The CBEX boiler is a new standard in Steam Generation. EX Technology has made the New Firetube Line a reality.

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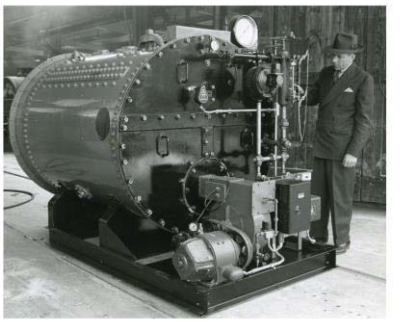
Background

- **Cleaver-Brooks has set the standard for Firetube boiler design for over 75 years**
- **Today we have upped it again by aligning the most cutting-edge technology in the industry with the latest in advanced controls**



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CleaverBrooks

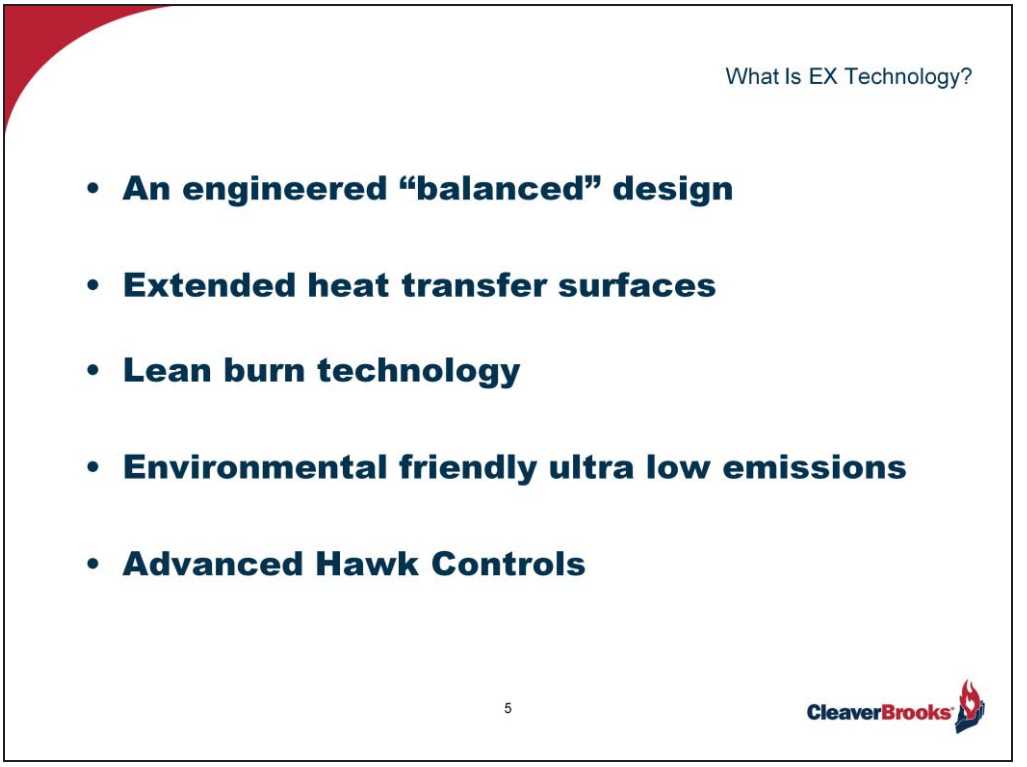
Cleaver Brooks introduced the Package Boiler concept over 75 years ago. Cleaver Brooks has set the standard for packaged designs during this time.

Now Cleaver Brooks is raising the bar by aligning the most cutting-edge technology with latest in advanced controls.

- **Introducing EX Technology – the first major breakthrough in the industry since WWII**

CleaverBrooks

EX Technology is the first major break through in the boiler industry since WWII. Boiler design in recent times has mainly consisted of re arranging tube patterns and styles within the existing shells. This series of boilers was designed from the ground up, using a blank sheet of paper and evaluating the various boiler and burner parameters to achieve an optimized design.



What is EX Technology. EX Technology is the combination of 5 key components. These components are as follow;

An engineered “balanced” design

Extended heat transfer surfaces

Lean burn technology

Environmental friendly ultra low emissions

Advance Hawk Controls

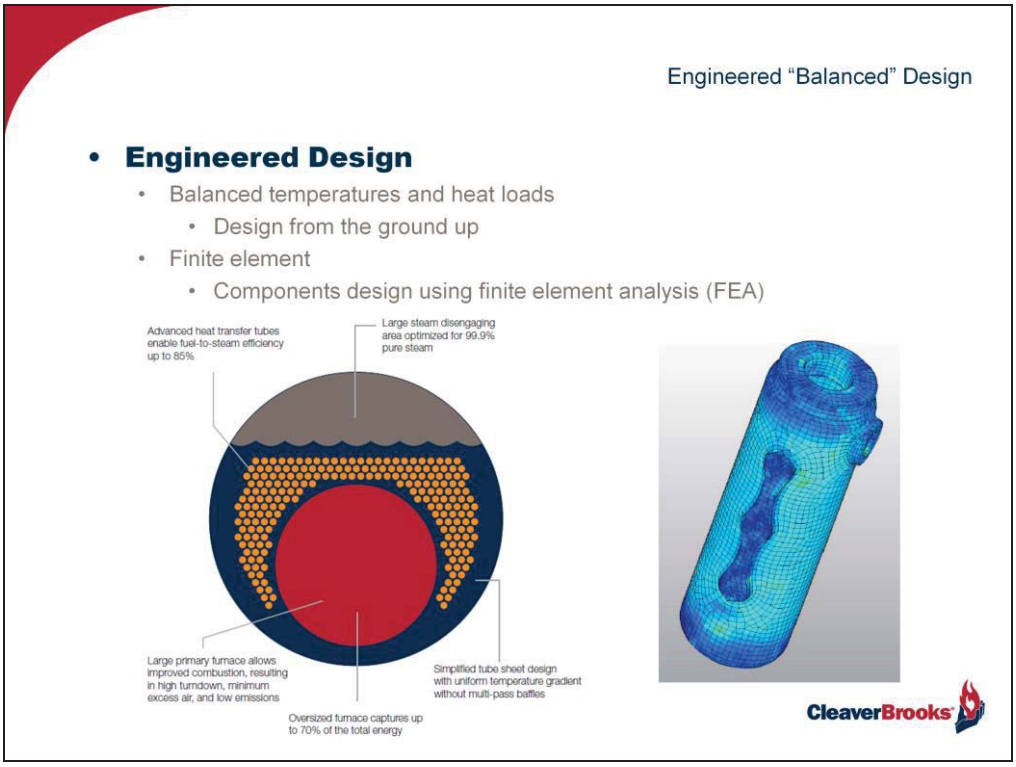
An engineered “balanced” design

Extended heat transfer surfaces

Lean burn technology

Environmental friendly ultra low emissions

Advance Hawk Controls



The 1st key component is the engineered “balanced” design.

The design incorporates balanced temperature and heat loads.

Boiler furnace and heat transfer area were designed from the ground up.

Large primary furnace allows for improved combustion which results in high turndown, minimum excess air and low emissions.

Oversized furnace captures up to 70% of the total energy

Simplified tube sheet design with uniform temperature gradient without the need for multi-pass baffles.

Advance heat transfer tubes enable high fuel-to-steam efficiency

Disengaging area optimized for 99.9% pure steam

Boiler furnace and heat transfer area were designed from the ground up.

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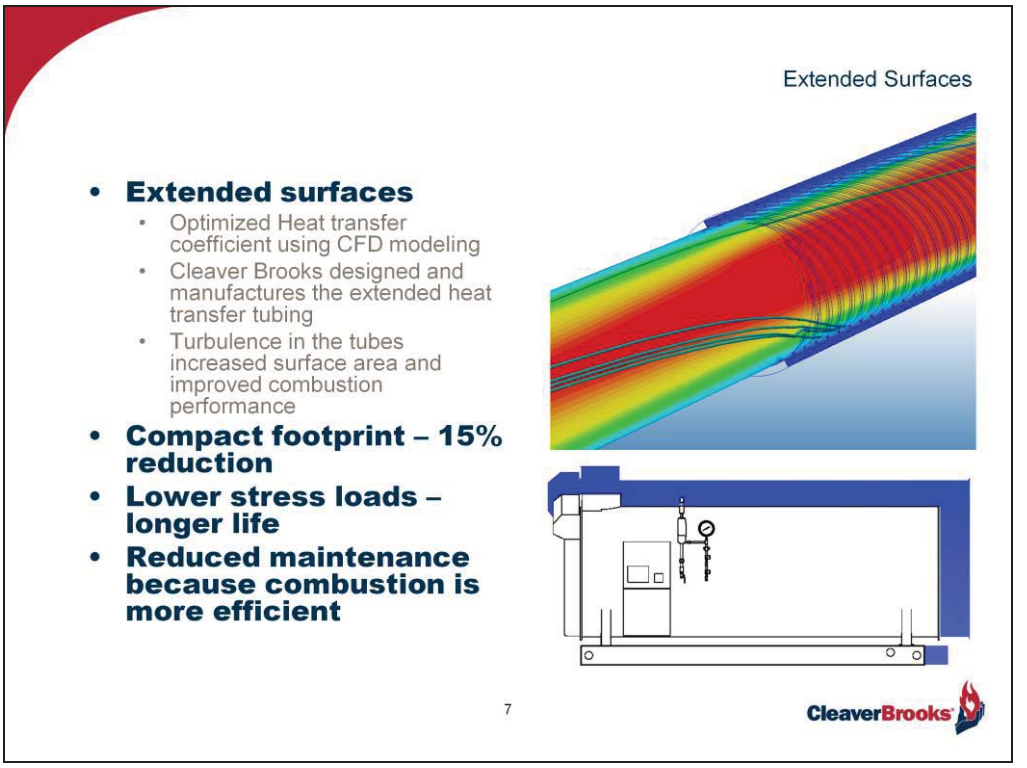


The 2nd key component of this design is the use of "Extended Surfaces"

