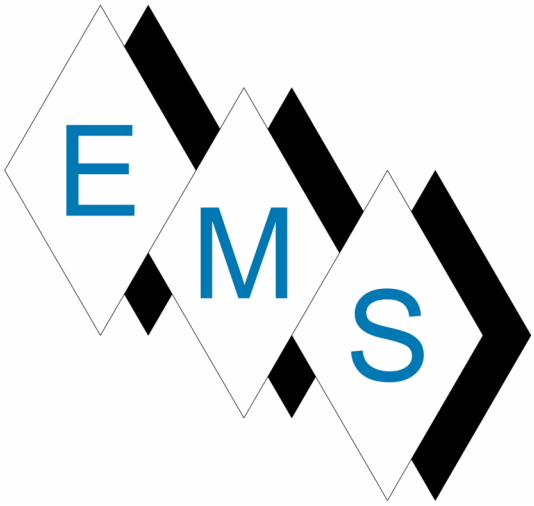
QUINNIPIAC CATHOLIC CENTER

O&M DOCUMENTS
Job 4666



Eastern Mechanical Services, Inc.
3 Starr Street
Danbury, CT 06810
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Installation, Operation and Maintenance Manuals

Job Title: **Quinnipiac Univ Catholic Center**

Job Site: Quinnipiac Univ Catholic Center
385 New Rd

Hamden, CT 06518
United States

Customer PO#: 4666-7
Engineer: Q, G & L
Contractor: Eastern Mechanical Services
Elevation: (ft) 20
Date: 7/31/2017
Submitted By: Thomas Sparks
Agent Order#: N41021

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Quinnipiac Univ Catholic Center

Product IOMs

Mark Name	Model Name
ERV-1	ECV
Hood	GRRS

GREENHECK
Building Value in Air.

Document 480955
Model ECV
Energy Core Ventilator

Installation, Operation and Maintenance Manual

Please read and save these instructions for future reference. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage!

General Safety Information

Only qualified personnel should install this system. Personnel should have a clear understanding of these instructions and should be aware of general safety precautions. Improper installation can result in electric shock, possible injury due to coming in contact with moving parts, as well as other potential hazards. Other considerations may be required if high winds or seismic activity are present. If more information is needed, contact a licensed professional engineer before moving forward.

DANGER
Always disconnect power before working on or near this equipment. Lock and tag the disconnect switch or breaker to prevent accidental power up.
CAUTION
When servicing the unit, the internal components may be hot enough to cause pain or injury. Allow time for cooling before servicing.
CAUTION
Precaution should be taken in explosive atmospheres.

1. Follow all local electrical and safety codes, as well as the National Electrical Code (NEC), the National Fire Protection Agency (NFPA), where applicable. Follow the Canadian Electrical Code (CEC) in Canada.
2. All moving parts must be free to rotate without striking or rubbing any stationary objects.
3. Unit must be securely and adequately grounded.
4. Do not spin fan wheel faster than maximum cataloged fan RPM. Adjustments to fan speed significantly effects motor load. If the fan RPM is changed, the motor current should be checked to make sure it is not exceeding the motor nameplate amps.
5. Do not allow the power cable to kink or come in contact with oil, grease, hot surfaces or chemicals. Replace cord immediately if damaged.
6. Verify that the power source is compatible with the equipment.
7. Never open access doors to the unit while it is running.

Receiving

Upon receiving the product, check to ensure all items are accounted for by referencing the delivery receipt or packing list. Inspect each crate or carton for shipping damage before accepting delivery. Alert the carrier of any damage detected. The customer will make a notation of damage (or shortage of items) on the delivery receipt and all copies of the bill of lading which is countersigned by the delivering carrier. If damaged, immediately contact your Greenheck Representative. Any physical damage to the unit after acceptance is not the responsibility of Greenheck Fan Corporation.

Unpacking

Verify that all required parts and the correct quantity of each item have been received. If any items are missing, report shortages to your local representative to arrange for obtaining missing parts. Sometimes it is not possible that all items for the unit be shipped together due to availability of transportation and truck space. Confirmation of shipment(s) must be limited to only items on the bill of lading.

Handling

Units are to be rigged and moved by the lifting brackets provided or by the skid when a forklift is used. Location of brackets varies by model and size. Handle each piece in such a manner as to keep from scratching or chipping the coating. Damaged finish may reduce ability of the unit to resist corrosion.

Storage

Units are protected against damage during shipment. If the unit cannot be installed and operated immediately, precautions need to be taken to prevent deterioration of the unit during storage. The user assumes responsibility of the unit and accessories while in storage. The manufacturer will not be responsible for damage during storage. These suggestions are provided solely as a convenience to the user.

Inspection and Maintenance during Storage

While in storage, inspect units once per month. Keep a record of inspection and maintenance performed

If moisture or dirt accumulations are found on parts, the source should be located and eliminated. At each inspection, rotate all moving components by hand ten to fifteen revolutions to distribute lubricant on motor and bearings. If paint deterioration begins, consideration should be given to touch-up or repainting. Units with special coatings may require special techniques for touch-up or repair.

Machined parts coated with rust preventive should be restored to good condition promptly if signs of rust occur. Immediately remove the original rust preventive coating with petroleum solvent and clean with lint-free cloths. Polish any remaining rust from surface with crocus cloth or fine emery paper and oil. Do not destroy the continuity of the surfaces. Wipe clean thoroughly with Tectyl® 506 (Ashland Inc.) or the equivalent. For hard to reach internal surfaces or for occasional use, consider using Tectyl® 511M Rust Preventive or WD-40® or the equivalent.

Table of Contents

Product Overview

The ECV brings in fresh, outdoor air and removes stale, exhaust air. Prior to discharging the exhaust air, the energy recovery core transfers energy from the exhaust air to the outdoor air at an efficiency of 50-60%. Simply put, this unit preconditions the outdoor air to save money on heating and cooling costs.

Standard Components

Outdoor Air Weatherhood

Outdoor air weatherhood will be factory-mounted.

Exhaust Weatherhood

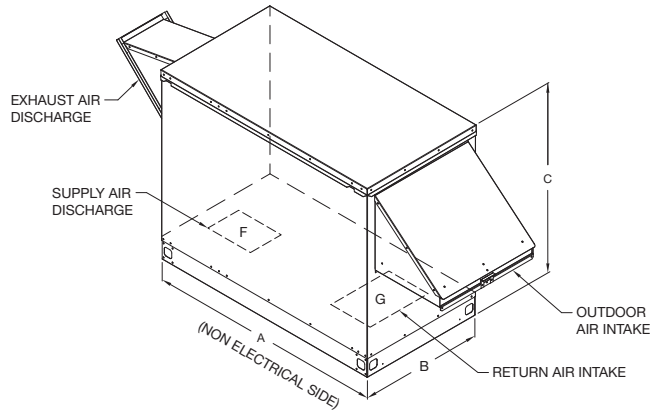
The exhaust weatherhood is shipped separately as a kit with its own instructions.

Dampers

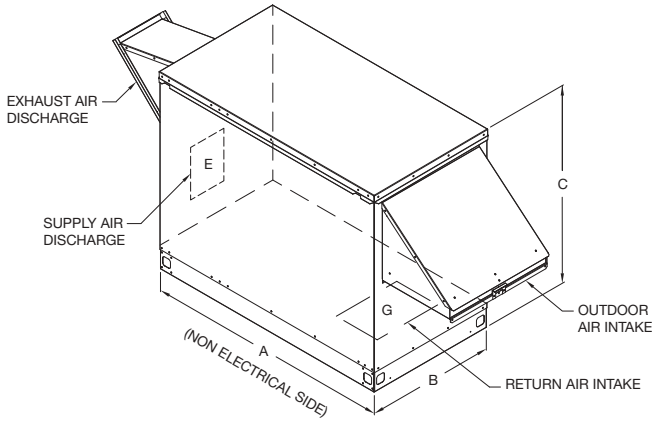
Backdraft dampers are always included as an integral part of the exhaust hood assemblies. Motorized outdoor air and exhaust air dampers are optional and are factory-mounted and wired at the intake.

Installation

Outdoor Mounting Options

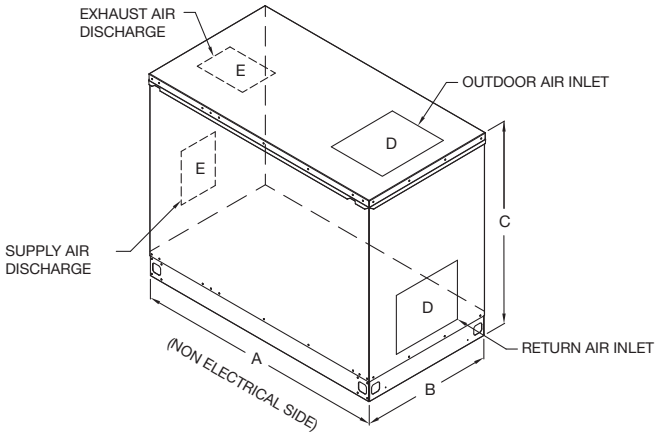


Outdoor Air Discharge Bottom

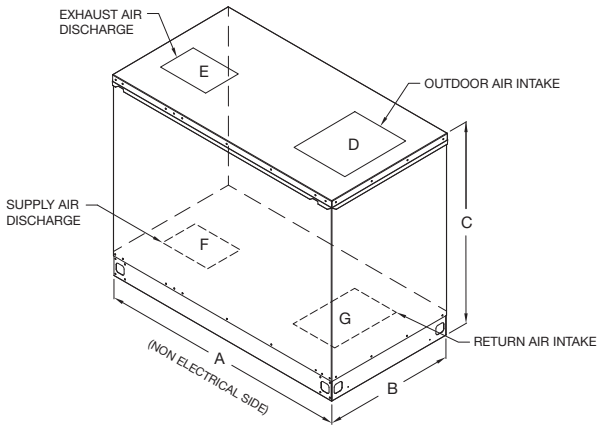


Outdoor Air Discharge End

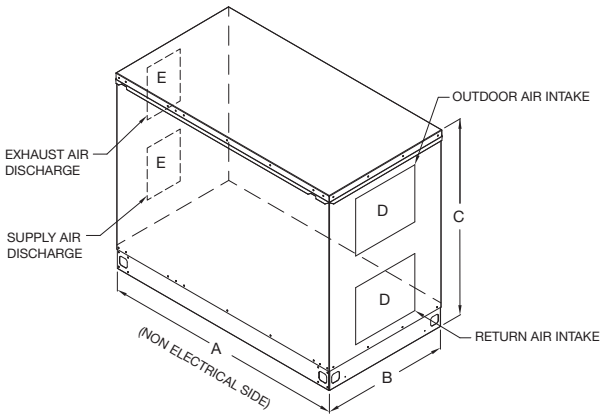
Indoor Mounting Options



Top and End Connections



Top and Bottom Connections



End Connections

	Intake and Discharge Options			
	Bottom	Top	Side	End
OA Intake		X		X
SA Discharge	X			X
RA Intake	X			X
EA Discharge		X		X

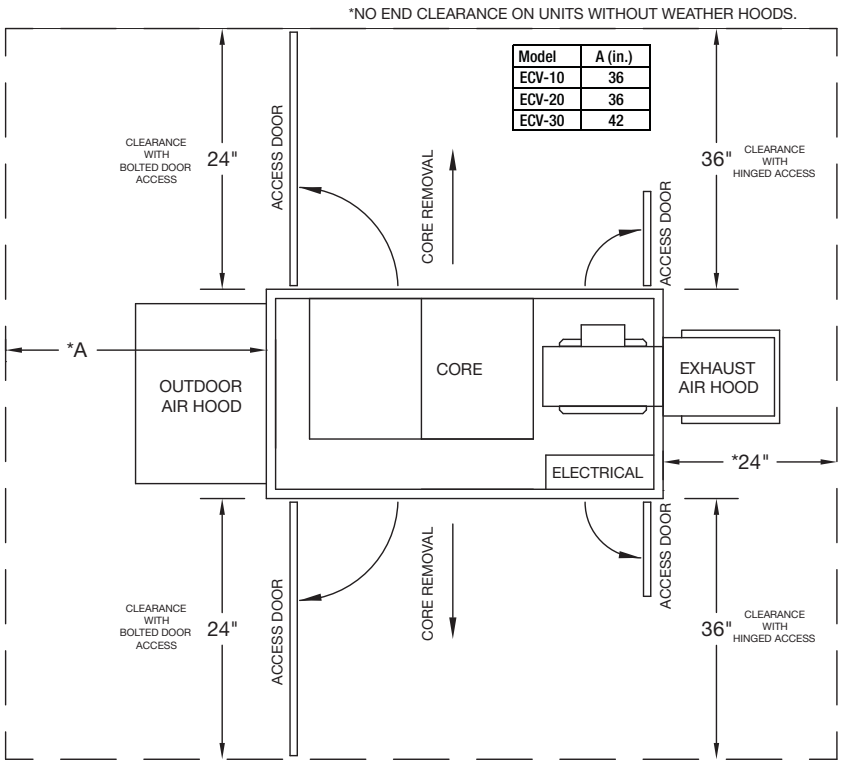
Dimensional Data and Weights

Unit Size	Exterior Dimensions			Unit Connection Dimensions				Approx. Weight* (lbs.)
	A	B	C	D	E	F	G	
ECV-10	54.8	28.9	43.9	18.4 x 15.9	13.6 x 13.6	8.5 x 11.6	16.5 x 11.5	485
ECV-20	65	43.9	56.9	31.2 x 19.2	13.6 x 13.6	11 x 14	30.5 x 17.2	816
ECV-30	69	61.4	60.7	43.2 x 18.2	20 x 20	16 x 13.8	41 x 15.7	1286

All dimensions are in inches. *Weight assumes outdoor unit with filters, weatherhoods, outdoor air intake damper, controls and internal double-wall sheet metal.

Service Clearances

The ECV unit requires minimum clearances to perform routine maintenance, such as filter replacement and energy core inspection. Blower and motor assemblies, energy recovery core and filter sections are always provided with a service door or panel for proper component access. ***Clearances for component removal may be greater than the service clearances, refer to drawing below for these dimensions.***



Recommended Service Clearances								
Unit Size	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**
ECV-10	102.9	120.8	35.5	28.9	22	36	54.8	30
ECV-20	114.9	131	35.5	43.9	22	36	65	30
ECV-30	132.4	145	35.5	61.4	22	44	69	32

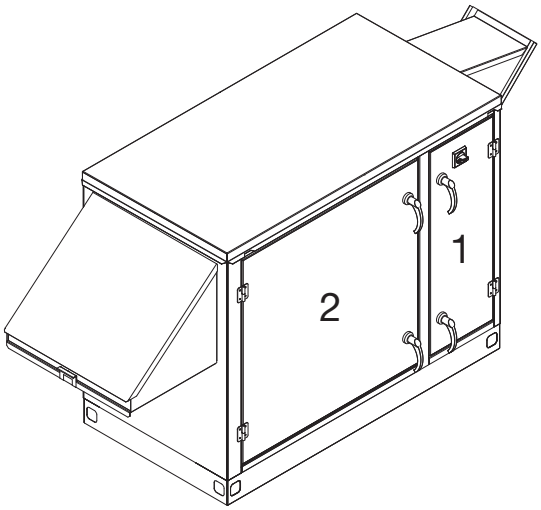
All dimensions are in inches.

NOTE

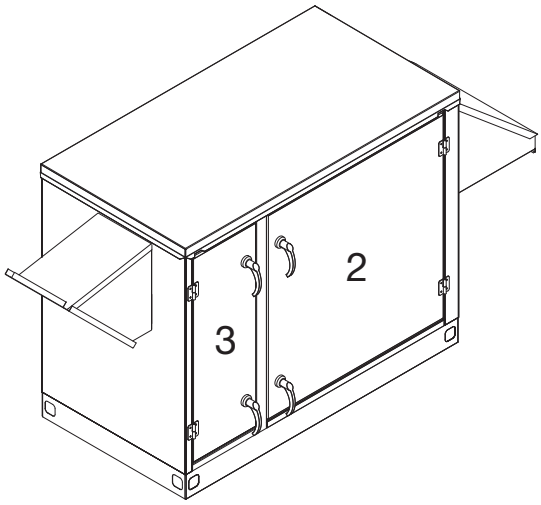
If top/bottom connections are selected, the F and H clearances can be disregarded.

Access Panel Locations

The ECV is provided with access panels on both sides of the unit. **The non electrical side can be placed against a wall. Clearance to the electrical side is essential to provide access to the control center and component maintenance.**



Electrical Side



Non Electrical Side

1	Control Center
2	Core Filters Inlet Dampers Bypass Damper Blowers
3	Blowers

Handling

While this unit was constructed with quality and dependability in mind, damage still may occur during handling of the unit for installation.

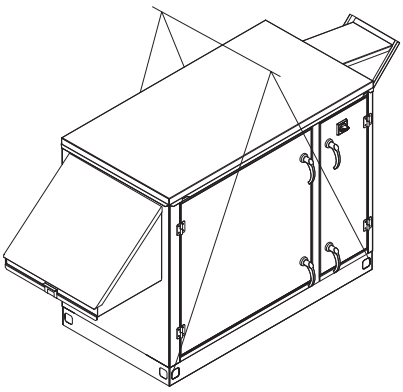
The system design and installation should follow accepted industry practice, such as described in the ASHRAE Handbook. Adequate space should be left around the unit for filter replacement and maintenance. Sufficient space should be provided on the side of the unit for routine service and component removal should that become necessary.

Lifting

WARNING

All factory provided lifting lugs must be used when lifting the unit. Failure to comply with this safety precaution could result in property damage, serious injury or death.

1. Before lifting, be sure that all shipping material has been removed from unit.
2. To assist in determining rigging requirements, weights are shown under the Dimensional Data and Weights section.
3. Unit must be lifted by all lifting lugs provided on base structure.



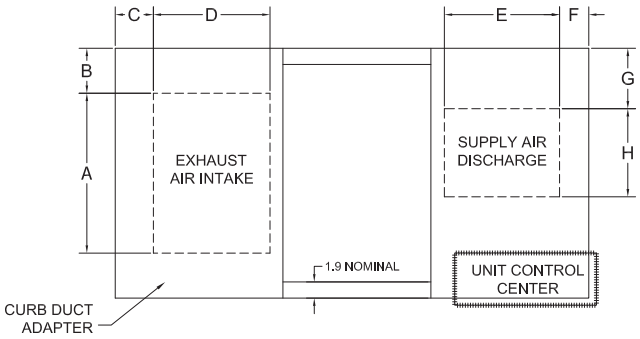
4. Rigger to use suitable mating hardware to attach to unit lifting lugs.
5. Spreader bar(s) must span the unit to prevent damage to the cabinet by the lift cables.
6. Always test-lift the unit to check for proper balance and rigging before hoisting to desired location.
7. Never lift units by weatherhoods.
8. Never lift units in windy conditions.
9. Preparation of curb and roof openings should be completed prior to lifting unit to the roof.
10. Check to be sure that gasketing (supplied by others) has been applied to the curb prior to lifting the unit and setting on curb.
11. Do not use fork lifts for handling unit.

Recommended Roof Openings

Position the unit roof opening such that the supply discharge and return inlet of the unit will line up with the corresponding ductwork. Be sure to allow for the recommended service clearances when positioning opening (see Service Clearances). Do not face the outdoor air intake of the unit into prevailing wind and keep the intake away from any other exhaust fans. Likewise, position the exhaust discharge opening away from outdoor air intakes of any other equipment.

When cutting only duct openings, cut opening 1-inch *(25 mm)* larger than duct size to allow clearance for installation. Area enclosed by roof curb must comply with clearance to combustible materials. If the roof is constructed of combustible materials, area within the roof curb must be ventilated, left open, or covered with non-combustible material which has an “R” value of at least 5. If area within curb is open, higher radiated sound levels may result.

Where the supply or warm air duct passes thru a combustible roof, a clearance of 1-inch *(25 mm)* must be maintained between the outside edges of the duct and combustible material in accordance with NFPA Standard 90A.



Unit Size	Recommended Roof Openings							
	A	B	C	D	E	F	G	H
ECV-10	18.5	3.9	3.2	13.5	13.6	2	5.6	10.5
ECV-20	32.5	4.4	2	18.2	16	3.7	14.2	13
ECV-30	43	7.2	2	16.7	15.8	2.9	19.7	18

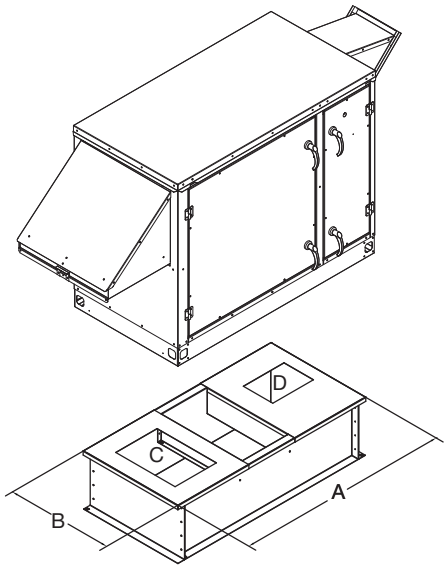
All dimensions are in inches.

Roof Curb Mounting

Rooftop units require curbs to be mounted first. The duct connections must be located so they will be clear of structural members of the building.

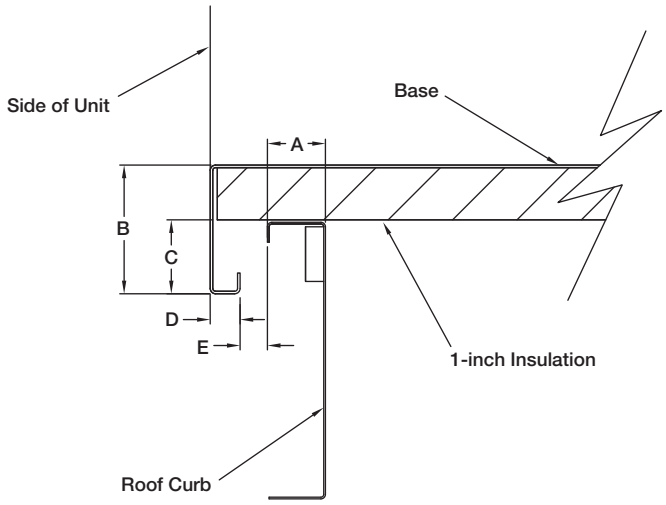
1. **Factory Supplied Roof Curbs:** Roof curbs are Model GKD. The GKD ships in a knockdown kit (includes duct adapter) and requires field assembly (by others). Assembly instructions are included.
2. **Install Curb:** Locate curb over roof opening and fasten in place. (Refer to Recommended Roof Openings). Check that the diagonal dimensions are within ±1/8 inch of each other and adjust as necessary. For proper unit operation, it is important that the installation be level. Shim as required to level.
3. **Install Ductwork:** Installation of all ducts should be done in accordance with SMACNA and AMCA guidelines. Duct adapter provided to support ducts prior to setting the unit.
4. **Set the Unit:** Lift unit to a point directly above the curb and duct openings. Guide unit while lowering to align with duct openings. Roof curbs fit inside the unit base. Make sure the unit is properly seated on the curb and is level.

Curb Outside Dimensions and Weights



Unit Size	A	B	C	D	Curb Weight (lbs.)
ECV-10	52.2	26.3	16.5 x 11.5	8.5 x 11.6	60
ECV-20	62.5	41.3	30.5 x 17.2	11 x 14	80
ECV-30	65	57.4	41 x 15.7	16x x13.8	106

All dimensions are in inches. Weight is for 14-inch high model GKD curbs.



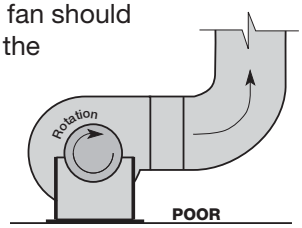
Curb Cap Details for Factory-Supplied Roof Curbs

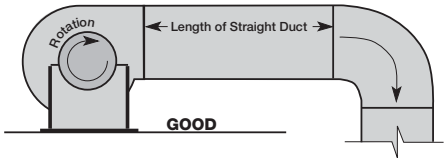
Unit Size	A	B	C	D	E
ECV-10	1.9	5.3	4.3	0.8	0.5
ECV-20	1.9	5.3	4.3	0.8	0.5
ECV-30	1.9	5.3	4.3	0.8	0.5

All dimensions are in inches.

Ductwork Connections

Examples of poor and good fan-to-duct connections are shown. Airflow out of the fan should be directed straight or curve the same direction as the fan wheel rotates. Poor duct installation will result in low airflow and other system effects.



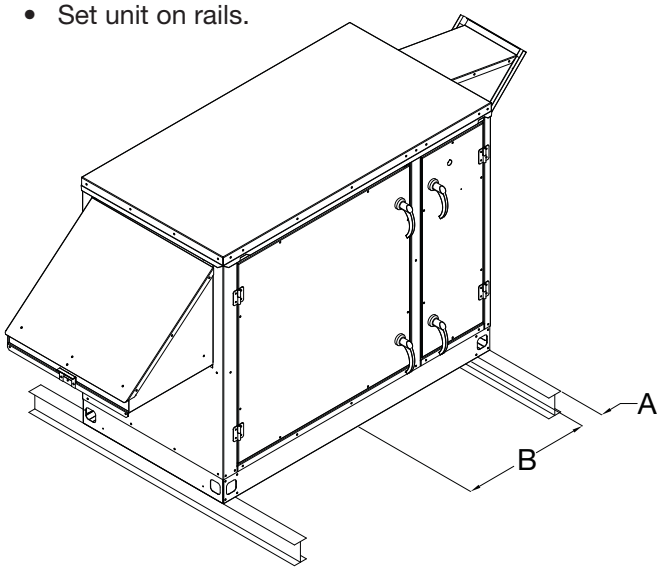


Recommended Discharge Duct Size and Length				
Unit Size	Blower Size (dia.-width)		Duct Size (in.)	Straight Duct Length (ft.)
ECV-10	10-6		14 x 14	35
ECV-20	10-6		14 x 14	35
ECV-30	12-8	12-12	20 x 20	50

- Recommended duct sizes are based on velocities across the cfm range of each model at approximately 800 feet per minute (FPM) at minimum airflow and up to 1600 fpm at maximum airflow. Recommended duct sizes are only intended to be a guide and may not satisfy the requirements of the project. Refer to plans for appropriate job specific duct size and/or velocity limitations.
- Straight duct lengths were calculated based on 100% effective duct length requirements as prescribed in AMCA Publication 201. Calculated values have been rounded up to nearest foot.

Rail Mounting / Layout

- Rails designed to handle the weight of the unit should be positioned as shown on the diagram (rails by others).
- Make sure that rail positioning does not interfere with the supply air discharge opening or the exhaust air intake opening on the unit. Avoid area dimensioned “B” below.
- Rails should extend beyond the unit a minimum of 12 inches on each side.
- Set unit on rails.



Unit Size	A	B
ECV-10	4.2	11.5
ECV-20	5	15
ECV-30	2.9	13.8

All dimensions are in inches.

Electrical Information

The unit must be electrically grounded in accordance with the current National Electrical Code, ANSI/NFPA 70. In Canada, use current CSA Standard C22.1, Canadian Electrical Code, Part 1. In addition, the installer should be aware of any local ordinances or electrical company requirements that might apply. System power wiring must be properly fused and conform to the local and national electrical codes. System power wiring is to the unit main disconnect (door interlocking disconnect switch standard on most units) or distribution block and must be compatible with the ratings on the nameplate: supply power voltage, phase, and amperage (Minimum Circuit Amps - MCA, Maximum Overcurrent Protection - MOP). All wiring beyond this point has been done by the manufacturer and cannot be modified without affecting the unit's agency / safety certification.

If field installing an additional disconnect switch, it is recommended that there be at least four feet of service room between the switch and system access panels. When providing or replacing fuses in a fusible disconnect, use dual element time delay fuses and size according to the rating plate.

If power supply is desired through bottom of unit, run the wiring through the curb, cut a hole in the cabinet bottom, and wire to the disconnect switch. Seal penetration in cabinet bottom to prevent leakage.

The electric supply to the unit must meet stringent requirements for the system to operate properly. Voltage supply and voltage imbalance between phases should be within the following tolerances. If the power is not within these voltage tolerances, contact the power company prior to operating the system.

Voltage Supply: See voltage use range on the rating plate. Measure and record each supply leg voltage at all line disconnect switches. Readings must fall within the allowable range on the rating plate.

Key: V1, V2, V3 = line voltages as measured

VA (average) = (V1 + V2 + V3) / 3

VD = Line voltage (V1, V2 or V3) that deviates farthest from average (VA)

Formula: % Voltage Imbalance = [100 x (VA-VD)] / VA

CAUTION

If any of the original wire as supplied with the appliance must be replaced, it must be replaced with wiring material having a temperature rating of at least 105°C.

WARNING

To prevent injury or death due to electrocution or contact with moving parts, lock disconnect switch open.

Most factory-supplied electrical components are prewired. To determine what electrical accessories require additional field wiring, refer to the unit specific wiring diagram located on the inside of the unit control center access door. The low voltage control circuit is 24 VAC and control wiring should not exceed 0.75 ohms.

Refer to Field Control Wiring Length/Gauge table for wire length maximums for a given wire gauge

Field Control Wiring Length/Gauge	
Total Wire Length	Minimum Wire Gauge
125 ft.	18
200 ft.	16
300 ft.	14
450 ft.	12

Control wires should not be run inside the same conduit as that carrying the supply power. Make sure that field-supplied conduit does not interfere with access panel operation.

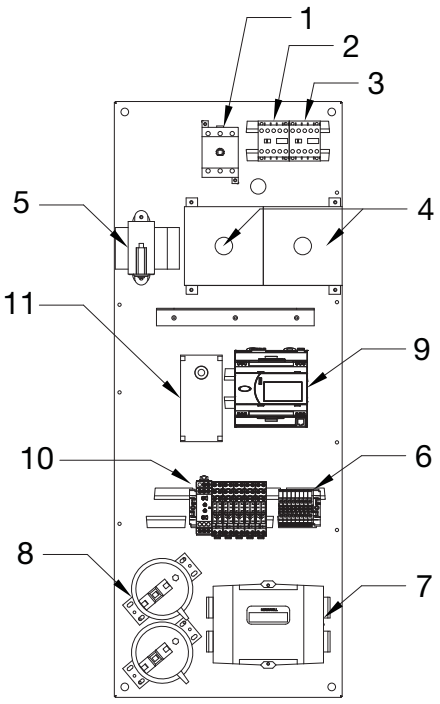
If wire resistance exceeds 0.75 ohms, an industrial-style, plug-in relay should be added to the unit control center and wired in place of the remote switch (typically between terminal blocks R and G on the terminal strip (located on the 24 VAC terminal strip under the Typical Control Center Components). The relay must be rated for at least 5 amps and have a 24 VAC coil. Failure to comply with these guidelines may cause motor starters to "chatter" or not pull in which can cause contactor failures and/or motor failures.

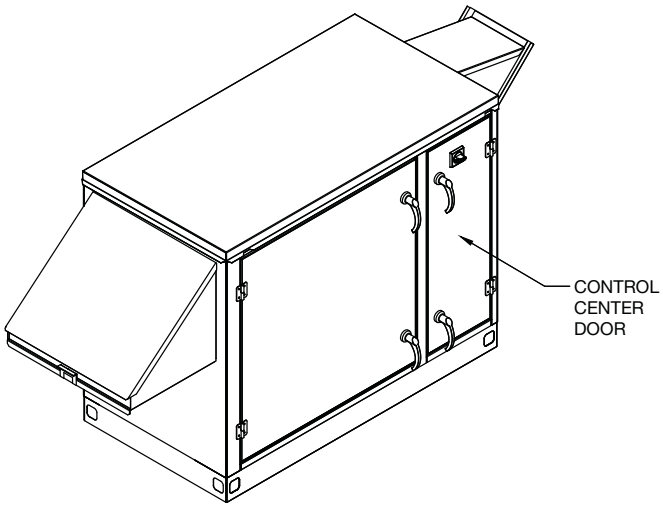
Typical Control Center Components

1. Main Disconnect (nonfusible, lockable)
2. Motor Starter – Exhaust Air Fan
3. Motor Starter – Outdoor Air Fan
4. Speed Controllers/VFDs (Supply & Exhaust)
5. 24 VAC Control Transformer
6. 24 VAC Terminal Strip

Optional Control Center Components

7. Economizer Controller
8. Dirty Filter Pressure Switches
9. BMS Controller
10. Frost Control Timer
11. Thermostat





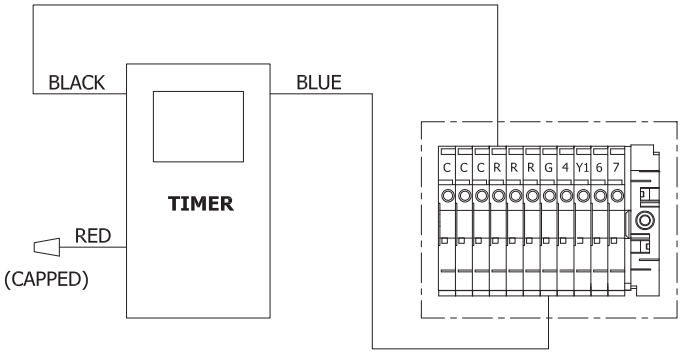
Optional Accessory Wiring Schematics

Remote Panel

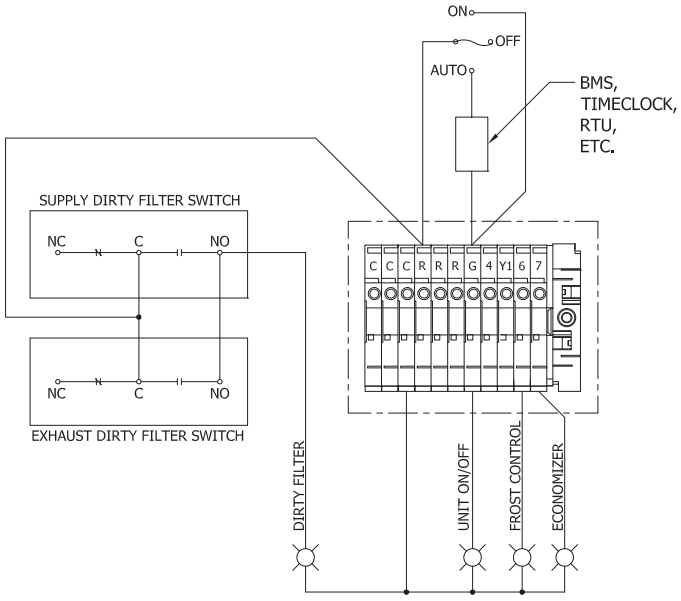
The remote panel is available with a number of different alarm lights and switches to control the unit. The remote panel ships loose and requires mounting and wiring in the field. The remote panel is available with the following options:

- Unit on/off switch
- Unit on/off light
- 7-day time clock
- Hand/off/auto switch
- Dirty filter light
- Economizer light
- Frost control light

7-Day Timer

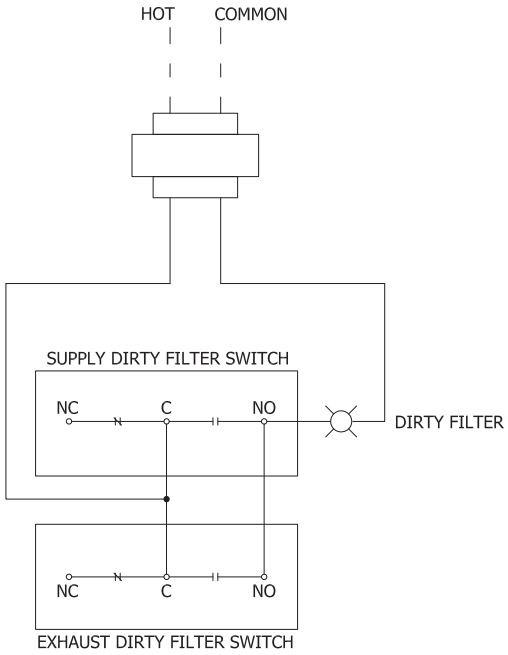


On/Off/Auto Switch & Indictor Light Wiring



ON/OFF/AUTO SWITCH ALLOWS THREE MODES OF OPERATION
"ON" - UNIT IS TURNED ON MANUALLY
"OFF" - UNIT IS TURNED OFF MANUALLY
"AUTO" - UNIT IS CONTROLLED VIA SCHEDULER OF BMS, TIMECLOCK, TSAT, ETC.

Dirty Filter Indicator
(powered by others)



Unit Overview

Basic Unit

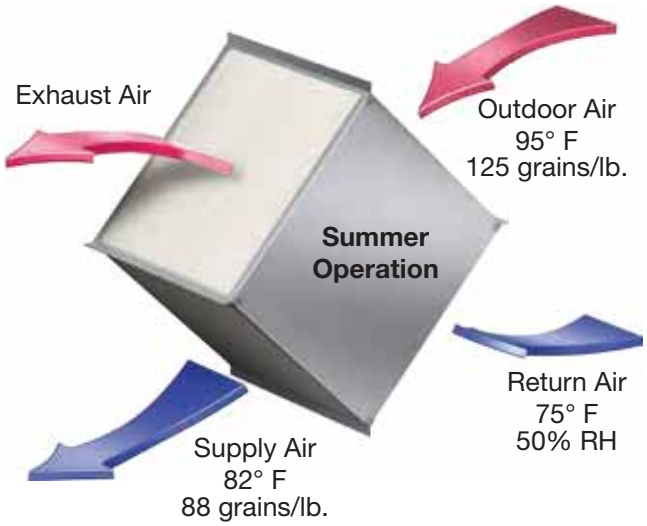
The unit is prewired such that when a call for outside air is made (via field-supplied 24 VAC control signal wired to unit control center), the supply and exhaust fans are energized and optional motorized dampers open. The unit is normally interlocked (24 volt) to the rooftop air handler. When the rooftop air handler starts, the auxiliary contactor in the air handler closes to start the unit.

Summer Operation

Outdoor air is preconditioned (temperature and moisture levels are decreased) by the transfer of energy from the cooler, drier return air through the energy recovery core. The preconditioned air is typically mixed with return air going back to the air handler for final conditioning.

Winter Operation

Outdoor air is preconditioned (temperature and moisture levels are increased) by the transfer of energy from the warmer, more humid return air through the energy recovery core. The preconditioned air is typically mixed with return air going back to the air handler for final conditioning.



Optional Component Overview

Economizer

The energy core operation can be altered to take advantage of economizer operation (free cooling).

Two modes are available:

1. Bypass damper
2. Independent blower control

Bypass damper: An integral bypass damper will cycle into a bypass condition allowing cool air to flow past the energy recovery core rather than flow through it. When outdoor air conditions are not suitable for economizer operation, the damper will remain closed. Economizer mode is initiated by temperature or enthalpy and dependent on the sensor. To eliminate unnecessary control sequences and the concern of overloading fans. Energizing the bypass damper is accomplished one of two ways:

1. The outdoor air temperature is <40°F or >65°F.
2. The outdoor air temperature is <40°F or >65°F DB or >55°F dew point.

Independent blower control: The unit will have the capability to receive an external signal to power off the supply fan.

Frost Control

Extremely cold outdoor air temperatures in combination with higher indoor humidity levels, can cause moisture condensation and frosting on the energy recovery core. Timed exhaust frost control is an optional feature available to prevent and/or control core frosting.

Timed exhaust includes a timer in addition to the temperature sensor. If the exhaust air temperature is below 32°F, the supply blower is cycled approximately 30 minutes on and 5 minutes off to allow the warm exhaust air to heat the core. Once the exhaust air temperature rises above 32°F, the supply blower is no longer cycled.

Variable Frequency Drives (VFD)

VFDs are used to control the speed of the fan as either multi-speed or modulating control. Multi-speed VFDs reference a contact which can be made by a switch or a sensor with a satisfied set point. Modulating control references a 2-10 VDC signal to the VFD which will vary the fan speed from a minimum 50% to full 100% rpm. An optional CO_2 sensor is available to provide both a set point contact or a modulating 2-10 VDC signal.

CO_2 Sensor

The factory-provided sensors can be set to reference a set point for on/off operation.

On model ECV, this accessory is often used in Demand Control Ventilation (DCV) applications. The factory provided sensor can be set to reference a set point for multi-speed operation on the ECV-20 and ECV-30. The CO_2 sensor can also be used to output a 2-10 VDC signal to modulate the fan speed on the ECV-10-VG, ECV-20 and ECV-30.

The CO_2 sensor is either shipped loose to mount in the room space, ductwork, or is factory-mounted in the return air intake. Follow instructions supplied with sensor for installation and wiring details.

Dirty Filter Sensor

Dirty filter sensors monitor pressure drop across the outdoor air filters, exhaust air filters, or both. If the pressure drop across the filters exceeds the set point, the sensor will close a set of contacts in the unit control center. Field-wiring of a light (or other alarm) to these contacts will notify maintenance personnel when filters need to be replaced. The switch has not been set at the factory due to external system losses that will affect the switch. This switch will need minor field adjustments after the unit has been installed with all ductwork complete. The dirty filter switch is mounted in the unit control center.

Start-Up

DANGER

Electric shock hazard. Can cause injury or death. Before attempting to perform any service or maintenance, turn the electrical power to unit to OFF at disconnect switch(es). Unit may have multiple power supplies.

WARNING

Use caution when removing access panels or other unit components, especially while standing on a ladder or other potentially unsteady base. Access panels and unit components can be heavy and serious injury may occur.
Do not operate energy core ventilator without the filters and birdscreens installed. They prevent the entry of foreign objects such as leaves, birds, etc.

CAUTION

Do not run unit during construction phase. Damage to internal components may result and void warranty.

General Start-Up Information

Every installation requires a comprehensive start-up to ensure proper operation of the unit. As part of that process, the following checklist must be completed and information recorded. Starting up the unit in accordance with this checklist will not only ensure proper operation, but will also provide valuable information to personnel performing future maintenance. Should an issue arise which requires factory assistance, this completed document will allow unit experts to provide quicker resolve. Qualified personnel should perform start-up to ensure safe and proper practices are followed.

Unit Model Number _____
(e.g. ECV-10)

Unit Serial Number _____
(e.g. 04C99999 or 10111000)

Start-Up Date _____

Start-Up Personnel Name _____

Start-Up Company _____

Phone Number _____

Pre Start-Up Checklist – check as items are completed.

- ☐ Disconnect and lock-out all power switches
- ☐ Remove any foreign objects that are located in the energy recovery unit.
- ☐ Check all fasteners, set-screws, and locking collars on the fans, bearings, drives, motor bases and accessories for tightness.
- ☐ Rotate the fan wheels by hand to ensure no parts are rubbing. If rubbing occurs, refer to Start-Up section for more information.
- ☐ Check the fan belt drives for proper alignment and tension (refer to Start-Up section for more information).
- ☐ Filters can load up with dirt during building construction. Replace any dirty pleated filters and clean the aluminum mesh filters in the intake hood (refer to Routine Maintenance section).
- ☐ Verify that non-motorized dampers open and close properly.
- ☐ Check the tightness of all factory wiring connections.
- ☐ Verify control wire gauge (refer to the Electrical Connections section).

SPECIAL TOOLS REQUIRED

- Voltage Meter (with wire probes)
- Amperage Meter
- Thermometer
- Tachometer
- Incline Manometer or Equivalent

Start-Up Checklist

The unit will be in operational mode during start-up. Use necessary precautions to avoid injury. All data must be collected while the unit is running. In order to measure volts & amps, the control center door must be open, and the unit energized using a crescent wrench to turn the disconnect handle.

Check line voltage at unit disconnect

_____ L1-L2 volts

_____ L2-L3 volts

_____ L1-L3 volts

Motor Amp Draw

• Supply Fan		• Exhaust Fan	
_____	L1 amps	_____	L1 amps
_____	L2 amps	_____	L2 amps
_____	L3 amps	_____	L3 amps

Fan RPM

_____ Supply Fan _____ Exhaust Fan

Correct fan rotation direction

Supply Fan Yes / No

Exhaust Fan Yes / No

Optional Accessories Checklist

Refer to the respective sections in this Installation, Operation and Maintenance Manual for detailed information.

Refer to wiring diagram in unit control center to determine what electrical accessories were provided.

Provided with Unit?

Frost Control Application / Operation section:			Setting	Factory Default
Yes	No	Frost Control set point		32ºF
		Differential		2ºF
		Timer		Refer to page 16

Economizer Application / Operation section:				
Yes	No	Economizer (temperature)		
		Set point		65ºF
		Offset		20ºF
		Differential		2ºF
Yes	No	Economizer (enthalpy)		
		Set point		D

Optional Accessories section:			Operational		
Yes	No	OA Dirty Filter Sensor	Yes	No	N/A
Yes	No	EA Dirty Filter Sensor	Yes	No	N/A
Yes	No	CO_2 Sensor	Yes	No	N/A
Yes	No	Remote Control Panel	Yes	No	N/A

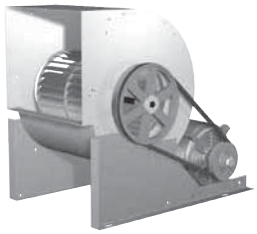
Variable Frequency Drives section:			Operational		
Yes	No	Blower VFDs	Yes	No	N/A

Damper section:			Operational		
Yes	No	Outdoor Air Damper	Yes	No	N/A
Yes	No	Exhaust Air Damper	Yes	No	N/A

Start-Up Components

Fans

The unit contains two forward curved (supply and exhaust) fans. These forward curved fans should be checked for free rotation. If any binding occurs, check for concealed damage and foreign objects in the fan housing. Be sure to check the belt drives per the start-up recommendations in the following section.



Forward Curved Exhaust Fan

CAUTION

When operating conditions of the fan are to be changed (speed, pressure, temperature, etc.), consult Greenheck to determine if the unit can operate safely at the new conditions.

Fan Performance Modifications

Due to job specification revisions, it may be necessary to adjust or change the sheave or pulley to obtain the desired airflow at the time of installation. Start-up technician must check blower amperage to ensure that the amperage listed on the motor nameplate is not exceeded. Amperage to be tested with access doors closed and ductwork installed.

Fan Belt Drives

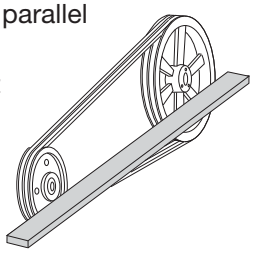
The fan belt drive components, when supplied by Greenheck, have been carefully selected for the unit's specific operating condition. Utilizing different components than those supplied could result in unsafe operating conditions which may cause personal injury or failure of the following components:

- Fan Shaft
- Bearings
- Motor
- Fan Wheel
- Belt

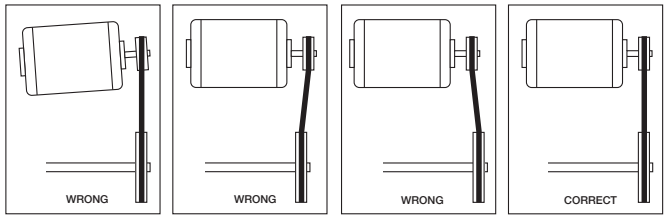
Tighten all fasteners and set screws securely and realign drive pulleys after adjustment. Check pulleys and belts for proper alignment to avoid unnecessary belt wear, noise, vibration and power loss. Motor and drive shafts must be parallel and pulleys in line (see diagrams in this section).

Belt Drive Installation

1. Remove the protective coating from the end of the fan shaft and assure that it is free of nicks and burrs.
2. Check fan and motor shafts for parallel and angular alignment.
3. Slide sheaves on shafts. Do not drive sheaves on as this may result in bearing damage.
4. Align fan and motor sheaves with a straight-edge or string and tighten.

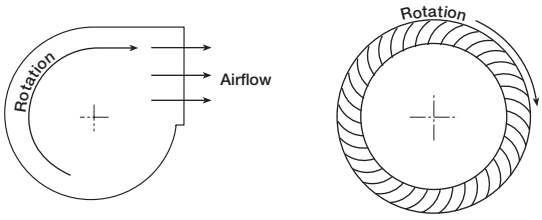


5. Place belts over sheaves. Do not pry or force belts, as this could result in damage to the cords in the belts.
6. With the fan off, adjust the belt tension by moving the motor base. (See belt tensioning procedures in the Routine Maintenance section of this manual). When in operation, the tight side of the belts should be in a straight line from sheave to sheave with a slight bow on the slack side.



Direction of Fan Wheel Rotation

Blower access is labeled on unit. Check for proper wheel rotation by momentarily energizing the fan. Rotation is determined by viewing the wheel from the drive side and should match the rotation decal affixed to the fan housing (see Rotation Direction figures). If the wheel is rotating the wrong way, direction can be reversed by interchanging any two of the three electrical leads. Check for unusual noise, vibration, or overheating of bearings. Refer to the Troubleshooting section of this manual if a problem develops.



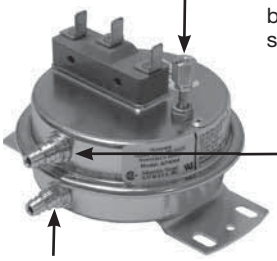
Forward Curved

Fan RPM

Supply fan and exhaust fan will have an adjustable motor pulley (on 15 HP and below) preset at the factory to the customer specified RPM. Fan speed can be increased or decreased by adjusting the pitch diameter of the motor pulley. Multi-groove variable pitch pulleys must be adjusted an equal number of turns open or closed. Any increase in fan speed represents a substantial increase in load on the motor. Always check the motor amperage reading and compare it to the amperage rating shown on the motor nameplate when changing fan RPM. All access doors must be installed except the control center door. ***Do not operate units with access doors open or without proper ductwork in place as the fan motors will overload.***

Optional Start-Up Components

Optional Dirty Filter Switch



Setscrew (on front of switch) must be manually adjusted after the system is in operation.

Negative pressure connection is toward the 'front or top' of the switch. *(Senses pressure on the blower side of filters)*

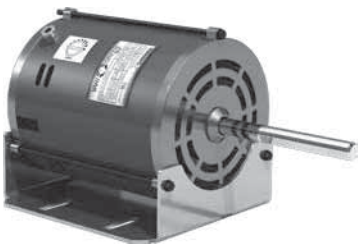
Positive pressure connection is toward the 'back or bottom' of the switch. *(Senses pressure at air inlet side of filters)*

To adjust the switch, the unit must be running with all of the access doors in place, except for the compartment where the switch is located (exhaust intake compartment). The adjusting screw is located on the top of the switch.

1. Open the filter compartment and place a sheet of plastic or cardboard over 50% of the filter media.
2. Replace the filter compartment door.
3. Check to see if there is power at the alert signal leads (refer to electrical diagram).
4. Whether there is power or not, turn the adjustment screw on the dirty filter gauge (clockwise if you did not have power, counterclockwise if you did have power) until the power comes on or just before the power goes off.
5. Open the filter compartment and remove the obstructing material.
6. Replace the door and check to make sure that you do **not** have power at the alert signal leads.

The unit is now ready for operation.

Optional EC Motor Features



Soft start – All motors feature soft start technology which eliminates inrush current at start-up. The motors will reliably start at any speed setting.

Overload protection – If the motor becomes overloaded, it will automatically reduce its speed until it is no longer overloaded. This means that the motor will never operate in the "service factor" which is possible with many AC motors. The motor and control are electrically protected with lightning surge protection.

Optional Economizer

Relevant Set Points

1. MAT SET The outdoor air temperature set point after the energy core. The control will open/close the bypass damper to maintain temperature as best as it can. (Set point menu, default 53°F)
2. LOW T LOCK The set point for the low temperature mechanical cooling lockout. (Set point menu, default 32°F)
3. DRYBLB SET The outdoor air set point to call for economizer. (Set point menu, default 63°F)
4. AUX1 O The controllers operating sequence structure. (Set point menu, default 'None')
5. ERV OAT SP The set point for low temperature economizer lockout. This is the low temperature set point when AUX1 O is set to ERV. (Set point menu, default 40°F)

Using the Keypad with Settings and Parameters

To use the keypad when working with set points, system and advanced settings, checkout tests, and alarms:

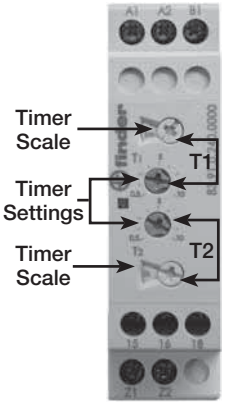
1. Navigate to the desired menu.
2. Press ↵ (enter) to display the first item in the currently displayed menu.
3. Use the ▲ and ▼ buttons to scroll to the desired parameter.
4. Press ↵ (enter) to display the value of the currently displayed item.
5. Press the ▲ button to increase (change) the displayed parameter value.*
6. Press the ▼ button to increase (change) the displayed parameter value.*
7. Press ↵ (enter) to accept the displayed value and store it in non-volatile RAM.
8. CHANGE STORED displays.
9. Press ↵ (enter) to return the current menu parameter.
10. Press ⓘ (escape) to return to the current menu parameter.

*When values are displayed, pressing and holding the ▲ or ▼ button causes the display to automatically increment.

Optional Frost Control

Timed Exhaust

1. Remove power from unit.
2. Jumper the temperature indicating sensor in the unit control center. Thermostat controller has a pre-set temperature of 32ºF.
3. Set the frost control timer scale for T1 and T2 to 5m. Set the timer settings for T1 and T2 to 30.
4. Add power to the unit. Blower should cycle on for 30 minutes, then turn off for 5 minutes.
5. Remove power from unit and remove jumpers that were placed. Reset timer settings.
   - **T1** timer setting set to **5** and timer scale set to **10m** for 5 minutes of blower off time.
   - **T2** timer setting set to **5** and timer scale set to **1h** for 30 minutes of blower on time.



Optional CO_2 Proportional Control

Speed Controller

A carbon dioxide sensor is provided from the factory for field mounting OR unit mounting in the space(s) being served by the energy recovery unit.

The ECV-10-VG carbon dioxide sensor is wired to the speed controller with default factory settings for proportional control of 500 PPM or less CO_2 = 50% fan speed and 1500 PPM or greater CO_2 = 100% fan speed. The blower's speed proportionally modulates between 500 and 1500 PPM CO_2.

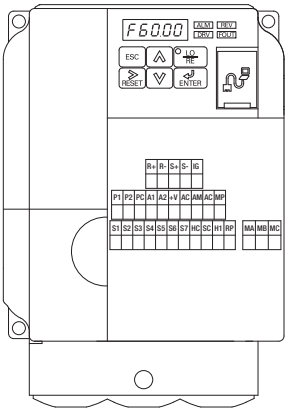
Variable Frequency Drive

The ECV-20 and ECV-30 are wired to the Variable Frequency Drive (VFD). Refer to the Variable Frequency Drive section for control sequence and programming.

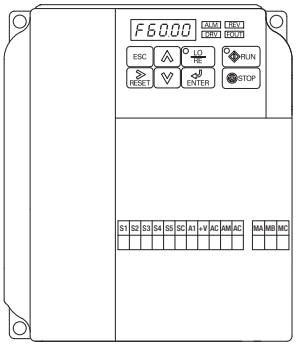
Variable Frequency Drives

Optional factory installed, wired, and programmed variable frequency drives (VFDs) may have been provided for modulating or multi-speed control of the blowers. One VFD, either Yaskawa model V1000 or J1000, is provided for each blower (supply air and exhaust).

Refer to the tables in this section for factory settings and field wiring requirements. Refer to the unit control center for unit specific wiring diagram. When making adjustments outside of the factory set points, refer to Yaskawa VFD instruction manual, which can be found online at www.drives.com. For technical support, contact Yaskawa direct at 1-800-927-5292.



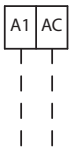
V1000



J1000

☐ OPTION 1 - 0-10 VDC CONTROL

USER TO PROVIDE ISOLATION AS REQUIRED



0-10 VDC CONTROL SIGNAL (BY OTHERS)
WIRED TO A1 (+) AND AC (COMMON)
0 VDC = 30 Hz
10 VDC = 60 Hz

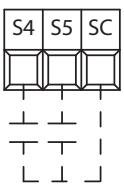
FOR ONE 0-10 SIGNAL, WIRE TO DRIVES IN PARALLEL

SEE VFD INSTALLATION MANUAL FOR MORE DETAIL

FOR CONTINUOUS 60Hz OPERATION JUMPER TERMINALS A1 AND +V.

☐ OPTION 2 - MULTI SPEED CONTROL

USER TO PROVIDE CONTACTS AND ISOLATION AS REQUIRED



NEITHER S4 OR S5 CONTACT CLOSED
DRIVE SPEED = 60 Hz.

S4 TO SC CONTACT CLOSED (BY OTHERS)
DRIVE SPEED = 40 Hz.

S5 TO SC CONTACT CLOSED (BY OTHERS)
DRIVE SPEED = 30 Hz.

SEE VFD INSTALLATION MANUAL FOR MORE DETAIL

Factory Set Points

Variable frequency drives (VFDs) for the blowers are factory setup to operate in one of the three following modes:

- **Modulating:** 0-10 VDC signal wired in the field by others varies the speed of the blower between 30 and 60 Hz
- **Multi-speed:** Digital contact closures by others command the VFD to run at multiple speed settings:
  - Open - Drive runs at 60 Hz
  - SC to S4 - Drive runs at 40 Hz
  - SC to S5 - Drive runs at 30 Hz
- **CO_2 Sensor:**
  - **Set Point Control:** A carbon dioxide sensor is provided from the factory for field mounting OR unit mounting in the space(s) being served by the energy recovery unit. The CO_2 sensors are wired to the unit VFD's with two preset speeds of 700 PPM or less CO_2 = 50% fan speed and 800 PPM or greater CO_2 = 100% fan speed.
  - **Proportional Control:** A carbon dioxide sensor is provided from the factory for field mounting OR unit mounting in the space(s) being served by the energy recovery unit. The CO_2 sensors are wired to the unit VFD's with default factory settings of 500 PPM or less CO_2 = 50% fan speed and 1000 PPM or greater CO_2 = 100% fan speed. Modulation of VFD occurs proportional to CO_2 between 500 and 1000 PPM.

The terminal locations for modulating and multi-speed are shown on the previous page. Most of the set points in the VFDs are Yaskawa factory defaults. However, a few set points are changed at Greenheck and are shown in the tables. These settings are based on the VFD mode selected.

Change Set Points

To gain access to change set points on the V1000 and J1000 drives, parameter A1-01 needs to be set at "2". To prevent access or tampering with drive settings on either drive, change parameter A1-01 to "0".

- **Drive Operation**
  - SC to S1 contact for On/Off
  - A1 (0-10 VDC) referenced to AC. ***Can use +15 VDC from +V.***

Resetting the V1000 drive to factory defaults

To reset the V1000 drive back to Greenheck factory defaults, go to parameter A1-01 and set it to "2". Then go to A1-03 and change it to "1110" and press enter. The drive is now reset to the settings programmed at Greenheck. This option is not available on the J1000.

MODULATING CONTROL FOR FAN SPEED (0-10 VDC)			
Parameter		Setting	
		V1000	J1000
A1-01	Access Level	2	2
B1-17	VFD Start-Up Setting	1	1
C6-02	Carrier Frequency	1	1
D2-02	Ref Lower Limit	50%	50%
E2-01	Motor Rated FLA	Motor FLA	Motor FLA
H2-01	Terminal MA, MC Function	5	5
H3-04	Terminal A1 Bias	50%	50%
L4-01	H2-01 Frequency Detection	15	15
L5-01	Auto Restart Attempt	5	5
A1-01	Access Level	0	0

CO_2 PROPORTIONAL CONTROL			
Parameter		Setting	
		V1000	J1000
B1-17	VFD Start-Up Setting	1	1
C6-02	Carrier Frequency	1	1
D2-02	Ref Lower Limit	50%	50%
E2-01	Motor Rated FLA	FLA	FLA
H3-03	Analog Frequency Reference (Gain)	150%	150%
H3-04	Analog Frequency Reference (Bias)	25%	25%
L2-01	Ride Thru Power Loss	2	2
L4-05	Frequency Ref Loss	0	NA
L5-01	Auto Restart Attempt	5	5
A1-01	Access Level	0	0

CO_2 SENSOR CONTROL FOR FAN SPEED (1/2 SPEED WHEN CO_2 DROPS BELOW 700 PPM) (FULL SPEED WHEN CO_2 RISES ABOVE 800 PPM)			
MULTI-SPEED CONTROL FOR FAN SPEED (1/3 OR 1/2 SPEED REDUCTION)			
Parameter		Setting	
		V1000	J1000
A1-01	Access Level	2	2
B1-01	Reference Source (Frequency)	0	0
B1-17	VFD Start-Up Setting	1	1
C6-02	Carrier Frequency	1	1
D1-01	Frequency Reference 1	60 Hz	60 Hz
D1-02	Frequency Reference 2	40 Hz	40 Hz
D1-03	Frequency Reference 3	30 Hz	30 Hz
D1-04	Frequency Reference 4	60 Hz	60 Hz
D2-02	Ref Lower Limit	50%	50%
E2-01	Motor Rated FLA	Motor FLA	Motor FLA
H1-04	Multi-Function Input Sel 4 (Terminal S4)	3	3
H1-05	Multi-Function Input Sel 5 (Terminal S5)	4	4
H1-06	Multi-Function Input Sel 6 (Terminal S6)	5	NA
H2-01	Terminal MA, MC Function	5	5
H3-10	A2 Not Used	F	NA
L4-01	H2-01 Frequency Detection	15	15
L5-01	Auto Restart Attempt	5	5
A1-01	Access Level	0	0

Routine Maintenance

DANGER

Electric shock hazard. Can cause injury or death. Before attempting to perform any service or maintenance, turn the electrical power to unit to OFF at disconnect switch(es). Unit may have multiple power supplies.

CAUTION

Use caution when removing access panels or other unit components, especially while standing on a ladder or other potentially unsteady base. Access panels and unit components can be heavy and serious injury may occur.

Once the unit has been put into operation, a routine maintenance program should be set up to preserve reliability and performance. Items to be included in this program are:

Lubrication
Apply lubrication where required

Dampers
Check for unobstructed operation

Fan Belts
Check for wear, tension, alignment

Motors
Check for cleanliness

Blower Wheel & Fasteners
Check for cleanliness
Check all fasteners for tightness
Check for fatigue, corrosion, wear

Bearings
Check for cleanliness
Check set screws for tightness
Lubricate as required

External Filter
Check for cleanliness - clean if required

Internal Filter
Check for cleanliness - replace if required

Door Seal
Check if intact and pliable

Maintenance Procedures:

Lubrication

Check all moving components for proper lubrication. Apply lubrication where required. Any components showing excessive wear should be replaced to maintain the integrity of the unit and ensure proper operation.

Dampers

Check all dampers to ensure they open and close properly and without binding. Backdraft dampers can be checked by hand to determine if blades open and close freely. Apply power to motorized dampers to ensure the actuator opens and closes the damper as designed.

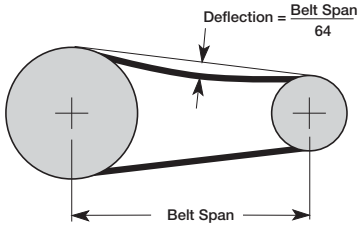
Fan Belts

Belts must be checked on a regular basis for wear, tension, alignment, and dirt accumulation. Premature or frequent belt failures can be caused by improper belt tension (either too loose or too tight) or misaligned sheaves. Abnormally high belt tension or drive misalignment will cause excessive bearing loads and may result in failure of the fan and/or motor bearings. Conversely, loose belts will cause squealing on start-up, excessive belt flutter, slippage, and overheated sheaves. Both loose and tight belts can cause fan vibration.

When replacing belts on multiple groove drives, all belts should be changed to provide uniform drive loading. Do not pry belts on or off the sheave. Loosen belt tension until belts can be removed by simply lifting the belts off the sheaves. After replacing belts, insure that slack in each belt is on the same side of the drive. Belt dressing should never be used.

Do not install new belts on worn sheaves. If the sheaves have grooves worn in them, they must be replaced before new belts are installed.

The proper belt setting is the lowest tension at which the belts will not slip under peak load operation. For initial tensioning, set the belt deflection at 1/64-inch for each inch of belt span (measured half-way between sheave centers). For example, if the belt span is 64 inches, the belt deflection should be one inch (using moderate thumb pressure at mid-point of the drive). Check belt tension two times during the first 24 hours of operation and periodically thereafter.



Fan Motors

Motor maintenance is generally limited to cleaning and lubrication. Cleaning should be limited to exterior surfaces only. Removing dust and grease buildup on the motor housing assists proper motor cooling. Never wash-down motor with high pressure spray. Greasing of motors is only intended when fittings are provided. Many fractional motors are permanently lubricated for life and require no further lubrication.

Fan Wheel & Fasteners

Wheels require very little attention when moving clean air. Occasionally oil and dust may accumulate on the wheel causing imbalance. When this occurs the wheel and housing should be cleaned to assure smooth and safe operation. Inspect fan impeller and housing for fatigue, corrosion or wear.

Routinely check all fasteners, set screws and locking collars on the fan, bearings, drive, motor base and accessories for tightness. A proper maintenance program will help preserve the performance and reliability designed into the fan.

Bearings

Most bearings are permanently lubricated and require no further lubrication under normal use. Normal use being considered -20ºF to 120ºF and in a relatively clean environment. Some bearings are relubricatable and will need to be regreased depending on fan use. Check your bearings for grease zerk fittings to find out what type of bearing you have. If your fan is not being operated under normal use, bearings should be checked monthly for lubrication.

External Filter Maintenance

Aluminum mesh, 2-inch deep filters are located in the supply weatherhood (if the weatherhood option was ordered). Filters should be checked and cleaned on a regular basis for best efficiency. The frequency of cleaning depends upon the cleanliness of the incoming air. These filters should be cleaned prior to start-up. Clean filters by rinsing with a mild detergent in warm water.

Internal Filter Maintenance

The units will typically be provided with 2-inch, pleated filters in the outdoor air and exhaust airstreams. These filters should be checked per a routine maintenance schedule and replaced as necessary to ensure proper airflow through the unit. See table for pleated filter size and quantity for each unit. Replacement filters shall be of same performance and quality as factory installed filters. Filter type must be pleated design with integral metal grid. Two acceptable filter replacements are Aerostar Series 400 or Farr 30/30®.

Outdoor Air Filters: Access to the outdoor air filters is through the door labeled as “Filter Access” on the sides of the unit.

Pleated Filter Size and Quantities				
Unit Size	Supply		Exhaust	
	Size	Qty	Size	Qty
ECV-10	16 x 20	2	20 x 20	2
ECV-20	16 x 20	2	20 x 20	2
ECV-30	20 x 20	3	20 x 20	3

All dimensions in inches.

Exhaust Air Filters: Access to the exhaust air filters is through the door labeled as “Filter Access” on the sides of the unit.

Refer to Access Panel Location section for additional information on filter locations.

Door Seal Maintenance

A bulb seal is installed on the perimeter of the door frame. Inspect at least annually to ensure that the seal is still intact.

Energy Recovery Core

Annual inspection of the energy recovery core is recommended. Units ventilating smoking lounges and other nonclean air spaces should have energy recovery core inspections more often based upon needs.

Accessing the energy recovery core - Disconnect the power to the ECV. Remove access panel.

Removing the energy recovery core - Once the energy core access doors are removed, the core can be pulled from the housing. To replace the core, reverse the procedure.

Recommended cleaning procedure - First, remove the energy recovery core by following the instructions on this page.

Once the core is removed, gently vacuum the surfaces of the core to remove the dirt and debris that has accumulated.

Frequency of cleaning - A regular cleaning cycle must be established for the energy recovery core in order to maintain optimum sensible and latent energy transfer. In reasonably clean environments such as schools, offices or retail stores, the energy recovery core should be inspected annually and cleaned as needed.

Failure to follow a regular cleaning cycle for the energy recovery core can result in significant energy transfer performance losses.

WARNING

Do not wash, soak in water or use detergents and cleaners on the core. This will result in a damaged core.

Troubleshooting - Economizer Alarms

Addressing Alarms

Alarms will signify a faulty sensor. When this occurs, verify all connections to the sensor and controller are secure. Press enter twice to clear the alarm. If the issue persists, consult the factory.

Clearing Alarms

Once the alarm has been identified and the cause has been removed (e.g. replaced faulty sensor), the alarm can be cleared from the display.

To clear an alarm, perform the following:

1. Navigate to the desired alarm.
2. Press the ↵ (enter).
3. ERASE? displays.
4. Press ↵ (enter).
5. ALARM ERASED displays.
6. Press ⓣ (escape) to complete the action and return to the previous menu.

NOTE

If an alarm still exists after you clear it, it redisplays within 5 seconds.

Troubleshooting – Airflow

Test and Balance Report

The Test and Balance Report (TAB) is utilized to determine whether the appropriate amount of outdoor air and exhaust air is being supplied and removed from a building, respectively. There are no set rules on what information must be included in a TAB report. As such, if a TAB report indicates that the airflow on a unit is low, prior to contacting the factory, please determine the following information:

	Unit #1	Unit #2	Unit #3	Unit #4
Model Number				
Serial Number				
Nameplate Information				
Voltage				
Hertz				
Phase				
Outdoor Air Fan Amps				
Exhaust Fan Amps				
Outdoor Air Fan Horsepower				
Exhaust Fan Horsepower				
Design Airflow				
Outdoor Air				
Exhaust				
Measured Airflow				
Outdoor Air				
Exhaust				
Measured Data				
Blower Rotation				
Outdoor Air Fan RPM				
Exhaust Fan RPM				
Outdoor Air Fan Amp Draw				
Exhaust Fan Amp Draw				

Airflow problems can often be tied back to improper ductwork installation. Be sure to install ductwork in accordance with SMACNA and AMCA guidelines.

Troubleshooting – Unit

Symptom	Possible Cause	Corrective Action
Blower fails to operate	Blown fuse or open circuit breaker.	Replace fuse or reset circuit breaker and check amps.
	Defective motor or capacitor.	Replace.
	Motor starter overloaded.	Reset starter and check amps.
	Electrical.	Check for On/Off switches. Check for correct supply voltage.
	Drive.	Check for broken or loose belts. Tighten loose pulleys.
Motor starters “chatter” or do not pull in	Control power (24 VAC) wiring run is too long (resistance should not exceed 0.75 ohms).	Shorten wiring run to mechanical room or install a relay which will turn unit on/off. Consult factory for relay information.
	Incoming supply power is less than anticipated. Voltage supplied to starter coil must be within +10% / -15% of nominal voltage stated on the coil.	Need to increase supply power or use a special control transformer which is sized for the actual supply power.
Motor over amps	CFM too high.	Check cfm and adjust drives if needed.
	Static pressures are higher or lower than design.	If higher, ductwork should be improved. If lower, fan rpm should be lower.
	Blower rotation is incorrect.	Check rotation and reverse if necessary.
	Motor voltage incorrect.	Check motor nameplate versus supplied voltage.
	Motor horsepower too low.	See specifications and catalog for fan curves to determine if horsepower is sufficient.
	Shorted windings in motor.	Replace motor.
Low airflow (cfm)	Unit damper not fully open.	Adjust damper linkage or replace damper motor.
	System static pressure too high.	Improve ductwork to eliminate losses using good duct practices.
	Blower speed too low.	Check for correct drives and rpm with catalog data.
	Fan wheels are operating backwards.	For 3-phase, see Direction of Fan Wheel Rotation under Unit Start-Up section.
	Dirty filter or energy core.	Follow cleaning procedures in Routine Maintenance section.
	Leaks in ductwork.	Repair.
	Elbows or other obstructions may be obstructing fan outlet.	Correct or improve ductwork.
	Belt slippage.	Adjust belt tension.
High airflow (cfm)	Blower fan speed too high.	Check for correct fan rpm. Decrease fan speed if necessary.
	Filter(s) not in place.	Install filters.
	Insufficient static pressure (Ps) (airflow resistance).	Induce Ps into system ductwork. Make sure grilles and access doors are installed. Decrease fan speed if necessary.
One or both blowers turn off intermittently and back on after about 2 minutes	Frost control sensors are tripping.	Adjust frost temperature sensor set point as needed.

Always have a completed Pre Start-Up Checklist, unit Start-Up Checklist, and Optional Accessories Checklist prior to requesting parts or service information.

Troubleshooting – Unit

Symptom	Possible Cause	Corrective Action
Excessive noise or vibration	Fan wheel rubbing on inlet.	Adjust wheel and/or inlet cone. Tighten wheel hub or bearing collars on shaft.
	Bearings.	Replace defective bearing(s). Lubricate bearings. Tighten collars and fasteners.
	Motor base or blower loose.	Tighten mounting bolts.
	Bearing and drive misaligned.	Realign.
	Noise being transmitted by duct.	Make sure ductwork is supported properly. Make sure ductwork metal thickness is sized for proper stiffness. Check duct size at discharge to ensure that air velocities are not too high.

Always have a completed Pre Start-Up Checklist, unit Start-Up Checklist, and Optional Accessories Checklist prior to requesting parts or service information.

Maintenance Log

Date _____Time _____ AM/PM
Notes:_____

Date _____Time _____ AM/PM
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Maintenance Log

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Our Commitment

As a result of our commitment to continuous improvement, Greenheck reserves the right to change specifications without notice.

Specific Greenheck product warranties are located on greenheck.com within the product area tabs and in the Library under Warranties.

Greenheck catalog, Energy Core Ventilators, Model MiniCore and ECV, provides additional information describing the equipment, fan performance, available accessories, and specification data.

AMCA Publication 410-96, Safety Practices for Users and Installers of Industrial and Commercial Fans, provides additional safety information. This publication can be obtained from AMCA International, Inc. at www.amca.org.

GREENHECK
Building Value in Air.

Phone: 715.359.6171 • Fax: 715.355.2399 • Parts: 800.355.5354 • E-mail: gfcinfo@greenheck.com • Website: www.greenheck.com

GREENHECK
Building Value in Air.

Model GRRS
Fire Ready Hood

Installation, Operation and Maintenance Manual

Please read and save these instructions for future reference. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage!

Intertek

ICC ES PMG
REPORT #1293

Listed to UL 300A Standard

WARNING

To reduce the risk of fire, electric shock, or injury to persons, observe the following:

- Use this unit only in the manner intended by the manufacturer.
- Before servicing or cleaning unit, switch power off at service panel and lock the service disconnecting means to prevent power from being switched on accidentally. When the service disconnecting means cannot be locked, securely fasten a prominent warning device, such as a tag, to the service panel.
- Installation work and electrical wiring must be done by a qualified person(s) in accordance with all applicable codes and standards, including fire rated construction codes and standards.
- Sufficient air is needed for proper combustion and exhausting of gases through the flue (chimney) of fuel burning equipment to prevent backdrafting. Follow the heating equipment manufacturer's guideline and safety standards such as those published by the National Fire Protection Association (NFPA), and the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), and the local code authorities.
- When cutting or drilling into wall or ceiling, do not damage electrical wiring and other hidden utilities.
- To reduce the risk of fire or electric shock, do not use this range hood with an additional speed control device.
- Ducted fans must always be vented to the outdoors.
- To reduce the risk of fire, use only metal ductwork.
- Use with approved wiring only.
- This unit must be grounded.

WARNING

To reduce the risk of range top grease fire:

- Never leave surface units unattended at high settings. Boilovers cause smoking and greasy spillovers that may ignite. Heat oils slowly on low or medium settings.
- Always turn hood ON when cooking at high heat or when cooking flaming foods.
- Clean ventilation fans frequently. Grease should not be allowed to accumulate on fan or filter.
- Use proper pan size. Always use cookware appropriate for the size of the surface element.

To reduce the risk of injury to persons in the event of a range top grease fire, observe the following:*

- SMOTHER FLAMES with a close-fitting lid, cookie sheet, or metal tray, then turn off the burner. BE CAREFUL TO PREVENT BURNS. If the flames do not go out immediately, EVACUATE AND CALL THE FIRE DEPARTMENT.
- NEVER PICK UP A FLAMING PAN. You may be burned.
- DO NOT USE WATER, including wet dishcloths or towels - violent steam explosion will result.

*Based on "Kitchen Fire Safety Tips" published by NFPA.

Table of Contents

Receiving

Upon receiving the product, check to ensure all items are accounted for by referencing the delivery receipt or packing list. Inspect each crate or carton for shipping damage before accepting delivery. Alert the carrier of any damage detected. The customer will make notation of damage (or shortage of items) on the delivery receipt and all copies of the bill of lading which is countersigned by the delivering carrier. If damaged, immediately contact your Greenheck Representative. Any physical damage to the unit after acceptance is not the responsibility of Greenheck Fan Corporation.

Unpacking

Verify that all required parts and the correct quantity of each item have been received. If any items are missing, report shortages to your local representative to arrange for obtaining missing parts. Confirmation of shipment(s) must be limited to only items on the bill of lading.

Handling

Handle in such a manner as to keep from scratching or chipping the coating. Damaged finish may reduce ability of unit to resist corrosion.

Storage

Units are protected against damage during shipment. If the unit cannot be installed and operated immediately, precautions need to be taken to prevent deterioration of the unit during storage. The user assumes responsibility of the unit and accessories while in storage. The manufacturer will not be responsible for damage during storage. These suggestions are provided solely as a convenience to the user.

The ideal environment for the storage of units and accessories is indoors, above grade, in a low humidity atmosphere which is sealed to prevent the entry of blowing dust, rain, or snow. Temperatures should be evenly maintained between 30°F *(-1°C)* and 110°F *(43°C)*. All accessories must be stored indoors in a clean, dry location.

Model Number Code

GRRS - 30 - F - E - D - N

Type
Residential
Range
Suppression

Length
30 inches
36 inches

Ventilation
F - Integral Fan - Front Recirculation
R - Integral Fan - Rear Discharge
T - External Fan - Top Discharge

Range Disconnect Type
E - Electric
G - Gas
D - Dual (gas and electric)

External Fan Type
D - Inlet Duct
W - Wall Mount

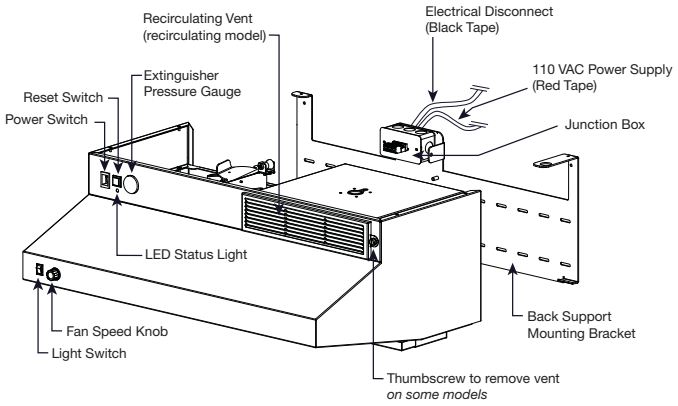
NFPA 101 Compliance
X - Noncompliant
N - Compliant

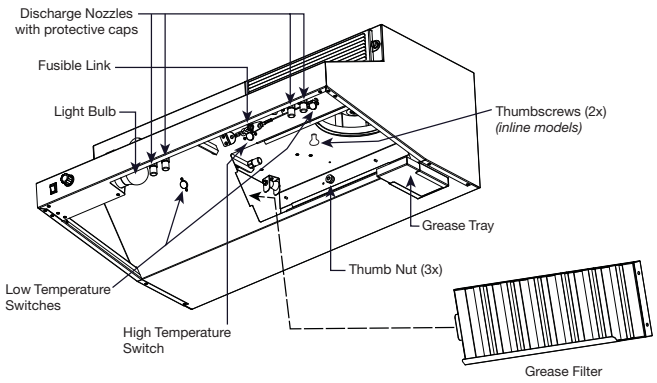
Example: GRRS-30-F-D-N
Greenheck RRS, 30 inches long, with front fan discharge, with dual element disconnect, NFPA 101 Compliant

Parts Checklist

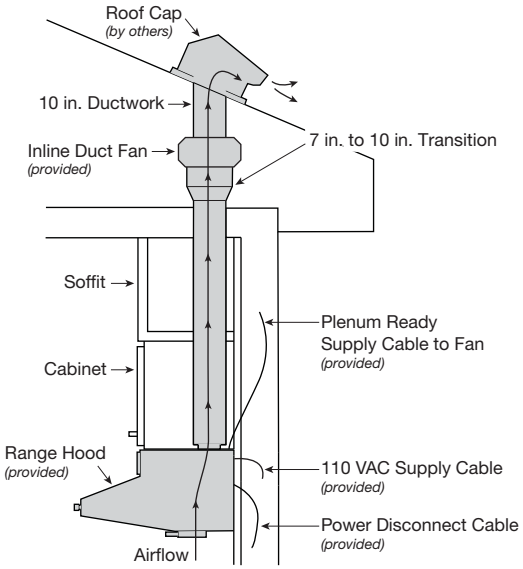
- ☐ Hood
- ☐ Back support mounting bracket
- ☐ External fan (Inline / Wall Mount / None)
  - 25 ft. plenum rated wire for plug and play connection
- ☐ 8 ft. of metal clad wire for hood power connection (marked with red tape)
- ☐ Gas disconnect valve (optional)
  - 6 ft. shielded control wire for plug and play connection
- ☐ Electrical disconnect box (optional)
  - 6 ft. shielded control wire for plug and play connection
- ☐ 8 ft. of metal clad wire for gas disconnect/electrical disconnect connection (marked with black tape)
- ☐ Remote switches, ADA (optional)
- ☐ Manual Pull Kit (optional) consisting of the following:
  - Pull Box (1)
  - Pull Face (1)
  - Elbow Pulley (3)
  - 25 ft. Cable and Pin
- ☐ The ClockBox (optional)
  - 20 ft. shielded control wire for plug and play connection

Exploded View

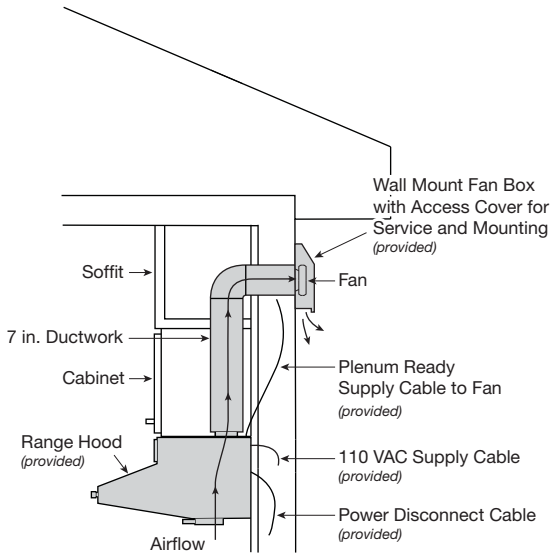




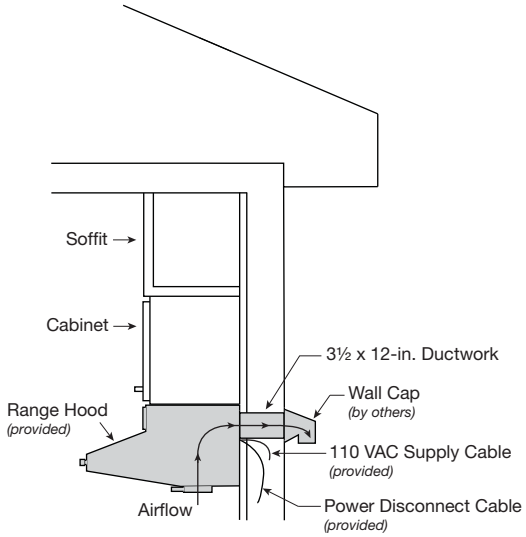
Sample Installations



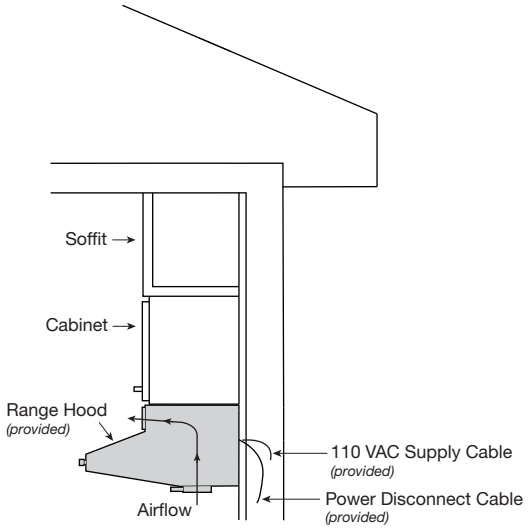
External Fan | Inline Fan



External Fan | Wall Mount Fan



Integral Fan | Rear Discharge



Integral Fan | Front Recirculation

Preparing the Install Location

Mounting Bracket - The mounting bracket and hood must be centered over the range. If the range is not in place, the center marking should be relative to it's final position. Refer to page 7 for bracket mounting points, rear access holes and access points.

Ductwork - The ductwork and fittings used for outside venting (if applicable) must be carefully selected to ensure that the static pressure is in line with the fan parameters. The table below displays maximum duct length allowed for the various fan options.

Hood Width	NFPA 101 Compliance	Fan Type	Venting	CFM (at hood)	Duct Length (maximum)
30 inches	No	Internal	Front (recirculating)	140	Not applicable
	No	Internal	Rear Discharge	250	Not applicable
	No	Inline Duct Fan	Vertical Duct	470	35 feet
	No	Exterior Wall Fan	Vertical Duct	150	20 feet
	Yes	Internal	Front (recirculating)	500	Not applicable
	Yes	Internal	Rear Discharge	500	Not applicable
	Yes	Inline Duct Fan	Vertical Duct	510	35 feet
	Yes	Exterior Wall Fan	Vertical Duct	550	20 feet
36 inches	No	Internal	Front (recirculating)	140	Not applicable
	No	Internal	Rear Discharge	250	Not applicable
	No	Inline Duct Fan	Vertical Duct	470	35 feet
	No	Exterior Wall Fan	Vertical Duct	150	20 feet
	Yes	Internal	Front (recirculating)	500	Not applicable
	Yes	Internal	Rear Discharge	500	Not applicable
	Yes	Inline Duct Fan	Vertical Duct	510	35 feet
	Yes	Exterior Wall Fan	Vertical Duct	550	20 feet

Maximum duct length equals horizontal and vertical duct runs plus duct components such as fittings, elbows, and transitions.

For installations requiring vertical duct venting to an inline fan and NFPA 101 compliance, the hood should be adapted from a 7-inch round duct access hole to a minimum 12-inch duct.

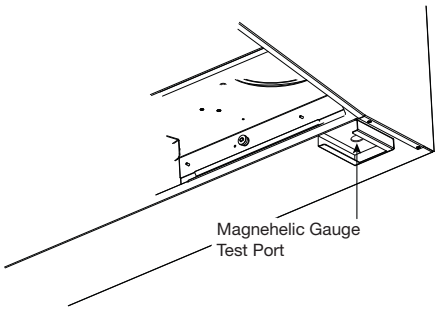
For installations requiring vertical duct venting to an inline fan and NFPA 101 compliance is NOT required, the hood can be adapted to a minimum 10-inch duct.

WARNING

The amount of fittings and ductwork directly affects the resistance or static pressure placed on the system. If the system is not within the proper static pressure range, the heat sensors and controls will be adversely affected and will impact the proper function of the safety controls. Therefore it is required that airflow testing be recorded along with installation documentation. The air testing is accessed by the removal of the grease tray and measured with an airflow pressure gauge.

Static Pressure Testing - The magnehelic gauge test port opening is located beneath the grease tray. The static pressure needs to be measured to ensure airflows meet design criteria. The airflow is measured by attaching the gauge tubing to the magnehelic gauge inlet, and the hood fitting is attached to the grease drain hole beneath the grease tray.

A reading of 0.45 to 0.85 inches wg. is required to meet design standards. This reading will correspond to the static pressure of the ductwork, hood and fan combination.



Fans

For inline fans and exterior wall fans, fan location and proper mounting will be required.

If the hood system is configured for front recirculation discharge or rear discharge and NFPA 101 compliance, the unit will come equipped with a fan box. If installing under cabinets, keeping the fan box flush to the underside of cabinet will guarantee correct spacing. Otherwise, center and mark the installation area according to wall mounting bracket prior to hanging.

The following steps will be required.

1. Insert/attach the top portion of the manual pull kit conduit through the fan box.

2. Attach square duct collar to the bottom of the fan box with included hardware.

3. Attach the fan box to the mounting bracket with included 8/32 nuts, then complete the installation on the manual pull kit conduit and top/bottom unions.

When prepping a space for installation, a 4-9/16 inch space must be allowed between the top of the mounting bracket and the bottom of the cabinet for the fan box. The additional height of the unit should not result in reduced range clearance. Cabinets should be installed approximately 5 inches higher to accommodate the additional size of the NFPA 101 fan box assembly.

Accessories

Location restrictions will apply if the hood system supplied is provided with any of the optional accessories:

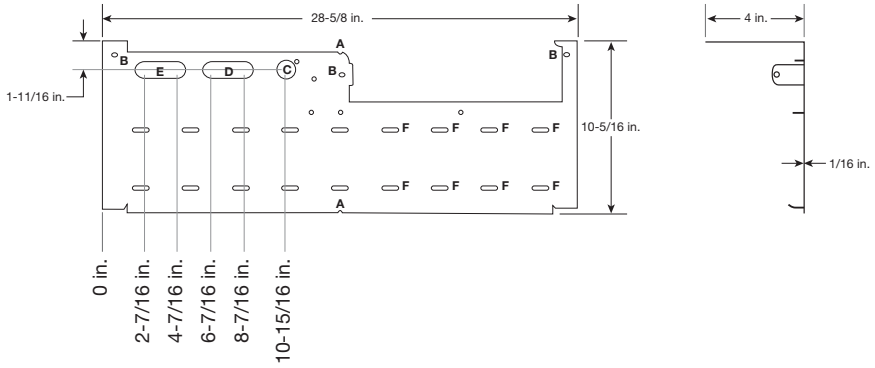
- ClockBox
- Remote ADA Switches
- Manual Pull Station

Installation

Installation Elevation

A. Hood (30 or 36 inches)
B. Appliance (for reference purposes)
C. Range Disconnect - electric, gas or dual (optional)
D. Gas Range Element Disconnect (not shown)
E. The ClockBox. Range Element Time-Out System (optional)
F. Handicapped Accessible Control Box (optional)
G. Manual Pull Station (optional)

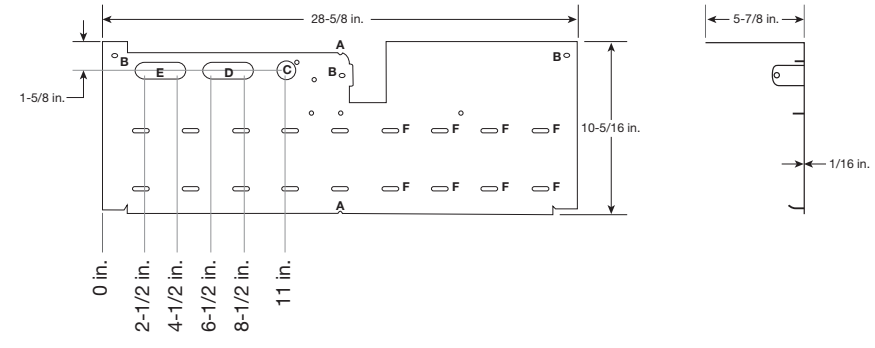
Mounting Bracket for a 30-inch unit

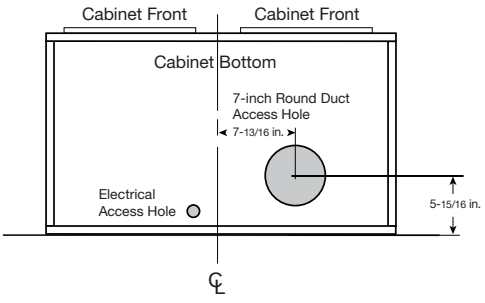


Mounting Bracket

A. Center notches
B. Critical mounting points must be secured to studs or drywall hangers.
C. Rear access to junction box connection
D. Primary access point for connections to junction box
E. Secondary access point for connections to hood (options/ accessories)
F. Additional mounting points. Secure minimum of three (3) screws per row.

Mounting Bracket for NFPA Installation



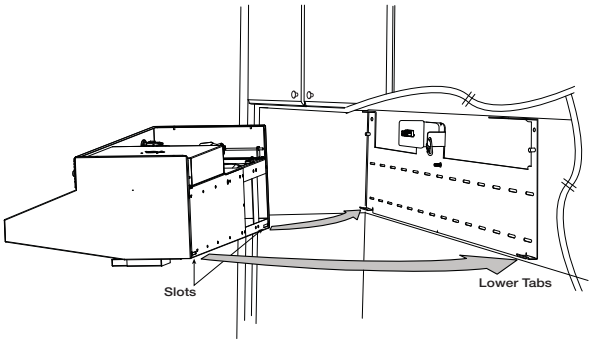


Installing Hood onto Mounting Bracket

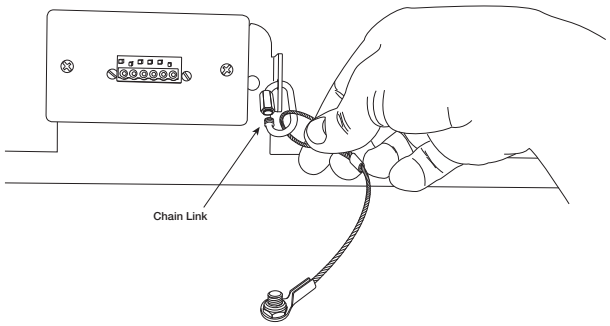
NOTE

Install manual pull station, if provided, before arming the system.

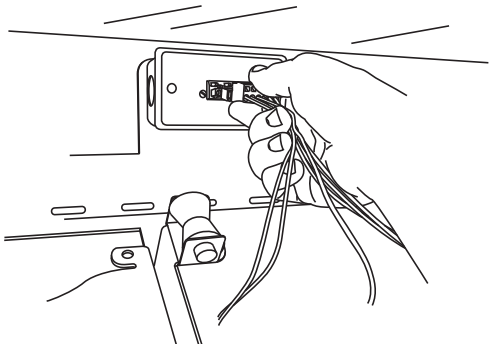
1. Lift hood onto mounting bracket and seat the lower tabs of the mounting bracket into slots in back of hood.



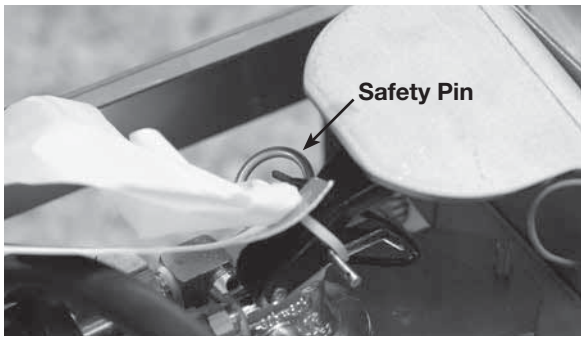
2. While holding the hood up, hook safety cable to chain link on mounting bracket and screw nut to close the link. The hood is now in the service position.



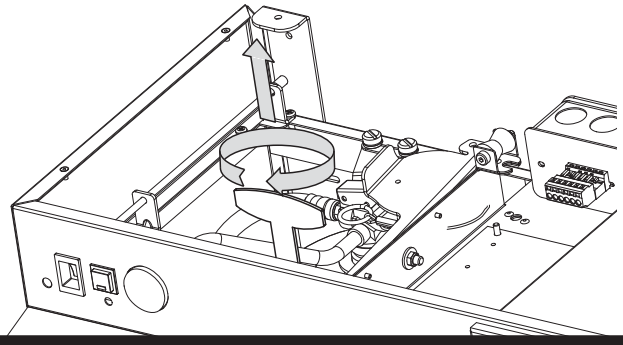
3. Connect male plug from top of hood into female plug mounted in junction box.



4. Remove the safety pin - identified with the yellow CAUTION flag from the trigger on top of the extinguisher bottle.



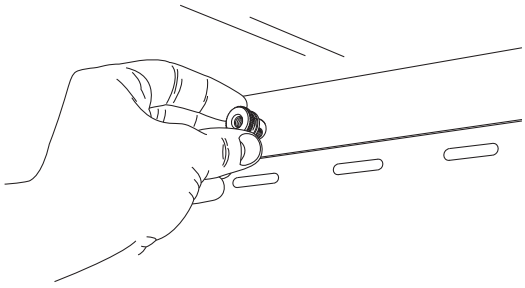
5. Remove the safety key from the actuator arm by rotating and lifting straight upwards. **The system will not actuate without completing steps 4 and 5.**



CAUTION

The system is now armed.

6. Rotate hood to wall and thread the three thumb nuts to the bolts in the mounting plate. Check page 18 for location of thumb nuts.



Installing Fan (if applicable)

Inline

Install fan vertically in ductwork running between the unit and roof cap.

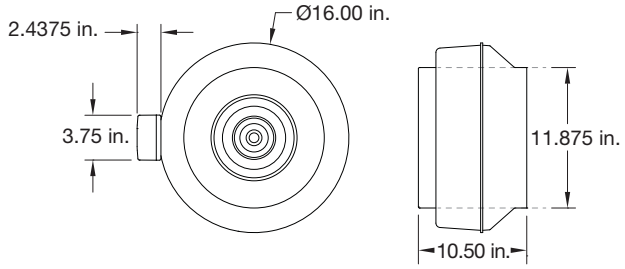
For best results, use as few elbows or transitions as possible. If necessary, long radius elbows or bends are recommended.

To attach ductwork, use duct tape at inlet and outlet to assure a good seal. If using fan clamps, attach clamps and insert screws through clamp into inlet and outlet flanges.

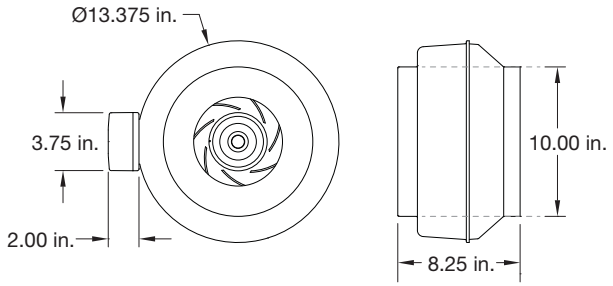
CAUTION

Use sheet metal screws to secure ductwork to inlet and outlet. It is critical that the screw penetrate the metal of the flange, but not so far as to bind the impeller. It may be necessary to angle screws away from impeller.

Inline Exhaust Fan - NFPA



Inline Exhaust Fan - Non-NFPA



Wall Mounted Fan

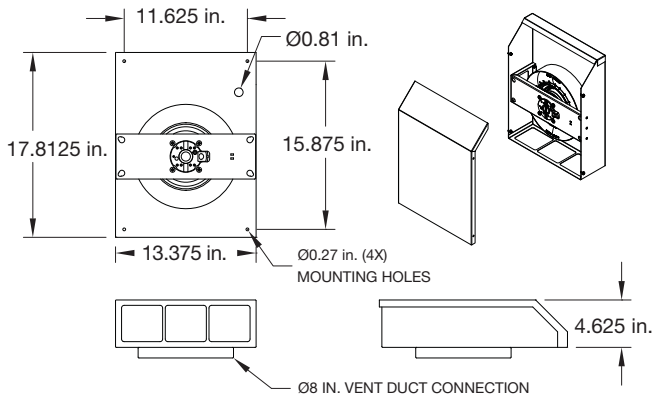
Fasten the fan box to an external wall via the four 0.27-inch mounting holes.

Run electrical through the 0.81-inch hole towards the top right corner of the box.

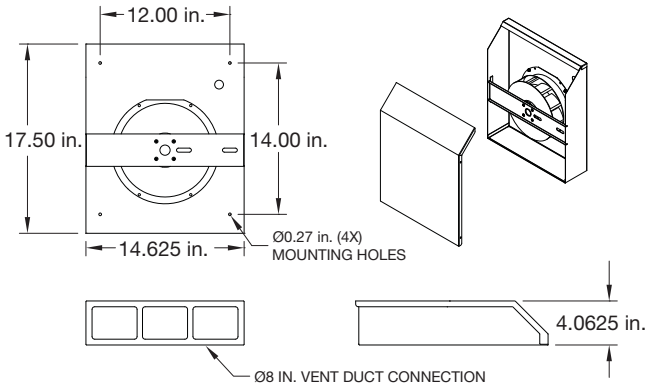
Attach ductwork using duct sealant, caulk, or tape to all seams to prevent air leakage and maximize air performance.

For best results use as few elbows or transitions as possible. If necessary, long radius elbows or bends are recommended.

Wall Fan - NFPA



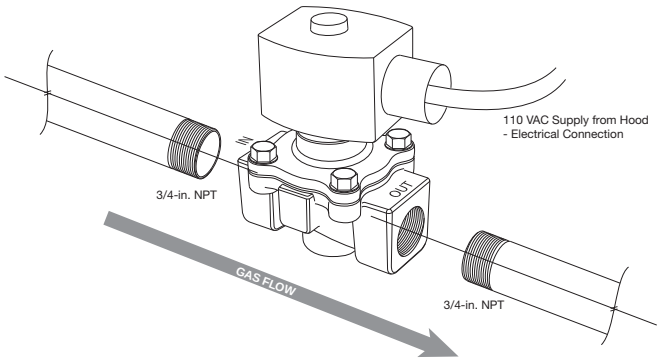
Wall Fan - Non-NFPA



Range Element Disconnect Installation

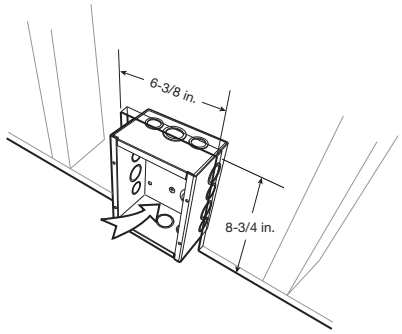
Gas Disconnect Valve (if applicable)

The gas solenoid is designed for use with 3/4-inch NPT pipe. Be sure to note the “IN” and “OUT” ends of the solenoid body (as marked on the body). This determines direction of gas flow. Refer to wiring diagram on pages 13 and 15 for details on electrical connection.

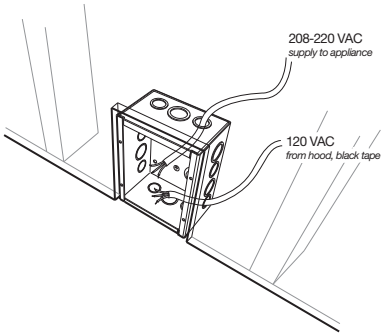


Electrical Disconnect Box (if applicable)

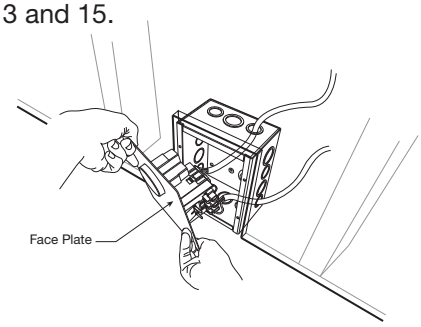
1. Cut a hole in the drywall for the relay box; refer to the submittal for dimensions. Be sure to note the 1-1/4 inch overhang on each side of the face plate. Given this, the hole should be about 6-3/8 by 8-3/4 inch. The relay box has been designed to fit in a standard 2x4 studded wall.



2. If you haven’t already done so, run wiring from the junction box location (on the unit mounting plate) to the power disconnect box location and string through one of the knockouts in the box.



3. Make all wiring connections and secure face plate to box in wall. Wiring information is provided on pages 13 and 15.



Installing Accessories

Refer to your submittal for installation dimensions of these accessories.

ClockBox (optional)

The ClockBox works by controlling the cooking element (gas, electric and dual element ranges) and minimizes the likelihood of an unattended cooking fire. The system disables the cooking element until the operator unlocks the cover and presses the GO button. After two hours the cooking element is automatically disabled.

If this unit was provided with the ClockBox, a ClockBox controller and Touchscreen user-interface will be provided. Both will need to be remotely mounted near the appliance (range) on a nearby wall.

Remote ADA Switches (optional)

If the unit is provided with the remote ADA switches, these will have to be installed to be in compliance with ADA standards for Accessible Design.

Manual Pull Station Installation (optional)

If the unit is provided with the remote ADA switches, these will have to be installed to be in compliance with ADA standards for Accessible Design.

Parts included in the kit:


Pull Box (x1)

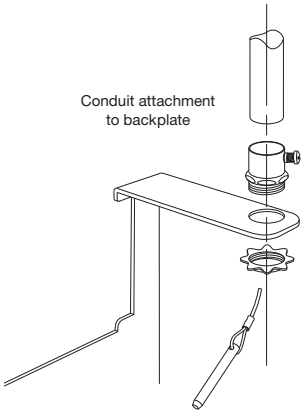
Pull Face (x1)


Elbow Pulley (x3)


Cable and Pin (25 ft)

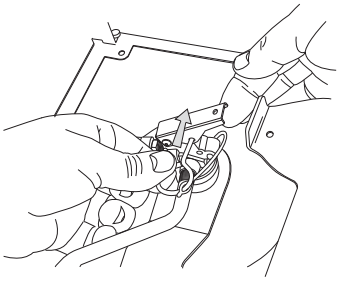
Step 1: Installing Conduit

Mount the pull box in an appropriate location according to local building codes. Keep in mind you are supplied with 25 feet of cable and three (3) elbow pulleys. Install 1/2 inch conduit (not included) between the unit and the pull box, using the pulleys as needed. Pull cable through the conduit, and allow 8 to 12 inches of slack to be left at the hood unit end. Be sure to abide by all local building codes when installing conduit.



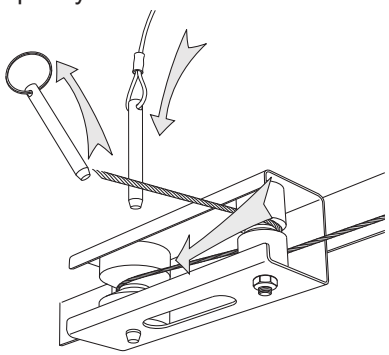
Step 2: Replace Safety Pin and Key (to prevent accidental discharge)

With the unit lowered into its service position, put the safety pin in its slot at the top of the extinguisher tank. Also replace the safety key in its slot in the actuator arm. Then remove the cable from the actuator arm.



Step 3: Install Cable and Pin to hood

Thread the cable through the conduit, with the pin reaching the unit. Remove the grease filter. In the upper right corner, find the two pulleys as illustrated. Hold the rear-most pulley in place. From the top of the unit, replace its pin with the one on the cable. Push the pin through the pulley until you hear it click in place. Go back to the actuator arm and rehook cable onto the arm.



WARNING

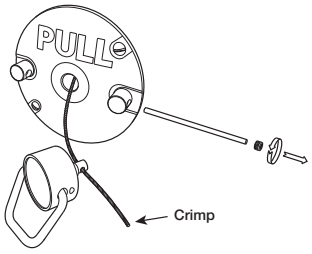
You must allow for 8 to 12 inches of slack in the cable to sit at the pull face. Failure to do so will cause the unit to discharge the next time the unit is lowered into its service position.

CAUTION

Make sure the cable does not become caught on any part of the hood or conduit, or the cable will not be able to be pulled, and the unit will not discharge.

Step 4: Install Cable to Pull Face

With the unit in its lowered position, attach the cable to the pull face by crimping a loop in the cable through the hole on the back side of the handle. Be sure cable is securely crimped to withstand at least 50 lbs. of pull force. Leave no more than 12 inches of slack in the line on the pull face end, but maintain 8 to 12 inches. To make this easier, the handle may be removed by loosening the set screw in one of the studs, and sliding the red plastic rod out. Attach the pull face to the pull box already mounted on the wall, collecting any slack into the pull box. Do not allow slack cable to collect above the hood.



Installing Ductwork (optional)

Ductwork will need to be provided and installed if the unit was provided with an external fan.

Installation work must be done by qualified person(s) in accordance with all applicable codes and standards, including fire-rated construction.

To minimize static pressure losses and promote adequate airflow, minimize duct run lengths where possible.

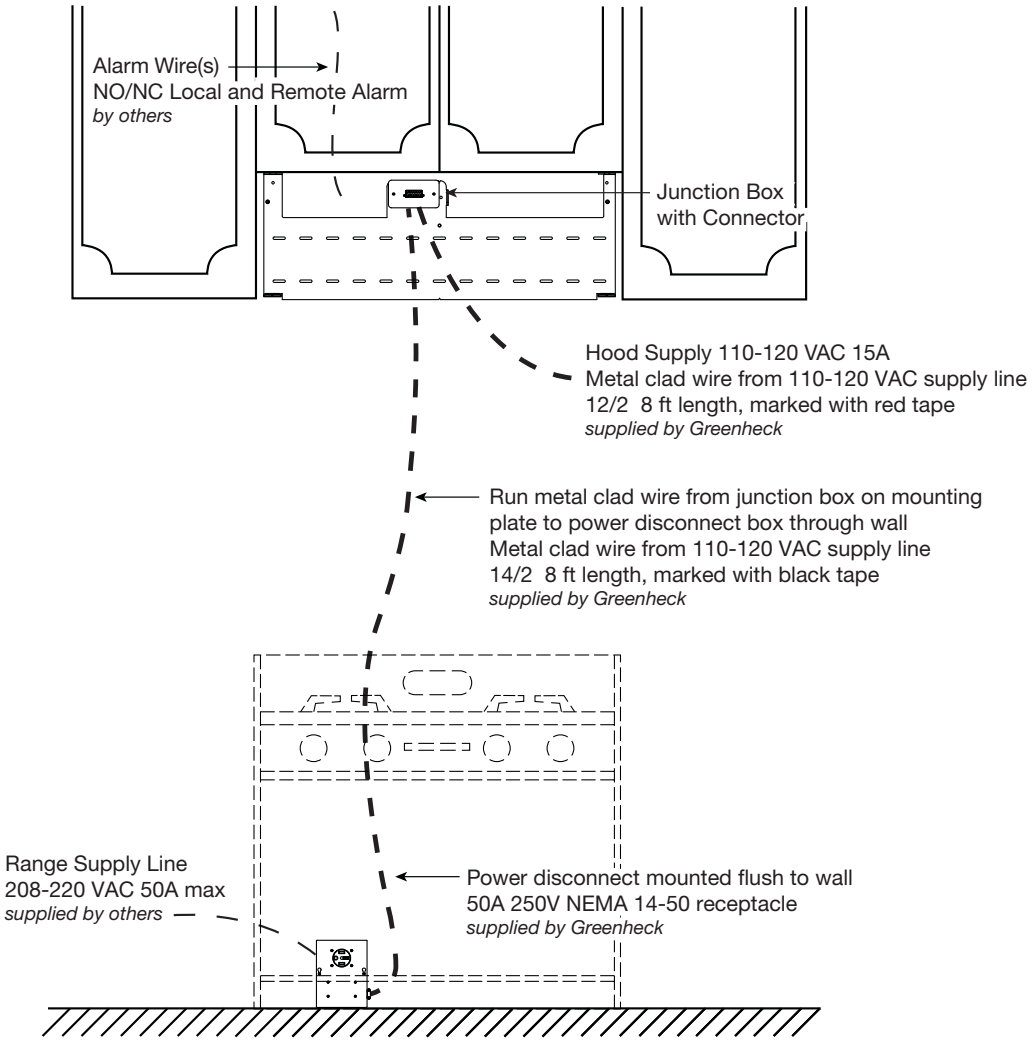
Electrical Installation

Main Control Power

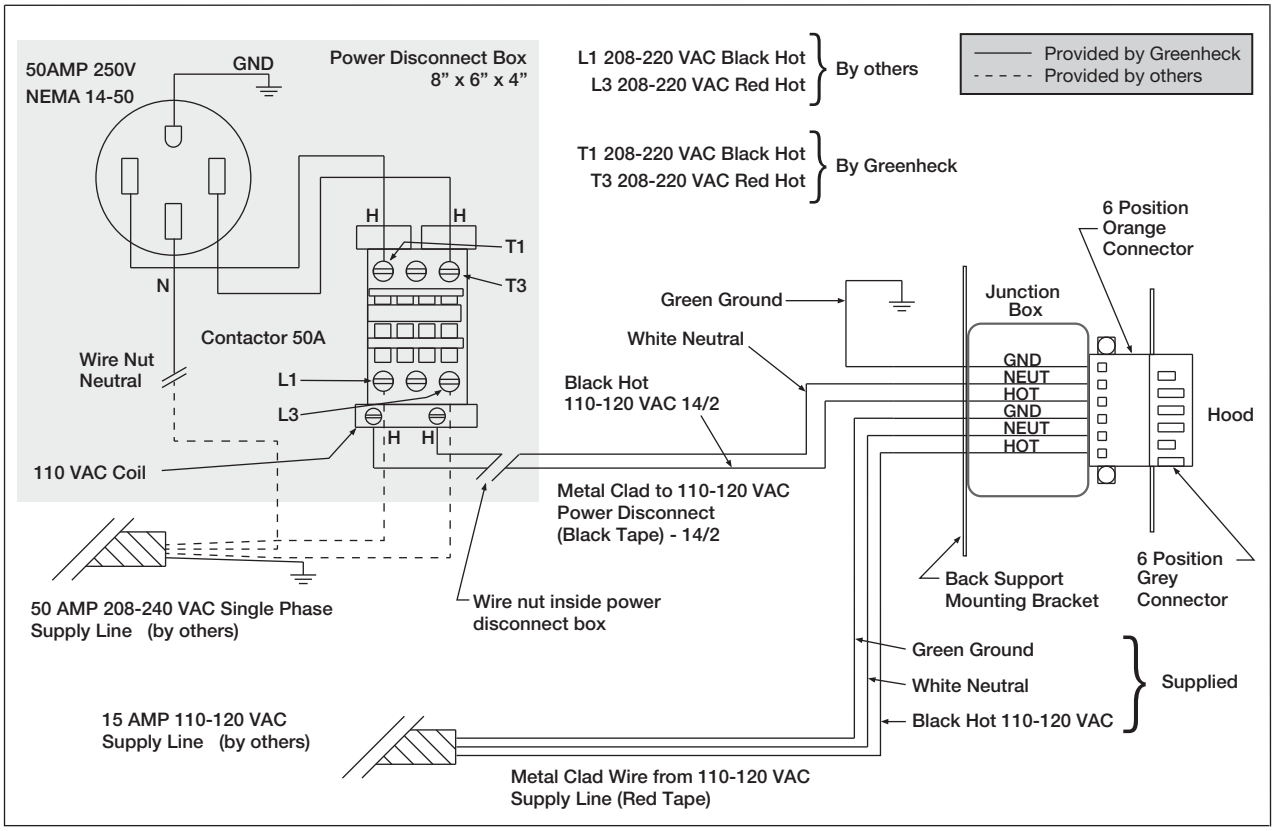
1. Determine mounting location of the appliance disconnect (contactor box and/or gas valve) and mounting bracket, if not already done.
2. Run factory-provided wire from junction box through the wall to the appliance disconnect, unless ClockBox option is provided. For electrical installation information regarding the ClockBox, refer to page 16. Wire the factory-provided 110 VAC main power connection to a 15 amp rated circuit.
3. If the hood unit is to be linked to a fire alarm system, accommodations for those wires will need to be made at this time as well. Refer to fire alarm electrical installation information on page 14.

CAUTION

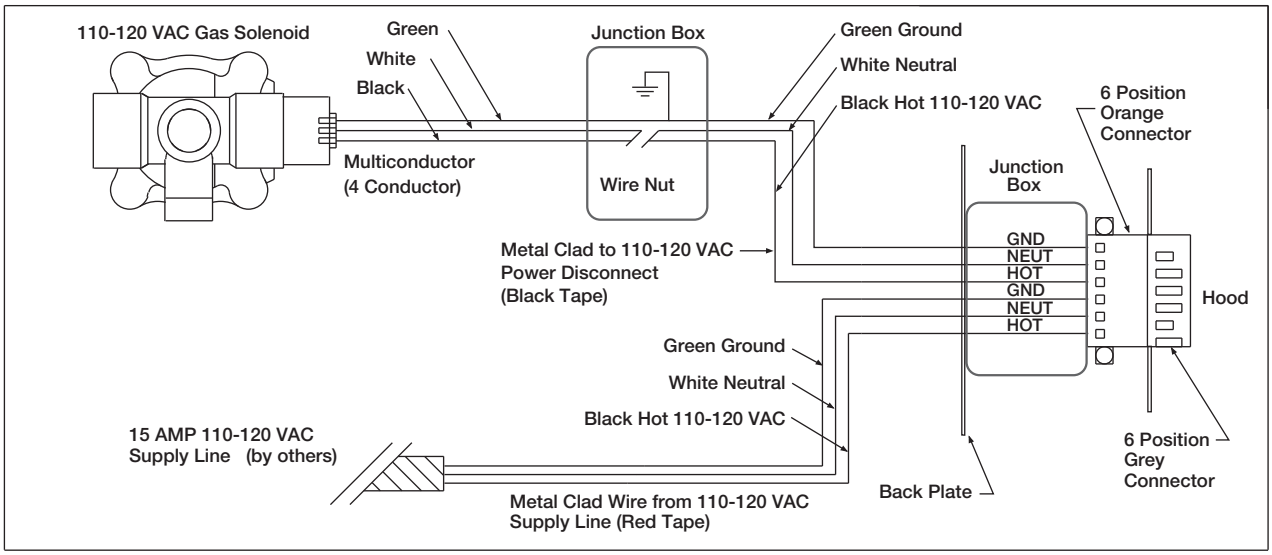
Electrical installation should be performed by a licensed electrician. Installation should be performed according to all applicable codes and regulations. Shut off power at the main breaker to prevent electrical shock when accessing electrical connections.
All field installation and wiring of electrical equipment must be done to meet NEC and local codes



Electric Disconnect Box (if applicable)



Gas Disconnect Valve (if applicable)



Inline/Wall Mount Fan Power (if applicable)

Twenty-five (25) feet of plenum rated wire is provided with both the inline fan and wall mounted fan option. The fan needs to be connected with the provided connector within the hood controls. See wiring diagram on page 15 for wiring information.

ClockBox (if applicable)

Twenty (20) feet of shielded control wire is provided with the ClockBox option to connect the ClockBox controller to the touchscreen interface. The ClockBox needs to be connected back via the connector within hood controls. See wiring diagram on page 15 for wiring information.

Remote ADA Switches (if applicable)

Eight (8) feet of shielded control wire is provided with the ADA remote switch option. The switches need to be connected back with the provided connector within the hood controls. See wiring diagram on page 15 for wiring information.

Fire Alarm System Connections

The hood unit has two fire alarm connections (discrete switches), each with its own trigger. A connection is made to one output (Y#) and one common (C#) at the controller. The output labeled Y0 is triggered by a fault from the high temperature switch (190°F), or pressure switch, or hose switch. Output Y1 is triggered by a high temperature switch (190°F) **and** a low pressure fault in the extinguisher tank (the fire suppressant has discharged). You may use either one connection or both, depending on your situation. When there is a fault, a buzzer in the unit will sound and the power disconnect will turn off.

Local Alarm Connection: Connect to output Y0 and common C0

Remote Alarm Connection: Connect to output Y1 and common C1

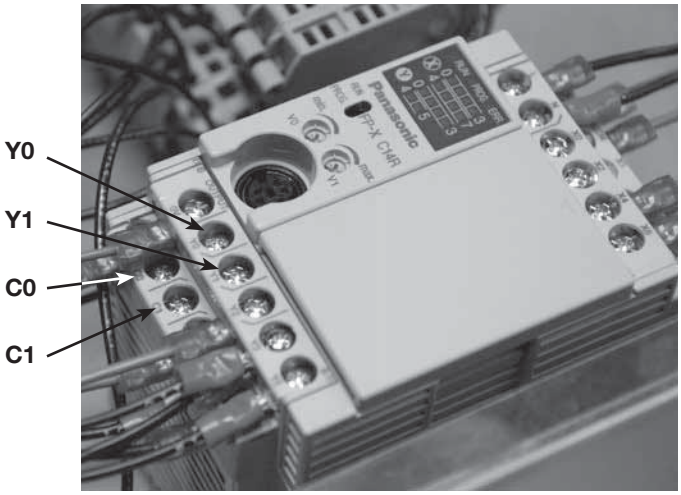
To connect to the alarms, it is preferred that you use a spade terminal connector (supplied), but a stripped wire is acceptable.

Connecting the alarm system in the configuration described above results in a normally open connection.

To switch these two alarm contacts to normally closed connections, insert a jumper into the blue and the gray terminal adjacent to it **(terminal blocks 4 and 5)**. One leg of the provided jumper is inserted into the blue terminal and the other into the gray terminal.

NOTE

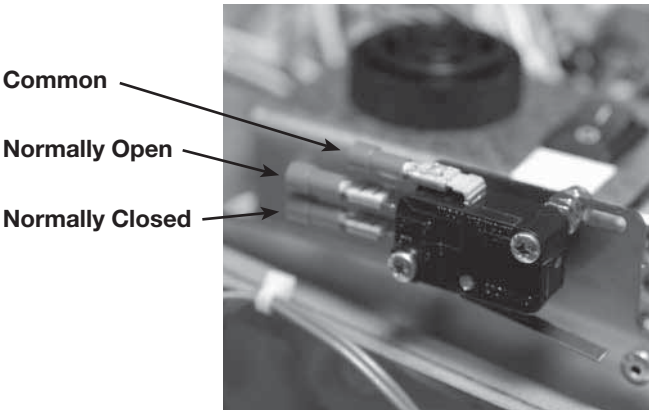
Ensure jumper is inserted completely and the top of the jumper is level with the other jumpers.



Onboard Controller

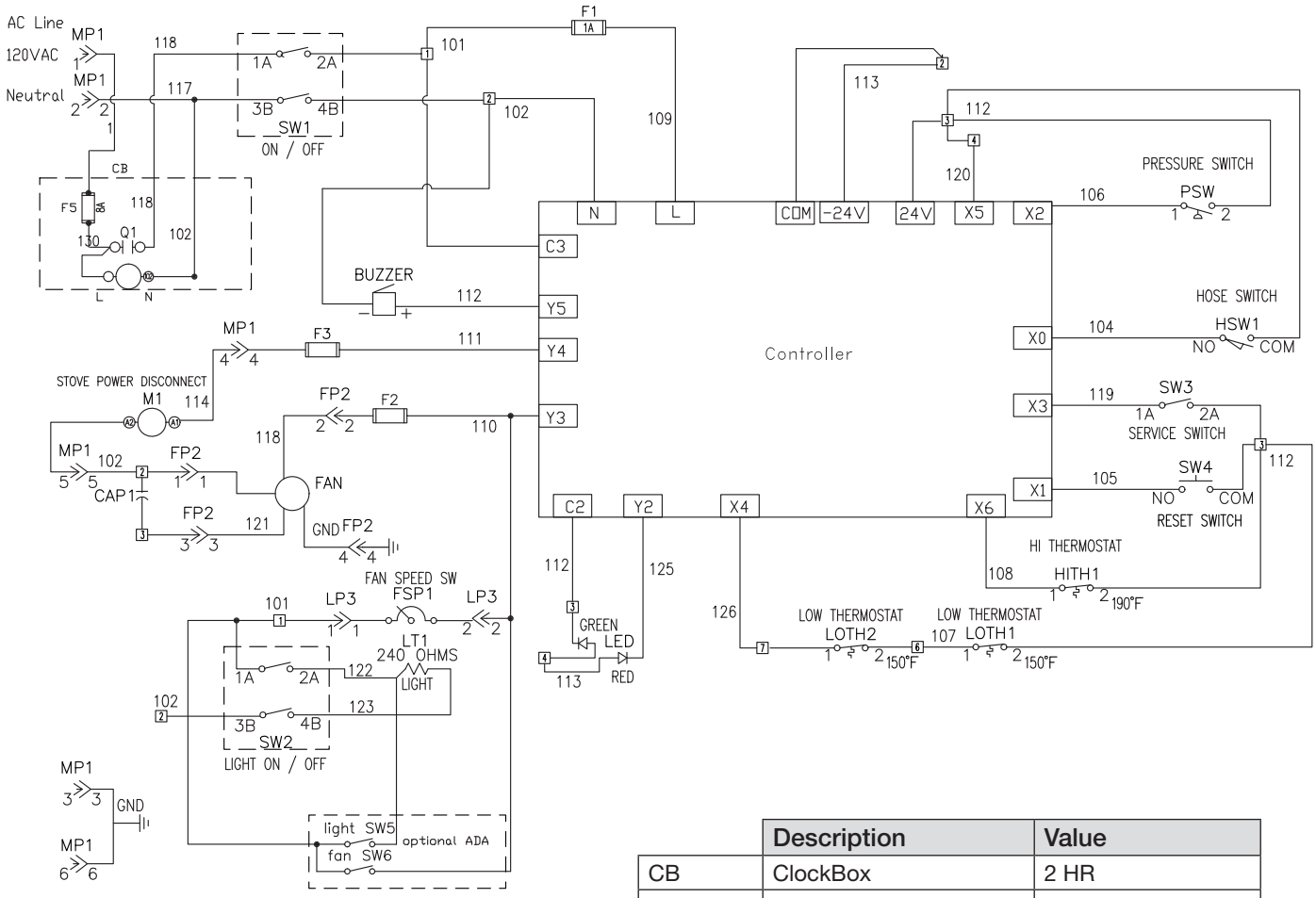
In addition to the fire alarm system connections described previously, a second connection may be made to the fire alarm switch installed in the unit. Unlike the connection above, this switch does not require power to be fed to the hood in order to function. The fire alarm switch is located above the actuator arm, beside the controller assembly. The fire alarm switch is activated when the actuator arm trips.

To connect the fire alarm switch, wire the fire alarm to the common connector and normally open or normally closed connection as shown.



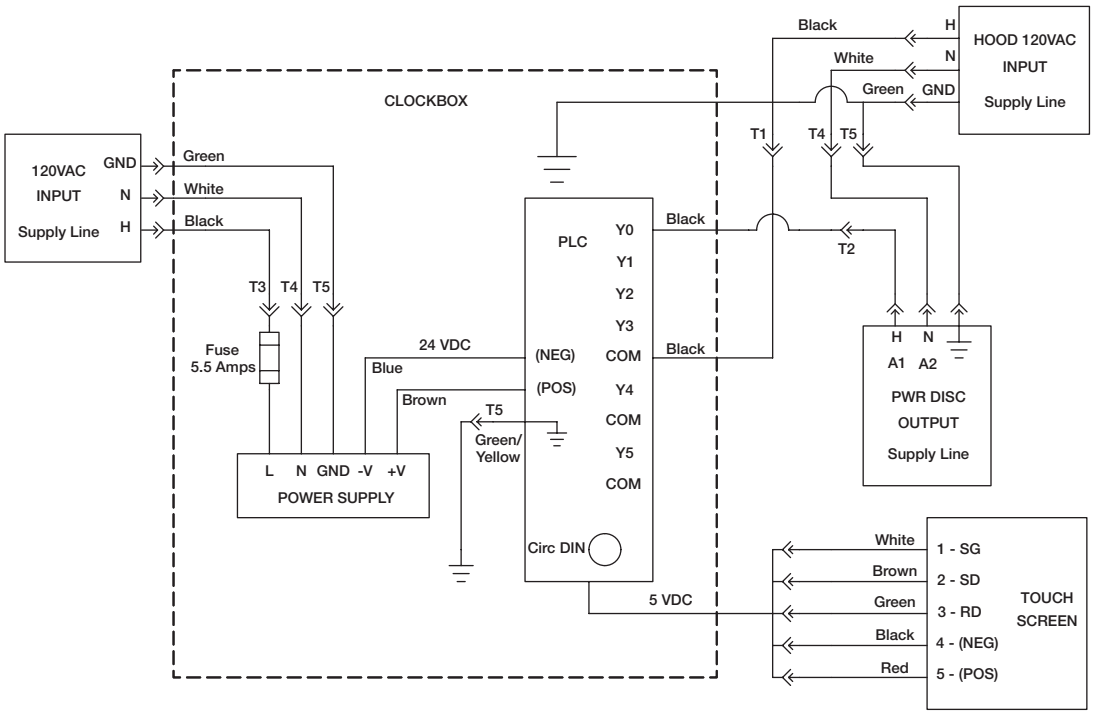
Fire Alarm Switch

Wiring Diagram



	Description	Value
CB	ClockBox	2 HR
F1	Controller Fuse	1 AMP Fast Blow
F2	Fan Fuse	2 AMP Slow Blow
F3	Dual Disconnect	1 AMP Slow Blow
F3	Disconnect Fuse	0.5 AMP Slow Blow
F4	Main Fuse	8 AMP Slow Blow
F5	ClockBox Fuse	8 AMP Slow Blow
MP1	Main Power Connector	
FP2	Fan Connector	
SW1	Main Power Switch	
SW2	Light Switch	
SW3	Service Switch	
SW4	Reset Switch	
SW5	Optional ADA Light	
SW6	Optional ADA Fan	
HSW1	Hose Switch	
HITH1	High Temp Thermostat	190°F
LOTH1,2	Low Temp Thermostat	150°F
FSP1	Fan Speed Controller	4.0 FLA
FAN	Inline or Recirc Fan	
CAP1	Capacitor for Recirc Fan	10 UF
M1	Stove Disconnect	40 FLA 50 A RES
LIGHT	Hood Light	60 WATT
Controller	Computer Driving Hood	
BUZZER	Alarm in Hood	90 DB

ClockBox Wiring Diagram (if applicable)

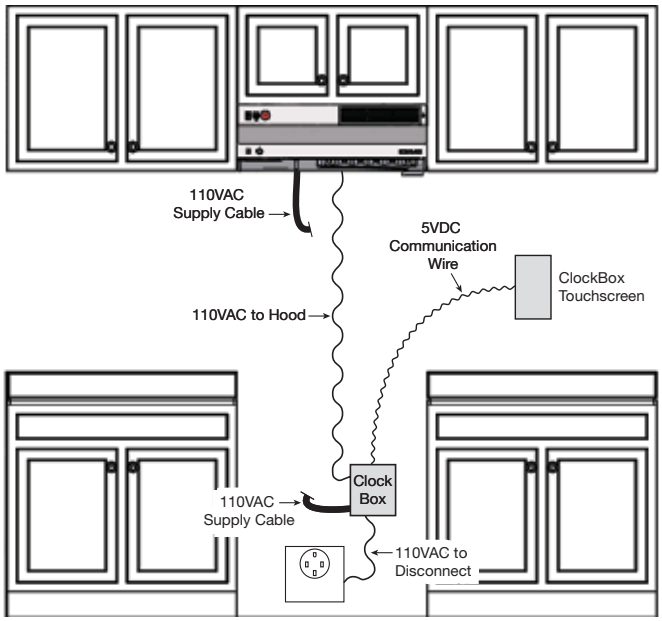


1. An independent 110 VAC supply line is provided to the ClockBox.
   a. This supply line provides power to the ClockBox, which is independent from the supply line to the hood.
2. The ClockBox provides 110 VAC to the Power Disconnect Assembly
3. The ClockBox provides control signal voltage (5VDC) and logic control to the Touchscreen [HMI]
4. The Power Disconnect Assembly supplies the input line to the stove/range as follows:
   a. If an **Electric Disconnect**
      - Controls the 110 VAC contactor coil allowing the 220 VAC supply line to the stove/range via the NEMA 14-50 receptacle.
   b. If a **Gas Disconnect**
      - Open the solenoid valve allowing gas to flow to the input line of the stove/range
   c. If **Dual Disconnect**
      - Both conditions 6.a.i and 6.b.i will apply
   d. The above reference will be maintained for as long as there is time left at the ClockBox, it will open the contact in the timer, stopping the supply line to the Power Disconnect, which in turn, will shut off the stove.

NOTE

Some electric stoves/ranges have a warning light to alert the user that the burners/coils are hot. These warning lights will be off since the supply line powering the stove/range is not present.

ClockBox System Interface Diagram



Operation - How it Works

The GRRS functions as a standard ventilation range hood with the added capability to suppress stove top fires.

Designed for use over a standard 30 and 36 inch residential range, it uses a mechanical, commercial style automatic fire suppression system.

Refer to the illustration below to familiarize yourself with the following functions.

- A controller provides an internal alarm plus connections for up to two external alarms that may go to a local alarm panel and/or remote location, i.e. the local fire department.
- The unit is powered from standard 115 VAC / 60 Hz / single phase. A main Power Switch is located at the upper left of the front surface. (Remote ADA switches provided).
- For normal daily use, the unit provides a fan speed control knob and a light switch for the light.
- A Reset Button (white) is provided to energize the controller and the main power disconnect contactor (electric range) or valve (gas stove). Upon initial power up, the control system is not enabled and this reset button needs to be pressed. In doing so the Status LED below the reset switch will turn from red to green.

Environmental Monitoring / Pre-Suppression Functions

The controller operating system is designed to enhance the functionality of the unit and the safety of the cooking environment.

The system relies on input from a set of thermostats to control the fan and shutoff power to the stove when the temperature reaches preset points.

As the temperature rises, the controller monitors the environment with the three (3) thermostats. The board is programmed to respond to two temperature thresholds. The first at 150°F and the second at 190°F.

At the first temperature threshold of 150°F, the ventilation fan will turn on, **regardless of the front panel switch setting.**

At the second temperature threshold of 190°F:

1. The power disconnect to the stove (valve or contactor) is de-energized, shutting off power to the stove.
2. The “local” alarm output is tripped, indicating a trouble condition with the unit. This output is from contacts C0 and Y0 on the controller.
3. The on-board audible alarm sounds (high pitched tone).

NOTE

See page 21 for controller schematic.

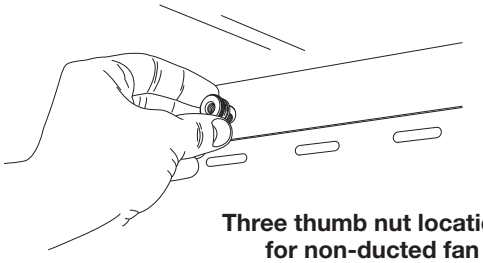
Accessing the Internal Components

Moving the unit between 'operating' and 'service' positions.

All GRRS models have been configured as a stand alone unit mounted to a wall plate. As such, the unit may easily be tilted down into a service position, giving you access to the electronics and extinguisher tank, or be removed completely for maintenance and cleaning. Provisions have been made to facilitate easy removal including a minimal amount of fasteners and modular electrical connections.

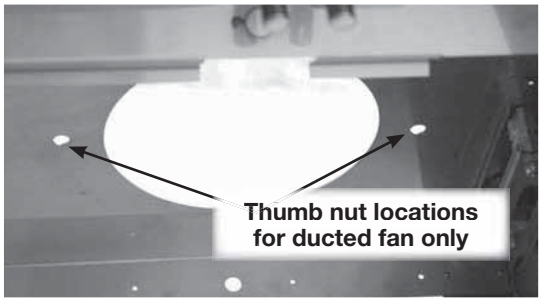
To place the unit in the service position, a few simple steps are required. Be sure to wear safety glasses at all times during this process:

1. Shut the unit off with the power switch on the front of the hood.
2. Remove the grease tray and the grease entrapment filter.
3. For **non-ducted installation**, loosen and remove the thumb nuts that are on the rear inside wall of fan housing compartment.



Three thumb nut locations for non-ducted fan

On **ducted installations**, remove the two thumb nuts located at the top inside near the fan intake. Slowly lower the unit.



4. The unit will now freely pivot downward to a stop position. A safety cable is provided to prevent the unit from falling or lowering too far.
5. Place safety pin in the tank valve to avoid accidental discharge.

With the unit in this position, basic servicing and cleaning may be performed, including servicing the extinguisher tank assembly.

To move the unit back to the operating position, simply reverse the process as outlined above.

CAUTION

- Be careful while working with the unit in the service position. Release of the cable system or applying force to the tank valve assembly may cause discharge of the tank. The high pressure discharge has the potential to cause skin or eye damage and injury!
- An electrical shock hazard is present at the electrical compartment whenever there is power to the hood. Use caution when working around this device while the unit has power.

ClockBox Operation and Navigation (if applicable)

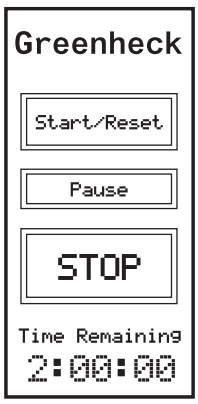


Figure 1

FIGURE 1

1. Press **Start/Reset** to allow the 2 hour timer to begin. This will prompt to the password screen. See Figure 2.
2. Press **Pause** to pause the timer, press again to continue.
3. Press **STOP** to stop the timer.
4. If the timer is running, pressing the **Start/Reset** button will reset the timer at the original timer value and start running the timer again.
5. The Greenheck logo is a hidden button which allows access to background menus. Press the **Greenheck** logo to access hidden menu to modify timer values and passwords. See Figure 3.

NOTE: Main Screen will always show available time. System is pre-set to countdown remaining time.

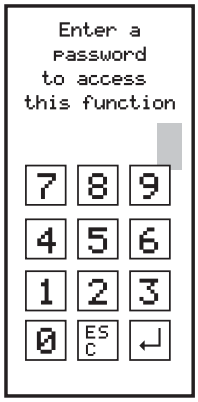


Figure 2

FIGURE 2

1. Factory preset master password: 06412
2. Enter password 06412 and then press the enter symbol (↵).

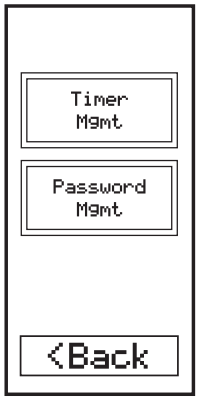


Figure 3

FIGURE 3

1. Press **Timer Mgmt** to modify the timer value. See Figure 4 for timer management screen.
2. Press **Password Mgmt** to add/modify/delete passwords. See Figure 5 for password management screen.

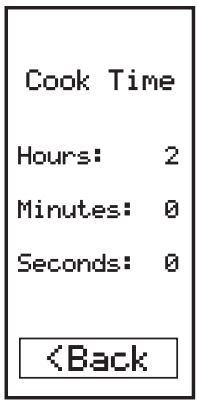


Figure 4

FIGURE 4

1. To adjust hours, minutes, or seconds of cook timer, press on respective number. Enter the new value and press enter symbol (↵) to store the value.

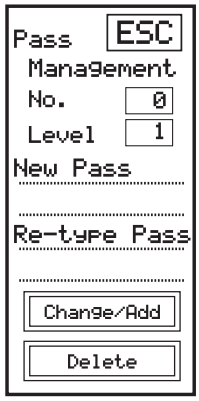


Figure 5

FIGURE 5

1. Adjust pasword number and level. Press under **New Pass** to key new password. To validate the password, re-type the password under **Re-Type Pass**. Press the **Change/Add** key to add or adjust a password or **Delete** to omit a stored password.

Test Tank and Demonstration

Once the hood has been installed, it may be necessary or desired to test the unit with a test tank filled with pressurized nitrogen (optional).

1. Following the "Removing the Extinguisher Tank" instructions on page 25, remove the extinguisher tank and replace it with a test tank.

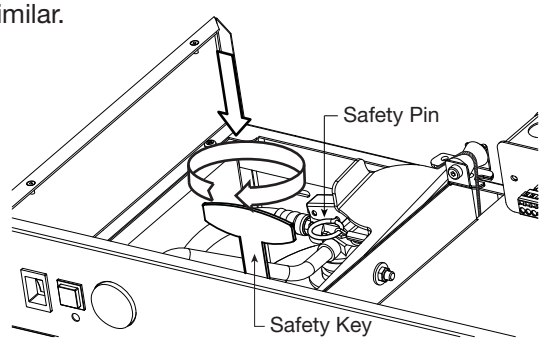
WARNING

The safety pin must be in place in the extinguisher tank until the unit is ready to be returned to service or to be tested. **Always wear safety glasses during this procedure.**

2. The unit can be actuated one of two ways:

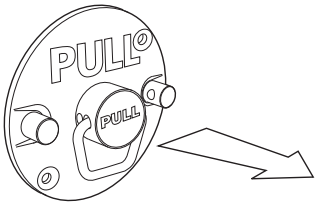
A. Cut Test Links

Replace the actuator arm's safety key. Loosen the turnbuckle in the fusible link cable assembly (underside of hood). Replace one of the fusible links with a test link. Retighten the turnbuckle to the proper tension. Remove the safety key and raise the unit to its operational position. To test, cut the test link with wire cutters or similar.



B. Manual Pull Kit (if installed)

Raise the unit to its operational position after the test tank has been installed. Remove the plastic break rod from the pull face with an allen wrench (refer to manual pull station appendix for more detailed information on this). Pull the handle to actuate the unit. Refer to the "Manual Pull Kit" section on the method to return the pull station to an operational state.



3. Nitrogen should be released from each nozzle simultaneously.

WARNING

Be careful of the protective caps on the nozzles. These will fly off the nozzles when the unit is actuated. **Always wear safety glasses during this procedure.**

4. Replace the test tank with the extinguisher tank, the test link with a fusible link, and place the unit to its operational position. The unit is now ready to be put into service.

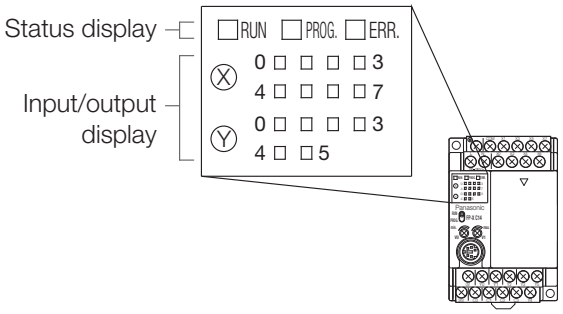
Controller Schematic

On the controller, there are two rows of LED indicators next to the X (inputs) and two rows of LED's on the Y area (outputs).

LED Label	Input Function	Scenario	LED State
X0	Hose Switch	Hose in place	On
		Hose disconnected	Off
X1	Reset Switch	When switch is depressed	On
		Switch not pressed	Off
X2	Pressure Switch	Pressure okay	On
		Pressure failure	Off
X3	Service Switch	Servicing unit	On
		Normal operation	Off
X4	Low Temperature Switch	Both low temp thermostats below 150°F	On
		Either thermostat at or above 150°F	Off
X5	Remote and Local Alarms	Alarms are configured for normally closed (jumper installed)	On
		Alarms are configured for normally open (no jumper)	Off
X6	High Temperature Switch	High temperature thermostat below 190°F	On
		High temperature thermostat at or above 190°F	Off

LED Label	Output Function	Scenario	LED State
Y0	Output for Local Alarm	Low gas switch activates OR hose switch activates OR high temperature switch activates	On*
		Normal operation	Off*
Y1	Output for Remote Alarm	Loss of pressure AND high temperature (fire suppression discharge)	On*
		Normal Operation	Off*
Y2	Normal Condition	Alarm condition	On
		Normal condition	Off
Y3	Fan	When controller turns the fan on	On
		When controller is not running the fan	Off
Y4	Power Disconnect	When power is being set to gas/electric disconnect (normal operation)	On
		When power is lost to gas/ electric disconnect	Off
Y5	Horn	Horn is on	On
		Horn is off	Off

*The LED's state depends on whether the alarm contacts are set up for normally open or normally closed. These contacts are set up for normally open from the factory (LED's illuminate during alarm). To configure the fire contacts for normally closed state (LED's illuminate on no alarm), a jumper must be placed between two terminals. Please see page 14 for additional information.



The controller's operating system is designed to enhance the functionality of the unit and the safety of the cooking environment.

Alarm Connections

Alarm Outputs: The other function of the controller is to report alarms from the system either for a system fault or as a result of a system discharge. Refer to Fire Alarm System Connections on page 14 in this installation manual for information on how to connect the alarm outputs.

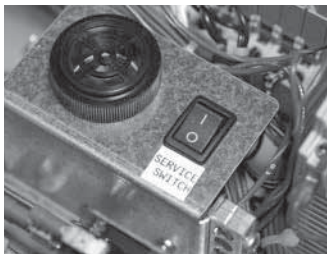
Output Y1 and common C1 are configured to close with the discharge of the extinguisher tank. This condition is determined by the controller with the low pressure input from the switch and a high temperature condition from the 190°F rated thermostat. Both conditions must be present in order for this output to trigger.

Note that the microswitch outputs are dry contact type, rated for low voltage, and can be normally open (NO) or normally closed (NC), with a common. Therefore do not produce any current or voltage output.

NOTE

Pressing the reset button will not turn off alarm. Unit needs to be recharged to reset alarm.

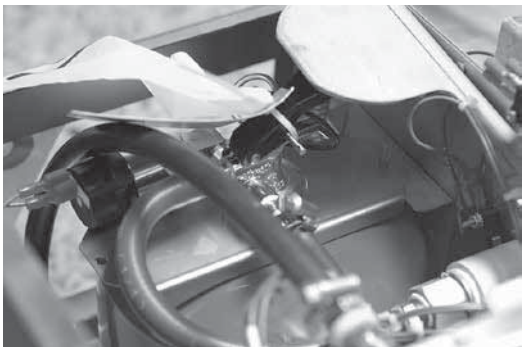
Service Switch: The black switch next to the controller and internal audible alarm is the service switch. It can be switched on or off. When it is switched to on, the remote alarm and local alarm are deactivated. Its purpose is to allow service to be conducted and components tested without setting off the alarm. Once testing or service is done, turn the service switch to off for normal operation. NOTE: LED will flash orange and green.



Service Switch in the OFF position

Self-Monitoring System

These functions are to be checked at start-up.



Low Pressure

HOW TO TEST FUNCTION

a. Unplug one of the wire terminal connections attached to the pressure switch.
b. LED turns from green to orange blinking with buzzer.
c. Power for gas valve or disconnect turns off.
d. Audible buzzer inside of hood beeps 4 times.
e. Local Alarm Activation “Y0-C0”.
f. Hood remains powered.

Loose Connection on Discharge Hose

HOW TO TEST FUNCTION

a. Unplug the hose quick disconnect coupling to discharge manifold.
b. LED turns from green to orange blinking with buzzer.
c. Power for gas valve or disconnect turns off.
d. Audible buzzer inside of hood beeps 3 times.
e. Local Alarm Activation “Y0 to C0”.
f. Hood remains powered.

High Temperature Switch

HOW TO TEST FUNCTION

a. Unplug red wire terminal located on terminal strip #4. NOTE: Do not remove the wire, just unplug the terminal. You can also use a heat gun on the center of the hood to simulate a high temperature.
b. LED turns from green to orange blinking with buzzer.
c. Power for gas valve or disconnect turns off.
d. Audible buzzer inside of hood beeps 5 times.
e. Local Alarm Activation “Y0 to C0”.
f. Fan turns on.
g. Fan remains on for 3 minutes after you lower temperature or put red wire back on.
h. Hood remains powered.

Low Temperature Switches

HOW TO TEST FUNCTION

a. Use heat gun on either left or right low temp switch.
b. Fan turns on.
c. Fan remains on for three minutes after temperature falls below 150ºF.

High Temperature and Low Pressure Switches

HOW TO TEST FUNCTION

a. Unplug red wire terminal located on terminal strip #4. NOTE: Do not remove wire, just unplug it’s round connector. Unplug one of the wire terminal connection attached to pressure switch.
b. Fan turns on.
c. LED turns from green to orange.
d. Power for gas valve or disconnect turns off.
e. Audible buzzer inside of hood on continuously.
f. Local Alarm Activation “Y0 to C0”.
g. Remote Alarm Activation “Y1 to C1”.
h. Hood remains powered.

Alarm Discharge Switch

HOW TO TEST FUNCTION

a. Depress actuator lever located at the micro-switch next to tank.
b. Check continuity of both normally open and closed contacts.

Service Switch in ON (1) Position

HOW TO TEST FUNCTION

a. LED turns from green to blinking orange/green.
b. Power for gas valve or disconnect turns off.
c. No alarm closure at Y1-C1 or Y0-C0.
d. Pressing the reset button will not reset the hood until the service switch is put back in the off (normal) position.

After an Actuation

The fire suppression system must be recharged and restored to service immediately after any discharge for continued fire suppression protection.

WARNING

- Safety glasses and gloves must be worn for all the following operations. Flush thoroughly with clean water if agent comes in contact with skin or eyes.
- Allow time for cooling before attempting any cleaning. Using water to clean any appliance that contains hot grease or cooking oils, may result in violent steaming or splattering.

Clean-Up Procedures

Due to the alkaline nature of the fire suppressing agent, kitchen surfaces must be cleaned immediately after system discharge. The wet chemical agent discharged produces a foamy by-product that can be wiped up with a cloth or sponge.

Clean-up procedures are as follows:

1. Before clean-up ensure that all fuel or electrical sources to the equipment to be cleaned have been shut off. Unplug exhaust hood and all appliance electrical controls to avoid any chance of electrical shock resulting from the cleaning process or from an electrically conductive liquid agent.
2. Discard food and cooking oil that has contacted the extinguishing agent since it is no longer suitable for consumption.
3. Wipe up as much of the agent as possible with paper towel or disposable rags.
4. Use hot, soapy water to clean away all residue and any surfaces that the agent has come in contact with.
5. Completely dry all areas before continuing the service procedure.

Inspect the Unit for Damage

Be sure no components of the hood were damaged from fire/heat.

Determine Cause of Discharge

Determining the reason for the system discharge before recharging the fire suppression system and resetting the unit is critical to ensure either the system performed as designed, or was caused by a component malfunction. Great care has been taken to simplify field installations, so system malfunctions should be extremely rare.

- A fire may have caused the fusible links to melt, causing the system to discharge. In case of fire, inspect the electrical system and all wiring for heat damage.
- The remote pull station (optional) may have been pulled.
- If fusible links have not been changed within the past 12 months, they may have stretched and released the actuation cable.

How to Reset the Suppression System

Resetting and testing release mechanisms, remote pull, and fusible links.

Reset detection system by completing the following steps:

1. Remove extinguisher tank
2. Make sure tension arm cable is in the released slack position.
3. Remove the 3 fusible links from the cable assembly and replace links with 2 new properly rated links and one test link at terminal end.
4. Return tension arm and cable mechanism to a cocked position.
5. Using wire snips, cut the test link at the terminal end to simulate an actuation.
6. If system actuates successfully, go to Step 8.
7. If the release mechanism does not actuate, check the following components and remedy any disorder as follows:
   a. Check the detector links for correct positioning through pulleys in system and for possible twists or knots in the cable
   b. Ensure that actuator arm is in place and is cocked.
   c. Retest the system after installing a new test link on the terminal end.
   d. Verify that safety pin is removed from suppression tank. If problems persist call the factory at 1-800-371-6858.
8. Upon successful actuation of the system, complete the following steps:
   a. Release cable from actuation lever and install a properly rated fusible link in the terminal location.
   b. Replace extinguisher tank and reattach cable to actuation lever to place it into its “ready” position.

Recharge Tank

1. Placing the hood into the service position allows for removal of tank and examination of components.
2. Disconnect the tank pressure switch and the hose discharge assembly connection and remove the tank from the hood. It is recommended to replace the pin back into the tank in case of left over suppression media.
3. Remove the tank valve assembly and inspect the valve and O-rings for damage. Thoroughly flush the valve and O-ring with water.
4. Once flushing is complete, refill the tank with the measured amount in the recharge and refill kit, screw on valve assembly, and recharge with nitrogen to a pressure of 100-105 psi (green zone on pressure gauge).
5. Reinstall tank and ensure all systems have been thoroughly checked and retested with new links. The system can now be put into service.

The pressure gauge is directly plumbed to the wet chemical tank valve assembly and indicates the pressure status of the nitrogen in the tank. The tank includes a pressure switch that closes if pressure is in the “green” or normal operation range.

Resetting Gas Shut-Off Valve

Before the gas supply is turned back on, extinguish any open flames and turn off all burners and any electrical or mechanical devices that are capable of igniting gas to reduce the risk of explosion due to leaking gas. Check to ensure the power switch is on.

Reset gas shut-off valve by completing the following steps:

1. On the top of the hood press the white manual reset button. The gas valve will energize into its normal operating (open) position.
2. Examine burners for gaseous odor. If gas odor exists, turn off power switch which will cause the gas valve to close and shut off gas supply. Clear gas fumes by opening windows and doors and then correct gas leak before proceeding.
3. Reset gas valve again and if there is no gaseous odor, pilot lights may be ignited at this time. Gas stoves with a pilot light that is always on require added caution. The pilot light must be relit manually.

Resetting Electrical Relay Shut-Off

1. Check to ensure the power source is on.
2. Press the white manual reset switch on the top of the hood.
3. Status LED will turn from red to green.

If the system does not reset, one of the following possibilities may be the problem:

- Tank hose not connected properly
- Tank pressure sensor wire disconnected
- Tank not to adequate pressure
- Electric power is shut off

Maintaining the System

Cleaning the Hood

To remove built up grease and cooking debris, clean the unit thoroughly with mild detergent and water. Be careful when using abrasive cleaning pads as they may scratch or mar the stainless steel surfaces. The grease entrapment filter, front discharge grille and grease tray are dishwasher safe. The carbon filter cannot be washed and should be replaced periodically as needed.

Inspection Procedures

Inspect the Nozzle Caps

The nozzle caps should be inspected and cleaned. All five (5) nozzles should have protective caps installed. If necessary, remove the caps and check for build up of debris or any signs of clogging of the nozzle orifice. If clogging is suspected, remove the nozzle with a 7/16-inch wrench, and flush with hot water until it flows freely through the nozzle.

Replace the nozzle and protective cap.

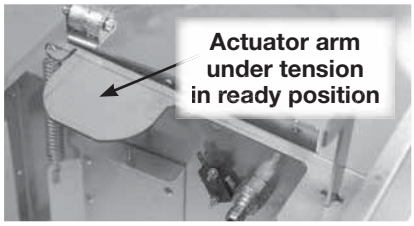
Replacement caps and nozzle O-rings are available from Greenheck or through your representatives.

WARNING

The protective caps stay on the nozzles at all times. In the event of a discharge, the caps will blow off.

Inspect Fusible Link System*

Periodic inspection of the fusible link system ensures the unit is ready to work in the case of a fire.



1. Place safety pin in tank valve.
2. Remove tank from hood.
3. Remove tension from cable system by loosening the turnbuckle.
4. If the fusible links need to be replaced, call 1-800-355-5354 or contact your representative.
5. Inspect pulleys and cable. Pulleys should rotate freely and cable should be flexible. Everything should be free of grease build-up.
6. Tighten the turnbuckle, reapplying tension to the stainless steel rope, making sure the cable is running through the pulleys properly and there are no kinks or knots.
7. Reposition the tank.
8. Remove safety pin from tank valve.

*Each fusible link is date-stamped and must be replaced if expired or after 12 months of use.

WARNING

If grease build-up on the cable system is not kept to a minimum, the cable could become stiff and will not discharge the suppressant in the event of a fire.

10 Year Maintenance

Hydrostatic testing and new liquid agent, or tank replacement is recommended at ten-year intervals. The manufactured date is stamped on the top of the tank. This should be performed by an authorized technician or at the manufacturer's facilities. Material safety data sheets are available from Greenheck.

WARNING

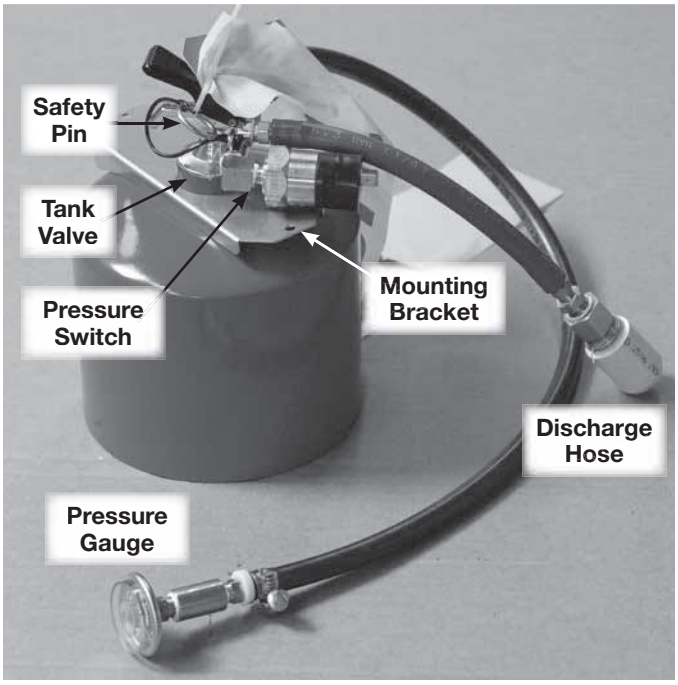
Rubber gloves and safety glasses should be worn during service or inspection of the tank. If contact with the chemical agent skin or eyes occurs, flush immediately with water for 15 minutes. If irritation persists, contact a physician. If taken internally, do not induce vomiting. Dilute with water or milk and contact a physician.

Lighting

Illumination is provided by a 60 watt medium-base shatterproof incandescent light bulb. To replace, make sure the light switch is in the "OFF" position and then gently unscrew the bulb. (Bulb: 60A15/TF)

Removing the Extinguisher Tank

1. Lower the hood to its service position
2. Insert the safety pin in the valve head so that accidental release of the suppressant does not occur.
3. Unplug the pressure switch wire and move it out of the way for now.
4. Disconnect the discharge hose from its fitting located inside the unit closest to the user.
5. Unscrew the two wingnuts holding the bracket for the tank.
6. Lift the tank out of the hood.
7. To replace the tank, simply reverse these steps.



Recommended Service and Recertification Schedule

WARNING

Safety glasses must be worn whenever service operations are performed.

	Monthly	Annually	Every 10 years
Cleaning	Yes	Yes	
Suppression Nozzles	Inspect	Inspect	
Fusible Links	Inspect	Replace	
Extinguisher Tank	Inspect	Recertify	Replace

Replacement Parts

Part Number	Description
479683	Fire Ready Annual Service Kit (3) Links and Service Tag
479684	Fire Ready Recharge Kit Tank Assembly fully charged with adapter
479685	Fire Ready Test Kit, Tank Assembly Nitro only with adapter and test link
479686	Fire Ready Tank Kit, Tank Assembly Empty with adapter
479687	Fire Ready Test Kit Set of 2 Test Links, 4 Nozzle Caps and 1 Safety Key
479688	Fire Ready Electrical Disconnect Box 208-240VAC/50A (as replacement)
479689	Fire Ready 3/4-inch Gas Valve 115VAC (as replacement)
479690	Fire Ready 60W Shatterproof Bulb, pack of 2
479691	Fire Ready Fusible Links, 212°F, 3 links
479692	Fire Ready Fusible Links, 280°F, 3 links
479693	Fire Ready Nozzle Caps, set of 10
479694	Fire Ready Wire Rope Assembly Set Hood Width of 30 inches
479695	Fire Ready Wire Rope Assembly Set Hood Width of 36 inches
479696	Fire Ready Replacement Charcoal Filters “F” Calibrations, pack of 10
479697	Fire Ready Grease Entrapment Filter
479698	Fire Ready Grease Filter Cup
479699	Fire Ready Replacement Fuse Kit for Control Systems

Maintenance Log

Date _____Time _____ AM/PM
Notes:_____

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Our Commitment

As a result of our commitment to continuous improvement, Greenheck reserves the right to change specifications without notice.

Specific Greenheck product warranties are located on greenheck.com within the product area tabs and in the Library under Warranties.

Greenheck's Fire Ready Residential Range Hood, Model GRRS catalog provides additional information describing the equipment, available accessories, and specification data.

AMCA Publication 410-96, Safety Practices for Users and Installers of Industrial and Commercial Fans, provides additional safety information. This publication can be obtained from AMCA International, Inc. at www.amca.org.

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Air Handlers, Heat Pumps and Air Conditioners – Owner's Guide

Congratulations on the purchase of your new outdoor unit. Your outdoor unit is designed to work with a matched indoor unit creating a system that delivers years of dependable service and performance.

Proper Maintenance*

Your system requires maintenance and repair by a properly trained service technician. "Do-it-yourself" repairs on an in-warranty unit may void your warranty.

Other than performing the simple maintenance recommended below, you should not attempt to make any adjustments or repairs to your system. Your dealer can assist you with questions or problems.

1) Replace the air filter(s)

A clean filter saves you money by helping ensure top system efficiency.

When replacing your filter(s), always use the same size and type that was originally supplied or consult with your dealer for recommendations. Be sure to replace it with the arrows pointing in the direction of the airflow.

Where disposable filters are used, they must be replaced every month with the same size as originally supplied. Clean or replace your filter twice a month during seasons when the unit runs more often.

Ask your dealer where the filter is located in your system and how to service it.

2) Maintain free outdoor coil airflow

Efficient operation of your system depends on the free flow of air over outdoor unit's coil.

Do not plant flowers or shrubbery right next to the unit. Also, make sure that nothing is stacked against the sides of the unit or draped over it.

Buildup of snow and ice can restrict airflow. As soon as possible after accumulation, clean snow from the area around the outdoor unit.

3) Clean the finish

To keep your system looking new for years, clean the enamel finish with soap and water. For stubborn grease spots, use a household detergent. Do not use lacquer thinner or other synthetic solvents as they may damage the finish.

4) Call your dealer for additional routine maintenance

Your system should be inspected at least once per year by a properly trained service technician.

Ask your dealer about economical service or preventative maintenance agreements that cover seasonal inspections. **Optional extended warranties are also available.**

⚠ WARNINGS

1. Disconnect all electrical power to the indoor air handler or furnace before removing access panels to perform any maintenance. Disconnect power to both the indoor and outdoor units. NOTE: There may be more than one electrical disconnect switch. Electric shock can cause personal injury or death.
2. Improper installation, adjustment, alteration, service, maintenance, or use can cause explosion, fire, electrical shock, or other conditions which may cause personal injury or property damage. Consult a qualified installer or service agency for information or assistance.

⚠ CAUTIONS

1. To prevent injury, death, or property damage, read and follow all instructions and warnings, including labels shipped with or attached to unit before operating your new outdoor system.
2. Although special care has been taken to minimize sharp edges in the construction of your unit, be extremely careful when handling parts or reaching into the unit.
3. Condensate drains should be checked and cleaned periodically to assure condensate can drain freely from coil to drain. If condensate cannot drain freely, water damage could occur.
4. If heating system is not operational during the cold weather months, provisions must be taken to prevent freeze-up of all water pipes and water receptacles. This is very important during times of vacancy.

IMPORTANT: If the indoor air exceeds 60% relative humidity or simply feels uncomfortably humid, it is recommended that the indoor fan only be used in the AUTO mode.

***Visit our website or ask your dealer for more information on:**

- System operation
- Troubleshooting\Maintenance
- Optimizing system performance\Energy savings
- Warranties and Product Registration

Before you call for service, check the following:

Problem	Possible cause	Remedy
Insufficient heating or cooling	a. dirty filters b. air not circulating freely c. blocked outdoor coil	a. clean or replace b. check supply registers and return grills for blockage c. clear away leaves or other debris
Failure to operate	a. power off b. open circuit breaker or burned-out fuses c. improperly adjusted thermostat	a. make sure main switch is in ON position b. reset circuit breaker, or replace burned-out fuses c. check setting, adjust thermostat
Auxiliary heat indicator on	When outdoor temperature falls, intermittent lighting is normal	Monitor light. If it stays on continuously when above 30°F, or if it comes on when 50°F outdoors, call for service.
No Heating or Cooling – Blower does not operate	Blower door removed or ajar	Close door securely to restore power to blower
Unusual Noise		Call your local servicer

Product Registration

Registered Limited Warranty terms are available if the product is registered within 60 days of installation. If the product is not registered within 60 days of installation, the Base Limited Warranty terms will apply.

Registration can be completed online. Please take a few moments to record the following information to ensure your product registration process is quick and easy:

Indoor Unit Model No: _____ Serial No: _____

Outdoor Unit Model No: _____ Serial No: _____

Thermostat Model Number _____

Installation/Startup Date _____ _____

Dealer _____

Dealer Service Phone _____

Doc. 32-5084-01

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2. Improper installation, adjustment, alteration, service, maintenance, or use can cause explosion, fire, electrical shock, or other conditions which may cause personal injury or property damage. Consult a qualified installer or service agency for information or assistance.

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Failure to operate	a. power off b. open circuit breaker or burned-out fuses c. improperly adjusted thermostat	a. make sure main switch is in ON position b. reset circuit breaker, or replace burned-out fuses c. check setting, adjust thermostat
Auxiliary heat indicator on	When outdoor temperature falls, intermittent lighting is normal	Monitor light. If it stays on continuously when above 30°F, or if it comes on when 50°F outdoors, call for service.
No Heating or Cooling – Blower does not operate	Blower door removed or ajar	Close door securely to restore power to blower
Unusual Noise		Call your local servicer

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Registration can be completed online. Please take a few moments to record the following information to ensure your product registration process is quick and easy:

Indoor Unit Model No: _____ Serial No: _____

Outdoor Unit Model No: _____ Serial No: _____

Thermostat Model Number _____

Installation/Startup Date _____ _____

Dealer _____

Dealer Service Phone _____

Doc. 32-5084-01

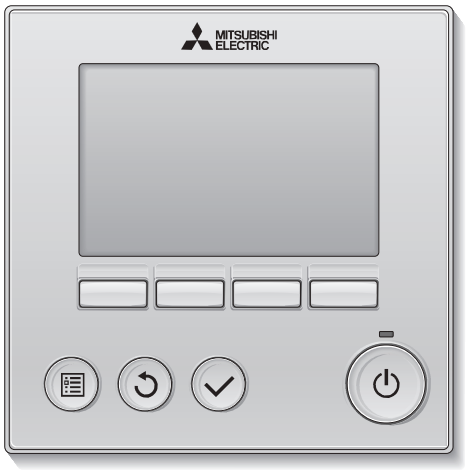
<ORIGINAL>

English
Français
Español
Italiano
Português
Ελληνικά
Türkçe
Slovenščina
Svenska
Hrvatski
Română
Dansk

CITY MULTI Control System
and Mitsubishi Mr. Slim Air Conditioners

MA Remote Controller PAR-32MAA

Instruction Book

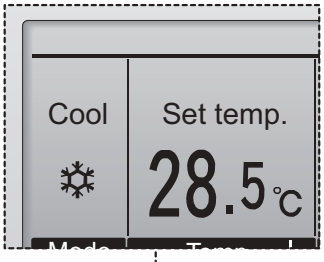


Prior to use, thoroughly read the instructions in this manual to use the product correctly.
Retain for future reference.
Make sure that this CD-ROM and the Installation Manual are passed on to any future users.
To ensure safety and proper operation of the remote controller, the remote controller should only be installed by qualified personnel.

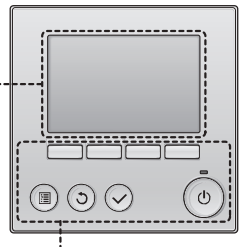
Product features

Feature 1

Large, easy-to-see display



Full-dot LCD display with large characters for easy viewing



Feature 2

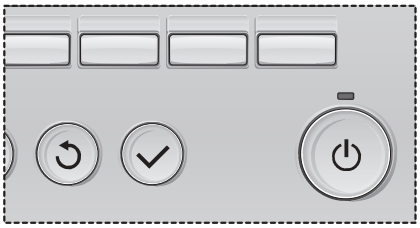
Simple button arrangement

Feature 3

Large, easy-to-press buttons

Buttons are arranged according to usage to allow for intuitive navigation.

Frequently used buttons are larger than other buttons to prevent unintended pressing of other buttons.



Contents

Safety precautions

- Thoroughly read the following safety precautions before using the unit.
- Observe these precautions carefully to ensure safety.

⚠ WARNING	Indicates a risk of death or serious injury.
⚠ CAUTION	Indicates a risk of serious injury or structural damage.

- After reading this manual, pass it on to the end user to retain for future reference.
- Keep this manual for future reference and refer to it as necessary. This manual should be made available to those who repair or relocate the controller. Make sure that the manual is passed on to any future users.

General precautions

⚠ WARNING

Do not install the unit in a place where large amounts of oil, steam, organic solvents, or corrosive gases, such as sulfuric gas, are present or where acidic/alkaline solutions or sprays are used frequently. These substances can compromise the performance of the unit or cause certain components of the unit to corrode, which can result in electric shock, malfunctions, smoke, or fire.

To reduce the risk of shorting, current leakage, electric shock, malfunctions, smoke, or fire, do not wash the controller with water or any other liquid.

To reduce the risk of electric shock, malfunctions, smoke or fire, do not operate the switches/buttons or touch other electrical parts with wet hands.

When disinfecting the unit using alcohol, ventilate the room adequately. The fumes of the alcohol around the unit may cause a fire or explosion when the unit is turned on.

To reduce the risk of injury or electric shock, before spraying a chemical around the controller, stop the operation and cover the controller.

To reduce the risk of injury or electric shock, stop the operation and switch off the power supply before cleaning, maintaining, or inspecting the controller.

If any abnormality (e.g., burning smell) is noticed, stop the operation, turn off the power switch, and consult your dealer. Continued use of the product may result in electric shock, malfunctions, or fire.

Properly install all required covers to keep moisture and dust out of the controller. Dust accumulation and water can cause electric shock, smoke, or fire.

⚠ CAUTION

To reduce the risk of fire or explosion, do not place flammable materials or use flammable sprays around the controller.

To reduce the risk of damage to the controller, do not directly spray insecticide or other flammable sprays on the controller.

To reduce the risk of environmental pollution, consult an authorized agency for proper disposal of remote controller.

To reduce the risk of electric shock or malfunctions, do not touch the touch panel, switches, or buttons with a pointy or sharp object.

To reduce the risk of injury and electric shock, avoid contact with sharp edges of certain parts.

To reduce the risk of injury, wear protective gear when working on the controller.

To avoid injury from broken glass, do not apply excessive force on the glass parts.

Precautions for moving or repairing the controller

⚠ WARNING

The controller should be repaired or moved only by qualified personnel. Do not disassemble or modify the controller.
Improper installation or repair may cause injury, electric shock, or fire.

⚠ CAUTION

To reduce the risk of shorting, electric shock, fire, or malfunction, do not touch the circuit board with tools or with your hands, and do not allow dust to accumulate on the circuit board.

Additional precautions

To avoid damage to the controller, use appropriate tools to install, inspect, or repair the controller.

This controller is designed for exclusive use with the Building Management System by Mitsubishi Electric. The use of this controller for with other systems or for other purposes may cause malfunctions.

This appliance is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety.
Children should be supervised to ensure that they do not play with the appliance.

To avoid discoloration, do not use benzene, thinner, or chemical rag to clean the controller. To clean the controller, wipe with a soft cloth soaked in water with mild detergent, wipe off the detergent with a wet cloth, and wipe off water with a dry cloth.

