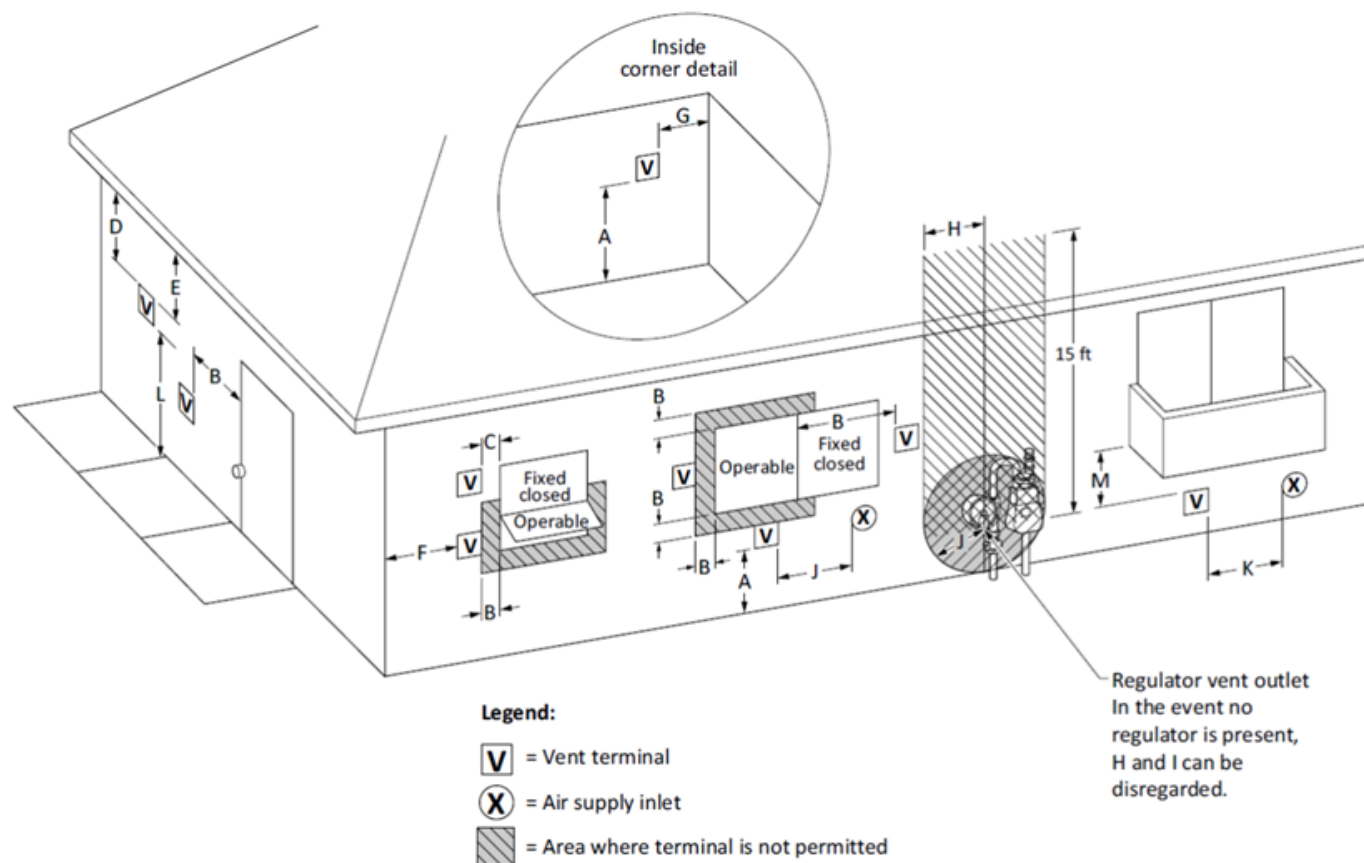
		Canadian Installations <sup>1</sup>	US Installations <sup>2</sup>
A =	Clearance above grade, veranda, porch, deck, or balcony	12 in (30 cm)	12 in (30 cm)
B =	Clearance to window or door that may be opened	6 in (15 cm) for appliances ≤ 10,000 Btuh (3 kW), 12 in (30 cm) for appliances > 10,000 Btuh (3 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) and not exceeding > 150,000 Btuh (30 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	*	*
I =	Clearance to service regulator vent outlet	Above a regulator within 3 ft (91 cm) horizontally of the vertical center line of the regulator vent outlet to a maximum vertical distance of 15 ft (4.5 m)	*

## 4 Sidewall direct venting *(continued)*

**Table 4B** 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 $\leq 10,000$ Btuh (3kW), 12 in (30 cm) for appliances $> 10,000$ Btuh (3 kW) and $\leq 100,000$ Btuh (30 kW), 36 in (91 cm) for appliances $> 100,000$ Btuh (30 kW)	6 in (15 cm) for appliances $\leq 10,000$ Btuh (3kW), 9 in (23 cm) for appliances $> 10,000$ Btuh (3 kW) and $\leq 50,000$ Btuh (15 kW), 12 in (30 cm) for appliances $> 50,000$ Btuh (15 kW) and not exceeding $> 150,000$ Btuh (30 kW)
K =	Clearance to a mechanical air supply inlet	6 ft (1.83 m)	3 ft (91 cm) above if within 10 ft (3 m) horizontally
L =	Clearance above paved sidewalk or paved driveway located on public property	7 ft (2.13 m)†	7 ft (2.13 m) for mechanical draft systems (Category I appliances). Vents for Category II and IV appliances cannot be located above public walkways or other areas where condensate or vapor can cause a nuisance or hazard.*
M =	Clearance under veranda, porch, deck, or balcony	12 in (30 cm)‡	*
<p>* Clearance in accordance with local installation codes and the requirements of the gas supplier.</p> <p>† A vent shall not terminate directly above a sidewalk or paved driveway that is located between two single family dwellings and serves both dwellings.</p> <p>‡ Permitted only if veranda, porch, deck, or balcony is fully open on a minimum of two sides beneath the floor.</p> <p><b>NOTES:</b></p> <p>1) In accordance with the current CSA B149.1, Natural Gas and Propane Installation Code</p> <p>2) In accordance with the current ANSI Z223.1/NFPA 54, National Fuel Gas Code</p>			

**Figure 4-4B** Other than Direct Vent Terminal Clearances



## 4 Sidewall direct venting

**Table 4C Other than Direct Vent Terminal Clearances**

		Canadian Installations <sup>1</sup>	US Installations <sup>2</sup>
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	*	*
I =	Clearance to service regulator vent outlet	Above a regulator within 3 ft (91 cm) horizontally of the vertical center line of the regulator vent outlet to a maximum vertical distance of 15 ft (4.5 m)	*
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

## 4 Sidewall direct venting *(continued)*

### Prepare wall penetrations

1. Use the factory supplied wall plate as a template to locate the vent and air intake holes and mounting holes.

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.

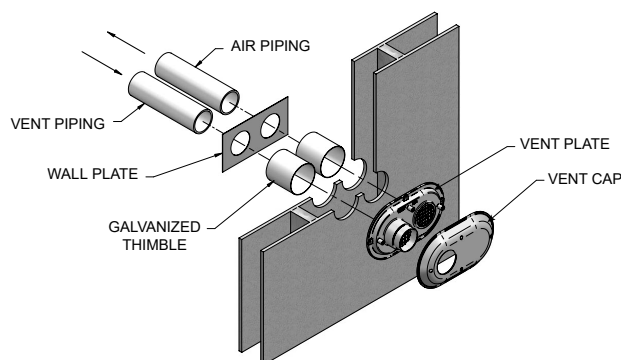
Vent pipe penetration:

- a. Cut a hole for the vent pipe. For either combustible or noncombustible construction, size the vent pipe hole with at least a 1/2 inch clearance around the vent pipe outer diameter:
  - 5½ inch hole for 4 inch vent pipe
  - 7½ inch hole (191 mm) hole for 6 inch (152 mm) vent pipe

Drill 3/16" diameter holes for inserting the plastic anchors into the wall.

2. For Polypropylene Only: Install the vent and air intake sidewall adapters from Table 3J into the vent plate. Slide the sidewall retaining bracket down the sidewall adapters flush to the vent plate.
3. For PVC/CPVC Only: Install the vent and air intake piping through the wall into the vent plate openings. Use RTV silicone sealant to seal the air pipe. Use the cement/primer listed in Table 3H to seal the vent pipe.
4. Mount and secure the vent plate to the wall using stainless steel screws. Seal around the plate to the wall assuring no air gaps.
5. Seal all gaps between the pipes and wall. Seal around the plate to the wall assuring no air gaps.
6. Assemble the vent cap to the vent plate. Insert the stainless steel screws into the vent cap screw hole openings and securely attach the vent cap to the vent plate.
7. Seal all wall cavities.
8. PVC/CPVC terminations are designed to accommodate any wall thickness of standard constructions per the directions found in this manual.
9. Stainless steel terminations are designed to penetrate walls with a thickness up to 9.25 inches of standard construction.

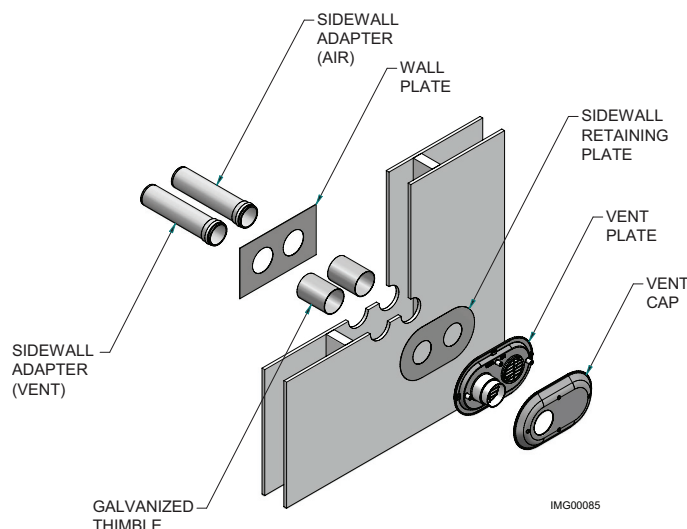
**Figure 4-5A Sidewall Termination Assembly**



**Table 4D Sidewall Vent Centerline Dimensions**

Model	Air	Vent
400 - 500	4"	4"
650 - 800	4"	6"
1000	6"	6"

**Figure 4-5B Polypropylene Sidewall Termination Assembly**

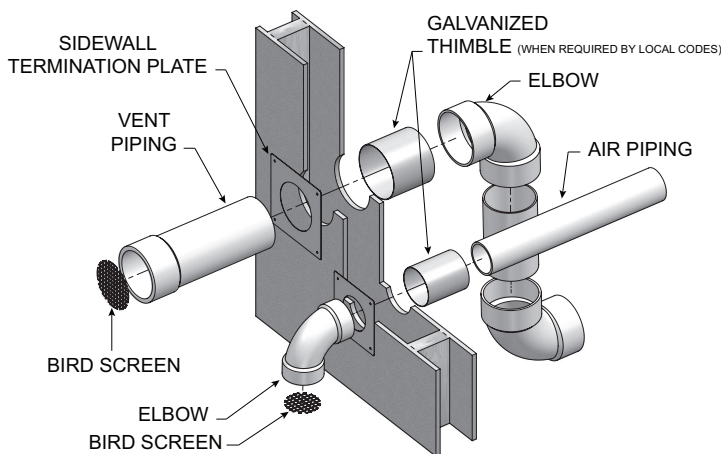


## 4 Sidewall direct venting

### Prepare wall penetrations (Alternate - Field Supplied Option)

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 with at least a 1/2 inch clearance around the vent pipe outer diameter:
    - 5½ inch hole (140 mm) or 4 inch (102 mm) vent pipe
    - 7½ inch hole (191 mm) for 6 inch (152 mm) vent pipe
  - b. Insert a galvanized metal thimble in the vent pipe hole as shown in FIG. 4-5C.
3. Use a sidewall termination plate as a template for correct location of hole centers.
4. Follow all local codes for isolation of vent pipe when passing through floors or walls.
5. Seal exterior openings thoroughly with exterior caulk.

**Figure 4-5C** A Typical Sidewall Termination Assembly - PVC/CPVC or Stainless Steel



### Multiple vent/air terminations

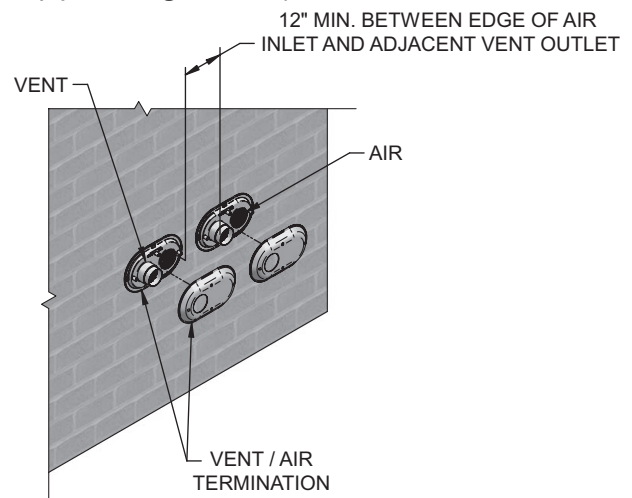
1. When terminating multiple Armor water heaters terminate each vent/air connection as described in this manual (FIG. 4-6A).

#### **WARNING**

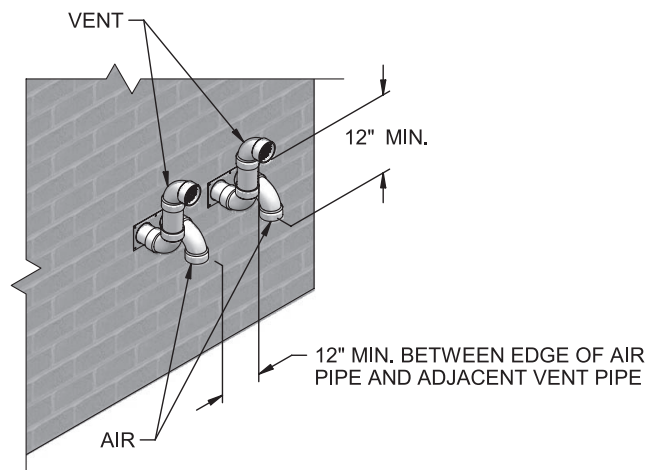
All vent pipes and air inlets must terminate at the same height to avoid possibility of severe personal injury, death, or substantial property damage.

2. Place wall penetrations to obtain minimum clearance of 12 inches between edge of air inlet and adjacent vent outlet, as shown in FIG. 4-6A for U.S. installations. For Canadian installations, provide clearances required by CSA B149.1 Installation Code.
3. The air inlet of a Armor water heater is part of a direct vent connection. It is not classified as a forced air intake with regard to spacing from adjacent water heater vents.

**Figure 4-6A** Multiple Vent Terminations (must also comply with Figure 4-1A)



**Figure 4-6B** Alternate Multiple Vent Terminations w/Field Supplied Fittings (must also comply with Figure 4-1B)





## 4 Sidewall direct venting *(continued)*

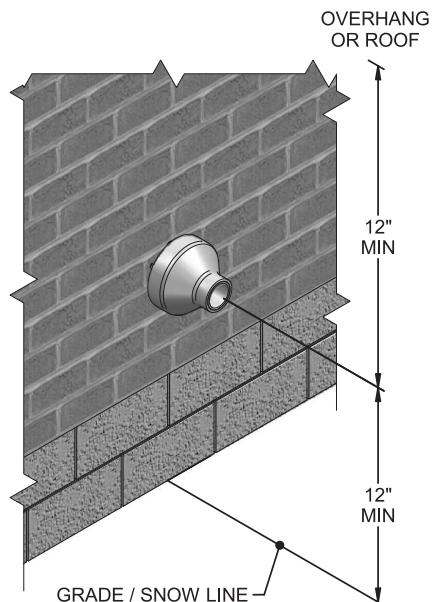
### Sidewall termination – optional concentric vent: Models 400 - 500

#### Description and usage

Lochinvar offers optional concentric combustion air and vent pipe termination kits (Factory Kit #100140484 for 4" diameter - Models 400 - 500). Both combustion air and vent pipes must attach to the termination kit. The termination kits must terminate outside the structure and must be installed as shown below in FIG. 4-7.

The required combustion vent pipe materials are listed in Table 3H of this manual.

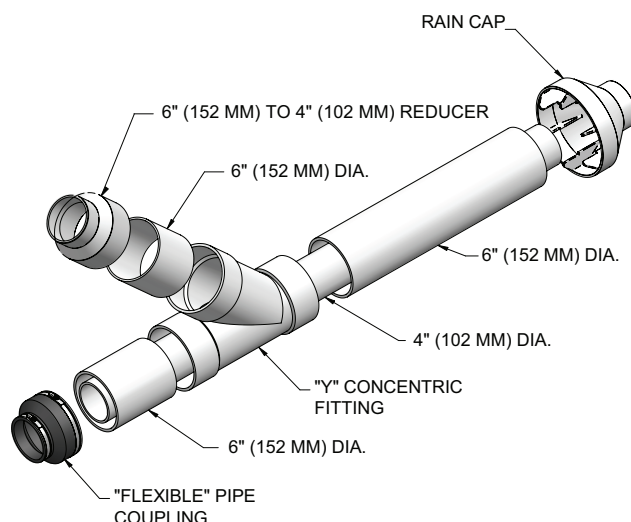
**Figure 4-7 Concentric Sidewall Termination**



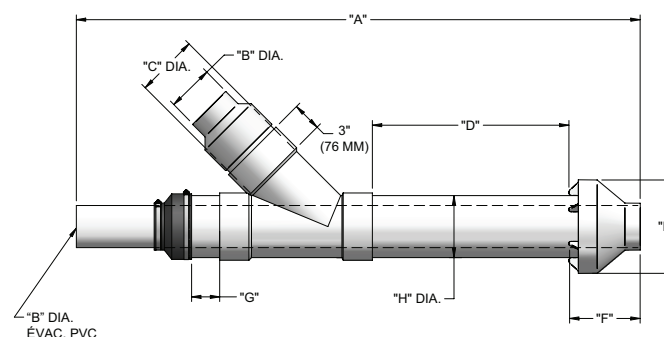
#### Sidewall termination installation

1. Determine the best location for the termination kit (see FIG. 4-7).
2. Reference the *Determine Location Section* of this manual for general termination considerations.
3. Cut one (1) hole 7 inch diameter into the structure to install the termination kit.
4. Partially assemble the concentric vent termination kit. Clean and cement using the procedures found in these instructions.
  - a. Cement the Y concentric fitting to the larger kit pipe (FIG. 4-9).
  - b. Cement the rain cap to the smaller diameter kit pipe (FIG. 4-9).