Extended Surfaces – The following are important factors in the design process

Heat transfer coefficient is optimized by use of CFD Modeling

Cleaver Brooks designed and manufactures the extended heat transfer tubing

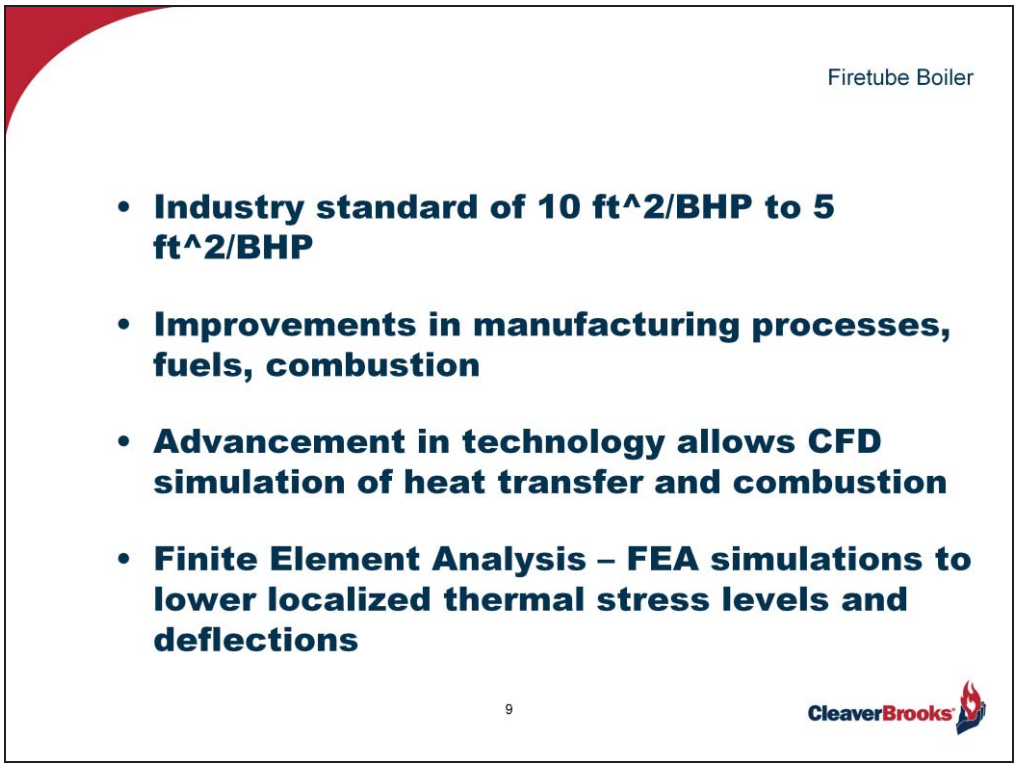
The extended surface which increases the surface area also creates turbulence in the tubes both of which increase heat transfer.

Typically this allows for a more compact footprint up to a 15% reduction

This design results in lower stress in the pressure vessel improving life

Reduce maintenance is realized as a result of improved combustion

Advanced Design Software Catapults Firetube Boiler Functionality

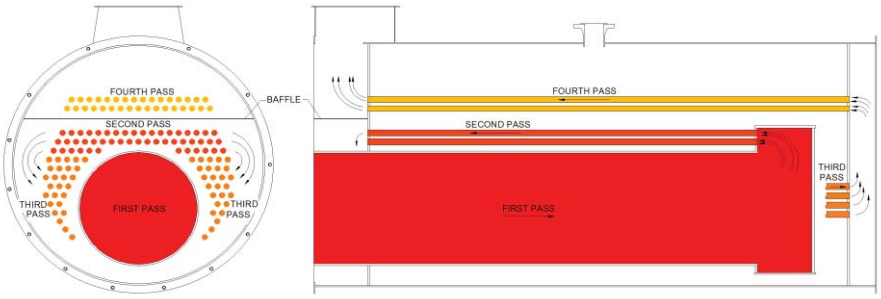


Firetube boiler design has evolved from 10 to 5 sqft/BHP standard

Improvements in manufacturing, cleaner fuels and better combustion has enabled us change design stds

Advancements in computer technology has allowed a design engineer to use Computational Fluid Dynamics and Finite Element Analysis to optimize designs for heat transfer, combustion, thermal stresses & deflections.

- **Furnace or combustion chamber**
- **Tubes passes**



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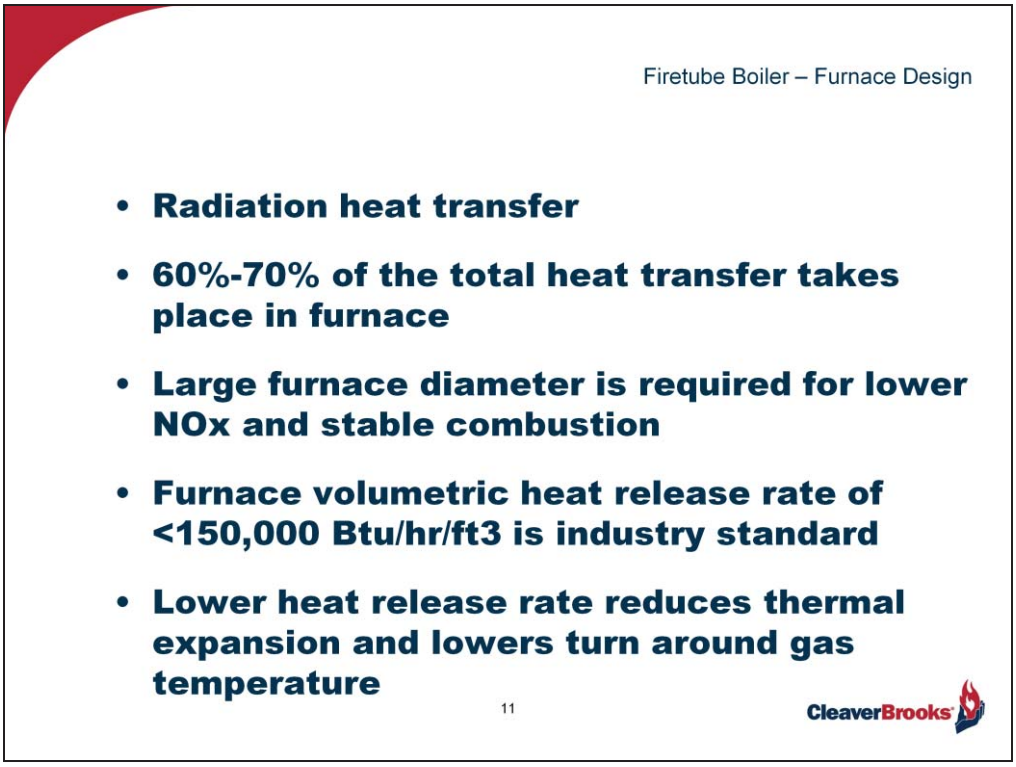
There are two critical areas for Firetube boiler

Furnace or combustion chamber &

Tubes – These tubes can be arranged in 2, 3 or 4 pass configurations

Layout shown here is for 4-pass configuration



Furnace is where majority of heat transfer takes place

It is radiation heat transfer

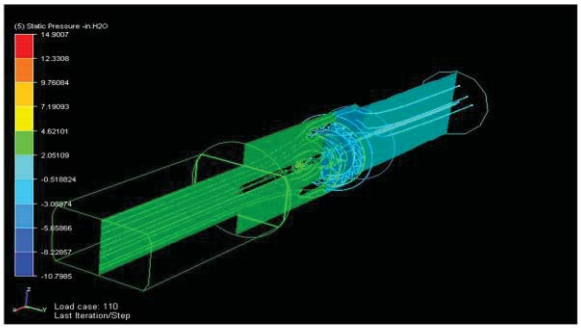
Heat transfer in the furnace is 60-70% of the total boiler heat transfer

Larger furnace diameters helps achieve lower Nox with stable combustion

Industry standard of <150,000 btu/hr/cuft for volumetric heat release rate

Lower heat release rates keeps flue gas temperature lower and reduces thermal expansion. This helps with longevity of pressure vessel.

- **CFD simulation to optimize fuel-air mixing**
- **Improved combustion, low excess air, reduced emissions, high turn down range**



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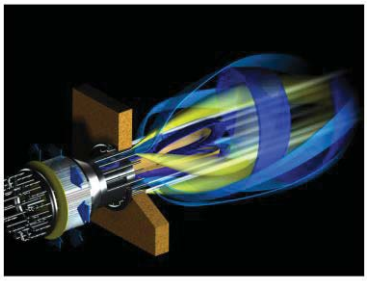
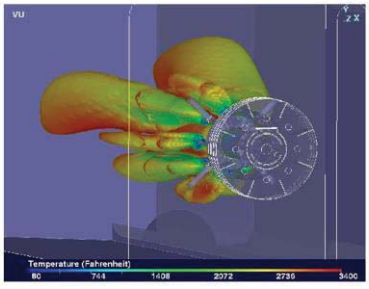
This plot is from CFD simulation for fuel and air. CFD helps to achieve optimum mixing and that translates to better combustion, low excess air, lower emissions and greater turn down range for the burner.