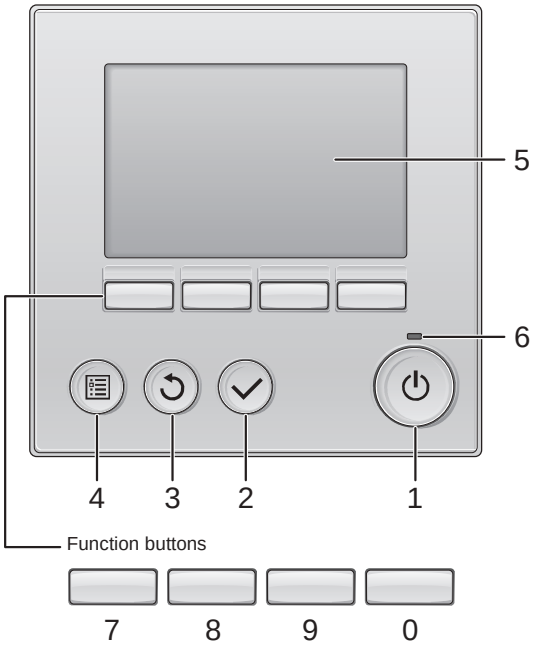
To avoid damage to the controller, provide protection against static electricity.

This appliance is intended to be used by expert or trained users in shops, in light industry and on farms, or for commercial use by lay persons.

If the supply cord is damaged, it must be replaced by the manufacturer, its service agent or similarly qualified persons in order to avoid a hazard.

Names and functions of controller components

Controller interface



1 ON/OFF button

Press to turn ON/OFF the indoor unit.

2 SELECT button

Press to save the setting.

3 RETURN button

Press to return to the previous screen.

4 MENU button Page 20

Press to bring up the Main menu.

5 Backlit LCD

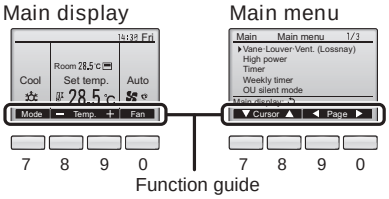
Operation settings will appear.
When the backlight is off, pressing any button turns the backlight on and it will stay lit for a certain period of time depending on the screen.

> When the backlight is off, pressing any button turns the backlight on and does not perform its function. (except for the ON/OFF button)

6 ON/OFF lamp

This lamp lights up in green while the unit is in operation. It blinks while the remote controller is starting up or when there is an error.

The functions of the function buttons change depending on the screen.
Refer to the button function guide that appears at the bottom of the LCD for the functions they serve on a given screen.
When the system is centrally controlled, the button function guide that corresponds to the locked button will not appear.



7 Function button F1

Main display: Press to change the operation mode.
Main menu: Press to move the cursor down.

8 Function button F2

Main display: Press to decrease temperature.
Main menu: Press to move the cursor up.

9 Function button F3

Main display: Press to increase temperature.
Main menu: Press to go to the previous page.

0 Function button F4

Main display: Press to change the fan speed.
Main menu: Press to go to the next page.

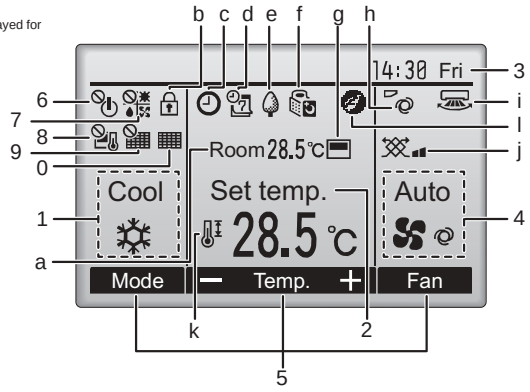
Names and functions of controller components

Display

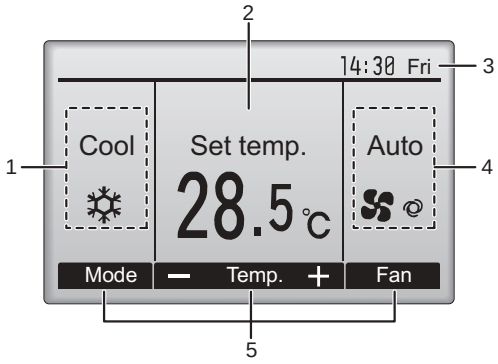
The main display can be displayed in two different modes: "Full" and "Basic." The factory setting is "Full." To switch to the "Basic" mode, change the setting on the Main display setting. (Refer to page 48.)

Full mode

* All icons are displayed for explanation.



Basic mode



1 Operation mode Page 14

Indoor unit operation mode appears here.

2 Preset temperature Page 15

Preset temperature appears here.

3 Clock
(See the Installation Manual.)

Current time appears here.

4 Fan speed Page 16

Fan speed setting appears here.

5 Button function guide

Functions of the corresponding buttons appear here.

6

Appears when the ON/OFF operation is centrally controlled.

7

Appears when the operation mode is centrally controlled.

8

Appears when the preset temperature is centrally controlled.

9

Appears when the filter reset function is centrally controlled.

0 Page 54

Indicates when filter needs maintenance.

a Room temperature
(See the Installation Manual.)

Current room temperature appears here.

b Page 36

Appears when the buttons are locked.

c Page 26, 28, 43

Appears when the On/Off timer (Page 26), Night setback (Page 43), or Auto-off timer (Page 28) function is enabled.

appears when the timer is disabled by the centralized control system.

d Page 30

Appears when the Weekly timer is enabled.

e Page 41

Appears while the units are operated in the energy-save mode. (Will not appear on some models of indoor units)

f Page 32

Appears while the outdoor units are operated in the silent mode.

g

Appears when the built-in thermistor on the remote controller is activated to monitor the room temperature (a).

appears when the thermistor on the indoor unit is activated to monitor the room temperature.

h Page 22

Indicates the vane setting.

i Page 23

Indicates the louver setting.

j Page 23

Indicates the ventilation setting.

k Page 34

Appears when the preset temperature range is restricted.

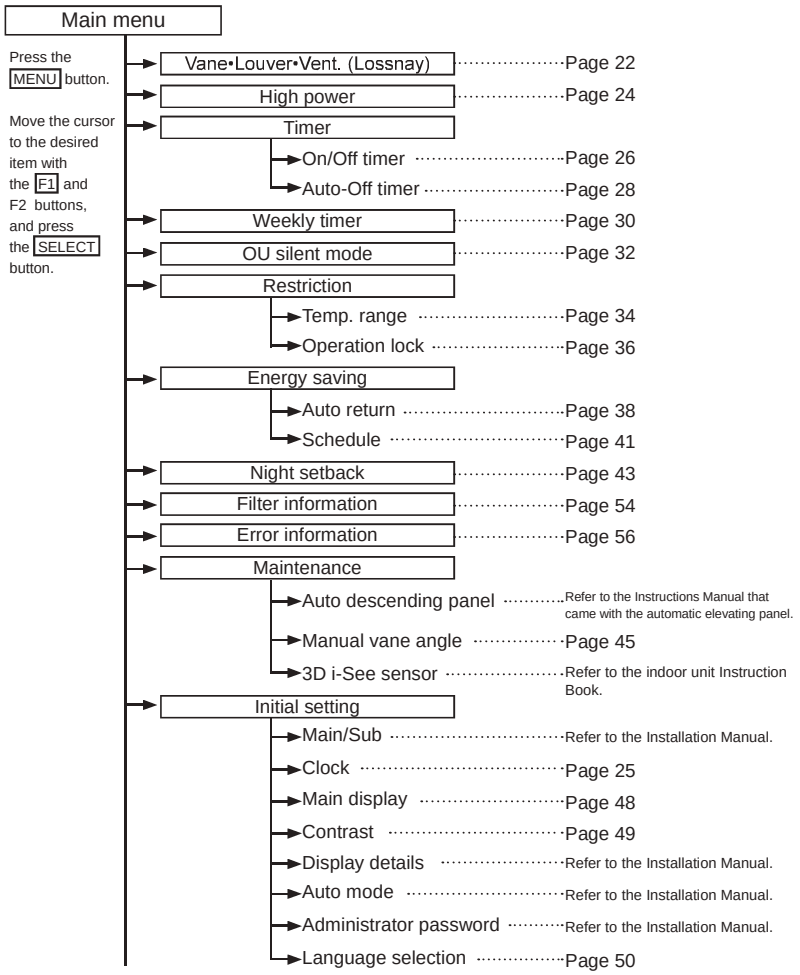
l

Appears when an energy-saving operation is performed using a "3D i-See sensor" function.

Most settings (except ON/OFF, mode, fan speed, temperature) can be made from the Menu screen. (Refer to page 20.)

Read before operating the controller

Menu structure



- Service
  - Test run ..... Refer to the indoor unit Installation Manual.
  - Input maintenance info. ..... Refer to the indoor unit Installation Manual.
  - Function setting (Mr. Slim) ..... Refer to the Installation Manual.
  - Function setting (City Multi) ..... Refer to page 52.
  - Lossnay (City Multi only) ..... Refer to the Installation Manual.
  - Check ..... Refer to the indoor unit Installation Manual.
  - Self check ..... Refer to the Installation Manual.
  - Maintenance password ..... Refer to the Installation Manual.
  - Remote controller check ..... Refer to the Installation Manual.

Not all functions are available on all models of indoor units.

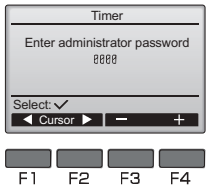
Icon explanations

Controller operation

Timer

P

The table below summarizes the square icons used in this manual.

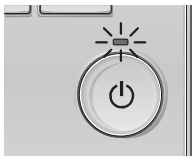
P	The administrator or maintenance user password must be entered on the password input screen to change settings. There is no settings that can skip this process.  F1 : Press to move the cursor left. F2 : Press to move the cursor right. F3 : Press to decrease the value by 1. F4 : Press to increase the value by 1. *Changes cannot be made unless the correct password is entered.	Main	Indicates settings that can be made only from the main remote controller.
ON	Indicates settings that can be changed only while the units are in operation.	OFF	Indicates settings that can be changed only while the units are not in operation.
	Indicates settings that can be changed only while the units are operated in the Cool, Heat, or Auto mode.		Indicates functions that are not available when the buttons are locked or the system is centrally controlled.

Basic operations

Power ON/OFF

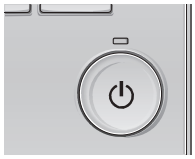
Button operation

ON



Press the ON/OFF button.
The ON/OFF lamp will light up in green, and the operation will start.

OFF



Press the ON/OFF button again.
The ON/OFF lamp will come off, and the operation will stop.

Operation status memory

	Remote controller setting
Operation mode	Operation mode before the power was turned off
Preset temperature	Preset temperature before the power was turned off
Fan speed	Fan speed before the power was turned off

Settable preset temperature range

Operation mode	Preset temperature range
Cool/Dry	19 ~ 30 ºC (67 ~ 87 ºF)
Heat	17 ~ 28 ºC (63 ~ 83 ºF)
Auto (Single set point)	19 ~ 28 ºC (67 ~ 83 ºF)
Auto (Dual set points)	[Cool] Preset temperature range for the Cool mode [Heat] Preset temperature range for the Heat mode
Fan/Ventilation	Not settable

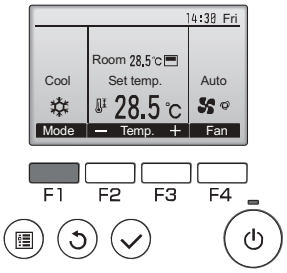
The settable temperature range varies with the model of indoor units.

Basic operations

Operation mode, temperature, and fan speed settings

Button operation

Operation mode



Press the F1 button to go through the operation modes in the order of "Cool, Dry, Fan, Auto, and Heat." Select the desired operation mode.

Cool Dry Fan

Auto Heat

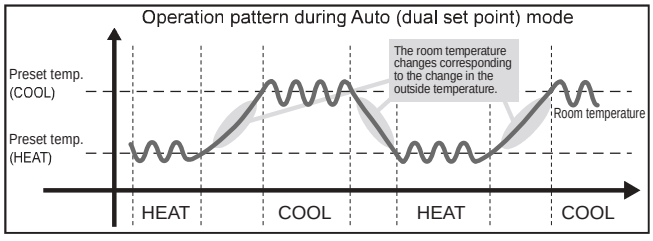
•Operation modes that are not available to the connected indoor unit models will not appear on the display.

What the blinking mode icon means
The mode icon will blink when other indoor units in the same refrigerant system (connected to the same outdoor unit) are already operated in a diff t mode. In this case, the rest of the unit in the same group can only be operated in the same mode.

<AUTO (dual set point) mode>

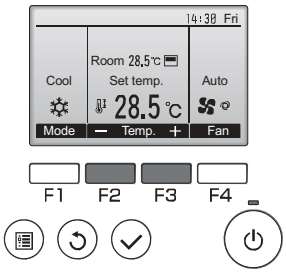
When the operation mode is set to the Auto (dual set point) mode, t t temperatures (one each for cooling and heating) can be set. Depending on the room temperature, indoor unit will automatically operate in either the Cool or Heat mode and keep the room temperature within the preset range.

The graph below shows the operation pattern of indoor unit operated in the Auto (dual set point) mode.



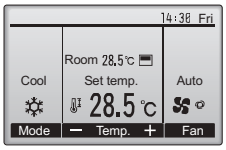
Preset temperature

<Cool, Dr , Heat, and Auto (single set point)>



Press the F2 button to decrease the preset temperature, and press the F3 button to increase.

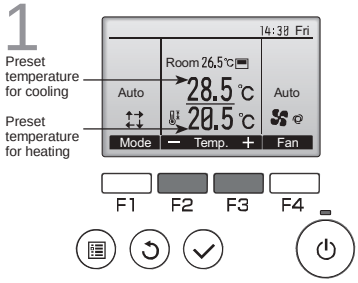
- Refer to the table on page 13 for the settable temperature range for different operation modes.
- Preset temperature range cannot be set for Fan/ Ventilation operation.
- Preset temperature will be displayed either in Centigrade in 0.5- or 1-degree increments, or in Fahrenheit, depending on the indoor unit model and the display mode setting on the remote controller.



Example display
(Centigrade in 0.5-degree increments)

<Auto (dual set point) mode>

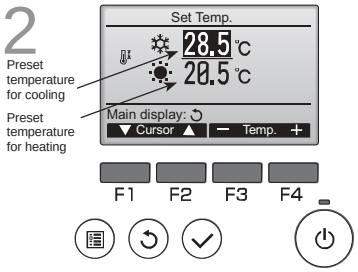
1



The current preset temperatures will appear. Press the F2 or F3 button to display the Settings screen.

Basic operations

2



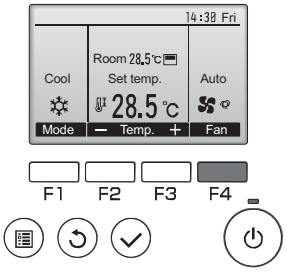
Press the F1 or F2 button to move the cursor to the desired temperature setting (cooling or heating).
Press the F3 button to decrease the selected temperature, and F4 to increase.

- Refer to the table on page 13 for the settable temperature range for different operation modes.
- The preset temperature settings for cooling and heating in the Auto (dual set point) mode are also used by the Cool/Dry and Heat modes.
- The preset temperatures for cooling and heating in the Auto (dual set point) mode must meet the conditions below:
  - Preset cooling temperature is higher than preset heating temperature.
  - The minimum temperature difference requirement between cooling and heating preset temperatures (varies with the models of indoor units connected) is met.

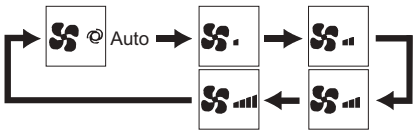
  * If preset temperatures are set in a way that does not meet the minimum temperature difference requirement, both preset temperatures will automatically be changed within the allowable setting ranges.

Navigating through the screens
- To return to the Main screen ..... RETURN button

Fan speed



Press the F4 button to go through the fan speeds in the following order.



- The available fan speeds depend on the models of connected indoor units.

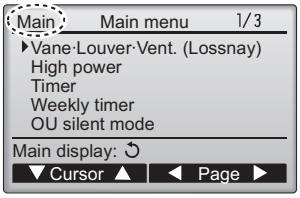
Navigating through the menu

Main menu list

Setting and display items		Setting details	Reference page
V •Louver•Vent. (Lossnay)		Use to set the vane angle. •Select a desired vane setting from five different settings. Use to turn ON/OFF the louver. •Select a desired setting from "ON" and "OFF." Use to set the amount of ventilation. •Select a desired setting from "Off," "Low," and "High."	22
High power		Use to reach the comfortable room temperature quickly. •Units can be operated in the High-power mode for up to 30 minutes.	24
Timer	On/Off timer	Use to set the operation On/Off times. •Time can be set in 5-minute increments. * Clock setting is required.	26
	Auto-Off timer	Use to set the Auto-Off time. •Time can be set to a value from 30 to 240 in 10-minute increments.	28
Weekly timer		Use to set the weekly operation On/Off times. •Up to eight operation patterns can be set for each day. * Clock setting is required. * Not valid when the On/Off timer is enabled. * 1ºC increments	30
OU silent mode		Use to set the time periods in which priority is given to quiet operation of outdoor units over temperature control. Set the Start/Stop times for each day of the week. •Select the desired silent level from "Normal," "Middle," and "Quiet." * Clock setting is required.	32
Restriction	Temp. range	Use to restrict the preset temperature range. •Different temperature ranges can be set for different operation modes. * 1ºC increments	34
	Operation lock	Use to lock selected functions. •The locked functions cannot be operated.	36
Energy saving	Auto return	Use to get the units to operate at the preset temperature after **performing energy-save operation for a specified time period.** •Time can be set to a value from 30 and 120 in 10-minute increments. * This function will not be valid when the preset temperature ranges are restricted. * 1ºC increments	38
	Schedule	Set the start/stop times to operate the units in the energy-save mode for each day of the week, and set the energy-saving rate. •Up to four energy-save operation patterns can be set for each day. •Time can be set in 5-minute increments. •Energy-saving rate can be set to a value from 0% and 50 to 90% in 10% increments. * Clock setting is required.	41

Setting and display items		Setting details	Reference page
Night setback		Use to make Night setback settings. •Select "Yes" to enable the setting, and "No" to disable the setting. The temperature range and the start/stop times can be set. * Clock setting is required. * 1ºC increments	43
Filter information		**Use to check the filter status.** •The filter sign can be reset.	54
Error information		Use to check error information when an error occurs. •Error code, error source, refrigerant address, unit model, manufacturing number, contact information (dealer's phone number) can be displayed. * The unit model, manufacturing number, and contact information need to be registered in advance to be displayed.	56
Maintenance	Manual vane angle	**Use to set the vane angle for each vane to a fixed position.**	45
Initial setting	Clock	Use to set the current time.	25
	Main display	Use to switch between "Full" and "Basic" modes for the Main display. •The default setting is "Full."	48
	Contrast	Use to adjust screen contrast.	49
	Language selection	Use to select the desired language.	50
Service	Function setting (City Multi)	Use to make settings for indoor unit's functions.	52

Restrictions for the sub remote controller



The following settings cannot be made from the sub remote controller. Make these settings from the main remote controller. "Main" is displayed in the title of the Main menu on the main remote controller.

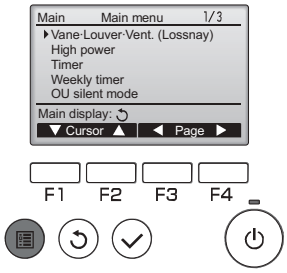
- Timer (On/Off timer, Auto-Off timer)
- Weekly timer
- OU silent mode
- Energy saving (Auto return, Schedule)
- Night setback
- Maintenance (Manual vane angle)

Navigating through the menu

Navigating through the Main menu

Button operation

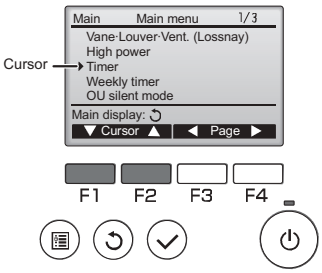
Accessing the Main menu



Press the MENU button.

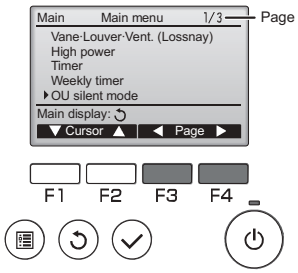
The Main menu will appear.

Item selection



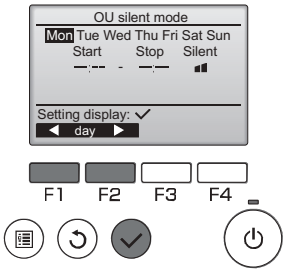
Press F1 to move the cursor down.
Press F2 to move the cursor up.

Navigating through the pages



Press F3 to go to the previous page.
Press F4 to go to the next page.

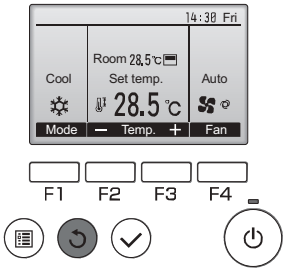
Saving the settings



Select the desired item, and press the SELECT button.

The screen to set the selected item will appear.

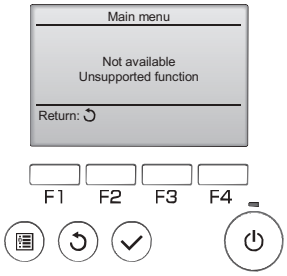
Exiting the Main menu screen



Press the RETURN button to exit the Main menu and return to the Main display.

If no buttons are touched for 10 minutes, the screen will automatically return to the Main display. Any settings that have not been saved will be lost.

Display of unsupported functions



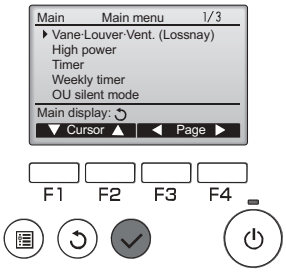
The message at left will appear if the user selects a function not supported by the corresponding indoor unit model.

Controller operation-Function settings

Vane•Louver•Vent. (Lossnay) ON

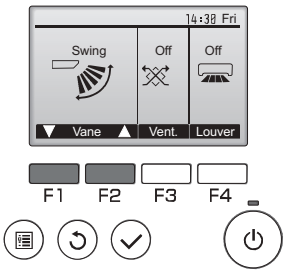
Button operation

Accessing the menu



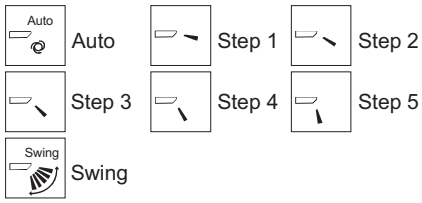
Select "Vane•Louver•Vent. (Lossnay)" from the Main menu (refer to page 20), and press the SELECT button.

Vane setting

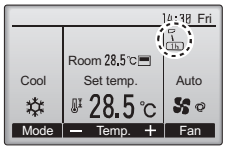


(Sample screen on City Multi)

Press the F1 or F2 button to go through the vane setting options: "AUTO," "Step 1," "Step 2," "Step 3," "Step 4," "Step 5," and "Swing."
Select the desired setting.

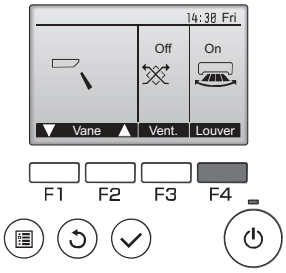


Select "Swing" to move the vanes up and down automatically.
When set to "Step 1" through "Step 5", the vane will be fixed at the selected angle.



- 1h under the vane setting icon
  This icon will appear when the vane is set to "Step 5" and the fan operates at low speed during cooling or dry operation (depends on the model).
  The icon will go off in an hour, and the vane setting will automatically change.

Louver setting

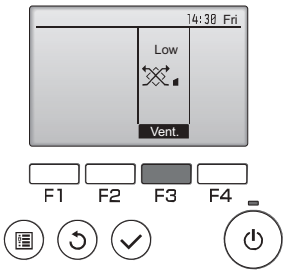


(Sample screen on City Multi)

Press the F4 button to turn the louver swing ON and OFF.

Off Off On On

Vent. setting



(Sample screen on Mr. Slim)

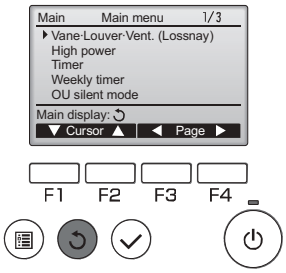
Press the F3 button to go through the ventilation setting options in the order of "Off," "Low," and "High."

* Settable only when LOSSNAY unit is connected.

Off Off Low Low High High

- The fan on some models of indoor units may be interlocked with certain models of ventilation units.

Returning to the Main menu



Press the RETURN button to go back to the Main menu.

Controller operation-Function settings

High power

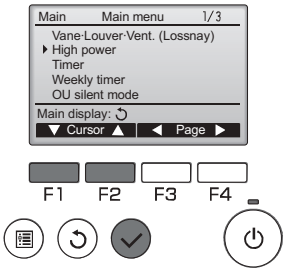
ON

Function description

High-power operation function allows the units to operate at higher-than-normal capacity so that the room air can be conditioned to an optimum temperature quickly. This operation will last for up to 30 minutes, and the unit will return to the normal operation mode at the end of the 30 minutes or when the room temperature reaches the preset temperature, whichever is earlier. The units will return to the normal operation when the operation mode or fan speed is changed.

Button operation

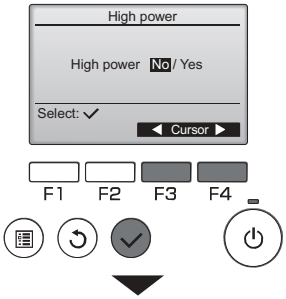
1



Select "High power" from the Main menu during Cooling, Heating, or AUTO operation (r fer to page 20), and press the SELECT button.

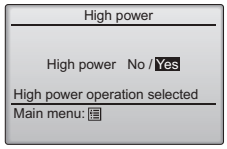
"High power" function is available only on the models that support the function.

2



Move the cursor to "YES" with the F3 or F4 button, and press the SELECT button.

A confirmation screen will appear.

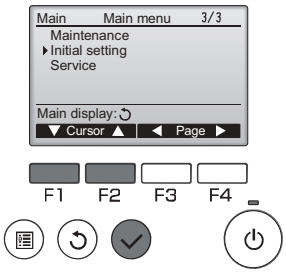


Navigating through the screens
- To go back to the Main menu ..... MENU button
- To return to the previous screen ..... RETURN button

Clock

Button operation

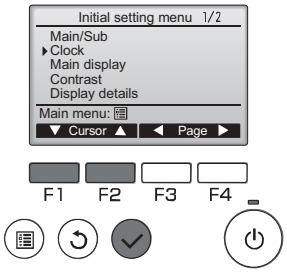
1



Select "Initial setting" from the Main menu (refer to page 20), and press the SELECT button.

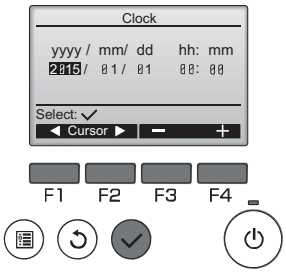
Clock setting is required before making the following settings.
- On/Off timer
- Weekly timer
- OU silent mode
- Energy saving
- Night setback

2



Move the cursor to the "Clock" with the F1 or F2 button, and press the SELECT button.

3



Move the cursor to the desired item with the F1 or F2 button out of year, month, date, hour, or minute.

Increase or decrease the value for the selected item with the F3 or F4 button, and press the SELECT button.
A confirmation screen will appear.

Navigating through the screens
- To go back to the Main menu ..... MENU button
- To return to the previous screen ..... RETURN button

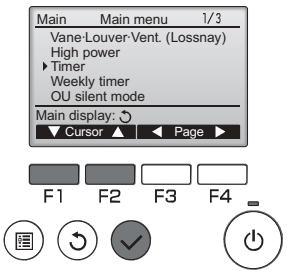
Controller operation-Function settings

Timer (On/Off timer)

Main P

Button operation

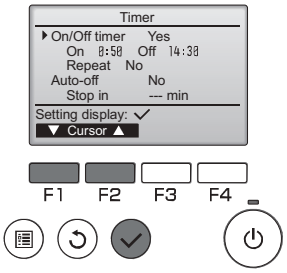
1



Select "Timer" from the Main menu (refer to page 20), and press the SELECT button.

The On/Off timer will not work in the following cases: when On/Off timer is disabled, during an error, during check (in the service menu), during test run, during remote controller diagnosis, when the clock is not set, during Function setting, when the system is centrally controlled (when On/Off operation or Timer operation from local r ller is prohibited).

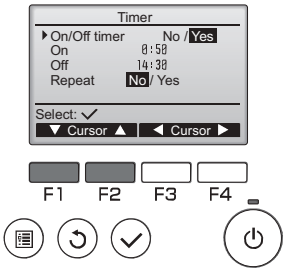
2



The current settings will appear.

Move the cursor to the On/Off timer, and press the SELECT button.

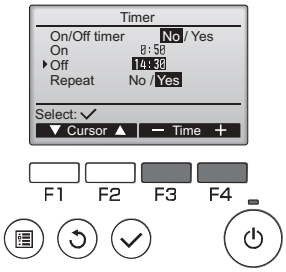
3



The screen to set the timer will appear.

Select the desired item with the F1 or F2 button out of "On/Off timer," "On," "Off," or "Repeat."

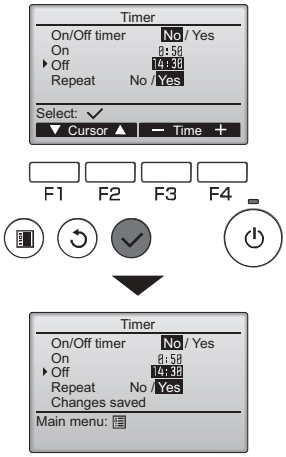
4



Change the setting with the F3 or F4 button.

- On/Off timer: No (disable)/Yes (enable)
- On: Operation start time
  (settable in 5-minute increments)
  * Press and hold the button to rapidly advance the numbers.
- Off: Operation stop time
  (settable in 5-minute increments)
  * Press and hold the button to rapidly advance the numbers.
- Repeat: No (once)/Yes (repeat)

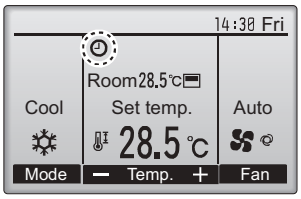
5



Press the SELECT button to save the settings.

A confirmation screen will appear.

Navigating through the screens
- To go back to the Main menu ..... MENU button
- To return to the previous screen ..... RETURN button



will appear on the Main display in the Full mode when the On/Off timer is enabled.

appears when the timer is disabled by the centralized control system.

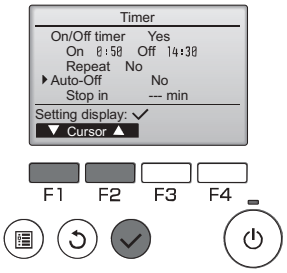
Controller operation-Function settings

Timer (Auto-Off timer)

Main P

Button operation

1

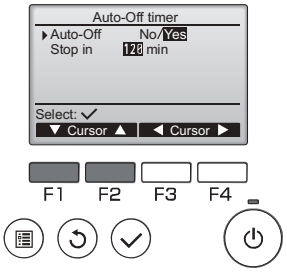


Bring up the Timer setting screen.
(Refer to page 26.)

Select "Auto-Off", and press the SELECT button.

The Auto-Off timer will not work in the following cases: when Auto-Off timer is disabled, during an error, during check (in the service menu), during test run, during remote controller diagnosis, during Function setting, when the system is centrally controlled (when On/Off operation or Timer operation from local controller is prohibited).

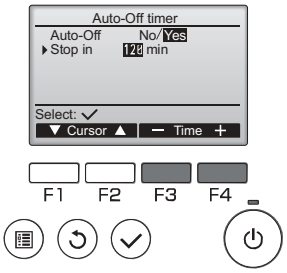
2



The current settings will appear.

Move the cursor to the "Auto-Off" or "Stop in --- min" with the F1 or F2 button.

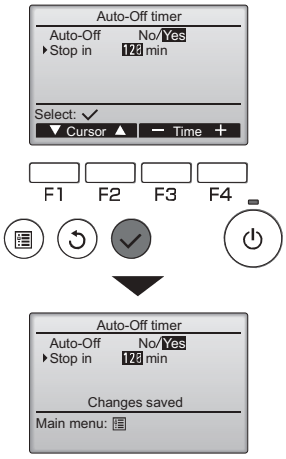
3



Change the setting with the F3 or F4 button.

- Auto-Off: No (disable)/ (enable)
- Stop in --- min: Timer setting (The settable range is 30 to 240 minutes in 10-minute increments.)

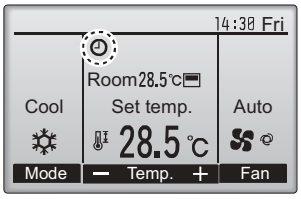
4



Press the SELECT button to save the settings.

A confirmation screen will appear.

Navigating through the screens
- To go back to the Main menu ..... MENU button
- To return to the previous screen ..... RETURN button



will appear on the Main display in the Full mode when the Auto-Off timer is enabled.

appears when the timer is disabled by the centralized control system.

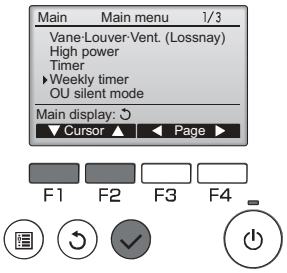
Controller operation-Function settings

Weekly timer

Main P

Button operation

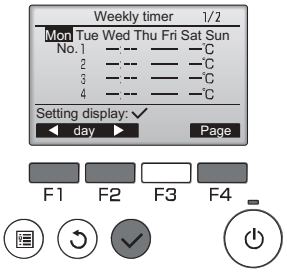
1



Select "Weekly timer" from the Main menu (refer to page 20), and press the SELECT button.

The Weekly timer will not work in the following cases: when the On/Off timer is enabled, when the weekly timer is disabled, during an error, during check (in the service menu), during test run, during remote controller diagnosis, when the clock is not set, during Function setting, when the system is centrally controlled (On/Off operation, temperature setting, or Timer operation from local remote controller is prohibited).

2

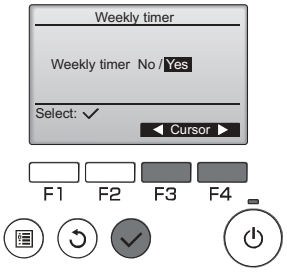


The current settings will appear.

Press the F1 or F2 button to see the settings for each day of the week.
Press the F4 button to see patterns 5 through 8.

Press the SELECT button to go to the setting screen.

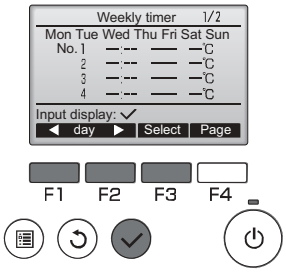
3



The screen to enable (Yes) and disable (No) the weekly timer will appear.

To enable the setting, move the cursor to "Yes" with the F3 or F4 button, and press the SELECT button.

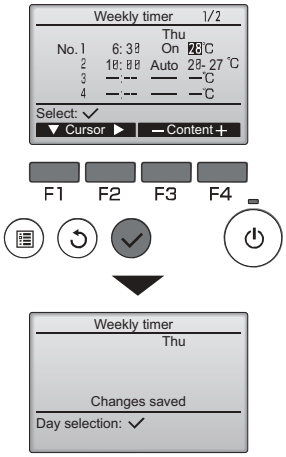
4



The weekly timer setting screen will appear and the current settings will be displayed.
Up to eight operation patterns can be set for each day.
Move the cursor to the desired day of the week with the F1 or F2 button, and press the F3 button to select it. (Multiple days can be selected.)

Press the SELECT button.

5

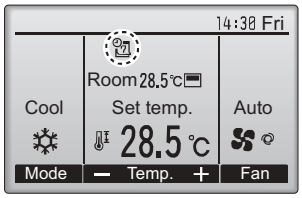


Operation pattern setting screen will appear.
Press the F1 button to move the cursor to the desired pattern number.
Move the cursor to the time, On/Off, or temperature with the F2 button.
Change the settings with the F3 or F4 button.

- Time: settable in 5-minute increments
  * Press and hold the button to rapidly advance the numbers.
- On/Off/Auto: Selectable settings depend on the model of connected indoor unit. (When an Auto pattern is executed, the system will operate in the Auto (dual set point) mode.)
- Temperature: The settable temperature range depends on the connected indoor units. (1ºC increments) When the Auto (dual set point) mode is selected, two preset temperatures can be set. If an operation pattern with a single preset temperature setting is executed during the Auto (dual set point) mode, its setting will be used as the cooling temperature setting in the Cool mode.

Press the SELECT button to save the settings.
A confirmation screen will appear.

Navigating through the screens
- To go back to the setting change/day of the week selection screen ..... SELECT button
- To go back to the Main menu ..... MENU button
- To return to the previous screen ..... RETURN button



will appear on the Main display in the Full mode when the weekly timer setting for the current day exists.
The icon will not appear while the On/Off timer is enabled or the system is under centralized control (Timer operation from local r
ller is prohibited).

Controller operation-Function settings

OU silent mode

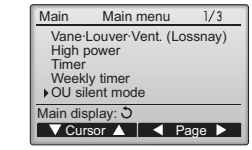
Main P

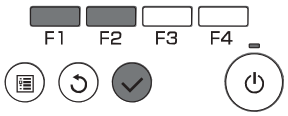
Function description

This function allows the user to set the time periods in which priority is given to quiet operation of outdoor units over temperature control. Set the start and stop times each day of the week for the quiet operation. Select the desired silent level from "Middle" and "Quiet".

Button operation

1

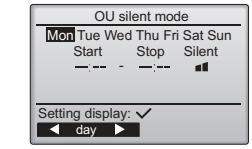


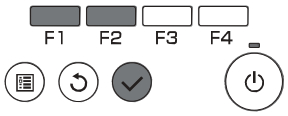


Select "OU silent mode" from the Main menu (refer to page 20), and press the SELECT button.

"OU silent mode" function is available only on the models that support the function.

2

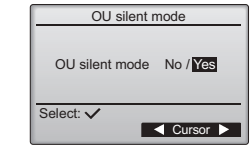


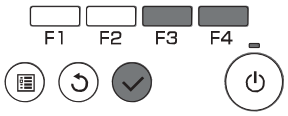


The current settings will appear.

Press the F1 or F2 button to see the settings for each day of the week.
Press the SELECT button to go to the setting screen.

3

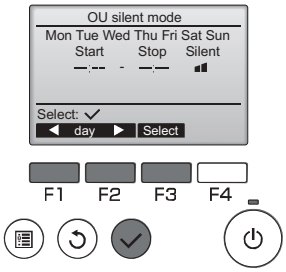




The screen to enable (Yes) and disable (No) the silent mode will appear.

To enable this setting, move the cursor to "Yes" with the F3 or F4 button, and press the SELECT button .

4

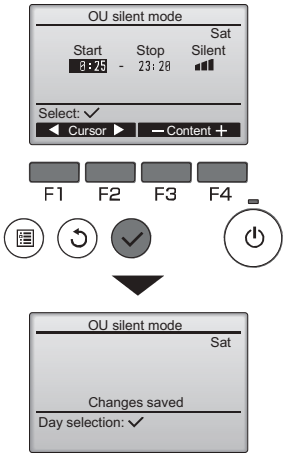


The OU silent mode setting screen will appear.

To make or change the setting, move the cursor to the desired day of the week with the F1 or F2 button, and press the F3 button to select it. (Multiple days can be selected.)

Press the SELECT button.

5



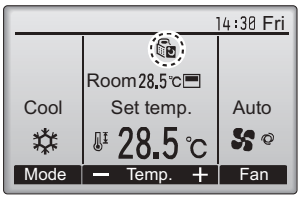
The setting screen will appear.
Move the cursor to the desired item with the F1 or F2 button out of Start time, Stop time, or Silent level.
Change the settings with the F3 or F4 button.

- Start/Stop time: settable in 5-minute increments
  * Press and hold the button to rapidly advance the numbers.
- Silent level: Normal, Middle, Quiet

Normal Middle Quiet

Press the SELECT button to save the settings.
A confirmation screen will appear.

Navigating through the screens
- To go back to the setting change/day of the week selection screen ..... SELECT button
- To go back to the Main menu ..... MENU button
- To return to the previous screen ..... RETURN button



will appear on the Main display in the Full mode during the OU silent mode.

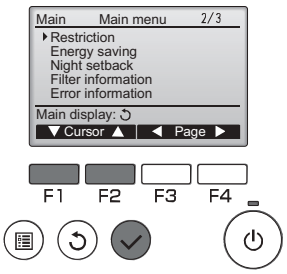
Controller operation-Function settings

Restriction

Setting the temperature range restriction

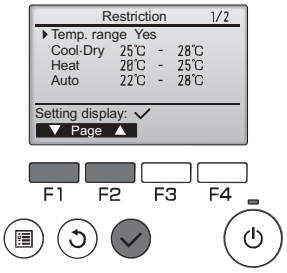
Button operation

1



Select "Restriction" from the Main menu (refer to page 20), and press the SELECT button.

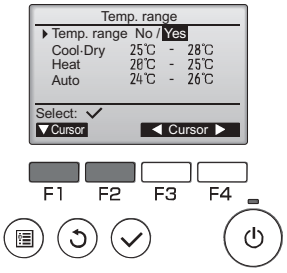
2



The current settings will appear.

Move the cursor to "Temp. range" with the F1 or F2 button, and press the SELECT button.

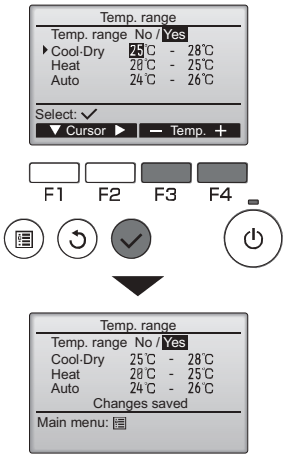
3



The screen to set the temperature range will appear.

Move the cursor to the desired item with the F1 button out of "Temp. range," "Cool•Dry," "Heat," or "Auto."

4



Change the settings with the F3 or F4 button.

- Temp. range: No (unrestricted) or Yes (restricted)
- Cool•Dr Upper and lower limit temperature (1°C increments)
- Heat: Upper and lower limit temperature (1°C increments)
- Auto: Upper and lower limit temperature (1°C increments)

Temperature setting ranges

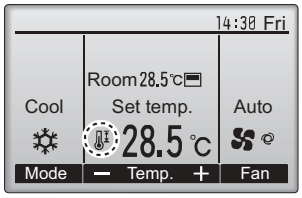
Mode	Lower limit	Upper limit
Cool•Dry *1 *3	19 ~ 30°C (67 ~ 87°F)	30 ~ 19°C (87 ~ 67°F)
Heat *2 *3	17 ~ 28°C (63 ~ 83°F)	28 ~ 17°C (83 ~ 63°F)
Auto *4	19 ~ 28°C (67 ~ 83°F)	28 ~ 19°C (83 ~ 67°F)

* The settable range varies depending on the connected unit.
*1 Temperature ranges for the Cool, Dry, and Auto (dual set point) modes can be set.
*2 Temperature ranges for the Heat and Auto (dual set point) modes can be set.
*3 Temperature ranges for the Heat, Cool, and Dry modes must meet the conditions below:
- Upper limit for cooling - upper limit for heating ≥ Minimum temperature difference (varies with indoor unit model)
- Lower limit for cooling - lower limit for heating ≥ Minimum temperature difference (varies with indoor unit model)

*4 Temperature range for the Auto (single set point) mode can be set.

Press the SELECT button to save the settings.
A confirmation screen will appear.

Navigating through the screens
- To go back to the Main menu ..... MENU button
- To return to the previous screen ..... RETURN button



will appear on the Main display in the Full mode when the temperature range is restricted.

Controller operation-Function settings

Restriction

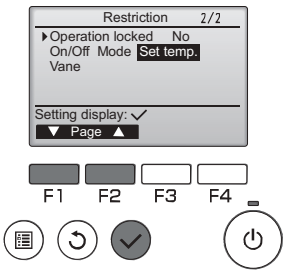
P

Operation lock function

To enable the operation lock function, set the item "Operation locked" to " Yes".

Button operation

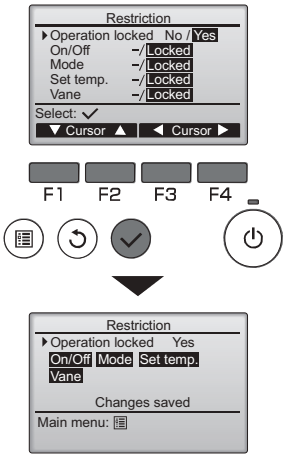
1



Bring up the Restriction setting screen. (Refer to page 34.)

Move the cursor to "Operation locked" and press the SELECT button.

2



The screen to make the settings for the operation lock function will appear.

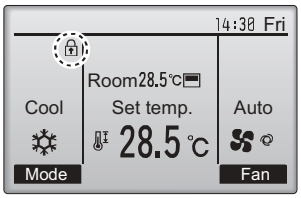
Move the cursor to the desired item with the F1 or F2 button out of "Operation locked," "On/Off," "Mode," "Set temp.," or "Vane."

Change the settings with the F3 or F4 button.
- Operation locked: No (disable)/ (enable)
- On/Off: On/Off operation
- Mode: Operation mode setting
- Set temp.: Preset temp. setting
- Vane: Vane setting

"-" / "Locked"

Press the SELECT button to save the settings. A confirmation screen will appear.

Navigating through the screens
- To go back to the Main menu ..... MENU button
- To return to the previous screen ..... RETURN button



(When Set temp. is locked)

will appear on the Main display in the Full mode when the operation lock function setting is enabled.

Operation guide that corresponds to the locked function will be suppressed.

Controller operation-Function settings

Energy saving

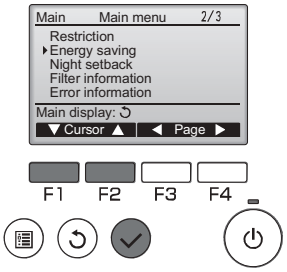
Main P

Automatic return to the preset temperature

After the Auto return function is enabled, when the operation mode change or ON/OFF operation is performed from this remote controller, the set temperature automatically returns to the required temperature regardless of the set time.

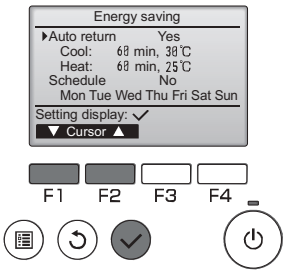
Button operation

1



Select "Energy saving" from the Main menu (refer to page 20), and press the SELECT button.

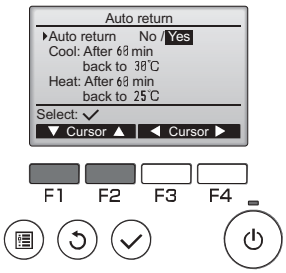
2



The current settings will appear.

Move the cursor to "Auto return" with the F1 or F2 button, and press the SELECT button.

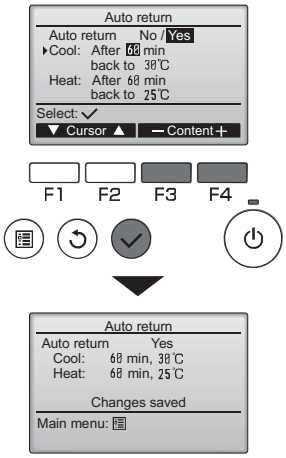
3



The screen to make the settings for the automatic return to the preset temperature will appear.

Move the cursor to the desired item with the F1 or F2 button out of "Auto return," "Cool," or "Heat."

4



Change the settings with the F3 or F4 button.

- Auto return: No (disable)/Yes (enable)
- Cool: Timer setting range is 30 to 120 minutes in 10-minute increments.
  Temperature setting range is 19 to 30ºC (67 to 87ºF) (1ºC increments).
- Heat: Timer setting range is 30 to 120 minutes in 10-minute increments.
  Temperature setting range is 17 to 28ºC (63 to 83ºF) (1ºC increments).

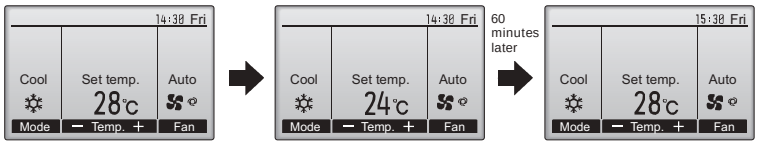
Press the SELECT button to save the settings. "Cool" includes "Dry" and "AUTO Cooling" modes, and "Heat" includes "AUTO Heating" mode.
The screen to set the selected item will appear.

Navigating through the screens
- To go back to the Main menu ..... MENU button
- To return to the previous screen ..... RETURN button

Timer or Preset temperature settings will not be effective when the Temp. range is restricted and when the system is centrally controlled (when the Temp. range setting from local controller is prohibited). When the system is centrally controlled (when Timer operation from local remote controller is prohibited), only the Timer setting will be ineffective.

<Sample screens when the Auto return function is enabled>

Example: Lower the Set temp. to 24ºC (75ºF). 60 minutes later, the Set temp. will be back to 28ºC (83ºF).



The Set temp. is changed from 28ºC (83ºF) to 24ºC (75ºF) by a user.

60 minutes later, the Set temp. returns to 28ºC (83ºF) automatically.

Controller operation-Function settings

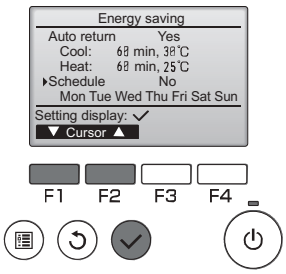
Energy saving

Main P

Setting the energy-saving operation schedule

Button operation

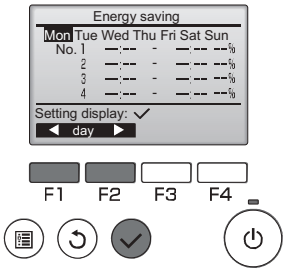
1



Bring up the "Energy saving" screen. (Refer to page 38.)

Move the cursor to the "Schedule," and press the SELECT button.

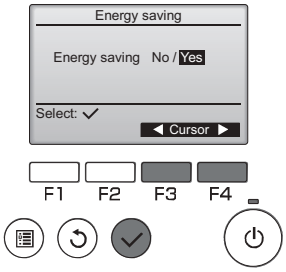
2



The screen to see the schedule will appear.

Press the F1 or F2 button to see the settings for each day of the week.
Press the SELECT button to go to the setting screen.

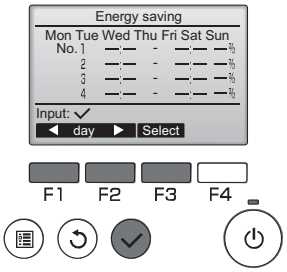
3



The screen to enable (Yes)/disable (No) the energy-saving operation schedule will appear.

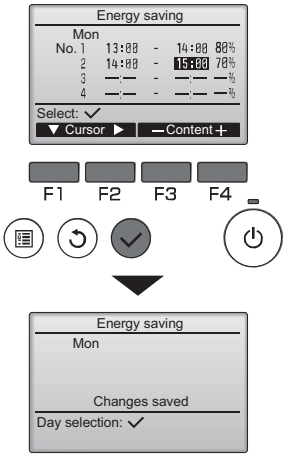
Select "No" or "Yes" with the F3 or F4 button.
Press the SELECT button to go to the setting change/day of the week selection screen.

4



The setting change/day of the week selection screen will appear.
Up to four operation patterns can be set for each day.
Move the cursor to the desired day of the week with the F1 or F2 button, and press the F3 button to select it. (Multiple days can be selected.)
Press the SELECT button to go to the pattern setting screen.

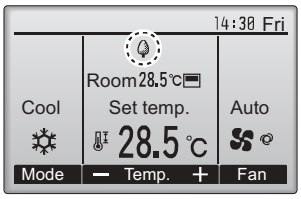
5



The pattern setting screen will appear.
Press the F1 button to move the cursor to the desired pattern number.
Move the cursor to the desired item with the F2 button out of the start time, stop time, and energy-saving rate (arranged in this order from the left).
Change the settings with the F3 or F4 button.
- Start/Stop time: settable in 5-minute increments
  * Press and hold the button to rapidly advance the numbers.
- Energy-saving rate: The setting range is 0% and 50 to 90% in 10% increments.

Press the SELECT button to save the settings.
A confirmation screen will appear.

The lower the value, the greater the energy-saving effect.



will appear on the Main display in the Full mode when the unit is operated in the energy saving mode.

Navigating through the screens
- To go back to the setting change/day of the week selection screen ..... SELECT button
- To go back to the Main menu ..... MENU button
- To return to the previous screen ..... RETURN button

Controller operation-Function settings

Night setback

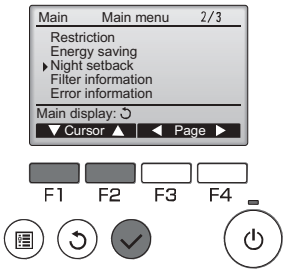
Main P

Function description

This control starts heating operation when the control object group is stopped and the room temperature drops below the preset lower limit temperature. Also, this control starts cooling operation when the control object group is stopped and the room temperature rises above the preset upper limit temperature.
The Night setback function is not available if the operation and the temperature setting are performed from the remote controller.
If the room temperature is measured by the air-conditioner's suction temperature sensor, the accurate temperature may not be obtained when the air-conditioner is inactive or when the air is not clean. In this case, switch the sensor to a remote sensor (P -SE40TSA/PAC-SE41TS-E) or a remote control sensor.

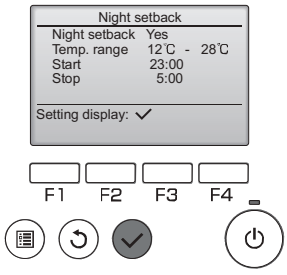
Button operation

1



Select "Night setback" from the Main menu (refer to page 20), and press the SELECT button.

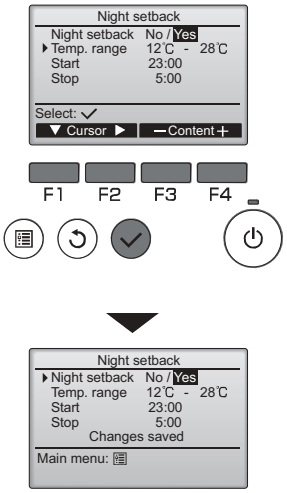
2



The current settings will appear.

Press the SELECT button to go to the setting screen.

3

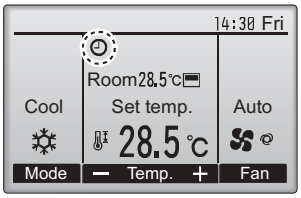


Move the cursor to the desired item with the F1 or F2 button out of Night setback No (disable)/Yes (enable), Temp. r t time, or Stop time. Change the settings with the F3 or F4 button.

- Temp. range: The lower limit temperature (for heating operation) and the upper limit temperature (for cooling operation) can be set. The temperature difference between the lower and upper limits must be 4ºC (8ºF) or more. The settable temperature range varies depending on the connected indoor units.
  * 1ºC increments
- Start/Stop time: settable in 5-minute increments
  * Press and hold the button to rapidly advance the numbers.

Press the SELECT button to save the settings. A confirmation screen will appear.

Navigating through the screens
- To go back to the Main menu ..... MENU button
- To return to the previous screen ..... RETURN button



will appear on the Main display in the Full mode when the Night setback function is enabled.

appears when the timer is disabled by the centralized control system.

The Night setback will not work in the following cases: when the unit is in operation, when the Night setback function is disabled, during an error, during check (in the service menu), during test run, during remote controller diagnosis, when the clock is not set, during Function setting, when the system is centrally controlled (On/Off operation, temperature setting, or Timer operation from local r ller is prohibited).

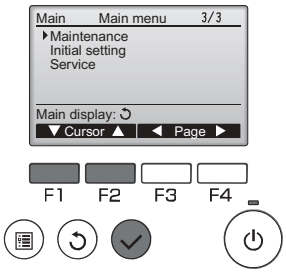
Controller operation-Function settings

Manual vane angle

Main OFF

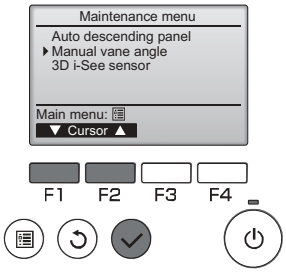
Button operation

1



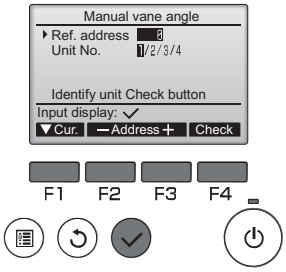
Select "Maintenance" fr the Main menu (refer to page 20), and press the SELECT button.

2



Select "Manual vane angle" with the F1 or F2 button, and press the SELECT button.

3

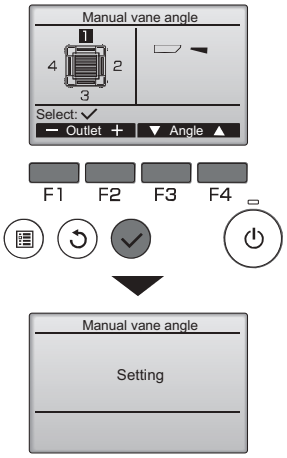


Move the cursor to "Ref. address" or "Unit No." with the F1 button to select.
Select the refrigerant address and the unit number for the units to whose vanes are to be fixed, with the F2 or F3 button, and press the SELECT button.
- Ref. address: Refrigerant address
- Unit No.: 1, 2, 3, 4

Press the F4 button to confirm the unit.

The screen at left shows a sample display on Mr. Slim. On City Multi units, "M-NET address," is displayed instead of "Ref. address", and the "Unit No." will not be displayed.

4



The current vane setting will appear.

Select the desired outlets from 1 through 4 with the F1 or F2 button.

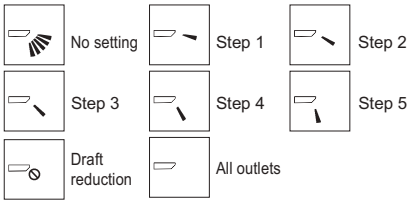
• Outlet: "1," "2," "3," "4," and "1, 2, 3, 4, (all outlets)"

Press the F3 or F4 button to go through the option in the order of "No setting (reset)," "Step 1," "Step 2," "Step 3," "Step 4," "Step 5," and "Step 6."

Select the desired setting.

* Step 6 can only be set for one outlet.

■ Vane setting



Press the SELECT button to save the settings.

A screen will appear that indicates the setting information is being transmitted.

The setting changes will be made to the selected outlet.

The screen will automatically return to the previous screen when the transmission is completed.

Make the settings for other outlets, following the same procedures.

If all outlets are selected, ▭ will be **displayed the next time the unit goes** into operation.

Navigating through the screens

• To go back to the Main menu ..... MENU button

• To return to the previous screen ..... RETURN button

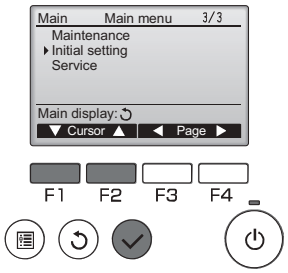
*Draft reduction
The [Draft reduction] mode keeps the vane angle more horizontal than the angle of Step 1 so that the airflow will not be directed toward the people.
This function can be set only for one outlet.
This function cannot be set for models with two or three outlets.
In the Draft reduction mode, the airflow may cause the ceiling discoloration.

Controller operation-Function settings

Main display

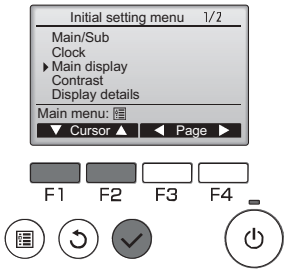
Button operation

1



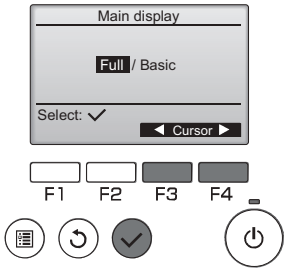
Select "Initial setting" from the Main menu (refer to page 20), and press the SELECT button.

2



Move the cursor to the "Main display" with the F1 or F2 button, and press the SELECT button.

3



Select "Full" or "Basic" (refer to page 8) with the F3 or F4 button, and press the SELECT button.

A confirmation screen will appear.

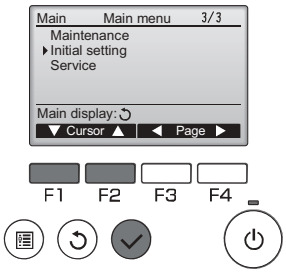
Navigating through the screens
- To go back to the Main menu ..... MENU button
- To return to the previous screen ..... RETURN button

Contrast

P

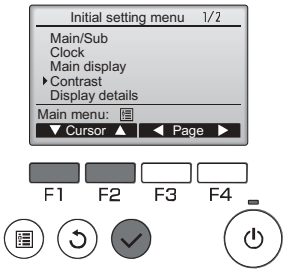
Button operation

1



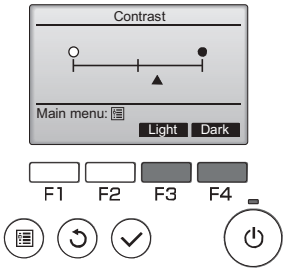
Select "Initial setting" from the Main menu (refer to page 20), and press the SELECT button.

2



Move the cursor to the "Contrast" with the F1 or F2 button, and press the SELECT button.

3



Adjust the contrast with the F3 or F4 button, and press the MENU or RETURN button.

Navigating through the screens
- To go back to the Main menu ..... MENU button
- To return to the previous screen ..... RETURN button

Controller operation-Function settings

Language selection

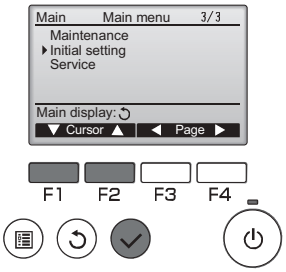
P

Function description

The desired language can be set. The language options are English, French, German, Spanish, Italian, Portuguese, Swedish, and Russian.

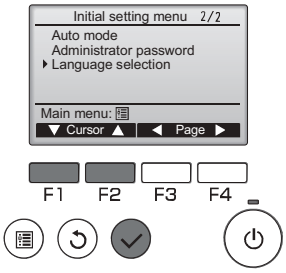
Button operation

1



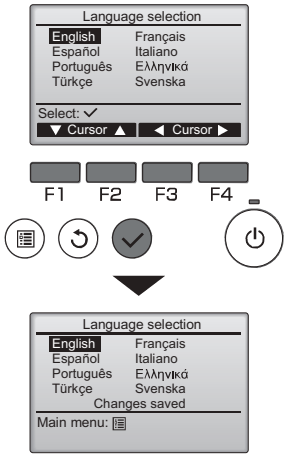
Select "Initial setting" from the Main menu (r to page 20), and press the SELECT button.

2



Move the cursor to the "Language selection" with the F1 or F2 button, and press the SELECT button.

3



Move the cursor to the language you desire with the F1 through F4 buttons, and press the SELECT button to save the setting.

When the power is on for the first time, the Language selection screen will be displayed. Select a desired language. The system will not start-up without language selection.

A screen will appear that indicates the setting has been saved.

Navigating through the screens
- To go back to the Main menu ..... MENU button
- To return to the previous screen ..... RETURN button

Controller operation-Function settings

Function setting (City Multi) OFF P

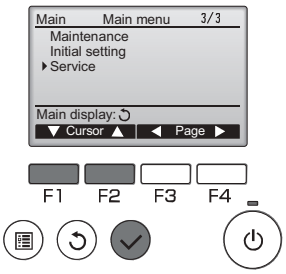
Function description

Make the indoor units' function settings from the remote contr ller as necessary.

- The following settings should be made only for City Multi units and as necessary.
- Refer to the Installation Manual for how to make the settings for Mr. Slim units.
- Refer to the indoor unit Installation Manual for information about the factory settings of indoor units, function setting numbers, and setting values.
- When changing the indoor units' function settings, record all the changes made to keep track of the settings.

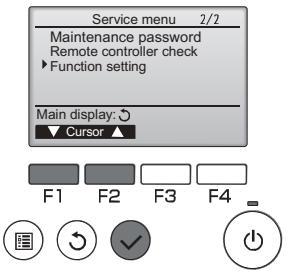
Button operation

1



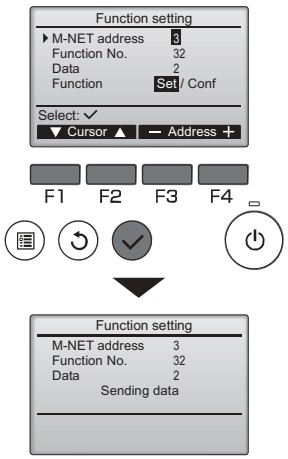
Select Service on the Main menu (see page 20), and press the SELECT button.

2



Select Function Setting on the Service Menu screen, and press the SELECT button.

3

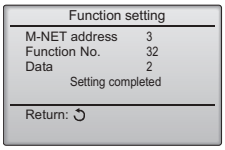


The Function Setting screen will appear.
Press the F1 or F2 button to move the cursor to one of the following: M-NET address, function setting number, or setting value. Then, press the F3 or F4 button to change the settings to the desired settings.

Once the settings have been completed, press the SELECT button.
A screen will appear that indicates that the settings information is being sent.

To check the current settings of a given unit, enter the setting for its M-NET address and function setting number, select Conf for the Function, and press the SELECT button.
A screen will appear that indicates that the settings are being searched for. When the search is done, the current settings will appear.

4



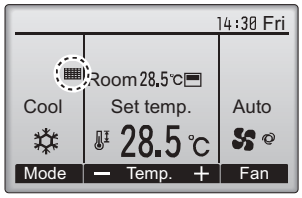
When the settings information has been sent, a screen will appear that indicates its completion.

To make additional settings, press the RETURN button to return to the screen shown in Step 3 above. Set the function numbers for other indoor units by following the same steps.

Navigating through the screens
- To return to the Service Menu screen ..... MENU button
- To return to the previous screen ..... RETURN button

Maintenance

Filter information

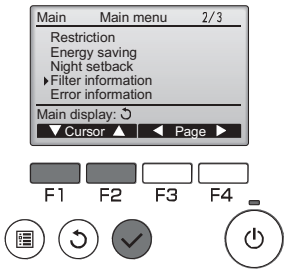


will appear on the Main display in the Full mode when it is time to clean the filters.

Wash, clean, or replace the filters when this sign appears.
Refer to the indoor unit Instructions Manual for details.

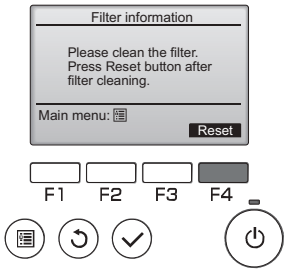
Button operation

1



Select "Filter information" from the Main menu (refer to page 20), and press the SELECT button.

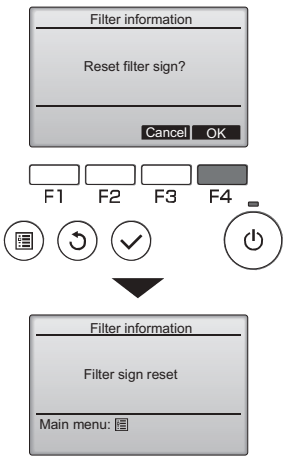
2



Press the F4 button to reset filter sign.

Refer to the indoor unit Instructions Manual for how to clean the filter.

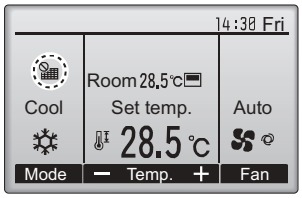
3



Select "OK" with the F4 button.

A confirmation screen will appear.

Navigating through the screens
- To go back to the Main menu ..... MENU button
- To return to the previous screen ..... RETURN button



When the is displayed on the Main display in the Full mode, the system is centrally controlled and the filter sign cannot be reset.

If two or more indoor units are connected, filter cleaning timing for each unit may be different, depending on the filter type.

The icon will appear when the filter on the main unit is due for cleaning.

When the filter sign is reset, the cumulative operation time of all units will be reset.

The icon is scheduled to appear after a certain duration of operation, based on the premise that the indoor units are installed in a space with ordinary air quality. Depending on the air quality, the filter may require more frequent cleaning.

The cumulative time at which filter needs cleaning depends on the model.

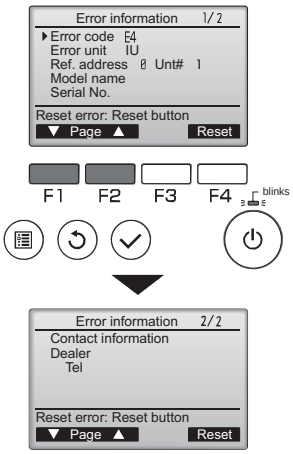
Troubleshooting

Error information

When an error occurs, the following screen will appear.
Check the error status, stop the operation, and consult your dealer.

Button operation

1

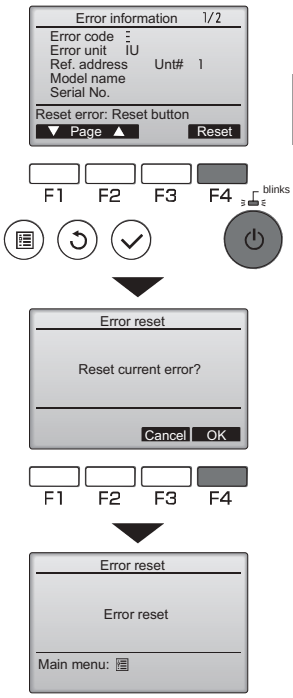


Error code, error unit, refrigerant address, unit model name, and serial number will appear.
The model name and serial number will appear only if the information have been registered.

Press the F1 or F2 button to go to the next page.

Contact information (dealer's phone number) will appear if the information have been registered.

2



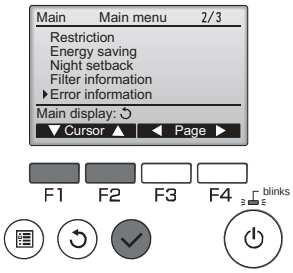
Press the F4 button or the ON/OFF button to reset the error that is occurring.

Errors cannot be reset while the ON/OFF operation is prohibited.

Select "OK" with the F4 button.

Navigating through the screens
• To go back to the Main menu ..... MENU button

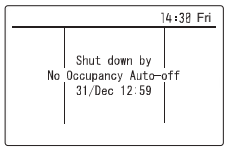
Checking the error information



While no errors are occurring, page 2/2 of the error information (refer to page 56) can be viewed by selecting "Error information" from the Main menu (r to page 20).
Errors cannot be reset from this screen.

No occupancy Auto-OFF

The following screen will appear for the 3D i-See sensor panel model when the unit is stopped due to the No occupancy Auto-OFF function of the energy saving option.
Refer to the indoor unit Instruction Book for the 3D i-See sensor setting.



Specifications

Controller specifications

	Specification
Product size	120(W (H) x 19(D) mm (4 3/4 x 4 3/4 x 3/4 [in]) (not including the protruding part)
Net weight	0.25 kg (9/16 lb.)
Rated power supply voltage	12 VDC (supplied from indoor units)
Power consumption	0.3 W
Usage environment	Temperature 0 ~ 40°C (32 ~ 104°F) Humidity 30 ~ 90%RH (with no dew condensation)
Material	Panel: PMMA Main body: PC + ABS
Sound Pressure Level	The A-weighted sound pressure level is below 70 dB.

Function list (as of October 1, 2015)

○: Supported ×: Unsupported

	Function	City Multi	Mr. Slim	Required password
Operation/ Display	Power ON/OFF	○	○	-
	Operation mode switch	○	○	-
	Room temperature setting	○	○	-
	Auto (dual set point) mode	○	○	-
	Fan speed setting	○	○	-
	Vane angle setting	○	○	-
	Louver setting	○	○	-
	Ventilation setting	○	○	-
	High power operation	×	○	-
	Auto descending panel	○	○	-
	Backlight	○	○	-
	Contrast setting	○	○	administrator
	Main display mode switch	○	○	administrator
	Clock setting	○	○	administrator
	Clock display format setting	○	○	administrator
	Language selection (8 languages)	○	○	administrator
	Room temperature display	○	○	administrator
	Error display	○	○	-
	Filter information	○	○	-
Schedule/ Timer	On/Off timer	○	○	administrator
	Auto-off timer	○	○	administrator
	Weekly timer	○	○	administrator
	Night setback	○	○	administrator
	OU silent mode	×	○	administrator
Energy saving	Auto return	○	○	administrator
	Schedule	×	○	administrator
Restriction	Operation lock	○	○	administrator
	Temperature range restriction	○	○	administrator
	Password (Administrator and Maintenance)	○	○	administrator maintenance
Others	Manual vane angle	○	○	-
	3D i-See sensor	○	○	-
	Test run	○	○	maintenance
	Model information input	○	○	maintenance
	Dealer information input	○	○	maintenance
	Function setting	○	○	maintenance
	Smooth maintenance	×	○	maintenance
	Refrigerant volume check	×	○	maintenance
	Refrigerant leak check	×	○	maintenance

* The supported functions vary depending on the unit model.

List of functions that can/cannot be used in combination

	High power	On/Off timer	Auto-off timer	Weekly timer	OU silent mode	Temperature range	Operation lock	Auto return	Energy saving schedule	Night setback
High power		○	○	○	△1	○	△2	○	△1	○
On/Off timer	○		○	×1	○	○	○	○	○	△3
Auto-off timer	○	○		○	○	○	○	○	○	△4
Weekly timer	○	×1	○		○	○	○	○	○	△5
OU silent mode	△1	○	○	○		○	○	○	○	○
Temperature range	○	○	○	○	○		○	×2	○	△6
Operation lock	△2	○	○	○	○	○		○	○	○
Auto return	○	○	○	○	○	×2	○		○	△7
Energy saving schedule	△1	○	○	○	○	○	○	○		○
Night setback	○	△3	△4	△5	○	△6	○	△7	○	

○ : Can be used in combination ×: Cannot be used in combination △: Restricted

△1: This function is enabled after completing the high power operation because the high power operation has the higher priority.
△2: This function cannot be operated if some operation is locked.
△3: Night setback function cannot be used when the unit is in operation by On/Off timer setting.
△4: Auto-off function cannot be used for Night setback operation.
△5: Night setback function cannot be used when the unit is in operation by Weekly timer setting.
△6: Temperature range setting cannot be used for Night setback operation.
△7: Auto return function cannot be used for Night setback operation.

×1: Weekly timer setting is not effective because On/Off timer has the higher priority.
×2: Auto return function cannot be used because Temperature range setting has the higher priority.

MITSUBISHI ELECTRIC

Mr.SLIM

SPLIT-SYSTEM HEAT PUMP
PKA-A·HA7

OPERATION MANUAL

FOR USER

For safe and correct use, please read this operation manual thoroughly before operating the air-conditioner unit.

English

MANUEL D'UTILISATION

POUR L'UTILISATEUR

Pour une utilisation correcte sans risques, veuillez lire le manuel d'utilisation en entier avant de vous servir du climatiseur.

Français

MANUAL DE INSTRUCCIONES

PARA EL USUARIO

Lea este manual de instrucciones hasta el final antes de poner en marcha la unidad de aire acondicionado para garantizar un uso seguro y correcto.

Español

Contents

1. Safety Precautions

► Before installing the unit, make sure you read all the "Safety Precautions".
► The "Safety Precautions" provide very important points regarding safety. Make sure you follow them.
► Please report to or take consent by the supply authority before connection to the system.

Symbols used in the text

⚠ Warning:
Describes precautions that should be observed to prevent danger of injury or death to the user.

⚠ Caution:
Describes precautions that should be observed to prevent damage to the unit.

Symbols used in the illustrations

⏚ : Indicates a part which must be grounded.

⚠ Warning:

- **The unit must not be installed by the user. Ask the dealer or an authorized company to install the unit. If the unit is installed improperly, water leakage, electric shock or fire may result.**
- **Do not stand on, or place any items on the unit.**
- **Do not splash water over the unit and do not touch the unit with wet hands. An electric shock may result.**
- **Do not spray combustible gas close to the unit. Fire may result.**
- **Do not place a gas heater or any other open-flame appliance where it will be exposed to the air discharged from the unit. Incomplete combustion may result.**
- **Do not remove the front panel or the fan guard from the outdoor unit when it is running.**
- **When you notice exceptionally abnormal noise or vibration, stop operation, turn off the power switch, and contact your dealer.**
- **Never insert fingers, sticks etc. into the intakes or outlets.**
- **If you detect odd smells, stop using the unit, turn off the power switch and consult your dealer. Otherwise, a breakdown, electric shock or fire may result.**
- **This air conditioner is NOT intended for use by children or infirm persons without supervision.**
- **Young children must be supervised to ensure that they do not play with the air conditioner.**
- **If the refrigeration gas blows out or leaks, stop the operation of the air conditioner, thoroughly ventilate the room, and contact your dealer.**
- **When installing or relocating, or servicing the air conditioner, use only the specified refrigerant (R410A) to charge the refrigerant lines. Do not mix it with any other refrigerant and do not allow air to remain in the lines. If air is mixed with the refrigerant, then it can be the cause of abnormal high pressure in the refrigerant line, and may result in an explosion and other hazards. The use of any refrigerant other than that specified for the system will cause mechanical failure or system malfunction or unit breakdown. In the worst case, this could lead to a serious impediment to securing product safety.**

⚠ Caution:

- **Do not use any sharp object to push the buttons, as this may damage the remote controller.**
- **Never block or cover the indoor or outdoor unit's intakes or outlets.**

Disposing of the unit

When you need to dispose of the unit, consult your dealer.

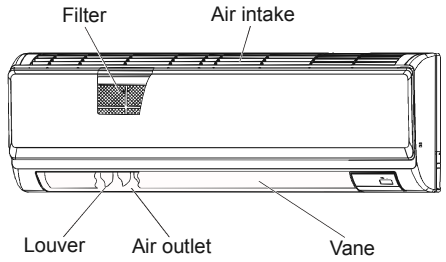
2. Parts Names

■ Indoor Unit

	PKA-A·HA7
Fan speed	3 speeds + Auto
Vane	Auto with swing
Louver	Manual
Filter	Normal
Filter cleaning indication	100 hr

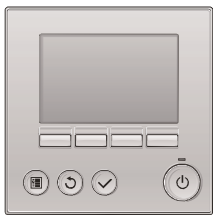
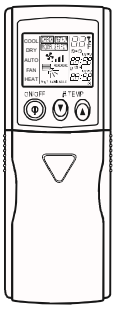
■ PKA-A·HA7

Wall Mounted



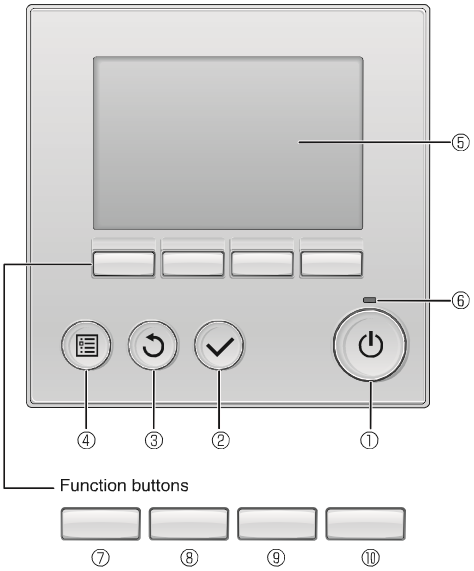
2. Parts Names

■ **Remote controller (Optional parts)**

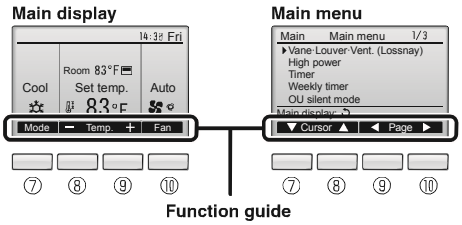
Wired remote controller	IR wireless remote controller
	

■ **Wired Remote Controller**

Controller interface



The functions of the function buttons change depending on the screen.
Refer to the button function guide that appears at the bottom of the LCD for the functions they serve on a given screen.
When the system is centrally controlled, the button function guide that corresponds to the locked button will not appear.



① [ON/OFF] button

Press to turn ON/OFF the indoor unit.

② [SELECT] button

Press to save the setting.

③ [RETURN] button

Press to return to the previous screen.

④ [MENU] button

Press to bring up the Main menu.

⑤ Backlit LCD

Operation settings will appear.

When the backlight is off, pressing any button turns the backlight on and it will stay lit for a certain period of time depending on the screen.

When the backlight is off, pressing any button turns the backlight on and does not perform its function. (except for the [ON/OFF] button)

⑥ ON/OFF lamp

This lamp lights up in green while the unit is in operation. It blinks while the remote controller is starting up or when there is an error.

⑦ Function button [F1]

Main display: Press to change the operation mode.

Main menu: Press to move the cursor down.

⑧ Function button [F2]

Main display: Press to decrease temperature.

Main menu: Press to move the cursor up.

⑨ Function button [F3]

Main display: Press to increase temperature.

Main menu: Press to go to the previous page.

⑩ Function button [F4]

Main display: Press to change the fan speed.

Main menu: Press to go to the next page.

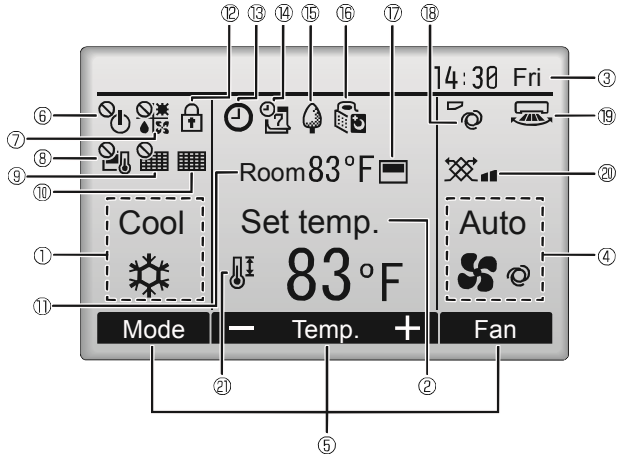
2. Parts Names

Display

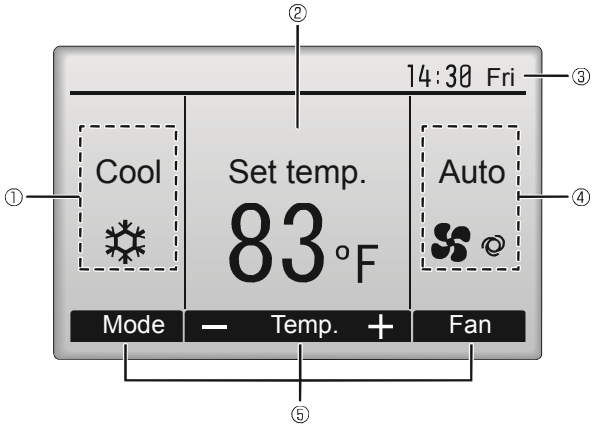
The main display can be displayed in two different modes: “Full” and “Basic”. The factory setting is “Full”. To switch to the “Basic” mode, change the setting on the Main display setting. (Refer to operation manual included with remote controller.)

<Full mode>

* All icons are displayed for explanation.



<Basic mode>



① Operation mode

Indoor unit operation mode appears here.

② Preset temperature

Preset temperature appears here.

③ Clock (See the Installation Manual.)

Current time appears here.

④ Fan speed

Fan speed setting appears here.

⑤ Button function guide

Functions of the corresponding buttons appear here.

⑥

Appears when the ON/OFF operation is centrally controlled.

⑦

Appears when the operation mode is centrally controlled.

⑧

Appears when the preset temperature is centrally controlled.

⑨

Appears when the filter reset function is centrally controlled.

⑩

Indicates when filter needs maintenance.

⑪ Room temperature (See the Installation Manual.)

Current room temperature appears here.

⑫

Appears when the buttons are locked.

⑬

Appears when the On/Off timer, Night setback, or Auto-off timer function is enabled.

appears when the timer is disabled by the centralized control system.

⑭

Appears when the Weekly timer is enabled.

⑮

Appears while the units are operated in the energy-save mode. (Will not appear on some models of indoor units)

⑯

Appears while the outdoor units are operated in the silent mode.

⑰

Appears when the built-in thermistor on the remote controller is activated to monitor the room temperature (⑪).

appears when the thermistor on the indoor unit is activated to monitor the room temperature.

⑱

Indicates the vane setting.

⑲

Indicates the louver setting.
(This indication is not available for this model.)

⑳

Indicates the ventilation setting.

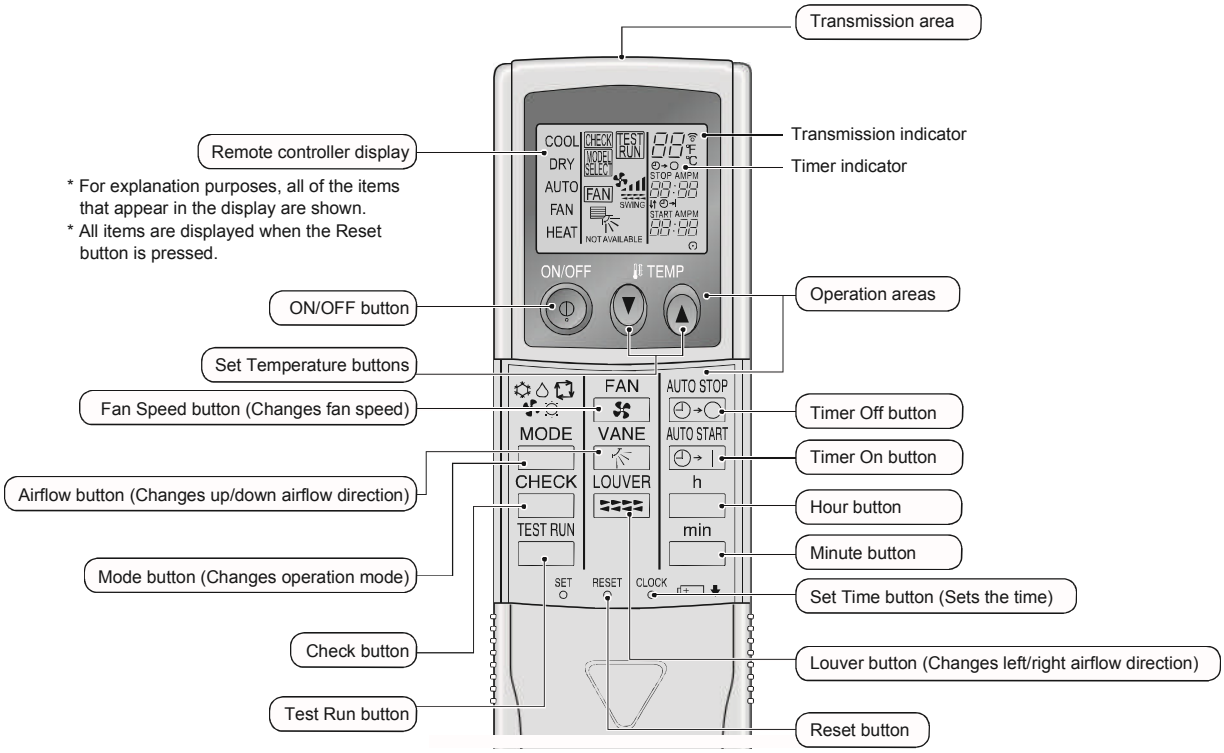
㉑

Appears when the preset temperature range is restricted.

Most settings (except ON/OFF, mode, fan speed, temperature) can be made from the Menu screen. (Refer to operation manual included with remote controller.)

2. Parts Names

■ **IR Wireless remote controller**

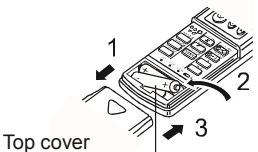


Note: (Only for IR wireless remote controller)

- When using the IR wireless remote controller, point it towards the receiver on the indoor unit.
- If the IR wireless remote controller is operated within approximately 2 minutes after power is supplied to the indoor unit, the indoor unit may beep twice as the unit is performing the initial automatic check.
- The indoor unit beeps to confirm that the signal transmitted from the IR wireless remote controller has been received. Signals can be received up to approximately 7 meters, 275-19/32 inch in a direct line from the indoor unit in an area 45° to the left and right of the unit. However, illumination such as fluorescent lights and strong light can affect the ability of the indoor unit to receive signals.
- If the operation lamp near the receiver on the indoor unit is blinking, the unit needs to be inspected. Consult your dealer for service.
- Handle the IR wireless remote controller carefully! Do not drop the IR wireless remote controller or subject it to strong shocks. In addition, do not get the IR wireless remote controller wet or leave it in a location with high humidity.
- To avoid misplacing the IR wireless remote controller, install the holder included with the IR wireless remote controller on a wall and be sure to always place the IR wireless remote controller in the holder after use.

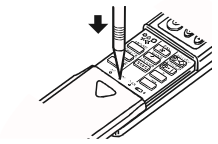
Battery installation/replacement

1. Remove the top cover, insert 2 AAA batteries, and then install the top cover.



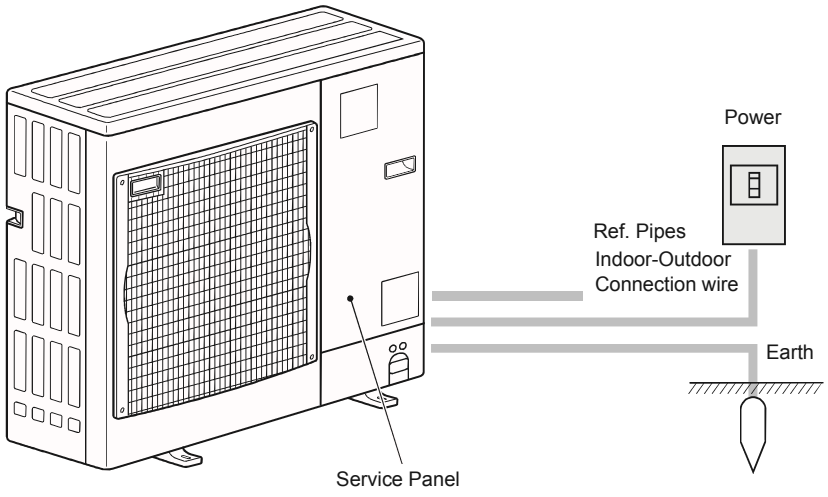
2 AAA batteries
Insert the negative (–) end of each battery first. Install the batteries in the correct directions (+, –)!

2. Press the Reset button.



Press the Reset button with an object that has a narrow end.

■ **Outdoor unit**



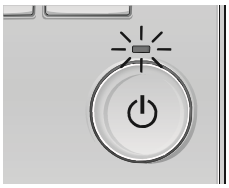
3. Operation

■ **About the operation method, refer to the operation manual that comes with each remote controller.**

3.1. Turning ON/OFF

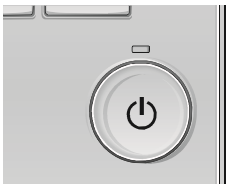
<For wired remote controller>

[ON]



Press the [ON/OFF] button.
The ON/OFF lamp will light up in green, and the operation will start.

[OFF]



Press the [ON/OFF] button again.
The ON/OFF lamp will come off, and the operation will stop.

Note:
Even if you press the ON/OFF button immediately after shutting down the operation is progress, the air conditioner will not start for about 3 minutes. This is to prevent the internal components from being damaged.

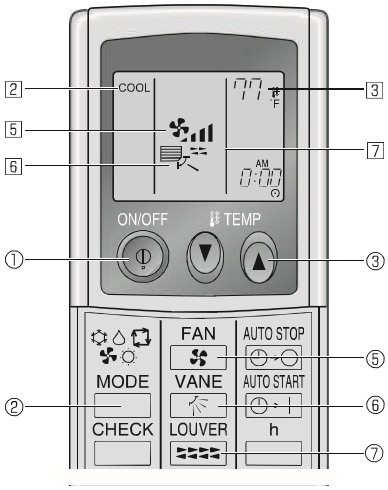
■ **Operation status memory**

	Remote controller setting
Operation mode	Operation mode before the power was turned off
Preset temperature	Preset temperature before the power was turned off
Fan speed	Fan speed before the power was turned off

■ **Settable preset temperature range**

Operation mode	Preset temperature range
Cool/Dry	19 ~ 30 °C, 67 ~ 87 °F
Heat	17 ~ 28 °C, 63 ~ 83 °F
Auto	19 ~ 28 °C, 67 ~ 87 °F
Fan/Ventilation	Not settable

<For IR wireless remote controller>



<To Start Operation>

■ Press the ON/OFF button ①.

- The ON lamp [1] and the display area come on.

<To Stop Operation>

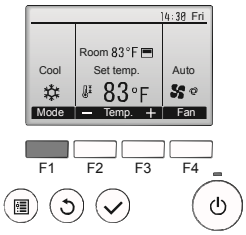
■ Press the ON/OFF button ① again.

- The ON lamp [1] and the display area go dark.

Note:
Even if you press the ON/OFF button immediately after shutting down the operation is progress, the air conditioner will not start for about three minutes. This is to prevent the internal components from being damaged.

3.2. Operation mode select

Cool/Dry/Fan/Heat/Automatic (cool/heat)/Ventilation modes are available.



Press the [F1] button to go through the operation modes in the order of “Cool”, “Dry”, “Fan”, “Auto”, and “Heat”. Select the desired operation mode.

Cool Dry Fan
Auto Heat

- Operation modes that are not available to the connected outdoor unit models will not appear on the display.

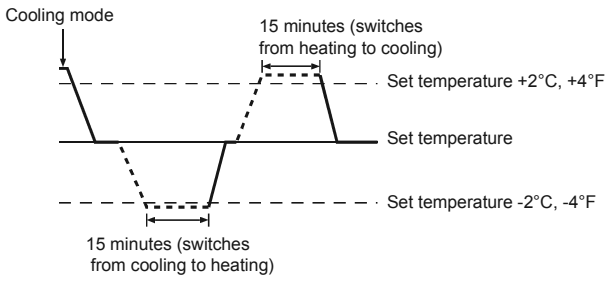
What the blinking mode icon means
The mode icon will blink when other indoor units in the same refrigerant system (connected to the same outdoor unit) are already operated in a different mode. In this case, the rest of the unit in the same group can only be operated in the same mode.

Note:

- **Heat and Automatic mode can not be available for cooling only units.**
- **Ventilation mode: only indicated on the following condition. Wired remote controller is used and LOSSNAY is connected.**
- **Automatic mode**

■ According to a set temperature, cooling operation starts if the room temperature is too hot and heating operation starts if the room temperature is too cold.

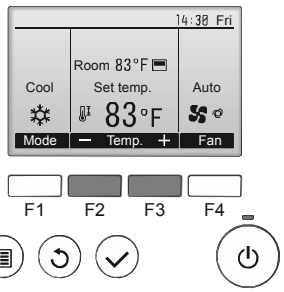
■ During automatic operation, if the room temperature changes and remains 2 °C, 4 °F or more above the set temperature for 15 minutes, the air conditioner switches to cooling mode. In the same way, if the room temperature remains 2 °C, 4 °F or more below the set temperature for 15 minutes, the air conditioner switches to heating mode.

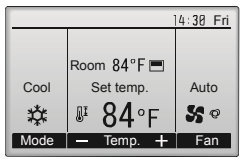


3. Operation

3.3. Temperature setting

<For wired remote controller>
<Cool, Dry, Heat, and Auto>





Example display
(Centigrade in 0.5-degree increments)

Press the [F2] button to decrease the preset temperature, and press the [F3] button to increase.

- Refer to the table on page 6 for the settable temperature range for different operation modes.
- Preset temperature range cannot be set for Fan/Ventilation operation.
- Preset temperature will be displayed either in Centigrade in 0.5- or 1-degree increments, or in Fahrenheit, depending on the indoor unit model and the display mode setting on the remote controller.

<For IR wireless remote controller>

► To decrease the room temperature:

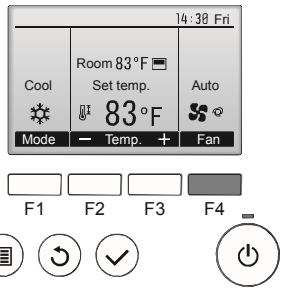
Press ▼ button ③ to set the desired temperature.
The selected temperature is displayed 3.

► To increase the room temperature:

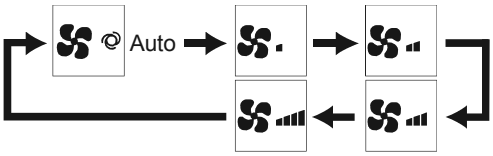
Press ▲ button ③ to set the desired temperature.
The selected temperature is displayed 3.

3.4. Fan speed setting

<For wired remote controller>



Press the [F4] button to go through the fan speeds in the following order.



- The available fan speeds depend on the models of connected indoor units.

<For IR wireless remote controller>

■ Press the Fan Speed button as many times as necessary while the system is running.
  - Each press changes the force. The currently selected speed is shown at display.

Note:

- **The number of available fan speeds depends on the type of unit connected.**
- **In the following cases, the actual fan speed generated by the unit will differ from the speed shown the remote controller display.**
  1. **When the unit is in STANDBY or DEFROST states.**
  2. **When the temperature of the heat exchanger is low in the heating mode. (e.g. immediately after heating operation starts)**
  3. **In HEAT mode, when room temperature is higher than the temperature setting.**
  4. **When the unit is in DRY mode.**

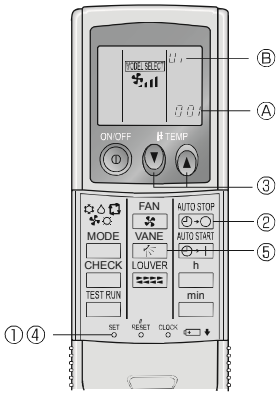
■ Automatic fan speed setting (For IR wireless remote controller)
It is necessary to set for wireless remote controller only when automatic fan speed is not set at default setting.
It is not necessary to set for wired remote controller with automatic fan speed at default setting.

① Press the SET button with something sharp at the end.
Operate when display of remote controller is off.
MODEL SELECT blinks and Model No. is lighted Ⓐ.

② Press the AUTO STOP button.
blinks and setting No. is lighted Ⓑ.
(Setting No.01: without automatic fan speed)

③ Press the temp. buttons to set the setting No.02.
(Setting No.02:with automatic fan speed)
If you mistook the operation, press the ON/OFF button and operate again from procedure ②.

④ Press the SET button with something sharp at the end.
MODEL SELECT and Model No. are lighted for 3 seconds, then turned off.

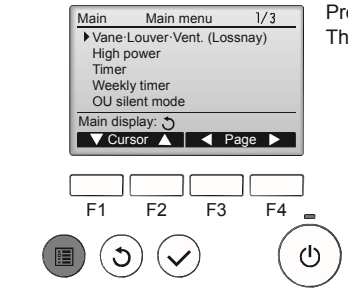


3.5. Airflow up/down direction setting

<For wired remote controller>

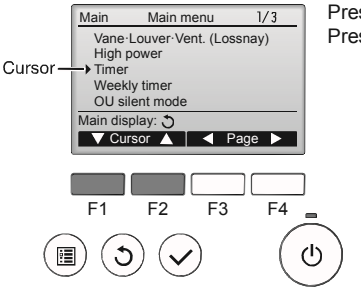
3.5.1 Navigating through the Main menu

<Accessing the Main menu>



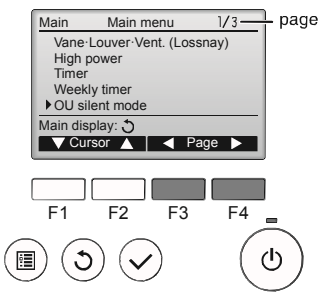
Press the [MENU] button.
The Main menu will appear.

<Item selection>



Press [F1] to move the cursor down.
Press [F2] to move the cursor up.

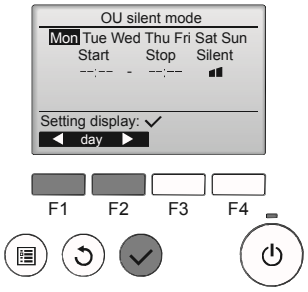
<Navigating through the pages>



Press [F3] to go to the previous page.
Press [F4] to go to the next page.

3. Operation

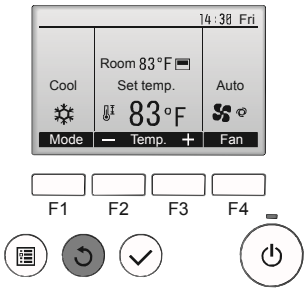
<Saving the settings>



Select the desired item, and press the [SELECT] button.

The screen to set the selected item will appear.

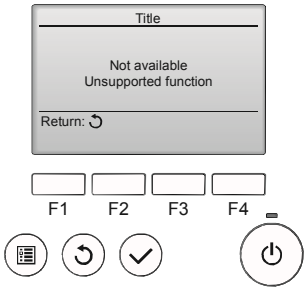
<Exiting the Main menu screen>



Press the [RETURN] button to exit the Main menu and return to the Main display.

If no buttons are touched for 10 minutes, the screen will automatically return to the Main display. Any settings that have not been saved will be lost.

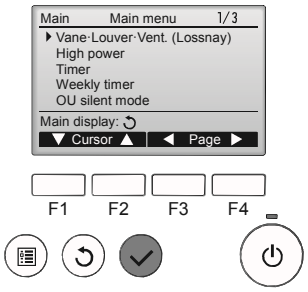
<Display of unsupported functions>



The message at left will appear if the user selects a function not supported by the corresponding indoor unit model.

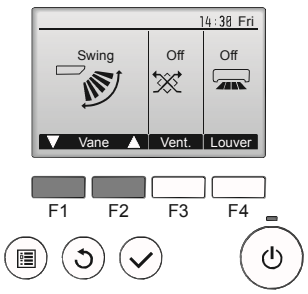
3.5.2 Vane·Vent. (Lossnay)

<Accessing the menu>

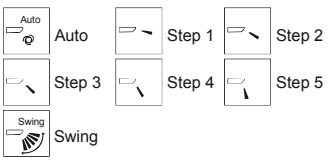


Select "Vane·Louver·Vent. (Lossnay)" from the Main menu (refer to page 7), and press the [SELECT] button.

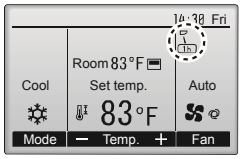
<Vane setting>



Press the [F1] or [F2] button to go through the vane setting options: "Auto", "Step 1", "Step 2", "Step 3", "Step 4", "Step 5" and "Swing".
Select the desired setting.

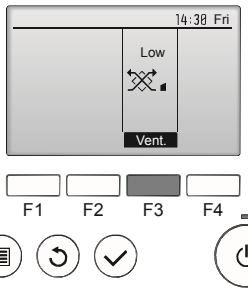


Select "Swing" to move the vanes up and down automatically.
When set to "Step 1" through "Step 5", the vane will be fixed at the selected angle.



- 1h under the vane setting icon
  This icon will appear when the vane is set to "Step 2" to "Step 5" and the fan operates at "Mid 1" to "Low" speed during cooling or dry operation (depends on the model).
  The icon will go off in an hour, and the vane setting will automatically change.

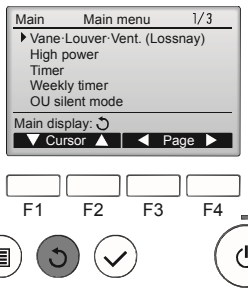
<Vent. setting>



Press the [F3] button to go through the ventilation setting options in the order of "Off", "Low", and "High".
* Settable only when LOSSNAY unit is connected.

- The fan on some models of indoor units may be interlocked with certain models of ventilation units.

<Returning to the Main menu>



Press the [RETURN] button to go back to the Main menu.

Note:

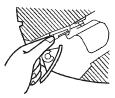
- **During swing operation, the directional indication on the screen does not change in sync with the directional vanes on the unit.**
- **Available directions depend on the type of unit connected.**
- **In the following cases, the actual air direction will differ from the direction indicated on the remote controller display.**
  1. **While the display is in "STAND BY" or "DEFROST" states.**
  2. **Immediately after starting heat mode (while the system is waiting for the mode change to take effect).**
  3. **In heat mode, when room temperature is higher than the temperature setting.**

<[Manual] To Change the Airflow's Left/Right Direction>

* The louver button cannot be used.

- Stop the unit operation, hold the lever of the louver, and adjust to the desired direction.

* Do not set to the inside direction when the unit is in the cooling or drying mode because there is a risk of condensation and water dripping.



⚠ Caution:
To prevent falls, maintain a stable footing when operating the unit.

3. Operation

<To Change the Airflow's Up/Down Direction>
<For IR wireless remote controller>

■ With the unit running, press the Airflow Up/Down button ⑥ as necessary.
- Each press changes the direction. The current direction is shown at 6.
- The change sequence, and the available settings, are as follows.

Remote controller	Display
IR Wireless remote controller	Swing → 1 → 2 → 3 → 4 → Swing

3.6. Ventilation

►For LOSSNAY combination

● The following 2 patterns of operation is available.
- Run the ventilator together with the indoor unit.
- Run the ventilator independently.

Note:
● **With some model configurations, the fan on the indoor unit may come on even when you set the ventilator to run independently.**

Note: (for IR wireless remote controller and RF thermostat)
● **Running the ventilator independently is not available.**
● **No indication on the remote controller.**

4. Timer

■ Timer functions are different by each remote controller.
■ For details on how to operate the remote controller, refer to the appropriate operation manual included with each remote controller.

5. Emergency Operation for IR wireless remote controller

(For PKA-A·HA7)

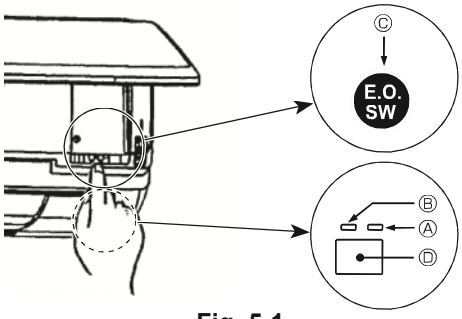


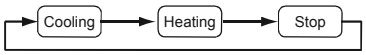
Fig. 5-1

When the IR wireless remote controller cannot be used
When the batteries of the IR wireless remote controller run out or the IR wireless remote controller malfunctions, the emergency operation can be done using the emergency buttons.

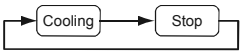
[Fig. 5-1] Ⓐ DEFROST/STAND BY lamp (Orange)
Ⓑ Operation lamp (Green)
Ⓒ Emergency operation switch (cooling/heating)
Ⓓ Receiver

- Each press of the emergency operation switch will toggle the operation mode.
- Check "COOL/HEAT" with the operation monitor display. (The orange lamp Ⓐ follows this monitor display for 5 seconds after pressing the emergency operation switch.)

[Heat pump type]



[Cooling only type]



Operation Monitor Display

	GREEN	ORANGE	
STOP	○	○	The orange lamp follows the switch operation as indicated at the left for 5 seconds, and then it will return to the normal display.
COOL	●	○	
HEAT	●	●	

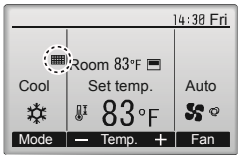
○: Turning off ●: Lighting

Note:
- **Details of emergency mode are as shown below.**

Operation mode	COOL	HEAT
Set temperature	24°C, 75°F	24°C, 75°F
Fan speed	High	High
Airflow direction	Step 1	Step 5

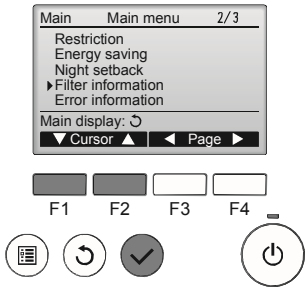
6. Care and Cleaning

■ **Filter information**

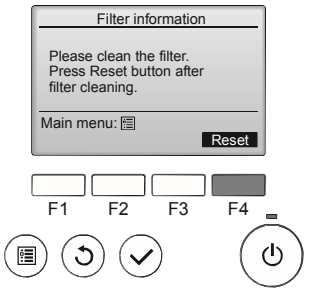


▦ will appear on the Main display in the Full mode when it is time to clean the filters.

Wash, clean, or replace the filters when this sign appears.
Refer to the indoor unit Instructions Manual for details.

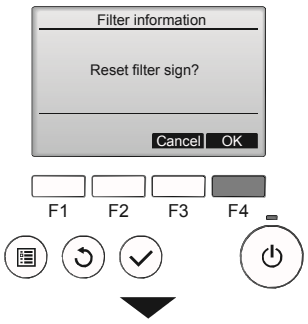


Select "Filter information" from the Main menu (refer to page 7), and press the [SELECT] button.



Press the [F4] button to reset filter sign.
Refer to the indoor unit Instructions Manual for how to clean the filter.

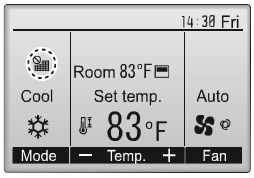
6. Care and Cleaning



Select "OK" with the [F4] button.

A confirmation screen will appear.

Navigating through the screens
- To go back to the Main menu ..... [MENU] button
- To return to the previous screen ..... [RETURN] button



When the icon is displayed on the Main display in the Full mode, the system is centrally controlled and the filter sign cannot be reset.

If two or more indoor units are connected, filter cleaning timing for each unit may be different, depending on the filter type.

The icon will appear when the filter on the main unit is due for cleaning.

When the filter sign is reset, the cumulative operation time of all units will be reset.

The icon is scheduled to appear after a certain duration of operation, based on the premise that the indoor units are installed in a space with ordinary air quality. Depending on the air quality, the filter may require more frequent cleaning.

The cumulative time at which filter needs cleaning depends on the model.
- This indication is not available for wireless remote controller.

► Cleaning the filters
- Clean the filters using a vacuum cleaner. If you do not have a vacuum cleaner, tap the filters against a solid object to knock off dirt and dust.
- If the filters are especially dirty, wash them in lukewarm water. Take care to rinse off any detergent thoroughly and allow the filters to dry completely before putting them back into the unit.

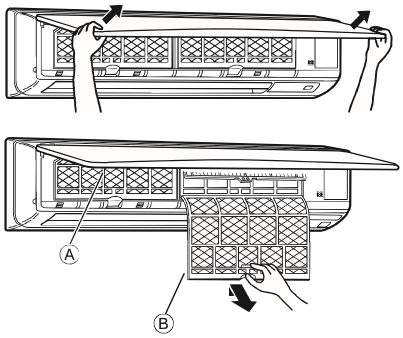
⚠ Caution:
- **Do not dry the filters in direct sunlight or by using a heat source, such as an electric heater: this may warp them.**
- **Do not wash the filters in hot water (above 50°C, 122°F), as this may warp them.**
- **Make sure that the air filters are always installed. Operating the unit without air filters can cause malfunction**

⚠ Caution:
- **Before you start cleaning, stop operation and turn OFF the power supply.**
- **Indoor units are equipped with filters to remove the dust of sucked-in air. Clean the filters using the methods shown in the following sketches.**

► Filter removal

⚠ Caution:
- **In removing the filter, precautions must be taken to protect your eyes from dust. Also, if you have to climb up on a stool to do the job, be careful not to fall.**
- **When the filter is removed, do not touch the metallic parts inside the indoor unit, otherwise injury may result.**

■ PKA-A·HA7



① Using both hands, pull both the bottom corners of the intake grille to open the grille, then lift the filter until it clicks at the stop position.
② Hold the knobs on the filter and pull the filter up, then pull it out downward.
(Located in two places, on the left and right.)
Ⓐ Front grille
Ⓑ Filter

- Wipe the outside of the unit with a clean, dry, soft cloth.
- Clean off any oil stains or finger marks using a neutral household detergent (such as dishwashing liquid or laundry detergent).

⚠ Caution:
Never use gasoline, benzene, thinner, scouring powder or any type of non-neutral detergent, as these substances may damage the unit's case.

7. Trouble Shooting

Having trouble?	Here is the solution. (Unit is operating normally.)
Air conditioner does not heat or cool well.	■ Clean the filter. (Airflow is reduced when the filter is dirty or clogged.) ■ Check the temperature adjustment and adjust the set temperature. ■ Make sure that there is plenty of space around the outdoor unit. Is the indoor unit air intake or outlet blocked? ■ Has a door or window been left open?
When heating operation starts, warm air does not blow from the indoor unit soon.	■ Warm air does not blow until the indoor unit has sufficiently warmed up.
During heating mode, the air conditioner stops before the set room temperature is reached.	■ When the outdoor temperature is low and the humidity is high, frost may form on the outdoor unit. If this occurs, the outdoor unit performs a defrosting operation. Normal operation should begin after approximately 10 minutes.

7. Trouble Shooting

Having trouble?	Here is the solution. (Unit is operating normally.)
Airflow direction changes during operation or airflow direction cannot be set.	■ During cooling mode, the vanes automatically move to the horizontal (down) position after 1 hour when the down (horizontal) airflow direction is selected. This is to prevent water from forming and dripping from the vanes. ■ During heating mode, the vanes automatically move to the horizontal airflow direction when the airflow temperature is low or during defrosting mode.
When the airflow direction is changed, the vanes always move up and down past the set position before finally stopping at the position.	■ When the airflow direction is changed, the vanes move to the set position after detecting the base position.
A flowing water sound or occasional hissing sound is heard.	■ These sounds can be heard when refrigerant is flowing in the air conditioner or when the refrigerant flow is changing.
A cracking or creaking sound is heard.	■ These sounds can be heard when parts rub against each due to expansion and contraction from temperature changes.
The room has an unpleasant odor.	■ The indoor unit draws in air that contains gases produced from the walls, carpeting, and furniture as well as odors trapped in clothing, and then blows this air back into the room.
A white mist or vapor is emitted from the indoor unit.	■ If the indoor temperature and the humidity are high, this condition may occur when operation starts. ■ During defrosting mode, cool airflow may blow down and appear like a mist.
Water or vapor is emitted from the outdoor unit.	■ During cooling mode, water may form and drip from the cool pipes and joints. ■ During heating mode, water may form and drip from the heat exchanger. ■ During defrosting mode, water on the heat exchanger evaporates and water vapor may be emitted.
" " appears in the wired remote controller display. (*1)	■ During central control, " " appears in the wired remote controller display and air conditioner operation cannot be started or stopped using the wired remote controller.
When restarting the air conditioner soon after stopping it, it does not operate even though the ON/OFF button is pressed.	■ Wait approximately three minutes. (Operation has stopped to protect the air conditioner.)
Air conditioner operates without the ON/OFF button being pressed. (*1)	■ Is the on timer set? Press the ON/OFF button to stop operation. ■ Is the air conditioner connected to a central wired remote controller? Consult the concerned people who control the air conditioner. ■ Does " " appear in the wired remote controller display? Consult the concerned people who control the air conditioner. ■ Has the auto recovery feature from power failures been set? Press the ON/OFF button to stop operation.
Air conditioner stops without the ON/OFF button being pressed. (*1)	■ Is the off timer set? Press the ON/OFF button to restart operation. ■ Is the air conditioner connected to a central wired remote controller? Consult the concerned people who control the air conditioner. ■ Does " " appear in the wired remote controller display? Consult the concerned people who control the air conditioner.
Wired remote controller timer operation cannot be set. (*1)	■ Are timer settings invalid? If the timer can be set, or appears in the wired remote controller display.
"PLEASE WAIT" appears in the wired remote controller display. (*1)	■ The initial settings are being performed. Wait approximately 3 minutes.
An error code appears in the remote controller display.	■ The protection devices have operated to protect the air conditioner. ■ Do not attempt to repair this equipment by yourself. Turn off the power switch immediately and consult your dealer. Be sure to provide the dealer with the model name and information that appeared in the remote controller display.
Draining water or motor rotation sound is heard.	■ When cooling operation stops, the drain pump operates and then stops. Wait approximately 3 minutes.
Noise is louder than specifications.	■ The indoor operation sound level is affected by the acoustics of the particular room as shown in the following table and will be higher than the noise specification, which was measured in an echo-free room.
Nothing appears in the IR wireless remote controller display, the display is faint, or signals are not received by the indoor unit unless the IR wireless remote controller is close. (*2)	■ The batteries are low. Replace the batteries and press the Reset button. ■ If nothing appears even after the batteries are replaced, make sure that the batteries are installed in the correct directions (+, –).
The operation lamp near the receiver for the IR wireless remote controller on the indoor unit is blinking. (*2)	■ The self diagnosis function has operated to protect the air conditioner. ■ Do not attempt to repair this equipment by yourself. Turn off the power switch immediately and consult your dealer. Be sure to provide the dealer with the model name.

	High sound-absorbing rooms	Normal rooms	Low sound-absorbing rooms
Location examples	Broadcasting studio, music room, etc.	Reception room, hotel lobby, etc.	Office, hotel room
Noise levels	3 to 7 dB	6 to 10 dB	9 to 13 dB

7. Trouble Shooting

Having trouble?	Here is the solution. (Unit is operating normally.)
When dry mode starts, the set temperature changes.	■ When Dry mode starts, the set temperature automatically changes to the optimum initial set temperature.

*1. Only for Wired remote controller
*2. Only for IR wireless remote controller.

8. Specifications

Model		PKA-A12HA7	PKA-A18HA7
Power source (Phase, Voltage <V>, Frequency <Hz>)		Single 208/230, 60	
Fan motor	<FLA>	0.33	
MCA	<A>	1	1
MOCP	<A>	15	15
Dimension (Height)	<inch>	11-5/8	
Dimension (Width)	<inch>	35-3/8	
Dimension (Depth)	<inch>	9-13/16	
Airflow (Low-Middle-High)	DRY <CFM>	320-370-425	
	WET <CFM>	290-335-380	
Noise level (Low-Middle-High)	<dB>	36-40-43	
Net weight	<lbs>	29	

INSTALLATION INSTRUCTIONS

VERSA-LINE

COMMERCIAL FINNED-TUBE RADIATION
A/B/K OR SP BARE ELEMENT

1. Determine quantities of elements required per wall or run.

2A. **Hot Water Systems:** Install two (2) wall mounted hangers (elevation location will be found on submittal document or mechanical drawings.) per element length up to 5'-0" of length. Three (3) wall mounted hangers per element length 5'-6" up to 9'-6" (8'-0" for ¾" copper/aluminum) of length. Four (4) wall mounted hangers per element length 9'-6" up to 12'-6". Apply the same for second and/or third tier of element if required. The vertical distance between element tube center lines should be 6 inches minimum for a second or third tier element.

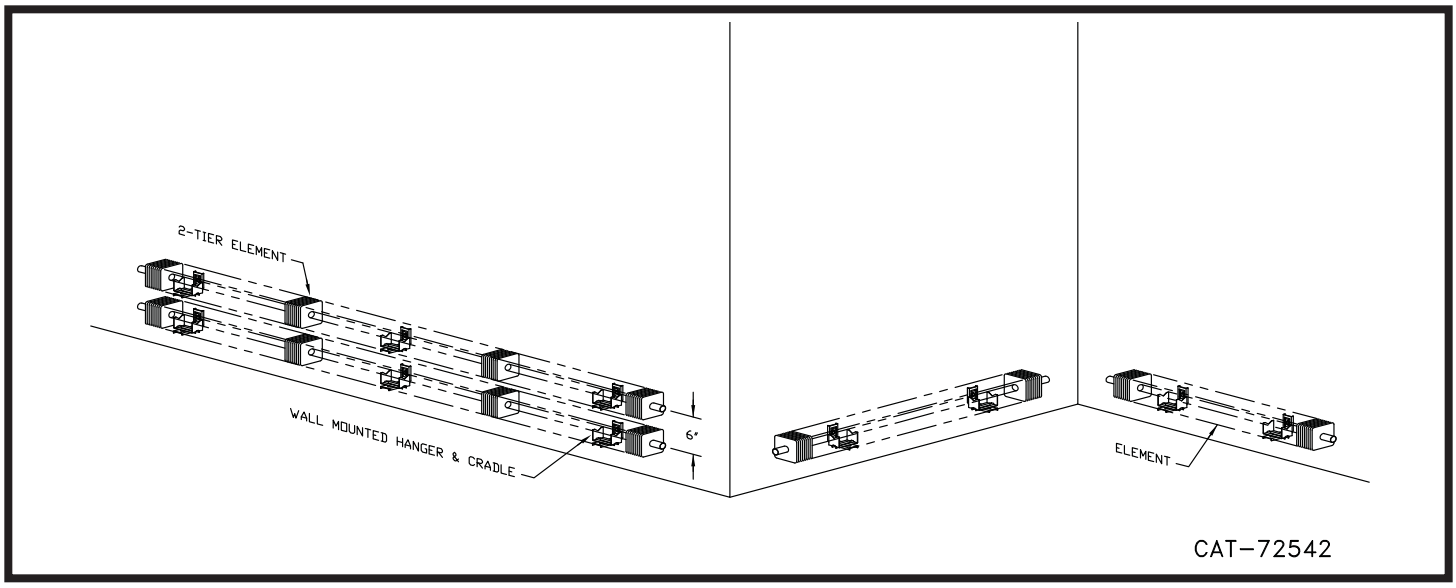
2B. **Steam Systems (Two Pipe):** If the element(s) is used on two pipe steam applications, the wall mounted brackets will have to be pitched downward from the supply end of the element. The minimum rate of pitch is ½" drop over a 20 foot run. Install two (2) wall mounted hangers (elevation location will be found on submittal document.) per element length up to 5'-0" of length. Three (3) wall mounted hangers per element length 5'-6" up to 9'-6" (8'-0" for ¾" copper/aluminum) of length. Four (4) wall mounted hangers per element length 9'-6" up to 12'-6". Accessories do not require brackets. Apply the same for second and/or third tier of element if required. The vertical distance between element tube center lines should be 6 inches minimum for a second or third tier element.

3. Lay out element(s) as required. Place a slide cradle onto the bottom of element at each bracket location. The element cradle has two legs that angle out slightly. Position the legs between the fins so there is tension against the legs. This holds the cradle in position. Check submittal drawing for correct position of element fin. **For copper tube elements, flush the loop or series with system water after soldering to neutralize the remaining flux material and prevent corrosive action and resulting pinhole leaks.**

MAINTENANCE

Before each heating season, remove accessories and enclosure panel to inspect finned tube elements for accumulation of dust or other debris that may accumulate and block airflow between fins. Remove dust and debris from coil fins with a vacuum cleaner or compressed air. Inspect for leaks or areas of corrosion. It should not be required, but if necessary, place a drop of lubricant (machine oil) onto each ball bearing (where applicable) located in the water brackets or bracket mounted hangers. Replace cover and accessories.

GENERAL LAYOUT



STERLING®
COMMERCIAL HYDRONIC PRODUCTS

260 NORTH ELM ST., WESTFIELD, MA 01085
TEL: (413) 568-9571 FAX: (413) 562-8437

A MESTEK COMPANY

INSTALLATION INSTRUCTIONS

VERSA-LINE

COMMERCIAL FINNED-TUBE RADIATION

JVB-PM/2PM

Pedestal mounted enclosure is not recommended for use with steam systems.

1. Per the mechanical drawings, layout the pedestal brackets based on the enclosure lengths of the run. For enclosures 2'-0" to 5'-0" lengths, two (2) brackets will be required. These brackets should start and end 6" to 12" in from each end of the enclosure. For enclosures 5'-6" to 8'-0" lengths, three (3) brackets will be required. The third bracket will be centered between the two outer brackets.

2. Once the bracket locations along the run have been determined, secure them to the floor with the specified fasteners (by others). The rear vertical bracket leg should be a minimum of 2" from the wall. Depending on the flatness of the finished floor, it has to be determined which (if any) of the brackets need to be shimmed to allow for a level and straight enclosure installation. An enclosure support bar will be installed between the two vertical legs of the pedestal bracket after the element(s) have been installed.

3. Locate finned tube element where identified on mechanical drawings. Place element slide cradle supports onto element where brackets are located. The legs of the element cradles are tapered slightly outward so that a friction or compression fit will occur and hold them in place when pressing the cradles into place between the element fins. Place element and element slide cradles onto the ball bearings in the bracket and make sweat connections. For steel element, apply specified pipe dope or sealing tape for threaded connections with the required threaded fittings. Check submittal drawings to confirm dimension out from wall to center of element and up from finished floor. Once the elements are connected into the heating system, a standard pressure leak test should be conducted as specified by the Mechanical Engineer. **For copper tube elements, flush the loop or series with system water after soldering to neutralize the remaining flux material and prevent corrosive action and resulting pinhole leaks.**

4. When the enclosure run is laid out wall to wall with the supply and return tube running through the wall, it is typical to start and finish the run of enclosure with a “Wall Sleeve". This over lapping accessory provides for make-up in the run where the wall-to-wall dimension does not coincide with the standard enclosure lengths. The slip-jointed enclosures interlock with each other along the run. Inside or outside corners are universal with the pedestal style enclosure.

5. When enclosure is installed short of wall with supply and return lines coming out of the floor, end caps will be used to terminate the enclosure run at each end. For JVB-PM & 2PM enclosures, the end caps provided are either left hand or right hand and interlock with the enclosure slip-joints.

6. If access is needed to air vents or shut off valves, it is recommended that a two (2) foot piece of enclosure is installed in the run where the device is located. This piece of enclosure will act as a valve compartment or access panel.

MAINTENANCE

Before each heating season, remove accessories and enclosure panel to inspect finned tube elements for accumulation of dust or other debris that may accumulate and block airflow between fins. Remove dust and debris from coil fins with a vacuum cleaner or compressed air. Inspect for leaks or areas of corrosion. It should not be required, but if necessary, place a drop of lubricant (machine oil) onto each ball bearing (where applicable) located in the water brackets or bracket mounted hangers. Replace cover and accessories.

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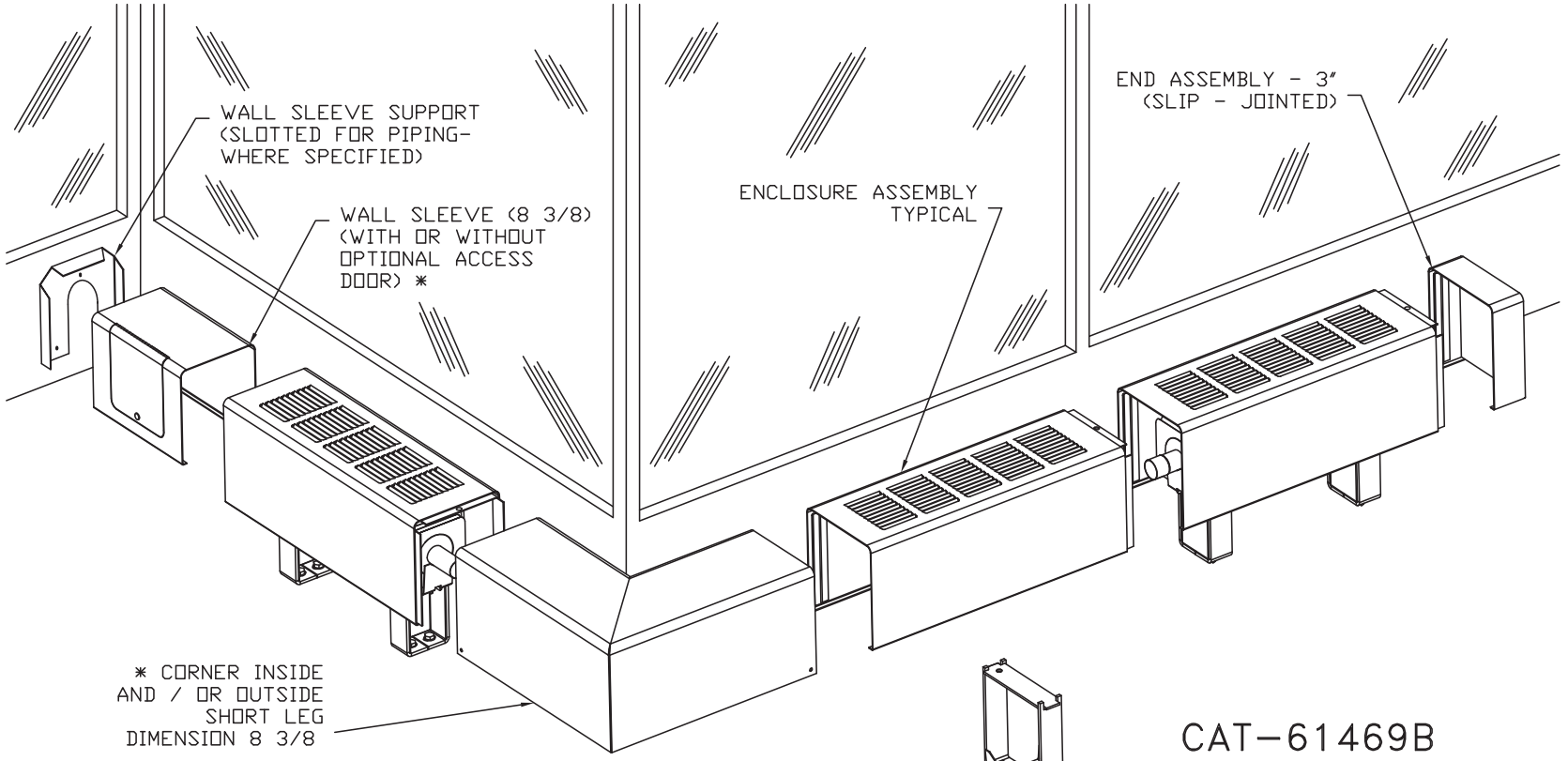
A MESTEK COMPANY

GENERAL LAYOUT



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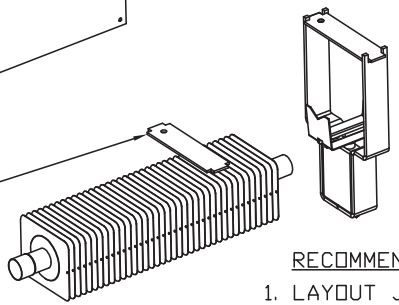
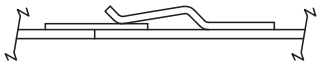
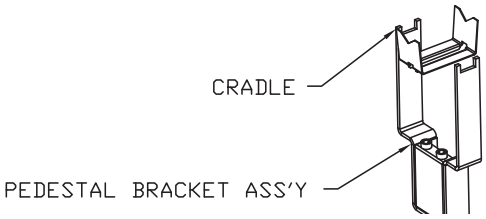




TYPICAL SLIP JOINT



RECOMMENDED INSTALLATION PROCEDURE

1. LAYOUT JOB, SELECTING ENCLOSURE LENGTHS TO SUIT. ALLOW FOR ACCESSORIES AS REQ'D.
2. LAY OUT PEDESTAL BRACKET LOCATIONS SO THE BRACKETS ARE 6" TO 12" FROM THE END OF ENCLOSURE. FOR ENCLOSURES OVER 5 FT LONG, LOCATE AN ADDITIONAL BRACKET AT THE CENTER OF THAT ENCLOSURE.
3. INSTALL ENCLOSURES WITH MALE STRAPS ON RIGHT END SO ACCESSORIES WILL MATE PROPERLY.

RADIANT PANEL
WARRANTY

The Manufacturer warrants to the original owner at the original installation site that the Radiant Ceiling Panel (the “Product”) will be free from defects in material or workmanship for a period not to exceed (1) year from date of shipment from the factory. If upon examination by the Manufacturer the Product is shown to have a defect in material or workmanship during the warranty period, the Manufacturer will repair or replace, at its option, that part of the Product which is shown to be defective.

This limited warranty does not apply:

(a) if the Product has been subjected to misuse or neglect, has been accidentally or intentionally damaged, has not been installed, maintained or operated in accordance with the furnished written instructions, or has been altered or modified in any way by any unauthorized person.
(b) to any expenses, including labor or material, incurred during removal or reinstallation of the defective Product or part thereof.
(c) to any workmanship of any installer of the Product.

This limited warranty is conditional upon:

(a) shipment, to the Manufacturer, of that part of the Product thought to be defective. Goods may only be returned with the prior written approval of the Manufacturer. All returns must be freight prepaid.
(b) determination in the reasonable opinion of the Manufacturer that there exists a defect in material or workmanship.

Repair or replacement of any part under this Limited Warranty shall not extend the duration of the warranty with respect to such repaired or replaced part beyond the stated warranty period.

THIS LIMITED WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED, AND ALL SUCH OTHER WARRANTIES, INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY DISCLAIMED AND EXCLUDED FROM THIS LIMITED WARRANTY. IN NO EVENT SHALL THE MANUFACTURER BE LIABLE IN ANY WAY FOR ANY CONSEQUENTIAL, SPECIAL, OR INCIDENTAL DAMAGES OF ANY NATURE WHATSOEVER, OR FOR ANY AMOUNTS IN EXCESS OF THE SELLING PRICE OF THE PRODUCT OR ANY PARTS THEREOF FOUND TO BE DEFECTIVE. THIS LIMITED WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS. YOU MAY ALSO HAVE OTHER RIGHTS WHICH MAY VARY BY EACH JURISDICTION.

COMMERCIAL FINNED TUBE RADIATION
LIMITED WARRANTY

1. The Manufacturer warrants to the original owner at the original installation site that the Commercial Finned Tube (the “Product”) will be free from defects in material or workmanship for a period not to exceed (1) year from date of shipment from the factory. If upon examination by the Manufacturer the Product is shown to have a defect in material or workmanship during the warranty period, the Manufacturer will repair or replace, at its option, that part of the Product which is shown to be defective.

2. This limited warranty does not apply:
   (a) if the Product has been subjected to misuse or neglect, has been accidentally or intentionally damaged, has not been installed, maintained or operated in accordance with the furnished written instructions, or has been altered or modified in any way by any unauthorized person.
   (b) to any expenses, including labor or material, incurred during removal or reinstallation of the defective Product or part thereof.
   (c) to any workmanship of any installer of the Product.

3. This limited warranty is conditional upon:
   (a) shipment, to the Manufacturer, of that part of the Product thought to be defective. Goods may only be returned with the prior written approval of the Manufacturer. All returns must be freight prepaid.
   (b) determination in the reasonable opinion of the Manufacturer that there exists a defect in material or workmanship.

4. Repair or replacement of any part under this Limited Warranty shall not extend the duration of the warranty with respect to such repaired or replaced part beyond the stated warranty period.

5. THIS LIMITED WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED, AND ALL SUCH OTHER WARRANTIES, INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY DISCLAIMED AND EXCLUDED FROM THIS LIMITED WARRANTY. IN NO EVENT SHALL THE MANUFACTURER BE LIABLE IN ANY WAY FOR ANY CONSEQUENTIAL, SPECIAL, OR INCIDENTAL DAMAGES OF ANY NATURE WHATSOEVER, OR FOR ANY AMOUNTS IN EXCESS OF THE SELLING PRICE OF THE PRODUCT OR ANY PARTS THEREOF FOUND TO BE DEFECTIVE. THIS LIMITED WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS. YOU MAY ALSO HAVE OTHER RIGHTS WHICH MAY VARY BY EACH JURISDICTION.

Taco Comfort Solutions
A Taco Group Company

Instruction Sheet

102-054

"00" Cartridge Circulators

SUPERSEDES: May 1, 2010 EFFECTIVE: July 1, 2015

Plant I.D. 001-934

APPLICATION:

1. Maximum operating pressure is 125 psi (862 kPa).
2. Maximum water temperature not to exceed nameplate rating.
3. Cast iron circulators are to be used for closed loop systems. Bronze or stainless steel circulators are to be used for open loop, fresh water, or potable water systems.
4. Taco Cartridge circulator pumps are for indoor use only – employer uniquement a l´interieur.

INSTALLATION:

1. Mounting position – Circulator must be mounted with the motor in a horizontal position. It may be mounted vertically with the motor up, provided that the system pressure is at least 20 psi (138 kPa).

CAUTION: DO NOT USE FLAT RUBBER GASKETS. ONLY USE O-RING GASKETS PROVIDED OR LEAKS MAY RESULT. WARRANTY WILL BE VOID.

2. Rotating body – Body has an arrow on the front that indicates direction of flow. To rotate body, remove the four body bolts, rotate body and replace bolts. Make sure that the junction box is NOT located underneath the circulator. (The junction box must NOT be located in the 6 o'clock position, as viewed from the motor end.)
3. Electrical connections – Observe all applicable codes when connecting to power supply. The motor is impedance protected, and does not require overload protection. Either colored wire from the capacitor box can be attached to either colored wire from the power supply. There is no "hot" or "common" wire leading from the capacitor box. Typical installation would be to attach the white wire to the white (common) power supply wire and either the yellow or blue wire to the black (hot) power supply wire. The pump cannot run backwards.

WARNING: Do not use in swimming pool or spa areas; pump has not been investigated for this application.

WARNING: In the event the retaining screws have been pulled out of the housing, DO NOT replace them. Use of any other screw may short out the stator windings, creating a risk of electrical shock.

CAUTION: When installing electrical connections, do not apply mechanical loads to the capacitor box; otherwise, retaining screws may be pulled out of the housing, making circulator unusable.

CAUTION: Installations at higher elevations over 5000 feet must have higher fill pressure of 20 psi minimum to prevent pump cavitation and flashing. Premature failure may result. Adjust expansion tank pressure to equal fill pressure. A larger size expansion tank may be required.

4. Fill system with tap water – The system must be filled before operating the circulator. The bearings are water lubricated and should not be allowed to operate dry. Filling the system will result in immediate lubrication of the bearings. It is always good practice to flush a new system of foreign matter before starting the circulator.

CAUTION: Never run the circulator dry or permanent damage will result.

5. Circulator operation – Operate the circulator for 5 minutes immediately after filling system to purge remaining air from the bearing chamber. This is especially important when installing the circulator during the off-season.

CAUTION:
1. The addition of petroleum based fluids or certain chemical additives to systems utilizing TACO equipment voids the warranty.
2. Use supply wires suitable for 90°C – ATTENTION: Employer des fils d´alimentation adequats pour 90°C.

WARNING: To avoid electrical shock, disconnect the power supply to the circulator and the main electrical unit.

REPLACING MOTOR ASSEMBLY:

1. Disconnect the electrical supply.
2. Reduce system pressure to 0 psi and allow system to return to room temperature. Isolate the circulator by closing the service valves or draining the system.
3. Remove the body bolts and swing motor assembly away from the body.
4. Install new motor, and reassemble circulator using the new gasket and bolts supplied.
5. Follow the “installation” procedure to start up the circulator.

REPLACING CARTRIDGE ASSEMBLY:

1. Disconnect the electrical supply.
2. Reduce system pressure to 0 psi and allow system to return to room temperature. Isolate the circulator by closing the service valves or draining the system.
3. Remove the body bolts and swing motor assembly away from the body.
4. Pull cartridge out of the motor housing.
5. Install replacement cartridge, making sure that the cover plate is between the cartridge flange and motor.
6. Make sure the replacement cartridge corresponds to the full circulator product number. A complete parts list is available from your local plumbing supply wholesaler.
7. Reassemble the circulator using the new gasket and bolts supplied.
8. Follow the “Installation” procedure to start up the circulator.

REPLACING CAPACITOR:

1. Replacement capacitor must have same rating as originally furnished.

LIMITED WARRANTY STATEMENT

Taco, Inc. will repair or replace without charge (at the company’s option) any Taco 00 Series circulator or circulator part which is proven defective under normal use within three (3) years from the date of manufacture.

In order to obtain service under this warranty, it is the responsibility of the purchaser to promptly notify the local Taco stocking distributor or Taco in writing and promptly deliver the subject product or part, delivery prepaid, to the stocking distributor. For assistance on warranty returns, the purchaser may either contact the local Taco stocking distributor or Taco. If the subject product or part contains no defect as covered in this warranty, the purchaser will be billed for parts and labor charges in effect at time of factory examination and repair.

Any Taco product or part not installed or operated in conformity with Taco instructions or which has been subject to misuse, misapplication, the addition of petroleum-based fluids or certain chemical additives to the systems, or other abuse, will not be covered by this warranty.

If in doubt as to whether a particular substance is suitable for use with a Taco product or part, or for any application restrictions, consult the applicable Taco instruction sheets or contact Taco at (401-942-8000).

Taco reserves the right to provide replacement products and parts which are substantially similar in design and functionally equivalent to the defective product or part. Taco reserves the right to make changes in details of design, construction, or arrangement of materials of its products without notification.

TACO OFFERS THIS WARRANTY IN LIEU OF ALL OTHER EXPRESS WARRANTIES. ANY WARRANTY IMPLIED BY LAW INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS IS IN EFFECT ONLY FOR THE DURATION OF THE EXPRESS WARRANTY SET FORTH IN THE FIRST PARAGRAPH ABOVE.

THE ABOVE WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR STATUTORY, OR ANY OTHER WARRANTY OBLIGATION ON THE PART OF TACO.

TACO WILL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OF ITS PRODUCTS OR ANY INCIDENTAL COSTS OF REMOVING OR REPLACING DEFECTIVE PRODUCTS.

This warranty gives the purchaser specific rights, and the purchaser may have other rights which vary from state to state. Some states do not allow limitations on how long an implied warranty lasts or on the exclusion of incidental or consequential damages, so these limitations or exclusions may not apply to you.

Taco® Comfort Solutions™ A Taco Group Company
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Visit our web site: www.TacoComfort.com | Printed in USA |

EXTROL®

HYDRONIC EXPANSION TANKS FOR NON-POTABLE WATER

INSTALLATION & OPERATION INSTRUCTIONS

Models EX-15 through EX-90
Models SX-30V through SX-160V

NOTE: Inspect for shipping damage. Notify freight carrier or store where purchased immediately if damage is present. To avoid risk of personal injury and property damage, if the product appears to be malfunctioning or shows signs of corrosion, call a qualified professional immediately. Current copies of the product manual can be viewed at www.amtrol.com. Use proper safety equipment when installing.

THIS IS THE SAFETY ALERT SYMBOL. IT IS USED TO ALERT YOU TO POTENTIAL PERSONAL INJURY AND OTHER HAZARDS. OBEY ALL SAFETY MESSAGES THAT FOLLOW THIS SYMBOL TO REDUCE THE RISK OF PERSONAL INJURY AS WELL AS PROPERTY DAMAGE.

⚠WARNING **USE ONLY IN RESIDENTIAL CLOSED HYDRONIC SYSTEMS.** Do not install on domestic water systems, or in open heating systems. Corrosion and tank failure may result. Use a Therm-X-Trol® or Therm-X-Span® for domestic water systems. Use a Radiant EXTROL® for radiant heating systems where air elimination equipment or barrier tubing is not used.

⚠WARNING **READ CAREFULLY THE PRODUCT INSTALLATION, OPERATING AND MAINTENANCE MANUAL. FAILURE TO FOLLOW THE INSTRUCTIONS AND WARNINGS IN THE MANUAL MAY RESULT IN SERIOUS OR FATAL INJURY AND/OR PROPERTY DAMAGE, AND WILL VOID THE PRODUCT WARRANTY. THIS PRODUCT MUST BE INSTALLED BY A QUALIFIED PROFESSIONAL. FOLLOW ALL APPLICABLE LOCAL AND STATE CODES AND REGULATIONS, IN THE ABSENCE OF SUCH CODES, FOLLOW THE CURRENT EDITIONS OF THE NATIONAL PLUMBING CODE AND NATIONAL ELECTRIC CODE, AS APPLICABLE.**

⚠WARNING This Product, like most Products under pressure, may over time corrode, weaken and burst or explode, causing serious or fatal injury, leaking or flooding and/or property damage. To minimize risk, a licensed professional must install and periodically inspect and service the Product. A drip pan connected to an adequate drain must be installed if leaking or flooding could cause property damage. Do not locate in an area where leaking could cause property damage to the area adjacent to the appliance or to lower floors of the structure.

CALIFORNIA PROPOSITION 65 WARNING! This product contains a chemical known by the State of California to cause cancer and to cause birth defects or other reproductive harm. (California Installer/Contractor - California law requires that this notice be given to consumer/end user of this product.) **For more information: www.amtrol.com/prop65.html**

⚠WARNING **RUPTURE OR EXPLOSION HAZARD.** Do not expose product to freezing temperatures or temperatures in excess of **240°F**. Do not adjust the pre-charge or re-charge this Product except during installation or regular inspection. Replace the Product and do not adjust the pre-charge if corroded, damaged or with diminished integrity. Adjustments to pre-charge must be done at ambient temperature only. Failure to properly size the Product or follow these instructions may result in excessive strain on the system and may lead to Product failure, serious or fatal personal injury, leakage, and/or property damage.

⚠WARNING A relief valve must be installed to prevent pressure in excess of local code requirement or maximum working pressure designated in the Product Manual, whichever is less. At least once every 3 years or if discharge is present, a licensed contractor should inspect the pressure relief valve and replace if corrosion is evident or the valve does not function. **FAILURE TO INSPECT THIS VALVE AS DIRECTED COULD RESULT IN UNSAFE PRESSURE BUILD-UP WHICH CAN RESULT IN PRODUCT FAILURE, SERIOUS INJURY OR DEATH AND/OR SEVERE PROPERTY DAMAGE AND VOID THE PRODUCT WARRANTY.**

⚠WARNING **Chlorine & Aggressive Water:** The water quality can significantly influence the life of this Product. You should test for corrosive elements, acidity, total solids and other relevant contaminants, including chlorine and treat your water appropriately to insure satisfactory performance and prevent premature failure.

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY
IMPORTANT GENERAL SAFETY INFORMATION -
ADDITIONAL SPECIFIC SAFETY ALERTS APPEAR IN THE FOLLOWING INSTRUCTIONS.

Pre-Installation

1 Visually inspect for any damage. Ensure expansion tank is sized properly for application (Figure 1).

2. Remove plastic cap from air valve.
3. With tank empty of water, adjust air precharge to match system fill pressure.
4. Replace and tighten plastic cap on air valve.

⚠WARNING **FAILURE TO PROPERLY SEAL VALVE CAP WILL RESULT IN LOSS OF PRECHARGE CAUSING PRODUCT TO FAIL.**

⚠WARNING Mount tank vertically in downward position only. Ensure the piping can support the entire weight of the tank when full of water.

⚠WARNING Models SX-30V through SX-160V are floor standing and may not be hung from the piping.

⚠WARNING Do not install the EXTROL on a dead-end pipe or wherever air can collect. This can cause corrosion and possible leakage.

Installation

1. Drain the boiler system or isolate the area where the EXTROL will be installed.
2. Install the EXTROL on the supply side of the boiler, on the suction-side of the heating circulator(s) (Figure 2).
3. Pressurize the system and check for leaks. Repair as necessary.
4. Restart the boiler system and check for relief valve discharge. If the relief valve drips, the tank may be improperly charged or undersized.
5. The EXTROL is now operational and will absorb expanded water during boiler operation.

Maintenance

A professional plumber should check the complete system, including the expansion tank, yearly and more frequently as the system ages. Checking the precharge allows a small quantity of air to escape and can result in an insufficient air charge. Always check the precharge while the tank is isolated and empty of water, and be sure to maintain the proper precharge whenever the tank is inspected.

Warranty

EX Models: Five (5) Year Limited Warranty

SX Models: One (1) Year Limited Warranty

Visit www.amtrol.com for complete warranty details.

Figure 1.

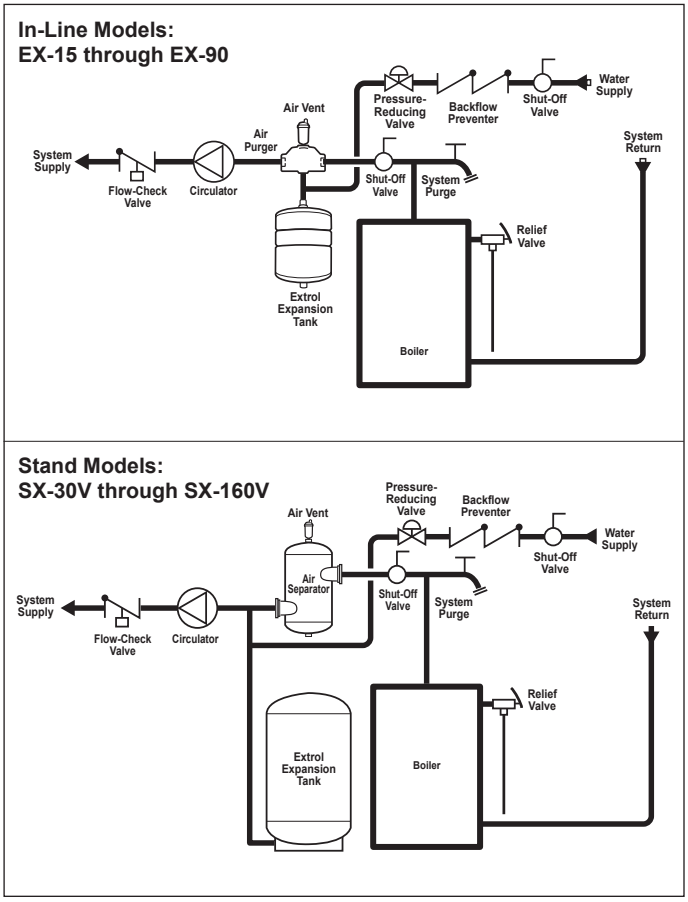
Boiler Net Output in 1000'S of BTU/Hr.	Type of Radiation			
	Finned Tube Baseboard or Radiant Panel	Convectors or Unit Heaters	Radiators Cast Iron	Baseboard Cast Iron
25	EX-15	EX-15	EX-15	EX-15
50	EX-15	EX-15	EX-30	EX-30
75	EX-30	EX-30	EX-30	EX-60
100	EX-30	EX-30	EX-60	EX-60
125	EX-30	EX-60	EX-60	EX-90
150	EX-30	EX-60	EX-90	EX-90
175	EX-60	EX-60	SX-30V	SX-30V
200	EX-60	EX-60	SX-30V	SX-30V
250	EX-60	EX-90	SX-30V	SX-40V
300	EX-90	SX-30V	SX-30V	SX-40V
350	SX-30V	SX-30V	SX-40V	SX-60V
400	SX-30V	SX-40V	SX-40V	SX-60V

Sizing based on: 12 psig Fill; 30 psig Relief Valve; 200°F Average Temperature.

Boiler Net Output in 1000's of BTU	Type of Radiation and Piping System			
	Finned Tube Baseboard or Radiant Panels with Series Loop System	Convectors or Unit Heaters with One Pipe System	Radiators or One Pipe System	Cast Iron Radiators with Series Loop System
200	SX- 30V	SX-30V	SX-30V	SX-30V
250	SX- 30V	SX-30V	SX-30V	SX-40V
300	SX- 30V	SX-30V	SX-40V	SX-40V
350	SX-30V	SX-30V	SX-40V	SX-60V
400	SX-30V	SX-40V	SX-60V	SX-60V
450	SX-40V	SX-40V	SX-90V	SX-90V
500	SX-40V	SX-40V	SX-60V	SX-90V
550	SX-40V	SX-60V	SX-60V	SX-90V
600	SX-40V	SX-60V	SX-90V	SX-90V
650	SX-60V	SX-60V	SX-90V	SX-90V
700	SX-60V	SX-60V	SX-90V	SX-90V
750	SX-60V	SX-60V	SX-90V	SX-110V
800	SX-60V	SX-90V	SX-90V	SX-110V
850	SX-60V	SX-90V	SX-90V	SX-110V
900	SX-60V	SX-90V	SX-110V	SX-110V
950	SX-90V	SX-90V	SX-110V	SX-110V
1,000	SX-90V	SX-90V	SX-110V	SX-110V
1,100	SX-90V	SX-90V	SX-110V	SX-130V
1,200	SX-90V	SX-90V	SX-110V	SX-130V
1,300	SX-90V	SX-110V	SX-130V	SX-160V
1,400	SX-110V	SX-130V	SX-160V	SX-160V
1,500	SX-110V	SX-130V	SX-160V	(2)SX-110V

Sizing based on: Average Boiler Water Volume; Average Water Volume; Fill Pressure 12 psig; Relief Pressure 30 psig

Figure 2.



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100287110_2000544742_Rev A

KNIGHT®
FIRE TUBE BOILER

Installation & Operation Manual
Models: 56 - 400

DIR #2000543091 00

DESIGN CERTIFIED®

CSA CERTIFIED®

ENERGY STAR

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 Knight Wall Hung Fire Tube Boiler 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.

Contents

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 Knight Wall Hung Fire Tube Boiler Service Manual, before installing. Perform steps in the order given.

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

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

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

NOTICE

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

Consider piping and installation when determining boiler location.

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

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

⚠ WARNING

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

⚠ WARNING

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

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

WHAT TO DO IF YOU SMELL GAS

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

⚠ WARNING

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

When servicing boiler –

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

Boiler operation –

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

Boiler water –

- Thoroughly flush the system to remove debris. Use an approved pre-commissioning cleaner (see Start-Up Section), without the boiler connected, to clean the system and remove sediment. The high-efficiency heat exchanger can be damaged by build-up or corrosion due to sediment.
  Note: Cleaners are designed for either new systems or pre-existing systems. Choose accordingly.

⚠ CAUTION

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

⚠ CAUTION

Do not use "homemade cures" or "boiler patent medicines". Serious damage to the boiler, personnel, and/or property may result.

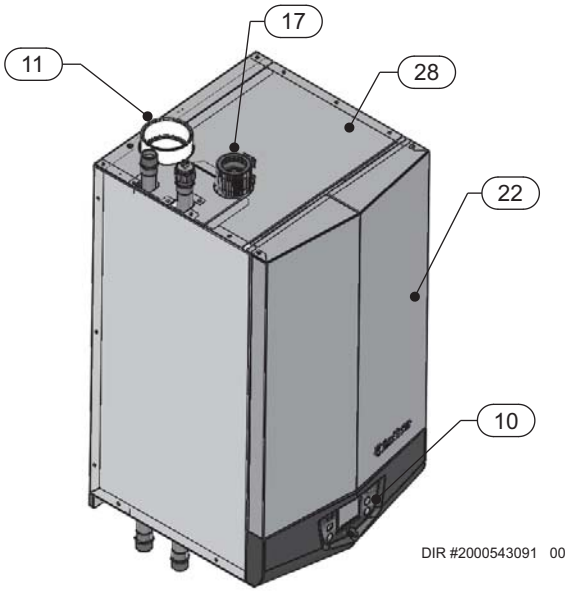
Freeze protection fluids –

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

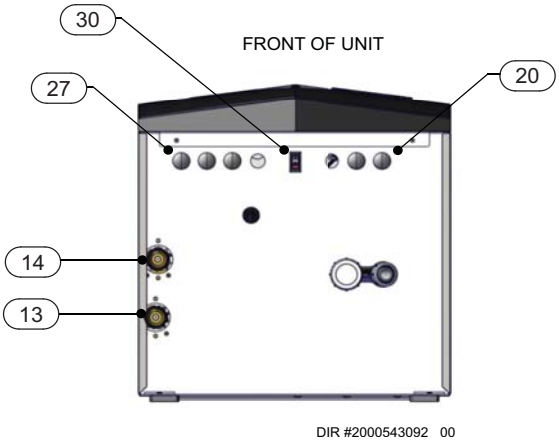
The Knight Wall Hung Fire Tube Boiler - How it works...

1. **Stainless steel heat exchanger**
   Allows system water to flow around specially designed tubes for maximum heat transfer, while providing protection against flue gas corrosion.
2. **Combustion chamber access cover**
   Allows access to the combustion side of the heat exchanger.
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)**
   This sensor monitors the flue gas exit temperature. The control module will modulate and shut down the boiler if flue gas temperature gets too hot. This protects the flue pipe from overheating.
7. **Boiler outlet temperature sensor (housed with the high limit sensor)**
   This sensor monitors boiler outlet water temperature (system supply). If selected as the controlling sensor, the control module adjusts boiler firing rate so the outlet temperature is correct.
8. **Boiler inlet temperature sensor**
   This sensor monitors return water temperature (system return). If selected as the controlling sensor, the control module adjusts the boiler firing rate so the inlet temperature is correct.
9. **Temperature and pressure gauge (field installed, not shown)**
   Monitors the outlet temperature of the boiler as well as the system water pressure.
10. **Electronic LCD display**
    The display features a high resolution liquid crystal screen, three (3) buttons, and a navigation dial. A serial and USB port support additional communication with the control.
11. **Flue pipe adapter**
    Allows for the connection of the vent system to the boiler.
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 (system supply)**
    Copper connection that supplies hot water to the system, either 1" NPT, 1-1/4" NPT, or 1-1/2" sweat, depending on the model.
14. **Water inlet (system return)**
    Copper connection that returns water from the system to the heat exchanger, either 1" NPT, 1-1/4" NPT, or 1-1/2" sweat, depending on the model.
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 boiler.
16. **SMART SYSTEM Control Module**
    The SMART SYSTEM Control responds to internal and external signals to regulate the blower, gas valve, and pump functions to meet heating demand. Optional remote connectivity allows boiler settings to be monitored and modified when connected to the internet.
17. **Air intake adapter**
    Allows for the connection of the PVC air intake pipe to the boiler.
18. **High voltage junction box**
    The junction box contains the connection points for the line voltage power and all pumps.
19. **Low voltage connection board**
    The connection board is used to connect external low voltage devices.
20. **Low voltage wiring connections**
    Conduit connection points for the low voltage connection board.
21. **Condensate trap (field installed)**
    The condensate trap prevents flue gasses from escaping the condensate drain line.
22. **Access cover - front**
    Provides access to the gas valve, control panel, and heat exchanger.
23. **Ignition electrode**
    Provides direct spark for igniting the burner.
24. **Flame inspection window**
    The quartz glass window provides a view of the burner surface and flame.
25. **Relief valve (shipped loose - factory installed on Model 400 only)**
    Protects the heat exchanger from an over pressure condition. The relief valve provided with the unit is set at 30 psi.
26. **Flame sensor**
    Used by the control module to detect the presence of burner flame.
27. **Line voltage wiring connections**
    Conduit connection points for the high voltage junction box.
28. **Top panel**
    Removable panel allows access to the gas train and combustion chamber.
29. **Gas shutoff switch (Models 056 - 286 only)**
    An electrical switch designed to cut power to the gas valve to prevent releasing any gas.
30. **Power switch**
    Turns 120 VAC ON/OFF to the boiler.
31. **Auto air vent (Models 56 - 286 only, not shown)**
    Used to allow removal of trapped air from the heat exchanger.
32. **Transformer**
    The transformer provides 24V power to the integrated control.
33. **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 boiler down.
34. **Stainless steel flue collector**
    Flue gas and condensate enter the stainless flue collector through the fire tubes. A 1 1/4" drain connection allows condensate to flow through the collector into a condensate trap for disposal.
35. **Manual air vent**
    Used to allow removal of trapped air from the heat exchanger. For Models 56 - 286 a coin vent is provided in the water inlet cap for installations where top connections are not used.

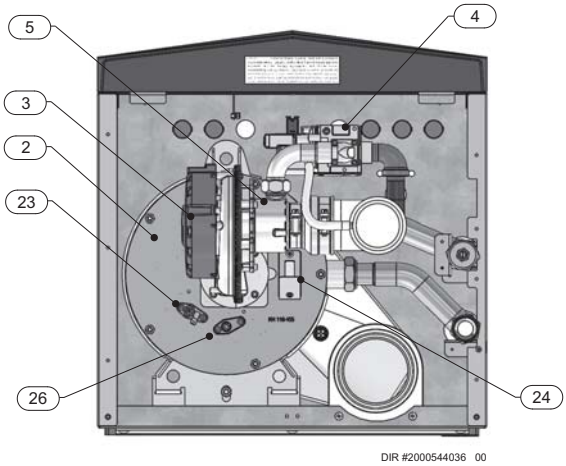
The Knight Wall Hung Fire Tube Boiler - How it works... *(continued)*



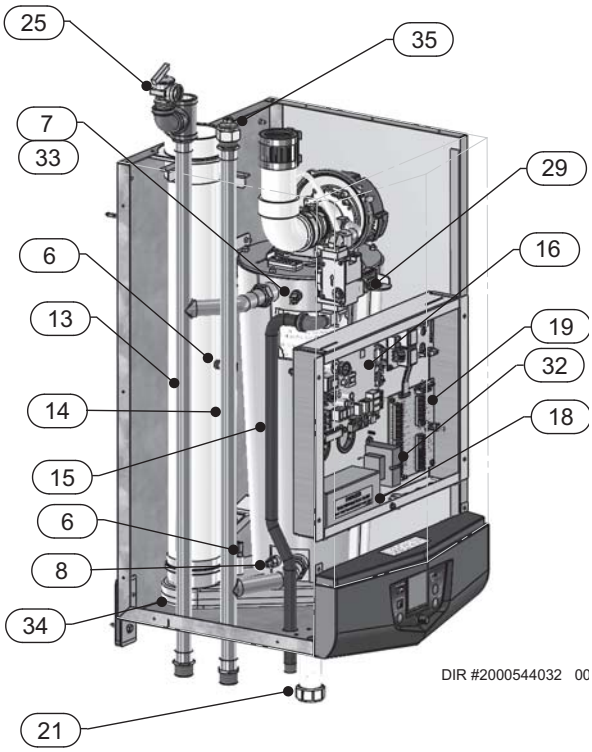
Front View



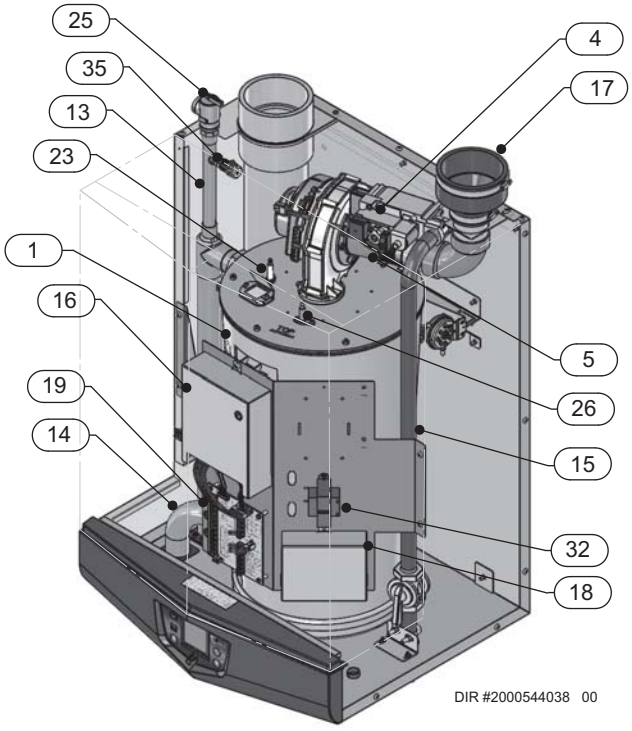
Bottom View



Top View (inside unit)



Left Side (inside unit)



Front View (inside unit_Model 400)

Ratings

Knight Wall Hung Fire Tube Boiler AHRI Rating						Other Specifications				
Model Number Note: Change "N" to "L" for L.P. gas models.	Input MBH (Note 5)		Heating Capacity MBH	Net AHRI Ratings Water, MBH	AFUE %	Boiler Water Content Gallons	Water Connections	Gas Connections	Air Size	Vent Size (Note 4,8)
	Min	Max	(Note 2,7)	(Note 3,7)	(Note 1, 7)					
WHN056	8.2	55	51	44	95	2.3	1"	1/2"	2"	2"
WHN086	8.5	85	79	69	95	2.2	1"	1/2"	2"	2"
WHN111	11	110	102	89	95	2.3	1"	1/2"	3"	3"
WHN156	15.5	155	144	125	95	3.2	1"	1/2"	3"	3"
WHN200	20	199	184	160	95	5.2	1-1/4"	1/2"	3"	3"
WHN286	28.5	285	264	229	95	4.9	1-1/4"	1/2"	3"	3"
WHN400*	80	399	379	330	94.4*	6.5	1-1/2"	3/4"	4"	4"

***Note:** WHN400 value is thermal efficiency.

NOTICE Maximum allowed working pressure is located on the rating plate.

Notes:

1. As an Energy Star Partner, Lochinvar has determined that Knight Wall Hung Fire Tube boilers meet the Energy Star guidelines for energy efficiency.
2. The ratings are based on standard test procedures prescribed by the United States Department of Energy.
3. Net AHRI ratings are based on net installed radiation of sufficient quantity for the requirements of the building and nothing need be added for normal piping and pickup. Ratings are based on a piping and pickup allowance of 1.15.
4. Knight Wall Hung Fire Tube boilers require special gas venting. Use only the vent materials and methods specified in the Knight Wall Hung Fire Tube Installation and Operation Manual.
5. Standard Knight Wall Hung Fire Tube boilers are equipped to operate from sea level to 4,500 feet **only**. The boiler will de-rate by 4% for each 1,000 feet above sea level up to 4,500 feet.
6. High altitude Knight Wall Hung Fire Tube boilers are equipped to operate from 3,000 to 9,600 feet **only**. The boiler will not de-rate up to 5,000 feet and will de-rate 1.7% for each 1000 feet above 5000 feet. The operation given in this manual remains the same as the standard boilers. A high altitude label (as shown in FIG A.) is also affixed to the unit.

   De-rate values are based on proper combustion calibration and CO_2's adjusted to the recommended levels.
7. Ratings have been confirmed by the Hydronics Section of AHRI.
8. Models WH056 - 086 can be alternatively vented using a 3" vent/air size. If a 2" vent/air size is used, the maximum vent/air pipe lengths for the WH056 model is 80 feet and 50 feet for the WH086 model. The WH111 model can be alternatively vented using a 2" vent/air size. If the 2" vent/air size is used, the maximum vent/air pipe lengths are limited to 40 equivalent feet each. The WH286 model can be alternatively vented using a 4" vent/air size. If the 3" vent/air size is used, the maximum vent/air pipe lengths are limited to 50 equivalent feet each.
9. The manual reset high limit provided with the Knight Wall Hung Fire Tube is listed to UL353.

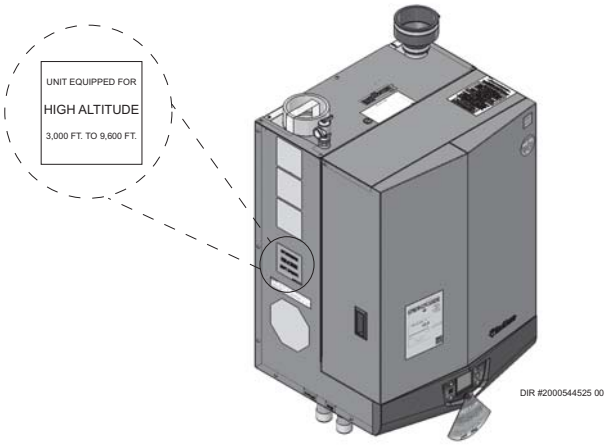


***Figure A** High Altitude Label Location*

1 Determine boiler location

Installation must comply with:

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

NOTICE The Knight Wall Hung Fire Tube boiler gas manifold and controls met safe lighting and other performance criteria when the boiler underwent tests specified in ANSI Z21.13 – latest edition.

Before locating the boiler, check:

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

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

4. The Knight Wall Hung Fire Tube boiler must be installed so that gas control system components are protected from dripping or spraying water or rain during operation or service.
5. If a new boiler will replace an existing boiler, check for and correct system problems, such as:
   - System leaks causing oxygen corrosion or heat exchanger cracks from hard water deposits.
   - Incorrectly-sized expansion tank.
   - Lack of freeze protection in boiler water causing system and boiler to freeze and leak.
   - Debris left from existing piping, if not flushed and cleaned with an appropriate cleaner.
6. Check around the boiler for any potential air contaminants that could risk corrosion to the boiler or the boiler combustion air supply (see Table 1B on page 10). Prevent combustion air contamination. Remove any of these contaminants from the boiler area.

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

⚠ WARNING This appliance is certified as an indoor appliance. Do not install the appliance outdoors or locate where the appliance will be exposed to freezing temperatures or to temperatures that exceed 100°F.

Do not install the appliance where the relative humidity may exceed 93%. 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 the starter CPVC pipe section provided with the appliance. The field provided vent fittings must be cemented to the CPVC pipe section. Use only the vent materials, primer and cement specified in this manual to make the vent connections. Failure to follow this warning could result in fire, personal injury, or death.

Closet and alcove installations

A closet is any room the boiler is installed in which the room volume is less than the room volume listed in the table below. An alcove is any room which meets the criteria for a closet, but it does not have a door.

***Table 1A** Room Volume*

Model	Room Volume (in cubic feet)
56 - 086	90
111 - 200	108
286	124
400	178

Example: Room dimensions = 4 feet long, 3 feet wide, and 8 foot ceiling = 4 x 3 x 8 = 96 cubic feet. This would be considered a closet for a WHN286 model.

⚠ WARNING For closet and alcove installations CPVC, polypropylene or stainless steel vent material must be used. The ventilating air openings shown in FIG. 1-1 are required for closet installations. Failure to follow this warning could result in fire, personal injury, or death.

