Steam Generators
Advanced Steam Boiler Technology that is Safe Efficient and Reliable

Clayton
INNOVATIVE STEAM SOLUTIONS
Clayton Industries

Worldwide Headquarters
City of Industry, California

Established in 1930
Privately Owned
Clayton Industries

Bornem, Belgium

Maquiladora Plant
Tijuana, Baja Mexico

Mexico City, Mexico

Service & Chemical Sales Headquarters
Cincinnati, Ohio, USA
Clayton U.S. / Canada Sales/Service Offices
Europe Sales/Service Offices
Clayton Industries
Thermal Products

**Steam Generators** -
- Fired and Un-Fired Units
  - 25 to 1500 BHP, Saturated Steam
  - 200 to 1500 BHP, Superheated Steam
  - Pressures up to 3000 psig
- Low NOx Burners - 50 to 1500 BHP

**Feedwater Treatment Systems** -
- Atmospheric, D/A, and Semi-Closed Systems
- Automatic Water Softeners
- Chemical Injection Systems
- Blowdown Systems

**Chemicals** -
- Feedwater Treatment
- Condensate Treatment
- Cooling Tower Treatment
Clayton Industries
Major Design Features

Counter-Flow Heat Exchanger
Controlled Circulation
How We Make Steam

THE CLAYTON PUMP
- Small Water Content
- Pre-Heated Water
- Controlled Water Flow

THE CLAYTON COIL
- Counter Flow Heat
- No Refractory Insulation
- Small Steel Mass

THE CLAYTON SEPARATOR
- Vortex Action
- No Moving Parts

WATER

STEAM
Clayton Industries

Main Steam Generator Components

- Feedwater from Receiver
- Feedwater Flow
- Exhaust Gas Flow
- High Quality Steam to Header
- Liquid to Feedwater Receiver
- Clayton Feedwater Pump
- Helical Coil Heat Exchanger
- Mechanical Separator
Clayton Industries

Positive Displacement Feedwater Pump
Consistent Quality Steam

Steam Separator
99.5% Quality
Fixed Vane design
Unique Coil Design

Controlled Circulation, Counter Flow Heat Exchanger

Staggered tube spacing creates turbulent gas flow

Varying tube spacing ensures high gas velocity
Typical Coil Assembly
Coil Features

Continuous Mono-tube Coil

Steel tubing – SA-178 Grade A

No drums, headers or manifolds

Entire Coil housed in Steel Jacket

Ultra-Low Water Volume
SIGMA-FIRE PRODUCT LINE
25 to 200 BHP

Compact Footprint
Reduced Noise & Vibration
Off-Mounted FW pump
Modulating Controls
Low NOx Burners
High Efficiency
E-SERIES PRODUCT LINE
150 to 1,500 BHP

- Compact Footprint
- Rapid Start-up and Load Response
- High Efficiency
- Modulating Controls
- Low NOx Burners
- Up to 3000 psig
  Superheat Models
Clayton Industries

Controlled Water Circulation

Good Circulation = Good Heat Transfer

Steam Blanketing = Poor Heat Transfer
Thermal Efficiency

Typical Efficiency vs Firing Rate.

- Clayton Model SE
- Standard Clayton
- Typical Conventional Boiler
Blow Down Savings

Fire Tube Boiler

Inlet TDS @ 150 ppm

Blow Down TDS @ 3,000 ppm

Clayton

Recycle TDS, concentrated by Separator

Inlet TDS @ 6,000 ppm

Blowdown TDS @ 30,000 ppm

Feedwater Tank

Inlet TDS @ 150 ppm

Blow Down Feedwater Tank
Design

Counter-Flow Heat Exchanger
Controlled Water Circulation

- Using these two principles we eliminate the need for a large vessel. This greatly reduces the water volume and size of the heat exchanger needed. The benefits are:
  - Smaller physical size and weight
  - Much quicker start-up and load response.
  - Lower radiation and convention losses.
  - Linear thermal efficiency – No penalty for part load operation
  - Reduced blow down by concentrating the TDS in less water.
  - Greatly reduced risk of explosion.
Clayton Requires $\frac{1}{2}$ the Floor Space
Clayton Industries

Water / Steam Safeties

**MAIN FEEDWATER PUMP RELIEF VALVE** - Protects pump against blockage in water line.

**POLS – Pump Oil Level Switch** – shuts off pump if fluid level inside pump either goes up or down.

**MTLC – Main Temperature Limit Controller** – Dual thermocouple embedded in coil that senses fire side metal temperature and shuts down unit if temperature limits exceeded.