Firetube Boiler – Furnace Design

- **Optimize burner flame pattern and temperatures using CFD**
- **Theoretical calculation reduces burner development time and enables to achieve single digit NOx levels**





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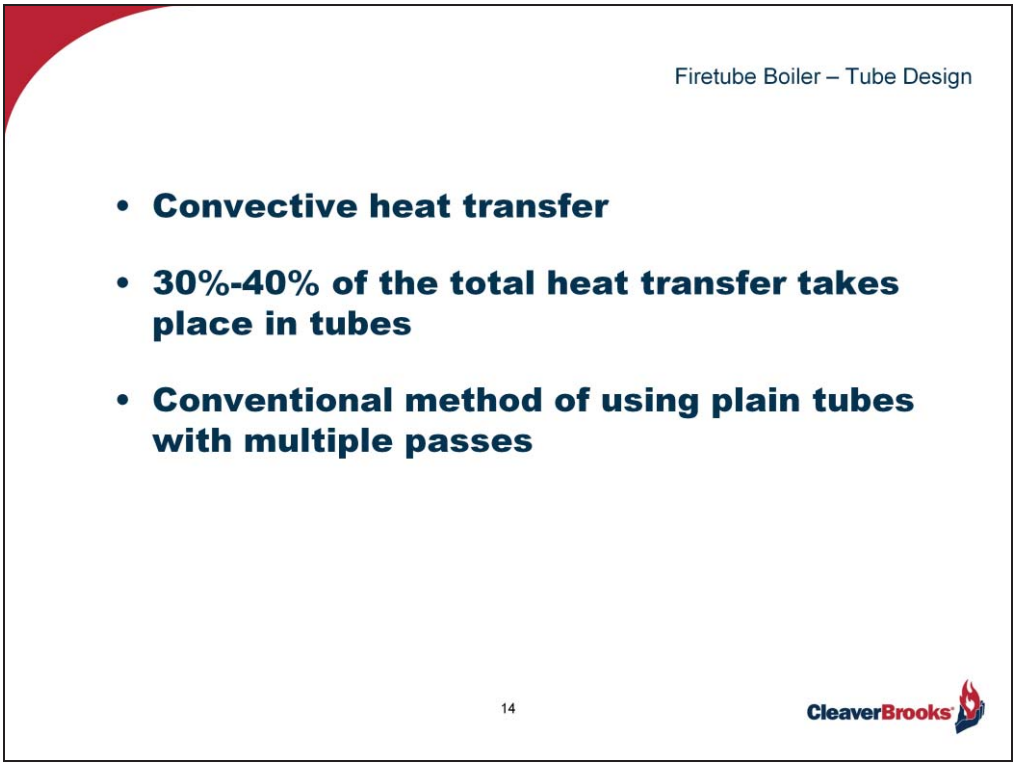
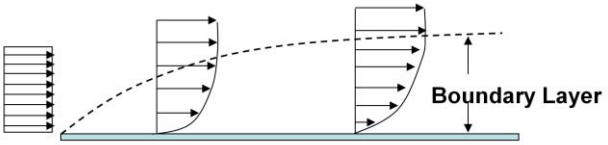
CFD plot here shows shaping of flame to optimize flame temperatures.

These simulations enables engineers reduce burner development or testing time and achieve single digit Nox levels.



So, last few slides we reviewed furnace design and combustion. Now flue gases enter tubes for convective heat transfer. 30-40% of total heat transfer takes place in tubes. Typical Firetube boiler has plain tubes with multiple passes.

- **Heat transfer mechanism with plain tubes involves boundary layer**
- **Flue gas boundary layer builds up with distance and increases resistance to heat transfer**
- **This phenomenon reduces convective heat transfer coefficient**
- **Boilers with more tubes and 3 or 4 pass designs are developed to improve heat transfer**



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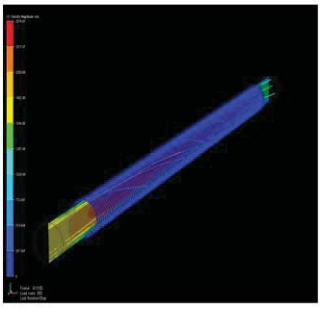
Design engineers face boundary layer phenomenon when dealing with heat transfer through plain tubes. This boundary layer builds up with distance and increases resistance to heat transfer and decreases convective heat transfer coefficient. Flue gases flowing through center of the tube have highest resistance to heat transfer. Boiler designs with 3 or 4 pass are developed to improve heat transfer.

Firetube Boiler – Tube Design

- **Spiral tube designs to improve heat transfer**
- **Break down boundary layer to increase convective heat transfer coefficient**
- **CFD simulations to optimize for flow rate, Reynolds number**
- **Turbulent flow**
- **Heat transfer increase of up to 85% compared to plain tube**



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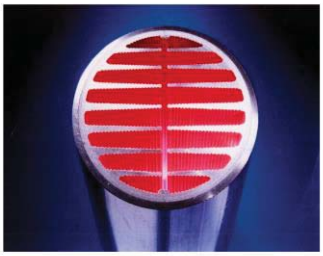
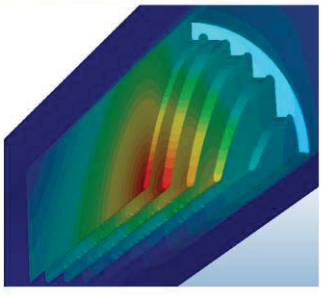
With current technologies design engineers can use spiral tubes to improve heat transfer. Flow through the tube is such that it breaks down the boundary layer and increases convective heat transfer coefficient. Computational Fluid dynamics can be used to optimize flow rate per tube and for Reynolds number. Overall heat transfer increase of upto 85% can achieved compared to plain tubes.

Firetube Boiler – Tube Design

- **Development of tube with extended heating surface**
- **Aluminum extrusion inside steel tube**
- **CFD simulations to optimize extrusion profile**
- **Gas flow through channels**
- **Aluminum is better heat conductor compared to steel(5 times)**
- **Overall convective heat transfer increases by a factor of 4 compared to plain tube**





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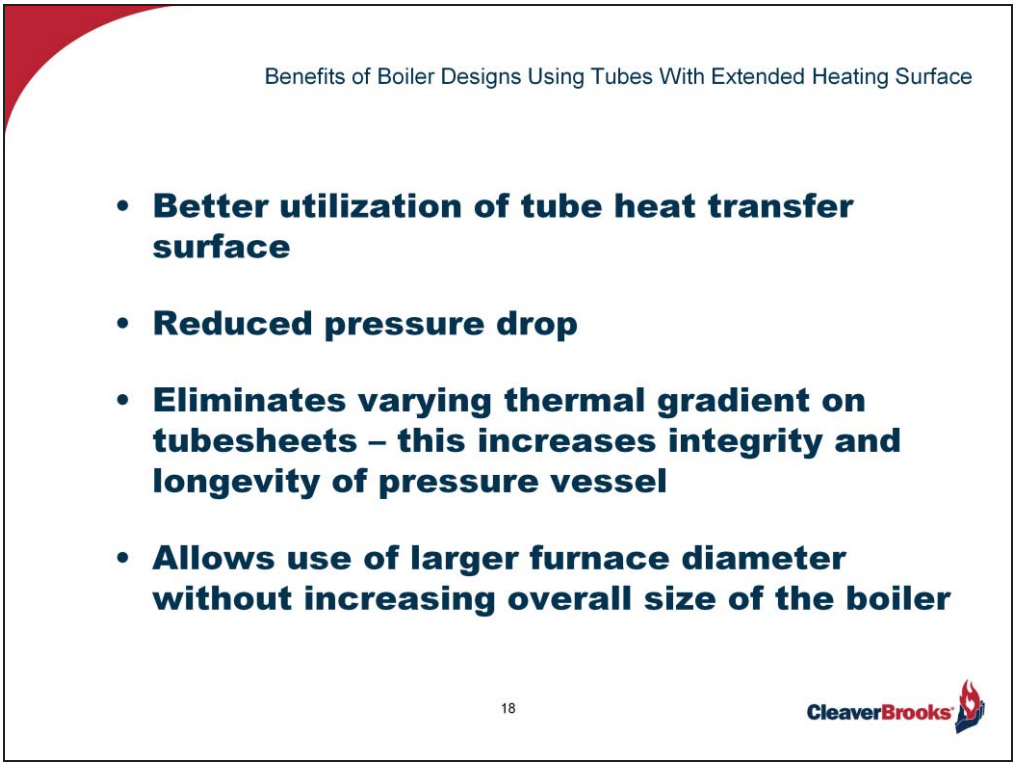
Another tube design Cleaver Brooks has developed with extended heating surface. Aluminum extrusion is used inside a tube. CFD simulations are performed to optimize aluminum extrusion profile and flue gas flow through the channels. Aluminum thermal conductivity is about 5 times of steel. With proper optimization, overall convective heat transfer increase by a factor of 4 can be achieved.



Ok, now let's review the benefits of having boiler designs using tubes with extended heating surface.

We achieve better utilization of tube heat transfer surfaces as we breakdown boundary layers.

Overall flue gas pressure drop is reduced compared to a 4-pass boiler.

Eliminates varying thermal gradients on tubesheets and this increases pressure vessel integrity and longevity.

Allows design engineers to use larger furnace diameter without increasing overall size of the pressure vessel.

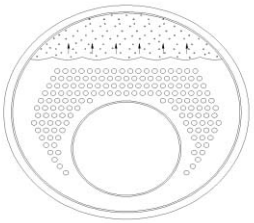
- **Finite Element Analysis (FEA) to review thermal gradient and stresses at the joint**
- **FEA results allows an engineer to predict fatigue life of the joint**
- **Changes can be made to reduce thermal stress level**

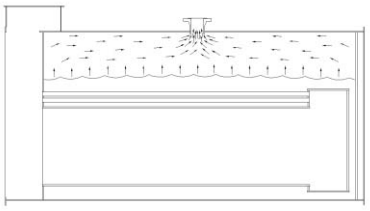
CleaverBrooks

What else design engineers can do with current technologies?

Finite Element Analysis software can be used to review thermal gradients and thermal stresses at critical locations. These plots here show FEA simulations for tube to tubesheet attachment. FEA results can be used to predict fatigue life of the joint. FEA results lets engineers make changes to reduce thermal stresses and improve fatigue life.