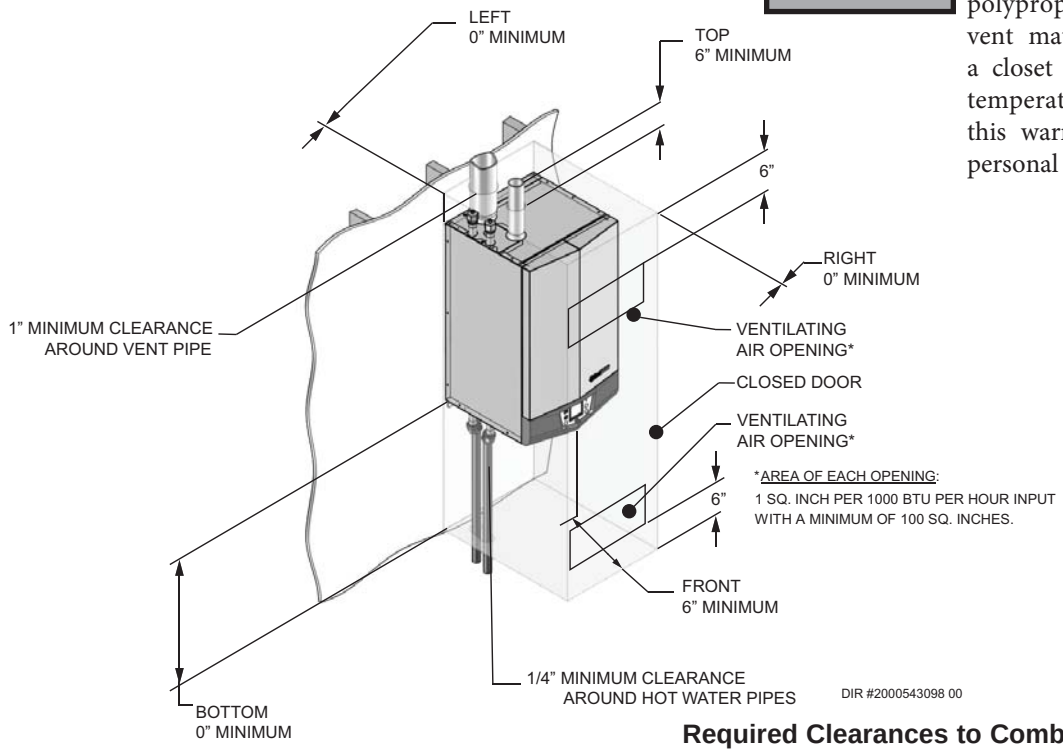
Recommended clearances for service access

- Front / Top / Bottom ..... 24"
- Left Side..... 12"
- Right Side..... 0"

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

1 Determine boiler location

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



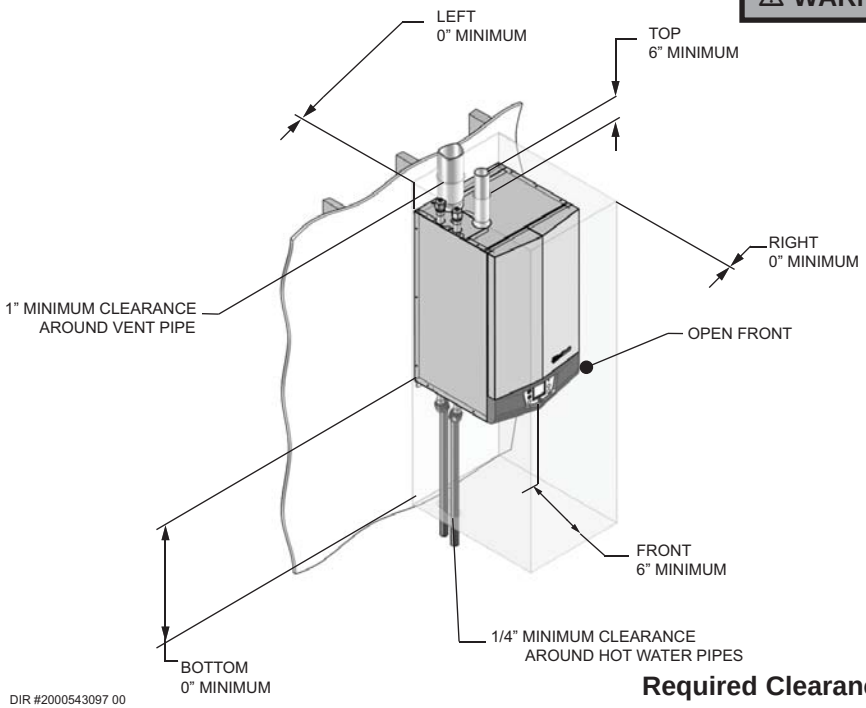
⚠ WARNING

For closet installations, CPVC, polypropylene or stainless steel vent material MUST BE used in a closet structure due to elevated temperatures. Failure to follow this warning could result in fire, personal injury, or death.

Required Clearances to Combustible Materials

- Front / Top ..... 6"
- Bottom ..... 0"
- Left / Right Side ..... 0"

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



⚠ WARNING

For alcove installations, CPVC, polypropylene or stainless steel vent material MUST BE used in an alcove structure due to elevated temperatures. Failure to follow this warning could result in fire, personal injury, or death.

Required Clearances to Combustible Materials

- Front / Top ..... 6"
- Bottom ..... 0"
- Left / Right Side ..... 0"

1 Determine boiler location *(continued)*

Provide clearances:

Clearances from combustible materials

1. Hot water pipes—at least 1/4" (6 mm) from combustible materials.
2. Vent pipe – at least 1" (25 mm) from combustible materials.
3. See FIG.'s 1-1 and 1-2 on page 8 for other clearance minimums.

Provide air openings to room:

Knight Wall Hung Fire Tube boiler alone in boiler room

1. No air ventilation openings into the boiler room are needed when the total room volume is greater than the values given for closet installations (see Table 1A). For spaces that do NOT fit this criteria, provide one square inch free area per 1,000 Btu/hr of boiler input.

Knight Wall Hung Fire Tube boiler 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 Knight Wall Hung Fire Tube boiler.

Do not install the boiler 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 Knight Wall Hung Fire Tube boiler because it takes its combustion air from outside (direct vent installation).

Wall mounting location

Ensure the wall for which the boiler is intended to be mounted is composed of either, cement, brick, block, or wooden studs spaced 16 inches apart from center. Ensure the wall is capable of supporting at least 250 pounds for Models 056 - 286 and 300 pounds for the 400 models.

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

Ensure the boiler is installed in a location that minimizes the risk of water damage due to valves, pumps, etc.

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 Knight Wall Hung Fire Tube boiler requires a special vent system, designed for pressurized venting.

The boiler is to be used for either direct vent installation or for installation using indoor combustion air. When room air is considered, see Section 3, General Venting. 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 Knight Wall Hung Fire Tube boiler using any other means.

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

Prevent combustion air contamination

Install air inlet piping for the Knight Wall Hung Fire Tube boiler as described in this manual. Do not terminate vent/air in locations that can allow contamination of combustion air. Refer to Table 1B, page 10 for products and areas which may cause contaminated combustion air.

⚠ WARNING You must pipe combustion air to the boiler air intake. Ensure that the combustion air will not contain any of the contaminants in Table 1B, page 10. Contaminated combustion air will damage the boiler, resulting in possible severe personal injury, death or substantial property damage. Do not pipe combustion air near a swimming pool, for example. Also, avoid areas subject to exhaust fumes from laundry facilities. These areas will always contain contaminants.

1 Determine boiler location

Table 1B *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 boiler:

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

Check the following venting components before installing:

- **Material** - For materials listed for use with this appliance, see Section 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 3E and 3F 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 Sidewall or Vertical options listed in the General Venting Section. For stainless steel vent, only use terminations listed in Table 3H 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 Boiler Section on page 11.

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

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

1 Determine boiler location *(continued)*

When removing a boiler from existing common vent system:

⚠ DANGER Do not install the Knight Wall Hung Fire Tube boiler 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 boiler, the following steps shall be followed with each appliance remaining connected to the common venting system placed in operation, while the other appliances remaining connected to the common venting system are not in operation.

a. Seal any unused openings in the common venting system.

b. Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion, or other deficiencies, which could cause an unsafe condition.

c. Test vent system – Insofar as is practical, close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliance not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.

d. Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.

e. Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar, or pipe.

f. After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined herein, return doors, windows, exhaust fans, fireplace dampers, and any other gas-burning appliance to their previous conditions of use.

g. Any improper operation of the common venting system should be corrected so the installation conforms with the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and/or CAN/CSA B149.1, Natural Gas and Propane Installation Code. When 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.

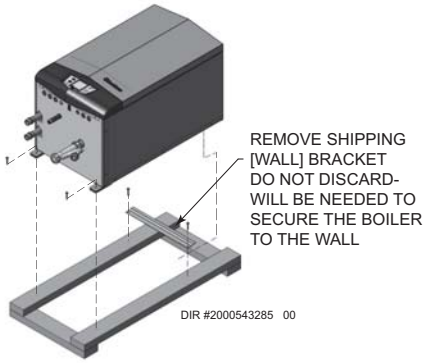
2 Prepare boiler

Remove boiler from wood pallet

1. After removing the outer shipping carton from the boiler, remove the parts box.
2. To remove the boiler from the pallet:
   a. Remove the two (2) lag bolts securing the bottom of the unit to the pallet.
   b. Lift the boiler off the wall bracket mounted to the pallet.
3. Remove the three (3) lag bolts securing the wall bracket to the wood pallet. Be certain not to lose the wall bracket as it will be needed for securing the boiler to the wall (FIG. 2-1).

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

Figure 2-1 *Boiler Mounted on Shipping Pallet*



Gas conversions

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

For models WH56 - 286 you must install a propane venturi and any additional components supplied in the kit to operate the Knight Wall Hung Fire Tube boiler on propane gas. On the WH400 model, a propane orifice must be installed. Verify when installing that the venturi label and orifice marking matches the boiler size (see Table 2A).

Table 2A *LP Conversion Table*

Model	Kit #	Venturi Ø (mm)	Orifice Ø		Air Shutter	Orifice Stamping
			Bottom	Top		
56	100268040	20 mm	2.45 mm	2.65 mm	100150434	N/A
86	100268104	20 mm	2.45 mm	2.55 mm	100150434	N/A
111	100285815	22 mm	3.00 mm	2.85 mm	100284510	.250
156	100285817	24 mm	3.35 mm	2.95 mm	100284509	.302
200	100285818	24 mm	3.40 mm	3.00 mm	100150947	.302
286	100268109	30 mm	4.20 mm	4.00 mm	100150947	N/A
400	100159011	N/A	N/A	N/A	N/A	8.0

*Note: The WHL200 air shutter should have the hole oriented towards the back right corner of the unit.

To gain access and remove the venturi - All Models:

1. If boiler is already installed, you must turn off the gas supply, turn off the power, and allow the boiler to cool before proceeding.
2. Remove the front access cover from the unit (no tools required for removal).
3. 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.
4. Disconnect the gas piping from the valve or venturi. On Models WH56 - 286 loosen the threaded nut on the venturi. Remove the gasket between the gas piping and venturi. On the WH400 model disconnect the Molex plug from the gas valve. Using a 5 mm Allen wrench, remove the screws securing the gas pipe to the gas valve.
5. Remove the bolts (using a 4 mm Allen wrench for models WH56 - 286 and a 6 mm Allen wrench on the WH400 model) connecting the venturi to the fan and proceed to remove the venturi from the unit, making sure not to damage the blower O-ring gasket (FIG.'s 2-2 and 2-3).

LP conversion procedure - Models WH56 - 286

1. Install the LP air shutter provided in the kit (see Table 2A).
   a. Disconnect the wiring from the fan and remove the bolts securing the fan to the combustion chamber access cover.
   b. Remove the fan and gasket. Install the LP air shutter.

   Note: On the WHL200 model, the air shutter MUST be installed in the proper direction. Install the air shutter so that the hole in the corner is oriented towards the back right corner of the unit (opposite the front door and gas piping).

   c. Replace all torn or damaged gaskets and reassemble the fan.
   d. Reconnect the wiring harness before operation.
2. Install the propane venturi and verify the following:
   a. The UP arrow on the plastic housing is pointing up.
   b. The threaded connection for the gas piping is facing towards the front of the unit.
3. Models WHL111 - 200 ONLY require an orifice to be installed in the threaded venturi connection:
   a. Locate the propane orifice from the conversion kit bag and verify the stamping on the orifice matches the boiler size (see Table 2A).
   b. With the stamped side facing inwards, place the orifice in the cavity provided in the threaded connection.
4. Reassemble the gas pipe to the threaded connection on the venturi. Replace torn or damaged gasket(s) and ensure the venturi gasket is seated properly before tightening the nut on the venturi.

2 Prepare boiler *(continued)*

LP conversion procedure - Model WH400

1. Using a 5 mm Allen wrench, remove the venturi from the gas valve.
2. Locate the propane orifice from the conversion kit bag and verify the stamping on the orifice matches the boiler size (see Table 2A).
3. Place the orifice into the black rubber grommet in the side of the gas valve and secure inside the gas valve (FIG. 2-3).
4. Reattach the venturi to the gas valve and reposition the gas valve venturi assembly inside the unit. Reattach the gas pipe to the gas valve. Reattach the air intake and coupler and tighten down on the band clamp.
5. Reattach the Molex plug to the gas valve.

Reassemble the appliance and complete installation - All Models

1. Reconnect the rubber boot on the air inlet to the venturi inlet and tighten the band clamp at this connection.
2. After installation is complete, attach the propane conversion label (inside the conversion kit) next to the boiler rating plate. Attach the LP caution label (inside the conversion kit bag) to the left side of the boiler underneath the gas supply piping.
3. Replace the front access cover removed in Step 1 of the *"To Gain Access and Remove the Venturi"* section on page 12 and resume operation.

⚠ DANGER When removing the natural gas venturi, inspect the gasket at the gas connection and the O-ring at the blower. These gaskets must be in good condition and must be installed. Failure to comply will cause a gas leak, resulting in severe personal injury or death.

Figure 2-2 *Install LP Air Shutter and Orifice - Models 56 - 286*

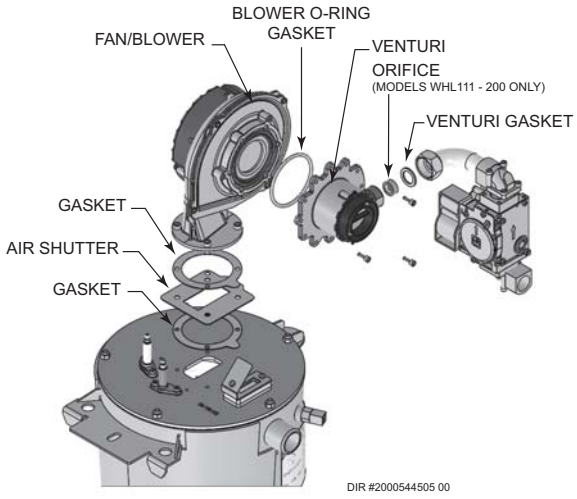
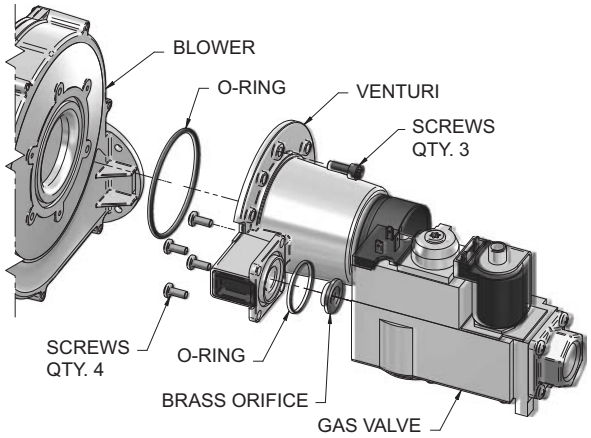


Figure 2-3 *Install Orifice - Model 400*



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

Mounting the boiler

See page 9 of this manual for boiler mounting location instructions.

NOTICE The Knight Wall Hung Fire Tube boiler is not intended for floor installation.

Mounting to a wood studded wall:

1. The wall mount bracket is designed for a stud spacing of 16 inches from center. For other stud spacing a solid mounting surface must be provided by the installer.

⚠ WARNING Do not mount the boiler to a hollow wall. Be sure to mount the boiler to the studs only.

2. Mount the wall bracket using the 3 1/4" lag bolts provided. Make sure the top edge of the bracket is away from the wall. Ensure the bracket is level when mounted. Extreme care is needed to ensure the bolts are secured in the center of the studs.
3. Hang the boiler on the bracket and secure the bottom of the boiler with two (2) additional lag bolts provided.

2 Prepare boiler

⚠ WARNING The boiler is too heavy for a single person to lift. A minimum of two people is needed for mounting the boiler onto the bracket.

Mounting to a concrete wall:

1. Mount the wall bracket using the two (2) wedge anchor bolts provided with the bracket. To mount the wedge anchor bolts, drill a 1/4" diameter hole 1 1/8" deep and insert anchor. Hang the bracket from the anchor and secure with the two nuts provided. Make sure the top edge of the bracket is away from the wall. Ensure bracket is level when mounted. Extreme care is needed to ensure the bolts are secured in the center of the studs.

Note: If wall thickness does not allow a 1 1/8" deep hole, field supplied hardware suitable for the application should be provided.

2. Hang the boiler on the bracket and secure the bottom of the boiler with two (2) remaining anchors, following the instructions above.

⚠ WARNING The boiler is too heavy for a single person to lift. A minimum of two people is needed for mounting the boiler onto the bracket.

Mounting to a metal studded wall:

1. The wall mount bracket is designed for a stud spacing of 16 inches from center. For other stud spacing a solid mounting surface must be provided by the installer.

⚠ WARNING Do not mount the boiler to a hollow wall. Be sure to mount the boiler to the studs only.

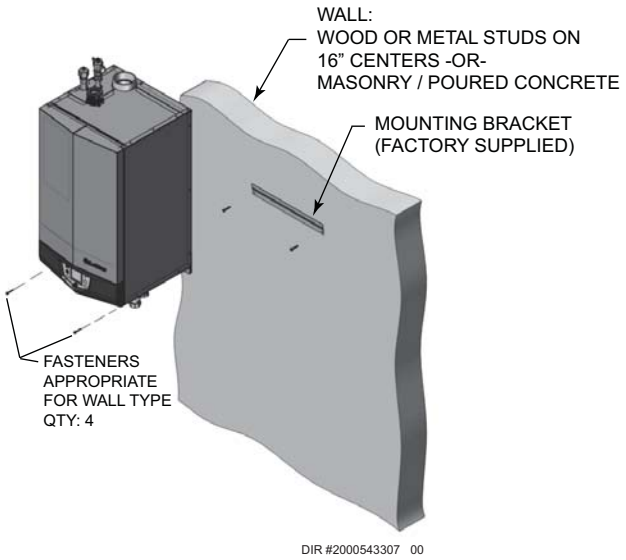
2. Mount the wall bracket using two (2) field supplied toggle bolts capable of supporting 100 pounds each.

   Ensure the top edge of the bracket is away from the wall. Ensure the bracket is level when mounted. Extreme care is needed to ensure the bolts are secured in the center of the studs.

3. Hang the boiler on the bracket and secure the bottom of the boiler with two (2) field supplied toggle bolts.

⚠ WARNING The boiler is too heavy for a single person to lift. A minimum of two people is needed for mounting the boiler onto the bracket.

Figure 2-4 *Mounting the Boiler*



3 General venting

Direct venting options - Sidewall Vent

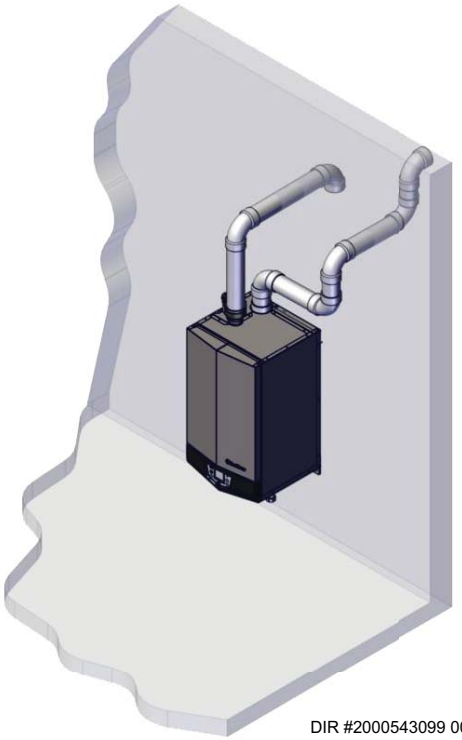


Figure 3-1 *Two-Pipe Sidewall Termination - See page 23 for more details*

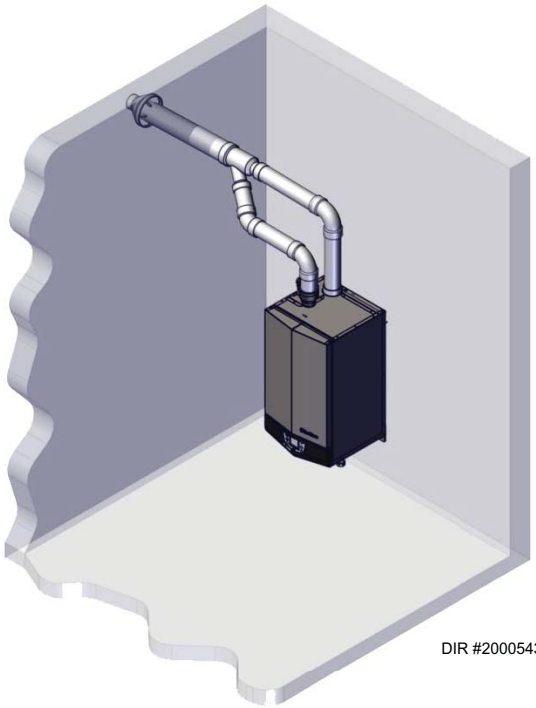


Figure 3-2 *PVC/CPVC Concentric Sidewall Termination - See page 27 for more details*

Direct venting options - Vertical Vent

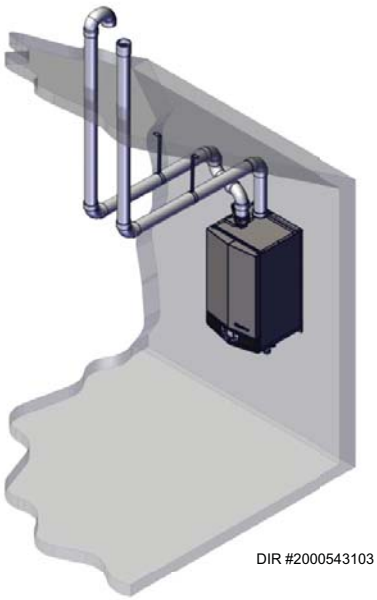


Figure 3-3 *Two-Pipe Vertical Termination - See page 30 for more details*

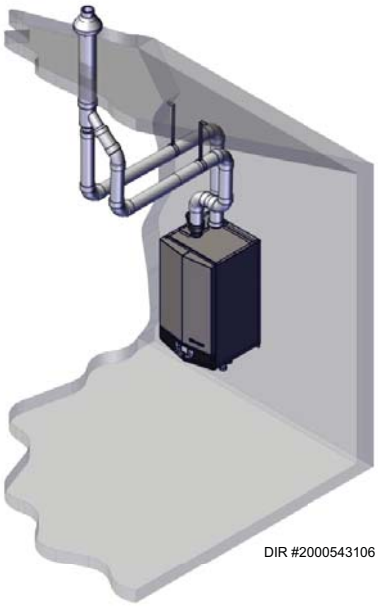


Figure 3-4 *PVC/CPVC Concentric Vertical Termination - See page 32 for more details*

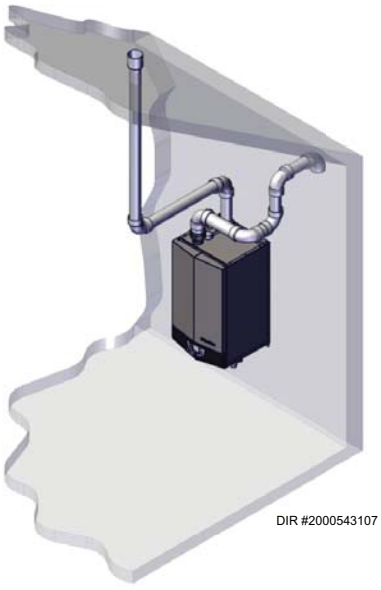


Figure 3-5 *Vertical Vent, Sidewall Air*

3 General venting

Install vent and combustion air piping

⚠ DANGER The Knight Wall Hung Fire Tube boiler 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 3D, 3E, and 3F 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 boiler from an existing vent system.

⚠ WARNING Do not connect any other appliance to the vent pipe or multiple boilers to a common vent pipe. Failure to comply could result in severe personal injury, death, or substantial property damage.

The Knight Wall Hung Fire Tube boiler 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.

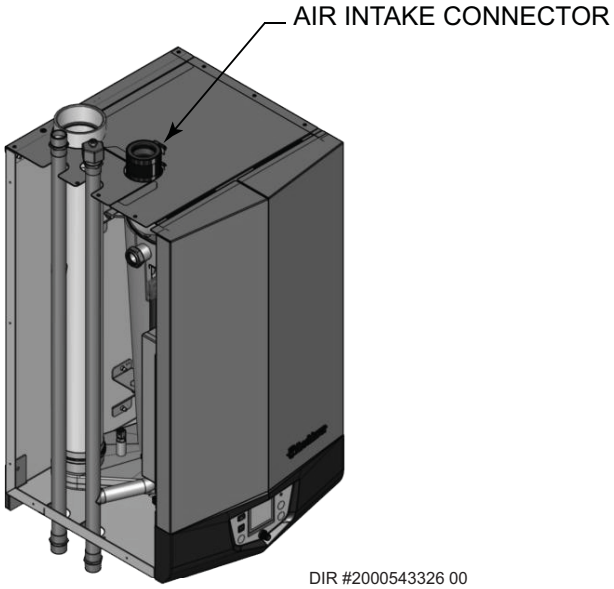
You may use any of the vent/air piping methods covered in this manual. Do not attempt to install the Knight Wall Hung Fire Tube boiler using any other means.

You must also install air piping from outside to the boiler air intake adapter unless following the Optional Room Air instructions on page 19 of 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 units 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.'s 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 Boiler Air Piping*



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3 General venting *(continued)*

Requirements for installation in Canada

1. Installations must be made with a vent pipe system certified to ULC-S636.
2. The first three (3) feet of plastic vent pipe from the appliance flue outlet must be readily accessible for visual inspection.
3. 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.
4. The 2", 3" and 4" Concentric Vent Kit available from Lochinvar (see Section 4 – *Sidewall Termination – Optional Concentric Vent*) and the 2", 3" and 4" Concentric Vent Kit available from IPEX are both approved for use on the Knight Wall Hung Fire Tube boiler. Both kits are listed to the ULC-S636 standard for use in Canada.

Sizing

The Knight Wall Hung Fire Tube boiler uses model specific combustion air intake and vent piping sizes as detailed in Table 3A below.

Table 3A *Air Intake/Vent Piping Sizes*

Model	Inlet Diameter	Vent Diameter	Maximum Length
56	2 inches / 3 inches	2 inches / 3 inches	80 feet / 100 feet
86	2 inches / 3 inches	2 inches / 3 inches	50 feet / 100 feet
111	2 inches / 3 inches	2 inches / 3 inches	40 feet / 100 feet
156	3 inches	3 inches	100 feet
200	3 inches	3 inches	100 feet
286	3 inches / 4 inches	3 inches / 4 inches	50 feet / 100 feet
400	4 inches	4 inches	100 feet

NOTICE Increasing or decreasing combustion air or vent piping sizes is not authorized.

NOTICE For Models 56 - 111 using 2" venting and Model 286 using 3" venting, the first seven (7) equivalent feet of vent must be CPVC or polypropylene (field supplied). This includes any transition piece used to increase or decrease the vent diameter.

NOTICE The minimum combustion air and vent piping length is 12 equivalent feet.

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 (100269005) = 49 equivalent feet of piping.

NOTICE The appliance output rating will reduce by up to 2.3% for each 25 feet of vent length. Consult factory to determine de-rate values.

Table 3B *Approved Concentric Vent Systems*

Vent Diameter	Vent Supplier	Vent Material	Part Number
2 inch	Lochinvar	PVC	100140485
3 inch	Lochinvar	PVC	100269005
4 inch	Lochinvar	PVC	100140484
2 inch	IPEX	PVC	196005
3 inch	IPEX	PVC	196006
4 inch	IPEX	PVC	196021
3 inch	IPEX	CPVC	197009
4 inch	IPEX	CPVC	197021

3 General venting

Materials

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.

*Depending on the installation, a field provided adapter may be required to transition between the air inlet connection on the appliance and the air inlet piping.

⚠ 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.

3 General venting *(continued)*

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 Knight Wall Hung Fire Tube boiler 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 3C).
- The equipment room MUST be provided with properly sized openings to assure adequate combustion air. Please refer to 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 3C *Optional Room Air Kit*

Model	Vent Diameter	Part Number
56 - 86	2 inch	100157614
111 - 286	3 inch	100157615
400	4 inch	100157616

Air contamination

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

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

⚠ WARNING If the boiler 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 1B, page 10 before installing the boiler 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

PVC/CPVC

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

Installing vent and air piping

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

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

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

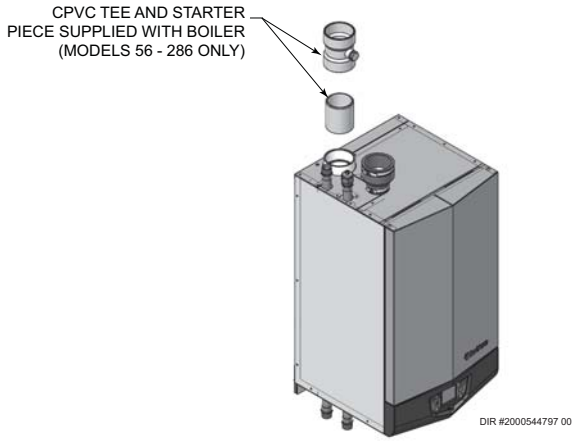
***Table 3D** PVC/CPVC Vent Pipe, and Fittings*

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 - DMV	ANSI/ASTM D2665
Pipe Cement / Primer	PVC	ANSI/ASTM D2564
	CPVC	ANSI/ASTM F493
NOTICE: DO NOT USE CELLULAR (FOAM) CORE PIPE		

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

1. Work from the boiler 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 Boiler PVC/CPVC Venting*



3 General venting *(continued)*

Polypropylene

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

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.

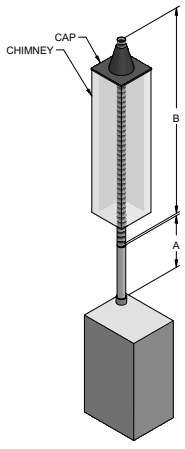
When determining equivalent combustion air and vent length for polypropylene single-wall piping:

- 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).

Figure 3-8 *Near Boiler Flexible Polypropylene Venting*



Duravent 3"

"A" DIM	"B" DIM	
3" RIGID	3" FLEX	4" FLEX
10 FT	60 FT	90 FT
20 FT	53 FT	80 FT
30 FT	47 FT	70 FT
40 FT	40 FT	60 FT
50 FT	33 FT	50 FT
60 FT	27 FT	40 FT
70 FT	20 FT	30 FT
80 FT	13 FT	20 FT
90 FT	7 FT	10 FT

Duravent 4"

"A" DIM	"B" DIM	
4" RIGID	4" FLEX	5" FLEX
10 FT	30 FT	90 FT
20 FT	27 FT	80 FT
30 FT	23 FT	70 FT
40 FT	20 FT	60 FT
50 FT	17 FT	50 FT
60 FT	13 FT	40 FT
70 FT	10 FT	30 FT
80 FT	7 FT	20 FT
90 FT	3 FT	10 FT

Centrotherm 3"

"A" DIM	"B" DIM	
3" RIGID	3" FLEX	4" FLEX
10 FT	45 FT	90 FT
20 FT	40 FT	80 FT
30 FT	35 FT	70 FT
40 FT	30 FT	60 FT
50 FT	25 FT	50 FT
60 FT	20 FT	40 FT
70 FT	15 FT	30 FT
80 FT	10 FT	20 FT
90 FT	5 FT	10 FT

Centrotherm 4"

"A" DIM	"B" DIM
4" RIGID	4" FLEX
10 FT	33 FT
20 FT	29 FT
30 FT	26 FT
40 FT	22 FT
50 FT	18 FT
60 FT	15 FT
70 FT	11 FT
80 FT	7 FT
90 FT	4 FT

*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

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 3F 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 Table 3E. DO NOT mix vent systems of different types or manufacturers. Failure to comply could result in severe personal injury, death, or substantial property damage.

NOTICE

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

NOTICE

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

Figure 3-9 *Near Boiler Polypropylene Venting*

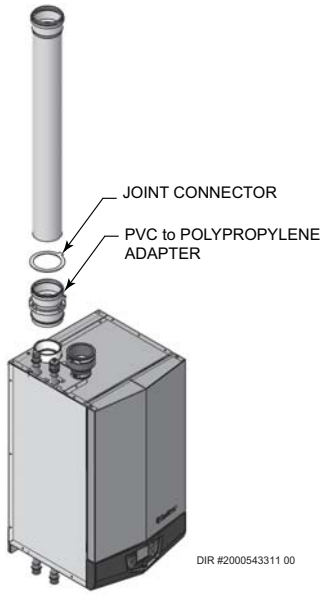


Table 3E *Approved Polypropylene System Adapters*

Vent Diameter	Manufacturer	Model	Type	PVC Adapter	Adapter Clamp	Joint Connector	Sidewall Kit
2 inch	Centrotherm	Innoflue	Single-Wall / Flex	ISAGL0202	IAFC02	IANS02	ISLTK02*
3 inch	Centrotherm	Innoflue	Single-Wall / Flex	ISAGL0303	IAFC03	IANS03	ISLTK03*
4 inch	Centrotherm	Innoflue	Single-Wall / Flex	ISAGL0404	IAFC04	IANS04	ISLTK04*
2 inch	DuraVent	PolyPro	Single-Wall / Flex	2PPS-ADL	Included	2PPS-LB	2PPS-HLKL*
3 inch	DuraVent	PolyPro	Single-Wall / Flex	3PPS-ADL	Included	3PPS-LB	3PPS-HLKL*
4 inch	DuraVent	PolyPro	Single-Wall / Flex	4PPS-ADL	Included	4PPS-LB	4PPS-HLKL*

*The sidewall kit components are only needed if the sidewall termination assembly is used (see FIG. 4-1B on page 23).

3 General venting

Stainless steel vent

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

⚠ WARNING Use only the materials, vent systems, and terminations listed in Table 3F. 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 connection, supplied by the vent manufacturer to adapt to its vent system. See Table 3F for approved vent adapters. Refer to adapter notation in Table 3F to determine if a CPVC starter piece is needed.

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 Boiler Stainless Steel Venting*

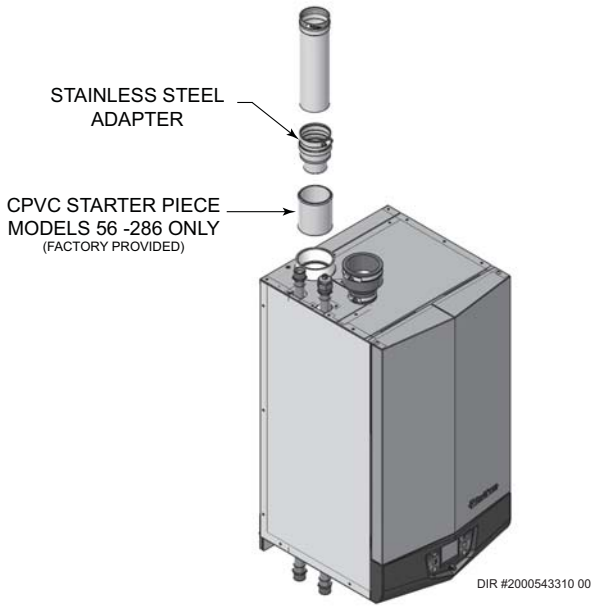


Table 3F *Approved Stainless Steel (S.S.) Venting System Adapters and Terminations*

Manufacturer	Model	Vent Adapters and Terminations		
		Description	Size	Part Number
DuraVent	FasNSeal*	Flue Coupler Adapter	2" to 3"	FSA-2PVCS-3FNSF[1]
DuraVent	FasNSeal*	Flue Coupler Adapter	3" (4")	FSA-3(4)PVCS-3(4)FNSF[1]
DuraVent	FasNSeal*	Flue CPVC Starter Adapter	3" (4")	FSA-3(4)PVCO-3(4)FNSF[2]
DuraVent	FasNSeal*	Flue Flue Collar Adapter	4"	FSA-KNWH399[3]
DuraVent	FasNSeal*	Bird Screen Termination	3" (4")	FSBS3(4)
DuraVent	FasNSeal*	Rain Cap Termination	3" (4")	FSRC3(4)
Heat Fab	Saf-T-Vent	Flue Coupler Adapter	3" (4")	93(4)01PVC[1]
Heat Fab	Saf-T-Vent	Flue Collar Adapter	4"	WH0004[3]
Heat Fab	Saf-T-Vent	Bird Screen Termination	3" (4")	93(4)92
Heat Fab	Saf-T-Vent	Rain Cap Termination	3" (4")	53(4)00CI
Heat Fab	Saf-T-Vent	Elbow w/Screen Termination	3" (4")	93(4)12TERM
Z-Flex	Z-Vent	Flue Coupler Adapter	3"	2SVSTTA03[1]
Z-Flex	Z-Vent	Flue Coupler Adapter	3" to 4"	2SVSTTA04[1]
Z-Flex	Z-Vent	Flue Coupler Adapter	4"	2SVSTTA04.5[1]
Z-Flex	Z-Vent	Flue Collar Adapter	4"	2SVAKA04[3]
Z-Flex	Z-Vent	Bird Screen Termination	3" (4")	2SVSTP03(4)
Z-Flex	Z-Vent	Rain Cap Termination	3" (4")	2SVSRCF03(4)
Z-Flex	Z-Vent	Elbow w/Screen Termination	3" (4")	2SVSTEX03(4)90

*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.

1) Install adapter directly into the flue vent coupler connector. An approved high-temperature RTV silicone sealant MUST be used to make the joint between the flue vent and adapter.
2) A CPVC starter piece must be properly cemented into the flue collar connection before installing the adapter. Ensure the CPVC starter piece is an appropriate length such that the adapter inner sleeve can fit into the piping and the outer sleeve will securely clamp.
3) For use on Model WH400 ONLY. Replace the appliance secured CPVC flue vent with the flue collar adapter listed.

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

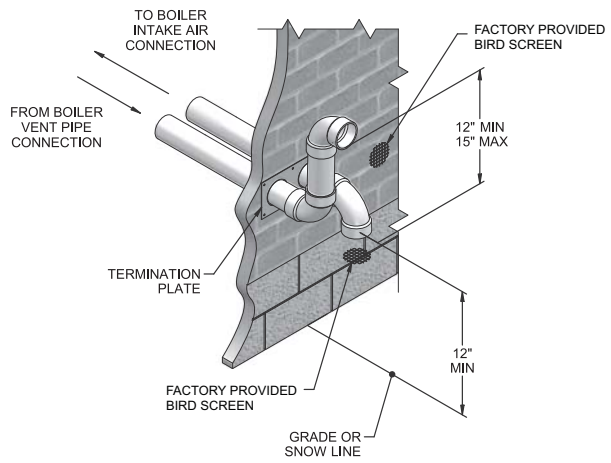
Locate the vent/air terminations using the following guidelines:

1. The total length of piping for vent or air must not exceed the limits given in the General Venting Section on page 17 of this manual.
2. You must consider the surroundings when terminating the vent and air:
   a. Position the vent termination where vapors will not damage nearby shrubs, plants or air conditioning equipment or be objectionable.
   b. The flue products will form a noticeable plume as they condense in cold air. Avoid areas where the plume could obstruct window views.
   c. Prevailing winds could cause freezing of condensate and water/ice buildup where flue products impinge on building surfaces or plants.
   d. Avoid possibility of accidental contact of flue products with people or pets.
   e. Do not locate the terminations where wind eddies could affect performance or cause recirculation, such as inside building corners, near adjacent buildings or surfaces, window wells, stairwells, alcoves, courtyards, or other recessed areas.

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

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

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



If using the sidewall termination:

3. The air piping must terminate in a down-turned elbow as shown in FIG. 4-1A. This arrangement avoids recirculation of flue products into the combustion air stream.
4. The vent piping must terminate in an elbow pointed outward or away from the air inlet, as shown in FIG. 4-1A.

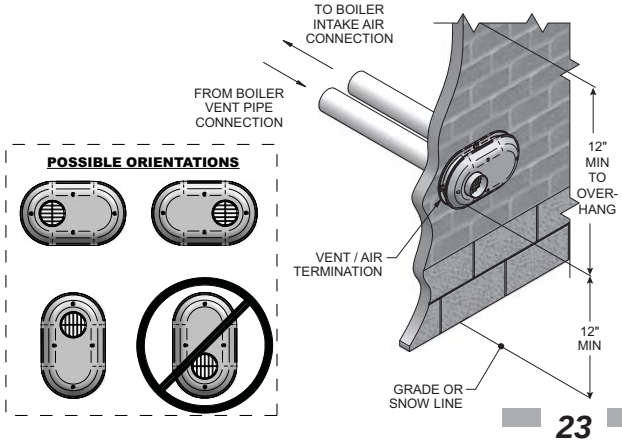
⚠ WARNING Do not exceed the maximum lengths of the outside vent piping shown in FIG. 4-1A. Excessive length exposed to the outside could cause freezing of condensate in the vent pipe, resulting in potential boiler shutdown.

When venting out a sidewall using PVC, CPVC, or Polypropylene vent materials, an optional sidewall vent termination kit can be ordered (reference Table 4A for kit numbers).

Table 4A *Alternate Sidewall Vent Kits*

Vent Diameter	Supplier	Part Number
2 inch	Lochinvar	100157609
3 inch	Lochinvar	100157610
4 inch	Lochinvar	100157611

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



4 Sidewall direct venting

Vent/air termination – sidewall

Figure 4-1C *Alternate PVC/CPVC/SS/ Polypropylene Venting Arrangement (if Space Allows) w/Field Supplied Fittings*

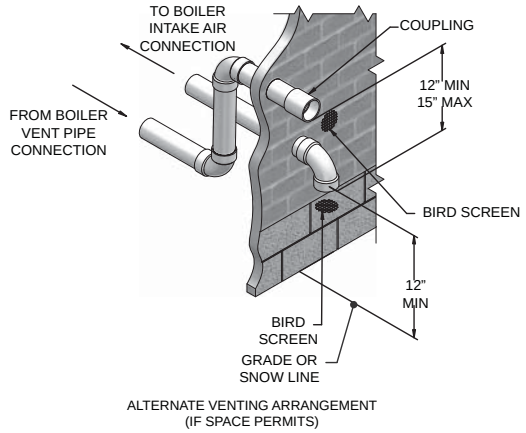
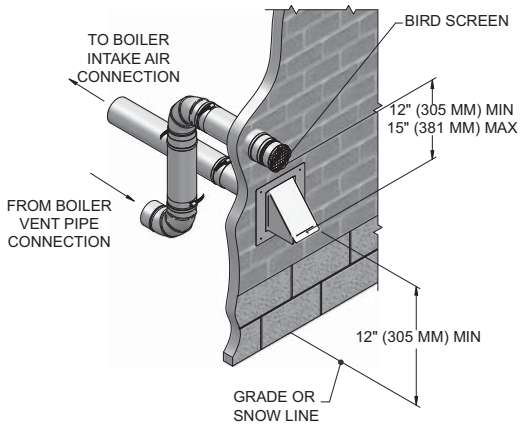


Figure 4-1D *Alternate SS Venting Arrangement - Typical Stainless Steel Sidewall Termination of Air and Vent w/Field Supplied Fittings, Utilizing a Hood Intake*



5. Maintain clearances as shown in FIG.'s 4-1A thru 4-3B, pages 23 - 25. Also maintain the following:
   a. Vent must terminate:
      - At least 6 feet from adjacent walls.
      - No closer than 12 inches below roof overhang.
      - At least 7 feet above any public walkway.
      - At least 3 feet above any forced air intake within 10 feet.
      - No closer than 12 inches below or horizontally from any door or window or any other gravity air inlet.
   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. Condensate could freeze and block vent pipe.
   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 4-2A *Clearance to Gravity Air Inlets*

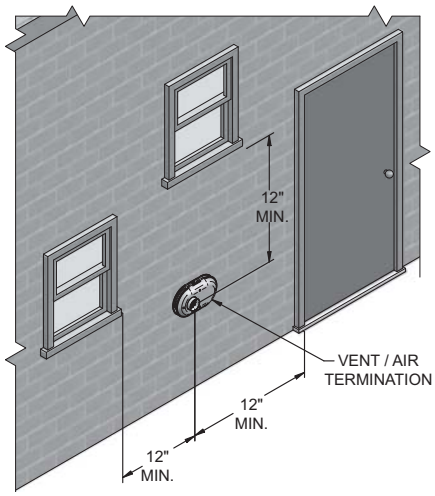


Figure 4-2B *Alternate Clearance to Gravity Air Inlets w/ Field Supplied Fittings*

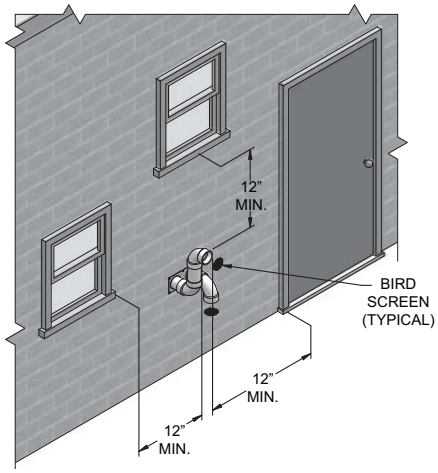
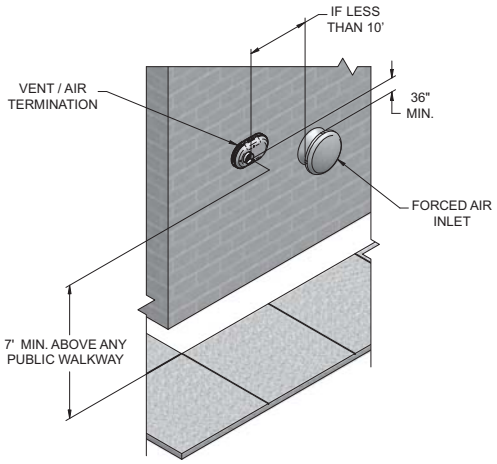
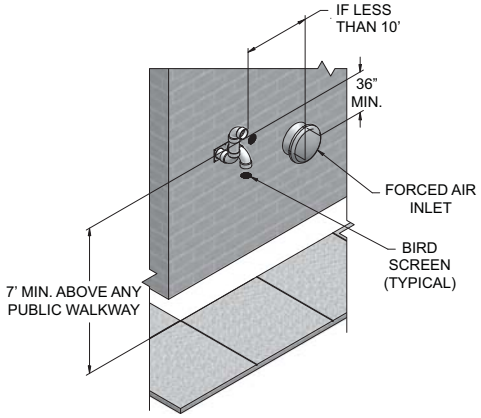


Figure 4-3A *Clearance to Forced Air Inlets*



4 Sidewall direct venting *(continued)*

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



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:
      - 3½ inch hole for 2 inch vent pipe
      - 4½ inch hole for 3 inch vent pipe
      - 5½ inch hole for 4 inch 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 3E on page 21 into the vent plate. Slide the sidewall retaining bracket down the sidewall adapters flush to the vent plate (FIG. 4-4B).
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 3D on page 20 to seal the vent pipe.
4. Mount and secure the vent plate to the wall, using stainless steel screws.
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 (see FIG.'s 4-4A and 4-4B). 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 4-4A *PVC/CPVC Sidewall Termination Assembly*

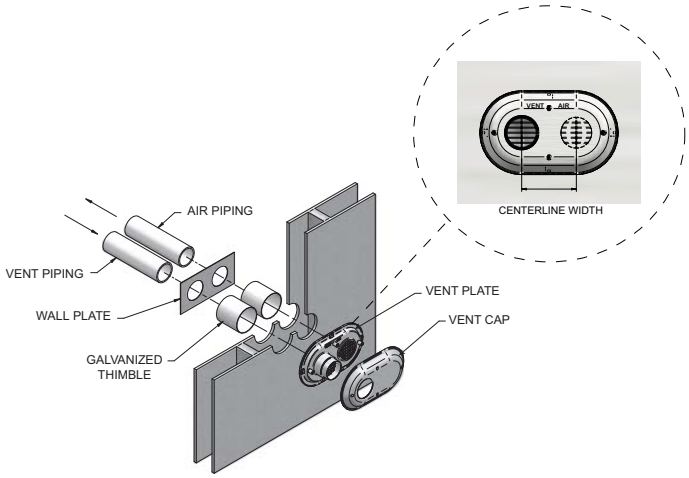
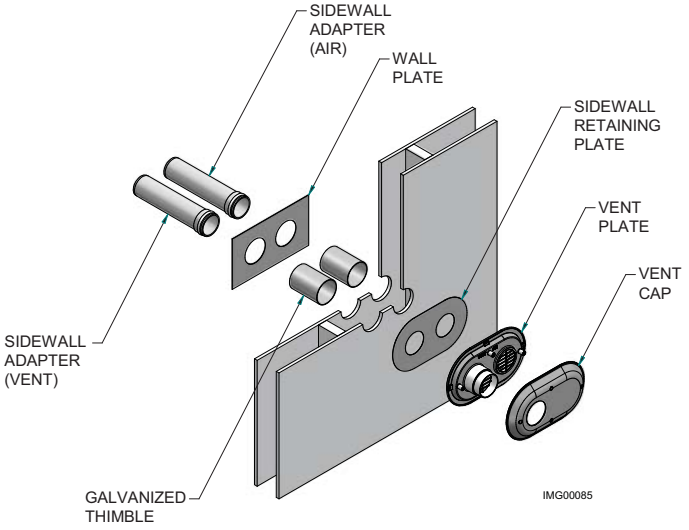


Figure 4-4B *Polypropylene Sidewall Termination Assembly*

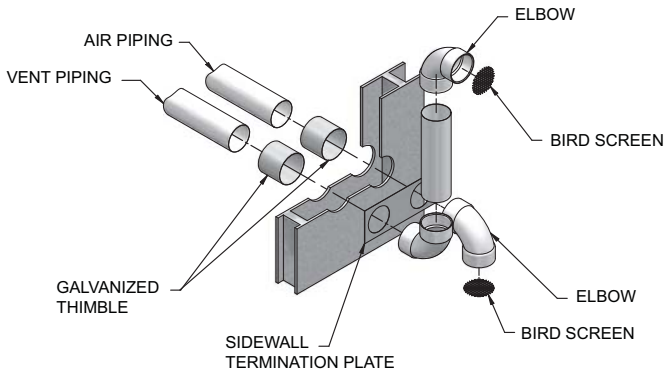


4 Sidewall direct venting

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:
      - 3½ inch hole for 2 inch vent pipe
      - 4½ inch hole for 3 inch vent pipe
      - 5½ inch hole for 4 inch vent pipe
   b. Insert a galvanized metal thimble in the vent pipe hole as shown in FIG. 4-4C.
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 4-4C *Alternate Sidewall Termination Assembly w/Field Supplied Fittings*



Multiple vent/air terminations

1. When terminating multiple Knight Wall Hung Fire Tube boilers terminate each vent/air connection as described in this manual (FIG. 4-5A).

⚠ 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. 4-5A for U.S. installations. For Canadian installations, provide clearances required by CSA B149.1 Installation Code.
3. The air inlet of a Knight Wall Hung Fire Tube boiler is part of a direct vent connection. It is not classified as a forced air intake with regard to spacing from adjacent boiler vents.

Figure 4-5A *Multiple Vent Terminations (must also comply with* ***Figure 4-1A****)*

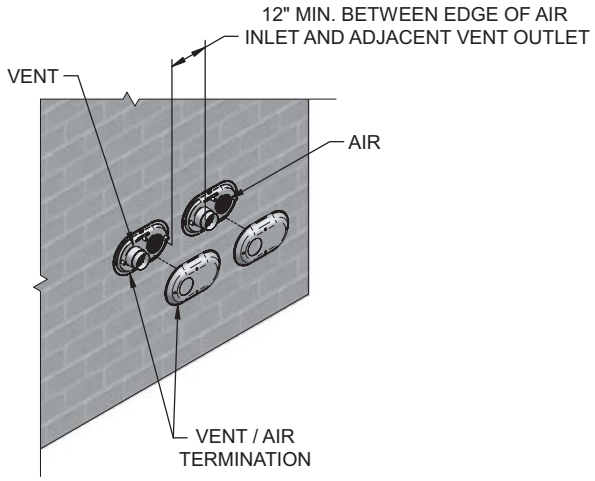
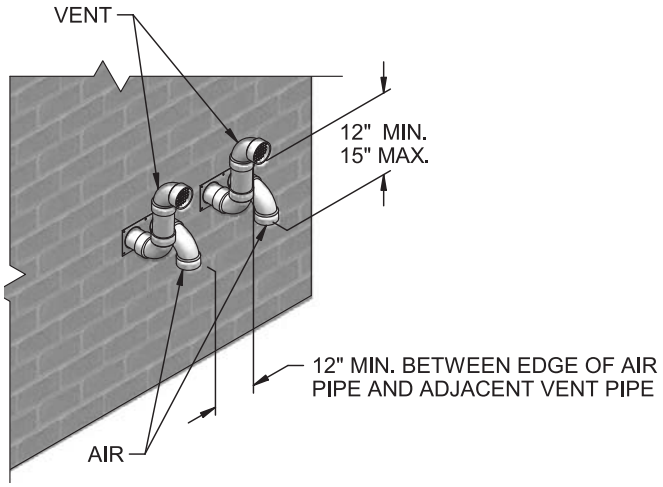


Figure 4-5B *Alternate Multiple Vent Terminations w/Field Supplied Fittings (must also comply with* ***Figure 4-1B****)*



4 Sidewall direct venting *(continued)*

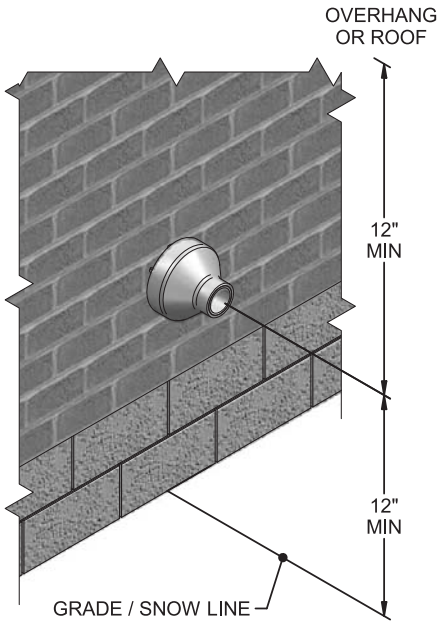
Sidewall termination – optional concentric vent

Description and usage

Lochinvar offers optional concentric combustion air and vent pipe termination kits (Factory Kit #100140485 for 2" diameter - Models 56 - 86, #100269005 for 3" diameter - Models 56 - 200 and #100140484 for 4" diameter - Models 286 - 400). 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. 4-6.

The required combustion air and vent pipe materials are listed in Table 3D, on page 20 of this manual.

Figure 4-6 *Concentric Sidewall Termination*



Sidewall termination installation

1. Determine the best location for the termination kit (see FIG. 4-6).
2. Reference the *Determine Location Section* on page 23 of this manual for general termination considerations.
3. Cut one (1) hole (5 inch diameter for #100269005 installations, 4 inch diameter for #100140485, or 7 inch diameter for #100140484 installations) 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.'s 4-7 and 4-8).
   b. Cement the rain cap to the smaller diameter kit pipe (FIG.'s 4-7 and 4-8).

Figure 4-7 *Kit Contents_100140485 & 100269005 (reference Table 3B on page 17)*

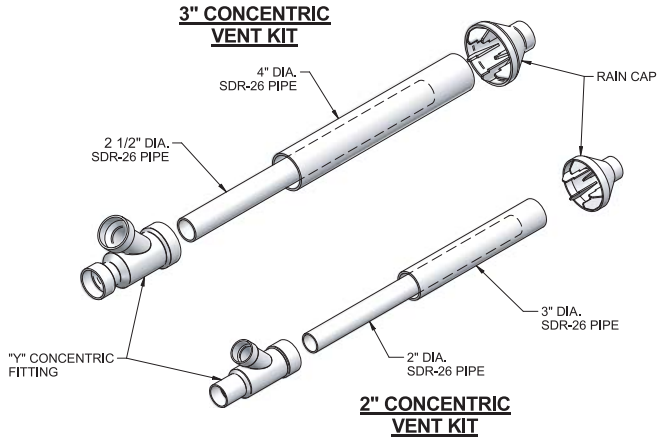
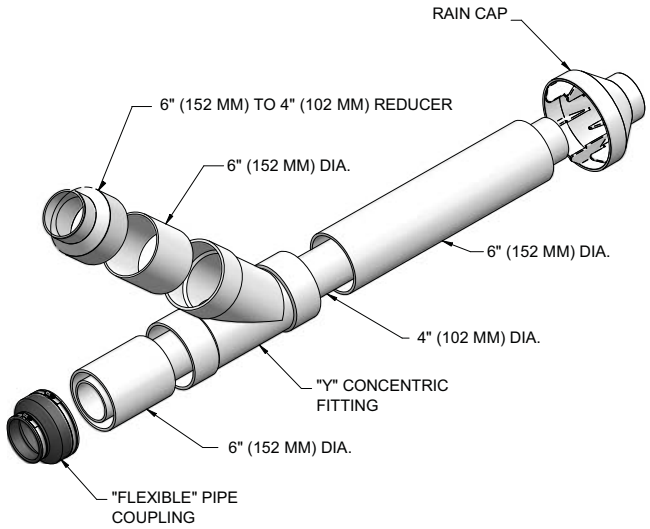


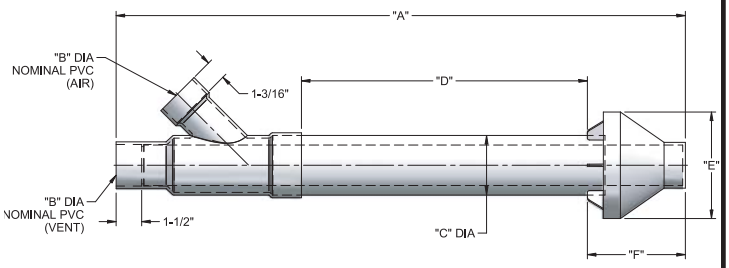
Figure 4-8 *Kit Contents_100140484 (reference Table 3B on page 17)*



4 Sidewall direct venting

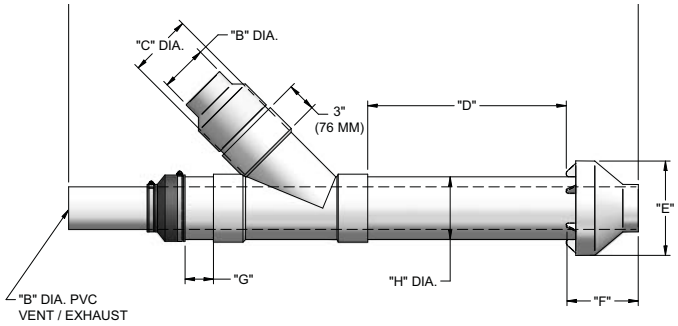
Sidewall termination – optional concentric vent

Figure 4-9 *2" and 3" Concentric Vent Dimensional Drawing (reference Table 3B on page 17)*



	"A"	"B"	"C"	"D"	"E"	"F"
2" VENT KIT	33-3/8"	2"	3-1/2"	16-5/8"	6-1/4"	5-3/4"
3" VENT KIT	38-7/8"	3"	4-1/2"	21-1/8"	7-3/8"	6-1/2"

Figure 4-10 *4" Concentric Vent Dimensional Drawing (reference Table 3B on page 17)*



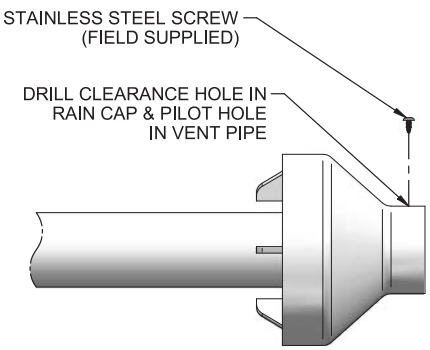
A	B	C	D	E	F	G	H
60" (1524 MM)	4" (102 MM)	6" (152 MM)	21 1/8" (537 MM)	10" (254 MM)	7 5/8" (194 MM)	3" (76 MM)	6 5/8" (168 MM)

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.

⚠ 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.

Figure 4-11 *Rain Cap to Vent Pipe Alternate Assembly*



5. Install the Y concentric fitting and pipe assembly through the structure's hole from an inside wall.

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

6. Install the rain cap and small diameter pipe assembly into the Y concentric fitting and large pipe assembly from an outside wall. Ensure small diameter pipe is bottomed and cemented in the Y concentric fitting for #100140485 and #100269005 installations and fastened tightly into the rubber adapter for #100140484 installations.

7. Secure the assembly to the structure as shown in FIG. 4-12 using field-supplied metal strapping or equivalent support material.

NOTICE Ensure termination location clearance dimensions are as shown in FIG. 4-6.

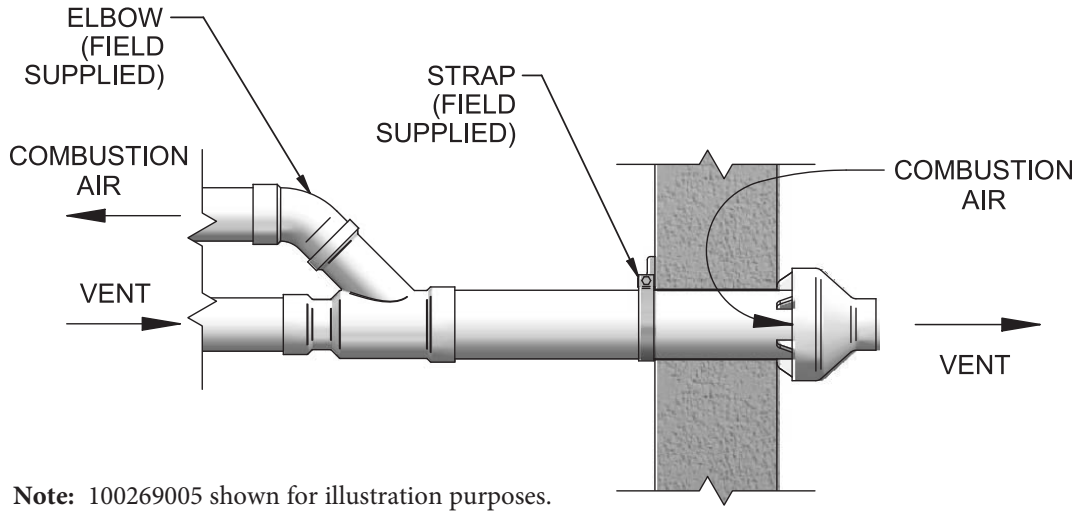
NOTICE If assembly needs to be extended to allow sidewall thickness requirement, the two (2) pipes supplied in the kit may be replaced by using the same diameter, field-supplied SDR-26 PVC (D2241) pipe for #100140485 and #100269005 and standard schedule 40 PVC for #100140484. Do not extend dimension D* more than 60 inches (see FIG.'s 4-9 and 4-10).

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

4 Sidewall direct venting *(continued)*

Sidewall termination – optional concentric vent

Figure 4-12 *Concentric Vent Sidewall Attachment*



Note: 100269005 shown for illustration purposes.

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

8. Cement appliance combustion air and vent pipes to the concentric vent termination assembly. See FIG. 4-12 for proper pipe attachment.

9. Operate the appliance one (1) heat cycle to ensure combustion air and vent pipes are properly connected to the concentric vent termination connections.

Multi-venting sidewall terminations

When two (2) or more direct vent appliances are vented near each other, each appliance must be individually vented (see FIG. 4-13). 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. 4-13. It is important that vent terminations be made as shown to avoid recirculation of flue gases.

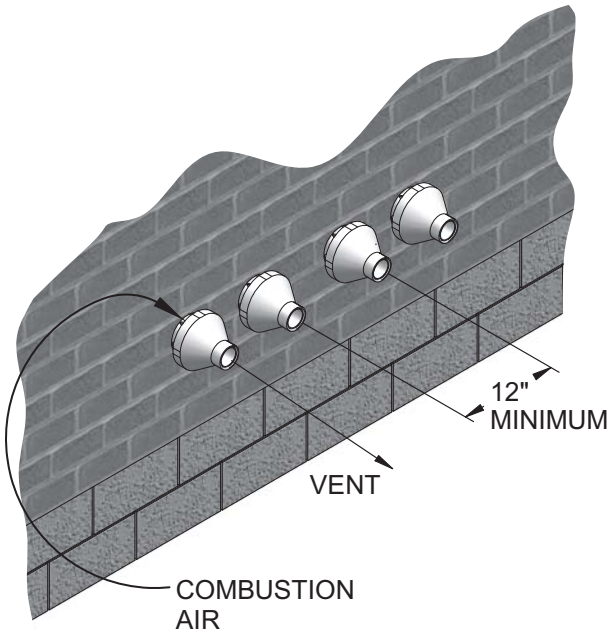


Figure 4-13 *Concentric Vent and Combustion Air Termination*

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 on page 17 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/Polypropylene Vertical Termination of Air and Vent*

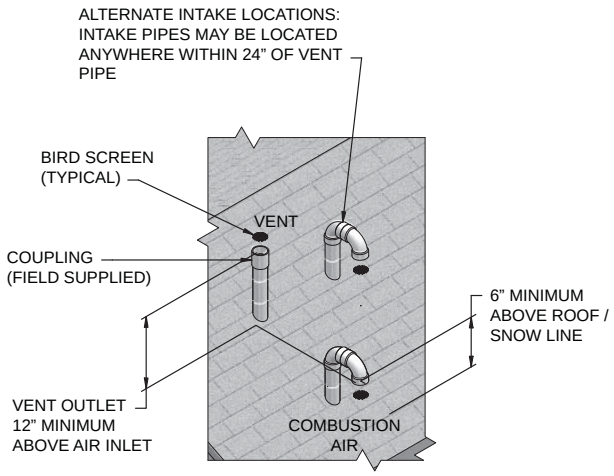
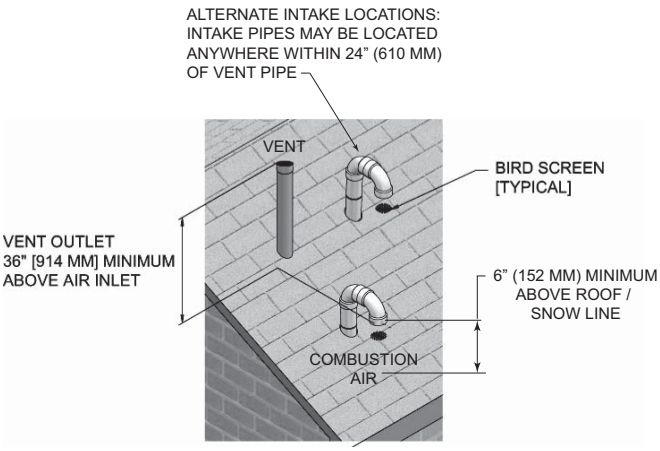


Figure 5-1B *Stainless Steel Vertical Termination of Air and Vent*



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

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:
      • 3½ inch hole for 2 inch vent pipe
      • 4½ inch hole for 3 inch vent pipe
      • 5½ inch hole for 4 inch 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, page 30.

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 Knight Wall Hung Fire Tube boilers, 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 boiler 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 a Knight Wall Hung Fire Tube boiler is part of a direct vent connection. It is not classified as a forced air intake with regard to spacing from adjacent boiler vents.

Figure 5-2 *Vertical Terminations with Multiple Boilers*

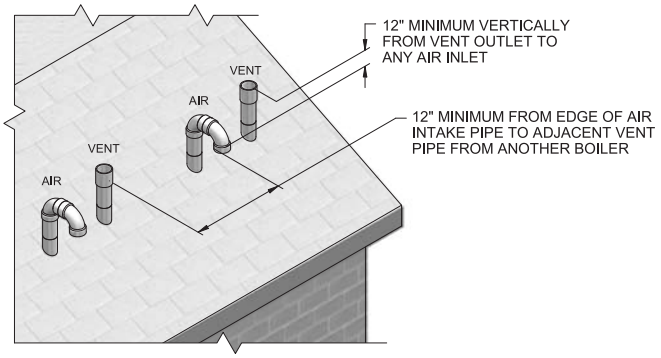
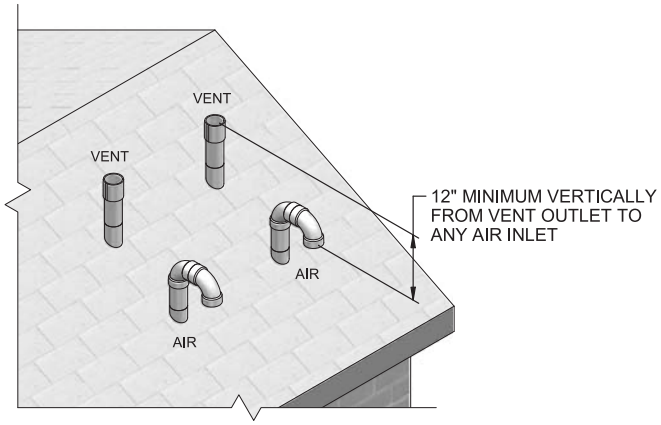


Figure 5-3 *Alternate Vertical Terminations with Multiple Boilers*



5 Vertical direct venting

Vertical termination – optional concentric vent

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 3D, on page 20 of this manual.

Vertical termination installation

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

Figure 5-4 *Concentric Vertical Termination*

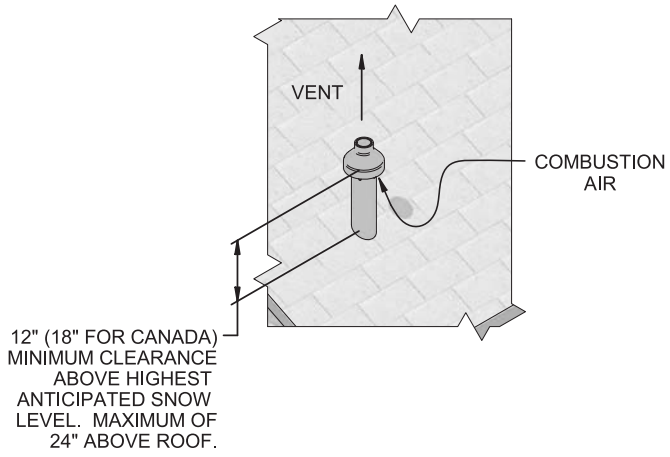


Figure 5-5 *Do Not Install U-Bend to Rain Cap*

2. Cut one (1) hole (5 inch diameter for #100269005 installations, 4 inch diameter for #100140485, or 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.'s 4-7 and 4-8, page 27).
   b. Cement rain cap to the smaller diameter kit pipe (see FIG.'s 4-7 and 4-8, page 27).

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, page 28).

⚠ 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.

5 Vertical direct venting *(continued)*

Vertical termination – optional concentric vent

⚠ 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.

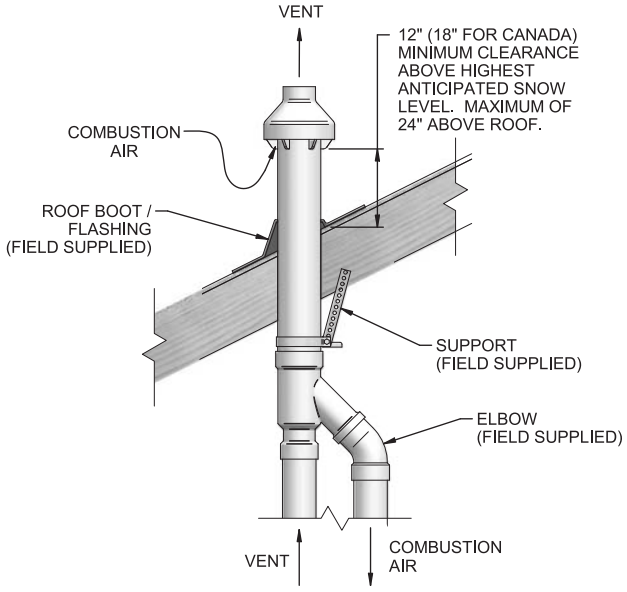
4. Install the Y concentric fitting pipe assembly up through the structure's hole and field supplied roof boot/flashing.

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*

Note: 100269005 shown for illustration purposes.



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, page 32.

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 for 100269005/100140485 and standard schedule 40 PVC for 100140484. Do not extend dimension D* more than 60 inches (see FIG.'s 4-9 and 4-10, page 28).

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 cemented and bottomed in the Y concentric fitting for #100269005 and #100140485 installations and fastened tightly into the rubber adapter for #100140484 installations.

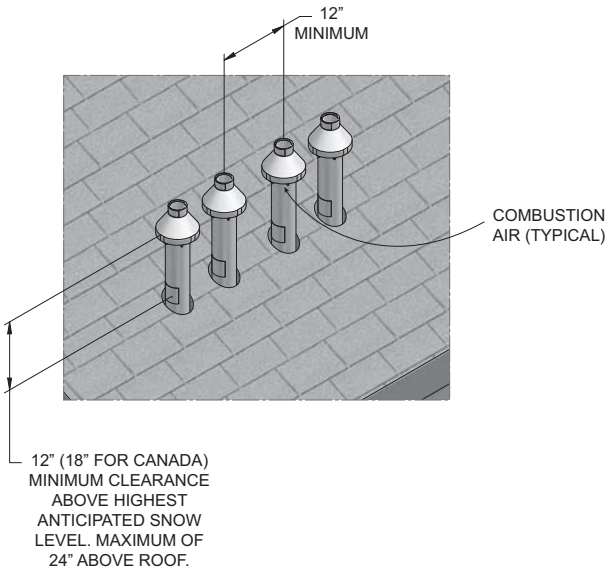
7. Cement the appliance combustion air and vent pipes to the concentric vent termination assembly. See FIG. 5-6 for proper pipe attachment.

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.

Multi-venting 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.'s 5-8 and 5-9.

Approved venting materials must be used as specified in Table 3D on page 20.

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.

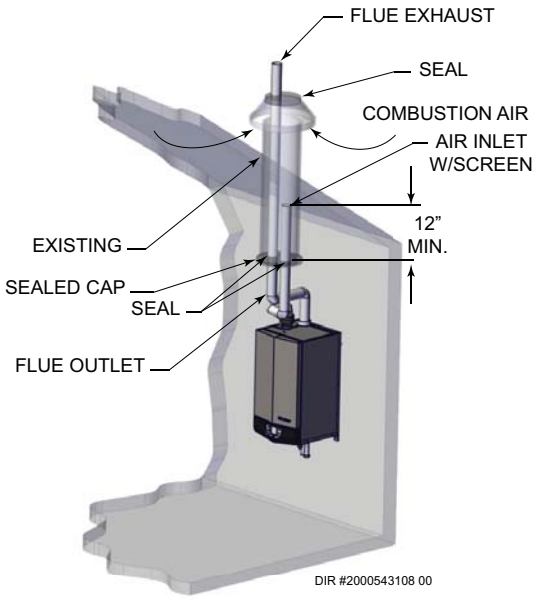
If an existing unused venting system is converted for use with this method of concentric venting, the installer must ensure that the existing venting system is clean and free from particulate contamination that will harm this appliance and cause increased nuisance calls or maintenance. See Table 1B on page 10 for a list of corrosive contaminants and sources.

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

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

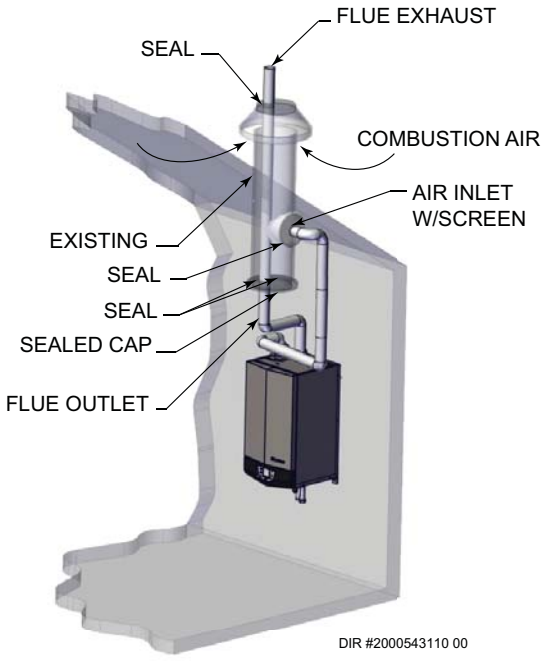
Vent / Air Inlet Size	Minimum Existing Vent / Chase Size
2"	4"
3"	5"
4"	7"

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*



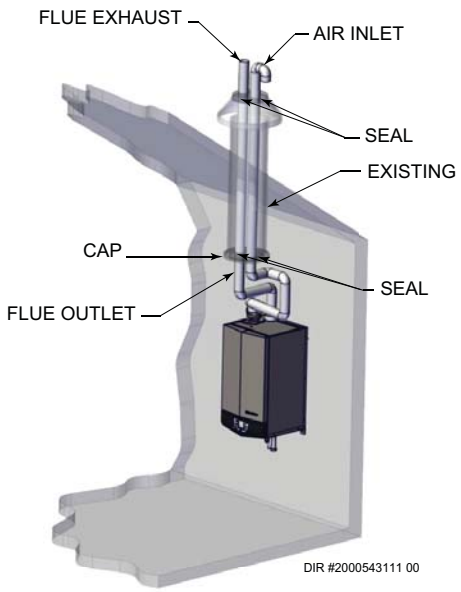
*For concept illustration only. Individual installations may vary due to job site specific equipment.

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 Hydronic piping

System water piping methods

The Knight Wall Hung Fire Tube is designed to function in a closed loop pressurized system not less than 12 psi. (Non-metallic system piping must have an oxygen barrier to be considered a closed loop). A temperature and pressure gauge is included to monitor system pressure and outlet temperature and should be located on the boiler outlet.

It is important to note that the boiler has a minimal amount of pressure drop and must be figured in when sizing the circulators. Each boiler installation must have an air elimination device, which will remove air from the system. Install the boiler so the gas ignition system components are protected from water (dripping, spraying, etc.) during appliance operation for basic service of circulator replacement, valves, and others.

Observe a minimum of 1/4 inch (6 mm) clearance around all un-insulated hot water pipes when openings around the pipes are not protected by non-combustible materials.

Low water cutoff device

On a boiler installed above radiation level, some states and local codes require a low water cutoff device at the time of installation.

Chilled water system

If the boiler supplies hot water to heating coils in air handler units, flow control valves or other devices must be installed to prevent gravity circulation of heater water in the coils during the cooling cycle. A chilled water medium must be piped in parallel with the heater.

Freeze protection

Freeze protection for new or existing systems must use glycol that is specially formulated for this purpose. This includes inhibitors, which prevent the glycol from attacking the metallic system components. Make certain to check that the system fluid is correct for the glycol concentration and inhibitor level. The system should be tested at least once a year and as recommended by the producer of the glycol solution. Allowance should be made for the expansion of the glycol solution in the system piping.

⚠ WARNING Use only inhibited propylene glycol solutions, which are specifically formulated for hydronic systems. Ethylene glycol is toxic and can attack gaskets and seals used in hydronic systems.

General piping information

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

Basic steps are listed in this section along with illustrations on the following pages (FIG.'s 6-5 thru 6-15), which will guide you through the installation of the Knight Wall Hung Fire Tube boiler.

The WH56 - 286 models are equipped with optional water connections from the top or bottom. These models ship from the factory configured for bottom connections. A relief valve and fittings are provided in the install kit shipped with the boiler and are to be field installed on the top outlet connection (see FIG. 6-1 on page 37). If bottom connections are not used, reinstall the factory provided cap on the outlet piping connection and a field provided drain on the inlet piping connection as shown in FIG. 6-2 on page 37.

Note: The threaded NPT connections MUST be used for initial connection. DO NOT attempt to change the boiler internal piping.

⚠ WARNING Use two (2) wrenches when tightening water piping at the boiler. Using one of the wrenches to prevent the boiler interior piping from turning. Failure to support the boiler piping connections to prevent them from turning could cause damage to boiler components.

1. Connect the system return marked "Inlet".
2. Connect the system supply marked "Outlet".
3. Install purge and balance valve or shutoff valve and drain on system return to purge air out of each zone.
4. Install a backflow preventer on the cold feed make-up water line.
5. Install a pressure reducing valve on the cold feed make-up water line, (15 psi nominal). Check temperature and pressure gauge (shipped separately), which should read a minimum pressure of 12 psi.
6. Install a circulator as shown on the piping diagrams in this section. Make sure the circulator is properly sized for the system and friction loss.
7. 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.
8. Install an air elimination device on the system supply.
9. Install a drain valve at the lowest point of the system. **Note:** The boiler cannot be drained completely of water without purging the unit with an air pressure of 15 psi.
10. 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 prevent injury in the event of pressure relief. Pipe the discharge to a drain. Provide piping that is the same size as the safety relief valve outlet. Never block the outlet of the safety relief valve.

NOTICE The relief valve, tee and any necessary fittings are shipped in the install kit with the boiler and are to be field installed (FIG. 6-1). On the WH400 model the relief valve is installed at the factory on the left side of the boiler.

11. Install a field supplied strainer to prevent damage to the heat exchanger caused by debris entering from the system piping. When installing in a pre-existing system, a strainer/filter capable of removing debris left in the system is recommended.

*See the piping illustrations included in this section, FIG.'s 6-5 thru 6-15 for suggested guidelines in piping the Knight Wall Hung Fire Tube boiler with either zone valves or circulator pumps.

6 Hydronic piping *(continued)*

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.

CAUTION

The Knight Wall Hung Fire Tube boiler is capable of servicing multiple temperature loop systems. It is the responsibility of the installer to protect the loops with lower temperature requirements from higher temperatures that may be required by other loops.

Relief valve, automatic air vent, and temperature and pressure gauge installation (Models WH56 - 286)

Basic steps are listed below to guide you through the installation of the relief valve, automatic air vent, and the temperature and pressure (T & P) gauge provided with the unit (reference FIG.'s 6-1 and 6-2).

1. Install the tee with the 3/4" fitting positioned horizontally towards the left side of the boiler.
2. Install the 3/4" elbow into the tee installed in Step 1, with the fitting positioned vertically and on the top.
3. Install the relief valve into the 3/4" fitting of the elbow installed in Step 2.
4. Using field provided fittings, install a tee with a 3/8" fitting positioned horizontally towards the front of the boiler. For installations with top water connections, locate the tee directly above the relief valve tee installed in Step 1. If top connections are not used, connect the tee directly to the bottom outlet piping.
5. Install the temperature and pressure (T & P) gauge provided with the unit into the front of the fitting of the tee installed in Step 4.
6. If top connections are not used, install a 1/4" bushing and the automatic air vent into the relief valve tee installed in Step 1.

Figure 6-1 *Top Connections Installation*

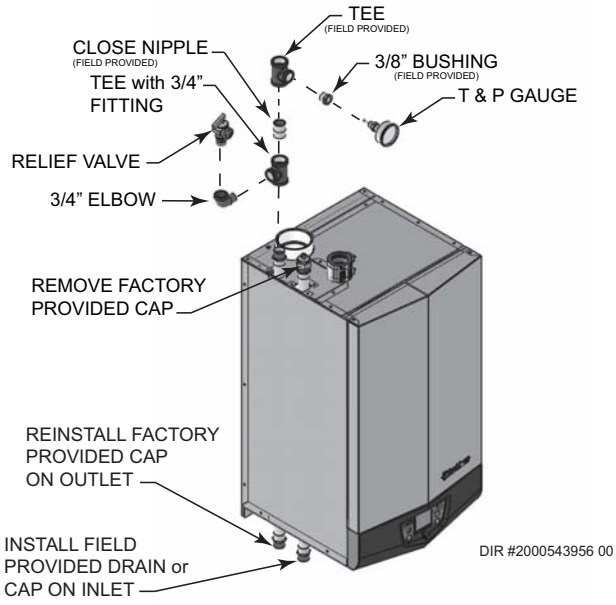
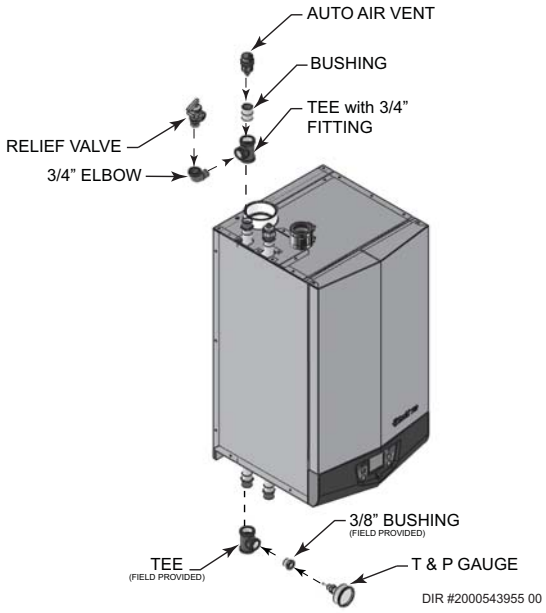


Figure 6-2 *Bottom Connections Installation*



Near boiler piping components

1. **Boiler system piping:**
   Boiler system piping MUST be sized per the pipe requirements listed in Table 6B. Reducing the pipe size can restrict the flow rate through the boiler, causing inadvertent high limit shutdowns and poor system performance.
2. **Boiler circulating pump:**
   A Grundfos UPS15-58FC pump for Models 56 - 156 and a Grundfos UPS26-99FC for Models 200 - 400 will be provided by the factory as the boiler circulation pump. Knight Wall Hung Fire Tube boilers are capable of controlling a variable speed boiler circulator. Variable speed circulators MUST be sized to meet the specified minimum flow requirements listed in Table 6B on page 40 at full speed.
3. **Domestic hot water circulating pump:**
   Field supplied. The pump MUST be sized to meet the specified minimum flow requirements listed in Table 6B. Consult the indirect water heater operating guide to determine flow characteristics for the selected product used.
4. **Boiler 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 boiler.

6 Hydronic piping

5. Check valves:
Field supplied. Check valves are recommended for installation as shown in FIG.'s 6-5 thru 6-14. Failure to install check valves could result in a reverse flow condition during pump(s) off cycle.

6. Domestic indirect hot water 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 boiler.

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

8. Unions:
Field supplied. Recommended for unit serviceability.

9. Temperature and pressure gauge:
Factory supplied. The temperature and pressure gauge is shipped loose. It is the responsibility of the contractor to install the temperature and pressure gauge on the boiler water outlet.

10. Pressure relief valve:
Factory supplied. The pressure relief valve is sized to ASME specifications.

11. Boiler purge valve:
Factory supplied. The boiler purge valve is used to remove entrapped air from the heat exchanger during start-up.

12. System temperature sensor:
Lochinvar supplies a system temperature sensor. The sensor is to be installed in the heating loop downstream from the boiler hot water piping and heating loop junction. Typically the sensor will be located far enough downstream to sense system diluted water temperature.

13. Indirect water heaters:
The Knight Wall Hung Fire Tube boiler may be piped to an indirect water heater to heat domestic hot water with the space heat transfer medium. As depicted on pages 41 through 49 there are two options when utilizing an indirect water heater.

A. The space heating piping will branch off to flow the space heat transfer medium through a single wall heat exchanger coil inside the indirect water heater.

B. The indirect water heater is connected to the system supply piping. A pump controlled by the Knight Fire Tube boiler's control will regulate the flow of water through the indirect water heater. The indirect water heater's temperature will be regulated by the Knight Wall Hung Fire Tube boiler's control.

The Knight Wall Hung Fire Tube boiler is pre-configured to control the operation of the DHW pump with Domestic Hot Water Prioritization programming. The DHW programming is designed to control and balance the space heating demand by switching between DHW and space heating.

Lochinvar offers the Squire which is a series of indirect water heaters. The Squire features a stainless steel vessel with a single wall stainless steel heat exchanger.

CAUTION It is up to the installer to ensure the minimum system flow is not less than the minimum boiler flow at any time.

⚠ WARNING The National Standard Plumbing Code, the National Plumbing Code of Canada and the Uniform Plumbing Code limit the pressure of the heat transfer fluid to less than the minimum working pressure of the potable water system up to 30 psi maximum. Also, the heat transfer fluid must be water or other non-toxic fluid having a toxicity of Class 1, as listed in Clinical Toxicology of Commercial Products, 5th Edition.

14. Water Meter:
Field supplied. A water meter to monitor makeup water is recommended. Makeup water volume should not exceed 5% of total system per year.

15. Y-Strainer:
Field supplied. Install a Y-strainer or equivalent multi-purpose strainer just before the boiler pump at the inlet of the heat exchanger. This item is used to remove system debris from older hydronic systems and to protect newer systems.

Circulator sizing

The Knight Wall Hung Fire Tube boiler heat exchanger does have a pressure drop, which must be considered in your system design. Refer to the graph in FIG. 6-2 for pressure drop through the Knight Wall Hung Fire Tube boiler heat exchanger.

6 Hydronic piping *(continued)*

Figure 6-3 *Pressure Drop vs. Flow*

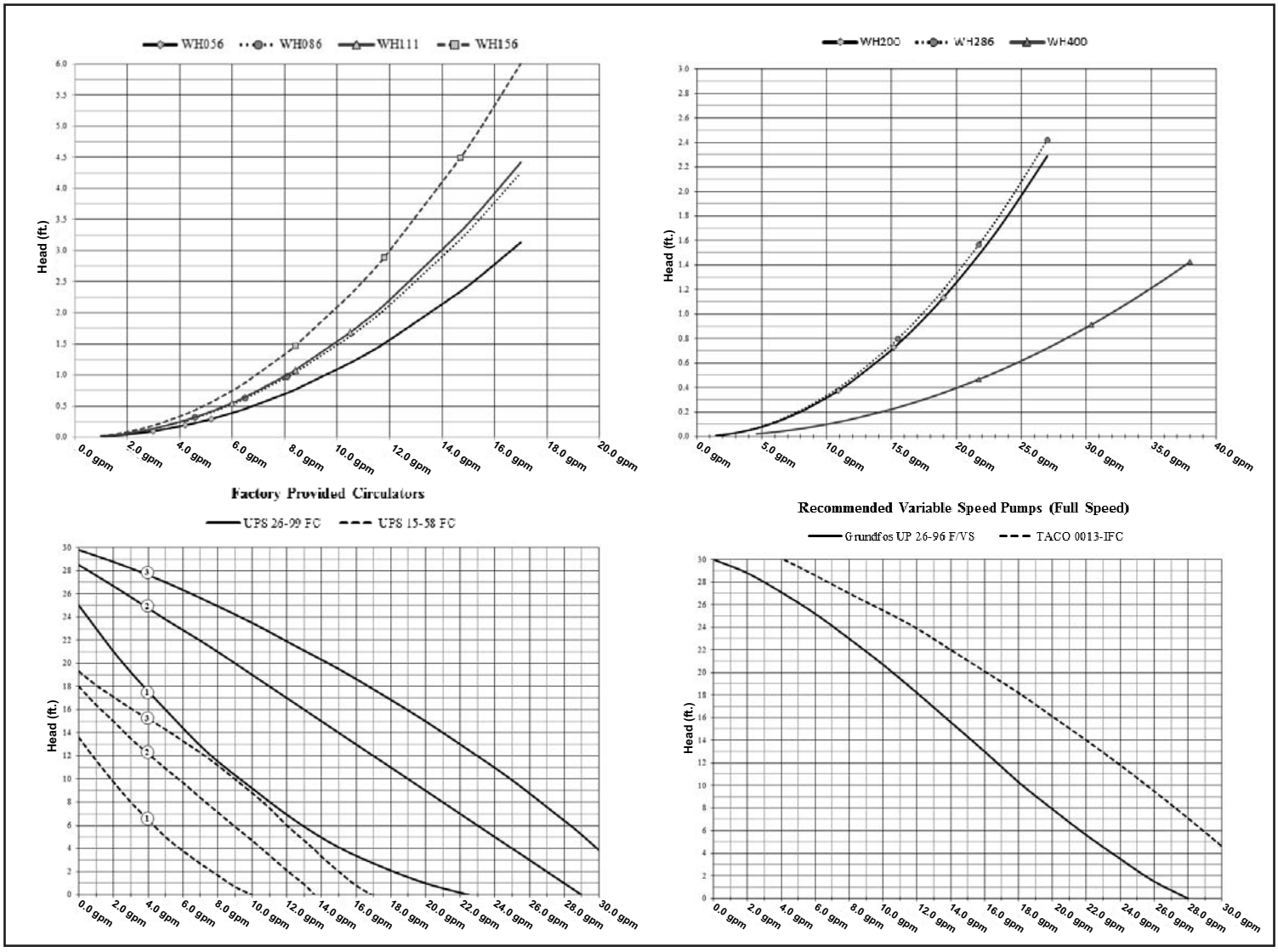


Table 6A - Boiler Flow Requirements												
Temperature Rise and Head Loss Based on Boiler Output in Btu/hr												
Model	Minimum Pipe Ø	Factory Provided Circulator	20°F		25°F		35°F		Maximum Flow		Minimum Flow	
											High Fire	Low Fire
56	1"	UPS 15-58 FC	3.0 gpm	0.1 ft/hd	4.2 gpm	0.2 ft/hd	5.2 gpm	0.3 ft/hd	17.0 gpm	3.1 ft/hd	2.1 gpm	1.0 gpm
86	1"	UPS 15-58 FC	4.6 gpm	0.3 ft/hd	6.5 gpm	0.6 ft/hd	8.1 gpm	1.0 ft/hd	17.0 gpm	4.3 ft/hd	3.2 gpm	1.0 gpm
111	1"	UPS 15-58 FC	6.0 gpm	0.5 ft/hd	8.4 gpm	1.1 ft/hd	10.5 gpm	1.7 ft/hd	17.0 gpm	4.4 ft/hd	4.2 gpm	1.0 gpm
156	1"	UPS 15-58 FC	8.4 gpm	1.5 ft/hd	11.8 gpm	2.9 ft/hd	14.7 gpm	4.5 ft/hd	17.0 gpm	6.0 ft/hd	5.9 gpm	1.0 gpm
200	1-1/4"	UPS 26-99 FC	10.9 gpm	0.4 ft/hd	15.2 gpm	0.7 ft/hd	19.0 gpm	1.1 ft/hd	27.0 gpm	2.3 ft/hd	7.6 gpm	1.5 gpm
286	1-1/4"	UPS 26-99 FC	15.5 gpm	0.8 ft/hd	21.7 gpm	1.6 ft/hd	27.0 gpm	2.4 ft/hd	27.0 gpm	2.4 ft/hd	10.8 gpm	1.5 gpm
400	1-1/2"	UPS 26-99 FC	21.7 gpm	0.5 ft/hd	30.4 gpm	0.9 ft/hd	38.0 gpm	1.4 ft/hd	38.0 gpm	1.4 ft/hd	15.2 gpm	4.5 gpm

NOTICE Pump sizing and flow requirements are based on 20 feet of piping, 4 - 90° elbows, and 2 - fully ported ball valves.

NOTICE Reference Table 6B for pump speed selection.

6 Hydronic piping

***Table 6B** Pump Speed Selection Chart*

Model	Speed	TACO	Bell & Gossett	Armstrong
UPS 15-58 FC	**High**	005F, 007F, 008F, 0010F-1FC,OOR-MSF1-IFC,0015	NRF-22,LR-20WR	Astro 0, Astro 30-(3), Astro 50-3, Astro 230CI, Compass
	Medium	005F-(IFC),007F-(IFC),008F-(IFC),0010F-IFC,00R-IFC,00R-MSF1-IFC	NRF9F/LW,NRF-25-SP-1 & 2	Astro 25, Astro 30-3
	Low	005F-(IFC),006-(IFC),00R-MSF1-IFC	--	Astro 20
UPS 26-99 FC	**High**	0013(B)-IFC	NRF-36 SP-2,NRF-45 SP-2, H-41(B)	E7(B), Astro 50(B)-(3)
	Medium	0011(B)-(IFC),0014(B)-(IFC)	Series 100, PL-30, PR, NRF-36 SP-1, NRF-45 Sp-1	Astro 50(B), H41
	Low	--	LR-15BWR	Astro 30(B)
UPS 26-150 F	**High**	1400-45(B), 1400-50(B),2400-45	PL-55(B)	E15(B)
	Medium	0011(B, SF), 0013(B, SF), 1400-20(B), 1400-30(B), 1400-40(B), 2400-30	PL-36(B)	E8(B), E9(B), E11(B), E13(B)
	Low	2400-20, 2400-40	NRF(NBF)-36 Sp-2 & 3	E7(B), E10(B)

Variable speed pump setup

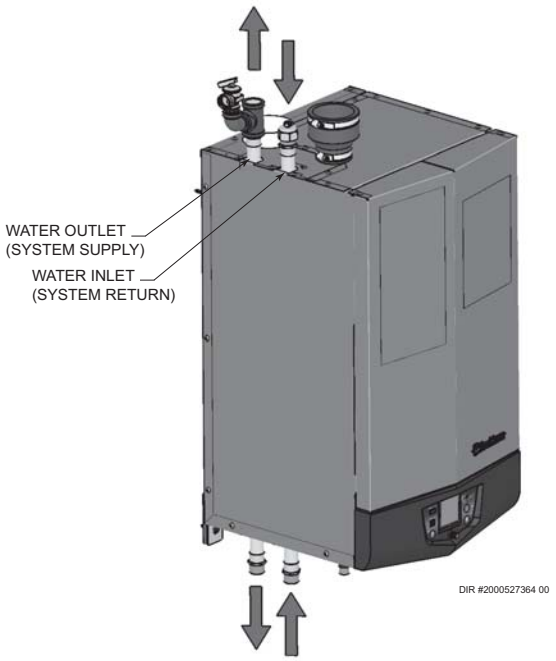
Before operation, ensure the following:

- Pump is set for an input signal of 0 - 10Vdc by the dip switches on the pump control
- Pump is set for external signal control (if applicable)
- Pump is set for linear output (if applicable)
- If pump does not come equipped with a 0 - 10 Vdc input option, an optional module will be required from the vendor

SMART SYSTEM / Multi-temperature loop control option

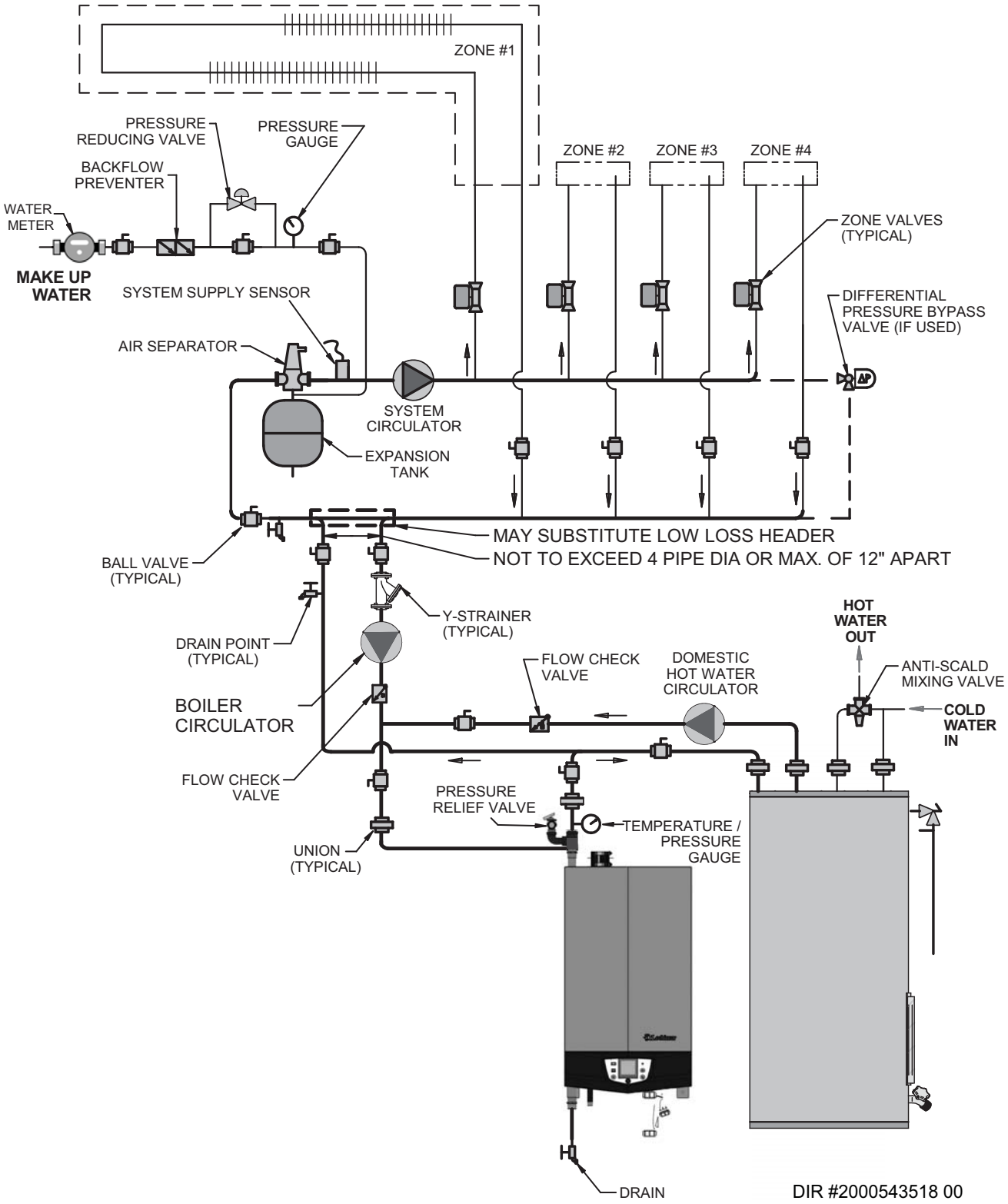
The Knight Wall Hung Fire Tube boiler is capable of producing up to three (3) set point temperatures to meet different space heating demands. When using more than one temperature demand it is necessary to protect the lower temperature loop from overheating. To help aid with this protection, Lochinvar offers the Multi-Temperature Loop Control Board Kit (#100167843).

***Figure 6-4** Supply Return Locations*



6 Hydronic piping *(continued)*

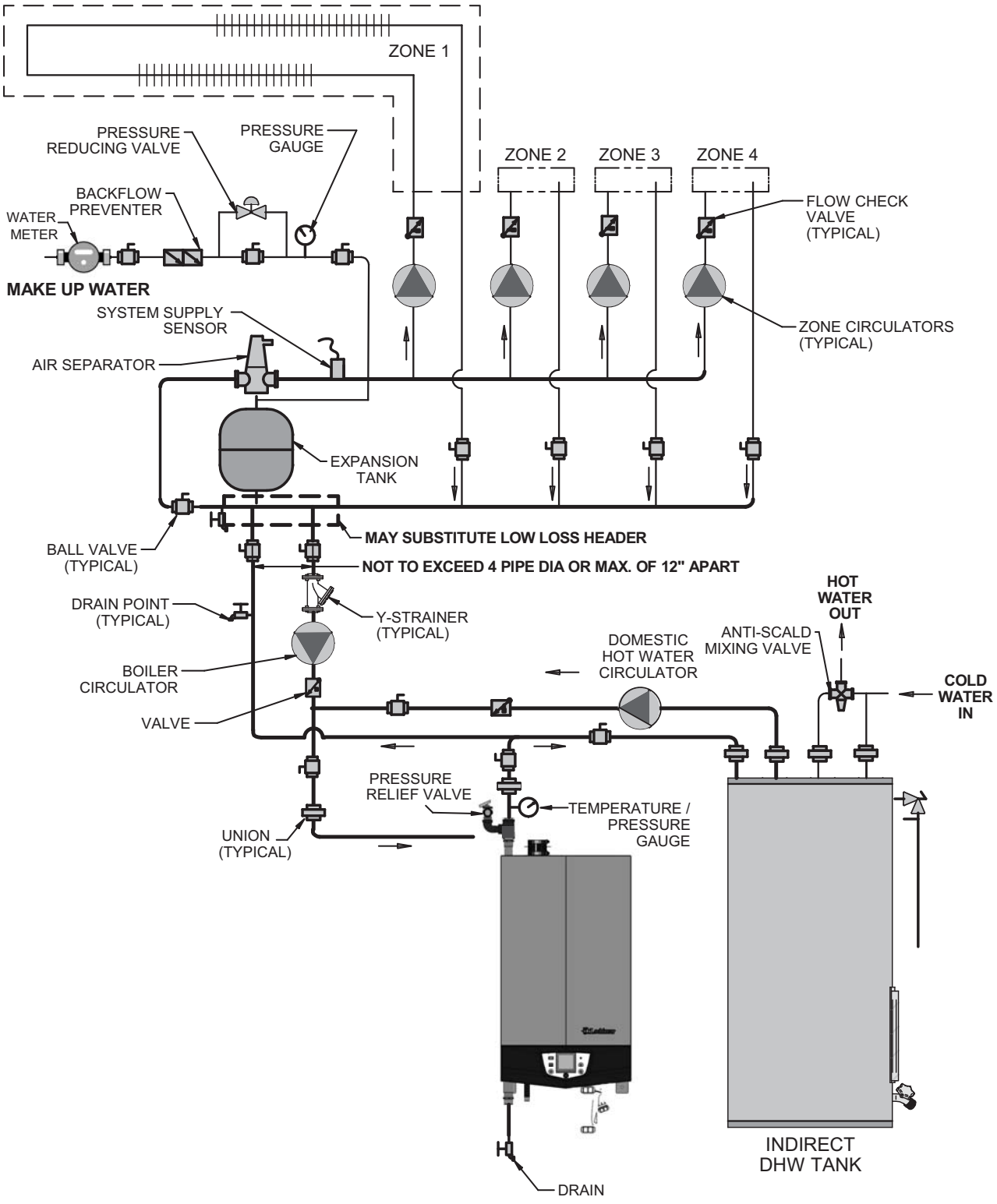
Figure 6-5 *Single Boiler - Single Temperature with Zone Valves - DHW Priority*



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.

6 Hydronic piping

Figure 6-6 *Single Boiler - Single Temperature Zoned with Circulators - DHW Priority*



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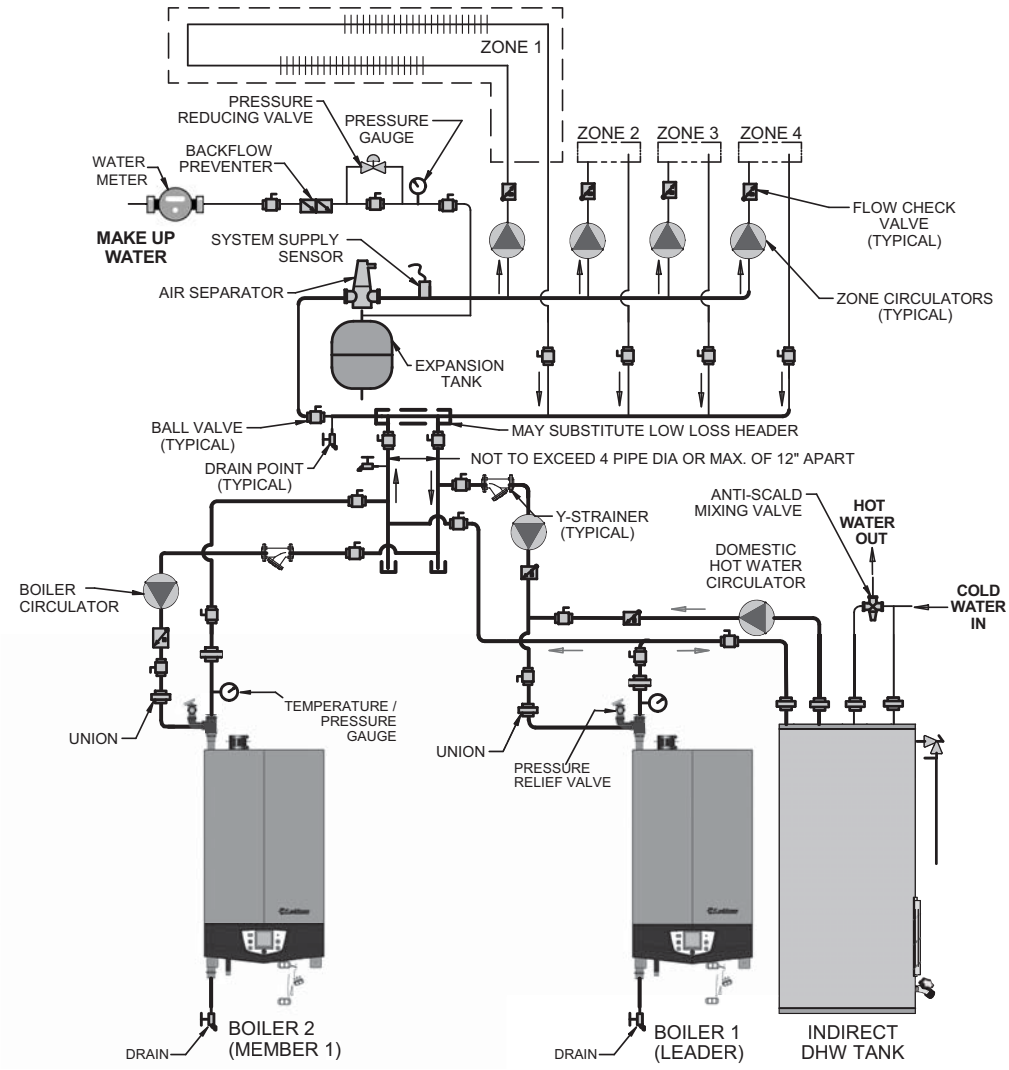
NOTICE Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment and detailing required by local codes.

6 Hydronic piping *(continued)*

Figure 6-7 *Multiple Boilers - Single Temperature Zoned with Circulators - DHW Priority*

Model	Recommended Water Pipe Diameter - Cascade							
	1 Unit	2 Units	3 Units	4 Units	5 Units	6 Units	7 Units	8 Units
56	1"	1 1/4"	1 1/2"	1 1/2"	2"	2"	2 1/2"	2 1/2"
86	1"	1 1/4"	1 1/2"	1 1/2"	2"	2"	2 1/2"	2 1/2"
111	1"	1 1/4"	1 1/2"	1 1/2"	2"	2"	2 1/2"	2 1/2"
156	1"	1 1/4"	1 1/2"	1 1/2"	2"	2"	2 1/2"	2 1/2"
200	1 1/4"	1 1/2"	2"	2 1/2"	2 1/2"	3"	3"	3 1/2"
286	1 1/4"	1 1/2"	2"	2 1/2"	2 1/2"	3"	3"	3 1/2"
400	1 1/2"	2"	2 1/2"	3"	3"	3 1/2"	4"	4"



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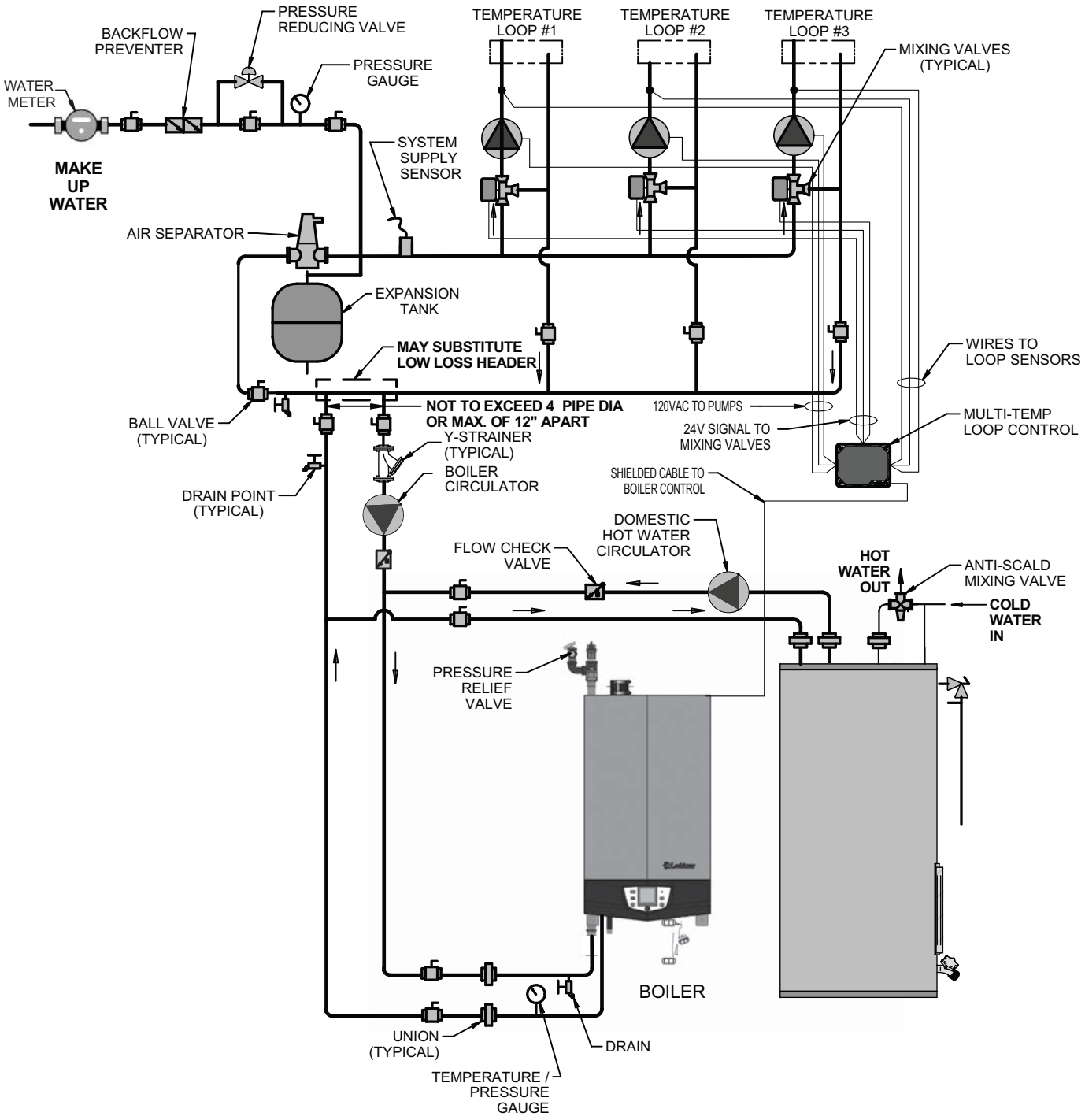
NOTICE Required pipe diameter is based on maximum flow (17 gpm for Models 56 - 156, 27 gpm for Models 200 - 286 and 38 gpm for Model 400) through all units in Cascade. It is the responsibility of the installer to maintain flow rates based on system piping requirements.

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.

6 Hydronic piping

Figure 6-8 *Single Boiler - Multiple Temperatures - DHW Priority*



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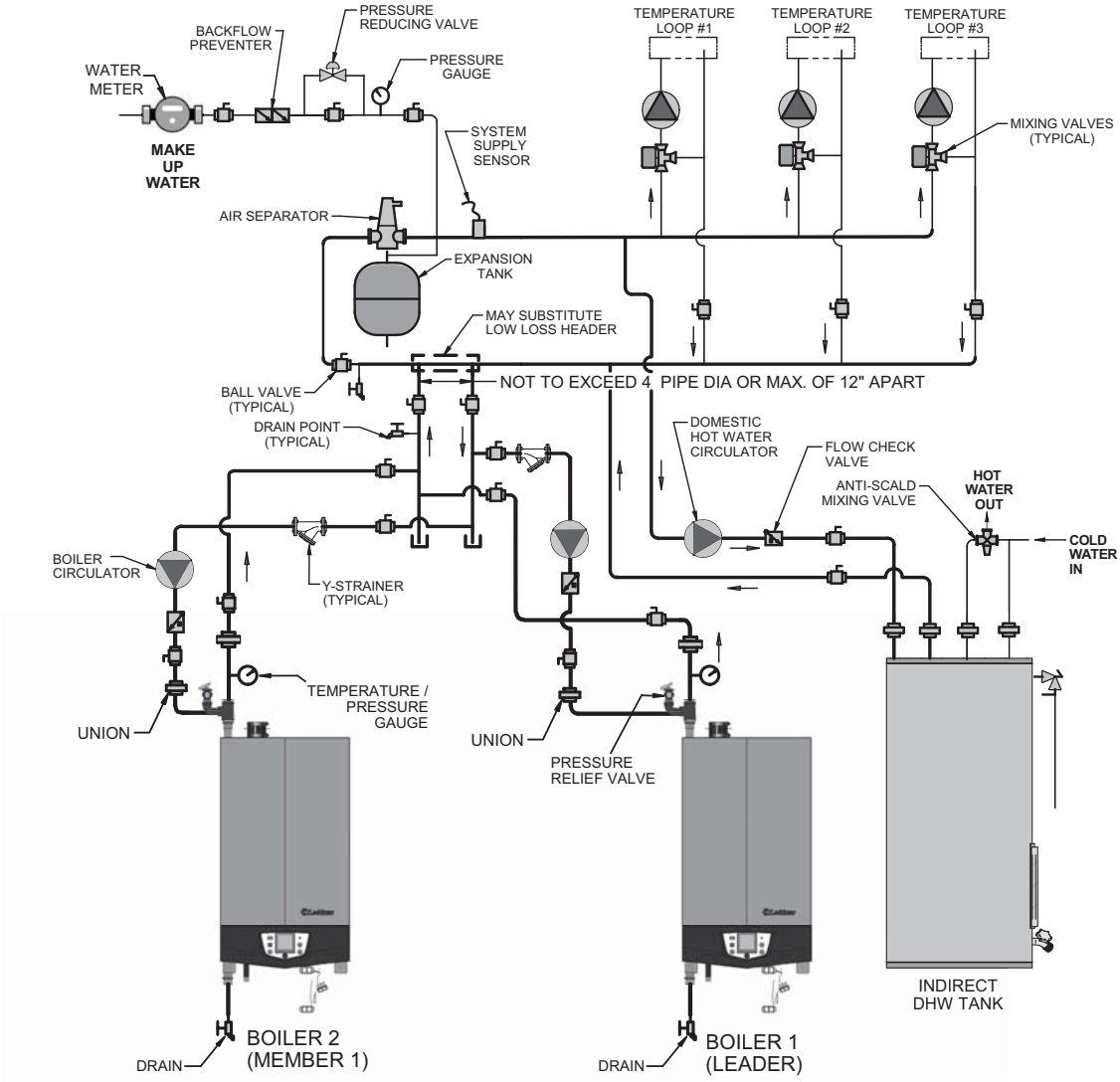
CAUTION Mixing valves are required for the protection of low temperature loops.

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.

6 Hydronic piping *(continued)*

Figure 6-9 *Multiple Boilers - Multiple Temperatures - DHW Piped as a Zone*

Model	Recommended Water Pipe Diameter - Cascade							
	1 Unit	2 Units	3 Units	4 Units	5 Units	6 Units	7 Units	8 Units
56	1"	1 1/4"	1 1/2"	1 1/2"	2"	2"	2 1/2"	2 1/2"
86	1"	1 1/4"	1 1/2"	1 1/2"	2"	2"	2 1/2"	2 1/2"
111	1"	1 1/4"	1 1/2"	1 1/2"	2"	2"	2 1/2"	2 1/2"
156	1"	1 1/4"	1 1/2"	1 1/2"	2"	2"	2 1/2"	2 1/2"
200	1 1/4"	1 1/2"	2"	2 1/2"	2 1/2"	3"	3"	3 1/2"
286	1 1/4"	1 1/2"	2"	2 1/2"	2 1/2"	3"	3"	3 1/2"
400	1 1/2"	2"	2 1/2"	3"	3"	3 1/2"	4"	4"



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NOTICE Please note that the installer is responsible for ensuring DHW prioritization when piped as a zone.

CAUTION Mixing valves are required for the protection of low temperature loops.

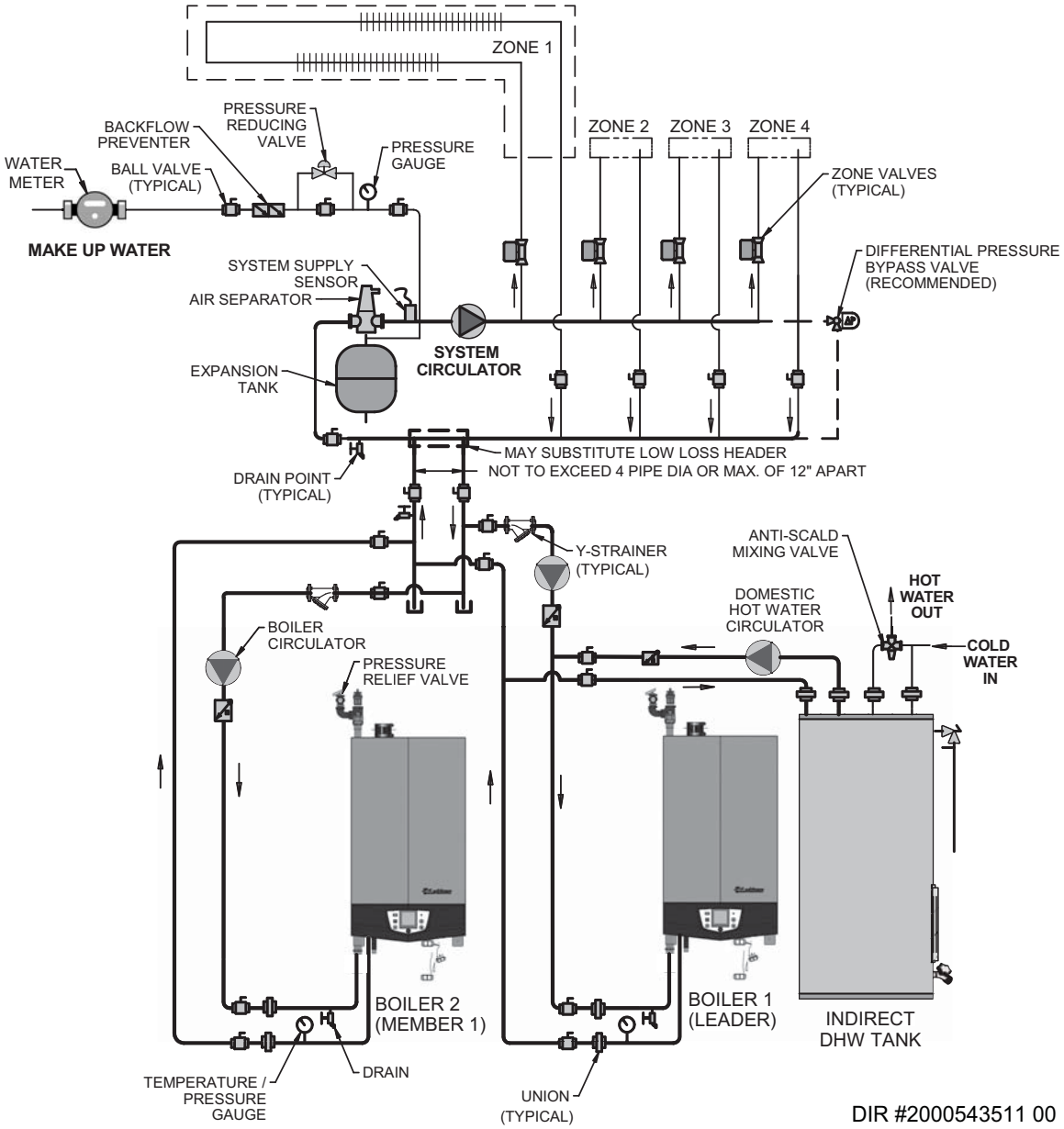
NOTICE Required pipe diameter is based on maximum flow (17 gpm for Models 56 - 156, 27 gpm for Models 200 - 286 and 38 gpm for Model 400) through all units in Cascade. It is the responsibility of the installer to maintain flow rates based on system piping requirements.

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.

6 Hydronic piping *(continued)*

Figure 6-11 *Multiple Boilers - Single Temperature Zoned with Valves*

Model	Recommended Water Pipe Diameter - Cascade							
	1 Unit	2 Units	3 Units	4 Units	5 Units	6 Units	7 Units	8 Units
56	1"	1 1/4"	1 1/2"	1 1/2"	2"	2"	2 1/2"	2 1/2"
86	1"	1 1/4"	1 1/2"	1 1/2"	2"	2"	2 1/2"	2 1/2"
111	1"	1 1/4"	1 1/2"	1 1/2"	2"	2"	2 1/2"	2 1/2"
156	1"	1 1/4"	1 1/2"	1 1/2"	2"	2"	2 1/2"	2 1/2"
200	1 1/4"	1 1/2"	2"	2 1/2"	2 1/2"	3"	3"	3 1/2"
286	1 1/4"	1 1/2"	2"	2 1/2"	2 1/2"	3"	3"	3 1/2"
400	1 1/2"	2"	2 1/2"	3"	3"	3 1/2"	4"	4"



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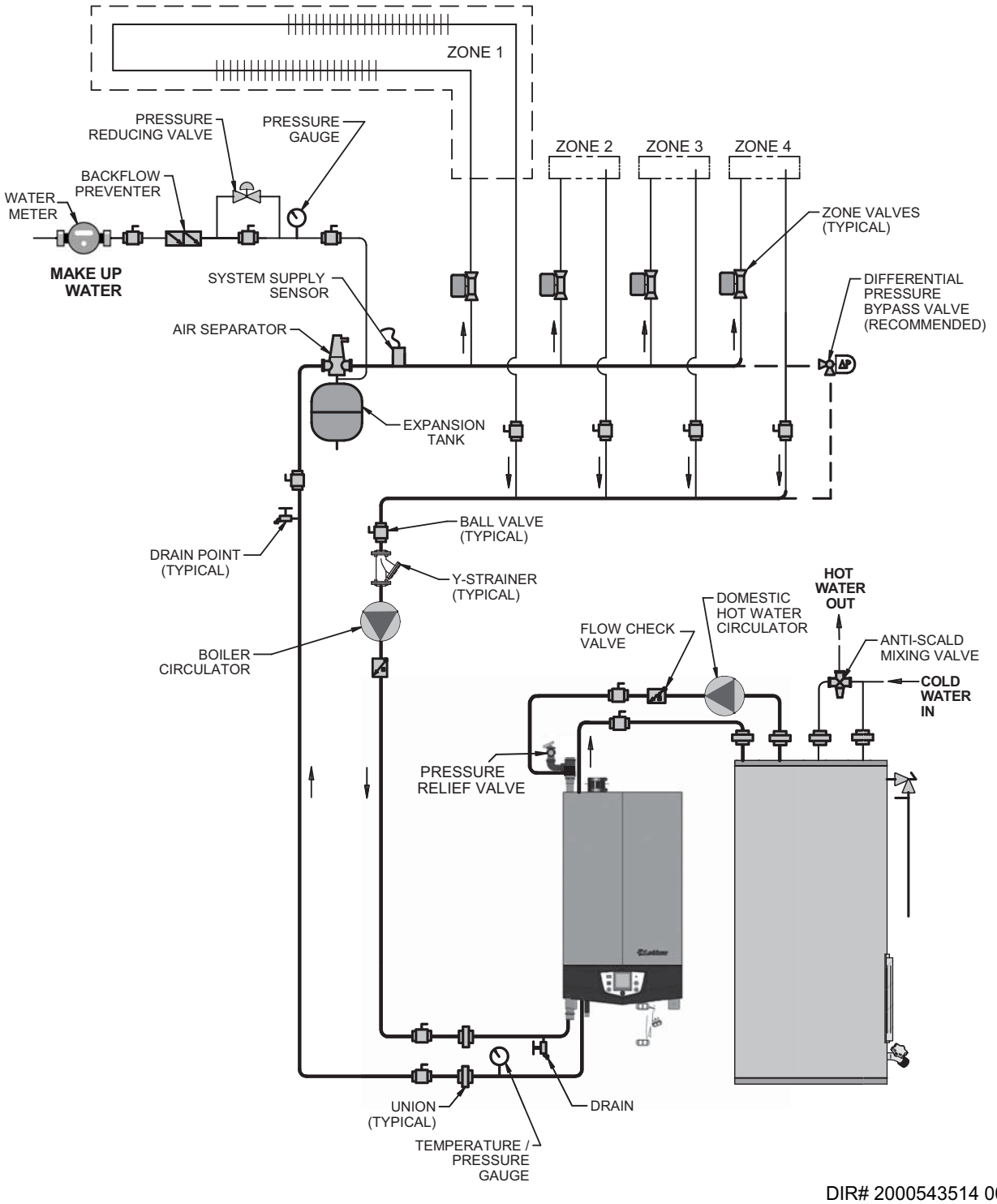
NOTICE Required pipe diameter is based on maximum flow (17 gpm for Models 56 - 156, 27 gpm for Models 200 - 286 and 38 gpm on Model 400) through all units in Cascade. It is the responsibility of the installer to maintain flow rates based on system piping requirements.

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.

6 Hydronic piping *(continued)*

Figure 6-13 *Single Boiler - Full Flow - Single Temperature - Zoned with Zone Valves - DHW Priority*



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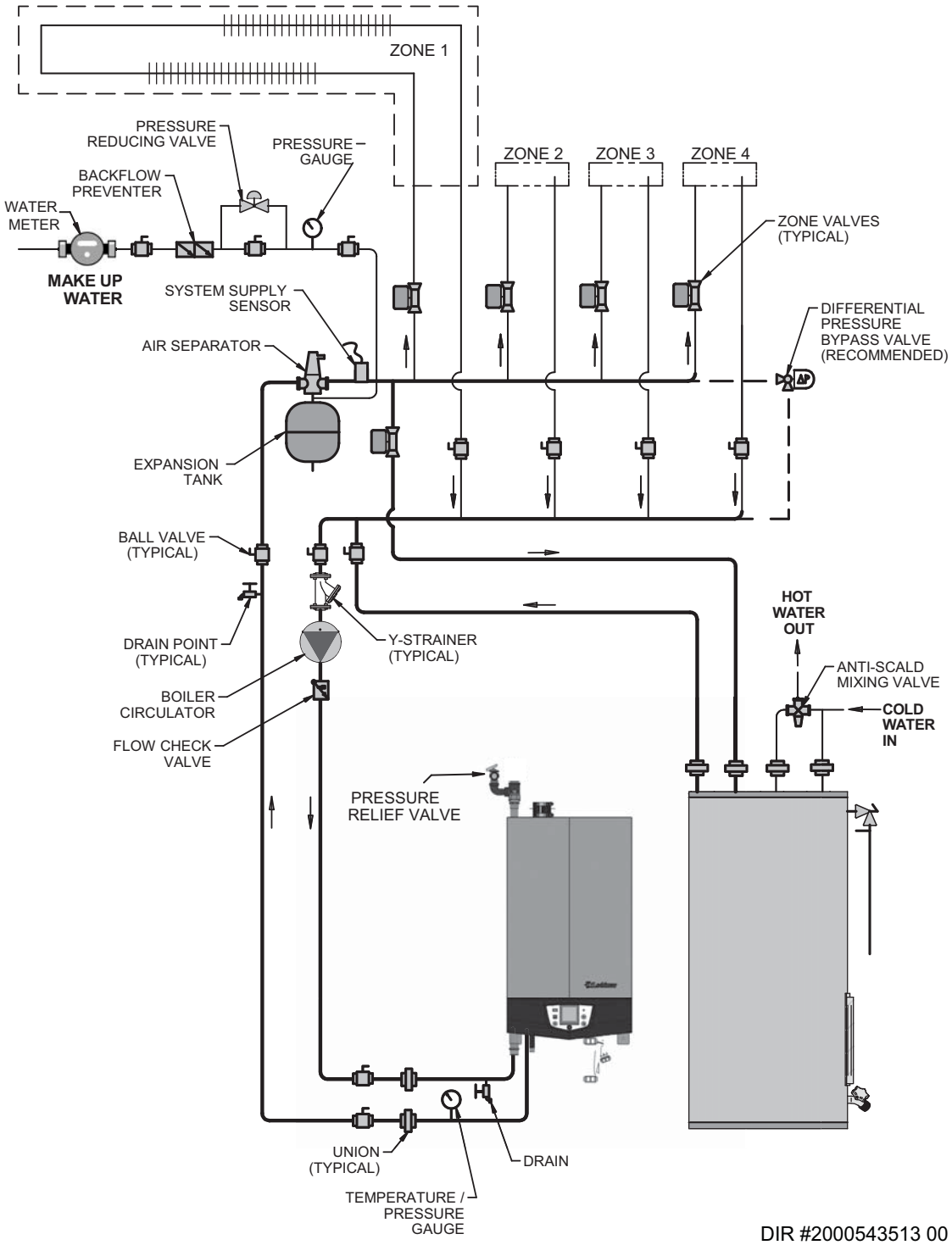
NOTICE Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment and detailing required by local codes.

NOTICE It is the responsibility of the installer to ensure that the minimum flow requirements of the boiler are met at all times during boiler operation. If the minimum flow requirements cannot be met at any time the boil must be hydraulically separated from the system.

6 Hydronic piping

Figure 6-14 *Single Boiler - Full Flow - Single Temperature Zoned with Valves - DHW Piped as a Zone*



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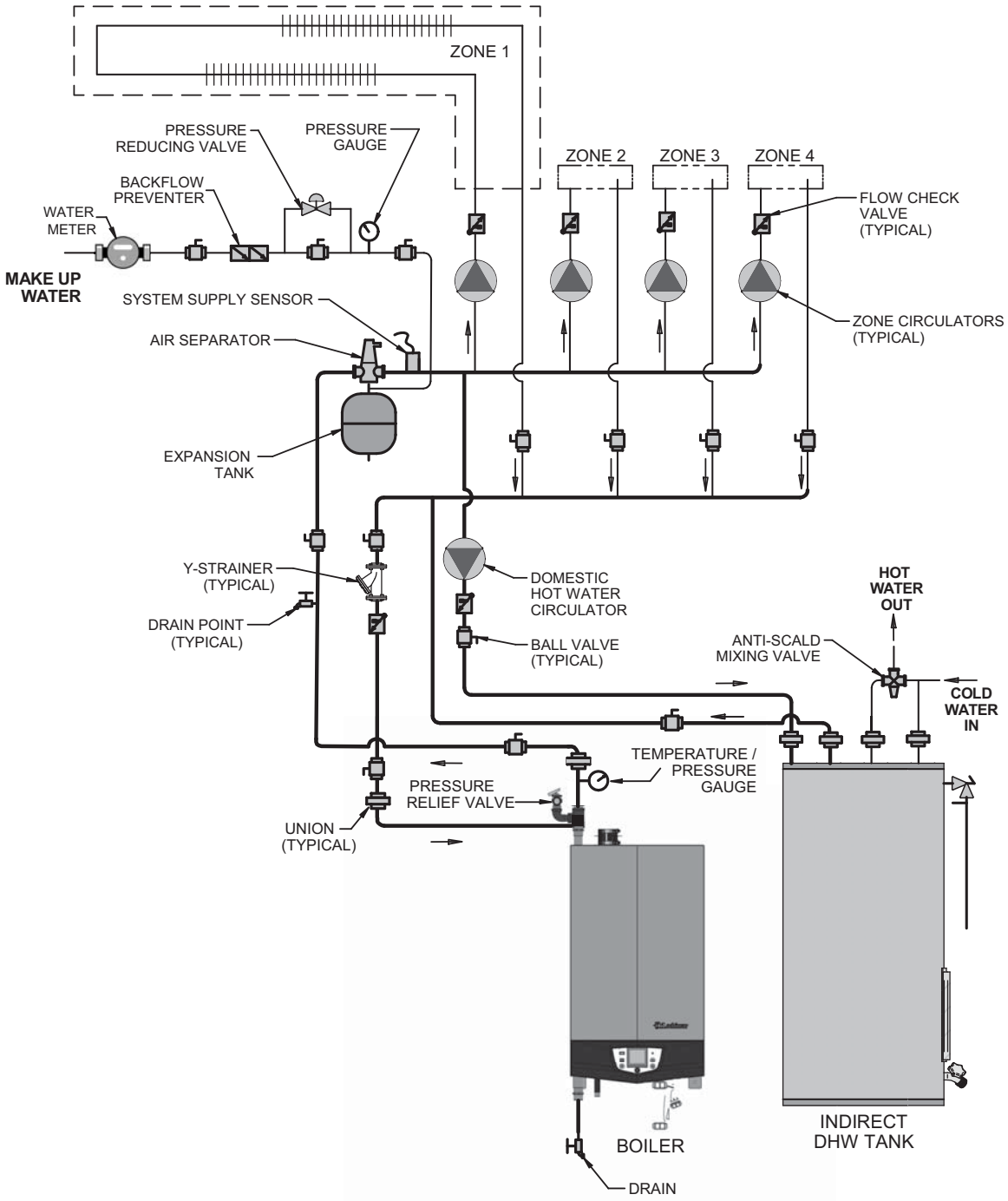
NOTICE Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment and detailing required by local codes.

NOTICE It is the responsibility of the installer to ensure that the minimum flow requirements of the boiler are met at all times during boiler operation. If the minimum flow requirements cannot be met at any time the boiler must be hydraulically separated from the system.

NOTICE Please note that the installer is responsible for ensuring DHW prioritization when piped as a zone.

6 Hydronic piping *(continued)*

Figure 6-15 *Single Boiler - Full Flow - Single Temperature Zoned with Circulators - DHW Piped as a Zone*



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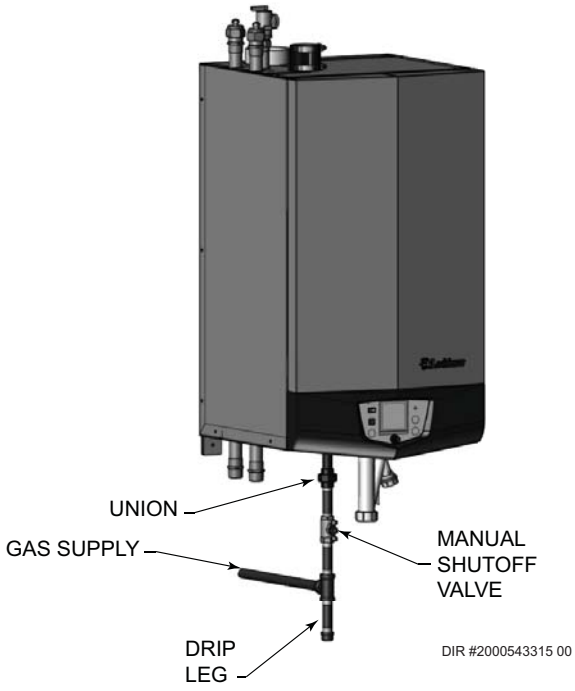
7 Gas connections

Connecting gas supply piping

1. Reference FIG.'s 7-1 and 7-2 to pipe gas to the boiler.
   a. Install a field supplied sediment trap / drip leg upstream of the boiler gas controls.
   b. Install a ground joint union for servicing, when required.
   c. Install a manual shutoff valve in the gas supply piping outside the boiler jacket when required by local codes or utility requirements.
   d. In Canada – When using manual main shutoff valves, it must be identified by the installer.

Figure 7-1 *Union Connection and Gas Supply Piping*



2. Support piping with hangers, not by the boiler 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 boiler or its accessories. Failure to comply could result in severe personal injury, death, or substantial property damage.

3. Purge all air from the gas supply piping.

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

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

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

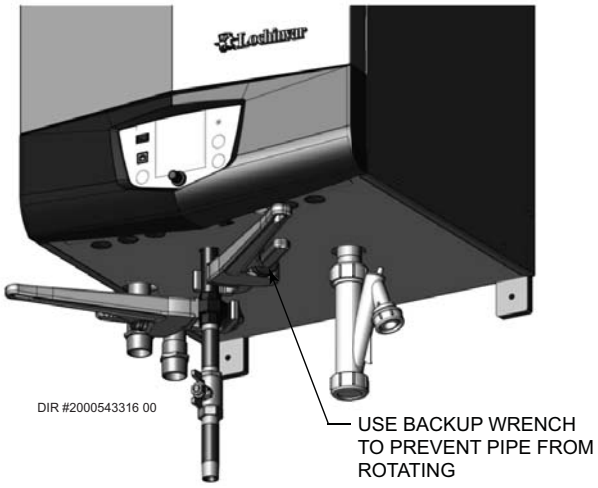
⚠ WARNING Failure to apply pipe sealing compound as detailed in this manual can result in severe personal injury, death, or substantial property damage.

⚠ WARNING Knight Wall Hung Fire Tube boilers are typically shipped ready to fire on natural gas. Check boiler rating plate to determine which fuel the boiler is set for. If set to natural gas, it may be converted to LP by installing an LP venturi and any additional components provided in the LP conversion kit (Models WH56 - WH286 only) or by installing a propane orifice (Model WH400 only) (see pages 12 and 13). In order to operate on LP gas, these components MUST BE installed. Failure to comply could result in severe personal injury, death, or substantial property damage.

7 Gas connections *(continued)*

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

Figure 7-2 *Inlet Pipe with Backup Wrench*



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

Natural gas:

Pipe sizing for natural gas

1. Refer to Table 7A for pipe length and diameter. Based on rated boiler input (divide by 1,000 to obtain cubic feet per hour).
   a. Table 7A is only for natural gas with specific gravity 0.60 inches, with a pressure drop through the gas piping of 0.3 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 boiler on.
   - Minimum 4 inches w.c. with gas flowing (verify during boiler 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 Knight Wall Hung Fire Tube boilers are typically shipped ready to fire on natural gas. Check boiler rating plate to determine which fuel the boiler is set for. If set to natural gas, it may be converted to LP by installing an LP venturi and any additional components provided in the LP conversion kit (Models WH56 - WH286 only) or by installing a propane orifice (Model WH400 only) (see pages 12 and 13). In order to operate on LP gas, these components MUST BE installed. 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 boiler on.
   - Minimum 8 inches w.c. with gas flowing (verify during boiler startup).

⚠ WARNING Ensure that the high gas pressure regulator is at least 6 - 10 feet upstream of the appliance.

7 Gas connections

Table 7A *Natural Gas Pipe Size Chart*

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

⚠ WARNING Knight Wall Hung Fire Tube boilers are typically shipped ready to fire on natural gas. Check boiler rating plate to determine which fuel the boiler is set for. If set to natural gas, it may be converted to LP by installing an LP venturi and any additional components provided in the LP conversion kit (Models WH56 - WH286 only) or by installing a propane orifice (Model WH400 only) (see pages 12 and 13). In order to operate on LP gas, these components MUST BE installed. Failure to comply could result in severe personal injury, death, or substantial property damage.

Check inlet gas supply

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

⚠ 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.

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. Loosen the set screw one (1) full turn from inside the pressure tap on top of the gas valve. Place the tubing of the manometer over the tap once the set screw is loosened as shown in FIG. 7-3.
4. Slowly turn on the gas supply at the field installed manual gas valve.
5. Turn the power switch to the “ON” position.
6. Locate the pinhole button above the RESET button on the display board (FIG. 11-1 on page 75). Insert a thin wire (such as a paper clip) into the hole and press the button once and hold for 5 seconds to place the boiler into Service Mode. In Service Mode the boiler will fire at ignition speed and will then modulate up to full fire.
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. Place the boiler back into normal operation by pressing STOP.

7 Gas connections *(continued)*

⚠ 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.

12. Turn the power switch to the "OFF" position.
13. Shut off the gas supply at the manual gas valve in the gas piping to the appliance.
14. Remove the manometer from the pressure tap on top of the gas valve. Re-tighten the set screw inside the pressure tap.
15. Turn on the gas supply at the manual gas valve.
16. Turn the power switch to the "ON" position.
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.

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 Knight Wall Hung Fire Tube boiler. 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.

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

Figure 7-3 *Inlet Gas Supply Check - Models WH56 - 286*

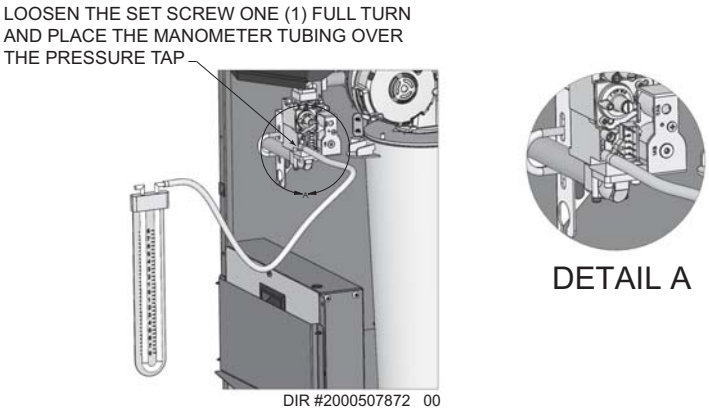
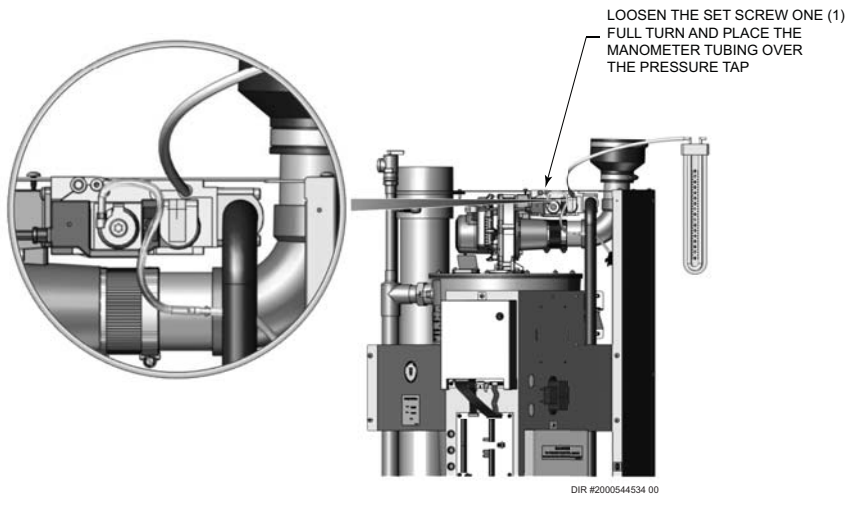


Figure 7-4 *Inlet Gas Supply Check - Model WH400*



8 Field wiring

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

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

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

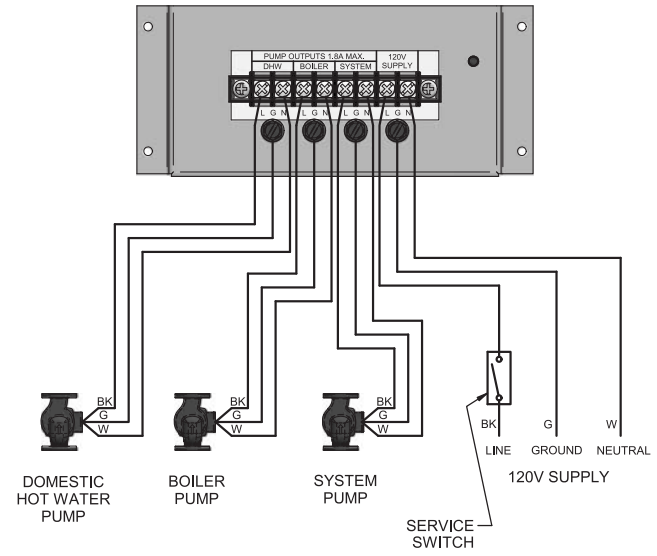
Boiler must be electrically grounded as required by National Electrical Code ANSI/NFPA 70 – latest edition.

NOTICE This boiler is equipped with a feature that saves energy by reducing the boiler water temperature as the heating load decreases. This feature is equipped with an override, which is provided primarily to permit the use of an external energy management system that serves the same function. This override MUST NOT be used unless at least one of the following conditions is true:

1. An external energy management system is installed that reduces the boiler water temperature as the heating load decreases.
2. This boiler is not used for any space heating.
3. This boiler's input is 300,000 Btu/hr or greater or is part of a modular or multiple boiler system having a total input of 300,000 Btuh/hr or greater.
4. This boiler is equipped with a tankless coil.

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

Figure 8-1 *Line Voltage Field Wiring Connections*



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.

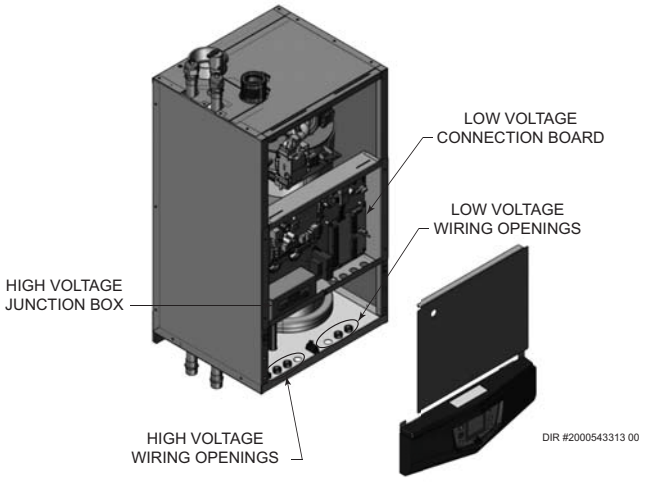
Line voltage connections

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. 8-1).
3. The boiler pump is shipped loose. Wire the boiler pump as shown in FIG. 8-1.
4. When connecting a domestic hot water (DHW) pump, connect the wiring to the line voltage terminal strip as shown in FIG. 8-1.
5. To activate a system pump, wire as shown in FIG. 8-1. If the motor is larger than 1/8 hp or 1.8 amps, you must isolate with a relay.

Low voltage connections

1. Route all low voltage wires through the openings on the bottom, as shown in FIG. 8-2.
2. Connect low voltage wiring to low voltage connection board as shown in FIG. 8-3 on page 58 of this manual and the boiler wiring diagram.

Figure 8-2 *Routing Field Wiring*



8 Field wiring *(continued)*

Thermostat

1. Connect the room thermostats or end switches (isolated contact only) to Heat/Loop Demand 1, 2, or 3, as shown in FIG. 8-3.
2. Install the thermostat on the inside wall away from influences of drafts, hot or cold water pipes, lighting fixtures, television, sunlight, or fireplaces.
3. Thermostat anticipator (if applicable):
   a. If connected directly to boiler, set for 0.1 amps.
   b. If connected to relays or other devices, set to match total electrical power requirements of connected devices. See device manufacturers' specifications and thermostat instructions for details.

Outdoor temperature sensor

In the absence of an external energy management system, an outdoor temperature sensor must be used for all models with inputs less than 300,000 Btu/hr.

1. Mount the sensor on an exterior wall, shielded from direct sunlight or flow of heat or cooling from other sources.
2. Route sensor wires through a knockout at the rear of the boiler (see FIG. 8-2).
3. Connect outdoor temperature sensor (FIG. 8-3) to the outdoor sensor terminals on the connection board to enable outdoor reset operation of the Knight Wall Hung Fire Tube boiler.

DHW thermostat

Connect storage indirect water heater (DHW) thermostat (FIG. 8-3) to the DHW thermostat terminals on the connection board. If a tank sensor is connected (see DHW Tank Sensor below) the tank thermostat is ignored.

DHW tank sensor

1. By installing a tank sensor, the SMART SYSTEM control can perform the tank thermostat function. The SMART SYSTEM control automatically detects the presence of this sensor and generates a DHW call for heat when the tank temperature drops 6°F (3°C) below the tank set point and finishes the call for heat when the tank temperature reaches the tank set point.
2. The tank sensor included with the Lochinvar Squire Indirect DHW tank (#100170544) is the only sensor suitable for use with the SMART SYSTEM control. Connect the sensor leads to the Tank Sensor terminals on the Low Voltage Connection Board (FIG. 8-3).

⚠ WARNING Failure to use the correct sensor may result in the tank temperature being either above or below the set point.

3. If the #100170544 is not compatible with the indirect tank, a tank thermostat can be used to control the boiler. The tank thermostat should be installed per the manufacturers instructions and wired to the DHW Thermostat terminals on the Low Voltage Connection Board.

Louver relay

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

Louver proving switch

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

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. 8-3).

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. 8-3).
2. If both a high and low gas pressure switch is used, connect their respective contacts in series, and connect them to the terminals on the connection board (FIG. 8-3).

Variable speed system pump

If a variable speed pump is used in the primary loop, and a 0-10V signal is available from the pump speed control, this signal can be used by the SMART SYSTEM control to anticipate changes in the building heat load. By connecting this 0 - 10V signal to the 0 - 10V SYS PUMP IN terminals, the boiler (or cascade) can modulate up and down as the primary flow increases and decreases.

Boiler pump speed output

This 0 - 10V output is available to control the speed of a variable speed boiler pump. The SMART SYSTEM control will vary the speed of this pump in order to maintain a minimum ΔT across the heat exchanger, as well as prevent high limit lockouts when the flow in the primary loop is extremely low. Note: This feature is to be used with Primary Secondary Piping systems only. A system supply sensor must be installed. Connect this output to the 0 - 10V input on the boiler pump speed control.

Rate output

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

ModBus/BACnet

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

8 Field wiring

Flow switch

1. A flow switch is used to guarantee flow through the boiler before allowing it to fire. The flow switch must be installed at the boiler outlet.
2. Remove the jumper wire from these terminals, and connect these terminals to the normally open contacts on the flow switch (FIG. 8-3).

System supply sensor

1. By installing the system supply sensor into the supply of the primary loop, the temperature of the primary supply can be controlled. The SMART SYSTEM control automatically detects the presence of this sensor, and controls the boiler firing rate to maintain the system supply temperature to the set point (if the outlet sensor control is currently selected). If it is desired to control the system return temperature, then program the SMART SYSTEM control to use the inlet sensor as the controlling sensor. See the Knight Wall Hung Fire Tube Boiler Service Manual for instructions on how to use the inlet sensor as the controlling sensor. When the inlet sensor is programmed as the controlling sensor, it is vital that the SYSTEM SUPPLY sensor be installed. DO NOT INSTALL THE SYSTEM SUPPLY SENSOR INTO THE SYSTEM RETURN.
2. The #100170581 sensor provided with the boiler must be used for the system sensor.
3. Connect these terminals to the system supply sensor (FIG. 8-3).

Boiler management system

The United States Energy Policy and Conservation Act requires residential heating boilers with inputs less than 300,000 Btu/hr be equipped with a control that automatically adjusts boiler water temperature in relation to heat demand. An external control may be connected to control the firing rate or the set point of the boiler provided that either an external energy management system is installed that reduces the boiler water temperature as the heating load decreases, the boiler is not used for any space heating, or the boiler is part of a modular or multiple boiler system having a total input of 300,000 Btu/hr or greater.

1. An external control may be connected to control either the firing rate or the set point of the boiler. If the external control uses a set of contacts to enable the boiler, connect the contacts to the Heat/Loop Demand 1 terminals. Otherwise, the SMART SYSTEM 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 0 - 10 Vdc terminal is connected to the 0 - 10 Vdc terminal of the external control. Make sure the (-) voltage is not below ground.

Runtime contacts

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

Alarm contacts

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

DHW recirculation sensor

The Knight Wall Hung Fire Tube boiler is able to control a DHW recirculation pump. To operate this feature, a #100170581 temperature sensor must be installed in the circulation loop return. Connect this sensor to the DHW recirculation sensor terminals on the Low Voltage Connection Board.

DHW recirculation pump

When the DHW recirculation sensor (as described above) is connected, the Knight Wall Hung Fire Tube SMART SYSTEM control will output 24 VAC to control a DHW recirculation pump relay (field supplied). Connect the coil of the DHW recirculation pump relay to the 24 VAC recirculation pump relay coil terminals on the Low Voltage Connection Board.

Wiring of the cascade

When wiring the boilers for Cascade operation, select one boiler as the Leader boiler. The remaining boilers will be designated as Members. See page 65 “Configuration of the Cascade” for a detailed explanation of this procedure.

Connect the system supply sensor and outdoor air sensor (if used) to the Leader boiler. For the Cascade system to work properly the system supply sensor must be installed. The location of the system supply sensor should be downstream of the boiler connections in the main system loop (FIG.’s 6-7, 6-8, and 6-9). The system supply sensor should be wired to the Low Voltage Connection Board at the terminals marked for the system sensor (see FIG. 8-3). The Leader control will use the water temperature at the system supply sensor to control the operation of the Cascade.

8 Field wiring *(continued)*

If outdoor air reset is desired, the outdoor air sensor should be wired to the Low Voltage Connection Board at the terminals marked for the outdoor air sensor (FIG. 8-3). If the outdoor air sensor is connected, the Leader control will calculate the water temperature set point based on the programmed reset curve parameters. If the outdoor air sensor is not connected, the Leader control will maintain the fixed water temperature set point that is programmed into the control.

If a Thermostat, Zone Control enable output, or Building Management System enable output is available, it should be wired to the Low Voltage Connection Board on the Leader boiler at the terminals marked for one of the heat/loop demands 1-3 (FIG. 8-3). If the boilers are to run continuously, connect a jumper wire between the R and W terminals for the heat/loop demand input. This will initiate a call for heat on the Cascade.

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

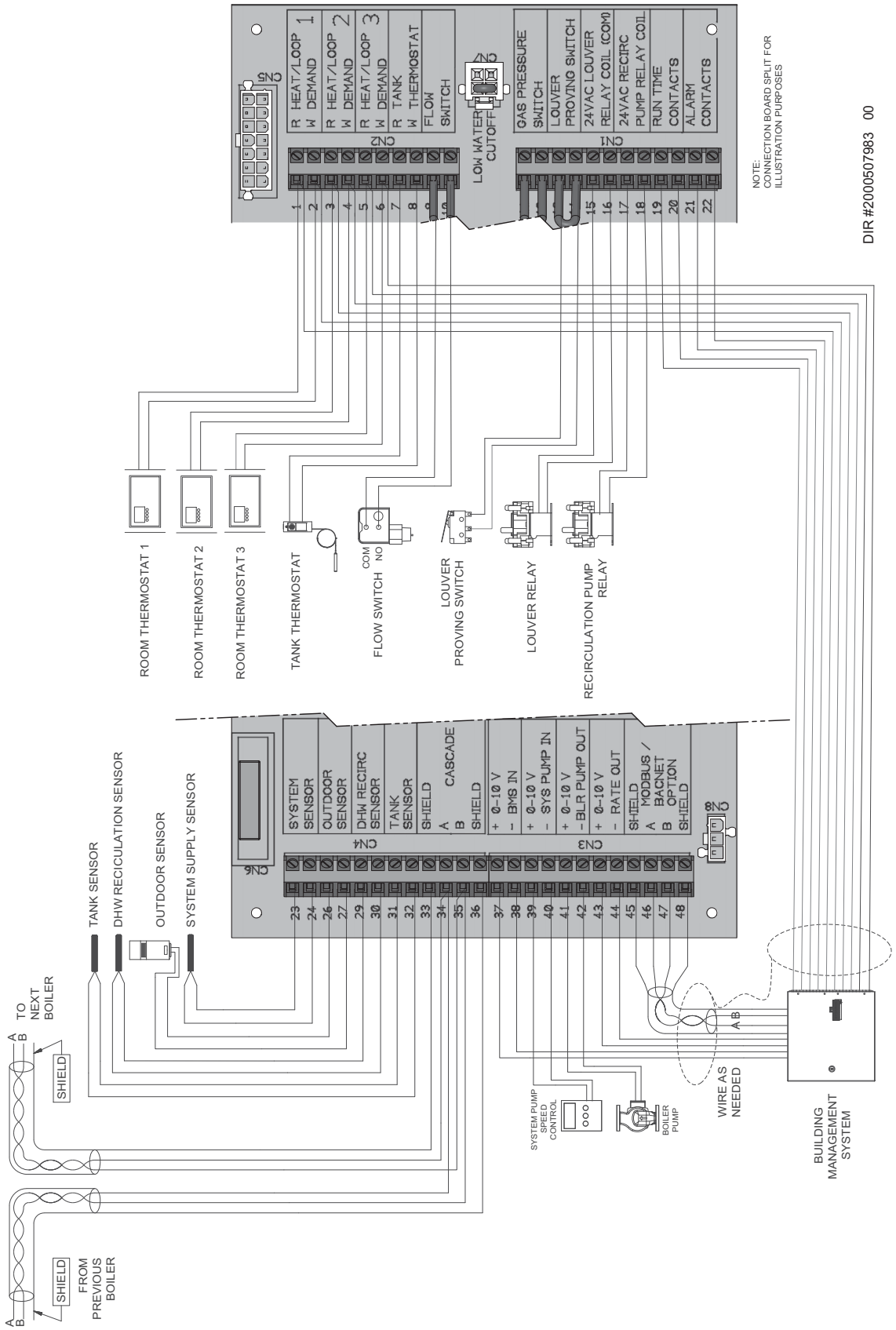
When the Member 1 boiler is programmed as an alternate leader this allows the Member 1 boiler to automatically assume control of the Cascade should it lose communications with the Leader boiler. When programmed to YES, it is recommended that the Member 1 boiler have its own set of external sensors installed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

⚠ WARNING DO NOT connect the sensors connected to the Leader boiler to the Member 1 boiler. 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 boiler, Member 1 will automatically relinquish control of the Cascade to the Leader boiler.

8 Field wiring

Figure 8-3 *Low Voltage Field Wiring Connections*



9 Condensate disposal

Condensate drain

1. This boiler is a high efficiency appliance that produces condensate.
2. The bottom of the boiler has a 1 1/4 inch pipe for connection of the condensate trap (FIG. 9-1).
3. 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.
4. Fill condensate trap with enough water to make the ball float (FIG. 9-1).
5. Loosen compression fitting (FIG. 9-1).
6. Slide the condensate trap onto the condensate drain at the bottom of the unit. As the trap is pressed on, a stainless steel retaining ring will engage the drain pipe allowing the trap to be pushed on, but not pulled off.
7. Tighten compression fitting.
8. Slope condensate tubing down and away from the boiler into a drain or condensate neutralizing filter. Condensate from the Knight Wall Hung Fire Tube boiler 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 (100157721).
9. Do not expose condensate line to freezing temperatures.
10. Use only plastic tubing or piping as a condensate drain line (FIG. 9-1).
11. A condensate removal pump is required if the boiler is below the drain. When installing a condensate pump, select one approved for use with condensing boilers 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 air pressure switch inside the boiler.

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.

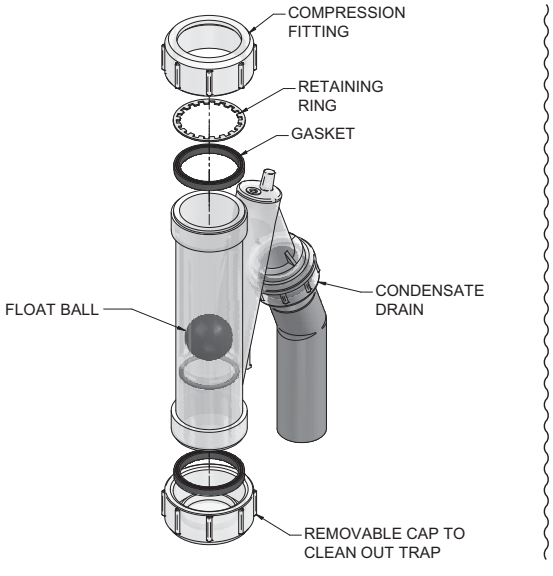
NOTICE To allow for proper drainage on large horizontal runs, a second line vent may be required and tubing size may need to increase to 1 inch.

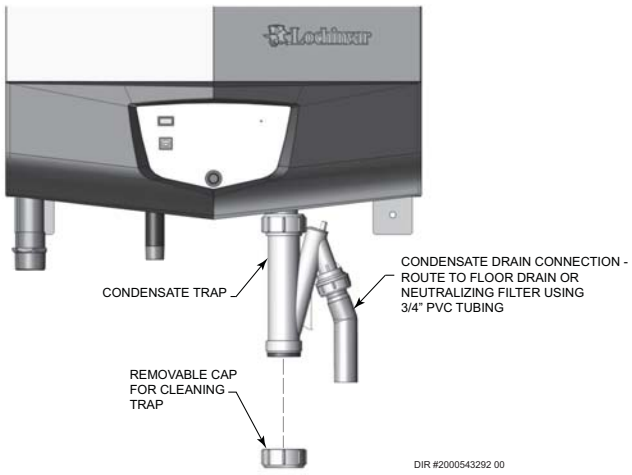
The condensate line must remain unobstructed, allowing free flow of condensate. If condensate is allowed to freeze in the line or if the line is obstructed in any other manner, condensate can exit from the condensate trap vent opening, resulting in potential water damage to property.

⚠ WARNING The stainless steel retaining ring must be installed between the rubber sealing gasket and the compression fitting (FIG. 9-1). The compression fitting must be tightened.

The condensate trap must have the float ball (FIG. 9-1) in place during all times of boiler 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 9-1 *Condensate Disposal*





10 Start-up

Pre-Commissioning Cleaning

1. Prior to fill and start-up, flush the entire heating system.
2. Clean the entire heating system with an approved pre-commissioning cleaner (comparable to Sentinel X300 or X400 and Fernox F3 or DS40) in accordance with the manufacturer's recommendation to remove debris and prolong the life of the heat exchanger.
3. Clean all water filtering devices in the system.
4. Flush the cleaning solution out of the entire system and refill.

Fill water

Check/control fill water chemistry

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

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

Hardness between 5 and 12 grains per gallon

1. Consult local water treatment companies for hard water areas (above 12 grains per gallon hardness).
2. Hardness levels that are above 12 grains/gallon can lead to lime scale buildup throughout the boiler system. If the fill water is below 5 grains/gallons, usually due to use of a water softener, it is recommended to mix in some potable water at the inlet to increase the hardness of the water to above 5 grains/gallons.

pH between 6.5 and 8.5

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

Total Dissolved Solids (TDS) less than 350 ppm

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

Chlorine concentration less than 150 ppm

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

Boiler water

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

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

Table 10A *Boiler Water Chemistry*

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

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

Freeze protection

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

10 Start-up *(continued)*

1. Use glycol only if needed for freeze protection.
2. Propylene glycol is the recommended freeze protection.
3. Make sure to flush the boiler system before adding glycol.
4. Determine the freeze protection fluid quantity using system water content, following the fluid manufacturer's instructions. Boiler water content is listed on page 6. Remember to include expansion tank water content.
5. Local codes may require a backflow preventer or actual disconnect from city water supply.
6. When using freeze protection fluid with automatic fill, it is suggested to install a water meter to monitor water makeup. Freeze protection fluid may leak before the water begins to leak, causing the concentration to drop, which reduces the freeze protection level.
7. The freeze protection set points may be lowered when freeze protection fluid is used (see the Knight Wall Hung Fire Tube Service Manual).
8. Consult the glycol manufacturer for details on the suggested mix of glycol and water for the desired freeze protection level and the de-rate effect it will have on the boiler output.

Test / replace freeze protection fluid

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

Oxygen prevention

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

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

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

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

Fill and test water system

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

Purge air from water system

1. Purge air from system:
   a. Connect a hose to the purge valve (see purge/drain valve in the piping diagrams on pages 41 through 49). Route the hose to an area where water can drain and be seen.
   b. Close the boiler or system isolation valve between the purge valve and fill connection to the system.
   c. Close zone isolation valves.
   d. Open the quick-fill valve on the cold water makeup line.
   e. Open purge valve.
   f. Open the isolation valves one zone at a time. Allow water to run through the zone, pushing out the air. Run until no noticeable air flow is present. Close the zone isolation valves and proceed with the next zone. Follow this procedure until all zones are purged.
   g. Close the quick-fill water valve and purge valve and remove the hose. Open all isolation valves. Watch that system pressure rises to correct cold-fill pressure.
   h. After the system has operated for a while, eliminate any residual air by using the manual air vents located throughout the system.
   i. If purge valves are not installed in the system, open the manual air vents in the system one at a time, beginning with the lowest floor. Close the vent when water squirts out. Repeat with remaining vents.
2. Open the automatic air vent (diaphragm-type or bladder type expansion tank systems only) one turn.
3. Open other vents:
   a. Starting on the lowest floor, open air vents one at a time until water squirts out.
   b. Repeat with remaining vents.
4. Refill to correct pressure.

10 Start-up

Check for gas leaks

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

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

Check thermostat circuit(s)

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

Inspect condensate system

Inspect/check condensate lines and fittings

1. Inspect the condensate drain line, condensate fittings and condensate trap to ensure the trap is properly installed and connected to the condensate pipe under the boiler. Reference *Section 9: Condensate Disposal* for installation instructions.

Final checks before starting the boiler

- ❑ Read the Knight Wall Hung Fire Tube Boiler Service Manual to familiarize yourself with SMART SYSTEM control module operation. Read this manual, pages 66 and 67 for proper steps to start boiler.
- ❑ Verify the boiler and system are full of water and all system components are correctly set for operation.
- ❑ Verify the preparation procedures of Section 10, pages 60 thru 63 have been completed.
- ❑ Verify electrical connections are correct and securely attached.
- ❑ Inspect vent piping and air piping for signs of deterioration from corrosion, physical damage or sagging. Verify air piping and vent piping are intact and correctly installed per this manual.

Start the boiler

1. Read and follow the Operating instructions in FIG.'s 10-2 and 10-3, pages 66 and 67.

If boiler does not start correctly

1. Check for loose connections, blown fuse or service switch off?
2. Is boiler water temperature above 200°F?
3. Is thermostat set below room temperature?
4. Is gas turned on at meter or boiler?
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 Knight Wall Hung Fire Tube Boiler Service Manual.

Check system and boiler

- ❑ **Check water piping**

1. Check system piping for leaks. If found, shut down the boiler and repair immediately. (See WARNINGS on pages 60 thru 63 (startup) regarding failure to repair leaks.)
2. Vent any remaining air from the system using manual vents. Air in the system will interfere with circulation and cause heat distribution problems and noise.

10 Start-up *(continued)*

❑ Check vent piping and air piping

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

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

❑ Check gas piping

1. Check around the boiler for gas odor following the procedure on page 50 of this manual (connecting gas supply piping).

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

❑ Propane boilers – 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 Knight Wall Hung Fire Tube boilers are typically shipped ready to fire on natural gas. Check boiler rating plate to determine which fuel the boiler is set for. If set to natural gas, it may be converted to LP by installing an LP venturi and any additional components provided in the LP conversion kit (Models WH56 - WH286 only), or by installing a propane orifice (Model WH400 only) (see pages 12 and 13). In order to operate on LP gas, these components MUST BE installed. Failure to comply could result in severe personal injury, death, or substantial property damage.

Check flame and combustion

1. Turn the main power off to the boiler by placing the "On/Off" switch in the OFF position.
2. When using PVC/CPVC remove the 1/2" combustion plug from the tee supplied in the installation kit. For all other venting options, remove the flue temperature sensor from the flue pipe connection. **Note:** Combustion measurements will be made at this point.
3. Turn the main power on to the boiler by placing the "On/Off" switch in the ON position.

NOTICE Please note that the brackets ([]) denote screen status.

4. Place the boiler into the active position by pressing the RIGHT SELECT [ON] key (FIG. 11-1, page 75).
5. Locate the pinhole button above the RESET button on the display board (FIG. 11-1). Insert a thin wire (such as a paper clip) into the hole and press the button once and hold for 5 seconds to place the boiler into Service Mode. In Service Mode the boiler will fire at ignition speed and will then modulate up to full fire.
6. Insert the probe from a combustion analyzer into the hole left by the removal of the 1/2" combustion plug or the flue temperature sensor.
7. Once the boiler has modulated up to full fire, measure the combustion. The values should be in the range listed in Table 10B below. The CO levels should be less than 200 ppm for a properly installed unit.

