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HEAT-TIMER® CORPORATION

INSTALLATION & OPERATION MANUAL

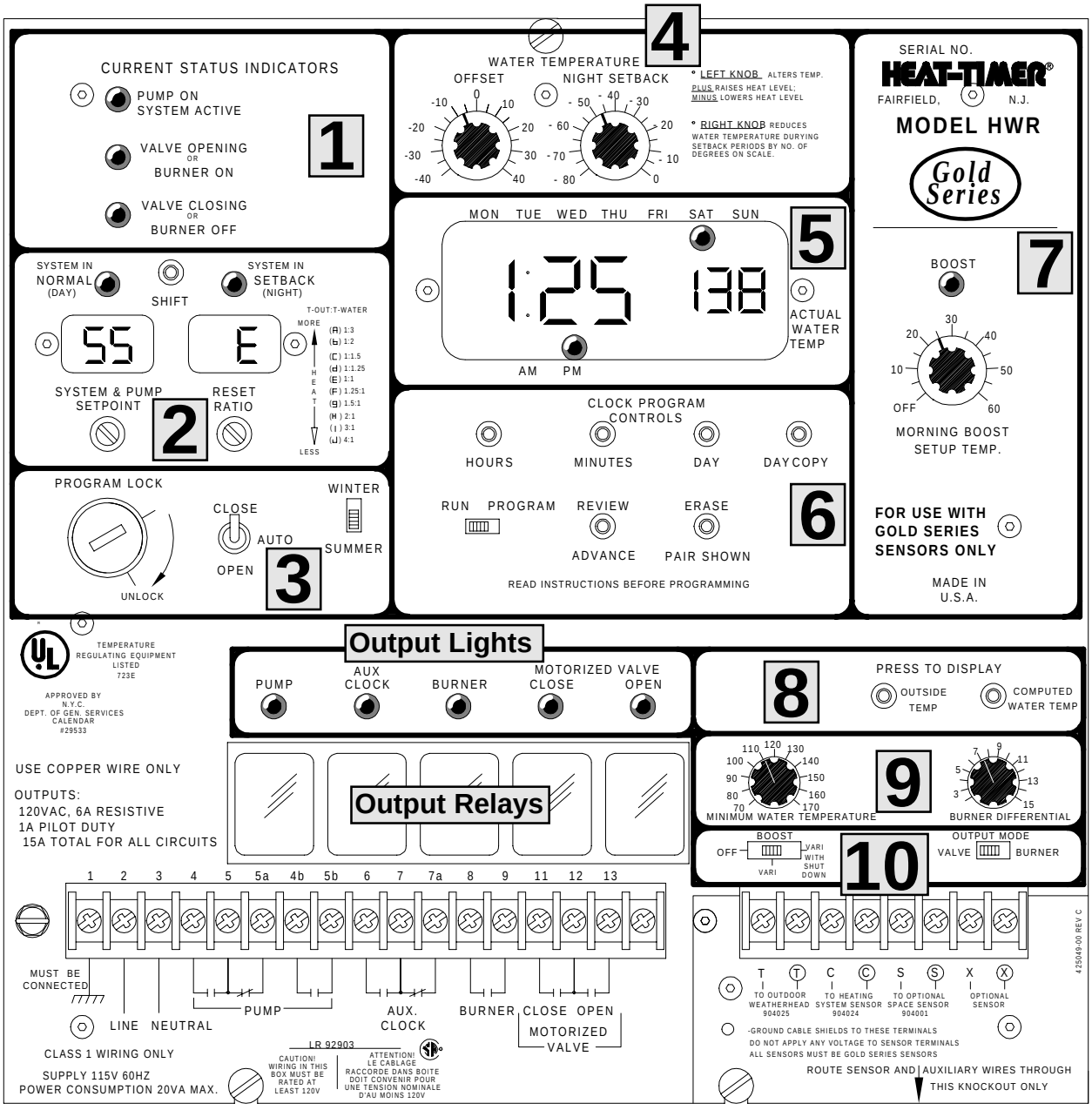
MODEL HWR

GOLD SERIES

TABLE OF CONTENTS

THIS HEAT-TIMER MODEL HWR HAS BEEN APPROVED BY UNDERWRITERS LABORATORIES **E-60760(M)** AND THE CANADIAN STANDARDS ASSOC. THIS MODEL IS APPROVED FOR INSTALLATION AND OPERATION IN THE CITY OF NEW YORK BY THE DIVISION OF PUBLIC STRUCTURES. THE CALENDAR NUMBER APPROVAL IS **29533.**

HT #059136 REV A



Functions

To help simplify these instructions, sections of the control panel are keyed and referred to in the text by the above numbers

Control Panel

Functions

1 **CURRENT STATUS INDICATORS**

- ***Indicator lights*** show status of heating system at all times.

2 **SYSTEM & PUMP SET POINT and RESET RATIO**

- ***Digital display*** of system and pump sensor set point
- ***Digital display*** of reset ratio adjustment 1:3 to 4:1 (Outdoor:Water)
- ***SHIFT*** manual switch to change NORMAL (DAY) to SETBACK (NIGHT) and reverse.
- ***RED LIGHT*** to show when unit is in ***NORMAL (DAY)*** mode.
- ***RED LIGHT*** to show when unit is in ***SETBACK (NIGHT)*** mode.

3 **PROGRAM LOCK , BY- PASS SWITCH and WINTER / SUMMER SWITCH**

- ***KEY*** locks program, outside set point, and reset ratio setting
- ***BY-PASS SWITCH*** puts unit in ***AUTO*** mode or by-passed ***OPEN*** or ***CLOSE.***
- ***WINTER / SUMMER SWITCH*** auto / heat-off switch.

4 **WATER TEMPERATURE ADJUSTMENT**

- ***OFFSET*** fine tunes the reset ratio adjustments.
- ***NIGHT SETBACK*** lowers ambient temperatures during the SETBACK (NIGHT) mode.

5 **CLOCK & OUTDOOR TEMPERATURE DISPLAY**

- ***Clock*** displays ***PRESENT TIME*** while the unit is in AUTO mode.
- ***RED LIGHT*** indicates ***AM or PM .***
- ***RED LIGHT*** indicates the ***day of the week.***
- ***ACTUAL WATER TEMP*** displays current heating water temperature.

6 **CLOCK PROGRAM CONTROLS**

- Used to program 7-day clock for NORMAL (DAY) and SETBACK (NIGHT) heat levels.

7 **BOOST**

- ***RED LIGHT*** indicates unit is in ***BOOST*** and ***BOOST*** adjustment curve knob.

8 **PRESS TO DISPLAY**

- ***OUTSIDE TEMPERATURE*** displays temperature of the outdoor sensor.
- ***COMPUTED WATER TEMPERATURE*** displays temperature HWR will maintain.

9 **MINIMUM WATER TEMP & BURNER DIFFERENTIAL**

- ***MINIMUM WATER TEMPERATURE*** adjustment for burner applications.
- ***BURNER DIFFERENTIAL*** adjustment to prevent burner short cycling.

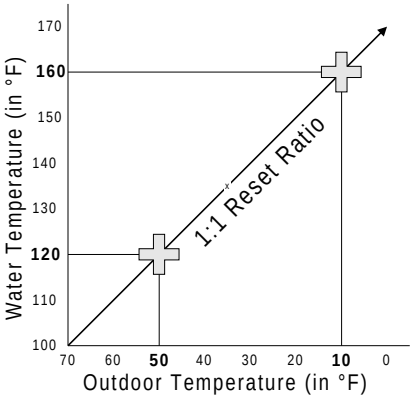
10 **BOOST & OUTPUT MODE**

- ***BOOST*** switch to select type of morning Boost and shutdown.
- ***OUTPUT MODE*** switch to between burner and valve operation.

Understanding the "Gold Series" Model HWR

The Model HWR controls a hot water heating system to provide a building with comfortable and even heat levels. The HWR varies the temperature of the circulating heating water in response to changes in the outdoor temperature. The heating water temperature is controlled through the use of either a motorized valve or through direct burner operation.

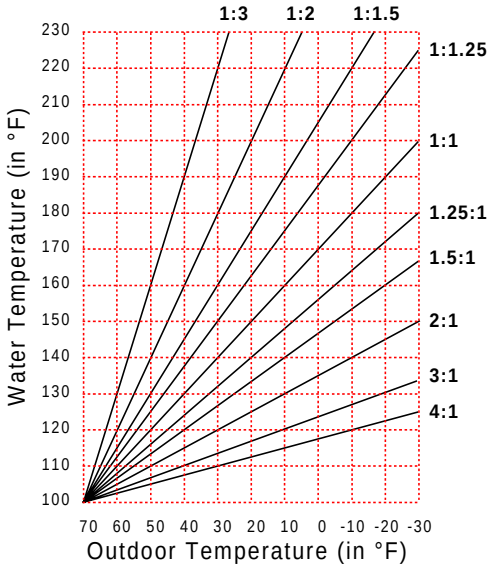
The HWR also controls the system circulating pump with an adjustable outdoor cutoff. When the outdoor temperature is warm, the pump is off and no heating water is circulated through the system. When the outdoor temperature drops, the pump is activated and the heating water circulates through the system. The temperature of the heating water is controlled by the Reset Ratio and changes with outdoor temperature.



The Reset Ratio Concept

When a building is being heated, heat escapes through the walls, doors, and windows to the colder outside air. The amount of heat that escapes depends on the outside temperature. The colder the outside temperature, the more heat escapes. If you can input heat into the building at the exact same rate that it is lost out of the building, then the building temperatures will remain constant. The Reset Ratio is an adjustment which allows you to achieve this equilibrium between heat input and heat loss.

The starting point for most systems is the 1:1 (Outdoor Air Temperature : Heating Water Temperature) ratio. This means that for every degree the outdoor temperature drops, the temperature of the heating water will increase one degree. The starting point of the curves is adjustable, but comes factory selected at 70°F Outdoor Temp. and 100°F Water Temp. For example with a 1:1 ratio, if the outdoor temperature is 50°F, this means the temperature has fallen 20° from the starting point of 70°F. Therefore, the heating water temperature will be increased 20° to 120°F.



Each building has different heat loss characteristics. A very well insulated building will not lose much heat to the outside air, and may need a Reset Ratio of 2:1 (Outdoor:Water). This means the outdoor temperature would have to drop 2 degrees to increase the water temperature 1 degree. On the other hand, a poorly insulated building with insufficient radiation may need a Reset Ratio of 1:2 (Outdoor:Water). This means that for each degree the outdoor temperature dropped the water temperature will increase 2 degrees. The HWR has a full range of Reset Ratios to match any buildings heat loss characteristics.

Computed and Actual Water Temperature

The HWR constantly monitors outdoor temperature. When the outdoor temperature falls below an adjustable outdoor set point temperature, the HWR activates the system pump and begins to calculate the Computed Water Temperature. The Computed Water Temperature is the temperature of the circulating system water the HWR calculates based on outdoor temperature and the Reset Ratio curves. If the HWR has been set up correctly, then by circulating water at the Computed Water Temperature, the amount of heat entering the building will equal the heat loss.

The HWR also monitors the Actual Water Temperature. This value is constantly displayed on the small right-hand display on the panel. When the Actual Water Temperature is different from the Computed Water Temperature, the HWR will take action to correct the difference. If the HWR is controlling a boiler directly, then the HWR will turn the boiler on and off to regulate the circulating system water temperature. If the HWR is controlling a valve, the HWR will pulse the valve open or shut to regulate the circulating system water temperature.

Sequence of Operation

The HWR checks outside temperature by means of a solid state sensor located on the exterior of the building. At the same time it monitors the water temperature of the building's heating system by means of a heating system sensor located on a common supply line.

Whenever the outdoor temperature falls below a set point, the system pump is activated and the HWR regulates the heating system to hold the Computed Water temperature. As the outdoor temperature changes, the HWR adjusts the actual water temperature to hold a constant or Normal (Day) heat level. The Normal heat level is for when occupants are present and active.

The HWR can also hold a lower or Setback (Night) heat level. This lower level of heat is for when the building is unoccupied, or tenants are sleeping. The HWR has the capability of programming up to 4 Normal and 4 Setback times for each day of the week. When the building comes out of Setback, there is an optional Boost setting to quickly bring the building up to comfortable temperatures.

Getting the installation started

Before beginning the installation, carefully evaluate your heating system. The HWR can control the heating system through these different methods:

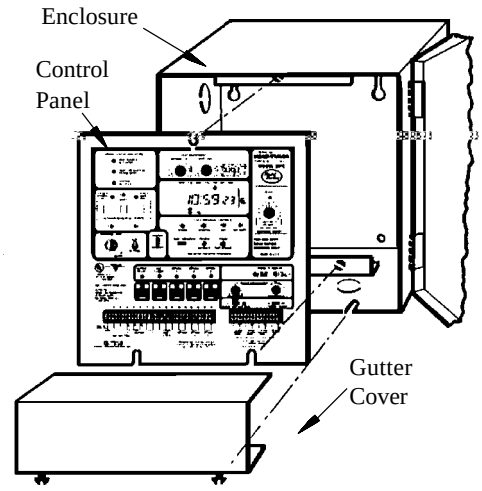
- Direct Boiler Control
- Controlling a 3-Way Motorized Valve
- Controlling a 2-Way Steam Valve into a Heat-Exchanger
- Controlling up to 8 Full Modulation Burners by interfacing to a Heat-Timer MOD-4.

Installation of this control is relatively simple if you follow the instructions carefully. The installation consists of four basic steps:

- Locating and mounting the control,
- Locating and mounting the sensors, both the outside sensor and the heating system sensor,
- Wiring the power, input and output lines,
- Creating an initial pilot program of settings.

Warning: *The Heat-Timer Model HWR is strictly an operating control; under no circumstances should it be used as a primary limit or safety control. The boiler must have its own certified limit and safety controls as required by local codes. These are the responsibility of the installing contractor who must verify proper operation and correct any safety problems prior to starting the HWR installation.*

First Step: Mount the Control



Locate an appropriate site

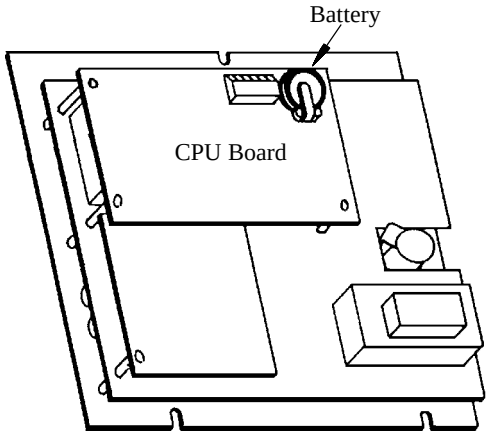
- Near the equipment to be controlled
- Away from excessively high or low temperatures
- At eye level, or where the displays are easily visible
- The surface must be strong enough to hold the weight of the control and the metal enclosure.
- Leave 12" of clearance under the enclosure to allow access to gutter cover screws.

Remove the HWR from the yellow metal enclosure

- Take off the gutter cover by loosening the screws at its bottom
- Remove the top center screw holding the panel to the enclosure
- Loosen the two screws at the bottom of the enclosure
- Lift the panel from the enclosure

Screw the enclosure to the mounting surface through the holes provided.

On the rear of the panel:



Activate the battery

- Turn the HWR panel over to reveal the piggyback circuit board (CPU board).
- Remove the insulating strip from the coin-type battery.

CAUTION: Do not activate the battery unless you plan to power the control at once. If the control is not powered, the battery will lose its charge in 100 days.

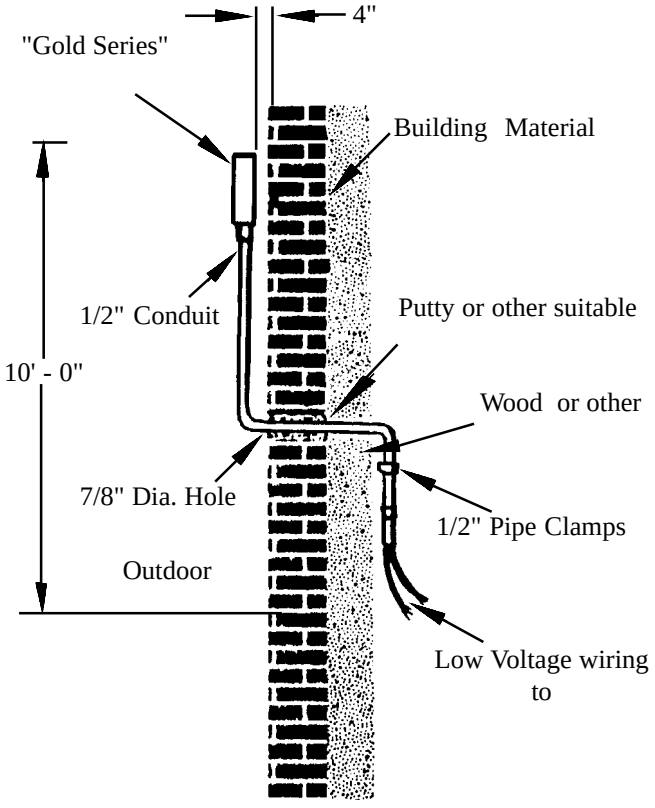
Screw the HWR back into the yellow enclosure

Second Step: Install the Sensors

Installing the outdoor sensor

- Only use the Heat-Timer Gold Series sensor included with the unit (#904025). If you are replacing an earlier model Heat-Timer, it is necessary to upgrade the sensor.
- Locate the sensor in the shade on the north side of the building. The sensor should never be in direct sunlight.
- Be sure the location is away from doors, windows, exhaust fans, vents, or other possible heat sources
- The sensor should be mounted at least 4 inches away from the building wall and approximately 10 feet above ground level
- The sensor wires can be extended up to 500' using shielded 2 conductor cable (Belden #8760 or equivalent). Do not ground the shield at the sensor.
- Do not run sensor wires in conduit with line voltage wiring.