**Figure 4-8 Kit Contents\_100140484 - Models 400 - 500**



**Figure 4-9 Concentric Vent Dimensional Drawing - Models 400 - 500**



A	B	C	D	E	F	G	H
60"	4"	6"	21 1/8"	10"	7 5/8"	3"	6 5/8"

#### NOTICE

Instead of cementing the smaller pipe to the rain cap, a field-supplied stainless steel screw may be used to secure the two (2) components together when field disassembly is desired for cleaning (see FIG. 4-11).

#### WARNING

When using the alternate screw assembly method, drill a clearance hole in the rain cap and a pilot hole in the vent pipe for the screw size being used. Failure to drill adequate holes may cause cracking of PVC components, allowing combustion products to be recirculated. Failure to follow this warning could result in personal injury or death.

## 4 Sidewall direct venting

### Sidewall termination – optional concentric vent: Models 400 - 500

**WARNING** Do not operate the appliance with the rain cap removed or recirculation of combustion products may occur. Water may also collect inside the larger combustion air pipe and flow to the burner enclosure. Failure to follow this warning could result in product damage or improper operation, personal injury, or death.

**NOTICE**

Ensure termination location clearance dimensions are as shown in FIG. 4-7.

**NOTICE**

If assembly needs to be extended to allow sidewall thickness requirement, the two (2) pipes supplied in the kit may be replaced by using the same diameter, field-supplied SDR-26 PVC (D2241) pipe and standard schedule 40 PVC. Do not extend dimension D\* more than 60 inches (see FIG. 4-9 thru 4-11).

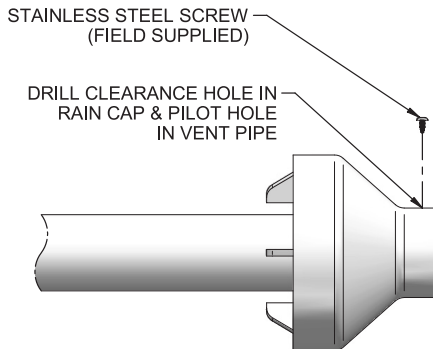
**NOTICE**

If assembly depth needs to be reduced, dimension D can be as short as possible.

**CAUTION**

DO NOT use field-supplied couplings to extend pipes. Airflow restriction will occur and may cause intermittent operation.

**Figure 4-10 Rain Cap to Vent Pipe Alternate Assembly**



6. Install the Y concentric fitting and pipe assembly through the structure's hole.

**NOTICE**

Do not allow insulation or other materials to accumulate inside the pipe assembly when installing through the hole.

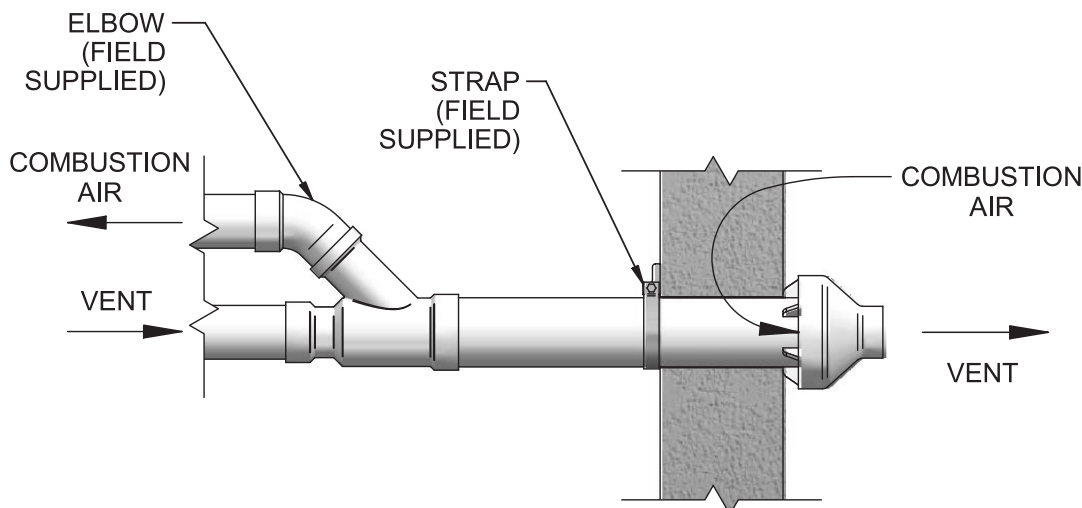
7. Install the rain cap and small diameter pipe assembly into the Y concentric fitting and large pipe assembly. Ensure small diameter pipe is fastened tightly into the rubber adapter.
8. Secure the assembly to the structure as shown in FIG. 4-11 using field-supplied metal strapping or equivalent support material.

9. Cement appliance combustion air and vent pipes to the concentric vent termination assembly. See FIG. 4-11 for proper pipe attachment.
10. Operate the appliance one (1) heat cycle to ensure combustion air and vent pipes are properly connected to the concentric vent termination connections.

#### Multiventing sidewall terminations

When two (2) or more direct vent appliances are vented near each other, each appliance must be individually vented (see FIG. 4-12). NEVER common vent or breach vent this appliance. When two (2) or more direct vent appliances are vented near each other, two (2) vent terminations may be installed as shown in FIG. 4-12. It is important that vent terminations be made as shown to avoid recirculation of flue gases.

**Figure 4-11 Concentric Vent Sidewall Attachment**

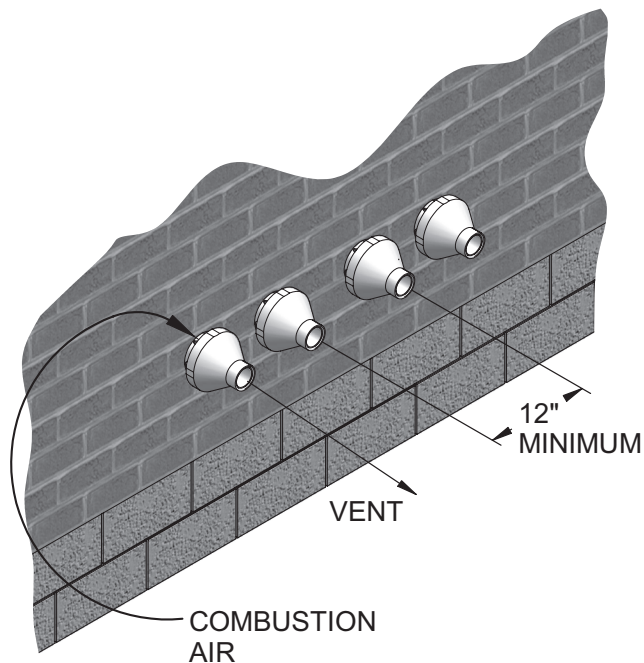


**Note:** 100140480 shown for illustration purposes.

## 4 Sidewall direct venting *(continued)*

### Sidewall termination – optional concentric vent: Models 400 - 500

**Figure 4-12** Concentric Vent and Combustion Air Termination



## 5 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.

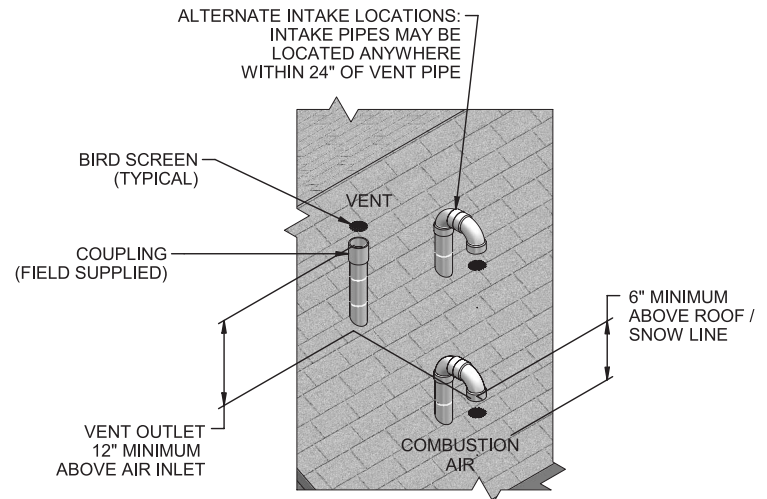
#### Determine location

Locate the vent/air terminations using the following guidelines:

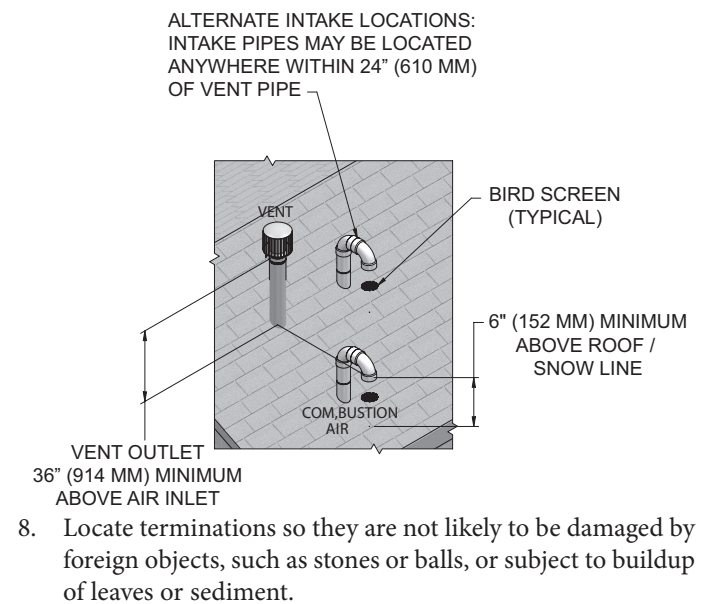
1. The total length of piping for vent or air must not exceed the limits given in the General Venting Section of this manual.
2. Prepare the vent termination and the air termination elbow (FIG. 5-1A) by inserting bird screens. Bird screens should be obtained locally.
3. The vent must terminate at least 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.
4. The air piping must terminate in a down-turned 180° return pipe no further than 2 feet from the center of the vent pipe. This placement avoids recirculation of flue products into the combustion air stream.
5. The vent piping must terminate in an up-turned coupling as shown in FIG. 5-1A. The top of the coupling must be at least 1 foot above the air intake. When the vent termination uses a rain cap as illustrated in FIG. 5-1B maintain at least 36" (914 mm) above the air inlet. 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 1 foot for PVC and 3 feet for stainless steel, above the air intake.
6. Maintain the required dimensions of the finished termination piping as shown in FIG. 5-1A.
7. Do not extend exposed vent pipe outside of building more than shown in this document. Condensate could freeze and block vent pipe.

**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 5-1A PVC/CPVC Vertical Termination of Air and Vent**



**Figure 5-1B Stainless Steel Vertical Termination of Air and Vent**



## 5 Vertical direct venting *(continued)*

### Vent/air termination – vertical

#### 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 with at least a 1/2 inch clearance around the vent pipe outer diameter:
    - 5½ inch (140 mm) hole for 4 inch (102 mm) vent pipe
    - 7½ inch (191 mm) hole for 6 inch (152 mm) vent pipe
  - b. Insert a galvanized metal thimble in the vent pipe hole.
3. Space the air and vent holes to provide the minimum spacing shown in FIG. 5-1A.
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.

#### Multiple vent/air terminations

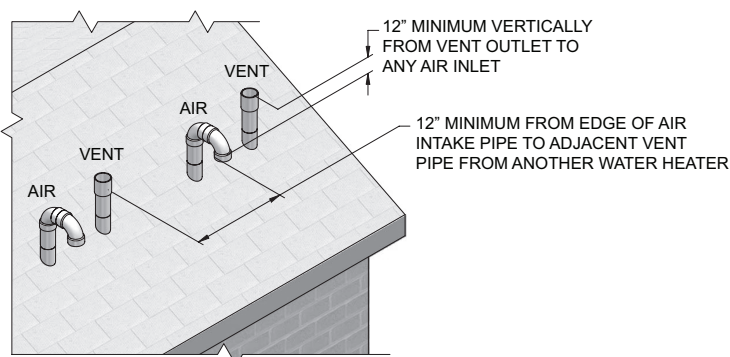
1. When terminating multiple Armor water heaters, terminate each vent/air connection as described in this manual (FIG. 5-2).

#### **⚠ WARNING**

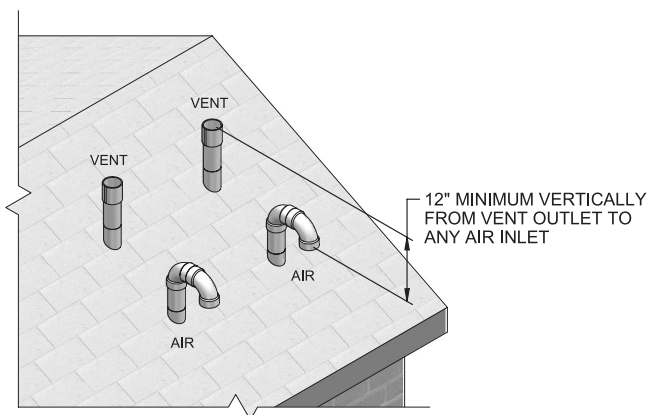
Terminate all vent pipes at the same height and all air pipes at the same height to avoid possibility of severe personal injury, death, or substantial property damage.

2. Place roof penetrations to obtain minimum clearance of 12 inches between edge of air intake elbow and adjacent vent pipe of another water heater for U.S. installations (see FIG. 5-2). For Canadian installations, provide clearances required by CSA B149.1 Installation Code.
3. The air inlet of an Armor water heater is part of a direct vent connection. It is not classified as a forced air intake with regard to spacing from adjacent water heater vents.

**Figure 5-2 Vertical Terminations with Multiple Water Heaters**



**Figure 5-3 Alternate Vertical Terminations with Multiple Water Heaters**





## 5 Vertical direct venting

### Vertical termination – optional concentric vent: Models 400 - 500

#### Description and usage

Lochinvar offers an optional concentric combustion air and vent pipe termination kit. Both combustion air and vent pipes must attach to the termination kit. The termination kit must terminate outside the structure and must be installed as shown in FIG. 5-4.

Field supplied pipe and fittings are required to complete the installation.

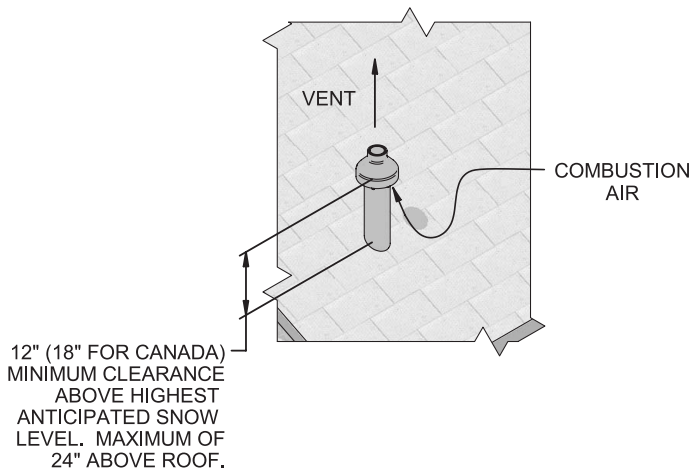
The required combustion vent pipe and fittings are listed in Table 3H of this manual.

#### Vertical termination installation

1. See Section 5, Vertical Direct Venting - Determine Location (where applicable).

2. Cut one (1) hole (7 inch diameter for #100140484 installations) into the structure to install the termination kit.
3. Partially assemble the concentric vent termination kit. Clean and cement following the cleaning procedures in these instructions.
  - a. Cement the Y concentric fitting to the larger diameter kit pipe (see FIG. 4-8 and 4-9).
  - b. Cement rain cap to the smaller diameter kit pipe (see FIG. 4-8 and 4-9).
  - c. Do not attach a U-Bend to the rain cap. Doing so could cause recirculation (see FIG. 5-5).

**Figure 5-4 Concentric Vertical Termination**



#### NOTICE

Instead of cementing the smaller pipe to the rain cap, a field supplied stainless steel screw may be used to secure the two (2) components together when field disassembly is desired for cleaning (see FIG. 4-12).

#### WARNING

When using the alternate screw assembly method, drill a clearance hole in the rain cap and a pilot hole in the vent pipe for the screw size being used. Failure to drill adequate holes may cause cracking of PVC components, allowing combustion products to be recirculated. Failure to follow this warning could result in personal injury or death.

**Figure 5-5 Do Not Install U-Bend to Rain Cap**



## 5 Vertical direct venting *(continued)*

### Vertical termination – optional concentric vent: Models 400 - 500

#### ⚠ WARNING

Do not operate the appliance with the rain cap removed or recirculation of combustion products may occur. Water may also collect inside the larger combustion air pipe and flow to the burner enclosure. Failure to follow this warning could result in product damage or improper operation, personal injury, or death.