   If the combustion is not within the specified range, reference the Troubleshooting Section of the Knight Wall Hung Fire Tube Boiler Service Manual for possible causes and corrective actions.

Table 10B *Flue Products Chart*

Natural Gas				
Input Rate	Target		Range	
	CO_2	O_2	CO_2	O_2
High Fire	9.2%	4.5%	9.0% - 10.5%	2.1% - 4.8%
Low Fire	9.0%	4.8%	8.8% - 9.5%	3.9% - 5.2%

Propane				
Input Rate	Target		Range	
	CO_2	O_2	CO_2	O_2
High Fire	10.8%	4.5%	10.5% - 11.5%	3.5% - 5.0%
Low Fire	10.5%	5.0%	10.0% - 11.0%	4.2% - 5.8%

8. Once the combustion analysis is complete, test the safety shutoff device by turning the manual shutoff switch to the OFF position and ensuring that the boiler shuts down and registers an alarm. Turn the manual shutoff switch to the ON position and reset the control.
9. Turn the main power off to the boiler and re-install the 1/2" combustion plug or replace the flue temperature sensor into the flue pipe connection.
10. Place the boiler back into normal operation.

⚠ WARNING You must replace the flue gas temperature sensor / 1/2" combustion plug (depending on venting option) to prevent flue gas spillage into the room. Failure to comply could result in severe personal injury, death, or substantial property damage.

10 Start-up

Set space heating operation

Determine controlling sensor

For space heating systems, the temperature control can be based on one of three sensors; the inlet, outlet, or system supply sensor. The SMART SYSTEM control is programmed at the factory to control the temperature of the outlet sensor. The control will automatically switch to the system supply sensor once it is connected. If it is desired to base the temperature control on the inlet sensor, the appropriate parameter must be changed in the control. See the Knight Wall Hung Fire Tube Boiler Service Manual for a detailed explanation of this procedure.

Verify space heat circulator mode

The Space Heating Mode controls both the system pump (if connected), and the boiler pump. When the SMART SYSTEM control receives a space heating call for heat, it turns on the system pump. If the boiler is not heating an indirect DHW (Domestic Hot Water) tank, and the set point is not met, it also turns on the boiler pump. After the space heating call for heat ends, the system pump continues to run for a short period of time. The system pump can be programmed to run continuously, except during outdoor shutdown. If the boiler pump was running, it continues to run for a short period of time as well. These pump delays are factory set to 30 seconds. If different delays are desired, the appropriate parameters in the control must be changed. See the Knight Wall Hung Fire Tube Boiler Service Manual for a detailed explanation of this procedure.

Adjust set point temperature(s)

NOTICE Please note that the brackets ([]) denote screen status.

The NAVIGATION dial may be used during normal operation to adjust the space heating and tank set point temperatures.

1. From the Status Screen press the NAVIGATION dial.
2. Turn the NAVIGATION dial counterclockwise to select the appropriate set point.
3. Press the NAVIGATION dial to adjust the temperature.
4. Once the desired temperature is displayed, press the RIGHT SELECT [SAVE] key.
5. If necessary repeat Steps 3 and 4 to make adjustments to additional set points.
6. Press the RIGHT SELECT [HOME[key to upload the changes.
7. If the RIGHT SELECT [SAVE] key is not pressed, the new settings will be discarded.

Set domestic hot water (DHW) operation

Verify DHW mode

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

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

Set DHW boiler target temperature

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

Set maximum DHW fan speed

If the rated input of the indirect tank is less than the maximum output of the boiler, change the maximum DHW fan speed setting to limit the boiler output accordingly, see the Knight Wall Hung Fire Tube Boiler Service Manual for a detailed explanation of this procedure.

Set clock

NOTICE Please note that the brackets ([]) denote screen status.

The SMART SYSTEM 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 boiler is installed, and anytime the boiler has been powered off for more than 4 hours. Use the following procedure to set the clock:

1. Press and hold the LEFT SELECT [MENU] key for at least 5 seconds.
2. The display changes to read [PASSWORD], with four (4) zeros below it.
3. Press the RIGHT SELECT [SAVE] key.
4. The display will then show a menu with the time and date and temperature unit.
5. Press the NAVIGATION dial twice.
6. Turn the NAVIGATION dial to adjust the hours. Press the NAVIGATION dial.

10 Start-up *(continued)*

7. Turn the NAVIGATION dial to adjust the minutes. Press the NAVIGATION dial.
8. Turn the NAVIGATION dial to adjust the month. Press the NAVIGATION dial.
9. Turn the NAVIGATION dial to adjust the date. Press the NAVIGATION dial.
10. Turn the NAVIGATION dial to adjust the year. Press the RIGHT SELECT [SAVE] key.
11. Press the RIGHT SELECT [HOME] key.

NOTICE The internal clock does not adjust for Daylight Savings Time and therefore, will require a manual adjustment.

The clock is automatically updated whenever a PC is connected and the Win Pro-Installer program is started.

Configuration of the cascade

NOTICE Please note that the brackets ([]) denote screen status.

When installed in a Cascade system, the individual controls must be programmed for cascade operation. This is accomplished by accessing the control parameters.

Press the [MENU] key for at least five (5) seconds. Input the Installer code as described in the Knight Wall Hung Fire Tube Boiler Service Manual. Once the control parameters have been accessed, use the NAVIGATION dial to select the Control Mode parameters. Press the NAVIGATION dial to access these parameters.

Rotate the NAVIGATION dial to select the parameter “Cascade Address”. Press the NAVIGATION dial to access this parameter. Each appliance in the Cascade system must be programmed with its own address. The boiler designated as the Leader will have an address of 0. The remaining boilers in the Cascade will be Members and have addresses from 1 - 7. Rotate the NAVIGATION dial to select the appropriate address. Press the RIGHT SELECT [SAVE] key.

Press the RIGHT SELECT [HOME] key to upload the address into the control. Repeat this procedure for all boilers in the Cascade, designating the Leader control and the Member controls.

10 Start-up

Figure 10-2 *Operating Instructions_ Models WH56 - WH286*

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.

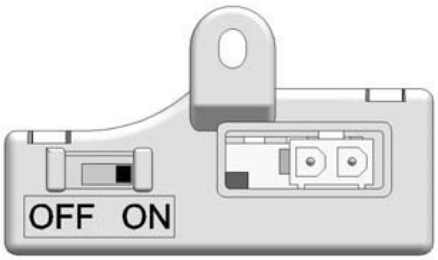
If you cannot reach your gas supplier, call the fire department.

C. Use only your hand to move the gas control switch. Never use tools. If the switch will not move by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.

D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

OPERATING INSTRUCTIONS

1. **STOP!** Read the safety information above on this label.
2. Set the thermostat to lowest setting.
3. Turn off all electric power to the appliance.
4. This appliance is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.
5. Remove front door.
6. Move switch to the "OFF" position.
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. Move the switch to the "ON" position.
9. Install front door.
10. Turn on all electric power to appliance.
11. Set thermostat to desired setting.
12. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier.



TO TURN OFF GAS TO APPLIANCE

1. Set the thermostat to lowest setting.
2. Turn off all electric power to the appliance if service is to be performed.
3. Remove front door.
4. Move switch the "OFF" position.
5. Install front door.

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10 Start-up *(continued)*

Figure 10-3 *Operating Instructions_Model WH400*

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

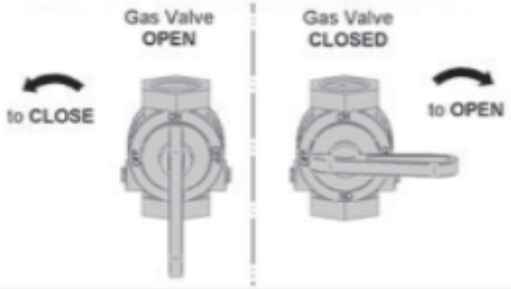
- Do not try to light any appliance.
- Do not touch any electric switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

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.

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11 Operating information

General

How the boiler operates

The Knight Wall Hung Fire Tube boiler 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 boiler through the heat exchanger and flue piping. The control module regulates blower speed to control the boiler firing rate. The gas valve senses the amount of air flowing into the boiler and allows only the right amount of gas to flow.

How the control module operates

The SMART SYSTEM control module receives inputs from boiler sensors and external devices. The control module activates and controls the blower and gas valve to regulate heat input and switches the boiler, Domestic Hot Water (DHW), and system pumps on and off as needed. The user programs the module to meet system needs by adjusting control parameters. These parameters set operating temperatures and boiler operating modes. Boiler operation can be based on boiler outlet water temperature, boiler inlet water temperature, system temperature, a 0-10V signal or ModBus or BACnet, depending on the parameter settings.

Control inputs and outputs

Room thermostat

There are three (3) heat/loop demand connections available on this control. These inputs tell the boiler to provide water for space heating. Each demand connection has its own set point and outdoor air reset curve. When multiple demands have a call for heat the control will give priority to the demand with the highest set point.

Example: Assume that both heat/loop demand 1 and heat/loop demand 2 have a call for heat. Demand 1 has a set point of 110°F. Demand 2 has a set point of 140°F. The boiler will regulate the system temperature to 140°F until Demand 2 has been satisfied. Once Demand 2 has been satisfied the boiler will provide 110°F water to the system.

⚠ CAUTION When multiple temperature loops are used, mixing valves are required for the protection of any low temperature loops.

SMART SYSTEM Multi-temp loop control

The Knight Wall Hung Fire Tube boiler is capable of producing up to three (3) set point temperatures to meet different space heating demands. This device controls the temperatures of up to three (3) separate loops, based on the settings for the three (3) heat/loop demands (reference Lochinvar kit #100167843).

0 - 10V input (set point or power)

The Knight Wall Hung Fire Tube boiler can be controlled by a Building Management System (BMS) provided that either an external energy management system is installed that reduces the boiler water temperature as the heating load decreases, the boiler is not used for any space heating, the boiler has an input rate of 300,000 Btu/hr or greater, or the boiler is part of a modular or multiple boiler system having a total input of 300,000 Btu/hr or greater.

The control can be configured by the installer to use a 0 - 10 Vdc signal to either control set point or firing rate.

The Knight Wall Hung Fire Tube boiler can also be programmed to accept a call for heat from a 0 - 10V signal, reference the Knight Wall Hung Fire Tube Boiler Service Manual for a detailed explanation of this procedure.

DHW priority

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

DHW / space heating (SH) cycling

If a DHW call for heat is received while a space heating call is in progress, and the DHW is in Normal Mode, the control will start the DHW pump and shut the boiler pump off. The system pump will remain on. For stand-alone boilers, if the space heating call is still active while the DHW call is in operation, the control will wait for 30 minutes (time adjustable by installer) then it will switch back to the space heating demand. There is a timer to switch from space heating to DHW and a timer to switch from DHW to space heating. The control will switch back and forth until one of the heat demands end.

Programmable controlling sensor

The control module is programmed to use the outlet sensor as the control sensor by default. If a system supply sensor is connected, the control automatically uses it as the control sensor. For stand-alone boilers, the control sensor can be changed by the installer to the inlet sensor. If the inlet sensor is chosen as the controlling sensor, it is recommended that the system supply sensor be installed in the system supply in order to provide the best control of the inlet temperature.

11 Operating information *(continued)*

Anti-cycling

After the burner turns off, the control will delay the next burner cycle for a set time period (time is adjustable by the installer). The time delay will be bypassed if the inlet water temperature drops too far during the delay.

Boiler and system pump control

The boiler pump will run whenever the burner is firing, unless the DHW is programmed for Normal Mode and the boiler is heating the DHW tank. The boiler pump will run during Freeze Protection Mode as well. It will continue to run for a short time after the burner turns off or the Freeze Protection Mode ends.

The system pump will run whenever there is a space heating call for heat, or the boiler goes into Freeze Protection Mode. It may be programmed to run during a DHW call for heat when the DHW is programmed for Zone Mode. It will continue to run for a short time after the end of the heat demand or the Freeze Protection Mode. The system pump can be programmed to run continuously if desired, except during outdoor shutdown and/or a DHW call for heat.

DHW recirculation pump control

When a DHW recirculation loop is used, the Knight Wall Hung Fire Tube boiler can control the recirculation pump. To activate this function, simply install the DHW recirculation sensor into the return water from the DHW circulation loop. The control will turn on the DHW recirculation pump when the return water drops 10°F (5.5°C) below the DHW tank set point, and will turn back off when the return water rises to within 5°F (2.5°C) of the DHW tank set point. The control will turn the DHW recirculation pump off whenever DHW night setback is active.

Temperature control

Modulation

The Knight Wall Hung Fire Tube boiler is capable of modulating its firing rate on WH56 models only from a minimum of 15% to a maximum of 100%, WH86 - 286 models from a minimum of 10% to a maximum of 100% and the WH400 model from a minimum of 20% to a maximum of 100%. The firing rate is dictated by the call for heat (i.e., space heating or domestic hot water), the heating load, ramp delay (if enabled), and various other temperature limitations.

Ramp delay

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

Gradient limiting

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

Outdoor air reset

With the outdoor air sensor connected, the control module will calculate the set points of the three (3) space heating demands based on the programmed reset curves. The installer can change the slope of the reset curves by several adjustable parameters. The user can limit the maximum set point for the system using the space heating set points.

Boost function

If outdoor air reset is active, and any space heating demand has been active continuously for a set period of time (time adjustable by installer) and there has been no DHW demands, the control will increase the set point of that demand by a fixed number of degrees (adjustable by installer). This process will continue until the space heating demand ends, the set point reaches the programmed set point or a maximum of 20 increases has occurred. Once the system heat demand is satisfied, the set point will revert to the value determined by the reset curve.

Night setback

The controller may be programmed to reduce the space heating and DHW set points during certain times each week. Seven different start and stop times may be programmed for the space heating setback and seven start and stop times for the DHW setback. Any night setback event scheduled within the next seven (7) days can be temporarily bypassed if desired.

Vacation mode

Vacation Mode is used to lower the Space Heat (SH) and / or DHW set points much like Night Setback. The set points will remain lowered until Vacation Mode is disabled. Night Setback will not function when Vacation Mode is enabled.

Flame current support

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

11 Operating information

Protection features

Outlet temperature, flue temperature, and temperature rise limiting

The outlet temperature is monitored by the boiler 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 240°F the control will shut the unit down. The unit will restart automatically once the flue temperature drops 25°F and the minimum off time has expired.

The control monitors the temperature difference between the inlet and the outlet sensor. If this difference exceeds 55°F the control will reduce the maximum fan speed. If the temperature difference exceeds 60°F the control will shut the unit down. The unit will restart automatically once the temperature difference has dropped below 55°F and the minimum off time has expired.

Freeze protection

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

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

- The SMART SYSTEM control module provides freeze-up protection as follows when the boiler water temperature drops below 45°F:
- Below 45°F, the boiler and system pumps operate constantly.
- Below 37°F, the boiler turns on.
- Boiler and pumps turn off if boiler water temperature rises above 45°F.
- Lower temperatures may be programmed for systems with anti-freeze solutions.

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

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

Low voltage blocking

The blower and gas valve require a minimum amount of voltage in order to operate properly. If an ignition attempt is made when the line voltage is temporarily low (such as during a brownout), the control could enter a manual reset lockout. To prevent this, the control monitors the voltage and blocks any heat demands until the voltage returns to an acceptable level.

Monitor external limits

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

Run-time and alarm outputs

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

Run-time and cycle counting

The control uses two timers to monitor the total hours of burner operation. One timer monitors the time the boiler is firing in the Space Heating Mode. The other timer monitors the time the boiler is firing in the DHW Mode.

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

Service reminder

The control can be programmed for service reminder notification. This notification will become active when either a set time frame 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.

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.

11 Operating information *(continued)*

Boiler temperature regulation

Operating temperature (target)

The SMART SYSTEM control module senses water temperature and regulates boiler firing and firing rate to achieve a target temperature. The target temperature can be set between 32°F and 190°F.

- Target temperature is calculated as described in the *"Outdoor Reset Operation"* section, when the outdoor sensor is connected.
- If the outdoor sensor is not connected, the target temperature is fixed at SH (1 - 3) set points. An outdoor sensor fault will remain on the display screen until the outdoor sensor is reconnected.

High limit operations

The Knight Wall Hung Fire Tube boiler is equipped with adjustable automatic reset and manual reset high limits. The automatic reset high limit has a maximum 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 boiler 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

NOTICE Please note that the brackets ([]) denote screen status.

1. Turn ON the main power to the boiler by placing the ON/OFF switch in the ON position.
2. From the Status Screen, press the NAVIGATION dial to access the Set Points Screen.
3. Press the LEFT SELECT (LIMITS) key.
4. Select the manual reset high limit (MRHL) by rotating the NAVIGATION dial counterclockwise, then press the NAVIGATION dial.
5. Decrease the set point of the MRHL to below the current outlet temperature (or to its minimum setting, whichever is higher) by turning the NAVIGATION dial counterclockwise.
6. Press the RIGHT SELECT [SAVE] key.
7. Press the RIGHT SELECT [HOME] key. The new parameter will upload to the control.
8. If the current outlet temperature is above the new MRHL set point, the MRHL will function causing boiler lockout. If this occurs, skip to Step 11.
9. If the current outlet temperature is below the new MRHL set point, locate the pinhole (SERVICE button) above the RESET button on the display board. Insert a thin probe (such as a paper clip) into the hole and press the button continuously for five (5) seconds to place the boiler into Service Mode. In Service Mode, the boiler will fire at ignition speed and will then modulate up to full fire.
10. Once the outlet temperature rises up to the MRHL set point, the MRHL will function, causing the boiler to shut down and lock out.
11. Repeat Steps 2 - 7 to adjust the MRHL to its normal settings.

Low water cutoff protection

1. The SMART SYSTEM 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 boiler down. This ensures boiler 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 (#100208651).

Outdoor reset operation

Target temperature with outdoor reset

This feature improves the system's efficiency by decreasing set point as the outdoor temperature increases. For boilers with input rates less than 300,000 Btu/hr Energy Efficiency Standards require the use of a control that automatically adjusts set point in relation to heat demand. In the absence of an external energy management system, this feature MUST BE used.

See the Knight Wall Hung Fire Tube Boiler Service Manual to change the settings.

Reset curve

The reset curve looks at outdoor air temperature and adjusts the set point in relation to heat demand.

11 Operating information

Cascade

When multiple boilers are installed, they can be wired together in a cascade sequence. A maximum of eight boilers can be controlled from a single control. In this application one boiler would be designated as the Leader control and all others would be designated as Member controls. Member 1 can be configured to take over control of the Cascade should the Leader stop communicating with the members. The Leader control can be programmed to use Lead/Lag or Efficiency Optimization control methods.

Once the Leader boiler receives a call for heat from a room thermostat, BMS, or ModBus or BACnet, the control will determine what the set point will be. If outdoor air reset is desired, connect the outdoor air sensor to the terminals on the Low Voltage Connection Board on the Leader boiler. The set point will be calculated based on the programmed reset curve parameters. See the Knight Wall Hung Fire Tube Boiler Service Manual to program the reset curve. If outdoor air reset is not desired, do not connect the outdoor air sensor. A fixed temperature set point can be programmed into the control. See page 64 of this manual to program the set point.

If the water temperature at the system supply sensor is less than the set point + the turn-off offset - the off-on differential, then the control will initiate a call for heat on the Cascade (see the Knight Wall Hung Fire Tube Boiler Service Manual for an explanation of the offset and differential). The Leader will energize the lead boiler on the Cascade. For a new startup this will be the Leader boiler.

Sequence of the cascade

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

During the first 24 hours of operation, the sequence will change every hour. After that, the sequence will change 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

After the first 24 hours, the sequence will change every night at 2:00 a.m. If a boiler locks out or is used to heat an indirect DHW tank, it will automatically be given the lowest priority until 2:00 a.m.

DHW, Night Setback, and Ramp Delay operation with cascade

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

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

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

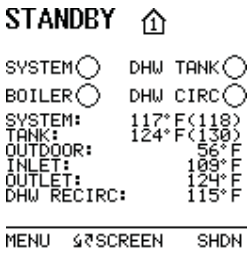
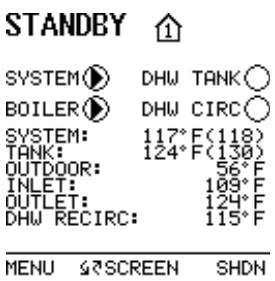
When DHW is programmed for Zone Mode, connect the DHW thermostat or tank sensor to the Leader boiler. When a DHW call is received, the Leader will modulate the entire Cascade to bring the system supply temperature up to the DHW boiler set point (if higher).

Night Setback operation of the boilers within the Cascade is available. Programming of the Night Setback will be done through the Leader boiler. Refer to the Knight Wall Hung Fire Tube Boiler Service Manual for information regarding Night Setback.

Ramp Delay operation of the boilers as described in the Knight Wall Hung Fire Tube Boiler Service Manual is available when the boilers are part of a Cascade system.

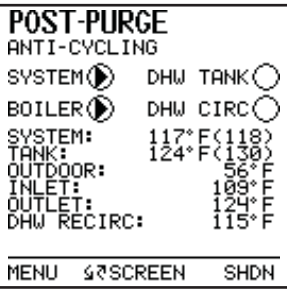
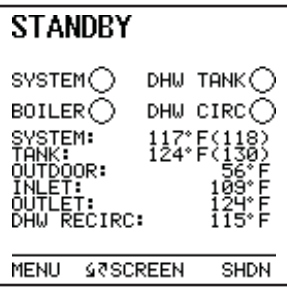
11 Operating information *(continued)*

Sequence of operation

OPERATION	DISPLAY
1. Upon a call for heat, the gas pressure switch(es) must be closed.	
2. Once the gas pressure switch(es) are closed, the control turns on the appropriate pumps (system and boiler pumps for space heating, DHW pump for DHW). The flow switch and/or LWCO must close.	
3. The control turns on power to the louver relay. The louver proving switch, and blocked drain switch must close.	
4. The control starts the prepurge cycle by initiating the blower.	
5. The control starts the trial for ignition by firing the spark electrode and opening the gas valve.	
6. If 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. The control will perform a total of 4 attempts before locking out.	

11 Operating information

Sequence of operation *(continued)*

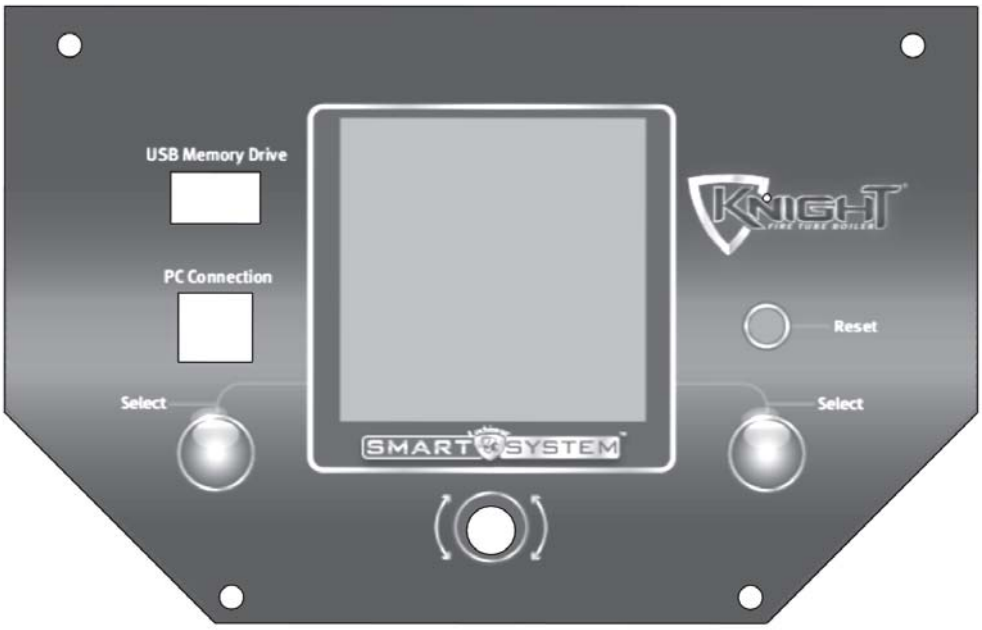
OPERATION	DISPLAY
7. If flame is detected, it holds the firing rate steady for a few seconds to let the flame stabilize, then it begins to modulate the firing rate based on a set point or some other command (such as a 0-10V BMS signal).	
8. If the space heating call for heat is active, and the tank thermostat or sensor starts a DHW call for heat, the boiler will switch to the DHW mode. If programmed for normal DHW operation (not as a zone), the DHW pump will turn on first, then the boiler pump will turn off (boiler and DHW pump operation briefly overlap to ensure flow is maintained through the unit). This will divert the boiler's outlet water from the heating system and send it to the tank coil instead. The control will then modulate to maintain the outlet temperature to the DHW boiler set point.	
9. If the boiler is not part of a Cascade, and both the space heating and DHW calls for heat remain active long enough, the boiler will switch back and forth between the two heating modes until one of them is satisfied.	
10. Once both calls for heat are satisfied, the control will turn off the burner. The blower will continue to run during the postpurge period.	
11. Any pumps that are running will continue to run for their respective pump delay times before turning off, unless programmed to remain on continuously. A 60 second anti-cycle period will start, which will delay any new call for heat until it times out.	
12. In Standby, ready to start a new cycle.	

11 Operating information *(continued)*

Knight Wall Hung Fire Tube boiler control module

Use the control panel (FIG. 11-1) to set temperatures, operating conditions, and monitor boiler operation.

Figure 11-1 *Control Panel*



DIR #2000544469 00

The information on the bottom of the display shows the functions of the two SELECT keys (on either corner), and the NAVIGATION dial (in the center):

MENU = Left SELECT Key
SETPOINTS = NAVIGATION Dial - Pressing Down
SHDN = Right SELECT Key

Access modes

User

The user can adjust space heating and tank target temperatures by pressing the NAVIGATION dial when "↓SETPOINTS" is flashing at the bottom of the display. The date and time, and the temperature units can also be changed (see page 64).

Installer

Most parameters are available only to the installer, accessible by entering the installer password, see the Knight Wall Hung Fire Tube Boiler Service Manual.

Saving parameters *(reference the Parameter Table in the Knight Wall Hung Fire Tube Boiler Service Manual)*

NOTICE Please note that the brackets ([]) denote screen status.

To save parameters and exit programming:

Press the RIGHT SELECT [SAVE] key and then press the RIGHT SELECT [HOME] key.

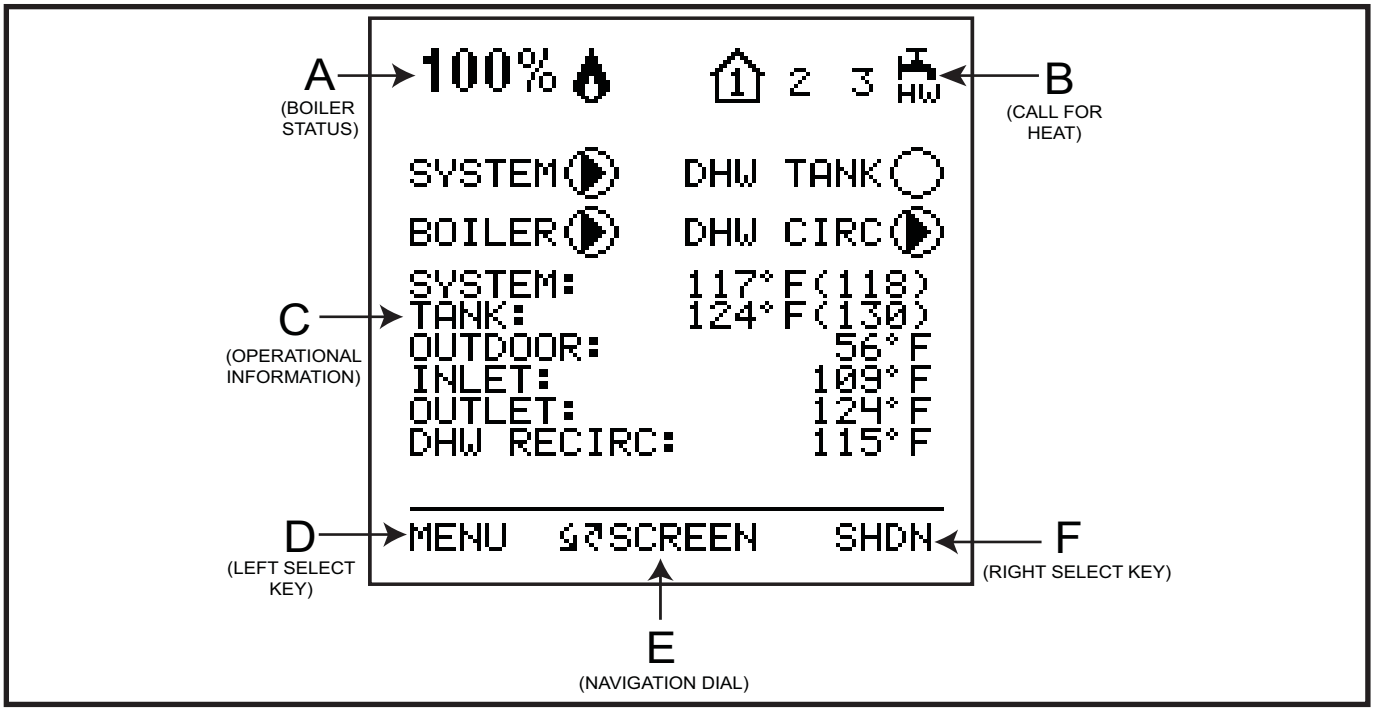
To enter a parameter and continue programming:

Press the RIGHT SELECT [SAVE] key 1 time to return to the parameter listings; press again to return to the menu listings. Remember to press the RIGHT SELECT [HOME] key when finished programming in order to save the changes made.

See the Knight Wall Hung Fire Tube Boiler Service Manual for a detailed description of parameters and access modes.

11 Operating information

Figure 11-2 *Status Display Screen*



Status Display Screens NOTE: All screens show burner status, heat demands, lockout/blocking, pump status, and soft keys.		
Section	**Display**	**Description**
A (Boiler Status Bar)	**STANDBY**	The unit has not received a call for heat from a remote thermostat nor has it received a call for heat from a DHW thermostat.
	START	The unit has begun a burn cycle and is checking all safety circuits.
	PREPURGE	The unit has initiated a prepurge period on a call for heat.
	IGNITION	The unit has begun a spark period to ignite the main burner.
	%	The unit has fired and is running at the displayed percentage.
	POSTPURGE	The call for heat has been satisfied and the unit runs the fan for an additional postpurge period to clear the combustion chamber and vent system of residual flue products.
	SHUTDOWN	The unit has been placed in the OFF position.
	SETPOINT MET	The controlled temperature has exceeded its set point and its offset.
	BLOCKED	The unit has detected a condition that has temporarily interrupted the current call for heat.
B (Call for Heat Indicators)	1	Room Thermostat 1 has a call for heat.
	2	Room Thermostat 2 has a call for heat.
	3	Room Thermostat 3 has a call for heat.
	HW	The tank thermostat or sensor has a call for heat.
	1 2 3	Indicates which room thermostat demand has priority.
	V	The unit is being controlled by a 0 - 10V BMS signal.
	C	The member unit is supplying heat while in Cascade Mode.

11 Operating information *(continued)*

Status Display Screens *(cont'd)* NOTE: All screens show burner status, heat demands, lockout/blocking, pump status, and soft keys.		
Section	**Display**	**Description**
C (Operational Information)	**DETAILS SCREEN 1**	a. SYSTEM TEMP b. TANK TEMP c. OUTDOOR TEMP d. INLET TEMP e. OUTLET TEMP f. DHW RECIRC TEMP - The temperature read by the DHW recirculation sensor (if connected).
	DETAILS SCREEN 2	a. DELTA T b. FLUE TEMP c. FLAME CURRENT d. FAN SPEED e. LOOP 1 TEMP - The temperature of Loop 1 reported by the MTLC control. f. LOOP 2 TEMP - The temperature of Loop 2 reported by the MTLC control. g. LOOP 3 TEMP - The temperature of Loop 3 reported by the MTLC control.
	I/O SCREEN	a. GAS PRESS SW - The state of the gas pressure switch. b. FLOW SW - The state of the flow switch. c. LOUVER RELAY - The state of the louver relay output. d. LOUVER SW - The state of the louver proving switch. e. BLOCKED DRAIN - The state of the blocked drain switch. f. GAS VALVE - The state of the gas valve output.
	BMS SCREEN	a. 0 - 10V BMS IN b. 0 - 10V RATE OUT c. BMS ADDRESS d. BMS CONTROL? e. SYS PUMP SPEED f. BLR PUMP OUT
	HISTORY SCREEN	a. SH RUN TIME - Total time running for Space Heat (SH). b. SH CYCLES - Total Space Heat (SH) demand cycles. c. DHW RUN TIME - Total time running for DHW. d. DHW CYCLES - Total DHW demand cycles. e. POWER TIME - Total time powered ON. f. IGNITIONS - Total number of successful ignitions. g. IGN ATTEMPTS - Total number of ignition attempts.
	LAST 10 FAULTS	a. FAULT NO. b. FAULT c. DATE d. TIME

11 Operating information

Status Display Screens *(cont'd)* NOTE: All screens show burner status, heat demands, lockout/blocking, pump status, and soft keys.		
Section	**Display**	**Description**
C (Operational Information cont.)	**CASCADE STATUS**	a. CASCADE STATUS b. CASCADE POWER c. PRESENT
	NIGHT SETBACK	a. TRIGGER 1 - Next Space Heat (SH) night setback trigger. b. TRIGGER 2 - Next DHW night setback trigger.
D (LEFT SELECT key function)	**USB**	Press the LEFT SELECT key to access the USB and Installer menu.
E (NAVIGATION dial function)	**MODIFY**	Pressing the NAVIGATION dial will allow the installer to change the text.
F (RIGHT SELECT key function)	**SHDN**	Press the RIGHT SELECT key to turn the boiler OFF.
	ON	Press the RIGHT SELECT key to turn the boiler ON.
	NO	Press the RIGHT SELECT key to cancel the shutdown operation.
	SAVE	Press the RIGHT SELECT key to save the current change.
	HOME	Press the RIGHT SELECT key to return to the Status Screen and upload parameter changes.

12 Maintenance

Maintenance and annual startup

Table 12A *Service and Maintenance Schedules*

Service technician (see the following pages for instructions)	
ANNUAL START-UP	**General:** • Address reported problems • Inspect interior; clean and vacuum if necessary; • Clean condensate trap and fill with fresh water • Check for leaks (water, gas, flue, condensate) • Verify flue and air lines in good condition and sealed tight • Check system water pressure/system piping/expansion tank • Check fill water meter • Test boiler water. When test indicates, clean system water with approved system restorer following manufacturer's information • Check control settings • Check ignition and flame sense electrodes (sand off any deposits; clean and reposition) • Check wiring and connections • Perform start-up checkout and performance verification per Section 10 of this manual. • Flame inspection (stable, uniform) • Flame signal (at least 10 microamps at high fire) • Clean the heat exchanger if flue temperature is more than 54°F above return water temperature **If combustion or performance indicate need:** • Clean heat exchanger • Remove and clean burner using compressed air only • Clean the blower wheel

Owner maintenance (see the Knight Wall Hung Fire Tube User's Information Manual for instructions)	
Daily	• Check boiler area • Check pressure / temperature gauge
Monthly	• Check vent piping • Check air piping • Check air and vent termination screens • Check relief valve • Check condensate drain system • Check air vents
Periodically	• Test low water cutoff (if used) • Reset button (low water cutoff)
Every 6 months	• Check boiler piping (gas and water) for leaks • Operate relief valve
End of season months	• Shut boiler down (unless boiler used for domestic hot water)

12 Maintenance

⚠ WARNING Follow the service and maintenance procedures given throughout this manual and in component literature shipped with the boiler. Failure to perform the service and maintenance could result in damage to the boiler 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 boiler should be inspected annually only by a qualified service technician. In addition, the maintenance and care of the boiler designated in Table 12A and explained on the following pages must be performed to assure maximum boiler efficiency and reliability. Failure to service and maintain the boiler and system could result in equipment failure.

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

Address reported problems

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

Inspect boiler area

1. Verify that boiler area is free of any combustible materials, gasoline and other flammable vapors and liquids.

2. Verify that air intake area is free of any of the contaminants listed in Section 1 of this manual. If any of these are present in the boiler intake air vicinity, they must be removed. If they cannot be removed, reinstall the air and vent lines per this manual and the Knight Wall Hung Fire Tube Boiler Service Manual.

Inspect boiler interior

1. Remove the front access cover and inspect the interior of the boiler.

2. Vacuum any sediment from inside the boiler and components. Remove any obstructions.

Clean condensate trap

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

Inspect condensate trap

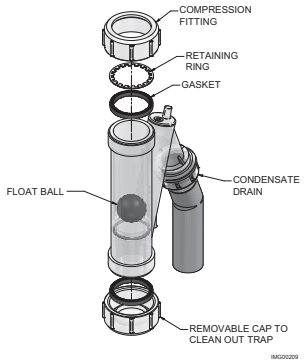
Monthly inspection:

1. The condensate trap should be inspected monthly to ensure the trap is properly installed and connected to the condensate pipe under the boiler, see FIG. 12-1.
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 9 - Condensate Disposal for installation instructions.

Figure 12-1 *Condensate Trap*



Check all piping for leaks

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

1. Inspect all water and gas piping and verify to be leak free.
2. Look for signs of leaking lines and correct any problems found.
3. Check gas line using the procedure found in Section 7 - Gas Connections.

12 Maintenance *(continued)*

Flue vent system and air piping

1. Visually inspect the entire flue gas venting system and air piping for blockage, deterioration or leakage. Repair any joints that show signs of leakage. Verify that air inlet pipe is connected and properly sealed.

2. Verify that boiler vent discharge and air intake are clean and free of obstructions.

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

Check water system

1. Verify all system components are correctly installed and operational.

2. Check the cold fill pressure for the system. Verify it is correct (must be a minimum of 12 psi).

3. Watch the system pressure as the boiler heats up (during testing) to ensure pressure does not rise too high. Excessive pressure rise indicates expansion tank sizing or performance problem.

4. Inspect automatic air vents and air separators. Remove air vent caps and briefly press push valve to flush vent. Replace caps. Make sure vents do not leak. Replace any leaking vents.

Check expansion tank

1. Expansion tanks provide space for water to move in and out as the heating system water expands due to temperature increase or contracts as the water cools. Tanks may be open, closed or diaphragm or bladder type. See Section 6 - Hydronic Piping for suggested best location of expansion tanks and air eliminators.

Check fill water meter

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

Test boiler water

1. Test boiler water. Reference the Knight Wall Hung Fire Tube Installation and Operation Manual for guidelines. When test indicates, clean system water with approved system restorer following the manufacturer's information.

Check boiler relief valve

1. Inspect the relief valve and lift the lever to verify flow. Before operating any relief valve, ensure that it is piped with its discharge in a safe area to avoid severe scald potential. Read Section 6 - Hydronic 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 boiler relief valve as directed could result in unsafe pressure buildup, which can result in severe personal injury, death, or substantial property damage.

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

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

12 Maintenance

Inspect ignition and flame sense electrodes

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

Check ignition ground wiring

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

Check all boiler wiring

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

Check control settings

1. Set the SMART SYSTEM control module display to Parameter Mode and check all settings. See Section 1 of Knight Wall Hung Fire Tube Boiler Service Manual. Adjust settings if necessary. See Section 1 of the Knight Wall Hung Fire Tube Boiler Service Manual for adjustment procedures.
2. Check settings of external limit controls (if any) and adjust if necessary.

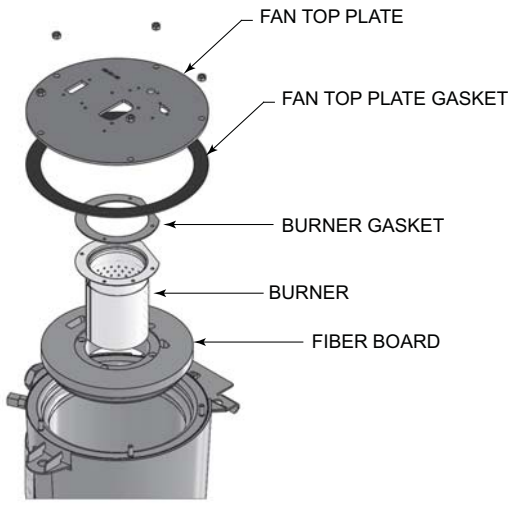
Perform start-up and checks

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

Check burner flame

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

Figure 12-2 *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 of the Knight Wall Hung Fire Tube Boiler Service Manual for other procedures to deal with low flame signal.

12 Maintenance *(continued)*

Review with owner

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

Cleaning boiler heat exchanger

1. Shut down boiler:
   - Follow the "To Turn Off Gas to Appliance" instructions for the boiler in Section 10 - Startup.
   - Do not drain the boiler unless it will be exposed to freezing temperatures. If using freeze prevention fluid in system, do not drain.
2. Allow time for the boiler to cool to room temperature if it has been firing.
3. Remove the front access panel (no tools required for removal). Use a Phillips head screwdriver to remove the top access panel.
4. Remove the wiring from the ignitor, flame rod, and the fan. Remove the reference tubing from the air intake.
5. Loosen the band clamp on the air intake coupling using a field provided 5/16" driver and disconnect the air inlet from the venturi.
6. On Models WH56 - WH286 loosen the threaded nut on the venturi. Remove the gasket between the gas piping and venturi. On the WH400 model disconnect the Molex plug from the gas valve. Using a 5 mm Allen wrench, remove the screws securing the gas pipe to the gas valve.
7. Remove the 10 mm nuts securing the heat exchanger top plate to gain access to the heat exchanger and set aside.

⚠ WARNING The boiler 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.

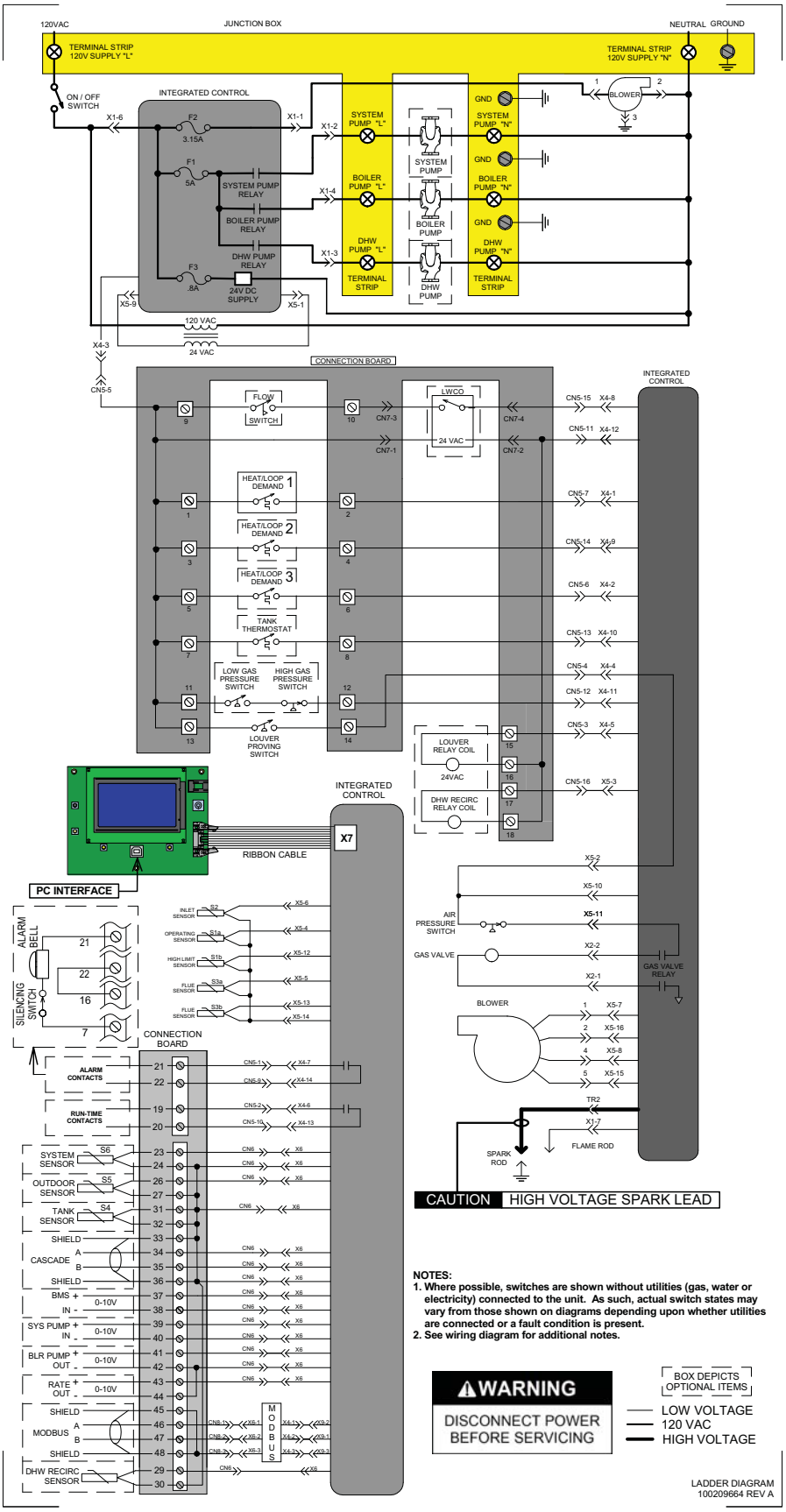
8. Remove the condensate trap from the bottom of the boiler. Place a bucket underneath the condensate fitting attached to the heat exchanger.
9. Use a vacuum cleaner to remove any accumulation on the boiler heating surfaces. Do not use any solvent.
10. Using a clean cloth dampened with warm water, wipe out the combustion chamber. Rinse out debris with a low pressure water supply.
11. Allow the heat exchanger to thoroughly dry.
12. Reassemble the unit in reverse order of component removal, and re-install the condensate hose.

⚠ CAUTION Damaged gaskets and seals in the system can result in substantial property damage. Ensure that damaged or torn gaskets are replaced.

13. Perform a combustion analysis by following the instructions in Section 10 - Startup - Check Flame and Combustion on page 63 of this manual.
14. Resume operation.

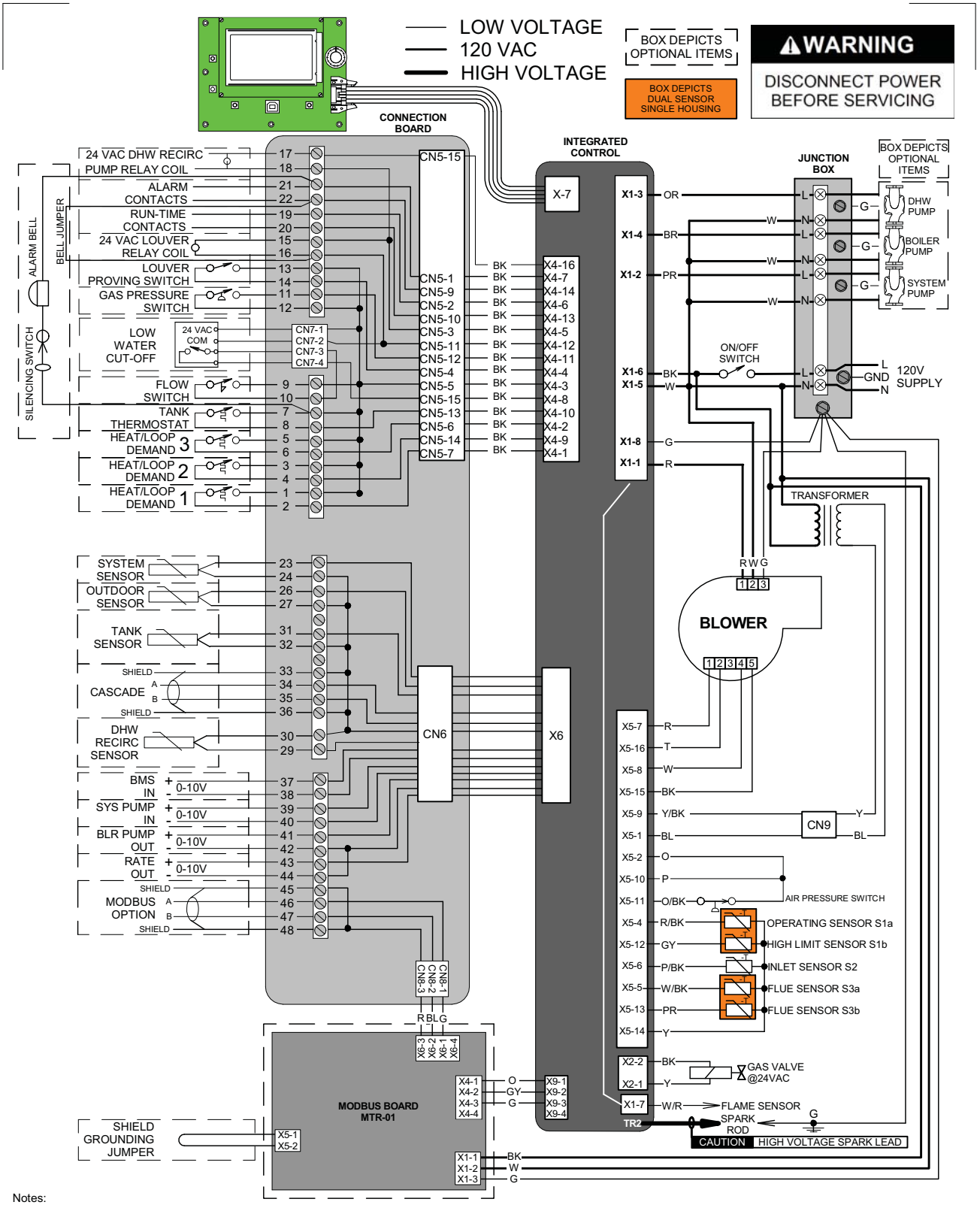
13 Diagrams

Figure 13-1 *Ladder Diagram*



13 Diagrams *(continued)*

Figure 13-2 *Wiring Diagram*



Notes:
1. All wiring must be installed in accordance with: local, state, provincial and national code requirements per either N.E.C. in USA or C.S.A. in Canada.
2. If any original equipment wire as supplied with the appliance must be replaced, it must be replaced with wire having same wire gauge (AWG) and rated for a minimum of 105℃. Exceptions: Replacement high vo ltage 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 troubleshoot unit.

WIRING DIAGRAM
100209663 REV B

Notes

Notes

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HIGH EFFICIENCY BOILERS & WATER HEATERS
300 Maddox Simpson Parkway
Lebanon, TN 37090
615-889-8900 / Fax: 615-547-1000
www.Lochinvar.com

Revision Notes: *Revision A (Process #3000008912_Change #500009028) initial release.*

MM #100287110_ DIR #2000544742_Rev A
06/17

100287990_2000545748 Rev A

KNIGHT®
FIRE TUBE BOILER

User's Information Manual
Models: 56 - 400

DIR #2000543091 00

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Lochinvar®
HIGH EFFICIENCY BOILERS & WATER HEATERS

⚠ WARNING

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

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

WHAT TO DO IF YOU SMELL GAS

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

Save this manual for future reference.

Contents

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

NOTICE

The Knight Wall Hung Fire Tube Boiler Installation and Operation Manual along with the Knight Wall Hung Fire Tube Boiler Service Manual are for use only by a qualified heating installer/service technician. Refer only to this User's Information Manual for your reference. Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury (exposure to hazardous materials) or loss of life. Installation and service must be performed by a qualified installer, service agency or the gas supplier (who must read and follow the supplied instruction before installing, servicing, or removing this boiler. This boiler contains materials that have been identified as carcinogenic, or possibly carcinogenic, to humans).

NOTICE

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

Consider piping and installation when determining boiler location.

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

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

⚠ WARNING

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

⚠ WARNING

DO NOT install units in rooms or environments that contain corrosive contaminants (see Table 1 on page 4). Failure to comply could result in severe personal injury, death, or substantial property damage.

Boiler service and maintenance –

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

Boiler operation –

- Do not block flow of combustion or ventilation air to the boiler. This boiler is equipped with a control which will automatically shut down the boiler should air or vent be blocked. If vent or air blockage is easily accessible and removable, remove it. The boiler should attempt to restart. If blockage is not obvious or cannot be removed, have the boiler and system checked by a qualified service technician.
- Should overheating occur or gas supply fail to shut off, do not turn off or disconnect electrical supply to the circulator. Instead, shut off the gas supply at a location external to the appliance.
- Do not use this boiler if any part has been under water. The possible damage to a flooded appliance can be extensive and present numerous safety hazards. Any appliance that has been under water must be replaced.

Boiler water –

- Thoroughly flush the system (without boiler connected) to remove sediment. The high-efficiency heat exchanger can be damaged by build-up or corrosion due to sediment.
- Do not use petroleum-based cleaning or sealing compounds in the boiler system. Gaskets and seals in the system may be damaged. This can result in substantial property damage.
- Do not use "homemade cures" or "boiler patent medicines". Serious damage to the boiler, personnel, and/or property may result.
- Continual fresh make-up water will reduce boiler life. Mineral buildup in the heat exchanger reduces heat transfer, overheats the stainless steel heat exchanger, and causes failure. Addition of oxygen carried in by makeup water can cause internal corrosion. Leaks in boiler or piping must be repaired at once to prevent makeup water.

Freeze protection fluids –

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

1 Prevent combustion air contamination

⚠ WARNING If the boiler combustion air inlet is located in any area likely to cause contamination, or if products which would contaminate the air cannot be removed, you must have the combustion air and vent re-piped and terminated to another location. Contaminated combustion air will damage the boiler, resulting in possible severe personal injury, death, or substantial property damage.

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

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

Please read the information listed in Table 1. If contaminating chemicals will be present near the location of the boiler combustion air inlet, have your installer pipe the boiler combustion air and vent to another location, per the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual.

⚠ WARNING To prevent the potential of severe personal injury or death, check for areas and products listed in Table 1 before installing the boiler or air inlet piping.

If contaminants are found, you MUST:

- Remove contaminants permanently.

—OR—

- Relocate air inlet and vent terminations to other areas.

Table 1 *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

2 Maintenance schedule

Service technician
(see the Knight Wall Hung Fire Tube Boiler Service Manual)

ANNUAL START-UP

General:

- Reported problems
- Inspect interior; clean and vacuum if necessary
- Clean condensate trap and fill with fresh water
- Check for leaks (water, gas, flue, condensate)
- Verify flue and air lines in good condition and sealed tight
- Check system water pressure/system piping/expansion tank
- Check fill water meter
- Test boiler water. When test indicates, clean system water with approved system restorer following manufacturer's information
- Check control settings
- Ignition and flame sense electrodes (sand off any deposits; clean and reposition)
- Wiring and connections
- Perform start-up checkout and performance verification per Section 10 in the Knight Fire Tube Installation and Operation Manual.
- Flame inspection (stable, uniform)
- Flame signal (at least 4 mA)
- Clean the heat exchanger if flue temperature is more than 54°F above return water temperature.

If combustion or performance indicate need:

- Clean heat exchanger
- Remove and clean burner using compressed air only
- Clean the blower wheel

Owner maintenance
(see pages 6 - 8 for detailed instructions)

Daily	• Check boiler area • Check pressure/temperature gauge
Monthly	• Check vent piping • Check air piping • Check air and vent termination screens • Check relief valve • Check condensate drain system
Periodically	• Test low water cutoff (if used) • Reset button (low water cutoff)
Every 6 months	• Check boiler piping (gas and water) for leaks • Operate relief valve
End of season months	• Shut boiler down (unless boiler used for domestic hot water)

⚠ WARNING Follow the maintenance procedures given throughout this manual. Failure to perform the service and maintenance or follow the directions in this manual could result in damage to the boiler or system, resulting in severe personal injury, death, or substantial property damage.

2 Maintenance schedule

Maintenance procedures

Boiler must be serviced and maintained

⚠ WARNING The boiler must be inspected and started annually at the beginning of the heating season by a qualified service technician. In addition, the maintenance and care of the boiler designated on page 5 of this manual and explained on pages 6 through 8 must be performed to assure maximum boiler efficiency and reliability. Failure to service and maintain the boiler and system could result in equipment failure, causing possible severe personal injury, death, or substantial property damage.

NOTICE The following information provides detailed instructions for completing the maintenance items listed in the maintenance schedule on page 5. In addition to this maintenance, the boiler must be serviced and started up at the beginning of each heating season by a qualified service technician.

Check boiler area

⚠ WARNING To prevent potential of severe personal injury, death, or substantial property damage, eliminate all materials discussed below from the boiler vicinity and the vicinity of the boiler combustion air inlet. If contaminants are found:

Remove products immediately from the area. If they have been there for an extended period, call a qualified service technician to inspect the boiler for possible damage from acid corrosion.

If products cannot be removed, immediately call a qualified service technician to re-pipe vent and air piping and locate vent termination/air intake away from contaminated areas.

1. Combustible/flammable materials -- Do not store combustible materials, gasoline or any other flammable vapors or liquids near the boiler. Remove immediately if found.

2. Air contaminants -- Products containing chlorine or fluorine, if allowed to contaminate the boiler intake air, will cause acidic condensate in the boiler. This will cause significant damage to the boiler if allowed to continue.

   Read the list of potential materials listed in Table 1 on page 4 of this manual. If any of these products are in the room from which the boiler takes its combustion air, they must be removed immediately or the boiler combustion air (and vent termination) must be relocated to another area.

Check pressure/temperature gauge

1. Make sure the pressure reading on the boiler pressure/temperature gauge does not exceed 24 psi. Higher pressure may indicate a problem with the expansion tank.

2. Contact a qualified service technician if problem persists.

Check vent piping

1. Visually inspect the flue gas vent piping for any signs of blockage, leakage, or deterioration of the piping. Notify your qualified service technician at once if you find any problems.

⚠ WARNING Failure to inspect the vent system as noted above and have it repaired by a qualified service technician can result in vent system failure, causing severe personal injury or death.

Check air piping

1. Visually inspect the air inlet termination to be sure it is unobstructed. Inspect the entire length of air piping to ensure piping is intact and all joints are properly sealed.

2. Call your qualified service technician if you notice any problems.

Check relief valve

1. Inspect the boiler relief valve and the relief valve discharge pipe for signs of weeping or leakage.

2. If the relief valve often weeps, the expansion tank may not be working properly. Immediately contact your qualified service technician to inspect the boiler and system.

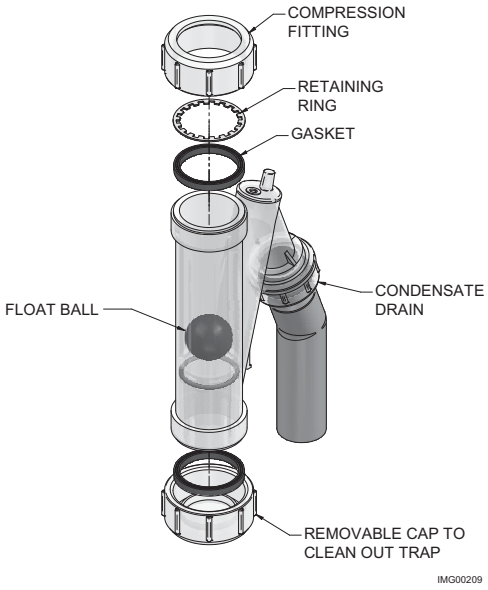
Check condensate drain system

Inspect/check condensate lines and fittings

1. Inspect the condensate drain line, condensate PVC fittings and condensate trap (FIG. 2-1).

2 Maintenance schedule *(continued)*

Figure 2-1 *Condensate Trap*



Condensate drain

1. This boiler is a high efficiency appliance that produces condensate.
2. The bottom of the boiler has a 1 1/4 inch pipe for connection of the condensate trap (FIG. 2-2).
3. 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.
4. Fill condensate trap with enough water to make the ball float (FIG. 2-1).
5. Loosen compression fitting (FIG. 2-1).
6. Slide the condensate trap onto the condensate drain at the bottom of the unit. As the trap is pressed on, a stainless steel retaining ring will engage the drain pipe allowing the trap to be pushed on, but not pulled off.
7. Tighten compression fitting.
8. Slope condensate tubing down and away from the boiler into a drain or condensate neutralizing filter. Condensate from the Knight Wall Hung Fire Tube boiler 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 (100157721).
9. Do not expose condensate line to freezing temperatures.
10. Use only plastic tubing or piping as a condensate drain line (FIG. 2-2).
11. A condensate removal pump is required if the boiler is below the drain. When installing a condensate pump, select one approved for use with condensing boilers 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 air pressure switch inside the boiler.

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.

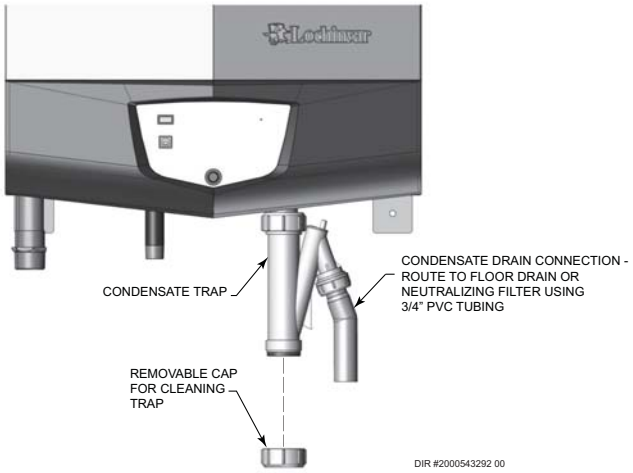
The condensate line must remain unobstructed, allowing free flow of condensate. If condensate is allowed to freeze in the line or if the line is obstructed in any other manner, condensate can exit from the condensate trap vent opening, resulting in potential water damage to property.

⚠ WARNING

The stainless steel retaining ring must be installed between the rubber sealing gasket and the compression fitting (FIG. 2-1). The compression fitting must be tightened.

The condensate trap must have the float ball (FIG. 2-1) in place during all times of boiler 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 2-2 *Condensate Disposal*



2 Maintenance schedule

Test low water cutoff (if installed)

1. If the system is equipped with a low water cutoff, test the low water cutoff periodically during the heating season, following the low water cutoff manufacturer's instructions.

Reset button (low water cutoff)

1. Testing the low water cutoff shuts the unit off. Press the RESET button on the low water cutoff to turn the unit back on.

Check boiler piping (gas and water)

1. Remove the boiler front access door and perform a gas leak inspection per steps 1 through 7 of the Operating Instructions on page 9. If gas odor or leak is detected, immediately shut down the boiler following the procedures on page 9. Call a qualified service technician.

2. Visually inspect for leaks around water piping. Also inspect the circulators, relief valve, and fittings. Immediately call a qualified service technician to repair any leaks.

⚠ WARNING Have leaks fixed at once by a qualified service technician. Failure to comply could result in severe personal injury, death, or substantial property damage.

3. Replace the front access door.

Operate relief valve

1. Before proceeding, verify that the relief valve outlet has been piped to a safe place of discharge, avoiding any possibility of scalding from hot water.

⚠ WARNING To avoid water damage or scalding due to valve operation, a metal discharge line must be connected to the relief valve outlet and run to a safe place of disposal. This discharge line must be installed by a qualified heating installer or service technician in accordance with the instructions in the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual. The discharge line must be terminated so as to eliminate possibility of severe burns or property damage should the valve discharge.

2. Read the boiler pressure/temperature gauge to make sure the system is pressurized. Lift the relief valve top lever slightly, allowing water to relieve through the valve and discharge piping.

3. If water flows freely, release the lever and allow the valve to seat. Watch the end of the relief valve discharge pipe to ensure that the valve does not weep after the line has had time to drain. If the valve weeps, lift the seat again to attempt to clean the valve seat. If the valve continues to weep afterwards, contact your qualified service technician to inspect the valve and system.

4. If water does not flow from the valve when you lift the lever completely, the valve or discharge line may be blocked. Immediately shut down the boiler, following the operating instructions on page 9 of this manual. Call your qualified service technician to inspect the boiler and system.

Shut boiler down (unless boiler is used for Domestic Water)

1. Follow "To Turn Off Gas to Appliance" on page 9 of this manual.

2. Do not drain the system unless exposure to freezing temperatures will occur.

3. Do not drain the system if it is filled with an antifreeze solution.

4. DO NOT shut down boilers used for domestic water heating, they must operate year-round.

3 Operating instructions

Figure 3-1 *Operating Instructions_ Models WH56 - WH286*

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.

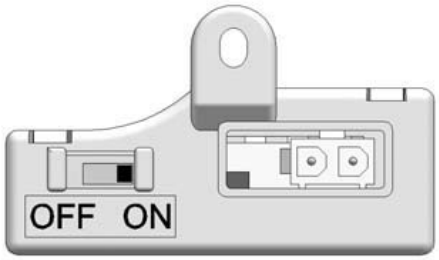
If you cannot reach your gas supplier, call the fire department.

C. Use only your hand to move the gas control switch. Never use tools. If the switch will not move by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.

D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

OPERATING INSTRUCTIONS

1. **STOP!** Read the safety information above on this label.
2. Set the thermostat to lowest setting.
3. Turn off all electric power to the appliance.
4. This appliance is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.
5. Remove front door.
6. Move switch to the "OFF" position.
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. Move the switch to the "ON" position.
9. Install front door.
10. Turn on all electric power to appliance.
11. Set thermostat to desired setting.
12. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier.



TO TURN OFF GAS TO APPLIANCE

1. Set the thermostat to lowest setting.
2. Turn off all electric power to the appliance if service is to be performed.
3. Remove front door.
4. Move switch the "OFF" position.
5. Install front door.

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3 Operating instructions

Figure 3-2 *Operating Instructions_ Model WH400*

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

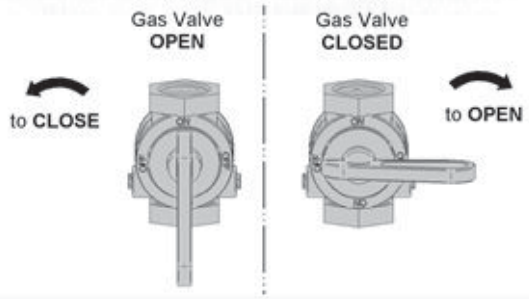
- Do not try to light any appliance.
- Do not touch any electric switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

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.

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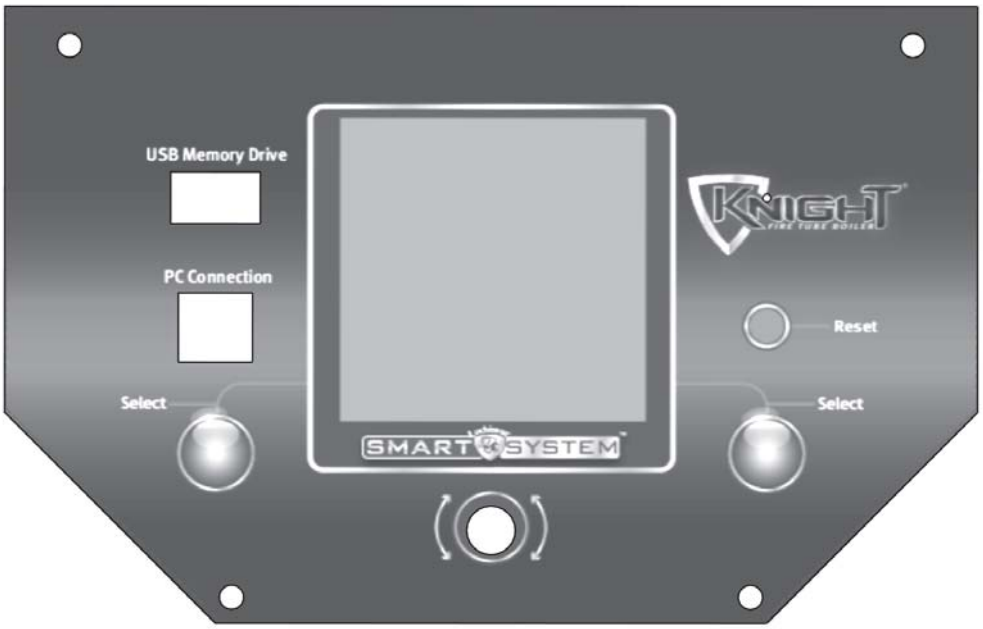
4 SMART SYSTEM control module

Knight Wall Hung Fire Tube Boiler control module

Use the control panel (FIG. 4-1) to set temperatures, operating conditions, and monitor boiler operation.

Figure 4-1 *Control Panel*



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The information on the bottom of the display shows the functions of the two SELECT keys (on either corner), and the NAVIGATION dial (in the center):

MENU = Left SELECT Key
SETPOINTS = NAVIGATION Dial - Pressing Down
SHDN = Right SELECT Key

Access modes

User

The user can adjust space heating and tank target temperatures by pressing the NAVIGATION dial when "↓SETPOINTS" is flashing at the bottom of the display. The date and time, and the temperature units can also be changed (see page 11).

Installer

Most parameters are available only to the installer, accessible by entering the installer password, see the Knight Wall Hung Fire Tube Boiler Service Manual.

Saving parameters *(reference the Parameter Table in the Knight* Wall Hung Fire Tube *Boiler Service Manual)*

NOTICE Please note that the brackets ([]) denote screen status.

To save parameters and exit programming:

Press the RIGHT SELECT [SAVE] key and then press the RIGHT SELECT [HOME] key.

To enter a parameter and continue programming:

Press the RIGHT SELECT [SAVE] key 1 time to return to the parameter listings; press again to return to the menu listings. Remember to press the RIGHT SELECT [HOME] key when finished programming in order to save the changes made.

See the Knight Wall Hung Fire Tube Boiler Service Manual for a detailed description of parameters and access modes.

Set space heating operation

Determine controlling sensor

For space heating systems, the temperature control can be based on one of three sensors; the inlet, outlet, or system supply sensor. The SMART SYSTEM control is programmed at the factory to control the temperature of the outlet sensor. The control will automatically switch to the system supply sensor once it is connected. If it is desired to base the temperature control on the inlet sensor, the appropriate parameter must be changed in the control. See the Knight Wall Hung Fire Tube Boiler Service Manual for a detailed explanation of this procedure.

4 SMART SYSTEM control module *(continued)*

Verify space heat circulator mode

The Space Heating Mode controls both the system pump (if connected), and the boiler pump. When the SMART SYSTEM control receives a space heating call for heat, it turns on the system pump. If the boiler is not heating an indirect DHW (Domestic Hot Water) tank, and the set point is not met, it also turns on the boiler pump. After the space heating call for heat ends, the system pump continues to run for a short period of time. The system pump can be programmed to run continuously, except during outdoor shutdown. If the boiler pump was running, it continues to run for a short period of time as well. These pump delays are factory set to 30 seconds. If different delays are desired, the appropriate parameters in the control must be changed. See the Knight Wall Hung Fire Tube Boiler Service Manual for a detailed explanation of this procedure.

Adjust set point temperature(s)

NOTICE Please note that the brackets ([]) denote screen status.

The NAVIGATION dial may be used during normal operation to adjust the space heating and tank set point temperatures.

1. From the Status Screen press the NAVIGATION dial.
2. Turn the NAVIGATION dial counterclockwise to select the appropriate set point.
3. Press the NAVIGATION dial to adjust the temperature.
4. Once the desired temperature is displayed, press the RIGHT SELECT [SAVE] key.
5. If necessary repeat Steps 3 and 4 to make adjustments to additional set points.
6. Press the RIGHT SELECT [HOME[key to upload the changes.
7. If the RIGHT SELECT [SAVE] key is not pressed, the new settings will be discarded.

Set domestic hot water (DHW) operation

Verify DHW mode

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

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

Set DHW boiler target temperature

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

Set maximum DHW fan speed

If the rated input of the indirect tank is less than the maximum output of the boiler, change the maximum DHW fan speed setting to limit the boiler output accordingly, see the Knight Wall Hung Fire Tube Boiler Service Manual for a detailed explanation of this procedure.

Set clock

NOTICE Please note that the brackets ([]) denote screen status.

The SMART SYSTEM 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 boiler is installed, and anytime the boiler has been powered off for more than 4 hours. Use the following procedure to set the clock:

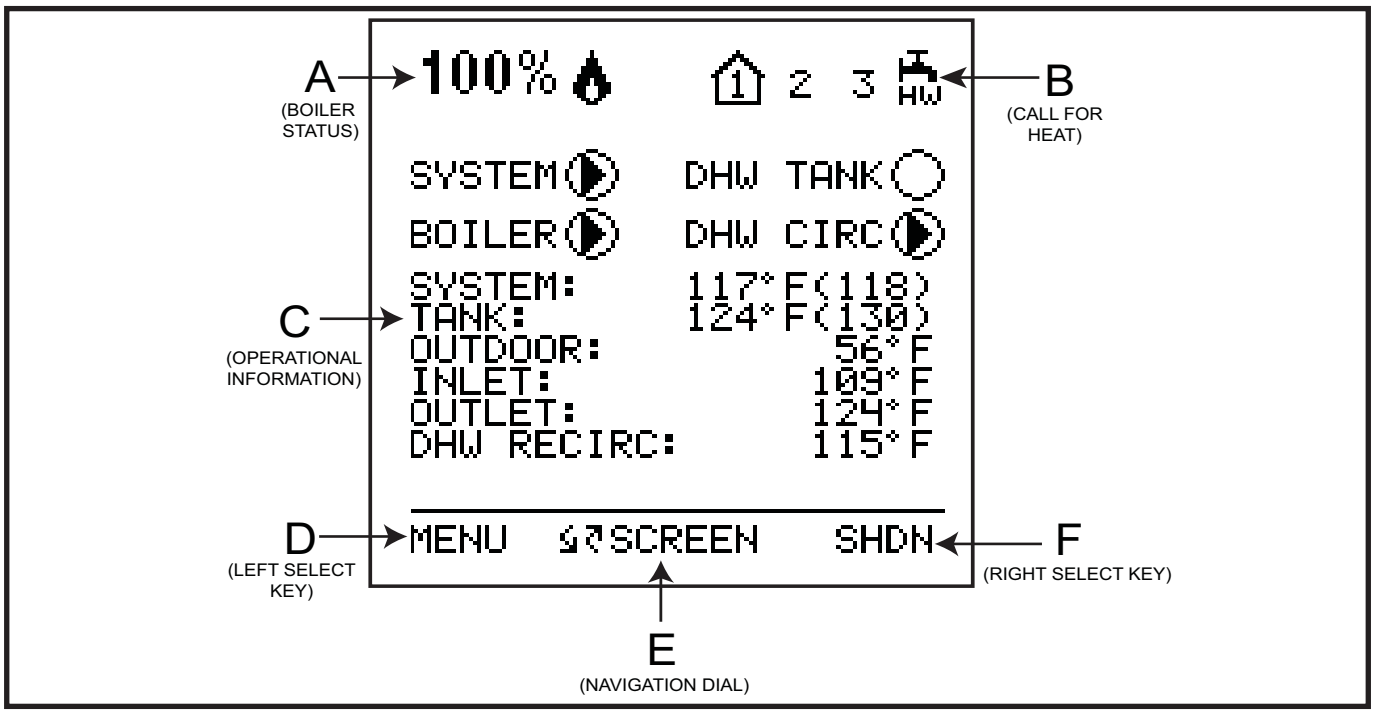
1. Press and hold the LEFT SELECT [MENU] key for at least 5 seconds.
2. The display changes to read [PASSWORD], with four (4) zeros below it.
3. Press the RIGHT SELECT [SAVE] key.
4. The display will then show a menu with the time and date and temperature unit.
5. Press the NAVIGATION dial twice.
6. Turn the NAVIGATION dial to adjust the hours. Press the NAVIGATION dial.
7. Turn the NAVIGATION dial to adjust the minutes. Press the NAVIGATION dial.
8. Turn the NAVIGATION dial to adjust the month. Press the NAVIGATION dial.
9. Turn the NAVIGATION dial to adjust the date. Press the NAVIGATION dial.
10. Turn the NAVIGATION dial to adjust the year. Press the RIGHT SELECT [SAVE] key.
11. Press the RIGHT SELECT [HOME] key.

NOTICE The internal clock does not adjust for Daylight Savings Time and therefore, will require a manual adjustment.

The clock is automatically updated whenever a PC is connected and the Win Pro-Installer program is started.

4 SMART SYSTEM control module

Figure 4-2 *Status Display Screen*



Status Display Screens NOTE: All screens show burner status, heat demands, lockout/blocking, pump status, and soft keys.		
Section	**Display**	**Description**
A (Boiler Status Bar)	**STANDBY**	The unit has not received a call for heat from a remote thermostat nor has it received a call for heat from a DHW thermostat.
	START	The unit has begun a burn cycle and is checking all safety circuits.
	PREPURGE	The unit has initiated a prepurge period on a call for heat.
	IGNITION	The unit has begun a spark period to ignite the main burner.
	%	The unit has fired and is running at the displayed percentage.
	POSTPURGE	The call for heat has been satisfied and the unit runs the fan for an additional postpurge period to clear the combustion chamber and vent system of residual flue products.
	SHUTDOWN	The unit has been placed in the OFF position.
	SETPOINT MET	The controlled temperature has exceeded its set point and its offset.
	BLOCKED	The unit has detected a condition that has temporarily interrupted the current call for heat.
B (Call for Heat Indicators)	1	Room Thermostat 1 has a call for heat.
	2	Room Thermostat 2 has a call for heat.
	3	Room Thermostat 3 has a call for heat.
	HW	The tank thermostat or sensor has a call for heat.
	1 2 3	Indicates which room thermostat demand has priority.
	V	The unit is being controlled by a 0 - 10V BMS signal.
	C	The member unit is supplying heat while in Cascade Mode.

4 SMART SYSTEM control module

Status Display Screens *(cont'd)* NOTE: All screens show burner status, heat demands, lockout/blocking, pump status, and soft keys.		
Section	**Display**	**Description**
C (Operational Information)	**DETAILS SCREEN 1**	a. SYSTEM TEMP b. TANK TEMP c. OUTDOOR TEMP d. INLET TEMP e. OUTLET TEMP f. DHW RECIRC TEMP - The temperature read by the DHW recirculation sensor (if connected).
	DETAILS SCREEN 2	a. DELTA T b. FLUE TEMP c. FLAME CURRENT d. FAN SPEED e. LOOP 1 TEMP - The temperature of Loop 1 reported by the MTLC control. f. LOOP 2 TEMP - The temperature of Loop 2 reported by the MTLC control. g. LOOP 3 TEMP - The temperature of Loop 3 reported by the MTLC control.
	I/O SCREEN	a. GAS PRESS SW - The state of the gas pressure switch. b. FLOW SW - The state of the flow switch. c. LOUVER RELAY - The state of the louver relay output. d. LOUVER SW - The state of the louver proving switch. e. BLOCKED DRAIN - The state of the blocked drain switch. f. GAS VALVE - The state of the gas valve output.
	BMS SCREEN	a. 0 - 10V BMS IN b. 0 - 10V RATE OUT c. BMS ADDRESS d. BMS CONTROL? e. SYS PUMP SPEED f. BLR PUMP OUT
	HISTORY SCREEN	a. SH RUN TIME - Total time running for Space Heat (SH). b. SH CYCLES - Total Space Heat (SH) demand cycles. c. DHW RUN TIME - Total time running for DHW. d. DHW CYCLES - Total DHW demand cycles. e. POWER TIME - Total time powered ON. f. IGNITIONS - Total number of successful ignitions. g. IGN ATTEMPTS - Total number of ignition attempts.
	LAST 10 FAULTS	a. FAULT NO. b. FAULT c. DATE d. TIME

4 SMART SYSTEM control module *(continued)*

Status Display Screens *(cont'd)* NOTE: All screens show burner status, heat demands, lockout/blocking, pump status, and soft keys.		
Section	**Display**	**Description**
C (Operational Information cont.)	**CASCADE STATUS**	a. CASCADE STATUS b. CASCADE POWER c. PRESENT
	NIGHT SETBACK	a. TRIGGER 1 - Next Space Heat (SH) night setback trigger. b. TRIGGER 2 - Next DHW night setback trigger.
D (LEFT SELECT key function)	**MENU**	Press and hold the LEFT SELECT key for five (5) seconds to access the Parameter Settings Menu.
	HOME	Press the LEFT SELECT key to go back to the Home Status Screen and upload any changes.
	EXIT	Press the LEFT SELECT key to go back to the previous Menu Screen.
	YES	Press the LEFT SELECT key to accept current operation.
	SKIP	Press the LEFT SELECT key to skip / un-enable the current selected setback trigger.
	LIMITS	Press the LEFT SELECT key to access the High Limit Settings Menu.
E (NAVIGATION dial function)	**MODIFY**	Pressing the NAVIGATION dial will allow the installer to change the text.
F (RIGHT SELECT key function)	**SHDN**	Press the RIGHT SELECT key to turn the boiler OFF.
	ON	Press the RIGHT SELECT key to turn the boiler ON.
	NO	Press the RIGHT SELECT key to cancel the shutdown operation.
	SAVE	Press the RIGHT SELECT key to save the current change.
	HOME	Press the RIGHT SELECT key to return to the Status Screen and upload parameter changes.

Lochinvar®
HIGH EFFICIENCY BOILERS & WATER HEATERS
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Revision Notes: *Revision A (Process #3000008912_Change #500009028) initial release.*

MM #100287990_DIR #2000545748
Rev A
06/17

100288296_2000546130_Rev A

KNIGHT® FIRE TUBE BOILER

Service Manual

Models: 56 - 400

DIR #2000544469 00

DESIGN CERTIFIED®

CSA CERTIFIED®

ENERGY STAR

⚠ WARNING This manual must only be used by a qualified heating installer / service technician. Read all instructions, including this manual and the Knight Wall Hung Fire Tube Boiler Installation and Operation 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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HIGH EFFICIENCY BOILERS & WATER HEATERS

Contents

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 Knight Wall Hung Fire Tube Boiler Installation and Operation Manual, before installing. Perform steps in the order given.

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

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

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

NOTICE

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

Consider piping and installation when determining boiler location (see the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual).

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

Handling ceramic fiber materials

REMOVAL OF COMBUSTION CHAMBER LINING

⚠ WARNING

The combustion chamber insulation in this appliance contains ceramic fiber material. Ceramic fibers can be converted to cristobalite in very high temperature applications. The International Agency for Research on Cancer (IARC) has concluded, "Crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1)." Normal operating temperatures in this appliance are below the level to convert ceramic fibers to cristobalite. Abnormal operating conditions would have to be created to convert the ceramic fibers in this appliance to cristobalite.

The ceramic fiber material used in this appliance is an irritant; when handling or replacing the ceramic materials it is advisable that the installer follow these safety guidelines.

- Avoid breathing dust and contact with skin and eyes.
  - Use NIOSH certified dust respirator (N95). This type of respirator is based on the OSHA requirements for cristobalite at the time this document was written. Other types of respirators may be needed depending on the job site conditions. Current NIOSH recommendations can be found on the NIOSH website at http://www.cdc.gov/niosh/homepage.html. NIOSH approved respirators, manufacturers, and phone numbers are also listed on this website.
  - Wear long-sleeved, loose fitting clothing, gloves, and eye protection.
- Apply enough water to the combustion chamber lining to prevent airborne dust.
- Remove the combustion chamber lining from the appliance and place it in a plastic bag for disposal.
- Wash potentially contaminated clothes separately from other clothing. Rinse clothes washer thoroughly.

NIOSH stated First Aid.

- Eye: Irrigate immediately.
- Breathing: Fresh air.

Please read before proceeding

When servicing boiler –

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

Boiler operation –

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

Boiler water –

- Thoroughly flush the system (without boiler connected) to remove sediment. The high-efficiency heat exchanger can be damaged by build-up or corrosion due to sediment.
- Do not use petroleum-based cleaning or sealing compounds in the boiler system. Gaskets and seals in the system may be damaged. This can result in substantial property damage.
- Do not use “homemade cures” or “boiler patent medicines”. Serious damage to the boiler, personnel, and/or property may result.
- Continual fresh make-up water will reduce boiler life. Mineral buildup in the heat exchanger reduces heat transfer, overheats the stainless steel heat exchanger, and causes failure. Addition of oxygen carried in by makeup water can cause internal corrosion. Leaks in boiler piping must be repaired at once to prevent the introduction of makeup water.

Freeze protection fluids –

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

What is in this manual?

Service

The Knight Wall Hung Fire Tube Boiler display
- Display panel readout, buttons and their functions

Control module inputs
- Control module inputs and options

Control module outputs
- Control module outputs and options

General
- How the boiler operates
- How the control module operates
- Access modes -- user and installer
- Sequence of operation -- Domestic Hot Water (DHW)/space heating

Control panel menu access
- Accessing programming mode and locating menus (See separate guide covering the interface.)

Control panel parameter access
- Accessing and changing parameters from the display panel

Quick start information -- parameter table
- An index of available adjustments and readouts, where to access them and where to find detailed information.

Knight Wall Hung Fire Tube Boiler parameters
- General
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- Data Logging
- Functions
- DHW Settings
- Outdoor Reset
- Anti-cycling
- Control Modes
- Building Management System (BMS)
- Circulation Pumps
- Service Notification
- Basic Setup
- USB

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- Flue vent system and air piping
- Check water system
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- Check ignition ground wiring
- Check all boiler wiring
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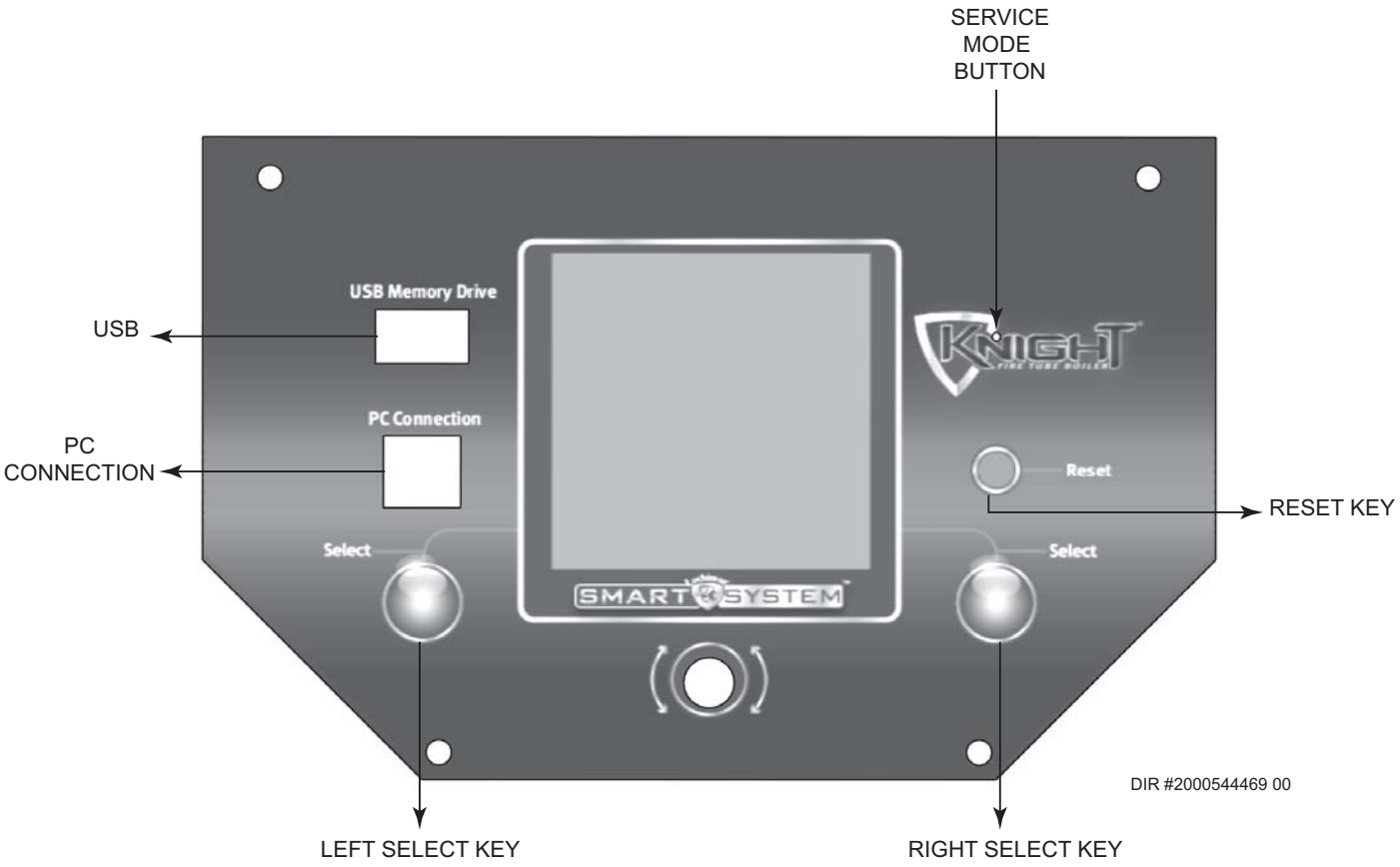
- Review with owner
- Cleaning boiler heat exchanger

Troubleshooting

- Troubleshooting table - No display
- Checking temperature sensors
- Sensor tables
- Troubleshooting table - Fault messages displayed on boiler interface
- Combustion analysis procedure
- Gas valve adjustment procedure

1 Service

The Knight Wall Hung Fire Tube Boiler display

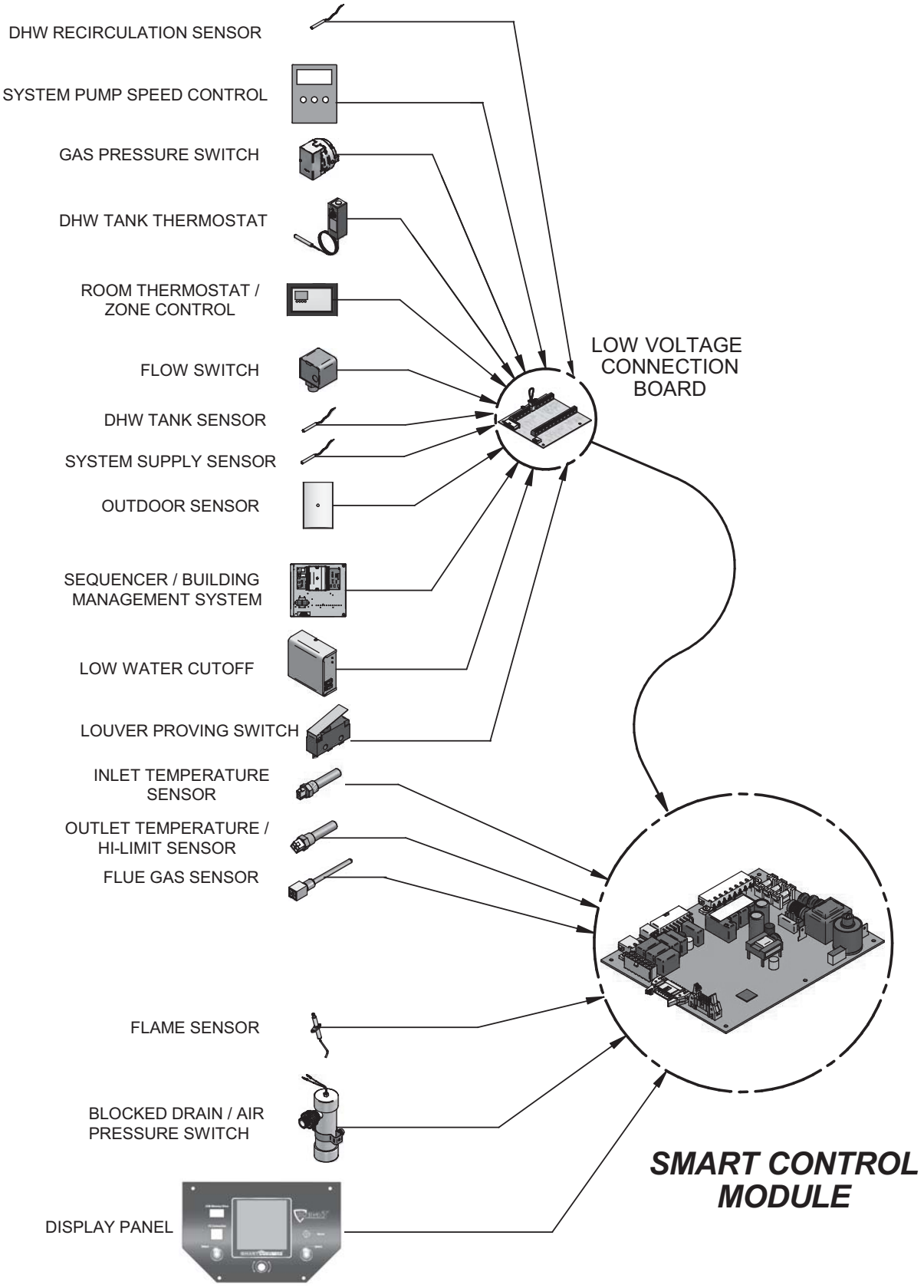


The information on the bottom of the display shows the functions of the two SELECT keys (on either corner), and the NAVIGATION dial (in the center):

MENU = Left SELECT Key
SETPOINTS = NAVIGATION Dial - Pressing Down
SHDN = Right SELECT Key

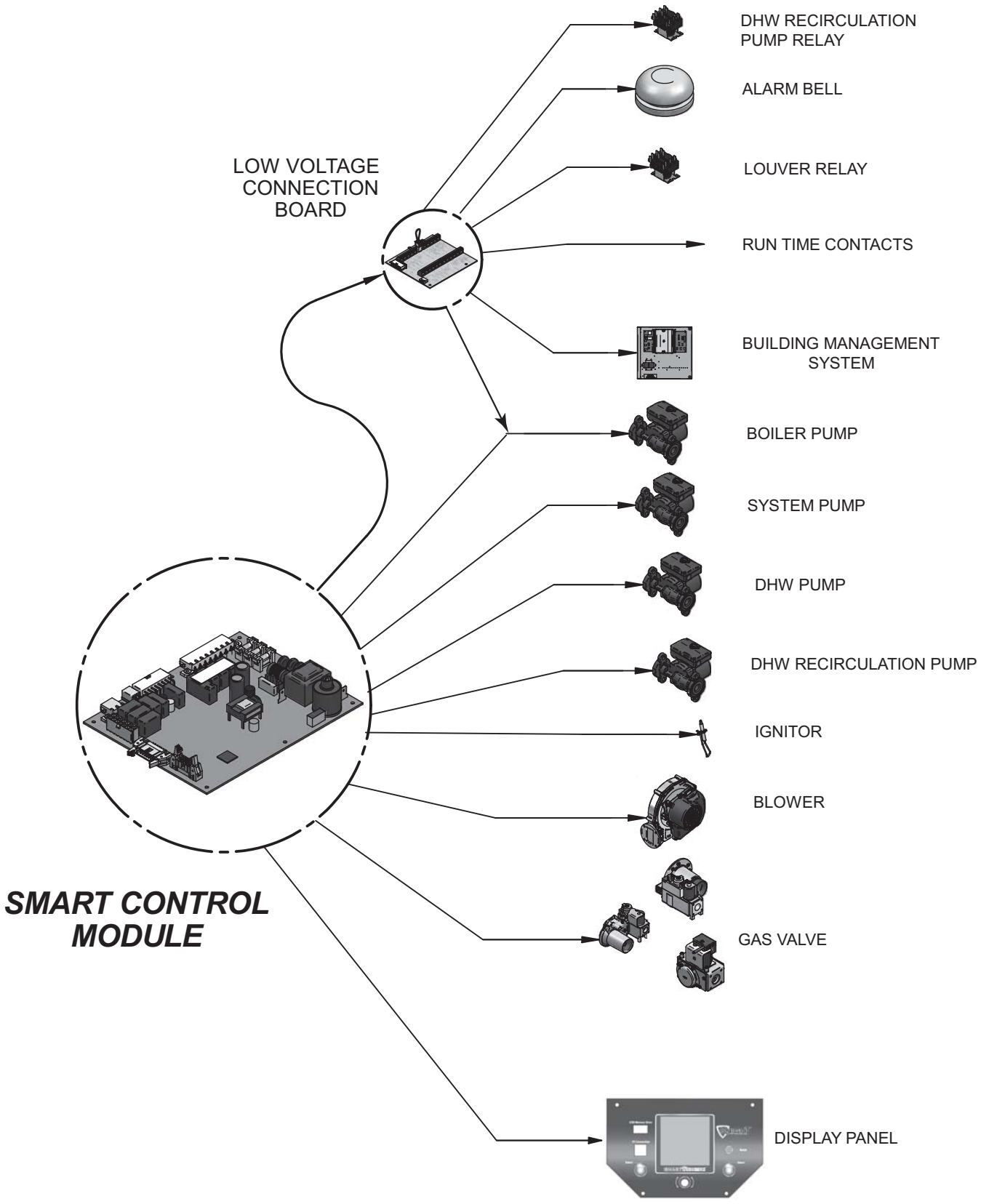
1 Service *(continued)*

Control inputs



1 Service

Control outputs



1 Service *(continued)*

General Operation

How the boiler operates

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

How the control module operates

The Knight Wall Hung Fire Tube boiler control module receives input from boiler sensors. The control module activates and controls the blower and gas valve to regulate heat input and switches boiler, DHW, DHW recirculation, and system pumps on and off as needed. The user/installer programs the module to meet system needs by adjusting control parameters. These parameters set operating temperatures and boiler operating modes. Boiler operation can be based on boiler outlet water temperature, boiler return water temperature or system supply temperature, depending on the parameter setting.

Sequence of operation

Table 1-1 shows control module normal sequences of operation for space heating and DHW operation. The combined operation sequence is for a typical application, programmed to provide DHW priority.

Access modes

User

The user can adjust space heating and tank target temperatures by pressing the NAVIGATION dial when "↓SETPOINTS" is flashing at the bottom of the display. The date and time, and the temperature units can also be changed.

Installer

Most parameters are available only to the installer, accessible by entering the installer password (5309).

Saving parameters *(reference the Parameter Table - Table 1-4 on pages 15 - 18 of this manual)*

NOTICE Please note that the brackets ([]) denote screen status.

To save parameters and exit programming:

Press the RIGHT SELECT [SAVE] key and then press the RIGHT SELECT [HOME] key.

To enter a parameter and continue programming:

Press the RIGHT SELECT [SAVE] key 1 time to return to the parameter listings; press again to return to the menu listings. Remember to press the RIGHT SELECT [HOME] key when finished programming in order to save the changes made.

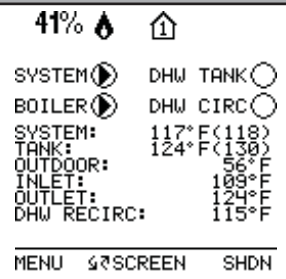
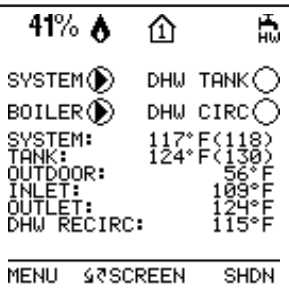
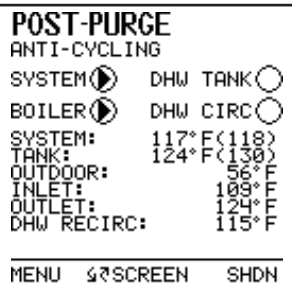
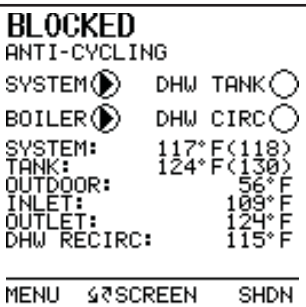
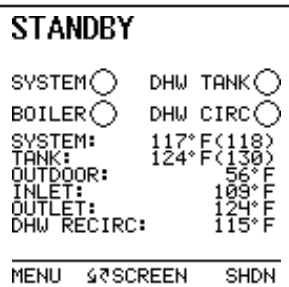
1 Service

Table 1-1 *Sequence of Operation*

OPERATION	DISPLAY
1. Upon a call for heat, the gas pressure switch(es) must be closed.	STANDBY SYSTEM ○ DHW TANK ○ BOILER ○ DHW CIRC ○ SYSTEM: 117°F(118) TANK: 124°F(130) OUTDOOR: 56°F INLET: 109°F OUTLET: 124°F DHW RECIRC: 115°F MENU SCREEN SHDN
2. Once the gas pressure switch(es) are closed, the control turns on the appropriate pumps (system and boiler pumps for space heating, DHW pump for DHW). The flow switch and/or LWCO must close.	STANDBY SYSTEM ▶ DHW TANK ○ BOILER ▶ DHW CIRC ○ SYSTEM: 117°F(118) TANK: 124°F(130) OUTDOOR: 56°F INLET: 109°F OUTLET: 124°F DHW RECIRC: 115°F MENU SCREEN SHDN
3. The control turns on power to the louver relay. The louver proving switch, and blocked drain / air pressure switch must close.	START SYSTEM ▶ DHW TANK ○ BOILER ▶ DHW CIRC ○ SYSTEM: 117°F(118) TANK: 124°F(130) OUTDOOR: 56°F INLET: 109°F OUTLET: 124°F DHW RECIRC: 115°F MENU SCREEN SHDN
4. The control starts a prepurge cycle by starting the blower.	PRE-PURGE SYSTEM ▶ DHW TANK ○ BOILER ▶ DHW CIRC ○ SYSTEM: 117°F(118) TANK: 124°F(130) OUTDOOR: 56°F INLET: 109°F OUTLET: 124°F DHW RECIRC: 115°F MENU SCREEN SHDN
5. The control starts a trial for ignition by firing the spark electrode and opening the gas valve.	IGNITION SYSTEM ▶ DHW TANK ○ BOILER ▶ DHW CIRC ○ SYSTEM: 117°F(118) TANK: 124°F(130) OUTDOOR: 56°F INLET: 109°F OUTLET: 124°F DHW RECIRC: 115°F MENU SCREEN SHDN
6. If 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. The control will perform a total of 4 attempts before locking out.	POST-PURGE SYSTEM ▶ DHW TANK ○ BOILER ▶ DHW CIRC ○ SYSTEM: 117°F(118) TANK: 124°F(130) OUTDOOR: 56°F INLET: 109°F OUTLET: 124°F DHW RECIRC: 115°F

1 Service *(continued)*

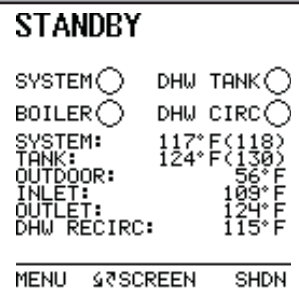
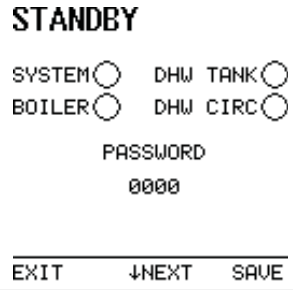
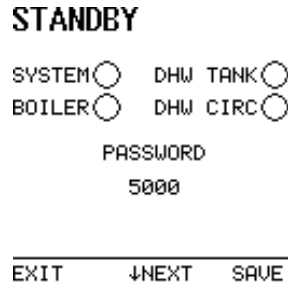
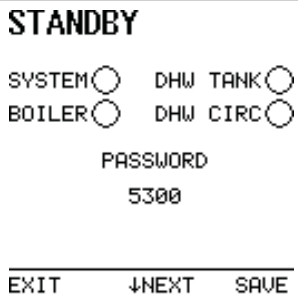
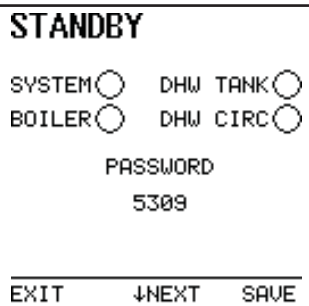
***Table 1-1** (continued from previous page) Sequence of Operation*

OPERATION	DISPLAY
7. If flame is detected, it holds the firing rate steady for a few seconds to let the flame stabilize, then it begins to modulate the firing rate based on a set point or some other command (such as a 0-10V BMS signal).	
8. If the space heating call for heat is active, and the tank thermostat or sensor starts a DHW call for heat, the boiler will switch to the DHW mode. If programmed for normal DHW operation (not as a zone), the DHW pump will turn on first, then the boiler pump will turn off (boiler and DHW pump operation briefly overlap to ensure flow is maintained through the unit). This will divert the boiler's outlet water from the heating system and send it to the tank coil instead. The control will then modulate to maintain the outlet temperature to the DHW boiler set point.	
9. If the boiler is not part of a Cascade, and both the space heating and DHW calls for heat remain active long enough, the boiler will switch back and forth between the two heating modes until one of them is satisfied.	
10. Once both calls for heat are satisfied, the control will turn off the burner. The blower will continue to run during the postpurge period.	
11. Any pumps that are running will continue to run for their respective pump delay times before turning off, unless programmed to remain on continuously. A 60 second anti-cycle period will start, which will delay any new call for heat until it times out.	
12. In Standby, ready to start a new cycle.	

1 Service

Display panel menu access

Table 1-2 *Use this procedure to access menus from the display panel*

BUTTON	SCREEN STATUS	OPERATION	DISPLAY
	[MENU]	Press and hold the LEFT SELECT soft key [MENU] for five (5) seconds.	
		Rotate the NAVIGATION dial clockwise until 5 is displayed (first digit on the left).	
		Press the NAVIGATION dial to select the next digit. Rotate the NAVIGATION dial clockwise until 3 is shown in the display.	
		Press the NAVIGATION dial 2 times to move to the last digit. Rotate the NAVIGATION dial counterclockwise until 9 is displayed.	
	[SAVE]	Press the RIGHT SELECT soft key [SAVE].	

1 Service *(continued)*

Display panel parameter access

Table 1-3 *This is a typical example of accessing a parameter, shown for parameter Temperature Settings, MIN SH Setpt*

BUTTON	SCREEN STATUS	OPERATION	DISPLAY
This example shows how to access parameter Temperature Settings. The first display shown is at the beginning of the menu listings, after entering the installer access code.			
		Rotate the NAVIGATION dial counterclockwise until the arrow (>) is next to ***TEMPERATURE SETTINGS***.	STANDBY SYSTEM ◯ DHW TANK ◯ BOILER ◯ DHW CIRC ◯ PASSWORD 5309 EXIT ↓NEXT SAVE
		Press the NAVIGATION dial one time.	STANDBY SYSTEM ◯ DHW TANK ◯ BOILER ◯ DHW CIRC ◯ GENERAL >TEMPERATURE SETTINGS DATA LOGGING FUNCTIONS DHW SETTINGS ANTI-CYCLING CONTROL MODES HOME ↕SCROLL
		Rotate the NAVIGATION dial counterclockwise until the arrow (>) is next to ***MIN SETPT***.	STANDBY SYSTEM ◯ DHW TANK ◯ BOILER ◯ DHW CIRC ◯ >SH1 SETPT: 125°F MIN SH SETPT: 60°F MAX SH SETPT: 185°F SH1 OFFSET: 10°F SH1 DIFF: 20°F SH2 SETPT: 125°F SH2 DIFF: 10°F EXIT ↕SCROLL HOME
		Press the NAVIGATION dial one time.	STANDBY SYSTEM ◯ DHW TANK ◯ BOILER ◯ DHW CIRC ◯ SH1 SETPT: 125°F >MIN SH SETPT: 60°F MAX SH SETPT: 185°F SH1 OFFSET: 10°F SH1 DIFF: 20°F SH2 SETPT: 125°F SH2 DIFF: 10°F EXIT ↕SCROLL HOME
		Rotate the NAVIGATION dial to the desired temperature.	STANDBY SYSTEM ◯ DHW TANK ◯ BOILER ◯ DHW CIRC ◯ SH1 SETPT: 125°F >MIN SH SETPT: 60°F MAX SH SETPT: 185°F SH1 OFFSET: 10°F SH1 DIFF: 20°F SH2 SETPT: 125°F SH2 DIFF: 10°F EXIT ↕ADJUST SAVE

1 Service

Display panel parameter access (cont.)

Table 1-3 *This is a typical example of accessing a parameter, shown for parameter Temperature Settings, MIN SH Setpt*

BUTTON	SCREEN STATUS	OPERATION	DISPLAY
This example shows how to access parameter Temperature Settings. The first display shown is at the beginning of the menu listings, after entering the installer access code.			
Select	[SAVE]	Press the RIGHT SELECT soft key [SAVE] one time.	STANDBY SYSTEM ◯ DHW TANK ◯ BOILER ◯ DHW CIRC ◯ SH1 SETPT: 125°F >MIN SH SETPT: 40°F MAX SH SETPT: 185°F SH1 OFFSET: 10°F SH1 DIFF: 20°F SH2 SETPT: 125°F SH2 DIFF: 10°F EXIT ↕ADJUST SAVE
Select	[EXIT]	Press the LEFT SELECT soft key [EXIT] if all desired changes have been made.	STANDBY SYSTEM ◯ DHW TANK ◯ BOILER ◯ DHW CIRC ◯ SH1 SETPT: 125°F >MIN SH SETPT: 40°F MAX SH SETPT: 185°F SH1 OFFSET: 10°F SH1 DIFF: 20°F SH2 SETPT: 125°F SH2 DIFF: 10°F EXIT ↕SCROLL HOME
Select	[HOME]	Press the LEFT SELECT soft key [HOME].	STANDBY SYSTEM ◯ DHW TANK ◯ BOILER ◯ DHW CIRC ◯ GENERAL >TEMPERATURE SETTINGS DATA LOGGING FUNCTIONS DHW SETTINGS ANTI-CYCLING CONTROL MODES HOME ↕SCROLL
Wait for the new settings to be saved.			STANDBY SYSTEM ◯ DHW TANK ◯ BOILER ◯ DHW CIRC ◯ Uploading parameters Please wait..

1 Service *(continued)*

Parameter table

Table 1-4 *This table lists SMART SYSTEM control module parameters and where to access them*

Menu	Description	See Page	User Access	Installer Access
GENERAL	Vacation Mode (On/Off)	19	Yes	Yes
	Time and Date	19	Yes	Yes
	Software Version (read only)	19	No	Yes
	Temperature Units (ºC/ºF)	19	Yes	Yes
	SH Night Setback Offset IF SH NSB > 0: i. SH Night Setback On Times ii. SH Night Setback Off Times	19	No	Yes
	DHW Night Setback Offset IF DHW NSB > 0: i. DHW Night Setback On Times ii. DHW Night Setback Off Times	20	No	Yes
	Display Timeout	20	No	Yes
	Display Contrast	20	Yes	Yes
TEMPERATURE SETTINGS	SH1 Set Point User	20	Yes	Yes
	Minimum SH Set Point	20	No	Yes
	Maximum SH Set Point	20	No	Yes
	Offset SH1 Set Point	20	No	Yes
	Differential SH1 Set Point	20	No	Yes
	SH2 Set Point User	20	Yes	Yes
	Offset SH2 Set Point	20	No	Yes
	Differential SH2 Set Point	20	No	Yes
	SH3 Set Point User	20	Yes	Yes
	Offset SH3 Set Point	20	No	Yes
	Differential SH3 Set Point	20	No	Yes
	3-Way Valve Time	20	No	Yes
DATA LOGGING	Reset Last 10 Errors	20	No	Yes
FUNCTIONS	Service Mode Delay	21	No	Yes
	Freeze Protection Pump On	21	No	Yes
	Freeze Protection Burner On	21	No	Yes
	Freeze Protection Burner Differential	21	No	Yes
DHW SETTINGS	Tank Set Point	21	Yes	Yes
	Tank Set Point Differential	21	No	Yes
	DHW Boiler Set Point	21	No	Yes
	Boiler Set Point Offset	21	No	Yes
	Boiler Set Point Differential	21	No	Yes
	DHW Recirc Pump Offset	21	No	Yes
	DHW Recirc Pump Differential	21	No	Yes

1 Service

Parameter table

Table 1-4 *(continued from previous page) This table lists SMART SYSTEM control module parameters and where to access them*

Menu	Description	See Page	User Access	Installer Access
DHW SETTINGS (CONT.)	Tank Minimum Set Point	22	No	Yes
	Tank Maximum Set Point	22	No	Yes
	DHW Max Rate	22	No	Yes
	DHW Type (normal, zone) i. SH/DHW Switching Time ii. DHW/SH Switching Time ELSE: i. DHW FORCES SYSP (YES/NO) ii. DHW BLOCKS SYSP (YES/NO)	22	No	Yes
OUTDOOR RESET	IF Outdoor Sensor Connected:			
	Low Outdoor Temperature 1	22	No	Yes
	High Outdoor Temperature 1	22	No	Yes
	SH1 Set Point at Low Outdoor Temp	23	No	Yes
	SH1 Set Point at High Outdoor Temp	23	No	Yes
	Outdoor Shutdown Temp 1	23	No	Yes
	Outdoor Shutdown Differential 1	23	No	Yes
	Shift Heat Curve 1	23	No	Yes
	Low Outdoor Temperature 2	23	No	Yes
	High Outdoor Temperature 2	23	No	Yes
	SH2 Set Point at Low Outdoor Temp	23	No	Yes
	SH2 Set Point at High Outdoor Temp	23	No	Yes
	Outdoor Shutdown Temp 2	23	No	Yes
	Outdoor Shutdown Differential 1	23	No	Yes
	Shift Heat Curve 2	23	No	Yes
	Low Outdoor Temperature 3	23	No	Yes
	High Outdoor Temperature 3	23	No	Yes
	SH3 Set Point at Low Outdoor Temp	23	No	Yes
	SH3 Set Point at High Outdoor Temp	23	No	Yes
	Outdoor Shutdown Temp 3	23	No	Yes
	Shift Heat Curve 3	23	No	Yes
	Boost Temperature IF Boost Temperature > 0 i. Boost Time	24	No	Yes

1 Service *(continued)*

Parameter table

Table 1-4 *(continued from previous page) This table lists SMART SYSTEM control module parameters and where to access them*

Menu	Description	See Page	User Access	Installer Access
ANTI-CYCLING	Anti-cycling Time	24	No	Yes
	Anti-cycling Override Differential	24	No	Yes
	Ramp Delay (Enable/Disable)	24	No	Yes
	Modulation Factor	24	No	Yes
CONTROL MODES	Controlling Sensor(Outlet/System Supply/Inlet)	25	No	Yes
	Cascade Address IF Address = 0: Maximum Cascade Outlet Set Point Cascade Offset Cascade Differential Cascade Type (L/L, EFF) Minimum On/Off Time Minimum Next On Time Minimum Pumps On ELSE IF Address = 1: Alternate Leader? (Y/N) IF Yes: Maximum Cascade Outlet Set Point Cascade Offset Cascade Differential Cascade Type (L/L, Eff) Minimum On/Off Time Minimum Next On Time Minimum Pumps On	25	No	Yes
	Boiler Size i. Cascade Address ii. Type iii. Input	26	No	Yes
	BMS (Active, Inactive) IF Active: i. BMS Type (Power, Set Point) IF Power: 1. Power at Minimum Volts 2. Power at Maximum Volts ELSE: 1. Set Point at Minimum Volts 2. Set Point at Maximum Volts ii. Minimum Volts iii. Maximum Volts iv. TStat Input (Active, Inactive) IF Inactive: 1. On Volts 2. Off Differential Volts	27	No	Yes
	ModBus/BACNet (Active, Inactive) IF Active: i. BAS Timeout	27	No	Yes

1 Service
Parameter table

Table 1-4 *(continued from previous page) This table lists SMART SYSTEM control module parameters and where to access them*

Menu	Description	See Page	User Access	Installer Access
CIRCULATION PUMPS	System Pump Delay	28	No	Yes
	Boiler Pump Delay	28	No	Yes
	DHW Pump Delay	28	No	Yes
	System Pump Anti-Seize Delay	28	No	Yes
	Boiler Pump Anti-Seize Delay	28	No	Yes
	DHW Pump Anti-Seize Delay	28	No	Yes
	System Pump Type (CFH, WWSD)	28	No	Yes
	Boiler Pump Delta T Set Point	28	No	Yes
	Boiler Pump Minimum Volts	28	No	Yes
SERVICE NOTIFICATION	Service Notification Months	28	No	Yes
	Service Notification Running Time	28	No	Yes
	Service Notification Cycles	28	No	Yes
	Reset Service Reminder	29	No	Yes
	Installer Name	29	No	Yes
	Installer Phone Number	29	No	Yes
BASIC SETUP	Time & Date	29	No	Yes
	IF Outdoor Sensor Connected: i. Low Outdoor Temperature 1 ii. High Outdoor Temperature 1 iii. SH1 Set Point at Low Outdoor Temperature iv. SH1 Set Point at High Outdoor Temperature v. Outdoor Shutdown Temperature vi. Outdoor Shutdown Differential 1	29	No	Yes
	Cascade Address IF Address = 0: i. Maximum Cascade Set Point ii. Cascade Offset iii. Cascade Differential iv. Cascade Type (L/L, EFF)	29	No	Yes
	BMS (Active, Inactive) IF Active: i. BMS Type (Power, Set Point) IF Power: 1. Power at Minimum Volts 2. Power at Maximum Volts ELSE: 1. Set Point at Minimum Volts 2. Set Point at Maximum Volts ii. Minimum Volts iii. Maximum Volts iv. TStat Input (Active, Inactive) IF Inactive: 1. On Volts 2. Off Differential Volts	29	No	Yes
USB	IF USB Drive Contains “Lochinvar” Folder: Existing Parameter Files Displayed ELSE IF USB Drive Does Not Contain “Lochinvar” Folder: Option to Create “Lochinvar” Folder	29	No	Yes

1 Service *(continued)*

Viewable and changeable control parameters

CAUTION Before changing parameters, note the settings so that the unit can be returned to its original operating parameters.

General

Vacation Mode

This parameter forces the Space Heating (SH) and DHW set points to decrease by the amounts programmed in the Night Setback Offset parameters. It is used to save energy, such as when the building is unoccupied for an extended period of time. For this function to work, the *Space Heating Night Setback Offset* and/or *DHW Night Setback Offset parameters* must be set to a value higher than 0°. The default value of this parameter is OFF.

Time and Date

The control uses an internal clock for the night setback feature and for logging of events. For these features to work correctly, the clock must be set when the boiler is first installed or anytime the boiler has been powered off for more than four (4) hours. This parameter must be accessed to set the clock.

NOTICE The internal clock does not adjust for Daylight Savings Time and therefore, will require a manual adjustment.

The clock is automatically updated whenever a PC is connected and the Win_Pro-Installer program is started.

Software Version

The software version allows the user to view the software version in use by the control. This software controls the operation of the boiler. When a new software version becomes available, the existing control can be replaced with a new control to update the software.

Software version is read only.

Temperature units (°C / °F)

The control can be configured to display temperature in either °C or °F. This parameter can be changed by the user or the installer by accessing the *Temperature Units parameter*. The default is °F.

Space Heating (SH) and Domestic Hot Water (DHW) Night Setback Offset

Once the unit's internal clock has been set correctly, the Night Setback feature can be used to program a lower set point during unoccupied times. Both the space heating and DHW can be programmed for night setback. When in night setback, the control reduces the set point by a fixed amount. For space heating, it subtracts the space heating night setback offset from each of the SH user set points *(SH1, 2, and 3 Set point parameters)*, or the calculated outdoor reset set point (if lower). For DHW, it subtracts the DHW night setback offset from the tank set point *(Tank Set point parameter)*.

NOTE: The DHW night setback will not work without a tank sensor installed.

The installer may adjust the space heating night setback offset by accessing the *SH Night Setback Offset parameter* and the DHW night setback offset by accessing the *DHW Night Setback Offset parameter*. The minimum setting is 0°F (0°C) and the maximum setting is 90°F (50°C).

Space Heating (SH) and Domestic Hot Water (DHW) Night Setback On and Off Times

These are the times at which the SH Night Setback and DHW Night Setback Offsets become active and inactive. There are seven (7) stop times and seven (7) start times each for the SH and DHW night setback functions. Any start or stop time may be set to any time during the week. When a start time and a stop time are programmed for the same day and time, the stop time has priority (this is how a start time can be disabled). The installer can adjust the SH Night Setback start and stop times by accessing the parameter *SH NSB On/Off Times*. The installer can access the DHW Night Setback start and stop times by accessing the *DHW NSB On/Off Times parameter*. These settings can be adjusted as follows:

1. When the screen is first accessed, start and stop triggers 1 are displayed. If a different trigger number is desired, rotate the NAVIGATION dial until the desired trigger number appears. Once it is found, press the NAVIGATION dial to adjust the start and stop times. The day of the week for the start time will flash.

2. Rotate the NAVIGATION dial to adjust the day of the week of the start trigger. Once it is set to the desired day of the week, press the NAVIGATION dial again. The start time hour will flash.

3. Rotate the NAVIGATION dial to adjust the start time hour to the desired time. Press the NAVIGATION dial again. The start time minutes will flash.

4. This process may be continued until the start and stop days and times are adjusted as desired. When finished with this set of triggers, press the [SAVE] key.

5. Rotate the NAVIGATION dial to select another set of start and stop triggers, or press the [EXIT] key to return to the previous menu.

1 Service

Night Setback Override

Any Night Setback On trigger currently active or scheduled within the next seven (7) days can be skipped. To skip a trigger, go to the Night Setback Status Screen and press the SKIP button. Rotate the NAVIGATION dial until the arrow (>) is next to the trigger you wish to skip. Press the NAVIGATION dial once. "SK" will appear next to that trigger to indicate that it will be skipped. You can restore an upcoming trigger by selecting that trigger, and pressing the NAVIGATION dial again. The "SK" next to that trigger will disappear.

To save any changes and return to the Home Screen, press the RIGHT SELECT [HOME] key. To return to the Status Screen without saving the changes, press the LEFT SELECT [EXIT] key.

Display Timeout

This is the time in which the display remains illuminated. The range is 10 seconds to 10 minutes. The default is 10 minutes.

Display Contrast

The contrast of the LCD display can be adjusted to improve readability. The contrast is adjusted automatically when the display board is tested at the factory, but different ambient conditions may warrant changing the setting. This parameter can be changed by accessing the *Display Contrast* setting. The range of this parameter is -10 to +10. The default setting is 0.

Temperature Settings

Space Heating (SH1, SH2, SH3) Set Point

CAUTION Mixing valves are required for the protection of any low temperature loops.

There are three (3) individual user set points for better zone control. These are listed as SH1 Set Point through SH3 Set Point. If multiple set points are calling for heat the highest set point has priority. The range is *SH Minimum Set point* to *SH Maximum Set point*. The default is 125°F (52°C).

Space Heating (SH) Minimum Set Point

The SH minimum set point sets the minimum water temperature set point that can be used for space heating operation. The user or installer will not be able to program the control with a lower SH set point. This parameter can only be changed by the installer by accessing *Minimum SH Set point parameter*. The temperature range of this parameter is 32°F (0°C) to the space heating maximum set point. The default value is 60°F (16°C).

Space Heating (SH) Maximum Set Point

The SH maximum set point sets the maximum water temperature set point that can be used for space heating. The user or installer will not be able to program the control with a higher SH set point. This parameter can only be changed by the installer by accessing *Maximum SH Set point parameter*. The temperature range of this parameter is the space heating minimum set point to 190°F (88°C). The default value is 185°F (85°C).

SH1 - SH3 Offset Set Point

The SH offset sets how many degrees above set point the temperature has to go before the boiler will shut off. This parameter can only be changed by the installer by accessing parameters *SH1, 2 and 3 Offset Set point parameters*. The temperature range of these parameters is 0°F to 20°F. The default value is 10°F.

SH1 - SH3 Differential Set Point

The SH differential sets how many degrees below the offset the temperature has to drop before the boiler turns back on. This parameter can only be changed by the installer by accessing the *SH1, 2 and 3 Differential Set point parameters*. The range is 0°F to 60°F. The default is 20°F.

3-Way Valve Time

The optional Lochinvar Multi-Temperature Loop Control Board (MTLC) can be used to control the supply temperature in up to three (3) sub-loops, corresponding to each of the three (3) SH set points, through the use of 3-way mixing valves. To ensure the MTLC will control these temperature properly, it is necessary to let the control know how much time these mixing valves require to fully open and close. Program this time into the *3-Way Valve Time* parameter. Since this parameter applies to all of the mixing valves used, the actual open/close time must be approximately the same for each one. The minimum setting is 1 second, and the maximum setting is 255 seconds. The default setting is 20 seconds.

Data Logging

Reset log errors

The reset log errors function clears the last 10 errors log.

1 Service *(continued)*

Functions

Service Mode Delay

By pressing the pin button on the front of the display for five (5) seconds, the control will be placed in Service Mode. This will override all other heat demands. The Service Mode allows the installer to set the unit to any firing rate for the purpose of combustion analysis. The delay sets the length of time the boiler will stay in the Service Mode if no keys have been pressed before going back to its original state. This parameter can only be changed by the installer by accessing the *Service Mode Delay parameter*. The time range of this parameter is 1 to 10 minutes. The default value is 10 minutes.

Freeze Protection Pump On

The SMART SYSTEM control will turn on the boiler and system pump outputs whenever the inlet temperature drops below this setting. This is done to prevent the water in the heat exchanger from freezing. Certain low-temperature applications (such as snow melt) can operate at temperatures around freezing, so this setting needs to be lowered in these cases. The installer can adjust the temperature at which the pump outputs are turned on by accessing the *Freeze Protection Pump On parameter*. The minimum setting is -4°F (-20°C), and the maximum setting is 45°F (7.2°C). The default setting is 45°F (7.2°C).

Freeze Protection Burner On

If running the pumps does not prevent the inlet temperature from falling closer to freezing, the SMART SYSTEM control will fire the burner at low fire. The installer can adjust the temperature at which the burner fires by adjusting the F*reeze Protection Burner On parameter*. The minimum setting is -4°F (-20°C), and the maximum setting is the *Freeze Protection Pump On parameter*. The default setting is 37°F (2.8°C).

Freeze Protection Burner Differential

Once the burner has started firing due to a low inlet temperature, the inlet temperature must increase by this amount before the burner turns back off. The installer can adjust this differential by accessing the *Freeze Protection Burner Differential parameter*. The minimum setting is 0°, and the maximum is 20°F (11°C). The default setting is 5°F (2.8°C).

DHW Settings

DHW Tank Set Point

By installing a tank sensor, the SMART SYSTEM control can perform the tank thermostat function. The SMART SYSTEM control automatically detects the presence of this sensor, and generates a DHW call for heat when the tank temperature drops below the tank set point differential (*Tank Set point Differential parameter)*, and finishes the call for heat when the tank temperature reaches tank set point. This parameter can be changed by the installer by accessing the *DHW Tank Set point parameter*. The temperature range of this parameter is from the tank minimum set point to the tank maximum set point. The default value is 120°F (49°C).

Tank Set Point Differential

When a tank sensor is installed, the tank temperature must drop this amount below the tank set point (*DHW Tank Set point parameter*) before the boiler turns back on. The installer can adjust this setting by accessing the *Tank Set point Differential parameter*. The minimum setting is 0° (0°C), and the maximum is 40°F (22°C). The default setting is 6°F (3°C).

DHW Boiler Set Point

When a DHW call for heat becomes active, the control will use the DHW boiler set point to determine the firing rate of the boiler based on the boiler outlet water temperature, or system temperature when DHW is programmed as a zone. This parameter can be changed by the installer by accessing the *DHW Boiler Set point parameter*. The temperature range of this parameter is 68°F (20°C) to 190°F (88°C). The default value is 180°F (82°C).

DHW Boiler Offset

This parameter reflects the degrees above DHW boiler set point the temperature has to go before the boiler will shut off. The range is 0°F (0°C) to 20°F (11°C). The default setting is 5°F (2.8°C).

DHW Boiler Differential

This parameter reflects the degrees below DHW boiler offset set point the temperature has to go before the boiler turns back on. The range is 0°F (0°C) to 60°F (33°C). The default setting is 10°F (6°C).

DHW Recirculation Pump Offset (Recirculation Pump)

The SMART SYSTEM control will turn the DHW recirculation pump on when the DHW return water temperature drops below the *DHW Tank Set Point* minus the *DHW Recirculation Pump Offset*. The range for this parameter is 0° to 54°F (30°C). The default value is 10°F (5°C).

DHW Recirculation Pump Differential

Once the SMART SYSTEM control turns the DHW recirculation pump on, the DHW return water temperature must increase by the *DHW Recirculation Pump Differential* before the control turns the DHW recirculation pump back off. The range of this parameter is 0° to 90°F (50°C). The default value is 5°F (2°C).

Tank Minimum Set Point

This setting controls the minimum tank set point for the tank temperature. The installer can adjust this by accessing the *Tank Minimum Set point parameter*. The minimum setting is 60°F (16°C) and the maximum setting is the maximum tank set point *(Tank Maximum Set point parameter)*. The default value is 60° (16°C).

Tank Maximum Set Point

This setting controls the maximum tank set point for the tank temperature. The installer can adjust this by accessing the *Tank Maximum Set point parameter*. The minimum setting is the minimum tank set point *(Tank Minimum Set point parameter)* and the maximum setting is 190°F (88°C). The default value is 140°F (60°C).

1 Service

Fan Speed Limiting for Indirect DHW Tank

This parameter determines the maximum fan speed (and therefore the maximum rate) to be used when heating an indirect DHW tank. This setting may be used when the tank is unable to accept all of the BTU's available from the boiler. This parameter may be adjusted by the installer by accessing the F*an Speed Limiting for Indirect DHW Tank parameter*. The default value is the maximum fan speed for that model.

DHW Type

This parameter determines whether the Knight Wall Hung Fire Tube boiler treats the indirect DHW tank as a separate load, or as a zone on the primary loop. When programmed as a separate load, the boiler will turn on the DHW pump and then turn off the boiler pump when an indirect DHW demand begins. When programmed as a zone, the boiler will turn on the DHW pump, leave the boiler pump on and change the system set point to the DHW boiler set point *(DHW Boiler Set point parameter)*.

This setting may be changed by the installer by accessing the *DHW Type parameter*. The choices are NORMAL and ZONE. The default setting is NORMAL.

SH/DHW Switching Time

When a boiler has a space heating demand and it receives a DHW demand, it will immediately switch to the DHW demand and start a timer. Once the timer has expired, the boiler will switch back to the space heating demand and start another timer. Once this other timer expires, it will switch back to the DHW demand. The installer can adjust the length of time the boiler will service the space heating demand by accessing the *SH/DHW Switching Time parameter*. The minimum setting is 0 minutes and the maximum setting is 55 minutes. The default time is 30 minutes.

DHW/SH Switching Time

When a boiler has a DHW demand and it receives a space heating demand, the SMART SYSTEM control will start a timer. Once the timer expires, it will stop the DHW demand and service the space heating demand. The installer can adjust the length of time the boiler will service the DHW demand by accessing the *DHW/SW Switching Time parameter*. The minimum setting is 0 minutes and the maximum setting is 55 minutes. The default setting is 30 minutes.

DHW Forces Sys Pump

When the indirect DHW tank is connected as a zone on the primary loop, the *DHW Forces Sys Pump* parameter tells the system pump if it must run when there is a DHW demand. To have the system pump constantly running during a DHW demand, set the *DHW Forces Sys Pump* parameter to YES (the parameter *DHW Blocks Sys Pump* must be set to NO). If this parameter and the *DHW Blocks Sys Pump* parameter are both set to NO, the system pump operation will be based strictly on the *System Pump Type* parameter setting. The default setting of this parameter is YES.

DHW Blocks Sys Pump

When the indirect DHW tank is connected as a zone on the primary loop, the *DHW Blocks Sys Pump* parameter tells the system pump if it is allowed to run during a DHW demand. To force the system pump to turn off during a DHW demand, set the *DHW Blocks Sys Pump* parameter to YES. The default setting is NO.

Outdoor Reset

Knight Wall Hung Fire Tube boilers are equipped with outdoor reset, a feature that saves energy by reducing the boiler water temperature as the heating load decreases. In accordance with the United States Energy Policy and Conservation Act, boilers with inputs less than 300,000 Btu/hr must use either outdoor air reset or an external energy management system. To use the outdoor reset feature, the outdoor sensor provided with the boiler must be properly installed.

For better zone control, three (3) individual outdoor resets for low outdoor temperatures are available. If multiple zones are calling for heat, the highest set point has priority. Each curve is created using four (4) adjustable parameters: low outdoor air temperature, high outdoor air temperature, set point at low outdoor air temperature, and set point at high outdoor air temperature. The set point is calculated using the individual curve for each zone.

Outdoor (1 - 3) Low

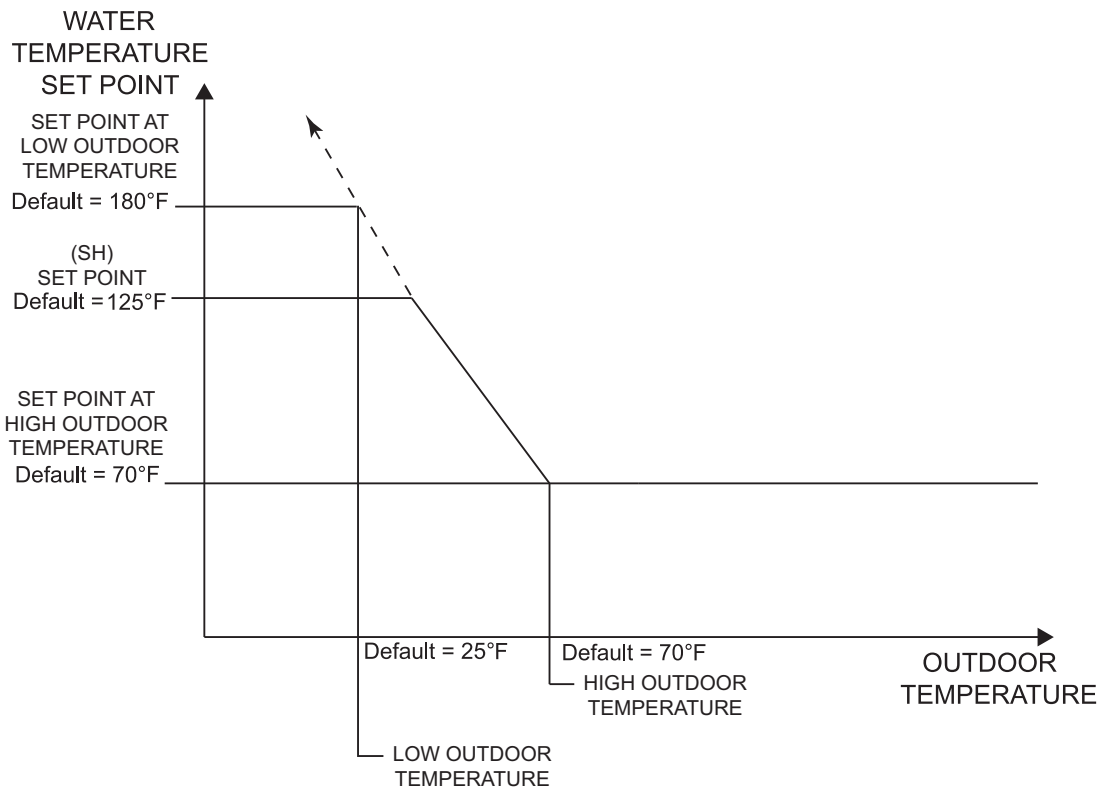
When the outdoor air temperature drops to this point, the water temperature will be at the *Set point 1 at Low Outdoor Temp 1, Set point 2 at Low Outdoor Temp 2 and Set point 3 at Low Outdoor Temp 3 parameters* (FIG. 1-1 on page 23). If the outdoor air temperature drops further, the set point will continue to increase above this setting. This parameter can be changed by the installer by accessing the *Outdoor (1-3) Low parameter*. The temperature range of this parameter is -39°F (-39°C) to high outdoor temperature set point. The default value is 25°F (-4°C).

Outdoor (1 - 3) High

When the outdoor air temperature rises to or above this point, the water temperature will be at the *Set point 1 at High Outdoor Temp 1, Set point 2 at High Outdoor Temp 2 and Set point 3 at High Outdoor Temp 3 parameters* (FIG. 1-1 on page 23). This parameter can be changed by the installer by accessing the *Outdoor (1-3) High parameter*. The temperature range of this parameter is low outdoor temperature set point to 104°F (40°C). The default value is 70°F (21°C).

1 Service *(continued)*

Figure 1-1 *Outdoor Air Reset Curve*



Set Point (1 - 3) at Low Outdoor Temperature

When the outdoor air temperature drops to the *Outdoor (1 - 3) Low parameters*, the calculated set point will be at this setting (FIG. 1-1). If the outdoor air temperature drops further, the set point will continue to increase above this setting. However, if SH1, SH2, and SH3 are set lower, the water temperature will be limited by these set points instead. These parameters can be changed by the installer by accessing the *Set point 1 at Low Outdoor Temp 1, Set point 2 at Low Outdoor Temp 2 and Set point 3 at Low Outdoor Temp 3 parameters*. The temperature range of this parameter is 68°F (20°C) to 190°F (88°C). The default value is 180°C (82°C).

Set Point (1 - 3) at High Outdoor Temperature

When the outdoor air temperature rises to or above *Outdoor (1 - 3) High parameters*, the calculated set point will be at this setting (FIG. 1-1). These parameters can be changed by the installer by accessing the *Set point 1 at High Outdoor Temp 1, Set point 2 at High Outdoor Temp 2 and Set point 3 at High Outdoor Temp 3 parameters.* The temperature range of this parameter is 68°F (20°C) to 190°F (88°C). The default value is 70°F (21°C).

Outdoor Air Shutdown (SH1 - SH3)

When the outdoor temperature rises above this point, the control will block the corresponding SH demand (DHW demands will still be active). These parameters can be changed by the installer by accessing the *Outdoor Air Shutdown SH1, SH2, and SH3 parameters*. The temperature range of this parameter is 32°F (0°C) to 104°F (40°C). The default value is 70°F (21°C).

Outdoor Air Shutdown Differential (SH1 - SH3)

The outdoor air shutdown differential parameter is the number of degrees below *Outdoor Air Shutdown SH1, SH2, and SH3 parameters* the outdoor air temperature must go before the boiler will respond to the corresponding SH demand. These parameters can be changed by the installer by accessing the *Outdoor Air Shutdown Differential SH1, SH2, and SH3 parameters* The temperature range of this parameter is 0°F (0°C) to 54°F (30°C). The default value is 10°F (6°C).

Shift Reset Curve (SH1 - SH3)

There is a shift reset parameter for each outdoor reset curve. The shift reset parameter shifts the actual set point above or below the calculated set point by the number of degrees in this parameter. These parameters can be changed by the installer by accessing the *Shift Reset Curve SH1, SH2, and SH3 parameters*. The temperature range of this parameter is -18°F (-10°C) to 18°F (10°C). The default value is 0°F (0°C). This feature will be active if this parameter is set to anything other than 0°F (0°C).

1 Service

Boost Temperature

If a SH demand lasts longer than the programmed time delay setting and there have been no DHW demands, the control will increase the water temperature set point by the amount in this parameter. If the SH demand continues through another time period, the set point will be increased again. This will continue until either the SH demand ends, a maximum of 20 increases has occurred, or SH1, SH2, SH3 maximum set point has been reached. Once the SH demand has been satisfied the set point will revert back to its calculated setting. The boost temperature can be changed by the installer by accessing the *Boost Temperature parameter*. The temperature range of this parameter is 0°F (0°C) to 25°F (14°C). The default value is 0°F (0°C). This feature will be active if this parameter is set to anything other than 0°F (0°C).

Boost Time

The boost time parameter sets the amount of time that must elapse with a SH demand before the water temperature calculated set point will be increased. This parameter can be changed by the installer by accessing the *Boost Time parameter*. The time range for this parameter is 0 minutes to 55 minutes. The default value is 0 minutes.

Anti-Cycling

Anti-Cycling Time

Once the burner turns off, a set amount of time must elapse before the control will respond to a new demand. The control will block the new heat demand and anti-cycling will be shown in the display until the time has elapsed or the water temperature drops below the *Anti-Cycling Override Differential parameter*. This parameter can be changed by the installer by accessing the *Anti-Cycling Time parameter*. The time range for this parameter is 1 minute to 10 minutes. The default value is 1 minute.

Anti-Cycling Override Differential

The control will bypass the anti-cycling time if the inlet water temperature drops too much. The control will use the inlet water temperature present at the boiler when it shuts off as the starting point. If the inlet temperature drops below the temperature parameter the control will abort anti-cycling and allow the boiler to fire. This parameter can be changed by the installer by accessing the *Anti-Cycling Override Differential parameter*. The temperature range of this parameter is 0°F (0°C) to 54°F (30°C). The default value is 10°F (6°C).

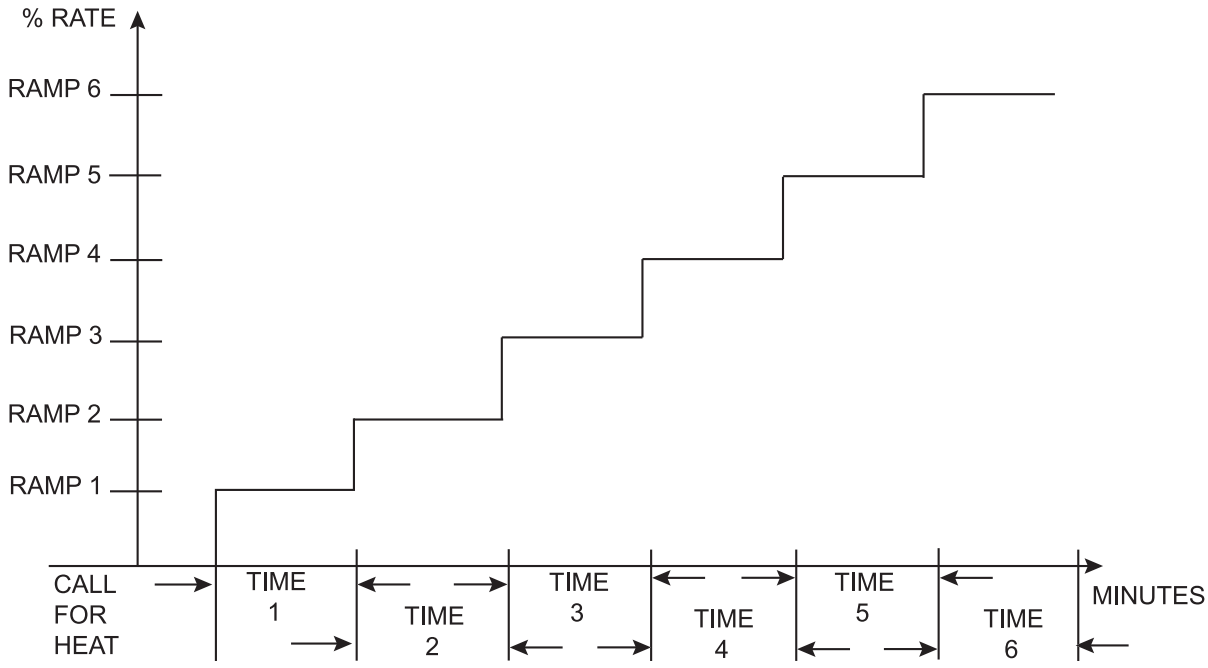
Ramp Delay (Enable / Disable)

This parameter allows the installer to enable or disable the SH ramp delay. The default setting is disabled.

Modulation Factor

This parameter allows the installer to reduce the responsiveness of the temperature control function, for situations where, for example, redundant heating capacity is installed. The values that are available are 40, 50, 60, 70, 80, 90, and 100, with 100 being the most responsive. The default value is 100.

Figure 1-2 *Ramp Delay Interval*



1 Service *(continued)*

Ramp Settings

NOTICE Please note that the brackets ([]) denote screen status.

The SMART SYSTEM control can be programmed to limit the firing rate for a fixed period of time at the start of a space heating or BMS set point demand. There are six (6) possible limits, each with their own time delay. The first limit applies as soon as the burner starts. Once its time delay expires, the second limit is applied and its timer begins. The control steps through these limits until the 6th (sixth) limit expires. Note, however, that the 6th limit will also limit the rate for the rest of that heat demand. The installer can adjust the firing limits and time delays by accessing the *Ramp Settings parameter*. Once this parameter is selected, the screen will show the step number, the time delay for that step and the limit value corresponding with that step. If the installer wishes to adjust one of the values in that step, he can press the NAVIGATION dial until the value he wishes to change is flashing. The installer can then rotate the NAVIGATION dial to adjust that value. If the installer presses the RIGHT SELECT [SAVE] key while the limit value is flashing, the step value will flash again. The installer can then select the next step and adjust the delay and limit values corresponding with that step.

When finished, the installer can press the RIGHT SELECT [SAVE] key to store the new settings, or the LEFT SELECT [EXIT] key to return to the **Anti-Cycling** parameter list without saving the changes. The delay value can be set between 0 minutes and 40 minutes. The limit value can be set between 0% and 100%.

Control modes

Controlling Sensor

The SH controlling sensor parameter selects the sensor the control will use to regulate the boiler firing rate. This parameter is adjustable by the installer by accessing the *Controlling Sensor parameter*. The sensor selections are as follows: The outlet sensor regulates the firing rate based on the outlet water temperature of the boiler and the inlet sensor regulates the firing rate based on the inlet water temperature of the boiler. If the outlet sensor is selected, and the optional system supply sensor is connected, the control will regulate the firing rate based on the system supply sensor temperature. The default sensor is the Outlet Sensor.

Cascade Address

The boiler designated as the Leader needs to be programmed with address 0. All the Member boilers require addresses from 1 to 7, and the addresses must be different for each Member. The addresses can be in any order, regardless of the order in which the units are wired together. This parameter is adjustable by the installer by accessing the *Cascade Address* parameter. The outdoor air (if used) and system supply sensor must be connected to the Leader boiler. The default address is 1.

Maximum Cascade Set Point

This parameter determines the set point used by the individual boilers in a Cascade when a system sensor is connected to the Leader boiler. When a boiler is commanded to fire by the Leader boiler, it will attempt to achieve this temperature at its outlet. The Leader boiler will limit the modulation of the boiler(s) in order to hold the temperature at the system supply sensor to the user set point. If any of the boiler outlet temperatures reach the maximum cascade set point, that boiler will then modulate down on its own in order to keep its outlet temperature within the maximum cascade set point. Therefore, this parameter can be used to limit the outlet temperatures of all the boilers in a Cascade. Note that this parameter does not apply when the boiler is heating an indirect DHW tank programmed as normal. This parameter is adjustable by the installer by accessing the *Maximum Cascade Set Point* parameter**.** The temperature range of this parameter is 32°F (0°C) to 190°F (88°C). The default maximum cascade set point is 185°F (85°C).

Cascade Offset

This parameter determines how much the temperature must go above set point before the lead boiler will turn off. This parameter can be adjusted by the installer by accessing the *Cascade Offset* parameter. The temperature range of this parameter is 0° to 20°F (11°C) The default value is 10°F (6°C).

Cascade Differential

This parameter determines how much the temperature must go below the turn off temperature (Set point + Offset) before the lead boiler turns on. This parameter can be adjusted by the installer by accessing the *Cascade Differential* parameter. The temperature range of this parameter is 0°F to 60°F (33°C) The default value is 20°F (11°C).

Cascade Type (L/L / EFF)

There are two (2) options for the way a Cascade divides the load between its heaters. The first is Lead/Lag, designated as L/L in the menu. This method is used when it is desired to have the least amount of total flow through the boilers. This method will modulate the last two (2) boilers that are firing. This provides for smooth transitions when a boiler turns on or off. When the last boiler reaches 100% and the calculated load is still increasing, it will start the next boiler at 20% and reduce the previous boiler to 80%, thus eliminating the sudden jump in total output of the Cascade. When the calculated load is decreasing and the last boiler gets down to 20% fire, it will hold it there and start lowering the firing rate on the next-to-last boiler. When the next-to-last boiler reaches 20%, it will turn the last boiler off and raise the rate of the next-to-last boiler to 40%, thus eliminating the sudden drop in total output of the Cascade.

The other Cascade divider method is Efficiency Optimization, designated as EFF in the menu. This method is used, as the name implies, when it is desired to have the most efficient system. When the first boiler reaches 100% rate, it lowers its rate to 50% and turns on the next boiler at 50%. The two (2) boilers then modulate at the same rate.

1 Service

As the calculated load increases further and both boilers ramp up to 100%, it lowers the rate of the first two (2) boilers to 67% and brings the next boiler on at 67%. The three (3) boilers then modulate together. As the calculated load decreases, the boilers will reach 20%, at which time the last boiler (the third in our example) will turn off and the Cascade will increase the rates of the remaining boilers to provide the equivalent total output as before ((3 x 20%) / 2 = 30% in our example).

Efficiency optimization is automatically selected when boilers of different sizes are programmed into the Leader control (see *Boiler Size* on page 26).

Minimum On/Off Time

In order to prevent units in a Cascade from short cycling, this parameter defines the minimum ON and OFF time for each unit. The installer can adjust this time by accessing the *Minimum On/Off Time* parameter. The minimum setting is 0 seconds and the maximum setting is 10 minutes. The default is 30 seconds.

Minimum Next On Time

In order to reduce the risk of temperature overshoot with a Cascade, this parameter defines the minimum time delay from starting one unit until the next unit may be started. The installer can adjust this time delay by accessing the *Minimum Next On Time* parameter. The minimum setting is 0 minutes and the maximum setting is 10 minutes. The default is 60 seconds.

Minimum Number of Pumps On

When the boiler is a Cascade Leader, it can force a minimum number of boiler pump outputs to be on continuously, regardless of how many boilers are firing. This is normally used when the boilers are piped in a full-flow configuration, and the boiler pump outputs are controlling isolation valves. The Leader will force the boiler pump output on the highest priority boiler to turn on first, then the boiler pump output on the second highest priority boiler, and so forth, until the minimum number of pump outputs are turned on. The range of this parameter is 0 to 8. The default value is 0.

Alternate Leader

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

⚠ WARNING DO NOT connect the sensors connected to the Leader boiler to the Member 1 boiler. 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 boiler, Member 1 will automatically relinquish control of the Cascade to the Leader boiler.

The default value of this parameter is NO.

Boiler Size

When boilers of different sizes are connected together in a Cascade, the Leader boiler has to know the size of each boiler in that Cascade. The *Boiler Size* parameters allow the installer to program the size based on the Cascade address. This screen shows the Cascade address and the size of the boiler with that address (in kBtu/hr):

1. When the Boiler Size screen is first accessed, Cascade Address (SELF) is shown.
2. Press the NAVIGATION dial twice to access the Input setting. Rotate the NAVIGATION dial to increase the boiler input. Input settings 0 - 400 kBtu/hr can be adjusted in increments of 5 (5000 Btu/hr). When the closest approximate boiler size is shown, press the RIGHT SELECT [SAVE] key.
3. Rotate the NAVIGATION dial to select the address of the next boiler in the Cascade. Repeat Step 2.
4. Once the size of the last boiler in the Cascade has been entered and saved, press the LEFT SELECT [EXIT] key to return to the Control Modes menu.
5. If no other parameters are to be adjusted, press the RIGHT SELECT [HOME] key to save the new settings and return to the Status screens.

The SMART SYSTEM control automatically uses the Efficiency Optimization Cascade type when controlling boilers of different sizes.

If the Leader boiler is controlling larger boilers (e.g., Copper-fin II), those members will send their sizes to the Leader boiler automatically. Do not program those sizes into the Leader boiler.

1 Service *(continued)*

Building Management System (BMS)

BMS

The set point or modulation of the boiler may be controlled through the 0 - 10V BMS input, BACnet, or ModBus. When the *BMS parameter* is set to INACTIVE, the 0 - 10V input will be ignored. When set to ACTIVE, the set point or modulation will be controlled by the voltage on the 0 - 10V input (in the case of 0 - 10V BMS control), or the 0 - 10V input value received through ModBus or BACnet. The default value is INACTIVE.

BMS Type

When programmed for BMS control through the 0 - 10V BMS input or through ModBus/BACnet, the 0 - 10V signal can be interpreted as either a modulation command or a set point. When the *BMS Type* parameter is set to POWER, the 0 - 10V signal will control the modulation. When set to SETPOINT, the 0 - 10V signal will control the SH set point. The default setting is SETPOINT.

Rate at Minimum Volts

When programmed for BMS control through the 0 - 10V BMS input or through ModBus/BACnet and the BMS Type is programmed as POWER, the modulation percentage represented by the *Volts at Minimum* parameter is set by the *Rate at Minimum Volts* parameter. The minimum value is 0% and the maximum is the *Rate at Maximum Volts* setting. The default value is model dependant.

Rate at Maximum Volts

When programmed for BMS control through the 0 - 10V BMS input or through ModBus/BACnet and the BMS Type is programmed as POWER, the modulation percentage represented by the *Volts at Maximum* parameter is set by the *Rate at Maximum Volts* parameter. The minimum value is the *Rate at Minimum Volts* setting and the maximum is 100%. The default value is 100%.

Set Point at Minimum Volts

When programmed for BMS control through the 0 - 10V BMS input or through ModBus/BACnet and the BMS Type is programmed as SETPOINT, the set point represented by the *Volts at Minimum* parameter is set by the *Set Point at Minimum Volts* parameter. The minimum value is 32°F (0°C) and the maximum is the *Set Point at Maximum Volts* setting. The default value is 70°F (21°C).

Set Point at Maximum Volts

When programmed for BMS control through the 0 - 10V BMS input or through ModBus/BACnet and the BMS Type is programmed as SETPOINT, the set point represented by the *Volts at Maximum* parameter is set by the *Set Point at Maximum Volts* parameter. The minimum value is the *Set Point at Minimum Volts* setting and the maximum is 190°F (88°C). The default value is 180°F (82°C).

Volts at Minimum

When programmed for BMS control through the 0 - 10V BMS input or through ModBus/BACnet, the *Volts at Minimum* parameter should be set to the minimum voltage signal sent to the SMART SYSTEM control. The range of this parameter is 0.0V to the *Volts at Maximum* value. The default setting is 2.0V.

Volts at Maximum

When programmed for BMS control through the 0 - 10V BMS input or through ModBus/BACnet, the *Volts at Maximum* parameter should be set to the maximum voltage signal sent to the SMART SYSTEM control. The range of this parameter is the *Volts at Minimum* value to 10.0V. The default value is 10.0V.

BMS Thermostat Input

When controlling the boiler through the 0 - 10V BMS input, BACnet, or ModBus, the boiler can be enabled one of two ways. With the *BMS Thermostat Input parameter* set to ACTIVE, the boiler will be enabled by closing the Heat/Loop Demand 1 input. When set to INACTIVE, the boiler will be enabled by the voltage level on the 0 - 10V input (in the case of 0 - 10V BMS control), or the 0 - 10V input value received through BACnet or ModBus. The default value is INACTIVE.

On Volts

When programmed for BMS control through the 0 - 10V BMS input or through ModBus/BACnet and the BMS Thermostat Input is set to INACTIVE, the *On Volts* parameter determines the 0 - 10V BMS input voltage at which the boiler is enabled. The minimum value is 0.5V and the maximum is 10.0V. The default value is 2.0V.

Off Differential Volts

When programmed for BMS control through the 0 - 10V BMS input or through ModBus/BACnet and the BMS Thermostat Input is set to INACTIVE, the *Off Differential Volts* parameter determines how far below the *On Volts* setting the 0 - 10V BMS input voltage must be in order to disable the boiler. The minimum value is 0.2V and the maximum is the *On Volts* setting. The default value is 1.0V.

ModBus/BACnet

When BMS is set to ACTIVE (see BMS Active / Inactive) and the boiler is being controlled through BACnet or ModBus, set *ModBus/BACnet* parameter to ACTIVE. Otherwise, set the *ModBus/BACnet* parameter to INACTIVE. Note that the boiler can still be monitored by ModBus or BACnet with this parameter set to INACTIVE. The default value is INACTIVE.

1 Service

BAS T/O

This is the amount of time the unit controls will wait to receive a communication string from the BMS controller before reverting back to its own internal parameters. This parameter is adjustable by the installer by accessing the *BAS T/O* parameter. The adjustment range of this parameter is 5 seconds to 2 minutes. The default value is 10 seconds.

Circulation pumps

System Pump Delay

The system pump delay parameter sets the length of time the system pump (if connected) will run after a SH demand has been satisfied or outdoor shutdown has begun. This parameter is adjustable by the installer by accessing the *System Pump Delay* parameter. The time range for this parameter is 1 second to 40 minutes. The default time is 30 seconds.

Boiler Pump Delay

The SH pump delay parameter sets the length of time the boiler pump will run after a SH demand has been satisfied. Setting the delay time to 0 will disable the pump. This parameter is adjustable by the installer by accessing the *Boiler Pump Delay* parameter. The time range for this parameter is 1 second to 40 minutes. The default time is 30 seconds.

DHW Pump Delay

The DHW pump delay parameter sets the length of time the DHW pump (if connected) will run after a DHW demand has been satisfied. This parameter is adjustable by the installer by accessing the *DHW Pump Delay* parameter. The time range for this parameter is 10 seconds to 40 minutes. The default time is 1 minute.

System Pump Anti-Seize Delay

If the boiler pump does not run for 24 hours, it will be turned on briefly to prevent it from seizing. The length of time it runs is determined by the *System Pump Anti-Seize Delay* parameter. The range of this setting is 0 seconds to 40 minutes. The default setting is 20 seconds.

Boiler Pump Anti-Seize Delay

If the boiler pump does not run for 24 hours, it will be turned on briefly to prevent it from seizing. The length of time it runs is determined by the *Boiler Pump Anti-Seize Delay* parameter. The range of this setting is 0 seconds to 40 minutes. The default setting is 20 seconds.

DHW Pump Anti-Seize Delay

If the boiler pump does not run for 24 hours, it will be turned on briefly to prevent it from seizing. The length of time it runs is determined by the *DHW Pump Anti-Seize Delay* parameter. The range of this setting is 0 seconds to 40 minutes. The default setting is 20 seconds.

System Pump Type

The system pump can be programmed to operate in response to any of the Room Thermostat inputs, or to run continuously until all three (3) SH demands go into Outdoor Shutdown. To program the system pump to operate only with a space heating call for heat, set the *System Pump Type* parameter to CFH. To program the system pump to run continuously until outdoor shutdown starts, set the *System Pump Type* parameter to WWSD. The default setting is CFH.

Boiler Pump Delta T Set Point

When using a variable speed boiler pump, and controlling it by means of the 0 - 10V Boiler Pump Speed Output, the boiler pump will be controlled in order to maintain a minimum Delta T across the heat exchanger in the boiler (other factors may override this target). This feature is to be used with Primary / Secondary piping systems only. A system supply sensor MUST be installed. This parameter sets the target minimum Delta T it will use. The range of this parameter is 15°F (8°C) to 60°F (33°C). The default value is 20°F (11°C).

Boiler Pump Minimum Voltage

The speed of the boiler pump can be controlled by the SMART SYSTEM control in order to maintain a minimum ΔT through the heat exchanger. Thus, as the firing rate decreases, the speed of the boiler pump can decrease as well. The SMART SYSTEM control outputs a 0 - 10V signal to the boiler pump to control its speed. The *Boiler Pump Minimum Voltage* parameter determines the minimum voltage given to the boiler pump, thereby setting its minimum speed. The range of this setting is 2.5V to 10V. The default setting is 3.5V.

Service Notification

Service Notification in Months

When the boiler control determines that a scheduled service is due based on days of installation, the boiler display will turn yellow and a new status screen will appear informing the user that maintenance is required. This parameter is adjustable by the installer by accessing the *Service Notification in Months* parameter. The time range for this parameter is 0 months to 100 months. The default time is 13 months.

Service Notification Running Time

When the boiler control determines that a scheduled service is due based on the hours of actual operation, the boiler display will turn yellow and a new status screen will appear informing the user that maintenance is required. This parameter is adjustable by the installer by accessing the *Service Notification Running Time* parameter. The time range for this parameter is 0 hours to 17,500 hours. The default time is 8,760 hours.

Service Notification Cycles

When the boiler control determines that a scheduled service is due based on the number of boiler cycles, the boiler display will turn yellow and a new status screen will appear informing the user that maintenance is required. This parameter is adjustable by the installer by accessing the *Service Notification Cycles* parameter. The range for this parameter is 0 cycles to 100,000 cycles. The default is 50,000 cycles.

1 Service *(continued)*

Reset Maintenance Reminder

Once servicing has been completed, the service notification counter should be reset. This parameter can be reset by the installer by accessing the *Reset Maintenance Reminder* parameter. Once accessed, press the RESET key to reset the service notification counter.

Service Name and Phone Number

NOTICE Please note that the brackets ([]) denote screen status.

When a Maintenance Reminder timer or counter has expired, a Maintenance Reminder screen will appear on the display. By programming the installer's name and phone number, this information will appear on the Maintenance Reminder Screen at that time. This can be programmed by accessing the *Service Name and Phone Number* parameter. When selected, another menu will appear with PHONE and NAME.

1. Rotate the NAVIGATION dial to point to the name/phone number to program and press the NAVIGATION dial. The screen will now display the selected item (either PHONE or NAME).
2. Press the NAVIGATION dial again. A cursor will appear at the bottom of the screen. By rotating the NAVIGATION dial, various numbers and characters will appear. When the desired number/character is found, press the NAVIGATION dial. The cursor will move to the next position.
3. Repeat this procedure until the entire message is entered. If you make a mistake and wish to back up one character, rotate the NAVIGATION dial until the back arrow (←) character is displayed and press the NAVIGATION dial.
4. When finished, press the RIGHT SELECT [SAVE] key to return to the previous menu.

Basic Setup

The Basic Setup Menu contains the most frequently used parameters from the list above. See the descriptions above to set these parameters.

Loch-N-Link™

Parameter files can be copied directly to and from a USB flash drive. When USB is selected from the Main Menu, the display will ask you to insert a flash drive into the USB-A (rectangular) port next to the display. Once a drive is inserted, the display will search the root directory of this drive for a folder named "lochinvar". If it does not find it, the display will ask if you want it to create this folder? Press either the [YES] or [NO] key. If you press [NO], no further operations are allowed, so you must remove the flash drive. If you press [YES], it will create the folder in the flash drive. If the flash drive contains a folder named lochinvar, the display will show all of the parameter files stored in that folder.

If you wish to copy the parameters from the Smart System control into the flash drive, press the [SAVE] key. The display will create a file name based on the current date and time (year-month-date-hours-minutes). If you wish to cancel this operation, press the [NO] key. If you wish to change the filename, press the NAVIGATION dial. The first character of the filename will flash. Rotate the NAVIGATION dial to change this character. Once it is correct, press the NAVIGATION dial again, and edit the next character as before. When the new filename is ready, press the [SAVE] key. The control will save the parameters to the flash drive, and the new file will appear in the list of parameter files. Press the [EXIT] key to return to the Main Menu.

If you wish to copy a parameter file from the flash drive into the Smart System control, rotate the NAVIGATION dial until the file you wish to copy is selected. Press the NAVIGATION dial once. The display will ask you if you want to load the parameters from the file you selected. You can press [NO] to cancel the operation, or press [YES] to continue with writing the parameters into the control. Once the loading process is complete, the display will return to the Main Status Screen.

2 Maintenance

Maintenance and annual startup

Table 2-1 *Service and Maintenance Schedules*

Service technician (see the following pages for instructions)		Owner maintenance (see the Knight Wall Hung Fire Tube Boiler User's Information Manual for instructions)	
ANNUAL START-UP	**General:** • Address reported problems • Inspect interior; clean and vacuum if necessary; • Clean condensate trap and fill with fresh water • Check for leaks (water, gas, flue, condensate) • Verify flue and air lines in good condition and sealed tight • Check system water pressure/system piping/expansion tank • Check fill water meter • Test boiler water. When test indicates, clean system water with approved system restorer following manufacturer's information • Check control settings • Check ignition and flame sense electrodes (sand off any deposits; clean and reposition) • Check wiring and connections • Perform start-up checkout and performance verification per Section 10 in the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual. • Flame inspection (stable, uniform) • Flame signal (at least 10 microamps at high fire) • Clean the heat exchanger if flue temperature is more than 54°F (30°C) above return water temperature. • Test low water flow conditions. **If combustion or performance indicate need:** • Clean heat exchanger • Remove and clean burner using compressed air only • Clean the blower wheel	**Daily**	• Check boiler area • Check pressure/temperature gauge
		Monthly	• Check vent piping • Check air piping • Check air and vent termination screens • Check relief valve • Check condensate drain system • Check air vents
		Periodically	• Test low water cutoff • Reset button (low water cutoff)
		Every 6 months	• Check boiler piping (gas and water) for leaks • Operate relief valve
		End of season months	• Shut boiler down (unless boiler used for domestic hot water)

2 Maintenance *(continued)*

⚠ WARNING Follow the Service and maintenance procedures given throughout this manual and in component literature shipped with the boiler. Failure to perform the service and maintenance could result in damage to the boiler 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 boiler should be inspected annually only by a qualified service technician. In addition, the maintenance and care of the boiler designated in Table 2-1 and explained on the following pages must be performed to assure maximum boiler efficiency and reliability. Failure to service and maintain the boiler and system could result in equipment failure.

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

Address reported problems

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

Inspect boiler area

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

Inspect boiler interior

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

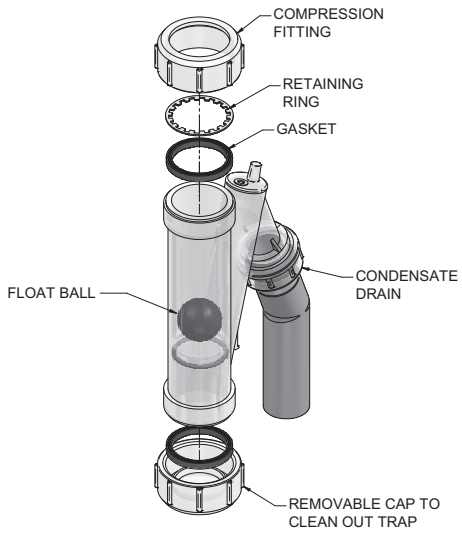
Inspect condensate trap

1. Inspect the condensate trap and drain line monthly to ensure it is properly installed and there are no obstructions in the drain line.
2. Inspect the neutralizing kit (if installed) monthly to ensure the condensate is draining properly and there is 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. Remove the clean out cap on the bottom of the trap (FIG. 2-1). Let the condensate and any debris drain out and clean out any sediment that exists. Ensure the gasket is seated in the cap before reinstalling.
2. To remove the condensate trap from the unit, loosen the compression fitting located on top of the condensate (FIG. 2-1). Condensate fluid may run out of the heat exchanger.
3. 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.
4. Fill condensate trap with enough water to make the ball float (FIG. 2-1).
5. Reinstall the condensate trap onto the condensate drain. The stainless steel retaining ring, which allows the trap to be pushed on, but not pulled off, must be installed between the rubber sealing gasket and the compression fitting. The compression fitting must be tightened.
6. Ensure condensate tubing slopes down and away from the boiler into a drain or condensate neutralizing filter (if installed).

Figure 2-1 *Condensate Trap*



2 Maintenance

Check all piping for leaks

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

1. Inspect all water and gas piping and verify to be leak free.
2. Look for signs of leaking lines and correct any problems found.
3. Check gas line using the procedure found in Section 7 - Gas Connections of the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual.

Flue vent system and air piping

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

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

Check water system

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

Check expansion tank

1. Expansion tanks provide space for water to move in and out as the heating system water expands due to temperature increase or contracts as the water cools. Tanks may be open, closed or diaphragm or bladder type. See Section 6 - Hydronic Piping of the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual for suggested best location of expansion tanks and air eliminators.

Check fill water meter

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

Test boiler water

1. Test boiler water. Reference the Knight Wall Hung Fire Tube Installation and Operation Manual for guidelines. When test indicates, clean system water with approved system restorer following the manufacturer's information.

Check boiler relief valve

1. Inspect the relief valve and lift the lever to verify flow. Before operating any relief valve, ensure that it is piped with its discharge in a safe area to avoid severe scald potential. Read Section 6 - Hydronic Piping of the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual before proceeding further.

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

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

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

2 Maintenance *(continued)*

Inspect ignition and flame sense electrodes

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

Check ignition ground wiring

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

Check all boiler wiring

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

Check control settings

1. Set the SMART SYSTEM control module display to Parameter Mode and check all settings. See Section 1 of this manual. Adjust settings if necessary. See Section 1 of this manual for adjustment procedures.
2. Check settings of external limit controls (if any) and adjust if necessary.

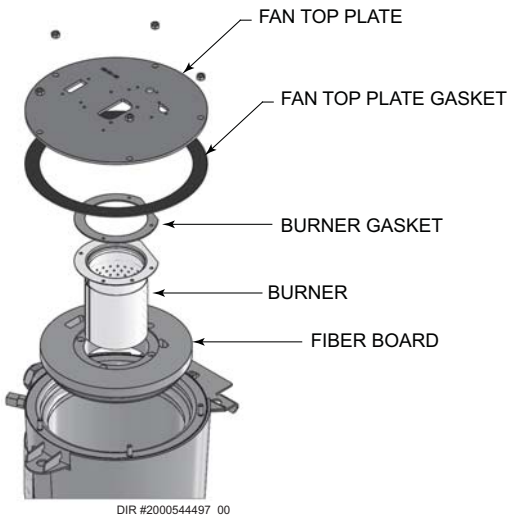
Perform start-up and checks

1. Start boiler and perform checks and tests specified in Section 10 - Start-up of the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual.
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 boiler and allow boiler 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. 2-2.
4. When replacing the burner, ensure gasket is in good condition and positioned correctly (FIG. 2-2).

Figure 2-2 *Burner Assembly*



2 Maintenance

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 this manual for other procedures to deal with low flame signal.

Review with owner

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

Cleaning boiler heat exchanger

1. Shut down boiler:

   - Follow the "To Turn Off Gas to Appliance" instructions for the boiler in Section 10 - Startup of the Knight Fire Tube Installation and Operation Manual.
   - Do not drain the boiler unless it will be exposed to freezing temperatures. If using freeze prevention fluid in system, do not drain.

2. Allow time for the boiler to cool to room temperature if it has been firing.

3. Remove the top and front access panels (no tools required for removal) along with the bezel.

4. Remove the wiring from the ignitor, flame rod, and the fan. Remove the reference tubing from the air intake.

5. Loosen the band clamp on the air intake coupling using a field provided 5/16" driver.

6. Remove the 4 mm screws holding the fan to the heat exchanger top plate.

7. Loosen the union on the venturi

8. The fan and the venturi may now be removed from the unit together by sliding the fan away from the air intake.

9. Remove the 10 mm nuts securing the heat exchanger top plate to gain access to the heat exchanger and set aside.

⚠ WARNING The boiler contains ceramic fiber materials. Use care when handling these materials per instructions on page 3 of this manual. Failure to comply could result in severe personal injury.

