When equipment in the boiler room fails, it can be a building owner's and facility manager's worst nightmare. Whether a boiler is condensing or non-condensing or built with copper, cast iron, or stainless steel, it is important to conduct a maintenance program to make sure systems remain in tip-top condition to avoid potential pitfalls.

Maintenance of the heat exchanger is key. Following the manufacturer's recommendation for proper flow is critical to maintaining the overall performance of the boiler heat exchanger. Copper boilers also may be sensitive to improper flow rate. Too much flow will result in erosion corrosion, while too little flow will cause localized boiling in the heat exchanger that could result in premature heat exchanger failure.

The cooler a boiler system runs, the more efficient it becomes. Some efficiencies are gained by adding more surface area to the heat exchanger, thereby increasing heat transfer. By doing so it is possible to get 10%–12% better efficiency over traditional boilers.

While copper is the most effective heat-transfer material known today, cast iron boilers are more durable and resilient to handling the extremes that come with marginal flow fluctuations. In regards to heat transfer, cast iron boilers are superior to steel boilers.
A hydronic heating system offers numerous applications for whole-house heating and can satisfy many heating needs. Utilizing an indirect fired water heater in conjunction with an existing boiler can provide a highly efficient, virtually limitless supply of hot water for bathing, cooking, laundry and dishwashing.
This unit is ideal for confined spaces and weight-restricted areas, a critical solution for commercial retrofit projects.

The HVAC industry is in a transitional phase when it comes to steam boilers. It is recommended that a steam boiler be visually inspected by a certified inspector while the boiler is in operation. However, these types of boilers are less common. A paradigm shift happened somewhere around 15 years ago when technicians were becoming aware that older steam systems were not so efficient. Many have converted them from steam to hot water.

A condensing boiler, on the combustion side, will use oil, natural gas, propane or a mixture of gases and will combine the fuel with an oxidizer to produce a chemical, exothermic reaction. Condensing heat exchangers are made of aluminum or stainless steel to withstand the harsh acidity created in the combustion process.

A condensing boiler extracts additional heat from the exhaust gases by condensing hot water vapor to liquid water, thus recovering its latent heat of vaporization. By capturing some of the waste heat, the condensing boiler heat exchanger can be up to 10% more efficient than a conventional boiler operating in the proper conditions.

As a point of reference, it takes 1,000 Btu to change 1 lb of water into steam. Condensing boilers are used to recover the latent heat from the flue gases that would otherwise be wasted in a non-condensing boiler. Because the flue gases contain superheated steam and acids, if the gas can be condensed back into a liquid by cooling it, the byproduct is not only water but additional matter, thus reclaiming the Btu that were initially used in the process. Day-to-day, the cost and energy savings may appear small. But per heating season, per year and over the long-term life of the appliance, the savings that accumulate are vastly substantial.

Due to the acidity produced during the condensing process, physically cleaning the surface of the heat exchanger once a year on a routine and scheduled basis is vital. This allows for the efficient energy transfer. The flame rod and igniter also are exposed to the warm, moist, acidic environment, and keeping the boiler running efficiently means catching problems and replacing parts before they wear out entirely.

**Best maintenance practices**

There are a number of methods one can implement to increase boiler system longevity. The best operating practices to increase seasonal efficiency in an existing system include:

1. **Check for leaks.** Replacement water is usually colder than the system return water, requiring an additional amount of heat. Thus, replacement water costs money.

2. **Use proper water treatment.** The lime that is deposited when the water is heated can coat the boiler surfaces, reducing the heat-transfer efficiency. Proper water treatment does not just protect the boiler against scale and corrosion, it also protects the entire system, including pumps, valves and heat emitters.

3. **Utilize control methods.** Air temperature reset and programmable thermostats adjust water temperature in the system loop in response to lower building demand for heat. Because boilers operate at the maximum design capacity only a fraction of the time, these controllers can be very effective and save significant amounts of money.

4. **Reduce burn cycles.** Consider widening the operating and limit control differentials. This method will reduce the number of burner firing cycles. The fewer the cycles, the higher the efficiency.
5. Conduct annual boiler maintenance. Cleaning heat exchangers, replacing worn out components, adjusting air/fuel mixture and maintaining the water pH balance will improve the boiler seasonal efficiency, prevent costly failures and will extend the useful lifecycle. Seasonal efficiency is one of the most important measurements because it determines how much a building owner will pay for fuel during the heating season.

Preventative maintenance key
Facility managers today also seek preventative maintenance analyses to avoid an expensive critical failure. With this new advancement, maintenance personnel can receive a predictive analysis of what may happen to a boiler over a specific length of time, such as the next six to 12 months.

Manufacturers have developed this technology by factoring a certain set of parameters and based on changes in those factors, can predict when specific maintenance procedures—such as cleaning tubes or a heat exchanger—should occur to prevent catastrophic failure.

Conclusion
Proper inspection and regular routine maintenance are necessary to assure uninterrupted, dependable and safe boiler operation. It is also important that building owners and facility managers maintain current maintenance documentation on equipment to assure reliable and safe operation.

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