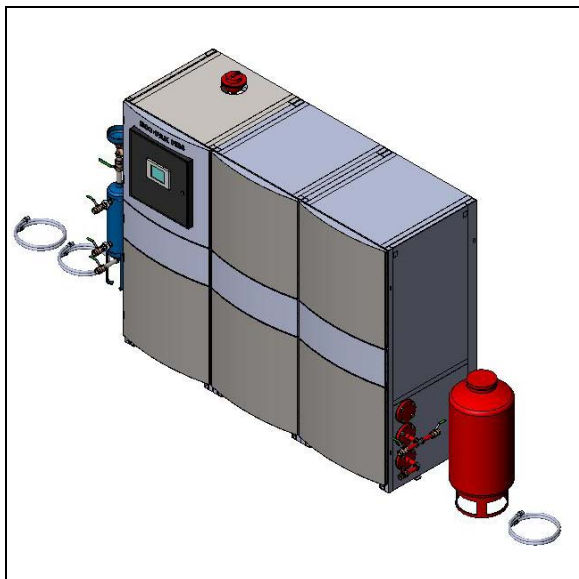


## INSTALLATION AND OPERATING INSTRUCTIONS

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# Armstrong ECO\*PAK MBS™ Ultra Efficient Integrated Heating Solution

Armstrong Packaged ECO\*PAK MBS™ Systems are completely factory-assembled, tested, adjusted, and shipped to the job site as integral units ready to receive hot water supply and return piping and incoming power supply. These instructions describe the procedures to be followed during installation, commissioning and operation to ensure optimum performance and reliability. When contacting the factory for assistance, please provide the unit Serial Number and other pertinent data, such as motor amperage, voltage and suction and discharge pressures.

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## 1. General

### 1.1 Introduction

The Armstrong ECO\*PAK MBS™ is a fully-integrated, high-efficiency, modular heating system with a compact design that makes it an ideal solution for new constructions, retrofit commercial installations and larger residential applications. Available in standard model sizes ranging from 420 to 1,140 MBH, this packaged boiler system is pre-engineered for optimal performance under varying load conditions and therefore it is significantly more efficient than conventional field-assembled boiler systems. The innovative, modular configuration results in a small package that can be easily moved through the doors, positioned in place and installed in a matter of hours.

The ECO\*PAK MBS includes as standard the following components: intelligent variable speed hot water pumps, condensing boilers, integrated controller with temperature sensors & serial communication to BAS, expansion tank, air separator, isolating valves, strainer, chemical pot feeder, water make-up system, interconnecting piping with air vents, drain cocks and test points, electrical wiring and thermal insulation. As an option, the ECO\*PAK MBS can be supplied with a gas meter and hot water flow sensor.

Armstrong intelligent twin-head pump for duty/standby operation incorporates Armstrong's motor-mounted variable frequency drives (VFD's) which will constantly adapt to changes in the distribution system characteristics. The pump features economical inside-type, single-spring mechanical seal, serviced by removing the rotating assembly while the pump casing remains in the line. Dynamically balanced impeller assures smooth, vibration-free operation. Radially split volute has equal suction and discharge flange sizes. Separate tapped openings are provided for gauge, flush and drain connections. The pump controls and boiler combustion controls are integrated to ensure that the minimum flow rates are maintained and that the boilers are running in the condensing mode as long as possible.

Low NOx gas fired condensing boilers with stainless steel heat exchangers and modulating premix gas burners are at the heart of the ECO\*PAK MBS System. Through the sophisticated ECO\*PAK MBS integrated controller, the boilers are capable of operating at overall seasonal efficiencies of over 94% with low carbon emissions. The boilers bear ASME and National Board stamps and are certified for use on Natural Gas and LPG. The boilers comply also with the energy efficiency requirements of the latest edition of the ASHRAE 90.1 Standard and the minimum efficiency requirements of the latest edition of the ASHRAE 103 Standard. The boilers meet as a minimum U.S. Environmental Protection Agency and Department of Energy guidelines for "Energy Star" efficiency. On site, a concentric balanced flue system discharges products of combustion through the inner annulus and draws combustion air through the outer annulus, allowing room sealed applications.

The integrated controller provides the following functions:

1. Ensure minimum hot water flow rates are maintained to operate in the high efficient condensing mode at all times within a variable primary flow configuration
2. Optimize boiler firing rate to match exact heating loads
3. Optimize boiler sequencing to achieve the highest efficiency possible from the system

The integrated controller has a NEMA 12 enclosure and houses PLC's, circuit breaker, terminal strip and main disconnect switch. The controller incorporates a door mounted 5.7" touch-screen Human Machine Interface (HMI) for all necessary user set up and troubleshooting operations. The integrated controller is pre-programmed with project specific data for easy start-up and commissioning. On start-up, a read only screen displays Outdoor Air (OA) temperature, HWS temperature, HWR temperature, system hot water  $\Delta T$ , system heat output in MBH (optional), and pump kW usage. The initial screen displays also boilers status, pump status, system status, system run time and individual pump hours run time. Alarms, data trending of system parameters are also displayed on the touch-screen HMI and logged in the memory of the HIM available for upload when required.

A second screen (password protected for access to field adjustable parameters) provides access to input time, night setback, holiday settings, virtual hand/off/auto (HOA) and time extension buttons. Subsequent screens are also password protected and provide access to mode/system set-up, PID set-up, frost protection, clock set-up and reset and restore default screen.



The logic controller is based on Flash style memory. The integrated controller performs self-diagnostic testing of the CPU(s), RAM and flash memory. Existing data is stored and protected during momentary power supply interruptions.

The ECO\*PAK MBS integrated controller is capable of both, hard-wired and serial communication with the BAS. The standard communication protocol is Modbus. Optional communication protocols include BACnet IP, BACnet Ethernet, BACnet MS/TP and LonWorks. Clearly marked terminals are provided for BAS interface and for various field-mounted devices such as OA sensor. A hot water flow sensor can also be supplied as an option (connected to the terminal strip) and will display water flow reading in GPM on the HMI.

A make-up cold water fill assembly is provided to automatically fill the entire system to the pre-set cold fill pressure. An expansion tank with heavy duty butyl replaceable bladder is provided loose for field connection to the return header with isolating valve.

An optional in-line, turbine type gas flow meter shall be fitted in the gas header in order to read gas consumption and monitor thermal efficiency. When the gas meter is connected to the controller terminal strip, it will display gas consumption reading in SCF on the HMI. Safety valves are fitted to each boiler supply pipe and a plugged gas purge valve is fitted to the end of the gas header

The ECO\*PAK MBS Integrated Heating Solution is manufactured by Armstrong to meet the requirements of its ISO 9001:2000 and ISO14001: 2004 Registrations.

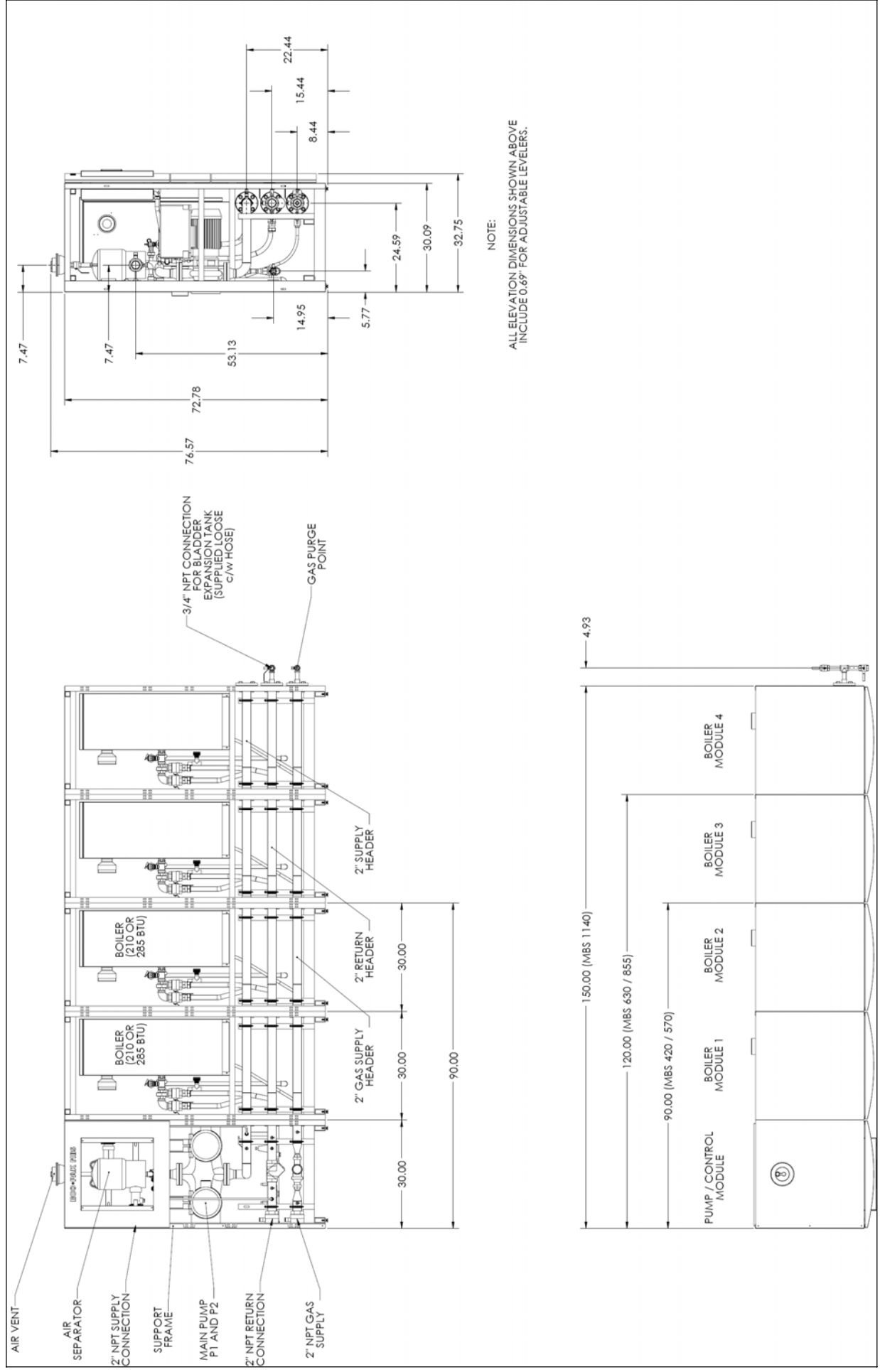


## 1.2 Technical Data

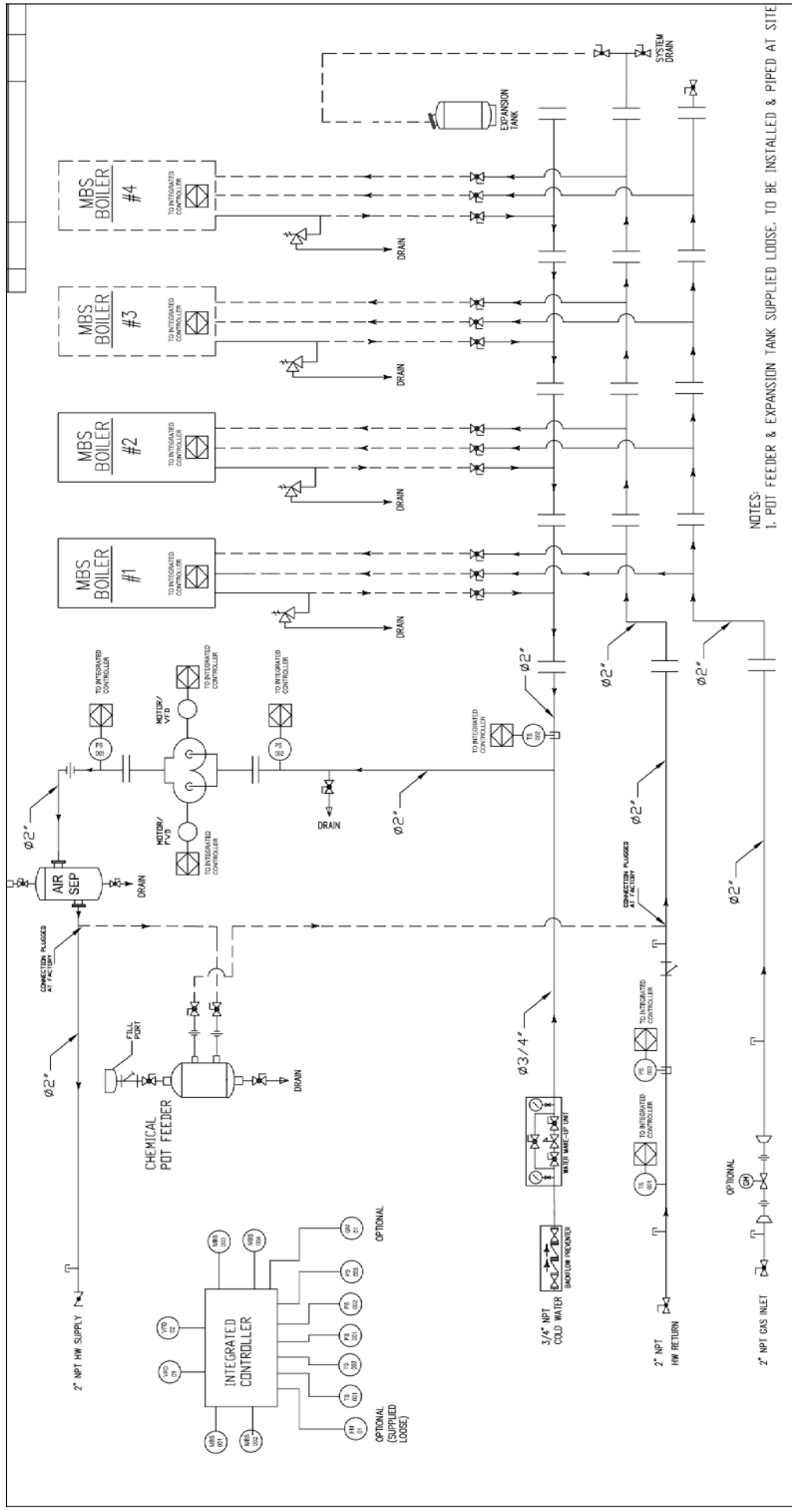
ECO*PAK MBS™ Technical Data		ECO*PAK MBS™ 420	ECO*PAK MBS™ 570	ECO*PAK MBS™ 630	ECO*PAK MBS™ 855	ECO*PAK MBS™ 1140
<b>Boiler Modules</b>						
Number of boilers		2 x MB210	2 x MB285	3 x MB210	3 x MB285	4 x MB285
Total nominal heat input range (net)		MBH (kW)	102 to 512 (30 to 150)	111 to 567 (33 to 166)	153 to 768 (45 to 225)	204 to 1024 (60 to 300)
Total nominal heat input range (gross)		MBH (kW)	114 to 570 (33 to 167)	126 to 630 (37 to 185)	171 to 855 (50 to 251)	248 to 1140 (73 to 334)
Total heat capacity output 150/115°F (66/46°C )		MBH (kW)	520 (152)	570 (167)	780 (229)	1040 (305)
Total gas consumption (NG)		CFH (m³/h)	530 (15)	585 (17)	795 (23)	1060 (30)
Total gas consumption (LPG)		CFH (m³/h)	228 (6)	252 (7)	342 (10)	456 (13)
Flue gas temperature 150/115°F (66/46°C )		°F (°C)	120 (49)	127 (53)	120 (49)	120 (49)
Nominal gas inlet pressure (NG)		in W.C. (mbar)	4 to 13 (10 to 32)	4 to 13 (10 to 32)	4 to 13 (10 to 32)	4 to 13 (10 to 32)
Nominal gas inlet pressure (LPG)		in W.C. (mbar)	8 to 13 (20 to 32)	8 to 13 (20 to 32)	8 to 13 (20 to 32)	8 to 13 (20 to 32)
CO <sub>2</sub> (NG)		%	8.0 to 10.0	8.0 to 10.0	8.0 to 10.0	8.0 to 10.0
CO <sub>2</sub> (LPG)		%	9.0 to 11.0	9.0 to 11.0	9.0 to 11.0	9.0 to 11.0
Maximum pressure at flue outlets		in W.C. (mbar)	5 (12)	5 (12)	5 (12)	5 (12)
Combustion air/flue connection size		in (mm)	3/3 (76/76)	3/3 (76/76)	4/4 (101/101)	4/4 (101/101)
Boiler module weight (each)		lbs (kg)	344 (156)	344 (156)	396 (180)	396 (180)
<b>Pump/Control Module</b>						
Design flow rate (35°F Δt)		GPM (l/s)	30 (1.89)	33 (2.08)	45 (2.84)	60 (3.79)
Residual head		ft (kPa)	34.7 (104)	32.9 (98)	34.7 (104)	34.7 (104)
Minimum operating pressure (at boiler inlet)		psi (bar)	12 (0.8)	12 (0.8)	12 (0.8)	12 (0.8)
Cold fill pressure (setting at water make up and expansion tank)		psi (bar)	15 (1.0)	15 (1.0)	15 (1.0)	15 (1.0)
Maximum system rated pressure		psi (bar)	80 (5.5)	80 (5.5)	80 (5.5)	80 (5.5)
Factory set safety valve relief pressure		psi (bar)	30 (2.1)	30 (2.1)	30 (2.1)	30 (2.1)
Maximum operating temperature		°F (°C)	210 (99)	210 (99)	210 (99)	210 (99)
Electric supply 208/230/460V / 3 / 60Hz or 575V / 3 / 60Hz						
Full load current at 208/460V/575V		A	15.21/9.8/8.4	15.81/10.4/9	16.71/11.3/9.9	18.21/12.8/11.4
LTHW supply and return connections		in (mm)	2 (50)	2 (50)	2 (50)	2 (50)
Gas connection		in (mm)	2 (50)	2 (50)	2 (50)	2 (50)
Condensate drain connection		in (mm)	1/2 (13)	1/2 (13)	1/2 (13)	1/2 (13)
Boosted cold water/mains water connection		in (mm)	3/4 (19)	3/4 (19)	3/4 (19)	3/4 (19)
Minimum cold water supply pressure		psi (bar)	15 (1)	15 (1)	15 (1)	15 (1)
Pump module weight		lbs (kg)	462 (210)	462 (210)	462 (210)	462 (210)
<b>General Information</b>						
Overall assembly length		in (mm)	95.13 (2416)	125.19 (3180)	125.19 (3180)	155.25 (3943)
Overall assembly depth		in (mm)	33.50 (851)	27 (686)	27 (686)	27 (686)
Overall assembly height		in (mm)	76.42 (1941)	72 (1829)	72 (1829)	72 (1829)
Total weight (dry)		lbs (kg)	1150 (522)	1494 (678)	1650 (748)	2046 (928)
Total weight (wet)		lbs (kg)	1190 (540)	1549 (703)	1712 (776)	2121 (962)



## 1.5 General Arrangement Drawings



## 1.4 P&ID



## 1 General

### 1.5 ECO\*PAK MBS Integrated Controller Sequence of Operation

#### General Information

The MBS NA Integrated Controller is designed as a modular system controlling 2 to 4 condensing boilers and 2 variable speed pumps in duty/standby configuration. All system functions are monitored and controlled by a PLC, (Programmable Logic Controller). System data may be read from or input to the PLC by a 5.7" touch screen display panel (HMI).

*Output signals are to the variable frequency drives (VFD), condensing boilers, and to the building automation system (BAS). The following summarizes the range of input/output variables possible for the Integrated Controller:*

#### Possible (maximum) Input/Output (I/O) Variables:

1. 1 digital input (DI) for remote start/stop signal from BAS
2. 4 digital outputs (DO) for alarms:
  - a. pump/motor/VFD alarm,
  - b. temperature sensor alarm,
  - c. boiler alarm,
  - d. system general alarm for possibility to send to BAS
3. 3 AI's for system hot water supply and return temperatures (NTC type) and for outdoor air temperature (transmitter 4-20 mA configurable range)
4. 4 DO's for up to 4 boiler start/stop run signal
5. 4 DI's for up to 4 boiler run feedback signal
6. 4 DI's for up to 4 boiler alarm status fault signal
7. 4 analog outputs (AO) for boiler capacity modulation signal, 0-10Vdc
8. 1 DI for gas emergency shut off for possibility of connection to external emergency switch
9. 1 serial port for communication with the BAS (standard protocol Modbus)
10. 1 serial port for communication with the VFD's using Modbus protocol (communicate pump speed, alarm, feedback and kW)

#### Optional Integrated Controller I/O:

1. 1 AI for system HW supply flow measurement
2. 1 AO for 2-way modulating bypass valve
3. Pulse input for optional gas meter
4. 1 DI for gas meter open feedback signal
5. Serial communication to BAS using BACnet/IP, BACnet/Ethernet, BACnet/MSTP, and Lonworks

#### Processor Generic Logical Features:

1. Standard MBS NA Integrated Controller is supplied with 5.7" Human Machine Interface (HMI) with color touch-screen
2. A schematic of the system is displayed on the HMI showing all variable speed primary pumps variables on the screen
3. System hot water supply & return temperatures shall be displayed. These temperature sensors shall be located on inlet and outlet headers of the MBS NA package
4. Outdoor air temperature shall be displayed
5. Control boilers output temperature (SHWST) by sending modulating signal to maintain system hot water supply temperature set-point, control algorithm in Sequence of Operation section below
6. Monitor boiler(s) minimum and maximum flows (when flow sensor ordered separately) and perform necessary control outside operating flow range. Minimum and maximum pump speeds shall be pre-defined and entered for each MBS Model
7. Re-set system hot water supply temperature based on outdoor air temperature
8. Sequence boiler(s) based on their best efficiency performance curve as required by system demand



9. Monitor System HWRT
10. Compare System hot water return temperature to its set-point
11. SHWRT set-point shall be reset based outdoor air temperature
12. PID control algorithms for pump speed control based on SHWRT and modulating boiler capacity control in PLC based on.
13. Ability to select one of three default hot water system sizes (small, medium, & large) for pump control loop
14. Manual and automatic alternation of primary pumps based on hours of operation, 1 week alternation, adjustable
15. Alarms shall include temperature sensor failure, pump/motor/drive failure, boiler failure, and general system alarm
16. 3 levels of password protection on operator interface
  - a. level 1 is operator level: H-O-A function, display of all parameters
  - b. level 2 is installer level: all parameter setup except for PID variables
  - c. level 3 is factory level: all parameter settings including defaults
17. As options, display system hot water flow and gas consumption on the HMI

## Pump Speed Control Algorithm:

Upon start-up the Integrated Controller shall calculate the SHWRT set-point based on outdoor air temperature sensor. The Controller shall compare actual SHWRT with its set-point and display an "error" value which shall control pump speed.

Controller shall vary pump speed in order to maintain SHWRT set-point

## Sequence of Operation:

1. When MBS NA Integrated Controller (Controller) is set to "Local" the HW duty pump shall automatically be started at preset minimum speed and **ALL** boilers enabled
2. When Controller is set to "REMOTE", BAS shall sense heat demand called by system
3. BAS shall send signal to controller to start hot water duty pump at preset minimum speed and enable **ALL** boilers  
Once enable signal by BAS is received AND the building schedule is satisfied AND OAT drops below 60°F (adjustable) then enable MBS system
4. Once started the Controller calculates the system hot water supply temperature (SHWST) set-point by measuring outside air temperature

Default values are as follows:

Min OAT = 0°F

Max OAT = 60°F

Min SHWST = 100°F

Max SHWST = 140°F

5. ALL boilers shall start once flow has been verified by their own control system (boiler flow switch)
6. If hot water flow has not been verified by Controller within specified time delay then send start signal to HW standby pump at same preset minimum speed and issue HW duty pump alarm on HMI
7. If lag pump does not start shut down, and issue pump and general alarms
8. Controller shall send an analog signal to modulate boilers capacity to maintain the SHWST set-point
9. Controller shall modulate HW duty pump speed to satisfy hot water system demand
10. Controller shall calculate boiler heat output capacity in MBH if optional water flow sensor is selected and installed
11. Display of actual boiler heat output capacity in MBH on HMI



## **BOILER SEQUENCING ALGORITHM**

12. Controller shall run the boilers at best efficiency by sequencing boilers on and off at predetermined optimum efficiency staging points
13. When lead boiler is running at less than its minimum capacity for more than 2 minutes (adjustable), shut down boiler
14. Duty pump still running at pre-determined minimum speed
15. If no heat demand is required while lead boiler is OFF for more than 20 minutes (adjustable), shut OFF HW duty pump
16. Should more heat capacity to building load be required start LEAD boiler provided a time delay has elapsed since LEAD boiler has been OFF
17. HW duty pump will start once LEAD boiler is enabled
18. Any boiler alarm shall be displayed on HMI (touch-screen)
19. Controller shall perform manual and automatic alternation of HW pumps based on hours of operation (1 week alternation adjustable)
20. IF gas emergency shut off signal is connected to Controller, when activated Controller will shut off operation of MBS system, and issue an alarm (general system alarm).
21. First shut down boiler and after 1 minute delay (adjustable) shut down pump.
22. 1<sup>st</sup> and 2<sup>nd</sup> stage frost protection shall be provided as standard. This feature is only active when MBS system is disabled by BAS
23. Controller shall monitor SHWST and maintain it above 41°F (adjustable)
24. When SHWST drops below 41°F but above 37°F (adjustable) then start duty pump and run at preset minimum speed
25. If SHWST drops below 37°F then LEAD boiler is signaled to run at minimum capacity with pump running at minimum speed
26. The frost protection shall be enabled even though the MBS is in REMOTE and BAS is commanding OFF

## 1 General

### 1.6 Location

The ECO\*PAK MBS™ modules should be installed on a clean flat surface. Modules installed in a straight line or “L” configuration should be located against a solid, preferably external wall. It is recommended that the modules are fixed back to the wall to prevent accidental toppling of the units. Where units are located in the centre of a plant room they should be fixed down to floor. Space should be allowed at the front of the modules (minimum 3 ft) to allow for maintenance and at the sides for access to the pipe connections (see section 1.13).

The boiler room must be dry and the room temperature should be between 40°F and 104°F.

### 1.7 Gas Supply

At the early planning stage, please contact the local gas supplier to determine the availability of an adequate supply. An existing supply must only be used with the permission of the gas supplier and a new primary gas meter can only be connected by the gas supplier or a gas registered installer.

The primary meter and its associated supply pipe must be capable of passing the gas quantity and nominal pressure detailed in section 1.2. The supply pipe must not be smaller than the gas header (2 inches) and may in some cases need to be larger to offset the pressure loss through the pipe.

A secondary in-line turbine type gas meter is provided on the ECO\*PAK MBS™ gas header as an option.

The complete gas installation (site supply pipe and ECO\*PAK MBS™ gas header) must be tested for gas soundness and purged in accordance with the applicable local standards.

The ECO\*PAK MBS™ is designed for use with natural gas with a nominal supply pressure of 8 in. water column (LPG option available).

For more detailed information see Boiler I&O manual - Gas Supply section.

### 1.8 Venting Systems

ECO\*PAK MBS™ boiler modules are designed as room sealed appliances and must use Direct Venting Cat IV. Individual vent terminations can be made either vertically through the roof or horizontally through the sidewall. Horizontal vent runs must be inclined  $\frac{1}{4}$ " for every ft of pipe run to allow condensate to drain back to the boiler. The vent ducts and terminals MUST NOT be closer than 1 inch to combustible material. 3" (75 mm) and 4" (100 mm) Concentric Vent kits are available through Armstrong upon request.

Due to the high efficiency of the boilers, pluming will occur. For this reason, it is generally recommended that vents terminate through the roof. However, regardless of whether vents are installed vertically or horizontally, they should never terminate in a position that could cause problems. It is the responsibility of the installer to ensure that products of combustion cannot re-enter the building or any adjacent building through louvres, windows, doors, mechanical ventilation, air conditioning systems or natural infiltration.

For minimum distances between vents and air intakes refer to Boiler I&O manual – General Venting section.

### 1.9 Heating Circulation System

The ECO\*PAK MBS™ is designed to be the building's primary heat source. Its intelligent control system is able to modulate its heat output and system supply temperature in relation to varying external conditions. No other controls (except thermostatic radiator valves or zone control valves if required) are necessary for most applications.

The ECO\*PAK MBS™ can feed radiators, fan convectors, underfloor heating or a mixture of all three. However, zone pumps and low loss headers would be required when circuits with differing temperature requirements are installed.

Highest efficiencies can be gained when the system is designed to run in condensing mode. To achieve this, return temperatures should be below 130°F (55°C). Ideal supply and return temperatures are therefore 150°F (65°C)/115°F (46°C). Radiators, underfloor heating systems as well as air handling units and other constant temperature heat emitters can all be sized to operate efficiently at these temperatures.

The ECO\*PAK MBS™ should not be used to generate domestic hot water and should only be used in sealed LTHW heating systems.

## 1.10 System Water Quality

**Warning:** Lowering water pH levels and changes in water temperature (replacing conventional boilers with condensing boilers) can cause scaling being freed from metal surfaces and clogging the system. In existing systems where the non-condensing boilers have been replaced with condensing boilers, a use of filters to remove scaling and other deposits is recommended. Filters such as Pentair C44 or C66 with replaceable media can offer good solution to potential boiler clogging problems. These filters are typically installed as bypass with less than 40% of the total water flow. They should be inspected 10 days after the initial installation and have cartridge replaced as necessary. After the initial inspection, they should be inspected frequently until the water has been cleaned from scaling and other deposits. After the system has been clean, an annual inspection is recommended.

Cleansing, flushing and water treatment must be carried out in accordance with the requirements of the applicable local codes.

To ensure that the boiler heat exchangers remain in good condition it is essential to condition and monitor the system water to the following criteria:

- **Water hardness**  
If the system fill water has a hardness in excess of 7 grains, the water should be softened prior to filling the system to ensure that excessive scaling does not occur within the heat exchanger.
- **Water acidity**  
The system fill water should have a pH value between 7 and 8.3 to ensure that corrosion of the heat exchanger does not occur.

If, in special circumstances, a need arises to use additives in a mixture (e.g. hardness stabiliser, frost protection agent, sealing agent etc.) it is important that the additives are compatible with each other and the pH value is not altered. Preferably, additives from the same manufacturer should be used. The instructions of the manufacturer should always be observed.

The hardness of the system water has to be checked every year and an appropriate amount of additive introduced via the dosing pot as necessary. Failure to observe the requirements in this section will render the warranty void.

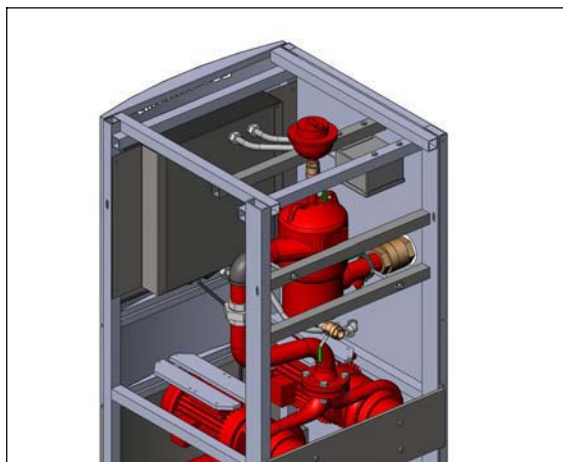
For more detailed information on water quality see Boiler I&O manual - Start-up section.

## 1.11 Electric Supply

All interconnecting wiring between the control panel, twin-head pump, boiler modules, and sensors is completed and tested in the factory prior to shipping. Plug and socket arrangements are provided to connect the boiler modules to the control module.

The only site wiring required (by others) is to bring the incoming 3-phase power supply, outdoor air temperature sensor, and BAS serial communication wiring into the junction box located on the back of the pump module. All electrical work **must** be in accordance with the current NEC Wiring Regulations and any other local regulations that may apply.

## Junction Box Terminals:



For more detailed information on electrical wiring connections on site refer to Controller I/O manual – Installation Instructions

### 1.12 Condensate Drain

The condensate drains from each boiler to be connected on site (by others) into a 2" (50 mm) plastic drainpipe header. The drainpipe header must be extended to discharge over a suitable drain. Plastic (PVC) drainpipe **must** be used.

The condensate is slightly acidic and its discharge into the sewage system is permitted; neutralizing filters are available upon request if required by local codes. If the ECO\*PAK MBS™ is installed below ground level and surface drains are not available, a condensate removal pump set should be installed.

See Boiler I/O manual – Condensate Disposal section for information on condensate lines

### 1.13 Clearances

The boiler modules are fully serviceable from the front but the following minimum clearances must be maintained for efficient operation and servicing:

Front	36" (915 mm)
Sides	
Pump module	24" (610 mm)
Opposite end	24" (610 mm)
Top	24" (610 mm)

Junction Box TB		
37	PH1	Incoming Power 208, 230, 460 or 575 VAC @ 60 Hz
38	PH2	
39	PH3	
40	GND	

Junction Box TB		
1	+	Outside Air Temperature Sensor
2	-	
GND		
13	+	Flow Sensor (Optional)
14	-	
15	+	Remote Start/Stop BAS
16	-	
17	+	Gas Emergency Shutoff (Optional)
18	-	
21	+	General System Alarm
22	-	
23	+	Boiler Alarm
24	-	
25	+	Pump Alarm
26	-	
27	+	Sensor Alarm
28	-	
34	GND	BAS Communication
35	+	
36	-	

## Installation

### 2.1 Offloading

ECO\*PAK MBS™ modules are normally delivered to site on wooden skids with transparent plastic wrapped around wooden frame. The modules should preferably be offloaded by forklift or crane using slings attached to the steel module framework.

Once safely at ground level, the modules can be moved into position with a forklift or trolley. Do **not** attempt to join modules together until they are in their final position.

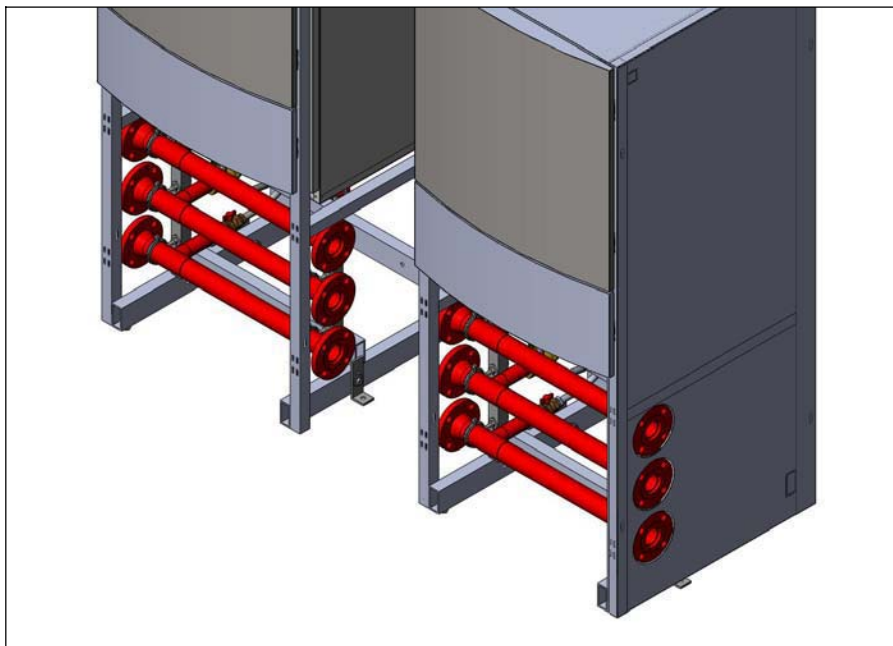
### 2.2 Unpacking

Each module is individually wrapped with plastic and system components are enclosed inside an enclosure made of galvanized steel framework and metal panels protecting the equipment. It is recommended that wrapping is kept in position initially, particularly whilst holes are cut for flues, to provide protection during installation. The wrapping can then be cutback around the pipe and flue connections to facilitate the installation.

Prior to the commencement of pre-commissioning activities, remove all wrapping and protection making sure that none remains to block pipes, vents or air intake piping.

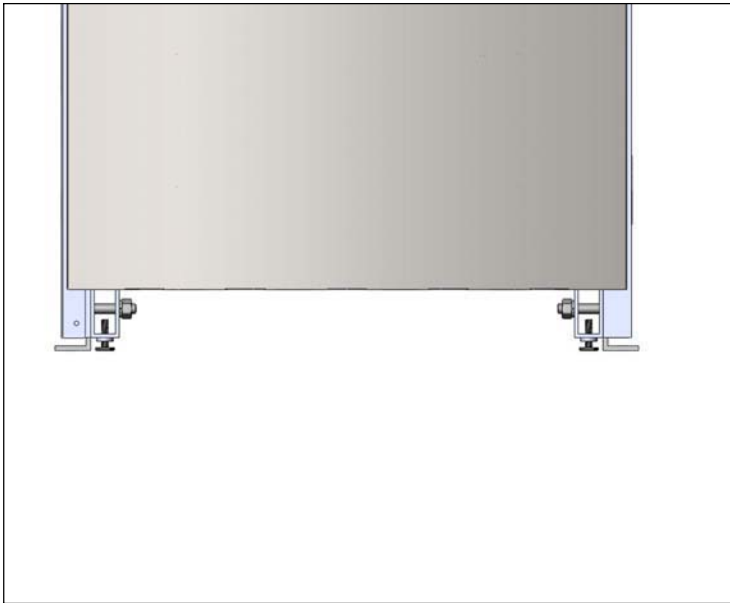
### 2.3 Fixing in Position

To allow perfect alignment, it is not recommended to fix the frames to the wall or floor until the flanged connections on each module have been bolted together.

