BURNHAM Commercial Boilers

TECHNICAL BULLETIN

Date: November 26, 2007 **Bulletin Number: HP600**

Subject: Commercial Boiler Operation – Controlling Water Temperature

Scotch Marine boiler manufacturers have been using blend pumps and low fire hold aquastats as standard equipment for years. Why? For the same reasons that cast iron boiler manufacturers deal with:

- Seasonal start ups
- Zone scheduling
- Setback schedules
- Outdoor reset
- Large water content systems
- Oversized boilers

These are all typical operating characteristics of modern hydronic heating systems and are why today's heating systems are designed with hot water as the preferred heating medium. The flexibility to control the space temperature with hot water has its advantages over steam systems. However, one or all of these conditions can create an opportunity for thermal shock, or thermally induced stress cycling to the cast iron sections.

Thermal Shock

Thermal shock occurs when there is a sudden thermal change that occurs within the boiler causing rapid and uneven contractions of the boilers cast iron or steel material. Here are a few examples of how this can occur:

- Return water coming back at too low a temperature to the boiler for extended periods
- Firing the boiler and heating up the water before the system circulator is turned on
- Moving the burner into high fire with the boiler water at too low a temperature

These conditions may go undetected for several months or years until the boiler finally has a failure. For cast iron boilers, a failure can manifest itself as a nipple leak between sections, a cracked push nipple port, or a crack in any one of the sections.

Maintaining the proper flow and temperature through a cast iron boiler is key to its longevity. For cast iron boilers, the delta T through the boiler should not exceed 40°F and the return water should not go below 135°F for extended periods. Here are some affective methods for accomplishing these goals:

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Primary Secondary Piping

By creating a separate "boiler loop", the flow in the boiler circuit is decoupled from the system flow and becomes fixed by installing a properly sized secondary pump. The system flow can vary, depending on how many zones are running, while the boiler loop flow remains the same. Primary secondary piping alone does not offer total protection from thermal shock. By adding a by-pass from the supply to the return adds a blending point to help offset cool temperatures returning from the system. Primary-secondary pumps are typically sized for a 20°F or 40°F ? T and would operate any time the burner is energized.

Blend Pump Piping

Another method commonly used in single and multiple boiler hydronic heating applications is the blend pump method. A blend pump is added to move hot supply water to the return, offsetting cool return water temperatures and making the flow constant any time the blend pump runs. Normally, blend pumps are sized to the industry accepted axiom of ½ gal per boiler HP (i.e.: 100 HP = 50 gpm blend pump). The pump can operate any time the burner is energized or as constant circulation.

Motorized Valve or Variable Speed Injection Piping

Some hybrid heating systems may operate as dual temperature, providing high temperature water for fan coils and baseboard and low temperature water for radiant or snowmelt systems. Other systems may use re-heat coils for dehumidification during cooling or outdoor reset applications that use low temperature water during mild weather conditions. This exposes the boiler to lower water temperature conditions and requires a higher level of protection. These types of conditions typically require the use of three or four way valves, controlled by electronic sensors, to automatically divert hot water into the return based on the return water temperature. An alternate method to the motorized valve method is the variable speed injection arrangement. In this arrangement, an injection pump is used to move water to the system, piped in primary secondary fashion. As the returning water gets too cool, a sensor will operate a variable speed drive to slow the injection pump down and limit the flow of cool water returning into the boiler loop.

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Low Fire Hold

Low fire hold aquastats are used on low high low or full modulation burners to provide a "soft" start, bringing boiler temperature to a minimum temperature before releasing to high fire. This is accomplished through the use of a Honeywell L4006B or L6006A and is typically set for 140°F. On a call for heat, the control will keep the burner from going to the high fire position until the water temperature in the boiler has reached 140°F. This allows for a more gradual increase in temperature as the boiler heats up.

Temperature Awareness

Let's face it, some commercial boiler systems are installed and initially set up, but are not observed for extended periods of time to check for temperature variances. Not all systems have computerized controls that provide system temperature feedback. System temperature conditions will change during the heating season and the ability to compensate for those changes is key in protecting the life of the boiler. Proper piping practices, intelligent control schemes and a sound maintenance schedule all play a part in preventing premature boiler failure and will maintain safe and efficient operation.