KNIGHT
HEATING BOILER

Service Manual

Models: 80 - 500



⚠ WARNING This manual must only be used by a qualified heating installer / service technician. Read all instructions, including this manual and the Knight Boiler Installation and Operation Manual, before installing. Perform steps in the order given. Failure to comply could result in severe personal injury, death, or substantial property damage.

Save this manual for future reference.

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High Efficiency Water Heaters, Boilers and Pool Heaters

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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 Knight Boiler Installation and Operation Manual, before installing. Perform steps in the order given.

User – This manual is for use only by a qualified heating installer/service technician. Refer to the Knight Boiler User's Information Manual for your reference.

Have this boiler serviced/inspected by a qualified service technician at least annually.

Failure to comply with the above could result in severe personal injury, death or substantial property damage.

NOTICE

When calling or writing about the boiler – Please have the boiler model and serial number from the boiler rating plate.

Consider piping and installation when determining boiler location (see the Knight Boiler Installation and Operation Manual).

Any claims for damage or shortage in shipment must be filed immediately against the transportation company by the consignee.

Handling ceramic fiber materials

REMOVAL OF COMBUSTION CHAMBER LINING

⚠ WARNING

The combustion chamber door insulation in this product contains ceramic fiber material. Ceramic fibers can be converted to cristobalite in very high temperature applications. The International Agency for Research on Cancer (IARC) has concluded, "Crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1).":

- Avoid breathing dust and contact with skin and eyes.
  • Use NIOSH certified dust respirator (N95). This type of respirator is based on the OSHA requirements for cristobalite at the time this document was written. Other types of respirators may be needed depending on the job site conditions. Current NIOSH recommendations can be found on the NIOSH website at http://www.cdc.gov/niosh/homepage.html. NIOSH approved respirators, manufacturers, and phone numbers are also listed on this website.

  • Wear long-sleeved, loose fitting clothing, gloves, and eye protection.

- Apply enough water to the combustion chamber lining to prevent airborne dust.

- Remove the combustion chamber lining from the boiler and place it in a plastic bag for disposal.

- Wash potentially contaminated clothes separately from other clothing. Rinse clothes washer thoroughly.

NIOSH stated First Aid.

- Eye: Irrigate immediately.
- Breathing: Fresh air.

Please read before proceeding

When servicing boiler –

• To avoid electric shock, disconnect electrical supply before performing maintenance.

• To avoid severe burns, allow boiler to cool before performing maintenance.

Boiler operation –

• Do not block flow of combustion or ventilation air to the boiler.

• Should overheating occur or gas supply fail to shut off, do not turn off or disconnect electrical supply to circulator. Instead, shut off the gas supply at a location external to the appliance.

• Do not use this boiler if any part has been under water. The possible damage to a flooded appliance can be extensive and present numerous safety hazards. Any appliance that has been under water must be replaced.

Boiler water –

• Thoroughly flush the system (without boiler connected) to remove sediment. The high-efficiency heat exchanger can be damaged by build-up or corrosion due to sediment.

• Do not use petroleum-based cleaning or sealing compounds in the boiler system. Gaskets and seals in the system may be damaged. This can result in substantial property damage.

• Do not use "homemade cures" or "boiler patent medicines". Serious damage to the boiler, personnel, and/or property may result.

• Continual fresh make-up water will reduce boiler life. Mineral buildup in the heat exchanger reduces heat transfer, overheats the stainless steel heat exchanger, and causes failure. Addition of oxygen carried in by makeup water can cause internal corrosion. Leaks in boiler piping must be repaired at once to prevent the introduction of makeup water.

Freeze protection fluids –

• NEVER use automotive antifreeze. Use only inhibited propylene glycol solutions which are specifically formulated for hydronic systems. Ethylene glycol is toxic and can attack gaskets and seals used in hydronic systems.

What is in this manual?

Service

Near boiler piping
• Typical system components

The Knight boiler display
• Display panel readout, buttons and their functions

Control module inputs
• Control module inputs and options

Control module outputs
• Control module outputs and options

General
• How the boiler operates
• How the control module operates
• Access modes -- user and installer
• Sequence of operation -- Domestic Hot Water (DHW)/space heating

Control panel menu access
• Accessing programming mode and locating menus (See separate guides covering the PC and pocket PC interfaces.)

Control panel parameter access
• Accessing and changing parameters from the display panel

Quick start information -- parameter table
• An index of available adjustments and readouts, where to access them and where to find detailed information.

Knight boiler operation
• A: General
• B: Temperature Setting
• C: Data Logging
• D: Functions
• E: DHW Settings
• F: Outdoor Air Reset Curve
• G: Anti-cycling
• H: Control Modes
• I: Circulation Pumps
• J: Service Notification

Maintenance

• Service and maintenance schedules
• Address reported problems
• Inspect boiler area and boiler interior
• Clean condensate trap
• Check all piping for leaks
• Check air openings
• Flue vent system and air piping
• Check water system
• Check expansion tank
• Check boiler relief valve
• Inspect ignition electrode
• Check ignition ground wiring
• Check all boiler wiring
• Check control settings
• Perform start-up and checks
• Check burner flame
• Check flame signal
• Check flue gas temperature
• General maintenance
• Review with owner
• Cleaning boiler heat exchanger
• Oiled bearing circulators

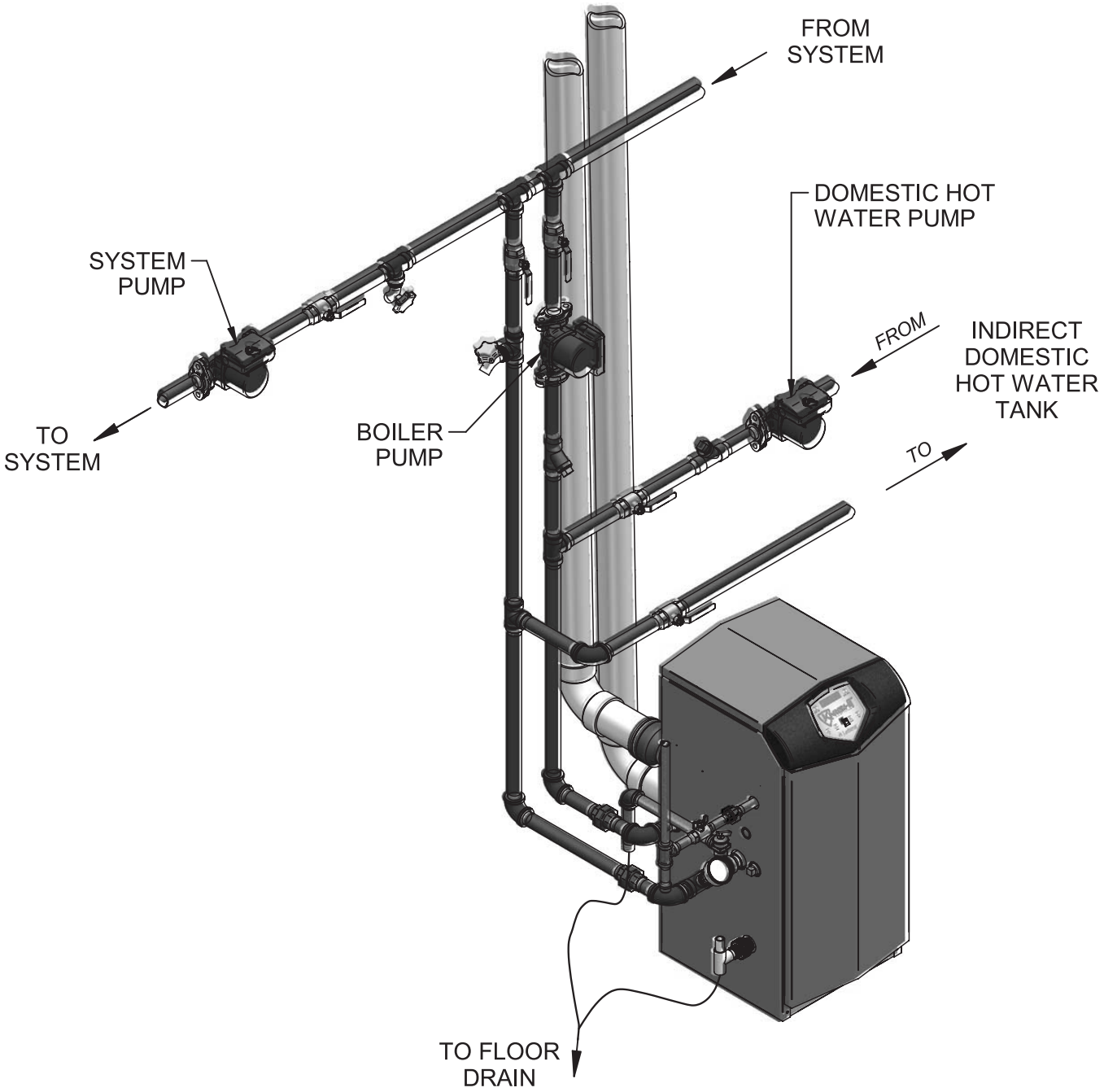
Troubleshooting

• Troubleshooting table - No display
• Checking temperature sensors
• Sensor tables
• Troubleshooting table - Fault messages displayed on boiler interface
• Combustion analysis procedure
• Gas valve adjustment procedure

