

The world's standard in efficiency.

CBEX

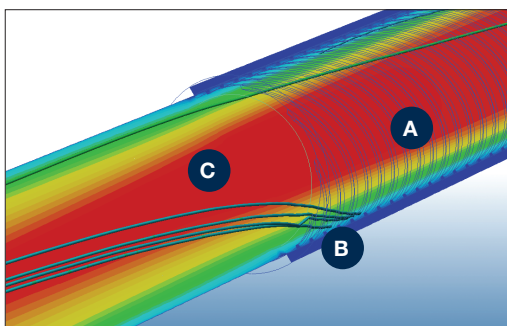
FIRETUBE

CBEX Firetube Boilers

For decades, engineers have been trying to build a better and more efficient boiler system, but it took Cleaver-Brooks to challenge the status quo and reimagine what is possible. Since Cleaver-Brooks is the only company that manufactures every component of the boiler system, we were able to design a completely new system from the ground up, incorporating our EX technology. It can only be described as a quantum leap in firetube design, with the highest operating efficiency and lowest possible NOx ever achieved.

DESIGN ADVANCEMENT ONE: Optimizing the tubes for better heat transfer

Computational Fluid Dynamics (CFD) modeling allows us to optimize the extended surfaces of the spiral heat transfer tube, where 30% to 40% of the boiler's heat transfer takes place. This proprietary design increases heat transfer by 85% compared to a traditional bare tube.



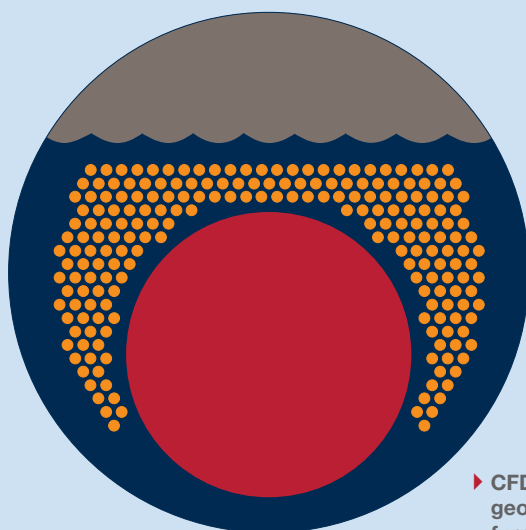
CFD model of an advanced heat transfer tube.

- A** The number of ribs, angle of the ribs, and height and width of the ribs have been optimized for peak tube performance.
- B** Improved tube profile utilizes 100% of the tube diameter for heat transfer.
- C** Increased surface area and a complex boundary layer separation reattachment phenomenon result in better heat transfer.

DESIGN ADVANCEMENT TWO: Optimizing the geometry of the furnace for near-perfect combustion

With the tubes optimized, they could transfer more heat in less space. We then used this space to optimize the geometry of the furnace, where the remaining 60% to 70% of the boiler's heat transfer occurs for low heat release rates and near-perfect combustion.

▶ Maximum heat transfer in the furnace radiant zone achieves the optimum balance of high heat transfer with the lowest pressure drop.



▶ Low heat release rates result in lower turnaround gas temperature and reduced thermal expansion of the furnace, extending the life of the tube sheet and tube attachments.

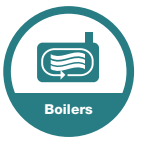
▶ Lower and more uniform flame temperature means less thermal stresses on the furnace.

▶ CFD Modeling leads to a geometrically optimized furnace with average heat release rates of 125,000 BTU/hr/cu. ft. This leads to near-perfect combustion and the lowest possible NOx levels.

DESIGN ADVANCEMENT THREE: Integrating the burner and controls

Ultimately, the performance of a boiler is based on the ability of the burner, boiler, and controls to work together. Controlling the CBEX is the Cleaver-Brooks Hawk, an integrated control system embodying precise boiler/burner management and safety with logic-based ancillary devices and functions. The Hawk keeps your boiler and burner consistently operating at peak efficiency with the lowest possible emissions, regardless of changes in environmental conditions.

