



HRSG

When Reliability
and Sustainability
Matter



A Clever-Brooks
Sustainable Solution



Lowering Your Carbon Footprint While Raising Plant Efficiency

Cleaver-Brooks is the leading provider of energy recovery solutions and the only totally integrated, single-source supplier in the world, from gas turbine or reciprocating engine exhaust to stack outlet.

Whether you need a packaged Heat Recovery Steam Generator (HRSG) or a field-erected, modular HRSG, our systems achieve energy efficiency, emissions reduction and decarbonization.

Supporting your sustainability goals, our HRSG solutions can:

- » Increase onsite power generation efficiency by >80%
- » Reduce fuel usage up to 7.0 MMBTU/hr in conventional boilers
- » Eliminate 2,870 tons of CO₂ emissions annually for every MWe of gas turbine generation

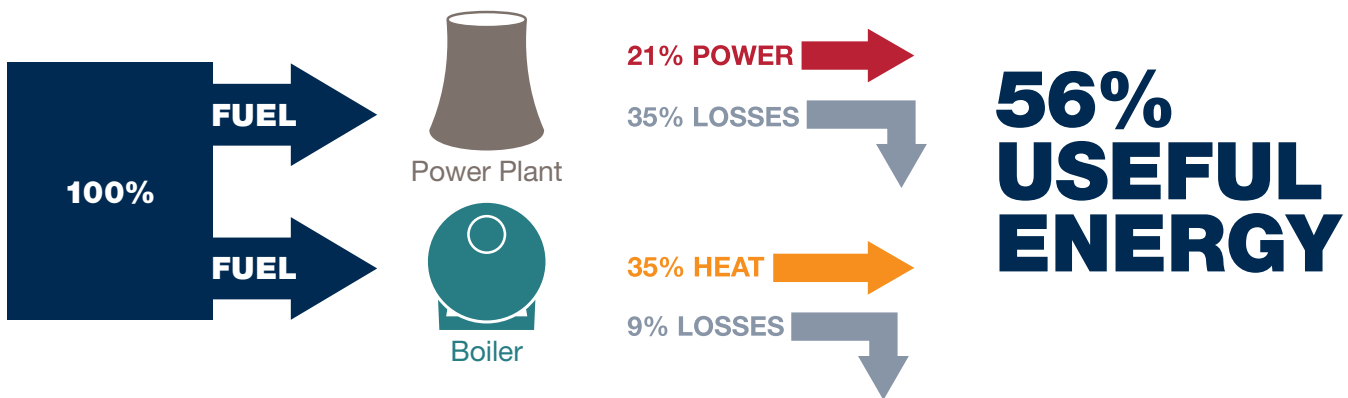


Our HRSGs meet the strict performance and sustainability criteria required to earn the Cleaver-Brooks Sustainability Seal. Find out more at cleaverbrooks.com/sustainability.

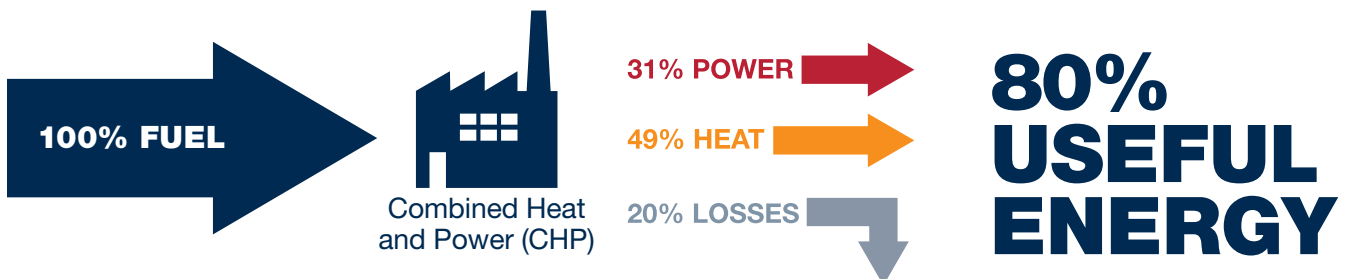
Reliability, Sustainability and Efficiency

Engineered by the experts

The Cleaver-Brooks HRSG line utilizes the exhaust from gas turbines or reciprocating engines to achieve efficiencies of more than 80 percent, compared to 56 percent for traditional technologies such as conventional electricity generation and an onsite boiler.