1 Service

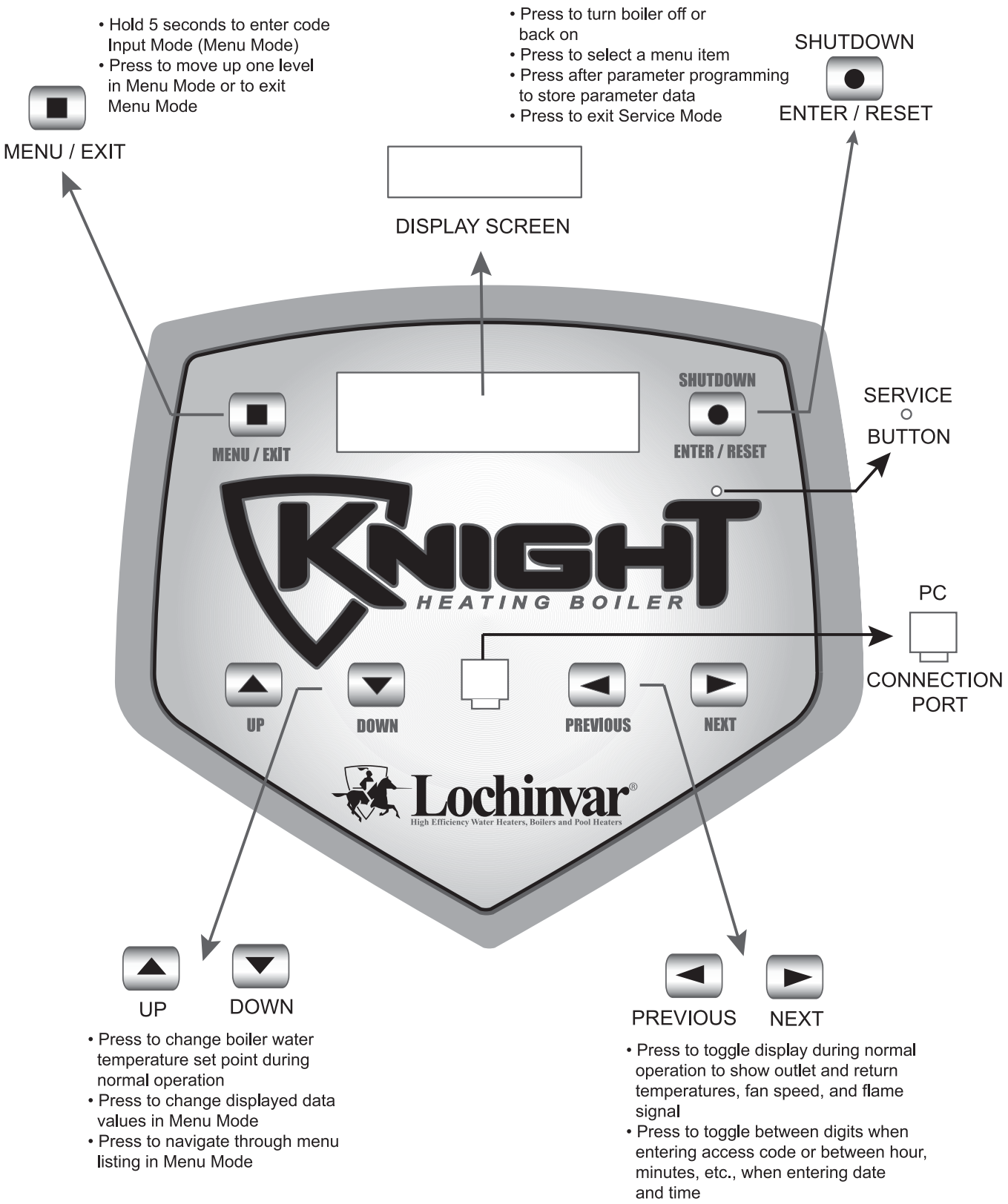
Near boiler piping

This piping reference is included to specify the *Near Boiler Piping* specific to the Knight boiler. This piping scheme is important for proper operation of the SMART SYSTEM control. See the Knight Boiler Installation and Operation Manual for more detailed piping diagrams.



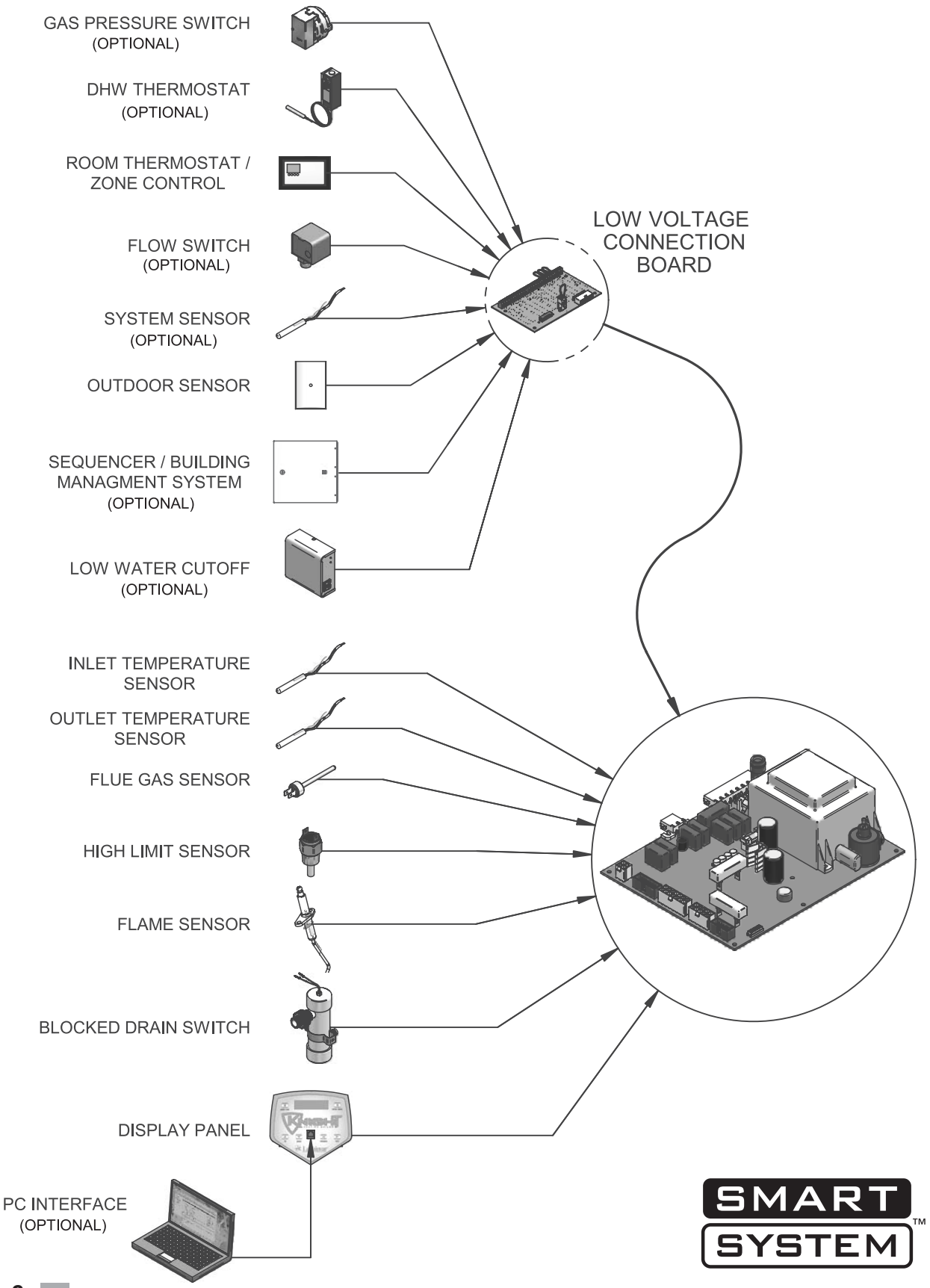
1 Service *(continued)*

The Knight boiler display



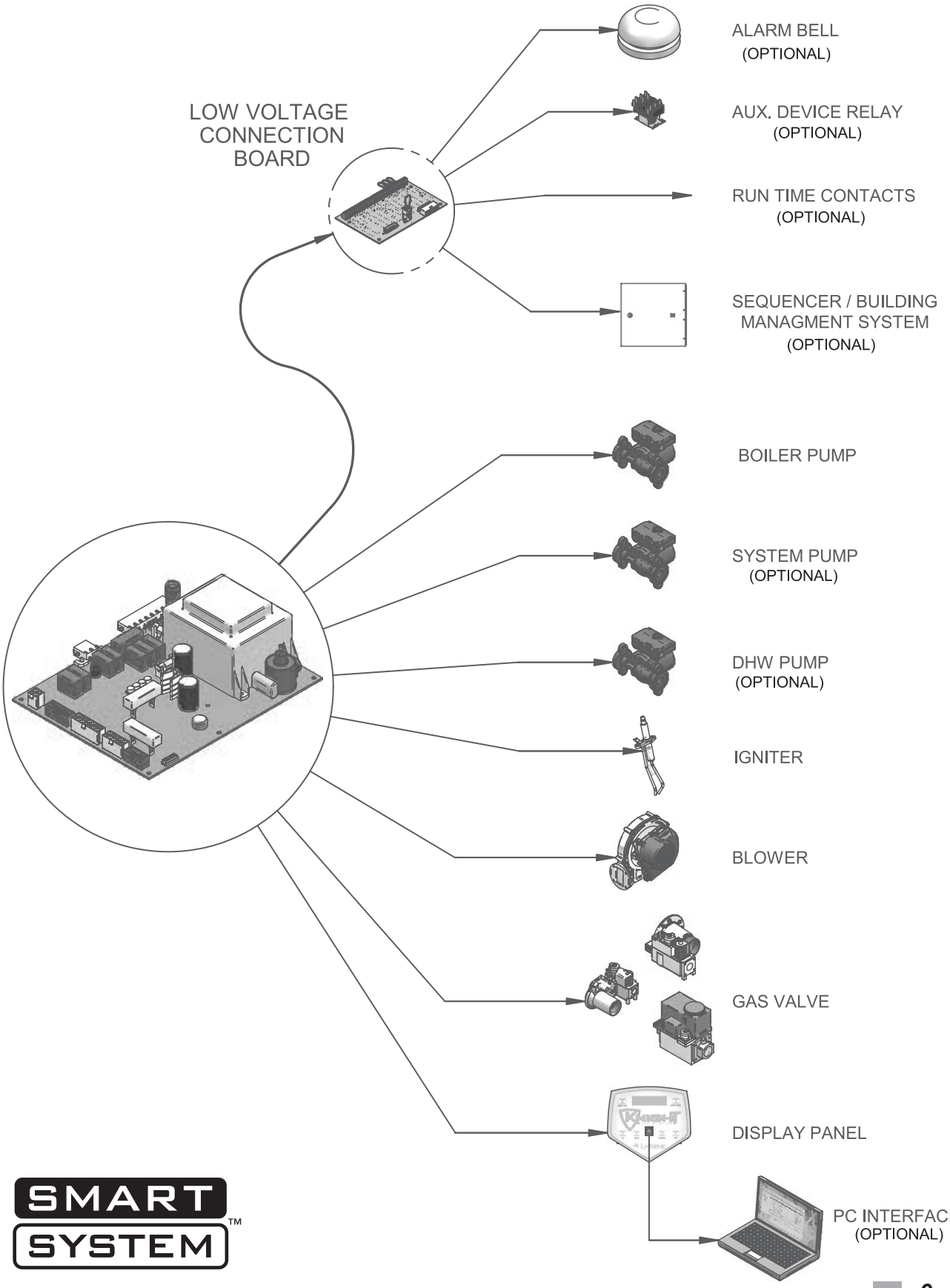
1 Service

Control inputs



1 Service *(continued)*

Control outputs



SMART SYSTEM™

1 Service

General Operation

How the boiler operates

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

How the control module operates

The Knight boiler control module receives input from boiler sensors. The control module activates and controls the blower and gas valve to regulate heat input and switches boiler, DHW and system pumps on and off as needed. The user/installer programs the module to meet system needs by adjusting control parameters. These parameters set operating temperatures and boiler operating modes. Boiler operation can be based on boiler outlet water temperature, boiler return water temperature or system supply temperature, depending on the parameter setting.

Sequence of operation

Table 1 shows control module normal sequences of operation for space heating and DHW operation. The combined operation sequence is for a typical application, programmed to provide DHW priority.

Access modes

User

The user can adjust space heating set point using the UP and DOWN buttons at any time during normal operation. By entering the USER code (0704), the user can also change temperature units, time and date, and night setback settings. In user mode, the following parameters can be viewed but not changed: Boiler outlet water temperature in DHW mode; boiler model number; software version; total operating hours, and total cycles.

Installer

Most parameters are available only to the installer, accessible only by entering the installer access code (5309).

Saving parameters

To save parameters:

Press the ENTER/RESET button.

To keep parameter settings only for a current operating cycle:

Press the MENU/EXIT button 1 time to return to the parameter listings; press again to return to the menu listings.