CAUTION: Determining the proper location for the outdoor sensor is very important. The HWR will base the heat on the outdoor temperature information it receives from this location. If the sensor is in the sun, or covered with ice, its reading will be different from the actual outdoor temperature.

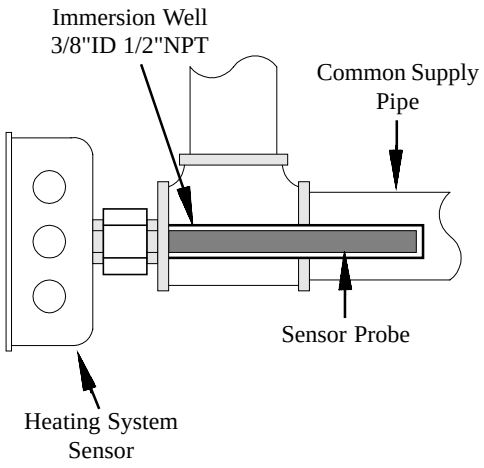


The Heating System Sensor (HSS) must be located where it will indicate the temperature of the water being *supplied* to the heating system.

Locating the HSS

- If the HWR is directly controlling the boiler, put the sensor approximately 10' past the boiler but before any major takeoffs.
- If the HWR is controlling a 3-way valve, place the sensor on the outlet side of the valve which feeds the heating system. The sensor should be approximately 10' past the valve, but before any major takeoffs.
- If the HWR is controlling a steam valve into a heat-exchanger, the sensor must be on the outlet of the coil of the heat-exchanger which is feeding the heating system supply water. The sensor should be approximately 10' past the heat-exchanger, but before any major takeoffs. ***Never place the sensor in the steam line.***
- If the HWR is controlling a MOD-4, the sensor must be in the common supply header after all the boiler connections. The sensor must be located where it can detect the inputs from all the boilers. Place the sensor approximately 10' downstream from the boilers, but before any major takeoffs.

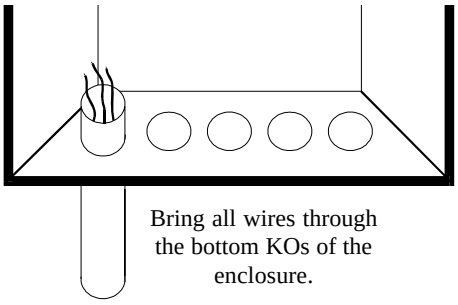
CAUTION: If the HSS can not sense the heating system water temperature being supplied to the building, the HWR will not provide comfortable heat levels. Be sure the HSS is located on a main supply pipe which can not easily be isolated from the system.



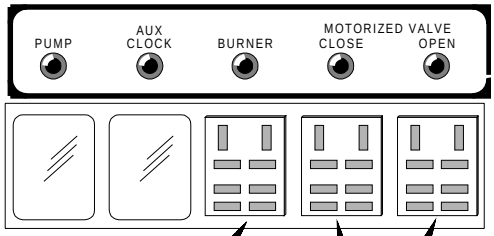
Installing the HSS

- Only use a Gold Series sensor. If you are replacing an earlier model Heat-Timer, it is necessary to upgrade the sensor.
- Install a 3/8"ID 1/2"NPT immersion well (Heat-Timer part #904011 or equivalent).
- Insert the sensor probe of the supplied immersion sensor (HT #904024) into the well, and screw the handy-box into the threaded top of the well.
- The sensor wires can be extended up to 500' using shielded 2 conductor cable (Belden #8760 or equivalent). Do not ground the shield at the sensor.
- Do not run sensor wires in conduit with line voltage wiring

Third Step: Wire the Power and Output Terminals



Bring all wires through the bottom KOs of the enclosure.



Install a relay in this socket if controlling the burner directly

Install relays in each of these sockets if controlling a motorized valve or MOD-4

Wire the power terminals

- Bring the power wires through the bottom **left** hand knock out of the enclosure. ***Do not bring wires through sides or the top as this will interfere with servicing the control.***
- Attach 120V 60 Hz to terminals *2 LINE*, and *3 NEUTRAL*.
- Terminal *1*, ground, must be connected.
- Class 1 copper wire is required by UL.

Wire the heat circulation pump

- The *PUMP* contacts are dry contacts only. They do not source any power.
- Wire the Normally Open (N.O.) dry contacts, Terminals *4* and *5*, to the pump starter.
- Terminals *4b* and *5b* are separate N.O. dry contacts which will be energized whenever Terminals *4* and *5* are energized. They can be used to run a second pump, or any other output which should be on continuously when the outdoor temperature falls below the *SYSTEM & PUMP SETPOINT*.

Installing the Burner or Motorized Valve Relays

- The HWR is shipped with four relays. With direct burner operation, only 3 of the relays will be used, with motorized valve or MOD-4 operation, all four relays will be used.
- One relay must be installed in the socket marked *PUMP*.
- One relay must be installed in the socket marked *AUX CLOCK*.
- If controlling a burner directly, one relay must be installed in the socket marked *BURNER*. The other relay can be in either of the *MOTORIZED VALVE* sockets and can be used as a spare.
- If controlling a motorized valve, or a MOD-4, two relays must be installed in the sockets marked *MOTORIZED VALVE* (and there will be no relay in the *BURNER* socket).

Wire the output

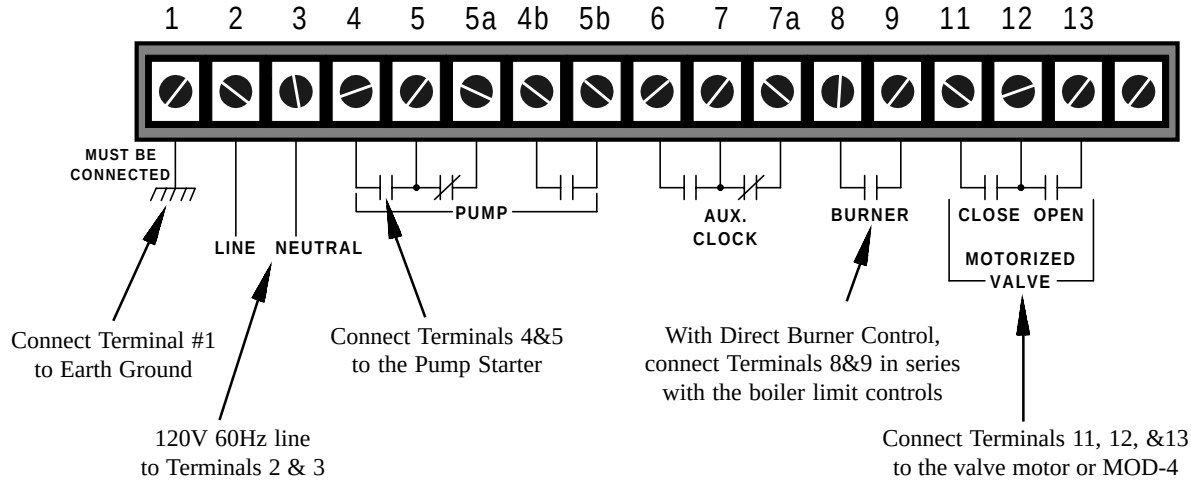
- The HWR outputs are dry contacts only. They do not source any power.
- With direct burner operation, wire the N.O. dry contact Terminals *8* & *9* in series with the limit circuits of the boiler. (Diagram pg. 36)
- With a motorized valve, the motor must be of the floating type. If using a pneumatic valve, use the Electro-Pneumatic transducer (HT #926018-00). Wire Terminal *12* to the Common (Red) of the motor. Wire Terminal *11* to the Close

(White) and Terminal *13* to the Open (Black) of the motor. (Diagram pg. 37)

- With a MOD-4 wire the Terminal *12* to the MOD-4 input COM. Wire Terminal *11* to the MOD-4 input CLOSE. Wire Terminal *13* to the MOD-4 input OPEN. (Diagram pg. 38)
- The *AUX CLOCK* outputs are an extra set of contacts which switch based solely on time (see pg. 23). These contacts can be used in place of an external time clock. To switch units on or off, use the N.O. dry contacts Terminals *6* and *7*. To open a damper or activate a motor, use Terminal *7* as Common terminal, Terminal *6* as Open, and Terminal *7a* as Close.

CAUTION: Each relay is rated at 1 amp inductive, 6 amps resistive at 120V. The total output of all relays must not exceed 15A.

Warning: The HWR is an operating control only. The boiler must have all safety and limit controls required by code. It is the responsibility of the installer to verify that all the safety and limits are working properly before the HWR is installed.



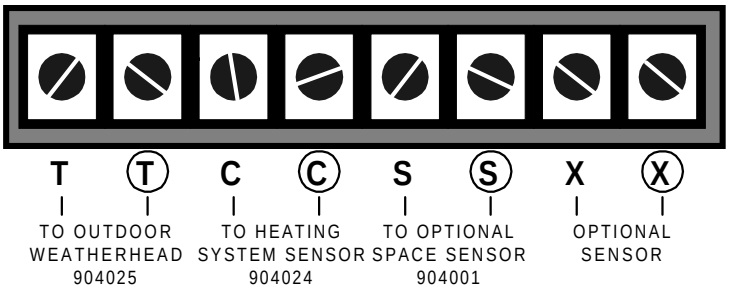
Fourth Step: Wire the Input Terminals

Wiring the outdoor sensor

- Bring outdoor sensor wires through the bottom **right** hand knock out in the enclosure (see pg. 8 on running the wires).
- Attach the sensor wires to the *T-T* terminals.
- Connect the shield to the right hand *T* terminal with a circle around it.

Wiring the heating system sensor (HSS)

- Bring HSS wires through the bottom **right** hand knock out in the enclosure (see pg. 9 on running the wires).
- Attach the sensor wires to the *C-C* terminals.
- Connect the shield to the right hand *C* terminal with a circle around it.



WARNING: Never apply external voltage to the input terminals. Permanent damage will occur, voiding the warranty.

Testing the Sensor Installation

Testing the sensors

- Power up the HWR.
- The control will go through a countdown, and then the small rightmost three digit display marked *ACTUAL WATER TEMP* will show the temperature read by the heating system sensor.
- If the display reads OPN, SHT, or an incorrect temperature, see pg. 47 to determine the source of the problem.
- Press the button marked *OUTSIDE TEMP*. The small rightmost display will now show the temperature read by the outdoor sensor.
- If the display reads OPN, SHT, or an incorrect temperature, see pg. 47 to determine the source of the problem.

Final Step: Make these Initial Settings

Once the control is mounted and wired, set up an initial program. The list below acts as a check list and provides typical settings. The settings may have to be adjusted later based on actual building conditions.

The list numbers correspond to the detailed descriptions of each setting in the following section THE CONTROL SETTINGS.

1. Set the *WINTER/SUMMER* switch to ***WINTER.***

2. Adjust the *SYSTEM & PUMP SETPOINT* to ***60°F*** (Key must be unlocked).

3. Adjust the *RESET RATIO* to ***E*** **(**Key must be unlocked**)**.

4. Adjust the *WATER TEMPERATURE OFFSET* knob to ***0°*** (12 o'clock position).

5. Turn the *WATER TEMPERATURE NIGHT SETBACK* knob to ***-20°*** (2 o'clock position).

6. Set the *CLOSE/AUTO/OPEN* switch to the ***AUTO*** position.

7. Set the present time.*

8. Day/Night program is factory set for the Normal (Day) heat level from 6AM to 10PM, and the Setback (Night) heat level from 10PM to 6AM for the entire week.*

9. With direct burner operation, the *OUTPUT MODE* switch must be set to ***BURNER***. With a 2 or 3-way motorized valve or a MOD-4, the switch must be set to ***VALVE***.

10. Set the *BURNER DIFFERENTIAL* to ***5°*** (10 o'clock position).

11. With direct burner operation, or with a MOD-4, set the *MINIMUM WATER TEMPERATURE* knob to the boiler manufacturer's specifications. With a 2 or 3-way valve, turn the knob fully counterclockwise to 70°F.

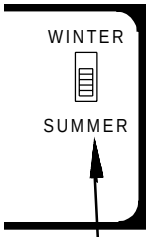
12. Turn the *MORNING BOOST SETUP TEMP.* to ***20°*** (11 o'clock position). Switch the *BOOST* to ***VARI***.

* To adjust, see the next section *CONTROL SETTINGS*

As you start up the control, learn each setting and how it operates

The start-up list on the previous page serves to get the HWR up and running. To adjust the HWR to run optimally in your system, additional adjustments will probably have to be made.

The following pages provide complete descriptions of the HWR functions. All the settings are keyed by number to the list of Initial Settings for easy reference.



In the SUMMER position,
the HWR will not give heat

1. Winter/Summer switch

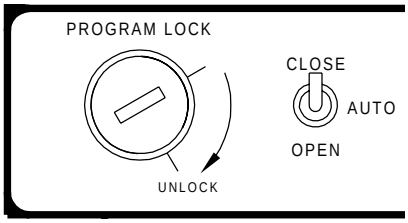
The HWR will turn off the system pump when this switch is in *SUMMER*. In addition, the burner will be off for heating, or the motorized valve will be fully closed. When the switch is in the *WINTER* position, the HWR will activate the system pump and begin heating whenever the outdoor temperature falls below the *SYSTEM & PUMP SETPOINT*.

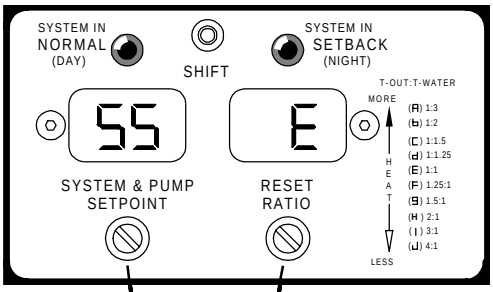
Therefore, during the heating season, this switch must be in the *WINTER* position. When the heating season is over, it is a good practice to move the switch into the *SUMMER* position.

CAUTION: Do not turn the power off to the HWR when the heating season is over. If you do so, the battery will run down and have to be replaced. Instead, switch to *SUMMER*.

2. System & Pump Setpoint

Turn key to UNLOCK
to program set points





Knobs rotate to change Setpoint
and Ratio settings on display

The *SYSTEM & PUMP SETPOINT* will determine when the HWR turns on the system pump and begins heating the system water. When the outside temperature is above the Setpoint, the HWR will turn off the system pump. In addition, the burner will be off for heating, or the valve will be fully closed. When the outside temperature falls below the Setpoint, the HWR will activate the pump and control the burner or valve to hold the calculated heating water system temperature.

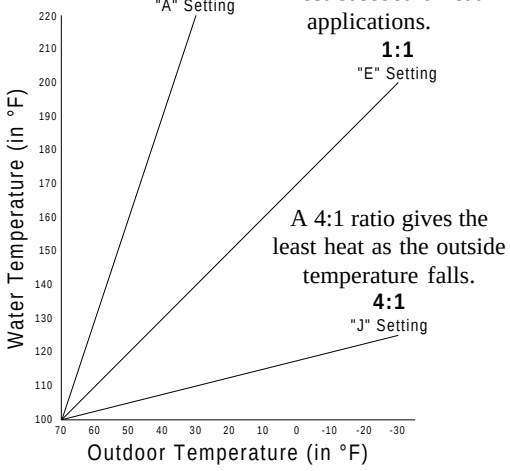
To change the *SYSTEM & PUMP SETPOINT*, you must first unlock the *PROGRAM LOCK*. This is to prevent the settings from being changed by unauthorized users. Simply insert the program key and rotate it clockwise to the *UNLOCK* position. Then rotate the knob under the *SYSTEM & PUMP SETPOINT* until the desired temperature is displayed.

The *SYSTEM & PUMP SETPOINT* can be set from 30°F to 75°F. In addition, the Setpoint can be set to *ON* or *OFF*. In the *ON* position, the system pump will run regardless of the outside temperature and the burner and valve will be active to hold the system water temperature. (Note: The lowest system water temperature the HWR will circulate is 70°F. If the *SYSTEM & PUMP SETPOINT* is turned *ON*, the HWR will circulate at least 70°F water even in the hottest of weather.) In the *OFF* position, the system pump will always be off and the burner will be off for heating or the valve will be fully closed.

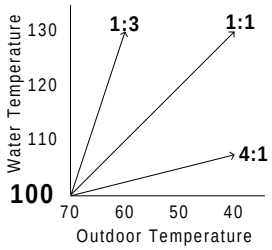
A 1:3 ratio gives the most heat as the outside temperature falls.

A 1:1 ratio works well in most baseboard heat applications.

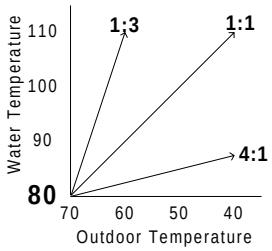
A 4:1 ratio gives the least heat as the outside temperature falls.



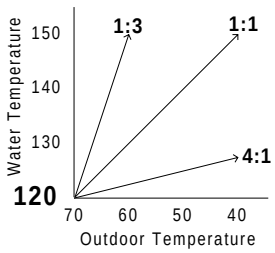
With a 0° Offset, the ratio curves begin at 100° Water Temperature.



With a -20° Offset, the ratio curves begin at 80° Water Temperature.



With a +20° Offset, the ratio curves begin at 120° Water Temperature.



3. Reset Ratio

The *RESET RATIO* determines how the system water temperature will vary with outside temperature. With any of the ratios, the colder it becomes outside, the hotter the temperature of the system water. The ratios are adjustable from 1:3 (A) to 4:1 (J). To adjust the *RESET RATIOS*, you must first unlock the *PROGRAM LOCK* (see diagram pg. 15). Then rotate the knob until the desired letter setting is shown.