- **Optimize steam chest to achieve better steam quality and being able to handle rapid and large load swings**
- **Mathematical models can be developed to size the steam chest using vertical and horizontal steam velocity calculations**





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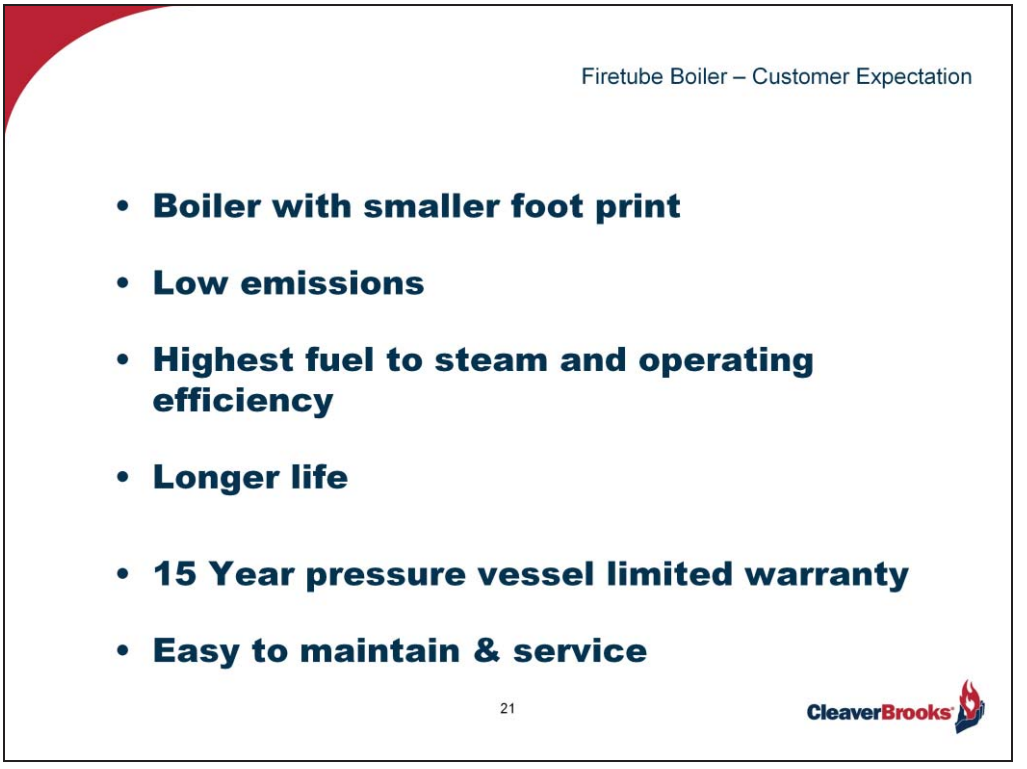
Engineers can develop mathematical models to optimize steam chest. This helps achieve better steam quality and allows boiler to handle rapid and large load swings.

Typically these mathematical models calculates vertical and horizontal steam velocities.



So, with all this, what is customer getting:

Boiler with smaller footprint, smaller boiler room.

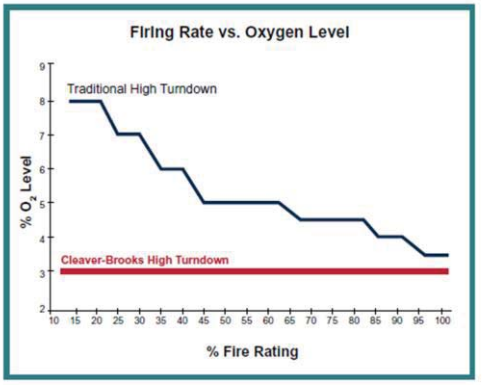
Lower emissions

Achieve high fuel to steam and operating efficiency

Longer boiler life

Easy to maintain and service the boiler

- **Lean burn technology the force for near Stoichiometric Combustion**
  - Fuel and air ratio/mixture controlled over the entire operating range
  - Modulating / load following capability over 10:1 Broadest modulation range in the industry
  - Best in industry in use fuel efficiency
  - Guaranteed improved fuel efficiency
  - Faster load response



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The 3nd key component of this design is “Lean burn technology”

Lean burn technology is the force fpr near Stoichiometric Combustion

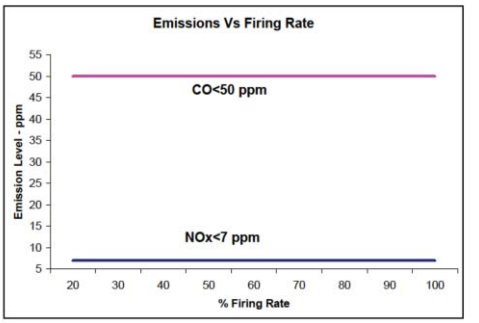
The ratio of the fuel / air mixture is controlled over the entire operating range.

High burner turndown with constant Oxygen level over the entire turndown of the burner. 10:1 which is the broadest range in the industry. Traditional high turndown burners require that Oxygen level ramps up as firing rate is reduced.

Constant Oxygen level results in the best overall efficiency in the industry

Fast load response with full burner modulation

- **Ultra low emissions**
  - NOx levels to 5 ppm on natural gas
  - Low CO < 50 ppm
  - Low VOC



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The 4nd key component/feature is a boiler burner combination that is "Environmental Friendly"

Ultra low emissions is achieve with this design. The burner and boiler combustion camber are matched/designed to reduce emissions.

Nox levels as low as 5 ppm on natual gas while maintaining CO less than 50 ppm and reducing VOC.

- **Advanced Hawk Controls -- The driver behind the technology**
  - Linkage less control
  - Air and fuel load following capabilities
  - Automatic tuning to changes in environmental conditions
  - Reduced fan hp with VSD control
  - NOx trim

CleaverBrooks

The 5th and final key component is a control system that allows all of this technology to be utlizied to its fullest.

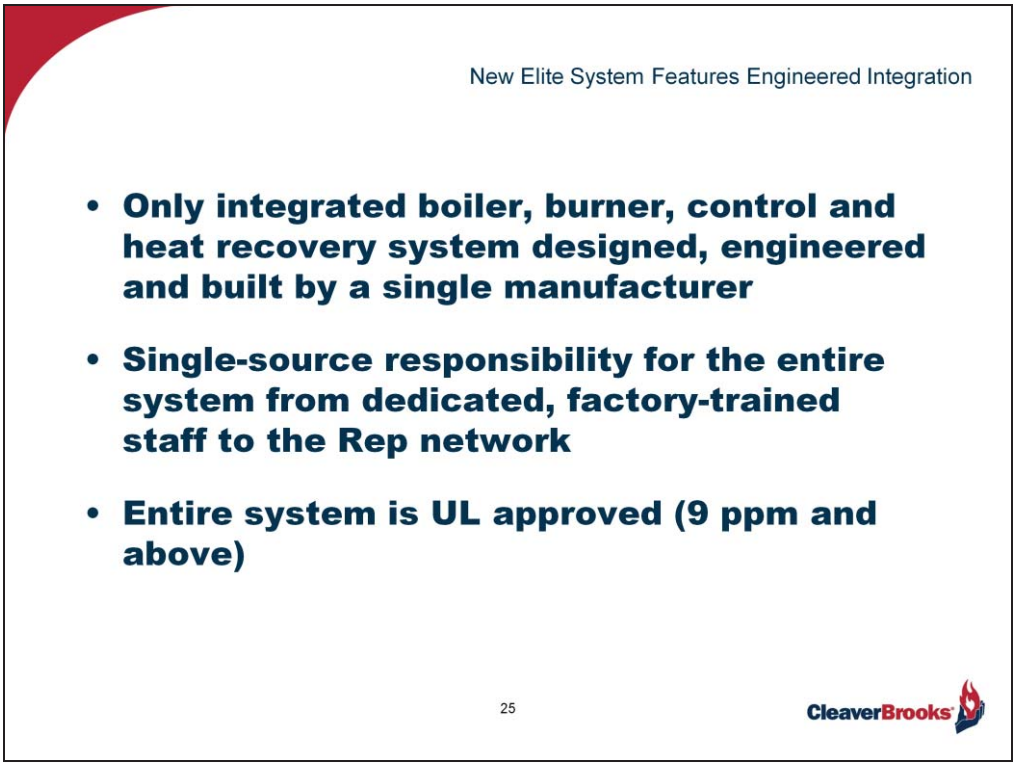
Linkage less control to allow consistent air to fuel control.

Matching of air and fuel to follow load requirements.

Automatic tuning through oxygen trim to follow changes in environmenta conditions

Reduced fan hp with the use use of VSD control

NOx trim to meet Ultra Low NOx when required.



The EX Elite is an integrated engineered system.

The only fully integrated boiler, burner and control package design engineered and built by a single manufacturer. Fully integrated packages with heat recovery systems are also available.

Cleaver Brooks offers single-source responsibility for the entire system starting with a factory-trained staff at the Rep level.

to a Rep network 5th and final key component is a control system that allows all of this technology to be utilized to its fullest.

Boiler / Burner / Control packages are UL approve for NOx applications at 9 ppm and above.

- **Equipment manufactured in state-of-the-art facilities**
- **Manufactured under demanding quality control requirements using ISO standards**

CleaverBrooks

Equipment is manufactured in state of the art facilities. We welcome customers to visit our facilities, witness their equipment during the manufacturing process and see it checked out a final assembly.

Equipment is manufactured under demanding quality control requirement and ISO standards.

- New EX Technology strengthens Cleaver-Brooks position as the leader in package boiler, burner and control design. It allows our customers to have the best and only package system available from a single source manufacturer
- This completely engineered boiler-burner-control package was designed from the ground up, this is an industry first
- Watch for further developments by Cleaver-Brooks

CleaverBrooks

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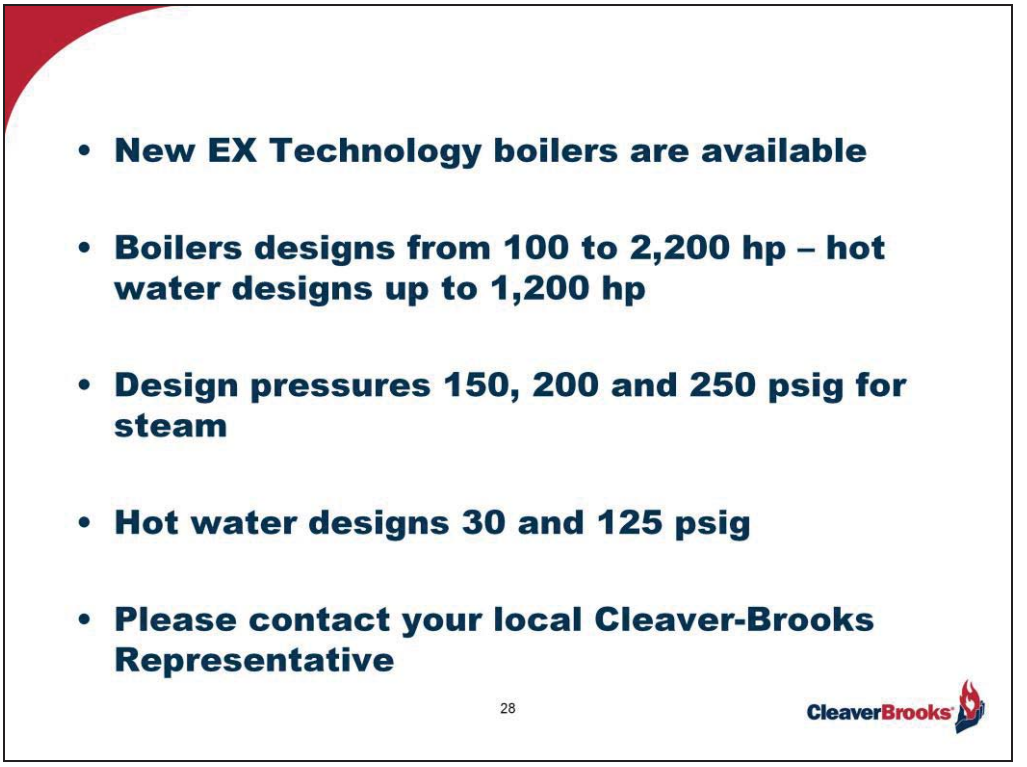


New EX Technology boilers are available.