1 Service *(continued)*

Sequence of operation

Table 1 *Sequence of operation - space heating and DHW*

OPERATION	DISPLAY
1. Upon a call for heat, the control turns on the appropriate pumps (system and boiler pumps for space heating call; DHW pump for DHW call).	BLR: Standby OUT: 123.8F(129)
2. The control connects 120 vac to the blower. The blower does not run at this time. • If the unit is equipped with a flow switch or low water cutoff, it must close before the control powers up the blower. • If the unit is equipped with a manual reset high limit it must be closed before the control powers up the blower. • If the unit is equipped with a solenoid valve and/or a vent valve, they will be energized along with the blower. • If the unit is equipped with a gas pressure switch, it must close at this time. • If there is an auxiliary device connected to the unit, the unit will then provide 24 vac to its enable relay. If the auxiliary device has a proving switch, it must close before the sequence continues.	BLR: Standby OUT: 123.8F(129)
3. The control then starts a 10 second prepurge cycle.	BLR: PREPURGE OUT: 123.9F(129)
4. Once the prepurge cycle is complete, and the blocked drain switch 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.	BLR: IGNITION OUT: 123.9F(129)
5. 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 (1 trial on the 500 model), the control locks out for 1 hour and then tries another set of 4 trials, except on the 500 model which is 100% lockout.	BLR: POSTPURGE, PREPURGE OUT: 123.9F(129)
6. 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. If the boiler lights due to a space heating call for heat, and the ramp delay function is active (default is active), the modulation will be held to a series of increasing limits after the burner has lit.	BLR: SH 20% RATE OUT: 124.8F(129)
7. If the space heating call for heat is active, and the DHW thermostat closes, the control will turn on the DHW pump, wait 2 seconds, and then turn off the boiler pump. This will divert the hot water away from the heating zone(s) and send it to the DHW tank instead. The control will then modulate to maintain the outlet temperature to the DHW boiler set point.	BLR: DHW 85% RATE OUT: 177.8(180)

1 Service

Sequence of operation *(continued)*

Table 1 *(continued from previous page) Sequence of operation - space heating and DHW*

OPERATION	DISPLAY
8. If the DHW thermostat remains on for more than 30 minutes, and the space heating call for heat is also on, then the control will turn on the boiler pump, turn off the DHW pump after 2 seconds, and resume modulating based on the space heating set point. As long as both the space heating and DHW calls for heat remain active, the control will switch back and forth between the two modes until one of them is satisfied.	BLR: SH 41% RATE OUT: 123.0F(129)
9. Once both calls for heat are 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.	BLR: POSTPURGE OUT: 127.4F(129)
10. Boiler pump off, system pump continues its delay if longer.	BLR: Standby OUT: 124.7F(129)
11. System pump off.	BLR: Standby OUT: 122.9F(129)

1 Service *(continued)*

Display panel menu access

Table 2 *Use this procedure to access menus from the display panel*

BUTTON		OPERATION	DISPLAY	COMMENTS
■	ENTER/RES	Press 1 time in normal operation	BLR:OFF PMP:OFF	*Boiler turns off (this ensures uninterrupted programming)*
●	MENU/EXIT	Hold for 5 seconds -- display will change	Enter Menu Code: 0000 ← flashing	*Digit shown underlined at left will flash*
▲	UP	Press 9 times to change last digit in readout to "9"	Enter Menu Code: 0009	*Digit shown underlined at left will flash*
◀	PREVIOUS	Press 2 times to move to the second digit	Enter Menu Code: 0009	*Digit shown underlined at left will flash*
▲	UP	Press 3 times to change second digit in readout to "3"	Enter Menu Code: 0309	*Digit shown underlined at left will flash*
◀	PREVIOUS	Press 1 time to change to the first digit	Enter Menu Code: 0309	*Digit shown underlined at left will flash*
▲	UP	Press 5 times to change first digit in readout to "5"	Enter Menu Code: 5309	*Digit shown underlined at left will flash*
		If you enter a digit incorrectly, you can move to the digit by using the NEXT and PREVIOUS buttons as needed until the digit you want is flashing. Then use UP and/or DOWN buttons to change the value.		
■	ENTER/RES	Press to enter the code	Enter Menu Code: INSTALLER CODE	*The words,* "INSTALLER CODE" *will flash while displayed*
	⌛	After 2 seconds, display shows menus (press ENTER/RESET to select a menu)	>A General B Temp Settings	*The caret symbol, ">" highlights the selectable line*
		If the code is entered incorrectly, the display will return to its previous mode. You will have to start over at step 1 to enter the code.		
▼	DOWN	Press 1 time to highlight second listing	A General >B Temp Settings	*The caret symbol, ">" highlights the selectable line*
▼	DOWN	Press 1 time to toggle menu listing	>C Data Logging D Functions	*The menu toggles to the next two menu options*
▼	DOWN	Press 2 times to toggle menu listing	>E DHW Settings F Outdoor Reset	*The menu toggles to the next two menu options*
▼	DOWN	Press 2 times to toggle menu listing	>G Anti-cycling H Control Modes	*The menu toggles to the next two menu options*
▼	DOWN	Press 2 times to toggle menu listing	>I Circulation Pumps J Service Notification	*The menu toggles to the next two menu options*
		To select a highlighted menu, press the ENTER/RESET button one time. The display will change to the first parameter under that menu, with the first characters flashing.		

1 Service

Display panel parameter access

Table 3 *This is a typical example of accessing a parameter, shown for parameter I2, boiler pump delay*

BUTTON		OPERATION	DISPLAY	COMMENTS
This example shows how to access parameter I2, boiler pump delay. The first display shown is at the beginning of the menu listings, after entering the installer access code.				
	-	Beginning of menu listings.	>A General B Temp Settings	*The caret symbol, ">" highlights the selectable line*
▼	DOWN	Press 1 time to highlight second listing	A General B Temp Settings	*The caret symbol, ">" highlights the selectable line*
▼	DOWN	Press 1 time to toggle menu listing	>C Data Logging D Functions	*The menu toggles to the next two menu options*
▼	DOWN	Press 2 times to toggle menu listing	>E DHW Settings F Heat Curve	*The menu toggles to the next two menu options*
▼	DOWN	Press 2 times to toggle menu listing	>G Anti-Cycling H Control Modes	*The menu toggles to the next two menu options*
▼	DOWN	Press 2 times to toggle menu listing	>I Circulation Pumps J Service Notification	*The menu toggles to the next two menu options*
■	ENTER/RES	Press 1 time to list parameters	I1 Postrun Time System Pump	**I1** *will flash*
▲	UP	Press 1 time to change parameter	I2 Postrun Time SH Pump	**I2** *will flash*
■	ENTER/RES	Press 1 times to select parameter	I2 Postrun Time SH Pump 0.50 minutes	**I2** *will stop flashing; parameter value will appear*
▲	UP (or DOWN)	Press to increase (or decrease) value	I2 Postrun Time SH Pump 0.67 minutes	*Parameter will increase or decrease, depending on button pressed*
■	ENTER/RES	Press 1 time to save (or press MENU/EXIT to continue)	SH:OFF OUT:123.7˚F	*Display will change to normal display as you exit menu mode*
■	ENTER/RES	Press 1 time to return to normal operation	SH:Pre-Purge OUT:123.7˚F	*This display example assumes a call for space heating is present*

1 Service *(continued)*

Parameter table

Table 4 *This table lists SMART SYSTEM control module parameters and where to access them*

	MENU	SUB ITEM	DESCRIPTION	SEE PAGE	USER ACCESS		INSTALLER ACCESS	
					DISPLAY	MODIFY	DISPLAY	MODIFY
GENERAL	A	1	Boiler Model	17	Yes	No	Yes	No
		2	User Code	17	Yes	Yes	Yes	Yes
		3	Time and Date	17	Yes	Yes	Yes	Yes
		4	Software Version	17	Yes	No	Yes	No
		5	Unit °C or °F	17	Yes	Yes	Yes	Yes
		6	Night Setback Temperature	17	Yes	Yes	Yes	Yes
		7	Night Setback Times	17	Yes	Yes	Yes	Yes
TEMPERATURE SETTING	B	1	SH Set Point User	17	Yes	Yes	Yes	Yes
		2	Minimum SH Set Point	17	No	No	Yes	Yes
		3	Maximum SH Set Point	17	No	No	Yes	Yes
		4	Offset SH	17	No	No	Yes	Yes
		5	Differential SH	18	No	No	Yes	Yes
DATA LOGGING	C	1	SH Hours Running	18	Yes	No	Yes	No
		2	DHW Hours Running	18	Yes	No	Yes	No
		3	Burner Starts	18	Yes	No	Yes	No
		4	Show Last 10 Errors	18	Yes	No	Yes	No
FUNCTIONS	D	1	Reset Last 10 Errors	18	No	No	Yes	Yes
		2	Service Mode Delay	18	No	No	Yes	Yes
DHW SETTINGS	E	1	DHW Boiler Set Point	18	Yes	Yes	Yes	Yes
		2	SH/DHW Switching Time	18	Yes	Yes	Yes	Yes
OUTDOOR AIR RESET	F	1	Minimum Air Temperature	18	No	No	Yes	Yes
		2	Maximum Air Temperature	18	No	No	Yes	Yes
		3	Maximum SH Set Point	19	No	No	Yes	Yes
		4	Minimum SH Set Point	19	No	No	Yes	Yes
		5	Outdoor Air Shutdown	19	Yes	Yes	Yes	Yes
		6	Outdoor Air Shutdown Differential	19	Yes	Yes	Yes	Yes
		7	Shift Air Reset	19	No	No	Yes	Yes
		8	Boost Temperature	20	Yes	Yes	Yes	Yes
		9	Boost Time	20	Yes	Yes	Yes	Yes

1 Service

Parameter table *(continued)*

Table 4 *(continued from previous page) This table lists SMART SYSTEM control module parameters and where to access them*

	MENU	SUB ITEM	DESCRIPTION	SEE PAGE	USER ACCESS		INSTALLER ACCESS	
					DISPLAY	MODIFY	DISPLAY	MODIFY
ANTI-CYCLING	G	1	Anti-cycling Time	20	No	No	Yes	Yes
		2	Return Temperature Differential for Ending Anti-Cycling	20	No	No	Yes	Yes
		3	Ramp Delay On/Off	20	No	No	Yes	Yes
		4	Ramp Delay Settings	20	No	No	Yes	Yes
CONTROL MODES	H	1	Controlling Sensor (Outlet/System, Inlet)	21	No	No	Yes	Yes
		2	SH Control (Thermostat, BMS)	21	No	No	Yes	Yes
CIRCULATION PUMPS	I	1	Pump Delay System Pump	21	No	No	Yes	Yes
		2	Pump Delay SH Pump	21	No	No	Yes	Yes
		3	Pump Delay DHW Pump	21	No	No	Yes	Yes
SERVICE NOTIFICATION	J	1	Service Notification in Month	22	No	No	Yes	Yes
		2	Service Notification Running Hours	22	No	No	Yes	Yes
		3	Service Notification Boiler Cycles	22	No	No	Yes	Yes
		4	Reset Service Notification Counter	22	No	No	Yes	Yes

NOTICE

The parameters for Building Management System operation are not listed in this table. They are only accessible using the PC interface software. See separate documentation for access information. See page 21 of this manual for a brief discussion.