10. Remove the condensate trap from the bottom of the boiler. Place a bucket underneath the condensate drain attached to the heat exchanger.

11. Use a vacuum cleaner to remove any accumulation on the boiler heating surfaces. Do not use any solvent.

12. Using a clean cloth dampened with warm water, wipe out the combustion chamber. Rinse out debris with a low pressure water supply.

13. Allow the heat exchanger to thoroughly dry.

14. Reassemble the unit in reverse order of component removal, and re-install the condensate trap.

⚠ CAUTION Damaged gaskets and seals in the system can result in substantial property damage. Ensure that damaged or torn gaskets are replaced.

15. Perform a combustion analysis by following the instructions in Section 3 - Troubleshooting - Check Flame and Combustion on pages 46 and 47 of this manual.

16. Resume operation.

2 Maintenance *(continued)*

Test low water flow conditions

NOTICE

This test is to be carried out once the Knight Wall Hung Fire Tube boiler is completely piped in with adequate gas and water flow. Once the test is completed, ensure that the isolation valve is opened up to allow full water flow.

Test procedure

1. Locate the pinhole button above the RESET button on the display board (see page 6). Insert a thin wire (such as a paper clip) into the hole and press the button once and hold for 5 seconds to place the boiler into Service Mode. In Service Mode the boiler will fire at ignition speed and will then modulate up to full fire.

2. Allow the unit to progress through its normal diagnostics and pre-purge programming.

3. Allow the unit to fire and operate until the temperatures stabilize. This occurs when the inlet and outlet temperatures are rising together and the Delta T (△ T) is maintained.

4. When the unit stabilizes, begin to slowly shut off the isolation valve on the outlet piping of the boiler (see FIG. 2-3). This will begin to restrict the flow and simulate a low flow condition.

5. While slowly shutting off the isolation valve, refer to the Status Screens to watch the behavior of the boiler. These screens allow you to monitor the inlet temperature, outlet temperature, and △T.

6. When the △ T reaches 55˚F (13°C), the control will attempt to modulate the firing rate down to protect it from low flow conditions.

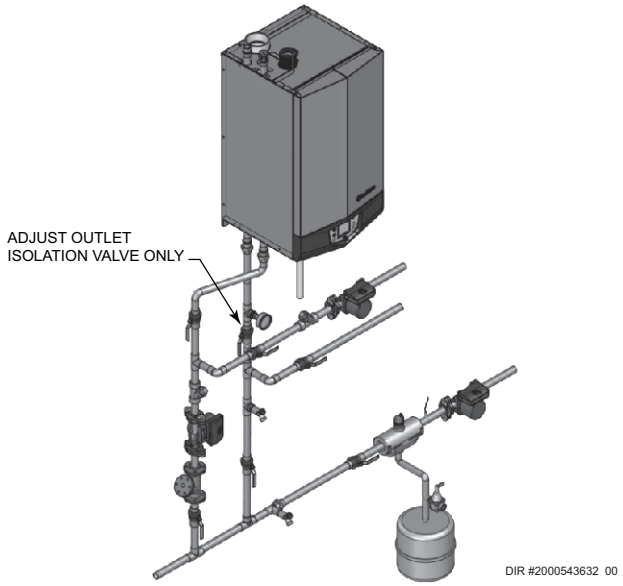
7. When the △T reaches 60°F (16°C), the control module will turn off the burner. If the control module shuts down, the test was successful.

8. Completely open the isolation valve on the outlet piping of the boiler.

9. Resume operation.

   NOTE: This lockout is a soft lockout. Once the △ T has decreased to an acceptable level and there is a call for heat, the unit will fire again to meet the demand.

Figure 2-3 *Adjust outlet isolation valve*



3 Troubleshooting

⚠ WARNING Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation. Always disconnect power to the boiler before servicing. Failure to comply could result in severe personal injury, death, or substantial property damage.

⚠ WARNING Never jumper (bypass) any device except for momentary testing as outlined in the Troubleshooting chart. Severe personal injury, death, or substantial property damage can result.

Before troubleshooting:

1. Have the following items:
   a. Voltmeter that can check 120 VAC, 24 VAC, and 12 VDC.
   b. Continuity checker.
   c. Contact thermometer.
2. Check for 120 VAC (minimum 102 VAC to maximum 132 VAC) to boiler.
3. Make sure thermostat is calling for heat and contacts (including appropriate zone controls) are closed. Check for 24 VAC between thermostat wire nuts and ground.
4. Make sure all external limit controls are installed and operating.

Check the following:

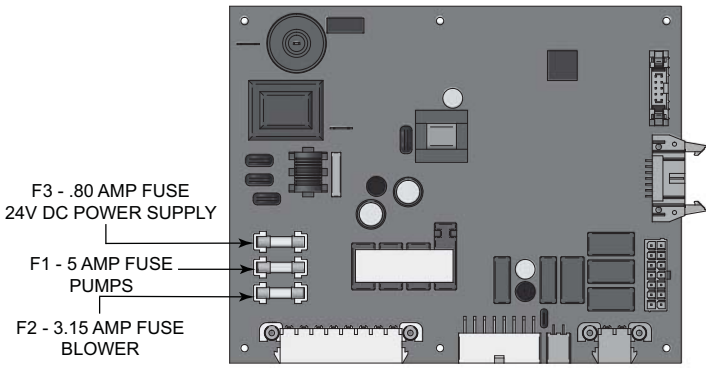
1. Wire connectors to control module are securely plugged in at the module and originating control.
2. Gas pressures:
   - Maximum: 14 inches w.c. (3.5 kPa) (natural and LP) with no flow (lockup) or with boiler on
   - Minimum: 4 inches w.c. (1.0 kPa) (natural), 8 inches w.c. (2.0 kPa) (LP) with gas flowing (verify during boiler startup)

Check control module fuses

NOTICE ALWAYS check control module fuses before replacing control module or any major components (blower, etc.). If one of these fuses is blown, it can prevent the control module or other components from operating.

1. Turn OFF the power to the boiler at the external line switch.
2. Remove front access cover.
3. Remove the control module cover.
4. Inspect fuses F1, F2, and F3, see FIG 3-1 below.

Figure 3-1 *Control Module Fuses*



5. The boiler is shipped with three (3) spare fuses in a plastic bag attached to the control module cover.
6. If necessary, replace open fuse (F3 is .80 amps, F2 is 3.15 amps and F1 is 5 amps).

Note: Fuses F1, F2, and F3 are all slow blow fuses.

⚠ WARNING Do not jumper fuse or replace with any fuse except as specified. Failure to comply could result in severe personal injury, death, or substantial property damage.

7. Install control module cover and front access cover after fuse inspection.
8. Restore power to the boiler at the external line switch and verify boiler operation (Section 10 - Start-up in the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual) after completing boiler service.

3 Troubleshooting *(continued)*

Table 3-1 *Troubleshooting Chart - No Display*

FAULT	CAUSE	CORRECTIVE ACTION
No Display	- No 120 vac supplied to unit.	• Check external line switch, fuse, or breaker. • Check position of ON/OFF switch. Turn switch to the ON position. • Check 120 vac through the ON/OFF switch. • Check wiring harness connection between display board and main control board. Connect harness at both points.
	- No voltage through the switch.	• Replace switch.
	- Bad display board.	• Replace board.
	- Bad main control board.	• Replace the main control board.
	- Blown fuse.	• Replace fuse F3 on the main control board, see page 36 of this manual.
No Burner Operation	- Main control board temperature set point satisfied.	• Review temperature setting.
	- Remote thermostat satisfied.	• Review remote thermostat setting.
	- Outside air temperature above Warm Weather Shutdown (WWSD) set point for main control board.	• Check location of outside air sensor. Check resistance of outdoor air sensor and compare to Table 3-2B on page 38 of this manual.
	- Unit locked out on fault.	• Consult display for specific fault. Refer to fault descriptions on page 40 of this manual for corrective actions.
	- Unit in Shutdown Mode.	• Take unit out of Shutdown Mode.
Unit Does Not Modulate Above 50%	- Ramp delay active.	• Check ramp delay parameter settings. • Turn ramp delay feature off. See page 24 of this manual for instructions on how to turn this feature off.
	- Boiler controlled by BMS.	• Check BMS parameter settings.
	- Flue sensor open.	• Verify that the flue sensor is located in the flue outlet. • Check wiring connections at the flue sensor. • Check the resistance of the flue sensor and compare to Table 3-2D on page 38 of this manual.

3 Troubleshooting

Checking temperature sensors

The boiler temperature sensors (inlet water, outlet water, system water, flue, and outdoor air) are all resistance type devices. The following tables show the correct values for the sensors at various temperatures. Use an ohmmeter to read the resistance of the sensor at a known temperature. If the resistance of the sensor does not closely match its corresponding table, replace the sensor

It is important to note that the flue and outlet water sensors have two temperature sensing devices in one housing. These devices are designated as S1a/S1b, outlet sensor and S3a/S3b, flue sensor. Please reference the wiring diagram in the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual for correct terminal location.

Table 3-2A - *Inlet Water/System Sensor Resistance vs. Temperature*

Temperature	Resistance	Temperature	Resistance
50	18,780	158	1,990
68	12,263	176	1,458
86	8,194	194	1,084
104	5,592	212	817
122	3,893		
140	2,760		

Table 3-2B - *Outdoor Air Sensor Resistance vs. Temperature*

Temperature	Resistance	Temperature	Resistance
-50	490,813	20	46,218
-40	336,606	30	34,558
-30	234,196	40	26,099
-20	165,180	50	19,900
10	118,018	60	15,311
0	85,362	70	11,883
10	62,465	80	9,299

Table 3-2C - *Outlet Water Sensor Resistance vs. Temperature*

S1a (Wire Color - R/BK and Y)				S1b (Wire Color - G and Y)			
Temperature	Resistance	Temperature	Resistance	Temperature	Resistance	Temperature	Resistance
50	19,553	158	2,004	50	40,030	158	3,478
68	12,690	176	1,464	68	25,030	176	2,492
86	8,406	194	1,084	86	16,090	194	1,816
104	5,715	212	816	104	10,610	212	1,344
122	3,958			122	7,166		
140	2,786			140	4,943		

Table 3-2D - *Flue Sensor Resistance vs. Temperature*

S3a (Wire Color - W/B and Y)				S3b (Wire Color - PR and Y)			
Temperature	Resistance	Temperature	Resistance	Temperature	Resistance	Temperature	Resistance
50	40,030	158	3,478	50	258,500	158	16,870
68	25,030	176	2,492	68	125,500	176	12,000
86	16,090	194	1,816	86	80,220	194	8,674
104	10,610	212	1,344	104	52,590	212	6,369
122	7,166			122	35,270		
140	4,943			140	24,160		

3 Troubleshooting *(continued)*

Table 3-3 *Troubleshooting Chart - Noisy System*

FAULT	CAUSE	CORRECTIVE ACTION
Noisy Operation	- Supply gas problem. Natural gas pressures should be between 4 inches w.c. and 14 inches w.c. LP gas pressures should be between 8 inches w.c. and 14 inches w.c.	• Refer to Section 7 - Gas Connections of the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual for detailed information concerning the gas supply.
	- Gas/air mixture problem.	• Refer to the Gas Valve Adjustment Procedure on page 47 of this manual for the proper gas valve setting. Verify that the vent/air intake lengths do not exceed the maximum listed in the General Venting section of the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual.
	- Dirty/damaged burner.	• Refer to page 33 in this manual for the burner removal and inspection procedure. Clean or replace the burner as necessary.
	- Low water flow through the heat exchanger.	• Refer to Section 6 - Hydronic Piping of the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual for minimum flow rates. Verify that the boiler and system pump are running on a call for heat.
	- Air in the piping system.	• Properly purge all air from the piping system.
	- Low system water pressure.	• Verify system pressure is a minimum of 12 psi.
No Pump Operation - Boiler Pump System Pump or DHW Pump	- Blown fuse.	• Replace fuse F1 on the control board, see page 36 of this manual. **Note:** Make sure pump amperage does not exceed 1.8 amps.
	- Faulty pump.	• Replace pump.
	- Internal fault on control board.	• Replace main control board.
No Blower Operation	- Internal fault on control board.	• Replace control board.
	- Faulty blower.	• Replace blower.
Relief Valve Opening	- System pressure exceeds relief valve setting.	• Lower the system pressure below the 30 psi rating of the supplied relief valve or replace the standard relief valve with a higher rated valve up to the maximum pressure of the heat exchanger. • Improperly sized expansion tank.
No Pump Operation - DHW Recirculation Pump	- Failed external relay. - Line voltage shut off. - Faulty pump. - Faulty DHW recirculation sensor. - Fault in connection board. - Fault in control board.	• Check function of external relay. • Check line voltage to external relay. • Check recirculation pump. • Check DHW recirculation sensor. • Check low voltage connection board. • Replace control board.

3 Troubleshooting

Table 3-4 *Troubleshooting Chart - Fault Messages Displayed on Boiler Interface*

FAULT	DESCRIPTION	CORRECTIVE ACTION
Gas Pressure SW (will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	- The gas pressure switch contacts on the Low Voltage Connection Board are open.	• Check for a loose or misplaced jumper on the Low Voltage Connection Board. • Check for the addition of a device wired across the gas pressure switch terminals on the Low Voltage Connection Board.
Flow Switch/ LWCO (will require a manual reset once condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	- Either the optional flow switch or the low water cutoff (LWCO) is not making.	• Check boiler pump operation on a call for heat. • Check for closed valves or obstructions in the boiler piping. • Verify system is full of water and all air has been purged from the system. • Check for a loose or misplaced jumper if flow switch is not installed. • Replace LWCO.
	- Blown fuse.	• Replace fuse F3 on the control board, see page 36 of this manual.
Blocked Drain SW (will require a manual reset once condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	Air pressure switch contacts are open.	• Check the wiring connections to switch. Wires should be connected to the common and normally closed terminals. • Air intake lengths exceed the maximum allowed lengths. Reference Section 3 - General Venting of the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual for proper lengths. • Check hoses connected to the air pressure switch for blockage or obstruction. • Inspect the burner and heat exchanger. Reference pages 33 and 34 of this manual for removal and cleaning procedures. Replace if necessary. • Faulty air pressure switch. Replace switch.
Too Many Recyclings	One or more limit switches has opened more than five (5) times during the last call for heat.	• Check the following limit switches for intermittent operation: - Louver Proving Switch - Air Pressure Switch - Gas Pressure Switch • Check harness connections at the control board and low voltage connection board.

3 Troubleshooting *(continued)*

Table 3-4 *(continued from previous page) Troubleshooting Chart - Fault Messages Displayed on Boiler Interface*

FAULT	DESCRIPTION	CORRECTIVE ACTION
Anti-cycling	The burner recently turned off.	• The control board will release the call for heat after a set time period. • The control board will release the call for heat if the outlet temperature drops too quickly.
Flame Fail Ign (will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	The unit has failed to prove main burner ignition after several attempts.	• Inspect spark electrode and associated wiring for damage and connection. Reference page 33 of this manual for removal and cleaning procedures. Replace if necessary. • Check for proper electrical grounding of the unit. • Check incoming supply gas pressure. Natural gas pressures should be between 4 - 14 inches w.c. and LP gas pressures should be between 8 - 14 inches w.c. Refer to Section 7 - Gas Connections of the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual for detailed information concerning the gas supply.
		• Verify that the plastic hose from the gas valve to the air inlet is connected and is not damaged. • Verify that the vent/air intake pipes are correctly installed and that there are no obstructions. • Check for 24 vac to the gas valve at the 2-pin connection on the side of the main control board during the ignition attempt. If no voltage is present, replace the main control board. • If 24 vac is present at the main control board, check the wiring between the main control board and the gas valve. Replace the wiring if necessary. Do not disconnect the wiring from the gas valve and attempt to measure voltage at that point. The main control board can detect if the gas valve is not connected and will display the Gas Valve or Gas Valve Fail fault. • If 24 vac is present, check the outlet of the valve to ensure the valve is flowing gas. With a manometer connected to the outlet tap of the gas valve, when the unit is in the prepurge period, there should be a negative pressure present. When the valve is energized a change in pressure should occur. If the pressure change does not occur, the gas valve is not opening. Replace the gas valve. • Inspect flame sensor and associated wiring. Reference page 33 of this manual for removal and cleaning procedures. Replace if necessary. • Inspect and clean the heat exchanger as necessary. Reference page 34 of this manual for cleaning procedures. • Inspect the burner. Reference page 33 of this manual for removal and cleaning procedures. Replace if necessary. • Replace the main control board.

3 Troubleshooting

Table 3-4 *(continued from previous page) Troubleshooting Chart - Fault Messages Displayed on Boiler Interface*

FAULT	DESCRIPTION	CORRECTIVE ACTION
Flame Sequence (will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	The flame detector circuit is seeing a flame signal while the gas valve is off.	• Check supply voltage for proper polarity. • Check external wiring for voltage feedback. • Check the flame rod and make sure it is clean. • Check the internal wiring for bad connections. • Replace main control board.
Outlet ARHL	The outlet water temperature has exceeded the setting of the automatic reset high limit.	• Adjust the set point of the auto reset limit to a higher setting up to a maximum of 200°F. Reference the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual for adjusting procedures. • Verify that the system is full of water and that all air has been properly purged from the system. • Verify that the boiler is piped properly into the heating system. Refer to Section 6 - Hydronic Piping of the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual for the proper piping methods for the Knight Wall Hung Fire Tube boiler. • Check 120 vac to boiler pump motor on a call for heat. If voltage is not present, check wiring back to the main control board. • If 120 vac is present on a call for heat and the boiler pump is not operating, replace the pump. • If the system pump is a variable speed pump, ensure that the system flow is not less than the boiler flow. • If operating on something other than an outlet sensor, check temperature setting of the main control board. • Check resistance of water sensors and compare to Table 3-2A on page 38 of this manual. Replace sensor if necessary. • Replace the main control board if necessary.
Outlet MRHL (will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	The outlet water temperature has exceeded the setting of the manual reset high limit.	• Adjust the set point of the manual reset limit to a higher setting up to a maximum of 210°F. Reference the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual for adjusting procedures. • Verify that the system is full of water and that all air has been properly purged from the system. • Verify that the boiler is piped properly into the heating system. Refer to Section 6 - Hydronic Piping of the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual for the proper piping methods for the Knight Wall Hung Fire Tube boiler. • Check 120 vac to boiler pump motor on a call for heat. If voltage is not present, check wiring back to the main control board.

3 Troubleshooting *(continued)*

***Table 3-4** (continued from previous page) Troubleshooting Chart - Fault Messages Displayed on Boiler Interface*

FAULT	DESCRIPTION	CORRECTIVE ACTION
Outlet MRHL (cont'd) (will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	The outlet water temperature has exceeded the setting of the manual reset high limit.	• If 120 vac is present on a call for heat and the boiler pump is not operating, replace the pump. • If the system pump is a variable speed pump, ensure that the system flow is not less than the boiler flow. • If operating on something other than an outlet sensor, check temperature setting of the main control board. • Check resistance of water sensors and compare to Table 3-2A on page 38 of this manual. Replace sensor if necessary. • Replace the main control board if necessary.
Fan Speed (will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	The actual fan RPM is 30% lower or higher than the fan speed target.	• Vent/air intake lengths exceed the maximum allowed lengths. Refer to Section 3 - General Venting of the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual for proper lengths. • Check for obstruction or blockage in the vent/air intake pipes or at terminations. • Check the wiring connections at the fan and at the main control board. • Check the fan using the RLY20119 / 100167625 fan test tool. • Replace the fan. • Replace the main control board.
	Blown fuse.	• Replace fuse F2 on the control board, see page 36 of this manual.
Inlet, Outlet, or Flue Sensor Fault (will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	Either the flue, inlet water, or outlet water temperature sensor has been disconnected or shorted.	• Check the sensors and their associated wiring. Repair or replace the sensor or wiring if damaged. • Measure the resistance of the sensors and compare the resistance to the tables on page 38 of this manual. • Replace the sensor if necessary.

3 Troubleshooting

Table 3-4 *(continued from previous page) Troubleshooting Chart - Fault Messages Displayed on Boiler Interface*

FAULT	DESCRIPTION	CORRECTIVE ACTION
Louver Proving Sw (will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	An optional remote proving switch is not making.	• Check function of remote devices. • Check for loose or misplaced jumper if louver proving switch is not connected.
Outlet Temp Diff (will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	The temperature difference between the two (2) outlet sensors is too high.	• Check wiring to sensor. Make sure wiring is connected and not damaged. Reconnect / repair wiring if necessary. • Measure the resistance of the sensor and compare to the resistance in Table 3-2C on page 38 of this manual. Replace sensor if necessary. • Restore control parameter defaults from optional PC software. • Replace control module.
Flue Temp Limit (will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	The stack temperature has exceeded the Flue Temp Limit set parameters.	• Inspect the heat exchanger. Reference page 34 of this manual for the procedure on how to clean the flue side of the heat exchanger. • Inspect the flue sensor and associated wiring. Measure the resistance of the flue sensor and compare to Table 3-2D on page 38 of this manual. Replace the sensor if necessary. • Verify that the vent/air intake pipes are properly installed and that there are no obstructions. • Replace the main control board.
Fatal Error	The control module has detected parameter settings that are corrupted.	• Restore the parameter defaults from the optional PC software. • Replace control module.
Memory Error	A lockout occurs at the same time as a power outage.	• Reset control module.

3 Troubleshooting *(continued)*

Table 3-4 *(continued from previous page) Troubleshooting Chart - Fault Messages Displayed on Boiler Interface*

FAULT	DESCRIPTION	CORRECTIVE ACTION
Flue Temp High	The stack temperature has exceeded the set parameters for the boiler.	• Inspect the heat exchanger. Reference page 34 of this manual for the procedure on how to clean the flue side of the heat exchanger. • Inspect the flue sensor and associated wiring. Measure the resistance of the flue sensor and compare to Table 3-2D on page 38 of this manual. Replace the sensor if necessary. • Verify that the vent/air intake pipes are properly installed and that there are no obstructions. • Replace the main control board.
Delta T High	The temperature rise across the heat exchanger has exceeded the set parameters for the boiler.	• Verify that the system is full of water and that all air has been properly purged from the system. • Verify that the boiler is piped properly into the heating system. Refer to Section 6 - Hydronic Piping of the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual for the proper piping methods for the Knight Wall Hung Fire Tube boiler. • Check for 120 vac to the boiler pump motor on a call for heat. If voltage is not present, check the wiring back to the main control board. Replace the main control board if necessary. • If 120 vac is present on a call for heat and the boiler pump is not operating, replace the pump. • Verify that the boiler pump is set to the proper speed or that the pump is the proper size. Reference Section 6 - Hydronic Piping of the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual for boiler pump specifications.
Outlet Temp High	Outlet water temperature has exceeded the maximum outlet water temperature.	• Verify that the system is full of water and that all air has been properly purged from the system. • Verify that the boiler is piped properly into the heating system. Refer to Section 6 - Hydronic Piping of the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual for the proper piping methods for the Knight Wall Hung Fire Tube boiler. • Check for 120 vac to the boiler pump motor on a call for heat. If voltage is not present, check wiring back to the main control board. Replace the main control board if necessary. • If 120 vac is present on a call for heat and the boiler pump is not operating, replace the pump. • Verify that the boiler pump is set to the proper speed or that the boiler pump is the proper size. Reference Section 6 - Hydronic Piping of the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual for boiler pump specifications. • Replace the main control board.

3 Troubleshooting

Table 3-4 *(continued from previous page) Troubleshooting Chart - Fault Messages Displayed on Boiler Interface*

FAULT	DESCRIPTION	CORRECTIVE ACTION
Low 24 vac	120 vac input to the main control board has dropped below 80 vac.	• Check 120 vac supply to the transformer. • Check wiring connections at the low voltage terminal strip. • Check the wire size/length to remote devices. • Replace the transformer.
Watch Dog Error	The main control board has detected an internal fault.	• Cycle power to the boiler. • Replace the main control board.
Write EEProm	The main control board has detected an internal fault.	• Cycle power to the boiler. • Replace the main control board.
CRC Parameters	The main control board has detected an internal fault.	• Cycle power to the boiler. • Replace the main control board.
No Error Stored	The particular lockout information has been lost.	• Press the RESET button. • Replace the main control board.

Combustion Analysis Procedure

1. Turn the main power off to the boiler by placing the "On/Off" switch in the OFF position.
2. When using PVC/CPVC remove the 1/2" combustion plug from the tee supplied in the installation kit for models 56 - 286 only. For all other venting options, remove the flue temperature sensor. Note: Combustion measurements will be made at this point.
3. Turn the main power on to the boiler by placing the "On/Off" switch in the ON position.
4. Place the boiler into the active position by pressing the RIGHT SELECT [ON] key (see page 6).
5. Locate the pinhole button above the RESET button on the display board (page 6). Insert a thin wire (such as a paper clip) into the hole and press the button once and hold for 5 seconds to place the boiler into Service Mode. In Service Mode the boiler will fire at ignition speed and will then modulate up to full fire.
6. Insert the probe from a combustion analyzer into the hole left by the removal of the 1/2" combustion plug or the flue temperature sensor.

Figure 3-2 *CPVC Tee Supplied with the Boiler*

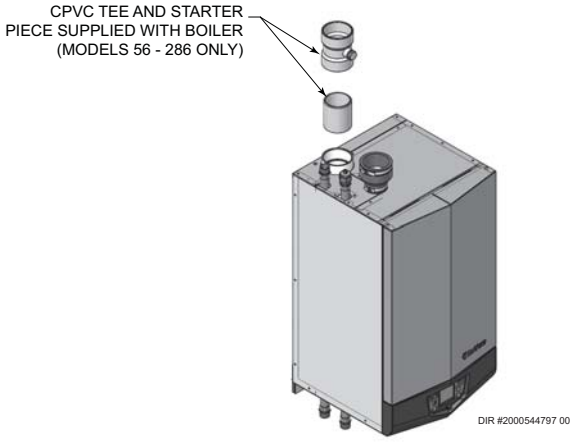


Table 3-5 *Flue Products*

Natural Gas				
Input Rate	Target		Range	
	CO_2	O_2	CO_2	O_2
High Fire	9.2%	4.5%	9.0% - 10.5%	2.1% - 4.8%
Low Fire	9.0%	4.8%	8.8% - 9.5%	3.9% - 5.2%

Propane				
Input Rate	Target		Range	
	CO_2	O_2	CO_2	O_2
High Fire	10.8%	4.5%	10.5% - 11.5%	3.5% - 5.0%
Low Fire	10.5%	5.0%	10.0% - 11.0%	4.2% - 5.8%

3 Troubleshooting *(continued)*

7. Once the boiler has modulated up to full fire, measure the combustion. The values should be in the range listed in Table 3-5 on page 46. The CO levels should be less than 200 ppm for a properly installed unit.

   If the combustion is not within the specified range, reference Table 3-6 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 boiler shuts down and registers an alarm. Turn the manual shutoff switch to the ON position and reset the control.
9. Turn the main power off to the boiler and re-install the 1/2" combustion plug or replace the flue temperature sensor.
10. Place the boiler back into normal operation.

⚠ WARNING You must replace the flue gas temperature sensor / 1/2" combustion plug (depending on venting option) to prevent flue gas spillage into the room. Failure to comply could result in severe personal injury, death, or substantial property damage.

Gas valve adjustment procedure

If adjustment of the gas valve is deemed necessary, use the following procedure:

CAUTION Under normal operating conditions this valve should not need adjusting.

Models WH56 - 286

Locate the throttle adjustment screw on the top of the gas valve, see FIG. 3-3. Using a 2.5 mm Allen wrench, turn the screw 1/8 turn **counterclockwise** to increase CO_2 levels or 1/8 turn **clockwise** to decrease CO_2 levels.

Model WH400

Locate the throttle adjustment screw on the side of the venturi valve, see FIG. 3-4. Using a screwdriver, turn the screw 1/4 turn **counterclockwise** to increase CO_2 levels or 1/4 turn **clockwise** to decrease CO_2 levels.

After one adjustment on the valve, follow the Combustion Analysis Procedure on pages 46 and 47 of this manual to measure the combustion.

If combustion is still not within the specified range, repeat the procedure. This procedure SHOULD NOT be performed more than four (4) times. If after four (4) adjustments and the combustion is still not within the specified range, revisit the possible causes in Table 3-6 or replace the gas valve.

Figure 3-3 *Gas Valve Adjustment - Models WH56 - 286*

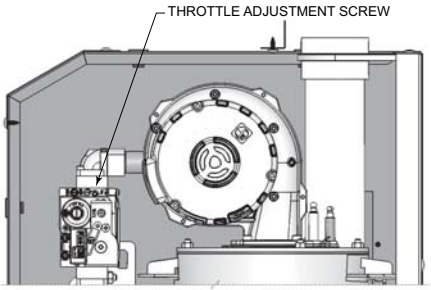


Figure 3-4 *Gas Valve Adjustment - Model WH400*

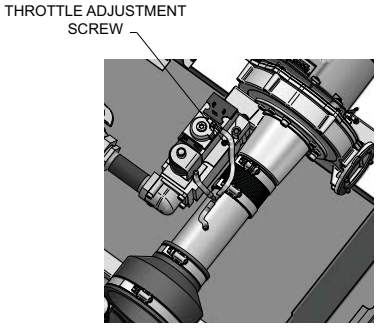


Table 3-6 *Troubleshooting Chart - Combustion Levels*

POSSIBLE CAUSE	CORRECTIVE ACTION
Vent/Air Intake Length or Obstruction	• Refer to Section 3 - General Venting of the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual for the proper venting and air intake methods for the Knight Wall Hung Fire Tube boiler. • Check for obstructions at the vent/air intake terminals.
Gas Supply Pressure	• Refer to Section 7 - Gas Connections of the Knight Wall Hung Fire Tube Boiler Installation and Operation Manual for the proper gas supply for the Knight Wall Hung Fire Tube boiler.
Dirty/Damaged Burner	• Refer to page 33 of this manual for burner removal and cleaning procedures. • Replace burner if necessary.
Gas Valve Adjustment	• Refer to this page for the gas valve adjustment procedure.

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Revision Notes: *Revision A (PCP# 3000008912 / CN# 500009028) initial release.*

MM #100288296_DIR #2000546130_Rev A
06/17

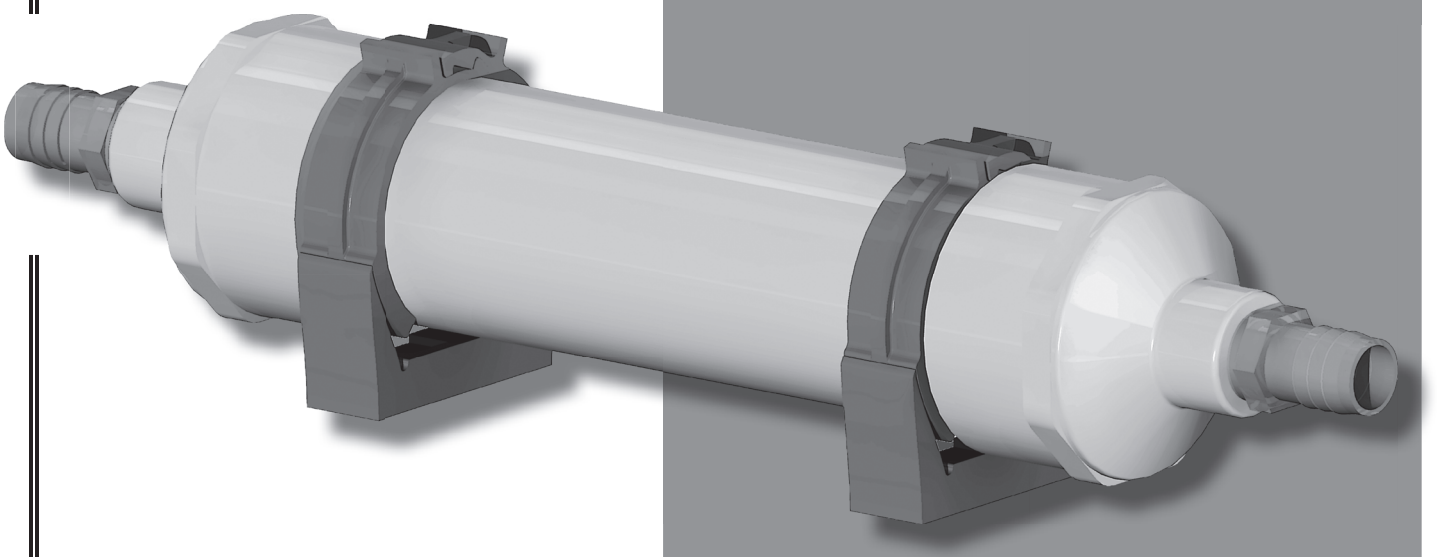
Revised - October, 2014

Installation Operation & Maintenance

Models: JM-2 & JM-3

JM series

Condensate neutralizing tubes



JJM Boiler Works, Inc.

69 Ferry Street - Units 17-20
Easthampton, MA 01027

Phone 413-527-1893
web: www.jjmboilerworks.com

Overview

Read before proceeding

⚠WARNING Failure to comply with these guidelines could result in severe personal injury, death or substantial property damage.

Neutralizer and lines must be wet

- **Before operating the boiler or furnace, fill the JM tube and traps with tap water. NEVER operate with tubes or P-traps dry.**

Application restrictions

- Condensing boilers, furnaces, and flue pipe condensate drains only.
- DO NOT exhaust flue gases through JM tubes, they are not rated for boiler or furnace flue gases. Operating JM tubes as exhaust vents can cause injury or death from carbon monoxide.
- Gas traps must be installed between the boiler, vent drains, and furnace condensate outlet and the inlet of all JM tubes.
- JM tubes must be installed below system P-traps, boiler, furnace, and breeching condensate drains.

Combined piping options

Flue pipe condensate drains

- Boiler/furnace condensate drain and flue condensate drain can be common piped to a neutralizer tube ONLY if the boiler/furnace is individually vented (NOT connected to a common vent system). Also, the flue pipe must be terminated so rain water cannot enter the flue pipe.
- DO NOT connect any flue pipe condensate line to a neutralizer tube that serves more than one boiler.

Boiler/furnace condensate line common piping

- DO NOT combine vent condensate drain lines and boiler/furnace condensate lines if appliances are common vented. Use a separate JM-series tube for each application. For individually-vented appliances, vent and condensate drain lines can be combined. Common vent drains cn be piped together into one neutralizer. Sizing is 33% of total connected BTU inputs.

Recharge tubes regularly

- Tubes should be recharged when pH level moves below 5.5. The pH should be checked regularly (at least twice during the first year of operation) to determine the required recharging schedule.
- This may require recharging as often as twice per year for high-usage systems, such as boiler systems equipped with indirect water heaters.
- Boiler/furnace applications for space heating only (no DHW) may require recharging only once per year or when PH falls below 5.

What is pH?

The pH measurement of a fluid is an indicator of the acidity or alkalinity. Neutral fluids have pH of 7.0. Acid fluids have pH below 7. And alkaline fluids have pH above 7 (up to 14). The pH can be easily measured using litmus paper.

Condensate pH from condensing boilers and furnaces is typically around 4 (slightly acidic). The condensate pH needs to be increased (made more neutral) to prevent possible damage to cast iron soil pipe, ABS pipe, septic tanks, plants, wastewater treatment plants and other materials handling waste water.

JM-series condensate neutralizing tubes increase pH (reduce acidity).

JM-series residential/commercial flue-side condensate neutralizing tubes & tanks are designed to raise the pH level of the condensate discharged by high-efficiency boilers and warm air furnaces.

Each increase of 1.0 in pH is a 10-times decrease in acidity. The pH of condensate is increased by approximately 1.0 to 3.0 after passing through neutralizing tubes & tanks. (This is a reduction in acid concentration of from 10 to 1000 times.)

Applying JM-series neutralizing tubes

Condensate can be collected from flueways and boiler/furnace condensate trap outlets. See WARNING section at left for guidelines on application.

Match neutralizing tubes to boiler/furnace ratings. Use multiple tubes if needed to handle the load.

Locate the neutralizing tube below the condensate connection and slightly above the floor drain or inlet to a condensate pump reservoir (if used).

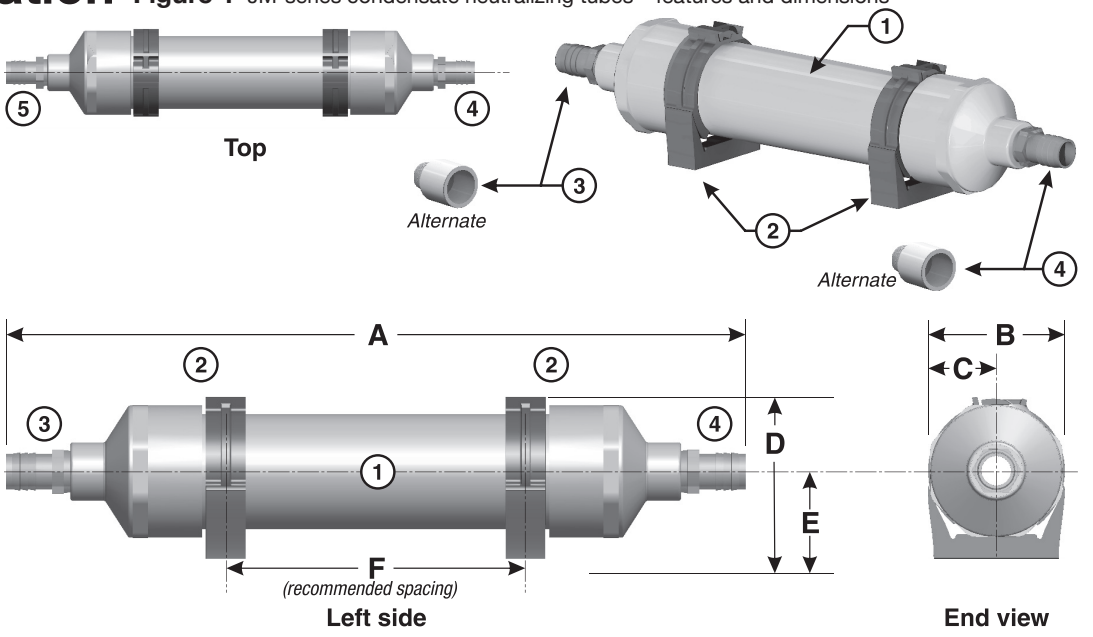
Follow the guidelines in this manual, the boiler/furnace manual and all applicable local codes when installing, using and maintaining JM-series condensate neutralizing tubes.

Installation sequence

1. Before installing boiler or furnace, determine if a mounting pad will be needed to elevate the boiler or furnace so that the condensate connection will be above bottom of the JM tube OUTLET. See Figure 2 or Figure 3. Provide a mounting pad for the JM tube if needed to obtain the proper elevation relative to a condensate pump reservoir (when used — see Figure 3).
2. Mount the strut channel to the wall or floor, insert strut clamps to the JM tube, tighten bolts & nuts.
3. Connect PVC piping from appliance or breaching drains to P-traps and then from P-trap outlets to either one of the two JM tube inlets.
4. Connect the JM tube outlet to house drain or condensate pump.
5. Use Teflon tape on all threaded plastic fittings.
6. **NOTE** — Always consult the local authority regarding any requirements concerning flue gas condensate handling codes.
7. JM tube outlet port should be positioned at 12 o'clock and the two inlet ports should be positioned at 3 & 9 o'clock.

Installation

Figure 1 JM-series condensate neutralizing tubes – features and dimensions



RATINGS & DIMENSIONS *(in inches)*								
Model	**MBH**	**GPH**	**A**	**B**	**C**	**D**	**E**	**F**
JM-2	150	2	10.5	2.75	1.375	3.5	1.875	6.5
JM-3	300	2	19.5	2.75	1.375	3.5	1.875	9.5

1	PVC tubing filled with ⅜" limestone and 97% MgO Pellets	
2	Clamp-on support brackets	
3	Condensate outlet hose barb fitting	¾" hose barb x ½" NPT — or — ¾" PVC x ½" NPT (both supplied)
4	Condensate inlet hose barb fitting	

Figure 2 JM-series tube with floor drain, typical

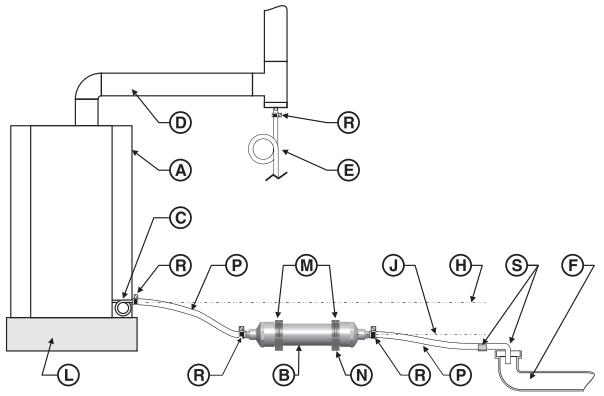
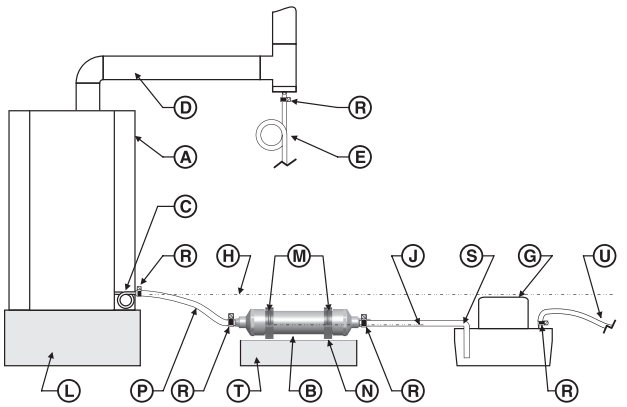


Figure 3 JM-series tube with condensate pump, typical



A Condensing boiler or furnace

B ondensate neutralizing tube (or multiple tubes piped in parallel)

C Boiler/furnace condensate trap connection

D Boiler/furnace vent

E Vent condensate trap, when used — Install a trap as shown. Connect the tubing to a separate JM tube if appliances are common vented. For individually-vented appliances, the vent condensate drain can be connected to the appliance condensate drain line.

F Drain or sump

G Condensate pump

H Bottom of boiler/furnace condensate outlet — MUST be ABOVE condensate pump inlet connection

J Bottom of JM tube condensate outlet

L Mounting pad or structural platform, when required to elevate boiler condensate drain as needed

M Mounting clamps

N Mounting clamps must be secured to the mounting surface

P Plastic tubing or PVC pipe — When using PVC pipe, remove the JM inlet and outlet hose barb fittings and replace with threaded PVC fittings. Include unions in the piping to allow removal of the JM tube for inspection and service. — Secure pipe or tubing in place. — Protect with a shield if necessary if routed through traffic areas.

R Use hose clamps at all connections when using plastic tubing.

S Condensate drain termination at floor drain (or condensate pump reservoir inlet) — secure in place with clamps. — Follow instructions for condensate pump.

T Elevate the JM tube on a structural base if necessary for the outlet to be raised.

U Route condensate discharge line from to appropriate drain location.

Installation *(continued)*

Piping Options

Overflow by-pass piping

See Figure 4 and Figure 5 for installation with a y-fitting for an overflow by-pass line.

Locate the overflow discharge so flow can be easily seen. **Instruct the owner to notify the service technician immediately if flow through the overflow line is frequent or steady.**

Make sure the installation complies with all local code requirements.

Piping for multiple boilers/furnaces

Follow the guidelines on page 2, do not connect a flue pipe with multiple boilers or furnaces.

As stated on page 2, do not connect a flue pipe condensate line to the to the same neutralizer as used for a boiler/furnace unless the boiler/furnace is individually vented, the vent will not allow rain water to enter the flue pipe, and no other appliance is connected to the same neutralizer tube.

Legend for Figure 4 and Figure 5

- **A** Condensing boiler or furnace, floor-mounted type
- **B** Condensing boiler or furnace, wall-mounted type
- **C** JM neutralizing tube floor-mounted (or multiple tubes piped in parallel)
- **D** JM neutralizing tube wall-mounted (or multiple tubes piped in parallel)
- **E** Y-fitting, 3/4" PVC minimum – locate a minimum of 2 inches above the neutralizing tube and so the overflow line is below the bottom of appliances condensate drain connection (item L)
- **F** Appliance condensate trap/condensate drain connection
- **H** Overflow drain line (terminate so flow from line is easily seen)
- **J** Floor drain, sump or condensate pump reservoir
- **L** Bottom of appliance condensate drain connection – all condensate piping and components must be below this level
- **M** Bottom of JM neutralizer tube outlet connection
- **N** Terminate the overflow line above the drain location so any flow from the line is easily visible

⚠WARNING

OUTDOOR INSTALLATIONS — provide and install electric heat tape on the condensate drain lines and around the JM tube to prevent possibility of neutralizer tube damage or line blockage due to freezing. Failure to comply with the following guidelines could result in severe personal injury, death or substantial property damage.

Figure 4 Y-fitting by-pass with floor-mounted boiler (see legend at left)

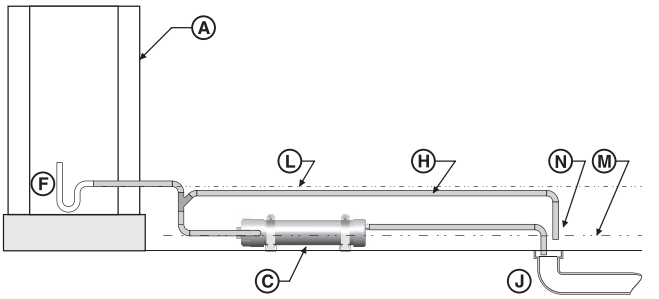
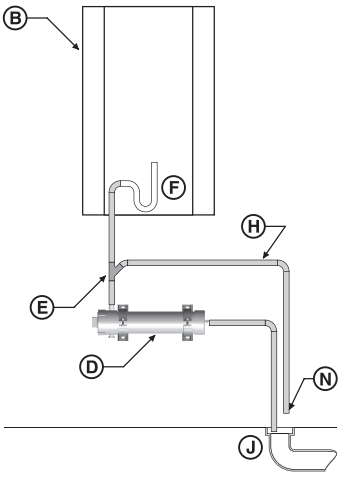
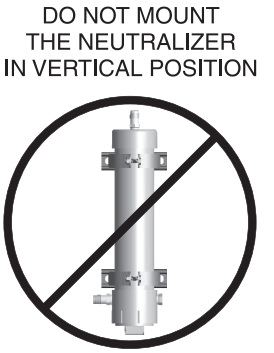


Figure 5 Y-fitting by-pass with wall-mounted boiler (see legend at left)





Maintenance

Inspect frequently

Installer — Instruct the building owner to frequently inspect the JM neutralizer and all condensate connections. The owner must notify a qualified technician if any problems are noticed.

Recharge as required

When pH tube or tank outlet falls below 5PH. Local codes may have different requirement, check with local authority.

Replacement parts

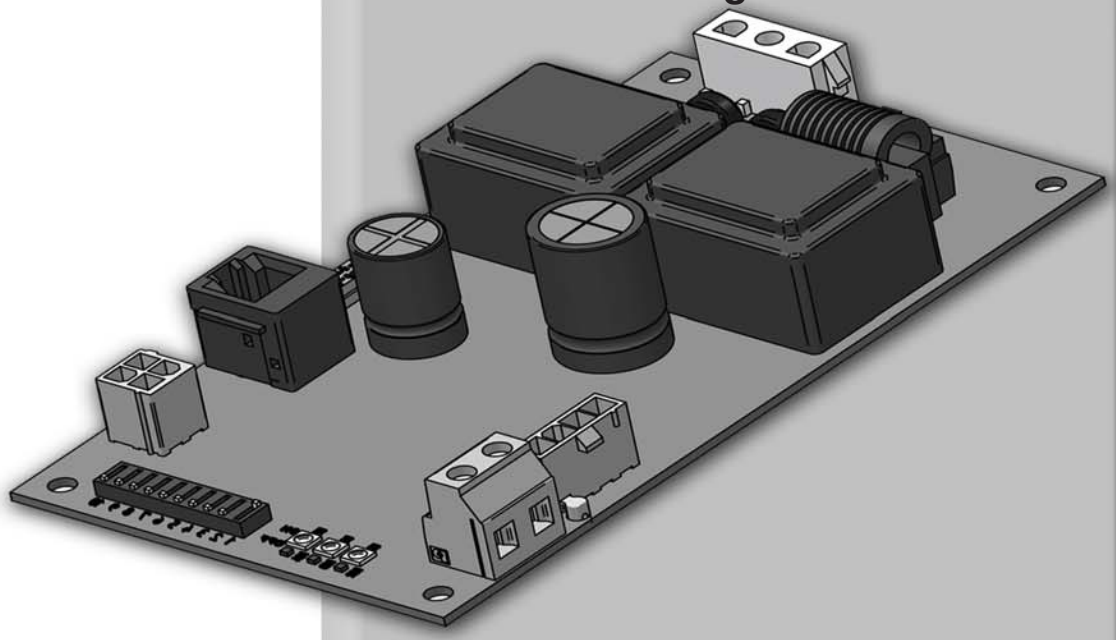
Contact your local wholesaler or manufacturer's representative for replacement parts.

Dealer listing at www.jjmboilerworks.com

MODBUS AND BACNET COMMUNICATION INSTRUCTIONS

Models:

Knight 81 - 286, Knight XL 400 - 801, Armor 151 - 801, Outdoor Knight 151 - 286, Outdoor Knight XL 400 - 801, Outdoor Armor 151 - 801, AQUAS 400 - 801, FTXL 400 - 850, Wall Mount 51 - 211 and Wall Hung 55 - 399



⚠ WARNING

This manual must only be used by a qualified heating installer / service technician. Read all instructions, including this manual, the Installation and Operation Manual, and the 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.

Lochinvar®
High Efficiency Water Heaters, Boilers and Pool Heaters

Contents

1 Introduction

The information contained in this manual provides general guidelines for the implementation of ModBus and BACnet communication with the Lochinvar Armor water heaters (151 - 801), Knight (81-286), Knight XL (400 - 801), Outdoor Knight (151-286), Outdoor KnightXL (400-801), Outdoor Armor (151-801), Wall Mount (51 - 211), and Wall Hung (55 - 399) boilers.

All ModBus networks are implemented utilizing a master-slave arrangement where all boilers/water heaters are slaves and the master is a building automation system capable of communicating over a RS-485 half duplex serial connection. BACnet networks are implemented using a token passing process where multiple masters and slaves share a common RS-485 bus. The Lochinvar BACnet interface is a master only.

Definitions

Abbreviation or Acronym	Meaning
ASCII	American Standard Code for Information Interchange
BACnet	A data communication protocol for Building Automation and Control Networks
BAS	Building Automation System
Baud (Baud Rate)	Number of data bits transmitted per second (bps)
EMS	Energy Management System
FDX	Full-Duplex
HDX	Half-Duplex
Hex	Hexadecimal Number (0 - 9, A - F)
I/O Box	Input/Output (I/O)
LSB	Least Significant Byte
ModBus	A serial, half-duplex data transmission protocol developed by AEG Modicon
MSB	Most Significant Byte
RS232	A standard for serial, full-duplex (FDX) transmission of data based on the RS232 Standard
RS485	A standard for serial transmission of data based on the RS-485 Standard
RTU	Remote Terminal Unit

Minimum System Requirements

- BAS system or computer with a serial or USB port with a converter to RS-485 half duplex.
- Unit equipped with communication board.
- Shielded twisted pair communication cable.

2 Installation

Installation procedure - for Models WB, AW, KB, OA, OK and KBX

1. Turn OFF the main electrical power to the appliance.
2. Turn OFF the main manual gas shutoff to the appliance.
3. Assemble the communication control board to the sheet metal base as shown in FIG. 2-1a and 2-1b, depending on model.
4. Connect the power harness from the appliance to the communication board through the sheet metal cover hole (see FIG. 2-2a and 2-2b, depending on model).
5. Using the two (2) sheet metal screws provided in the kit, attach the pre-painted sheet metal cover over the Communication board for protection from line voltage (FIG. 2-2a and 2-2b, depending on model).
6. Locate the pilot holes on the side of the jacket (left side if AW/KB/KXL or right side if WB), using the sheet metal screws provided in the kit, mount the communication board assembly to the appliance (FIG. 2-3a and 2-3b, depending on model).

Wiring

7. Disconnect power to the transformer by removing connection “B”, see FIG. 2-4, page 4.
8. Connect A, C, D, and B (FIG. 2-4).
9. Connect the communication board to the control board of the appliance (see FIG. 2-5 on page 4).
10. Turn on the main electrical power and the main manual gas shutoff to the appliance.
11. Configure the control board and unit controls per this manual and resume operation.

Figure 2-1a_Assemble Communication Board for Models WB, AW, KB and KBX

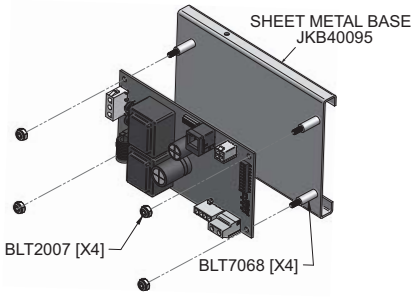


Figure 2-1b_Assemble Communication Board for Models OA and OK

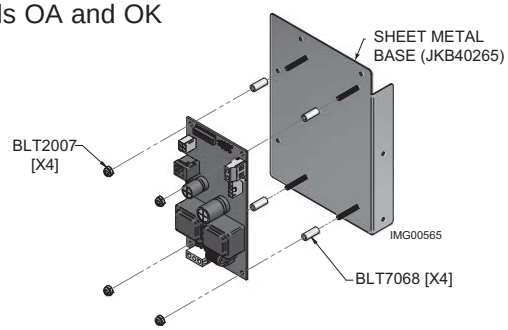


Figure 2-2a_Attach Cover to Communication Board for Models WB, AW, KB and KBX

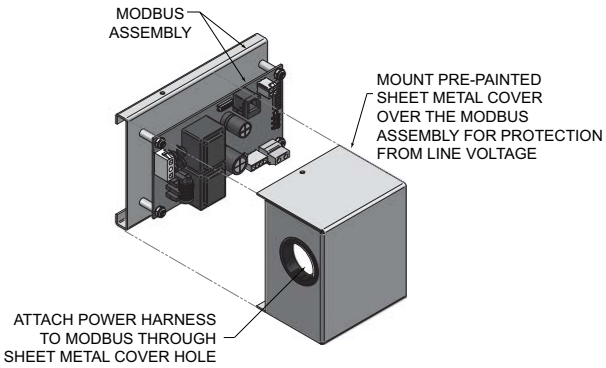


Figure 2-2b_Attach Cover to Communication Board for Models OA and OK

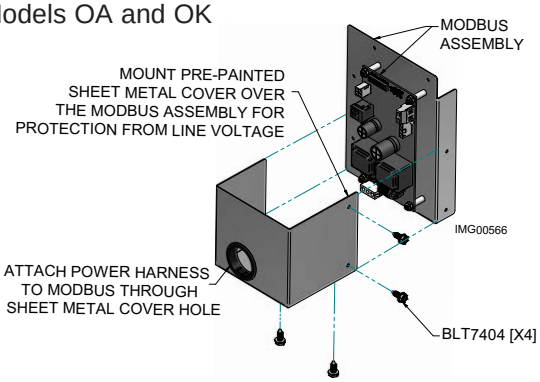
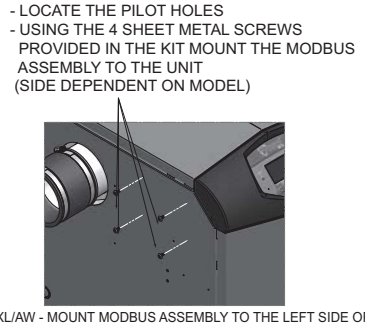
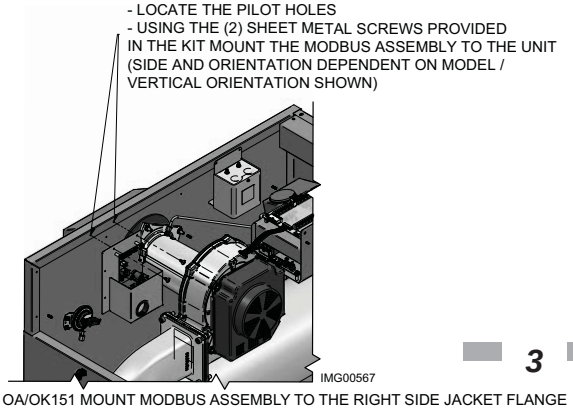


Figure 2-3a_Mount Communication board to Unit for Models WB, AW, KB and KBX



NOTE: KB/KXL/AW - MOUNT MODBUS ASSEMBLY TO THE LEFT SIDE OFTHE JACKET. WB - MOUNT MODBUS ASSEMBLY TO THE RIGHT SIDE OF THE JACKET.

Figure 2-3b_Mount Communication board to Unit for Models OA and OK



NOTE: OA/OK151 MOUNT MODBUS ASSEMBLY TO THE RIGHT SIDE JACKET FLANGE
OA/OK400-501 MOUNT MODBUS ASSEMBLY IN HORIZONTAL ORIENTATION

2 Installation

Figure 2-4_Harness Connections_WB, AW, KB, KBX, OA, and OK models

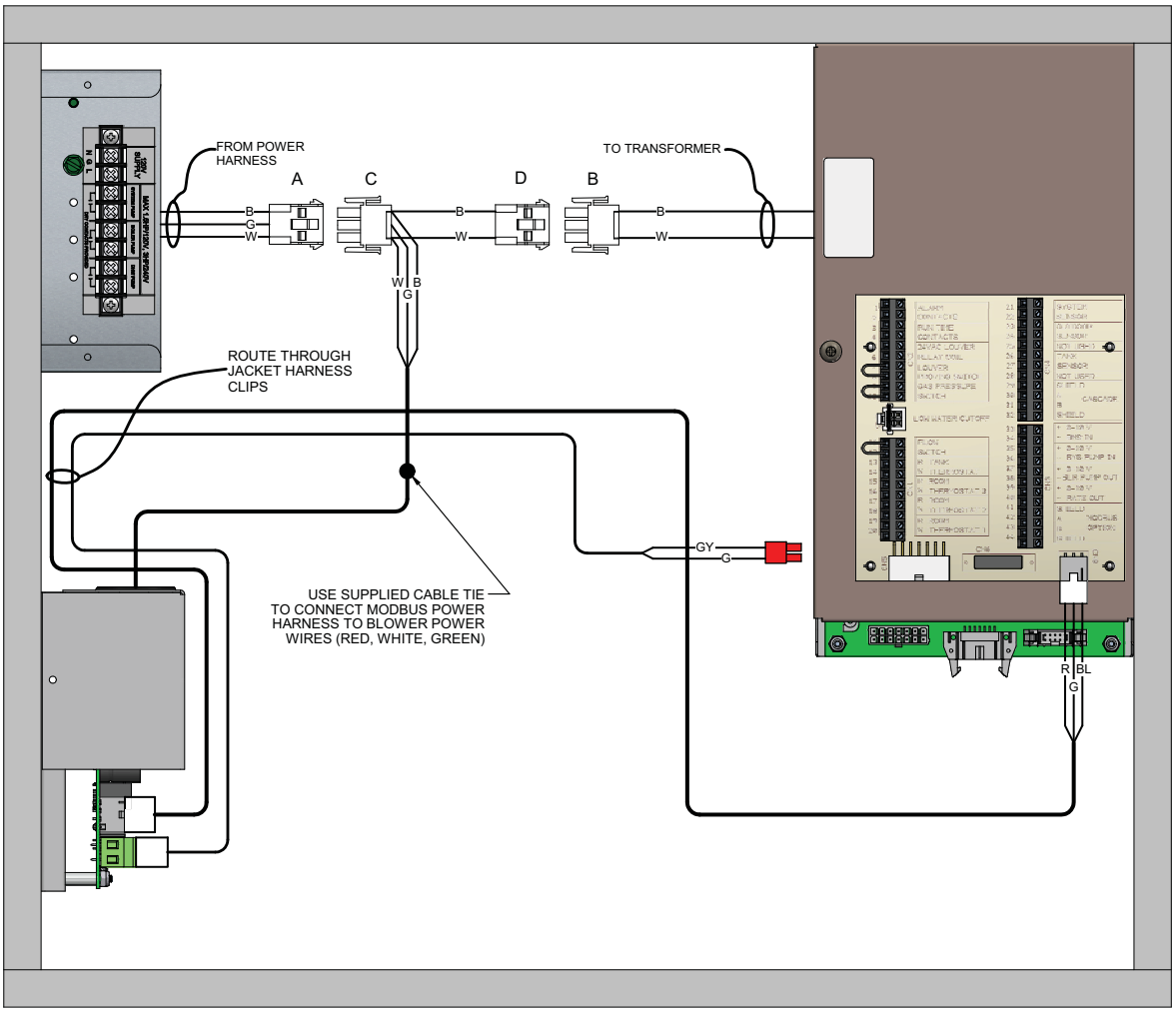
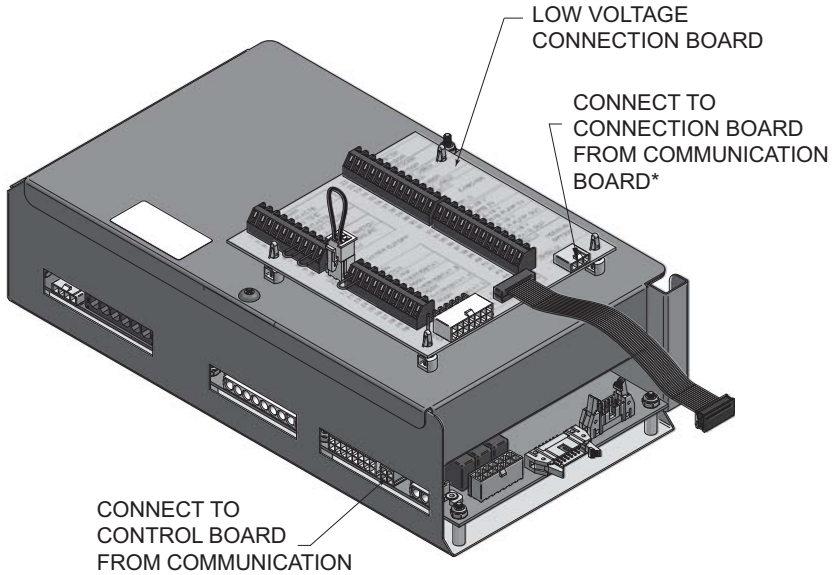


Figure 2-5_Connect Communication Board to Control Board



*HARNESSES CAN ONLY BE CONNECTED ONE WAY.

2 Installation *(continued)*

ModBus installation procedure - for FTXL Models

Figure 2-6a_Assemble ModBus Control Board for FTXL

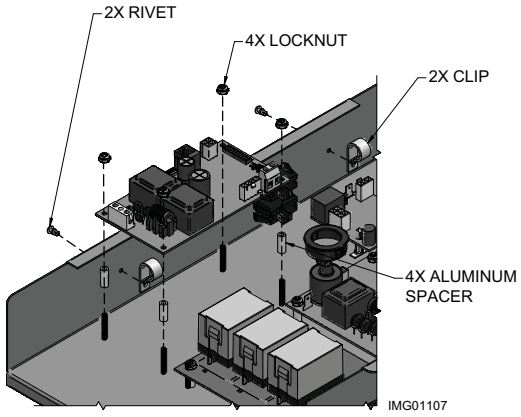
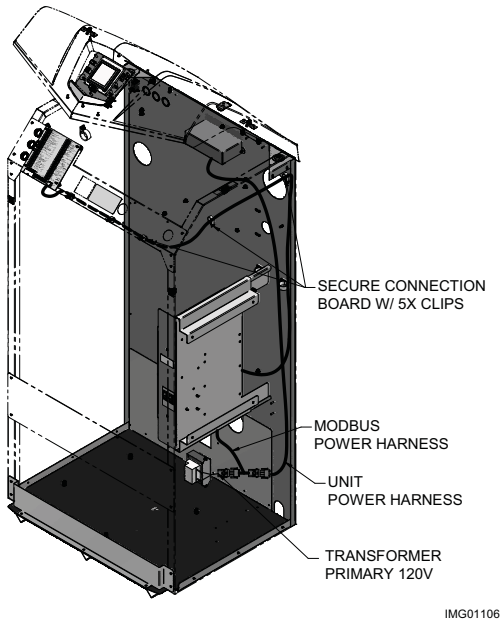
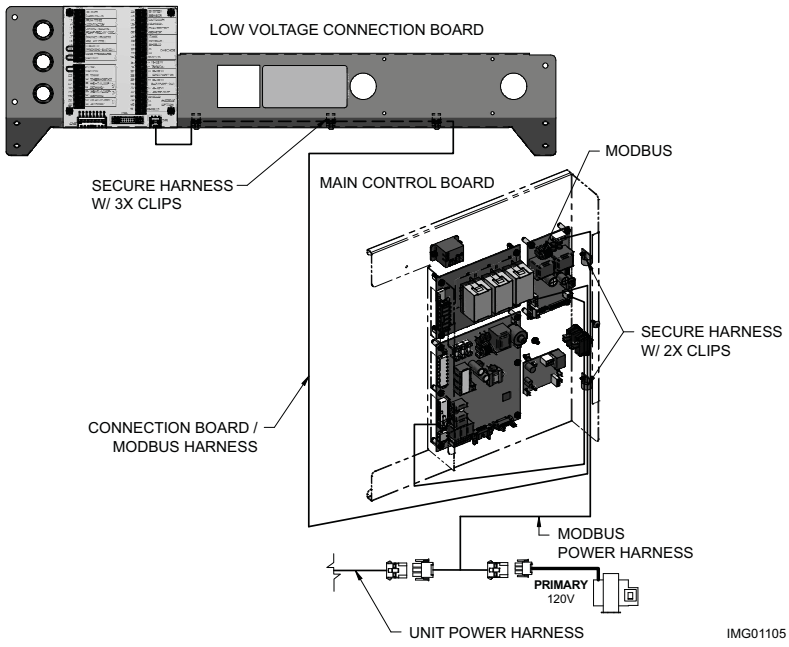


Figure 2-6b_Secure Control Board to FTXL Unit



1. Turn OFF the main electrical power to the appliance.
2. Turn OFF the main manual gas shutoff to the appliance.
3. Assemble the ModBus control board and provided cable clamps to the control panel as shown in FIG. 2-6a.
4. Connect the ModBus power, control board and connection board wiring harnesses. Secure the wiring with the provided cable clips and route it through the bottom of the control panel. Perform the wiring connections referencing FIG.'s 2-6b and 2-6c.
5. Turn ON the main electrical power to the appliance.
6. Configure the control board and unit controls per this manual and resume operation.

Figure 2-6c_Perform Wiring Connections for FTXL



2 Installation

Installation Procedure - for WH Models

1. Turn OFF the main electrical power to the appliance.
2. Turn OFF the main manual gas shutoff to the appliance.
3. To assemble the communication board to the sheet metal, insert four (4) standoffs into the front access panel (FIG. 2-6).
4. Place the communication board onto the standoffs installed in Step 3. Use the screw (provided in kit) to secure the control panel cover (FIG. 2-6).
5. Connect the wire harnesses (100172824 , 100172826 and 100172828) from the appliance to the communication board following the diagram shown in FIG. 2-7.
6. Turn on the main electrical power and the main manual gas shutoff to the appliance.
7. Configure the communication board and unit controls per this manual and resume operation.

Figure 2-6_Assemble Communication Board_WH

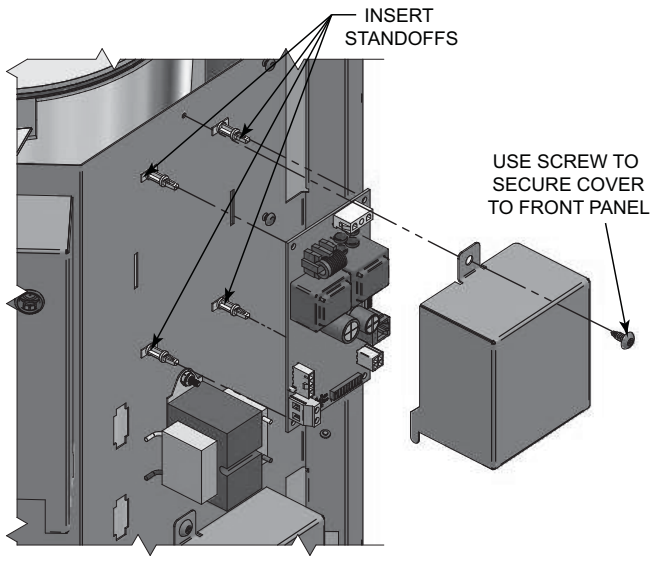
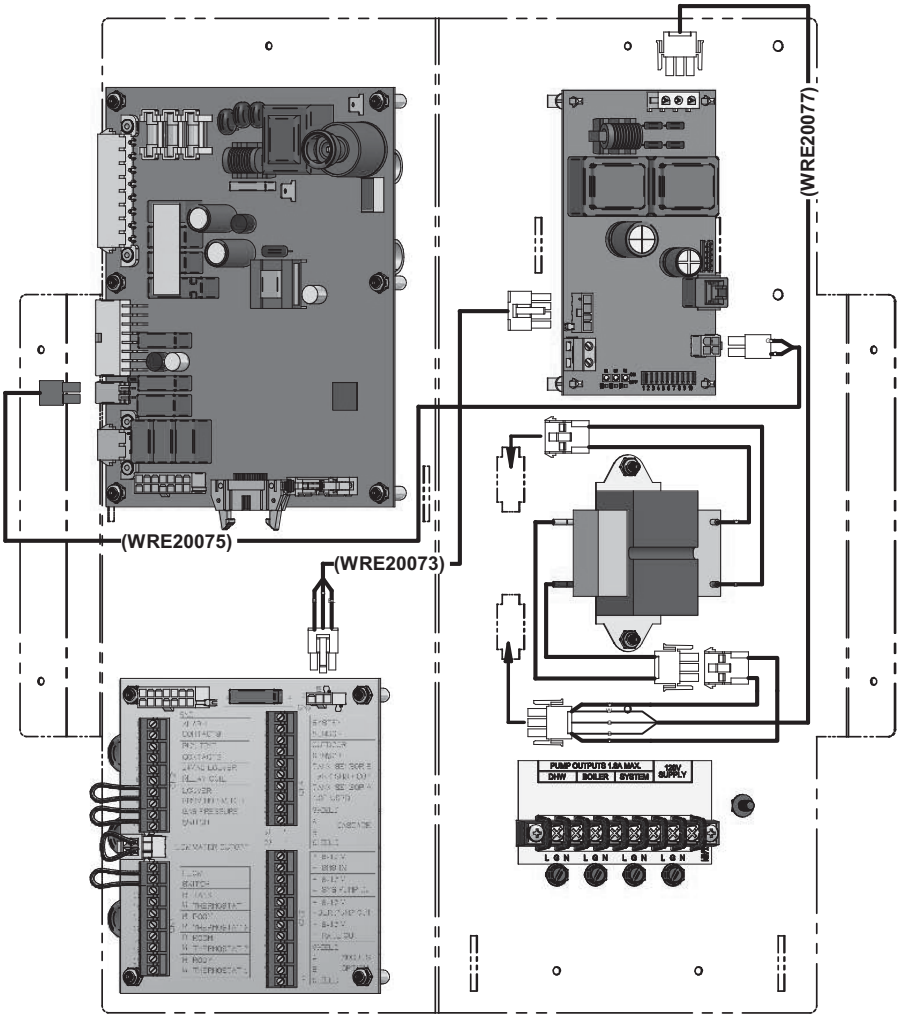


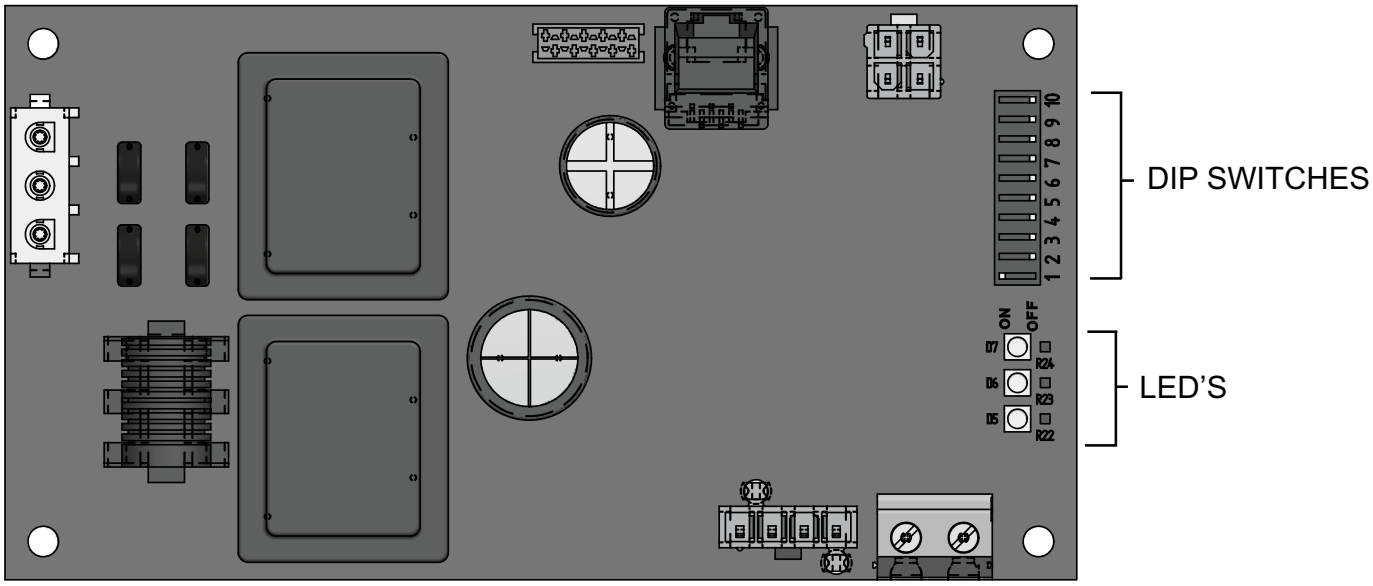
Figure 2-7_Harness Connections_WH



3 ModBus Configuration

The ModBus communication board is equipped with a set of ten dip switches that are used to set the board configuration (address, baud rate, and parity settings). The first eight are used to set the address of each board. The ninth is baud rate. The tenth is parity.

Figure 3-1_ModBus Communication Board



Addressing

The ModBus addressing space is comprised of 256 different addresses.

- 0 is reserved for broadcast messages from the master device
- 1 - 247 are free to use for each unique device
- 248 - 255 are reserved

To set the ModBus address the dip switches can be set in either the 0 position or the 1 position. For switches set to the 1 position their value will be added together to determine the address.

Each switch set to the 1 position has the following value:

Dip switch 1 = 1
Dip switch 2 = 2
Dip switch 3 = 4
Dip switch 4 = 8
Dip switch 5 = 16
Dip switch 6 = 32
Dip switch 7 = 64
Dip switch 8 = 128

Any dip switch set to 0 has a value equal to 0.

Example:

To set the address of the ModBus board to 50, dip switches 2, 5, and 6 have to be set to the 1 position. The address is determined by adding the values of all the dip switches together.

Address = Value of Dip switch 1 + Value of Dip switch 2 + Value of Dip switch 3 + Value of Dip switch 4 + Value of Dip switch 5 + Value of Dip switch 6 + Value of Dip switch 7 + Value of Dip switch 8

In this example:

Address = 0 + 2 + 0 + 0 + 16 + 32 + 0 + 0 = 50

3 ModBus Configuration

Timing Specifications

The baud rate for the ModBus board is selectable with Dip switch #9.

1 = 19200 bps
0 = 9600 bps

Each message is started by at least 3.5 character times of silence. The maximum delay between frames is 1.5 character times.

When the system temperature, tank temperature, and/or 0-10V BMS voltage is provided by the BAS to the boiler, it is critical that the values be updated every few seconds. If the boiler does not receive updated values within a timeout period (installer adjustable), the control will revert to using its own readings (if connected). The timeout is programmable as follows:

NOTICE Please note that the brackets ([]) denote screen status.

1. Press and hold the LEFT SELECT [MENU] key for 5 seconds.
2. Enter installer code - 5309.
3. Scroll down and select [CONTROL MODES].
4. Scroll down and select [MODBUS T/O].
5. Scroll to desired time. Press the RIGHT SELECT [SAVE] key.

The timeout is adjustable between 5 and 120 seconds. The default timeout is 10 seconds.

When the BAS is not providing any of these values, but is still controlling the boiler (such as providing an enable command), the BAS must refresh these commands at least every 4 minutes. If the commands are not refreshed, the boiler will revert to operating based on its own inputs.

Parity

Parity is set by the position of Dip switch #10.

0 = No Parity
1 = Even Parity

If No Parity is selected there will be two stop bits, otherwise there will be one.

Data Transmission Mode

Many ModBus bus master devices can be configured to transmit data in either ModBus RTU or ModBus ASCII modes. Since RTU messages can be formatted to use fewer data bits and are therefore more efficient, RTU has been chosen to be used with all Lochinvar ModBus communication. Please ensure that the master device is transmitting ModBus RTU.

ModBus Board Diagnostics

The ModBus board is equipped with three LED's for visual diagnostics: Two yellow LED's and one green. One yellow LED (D5) is used to indicate transmission of data. The other yellow LED (D6) is used to indicate reception of data. The green LED (D7) is used to show internal faults.

Internal Faults:

Normal Operation = 1 second bright, 1 second dim
Controller Fault = Continuously on
No Burner Control Communication = 0.5 seconds on, 1.5 seconds off
No ModBus Communication = 1.5 seconds on, 0.5 seconds off

ModBus Communication

The ModBus communication commands and exception codes that are supported by the ModBus communication board can be found on pages 8 and 9 of this manual.

3 ModBus Configuration *(continued)*

ModBus Function Set

Function		Sub Function	HEX	Description
Dec	HEX	Dec		
1	01			Read Coil Status
2	02			Read Input Status
3	03			Read Holding Registers
4	04			Read Input Registers
5	05			Force Single Coil
6	06			Preset Single Register
7	07			Read Exception Status
8	08	0	00	Diagnostic - Return Query Data
		1	01	Diagnostic - Restart Communication
		2	02	Diagnostic - Return Diagnostic Register
		4	04	Diagnostic - Force Listen Mode
		10	0A	Diagnostic - Clear Counters and Diagnostic Registers
		11	0B	Diagnostic - Return Bus Message Count
		12	0C	Diagnostic - Bus Communication Error Count
		13	0D	Diagnostic - Bus Exception Error Count
		14	0E	Diagnostic - Return Slave Message Count
		15	0F	Diagnostic - Return Communication Error Count
		16	10	Diagnostic - Return Slave NAK Count
		17	11	Diagnostic - Return Slave Busy Count
		18	12	Diagnostic - Return Bus Character Overrun Count
		20	14	Diagnostic - Clear Overrun Counter and Flag
11	0B			Get Communication Event Counter
12	0C			Get Communication Event Log
15	0F			Write Multiple Coils
16	10			Write Multiple Registers
17	11			Report Slave ID
23	17			Read / Write Multiple Registers

3 ModBus Configuration

ModBus Exception Codes

MODBUS Exception Codes		
Code	**Name**	**Meaning**
01	ILLEGAL FUNCTION	The function code received in the query is not an allowable action for the server (or slave). This may be because the function code is only applicable to newer devices, and was not implemented in the unit selected. It could also indicate that the server (or slave) is in the wrong state to process a request of this type, for example because it is unconfigured and is being asked to return register values.
02	ILLEGAL DATA ADDRESS	The data address received in the query is not an allowable address for the server (or slave). More specifically, the combination of reference number and transfer length is invalid. For a controller with 100 registers, the PDU addresses the first register as 0, and the last one as 99. If a request is submitted with a starting register address of 96 and a quantity of registers of 4, then this request will successfully operate (address-wise at least) on registers 96, 97, 98, 99. If a request is submitted with a starting register address of 96 and a quantity of registers of 5, then this request will fail with Exception Code 0x02 “Illegal Data Address” since it attempts to operate on registers 96, 97, 98, 99 and 100, and there is no register with address 100.
03	ILLEGAL DATA VALUE	A value contained in the query data field is not an allowable value for server (or slave). This indicates a fault in the structure of the remainder of a complex request, such as that the implied length is incorrect. It specifically does NOT mean that a data item submitted for storage in a register has a value outside the expectation of the application program, since the MODBUS protocol is unaware of the significance of any particular value of any particular register.
04	SLAVE DEVICE FAILURE	An unrecoverable error occurred while the server (or slave) was attempting to perform the requested action.
05	ACKNOWLEDGE	Specialized use in conjunction with programming commands. The server (or slave) has accepted the request and is processing it, but a long duration of time will be required to do so. This response is returned to prevent a timeout error from occurring in the client (or master). The client (or master) can next issue a Poll Program Complete message to determine if processing is completed.
06	SLAVE DEVICE BUSY	Specialized use in conjunction with programming commands. The server (or slave) is engaged in processing a long -- duration program command. The client (or master) should re-transmit the message later when the server (or slave) is free.
08	MEMORY PARITY ERROR	Specialized use in conjunction with function codes 20 and 21 and reference type 6, to indicate that the extended file area failed to pass a consistency check. The server (or slave) attempted to read record file, but detected a parity error in the memory. The client (or master) can retry the request, but service may be required on the server (or slave) device.
0A	GATEWAY PATH UNAVAILABLE	Specialized use in conjunction with gateways, indicates that the gateway was unable to allocate an internal communication path from the input port to the output port for processing as the request. Usually means that the gateway is misconfigured or overloaded.
0B	GATEWAY TARGET DEVICE FAILED TO RESPOND	Specialized use in conjunction with gateways, indicates that no response was obtained from the target device. Usually means that the device is not present on the network.

4 ModBus Memory Map

Primary Data Tables

Table	Data Type	Read / Write
Discrete Inputs	Single Bit	Read Only
Coils	Single Bit	Read / Write
Input Registers	16-Bit Word	Read Only
Holding Registers	16 Bit Word	Read / Write

Memory Map

Coils						
Address	**Description**	**Default**	**Unit**	**Min.**	**Max.**	**Resolution**
00001	Room Thermostat 1	0	1=ON / 0=OFF	0	1	1
00002	Room Thermostat 2	0	1=ON / 0=OFF	0	1	1
00003	Room Thermostat 3	0	1=ON / 0=OFF	0	1	1
00005	Tank Thermostat	0	1=ON / 0=OFF	0	1	1
Discrete Inputs						
10002	Flow Switch	0	1=ON / 0=OFF	0	1	1
10003	Gas Pressure Switch	0	1=ON / 0=OFF	0	1	1
10004	Louver Proving Switch	0	1=ON / 0=OFF	0	1	1
10005	Air Pressure Switch	0	1=ON / 0=OFF	0	1	1
10006	Blocked Drain Switch	0	1=ON / 0=OFF	0	1	1
10007	Auto Reset High Limit	0	1=ON / 0=OFF	0	1	1
10008	Flame	0	1=ON / 0=OFF	0	1	1
10009	Room Thermostat 1	0	1=ON / 0=OFF	0	1	1
10010	Tank Thermostat	0	1=ON / 0=OFF	0	1	1
10024	Room Thermostat 2	0	1=ON / 0=OFF	0	1	1
10033	Run-time Contacts	0	1=ON / 0=OFF	0	1	1
10034	Alarm Contacts	0	1=ON / 0=OFF	0	1	1
10035	CH Pump	0	1=ON / 0=OFF	0	1	1
10036	DHW Pump	0	1=ON / 0=OFF	0	1	1
10037	Louver Relay	0	1=ON / 0=OFF	0	1	1
10038	Gas Valve	0	1=ON / 0=OFF	0	1	1
10039	System Pump	0	1=ON / 0=OFF	0	1	1
10044	DHW Recirculation Pump	0	1=ON / 0=OFF	0	1	1

4 ModBus Memory Map

Memory Map

Input Registers						
Address	**Description**	**Default**	**Unit**	**Min.**	**Max.**	**Resolution**
30001	Discrete Inputs 1 - 16	0	HEX	0	65535	1
30002	Discrete Inputs 17 - 32	0	HEX	0	65535	1
30003	Discrete Inputs 33 - 48	0	HEX	0	65535	1
30004	System / Cascade Setpoint	0	Degrees Celsius	0	130	0,5
30005	System Pump Speed	0	%	0	100	1
30006	Cascade Total Power	0	%	100	800	1
30007	Cascade Current Power	0	%	0	800	1
30008	Outlet Setpoint	0	Degrees Celsius	0	130	0,5
30009	Outlet Temperature	0	Degrees Celsius	0	130	0,1
30010	Inlet Temperature	0	Degrees Celsius	-20	130	0,1
30011	Flue Temperature	0	Degrees Celsius	-20	130	0,1
30012	Firing Rate	0	%	0	100	1
30013	Boiler Pump Speed	0	%	0	100	1
30014	Boiler Status Code	0	HEX	0	65535	1
30015	Boiler Blocking Code	0	HEX	0	65535	1
30016	Boiler Lockout Code	0	HEX	0	65535	1
Holding Registers						
40001	Configuration	0	NA	0	65535	1
40002	Coils	0	NA	0	65535	1
40003	0-10 Volt Input / Rate Command / Setpoint Command	0	%	0	100	1
40004	Tank Setpoint	0	Degrees Celsius	0	87,5	0,5
40005	Tank Temperature	0	Degrees Celsius	-20	130	0,1
40006	Outdoor Temperature	0	Degrees Celsius	-40	60	0,1
40007	System Supply Temperature	0	Degrees Celsius	-20	130	0,1
40008	DHW Recirculation Temperature	0	Degrees Celsius	-20	130	0,1

Configuration Bits

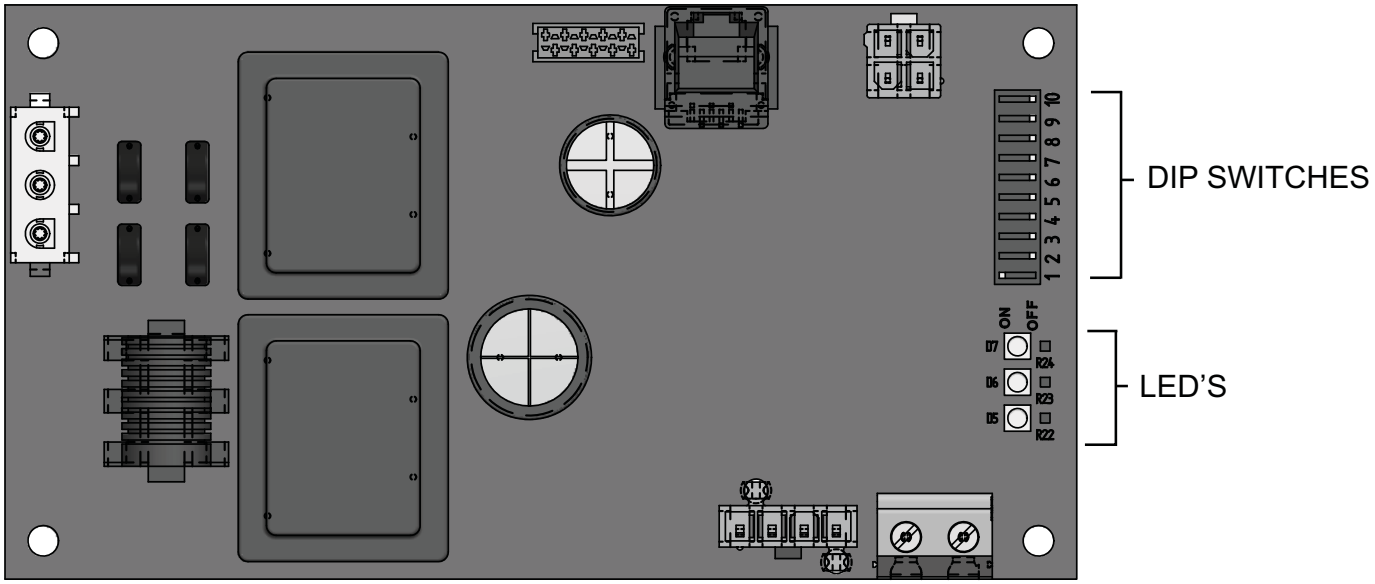
Address 40001 contains configuration bits sent from the BAS to the appliance. These bits tell the boiler/water heater to use its own internal inputs, or inputs from the BAS. When a bit is set to 1, the boiler/water heater will ignore the corresponding value contained internally, and expect the BAS to write that value into the Holding Registers. The configuration bits are as follows:

Bit 0 (LSB): Boiler Enable
Bit 1: Tank Thermostat
Bit 2: Rate Command / 10 - 10V Input / Setpoint Command
Bit 3: Tank Setpoint
Bit 4: System Supply Temperature
Bit 5: Outdoor Temperature
Bit 6: Tank Temperature
Bit 7: System Return Temperature
Bit 8 - 15: Not Used (Default = 0)

5 BACNET Configuration

The BACnet communication board is equipped with a set of ten dip switches that are used to set the board configuration (address and baud rate). The first eight are used to set the address of each board. The ninth and tenth are baud rate.

Figure 5-1_Communication Board



Addressing

The BACnet local addressing space is comprised of 256 different addresses.

- 255 is reserved for broadcast messages from a master device.
- 128 - 254 are free to use for slave devices only.
- 0 - 127 are free to use for master or slave devices.

To set the BACnet local address, the dip switches can be set in either the 0 position or the 1 position. For switches set to the 1 position their value will be added together to determine the address.

Each switch set to the 1 position has the following value:

Dip switch 1 = 1
Dip switch 2 = 2
Dip switch 3 = 4
Dip switch 4 = 8
Dip switch 5 = 16
Dip switch 6 = 32
Dip switch 7 = 64
Dip switch 8 = 128

Any dip switch set to 0 has a value equal to 0.

Example:

To set the address of the BACnet board to 50, dip switches 2, 5, and 6 have to be set to the 1 position. The address is determined by adding the values of all the dip switches together.

Address = Value of Dip switch 1 + Value of Dip switch 2 + Value of Dip switch 3 + Value of Dip switch 4 + Value of Dip switch 5 + Value of Dip switch 6 + Value of Dip switch 7 + Value of Dip switch 8

In this example:

Address = 0 + 2 + 0 + 0 + 16 + 32 + 0 + 0 = 50

The BACnet Device Instance is calculated by adding the BACnet local address to 600000. Using the above example, the Device Instance will be:

Device Instance = 600000 + 50 = 600050

Since the BACnet communication board is a BACnet master, address 127 is the highest address that can be used.

5 BACnet Configuration

Timing Specifications

The baud rate for the BACnet board is selectable with Dip switches #9 and #10.

Switch #9	Switch#10	Baud Rate
OFF	OFF	9600
ON	OFF	19200
OFF	ON	38400
ON	ON	76800

When the system temperature, tank temperature, and/or 0-10V BMS voltage is provided by the BAS to the boiler, it is critical that the values be updated every few seconds. If the boiler does not receive updated values within a timeout period (installer adjustable), the control will revert to using its own readings (if connected). The timeout is programmable as follows:

NOTICE Please note that the brackets ([]) denote screen status.

1. Press and hold the LEFT SELECT [MENU] key for 5 seconds.
2. Enter installer code - 5309.
3. Scroll down and select [CONTROL MODES].
4. Scroll down and select [MODBUS T/O].
5. Scroll to desired time. Press the RIGHT SELECT [SAVE] key.

The timeout is adjustable between 5 and 120 seconds. The default timeout is 10 seconds.

When the BAS is not providing any of these values, but is still controlling the boiler (such as providing an enable command), the BAS must refresh these commands at least every 4 minutes. If the commands are not refreshed, the boiler will revert to operating based on its own inputs.

Communication Board Diagnostics

The Communication board is equipped with three LED's for visual diagnostics: Two yellow LED's and one green. One yellow LED (D5) is used to indicate transmission of data. The other yellow LED (D6) is used to indicate reception of data. The green LED (D7) is used to show internal faults.

Internal Faults:

Normal Operation = 1 second bright, 1 second dim
Controller Fault = Continuously on
No Burner Control Communication = 0.5 seconds on, 1.5 seconds off
No BACnet Communication = 1.5 seconds on, 0.5 seconds off.

6 BACnet Memory Map

Primary Data Tables

Object Type	Data Type	Read / Write
Binary Input (BI)	Single Bit	Read Only
Binary Value (BV)	Single Bit	Read / Write
Analog Input (AI)	16-Bit Word	Read Only
Analog Value (AV)	16 Bit Word	Read / Write

Memory Map

Object Name	Object Type	Object Instance	Units	Min	Max	Resolution
Binary Values						
Boiler Enable / Room Th. 1	BV	0	none	0	1	1
Room Th.2	BV	1	none	0	1	1
Room Th.3	BV	2	none	0	1	1
Tank Thermostat	BV	4	none	0	1	1
Binary Inputs						
Flow Switch	BI	1	none	0	1	1
Gas Pressure Switch	BI	2	none	0	1	1
Louver Proving Switch	BI	3	none	0	1	1
Air Pressure Switch	BI	4	none	0	1	1
Blocked Drain Switch	BI	5	none	0	1	1
Auto Reset High Limit	BI	6	none	0	1	1
Flame	BI	7	none	0	1	1
Room Thermostat 1	BI	8	none	0	1	1
Tank Thermostat	BI	9	none	0	1	1
Room Thermostat 2	BI	23	none	0	1	1
Run Time Contacts	BI	32	none	0	1	1
Alarm Contacts	BI	33	none	0	1	1
Boiler Pump	BI	34	none	0	1	1
DHW Pump	BI	35	none	0	1	1
Louver Relay	BI	36	none	0	1	1
Gas Valve	BI	37	none	0	1	1
System Pump	BI	38	none	0	1	1
Inputs						
BI Inputs 0 - 15	AI	0	none	0	1	1
BI Inputs 16 - 31	AI	1	none	0	1	1
BI Inputs 32 - 47	AI	2	none	0	1	1
System / Cascade Setpoint	AI	3	Deg C	0	1	0.5
System Pump Speed	AI	4	Percent	0	1	1
Cascade Total Power	AI	5	Percent	0	1	1
Cascade Current Power	AI	6	Percent	0	1	1
Outlet Setpoint	AI	7	Deg C	0	1	0.5
Outlet Temperature	AI	8	Deg C	0	1	0.1
Inlet Temperature	AI	9	Deg C	0	1	0.1

6 BACnet Memory Map

Memory Map *(continued)*

Object Name	Object Type	Object Instance	Units	Min	Max	Resolution
Flue Temperature	AI	10	Deg C	-20	130	0.1
Firing Rate	AI	11	Percent	0	100	1
Boiler Pump Speed	AI	12	Percent	0	100	1
Boiler Status Code	AI	13	none	0	65535	1
Boiler Blocking Code	AI	14	none	0	65535	1
Boiler Lockout Code	AI	15	none	0	65535	1
Analog Values						
Configuration	AV	0	none	0	65535	1
BV 0-4	AV	1	none	0	65535	1
0-10V BMS Input	AV	2	Percent	0	100	1
Tank Setpoint	AV	3	Deg C	0	87.5	0.5
Tank Temperature	AV	4	Deg C	-20	130	0.1
Outdoor Temperature	AV	5	Deg C	-40	60	0.1
System Supply Temperature	AV	6	Deg C	-20	130	0.1

7 Wiring Requirements

Note that when the System Supply Temperature and/or the Tank Temperature are provided by the BAS, they need to be refreshed every few seconds. This is required in order to prevent unwanted fluctuations in these temperatures. If these values are not provided every few seconds (timeout is programmable), the boiler will revert to its own internal control. If neither of these temperatures is provided by the BAS, but any of the other control signals are being provided, the BAS will still need to refresh these inputs at least every 4 minutes.

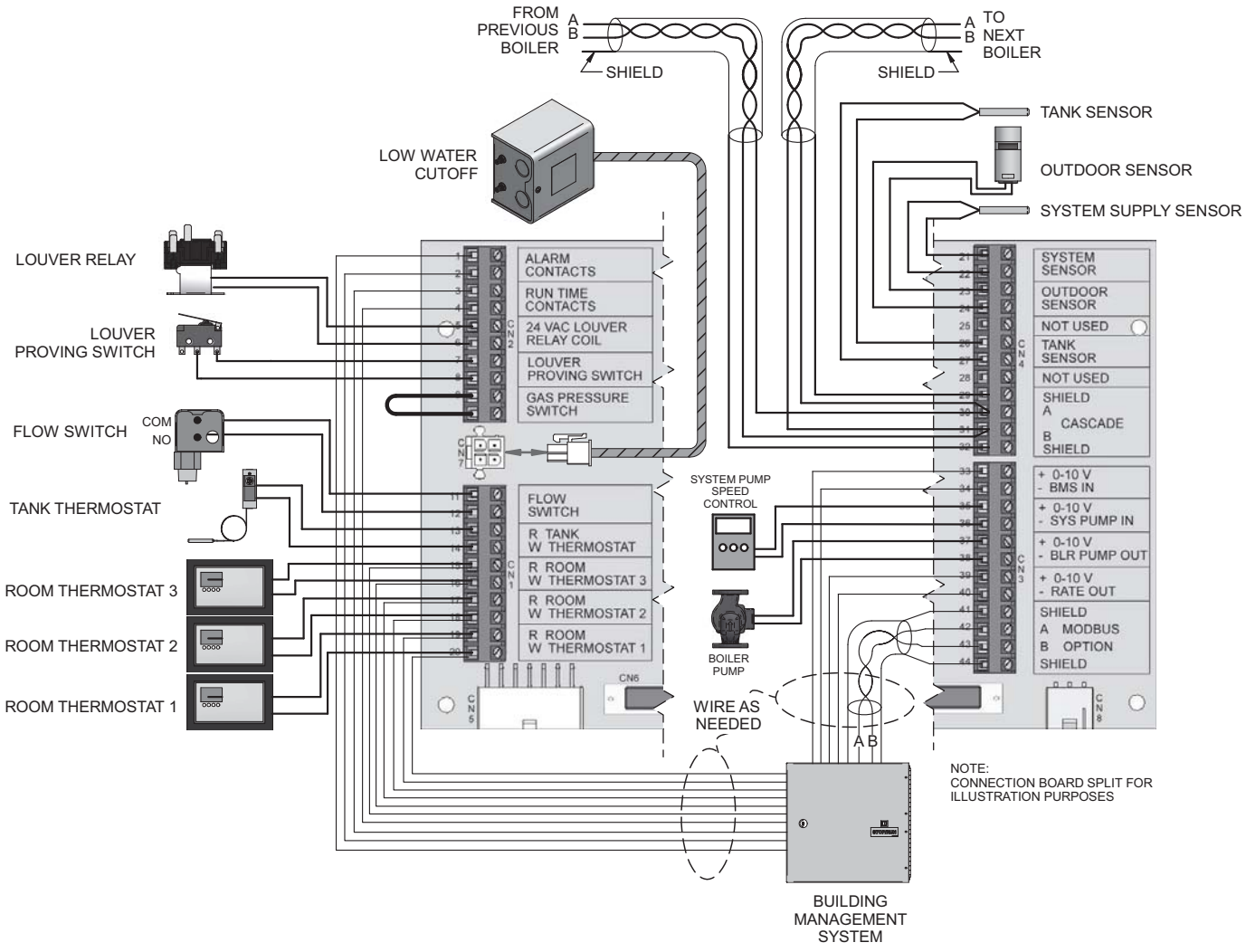
Physical Wiring

RS-485 Communication Bus

- Maximum Length = 4000 feet
- Cable Specification = 24 AWG / A,B (twisted pair) and GND Shielded, with characteristic Impedance = 120 ohm
- Maximum Load = 32 units (32 nodes)

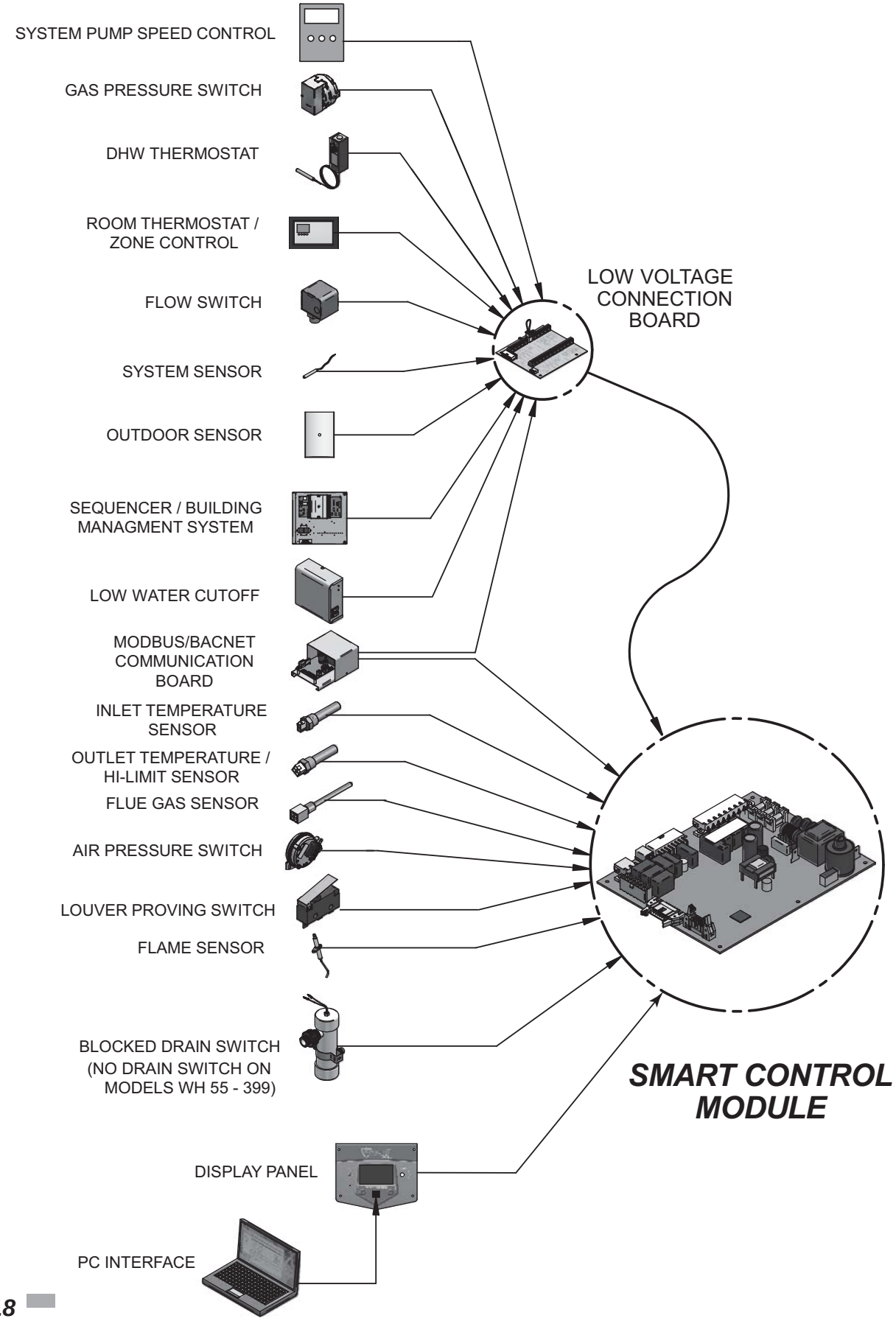
NOTE: Cable must be terminated with 120 ohm impedance matching resistor on each end.
A + (positive)
B - (negative)

Figure 7-1_Terminal Strip Connections



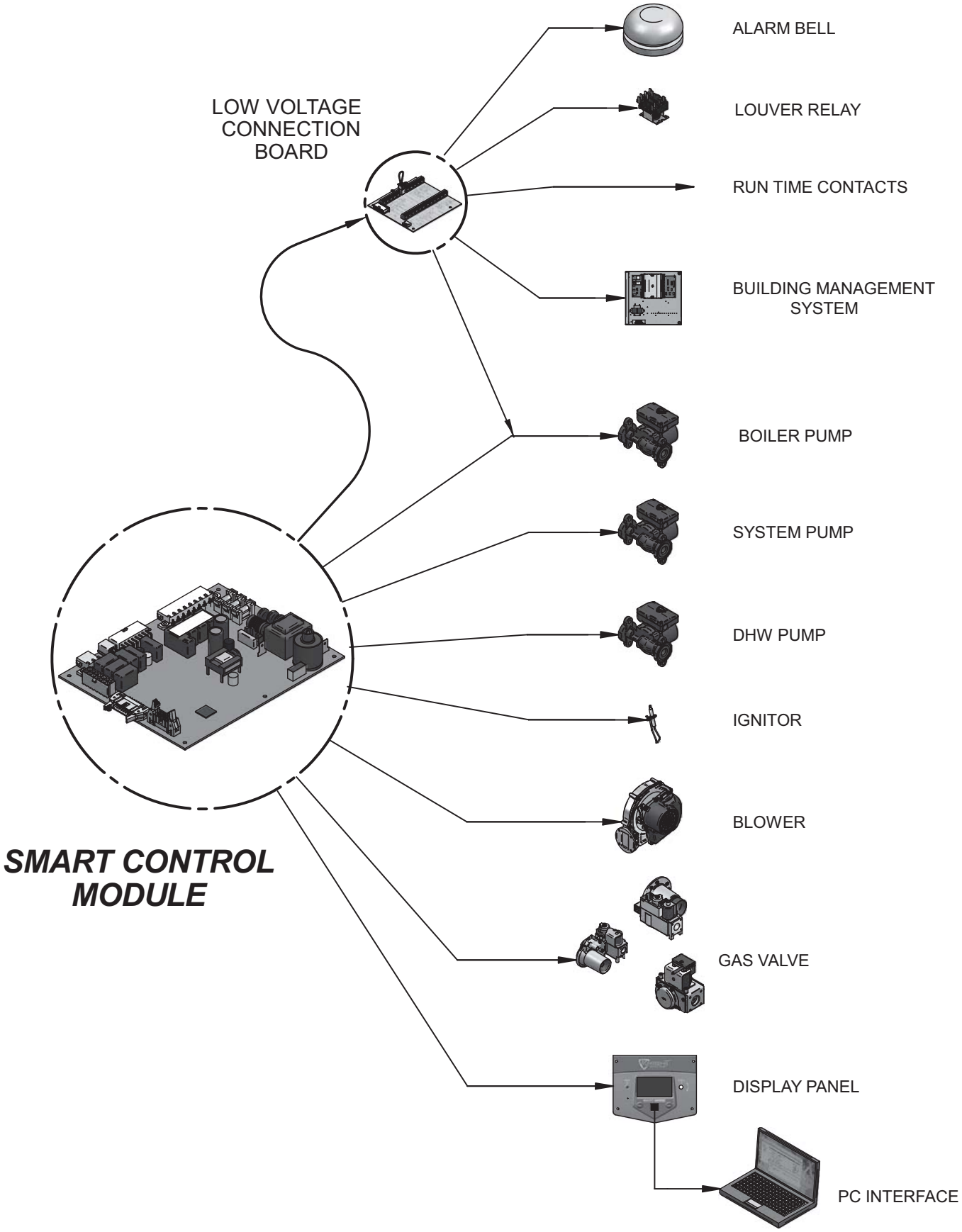
7 Wiring Requirements

Figure 7-2_Control Inputs



7 Wiring Requirements *(continued)*

Figure 7-3_Control Outputs



7 Wiring Requirements

Figure 7-4_Control Location_Knight , Knight XL and Armor

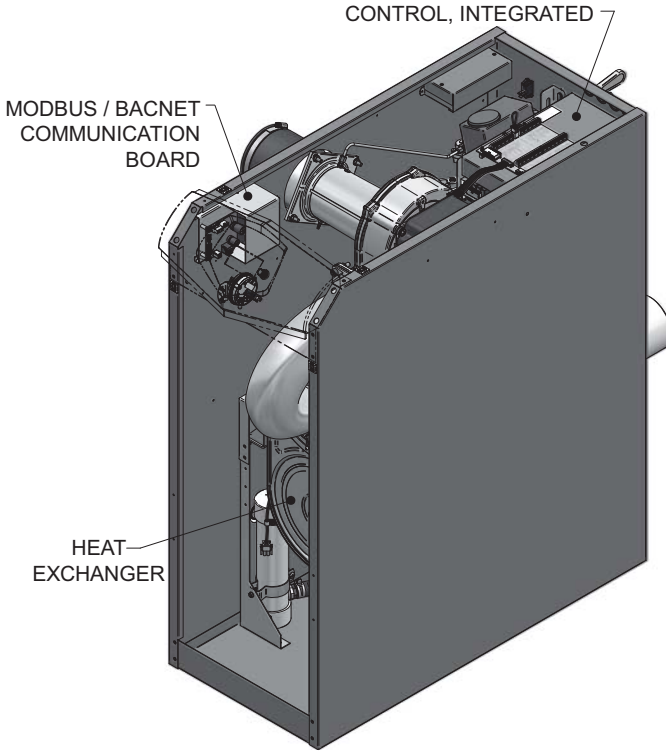


Figure 7-5_Control Location_Outdoor Knight, Outdoor Knight XL, Outdoor Armor

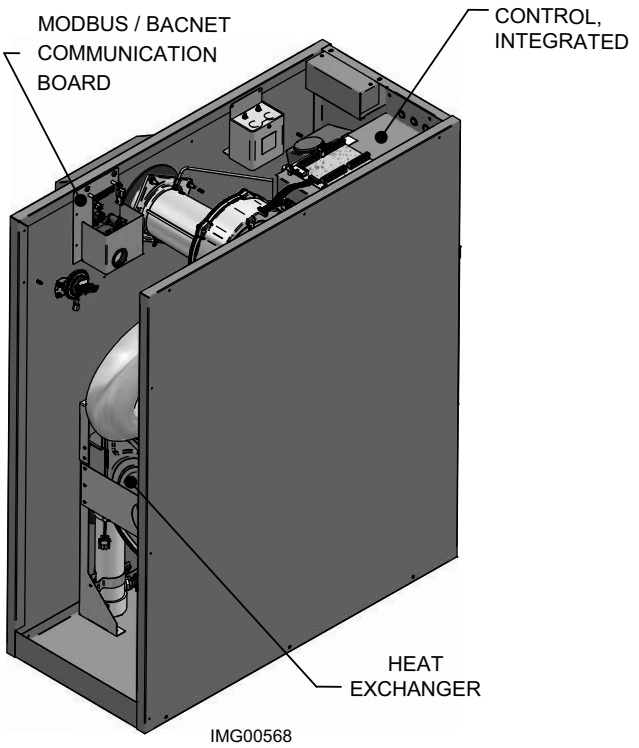


Figure 7-6_Control Location_Knight Wall Mount

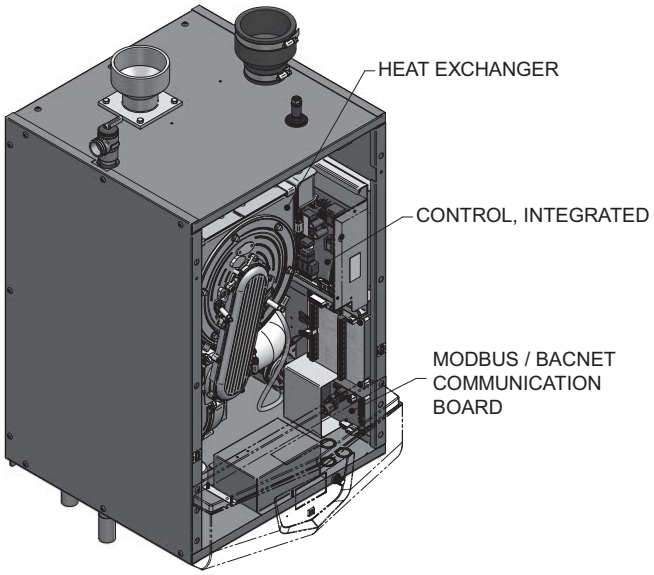
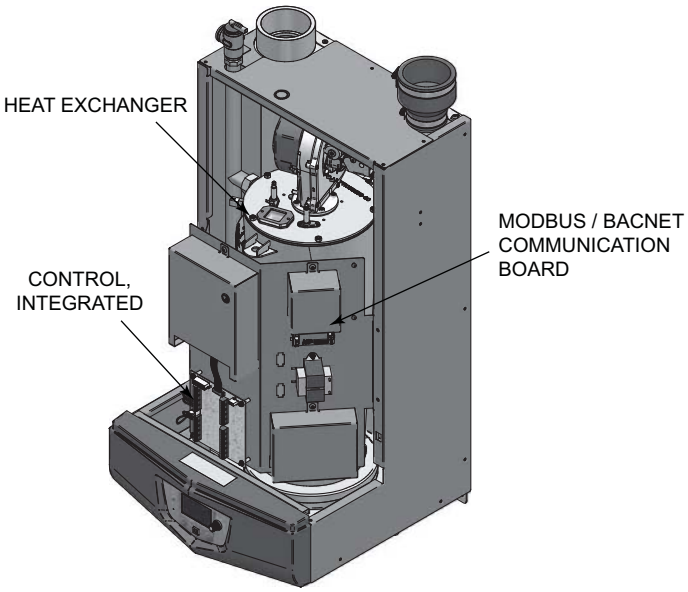
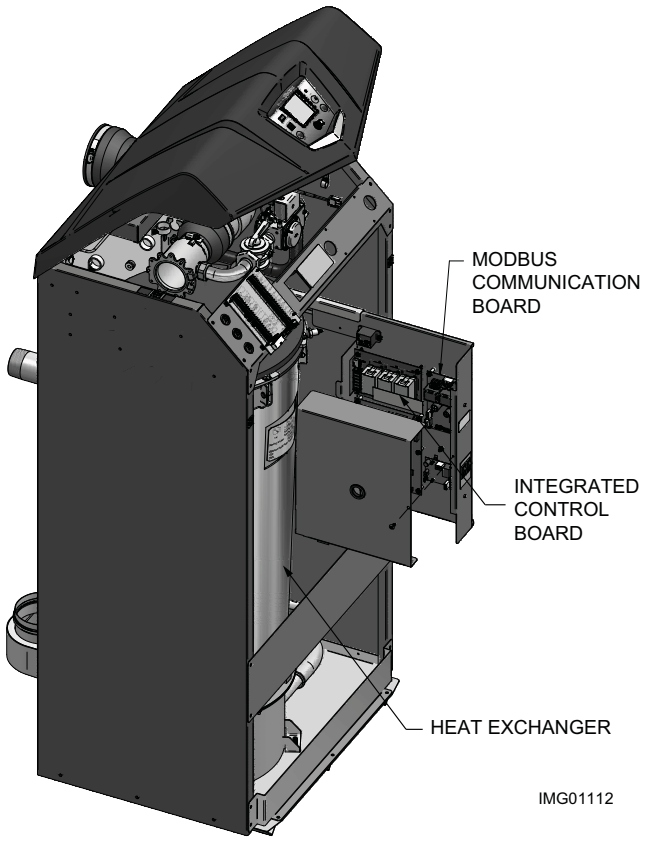


Figure 7-7_Control Location_Knight Wall Hung



7 Wiring Requirements *(continued)*

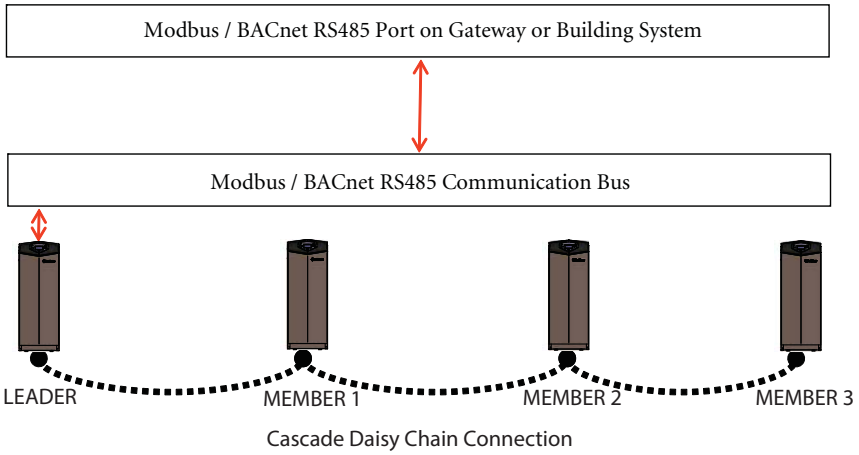
Figure 7-8_Control Location_FTXL



7 Wiring Requirements

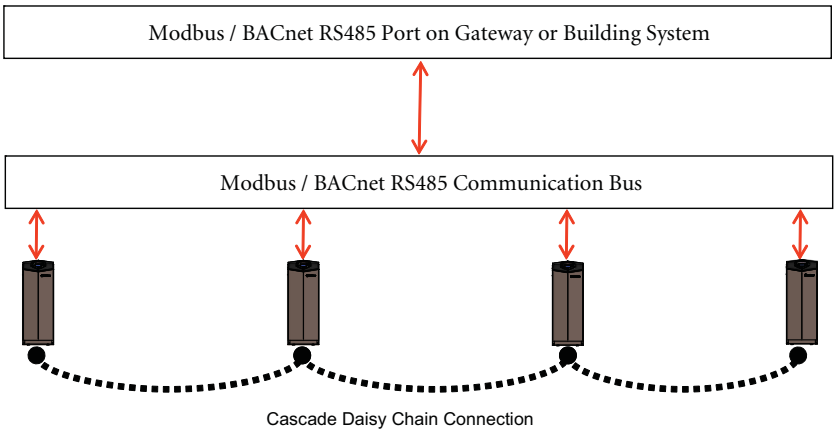
Typical Boiler/Water Heater System Wiring

Physical Configuration: Cascade without Individual Monitoring



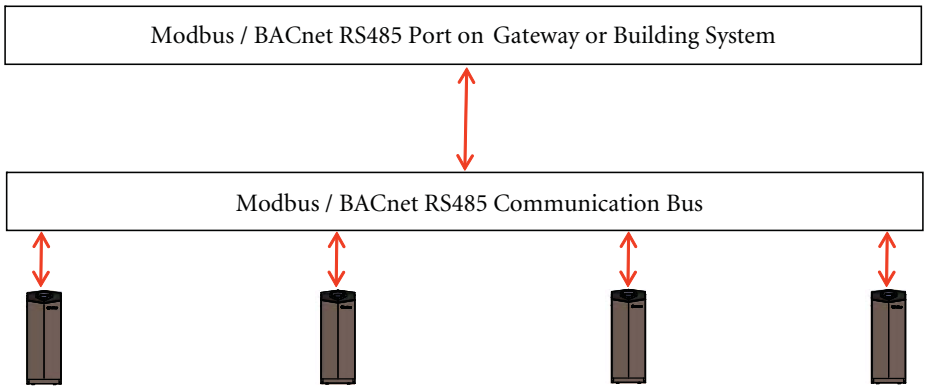
NOTICE You will need a Modbus or BACnet board only for the Leader.

Physical Configuration: Cascade with individual Monitoring



NOTICE You will need a Modbus or BACnet board for all appliances.

Physical Configuration: Direct Control



NOTICE You will need a Modbus or BACnet board for all appliances.

8 Unit Operation

Unit Operation with ModBus or BACnet Communications

To control a boiler/water heater through a Building Management System communicating through ModBus or BACnet, the boiler/water heater control mode must be properly configured. These configurations allow different control points for a variety of applications. There are five (5) configuration parameters that need to be set.

General Set-up

NOTICE Please note that the brackets ([]) denote screen status.

1. Press and hold LEFT SELECT [MENU] key.
2. Enter installer code - 5309.
3. Scroll down and select [CONTROL MODES].
4. Select ModBus or BACnet by pressing the NAVIGATION dial.
5. Scroll to ACTIVE.
6. Press the RIGHT SELECT [SAVE] key.
7. Exit one level.
8. Choose the appropriate Control Mode and continue set-up to complete.

Figure 8-1_Control Modes (Default)

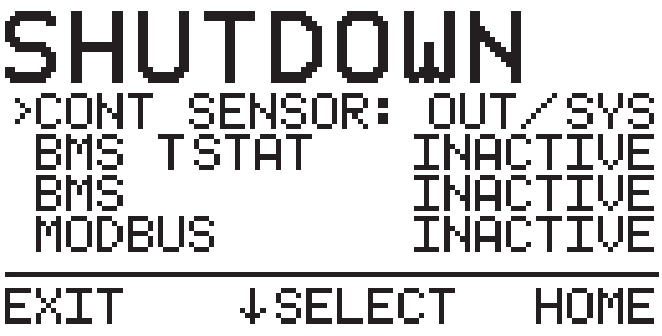
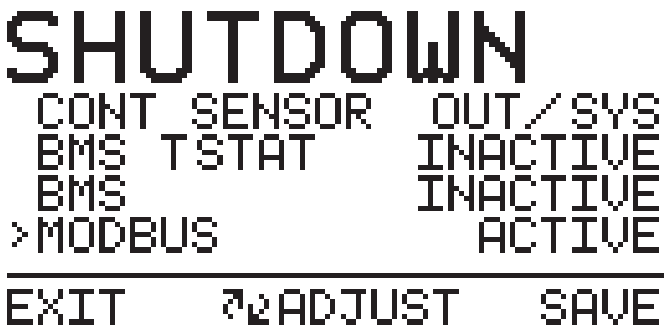


Figure 8-2_Control Modes - ModBus Active



The boiler/water heater is equipped with a ModBus communication timer. This timer is programmable from 0 - 120 seconds. The timer can be programmed in the ModBus T/O Menu, reference Section 3 - Timing Specifications on page 7 of this manual. The purpose of the timer is to ensure proper temperature data is communicated to the boiler/water heater in a timely manner. Additionally, it will provide for fail safe operation should BMS communication be lost. This timer will cause the unit to revert back to internal unit controls should the BMS communication be interrupted longer than the ModBus timer. The timer is reset every time a write command is received with updated temperatures or commands. It is the recommendation of Lochinvar that this timer be set to the shortest value possible.

When operating off the BMS communication bus and with remote sensors connected to the Building Automation System (BAS), it is very important to ensure that the correct configuration bits are sent to holding register 40001 (ModBus) or AVO(BACnet), and that the correct data and enable signals are sent to holding registers 40002 - 40008 (ModBus) or AVO(BACnet), per the control mode.

Control Mode 1

In this configuration the unit is controlled by setting the set points locally on the boiler/water heater and providing an enable signal through BMS communications.

All sensors and limiting devices should be hardwired to the terminal strip on the back of the unit excluding the thermostat enable and tank thermostat enable signal. These signals will be sent to the unit via ModBus or BACnet.

8 Unit Operation

Control Mode 1 - Set-up (Configuration Parameters)

BMS Type default (FIG. 6-3) remains.

Object	Holding Registers	Definition	Bit Value (HEX)	Action
AV0	**40001**	Configuration	00 01	Set Configuration to read 40002
AV1	**40002**	Coils / BV	00 01	Enables unit *(00 00 disables unit)*

NOTE: To ensure proper operation re-send the configuration bits to holding register 40001 or object AV**0** prior to issuing a command.

Control Mode 2

In this configuration the unit is controlled by setting the set points locally on the boiler/water heater and providing an enable signal and a rate command through ModBus or BACnet communications.

The BMS Type will be 0 - 100% of modulation or a temperature set point.

Control Mode 2 - Set-up (Configuration Parameters)

To Set BMS Type:

1. While still in Installer Menu Set, scroll down and select [BMS] by pressing the NAVIGATION dial.
2. In the BMS Menu, select [BMS TYPE], scroll to [POWER] or [SETPOINT] and press the RIGHT SELECT [SAVE] key.

Reference FIG.'s 6-3 and 6-4 to set BMS Type to the appropriate operation.

Figure 8-3_BMS Type - Set Point (Default) (KB screen shown for illustration purposes only)

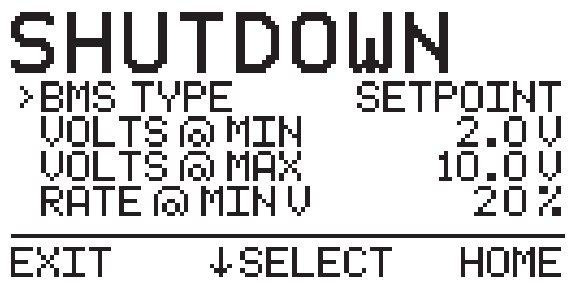
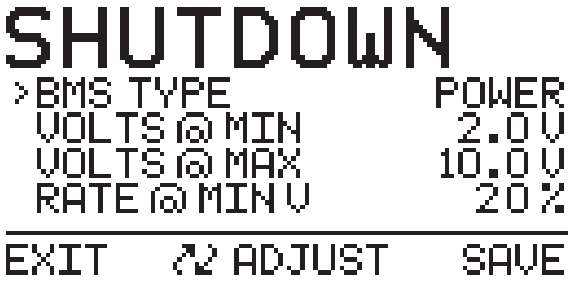


Figure 8-4_BMS Type - Power (KB screen shown for illustration purposes only)

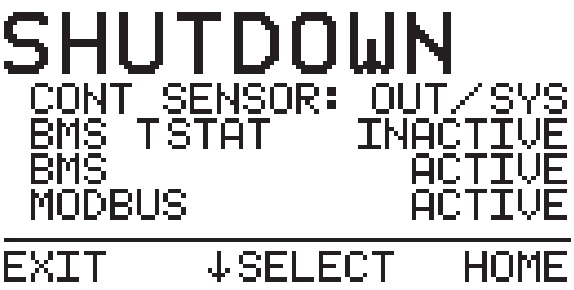


All sensors and limiting devices should be hardwired to the terminal strip on the back of the unit excluding the thermostat enable and tank thermostat enable signal. These signals will be sent to the unit via ModBus.

Control Mode 2 - Set-up (Command Parameters)

1. While in the Control's Installer Main Menu, select [CONTROL MODES].
2. In Control Modes Menu select [BMS] and set to [ACTIVE].
3. Press the RIGHT SELECT [SAVE] key.

Figure 8-5_Control's Installer Main Menu (KB screen shown for illustration purposes only)



8 Unit Operation *(continued)*

Control Mode 2 - Set-up (Command Parameters) *(continued)*

The holding registers/objects will need to be set as follows:

Object	Holding Registers	Definition	Bit Value (HEX)	Action
AV0	**40001**	Configuration	00 05	Set Configuration to read 40002 & 3
AV1	**40002**	Coils / BV	00 01	Enables unit *(00 00 disables unit)*
AV2	**40003**	Rate Command	00 ##	Sets Modulation % or Setpoint

NOTE: To ensure proper operation re-send the configuration bits to holding register 40001 or Object AV**0** prior to issuing a command.

For proper hexadecimal conversion of rate percentage or temperature conversion, please refer to the Rate and Temperature Conversions section on page 21 of this manual.

Control Mode 3

In this configuration the unit is controlled by setting the modulation set point from 0 - 100%. The modulation set point will provide the enable function as well.

The BMS Type will be 0 - 100% of modulation.

Control Mode 3 - Set-up (Configuration Parameters)

Reference FIG.'s 8-3 and 8-4 to set BMS Type to [POWER].

All sensors and limiting devices should be hardwired to the terminal strip on the back of the unit excluding the thermostat enable and tank thermostat enable signal. These signals will be sent to the unit via ModBus.

Control Mode 3 - Set-up (Command Parameters)

1. Enter the installer code - 5309.
2. While in the Control's Installer Main Menu, scroll to and select [CONTROL MODES].
3. In Control Modes Menu select [BMS] and set to [ACTIVE] (see FIG. 6-5 on page 18).
3. Press the RIGHT SELECT [SAVE] key.

The holding registers/objects will need to be set as follows:

Object	Holding Registers	Definition	Bit Value (HEX)	Action
AV0	**40001**	Configuration	00 04	Set Configuration to read 40003
AV2	**40003**	Rate Command	00 00	Sets Modulation %

NOTE: To ensure proper operation re-send the configuration bits to holding register 40001 or Object AV**0** prior to issuing a command.

For proper hexadecimal conversion of rate percentage, please refer to the Rate and Temperature Conversions section on page 21 of this manual.

8 Unit Operation

Control Mode 4 (DHW)

Domestic Hot Water Generation (DHW) can be accomplished with one of two methods when a boiler/water heater is connected to a BAS system, DHW with direct control, and DHW with remote control.

DHW with direct control:

This is a typical installation with a hot water generator in close proximity to the boiler/water heater with the tank thermostat or the tank temperature sensor wired to the terminal strip of the unit.

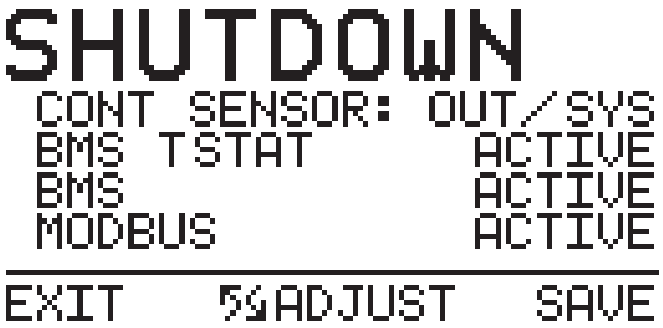
DHW with remote control:

This installation may have the hot water generator in close proximity to the boiler/water heater. Its sensors or thermostat values are only available through the ModBus / BACnet communication bus.

Control Mode 4 - Set-up

1. Enter the installer code - 5309.
2. While in the Control's Installer Main Menu, scroll to and select [CONTROL MODES].
3. In Control Modes Menu select [BMS TSTAT] and set to [ACTIVE] (see FIG. 8-6).
4. Perform Step 2 to set BMS TSTAT, and BMS reference FIG. 8-6.
5. Press the RIGHT SELECT [SAVE] key (see FIG. 8-6) to save all of the above parameter settings.

Figure 8-6_Control Modes Menu - Control Mode 4 - Set-up



To ensure that the boiler/water heater can properly respond to a call for hot water generation the following holding registers must be set in addition to other commands:

Object	Holding Registers	Definition	Bit Value (HEX)	Action
AV0	**40001**	Configuration	00 4A	Set Configuration to read 40002, 4 & 5
AV1	**40002**	Coils / BV	00 08	Enables Tank Tstat *(00 00 disables unit)*
AV3	**40004**	Tank Set Point	0# ##	Sets Set Point
AV4	**40005**	Tank Temperature	0# ##	Passes tank temp from remote sensor

NOTE: To ensure proper operation re-send the configuration bits to holding register 40001 or Object AVØ prior to issuing a command.

For proper hexadecimal conversion of rate percentage, please refer to the Rate and Temperature Conversions section on page 21 of this manual.

8 Unit Operation *(continued)*

Cascade

In order to operate the boiler/water heater in Cascade with ModBus or BACnet communications, configure the Leader unit per the control modes in this manual. Connect the remaining boilers/water heaters in the Cascade through the normal daisy chain Cascade communications wiring. Cascade control can then be accomplished automatically through the Leader boiler.

Please note that with ModBus or BACnet communication connected to only the Leader unit, only total Cascade information can be seen through the communications link. If you wish to see all the individual temperatures of each unit in the Cascade, each unit will have to have a ModBus / BACnet communication board. However, each unit can be monitored without the need to control each one individually.

Monitoring Only

Any boiler/water heater can be equipped with the communication board and then set up to operate with its own internal controls. By default settings, the communication board is a ready monitoring device for the read only variables by polling the board.

Rate and Temperature Conversions:

Rate

When issuing a rate command the rate can be communicated as percent modulation or a desired set point, depending on the setting of the BMS Type in the BMS Setup Menu.

The proper data format for the modulation percentage is the direct conversion to hexadecimal. This conversion can be accomplished through online number based converters or some scientific calculators.

For Example:

Rate %	HEX
0	00
20	14
45	2D
60	3C
80	50
95	5F
100	64

To send a desired setpoint, the hexadecimal value must be determined through linear interpolation of programmable parameters on the BMS Setup Menu:

- BMS temperature set point at low analog input
- BMS temperature set point at high analog input

These variables set the temperature values corresponding to the minimum and maximum voltage settings of the 0-10 volt signal. The defaults are as follows:

PARAMETER	DEFAULT VALUES		DEFAULT
	Deg C	Deg F	Voltages
BMS temperature set point at low analog input	21	70	2
BMS temperature set point at high analog input	82	180	10

For Example:

Send a set point of 110°F.

The formula to use for the interpolation is:

Rate Command =

$$\frac{\text{(Desired Set point – BMS Temp at Low Analog Input) (High Voltage-Low Voltage) + Low Voltage}}{\text{(BMS Temp at High Analog Input – BMS Temp at Low Analog Input)}}$$

From the default values:

Desired Setpoint = 110
BMS Temp at Low Analog Input =68
BMS Temp at High Analog=158
High Voltage =10
Low Voltage = 2

[(110-69)(10-2)/(158-68)] + 2 = 5.73 Volts

5.73 Volts = 57.3% Modulation

57% = 39 Hexadecimal

A value of [00][39] in hexadecimal would be written to Holding register 40003 to issue a command for a 110°F setpoint.

Temperature

The boiler/water heater passes temperature data in degrees Celsius. Also, to accommodate decimal places the decimal value must be divided by 10.

Here are the conversions to and from Celsius:

$T_c = (5/9) * (T_f-32)$ $T_f = (9/5) * T_c+32$

Example:
Outdoor temperature from remote sensor on BAS System = 80°F

80°F = 26.7°C
Data that needs to be transmitted is 26.7 * 10 = 267

Decimal	Binary	HEX
267	100001011	10B

Outlet temperature from unit sensor = 155°F

155°F = 68.3°C
Data transmitted from unit in HEX = 2AB = 683
683 ÷ 10 = 68.3 (°C)

Decimal	Binary	HEX
683	1010101011	2AB

9 Troubleshooting

Should you encounter problems communicating over ModBus, the following items should be checked in this order:

1. Physical Layer
2. Communications Configuration and Port Settings
3. ModBus Error Codes
4. Unit Status / Blocking / Lockout Codes

Physical Layer

1. Check that all components have power (Boiler, Gateway, BAS Master)
2. Check all wire lengths. Are any drops too long?
3. Check proper shield grounding
4. Check A, B terminal connections
5. Check for Terminating Resistors (120 ohms)
6. Check for broken wires

Communications

1. Check Dip Switch Configuration of Communication Board
2. Check Baud Rate (9600, 19200, etc.)
3. Check Parity (ModBus only)
4. Check Slave ID
5. Check Port Setting on Master, Gateway, and Computers

ModBus Error Codes

1. Check ModBus communication for error codes (see page 9 for ModBus Exception Codes)
2. Check ModBus PDU
3. Check Slave ID
4. Check ModBus Command
5. Check Configuration bits for Holding Register 40001
6. Check Commands and data for Holding Registers 40002 - 40007

Unit Status Codes

See Codes in this section.

Boiler Status

The boiler/water heater status code indicates what the unit is actually doing. This status code should be compared to the command issued and what is expected. If the boiler/water heater status code does not agree with the command issued, check communication and configuration.

Status Codes (Input Register 30014 or Analog Input AI13)

2 = Heat Demand blocked due to high absolute outlet temperature
3 = Heat Demand blocked due to high absolute flue temperature
4 = Heat Demand blocked due to high absolute Delta T (Outlet - Inlet)
8 = Heat Demand blocked due to Low 24 VAC
9 = Outdoor shutdown
10 = Block due to switch OFF boiler (ON/OFF of Display)
12 = Block due to no correct communication Cascade
16 = Service function
19 = DHW function Storage Tank
21 = SH function Heat demand from Room Thermostat
22 = SH function Heat demand from Boiler Management System
23 = SH function Heat demand from Cascade
30 = Heat demand activated by Freeze Protection
32 = DHW Pump Delay
33 = SH Pump Delay
34 = No heat function (after pump delay)
40 = Lockout
32764 = Busy with updating status
32765 = DHW blocked due to no present tank sensor
32766 = Burner control(s) manually shut down
32767 = Code not present

Blocking Codes (Input Register 30015 or AI14)

0 = No blocking _> is divided into sub blockings
1 = SH blocking
2 = Blocking Due to Low 24 VAC Supply
3 = Blocking due to General block
4 = Blocking MRHL is open
5 = Blocking due to Switched OFF boiler (Display ENTER switch)
6 = Blocking due to wrong communication of Cascade
7 = Blocking due to High Delta
8 = Blocking due to High Flue Temperature
9 = Blocking due to High Outlet Temperature
10 = Service blocking
12 = DHW blocking high outlet temperature (DHW configured as storage tank)
13 = Blocking anti-cycling time
14 = Storage Tank demand Blocked due to Fan problems
15 = No system sensor connected and leader control present
16 = Limit fan speed due to high outlet temperature
17 = Fan min decreased due to low flame current
18 = Limit max fan speed due to high Delta T
19 = Limit max fan speed due to high flue temp
32767 = Code not present

9 Troubleshooting *(continued)*

Lockout Codes (Input Register 30016 or AI15)

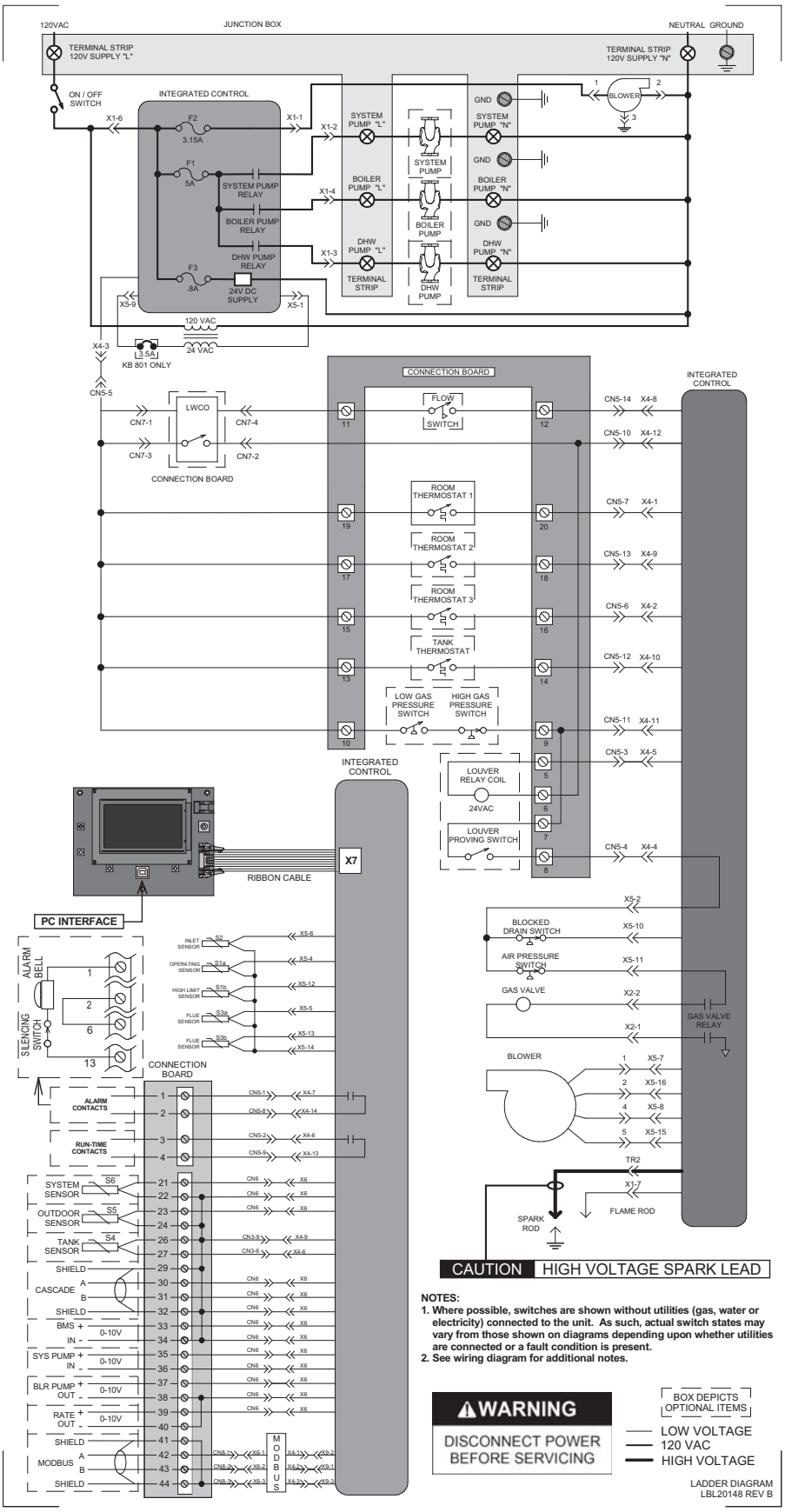
NOTICE

The lockout code is constantly changing during operation and should not be used for lockout notification until the status code (Input Register 30014 or AI13) indicates a code of 40.

161 = EEPROM code Parameters not Re-Programmed by Lochinvar
164 = EEPROM code No Reset Allowed (> 15 minutes)
166 = EEPROM code Auto Reset High Limit
167 = EEPROM code Blocked Drain
168 = EEPROM code Louver Proving
169 = EEPROM code Gas Pressure Sw
170 = EEPROM code Flow Switch
177 = Sensor 3 short (Flue Sensor)
178 = Sensor 3 open (Flue Sensor)
179 = Sensor 2 short (Inlet Sensor)
180 = Sensor 2 open (Inlet Sensor)
192 = Sensor 1 short (Outlet Sensor)
193 = Sensor 1 open (Outlet Sensor)
204 = CRC EEPROM failed
205 = EEPROM programmed (display shows “PP”)
206 = EEPROM error in programming
207 = Write error EEPROM
229 = EEPROM code Watch Dog
230 = EEPROM code fan low (should be high)
231 = EEPROM code fan high (should be low)
232 = EEPROM code no flame when running
233 = EEPROM code no flame after ignition
234 = EEPROM code simultaneous output APS and Fan
235 = EEPROM code APS active not Closed
236 = EEPROM code APS active not Open
237 = EEPROM code flame out of sequence
239 = EEPROM code when gas valve relay test fails
240 = EEPROM code MRHL
32767 = Code not present

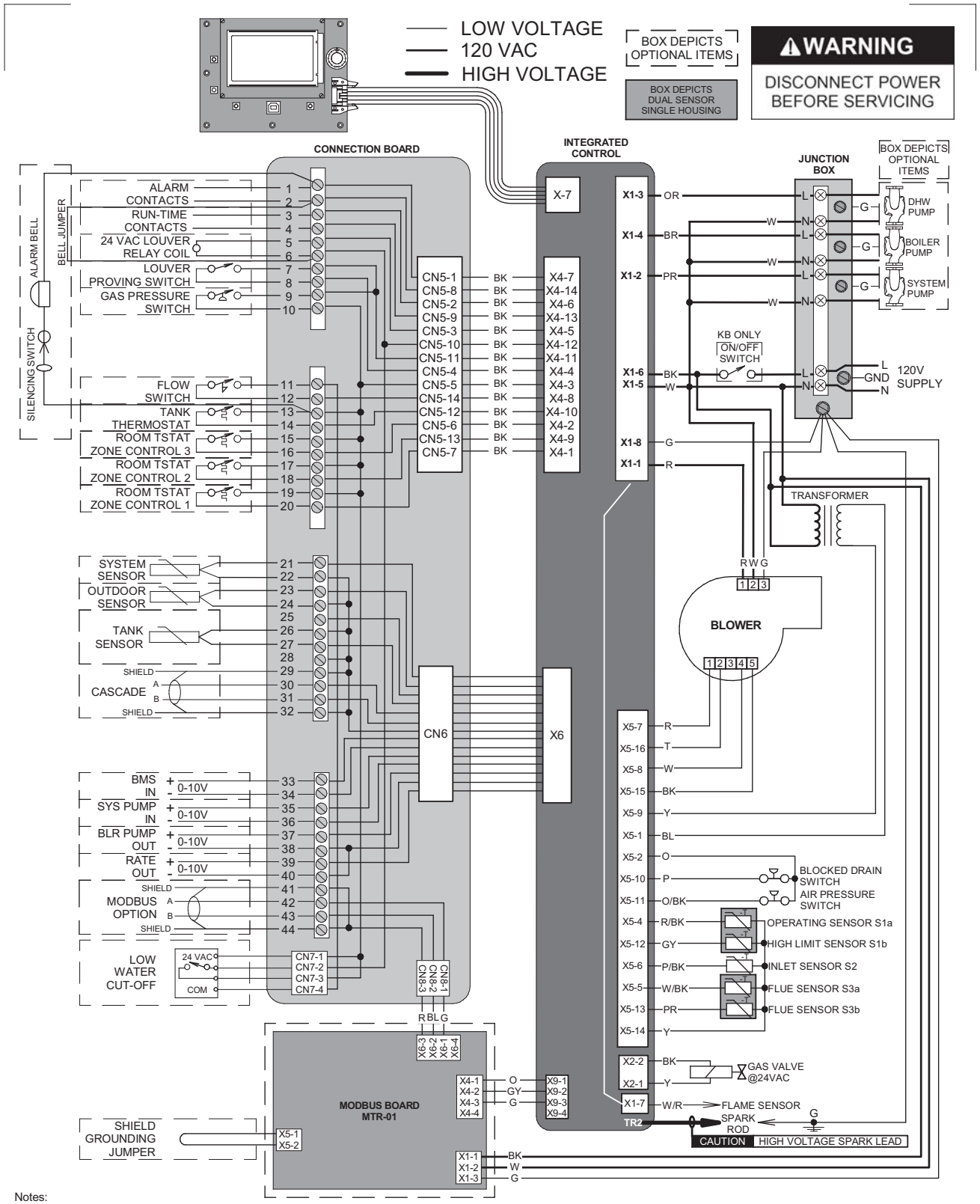
10 Diagrams

Figure 10-1 *Ladder Diagram_Knight/Knight Wall Mount*



10 Diagrams *(continued)*

Figure 10-2 *Wiring Diagram_Knight/Knight Wall Mount*

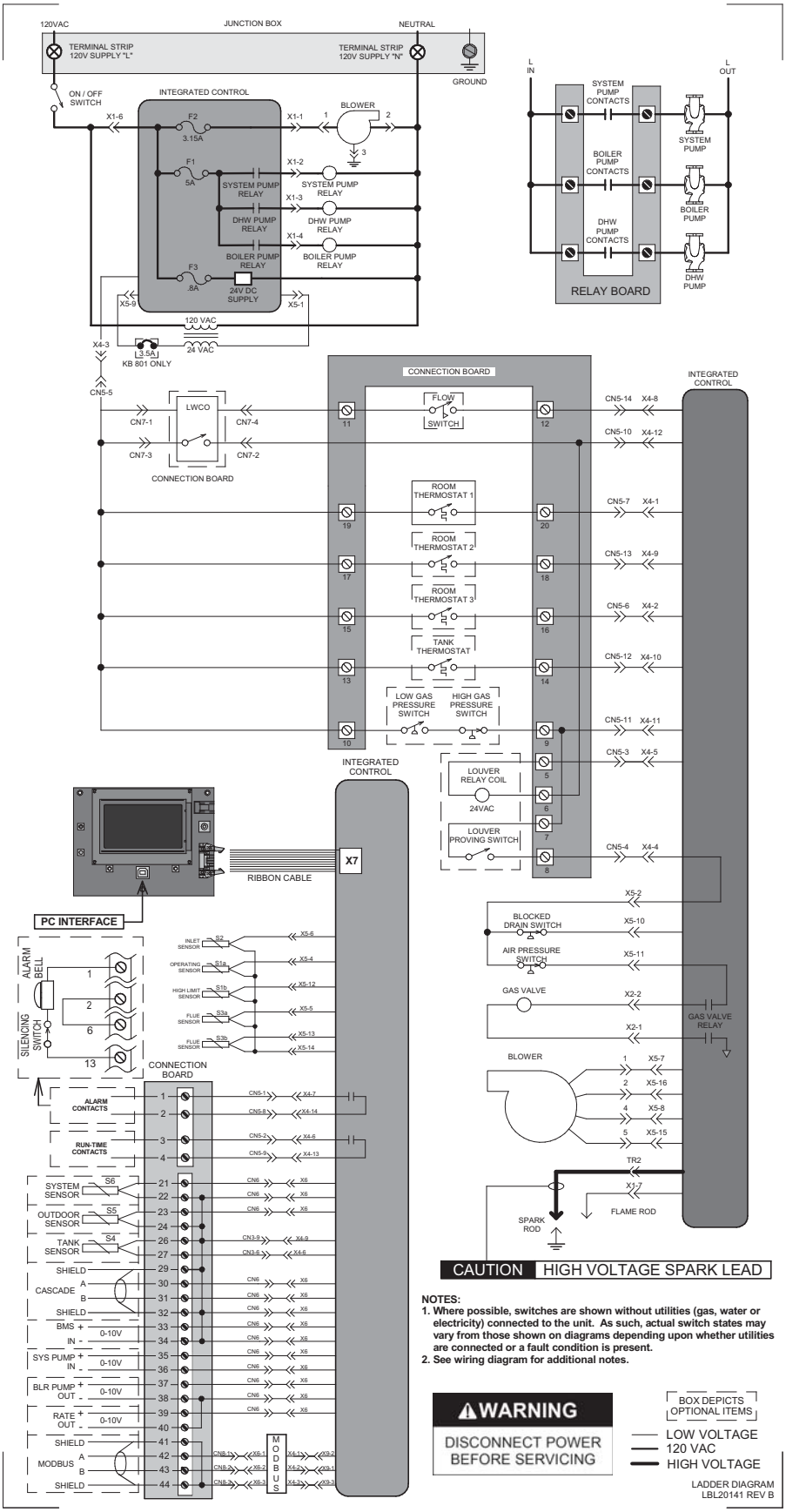


Notes:
1. All wiring must be installed in accordance with: local, state, provincial and national code requirements per either N.E.C. in USA or C.S.A. in Canada.
2. If any original equipment wire as supplied with the appliance must be replaced, it must be replaced with wire having same wire gauge (AWG) and rated for a minimum of 105℃. Exceptions: Replacement high vo ltage 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 troubleshoot unit.

WIRING DIAGRAM
LBL20127 REV B

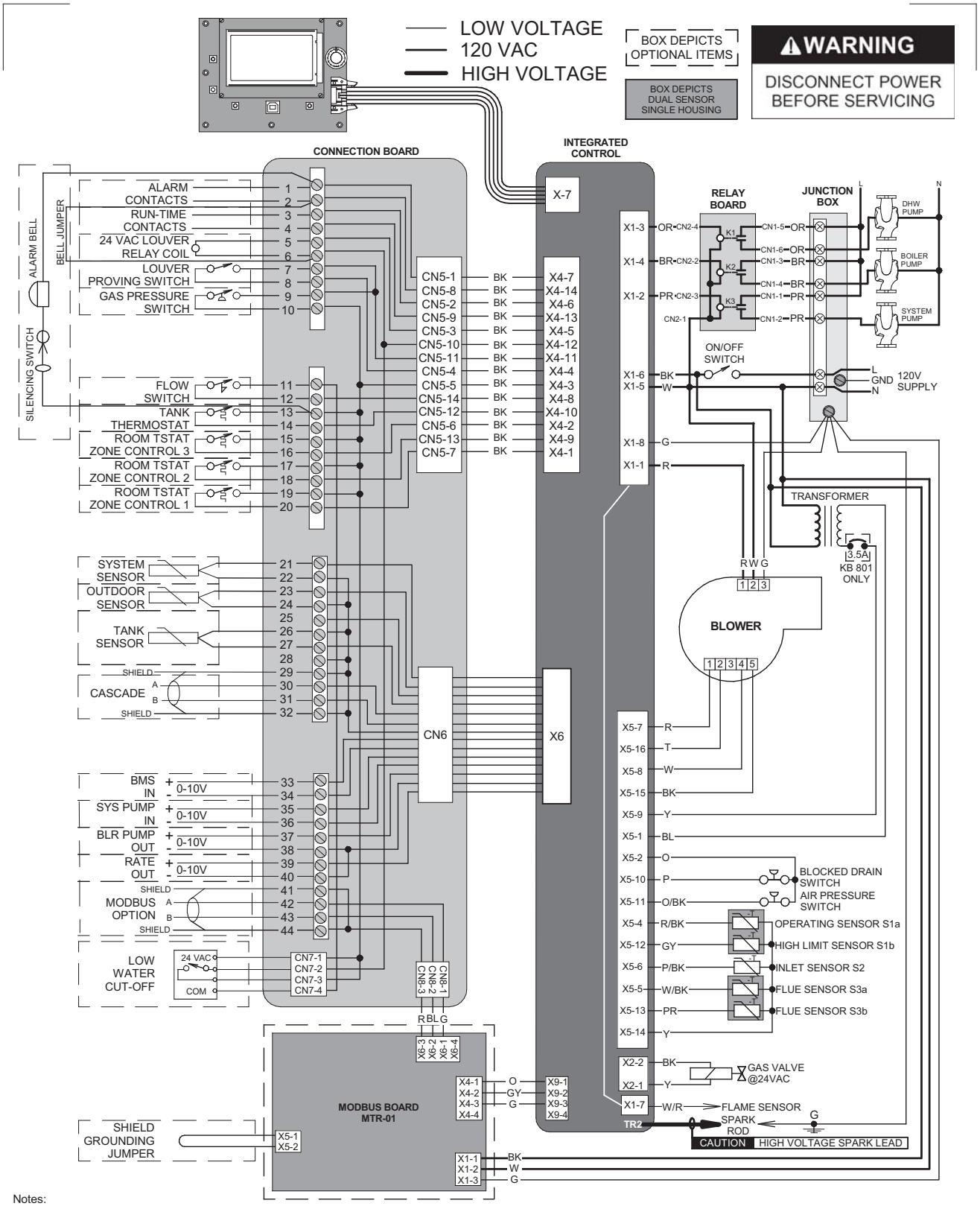
10 Diagrams

Figure 10-3 *Ladder Diagram_Knight XL*



10 Diagrams *(continued)*

Figure 10-4 *Wiring Diagram_Knight XL*

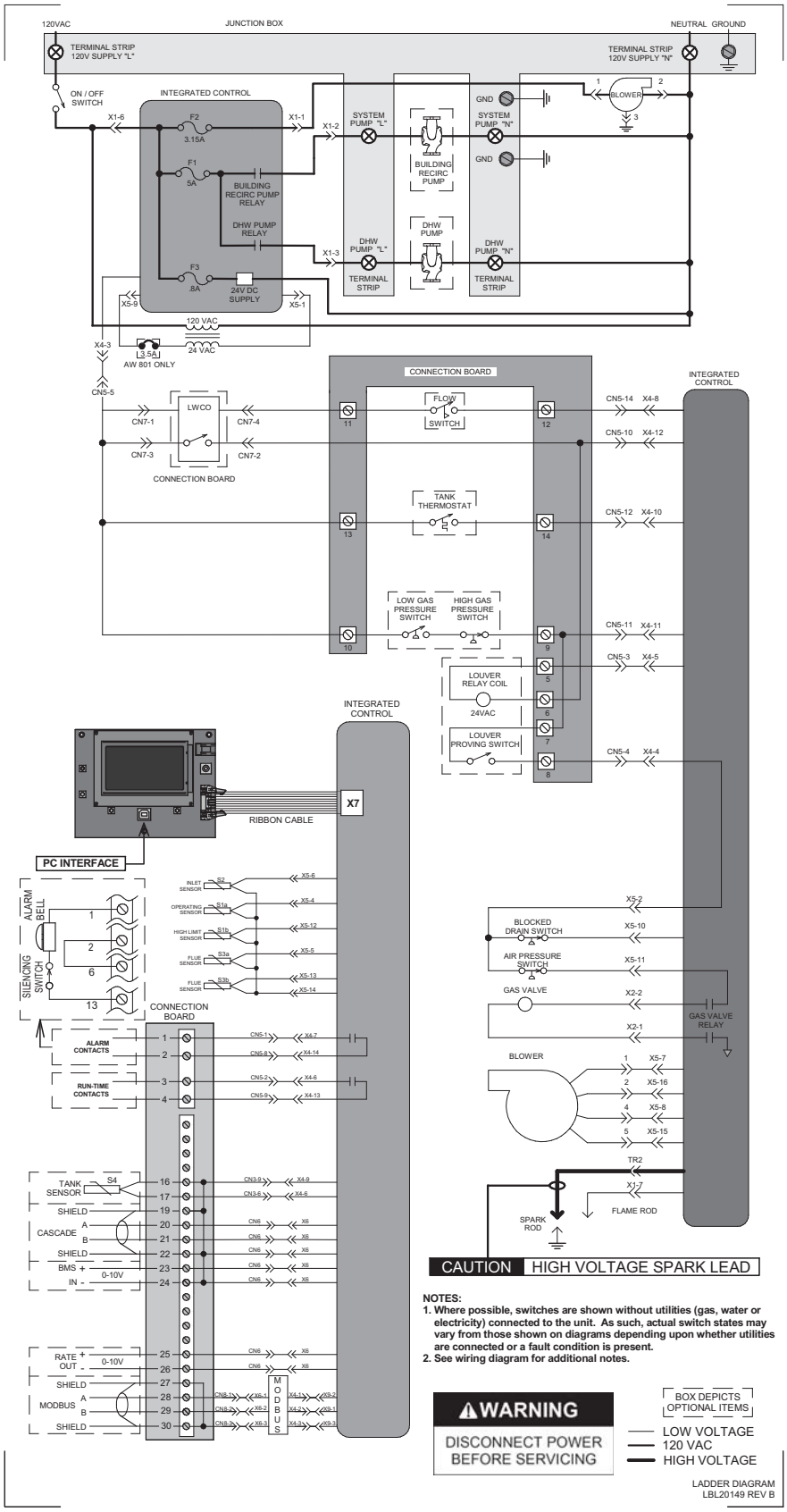


Notes:
1. All wiring must be installed in accordance with: local, state, provincial and national code requirements per either N.E.C. in USA or C.S.A. in Canada.
2. If any original equipment wire as supplied with the appliance must be replaced, it must be replaced with wire having same wire gauge (AWG) and rated for a minimum of 105℃. Exceptions: Replacement high vo ltage 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 troubleshoot unit.

WIRING DIAGRAM
LBL20116 REV B

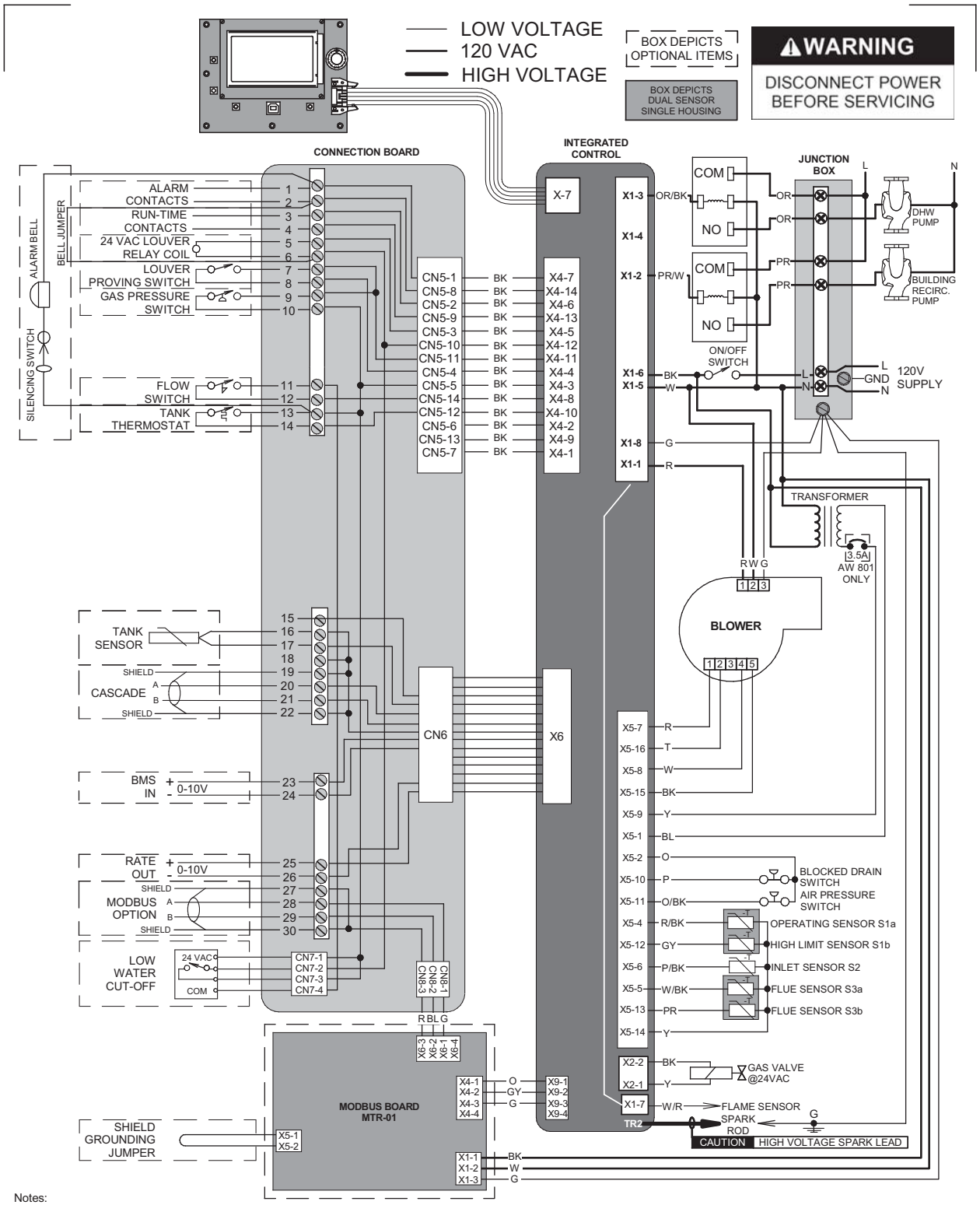
10 Diagrams

Figure 10-5 *Ladder Diagram_Armor*



10 Diagrams *(continued)*

Figure 10-6 *Wiring Diagram_Armor*

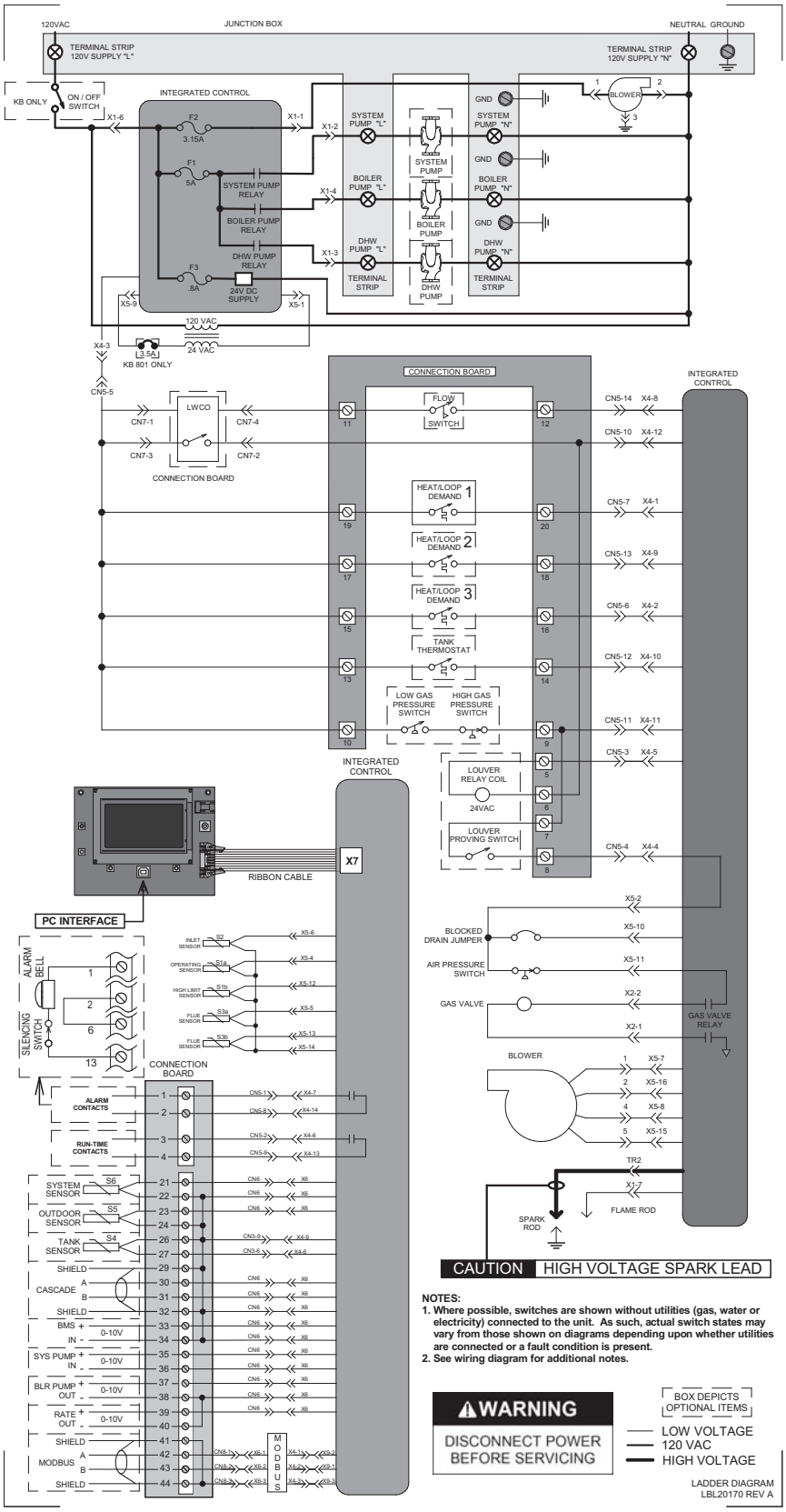


Notes:
1. All wiring must be installed in accordance with: local, state, provincial and national code requirements per either N.E.C. in USA or C.S.A. in Canada.
2. If any original equipment wire as supplied with the appliance must be replaced, it must be replaced with wire having same wire gauge (AWG) and rated for a minimum of 105℃. Exceptions: Replacement high vo ltage 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 troubleshoot unit.

WIRING DIAGRAM
LBL20134 REV B

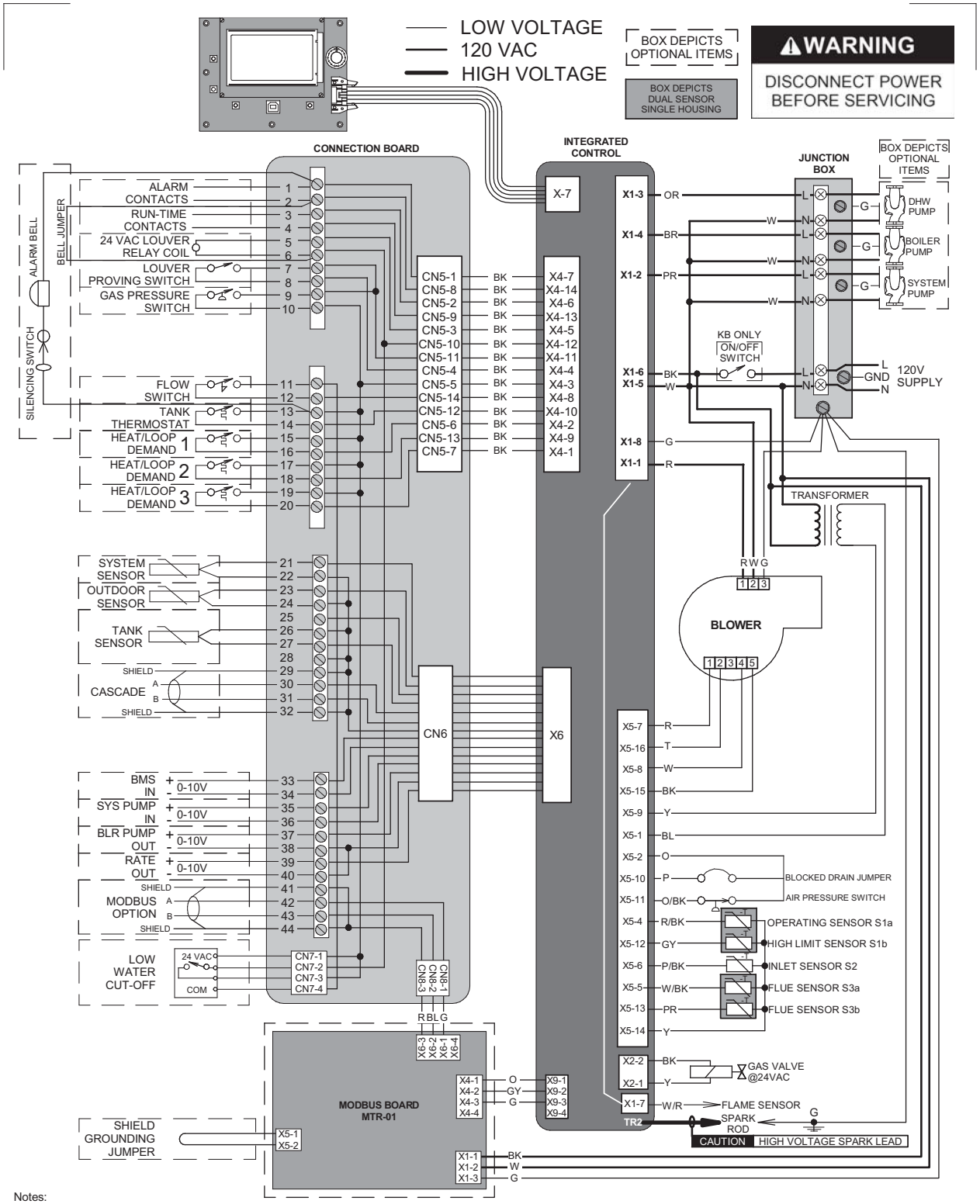
10 Diagrams

Figure 10-7 *Ladder Diagram_Wall Hung*



10 Diagrams *(continued)*

Figure 10-8 *Wiring Diagram_Wall Hung*

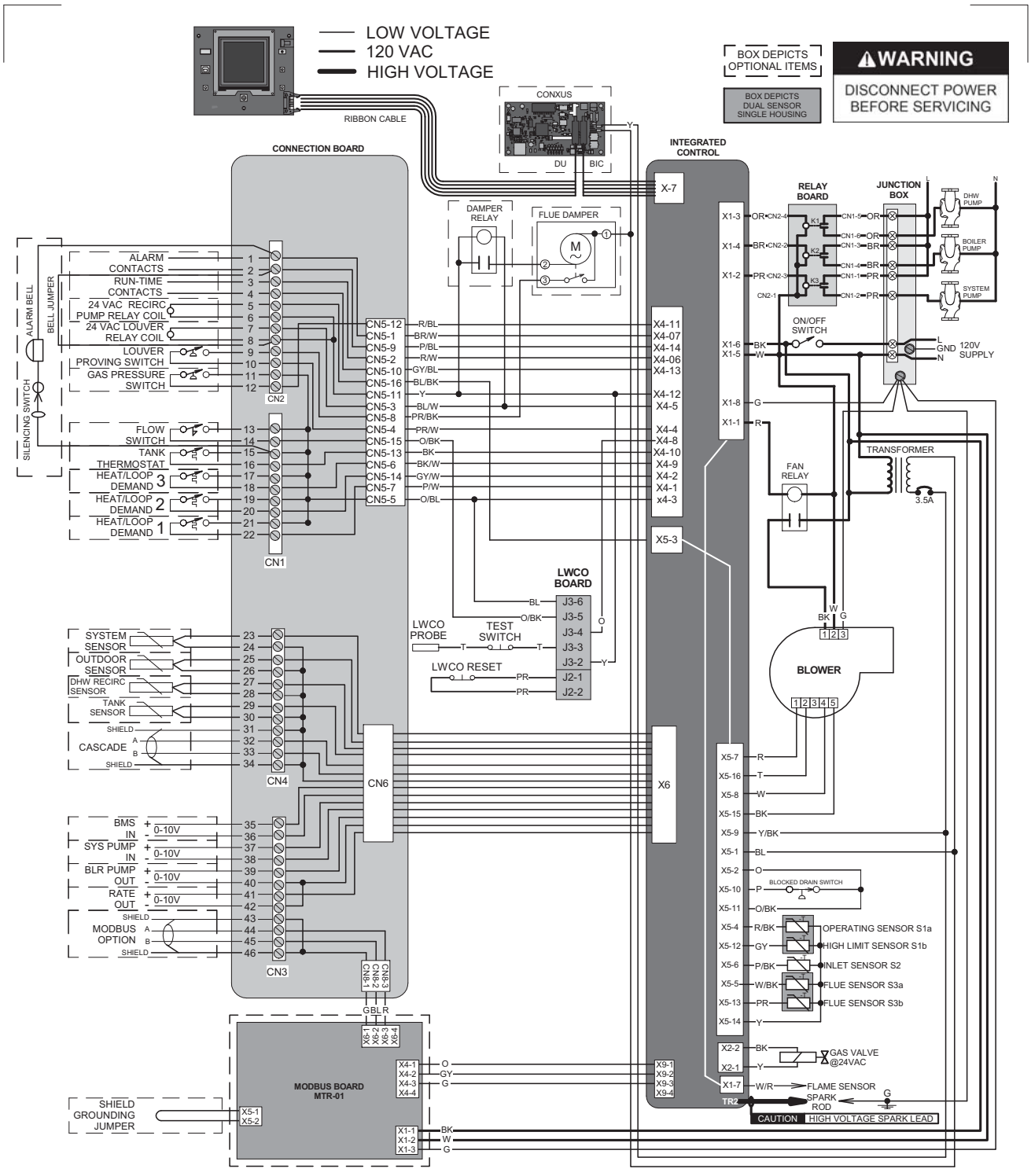


Notes:
1. All wiring must be installed in accordance with: local, state, provincial and national code requirements per either N.E.C. in USA or C.S.A. in Canada.
2. If any original equipment wire as supplied with the appliance must be replaced, it must be replaced with wire having same wire gauge (AWG) and rated for a minimum of 105℃. Exceptions: Replacement high vo ltage 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 troubleshoot unit.

