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Cold Water Start Protection Requirements for Hi Delta Boilers

Because of their high efficiency and closed combustion chamber design the Hi Delta Boilers are less tolerant to cold water operation than Raypak's Raytherm atmospheric boilers. Many boiler designs require a minimum inlet temperature of 140F, but because of the unique heat transfer characteristics of Raypak's copper finned tube boilers they all can operate continuously with inlet temperatures as low as 105 F. But with the fan assisted combustion systems utilized on the Hi Delta's and ADB's that will experience frequent, prolonged, cold water starts, protection provisions must be designed into the installation to avoid potential deterioration from condensation.

"Frequent" refers to daily or even weekly shutdowns where the system cools to ambient conditions that occur with night setback systems, weekend shut down systems, or daytime shut down. "Prolonged cold water starts" refers to start ups where the inlet temperature remains below 105 F for more than 10 minutes and is further quantified in the next paragraph.

Many commercial Hydronic systems maintain a continuous hot water loop during the heating system and thus do not have frequent cold water starts. Also, many Hydronic systems have far less than the maximum water volume in the following paragraph and therefore do not experience prolonged cold water operation. Most boiler/tank systems maintain above 105 F in the loop after initial start up, so we are referring in this discussion to the exception rather than the norm.

The following guideline/rule for determining when protection is needed has been prepared based on the boiler capacity and the volume of water in the heating system. The rule is that if the system contains more than 30 gallons for each 100,000 BTUH input and frequent cold water starts occur, a by-pass must be installed to blend boiler outlet water with the inlet water and thereby raise the inlet temperature to 105 F or higher. For example, for a model 902 the maximum acceptable system volume without a cold water start by-pass would be 900/100 X 30 = 270 gallons. Likewise for a model 2342 the acceptable volume without a by-pass would be 2340/100 X 30 = 702 gallons.

On many of the applications where cold water start protection is needed the by pass will need to be deactivated as the system heats up. This is especially true on systems that have high final operating temperatures. The temperature rise between the system water and the boiler outlet at start up with the by-pass properly adjusted will need to be in the range of 70 F to 80 F while the temperature rise in the boiler itself with the blended inlet water will be 20 F to 30 F (depending on boiler and pump sizing). For example, when starting with a 55 F system temperature, the blended boiler inlet will be 105 F and the boiler outlet will be 125 to 135 F (70 to 80 degrees higher than the 55 F system water). If the system return, after reaching full operating temperature, is 160 F and the by-pass is still operating, the boiler outlet would then be 230 F to 240 F and would likely be tripping the high limit. To avoid this the bypass should be closed after 105 F system return is achieved. Raypak now offers a PID based controller and three way motorized valve packages to maintain proper inlet temperatures during cold water starts. There are other acceptable ways that may be utilized as long as the boiler flow rates remain between the minimum and maximum specified for the boiler and the inlet is kept at 105 or higher.

Note that this paper addresses cold water start protection for Hydronic, DHW, and process water systems. Continuous low temperature systems such as pool heaters and water source heat pump boilers require constant tempering of inlet water and are addressed in other Raypak documents.

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