

## AN INTRODUCTION TO THE BECKETT *HeatManager*<sup>™</sup> (#7512)

The *HeatManager* is the new microprocessor-based energy saving control from Beckett for use with new or existing boiler systems. This technical bulletin is intended to familiarize you with the *HeatManager*, and to help you understand exactly how it works to save energy.

### THEORY BEHIND THE *HEATMANAGER*

- The *HeatManager* adjusts the burner firing pattern to accurately match the boiler output to the home's heat load (also referred to as heat loss) at that moment.
  - **Heat Load:** The number of BTU's per hour (BTUH) needed to maintain the home at a comfortable temperature (i.e. 70° F). The heat load is affected by many factors, including: local temperature, wind, and sun; insulation levels, window orientation, home occupancy, etc. On a very cold day, the heat load will be heavy; on a milder day, the heat load will be much lighter.
- A boiler is sized to insure comfort at temperatures well below the worst anticipated. At any temperature warmer than the most extreme, the boiler is able to provide more BTUH than the home needs. The result is that the burner cycles on and off many times an hour to keep the home from overheating. This repeated on/off cycling is a very inefficient way for the boiler system to operate.
- Most of today's boiler systems don't adjust to the home's heat load. They usually turn on both the burner and circulator every time there is a call for heat. This result is that the burner will fire even though there is still plenty of usable heat in the boiler.
- The *HeatManager* adds intelligence to the system, and ensures that **the burner fires only after all of the usable BTU's have been extracted from the boiler.**

### DETERMINING HEAT LOAD

- The *HeatManager* uses a single, easily installed strap-on temperature sensor attached to the boiler supply (out-flow) pipe to measure both heat load and boiler water temperature. **See Figure 1.**
- Every time the burner shuts off – either due to high limit or end of heat call – the sensor begins taking temperature readings of the boiler water. The sensor takes 3 readings per second and transmits them back to the *HeatManager*.
- The *HeatManager* then determines the heat load by analyzing the temperature drop off rate of the boiler water during the burner off cycle.
- On cold days the water temperature will drop more quickly than on mild days. Whether or not the circulator is running during the burner off cycle also has an affect on the rate of temperature drop.

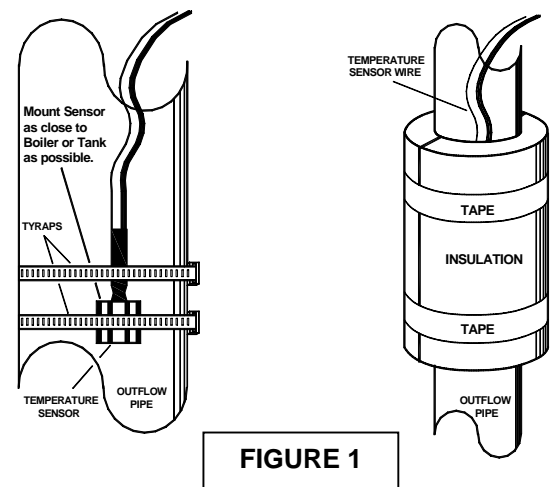
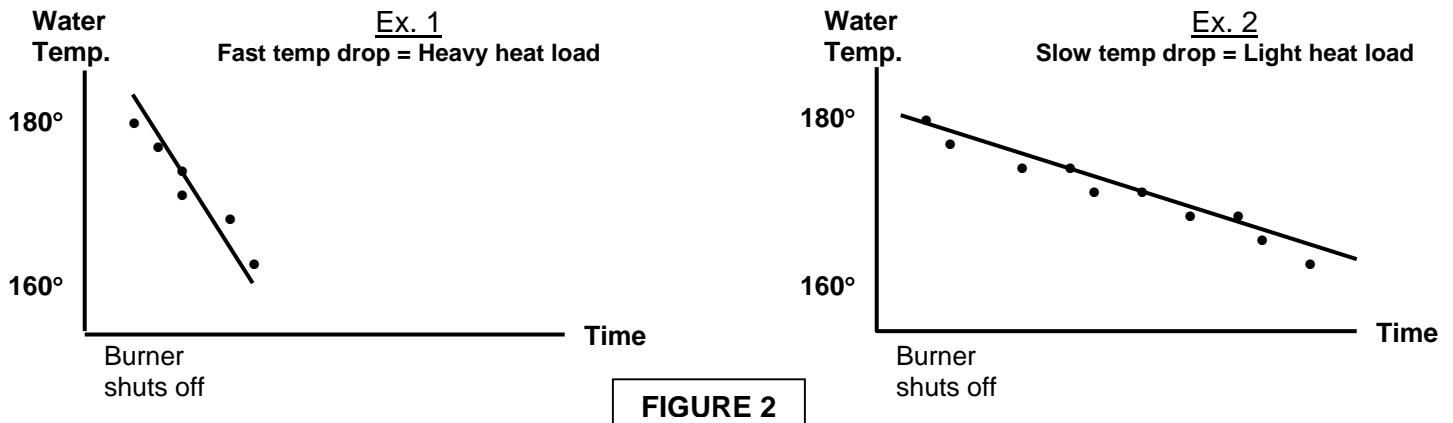


