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## Boiler room 'myths'

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How many boilers does it take to keep occupants comfortable?

Boiler Room Size (sq ft)	Number of Boilers	Boiler Capacity (MBH)
100	1	100
200	1	200
300	1	300
400	1	400
500	1	500
600	1	600
700	1	700
800	1	800
900	1	900
1000	1	1000
1100	1	1100
1200	1	1200
1300	1	1300
1400	1	1400
1500	1	1500
1600	1	1600
1700	1	1700
1800	1	1800
1900	1	1900
2000	1	2000
2100	1	2100
2200	1	2200
2300	1	2300
2400	1	2400
2500	1	2500
2600	1	2600
2700	1	2700
2800	1	2800
2900	1	2900
3000	1	3000
3100	1	3100
3200	1	3200
3300	1	3300
3400	1	3400
3500	1	3500
3600	1	3600
3700	1	3700
3800	1	3800
3900	1	3900
4000	1	4000
4100	1	4100
4200	1	4200
4300	1	4300
4400	1	4400
4500	1	4500
4600	1	4600
4700	1	4700
4800	1	4800
4900	1	4900
5000	1	5000
5100	1	5100
5200	1	5200
5300	1	5300
5400	1	5400
5500	1	5500
5600	1	5600
5700	1	5700
5800	1	5800
5900	1	5900
6000	1	6000
6100	1	6100
6200	1	6200
6300	1	6300
6400	1	6400
6500	1	6500
6600	1	6600
6700	1	6700
6800	1	6800
6900	1	6900
7000	1	7000
7100	1	7100
7200	1	7200
7300	1	7300
7400	1	7400
7500	1	7500
7600	1	7600
7700	1	7700
7800	1	7800
7900	1	7900
8000	1	8000
8100	1	8100
8200	1	8200
8300	1	8300
8400	1	8400
8500	1	8500
8600	1	8600
8700	1	8700
8800	1	8800
8900	1	8900
9000	1	9000
9100	1	9100
9200	1	9200
9300	1	9300
9400	1	9400
9500	1	9500
9600	1	9600
9700	1	9700
9800	1	9800
9900	1	9900
10000	1	10000

Table 1.

Growing up with a red-haired, Irish mother, I had to learn all the Irish superstitions. For example:

- Never cross a person on the stairs in a house.
- If you spill salt, throw some over your shoulder.
- Never open an umbrella inside a house.
- Never place shoes on a table.
- Always give a coin to every stranger you meet on New Year's Day.

When I asked her about these, I was told that neglecting these rules would bring bad luck to the person or the family, sometimes for years. No other explanation was ever given. These have been passed down from generation to generation without question.

Do we do the same thing when designing a boiler room?

How many boilers should we use in a boiler room project? One, two or several? Let's explore the pros and cons of each.

### The one-boiler argument

Some people believe that one boiler should be adequate. After all, many buildings used one boiler for years. The old single boiler worked well for years because parts were accessible locally for the older boilers. Most service calls involved replacing a thermocouple, gas valve or control. These were available at the local supply

house.

However, most of the newer boilers use proprietary parts only available from the manufacturer. Good luck finding that part on a Friday afternoon. In addition, a single boiler will be grossly oversized for the majority of the winter and will cycle constantly. Cycling will cause more frequent breakdowns. If you are installing a single boiler, you should discuss purchasing some common spare parts for the owner to stock. This could reduce downtime and make a happy client.

We had a client with a failed inducer fan on his boiler on a Friday afternoon. No one stocked the part and we had order it from the factory. It arrived on Monday. Have you ever noticed how cranky people get when they have no heat for a weekend?

## How about two boilers?

For years, two boilers have been the staple of the commercial boiler room. When designing a boiler room, we size the heating plant to be greater than the heat loss of the building, obviously. The question is, “How much larger?”

Let’s consider a hypothetical building with a heat loss of 1 million Btuh at the design temperature. If we use two boilers, we have to split the heating load between the two boilers. Some manufacturers suggest that each boiler should be sized for 50% of the load. In this scenario, each boiler would be sized for 625,000 Btuh input and 500,000 Btuh output.

Most designers are hesitant to have two boilers sized that close in case one of the boilers breaks down. When sized at 50% each, one boiler could handle the load when the outside temperature is above 34° F. If the outdoor temperature is below that, the lone operating boiler cannot keep up and the inside temperature will drop. The speed at which the building loses heat depends on the outside air temperature and the building shell.

In most instances, the designers will size each boiler for 75% of the load. In our fictional boiler room, each boiler will be sized for 937,000 Btuh input and 750,000 Btuh output. This will assure that the building will heat safely with one boiler down to about 17°. The designer feels good and the owner has heat.

I contend that this is a disservice to the owner. On the coldest day of the year, our heating plant will be sized at 150% of the heating load and the oversized percentage will grow exponentially as the outdoor temperature rises, as seen in **Table 1**. That means our boilers will be 50% larger than they should be. This causes a ripple effect in the whole project. In addition to the boilers being oversized by 50%, everything else will be 50% larger including the pumps, combustion air openings, expansion tank, flue piping, chimney, gas piping, pipe insulation, electrical and system piping.

As you can imagine, the price for this project has just jumped dramatically. In addition, the maintenance costs will be higher for an oversized heating plant due to excessive cycling. In the above example, you would be hard-pressed to find a boiler sized at 937,000 Btuh, so you would have to choose the next larger size boiler, which would most likely be 1 million Btuh with a rated output of 800,000 Btuh. Our heating plant is now 60% larger than we need.

Many installers will argue that modulating burners will reduce the boiler cycling. In the above example, the typical boilers will have a 3-to-1 turndown. That means the burner will be able to drop to 33% of its firing rate. Combined, the two heating boilers will have a 6-to-1 turndown, meaning the heating plant will be able to drop to about 309,000 Btuh input or 30% of the building load.

## The modular boiler plant

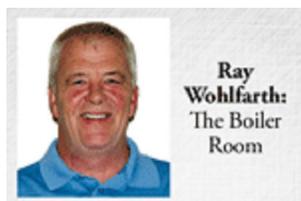
Now, consider a modular boiler plant. In this example, I will use four boilers each sized for 25% of the load. Each boiler will be sized for 313,000 Btuh input and 250,000 Btuh output. Our heating plant will be sized for the load of the building. If one boiler fails, the building will still have 75% backup like the two-boiler plant, but the boiler plant will be 33% smaller. In addition to having a smaller boiler plant, our pumps, combustion air louver, flue, piping, etc., also will be 33% smaller.

The maintenance costs will be reduced, as will the operating costs because the system will be able to track the heat loss of the building better than two larger boilers. If we use modulating burners on this project, the system turndown will be 12 to 1, double the turndown of the two-boiler plant. The heating plant will be able to drop to about 103,000 Btuh input or 10% of the heating load. If you use more than four boilers, your seasonal efficiency is even greater.

Oh, one more thing: If you meet a magpie or a cat with a limp while you're on a trip, it is bad luck.

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