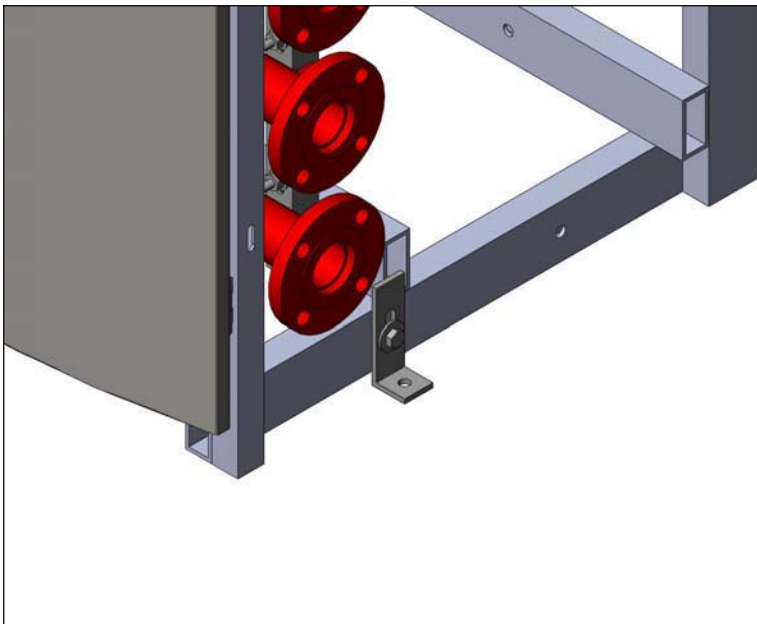


Although each module is stable, care must be taken at this stage not to put excessive force on to the top of any module to prevent accidental toppling.

Once the flanged connections are made good, fine adjustments can be achieved using the levellers on each module so the modules sit straight on the concrete pad.



Then modules can be anchored and fixed to the ground using the angle brackets supplied with each module.



## **2.4 Ventilation**

Although these are room-sealed appliances, general ventilation is still required. The air supplied for the boiler space ventilation shall be such that the maximum temperatures shall not exceed 77°F (25°C) at floor level or 4" (100 mm) above, 90°F (32°C) at mid level (5 ft or 1.5 m above floor level) and 104°F (40°C) at ceiling level or 4" (100 mm) below ceiling level.

Failure to provide and maintain adequate ventilation will mean that the units will have to be shutdown.

## 2.5 Vent and Air Intake Installation

The ECO\*PAK MBS™ utilizes two sizes of vent and air intake piping; 3" on the ECO\*PAK MBS™ 420 and 630 and 4" on the ECO\*PAK MBS™ 570, 855 and 1140. .

Use a core drill of 4-1/2" for 3" vent and 5-1/2" for 4" vent size to form holes through the wall. For concentric venting option use 5" core drill size for a 3" venting system and 7" for a 4" venting system. It is important to make sure that masonry falling outside the building does not cause damage or injury. Cavity walls must be sleeved if there is a joint within the cavity.

Keep the vent piping length below 100 ft long, the ECO\*PAK MBS output rating will reduce by up to 1.5% for each 25 ft of vent length.

For more detailed information see Boiler I&O manual - Venting section.

## Installation

Vent Type	Vent/Air size (inches)	ECO*PAK MBS 420 & 630		Vent/Air size (inches)	ECO*PAK MBS 570, 855 & 1140	
		max vent length (ft)	max no 90° bends		max flue length (ft)	max no 90° bends
Two-Pipe System	3/3	100	5	4/4	100	5
Concentric System	3/4	100	5	4/6	100	5

The combustion air must be free from corrosive elements - especially fluorine and chlorine vapours which are found, for example, in solvents and cleaning agents, propellant gases etc. When connecting boilers to under-floor heating systems, using plastic pipe work that is not impervious to oxygen, heat exchangers must be used for separation purposes.

## Installation

### 2.6 Piped Connections

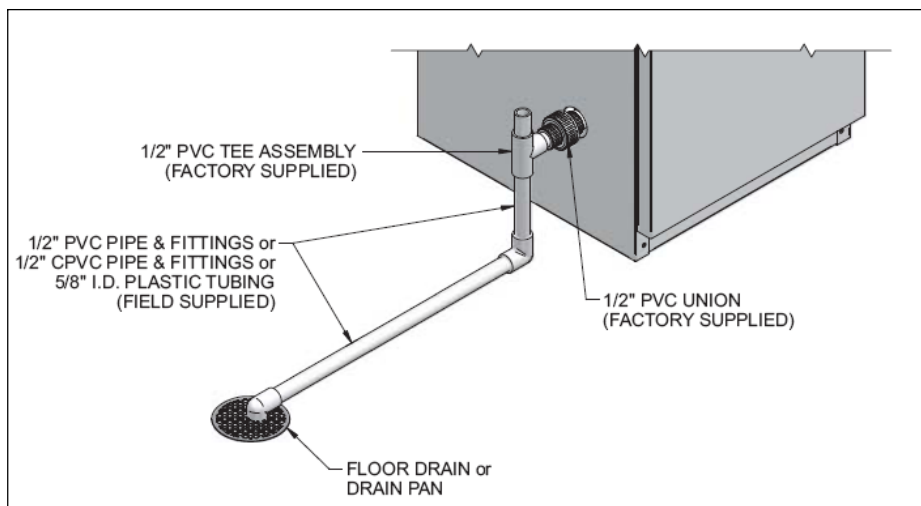
The ECO\*PAK MBS™ installation including commissioning, servicing and maintenance must only be carried out by an approved gas installer.

The LTHW supply, LTHW return and gas headers should be bolted together using the bolts and joint rings supplied. Care should be taken to ensure that the joint rings are correctly positioned. Under no circumstances should the bolting up of the headers be used to pull the units together as this could cause undue strain. The gas purge valve should be fitted to the blank on the end of the gas header.

A reinforced hose and isolating valve are supplied to fit on to the end of the LTHW return header and connect to the expansion vessel supplied loose.

The 1/2" plastic condensate drain piping should be headered on site and should then be connected and extended to discharge over the floor drain or into a condensate pump (supplied by others if required).





Incoming connections can then be made; 2" (50 mm) NPT to the LTHW supply and return valve, 2" (50 mm) NPT to the incoming gas isolation valve and 3/4" (20 mm) NPT to the incoming water make-up line.

All connections should be tested to ensure that they are leak free.

## 2.7 Electrical Connections

**Danger of electrical shock!** All electrical work in connection with the installation must be carried out by a qualified electrician and tested prior to energizing the supply.

All interconnecting wiring between the integrated controller, pump, boiler modules, temperature and pressure sensors is completed and tested in the factory prior to shipping. Plug and socket arrangements are provided to connect the boiler modules to the integrated controller on site.

The only site wiring required (by others) is to bring the incoming power supply into the 3-phase terminals inside the junction box as previously shown; outdoor air sensor and BAS communication wiring (if applicable) should also be completed on site by a certified electrician. All electrical work **must** be in accordance with the current NEC Wiring Regulations and any other local regulations that may apply.

A suitably sized and fused 4 wire 3 phase supply is to be terminated at the terminals provided within junction box in the back of the pump/control module. Refer to the project specification for the main power supply requirement.

The outdoor air temperature sensor should be sited on a nearby north-facing wall and wired to terminals 1 & 2 within the junction box using a , two wire shielded twisted cable. The shield should be earthed within the junction box.

Cables for sensors do not carry mains voltage, but are low voltage. The maximum lengths of wires for all sensors are;

Copper wires up to 394 ft (120 m)

16 gauge (1.5 mm<sup>2</sup>)

## Commissioning

The commissioning of the system should be undertaken by suitably qualified personnel. The following steps should be undertaken in the sequence described below. The commissioning process is to be documented and the results recorded on the commissioning record sheet provided. Please return the completed record sheet to Armstrong to confirm your warranty period.

### 3.1 Filling the System

Before attempting to fill the system, ensure that there are no loose or open connections on the ECO\*PAK MBS or within the system. Once satisfied, then:

- Check the expansion vessel charge pressure and adjust if necessary. Factory set at 15 psig (1.0 bar)
- Open LTHW isolating valves and incoming water isolating valve.
- Turn the main disconnect switch on to integrated controller.
- System overview screen is on

Fill the system using make up water line. On completion of filling the entire system should be thoroughly vented while cold using the air vent on the air separator of the ECO\*PAK MBS. If large amounts of air are expelled the water make-up will be opened and refill the system.

Once venting is complete, the **entire** system should be flushed and the appropriate water treatment applied (see section 1.10).

### 3.2 Gas Purging

The gas type and supply pressure must be checked before commissioning. The gas type should be natural gas and the supply pressure between 4" and 14" of w.c. For LPG the nominal pressure should be 10 inches of w.c. not exceeding 14 inches of w.c.

To prevent damage to the gas meter, the incoming gas valve **must** be opened slowly.

The entire gas inlet pipe system, particularly the joints, should be checked for leaks before commissioning. The gas burner valve must only be tested up to a maximum of 60" of w.c.

The ECO\*PAK MBS must not be operated at gas pressures outside the quoted figures.

For detailed information refer to Boiler I&O manual – Gas Connections section

### 3.3 Controls

With all boilers switched OFF at their local isolators, the control system can now be commissioned. The plc has been factory tested and pre programmed with default settings. The plc menu structure should now be accessed and the default settings confirmed. Any alterations required for the specific application (min speed, temperatures etc) should be recorded. The pump rotation should also be checked. If found to be incorrect, swap two of the incoming phases. If phase rotation checks have been completed on the incoming supply, this should however not be necessary.

## Commissioning

### 3.4 Factory Default Settings

Default settings can be viewed using the HMI touch screen. Follow the instructions in the Controller I&O manual.

### 3.5 Initial Firing

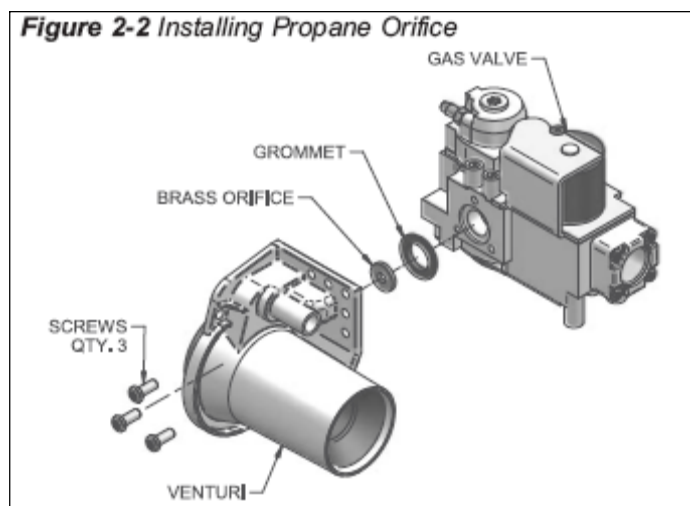
The CO<sub>2</sub> - content in the flue must be checked during commissioning and during regular maintenance of the boiler, as well as, after reconstruction work on the boiler or on the flue system. CO<sub>2</sub> - content during operation see section Technical Data. Too high CO<sub>2</sub> - values can lead to unhygienic combustion (high CO - values) and damage to the burner. Too low CO<sub>2</sub> - values can lead to ignition problems. The CO<sub>2</sub> - value has to be set by modifying the gas pressure at the gas valve.

### Changing over from LPG to natural gas and vice versa

The gas type of the boiler must only be modified by an approved gas installer.

- De-energize gas boiler
- Close gas shut-off facility
- Replace injector. Use enclosed new seals!

The CO<sub>2</sub> - content has to be set by setting the injector pressure at the gas valve. The CO<sub>2</sub> - content at full load, as well as, low load must be between the values according to Technical Data in section 1.2.



For more details see Boiler I&O manual – Prepare Boiler section

## **Commissioning**

### **Adjusting and Checking the CO<sub>2</sub> Values**

Turn on the local main disconnect switch and operate the ECO\*PAK MBS Boiler in the controller stop mode to adjust and check the CO<sub>2</sub> value. Each boiler should be operated individually to preserve the available load. Only once the required checks have been carried out and the record sheet completed should all available boiler be left in the on position and allowed to be controlled by the plc.

For more details see Boiler I&O manual – Start-up section

### **3.6 Starting the System**

Upon completion of the set up steps described in section 3.1 to 3.5 the plc will take over control of the MBS and operate the pump and boilers in accordance with the system requirements programmed in section 3.4

The plc control will automatically monitor the entire ECO\*PAK MBS system and display all relevant data on the touch screen. All components are monitored for fault conditions and any fault condition will be displayed on the touch screen.

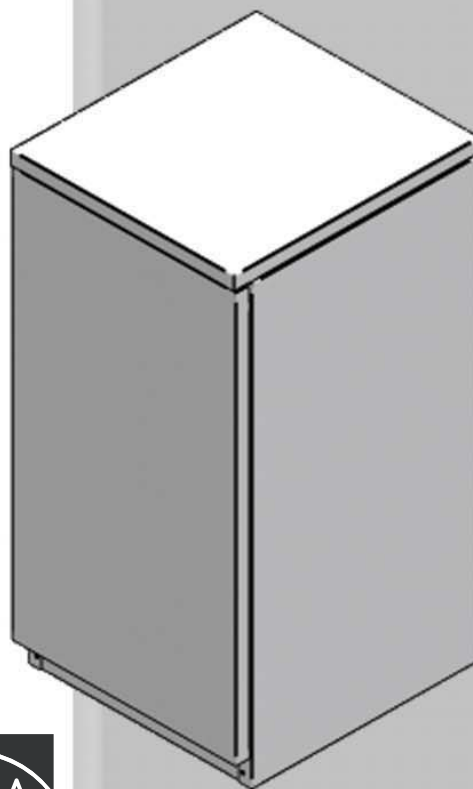
**All details of starting the system is in Integrated Controller I&O manual – System Start-up Procedure section**

### **3.7 Handing Over**

Upon completion of the commissioning checks the system should be handed over to the end user. Please provide copies of the completed record sheet in addition to this manual. The end user should be instructed on how to alter basic settings within the first level control of the plc and instructed on what actions to take in the event of a fault occurring.

### ECO\*PAK™ BOILER

Installation & Operation Manual  
Models: 210 & 285



#### **WARNING**

This manual must only be used by a qualified heating installer / service technician. Read all instructions, including this manual and the ECO\*PAK™ 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.

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## Hazard definitions

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

### DANGER

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

### WARNING

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

### CAUTION

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

### CAUTION

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

### NOTICE

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

## Please read before proceeding

**⚠ WARNING**

**Installer** – Read all instructions, including this manual and the ECO\*PAK™ 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.

### 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 in system components. 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.

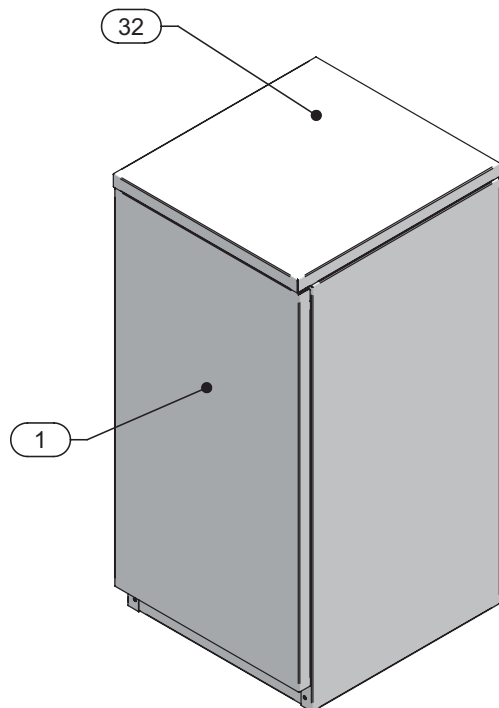
## The Boiler - How it works...

- 1. Access cover - front**  
Provides access to the gas train and the heat exchanger.
- 2. Air intake adapter**  
Allows for the connection of the PVC air intake pipe to the boiler.
- 3. Air pressure switch**  
The air pressure switch detects blocked inlet conditions.
- 4. Automatic air vent**  
Designed to remove trapped air from the heat exchanger coils.
- 5. Blower**  
The blower pulls in air and gas through the venturi (item 33). Air and gas mix inside the blower and are pushed into the burner, where they burn inside the combustion chamber.
- 6. Boiler drain port**  
Location from which the heat exchanger can be drained.
- 7. 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.
- 8. Boiler outlet temperature 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.
- 9. 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.
- 10. Condensate drain connection**  
Connects the condensate drain line to a 1/2" PVC union.
- 11. Control Module**  
The Control Module responds to internal and external signals and controls the blower, gas valve, and pumps to meet the heating demand.
- 12. Electronic display**  
The electronic display consists of 7 buttons and a dual line 32-character liquid crystal display.
- 13. Flame inspection window**  
The quartz glass window provides a view of the burner surface and flame.
- 14. Flame sensor**  
Used by the control module to detect the presence of burner flame.
- 15. Flue gas sensor**  
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.
- 16. Flue pipe adapter**  
Allows for the connection of the PVC vent pipe system to the boiler.
- 17. Gas connection pipe**  
Threaded pipe connection, either 1/2" or 3/4", depending on the model. This pipe should be connected to the incoming gas supply for the purpose of delivering gas to the boiler.
- 18. Gas shutoff valve**  
Manual valve used to isolate the gas valve from the gas supply.
- 19. 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.
- 20. Heat exchanger access cover**  
Allows access to the combustion side of the heat exchanger coils.
- 21. High limit sensor**  
Device that monitors the outlet water temperature. If the temperature exceeds its setting, it will break the control circuit, shutting the boiler down.
- 22. High voltage junction box**  
The junction box contains the connection points for the line voltage power and all pumps.
- 23. Ignition electrode**  
Provides direct spark for igniting the burner.
- 24. Leveling legs**  
Used to allow the heat exchanger to be leveled. This is needed for the proper draining of the condensate from the combustion chamber.
- 25. Line voltage wiring connections (knockouts)**  
Conduit connection points for the high voltage junction box.
- 26. Low voltage connection board**  
The connection board is used to connect external low voltage devices.
- 27. Low voltage wiring connections (knockouts)**  
Conduit connection points for the low voltage connection board.
- 28. Power switch**  
Turns 120 VAC ON/OFF to the boiler.
- 29. Relief valve**  
Protects the heat exchanger from an over pressure condition. The relief valve may be set at 30 psi.
- 30. Stainless steel heat exchanger**  
Allows system water to flow through specially designed coils for maximum heat transfer, while providing protection against flue gas corrosion. The coils are encased in a jacket that contains the combustion process.
- 31. Temperature and pressure gauge (field installed, not shown)**  
Monitors the outlet temperature of the boiler as well as the system water pressure.
- 32. Top panel**  
Removable panel to gain access to the internal components.
- 33. Venturi**  
The venturi controls air and gas flow into the burner.
- 34. Water inlet (system return)**  
NPT water connection that returns water from the system to the heat exchanger, either 1" or 1-1/4", depending on the model.
- 35. Water outlet (system supply)**  
NPT water connection that supplies hot water to the system, either 1" or 1-1/4", depending on the model.

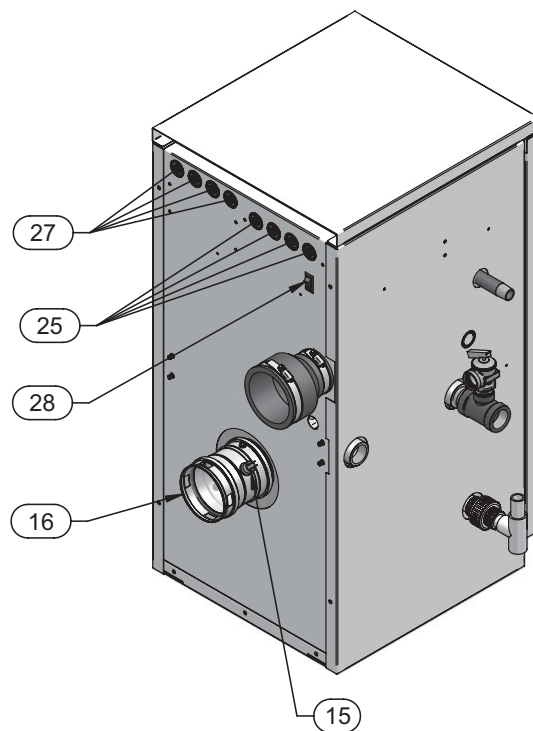


## The Boiler - How it works... (continued)

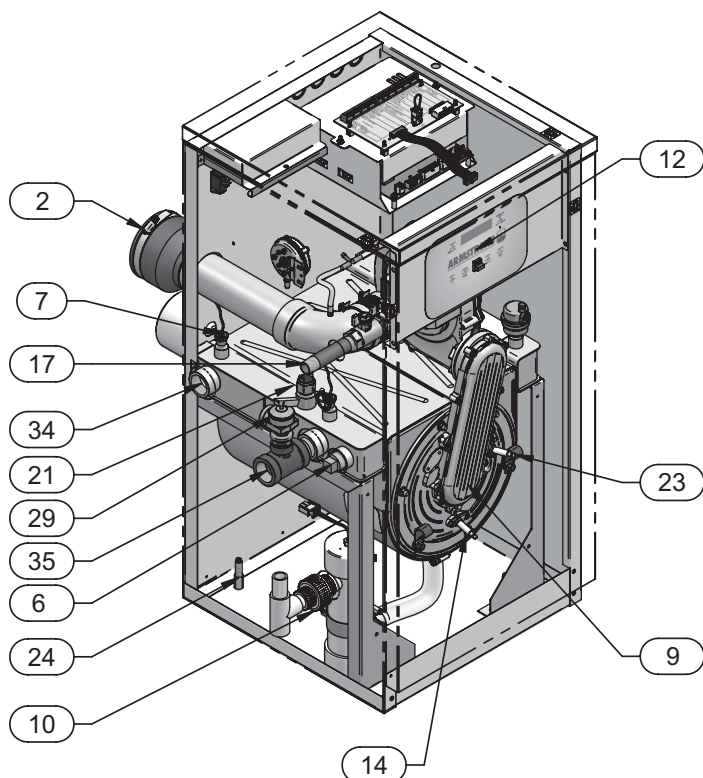
### Model 210



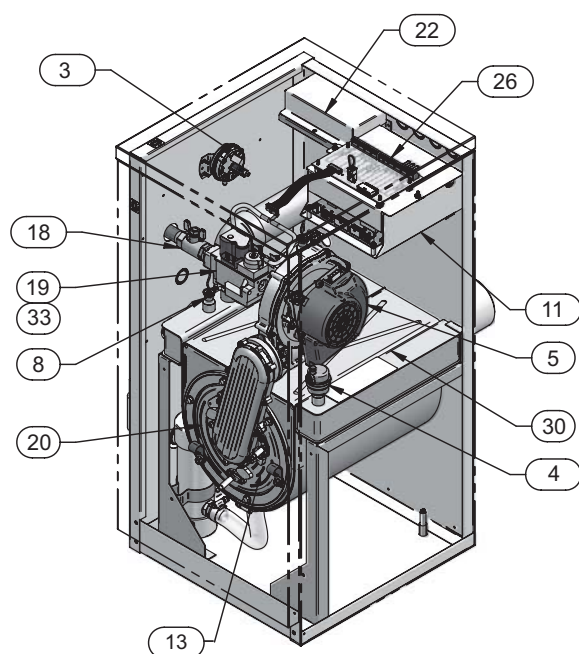
Front View - Model 210



Rear View - Model 210



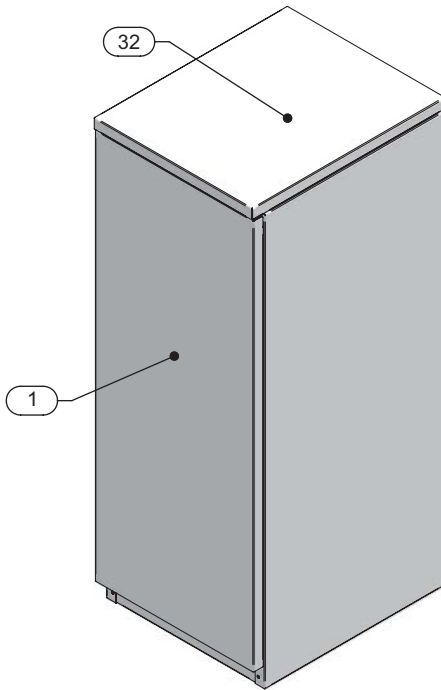
Left Side (inside unit) - Model 210



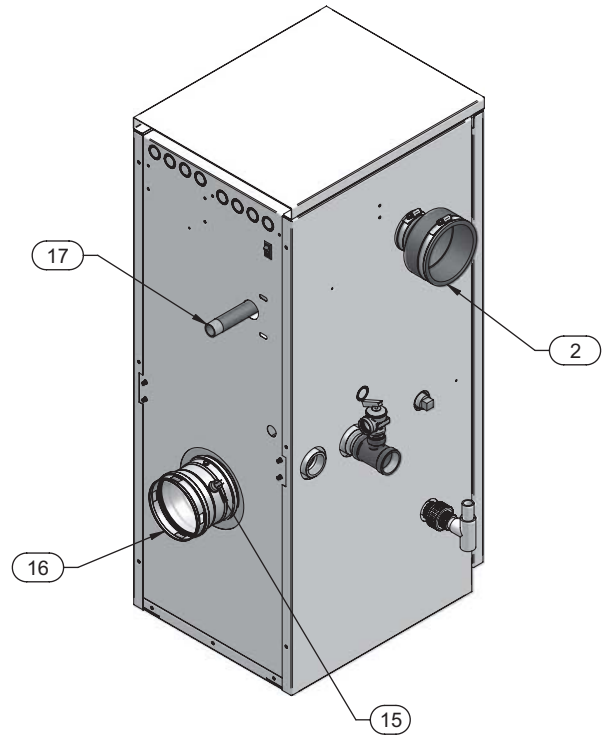
Right Side (inside unit) - Model 210

# The Boiler - How it works...

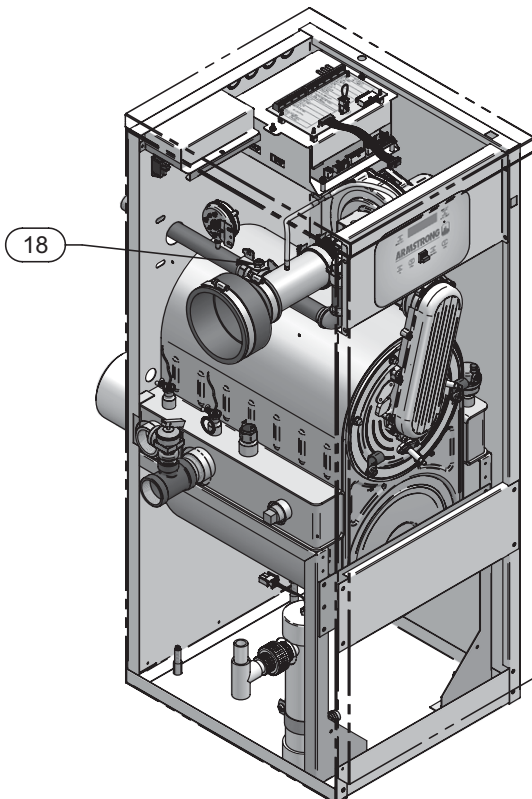
## Model 285



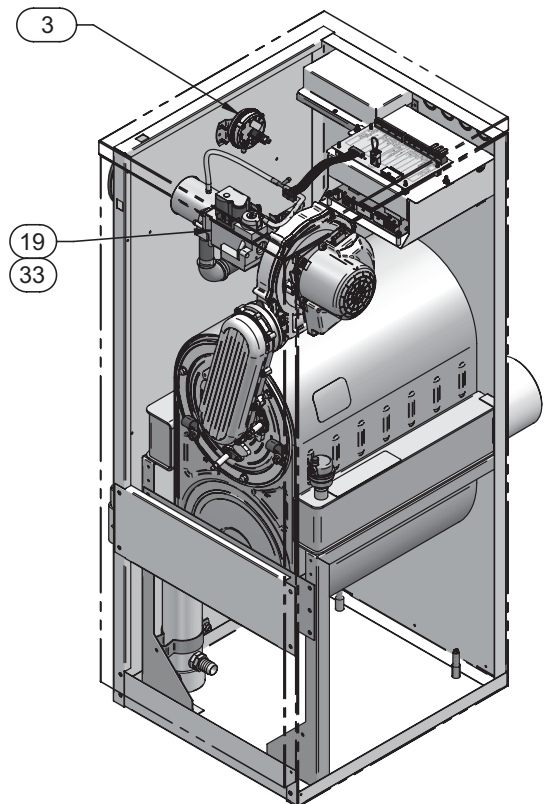
Front View - Model 285



Rear View - Model 285



Left Side (inside unit) - Model 285




Right Side (inside unit) - Model 285

## Ratings



DOE



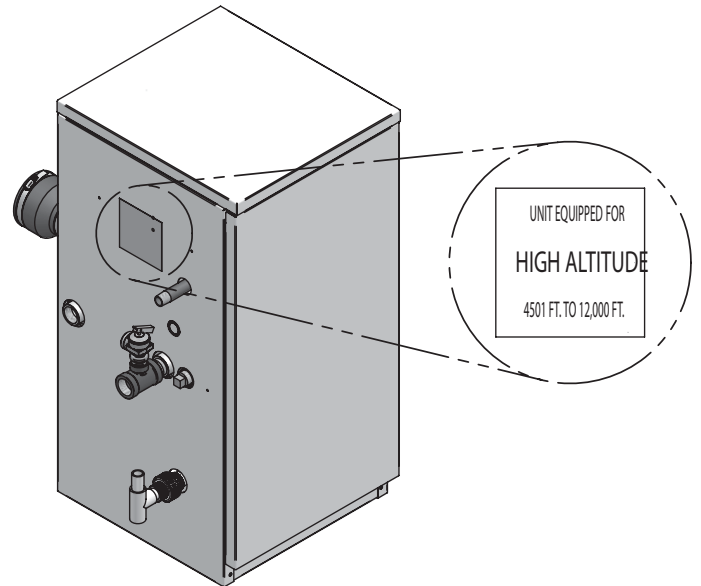
 <b>ECO*PAK™ Boiler</b> <b>I=B=R Rating</b>					Other Specifications				
Model Number	Input MBH (Note 5)		Gross Output MBH (Note 2,7)	Net I=B=R Ratings Water, MBH (Note 3,7)	Boiler Water Content Gallons	Water Connections	Gas Connections	Air Size	Vent Size (Note 4)
	Min	Max							
ECO*PAK™ 210	42	210	190	165	1.7	1"	1/2"	3"	3"
ECO*PAK™ 285	57	285	260	226	2.4	1-1/4"	3/4"	4"	4"

**NOTICE**

Maximum allowed working pressure is located on the rating plate.

**Notes:**

1. As an Energy Star Partner, Armstrong has determined that ECO\*PAK™ 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 I=B=R 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. ECO\*PAK™ boilers require special gas venting. Use only the vent materials and methods specified in the ECO\*PAK™ Boiler Installation and Operation Manual.
5. Standard ECO\*PAK™ boilers are equipped for operation up to 4,500 feet with no field adjustments. Output ratings will be reduced by 4% for each 1,000 feet above sea level up to 4,500 feet only.
6. High altitude ECO\*PAK™ boilers will have a high altitude label affixed to the unit (as shown in FIG. A) and are equipped for operation of 4,501 feet to 12,000 feet only with no field adjustments. For high altitude models, output ratings will be reduced by 2% for each 1,000 feet above sea level.  
High altitude models have a different control module for altitude operation, but the operation given in this manual for standard models remains the same.
7. Ratings have been confirmed by the Hydronics Institute, Section of AHRI.



**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 ECO\*PAK™ 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 ECO\*PAK™ 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.

### ⚠ 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.

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. 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 is less than 107 cubic feet for ECO\*PAK™ 210 models and 120 cubic feet for ECO\*PAK™ 285 models.

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

**Example:** Room dimensions = 3 feet long, 3 feet wide, and 9 foot ceiling = 3 x 3 x 9 = 81 cubic feet. This would be considered a closet for an ECO\*PAK™ Boiler.

### ⚠ WARNING

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

## Provide clearances:

### Clearances from combustible materials

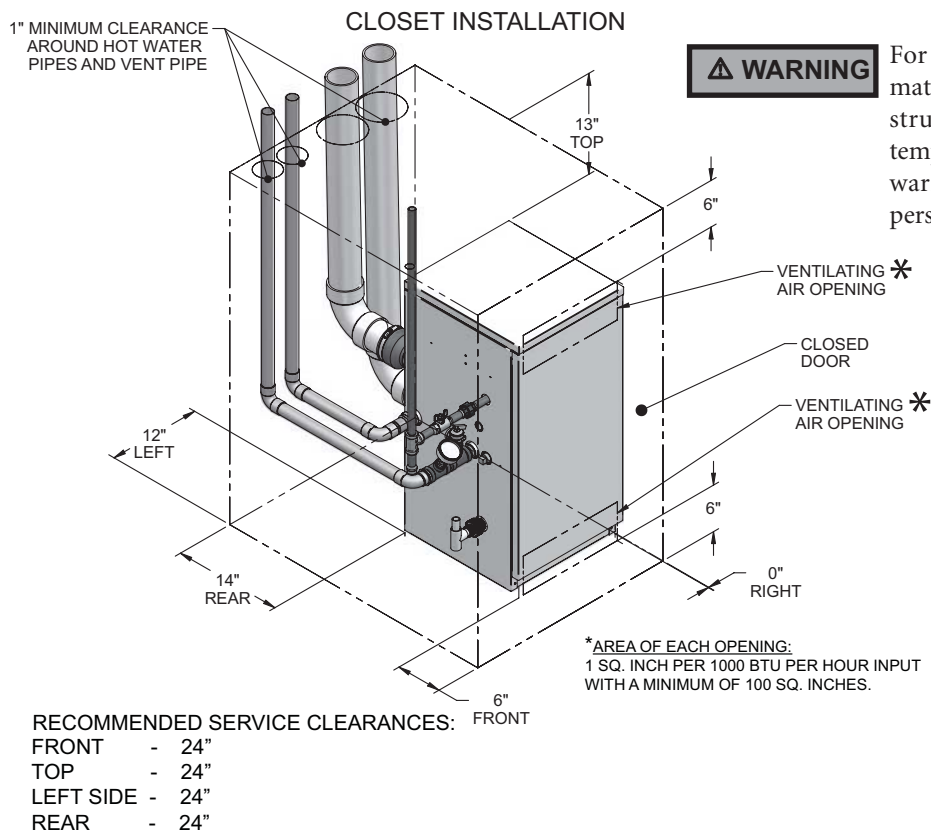
1. Hot water pipes—at least 1" from combustible materials.
2. Vent pipe – at least 1" from combustible materials.
3. See FIG.'s 1-1 and 1-2 on page 9 for other clearance minimums.

### Clearances for service access

1. See FIG.'s 1-1 and 1-2 on page 9 for recommended service clearances. If you do not provide the minimum clearances shown, it may not be possible to service the boiler without removing it from the space.

# 1 Determine boiler location *(continued)*

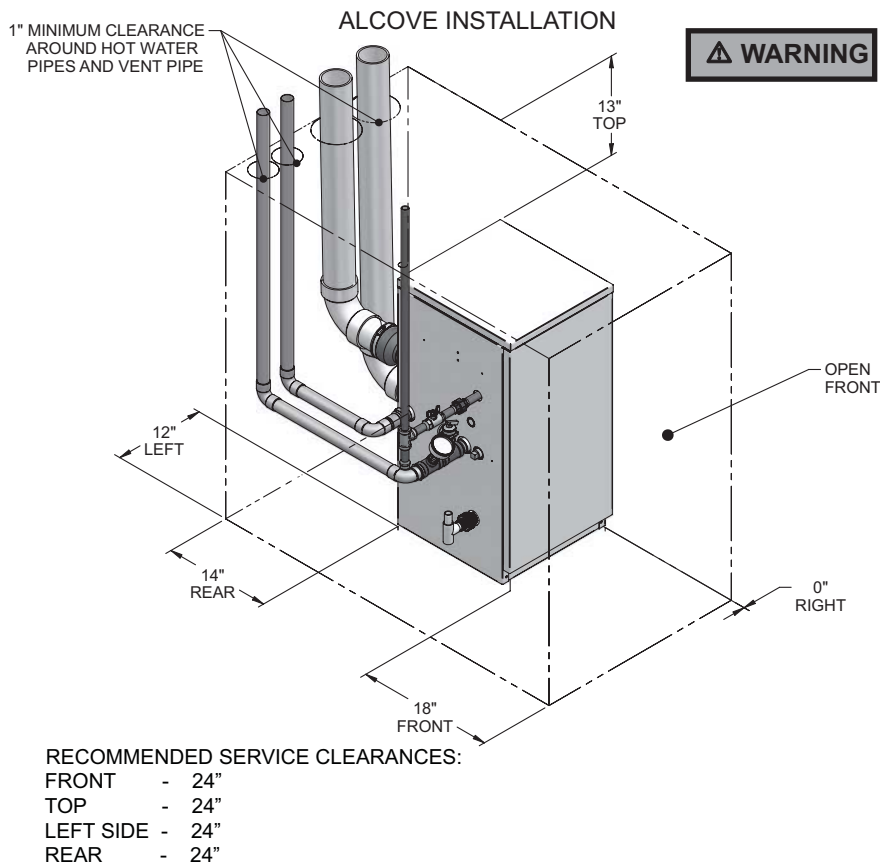
**Figure 1-1 Closet Installation - Minimum Required Clearances**



## ⚠ WARNING

For closet installations, CPVC 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.

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



## ⚠ WARNING

For alcove installations, CPVC 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.