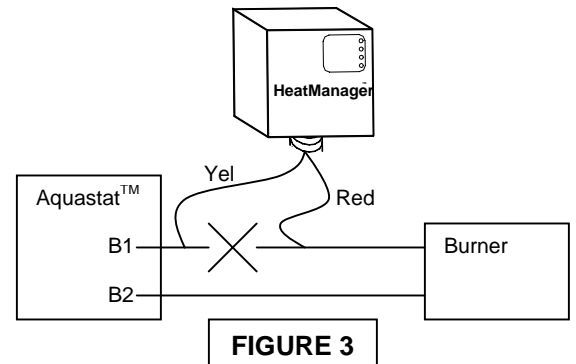
FIGURE 1

- Therefore, a fast temperature drop of the boiler water corresponds to a heavy heat load, and a slow temperature drop corresponds to a light heat load. **See the graphs in Figure 2 below:**



### HEATMANAGER OPERATION

- The HeatManager is installed in series between the boiler control and the burner. This wiring configuration gives the HeatManager the ability to interrupt the call to the burner, and to hold off burner firing when appropriate. **See Figure 3.**
- After determining the heat load, the *HeatManager* uses a patented algorithm to calculate the minimum boiler water temperature needed to maintain comfort at the measured heat load. This is the ideal burner cut-in temperature.



- If there is a call for the burner to fire while the boiler water temperature is above the ideal cut-in temperature, the HeatManager will delay burner firing. The preheated water already in the boiler will circulate to provide heat. Below are **two examples** of how the *HeatManager* would operate to conserve fuel in two different scenarios:

#### EXAMPLE 1

##### Demand (Cold Start) Type System

###### Example Background

- Boiler System:** 100,000 BTUH system with high limit only Aquastat™ (such as Honeywell L8148). High limit set at 200°
- Heat Load:** Based on temperature drop-off rate of boiler water, assume heat loss at the time of the example to be 50,000 BTUH.

###### System Operation

- At initial heat call, both burner and circulator will come on. During this time the burner output is 100,000 BTUH. However, the home only needs to absorb the current heat load – in this case, 50,000 BTUH. Much excess heat is stored in the boiler walls, jacket, and water.
- At the next call for heat, both the burner and circulator would normally turn on. However, *HeatManager* has sensed that there is still excess heat in the boiler from the last cycle that can be used without burning fuel. **The burner is held off until all of the usable heat already in the boiler is used up.**

## EXAMPLE 2

### Maintained Type System With Tankless Coil for Domestic Hot Water

#### Example Background

- **Boiler System:** 100,000 BTUH system with high and low limit Aquastat™ (such as Honeywell L8124). High limit set at 200°, low limit set at 140°, and differential of 10°.
- **Heat Load:** Based on temperature drop-off rate at supply pipe, assume heat loss at time of example to be 50,000 BTU/hr.