Boilers designs from 100 to 2200 hp – hot water designs up to 1200 hp

Design pressures 150, 200 and 250 psig for steam

Hot water designs 30 and 125 psig

Please contact your local Cleaver Brooks Representative

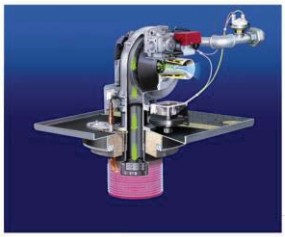
ClearFire-H (Model CFH)

Model CFH

CleaverBrooks

Model CFH

- Type: Horizontal Alufer-tube Single Pass, Commercial Boiler.
- 8 Sizes: 10 through 60 horsepower.
- Design: 15 PSIG Steam, 150 PSIG Steam.
- Fuel: Natural Gas or LPG [No oil firing].
- Codes: ASME Section I or IV, UL, ASME CSD-1.



Plus

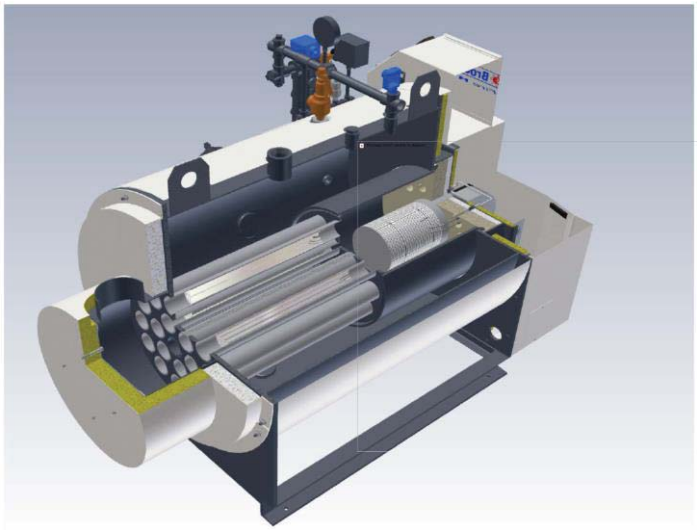
Equals

Condensing

Steam

CleaverBrooks

Model CFH Heat Transfer



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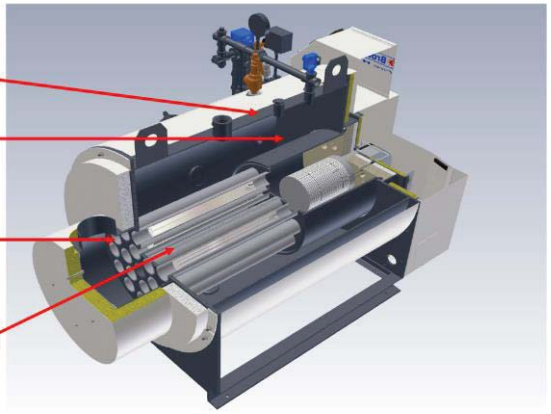
Model CFH Heat Transfer non-condensing

Carbon Steel Shell

Carbon Steel Burner Housing

Carbon Steel Tubes and Tubesheets

Alufer Inserts



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Model CFH - Heat Transfer

CFC TUBE

CFH TUBE

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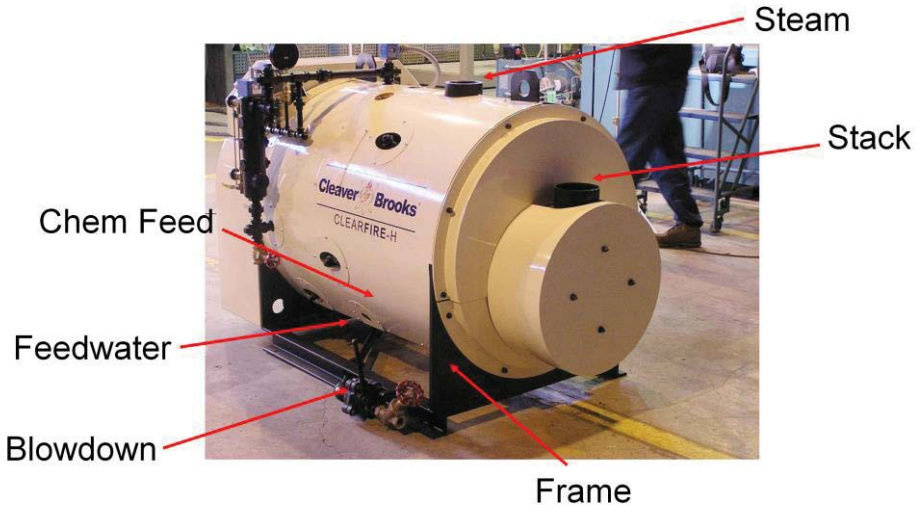
Model CFH - Connections



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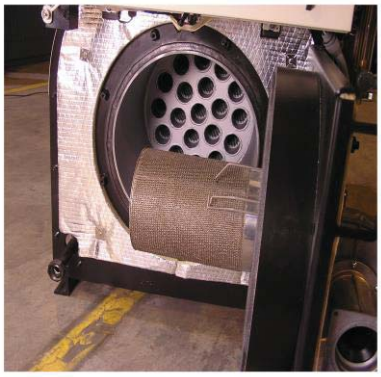
Model CFH - Burner



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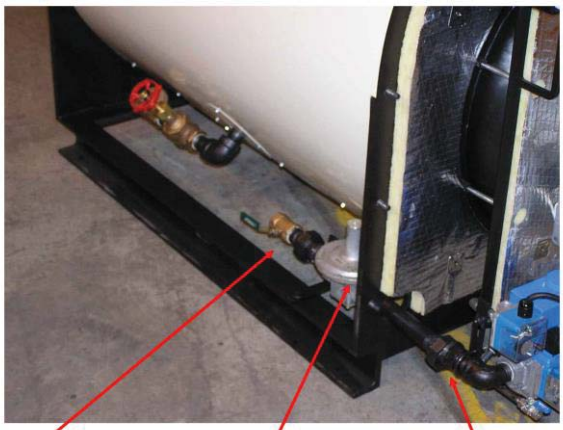
Model CFH - Gas Train



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Model CFH - Gas Train

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Model CFH - Options

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Model CFH - Summary

- Hinged Forced Draft Premix Burner with Metal Fiber Head. Low NOx < 20 ppm
- Linkageless Full Modulation
- 5:1 Turndown.
- Variable Speed Fan
- Low Noise < 70 dBA
- Outstanding Efficiency
  - 85% LP (W/O economizer)
  - 82% HP (W/O economizer)
  - 85% HP (With economizer)
- UL/ULc Listed Boiler
- 10 - 60 Horsepower

CleaverBrooks

CF "V"
- 10 to 60 HP
- High Pressure Steam

CF "W"
- 400 MBH to 2,400 MBH
- Hot Water

CF "H"
- 10 to 60 HP
- Low Pressure Steam
- High Pressure Steam

CF "C"
- 500 MBH to 2,500 MBH
- Hot Water – Full Condensing

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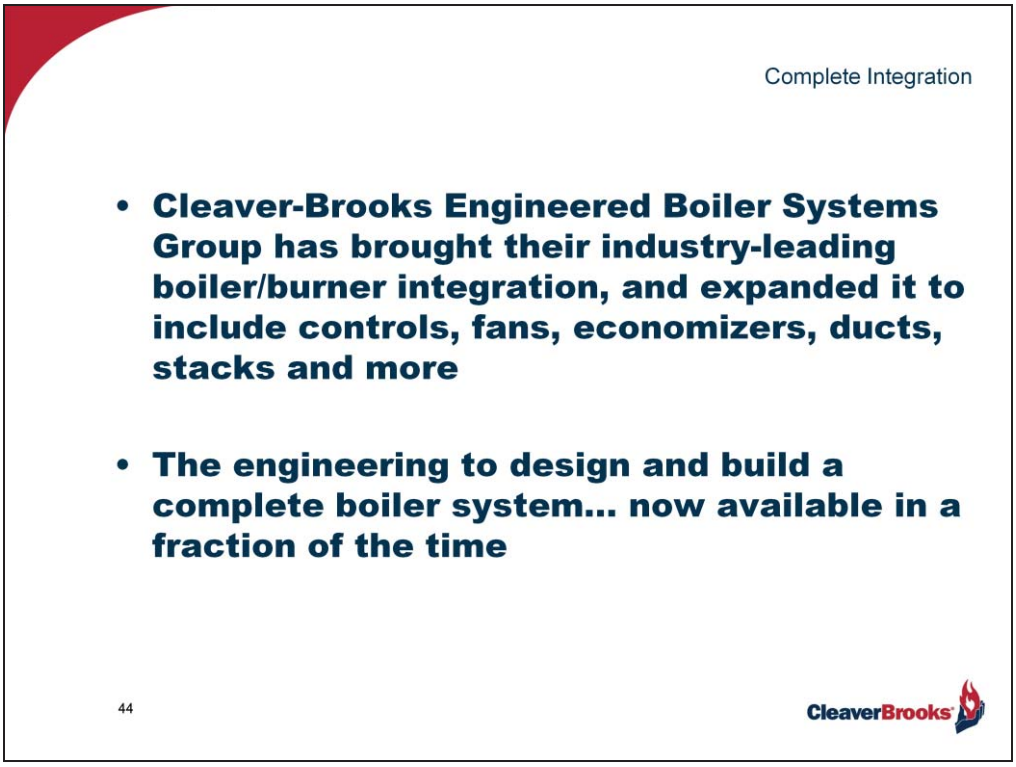
Available via Cleaver-Brooks Sales Reps.