# 1 Determine boiler location

## Provide air openings to room:

### ECO\*PAK™ boiler alone in boiler room

1. No air ventilation openings into the boiler room are needed when clearances around the ECO\*PAK™ boiler are at least equal to the SERVICE clearances shown in FIG.s 1-1 and 1-2. For spaces that do NOT supply this clearance, provide two openings as shown in FIG. 1-1. Each opening must provide one square inch free area per 1,000 Btu/hr of boiler input.

### ECO\*PAK™ 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 ECO\*PAK™ 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 ECO\*PAK™ boiler because it takes its combustion air from outside (direct vent installation).

## Flooring and foundation

### Flooring

The ECO\*PAK™ boiler is approved for installation on combustible flooring, but must never be installed on carpeting.

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

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

## 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 ECO\*PAK™ boiler requires a special vent system, designed for pressurized venting.

You must also install air piping from outside to the boiler air intake adapter. The resultant installation is direct vent (sealed combustion). 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. You may use any of the vent/air piping methods covered in this manual. Do not attempt to install the ECO\*PAK™ 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 ECO\*PAK™ boiler as described in this manual. Do not terminate vent/air in locations that can allow contamination of combustion air. Refer to Table 1A, page 11 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 1A, page 11. 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 *(continued)*

**Table 1A Corrosive Contaminants and Sources**

<b>Products to avoid:</b>
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
<b>Areas likely to have contaminants</b>
Dry cleaning/laundry areas and establishments
Swimming pools
Metal fabrication plants
Beauty shops
Refrigeration repair shops
Photo processing plants
Auto body shops
Plastic manufacturing plants
Furniture refinishing areas and establishments
New building construction
Remodeling areas
Garages with workshops

## When removing a boiler from existing common vent system:

### **⚠ DANGER**

Do not install the ECO\*PAK™ 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.

- Seal any unused openings in the common venting system.
- 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.
- 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.
- Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.
- 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.
- 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.
- 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

### 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.

You must install a propane orifice to operate the ECO\*PAK<sup>™</sup> boiler on propane gas. Verify when installing that the orifice size marking matches boiler size (Table 2A).

1. Remove the top and front access covers from the unit (no tools required for removal).
2. Remove the three screws securing the gas valve to the venturi (FIG. 2-2).
3. Locate the propane orifice disk from the conversion kit bag. Verify that the stamping on the orifice disk matches the boiler size (see Table 2A).

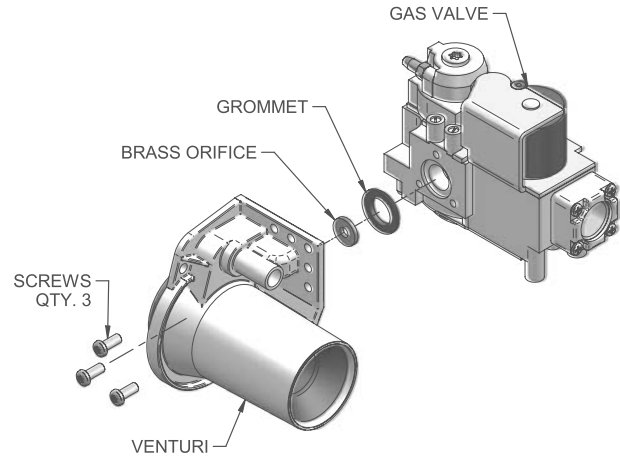
Place the orifice into the black rubber grommet in the side of the gas valve and secure in the valve (FIG. 2-2).

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

#### ⚠ WARNING

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

**Figure 2-2** Installing Propane Orifice



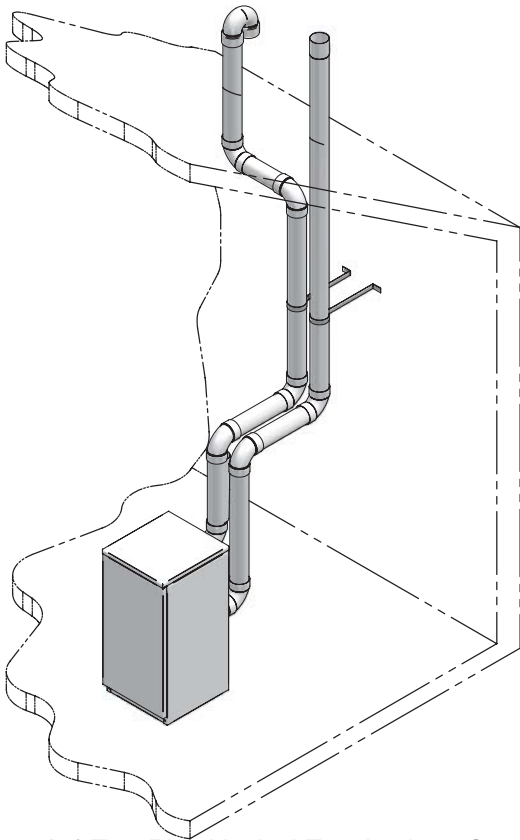
**Table 2A** LP Conversion Table

LP Conversion Table	
Model	LP Orifice Stamping
210	210 / W150
285	285

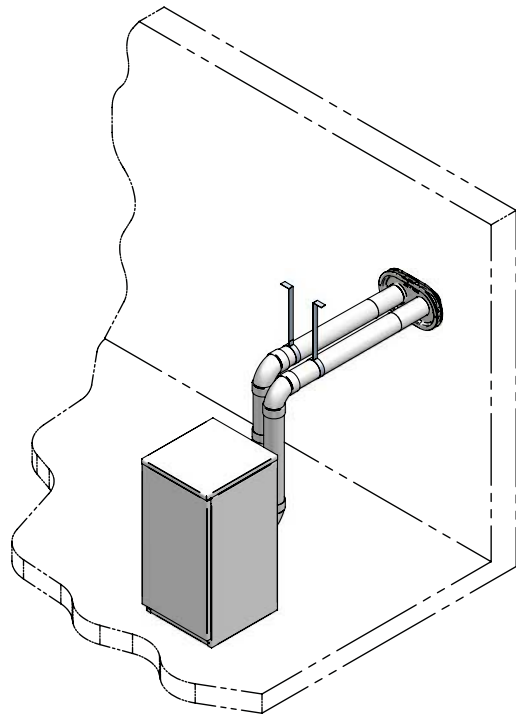


### 3 General venting

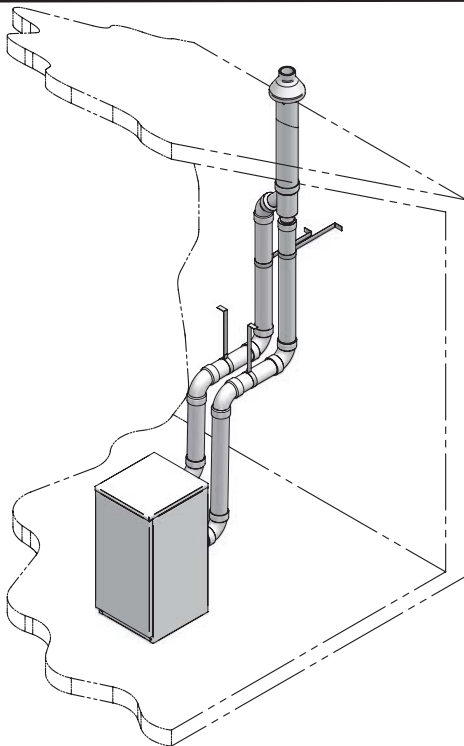
#### Direct venting options



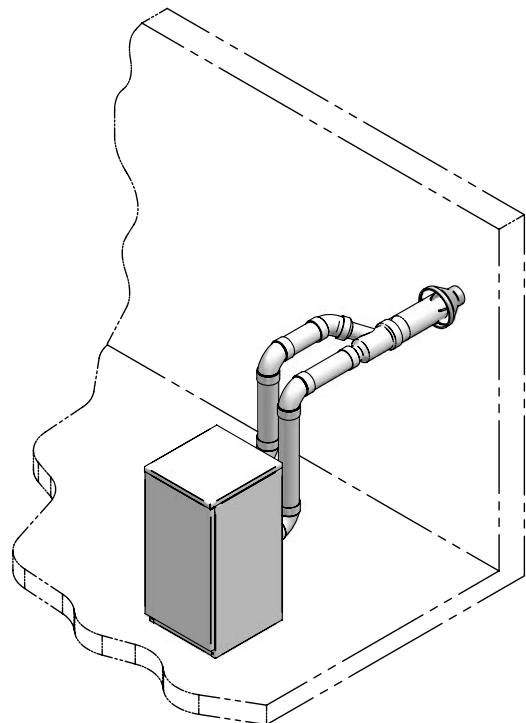
**Figure 3-1** Two-Pipe Vertical Termination - See page 24 for more details



**Figure 3-2** Two-Pipe Sidewall Termination - See page 17 for more details



**Figure 3-3** Concentric Vertical Termination - See page 26 for more details



**Figure 3-4** Concentric Sidewall Termination - See page 21 for more details

### 3 General venting

#### Install vent and combustion air piping

##### ⚠ DANGER

The ECO\*PAK™ 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. 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 using an “All Purpose Cement” suitable for PVC and CPVC pipe. 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.

#### Vent piping materials

##### ⚠ WARNING

Use only the materials listed in Table 3A below for vent pipe, and fittings. Failure to comply could result in severe personal injury, death, or substantial property damage.

##### NOTICE

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

##### ⚠ WARNING

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

##### NOTICE

All 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).

#### Requirements for installation in Canada

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

**Table 3A Vent Pipe, and Fittings**

All vent pipe materials and fittings must comply with the following:			
Item	Material	Standards for installation in:	
		United States	Canada
Vent pipe and fittings	PVC schedule 40	ANSI/ASTM D1785	CPVC and PVC venting must be ULC-S636 Certified. IPEX is an approved manufacturer in Canada supplying vent material listed to ULC-S636.
	PVC-DWV	ANSI/ASTM D2665	
	CPVC schedule 40	ANSI/ASTM F441	
Pipe cement/primer	PVC	ANSI/ASTM D2564	IPEX System 636 Cements & Primers
	CPVC	ANSI/ASTM F493	
NOTICE: DO NOT USE CELLULAR (FOAM) CORE PIPE			

### 3 General venting *(continued)*

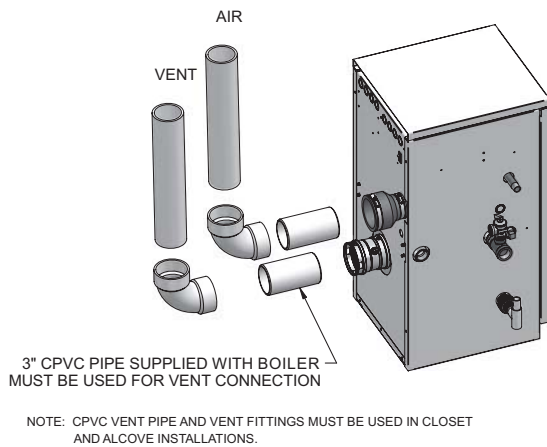
#### NOTICE

Combustion air piping to the outside **MUST BE** used. Use of combustion air from the room via louvers, plenums, or any other device is not authorized.

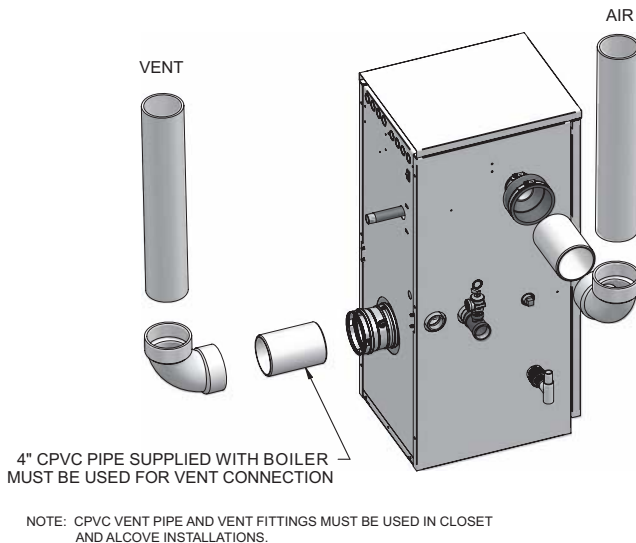
#### Air intake/vent connections

1. **Combustion Air Intake Connector** (FIG.'s 3-5 and 3-6) - Used to provide combustion air directly to the unit from outdoors. A fitting is provided on the unit for final connection. Combustion air piping must be supported per guidelines listed in the National Mechanical Code, Section 305, Table 305.4 or as local codes dictate.
2. **Vent Connector** (FIG.'s 3-5 and 3-6) - 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 3-5 Near Boiler Venting Model 210**



**Figure 3-6 Near Boiler Venting Model 285**



#### Air inlet pipe materials:

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

PVC, CPVC or ABS

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

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

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

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

The ECO\*PAK™ boiler uses model specific combustion air intake and vent piping sizes as detailed in Table 3B below.

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

Model	Air Intake	Vent
210	3 inches	3 inches
285	4 inches	4 inches

#### NOTICE

Increasing or decreasing combustion air or vent piping is not authorized.

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

**Combustion Air** = 12 equivalent feet minimum / 100 equivalent feet maximum

**Vent** = 12 equivalent feet minimum / 100 equivalent feet maximum

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

**EXAMPLE:** 20 feet of PVC pipe + (4) 90° elbows + (2) 45° elbows + (1) 3" concentric vent kit = 49 equivalent feet of piping.

#### NOTICE

The appliance output rating will reduce by up to 1.5% for each 25 feet of vent length.

## 3 General venting

### Removing from existing vent

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

### Vent and air piping

#### Vent and air system:

**NOTICE**

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

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

You may use any of the vent/air piping methods covered in this manual. Do not attempt to install the ECO\*PAK™ boiler using any other means.

**⚠ WARNING**

DO NOT mix components from different systems. The vent system could fail, causing leakage of flue products into the living space. Use only PVC or CPVC pipe and fittings, with primer and cement specifically designed for the material used.

#### Vent, air piping and termination:

The ECO\*PAK™ 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.

#### 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 1A, page 11, 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 1A, page 11 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.

## 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.

**⚠ 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.

**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.

### Determine location

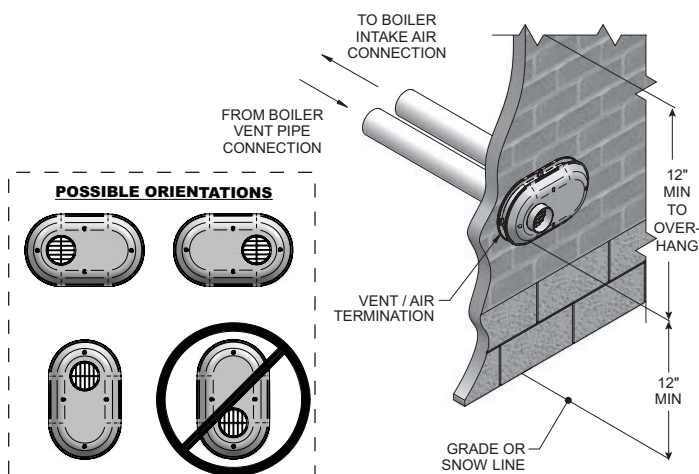
Locate the vent/air terminations using the following guidelines:

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

**⚠ 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 Sidewall Termination of Air and Vent**

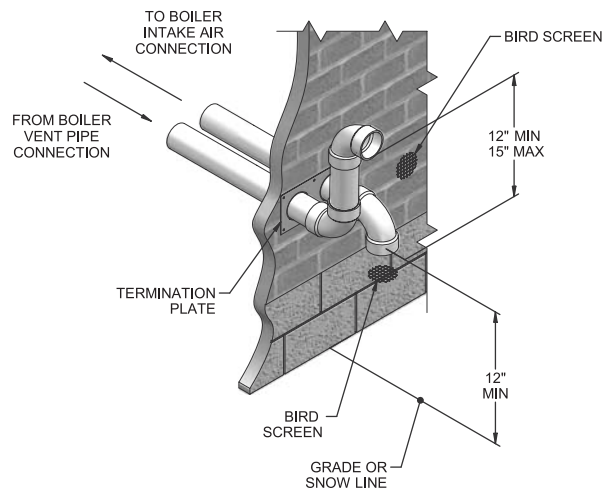


### If using the alternate sidewall termination:

3. The air piping must terminate in a down-turned elbow as shown in FIG. 4-1B. This arrangement avoids recirculation of flue products into the combustion air stream.
4. The vent piping must terminate in an elbow pointed outward or away from the air inlet, as shown in FIG. 4-1B.

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

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

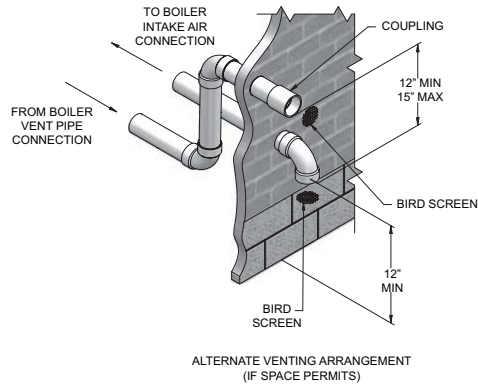




## 4 Sidewall direct venting

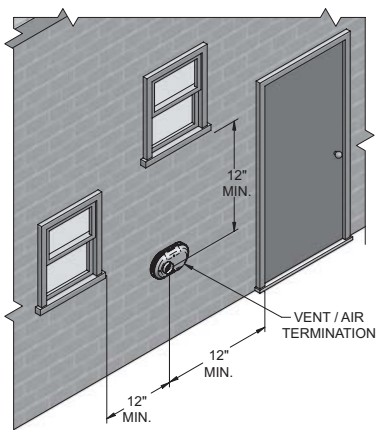
### Vent/air termination – sidewall

**Figure 4-1C** Alternate Venting Arrangement (if Space Allows) w/Field Supplied Fittings

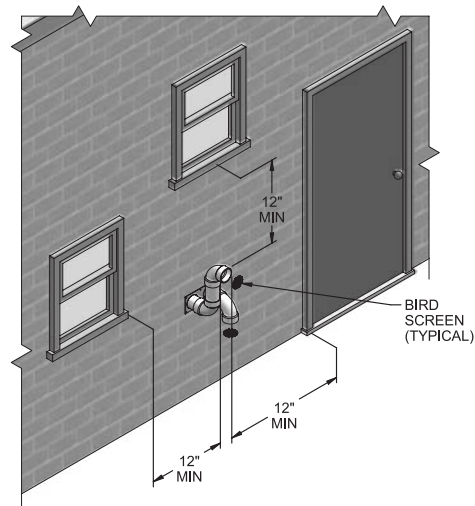


5. Maintain clearances as shown in FIG.'s 4-1A thru 4-3B, pages 17 and 18. Also maintain the following:
  - a. Vent must terminate:
    - At least 6 feet from adjacent walls.
    - No closer than 12 inches below roof overhang.
    - At least 7 feet above any public walkway.
    - At least 3 feet above 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.
  - 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.

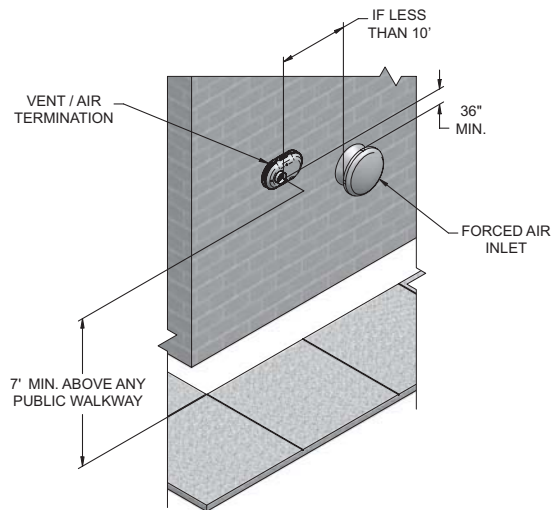
**Figure 4-2A** Clearance to Gravity Air Inlets



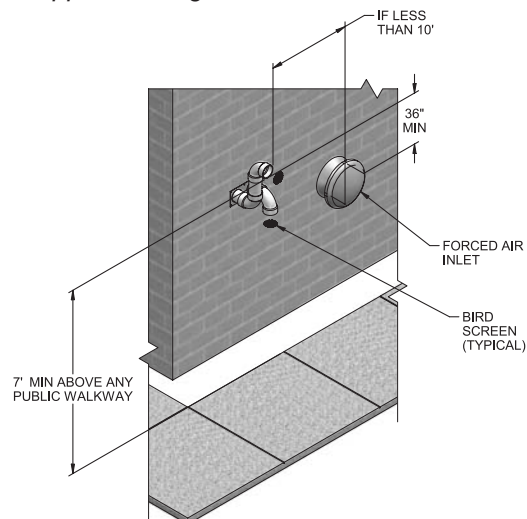
**Figure 4-2B** Alternate Clearance to Gravity Air Inlets w/Field Supplied Fittings



**Figure 4-3A** Clearance to Forced Air Inlets



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



## 4 Sidewall direct venting *(continued)*

### Prepare wall penetrations

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

Air pipe penetration:

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

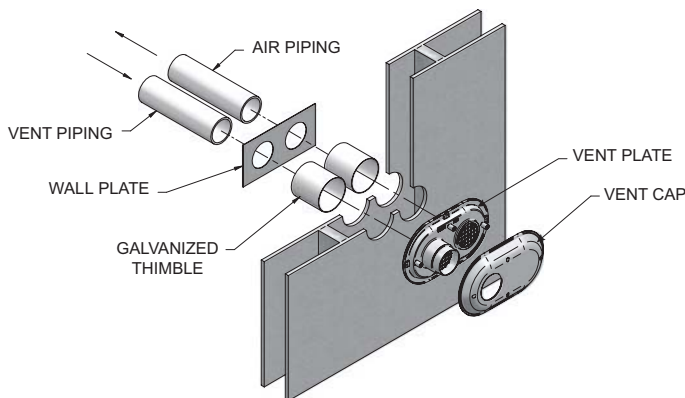
Vent pipe penetration:

- a. Cut a hole for the vent pipe. For either combustible or noncombustible construction, size the vent pipe hole with at least a 1/2 inch clearance around the vent pipe outer diameter:
  - 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. Install the vent and air intake piping through the wall into the vent plate openings. Seal all gaps between the pipes and wall. Use RTV silicone sealant to seal the air pipe. Use the cement/primer listed in Table 3A on page 14 to seal the vent pipe.
3. Mount and secure the vent plate to the wall using stainless steel screws. Seal around the plate to the wall assuring no air gaps.
4. Assemble the vent cap to the vent plate (see FIG. 4-4A). Insert the stainless steel screws into the vent cap screw hole openings and securely attach the vent cap to the vent plate.
5. Seal all wall cavities.

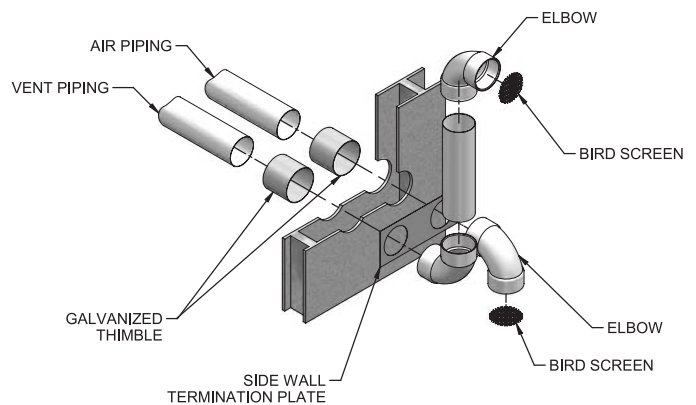
**Figure 4-4A Sidewall Termination Assembly**



### 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:
    - 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. 4-4B.
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 4-4B Alternate Sidewall Termination Assembly w/Field Supplied Fittings**



### Termination and fittings

1. The air termination coupling must be oriented at least 12 inches above grade or snow line as shown in FIG. 4-1A, page 17.
2. Maintain the required dimensions of the finished termination piping as shown in FIG. 4-1A, page 17.
3. If using the alternate sidewall termination do not extend exposed vent pipe outside of the building more than what is shown in this document. Condensate could freeze and block vent pipe.

## 4 Sidewall direct venting

### Multiple vent/air terminations

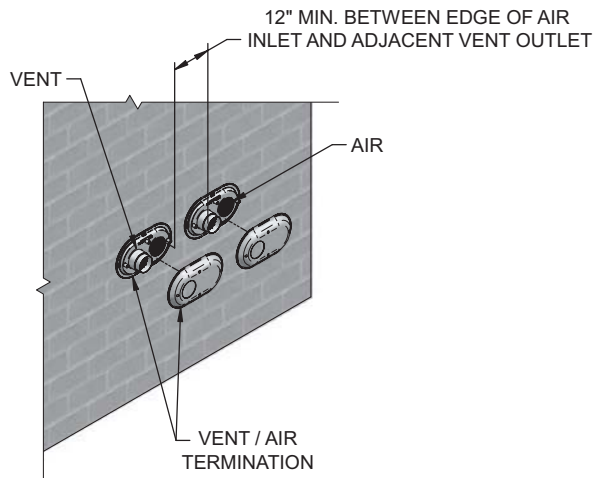
1. When terminating multiple ECO\*PAK™ boilers terminate each vent/air connection as described in this manual (FIG. 4-5A).

#### ⚠ WARNING

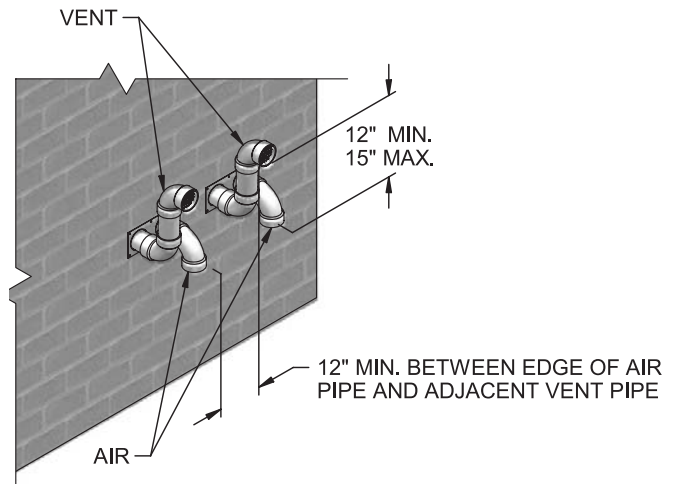
All vent pipes and air inlets must terminate at the same height to avoid possibility of severe personal injury, death, or substantial property damage.

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 an ECO\*PAK™ 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)*

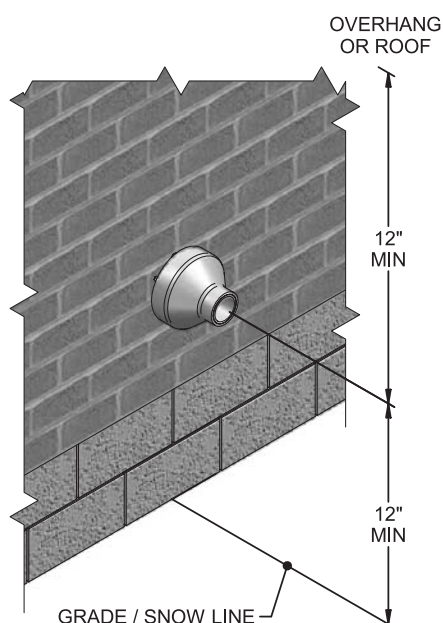
### Sidewall termination – optional concentric vent

#### Description and usage

Armstrong offers optional concentric combustion air and vent pipe termination kits (Factory Kit for 3" diameter - Model 210 and for 4" diameter - Model 285). 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 3A, on page 14 of this manual.

**Figure 4-6 Concentric Sidewall Termination**

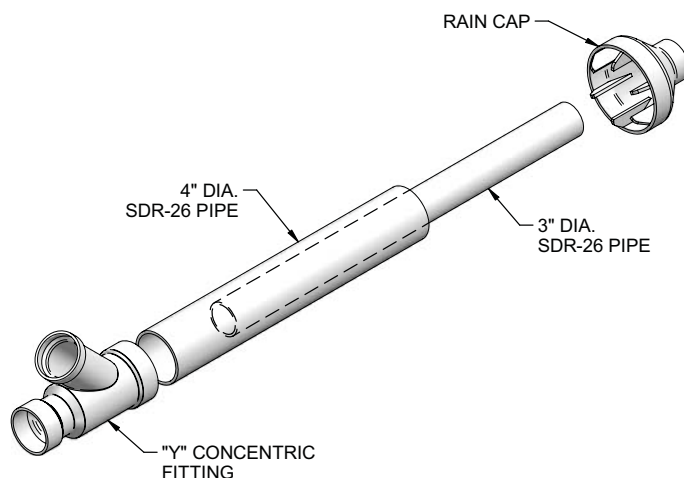


#### Sidewall termination installation

1. Determine the best location for the termination kit (see FIG. 4-6).
2. The total length of piping for vent or air must not exceed the limits given in the General Venting section on page 15 of this manual.
3. 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.

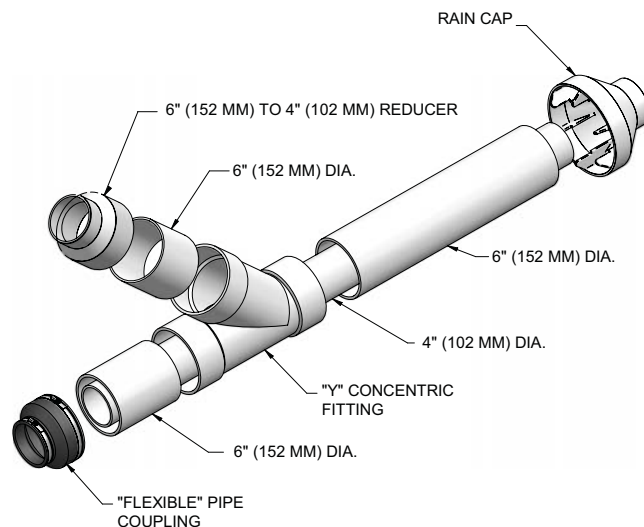
- e. Do not terminate above any door or window. Condensate can freeze, causing ice formations.
  - f. Locate or guard vent to prevent condensate damage to exterior finishes.
4. Cut one (1) hole (5 inch diameter for 3" Concentric Vent installations or 7 inch diameter for 4" Concentric Vent installations) into the structure to install the termination kit.
  5. 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\_3" Concentric Vent**



**Figure 4-8 Kit Contents\_4" Concentric Vent**

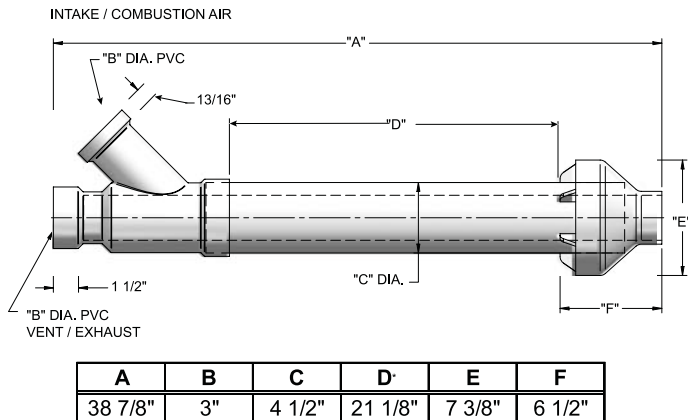
**NOTE:** Not available for Canadian installation.



## 4 Sidewall direct venting

### Sidewall termination – optional concentric vent

**Figure 4-9** Concentric Vent Dimensional Drawing - Model 210



#### 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).

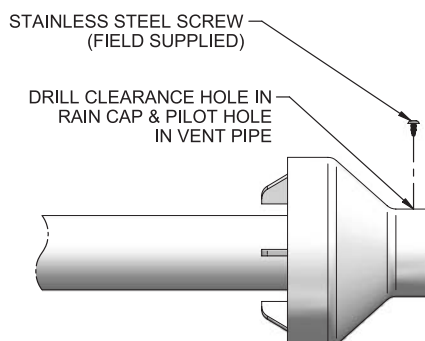
#### ⚠ WARNING

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

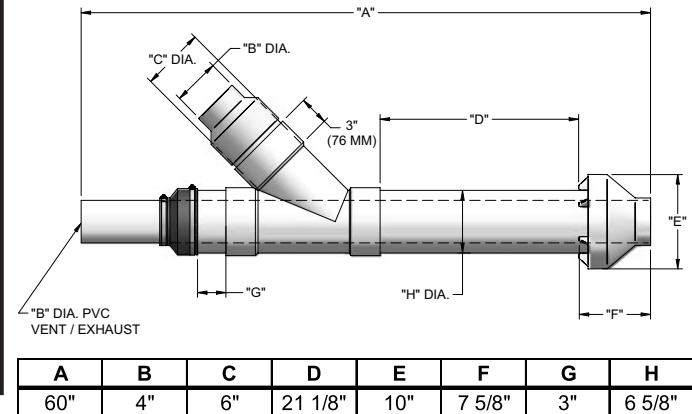
Do not operate the appliance with the rain cap removed or recirculation of combustion products may occur. Water may also collect inside the larger combustion air pipe and flow to the burner enclosure. Failure to follow this warning could result in product damage or improper operation, personal injury,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

**Figure 4-11** Rain Cap to Vent Pipe Alternate Assembly



**Figure 4-10** Concentric Vent Dimensional Drawing - Model 285

**NOTE:** Not available for Canadian installation.



6. 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.

7. 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 3" Concentric Vent installations and fastened tightly into the rubber adapter for 4" Concentric Vent installations.
8. 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 3" Concentric Vent and standard schedule 40 PVC for 4" Concentric Vent. Do not extend dimension D\* more than 60 inches (see FIG's 4-9 and 4-10).

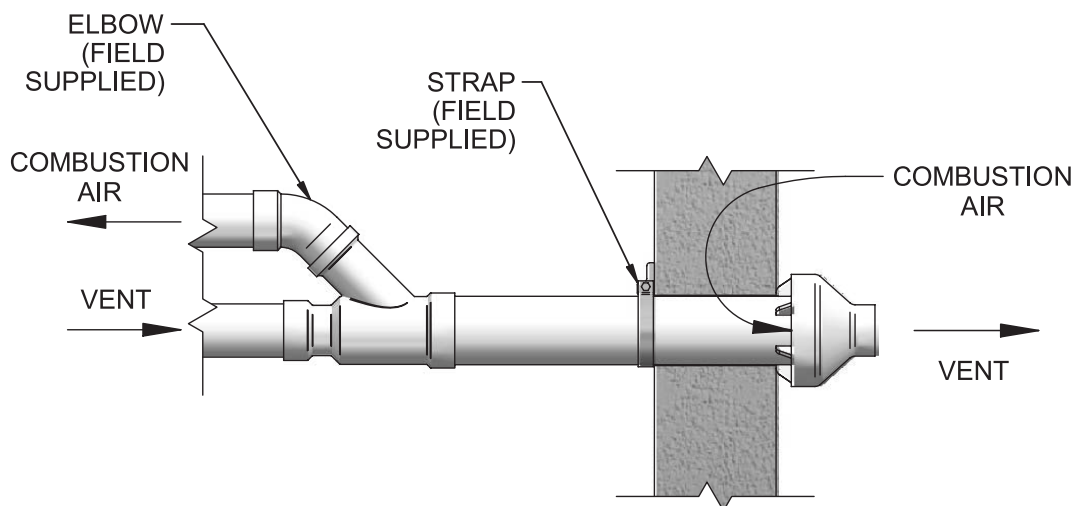
#### NOTICE

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:** 3" Concentric Vent shown for illustration purposes.

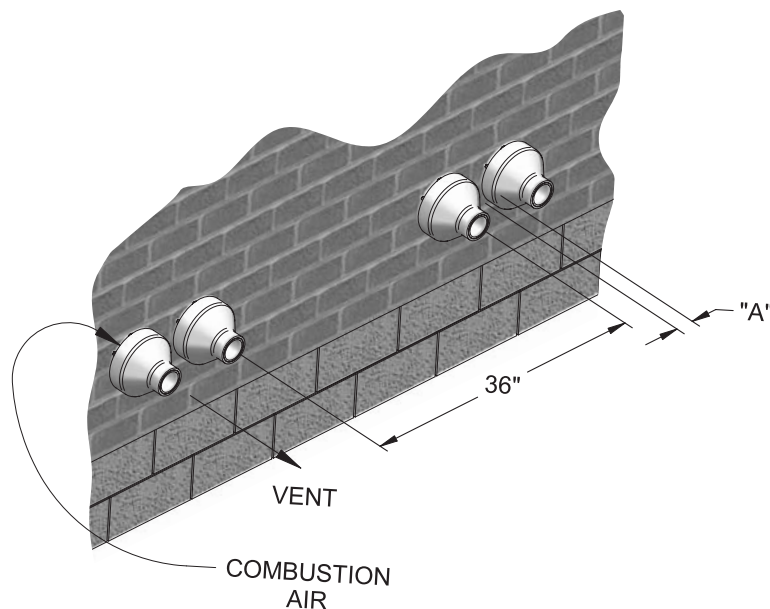
#### CAUTION

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

9. Cement appliance combustion air and vent pipes to the concentric vent termination assembly. See FIG. 4-12 for proper pipe attachment.
10. Operate the appliance one (1) heat cycle to ensure combustion air and vent pipes are properly connected to the concentric vent termination connections.

#### Multiventing sidewall terminations

When two (2) or more direct vent appliances are vented near each other, each appliance must be individually vented (see FIG. 4-13). 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. The next two (2) vent terminations must be at least 36 inches away from the first two (2) terminations. It is important that vent terminations be made as shown to avoid recirculation of flue gases. Dimension A in FIG. 4-13 represents the distance between pipes or rain shields, as touching or a 2 inch maximum separation.