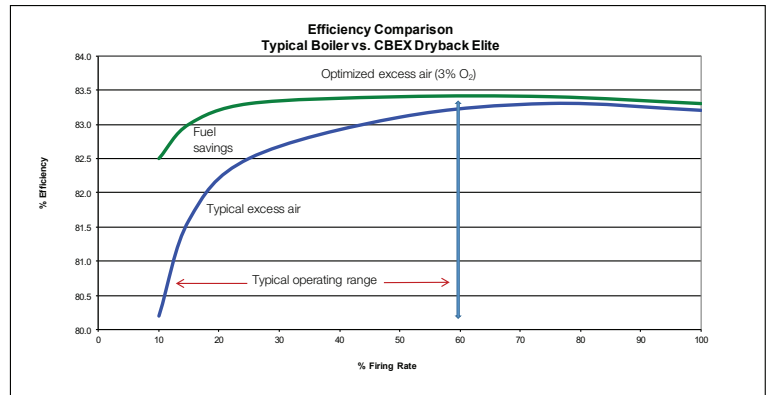
The Benefits Of EX Technology



EX technology provides for a revolutionary boiler system that features the lowest emissions, most robust combustion, and best thermal efficiency across all operating ranges. Compared to existing models, the CBEX attains the highest fuel efficiency in lower firing ranges. It also emits fewer air pollutants than any firetube system on the market today.

Highest Operating Efficiency of any Firetube: 10:1 turndown while maintaining 3% O₂ across the firing range

To achieve the best operating efficiency, boiler engineers strive to maintain the lowest excess air throughout the firing range. Maintaining low excess air translates into higher efficiency. The CBEX Elite is the only firetube to achieve 3% O₂ across the entire 10:1 turndown range*, making it the most efficient firetube boiler ever built. The high operating efficiency paired with the high turndown rate means the boiler cycles less, minimizing the purging of energy caused by boiler cycling.



*At 30 ppm NOx on select models

Sub-5 ppm NOx while maintaining 3% stack oxygen and 5:1 turndown. All without SCR.†

Advanced technology highlighted by a unique flame pattern enables our proprietary burner to attain the highest combustion efficiency at sub-5 ppm NOx of any burner in the industry. Prior to the development of the CBEX, sub-5 ppm NOx without Selective Catalytic Reduction had never been achieved.

†Select Elite models

Quick Steam Up

With the smaller footprint and lower water volume, the system heats up 20% quicker than traditional firetube models.

Smaller Footprint and Weight

By optimizing the heat transfer of both the tubes and furnace, the CBEX requires less heating surface to achieve the same BTU output as traditional firetubes, while maintaining the highest possible efficiencies. As a result, the CBEX on average has a 15% smaller footprint and weighs 20% less than traditional boilers.

Extended Pressure Vessel Life

The temperature is more uniform in an optimized furnace and reduces the turnaround gas temperature. This lowers the stresses on the furnace and second-pass tube attachments, extending the life of the tube sheet and attachments. As a result, Cleaver-Brooks offers an industry-leading, 15-year pressure vessel limited warranty.†

†Select Elite models

> Learn more about the revolutionary technology behind the CBEX at cleaverbrooks.com/cbex

CBEX Dryback Elite Model

The CBEX Elite is the most efficient firetube system ever built. It surpasses traditional firetube boilers in its ability to generate steam quickly, operate efficiently and minimize emissions.