#### System Operation

- Most of the time, the system will operate identically to the demand type system explained above.
- The *HeatManager* has a port for an additional temperature sensor (#7518) to be used with a system with a tankless coil. This sensor goes on the outflow pipe from the coil/storage tank. If the DHW sensor detects a demand for hot water, it will override any burner firing delay. This assures that DHW is not sacrificed at the expense of saving heating fuel.

By delaying the burner firing to match the heat load, the *HeatManager* enables the boiler system to keep the home at the desired temperature while using less fuel.

## RESULTS

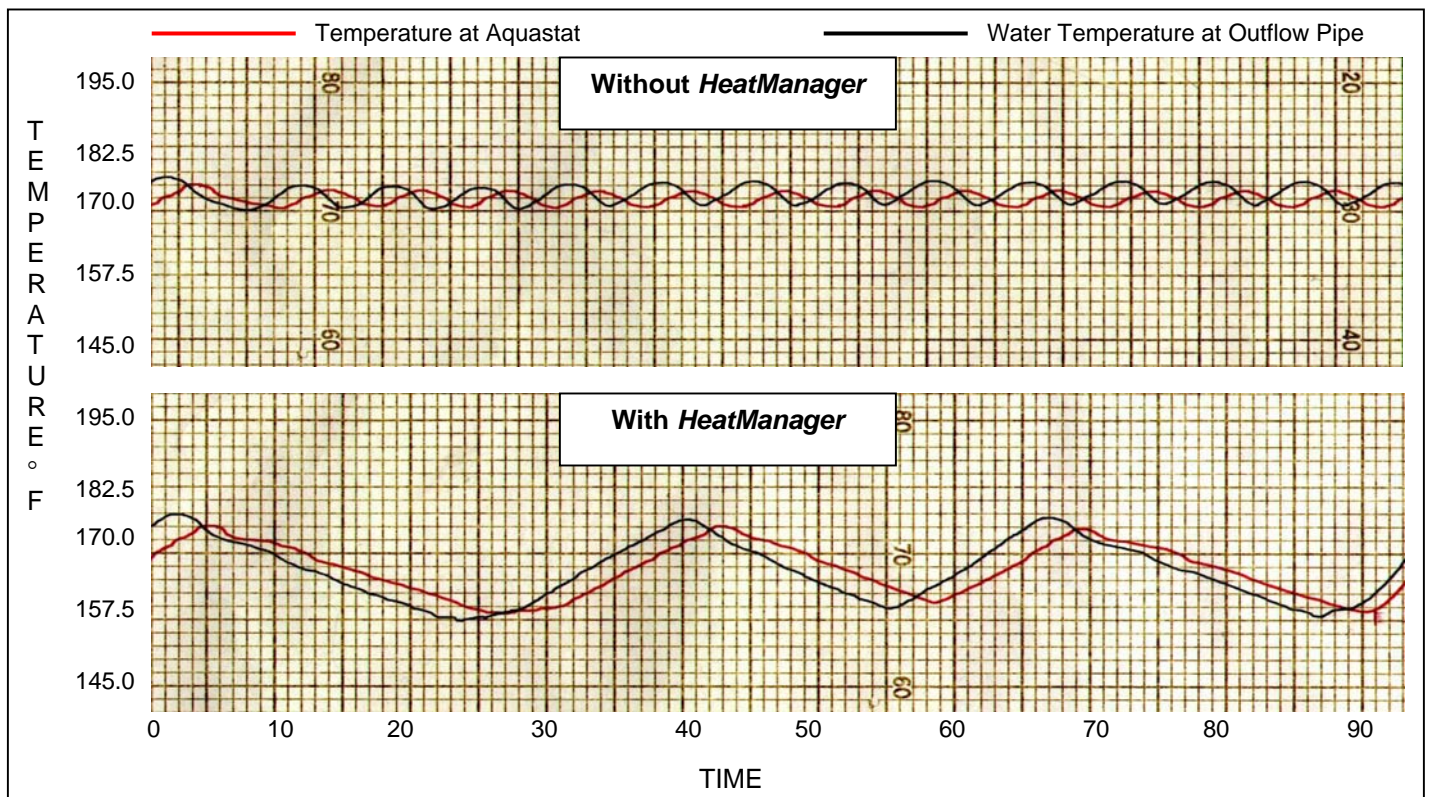
There has been much testing done to validate the energy saving claims of the *HeatManager*. Some of the most significant testing was done by Brookhaven National Laboratory and Atlantic Testing Laboratory. The results of their tests are captured in the table in **Figure 4** below.

