FAQ

When Are Hydronic Buffer Tanks Required?

Question: Does the mass of my boiler determine the need for a hydronic buffer tank?
Answer: No, although it is a contributing factor.

There is no ASME classification that defines high-mass, mid-mass, or low-mass boilers. It is a terminology adapted by individual manufacturers to describe their product compared to other boiler types. Typically, non-condensing boilers with Scotch-Marine or cast iron designs are considered high-mass when compared to boilers with stainless steel, copper, or aluminum heat exchangers. Some designs, such as larger condensing stainless steel boilers or condensing cast-iron boilers, may be described as "mid-mass" simply as a hybrid between the styles of boiler. Ultimately, what defines the need for a buffer tank is the thermal mass present in the heating system (including the boiler), minimum system load, minimum boiler cycle time, and the boiler plant turndown.

Q: How do I know when a hydronic buffer tank is required?
A: The minimum system volume is determined by the following equation

$$\text{Min. Volume [gal]} = \frac{\text{Min. Cycle Time [mins]} * (\text{Min. Boiler Input [BTU/hr]} - \text{Min. System Load [BTU/hr]})}{\text{Temperature Rise [°F]} * 500}$$

Some of this volume will be covered by the system piping and boiler internal water volume. If this volume is less than the required minimum volume, a hydronic buffer tank should be considered to add additional volume.

Q: What effect does the boiler's thermal mass have on the hydronic buffer tank?
A: The water volume internal to the boiler is included in the minimum system volume. The mass of the boiler itself factors into the minimum cycle time. This value will be different from model to model and manufacturer to manufacturer.

Q: What effect does a water-tube versus fire-tube design have on the hydronic buffer tank?
A: There is no direct effect. The volume of water inside the boiler may be counted towards the minimum required system volume. Water-tube boilers tend to have less water volume than fire-tube boilers, but volumes vary widely from model to model and manufacturer to manufacturer.

Q: Why does my commercial boiler not require a buffer tank, yet my residential boiler does?
A: System volume, minimum heating load, and boiler turndown. In commercial applications, system volumes are significantly higher and provide much more thermal mass than a small, residential system.
The minimum heating load in a commercial building is also much larger than that of a residential building. In a zoned system, the minimum heating load of a commercial building may be as large as several floors worth of heat. In a residence, heating loads may be as small as the smallest room with individual heat controls. Finally, the minimum firing rate of a single residential boiler is much less than that of a multiple-boiler commercial plant. For instance, a 199 MBH boiler with 5:1 turndown can operate as low as 40 MBH, or 20% of the maximum. On a commercial building with (3) 2000 MBH boilers at 20:1 turndown each, the minimum firing rate is a single unit at low fire, or 100 MBH, which is 1.7% of the total input.

Example 1: Three 2000 MBH mid-mass boilers with 20:1 turndown each. Internal volume is 20 gal. Recommended cycle time is 15 minutes. System volume is 50 gallons. Setpoint is 160ºF with 120ºF return water. Minimum system load is 50 MBH.

$$\frac{15 \text{ min} * (100{,}000 \text{ BTU/hr} - 50{,}000 \text{ BTU/hr})}{500 * 40^{\circ}\text{F}} = 37.5 \text{ gal}$$

The total system volume plus boiler volume is 70 gallons. As this is greater than the required 37.5 gallons, no buffer tank will be required.

Example 2: Three 2000 MBH high-mass boilers with 5:1 turndown each. Internal volume is 100 gallons. Recommended cycle time is 10 minutes. System volume is 50 gallons. Setpoint is 160ºF with 120ºF return water temperature. Minimum system load is 50 MBH.

$$\frac{10 \text{ min} * (400{,}000 \text{ BTU/hr} - 50{,}000 \text{ BTU/hr})}{500 * 40^{\circ}\text{F}} = 175 \text{ gal}$$

The total system volume plus boiler volume is 150 gallons. An additional 25 gallon buffer tank will be required to prevent this system from cycling.

AERCO International, Inc. • 100 Oritani Drive • Blauvelt, NY 10913
USA: T: (845) 580-8000 • Toll Free: (800) 526-0288 • AERCO.com