250 – 800 HP

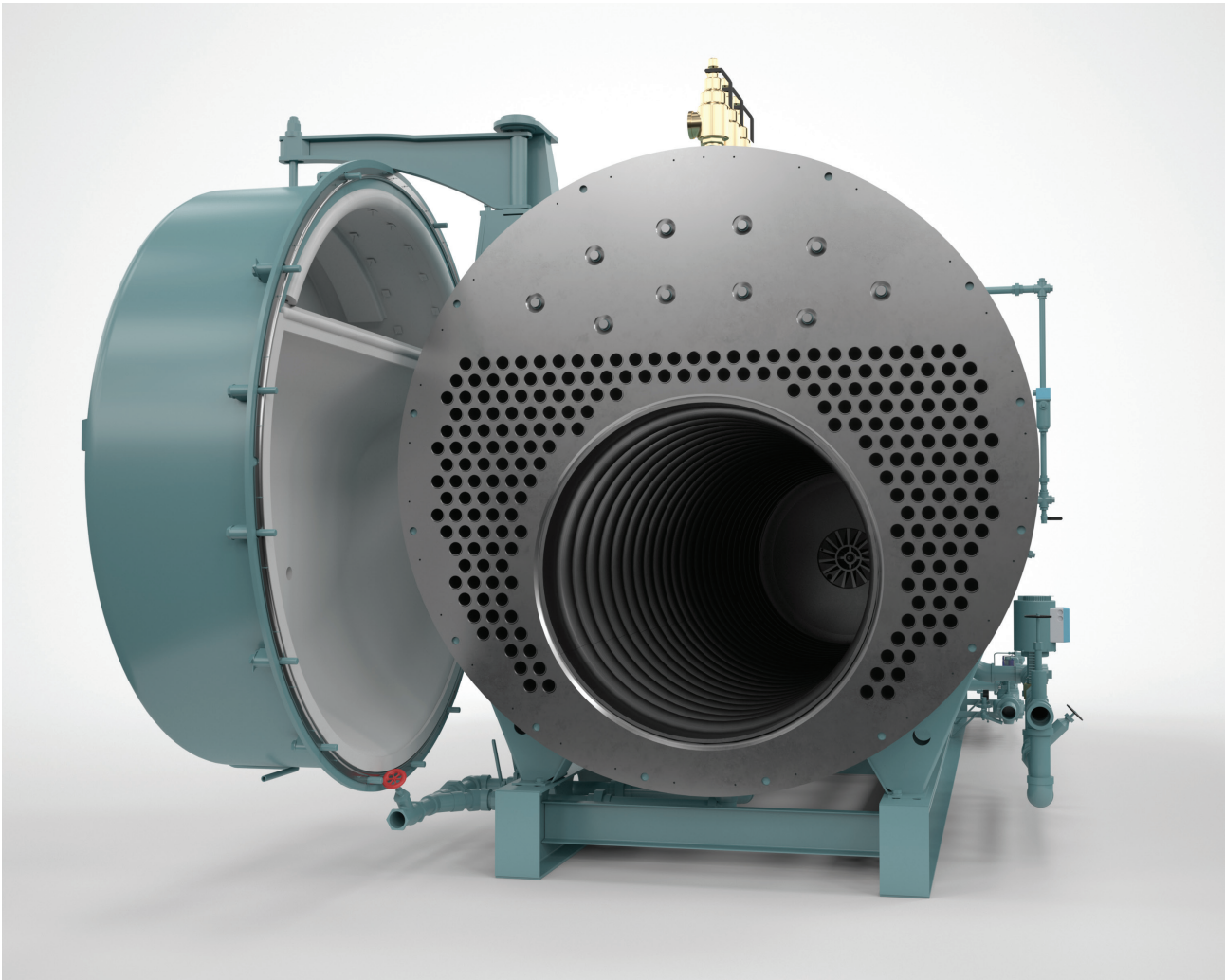
Steam and hot water

Designed to 82% nominal efficiency

Offers 30 ppm NOx with 3% oxygen across the 10:1 turndown range

Meets 10 ppm CO emissions requirements

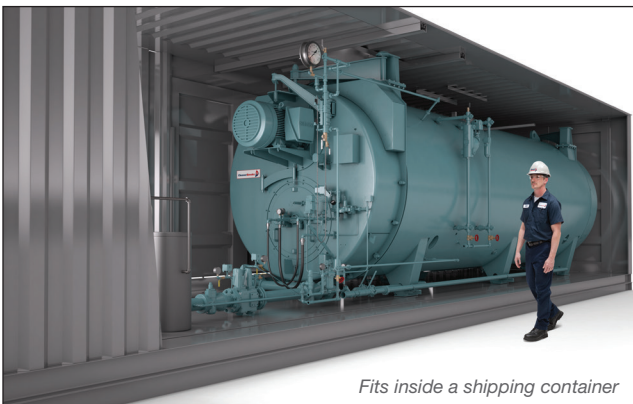
Dryback construction offers unencumbered access to all parts of the boiler for ease of maintenance



Exclusive Cleaver-Brooks integral head burner with air-cooled front head

Oxygen trim with Hawk controls for maximum efficiency

20% smaller (generally) than traditional firetube boilers



Ideal for Steam Back-up or Mobile Field Processes

The CBEX Dryback Elite is specifically designed to fit inside a shipping container. Cleaver-Brooks offers a complete operable boiler room shippable worldwide up to 1000 HP. All components are supplied by Cleaver-Brooks for single-source responsibility.

CBEX Elite Waterback Model

Delivering the best efficiency and emissions control in the world.

The CBEX Elite is our flagship system. Every core component has been designed and built by Cleaver-Brooks to work together, resulting in the most efficient and lowest-emissions firetube system ever built.