1 Service *(continued)*

Viewable and changeable control parameters

CAUTION Before changing parameters, note the settings so that the unit can be returned to its original operating parameters.

A: General

Boiler model

The control will display "Knight Boiler" as the model number because the same control is used on several models. This will be displayed when parameter **A1** has been accessed. This parameter is not changeable.

User code

The User Code allows the user to access and change a limited number of control parameters. The access code can be changed by the user or the installer to a code of their choosing. To change the code, parameter **A2** must be accessed. The default code is 0704. The code can be changed one digit at a time by using the arrow keys on the display.

Time and date

The control uses an internal clock for the night setback feature and for logging of events. For these features to work correctly, the clock must be set when the boiler is first installed or anytime the boiler has been powered off for more than 30 days. To set the clock, parameter **A3** must be accessed. The date and time are displayed as "YY:MM:DD W hh:mm". YY = year, MM = month, DD = date, W = day (1 = Sunday, 2 = Monday, etc.), hh = hour (24 hour time; 2:00 PM = 14:00), mm = minutes.

Software version

The software version allows the user to view the software version in use by the control. This software controls the operation of the boiler. When a new software version becomes available, the existing control can be replaced with a new control to update the software.

Unit °C or °F

The control can be configured to display temperature in either °C or °F. This parameter can be changed by the user or the installer by accessing parameter **A5**. The default is °F.

Night setback temperature

Once the internal clock has been set correctly, the night setback feature can be used to program a lower water temperature set point for space heating. This parameter can be changed by the user or the installer by accessing parameter **A6**. The temperature range for this parameter is 32°F to 140°F. The feature is turned off with a setting of 32°F. The default value is 32°F.

Night setback times

If parameter A6 is set to anything other than 32°F, the night setback feature becomes active. This will require start and stop times to be programmed for the days that reduced temperatures are required. These times can be changed by the user or the installer by accessing parameter **A7**. Each day of the week (Sunday through Saturday) will have an on and off time.

Example: Monday ON: 22:30, Tuesday OFF: 6:45. If you wish to skip a day and have no night setback, leave the on and off times the same. The default times for each day will be 00:00 (midnight).

B: Temperature settings

SH set point user

The SH set point user sets the water temperature set point for fixed operation or the maximum temperature set point when the outdoor air sensor is used. This parameter can be changed by the user or the installer by accessing parameter **B1**. The temperature range of this parameter is 50°F to 190°F. The default value is 125°F.

Minimum SH set point

The minimum SH set point sets the minimum water temperature set point that can be used for space heating operation. The user or installer will not be able to program the control with a lower SH set point. This parameter can only be changed by the installer by accessing parameter **B2**. The temperature range of this parameter is 32°F to 190°F. The default value is 70°F.

Maximum SH set point

The maximum SH set point sets the maximum water temperature set point that can be used for space heating. The user or installer will not be able to program the control with a higher SH set point. This parameter can only be changed by the installer by accessing parameter **B3**. The temperature range of this parameter is 32°F to 190°F. The default value is 190°F.

Offset SH

The offset SH sets how many degrees above set point the temperature has to go before the boiler will shut off. This parameter can only be changed by the installer by accessing parameter **B4**. The temperature range of this parameter is 0°F to 86°F. The default value is 10°F.

1 Service

Differential SH

The differential SH sets how many degrees below the turn off temperature the temperature has to go before the boiler will turn on. This parameter can only be changed by the installer by accessing parameter **B5**. The temperature range of this parameter is 0°F to 86°F. The default value is 20°F.

C: Data logging

SH hours running

The SH hours running parameter shows the total number of hours the boiler has been in the SH firing position. This parameter can be viewed by the user and the installer by accessing parameter **C1**.

DHW hours running

The DHW hours running parameter shows the total number of hours the boiler has been in the DHW firing position. This parameter can be viewed by the user and the installer by accessing parameter **C2**.

Burner starts

The burner starts parameter shows the total number of times the boiler has attempted to fire. This parameter can be viewed by the user and the installer by accessing parameter **C3**.

Show last 10 errors

The control will log the 10 most current errors with the date and time the error occurred. This parameter can be viewed by the user and the installer by accessing parameter **C4**.

D: Functions

Reset last 10 errors

The reset last 10 errors parameter allows the error counter to be reset to 0. This parameter can only be cleared by the installer by accessing parameter **D1**. Once accessed, press the RESET key to clear the counter.

Service mode delay

By pressing the pin button on the front of the display for five (5) seconds, the control will be placed in Service Mode. This will override all other heat demands. The Service Mode allows the installer to set the unit to either maximum firing rate or minimum firing rate for the purpose of combustion analysis. The delay sets the length of time the boiler will stay in the Service Mode if no keys have been pressed before going back to its original state. This parameter can only be changed by the installer by accessing parameter **D2**. The time range of this parameter is 0 to 40 minutes. The default value is 20 minutes.

E: DHW settings

DHW boiler set point

When a DHW call for heat becomes active, the control will use the DHW boiler set point to determine the firing rate of the boiler based on the actual water temperature. This parameter can be changed by the installer by accessing parameter **E1**. The temperature range of this parameter is 50°F to 190°F. The default value is 180°F.

SH/DHW switching time

The SH/DHW switching time parameter sets the length of time the control will stay in DHW Mode when a SH call has been received. After this time period has expired the control will revert to SH Mode. If a DHW call is still active the timer will reset. After the time period has expired the control will revert back to DHW Mode. This will continue until one of the demands has been satisfied. This parameter can be changed by the installer by accessing parameter **E2**. The time range of this parameter is 10 minutes to 240 minutes. The default value is 30 minutes.

F: Outdoor air reset

Outdoor air reset operation

When the outdoor air sensor is installed, the control will calculate the water temperature set point based on the outdoor air temperature. As the outdoor air temperature drops the water temperature set point increases. This feature allows the boiler to be more efficient in periods of mild weather, see FIG. 1 on page 19.

Minimum air temperature

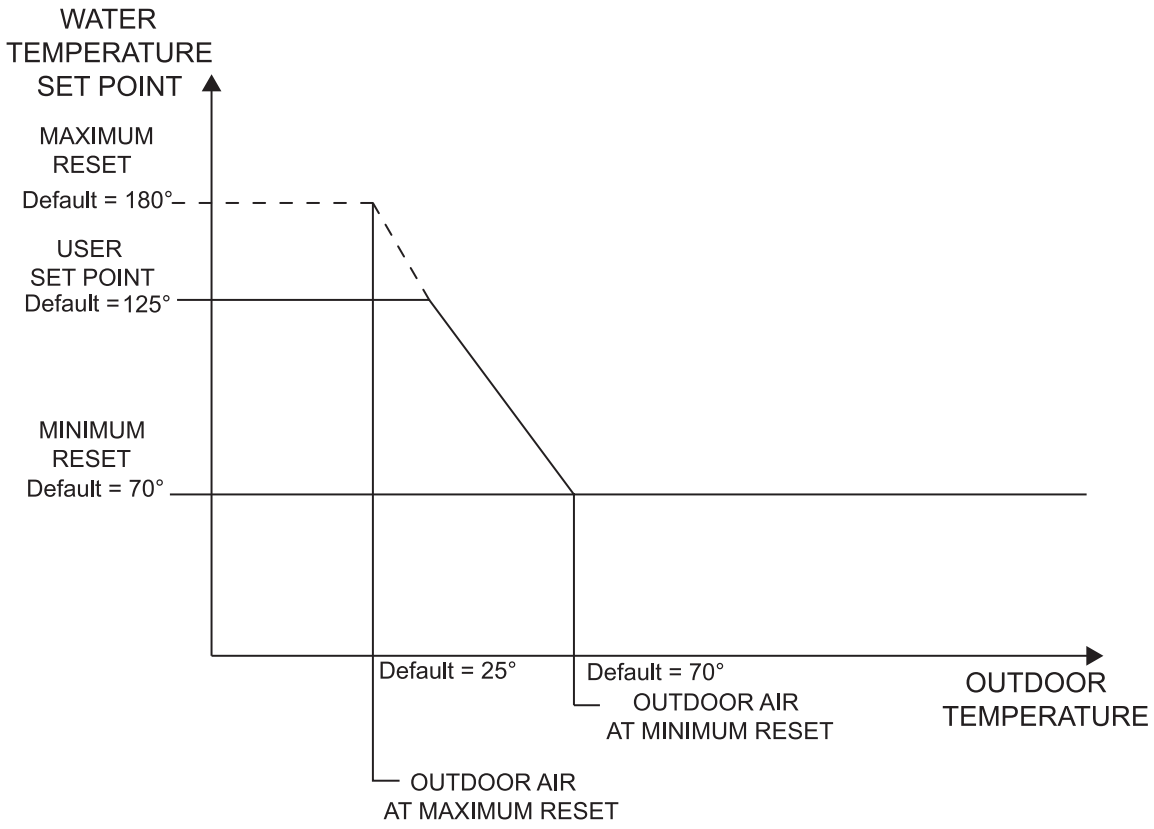
When the minimum air temperature drops to or below this point, the water temperature will be at its maximum setting (FIG. 1). This parameter can be changed by the installer by accessing parameter **F1**. The temperature range of this parameter is -30°F to 90°F. The default value is 25°F.

Maximum air temperature

When the maximum air temperature rises to or above this point, the water temperature will be at its minimum setting (FIG. 1). This parameter can be changed by the installer by accessing parameter **F2**. The temperature range of this parameter is -30°F to 90°F. The default value is 70°F.

1 Service *(continued)*

Figure 1 *Outdoor Air Reset Curve*



Maximum SH set point

When the maximum SH set point drops to or below its minimum setting the water temperature will be at this point, if the SH set point is set higher (FIG. 1). This parameter can be changed by the installer by accessing parameter **F3**. The temperature range of this parameter is 0°F to 190°F. The default value is 180°F.

Minimum SH set point

When the minimum SH set point rises to or above its maximum setting the water temperature will be at this point (FIG. 1). This parameter can be changed by the installer by accessing parameter **F4**. The temperature range of this parameter is 0°F to 190°F. The default value is 70°F.

Outdoor air shutdown

When the outdoor air shutdown rises above this point, the control will block all SH demands (DHW demands will still be active). This parameter can be changed by the user or the installer by accessing parameter **F5**. The temperature range of this parameter is 0°F to 120°F. The default value is 80°F.

Outdoor air shutdown differential

The outdoor air shutdown differential parameter is the number of degrees below parameter F5 the outdoor air temperature must go before the boiler will respond to a SH demand. This parameter can be changed by the user or the installer by accessing parameter **F6**. The temperature range of this parameter is 0°F to 90°F. The default value is 10°F.

Shift reset curve

The shift reset curve parameter shifts the actual set point above the calculated set point the number of degrees in this parameter. This parameter can be changed by the installer by accessing parameter **F7**. The temperature range of this parameter is -27°F to 27°F. The default value is 0°F. This feature will be active if this parameter is set to anything other than 0°F.