WIRING DIAGRAM
LBL20169 REV A

10 Diagrams

Figure 10-9 *Wiring Diagram_FTXL*

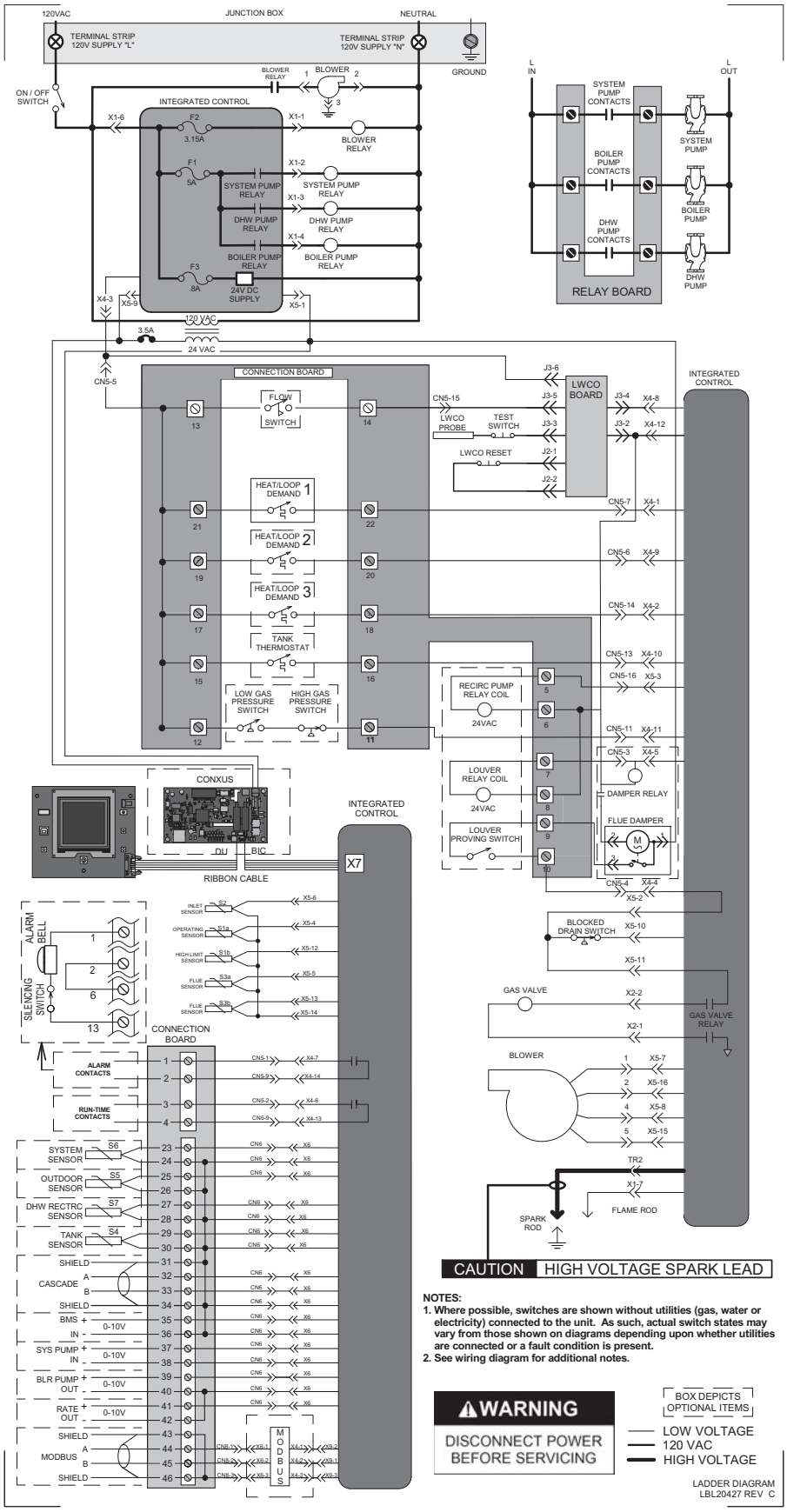


Notes:
1. All wiring must be installed in accordance with: local, state, provincial and national code requirements per either N.E.C. in USA or C.S.A. in Canada.
2. If any original equipment wire as supplied with the appliance must be replaced, it must be replaced with wire having same wire gauge (AWG) and rated for a minimum of 105℃. Exceptions: Rep lacement 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 troubleshoot unit.

WIRING DIAGRAM
LBL20426 REV C

10 Diagrams *(continued)*

Figure 10-10 *Ladder Diagram_FTXL*



Revision Notes: *Revision A (ECO #C06020) initial release.*

Revision B (ECO #C06188) reflects updates made to the ladder and wiring diagrams (ECO #C06158).

Revision C (ECO C07191) reflects the correction information in the Parity section on page 4.

Revision D (ECO C07281) reflects the addition of Armor information and Wall Hung unit information on page 13, image 5-6 on page 15 for Wiring Requirements, Wall Hung ModBus installation procedure and images 2-6 and 2-7 on page 5, Armor Ladder and Wiring diagrams on pages 28 and 29 and Wall Hung Ladder and Wiring diagrams on pages 30 and 31. Section 2 "Installation" was created using information previously included in Section 7 "Troubleshooting".

Revision E (ECO C11616) reflects the addition of the lockout code notice on page 23 (R05772).

Revision F (ECO C11792) reflects the addition of Outdoor Knight, Knight XL and Armor models.

Revision G (ECO C13647) reflects the inclusion of AQUAS models.

Revision H (ECO C16066) reflects the addition of FTXL model information, images and diagrams.

Revision J (PCP# 3000002377 / CN# 500002607) reflects the addition of BACnet information and images, edits made to the Memory Map tables on pages 15 and 16.

Revision K (PCP# 3000007541 / CN# 500007580) reflects the addition of references to A+ and B- on page 17.

Lochinvar®
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MODB-I-O_MM# 100161545_DIR# 2000014822_Rev K
03/17

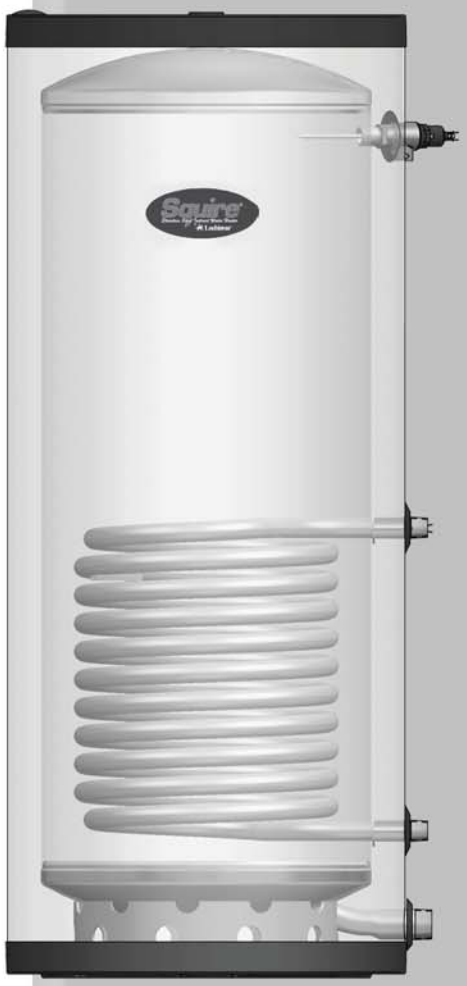
SIT-I-O_100161693_2000017215_Rev T

Squire®

Stainless Steel Indirect Water Heater

Installation & Operation Manual

Models: SIT030 - SIT119



CAUTION:

The heat transfer medium must be water or other nontoxic fluid having a toxicity rating or class of 1, as listed in Clinical Toxicology of Commercial Products, 5th edition.

The pressure of the heat transfer medium must be limited to a maximum of 30 PSIG by an approved safety or relief valve.

C US LOW LEAD CONTENT

⚠ WARNING This manual must only be used by a qualified heating installer / service technician. Read all instructions 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.

Lochinvar®

High Efficiency Water Heaters, Boilers and Pool Heaters

Contents

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 before installing. Perform steps in the order given.

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

Consider piping and installation when determining appliance location.

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

Factory warranty (shipped with appliance) does not apply to appliances improperly installed or improperly operated.

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

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

WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
- Do not touch any electric switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's 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 Failure to adhere to the guidelines on this page can result in severe personal injury, death, or substantial property damage.

When servicing the indirect water heater –

- To avoid severe burns, allow the appliance to cool before performing maintenance.

Indirect water heater operation –

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

The following chart 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.

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

Hot Water Can Scald!

- Water heated to temperatures for clothes washing, dish washing, and other sanitizing needs can scald and cause permanent injury.
- Children, elderly, and infirm or physically handicapped persons are more likely to be permanently injured by hot water. Never leave them unattended in a bathtub or shower. Never allow small children to use a hot water tap or draw their own bath.
  - If anyone using hot water in the building fits the above description, or if state laws or local codes require certain water temperatures at hot water taps, you must take special precautions:
    - Use lowest possible temperature setting.
    - Install some type of tempering device, such as an automatic mixing valve, at hot water tap or water heater. Automatic mixing valve must be selected and installed according to valve manufacturer's recommendations and instructions.
- Water passing out of drain valves may be extremely hot. To avoid injury:
  - Make sure all connections are tight.
  - Direct water flow away from any person.

Protection Must Be Taken Against Excessive Temperature and Pressure!
--Installation of a Temperature & Pressure (T&P) relief valve is required.

1 General information

The Lochinvar SIT series indirect water heater (FIG. 1-1) is designed to generate domestic hot water in conjunction with a hot water boiler using forced boiler water circulation. This indirect water heater consists of a 316L Stainless Steel tank in which a smooth 316L stainless steel coil is located (Table 1A). Boiler water is pumped through the coil and heats the water in the tank. This tank is not intended for use in pool heating applications or for heating any fluid other than water. It is also not intended for use in gravity hot water heating systems.

Operating restrictions:

- Maximum domestic hot water temperature is 194°F.
- Maximum boiler water temperature is 210°F.
- Maximum working pressure for the vessel tank is 150 psig.

Table 1A
Component Materials

Component	Material
Tank	316L Steel Stainless Steel
Coil	316L Stainless Steel
Insulation	Polyurethane
Jacket	Polypropylene / ABS

Single-wall heat exchanger

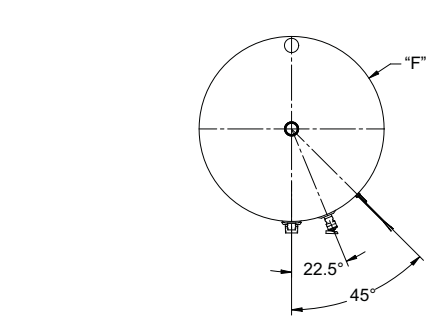
Uniform plumbing code

Single-wall heat exchangers are permitted if they satisfy all of the following requirements --

1. The heat transfer medium is potable water or contains only substances which are recognized as safe by the U.S. Food and Drug Administration.
2. The pressure of the heat transfer medium is maintained less than the normal minimum operating pressure of the potable water system.
3. The equipment is permanently labeled to indicate that only additives recognized as safe by the FDA shall be used in the heat transfer medium.

Other heat exchanger designs may be permitted where approved by the Administrative Authority.

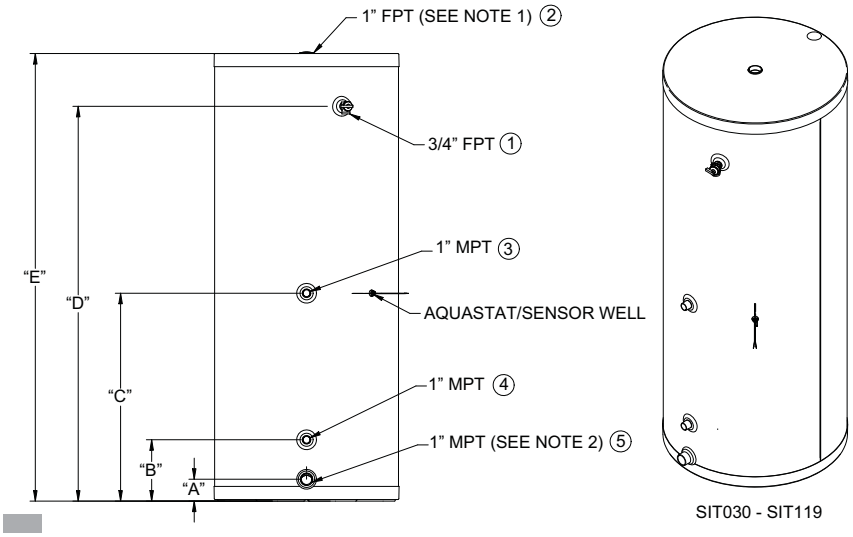
Figure 1-1 *Lochinvar SIT Series Indirect Water Heater*



PART NO.	"A" (in.)	"B" (in.)	"C" (in.)	"D" (in.)	"E" (in.)	"F" (in.)	WEIGHT FULL OF WATER (lbs.)
SIT030	3 1/16	8 3/16	21 3/4	32 1/4	39 1/2	20	393
SIT040	3 1/16	8 3/16	25 1/4	48 1/2	55 9/16	20	515
SIT050	3 5/8	9 1/8	24 7/16	39 3/4	47 1/4	24	614
SIT065	3 5/16	9 1/8	27 15/16	52 1/4	59 7/8	24	820
SIT080	3 5/16	9 1/8	27 15/16	61 3/4	69 3/8	24	921
SIT119	3 5/16	9 3/8	31 11/16	60 1/4	68 3/16	28	1268

NOTES:
1. 1-1/2" FPT ON MODELS SIT065 - 119
2. 1-1/2" MPT ON MODELS SIT065 - 119

1. RELIEF VALVE CONNECTION
2. HOT WATER OUTLET
3. BOILER WATER IN
4. BOILER WATER OUT
5. DRAIN/COLD WATER INLET



SIT030 - SIT119

2 Pre-installation

1. The installation must conform to the instructions in this manual and all applicable local, state, provincial, and national codes, laws, regulations, and ordinances. Installations in Canada must conform to B149.2 Installation Code.

2. Be certain the domestic water supply to the tank has physical and chemical characteristics that fall within the limits shown in Table 2A. Where questions exist as to the composition of the water on the job, a qualified water treatment expert should be consulted.

CAUTION Water with characteristics outside the limits shown in Table 2A may severely shorten the life of the tank due to corrosion. Damage to tanks in such cases is not covered under warranty.

3. Read and understand all installation requirements in this manual.

Table 2A
Water Chemistry Requirements

Water used in the tank must have characteristics falling within the following limits:

Characteristic	Min.	Max.
Ph	6.0	8.0
Chloride (PPM)	--	80

Locating the tank

1. Choose a location for your water heater centralized to the piping system. You must also locate the SIT water heater where it will not be exposed to freezing temperatures. Additionally, you will need to place the water heater so that the controls, drain, and inlet/outlets are easily accessible. This appliance must not be installed outdoors, as it is certified as an indoor appliance, and must also be kept vertical on a level surface.

2. Keep distance between boiler and water heater to a minimum to:
   a. reduce piping heat loss
   b. provide minimal friction loss

3. Figure 1-1 on page 4 shows the weights of all the tanks filled with water. Make sure that the location chosen for the tank is capable of supporting it.

CAUTION This appliance must be placed where leakage from the relief valve, leakage from the related piping, or leakage from the tank or connections, will not result in damage to the surrounding areas, or to the lower floors of the building. A water heater should always be located in an area with a floor drain or installed in a drain pan suitable for water heaters. Lochinvar shall not be held liable for any such water damage.

4. The tank may be located some distance from the boiler provided the pump is designed to provide the flow called for in Table 3B - Pressure Drop Values, through the coil. Also, the further the tank is from the boiler, the longer the response of the boiler will be to a call from the tank zone. Insulate piping between the boiler and the tank.

⚠ WARNING Failure to properly support the tank could result in property damage or personal injury.

Recommended clearances

The installation location must provide adequate clearances for servicing and proper operation of the water heater. A 12 inch vertical clearance is recommended from the top of the water heater. A zero clearance is allowed for the sides of the water heater. However, boiler and servicing clearances must be figured when locating the water heater.

3 Boiler side piping

Figures 3-1 thru 3-4 show typical boiler side piping for several common situations. Regardless of which system is used it is imperative that the flow rates called for in Table 3B are developed through the coil. This requires properly sized piping and a properly sized pump.

The system shown in FIG's 3-1 thru 3-4 are described below:

Zone with circulator to Aquastat

This system is like the circulator zone system on a straight heat job except that one of the zones goes to the tank instead of radiation. As on any circulator zone system check valves should be installed in each zone to prevent unwanted circulation through zones which are not calling for heat. Figure 3-1 on page 7 illustrates typical circulator zone piping.

Zone with valve to Aquastat

As with the circulator zone system, this system is just like a standard heating zone system except that one of the zones is connected to the tank coil as shown in FIG. 3-2. The system circulator must be large enough to move boiler water through the coil regardless of the flow rate required through the heating zones.

DHW prioritization

This piping system is designed to provide direct hot water priority over the other zones in the heating system. When there is a Domestic Hot Water (DHW) call for heat, the Knight control will shut off the boiler circulator and activate the domestic hot water circulator. Once the DHW demand is satisfied, the boiler circulator will be readjusted as demand requires. The circulator must be large enough to move the boiler water through the coils. The recommended piping for a DHW priority system is depicted in FIG. 3-3 on page 9.

Multiple tank connections (boiler side)

Multiple tank installations must be done in the "reverse-return" manner. The reason for this is to create the same pressure drop (and therefore, the same flow) through the coil of each tank. The boiler manifold piping must be sized so that each coil has the flow rate called for in Table 3B.

Because the pressure drop through tank coils varies from size to size, it is hard to predict the flow rate that will be developed through each coil when two tanks of different sizes are placed in the same manifold. For this reason it is best not to mix tanks of different sizes in the same zone if their recovery is critical.

Table 3A
Pressure Drop Chart

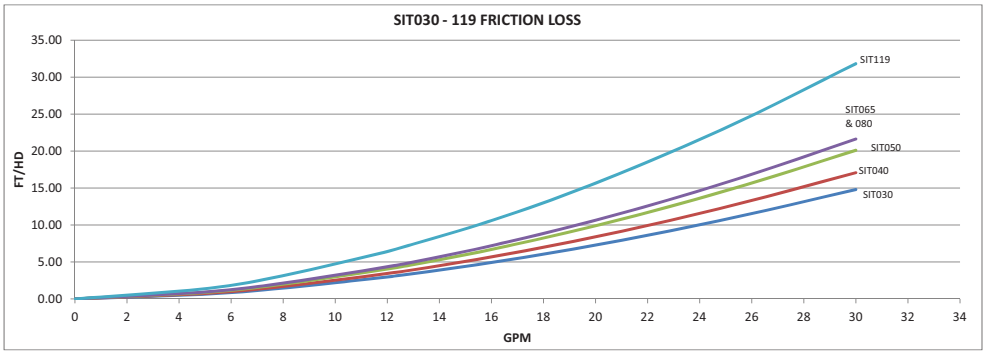
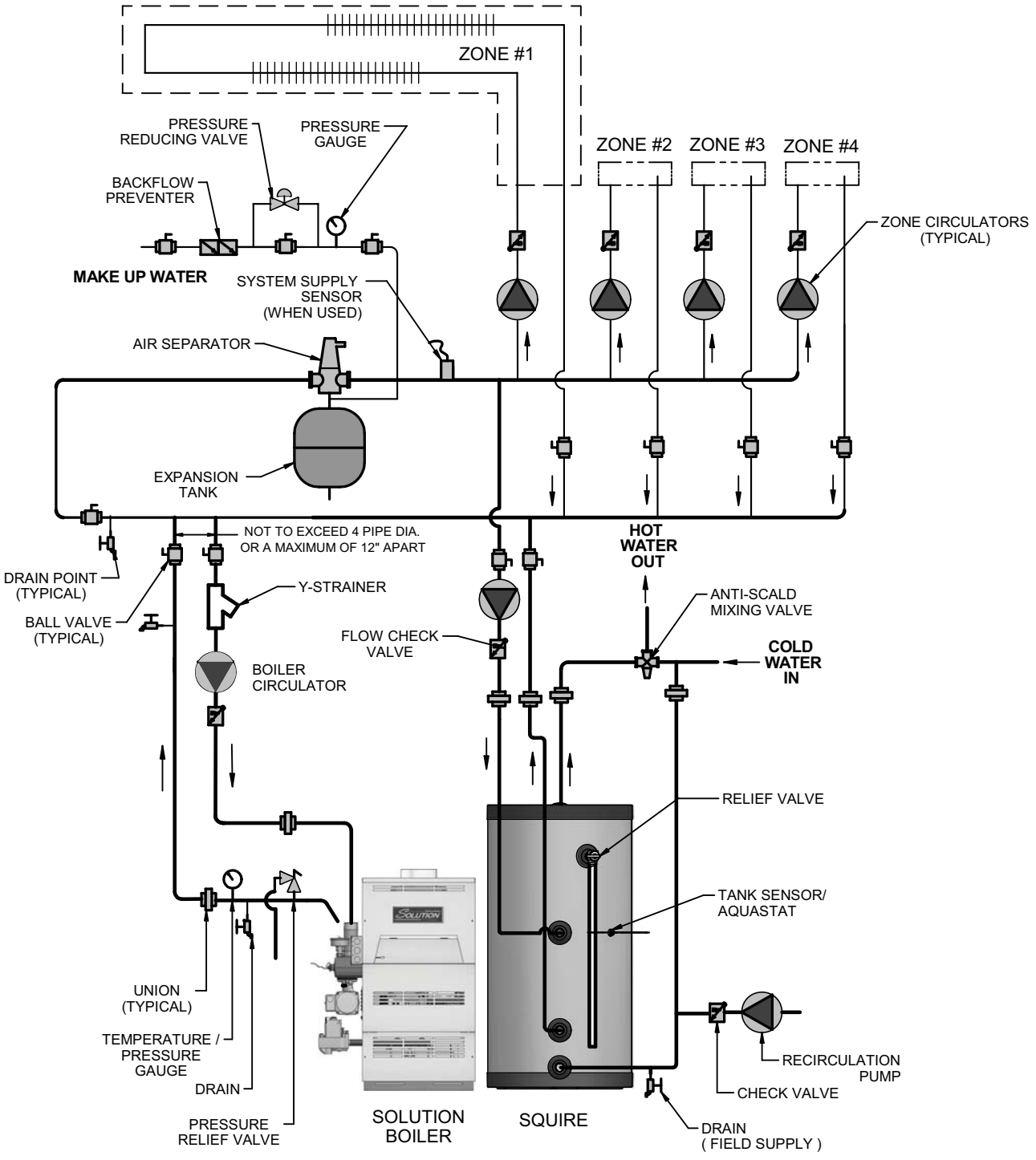


Table 3B
Pressure Drop Values

MODEL	WATER INLET (NPT)	WATER OUTLET (NPT)	COIL CONNECTION (NPT)	COIL LENGTH (FT)	SQ FT SURFACE AREA	PRESSURE DROP (FT/HD)						
						5 GPM	8 GPM	12 GPM	16 GPM	20 GPM	25 GPM	30 GPM
SIT030	1	1	1	24	8.0	.64	1.46	2.98	4.93	7.28	10.76	14.80
SIT040	1	1	1	30.8	10.0	.74	1.69	3.44	5.68	8.4	12.41	17.08
SIT050	1	1	1	36.5	12.0	.87	1.99	4.05	6.7	9.89	14.62	20.11
SIT065	1.5	1.5	1	41.5	13.5	.94	2.14	4.35	7.2	10.64	15.72	21.63
SIT080	1.5	1.5	1	41.5	13.5	.94	2.14	4.35	7.2	10.64	15.72	21.63
SIT119	1.5	1.5	1	67.3	22.0	1.38	3.15	6.41	10.6	15.66	23.14	31.84

3 Boiler side piping *(continued)*

Figure 3-1 *Piping Diagram Zoned with Circulators*

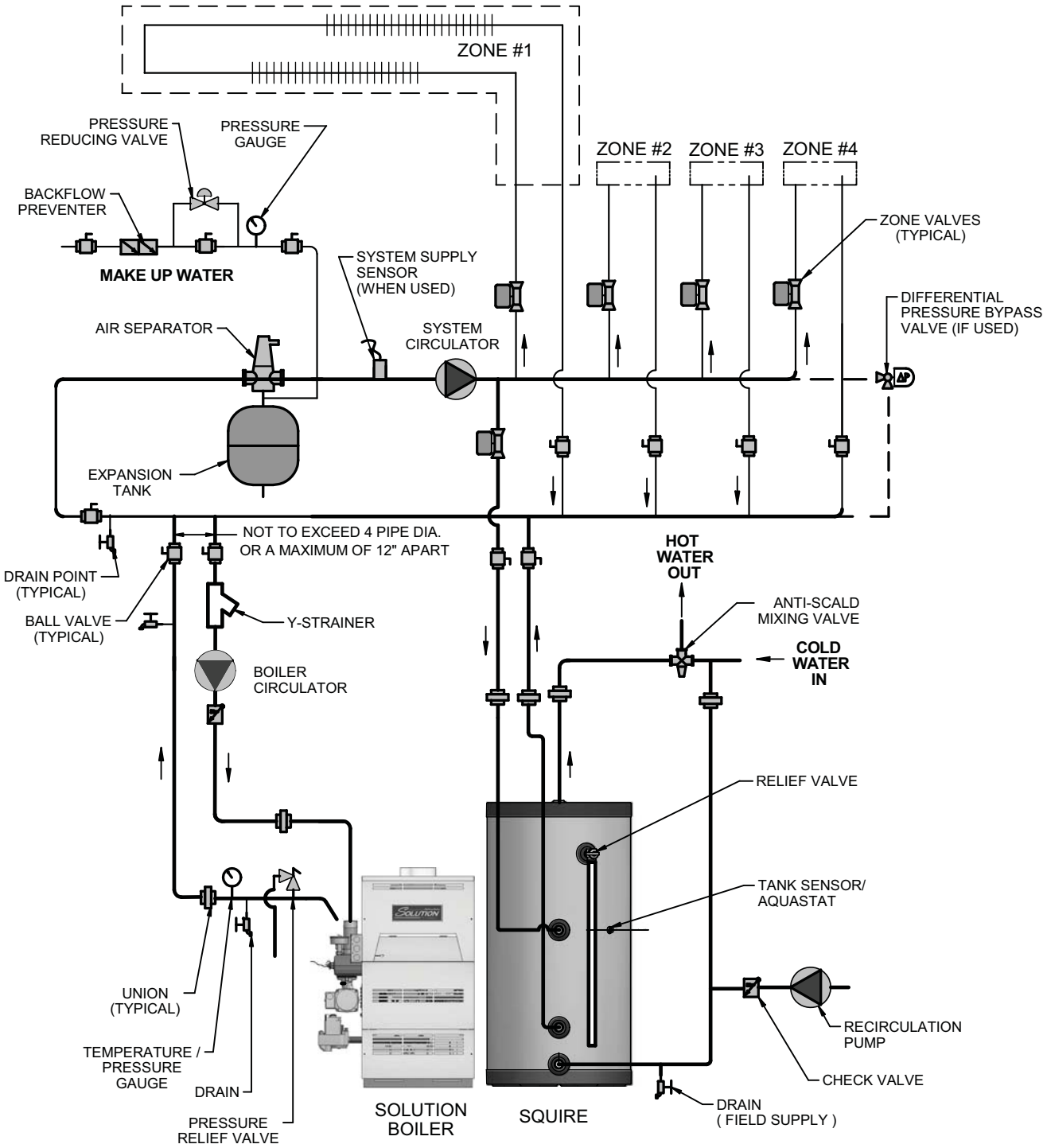


NOTICE Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment and detailing required by local codes.

NOTICE Please note that the installer is responsible for ensuring DHW prioritization when piped as a zone.

3 Boiler side piping

Figure 3-2 *Piping Diagram Zoned with Valves*

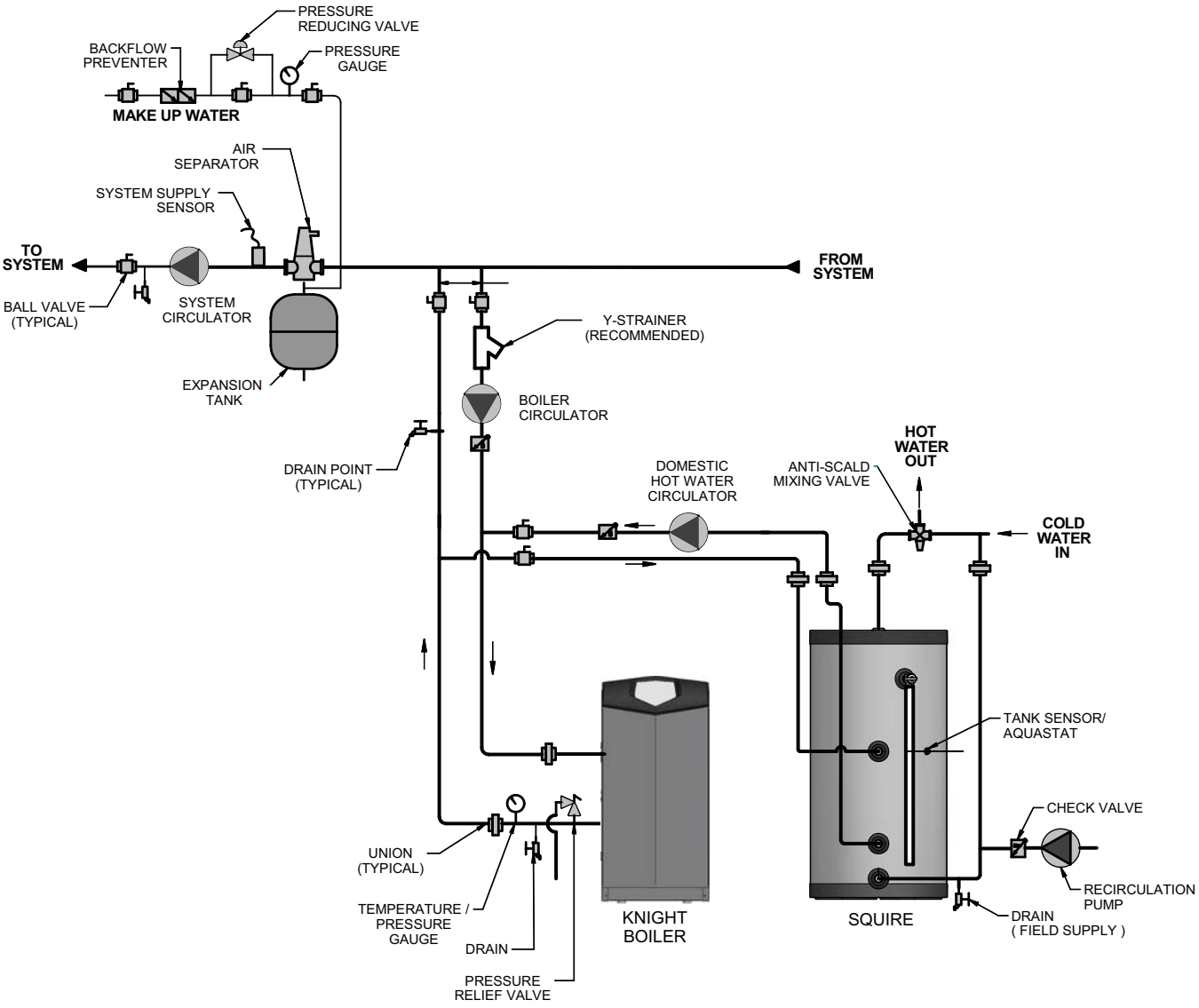


NOTICE Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment and detailing required by local codes.

NOTICE Please note that the installer is responsible for ensuring DHW prioritization when piped as a zone.

3 Boiler side piping *(continued)*

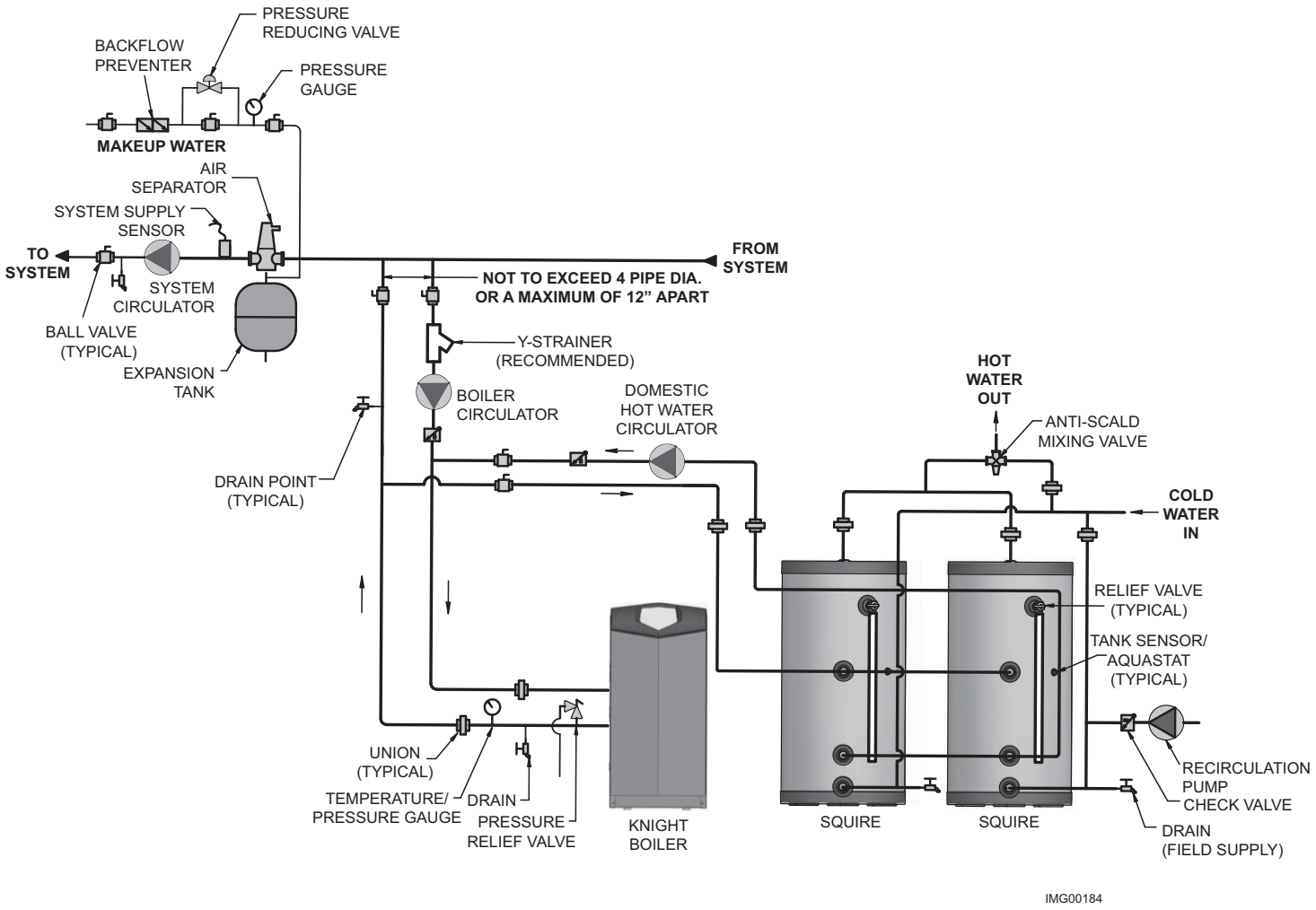
Figure 3-3 *Knight Boiler Primary / Secondary Piping*



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

3 Boiler side piping

Figure 3-4 *Multiple Tank Connections*



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.

4 Domestic side (tank) piping

Basic domestic piping

Figure 4-2 on page 14 shows typical domestic water piping for a tank. The function of the components shown are as follows:

a. Shut-off valves (recommended) - Used to isolate the tank for servicing.

b. Backflow Preventer (required by some codes) - Used to prevent water from backing out of the tank and into the main potable water supply in the event that inlet water pressure drops.

c. Expansion Tank (required for thermal expansion) - This expansion tank absorbs the increased volume caused by heating water.

   Use an expansion tank designed for use on domestic water systems. Refer to the expansion tank manufacturer's literature for the proper size expansion tank to use.

NOTICE If an expansion tank is used, do not put any valves between the expansion tank and tank inlet.

d. Unions (optional) - Used to disconnect the tank in the unlikely event that this is necessary.

e. Drain (required) - Used to drain the tank for inspection or servicing.

Multiple tank domestic water piping

The two pipe reverse return piping uses more pipe than the two pipe direct return piping, but the flow is more balanced and even in the two pipe reverse return piping layout (see FIG. 3-4).

Each tank must have its own T&P valve. It is recommended that each tank be equipped with its own isolation valves, unions, and drains so that one tank may be removed from the system. If local codes require a backflow preventer, check with the appropriate authority to find out whether one backflow preventer may be used for tanks or each tank must be equipped with its own backflow preventer. If each tank must have its own backflow preventer, each tank must also have its own expansion tank. If a common backflow preventer is permitted, an expansion tank must be sized to accommodate the expansion volume of all tanks.

Domestic water piping for distant fixtures

In some cases the furthest fixture may be quite distant from the tank. Such an installation would result in an unacceptable delay before hot water reaches these distant fixtures. Even if all the fixtures are relatively close to the tank, the building owner may want hot water at all fixtures as soon as they are opened.

To prevent delays, return circulation piping with a check valve that allows flow to the inlet of the tank. This should be installed on each branch circuit at the farthest fixture or device, so that hot water is supplied upon demand.

Because hot water is always circulating in the hot water branch, the entire branch should be insulated to prevent excessive heat loss.

4 Domestic side (tank) piping

Anti-scald valves (mixing valves)

Anti-scald valves used with water heaters are also called tempering valves or mixing valves. An anti-scald valve mixes cold water in with the outgoing hot water to assure that hot water reaching a building fixture is at a temperature low enough to be safe. ASSE1017 and ASSE1070 certified valves are recommended.

Usually, the maximum temperature of the outlet water will stay near the setting of the tank control. In some cases, however, hot water usage patterns can cause the outlet water temperature to rise significantly above the control setting.

The temperature of water going to the fixtures may be more carefully controlled through the use of a thermostatic mixing valve. This device blends a controlled amount of cold water with the hot water leaving the tank so that water at a more constant temperature exits the mixing valve. Anti-scald mixing valve piping is illustrated in FIG.'s 3-1 thru 3-4.

⚠ WARNING An anti-scald mixing valve does not eliminate the risk of scalding.

* Set the tank thermostat as low as practical.
* Feel water before bathing or showering.
* If anti-scald or anti-chill protection is required, use devices specifically designed for such service. Install these devices in accordance with their manufacturer's instructions.

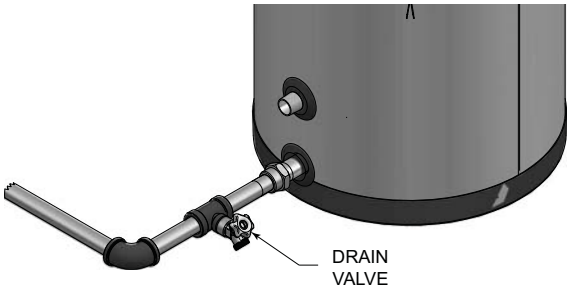
Install drain valve

Drain valve and fittings are supplied by others.

Standard Installation

- Install a tee connection at the domestic cold water inlet (FIG. 4-1).

Figure 4-1 *Drain Valve Installed*



Temperature & pressure (T&P) relief valve

⚠ WARNING For protection against excessive temperatures and pressure, install temperature and pressure protective equipment required by local codes. This equipment shall not be less than a combination temperature and pressure relief valve certified by a nationally recognized testing laboratory that maintains periodic inspection of production of listed equipment or materials as meeting the requirements for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems, ANSI Z21.22 and the Standard CAN1-4.4, Temperature, Pressure, Temperature and Pressure Relief Valves and Vacuum Relief Valves. The combination temperature and pressure relief valve shall be marked with a maximum set pressure not to exceed the maximum working pressure of the water heater. The combination temperature and pressure relief valve shall also have an hourly rated temperature steam BTU discharge capacity not less than shown in Table 4A.

Install the combination temperature and pressure relief valve into the opening provided and marked for this purpose on the water heater.

NOTICE Verify that the combination temperature and pressure relief valve complies with local codes. If the combination temperature and pressure relief valve does not comply with local codes, replace it with one that does. Follow the installation instructions in this section.

Do not place a valve between the combination T&P relief valve and the tank.

Determine T&P relief valve size by the following specifications, unless they conflict with local codes:

- SIT030/040/050 - 3/4" NPT with a minimum CSA Rating of 105,000 Btu/hr.
- SIT065/080/119 - 3/4" NPT with a minimum CSA Rating of 205,000 Btu/hr.

NOTICE The Lochinvar SIT series water heaters will absorb/store less than 205,000 Btu/hr when domestic water outlet temperature is 210°F and boiler water supply temperature is 240°F. Listed outputs are based on ASME Section VIII Interpretation VIII-1-86-136. Check with local codes for applicability.

4 Domestic side (tank) piping *(continued)*

Table 4A Minimum Relief Valve (CSA Rating)	
Model	**Btu/hr**
SIT030	105,000
SIT040	105,000
SIT050	105,000
SIT065	205,000
SIT080	205,000
SIT119	205,000

Standard installation

- Install the T&P relief valve in the connection marked "Relief Valve".

T&P relief valve discharge piping

T&P relief valve discharge piping **MUST** be:
- made of material serviceable for a temperature of 250°F or greater.
- directed so that hot water flows away from all persons.
- directed to a suitable place for disposal.
- installed so as to allow complete draining of the T&P relief valve and discharge line.
- terminated within 6" of the floor.

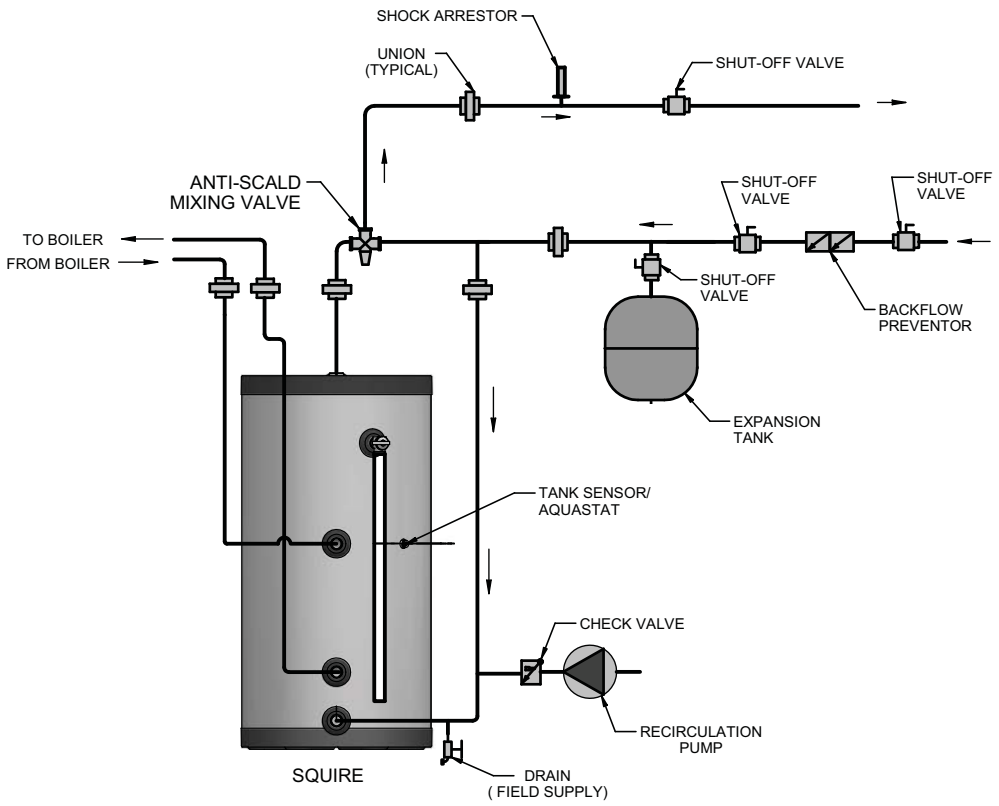
T&P relief valve discharge piping **MUST NOT** be:
- excessively long. Using more than two (2) elbows or 15 feet of piping can reduce discharge capacity.
- directly connected to a drain. Refer to local codes.
- subject to freezing.

⚠ WARNING Do not install any valve between the T&P relief valve and the tank connection or on the T&P relief valve discharge piping. Improper placement and piping of T&P relief valve can cause severe personal injury, death or substantial property damage.

⚠ CAUTION The T&P relief valve is not intended for constant duty, such as relief of pressure due to repeated normal system expansion. Correct this condition by installing a properly sized expansion tank in a domestic water system. Refer to the expansion tank manufacturer's installation instructions for proper sizing.

⚠ WARNING Failure to install and maintain a new, listed 3/4" X 3/4" T&P relief valve will release the manufacturer from any claim which might result from excessive temperature and pressures.

Figure 4-2 *Recommended Domestic Water Piping*



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.

5 Wiring

Indirect water heater sensor setup (Knight boiler)

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

NOTICE The sensor supplied contains an Auto Reset High Limit (194°F).

Install tank sensor

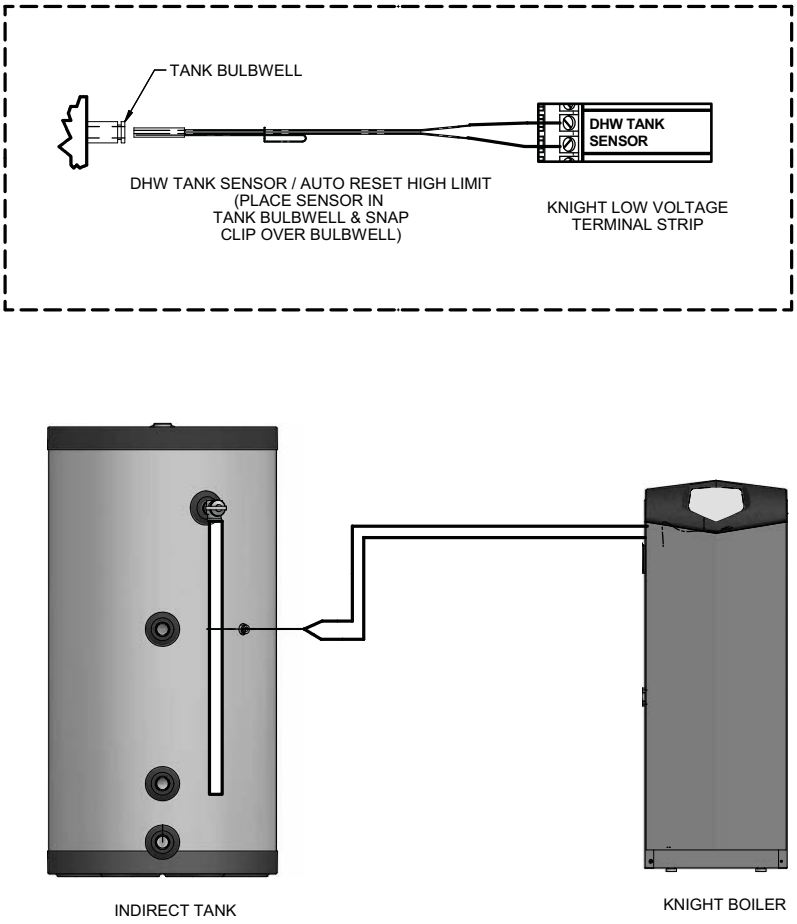
The tank sensor is a dual sensor which controls the temperature of the tank from the boiler(see FIG. 4-1). The tank sensor has a built-in high temperature limit set at 194°F.

1. Install the sensor inside the tank as depicted in FIG. 5-1.
2. Connect the wire leads to the DHW Tank Sensor (AUX) connection point on the Knight boiler connection board (see FIG. 5-1).
3. The Knight boiler will automatically read the sensor and default the tank temperature setting to 125°F.
4. Adjust the tank setpoint program. Reference the Knight Installation and Operation Manual for a detailed explanation of the tank setpoint program.

Connect tank sensor

1. Turn OFF the power to the unit. Use wire strippers to strip one inch of insulation from the ends of each wire that will be spliced.
2. Splice the two ends of bare wire by twisting them together with a pair of electrical pliers. Turn the pliers three or four times to make a sufficient connection.
3. Attach a wire nut at the point where the two wires have been twisted together. Twist the wire nut until it fits snugly, or until it cannot be twisted any more.
4. Wrap the wire nut and the two wires with electrical tape to secure the connection. Cover any exposed wiring with electrical tape.

Figure 5-1 *Indirect Water Heater Controlled Using Tank Sensor*

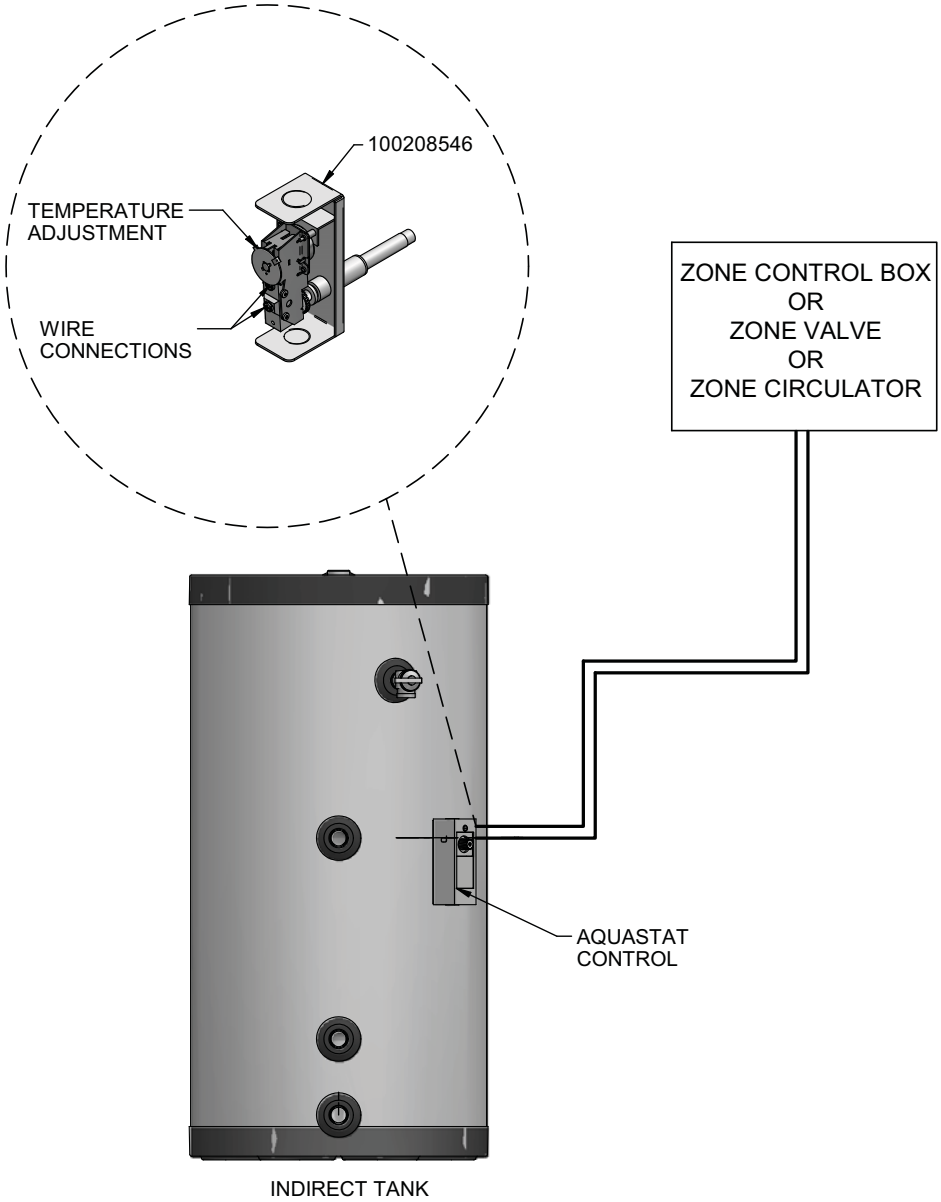


5 Wiring *(continued)*

Indirect water heater controlled using Aquastat and zone circulator / valve

1. Install Aquastat to tank. Aquastat control (100208546) can be ordered from your local Lochinvar distributor.
2. Connect Aquastat to the zone controller for the Indirect Water Heater Zone.
3. Adjust Aquastat to the desired temperature.

Figure 5-2 *Wiring for Zone Control*



6 Start-up and check-out

1. Make sure the system is free of leaks and that air is purged from the system.

CAUTION Fix any leaks found before proceeding further. Leakage from the boiler piping can result in severe damage to the boiler.

2. Many soldering fluxes contain Zinc Chloride which can cause severe corrosion damage to stainless steel. After completing all domestic water connections, flush the indirect water heater thoroughly before leaving the installation. This is particularly important if the indirect water heater will be unused for an extended period of time after installation. Flush the indirect water heater by drawing at least three times its volume from the tank.

3. Make sure that all electrical connections are made correctly and that no exposed high voltage wiring is present.

4. Make sure that each zone valve or circulator operates when, and only when, its thermostat calls for heat. Let each zone operate long enough to purge any remaining air from the system.

5. Set the indirect water heater to the desired temperature. Because hot water presents a scald hazard, it is best to set the thermostat at 120°F or lower and raise it only if necessary to provide adequate hot water.

6. Re-enable the burner and allow the boiler to operate. Make sure that the boiler shuts down when the indirect water heater is satisfied.

7 Maintenance

The Lochinvar SIT series indirect water heater is an extremely simple device and as such requires very little maintenance. There are, however, several items which should be checked out on an annual or as needed basis to ensure a reliable supply of hot water:

* Make sure that the rest of the boiler and domestic water piping is free of leaks.
* If there is an oil lubricated circulator in the system, make sure it is lubricated as called for by the circulator manufacturer.
* Make sure that the boiler is maintained in accordance with the boiler manufacturer's instructions.
* If a water treatment system is required to keep the water chemistry within the parameters shown in Table 2A (see Section 2 - Pre-Installation), make sure that this system is properly maintained.

Maintenance Schedule

Annual service by a qualified service technician should include the following:

- ❑ Any procedure required by local codes.
- ❑ Verify system pressure. Air venting procedure may require adding water to bring boiler system up to pressure, typically 12 psig.
- ❑ Manually operate T&P relief valve at least once a year. This will release some hot water.

⚠ WARNING Before operating a T&P relief valve, make sure no one is in front of or around the T&P relief valve discharge piping. Hot discharge water can cause severe personal injury or substantial property damage.

- ❑ Move operating lever to open position for a few seconds and then move it back, allowing it to snap closed. After the T&P relief valve is operated, if it continues to release water, close the cold water inlet to the water heater immediately. Follow the draining instructions, and replace the T&P relief valve. If the T&P relief valve weeps periodically, it may be due to thermal expansion. Do not plug the T&P relief valve or discharge piping.

⚠ DANGER Plugging the T&P relief valve or discharge piping can cause excessive pressure in the water heater, resulting in severe personal injury, death, or substantial property damage.

- ❑ Follow instructions on circulator to oil, if required.
- ❑ Check mixing valve, valves, pipes, and fittings for leaks.
- ❑ Check function of the field-installed controls and valves. See component manufacturer's instructions.
- ❑ Review homeowner's maintenance responsibilities and their frequencies, including any not listed in the following section.

Homeowner monthly maintenance to include:

- ❑ Visually check valves, pipes, and fittings for leaks. Call a qualified service technician to repair leaks.

To Fill the Water Heater

1. Close the water heater drain valve by turning the knob clockwise.
2. Open the cold water supply shutoff valve.
3. Open several hot water faucets to allow air to escape from the system.
4. When a steady stream of water flows from the faucets, the water heater is filled. Close the faucets and check for water leaks at the water heater drain valve, combination temperature and pressure relief valve and the hot and cold water connections.

⚠ WARNING Water from opened drain valves, unions and other connections may be extremely hot. To avoid severe personal injury, death, or substantial property damage:

- Tighten all drain hose connections.
- Direct hot water away from all persons.

To Drain the Water Heater

Should it become necessary to completely drain the water heater, be sure to follow the steps below:

1. Disconnect the power supply to the heat source. Consult the plumbing professional or electric company in your area for service.
2. Close the cold water supply shutoff valve.
3. Open the drain valve on the water heater.
4. Open a hot water faucet to allow air to enter the system.

Drain the water heater if it will be shut off and exposed to freezing temperatures. Freezing water will expand and damage the water heater.

- If boiler water contains sufficient antifreeze, then only the domestic water needs to be drained.
- If boiler water does not contain sufficient antifreeze, the boiler water and the domestic water must be drained.

If antifreeze is used in the boiler water, check concentration. Boiler water (including additives) must be practically non-toxic, having a toxicity rating or class of 1, as listed in the "Clinical Toxicology of Commercial Products". A maximum 50/50 mixture of inhibited propylene glycol is recommended. Follow the antifreeze manufacturer's instructions.

⚠ WARNING Do not use automotive, ethylene glycol or petroleum-based antifreeze. Do not use any undiluted antifreeze. This can cause severe personal injury, death, or substantial property damage.

8 Performance data

Table 8A *AHRI Chart*

Squire Indirect Water Heater AHRI Rating

Indirect Water Heater Model Number	Potable Water Volume Gal.	Heat Source Water Volume Gal.	Standby Heat Loss F/hr	Continuous Draw Rating Gal/hr	First Hour Rating Gal/ hr	Minimum Heat Output Rate from Heat Source Btu/hr	Minimum Heat Source Flow Rate GPM	Tank Heat Source Friction Loss Feet W.C.
SIT030	27.0	1.1	1.5	160	184	99,000	14.0	3.9
SIT040	40.0	1.6	0.9	181	208	115,000	14.0	4.5
SIT050	51.6	1.7	0.8	210	255	133,000	14.0	5.3
SIT065	67.0	1.9	0.7	263	328	154,000	14.0	5.7
SIT080	81.5	2.1	0.6	266	340	160,000	14.0	5.7
SIT119	113.4	3.2	0.5	308	418	199,999	12.1	6.5

• These ratings were obtained with a heat source output and heat source flow rate as listed in the chart using the parameters of the Domestic Cold Water Inlet at 58°F, Domestic Temperature Rise of 77°F, and a Boiler Temperature Output of 180°F. Other results will be obtained under different conditions.

8 Performance data *(continued)*

How to properly Size Your Indirect Water Heater

Use the First Hour Rating (FHR) to properly size your Indirect Water Heater. The First Hour Rating is the amount of hot water in gallons the heater can supply per hour (starting with a tank full of hot water), depending on tank capacity, source of heat, and the size of the burner.

Estimate your peak hour demand as follows:

- Determine what time of day (morning, noon, evening) you use the most hot water in your home. Keep in mind the number of people living in your home.
- Use the worksheet below to estimate your maximum usage of hot water during this one hour of the day -- this is your peak hour demand. ***Note:*** The worksheet does not estimate total daily hot water usage.

The worksheet example shows a total peak hour demand of 165 gallons; therefore, this household would need a water heater with a First Hour Rating of no less than 165 gallons.

Fixture Count Guide

To quickly estimate the minimum gallons of hot water required based on a family size number of baths and hot water appliances the First Hour Rating of the Squire must be equal to or exceed the total first hour requirements.

Peak Hour Demand Worksheet

Description	Fill in the Blank		Example	
40 Gallons for the first 2 people	_____	Gals.	40	Gals.
10 Gallons for each additional person	_____	Gals.	20	Gals.
20 Gallons for each bath after the first (consecutive bath)	_____	Gals.	20	Gals.
10 Gallons if dishwasher is used	_____	Gals.	10	Gals.
20 Gallons if clothes washer is used	_____	Gals.	20	Gals.
TOTAL	_____	Gals.	**110**	Gals.
Heavy Usage Buffer Use if family members take longer than average showers, etc.	x 1.5		x 1.5	
First Hour Rating	_____	Gals.	**165**	Gals.

Proceed to pages 21 – 23 of this manual to locate your Indirect Water Heater and Boiler in the sizing charts. Using the First Hour Rating calculated in this worksheet, locate your Indirect Water Heater and Boiler along with your First Hour Rating. This will also determine the flow needed between the Indirect Water Heater and Boiler.

8 Performance data

Table 8B *First Hour Rating - 180°F Boiler Loop Water (Knight Boiler)*

First Hour Rating - 180°F Boiler Loop Water (Knight Boiler - Models SIT030 - SIT050)

Model			SIT030												SIT040												SIT050											
Circulator Flow GPM			5		8		12		16		20		25		30		5		8		12		16		20		25		30		5		8		12		16		20		25		30	
Domestic Outlet			115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140
Boiler Heating Capacity	52,250	WH55	121	93													135	106													150	120												
	72,000	KB81	159	119													172	132													189	148												
	80,750	WH85	168	126													188	144													206	160												
	99,750	KB106	168	126	191	142	211	156											224	169											233	179	243	186										
	104,500	WH110					220	163											232	176													252	193										
	142,500	KB151							240	177	268	197	292	214					248	187	268	201	280	209	286	213	304	226					271	206	293	221	310	234	327	246	327	246		
	147,250	WH155											301	220	301	220							280	209	286	213	312	232	312	232									335	251	337	253	337	253
	189,999	WH199													334	243											319	237	343	245											368	275	398	296
MAX BTU INPUT			77,008		89,165		105,532		114,761		129,676		147,200		164,200		92,998		112,972		123,331		129,574		132,764		150,750		163,450		94,115		114,116		125,111		134,044		146,207		163,000		178,650	

First Hour Rating - 180°F Boiler Loop Water (Knight Boiler - Models SIT065 - SIT119)

Model			SIT065												SIT080												SIT119											
Circulator Flow GPM			5		8		12		16		20		25		30		5		8		12		16		20		25		30		5		8		12		16		20		25		30	
Domestic Outlet			115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140
Boiler Heating Capacity	52,250	WH55	168	138													177	148													212	182												
	72,000	KB81	207	165													215	175													251	210												
	80,750	WH85	224	178													232	187													268	222												
	99,750	KB106	261	204													269	213													304	248												
	104,500	WH110	271	211													278	220													314	255												
	142,500	KB151	298	230	319	245	346	264	346	264							300	235	345	267	352	272									386	306	388	307										
	147,250	WH155					354	270	355	271	355	271	355	271							361	278	361	278									397	313										
	189,999	WH199							388	294	396	300	439	330	439	330					374	288	408	311	428	325	444	337					480	373	480	373								
	199,500	KB211													458	344											462	350	462	350					499	386								
	270,750	KB286/ WH285													474	355											468	354	507	382					509	393	573	438	603	460	637	484		
	372,267	KB400																																							686	519	755	568
MAX BTU INPUT			118,488		129,139		146,864		163,768		167,924		189,925		207,575		115,860		139,106		154,002		171,229		181,544		202,550		222,500		141,419		190,161		204,765		237,649		253,504		295,875		331,225	

8 Performance data *(continued)*

***Table 8C** First Hour Rating - 180°F Boiler Loop Water (Universal Sizing)*

First Hour Rating - 180°F Boiler Loop Water (Universal Sizing - 45,000 - 295,000 Btu/hr)

Model: SIT030

Circulator Flow GPM	5		8		12		16		20		25		30	
Domestic Outlet	115	140	115	140	115	140	115	140	115	140	115	140	115	140
Boiler Heating Capacity 40,000	98	76												
60,000	136	103												
70,000	155	117												
100,000	168	126	191	142	212	157	212	157						
120,000					222	164	240	177	250	184				
140,000									268	197	288	211		
165,000											301	220	334	243
195,000														
MAX BTU INPUT	77,008		89,165		105,532		114,761		129,676		147,200		164,200	

Model: SIT040

Circulator Flow GPM	5		8		12		16		20		25		30	
Domestic Outlet	115	140	115	140	115	140	115	140	115	140	115	140	115	140
Boiler Heating Capacity 40,000	112	90												
60,000	149	117												
70,000	168	130												
100,000	211	160	224	170										
120,000			248	187	261	196								
140,000					268	201	278	209	286	213	299	223		
165,000											319	237	343	254
195,000														
MAX BTU INPUT	92,998		112,972		123,331		129,574		132,764		150,750		163,450	

Model: SIT050

Circulator Flow GPM	5		8		12		16		20		25		30	
Domestic Outlet	115	140	115	140	115	140	115	140	115	140	115	140	115	140
Boiler Heating Capacity 40,000	126	103												
60,000	165	131												
70,000	185	145												
100,000	233	179	244	187										
120,000			271	206										
140,000					293	221	310	234	323	243				
165,000									335	251	368	275	371	277
195,000													398	296
MAX BTU INPUT	94,115		114,111		125,111		134,044		146,207		163,000		178,650	

First Hour Rating - 180°F Boiler Loop Water (Universal Sizing - 45,000 - 295,000 Btu/hr)

Model: SIT0065

Circulator Flow GPM	5		8		12		16		20		25		30	
Domestic Outlet	115	140	115	140	115	140	115	140	115	140	115	140	115	140
Boiler Heating Capacity 40,000	144	121												
60,000	183	149												
70,000	203	163												
100,000	262	205												
120,000	298	230	301	232										
140,000			319	245	3471	261								
165,000					354	270	388	294	390	295	390	295		
195,000									396	300	439	330	449	337
225,000													474	355
260,000														
295,000														
325,000														
MAX BTU INPUT	118,488		129,139		146,864		163,768		167,924		189,925		207,575	

Model: SIT080

Circulator Flow GPM	5		8		12		16		20		25		30	
Domestic Outlet	115	140	115	140	115	140	115	140	115	140	115	140	115	140
Boiler Heating Capacity 40,000	154	131												
60,000	192	158												
70,000	212	172												
100,000	270	213												
120,000	300	235	308	241										
140,000			345	267	347	268	347	268						
165,000							396	303						
195,000							408	311	428	325	453	344		
225,000											468	354	507	382
260,000														
295,000														
325,000														
MAX BTU INPUT	115,860		139,106		154,002		171,229		181,544		202,550		222,500	

Model: SIT119

Circulator Flow GPM	5		8		12		16		20		25		30	
Domestic Outlet	115	140	115	140	115	140	115	140	115	140	115	140	115	140
Boiler Heating Capacity 40,000	188	165												
60,000	227	193												
70,000	247	207												
100,000	305	248												
120,000	344	276												
140,000	383	304												
165,000	386	306	431	338										
195,000			480	373	490	379								
225,000					509	393	548	421						
260,000							573	438	603	460	616	469		
295,000											686	519	685	518
325,000													743	559
MAX BTU INPUT	141,419		190,161		204,795		237,649		253,504		295,875		331,225	

8 Performance data

Table 8D *First Hour Rating 200°F Boiler Loop Water (Knight Boiler)*

First Hour Rating - 200°F Boiler Loop Water (Knight Boiler - Models SIT030 - SIT050)

Model			SIT030												SIT040												SIT050											
Circulator Flow GPM			5		8		12		16		20		25		30		5		8		12		16		20		25		30		5		8		12		16		20		25		30	
Domestic Outlet			115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140
Boiler Heating Capacity	52,250	WH55	118	93													131	106													147	120												
	72,000	KB81	154	119													167	132													184	148												
	80,750	WH85	170	131													183	144													201	160												
	99,750	KB106	205	156													217	169													237	187												
	104,500	WH110	214	163													226	176													246	193												
	142,500	KB151	265	201	283	214											294	226													318	246												
	147,250	WH155			292	220											302	232													327	253												
	189,999	WH199			302	228	354	266	370	278							325	249	380	289											354	273	407	312										
	199,500	KB211							383	288	387	291							387	295	397	302											419	320	425	325								
	270,750	KB286/ WH285									430	322	485	363	517	386					402	318	440	333	449	340	505	381	526	396					454	347	483	368	524	398	561	425		
	372,267	KB400													239	402													544	410											579	438	629	475
MAX BTU INPUT			132,453		153,363		181,514		197,389		223,043		253,184		282,424		159,957		194,312		212,130		222,867		228,354		259,290		281,134		161,877		196,280		215,191		230,555		251,476		280,360	307,278

First Hour Rating - 200°F Boiler Loop Water (Knight Boiler - Models SIT065 - SIT119)

Model			SIT065												SIT080												SIT119											
Circulator Flow GPM			5		8		12		16		20		25		30		5		8		12		16		20		25		30		5		8		12		16		20		25		30	
Domestic Outlet			115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140	115	140
Boiler Heating Capacity	52,250	WH55	164	138													174	148													208	182												
	72,000	KB81	202	165													211	175													246	210												
	80,750	WH85	218	178													227	187													262	222												
	99,750	KB106	254	204													262	213													298	248												
	104,500	WH110	263	211													271	220													307	255												
	142,500	KB151	336	264													342	272													378	307												
	147,250	WH155	345	271													351	278													387	314												
	189,999	WH199	426	330													431	337													468	373												
	199,500	KB211	444	344													448	350													485	386												
	270,750	KB286/ WH285	452	350	487	375	545	418	580	443									523	405	571	440	582	448							568	447	619	484										
	372,267	KB400							601	459	614	469	686	522	744	564							626	480	659	505	726	554	772	588			724	562	772	597	809	624						
	379,999	WH399																											786	598							824	635						
	467,000	KB501																											791	602							878	675	929	712	987	755	987	755
MAX BTU INPUT			203,799		222,120		252,607		281,681		288,830		326,671		357,029		199,280		239,261		264,883		294,513		312,255		348,386		382,700		243,240		327,077		352,247		408,756		436,026		508,905	569,707

8 Performance data *(continued)*

***Table 8E** First Hour Rating - 200°F Boiler Loop Water (Universal Sizing)*

First Hour Rating - 200°F Boiler Loop Water (Universal Sizing - 45,000 - 295,000 Btu/hr)

Model	SIT030													
Circulator Flow GPM	5		8		12		16		20		25		30	
Domestic Outlet	115	140	115	140	115	140	115	140	115	140	115	140	115	140
Boiler Heating Capacity 40,000	96	76												
Boiler Heating Capacity 60,000	132	103												
Boiler Heating Capacity 70,000	150	117												
Boiler Heating Capacity 100,000	205	157												
Boiler Heating Capacity 120,000	242	184												
Boiler Heating Capacity 140,000	265	201	278	210										
Boiler Heating Capacity 165,000			302	228	324	244								
Boiler Heating Capacity 195,000					354	266	379	285	379	285				
Boiler Heating Capacity 225,000							383	288	430	322	434	325		
Boiler Heating Capacity 260,000											485	363	498	372
Boiler Heating Capacity 295,000													539	402
Boiler Heating Capacity 325,000														
MAX BTU INPUT	132,453		153,363		181,514		197,389		223,043		253,184		282,424	

Model	SIT040													
Circulator Flow GPM	5		8		12		16		20		25		30	
Domestic Outlet	115	140	115	140	115	140	115	140	115	140	115	140	115	140
Boiler Heating Capacity 40,000	109	90												
Boiler Heating Capacity 60,000	145	117												
Boiler Heating Capacity 70,000	163	130												
Boiler Heating Capacity 100,000	217	170												
Boiler Heating Capacity 120,000	253	196												
Boiler Heating Capacity 140,000	289	223												
Boiler Heating Capacity 165,000	325	249	335	256										
Boiler Heating Capacity 195,000			387	295	389	286								
Boiler Heating Capacity 225,000					420	318	440	333	443	336				
Boiler Heating Capacity 260,000									449	340	505	381	506	382
Boiler Heating Capacity 295,000													554	410
Boiler Heating Capacity 325,000														
MAX BTU INPUT	159,957		194,312		212,130		222,867		228,354		259,290		281,134	

Model	SIT050													
Circulator Flow GPM	5		8		12		16		20		25		30	
Domestic Outlet	115	140	115	140	115	140	115	140	115	140	115	140	115	140
Boiler Heating Capacity 40,000	123	103												
Boiler Heating Capacity 60,000	161	131												
Boiler Heating Capacity 70,000	180	145												
Boiler Heating Capacity 100,000	237	187												
Boiler Heating Capacity 120,000	275	215												
Boiler Heating Capacity 140,000	313	243												
Boiler Heating Capacity 165,000	354	273	360	277										
Boiler Heating Capacity 195,000			419	320										
Boiler Heating Capacity 225,000					454	347	473	360	474	361				
Boiler Heating Capacity 260,000							483	368	524	398	540	410		
Boiler Heating Capacity 295,000											579	438	606	458
Boiler Heating Capacity 325,000													629	475
MAX BTU INPUT	161,877		196,280		215,191		230,555		251,476		280,360		307,278	

First Hour Rating - 200°F Boiler Loop Water (Universal Sizing - 45,000 - 295,000 Btu/hr)

Model	SIT065													
Circulator Flow GPM	5		8		12		16		20		25		30	
Domestic Outlet	115	140	115	140	115	140	115	140	115	140	115	140	115	140
Boiler Heating Capacity 40,000	141	121												
Boiler Heating Capacity 60,000	179	149												
Boiler Heating Capacity 70,000	198	163												
Boiler Heating Capacity 100,000	255	205												
Boiler Heating Capacity 120,000	293	233												
Boiler Heating Capacity 140,000	331	260												
Boiler Heating Capacity 165,000	378	295												
Boiler Heating Capacity 195,000	436	337												
Boiler Heating Capacity 225,000	452	350	487	375	493	380								
Boiler Heating Capacity 260,000					545	418	559	428						
Boiler Heating Capacity 295,000							601	459	614	469	626	477		
Boiler Heating Capacity 325,000											683	519		
Boiler Heating Capacity 368,999											686	522	744	564
Boiler Heating Capacity 460,000														
MAX BTU INPUT	203,799		222,120		252,607		281,681		288,830		326,671		357,029	

Model	SIT080													
Circulator Flow GPM	5		8		12		16		20		25		30	
Domestic Outlet	115	140	115	140	115	140	115	140	115	140	115	140	115	140
Boiler Heating Capacity 40,000	151	131												
Boiler Heating Capacity 60,000	188	158												
Boiler Heating Capacity 70,000	207	172												
Boiler Heating Capacity 100,000	263	213												
Boiler Heating Capacity 120,000	300	241												
Boiler Heating Capacity 140,000	338	268												
Boiler Heating Capacity 165,000	384	303												
Boiler Heating Capacity 195,000	440	344												
Boiler Heating Capacity 225,000	448	350	496	385										
Boiler Heating Capacity 260,000			523	405	562	433								
Boiler Heating Capacity 295,000					571	440	626	480	627	481				
Boiler Heating Capacity 325,000									659	505	683	522		
Boiler Heating Capacity 368,999											726	554	766	583
Boiler Heating Capacity 460,000													791	602
MAX BTU INPUT	199,280		239,261		264,883		294,513		312,255		348,386		382,700	

Model	SIT119													
Circulator Flow GPM	5		8		12		16		20		25		30	
Domestic Outlet	115	140	115	140	115	140	115	140	115	140	115	140	115	140
Boiler Heating Capacity 40,000	185	165												
Boiler Heating Capacity 60,000	223	193												
Boiler Heating Capacity 70,000	242	207												
Boiler Heating Capacity 100,000	298	248												
Boiler Heating Capacity 120,000	336	276												
Boiler Heating Capacity 140,000	373	304												
Boiler Heating Capacity 165,000	421	338												
Boiler Heating Capacity 195,000	477	380												
Boiler Heating Capacity 225,000	533	421												
Boiler Heating Capacity 260,000	568	447	598	469										
Boiler Heating Capacity 295,000			664	518										
Boiler Heating Capacity 325,000			721	559										
Boiler Heating Capacity 368,999			724	562	772	597	803	620						
Boiler Heating Capacity 460,000							878	675	929	712	974	745		
MAX BTU INPUT	243,240		327,077		352,247		408,756		436,026		508,905		569,707	

Revision Notes: *Revision A (ECO C05265) initial release.*

Revision B (ECO C05399) reflects the addition of the Pressure Drop Chart and updates made to the Performance Data Charts.

Revision C (ECO C05587) reflects the update of tables 3A and 3B (Pressure Drop charts) on page 6, table 4A on page 13, the update of the "Domestic water piping" paragraph on page 11, and the update of Performance data table 8A on page 19.

Revision D (ECO C05788) reflects new images for section 3 "Boiler Side Piping" FIG. 3-1 -- 3-4, a new image for section 4 "Domestic Side (Tank) Piping" FIG. 4-2, and the update of the Pressure Drop chart on page 6.

Revision E (ECO C06035) reflects the update of FIG. 1-1 on page 4 to revise listed dimensions.

Revision F (ECO C06300) reflects the update of images and additional CSA cautions on manual cover and "Connect tank sensor" section added to "Wiring" on page 15.

Revision G (ECO C06670) reflects the update of the IBR chart information on page 19.

Revision H (ECO C08396) reflects the addition of the First Hour Ratings of SIT080 at 20GPM for 115°F to Table 8B on page 21.

Revision I (ECO C09691) reflects the update of Table 8A on page 19 to reflect the new AHRI logo and the update of FIG. 3-4 on page 10.

Revision J (ECO C10122) reflects the update of rating information for SIT119 Models within Table 8A on page 19.

Revision K (ECO C10535) reflects the update of SIT080 First Hour Rating within Table 8A on page 19.

Revision L (ECO #C12382) reflects the addition of the CSA Low Lead Content logo.

Revision M (ECO C12829) reflects the update of coil material information in Table 1A on page 4.

Revision N (ECO C14064) reflects the update of data on pages 4 and 21.

Revision P (Change #500002160 / PCP #3000001833) reflects edits made to FIG 1-1 on page 4 along with edits made to the AHRI Chart (Table 8A) on page 18.

Revision R (PCP# 3000003438 / CN# 500003475) reflects an update to the Temperature & Pressure (T&P) Relief Valve section on page 12 as well as edits made to the data in Table 4A on page 13. SAP numbers have been updated.

Revision T (PCP# 3000005826 / CN# 500006177) reflects changes made to the Performance Data Tables.

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Instruction Sheet

302-368

00e™ Series VR3452

SUPERSEDES: February 29, 2016 EFFECTIVE: February 17, 2017

1. GENERAL INFORMATION:

The circulating pumps are used for the transfer of liquid media within a closed-looped hot-water heating or air-conditioning hydronic system. They are designed as single or parallel main/standby operation variable-speed pumps, where the speed is regulated by an on-board electronic device. They are to be used with a water or glycol/water mixture.

2. SAFETY:

These instructions should be studied carefully before installing or operating the pump. They are meant to help you with installation, use and maintenance and to increase your safety. Installation should be performed with regards to local or national standards. Only qualified personnel should maintain and service these products. Failure to comply with safety precautions could cause personal injury or machinery damage.

WARNING: Do not use in swimming pool or spa areas. Pump has not been investigated for these applications.
AVERTISSEMENT: Ne pas utiliser dans une piscine ou un spa. La pompe n'a pas été étudiée pour ces applications.

WARNING: To avoid electrical shock, disconnect the power supply to the circulator and the main electrical unit. Follow all local electrical and plumbing codes.
AVERTISSEMENT: Pour éviter tout choc électrique, débranchez l'alimentation électrique vers le circulateur et l'unité électrique principale. Respectez tous les codes de plomberie et électriques locaux.

WARNING: Hot surfaces can cause burns. The motor can also reach temperatures that could cause injury.
AVERTISSEMENT: Les surfaces chaudes peuvent provoquer des brûlures. Le moteur peut également atteindre des températures qui peuvent entraîner des blessures.

CAUTION: The addition of petroleum based fluids or certain chemical additives to systems using TACO equipment voids the warranty.
ATTENTION: L'ajout de liquides à base de pétrole ou de certains additifs chimiques à des systèmes utilisant un équipement TACO annule la garantie.

CAUTION: Use supply wires suitable for 90°C.
ATTENTION: Employer des fils d'alimentation adeqauts pour 90°C.

CAUTION: Misconnection or overload of electrical or signal connections could cause pump to shutdown or cause permanent damage.
ATTENTION: Toute erreur de raccordement ou surcharge des connexions électriques ou de signalisation peut entraîner un arrêt de la pompe ou des dommages permanents.

CAUTION: Do not operate pump without the electrical cover securely attached.
ATTENTION: Ne pas actionner la pompe si le couvercle électrique n'est pas correctement fixé.

CAUTION: Pump motor, electronics enclosure and condensate drain openings should not be thermally insulated as it could interfere with cooling and condensate drainage.
ATTENTION: Le moteur de pompe, l'enceinte électronique et les ouvertures de drainage de condensat doivent être thermiquement isolés car il peut y avoir interférence avec l'évacuation de condensat et de liquide de refroidissement.

3. PUMP DESCRIPTION:

The high efficiency, electronically commutated Vr3452 pumps consist of two main parts, the centrifugal pump and the electronic regulator. The hydraulic part is hermetically sealed from the motor assembly and has no mechanical seals. Vr3452 pumps are powered by an ECM permanent magnet motor which does not consume energy to magnetize the rotor, providing superior energy efficiency.

The ECM motor is run by an on-board frequency converter with an integrated PFC (Power Factor Correction) filter. The converter estimates current flow and head from the motor load, information essential for differential pressure control.

4. USE:

The Taco 00e VR3452 pumps are intended for circulation of solid-free fluid in pressurized, hot and chilled hydronic systems. The self-sensing ECM pump constantly calculates pressure and flow, and adapts its speed to the appropriate flow.

5. PUMPED FLUIDS:

Use water and water/glycol mixtures only. Water/glycol mixtures must be HVAC-system compatible and should have no more than 50% concentration of glycol. The fluid shall not consist of aggressive or explosive additives and mixtures of mineral oils and solid or fibrous particles. The pump should not be used for pumping flammable, explosive fluids, and in an explosive environment.

6. INSTALLATION:

The pump must be mounted with motor shaft in a horizontal position (see Figure 1). The permitted and prohibited positions are shown in Figure 2. The arrow on the hydraulic part indicates the proper direction of the fluid flow. Pumping in a downward direction may cause system issues but will not shorten the life of the pump.

Installing the pump with the electrical connector vertically above the motor is not recommended (see Figure 3). Where the installation causes the electrical connector vertically above the motor, the motor can be rotated so that the electrical connector is in a horizontal position as described in Section 6.1.

PERMITTED AMBIENT AND MEDIA TEMPERATURE:

Ambient Temperature [°F]	Fluid Temperature	
	Min. [°F]	Max. [°F]
Up to 75	36	230
85	36	212
95	36	203
105	36	175

Ambient Temperature [°C]	Fluid Temperature	
	Min. [°C]	Max. [°C]
Up to 25	2	110
30	2	100
35	2	90
40	2	80

Note: Operation outside recommended conditions may shorten pump lifetime and void the warranty.

FIGURE 1

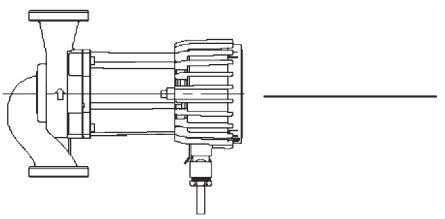


FIGURE 2

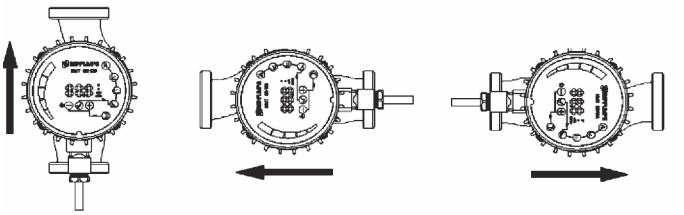


FIGURE 3

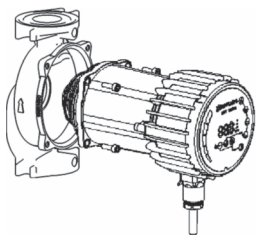


FIGURE 4

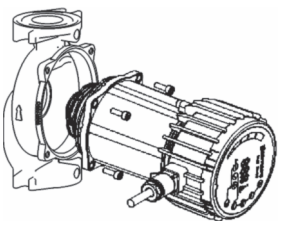
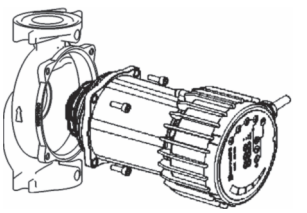


FIGURE 5



6.1 Motor Rotation Procedure

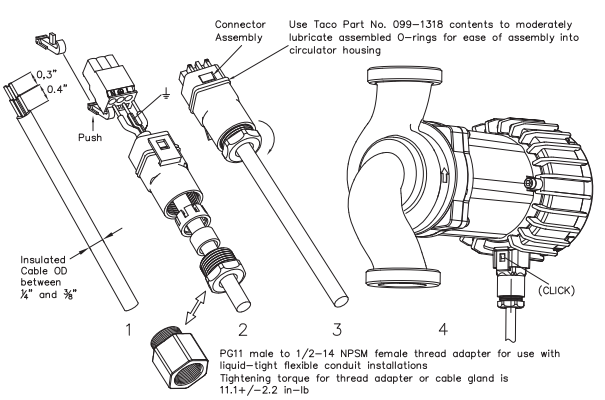
1. If possible, change the orientation of the motor before installing pump in piping. With motor in a vertical position, remove the 4 bolts (Figure 4 - **5⁄32" or 4mm Allen hex wrench required**) and turn the motor (Figures 5 or 6) to conform with the desired orientation of pump (see Figure 2). If motor won't rotate, insert a screwdriver between pump casing and motor stator housing and raise slightly. Try turning motor. Insert screwdriver on opposite side, raise slightly, and try turning the motor. Motor should now turn - line up bolt holes when desired orientation is achieved.
2. **Caution:** If system is filled and pressurized, shut off valve before and after the Vr3452. Allow to cool if system fluid is hot.
3. If the pump is already installed in the piping, remove the 4 bolts **(5⁄32" or 4mm hex wrench required)** and try rotating the motor without backing it out from the pump casing. Try lifting the motor approximately .020" using a screwdriver between the motor and pump housing and try turning the motor.
4. If motor will not move, remove motor completely.
5. Remove impeller, rotor, and rotor can from the motor. **Note: Rotor and impeller assembly will come out first. Remove rotor can from motor and put aside.**
6. Install impeller and rotor assembly into pump.
7. While holding rotor, install O-ring in casing, and then slide rotor can over rotor and slide all the way in. **Note: The rotor and rotor can is a sealed unit.**
8. Pick up the motor with the terminals properly orientated and carefully start to slide the motor over the rotor can. The resistance of the sliding will keep the rotor and rotor can assembly in place and the screwdriver can be moved. **Note: Do not allow the motor to droop or the O-ring might get out of position.**

Before starting the pump, the system (and pump) must be filled with fluid, and air completely bled out of the system. For proper operation, pressure must be maintained on the suction side of the pump. The pump does not have screws for bleeding the air, as it is automatically bled as a function of the design of the pump. Temporary air in the pump will generate noise that disappears after a short time.

WARNING!

- The maximum system pressure is 145 psi (1 MPa or 10 bar).
- The pump must always be filled with system fluid as it is water lubricated and water cooled.
- The motor stator openings and stator housing (Figure 7) should not be insulated, since the thermal insulation might prevent motor cooling and the evacuation of condensate from the pump's motor housing in high ambient humidity applications where the system fluid temperature is below the motor temperature.

FIGURE 7



7. ELECTRICAL CONNECTION:

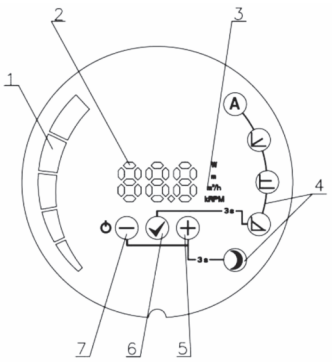
Connection of the pump must comply with local electrical codes and be carried out by qualified personnel. Connection to the power supply is carried out with the enclosed connector, the mounting of which is shown in the picture accompanying the connector. When connecting the pump, the following must be considered:

- Liquid tight power connection required to maintain IP44 enclosure rating. Use supplied thread adapter option for flexible or armored cable installations.
- Maximum power input wire size: 16 & 12 AWG solid or multi-strand copper for portable cord & flexible conduit installations; respectively.
- Local or national electrical code requirements supersede Taco's specification.
- Install an electrical disconnect to comply with national electrical code.
- Connection of the power supply electrical cable must be done in a manner that ensures it does not contact the motor housing and volute of the device, due to potential high temperatures of both.

The pump has built-in over current fuse protection, temperature protection, and basic overvoltage protection. It does not require additional overload protection devices unless required by local electrical codes. Power supply cabling should be capable of carrying rated power and be properly fused. Grounding connection is essential for safety and should be connected first. Grounding is only meant for pump safety. System piping should be grounded separately.

8. SETUP AND OPERATION:

8.1 Control Panel



1. Bar Display of Values
2. Numerical Display of Values
3. Unit Display of the Currently Selected Parameter (Watts, Head Setting, Flow, or Speed)
4. Display of the Currently Selected Mode
5. **[+]** Button
6. **[✓]** Button
7. **[–]** Button

8.2 Switching the Pump Motor On and Off

When the pump is powered for the first time, it operates with the factory default settings in automatic mode.

With subsequent motor start-ups and/or power-ups, due to the non-volatile memory the pump will operate with the last settings that were set prior to its shut-down. Battery back-up is not required.

To switch the pump off, press and hold the **[–]** key for 5 seconds, until OFF is shown on the display. When the pump is switched off, the numerical display shows OFF.

To turn the pump on, press the **[–]** key briefly.

8.3 Pump Functions

[–] Key

Short press:

- Scrolling through parameters downwards, not changing parameter values.
- Scrolling through modes downwards when mode selection is selected.
- Changing parameters downwards when setting parameter values.

Long press:

- 3 seconds together with **[+]** key to select night setback mode.
- 5 seconds to switch off the pump.
- 5 seconds together with **[✓]** and **[+]** keys to restore pump to factory default settings.

[✓] Key

Short press:

- To confirm currently selected values of both mode and parameter.

Long press:

- 3 seconds to enable mode selection.
- 5 seconds together with long press on **[+]** and **[–]** keys to restore pump to factory default settings.

[+] Key

Short press:

- Scrolling through parameters upwards, not changing parameter values.
- Scrolling through modes upwards when mode selection is selected.
- Changing parameters downwards when setting parameter values.

Long press:

- 3 seconds together with **[–]** key to enable night setback mode.
- 5 seconds together with **[✓]** and **[–]** keys to restore pump to factory default settings.

8.4 Operation and Setting of Pump Modes

To switch between modes (except night mode) press and hold the **[✓]** key for 3 seconds then select the desired mode with the **[+]** or **[–]** key. Once desired mode is selected, press the **[✓]** key to confirm.

Once the desired mode is selected, the factory default parameter is displayed numerical display (except for Auto Mode). If required, the parameter value can be changed with the **[+]** or **[–]** key, then confirm the parameter setting by pressing the **[✓]** key.

To activate or deactivate the night setback feature, simultaneously press and hold the **[+]** and **[–]** keys for 3 seconds.

To scroll through the parameter values within a mode, use the **[+]** or **[–]** keys. The desired parameter is selected (see individual mode) with the **[✓]** key. The parameter value is then selected using the **[+]** or **[–]** keys. The selected value is confirmed using the **[✓]** key.

8.5 Mode Descriptions

The pump can operate in 4 different modes to optimize the performance of the pump and maximize the system efficiency, based on the specific system type.

The pump modes are:

- Automatic Mode (factory default)
- Proportional Pressure (increased differential head as flow increases)
- Constant Pressure (constant pressure as flow increased)
- Constant Speed (user selectable to match system requirements)

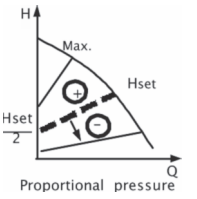
Each mode can be combined together with night mode.

Automatic Mode (factory default)

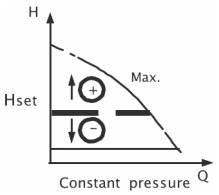
In automatic mode the pump automatically sets the operating pressure, depending on the hydronic system. By doing so, the pump finds the optimal operating setting. **This mode is recommended in most systems.** The parameters cannot be set; they can only be scrolled through.

Proportional Pressure

The pump maintains the pressure with relation to the current flow. The maximum differential head is the set pressure (Hset on the diagram) at maximum speed; at 0 flow the differential pressure is 50% of the Hset setting. As the

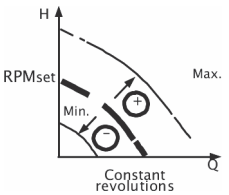


system flow changes the pump's differential pressure changes linearly along the line between Hset and 0 flow.



Constant Pressure

The pump maintains the current set pressure (Hset on the drawing), from 0 flow to maximum flow, where the pressure begins to drop.



Constant Speed

The pump operates with the currently set speed (RPMset on the drawing). In the unregulated mode, we can only set the speed at which the pump will operate and scroll through the other parameters.

Night Mode ◑

When the pump operates in night mode, it automatically switches between the selected operating mode and night curve. The transition to the night mode depends on the fluid temperature in the system.

When the night mode is enabled, its icon illuminates and the pump operates in the selected operating curve of the mode. When the pump identifies the media temperature falling by 60 to 70 F° (15-20 C°) over a 2 hour time period, the icon starts to blink and the pump switches to the night curve. When the fluid temperature rises again, the icon stops blinking and the pump switches to the operating curve in the selected operating mode. The night mode operates only in combination with the above indicated modes. It is not an independent operating mode.

8.6 Setting the Pump to Factory Settings

To restore factory defaults, press and hold all three buttons for 5 seconds. The pump will be set to the automatic mode of operation. Any previously set values for pressure and RPM will be deleted.

9. OVERVIEW OF POSSIBLE ERRORS AND SOLUTIONS

If a pump failure or overload occurs, the error code will appear on the display screen as indicated in the table below. X is the error group and Y is the service code (intended for service personnel.

Error Group (X)	Error Description	Possible Cause & Solution
1	Low Load Detected	Pump running dry - purge/fill the system.
2	Motor Overload	Excessive amperage and/or sticking rotor assembly. Confirm voltage/amperage and check rotor/impeller spins freely.
3	Motor Too Hot	Motor exceeded temperature limitation and is stopped to allow the motor to cool down. Once cooled the pump will automatically restart and the error code recorded.
4	Electronics Error	An electronic error was detected. The pump can still operate but requires servicing.
5	Motor/Stator Failure	Possible motor wiring failure. Pump motor requires servicing.

See page 5 for error codes.

10. SPECIFICATIONS AND PUMP CHARACTERISTICS:

10.1 Application:

- Maximum Operating Pressure: 145 PSI (10 bar)
- Water Temperature Range: 36º – 230ºF (-10º – 110ºC)
- Ambient Operation Temperature Range: 32º – 104ºF (0º – 40ºC). Ambient temperature should be 104ºF (40ºC) or lower when fluid temperature exceeds 194ºF (90ºC).
- Minimum static inlet pressure at pump suction to avoid damage to the bearing assembly:
- Relative Humidity: Max. 95%
- System Pressure: Up to 145 PSI (10 bar)
- Designed for closed loop heating and cooling systems pumping water or a water/glycol mixture.
- For indoor use only - employer uniquement a l'interieur.

FLUID TEMPERATURES	PSI / bar
112ºF (50ºC)	0.73 / 0.05
176ºF (80ºC)	5.80 / 0.40
230ºF (110ºC)	15.95 / 1.10

10.2 Electrical Data:

- Pump Ratings: 1 phase, 110 - 120V, 47 - 63Hz (VR3452-HY1)
  1 phase, 200 - 240V, 47 - 63Hz (VR345-HB1)
- Power Consumption (HP): ¼ HP
- Power Consumption (W): 10 - 180 W
- Rated Current (1 phase, 115V): 0.1 - 2.5 A
- Rated Current (1 phase, 230V): 0.1 - 1.5 A

10.3 Standards, Protection and Connection:

- Insulation: Class H (VR3452-HY1)
  Class F (VR3452-HB1)
- Enclosure: Class 2, IP44
- Integrated Motor Protection (electronically protected)
- UL 778, 1004-1, 508C
- CAN/CSA C22.2 #108, #100, #107.1
- EMC (89/366 EEC): EN 61000
- LVD (73/23/EC): EN 60335-1, EN 60335-2-51
- Machine Safety (98/37/EC): EN ISO 12100
- Flange Connections: Residential 2 bolt flange from 3/4" to 1½" NPT - See Freedom Flange catalog (100-7.3), Shut-off Freedom Flange catalog (100-31), and Shut-off Freedom Swivel Flange catalog (100-56) on www.taco-hvac.com. The VR3452 uses the same flanges as "00" series (exc 0012).

10.4 Materials of Construction:

- Casing: Cast Iron, Cataphoresis Coated
- Impeller: PES
- Shaft: Stainless Steel
- Bearing: Carbon

ERROR CODES		
The following codes will show up on display panel and on the appropriate Modbus registers to help you diagnose the cause of improper operation.		
Error code	**Description**	**Probable cause**
E1x	Load errors	
E10 (drY)	Low motor load	Low load detected. Pump is running dry.
E11	High motor load	Motor might be faulty or viscous medium is present.
E2x	**Protection active**	
E22 (hot)	Converter temperature limit	Circuit is too hot and power was reduced to less than 2/3 of rated power.
E23	Converter temperature protection	Circuit is too hot to run, pump stopped.
E24	Converter overcurrent	Hardware overcurrent protection triggered.
E25	Overvoltage	Line voltage is too high.
E26	Undervoltage	Line voltage is too low for proper operation.
E3x	**Pump errors**	
E31	Software motor protection active	Average motor current was too high, pump load is much higher than expected.
E4x	**Device specific error codes**	
E40	General frequency converter error	Electrical circuitry did not pass self-test.
E42 (LEd)	LED faulty	One of the display segment diodes is faulty (open/short).
E43 (con)	Communications failed	Display board does not detect proper connection to main board, but power supply is present.
E44	DC link current offset	Voltage on DC link shunt (R34) not in expected range.
E45	Motor temperature outside limits	During MFG. TEST, this is 10 kΩ, 1% resistor for 10 °C..30 °C During operation, expected values are -55 °C..150 °C.
E46	Circuit temperature outside limits	During MFG. TEST, this is 0 °C..50°C. During operation, expected values are -55 °C..150 °C.
E47	Voltage reference outside limits.	Comparison between internal references does not match.
E48	15V outside limits	15 V supply not 15 V.
E49	Test load does not match	No test load detected or current measurement does not work properly (MFG. TEST).
E5x	**Motor error codes**	
E51	Motor parameters out of range	Motor does not behave as expected.

LIMITED WARRANTY STATEMENT

Taco, Inc. will repair or replace without charge (at the company's option) any product or part which is proven defective under normal use within one (1) year from the date of start-up or one (1) year and six (6) months from date of shipment (whichever occurs first).

In order to obtain service under this warranty, it is the responsibility of the purchaser to promptly notify the local Taco stocking distributor or Taco in writing and promptly deliver the subject product or part, delivery prepaid, to the stocking distributor. For assistance on warranty returns, the purchaser may either contact the local Taco stocking distributor or Taco. If the subject product or part contains no defect as covered in this warranty, the purchaser will be billed for parts and labor charges in effect at time of factory examination and repair.

Any Taco product or part not installed or operated in conformity with Taco instructions or which has been subject to misuse, misapplication, the addition of petroleum-based fluids or certain chemical additives to the systems, or other abuse, will not be covered by this warranty.

If in doubt as to whether a particular substance is suitable for use with a Taco product or part, or for any application restrictions, consult the applicable Taco instruction sheets or contact Taco at [401-942-8000].

Taco reserves the right to provide replacement products and parts which are substantially similar in design and functionally equivalent to the defective product or part. Taco reserves the right to make changes in details of design, construction, or arrangement of materials of its products without notification.

TACO OFFERS THIS WARRANTY IN LIEU OF ALL OTHER EXPRESS WARRANTIES. ANY WARRANTY IMPLIED BY LAW INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS IS IN EFFECT ONLY FOR THE DURATION OF THE EXPRESS WARRANTY SET FORTH IN THE FIRST PARAGRAPH ABOVE.

THE ABOVE WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR STATUTORY, OR ANY OTHER WARRANTY OBLIGATION ON THE PART OF TACO.

TACO WILL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OF ITS PRODUCTS OR ANY INCIDENTAL COSTS OF REMOVING OR REPLACING DEFECTIVE PRODUCTS.

This warranty gives the purchaser specific rights, and the purchaser may have other rights which vary from state to state. Some states do not allow limitations on how long an implied warranty lasts or on the exclusion of incidental or consequential damages, so these limitations or exclusions may not apply to you.

Taco® Comfort Solutions™ A Taco Family Company
Taco, Inc., 1160 Cranston Street, Cranston, RI 02920 | Tel: (401) 942-8000 | FAX: (401) 942-2360
Taco (Canada), Ltd., 8450 Lawson Road, Suite #3, Milton, Ontario L9T 0J8 | Tel: (905) 564-9422 | FAX: (905) 564-9436
Visit our web site: www.TacoComfort.com | Printed in USA | ©2017 Taco, Inc.

INSTALLATION INSTRUCTIONS
CARE AND MAINTENANCE

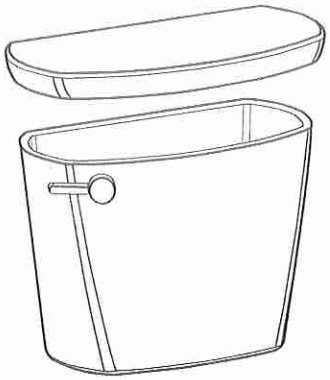
American Standard
Style That Works Better

Cadet® PRO 2-piece Toilet
Elongated and Round Front
Models 215AA, 215BA, 215AB, 215BB, 215FA, 215FC, 215CA, 215DA, 215CB, 215DB Series

Thank you for selecting American Standard - the benchmark of fine quality for over 100 years. To ensure this product is installed properly, please read these instructions carefully before you begin. (Certain installations may require professional help.) Also be sure your installation conforms to local codes.

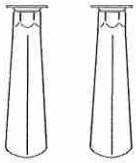
⚠ CAUTION: PRODUCT IS FRAGILE. TO AVOID BREAKAGE AND POSSIBLE INJURY HANDLE WITH CARE!
NOTE: *Pictures may not exactly define contour of china and components.*

TANK 4188A and 4188B



EZ-INSTALL KIT INCLUDED WITH TANK

Tank To Bowl Gasket

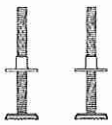


Attachment Handles with Nuts (2)

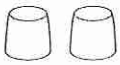
Plastic Washers (2)

BOWL 3517A, 3517C, 3517F ELONGATED
BOWL 3517B, 3517D ROUND FRONT

EZ-INSTALL KIT INCLUDED WITH BOWL



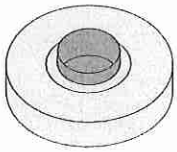
T-Bolts with Retainer (2)



Bolt Caps (2)

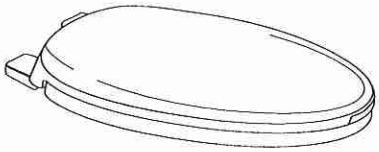
Bowl-To-Floor Knobs (2)

SOLD SEPARATELY



Wax Ring

Water Supply Line

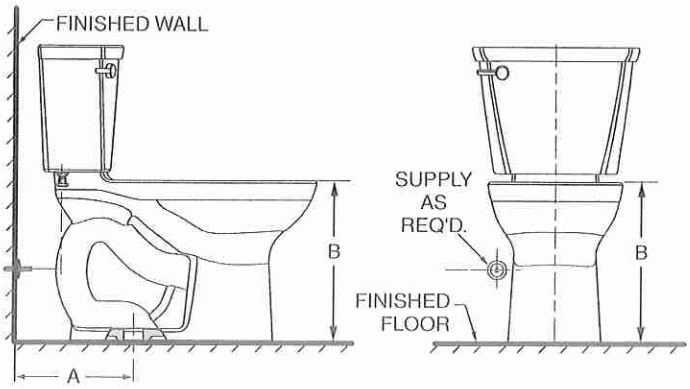


Slow Close Toilet Seat

SAVE FOR FUTURE USE

7301878-100 Rev. A

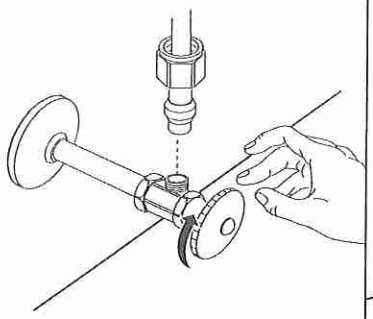
ROUGHING-IN DIMENSIONS:
NOTE: *Distance from wall to closet flange centerline must be as listed on chart under ROUGH-IN DIMENSION "A", the BOWL HEIGHT is listed as DIMENSION "B".*



BOWL SHAPE	ROUGH-IN DIM. "A"	BOWL HEIGHT DIM. "B"	COMBO MODEL	BOWL MODEL	TANK MODEL
RIGHT HEIGHT® ELONGATED	12" (305mm)	16-1/2" (419mm)	215AA	3517A	4188A
	10" (254mm)	16-1/2" (419mm)	215AB	3517A	4188B
RIGHT HEIGHT® ROUND FRONT	12" (305mm)	16-1/2" (419mm)	215BA	3517B	4188A
	10" (254mm)	16-1/2" (419mm)	215BB	3517B	4188B
COMPACT RIGHT HEIGHT® ELONGATED	12" (305mm)	16-1/2" (419mm)	215FA	3517F	4188B
	14" (356mm)	16-1/2" (419mm)	215FC	3517F	4188A
ELONGATED	12" (305mm)	15" (381mm)	215CA	3517C	4188A
	10" (254mm)	15" (381mm)	215CB	3517C	4188B
ROUND FRONT	12" (305mm)	15" (381mm)	215DA	3517D	4188A
	10" (254mm)	15" (381mm)	215DB	3517D	4188B

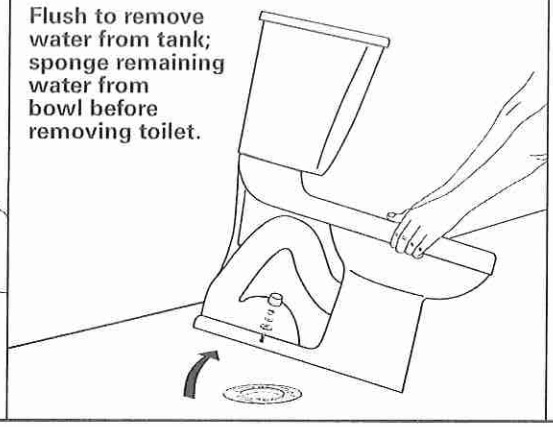
Before You Start:

Turn Off Water Supply

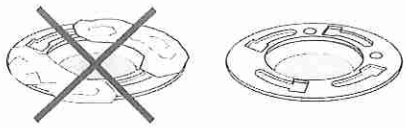


If Removing An Existing Toilet

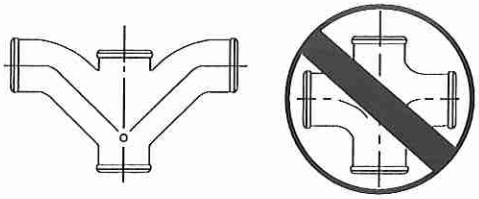
Flush to remove water from tank; sponge remaining water from bowl before removing toilet.



Clean Flange



⚠ Caution: If leaving floor flange open for more than 1-2 hours, cover flange to prevent escaping sewer gases.

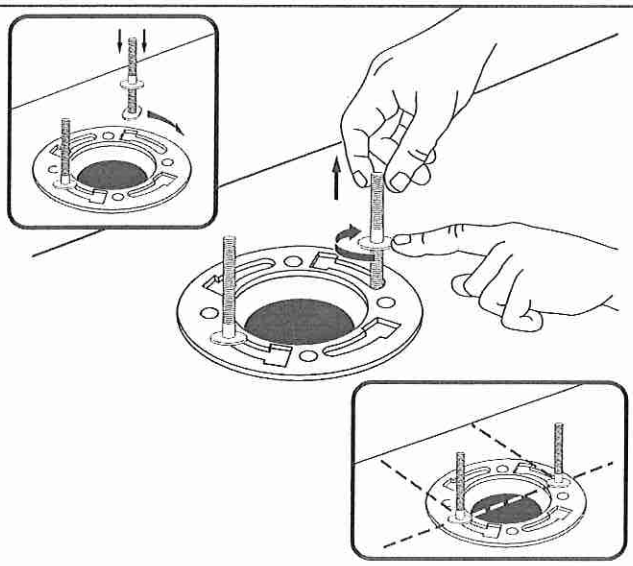


Recommended fitting type for back-to-back installations.

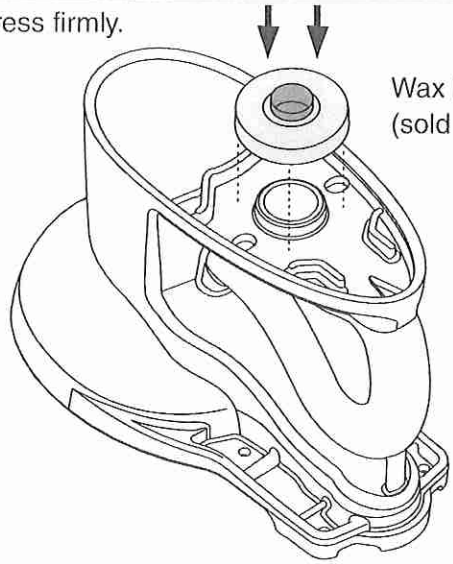
BACK-TO-BACK INSTALLATION

Depending upon your plumbing and venting conditions, the flow from the Cadet® PRO in a back-to-back installation may create a vacuum on the system and draw water from the opposing bowl. The National Standards Plumbing Code prohibits the use of a cross fitting for drainage as throw over is possible. The code does approve a directional "Y" style fitting with proper venting to direct the water downward and away from the other toilet.

1

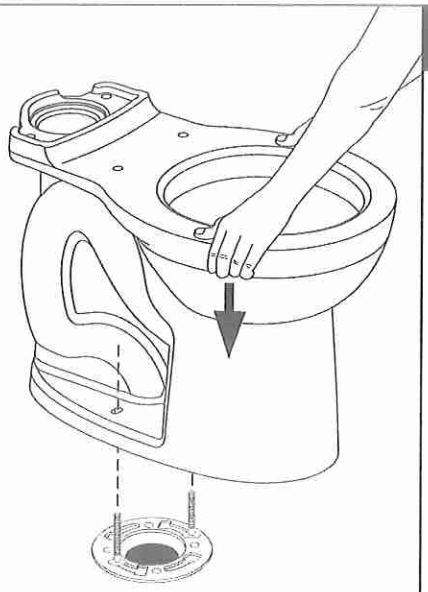


2 Press firmly.



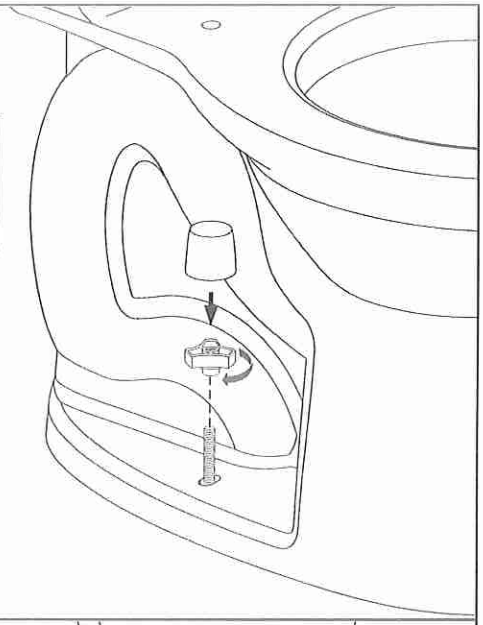
3

Apply weight evenly. Do not move after placement. Water tight seal may break.

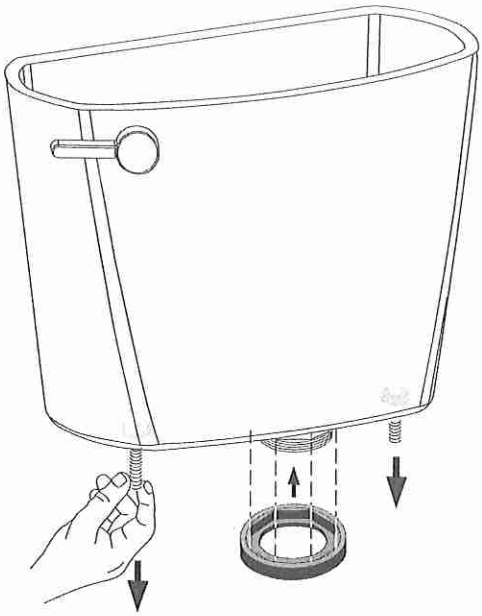


4

⚠ **Hand tighten only. Do not overtighten.**



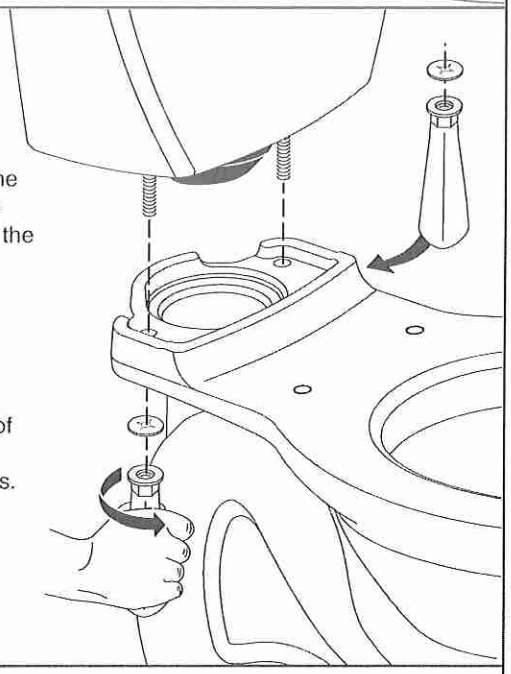
5



6

Tighten handles alternately until the tank contacts the front and back of the bowl achieving china-to-china contact.

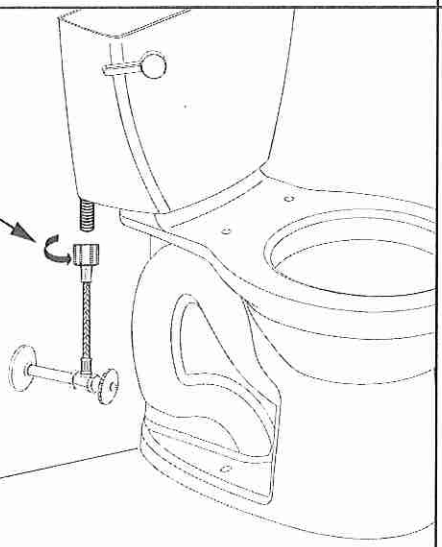
NOTE: To ease installation, push down on the top of the tank while tightening handles.



7

Ⓐ Connect water supply line. (Sold separately) Hand tighten nut.

Ⓑ Turn on water supply.



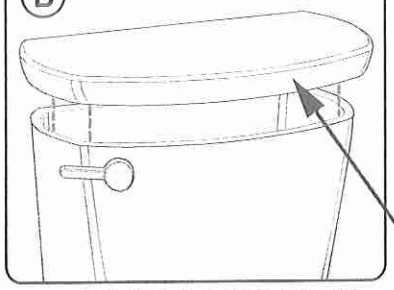
⚠ **WARNING:** Overtightening of water supply line nuts could result in breakage and potential flooding. If the connection leaks after hand tightening, replace the supply line. Do not use any type of sealant on the water supply connection. Use of plumber's putty, pipe dope, or any other type of sealant will void the warranty.

8

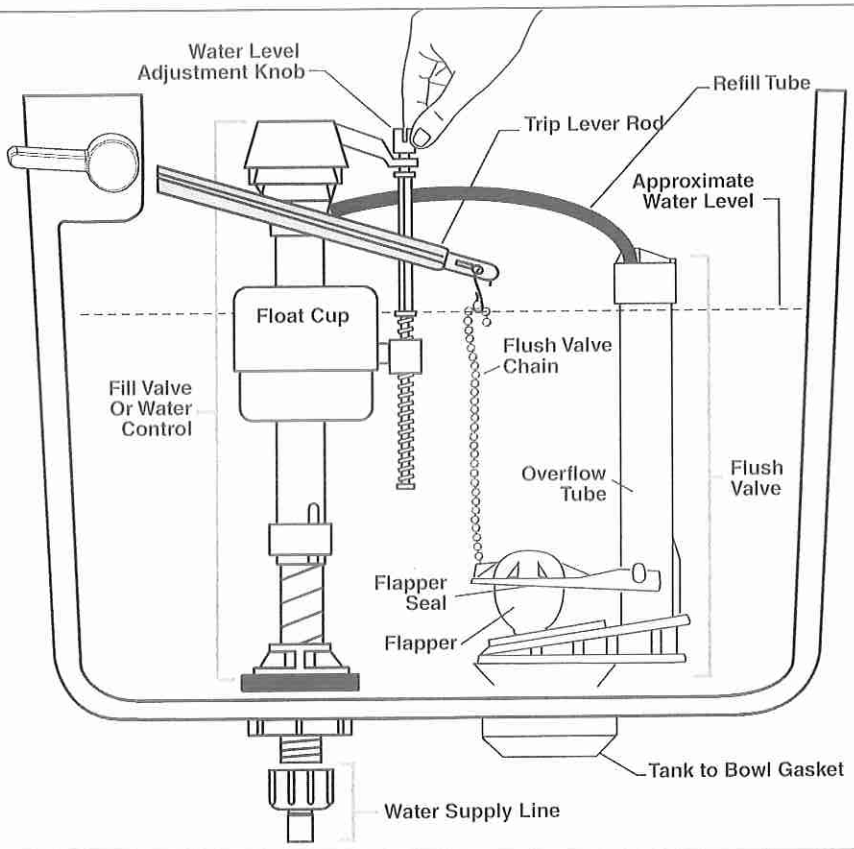
A

Adjust water level to level indicated on tank by turning water level adjustment knob to move float cup up or down.

B



REPAIR PARTS LABEL LOCATED UNDER TANK LID.



CARE AND CLEANING

When cleaning your toilet, wash it with mild, soapy water, rinse thoroughly with clear water and dry with a soft cloth.
WARNING: Do not use in-tank cleaners. These products can seriously corrode fittings in the tank. This damage can cause leakage and property damage. American Standard shall not be responsible or liable for any damage caused by the use of in-tank cleaners.

TROUBLESHOOTING GUIDE - See Step 8 For Diagram

Problem	Possible Cause	Corrective Action
Does not flush	a. Water supply valve closed. b. Supply line blocked. c. Flush valve chain too loose or disconnected. d. Sand or debris lodged in water control.	a. Open valve and allow water to fill tank. b. Shut off water supply, disconnect supply line and inspect all gaskets and washers. Reassemble. c. Readjust chain length as required. d. Shut off water supply. Remove cap and clean as per Fluidmaster maintenance instructions at: www.americanstandard-us.com/enews/fluidmasterguide.pdf
Poor or sluggish flush	a. Bowl water level too low. b. Supply valve partly closed. c. Partially clogged trapway and/or drain pipe and/or vent. d. Supply pressure too low.	a. Check that refill tube is connected to water control and inserted into overflow tube without being kinked or damaged. b. Open supply valve fully. Be sure that proper supply tube size is used. c. Remove obstruction. Consult a plumber if necessary. d. Normal supply pressure must be at least 20 psi.
Toilet leaks	a. Poor supply line connection. b. Poor bowl to tank/floor connection.	a. Review Step 7 of installation procedure. b. Review Step 1 through 6 of installation procedure.
Toilet does not shut off	a. Flapper seal leaking or deformed. b. Sand or debris lodged in water control. c. Flush valve chain too tight, holding flapper open.	a. Clean debris from seal surface. Replace flapper seal as needed. See web for more info. b. Shut off water supply. Remove cap and clean as per Fluidmaster maintenance instructions at: www.americanstandard-us.com/enews/fluidmasterguide.pdf c. Readjust chain length as needed.
Toilet bowl rocks after installation	a. Wax ring not fully compressed. b. Floor not level.	a. Retighten bowl-to-floor knobs. b. Use toilet shims and /or place a bead of caulk around the base of the toilet.

FOR REPAIR PARTS LIST, SEE LABEL UNDER TANK LID.

In the United States:
American Standard Brands
P.O. Box 6820
Piscataway, New Jersey 08855
Attention: Director of Customer Care
For residents of the United States, warranty information may also be obtained by calling the following toll free number: (800) 442-1902
www.americanstandard.com

In Canada:
AS Canada, ULC
5900 Avebury Rd.
Mississauga, Ontario
Canada L5R 3M3
Toll Free: (800) 387-0369
www.americanstandard.ca

In Mexico:
American Standard B&K Mexico
S. de R.L. de C.V.
Via Morelos #330
Col. Santa Clara
Ecatepec 55540 Edo. Mexico
Toll Free: 01-800-839-1200
www.americanstandard.com.mx

REPAIR PARTS LIST

Repair parts are determined by toilet tank number which can be found marked inside tank.

NOTE: *"XXX" represents color or trim finish options. Specify when ordering.*

PART NO.	DESCRIPTION
7381231-200.XXX0A	Cadet® PRO LH Trip Lever
7381231-201.XXX0A	Cadet® PRO RH Trip Lever
7381146-407.0070A	Flush Valve Assembly
738570-1000A	Refill Tube
7381251-200.XXX0A	EZ-Install Bolt Cap Kit
7381253-201.0070A	EZ-Install Tank to Bowl Kit
738565-462.0070A	Cadet® PRO Fluidmaster 400A Valve
735172-400.XXX	Cadet® PRO Tank Cover

⚠ WARNING:

Use of in tank cleaning products voids warranty as they may damage parts and cause leakage that may lead to property damage.

7301906-100

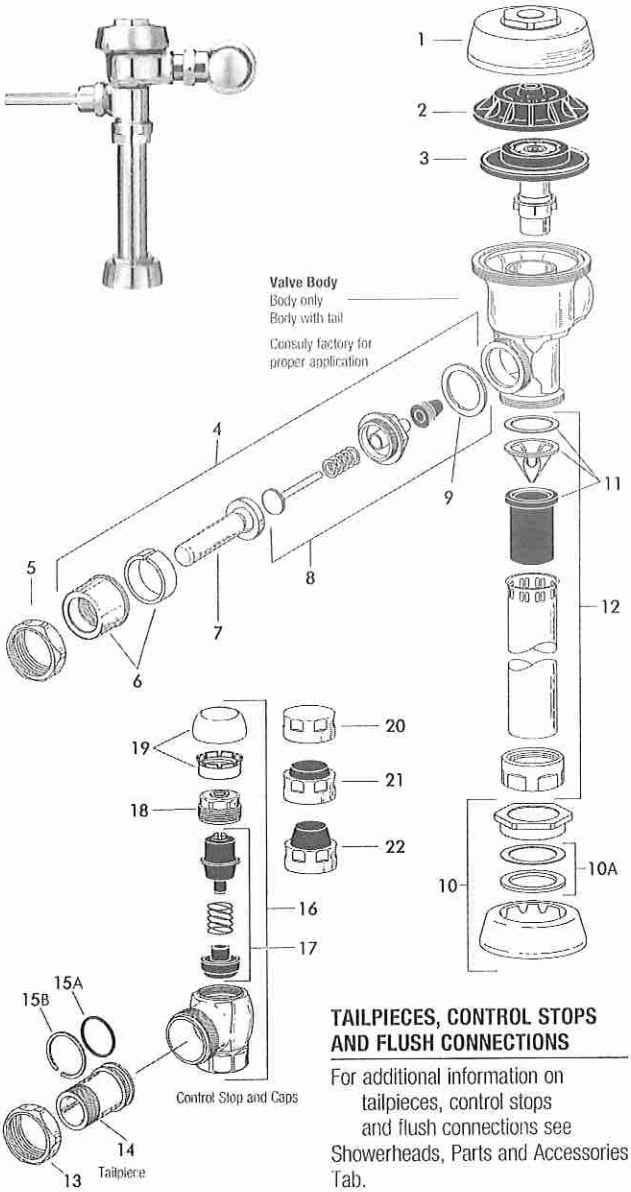
FOR FURTHER ASSISTANCE PLEASE CALL:

In the USA **(800) 442-1902** or **www.americanstandard-us.com**

In Canada **(800) 387-0369** or **www.americanstandard.ca**

7301906-100

Royal® Flushometer



TAILPIECES, CONTROL STOPS AND FLUSH CONNECTIONS

For additional information on tailpieces, control stops and flush connections see Showerheads, Parts and Accessories Tab.

ITEM 10A. SLIP JOINT GASKETS AND RINGS

Size	Code No.	Part No.	Description
1-1/2"	5306058	F-3	Red Friction Ring
	5322001	VBF-5	Black Slip Joint Gasket
	0319086/5319086	S-30	Flexible Seat
	0319079	S-21	Rigid Seat (rubber over brass)
1-1/2" x 1-1/4"	0396062	F-105	Slip Joint Gasket – Rigid
1-1/4"	5306057	F-3	Red Friction Ring
	5322176	VBF-5	Black Slip Joint Gasket
	0307052/5307052	G-21	Rigid Seat (rubber over brass)
1"	5306056	F-3	Red Friction Ring
	5306115	F-5	Black Slip Joint Gasket
3/4"	5306055	F-3	Red Friction Ring
	5306113	F-5	Black Slip Joint Gasket

* See pages 102-103 for additional lengths
† For use with 1" and 3/4" H-700-A and 1" H-600-A Bak-Chek® screwdriver control stop
‡ For use with 3/4" H-600-A Bak-Chek® screwdriver control stop
RW for use with Reclaimed Water Flushometers

Sloan products are also available in satin, brushed nickel, chrome, gold and polished brass finishes – contact factory for part numbers.

PARTS LIST

Item No.	Code No.	Part No.	Description
1.	0301172PK	A-72	CP Cover
	0301435PK	A-72-HE	CP High Efficiency Cover
2.	0301168	A-71	Inside Cover
	0301336	A-71-1	Inside Cover (Purple)
3.	—		Dual-Filtered Bypass Diaphragm Assembly (refer to table and diagram on following page)
4.	0302390	B-73-A	CP ADA-Compliant Triple Seal Handle Assembly
	0302267	B-73-A-PH	CP ADA-Compliant Triple Seal Handle Assembly
5.	0301082	A-6	CP Handle Coupling
6.	0302109	B-7-A	CP Socket Assembly
7.	0302389	B-74-A	CP ADA-Compliant Handle
	0302264	B-74-A-PH	CP ADA-Compliant Handle (Purple Handle)
8.	3302306	B-51-A	Triple Seal Handle Repair Kit
9.	5301139	A-31	Handle Gasket – 48 per package
10.	0306125	F-5-AW	3/4" (19 mm) CP Spud Coupling Assembly
	0306140	F-5-AU	1-1/4" (32 mm) CP Spud Coupling Assembly
	0306146	F-5-AT	1-1/2" (38 mm) CP Spud Coupling Assembly
10A.	SEE SLIP JOINT GASKETS AND RINGS TABLE BELOW LEFT		
11.	3323182	V-651-A	High Back Pressure Vacuum Breaker Repair Kit
12.	3393004	V-600-AA	3/4" (19 mm) x 9" (228 mm) CP Vacuum Breaker
	3393006	V-600-AA	1-1/4" (32 mm) x 9" (228 mm) CP Vacuum Breaker
	3393007	V-600-AA	1-1/2" (38 mm) x 9" (228 mm) CP Vacuum Breaker
13.	0308676	H-550	CP Stop Coupling
14.	0308801	H-551-A	CP Adjustable Tailpiece 2-1/16" (52 mm long) Standard Length*
15A.	5308696	H-553	O-ring – 24 per package
15B.	5308381	H-552	Locking Ring – 12 per package
16.	3308386	H-700-A	1" (25 mm) CP Bak-Chek® Screwdriver Stop
	0388141	H-700-A-RW	1" (25 mm) CP Bak-Chek® Screwdriver Stop
	3308384	H-700-A	3/4" (19 mm) CP Bak-Chek® Screwdriver Stop
	0388142	H-700-A-RW	3/4" (19 mm) CP Bak-Chek® Screwdriver Stop
17.	3308853	H-541-ASD	Control Stop Repair Kit †
	3308856	H-543-ASD	Control Stop Repair Kit †
18.	0308612	H-622	CP Bonnet †
	0308892	H-608-RW	CP Bonnet †
	0308843	H-577	CP Bonnet DISCONTINUED
19.	3308772	H-1010-A	Vandal Resistant Control Stop Cap Assembly †
	3308790	H-1009-A	Vandal Resistant Control Stop Cap Assembly † H-600 3/4" Stop only
20.	0308738	H-573	Control Stop Cap CP †
	0308848	H-582	Control Stop Cap CP ‡
21.	3308866	H-574	Control Stop Cap with Bumper † (–YO Variation)
22.	3308867	H-576	Control Stop Cap with Extended Bumper † (–YG Variation)
23.	3388015	H-1015	Flow Control Kit (not Shown) (HEU Only)
24.	3308735	H-634-AA-RW	1" (25 mm) Sweat Solder Kit w/ Cast Set Screw Purple Flange (not shown)
	3308736	H-636-AA-RW	3/4" (19 mm) Sweat Solder Kit w/ Cast Set Screw Flange (not shown)
	3308785	H-636-AA	1" (25 mm) Sweat Solder Kit w/ Cast Set Screw Purple Flange (not shown)
	3308788	H-636-AA	3/4" (19 mm) Sweat Solder Kit w/ Cast Set Screw Flange (not shown)

Royal® Flushometer

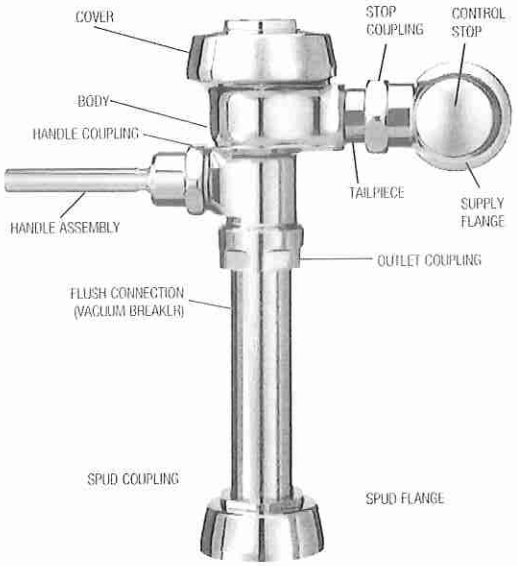
DUAL-FILTERED DIAPHRAGM ASSEMBLY

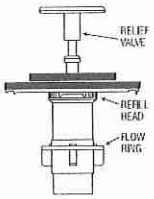
Available in diaphragm only and Royal® Performance™ Kits.

Royal® Performance™ Kit includes dual-filtered diaphragm assembly (item 3), handle repair kit with triple seal packing (item 8), high back pressure vacuum breaker repair kit (item 11), and one tailpiece O-ring (item 15A). DIAPHRAGM ONLY KIT contains "drop-in" dual-filtered diaphragm assembly (item 3) ONLY.

The dual-filtered diaphragm can be used in Royal,® Regal,® and similar diaphragm-style valve bodies. For use in Sloan valve bodies with a bell-shaped cover (manufactured before 1964), replace the bottom filter ring in these kits with a blue A-108 filter ring (not shown Sloan Code No. **5301283**).

NOTE: In January 1998, the Royal® diaphragm design was upgraded to a preassembled unit with two (2) plastic filtering rings attached to the rubber diaphragm (one on top and one on bottom). If the flushometer you are servicing has our older, segmented diaphragm with brass by-pass hole, refer to our Regal section for additional troubleshooting information.





The colors of the relief valve and the refill head plus the shape of flow ring identify the flush volume of a DUAL-FILTERED DIAPHRAGM ASSEMBLY.

ROYAL® PERFORMANCE KIT

Code No.	Part No.	Description	Relief Valve†	Refill Head*	Flow Ring
3301070	A-1101-A	Low Consumption Water Closets-1.6 gpf (6.0 Lpf)**	Green	Gray	Smooth
3301071	A-1102-A	Water Saver Water Closets-3.5 gpf (13.2 Lpf)**	White	Gray	Smooth
3301072	A-1103-A	9 Liter European Water Closets-2.4 gpf (9.0 Lpf)	Blue	Gray	Smooth
3301073	A-1106-A	Wash Down Urinals-0.5 gpf (1.9 Lpf)	Green	Black	Smooth
3301074	A-1107-A	Low Consumption Urinals-1.0 gpf (3.8 Lpf)**	Green	Black	Slotted
3301075	A-1108-A	Water Saver Urinals-1.5 gpf (5.7 Lpf)**	Black	Black	Smooth

*Closet refill heads (gray) have larger slots than urinal refill heads (black).

DIAPHRAGM ONLY KIT

Code No.	Part No.	Description	Relief Valve†	Refill Head*	Flow Ring
3301502	A-1041-A	Low Consumption Water Closets-1.6 gpf (6.0 Lpf)**	Green	Gray	Smooth
3301501	A-1038-A	Water Saver Water Closets-3.5 gpf (13.2 Lpf)**	White	Gray	Smooth
3301505	A-1044-A	9 Liter European Water Closets-2.4 gpf (9.0 Lpf)	Blue	Gray	Smooth
3301504	A-1043-A	Wash Down Urinals-0.5 gpf (1.9 Lpf)	Green	Black	Smooth
3301503	A-1042-A	Low Consumption Urinals-1.0 gpf (3.8 Lpf)**	Green	Black	Slotted
3301500	A-1037-A	Water Saver Urinals-1.5 gpf (5.7 Lpf)**	Black	Black	Smooth
3301506	A-1045-A	High-Efficiency Water Closets-1.28 gpf (4.8 Lpf)	Blue	Gray	Smooth
3301142	A-1047-A	High-Efficiency Urinals-0.25 gpf (1.0 Lpf) with White Inserts	White	HEU Black	Smooth
3301143	A-1050-A	High-Efficiency Urinals-0.125 gpf (0.5 Lpf) with White Inserts	Blue	HEU Black	Smooth
3301594	A-1075-A-BX	High-Efficiency Water Closets-1.28 gpf (4.8 Lpf) RW	Blue	Black	Smooth
3301592	A-1073-A-BX	High-Efficiency Urinals-0.5 gpf (1.9 Lpf) RW	Green	Black	Smooth + Slotted
3301591	A-1077-A-BX	High-Efficiency Urinals-0.25 gpf (1.0 Lpf) RW	White	HEU Black	Smooth
3301590	A-1070-A-BX	High-Efficiency Urinals-0.125 gpf (0.5 Lpf) RW	Blue	HEU Black	Smooth

† Consult factory for availability of replacement plastic relief valves (green, black, blue, and white) and brass relief valves.
NOTE: For older water closets that require 4.5 gpf (17.0 Lpf), choose kits A-1102-A or A-1038-A, but remove the flow ring before use. For blowout-style urinals that require 3.5 gpf (13.2 Lpf), choose kits A-1102-A or A-1038-A. For service sinks that require 6.5 gpf (24.6 Lpf), order A-36-A diaphragm repair kit (not shown Sloan Code No. **3301036**) and remove the flow ring before use. Regulations for low consumption fixtures prohibit the use of higher flush volumes.

*Closet refill heads (gray) have larger slots than urinal refill heads (black).

** Water Saver (3.5 gpf closet and 1.5 gpf urinal) and Low Consumption (1.6 gpf closet and 1.0 gpf urinal) fixtures must use matching gpf (Lpf) diaphragm kits; using a smaller gpf (Lpf) kit in fixtures not intended for less volume will result in inadequate dilution in urinals and improper evacuation in closets.

RW for use with Reclaimed Water Flushometers.

Royal® Flushometer

TROUBLESHOOTING GUIDE

ATTENTION INSTALLERS: With the exception of the control stop inlet, **DO NOT USE** pipe sealant or plumbing grease on any valve component or coupling! To protect the chrome or special finish of Sloan flushometers, **DO NOT USE** toothed tools to install or service these valves. Use our A-50 Super-Wrench or other smooth-jawed wrench to secure couplings. Regulations for low consumption fixtures (1.6 gpf/6.0 Lpf closets and 1.0 gpf/3.8 Lpf urinals) prohibit use of higher flush volumes.

1. **Flushometer does not function (no flush).**
   - A. Control stop or main supply valve is closed. Open control stop or main supply valve.
   - B. Handle assembly is damaged. Replace B-73-A handle or repair with B-51-A handle repair kit.
   - C. Relief valve is damaged. Replace relief valve.
2. **Handle leaks.**
   - A. Handle seal or handle assembly is damaged. Replace B-73-A handle or repair with B-51-A handle repair kit.
3. **Water splashes from fixture.**
   - A. Control stop is open wider than necessary. Adjust control stop for desired delivery of water volume.
   - B. Water saver/conventional diaphragm assembly is installed on low consumption fixture or closet diaphragm assembly is installed on urinal fixture. Determine the required flush volume (see label on valve or markings on fixture). Replace diaphragm assembly or relief valve for appropriate flush volume of fixture.
4. **Volume of water is insufficient to adequately siphon fixture.**
   - A. Control stop is not open wide enough. Adjust control stop for desired delivery of water volume.
   - B. Diaphragm assembly is damaged. Replace diaphragm assembly.
   - C. Low consumption diaphragm assembly is installed on water saver/conventional fixture or urinal diaphragm assembly is installed on closet fixture. Determine the required flush volume (see label on valve or markings on fixture). Replace diaphragm assembly or relief valve for appropriate flush volume of fixture.
   - D. Inadequate water volume or pressure is available from supply. Increase flow rate or pressure to the valve. If gauges are not available to measure supply pressure/volume, remove relief valve from diaphragm assembly and open the control stop.

     If the fixture siphons: Additional water volume is required. Install higher flushing volume relief valve or diaphragm assembly or cut flow ring from guide. **IMPORTANT: LAWS AND REGULATIONS PROHIBIT THE USE OF HIGHER FLUSHING VOLUMES THAN LISTED ON FIXTURE OR FLUSHOMETER.**

     If the fixture **DOES NOT** siphon (or a low consumption flush is required): Additional steps must be taken to increase the water pressure and/or volume at the water supply. Contact fixture manufacturer for minimum supply requirements of fixture.
5. **Flushometer valve closes immediately (short flush).**
   - A. Worn or damaged diaphragm assembly. Replace diaphragm assembly.
   - B. Handle assembly is damaged. Replace B-73-A handle or repair with B-51-A handle repair kit.
   - C. Low consumption diaphragm assembly is installed on water saver/conventional fixture or urinal diaphragm assembly is installed on closet fixture. Determine the required flush volume (see label on valve or markings on fixture). Replace relief valve or diaphragm assembly for appropriate flush volume of fixture.
6. **Length of flush is too long (long flush) or fails to shut off.**
   - A. Bypass hole (upper filter ring) of diaphragm assembly is dirty. Remove the diaphragm assembly. Disassemble the filter rings from the diaphragm, wash under running water, and reassemble. Replace as necessary.
   - B. Relief valve or diaphragm assembly is damaged. Replace relief valve or diaphragm assembly.
   - C. Water saver/conventional diaphragm assembly is installed on low consumption fixture or closet diaphragm assembly is installed on urinal fixture. Determine the required flush volume (see label on valve or markings on fixture). Replace diaphragm assembly or relief valve for appropriate flush volume of fixture.
   - D. Inside cover is damaged. Install new A-71 part.
   - E. Line water pressure dropped and is insufficient to close valve. Close the control stop until pressure is restored.
   - F. Relief valve is not seated properly. Disassemble diaphragm components (relief valve, filter rings, and diaphragm unit), wash under running water, and reassemble. Replace as necessary.
7. **Chattering noise is heard during flush.**
   - A. Inside cover is damaged. Install new A-71 part.
   - B. Relief valve or diaphragm assembly is damaged. Replace relief valve or diaphragm assembly.

CARE AND CLEANING INSTRUCTIONS

DO NOT USE abrasive or chemical cleaners to clean flushometers that may dull the luster and attack the chrome or decorative finish. Use **ONLY** mild soap and water, then wipe dry with a clean towel or cloth. When cleaning the bathroom tile, protect the flushometer from any splattering of cleaner. Acids and cleaning fluids can discolor or remove chrome plating.

When assistance is required, please contact Sloan Technical Support at: 1-888-SLOAN-14 (1-888-756-2614).

DELTA COMMERCIAL

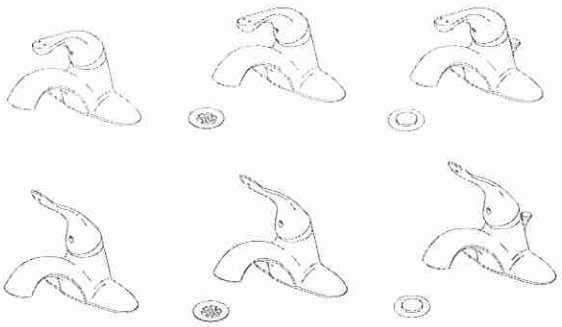
73420

SINGLE HANDLE LAVATORY CENTERSET FAUCETS

LLAVES MONOCONTROL DE MONTURA DE CENTRO PARA LAVAMANOS

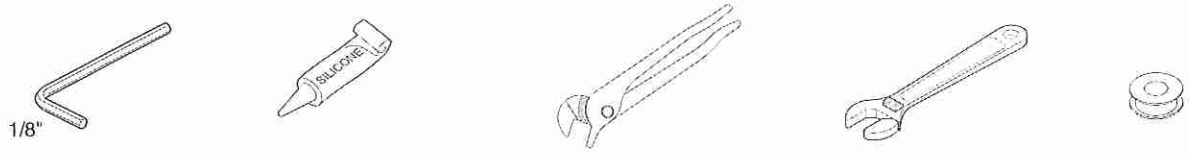
ROBINETS À ENTRAXE COURT À UNE POIGNÉE

Models/Modelos/Modèles
501LF-HDF, 511LF-HDF, 515LF-HDF,
516LF-HDF, 520LF-HDF & 523LF-HDF
Series/Series/Seria



Write purchased model number here.
Escriba aquí el número del modelo comprado.
Inscrivez le numéro de modèle ici.

You may need/Usted puede necesitar/ Articles dont vous pouvez avoir besoin:



For easy installation of your Delta faucet you will need:

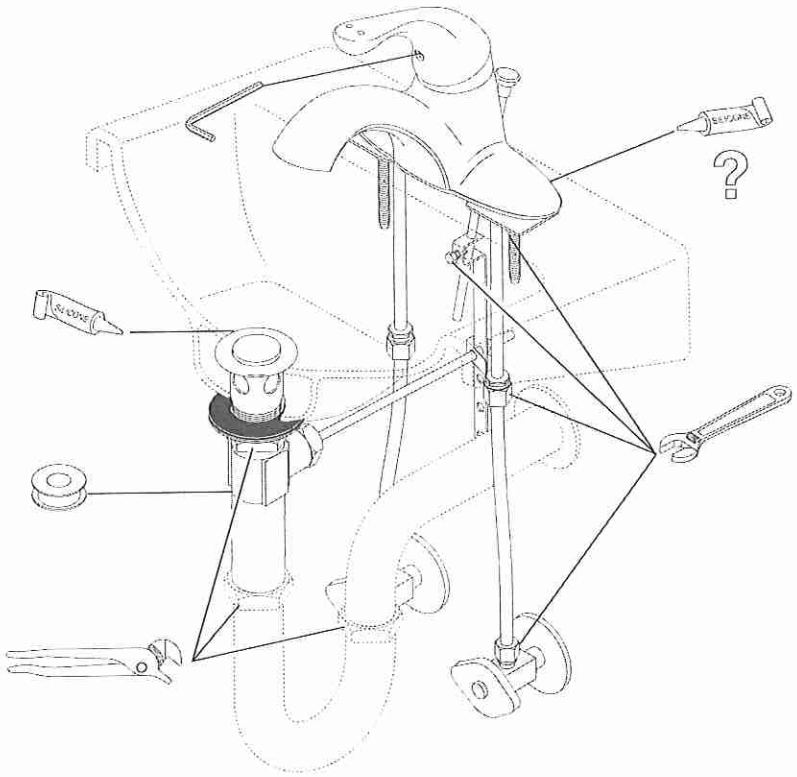
- To **READ ALL** the instructions completely before beginning.
- To **READ ALL** warnings, care, and maintenance information.
- To purchase the correct **water supply hook-up.**

Para instalación fácil de su llave Delta usted necesitará:

- **LEER TODAS** las instrucciones completamente antes de empezar.
- **LEER TODOS** los avisos, cuidados, e información de mantenimiento.
- Comprar las conexiones correctas para el **suministro de agua**.

Pour installer votre robinet Delta facilement, vous devez:

- **LIRE TOUTES** les instructions avant de débuter;
- **LIRE TOUS** les avertissements ainsi que toutes
- Acheter le bon nécessaire de raccordement.



Delta Commercial Faucet Limited Warranty

All parts of the Delta® HDF® and TECK® faucets are warranted to the original consumer purchaser to be free from defects in material, finish and workmanship for a period of five (5) years unless otherwise specifically stated in the catalogue and price book. This warranty is made to the original consumer purchaser and shall be effective from date of purchase as shown on purchaser's receipt.

Delta will, at its option, repair or replace, FREE OF CHARGE, during the warranty period, any part which proves defective in material or workmanship under normal installation, use and water and service conditions. If Delta Faucet concludes that the returned part was manufactured by Delta Faucet and is, in fact, defective, then Delta Faucet will honour the warranty stated herein. Replacement parts can be obtained from your local dealer or distributor listed in the telephone directory or by returning the part along with the purchaser's receipt to our factory, TRANSPORTATION CHARGES PREPAID, at the address listed. THIS WARRANTY IS THE ONLY EXPRESS WARRANTY MADE BY DELTA. ANY CLAIMS MADE UNDER THIS WARRANTY MUST BE MADE DURING THE FIVE YEAR PERIOD REFERRED TO ABOVE. ANY IMPLIED WARRANTIES, INCLUDING THE IMPLIED WARRANTY OF MERCHANTABILITY OF FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO THE DURATION OF THIS WARRANTY. LABOUR CHARGES AND/OR DAMAGE INCURRED IN INSTALLATION, REPAIR OR REPLACEMENT AS WELL AS INCIDENTAL AND CONSEQUENTIAL, SPECIAL, INDIRECT OR PUNITIVE DAMAGES CONNECTED THEREWITH ARE EXCLUDED AND WILL NOT BE PAID BY DELTA FAUCET.

Some states do not allow limitations on how long an implied warranty lasts, or the exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

This warranty is for commercial products only from Delta Faucet Company and Delta Faucet Canada and is void for any damage to this faucet due to misuse, abuse, neglect, accident, improper installation, any use in violation of instructions furnished by Delta Faucet or any use of replacement parts other than genuine Delta parts.

Garantía Limitada de las Llaves de Agua Comerciales Delta

Todas las piezas de las llaves de agua (grifos) Delta®, HDF®, TECK® están garantizadas al comprador consumidor original de estar libres de defectos de material, acabado y fabricación por un período de cinco (5) años a menos que sea establecido específicamente de otra manera en el catálogo o libro de precios. Esta garantía se le hace al comprador consumidor original y será efectiva desde la fecha de compra como mostrado en el recibo del comprador.

Delta, a su opción, reparará o reemplazará, GRATISMENTE, durante el período de garantía, cualquier pieza que pruebe ser defectuosa en material o fabricación bajo instalación, uso, agua y condiciones de servicio normales. Si Delta Faucet concluye que la pieza devuelta fue fabricada por Delta Faucet y es, de hecho, defectiva, entonces Delta Faucet honrará la garantía establecida en este documento.

Las piezas de repuesto se pueden obtener de su comerciante o distribuidor local listado en el libreto telefónico o devolviendo la pieza junto con el recibo del comprador a nuestra fábrica, CARGOS DE TRANSPORTE PRE-PAGADOS, a la dirección incluida. ESTA GARANTÍA ES LA ÚNICA GARANTÍA EXPRESA HECHA POR DELTA. CUALQUIER RECLAMO HECHO BAJO ESTA GARANTÍA DEBE SER HECHO DURANTE EL PERÍODO DE CINCO AÑOS ARRIBA MENCIONADO. CUALQUIER GARANTÍA IMPLÍCITA, INCLUYENDO LA GARANTÍA INPLICITA DE COMERCIABILIDAD DE EMPLEO PARA UN PROPÓSITO PARTICULAR, TIENE UNA DURACIÓN LIMITADA A LA DURACIÓN DE ESTA GARANTÍA. LOS CARGOS DE LABOR Y/O DAÑO INCURRIDO DURANTE LA INSTALACIÓN, REPARACIÓN O REPUESTO COMO TAMBIÉN DAÑOS INCIDENTALES O RESULTANTES, ESPECIALES, INDIRECTOS O PUNITIVOS RELACIONADOS CON LO MENCIONADO SON EXCLUIDOS Y NO SERÁN PAGADOS POR DELTA FAUCET.

Algunos estados no permiten limitaciones de la duración de una garantía implícita limitada, o la exclusión o limitación de daños incidentales o consecuentes, de manera que las limitaciones o exclusiones arriba mencionadas puedan no aplicarle a usted. Esta garantía le da derechos legales específicos, y usted también puede tener otros derechos que varían de estado a estado.

Esta garantía es solo para productos comerciales de Delta Faucet Company y Delta Faucet Canada y es nula por cualquier daño hecho a esta llave de agua resultante del mal uso, abuso, descuido, accidente, instalación incorrecta, cualquier uso en violación de las instrucciones proporcionadas por Delta Faucet o cualquier uso de piezas de repuesto que no sean de piezas genuinas de Delta.

Garantie Limitee Delta Commercial

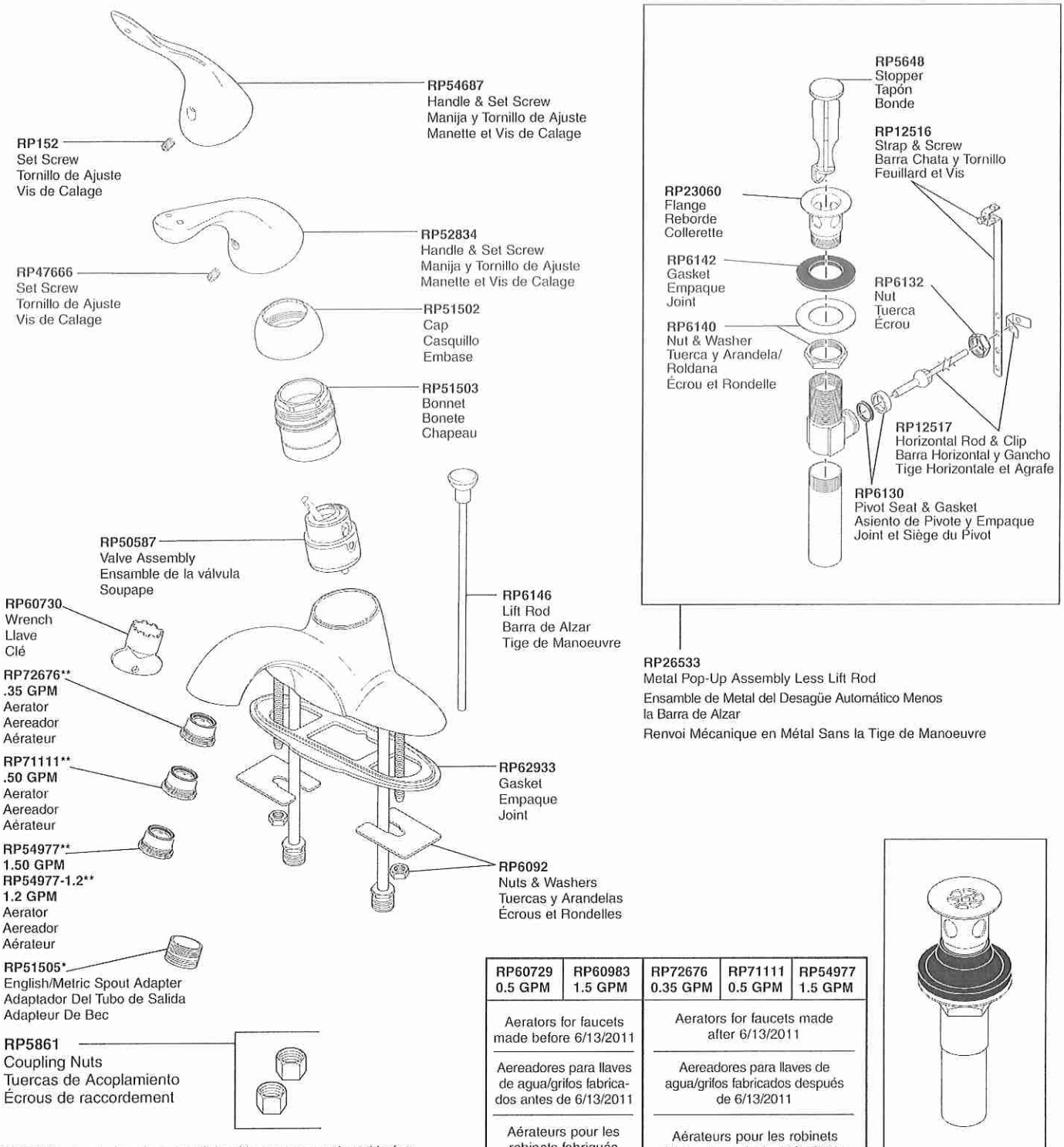
Toutes les pièces des robinets de marque Delta® HDF® et TECK® sont garanties contre tout défaut de matière, de finition et de main d'oeuvre pour une période de cinq (5) ans, sauf indication contraire stipulée dans le catalogue et la liste des prix. Cette garantie est offerte à l'acheteur original et entre en vigueur à compter de la date d'achat indiquée sur la preuve d'achat.

Delta procédera, à son entière discrétion, à la réparation ou au remplacement, SANS FRAIS, durant la période de garantie, de toute pièce qui présente un défaut de matière ou de main d'oeuvre dans des conditions d'installation, d'usure, d'eau et de service normales. Si Delta Faucet détermine que la pièce retournée a été fabriquée par Delta Faucet et qu'en effet, cette pièce fait défaut, Delta Faucet respectera alors la garantie stipulée aux présentes. Les pièces de rechange peuvent être obtenues chez votre marchand local ou le distributeur inscrit dans votre annuaire téléphonique ou en retournant la pièce ainsi que la preuve d'achat à notre usine, FRAIS DE TRANSPORT PRÉPAYÉS, à l'adresse indiquée. CETTE GARANTIE EST LA SEULE GARANTIE EXPRESSE FAITE PAR DELTA.

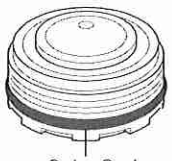
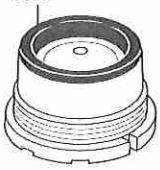
TOUTE RÉCLAMATION FAITE EN VERTU DE CETTE GARANTIE DOIT ÊTRE PRÉSENTÉE DURANT LA PÉRIODE DE CINQ ANS MENTIONNÉE CI-DESSUS. TOUTE GARANTIE IMPLICITE, Y COMPRIS LA GARANTIE IMPLICITE DE VALEUR COMMERCIALE RELATIVEMENT À L'APTITUDE À LA FONCTION, EST LIMITÉE EN TERMES DE DURÉE POUR LA DURÉE DE CETTE GARANTIE. LES FRAIS DE MAIN D'OEUVRE ET/OU DE DOMMAGES ENCOURUS DURANT L'INSTALLATION, LA RÉPARATION OU LE REMPLACEMENT AINSI QUE LES DOMMAGES-INTÉRÊTS ACCESSOIRES OU IMMATÉRIELS, SPÉCIAUX, INDIRECTS OU PUNITIFS S'Y RAPPORTANT SONT EXCLUS ET NE SERONT PAS PAYÉES PAR DELTA FAUCET.

Certains états ne permettent pas la limitation de la durée de la garantie implicite, ou l'exclusion ou la limitation des dommages-intérêts accessoires ou immatériels, et par conséquent, les limitations ou les exclusions stipulées ci-dessus peuvent ne pas s'appliquer dans votre cas. Cette garantie vous accorde certains droits reconnus par la loi et vous avez peut-être aussi d'autres droits qui varient d'un état à l'autre.

Cette garantie s'applique seulement aux produits commerciaux des sociétés Delta Faucet et Delta Faucet Canada et est nulle de plein droit pour tout dommage causé à ce robinet en raison d'usage excessif, d'abus, de négligence, d'accident, de mauvaise installation, tout usage en contravention des directives fournies par Delta Faucet ou tout usage de pièces de rechange autres que des pièces originales Delta.



RP26533
Metal Pop-Up Assembly Less Lift Rod
Ensamble de Metal del Desagüe Automático Menos la Barra de Alzar
Renvoi Mécanique en Métal Sans la Tige de Manoeuvre

RP60729 0.5 GPM	RP60983 1.5 GPM	RP72676 0.35 GPM	RP71111 0.5 GPM	RP54977 1.5 GPM
Aerators for faucets made before 6/13/2011		Aerators for faucets made after 6/13/2011		
Aereadores para llaves de agua/grifos fabricados antes de 6/13/2011		Aereadores para llaves de agua/grifos fabricados después de 6/13/2011		
Aérateurs pour les robinets fabriqués avant le 13/06/2011		Aérateurs pour les robinets fabriqués après le 13/06/2011		
 O-ring Seal Anillos "O" Joints Torique		 Gasket Seal Empaque Joint		

RP6346
Grid Strainer
Tamiz de la rejilla
Tamis de grille

*RP51505 adapter is only compatible with aerators produced before 6/13/2011.

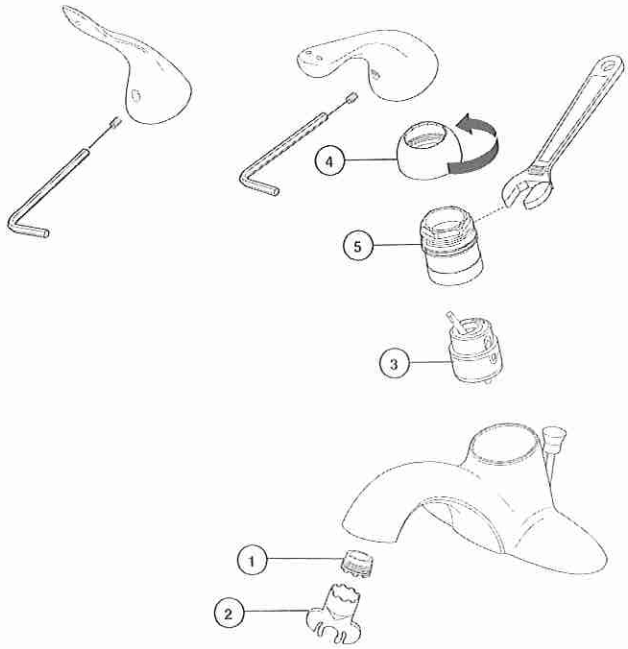
Adaptador *RP51505 solo es compatible con aireadores fabricados antes de junio 13, 2011.

*L'adaptateur *RP51505 est compatible uniquement avec les aérateurs produits avant le 13 juin 2011.

**If you are unsure of the manufacture date, please order both aerators in the flow rate you desire.

**Si no está seguro de la fecha de fabricación, por favor, ordene ambos aireadores para el flujo deseado.

**Si vous n'êtes pas certain de la date de fabrication, veuillez commandez les aérateurs de chacun des modèles qui ont les caractéristiques de débit que vous désirez.



Maintenance

If faucet exhibits very low flow:
A. Remove and clean Aerator (1) with supplied wrench (2), or
B. SHUT OFF WATER SUPPLIES. Replace valve cartridge (3). When reinstalling parts, make sure bonnet nut (5) is tightened securely with a wrench.*

If faucet leaks from under handle:
Remove handle and unthread trim cap (4). Using a wrench, ensure bonnet nut (5) is tight.

If leak persists–SHUT OFF WATER SUPPLIES. Replace valve cartridge (3). When reinstalling parts, make sure bonnet nut (5) is tightened securely with a wrench.*

If faucet leaks from spout outlet–SHUT OFF WATER SUPPLIES. Replace valve cartridge (3). When reinstalling parts, make sure bonnet nut (5) is tightened securely with a wrench.*

*** WARNING: Failure to securely tighten bonnet nut with a wrench could result in water damage.**

Note: Do not attempt to disassemble cartridge (3). There are no repairable parts inside.

Cleaning and Care

Care should be given to the cleaning of this product. Although its finish is extremely durable, it can be damaged by harsh abrasives or polish. To clean, simply wipe gently with a damp cloth and blot dry with a soft towel.

Mantenimiento

Si la lave de agua exhibe muy poco flujo:
A. Quite y limpie el aereador (1) con la llave de tuerca incluida (2), o
B. CIERRE LOS SUMINISTROS DE AGUA. Cambie el cartucho de la válvula (3).Sando una llave de tuercas, asegúrese que la tuerca tapa (5) esté apretada.*

Si la llave de agua tiene una filtración por debajo de la manija:
Quite la manija y casquillo (4). Usando una llave de tuercas, asegúrese que la tuerca tapa (5) esté apretada.*

Si la filtración persiste – CIERRE LOS SUMINISTROS DE AGUA. Cambie el cartucho de la válvula (3). Usando una llave de tuercas, asegúrese que la tuerca tapa (5) esté apretada.*

Si la llave de agua tiene una filtración desde la salida del surtidor – CIERRE LOS SUMINISTROS DE AGUA. Cambie el cartucho de la válvula (3). Sando una llave de tuercas, asegúrese que la tuerca tapa (5) esté apretada.*

*** AVISO: Si no aprieta fijamente la tuerca tapa con una llave de tuercas pudiera resultar en daño por agua.**

Nota: No procure desmontar el cartucho (3). No hay piezas reparables adentro.

Limpieza y Cuidado de su Llave

Tenga cuidado al ir a limpiar este producto. Aunque su acabado es sumamente durable, puede ser afectado por agentes de limpieza o para pulir abrasivos. Para limpiar su llave, simplemente frótela con un trapo húmedo y luego séquela con una toalla suave.

Entretien

Si le débit du robinet est très faible :
A. Enlevez l'aérateur (1) à l'aide de l'outil fourni (2) et nettoyez-le ou
B. FERMEZ LES ROBINETS D'ALIMENTATION. Remplacez la cartouche de la soupape (3). Usando una llave de tuercas, asegúrese que la tuerca tapa (5) esté apretada.*

Si le robinet fuit par le dessous de la manette :
Enlevez la manette et embase (4). À l'aide d'une clé, assurez-vous que l'écrou-chapeau (5) est serré.*.

Si la fuite persiste, COUPEZ L'ARRIVÉE D'EAU. Remplacez la cartouche de la soupape (3). Usando una llave de tuercas, asegúrese que la tuerca tapa (5) esté apretada.*

Si le robinet fuit par la sortie du bec, COUPEZ L'ARRIVÉE D'EAU. Remplacez la cartouche (3). Usando una llave de tuercas, asegúrese que la tuerca tapa (5) esté apretada.*

*** MISE EN GARDE : L'omission de bien serrer l'écrou-chapeau peut entraîner une fuite d'eau et des dommages.**

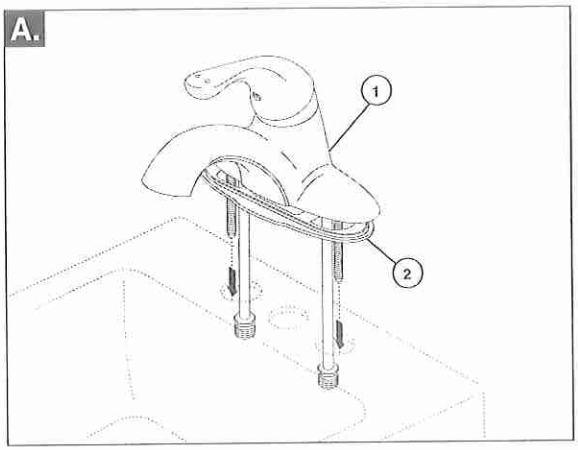
Note : N'essayez pas de démonter la cartouche (3). Il n'y a aucune pièce réparable à l'intérieur.

Instructions de nettoyage

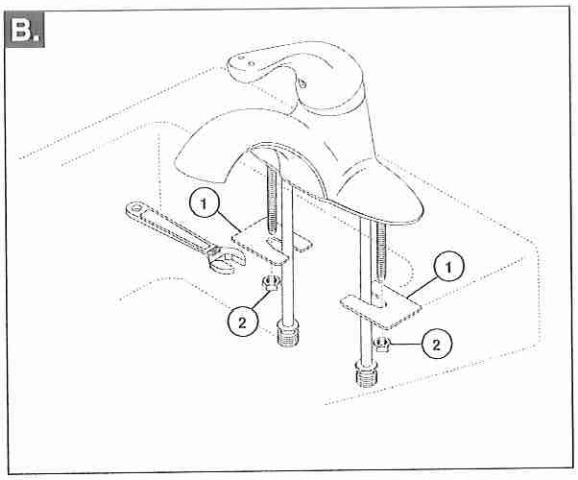
Il faut le nettoyer avec soin. Même si son fini est extrêmement durable, il peut être abîmé par des produits fortement abrasifs ou des produits de polissage. Il faut simplement le frotter doucement avec un chiffon humide et le sécher à l'aide d'un chiffon doux.

1

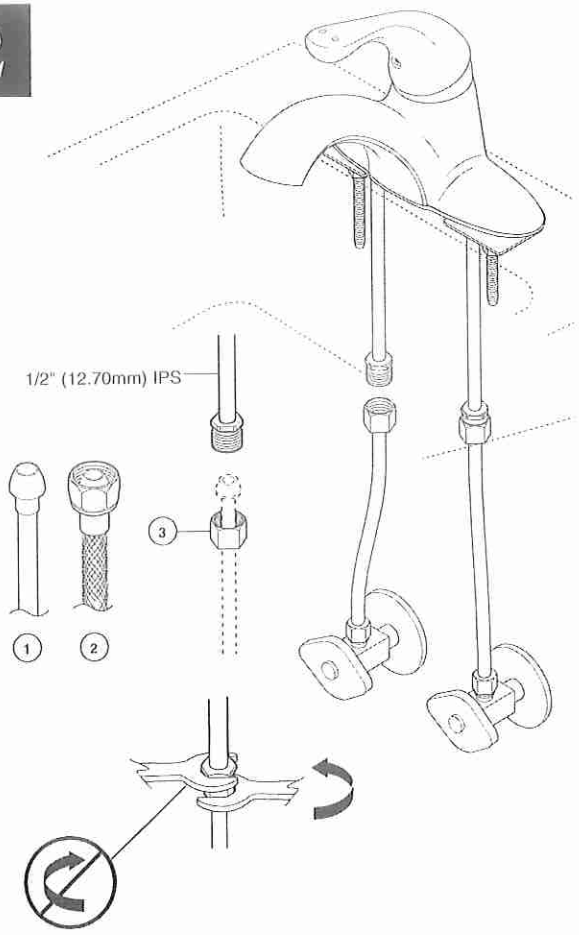
A.



B.