With a 1:3 (A) ratio, the system water temperature will increase rapidly as the outside temperature falls, hitting the maximum of 240°F at 24°F outside temperature. With a 4:1 (J) ratio, the system water temperature will increase slowly as the outside temperature falls. Even at -30°F, the system water will only be 125°F, and at 24°F outside, the system water will be 112°F. Such a low Reset Ratio might be used with radiant floor heating applications. (For a complete Reset Ratio chart see pg. 28.)

With most baseboard heating applications, a 1:1 (E) setting is a good place to start. With a 1:1 (E) ratio, for every degree the outside temperature falls, the system water temperature is increased one degree.

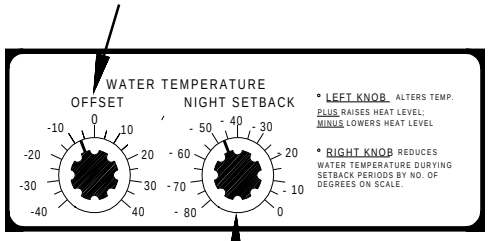
If required: **Adjust the *RESET RATIO* in cold weather**. If the ambient building temperatures are too cold in cold weather, change the ratio counterclockwise by one letter (ie. from E to D). If the building temperatures are too warm in cold weather, change the ratio clockwise by one letter (ie. from E to F).

4. Water Temperature Offset

The *WATER TEMPERATURE OFFSET* knob allows you to adjust the starting points of the Reset Ratio curves (see charts on left). This means that regardless of the outdoor temperature, or the Reset Ratio that has been selected, when the Offset knob is changed, that change is directly added or subtracted to the calculated water temperature. For instance, if the calculated water temperature were 130°F and the Offset knob was rotated from 0° to 10° (an increase of 10°), then the calculated water temperature would immediately change to 140°F.

The *WATER TEMPERATURE OFFSET* does not change the effect that outdoor temperature has on system water temperature. For instance, with a 1:1 Reset Ratio, the system water temperature will always increase one degree for each degree the outdoor

A -40° Offset gives the least amount of heat. A +40° Offset gives the most amount of heat. Adjust the Offset in mild weather.



A -80° Setback reduces the temperature of the circulating hot water by 80° during Night period. A 0° Setback does not reduce the water temperatures.

Sample Offset and Setback Calculations:
Outside Temp: 30°F
Ratio: 1:1

With 0° Offset and Day Settings
Target Water Temperature: 140°F

With -20° Offset and Day Settings
Target Water Temperature: 120°F

With +20° Offset and Day Settings
Target Water Temperature: 160°F

With 0° Offset and 20° Setback
Target Water Temperature: 120°F

With 0° Offset and 40° Setback
Target Water Temperature: 100°F

With -20° Offset and 20° Setback
Target Water Temperature: 100°F

With -20° Offset and 40° Setback
Target Water Temperature: 80°F

With +20° Offset and 20° Setback
Target Water Temperature: 140°F

With +20° Offset and 40° Setback
Target Water Temperature: 120°F

temperature drops. What the Offset does is add or subtract a constant temperature value.

If required: **Adjust the *WATER TEMPERATURE OFFSET* in mild weather**. If the ambient building temperatures are warm in the warm weather, decrease the Offset. If the ambient building temperatures are cold in the warm weather, increase the Offset. The rule of thumb for baseboard radiation is to change the Offset by 4° for every degree you wish to change the building temperatures. For radiant heat applications, change the Offset by 1° or 2° for every degree you wish to change the building temperature.

To adjust the Offset simply rotate the knob *WATER TEMPERATURE OFFSET*. The knob is adjustable from *-40°* to *+40°*. A minus Offset reduces the circulating water temperature, and a positive Offset increases the temperature. A good starting point is in the halfway position at *0°*.

5. Water Temperature Night Setback

The HWR has two heat levels. The *NORMAL (Day)* settings are for when a building is occupied and people are active. The *SETBACK (Night)* settings hold a lower ambient temperature, and are for when a building is unoccupied, or people are sleeping.

The *WATER TEMPERATURE NIGHT SETBACK* knob lowers the temperature of the circulating system water by the number of degrees indicated. In other words, the HWR will first calculate the temperature of the circulating system water by using the outside temperature and Reset Ratio. Then the HWR will add or subtract the value of the Offset knob. Finally, if the control is in Setback, the HWR will subtract the value of the Setback knob. This final value is the temperature the HWR will use for the circulating system water. This procedure will occur automatically.

To adjust the amount of Setback rotate the knob *WATER TEMPERATURE NIGHT SETBACK*. The knob is adjustable from 0° (no night Setback) to 80° (the circulating water temperatures will be lowered 80° when the control enters the Setback mode.) For baseboard radiation, begin by setting the night Setback 4° for every degree you wish to decrease the ambient building temperatures. For example, if you wish the building to be 5° cooler during Setback, set the knob to -20°. For radiant applications, begin by setting the Setback 1° or 2° for every degree you wish to decrease the ambient building temperatures.

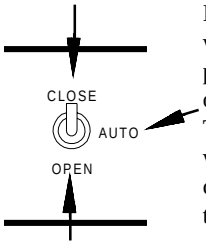
6. Close/Auto/Open Switch

The switch must be in the *AUTO* position for the HWR to control the pump and the circulating system water temperatures. In the *OPEN* (Bypass) position, the pump will run constantly, and either the burner will run on its limits, or the motorized valve will be fully open. In the *CLOSE* position, the pump will also run constantly, but the burner will be off, or the motorized valve will be fully closed.

When the HWR is in the *OPEN* (Bypass) position, no normal functions will be executed. The display will change to read the total amount of time the control has been set to *OPEN*. The large central display will show the number of hours in *OPEN*, and the smaller right hand display will show the number of minutes.

When switched to *OPEN*, the pump will run, and the burner will run on its limits or the valve will open, even if the HWR has been damaged or is not powered. The *OPEN* switch directly connects the Normally Open contacts 4 to 5, contacts 8 to 9, and contacts 12 to 13. Therefore, if there is no heat, test the pump and boiler or valve by putting the control in *OPEN*. If the units do not run, the problem is not with the HWR panel.

In the Close position, the pump runs constantly. The burner will be off, or the valve will be fully closed.



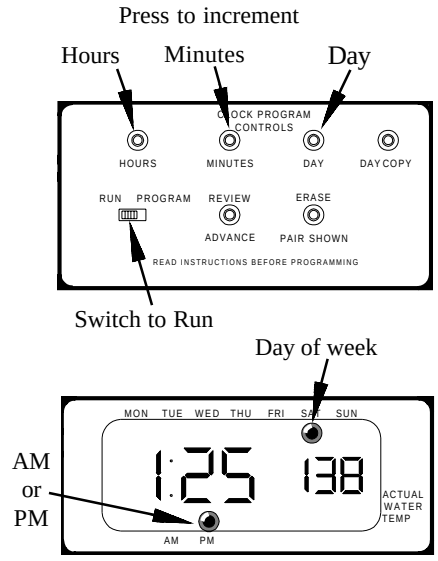
In Auto, the HWR will control the pump based on outside temperature. The burner or valve will hold the calculated water temperature.

In the Open position, the pump runs constantly. The burner will run on its limits or the valve will be fully open. The main display will change to read the total amount of time the control has been Open.

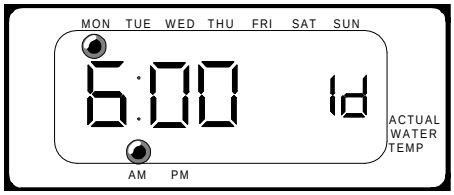
7. Setting the Present Time

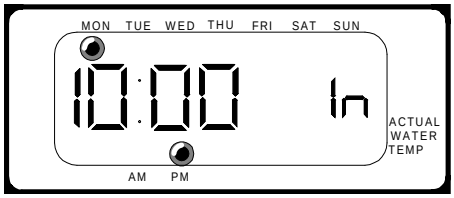
When an HWR is first powered up, the central display will show *NONE*. This may also occur if the control has been turned off for an extended period of time and the battery has drained down. (See Winter/Summer switch pg. 15 on how to avoid this.) To set the present time, use the following procedure:

- Use the programming key to turn the *PROGRAM LOCK* switch to the *UNLOCK* position.
- Switch the *RUN/PROGRAM* switch to *RUN*. This will cause the display to show the present time and actual water temperature.
- Press the *HOURS* button until the correct hour and *AM* or *PM* is shown. It is very important to note the *AM* and *PM* lights directly under the central display. If the time is 4:35 PM, keep pressing the hours button until the hour shows *4* and the red *PM* light is lit.
- Press the *MINUTES* button until the correct number of minutes is shown.
- Press the *DAY* button until the correct day of week, *MON*, *TUE*, *WED*, *THU*, *FRI*, *SAT*, or *SUN* is lit.

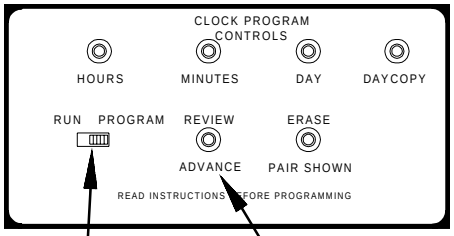


Time displayed is 1:25 PM on Saturday. The actual water temperature is 138°F.





The first Normal (day) setting for MON is 6:00 AM, the first Setback (night) setting for MON is 10:00 PM



Switch to Program

Press Review/Advance to move through the day/ night program

8. Setting the Normal (Day) and Setback (Night) Program Schedules

The HWR has two levels of control. The *NORMAL (DAY)* level is used when a building is occupied, and people are active. The *SETBACK (NIGHT)* level is used when a building is not occupied, or when people are sleeping.

The HWR can have up to four Normal and four Setback periods for each individual day of the week. When in the programming mode, a Normal level is shown with the small right-hand display of ***1d***, ***2d***, ***3d***, or ***4d*** and the Setback levels are shown by ***1n***, ***2n***, ***3n***, and ***4n***. If there is a time shown, then that is the time when that Normal (***d***) or Setback (***n***) heat level will begin. If the display shows *NONE*, that means that particular mode is not programmed.

Every time the HWR updates the clock time, it checks the Normal/Setback program. If there is a matching Normal/Setback time programmed, it sets the heat level accordingly, otherwise the heat level is not changed. This means you do not have to program every day of the week. If an office building is unoccupied all weekend, simply set the last programmed ***n*** setting (*8:00* ***2n*** *PM* for example) on *FRI*. Set all the *SAT* and *SUN* programs to *NONE* (using the *ERASE PAIR SHOWN* button). The control will stay in Setback until it reaches a ***d*** setting (*6:00* ***1d*** *AM* for example) on *MON* morning.

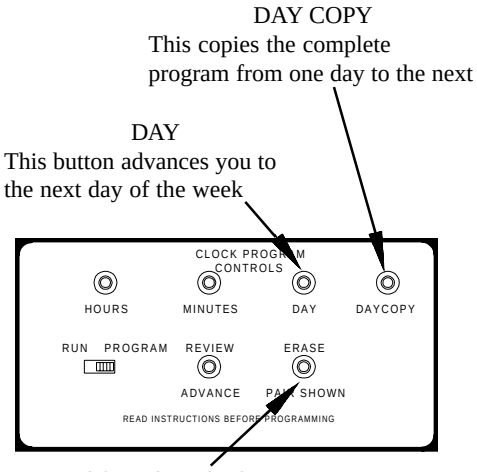
Use the following procedure to program the HWR:

- Use the programming key to turn the *PROGRAM LOCK* switch clockwise to the *UNLOCK* position.
- Switch the *RUN/PROGRAM* switch to *PROGRAM*. This will cause the display to show the first program time. The factory default display will show *6:00* ***1d*** and the *AM* light will be lit. The day of the week lights will show *MON*. This means the Normal heat level will begin on Monday at 6:00 AM.
- To adjust this time, push the *HOURS* and *MINUTES* buttons until the desired time is shown. For example, to change the time to *7:00 AM*, simply press the *HOURS* button once. Be sure the *AM* and *PM* lights below the time are correct.
- Now press the *REVIEW/ADVANCE* Button. If still set at the factory default

DAY button

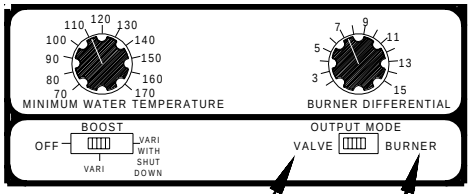
Review/Advance button

	MON	TUE	WED	THU	FRI	SAT	SUN
1d	6:00AM	6:00AM	6:00AM	6:00AM	6:00AM	6:00AM	6:00AM
1n	10:00PM	10:00PM	10:00PM	10:00PM	10:00PM	10:00PM	10:00PM
2d	NONE	NONE	NONE	NONE	NONE	NONE	NONE
2n	NONE	NONE	NONE	NONE	NONE	NONE	NONE
3d	NONE	NONE	NONE	NONE	NONE	NONE	NONE
3n	NONE	NONE	NONE	NONE	NONE	NONE	NONE
4d	NONE	NONE	NONE	NONE	NONE	NONE	NONE
4n	NONE	NONE	NONE	NONE	NONE	NONE	NONE



times, the display will change to *10:00* ***1n*** and the *PM* and *MON* light will be lit. This means the Setback heat level will begin on Monday at 10:00 PM.

- Adjust the time with the *HOURS* and *MINUTES* buttons.
- Continue to press the *REVIEW/ADVANCE* button. The small display will change to ***2d***, ***2n***, ***3d***, ***3n***, ***4d***, and ***4n.*** Set any of these by pressing the *HOURS* and *MINUTES* buttons.
- When you continue to press the *REVIEW/ADVANCE* button past ***4n***, the small display will read ***1o***, ***1c***, ***2o***, ***2c***, ***3o***, ***3c***, ***4o***, ***4c***, and then advance on to ***1d*** for the next day of the week. The ***o*** and ***c*** settings are for the auxiliary clock, are set with the *HOURS* and *MINUTES* button as above, and the functions are explained on pg. 23.
- To advance on to the next day at any point, press the *DAY* button. This will move you on to the ***1d*** for the next day of the week.
- To clear any of the programmed times simply press the *ERASE PAIR SHOWN* button. This will clear the pair (a matching ***d*** and ***n*** for that day) to *NONE*.
- To save time, you can copy one day's program to the next. If you have set up *MON* as you like it, press the *DAY* button until *TUE* is lit. Then press the *DAY COPY* button. Tuesday will now have the same program as Monday.
- When you are finished programming, be sure to move the *RUN/PROGRAM* switch back to the *RUN* position.



If controlling a motorized valve, or MOD-4, the switch must be in the VALVE position.

If controlling a burner directly, the switch must be in the BURNER position.

9. Output Mode

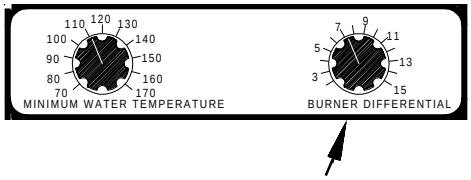
The HWR can control the water temperature by ***either*** directly controlling the burner ***or*** outputting a valve signal to a motorized valve or MOD-4. The HWR can not provide both outputs at the same time.

Therefore, if the HWR is resetting the circulating water temperature directly with the burner, the *OUTPUT MODE* switch must be set to *BURNER*. This will enable the Normally Open Burner contacts 8 & 9 to run the burner (see pg. 36 for wiring diagram.)

If the HWR is resetting the circulating water temperature with a motorized valve or MOD-4, the switch must be set to *VALVE*. This will enable the Motorized Valve contacts 11, 12, and 13 to modulate (see pg. 37 and 38 for wiring diagram.)

CAUTION: If the *OUTPUT MODE* switch is not set correctly, the HWR will not control the circulating water temperature.

10. Burner Differential



The Burner will turn off at the calculated water temperature, and not come back on until the actual water temperature falls through the differential.

The *BURNER DIFFERENTIAL* knob only has an effect when the *OUTPUT MODE* switch is in *BURNER*. If using a motorized valve, or MOD-4, the position of the knob has no effect on the HWR's operation.

The *BURNER DIFFERENTIAL* knob prevents the boiler from short cycling by allowing the actual circulating water temperature to fall by the set number of degrees before firing the boiler again. The burner will turn off at the calculated target water temperature, and not come back on until the actual water temperature falls through the differential. For example:

Calculated Water Temperature:	145°F
Output Mode:	BURNER
Burner Differential:	5°F

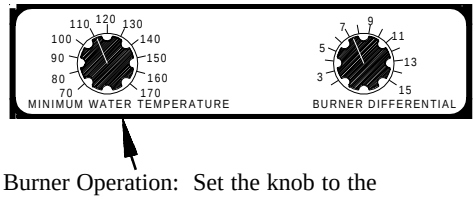
The burner will run until the actual temperature of the circulating water reaches 145°F. The burner will then be shut off. The circulating water temperature will begin to fall. When the circulating water temperature falls to 140°F, the burner will be started again.

Displaying the *BURNER DIFFERENTIAL*

To display the value of the *BURNER DIFFERENTIAL* knob do the following:

1. Switch the *RUN/PROGRAM* switch to the *PROGRAM* position.
2. Press the *COMPUTED WATER TEMP* button.
3. As long as the button is being pressed, the small right-hand display will show the value of the differential. If you rotate the knob, you will see the display change value.
4. Return the *RUN/PROGRAM* switch back to *RUN* when done.

11. Minimum Water Temperature



Burner Operation: Set the knob to the boiler manufacturer's specification.
Valve Operation: Set the knob to 70°F

If controlling a motorized valve set the *MINIMUM WATER TEMPERATURE* knob fully counterclockwise to *70°F*. This will allow the HWR to calculate the circulating water temperatures based on the outdoor temperature, the Reset Ratio, and the Offset value.

