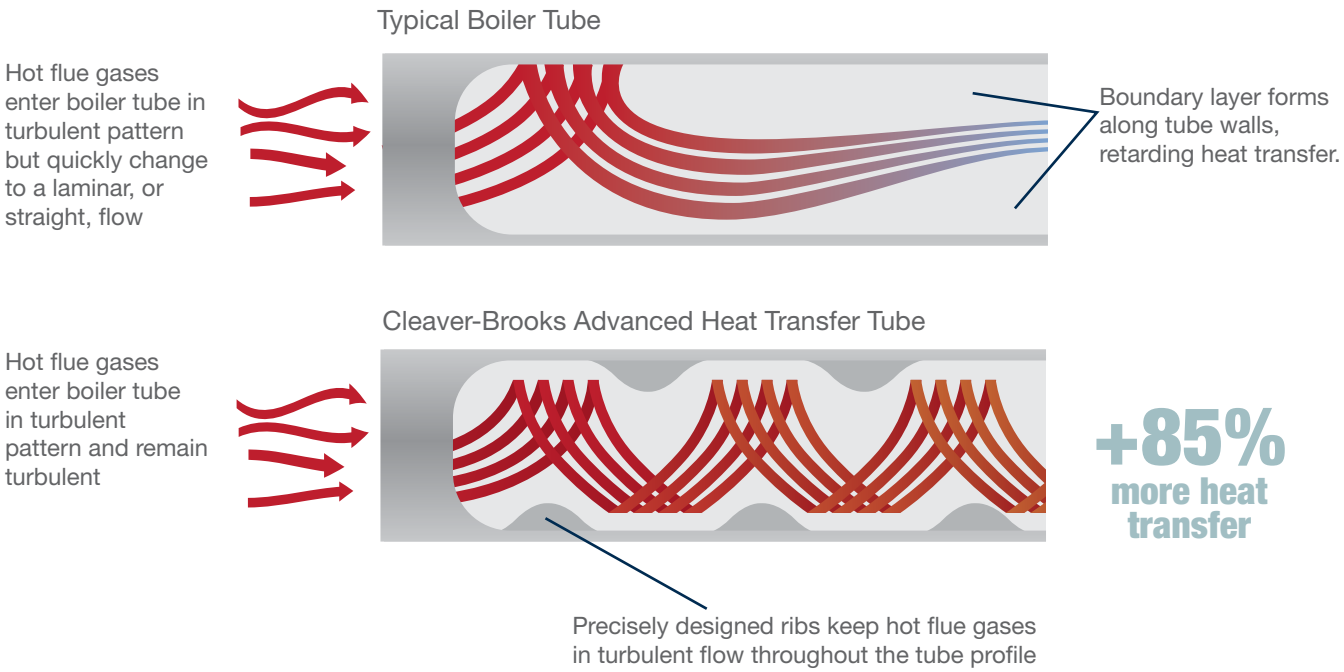

The technology behind the CBEX:

ADVANCED HEAT TRANSFER TUBES

In a firetube boiler, the hot flue gases travel through the boiler tubes and transfer heat to the water though the surface of the tube. The greatest heat transfer occurs when the hottest gases come in contact with the surface of the tube for the greatest amount of time.

In a traditional bare tube used in the majority of boiler designs, the hot combustion gases enter the tubes in a turbulent flow pattern. This initial turbulent pattern produces good heat transfer initially, but the hot flue gas pattern quickly changes to a laminar flow, or a straight parallel flow of gases. With the gases traveling in this straight pattern, a boundary layer forms along the tube walls, increasing with the distance of the tube. This layer serves as a barrier, retarding heat transfer. As a result, a bare tube only utilizes a fraction of its diameter for heat transfer, which equates to a lot of wasted space.