1 Service

Boost temperature

If a SH demand lasts longer than the programmed time delay setting and there have been no DHW demands, the control will increase the water temperature set point by the amount in this parameter. If the SH demand continues through another time period, the set point will be increased again. This will continue until either the SH demand ends, a maximum of 20 increases has occurred, or the maximum set point has been reached. Once the SH demand has been satisfied the set point will revert back to its calculated setting. The boost temperature can be changed by the installer by accessing parameter **F8**. The temperature range of this parameter is 0°F to 45°F. The default value is 0°F. This feature will be active if this parameter is set to anything other than 0°F.

Boost time

The boost time parameter sets the amount of time that must elapse with a SH demand before the water temperature set point will be increased. This parameter can be changed by the installer by accessing parameter **F9**. The time range for this parameter is 1 minute to 60 minutes. The default value is 20 minutes.

G: Anti-cycling

Anti-cycling time

Once a SH demand has been satisfied, a set amount of time must elapse before the control will respond to a new SH demand. The control will block the new heat demand and anti-cycling will be shown in the display until the time has elapsed or the water temperature drops below parameter G2. This parameter can be changed by the installer by accessing parameter **G1**. The time range for this parameter is 0 minutes to 40 minutes. The default value is 1 minute.

Inlet temperature differential for ending anti-cycling

The control will bypass the anti-cycling time if the water temperature drops too quickly. The control will use the water temperature the boiler was at when it shut off as the starting point. If the temperature drops below the temperature parameter the control will abort anti-cycling and allow the boiler to fire. This parameter can be changed by the installer by accessing parameter **G2**. The temperature range of this parameter is 0°F to 86°F. The default value is 10°F.

Ramp delay on/off

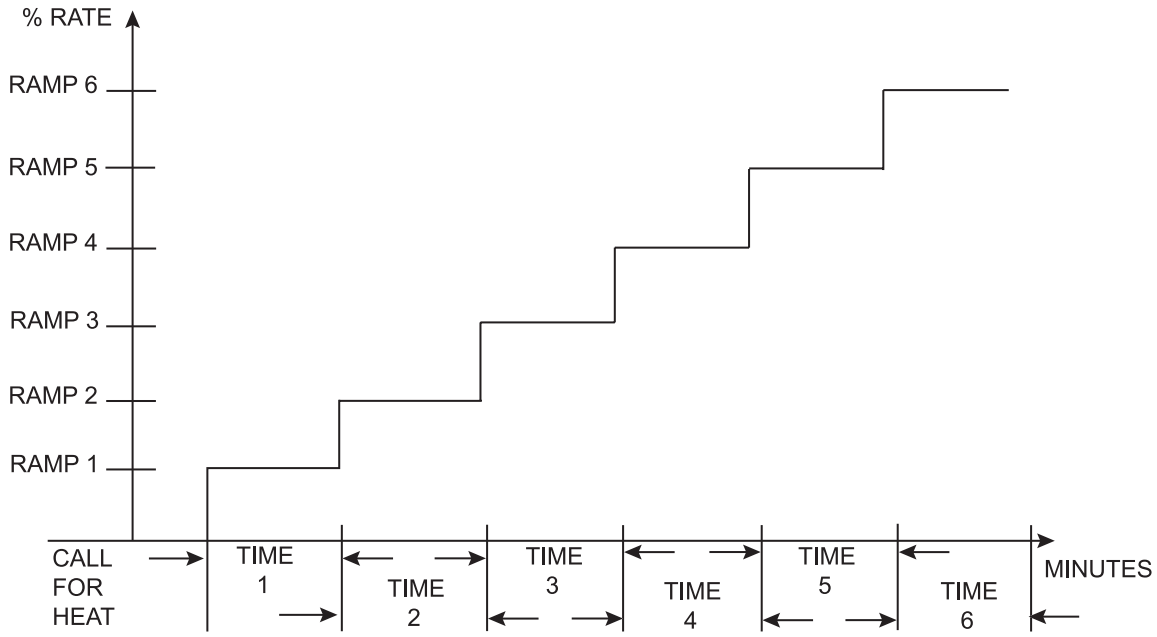
When the ramp delay on/off parameter is active, the ramp delay limits the boiler firing rate when a SH cycle has started. There are six (6) limiting steps used to limit temperature overshoot and short cycles, see FIG. 2 on page 21 of this manual. This feature can be turned on or off depending on the installation. This parameter can be changed by the installer by accessing parameter **G3**. The control range of this parameter is 0 = Off, 1 = Ramp Up Only, and 2 = Ramp Up and Ramp Down. The default value is 0.

Ramp delay settings

The time for each of the six (6) ramp delays as well as the power level for each of the six (6) ramp delays are adjustable. These parameters are adjustable by the installer by accessing parameter **G4**. The time range for each ramp delay is adjustable from 1 minute to 40 minutes with the total of all six (6) ramp delays not to exceed 109 minutes. The default time for each ramp delay is 1 minute. The power range for each ramp delay is adjustable from 0 to 100. The defaults for each ramp delay is ramp delay 1 = 50%, ramp delay 2 = 80%, ramp delay 3 = 100%, ramp delay 4 = 100%, ramp delay 5 = 100%, and ramp delay 6 = 100%, see FIG. 2.

1 Service *(continued)*

Figure 2 *Ramp Delay Interval*



H: Control modes

Controlling sensor

The controlling sensor parameter selects the sensor the control will use to regulate the boiler firing rate. This parameter is adjustable by the installer by accessing parameter **H1**. The sensor selections are as follows: The outlet sensor regulates the firing rate based on the outlet water temperature of the boiler and the inlet sensor regulates the firing rate based on the inlet water temperature of the boiler. If the outlet sensor is selected, and the optional system sensor is connected, the control will regulate the firing rate based on the system sensor temperature. The default sensor is the Outlet Sensor.

SH control

The SH control parameter selects the method used to control the modulation of the boiler. This parameter is adjustable by the installer by accessing parameter **H2**. The control methods are as follows:

1 - The control modulates the boiler based on the user set point and the temperature of the selected controlling sensor.

2 - BMS (Building Management System) The control modulates the boiler based on the 0 - 10 vdc signal delivered to the appropriate terminals on the connection board. When BMS is selected additional parameters for BMS operation will have to be adjusted. These can only be accessed by the optional PC software. See PC software information for additional BMS parameter information. The default control is Thermostat.

I: Circulation pumps

Pump delay system pump

The pump delay system pump parameter sets the length of time the system pump (if connected) will run after a SH demand has been satisfied. This parameter is adjustable by the installer by accessing parameter **I1**. The time range for this parameter is 0 minutes to 40 minutes. The default time is 30 seconds.

Pump delay SH pump

The pump delay SH pump parameter sets the length of time the boiler pump will run after a SH demand has been satisfied. This parameter is adjustable by the installer by accessing parameter **I2**. The time range for this parameter is 0 minutes to 40 minutes. The default time is 30 seconds.

Pump delay DHW pump

The pump delay DHW pump parameter sets the length of time the DHW pump (if connected) will run after a DHW demand has been satisfied. This parameter is adjustable by the installer by accessing parameter **I3**. The time range for this parameter is 0 minutes to 40 minutes. The default time is 30 seconds.

1 Service

J: Service Notification

Service notification in months

When the boiler control determines that a scheduled service is due based on days of installation, the boiler display will alternate the standard boiler display text with the message SERVICE DUE every 5 seconds. This parameter is adjustable by the installer by accessing parameter **J1**. The time range for this parameter is 0 months to 36 months. The default time is 12 months.

Service notification running hours

When the boiler control determines that a scheduled service is due based on the hours of actual operation, the boiler display will alternate the standard boiler display text with the message SERVICE DUE every 5 seconds. This parameter is adjustable by the installer by accessing parameter **J2**. The time range for this parameter is 0 hours to 100,000 hours. The default time is 10,000 hours.

Service notification boiler cycles

When the boiler control determines that a scheduled service is due based on the number of boiler cycles, the boiler display will alternate the standard boiler display text with the message SERVICE DUE every 5 seconds. This parameter is adjustable by the installer by accessing parameter **J3**. The range for this parameter is 0 cycles to 100,000 cycles. The default is 10,000 cycles.

Reset service notification counter

Once servicing has been completed, the service notification counter should be reset. This parameter can be reset by the installer by accessing parameter **J4**. Once accessed, press the RESET key to reset the service notification counter.

2 Maintenance

Maintenance and annual startup

Table 5 *Service and Maintenance Schedules*

Service technician (see the following pages for instructions)	
ANNUAL START-UP	**General:** • Address reported problems • Inspect interior; clean and vacuum if necessary; • Clean condensate trap and fill with fresh water • Check for leaks (water, gas, flue, condensate) • Verify flue and air lines in good condition and sealed tight • Check system water pressure/system piping/expansion tank • Check control settings • Check ignition and flame sense electrodes (sand off any deposits; clean and reposition) • Check wiring and connections • Perform start-up checkout and performance verification per Section 10 in the Knight Installation and Operation Manual. • Flame inspection (stable, uniform) • Flame signal (at least 10 microamps at high fire) • Clean the heat exchanger if flue temperature is more than 54°F above return water temperature. **If combustion or performance indicate need:** • Clean heat exchanger • Remove and clean burner using compressed air only • Clean the blower wheel

Owner maintenance (see the Knight User's Information Manual for instructions)	
Daily	• Check boiler area • Check pressure/temperature gauge
Monthly	• Check vent piping • Check air piping • Check relief valve • Check condensate drain system • Check automatic air vents
Periodically	• Test low water cutoff (if used) • Reset button (low water cutoff)
Every 6 months	• Check boiler piping (gas and water) for leaks • Operate relief valve
End of season months	• Shut boiler down (unless boiler used for domestic hot water)

2 Maintenance

⚠ WARNING Follow the Service and maintenance procedures given throughout this manual and in component literature shipped with the boiler. Failure to perform the service and maintenance could result in damage to the boiler or system. Failure to follow the directions in this manual and component literature could result in severe personal injury, death, or substantial property damage.

⚠ WARNING The boiler should be inspected annually only by a qualified service technician. In addition, the maintenance and care of the boiler designated in Table 5 and explained on the following pages must be performed to assure maximum boiler efficiency and reliability. Failure to service and maintain the boiler and system could result in equipment failure.

⚠ WARNING Electrical shock hazard – Turn off power to the boiler before any service operation on the boiler except as noted otherwise in this instruction manual. Failure to turn off electrical power could result in electrical shock, causing severe personal injury or death.

Address reported problems

1. Inspect any problems reported by the owner and correct before proceeding.

Inspect boiler area

1. Verify that boiler area is free of any combustible materials, gasoline and other flammable vapors and liquids.
2. Verify that air intake area is free of any of the contaminants listed in Section 1 of the Knight Boiler Installation and Operation Manual. If any of these are present in the boiler intake air vicinity, they must be removed. If they cannot be removed, reinstall the air and vent lines per this manual and the Knight Boiler Installation and Operation Manual.

