Lochinvar®
High Efficiency Water Heaters, Boilers and Pool Heaters

DESIGNER'S GUIDE COPPER-FIN II® BOILER

400,000 – 2,070,000 Btu/hr

Dear Specifier/Project Manager,

At Lochinvar, we have long recognized the importance of innovation to any product or service. Those who enter into business must also accept the challenge of meeting constantly changing needs.

The designer's guide you are now holding has been designed to make it more convenient for you to select the perfect Lochinvar boiler for your projects and provide correct specifications for your teams.

All information has been organized and presented in a succinct, easy-to-use manner, so you can use and share information confidently and with minimal effort.

However, it is important to remember that this guide is not intended to replace our installation manual. Installers should still refer to our installation manual for specific installation instructions.

We hope our manual will make your work easier and more productive.
As always, we greatly appreciate your input on additional improvements for the future.

Thanks once again for specifying the Lochinvar family of quality standard and custom-built water heaters and boilers.

Sincerely,

Lochinvar®
High Efficiency Water Heaters, Boilers and Pool Heaters

Lochinvar Corporation

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Boiler Piping Diagrams

In designing a hot water heating system, pay special attention to:

- **Water Velocity**
  (See Page 19 for minimum and maximum boiler flow rates.)
- **Piping Requirements and Specialties**
  (See Page 19 for water flow requirements and system piping.)
- **Low Water Temperature System**
  (See Page 21 for piping and design recommendations.)
- **System and Boiler Control**
  (See Page 24 for boiler operating and temperature control.)
- **Air Elimination and Expansion Tank Placement**
  (See Page 23 for air removal information.)

CODES

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

In the absence of such requirements, the installation shall conform to the latest edition of the *National Fuel Gas Code, ANSI Z223.1.* Where required by the authority having jurisdiction, the installation **must** conform to *American Society of Mechanical Engineers Safety Code for Controls and Safety Devices for Automatically Fired Boilers, ASME CSD-1.* Where required by the authority having jurisdiction, the installation **must** comply with the *Canadian Association Code, CAN/CGA-B149.1 and/or B149.2* and/or local codes.

LOCATION OF UNIT

1. Locate the unit 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 unit. The pan **must** not restrict combustion air flow.

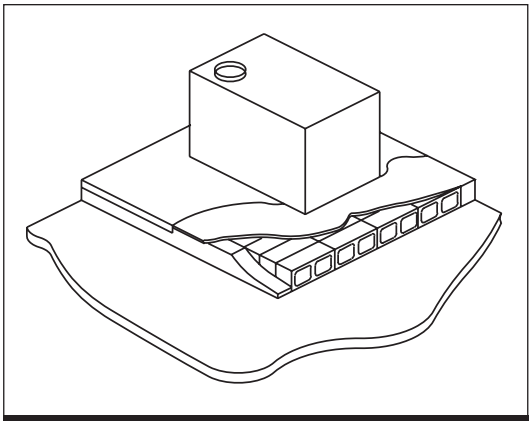
Under no circumstances is the manufacturer to be held responsible for water damage in connection with this unit or any of its components.

2. The indoor units **must** be installed so that the ignition system components are protected from water (dripping, spraying, rain, etc.) during appliance operation and service (circulator replacement, control replacement, etc.).

3. The appliance **must** be installed on a level, non-combustible floor. Concrete over wood is not considered a non-combustible floor. Maintain required clearances from combustible surfaces.

4. For installation on a combustible floor only when installed on special base: Units installed over a combustible floor **MUST** use the Special Combustible Floor Base. The unit **must** be centered on the base as shown in FIG. 1.

- Provide a base of hollow clay tile or concrete blocks from 8″ to 12″ thick and extending 24″ beyond the sides.
- The blocks **must** be placed in line so that the holes line up horizontally to provide a clear passage through the blocks.

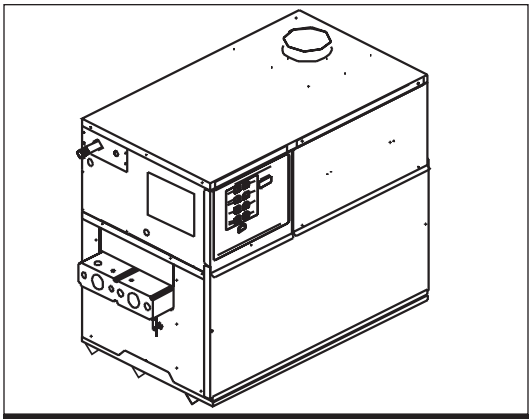


(FIG. 1) CH 991-2071 REQUIREMENTS FOR INSTALLATION OVER COMBUSTIBLE FLOOR

- **This procedure should also be followed if electrical conduit or radiant heat distribution piping runs through the floor and beneath the appliance.**
- Ensure that combustible floor base meets local fire code requirements.
- The correct kit number for the required base is noted on the rating plate of each unit and listed in Table A.

(TABLE A)
COMBUSTIBLE FLOOR KITS

MODEL NUMBER	KIT NUMBER
CH401	CFK3301
CH501	CFK3302
CH651	CFK3303
CH751	CFK3304



(FIG. 2) MODELS CH 401-751 INSTALLED WITH OPTIONAL COMBUSTIBLE FLOOR BASE

5. Outdoor models require the installation of an optional vent cap. Instructions for placement of the vent cap are included in the venting section.

Outdoor models **must** not be installed directly on the ground. The outdoor unit **must** be installed on a concrete brick, block or other non-combustible pad. Outdoor models have additional special location and clearance requirements. (See Outdoor Installation Pg. 16)

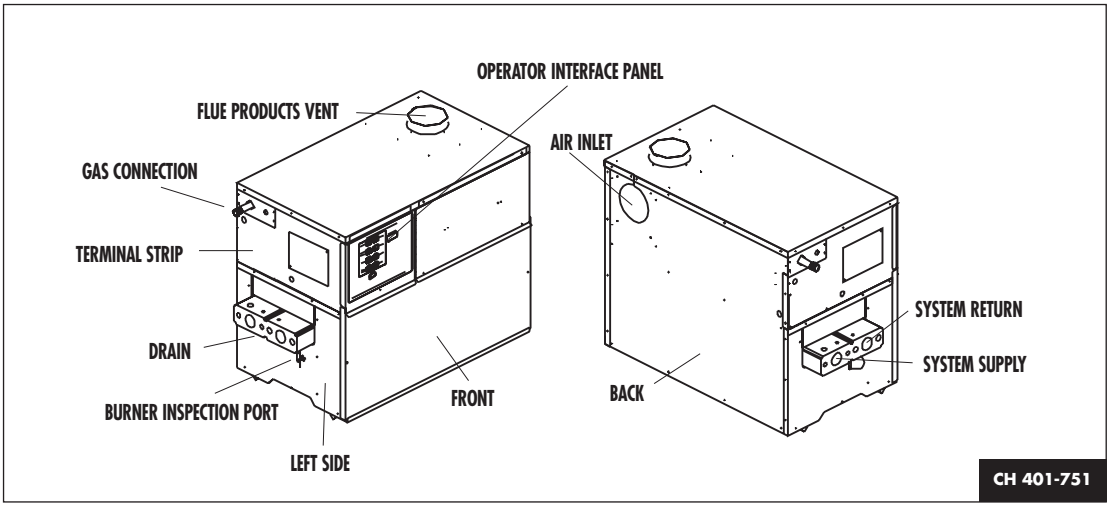
SPECIAL LOCATION: OUTDOOR USE

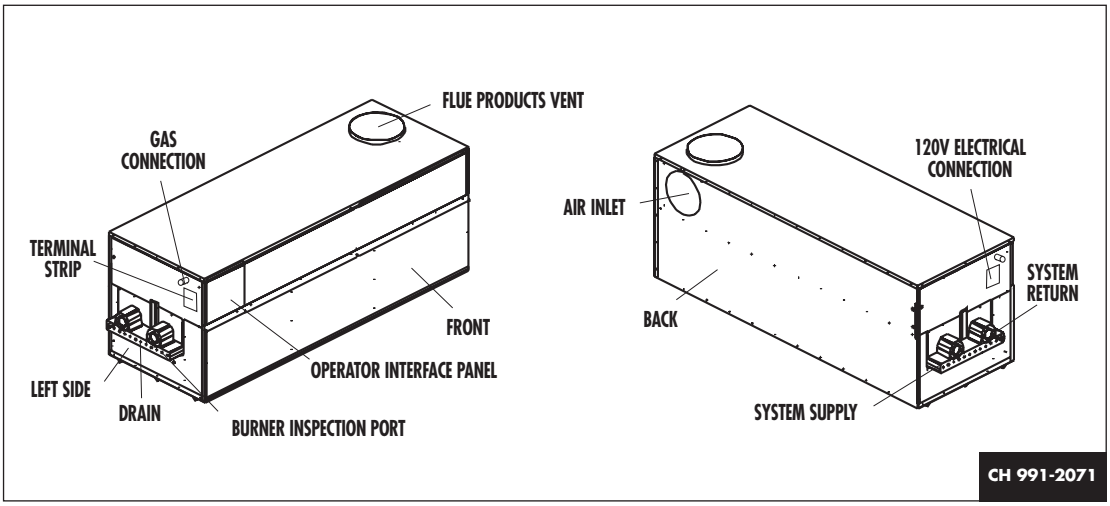
Copper-Fin II Models are approved for outdoor installations. Outdoor models have additional location and clearance requirements. These requirements **must** be adhered to carefully, since wind, rain, snow and cold cannot be controlled in outdoor applications. See **Outdoor Installation**, in the venting section on page 16.

(TABLE B) – CLEARANCES FROM COMBUSTIBLES

CLEARANCES	CH401-751	CH991-2071
Right Side	1″	3″
Rear	1″	3″
Left Side	6″ (24″ for Service)	3″ (24″ for Service)
Front	ALCOVE* (24″ for Service)	ALCOVE* (30″ for Service)
Top	1″	3″
Flue	1″+	1″+
Hot Water Pipes	1″	1″

* Alcove is a closet without a door.
\+ Consult local codes and/or vent manufacturer.





(FIG. 3) BOILER EQUIPMENT AND CONTROL ORIENTATION.

EXAMPLE OF SIZING FOR COMBUSTION & VENTILATION AIR OPENINGS (BOILER WITH 2,070,000 Btu/hr

When combustion and ventilated air is taken from directly outside the building (FIG. 4), divide the total BTU's by 4,000. This yields 517.5 sq.in. of "Free Area" without restriction.

(2,070,000 ÷ 4000 = 517.5 sq.in.)

Since the air opening is 50% closed due to screens and louvers, the total opening MUST be multiplied by 2.

(517.5 sq. in. x 2 = 1,035 sq.in.)