Validating Organization	Test Site	Test Description	Test Results
Brookhaven National Laboratory	Energy Efficiency Laboratory  Upton, NY	<ul style="list-style-type: none"> <li>• Lab test on oil-fired high efficiency boiler</li> <li>• Load was a constant flow, constant temperature water-cooled plate heat exchanger</li> <li>• Coolant flow to heat exchanger was adjusted to simulate burner cycle rate, boiler flow rate, and temperature differential for a typical residence</li> <li>• Test unit was run with and without <i>HeatManager</i> to obtain results</li> </ul>	<ul style="list-style-type: none"> <li>• Burner run time was <b>reduced by 14.2%</b> when the <i>HeatManager</i> was operating</li> <li>• Number of burner cycles was <b>reduced by 64.5%</b> when the <i>HeatManager</i> was operating</li> </ul>
Atlantic Testing Laboratories  ATL Report No.: CT1433N-1-8-97	New Energy Efficient Home  Plattsburgh, NY	<ul style="list-style-type: none"> <li>• Field test in a new energy efficient house with an oil-fired high efficiency boiler</li> <li>• <i>HeatManager</i> was operated every other day</li> <li>• One month test</li> </ul>	<ul style="list-style-type: none"> <li>• Burner run time was <b>reduced by 14.7%</b> when the <i>HeatManager</i> was operating</li> <li>• Number of burner cycles was <b>reduced by 18.2%</b> when the <i>HeatManager</i> was operating</li> </ul>

**FIGURE 4**

*Please contact RW Beckett for complete test results*

- The savings derived from the *HeatManager* are further exemplified in the graph shown in **Figure 5** on the following page. This graph shows both the water temperature at the Aquastat™ and the water temperature at the boiler supply pipe during a test in a New York residence.



**FIGURE 5**

- The graph above demonstrates the reduction in burner run time and the reduction in burner cycling as a result of the using the *HeatManager*. The following reductions are typical:
  - **Burner run time (and therefore fuel consumption) is reduced by 10 - 20%**
  - **The number of burner on/off cycles is reduced by 30%**

### ENERGY SAVINGS

The *HeatManager* benefits include both energy and cycling improvements. A breakdown of how the savings are achieved is shown below.

- **Reduced average on-cycle flue temperatures:** Due to lower average boiler water temperatures, there is more efficient heat transfer to the boiler water, so more of the BTU's from the burner are absorbed by the boiler water and less are lost up the flue.
- **Reduced off-cycle flue losses:** Because of lower average boiler water temperatures, the air in the flue will hold less heat, and will be slightly cooler and "heavier" than before. This "heavier" air will be less likely to rise and escape out of the flue during an off cycle, and will remove less heat when it does.
- **Reduced distribution losses:** With lower average boiler water temperatures, less heat is lost from the plumbing to unheated spaces and through the walls.
- **Reduced pre/post-purge losses:** At each pre and post-purge, heated air is blown out through the flue/chimney. A reduction in burner cycling results in less pre/post-purge and therefore less heat loss.
- **Improved burner life:** Frequent starts and stops are very stressful on an appliance. Reducing the number of on/off cycles will dramatically improve the life expectancy of the burner and its components.

For more information, please visit our website at [www.beckettcorp.com](http://www.beckettcorp.com). You can also email us at [techservice@beckettcorp.com](mailto:techservice@beckettcorp.com), or contact our technical service Hotline at (800) 645-2876.