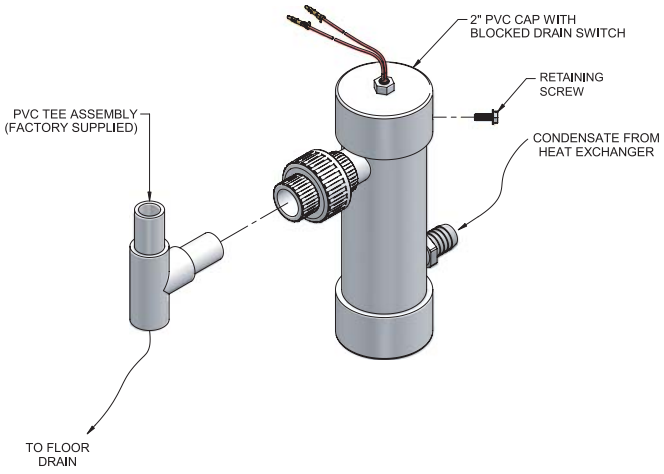
Inspect boiler interior

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

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. 3).
3. Remove the 2 inch PVC cap with the switch located at the top of the trap (FIG. 3).
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 3 *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 of the Knight Boiler Installation and Operation Manual.

2 Maintenance *(continued)*

Flue vent system and air piping

1. Visually inspect the entire flue gas venting system and air piping for blockage, deterioration or leakage. Repair any joints that show signs of leakage. Verify that air inlet pipe is connected and properly sealed.

2. Verify that boiler vent discharge and air intake are clean and free of obstructions.

⚠ WARNING Failure to inspect for the above conditions and have them repaired can result in severe personal injury or death.

Check water system

1. Verify all system components are correctly installed and operational.

2. Check the cold fill pressure for the system. Verify it is correct (must be a minimum of 12 psi).

3. Watch the system pressure as the boiler heats up (during testing) to ensure pressure does not rise too high. Excessive pressure rise indicates expansion tank sizing or performance problem.

4. Inspect automatic air vents and air separators. Remove air vent caps and briefly press push valve to flush vent. Replace caps. Make sure vents do not leak. Replace any leaking vents.

Check expansion tank

1. Expansion tanks provide space for water to move in and out as the heating system water expands due to temperature increase or contracts as the water cools. Tanks may be open, closed or diaphragm or bladder type. See Section 6 - Hydronic Piping of the Knight Boiler Installation and Operation Manual 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 of the Knight Boiler Installation and Operation Manual before proceeding further.

⚠ WARNING Safety relief valves should be re-inspected AT LEAST ONCE EVERY THREE YEARS, by a licensed plumbing contractor or authorized inspection agency, to ensure that the product has not been affected by corrosive water conditions and to ensure that the valve and discharge line have not been altered or tampered with illegally. Certain naturally occurring conditions may corrode the valve or its components over time, rendering the valve inoperative. Such conditions are not detectable unless the valve and its components are physically removed and inspected. This inspection must only be conducted by a plumbing contractor or authorized inspection agency – not by the owner. Failure to re-inspect the boiler relief valve as directed could result in unsafe pressure buildup, which can result in severe personal injury, death, or substantial property damage.

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

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

2 Maintenance

Inspect ignition and flame sense electrodes

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

Check ignition ground wiring

1. Inspect boiler ground wire from the heat exchanger access cover to ground terminal strip.
2. Verify all wiring is in good condition and securely attached.
3. Check ground continuity of wiring using continuity meter.
4. Replace ground wires if ground continuity is not satisfactory.

Check all boiler wiring

1. Inspect all boiler wiring, making sure wires are in good condition and securely attached.

Check control settings

1. Set the SMART SYSTEM control module display to Parameter Mode and check all settings. See Section 1 of this manual. Adjust settings if necessary. See Section 1 of this manual for adjustment procedures.
2. Check settings of external limit controls (if any) and adjust if necessary.

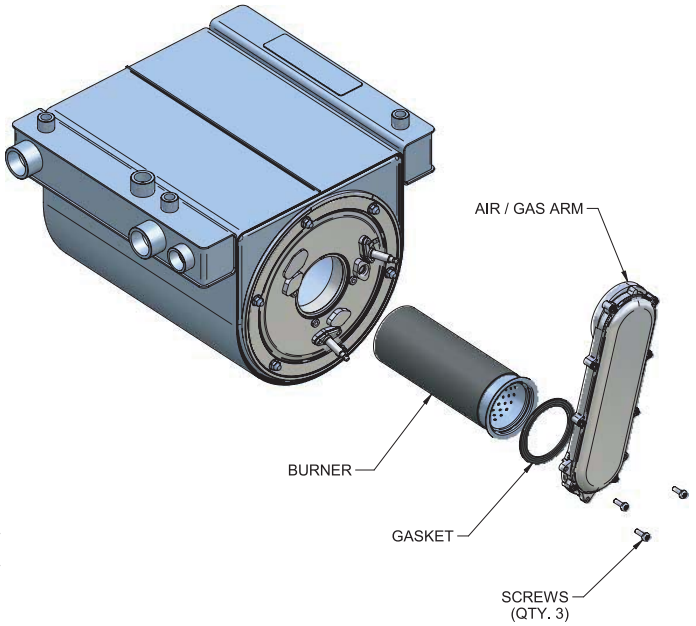
Perform start-up and checks

1. Start boiler and perform checks and tests specified in Section 10 - Start-up of the Knight Boiler Installation and Operation Manual.
2. Verify cold fill pressure is correct and that operating pressure does not go too high.

Check burner flame

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

Figure 4 *Burner Assembly*



2 Maintenance *(continued)*

Check flame signal

1. At high fire the flame signal shown on the display should be at least 10 microamps.

2. A lower flame signal may indicate a fouled or damaged flame sense electrode. If cleaning the flame sense electrode does not improve, ground wiring is in good condition, and ground continuity is satisfactory, replace the flame sense electrode.

3. See Section 3 - Troubleshooting in this manual for other procedures to deal with low flame signal.

Review with owner

1. Review the Knight Boiler User's Information Manual with the owner.

2. Emphasize the need to perform the maintenance schedule specified in the Knight Boiler User's Information Manual (and in this manual as well).

3. Remind the owner of the need to call a licensed contractor should the boiler or system exhibit any unusual behavior.

4. Remind the owner to follow the proper shutdown procedure and to schedule an annual start-up at the beginning of the next heating season.

Cleaning boiler heat exchanger

1. Shut down boiler:
   - Follow the "To Turn Off Gas to Appliance" instructions for the boiler in the Knight Boiler Installation and Operation Manual.
   - Do not drain the boiler unless it will be exposed to freezing temperatures. If using freeze prevention fluid in system, do not drain.

2. Allow time for the boiler to cool to room temperature if it has been firing.

3. Remove the 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 on page 3 of this 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 the Knight Boiler Installation and Operation Manual.

Oiled bearing circulators

1. The circulator shipped with the Knight boiler is water-lubricated. No oiling is required.

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

3. Replace the boiler front access cover.

3 Troubleshooting

⚠ WARNING Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation. Always disconnect power to the boiler before servicing. Failure to comply could result in severe personal injury, death, or substantial property damage.

⚠ WARNING Never jumper (bypass) any device except for momentary testing as outlined in the Troubleshooting chart. Severe personal injury, death, or substantial property damage can result.

Before troubleshooting:

1. Have the following items:
   a. Voltmeter that can check 120 vac, 24 vac, and 12 vdc.
   b. Continuity checker.
   c. Contact thermometer.
2. Check for 120 vac (minimum 102 VAC to maximum 132 vac) to boiler.
3. Make sure thermostat is calling for heat and contacts (including appropriate zone controls) are closed. Check for 24 vac between thermostat wire nuts and ground.
4. Make sure all external limit controls are installed and operating.

Check the following:

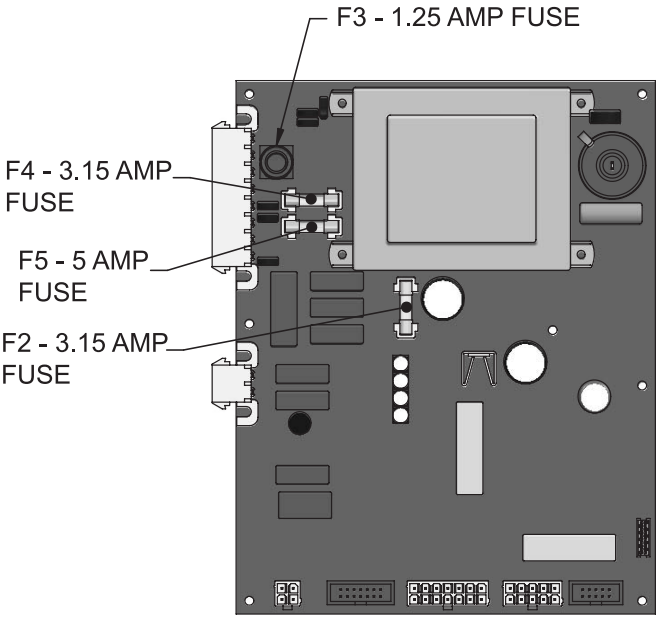
1. Wire connectors to control module are securely plugged in at the module and originating control.
2. Gas pressures:
   - Maximum: 10.5 inches w.c. (natural), 13 inches w.c. (LP) with no flow (lockup) or with boiler on
   - Minimum: 4 inches w.c. (natural), 8 inches w.c. (LP) with gas flowing (verify during boiler startup)

Check control module fuses

NOTICE ALWAYS check control module fuses before replacing control module or any major components (blower, etc.). If one of these fuses is blown, it can prevent the control module or other components from operating.

1. Turn OFF the power to the boiler at the external line switch.
2. Remove top access cover.
3. Remove the control module cover.
4. Inspect fuses F2, F3, F4, and F5, see FIG 5 below.

Figure 5 *Control Module Fuses*



5. The boiler is shipped with three (3) spare fuses in a plastic bag attached to the control module cover.
6. If necessary, replace open fuse (F3 is 1.25 amps, F2 and F4 are 3.15 amps, and F5 is 5 amps).

Note: Fuses F2 - F5 are all slow blow fuses.

⚠ WARNING Do not jumper fuse or replace with any fuse except as specified. Failure to comply could result in severe personal injury, death, or substantial property damage.

7. Install control module cover and top access cover after fuse inspection.
8. Restore power to the boiler at the external line switch and verify boiler operation (Section 10 - Start-up in the Knight Boiler Installation and Operation Manual) after completing boiler service.

3 Troubleshooting *(continued)*

Table 6 *Troubleshooting Chart - No Display*

FAULT	CAUSE	CORRECTIVE ACTION
No Display	- No 120 vac supplied to unit.	• Check external line switch, fuse, or breaker. • Check position of ON/OFF switch. Turn switch to the ON position. • Check 120 vac through the ON/OFF switch. • Check wiring harness connection between display board and main control board. Connect harness at both points.
	- No voltage through the switch.	• Replace switch.
	- Bad display board.	• Replace board.
	- Bad main control board.	• Replace the main control board.
	- Blown fuse.	• Replace fuse F3 on the main control board, see page 28 of this manual.
No Burner Operation	- Main control board temperature set point satisfied.	• Review temperature setting.
	- Remote thermostat satisfied.	• Review remote thermostat setting.
	- Outside air temperature above Warm Weather Shutdown (WWSD) set point for main control board.	• Check location of outside air sensor. Check resistance of outdoor air sensor and compare to Table 7C on page 30 of this manual.
	- Unit locked out on fault.	• Consult display for specific fault. Refer to fault descriptions on page 32 of this manual for corrective actions.

