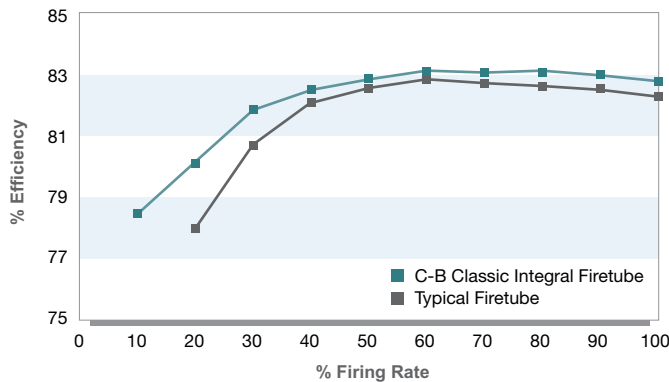




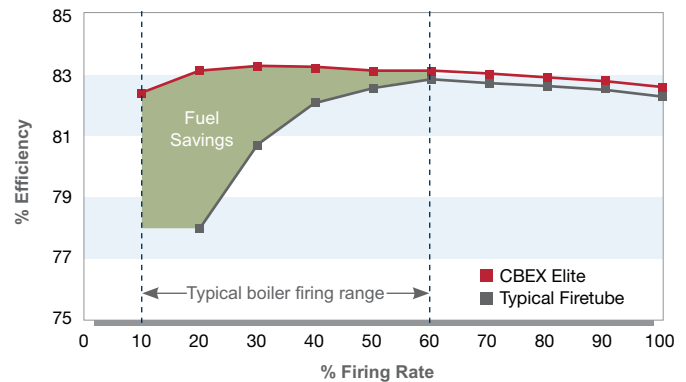
The technology behind the CBEX:

## DISCOVER HOW TO SAVE FUEL WITH TURNDOWN AND HIGH EFFICIENCY ACROSS THE FIRING RANGE

**EFFICIENCY % FOR A C-B CLASSIC INTEGRAL FIRETUBE VS. TYPICAL FIRETUBE THROUGH THE FIRING RANGE**



**EFFICIENCY % OF A CBEX ELITE VS. TYPICAL FIRETUBE THROUGH THE FIRING RANGE**



Efficiency curves based on natural gas firing at 125 psig steam at 30 ppm NOx. Efficiencies do not reflect secondary heat recovery options.

The typical boiler plant has boiler capacity larger than what would normally be required to run their given process. This is due to redundancy requirements, changes in long-term plant demand, new efficiencies in the process, or any number of other factors. Often, over-sizing of boiler equipment is incorporated into the original design. The over-capacity paired with the changing requirements for steam or hot water at a given time in the process means boilers have to move through their firing ranges to meet demand, most of the time operating at 60% or less of their full firing range (capacity).

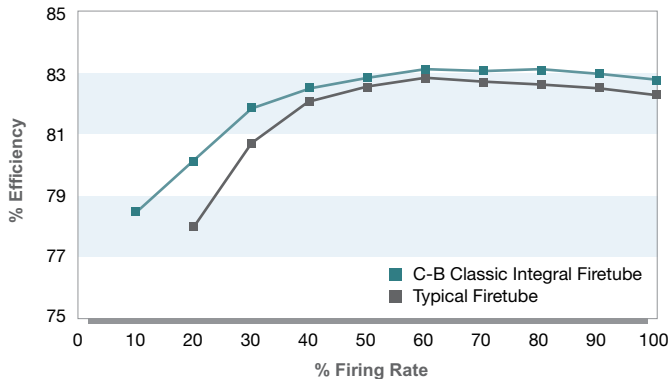
This leaves two important factors to consider: boiler turndown and boiler efficiency throughout the firing range. All burners have a specific turndown, ranging from 4:1 to 10:1 or higher, depending on the burner design. As the demand for steam or hot water decreases, the boiler's burner "turns down" to try to only meet the required demand. If a burner only has 4:1 turndown, that means it can only operate at 25% of firing capacity (100%/4=25%). As the process's demand continues to decrease, the firing rate must decrease. However, if the demand falls under the minimum turndown, the boiler will quickly meet the minimum process demands and then "cycle off" until more demand is needed. A boiler cycle consists of a firing interval, a post-purge, an idle period, a pre-purge, and a return to firing—causing valuable energy to be wasted.

*Continued on back*

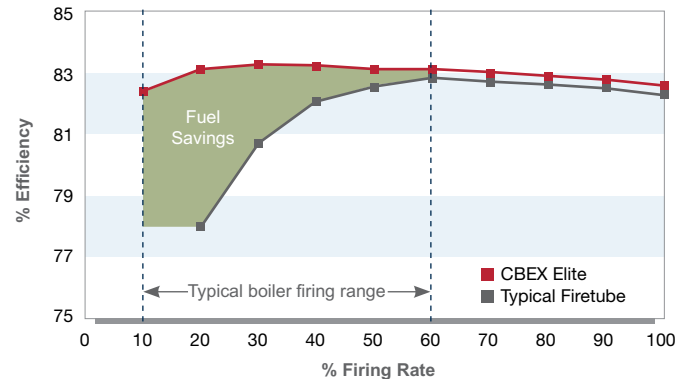
# BOILER EFFICIENCY AND FIRING RATE



**EFFICIENCY % FOR A C-B CLASSIC INTEGRAL FIRETUBE  
VS.  
TYPICAL FIRETUBE THROUGH THE FIRING RANGE**



**EFFICIENCY % OF A CBEX ELITE  
VS.  
TYPICAL FIRETUBE THROUGH THE FIRING RANGE**



Recognizing this, in 1990, Cleaver-Brooks engineers made 10:1 turndown standard in its classic line of firetube boilers, featuring the industry's benchmark integral burner. With 10:1 turndown, a boiler can "turn down" to 10% of capacity without cycling, preventing needless energy losses.

The efficiencies of boilers change as you go up and down the firing range—often falling off dramatically as the boiler enters the lower end of the firing range. If boilers are operating at 60% of capacity, this decrease in efficiency leads to lower operating efficiencies and increased fuel expense. While the classic Cleaver-Brooks line of integral firetubes prevents energy loss from cycling, the boilers still have reduced "thermal efficiency" in the lower firing ranges, albeit higher than other firetubes.

In 2011, Cleaver-Brooks engineers were challenged with pushing firetube boiler technology further. Taking advantage of advancements of Computational Fluid Dynamics (CFD) modeling and finite element analysis, engineers began the process of designing a new firetube boiler from the ground up. Engineers focused on three areas: 1) optimizing the heat transfer of the firetubes with a proprietary heat transfer tube, 2) using the space created from improving the tubes to geometrically optimize the shape of the furnace for more robust combustion, and 3) integrating the burner and controls for peak performance.

Their efforts paid off. The new CBEX Elite firetube boiler achieves extremely high efficiency throughout the boiler's entire 10:1 turndown range.\* Specifically, as the boiler turns down to 60% or below, the efficiencies remain high all the way down to the 10% firing range, not decreasing like other firetube boilers. With the advanced CBEX firetube boiler's 10:1 turndown combined with unprecedented high efficiencies across the turndown range, operators will recognize tremendous fuel savings while operating below the 60% firing rate and throughout the boilers entire firing range.

\*10:1 turndown available on CBEX models larger than 200 BHP.