CleaverBrooks

NEBRASKA D INDUSTRIAL WATERTUBE BOILERS



Read slide

Or

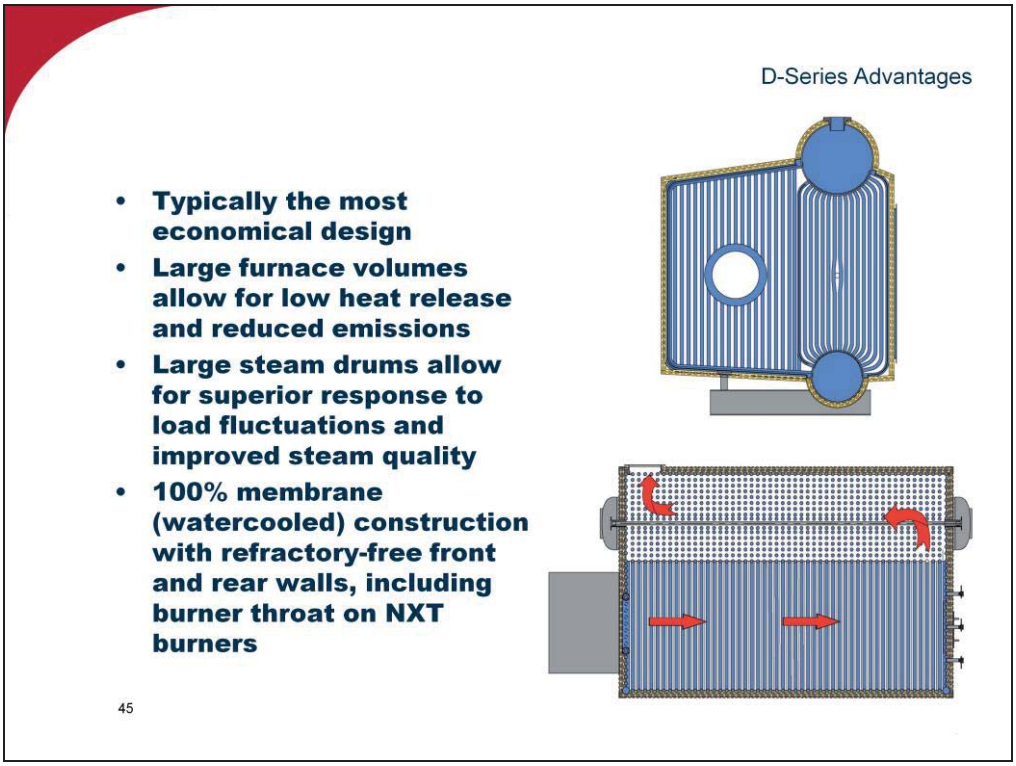
Just a brief history on the evolution of this product line:

In 1998 Cleaver Brooks goal of having a solution to every steam need led them to purchase Nebraska Boiler to expand the watertube product line.
When the increased demand for low emission burners became apparent CB's overall philosophy of single source integration led them to purchase National Combustion Burners in 2001.

At this time the Engineered Boiler Systems group was formed with the overall goal of making the most efficient most reliable boiler/burner system in the industry.

With the Nebraska D Series we have extended this integration into additional critical items like the controls, the economizers, and other auxiliary equipment like ductwork, stack, and more.

Most importantly we've invested the time to engineer these packages allowing us to offer a complete boiler system in a fraction of the time.



When this project started over 5 years ago a lot of time was invested in selecting a boiler/burner combination that would be the best fit for the majority of the industries applications.

We looked closely at driving factors such as reliability, system efficiency, ever changing emission requirements and of course economics

The benefits of a D type boiler made it the best fit for our initial efforts

For those of you that aren't familiar with a D type boiler you can see a couple of cross sections on the right side of the page. Looking at the front view you can see it's a two drum design with the water and steam drum sitting off to the side of the furnace. This has inherent advantages that we'll discuss shortly here. In the bottom picture you can see the flow of the gas path. The straight arrows show how the flame will project into an open furnace area, wrapping back around along a convection section, filled with evaporator tube (in a sort of 2 pass system), finally exiting out the side of the boiler.

With the furnace off to the side of the drums, this gives us flexibility when designing the geometry of the furnace section. You can see the furnace is not squeezed in between the drums as you would see on an A or O type boiler. You also have flexibility on the width only limited by shipping restraints.

This allows for low heat releases, in turn extending the life of the boiler and helping to ensure complete combustion.

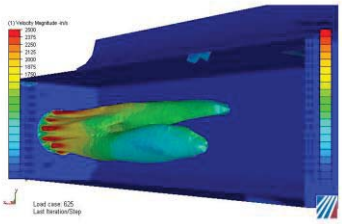
Not only do we gain from the furnace flexibility, but having the furnace off to the side also gives us flexibility on the size of the steam drum. Once again, because you are not in line with the steam and mud drums, you are not sacrificing furnace size to give you a larger steam drum.

Larger steam drums allow for superior response to load (with less trips and higher steam quality)

This D type design also leads itself to a gas tight watercooled membrane design throughout the furnace section.

Features of all CB-Engineered Systems Boilers

- **Integrated boiler / burner package – unique to the industry**
- **Single-source responsibility**
- **CFD design**
- **100% membrane (watercooled) construction**
- **Refractory-free front and rear walls**
- **Refractory-free burner throat for NXT burners**
- **CBRA – local service, local startup, spare parts**
- **State of the art manufacturing facility with ISO9001 quality control**



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Once we chose the D type boiler as our basis of design, we took this opportunity to look into our standard models and found areas for improvement.

With the same driving factors in mind of reliability and efficiency we started to optimize the flame to furnace geometry with CFD modeling. This proves a cooler, more homogenous flame ensuring lower emissions, no flame impingement and complete combustion. At the same time we looked at the water side to evaluate heat fluxes and circulation patterns.

We looked at the major issues in a boiler room. The most prevalent was refractory problems, either with refractory gas seals, or just general maintenance refractory repair work.

This drove us first to watercooled front and rear walls, then we took it to the next level with our header membrane wall design that eliminates the refractory corner seals.

With the burner as an integral part of Cleaver Brooks, now we could look at revolutionary designs like our refractory free burner throat to eliminate the diverging refractory tile throats that we were used to seeing.

We can safely say our boiler/burner combo’s have the least amount of refractory in the industry.

This along with our state of the art manufacturing facilities, and the Cleaver Brooks Rep Association solidified our position as the industry leader.

Operating Conditions Available

- **Boiler Capacities**
  - 10,000 to 225,000 lb/hr
- **Design Pressures**
  - 375 psig Maximum
- **Operating Pressures**
  - Up to 325 psig
  - Minimum 100 psig
- **Steam Temperature**
  - Saturated
- **Fuels**
  - Natural Gas and #2 Fuel Oil
- **Emissions**
  - NG – 30 ppm NOx or uncontrolled (consult factory for < 30 ppm NOx)
  - #2 Fuel Oil – 75-120 ppm NOx (based on burner & capacity) or uncontrolled

CleaverBrooks

To achieve this level of engineered integration we had to limit the number of available applications, however with the number of boiler models, the available pressures, the varying fuel options and other items, we feel we will have an excellent offering for nearly every saturated boiler need.

Truly Integrated System

- **Boiler**
- **FW Trim**
- **Steam Trim – with NRV & Stop**
- **Economizer**
- **Economizer Trim**
- **Stack**
- **Support Steel**
- **Ducting**
  - Boiler exit, Econ exit, Fan & FGR (if applicable)
- **Burner with Fuel Train(s)**
- **Fan – Silencer, Inlet Dampers**
- **Hawk BMS**
- **Hawk CCS**
- **Field Instrumentation**

CleaverBrooks

CB's immense product lines have allowed us to offer an *unparalleled* level of integration from feedwater in to steam out and fuel in to flue gas outlet.

Options Available

- **Controls**
  - Jackshaft, parallel, metering
- **Typical HAWK Options**
- **VFD for FD Fan**
- **O2 Trim**
- **Oil Firing**
- **Air Atomization**
- **Sootblowers**
- **Platforms & Ladders**
- **Varying Stack Heights**
- **1, 2 & 3 Element FW**
- **Lower Drum Heating Coil**
- **Hinged Manways**
- **Thicker Tubes**

CleaverBrooks

All of the benefits of an off-the-shelf boiler, while still having the flexibility to customize the application to fit your needs.

