Hybrid Boiler Systems

Whether you call them "hybrid", "Base-load" or even "Mixed-boiler" configuration, these types of systems combine the lower operating costs of a condensing boiler with the lower equipment cost of a non-condensing boiler and optimize the operational range of both in a specific application.

Of critical importance for optimizing any hybrid system is the sizing of the units, historically boiler systems were greatly oversized for the majority of the heating system based on actual "zero" degree days so firing of units on non-zero degree days used exponentially more energy than actually required. There are an additional 2 key components that must play a part in optimizing a hybrid system application: outdoor reset control and the understanding of the performance band of condensing boilers (flue gas and return water temperatures below dew point of130*) versus non-condensing boilers with varying boiler water loop temperatures. As boiler water loop temperatures increase, boiler condensing decreases as does the effective efficiency of a condensing boiler.

By utilizing outdoor air sensors with hybrid systems boiler loop temperatures can be kept at a level where the condensing boilers are operated in a fully condensing mode when temperatures are slightly warmer outside. Operation in a fully condensing mode offers the greatest efficiencies with quicker return on investment. Decreases in the outside air temperature result in an increase in the heat load which increases the boiler water loop temperature and subsequent return water temperatures thus raising the flue temperatures beyond the 130* dew point range. When this occurs, boilers no longer condense and their effective efficiencies drop accordingly.

When boiler loop temperatures exceed that of condensing, boilers operate much like a traditional non-condensing boiler, just with a much higher price tag.

Enter the hybrid approach.

To maximize the return on investment of your boiler system is to utilize the maximum benefits of both condensing and non-condensing boilers. When outdoor temperatures are warmer utilize your modulating condensing boilers for maximum efficiency at condensing temperatures. When temperatures drop and boiler water temperatures increase to the ranges outside of condensing switch operation to the less-expensive non-condensing boiler.

HeatNet, Mestek's proprietary integrated boiler control platform makes boiler to boiler communication in all types of applications including hybrid designs seamless while optimizing system efficiency by prioritizing the firing rotation or all boilers in the sequence (up to 16 units) both condensing and non-condensing.

Condensing vs. Non-Condensing Boilers:

Condensing boilers are dependent upon return water temperatures as boiler efficiencies are determined by not only the load but also the return water temperatures (Figure 1). The return water temperature for non-condensing boilers must be above 130-140* to prevent flue gas condensation which will shorten and possibly damage boilers not designed for condensing applications.

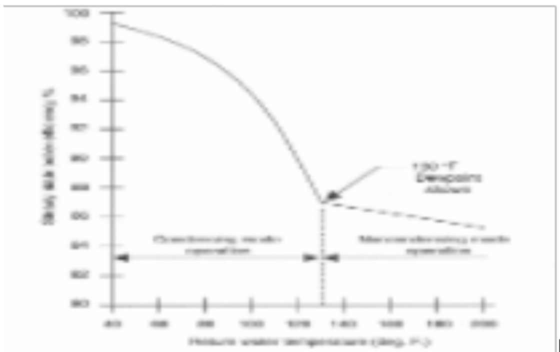


Figure 1

Condensing boilers are designed for return water temperatures below 130*. As the return water temperature decreases boiler efficiencies increase (Figure 2). Condensing boilers are typically seen in low return water temperature systems used in heat pump, snow melt and outdoor air reset based applications.

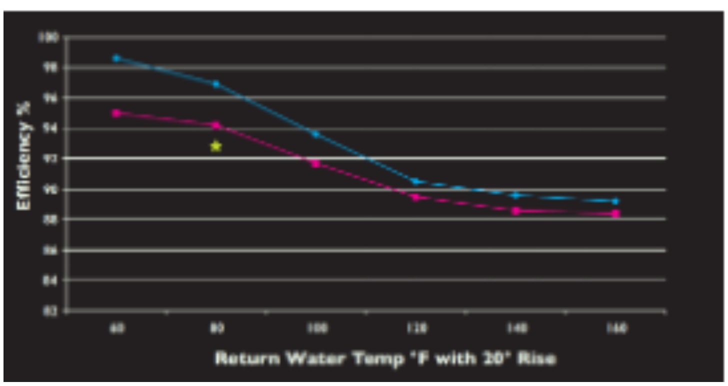


Figure 2

These efficiency curves show why a condensing boiler is not always the best solution for systems with return water temperature above 140°. The benefits of efficiency gains realized in a condensing boiler are not fully realized with higher return water temperatures. Based on the increased costs of purchasing condensing equipment it is often times more economically feasible to utilize the base load system approach where condensing equipment is utilized for operations within the condensing operational band and non-condensing equipment when the operation band reaches peak load where higher return water temperatures are seen (Figure 3).