**Figure 4-13** Concentric Vent and Combustion Air Termination Dimension A as Touching or 2 inches Maximum Separation

## 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.

**⚠ 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.

**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.

### Determine location

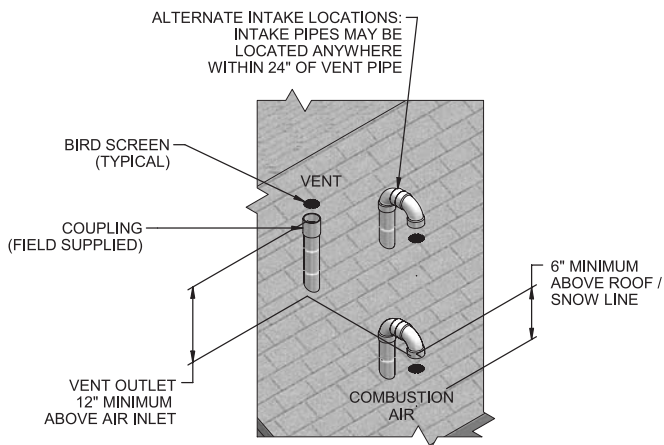
Locate the vent/air terminations using the following guidelines:

1. The total length of piping for vent or air must not exceed the limits given in the General Venting Section on page 15 of this manual.
2. The vent must terminate at least 3 feet above the highest place in which the vent penetrates the roof and at least 2 feet above any part of a building within 10 horizontal feet.
3. The air piping must terminate in a down-turned 180° return pipe no further than 2 feet from the center of the vent pipe. This placement avoids recirculation of flue products into the combustion air stream.
4. The vent piping must terminate in an up-turned coupling as shown in FIG. 5-1. The top of the coupling must be at least 1 foot above the air intake. The air inlet pipe and vent pipe can be located in any desired position on the roof, but must always be no further than 2 feet apart and with the vent termination at least 1 foot above the air intake.

**⚠ WARNING**

Rooftop vent and air inlet terminations must terminate in the same pressure zone.

**Figure 5-1 Vertical Termination of Air and Vent**



5. 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

- Air pipe penetration:
  - 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:
  - 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:
    - 4½ inch hole for 3 inch vent pipe
    - 5½ inch hole for 4 inch vent pipe
  - Insert a galvanized metal thimble in the vent pipe hole.
- Space the air and vent holes to provide the minimum spacing shown in FIG. 5-1, page 24.
- Follow all local codes for isolation of vent pipe when passing through floors, ceilings, and roofs.
- Provide flashing and sealing boots sized for the vent pipe and air pipe.

#### Termination and fittings

- Prepare the vent termination coupling and the air termination elbow (FIG. 5-1) by inserting the bird screens provided with the boiler. Bird screens are provided for either 3" (ECO\*PAK™ 210) or 4" (ECO\*PAK™ 285) fittings.
- The air piping must terminate in a down-turned 180° return bend as shown in FIG. 5-1. Locate the air inlet 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.
- The vent piping must terminate in an up-turned coupling as shown in FIG. 5-1. The top of the coupling must be at least 1 foot above the air intake. The air inlet pipe and vent pipe can be located in any desired position on the roof, but must always be no further than 2 feet apart and with the vent termination at least 1 foot above the air intake.
- Maintain the required dimensions of the finished termination piping as shown in FIG. 5-1.
- Do not extend exposed vent pipe outside of building more than shown in this document. Condensate could freeze and block vent pipe.

#### Multiple vent/air terminations

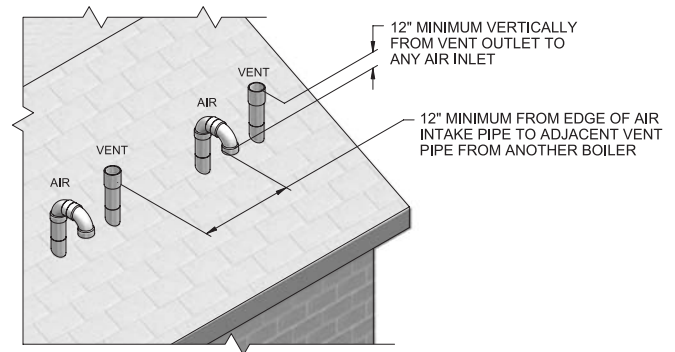
- When terminating multiple ECO\*PAK™ boilers, terminate each vent/air connection as described in this manual (FIG. 5-2).

#### ⚠ WARNING

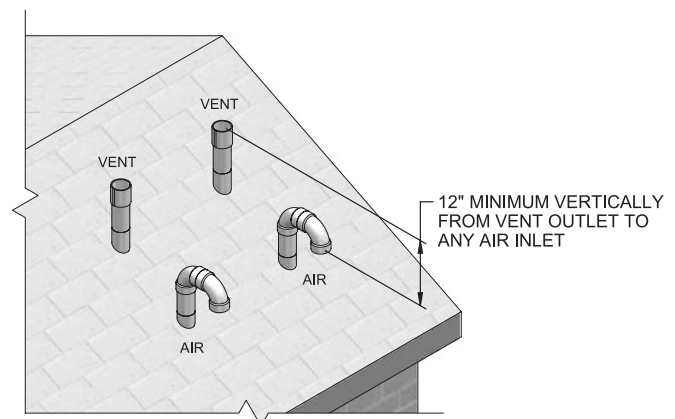
Terminate all vent pipes at the same height and all air pipes at the same height to avoid possibility of severe personal injury, death, or substantial property damage.

- 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.
- The air inlet of an ECO\*PAK™ 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

An optional concentric combustion air and vent pipe termination kit is offered. 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.

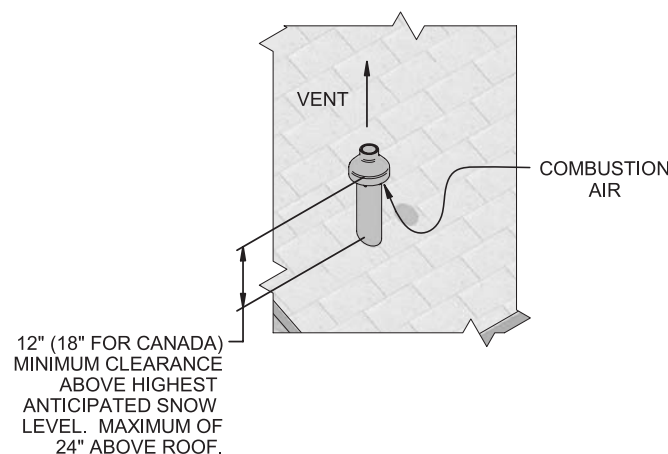
Field supplied pipe and fittings are required to complete the installation.

The required combustion vent pipe and fittings are listed in Table 3A, on page 14 of this manual.

#### Vertical termination installation

1. Determine the best location for the termination kit (see FIG. 5-4).
2. The total length of piping for vent or air must not exceed the limits given in the General Venting Section on page 15 of this manual.

**Figure 5-4** Concentric Vertical Termination



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



3. You must consider the surroundings when terminating the vent and air:
  - a. Position the vent termination where vapors will not damage nearby shrubs, plants, or air conditioning equipment or be objectionable.
  - b. The flue products will form a noticeable plume as they condense in cold air. Avoid areas where the plume could obstruct window views.
  - c. Prevailing winds could cause freezing of condensate and water/ice buildup where flue products impinge on building surfaces or plants.
  - d. Avoid possibility of accidental contact of flue products with people or pets.
  - e. Do not locate the terminations where wind eddies could affect performance or cause recirculation, such as inside building corners, near adjacent buildings or surfaces, window wells, stairwells, alcoves, courtyards, or other recessed areas.
  - f. Do not terminate above any door or window. Condensate can freeze, causing ice formations.
  - g. Locate or guard vent to prevent condensate damage to exterior finishes.
  - h. Do not attach a U-Bent to the rain cap. Doing so could cause recirculation (see FIG. 5-5).
4. Cut one (1) hole (5 inch diameter for 3" Concentric Vent installations or 7 inch diameter for 4" Concentric Vent installations) into the structure to install the termination kit.
5. 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 21).
  - b. Cement rain cap to the smaller diameter kit pipe (see FIG.'s 4-7 and 4-8, page 21).

#### 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 22).

#### ⚠ 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.

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

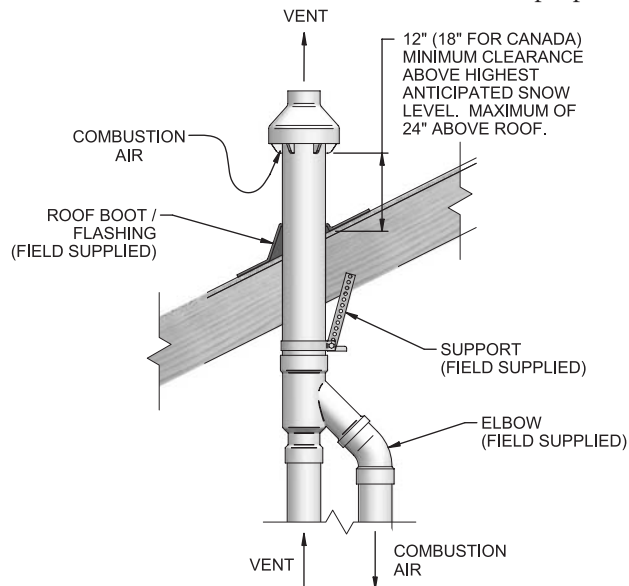
#### NOTICE

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

7. 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:** 3" Concentric Vent 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 26.

#### 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 3" Concentric Vent and standard schedule 40 PVC for 4" Concentric Vent. Do not extend dimension D\* more than 60 inches (see FIG.s 4-9 and 4-10, page 22).

#### CAUTION

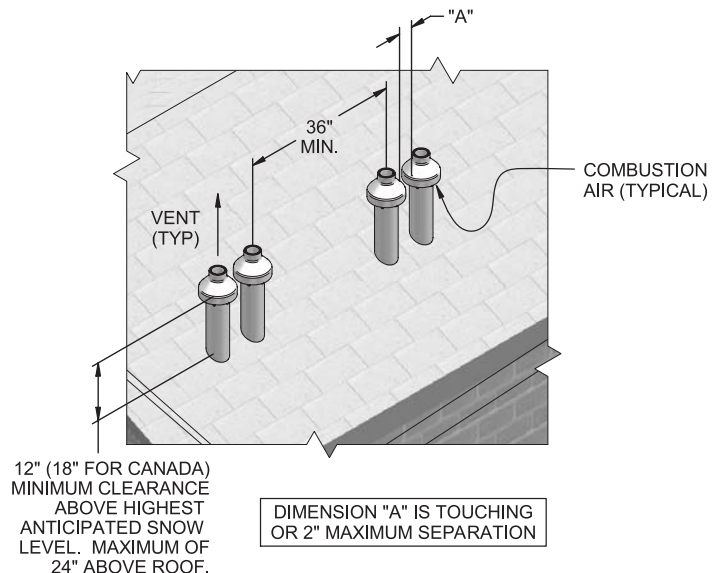
DO NOT use field-supplied couplings to extend pipes. Airflow restriction will occur.

8. 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 3" Concentric Vent installations and fastened tightly into the rubber adapter for 4" Concentric Vent installations.
9. Cement the appliance combustion air and vent pipes to the concentric vent termination assembly. See FIG. 5-6 for proper pipe attachment.
10. Operate the appliance through one (1) heat cycle to ensure combustion air and vent pipes are properly connected to the concentric vent termination connections.

### Multiventing vertical terminations

When two (2) or more direct vent appliances are vented near each other, each appliance must be individually vented (see FIG. 5-7). NEVER common vent or breach vent this appliance. When two (2) or more direct vent appliances are vented near each other, two (2) vent terminations may be installed as shown in FIG. 5-7. The next two (2) terminations must be at least 36 inches away from the first two (2) terminations. It is important that vent terminations be made as shown to avoid recirculation of flue gases. Dimension A in FIG. 5-7 represents the distance between pipes or rain shields, as touching or a 2 inch maximum separation.

**Figure 5-7 Concentric Vent and Combustion Air Vertical Termination (Dimension A as Touching or 2 inches Maximum Separation)**



## 6 Hydronic piping

### System water piping methods

The ECO\*PAK™ boiler is designed to function in a closed loop pressurized system not less than 12 psi. 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 inch 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

Basic steps are listed in this section, which will guide you through the installation of the ECO\*PAK™ boiler.

1. Connect the system return marked “Inlet”, make sure to install with pipe sealant compound.
2. Connect the system supply marked “Outlet”, make sure to install with pipe sealant compound.
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. 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.

#### WARNING

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).



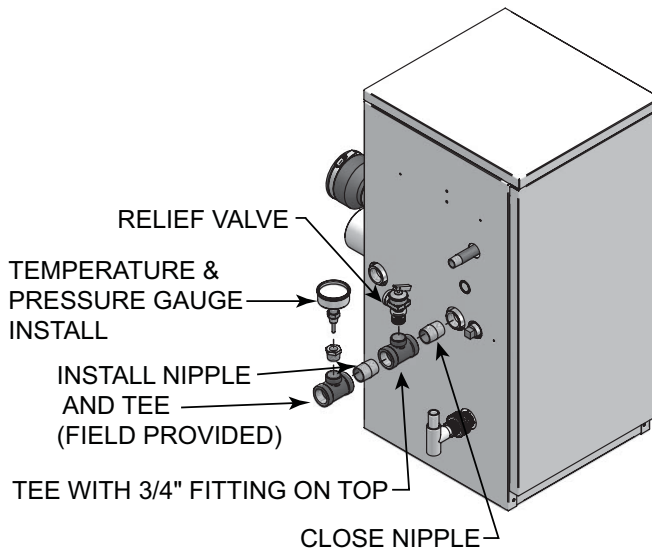
## 6 Hydronic piping *(continued)*

### Relief valve and temperature and pressure gauge installation

Basic steps are listed below to guide you through the installation of the relief valve and the temperature and pressure (T & P) gauge provided with the unit.

1. Install the tee with the 3/4 inch fitting positioned vertically and on the top as shown in FIG. 6-1.
2. Install the relief valve into the 3/4 inch fitting of the tee installed in Step 1 (FIG. 6-1).
3. Install a nipple and tee (field provided) as depicted in FIG. 6-1. Install a temperature and pressure gauge (FIG. 6-1).

**Figure 6-1** Relief Valve / T & P Installation



### Near boiler piping components

#### 1. Boiler isolation valves:

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

#### 2. Unions:

Factory supplied. Recommended for unit serviceability.

#### 3. 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.

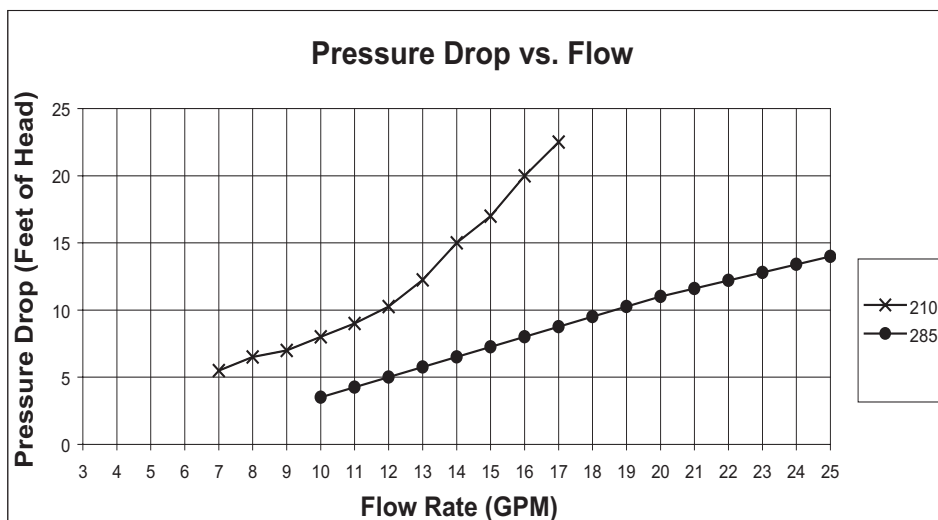
#### 4. Pressure relief valve:

Factory supplied. The pressure relief valve is sized to ASME specifications.

#### 5. Auto Air Vent:

Factory supplied. The boiler purge valve is used to remove entrapped air from the heat exchanger during start-up.

**Figure 6-2** Pressure Drop vs. Flow

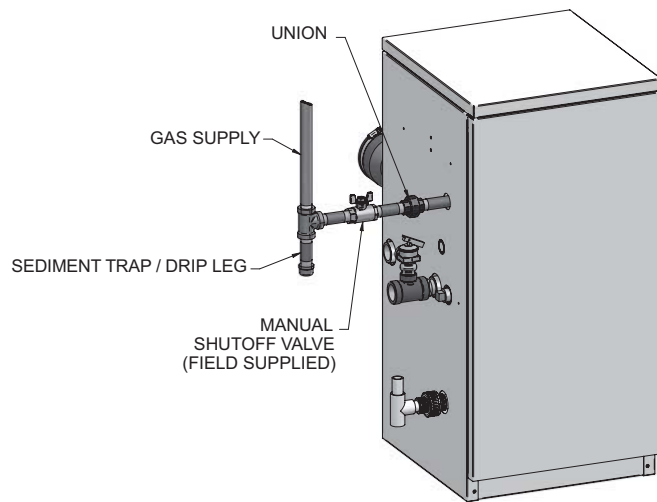


## 7 Gas connections

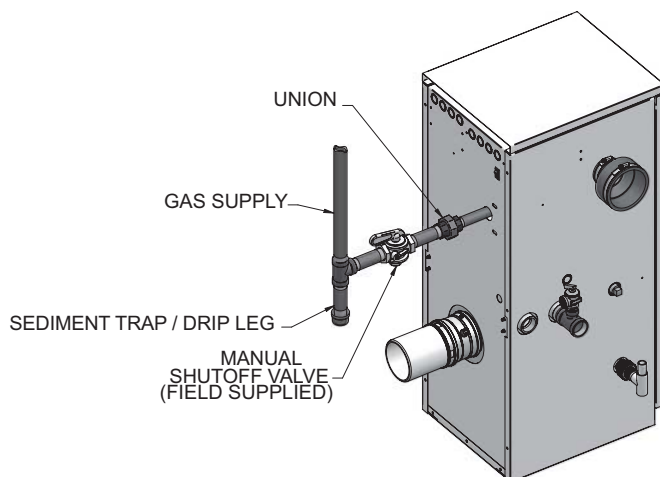
### Connecting gas supply piping

1. Remove the top access panel and refer to FIG.'s 7-1 and 7-2 to pipe gas to the boiler.
  - a. Install ground joint union for servicing, when required.
  - b. Install a manual shutoff valve in the gas supply piping outside boiler jacket when required by local codes or utility requirements.
  - c. In Canada – When using manual main shutoff valves, it must be identified by the installer.
2. Install sediment trap / drip leg.

**Figure 7-1 Gas Supply Piping - Model 210**



**Figure 7-2 Gas Supply Piping - Model 285**



3. 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.

4. Purge all air from the gas supply piping.
5. 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.

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

**⚠ WARNING**

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

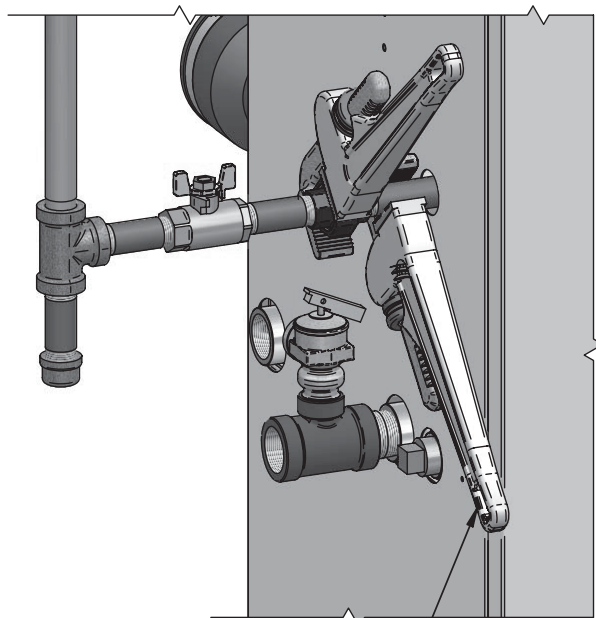
**⚠ WARNING**

ECO\*PAK™ 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 orifice (see page 12). In order to operate on LP gas, an orifice **MUST BE** installed. Failure to comply could result in severe personal injury, death, or substantial property damage.

## 7 Gas connections *(continued)*

**⚠ WARNING** Use two wrenches when tightening gas piping at boiler (FIG. 7-3), 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 7-3 Inlet Pipe with Backup Wrench**



USE BACK UP WRENCH  
TO PREVENT PIPE FROM  
ROTATING

**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 0.5 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**

ECO\*PAK™ 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 orifice (see page 12). In order to operate on LP gas, an orifice **MUST BE** installed. Failure to comply could result in severe personal injury, death, or substantial property damage.

#### 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**

Nominal Iron Pipe Size (Inches)	Single Unit Natural Gas Pipe Capacity Chart Length of Pipe in Straight Feet for 1/2 PSI													
	10	20	30	40	50	60	70	80	90	100	125	150	175	200
1/2	175	120	97	82	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3/4	369	256	205	174	155	141	128	121	113	106	95	86	79	74
1	697	477	384	328	292	267	246	236	210	200	179	164	149	138
1-1/4	1400	974	789	677	595	543	502	472	441	410	369	333	308	287
1-1/2	2150	1500	1210	1020	923	830	769	707	666	636	564	513	472	441
2	4100	2820	2260	1950	1720	1560	1440	1330	1250	1180	1100	974	871	820
2-1/2	6460	4460	3610	3100	2720	2460	2310	2100	2000	1900	1700	1540	1400	1300
3	11200	7900	6400	5400	4870	4410	4000	3800	3540	3330	3000	2720	2500	2340
4	23500	16100	13100	11100	10000	9000	8300	7690	7380	6870	6150	5640	5130	4720

## ⚠ WARNING

ECO\*PAK™ 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 orifice (see page 12). In order to operate on LP gas, an orifice **MUST BE** installed. Failure to comply could result in severe personal injury, death, or substantial property damage.

## Check inlet gas supply

### NOTICE

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

## ⚠ WARNING

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

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

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

1. Turn the main power switch to the "OFF" position.
2. Shut off gas supply at the manual gas valve in the gas piping to the appliance.

3. 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. 7-4.
4. Slowly turn on the gas supply at the field installed manual gas valve.
5. Turn the power switch to the "ON" position.
6. Adjust the temperature set point on the control panel of the control module to call for heat.
7. Observe the gas supply pressure as the burner fires at 100% of rated input. Percent of burner input will be displayed on the control panel.
8. Ensure inlet pressure is within specified range. Minimum and maximum gas supply pressures are specified in this section of the manual.
9. If gas supply pressure is within normal range and no adjustments are needed, proceed on to Step 11.
10. If the gas pressure is out of range, contact the gas utility, gas supplier, qualified installer or service agency to determine the necessary steps to provide proper gas pressure to the control.
11. Turn the power switch to the "OFF" position.
12. Shut off the gas supply at the manual gas valve in the gas piping to the appliance.
13. Remove the manometer from the pressure tap on top of the gas valve. Re-tighten the set screw inside the pressure tap.

## 7 Gas connections *(continued)*

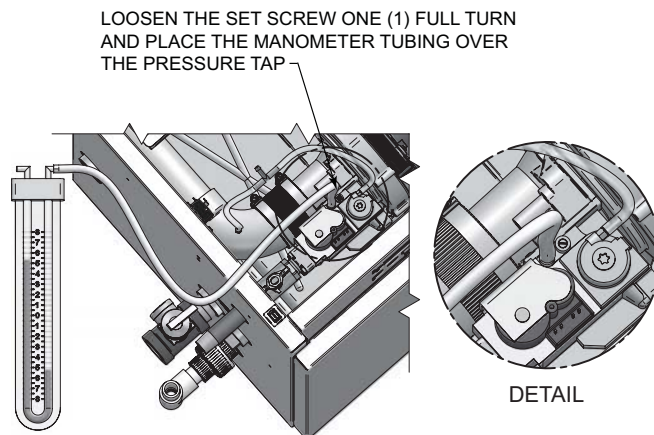
**⚠ WARNING**

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.

14. Turn on the gas supply at the manual gas valve.
15. Turn the power switch to the "ON" position.
16. Adjust the temperature set point on the control panel of the control module to the desired water temperature so the appliance will call for heat.
17. Check burner performance by cycling the system while you observe burner response. The burner should ignite promptly. Flame pattern should be stable. Turn system off and allow burner to cool, then cycle burner again to ensure proper ignition and flame characteristics.

**Figure 7-4 Inlet Gas Supply Check**



### Gas Pressure

The gas pressure must remain between 4 inches w.c. (natural), 8 inches w.c. (LP) minimum and 14 inches w.c. (natural and LP) maximum during stand-by (static) mode and while in operating (dynamic) mode. If an in-line regulator is used, it must be a minimum of 10 feet from the ECO\*PAK™ 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. As an additional safety feature, this gas valve has a flanged connection to the venturi and blower.

**⚠ WARNING**

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

**⚠ WARNING**

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

## 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.

**⚠ CAUTION**

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

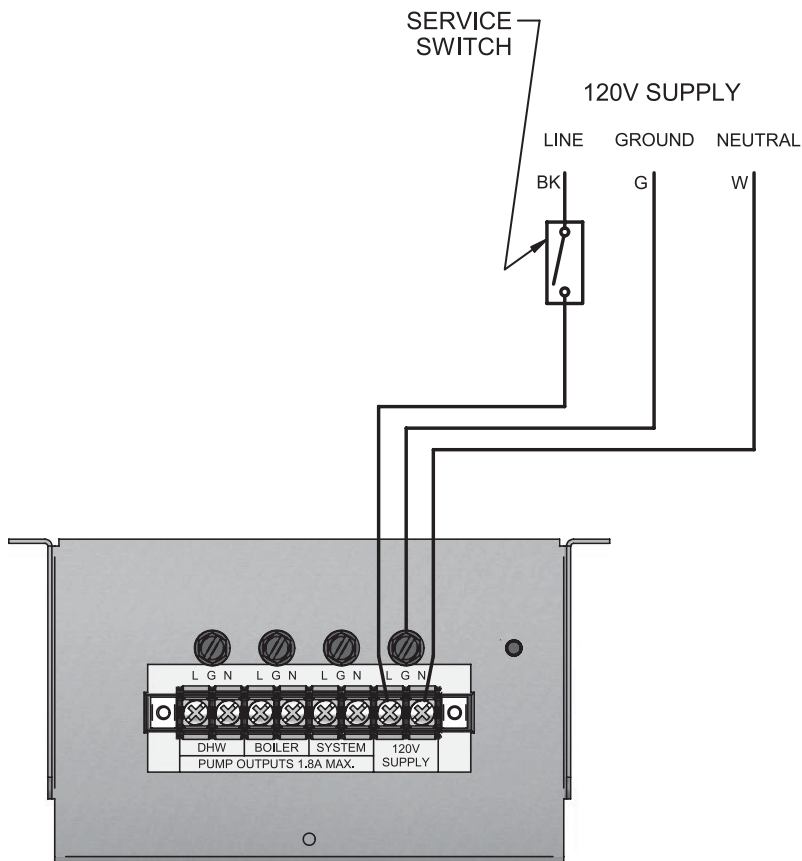
### Installation must comply with:

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

### Line voltage connections

1. 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).

**Figure 8-1** Line Voltage Field Wiring Connections



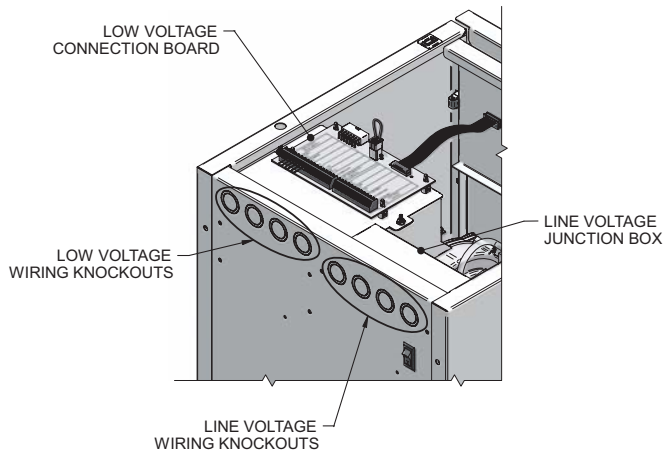


## 8 Field wiring *(continued)*

### Low voltage connections

1. Route all low voltage wires through the knockouts in the rear of the boiler, as shown in FIG. 8-2.
2. Connect low voltage wiring to low voltage connection board as shown in FIG. 8-3 on page 36 of this manual and the boiler wiring diagram.

**Figure 8-2 Routing Field Wiring**



### Thermostat

1. Connect the room thermostat or end switch (isolated contact only) to terminals R and W, 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.

### Flow switch (optional)

1. A flow switch is used to guarantee flow through the boiler before allowing it to fire. The flow switch must be installed in line with the boiler.
2. Connect these terminals to the normally open contacts on the flow switch (FIG. 8-3).

### Armstrong Integrated Control (AIC)

1. An external control may be connected to control either the firing rate or the set point of the boiler. Connect the Room Thermostat / Zone Control terminals to the enable output of the external control and connect the 0 - 10 vdc terminals to the 0 - 10 vdc output of the external control.
2. Make sure the ground terminal is connected to the ground output terminal of the external control, and the 0 - 10 vdc terminal is connected to the 0 - 10 vdc terminal of the external control.

### Runtime contacts

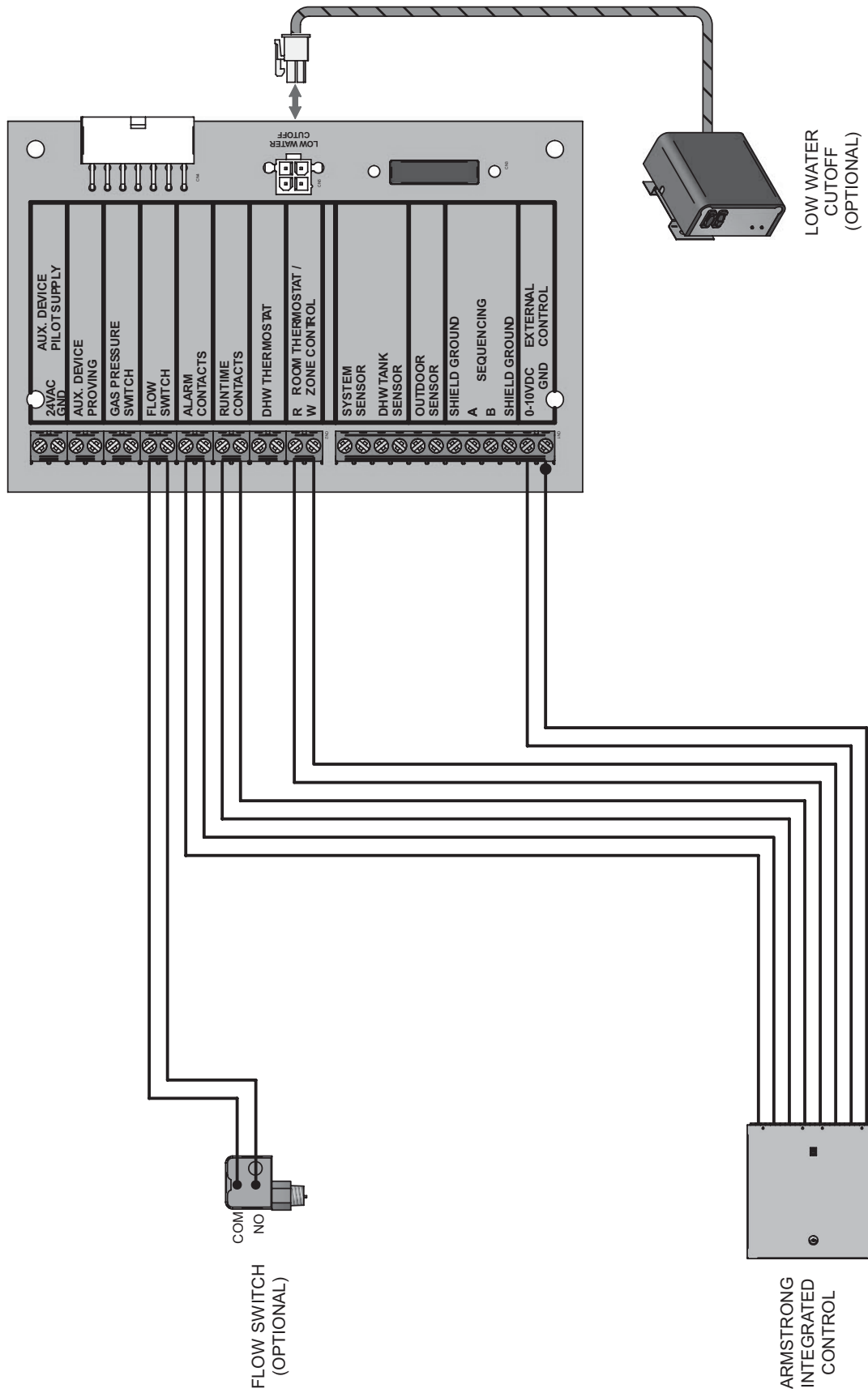
The control module closes a set of dry contacts whenever the burner is running. This is typically used by Building Management Systems to verify that the boiler is responding to a call for heat.

### Alarm contacts

The control module 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. Note that these contacts will close momentarily at the end of each call for heat.

## 8 Field wiring *(continued)*

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 side of the boiler has a 1/2 inch PVC union for connection of a 1/2 inch PVC pipe (FIG. 9-1).
3. Slope condensate tubing down and away from the boiler into a drain or condensate neutralizing filter. Condensate from the ECO\*PAK™ 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 (FIG. 9-1) is available from the factory.

4. Install the 1/2 inch PVC tee assembly (shipped with the unit) as shown in FIG. 9-1.
5. Leave the top of the 1/2 inch tee OPEN. This is needed as a vacuum break.
6. Do not expose condensate line to freezing temperatures.
7. Use only plastic tubing or piping as a condensate drain line (FIG. 9-1).

**NOTICE**

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

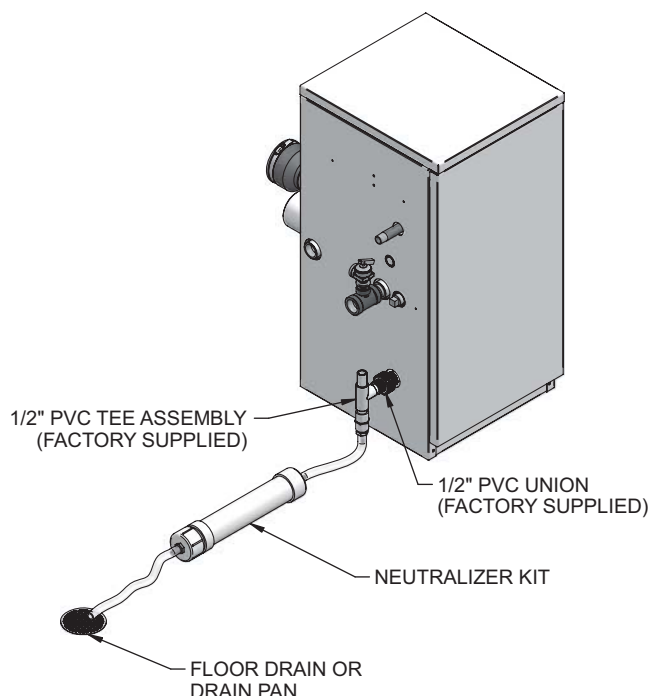
**NOTICE**

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

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

8. A condensate removal pump is required if boiler is below 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 to the auxiliary device proving switch terminals on the low voltage connection board.

**Figure 9-1** Condensate Disposal



# 10 Start-up

## Check/control water chemistry

### ⚠ CAUTION

Do not use petroleum-based cleaning or sealing compounds in the boiler system. Damage to elastomer seals and gaskets in the system could occur, resulting in substantial property damage.

### Hardness less than 7 grains

1. Consult local water treatment companies for hard water areas (above 7 grains hardness).

### Chlorine concentration less than 200 ppm

1. Do not fill boiler or operate with water containing chlorine in excess of 200 ppm.
2. Filling with chlorinated fresh water should be acceptable since drinking water chlorine levels are much lower.
3. Do not use the boiler to directly heat swimming pool or spa water.

### Test/replace freeze protection fluid

1. For systems using freeze protection fluids, follow fluid manufacturer's instructions.
2. Freeze protection fluid must be replaced periodically due to degradation of inhibitors over time. Follow all fluid manufacturer's instructions.

### Freeze protection (when used)

1. Determine freeze protection fluid quantity using system water content, following fluid manufacturer's instructions. Boiler water content is listed on page 7. Remember to include expansion tank water content.
2. Local codes may require a backflow preventer or actual disconnect from city water supply.
3. When using freeze protection fluid with automatic fill, install a water meter to monitor water makeup. Freeze protection fluid may leak before the water begins to leak, causing concentration to drop, reducing the freeze protection level.

### Fill and test water system

1. Fill system only after ensuring the water meets the requirements of this manual.
2. Close manual and automatic 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 residential system is 12 psi.
  - b. Pressure will rise when boiler is turned on and system water temperature increases.

4. At initial fill and during boiler startup and testing, check system thoroughly for any leaks. Repair all leaks before proceeding further.

### ⚠ WARNING

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.