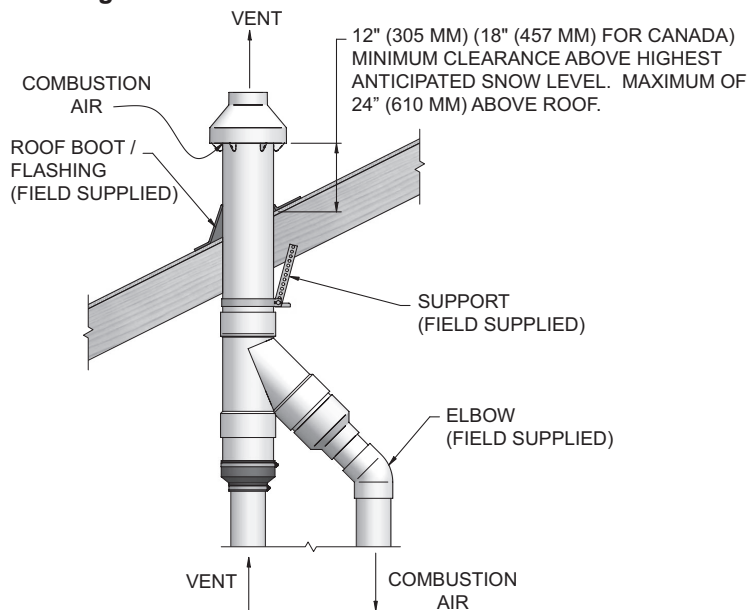
4. Install the Y concentric fitting pipe assembly up through the structure's hole and field supplied roof boot/flashing.

#### NOTICE

Do not allow insulation or other materials to accumulate inside the pipe assembly when installing through the hole.

5. Secure the assembly to the roof structure as shown below in FIG. 5-6 using field supplied metal strapping or equivalent support material.

**Figure 5-6 Concentric Vent Roof Installation**



#### NOTICE

Ensure termination height is above the roof surface or anticipated snow level (12 inches in U.S.A. or 18 inches in Canada) as shown in FIG. 5-4.

#### NOTICE

If assembly is too short to meet height requirement, the two (2) pipes supplied in the kit may be replaced by using the same diameter, field supplied SDR-26 PVC (D2241) pipe and standard schedule 40 PV. Do not extend dimension D\* more than 60 inches (see FIG. 4-10 and 4-11).

#### CAUTION

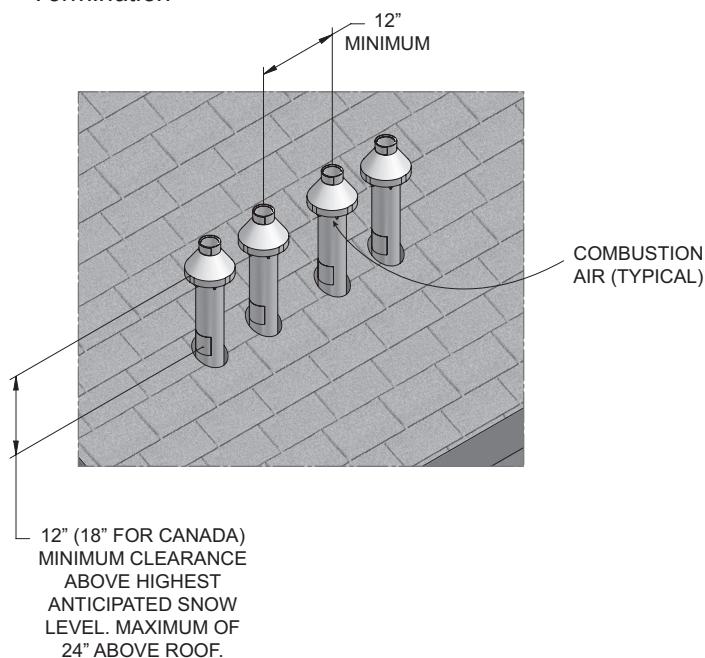
DO NOT use field-supplied couplings to extend pipes. Airflow restriction will occur.

6. Install the rain cap and the small diameter pipe assembly into the roof penetration assembly. Ensure the small diameter pipe is fastened tightly into the rubber adapter for #100140484 installations.
7. Cement the appliance combustion air and vent pipes to the concentric vent termination assembly. See FIG. 5-6 for proper pipe attachment.
8. Operate the appliance through one (1) heat cycle to ensure combustion air and vent pipes are properly connected to the concentric vent termination connections.

### Multiventing vertical terminations

When two (2) or more direct vent appliances are vented near each other, each appliance must be individually vented (see FIG. 5-7). NEVER common vent or breach vent this appliance. When two (2) or more direct vent appliances are vented near each other, two (2) vent terminations may be installed as shown in FIG. 5-7. It is important that vent terminations be made as shown to avoid recirculation of flue gases.

**Figure 5-7 Concentric Vent and Combustion Air Vertical Termination**



## 5 Vertical direct venting

### Alternate vertical concentric venting

This appliance may be installed with a concentric vent arrangement where the vent pipe is routed through an existing unused venting system; or by using the existing unused venting system as a chase for vent and combustion air routing.

#### Concentric Venting Arrangement

The venting is to be vertical through the roof. The annular space between the O.D. of the vent pipe and the I.D. of the existing unused venting system is utilized for the combustion air source.

The minimum size of the existing vent system required to achieve enough annular space for combustion air can be found in Table 5A below.

The upper and lower termination as well as any other unsealed joints in the existing vent system **must be** sealed to ensure that all combustion air is drawn from under the vent cap as shown in FIG. 5-8 and 5-9.

Approved venting materials must be used as specified in Table 3H.

Follow all vent / air termination and clearance requirements per this section to the appropriate example. Installation must comply with local requirements and with the National Fuel Gas Code.

The maximum allowable equivalent vent and air intake lengths for this venting arrangement are to be determined from the General Venting Section.

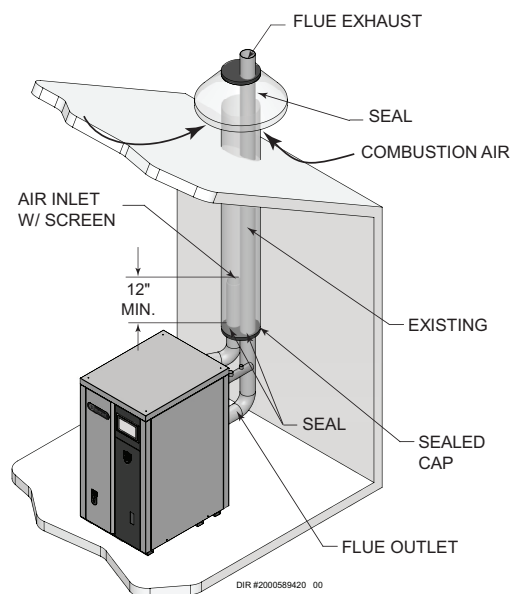
If an existing unused venting system is converted for use with this method of concentric venting, the installer must ensure that the existing venting system is clean and free from debris contamination that will harm this appliance and cause increased nuisance calls or maintenance. See Table 1A for a list of corrosive contaminants and sources.

Two example scenarios of a concentric venting arrangement are shown for illustrative purposes in FIG. 5-8 and 5-9.

**Table 5A Alternate Vertical Concentric Vent / Chase Sizes**

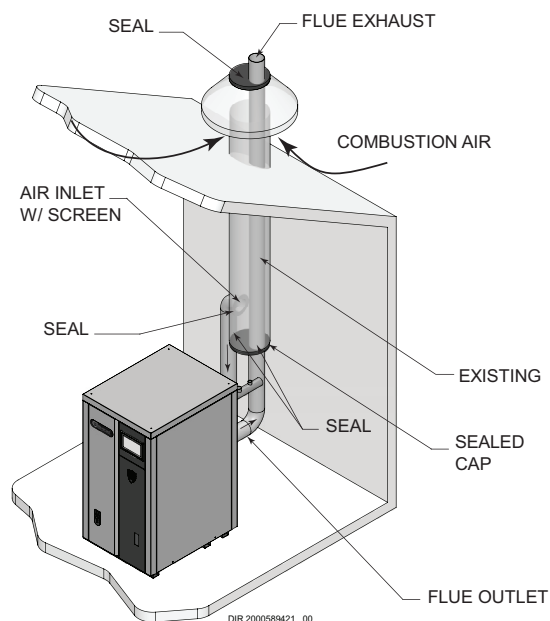
Model	Vent / Air Inlet Size	Minimum Existing Vent / Chase Size
400 - 500	4"	7"
650 - 1000	6"	10"

**Figure 5-8 Concentric Vent Example 1**



\*For concept illustration only. Individual installations may vary due to job site specific equipment.

**Figure 5-9 Concentric Vent Example 2**

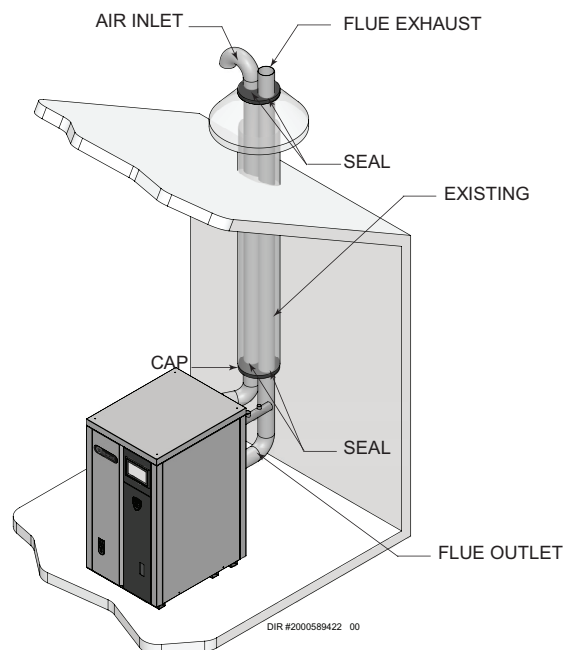


## 5 Vertical direct venting *(continued)*

### Existing vent as a chase

Follow all existing termination and clearance requirements and allowable pipe lengths. Use only approved venting materials listed in the General Venting Section of this manual.

**Figure 5-10** Existing Vent as a Chase



\*For concept illustration only. Individual installations may vary due to job site specific equipment.

## 6 Outdoor installations

### Outdoor venting

- In order to properly install the appliance in an outdoor configuration, the outdoor installation kit must be purchased from the factory.
- In order to properly install the appliance in an outdoor configuration the optional outdoor kit must be used (see Table 6A).
- 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 6B must be used.

**Table 6A Indoor to Outdoor Conversion Kit**

Model	Indoor to Outdoor Conversion Kit
400 - 500	100330250
600 - 1000	100361244

#### 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. All vent materials must be field supplied and supported per the vent manufacturer's instructions.



#### WARNING

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 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. A wind proof cabinet protects the unit from weather.

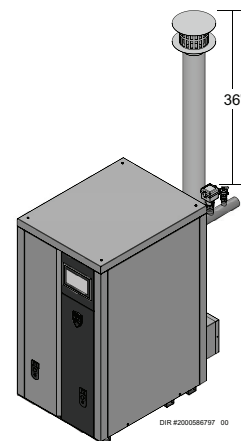
#### WARNING

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.

#### 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.

**Figure 6-1 Outdoor installation**



**Table 6B Approved Stainless Steel Adapters and Rain Caps**

Model	DuraVent		Z-Flex		Heat Fab		Metal Fab		Security Chimney	
	Adapter	Rain Cap	Adapter	Rain Cap	Adapter	Rain Cap	Adapter	Rain Cap	Adapter	Rain Cap
400 - 500	FSA-4PVC-4FNS	FSRC4	2SVSLA04	2SVSXITC04	9401PVC	CCA04EX06	4CGPVCA	4FCSEC-C60	SS4PVCU	SS4ECU
650 - 1000	810005231	FSRC6	-	-	9601PVC	CCA06EX08	6CGPVCA	6FCSEC-C60	SS6PVCU	SS6ECU



## 6 Outdoor installations *(continued)*

### Outdoor venting

#### 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.

Combustion air supply must be free of contaminants (see Combustion and Ventilation Air in 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 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 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.

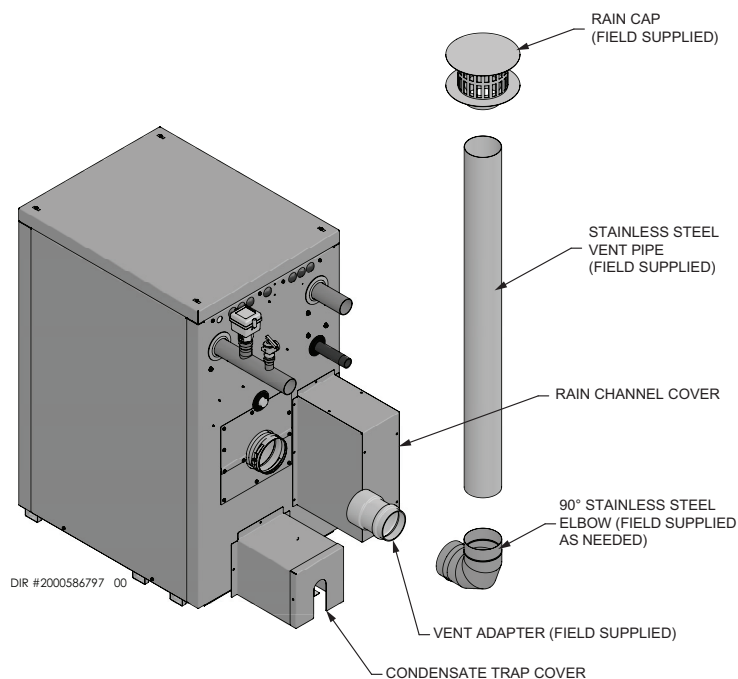
Locate unit at least 10 feet (3.05 m) away from any forced air inlet.

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 6-2 Outdoor Venting - Stainless Steel**



**NOTE:** See Table 6B for approved stainless steel adapters and rain caps.

# 7 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.

### Water connections

The inlet and outlet water connections on the AWH0400 - AWH0800 are 2" copper sweat. The inlet and outlet water connections on the AWH1000 are 2-1/2" copper sweat. The connections also have a groove in case a groove-lock fitting is preferred. For copper-to-copper connections, Victaulic style 607 QuikVic rigid couplings are recommended. For copper-to-stainless steel connections, Victaulic style 644 transition couplings are recommended. For other groove-lock connection styles contact the factory.

### General piping information

Basic steps are listed below along with illustrations on the following pages (FIG. 7-3 thru 7-7), which will guide you through the installation of the Armor water heater.

1. Connect the cold water supply to the inlet side of the water heater.
2. Connect the hot water supply to the outlet side of the water heater.
3. Install a backflow preventer on the cold feed makeup water line.
4. Install the factory supplied pump as shown in FIG. 7-3 thru 7-7.
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. 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. 7-3 thru 7-7 for suggested guidelines in piping the Armor water heater.

#### 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.

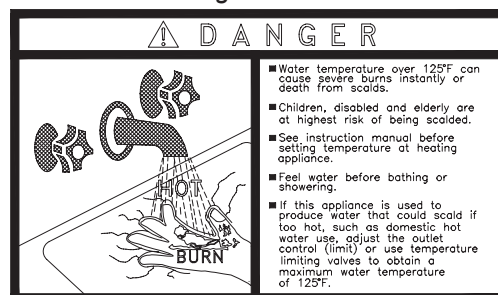
#### NOTICE

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.

## Scalding

This water heater 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 water heater 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 7-1 Scald Warning Label Located on the Appliance



The following chart (Table 7A) 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 7A 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 7B are selected based on the heating of potable water with a specified water chemistry. See Table 11A 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 11A 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.

# 7 System piping *(continued)*

## Piping components

### Water heater system piping:

Water heater system piping **MUST** be sized per the pipe requirements listed in Table 7B. Reducing the pipe size can restrict the flow rate through the water heater, causing inadvertent high limit shutdowns and poor system performance.

### Check valves:

Field supplied. Check valves are recommended for installation as shown in FIG. 7-3 thru 7-7.

### Water heater 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 water heater.

### 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 on water heaters. 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:

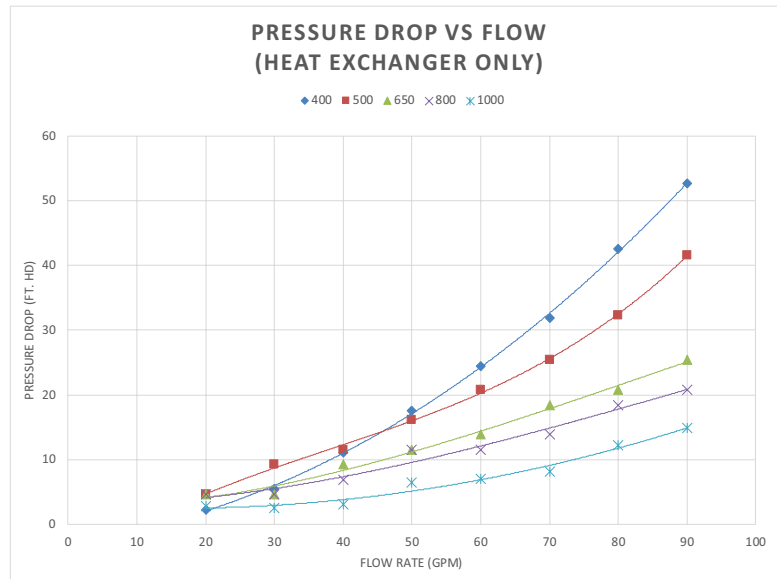
Field supplied. Required to help eliminate debris from causing damage to the heat exchanger. When installing in a pre-existing system, it is recommended to install a filter in the recirculation line capable of removing debris left in the system.

### Building Recirculation Filter:

Field supplied as required. 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.