If controlling a burner directly, or controlling a MOD-4, the *MINIMUM WATER TEMPERATURE* knob must be set to the boiler manufacturer's specification. The HWR will calculate the temperature of the circulating system water based on the outdoor

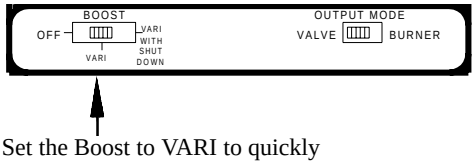
WARNING: If the Minimum Water Temp knob is not set correctly when directly resetting the boiler(s), the boiler(s) may be damaged.

temperature, the Reset Ratio, and the Offset value. The HWR will control the burner or MOD-4 to hold either the calculated temperature, or the temperature of the *MINIMUM WATER TEMPERATURE* knob, whichever is *higher*.

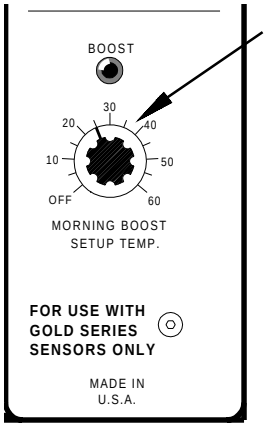
Displaying the *MINIMUM WATER TEMPERATURE*
To display the value of the *MINIMUM WATER TEMPERATURE* knob do the following:

1. Switch the *RUN/PROGRAM* switch to the *PROGRAM* position.
2. Press the *OUTSIDE TEMP* button.
3. As long as the button is being pressed, the small right-hand display will show the value of the *MINIMUM WATER TEMPERATURE*. If you rotate the knob, you will see the display change value.
4. Return the *RUN/PROGRAM* switch back to *RUN* when done.

12. Morning Boost



Set the Boost to VARI to quickly bring the ambient temperatures up after the Night Setback.



Set this knob to the number of degrees you wish to increase the actual water temperature during the Boost period.

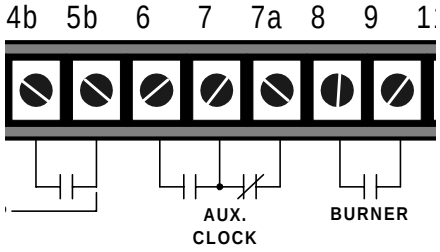
The morning Boost is designed to return the building to comfortable ambient temperatures after the cooler Setback (Night) period. The HWR will accomplish this by running elevated water temperatures for a given time period based on the ***1d*** time for that day. If you do not want a Boost on a day of the week, simply program the ***1d*** to *NONE* (see pg. 20), and use the ***2d*** program for any Normal (Day) settings.

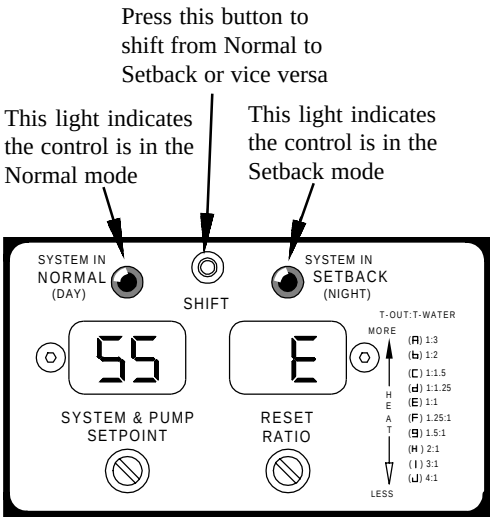
To set up the morning Boost, you must set the type of Boost you need (3-way *BOOST* switch) and the amount of Boost (*MORNING BOOST SETUP TEMP.* knob).

There are three types of Boost:

1. *OFF* - The HWR will begin running the Normal (Day) water temperatures at the ***1d*** time.
2. *VARI-BOOST* - This Boost begins earlier than the ***1d*** time. The length of the Boost time depends on the outside temperature (see pg. 30 for details). During the Boost period, the HWR will increase the calculated water temperature by the number of degrees set on the *MORNING BOOST SETUP TEMP* knob.
3. *VARI-BOOST WITH SHUTDOWN* - This should be used in commercial buildings where the building will be unoccupied in the Setback (Night) times. A Vari-Boost as described above is run. In addition, the HWR will switch into the Setback mode earlier than the latest ***n*** setting for that day. The warmer it is outside, the earlier the HWR will shift into Setback (see pg. 30 for details).

Additional HWR Functions





When the Normal mode light is flashing, this means the control has been manually shifted from Setback. In 90 minutes from the shift time, the Normal light will stop flashing, and the Setback light will come on.

The Auxiliary Clock

The *AUX CLOCK* provides extra outputs which switch based solely on the time. They are not affected by outdoor temperature, but act as a separate time clock which can be used to turn on lights, fans, dampers, or other equipment.

The *AUX CLOCK* has Normally Open and Normally Closed contacts. To program the auxiliary clock, keep pressing the *REVIEW/ADVANCE* button past ***4n*** to get ***1o***, ***1c***, ***2o***, ***2c***, ***3o***, ***3c***, ***4o***, and **4c**. With the ***o*** settings, the auxiliary clock relay will be open (de-energized), with ***c*** settings, the relay will be closed (energized).

The *AUX CLOCK* is separate from the program settings except for the *DAY COPY* button (see pg. 20). If you use the *DAY COPY* button, the auxiliary clock settings will be copied from one day to the next along with the program settings.

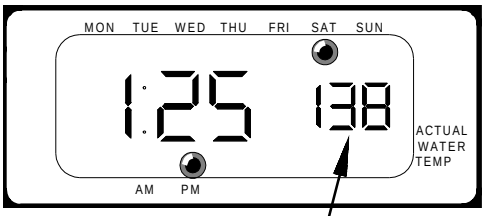
Shift Button

The *SHIFT* button allows you to manually shift from Normal (Day) settings into Setback (Night) settings or vice versa. This can be used to temporarily override the program. A typical example where the shift would be used is in a school where an event has gone into overtime. Instead of reprogramming the control to keep it from going into the Setback mode, simply press the *SHIFT* button and the HWR will run the Normal program.

The amount of time the HWR will hold the shift is:

Shifting from Normal to Setback - The control will stay in the Setback mode until either the control is shifted again, or until the next programmed Normal mode time

Shifting from Setback to Normal - The control will stay in the Normal mode for 90 minutes, and then revert automatically back to the program. This prevents a user (without a programming key) from putting the HWR in Normal mode for an extended period of time when it is programmed for Setback. When the control is manually shifted to Normal, the red light indicating the control is in the Normal mode will flash.



This display continuously displays the Actual Water Temperature. To display the Outside or Computer Water temperatures push the buttons shown below.

Reading the Temperature Values

The small right-hand display of the HWR constantly shows the temperature of the water being circulated (as measured by the heating system sensor). However, the HWR can also display the outdoor temperature and the computed water temperature.

To check the outside temperature, press the button marked *PRESS TO DISPLAY OUTSIDE TEMP*. The small right hand display will change to read the value of the outdoor sensor for as long as the button is pressed. If the heat seems erratic, check the outdoor sensor reading. The outdoor sensor may be reading an incorrect temperature because it is being affected by sun, or heat from open windows or doors.

To check the computed water temperature, press the button marked *PRESS TO DISPLAY COMPUTED WATER TEMP*. The small right hand display will change to read the temperature computed water temperature for as long as the button is pressed. The HWR will control the heating system to hold the computed water temperature. If the actual water temperature varies more than a few degrees (with direct burner control, the actual water temperature may differ from the computed water temperature by the amount set on the differential knob) from the computed water temperature, the heating plant may not be working correctly. Check the Troubleshooting section (see pg. 39).

NOTE: If the HWR is switched to *SUMMER*, or if the outdoor temperature is above the *SYSTEM AND PUMP SET POINT*, then the computed water temperature will display *OFF*. This means both the pump and heating system should not be activated.

Appendix

This section contains detailed technical information on the HWR. All of the following are included:

- Specifications
- Reset Ratio and Offset Charts
- Vari-Boost and Early Shutdown Charts
- Wiring Diagrams
- Troubleshooting Guide

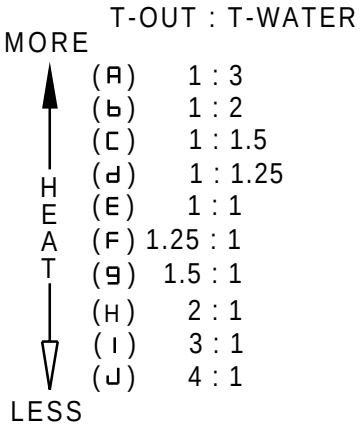
The Reset Ratio and Offset charts allow you to quickly determine how much heat the HWR will put into a building. The Vari-Boost chart shows the time of the recovery period after Setback (Night). Finally, the Early Shutdown chart how much earlier the system will be switched into Setback (Night).

The Troubleshooting section has guides to follow for most heating problems. If the HWR is hooked up to a MOD-4 controller, follow the charts for Valve outputs.

General Specifications HWR

Voltage Input: 120 VAC 60 Hz
Power Consumption: 30 VA Max
Pump Output: 1 S.P.D.T. and 1 N.O.
Heating Output: 1 S.P.D.T. and 1 N.O.
Auxiliary Output: 1 S.P.D.T.
Output Relay Ratings: 1 Amp inductive, 6Amp resistive at 120 VAC 60 Hz, 15A total for all circuits
Ambient Temp: Min 20°F, Max 130°F
Sensor Indicating Ranges:
Outdoor temperature sensor - minus 35°F to 250°F
Heating system sensor - minus 35°F to 250°F
Pump Set Point Range: 30°F to 75°F, ON and OFF
Reset Ratio Range: 1:3 to 4:1 (Outdoor:Water)
Offset Adjustment: minus 40 to plus 40 F degrees
Water Temperature Setback: 0 to 80 F degrees
Minimum Water Temperature: 70°F to 170°F
Burner Differential: 0 to 15 F degrees
Heating Clock: 4 NORMAL and 4 SETBACK settings per day
Auxiliary Clock: 4 open and 4 closed settings per day
Morning Boost:
Vari-Boost - Self-adjusting from 0 to 90 minutes - Water temperature increase 0 to 60 F degrees
Shutdown - Self-adjusting from 0 to 90 minutes
Power Backup: Lithium coin battery, 100 days minimum 5 year replacement
Enclosure: NEMA 1
Dimensions: 4-5/8" x 12-1/4" x 12-3/8"
Weight: 14 pounds

Reset Ratio



The HWR offers a range of 10 Reset Ratios (see side chart). Each Reset Ratio adjusts the amount of heat that enters the building based on the outdoor temperature. The ideal Reset Ratio for any building is when the amount of heat being input to the building exactly equals the amount of heat leaving the building through the walls, windows, and doors.

With any of the Reset Ratios, the colder it gets outside, the hotter the temperature of the circulating system water. What does change with each ratio is how much hotter the circulating water temperature becomes based on a 1° drop in the outdoor temperature. With an *A* ratio, for instance, the computed water temperature will increase 3° with a 1° drop in outdoor temperature. It is very unlikely that any building would lose heat as quickly as an *A* ratio would input heat. An *A* ratio might be used in a building under construction, with some of the windows or doors not in place yet.

With an *E* ratio, the computed water temperature will increase 1° with a 1° drop in outdoor temperature. This Reset Ratio is what would be most commonly used with standard baseboard radiation. In a new well insulated building, an *F* or *G* ratio might be applicable. In an older building with poor insulation, a *D* or *C* ratio might be needed.

Finally, with *J* ratio, the computed water temperature will increase just one quarter of a degree with a 1° drop in outdoor temperature. An *I* or *J* ratio might be used in a building with radiant floor heating. With radiant floor heating, there is a lot of radiation and relatively low water temperatures can be maintained.

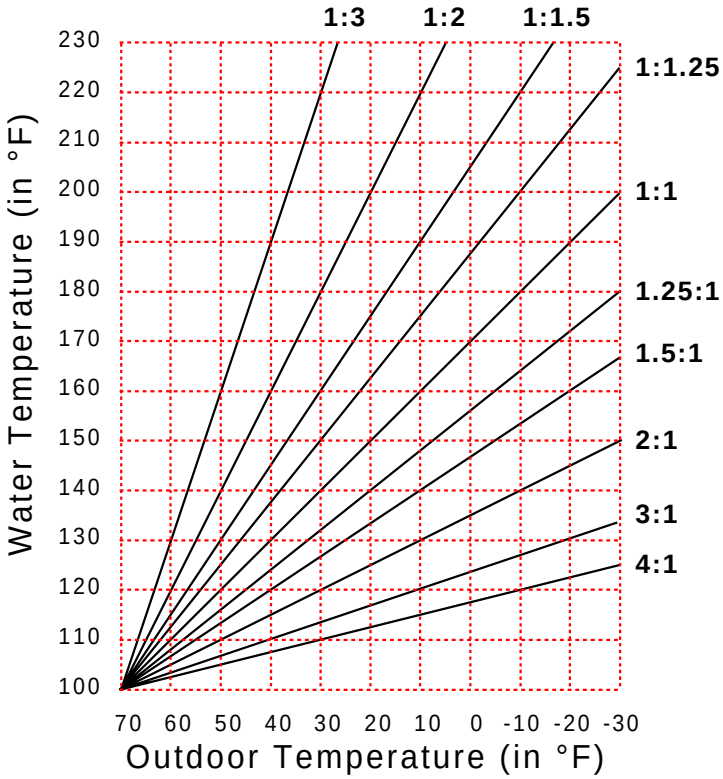
Adjust the Reset Ratios in the cold weather (in mild weather, adjust the Offset, see pg. 28). The reason for this can be seen by looking at the complete Reset Ratio chart on the next page. In mild weather (the lower left hand side of the chart), all the Reset Ratio lines are grouped closely together. However, as the outdoor temperature falls (moving toward the right) the Reset Ratio lines spread apart. The difference in computed water temperature between an *D* ratio and a *F* ratio at 60°F is just 4.5°, but at 30°F outside, the difference is 18°, and at 0°F outside, the difference is 31.5°. Therefore, an incorrect Reset Ratio change made in the mild weather might not have much of an effect, but when the outdoor temperature got colder, the building could be significantly over- or under-heated.

Adjust the Reset Ratio using the following procedure: If the ambient building temperatures are too cold in cold weather, change the

Reset ratio counterclockwise by one letter (ie. from E to D). If the building temperatures are too warm in cold weather, change the Reset ratio clockwise by one letter (ie. from E to F). After making a change to the Reset ratio, wait at least 24 hours before making another change. This will give the ambient temperatures time to stabilize and allow proper evaluation of the new Reset Ratio.

Reset Ratio Chart

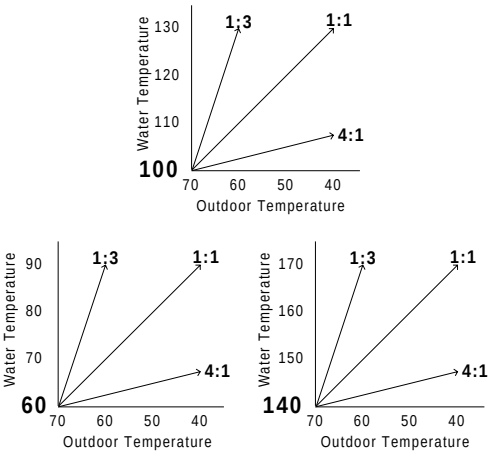
This chart shows the relationship between Outdoor Temperature (horizontal axis) and Computed Water Temperature (vertical axis) for each of the 10 Reset Ratios. The ideal Reset Ratio for a building will be when the amount of heat entering building equals the amount of heat leaving the building. The HWR controls the heating system to hold the actual temperature of the circulating system water at the Computed Water Temperature.



Offset Adjustment

The Offset adjustment sets the starting points of the Reset Ratios (see charts on next page). With an Offset of 0° the starting point of all the Reset Ratio curves are 100°F water temperature at 70°F outdoor temperature. The Offset can reduce the starting point of the curve down to 60°F (with a minus 40° Offset) or increase the starting point up to 140° (with a plus 40° Offset).

The Offset adjustment does not change as outdoor temperature changes. Whenever the Offset knob is changed, that change is directly added or subtracted to the computed water temperature. For instance, if the computed water temperature were 130°F and the *OFFSET* knob was rotated from 0° to 10° (an increase of 10°), then the calculated water temperature would immediately change to 140°F. In other words, the Offset adjustment shifts the



Reset Ratio curves up or down, but it does not affect how much the computed water temperature will change with a change in outside temperature.

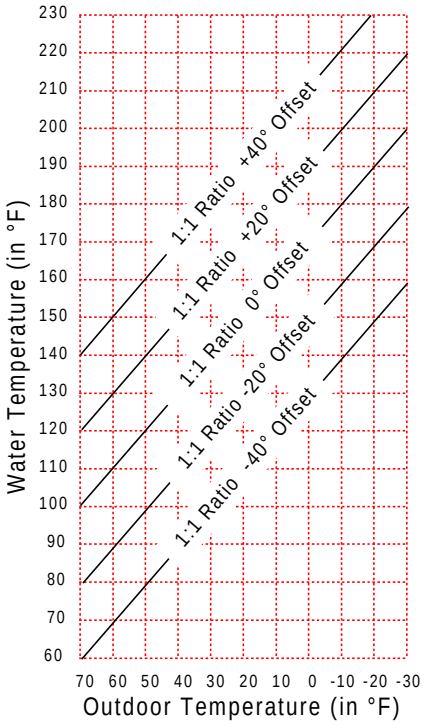
Adjust the *OFFSET* knob in mild weather. As discussed previously, the Reset Ratios are all bunched together in mild weather. In mild weather, a change of several ratios will not greatly effect the computed water temperature. However, changing the Offset can increase or decrease the computed water temperature by up to 80°F.

