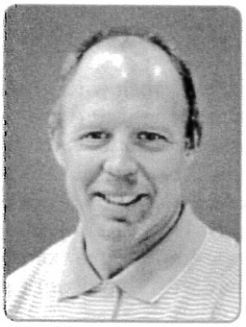
Boiler Facts

As the heating season begins...

Optimizing efficiency and minimizing short cycling



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During this past seminar season, one of the most popular topics was high efficiency boiler room operation—how to pipe them, where to apply them. The subject of short cycling was talked about the most, along with the kinds of problems it causes from either a mechanical or an economic standpoint.

Mechanical problems occur because of rapid on/off cycling of the boiler. All of the various components found on a boiler have an expected life cycle. When a boiler is short cycling, the components are seeing all of these cycles in a very short time span. This leads to premature control failures, nuisance lock-outs, service calls and frustrated customers. If you want to destroy a brand new boiler in a short period of time and frustrate your customer along the way, short cycle it!

The economic problem is often unknown and certainly under-appreciated. There's a rule of thumb that states, "A short cycling boiler will operate at least 12–15% below its rated efficiency when that same boiler is not short cycling." The loss of fuel efficiency can be staggering and, of course, the wasted fuel consumption is paid for by the homeowner with the new high efficiency boiler.

So, if you want to prevent short cycling, what can you do? The first step is to ensure that the boiler is not oversized. When a boiler is too big, it will always produce more energy than the system needs. By being too big, it also reaches its temperature limit very quickly, not allowing the boiler to operate in its "steady state fashion". The best way to make sure that a new boiler is not too big is to perform an accurate heat loss on the house. There are several software heat loss programs available that will help you establish the heat loss of any building. By using this information you can then select the right size boiler for the house.

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Unfortunately, as the expression goes, "no good deed goes unpunished." A boiler can still short cycle even when it is sized properly. Do you know why? Load and zoning are the reasons. A properly-sized boiler is sized for design conditions. This means that when it is very cold outside (design outdoor temperatures), the boiler is capable of keeping the occupants at design indoor temperatures. But these design outdoor conditions only exist for less than 5% of the total heating season, which means that for the remainder of the heating season, even the properly sized boiler is too big and can possibly short cycle.

One of the many advantages and selling features of a hydronic system is the fact that it can be zoned very easily. Most homeowners like the idea of being able to control sections of their house right down to room-by-room control. This unfortunately can also lead to short cycling. If one or two small zones are calling for heat and the boiler fires in response, the energy output of the boiler is too great compared to the needs of the smaller zones, the high limit is reached very rapidly and the boiler shuts off. The zones continue to call and the water temperature drops, the limit control responds and the boiler fires up again. Of course, the high limit is reached quickly and the boiler turns off. So, even though the hydronics industry promotes its zoning capabilities and homeowners enjoy the comfort and control offered by zoning, it can impact a boiler's potential operating efficiency.

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If you were to ask any boiler manufacturer what would be an acceptable firing on-time that would eliminate short cycling and all of its pitfalls, a minimum of ten minutes would be the answer. What can we do to achieve this ten minute firing "on-time"? Here are a couple of ideas:

One would be to improve the controlling operation of the *system*. And a *system it is*...for a long time we have allowed the individual zones to operate independently and therefore randomly. The net result is inconsistent and very uneven loading of the boiler, which often leads to harsh boiler short cycling. Nowadays, there are thermostats on the market that synchronize with each other (i.e. talk to each other). By synchronizing, they all call for heat at the same time at the beginning of each new heating cycle. Naturally, how long each one runs for is determined by that particular zone's needs. The benefit of this is the boiler is seeing a reasonable load/flow rate