**Figure 7-2 Pressure Drop vs. Flow**



**Table 7B Water Heater Pump Applications / Typical Temperature Rise**

Water Heater Pump Applications						
Model	Pipe Size	Water Hardness	*Grundfos	Flow Rate (GPM)	Loss (FT/HD)	Temp. Rise
400	2"	5 to 12 gpg	*UPS26-150SF, SPEED 2	35	9	22°F
		12 to 15 gpg	UPS26-150SF, SPEED 3	39	14	20°F
500	2"	5 to 12 gpg	*UPS26-150SF, SPEED 3	37	16	27°F
		12 to 15 gpg	UP43-110FN	53	28	19°F
650	2"	5 to 12 gpg	*UPS43-100SF, SPEED 3	44	15	29°F
		12 to 15 gpg	UP43-110FN	61	23	21°F
800	2"	5 to 12 gpg	*UP 43-110FN	61	22	26°F
		12 to 15 gpg	TP 50-80B	79	23	20°F
1000	2-1/2"	5 to 12 gpg	*UP 43-110FN	79	15	25°F
		12 to 15 gpg	TP 50-80B	90	21	22°F

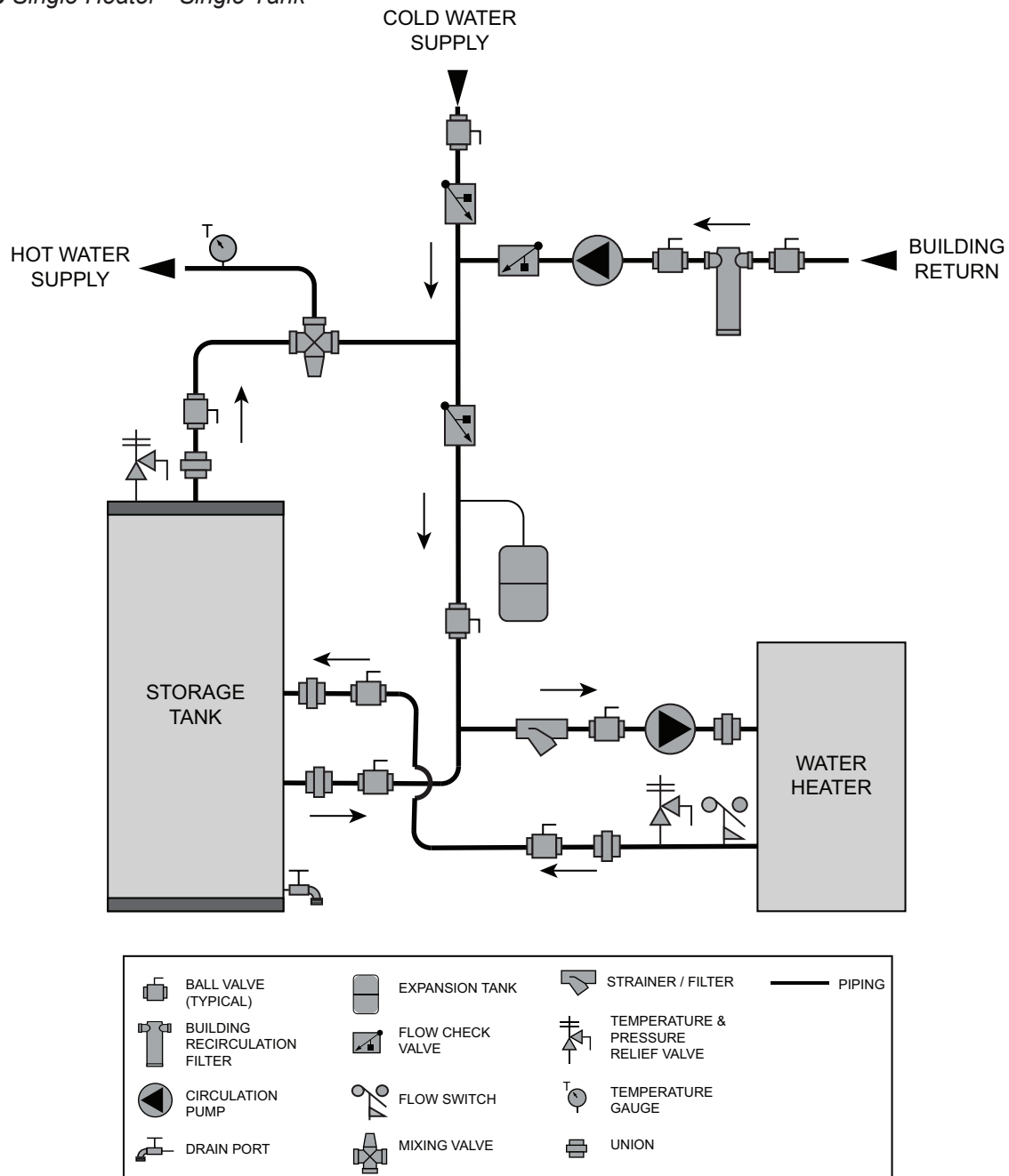
\*Denotes standard pump supplied with unit.

## NOTICE

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

## 7 System piping

Figure 7-3 Single Heater - Single Tank



DIR #2000589730 00



### CAUTION

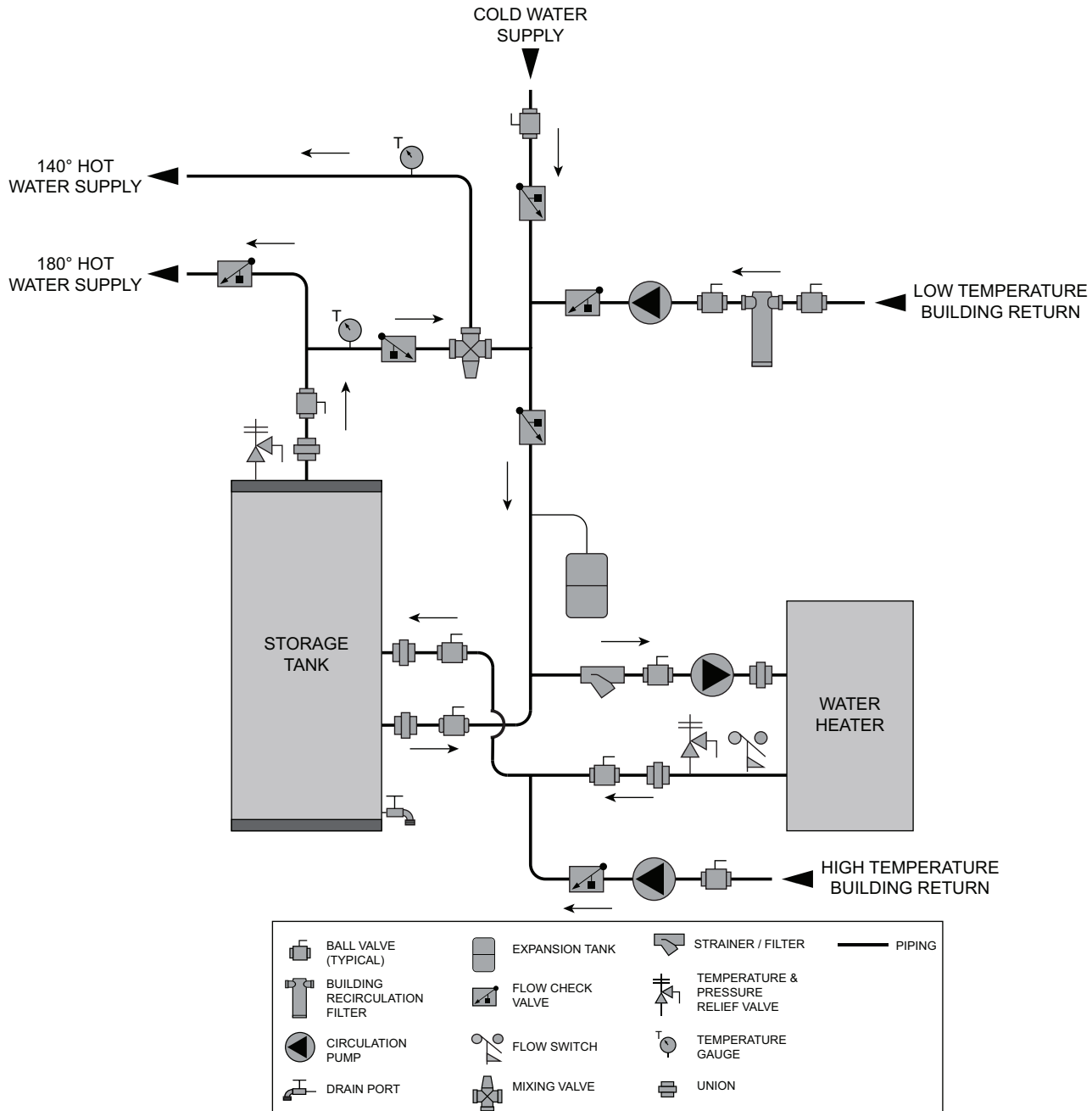
The piping will not support the weight of the water heater circulator pump. Do not attempt to support the weight of the water heater circulator pump with the piping or its accessories. Refer to the pump manufacturer's installation instructions. Failure to comply could result in severe personal injury, 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 System piping (continued)

Figure 7-4 Single Heater - Single Tank (2 Temperature)



### CAUTION

The piping will not support the weight of the water heater circulator pump. Do not attempt to support the weight of the water heater 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.

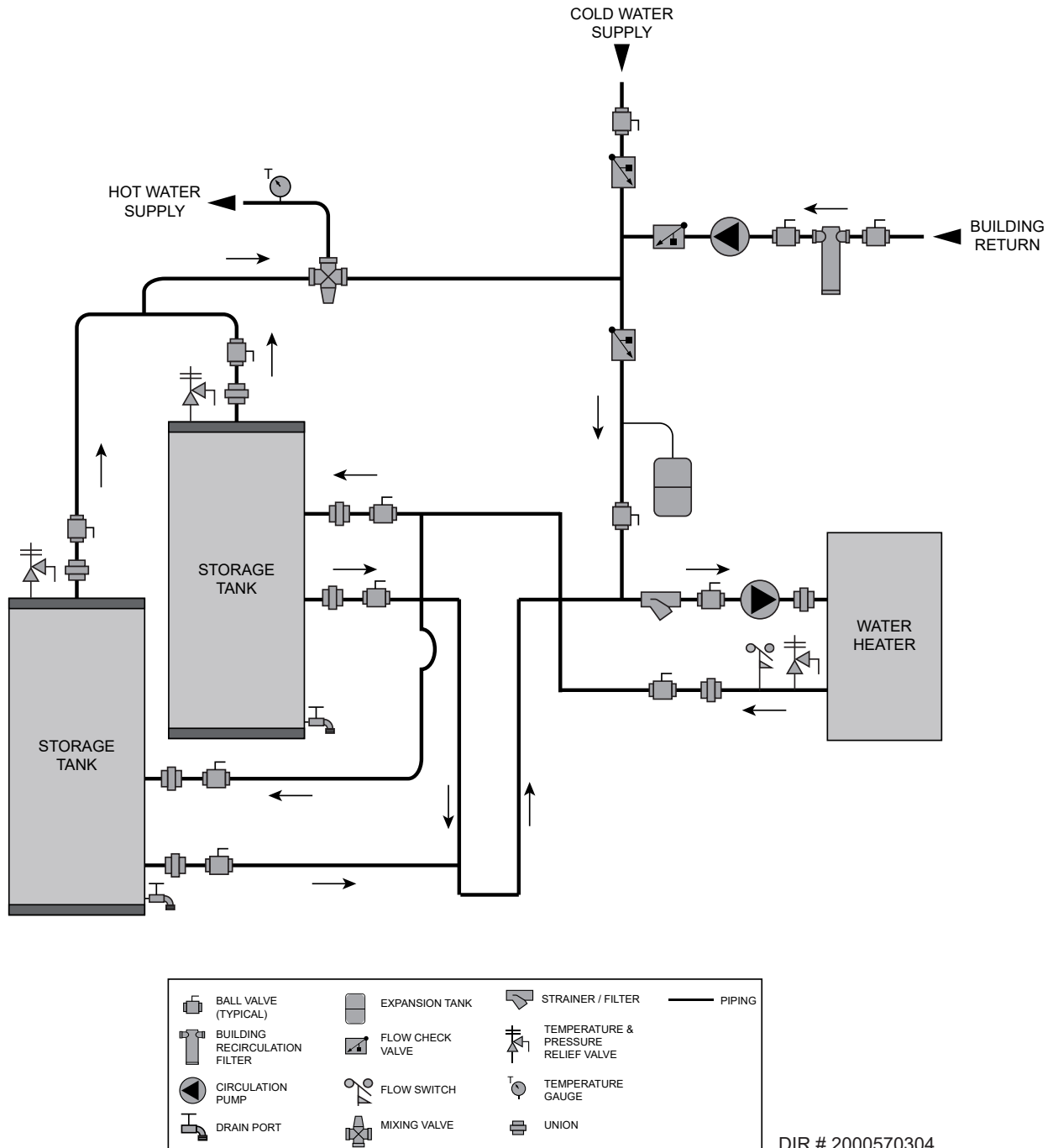
### NOTICE

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 System piping

Figure 7-5 Single Heater - Double Tank



### CAUTION

The piping will not support the weight of the water heater circulator pump. Do not attempt to support the weight of the water heater 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.

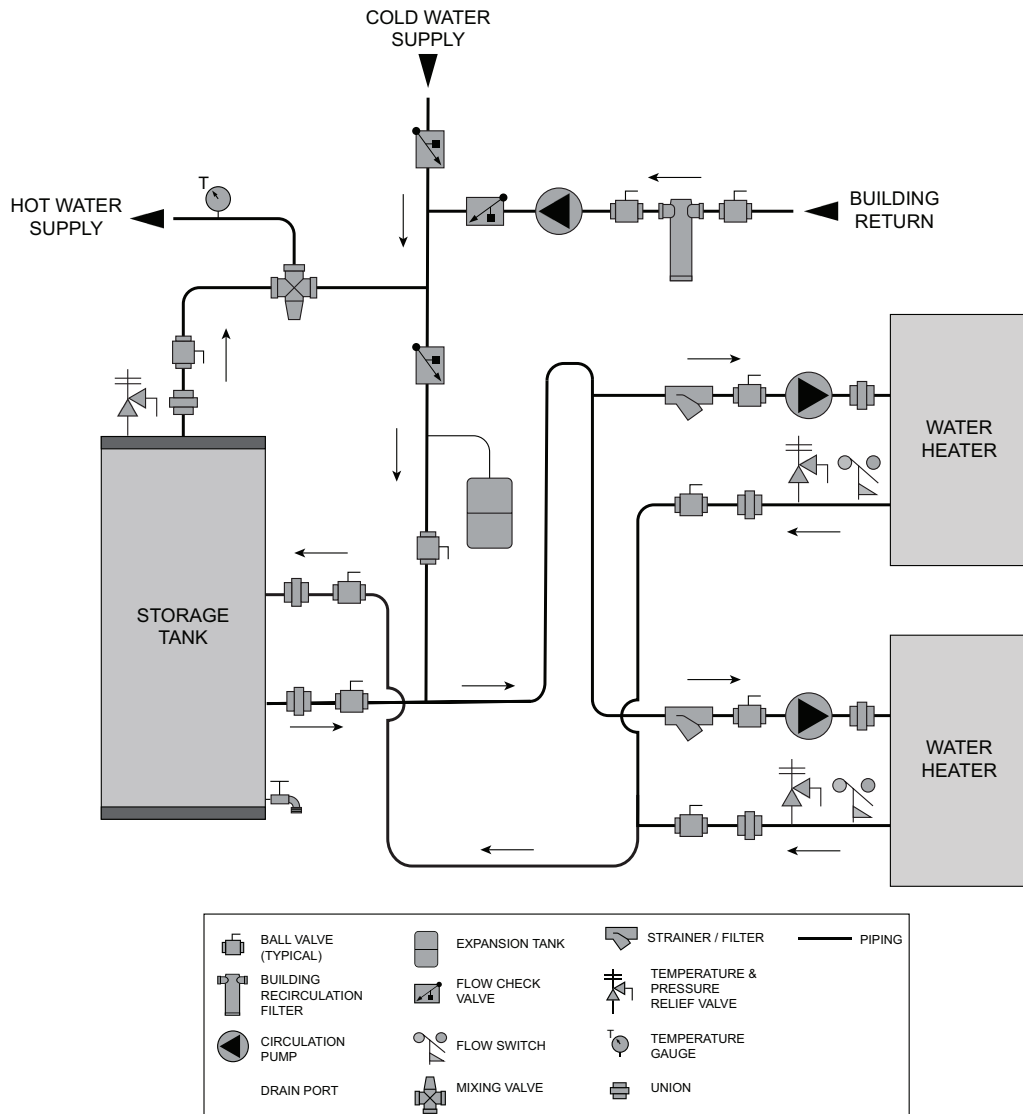
### NOTICE

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 System piping (continued)

Figure 7-6 Double Heater - Single Tank

Model	Number of Units						
	2	3	4	5	6	7	8
	Required Pipe Sizes in NPT (Based on 30° Δ)						
400	2 1/2"	3"	4"	4"	6"	6"	6"
500	3"	4"	4"	4"	6"	6"	6"
650	3"	4"	4"	6"	6"	6"	6"
800	4"	4"	6"	6"	6"	6"	8"
1000	4"	6"	6"	6"	8"	8"	8"



DIR #2000589733 00

### CAUTION

The piping will not support the weight of the water heater circulator pump. Do not attempt to support the weight of the water heater 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.