Use the following procedure to adjust the Offset: If the ambient building temperatures are warm in the warm weather, decrease the Offset. If the ambient building temperatures are cold in the warm weather, increase the Offset.

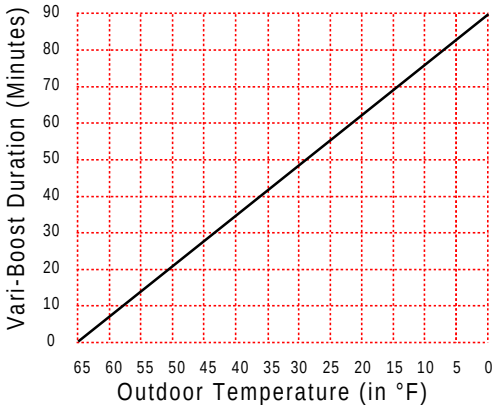
The rule of thumb for baseboard radiation is to change the Offset by 4° for every degree you wish to change the building temperatures. For radiant heat applications, change the Offset by 1° or 2° for every degree you wish to change the building temperature. After making a change, wait at least four hours (longer with radiant applications) before making another change. This will give the ambient temperatures time to stabilize.

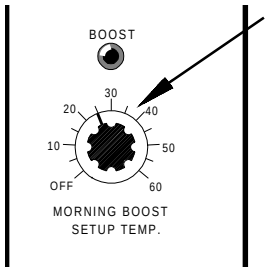
Offset Adjustment Chart

This chart shows the effect of the Offset knob on a particular (1:1) Reset Ratio. The Offset knob shifts the particular Reset Ratio curve up or down, but the Reset Ratio curve maintains the same relationship of outdoor temperature to computed water temperature. The Computed Water Temperature will be a function of both the Reset Ratio and the value of the Offset knob.

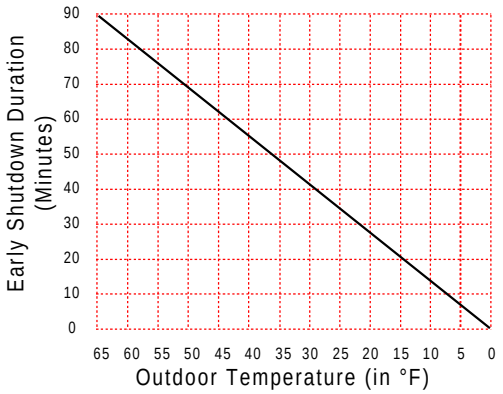


Vari-Boost and Early Shutdown Graphs





Set this knob to the number of degrees you wish to increase the actual water temperature during the Boost period.



The morning Vari-Boost allows a building to recover comfortable ambient temperatures after cooler Setback (Night) periods. This is accomplished by running hotter than Normal (Day) water temperatures for a time period based on outdoor temperature and the ***1d*** setting (the first day setting for each day of the week, see pg. 21).

The Vari-Boost should get the ambient building temperatures up to comfortable occupied levels by the time of the ***1d*** setting. Therefore, the Vari-Boost begins before the ***1d*** setting, and ends at the ***1d*** time. The amount of time the Vari-Boost begins before the ***1d*** setting depends on the outdoor temperature (see chart at side). For example, if the ***1d*** time is 7:00am, and the outdoor temperature is 30°F, then the Vari-Boost period will begin at 6:10am, or 50 minutes before the ***1d*** time.

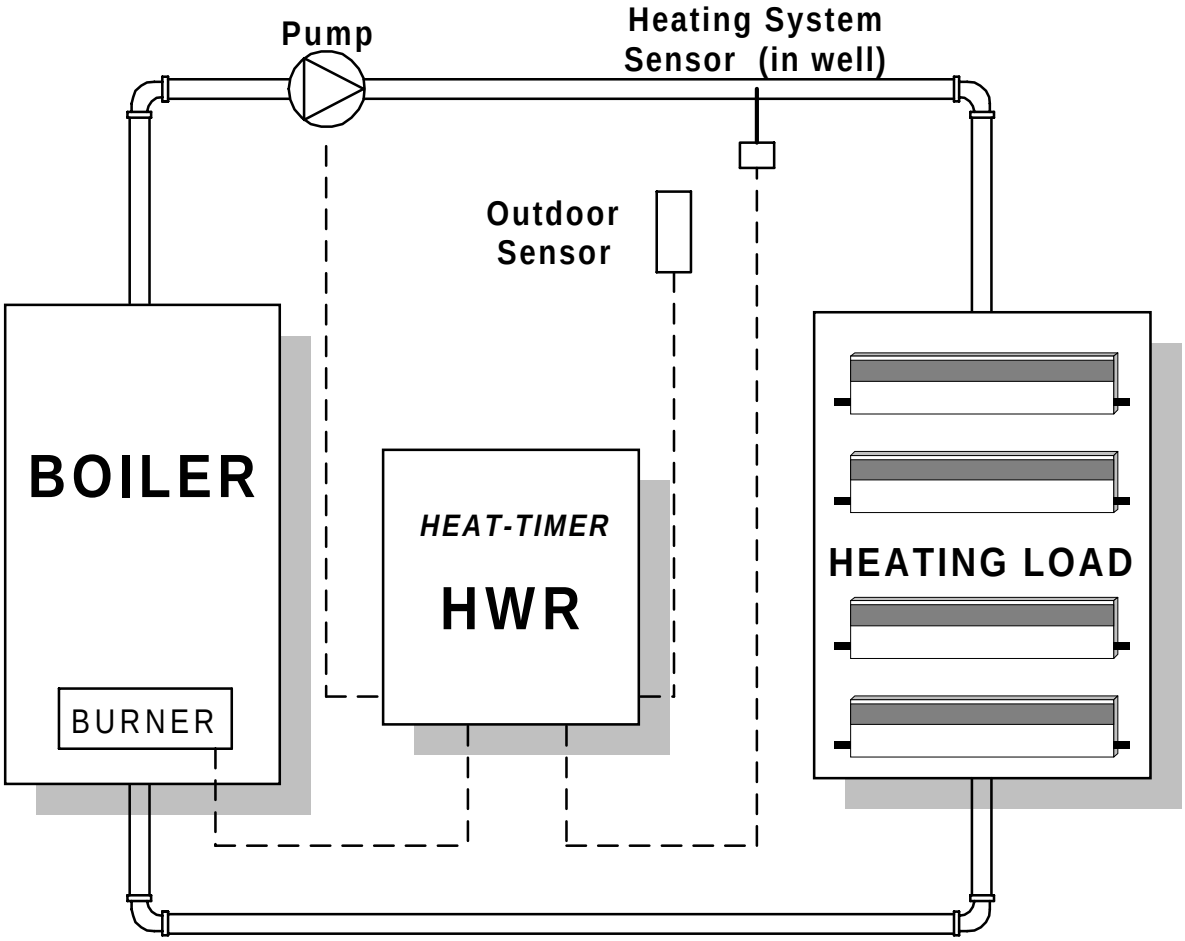
The second element of the Vari-Boost is the amount of increase to the computed water temperature. This is determined by the *MORNING BOOST SETUP TEMP.* knob. This knob can increase the computed water temperature up to 60°F above the Normal water temperatures. A good starting point is to set the degrees of Boost equal to the degrees of the Setback. For instance, if the *WATER TEMPERATURE NIGHT SETBACK* knob is set to -30° (approximately the 1:00 position of the knob), then set the *MORNING BOOST SETUP TEMP* to 30°F (approximately the 12:00 position of the knob).

If the ambient temperatures at the time of the ***1d*** settings are too cold, then increase the temperature of the *MORNING BOOST SETUP TEMP* by 10 degrees, and wait several days before adjusting the knob again. If the ambient temperatures are too hot at the time of the ***1d*** setting, then reduce the *MORNING BOOST SETUP TEMP* by 10 degrees, and wait several days before adjusting the knob again.

Early Shutdown

The early shutdown should be used in commercial buildings, or where the building will be unoccupied during the Setback periods. The early shutdown shifts the control into Setback mode before the last ***n*** setting. The early shutdown time is the reciprocal of the Vari-Boost time (see chart left) . The warmer it is outside, the earlier the HWR will shift to night. As it gets colder, the time between early shutdown and the last ***n*** setting diminishes. The maximum amount of early shutdown is 90 minutes when it is 65°F outside. At 0°F, the HWR will shift back into night at the time of the last ***n*** setting.

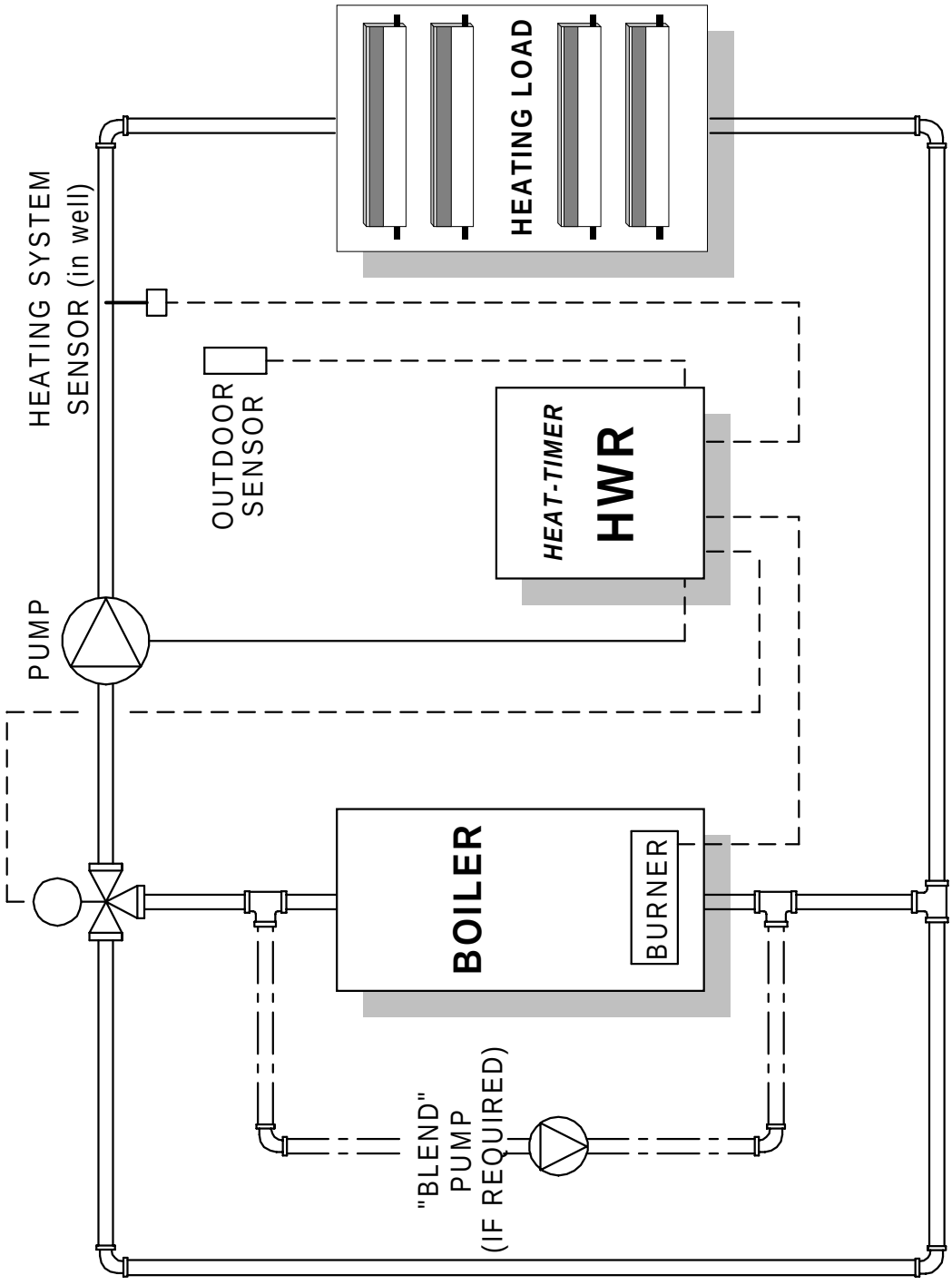
PIPING: HWR CONTROLLING BOILER DIRECTLY



Note: Diagram is for illustration only. It is not a complete piping diagram.

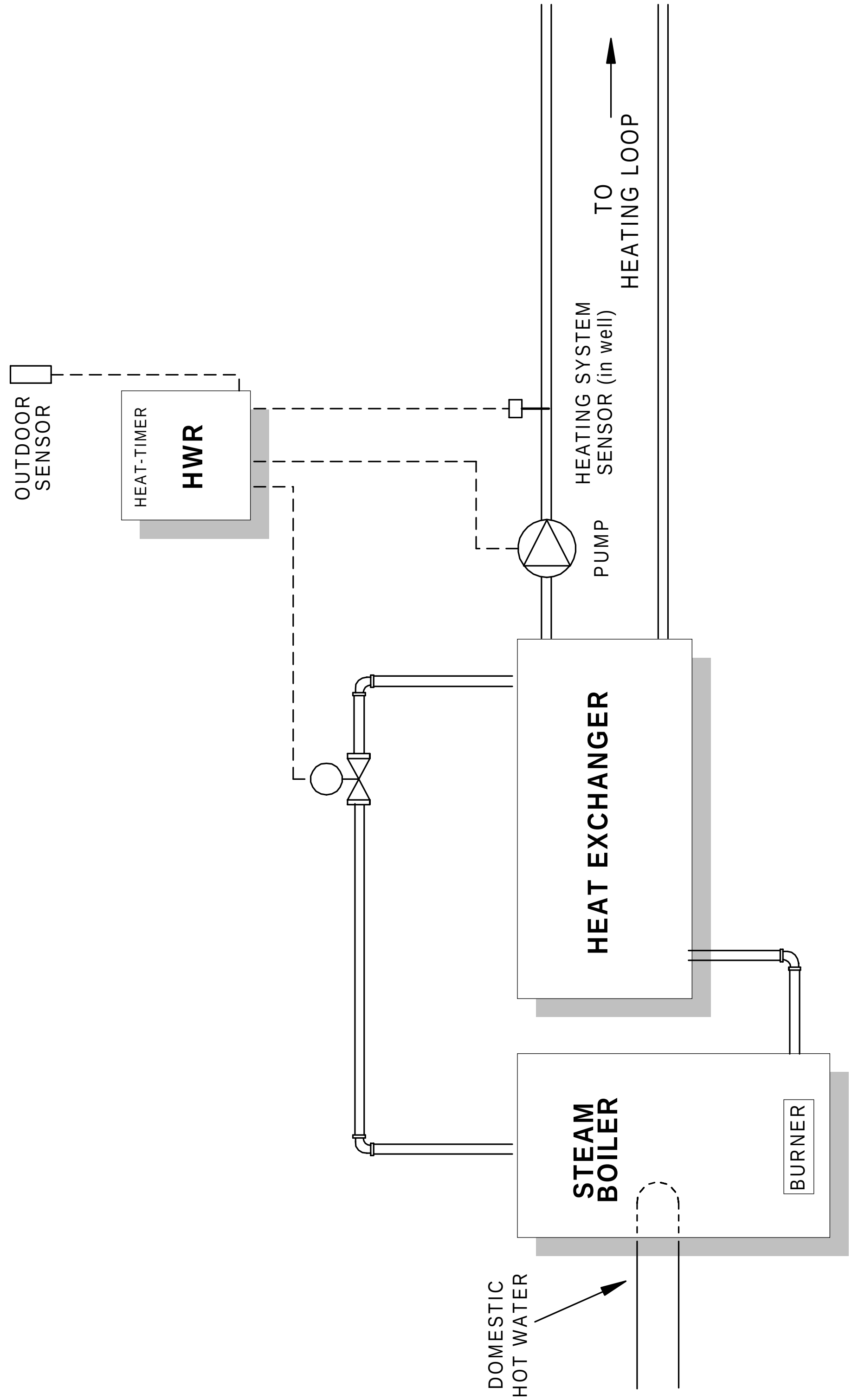
IMPORTANT: The above configuration works well with boilers whose minimum water temperature requirement is 120 degrees or lower (as often occurs with copper tube boilers). If the boiler's minimum water temperature requirement is higher (as it generally is with cast iron or steel tube boilers), then in mild weather, the building will tend to overheat. This is due to the fact that to protect the boiler, the HWR must constantly circulate water which is as least as hot as the minimum water temperature. In mild weather, the minimum water temperature requirement could be 10°, 20°, or even 40° higher than the calculated water temperature. Therefore, to gain the full advantage of the outdoor reset control when higher minimum temperatures are required, install a 3-way valve (see next page).