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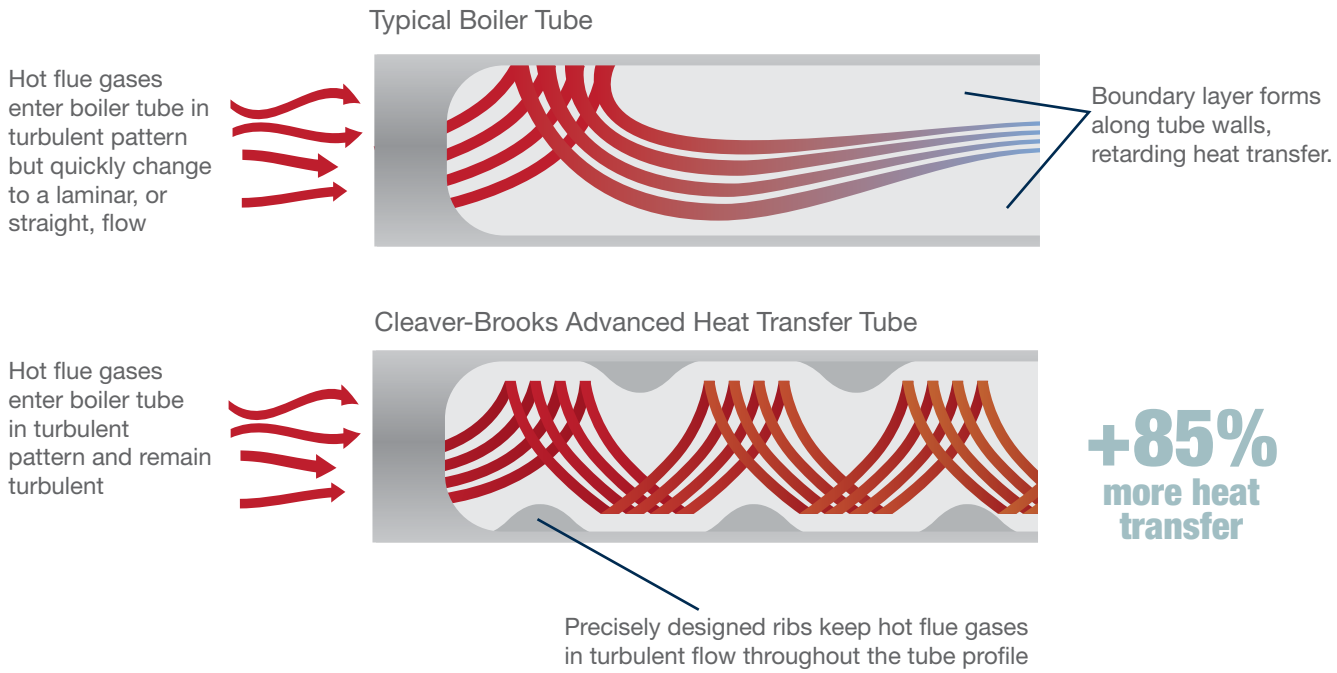
ADVANCED TUBE DESIGN



Because 30% to 40% of the boiler's heat transfer takes place in the tubes, it is important to generate as much heat transfer as possible within the tubes. Knowing that the laminar flow of the flue gases causes poor heat transfer, as described above, over the past 10+ years engineers have been looking at ways to create turbulence of the flue gases throughout the length of the tube to increase heat transfer and decrease the formation of boundary layers. By adding helical ribs or embossed spiral patterns to the inside of the tube, engineers were able to create more turbulence of the hot flue gases and thereby create more heat transfer. But more could still be done.

Using Computational Fluid Dynamics (CFD), finite element analysis, and mathematical modeling, Cleaver-Brooks engineers began to improve the tube profile. Coupling the modeling technology with their extensive knowledge of boiler systems, Cleaver-Brooks engineers dedicated countless hours to spiral tube engineering to perfect heat transfer within the proprietary spiral tube. To obtain the right cross section for optimal tube performance, the engineering team continuously made changes to the number of ribs, the angle of the ribs, and the height and width of the ribs. They would then analyze the calculations, continuing to refine the geometry to achieve the optimal result.

In the end, the advanced heat transfer spiral tube for the CBEX utilizes 100% of the tube diameter and increases heat transfer by 85% compared to a traditional bare tube. This proprietary tube is the only one to achieve these remarkable results.

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