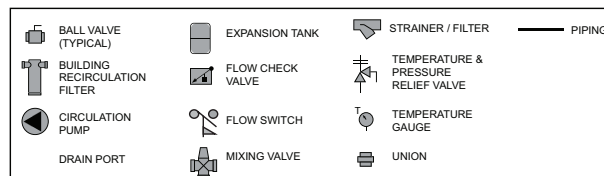
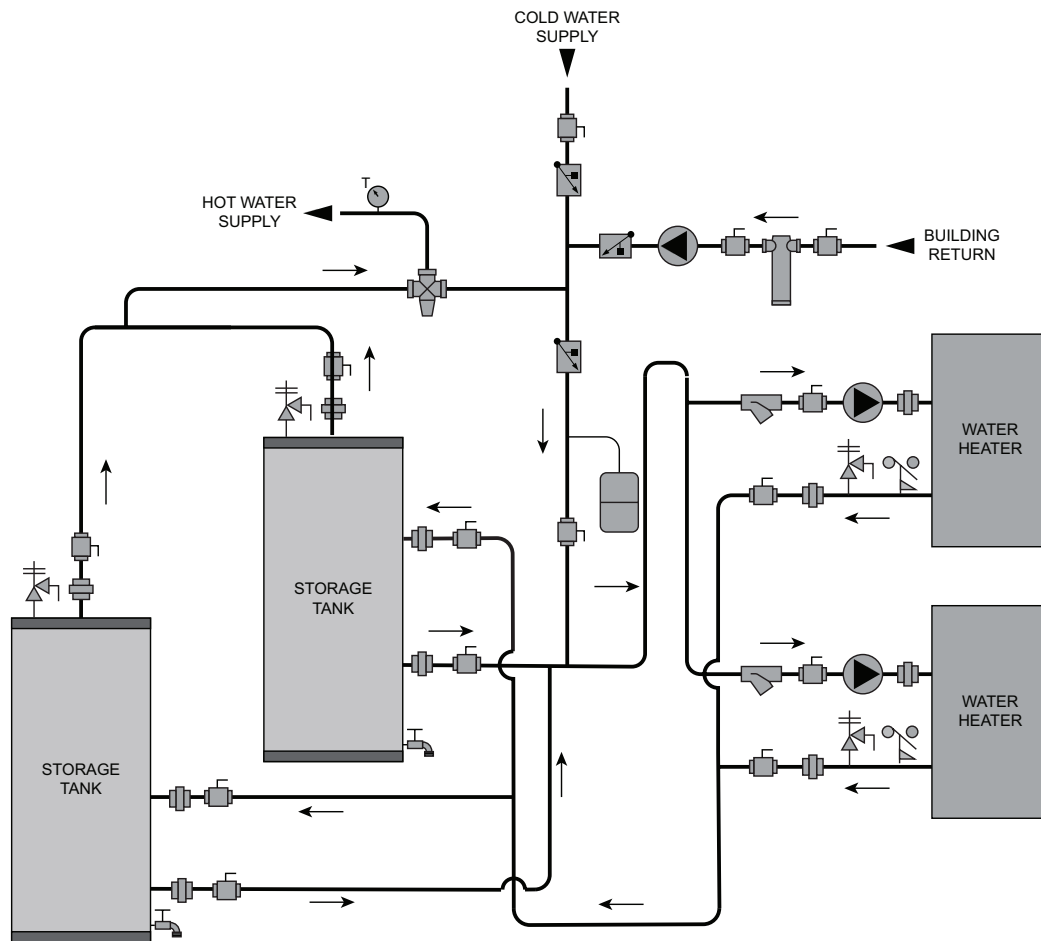
### NOTICE

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 System piping

Figure 7-7 Double Heater - Double Tank

Model	Number of Units						
	2	3	4	5	6	7	8
	Required Pipe Sizes in NPT (Based on 30° Δ)						
400	2 1/2"	3"	4"	4"	6"	6"	6"
500	3"	4"	4"	4"	6"	6"	6"
650	3"	4"	4"	6"	6"	6"	6"
800	4"	4"	6"	6"	6"	6"	8"
1000	4"	6"	6"	6"	8"	8"	8"



DIR #2000589734 00

### CAUTION

The piping will not support the weight of the water heater circulator pump. Do not attempt to support the weight of the water heater 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.

## 8 Gas connections

### Connecting gas supply piping

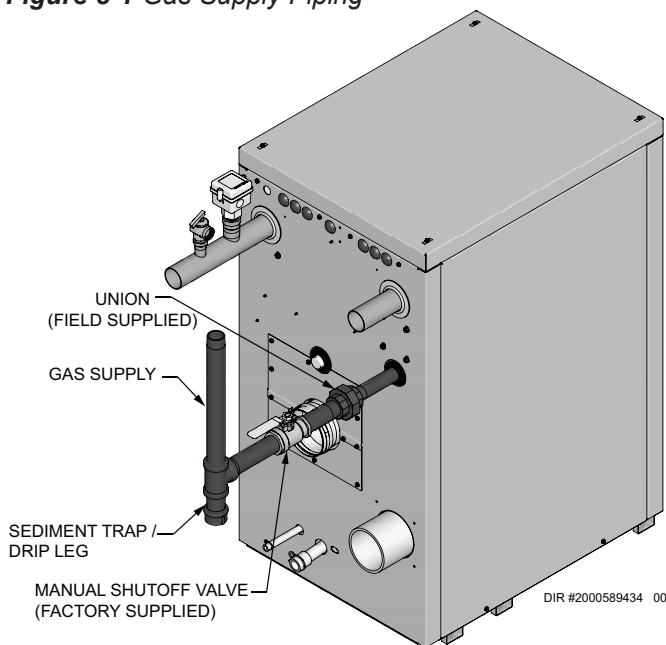
1. Remove the top access panel and refer to FIG. 8-1 to pipe gas to the water heater.
  - a. Install ground joint union for servicing, when required.
  - b. Install a manual shutoff valve in the gas supply piping outside water heater jacket when required by local codes or utility requirements.
  - c. In Canada – When using manual main shutoff valves, it must be identified by the installer.
2. Install sediment trap / drip leg.
3. Support piping with hangers, not by the water heater 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 water heater or its accessories. Failure to comply could result in severe personal injury, death, or substantial property damage.

4. Purge all air from the gas supply piping.
5. Before placing the water heater in operation, check the water heater 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 and its gas connection must be leak tested before placing it in operation.

**Figure 8-1 Gas Supply Piping**



## 8 Gas connections

**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.

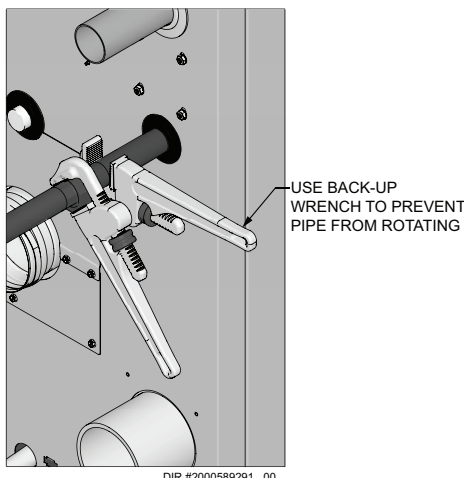
6. Use pipe sealing compound compatible with propane gases. Apply sparingly only to male threads of the pipe joints so that pipe dope does not block gas flow.

**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 water heaters are typically shipped ready to fire on natural gas. Check the water heater rating plate to determine which fuel the water heater is set for. If set to natural gas, it may be converted to LP by installing an orifice and making a gas valve adjustment (see pages 12 thru 13). 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 water heater (FIG. 8-2), using one wrench to prevent the water heater gas line connection from turning. Failure to support the water heater gas connection pipe to prevent it from turning could damage gas line components.

**Figure 8-2 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.

### Natural gas:

#### Pipe sizing for natural gas

1. Refer to Table 8A for pipe length and diameter. Based on rated water heater input (divide by 1,000 to obtain cubic feet per hour).
  - a. Table 8A 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 water heater on.
  - Minimum 4 inches w.c. with gas flowing (verify during water heater 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 water heaters are typically shipped ready to fire on natural gas. Check water heater rating plate to determine which fuel the water heater is set for. If set to natural gas, it may be converted to LP by installing a LP venturi and making a gas valve adjustment (see pages 12 thru 13). In order to operate on LP gas, an orifice **MUST BE** installed (for 500 Models) 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. Adjust propane supply regulator provided by the gas supplier for 14 inches w.c. maximum pressure.
2. Pressure required at gas valve inlet pressure port:
  - Maximum 14 inches w.c. with no flow (lockup) or with water heater on.
  - Minimum 8 inches w.c. with gas flowing (verify during water heater startup).

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



## 8 Gas connections *(continued)*

**Table 8A 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 water heaters are typically shipped ready to fire on natural gas. Check the water heater rating plate to determine which fuel the water heater is set for. If set to natural gas, it may be converted to LP by installing an orifice and making a gas valve adjustment (see pages 12 thru 13). 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 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 water heater 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. On Models 400 - 500 loosen the set screw one (1) full turn from inside the pressure tap on top of the gas valve. On Models 650 - 1000 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. 8-3 thru 8-4.
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 panel 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. On Models 400 - 500 re-tighten the set screw inside the pressure tap. On Models 650 - 1000 remove the 1/8" (3 mm) field supplied fitting and reinstall the pipe plug removed in Step 3.

**WARNING**

When re-tightening the set screw, be sure to tighten securely to prevent gas leaks.

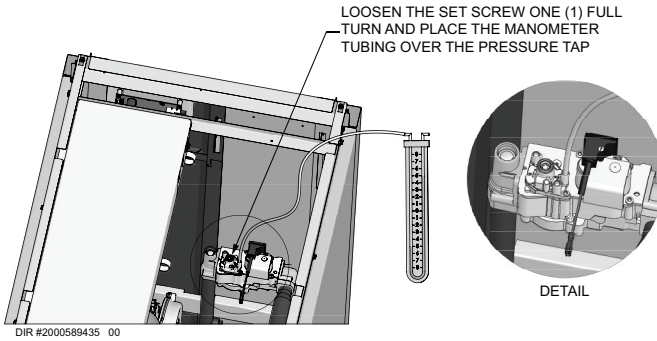
Do not check for gas leaks with an open flame -- use the bubble test. Failure to use the bubble test or check for gas leaks can cause severe personal injury, death, or substantial property damage.

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 panel of the SMART TOUCH control module to the desired water temperature so the appliance will call for heat.

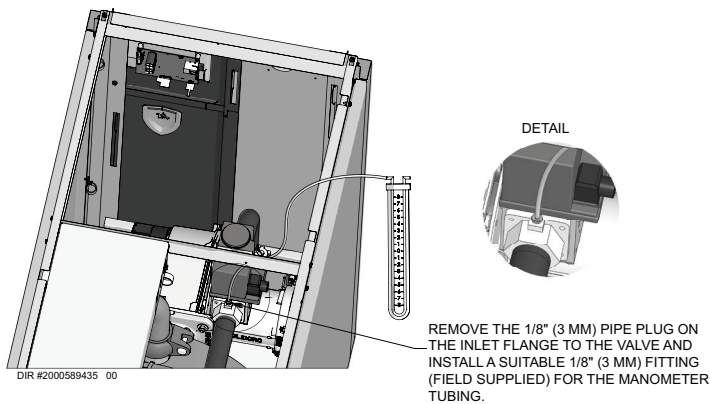
## 8 Gas connections

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 8-3 Inlet Gas Supply Check - Models 400 - 500**



**Figure 8-4 Inlet Gas Supply Check - Models 650 - 1000**



### 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 in-line regulator is used, it must be a minimum of 10 feet from the Armor water heater. 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.

## 9 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.

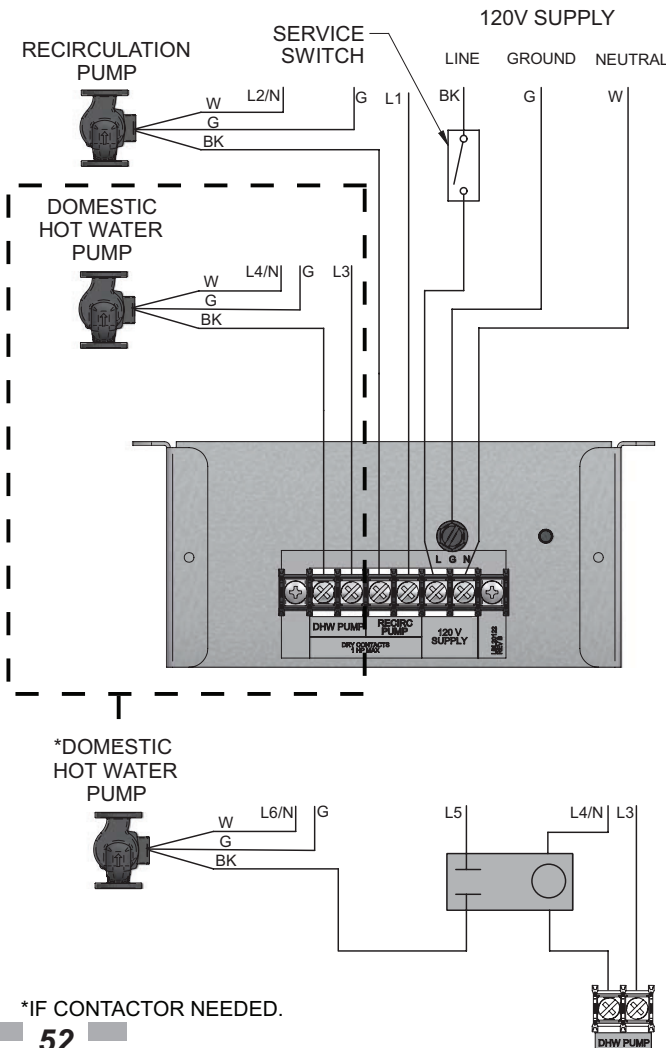
If original wiring as supplied with the water heater must be replaced, use only type 105°C wire or equivalent.

The water heater 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.

**Figure 9-1 Line Voltage Field Wiring Connections - With and Without Contactor**



\*IF CONTACTOR NEEDED.

## 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. Connect 120 VAC power wiring to the line voltage terminal strip in the junction box, as shown in FIG. 8-1.
2. Provide and install a fused disconnect or service switch (15 amp recommended) as required by the code (see FIG. 9-1).
3. The DHW (water heater) pump is shipped loose on all Armor models. Wire the water heater pump as shown in FIG. 9-1.
4. The Armor water heater is capable of controlling a building recirculation pump (field supplied). Wire the building recirculation pump as shown in FIG. 9-1.
5. Dry contacts are sized for 1 hp/120V or 2 hp/240V.

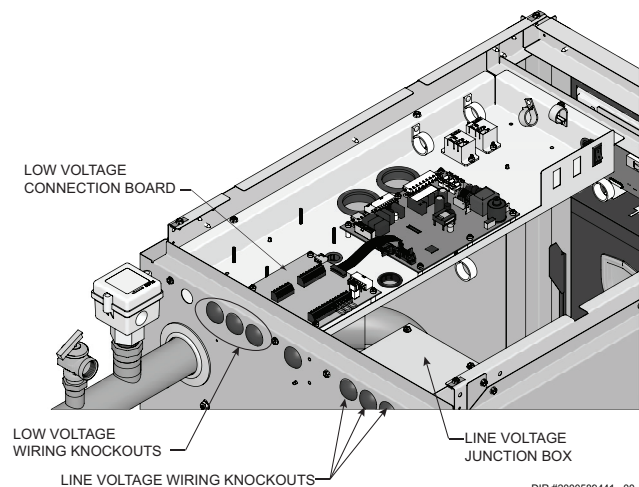
### ⚠ CAUTION

If using a pump greater than these ratings, a field supplied contactor must be installed. If not installed, electrical failures and unexpected operation may occur. See FIG. 9-1 for wiring information.

## Low voltage connections

1. Route all low voltage wires through the knockouts in the rear of the water heater, as shown in FIG. 9-2.
2. Connect low voltage wiring to low voltage connection board as shown in FIG. 9-3 and the water heater wiring diagram.

**Figure 9-2 Routing Field Wiring**



## 9 Field wiring

### Tank thermostat

1. Connect the tank thermostats (isolated contact only) to the tank thermostat contacts as shown in FIG. 9-1.

### 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 100208545 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. 9-1).

### Louver relay

If louvers need to operate when the water heater 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. 9-1).

### Louver proving switch

When the operation of the louvers needs to be verified before the water heater fires, remove the jumper wire from these terminals and connect them to the normally open contacts on its proving switch (FIG. 9-1).

### High gas pressure switch

If a switch is provided to detect excessive gas pressure, remove the jumper wire from the terminals on the connection board, and then connect them to its normally closed contacts (FIG. 9-1).

### Low gas pressure switch

1. If a switch is provided to detect low gas pressure, remove the jumper wire from the terminals on the connection board and connect them to its normally open contacts (FIG. 9-1).
2. If both a high and low gas pressure switch are used, connect their respective contacts in series, and connect them to the terminals on the connection board (FIG. 9-1).

#### NOTICE

See *Section 8 - Gas Connections* for a detailed explanation regarding high and low gas pressure switch operation.

### Flow switch

1. A flow switch is used to guarantee flow through the water heater before allowing it to fire. The flow switch must be installed at the water heater outlet.
2. Connect these terminals to the normally open contacts on the flow switch (FIG. 9-1).

### Rate output

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

### ModBus / BACnet

When the optional ModBus / BACnet interface module is installed, the RS-485 ModBus / BACnet 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 / BACnet interface module.

### Water heater Building Management System (BMS)

1. An external control may be connected to control either the firing rate or the set point of the water heater. If the external control uses a set of contacts to enable the water heater, 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.

## 9 Field wiring *(continued)*

### 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 water heater is responding to a call for heat.

### Alarm contacts

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

### Wiring of the cascade

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

Connect the tank sensor to the Leader water heater. 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. 9-3). The Leader control will use the water temperature at the tank sensor to control the operation of the Cascade.

Communication between the Leader water heater and the Member water heaters 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. 9-3). If more than two water heaters are on the Cascade, daisy chain the wiring from the Cascade terminals on the second water heater to the Cascade terminals on the third water heater, then from the third to the fourth, and so on. The connections between heaters can be made in any order, regardless of the addresses of the water heaters. Try to keep each cable as short as possible.

When the Member 1 heater is programmed as a redundant leader this allows the Member 1 heater to automatically assume control of the Cascade should it lose communication with the Leader water heater. When programmed to YES, it is recommended that the Member 1 heater have its own set of external sensors installed (such as the tank sensor), to maintain the same level of temperature control as with the Leader water heater. Voltage signals (such as 0-10V system pump speed input) can be connected to both water heaters.