XL-Series Burner

- **CBND: 100-D and 200-D 30,000 - 50,000 pph**
- **Package burner design**
- **NFPA-85**
- **GAS – OIL no.2**
- **Hawk 5000 controls**
- **Steam oil atomizing**
- **Burner mounted oil control valve with regulator**
- **Hinged door and side access covers**
- **Bolt-on head with gas manifold standard**
- **Backward curved impeller**
- **Air inlet silencer**

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CleaverBrooks

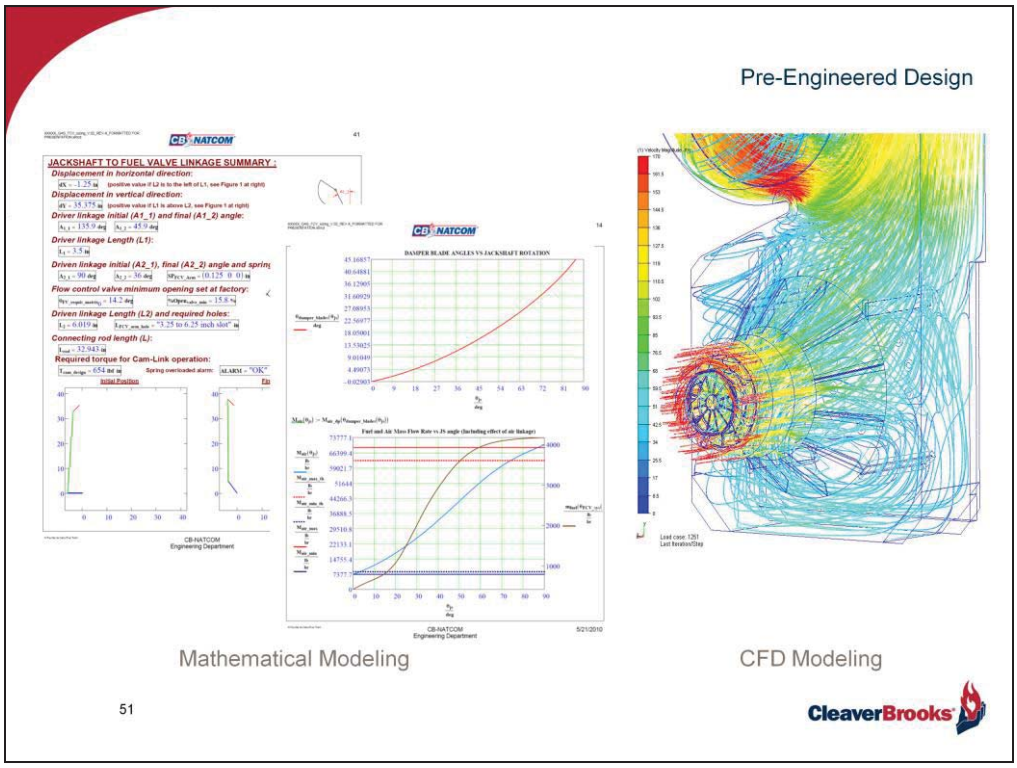
Item 1: Cleaver-Brooks Package Burner division will be providing the “XL” Series burner for the CBNB 100 D and 200 D series boilers firing between 30,000 and 50,000 lbs per hour.

Item 2: This is a package burner “Windbox” design. Built to NFPA standards and will incorporate the CB Hawk 5000 system.

Item 3: Standard fuels are Natural Gas, #2 Oil or combination Natural Gas / #2 Oil. Oil firing will incorporate a steam atomization train and burner mounted oil control valve with regulator.

Item 4: A 3600 rpm motor, backward curved impeller and a multiple blade airfoil type air damper are incorporated to give precise control of combustion air. This allows close metering of the air/fuel mixture. Thereby increasing efficiency over standard “blade” style systems. An air silencer is standard to help lower DBA levels.

Item 5: Other features include a bolt on gas manifold, hinged door and access covers for ease of maintenance. Internal inspections can be made quickly and easily. Should the gas manifold ever need changed, welding is not required.



The NXT has been thoroughly engineered and tested through the use of advance mathematical and flow modeling software to ensure state-of-the-art burner performance.

Liberty Packaging Case Study

Click Here for Liberty Packaging Case Study Link

CleaverBrooks

Fulton Boiler Works

Est. 1949

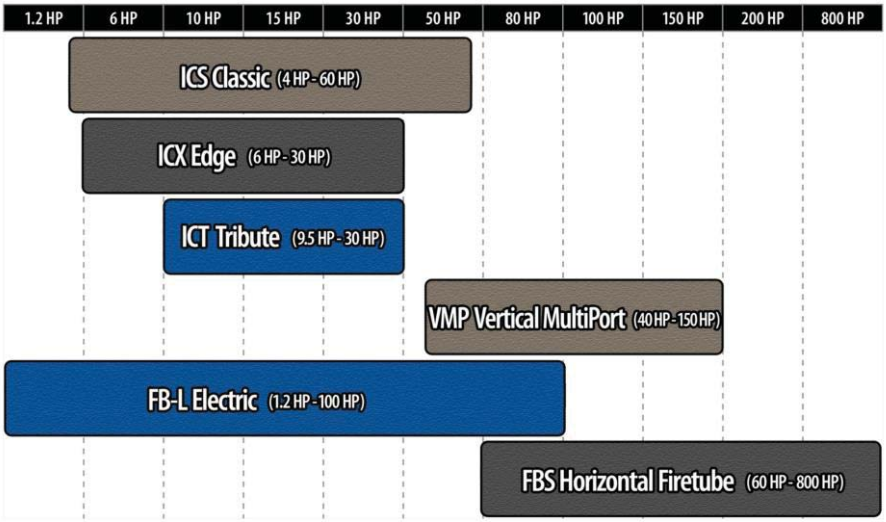
Fulton Steam Overview

Fulton The heat transfer innovators.

Steam Product Types of Fulton Boilers

Fulton The heat transfer innovators.

Fulton Steam Boilers



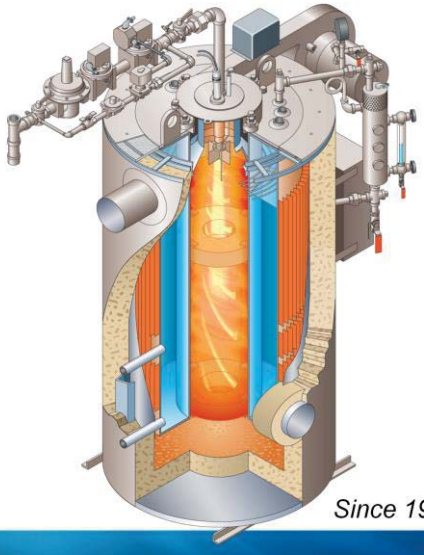
Fulton The heat transfer innovators.

Fulton Boilers

The Classic – ICS

- 2-pass, Vertical Tubeless
- Small Footprint
- Up to 81% Efficient
- High Temperature Castable Insulation
- Fulton Down-fired Burner
- UL listed as a Packaged Boiler
- Simple, reliable and very forgiving - over 100,000 installed
- Natural Gas/Propane/#2 Oil fuels
- 4HP – 60HP, Section I design boilers only

- 5 year standard PV Warranty
  - **10 years** with Engineered System



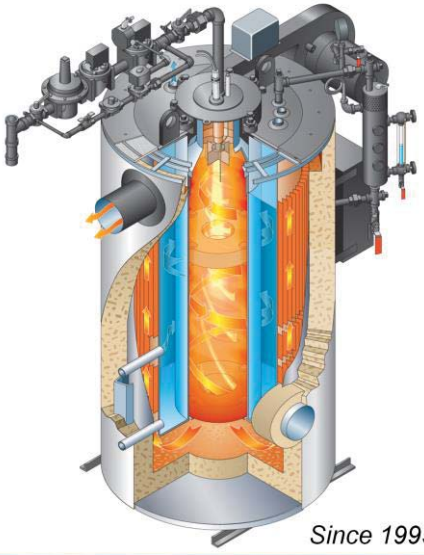
Since 1949

Fulton The heat transfer innovators.

Fulton Boilers

The Edge – ICX

- 2-pass, Vertical Tubeless
- Upgraded Fin Arrangement – More fins!
- Up to 83% Efficient
- Stainless Steel Jacket
- High Temperature Castable Insulation
- Fulton Down-fired Burner
- UL listed as a Packaged Boiler
- Natural Gas/Propane fuels
- 6HP – 30HP
- Section I or Section IV Design



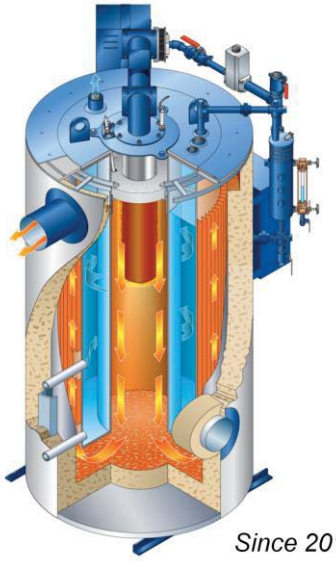
Since 1995

Fulton The heat transfer innovators.

Fulton Boilers

The Tribute – ICT

- 2-pass, Vertical Tubeless
- The "Edge" Pressure Vessel
- with Upgraded Fin Arrangement
- Mesh Burner
- Natural Gas/Propane fuels
- 9.5HP – 30HP
- High Temperature Castable Insulation
- Fulton Down-fired Burner
- ETL listed as a Packaged Boiler
- 4:1 Turndown
- 20ppm NOx standard
- 9ppm NOx configurable
- Section I design boilers only



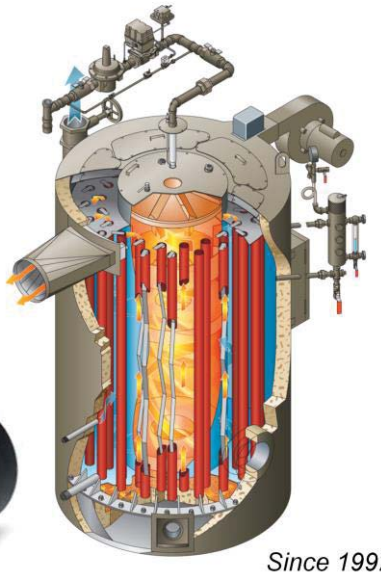
Since 2010

Fulton The heat transfer innovators.