### Purge air from water system

1. Purge air from system:
  - a. Connect a hose to the purge valve. 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 quick-fill valve on cold water makeup line.
  - e. Open purge valve.
  - f. One zone at a time, open the isolation valves. 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 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 *(continued)*

## Check for gas leaks

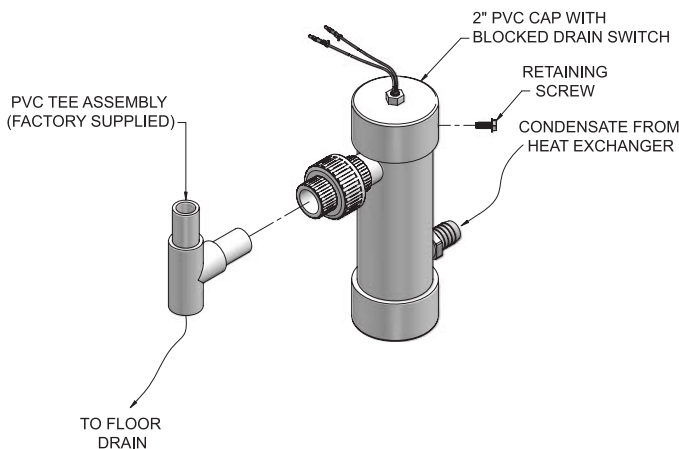
### ⚠ WARNING

Before starting the boiler, and during initial operation, smell near the floor and around the boiler for gas odorant or any unusual odor. Remove the 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 or attempt to measure gas valve outlet pressure. The gas valve is factory set for the correct outlet pressure. This setting is suitable for natural gas and propane, requiring no field adjustment. Attempting to alter or measure the gas valve outlet pressure could result in damage to the valve, causing potential severe personal injury, death, or substantial property damage.

**Figure 10-1** Condensate Trap



### ⚠ WARNING

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

## Check thermostat circuit(s)

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

## Inspect/fill condensate system

### Inspect/check condensate lines and fittings

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

### Fill condensate trap with water

1. Remove the PVC cap retaining screw from the PVC cap (FIG. 10-1).
2. Remove the 2 inch PVC cap with the switch located at the top of the trap (FIG. 10-1).
3. Fill with fresh water until the water begins to pour out of the drain.
4. Replace the cap. Press the cap onto the trap until the cap makes contact with the drain.
5. Replace the retaining screw.

### ⚠ WARNING

The condensate trap (FIG. 10-1) must be filled with water during all times of boiler operation to avoid flue gas emission from the condensate drain line. Failure to fill the trap could result in severe personal injury or death.

# 10 Start-up

## Final checks before starting the boiler

- ❑ Read the ECO\*PAK™ Boiler Service Manual to familiarize yourself with control module operation. Read this manual, page 41 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 38 and 39 have been completed.
- ❑ Fill the vent condensate trap with water (removing the retaining screw in order to remove the 2 inch PVC cap with the switch located at the top of the trap). Replace the cap. Press the cap onto the trap until the cap makes contact with the drain. Replace the retaining screw.
- ❑ 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. 10-2, page 41.

## If boiler does not start correctly

1. Check for loose connections, blown fuse or service switch off?
2. Is external limit control (if used) open? Is boiler water temperature above 200°F?
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 ECO\*PAK™ 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 38 and 39 (startup) regarding failure to repair leaks.)
2. Vent any remaining air from the system using manual vents. Air in the system will interfere with circulation and cause heat distribution problems and noise.

### ❑ Check vent piping and air piping

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

#### ⚠ WARNING

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

### ❑ Check gas piping

1. Check around the boiler for gas odor following the procedure on page 30 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 or attempt to measure gas valve outlet pressure. The gas valve is factory-set for the correct outlet pressure. This setting is suitable for natural gas and propane, requiring no field adjustment. Attempting to alter or measure the gas valve outlet pressure could result in damage to the valve, causing potential severe personal injury, death, or substantial property damage.

#### ⚠ WARNING

ECO\*PAK™ 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 orifice (see page 12). In order to operate on LP gas, an orifice MUST BE installed. Failure to comply could result in severe personal injury, death, or substantial property damage.

## Check flame and combustion

1. Turn the main power off to the boiler by placing the “On/Off” switch in the OFF position.
2. Remove the flue temperature sensor from the flue 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.

# 10 Start-up *(continued)*

Figure 10-2 Operating Instructions

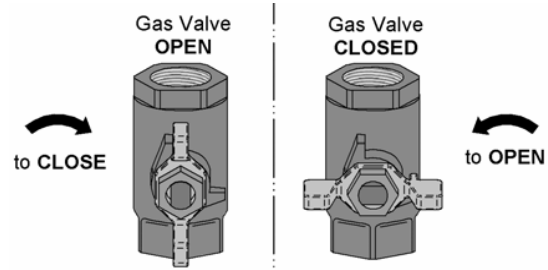
## FOR YOUR SAFETY READ BEFORE OPERATING

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

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

## OPERATING INSTRUCTIONS

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

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# 10 Start-up

## Check flame and combustion *(continued)*

- Place the boiler into the active position by pressing the SHUTDOWN button on the display board (FIG. 11-1, page 46) until **BLR:Standby** appears in the display window.
- Locate the pinhole button below the ENTER / 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.
- Insert the probe from a combustion analyzer into the hole left by the removal of the flue temperature sensor.
- Once the boiler has modulated up to full fire, measure the combustion. The values should be in the range listed in Table 10A below. The CO levels should be less than 150 ppm for a properly installed unit.

If the combustion is not within the specified range, reference the Troubleshooting Section of the ECO\*PAK™ Boiler Service Manual for possible causes and corrective actions.

**Table 10A Flue Products Chart**

Natural Gas		Propane	
CO <sub>2</sub>	O <sub>2</sub>	CO <sub>2</sub>	O <sub>2</sub>
8.0% - 10%	3.0% - 6.5%	9.0% - 11%	4.1% - 6.9%

- 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. Open the manual shutoff valve, and return to Service Mode.
- Turn the main power off to the boiler and replace the flue temperature sensor into the flue pipe connection.
- Place the boiler back into normal operation.

### **⚠ WARNING**

You must replace the flue gas temperature sensor to prevent flue gas spillage into the room. Failure to comply could result in severe personal injury, death, or substantial property damage.

## Set clock

The control module 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 one month. Use the following procedure to set the clock:

- Press and hold the MENU key for at least 5 seconds.
- The display changes to ready "ENTER MENU CODE", with four (4) zeros below it.
- Change the zeros to match the user code (factory set at "0704"). Use the UP and DOWN keys to increment or decrement the flashing digit, and the NEXT and PREVIOUS keys to select which digit flashes.
- Press the ENTER key.
- The display changes to read USER CODE for a few seconds, then displays a menu.
- Press the ENTER key.
- Press the UP key twice to display "A3 DATE AND TIME".
- Press the ENTER key once.
- The date and time are displayed as "YY:MM:DD W hh:mm", where:
  - mm: minutes
  - hh: hour (24 hour time; e.g., 2:00 PM = 14:00)
  - W: day of the week (1 = Sunday, 2 = Monday, 3 = Tuesday, etc.,)
  - DD: date
  - MM: month
  - YY: year

### **NOTICE**

The internal clock does not adjust for Daylight Savings Time and therefore, will require a manual adjustment.

Use the UP and DOWN keys to increment or decrement the flashing number, and the NEXT and PREVIOUS keys to select which number flashes.

- Press the ENTER key to save the setting.
- Press the MENU key twice to exit the Programming Mode.



# 11 Operating information

## General

### How the boiler operates

The ECO\*PAK™ 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 control module receives input from boiler sensors and external inputs. The control module activates and controls the blower and gas valve to regulate heat input and switches the boiler 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.

## Control inputs and outputs

### Room thermostat / zone control

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

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

The ECO\*PAK™ boiler will be controlled by the Armstrong Integrated Control using a 0 - 10 vdc signal.

## Temperature control

### Modulation

The ECO\*PAK™ boiler is capable of modulating its firing rate from a minimum of 20% to a maximum of 100%.

### 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.

### 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.

## 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 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 control module provides some protection for the boiler only -- not for the system.

- The 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.

### ⚠ CAUTION

This feature of the 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.

# 11 Operating information

## Monitor external limits

Connections are provided on the connection board for external limits such as flow switch, low water cutoff, gas pressure switches, and an auxiliary device proving switch. The control module 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 under 50% of rate. The other timer monitors the time the boiler is firing over 50% rate.

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

## Service reminder

The control can be programmed for service reminder notification. This notification will become active when either a set time frame has expired, or a set amount of running hours or cycles has expired (all adjustable by the installer). The display will alternate the standard text on the display screen with Service Due every 5 seconds. The service reminder notification can be reset by the installer.

## Error logging

The control will hold in memory the last 10 error codes as well as the last 10 turn-off functions. The date and time of the occurrence will be recorded as well. Only the 10 most current occurrences will be held in memory.

## Boiler temperature regulation

### Operating temperature (target)

The control module senses water temperature and regulates boiler firing and firing rate to achieve a target temperature. The target temperature can be set between 70°F and 190°F.

- Target temperature is fixed when the outdoor sensor is not installed.

## High limit operations

When outlet temperature exceeds 200°F, high limit action occurs. The boiler shuts down until the outlet water cools down.

If local codes require manual reset, an Adjustable Manual Reset High Limit Kit is available.

## Low water cutoff protection (optional)

1. The 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 kit(s) is available.



# 11 Operating information *(continued)*

## Sequence of operation

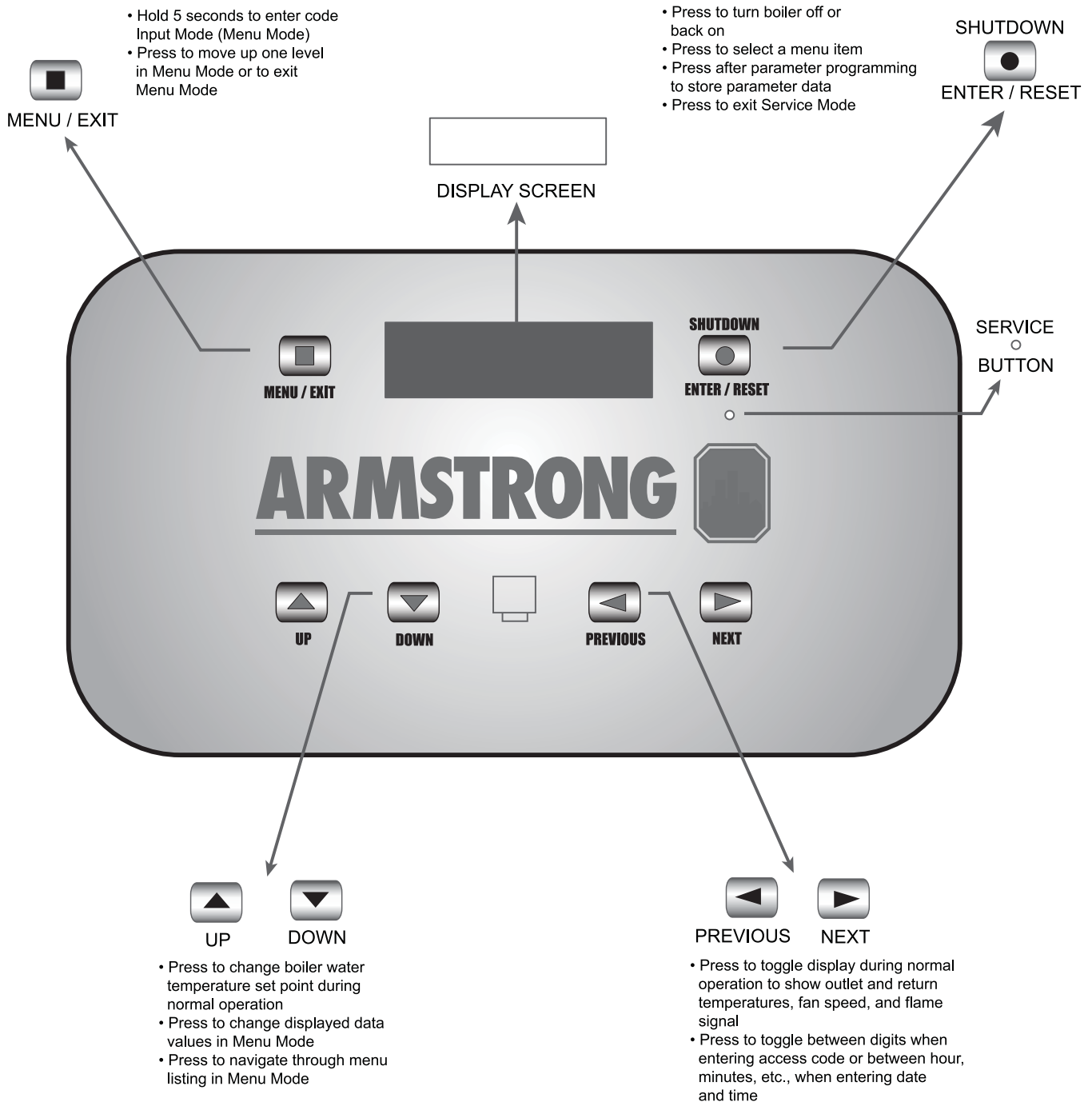
OPERATION	DISPLAY
1. Upon a call for heat, the control checks certain limit switches. <ul style="list-style-type: none"> <li>• If the unit is equipped with a flow switch or low water cutoff, it must close before the control powers up the blower.</li> <li>• If the unit is equipped with a solenoid valve and/or a vent valve, they will be energized along with the blower.</li> <li>• If the unit is equipped with a gas pressure switch, it must close at this time.</li> <li>• If there is an auxiliary device connected to the unit, and it has a proving switch, it must close before the sequence continues.</li> </ul>	<b>BLR: Standby</b> <b>OUT: 123.8F (129)</b>
2. The control then starts a 10 second prepurge cycle.	<b>BLR: PREPURGE</b> <b>OUT: 123.9F (129)</b>
3. Once the prepurge cycle is complete, and the blocked drain and auto-reset high limit are closed, the control starts the 5 second trial for ignition by sending spark voltage to the spark electrode and opening the gas valve.	<b>BLR: IGNITION</b> <b>OUT: 123.9F (129)</b>
4. If the control does not detect flame by the end of the trial for ignition, the control performs a 10 second postpurge, another prepurge and tries to light the burner again. If the burner does not light after 4 trials, the control locks out for 1 hour and then tries another set of 4 trials.	<b>BLR: POSTPURGE, PREPURGE</b> <b>OUT: 123.9F (129)</b>
5. If the control detects a flame before the trial for ignition ends, it begins to modulate the burner in order to maintain the set point.	<b>BLR: SH 20% RATE</b> <b>OUT: 124.8F (129)</b>
6. Once the call for heat is satisfied, the control will turn off the burner. The blower will remain on for the 10 second postpurge cycle. Any pumps that are running will continue to run for their respective pump delay times, then turn off.	<b>BLR: POSTPURGE</b> <b>OUT: 127.4F (129)</b>
7. Boiler pump off, system pump continues its delay if longer.	<b>BLR: Standby</b> <b>OUT: 124.7F (129)</b>
8. Boiler off.	<b>BLR: Standby</b> <b>OUT: 122.9F (129)</b>

# 11 Operating information

## Control module

Use the control panel (FIG. 11-1) to set temperatures, operating conditions, and monitor boiler operation.

**Figure 11-1** Control Panel



# 11 Operating information *(continued)*

## Access modes

### User

The user can adjust space heating target temperature by using the UP and DOWN buttons (FIG. 11-1) at any time during normal operation. By entering the USER code (0704), the user can also change temperature units, time and date. In User Mode, the following parameters can be viewed but not changed:

- Boiler model number
- Software version
- Total operating hours
- Total cycles

### Installer

Most parameters are available only to the installer, accessible only by entering the installer access code, see the ECO\*PAK™ Boiler Service Manual.

**Saving parameters** *(reference the Parameter Table in the ECO\*PAK™ Boiler Service Manual)*

**To save parameters and exit programming:**

Press the ENTER/RESET button.

**To keep parameter settings only for a current operating cycle:**

Press the MENU/EXIT button 3 times after making all desired parameter changes.

**To enter a parameter and continue programming:**

Press the MENU/EXIT button 1 time to return to the parameter listings; press again to return to the menu listings. Remember to press the ENTER/RESET button when finished programming in order to save the changes made.

See the ECO\*PAK™ Boiler Service Manual for a detailed description of parameters and access modes.

# 11 Operating information

## Status Display Screens

By using the Previous/Next (◀, ▶) arrow keys on the control module display panel, you can navigate through the eight (8) display screens. Each screen will contain two (2) viewable items. The following is a description of the individual items and what they can display:

Screen	Display shows:	Description
#1	BLR: OFF	The unit has been turned OFF by the Enter/Reset button on the control module display panel.
	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.
	Set Point Met	The unit has met the water temperature set point, but is still receiving a call for heat from either a remote thermostat or a DHW thermostat.
	Prepurge	The unit has initiated a 10 second purge period on a call for heat.
	Ignition	The unit has begun a 5 second spark period to ignite the main burner.
	SH***% Rate	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 10 seconds to clear the combustion chamber and vent system of residual flue products.
	Service	The unit has been placed in a temporary mode that will allow the unit to fire at 100% of rate for the purpose of combustion analysis.
	OUT: ***.°F(***)	When the outlet sensor has been selected as the control sensor (default), the control will display the outlet temperature as well as the set point in parenthesis.
	***.°F	If the outlet sensor has not been selected as the control sensor, only the outlet temperature will be displayed.
	Open	The control does not detect the outlet sensor.
	Shorted	The outlet sensor wires or the sensor itself has become shorted.
Press the Next ▶ arrow key on the control module display to access Screen #2.		
#2	IN: ***.°F	If the inlet sensor has not been selected as the control sensor, only the inlet temperature will be displayed.
	***.°F (***)	When the inlet sensor has been selected as the control sensor, the control will display the inlet temperature as well as the set point in parenthesis.
	Open	The control does not detect the inlet sensor.
	Shorted	The inlet sensor wires or the sensor itself has become shorted.
	RISE: ***.°F	The difference between the inlet temperature and the outlet temperature.
Press the Next ▶ arrow key on the control module display to access Screen #3.		

# 11 Operating information *(continued)*

## Status Display Screens *(cont'd)*

By using the Previous/Next (◀, ▶) arrow keys on the control module display panel, you can navigate through the eight (8) display screens. Each screen will contain two (2) viewable items. The following is a description of the individual items and what they can display:

Screen	Display shows:	Description
#3	SYS: ***.°F	If the system supply sensor has not been selected as the control sensor, only the system temperature will be displayed.
	***.°F (***)	When the system supply sensor has been selected as the control sensor, the control will display the system temperature as well as the set point in parenthesis.
	Open	The control does not detect the system supply sensor.
	Shorted	The system supply sensor wires or the sensor itself has become shorted.
	OUTDOOR: Open	Not used.
Press the Next ▶ arrow key on the control module display to access Screen #4.		
#4	FLUE: ***.°F	The control will display the flue temperature.
	Open	The control does not detect the flue sensor.
	Shorted	The flue sensor wires or the sensor itself has become shorted.
	AUX: Open	Not used.
Press the Next ▶ arrow key on the control module display to access Screen #5.		
#5	FAN SPD: ****RPM	The control will display the actual fan motor RPM.
	FLAME SIG: **.°uA	The control will display the flame signal in dc microamps.
Press the Next ▶ arrow key on the control module display to access Screen #6.		
#6	SH CFH: OFF	The control has not received a call for heat from a remote thermostat.
	ON	The control has received a call for heat from a remote thermostat.
	DHW CFH: OFF	Not used.
Press the Next ▶ arrow key on the control module display to access Screen #7.		
#7	DHW PUMP: OFF	Not used.
	0-10V IN: **.Vdc	The control will display a 0-10Vdc signal received from the Armstrong Integrated Control connected to the unit.
Press the Next ▶ arrow key on the control module display to access Screen #8.		
#8	SYS PUMP: OFF	Not used.
	BLR PUMP: OFF	Not used.

# 12 Maintenance

## Maintenance and annual startup

Table 12A Service and Maintenance Schedules

Service technician (see the following pages for instructions)		Owner maintenance (see the User's Information Manual for instructions)	
ANNUAL START-UP	<b>General:</b> <ul style="list-style-type: none"> <li>• Address reported problems</li> <li>• Inspect interior; clean and vacuum if necessary;</li> <li>• Clean condensate trap and fill with fresh water</li> <li>• Check for leaks (water, gas, flue, condensate)</li> <li>• Verify flue and air lines in good condition and sealed tight</li> <li>• Check system water pressure/system piping/expansion tank</li> <li>• Check control settings</li> <li>• Check ignition and flame sense electrodes (sand off any deposits; clean and reposition)</li> <li>• Check wiring and connections</li> <li>• Perform start-up checkout and performance verification per Section 10 of this manual.</li> <li>• Flame inspection (stable, uniform)</li> <li>• Flame signal (at least 10 microamps at high fire)</li> <li>• Clean the heat exchanger if flue temperature is more than 54°F above return water temperature.</li> </ul> <b>If combustion or performance indicate need:</b> <ul style="list-style-type: none"> <li>• Clean heat exchanger</li> <li>• Remove and clean burner using compressed air only</li> <li>• Clean the blower wheel</li> </ul>		
		<b>Daily</b>	<ul style="list-style-type: none"> <li>• Check boiler area</li> <li>• Check pressure/temperature gauge</li> </ul>
		<b>Monthly</b>	<ul style="list-style-type: none"> <li>• Check vent piping</li> <li>• Check air piping</li> <li>• Check relief valve</li> <li>• Check condensate drain system</li> <li>• Check automatic air vents</li> </ul>
		<b>Periodically</b>	<ul style="list-style-type: none"> <li>• Test low water cutoff (if used)</li> <li>• Reset button (low water cutoff)</li> </ul>
		<b>Every 6 months</b>	<ul style="list-style-type: none"> <li>• Check boiler piping (gas and water) for leaks</li> <li>• Operate relief valve</li> </ul>
		<b>End of season months</b>	<ul style="list-style-type: none"> <li>• Shut boiler down (unless boiler used for domestic hot water)</li> </ul>

# 12 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 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 ECO\*PAK™ Boiler Service Manual.

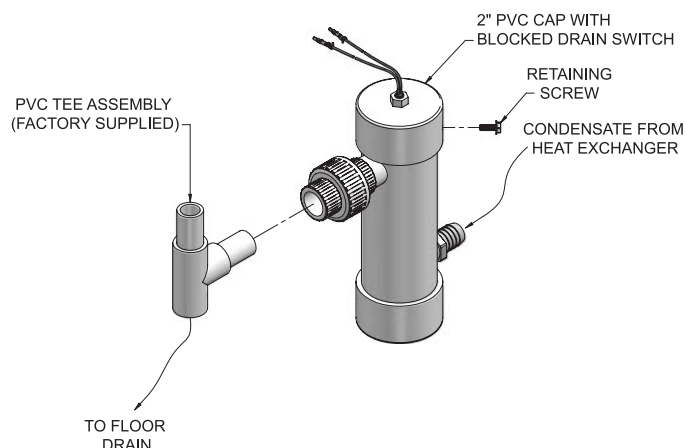
## Inspect boiler interior

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.
2. Remove the PVC cap retaining screw from the PVC cap (FIG. 12-1).
3. Remove the 2 inch PVC cap with the switch located at the top of the trap (FIG. 12-1).
4. Remove any sediment in the trap.
5. Fill with fresh water until the water begins to pour out of the drain.
6. Replace the cap. Press the cap onto the trap until the cap makes contact with the drain.
7. Replace the retaining screw.

Figure 12-1 Condensate Trap



## ⚠ WARNING

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

## Check all piping for leaks

## ⚠ WARNING

Eliminate all system or 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

## 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 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** 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.

### ⚠ 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.

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

## Inspect ignition and flame sense electrodes

1. Remove the ignition and flame sense electrodes from the 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.

# 12 Maintenance *(continued)*

## Check control settings

1. Set the control module display to Parameter Mode and check all settings. See Section 1 of ECO\*PAK™ Boiler Service Manual. Adjust settings if necessary. See Section 1 of the ECO\*PAK™ Boiler Service Manual for adjustment procedures.
2. Check settings of external limit controls (if any) and adjust if necessary.

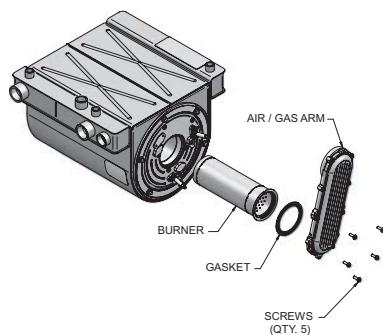
## Perform start-up and checks

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 ECO\*PAK™ Boiler Service Manual for other procedures to deal with low flame signal.

## Review with owner

1. Review the User's Information Manual with the owner.
2. Emphasize the need to perform the maintenance schedule specified in the 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 blower assembly (gas air/arm) from the heat exchanger access cover. Set bolts aside.
4. Remove the nuts securing the heat exchanger access cover to the heat exchanger and set aside.
5. Remove the heat exchanger access cover, cover gasket(s) and chamber insulation assembly.

### ⚠ WARNING

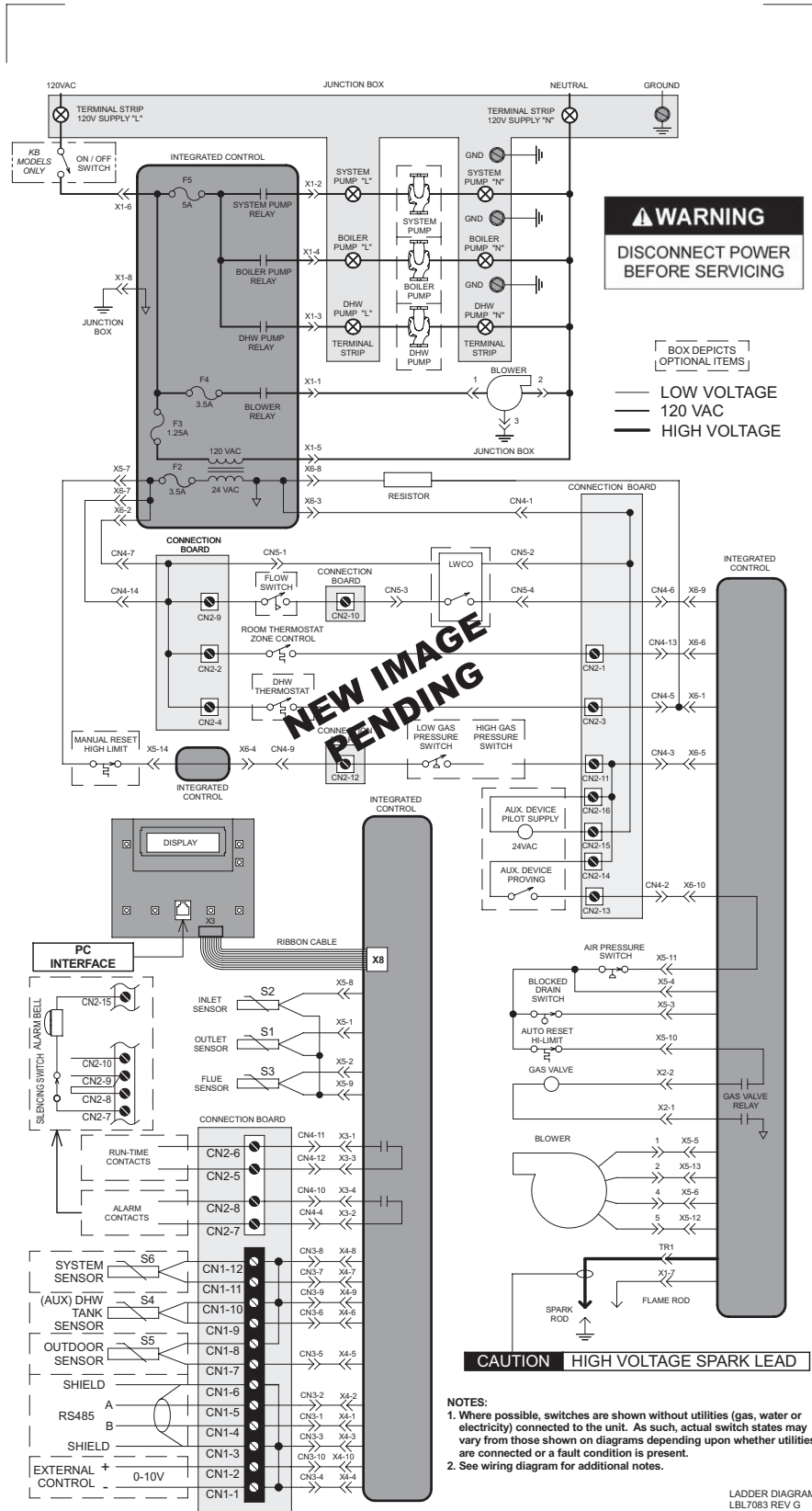
The boiler contains ceramic fiber materials. Use care when handling these materials per instructions in the ECO\*PAK™ Boiler Service Manual. Failure to comply could result in severe personal injury.

6. Use a vacuum cleaner to remove any accumulation on the boiler heating surfaces. Do not use any solvent.
7. Finish cleaning using a clean cloth dampened with warm water.
8. Install access cover gasket, chamber insulation assembly and cover.
9. Secure nuts on the studs. DO NOT overtighten.
10. Re-install the blower assembly (gas air/arm) using the bolts set aside in Step 3.
11. Close isolation valves on piping to isolate boiler from system. Attach a hose to the boiler drain and flush boiler thoroughly with clean water by using purging valves to allow water to flow through the water make-up line to the boiler.
12. When the boiler has been flushed, restore boiler to operation.
13. Perform start-up and check-out procedures in Section 10 - Startup.

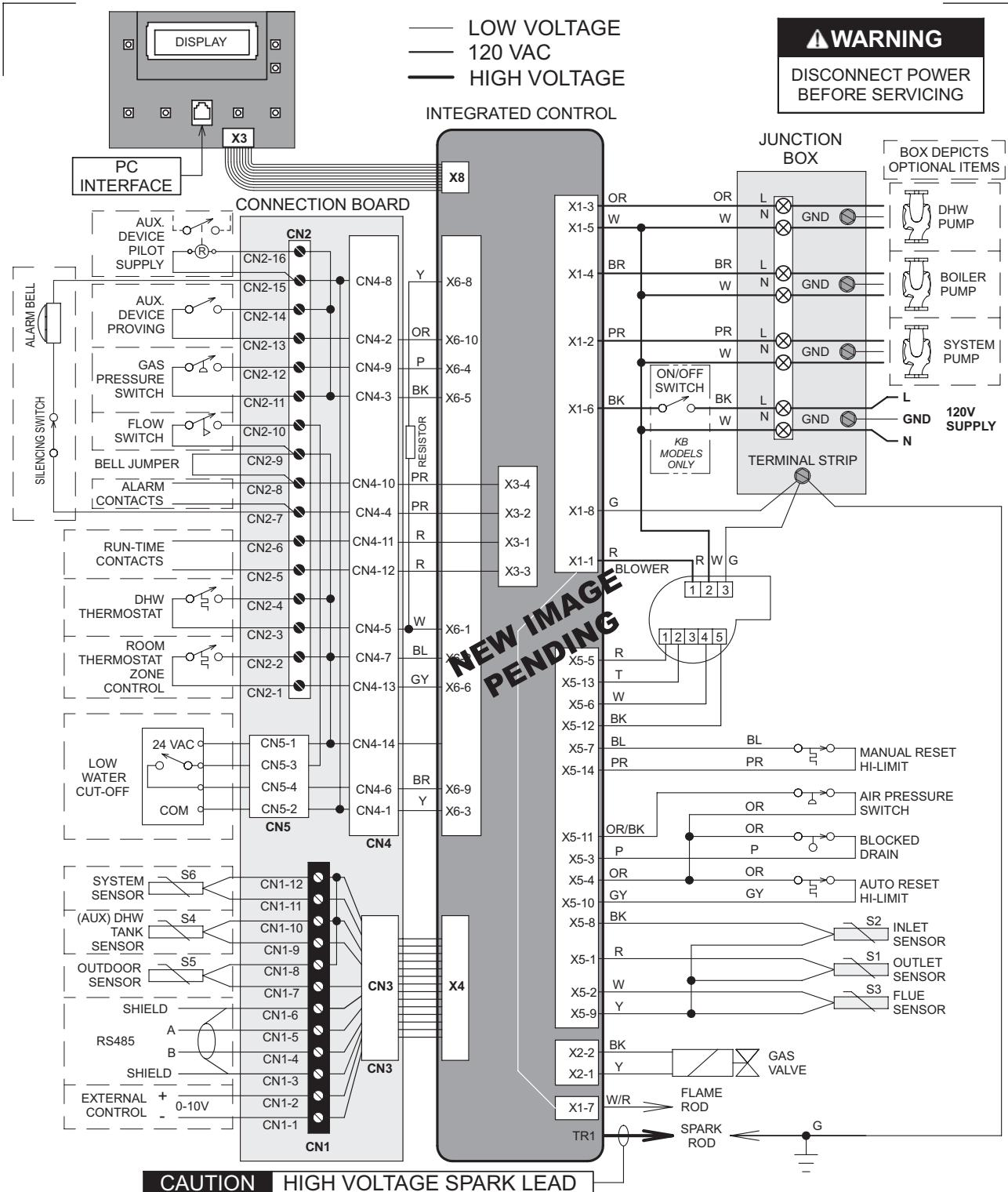
## Oiled bearing circulators

1. Check other circulators in the system. Oil any circulators requiring oil, following circulator manufacturer's instructions. Over-oiling will damage the circulator.

# 13 Diagrams

**Figure 13-1 Ladder Diagram**

# 13 Diagrams *(continued)*

**Figure 13-2 Wiring Diagram**


# **ECO\*PAK MBS™**

## **INTEGRATED BOILER PLANT PACKAGE**

### **CONTROLLER**

Armstrong Ultra Efficient Integrated Boiler Plant Controllers, ECO\*PAK MBS™ Controllers, are completely factory-assembled, tested, and shipped to the job site as integral units ready to receive incoming power supply. These instructions describe the procedures to be followed during installation, commissioning and operation to ensure optimum performance and reliability. When contacting the factory for assistance, please provide the unit Serial Number and other pertinent data, such as ECO\*PAK MBS™ Model no.

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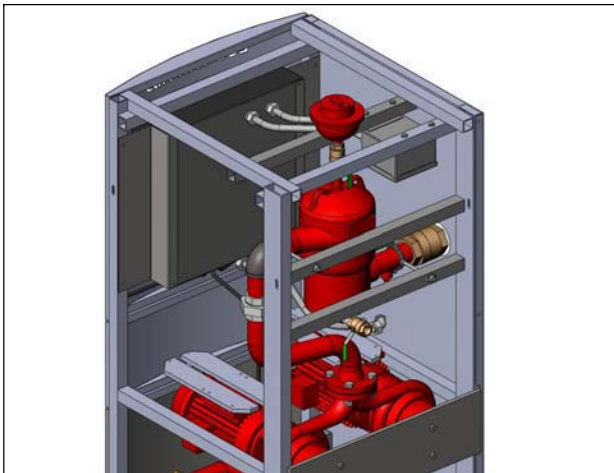
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The **ECO\*PAK MBS™ Integrated Controller** is powered through a step down transformer inside the cabinet. Internal wiring between the main panel and the service junction box located on the back of the package has been completed, tested and inspected in the factory prior to shipping. Connect the 3 phase power supply to the appropriate terminals inside the service junction box as shown below.

**NOTE: All electrical wiring should be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code, local codes and regulations.**



Junction Box TB		
37	PH1	Incoming Power 208, 230, 460 or 575 VAC @ 60 Hz
38	PH2	
39	PH3	
40	GND	

## FIELD DEVICES INSTALLATION INSTRUCTIONS

Before attempting to start configuring the ECO\*PAK MBS™ Controller using the Operator Interface (HMI – touch-screen), make sure all the field installed devices such as temperature sensors, flow sensors are properly installed and wired to the ECO\*PAK MBS™ Controller as per terminal block configuration. All field devices connections shall be wired inside the service junction box.

## BUILDING AUTOMATION SYSTEM (BAS) CONNECTION

The ECO\*PAK MBS™ Controller is provided with an RS 485 serial port to communicate serially to the BAS. The standard communication protocol is Modbus, BACnet and Lonworks are options. Refer to wiring diagram for wiring instructions. Please refer to the ECO\*PAK MBS™ Controller generic terminal block drawing for the different parameters and data points communicated to the BAS.

Junction Box TB		
1	+	Outside Air Temperature Sensor
2	-	
	GND	
13	+	Flow Sensor (Optional)
14	-	
15	+	Remote Start/Stop BAS
16	-	
17	+	Gas Emergency Shutoff (Optional)
18	-	
21	+	General System Alarm
22	-	
23	+	Boiler Alarm
24	-	
25	+	Pump Alarm
26	-	
27	+	Sensor Alarm
28	-	
34	GND	BAS Communication
35	+	
6	-	

**NOTE:** Please fill in the ECO\*PAK MBS™ *Pre-Commissioning Check List* (below) which will help you through the set-up procedure of the ECO\*PAK MBS™ Controller. The main information required would be the ECO\*PAK MBS™ bypass valve.



## ECO\*PAK MBS™ Pre-Commissioning Check List

<b>Armstrong Sales Order #:</b> _____
<b>Project Name:</b> _____
<b>Project Location:</b> _____
<b>Armstrong Service Dealer Name:</b> _____
<b>Requested Date of Site Visit:</b> _____

**To request a commissioning visit for your Armstrong IPP-MBS unit installation, please complete the following details and return to Armstrong, giving a minimum of 7 days prior notice**

DETAILED TASK	CHECK	INITIALS	COMMENTS
Work to be completed in the boiler plant prior to Armstrong Service Technician arrival on site			
Piping system has been charged with water and pressure tested			
Piping system has been filled with water treatment chemicals			
Water mains/boosted cold water connected			
Electrical supply and external wiring (sensors) and safety interlock have been completed and tested			
Serial communication between BMS and MBS Integrated Controller wiring is done (if applicable)			
Confirm that BAS ready to send/receive commands to MBS Integrated Controller			
Turn on MBS Integrated Controller after power wiring installed, record start up message from panel (or program version)			
Send pictures to Armstrong showing all wiring are terminated in the MBS Integrated Controller as specified			
Flue system and ventilation is complete and complies with standards			
Plant room has been swept and is clear of combustible materials			
Adequate lighting and safe access is provided			
Condensate drain pipework connected to a suitable drain			
All circuit, zone, balancing and radiator valves are installed			
The correct gas supply to system is tested and purged up to the MBS isolating valve			
Sufficient load is available for a full load test			

**NOTES:**

Armstrong will confirm attendance of our commissioning engineer, and every effort will be made to accommodate date(s) requested above

Any postponement to the agreed date must be notified to Armstrong at least 48 hours prior

All prices quoted by Armstrong assume a single visit to site and do not include for abortive visits, waiting time, site induction courses, revisiting site for hand over / training sessions, or servicing during guarantee period

**Signatures**

**Pre-Commissioning Prepared by:** \_\_\_\_\_

**Pre-Commissioning Reviewed by:** \_\_\_\_\_

**Project Manager Release:** \_\_\_\_\_

## DISPLAYS OVERVIEW

The ECO\*PAK MBS™ integrated controller HMI is divided in four set of displays: System, Setup, Alarm, and Trend Data management.

The System Displays are used by the users to view and control the Boilers and Pumps. The Setup Screens are used to set, view, save, and restore the system specific settings (i.e. ECO\*PAK MBS™ model, boilers parameters, pumps parameters, etc.). The Alarm screens are used to display the current alarms, store and display history alarms, give helpful information on each alarm and display events. The Trend Data screens are used to view real time trend charts and history trend charts, backup history data to USB.

The list of displays in each set is as follow:

### System Displays:

- Main Menu
- System Overview
- Pump Overview
- Boiler Overview
- Pump 1 Control
- Pump 2 Control
- Boiler 1 Control
- Boiler 2 Control
- Boiler 3 Control
- Boiler 4 Control
- Login

The System Displays can be accessed without any password.

### Alarm Displays:

- Alarm
- Alarm History
- Event

The Alarm Displays can be accessed and operated (such as pressing a “reset” button) without any password.

### Setup Displays:

The Setup Displays are divided in three levels. All the three levels have the same number of displays with different level of access. Level 0 setup displays are for viewing only and no adjustment can be made. Level 1 setup displays can be used for changing the system setup, restoring the system factory defaults except for the PID parameters in the PID Setup Displays. Level 2 setup displays can be used for changing the system setup, and saving and restoring the system factory defaults. To access Level 1 and level 2 Setup Displays an operator need to enter the proper password.

The list of Setup Displays for every level is as follow:

- SHWT(System Hot Water Temperature) Set point Setup
- Pump Setup
- Pump PID Setup
- Boiler Setup
- Boiler Staging Setup
- Boiler PID Setup
- Gas Consumption Setup
- Sensor Setup 1
- Sensor Setup 2

- Frost Protection Setup
- Bypass Valve Setup
- Bypass Valve PID Setup
- BAS Setup
- Clock Setup
- ECO\*PAK MBS™ System Schedule Setup

The Level 1 Setup Screens also have a set of “Restore Default Settings” to restore the default setup values on each screen. The Level 2 Setup Screens have a set of “Restore Default Settings” and “Save Default Settings” to restore or save the default values on each screen.

### **Trend Data Displays:**

The Trend Data Displays include 5 real time data trend charts and a history data menu. Through the history data menu, the history data trend charts can be accessed and backed up.

The list of Setup Displays for every level is as follow:

- Trend Menu
- Temperature Trend
- System Flow Trend
- Boiler Flame Trend
- Pump Speed Trend
- System Pressure Trend
- History Trend - Menu
- History Trend - Temperature
- History Trend - System Flow
- History Trend - Boiler Flame
- History Trend - Pump Speed
- History Trend - System Pressure

The Trend Data Displays can be accessed without any password.

## **SYSTEM FUNCTIONS**

The System functions of the HMI operator interface include the Operator Displays, the Installer Displays, and the Factory Displays. To access the Installer Displays, the user is required a level 1 password. To access the Factory Displays, the user is required a level 2 password. There is no password requirement to access the Operator Displays.

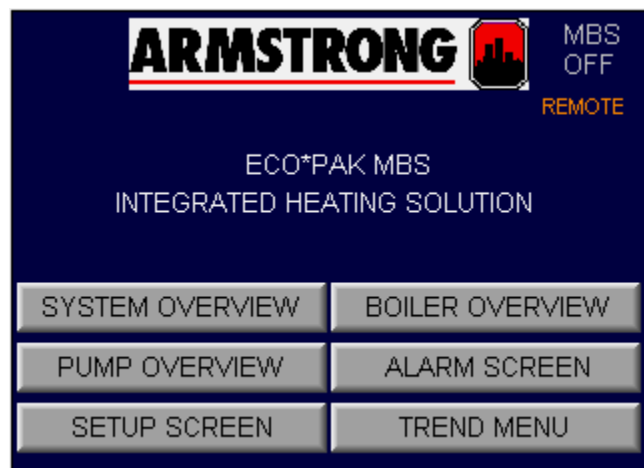
## **OPERATOR DISPLAYS**

Operator Displays include system displays, alarm management displays, trend displays and level 0 setup displays. These displays can be accessed without any password, and level 0 setup displays are for viewing only.

### **1.1.0 System Displays**

See the following table

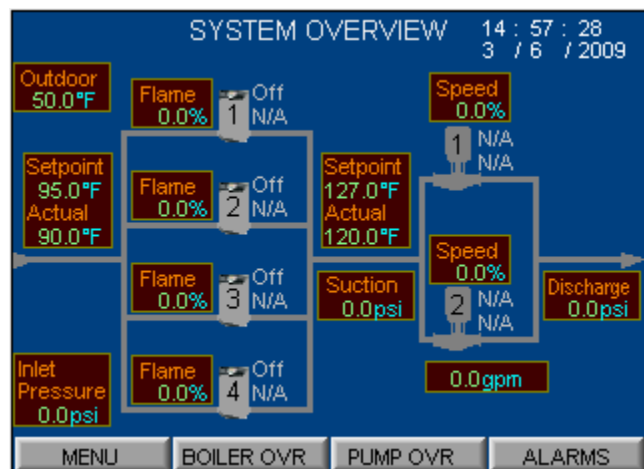
## 1.1.0 MAIN MENU



This is the screen the operator sees when powering up the unit.

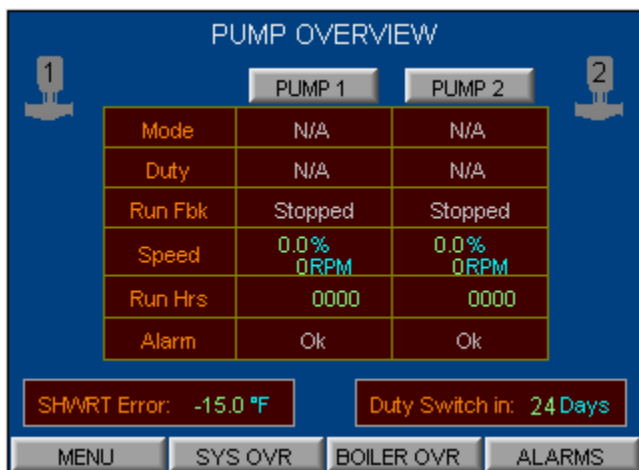
1. Press "SYSTEM OVERVIEW" to view the layout of the system, temperature setpoint and actual temperature value, system flow, inlet pressure, discharge and suction pressure, bypass valve opening (if available), pumps speed and boilers flame
2. Press "PUMP OVERVIEW" to view pumps status, speed, run time and alarm
3. Press "BOILER OVERVIEW" to view boilers status, run time, flame and total output capacity
4. Press "ALARM SCREEN" to view any alarm condition that might have occurred
5. Press "SETUP SCREEN" for boiler, pump, sensor, bypass valve, frost protection and system schedule setup (password protected)
6. Press "TREND MENU" to view temperature trends, system flow trends, boiler flame trends, pump speed trends, system pressure trends

## 1.1.1 SYSTEM OVERVIEW



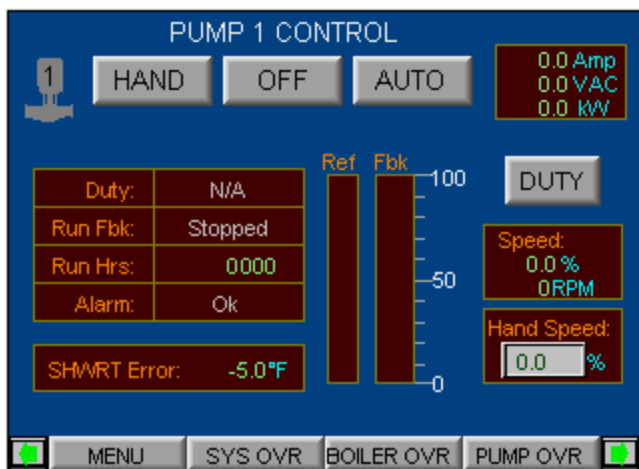
1. Outdoor air temperature is displayed.
2. System Hot Water Return Temperature (SHWRT) set-point and actual value are displayed
3. System Hot Water Supply Temperature (SHWST) set-point and actual value are displayed
4. Pumps' running status, duty/standby and speed are displayed
5. Boilers' running status, duty/lag and flame are displayed
6. The strainer inlet pressure, suction pressure and discharge pressure are displayed
7. Flow is displayed if flow sensor is enabled in "flow sensor setup" screen
8. Bypass valve opening value is displayed if bypass valve is enabled in "bypass valve setup" screen
9. Pressing the boiler icons will change current screen to boiler control screen
10. Pressing the pump icons will change current screen to pump control screen
11. Press the buttons on the menu at the bottom to bring up the desired screen

## 1.1.2 PUMP OVERVIEW



1. "Mode" displays pump operation mode: Hand, Off, or Auto
2. "Duty" shows which pump is duty and which one is standby
3. "Run Fbk" shows whether the pump is running or stopped
4. Speed is displayed in both % value of full speed and absolute RPM
5. Run Hours are displayed and can be reset in pump control screen
6. Alarm will be displayed if there is a problem with the pump
7. Pressing "Pump 1" button will bring up the "pump 1 control" screen to view and control pump parameters
8. Press the buttons on the menu at the bottom to bring up the desired screen

## 1.1.3 PUMP 1 CONTROL screen



**This screen is to control the pump, Hand, Off, Auto, Duty mode and hand speed**

1. Press the "HAND", "OFF", "AUTO" buttons to select the desired mode
2. The pump mode is displayed under these buttons, no display means "N/A"
3. Press "DUTY" button to set the Pump as duty pump (the other pump will become Stand-by)
4. When in "Hand" mode, enter the desired speed in the "Hand Speed" box
5. When in "Auto" mode, the speed of the pump is automatically determined by the controller
6. Pump duty is displayed (Duty or Standby)
7. Pump status is displayed (Running or Stopped)
8. Run Hours indicates the pump total running time since the last reset and can be reset by pressing the displaying area
9. Alarm will be displayed if there is a problem with the pump
10. Controller output speed (Referential speed sent to the VFD) is displayed in % value of pump full speed
11. Pump actual speed (Feedback from the VFD) is displayed in % value of pump full speed
12. SHWRT error, VFD amps, voltage and power is displayed
13. Press the buttons on the menu at the bottom to bring up the desired screen

## 1.1.4 BOILER OVERVIEW

BOILER OVERVIEW				
	BOILER 1	BOILER 2	BOILER 3	BOILER 4
Mode	Off	Off	Off	Off
Duty	N/A	N/A	N/A	N/A
Status	Ready	Ready	Ready	Ready
Flame	0.0%	0.0%	0.0%	0.0%
Run Hrs	0000	0000	0000	0000
SHWST: 120.0°F Duty Switch in: 24Days				
GAS CONSUMPTION				
Total boiler output capacity: 000MBH				
MENU	SYS OVR	PUMP OVR	ALARMS	

1. Pressing "BOILER N" button will bring up the boiler n control screen to view and control boiler parameters
2. "Mode" shows boilers operation mode: Hand, Off, or Auto
3. "Duty" shows boilers working sequence: Lead, Lag1, Lag2, Lag3
4. "Status" shows the boilers run status: Not Ready, Ready, Enabled, Started, Running and Alarm
5. Flame is displayed in % value of full value
6. Boiler run time is displayed
7. System Hot Water Supply Temperature (SHWST) is displayed
8. The remaining time to switch the lead boiler is displayed
9. "Gas consumption" button is displayed when gas pulses are enabled
10. Pressing "Gas consumption" button will bring up the "Gas consumption" pop-up box to view and reset the total gas consumption
11. Total boiler output capacity is displayed when flow sensor is enabled
12. Press the buttons on the menu at the bottom to bring up the desired screen

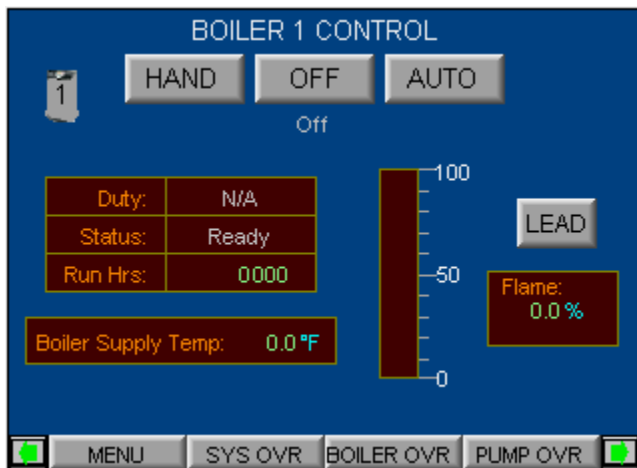
## 1.1.5 GAS CONSUMPTION POP-UP screen

GAS CONSUMPTION (OPTIONAL)		PUMP 3		PUMP 4	
0000 CF	Reset	Off	Off	Off	Off
0000 CFH		N/A	N/A	N/A	N/A
Thermal Efficiency:	0000.0	Ready	Ready	Ready	Ready
		0.0%	0.0%	0.0%	0.0%
		0000	0000	0000	0000
		Duty Switch in: 24Days			
GAS CONSUMPTION					
Total boiler output capacity: 000MBH					
MENU	SYS OVR	PUMP OVR	PUMP OVR	ALARMS	ALARMS

1. The box to the left of "Reset" button displays the total gas consumption in cubic feet
2. The middle box displays gas consumption rate in cubic feet / per hour
3. The right bottom box displays the thermal efficiency
4. Pressing cross mark button will close this pop-up



## 1.1.6 BOILER 1 CONTROL screen



**This screen is to control the boiler, Hand, Off, Auto and Duty mode**

1. Press the “HAND”, “OFF”, “AUTO” buttons to select the desired mode
2. The boiler mode is displayed under these buttons, no display means “N/A”
3. Press “LEAD” button to set current boiler as lead (the other boilers will reorganize as lag 1, 2 and 3)
4. When in Hand, the system will automatically start the duty pump. The boiler will start when flow is detected and the flame will be modulated to maintain the SHWST set point
5. The boiler’s duty is displayed (Lead, Lag1, Lag2, Lag3)
6. The Boiler’s status is displayed: Not Ready, Ready, Enabled, Started, Running and Alarm
7. Run time indicates the boiler’s total running time. It can be reset by pressing the displaying area
8. Flame is displayed in % value of full value
9. The calculated boiler supply temperature is displayed besides “Boiler Supply Temp:”
10. Press the buttons on the menu at the bottom to bring up the desired screen

## 1.1.7 LOGIN screen



1. In order to be able to modify any of the Setup parameters you must Login with the proper password
2. There are 3 level setup screens. Level 1 and level 2 require operator to input password. Level 0 will allow viewing the setup values only. Level 1 will allow changes to setup values and to restore the system factory defaults except for the PID parameters. Level 2 will allow changes to all the setup values, and to save or restore all the system factory defaults. All the three levels will allow controlling the pumps or boilers
3. From MAIN MENU screen, pressing the “SETUP SCREEN” button will call up this screen
4. Pressing the password area to the right of “Log In:” will pop-up this keypad, input the password through the keypad, press “Ent” button in the keypad will return to this screen or go to the screen corresponding to the password

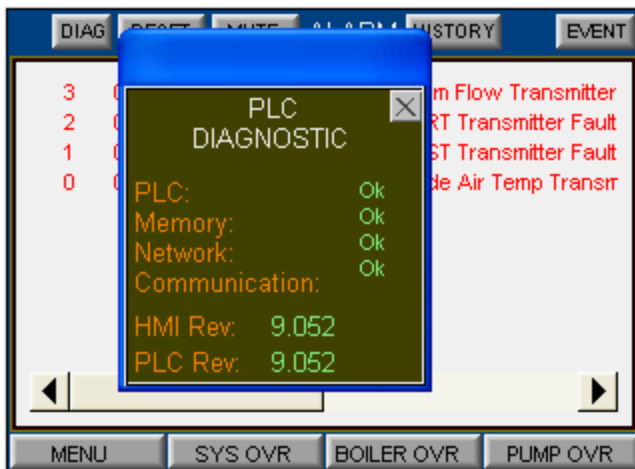
## 1.2 Alarm Management Displays

See the following table

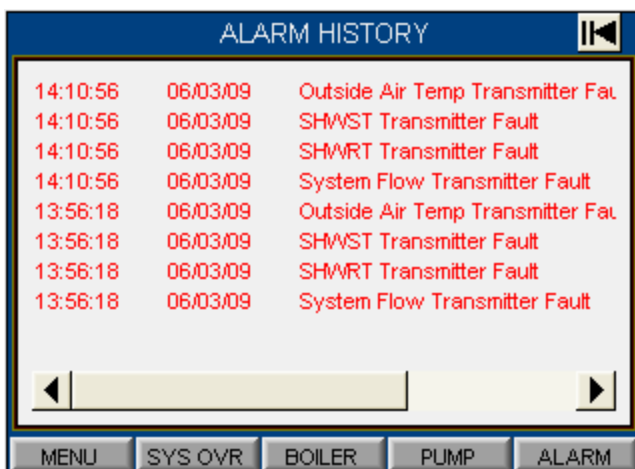
### 1.2.1 ALARMS screen



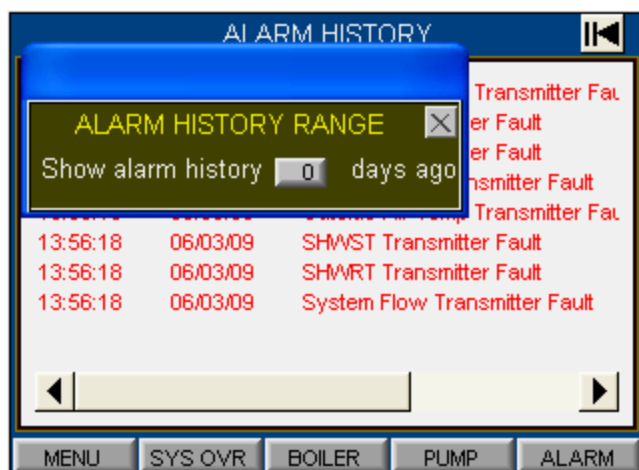
1. All alarms will be displayed in chronological order
2. The last alarm will be at the top of the screen
3. Press "DIAG" to pop up the PLC DIAGNOSTIC box
4. Press "RESET" to reset all active alarms
5. Pressing the "MUTE" button will silence the alarm Horn and stop the flashing of alarm light
6. Press the up and down arrow buttons to view more alarms
7. Press the left and right arrow buttons to view more content of alarms
8. Press the "HISTORY" button to bring up the Alarm History screen
9. Press the "EVENT" button to bring up the Event screen
10. Press the buttons on the menu at the bottom to bring up the desired screen



### 1.2.2 ALARM HISTORY screen



1. The history alarms saved in the internal memory of the HMI are displayed
2. Press the top-right button (black arrow) to select the history alarm to display. The selected number indicates the number of days before today. The history alarms will be displayed for that day
3. Press the up and down arrow buttons to view more alarms
4. Press the left and right arrow buttons to view more content of alarms
5. Press the buttons on the menu at the bottom to bring up the desired screen



## 1.2.3 EVENT screen



1. The events saved in the internal memory of the HMI are displayed
2. Press the top-right button (black arrow) to select the event to display. The selected number indicates the number of days before today. The event will be displayed for that day
3. Pressing the event displayed will bring up the event Information screen
4. Press the up and down arrow buttons to view more alarms
5. Press the left and right arrow buttons to view more content of alarms
6. Press the buttons on the menu at the bottom to bring up the desired screen

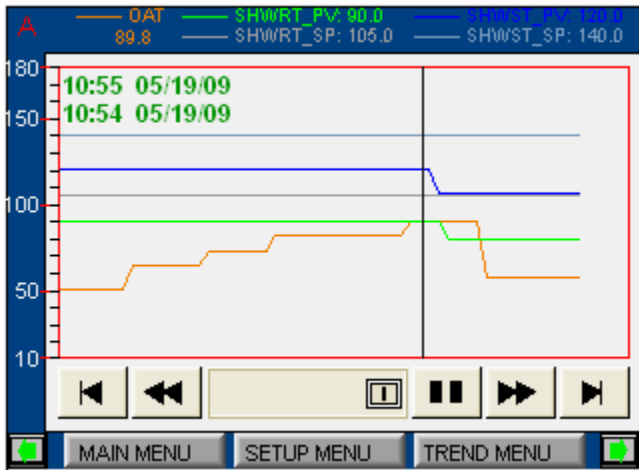
## 1.3 Trend Displays

### 1.3.0 TREND MENU



1. Touching the "TREND MENU" button from "Main Menu" will call up the Trend Menu screen
2. Touching any button from this screen will call up its corresponding trend chart display
3. Touching the "HISTORY" button will call up "Trend History Menu" screen
4. Touch the buttons on the menu at the bottom to bring up the desired screen

## 1.3.1 TREND - TEMPERATURE



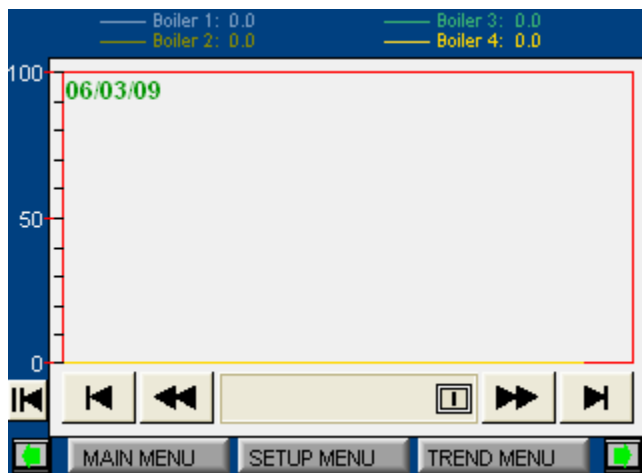
1. Touching the “TEMPERATURE” button from “TREND MENU” will call up the Temperature Chart screen. This will display 5 graphs consisting of
  - Outside Air Temperature
  - System Hot Water Return Temperature
  - System Hot Water Return Temp Setpoint
  - System Hot Water Supply Temperature
  - System Hot Water Supply Temp Setpoint
2. Touching chart display area will display a vertical line. Corresponding the time axis of the line, the values of 5 charts are displayed on top of this screen
3. The current time and the time point of the vertical line will be displayed on the left-top of the chart area
4. Touching the navigation buttons below the chart area will let you navigate the charts in different time periods
5. Touch the buttons on the menu at the bottom to bring up the desired screen

## 1.3.2 TREND – SYSTEM FLOW



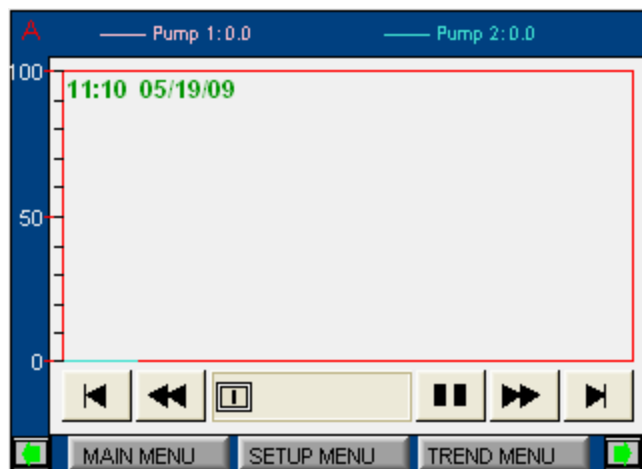
1. Touching the “SYSTEM FLOW” button from “TREND MENU” will call up the System Flow Chart screen. This will display 2 graphs consisting of
  - System Flow
  - System Flow Setpoint
2. Touching chart display area will display a vertical line. Corresponding the time axis of the line, the values of 2 charts are displayed on top of this screen
3. The current time and the time point of the vertical line will be displayed on the left-top of the chart area
4. Touching the navigation buttons below the chart area will let you navigate the charts in different time periods
5. Touch the buttons on the menu at the bottom to bring up the desired screen

## 1.3.3 TREND – BOILER FLAME



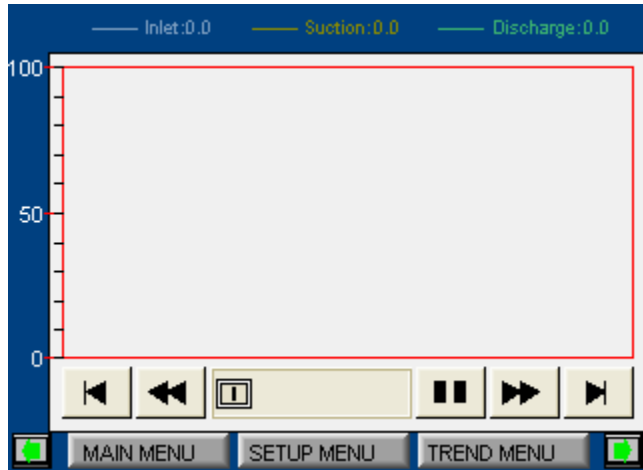
1. Touching the “BOILERS FLAME” button from “TREND MENU” will call up the Boiler Flame Chart screen. This will display maximum 4 graphs consisting of
  - Boiler 1 Flame
  - Boiler 2 Flame
  - Boiler 3 Flame
  - Boiler 4 Flame
2. The number of charts are depend on the number of boilers (Set up by ECO\*PAK MBS™ Model)
3. Touching chart display area will display a vertical line. Corresponding the time axis of the line, the values of charts are displayed on top of this screen
4. The current time and the time point of the vertical line will be displayed on the left-top of the chart area
5. Touching the navigation buttons below the chart area will let you navigate the charts in different time periods
6. Touch the buttons on the menu at the bottom to bring up the desired screen

## 1.3.4 TREND – PUMP SPEED



1. Touching the “PUMPS SPEED” button from “TREND MENU” will call up the Pump Speed Chart screen. This will display 2 graphs consisting of
  - Pump 1 Speed
  - Pump 2 Speed
2. Touching chart display area will display a vertical line. Corresponding the time axis of the line, the values of 2 charts are displayed on top of this screen
3. The current time and the time point of the vertical line will be displayed on the left-top of the chart area
4. Touching the navigation buttons below the chart area will let you navigate the charts in different time periods
5. Touch the buttons on the menu at the bottom to bring up the desired screen

## 1.3.5 TREND - PRESSURE



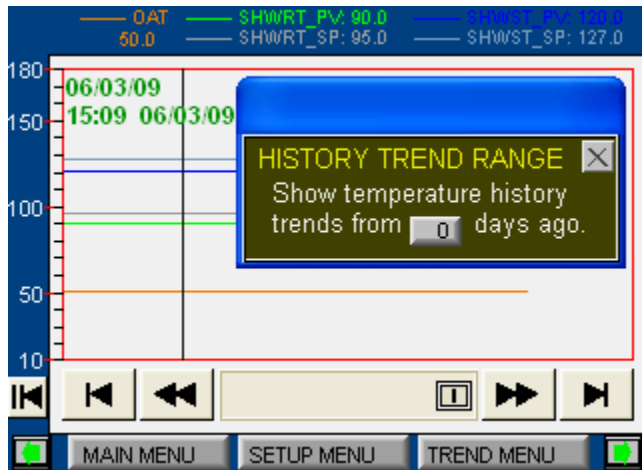
1. Touching the “PRESSURE” button from “TREND MENU” will call up the System Pressure Chart screen. This will display 3 graphs consisting of
  - The strainer Inlet Pressure
  - The Suction Pressure
  - The Discharge Pressure
2. Touching chart display area will display a vertical line. Corresponding the time axis of the line, the values of 3 charts are displayed on top of this screen
3. The current time and the time point of the vertical line will be displayed on the left-top of the chart area
4. Touching the navigation buttons below the chart area will let you navigate the charts in different time periods
5. Touch the buttons on the menu at the bottom to bring up the desired screen

## 1.3.6 TREND HISTORY - MENU



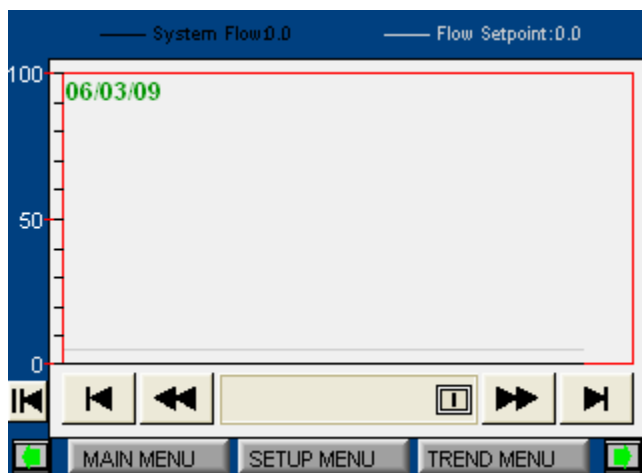
1. Touching the “HISTORY” button from “TREND MENU” will call up the Trend History Menu screen
2. Touching any button from this screen will call up its corresponding trend history chart display
3. Touching the “TREND MENU” button will go back to Trend Menu screen
4. Touching the “BACKUP TO USB” button will save history event log, alarm log and history trend data to USB within 31 days from today
5. Touch the buttons on the menu at the bottom to bring up the desired screen

## 1.3.6.1 TREND - TEMPERATURE



1. Touching the “TEMPERATURE” button from “TREND HISTORY MENU” will call up the History Temperature Chart screen. This will display 5 graphs consisting of
  - Outside Air Temperature
  - System Hot Water Return Temperature
  - System Hot Water Return Temp Setpoint
  - System Hot Water Supply Temperature
  - System Hot Water Supply Temp Setpoint
2. Touching chart display area will display a vertical line. Corresponding the time axis of the line, the values of 5 charts are displayed on top of this screen
3. The current time and the time point of the vertical line will be displayed on the left-top of the chart area
4. Touching the navigation buttons below the chart area will let you navigate the charts in different time periods
5. Touching the button to the left of navigation buttons will bring up the “History Trend Range” pop-up box to select the date to view history trend chart
6. Touch the buttons on the menu at the bottom to bring up the desired screen

## 1.3.6.2 TREND – SYSTEM FLOW



1. Touching the “SYSTEM FLOW” button from “TREND HISTORY MENU” will call up the History System Flow Chart screen. This will display 2 graphs consisting of
  - System Flow
  - System Flow Setpoint
2. Touching chart display area will display a vertical line. Corresponding the time axis of the line, the values of 2 charts are displayed on top of this screen
3. The current time and the time point of the vertical line will be displayed on the left-top of the chart area
4. Touching the navigation buttons below the chart area will let you navigate the charts in different time periods
5. Touching the button to the left of navigation buttons will bring up the “History Trend Range” pop-up box to select the date to view history trend chart
6. Touch the buttons on the menu at the bottom to bring up the desired screen

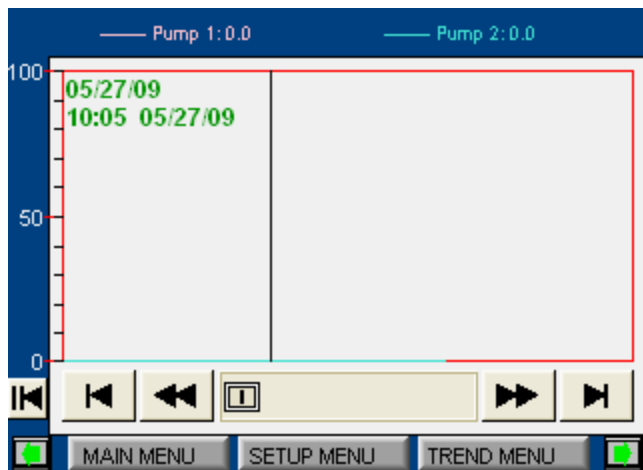


## 1.3.6.3 TREND – BOILER FLAME



1. Touching the “BOILERS FLAME” button from “TREND HISTORY MENU” will call up the History Boiler Flame Chart screen. This will display maximum 4 graphs consisting of
  - Boiler 1 Flame
  - Boiler 2 Flame
  - Boiler 3 Flame
  - Boiler 4 Flame
2. The number of charts are depend on the number of boilers (Set up by ECO\*PAK MBS™ Model)
3. Touching chart display area will display a vertical line. Corresponding the time axis of the line, the values of charts are displayed on top of this screen
4. The current time and the time point of the vertical line will be displayed on the left-top of the chart area
5. Touching the navigation buttons below the chart area will let you navigate the charts in different time periods
6. Touching the button to the left of navigation buttons will bring up the “History Trend Range” pop-up box to select the date to view history trend chart
7. Touch the buttons on the menu at the bottom to bring up the desired screen

## 1.3.6.4 TREND – PUMP SPEED



1. Touching the “PUMPS SPEED” button from “TREND HISTORY MENU” will call up the History Pump Speed Chart screen. This will display 2 graphs consisting of
  - Pump 1 Speed
  - Pump 2 Speed
2. Touching chart display area will display a vertical line. Corresponding the time axis of the line, the values of 2 charts are displayed on top of this screen
3. The current time and the time point of the vertical line will be displayed on the left-top of the chart area
4. Touching the navigation buttons below the chart area will let you navigate the charts in different time periods
5. Touching the button to the left of navigation buttons will bring up the “History Trend Range” pop-up box to select the date to view history trend chart
6. Touch the buttons on the menu at the bottom to bring up the desired screen

## 1.3.6.5 TREND - PRESSURE

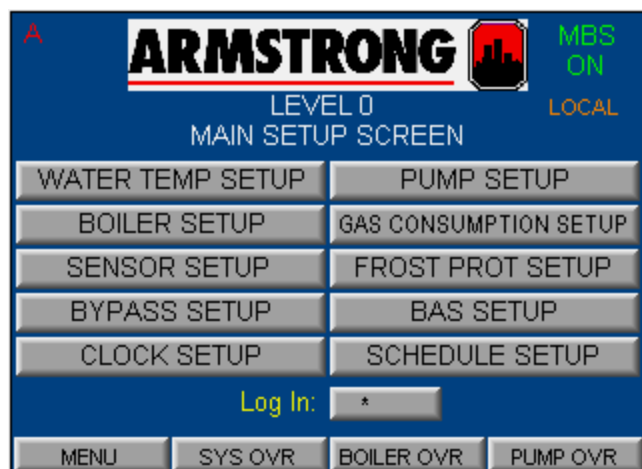


1. Touching the “PRESSURE” button from “TREND HISTORY MENU” will call up the History System Pressure Chart screen. This will display 3 graphs consisting of
  - The strainer Inlet Pressure
  - The Suction Pressure
  - The Discharge Pressure
2. Touching chart display area will display a vertical line. Corresponding the time axis of the line, the values of 3 charts are displayed on top of this screen
3. The current time and the time point of the vertical line will be displayed on the left-top of the chart area
4. Touching the navigation buttons below the chart area will let you navigate the charts in different time periods
5. Touching the button to the left of navigation buttons will bring up the “History Trend Range” pop-up box to select the date to view history trend chart
6. Touch the buttons on the menu at the bottom to bring up the desired screen

## 1.4 Level 0 Setup Displays

See the following table

### 1.4.0 LEVEL 0 SETUP MENU



1. Touching the “SETUP SCREEN” button from “Main Menu” will call up the Level 0 Setup screen
2. Pressing the password area to the right of “Log In:” will pop-up a keypad to log on to installer display or factory display
3. The top left corner of the screen will flash “A” when there is a new alarm. The “A” will be solid when the alarm is acknowledged or muted. Pressing the “A” will call up the alarm screen
4. Pressing any of the “SETUP” button will call up its corresponding Setup display
5. These displays are for viewing only. No values can be modified on these displays
6. Below are the screens that the user sees when pressing on each of those buttons
7. Touch the buttons on the menu at the bottom to bring up the desired screen
8. Touching the “Right” and “Left” arrow will navigate between the viewing only Setup Screens

## 1.4.1 SYSTEM HOT WATER TEMP SETUP

**SYSTEM HOT WATER TEMPERATURE SETPOINT SETUP**

1) Indoor temp. setpoint:  °F

2) Outside Air Temp, Min:  °F Max:  °F

	System Hot Water Temp	SHWRT	SHWST
3) Setpoint at Min OAT:	<input type="text" value="104.9"/> °F	<input type="text" value="180.0"/> °F	
4) Setpoint at Max OAT:	<input type="text" value="89.7"/> °F	<input type="text" value="100.0"/> °F	
5) Default setpoint when sensor fails:	<input type="text" value="104.9"/> °F	<input type="text" value="180.0"/> °F	
6) Calculation period:	<input type="text" value="60"/> Sec	<input type="text" value="60"/> Sec	

\* FOR VIEWING ONLY

MAIN MENU SYSTEM OVR MAIN SETUP

## 1.4.2 PUMP SETUP

**PUMP SETUP**

1) Pump minimum speed:  %

2) Pump maximum speed:  %

3) Default speed when SHWRT sensor fails:  %

4) Pump rated RPM:

5) Ramp time for pump speed:  Sec

6) Run time after emergency stop:  Min

7) Run time when all boilers off:  Min

8) Lead pump switch time:  Hrs

9) Default Settings:

MAIN MENU SYSTEM OVR MAIN SETUP

## 1.4.3 PUMP PID SETUP

**PUMP PID SETUP**

1) Enter the PID parameter for corresponding circuit:

Circuit	Small	Medium	Large
Proportional Gain	<input type="text" value="4000"/>	<input type="text" value="4000"/>	<input type="text" value="4000"/>
Integral Time	<input type="text" value="100"/>	<input type="text" value="200"/>	<input type="text" value="300"/>
Derivative Time	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>

2) Select hot water circuit size:

\* FOR VIEWING ONLY

MAIN MENU SYSTEM OVR MAIN SETUP

## 1.4.4 BOILER SETUP

**BOILER SETUP**

1) MBS model:

2) Minimum capacity setpoint:  %

3) Boiler supply temp high limit:  °F

4) Maximum time under minimum flow:  Min

5) SHWRT restart setpoint:  °F

6) Lead boiler switch time:  Hrs

7) Maximum DT across boilers:  °F

8) Maximum DT backoff factor:

\* FOR VIEWING ONLY

MAIN MENU SYSTEM OVR MAIN SETUP

## 1.4.5 BOILER STAGING SETUP

**BOILER STAGING SETUP**

1) Enter the Capacity Setpoints to Start and Stop Lag Boilers 1, 2, and 3:

Actual Flame:  %

Boiler	Stage Up	Stage Down
Lag 1	<input type="text" value="40.0"/> %	<input type="text" value=""/>
Lag 2	<input type="text" value="40.0"/> %	
Lag 3	<input type="text" value="30.0"/> %	
Delay	<input type="text" value="1"/> Min	

2) Lag Boilers Minimum Run Time:  Min

\* FOR VIEWING ONLY

MAIN MENU SYSTEM OVR MAIN SETUP

## 1.4.6 BOILER PID SETUP

**BOILER PID SETUP**

1) Enter the PID Proportional Gain:

2) Enter the PID Integral Time:

3) Enter the PID Derivative Time:

\* FOR VIEWING ONLY

MAIN MENU SYSTEM OVR MAIN SETUP

## 1.4.7 GAS CONSUMPTION SETUP

**GAS CONSUMPTION SETUP**

1) Gas pulses:

2) 1 pulse equals:  CF

\* FOR VIEWING ONLY

## 1.4.8 SENSOR SETUP 1

**SENSOR SETUP 1**

1) Outside Air Temp range:  °F

2) Outside Air Temp zero:  °F

3) Flow sensor:

4) Hot water supply flow range:  gpm

5) Hot water supply flow zero:  gpm

\* FOR VIEWING ONLY

## 1.4.9 SENSOR SETUP 2

**SENSOR SETUP 2**

1) Suction pressure range:  psi

2) Suction pressure zero:  psi

3) Discharge pressure range:  psi

4) Discharge pressure zero:  psi

5) Strainer inlet pressure range:  psi

6) Strainer inlet pressure zero:  psi

7) Default Settings:

\* FOR VIEWING ONLY

## 1.4.10 FROST PROTECTION SETUP

**FROST PROTECTION SETUP**

1) Frost protection:

2) SHWRT to start pump:  °F

3) SHWRT to start boiler:  °F

\* FOR VIEWING ONLY

## 1.4.11 BYPASS SETUP

**BYPASS VALVE SETUP**

1) Bypass valve:  °F

2) Flow setpoint:  usgpm

3) Default valve opening when sensor fails:  %

WHEN BYPASS VALVE IS OPENED AT 100%

4) Shut down lead boiler after:  Min

5) Shut down duty pump after:  Min

\* FOR VIEWING ONLY

## 1.4.12 BYPASS PID SETUP

**BYPASS VALVE PID SETUP**

1) Enter the PID Proportional Gain:

2) Enter the PID Integral Time:

3) Enter the PID Derivative Time:

\* FOR VIEWING ONLY

## 1.4.13 BAS SETUP

**BAS -- SETUP SCREEN**

1) Enter the BAS Protocol:

2) Enter the BAS Address:

3) Enter the Baud Rate:

4) Confirm that the proper interface card is installed.