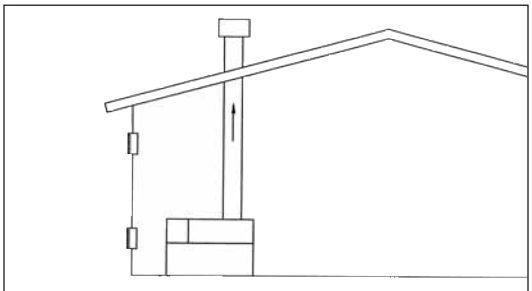
This project requires one Ventilation Air Opening with a net area of 1,035 square inches with louver dimensions of 30" x 35" and one Combustion Air Opening with a net area of 1,050 square inches with louver dimensions of 30" x 35".

COMBUSTION & VENTILATION AIR

Provisions for combustion and ventilation air **must** be in accordance with Section 5.3, 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.

The equipment room **must** be provided with properly sized openings to assure adequate combustion air and proper ventilation when the unit is installed with conventional venting or sidewall venting.

CAUTION: Under no circumstances should the equipment room be under a negative pressure when atmospheric combustion equipment is installed in the room.

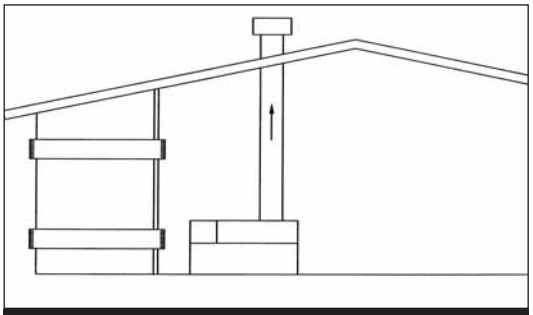


(FIG. 4) COMBUSTION AIR DIRECT FROM OUTSIDE

If air is taken directly from outside the building with no duct, provide two permanent openings:

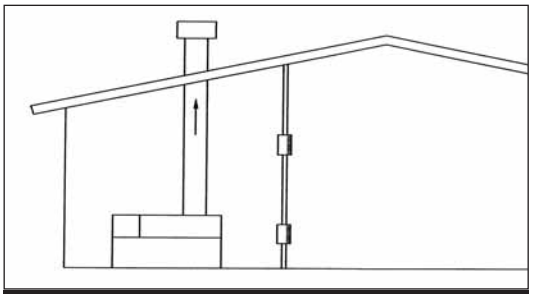
A. Combustion air opening with a minimum free area of one square inch per 4000 Btu input (5.5 cm^2 per kW). This opening **must** be located within 12" (30 cm) of the bottom of the enclosure.

B. Ventilation air opening with a minimum free area of one square inch per 4000 Btu input (5.5 cm^2 per kW). This opening **must** be located within 12" (30 cm) of the top of the enclosure.



(FIG. 5) COMBUSTION AIR THROUGH DUCTWORK

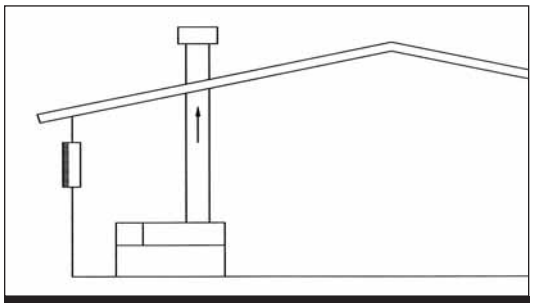
2. If combustion and ventilation air is taken from the outdoors using a duct to deliver the air to the mechanical room, each of the two openings should be sized based on a minimum free area of one square inch per 2000 Btu input (11cm^2 per kW).



(FIG. 6) COMBUSTION AIR FROM AN INTERIOR SPACE

3. If air is taken from another interior space, each of the two openings specified above should have a net free

area of one square inch for each 1000 Btu (22 cm^2 per kW) of input, but not less than 100 square inches (645 cm^2).



(FIG. 7) COMBUSTION AIR FROM OUTSIDE, SINGLE OPENING

4. **If a single combustion air opening is provided to bring combustion air in directly from the outdoors,** the opening **must** be sized based on a minimum free area of one square inch per 3000 Btu input (7 cm^2 per kW). This opening **must** be located within 12" (30 cm) of the top of the enclosure.

CONTAMINANTS

Combustion air drawn from an interior or exterior space **must** be free of any chemical fumes which could be corrosive to the water heater.

Burning chemical fumes results in the formation of corrosive acids which attack the water heater, cause improper combustion and premature failure of the water heater and vent.

These fumes are often present in areas where refrigerants, salts, and solvents are used. Therefore, be aware of swimming pool equipment, water softening, and cooling system placement.

VENTING

General

These boilers are classified as Category I appliances when tested to the latest ANSI Standard. This classification requires all conventionally vented combustion products to be vented using Category I listed vent pipe.

Additionally, it is recommended that this vent material be double wall construction or insulated in the field. A Category I appliance operates with a non-positive static vent pressure and with flue loss greater than 17 percent.

Vent installations for connection to gas vents or chimneys **must** be in accordance with Part 7, "Venting of Equipment," of the latest edition of the *National Fuel Gas Code, ANSI Z223.1*, or applicable provisions of the local building codes.

The connection from the appliance vent to the stack **must** be as direct as possible and sized correctly. The horizontal breeching of a vent **must** have at least 1/4" rise per linear foot. The horizontal portions should also be supported for the design and weight of the material employed to maintain clearances, prevent physical damage and separation of joints.

The connection from the appliance vent to the stack or vent termination outside the building **must** be made with listed

CAUTION!

EXHAUST FANS: Any fan or equipment which exhausts air from the equipment room may deplete the combustion air supply and/or cause a down draft in the venting system. If a fan is used to supply combustion air to the equipment room, it MUST be sized to make sure that it does not cause drafts which could lead to nuisance operational problems with the boiler.

Category I double wall vent (or equivalent) connectors and sized according to vent sizing tables (FAN column) in the latest edition of the *National Fuel Gas Code*.

The Category I vent and accessories, such as firestop spacers, thimbles, caps, etc., **must** be installed in accordance with the vent manufacturer's listing. The vent connector and firestop **must** provide correct spacing to combustible surfaces and seal to the vent connector on the upper and lower sides of each floor or ceiling through which the vent connector passes.

Any improper operation of the common venting system in an existing building should be corrected when new equipment is installed, so the installation conforms to the latest edition of the *National Fuel Gas Code, ANSI Z223.1*.

When resizing any portion of the common venting system, it should be resized to approach the minimum size as determined using the appropriate tables in the *National Fuel Gas Code*.

The weight of the venting system **must** not rest on the water heater. The venting system **must** be adequately supported in compliance with local codes and other applicable codes.

NOTE:
Flue gases will form a white plume in winter. Plume could obstruct window view. Flue gas condensate can freeze on exterior surfaces or on the vent cap. Flue gas condensate can cause discoloration of exterior building surfaces. Adjacent brick or masonry surfaces should be protected with a rust resistant sheet metal plate.

Vent Terminations

The vent terminal should be vertical and exhaust outside the building at least 2 feet (0.6 m) above the highest point of the roof when within a 10 foot (3.05 m) radius.

Additionally, vertical terminations **must** be a minimum of 3 feet (0.9 m) above the roof line, and when less than 10 feet (3.05 m) from a parapet wall **must** be a minimum of 2 feet (0.61 m) higher than the parapet wall.

Vent caps should have a minimum clearance of 4 feet (1.2 m) horizontally from, and in no case above or below [unless a 4 feet (1.2 m) horizontal distance is maintained], electric meters, gas meters, regulators and relief equipment.

Maintain a distance of at least 3 feet (0.9 m) above any forced air inlet within 10 feet (3.05 m) and a distance of at least 4 feet (1.2 m) below, 4 feet (1.2 m) horizontally from, or 1 foot (30 cm) above any door, window or gravity air inlet.

Do not terminate the vent in a window well, stairwell, alcove, courtyard or other recessed area. **The vent can not terminate below grade**. The bottom of the vent terminal shall be located at least 12 inches (30 cm) above grade and clear of snow, ice, leaves or other debris.

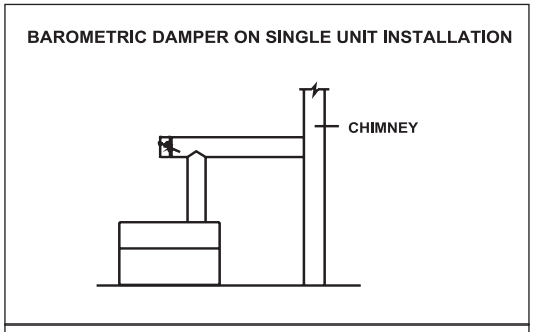
The distance of the vent terminal from adjacent public walkways, adjacent buildings, windows, and building openings

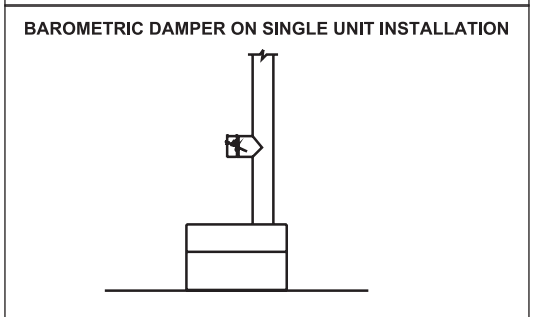
must be consistent with the *National Fuel Gas Code Z223.1* or in Canada, the latest edition of *CGA Standard B149 Installation Code for Gas Burning Appliances and Equipment.*

VENTING OPTIONS

Conventional Venting

A conventional venting system utilizes the natural buoyancy of the heated flue products to generate a negative draft. This draft forces flue products to rise vertically through a rooftop flue termination. The vent connection is made directly to the top of the unit and combustion air supplied from the mechanical room. Properly sizing vent material and the use of a barometric damper (when required) will lead to proper vent operation.





(FIG. 8) BAROMETRIC DAMPER INSTALLATION

A barometric damper is required when draft exceeds 0.08 inches of negative water column. When installed and adjusted properly, a barometric damper will maintain draft between 0.02 and 0.08 inches of negative water column ensuring proper operation.