#### **WARNING**

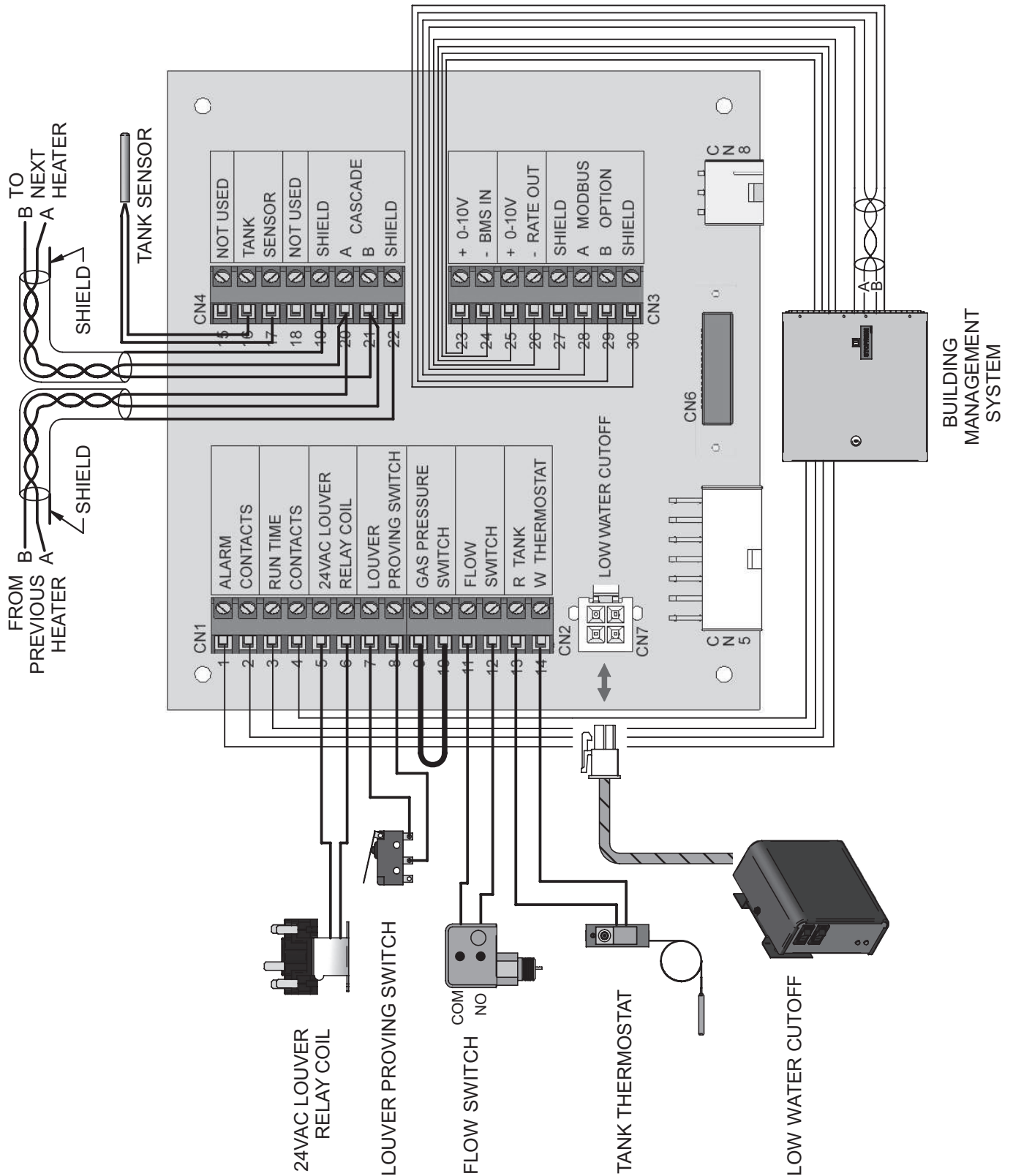
Do not connect the sensors connected to the Leader heater to the Member 1 heater. The actual water temperatures will be higher than expected, which could lead to property damage, personal injury, or death.

When communication is re-established with the Leader heater, Member 1 will automatically relinquish control of the Cascade to the Leader water heater.



## 9 Field wiring

Figure 9-3 Low Voltage Field Wiring Connections



# 10 Condensate disposal

## Condensate drain

1. This water heater is a high efficiency appliance that produces condensate.
2. The side of the water heater has a 1/2 inch PVC union for connection of a 1/2 inch PVC pipe (FIG. 10-1).
3. Slope condensate tubing down and away from the water heater into a drain or condensate neutralizing filter. Condensate from the Armor water heater 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. 10-1) is available from the factory.

4. Install the 1/2 inch PVC elbow (field supplied) as shown in FIG. 10-1.
5. Do not expose condensate line to freezing temperatures.
6. Use only plastic tubing or piping as a condensate drain line (FIG. 10-1).

### 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.

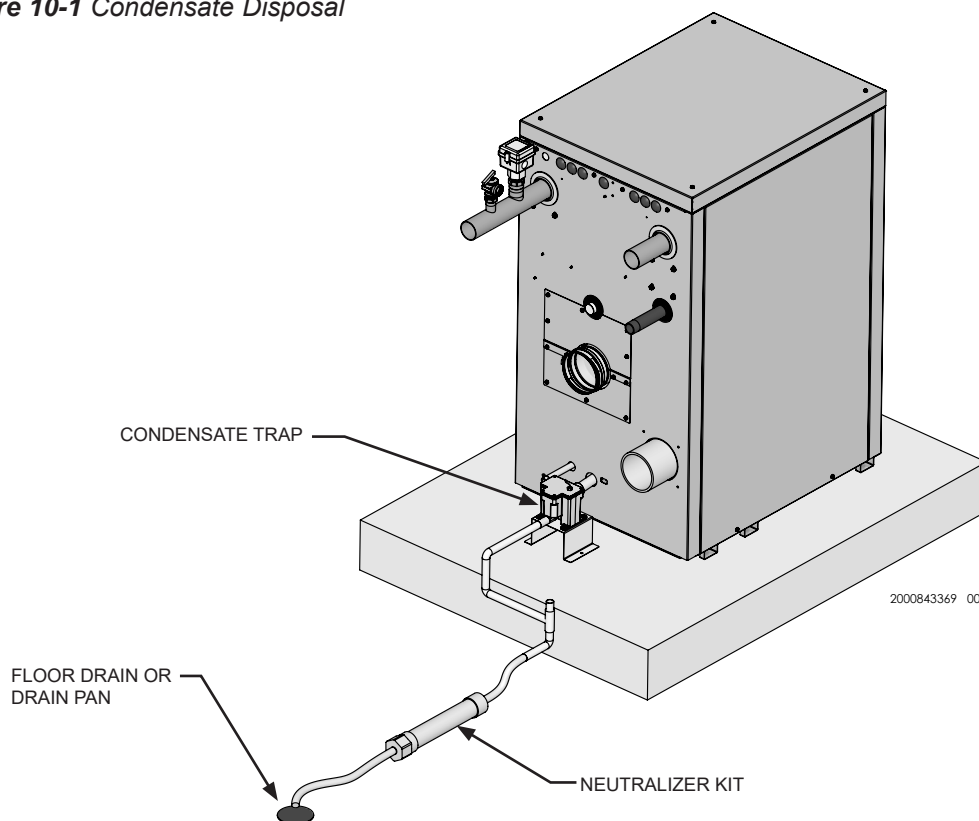
### NOTICE

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.

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 back up inside the heat exchanger resulting in potential water damage to property.

7. A condensate removal pump is required if the water heater is below the drain. When installing a condensate pump, select one approved for use with condensing water heaters and furnaces. The pump should have an overflow switch to prevent property damage from condensate spillage. The switch should be wired in series with the blocked drain switch inside the water heater (see FIG. 10-1).

**Figure 10-1** Condensate Disposal



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

# 11 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 water heater 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 11A Water Chemistry**

WATER CHEMISTRY		
Specification	Range	Requirement
Hardness	< 5 gpg	Follow recommendations detailed below (See Notice 3)
	5 to 12 gpg	Use Table 7B for pump recommendation
	12 to 15 gpg	Use Table 7B 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

1. Do not use the water heater to directly heat swimming pool or spa water.

2. At initial fill and during water heater start-up and testing, check system thoroughly for any leaks. Repair all leaks before proceeding further.

3. When water hardness levels are less than 5 gpg or 85.5 mg/l, the following is recommended:

- 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 7.
- 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.

4. When water softener is required, a Template Assisted Crystallization system is recommended.

## Check for gas leaks



### WARNING

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



### WARNING

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

# 11 Start-up *(continued)*

## Condensate drain

1. This appliance is a high efficiency appliance that produces condensate.
2. The provided condensate trap is equipped with a ball that acts as a seal against harmful flue gases escaping in case there is no condensate in the trap. If this ball is not present, flue gases may be able to pass through the trap when there is no condensate present, resulting in an unsafe environment. It is important to check and make sure the ball is located in the trap, acting as a seal against flue gases.
3. Connect the condensate trap to the condensate hoses located on the back of the unit near the bottom. Use the hose clamps to secure the connection. Connect the two-pin molex provided with the condensate trap to the mating connector on the rear of the appliance.
4. Slope condensate tubing down and away from the appliance into a drain or condensate neutralizing filter. Condensate from the Armor water heater will be slightly acidic (typically with a pH from 3 to 5). Install a neutralizing filter if required by local codes.  
A Neutralizer Kit is available from the factory.
5. Do not expose condensate line to freezing temperatures.
6. Use only plastic tubing or piping as a condensate drain line (FIG. 11-1).
7. A condensate removal pump is required if the appliance is below the drain. When installing a condensate pump, select one approved for use with condensing water heaters and furnaces. The pump should have an overflow switch to prevent property damage from condensate spillage. The switch should be wired in series with the blocked flue switch inside the appliance.

### 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.

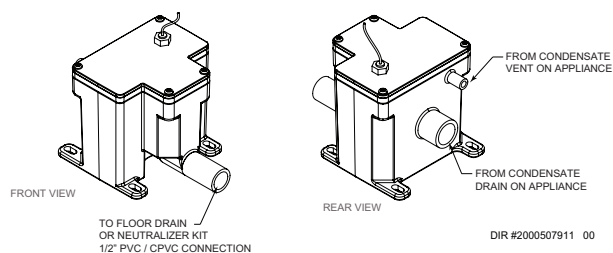
The condensate line must remain unobstructed, allowing free flow of condensate. If condensate is allowed to freeze in the line or if the line is obstructed in any other manner, condensate can exit from the condensate trap vent opening, resulting in potential water damage to property.

### WARNING

The stainless steel retaining ring must be installed between the rubber sealing gasket and the compression fitting (FIG. 11-1). The compression fitting must be tightened.

The condensate trap must have the float ball (FIG. 11-1) in place during all times of appliance operation to avoid flue gas emission from the condensate drain line. Failure to ensure the float ball is in place could result in severe personal injury or death.

**Figure 11-1 Condensate Trap**



# 11 Start-up

## Final checks before starting the water heater

- ❑ Read the Armor Water Heater Service Manual to familiarize yourself with SMART TOUCH control module operation. Read the preceding Start-up sections in this manual, for proper steps to start the appliance.
- ❑ Verify the preparation procedures have been completed.
- ❑ Verify the appliance and system are full of water and all system components are correctly set for operation.
- ❑ 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 water heater

1. Read and follow the Operating instructions in FIG. 11-2.

## If water heater does not start correctly

1. Check for loose connections, blown fuse, or service switch off?
2. Is water heater 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 water heater?
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 Water Heater Service Manual.

## Check system and water heater

### ❑ Check water piping

1. Check system piping for leaks. If found, shut down the water heater and repair immediately. (See WARNINGS on pages 56 and 57 (start-up) regarding failure to repair leaks.)
2. Check Delta T. Reference Section 7 - *System Piping* of this manual 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 water heater for gas odor following the procedure on page 47 of this manual (*Connecting Gas Supply Piping*).

#### **WARNING**

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

### ❑ Propane water heaters – 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 water heaters are typically shipped ready to fire on natural gas. Check water heater rating plate to determine which fuel the water heater is set for. If set to natural gas, it may be converted to LP by installing an orifice and by making a gas valve adjustment (see pages 12 thru 13). 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.

# 11 Start-up *(continued)*

Figure 11-2 Operating Instructions

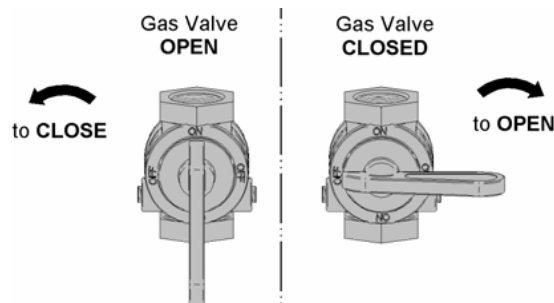
## FOR YOUR SAFETY READ BEFORE OPERATING

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

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

## OPERATING INSTRUCTIONS

1. **STOP!** Read the safety information above on this label.
2. Set the thermostat to lowest setting.
3. Turn off all electric power to the appliance.
4. This appliance is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.
5. Remove top cover.
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 top cover.
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 top cover.
4. Turn gas shut off valve counterclockwise to "OFF". Handle will be perpendicular to pipe. Do not force.
5. Install top cover.

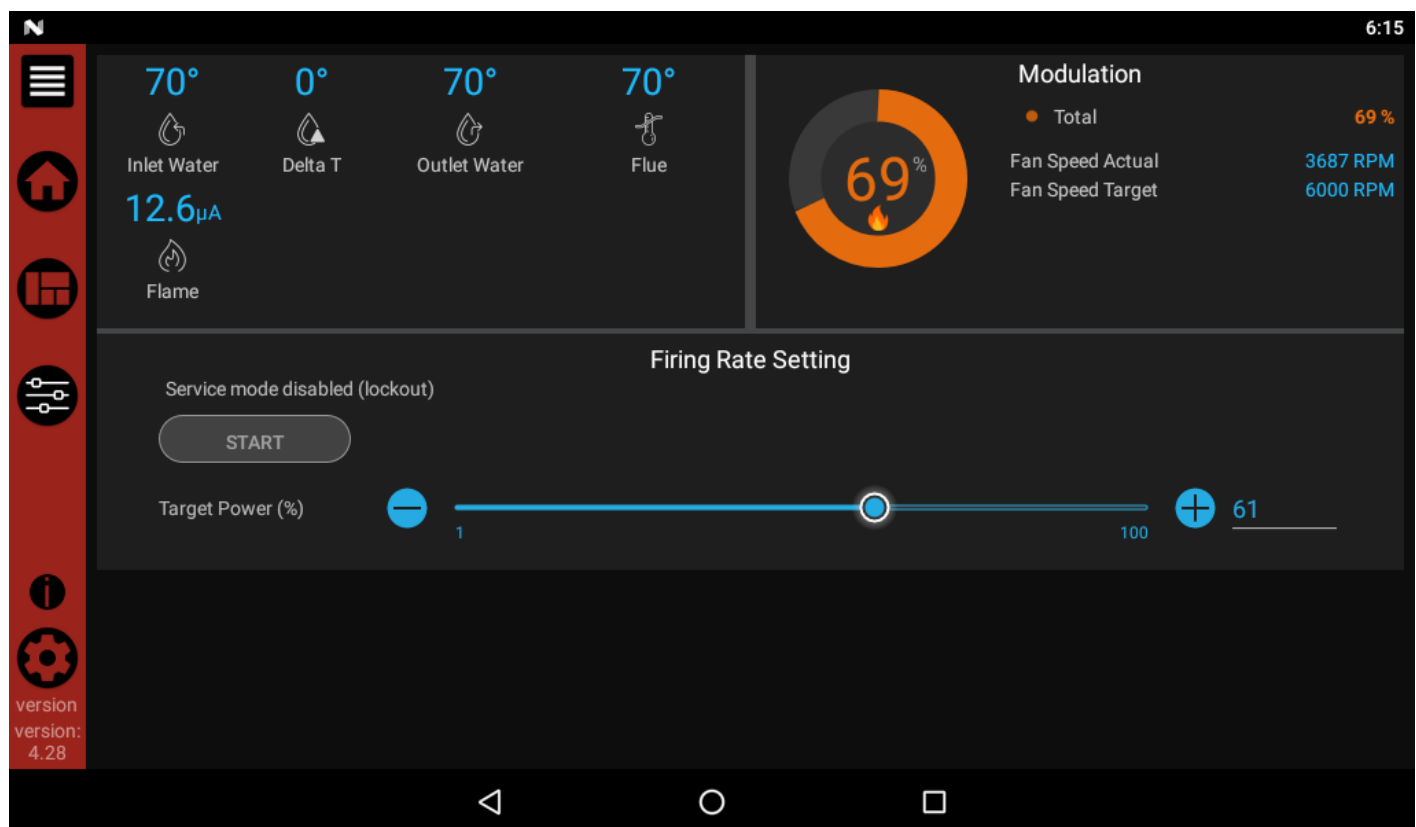


# 11 Start-up

## 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.
6. Select the Service Maintenance Screen. The tabs will scroll (up and down) to reveal more options. See FIG. 11-3.
7. Once the heat exchanger has modulated up to rate, measure the combustion. The values should be in the range listed in 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 11-3 Service Maintenance Screen



# 11 Start-up *(continued)*

## Adjust set point temperature(s)

During normal operation, set point temperatures can be adjusted from the Home Screen by pressing the DETAILS button on the bottom of the screen (see FIG. 12-1).

1. To change a set point, use the set point slider feature or the PLUS (+) and MINUS (-) buttons to adjust the set points as shown in FIG. 11-4.
2. Once the set point has been adjusted to the desired setting, press the Door Menu slider (top left) or the Setup button.
3. Press the APPLY CHANGES button on the top of the screen.