3 Troubleshooting

Checking temperature sensors

The boiler temperature sensors (inlet water, outlet water, system water, flue, and outdoor air) are all resistance type devices. The following tables show the correct values for the sensors at various temperatures. Use an ohmmeter to read the resistance of the sensor at a known temperature. If the resistance of the sensor does not closely match its corresponding table, replace the sensor.

Table 7A - *Inlet/Outlet System Sensor Resistance vs. Temperature*

Temperature	Resistance	Temperature	Resistance
50	18,780	158	1,990
68	12,263	176	1,458
86	8,194	194	1,084
104	5,592	212	817
122	3,893		
140	2,760		

Table 7B - *Flue Temperature Sensor Resistance vs. Temperature*

Temperature	Resistance	Temperature	Resistance
68	14,773	176	1,707
86	9,804	194	1,266
104	6,652	212	952
122	4,607	230	726
140	3,252	248	560
158	2,337		

Table 7C - *Outdoor Air Sensor Resistance vs. Temperature*

Temperature	Resistance	Temperature	Resistance
-50	490,813	20	46,218
-40	336,606	30	34,558
-30	234,196	40	26,099
-20	165,180	50	19,900
10	118,018	60	15,311
0	85,362	70	11,883
10	62,465	80	9,299

3 Troubleshooting *(continued)*

Table 8 *Troubleshooting Chart - Noisy System*

FAULT	CAUSE	CORRECTIVE ACTION
Noisy Operation	- Supply gas problem. Natural gas pressures should be between 4 inches w.c. and 10.5 inches w.c. LP gas pressures should be between 8 inches w.c. and 13 inches w.c.	• Refer to Section 7 - Gas Connections of the Knight Boiler Installation and Operation Manual for detailed information concerning the gas supply.
	- Gas/air mixture problem.	• Refer to the Gas Valve Adjustment Procedure on page 41 of this manual for the proper gas valve setting. Verify that the vent/air intake lengths do not exceed the maximum listed in the General Venting section of the Knight Boiler Installation and Operation Manual.
	- Dirty/damaged burner.	• Refer to page 26 in this manual for the burner removal and inspection procedure. Clean or replace the burner as necessary.
	- Low water flow through the heat exchanger.	• Refer to Section 6 - Hydronic Piping of the Knight Boiler Installation and Operation Manual for minimum flow rates. Verify that the boiler is piped in a primary/secondary fashion and that the boiler and system pump are running on a call for heat.
	- Air in the piping system.	• Properly purge all air from the piping system.
	- Low system water pressure.	• Verify system pressure is a minimum of 12 psi.
No Pump Operation - Boiler Pump System Pump or DHW Pump	- Blown fuse.	• Replace fuse F5 on the control board, see page 28 of this manual. **Note:** Make sure pump amperage does not exceed 1.8 amps.
	- Faulty pump.	• Replace pump.
	- Internal fault on control board.	• Replace main control board.
Relief Valve Opening	- System pressure exceeds relief valve setting.	• Lower the system pressure below the 30 psi rating of the supplied relief valve or replace the standard relief valve with a higher rated valve up to the maximum pressure of the heat exchanger. • Improperly sized expansion tank.

3 Troubleshooting

Table 9 *Troubleshooting Chart - Fault Messages Displayed on Boiler Interface*

FAULT	DESCRIPTION	CORRECTIVE ACTION
Gas Pressure (will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	Either the optional manual reset low gas pressure switch or the optional manual reset high gas pressure switch tripped. Available only on 500 models.	• Reset the pressure switches. • Measure the supply gas pressure to determine cause of failure. Natural gas pressures should be between 4 - 10.5 inches w.c. and LP gas pressures should be between 8 - 13 inches w.c. • Refer to Section 7 - Gas Connections of the Knight Boiler Installation and Operation Manual for detailed information concerning the gas supply. • Correct the supply gas pressure if necessary. • Check for a loose or misplaced jumper if pressure switches are not installed.
Flow Switch (will require a manual reset once condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	Either the optional flow switch or the optional low water cutoff is not making.	• Check boiler pump operation on a call for heat. • Check for closed valves or obstructions in the boiler piping. • Verify system is full of water and all air has been purged from the system. • Check for a loose or misplaced jumper if flow switch is not installed.
	Blown fuse.	• Replace fuse F2 on the control board, see page 28 of this manual.
Block Drain	The blocked drain switch has detected excessive condensate build up inside the unit.	• Check condensate tube from unit to floor drain for proper installation and obstructions. • Inspect condensate trap for blockage. Clean if necessary. • Bad blocked drain switch. Replace switch.
Flame Sequence (will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	The flame detector circuit is seeing a flame signal while no flame is present.	• Check supply voltage for proper polarity. • Check external wiring for voltage feedback. • Check the flame rod and make sure it is clean. • Check the internal wiring for bad connections. • Replace main control board.
GV/Control Fail (will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	The main control board did not detect the gas valve.	• Check wiring harness connection at the gas valve and at the main control board. • Replace the gas valve wire harness. • Replace the gas valve. • Replace the main control board.

3 Troubleshooting *(continued)*

Table 9 *(continued from previous page) Troubleshooting Chart - Fault Messages Displayed on Boiler Interface*

FAULT	DESCRIPTION	CORRECTIVE ACTION
Anti-cycling	The main control board has received a call for heat too quickly after the previous call for heat has ended.	• The control board will release the call for heat after a set time period. • The control board will release the call for heat if the outlet temperature drops too quickly.
No Flame Ign (will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	The unit has failed to prove main burner ignition after four (4) attempts. **Exception:** The 500 Model will lock out after one (1) try for ignition. It will require a manual reset before attempting to fire again.	• Inspect spark electrode and associated wiring for damage and connection. Reference page 26 of this manual for removal and cleaning procedures. Replace if necessary. • Check for proper electrical grounding of the unit. • Check incoming supply gas pressure. Natural gas pressures should be between 4 - 10.5 inches w.c. and LP gas pressures should be between 8 - 13 inches w.c. Refer to Section 7 - Gas Connections of the Knight Boiler Installation and Operation Manual for detailed information concerning the gas supply. • Verify that the plastic hose from the gas valve to the air inlet is connected and is not damaged. • Verify that the vent/air intake pipes are correctly installed and that there are no obstructions. • Check for 24 vac to the gas valve at the 2-pin connection on the side of the main control board during the ignition attempt. If no voltage is present, replace the main control board. • If 24 vac is present at the main control board, check the wiring between the main control board and the gas valve. Replace the wiring if necessary. Do not disconnect the wiring from the gas valve and attempt to measure voltage at that point. The main control board can detect if the gas valve is not connected and will display the Gas Valve or Gas Valve Fail fault. • If 24 vac is present, check the outlet of the valve to ensure the valve is flowing gas. With a manometer connected to the outlet tap of the gas valve, when the unit is in the prepurge period, there should be a negative pressure present. When the valve is energized a change in pressure should occur. If the pressure change does not occur, the gas valve is not opening. Replace the gas valve. • Inspect flame sensor and associated wiring. Reference page 26 of this manual for removal and cleaning procedures. Replace if necessary. • Inspect the burner. Reference page 26 of this manual for removal and cleaning procedures. Replace if necessary. • Replace the main control board.

3 Troubleshooting

Table 9 *(continued from previous page) Troubleshooting Chart - Fault Messages Displayed on Boiler Interface*

FAULT	DESCRIPTION	CORRECTIVE ACTION
No Flame Run (will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	The unit was running and lost the flame signal. The unit then failed to relight the main burner after four (4) tries. **Exception:** The 500 Model will lock out after one (1) try.	• Inspect spark electrode and associated wiring for damage and connection. Reference page 26 of this manual for removal and cleaning procedures. Replace if necessary. • Check for proper electrical grounding of unit. • Check incoming supply gas pressure. Natural gas pressures should be between 4 - 10.5 inches w.c. and LP gas pressures should be between 8 - 13 inches w.c. Refer to Section 7 - Gas Connections of the Knight Boiler Installation and Operation Manual for detailed information concerning the gas supply. • Verify that the plastic hose from the gas valve to the air inlet is connected and is not damaged. • Verify that the vent/air intake pipes are installed correctly and there are no obstructions. • Check for 24 vac to the gas valve at the 2-pin connection on the side of the main control board during the ignition attempt. If no voltage is present, replace the main control board. • If 24 vac is present at the main control board, check the wiring between the main control board and the gas valve. Replace the wiring if necessary. Do not disconnect the wiring from the gas valve and attempt to measure voltage at that point. The main control board can detect if the gas valve is not connected and will display the Gas Valve or Gas Valve Fail fault. • If 24 vac is present, check the outlet of the valve to ensure the valve is flowing gas. With a manometer connected to the outlet tap of the gas valve, when the unit is in the prepurge period, there should be a negative pressure present. When the valve is energized a change in pressure should occur. If the pressure change does not occur, the gas valve is not opening. Replace the gas valve. • Inspect flame sensor and associated wiring. Reference page 26 of this manual for removal and cleaning procedures. Replace if necessary. • Inspect the burner. Reference page 26 of this manual for removal and cleaning procedures. Replace if necessary. • Replace the main control board.

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3 Troubleshooting *(continued)*

Table 9 *(continued from previous page) Troubleshooting Chart - Fault Messages Displayed on Boiler Interface*

FAULT	DESCRIPTION	CORRECTIVE ACTION
Auto Reset High Limit (will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	The outlet water temperature has exceeded the fixed setting of the automatic reset high limit or the setting of an optional manual reset high limit.	• Verify that the system is full of water and that all air has been properly purged from the system. • Verify that the boiler is piped properly into the heating system. Refer to Section 6 - Hydronic Piping of the Knight Boiler Installation and Operation Manual for the proper piping methods for the Knight boiler. • Check 120 vac to boiler pump motor on a call for heat. If voltage is not present, check wiring back to the main control board. • Replace the main control board if necessary. • If 120 vac is present on a call for heat and the boiler pump is not operating, replace the pump. • If the system pump is a variable speed pump, ensure that the system flow is not less than the boiler flow. • If operating on something other than an outlet sensor, check temperature setting of the main control board. • If the optional manual reset high limit has tripped, check setting of the device. • Check resistance of water sensors and compare to Table 7A on page 30 of this manual. Replace sensor if necessary. • Replace high limit.
Fan Low OR Fan Speed Low (will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	The actual fan RPM is 30% lower than what is being called for.	• Vent/air intake lengths exceed the maximum allowed lengths. Refer to Section 3 - General Venting of the Knight Boiler Installation and Operation Manual for proper lengths. • Check for obstruction or blockage in the vent/air intake pipes or at terminations. • Check the wiring connections at the fan and at the main control board. • Replace the fan. • Replace the main control board.
	Blown fuse.	• Replace fuse F4 on the control board, see page 28 of this manual.