The minimum flue pipe diameters for all models, utilizing negative draft venting are as follows:

(TABLE C)
FLUE SIZES AND INLET AIR PIPE SIZES

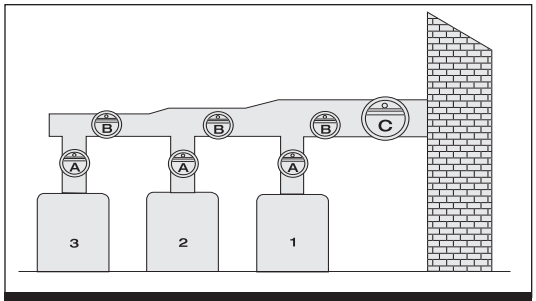
MODEL NUMBER	FLUE SIZE	DIRECTAIRE INLET SIZE
CH401	6″	6″
CH501	6″	6″
CH651	8″	8″
CH751	8″	8″
CH991	10″	10″
CH1261	12″	12″
CH1441	12″	12″
CH1801	14″	12″
CH2071	14″	12″

Size vent material using the "FAN" category of vent sizing tables in the latest edition of the *National Fuel Gas Code*. "FAN" applies to fan-assisted combustion appliances in Category I.

Multiple unit installations with combined venting also require barometric dampers to regulate draft at each unit. Again, the negative draft **must** be within the range of 0.02 to 0.08 inches of negative water column to ensure proper operation.

NOTE: Common venting systems may be too large when an existing unit is removed. Be careful to resize any common venting system when new appliances are installed or existing appliances are replaced.

NOTE: Venting of a high efficiency appliance into a cold or oversized masonry chimney can result in operational and safety problems.



(FIG. 9) MULTIPLE UNIT BAROMETRIC DAMPER INSTALLATION

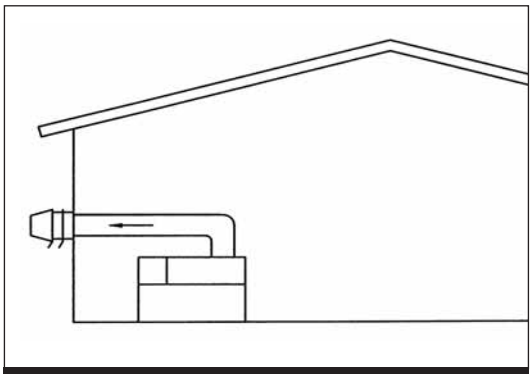
For this type of installation, it is best to use a draft control for each water heater located on the riser between the vent outlet and the breeching - Location "A". When this riser is too short to permit the installation of a draft control, locate a separate control for each water heater on the main breeching as illustrated in Location "B". If, because of general crowding or other reasons, neither of these locations are possible, use a single large control in the breeching between the water heater nearest the chimney and the chimney, as shown in Location "C".

All draft readings are made while unit is in stable operation (approximately 5 minutes running time).

Masonry Chimney

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

Carefully inspect all chimney systems during the project design phase. If there is any doubt about the sizing or condition of a masonry chimney, it is prudent to reline the chimney with a properly sized and approved chimney liner system. Metallic liner systems (Type "B" doublewall or flexible or rigid metallic liners) are recommended. Consult with local code officials to determine code requirements or the advisability of using or relining a masonry chimney.



(FIG. 10) POWERED SIDEWALL VENTING (POWERED VENT CAP SHOWN)

Powered Sidewall Venting

This venting system uses a powered vent cap assembly which pulls the flue products out of the stack. The fan in the powered vent cap generates a negative draft at the unit. Combustion air is drawn from the mechanical room (See Combustion and Ventilation Air Requirements, page 6).

Powered Sidewall Vent Kits

Models CH401-751 utilize a powered vent cap which has a fan mounted inside the cap. The powered vent cap **must** be placed on an exterior wall. The powered sidewall vent cap and accessories are included in a venting kit, which **must** be furnished by Lochinvar in accordance with CSA International requirements.

This venting kit includes the powered sidewall fan/cap, proving switch and all necessary relays to interlock with the water heater control system.

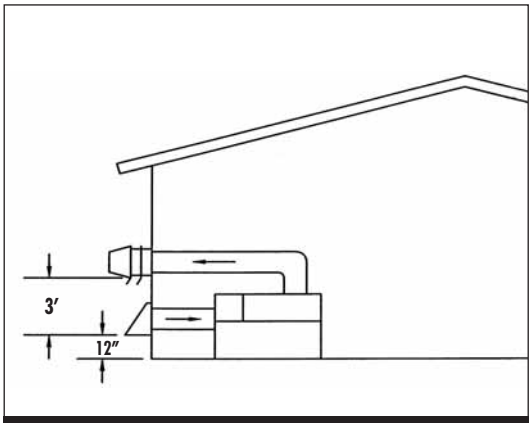
(TABLE D) – POWERED SIDEWALL VENT KIT PART NUMBERS

MODEL NUMBER	FLUE SIZE	SIDEWALL VENT CAP KIT
CH401	6″	SVK3006
CH501	6″	SVK3006
CH651	8″	SVK3008
CH751	8″	SVK3008
CH991	10″	SVK3009
CH1261	12″	SVK3010
CH1441	12″	SVK3011
CH1801	14″	SVK3012
CH2071	14″	SVK3012

Models CH991-2071 utilize an inline fan, which is positioned on the inside of the sidewall and connected to a vent hood mounted on the sidewall exterior. The inline fan and accessories are included in a venting kit, which **must** be furnished by Lochinvar in accordance with CSA International requirements.

This venting kit includes the inline fan, exterior vent hood, a tapered vent adapter, barometric damper, proving switch and all necessary relays to interlock with the water heater control system. The connection from the vent to the sidewall fan/powered vent cap **must** be made with listed Type "B" double wall (or equivalent) vent and accessories. The installer supplies this vent pipe material.

For models CH401-751, maximum total equivalent length of the vent pipe cannot exceed 50 equivalent feet (15.24 m). Models CH991-2071 allow a maximum total equivalent length of 100 feet (30.48 m). Subtract 5 feet (1.52 m) for each elbow in the vent.



(FIG. 11) POWERED DIRECTAIRE® HORIZONTAL (POWERED VENT CAP SHOWN)

Powered DirectAire® Horizontal

This vent system requires the installation of two vent pipes directly to the unit, one pipe for flue products and one for combustion air. Both vent pipes are installed horizontally with a sidewall termination point. The vent connection is made directly to the top of the unit and utilizes either the powered vent cap or inline fan as described in the power side wall venting section.

The combustion air supply system has specific vent material and installation requirements. The air inlet pipe connects directly to the water heater to supply combustion air. The combustion air inlet pipe will be a dedicated system with one air inlet pipe per water heater. The air inlet pipe **must** be connected to a combustion air inlet cap.

To prevent recirculation of flue products from an adjacent vent cap into the combustion air inlet, follow all applicable clearance requirements in the latest edition of the *National Fuel Gas Code* and the following instructions:

The combustion air inlet cap **must** be installed at least 1 foot (0.30 m) above ground level and above normal snow levels.

The point of termination for the combustion air inlet cap **must** be at least 3 feet (0.91 m) below the point of flue gas termination if it is located within 10 feet (3.05 m) of the flue outlet.

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

Both the combustion air inlet cap and the powered vent cap/inline fan vent hood **must** be installed on the same wall and in the same pressure zone.

The Horizontal DirectAire system requires installation of a single wall pipe to supply combustion air from outdoors directly to the water heater. The use of double wall vent material is recommended in cold climates to prevent the condensation of airborne moisture.

For models CH401-751, maximum total equivalent length of the vent pipe and combustion air inlet pipe cannot exceed 50 equivalent feet (15.24 m). Models CH991-2071 allow a maximum total equivalent length of 100 feet (30.48 m) for each pipe. Subtract 5 feet (1.52 m) for each elbow in the vent.

Powered DirectAire® Horizontal Kits

Models CH401-751 vent kit includes the powered sidewall fan/cap, proving switch, air inlet cap and all necessary relays to interlock with the water heater control system. Lochinvar **must** furnish this vent kit in accordance with CSA International requirements.

Models CH991-2071 vent kit includes the inline fan, exterior vent hood, a tapered vent adapter, barometric damper, proving switch, air inlet cap and all necessary relays to interlock with the water heater control system. Lochinvar **must** furnish this vent kit in accordance with CSA International requirements.

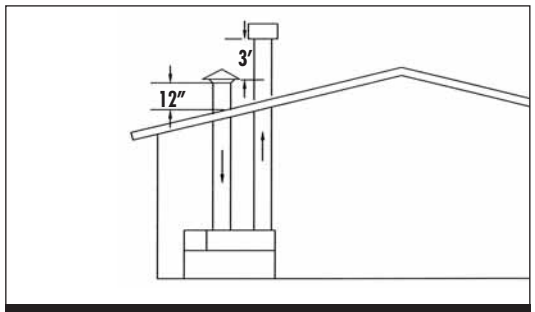
The installer supplies all vent pipe material.

(TABLE E) POWERED DIRECTAIRE® HORIZONTAL KIT PART NUMBERS

MODEL NUMBER	FLUE SIZE	DIRECT AIR INLET SIZE	HORIZONTAL DIRECTAIRE KIT
CH401	6″	6″	HDK3031
CH501	6″	6″	HDK3031
CH651	8″	8″	HDK3032
CH751	8″	8″	HDK3032
CH991	10″	10″	HDK3026
CH1261	12″	12″	HDK3027
CH1441	12″	12″	HDK3027
CH1801	14″	12″	HDK3028
CH2071	14″	12″	HDK3028

DirectAire® Vertical

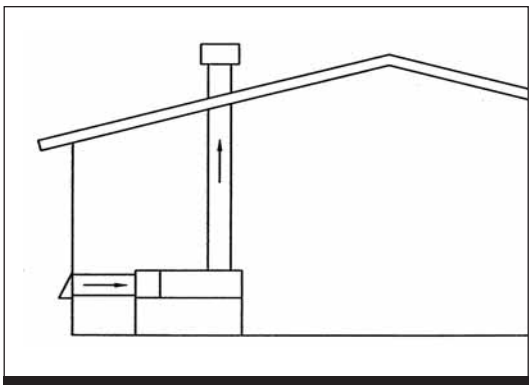
This vent system requires the installation of two pipes directly to the unit, one vertical pipe with a roof top termination for the flue products and one pipe for combustion air. The combustion air pipe may terminate horizontally with a sidewall air inlet or vertically with a roof top air inlet. Vent connection is made directly to the top of the unit.



(FIG. 12) VERTICAL VENT AND AIR INLET

No additional draft diverter or barometric damper is required on single unit installations with a dedicated stack and a negative draft maintained between 0.02 to 0.08 inches of negative water column. The flue may be combined with the vent from any other negative draft, Category I appliances.

Multiple unit installations common vented with other negative draft appliances require that each water heater **must** have a barometric damper. The common vent and connectors from multiple water heaters **must** be sized per the requirements of the venting tables for Type "B" double wall vents in the latest edition of the *National Fuel Gas Code, ANSI Z223.1*.