ENERGY USAGE



Our project teams ensure that the HRSG system is designed to your specifications, and our trained craftsmen produce boilers that are guaranteed to meet your exact standards. With state-of-the-art technology and expertise earned during 100 years in the industry, Cleaver-Brooks delivers reliability, sustainability and overall plant efficiency.



Cleaver-Brooks is a member of the EPA Combined Heat and Power Partnership

Heat Recovery Steam Generators

HRSG Solutions to meet today's CHP applications

Combined Heat and Power, or CHP, can increase overall plant efficiency by 30 to 40 percent, adding onsite power generation and heat recovery required for downstream heating or process needs. The HRSG is an integral component to any CHP system. When coupled with an SCR, an HRSG can significantly reduce greenhouse gas emissions, while also providing plant reliability and increased efficiency.

Slant HRSG Series

Single-pass energy recovery in a compact design

The Slant Series of natural circulation heat recovery steam generators features a single-pass design that offers the traditional Slant model and the VC (Vertical Drum Cross Flow) model. Both are tailored for applications with gas side inlet temperatures less than 1,700 °F. The traditional Slant model incorporates a steam and water (mud) drum positioned diagonally, which maximizes the amount of heating surface for a given shipping profile. This yields a compact and efficient method of heat recovery.



Steam
10,000 to 150,000+ lb/hr
Pressure
Up to 2,300 psig
Gas Flow
Up to 400,000+ lb/hr
Steam Temperature
Up to 1,050°F

Slant HRSG Series

VC Model (drum-over-drum) design

The VC model is a drum-over-drum design well suited for higher-pressure steam applications, integral CO / SCR systems, and horizontal exhaust flow arrangements. It can be customized with a stainless steel inner liner, refractory lining or water-cooled membrane wall construction, depending on your process requirements.



Steam
10,000 to 150,000+ lb/hr
Pressure
Up to 2,300 psig
Gas Flow
Up to 400,000+ lb/hr
Steam Temperature
Up to 1,050°F



“We needed to improve the facility and the equipment. Efficiency and emissions were a concern, and we wanted to make sure we were being good stewards of the environment.

We knew Cleaver-Brooks manufactured quality equipment, and we specifically liked the Natcom® burner options.”

Sam Merrick, Supervisor of HVAC Services, Facilities Management
Brigham Young University – Idaho

Max-Fire® HRSG Series

Cleaver-Brooks innovations are built into every unit

The Max-Fire® Series incorporates an integral furnace in a single, shop-assembled, packaged HRSG that combines a furnace, evaporator and superheater, if applicable, with a natural circulation design.

This innovative system combines a water-wall combustion chamber formed from membrane wall construction with an evaporator section. The integral water-cooled furnace allows for supplemental firing temperatures up to 2,800°F. Capable of steam flows up to 500,000+ lb/hr, the Max-Fire Series is offered in two different models.

Features

- » Water-cooled membrane wall construction extends throughout the boiler and eliminates high inner casing temperatures
- » Vertical (top) or horizontal gas outlet helps meet tight space restrictions
- » Combination of bare and finned tube sections for optimized heat transfer and pressure drop
- » Downcomers on both ends of the boiler for natural circulation
- » Available in A-type and O-type configurations

Steam
10,000 to 500,000+ lb/hr
Pressure
Up to 2,300 psig
Gas Flow
Up to 1,000,000+ lb/hr
Steam Temperature
Up to 1,050°F