2



A. Position faucet (1) and gasket (2) on sink. *Option: If sink is uneven, use silicone under the gasket.*

B. Secure with washers (1) and nuts (2).

Supply Line Connections

Note: Be careful when bending the copper tubing. Kinked tubes will void the warranty. Choose hook-ups for 1/2" I.P.S. connections: (1) Ball nose riser (3/8" O.D. copper tubing), or (2) 1/2" I.P.S. faucet connector. Use the enclosed coupling nuts (3) with the ball nose risers (1). **Important: Use two wrenches when tightening. Do not overtighten.**

A. Coloque la llave (1) y el empaque (2) en el lavamanos. *Opción: Si el lavamanos está desnivelado, use silicón debajo del empaque.*

B. Fije con arandelas (1) y tuercas (2).

Conexiones de las líneas de Suministro

Nota: Tenga cuidado cuando doble la tubería de cobre. Tubos torcidos anularán la garantía. Escoja las conexions IPS de 1/2": (1) Conexión Bola-nariz (Tubería cobre 3/8" D.E.), o (2) Conector de llave I.P.S. 1/2". Utilice las tuercas de acoplamiento incluidas (3) con la conexión bola-nariz (1). **Utilice dos llaves de tuercas cuando apriete. No apriete demasiado.**

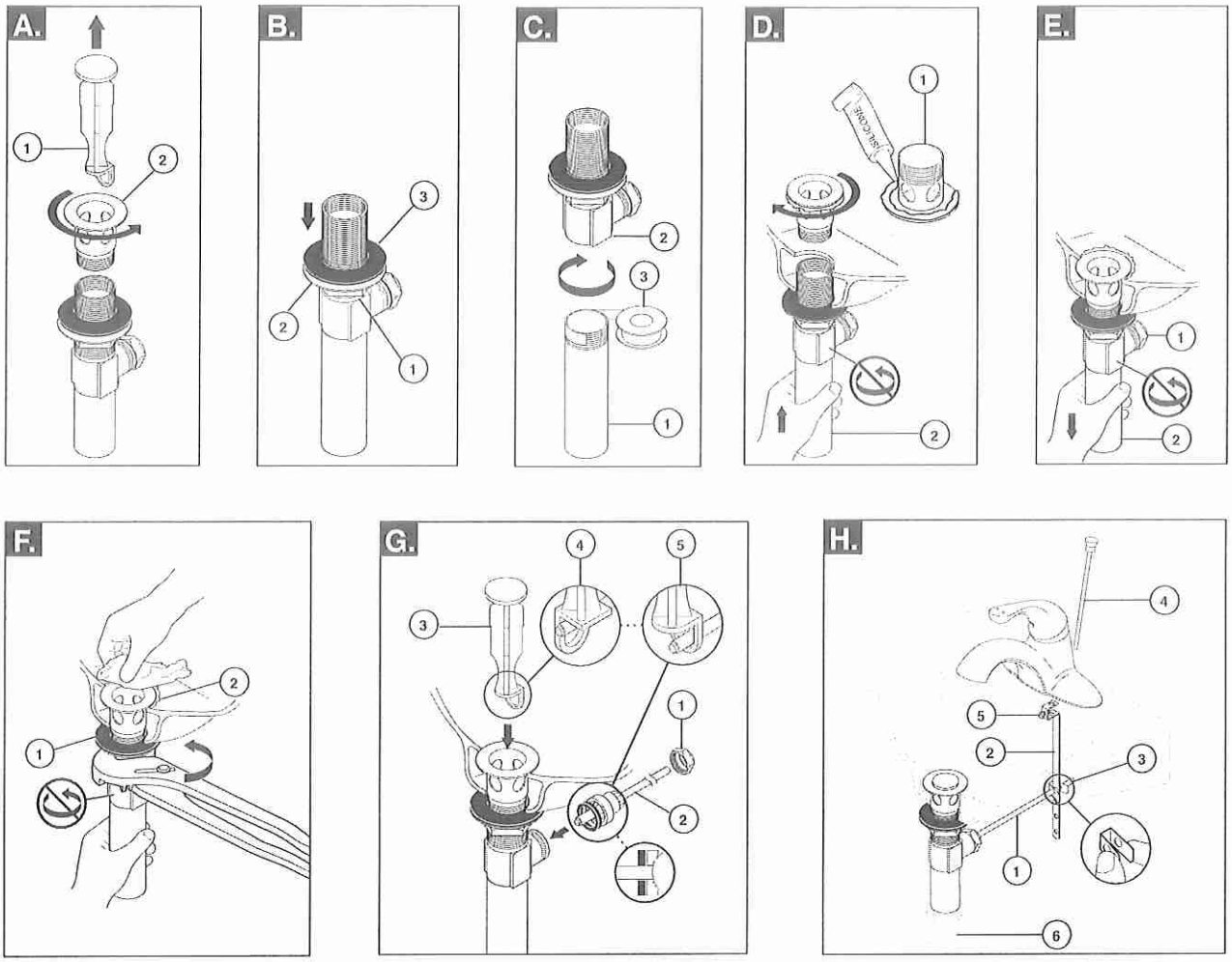
A. Placer le robinet (1) et le joint (2) sur l'évier. *Facultatif - Si la surface de l'évier est inégale, placez du composé d'étanchéité à la silicone sous le joint.*

B. Fixez le robinet à l'aide des rondelles (1) et des écrous (2).

Branchements à la tuyauterie d'alimentation

Note - Prenez garde de pincer les tubes en les cintrant. La garantie est nulle si les tubes ont été pincés. Choisissez des raccords compatibles 1/2 po IPS : (1) tubes-raccords à portée sphérique (tube en cuivre 3/8 po d.e.) ou (2) raccords de robinet 1/2 po IPS. Si vous utilisez des tubes-raccords à portée sphérique (1), servez-vous des écrous de raccordement fousrnis (3). **Utilisez deux clés pour serrer les raccords. Prenez garde de trop serrer.**

3



Metal Pop-Up Installation

A. Remove stopper (1) and flange (2).

B. Screw nut (1) all the way down. Push washer (2) and gasket (3) down.

C. Remove tailpiece (1) from body (2), add plumber tape (3), replace tailpiece.

D. Apply silicone to underside of flange (1). Insert body (2) into sink. Screw flange (1) into body (2).

E. Pivot (1) must face faucet. Pull assembly (2) down firmly and hold in place. DO NOT TWIST.

F. Tighten nut/washer/gasket (1), clean off excess silicone (2). DO NOT TWIST.

G. Remove pivot nut (1). Install horizontal rod (2) and stopper (3) as removable (4) or non-removable (5). Hand tighten pivot nut (1).

H. Attach horizontal rod (1) to strap (2) using clip (3). Install lift rod (4), tighten screw (5). Connect assembly to drain (6).

Desagüe Automático de Metal

A. Quite el tapón (1) y el reborde (2).

B. Atornille la tuerca (1) completamente hasta abajo. Empuje la arandela/roldana (2) y el empaque (3) hacia abajo.

C. Quite el tubo de cola (1) del cuerpo (2), aplique cinta para plomero (3), coloque otra vez el tubo de cola.

D. Aplique silicón a la parte interior del reborde (1). Inserte el cuerpo (2) en el lavamanos. Atornille el reborde (1) en el cuerpo (2).

E. El pivote (1) debe de estar de frente a la llave. Hale el ensamble (2) hacia abajo firmemente y sujételo en sitio. NO LO GIRE.

F. Apriete la tuerca/arandela/empaque (1), limpie el exceso de silicón (2). NO LO GIRE.

G. Quite la tuerca del pivote (1). Instale la barra horizontal (2) y el tapón (3) como desmontable (4) o fijo (5). Apriete a mano la tuerca del pivote (1).

H. Una la barra horizontal (1) a la barra chata (2) utilizando el gancho (3). Instale la barra de alzar (4), apriete el tornillo (5). Conecte el ensamble al desagüe (6).

Renvoi Mécanique en Métal

A. Enlevez la bonde (1) et la collerette (2).

B. Serrez l'écrou (1) pour le faire descen complètement. Poussez la rondelle (2) et le joint (3) vers le bas.

C. Enlevez le raccord droit de vidange (1) du corps (2), appliquez du ruban de plomberie (3), puis remettez le raccord droit en place.

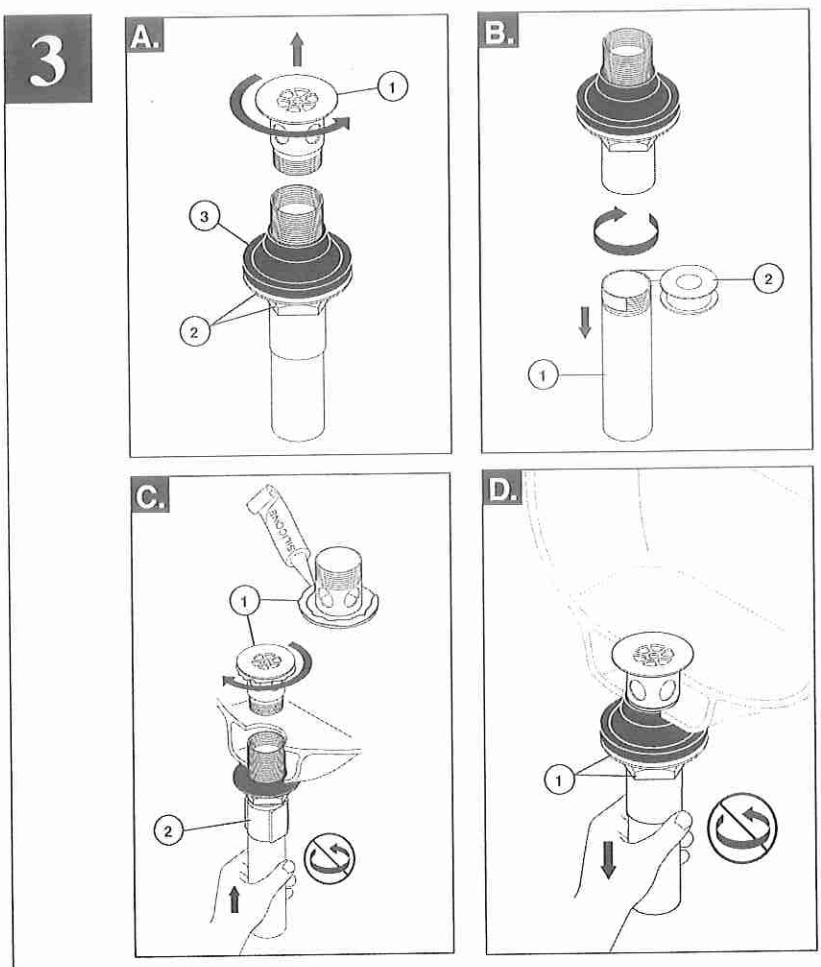
D. Appliquez du composé à la silicone sous la collerette (1). Introduisez le corps (2) dans lav-abo, puis vissez la collerette (1) dans le corps (2).

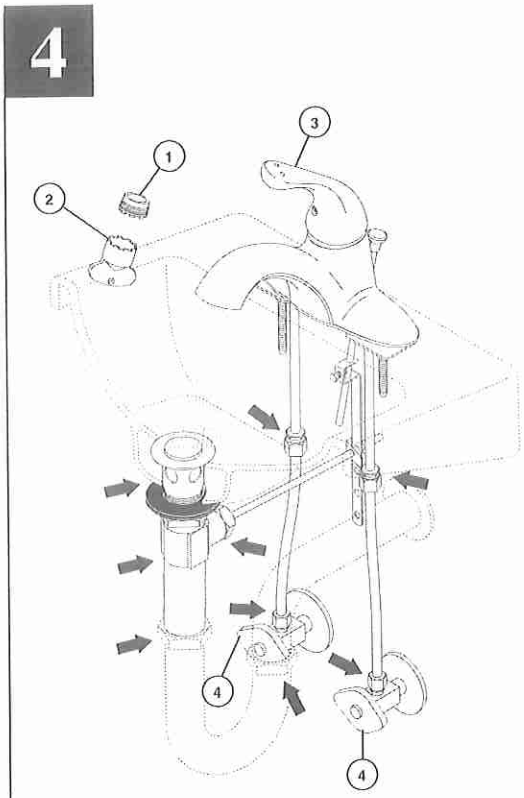
E. Le pivot (1) doit faire face au robinet. Tirez l'ensemble (2) vers le bas fermement et maintenez-le en place. PRENEZ GARDE DE LE TORDRE.

F. Serrez l'écrou contre la rondelle et le joint (1), puis enlevez le surplus de composé à la silicone (2). PRENEZ GARDE DE TORDRE LE PIVOT.

G. Enlevez l'écrou du pivot (1). Installez la tige horizontale (2) et la bonde (3) de manière que la bonde soit amovible (4) ou non amovible (5). Serrez l'écrou (1) du pivot à la main.

H. Fixez la tige horizontale (1) au feuillard (2) à l'aide de l'agrafe (3). Installez la tige de manoeuvre (4) et serrez la vis (5). Fixez l'ensemble au renvoi (6).





Grid Strainer Installation

A. Remove grid flange (1). Screw nut and washer (2) down as far as possible. Push gasket (3) down to nut and washer.

B. Remove tailpiece (1) and apply plumber tape (2) to threads. Replace tailpiece.

C. Apply silicone sealant to underside of grid flange (1). Insert grid strainer assembly (2) up through bottom of lavatory. Screw grid flange back on and secure.

D. Pull grid strainer straight down into drain hole and secure gasket nut and washer (1). DO NOT TURN GRID STRAINER WHILE TIGHTENING NUT OR SEALANT MAY NOT SEAL DRAIN. REMOVE EXCESS SEALANT. Connect assembly to drain.

Remove aerator (1) using supplied wrench (2) and move faucet handle (3) to the full on mixed position. Turn on hot and cold water supplies (4) and flush water lines for one minute. **Important: This flushes away any debris that could cause damage to internal parts.** Reinstall aerator.

Check all connections at arrows for leaks. Re-tighten if necessary, but do not overtighten.

Instalación de la Rejilla Coladora

A. Quite el reborde de la rejilla (1). Atornille la tuerca y la arandela (2) lo más posible. Empuje el empaque (3) hacia abajo, hacia la tuerca y la arandela.

B. Quite el tubo de cola (1) y aplique cinta para plomero (2) a las roscas. Coloque otra vez el tubo de cola.

C. Aplique sellador de silicón a la parte de abajo del reborde de la rejilla (1). Inserte el ensamble de la rejilla-colador (2) hacia arriba por debajo del lavamanos. Atornille, otra vez, el reborde de la rejilla y fíjelo.

D. Hale la rejilla colador directamente hacia abajo, que quede dentro del hoyo del drenaje, y fije la tuerca del empaque y la arandela (1). NO GIRE LA REJILLA O EL SELLADO PUEDA NO SELLAR EL DRENAJE. LIMPIE EL EXCESO DE SELLADOR. Conecte el ensamble al desagüe.

Quite el aereador (1) usando la llave de tuercas (2) proporcionada con su llave de agua y mueva la manija de la llave de agua (3) a la posición completamente abierta. Abra los suministros de agua caliente y fría (4) y deje correr en agua por la líneas por un minuto. **Importante: Esto limpia cualquier escombro que pudiera causar daño a las partes internas.** Reemplace el aereador.

Examine todas las conexiones donde señalan las flechas por si hay filtraciones de agua. Apriete de nuevo si es necesario, pero no apriete demasiado.

Installation de la crépine

A. Retirez la collerette de la crépine (1). Vissezz l'écrou avec la rondelle (2) autant ue possible. Abaissez le joint (3) contre l'écrou et la rondelle.

B. Enlevez le raccord droit de vidange (1) et appliquez du ruban de plomberie (2) sur les filtets. Remettez le raccord en place.

C. Appliquez du composé à la silicone contre le dessous de la collerette de la crépine (1). Introduisez la crépine (2) dans l'orifice par le dessous du lavabo. Remettez la collerette en place et vissez-la à fond.

D. Tirez la crépine vers le bas dans l'orifice et vissez l'écrou contre la rondelle et le joint (1). NE FAITES PAS TOURNER LA CRÉPINE EN SERRANT L'ÉCROU CAR LE COMPOSÉ D'ÉTANCHÉITÉ POURRA PERDRE SON EFFICACITÉ. ENLEVEZ LE COMPOSÉ D'ÉTANCHÉITÉ EN TROP. Fixez l'ensemble au renvoi.

Retirez l'aérateur (1) en utilisant la clé (2) et placez la poignée (3) du robinet en position d'écoulement maximum de l'eau chaude et de l'eau froide. Rétablissez l'alimentation en eau chaude et en eau froide (4) et laissez couler l'eau pendant une minute. **Important: Il faut laisser s'écouler l'eau pour évacuer les saletés qui pourraient abîmer les éléments internes du robinet.** Remettez l'aérateur en place.

Vérifiez l'étanchéité de tous les raccords identifiés par une flèche. Resserrez les raccords au besoin, mais prenez garde de trop les serrer.

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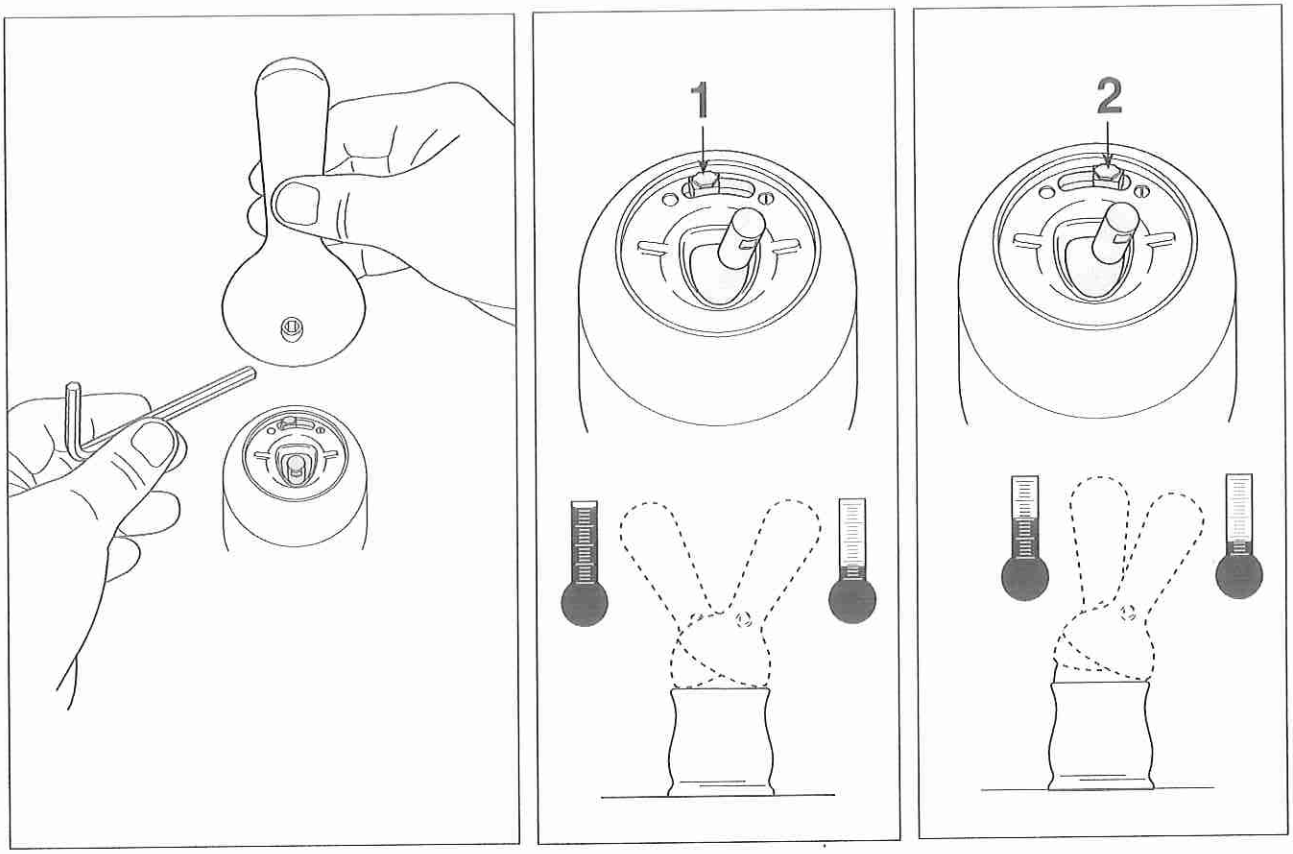


Setting The Handle Limit Stop (Optional)

This faucet includes an integrated handle limit stop that has two positions. Position 1, to the left, allows full handle motion (the full range between "all cold" to "all hot"). The faucet is set in position 1 in the factory. Position 2, to the right, allows half of the normal handle motion ("all cold" to "mixed hot/cold").

The handle limit stop can be adjusted by the homeowner once the faucet is installed. Setting the handle limit stop in position 2 may help to prevent scalding because it limits the amount of hot water in the mix; however, this handle limit stop will not always prevent scalding because it does not compensate for incoming pressure or sudden water temperature changes.

To change positions of the handle limit stop: remove the handle; move the valve stem to the all cold position so the water is on; change the position of the handle limit stop; turn off the water; reinstall the handle.

Fijando la parada de límite de la manija (opcional)

Esta llave de agua incluye una manija integrada, que tiene dos posiciones, para limitar la temperatura. La posición 1, a la izquierda, permite el movimiento completo de la manija (el alcance completo entre el agua "totalmente fría" hasta "totalmente caliente"). La fábrica preselecciona la llave de agua (grifo) a la posición 1. La posición 2, a la derecha, permite la mitad del alcance de movimiento normal de la manija ("totalmente fría" a la posición "mixta caliente/fría").

Una vez que la llave de agua (grifo) se ha instalado, el límite rotacional de la manija puede ajustarse por el propietario de la residencia. Ajustando la manija de ajuste del tope del límite de la temperatura a la posición 2 puede ayudar a prevenir escaldaduras porque limita la cantidad de agua caliente en la mezcla; sin embargo, esta manija que limita la temperatura del agua no siempre prevendrá escaldaduras porque no compensa la presión del agua de entrada o cambios repentinos de la temperatura del agua.

Para cambiar las posiciones de la manija que limitan la temperatura: quite la manija; cambie la posición de la espiga de la válvula a la posición totalmente fría de manera que el agua este abierta; cambie la posición de la manija que limita la temperatura; cierre el agua; reinstale la manija.

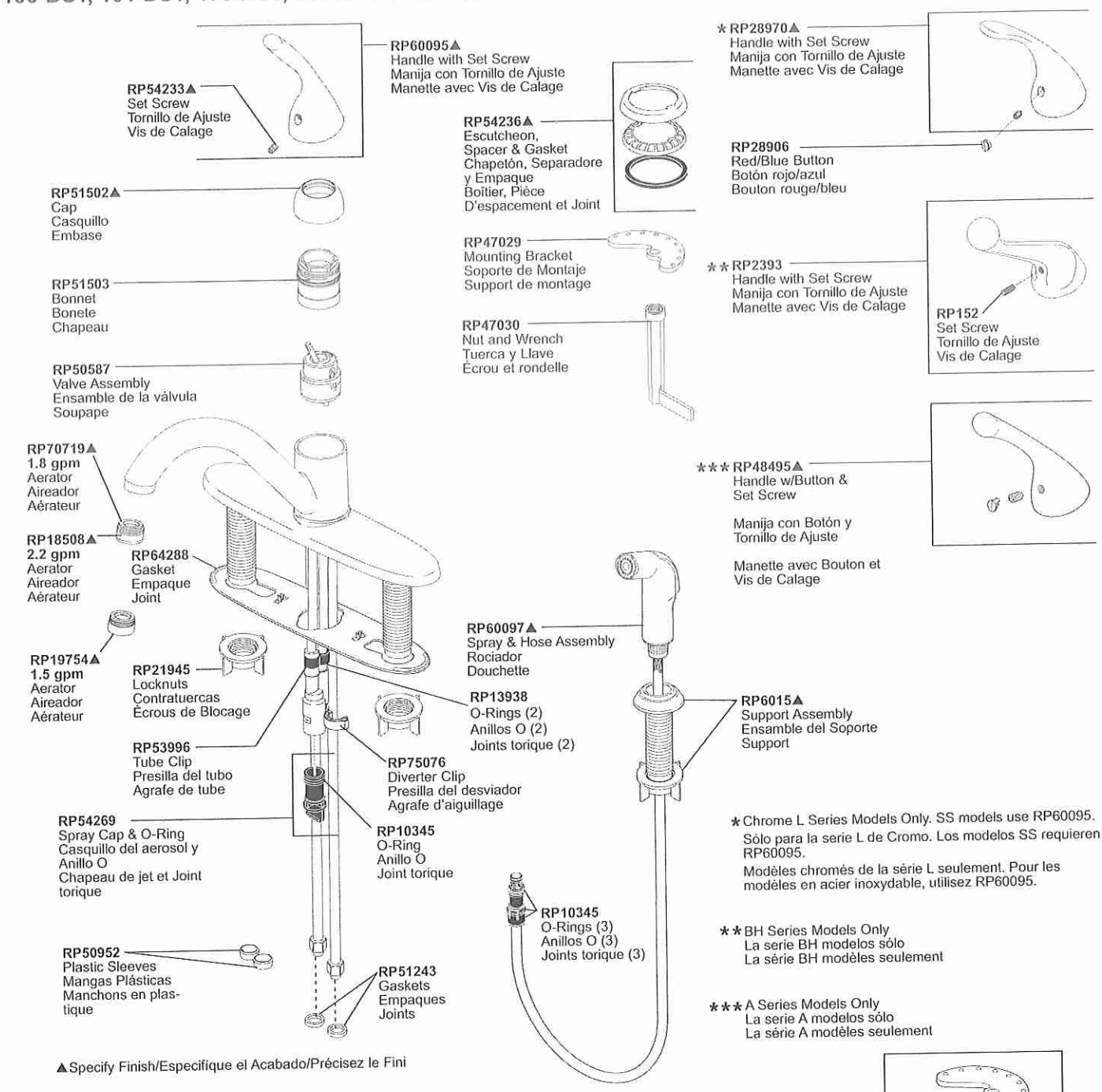
Plaçant l'arrêt de limite de poignée (facultatif)

Ce robinet est muni d'une butée de température maximale à deux positions. La position 1, à gauche, permet le déplacement de la manette entre les deux extrémités de la plage de température (eau très froide et eau très chaude). C'est la position sélectionnée en usine. La position 2, à droite, permet le déplacement de la manette sur la moitié de la plage de température (eau très froide et eau mitigée).

Il est possible de régler la butée de température maximale de la manette au moment de l'installation du robinet. Un réglage à la position 2 peut empêcher l'ébouillantage parce que cette position limite la quantité d'eau chaude dans le mélange. Toutefois, ce réglage de la butée de température maximale de la manette ne constitue pas une garantie absolue contre l'ébouillantage parce qu'il n'offre aucune protection contre les fluctuations de la pression d'alimentation ou les changements de température soudains.

Pour modifier la position de la butée de température maximale de la manette : enlevez la manette; amenez l'obturateur à l'extrémité de la plage du côté eau froide pour faire s'écouler l'eau; modifiez la position de la butée de température maximale; fermez le robinet; réinstallez la manette.

100-DST, 101-DST, 175-DST, 300-DST & 400-DST

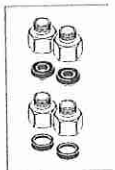


*Chrome L Series Models Only. SS models use RP60095.
Sólo para la serie L de Cromo. Los modelos SS requieren RP60095.
Modèles chromés de la série L seulement. Pour les modèles en acier inoxydable, utilisez RP60095.

**BH Series Models Only
La serie BH modelos sólo
La série BH modèles seulement

***A Series Models Only
La serie A modelos sólo
La série A modèles seulement

▲Specify Finish/Especifique el Acabado/Précisez le Fini



RP63263
Adapters
3/8"-24 UNEF to 1/2"-20 UN &
3/8"-24 UNEF to 1/2"-14 NPSM
Adaptadors
3/8"-24 UNEF a 1/2"-20 UN &
3/8"-24 UNEF a 1/2"-14 NPSM
Adapteurs
3/8 po-24 UNEF à 1/2 po-20 UN et
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RP63265
Adapters
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to 1/2"-14 NPSM
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a 1/2"-14 NPSM
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à 1/2 po-14 NPSM

RP63264
Adapters
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to 1/2"-20 UN
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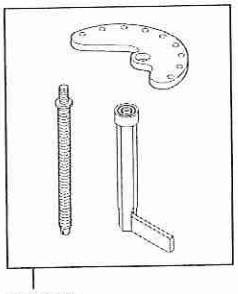
rs (10) 3/8"-24 UNEF
a 1/2"-20 UN
Adapteurs
(10) 3/8 po-24 UNEF
à 1/2 po-20 UN



RP63792
Stiffening Kit (Reduce Flexibility For Commercial Applications)
Juego Atiesador (Reduce la Flexibilidad en Aplicaciones Comerciales)
Kit de renfort (réduit la flexibilité pour les applications commerciales)

ELKAY®
SPECIFICATIONS

Elkay Single Hole with Concealed Deck Faucet with 4" Gooseneck Spout 4" Wristblade Handles Chrome
Model(s) LK500GN04T4

PRODUCT SPECIFICATIONS

Elkay Single Hole with Concealed Deck Faucet with 4" Gooseneck Spout 4" Wristblade Handles Chrome. Faucet has a flow rate of 1.5 GPM, and is made of Chrome Plated Brass material, with a Quarter Turn Ceramic Disc valve. Faucet requires 1 faucet holes.

Mounting Type:	Deck Mount
Special Features:	Low Flow Solid Brass Construction Spout swing restriction pin
Finish:	Chrome (CR)
Handle Type:	4" Wristblade Handle
Deck Clearance:	8-7/8"
Spout Reach:	4"
Spout Height:	11-5/16"
Hole Drillings:	1
Material:	Chrome Plated Brass
Valve Type:	Quarter Turn Ceramic Disc
Valve Connection:	1 1/8" Unified Screw Thread, Standard Series
Flow Rate:	1.5 GPM
Spout Type:	Gooseneck

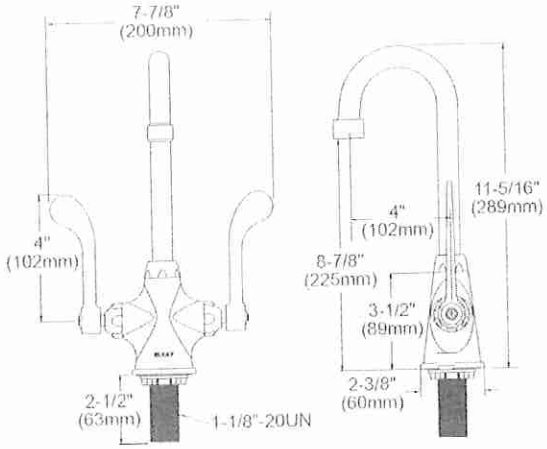
Special Note: 1.5 GPM VR aerator installed with 2.2 and .5 GPM inserts included

Chrome (CR)

AMERICAN PRIDE. A LIFETIME TRADITION.
Like your family, the Elkay family has values and traditions that endure. For almost a century, Elkay has been a family-owned and operated company, providing thousands of jobs that support our families and communities.

Product Compliance:
ADA & ICC A117.1
ASME A112.18.1/CSA B125.1
NSF 61
NSF 372 (lead free)

Clean and Care Manual (PDF)
Installation Instructions (PDF)
Limited Warranty (PDF)



PART:_____ QTY: _____
PROJECT:_____
CONTACT:_____
DATE:_____
NOTES:_____
APPROVAL:_____

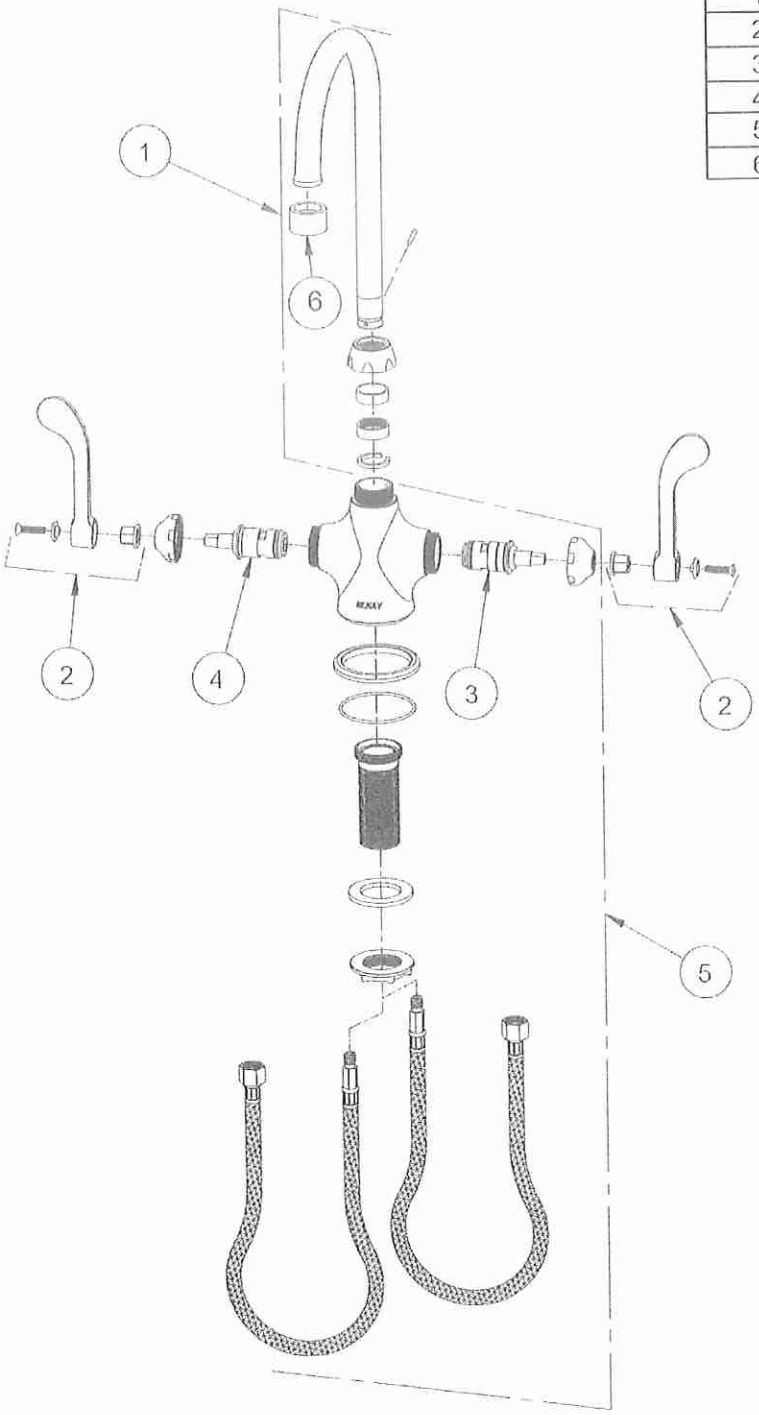
In keeping with our policy of continuing product improvement, Elkay reserves the right to change product specifications without notice. Please visit elkay.com for the most current version of Elkay product specification sheets. This specification describes an Elkay product with design, quality, and functional benefits to the user. When making a comparison of other producers' offerings, be certain these features are not overlooked.

ELKAY®
SPECIFICATIONS

Elkay Single Hole with Concealed Deck Faucet with 4" Gooseneck Spout 4" Wristblade Handles Chrome

Model(s) LK500GN04T4

ITEM	IND. PART	DESCRIPTION
1	A55397	Spout
2	45919C	Handle, 4"
3	45923C	Right Cold Cartridge
4	45924C	Left Hot Cartridge
5	45915C	Body
6	LK734	2.2 GPM VR Aerator



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Elkay Sinks, Faucets and Accessories Care and Cleaning

Sinks

Stainless Steel

- General cleaning: use an ordinary mild detergent and soft cloth, rinse and towel dry.
- Steel soap pads should never be used; particles can adhere to a stainless steel sink surface and will eventually rust.
- Light scratches are normal for stainless steel sinks; over time they will blend into the uniform finish pattern.
- Do not use dish mats as these can trap soap and dirt making sink maintenance more time-consuming.
- We recommend the use of an Elkay bottom grid or rinsing basket to protect your sink.
- Avoid storing open containers of household cleaners and chemicals containing chloride such as bleach, acid, and drain cleaners or toilet bowl cleaner beneath the sink. Vapor emission from the chlorides can cause corrosion and pitting to the exposed stainless steel and other metals including faucet water supply lines.

Stainless Steel Mirror or Hammered Mirror

- General cleaning: use an ordinary mild detergent and soft cloth, rinse and towel dry.
- Never use abrasive cleaners, including steel soap pads.

Antique Copper Hammered

- General cleaning: use non-abrasive, non-detergent soap and a soft cloth, rinse and towel dry.
- Never use abrasives, metal (copper) cleaners, scouring pads, lime or rust removal, alkaline-based, ammonia-based or acidic-based chemicals or cleaning products.
- Acidic foods such as juices and ketchup can remove the patina if left on the sink.
- Hard water spots and mineral deposits can be difficult to remove and may result in damage to the patina.
- Light scratches are normal for copper sinks; over time they will blend into the uniform finish pattern.
- Copper has a living finish and its surface tarnishes naturally. You can expect tarnish, scratches, and dents to appear in your sink over time.

CuVerro® Anti-microbial Copper

- Clean the surface to regular hospital protocols (i.e. appropriate disinfectants, frequency, etc.); be sure to rub in the direction of the satin finish grain lines; rinse and towel dry.
- Use a cleaner that will not leave a wax film or coating on the surface, so that cleaning will not interfere with the antimicrobial action of the surface.
- Never use abrasives, metal (copper) cleaners, scouring pads, lime or rust removal, alkaline-based, ammonia-based or acidic-based chemicals or cleaning products.
- Light scratches are normal for copper sinks; over time they will blend into the uniform finish pattern.

Cast Brass

- General cleaning: use a non-abrasive, non-detergent soap with a soft cloth, rinse and towel dry.
- Never use abrasives, metal cleaners, scouring pads, lime or rust removal, alkaline-based, ammonia-based or acidic-based chemicals or cleaning products.
- Brass has a living finish and its surface tarnishes naturally. You can expect tarnish, scratches, and dents to appear in your sink over time.
- Surface waxing is recommended. Each sink provides a factory applied layer of wax. However, after time and use, this wax layer will need to be rejuvenated. Johnson's or Trewax Sealer Finish for floors is recommended. Do not use any waxes that contain polishing agents.

Quartz

- Most dirt and stains: Wipe with a damp cotton cloth/sponge and soapy water. Towel dry with a cotton cloth. *It is recommended that you clean your sink prior to first use.*
- Stubborn stains and water marks: Wipe with a Mr. Clean® Magic Eraser® and either water or a 50/50 white vinegar and water solution. Towel dry with a cotton cloth.
- Difficult stains: Use a 3M Scotch-Brite™ Heavy Duty Scour Pad with either water, 50/50 white vinegar/water solution or non-abrasive cleaner. Start cleaning in a a circular motion with constant pressure over the area of the stain, rinse thoroughly with water and dry with a cotton cloth. Let dry 5-10 minutes. If stain persists, repeat.

Elkay Sinks, Faucets and Accessories Care and Cleaning

Sinks (cont.)

Fireclay

- General cleaning: use soapy water or vinegar-based cleaner and a sponge and towel dry.
- Water marks: wipe with damp cloth and towel dry.
- Difficult stains: use a 50/50 water/bleach solution or non-abrasive cleaners (follow cleaner manufacturer's instructions), rinse and towel dry.
- Do not use strong chemicals such as paint removers or oven cleaners, straight or undiluted bleach solution, abrasive cleaning products, scouring pads, steel wool or caustic solutions containing ammonia or alkalis.
- Do not set hot pans directly into sink.
- Run cold water when pouring boiling water into sink.

Faucets

- Simply wipe gently with a damp cloth and blot dry with a soft towel.
- Avoid build-up of soap or mineral deposits, as these tend to have an adverse effect on the appearance of the product.
- NEVER use cleaning products of any kind on this product—especially those containing ammonia, bleach or alcohol—or those with any form of abrasive.

Accessories

- Elkay colanders, cutting boards, rinsing baskets and bottom grids are not designed as "Dishwasher Safe" or "Microwave Safe". These products should be hand washed in a mild detergent, rinsed thoroughly and hand dried.
- For wood cutting boards – apply a coat of mineral oil to all wood surfaces on a monthly basis or more frequently if needed.
- The following are recommendations from the USDA regarding cutting boards:
  - Always use a clean cutting board.
  - If possible, use one cutting board for fresh produce and a separate one for raw meat, poultry, and seafood.
  - Once cutting boards become excessively worn or develop hard-to-clean grooves, you should replace them.

ELKAY®

Enhanced

INSTALLATION, CARE & USE MANUAL

Manual de instalación, cuidado y uso

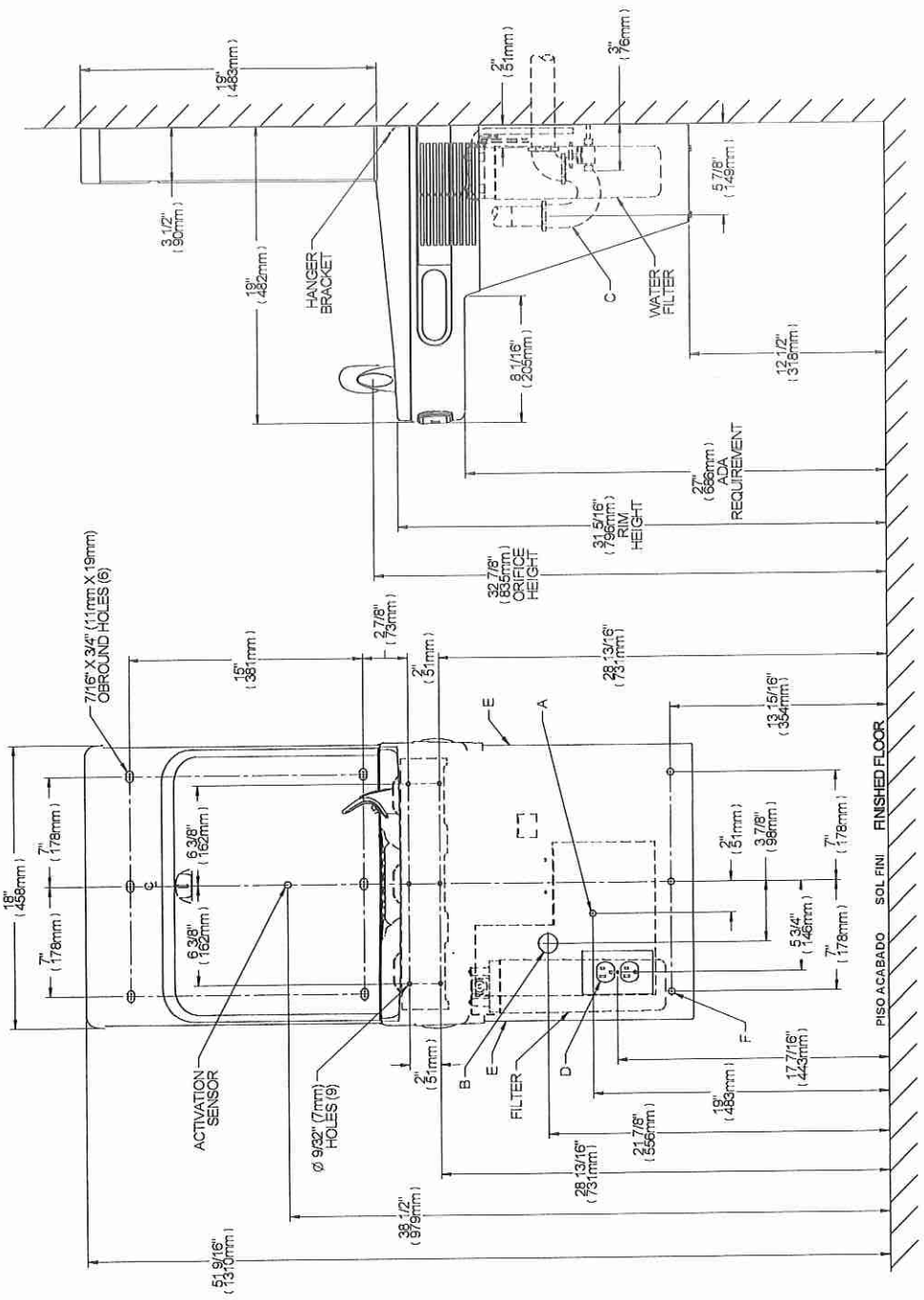
Manuel d'installation, d'entretien et d'utilisation

LZ™ & EZ™ Series Bottle Filling Stations & Coolers

Bebederos y estaciones llenadoras de botellas series LZ™ y EZ™ mejorados

Remplisseuses de bouteille et fontaines à eau fraîche séries LZ™ et EZ™ améliorées

1000002119 (Rev. E- 06/17)



LEGEND/LEYENDA/LÉGENDE
A = RECOMMENDED WATER SUPPLY LOCATION 3/8 O.D. UNPLATED COPPER TUBE CONNECT STUB WITH SHUT OFF (BY OTHERS) 3 IN. (76mm) MAXIMUM OUT FROM WALL
UBICACIÓN RECOMENDADA DEL SUMINISTRO DE AGUA. TUBERÍA DE COBRE SIN REVESTIMIENTO DE 3/8" DE DIAM. EXT. ADAPTADOR DE CONEXIÓN CON VÁLVULA DE CIERRE (DE TERCEROS) MÁXIMO A 76 mm (3") DE LA PARED.
EMPLACEMENT RECOMMANDÉ DE L'ARRIVÉE D'EAU. TUBE EN CUIVRE NON PLAQUÉ DE 3/8 PO DE DIA. EXT. RACCORDER À LA CONDUITE D'ALIMENTATION AVEC UN ROBINET D'ARRÊT (NON FOURNI) À 76 mm (3 PO) MAXIMUM DU MUR
B = RECOMMENDED LOCATION FOR WASTE OUTLET 1-1/4" O.D. DRAIN STUB 2 IN. OUT FROM WALL
UBICACIÓN RECOMENDADA DE LA SALIDA DE DESECHOS. ADAPTADOR DE DESAGÜE DE 1-1/14" DE DIÁM. EXT.. A 51 mm (2") DE LA PARED.
EMPLACEMENT RECOMMANDÉ DE LA SORTIE D'ECOULEMENT. CONDUITE D'ÉVACUATION DE 1-1/4 PO DE DIA. EXT. DÉPASSANT DE 51 mm (2 PO) HORS DU MUR
C = 1-1/4" TRAP NOT FURNISHED
NO SE INCLUYE SIFÓN DE 1-1/4"
SIPHON DE 1-1/4 PO NON FOURNI

LEGEND/LEYENDA/LÉGENDE
D = ELECTRICAL SUPPLY (3) WIRE RECESSED BOX DUPLEX OUTLET**
SUMINISTRO ELÉCTRICO (3) CAJA ENCHUFE DE ALAMBRE SALIDA DÚPLEX
ALIMENTATION ELECTRIQUE (3) BOÎTIER ENCASTRE
E = INSURE PROPER VENTILATION BY MAINTAINING 6" (152 mm) (MIN.) CLEARANCE FROM CABINET LOUVERS TO WALL.
PARA GARANTIZAR LA VENTILACION ADECUADA, MANTENGA 152 mm (6") (MIN.) DE SEPARACION DESDE LAS REJILLAS DEL GABINETE HASTA LA PARED.
POUR ASSURER UNE AERATION SUFFISANTE. PREVOIR UN DEGAGEMENT DE 152 mm (6 PO) (MIN.) ENTRE LES EVENTS DE L'ENCEINTE ET LE MUR
F = 7/16 BOLT HOLES FOR FASTENING UNIT TO WALL
ORIFICIOS PARA PERNOS DE 7/16, PARA FIJAR LA UNIDAD A LA PARED
TROUS DE VIS DE 7/16 PO POUR LA FIXATION DE L'APPAREIL AU MUR
**NEW INSTALLATIONS MUST USE GROUND FAULT CIRCUIT INTERRUPTER (GFCI)
**Las nuevas instalaciones deben usar un interruptor de circuito de falla a tierra (GFCI, por sus siglas en inglés)
**Les nouvelles installations doivent comporter un disjoncteur différentiel (GFCI)

Fig. 1

HANGER BRACKET INSTALLATION

1) Remove hanger bracket fastened to back of cooler by removing one (1) screw.
2) Mount the hanger bracket as shown in Figure 1 (Pg. 2)

NOTE: Hanger Bracket MUST be supported securely. Add fixture support carrier if wall will not provide adequate support. Anchor hanger securely to wall using all six (6) 1/4 in. dia. mounting holes.

IMPORTANT:

5-7/8 in. (150mm) dimension from wall to centerline of trap must be maintained for proper fit.

INSTALLATION OF COOLER

3) Hang the cooler on the hanger bracket. Be certain hanger bracket is engaged properly in the slots on the cooler back as shown in Figure 1 (Pg. 2).
4) Remove the four (4) screws holding the lower front panel at the bottom of the cooler. Remove the front panel by pulling straight down and set aside.
5) Secure cooler frame to wall by installing (2) screws and washers (not supplied). (See Fig. 2, Pg. 6). Make sure the screws engage in a structural member.
6) Connect the supply water to the filter inlet tube.
7) Install trap. Remove the slip nut and gasket from the trap and install them on the cooler waste line making sure that the end of the waste line fits into the trap. Assemble the slip nut and gasket to the trap and tighten securely.

IMPORTANT: If it is necessary to cut the drain, loosen the screw at the black rubber boot and remove tube, check for leaks after re-assembly.

BOTTLE FILLER INSTALLATION

8) Remove two (2) mounting screws with 5/32" Allen wrench holding bottle filler to wall mounting plate (See Fig.4, Pg. 6). Note do not discard mounting screws, they will be needed to secure bottle filler to wall mounting plate.
9) Remove wall mounting plate from Bottle Filler (see Fig 4, Pg. 6). Place wall mounting plate against wall on top of basin. Center the wall mounting plate side to side with the basin. Mark the six (6) mounting holes with a pencil (See Fig. 1, Pg. 2). Place tape over wiring harnes conection on top of cooler to prevent debris from falling into Connection (See Fig. 3, Pg. 6).
10) Remove wall mounting plate from wall. **NOTE**: Mounting plate **MUST** be supported securely. Add fixture support carrier if wall will not provide adequate support.
11) Install wall mounting plate to wall using six (6) 7/16" obround mounting holes (mounting bolts not included) (See Fig.4, Pg. 6). Use appropriate fasteners for your wall type.
12) Install gasket on bottom of bottle filler tower with gasket support bracket, (2) washers, & (2) screws (See Fig. 5, 6, Pg. 7).
13) Connect water line from cooler to 3/8" john guest fitting. Connect wiring harness to the top of cooler. (See Fig. 8, Pg. 8).
14) Place bottle filler on four (4) hooks on the mounting plate installed on wall. Make sure round boss in gasket fits in hole of basin. (See Fig. 9, Pg. 8).
15) Remove filter from carton, remove protective cap, attach filter to filter head by firmly inserting into head and rotating filter clockwise. Ensure that blue label can be read when filter is installed. (Fig. 14, Pg. 10.)
16) Turn water supply on and inspect for leaks. In both cooler and bottle filler. Fix all leaks before continuing.
17) Once cooler and bottle filter has been inspected for leaks and any leaks found corrected, plug cooler into wall.
18) Reinstall two mounting screws from first step (See Fig. 4, Pg. 6). Caution, do not over tighten screws.
19) Once power is applied to the cooler the GREEN LED light will illuminate on the bottle filler showing good filter status along with the LCD Bottle Counter.
20) Verify proper dispensing by placing cup, hand, or any opaque object in front of sensor area and verify water dispenses. Note: the first initial dispenses might have air in line which may cause a sputter. This will be eliminated once all air is purged from the line.
21) Once unit tests out, install Lower Panel back on water cooler(s). Units are now ready for use.

Instructions For Replacing Filters

1.) Remove lower cover on cooler by removing (4) screws (See Fig.10, Pg. 8).
2.) Turn off water supply; dispense water to relieve pressure.
3.) Turn used filter counterclockwise 1/4 turn to remove from filter head.
4.) Remove cap from new filter and use to seal used filter.
5.) Insert new filter into existing filter head and turn fully clockwise. Make sure you can read the label on the front of the filter once it is installed. (See Fig.14 on Pg. 10).
6.) Turn on water supply and run a minimum of two gallons of water through the filter to purge air any fine carbon particles from filter. Also run water through bottle filler

Note: Filter status light will automatically reset once new filter is installed.

SUSPENSIÓN DE LA INSTALACIÓN DEL SOPORTE

1) Retire un (1) tornillo para retirar el soporte colgante fijado en la parte posterior del bebedero.
2) Monte el soporte colgante como se muestra en la Figura 1 (pág. 2)

NOTA: El soporte colgante DEBE estar apoyado firmemente. Instale un soporte de apoyo auxiliar si la pared no proporciona un apoyo adecuado. Fije firmemente el soporte a la pared con los seis (6) orificios de montaje de 1/4" de diámetro.

IMPORTANTE:
Se debe mantener una dimensión de 150 mm (5-7/8") desde la pared hasta la linea central del sifón para un encaje adecuado.

INSTALACIÓN DEL BEBEDERO

3) Cuelgue el más fresco en el soporte de suspensión. Ser cierta fijador de suspensión calce correctamente en las ranuras de la parte posterior del enfriador como se muestra en la Figura 1 (Pág. 2).
4) Retire los cuatro (4) tornillos que sujetan el panel frontal inferior en la parte inferior de la nevera. Retire el panel frontal tirando hacia abajo y dejar de lado.
5) Secure marco más frío a la pared mediante la instalación (2) tornillos y arandelas (no suministrado). (Véase la Fig. 2, pág. 6). Asegúrese de que los tornillos se involucran en un elemento estructural.
6) Conectar el suministro de agua al tubo de entrada del filtro.
7) Instale el sifón. Retire la tuerca deslizante y la empaquetadura. instálelas en la tubería de desechos del bebedero y asegúrese de que el extremo de la tubería de desechos encaje en el sifón. Monte la tuerca deslizante y la empaquetadura en el sifón y apriete firmemente.

IMPORTANTE: Si es necesario cortar el desagüe, suelte el tornillo en el manguito de caucho negro y retire la tubería, revise si hay fugas después de volver a montar.

BOTELLA DE INSTALACIÓN DE RELLENO

8) Retire los dos tornillos (2) de montaje con 5/32 "llave Allen sostiene la botella de relleno a la pared la placa de montaje (Ver figura 4, Pág. 6). Nota No tire los tornillos de montaje, que serán necesarios para asegurar la botella de relleno para montaje en la pared plato.
9) Retire la placa de montaje de la pared de la botella de relleno (ver figura 4, pág. 6). Coloque la placa de montaje en la pared contra la pared en la parte superior de la cuenca. Centre el lado de la placa de montaje en pared ponerse del lado de la cuenca. Marcar los seis agujeros (6) de montaje con un lápiz (Ver Fig. 1, pág. 2). Coloque cinta adhesiva sobre el cableado HARNES conexión en la parte superior del refrigerador para evitar que los residuos caigan en la conexión (Ver Fig. 3, pág. 6).
10) Retire la placa de montaje en pared de la pared. **NOTA**: La placa de montaje **DEBE** estar apoyada firmemente. Instale un soporte de apoyo auxiliar si la pared no proporciona un apoyo adecuado.
11) Instale la placa de montaje en pared con seis (6) orificios de montaje ovalados de 7/16" (no se incluyen los pernos de montaje). (Consulte la Fig. 4, pág. 6). Use los sujetadores adecuados para su tipo de pared.
12) Instale la empaquetadura en la parte inferior de la torre de la llenadora de botellas con el soporte de empaquetadura, (2) arandelas y (2) tornillos. (Consulte las Fig. 5, 6, pág. 7).
13) Conecte la línea de agua del refrigerador a 3/8 "John apropiado invitado. Conectar el mazo de cables a la parte superior del refrigerador. (Ver Fig. 8, pág. 8).
14) Coloque la botella de relleno en cuatro (4) se engancha en la placa de montaje instalado en la pared. Asegúrese de que la ronda el jefe de la junta encaja en el agujero de la cuenca. (Véase la Fig. 9, pág. 8). .
15) Retire el filtro de la caja, retire la tapa de protección, inserte firmemente el filtro en el cabezal y gire el filtro hacia la derecha. Asegúrese de que la etiqueta azul se pueda leer cuando el filtro esté instalado. (Figura 14, página 10)
16) Abra el suministro de agua e inspeccione si hay fugas. En el bebedero y en la llenadora de botellas. Arregle todas las fugas antes de continuar.
17) Una vez que se ha inspeccionado si hay fugas en el bebedero y en la llenadora de botellas y que se han arreglado todas las fugas encontradas, enchufe el bebedero en la pared.
18) Vuelva a instalar dos tornillos de montaje de primera etapa (Ver Fig. 4, pág. 6). Precaución, No apriete los tornillos.
19) Una vez que se aplica potencia al refrigerador de la luz verde LED se iluminará en la botella de relleno que muestra el buen estado del filtro junto con el contador de la botella de cristal líquido.
20) Para verificar el dispensado correcto, coloque una taza, la mano o cualquier objeto opaco delante del área del sensor y verifique que se dispense agua. Nota: Las primeras veces que dispense agua puede haber aire en la tubería, lo que puede provocar que salga a borbotones. Esto se eliminará una vez que se purgue todo el aire de la tubería.
21) Una vez que la unidad pase las pruebas, instale el panel inferior de vuelta en los bebederos. Ahora, la unidad está lista para su uso.

Instrucciones para reemplazar filtros

1.) Retire la cubierta inferior en el enfriador quitando los tornillos (4) (Véase la figura 10, Pág. 8).
2.) Corte el suministro de agua; dispense agua para aliviar la presión.
3.) Gire el filtro usado 1/4 de vuelta hacia la izquierda para retirarlo del cabezal del filtro.
4.) Retire la tapa del filtro nuevo y úsela para sellar el filtro usado.
5.) Inserte el nuevo filtro en el cabezal del filtro y gírelo completamente hacia la derecha. Asegúrese de poder leer la etiqueta en la parte delantera del filtro una vez que esté instalado. (Consulte la Fig. 14 en la pág. 10).
6.) Abra el suministro de agua y deje correr un mínimo de ocho litros (dos galones) de agua a través del filtro para purgar el aire y todas las partículas finas de carbono del filtro. Además, deje correr agua a través de la llenadora de botellas

Nota: La luz de estado de la llenadora se restablecerá automáticamente una vez que se instale el filtro nuevo.

SUPPORT SUPPORT DE MONTAGE

1) Déposer la ferrure de suspension qui est fixée au dos de la fontaine à eau au moyen d'une (1) vis.
2) Monter la ferrure de fixation comme représenté à la Fig. 1 (p. 2).

REMARQUE : La ferrure de suspension doit IMPÉRATIVEMENT être solidement soutenue. Ajouter un socle d'appareil si le mur n'offre pas un support suffisant. Ancrer la ferrure solidement dans le mur en utilisant les six (6) trous de fixation de 1/4 po de diamètre.

IMPORTANT :

Prévoir un dégagement de 150 mm (5-7/8 po) entre le mur et l'axe central du siphon pour permettre une pose correcte.

INSTALLATION DE LA FONTAINE À EAU FRAÎCHE

3) Installez le refroidisseur sur le support de suspension. Être certain support de suspension est engagé correctement dans les fentes sur le refroidisseur de retour comme le montre la figure 1 (p. 2).
4) Retirez les quatre (4) vis qui maintiennent le panneau inférieur avant au fond de la glacière. Retirez le panneau avant en tirant vers le bas et mettre de côté.
5) Fixez cadre refroidisseur à la paroi par l'installation (2) vis et rondelles (non fourni). (Voir Fig. 2, p. 6). Assurez-vous que les vis se livrent à un élément de structure.
6) Branchez l'eau d'alimentation du tube d'entrée du filtre.
7) Poser le siphon. Retirer l'écrou de siphon et le joint du siphon et les poser sur la conduite d'écoulement de la fontaine en vérifiant que le bout de la conduite d'écoulement passe dans le siphon. Visser l'écrou avec le joint sur le siphon et serrer fermement.

IMPORTANT : Si l'écoulement doit être coupé, desserrer la vis au niveau du manchon noir en caoutchouc et déposer le tube; vérifier l'étanchéité après le remontage.

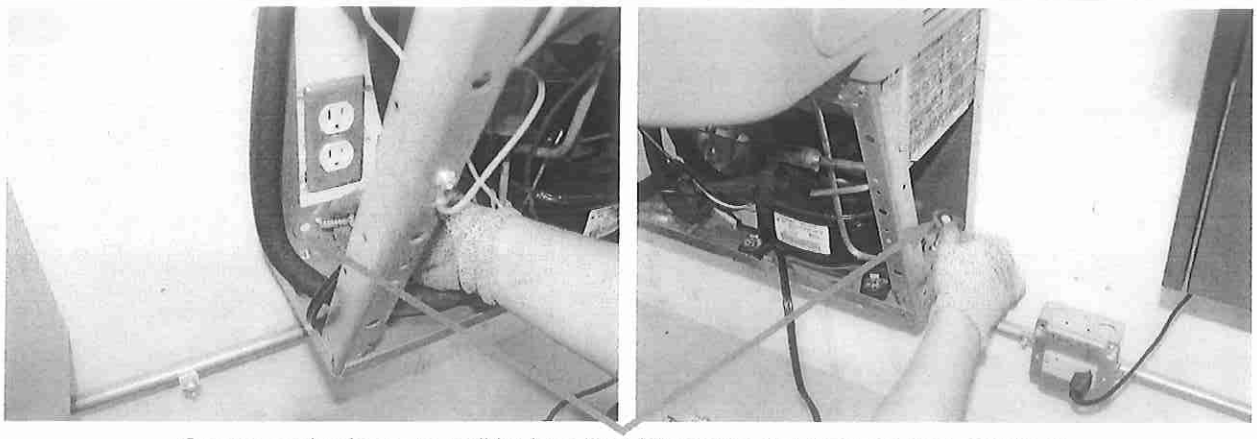
SOUTIREUSE INSTALLATION

8) Retirer les deux vis (2) de montage avec 5/32 «clé Allen de maintien de remplissage de la bouteille à la plaque murale de montage (Voir Fig.4, p. 6). Remarque ne jetez pas les vis de montage, ils seront nécessaires pour assurer la charge de la bouteille pour montage mural assiette.
9) Retirer la plaque murale de montage du flacon de remplissage (voir la figure 4, p. 6). Placez la plaque de montage mural contre le mur au-dessus du bassin. Centrez le côté de la plaque de montage mural à l'autre avec le bassin. Marquez les six trous (6) de montage avec un crayon (voir Fig. 1, p. 2). Placer du ruban adhésif sur le câblage HARNES conection sur le dessus du refroidisseur pour empêcher les débris de tomber dans la connexion (voir Fig. 3, p. 6).
10) Retirer la plaque de fixation murale du mur. **REMARQUE** : La plaque de fixation doit **IMPÉRATIVEMENT** être solidement soutenue. Ajouter un socle d'appareil si le mur n'offre pas un support suffisant.
11) Monter la plaque de fixation murale au mur en utilisant les six (6) trous de fixation oblongs de 7/16 po (vis de fixation non fournies) (voir Fig. 4, p. 6). Utiliser la visserie qui convient pour le type de mur.
12) Monter le joint sur le dessous de la remplisseuse de bouteille avec la bride de fixation de joint, deux (2) rondelles et deux (2) vis (voir Fig. 5, 6, p. 7).
13) Raccorder la conduite d'eau de refroidisseur à 3/8 «john raccord invité. Branchez le faisceau de câblage en haut de refroidisseur. (Voir Fig. 8, p. 8).
14) Lieu bouteille remplissage sur quatre (4) crochets sur la plaque de montage installée sur le mur. Assurez-vous que le patron ronde joint correspond au trou du bassin. (Voir fig. 9, p. 8).
15) Sortir le filtre de l'emballage, retirer le capuchon protecteur, attacher le filtre à la tête de filtre en l'enfonçant fermement dans la tête et en le tournant dans le sens des aiguilles d'une montre. Vérifier que l'étiquette bleue peut être lue une fois le filtre installé. (Figure 14, page 10.)
16) Ouvrir l'arrivée d'eau et vérifier l'étanchéité du circuit de la fontaine à eau fraîche et de la remplisseuse de bouteille. Réparer toutes les fuites avant de continuer.
17) Une fois que l'étanchéité de la fontaine et de la remplisseuse a été vérifiée et que toutes les fuites éventuelles ont été réparées, brancher la fontaine sur la prise électrique.
18) Réinstaller deux vis de montage de la première étape (voir Fig. 4, p. 6). Attention, ne pas trop serrer les vis.
19) Une fois que la tension est appliquée au refroidisseur le feu vert LED illuminera sur la charge de la bouteille montrant le bon état du filtre avec le LCD Bouteille compteur.
20) Pour vérifier le bon fonctionnement de la commande de remplissage, placer un gobelet, la main ou tout objet opaque devant le capteur et s'assurer que l'eau s'écoule. Remarque : Lors des premiers remplissages, la présence d'air dans la conduite peut produire des crachotements. Cela cesse une fois que tout l'air a été purgé de la conduite.
21) Une fois les essais de l'appareil satisfaisants, remonter le panneau inférieur sur la fontaine à eau fraîche. Les appareils sont à présent prêt à l'emploi.

Instructions de changement des filtres

1) Retirer le couvercle inférieur sur refroidisseur en enlevant (4) vis (Voir Fig.10, p. 8).
2) Fermer l'arrivée d'eau; activer la distribution d'eau pour libérer la pression.
3) Tourner le filtre usagé de 1/4 de tour dans le sens inverse des aiguilles d'une montre pour le détacher de la tête de filtre.
4) Retirer le capuchon du filtre neuf et l'utiliser pour reboucher le filtre usagé.
5) Insérer le filtre neuf dans la tête de filtre existante et le tourner à fond dans le sens des aiguilles d'une montre. Vérifier que l'étiquette est sur l'avant et peut être lue une fois le filtre installé (voir Fig. 14, p. 10).
6) Ouvrir l'arrivée d'eau et faire couler un minimum de 8 litres (2 gallons) d'eau à travers le filtre pour purger l'air et les fines particules de carbone du filtre. Laisser aussi l'eau couler à travers la remplisseuse de bouteille.

Remarque : Le voyant d'état du filtre se réinitialise automatiquement lorsqu'un filtre neuf est installé.



Secure cooler frame to wall by installing (2) screws and washers (not supplied).
Para fijar la estructura del bebedero a la pared, instale (2) tornillos y arandelas (no se proporcionan).
Fixer le bâti de la fontaine à eau fraîche au mur à l'aide de deux (2) vis et rondelles (non fournies).

FIG. 2

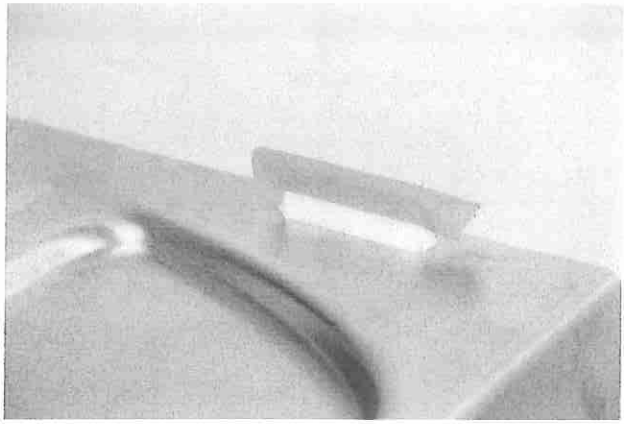


FIG. 3

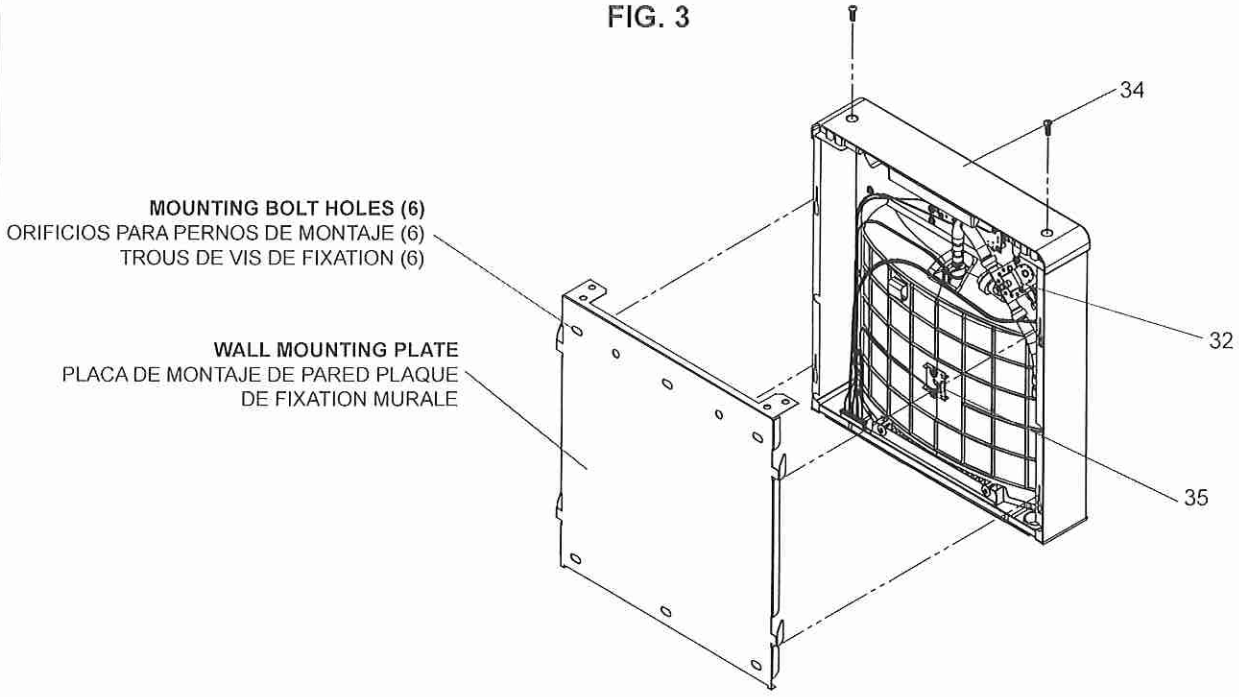


Fig. 4

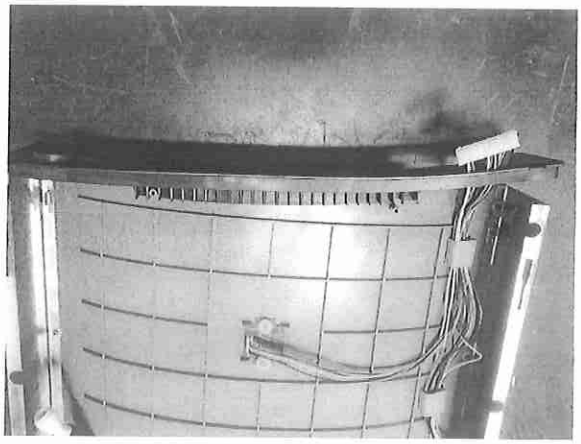
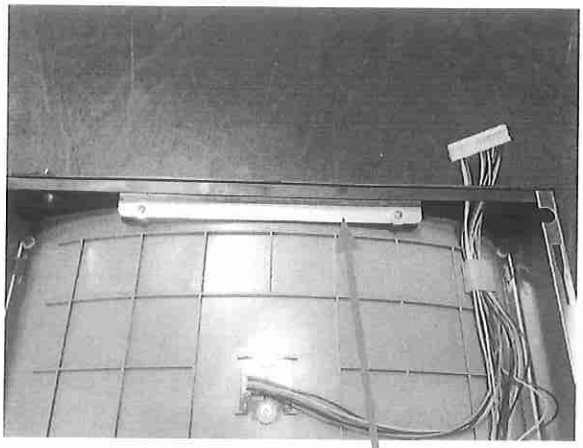


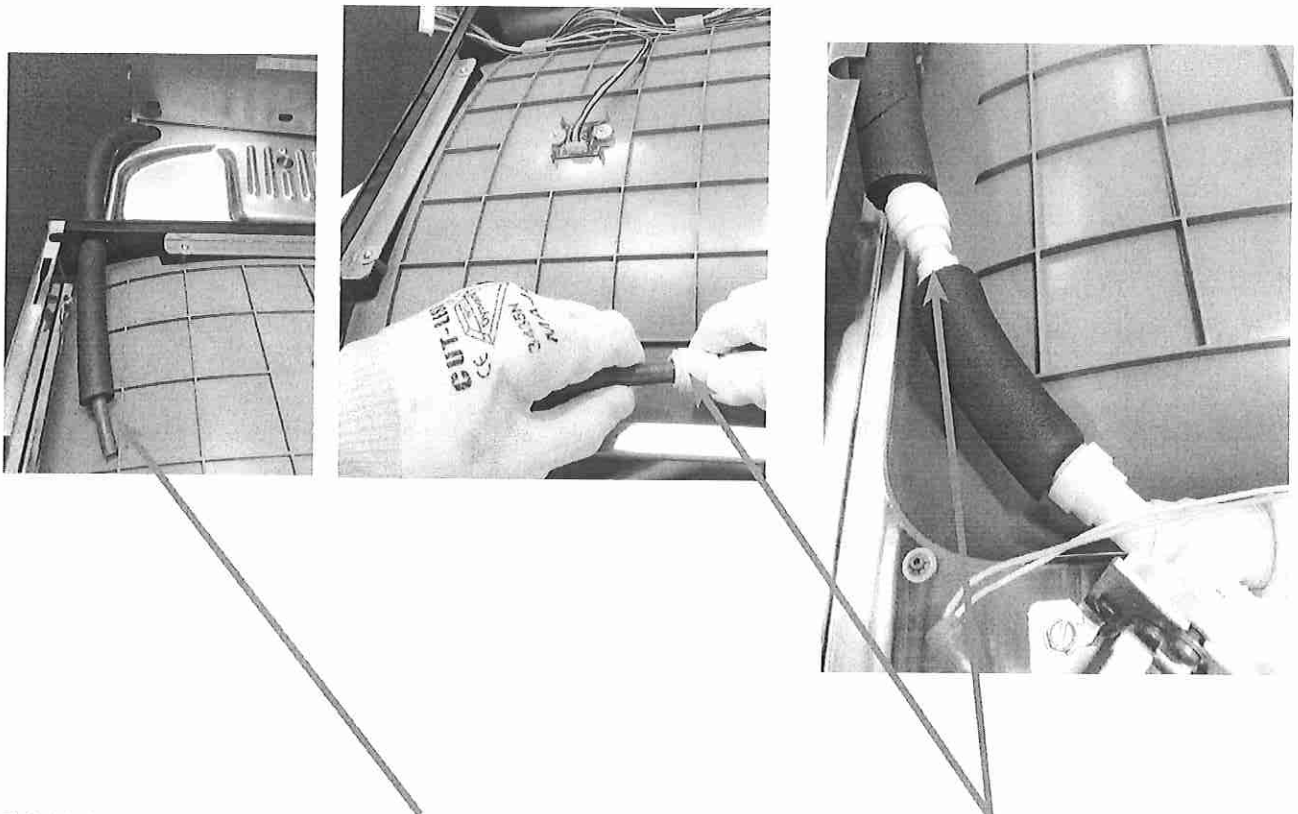
Fig. 5



BRACKET, WASHERS, & SCREWS
SOPORTE, ARANDELAS Y TORNILLOS
BRIDE, RONDELLES ET VIS

Fig. 6

BOTTLE FILLER PLUMBING CONNECTIONS
CONEXIONES DE PLOMERÍA DE LA LLENADORA DE BOTELLAS
RACCORDEMENTS DE TUYAUTERIE DE LA REMPLISSEUSE DE BOUTEILLE

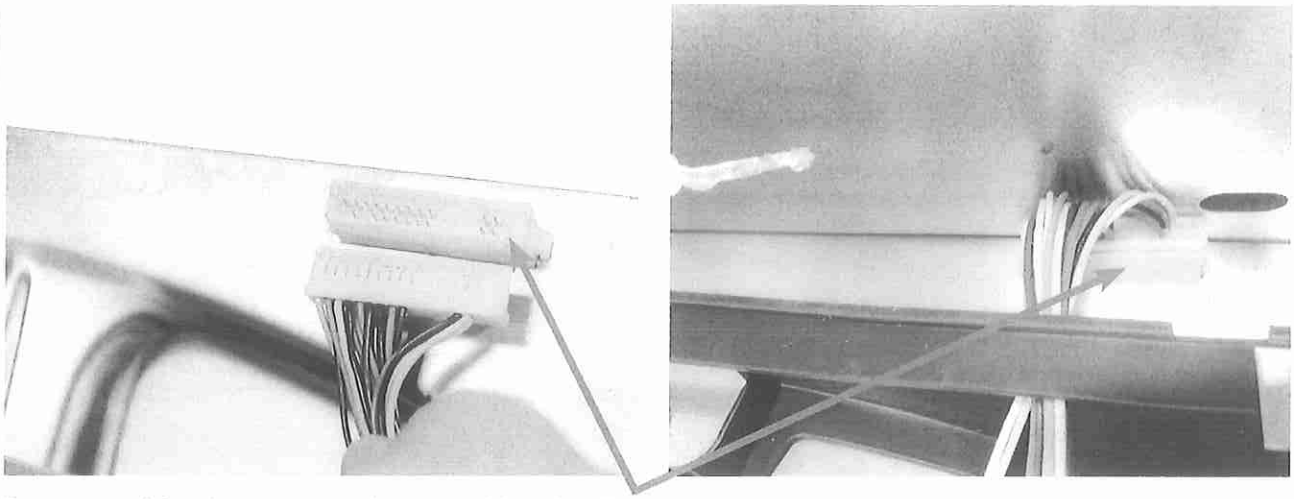


Fish 3/8 inch water line up through basin hole and hole in gasket.
Pase la tubería de agua de 3/8" a través del orificio de la tarja y del orificio en la empaquetadura.
Tirer la conduite d'eau de 3/8 po à travers le trou de la fontaine et le joint.

Connect 3/8 inch water line to White Connector.
Conecte la tubería de agua de 3/8" en el conector blanco.
Raccorder la conduite d'eau de 3/8 po au connecteur blanc.

Fig. 7

BOTTLE FILLER ELECTRICAL CONNECTIONS
Conexiones eléctricas de la llenadora de botellas
Raccordements électriques de la remplisseuse de bouteille



Connect wiring harness to the top of Cooler. Ensure all pins line up.
Conecte el haz de cables en la parte superior del bebedero. Asegúrese de que todas las clavijas estén alineadas.
Raccorder le faisceau de câbles au sommet de la fontaine à eau fraîche. Vérifier le bon alignement de toutes broches.

Fig. 8

Make sure round boss in gasket fits in hole of basin.
Asegúrese de que la saliente redonda de la empaquetadura encaje en el orificio de la tarja.
Vérifier que le bossage rond du joint s'engage dans l'orifice de la fontaine.

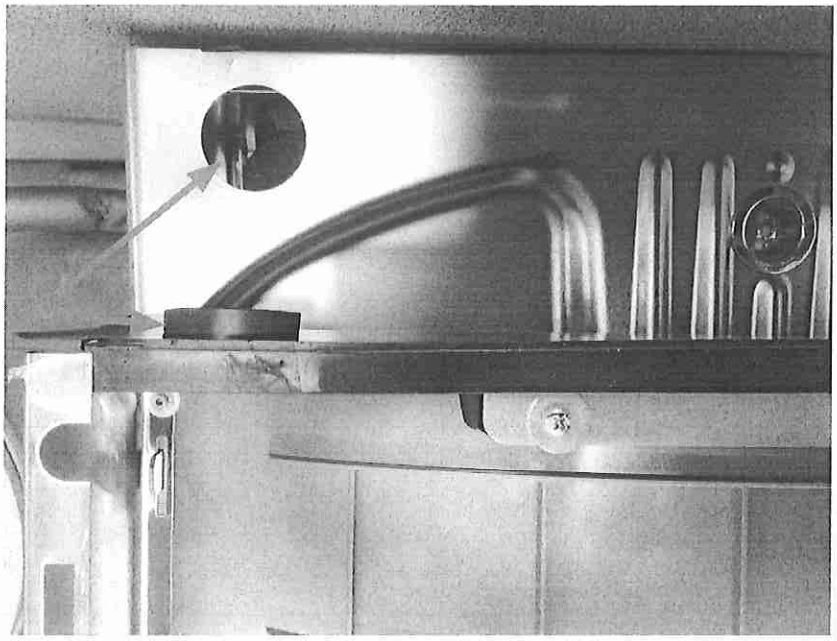


Fig. 9

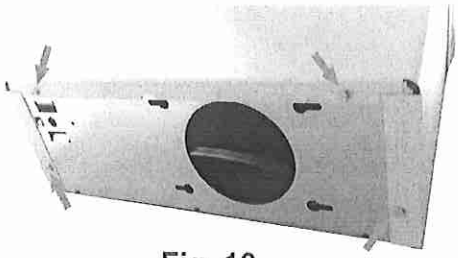


Fig. 10

115V Refrigerated Wiring Diagram with Alpha/Numeric Display

Diagrama de cableado de modelo refrigerado de 115 V con pantalla alfanumérica

Schéma de câblage du modèle réfrigéré de 115 V à affichage alphanumérique

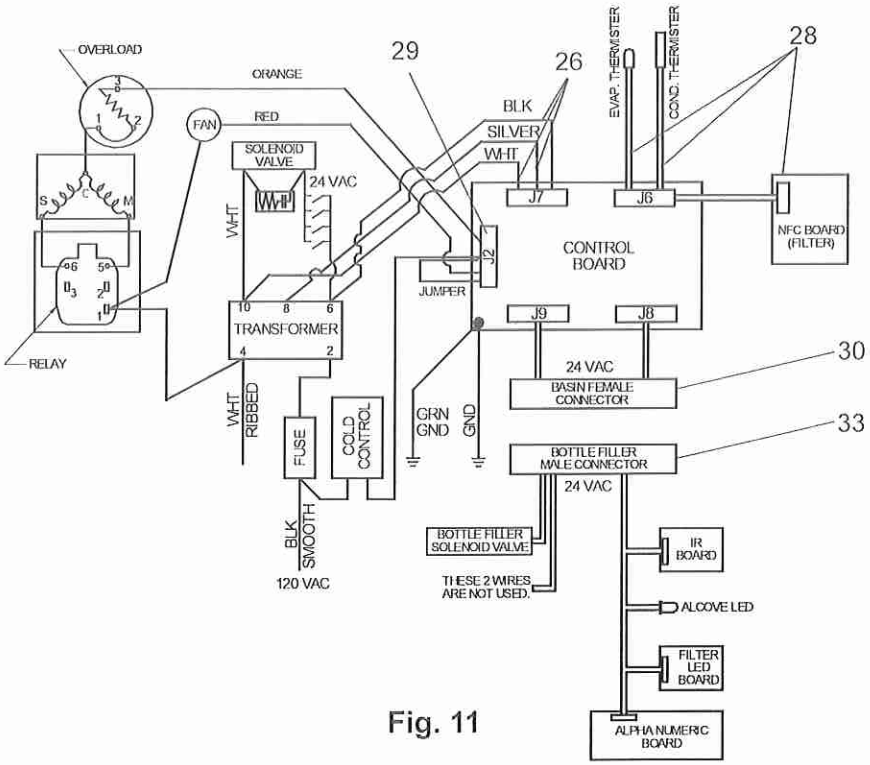
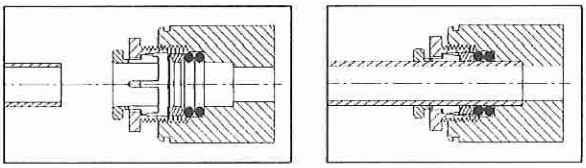


Fig. 11

Superseal Fitting Assembly

Montaje del conector Superseal

Assemblage du raccord Superseal



Note: Screw the locknut hand tight to seal

Nota: Atornille la contratuerca con la mano para sellar

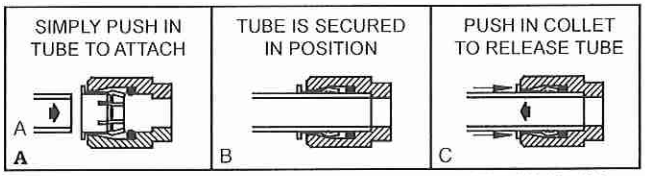
Remarque : Visser la main de l'écrou de blocage pour assurer l'étanchéité

Fig. 12

OPERATION OF QUICK CONNECT FITTINGS

FUNCIONAMIENTO DE LOS CONECTORES DE CONEXIÓN RÁPIDA

FONCTIONNEMENT DES RACCORDS RAPIDES



SIMPLEMENTE PRESIONE LA TUBERÍA HACIA ADENTRO PARA CONECTAR

IL SUFFIT D'ENFONCER LE TUBE POUR L'ATTACHER

LA TUBERÍA QUEDA FIJA EN SU POSICIÓN

LE TUBE EST BLOQUÉ EN PLACE

PRESIONE EL COLLAR HACIA ADENTRO PARA SOLTAR LA TUBERÍA

ENFONCER LE COLLET POUR LIBÉRER LE TUBE

PUSHING TUBE IN BEFORE PULLING IT OUT HELPS TO RELEASE TUBE

EMPUJAR LA TUBERÍA HACIA ADENTRO ANTES DE TIRAR DE ELLA HACIA AFUERA AYUDA A SOLTAR LA TUBERÍA

LE FAIT DE POUSSER SUR LE TUBE AVANT DE LE TIRER FACILITE SON DÉBLOCAGE

Fig. 13

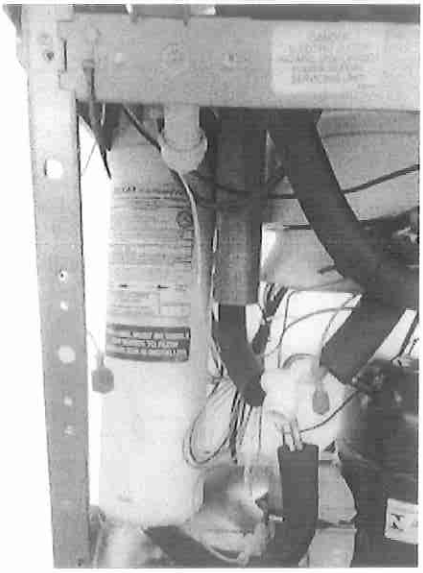


Fig. 14

Reference for Step 5
(Filter label location)
Referencia para el paso 5 (Ubicación de la etiqueta de filtro)
Référence à l'étape 5 (Emplacement de l'Etiquette filtre)

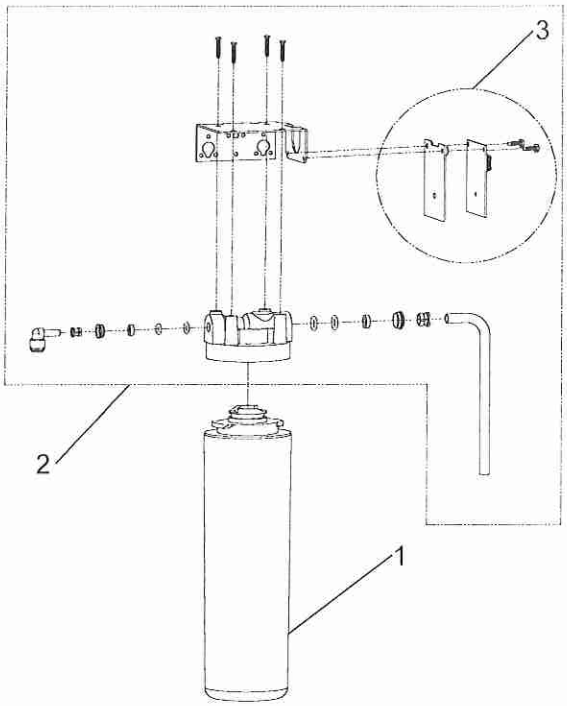
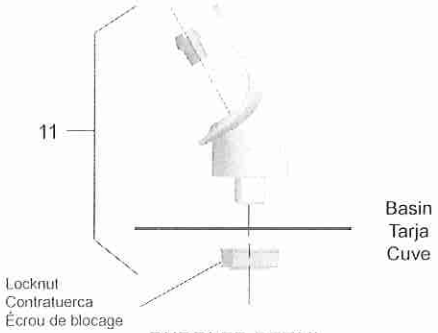


Fig. 15
WATERSENTRY® Filter Detail
Detalle del filtro WATERSENTRY®
Détail du filtre WATERSENTRY®



BUBBLER DETAIL
DETALLE DE LA BOQUILLA
DÉTAIL DU BARBOTEUR

Fig. 16

NOTE:
When installing replacement bubbler and pedestal, tighten nut only to hold parts snug in position. Do Not Overtighten.

NOTA:
Cuando instale la boquilla y el pedestal de repuesto, apriete la tuerca solo para ajustar las piezas en posición. No apriete en exceso.

REMARQUE:
Lors de la pose d'un socle et barboteur de rechange, serrer l'écrou juste assez pour tenir les pièces fermement en place. Ne pas forcer.

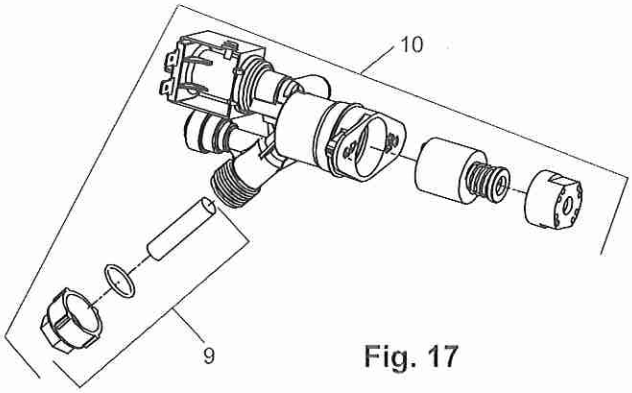


Fig. 17

Cleaning the strainer

To clean the strainer, unscrew the cap of the solenoid valve. Remove screen and rinse thoroughly with water. Insert screen back into solenoid valve and screw cap on. Make sure the o-ring is placed properly.

Limpieza del cedazo

Para limpiar el cedazo, destornille la tapa de la válvula de solenoide. Retire la rejilla y enjuague a fondo con agua. Vuelva a insertar la rejilla en la válvula de solenoide y atornille la tapa. Asegúrese de que la junta tórica esté instalada correctamente.

Nettoyage du filtre à tamis

Pour nettoyer le filtre à tamis, dévisser le capuchon de l'électrovanne. Déposer le tamis et bien le rincer à l'eau. Remettre le tamis en place dans l'électrovanne et revisser le capuchon. Vérifier que le joint torique est en position correcte.

WATERSENTRY® FILTER PARTS LIST (See Fig. 15)			LISTA DE PIEZAS DEL FILTRO WATERSENTRY® (Vea la Fig. 15)	LISTE DES PIÈCES DU FILTRE WATERSENTRY® (voir Fig. 15)
ITEM NO.	PART NO.	DESCRIPTION	DESCRIPCIÓN	DESCRIPTION
1	51300C	Filter Assy - 3000 Gal.	Conj. de filtro, 11.350 L (3.000 gal)	Filtre - 11 350 l (3 000 gal)
2	1000002030	Kit - Filter Head Fittings includes John Guest Fittings & 3/8" Elbow Filter Bracket/Screws	Kit: Los conectores del cabezal del filtro incluyen conectores John Guest y soporte y tornillos de filtro para codo de 3/8"	Trousse raccords de tête de filtre - comprend raccords John Guest et coude de 3/8 po Support de filtre/vis
3	1000002443	Kit - NFC Board/Cover	Kit: Panel NFC y cubierta	Trousse - Carte NFC/capot

Service Instructions

Lower and Upper Shroud

To access the refrigeration system and plumbing connections, remove four screws from bottom of cooler to remove the lower shroud. To remove the upper shroud for access to the pushbars, regulator, solenoid valve or other components located in the top of the unit, remove lower shroud, disconnect drain, remove four screws from tabs along lower edge of upper shroud, unplug two wires and water tube.

Bubbler

To remove the bubbler, first disconnect the power supply. The underside of the bubbler can be reached through the access panel on the underside of the upper shroud. Remove the access panel by removing the retaining screw. To remove the bubbler, loosen locknut from the underside of the bubbler and remove the tubing from the quick connect fitting per the Operation Of Quick Connect Fittings section in the General Instructions. After servicing, replace the access panel and retaining screw.

Switches Behind the Push Bar

The regulator in an EZ cooler is always held fully open by the use of a single regulator nut (See Fig. 17, Pg 10). Water is not dispensed until the pushbar is depressed to activate a switch which then opens a solenoid valve.

Single bar units will have the same wiring as side push bar units but will not have the extra leads attached to sidebars.

To remove sidebars, from the inside compress the flared tabs and pull out carefully. To reinstall side pushbars, the front of the pushbar is inserted first. While keeping the switch depressed, snap the rear of the pushbar into position.

Instrucciones de mantenimiento

Recubrimiento inferior y superior

Para acceder al sistema de refrigeración y a las conexiones de plomería, retire los cuatro tornillos de la parte inferior del bebedero para retirar el recubrimiento inferior. Para retirar el recubrimiento superior y acceder a las barras de empuje, al regulador, a la válvula de solenoide o a otros componentes ubicados en la parte superior de la unidad, retire el recubrimiento inferior, desconecte el desagüe, retire los cuatro tornillos de las lengüetas a lo largo del borde inferior del recubrimiento superior, desconecte los dos cables y la tubería de agua.

Boquilla

Para retirar la boquilla, primero desconecte el suministro de energía. Se puede alcanzar la parte inferior de la boquilla a través del panel de acceso en el lado inferior del recubrimiento superior. Para retirar el panel de acceso, retire el tornillo de retención. Para retirar la boquilla, suelte la contratuerca de la parte inferior de la boquilla y retire la tubería del conector de conexión rápida de acuerdo con la sección Funcionamiento de los conectores de conexión rápida en las instrucciones generales. Después de realizar mantenimiento, vuelva a colocar el panel de acceso y el tornillo de retención.

Interruptores detrás de la barra de empuje

El regulador de un bebedero EZ se mantiene siempre completamente abierto mediante el uso de una tuerca reguladora simple (consulte la Fig. 17, pág. 10). El agua no se dispensa hasta que se presiona la barra de empuje para activar un interruptor, el cual luego abre una válvula de solenoide.

Las unidades de una sola barra tienen el mismo cableado que las unidades con barra de empuje lateral, pero no tienen los conductores adicionales conectados a las barras laterales.

Para retirar las barras laterales, desde el interior comprima las lengüetas acampanadas y sáquelas con cuidado. Para volver a instalar las barras de empuje laterales, primero se inserta la parte delantera de la barra de empuje. Mientras mantiene el interruptor presionado, encaje la parte posterior de la barra de empuje en su posición.

Instructions d'entretien

Carénage supérieur et inférieur

Pour accéder au système de réfrigération et aux raccordements de tuyauterie, retirer les quatre vis du dessous de la fontaine à eau fraîche pour déposer le carénage inférieur. Pour déposer le carénage supérieur et accéder aux poussoirs, au régulateur, à l'électrovanne et aux autres composants installés dans la partie haute de l'appareil, déposer le carénage inférieur, débrancher l'écoulement de vidange, retirer les quatre vis des pattes le long du rebord inférieur du carénage supérieur, débrancher les deux fils et le tube à eau.

Barboteur

Pour déposer le barboteur, débrancher d'abord l'alimentation électrique. Le dessous du barboteur est accessible par le panneau d'accès situé sur le dessous du carénage supérieur. Retirer la vis de fixation pour déposer le panneau d'accès. Pour déposer le barboteur, desserrer l'écrou de blocage du dessous du barboteur et retirer le tube du raccord rapide conformément aux instructions de la section Fonctionnement des raccords rapides dans les instructions générales. Après l'intervention, remonter le panneau d'accès et la vis de fixation.

Interrupteurs derrière le poussoir

Le régulateur dans une fontaine à eau fraîche EZ est toujours maintenu complètement ouvert au moyen d'un écrou de régulateur unique (voir Fig. 17, p. 10). L'eau s'écoule lorsque le poussoir est enfoncé pour actionner un interrupteur qui commande alors l'ouverture d'une électrovanne.

Les modèles à poussoir unique comportent le même câblage que les modèles à poussoirs latéraux mais sans les fils supplémentaires raccordés aux poussoirs latéraux.

Pour déposer les poussoirs latéraux, comprimer les pattes évasées depuis l'intérieur et extraire avec précaution. Pour remonter les poussoirs latéraux, remettre d'abord le poussoir frontal en place. Tout en maintenant l'interrupteur enfoncé, encliqueter le poussoir latéral en place.

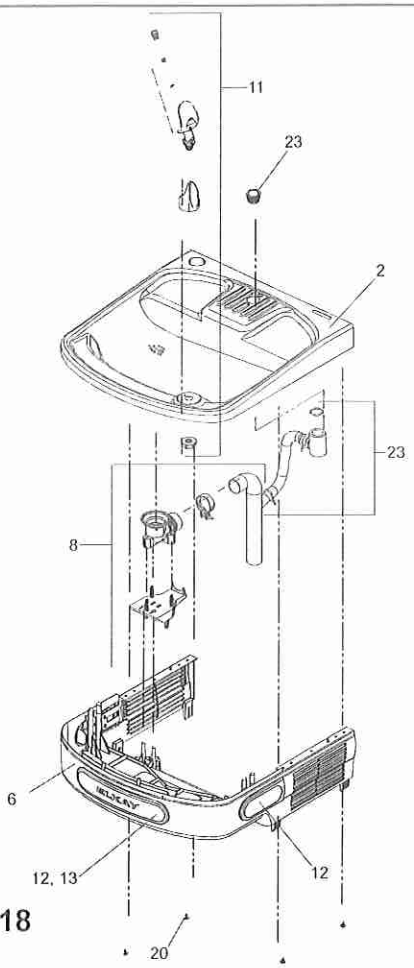


Fig. 18

Cleaning

Stainless Steel

- General cleaning: use an ordinary mild detergent and soft cloth, rinse and towel dry.
- Steel soap pads should never be used; particles can adhere to a stainless steel basin surface and will eventually rust.
- Light scratches are normal for stainless steel basins; over time they will blend into the uniform finish pattern.

Plastic Components

- General cleaning: use an ordinary mild detergent and soft cloth, rinse and towel dry.
- Wiping the surface clean to remove debris or build up will not hurt the antimicrobial properties.

Limpieza

Acero inoxidable

- Limpieza general: Use un detergente común suave y un paño suave, enjuague y seque con una toalla.
- Nunca se deben usar almohadillas de acero con jabón; las particulas se pueden adherir a la superficie de acero inoxidable de la tarja y finalmente se oxidarán.
- Las rayas ligeras son normales en las tarjas de acero inoxidable: con el tiempo, se mezclarán en un patrón de acabado uniforme.

Componentes de plástico

- Limpieza general: Use un detergente común suave y un paño suave, enjuague y seque con una toalla.
- Limpiar la superficie con un paño para retirar desechos o acumulaciones no afectará las propiedades antimicrobianas.

Nettoyage

Acier inoxydable

- Nettoyage général : utiliser un détergent doux ordinaire et un chiffon doux, rincer et sécher avec une serviette.
- Ne jamais utiliser de tampon savonneux en laine d'acier; des particules peuvent adhérer à la surface de la cuve en acier inoxydable et rouiller avec le temps.
- Les rayures légères sont normales sur les cuves en acier inoxydable ; avec le temps, elles finiront par former un motif de finition uniforme.

Pièces en plastique

- Nettoyage général : utiliser un détergent doux ordinaire et un chiffon doux, rincer et sécher avec une serviette.
- Le fait d'essuyer la surface pour éliminer les saletés ou les dépôts n'altère pas les propriétés antimicrobiennes.

Programming Instruction

Depress button for 3 seconds to activate main menu - release										
Cycles through main menu items 2 seconds each for 3 cycles then exits menu unless selected.										
Cycles through sub menu items 2 seconds each for 3 cycles then returns to main menu unless selected.										
Selections are saved and exits menu when idle for 10 seconds										
Top Level Menu	Action	Sub Menu 1	Action	Sub Menu/Action	Action	Sub Menu/Action	Action	Sub Menu/Action	Notes	End Action
Set Day/Time	Momentary									Drops to next level menu when selected
		Day (Sunday - Saturday)	Momentary						Flash days of week on display waiting for signal of selection. 3 cycles through days and display goes back to default.	Drops to next level menu when selected
		Hour (12 Hour)	Momentary						Scroll hours from 1-12, 3 cycles through hours and display goes back to default.	Drops to next level menu when selected
		Minute (0-60 in 5min increments)	Momentary						Scroll minutes from 0-60 in 5 minute increments, 3 cycles through minutes and display goes back to default.	Drops to next level menu when selected
		AM/PM	Momentary						Scroll AM and PM, 3 cycles through AM/PM and display goes back to default.	Returns to main menu
Filter Unit?	Momentary									
		No	Momentary	Turn off filter status and errors					No filter unit - LED board not used - Graphics Display does not show status - Error codes related to filter turned off.	Returns to main menu
		Yes	Momentary	Turn on filter status and errors					Filter unit has default config on - default config has read/write to filter. LED or Graphics stat display, filter error capability.	Returns to main menu
Refrigeration Unit?										
		No	Momentary	Turn off all regrigeration controls					Refrigeration off	Returns to main menu
		Yes	Momentary	Set unit to operate as refrigerated unit					Refrigeration on	Returns to main menu
Flow Rate?										
		High	Momentary	Set Water Rate 1.5 Gal/Min					Set water rate setting to 1.5gal/min.	Returns to main menu
		Low	Momentary	Set Water Rate 1.1 Gal/min					Set water rate setting to 1.1gal/min.	Returns to main menu
Water Temperature	Momentary									
		Cold	Momentary	Set to "Cold" Temperature					Approx 58° F	Returns to main menu
		Colder	Momentary	Set to Default Temperature					Approx 54° F	Returns to main menu
		Coldest	Momentary	Set to defined "Coldest" Temperature					Approx 50° F	Returns to main menu
Backlight Setting	Momentary	Set Backlight/Alcove light in idle mode	Momentary						Backlight settings are: 1=25%, 2=50%, 3=75% and 4=100%	
				1 (= 25%)	Momentary					Returns to main menu
				2 (=50%)	Momentary					Returns to main menu
				3 (=75%)	Momentary					Returns to main menu
				4 (=100%)	Momentary					Returns to main menu
Energy Save Mode	Momentary									
		Off	Momentary	Default operation					Unit runs with control board controlled refrigeration on always.	Returns to main menu
		On	Momentary	Set Energy Save Schedule					Unit refrigeration is shut off based on schedule.	Drops to next level menu when selected
						Select Weekdays (default when no time is selected = Always off)			Weekdays (Monday - Friday) schedule settings	Drops to next level menu when selected
							Momentary	Select Time on	24 Hours - 1-12AM and 1-12 PM	Drops to next level menu when selected
							Momentary	Select Time off	24 Hours - 1-12AM and 1-12 PM	Drops to next level menu when selected
						Select Weekend			Weekend (Saturday and Sunday) scheduled settings.	Drops to next level menu when selected
							Momentary	Select Time on	24 Hours - 1-12AM and 1-12 PM	Drops to next level menu when selected
							Momentary	Select Time off	24 Hours - 1-12AM and 1-12 PM	Returns to main menu
View Error Codes	Momentary	Flashes Error Codes							2 seconds each / 3 cycles through codes	Returns to main menu
Clear Error Codes	Momentary	Are you sure?	Momentary	Yes - Clear error modes					Clears all error codes in control board memory.	Exit Menu

Instrucción de programación

Presione el botón durante 3 segundos para activar el menú principal; suelte.										
Alterna a través de los elementos del menú principal por 2 segundos cada uno durante 3 ciclos, luego sale del menú a menos que se seleccione alguno.										
Alterna a través de los elementos del submenú principal por 2 segundos cada uno durante 3 ciclos, luego vuelve al menú principal a menos que se seleccione alguno.										
Las selecciones se guardan y se sale del menú cuando está inactivo durante 10 segundos.										
Menú de nivel superior	Acción	Submenú 1	Acción	Submenú/Acción	Acción	Submenú/Acción	Acción	Submenú/Acción	Notas	Acción final
Set Day/Time (Ajustar día y hora)	Momentánea									Pasa al menú del nivel siguiente cuando se selecciona
		Día (sábado - domingo)	Momentánea						Los días de la semana parpadean en la pantalla a la espera de una señal de selección; 3 ciclos a través de los días y la pantalla volverá al valor predeterminado.	Pasa al menú del nivel siguiente cuando se selecciona
		Hora (12 horas)	Momentánea						Desplácese por las horas de 1 a 12, 3 ciclos a través de las horas y la pantalla vuelve a predeterminado.	Pasa al menú del nivel siguiente cuando se selecciona
		Minuto (0 a 60 en incrementos de 5 min)	Momentánea						Desplácese por los minutos de 0 a 60 en incrementos de 5 min, 3 ciclos a través de los minutos y la pantalla vuelve a predeterminado.	Pasa al menú del nivel siguiente cuando se selecciona
		AM/PM	Momentánea						Desplácese por AM y PM, 3 ciclos a través de AM/PM y la pantalla vuelve a predeterminado.	Regresa al menú principal
Filter Unit? (¿Unidad de filtro?)	Momentánea									
		No	Momentánea	Apagar el estado y los errores del filtro					Sin unidad de filtro: El panel LED no se usa; la pantalla de gráficos no muestra el estado; códigos de error relacionados con el filtro apagado.	Regresa al menú principal
		Yes (Sí)	Momentánea	Encender el estado y los errores del filtro					La configuración predeterminada de la unidad de filtro está encendida: La configuración predeterminada tiene lectura y escritura de filtro; pantalla LED o de gráficos de estado; capacidad para determinar errores del filtro.	Regresa al menú principal
Refrigeration Unit? (¿Unidad de refrigeración?)										
		No	Momentánea	Apagar todos los controles de refrigeración					Refrigeración apagada	Regresa al menú principal
		Yes (Sí)	Momentánea	Ajustar la unidad para que funcione como unidad refrigerada					Refrigeracion encendida	Regresa al menú principal
Flow Rate? (¿Caudal?)										
		High (Alto)	Momentánea	Ajustar el caudal en 5.7 l/min (1.5 gal/min)					Ajustar la posición del caudal en 5.7 l/min (1.5 gal/min)	Regresa al menú principal
		Low (Bajo)	Momentánea	Ajustar el caudal en 4.2 l/min (1.1 gal/min)					Ajustar la posición del caudal en 4.2 l/min (1.1gal/min)	Regresa al menú principal
Water Temperature (Temperatura del agua)	Momentánea									
		Cold (Fría)	Momentánea	Ajustar a "Fría"					Aproximadamente a 14°C (58°F)	Regresa al menú principal
		Colder (Más fría)	Momentánea	Ajustar a la temperatura predeterminada					Aproximadamente a 12°C (54°F)	Regresa al menú principal
		Coldest (La más fría)	Momentánea	Ajustar a la temperatura definida como "La más fría"					Aproximadamente a 10°C (50°F)	Regresa al menú principal
Backlight Setting (Ajuste la luz de fondo)	Momentánea	Ajustar la luz de fondo/ Luz de cavidad en modo inactivo	Momentánea						Los ajustes de la luz de fondo son los siguientes: 1 = 25 %, 2 = 50 %, 3 = 75 % y 4 = 100 %	
				1 (= 25 %)	Momentánea					Regresa al menú principal
				2 (= 50 %)	Momentánea					Regresa al menú principal
				3 (= 75 %)	Momentánea					Regresa al menú principal
				4 (= 100 %)	Momentánea					Regresa al menú principal
Energy Mode (Modo de ahorro de energía)	Momentánea									
		Off (Apagado)	Momentánea	Funcionamiento predeterminado					La unidad funciona siempre con la refrigeración encendida controlada por el panel de control.	Regresa al menú principal
		On (Encendida)	Momentánea	Ajustar el programa de ahorro de energía					La unidad de refrigeración se apaga según el programa.	Pasa al menú del nivel siguiente cuando se selecciona
						Seleccionar los días hábiles (predeterminado cuando no se selecciona una hora= siempre apagado)			Ajustes de programa de los días hábiles (lunes a viernes)	Pasa al menú del nivel siguiente cuando se selecciona
							Momentánea	Seleccionar la hora de encendido	24 horas: De 1 a 12 AM y de 1 a 12 PM	Pasa al menú del nivel siguiente cuando se selecciona
							Momentánea	Seleccionar la hora de apagado	24 horas: De 1 a 12 AM y de 1 a 12 PM	Pasa al menú del nivel siguiente cuando se selecciona
						Seleccionar el fin de semana			Ajustes de programa del fin de semana (sábado y domingo)	Pasa al menú del nivel siguiente cuando se selecciona
							Momentánea	Seleccionar la hora de encendido	24 horas: De 1 a 12 AM y de 1 a 12 PM	Pasa al menú del nivel siguiente cuando se selecciona
							Momentánea	Seleccionar la hora de apagado	24 horas: De 1 a 12 AM y de 1 a 12 PM	Regresa al menú principal
View Erros (Ver códigos de error)	Momentánea	Parpadeo de los códigos de error							2 segundos cada uno / 3 ciclos a través de los códigos	Regresa al menú principal
Clear Error Codes (Borrar los códigos de error)	Momentánea	Are you sure? (¿Está seguro?)	Momentánea	Yes (Sí): borrar los modos de error					Borra todos los codigos de error en la memoria del panel de control.	Salir del menú

Instructions de programmation

Enfoncer le bouton pendant 3 secondes pour activer le menu principal - relâcher										
Les options du menu principal défilent durant 2 secondes chacune pendant 3 cycles complets puis le système quitte le menu si aucune option n'est sélectionnée.										
Les options du sous-menu défilent durant 2 secondes chacune pendant 3 cycles complets puis le système revient au menu principal si aucune option n'est sélectionnée.										
Le système enregistre les sélections puis quitte le menu au bout de 10 secondes d'inactivité.										
Menu principal	Action	Sous-menu 1	Action	Sous-menu/Action	Action	Sous-menu/Action	Action	Sous-menu/Action	Remarques	Action finale
Set Day/Time (Régler jour/heure)	Momentanée									Descend au niveau de menu suivant si sélectionné
		Jour (dimanche à samedi)	Momentanée						Les jours de la semaine défilent à l'écran jusqu'à la sélection, 3 cycles complets puis retour au réglage par défaut.	Descend au niveau de menu suivant si sélectionné
		Heure (12 heures)	Momentanée						Les heures défilent de 1 à 12, 3 cycles complets puis retour au réglage par défaut.	Descend au niveau de menu suivant si sélectionné
		Minutes (0 à 60 par incréments de 5 min)	Momentanée						Les minutes défilent de 0 à 60 par incréments de 5 min, 3 cycles complets puis retour au réglage par défaut.	Descend au niveau de menu suivant si sélectionné
		AM/PM	Momentanée						AM et PM défilent en alternance, 3 cycles complets puis retour au réglage par défaut.	Retour au menu principal
Filter Unit? (Filtre?)	Momentanée									
		No (Non)	Momentanée	Désactive l'état et les erreurs de filtre					Pas de filtre - Circuit de voyant non utilisé - L'affichage graphique n'indique pas l'état - Codes d'erreur concernant le filtre désactivés.	Retour au menu principal
		Yes (Oui)	Momentanée	Active l'état et les erreurs de filtre					Configuration par défaut du filtre activée - lecture/écriture vers filtre, voyant ou affichage graphique, capacité d'erreur de filtre.	Retour au menu principal
Refrigeration Unit? (Réfrigération?)										
		No (Non)	Momentanée	Désactive tous les commandes de refrigeration					La réfrigération est désactivée	Retour au menu principal
		Yes (Oui)	Momentanée	Configuré pour fonctionner en tant qu'appareil réfrigéré					La réfrigération est activée	Retour au menu principal
Flow Rate? (Débit?)										
		High (Haut)	Momentanée	Réglage du débit d'eau à 5,7 l/min (1,5 gal/min)					Réglage du débit d'eau à 5,7 l/min (1,5 gal/min)	Retour au menu principal
		Low (Bas)	Momentanée	Réglage du débit d'eau à 4,2 l/min (1,1 gal/min)					Réglage du débit d'eau à 4,2 l/min (1,1 gal/min)	Retour au menu principal
Water Temperature (Température de l'eau)	Momentanée									
		Cold (Froid)	Momentanée	Réglage de température « froid »					14 °C (58 °F) environ	Retour au menu principal
		Colder (Plus froid)	Momentanée	Réglage de température par défaut					12 °C (54 °F) environ	Retour au menu principal
		Coldest (Très froid)	Momentanée	Réglage de température « très froid »					10 °C (50 °F) environ	Retour au menu principal
Backlight Setting (Rétroéclairage)	Momentanée	Rétroéclairage/éclairage d'alcove en mode de veille	Momentanée						Les réglages de rétroéclairage sont : 1 = 25 %, 2 = 50 %, 3 = 75 % et 4 = 100 %	
				1 (= 25 %)	Momentanée					Retour au menu principal
				2 (= 50 %)	Momentanée					Retour au menu principal
				3 (= 75 %)	Momentanée					Retour au menu principal
				4 (= 100 %)	Momentanée					Retour au menu principal
Energy Save Mode (Mode d'économie d'énergie)	Momentanée									
		Off (Désactivé)	Momentanée	Mode de fonctionnement par défaut					Commande de réfrigération par la carte de commande toujours activée durant la marche de l'appareil.	Retour au menu principal
		On (Activé)	Momentanée	Active le mode d'économie d'énergie					La réfrigération est désactivée suivant un horaire défini.	Descend au niveau de menu suivant si sélectionné
						Sélectionner jours de semaine (réglage par défaut si aucun horaire n'est sélectionné = Toujours désactivé)			Paramètres de l'horaire de jours de semaine (lundi à vendredi)	Descend au niveau de menu suivant si sélectionné
							Momentanée	Sélectionner les heures d'activation	24 heures - 1 à 12 AM et 1 à 12 PM	Descend au niveau de menu suivant si sélectionné
							Momentanée	Sélectionner les heures de désactivation	24 heures - 1 à 12 AM et 1 à 12 PM	Descend au niveau de menu suivant si sélectionné
						Sélection la fin de semaine			Paramètres de l'horaire de fin de semaine (samedi et dimanche)	Descend au niveau de menu suivant si sélectionné
							Momentanée	Sélectionner les heures d'activation	24 heures - 1 à 12 AM et 1 à 12 PM	Descend au niveau de menu suivant si sélectionné
							Momentanée	Sélectionner les heures de désactivation	24 heures - 1 à 12 AM et 1 à 12 PM	Retour au menu principal
View Error Codes (Afficher les codes d'erreur)	Momentanée	Affiche les codes d'erreur en clignotant							2 secondes chacun / défilement de 3 cycles complets de codes	Retour au menu principal
Clear Error Codes (Effacer les codes d'erreur)	Momentanée	Are you sure? (Confirmer?)	Momentanée	Yes (Oui) - Efface les codes d'erreur					Efface tous les codes d'erreur de la mémoire de la carte de commande.	Quitte le menu

Enhanced EZH2O Error Codes

Error Code	Error Description	Corrective Action
E001	Evaporator Thermistor Open Circuit	• Verify cable connector is plugged into control board (10 pin connector on harness # 0000001225) • If error repeats, contact certified service professional
E002	Evaporator Thermistor Short Circuit	• Check for excessive moisture on control board around 10 pin connector on harness # 0000001225 • If error repeats, contact certified service professional
E003	Evaporator Low Temperature	• Unplug unit for at least 30 seconds and restart • Monitor compressor for run-on condition • If error repeats, contact certified service professional
E004	Condenser Thermistor Open Circuit	• Verify cable connector is plugged into control board (10 pin connector on harness # 0000001225) • If error repeats, contact certified service professional
E005	Condenser Thermistor Short Circuit	• Check for excessive moisture on control board around 10 pin connector on harness # 0000001225 • If error repeats, contact certified service professional
E006	Condenser Over Temperature	• Clean condenser if needed • Check for proper fan operation (powers on, not obstructed, etc.) • Contact certified service professional
E007	Not Used	
E008	Not Used	
E009	Too Many Compressor Cycles	• Contact certified service professional
E010	Not Used	
E011	Evaporator not cooling/Thermistor not measuring	• Contact certified service professional
E012	Bottle filler area obstructed	• Clean lens on IR sensor • Unplug unit for at least 30 seconds and restart • If error repeats, replace IR sensor with 1000002434 KIT - IR SENSOR
E013	Missing or Incompatible Filter	• Check that filter is installed correctly (label facing forward, white tag facing back) • Unplug unit for at least 30 seconds and restart • Replace filter • Replace filter head assembly with repair kit - 1000002030 KIT - FILTER HEAD-BRKT-FTGS • If error repeats, contact certified service professional
E014	Missing NFC Board	• Unplug unit for at least 30 seconds and restart • Verify cable connector is plugged into NFC board on filter head assembly • Verify cable connector is plugged into control board (10 pin connector on harness # 0000001225) • Replace filter head assembly with repair kit - 1000002030 KIT - FILTER HEAD-BRKT-FTGS • If error repeats, contact certified service professional
E015	Missing LED Board	• Verify cable connector is plugged into LED board in the bottle filler tower assembly • Verify cable connector is fully plugged into the basin from the tower assembly. • Verify cable connector is plugged into control board (18 pin connector on harness # 1000001608) • Replace LED filter status board with repair kit - 1000002436 KIT - ALPHA NUMERIC LED BOARD • Replace tower cable harness – 1000001609 HARNESS-BASIN FEED TO BF • Replace fountain cable harness – 1000001608 HARNESS-CNTRL BOARD TO BASIN FEED

Códigos de Error EZH2O mejorada

Código de error	Descripción del error	Action corrective
E001	Circuito abierto del termistor de evaporador	• Verificar el conector del cable está enchufado en el tablero de control (10 conector perno arnés 0000001225 #) • Si se repite el error, póngase en contacto con profesionales de servicio certificado
E002	Evaporador de termistor corto circuitot	• Compruebe la humedad excesiva en el tablero de control alrededor de 10 conector perno arnés 0000001225 # • Si se repite el error, póngase en contacto con profesionales de servicio certificado
E003	Evaporador baja temperatura	• Desconecte la unidad durante al menos 30 segundos y reinicia • Compresor de monitor para la condición de funcionamiento • Si se repite el error, póngase en contacto con profesionales de servicio certificado
E004	Circuito abierto de termistor condensador	• Verificar el conector del cable está enchufado en el tablero de control (10 conector perno arnés 0000001225 #) • Si se repite el error, póngase en contacto con profesionales de servicio certificado
E005	Condensador de termistor corto circuito	• Compruebe la humedad excesiva en el tablero de control alrededor de 10 conector perno arnés 0000001225 # • Si se repite el error, póngase en contacto con profesionales de servicio certificado
E006	Condensador superior a la temperatura	• Condensador limpieza si es necesario • Verificar el funcionamiento del ventilador adecuado (poderes sobre, no obstruido, etc.) • Comuníquese con servicio certificado profesional
E007	No se usa	
E008	No se usa	
E009	Muchos ciclos de compresor	• Comuníquese con servicio certificado profesional
E010	No se usa	
E011	Evaporador de refrigeración/termistor no medir la	• Comuníquese con servicio certificado profesional
E012	Área de llenado de botella obstruido	• Limpia lente de sensor IR • Desconecte la unidad durante al menos 30 segundos y restar • Si el error se repite, cambie sensor IR con KIT 1000002434 - SENSOR IR
E013	Filtro que falta o Incompatible	• Compruebe que el filtro está instalado correctamente (etiqueta de frente, blanco de la etiqueta hacia atrás) • Desconecte la unidad durante al menos 30 segundos y reinicia • Reemplace el filtro • Reemplace el cabezal de filtro con kit de reparación - KIT 1000002030 - filtro-accesorios de cabeza soporte • Si se repite el error, póngase en contacto con profesionales de servicio certificado
E014	Falta de NFC de jabalí	• Desconecte la unidad durante al menos 30 segundos y reinicia • Verificar el conector del cable está enchufado en el tablero de NFC en el cabezal del filtro • Verificar el conector del cable está enchufado en el tablero de control (10 conector perno arnés 0000001225 #) • Reemplace el cabezal de filtro con kit de reparación - KIT 1000002030 - filtro-accesorios de cabeza soporte • Si se repite el error, póngase en contacto con profesionales de servicio certificado
E015	Falta tablero LED	• Verificar el conector del cable está enchufado en el tablero del LED en el montaje de la torre de botella relleno • Verificar el conector del cable está enchufado completamente en la cuenca del montaje de la torre. • Verificar el conector del cable está enchufado en el tablero de control (pines 18 arnés # 1000001608) • Reemplazar filtro estado tablero de LED con repair kit - KIT 1000002436 - alfa numérico LED Junta • Reemplazar cables de torre-1000001609 cuenca de arnés de alimentación a BF • Reemplazar cables fuente – 1000001608 arnés de CONTROL junta a Cuenca de alimentación

Codes d'erreur EZH2O renforcée

Code d'erreur	Description de l'erreur	Action corrective
E001	Évaporateur thermistance Circuit ouvertt	• Vérifiez le connecteur du câble est bien branché de contrôle des stupéfiants (10 broches sur harnais # 0000001225) • Si l'erreur se répète, contact service professionnel certifié
E002	Évaporateur thermistance Court Circuit	• Recherchez une humidité excessive sur le contrôle des stupéfiants d'environ 10 broches sur harnais # 0000001225 • Si l'erreur se répète, contact service professionnel certifié
E003	Faible température de l'évaporateur	• Débrancher l'appareil pendant au moins 30 secondes puis redémarrezt • Compresseur de moniteur pour exécuter-sur condition • Si l'erreur se répète, contact service professionnel certifié
E004	Circuit ouvert thermistance de condenseur	• Vérifiez le connecteur du câble est bien branché de contrôle des stupéfiants (10 broches sur harnais # 0000001225) • Si l'erreur se répète, contact service professionnel certifié
E005	Condensateur Thermistance Court Circuit	• Recherchez une humidité excessive sur le contrôle des stupéfiants d'environ 10 broches sur harnais # 0000001225 • Si l'erreur se répète, contact service professionnel certifié
E006	Condensateur au-dessus de la température	• Condensateur nettoyer si nécessaire • Vérifier le fonctionnement correct fan (pouvoirs sur, pas obstrué, etc.) • Contacter le professionnel de services certifiés
E007	Non utilisé	
E008	Non utilisé	
E009	Trop de Cycles de compresseur	• Contacter le professionnel de services certifiés
E010	Non utilisé	
E011	Évaporateur de refroidissement/Thermistor non ne pas mesurer	• Contacter le professionnel de services certifiés
E012	Área de llenado de botella obstruido	• Lentille propre sur capteur IR • Desconecte la unidad durante al menos 30 segundos y restar • Si l'erreur se répète, remplacer le capteur IR avec KIT 1000002434 - capteur IR
E013	Filtre manquant ou Incompatible	• Vérifiez que le filtre est installé correctement (étiquette vers l'avant, blanc tag face arrière) • Débrancher l'appareil pendant au moins 30 secondes puis redémarrez • Remplacer filtre • Remplacer la tête de filtre avec kit de réparation - 1000002030 - filtre tête-support-accessoires • Si l'erreur se répète, contact service professionnel certifié
E014	Manque de sanglier NFC	• Débrancher l'appareil pendant au moins 30 secondes puis redémarrez • Vérifiez le connecteur du câble est bien branché Conseil NFC sur la tête de filtre • Vérifiez le connecteur du câble est bien branché de contrôle des stupéfiants (10 broches sur harnais # 0000001225) • Remplacer la tête de filtre avec kit de réparation - 1000002030 - filtre tête-support-accessoires • Si l'erreur se répète, contact service professionnel certifié
E015	Manque de LED Board	• Verify cable connector is plugged into LED board in the bottle filler tower assembly • Vérifiez le connecteur du câble est bien branché LED board à l'Assemblée de tour de remplissage de bouteille. • Vérifiez le connecteur du câble est bien branché de contrôle des stupéfiants (18 broches sur harnais # 1000001608)) • Remplacer filtre statut platine des LED avec réparation kit - KIT de 1000002436 - ALPHA numérique LED BOARD • Remplacer le faisceau de câbles tour – 1000001609 harnais-bassin d'alimentation de BF • Remplacer le faisceau de câbles de fontaine – 1000001608 harnais-contrôle Conseil de bassin de nourrir

Pictured is unit only without bottle filler.

En la ilustración solo se muestra la unidad sin la llenadora de botellas.

Appareil illustré seul sans remplisseuse de bouteille.

Note: Danger! Electrical shock hazard. Disconnect power before serviceing unit.

Nota: peligro! Peligro de descarga eléctrica. Desconecte antes de reparar la unidad

Remarque : Danger ! Risque de choc électrique. Débrancher avant de réparer l'appareil..

Uses HFC-134A refrigerant
Usa refrigerante HFC-134A
Utilise du réfrigérant HFC-134A

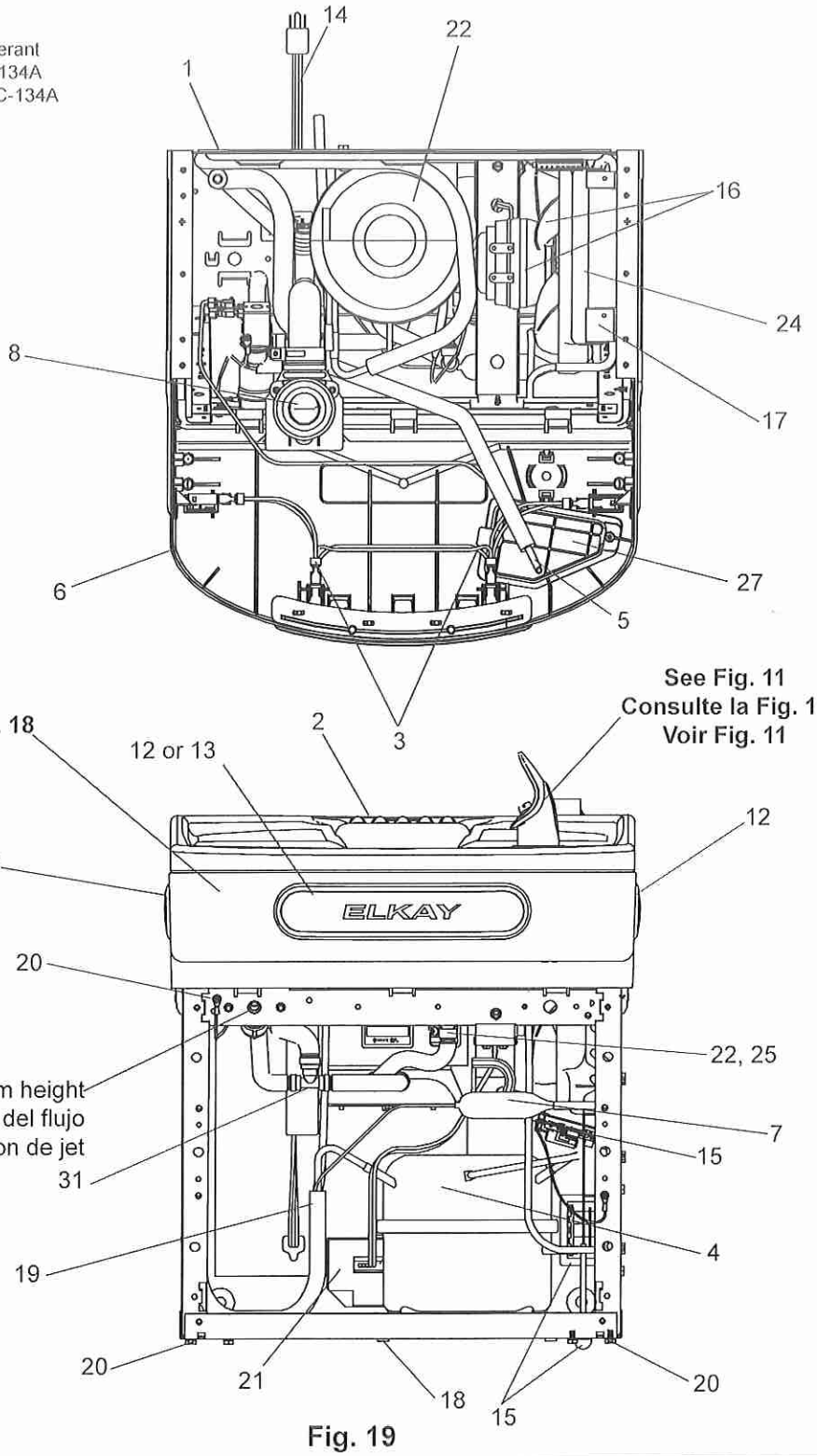


Fig. 19

115V PARTS LIST / LISTA DE PIEZAS DE 115 V / LISTE DES PIÈCES 115 V

ITEM NO.	PART NO.	DESCRIPTION	DESCRIPCIÓN	DESCRIPTION
1	28401C	Hanger Bracket	Soporte colgante	Ferrure de suspension
2	00000001337	Basin - Stainless Steel	Tarja: Acero inoxidable	Cuve - Acier inoxydable
3	36216C	Wiring - Front/Side Push Bar	Cableado: Barra de empuje delantera y lateral	Câblage - Poussoir frontal/latéral
*4	36322C	Compr - Service Pak 115V EMIS70HHR	Compresor: Paquete de servicio de 115 V EMIS70HHR	Compr - Ens. service 115 V EMIS70HHR
5	56092C	Tube - Poly (Cut To Length)	Tubería: Polietileno (corte a la longitud necesaria)	Tube - Poly (couper à la longueur)
6	56229C	Assy - Shroud - Upper (Front Side Push)	Conjunto; recubrimiento; superior (Empuje delantero y lateral)	Carénage supérieur (poussoir frontal/latéral)
7	66703C	Drier	Secador	Déshydrateur
8	1000001877	Kit - Drain Replacement (Bottle Filler) (Bracket, Tube, Fitting, Clamp)	Kit: Repuesto de desagüe (Llenadora de botellas) (Soporte, tubería, conector y abrazadera)	Trousse - Écoulement rechge (rempl. bouteille) (support, tube, raccord, collier de serrage)
9	98169C	Kit - Replacement Cap/Screen/O-Ring	Kit: Repuesto de tapa, rejilla y junta tórica	Trousse - Capuchon/tamis/joint torique rechge
10	1000002435	Kit - Solenoid Valve/Regulator Assy 24V	Kit: Conjunto de válvula de solenoide y de regulador de 24 V	Trousse - Ens. électrovanne/régulateur 24 V
11	92715C	Kit - Flexi Bubbler/"O"-Ring/Nut	Kit: Flexi Bubbler, junta tórica y tuerca	Trousse - Flexi Bubbler/joint torique/écrou
12	98734C	Kit - Pushbar (Front/Side) EZS TL	Kit: Barra de empuje (Delantera y lateral) EZS TL	Trousse - Poussoir (frontal/latéral) EZS TL
13	1000001600	Kit - Pushbar (Front Only)	Kit: Barra de empuje (Solo delantera)	Trousse - Poussoir (frontal seulement)
14	1000002442	Kit - Power Cord/Strain Relief Bushing	Kit: Cable de alimentación y casquillo de alivio de tensión	Trousse - Cordon alim./douille serre-câble
15	1000002437	Kit - Transformer/Board/Bracket	Kit: Transformador, panel y soporte	Trousse - Transformateur/carte/support
16	1000002439	Kit - Fan Motor/Blade/Screws/Nut	Kit: Motor del ventilador, aspa, tornillos y tuerca	Trousse - Moteur de ventilateur/pales/vis/écrou
17	1000002456	Kit - Condenser/Drier/WireTies	Kit: Condensador/secador/lazos de alambre	Trousse - Statiques/sécheur/Colliers
18	98777C	Kit - Compr Mtg Hdwe/Grommets/ Clips/Studs	Kit: Piezas metálicas de montaje del compresor, arandelas, sujetadores y remaches	Trousse - Visserie fix. compr./œillets/clips/goujons
19	98778C	Kit - Heatx/Drier	Kit: Intercambiador de calor y secador	Trousse - Échangeur chaleur/déshydrateur
20	98998C	Kit - Hardware	Kit: Piezas metálicas	Trousse - Visserie
21	0000000238	Kit - Elect/Relay/Overload/Cover	Kit: Eléctrico, relé, sobrecarga y cubierta	Trousse - Élect./relais/antisurcharge/capot
22	1000002438	Kit - Evap. Replacement	Kit: Repuesto de evaporador	Trousse - Évaporateur de rechange
23	1000001812	Kit - Bottle Filler Drain	Kit: Desagüe de la llenadora de botellas	Trousse - Écoulement remplisseuse de bouteille
24	56237C	Shroud	Recubrimiento	Carénage
25	1000001602	Kit - 75583C Elbow 5/16" x 1/4" (3 Pack)	Kit: 75583C Codo 5/16" x 1/4" (Paquete de 3)	Trousse - 75583C Coude 5/16 po x 1/4 po (paq. 3)
26	1000001610	Wiring Harness - 24V to Control Board/ Bubbler Sensor	Cableado - 24V al control Board/grifo Sensor	Câblage - 24V Ctrl Conseil / Capteur Bubbler
27	56213C	Access Panel	Panel de acceso	Panneau d'accès
28	1000002444	Kit - Thermistor/RFID Harness	Kit: Termistor y haz RFID	rousse - Faisceau thermistance/RFID
29	0000001226	Wiring Harness - Compressor & Fan	Haz de cables: Compresor y ventilador	Faisceau de câbles - Compresseur et ventil.
30	1000001608	Wiring Harness - Control Board to Basin	Haz de cables: Panel de control hacia la tarja	Faisceau de câbles - Carte commande à fontaine
NS	27416C	Wrapper - Stainless Steel	Revestimiento: Acero inoxidable	Enveloppe - Acier inoxydable
NS	27413C	Wrapper - Light Grey	Revestimiento: Gris claro	Enveloppe - Gris clair

NS = Not Shown
NS = No se muestra
NS = Non représenté

***INCLUDES RELAY & OVERLOAD. IF UNDER WARRANTY, REPLACE WITH SAME COMPRESSOR USED IN ORIGINAL ASSEMBLY.**
NOTE: All correspondence pertaining to any of the above water coolers or orders for repair parts MUST include Model No. and Serial No. of cooler, name and part number of replacement part.

***INCLUYE RELÉ Y SOBRECARGA. SI ESTÁ CUBIERTO POR LA GARANTÍA, REEMPLACE CON EL MISMO COMPRESOR QUE SE USA EN EL CONJUNTO ORIGINAL.**
NOTA: Toda la correspondencia que guarde relación con los bebedores descritos anteriormente, o los pedidos de piezas de repuesto, DEBEN incluir el n.° de modelo y el n.° de serie del bebedero, nombre y número de pieza del repuesto.

***COMPREND RELAIS ET LIMITEUR DE SURCHARGE. SI SOUS GARANTIE, REMPLACÉ PAR LE MÊME COMPRESSEUR QUE CELUI DE L'APPAREIL D'ORIGINE.**
REMARQUE : Toute correspondance concernant toute fontaine à eau fraîche ci-dessus ou toute commande de pièces détachées devra IMPÉRATIVEMENT inclure le numéro de modèle et le numéro de série de l'appareil, ainsi que le nom et le numéro de pièce des pièces de rechange.

BOTTLE FILLER REPLACEMENT PART KITS
KITS DE PIEZAS DE REPUESTO DE LA LLENADORA DE BOTELLAS
TROUSSES DE PIÈCES DE RECHANGE POUR LA REMPLISSEUSE DE BOUTEILLE

ITEM NO.	PART NO.	DESCRIPTION	DESCRIPCIÓN	DESCRIPTION
NS	98546C	Kit - Aerator Replacement	Kit: Repuesto de aireador	Trousse - Aérateur de rechange
31	98549C	Kit - Hardware & Waterway (BF)	Kit: Piezas metálicas y canales (LIB)	Trousse - Visserie et circuit d'eau (RB)
32	1000001622	Valve - Solenoid 24V (BF)	Válvula: Solenoide de 24 V (LIB)	Électrovanne 24 V (RB)
33	1000001609	Wiring Harness-Basin Feed to BF	Haz de cables: Paso de la tarja hacia la LIB	Faisceau câbles - Alim. fontaine à RB
NS	1000001981	Nameplate - Elkay Filtered	Placa de identificación: Elkay con filtro	Plaque signalétique - Elkay à filtre
NS	1000001982	Nameplate - Elkay Non-Filtered	Placa de identificación: Elkay sin filtro	Plaque signalétique - Elkay sans filtre
34	1000002433	Kit - Top Cover Assy (BF)	Kit: Conjunto de cubierta superior (LIB)	Trousse - Capot supérieur (RB)
35	1000002434	Kit - IR Sensor	Kit: Sensor infrarrojo	Trousse - Capteur IR
NS	1000002436	Kit - Alpha Numeric LED Board	Kit: Panel LED alfanumérico	Trousse - Carte voyant alphanumérique
NS	1000001813	Kit - Tower/Basin Gasket	Kit: Torre y empaquetadura de la tarja	Trousse - Joint tour/fontaine

NS = Not Shown
NS = No se muestra
NS = Non représenté

This device complies with part 15 of the FCC Rules. Operation is subject to the following two (2) conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not approved by the manufacturer could void the user's authority to operate the equipment.

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. The user should avoid prolonged exposure within 20 cm of the antenna, which may exceed the FCC radio frequency exposure limits.

This equipment complies with IC RSS-102 radiation exposure limits set forth for an uncontrolled environment. The user should avoid prolonged exposure within 20 cm of the antenna which may exceed the exposure limits.

Este dispositivo cumple con las normas de la Parte 15 de la FCC. El funcionamiento está sujeto a las siguientes dos (2) condiciones: (1) Este dispositivo no puede provocar interferencia perjudicial y (2) este dispositivo debe aceptar cualquier interferencia que reciba, incluso aquella que pueda provocar malfuncionamiento.

Los cambios o modificaciones que no estén aprobados por el fabricante podrían anular la autorización del usuario de operar el equipo.

Este dispositivo cumple con las normas RSS de exención de licencia de la Industria de Canadá. El funcionamiento está sujeto a las siguientes dos condiciones: (1) Este dispositivo no puede provocar interferencia y (2) este dispositivo debe aceptar cualquier interferencia que reciba, incluso aquella que pueda provocar un malfuncionamiento del dispositivo.

Según las normas del Ministerio de la Industria de Canadá, este radiotransmisor solo puede funcionar con una antena de un tipo y una ganancia máxima (o de menor grado) aprobados para el transmisor por el Ministerio de la Industria de Canadá. Para reducir la posible interferencia de radio para otros usuarios, el tipo de antena y su ganancia deben elegirse de tal manera que la potencia isotrópica radiada equivalente (PIRE) no sea mayor que la necesaria para obtener una comunicación exitosa.

Este equipo cumple con los límites de exposición a la radiación según la FCC establecidos para un ambiente que no está controlado. El usuario debe evitar la exposición prolongada dentro de 20 cm de la antena, lo cual puede sobrepasar los límites de exposición a la frecuencia de radio según la FCC.

Este equipo cumple con los límites de exposición a la radiación según la IC RSS-102 establecidos para un ambiente que no está controlado. El usuario debe evitar la exposición prolongada dentro de 20 cm de la antena, lo cual puede sobrepasar los límites de exposición.

Cet appareil est conforme à la partie 15 des règles de la FCC. L'exploitation est autorisée aux deux (2) conditions suivantes : (1) l'appareil ne doit pas produire de brouillage préjudiciable, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Les changements ou modifications non approuvés par le fabricant pourraient annuler les droits d'utilisation du matériel par l'utilisateur.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Conformément á la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique á l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e) ne dépasse pas l'intensité nécessaire á l'établissement d'une communication satisfaisante.

Cet équipement est conforme aux limites d'exposition aux rayonnements de la FCC, établies pour un environnement non contrôlé. L'utilisateur devra éviter l'exposition prolongée à moins de 20 cm de l'antenne, qui peut dépasser les limites d'exposition aux fréquences radioélectriques de la FCC.

Cet équipement est conforme aux limites d'exposition aux rayonnements CNR-102 d'IC, établies pour un environnement non contrôlé. L'utilisateur devra éviter l'exposition prolongée à moins de 20 cm de l'antenne, qui peut dépasser les limites d'exposition.

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SIEMENS

PXC Modular Series Owner's Manual

125-3582
April 18, 2013

Building Technologies

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Service Statement

Control devices are combined to make a system. Each control device is mechanical in nature and all mechanical components must be regularly serviced to optimize their operation. Siemens Industry, Inc. branch offices and authorized distributors offer Technical Support Programs that will ensure continuous, trouble-free system performance.

For further information, contact your nearest Siemens Industry, Inc. representative.

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The manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible could void the user's authority to operate the equipment.

For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*

- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

To the Reader

Your feedback is important to us. If you have comments about this manual, please submit them to: mailto:Sbt_technical.editor.us.sbt@siemens.com

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Table of Contents

How to Use This Manual

About This Manual

This manual is written for the owner and user of the PXC Modular Series. It is designed to help you become familiar with the PXC Modular and its applications.

This section covers manual organization, document conventions and symbols used in the manual, how to access help, related publications, and any other information that will help you use this manual.

Document Organization

This manual contains the following chapters:

- *Chapter 1—Introduction*, describes each section in this manual and presents an overview of PXC Modular operation.
- *Chapter 2—Hardware Features*, describes the PXC Modular hardware components and their functions.
- *Chapter 3—Applications*, describes the operating system and applications available with the PXC Modular.
- *Chapter 4—Troubleshooting*, describes basic corrective measures you should take if you encounter a problem when using a PXC Modular.

NOTE:
The troubleshooting section is not meant to be a full diagnostic guide, but is designed to help you address basic troubleshooting issues. If you encounter a problem not covered in this section or require further assistance, consult your Siemens Industry representative.

- A *Glossary* describes the terms and acronyms used in this manual.
- An *Index* is provided to assist you in finding information presented in this manual.

Prerequisites

In addition to reading this owner's manual, you should also become familiar with the following technical documentation. Each document has been written to help you get the most out of your PXC Modular Series hardware.

These manuals, along with information about other Siemens Industry products, technical training classes, and services can be obtained from your local Siemens Industry representative.

- *Powers Process Control Language (PPCL) User's Manual* (125-1896). This manual describes Powers Process Control Language (PPCL), the language used to write the control programs for the PXC Modular.
- *APOGEE P2 ALN Field Panel User's Manual* (125-3019) or *APOGEE BACnet ALN Field Panel User's Manual* (125-3020). This manual describes the operator interface program used to communicate with APOGEE field panels. It contains information on defining the PXC Modular database, including slopes and intercepts.

For Smoke Control Applications

Smoke Control Systems Application and Engineering Manual (125-1806). This manual is a comprehensive reference on smoke control applications for APOGEE equipment. It contains all of the various agency requirements and recommended practices of organizations that are widely-recognized in composing standards and testing equipment involved in life safety applications.

When Using Insight Software

Insight *3.x Documentation.* To view Insight 3.*x* documentation, see the Insight Online Documentation window, which you can access from the Insight Main Menu or the Insight program group.

Document Conventions

The following table lists conventions to help you use this manual in a quick and efficient manner.

Convention	Examples
Numbered Lists (1, 2, 3…) indicate a procedure with sequential steps.	1. Turn OFF power to the field panel. 2. Turn ON power to the field panel. 3. Contact the local Siemens Industry representative.
Conditions that must be completed or met before beginning a task are designated with a ▷. Intermediate results (what will happen following the execution of a step), are designated with a ⇨. Results, which inform the user that a task was completed successfully, are designated with a ⇨.	▷Composer software is properly installed. ▷A Valid license is available. 1. Select **Start** > **Programs** > **Siemens** > **GMS** > **Composer**. ⇨The Project Management window displays. 2. Open an existing project or create a new one. ⇨The project window displays.
Actions that should be performed are specified in boldface font.	Type **F** for Field panels. Click **OK** to save changes and close the dialog box.
Error and system messages are displayed in Courier New font.	The message `Report Definition successfully renamed` displays in the status bar.
New terms appearing for the first time are italicized.	The field panel continuously executes a user-defined set of instructions called the *control program*.
	This symbol signifies Notes. Notes provide additional information or helpful hints.
Cross references to other information are indicated with an arrow and the page number, enclosed in brackets: [→92]	For more information on creating flowcharts, see Flowcharts [→92].

Safety Symbols

The following table lists the safety symbols used in this manual to draw attention to important information.

Symbol	Meaning	Description
NOTICE	CAUTION	Equipment damage may occur if a procedure or instruction is not followed as specified. (For online documentation, the NOTICE displays in white with a blue background.)
	CAUTION	Minor or moderate injury may occur if you do not perform a procedure as specified.
	WARNING	Personal injury or property damage may occur if you do not perform a procedure as specified.
	DANGER	Electric shock, death, or severe property damage may occur if you do not perform a procedure as specified.

Getting Help

For more information about APOGEE products, contact your local Siemens Industry representative.

1 Chapter 1—Introduction

Chapter 1 provides an introduction to the PXC Modular Series and how it is integrated with the APOGEE Automation System. The following topics are discussed:

- PXC Modular Series Product Overview
- Compatibility with the APOGEE Automation System
  - BACnet Protocol Compatibility
  - TCP/IP Protocol Compatibility
- Principles of PXC Modular Operation
  - Gathering and Processing Field Inputs
  - Executing Control Programs
  - System Program
- APOGEE Automation Networking
  - Management Level Network
  - Automation Level Network
  - Field Level Network

1.1 Modular Product Overview

The PXC Modular is an integral part of the APOGEE Automation System. It is a high performance, modular Direct Digital Control (DDC) supervisory field panel.

The field panel operates stand-alone or networked to perform complex control, monitoring, and energy management functions without relying on a higher level processor.

- Up to 100 PXC Modular field panels communicate on a peer-to-peer network.
- With the addition of TX-I/O modules and a TX-I/O Power Supply on a self-forming bus, the PXC Modular can directly control up to 500 points.

See the *APOGEE Wiring Guidelines for Field Panels and Equipment Controllers* (125-3002) for information on setting up this configuration.

- With the addition of an Expansion Module, the PXC Modular also provides central monitoring and control for distributed wireless or wired Field Level Network (FLN) devices.

1.1.1 Ordering Information

Product Number	Description
PXC00-E96.A	PXC Modular, BACnet/IP or MS/TP ALN, P1 or MS/TP FLN. PXX-485.3 is also required as the connection to the FLN devices.
PXC00-PE96.A	PXC Modular, Ethernet/IP or RS-485 ALN, P1 FLN. PXX-485.3 is also required as the connection to the FLN devices.
PXC100-E96.A	PXC Modular, BACnet/IP or MS/TP ALN, P1 or MS/TP FLN, self-forming TX-I/O Island Bus. PXX-485.3 is also required as the connection to the FLN devices.

Product Number	Description
PXC100-PE96.A	PXC Modular, Ethernet/IP or RS-485 ALN, P1 FLN, self-forming TX-I/O Island Bus. PXX-485.3 is also required as the connection to the FLN devices.
PXX-485.3	Provides FLN support for the PXC Modular. Includes three RS-485 P1 FLN connections or one MS/TP FLN connection; maximum of 96 devices supported.

Optional Licenses

Product Number	Description
PXF-TXIO.A	License to enable the Island Bus on PXC00-E96.A and PXC00-PE96.A.
LSM-FPGO	License to enable Field Panel GO
LSM-SNMP	License to enable SNMP Agent on Siemens Modular or Compact hardware with BACnet Firmware Revision 3.2.3
LSM-VAEM	License to enable Virtual AEM support when the P2 ALN is connected to RS-485
LSM-FPWEB	License to enable BACnet Web Server (PXC-36) or Web Services (PXC-16/24)

TX-I/O I/O Modules

Product Number	Description
TXM1.8D	TX-I/O Module, 8 DI points
TXM1.16D	TX-I/O Module, 16 DI points
TXM1.8U	TX-I/O Module, 8 Universal points
TXM1.8U-ML	TX-I/O Module, 8 Universal points with LOID
TXM1.8X	TX-I/O Module, 8 Super Universal points
TXM1.8X-ML	TX-I/O Module, 8 Super Universal points with LOID
TXM1.6R	TX-I/O Module, 6 DO with Relay points
TXM1.6R-M	TX-I/O Module, 6 DO with Relay points with manual override

TX-I/O Power Supply and Bus Modules

Product Number	Description
TXS1.12F4	TX-I/O Power Supply, 1.2A, 4A Fuse
TXS1.EF4	TX-I/O Bus Connection Module, 4A Fuse

TXA1.IBE	TXIO Island Bus Expansion module with RS-485 connection.

TXB1.P1	TX-I/O Bus Interface Module, P1 (10-module)
TXB1.P1-4	TX-I/O Bus Interface Module, P1 (4-module)

Accessories

Product Number	Description
TXA1.K12	One set of address keys, numbers 1 - 12.
TXA1.K24	One set of address keys, numbers 1 - 24.
TXA1.K-48	One set of address keys, numbers 25 - 48.

Product Number	Description
TXA1.K-72	One set of address keys, numbers 49 - 72.
TXA1.LLT-P100	Labels for TX-I/O, 100 sheets/pack, letter format.
TXA1.LH	Replacement label holders.

1.2 Compatibility with the APOGEE Automation System

The PXC Modular Series is fully compatible with, and will communicate with, all the APOGEE or pre-APOGEE products in your facility.

For more information on compatibility of products, contact your Siemens Industry representative.

⚠ CAUTION

When working on a network with multiple firmware revisions, always connect to the operator interface at the field panel with the newest firmware revision.

Otherwise, you will not be able to view features in newer firmware revisions, or you may coldstart the field panel.

1.2.1 BACnet Protocol Compatibility

APOGEE BACnet is compatible with the BACnet/IP protocol.

⚠ CAUTION

When sharing data values from APOGEE P2 (proprietary) field panels to BACnet devices, the Cross-Trunk Service does not support requests originating from BACnet devices to access points (objects) that reside in APOGEE P2 field panels.

If you plan to share data values from APOGEE P2 field panels with BACnet devices (field panels), you must do one of the following:

- Install and enable the Insight BACnet Server Option.
- Use PPCL in the APOGEE P2 field panels to command values in the BACnet devices through the Insight Cross-Trunk service.

APOGEE P2 and BACnet Product Features Order of Implementation

The APOGEE field panel firmware supports the BACnet protocol as follows:

- If both the BACnet and APOGEE protocols have a function, the BACnet function is implemented.
- If APOGEE provides a function that the BACnet protocol does not support, the APOGEE function is retained.

This approach to BACnet implementation retains the APOGEE feature set while providing compatibility with standard BACnet/IP protocol.

1.2.2 TCP/IP Protocol Compatibility

PXC Modular Series controllers with BACnet/IP or Ethernet TCP/IP (P2) ALN provide the following:

- 100% compatibility with the TCP/IP protocol suite.
- Support of Dynamic Host Configuration Protocol (DHCP) and Domain Name Servers (DNS).
- Support and auto detection of 10Base-T and 100Base-TX Ethernet.

1.2.2.1 Required IP Addresses

APOGEE BACnet/IP or Ethernet TCP/IP (P2) ALN uses:

- One IP address per device (field panel or Insight workstation).
- One additional shared IP address per ALN for the multicast group (when using multicast optimization).

1.2.2.2 Device Registration

Devices register with the DHCP server and Domain Name Server, if either is present.

1.2.2.3 Address Assignment

IP addresses are dynamically assigned by the DHCP server.

If an address changes or is not recognized, the field panel firmware lets you release the dynamically assigned IP address and then reconnect the field panel to the DHCP server, accepting a new IP address assignment in the process.

If there is no DHCP server at the site, you must manually assign static IP addresses as part of the startup system configuration.

Physical Addressing

Each device on the BACnet/IP or Ethernet TCP/IP (P2) ALN has a hard-wired MAC address, which is printed on the product label.

Port Numbers

The default TCP/IP port number for APOGEE BACnet/IP or Ethernet TCP/IP (P2) ALN communications is **5033**. You can change the TCP/IP port number if necessary.

NOTE:
All devices on the network must use the same TCP/IP port number.

The default TCP/IP port number for Virtual AEM communications is **3001**.

You must specify a UDP port number when using multicast optimization. The default UDP port number is **8**.

Network Bandwidth

BACnet/IP or Ethernet TCP/IP (P2) ALN does not add significantly to your network overhead. Burst conditions for this product occur during:

- Database downloading after coldstart.
- Database uploading.
- Trend data uploading.
- Burst of alarms or COVs.

Data Exchange

BACnet/IP or Ethernet TCP/IP (P2) ALN sends and receives APOGEE data in TCP/IP packets.

BACnet/IP or Ethernet TCP/IP (P2) ALN synchronizes global data between all devices. Each device runs a global data replication engine that communicates with peer devices to:

- Exchange new and changed global data.
- Resolve conflicts when data does not match.

Device Naming Conventions

Field panel DNS node names are limited to 30 characters and cannot contain spaces.

Network Security

BACnet/IP or Ethernet TCP/IP (P2) ALN uses your intranet security within the firewall and a username/password combination to restrict access outside the firewall. You can use VLAN to improve internal security.

1.3 Principles of Field Panel Operation

The PXC Modular Series gathers information about the environment of your facility, as well as the equipment it monitors and controls. The PXC Modular receives updated information, stores information, executes control programs, handles operator commands and requests, and makes control management decisions. At the same time, the PXC Modular also translates decisions into actions and allows the operator to observe those actions. The operator can also override and modify the decisions made by the PXC Modular.

1.3.1 Gathering and Processing Field Inputs

The PXC Modular samples the information at all field inputs, or points, approximately once each second, and stores numerical representations of the sampled values.

Under certain conditions, some points require additional handling. The PXC Modular initiates required actions after these points are checked against previously-entered configuration data.

Example

A log entry might be required in a point history file every 20 samples, or notification of an alarm condition could be sent to the operator as a point crossed the alarm threshold.

1.3.2 Executing Control Programs

The PXC Modular continuously executes a user-defined set of instructions called the control program. This program uses the most recent point values and the most recent clock time. The control program does the following:

- Evaluates control strategies.
- Uses an internal calendar and time clock for time-based functions.
- Updates point values and commands field points according to the program results.
- Sends messages or reports to proper terminal locations as needed.

Example

During occupied hours (7:00 A.M. through 5:00 P.M.) a fan:

- Turns ON if the room temperature rises above 80°F (27°C).
- Turns OFF when the temperature drops below 73°F (23°C).

Between 5:00 P.M. and 7:00 A.M. the fan turns OFF regardless of the room temperature.

If the temperature rises to 85°F (29°C) at any time, the PXC Modular sends an alarm message to an alarm printer.

These specifications can be met by:

1. Connecting a room temperature sensor/transmitter and fan starter output to the PXC Modular.
2. Defining the room temperature sensor with a high alarm limit of 85°F (29°C) and the fan points in the PXC Modular database.
3. Writing a short control program that defines your control strategy.
4. Enabling the execution for that portion of the control program.

To perform this control strategy, the PXC Modular:

- Continuously executes the control program.
- Samples a current or voltage signal representing the room temperature and updates the value associated with that temperature in its memory.
  - If the temperature rises to 85°F (29°C), then the PXC Modular sends an alarm message to the printer.
- Checks the current time once per second.
  - Between 5:00 P.M. and 7:00 A.M., the fan remains OFF.
  - Between 7:00 A.M. and 5:00 P.M., the control program checks the current value of the temperature and sends the appropriate ON or OFF command to the fan starter.

If the ON command is issued, the PXC Modular updates the value of the starter point in its memory to reflect the current state of the fan.

1.3.3 System Program

The PXC Modular contains a non-volatile system program called firmware, which can be upgraded in the field. The firmware is stored in Flash ROM memory, which keeps it

virtually immune to all forms of power fluctuations or failure, including battery failure. For more information on Flash ROM memory, see Memory [→ 28].

General functionality of the firmware includes:

- Executing control programs.
- Communicating between other field panels and the Insight workstation.
- Monitoring points.
- Managing point-related information.
- Keeping track of real time (both clock and calendar time).
- Executing self-test and error detection in the PXC Modular.

License Manager

License Manager adds applications or functionality to a field panel without the need to replace the hardware or perform a firmware flash. Field panels with Firmware Revision 2.8.2/3.0.1 or later support the License Management attribute.

Contact your Siemens Industry representative for more information on applications and functionality that can be activated through License Manager.

License Manager Definitions

- A *feature* is an application or additional functionality that can be added to a field panel without the need to replace the hardware. Some features require a firmware flash.
- A *license* is the code provided by Siemens Industry to unlock a feature.
- The *ID_STRING* is a unique identifier that distinguishes an individual piece of hardware. It is composed of the panel's part number, revision, year and week of manufacture, and serial number. Therefore, a license for one field panel will not work on another field panel.

How does License Manager Work?

Field panels can either be ordered with licensed features and functionality pre-loaded, for example, FLN or TX-I/O island bus support, or upgraded to add special features, for example, integration drivers, Field Panel GO, and Virtual AEM.

NOTE:
The installation of some features and licenses require that the field panel be coldstarted, while others do not. For example, Field Panel GO requires the creation of Web server folders and therefore requires that the field panel be coldstarted. However, TX-I/O module installation does not.

Any or all of the licensed features can be activated at any time using licenses acquired from Siemens.

When the field panel is powered, the firmware reviews the inventory of installed features, comparing that list to the License Vault, where all installed licenses are stored. Every feature with a corresponding license is initiated and run. Because licenses are loaded into non-volatile memory, powering down the field panel will not erase them.

1.4 APOGEE Automation Networking

The following levels of networking provide varying levels of system integration in the APOGEE Automation System.

- Management Level Network (MLN)
- Automation Level Network (ALN)
- Remote Automation Level Network
- Field Level Network (FLN)

These systems also use a number of network protocols that add functionality or provide support for third-party devices.

1.4.1 Management Level Network

The Management Level Network (MLN) is the communications connection between individual Insight workstations. It allows multiple Insight users to access the entire APOGEE Automation System.

- An MLN is a TCP/IP Server-client network, and usually resides on the corporate LAN.
- APOGEE Automation Systems without an Insight workstation do not have a Management Level Network.

1.4.2 Automation Level Network

The APOGEE Automation Level Network (ALN) provides field panel-to-field panel and Insight workstation-to-field panel communication. The ALN types are:

- P2 RS-485 ALN
- Ethernet TCP/IP ALN
- Remote ALN (Auto-dial and AEM)
- BACnet/IP ALN
- BACnet Master-Slave/Token Passing (MS/TP) ALN

1.4.2.1 Simultaneous ALN Access

More than one operator or field panel can access the network at one time. For example, as one operator accesses the system, another operator can access the system at another terminal (or from a remote site using a modem). This ensures that field panels can send alarm information to the alarm printer even as an operator accesses other information.

1.4.2.2 How Information Moves Through the Network

When an operator issues a command over the ALN network through a field panel, that field panel validates the command, determines where to send it, and then passes the command to the destination over the network.

Example

In the figure *Commanding Over an Automation Level Network*, the operator at the Insight workstation, located in the lower level of the building, issues a command to control the main air-handling unit (AHU) of the building. This command is sent by the communication network to the field panel located on the top floor.

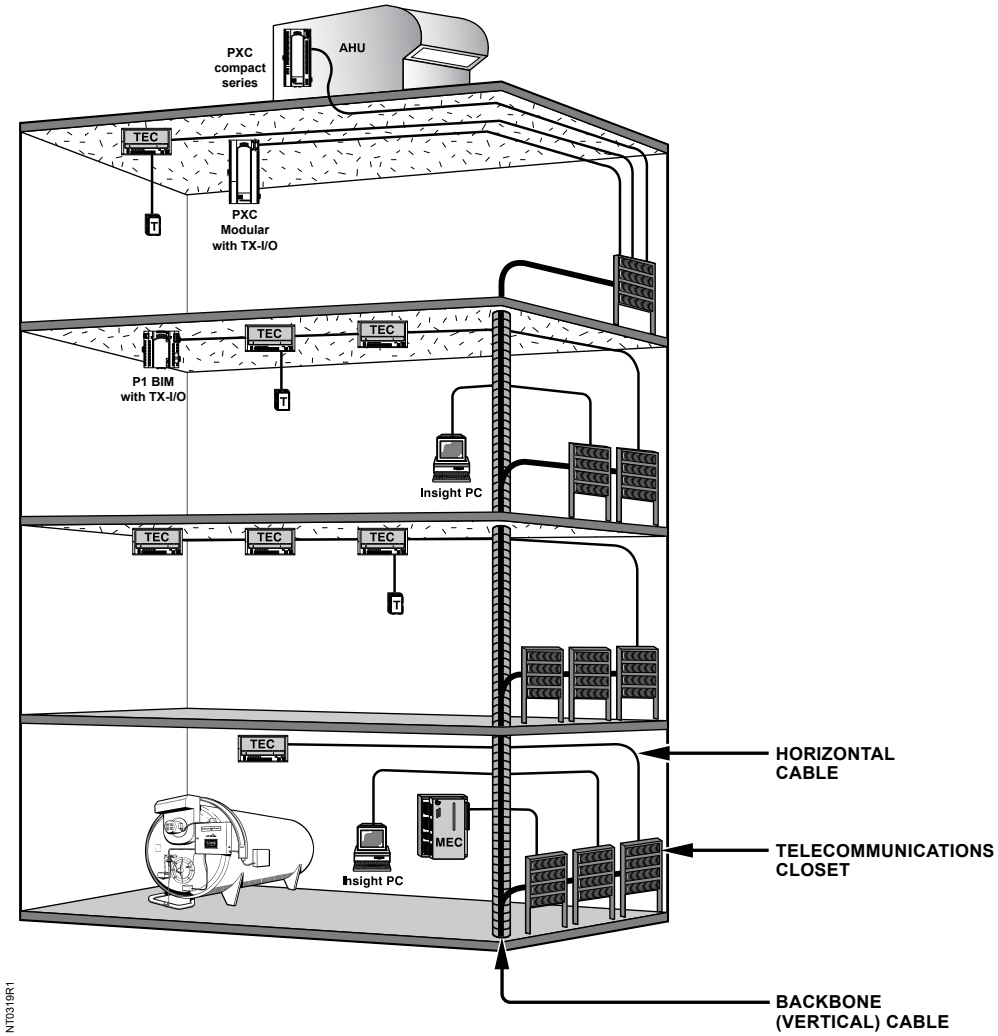


Figure 1: Figure. Commanding Over an Automation Level Network.

1.4.2.3 RS-485 P2 Automation Level Network

The RS-485 ALN is a proprietary token-passing network that communicates over RS-485 cabling. It is Protocol 3 (P3) at and above 38,400 bps, and Protocol 2 (P2) below 38,400 bps.

- An Insight workstation is optional with this ALN.
- Up to 100 field panels (99 with an Insight workstation) can be connected and can communicate by means of an RS-485 peer-to-peer network.
- Information can be sent and retrieved across the RS-485 ALN from any connected field panel.

Media

The RS-485 ALN can communicate over one or more of the following:

- Physical wire (RS-485 cabling)
- Dedicated telephone lines
- Leased-line modems
- Line drivers
- Trunk Isolator Extenders (TIE)
- Fiber Optic Interfaces

The trunk system provides connections within buildings or between buildings for multiple field panels and operator workstations.

The following figure shows a possible implementation of an RS-485 ALN network.

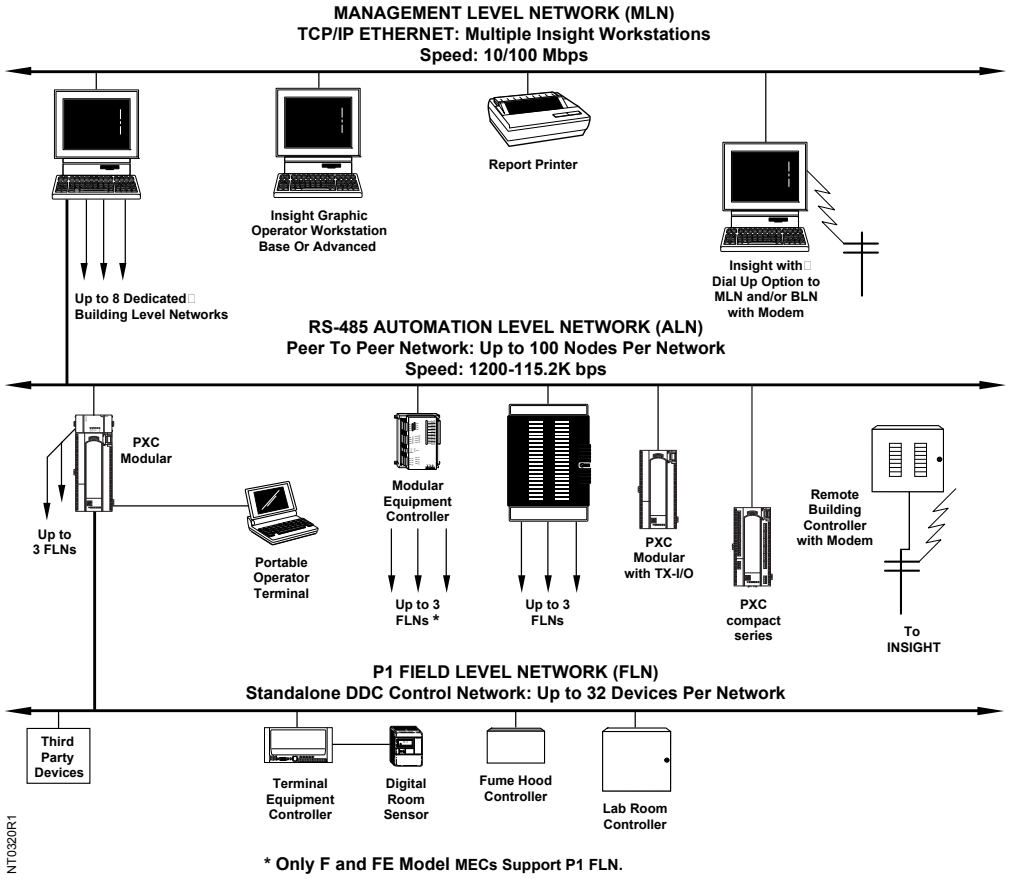


Figure 2: MLN, RS-485 ALN, and P1 FLN network example.

1.4.2.4 Ethernet TCP/IP Automation Level Network

The Ethernet Automation Level Network (EALN) uses TCP/IP-based communication over a customers Ethernet cabling and IP network to reduce overall system and maintenance costs. Otherwise, system operation is identical to RS-485 ALN installations.

- An Insight workstation is optional with this ALN.

- When an Insight workstation is used, multiple Insight workstations can be defined on the MLN.
- A maximum of 1000 Ethernet field panels can be defined for each Insight workstation on the MLN.
- Each Insight workstation can host up to 64 EALNs.
- The Insight workstation counts as a node on every EALN to which it is connected.

Information can be sent and retrieved across the EALN from any Ethernet capable field panel. The following figure shows a possible implementation of EALN over a corporate IP network. In this example, the MBCs contain Power Open Processors with Ethernet ALN.

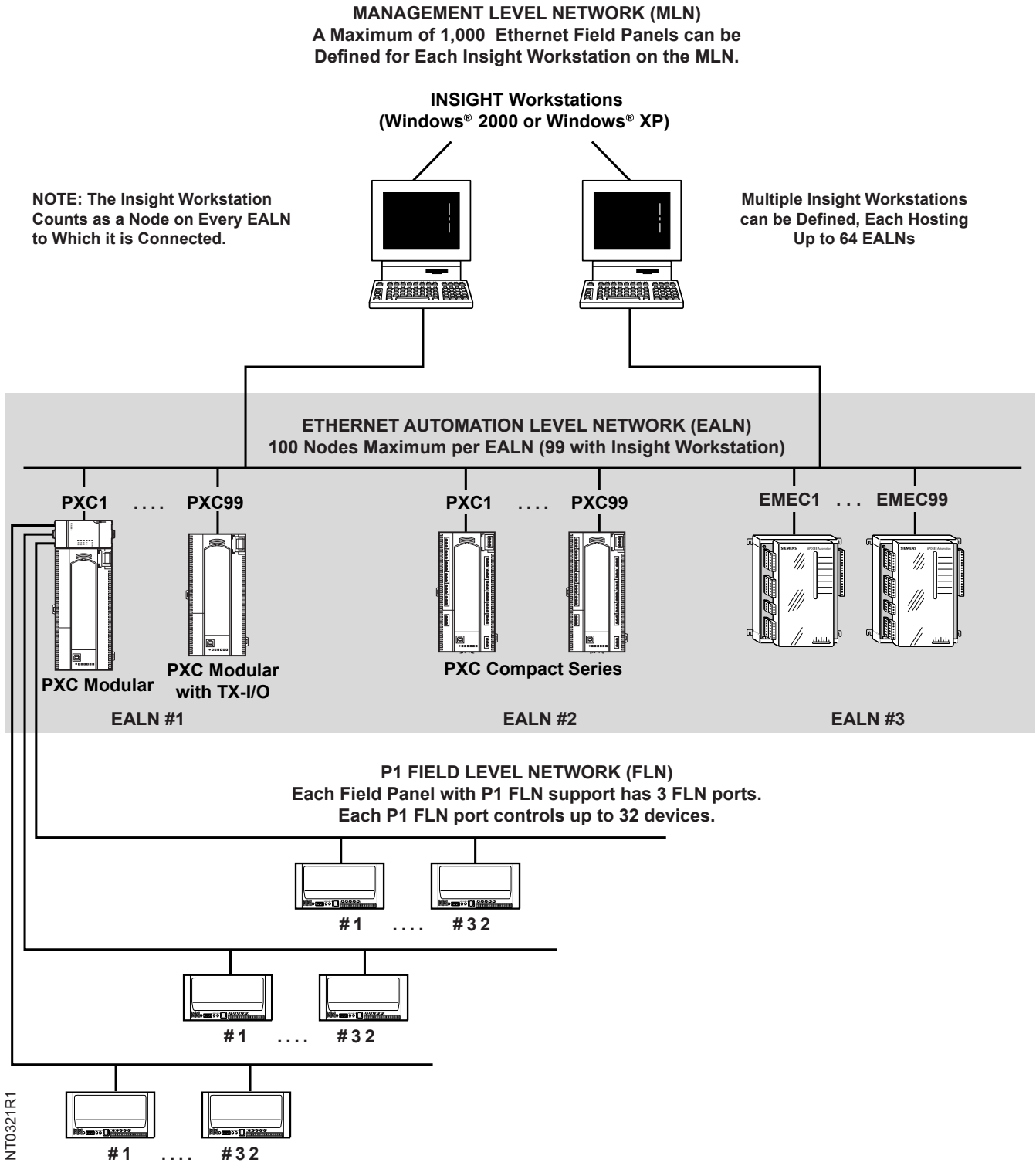


Figure 3: MLN, Ethernet ALN, and P1 FLN network example.