(FIG. 13) VERTICAL VENT AND SIDEWALL AIR INLET

The air inlet pipe connects directly to the water heater to supply combustion air. The maximum distance for the air inlet pipe is 50 equivalent feet. Subtract 5 feet (1.52 m) for each elbow in the air inlet pipe.

Single wall vent material is used to supply the combustion air to each unit. The use of double wall vent material is recommended in cold climates to prevent the condensation of airborne moisture.

To prevent recirculation of flue products from an adjacent vent cap into the combustion air inlet, follow all applicable clearance requirements in the latest edition of the *National Fuel Gas Code* and instructions in this manual.

The combustion air inlet cap **must** be installed at least one foot (0.30 m) above ground level and above normal snow levels. The point of termination for the combustion air inlet cap **must** be at least 3 feet (0.91 m) below the point of flue gas termination (vent cap), if it is located within 10 feet (3.05 m) of the flue outlet.

NOTE:
The use of double wall vent material for the combustion air inlet pipe is recommended in cold climates to prevent the accumulation of condensation on the pipe exterior.

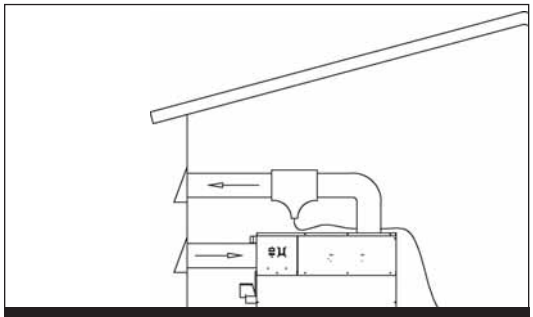
CAUTION!

Boilers which are shut down or will not operate may experience freezing due to convective air flow in the air inlet pipe connected to the unit. Proper freeze protection MUST be provided.

(TABLE F) DIRECTAIRE VERTICAL SIDEWALL & ROOFTOP AIR INLET KITS				
MODEL NUMBER	VENT SIZE	AIR INLET SIZE*	SIDEWALL AIR INLET KIT	ROOFTOP AIR INLET KIT
CH401	6″	6″	SVK3047	VDK3026
CH501	6″	6″	SVK3047	VDK3026
CH651	8″	8″	SVK3048	VDK3027
CH751	8″	8″	SVK3048	VDK3027
CH991	10″	10″	SVK3040	VDK3023
CH1261	12″	12″	SVK3041	VDK3024
CH1441	12″	12″	SVK3041	VDK3024
CH1801	14″	12″	SVK3041	VDK3024
CH2071	14″	12″	SVK3041	VDK3024

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

The vertical air inlet point for the combustion air inlet cap **must** be installed at least one foot (0.30 m) above the rooftop and above normal snow levels. Lochinvar is required to supply a vent kit for DirectAire applications. Each kit includes either a sidewall or roof top combustion air inlet cap to supply air to a single water heater (See Table F).



(FIG. 14) AIRE-LOCK DIRECT VENT

Aire-Lock™ Direct Vent

This vent system utilizes the internal blower of the unit to draw all combustion air from outside and vent the by-products of combustion to the outdoors. This vent system requires the installation of two vent pipes directly to the unit, one pipe for flue products and one pipe for combustion air. Both vent pipes can terminate horizontally at a sidewall or vertically at the rooftop. It is a requirement that both vent pipes terminate in the same pressure zone. The vent system has specific vent material and installation requirements.

The vent piping for flue products uses AL29-4C vent material and must be sealed "gas-tight" at all vent joints. The vent connection is made directly to the top of the unit. The maximum distance for the flue pipe is 50 equivalent feet (15.2 m). Subtract 5 feet (1.52 m) for each elbow in the flue pipe. The flue products vent pipe is a dedicated system with one flue pipe per unit.

The combustion air supply pipe connects directly to the unit to supply combustion air. The maximum distance for the air inlet pipe is 50 equivalent feet (15.2 m). Subtract 5 feet (1.52 m) for each elbow in the air inlet pipe.

The combustion air inlet pipe is a dedicated system with one air inlet pipe per unit. The air inlet pipe must be connected to the Direct Vent (DV) box adapter. The air inlet pipe must be sealed.

Aire-Lock™ Horizontal Direct Vent Kits

The vent kit includes a DV box adapter; sidewall air inlet cap and sidewall vent termination. Lochinvar must furnish this vent kit in accordance with CSA International requirements.

(TABLE G)
AIRE-LOCK™ DIRECT VENT KIT PART NUMBERS

MODEL NUMBER	FLUE SIZE	AIR INLET SIZE	PART NUMBER
CH401	6″	6″	DVK3004
CH501	6″	6″	DVK3004
CH651	8″	8″	DVK3005
CH751	8″	8″	DVK3005
CH991	10″	10″	DVK3000
CH1261	12″	12″	DVK3001
CH1441	12″	12″	DVK3001
CH1801	14″	12″	DVK3002
CH2071	14″	12″	DVK3002

Vertical Direct Vent Termination

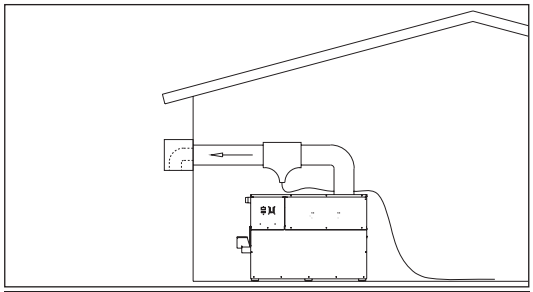
You must use the vent termination recommended by the vent manufacturer for vertical direct vent terminations.

The installer supplies all vent pipe material.

The combustion air inlet cap **must** be installed at least 1 foot (0.30 m) above ground level and above normal snow levels.

The point of termination for the combustion air inlet cap **must** be at least 3 feet (0.91 m) below the point of flue gas termination if it is located within 10 feet (3.05 m) of the flue outlet. The combustion air inlet cap **must** not be installed closer than 10 feet (3.05 m) from an inside corner of an L-shaped structure.

Both the combustion air inlet cap and flue gas vent termination **must** be installed in the same pressure zone.



(FIG. 15) SIDEWALL VENT

Sidewall Vent

This vent system utilizes the internal blower of the unit to vent the by-products of combustion to the outdoors. This vent system requires the installation of one pipe for flue products. The vent pipes terminates horizontally at a sidewall. The vent system has specific vent material and installation requirements. The vent piping for flue products uses AL29-4C vent material and must be sealed "gastight" at all vent joints. The vent connection is made directly to the top of the unit. The maximum distance for the flue pipe is 50 equivalent feet (15.2m). Subtract 5 feet (1.52m) for each elbow in the flue pipe. The flue products vent pipe is a dedicated system with one flue pipe per unit.

Sidewall Vent Kits

The vent kit includes a sidewall vent termination assembly to provide pressure equalization. Lochinvar must furnish this vent kit in accordance with CSA International requirements.

(TABLE H) SIDEWALL VENT KIT PART NUMBERS		
MODEL NUMBER	FLUE SIZE	PART NUMBER
CH401	6″	SVK3043
CH501	6″	SVK3043
CH651	8″	SVK3044
CH751	8″	SVK3044

The installer supplies all vent pipe material.

Combined Air Inlet Points

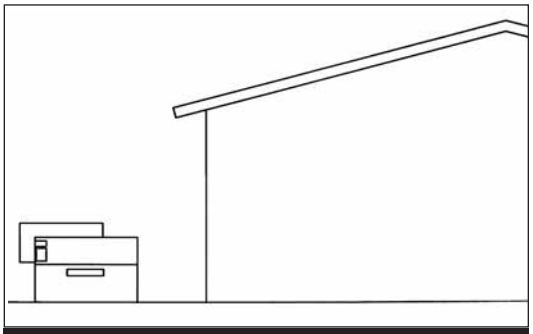
In most installations, the combustion air inlet pipe will be a dedicated system with one air inlet pipe per water heater.

Multiple air inlets may be combined to a single common connection if the common air inlet pipe has a cross sectional area equal to or larger than the total area of all air inlet pipes connected to the common air inlet pipe.

The air inlet point for multiple water heater air inlets **must** be provided with an exterior opening which has a free area equal to or greater than the total area of all air inlet pipes connected to the common air inlet. This exterior opening for combustion air **must** connect directly to the outdoors.

The total length of the combined air inlet pipe **must** not exceed a maximum of 50 (15.25 m) equivalent feet. Subtract 5 feet (1.52 m) for each elbow in the air inlet pipe.
Deduct the restriction in area provided by any screens, grills or louvers installed in the common air inlet point. These are common on the sidewall air inlet openings. Screens, grills or louvers installed in the common air inlet can reduce the free area of the opening from 25% to 75% based on the materials used.

OUTDOOR INSTALLATION



(FIG. 16) OUTDOOR VENTING

Units are self venting and can be used outdoors when installed with the optional Outdoor Cap. This cap mounts directly to the top of the water heater and covers the flue outlet and combustion air inlet openings on the jacket. No additional vent piping is required. Maintain a minimum clearance of 3″ (76 mm) to combustible surfaces and a minimum of 3″ (76 mm) clearance to the air inlet.

An outdoor unit should not be located 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. The unit should be located at least 3 feet (0.91m) from any wall or vertical surface to prevent adverse wind conditions from affecting performance.

Multiple unit outdoor installations require 48″ (1.22 m) clearance between each vent cap. The outdoor cap **must** be located 4 feet (1.22 m) below and 4 feet (1.22 m) horizontally from any window, door, walkway or gravity air intake.

The combustion air inlet of the outdoor cap **must** be located at least one foot (0.30 m) above grade and above normal snow levels. The water heater **must** be at least 10 feet (3.05 m) away from any forced air inlet and at least 3 feet (0.91 m) outside any overhang.

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

Lochinvar **must** furnish an outdoor vent kit in accordance with CSA international requirements. Each kit includes the flue outlet/combustion air inlet, assembly, and gasket.

(TABLE I) - OUTDOOR VENT CAP PART NUMBERS

MODEL NUMBER	PART NUMBER
CH401	0DK3019
CH501	0DK3020
CH651	0DK3021
CH751	0DK3022
CH991	0DK3036
CH1261	0DK3037
CH1441	0DK3037
CH1801	0DK3038
CH2071	0DK3038

Freeze Protection-
Outdoor Installation

A snow screen should be installed to prevent snow and ice accumulation around the appliance or its venting system.

If for any reason the unit is to be shut off:

(a.) Shut off water supply.
(b.) Drain unit completely.
(c.) Drain pump and piping.

If freeze protection is not provided for the system, a low ambient temperature alarm or automatic drain system is recommended.