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

## Set clock

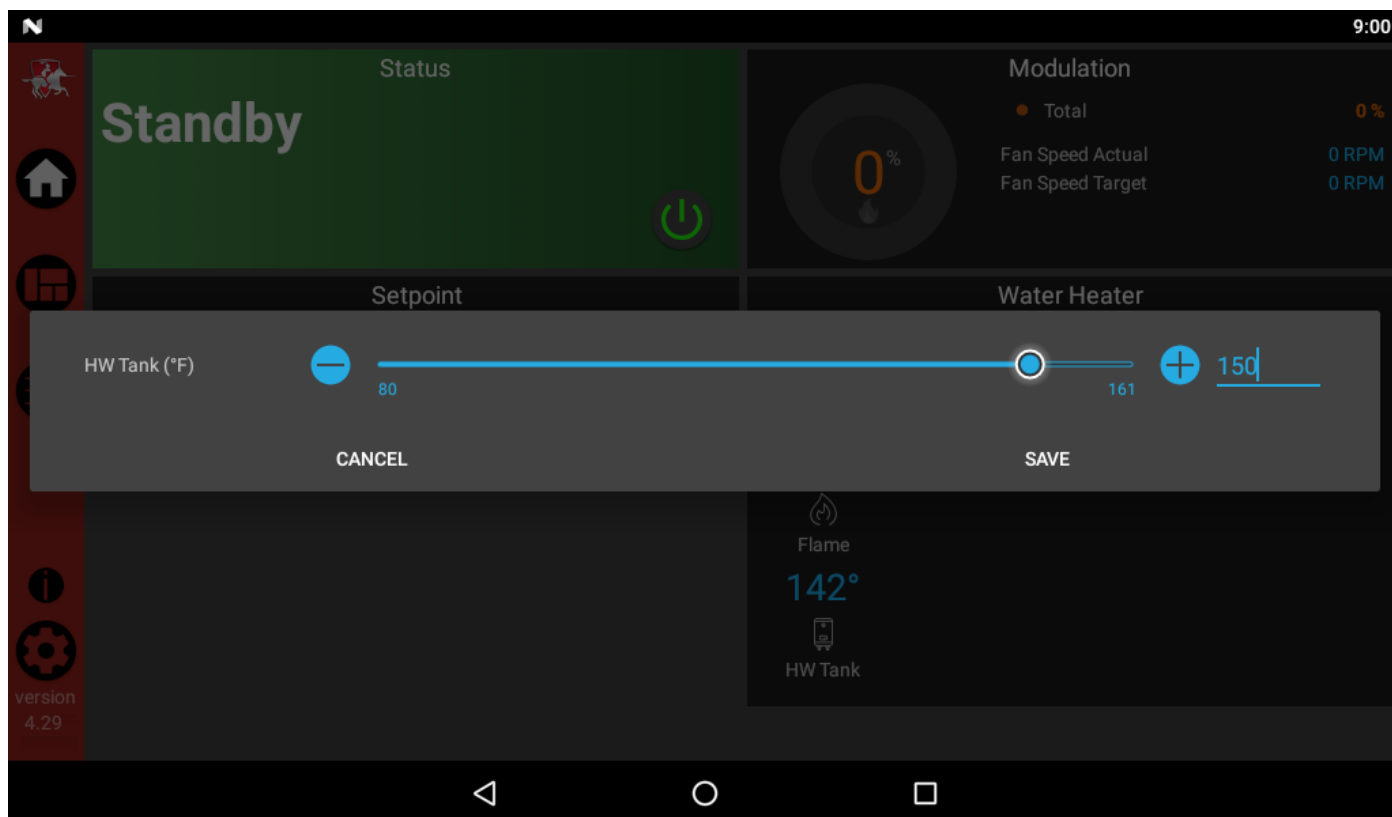
The SMART TOUCH control has a built-in clock that it uses for its night setback feature and for logging events. This clock must be set when the appliance is installed and anytime the appliance has been powered off for more than one day. Use the following procedure to set the clock:

1. Press the SETTINGS button under the Lochinvar logo (see Figure 12-1).
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 11-4** User Set Point Screen



# 11 Start-up

## Configuration of the cascade

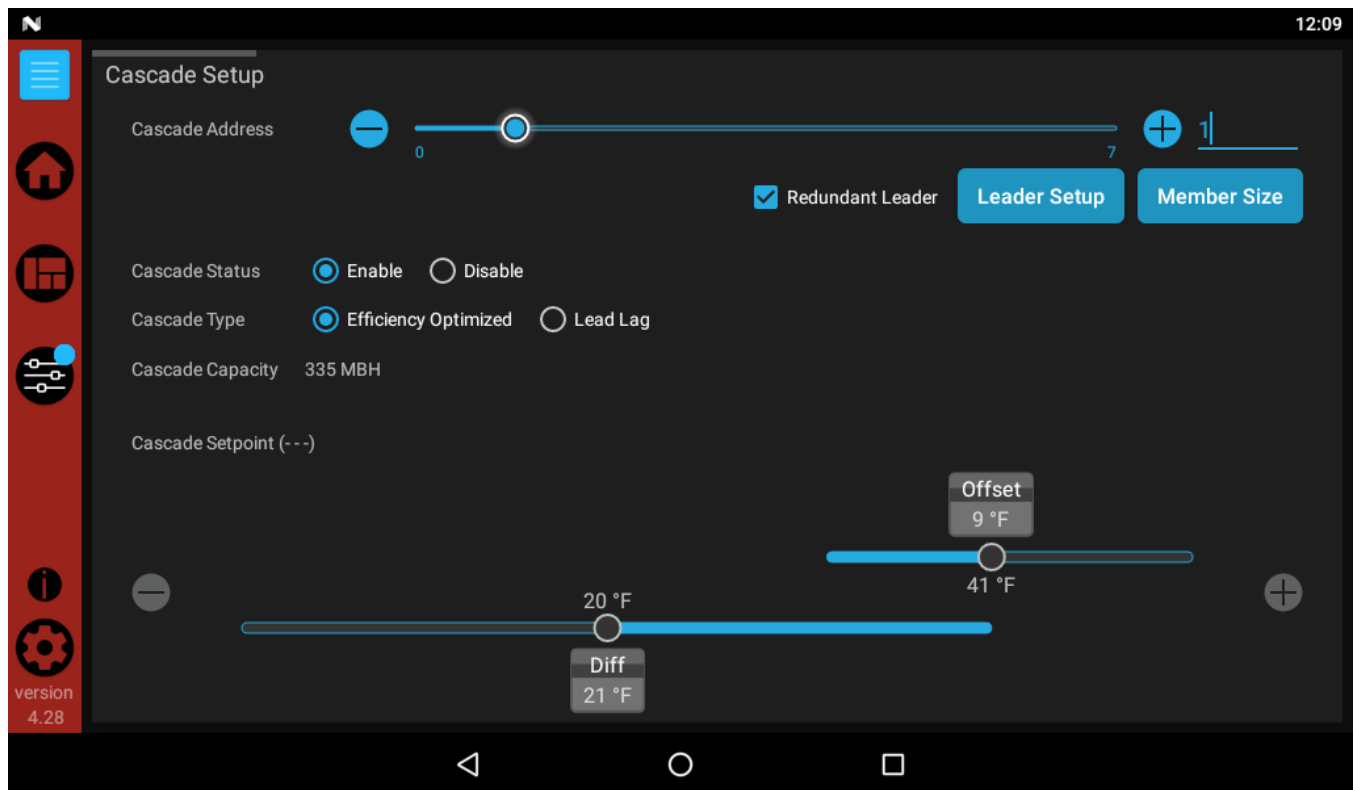
**NOTE:** For more detailed instructions, please refer to the Armor Service Manual.

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. 11-5.
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 11-5 Cascade Screen



# 12 Operating information

## General

### How the water heater operates

The Armor water heater uses an advanced stainless steel heat exchanger and electronic control module that allows fully condensing operation. The blower pulls in air and pushes flue products out of the water heater through the heat exchanger and flue piping. The control module regulates blower speed to control the water heater firing rate. The gas valve senses the amount of air flowing into the water heater and allows only the right amount of gas to flow.

### Control inputs and outputs

#### Tank thermostat / tank sensor

Either of these inputs will tell the water heater to provide heat to the water tank. If a tank sensor is connected, the SMART TOUCH control will ignore the tank thermostat.

#### 0 - 10VDC input (set point or power)

The Armor water heater 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. This signal can be sent to the heater through ModBus as well.

### Temperature control

#### Modulation

The Armor water heater is capable of modulating its firing rate from a minimum of 10% to a maximum of 100%. The firing rate is dictated by the hot water draw and various other temperature limitations.

#### Night setback

The controller may be programmed to reduce the DHW set point during certain times each week. Seven different start and stop times may be programmed for the DHW setback.

#### Flame current support

To prevent nuisance shutdowns when the water heater is firing at minimum rates, the control will increase fan speed when the flame signal drops too low.

## Protection features

### Outlet temperature, flue temperature, and temperature rise limiting

The outlet temperature is monitored by the water heater outlet temperature sensor. When the outlet temperature exceeds 185°F, the unit will reduce the fan speed. If the outlet water temperature exceeds 195°F the control will shut the unit down until it cools off.

The control module monitors the flue temperature by a sensor located in the flue exhaust. If the flue temperature exceeds 215°F the control will reduce the maximum fan speed. If the flue temperature exceeds 225°F (107°C) the control will shut the unit down. The unit will restart automatically once the flue temperature drops 10°F (6°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 water heater in a room likely to freeze.

#### DANGER

**Freezing Conditions:** If this appliance may have been exposed to freezing conditions, prevent from firing. Shut off power and gas to the appliance immediately and contact the factory for further instructions. Allowing the appliance to fire when the heat exchanger or near water heater piping is frozen will result in death or serious injury and significant property damage.

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

The water heater control module provides freeze-up protection as follows:

- Below an inlet temperature of 45°F (7°C), the water heater pump operates constantly.
- Below an inlet temperature of 37°F (3°C), the water heater turns on.
- Water heater and pumps turn off if water inlet temperature rises above 45°F (7°C).

# 12 Operating information

## Freeze protection (continued)

Neither this feature nor the water heater control module eliminates the possibility of freezing. The installation must still use recognized design, installation, and maintenance practice to prevent freeze potential for the appliance and system.

The Freeze Protection feature will not work if the appliance does not have power, is locked out, is in shutdown mode, had a component failure, or is otherwise prevented from firing.

### NOTICE

When system return temperatures are maintained below the dew point, condensation will form on the inside of the appliance jacket causing some internal sheet metal components to rust.

## Monitor external limits

Connections are provided on the connection board for external limits such as flow switch, gas pressure switches, and a louver proving switch. The SMART TOUCH will shut off the burner and inhibit relighting whenever any of these external limits open.

## Runtime and alarm outputs

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

## Runtime and cycle counting

The control uses a timer to monitor the total hours of burner operation. The timer monitors the time the water heater is firing.

The control uses two (2) ignition counters to monitor the amount of water heater cycles. The first counter counts all ignitions of the control. The second counter counts only ignition attempts that have failed.

## 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 display will show a Maintenance Required screen. The installer's name and phone number can be programmed into the control. This information will appear on the Maintenance Required screen. The service reminder notification can be reset or disabled by the installer.

The time dependent feature has been disabled by the manufacturer. To enable this feature change the parameter to the desired time interval, reference the Armor Service Manual for details regarding parameters.

## Error logging

The control will hold in memory the last 10 lockouts as well as the last 10 blockings. The date and time of the occurrence will be recorded as well. Only the 10 most current occurrences of each will be held in memory.

## Water heater temperature regulation

### Operating temperature (target)

The SMART TOUCH control module senses water temperature and regulates water heater firing and firing rate to achieve a target temperature. The target temperature can be set between 60°F and 190°F.

### High limit operations

The Armor water heater is equipped with a fixed automatic reset high limit and an adjustable manual reset high limit. The automatic reset high limit has a set point of 200°F and the manual reset high limit has a maximum set point of 210°F.

When the outlet temperature exceeds 200°F, the automatic high limit action occurs. The water heater shuts down until the outlet water temperature cools below 190°F, and a 60 second timer has expired. If the outlet temperature continues to increase, the manual reset high limit action will occur at 210°F.

### High limit test procedure

1. Turn ON the main power to the appliance by placing the ON/OFF switch in the ON position.
2. Navigate to the Setpoints Screen.
3. Use the slide bar to decrease the MRHL temperature below the current outlet temperature or to its minimum setting, whichever is higher.
4. Press the APPLY CHANGES button to save the setting.
5. If the current outlet temperature is above the MRHL setting then the MRHL will function, causing a appliance lockout. If the outlet temperature is below the MRHL setting, navigate to the Service Screen and place the appliance in service mode at full fire.
6. Once the outlet temperature rises above the MRHL setting, the MRHL will function causing a appliance lockout.
7. Repeat steps 2-4 to set the MRHL to the desired setting for normal operation.

### Low water cutoff protection

1. The SMART TOUCH control module uses temperature sensing of both supply and return areas of the heat exchanger. If the flow rate is too low or the outlet temperature too high, the control module modulates and shuts the water heater down. This ensures water heater shutdown in the event of low water or low flow conditions.
2. Some codes and jurisdiction may accept these integral features of the control in lieu of requiring an additional limit control or low water cutoff. Consult local jurisdiction to determine. A low water cutoff is available from the factory.

# 12 Operating information (continued)

## Cascade

When multiple water heaters are installed, they can be wired together in a cascade sequence. A maximum of eight water heaters can be controlled from a single control. In this application one water heater would be designated as the Leader control and all others would be designated as Member controls. The Leader control can be programmed to use Lead/Lag or Efficiency Optimization control methods.

Once the Leader water heater receives a call for heat from a tank sensor, BMS or Modbus, the control will determine what the set point will be. A fixed temperature set point can be programmed into the control. See page 61 of this manual to program the set point.

If the water temperature at the tank is less than the set point - differential, then the control will initiate a call for heat on the Cascade (see the Armor Water Heater Service Manual for an explanation of the differential). The Leader will energize the lead water heater on the Cascade. For a new startup this will be the Leader water heater.

## Sequence of the cascade

To equalize the runtime of all water heaters 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. The switching on/off sequence will be as follows:

TIME	SWITCHING ON SEQUENCE
Start	L-M1-M2-M3-M4-M5-M6-M7
+ 1 hour	M1-M2-M3-M4-M5-M6-M7-L
+ 2 hours	M2-M3-M4-M5-M6-M7-L-M1

If a water heater locks out, it will automatically be given the lowest priority for the rest of that 24 hour period.

## Night Setback operation with cascade

Night Setback operation of the water heaters within the Cascade is available. Programming of the Night Setback will be done through the Leader water heater. Refer to the Armor Water Heater Service manual for information regarding Night Setback.

## Access modes

### User

The USER can set the tank set point, turn the unit OFF and ON, and set up WiFi.

### Installer

Most parameters are available only to the installer, accessible by entering the installer password, see the Armor Water Heater Service Manual.

**NOTE:** The password will timeout after an hour from entry.



# 12 Operating information

## Sequence of operation

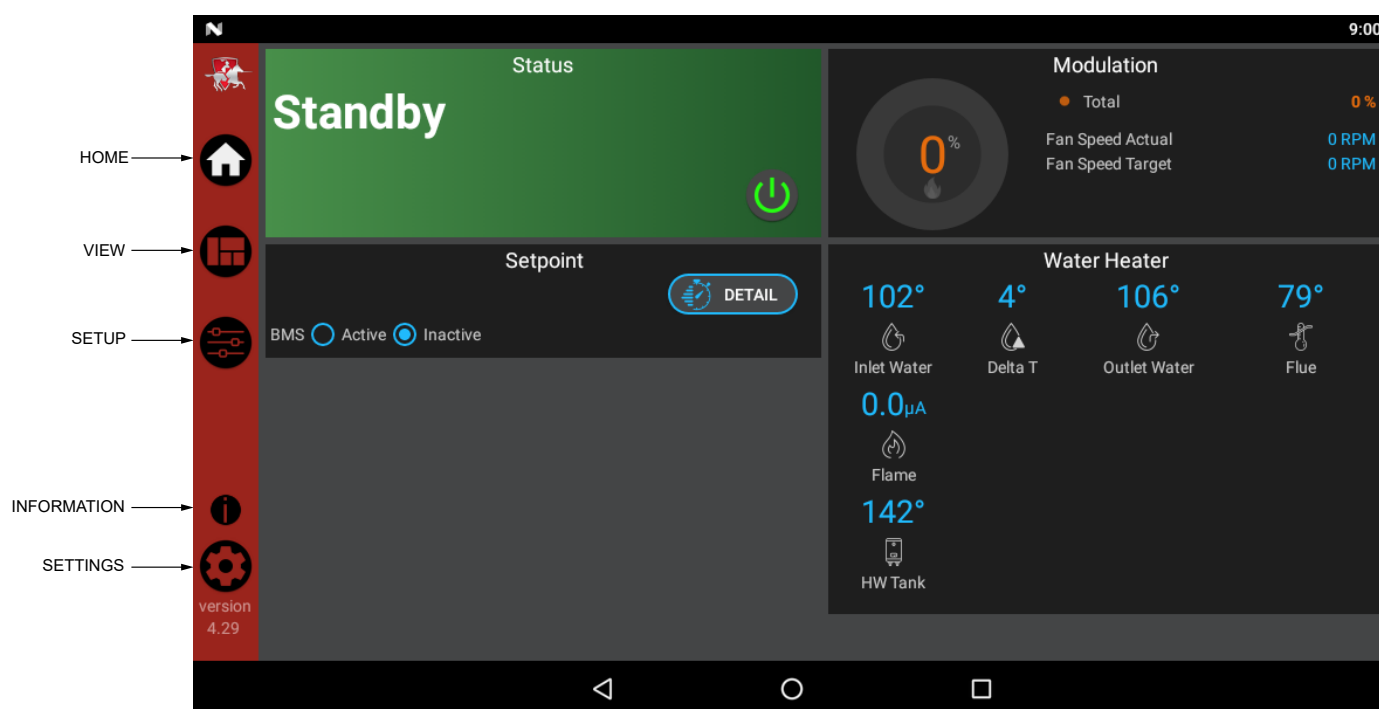
<b>1.</b>	Upon a call for heat, the control turns on the DHW pump.
<b>2.</b>	The control confirms that the low water cutoff / flow switch contacts are closed and energizes the louvers (optional).
<b>3.</b>	The control confirms that the gas pressure switch, blocked drain switch, limits, louver proving switch (optional), and contacts close. The Pre-Purge cycle begins.
<b>4.</b>	The control confirms the blower comes up to the desired speed.
<b>5.</b>	Once the Pre-Purge cycle is complete, the control lowers the blower speeds, initiates sparking of the ignition electrode, and opens the gas valve.
<b>6.</b>	After a short wait, the control stops sparking and checks for the presence of flame current through the flame sense electrode.
<b>7.</b>	If the flame is not detected after the sparking ends, the control will perform a postpurge, then start another prepurge cycle and try to light the burner again. On the 500 and larger models, the control will lock out if this second attempt also fails. On the 400 model, the control will perform a total of 4 attempts before locking out. Once the control has locked the unit out, the RESET button will need to be pressed on the touch screen LCD.
<b>8.</b>	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.
<b>9.</b>	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.
<b>10.</b>	At the end of the Post-Purge cycle, the louver relay contacts will de-energize.
<b>11.</b>	At the end of the Pump Delay cycle(s), the pump(s) will be turned off.