**ATS – Auxiliary Thermostat Switch** – sensing bulb in Upper body of steam separator that shuts down unit if superheat condition occurs.

**LPS – Limit Pressure Switch** – Shuts down unit if steam pressure approaches relief valve setting

**STEAM RELIEF VALVE (s)** – Mounted on top of steam separator to protect separator from over-pressurization
Coil Dual Thermocouple Assembly

ATS Switch
**Clayton Industries**  
**Fuel / Combustion Air Safeties**

**ESC – Electronic Safety Control** - Main burner control device.

Siemens LMV burner management controls. “Non-recycle” type controls requiring manual reset after any lockout condition.

**APS – Air Pressure Switch** - Senses combustion air pressure and closes gas valves if pressure drops below a pre-set level. Requires manual re-set.

**UV Scanner** – Monitors flame and de-energizes gas circuit if flame lost.

**GPSH/L** – Gas Pressure Switch for both High and Low Gas Pressure - If pressure outside of limits, shuts off unit and requires manual reset.
GROUP MOTOR PROTECTORS – GMPs are provide for protection of all electrical motors.

COOLING AIR PRESSURE SWITCH – shuts down unit if cooling air blower on low NOx does not put out proper air pressure.

VOLUTE TEMPERATURE SWITCH – shuts down unit on low NOx units if volute temperature exceeds limits.

EIS – Electrical Interlock Switch – De-energizes 115VAC control circuit if panel door opened during operation
Clayton Industries
A-B Micrologix PLC Based Control Systems

Clayton Industries' PLC based steam systems incorporate the latest technology in boiler controls, and provide instant touch access to operating control and information.

- Increased equipment reliability by eliminating mechanical relays and timers.
- Provides direct communication links with boiler room and plant control systems.
- Allows for multiple unit control sequencing.
- Compatible with Modbus, Ethernet/IP, and BACnet protocols.

CLAYTON COMPUSTEAM PLC
Siemens LMV51 Linkage-less Burner Management System
Siemens LMV51 Linkage-less Burner Management System

Air Damper Valve

Gas Actuator
Clayton Industries

Advanced Low NOx Technology

Since 1930, Clayton has been a leader in the development and manufacture of innovative and highly efficient Steam Generators. Backed by worldwide sales and service, our unique Steam Generators have proven the superiority and ability to provide reliable, cost effective steam production around the world. Working from proven designs and philosophies, our commitment to continuing research and development has made Clayton one of the most respected names in the boiler industry. In keeping with this strong background we are pleased to introduce our latest product line of very low NOx - Low CO Steam Generators. These unique combustion systems provide extremely low emissions without sacrificing efficiency and reliability. Clayton's clean emissions technology is "not just a step ahead, but A STEP BEYOND."

Clayton Steam Generators:

- **SAFE FUEL**
  The unique counter flow design provides higher fuel-to-steam efficiency than traditional boilers.

- **ARE SAFE FOR PERSONNEL AND EQUIPMENT**
  Inherently safe, the Clayton design eliminates hazardous steam explosions.

- **PROVIDE RAPID RESPONSE**
  The Clayton design responds rapidly to sudden or fluctuating load demands.

- **START FAST**
  The Clayton design will provide full output from a cold start within fifteen minutes, without thermal stress.

- **ARE COMPACT AND LIGHTWEIGHT**
  The Clayton design typically occupies one-third of the floor space and weighs 75% less than a traditional boiler.

- **ENSURES HIGH QUALITY STEAM**
  Clayton provides a 99.9% quality separator to minimize moisture in the steam.

- **OFFERS ADVANCED CONTROLS**
  PLC controls, Variable Speed Drives and a linkage-less servo controlled burner management system are standard.

- **INCLUDES OUTSTANDING SUPPORT**
  Every Steam Generator is backed by Clayton factory direct sales and service plus full service feedwater treatment.