GAS SUPPLY

1. Safe operation of unit requires properly sized gas supply piping (See TABLE J).

2. Gas pipe size may be larger than the heater connection.

3. A gas pressure regulator is suggested to help assure proper inlet gas pressure. If upstream pressure exceeds 6 oz. (10.5 inches of water column), an intermediate gas pressure regulator, of the lockup type, **must** be installed.

(TABLE J) – GAS SUPPLY PIPE SIZING

	Length of Pipe In Straight Feet													
Nominal Iron Pipe Size, Inches	10	20	30	40	50	60	70	80	90	100	125	150	175	200
3/4	369	256	205	174	155	141	128	121	113	106	95	86	79	74
1	697	477	384	328	292	267	256	246	210	200	179	164	149	138
1 1/4	1,400	974	789	677	595	543	502	472	441	410	369	333	308	287
1 1/2	2,150	1,500	1,210	1,020	923	830	769	707	666	636	564	513	472	441
2	4,100	2,820	2,260	1,950	1,720	1,560	1,440	1,330	1,250	1,180	1,100	974	871	820
2 1/2	6,460	4,460	3,610	3,100	2,720	2,460	2,310	2,100	2,000	1,900	1,700	1,540	1,400	1,300
3	11,200	7,900	6,400	5,400	4,870	4,410	4,000	3,800	3,540	3,300	3,000	2,720	2,500	2,340
3 1/2	23,500	16,100	13,100	11,100	10,000	9,000	8,300	7,690	7,380	6,870	6,150	5,640	5,130	4,720

Maximum capacity of pipe in thousands of BTU's per hour for gas pressures of 14" Inches Water Column (0.5 PSIG) or less and a total system pressure drop of 0.05 Inch Water Column (Based on NAT GAS, 1025 BTU's per Cubic Foot of Gas and 0.60 Specific Gravity).

EXAMPLE OF HIGH ALTITUDE APPLICATIONS

For example, if a unit's input is 100,000 Btu/hr at sea level, the rated input at 4000 feet of elevation can be calculated by derating input 4% per 1000 feet above sea level.

[Btu/hr Input] [1.00 - (Elevation ÷ 1000′ x 0.04)] = Btu/hr Input at Specified Elevation

[100,000] [1.00 - (4000′ ÷ 1000′ x 0.04)] = Btu/hr Input at 4000′ Elevation

[100,000] [0.84] = 84,000 Btu/hr Input at 4000′ Elevation

4. Installation of a union is suggested for ease of service.

5. Install a manual main gas shut-off valve with test plug, outside of the appliance gas connection and before the gas valve, when local codes require.

6. A trap (drip leg) should be provided in the inlet of the gas connection to the unit.

High Altitude Applications

Atmospheric pressure decreases as the height above sea level increases. At any altitude above sea level, a cubic foot will contain less gas than a cubic foot at sea level. Thus, the heating value of a cubic foot of fuel gas will decrease as height above sea level increases.

Specific gravity of a gas with respect to sea level also decreases with altitude. These changes in heating value and specific gravity tend to offset each other.

However, as elevation above sea level is increased, there is less oxygen per cubic foot of air. Therefore, heat input rate should be reduced in an appliance above 2000 feet. Ratings should be reduced at the rate of 4 percent for each 1000 feet above sea level.

(TABLE K) – INLET GAS PRESSURE

MODELS	NAT. GAS	LPG
CH401-751		
Maximum Allowable	**10.5″**	**13″**
Minimum Allowable	**4.5″**	**8″**
CH991-2071		
Maximum Allowable	**10.5″**	**13″**
Minimum Allowable	**5″**	**11″**

WATER CONNECTIONS

Inlet and Outlet Water Connections

For ease of service, install unions on inlet and outlet of the boiler.

The connection on the unit marked "Inlet" should be used for return water from the system. The connection on the header marked "Outlet" should be connected to the system supply. (See Boiler Piping Diagrams, Appendix A).

WATER VELOCITY CONTROL

IMPORTANT - To ensure proper velocity through the heat exchanger, it is necessary to regulate the temperature rise across the heat exchanger from inlet to outlet. (This **must** be done on initial installation and periodically rechecked). With the correct temperature rise across the heat exchanger (See TABLE L), you may be assured of the proper velocity in the tubes and long life and economical operation from the boiler.

***NOTE**: In Table L * indicates flows in excess of maximum flow rating for copper tube HEX. Cupronickel tube HEX are recomended for these flow rates.*

(TABLE L) – WATER FLOW REQUIREMENTS

TEMPERATURE RISE		15°F ΔT		20°F ΔT		25°F ΔT		30°F ΔT		35°F ΔT		40°F ΔT	
INPUT	OUTPUT	GPM	FT. HD	GPM	FT. HD	GPM	FT. HD	GPM	FT. HD	GPM	FT. HD	GPM	FT. HD
400,000	336,000	45	4.9	34	2.4	27	1.8	23	1.1	19	0.9	17	0.6
500,000	420,000	57	5.1	42	4.1	34	2.9	28	1.6	24	1.2	21	0.7
650,000	546,000	64*	5.7	55	5.2	44	4.1	37	3.0	32	2.3	28	1.6
750,000	630,000	-	-	64*	5.3	51	4.8	42	4.1	36	3.2	32	2.3
990,000	831,000	-	-	83	5.4	67	5.6	55	2.6	48	2.1	42	1.5
1,260,000	1,058,400	-	-	106*	8.4	86	6.9	71	4.4	61	4.0	53	2.7
1,440,000	1,209,600	-	-	-	-	100*	9.1	81	6.3	70	5.7	61	3.8
1,800,000	1,512,000	-	-	-	-	-	-	101*	10.1	87	8.3	76	6.6
2,070,000	1,738,800	-	-	-	-	-	-	-	-	97*	10.7	87	9.0

CIRCULATOR PUMP OPERATION

A pump control relay is optional on CH 401-2071 heating boilers. When designing a system to utilize primary / secondary operation, specify a pump control relay for intermittent pump operation.

WATER FLOW REQUIREMENTS and SYSTEM PIPING

Lochinvar boilers are generally capable of operating within the design flow rates for the building heating system. To ensure the most efficient operation, a boiler needs adequate water flow. Pump sizing, pipe sizing, and piping layout **must** be taken into consideration for proper system flow.

(Table L) provides Gallons Per Minute and boiler head-loss at various temperature rises for each boiler based on Btu/hr input. (Table M) provides maximum and minimum flow data for each model. These two charts will provide assistance in system flow design.

(TABLE M) – MINIMUM & MAXIMUM BOILER FLOW RATES

MODEL NUMBER	MINIMUM FLOW (GPM)*	MAXIMUM FLOW (GPM)
CH401	17	60
CH501	21	60
CH651	28	60
CH751	32	60
CH991	33	90
CH1261	42	90
CH1441	48	90
CH1801	61	90
CH2071	70	90

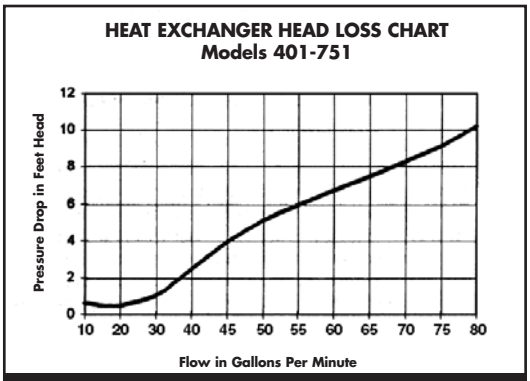
**Flow switch requires 20 GPM to allow boiler operation.*

Variable Speed System Pump

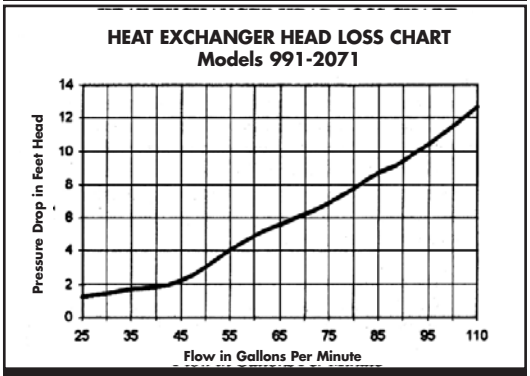
High efficiency boilers require minimum flow rates through the heat exchangers to operate safely and efficiently. A variable speed pump that reduces the flow rate, in the main system piping loop, below the minimum requirements of the total boiler system **must** not be installed.

Primary/Secondary Piping

Using a primary/secondary piping arrangement can solve many system flow complications.



(FIG. 17) BOILER HEAD LOSS CH 401-751



(FIG. 18) BOILER HEAD LOSS CH 991-2071

This piping arrangement uses a dedicated pump to supply flow to the boiler. The pump is sized based on the required boiler flow rate, boiler head-loss and head-loss in the secondary system piping. A separate pump is used to provide the desired flow for the system. Primary/Secondary piping allows the system and the boiler(s) to operate at their optimum flow rate. The system works best when the boiler(s) are supplied with pump control relays which are used to cycle the

IMPORTANT!

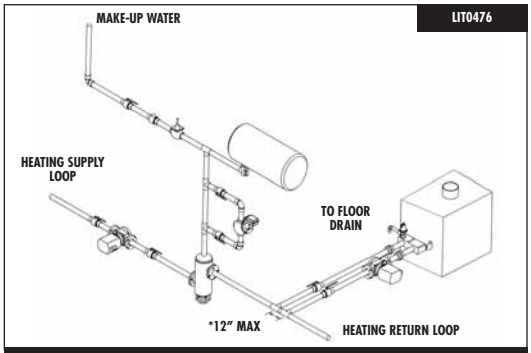
EXAMPLE OF VARIABLE SPEED PUMP REQUIREMENTS:

4 - CHN2071 (Min. Flow = 70 GPM)

The combined "minimum" flow for the boiler system is 70 GPM x 4 = 280 GPM. A variable speed pump must not reduce the system flow rate below 280 GPM.

IMPORTANT: Operation of this boiler on low temperature systems requires special piping to insure correct operation. Consult low temperature system section for piping details.

secondary pump(s). When piped correctly, the secondary pump helps to prevent flow through the boiler(s) when they are not firing. Use of a primary/secondary system will eliminate the need for a System or Boiler Bypass. (Figure 19) depicts one example of primary/secondary piping.



(FIG. 19) PRIMARY/SECONDARY SYSTEM PIPING

Water Flow Switch

Due to the low water content (between 1 and 6 gallons) of the Copper Finned Tube heat exchanger, a flow switch is factory installed as a low water cutoff device on all models. The flow switch is installed in the outlet piping of the boiler and wired into the ignition system. A minimum of 20 GPM is required to make the flow switch. Per ASME CSD1 and in most localities, a flow switch is accepted as a low water cutoff for boilers requiring forced circulation. (See CSD1 CW-210) It is prudent to verify preference with the local code official.