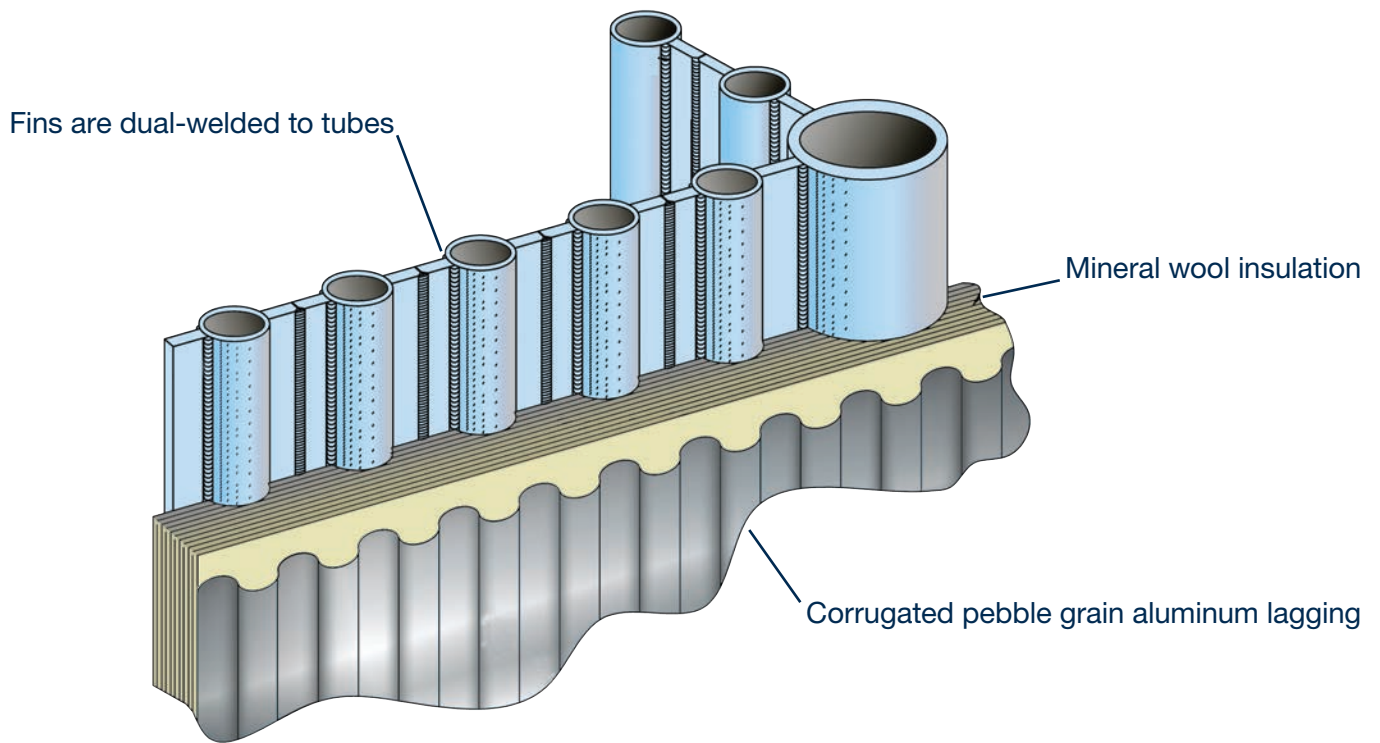
Max-Fire® HRSG Series

Cleaver-Brooks delivers expert engineering and precision fabrication

Membrane Wall Construction

The Max-Fire Series features an innovative design to help eliminate refractory wherever possible. Water-cooled membrane walls allow the boiler to safely withstand firing or flue gas temperatures up to 2,800°F.

This series also minimizes high-maintenance refractory, provides a positive inner gas seal, adds structural strength, eliminates flue gas entrapment, and helps maintain thermal efficiency.