\* FOR VIEWING ONLY

## 1.4.14 CLOCK SETUP

**CLOCK SETUP**

Real Time Clock	Time HH:MM:SS	Date MM/DD/YYYY	Day of week
HMI:	9 : 26 : 17	6 / 4 / 2009	Thu
PLC:	9 : 24 : 37	6 / 4 / 2009	Thu

\* FOR VIEWING ONLY

## 1.4.15 SCHEDULE SETUP

**MBS SYSTEM SCHEDULE SETUP**

1) Schedule:

2) Schedule minimum OAT:  °F

3) Schedule Clock	On Time HH:MM:SS	Off Time HH:MM:SS
Weekday:	6 : 0 : 00	18 : 0 : 00
Weekend:	11 : 0 : 00	15 : 0 : 00

\* FOR VIEWING ONLY

## INSTALLER DISPLAYS

Installer Displays include system displays, alarm management displays, trend displays and level 1 setup displays. To access level 1 setup displays the user is required a level 1 password.

### 2.1 System Displays

See previously in the Operator Displays

### 2.2 Alarm Management Displays

See previously in the Operator Displays

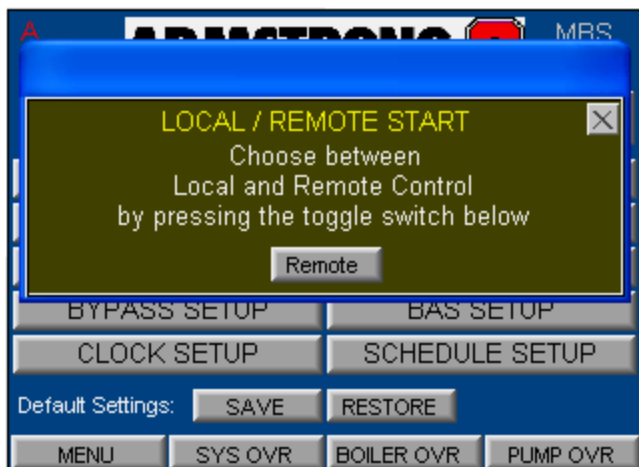
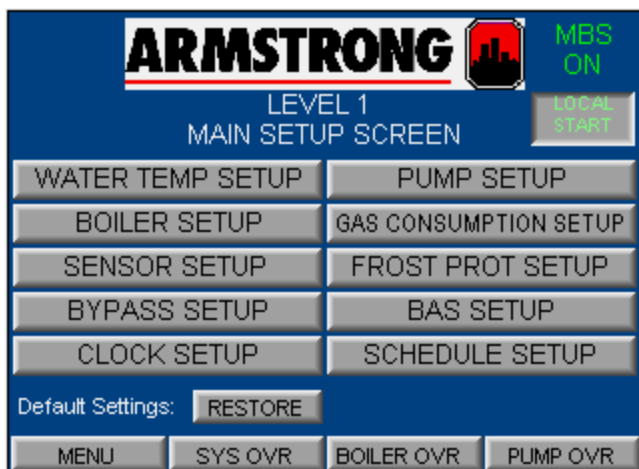
### 2.3 Trend Displays

See previously in the Operator Displays

### 2.4 Level 1 Setup Displays

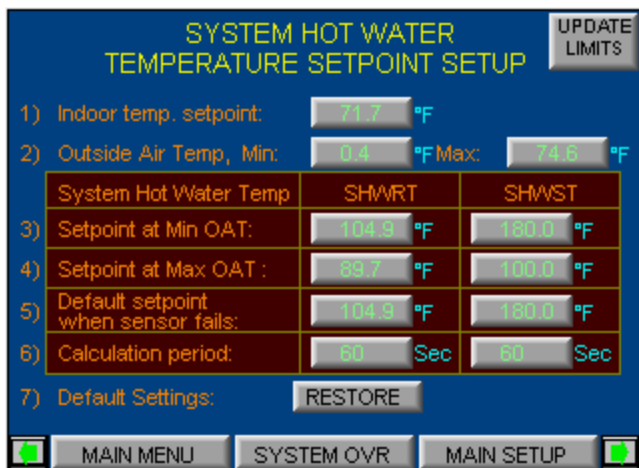
Most of the level 1 setup displays are almost the same as the level 1 setup displays, except that the user can press “Save” button to save changed values to the system factory defaults on each setup display screen. However, some different displays are listed in the following table

## 2.4.0 LEVEL 1 SETUP MENU



1. Pressing and inputting the proper password in “LEVEL 0 SETUP” screen will call up the Level 1 Setup screen
2. Pressing the “LOCAL/REMOTE START” button will pop-up a box to switch ECO\*PAK MBS™ between “LOCAL” and “REMOTE” status (next picture). Under local status ECO\*PAK MBS™ will be started immediately. Under remote status ECO\*PAK MBS™ will be stopped, or started by BAS or the customer’s hardwire contact
3. The top left corner of the screen will flash “A” when there is a new alarm. The “A” will be solid when the alarm is acknowledged or muted. Pressing the “A” will call up the alarm screen
4. Pressing any of the “SETUP” button will call up its corresponding Setup display. These displays are for changing the system setup and restoring the system factory defaults
5. PID setup displays are for viewing only
6. After changing values in any setup screens, should you want to regain the previous saved values, press “Restore” button to retrieve all the setup values from the system factory defaults
7. Below are the screens that the user sees when pressing on each of those buttons
8. Touch the buttons on the menu at the bottom to bring up the desired screen
9. Touching the “Right” and “Left” arrow will navigate between the Level 1 Setup Screens

### 2.4.1 SYSTEM HOT WATER TEMP SETUP

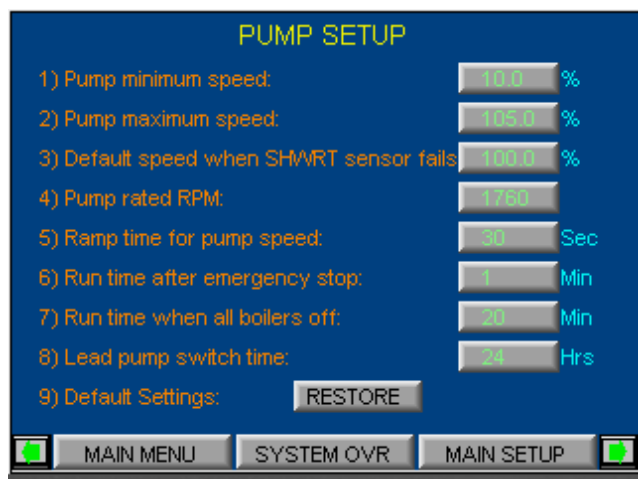


1. Touching the “WATER TEMP SETUP” button from “LEVEL 1 MAIN SETUP” screen will call up the System Hot Water Temperature Setpoint Setup screen
2. Indoor Temperature setpoint, Minimum OAT, Maximum OAT, Minimum OAT SHWRT, Minimum OAT SHWST, Maximum OAT SHWST, Maximum OAT SHWST. Contact S.A.Armstrong for information on these parameters
3. Enter the default SHWST and SHWRT set-point. When the OAT sensor returns an error value, SHWST and SHWRT set-point will be set at the value entered
4. After input the ‘Setpoint at Min OAT’, ‘Setpoint at Max OAT’, ‘Default setpoint when sensor fails’, and

'Schedule minimum OAT' in "SCHEDULE SETUP" screen, press "UPDATE LIMITS" button to make sure the values are within the limits

5. Enter calculation period for the SHWST and SHWRT set-point
6. Press "Restore" button to retrieve SHWT set-point setup values from the system factory defaults
7. Touch the buttons on the menu at the bottom to bring up the desired screen

## 2.4.2 PUMP SETUP



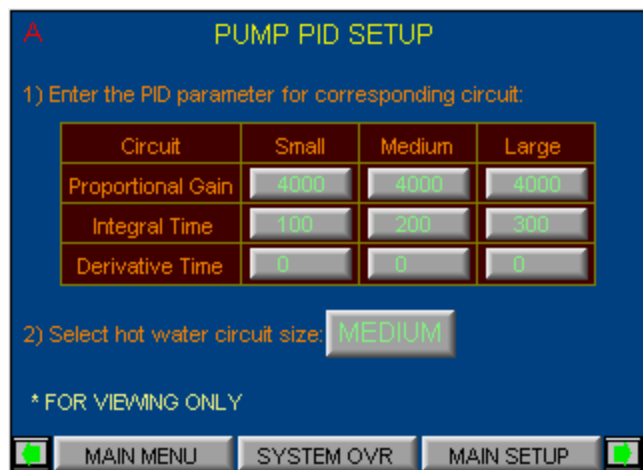
**PUMP SETUP**

- 1) Pump minimum speed:  %
- 2) Pump maximum speed:  %
- 3) Default speed when SHWRT sensor fails:  %
- 4) Pump rated RPM:
- 5) Ramp time for pump speed:  Sec
- 6) Run time after emergency stop:  Min
- 7) Run time when all boilers off:  Min
- 8) Lead pump switch time:  Hrs
- 9) Default Settings:

MAIN MENU SYSTEM OVR MAIN SETUP

1. From "LEVEL 1 MAIN SETUP" press on "PUMP SETUP" to call up this screen
2. Enter the pump minimum speed. The minimum speed the pump will be allowed to run in Auto or Hand mode
3. Enter the pump maximum speed. The maximum speed the pump will be allowed to run in Auto or Hand mode
4. Enter the pump default speed. If SHWRT sensor fails, the running pump in Auto mode will have its speed set to the default speed
5. Enter the pump rated RPM as indicated on the motor
6. Enter the speed ramp time. The minimum amount of time it will take the pumps to increase the speed from 0% to 100% or to decrease the speed from 100% to 0%
7. Enter the pump run time. After an emergent stop, the pump will continue to run for this period of time
8. Enter the pump run time. When all boilers are off the pump will continue to run for this period of time
9. Enter the lead pump switch time. After the duty pump runs for the entered amount of hours, the standby pump will switch to lead
10. Press "Restore" button to retrieve pump setup values from the system factory defaults
11. Touch the buttons on the menu at the bottom to bring up the desired screen

## 2.4.3 PUMP PID SETUP



**PUMP PID SETUP**

1) Enter the PID parameter for corresponding circuit:

Circuit	Small	Medium	Large
Proportional Gain	<input type="text" value="4000"/>	<input type="text" value="4000"/>	<input type="text" value="4000"/>
Integral Time	<input type="text" value="100"/>	<input type="text" value="200"/>	<input type="text" value="300"/>
Derivative Time	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>

2) Select hot water circuit size:

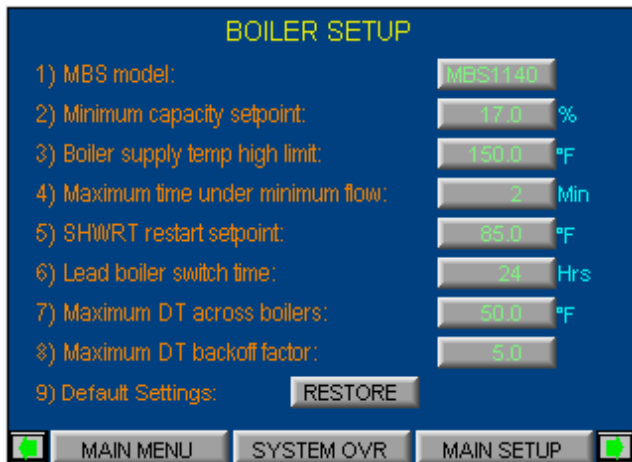
\* FOR VIEWING ONLY

MAIN MENU SYSTEM OVR MAIN SETUP

**This screen is for viewing only**

1. Press bottom right navigation button from "PUMP SETUP" to bring up this screen
2. Touch the buttons on the menu at the bottom to bring up the desired screen

## 2.4.4 BOILER SETUP



**BOILER SETUP**

- 1) MBS model: MBS1140
- 2) Minimum capacity setpoint: 17.0 %
- 3) Boiler supply temp high limit: 150.0 °F
- 4) Maximum time under minimum flow: 2 Min
- 5) SHWRT restart setpoint: 65.0 °F
- 6) Lead boiler switch time: 24 Hrs
- 7) Maximum DT across boilers: 50.0 °F
- 8) Maximum DT backoff factor: 5.0
- 9) Default Settings: RESTORE

MAIN MENU SYSTEM OVR MAIN SETUP

1. Press "BOILER SETUP" button from "LEVEL 1 MAIN SETUP" to bring up this screen
2. Touching the MBS model beside the description will toggle between "MBS 420", "MBS 570", "MBS 630", "MBS 855" and "MBS 1140". MBS 420 represents 2 boilers with capacity of 210 BTU/hr ea. MBS 570 represents 2 boilers with capacity of 285 BTU/hr ea. MBS 630 represents 3 boilers with capacity of 210 BTU/hr ea. MBS 855 represents 3 boilers with capacity of 285 BTU/hr ea. MBS 1140 represents 4 boilers with capacity of 285 BTU/hr ea.
3. Enter the minimum running capacity for boiler. Boilers should not operate at less than the minimum capacity.
4. Enter the high limit of Boiler Supply Temperature (BST). If BST is approaching its high limit, the lag boiler shall be added on to maintain BST below its high limit.
5. Enter the period of time to operate boilers under minimum flow. After this period of time, lead boiler shall be shut down.
6. Enter SHWRT restart set-point. When the actual SHWRT is lower than this set-point, system will start the lead boiler
7. Enter the lead boiler switch time. After the lead boiler runs for the entered amount of hours the lead boiler will transfer lead to the lag boiler (Lag 1)
8. Enter the differential temperature set-point between SHWST and SHWRT. When the actual DT is approaching this set-point, all the boilers are going to reduce their capacity by an amount determined by the back-off factor. If DT remains high, the boiler will shutdown
9. Enter the back-off factor. Determines how fast the boiler capacity is reduced
10. Press "Restore" button to retrieve boiler setup values from the system factory defaults
11. Touch the buttons on the menu at the bottom to bring up the desired screen



## 2.4.5 BOILER STAGING SETUP

**BOILER STAGING SETUP**

1) Enter the Capacity Setpoints to Start and Stop Lag Boilers 1, 2, and 3:

Actual Flame: 0.0 %

Boiler	Stage Up	Stage Down
Lag 1	40.0 %	
Lag 2	40.0 %	17.0 %
Lag 3	30.0 %	
Delay	1 Min	

2) Lag Boilers Minimum Run Time: 2 Min

3) Default Settings: **RESTORE**

MAIN MENU SYSTEM OVR MAIN SETUP

1. Press bottom right navigation button from “BOILER SETUP” to bring up this screen
2. Enter the stage up capacity for “Lag1”, “Lag2” and “Lag3” boilers in the boxes beside the descriptions. When the capacity of lead boiler reaches the corresponding capacity entered above for a specific time, the corresponding lag boiler shall be staged up
3. Enter the stage down capacity for all the lag boilers. When the capacity of lead boiler goes below this value for a specific time, the last lag boiler shall be staged down
4. Enter the delay time for staging up or staging down
5. Enter minimum run time for boilers. The minimum run time the boilers are going to run after they are started
6. Press “Restore” button to retrieve boiler sequencing setup values from the system factory defaults
7. Touch the buttons on the menu at the bottom to bring up the desired screen

## 2.4.6 BOILER PID SETUP

**BOILER PID SETUP**

1) Enter the PID Proportional Gain: 4000

2) Enter the PID Integral Time: 10

3) Enter the PID Derivative Time: 0

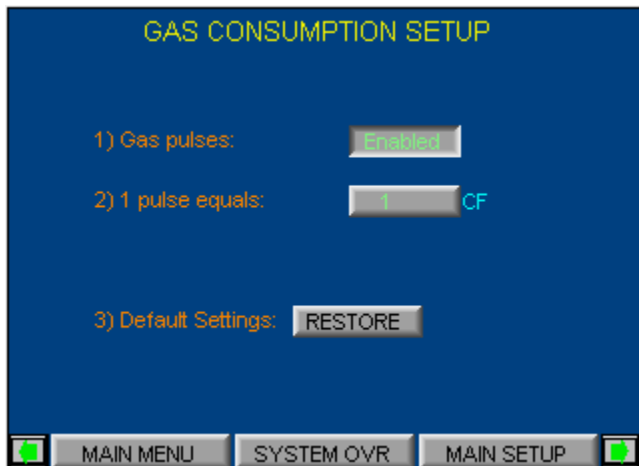
\* FOR VIEWING ONLY

MAIN MENU SYSTEM OVR MAIN SETUP

**This screen is for viewing only**

1. Press bottom right navigation button from “BOILER SETUP” to bring up this screen
2. Touch the buttons on the menu at the bottom to bring up the desired screen

## 2.4.7 GAS CONSUMPTION SETUP



**GAS CONSUMPTION SETUP**

1) Gas pulses: Enabled

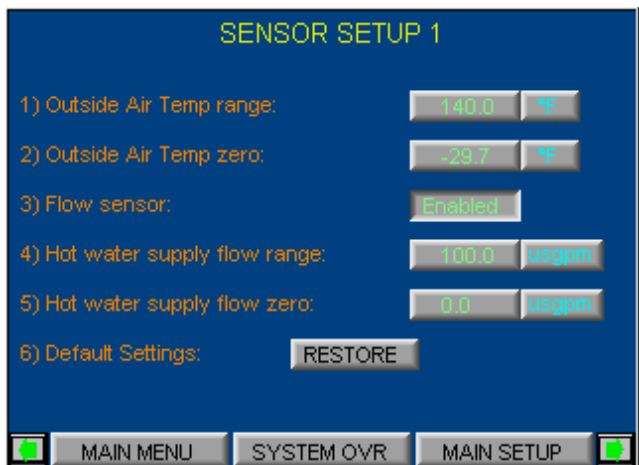
2) 1 pulse equals: 1 CF

3) Default Settings: RESTORE

MAIN MENU SYSTEM OVR MAIN SETUP

1. Press "GAS CONSUMPTION SETUP" button from "LEVEL 1 MAIN SETUP" to bring up this screen
2. Gas Pulses can be enabled to measure the gas consumption when the gas meter is installed in the system
3. Enter the magnitude of each pulse in Cubic Feet
4. Press "Restore" button to retrieve gas consumption setup values from the system factory defaults
5. Touch the buttons on the menu at the bottom to bring up the desired screen

## 2.4.8 SENSOR SETUP 1



**SENSOR SETUP 1**

1) Outside Air Temp range: 140.0 F

2) Outside Air Temp zero: -29.7 F

3) Flow sensor: Enabled

4) Hot water supply flow range: 100.0 usgpm

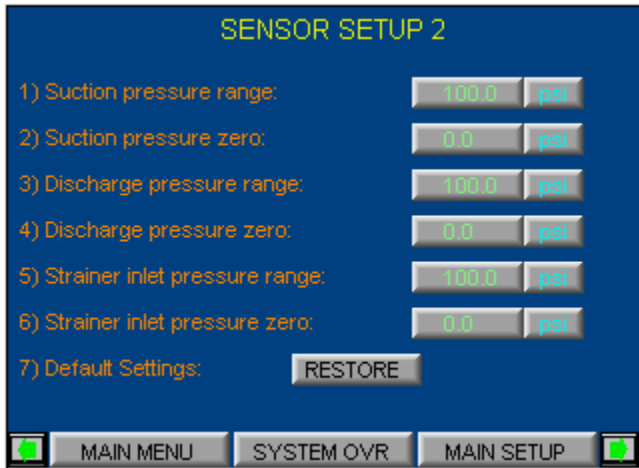
5) Hot water supply flow zero: 0.0 usgpm

6) Default Settings: RESTORE

MAIN MENU SYSTEM OVR MAIN SETUP

1. Press "SENSOR SETUP" button from "LEVEL 1 MAIN SETUP" to bring up this screen
2. Press the first two boxes to enter the range for outside air temperature sensor and toggle the temperature unit between "°F" and "°C"
3. Press the second two boxes to enter the zero (the lowest measure value) for outside air temperature sensor and toggle the temperature unit between "°F" and "°C"
4. Flow sensor can be enabled when the flow sensor is installed in the system
5. Press the boxes beside the "flow range" to enter flow sensor's range and toggle the flow unit among "usgpm", "lps", and "m³/hr"
6. Press the boxes beside the "flow zero" to enter flow sensor's zero (the lowest measure value) and toggle the flow unit among "usgpm", "lps", and "m³/hr"
7. Press "Restore" button to retrieve sensor setup 1 values from the system factory defaults
8. Touch the buttons on the menu at the bottom to bring up the desired screen

## 2.4.9 SENSOR SETUP 2



**SENSOR SETUP 2**

1) Suction pressure range: 100.0 psi

2) Suction pressure zero: 0.0 psi

3) Discharge pressure range: 100.0 psi

4) Discharge pressure zero: 0.0 psi

5) Strainer inlet pressure range: 100.0 psi

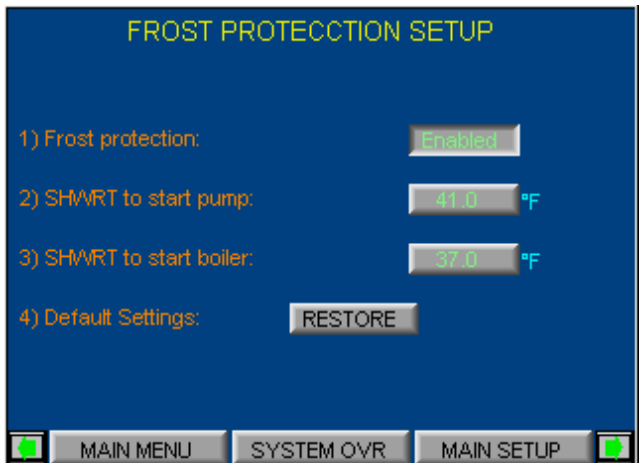
6) Strainer inlet pressure zero: 0.0 psi

7) Default Settings: RESTORE

MAIN MENU SYSTEM OVR MAIN SETUP

1. Press bottom right navigation button from "SENSOR SETUP 1" to bring up this screen
2. Press the first two boxes in column 1 to enter the range and zero for system suction pressure sensor
3. Press the second two boxes in column 1 to enter the range and zero for system discharge pressure sensor
4. Press the third two boxes in column 1 to enter the range and zero for system strainer inlet pressure sensor
5. Press any box in column 2 to toggle the pressure unit among "psi", "ft", "KPa", "m" and "bar"
6. Press "Restore" button to retrieve sensor setup 2 values from the system factory defaults
7. Touch the buttons on the menu at the bottom to bring up the desired screen

## 2.4.10 FROST PROTECTION SETUP



**FROST PROTECTION SETUP**

1) Frost protection: Enabled

2) SHWRT to start pump: 41.0 °F

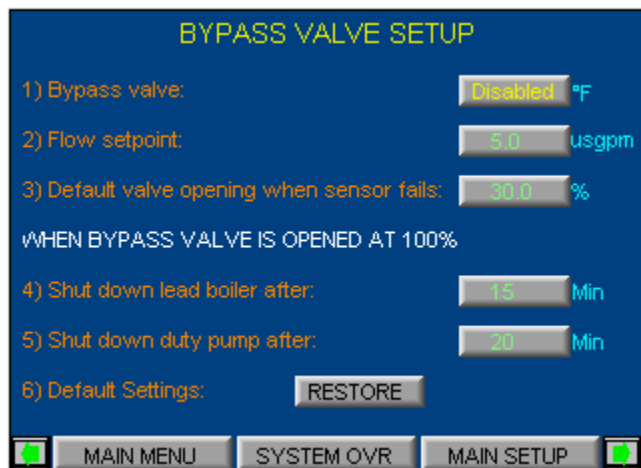
3) SHWRT to start boiler: 37.0 °F

4) Default Settings: RESTORE

MAIN MENU SYSTEM OVR MAIN SETUP

1. Press "FROST PROT SETUP" button from "LEVEL 1 MAIN SETUP" to bring up this screen
2. Frost protection can be enabled or disabled
3. Enter SHWRT set-point 1. When SHWRT drops below this value, duty pump will be started at the minimum speed
4. Enter SHWRT set-point 2. When SHWRT drops below this value, lead boiler will be started at the minimum capacity
5. Press "Restore" button to retrieve frost protection setup values from the system factory defaults
6. Touch the buttons on the menu at the bottom to bring up the desired screen

## 2.4.11 BYPASS SETUP



**BYPASS VALVE SETUP**

1) Bypass valve: Disabled \*F

2) Flow setpoint: 5.0 usgpm

3) Default valve opening when sensor fails: 30.0 %

WHEN BYPASS VALVE IS OPENED AT 100%

4) Shut down lead boiler after: 15 Min

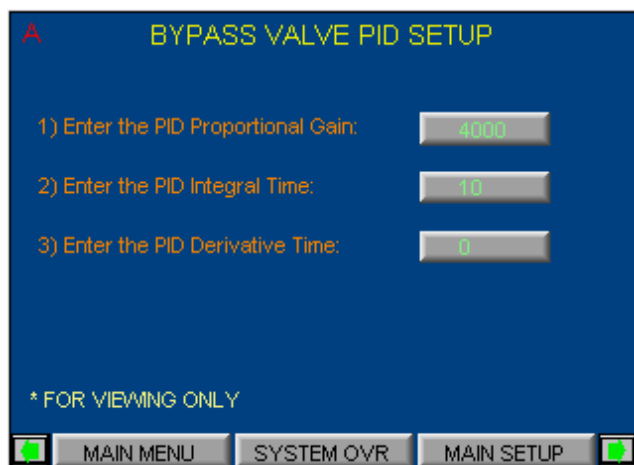
5) Shut down duty pump after: 20 Min

6) Default Settings: RESTORE

MAIN MENU SYSTEM OVR MAIN SETUP

1. Press “BYPASS SETUP” button from “LEVEL 1 MAIN SETUP” to bring up this screen
2. Bypass valve can be enabled if it is installed in the system
3. Enter the flow set-point (per boiler). When the flow is lower than this value, bypass valve opens and tries to maintain the flow above the set-point
4. Enter the default value of bypass valve. When the flow sensor fails, the bypass valve will open at this value
5. Enter the time to keep lead boiler running when the bypass valve is (100%) open
6. Enter the time to keep duty pump running when the bypass valve is (100%) open
7. Press “Restore” button to retrieve bypass valve setup values from the system factory defaults
8. Touch the buttons on the menu at the bottom to bring up the desired screen

## 2.4.12 BYPASS PID SETUP



**BYPASS VALVE PID SETUP**

1) Enter the PID Proportional Gain: 4000

2) Enter the PID Integral Time: 10

3) Enter the PID Derivative Time: 0

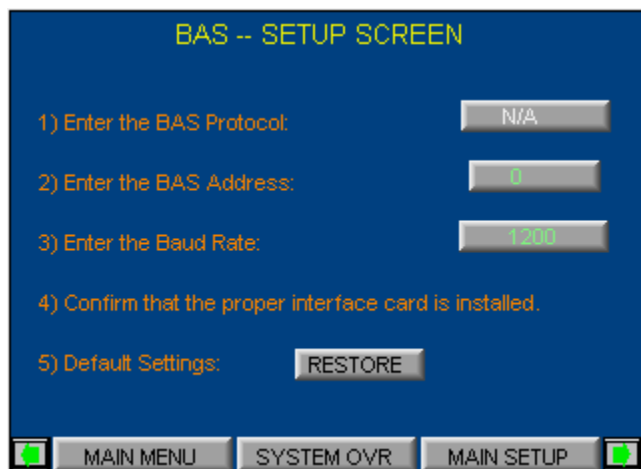
\* FOR VIEWING ONLY

MAIN MENU SYSTEM OVR MAIN SETUP

**This screen is for viewing only**

1. Press bottom right navigation button from “BYPASS VALVE SETUP” to bring up this screen
2. Touch the buttons on the menu at the bottom to bring up the desired screen

## 2.4.13 BAS SETUP



**BAS -- SETUP SCREEN**

1) Enter the BAS Protocol: N/A

2) Enter the BAS Address: 0

3) Enter the Baud Rate: 1200

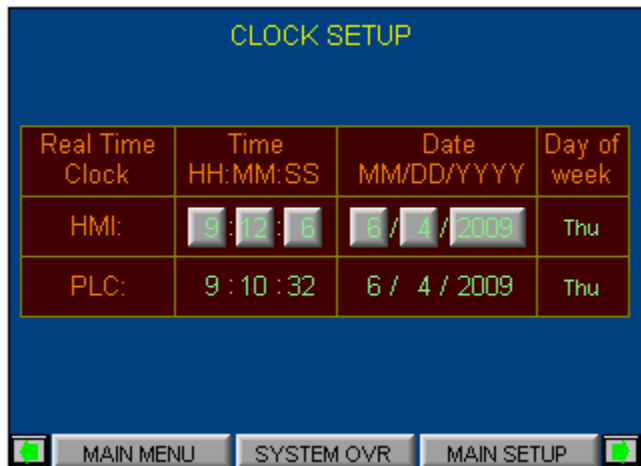
4) Confirm that the proper interface card is installed.

5) Default Settings: RESTORE

MAIN MENU SYSTEM OVR MAIN SETUP

1. From “LEVEL 1 MAIN SETUP” press on “BAS Setup” to set the protocol used to communicate between the ECO\*PAK MBS™ Controller and the BAS
2. Check that the proper hardware is installed in the ECO\*PAK MBS™ controller panel
3. Select the BAS communication protocol by pressing the protocol box to toggle between “Modbus”, “LonWorks”, and “BacNet”
4. Enter the network address as specified by the Building Management Administrator
5. Select the BAS communication baud rate as specified by the Building Management Administrator
6. Press “Restore” button to retrieve bas setup values from the system factory defaults
7. Touch the buttons on the menu at the bottom to bring up the desired screen

## 2.4.14 CLOCK SETUP

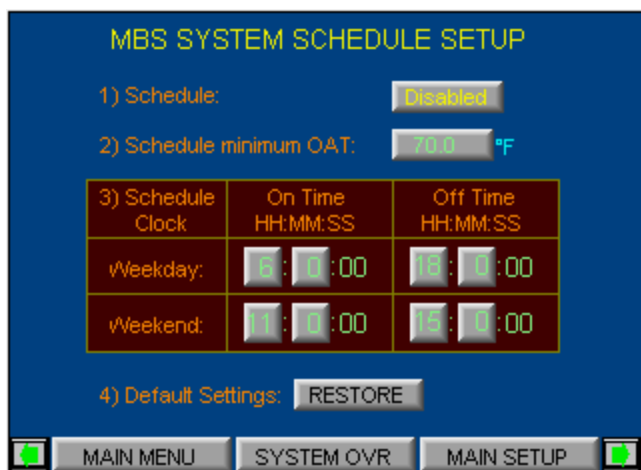


Real Time Clock	Time HH:MM:SS	Date MM/DD/YYYY	Day of week
HMI:	9:12:6	6/4/2009	Thu
PLC:	9:10:32	6/4/2009	Thu

MAIN MENU SYSTEM OVR MAIN SETUP

1. From the “LEVEL 1 MAIN SETUP” press “Clock Setup” button to call up this screen to adjust the time in the HMI and display the time in the PLC
2. The HMI time and date can be adjusted by pressing the individual hour, minute, month, day, year and day of the week box and entering the corresponding value
3. Touch the buttons on the menu at the bottom to bring up the desired screen

## 2.4.15 SCHEDULE SETUP



1) Schedule: Disabled

2) Schedule minimum OAT: 70.0 °F

3) Schedule Clock	On Time HH:MM:SS	Off Time HH:MM:SS
Weekday:	6:00:00	18:00:00
Weekend:	11:00:00	15:00:00

4) Default Settings: RESTORE

MAIN MENU SYSTEM OVR MAIN SETUP

1. Press “SCHEDULE SETUP” button from “LEVEL 1 MAIN SETUP” to bring up this screen
2. Schedule can be enabled or disabled by pressing the box beside the “schedule” text
3. Press the next box to enter minimum Outside Air Temperature. When the OAT is lower than the value, system schedule is enabled
4. Enter the on and off time respectively for weekday and weekend. When the time is inside the range, the MBS is enabled
5. Press “Restore” button to retrieve schedule setup values from the system factory defaults
6. Touch the buttons on the menu at the bottom to bring up the desired screen

## FACTORY DISPLAYS

Factory Displays include system displays, alarm management displays, trend displays and level 2 setup displays. To access level 2 setup displays the user is required a level 2 password.