3 Troubleshooting

Table 9 *(continued from previous page) Troubleshooting Chart - Fault Messages Displayed on Boiler Interface*

FAULT	DESCRIPTION	CORRECTIVE ACTION
Fan High OR Fan Speed High (will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	The actual fan RPM is 30% higher than what is being called for.	• Vent/air intake lengths exceed the maximum allowed lengths. Refer to Section 3 - General Venting of the Knight Boiler Installation and Operation Manual for proper lengths. • Check for obstruction or blockage in the vent/air intake pipes or at terminations. • Check the wiring connections at the fan and at the main control board. • Replace the fan. • Replace the main control board.
Sensor Open (will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	Either the inlet water, outlet water, or flue temperature sensor has been disconnected.	• Check the sensors and their associated wiring. Repair or replace the sensor or wiring if damaged. • Measure the resistance of the sensors and compare the resistance to the tables on page 30 of this manual. • Replace the sensor if necessary.
Sensor Shorted (will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	Either the inlet water, outlet water, or flue temperature sensor has been shorted.	• Check the sensors and their associated wiring. Repair or replace the sensor or wiring if damaged. • Measure the resistance of the sensors and compare the resistance to the tables on page 30 of this manual. • Replace the sensor if necessary.

3 Troubleshooting *(continued)*

Table 9 *(continued from previous page) Troubleshooting Chart - Fault Messages Displayed on Boiler Interface*

FAULT	DESCRIPTION	CORRECTIVE ACTION
Temp O/Shoot	The stack temperature has exceeded the set parameters for the boiler.	• Inspect the heat exchanger. Reference page 27 of this manual for the procedure on how to clean the flue side of the heat exchanger. • Inspect the flue sensor and associated wiring. Measure the resistance of the flue sensor and compare to Table 7B on page 30 of this manual. Replace the sensor if necessary. • Verify that the vent/air intake pipes are properly installed and that there are no obstructions. • Replace the main control board.
	The temperature rise across the heat exchanger has exceeded the set parameters for the boiler.	• Verify that the system is full of water and that all air has been properly purged from the system. • Verify that the boiler is piped properly into the heating system. Refer to Section 6 - Hydronic Piping of the Knight Boiler Installation and Operation Manual for the proper piping methods for the Knight boiler. • Check for 120 vac to the boiler pump motor on a call for heat. If voltage is not present, check the wiring back to the main control board. Replace the main control board if necessary. • If 120 vac is present on a call for heat and the boiler pump is not operating, replace the pump. • Verify that the boiler pump is set to the proper speed or that the pump is the proper size. Reference Section 6 - Hydronic Piping of the Knight Boiler Installation and Operation Manual for boiler pump specifications.
	Outlet water temperature has exceeded the maximum outlet water temperature.	• Verify that the system is full of water and that all air has been properly purged from the system. • Verify that the boiler is piped properly into the heating system. Refer to Section 6 - Hydronic Piping of the Knight Boiler Installation and Operation Manual for the proper piping methods for the Knight boiler. • Check for 120 vac to the boiler pump motor on a call for heat. If voltage is not present, check wiring back to the main control board. Replace the main control board if necessary. • If 120 vac is present on a call for heat and the boiler pump is not operating, replace the pump.

3 Troubleshooting

Table 9 (continued from previous page) Troubleshooting Chart - Fault Messages Displayed on Boiler Interface

FAULT	DESCRIPTION	CORRECTIVE ACTION
Temp O/Shoot (continued) (will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	Outlet water temperature has exceeded the maximum outlet water temperature.	• Verify that the boiler pump is set to the proper speed or that the boiler pump is the proper size. Reference Section 6 - Hydronic Piping of the Knight Boiler Installation and Operation Manual for boiler pump specifications. • Replace the main control board.
Rem Ctrl Flt	External control is cycling too often.	• Check set point of the external control. • Check the wiring between the external control and the unit. • Replace the control.
Parameters Progr (will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)	After downloading parameters from a laptop or a pocket pc, the main control board must be reset.	• Press the ENTER/RESET button on the SMART SYSTEM display panel.

3 Troubleshooting *(continued)*

Table 9 *(continued from previous page) Troubleshooting Chart - Fault Messages Displayed on Boiler Interface*

FAULT	DESCRIPTION	CORRECTIVE ACTION
Service Blk	While the unit is in Service Mode, the outlet temperature has exceeded 185°F.	• Establish a heating load to remove the heat from the boiler loop. • Verify that the system is full of water and that all air has been properly purged from the system. • Verify that the boiler is piped properly into the heating system. Refer to Section 6 - Hydronic Piping of the Knight Boiler Installation and Operation Manual for the proper piping methods for the Knight boiler. • Check 120 vac to the boiler pump motor on a call for heat. If voltage is not present, check the wiring back to the main control board. Replace the main control board if necessary. • If 120 vac is present on a call for heat and the boiler pump is not operating, replace the pump. • Verify that the boiler pump is set to the proper speed or that the boiler pump is the proper size. Reference Section 6 - Hydronic Piping of the Knight Boiler Installation and Operation Manual for boiler pump specifications.
Low 24 vac	120 vac input to the main control board has dropped below 80 vac.	• Check 120 vac supply to the transformer. • Check wiring connections at the low voltage terminal strip. • Check the wire size/length to remote devices. • Replace the transformer.
Watch Dog Error	The main control board has detected an internal fault.	• Replace the main control board.
Write EEProm	The main control board has detected an internal fault.	• Replace the main control board.
CRC Parameters	The main control board has detected an internal fault.	• Replace the main control board.
No Error Stored	The main control board has detected an internal fault.	• Replace the main control board.

3 Troubleshooting

Combustion Analysis Procedure

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.
4. Place the boiler into the active position by pressing the SHUTDOWN button on the display board (see page 7) until **`BOILER:Standby`** appears in the display window.
5. Locate the pinhole button above the "T" in the Knight logo on the display board (see page 7). Press the button once and hold for 5 seconds to place the boiler into Service Mode. In Service Mode the boiler will fire at ignition speed and will then modulate up to full fire.
6. Insert the probe from a combustion analyzer into the hole left by the removal of the flue temperature sensor.
7. Once the boiler has modulated up to full fire, measure the combustion. The values should be in the range listed in Table 11 above. 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 chart below for possible causes and corrective actions.

Table 11 *Flue Products*

Natural Gas				Propane			
CO_2 min.	CO_2 max.	O_2 min.	O_2 max.	CO_2 min.	CO_2 max.	O_2 min.	O_2 max.
8.0%	10.0%	3.0%	6.5%	8.0%	11.0%	4.0%	8.5%

8. Once the combustion analysis is complete, press the SHUTDOWN button on the display board (see page 7) to take the boiler out of Service Mode. The boiler will go to shutdown and the display will show **`BOILER:OFF`**.
9. Turn the main power off to the boiler and replace the flue temperature sensor into the flue pipe connection.
10. Place the boiler back into normal operation.

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

Table 10 *Troubleshooting Chart - Combustion Levels*

POSSIBLE CAUSE	CORRECTIVE ACTION
Vent/Air Intake Length or Obstruction	• Refer to Section 3 - General Venting of the Knight Boiler Installation and Operation Manual for the proper venting and air intake methods for the Knight boiler. • Check for obstructions at the vent/air intake terminals.
Gas Supply Pressure	• Refer to Section 7 - Gas Connections of the Knight Boiler Installation and Operation Manual for the proper gas supply for the Knight boiler.
Dirty/Damaged Burner	• Refer to page 26 of this manual for burner removal and cleaning procedures. • Replace burner if necessary.
Gas Valve Adjustment	• Refer to page 41 of this manual for the gas valve adjustment procedure.

3 Troubleshooting *(continued)*

Gas valve adjustment procedure

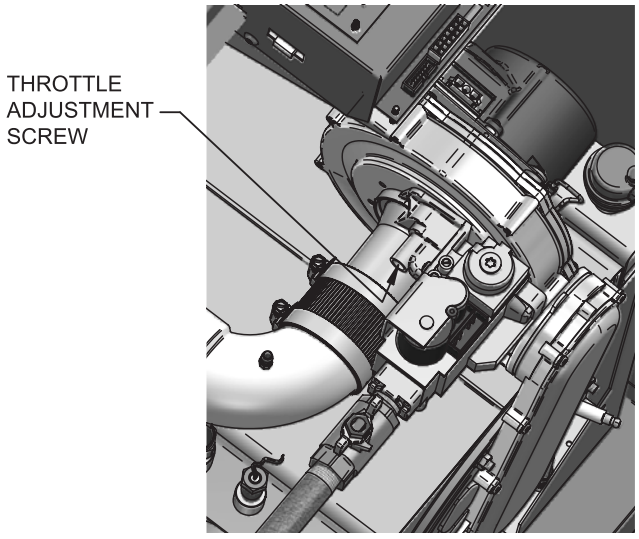
If adjustment of the gas valve is deemed necessary, use the following procedures: (**Note:** The procedures below are model specific.)

Models 80 - 285

Locate the throttle adjustment screw on the side of the venturi valve (FIG. 6). Using a screwdriver, turn the screw a 1/4 turn clockwise to increase CO2 levels or a 1/4 turn counterclockwise to decrease CO2 levels. After performing one adjustment on the valve, follow the Combustion Analysis Procedure on page 40 of this manual to measure the combustion.

If combustion is still not within the specified range, repeat the procedure. This procedure SHOULD NOT be performed more than four (4) times. If after four (4) adjustments and the combustion is still not within the specified range, revisit the possible causes in Table 10 on page 40 or replace the gas valve.

Figure 6 *Gas Valve Adjustment: Models 80 - 285*



Model 399

CAUTION Under normal operating conditions this valve should not need adjusting.

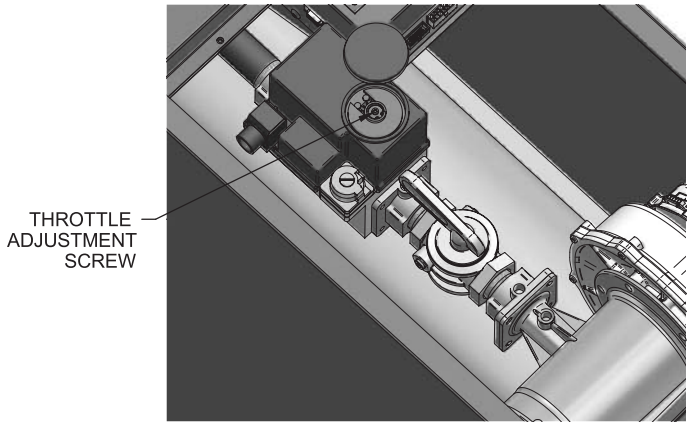
There is no adjustment for the gas valve on the 399 model. Revisit the possible causes in Table 10 on page 40 or replace the gas valve.

Model 500

Locate the throttle adjustment screw on top of the gas valve, see FIG. 7. Using a screwdriver, turn the screw a 1/4 turn clockwise to increase CO2 levels or a 1/4 turn counterclockwise to decrease CO2 levels. After one adjustment on the valve, follow the Combustion Analysis Procedure on page 40 of this manual to measure the combustion.

If combustion is still not within the specified range, repeat the procedure. This procedure SHOULD NOT be performed more than four (4) times. If after four (4) adjustments and the combustion is still not within the specified range, revisit the possible causes in Table 10 on page 40 or replace the gas valve.

Figure 7 *Gas Valve Adjustment: Model 500*



4 Notes

4 Notes

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