1.4.2.5 Remote Automation Level Network (Single Field Panel Remote Sites)

One PXC Modular can act as a stand-alone field panel. A stand-alone field panel is generally used in remote sites where only one field panel is needed to control the equipment for that site. Communications with the remote site are achieved by using modems or the Virtual APOGEE Ethernet Microserver (AEM).

The remote site PXC Modular can initiate a telephone call to a device such as a personal computer running Insight software, a dumb terminal, or a printer. Once the remote site connects to the device, an alarm or other user-defined event is issued. When the remote site no longer requires the connection to the device, the remote site disconnects. The remote site can also receive telephone calls from a device running Insight software to allow for centralized access of a local network's database.

The Virtual APOGEE Ethernet Microserver (AEM) allows an Automation Level Network (ALN) to be connected directly to an Ethernet network at all times (versus a modem, which connects when necessary). The ALN can consist of a single remote field panel or a maximum of 32 field panels.

For local access, operators can communicate with the remote site by physically connecting to the field panel via an operator's terminal. When an operator issues a command, the field panel validates the command and sends it to the appropriate device.

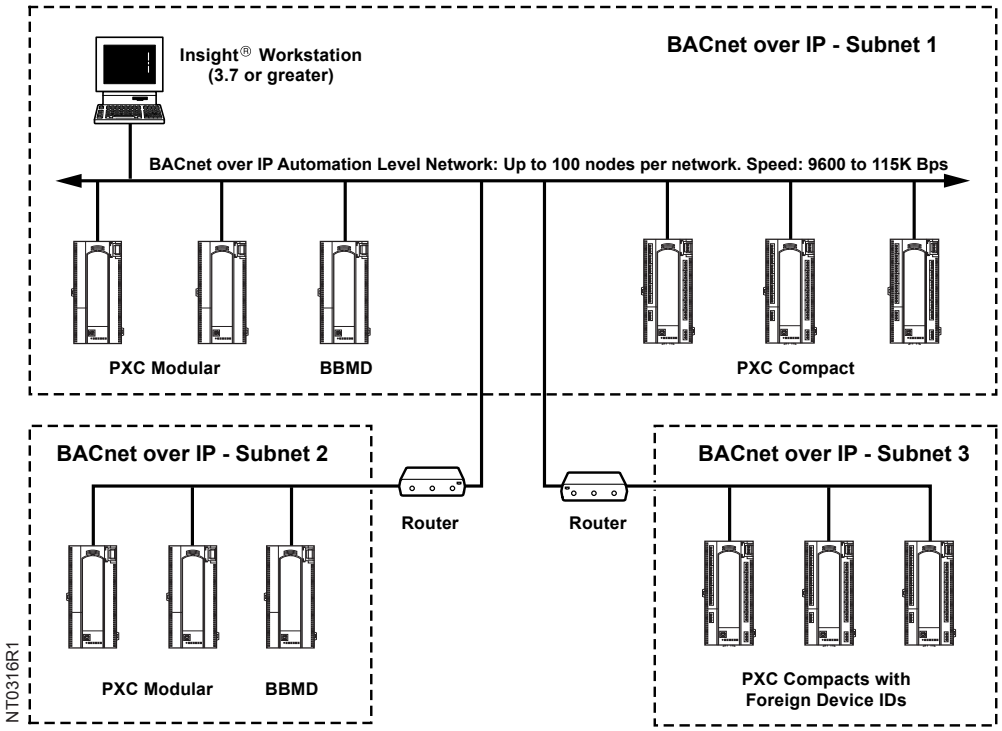
For more information about remote site field panels, contact your Siemens Industry representative.

1.4.2.6 BACnet/IP Automation Level Network

BACnet field panels communicate over a customer's Ethernet cabling and IP network using the ASHRAE Building Automation and Control Networking (BACnet) protocol.

- One Insight workstation can administer up to 64 Ethernet-based BACnet/IP ALNs.
- Up to 100 BACnet/IP or Ethernet TCP/IP (P2) field panels can reside on a BACnet/IP network (1000 maximum per Insight workstation).
- Because they use different networking protocols, APOGEE P2 Ethernet TCP/IP and BACnet/IP field panels cannot communicate directly with each other, even on the same physical network.

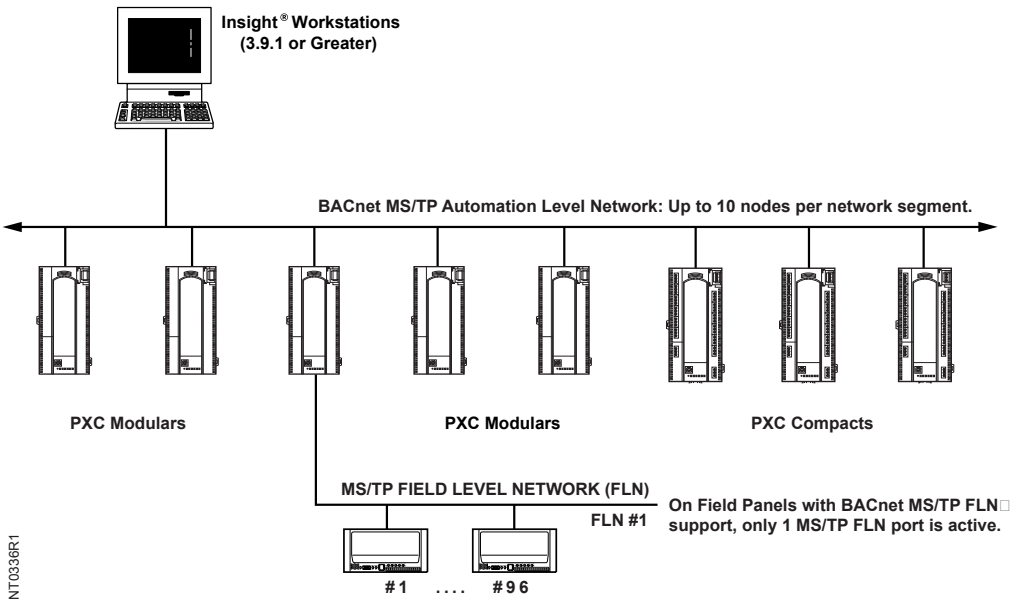
The following figure shows a possible implementation of APOGEE P2 Ethernet ALN and BACnet/IP ALN over a corporate IP network.



1.4.2.7 BACnet MS/TP Automation Level Network

BACnet field panels communicate over a customer's Ethernet cabling and IP network using the ASHRAE Building Automation and Control Networking (BACnet) MS/TP protocol.

- One Insight workstation can administer up to 64 Ethernet based MS/TP ALNs.
- Up to 10 BACnet MS/TP ALN field panels can reside on an MS/TP network segment (1000 maximum per Insight workstation). Network segments must be physically separated.
- BACnet devices (field panels or Insight workstations) can be set up as one of the following:
  - A standard BACnet MS/TP device
  - A BACnet Broadcast Management Device (BBMD)
  - A foreign device



1.4.3 Field Level Network

The APOGEE Field Level Network (FLN) is a data communications network that passes information between an FLN device or devices and an Automation Level Network (ALN) device, usually within one building. FLNs consist of devices that communicate using RS-485 P1 or MS/TP.

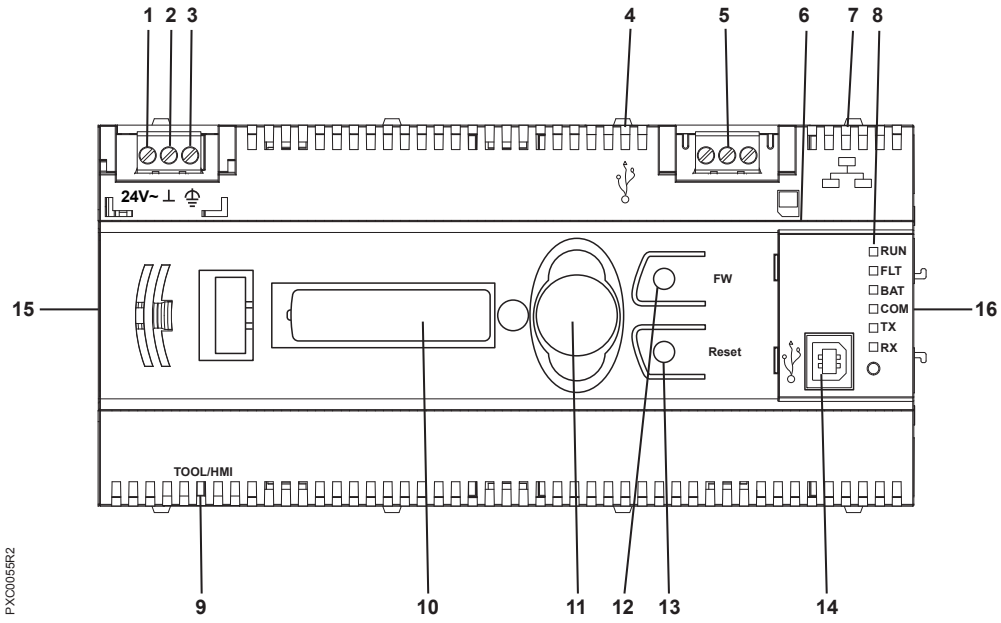
- P1 devices can include Terminal Equipment Controllers (TEC), Fume Hood Controllers (FHC) and other vendor equipment, such as ABB Speed Drives, which contain Protocol 1.
- Selected models of APOGEE field panels can communicate with other vendor protocols on the FLN, such as McQuay, Lumisys, EST IRC-3, and Allen Bradley. Contact your Siemens Industry representative for information on devices that can communicate with other vendor protocols.

2 Chapter 2—Hardware Features

Chapter 2 describes the PXC Modular Series components and functions, as well as the enclosure used for the PXC field panel series. The following topics are discussed:

- Product Diagrams
- Backup Batteries
- Memory
- Communication Connections
- PXC Modular Series Specifications
- Modular Series Smoke Control Application Requirements
- TX-I/O Product Range
- PX Series Enclosures and Service Boxes

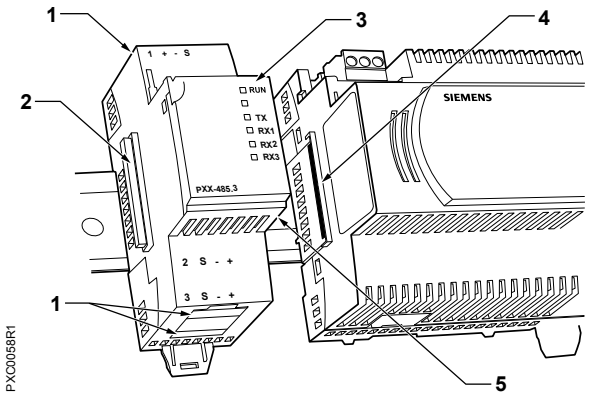
PXC Modular Product Diagram



Modular Series Features, Symbols, and Status LEDs.			
Label	**LED, Symbol, or Feature**	**Status**	**Indication**
1	24V~	-	Supply voltage, 24 Vac input.
2	⊥	-	System neutral.
3	⏚	-	Functional earth ground.
4		-	USB Host port. (Ancillary smoke control applications only.)
5	S - +	-	RS-485 P2 or BACnet MS/TP Automation Level Network (ALN) port.

Modular Series Features, Symbols, and Status LEDs.			
Label	**LED, Symbol, or Feature**	**Status**	**Indication**
6		-	Secure Digital (SD) memory card slot. (For future use.)
7		-	BACnet/IP or Ethernet TCP/IP (P2) Automation Level Network (ALN) port.
8	RUN (green)	ON	Normal operation. 24 Vac power is ON and the application firmware has booted.
		OFF	Error. - 24 Vac input is not present. - Power is ON, but the application firmware has not booted.
	FLT (red) (for future use)	-	-
	BAT (red)	ON	Error. Backup battery is low. Replace the battery.
		OFF	Normal operation.
	COM (yellow) (Ethernet only)	ON	Linked to Ethernet hub.
		OFF	No link to Ethernet hub.
		Flashing	Linked to Ethernet hub and communicating.
	TX (yellow) and RX (yellow) (RS-485 only)	Flashing	Normal operation. Transmitting (TX) or receiving (RX) over the RS-485 ALN trunk.
		OFF or Flashing	Error. No device, no connection, or bad connection.
9	Tool/HMI	-	Human-Machine Interface port (RJ-45, service only).
10	AA alkaline battery	-	SDRAM backup battery. See BAT LED in this table for related indication.
11	Coin cell battery	-	Real Time Clock backup battery.
12	FW (for future use)	-	Firmware reset button.
13	Reset	-	Hardware reset button. Coldstarts the PXC Modular.
14		-	USB Device port. For non-smoke control applications only.
15	Expansion port	-	Connection for an RS-485 Expansion Module or future expansion devices.
16	TX-I/O bus connector (male)	-	Connection for a TX-I/O Power Supply or Bus Connection Module, which powers TX-I/O Modules.

Expansion Module Product Diagram



	LED, Symbol, or Feature	Status	Indication
1	S - +	--	RS-485 P1 or MS/TP Field Level Network (FLN) ports.
2	Expansion connector	--	Connection for future expansion devices.
3	RUN (green)	ON	Normal operation. 24 Vac power is ON and the module firmware has booted.
		OFF	Error. ● 24 Vac input is not present. ● Power is ON, but the module firmware has not booted.
	TX (yellow) and RX (yellow)	Flashing	Normal operation. Transmitting (TX) or receiving (RX) over the RS-485 ALN trunk.
		OFF or ON solid	Error. No device, no connection, or bad connection.
4	PXC Modular Expansion port	--	PXC Modular connection for an RS-485 Expansion Module or future expansion devices.
5	Expansion connector	--	Connection to the PXC Modular.

2.1 Memory

The APOGEE firmware (program), its point database, PPCL program, trend data, and other information reside in the field panel memory. Memory consists of two areas: Flash Read-Only Memory (Flash ROM) and Random Access Memory (RAM).

2.1.1 Flash Read-Only Memory (Flash ROM)

Flash Read-Only Memory (Flash ROM) is the non-volatile, permanent memory of the PXC Modular, which stores the operating system, the APOGEE firmware, and the language files. A limited amount of secondary storage is provided in Electrically Erasable Programmable Read-Only Memory (EEPROM) for the field panel address or name, communication speeds, and other set-up parameters. In the event of a power surge, a power loss, or failure of the battery backup, the Flash ROM and EEPROM contents stay intact.

PXC Modular Flash ROM size cannot be upgraded in the field.

2.1.1.1 Compressed ROM

The PXC Modular has a large amount of high performance RAM. To allow for future features and to provide high system performance, the APOGEE firmware is stored in ROM in a compressed state; it is de-compressed into RAM on system power-up. As a result, the entire onboard RAM is not available for the point database, the PPCL program, and trend data.

2.1.1.2 Auto-Restore and Database Backup to Flash

APOGEE Firmware Revision 2.8.4/3.1 and later supports Auto-Restore and Database Backup to Flash.

- Database Backup to Flash allows the user to manually save a copy of the database in flash memory of the controller.
- The field panel may also be configured to automatically restore the database from flash memory after a coldstart.
  - When auto-restore is enabled, a coldstart does not result in the same downtime as with earlier revisions of APOGEE Firmware. Because there is no waiting on a full download from the backup system, the database is restored from flash so quickly that there is little to no down time. However, the accumulated trend data is deleted from memory.
  - Database restoration from flash is disabled by default.
  - When P1 Mode is selected for the PXC Compact, database restoration from flash is automatically enabled and 128K of memory is reserved for ISB files.

For procedures on using Auto-Restore and Database Backup to Flash, see the *APOGEE P2 ALN Field Panel User's Manual* (125-3019) or *APOGEE BACnet ALN Field Panel User's Manual* (125-3020).

Auto Save

This feature allows the database to be backed up automatically whenever database is changed, instead of being an operator selected function. It does not provide any safeguard and or protection against power loss while the process is underway. However, this feature sends messages to HMI that the auto save operation is in progress or finished.

The feature may be turned on or off using a prompt similar to the existing Autorestore prompt. See the APOGEE BACnet ALN Field Panel User's Manual (125-3020) for more information.

File System Operations

File System Operations provide many features and works on three drives of a field panel.

The following is a list of supported features: :

- List Drives — list the drives on the field panel where **A:** is the RAM drive, **B:** is the USB drive if attached, **IFD:** is the internal Flash Drive.
- Set_drive — identifies the drive that you desire to perform other functions on.

- listDirectory — lists the Files and folders contained on the selected drive.
- Change_dir — changes the current directory to allow you to view the contents of subfolders on the drive.
- File_ops — opens up the file control menu which allows you to copy, rename, delete and move files in the panel. These functions work on the drive that was selected by the Set_drive function.
- File_ops/Copy_file — allows you to copy files within a drive or to another drive.
- File_ops/Rename_file — allows you to rename a file.
- File_ops/Move_file — allows you to move a file within a drive or to another drive.
- File_ops/Delete_file — allows you to delete a file.

USB Media Support

- Support for USB mass storage devices (Memory sticks or USB hard drives).
- Backup of database, storage for graphics, Web Server upgrades

2.1.2 Random Access Memory (RAM)

Synchronous Dynamic Random Access Memory (SDRAM) is the working memory of the PXC Modular. When the PXC Modular has booted and is operating normally, the APOGEE firmware, the PPCL control program, the point database, and trend data have been transferred from Flash ROM. Information stored in RAM, such as the point database or PPCL, may be viewed, modified, deleted, activated, or deactivated from an operator terminal by any high-level authorized user. In the event of a power loss, the contents of RAM are kept intact by a backup battery.

PXC Modular RAM size cannot be upgraded in the field.

The program length, number of database points, and number of trend entries is limited only by available memory.

2.2 Communication Connections

The PXC Modular Series operates on the Automation Level Network (ALN) or the Field Level Network (FLN).

- When connected to the ALN, the PXC Modular uses a logical point firmware database to communicate directly with PXC Compacts, MBCs, RBCs, MECs, SCUs, and other nodes on the network.
- When connected to the MS/TP FLN, the PXC Modular operates as a third-party BACnet device.

The PXC Modular provides the following communication connections:

- HMI and Tools
- Network
  - 10B/100B Ethernet port
  - RS-485 port
  - USB Host port
- PXC Modular Expansion Module
- TX-I/O Bus

The following connections and features are available when communicating on a BACnet/IP Automation Level Network:

- Ethernet port
- RS-485 Port
- USB Host port
- Web Server support: Web-based Graphical User Interface (GUI) compatible with BACnet® networks. Ideal for small or remote facilities to monitor and control the Building Automation System.

The following connections and features are available when communicating on an Ethernet TCP/IP Automation Level Network:

- Ethernet port
- USB Host port
- Field Panel GO, a Web-based graphical user interface for the APOGEE System. Field Panel GO is suited for sites with up to six field panels on the Ethernet ALN. (Additional license required.)

The PXC Modular hardware can be changed between RS-485 P2 and Ethernet ALN through the HMI. The factory default is Ethernet ALN.

NOTE:
Changing the ALN type coldstarts the field panel.

NOTE:
In Ethernet ALN mode, RS-485 P2 parameters are displayed and may be entered as a selection. However, when in RS-485 P2 ALN mode, Ethernet ALN parameters are not an available selection.

2.2.1 HMI and Tool Ports

- The HMI port provides a connection to a laptop computer for local operation and engineering.
- The USB Device port supports a generic serial interface for an HMI or Tool connection.

Human-Machine Interface (HMI)/Tool Port

The Human-Machine Interface (HMI)/Tool port provides RS-232 compliant communications through a quick-connect RJ-45 jack. The HMI port supports the following functionality:

- Connecting a machine interface device, such as an operator terminal or a text-based operator terminal, to the PXC Modular.
- Executing firmware flash upgrades.
- 1200 bps to 115.2 Kbps communication is supported.

NOTE:
The communication speed of the port must match the communication speed of the device connected to it.

USB Device Port

The USB Device port supports a generic serial interface for an HMI or Tool device. The USB Device port does not support firmware flash upgrades.

2.2.2 10B/100B Ethernet Port

The 10B/100B Ethernet port provides a path for commands and information transmitted between field panels inside a firewall. This port provides both full- and half-duplex 10Base-T or 100Base-TX compliant communications over a BACnet/IP or Ethernet TCP/IP (P2) Automation Level Network (ALN). The highest possible communication speed is automatically detected and selected.

2.2.3 RS-485 Port

The RS-485 port provides a path for commands and information transmitted between field panels. This port provides communications over a RS-485 P2 or BACnet MS/TP Automation Level Network (ALN). The communication speed is set during startup.

The RS-485 port provides half-duplex, asynchronous serial RS-485 communications over shielded twisted pair cable. The RS-485 connector is labeled + – ⏚ to indicate the positive and negative connections. ⏚ is a reference pin.

The following features are available when communicating on an RS-485 Automation Level Network:

- RS-485 port
- Virtual AEM

Without additional hardware, the Virtual AEM connects an RS-485 APOGEE Automation Level Network (ALN) or individual RS-485 field panels to a P2 Ethernet network.

- An additional license is required.
- FLN support is not available when a Virtual AEM license is installed.

2.2.3.1 FLN Support

The Siemens Industry Field Level Network (FLN) can consist of devices that communicate over an RS-485 connection using either MS/TP or Protocol 1 (P1).

- BACnet/IP ALN networks support application-specific control devices that communicate using MS/TP or P1.
- Ethernet TCP/IP and RS-485 ALN networks only support application-specific control devices that communicate using P1.

PXC Modular Series FLN Support.				
ALN Protocol	**FLN Protocol Supported**	**Firmware Revision**	**Number of FLN Devices[1]**	**Drop Number Range**
BACnet/IP	MS/TP or P1 (RS-485)	3.1 and later	Up to 96 devices per FLN connection	0 to 254
Ethernet TCP/IP or RS-485	P1 (RS-485)	2.8.5 and later	Up to 96 devices per FLN connection	0 to 254
		2.8.4 and earlier	32 devices per FLN connection	0 to 31 if networked 0 to 99 if stand-alone

[1] Each field panel supports a total of 96 FLN devices. With Firmware Revisions 2.8.5 and later, the devices may be grouped in any combination on the FLN ports as long as the total number of FLN devices on the field panel does not exceed 96.

2.2.4 Expansion Module Overview

The Expansion Module provides the hardware connection for Field Level Network (FLN) devices including:

- Siemens Industry FLN
- Communications Drivers to Non-Siemens Networks
- Wireless P1 FLN

2.2.4.1 Siemens Industry FLN

Using the Triple RS-485 Expansion Module, the PXC Modular supports up to three RS-485 networks of P1 Field Level Network devices, or one RS-485 network of BACnet MS/TP devices.

2.2.4.2 Communication Drivers to Non-Siemens Networks

As an option, the PXC Modular can communicate to related building system controllers, such as boilers, chillers, rooftop units, Programmable Logic Controllers (PLCs), power meters, lighting panels, fire alarm and life safety systems, and access control systems.

2.2.4.3 Wireless P1 FLN

Wireless P1 FLN replaces the traditional FLN cabling with wireless communication links that form a wireless mesh network. The Wireless FLN is enabled through the PXC Modular HMI.

NOTE:
A P1 FLN license must be installed in order to use Wireless FLN.

2.2.5 TX-I/O Island Bus

The PXC-36 offers the flexibility of expanding the total point count through a self-forming island bus. With the addition of TX-I/O modules and a TX-I/O Power Supply, up to 32 points (or four TX-I/O modules) can be supported.

An additional license may be required to enable the Island Bus.

Modular Series Smoke Control Application Requirements

- The controller must be located at the bottom of the enclosure.
- The controller may be oriented either horizontally or vertically. See the following figures.

For Ethernet communications, the UL Listed surge protector (Ditek model DTK-MRJ45C5E) is required for BACnet/IP or Ethernet TCP/IP (P2) networks. The surge protector must be located in the same enclosure as the controller.

Modem Requirements

- The UL864 Listed surge protector (538-600) is required.
- Devices connected between the USB port and the UL Listed surge protector must be located within the same room.
- A USB-to-RS-232 adaptor may be needed for UL Listed modems or UL Listed printers that are not configured for USB communication.
- The modem may be located inside the PX Series enclosure.

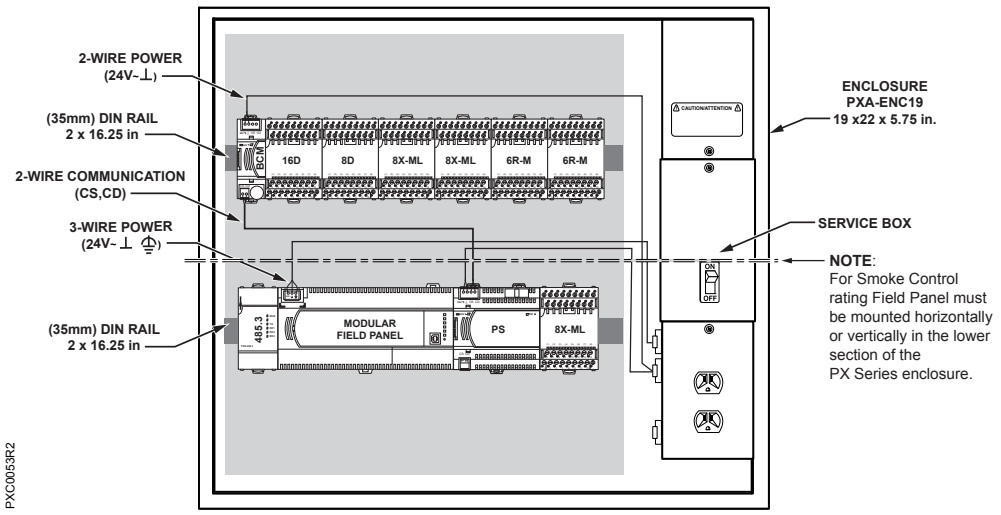


Figure 4:

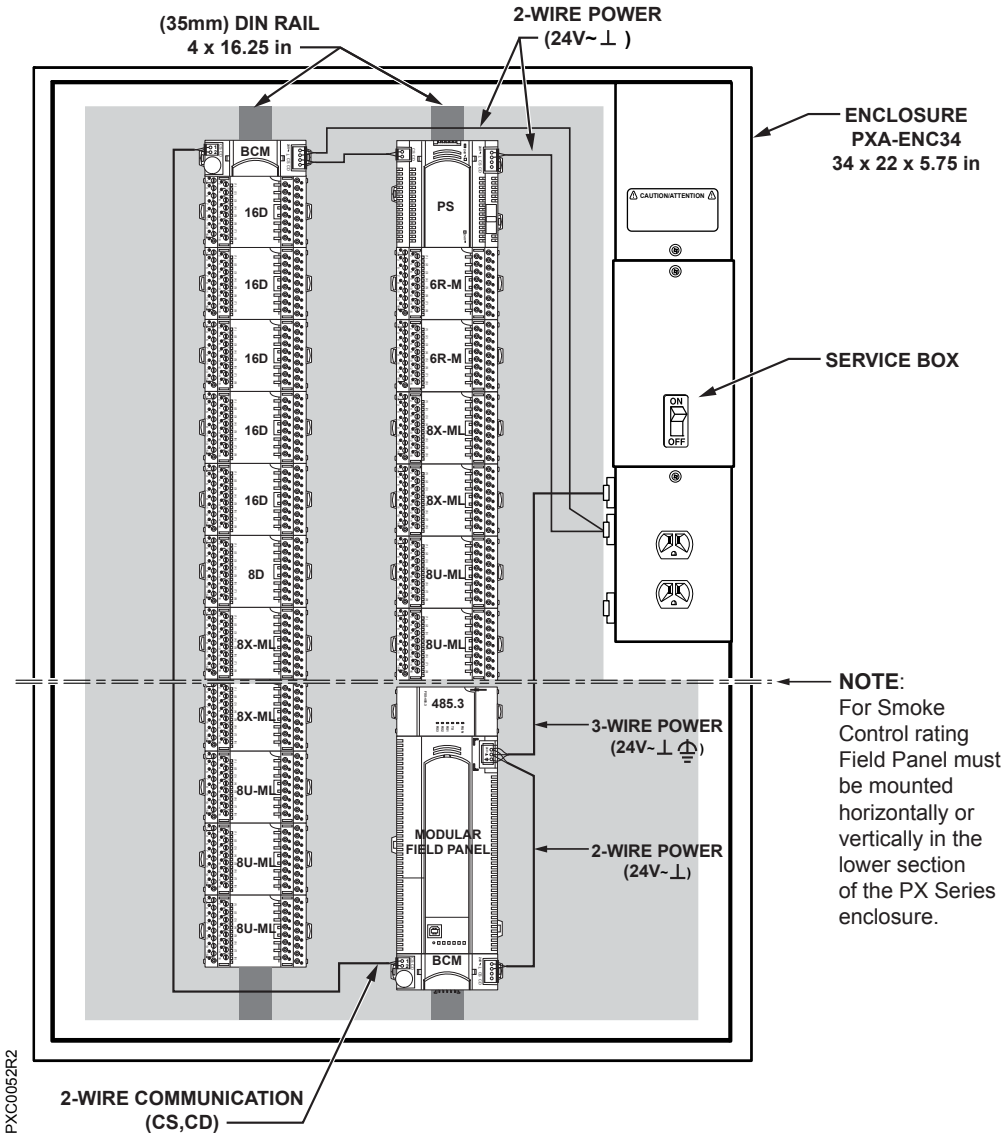


Figure 5:

Example ALN Configuration for Smoke Control Applications

The RS-485 ALN does not have the same restrictions as the Ethernet ALN for smoke control. Namely, Ethernet requires UL listed switches and routers.

The following figure displays a possible ALN configuration for smoke control.

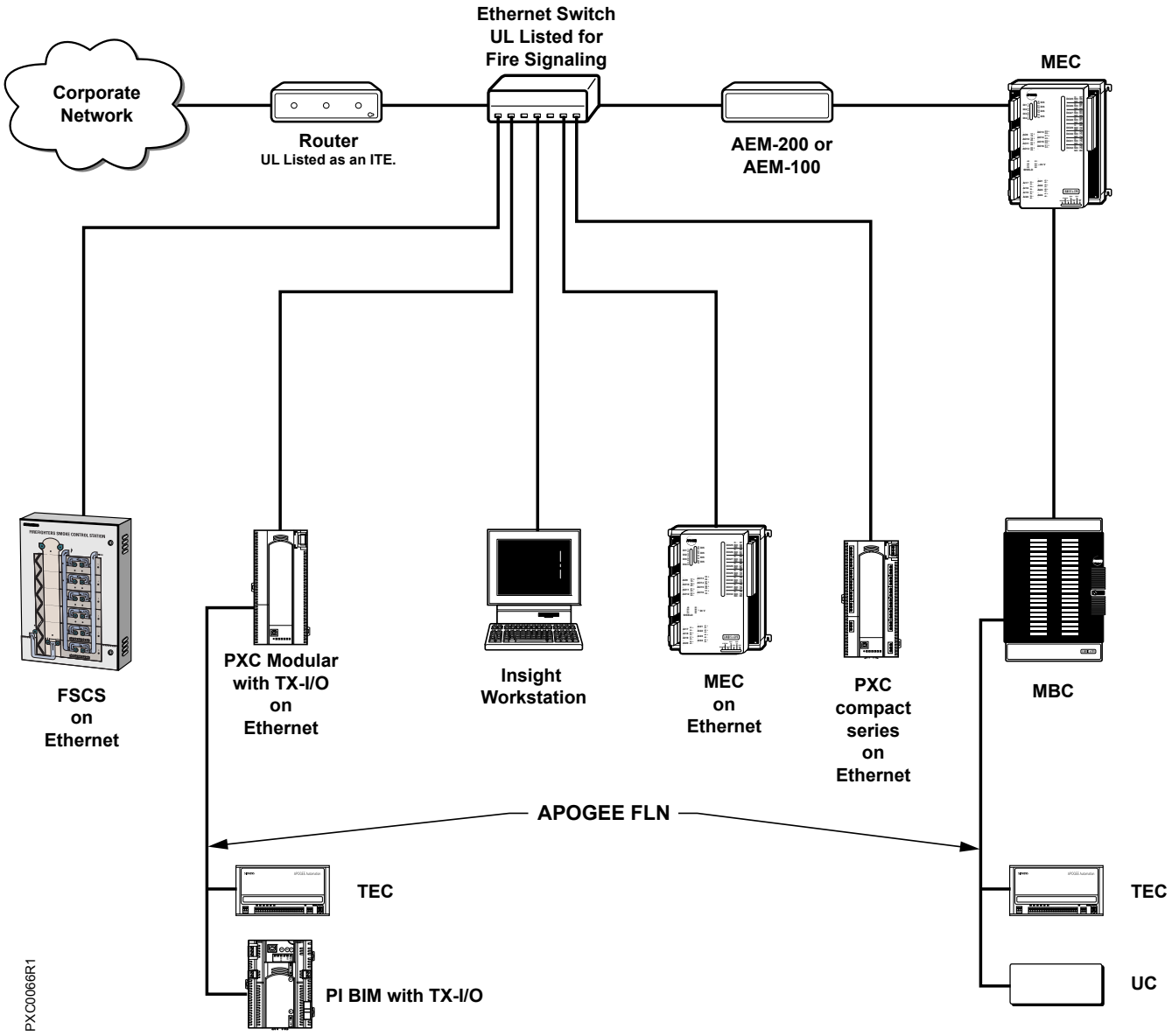


Figure 6: Example ALN Configuration for Smoke Control.

PXM10S/T Product Overview and Description

NOTE:
All figures show the BACnet version of the PXM10S and PXM10T. The appearance of the proprietary version may differ slightly.

PXM10S and PXM10T are optional controller mounted Operator Display modules that provide a password protected user interface. This interface allows you to interact with the existing field panel database and its immediate sub-networked Siemens (FLN) devices. (Optional remote enclosure door mount kit also available.)

NOTE:
All unacknowledged alarms are viewable even if you are not logged into the module.

Product Description

The PXM10S and PXM10T modules are available as an upgrade for use with all Siemens Compact and Modular Series field panels to provide additional local operator capabilities. The PXM10S and PXM10T modules are field mounted and replace the field panel covers.

There are three dedicated buttons, ALARM, INFO, ESC and one push DIAL. These buttons, the push dial, and LCD display screen allow for interactive feedback at the field panel controller.

The PXM10S and PXM10T modules support all the languages loaded in the host field panel.

There are two versions of the modules as follows:

- PXM10S has all available options, including Point Monitor and optional blue backlight color.
- PXM10T does not include the Point Monitor or the optional blue backlight color.

Language selection and user account timeout settings are configurable using an operator workstation or HyperTerminal at the field panel's HMI.

All PXM10S/T preferences are panel-specific and stored in the local panel configuration data.

NOTE:
For more information on creating and configuring user accounts, see the *APOGEE P2 ALN Field Panel User's Manual* (125-3019) or *APOGEE BACnet ALN Field Panel User's Manual* (125-3020).

Product Features

The PXM10S and PXM10T modules provide the following features:

- Plug and Play - Upon connection to the host field panel, the device is recognized and fully functional.
- Hot Swappable – The module can be installed or removed without powering down the controller and interrupting facility operations.
- User-friendly navigation and menu structure.
- Push DIAL for easy operation.
- Alarm button with red LED indicator for local alarm annunciations.
- INFO button provides one touch access to detailed system information for points.
- Manual and automatic login option for enhanced security or easy access.
- View point information and status, view and acknowledge alarms, and command/release local field panel points.
- Point Monitor – Can customize a group of points to continuously display and refresh with updated values (PXM10S only).
- Multi-language (English, Simplified Chinese, French, and Korean) support.

- The PXM10S and PXM10T modules can also be mounted on the inside or outside of an enclosure door, using an optional accessory sold separately.

Communication Connections

A field panel fully powered and running Firmware Revision 2.8.6/3.2.2 or later, recognizes the PXM10S and PXM10T modules within approximately 5 seconds of connection. Prior to that, the Operator Display is not operational.

If a field panel is coldstarted or it's the first time the panel is powered up, it takes approximately 15 to 30 seconds after connection before the PXM10S and PXM10T module is operational.

Requirements

System Requirements

The PXM10S and PXM10T modules can be used with Compact platforms (PXC-36, PXC-24, and PXC-16) as well as the PXC Modular field panels.

- All hardware must be installed.
- Power must be available to all devices.
- System components must be installed, running, and checked out by an appropriate system representative.

Hardware Platform

The PXM10T and PXM10S modules can be used on all Siemens Compact and Modular series controllers. An additional connecting ribbon cable (part number PXA-HMI.CABLEP5) is required when mounting to a PXC16 or PXC24.

Firmware Platform

The PXM10T and PXM10S modules are compatible with all Siemens Compact and Modular series controllers using Firmware Revision 2.8.6/3.2.2 or later (proprietary protocol/BACnet).

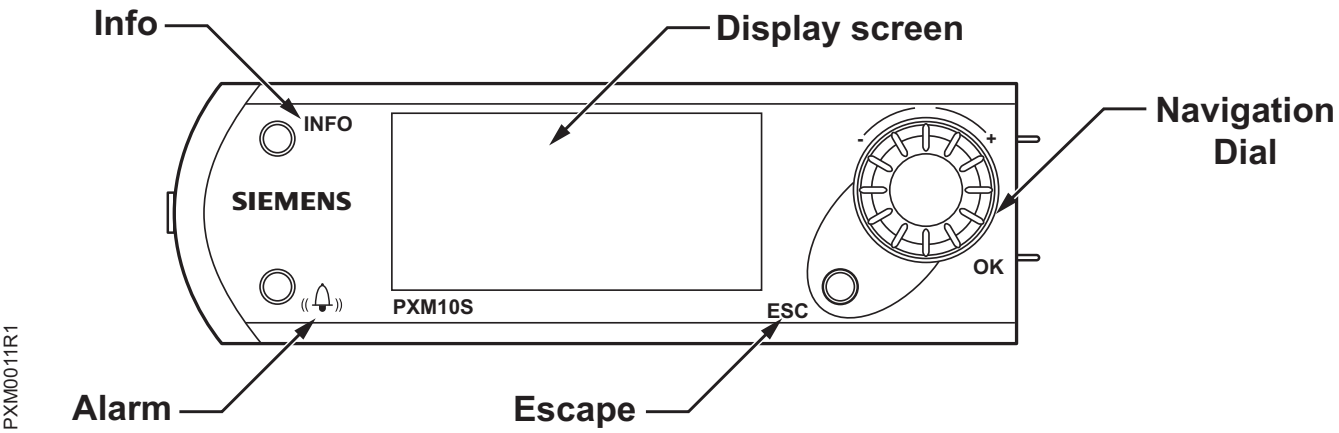
Application Menus

The following application menus are provided with the PXM10S and PXM10T modules.

- Login
- Alarms
- Points (Command and Release)
- Point Monitor
- Logoff
- Settings

NOTE:
You must have sufficient operator access permissions to the Alarms, Points, and Point Monitor applications to fully use all features and corresponding submenus.

Operator Display Layout



PXM0011R1

Display screen – Displays splash screen with either PXM10S or PXM10T module, device Firmware Revision, field panel Firmware Revision number, and Cimetrics BACstac revision number. Cursor position is indicated by either a right-angled bracket (>) or inverted text color, depending on field panel type and revision.

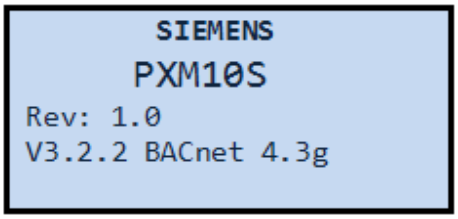


Figure 7: Splash Screen

NOTE:
If text information is too long for the display screen, the text scrolls horizontally across the screen, in a marquee style. If a high-priority task (such as a back-up) is being performed, the horizontal scrolling may be erratic.

NOTE:
The list of objects (once it is created) that displays for the Alarms, Points, and Point Monitor menus is static, however, the point information (current value, status, priority, etc.) is dynamic. You must leave the menu/page and return to it in order to view any updated information.

Navigation Push DIAL – Rotate clockwise or counter clockwise to highlight menu options (up or down). Press the dial to enter a menu or to make a selection. Rotate the dial to change a value. Pressing the dial is equivalent to selecting **OK**.

ESC button – Press once to return to previous menu/page or backspace during text/value editing.

INFO button – Press once to navigate to the window containing all available information about the point on selected line.

Alarm Window

There are two ways to view alarms, both of which display the alarm list with the point system name and status:

- **Alarm button**. Provides direct access to the list of unacknowledged alarms.
- **Alarm menu**. Displays any point in alarm, regardless if it has been acknowledged or not and provides three generic filters:
  - Unacknowledged Alarms filter allows you to filter all alarms and lists only unacknowledged alarms in local system.
  - All Alarms filter allows you to view all acknowledged and unacknowledged alarms in the system.
  - Failures/Faults filter allows you to view all failures/faults in the system for which alarming has been enabled.

Pressing the **INFO** button for point information displays:

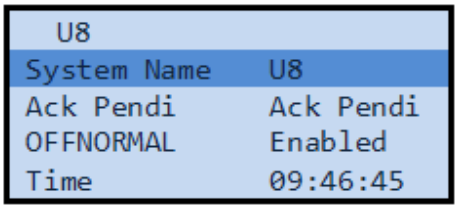
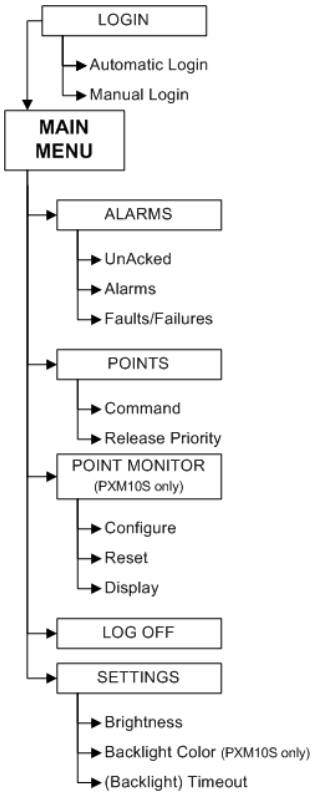


Figure 8: INFO for Alarms

Press **ESC** to close alarm window without affecting the alarm.

Operator Display Menu Tree



Main Menu Structure

All menu screen captures in this manual reflect the PXM10S module. Not all menu options/features shown are available with the PXM10T module.

NOTE:
A solid DOWN arrow in the top right corner of the display screen indicates more menu options are available and a solid UP arrow indicates more items are available after the last highlighted item.

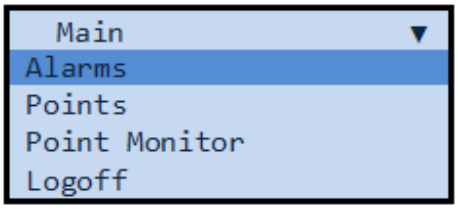


Figure 9: Main Menu

Alarms - Allows you to view and acknowledge alarms and failures/faults. However, you must be logged in with sufficient permissions (at least Command or Edit/Configure level access) to acknowledge an alarm.

Points - Allows you to view, command, and release the host field panel's onboard points and sub network points (FLN devices). To command and release points, you must have Command or Edit/Configure level access permissions.

Point Monitor - Displays a submenu, which allows an operator to configure and display a custom grouping of point and their values. The values are refreshed every four seconds. To configure points, you must have Edit/Configure level access permissions.

LogOff - Displays screen for confirming logoff.

Settings - Displays a submenu and screens that allow you to customize the LCD's display settings.

Login and Logoff

You must have at least Read Only level access permission to login to the PXM10S or PXM10T module. If you log in and you have no access level permissions, the system will immediately log you off the module.

After three failed login attempts, the user account will be locked. An administrator must use the HMI to unlock the user accounts by modifying that particular user account. Also, you can only change your password for the PXM10S or PXM10T modules from the HMI.

Logging In

Automatic Login

The PXM10S or PXM10T automatic login feature must be configured using the host field panel's HMI port. Only one user account can be flagged as the automatic login account.

NOTE:
Default user account login information for PXM10S or PXM10T is on a per ALN account basis.

If your network contains an assortment of field panels with Firmware Revisions earlier than 2.8.6/3.2.2, the AutoLogin account is not replicated or passed onto other field panels. For more information about workstation user accounts, see the *Insight Online Help* system.

Configuring AutoLogin at the HMI with HyperTerminal

Complete the following steps to configure an automatic login using HyperTerminal at the host field panel's HMI.

You must be logged into the field panel with an account that has Edit level access permission to the users access group.

To configure automatic login, complete the following steps:

HMI	**S, U, A, E, A** (System, Users, Accounts, Edit, Add)

Prompt/Field	Option/Entry	Description
User initials		Type the new user's initials.
Account name		Type the account name.
Password		Type a password for the user.
Verify password		Retype the password.
System, User namespace	S	View System point names.
	U	View User point names. (default setting)
Access group(s)	All groups	(default setting)
	A single access group	Valid value 1 through 30.
	Multiple access groups	Valid values 1 through 30 separated by commas, or use two periods to indicate a range (for example, 1..4,7,9,12..20).
Privilege **NOTE:** Auto User accounts need access to Point and Alarm ONLY.	Point	**N** (No_access) **R** (Read_only) **C** (Command) **E** (Edit) (default setting)
	Alarm	**N** (No_access) **R** (Read_only) **C** (Command) **E** (Edit) (default setting)
	Trend	**N** (No_access) **R** (Read_only) **C** (Command) **E** (Edit) (default setting)
	Application	**N** (No_access) **R** (Read_only) **C** (Command) **E** (Edit) (default setting)
	PPCL	**N** (No_access) **R** (Read_only) **C** (Command) **E** (Edit) (default setting)
	FLN devices	**N** (No_access) **R** (Read_only) **C** (Command) **E** (Edit) (default setting)
	Equipment Scheduler	**N** (No_access) **R** (Read_only) **C** (Command) **E** (Edit) (default setting)
	System	**N** (No_access) **R** (Read_only) **C** (Command) **E** (Edit) (default setting)
	Diagnostics	**N** (No_access) **R** (Read_only) **C** (Command) **E** (Edit) (default setting)
	Users	**N** (No_access) **R** (Read_only)

		C (Command) **E** (Edit) (default setting)
	Hardware	**N** (No_access) **R** (Read_only) **C** (Command) **E** (Edit) (default setting)
Language ID	Language	Default
	Particular language	Language ID, ? displays all available languages. **NOTE:** You can also enter nothing, to display all available languages.
Time format	(HH:MM:SS)	Default
	Particular format	Time format; ? displays all available formats. **NOTE:** You can also enter nothing, to display all available Time formats.
Date format	(MM/DD/YYYY)	Default
	Particular format	Date format; ? displays all available formats. **NOTE:** You can also enter nothing, to display all available Date formats.
AutoLogoff enabled (Y/N)	Y	Enable automatic logoff.
	AutoLogoff delay	1 to 1440 minutes
	N	Disable automatic logoff.
Password Expire Limit		0 to 365 days
Use for PXM10Tiny AutoLogin (Y/N)	Y	Enable automatic login.
	N	Disable automatic login.

Example

```
>User initials                  :  tiny
>Account name                   :  PXM10TINY----------------------
---
>Password                       :  ?????----------
>Verify password                :  ?????----------
>System, User namespace         :  U
>Access group(s)                :  1..30--------------------------
----------
>Point privilege - No_access, Read_only, Command, Edit: E
>Alarm privilege - No_access, Read_only, Command, Edit: E
>Trend privilege - No_access, Read_only, Command, Edit: E
>Application privilege - No_access, Read_only, Command, Edit: E
>PPCL privilege - No_access, Read_only, Command, Edit: E
>FLN devices privilege - No_access, Read_only, Command, Edit: E
>Equipment Scheduler privilege - No_access, Read_only, Command,
Edit: E
>System privilege - No_access, Read_only, Command, Edit: E
>Diagnostics privilege - No_access, Read_only, Command, Edit: E
>Users privilege - No_access, Read_only, Command, Edit: E
```

```
>Hardware privilege - No_access, Read_only, Command, Edit: E
>Language ID                    :  0409
>Time format                    :  HH:MM:SS---
>Date format                    :  MM/DD/YYYY-
>AutoLogoff enabled (Y/N)       :  Y
>AutoLogoff delay               :  5---
>Password Expire Limit          :  30-
>Use for PXM10Tiny AutoLogin (Y/N): Y
User account <tiny> added
```

NOTE:
For more information on creating and configuring user accounts, see the *APOGEE P2 ALN Field Panel User's Manual* (125-3019) or *APOGEE BACnet ALN Field Panel User's Manual* (125-3020).

Do the following to automatically log in to the PXM10S or PXM10T module.

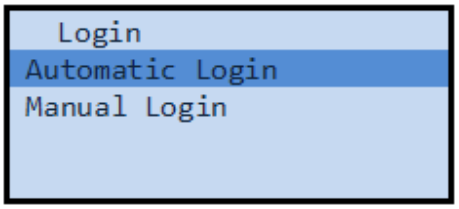


Figure 10: Automatic Login Submenu

Menu/Submenu	Step	Description
Splash screen/logo	Press the dial.	
	Rotate the dial to highlight **Automatic Login**.	Login menu displays.
Login	Press the dial to select **Automatic Login**.	System logs you into the Main menu of the module.

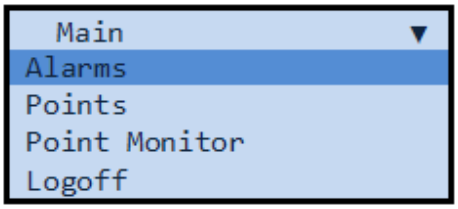


Figure 11: Main Menu

Manual Login

Do the following to manually log in to the PXM10S or PXM10T module. The default language for manual login is U.S. English.

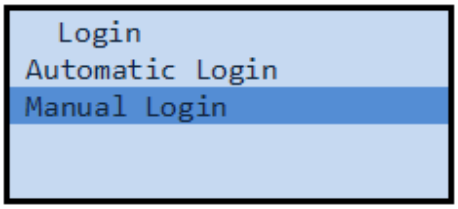


Figure 12: Manual Login Submenu

Menu/Submenu	Step	Description
Splash screen/logo	Press the dial.	
	Rotate the dial to highlight **Manual Login**.	Login menu displays.
Login	Press the dial to select **Manual Login**.	Displays the Manual Login submenu.
Manual Login	USR **** PWD **********	Enter your user name (up to 4 characters) and password (3 to 15 characters). A one character username is allowed. **NOTE:** You can only use capital letters A through Z for user name and passwords.
	For **USR**, rotate the dial to highlight each character.	
	Press the dial to select each character. Repeat until you enter the complete user name.	**NOTE:** If you make a mistake selecting a character, press **ESC** to return to the previous character.
	Press the dial twice to move to the PWD fields.	
	For **PWD**, rotate the dial highlight each character.	
	Press the dial to select a character. Repeat until you enter the complete password.	**NOTE:** If you need to return to the previous editable field, for example from PWD fields back to USR fields, press **ESC**. To proceed to the next field, press the dial.
	Press the dial to confirm USR and PWD.	System logs you into the Main menu of the module.

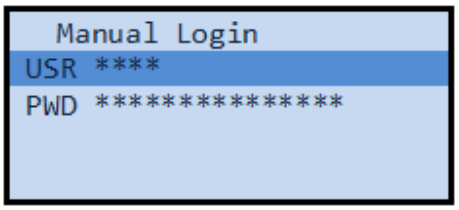


Figure 13: Manual Login Screen

Logging Off

There are three ways to log off.

- Automatic logoff – Occurs when the module interface has been idle for the amount of time defined in the user account settings. The timer feature is configured when a user account is created at the field panel.
- Manual logoff – Select **Logoff** on the screen – Prompts you to confirm logoff.
- Press **ESC** on the Main menu screen – Prompts you to confirm logoff.

NOTE:
When you log off the module, the screen may go blank for approximately two seconds.

Do the following to manually log off the PXM10S or PXM10T module.

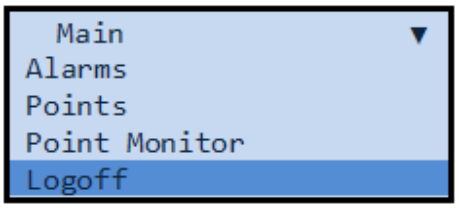


Figure 14: Logoff Menu

Menu/Submenu	Step	Description
Main	Rotate **DIAL** to highlight **Logoff**.	
	Press **DIAL/OK** to and select **Logoff**.	Displays the Logoff submenu.
Confirm Logoff Are you sure?	Rotate **DIAL** to highlight **Yes** or **No**.	
	Press **DIAL/OK** to make selection.	Confirms logoff and returns to splash screen. **NOTE:** If you press **ESC**, you are prompted with the same Confirm Logoff screen.

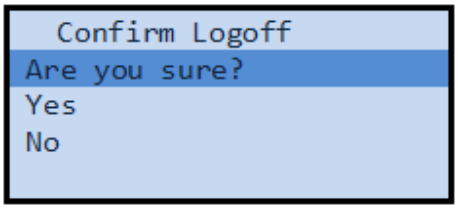


Figure 15: Confirm Logoff Submenu

Viewing, Commanding, and Releasing Points

Viewing Points

All points displayed on the screen are listed alphabetically, by system name.

NOTE:
Only four lines (excluding the title) of points are listed at a time for the English and French language.

Only three lines (excluding the title) of points are listed for the Chinese and Korean language.

Do the following to view and scroll to the next series of points in the field panel.

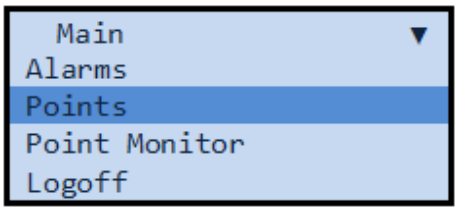
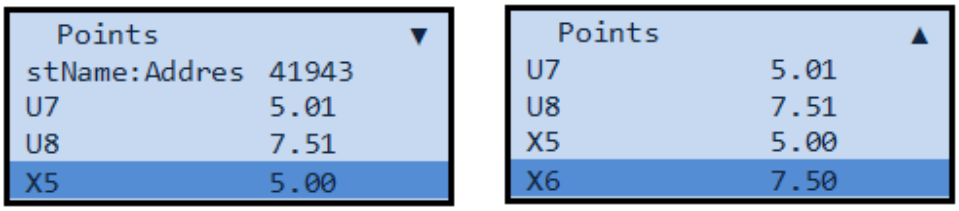


Figure 16: Points

Menu/Submenu	Step	Description
Main	Rotate **DIAL** to highlight **Points**.	
	Press **DIAL**/**OK** to select **Points**.	Displays the Points menu.
Points	Press **DIAL**/**OK** to highlight desired point.	
	Press **DIAL**/**OK** to select point.	
	Rotate **DIAL** to highlight the last point (bottom of screen), and then rotate **DIAL** once more.	Refreshes the screen and displays the previous screens last highlighted point, as well as the next series of points.
	Repeat steps until you reach the end of the point list.	The number of points you can enter is dependent on the number of points stored at the host's field panel database, and sub network devices connected/configured to the host's field panel you are connected to.
	Press **ESC**.	Returns you the Points menu.
	Press **INFO**.	Displays detailed point information of selected point.

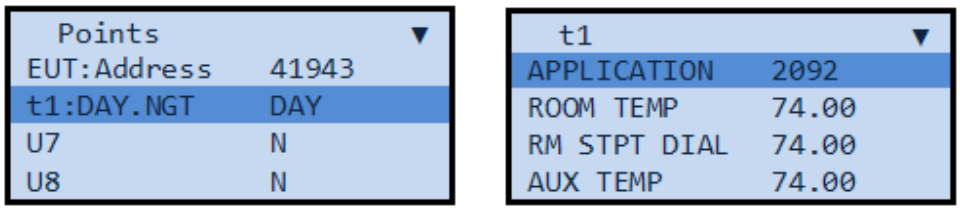


Scrolling the List of Points

The point name is displayed in the left column and values in the right column.

The PXM10Tiny on proprietary firmware will display point status as well as value. BACnet firmware will display value only.

For TECs, the prefix is the TEC name; and the exposed point in the Points menu is the DAY.NGT subpoint. To see a complete list of the device's subpoints, highlight the **DAY.NGT** point, and then press **DIAL**/**OK**.



TEC Subpoints Menu with List of Device Subpoints

NOTE:
Based on FLN speed and network traffic, there may be a delay in displaying a full point database.

Commanding Points

Do the following to change the point value and command the points in the field panel. These steps also apply to commanding TEC subpoints.

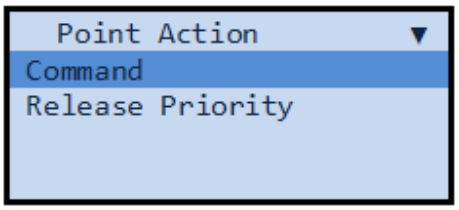


Figure 17: Point Action Command Submenu

Menu/Submenu	Step	Description
Main	Rotate **DIAL** to highlight **Points**.	
	Press **DIAL**/**OK** to select Points.	Displays the Points menu.

Menu/Submenu	Step	Description
Points	Press **DIAL**/**OK** to highlight desired point.	Displays the Point Action Command submenu.
Point Action	Rotate **DIAL** to highlight **Command**.	
	Press **DIAL**/**OK** to select **Command**.	Displays the point name in title. Lists the selected point's current value, edit (highlighted) and priority fields.
[selected point name]	With **Edit** field highlighted, rotate **DIAL** to each numeric character and decimal, and press **DIAL**/**OK** after each numeric increment, including decimal character, until you enter the new value.	Changes the specified point value.
	Press **DIAL**/**OK**.	Confirms the point value change and moves to the Priority field.
	With **Priority** field highlighted, repeat steps to change priority of selected point. **NOTE:** This field is BACnet-specific. P2 firmware always commands at a priority of OPER.	Confirms the point priority change and returns you to the Points menu.
	Press **ESC**.	Returns you to the previous menu without changing the point value or priority.

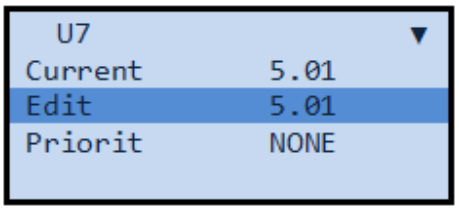


Figure 18: Command Point Value Submenu

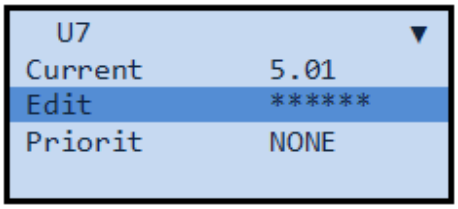


Figure 19: Edit Command Point Value Submenu

Releasing Points

Do the following to change a point priority and release a point.

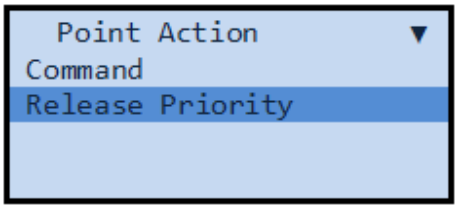


Figure 20: Point Action Release Priority Submenu

Menu/Submenu	Step	Description
Main	Rotate **DIAL** to highlight **Points**.	
	Press **DIAL/OK** to select **Points**.	Displays the Points menu.
Points	Rotate **DIAL** to highlight desired point.	
	Press **DIAL/OK** to select point.	Displays the Point Action Release Priority submenu.
BACnet Point Action	Rotate **DIAL** to highlight **Release Priority**.	
	Press **DIAL/OK** to select **Release Priority**.	**NOTE:** BACnet point priorities cannot be commanded lower than a priority value of 8.
	Rotate **DIAL** to change the numeric value of the point priority.	
	Press **DIAL/OK** to edit point priority.	
	Rotate **DIAL** to change point priority value.	
	Press **DIAL/OK** to confirm change.	Releases BACnet point priority.
	Press **ESC**.	Returns you to the previous menu without changing the point priority.
P2 Point Action:	Rotate **DIAL** to highlight **Release Priority**.	
	Press **DIAL/OK** to select **Release Priority**.	
	Rotate DIAL to select Yes or No. Press DIAL/OK.	This releases the priority to NONE.
	Press **ESC**.	Returns you to the previous menu without changing the point priority.

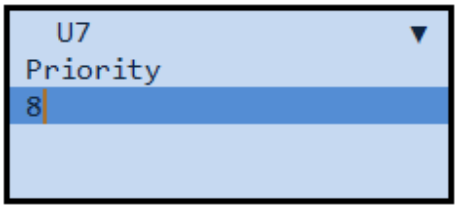


Figure 21: Release Priority Value Submenu

Configuring Point Monitor

NOTE:
This application and its sub-features are only available with the PXM10S module.

The Point Monitor allows you to select the points you frequently need to monitor and allows quick access to view a point status. This concept is similar to a Favorites list.

The maximum number of points listed and stored in Point Monitor is 10. You cannot add more points to the Point Monitor once you reach the maximum number. Reset/clear the Point Monitor of stored points and then add the desired set of 10 or fewer points you want to monitor.

NOTE:
Depending on user access rights, previously added points (by other users) to the Point Monitor may not be visible. In this situation you can't see or add any points in Point Monitor. If this happens, you must first reset the Point Monitor to purge the old information. This affects all users. While Point Monitor information can't be retrieved, the field panel database is not affected.

Configuring Points for Point Monitor

Do the following to configure the host field panel's points for monitoring in Point Monitor after logging in.

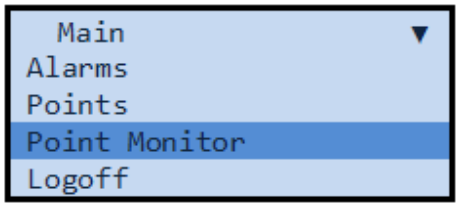


Figure 22: Point Monitor

Menu/Submenu	Step	Description
Main	Rotate **DIAL** to highlight **Point Monitor**.	
	Press **DIAL**/**OK** to select **Point Monitor**.	Displays the Point Monitor menu.

Menu/Submenu	Step	Description
Point Monitor	Rotate **DIAL** to highlight **Configure**.	Displays all available points at the field panel.
	Press **DIAL/OK** to select **Configure**.	
Edit Pt Monitor	Rotate **DIAL** to highlight desired point.	Displays black background, allowing you to edit field.
	Press **DIAL/OK** to select point.	
	Press **DIAL/OK** to select **Y** or **N**.	Y=Yes; point is monitored. N=No; point is not monitored. (This is the default setting.)
	Press **DIAL/OK** to select **Y** or **N**.	
	Press **ESC**.	Returns you to the Monitor menu.

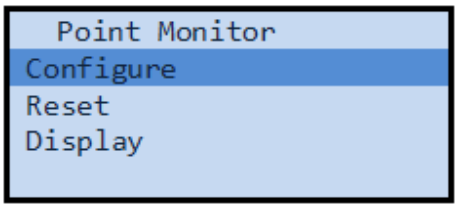


Figure 23: Configure Submenu

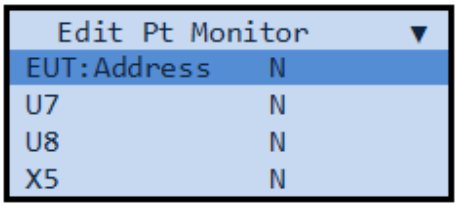


Figure 24: Edit Point Monitor Submenu

Do the following to configure bundled points in Point Monitor.

Menu/Submenu	Step	Description
Main	Rotate **DIAL** to highlight **Point Monitor**.	
	Press **DIAL/OK** to select **Point Monitor**.	Displays the Point Monitor menu.
Point Monitor	Rotate **DIAL/OK** to highlight **Configure**.	Displays all available points at the field panel.
	Press **DIAL/OK** to select **Configure**.	
Edit Pt Monitor	Rotate **DIAL** to select desired point.	Displays all available points and subpoints at the field panel.
Subpoints	Rotate **DIAL** to select subpoint.	Displays a list of subpoints associated with the selected point.

Menu/Submenu	Step	Description
	Press **DIAL**/**OK** to select **Y** or **N**.	Y=Yes; point is monitored. N=No; point is not monitored. (This is the default setting.)
	Press **ESC**.	Returns you to the Point Monitor menu.

Resetting Point Monitor

Do the following to reset points in Point Monitor.

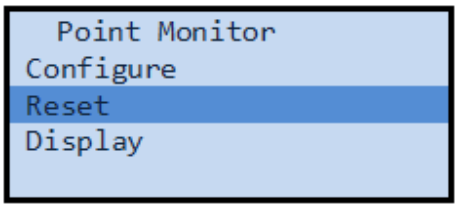


Figure 25: Reset Submenu

Menu/Submenu	Step	Description
Main	Rotate **DIAL** to highlight **Point Monitor**.	
	Press **DIAL**/**OK** to select **Point Monitor**.	Displays the Point Monitor menu.
Point Monitor	Rotate **DIAL** to highlight **Reset**.	
	Press **DIAL**/**OK** to select **Reset**.	Displays the Remove Monitor submen.
Remove Monitor	Rotate **DIAL** to highlight point.	
	Press **DIAL**/**OK** to make select point.	
Remove Monitor Are you sure?	Rotate **DIAL** to highlight **Yes** or **No**.	Confirms you want to remove a point(s) from being monitored.
	Press **DIAL**/**OK** to make selection.	
	Press **ESC**.	Returns you to the Monitor menu.

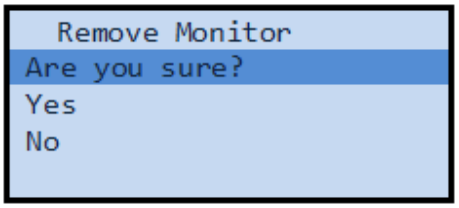


Figure 26: Remove Monitor Submenu

Displaying Monitored Points

Automatic logoff occurs after a predetermined amount of inactivity, however:

- The Point Monitor continues to display points and refreshes the Display screen every four seconds.
- You can scroll the Point Monitor but the function keys (INFO, ESC, Alarm) are disabled.
- If you press any of the key functions, the login splash screen prompts you to login.

Do the following to display monitored points.

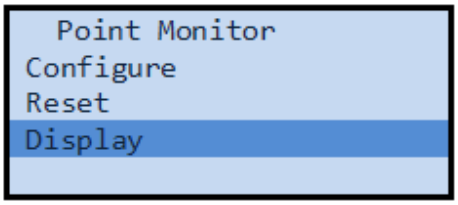


Figure 27: Display Submenu

Menu/Submenu	Step	Description
Main	Rotate **DIAL** to highlight **Point Monitor**.	
	Press **DIAL**/**OK** to select **Point Monitor**.	Displays the Point Monitor menu.
Point Monitor	Rotate **DIAL** to highlight **Display**.	
	Press **DIAL**/**OK** to select **Display**.	Displays the Display submenu.
Display		Displays the monitored points; one point and its value per line. Up to 10 points can be added the Point Monitor list.
	Press **ESC**.	Returns you to the Monitor menu.

Configuring Settings

Brightness

Do the following to modify the Brightness feature.

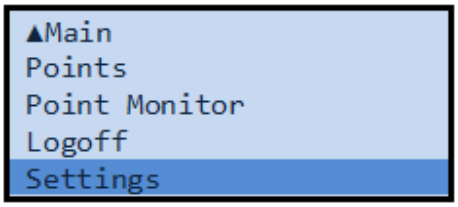


Figure 28: Settings Menu

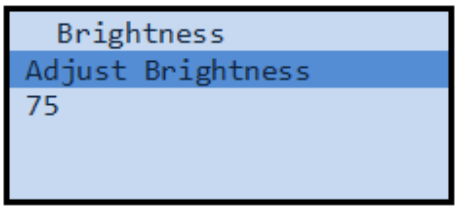


Figure 29: Adjust Brightness Submenu

Menu/Submenu	Step	Description
Main	Rotate **DIAL** to highlight **Settings**.	
	Press **DIAL**/**OK** to select.	Displays the Settings menu.
Settings	Press **DIAL**/**OK** to highlight **Brightness**.	
	Press **DIAL**/**OK** to select **Brightness**.	Displays the Brightness submenu.
Brightness	Rotate **DIAL** to highlight **Adjust Brightness**.	
	Press **DIAL**/**OK** to select **Adjust Brightness**.	
	Rotate **DIAL** to select a value.	Valid brightness values are 0 through 100.
	Press **DIAL**/**OK** to make selection.	Applies the value and returns you to the previous menu.
	Press **ESC**.	Returns you to the Settings menu without applying the new value.

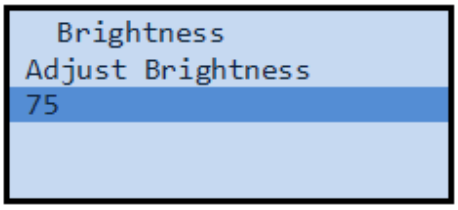


Figure 30: Brightness Submenu

Color

NOTE:
The Color feature is available only for the PXM10S module.

Do the following to modify the Color feature.

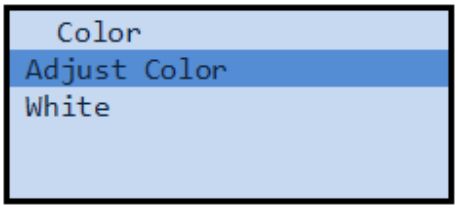


Figure 31: Adjust Color Submenu

Menu/Submenu	Step	Description
Main	Rotate **DIAL** to highlight **Settings**.	
	Press **DIAL**/**OK** to select.	Displays the Settings menu.
Settings	Press **DIAL**/**OK** to highlight and select **Color**.	Displays the Color submenu.
Color	Rotate **DIAL** to highlights and select **Adjust Color**.	
	Rotate **DIAL** to toggle between Blue and White color.	Displays the backlight color you choose.
	Press **DIAL**/**OK** to select.	Applies the value and returns you to the previous menu.
	Press **ESC**.	Returns you to the Settings menu without applying the new color.

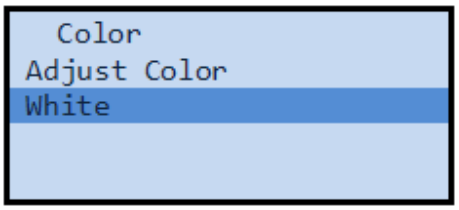


Figure 32: Color Submenu

Timeout

The PXM10S and PXM10T modules automatically turn off the backlight on the Display screen after a predetermined amount of inactivity. However, when you press any key, the backlight turns on again. If Point Monitor was active on the screen during this time, the point list is saved, even if you are logged off.

Do the following to modify the Timeout feature:

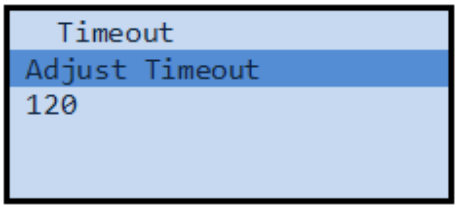


Figure 33: Adjust Timeout Submenu

Menu/Submenu	Step	Description
Main	Rotate **DIAL** to highlight **Settings**.	
	Press **DIAL**/**OK** to select.	Displays settings menu.
Settings	Press **DIAL**/**OK** to highlight and select **Timeout**.	Displays the Timeout submenu.
Timeout	Rotate **DIAL** to highlight and select **Adjust Timeout**.	
	Rotate **DIAL** to select a value.	Valid Timeout values are 0 through 240 seconds.
	Press **DIAL**/**OK** to select.	Applies the value and returns you to the previous menu.
	Press **ESC**.	Returns you to the Settings menu without applying the new value.

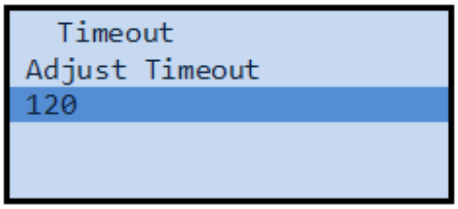


Figure 34: Timeout Submenu

2.3 TX-I/O Product Range Overview

TX-I/O is a range of I/O modules, with associated power and communication modules, for use within the APOGEE System. The I/O modules communicate between the PXC Modular or the PXC-36 and the related devices in the building services plant.

The TX-I/O product range includes the following:

- Eight types of I/O modules, which act as signal converters.
- TX-I/O Power Supply for the TX-I/O modules.
- TX-I/O Bus Connection Module, which bridges communication and power from one DIN rail to another.
- TX-I/O Island Bus Expansion (IBE) module, which increases the distance between the primary field panel and expansion field panels on the island bus.
- P1 Bus Interface Module (BIM), which connects TX-I/O modules to the P1 FLN. The P1 BIM provides power for TX-I/O modules, but it does not contain applications or perform control; the control database for the TX-I/O points resides in a field panel.

2.3.1 TX-I/O Module Overview

TX-I/O Modules are modular expansion I/O consisting of an electronics module and a terminal base; they receive power from a TX-I/O Power Supply, Bus Connection Module, or P1 BIM.

- The electronics module performs A/D or D/A conversion, signal processing, point monitoring, and command output.
- The terminal base provides for termination of field wiring and connection of the self-forming TX-I/O island bus.

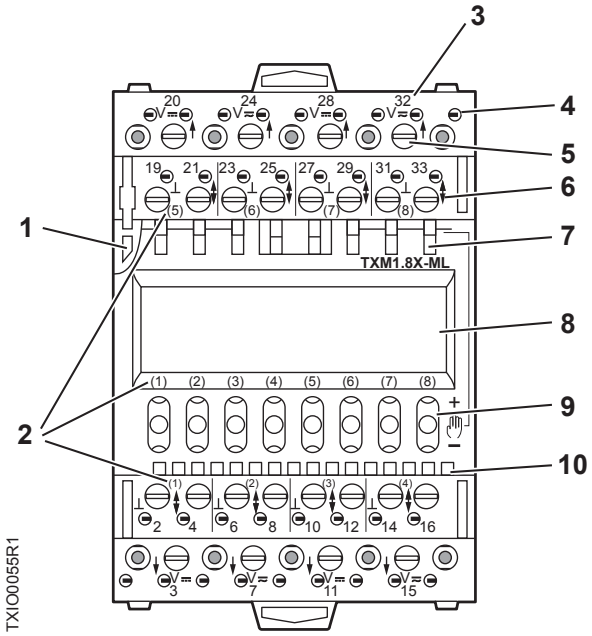
All TX-I/O modules provide the following features:

- DIN rail mounting.
- High density point count (compared to physical dimensions).
- Hardware addressed with address keys.

The design of the TX-I/O Modules provides optimum diagnostics and results in a more efficient installation and maintenance workflow.

- Field wiring may be terminated prior to installation of electronics.
- Connected peripheral devices can be measured without affecting or being affected by the I/O module.
- Hot-swappable electronic components allow powered electronics to be disconnected and replaced without removing terminal wiring or disturbing the self-forming bus.

2.3.1.1 TX-I/O Module Product Diagram



TX-I/O Module Symbols and Status LEDs			
	LED, Symbol, or Feature	**LED or Symbol**	**Indication**
1	Address key and module status LED (green)	-	Module status as a whole (as opposed to the I/O points).
		ON	Normal operation. 24 Vac (supply voltage) input present; fuse is intact.
		OFF	Error. - No 24 Vac (supply voltage) input. - Fuse is blown.

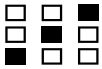
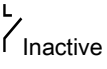
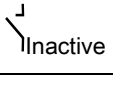
TX-I/O Module Symbols and Status LEDs			
	LED, Symbol, or Feature	LED or Symbol	Indication
		Flashing or pulsing	- Fault indication - No address key - Remote override
2	I/O point numbers	-	-
3	Terminal number	-	-
4	Test terminal	-	
5	Connection terminals	-	
6	⊥	-	System neutral.
	↕	-	Configurable point.
	↓	-	Output (arrow pointing OUT from center of module).
	↑	-	Input (arrow pointing IN toward center module).
	V⎓	-	24 Vdc output (field supply).
	V≈	-	24 Vac output (field supply).
7	Override status LEDs (yellow)	ON	Manual operation; a local override is active.
		OFF	No voltage or manual operation off.
		Flashing or pulsing	- Override action - Remote override - Output: Local override is off, operation is not possible. - Input: Operation is not possible.
8	LCD signal panel	-	Only on a TX-I/O modules with –ML suffix.
9	Local override switch	-	Only on a TX-I/O with –M or –ML suffix.
10	I/O status LEDs (green)	-	Status of the inputs and outputs (peripheral devices). LEDs are labeled with the I/O point number.
		ON	Binary value indication.
		OFF	No voltage or binary value indication.
		Flashing or pulsing	- Fault indication - Activity of field devices - Module unconfigured, no address key - Analog value indication

2.3.1.2 TX-I/O Module LCD Symbol Chart

The TX-I/O module LCD displays a symbol to indicate each point type and its current value.

TX-I/O Module LCD Panel for Errors and Reminders (Displays in LCD Top Row)	
⇧	Value above range limit
⇩	Value below range limit

TX-I/O Module LCD Panel for Errors and Reminders (Displays in LCD Top Row)	
	Open circuit
	Short circuit
	Point type invalid for use with manual override
	No sensor (current)
	No output signal
	24 Vdc supply < 22 Vdc
	Inactive point
	Invalid value
	No voltage
	Unconfigured point

TX-I/O LCD Panel by Point Type.			
Point Type (Displays in LCD Bottom Row)		Normal Operation (Displays in LCD Top Row)	
Analog Input, Current			Low or high value
Analog Input, Resistance			Temperature
Analog Input, Voltage			Low or high value
Analog Output, Current			Low or high value
Analog Output, Voltage			Low or high value
Digital Input, Counter			Step indicator
Digital Input, N/C Contact		 Inactive	 Active
Digital Input, N/O Contact		 Inactive	 Active

2.3.1.3 Address Keys

The P1 Bus Interface Module (BIM) (10-module) and I/O modules are addressed using a TX-I/O address key.

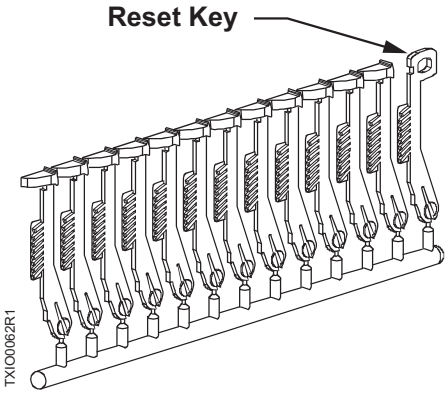


Figure 35: TX-I/O Module Keys.

The keys are available in sets of 24, up to a maximum value of 72 (2 sets of 12, 1-24, 25-48, and 49-72).

- The I/O module address is mechanically encoded in the address key.
  - Without an address key, the module is inactive.
  - With an address key inserted, the module has full functionality.
- Based on the address, the PXC Modular, PXC-36, or P1 BIM configures the I/O module, indicates which field devices are connected to this module, and which function is required for the field devices.

When replacing the plug-in I/O module, the address key must first be swiveled outward. This switches the load off but values remain saved in the PXC Modular, PXC-36, or P1 BIM. The key remains plugged into the terminal base so that the PXC Modular, PXC-36, or P1 BIM can communicate the required function to the new I/O module.

Reset Key

The reset key sets the module back to the factory settings (default function on each of the I/O points):

- The reset key is inserted in place of the address key and then swiveled out again.
- The module indicates the reset by briefly lighting all its I/O status LEDs.
- Note that a reset is only possible when the module is supplied with 24 Vdc.

TX-I/O Power Supply and Bus Modules

The TX-I/O Power Supply and Bus Modules provide power, communications, and expansion options for the TX-I/O Island Bus.

Power and Communication Modules

The TX-I/O Power Supply and Bus Connection Module provide the following functions for the island bus:

	Function		
Product	**TX-I/O Bus Communication**	**24 Vdc power**	**24 Vac power**
TX-I/O Power Supply (TXS1.12F4)	Signal pass-thru	Output 28.8 W (1.2A at 24 Vdc)	• NEC Class 2 Output , 96 VA max., fused at 4A • Class 1 Power Limited Input, 150 VA max.
Bus Connection Module (TXS1.EF4)	• Signal pass-thru • Allows for external connection of I/O signals.	Pass-thru	• NEC Class 2 Output, 96 VA max., fused at 4A • Class 1 Power Limited Input, 96 VA max.

The P1 Bus Interface Module (BIM) provides the following functions for the island bus:

	Function		
Product	**TX-I/O Bus Communication**	**24 Vdc power**	**24 Vac power**
P1 Bus Interface Module (10-module) (TXB1.P1)	Protocol translation	14.4 W (0.6A at 24 Vdc)	• NEC Class 2 Output, 96 VA max., fused at 4A • Class 1 Power Limited Input, 125 VA max.
P1 Bus Interface Module (4-module) (TXB1.P1-4)	Protocol translation	14.4 W (0.6A at 24 Vdc)	• NEC Class 2 Output, 96 VA max., fused at 4A • Class 1 Power Limited Input, 125 VA max.

Island Bus Expansion Module

The Island Bus Expansion (IBE) module provides the following functions for the island bus:

Product	**TX-I/O Bus Communication**	**Function**
Island Bus Expansion Module (TXA1.IBE)	• Signal pass-thru of Communication Data (CD) • Allows for external connection of the I/O signals • RS-485 interface	Increases the distance between the primary field panel and expansion field panels on the island bus

TX-I/O Power Supply Overview

The TX-I/O Power Supply bridges communication and power from one DIN rail to another and generates 28.8 W (1.2A at 24 Vdc) to power TX-I/O modules and peripheral devices.

- An LED provides an indication of 24 Vdc on the TX-I/O bus.
- Up to 4 TX-I/O Power Supplies can be operated in parallel, with a maximum of two per DIN rail.
- It can be located within a row of TX-I/O modules or at the beginning of a new DIN rail.

The TX-I/O Power Supply performs the following functions:

- Transfers 24 Vac at 4A to power TX-I/O modules and peripheral devices.
- Provides an input point for 24 Vac to power additional peripheral devices.
  - Isolates the 24 Vac peripheral device supply in case of overload or short-circuit.
  - The replaceable AC fuse can be accessed from an installed module.
  - Indicates the AC fuse status with an LED for easy diagnostics.
- Routes the bus signal between DIN rails (+24 Vdc Communication Supply (CS) and Communication Data (CD) signals).

Supply Terminal Connections

- 24 Vac supply terminals are fused (replaceable) for Class 2 (24 Vac at 50/60 Hz) through the TX-I/O Power Supply.
- 24 Vdc supply terminals are connected in the I/O module, not in the terminal base. 24 Vdc is supplied and overload protected in the TX-I/O Power Supply.

Bus Connection Module Overview

The Bus Connection Module bridges communication and power from one DIN rail to another. It provides the bus signal, module supply voltage, and field device supply voltage to TX-I/O Modules on an additional DIN rail.

The Bus Connection Module performs the following functions:

- Passes 24 Vac at 4A to power TX-I/O modules and peripheral devices.
- Provides an input point for 24 Vac to power additional peripheral devices.
  - Isolates the 24 Vac peripheral device supply in case of overload or short-circuit.
  - The replaceable AC fuse can be accessed from an installed module.
  - Indicates the AC fuse status with an LED for easy diagnostics.
- Routes the bus signal between DIN rails (+24 Vdc Communication Supply (CS) and Communication Data (CD) signals).

Supply Terminal Connections

- 24 Vdc is supplied to terminals one and four (CS) and to both ends of the TX-I/O bus connector for distribution to connected TX-I/O modules and external devices.
- 24 Vac is passed through an internal fuse from terminals three and four (system neutral) to the male TX-I/O bus connector.
- External devices draw power from the 24 Vdc, 24 Vac, and system neutral terminals on the TX-I/O modules.
- 24 Vdc supply terminals are connected in the I/O module, not in the terminal base. 24 Vdc is current-limited in the Bus Connection Module.

Island Bus Expansion Module Overview

The TX-I/O Island Bus Expansion (IBE) module increases the distance between the primary field panel and expansion field panels on the island bus. Up to 4 expansion enclosures may be connected to the primary enclosure using IBEs, for a maximum of five IBEs on the island bus.

- Each IBE supports two segments of up to 200 ft (61 m) each.

- All expansion field panels must be connected to the same building approved earth ground as the primary field panel.
- Each IBE must be installed on the male bus connector of the TX-I/O Power Supply or a Bus Connection Module which is connected to a TX-I/O Power Supply.
- An LED provides an indication of island bus communication.
- A programming tool is not required.

For information on expanding an island bus with the IBE, contact your local Siemens Industry representative.

2.4 PX Series Enclosures and Service Boxes

PX Series enclosures house both electronic and pneumatic components. The enclosures include a perforated backplane for mounting PXC Series field panels or other electronic or pneumatic components.

General features of the enclosures includes:

- Availability in three sizes to match installation needs: 18-, 19-, and 34-inch.
- Sturdy construction, which accommodates secure conduit fittings and protects components against incidental contact and falling dirt.
- UL Smoke Control listed for indoor use (19- and 34-inch enclosures only).
- Multiple knockouts along the top and bottom.
- Perforated backplane, which extends wall-to-wall for mounting of additional equipment.
- Spacious interior for easy routing and termination of wiring.

The 18-inch enclosure is a pull-box type utility cabinet for low cost installations. It is equipped with the following:

- Factory-installed 16” × 12” perforated panel
- DIN rail and wire tie bar kit

The 19- or 34-inch PX series enclosures are equipped with the following:

- Factory-installed backplane assembly, which includes wire tie down rails and DIN rails
- Label pouch
- Hinged door and key lock
- Conduit knockouts and venting

2.4.1 PX Series Service Box Features

The PX Series Service Box Assemblies transform either 115 Vac or 230 Vac to 24 Vac sized for either 192 VA or 384 VA.

- The 192 VA service boxes mount directly inside a 19- or 34-inch PX Series Enclosure.
- The 384 VA service boxes provide additional power for larger systems and mount only in the 34-inch PX Series Enclosure.

The service boxes provide protection against electrical transients and are Smoke Control and Energy Management listed when installed according to the *Service Box Assemblies Installation Instructions* (553-131).

The service box assemblies consist of the following:

- Chassis for mounting inside enclosure.
- ON/OFF circuit breaker for transformer.
- Two Class 1 power limited 24 Vac outputs, which include one terminal for earth ground for use inside enclosure only.
- One Class 2 output with circuit breaker to distribute up to 96 VA for use outside the enclosure.
- Wire cover for field connections.
- Duplex Service Outlet (115 Vac models only).
- Optional sidewall kits PXA-SW192VA and PXA-SW384VA may be used for installation in third-party enclosures, such as motor control cabinets.

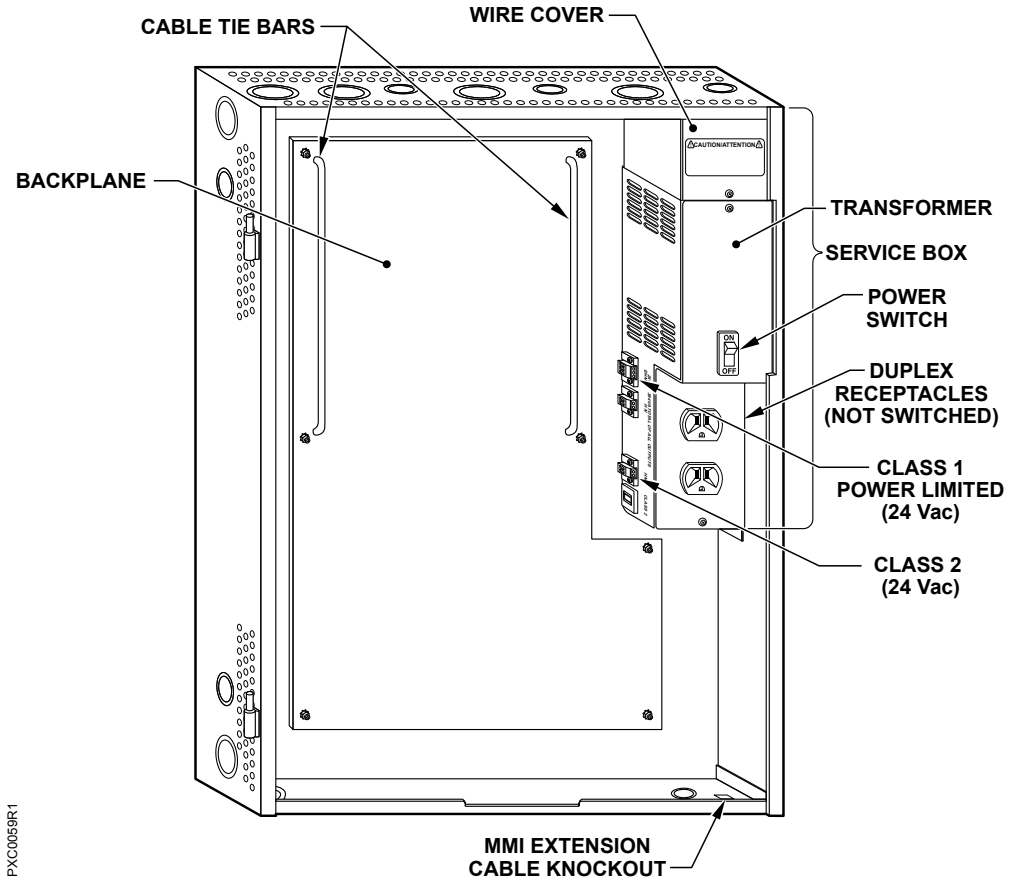


Figure 36: PX Series Service Box (115V), 34-inch enclosure.

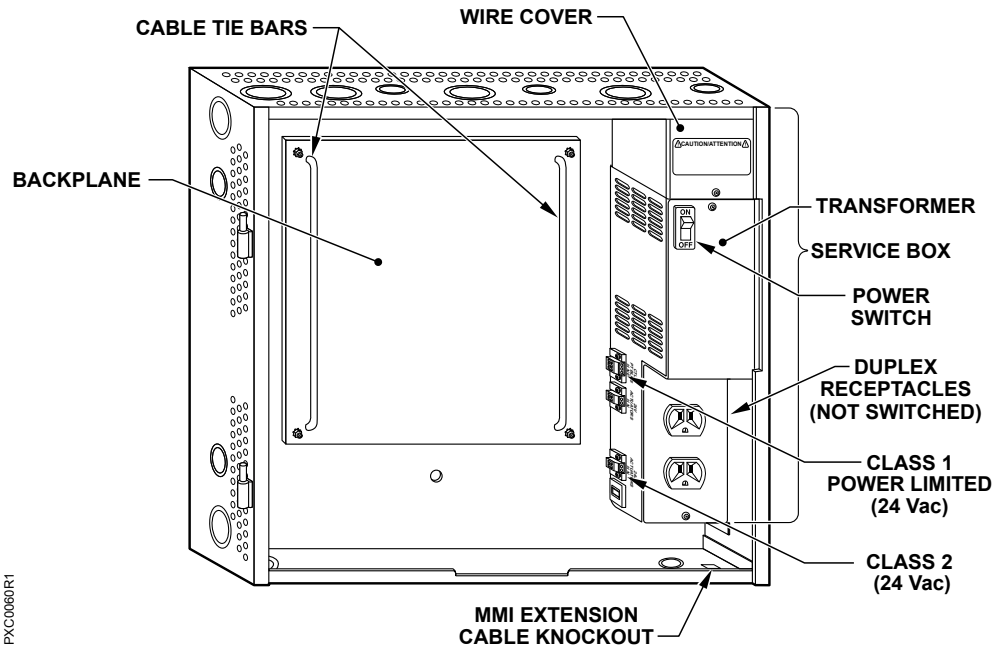


Figure 37: PX Series Service Box (115V), 19-inch enclosure.

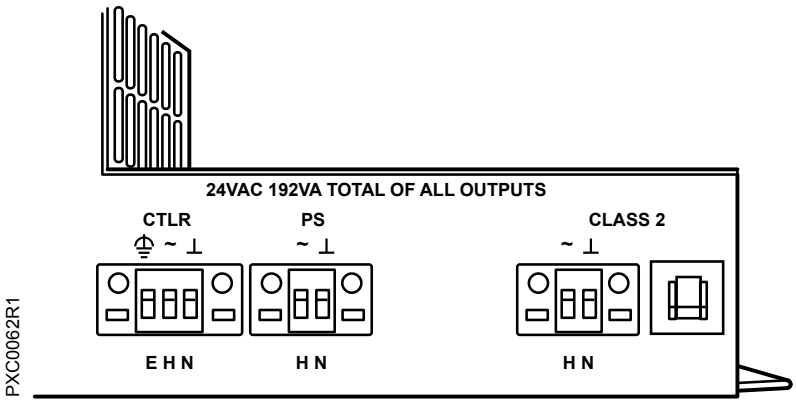


Figure 38: PX Series Service Box Connectors.

- Each Service Box distributes the total 24 Vac power provided to the plug-in terminations on the left side.
  - Two Class 1 power-limited terminations distribute up to the total power to controllers and power supplies inside the same enclosure.
  - Earth ground is provided on the CTLR termination.
  - One Class 2 termination distributes up to 96 VA to auxiliary devices outside of the enclosure.
- Each 115VAC Service Box has a duplex outlet on the front to power accessory devices such as modems and Portable Operator's Terminals.

2.4.2 Product Numbers

Product Number	Description
PXA-SB115V192VA	PX Series Service Box—115V, 24 Vac, 50/60 Hz, 192 VA
PXA-SB115V384VA	PX Series Service Box—115V, 24 Vac, 50/60 Hz, 384 VA
PXA-SB230V192VA	PX Series Service Box—230V, 24 Vac, 50/60 Hz, 192 VA
PXA-SB230V384VA	PX Series Service Box—230V, 24 Vac, 50/60 Hz, 384 VA
PXA-ENC18	18" Enclosure (Utility Cabinet) (UL Listed NEMA Type 1 Enclosure)
PXA-ENC19	19” Enclosure (UL Listed NEMA Type 1 Enclosure)
PXA-ENC34	34” Enclosure (UL Listed NEMA Type 1 Enclosure)

2.4.3 PX Series Enclosure Specifications

PX Series 18" Enclosure Specifications

Dimensions (H × W × D)

PXA-ENC18	18" × 14" × 6" (457.2 mm × 355.6 mm × 152.4 mm) UL Listed NEMA Type 1 Enclosure, Pull-box style

Operating Environment

Ambient operating environment	+32°F to +122°F (0°C to +50°C), 95% rh (Non-condensing)
Mounting Surface	Building wall or structural member (Do not mount on HVAC components or any other vibrating surface)

Agency Listings

Agency Compliance	UL 508A (acceptable for UL 916 applications) FCC Compliance

PX Series 19" and 34" Enclosure Specifications

Dimensions (H × W × D)

PXA-ENC19	19" × 22" × 5.75" (482.6 mm × 558.8 mm × 146.05 mm) UL Listed NEMA Type 1 Enclosure, Hinged Door with lock
PXA-ENC34	34" × 22" × 5.75" (863.6 mm × 558.8 mm × 146.05 mm) UL Listed NEMA Type 1 Enclosure, Hinged Door with lock

Operating Environment

Ambient operating environment	+32°F to +122°F (0°C to +50°C), 95% rh (Non-condensing)
Mounting Surface	Building wall or structural member (Do not mount on HVAC components or any other vibrating surface.)

Agency Listings

UL	UL 864 UUKL Smoke Control Equipment ULC-C100 UUKL7 UL 916 PAZX UL 508A
Agency Compliance	FCC Compliance Australian EMC Framework - with metal enclosure, maximum opening size is 34" European EMC Directive (CE) - with metal enclosure, maximum opening size is 34"

European Low Voltage Directive (LVD)

2.4.4 PX Series Service Box Specifications

Power Requirements for 115 Vac Service Boxes	**PXA-SB115V192VA** Input: 115 Vac +/- 15%, 50/60 Hz +/- 5%, 220 VA maximum, 2A CB Output: 24 Vac +/- 20%, 50/60 Hz +/- 5%, 192 VA maximum **PXA-SB115V384VA** Input: 115 Vac +/- 15%, 50/60 Hz +/- 5%, 440 VA maximum, 4A CB Output: 24Vac +/- 20%, 50/60 Hz +/- 5%, 384 VA maximum 115 Vac models also have a duplex outlet, which is protected by Mains 20A or 15A CB for use internal to enclosure to power laptop and peripheral devices.
Power Requirements for 230 Vac Service Boxes	**PXA-SB230V192VA** Input: 230 Vac +/- 15%, 50/60 Hz +/- 5%, 220 VA maximum, 1A CB Output: 24 Vac +/- 20%, 50/60 Hz +/- 5%, 192 VA maximum **PXA-SB230V384VA** Input: 230 Vac +/- 15%, 50/60 Hz +/- 5%, 440 VA maximum, 2A CB Output: 24 Vac +/- 20%, 50/60 Hz +/- 5%, 384 VA maximum
Service Box Output Jacks	One 3-terminal and one 2-terminal NEC Class 1 output jack for use internal to enclosure to power system components. One 2-terminal NEC Class 2 output jack with 4A CB for use external to enclosure to power actuators.

2.4.5 PX Series Enclosure Placement

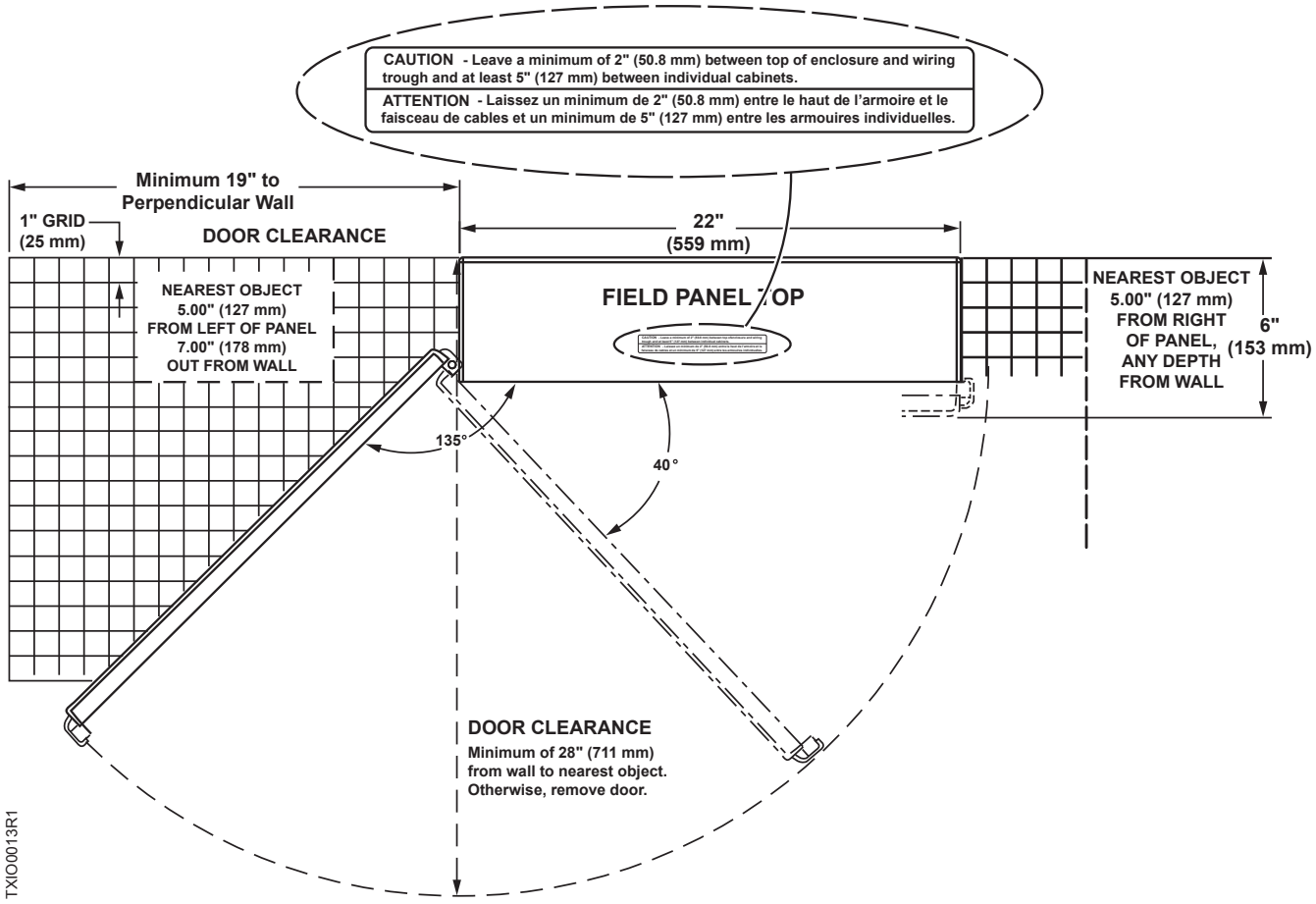
⚠ CAUTION

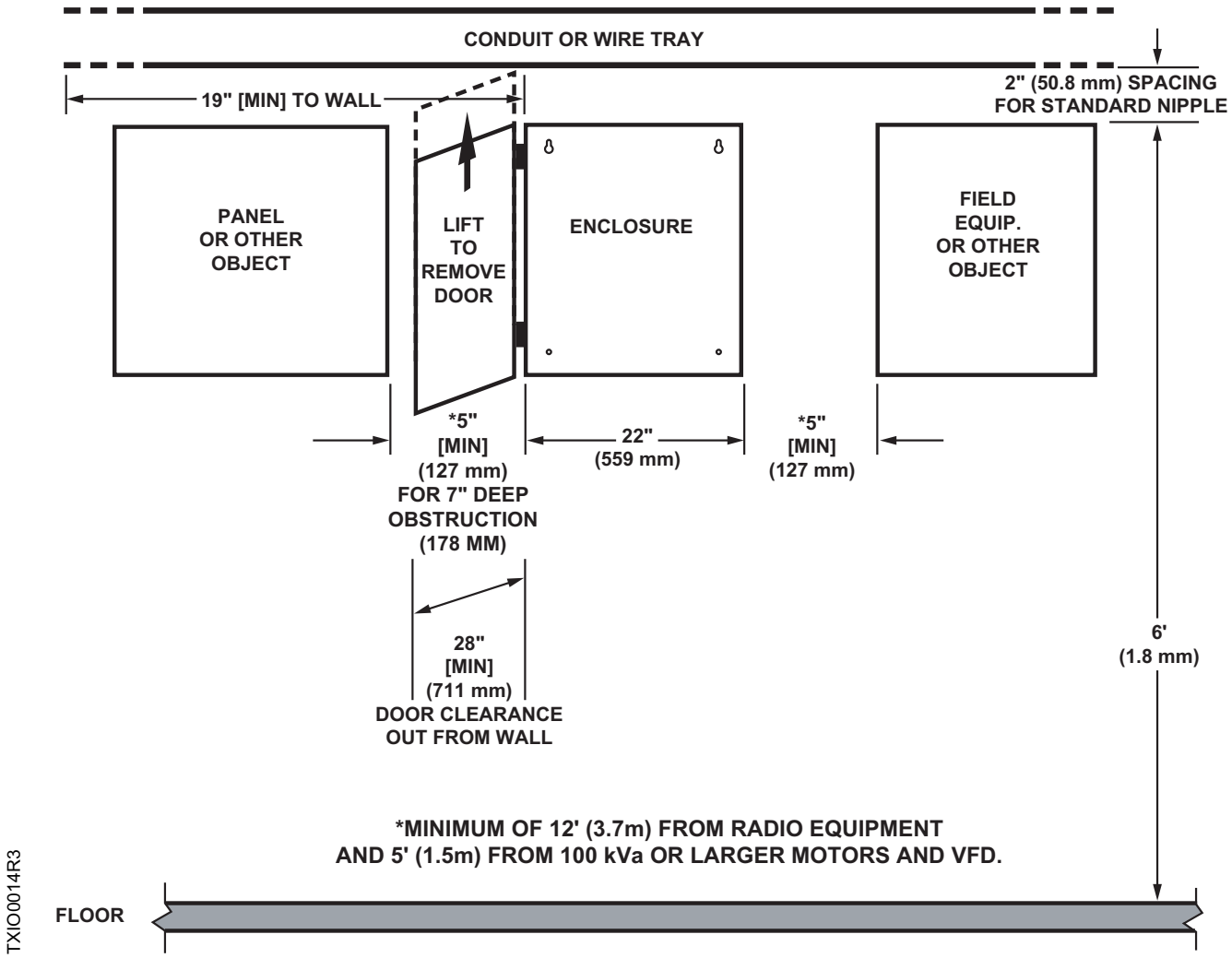
Do not mount the enclosure on ductwork, HVAC components, or any other vibrating surface.

- Mount the enclosure at least 12 feet (3.7 m) away from devices that can generate Radio Frequency Interference (RFI), such as Electro-pneumatic devices (EPs), relays, and walkie-talkies.
- Mount the enclosure at least 5 feet (1.5 m) away from 100 kVa or larger motors and variable frequency drives (VFD).

⚠ CAUTION

If the enclosure is mounted under a wire trough or any other obstruction, provide a minimum vertical clearance of 2 inches (50.8 mm) to allow for installation and removal of the enclosure door.





- Space between door panel and opening obstruction must be at least 11 inches (279.4 mm) to allow for door removal at 40 degrees, or 28 inches (711 mm) with a cabinet mounting at least 19 inches (483 mm) from the left side wall to allow door to completely open at 135 degrees.
- 5 inches (127 mm) minimum horizontal distance between the enclosure and any obstruction to the left and right.
- 7 inches (178 mm) minimum depth out from the wall on the left (hinged) side for door clearance.

Chapter 3—Applications

Chapter 3 describes the program and applications provided with or available for the PXC Modular Series. The following topics are discussed in this chapter:

- Operator Interface
  - Field Panel GO
- Powers Process Control Language (PPCL) Point Database and Control Program
  - Control Programs
  - Point Database
- Applications
- Customized Applications

Operator Interface

An operator issues commands or requests to the PXC Modular using an operator terminal and the operator interface. The operator interface is the software that allows the operator to communicate interactively with the PXC Modular Series. The operator interface does the following:

- Interprets and processes commands entered from operator terminals.
- Formats and sends all output directed to the operator.
- Provides levels of operator access that control an operator's authority to perform certain functions.

The operator interface is described in detail in the *APOGEE P2 ALN Field Panel User's Manual* (125-3019) or *APOGEE BACnet ALN Field Panel User's Manual* (125-3020). This manual is designed to help you become familiar with and use the operator interface. It describes the functions necessary for everyday operation of your system, plus the higher-level functions for commanding, displaying, editing, scheduling, networking, alarm management, and others.

Field Panel GO

The Field Panel GO license provides a Web-based user interface for your APOGEE® Building Automation System. It is an ideal solution for small or remote facilities with field panels on an Ethernet TCP/IP Automation Level Network (ALN).

A Field Panel GO Web Server-enabled controller can accommodate an unlimited number of user accounts, with up to two concurrent operator sessions. And each user account can be defined with customized levels of access and privileges to the system.

Field Panel GO encompasses the following operator applications:

- Alarm Status and acknowledgement
- Graphical Monitoring and Control
- Point Commander
- Schedule Overrides
- Status Reporting
- Historical Data Reporting
- Setup and Customization

Contact your local Siemens Industry representative for more information on Field Panel GO.

Field Panel Web Server

The Web Server resides on a TCP/IP-based BACnet PXC Compact 36 and/or PXC Modular controller. This means that the same field panel can serve as an automation controller, with full building automation and I/O features, and a host for the Web Server application. This eliminates the high cost of a separate “Web appliance” or dedicated Web server, which competitive solutions require be added to a building automation network.

The Web Server allows system-wide access through a single log-in. Web pages can be populated with data from any BACnet IP-enabled PXC controller and associated FLN devices. The Web Server will automatically connect and display data from BACnet PXC Modular or PXC Compact controllers that have the Web Services license enabled.

Any client device running Microsoft Internet Explorer 6.0 (IE6) or later, or Firefox 3.6 or later can be used to access the Field Panel Web Server. A Web Server-enabled controller can accommodate an unlimited number of user accounts. Each user account can be defined with customized levels of privileges and access to the system.

See the *Field Panel Web Server User Guide* (125-3584) for more detailed information.

The Field Panel Web Server encompasses the following operator applications:

- Graphical Monitoring and Control
- Network Layout
- System Status Bar
- Alarm Status and Acknowledgement
- Point Commanding
- Scheduling
- Graphical Trend Display
- Reporting
- Configuration and Customization
- Remote Notification

Graphics

- Customized system graphics
- Live animation of equipment
- Real-time point values and status updates

Network Layout

- View network layout
- Navigate to other Web-enabled panels
- Search database for individual points

System Status Bar

- Visual indication of new alarms and unacknowledged alarms
- Visual indication of out of service, faults, and failed devices

- Ability to view, filter, and acknowledge system alarms from a single page

Point Commanding

- Change point values
- Place points “Out of Service”
- Command BACnet MS/TP and P1 FLN points

Scheduler

- View schedules in a daily, weekly, or monthly view
- Add and delete schedules
- Create exceptions for existing schedules

Reporting

- Generate Point Log Report with multiple filters

Graphical Trend Display

- View one or more trends on a single display
- View raw data values and export to CSV file
- Print trend graph to network printers
- Display points with current values

Configuration and Customization

- Custom Welcome Page
- Translators user interface to any browser-supported language
- Customize font sizes and display colors

Powers Process Control Language (PPCL) Control Program and Point Database

The control programs and point database are stored in RAM. This information can also be saved or loaded into the PXC Modular using APOGEE Datamate software or Insight software.

Control Programs

The control programs define all user-defined control logic, calculations, applications, and so on for the PXC Modular. PPCL is written in an English-based programming language called Powers Process Control Language (PPCL). It is a powerful programming language developed specifically for controlling Heating, Ventilating, and Air Conditioning (HVAC) equipment. Multiple PPCL programs can be run simultaneously to provide instructions for the PXC Modular to operate equipment, control system loads, and optimize the system operation.

For a complete description of PPCL and how to use it, see the *APOGEE Powers Process Control Language (PPCL) User's Manual* (125-1896). This manual is available from your local Siemens Industry representative.

Point Database

The PXC Modular Series has the basic capabilities required to control and monitor a facility. However, the operator (or the installer) must program specific instructions into the PXC Modular and create databases that are customized for your particular facility. The databases contain information, such as point names, addresses, schedules, and alarm information for the equipment being supervised by the PXC Modular.

The PXC Modular uses information from the point database to define each point so that the firmware and the software know how to evaluate or command the point. Among the items kept in the point database are the following:

- Location, or address of field inputs/outputs
- Logical point names and descriptions of points
- Point type
- Alarm information
- Current value of a point
- Information to convert analog signals to engineering units (slope and intercept constants)

The point database is described in detail in the *APOGEE P2 ALN Field Panel User's Manual* (125-3019) or *APOGEE BACnet ALN Field Panel User's Manual* or (125-3020).

Applications

Applications are an important part of the energy management capabilities of your system. The applications that you can incorporate into the operation of your system include:

- Adaptive Control
- Alarm Management
- Daylight Saving Time
- Equipment Scheduling
- Loop/Loop Tuning
- Start/Stop Time Optimization (SSTO)
- Time and Calendar (schedules, Daylight Saving Time)
- Trend Data Collection
- User Access and Privileges

Adaptive Control

Adaptive control is a closed loop control algorithm that auto-adjusts to compensate for mechanical system/load/seasonal changes. It is designed to eliminate the compromises of traditional Proportional, Integral, Derivative (PID) control. When compared to traditional PID control, adaptive control provides more efficient, robust, fast, and stable control. Adaptive control achieves superior performance in a dynamic, non-linear system in terms of response time and holding steady state, while minimizing error, oscillations, and actuator repositioning.

Alarm Management

An alarm is a status that indicates whether a point value or state is above or below a defined value. Alarm management is the strategy used to define, route, acknowledge, and resolve those alarms.

Points are defined as alarmable for the following reasons:

- **To prevent critical problems**. Points that affect human safety or can cause a severe problem in building operation should be defined as alarmable. For example, an alarm that notifies you that the temperature of a heating coil is too low and action must be taken before it freezes.
- **To notify you when equipment is not functioning properly**. Sometimes problems may occur and go unnoticed. Alarming is a useful tool to identify equipment that is not working properly and to prevent other devices from becoming damaged.
- **To announce scheduled maintenance**. For example, an alarm can notify you when it is time to change air filters.

Daylight Saving Time

The Daylight Saving Time (DST) functionality adjusts the system time to match the daylight saving time change-over. If your area uses daylight saving time, this feature offers a convenient method to automatically adjust the system clock.

Equipment Scheduling

Equipment Scheduling is designed to provide 365-day, time-based control of a space in a facility. The basic design of this application begins with a definition of the space, called a zone. The state of the zone dictates how the field panel controls the points associated to that space. The state of the zone is known as the mode (in this document it is referred to as the current mode value of the zone).

Loop/Loop Tuning

The loop application is the PPCL Proportional, Integral, Derivative (PID) control loop algorithm. The loop tuning application evaluates and calculates gains and sample times for existing LOOP statements in PPCL. This feature calculates appropriate Proportional, Integral and Derivative (PID) gains and sample time for a selected control loop, based on specific building and control information defined in the LOOP statement. When complete, you decide how to apply the newly calculated variables.

Start-Stop Time Optimization (SSTO)

Start/Stop Time Optimization (SSTO) is an optional, self-adjusting routine that affects the start and stop times of various occupancy modes. SSTO can help conserve energy by starting a heating or cooling process, prior to occupancy, as late as possible. SSTO can also stop heating or cooling a zone as early as possible, prior to vacancy.

For example, a meeting in August occurs at 1:00 P.M. and lasts until 4:00 P.M. Based on the information provided in SSTO parameters, the equipment scheduling application calculates the latest possible time cooling can start and still reach the cooling setpoint.

Also, calculations are made to determine the earliest time cooling can stop without affecting comfort limits.

Time and Calendar

Calendar dates (in the form of day shifts and replacement days) are entries used to supplement the Equipment Scheduling application.

Time functions compensate for Daylight Savings Time (DST) and provide time-based control for building equipment.

Trend Data Collection

Trending is a function that records point data over time. Trend data is either collected when the current point value changes by a specified amount (the trend COV limit), or point values are recorded after the system waits a specific amount of time and then the process is repeated.

Trend data can be uploaded from the field panel to the Insight workstation for storage and reporting, and the data can be converted to several spreadsheet formats for further analysis and reporting.

User Access and Privileges

A user issues commands or requests to the PXC Modular Series using an operator terminal and the operator interface program that resides in the PXC Modular Series. The operations that a particular user can perform depend on the access level assigned to each field panel function in their user account.

User accounts are used to manage access and security for field panels on a specified Automation Level Network (ALN). By creating individual accounts, a system administrator can control each user's access to objects and functions residing in field panels on a specified ALN.

Specifically, a system administrator can perform the following tasks:

- Define the users that can access an ALN
- Assign access to access groups
- Assign privileges to field panel functions residing on an ALN

Controlling User Access to Field Panel Functions

The following four access levels can be assigned to any field panel function for any user.

- **No Access** – Users cannot see the function.
- **Read Only** – Users can only view the value or status of objects.
- **Command** – Users can command or display the value or status of objects.
- **Edit** – Users can add, delete, command, modify, and view objects.

Example

If a user has a Command access level for the Point Editing function, then only the functionality required to command a point is available to them. They do not see or have access to the prompts required to add, modify, or delete a point definition.

For more information on user accounts and privileges, see the *APOGEE P2 ALN Field Panel User's Manual* (125-3019) or *APOGEE BACnet ALN Field Panel User's Manual* (125-3020).

Customized Applications

Some PXC Modular Series applications are created in the Powers Process Control Language (PPCL). These applications use PPCL statements and additional hardware to perform customized operations or functions in your system. Examples of applications created in PPCL include:

- Duty Cycling
- Enthalpy and Dry Bulb Economizer Control
- Peak Demand Limiting (PDL)

Information on how to customize these applications for your facility is included in the APOGEE Powers Process Control Language (PPCL) User's Manual (125-1896) and the *APOGEE P2 ALN Field Panel User's Manual* (125-3019) or *APOGEE BACnet ALN Field Panel User's Manual* (125-3020). These manuals are available from your Siemens Industry representative.

SNMP

The Simple Network Management Protocol (SNMP) Agent is a firmware feature that has been added to BACnet Firmware Revision 3.2.3 and later. The SNMP Agent allows points in the field panel to communicate with an SNMP manager over Ethernet.

SNMP is an application layer protocol that facilitates the exchange of management information between network devices. It is part of the Transmission Control Protocol/Internet Protocol (TCP/IP) suite. SNMP enables network administrators to manage network performance, find and solve network problems, and plan for network growth.

Three versions of SNMP exist: SNMP version 1 (SNMPv1), SNMP version 2 (SNMPv2), and SNMP version 3 (SNMPv3). All three versions have a number of features in common, but SNMPv2 offers enhancements such as additional protocol operations. SNMPv3 offers additional enhancements to Internet security and communities.

SNMP users UDP ports 161 and 162, which must be opened within the firewall settings.

The panel may coldstart after the SNMP license is loaded.

For more information, see the *SNMP Agent Quick Start Guide* (140-0891).

3 Chapter 4—Troubleshooting

NOTE:
The following information is for qualified service personnel only.

Chapter 4 describes corrective measures you can take if you encounter a problem with a PXC Modular Series controller. If you encounter a symptom or a problem not covered in this manual, contact your Siemens Industry representative. The following topics are discussed in this chapter:

- Service Information
  - Electrostatic Discharge Requirements
  - Error Status Messages
  - Ordering Replacement Parts
  - Replacing the Batteries
  - Reinstalling the Mounting Tabs
- Troubleshooting the PXC Modular and TX-I/O Island Bus

3.1 Service Information

This section describes corrective measures you can take if you encounter a problem with a PXC Modular Series controller.

If you encounter a symptom or a problem not covered in this manual, contact your Siemens Industry representative.

NOTE:
When removing power to a controller to perform maintenance or service, make sure that the person in charge of the facility is aware of this and that appropriate steps are taken to keep the building in control.

NOTE:
When troubleshooting, record the problem and what actions were performed immediately before the problem occurred. Being able to describe the problem in detail is important should you need assistance from your local Siemens Industry representative.

To view the status of the PXC Modular and to call up reports for troubleshooting, you can use an operator's terminal and the operator interface or an Insight workstation. For more information, see the following documentation:

- *APOGEE P2 ALN Field Panel User's Manual* (125-3019) or *APOGEE BACnet ALN Field Panel User's Manual* (125-3020).
- Insight *Revision 3.x Documentation*. To view this documentation, see the Insight Online Documentation window, which you can access from the Insight Main Menu or the Insight program group.

It is good practice to back up the PXC Modular database routinely and whenever changes are made to the database or new equipment is added.

While performing the troubleshooting procedures outlined in this manual, you may wish to refer to the APOGEE Wiring Guidelines for Field Panels and Equipment Controllers (125-3002).

3.1.1 Electrostatic Discharge

An electrostatic discharge (ESD) wrist strap is generally not required when installing or servicing a PXC Modular. However, if the field panel is installed in a very dry environment where a high static discharge is likely, an ESD wrist strap is recommended.

3.1.2 Error Status Messages

For error status message descriptions, see the *APOGEE P2 ALN Field Panel User's Manual* (125-3019) or *APOGEE BACnet ALN Field Panel User's Manual* (125-3020).

3.1.3 Ordering Replacement Parts

If a PXC Modular Series is not operating correctly, it should be replaced.

3.1.4 Replacing the Batteries

	⚠ CAUTION
	AC power must be ON during battery replacement. Otherwise, data loss will occur.

NOTE:
The battery is taped in the tray to secure it during shipping. The tape does not need to be replaced.

1. Pull the release tab on the curved side of the battery compartment cover.
2. Remove the battery compartment cover.
3. Remove the failed battery, and place a fresh battery in the tray with the positive (+) and negative (-) ends properly aligned.
   - For the AA battery, make sure the positive (+) and negative (-) ends are properly aligned.
   - For the coin cell battery, make sure the positive (+) side is facing up.
4. Replace the battery compartment cover.

NOTE:
The LOW BATT LED remains ON if an alkaline battery is used in Compact models with extended temperature range operation.

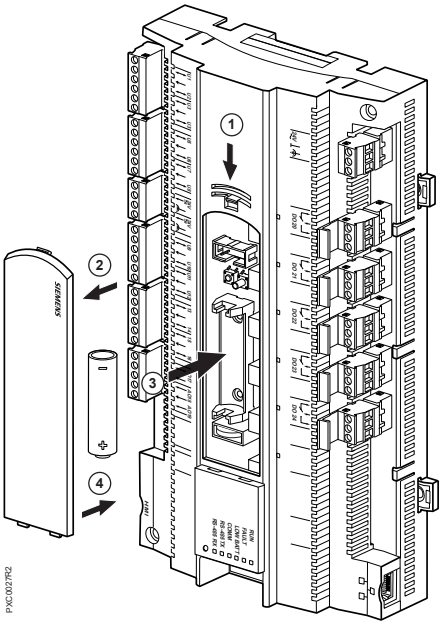


Figure 39: Replacing the AA Battery.

3.1.5 Reinstalling the Mounting Tabs

Do the following to reinstall a DIN mounting tab:

1. Place the wire spring clip into the pocket in the channel for the mounting tab.
2. Make sure the mounting tab is face down.
3. Working from the center (inside) of the base, slide the mounting tab into the channel. (See the following figure.)

NOTE:
The end with the screw hole slides into the channel first.

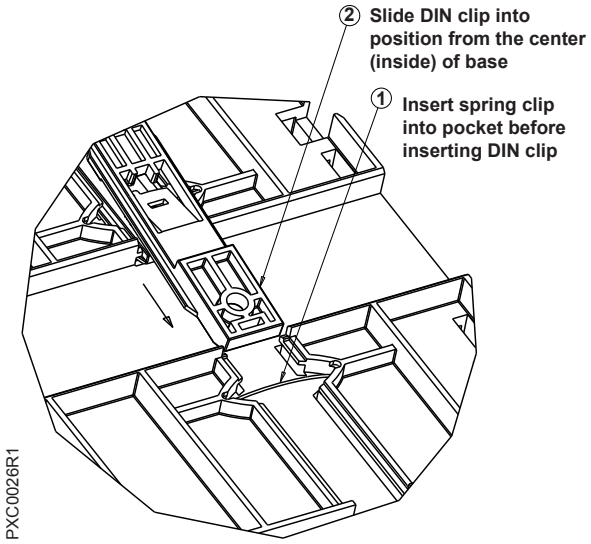


Figure 40: Reinstalling a DIN Mounting Tab.

3.2 Troubleshooting Modular Field Panels

Find the symptom below that best describes the problem and perform the corrective action that follows.

If the problem persists or other symptoms are present, contact your Siemens Industry representative.

	⚠ CAUTION
	Before performing any RS-485 Expansion Module troubleshooting procedures, complete a successful check-out of the PXC Modular.

3.2.1 BATT LOW LED

The BATT LOW LED is on or the battery low warning is displayed at the operator's terminal.

	⚠ CAUTION
	If you do not have a current backup, save the database before continuing.

1. Check that the mylar insert was removed from the AA (LR6) battery holder.
2. Check for polarity (+ to +) and (- to -).
3. Check that the battery is properly seated in the battery holder.
4. Replace the battery.

3.2.2 RUN LED

The RUN LED is on solid.

- The RUN LED is steadily lit during normal operation to indicate that 24 Vac power is ON and the application firmware has booted.

The RUN LED is off.

1. Verify that power is connected.
2. Check the service box and transformer ON switches.
3. If power is ON, verify that the application firmware has booted.
4. Measure voltage on **24V~** and ⊥ (Terminals 1 and 2).

The RS-485 Expansion Module RUN LED is off.

1. Check that the Expansion Module is properly seated on the DIN rail.
2. Verify the connection between the RS-485 Expansion Module and the PXC Modular.

3.2.3 TX and RX LEDs

3.2.4 Communication

Points cannot be read or commanded from the operator's terminal.

1. Verify that failed points have been properly addressed.
2. Verify the status of the points at the operator's terminal. Verify that points are not under Operator priority.

No communication over the FLN trunk.

1. Verify the FLN address and communication speed.
2. Verify the FLN trunk is connected to the correct FLN port.

3.2.5 Display

NOTE:
In USE FW REV TABLE ALN mode, RS-485 parameters are displayed and may be entered as a selection. However, when in RS-485 ALN mode, USE FW REV TABLE ALN parameters are not an available selection.

PXC Modular defaults to Ethernet ALN but continues to display parameters for RS-485 P2 ALN.

1. Generate the Field Panel Configuration report by entering the following at the HMI: **S**, **H**, **F**, **D** (System, Hardware, Fieldpanels, Display).
2. Verify the field panel settings on the Field Panel Configuration report (such as the ALN baud rate for P2 ALN or an IP address for Ethernet TCP/IP ALN).
3. Verify the current ALN type on the Field Panel Configuration report.

NOTE:
Changing the ALN type coldstarts the field panel.

4. If needed, change the ALN type by entering the following at the HMI: **S**, **H**, **F**, **C**, **E**, **M** (System, Hardware, Fieldpanels, Config, nEttype, Modify). (**S**, **H**, **F**, **C**, **S**, **T** for Firmware Revision 2.8.3 and earlier.)

3.2.6 Errors

PXC Modular program and database are not down-line loading properly.

- Verify that the Insight software is at least Revision 3.8.1 (P2) or 3.9.1 (BACnet).

Troubleshooting the TX-I/O Island Bus

The 24 Vac LED on the TX-I/O Power Supply or the P1 Bus Interface Module (BIM) is OFF.

1. Check for 24 Vac input.
2. Replace the fuse (4A, 5 × 20 mm, 250V, medium-acting, ceramic fuse).

All points on the TX-I/O island bus are failed.

- Verify all three signals, System Neutral (⊥), Communication Data (CD), and Communication Supply (CS) are connected throughout the entire TX-I/O island bus.

The I/O module status LED (under the address key) is flashing or the I/O point status LED is flashing on an open point. All points are operating normally.

⚠ CAUTION

The TX-I/O™ island bus must extend from the male bus connector of the TX-I/O Power Supply or Bus Connection Module.

- The TX-I/O Power Supply and Bus Connection Module only supply 24 Vac to I/O modules on the male bus connector.
- I/O modules on the female bus connector of the TX-I/O Power Supply or Bus Connection Module do not receive power and have a fault condition.

A point is failed or the point type displayed does not correspond to the point type defined in the database.

1. Using the job drawing or TX-I/O Island Bus layout sheet, verify that the address keys are in the correct module.
2. Reset the module to factory settings.
   - Verify that the module is supplied with 24 Vdc.
   - Remove keys that are in the wrong module.
   - Insert and then remove the reset key.
   - Cycle power to the module.
   - Insert the correct address key.

A current point on a Super Universal Module is failed.

- Verify that the sensor supply wire is connected to the DC terminal (3, 11, 20, or 28).

Glossary

The glossary contains terms and acronyms that are used in this manual.

1

100Base-TX: Fast Ethernet network implementation. 100Base-TX stands for 10Mbps baseband twisted-pair cable. The “X” stands for 100Base-X, the IEEE identifier for the media system used by 100Base-TX.

10Base-T: Ethernet network implementation. 10Base-T stands for 10Mbps baseband twisted-pair cable.

A

Adaptive Control: Closed loop control algorithm that auto-adjusts to compensate for mechanical system/load/seasonal changes.

AEM/AEM100/AEM200: Devices that allow APOGEE field panel networks to communicate with the Insight workstation across an Ethernet network. The APOGEE Ethernet Microserver (AEM) operates on a 10Base-Tconnection, but can also be routed across low speed networks (for example, across Frame Relay). The AEM100 supports auto-sensing 10Base-T and 100Base-TX Ethernet communication. The AEM200 adds a second serial port, allowing MMI access without disconnecting from the Insight network.

alarm priority: Ranking of a point alarm.

Automation Level Network (ALN) Devices: Extends Protocol 2 networks, leased line Modem, TI-2, Fiber Optic TIs, and TIE.

analog input-electric: Analog input point that receives either a current, voltage, or resistance input signal.

analog output-pneumatic: Analog output point that outputs a pneumatic signal.

AO-V point: Physical analog output point that generates a voltage signal.

Automation Level Network (ALN): The level in the communication hierarchy that consists of automation stations, automation devices, Application-Specific Controllers (ASCs), etc.

B

BACnet: A data communication protocol for Building Automation and Control Networks, ANSI/ASHRAE Standard 135-2004. BACnet allows devices from multiple manufacturers to work together on a network.

BACnet Broadcast Message Device (BBMD): BBMDs pass BACnet Broadcast Messages to other BBMDs on the network, allowing these messages to reach BACnet devices on the other side of a subnet router.

BACnet Encoded Name: A numeric representation of an object name that exceeds the APOGEE standard of 30 alphanumeric characters or less per name.

BACnet/IP: BACnet over IP protocol.

BBMD: See *BACnet Broadcast Message Device*.

broadcast: Destination IP address that represents all interfaces on all hosts. Usually, this is restricted to all hosts on the local subnet.

C

command priority: Ranking of a point command.

current value: Last commanded or sensed value of a logical point.

D

Device ID: Uniquely identifies a device object on the BACnet Inter network.

Device Instance Number: A number assigned to a BACnet device (for example, a BACnet field panel) that uniquely identifies it on the BACnet/IP network.

Device port: A USB Device port supports a generic serial interface for an HMI or Tool connection.

Device Specific Name: A textual representation of a BACnet object name that meets the APOGEE naming standard of 30 alphanumeric characters or less.

digitized value: Integer value used by the field panel to determine the logical value, state, and condition of logical points.

Domain Name Server (DNS): Common method of assigning computer names in UNIX-based networks. A DNS server maintains a list of host names and IP addresses, allowing computers that query them to find remote computers by specifying host names rather than IP addresses. DNS is a distributed database; therefore, DNS servers can be configured to use a sequence of name servers, based on the domain in the name being looked for.

Dynamic Host Configuration Protocol (DHCP): Protocol used for automatic TCP/IP configuration of nodes across a network. DHCP dynamically assigns addresses to nodes and allows for central administration of addresses.

dynamic point information: Information stored in the point database that may change during system operation and is not part of the data entered when defining points.

E

enclosure: Metal case that houses the field panel components.

English units: The foot-pound-second system of units for weights and measurements.

enhanced alarming: Application that allows floating alarms and alarm segregation.

Ethernet ready: Any device that communicates over Ethernet cabling. For example, both Ethernet ALN and BACnet/IP field panels are Ethernet ready, even though they use different communication protocols.

F

Field Level Network (FLN): A data communications link that passes information between an FLN device and an Automation Level Network (ALN) device. Terminal Equipment Controllers (TEC) are examples of FLN devices.

H

HAND-OFF-AUTO (HOA) switches: Manually operated control switches located on the face of HOA-equipped controllers that enable digital output points to be manually placed into HAND (ON), OFF, or AUTO control. Analog outputs can be placed into AUTO or multiple manual control positions.

Host port: A USB Host port provides support for USB modems and line printers.

Human-Machine Interface (HMI) port: Interfaces of various hardware and/or software units allowing the operator to transfer information to a technical system and/or receive information from the same.

I

Instance ID: The identifying number for objects (for example, points) within a BACnet device. Instance IDs can be assigned manually or automatically within the range set for the host device.

Internet Protocol (IP): A connection-less protocol that allows a packet to travel across multiple networks on its way to its destination. IP is the network layer of TCP/IP suite.

Intrinsic Alarming: BACnet alarming that incorporates alarm destinations (via Notification Classes) within a single alarm message.

M

multicast: Destination IP address that represents one or more interfaces. IP datagrams sent to a multicast address will be sent to all hosts participating in this multicast group.

N

notification class: Notification Class supports enable/disable based on the day of week and time of day and the alarm priority for all points associated with it.

P

Plain Old Telephone Service (POTS): Acronym for the standard telephone service that is used in most homes. Communication speed is generally restricted to 52K bps.

point condition: State of a point such as normal, alarm, alarm-by-command, failed, operator disabled, or proofing.

R

Read Only Memory (ROM): Non-volatile, permanent, but field-programmable memory that stores the operating system of the field panel. ROM stays intact even in the event of a power surge, a power loss, or failure of the battery backup.

Remote Automation Level Network (ALN): Automation Level Network (ALN) hosted by a remote field panel. The ALN is only seen at the remote site and at a centrally located Insight workstation.

remote field panel: Field panel not directly connected to the Insight ALN. Remote field panels connect over the telephone lines using a dial-up modem, or over an Ethernet network using an AEM/AEM100/AEM200.

S

service box: Component that receives the line power and converts it to 24 Vac for the field panel.

T

telnet: Program that runs on top of TCP/IP, it is the Internet standard protocol for remote login.

text-based terminal: Operator terminal that displays and accepts text only.

To-Fault: A BACnet event indicating that the BACnet object (point) has transitioned to the Fault state from some other state for the recipient or device. A BACnet object mayor may not require acknowledgement of this event by a user.

To-Normal: A BACnet event indicating that the BACnet object (point) has transitioned to the Normal state from some other state for the recipient or device. A BACnet object mayor may not require acknowledgement of this event by a user.

To-OffNormal: A BACnet event indicating that the BACnet object (point) has transitioned to the OffNormal state from some other state for the recipient or device. OffNormal states in BACnet are: OffNormal, high-limit, low-limit, and life-safety-alarm. A BACnet object may or may not require acknowledgement of this event by a user.

tombstone: Remnant or memento of a deleted record that is retained for a finite amount of time in a node's replication database. Tombstones are used to keep track of locally deleted records that must be deleted from replication partners during future global data replication sessions.

totalized value: Sum of information (in hours or minutes) about logical points such as run time, total volume, and degree days.

Transmission Control Protocol/Internet Protocol (TCP/IP): Protocol suite developed by the U.S. Department of Defense to link dissimilar computers across different kinds of networks. TCP/IP is the transport protocol employed by the Internet and is commonly used on Ethernet networks.

U

unbundle: Describes the action of entering a point that resides in an equipment controller's database into the field panel's database so that it can be monitored and controlled from the field panel.

Unicast: Destination IP address that represents a single interface to a single system. IP datagrams sent to a unicast address are sent to a single interface on a single IP host.

User Datagram Protocol (UDP): TCP/IP protocol that provides simple datagram services. UDP is a connection-less mode protocol that is layered on top of IP. UDP does not guarantee delivery and is not used for applications that require acknowledgements or re-transmission.

V

Virtual AEM: Without additional hardware, the Virtual AEM connects an RS-485 APOGEE Automation Level Network or individual field panels to a P2 Ethernet network. (Additional license required.)

Index

Numerics

A

B

C

D

E

Issued by
Siemens Industry, Inc.
Building Technologies Division
1000 Deerfield Pkwy
Buffalo Grove IL 60089
Tel. +1 847-215-1000

Document ID 125-3582
Edition April 18, 2013

Caldwell & Walsh
Building Construction, Inc.
Connecticut | Massachusetts | New Jersey | New York

Submittal #150000-16.0
150000 - HVAC

Caldwell & Walsh Building Construction - HQ
17 Berkshire Road
Sandy Hook, Connecticut 06482
Phone: (203) 270-4500
Fax: (203) 270-4501

Project: CT2882 - Quinnipiac Catholic Center
385 New Road
Hamden, Connecticut 06518

150000-16 Testing & Balance Report

SPEC SECTION:	150000 - HVAC	**SUBMITTAL MANAGER:**	Eric Hoyt **(Caldwell & Walsh Building Constructio)**
STATUS:	Open	**DATE CREATED:**	09/8/2017
ISSUE DATE:	09/8/2017	**REVISION:**	0
RESPONSIBLE CONTRACTOR:	Eastern Mechanical Services, Inc.	**RECEIVED FROM:**	Ted Huizinga
RECEIVED DATE:		**SUBMIT BY:**	
FINAL DUE DATE:	09/15/2017	**LOCATION:**	
TYPE:	Document	**COST CODE:**	
APPROVERS:	Kemal Zahirovic **(Amenta/Emma Architects)**		

BALL IN COURT:
Kemal Zahirovic **(Amenta/Emma Architects)**

DISTRIBUTION:

DESCRIPTION:

ATTACHMENTS:
6041-QUINNIPIAC UNIVERSITY-082917.pdf

SUBMITTAL WORKFLOW

#	NAME	SUBMITTER/ APPROVER	SENT DATE	DUE DATE	RETURNED DATE	RESPONSE	ATTACHMENTS	COMMENTS
1	Kemal Zahirovic	Approver	9/8/2017	9/15/2017		Pending		

AMENTA/EMMA ARCHITECTS, P.C.

- [X] NO EXCEPTIONS TAKEN
- [ ] APPROVED AS NOTED
- [ ] REVISE AND RESUBMIT
- [ ] REJECTED
- [ ] ACTION NOT REQUIRED

SHOP DRAWING REVIEW BY THE ARCHITECT DOES NOT RELIEVE THE CONTRACTOR FROM COMPLIANCE WITH REQUIREMENTS OF THE CONTRACT DOCUMENTS. THIS REVIEW IS ONLY FOR GENERAL CONFORMANCE WITH THE DESIGN CONCEPT OF THE PROJECT AND GENERAL COMPLIANCE WITH THE INFORMATION GIVEN IN THE CONTRACT DOCUMENTS. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMING AND CORRELATING ALL QUANTITIES AND DIMENSIONS; SELECTING FABRICATION PROCESSES; TECHNIQUE OF CONSTRUCTION; COORDINATING HIS WORK WITH THAT OF ALL OTHER TRADES; AND PERFORMING HIS WORK IN A SAFE AND SATISFACTORY MANNER.

DATE: 09/14/2017 BY: KZ

BY **DATE** **COPIES TO**

QGL Consulting Engineers LLC
32 Maple Ave
Windsor, CT 06095

Phone: 860-236-4288
Email: rdilullo@qglinc.com

PROJECT: Quinnipiac Catholic Center
Quinnipiac University

DATE: September 11, 2017

REVIEWER Richard DiLullo

PRODUCT: Mechanical

Balance Report

QGL Consulting Engineers, LLC	
NO EXCEPTIONS TAKEN	☑
MAKE CORRECTIONS NOTED	☐
AMEND AND RESUBMIT	☐
REJECTED – SEE REMARKS	☐
REVIEWED	☐
Review is for general conformance with contract Documents. No responsibility is assumed for correctness of dimensions or details.	

COMMENTS:

CFM TEST & BALANCE CORPORATION

14 DEPOT SQUARE

BETHEL, CONNECTICUT 06801

(203) 778-1900

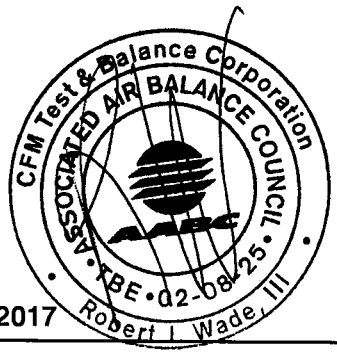
TESTING AND BALANCING SUBMITTAL

FOR

QUINNIPIAC UNIVERSITY

CATHOLIC CENTER

HAMDEN, CT



AUGUST 29, 2017

CFM # 6041

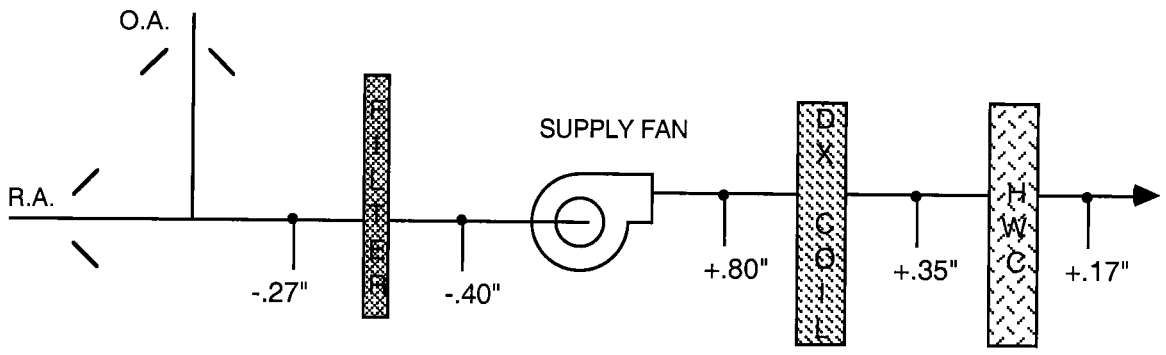
CFM TEST & BALANCE CORPORATION
14 DEPOT SQUARE, BETHEL, CT 06801
TEL (203) 778-1900 FAX (203) 778-1710

QUINNIPIAC UNIVERSITY CATHOLIC CENTER HAMDEN, CT		DATA SHEET #
DATE 8/29/17	BY DT	1
		CFM 6041

FAN	AHU-1
FAN LOCATION	ATTIC
AREA SERVED	CHAPEL
FAN MANUFACTURER	TRANE
MODEL	TAM7AOC
SHEAVE POSITION	DIRECT DRIVE
V.F.D. POSITION	N.A.

	SPECIFIED	ACTUAL
TOTAL CFM	1680	1740
R/A CFM	1305	1372
O/A CFM	375	368
FAN TSP	N.A.	1.20"
FAN ESP	N.A.	.44"
FAN RPM	N.A.	N.A.

	SPECIFIED	ACTUAL
MOTOR MFG.	N.A.	
MOTOR FRAME	N.A.	
MOTOR HP	3/4	3/4
MOTOR BHP	N.A.	.70
VOLTS/PHASE	200/1	203
AMPERAGE	4.2	3.9
MOTOR RPM	N.A.	N.A.
SERVICE FACTOR	N.A.	



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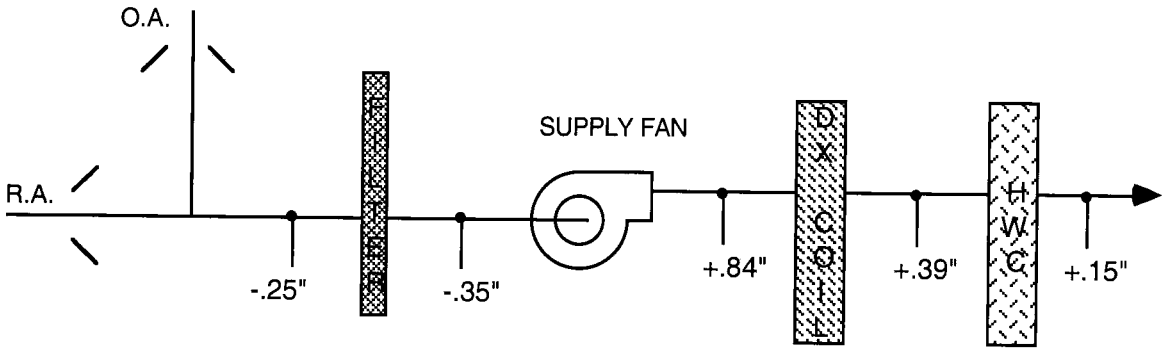
QUINNIPIAC UNIVERSITY CATHOLIC CENTER HAMDEN, CT		DATA SHEET # 2
DATE 8/29/17	BY DT	CFM 6041

FAN	AHU-2
FAN LOCATION	ATTIC
AREA SERVED	MULTIPURPOSE
FAN MANUFACTURER	TRANE
MODEL	TAM7AOC
SHEAVE POSITION	DIRECT DRIVE
V.F.D. POSITION	N.A.

	SPECIFIED	ACTUAL
TOTAL CFM	1600	1660
R/A CFM	1225	1286
O/A CFM	375	374
FAN TSP	N.A.	1.19"
FAN ESP	N.A.	.40"
FAN RPM	N.A.	N.A.

	SPECIFIED	ACTUAL
MOTOR MFG.	N.A.	
MOTOR FRAME	N.A.	
MOTOR HP	3/4	3/4
MOTOR BHP	N.A.	.71
VOLTS/PHASE	200/1	204
AMPERAGE	4.2	4.0
MOTOR RPM	N.A.	N.A.
SERVICE FACTOR	N.A.	



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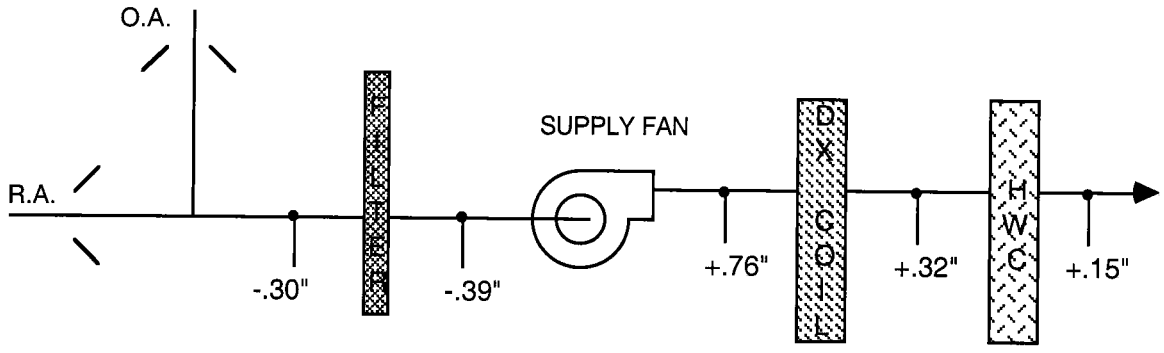
QUINNIPIAC UNIVERSITY CATHOLIC CENTER HAMDEN, CT		DATA SHEET # 3
DATE 8/29/17	BY DT	CFM 6041

FAN	AHU-3
FAN LOCATION	ATTIC
AREA SERVED	LOUNGE & OFFICES
FAN MANUFACTURER	TRANE
MODEL	7AM7OC
SHEAVE POSITION	DIRECT DRIVE
V.F.D. POSITION	N.A.

	SPECIFIED	**ACTUAL**
TOTAL CFM	1600	1610
R/A CFM	1450	1463
O/A CFM	150	147
FAN TSP	N.A.	1.15"
FAN ESP	N.A.	.45"
FAN RPM	N.A.	N.A.

	SPECIFIED	**ACTUAL**
MOTOR MFG.	N.A.	
MOTOR FRAME	N.A.	
MOTOR HP	3/4	3/4
MOTOR BHP	N.A.	.66
VOLTS/PHASE	200/1	203
AMPERAGE	4.2	3.7
MOTOR RPM	N.A.	N.A.
SERVICE FACTOR	N.A.	



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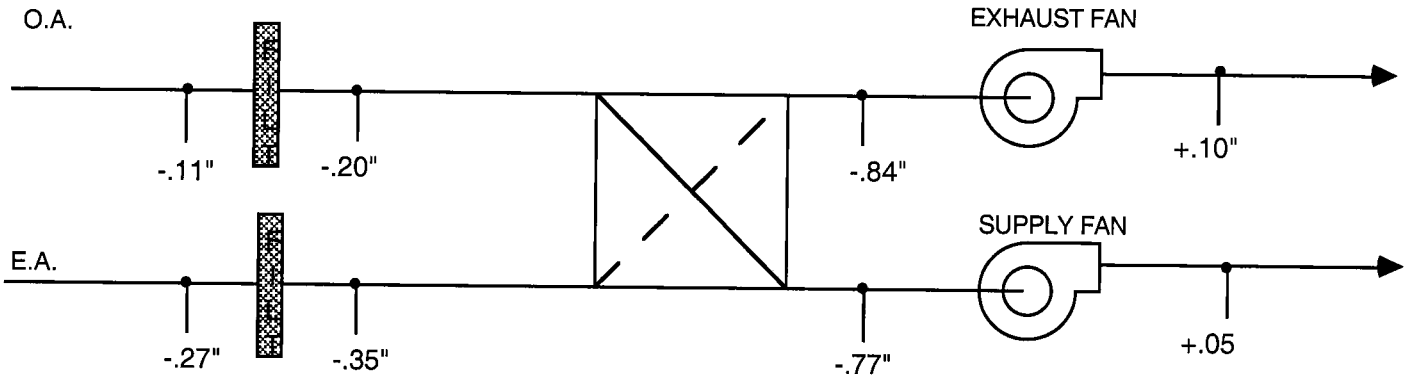
QUINNIPIAC UNIVERSITY CATHOLIC CENTER HAMDEN, CT		DATA SHEET #
DATE 8/29/17	BY DT	4
		CFM 6041

FAN	ERV-1 SUPPLY	ERV-1 RETURN
FAN LOCATION	ATTIC	ATTIC
AREA SERVED	CATHOLIC CENTER	CATHOLIC CENTER
FAN MANUFACTURER	GREENHECK	GREENHECK
MODEL	ECV-10	ECV-10
SHEAVE POSITION	DIRECT DRIVE	DIRECT DRIVE
VFD POSITION	N.A.	N.A.

	SPECIFIED	ACTUAL	SPECIFIED	ACTUAL
TOTAL CFM	900	889	900	1040
O/A CFM	900	889		
E/A CFM			900	1040
FAN TSP	N.A.	.82"	N.A.	.94"
FAN ESP	N.A.	.25"	N.A.	.37"
FAN RPM	N.A.	N.A.	N.A.	N.A.

	SPECIFIED	ACTUAL	SPECIFIED	ACTUAL
MOTOR MFG.	N.A.		N.A.	
MOTOR FRAME	N.A.		N.A.	
MOTOR HP	.5	.5	.5	.5
MOTOR BHP	N.A.	.46	N.A.	.49
VOLTS/PHASE	115/1	117	115/1	115
AMPERAGE	9.7	9.0	9.7	9.5
MOTOR RPM	N.A.	N.A.	N.A.	N.A.
SERVICE FACTOR	N.A.		N.A.	



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QUINNIPIAC UNIVERSITY
CATHOLIC CENTER
HAMDEN, CT

DATE 8/29/17 BY DT

DATA SHEET # 5

CFM 6041

DUCT TRAVERSE ZONE TOTALS

SYSTEM	DUCT SIZE	SQ. FT.	DESIGN		TEST		
			FPM	CFM	FPM	CFM	SP (in.wg)
ERV-1 SUPPLY							
AHU-1 O.A.	10"Ø	.545	688	375	675	368	-.34"
AHU-2 O.A.	10"Ø	.545	688	375	687	374	-.25"
AHU-3 O.A.	8"Ø	.35	429	150	421	147	-.15"
				900		889	

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QUINNIPIAC UNIVERSITY
CATHOLIC CENTER
HAMDEN, CT

DATE 8/29/17 BY DT

DATA SHEET # 6

CFM 6041

FAN	ROOM		REG/ DIFF	SIZE	C.F.M. DESIGN	C.F.M. TEST	REMARKS
AHU-1 SUPPLY							
	FORMAL CHAPEL	111	1	4'1 SLOT	200	210	
	FORMAL CHAPEL	111	2	4'1 SLOT	200	210	
	FORMAL CHAPEL	111	3	4'1 SLOT	200	200	
	FORMAL CHAPEL	111	4	4'1 SLOT	200	210	
	FORMAL CHAPEL	111	5	4'1 SLOT	200	200	
	FORMAL CHAPEL	111	6	4'1 SLOT	200	210	
	PLATFORM	111A	7	4'2 SLOT	200	200	
	FORMAL CHAPEL	111	8	4'2 SLOT	200	190	
	SACRISTY	112	9	2408	100	110	
AHU-1 RETURN							
	FORMAL CHAPEL	111	1	18X18	660	695	
	FORMAL CHAPEL	111	2	18X18	660	650	

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QUINNIPIAC UNIVERSITY
CATHOLIC CENTER
HAMDEN, CT

DATE 8/29/17 BY DT

DATA SHEET # 7

CFM 6041

FAN	ROOM		REG/ DIFF	SIZE	C.F.M. DESIGN	C.F.M. TEST	REMARKS
AHU-2 SUPPLY							
	MULTIPURPOSE	110	1	4'1 SLOT	200	210	
	MULTIPURPOSE	110	2	4'1 SLOT	200	220	
	MULTIPURPOSE	110	3	4'1 SLOT	200	205	
	MULTIPURPOSE	110	4	4'1 SLOT	200	210	
	MULTIPURPOSE	110	5	4'1 SLOT	200	200	
	MULTIPURPOSE	110	6	4'1 SLOT	200	200	
	MULTIPURPOSE	110	7	4'2 SLOT	200	215	
	MULTIPURPOSE	110	8	4'2 SLOT	200	200	
AHU-2 RETURN							
	MULTIPURPOSE	110	1	18X18	660	630	
	MULTIPURPOSE	110	2	18X18	660	640	

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QUINNIPIAC UNIVERSITY
CATHOLIC CENTER
HAMDEN, CT

DATE 8/29/17 BY DT

DATA SHEET # 8

CFM 6041

FAN	ROOM		REG/ DIFF	SIZE	C.F.M. DESIGN	C.F.M. TEST	REMARKS
AHU-3 SUPPLY							
	LOUNGE	101B	1	4'1 SLOT	200	190	
	LOBBY	101A	2	4'1 SLOT	200	215	
	VESTIBULE	100	3	2'1 SLOT	100	105	
	FATHER'S OFFICE	103	4	1208	200	200	
	MEETING	105	5	1208	300	275	
	STORAGE	107	6	908	80	80	
	MEN'S	104	7	908	60	65	
	WOMEN'S	106	8	908	60	60	
	KITCHENETTE	108	9	2412	400	420	
AHU-3 RETURN							
	VESTIBULE	100	1	2'1 SLOT	100	110	
	FATHER'S OFFICE	103	2	12X12	200	210	
	MEETING	105	3	14X14	300	290	
	STORAGE	107	4	12X12	80	75	
	CORRIDOR		5	18X18	770	740	

CFM TEST & BALANCE CORPORATION
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TEL (203) 778-1900 FAX (203) 778-1710

QUINNIPIAC UNIVERSITY
CATHOLIC CENTER
HAMDEN, CT

DATE 8/29/17 BY DT

DATA SHEET # 9

CFM 6041

FAN	ROOM		REG/ DIFF	SIZE	C.F.M.		REMARKS
					DESIGN	TEST	
ERV-1 EXHAUST							
	MEN'S	104	1	12X12	150	170	
	WOMEN'S	106	2	12X12	150	170	
	MULTIPURPOSE	110	3	18X18	275	350	
	FORMAL CHAPEL	111	4	18X18	275	350	

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TEL (203) 778-1900 FAX (203) 778-1710

QUINNIPIAC UNIVERSITY
CATHOLIC CENTER
HAMDEN, CT

DATE 8/29/17 BY DT

DATA SHEET # 10

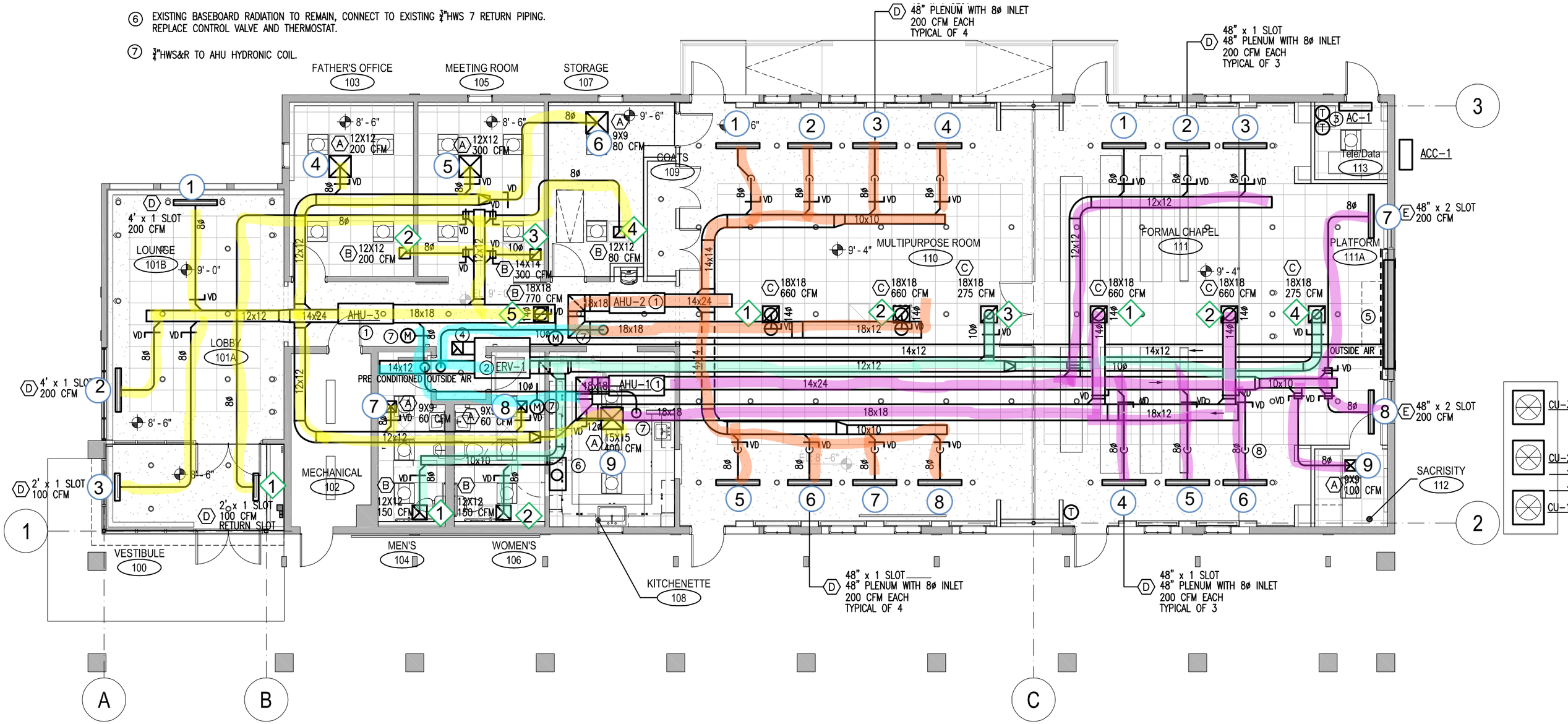
CFM 6041

CIRCUIT SETTERS

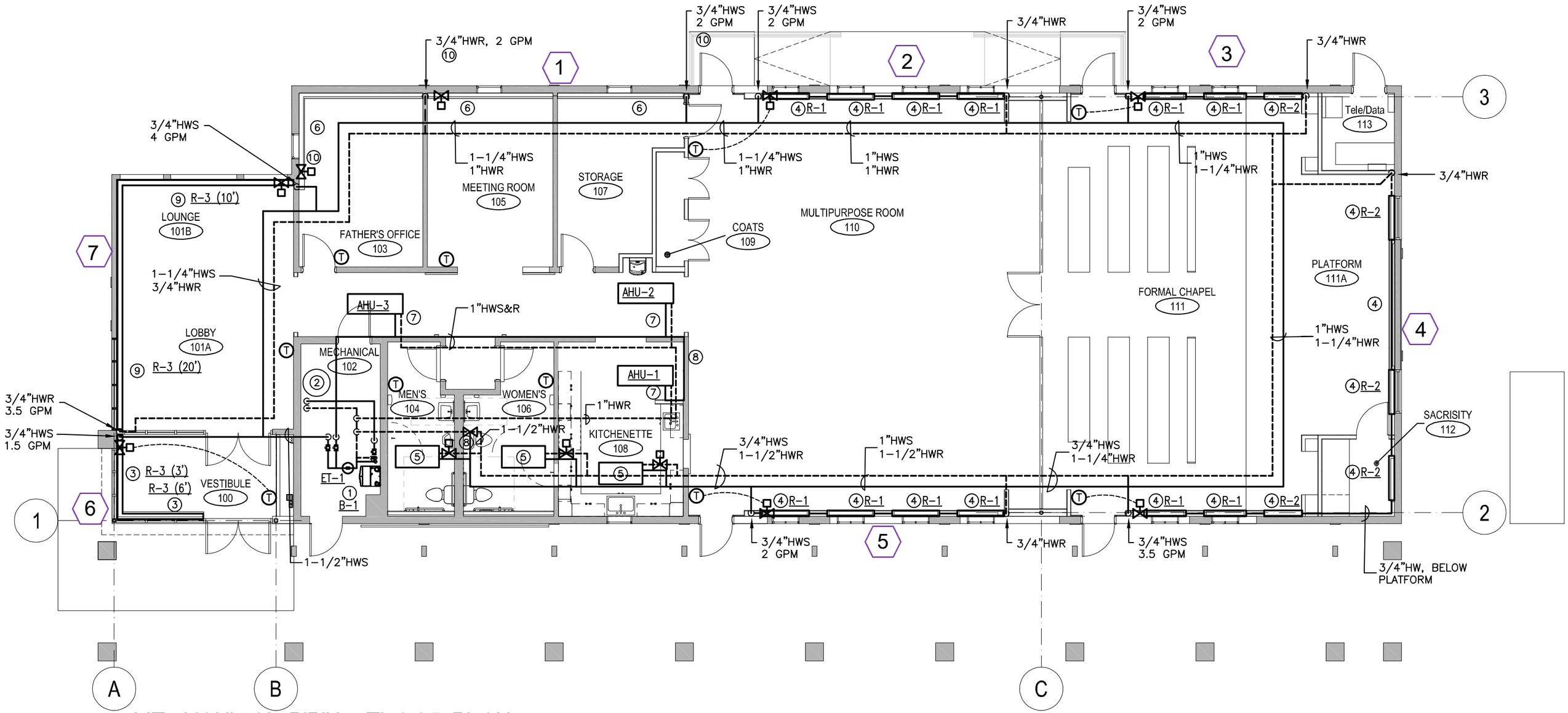
LOCATION	#	MODEL	SIZE	DESIGN GPM	VALVE SETTING	FINAL	
						PD	GPM
P-1	1	B&G	15	14	0°	11.9'	13.1
P-2							
FTR 103	1	B. VALVE	3/4S	2	50%	N.A.	2 EST
FTR 110	2	B&G	3/4S	2	20°	N.A.	2 EST
FTR 110	3	B&G	3/4S	2	18°	1.9'	1.9
FTR 111A	4	B&G	3/4S	3.5	0°	2.6'	3.6
FTR 110	5	B&G	3/4S	2	20°	N.A.	2 EST
FTR 100	6	B&G	3/4S	1.5	22°	1.5'	1.4
FTR 101A	7	B&G	3/4S	3.5	0°	2.2'	3.3
P-3							
AHU-1	1	B&G	3/4S	3.0	0°	2.1'	3.2
AHU-2	2	B&G	3/4S	3.0	0°	2.3'	3.4
AHU-3	3	B&G	3/4S	3.0	32°	15.7'	3.1

⑥ EXISTING BASEBOARD RADIATION TO REMAIN, CONNECT TO EXISTING ¾"HWS 7 RETURN PIPING. REPLACE CONTROL VALVE AND THERMOSTAT.

⑦ ¾"HWS&R TO AHU HYDRONIC COIL.



MECHANICAL FLOOR PLAN



MECHANICAL PIPING FLOOR PLAN

SCALE: 1/8"=1'-0"

EASTERN MECHANICAL SERVICES, INC

COMBUSTION TESTING GAS FIRED APPLIANCES/EQUIPMENT									
PROJECT NAME:	Quinnipiac University Catholic Center					INITIAL STARTUP DATE:		9/18/17	
PROJECT LOCATION:	385 New Rd, Hamden, CT								
EQUIPMENT TAG / NAME:	Gas Fired Boiler								
MANUFACTURER:	Lochinvar								
MODEL NUMBER:	SIT303								
SERIAL NUMBER:									
MEASUREMENTS	SERVICE DATE: 9/18/17 BY: Bob Unger	SERVICE DATE: BY:	SERVICE DATE: BY:	SERVICE DATE: BY:	SERVICE DATE: BY:	SERVICE DATE: BY:	SERVICE DATE: BY:	SERVICE DATE: BY:	***SETPOINT VALUE***
STATIC PRESSURE "W.C.	5.79								MAX 14" W.C.
RUNNING PRESSURE (SUPPLY PRESSURE)									
NATURAL GAS " W.C.	4.65								4-14 "W.C.
PROPANE GAS "W.C.	N/A								10-14 "W.C.
CARBON DIOXIDE CONTENT CO2									
AT LOWER END OF RATED INPUT RANGE VOL.-%	9.5								
AT UPPER END OF RATED INPUT RANGE VOL.-%	8.5								
OXYGEN CONTENT O2									
AT LOWER END OF RATED INPUT RANGE VOL.-%	3.9								
AT UPPER END OF RATED INPUT RANGE VOL.-%	5.9								
CARBON MONOXIDE CONTENT CO									
AT LOWER END OF RATED INPUT RANGE PPM	60								50 PPM AIR-FREE*
AT UPPER END OF RATED INPUT RANGE PPM	75								
IONIZATION CURRENT µA	4.49								

*FUEL TYPE, ALTITUDE, VENTING AND OTHER SITE PARAMETERS MAY CHANGE

AQUA ENVIRONMENTAL LAB
56 Church Hill Road • Newtown, CT 06470 • (203) 270–9973

Report of Analysis

Name: Eastern Mechanical Services, Inc.
3 Starr St.
Danbury, CT 06810
Sample Date: 9/6/2017 8:40 AM
Receipt Date: 9/6/2017 9:30 AM
Report Date: 9/7/2017
Sample Site: Quinnipiac University Catholic Center

Sample ID#: 203980
Sample Type: Drinking Water
Sample Source: Kitchen
Sampler: TJB

Parameter	Sample Result	Units	Limits	Method	MDL	Analysis Date
Biological						
Coliform Bacteria	absent	none	0	SM9223B	0	9/6/2017
e Coli Bacteria	absent	none	0	SM9223B	0	9/6/2017
Inorganic Compounds						
Chlorine, residual	0.08	mg/L	4	SM4500CLG	0.05	9/6/2017

Comments: Based on the bacteriological examination, according to the Federal Safe Drinking Water Act (SDWA), this water was safe for drinking purposes at the time the sample was collected.

ND = Not Detected
* = Above Specified Limit

Report Approved by: _____ CT Lic PH-0787 NY Lic 11706
Lab Director

September 19, 2017

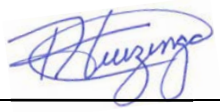
WARRANTY

We hereby warrant that the **HVAC work**

Which we have performed at the Quinnipiac University Catholic Center

Has been done in strict accordance with International Mechanical Code, 2012 Edition. The work installed will fulfill the requirements of those codes. We agree to repair or replace or cause to be repaired or replaced any or all of work which may prove to be defective in workmanship or materials, together with any adjacent work which requires repair or replacement because of our defective work, within a period of ***1*** year from August 23, 2017 to August 22, 2018, ordinary wear and tear and unusual abuse or neglect excepted.

If we fail to commence to comply with the above paragraph within ten (10) days after receipt of written notice from Owner to do so or fail to pursue such as compliance with diligence, we, jointly, and severally, do hereby authorize the Owner to proceed to have the defects repaired and made good at our sole expense, and we will honor and pay the costs and charges for it together with interest at the maximum rate permitted by law upon demand. If we fail to fulfill the preceding obligations, and if the Owner brings an action to enforce this warranty, we agree to pay the Owner's reasonable attorney's fees incurred in connection therewith.

Signed: 

Date 9/19/2017

September 19, 2017

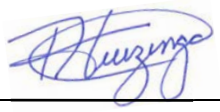
WARRANTY

We hereby warrant that the **Plumbing work**

Which we have performed at the Quinnipiac University Catholic Center

Has been done in strict accordance with International Plumbing Code 2012 Edition. The work installed will fulfill the requirements of those codes. We agree to repair or replace or cause to be repaired or replaced any or all of work which may prove to be defective in workmanship or materials, together with any adjacent work which requires repair or replacement because of our defective work, within a period of ***1*** year from August 23, 2017 to August 22, 2018, ordinary wear and tear and unusual abuse or neglect excepted.

If we fail to commence to comply with the above paragraph within ten (10) days after receipt of written notice from Owner to do so or fail to pursue such as compliance with diligence, we, jointly, and severally, do hereby authorize the Owner to proceed to have the defects repaired and made good at our sole expense, and we will honor and pay the costs and charges for it together with interest at the maximum rate permitted by law upon demand. If we fail to fulfill the preceding obligations, and if the Owner brings an action to enforce this warranty, we agree to pay the Owner's reasonable attorney's fees incurred in connection therewith.

Signed: 

Date 9/19/2017

Quinnipiac University Catholic Center 2017

VALVE TAG	DESCRIPTION	LOCATION
HTG 1	Boiler inlet	Boiler Room
HTG 2	Boiler outlet	Boiler Room
HTG 3	Return Storage Tank	Boiler Room
HTG 4	Supply Storage Tank	Boiler Room
HTG 5	System Return	Boiler Room
HTG 6	System Supply	Boiler Room
HTG 7	Supply Air Handlers	Attic
HTG 8	Supply Fin Tubes and Heating Panels	Boiler Room
HTG 9	Return for Pastors Office	Attic, Above Office
HTG 10	Supply for Pastors Office	Attic, Above Conf. Room
HTG 11	Return for Conference and Storage Room	Attic, Above Conf. Room
HTG 12	Supply Conference and Storage Room	Attic, Above Storage Room
HTG 13	Supply Common Area	Attic, Above Common Area
HTG 14	Return Commom Area	Attic, Above Common Area
HTG 15	Supply Common Area	Attic, Above Common Area
HTG 16	Return Commom Area	Attic, Above Stage
HTG 17	Return Stage	Attic, Above Stage
HTG 18	Supply Stage	Attic, Above Common Area
HTG 19	Return Commom Area	Attic, Above Common Area
HTG 20	Supply Common Area	Attic, Above Common Area
HTG 21	Supply Ceiling Panel Kitchen	Attic, Above Kitchen
HTG 22	Return Ceiling Panel Kitchen	Attic, Above Kitchen
HTG 23	Supply Ceiling Panel Ladies Room	Attic, Above Ladies Room
HTG 24	Return Ceiling Panel Ladies Room	Attic, Above Ladies Room
HTG 25	Supply Ceiling Panel Men's Room	Attic, Above Mens Room
HTG 26	Return Ceiling Panel Men's Room	Attic, Above Mens Room
HTG 27	Supply Vestibule	Attic, Above Vestibule
HTG 28	Return Vestibule	Attic, Above Vestibule
HTG 29	Supply Lounge	Attic, Above Lounge
HTG 30	Return Lounge	Attic, Above Lounge

Quinnipiac University Catholic Center 2017

VALVE TAG	DESCRIPTION	LOCATION
PLB 1	Water Main	Boiler Room
PLB 2	Cold Water To Bathrooms and Kitchen	Boiler Room
PLB 3	Cold Water Make Up to Storage Tank	Boiler Room
PLB 4	Cold Water to Mixing Valve	Boiler Room
PLB 5	Hot Water Mop Sink	Boiler Room
PLB 6	Cold Water Mop Sink	Boiler Room
PLB 7	Hot Water Main	Boiler Room
PLB 8	Cold Water Boiler Feed Make Up Water	Boiler Room