A specially sealed flow switch and conduit are furnished for outdoor installations.

Low Water Cutoff

If this boiler is installed above radiation level, a low water cutoff device **must** be installed at the time of boiler installation (option, available from factory).

Relief Valve

This boiler is supplied with a pressure relief valve sized in accordance with *ASME Boiler and Pressure Vessel Code, Section IV* "Heating Boilers".

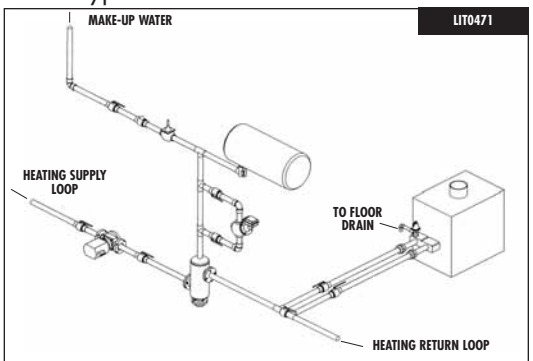
Low Flow Systems

When the system flow rate is less than the minimum flow required for proper boiler operation, the boiler should be installed with a primary/secondary piping system.

This will allow the installation of a secondary-circulating pump sized specifically to provide a higher flow rate through the boiler and the secondary loop piping to ensure proper operation. See "Primary/Secondary Piping" for installation and piping requirements.

High Flow Systems

When the flow rate of the system exceeds the maximum allowable flow rate through the boiler (Table L), boiler bypass piping should be installed. The bypass will divert the required portion of the system flow to the boiler and bypass excess system flow. This will effectively reduce boiler flow to an acceptable rate and increase system flow. The bypass piping should be sized equal to the system piping. Figure 18 depicts the proper piping arrangement for the boiler bypass.



(FIG. 20) HIGH FLOW SYSTEM PIPING

Low Water Temperature Systems

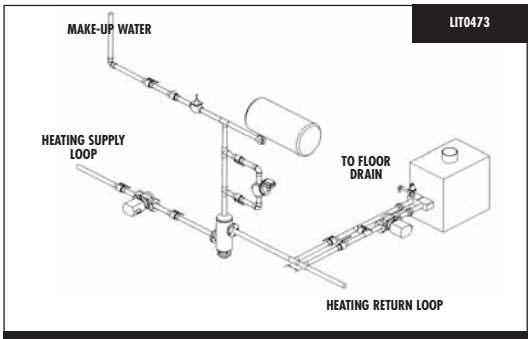
Any boiler system operating at a temperature of less than 140°F is considered a "low water temperature system" and must be piped with a low temperature bypass. There are a number of Hydronic boiler applications that call for system water temperatures in the range of 60°F to 100°F. Typical applications are: Radiant heating systems; Water source heat pump systems; Greenhouse soil heating and irrigation systems; Process and manufacturing operations. These installations often incur problems resulting from boiler condensation, thermal stresses and poor overall system efficiency. Copper-tube boilers are particularly adaptable to these applications for several reasons:

1. A copper-tube boiler is an instantaneous boiler, requiring virtually no heat-up time, and having no temperature "overshoot." Result - High system efficiency.

2. The boiler's unique construction prevents the transfer of heat exchanger thermal stresses to other boiler components, reducing wear and tear while increasing equipment life.

3. Its compact, simple design and low boiler mass permits a simple bypass arrangement which will allow the system to be operated at any temperature above 60°F.

A boiler operated with an inlet temperature of less than 140°F (60°C) must have a bypass to prevent problems with condensation.



(FIG. 21) LOW TEMPERATURE BYPASS SYSTEM PIPING

A Low Temperature bypass as shown in Figure 21 must be piped into all ON/OFF boilers at the time of installation. This piping is like a primary/secondary boiler installation with a bypass in the secondary boiler piping. Inlet water temperatures below 140°F (60°C) can excessively cool the products of combustion resulting in condensation on the heat exchanger and in the flue. The bypass allows part of the boiler discharge water to be mixed with the cooler boiler return water to increase the boiler inlet temperature to at least 140°F (60°C). This will prevent the products of combustion from condensing in most installations. Size Low Temperature bypass piping equal to system piping, and use fully ported control valves.

To prevent system return water temperature below 140° F from entering the inlet in a proportional stage-fired boiler, a quick acting, self contained, 3-way valve, set at 140°F, or an electric actuated 3-way valve with a sensor located on the boiler inlet pipe **must be** provided. To prevent manual reset high limit problems, 3-way valve minimum flow stops or a valve leak-through should be evaluated. The installation of a 3-way valve

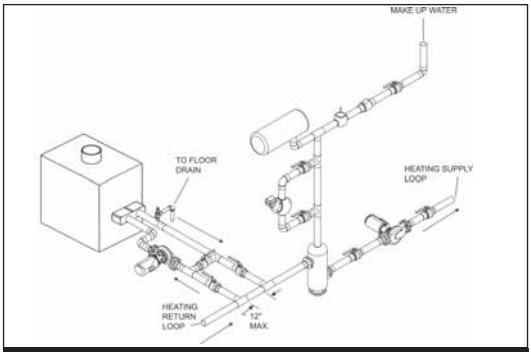
IMPORTANT!

An ON/OFF boiler may be protected with either a manual bypass valve or a 3-way valve, but a proportional stage-fired boiler MUST be protected with a 3-way valve ONLY.

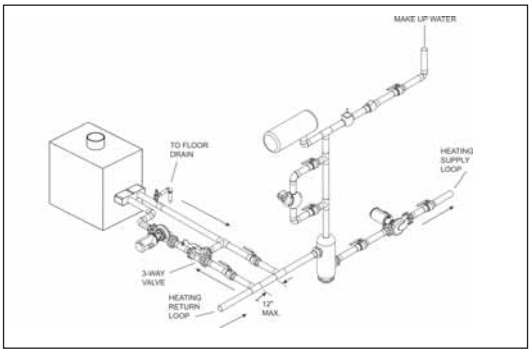
CAUTION!

For proper operation the system should not be operated at less than 12 PSIG.

in the piping system as shown in Figure 22 should not restrict or vary the water flow through the boiler. Constant water flow through the boiler must be provided at all times when the boiler is operating. The boiler's operating temperature sensor can be remote mounted in a bulb well installed in the system water flow to control boiler operation at a low temperature range.



(FIG. 22) LOW TEMPERATURE BYPASS SYSTEM PIPING ON/OFF FIRING ONLY

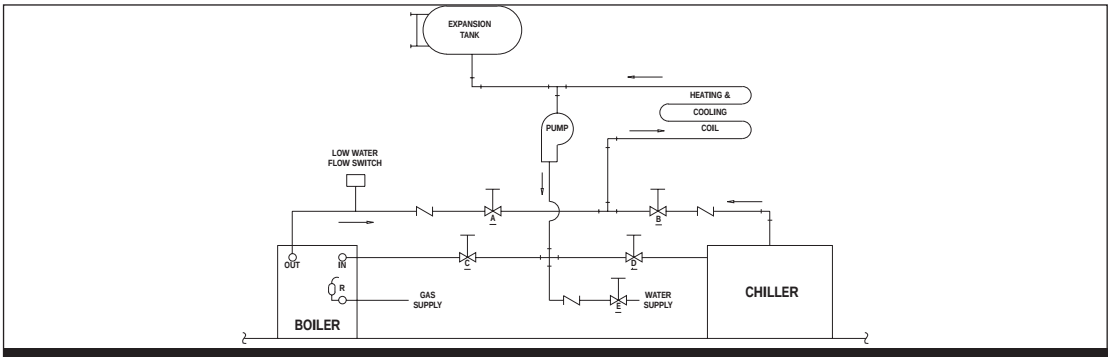


(FIG. 23) LOW TEMPERATURE BYPASS SYSTEM PIPING PROPORTIONAL STAGED-FIRING

SPECIAL DESIGN APPLICATIONS

Air Conditioning Re-Heat System

When used in connection with a refrigeration system, the boiler **must** be installed so the chilled medium is piped in parallel with the boiler and with appropriate valves to prevent the chilled medium from entering the boiler. The piping system of the hot water boiler (when connected to heating coils located in air handling units where they may be exposed to refrigerated air circulation) **must** be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle. The heating coil **must** be vented at the high point, and the hot water from the boiler **must** enter the coil at this point. Due to the fast heating capacity of the boiler, it is not necessary to provide a duct-stat to delay circulator operation; also, omit thermal flow checks, as the boiler is cold when the heating thermostat is satisfied. This provides greater economy overall by maintaining standby heat.



(FIG. 24) HEATING/CHILLED WATER SYSTEM

AIR REMOVAL

An air separation device should be placed in the installation piping, on the suction side of the system pump, to eliminate trapped air in the system. Locate a system air vent at the highest point in the system. Additionally, a properly sized expansion tank is required. Air charged, diaphragm-type compression tanks are common. The expansion tank **must** be installed close to the boiler and on the suction side of the system pump to ensure proper operation.

TEMPERATURE/PRESSURE GAUGE

This boiler is equipped with a dial type temperature/pressure gauge. This gauge is factory installed in the outlet side of the heat exchanger. The gauge has one scale for reading system pressure and a separate scale for water temperature in degrees Fahrenheit.

LOW SYSTEM WATER VOLUME

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

A Buffer Tank is an effective way to enhance a small system load and increase heating system efficiency. Buffer tanks add water volume to the system and act as a flywheel to absorb the additional Btu's provided by the boiler when only a single zone of a large system is calling for heat.