Low NOx Systems

FGR and Fiber Metal Designs available with NOx emissions guaranteed down to 6 ppmv
Complete Feedwater Skid Packages

All Components mounted on a single deck plate & connected together for ease of installation
Clayton Industries

Complete Generator / Feedwater System Skids
Clayton Exhaust Gas Boilers
How Steam Is Produced In A Clayton Heat Recovery Boiler

- Feedwater from Receiver
- Feedwater Flow
- Helical Coil Heat Exchanger
- Exhaust Gas Flow
- High Quality Steam to Header
- Mechanical Separator
- Liquid to Feedwater Receiver

Clayton Feedwater Pump

Diagram of the process:}

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Enhanced oil recovery (EOR) using thermal technology is the most widely employed EOR method. The two main methods for Thermal EOR (TEOR), cyclic and steamflood, have the greatest certainty of success and potential application in about 70% of enhanced oil recovery worldwide. Thermal methods also give the highest recoveries at the lowest costs.

The Clayton TEOR Steam Generator is a complete, self-contained, automatic generating unit ready for operation when connected to the heating system, fuel and power supply. The basic design is a once-through, forced circulation, spirally wound smooth tube heat exchanger. The Clayton design offers significant fuel savings and size/weight advantages. The Clayton design is inherently safe, with no possibility of a hazardous steam explosion.

Specifically tailored to oil field thermal recovery specifications, the Clayton TEOR Steam Generator is truly a portable heater. The compact design allows the unit to be skid mounted, trailer mounted or containerized. This portability means that they are versatile and adaptable to a variety of field conditions and applications.

The Clayton TEOR Steam Generator delivers more usable BTUs to the formation at a considerably lower cost than any combination of available components.

Compared with conventional steam boilers, Clayton Steam Generators are notable for their compact size, light weight and low emissions. They are prized for their reliability, fuel economy, fully automatic PLC controls, plus the ability to start-up and follow load cycles quickly.

Gas & Gas Liquids Lines From Yule #8

Trailer Mounted Steam Generator
OFFSHORE / MARINE

OFFSHORE STEAM GENERATORS...

AT THEIR BEST WHEN THE GOING GETS TOUGH

Size, Safety and Performance Are Ideal for Offshore Oil Rigs

Few environments pose greater demands on men and machinery than offshore oil rigs. The weather is seldom receptive. The work is demanding. Space is at a premium. And dependability is highly prized.

Small wonder that more and more petroleum and oil exploration companies call for Clayton steam generators on their offshore oil rigs. These multi-purpose generators — available in a wide range of capacities — perform numerous important functions:

- Heating work floors
- De-salinization
- Heating rooms
- Heating drilling fluid
- De-scaling
- Cooking
- General clean-up

But Clayton steam generators, used by major industries around the globe, are valued on offshore rigs for more than versatility. Compared with conventional steam boilers, the generators are notable for their compact size, light weight, low emissions and absence of explosion hazard. They are prized for their reliability, fuel economy, fully automatic PLC based controls, plus the ability to start-up and follow load cycles quickly.

And Clayton Steam Generators are backed by a worldwide support team of engineers and technicians to keep you online and in full production.

TYPICAL APPLICATIONS

- Floating Production Platforms
- Sub Sea Operations Vessels
- High Environment Jack-Up Rig
- Deep Water Jack-Up Rig
- Semi-Submersible Drilling Rig
- Offshore Steam Rents:
- GE Oil Services/EMCO
- Chemical Tankers
- Dynamically Position Drilling Ships
- General Marine/Offshore Use
- Product Tankers
- Cargo Vessels
Some of Clayton Customers
Compact, Highly-Efficient, Quick-Starting Steam Generator Systems

Since its inception on October 20, 1930, Clayton Industries has established a world-wide reputation as a leading manufacturer of equipment for industrial process steam generation—both fired boilers and unfired waste heat boilers. Their unique controlled circulation, counter-flow design offers many operational advantages and benefits over conventional boilers. Clayton Industries' design principles and the use of the latest technology in its control systems make them the favorite choice in today's high efficiency energy markets.

Welcome to our website! We look forward to hearing from you and serving your steam generating needs with our professional and experienced staff. For steam boiler and steam generator information, please see our Boiler and Steam Basics.

The company is headquartered in City of Industry, California, USA and has major manufacturing facilities located in the United States, Belgium and Mexico to serve its diverse worldwide markets. Direct Sales and Service support centers are located worldwide and are provided by carefully selected and thoroughly trained distributors in many areas throughout the world. Clayton understands that new ideas and technology are the driving force in the economies of developed and developing countries around the world. Clayton Industries is ideally positioned to lead this technological revolution through the 21st century and beyond by providing its customers with reliable and highly efficient compact steam generating systems.

Visit us at www.ClaytonIndustries.com