Reliable and Consistent Manufacturing

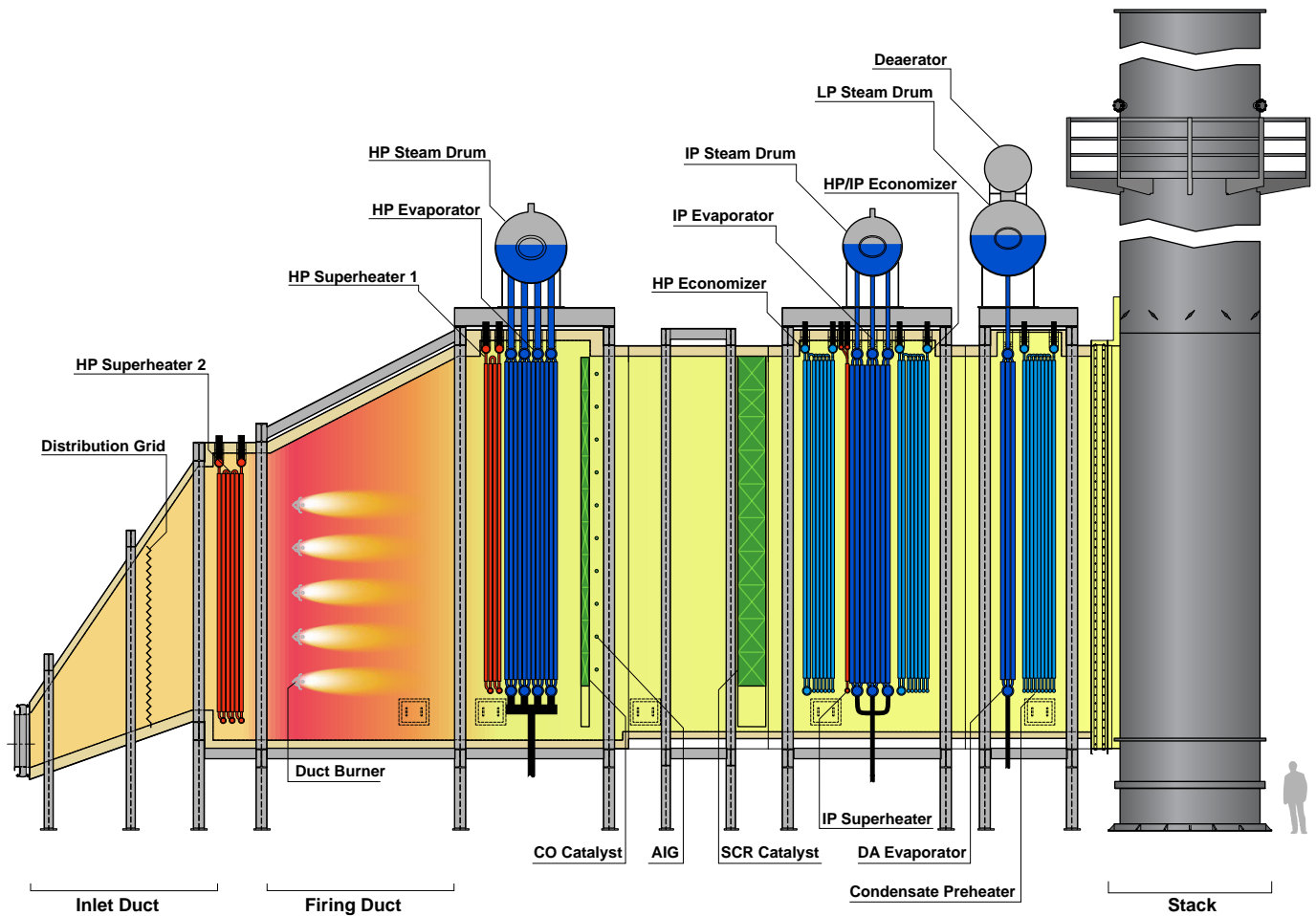
As a single-source expert provider, we control the manufacturing process of the burner, boiler, and controls, delivering consistency, reliability, and repeatability in all products.

Modular HRSG Series

Maximum shop assembly, minimum field labor

The Cleaver-Brooks Modular HRSG Series minimizes field erection costs by providing the maximum amount of shop assembly. The natural circulation design allows for minimal parasitic power consumption and reduced maintenance of rotating equipment. Our engineering team reviews thermal performance, mechanical fatigue evaluation, circulation studies and pipe stress analysis with every project.