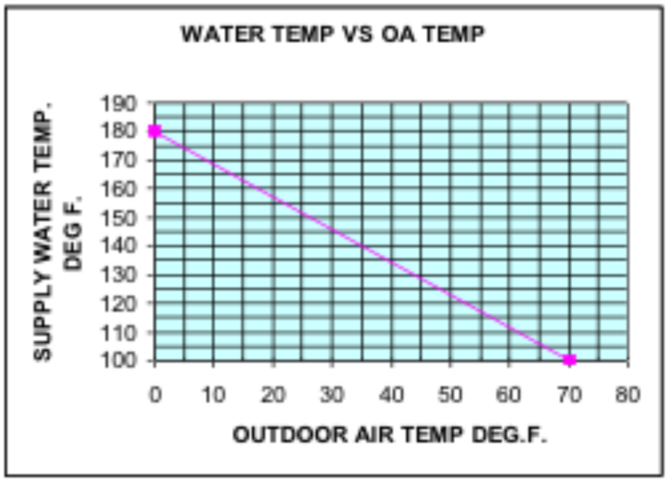


Figure 3

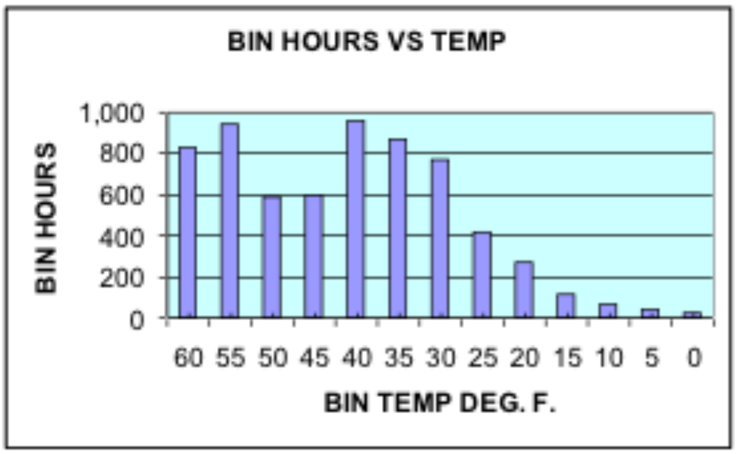


Figure 4

Based on the two figures above we can determine that at approximately 35* outdoor air temperature brings us approximately 140* supply water temperature which gives us return water temperature below 130* assuming a 20* delta t (Figure 3). When correlated to BIN Hours (Figure 4) we can see that there are approximately 4785 hours out of 6488 hours (74%) in which a boiler will run in full condensing mode leaving 26% of run time (1703 hours) in which the boiler will run in non-condensing mode. So, 74% of the time the “building” requires 40% of the “Design Heating Load”.

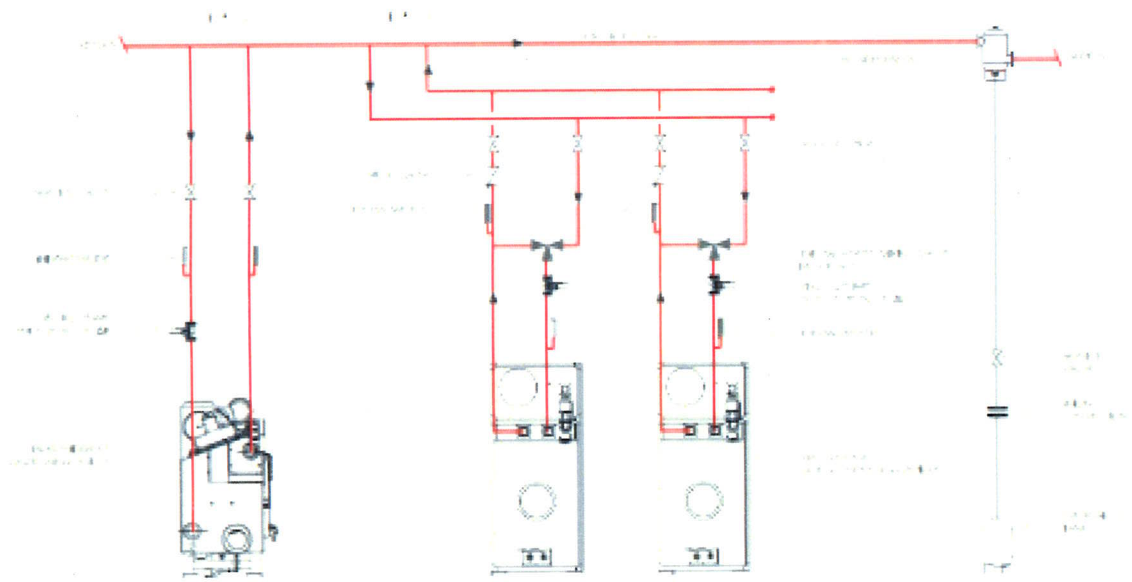
Typical Base Load Sizing & Selection:

Assuming a 4,500 MBH design load from which 40% (1800 MBH) can be concluded to be condensing with the remaining 2700 MBH being non-condensing.

Condensing – 1,800 MBH is a KN-20 (2000 MBH) high efficiency condensing cast-iron boiler.
Non-Condensing – 2,700 MBH is (2) Series 28HE 7 section mid efficiency boilers with a total rating 2,088 MBH.
Total gross output of condensing and non-condensing boilers is 5,244 MBH which is 116% of maximum design load.

Result:

The highest efficiency units will run in condensing mode 74% of the time, maximizing efficiency while still providing equipment redundancy at a substantially reduced cost over the installation of all condensing boilers.



Example of basic Base Load piping arrangement.