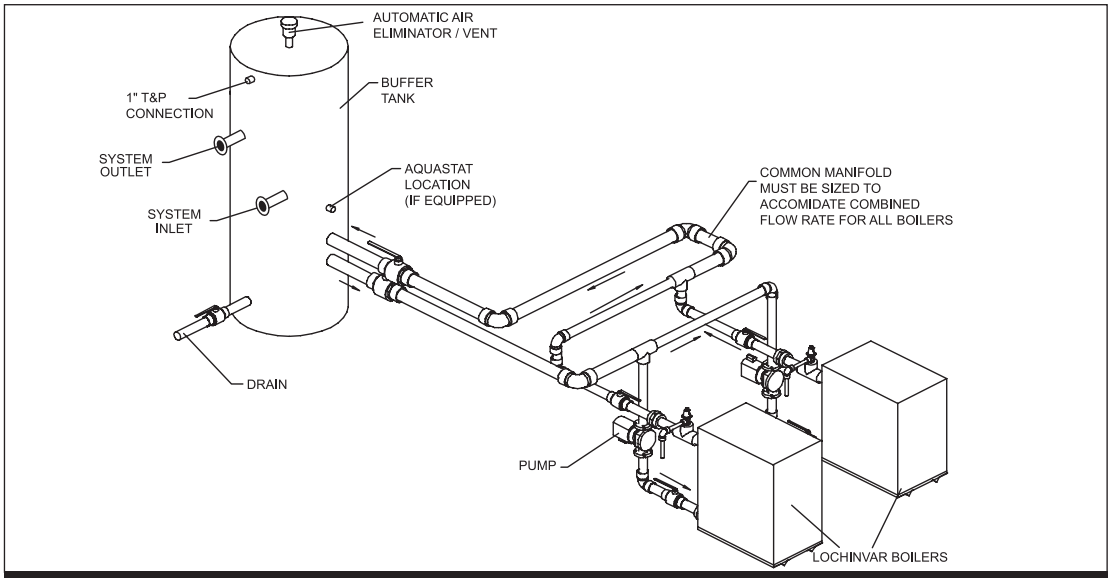
To calculate the proper buffer tank size for a multiple zone system:

$$\frac{\text{(Run Cycle) (Output - Minimum System Load)}}{\text{(Temp. Rise) (8.33)(60 Min.)}}$$

EXAMPLE OF BUFFER TANK APPLICATIONS

CHN1261 Boiler
Run Cycle = 10 Min.
Temp. Rise = 10°F
Min. Load = 100,000Btu/hr

(10)(1,000,000 - 100,000)
divided by
40 x 8.33 x 60
= 485 Gallons



(FIG. 25) BUFFER TANK PIPING

NOTE:
When the unit is installed in Canada, it MUST conform to the CAE C22.1, Canadian Electrical Code, Part 1 and/or local Electrical Codes.

BOILER OPERATING TEMPERATURE CONTROL

In the absence of a remote temperature control, a digital operator controls the boiler operating temperature. The sensing element for the operator is placed in a bulb well, installed in the inlet side of the heat exchanger front header. Due to the location of the temperature sensor, the operator will generally require a lower temperature setpoint to achieve the desired discharge water temperature from the boiler. This sensing element location allows a boiler operating with a low to moderate flow rate to sustain longer burner "ON" cycles, based on high discharge water temperatures.

For example, a boiler operating with a 180°F discharge and a 20°F temperature rise would require approximately a 160°F to 165°F set point with the temperature sensor installed on the inlet side of the heat exchanger. The exact temperature set point is based on system requirements.

REMOTE TEMPERATURE CONTROL, CONNECTION TO TERMINAL STRIP

A remote temperature control may be connected to the boiler. The boiler is equipped with a terminal strip to allow easy connection. Connection to the terminal strip will allow the remote temperature control to make and break the 24 VAC boiler control circuit, turning the boiler on and off based on building and system demands.

ELECTRICAL REQUIREMENTS

(North America)

1. The appliance is wired for 120 volts.

2. All wiring between the unit and field installed devices shall be made of type T wire [63°F (35°C) rise].

3. The pump **must** run continuously when the unit is firing.

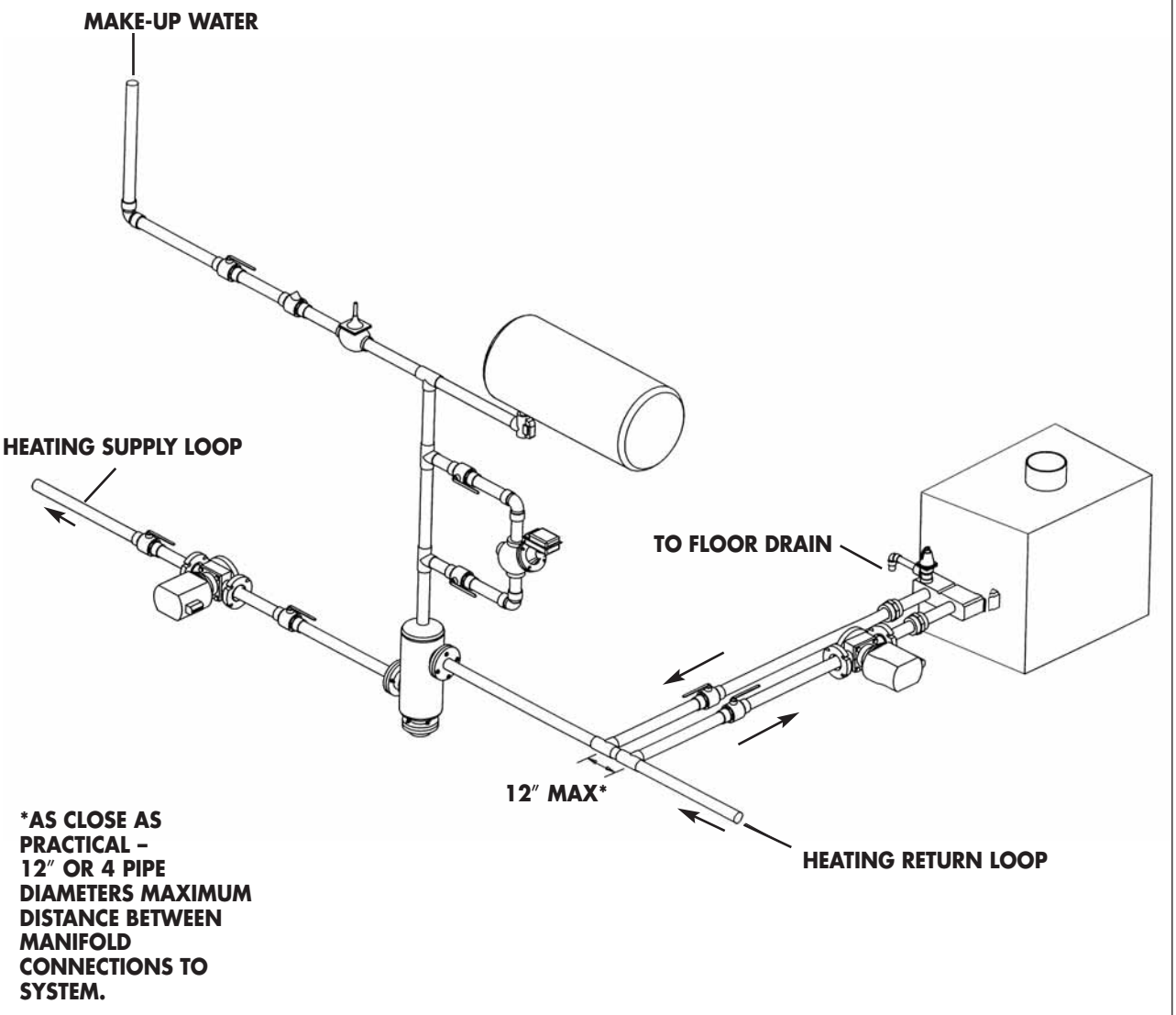
It is recommended that the boiler and pump be wired on separate circuits with

(TABLE N) – AMP DRAW DATA

MODEL NUMBER	FAN(S)	CONTROLS	APPRX. TOTAL AMPS @ 120 VAC
CH401	3.6	2.7	6.3
CH501	3.6	2.7	6.3
CH651	5.4	3.4	8.8
CH751	5.4	3.4	8.8
CH991	3.2	7.2	10.4
CH1261	3.2	7.2	10.4
CH1441	6.7	7.2	13.9
CH1801	6.7	7.2	13.9
CH2071	6.7	7.2	13.9

BOILER PIPING DIAGRAMS

PIPING DIAGRAM — PRIMARY/SECONDARY BOILER PIPING

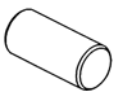
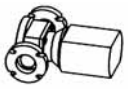


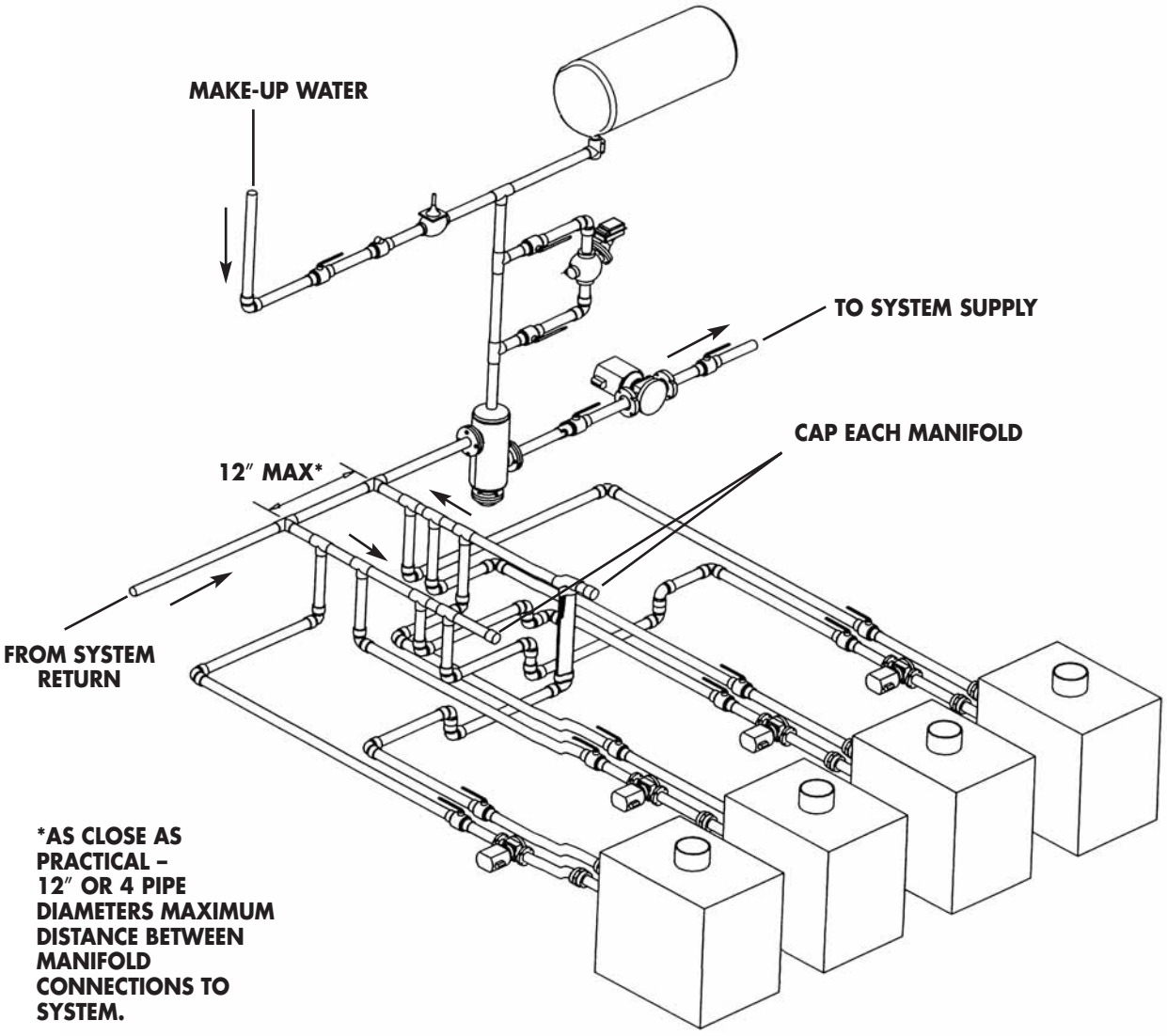
***AS CLOSE AS PRACTICAL – 12″ OR 4 PIPE DIAMETERS MAXIMUM DISTANCE BETWEEN MANIFOLD CONNECTIONS TO SYSTEM.**

This illustration is for concept only and should not be used for any actual installation without engineering or technical advice from a licensed engineer. All necessary equipment may not be illustrated.