# 12 Operating information *(continued)*

## 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 12-1** 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, Ramp Delay, and Night Setback. The Information Section provides information about the hardware and software including the current software version of the interface, the version of the 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.

# 13 Maintenance

## Maintenance and annual startup

Table 13A Service and Maintenance Schedules

Service technician (see the following pages for instructions)		Owner maintenance	
ANNUAL START-UP	<b>General:</b> <ul style="list-style-type: none"> <li>• Address reported problems</li> <li>• Inspect interior; clean and vacuum if necessary;</li> <li>• Clean condensate trap and fill with fresh water</li> <li>• Check for leaks (water, gas, flue, condensate)</li> <li>• Verify flue and air lines in good condition and sealed tight</li> <li>• Check system water pressure/system piping/expansion tank</li> <li>• Check control settings</li> <li>• Check ignition and flame sense electrodes (sand off any deposits; clean and reposition)</li> <li>• Check wiring and connections</li> <li>• Perform combustion start-up checkout and performance verification per Section 11 of this manual.</li> <li>• Flame inspection (stable, uniform)</li> <li>• Flame signal (at least 10 microamps at high fire)</li> <li>• Clean the heat exchanger if flue temperature is more than 54°F above return water temperature.</li> <li>• Check Delta T (Temperature Rise)</li> </ul>		<ul style="list-style-type: none"> <li>• Check water heater area</li> </ul>
	<b>If combustion or performance indicate need:</b> <ul style="list-style-type: none"> <li>• Clean heat exchanger</li> <li>• Remove and clean burner using compressed air only</li> <li>• Clean the blower wheel</li> </ul>	<b>Monthly</b>	<ul style="list-style-type: none"> <li>• Check vent piping</li> <li>• Check air piping</li> <li>• Check air and vent termination screens</li> <li>• Check relief valve</li> <li>• Check condensate drain system</li> <li>• Check automatic air vents</li> <li>• Check Delta T (Temperature Rise)</li> <li>• Remove debris from Y-strainer per manufacturer's instructions</li> <li>• Check building recirculation filter (if filter required)</li> <li>• Check for and clean any debris or obstruction from birdscreens (if equipped)</li> </ul>
		<b>Every 6 months</b>	<ul style="list-style-type: none"> <li>• Check water heater piping (gas and water) for leaks</li> <li>• Operate relief valve</li> <li>• Check water chemistry</li> </ul>

## 13 Maintenance *(continued)*

### ⚠ WARNING

Follow the service and maintenance procedures given throughout this manual and in component literature shipped with the water heater. Failure to perform the service and maintenance could result in damage to the water heater 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 water heater should be inspected annually only by a qualified service technician. In addition, the maintenance and care of the water heater designated in Table 13A and explained on the following pages must be performed to assure maximum water heater efficiency and reliability. Failure to service and maintain the water heater and system could result in equipment failure.

### ⚠ WARNING

Electrical shock hazard – Turn off power to the water heater before any service operation on the water heater 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 water heater area

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

### Inspect water heater interior

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

### Clean condensate trap

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

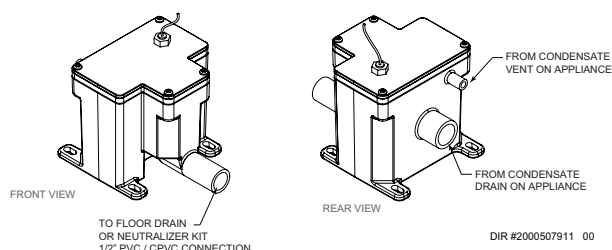
#### Monthly inspection:

1. The condensate trap should be inspected monthly to ensure the trap is properly installed and connected to the condensate pipe under the appliance, see FIG. 13-1.
2. The condensate line should be inspected monthly for obstructions, making sure it allows free flow for condensate to drain.
3. Inspect the neutralizing kit (if installed) monthly to ensure the condensate is draining properly, and there is still an adequate amount of neutralizing agent available.

#### Annual cleaning:

1. The condensate trap should be cleaned at least once annually, or at the end of each heating season, by removing the bottom cap and cleaning out any sediment that exists.
2. The provided condensate trap is equipped with a ball that acts as a seal against harmful flue gases escaping in case there is no condensate in the trap. If this ball is not present, flue gases may be able to pass through the trap when there is no condensate present, resulting in an unsafe environment. It is important to check and make sure the ball is still located in the trap, acting as a seal against flue gases at least once annually and after every cleaning.
3. After the condensate trap is cleaned or serviced, it must be checked to ensure that it is installed and draining properly. Reference Section 10 - Condensate Disposal for installation instructions.

**Figure 13-1 Condensate Trap**



### ⚠ WARNING

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

# 13 Maintenance

## Check all piping for leaks

### ⚠ WARNING

Eliminate all system or water heater 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 8 - 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 water heater vent discharge and air intake are clean and free of obstructions.
3. Verify that bird screens are clean and free of debris or obstruction.

### ⚠ 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 water heater 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 7 - System Piping for suggested best location of expansion tanks and air eliminators.

## Check water heater 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 7 - 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 water heater relief valve as directed could result in unsafe pressure buildup, which can result in severe personal injury, death, or substantial property damage.

### ⚠ WARNING

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

# 13 Maintenance *(continued)*

## Check ignition ground wiring

1. Inspect water heater 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 water heater wiring

1. Inspect all water heater 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.

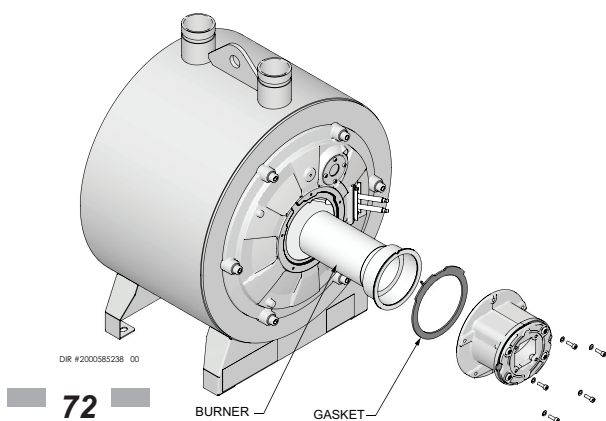
## Perform start-up and checks

1. Start water heater and perform checks and tests specified in Section 11 - 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 water heater and allow water heater 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. 13-2 below.
4. When replacing the burner, ensure gasket is in good condition and positioned correctly (FIG. 13-2).

**Figure 13-2 Burner Assembly**



## Check flame signal

1. At high fire the flame signal shown on the display should be at least 10 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 water heater 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 13B - Heat Exchanger Cleaning Kits.

1. Shut down water heater:
  - Follow the "To Turn Off Gas to Appliance" instructions for the water heater in Section 11 - Startup.
  - Do not drain the water heater unless it will be exposed to freezing temperatures. If using freeze protection fluids in the system, do not drain.
2. Allow time for the water heater to cool to room temperature if it has been firing.
3. Remove the nuts securing the heat exchanger access cover to the heat exchanger and set aside.
4. Remove the heat exchanger access cover, burner, and gas/air arm assembly.

### **WARNING**

The water heater 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 condensate hose from the heat exchanger end. Connect a field supplied 3/4" diameter hose to a drain pan. Using field supplied means, cover the refractory in the back of the combustion chamber of the heat exchanger.
6. Use a vacuum cleaner to remove any accumulation on the water heater heating surfaces. Do not use any solvent.



# 13 Maintenance

7. Brush the heat exchanger while dry using a nylon bristle brush. **Caution:** DO NOT use a metal brush. Re-vacuum the heat exchanger.
8. Finish cleaning using a clean cloth dampened with warm water. Rinse out debris with a low pressure water supply.
9. Allow the heat exchanger to thoroughly dry.
10. Remove the field supplied rear refractory cover from the back of the combustion chamber of the heat exchanger and reassemble.
11. Close isolation valves on piping to isolate water heater from system. Attach a hose to the water heater drain and flush water heater thoroughly with clean water by using purging valves to allow water to flow through the water makeup line to the water heater.
12. Perform start-up and check-out procedures in the Check Flame and Combustion - Section 11 - Startup on pages 57 and 60 of this manual.
13. Replace the access cover and restore water heater to operation.

**Table 13B** Heat Exchanger Cleaning Kit

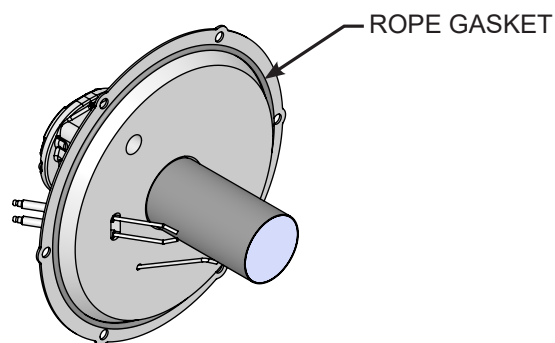
Model	Kit Number	Part Number	Component Description
400 - 1000	100157628	100333410	Rear Refractory Cover, 10.75" Diameter
		100208804	Rear Refractory Cover, 7.25" Diameter
		100208309*	Nylon 4" Wheel Brush*
		100208310	1/4" x 12" Drill Extension
		100208311	1/4" x 24" Drill Extension



## CAUTION

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

**Figure 13-3** Rope Gasket - Heat Exchanger Door



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

## NOTICE

Rope gasket is intended for sealing combustion (see FIG. 13-3). If gasket is damaged DO NOT reuse, the rope gasket must be replaced. Consult factory for replacement rope gasket.

## Check Delta T

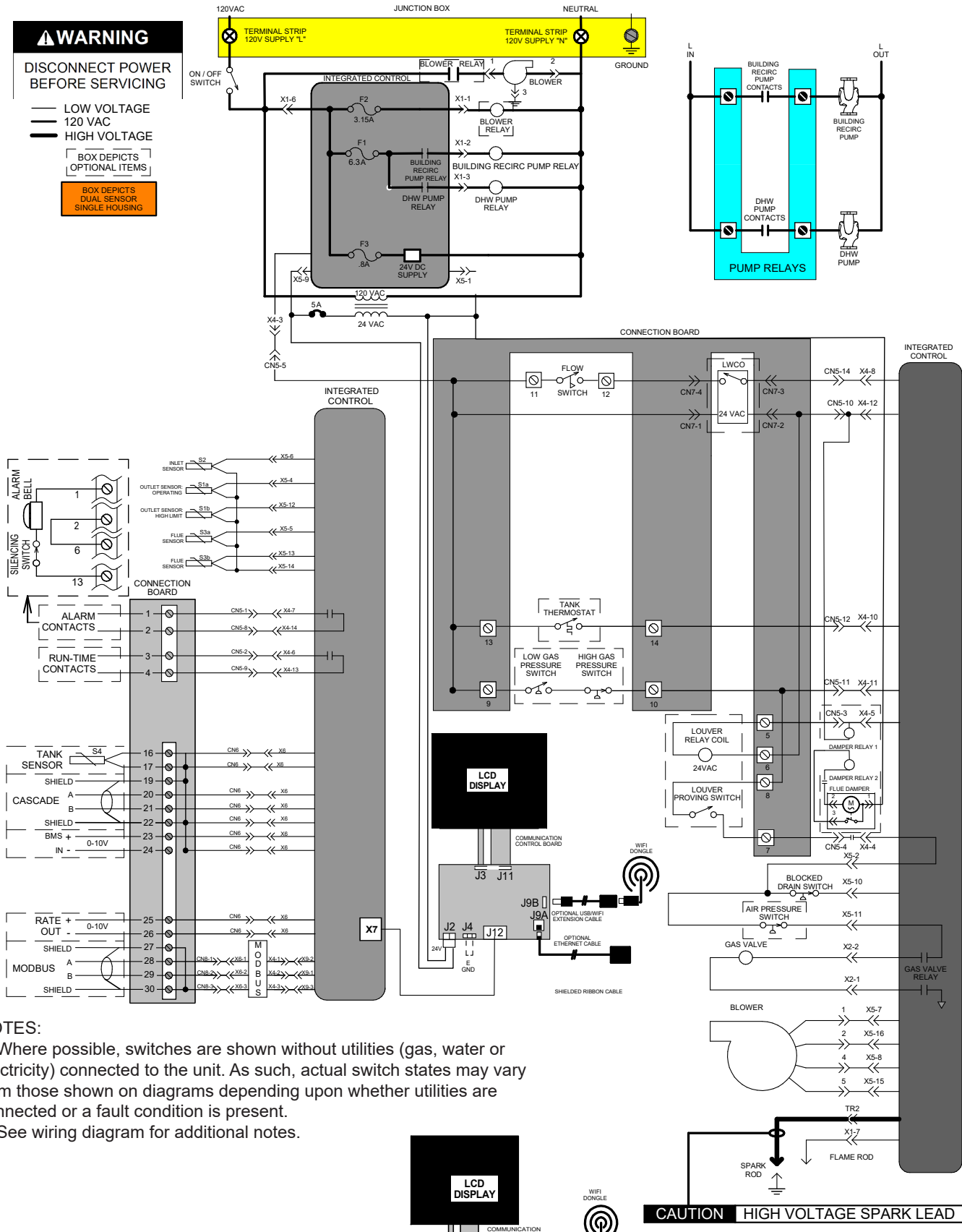
1. Check Delta T. Reference Section 7 - *System Piping* for more information regarding Delta T.

## Oiled bearing circulators

1. The circulator shipped with the Armor water heater 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.

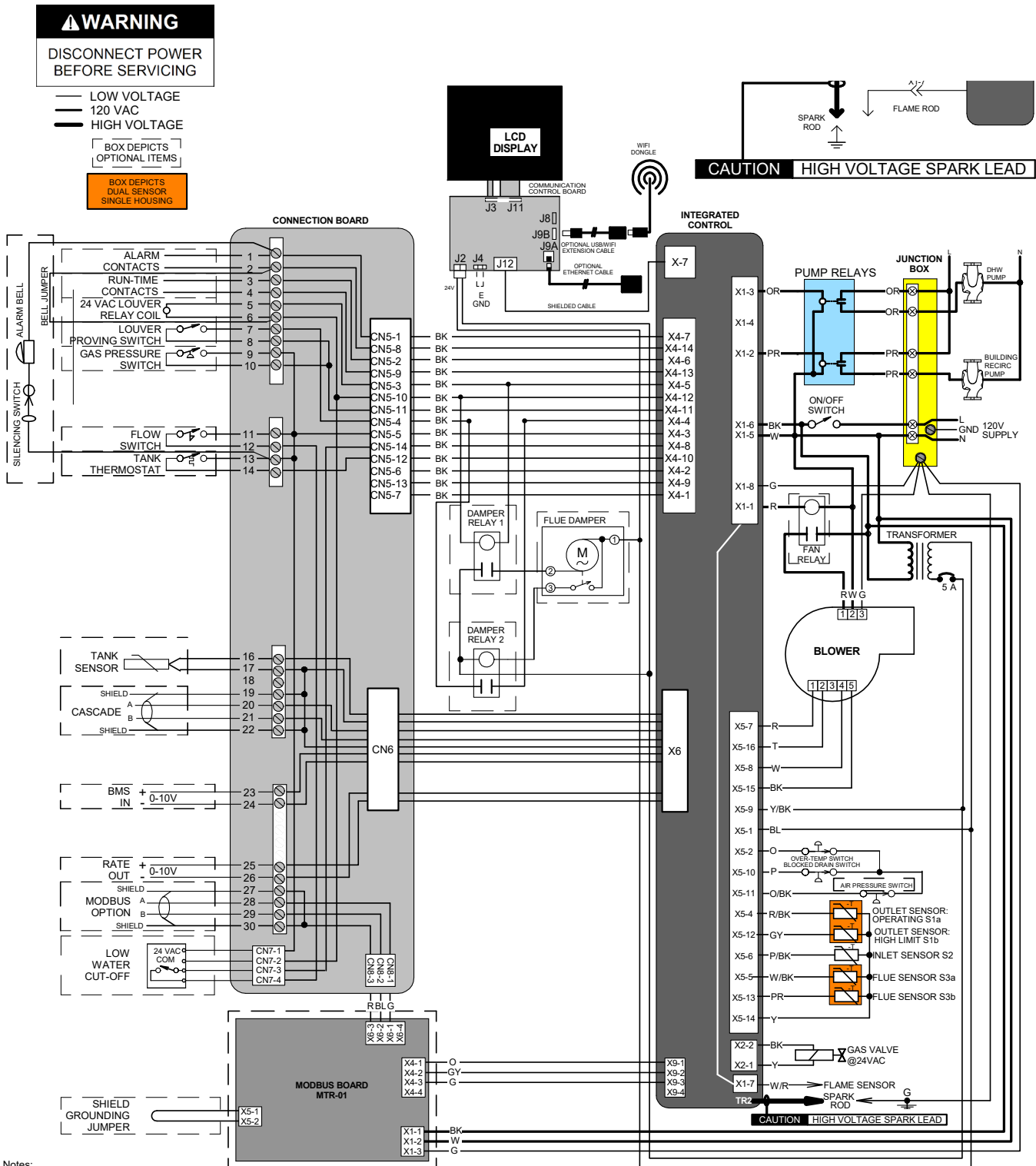
# 14 Diagrams

Figure 14-1 Ladder Diagram



# 14 Diagrams

Figure 14-2 Wiring Diagram



Notes:

1. All wiring must be installed with local, state, provincial, and national code requirements per either N.E.C. in USA or C.S.A. in Canada.
2. If any original equipment wire as supplied with appliance must be replaced, then 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 ribbon cables must be purchased from the factory. Use of a non-approved spark lead or ribbon 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 trouble shoot.
4. Where possible, switches are shown without utilities (gas, water, electricity) connected to the unit. As such, actual switch states may vary from those shown on diagrams depending upon whether utilities are connected or fault condition is present.

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# Notes

# Notes

**Revision Notes:** Revision A (PCP #3000062171 / CN #500048062) initial release.

Revision B (PCP #3000065127 / CN #500050793) reflects updates to figures 14-1 and 14-2.

Revision C (PCP #3000067934 / CN #500053443) reflects the removal of a warning on page 15.

Revision D (PCP #3000068505 / CN #500054027) reflects wording changes to step 11 on page 13.