PIPING: HWR CONTROLLING A 3-WAY VALVE



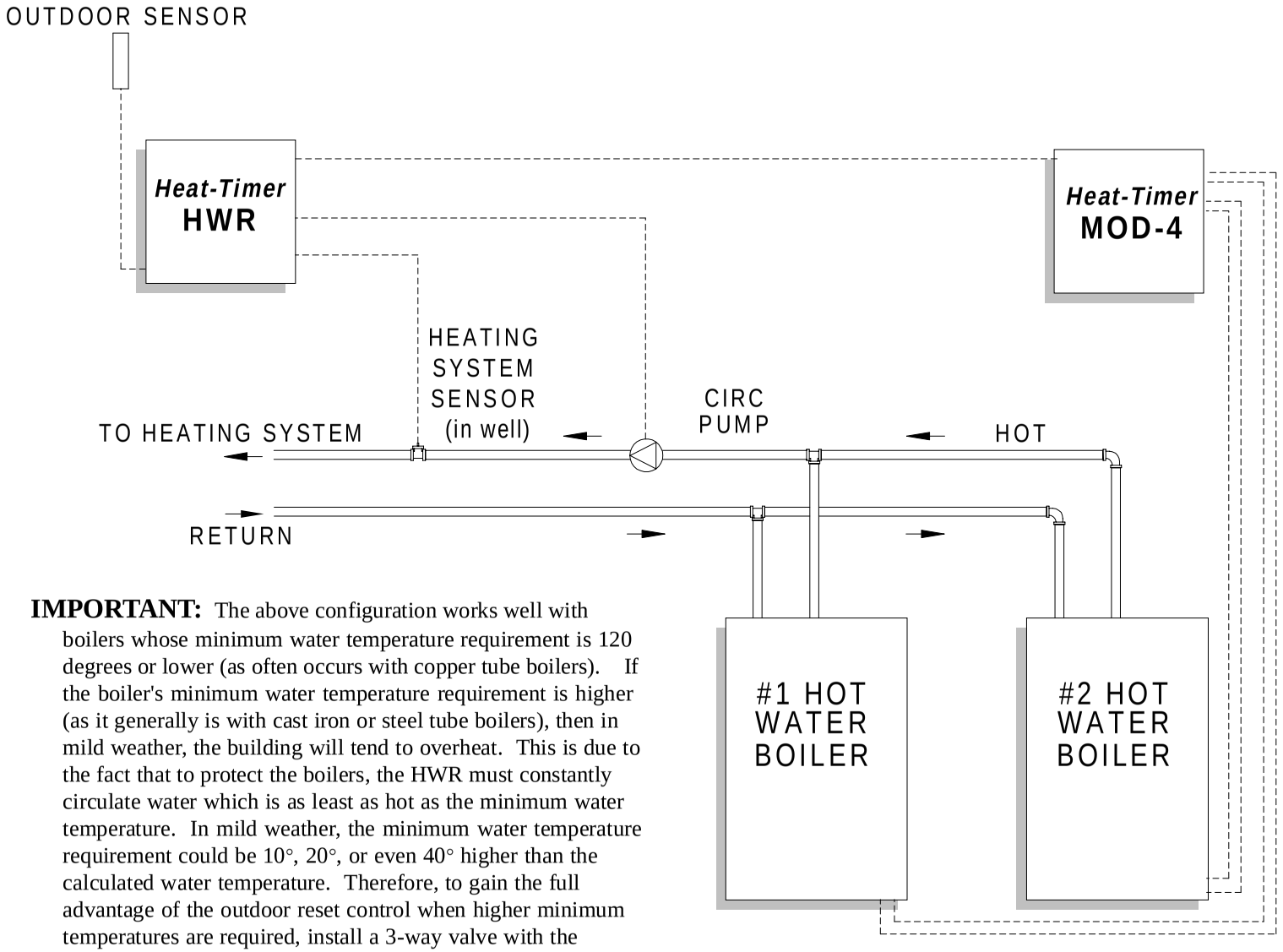
Note: Diagram is for illustration only. It is not a complete piping diagram.

PIPING: HWR CONTROLLING A 2-WAY VALVE INTO A HEAT-EXCHANGER



Note: Diagram is for illustration only. It is not a complete piping diagram.

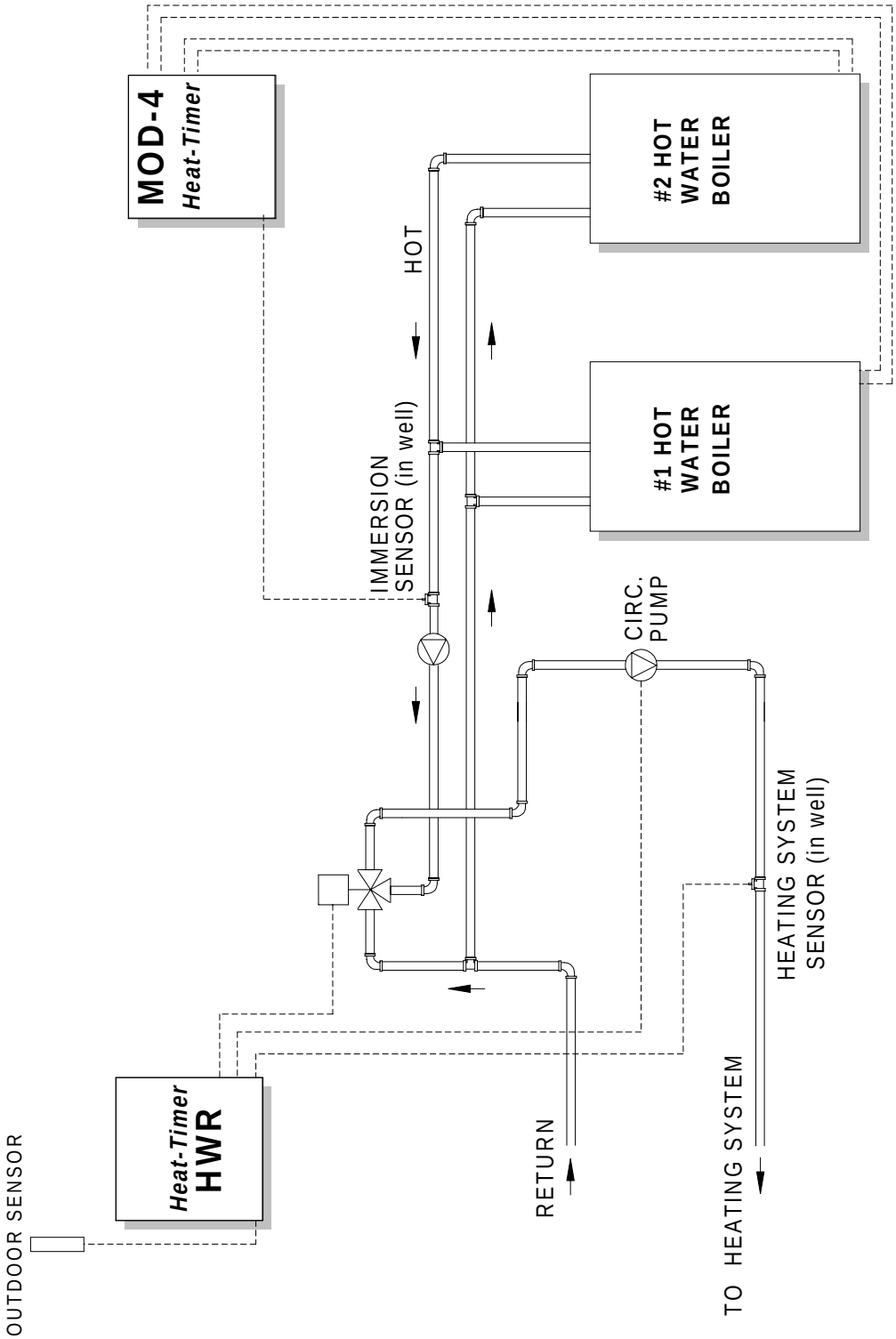
PIPING: HWR CONTROLLING A MOD-4 DIRECTLY



IMPORTANT: The above configuration works well with boilers whose minimum water temperature requirement is 120 degrees or lower (as often occurs with copper tube boilers). If the boiler's minimum water temperature requirement is higher (as it generally is with cast iron or steel tube boilers), then in mild weather, the building will tend to overheat. This is due to the fact that to protect the boilers, the HWR must constantly circulate water which is as least as hot as the minimum water temperature. In mild weather, the minimum water temperature requirement could be 10°, 20°, or even 40° higher than the calculated water temperature. Therefore, to gain the full advantage of the outdoor reset control when higher minimum temperatures are required, install a 3-way valve with the MOD-4 as shown on the next page.

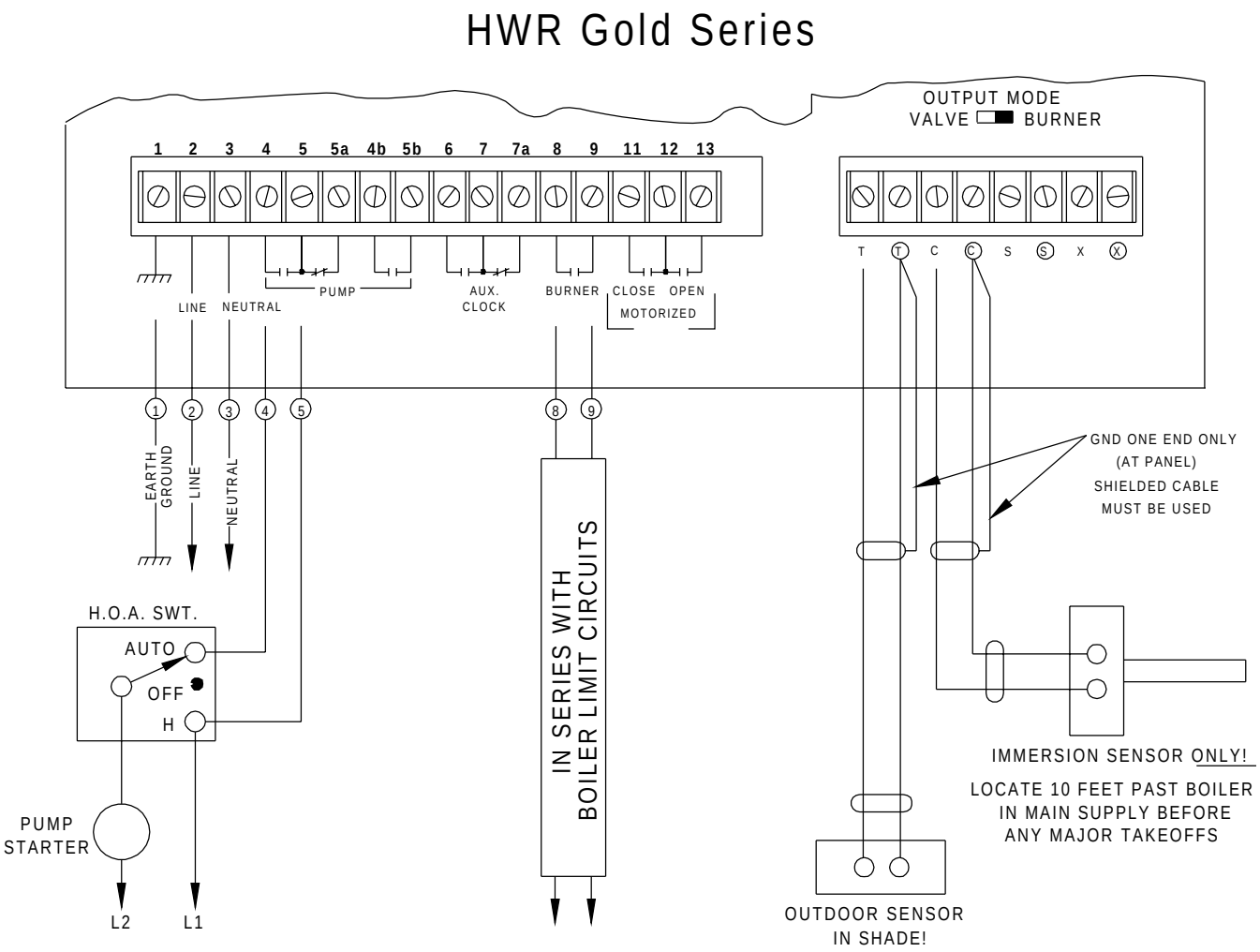
Note: Diagram is for illustration only. It is not a complete piping diagram.

PIPING: HWR CONTROLLING A 3-WAY VALVE, MOD-4 CONTROLLING FULL MODULATION BURNERS

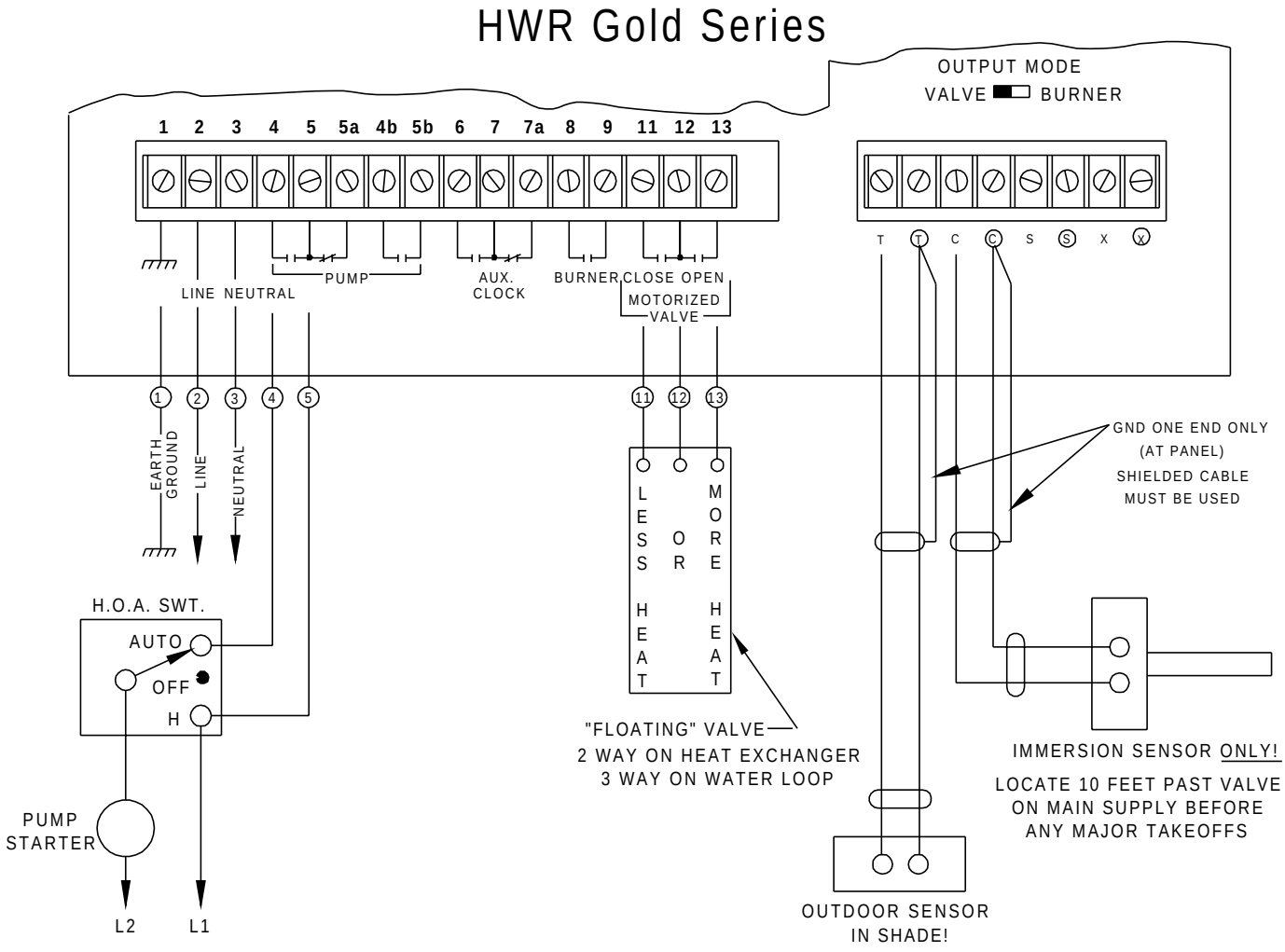


Note: Diagram is for illustration only. It is not a complete piping diagram.

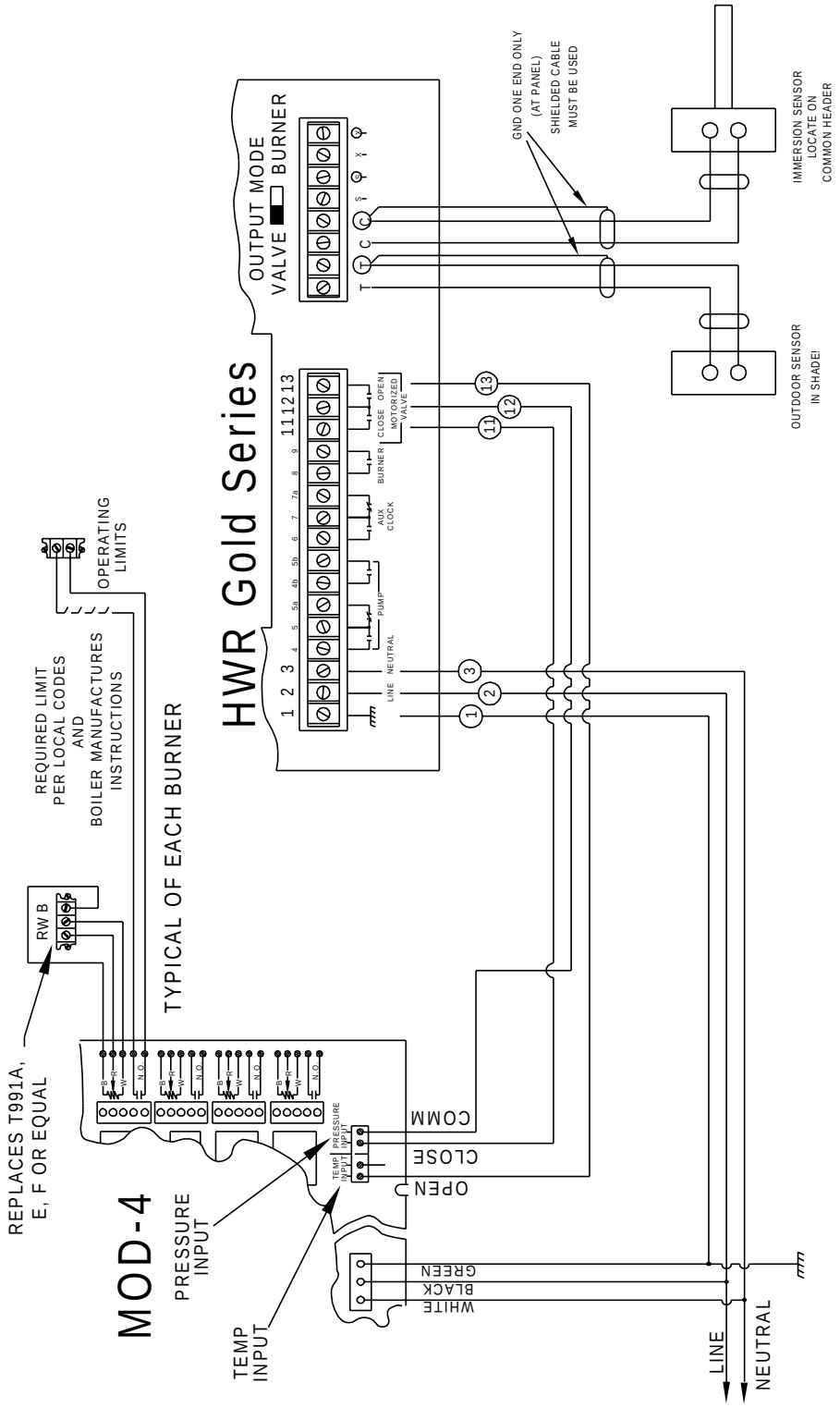
WIRING: HWR CONTROLLING BOILER DIRECTLY



WIRING: HWR CONTROLLING A 3-WAY VALVE, OR 2-WAY VALVE INTO HEAT EXCHANGER



WIRING: HWR CONTROLLING A MOD-4 DIRECTLY



Troubleshooting Guide

When there is a problem with heat in a building, the first place people look is at the heating control. And the heating control may be the problem, but so may be other system components, or perhaps the heating control is not adjusted properly. To help determine and correct the problem, simply follow the trouble-shooting guide that best describes your heating situation:
NOTE: When using a MOD-4, follow the Valve Application guidelines. When the chart says the valve should be opening, the MOD-4 should increase the amount of modulation. When the chart says the valve should be closing, the MOD-4 should decrease the amount of modulation.