Modular HRSG Diagram



Modular HRSG Series



Features

- » Multistage high-pressure and high-temperature superheaters
- » Vertical-tube, natural-circulation evaporators
- » Top-supported coils for unrestricted downward expansion
- » Tube bundles pre-installed in a shop-assembled casing
- » Large, remote steam drums with high-efficiency separators and high capacity for load swings
- » External, unheated downcomers
- » Convection access doors at each bundle for ease of inspection, maintenance and replacement

Steam Production

500,000+ lb/hr

Steam Pressure

Up to 2,300 psig

Steam Temperature

Up to 1,050°F

Exhaust Gas Flow

500,000 – 1,000,000+ lb/hr

Duct Burner

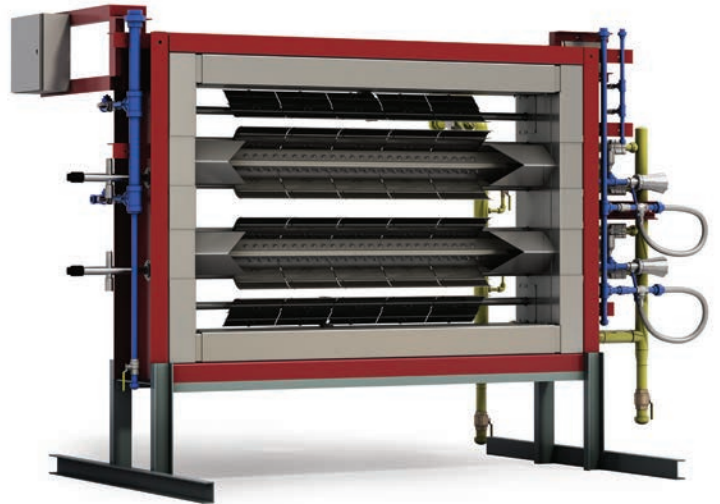
Boost the efficiency of your HRSG

Natcom® Duct Burners supplement the gas turbine in HRSG applications with an innovative flame stabilizer system and are ideal for use in CHP applications when additional steam is required for heat or process needs. Duct burners can fire a variety of gaseous fuels, including natural gas, LFG, digester gas, refinery gas and H₂, as well as fuel oil.

Our in-house simulation allows accurate and complete modeling of the turbine exhaust flow, distribution grid, combustion, heat recovery system and SCR. We offer a complete control system for the HRSG, duct burner and SCR, or a stand-alone burner management system (BMS) for the duct burner.

Features

- » Self-supporting, high-temperature stainless steel assembly
- » Complete Computational Fluid Dynamics (CFD) analysis, design and fabrication of turbine exhaust gas (TEG) flow correction devices



Custom Controls

Integrated industrial controls

Cleaver-Brooks manufactures custom PLC control systems for any combustion application. Regardless of system complexity, we provide state-of-the-art hardware and programming for safe, reliable and efficient operation.

Integrated Exhaust Solutions

SCR & CO Catalyst for HRSG

Reduce NOx by up to 95 percent, down to 1 ppm

Selective Catalytic Reduction (SCR) is a post-flue gas treatment capable of reducing NOx emissions from a variety of boiler systems. Computational Fluid Dynamics (CFD) analysis allows us to predict flue gas distribution and optimize the SCR design. The CO Catalyst converts both CO and hydrocarbons to carbon dioxide and water vapor.

Features

- » Integrated Cleaver-Brooks control system and SCR ensure fast response and minimal ammonia slip for increased operational flexibility and lowest emissions
- » Designed with an optimum temperature window for maximum NOx and CO reduction

Freestanding Stacks

Exhaust solutions for any application

Cleaver-Brooks engineers single- and double-wall freestanding stacks, which are available in carbon, COR-TEN® and stainless steel. Our integrated waste heat boiler solutions offer integral stack dampers, silencers and bypass stacks.





The power of total integration.

The **Power of Total Integration** is how Cleaver-Brooks delivers the world's broadest range of integrated, sustainable boiler plant solutions. In addition to our products, this includes our global representative and service network, training resources, and trusted expertise that add significant value to your Cleaver-Brooks investment.



Click or scan the QR code with a smartphone camera to access HRSG resources