100–1,200 HP

Exclusive Cleaver-Brooks integral burner with optional heat recovery system

Integral burner design now available with 50% more capacity

Air-cooled integral front head

Can meet 5 ppm NO_x emissions requirements without SCR* while maintaining 3% stack oxygen and 5:1 turndown

Can meet 10 ppm CO emissions requirements (at 30 ppm NO_x)

*Select Elite models



Best operating efficiency of any firetube ever built

Completely integrated boiler, burner, controls, and heat recovery system

Minimum excess air across the operating range

Ultra-low NOx emissions without Selective Catalytic Reduction (SCR)

15% reduction in footprint versus traditional designs



1,300–2,200 HP

System-matched Cleaver-Brooks packaged burner

Maintains a small footprint in large capacities

Affordable alternative to industrial watertube boilers

Can meet 9 ppm NOx emissions requirements

CBEX Premium Waterback Model

Get EX advantages with a packaged burner.

The CBEX Premium also includes our revolutionary EX technology, along with a completely integrated boiler and burner system. Extraordinarily efficient and capable of meeting low NOx requirements, the CBEX Premium provides a high-value solution with next-generation engineering.

EX technology in a high-value solution

Completely integrated boiler and burner system

High-efficiency, next-generation firetube

Can meet 30 ppm NOx and low emissions requirements

Smaller footprint than traditional firetubes



100–1,200 HP

High-quality, Cleaver-Brooks packaged burner

Available up to 1,200 HP with a traditional, packaged burner

Add available heat recovery and controls for a completely integrated package

The integration is the key in a CBEX system.

Hawk Control

The brain of the EX system, the Hawk Control allows you to run your boiler at the absolute maximum efficiency.

- Completely integrated boiler/burner control for maximum reliability and efficiency
- Automatically tunes boiler to changes in environmental conditions
- Easily pays for itself in fuel savings
- Linkageless control with air and fuel load following capabilities
- Reduced fan horsepower load with VSD control - option
- Control emissions with NOx trim
- Advanced communication options provide easy access to information and building automation system integration
- Unlimited options for system customization and optimization
- NPFA and UL® compliant for maximum safety

Standard on the Elite / Available on the Premium



Economizer

A stack economizer is an option that will reduce fuel use by recovering waste heat from flue gases and using it to preheat boiler feedwater.

- Versatility of fuel choices and fin-to-tube combinations
- Available for steam and hot water boilers
- Stainless steel access doors for easy maintenance
- Built to last, with stainless steel inner casing and carbon steel exterior
- Condensing designs available

Option for both the Elite and the Premium

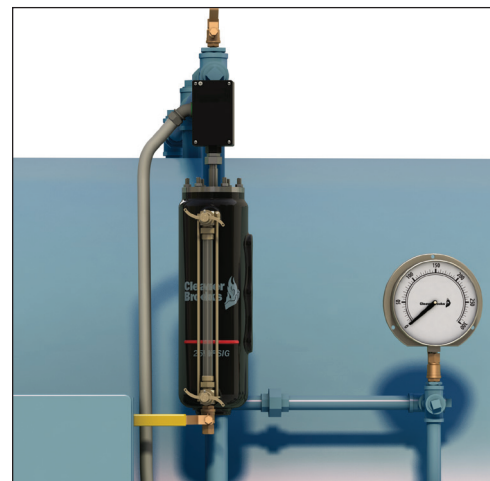


LevelMaster

The LevelMaster low water cutoff and pump control is the safest control available.

- User-friendly interface
- Magnetorestrictive technology eliminates levers and switches
- Multiple safety backups and redundancies constantly monitor float movement
- Secure and dependable blowdown and alarm log are password-protected
- Adaptable for any steam boiler
- Provides feedwater modulation signal and safety cutoff alarms

Standard on the Elite / Available on the Premium



Flexible Solutions

As the demand for more efficient and sustainable steam and hot water systems increases, differing combinations of boilers are required to deliver the best solution. Modular boiler systems that divide system load among boilers of similar size and type allow for more flexibility, because only the boilers you need to meet system demand will be operating at any given time. Not only can we provide you with modular systems, we can combine different types of Cleaver-Brooks boilers in a hybrid system for additional flexibility and ever-increasing efficiency.



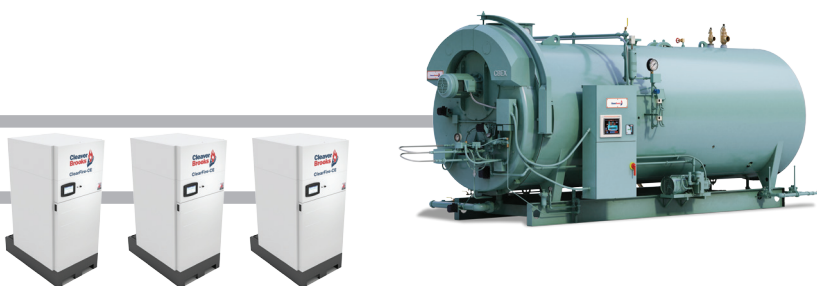
Conventional Solution



Integrated Control System



Modular Solution



Hybrid Solution

Conventional

Traditional, single-boiler solutions.