### 3.1 System Displays

See previously in the Operator Displays

### 3.2 Alarm Management Displays

See previously in the Operator Displays

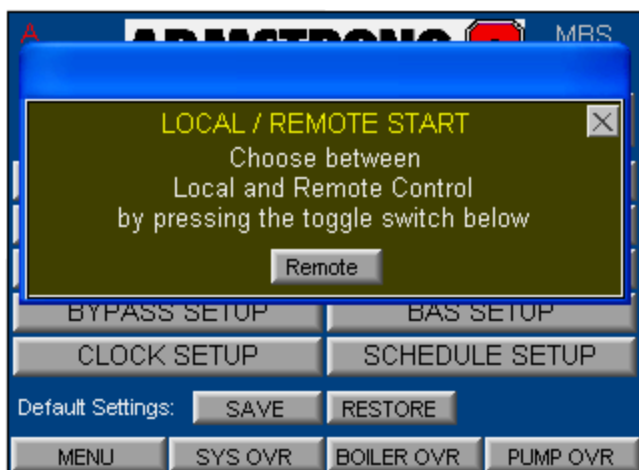
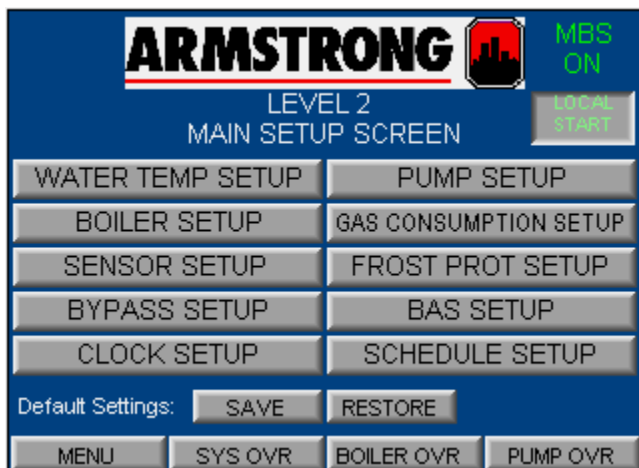
### 3.3 Trend Displays

See previously in the Operator Displays

### 3.4 Level 1 Setup Displays

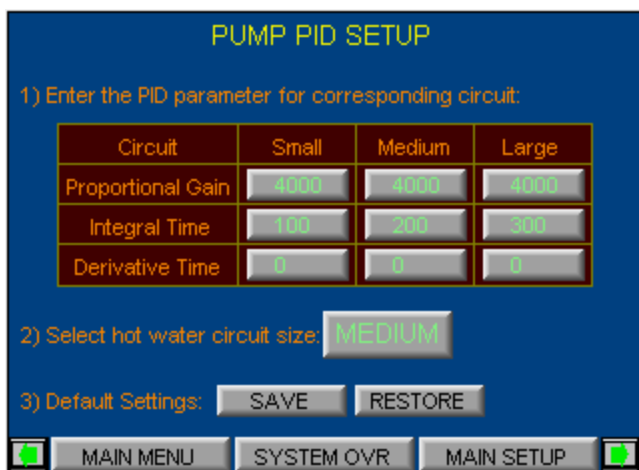
Most of the level 2 setup displays are almost the same as the level 1 setup displays, except that the user can press “Save” button to save changed values to the system factory defaults on each setup display screen. However, some different displays are listed in the following table

## 3.4.0 LEVEL 2 SETUP MENU



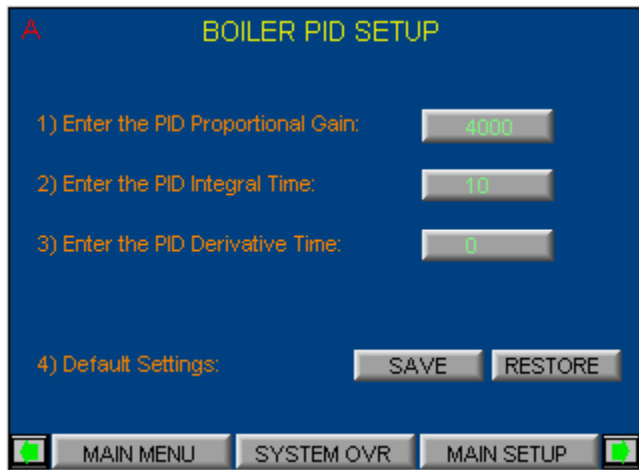
1. Pressing and inputting the proper password in "LEVEL 0 SETUP" screen will call up the Level 2 Setup screen
2. Pressing the "LOCAL/REMOTE START" button will pop-up a box to switch MBS between "LOCAL" and "REMOTE" status (next picture). Under local status MBS will be started immediately. Under remote status MBS will be closed, or started by BAS or the customer's hardwire contact
3. The top left corner of the screen will flash "A" when there is a new alarm. The "A" will be solid when the alarm is acknowledged or muted. Pressing the "A" will call up the alarm screen
4. Pressing any of the "SETUP" button will call up its corresponding Setup display. These displays are for changing the system setup, saving and restoring the system factory defaults
5. After changing values in any setup screens, press "Save" button to save all the changes as system factory defaults
6. After changing values in any setup screens, should you want to regain the previous saved values, press "Restore" button to retrieve all the setup values from the system factory defaults
7. Below are the screens that the user sees when pressing on each of those buttons
8. Touch the buttons on the menu at the bottom to bring up the desired screen
9. Touching the "Right" and "Left" arrow will navigate between the Level 2 Setup Screens

### 3.4.1 PUMP PID SETUP



1. Press bottom right navigation button from "PUMP SETUP" to bring up this screen
2. There are three groups of proportional gain, integral gain and derivative gain for small, medium and large size circuit. The PID modulation is based on the parameters in the group selected beside the description of "Select hot water circuit size:"
3. Enter the P, I and D parameters for selected circuit
4. Press "Save" button to save changed values to the system factory defaults, press "Restore" button to retrieve pump PID setup value from the system factory defaults
5. Touch the buttons on the menu at the bottom to bring up the desired screen

## 3.4.2 BOILER PID SETUP



**BOILER PID SETUP**

1) Enter the PID Proportional Gain: 4000

2) Enter the PID Integral Time: 10

3) Enter the PID Derivative Time: 0

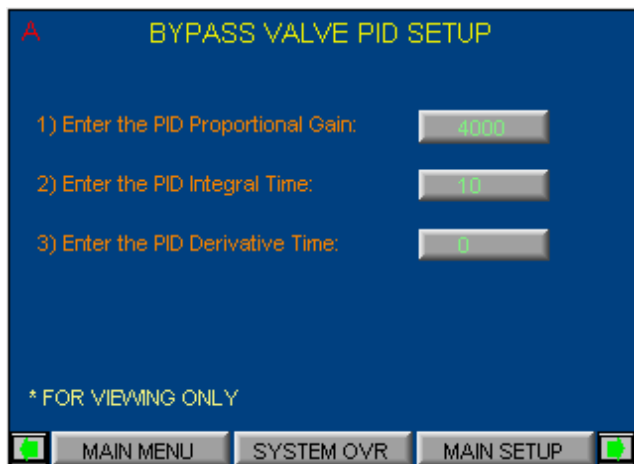
4) Default Settings: SAVE RESTORE

MAIN MENU SYSTEM OVR MAIN SETUP

1. Press bottom right navigation button from “BOILER SETUP” to bring up this screen, in order to set the Proportional, Integral and Derivative gains to be used for controlling boiler
2. Enter a proportional gain. Increasing the value will slow down the speed reaction to a system step change. Decreasing the value will increase the speed reaction to a system step change
3. Enter the Integral time gain. Increasing the value will slow down the speed reaction to a system step change. Decreasing the value will increase the speed reaction to a system step change
4. Enter the D derivative time. Increasing the value will increase the speed reaction to a system step change. Decreasing the value will decrease the speed reaction to a system step change
5. Press “Save” button to save changed values to the system factory defaults, press “Restore” button to retrieve pump PID setup value from the system factory defaults
6. Touch the buttons on the menu at the bottom to bring up the desired screen

**NOTE: The D gain is rarely used in HVAC applications; this parameter is used only when the changes in the controlled variable are rapid**

## 3.4.3 BYPASS PID SETUP



**BYPASS VALVE PID SETUP**

1) Enter the PID Proportional Gain: 4000

2) Enter the PID Integral Time: 10

3) Enter the PID Derivative Time: 0

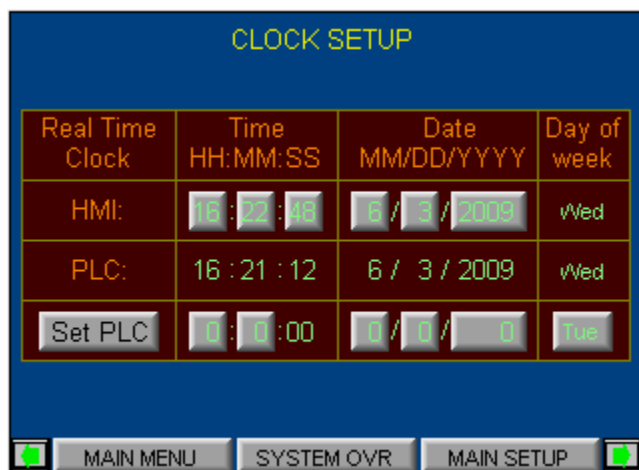
\* FOR VIEWING ONLY

MAIN MENU SYSTEM OVR MAIN SETUP

1. Press bottom right navigation button from “BOILER SETUP” to bring up this screen, in order to set the Proportional, Integral and Derivative gains to be used for controlling bypass valve
2. Enter a proportional gain. Increasing the value will slow down the speed reaction to a system step change. Decreasing the value will increase the speed reaction to a system step change
3. Enter the Integral time gain. Increasing the value will slow down the speed reaction to a system step change. Decreasing the value will increase the speed reaction to a system step change
4. Enter the D derivative time. Increasing the value will increase the speed reaction to a system step change. Decreasing the value will decrease the speed reaction to a system step change

**NOTE: The D gain is rarely used in HVAC applications; this parameter is used only when the changes in the controlled variable are rapid**

## 3.4.4 CLOCK SETUP



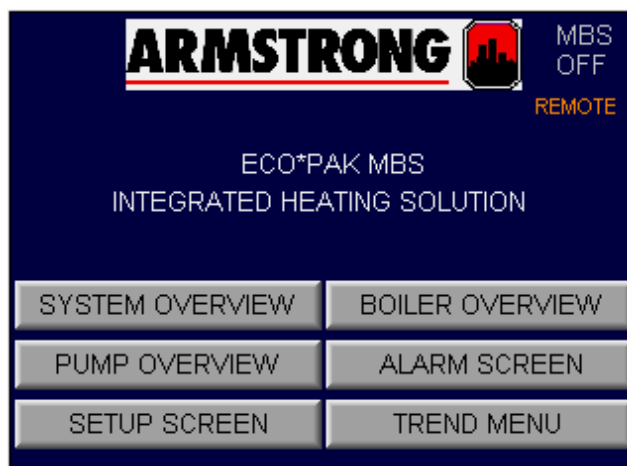
Real Time Clock	Time HH:MM:SS	Date MM/DD/YYYY	Day of week
HMI:	16:22:16	6 / 3 / 2009	Wed
PLC:	16:21:12	6 / 3 / 2009	Wed
Set PLC	0:0:00	0 / 0 / 0	Tue


MAIN MENU SYSTEM OVR MAIN SETUP

1. From the "LEVEL 2 MAIN SETUP" press "Clock Setup" button to call up this screen to adjust the time in the HMI and the time in the PLC
2. The HMI time and date can be adjusted by pressing the individual hour, minute, second, month, day, year box and entering the corresponding value. The day of the week will be changed automatically
3. The system (PLC) time and date can be adjusted by pressing the individual hour, minute, month, day, year and day of the week box and entering the corresponding value
4. Press "Set PLC" button to write the displayed time and date to system
5. Touch the buttons on the menu at the bottom to bring up the desired screen

## SYSTEM START-UP PROCEDURE

1. Ensure that the proper power supply is connected to the ECO\*PAK MBS™ as per specification
2. Turn on the main power disconnect on the door of ECO\*PAK MBS™ controller
3. Touch the 'SETUP SCREEN' button in the main menu screen



**ARMSTRONG**  MBS OFF REMOTE

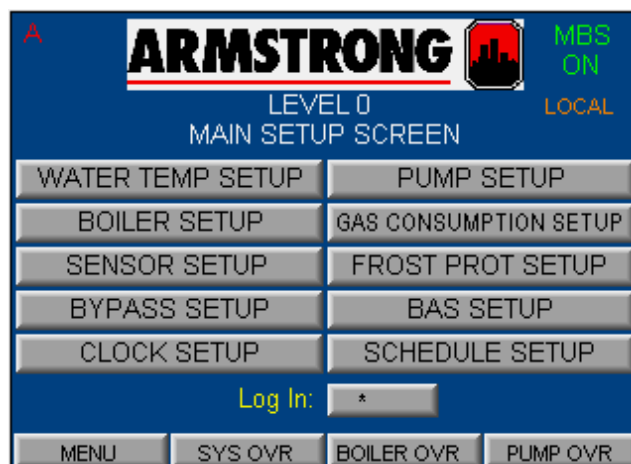
ECO\*PAK MBS  
INTEGRATED HEATING SOLUTION


SYSTEM OVERVIEW BOILER OVERVIEW

PUMP OVERVIEW ALARM SCREEN

SETUP SCREEN TREND MENU

4. The screen changes to 'LEVEL 0 MAIN SETUP SCREEN'. Press the button beside the text of 'Log In:'



**ARMSTRONG**  MBS ON LOCAL

LEVEL 0  
MAIN SETUP SCREEN

WATER TEMP SETUP PUMP SETUP

BOILER SETUP GAS CONSUMPTION SETUP

SENSOR SETUP FROST PROT SETUP

BYPASS SETUP BAS SETUP

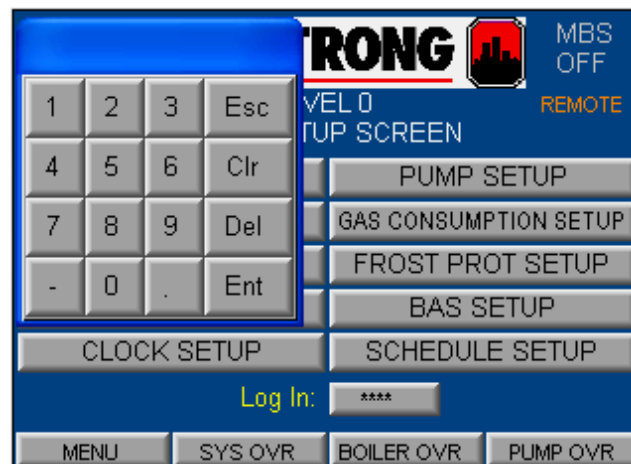
CLOCK SETUP SCHEDULE SETUP

Log In: \*

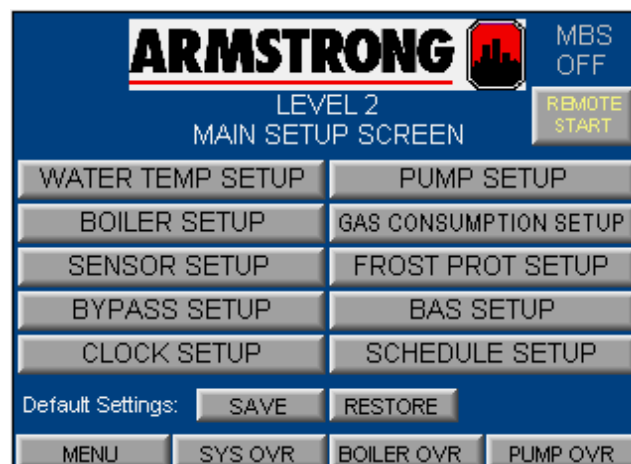
MENU SYS OVR BOILER OVR PUMP OVR



5. A keypad pops up. Touch the level 1 or level 2 password, then press 'Ent'



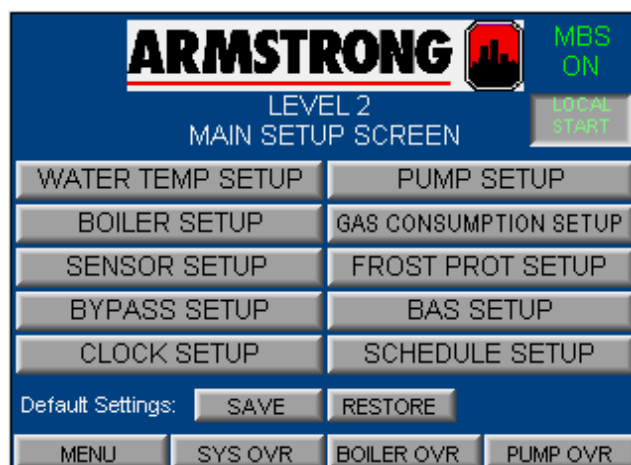
6. The screen changes to 'LEVEL 1 MAIN SETUP SCREEN' or 'LEVEL 2 MAIN SETUP SCREEN'. Press the button on the top-right corner indicated as 'REMOTE START'



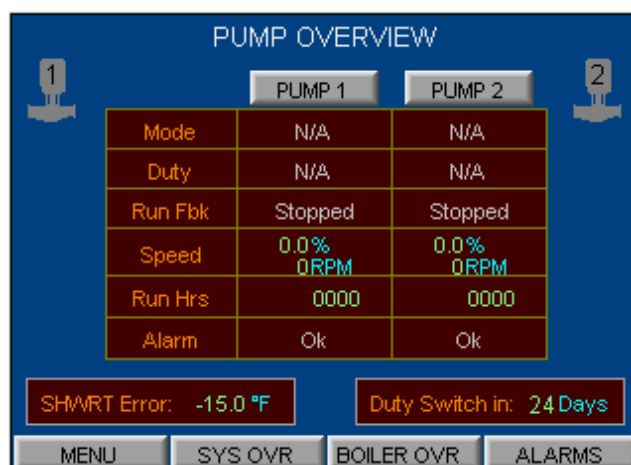
7. A pop-up window displays. Press the button indicated as 'Remote' and the button will show as 'Local'. Close the window by touching the crossing mark button



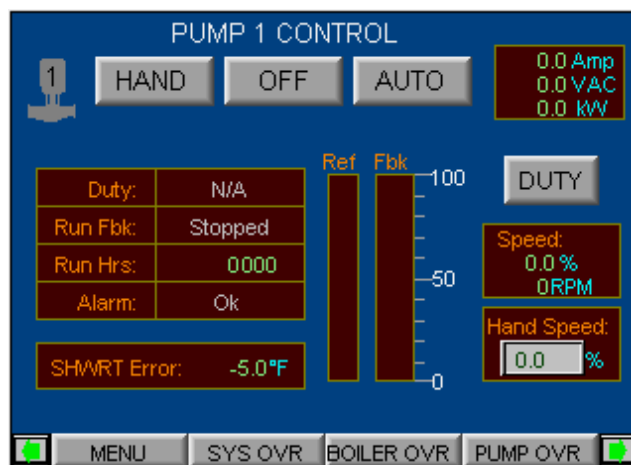
8. The screen changes back to 'LEVEL 2 SETUP SCREEN'. The top-right corner displays 'MBS ON'. Press the 'PUMP OVR' button.



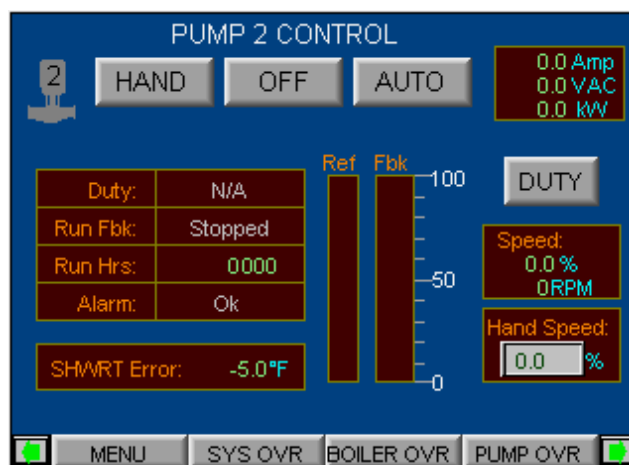
9. The screen changes to 'PUMP OVERVIEW'. Press 'PUMP 1' button



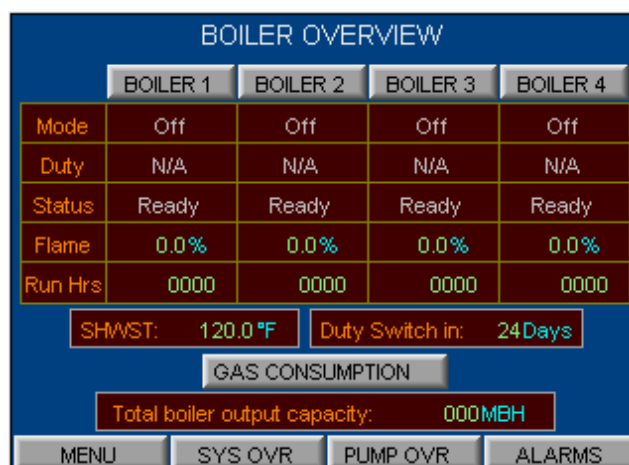
10. The screen changes to 'PUMP 1 CONTROL'. Press 'AUTO' button. Press the green right arrow button on the bottom-right corner, The screen changes to 'PUMP OVERVIEW' again



11. The screen changes to 'PUMP 2 CONTROL'.  
Press 'AUTO' button. Press 'BOILER OVR' button



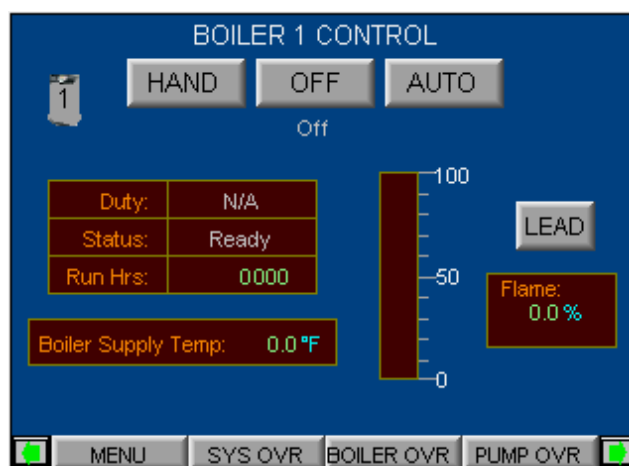
12. The screen changes to 'BOILER OVERVIEW'.  
Press 'BOILER 1' button



13. The screen changes to 'BOILER 1 CONTROL'.  
Press 'AUTO' button. Press the green right arrow button on the bottom-right corner. The screen changes to 'BOILER 2 CONTROL' again

14. Repeat the step 13. Set all the boilers in 'AUTO'

15. The ECO\*PAK MBS™ will start up automatically



## **6.0 Pump Operating Instructions**

### **OPERATION**

#### **STARTING PUMP**

Ensure that the pump turns freely by hand, or with some gentle mechanical help such as a strap or Allen key in coupling bolt.

Ensure that all protective guarding is securely fixed in position. The pump must be fully primed on start up. Fill the pump casing with liquid and rotate the shaft by hand to remove any air trapped in the impeller. Any air trapped in the casing as the system is filled must be removed by the manual air vent in the seal flush line.

#### **ENSURE ENTRAINED AIR IS REMOVED PRIOR TO STARTING, THROUGH THE AIR VENT ON THE SEAL FLUSH LINE – OPEN VENT UNTIL CLEAR OF AIR.**

Pumps are fitted with seal flush/vent lines piped to the pump suction area. When these units operate residual air is drawn out of the pump towards the suction piping.

“Bump” or energize the motor momentarily and check that the rotation corresponds with the directional arrow on the pump casing. To reverse rotation of a three phase motor, interchange any two power leads.

Start the pump with the discharge valve closed and the suction valve open, then gradually open the discharge valve when the motor is at operating speed. The discharge valve may be “cracked” or open slightly at start up to help eliminate trapped air. When stopping the pump: Close the discharge valve and de-energize the motor. **DO NOT** run the pump against a closed discharge valve for an extended period of time. (A few minutes maximum)

Should the pump be noisy or vibrate on start-up a common reason is overstated system head. Check this by calculating the pump operating head by deducting the suction pressure gauge value from the discharge gauge reading. Convert the result into the units of the pump head as stated on the pump nameplate and compare the values. Should the actual pump operating head be significantly less than the nameplate head value it is typically permissible to throttle the discharge isolation valve until the actual operating head is equal to the nameplate value. Any noise or vibration usually disappears. The system designer or operator should be made aware of this soon as some adjustment may be required to the pump impeller diameter or drive settings, if applicable, to make the pump suitable for the system as installed.

#### **CAUTION:**

Check rotation arrow prior to operating the unit. The rotation of all Armstrong Vertical In-Line units is “clockwise” when viewed from the drive end. (Looking from on top of / behind the motor)

#### **GENERAL CARE**

Vertical In-Line pumps are built to operate without periodic maintenance, other than motor lubrication on larger units. A systematic inspection made at regular intervals, will ensure years of trouble-free operation, giving special attention to the following:

1. Keep unit clean
2. Provide the motor with correctly sized overload protection
3. Keep moisture, refuse, dust or other loose particles away from the pump and ventilating openings of the motor
4. Avoid operating the unit in overheated surroundings (Above 100°F/40°C).

## **WARNING:**

Whenever any service work is to be performed on a pumping unit, disconnect the power source to the driver, LOCK it OFF and tag with the reason. Any possibility of the unit starting while being serviced must be eliminated.

If mechanical seal environmental accessories are installed, ensure water is flowing through the sight flow indicator and that filter cartridges are replaced as recommended.

## **LUBRICATION**

### **Pump**

Lubrication is not required. There are no bearings in the pump that need external lubrication service.

### **Motor**

Follow the lubrication procedures recommended by the motor manufacturer. Many small and medium sized motors are permanently lubricated and need no added lubrication. Generally if there are grease fittings evident the motor needs periodic lubrication. None if not.

Check the lubrication instructions supplied with the motor for the particular frame size indicated on the motor nameplate.

### **Mechanical Seal**

Mechanical seals require no special attention. The mechanical seal is fitted with a flush line. The seal is flushed / vented to the suction on close coupled pumps.

Do not run the pump unless properly filled with water as the mechanical seals need a film of liquid between the faces for proper operation.

Mechanical seals may 'weep' slightly at start-up. Allow the pump to continue operating for several hours and the mechanical seal to 'seat' properly prior to calling for service personnel.

## **SYSTEM CLEANLINESS**

Before starting the pump the system must be thoroughly cleaned, flushed and drained and replenished with clean liquid.

Welding slag and other foreign materials, "Stop Leak" and cleaning compounds and improper or excessive water treatment are all detrimental to the pump internals and sealing arrangement.

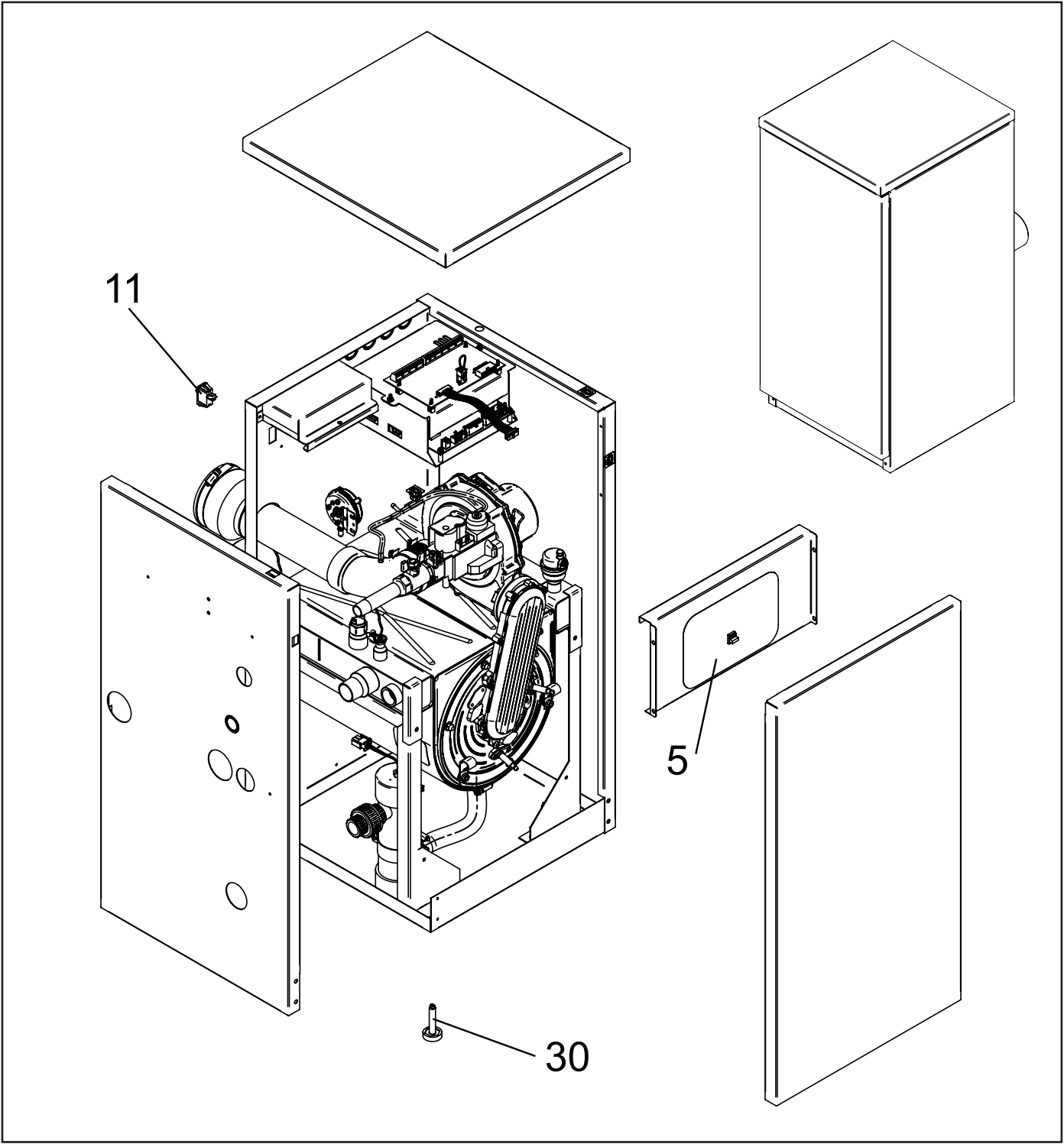
Proper operation cannot be guaranteed if the above conditions are not adhered to.

## **NOTE:**

Particular care must be taken to check the following before the pump is put into operation:

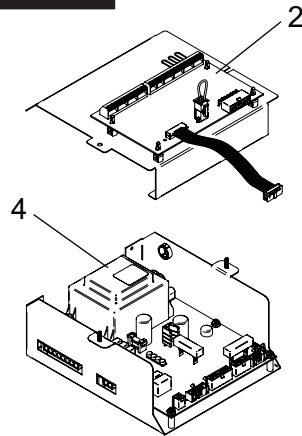
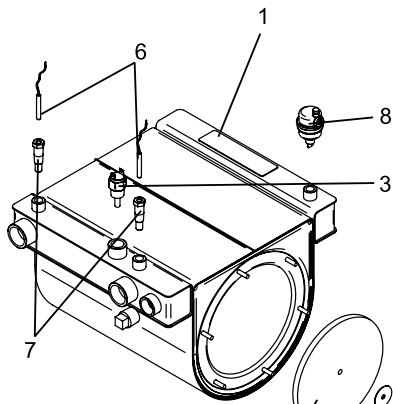
- A. Pump primed?
- B. Rotation OK?
- C. Lubrication OK?
- D. Pipe work properly supported?
- E. Voltage supply OK?
- F. Overload protection OK?
- G. Is the system clean?
- H. Is the area around the pump clean?

**ECO\*PAK™ Boiler**  
**210 & 285**

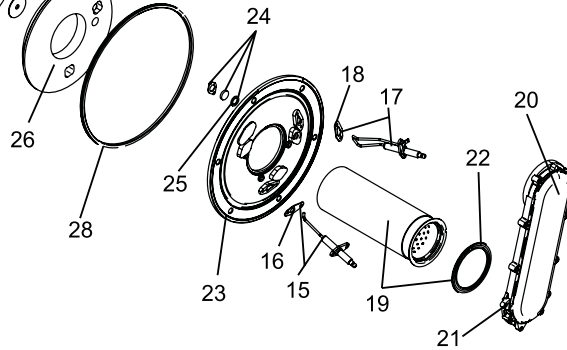
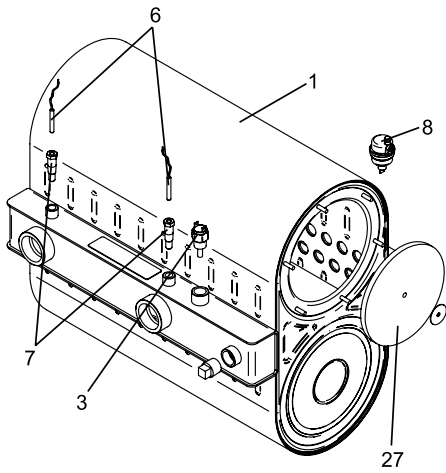


## HEAT EXCHANGER 210

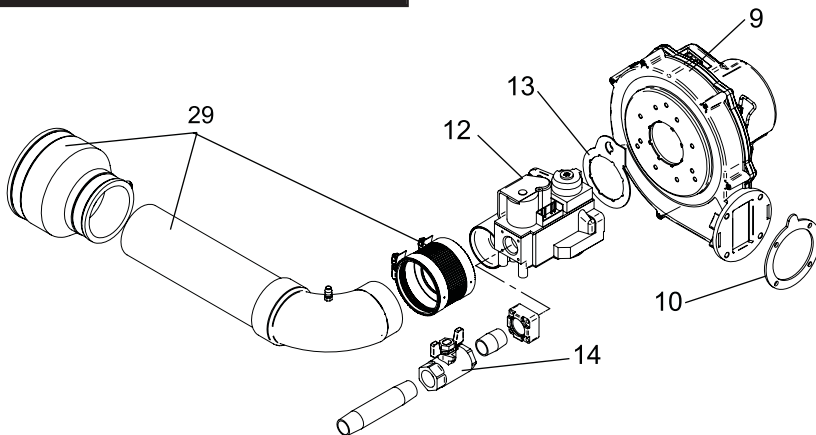
## CONTROL PANEL



## HEAT EXCHANGER 285



## GAS TRAIN 210 & 285



ITEM NO.	DESCRIPTION	MODEL NO.
<b>HEAT EXCHANGER ASSEMBLY</b>		
1	HEAT EXCHANGER	ECO*PAK™ BOILER 210
1	HEAT EXCHANGER	ECO*PAK™ BOILER 285
<b>CONTROLS</b>		
2	LOW VOLTAGE CONNECTION BOARD	BOTH
3	HIGH LIMIT	BOTH
4	INTEGRATED CONTROL	BOTH
4	HIGH ALTITUDE INTEGRATED CONTROL	BOTH
5	USER INTERFACE CONTROL	BOTH
6	WATER TEMP SENSOR	BOTH
7	BULB WELL	BOTH
8	AIR VENT VALVE	BOTH
9	FAN ASSEMBLY	ECO*PAK™ BOILER 210
9	FAN ASSEMBLY	ECO*PAK™ BOILER 285
10	GASKET / BLOWER	ECO*PAK™ BOILER 210
10	GASKET / BLOWER	ECO*PAK™ BOILER 285
11	ON / OFF SWITCH	BOTH
<b>GAS VALVES</b>		
12	GAS VALVE ASSEMBLY	ECO*PAK™ BOILER 210
12	GAS VALVE ASSEMBLY	ECO*PAK™ BOILER 285
13	GAS VALVE GASKET	BOTH
14	GAS CUT OFF VALVE	ECO*PAK™ BOILER 210
14	GAS CUT OFF VALVE	ECO*PAK™ BOILER 285
<b>PILOT &amp; BURNER ASSEMBLIES</b>		
15	FLAME SENSOR W/ GASKET	BOTH
16	GASKET, FLAME SENSOR	BOTH
17	IGNITOR W/ GASKET	BOTH
18	GASKET, IGNITOR	BOTH
19	BURNER W/ GASKET	ECO*PAK™ BOILER 210
19	BURNER W/ GASKET	ECO*PAK™ BOILER 285
20	GAS/AIR ARM ASSEMBLY W/ GASKET	BOTH
21	GASKET - GAS / AIR ARM ASSEMBLY	BOTH
22	GASKET, BURNER	BOTH
23	HEAT EXCHANGER ACCESS DOOR KIT	BOTH



ITEM NO.	DESCRIPTION	MODEL NO.
<b>MISCELLANEOUS</b>		
24	SIGHT GLASS	BOTH
25	GASKET / SIGHT GLASS	BOTH
26	BURNER PLATE, INSULATION, DOOR	BOTH
27	DIVIDER PLATE, INSULATION BAFFLE	BOTH
28	GASKET DOOR RUBBER	BOTH
29	AIR INLET KIT	ECO*PAK™ BOILER 210
29	AIR INLET KIT	ECO*PAK™ BOILER 285
30	LEVELING LEG	BOTH
	FLOW SWITCH	BOTH
	RELIEF VALVE 30 PSI	BOTH
	1.25 AMP	BOTH
	3.15 AMP	BOTH
	5 AMP	BOTH
	CONDENSATE TRAP	ECO*PAK™ BOILER 210
	CONDENSATE TRAP	ECO*PAK™ BOILER 285
	GAUGE TRIOMETER, 75# PSI	BOTH
	FLUE TEMP SENSOR KIT	BOTH
	MRLWCO WITH TEST	BOTH
	NEUTRALIZER KIT	BOTH
	LP CONVERSION KIT	ECO*PAK™ BOILER 210
	LP CONVERSION KIT	ECO*PAK™ BOILER 285

## 7.2 Pump

ITEM NO.	DESCRIPTION	PART NO.
1	Mechanical Seal 1-1/4" Ttype 21	9975000-991
2	Motor 2HP, 575V NEMA Premium TEFC	4001516-068
3	Motor 2HP, 208/230/460V NEMA Premium TEFC	4001516-083
4	Integrated VFD 2HP, 208/230V	751122-364
5	Integrated VFD 2HP, 575V	751122-368
6	Integrated VFD 2HP, 460V	751122-381
7	Casing CI 2x2x6	427759-111
8	Casing Gasket	426401-002
9	Impeller Bronze 6.18" dia.	427109-042

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**F (Main):** (416) 759-9101

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