In addition to these basic problems, you may have intermittent problems. If you

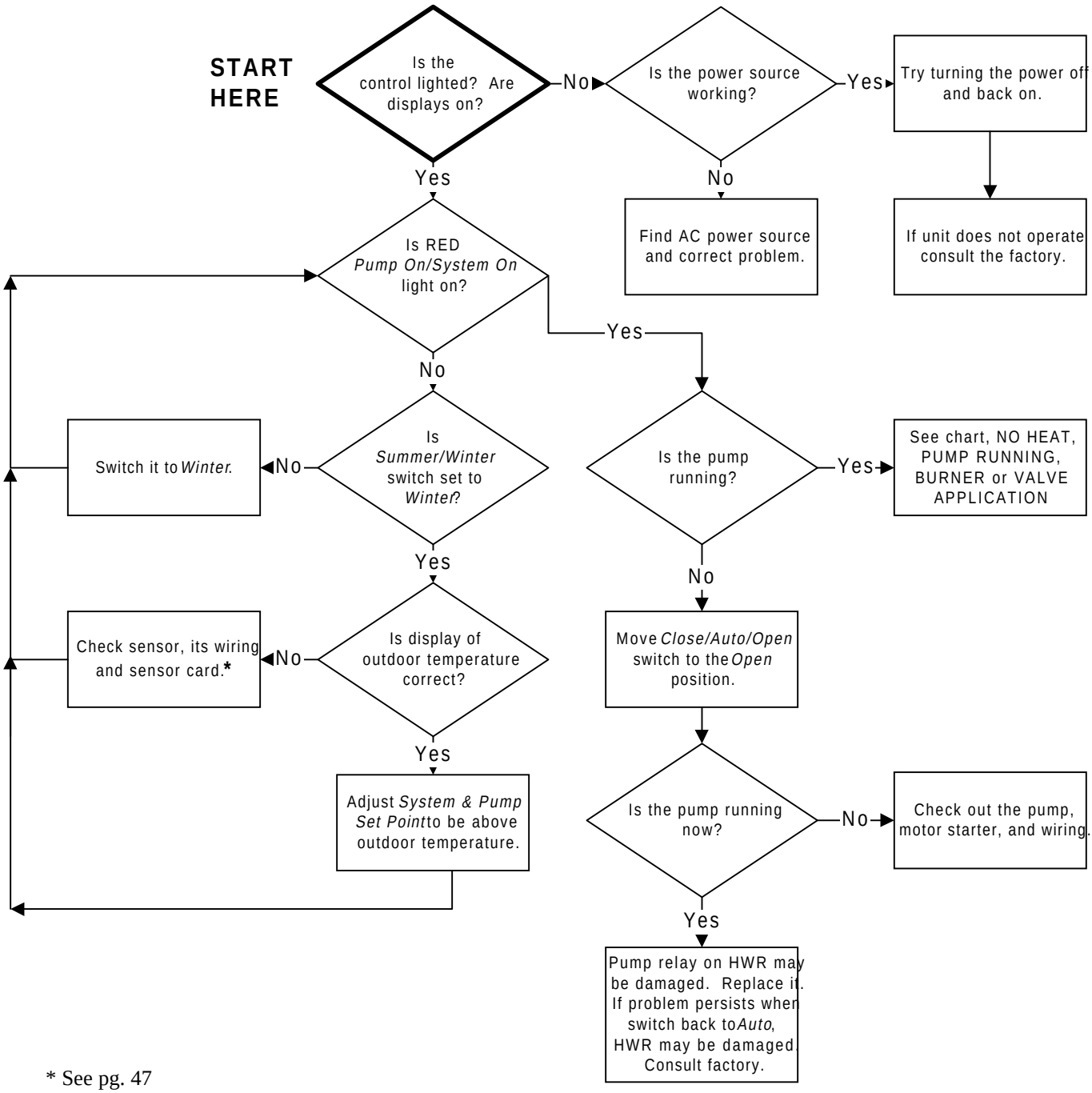
Sometimes have No Heat, too Little Heat or too Much Heat, the control may not be programmed correctly. Check through all the settings of the clock (see pg. 19) to make sure the Normal and Setback modes are when you want them to be. Go through all four settings for each day of the week, making sure any unused settings display *NONE*. Pay special attention to the *AM* and *PM* lights below the times, since if these are incorrect, the program will be 12 hours off.

Have too Little Heat or too Much Heat Only at the 1d Time, adjust your Boost. The Vari-Boost changes with outdoor temperature, and is therefore recommended If there is too little heat, increase the *MORNING BOOST SETUP TEMPERATURE* by 10°, it there is too much heat, reduce the *MORNING BOOST SETUP TEMPERATURE* by 10° (see pg. 22).

Have too Little Heat Before the Last Setback Program, you may not wish to use the *SHUTDOWN* feature. Simply move the *BOOST* switch to the middle *VARI* position (see pg. 22).

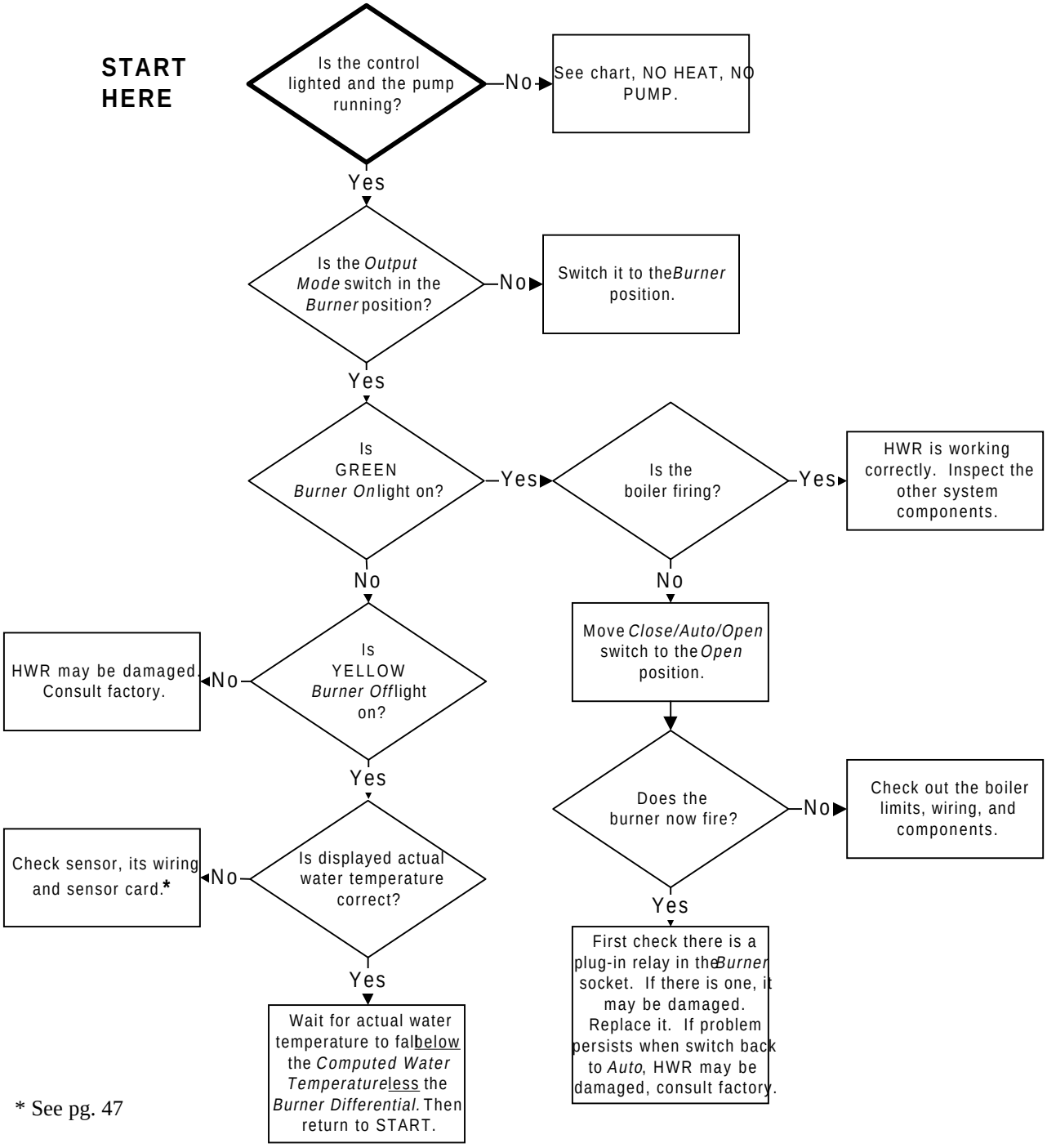
Have too Little Heat or too Little Heat Only in Parts of the Building, then check the heating system components. Check that there is no air trapped in the system, and that the pump(s) are working properly.

TROUBLESHOOTING: NO HEAT, NO PUMP



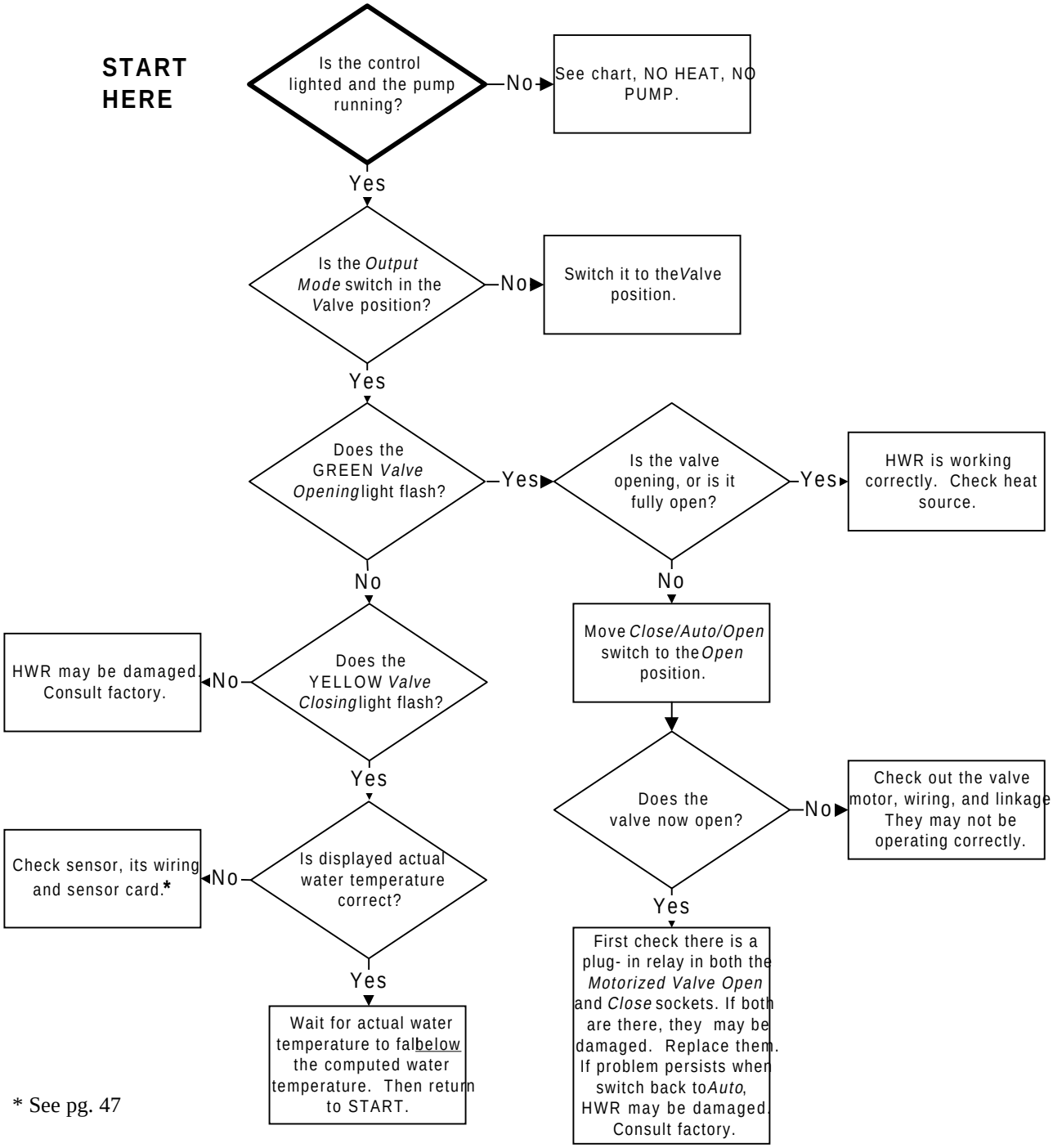
* See pg. 47

TROUBLESHOOTING: NO HEAT, PUMP RUNNING, BURNER APPLICATION



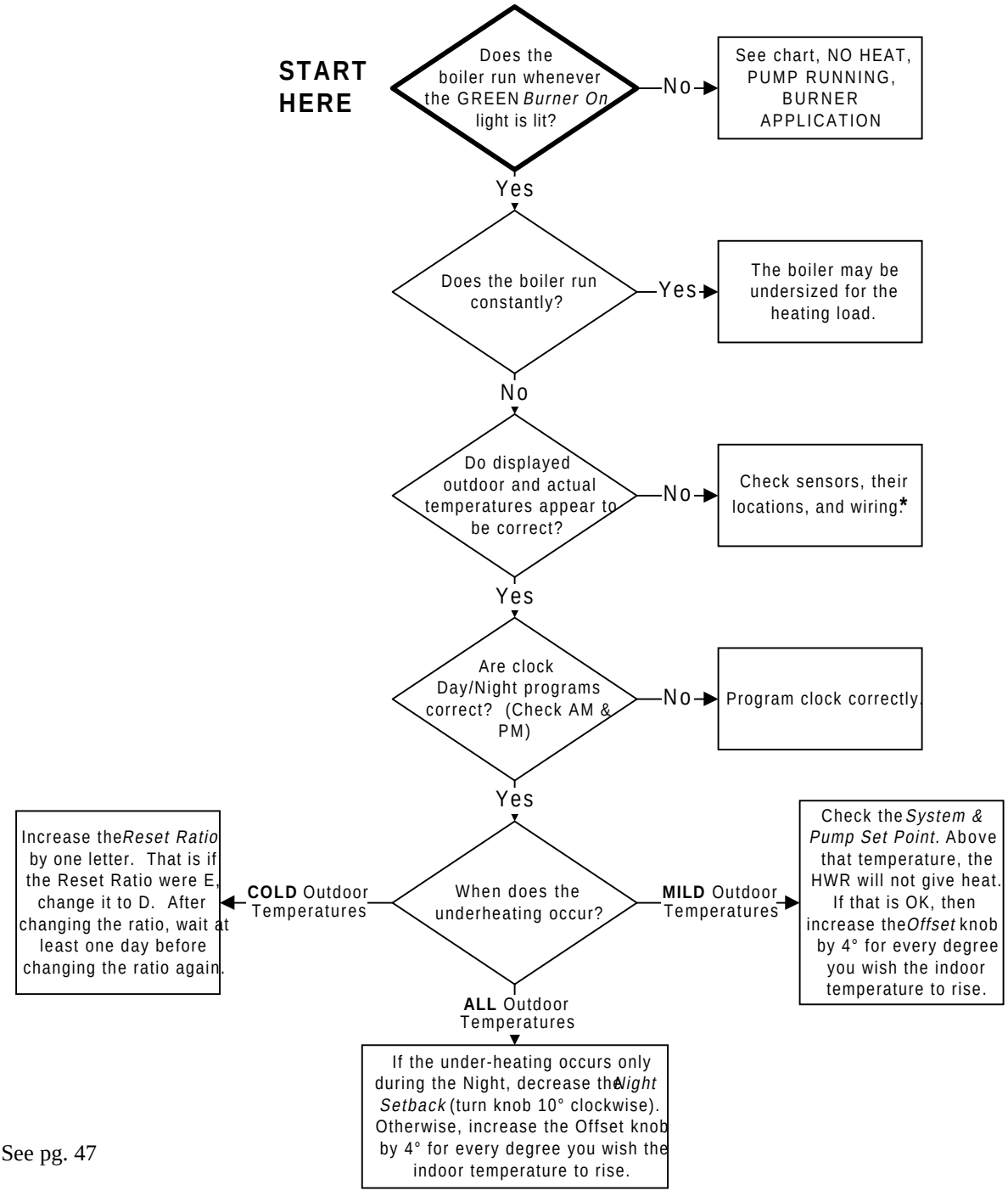
* See pg. 47

TROUBLESHOOTING: NO HEAT, PUMP RUNNING, VALVE APPLICATION



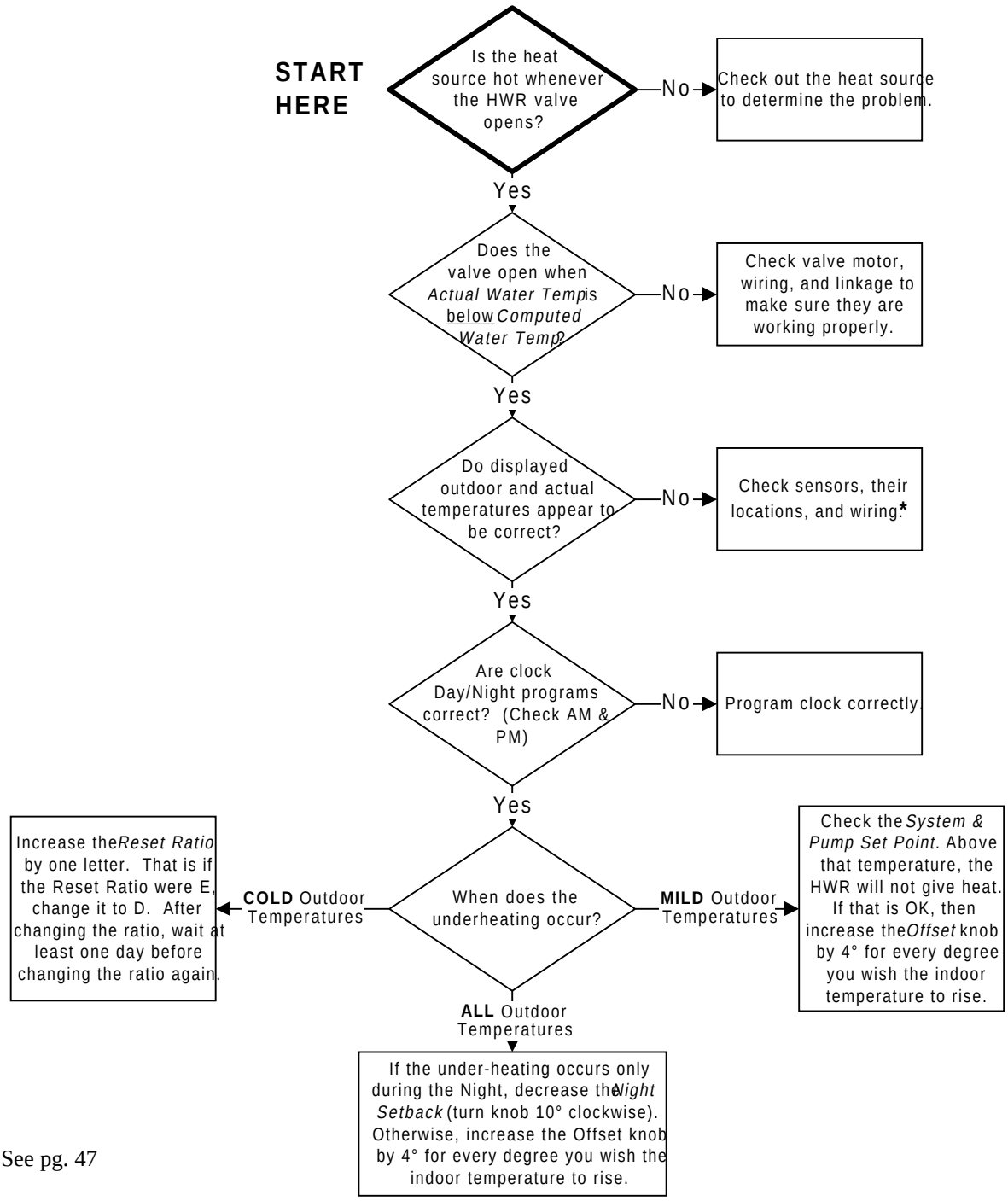
* See pg. 47

TROUBLESHOOTING: TOO LITTLE HEAT, BURNER APPLICATION



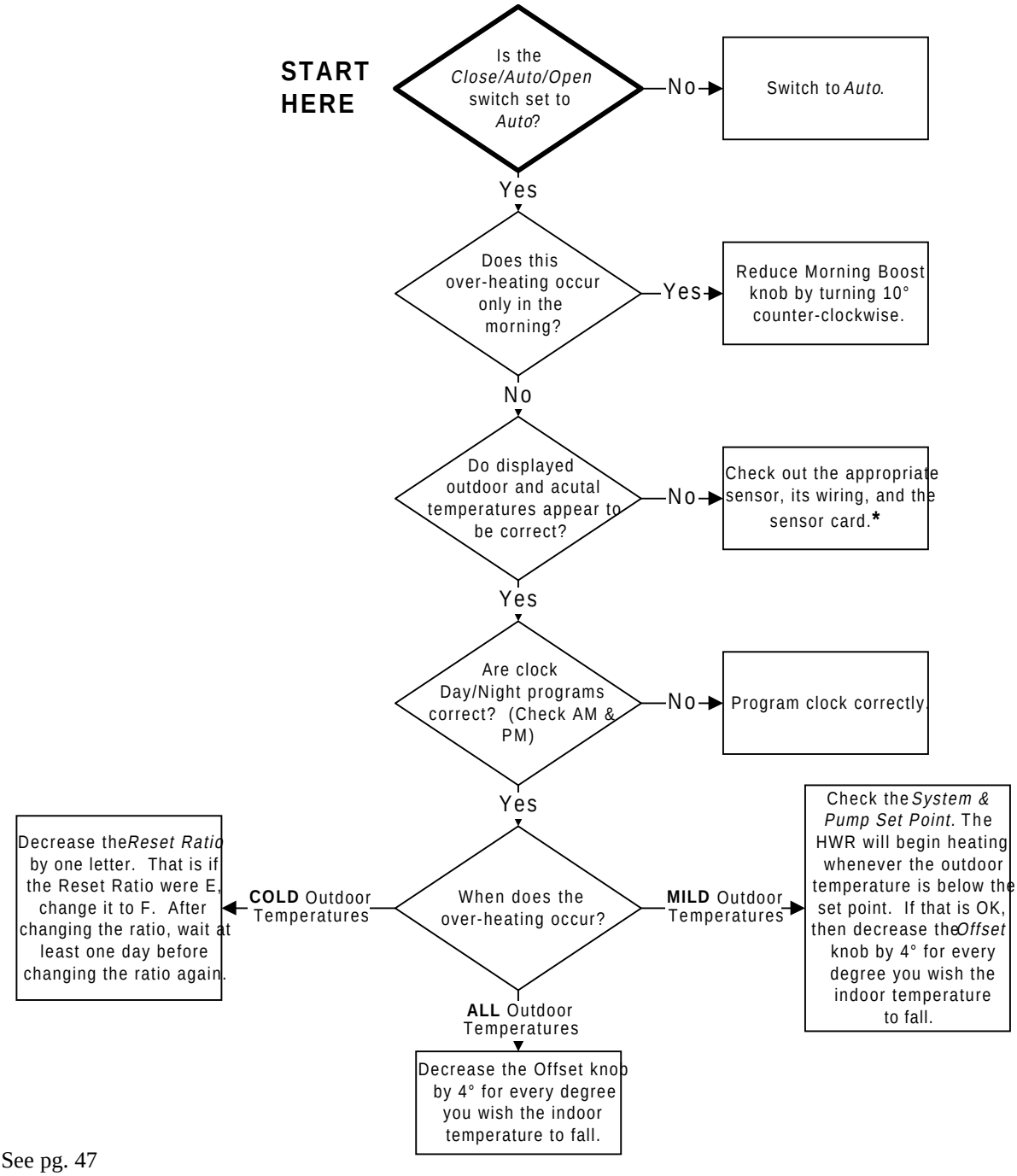
* See pg. 47

TROUBLESHOOTING: TOO LITTLE HEAT, VALVE APPLICATION



* See pg. 47

TROUBLESHOOTING: TOO MUCH HEAT



* See pg. 47

Error Messages

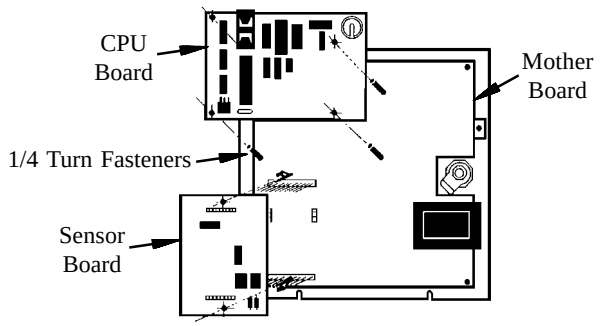
When the HWR is powered up, it runs through approximately 10 seconds of self-diagnostic tests. If there is an error, it will flash a three digit code. These tests will be run on start-up, and whenever the power to the control is interrupted.

If an installed panel begins flashing codes, first shut power off to the panel and then turn it back on. If the HWR then begins displaying normally, you may not need to take any action. In rare cases when the power comes back on slowly (as in a brownout condition) the HWR does not start up properly. If the codes continue to flash after re-powering the control, check the following chart for the appropriate action:

DIAGNOSTIC MESSAGES

This Message: (on main display)	Means this Problem:	The Solution:
PPP	ROM Error	Replace CPU Board
SSS	RAM Error	Replace CPU Board
bbb	Battery-backed RAM	Replace CPU Board
CCC	Real time clock	Replace CPU Board
EEE	EEPROM Error	Replace CPU Board
AAA	Mother Board	Replace Entire Control
(on small display)		
INP	Input Board A/D	Replace Sensor Board
OPN	Sensor Circuit Open	See next page
SHT	Sensor Circuit Shorted	See next page

Circuit boards easy to replace



The new Gold HWR includes a mother circuit board and two plug-on boards. The larger of the two plug-ons is the Central Processing Unit (CPU) board; the smaller one is the Sensor board. Both can easily be replaced in the field. The Sensor board simply snaps into place, the CPU Board uses four quarter-turn screws.

Checking the Sensors and Sensor Board

The HWR sensors record the temperature where they are located. Before assuming a sensor is not working, it is important to get an accurate reading at the sensor location. If the outdoor sensor is affected by sun, exhaust fans, open doors, or windows, the reading may vary significantly from the actual outdoor temperature. Similarly, if the heating system sensor (HSS) does not appear to be reading correctly, check it is located correctly (see pg. 9).

To perform the test, you will need a digital multimeter capable of reading resistances. The HSS temperature is constantly displayed in the small rightmost digits of the HWR. To see the value of the outside sensor, press the button marked *PRESS TO DISPLAY OUTSIDE TEMP*, and the display will change to read this.

Testing the Sensors

Remove the sensor wires from the *T-T* terminals (for the Outdoor sensor), or the *C-C* terminals (for the HSS). Use the multimeter to take a resistance reading across the detached wires going to the sensor. If the reading shows:

OPEN or a resistance in the MegaΩs - Check the wires going to the sensor. They may have been broken or become disconnected. If the wires are fine, check the resistance at the sensor itself. If the resistance is still open, the sensor has been damaged and needs to be replaced.

SHORT or a resistance less than 100Ωs - Check the wires going to the sensor. They may have become shorted together in the run of the wire. If not, check the resistance at the sensor itself. If there still is no resistance, the sensor has been damaged and needs to be replaced.

Resistances from 200Ωs to 100,000Ωs - Find the temperature that corresponds to the resistance value on the chart. If the sensor appears to be outputting correctly, check that the wires were properly connected to the HWR inputs. If they were, the Sensor Board may have been damaged (see next page). If the sensor is not outputting correctly, take another reading at the sensor itself. If this is correct, the problem is in the wiring between the sensor and the HWR. Otherwise, the sensor has been damaged, and should be replaced.

TEMPERATURE (in degrees F)	VALUE (in Ohms)
0	42683
10	31215
20	23089
25	19939
30	17264
35	14985
40	13040
45	11374
50	9944
55	8714
60	7653
70	5941
80	4649
90	3667
100	2914
110	2332
120	1879
130	1524
140	1243
150	1021
160	842
170	699
180	583
190	489
200	412

Testing the Sensor Board

To test the sensor board, first test the sensors as described in the previous sections. If the sensors outputs test correctly, then use the following procedure:

1. Remove the HSS wires from the *C-C* terminals. The small right-hand display should begin flashing *OPN* (for an OPeN circuit). If it does not, the sensor card should be replaced.
2. Remove the outdoor sensor wires from the *T-T* terminals. Press the button marked *PRESS TO DISPLAY OUTSIDE TEMP*, and the small right-hand display should begin flashing *OPN* (for an OPeN circuit). If it does not, the sensor card should be replaced.
3. Put the blue wires of a Heat-Timer calibrator (Part #900138) across the *T-T* terminals. The outdoor temperature should change to display 54°F ± 1°F. If it does not, the sensor card should be replaced. (If you do not have a calibrator, you can use any resistor with a known value. Simply put the resistor across the *T-T* terminals and the display should change to the value found on the chart on the previous page).
4. Put the grey wires of a Heat-Timer calibrator (Part #900138) across the *C-C* terminals. The HSS display should change to display 160°F ± 1°F. If it does not, the sensor card should be replaced. (If you do not have a calibrator, you can use any resistor with a known value. Simply put the resistor across the *C-C* terminals and the HSS display should change to the value found on the chart on previous page).
5. If the sensor board passes these tests, it is probably fine. Recheck the sensors and any wiring to the sensors.

Interpreting the Current Status Indicator Lights

The three *CURRENT STATUS INDICTORS* lights show the status of the HWR. By glancing at the lights it is possible to know the status of the heating system.

Six combinations: There are just six combinations of ONs and OFFs which tell you what the heating system is doing. Here is the whole list - with some examples of how they can be helpful in troubleshooting.

(RED) PUMP ON, SYSTEM ACTIVE ○
(GREEN) VALVE OPENING or BURNER ON ○
(AMBER) VALVE CLOSING or BURNER OFF ○

1. **ALL LIGHTS OFF** - Nothing is happening. The control is not calling for heat and the system pump is off.

   If the building is cold, perform the following checks. Look at the *WINTER/SUMMER* switch to see if it is at *WINTER*. Then check the *SYSTEM AND PUMP SETPOINT* to see if it is above the displayed outdoor temperature. If these are OK, look to the charts on pages 40-45 for full troubleshooting procedures for times when there is no heat.

(RED) PUMP ON, SYSTEM ACTIVE ○
(GREEN) VALVE OPENING or BURNER ON ○
(AMBER) VALVE CLOSING or BURNER OFF ●

2. **AMBER (alone) ON** - Whenever the pump is turned off, either manually, or automatically, the Valve output is closed for 4 minutes. The Amber light will come on to indicate that the valve is being closed.

BURNER OPERATION ONLY

(RED) PUMP ON, SYSTEM ACTIVE ●
(GREEN) VALVE OPENING or BURNER ON ●
(AMBER) VALVE CLOSING or BURNER OFF ○

3. **RED & GREEN both ON** - The outside temperature is below the *SYSTEM AND PUMP SETPOINT*, and the system pump is on. The HWR is calling for the burner to be active, since the actual water temperature is below the computed water temperature. If the building is too cold at this point, check to see if the boiler is working properly and check the charts on pages 40-45.

(RED) PUMP ON, SYSTEM ACTIVE ●
(GREEN) VALVE OPENING or BURNER ON ○
(AMBER) VALVE CLOSING or BURNER OFF ●

4. **RED & AMBER both ON** - The outside temperature is below the *SYSTEM AND PUMP SETPOINT*, and the system pump is on. The HWR is not calling for the boiler to be active as the actual water temperature is either above the computed water temperature, or is above the computed water temperature less the differential value. If the building is too cold at this point, you may need to reduce the *BURNER DIFFERENTIAL* adjustment.

VALVE OPERATION ONLY

(RED) PUMP ON, SYSTEM ACTIVE ●
(GREEN) VALVE OPENING or BURNER ON ☼
(AMBER) VALVE CLOSING or BURNER OFF ○

5. **RED ON & GREEN INTERMITTENTLY FLASHING** - The outside temperature is below the *SYSTEM AND PUMP SETPOINT*, and the system pump is on. The HWR is opening the valve, since the actual water temperature is below the computed water temperature. Every time the HWR adjusts the valve open, the green light will come on briefly. If the building is too cold or too hot at this point check the charts on pages 40-45.

(RED) PUMP ON, SYSTEM ACTIVE ●
(GREEN) VALVE OPENING or BURNER ON ○
(AMBER) VALVE CLOSING or BURNER OFF ☼

6. **RED ON & AMBER INTERMITTENTLY FLASHING** - The outside temperature is below the *SYSTEM AND PUMP SETPOINT*, and the system pump is on. The HWR is closing the valve as the actual water temperature is above the computed water temperature. Every time the HWR adjusts the valve closed, the red light will come on briefly. If the building is too cold or too hot at this point, check the charts on pages 40-45.

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Index cont.