LIT0476

LEGEND

 PRESSURE REDUCING VALVE	 FULL PORT BALL VALVE	 RELIEF VALVE	 CHECK VALVE	 TEE	 ELBOW
 EXPANSION TANK	 TANK FITTING	 SYSTEM PUMP	 LOW WATER CUTOFF	 UNION	 AIR SEPARATOR

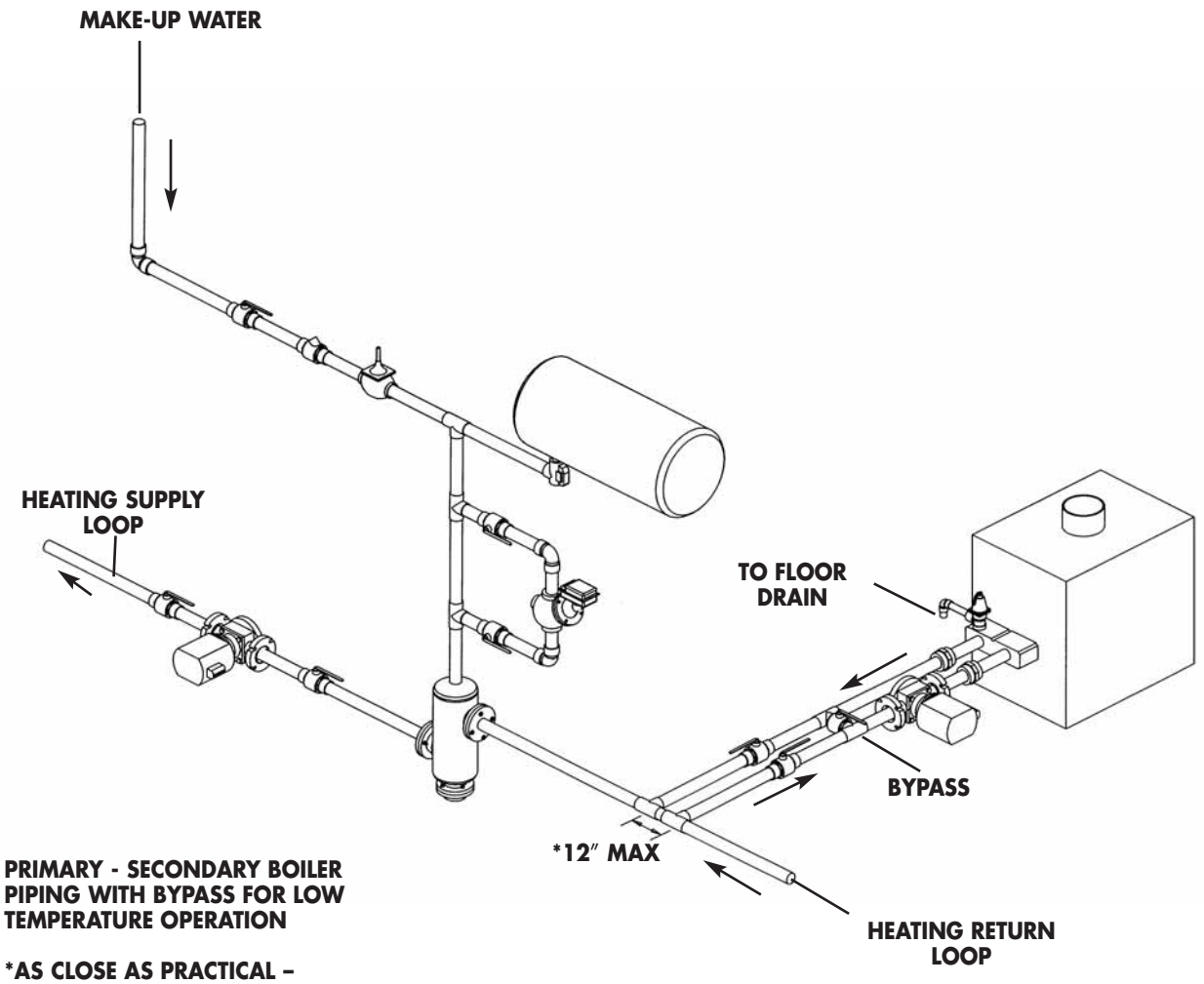


This illustration is for concept only and should not be used for any actual installation without engineering or technical advice from a licensed engineer. All necessary equipment may not be illustrated.

LIT0475

LEGEND

PRESSURE REDUCING VALVE	FULL PORT BALL VALVE	RELIEF VALVE	CHECK VALVE	TEE	ELBOW
EXPANSION TANK	TANK FITTING	SYSTEM PUMP	LOW WATER CUTOFF	UNION	AIR SEPARATOR



PRIMARY - SECONDARY BOILER PIPING WITH BYPASS FOR LOW TEMPERATURE OPERATION

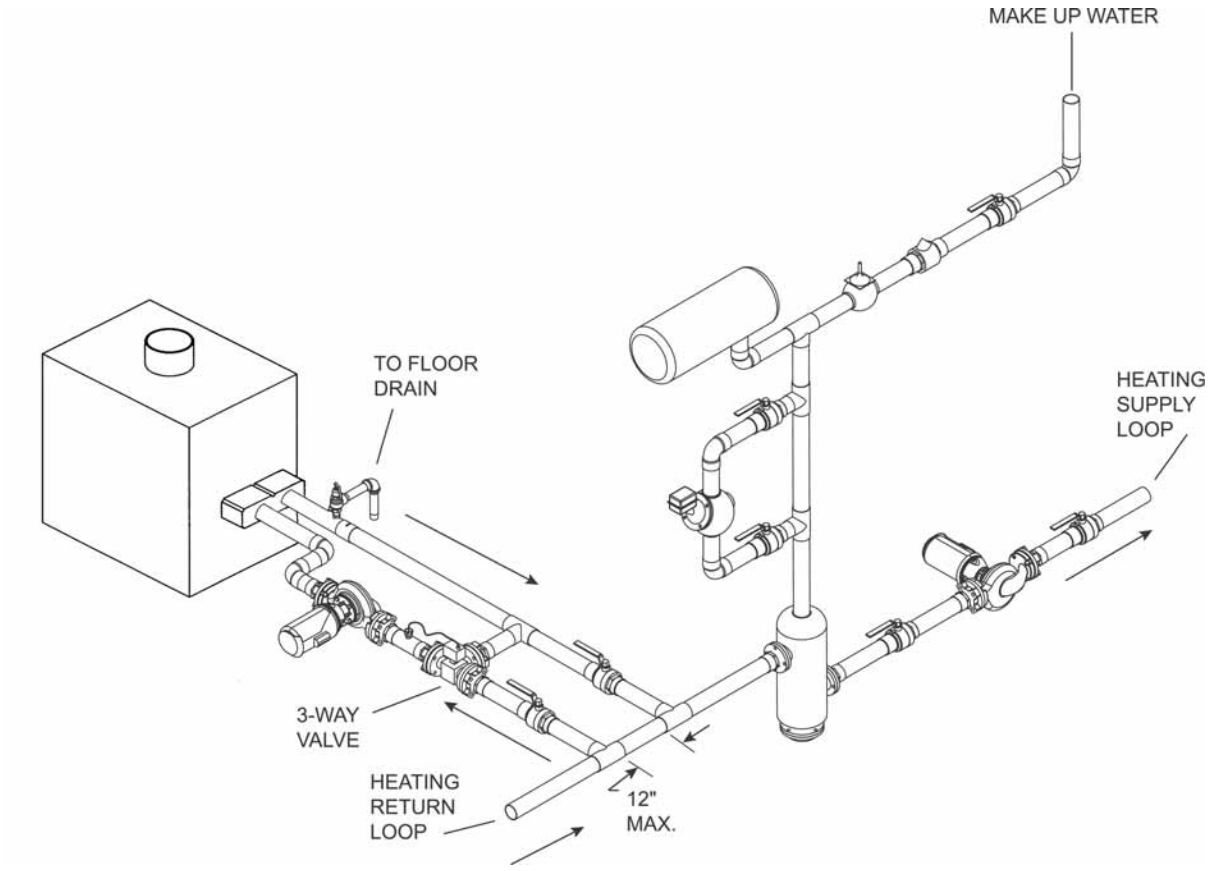
***AS CLOSE AS PRACTICAL – 12″ OR 4 PIPE DIAMETERS MAXIMUM DISTANCE BETWEEN MANIFOLD CONNECTIONS TO SYSTEM.**

This illustration is for concept only and should not be used for any actual installation without engineering or technical advice from a licensed engineer. All necessary equipment may not be illustrated.

LIT0473

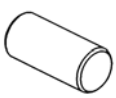
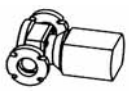
LEGEND

PRESSURE REDUCING VALVE	FULL PORT BALL VALVE	RELIEF VALVE	CHECK VALVE	TEE	ELBOW
EXPANSION TANK	TANK FITTING	SYSTEM PUMP	LOW WATER CUTOFF	UNION	AIR SEPARATOR



This illustration is for concept only and should not be used for any actual installation without engineering or technical advice from a licensed engineer. All necessary equipment may not be illustrated.

L E G E N D

 **PRESSURE REDUCING VALVE**	 **FULL PORT BALL VALVE**	 **RELIEF VALVE**	 **CHECK VALVE**	 **TEE**	 **ELBOW**
 **EXPANSION TANK**	 **TANK FITTING**	 **SYSTEM PUMP**	 **LOW WATER CUTOFF**	 **UNION**	 **AIR SEPARATOR**

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