Modular

Divide the load between different size boilers for more flexibility. Only the boilers you need to meet demand will be operating at any given time.

Hybrid

Combine steam, hot water and condensing boilers in hybrid systems for additional flexibility.



After-Sales Support



Training

Cleaver-Brooks is committed to helping you maximize the safety and performance of your boiler room, and is the only boiler manufacturer with a dedicated Training Department. We offer comprehensive, in-depth training that teaches how to operate and maintain boiler systems at maximum safety and performance, both at the Cleaver-Brooks Boiler House and Product Development facility in Milwaukee, Wis., or custom onsite programs at the customer's facility. We also offer web-based programs and co-sponsored authorized representative regional programs. If you're responsible for the day-to-day operation or maintenance of your company's boiler room, a plant

engineer, maintenance supervisor, operating engineer, facilities manager, plant manager, or boiler room supervisor, we have a boiler room training seminar that can help. Visit cleaverbrooks.com/training to register or view available classes.

Boiler Plant Optimization

Cleaver-Brooks engineers and understands every aspect of a boiler room, from the fuel inlet to the stack outlet, and can help customers develop a clear roadmap for improvements.

We use a multi-phase approach to assess each boiler room operation and identify opportunities for improvements. We then outline the procedures and methodology necessary to reduce a facility's energy costs and emissions while improving boiler system safety and reliability.

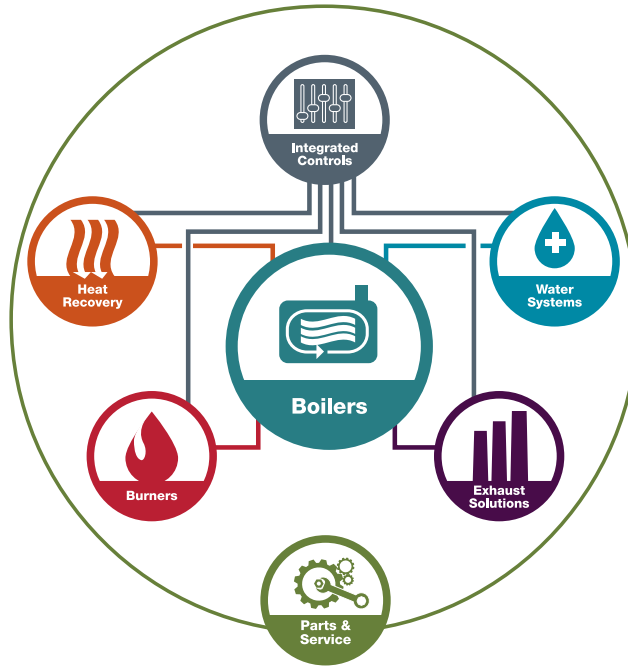


Depending on the size and state of a facility, we can help a company save thousands, even hundreds of thousands of dollars annually while ensuring reliable boiler operation for years to come.

Worldwide Industry-Leading Network



Cleaver-Brooks is proud to work with our Cleaver-Brooks Representative Association (CBRA). We have the first and only dedicated sales and service representative network in the industry. With more than 200 representative offices worldwide staffed by 4,500-plus trained professionals, we can provide comprehensive, ongoing support for our diverse product lines. Cleaver-Brooks and our representative network have 1,500 vehicles ready for dispatch, and maintain a combined parts inventory in excess of \$75,000,000. Together, we are uniquely positioned to offer skilled commissioning, upgrade solutions and maintenance options to extend the life cycle of Cleaver-Brooks OEM products.



Providing energy-efficient, environmentally friendly boiler room solutions

Cleaver-Brooks is one of only a few boiler room solution providers in the world to operate a dedicated research and development facility. Having pioneered several industry-leading technologies, we remain just as committed today to introducing technology and products that enable a more energy-efficient and environmentally friendly generation of steam and hot water.

We distribute our products through the Cleaver-Brooks Representatives Association, or CBRA, an alliance of independently owned and operated companies that provide boiler room products and service. CBRA companies can be counted on to provide Cleaver-Brooks products and parts, engineering support, customer training, technical service and system maintenance. To find a CBRA representative near you, please visit cleaverbrooks.com/rep.



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