Fulton Boilers

Vertical Multi-Port – VMP

- 2-pass, Pipe-Type
- Sch. 80 pipes, not tubes
- Up to 84% efficient
- Preheated combustion air
- Turbulators
- Small Footprint
- 40HP-150HP, 15psi-150psi
- Section I or Section IV design boilers

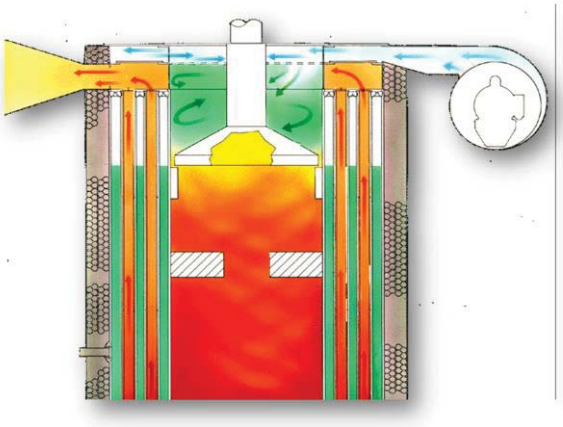


Since 1992

Fulton The heat transfer innovators.

Fulton Boilers

- VMP Preheated Combustion Air

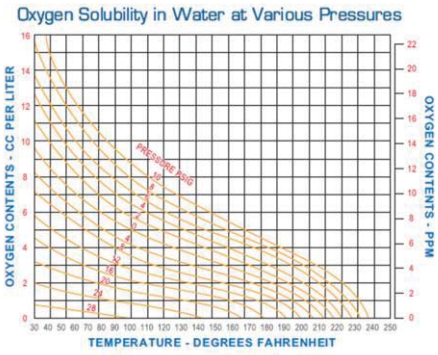


- VMP Pressure Vessel

Fulton The heat transfer innovators.

Fulton Ancillary Equipment

- Deaerator Tanks
  - Tray style: 316L stainless steel internal trays
  - Carbon steel or stainless steel tanks available
- Up to 600,000 lbs/hr (17,391 BHP) capacity available



Fulton Ancillary Equipment

- Feedwater/Condensate Return Tanks
- Surge Tanks
- Blowoff Separators/Tanks
- Chemical Feed Systems
- Water Softeners
- Carbon Filters
- Accumulators
- Economizers
- RO/DI Systems
- Flash Tanks

Fulton The heat transfer innovators.

Fulton Engineered Systems

- Standard Skids

  OR

- Completely Customizable Skids
  - Engineered per job

- Why Pre-pipe?
  - Single Source
  - **10 year PV warranty** with Fulton engineered systems

Fulton The heat transfer innovators.

Fulton Thermal Corporation

Fulton The heat transfer innovators.

Overview

- FTC - Introduction
- Direct vs. Indirect Heating
- Equipment
- Applications
- System Design
- Exercise
- Installation, Operation, and Maintenance

Types of Heating

- **Direct Heating** - the product is directly heated by combustion gases or electric elements
  - Ex: Direct fired ovens
- **Indirect Heating** - A re-circulating heat transfer medium is used between the heater and the product
  - Ex: Thermal fluid, steam, hot water, glycol

Advantages of Indirect Heating

- **Local overheating** of the product is avoided
- The **temperature of the product may be controlled** accurately and uniformly.
- Heat **energy can be stored** to deal with peak load fluctuations
- The heat source does not have to be installed in the **immediate vicinity** of the user or product
- A **single indirect heat transfer system may serve many** users more efficiently than multiple direct heaters

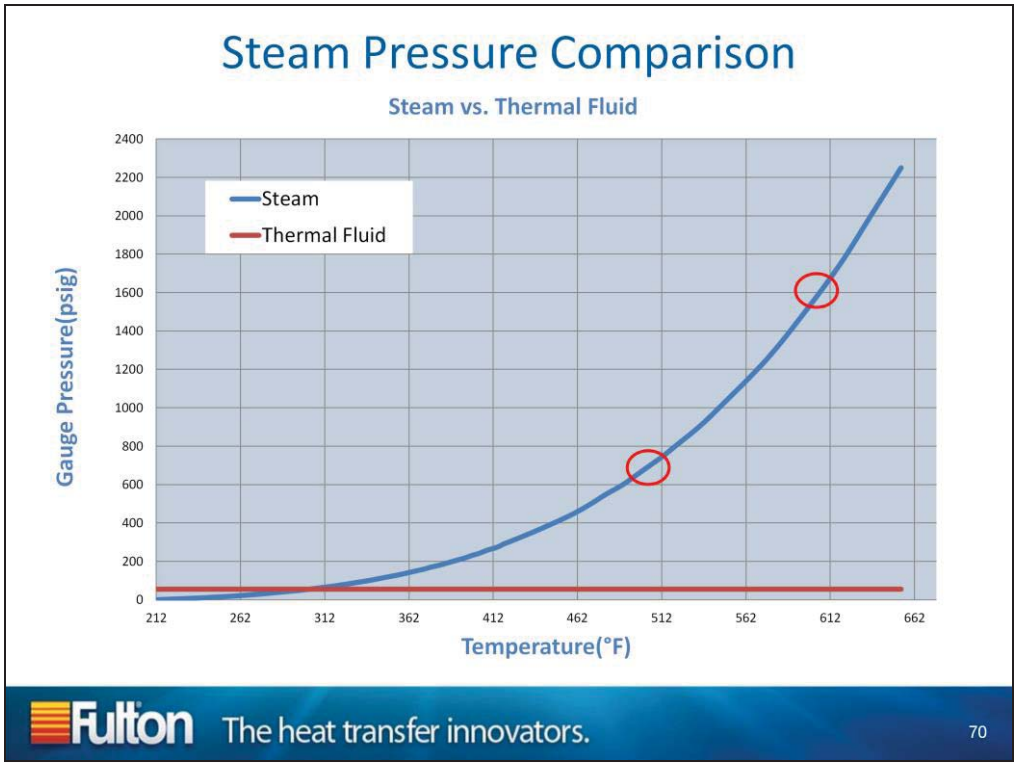
What is a Fulton Thermal Fluid Heating System?

- A Fulton Thermal Fluid System is a closed loop, indirect heating system utilizing mineral or synthetic oil as the heat transfer liquid
- These systems operate at elevated temperatures, while maintaining low system pressures
- A typical Fulton Thermal System is designed for operating at 650°F with a pump discharge pressure of 55 psig

System Components

A typical thermal fluid system is comprised of five main components

- Thermal fluid **heater**
- Thermal fluid circulating **pump**
- Deaerator/expansion **tank**
- Catch Tank
- User



400 ° F about 250 psig

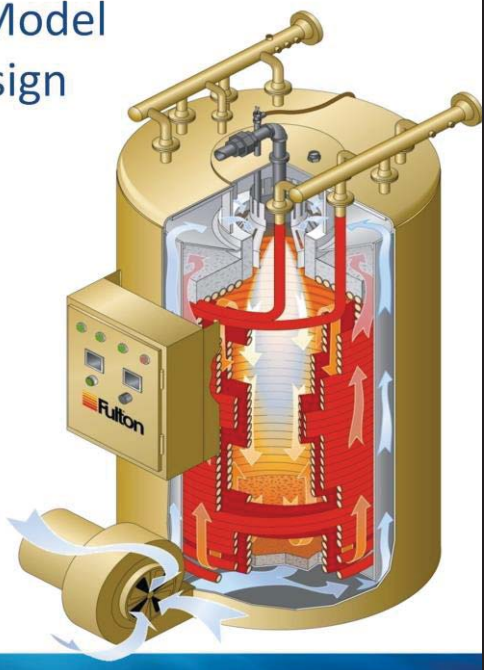
500 F about 700 psig

600F about 1600 psig

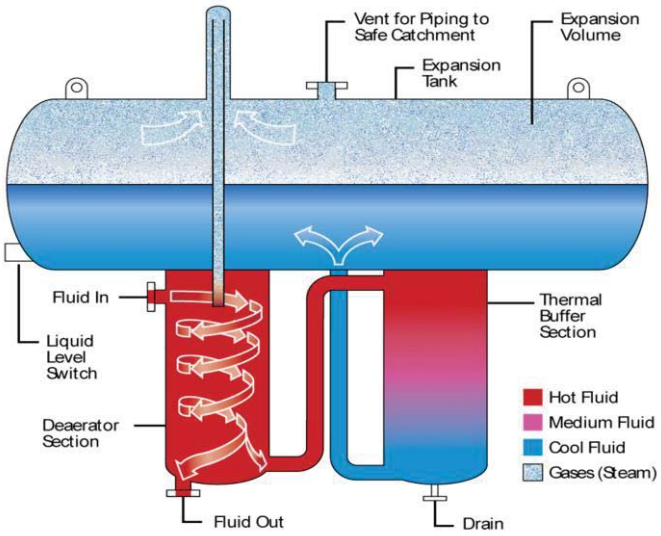
Fulton Thermal Fluid Heaters

Fulton "C" Model
4-Pass Design

- 1st pass – down, inner coil, inner channel
- 2nd pass –up, inner coil, inner channel
- 3rd pass – down, between inner and outer coil
- 4th pass – up, outside of outer coil
- Design incorporates air preheat



Fulton Thermal DA Tank Design

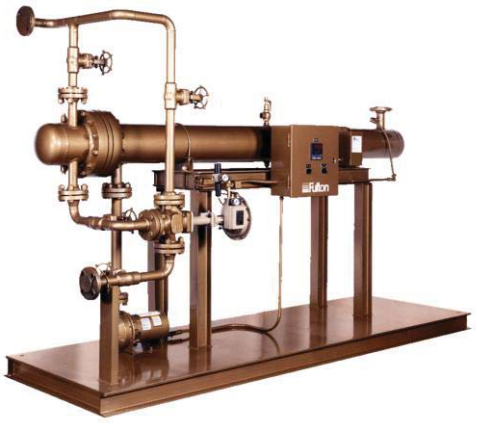


Unfired Steam Generator

- 15 psig to 300 psig
- Vertical Units – 10 HP to 100 HP
- Horizontal Units – 70 HP to 350 HP
- Customized Designs
- May eliminate the requirement for a stationary attendant

Unfired Hot Water Generator

- 200,000 to 14 MM Btu/hr
- Installed in conjunction with a thermal fluid system eliminating the need for a separate water heater
- Customized Designs



Customized TCUs

Features/Advantages

- Tight temperature control
- Eliminate corrosion of heat transfer surfaces by multiple mixed medias
- No cross contamination of utilities
- Ease of automation
- Ease of repetition for validation of processes

Hot oil can be utilized with the following types of equipment: