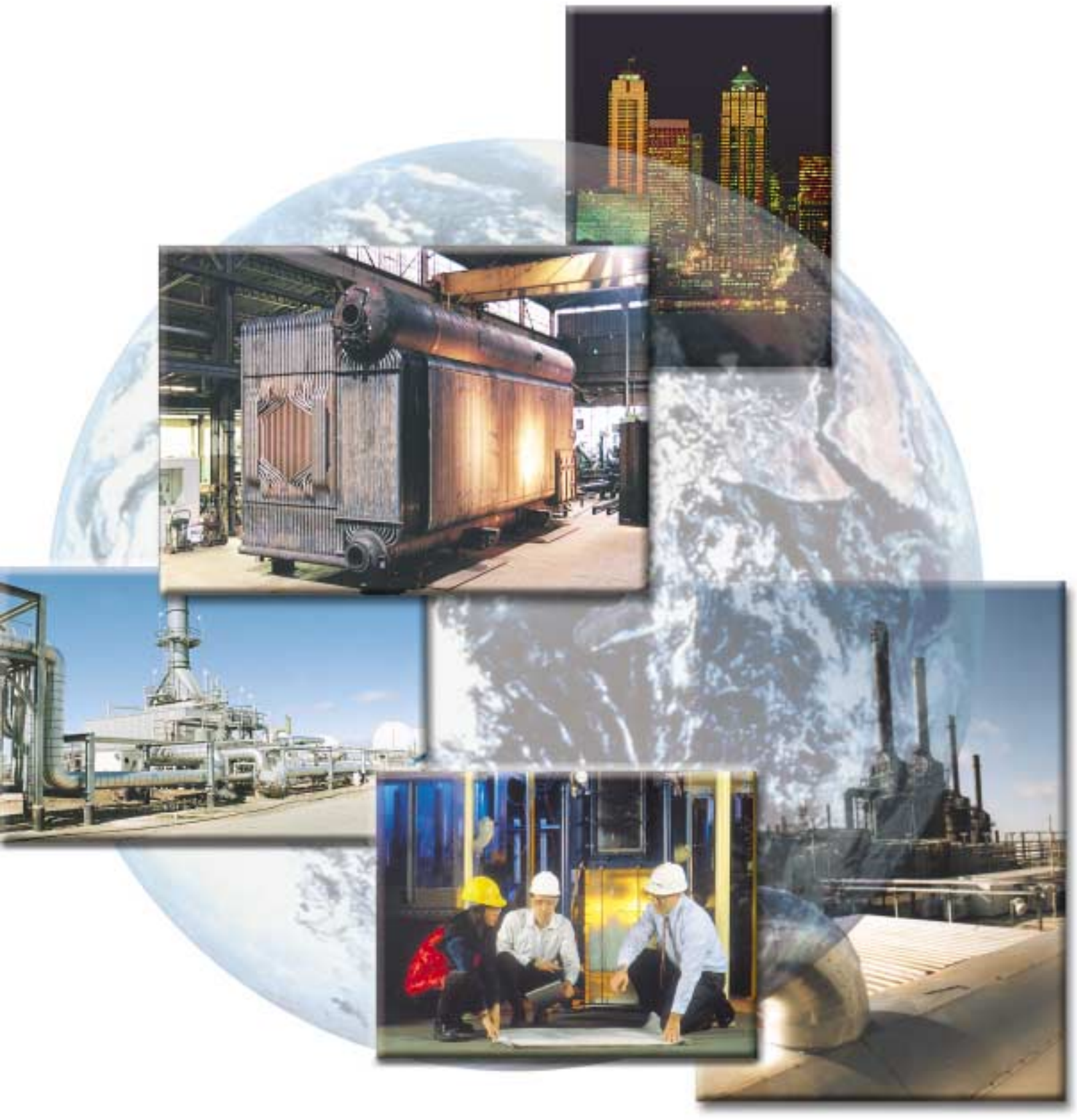
FOSTER WHEELER

PACKAGE STEAM GENERATING SYSTEMS



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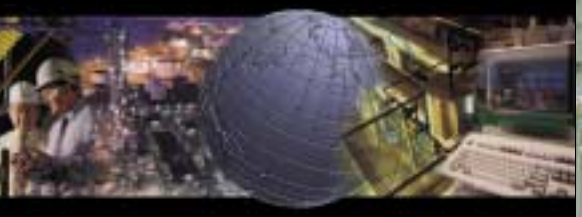


ENGINEERING TO HELP THE WORLD RUN BETTER.

Foster Wheeler Corporation is an international organization providing engineering services and products to a broad range of industries, including petroleum and gas, petrochemical, pharmaceutical, chemical processing and power generation. These services include design, engineering, construction, project development and management, research, plant operations and environmental services. The products include steam generators, related auxiliary equipment and fired heaters. Our experience reaches back over one hundred years. Foster Wheeler steam generators are responsible for providing 130,000 MW of power in over 50 countries on six continents.

Package Steam Generating Systems

Steam generation today demands strict adherence to emission regulations, utilization of alternative fuels, and the minimization of operating and maintenance costs. In this complex environment, Foster Wheeler provides a complete solution to your steam generation needs. Our experience, diversification of products and commitment to engineering integrity, ensure Foster Wheeler quality, resulting in maximum equipment availability and a reliable source of steam for your process, power or heating requirements.

At Foster Wheeler, our focus is on total system integration and optimization. This is accomplished by first listening to and understanding our customers' unique needs. By utilizing state-of-the-art automation tools, we then apply technical and cost factors in a combined value-added analysis. This provides our engineers the degree of freedom necessary to design a system best suited to each customers' steam generation needs by balancing capital and operational costs.

Our product focus is supported by the engineering and financial resources of the entire Foster Wheeler organization. Corporate experts in specialized fields such as combustion, circulation, noise, vibration, metallurgy, and global procurement are drawn upon as required to effectively address the most complex project requirements.

EXPERIENCE

Package Steam Generating Systems have been an integral part of Foster Wheeler's product base for over 50 years. Originally developed for steam capacities of 30,000 lb/hr, today's modern systems have unit capacities up to 450,000 lb/hr. With over 1,000 installations, we have earned our reputation as a proven and responsible leader in this industry.

INNOVATION

Our diligent pursuit of improved system performance is founded on the concepts of system reliability, value engineering, and minimization of the total cost of ownership. We make it a priority to understand the unique requirements of each project. Only then can we implement the most innovative solution to each individual steam-plant application.

FOCUS

Experienced people are the cornerstone of our business. Dedicated project specialists provide our customers with mature product expertise and are accountable for the entire project, from conception to successful operation. This promotes product development, continuity, and a results-oriented team approach to project success that ultimately leads to long-term customer satisfaction.

Process

Power

Heating

Custom Engineering at an Off-the-Shelf Price

One of the greatest strengths of the Foster Wheeler family is our diverse product base. Our ability to select from a full spectrum of steam generating equipment means our customers get the most suitable product for their application. The selection of a package boiler should not compromise your needs.

Within the Package Boiler Business Unit, we have asked our customers what they would most like to see in their next steam generator. The process, power, and heating industries each have unique requirements. Having the leaders of these industries as our customers, Foster Wheeler captured the fundamentals of today's package steam generation needs. The result is Foster Wheeler's *Generation 5000* product line, combining high-quality standard features with automated custom-design engineering. This change from off-the-shelf package boilers to automated designs means you, our customers, receive custom engineering at an "off-the-shelf" price.

The true value of this approach materializes over the life of the steam plant through lower operating costs, lower maintenance costs, and higher availability.

Services Offered

TÜV CERT ISO 9001

- Technical Support for Feasibility Studies
- Specification and Product Consulting
- Budget Estimates
- Firm-Priced Proposals
- Project Management
- Boiler System Engineering Optimization
- Boiler Fabrication
- Integration of Auxiliary Components
- Package Boiler Custom Design
- Single-Source Responsibility
- Shipping
- Field Construction Supervision
- Site Installation of Auxiliary Equipment
- Commissioning Service Engineers
- Retrofits
- Maintenance
- Replacement and Spare Parts

STANDARD SCOPE

- Burners
- Burner Management Systems
- Control Systems
- Attemperation Systems
- Fuel Valve Trains
- Instrumentation
- Fans
- Motor and Turbine Drives
- Economizers
- Stacks
- Valves and Trim
- ASME Piping
- Subcooler Condensers
- Sootblowing Systems
- Flues and Ducts
- Platforms and Walkways
- Structural Steel

EXTENDED SCOPE

- Deaerators
- Feedwater Pumps
- Blowdown Systems
- Chemical Feed Systems
- Water Treatment Systems
- Fuel Handling
- Emission Control Equipment
- Continuous Emission Monitoring
- Misc. Electrical Equipment
- External Piping and Wiring

Total System Design Capabilities

Our application specialists and project managers have extensive experience in the supply of integrated boiler systems – standard and extended scope – for installation in new and existing facilities.

Total system integrity is the foundation of our reputation. Individual components are selected based on specific project requirements and upgraded to meet Foster Wheeler standards. Our engineers then focus on the optimization of the relationships between the individual components. Performance, reliability, ease of operation, and cost are all balanced in a value-added approach providing a customized system which meets your specific needs, with the lowest overall cost of ownership.

Our long-established relationships with auxiliary equipment suppliers ensure a smooth project from initial design, through procurement, to delivery and commissioning – with Foster Wheeler accepting single-source responsibility for all equipment we supply. Whatever your application, we have the experience to meet your most complex challenges – all factors considered.

Comprehensive Emissions Control

The continuous lowering of allowable emissions levels has resulted in a more complex interrelationship of steam generating system variables, affecting performance, safety and cost.

Foster Wheeler has pioneered effective emission reduction technology in Package Steam Generating Systems and will continue to lead the industry into the 21st century by applying our total system design approach to emissions control.

All our package boilers include furnaces specifically designed for modern low-NO_X applications, dimensionally optimized for single and dual burner configurations. Our focus on the relationship between flame shape and furnace geometry results in burners which operate at optimum emission levels. To further reduce NO_X levels to meet most regulatory requirements, we draw on our extensive field experience in utilizing flue gas recirculation. SCRs and CO Oxidation Systems can also be employed to further reduce emission levels when required. Our experience as both a boiler and SCR supplier enables us to optimize the integration of these emission control technologies to efficiently meet even the most stringent customer-imposed or regulatory environmental limits.

For our customers, Foster Wheeler's emission know-how translates into compliance for even the most challenging applications.

Fuels

- Natural Gas
- Refinery Gas
- Landfill Gas
- Waste Gas
- CO Gas
- Blast Furnace Gas
- Alcohols
- Waste Liquids
- Heavy Oils
- Light Oils

Control Techniques

- Boiler Construction
- System Design
- Low NO_X Burners
- Flue Gas Recirculation
- CO Oxidation
- Selective Catalytic Reduction
- Baghouses
- Electrostatic Precipitators
- Scrubbers

Emission Control

- NO_X
- CO
- PM_{10}
- VOC
- UBHC
- SO_X

Generation 5000 Boiler Features

Foster Wheeler Package Boilers are a hybrid of proven technology, experience and ingenuity. We incorporate conservative design and construction standards adopted from our Utility and Large Industrial Products. These standards have been refined through many years of experience with the process, power and central heating industries.

The result is a boiler of superior construction, custom designed to specific project requirements, and focused on key project drivers: *a product fine-tuned for the demanding challenges of tomorrow*. The *Generation 5000* family consists of four distinct groupings of boilers, named the 5000, 5100, 5200 and 5300 Series. Each Series offers a unique set of standard geometries and flexible features.

Product Capabilities

CAPACITY
Up to 450,000 lb/hr

PRESSURE
Up to 1,560 psig

TEMPERATURE
Up to 950˚F

EMISSIONS
Best Available Technology

SCOPE
Full Turnkey

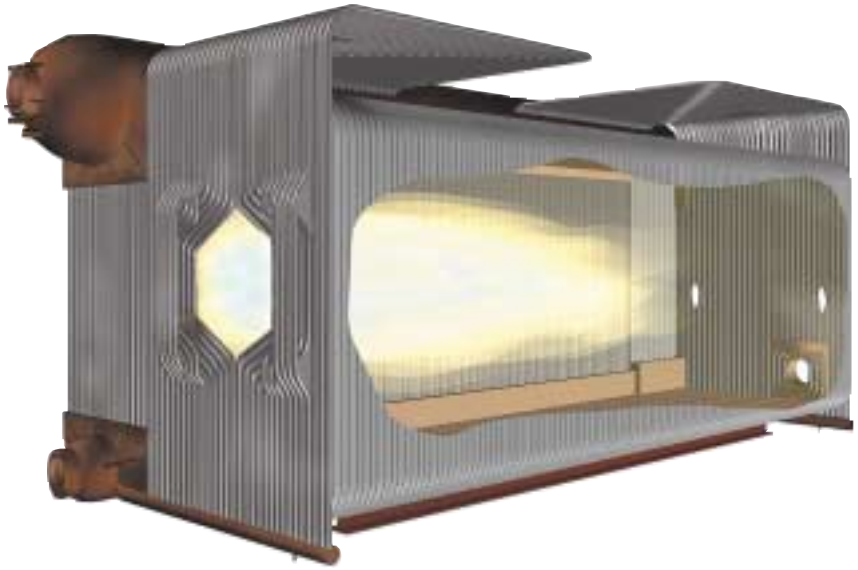
Aircooled Frontwall is standard on the 5000 and 5100 Series units.

Watercooled Frontwall is standard on the larger 5200 and 5300 Series boilers.

Refractory Floor Tile reduces floor heat absorption, allowing proper water-to-tube contact and thereby eliminating floor tube failure. Tile can be removed where NO_x emission benefits outweigh risk of premature floor tube failure.

MONO-WALL® Boiler Rearwall minimizes refractory and its related maintenance.

Easy Access for Inspection, Maintenance
Observation ports are supplied in the furnace and convection rear walls, while access to key maintenance areas is provided through large diameter manways in the furnace, water drum and steam drum.



Two Drum, D-Style Design

offers proven technology and reliability.

MONO-WALL® Division Wall

prevents gas bypassing from the furnace to the convective bank which would otherwise lead to high CO emissions and reduced thermal efficiencies.

No Bifurcation of Steam Flow.

Tubes are bent around all openings, eliminating localized recirculation patterns that result in panel hot-zones and ultimately tube failures.

MONO-WALL® Construction

GENERATION 5000 Steam Generators are constructed exclusively using a tubular membrane-wall (MONO-WALL®) – for a distortion-free, gas-tight enclosure.

Large Drums with Utility-Grade Internals

remove water carryover from the saturated steam. Primary separators (cyclones above 450 psig, channels below 450 psig) are utilized in conjunction with secondary-stage chevron driers – for maximum steam purity. A conservatively sized steam drum adds operational stability during steam ramping cycles and offers increased drum retention for maximum system availability.

Fully Convective and Drainable Superheaters

are installed in the convective section of the boiler, shielded from the radiant furnace by screen tubes. Metallurgical integrity is ensured through the optimization of steam mass flow rates and the balance of steam distribution within parallel passes. On larger 5200 and 5300 Series units, mechanical integrity is maintained by a matrix of clamps and supports developed to minimize flow-induced vibration.

Serrated Tube-to-Drum Connections

ensure integrity of the tube-to-drum seal. All convective bank tubes are inline to minimize gas-side draft losses and custom-engineered for optimum pitch and density to reduce fan power consumption.

5000 Series

		5040	5050	5060	5070	5080	5090
Typical Low NOx Maximum Capacity							
150 psi_g / Saturated…	[lbs/hr]	41,000	67,000	87,000	102,000	113,000	128,000
300 psi_g / Saturated…		40,000	65,000	85,000	100,000	110,000	120,000
650 psi_g / 750 °F…		35,000	45,000	60,000	75,000	95,000	110,000
900 psi_g / 850 °F…		33,000	40,000	52,000	65,000	80,000	95,000
Typical Vol. Heat Release Rate - HHV	Btu/hr-ft^3	65,000	70,000	75,000	80,000	85,000	90,000
Furnace Volume	[ft^3]	958	1099	1241	1382	1524	1665
Std Maximum Steam Temperature	[°F]	850	850	850	850	850	850
Std Maximum Operating Pressure	[psi_g]	1400/875/225	1400/875/225	1400/875/225	1400/875/225	1400/875/225	1400/875/225
Upper Drum Internal Diameter	[in]	42 / 48 / 54	42 / 48 / 54	42 / 48 / 54	42 / 48 / 54	42 / 48 / 54	42 / 48 / 54
Lower Drum Internal Diameter	[In]	24	24	24	24	24	24
Typical No. of Burners		1	1	1	1	1	1
Drum Length	[ft - in]	18 - 0	20 - 4	22 - 8	25 - 0	27 - 4	29 - 8
Typical Overall Height	[ft - in]	14 - 0	14 - 0	14 - 0	14 - 0	14 - 0	14 - 0
Typical Overall Width	[ft - in]	12 - 5	12 - 5	12 - 5	12 - 5	12 - 5	12 - 5
Typical Overall Length	[ft - in]	26 - 8	29 - 0	31 - 4	33 - 8	36 - 0	38 - 4
Approximate Weight @ 650 psi_g …	[tons]	35	40	45	50	55	60

Construction Standards

Furnace Front Wall:	air-cooled refractory
Furnace Rear Wall:	membrane panel - 2" OD on 3 1/2" spacing
All Other External Walls:	membrane panel - 2" OD on 3 1/2" spacing
Division Wall:	membrane panel - 2" OD on 3 1/2" spacing
Convective Tubing:	boiler - 2" OD superheater - 1 1/2" or 1 1/4" OD

5100 Series

		5105	5120	5135	5150	5165	5180	5195
Typical Low NOx Maximum Capacity								
300 psi_g / Saturated…		125,000	150,000	170,000	190,000	205,000	220,000	235,000
650 psi_g / 750 °F …	[lbs/hr]	105,000	120,000	135,000	155,000	175,000	200,000	230,000
900 psi_g / 850 °F …		90,000	105,000	120,000	140,000	160,000	185,000	215,000
1250 psi_g / 900 °F …		80,000	90,000	105,000	125,000	145,000	170,000	200,000
Typical Vol Heat Release Rate - HHV	Btu/hr-ft^3	65,000	70,000	75,000	80,000	85,000	90,000	90,000
Furnace Volume	[ft^3]	2053	2244	2435	2626	2817	3008	3370
Std Maximum Steam Temperature	[°F]	900	900	900	900	900	900	900
Std Maximum Operating Pressure	[psi_g]	1560/1050/260	1560/1050/260	1560/1050/260	1560/1050/260	1560/1050/260	1560/1050/260	1560/1050/260
Upper Drum Internal Diameter	[in]	48 / 54 / 60	48 / 54 / 60	48 / 54 / 60	48 / 54 / 60	48 / 54 / 60	48 / 54 / 60	48 / 54 / 60
Lower Drum Internal Diameter	[In]	24	24	24	24	24	24	24
Typical No. of Burners		1	1	1	1	1	1	2
Drum Length	[ft - in]	27-4	29-8	32-0	34-4	36-8	39-0	41-4
Typical Overall Height	[ft - in]	16-9	16-9	16-9	16-9	16-9	16-9	17-9
Typical Overall Width	[ft - in]	13-3	13-3	13-3	13-3	13-3	13-3	13-4
Typical Overall Length	[ft - in]	36-6	38-10	41-2	43-6	45-10	48-2	50-6
Approximate Weight @ 650 psi_g …	[tons]	65	75	85	95	105	115	130

Construction Standards

Furnace Front Wall:	air-cooled refractory with optional watercooling
Furnace Rear Wall:	membrane panel - 2 1/2" OD on 3 1/2" spacing
All Other External Walls:	membrane panel - 2 1/2" OD on 3 1/2" spacing
Division Wall:	membrane panel - 2 1/2" OD on 3 1/2" spacing
Convective Tubing:	boiler - 2" OD superheater - 1 1/2" or 1 1/4" OD

5200/5300 Series

		5205*	5225	5240	5250	5275	5325	5375	5450
Typical Low NOx Capacity									
300 psi_g / Saturated…		305,000	300,000	310,000	320,000	320,000	415,000	415,000	440,000
650 psi_g / 750 °F …	[lb/hr]	230,000	225,000	240,000	250,000	275,000	325,000	375,000	450,000
1250 psi_g / 900 °F …		215,000	205,000	-	225,000	248,000	293,000	338,000	405,000
1500 psi_g / 950 °F …		200,000	190,000	-	213,000	234,000	276,000	320,000	382,000
Typical Vol Heat Release Rate - HHV	Btu/hr-ft^3	75,000	70,000	55,000	65,000	60,000	55,000	55,000	50,000
Furnace Volume	[ft^3]	4438	4585	6287	5458	6390	8571	10540	14608
Std Maximum Steam Temperature	[°F]	950	950	950	950	950	950	950	950
Std Maximum Operating Pressure	[psi_g]	1500/910/380	1500/910/380	1160/750/220	1500/910/380	1500/910/380	1560/1130/625	1560/1130/625	1560/1130/625
Upper Drum Internal Diameter	[in]	54 / 60 / 66	54 / 60 / 66	54 / 60 / 66	54 / 60 / 66	54 / 60 / 66	60 / 66 / 72	60 / 66 / 72	60 / 66 / 72
Lower Drum Internal Diameter	[in]	30	30	30	30	30	36	36	36
Typical No. of Burners		1	1	1	1	1 or 2	2	2	2
Drum Length	[ft - in]	39 - 0	39 - 0	39 - 0	39 - 0	39 - 0	41 - 8	41 - 8	44 - 0
Typical Overall Height	[ft - in]	18 - 3	18 - 9	20 - 9	19 - 9	20 - 9	23 - 6	25 - 6	29 - 6
Typical Overall Width	[ft - in]	17 - 4	16 - 8	19 - 4	18 - 0	19 - 4	21 - 8	23 - 8	24 - 8
Typical Overall Length	[ft - in]	49 - 0	49 - 0	49 - 0	49 - 0	49 - 0	51 - 6	51 - 6	54 - 3
Approximate Weight @ 650 psi_g …	[tons]	130	135	160	150	165	195	215	245

Construction Standards:

Furnace Front Wall:	membrane panel - 3" OD on 4" spacing	
Furnace Rear Wall:	membrane panel - 3" OD on 4" spacing	
All Other External Walls:	membrane panel - 3" OD on 4" spacing	
Division Wall:	membrane panel - 3" OD on 4" spacing	
Convective Tubing:	boiler - 2" OD	superheater - 2" or 1 1/2" OD

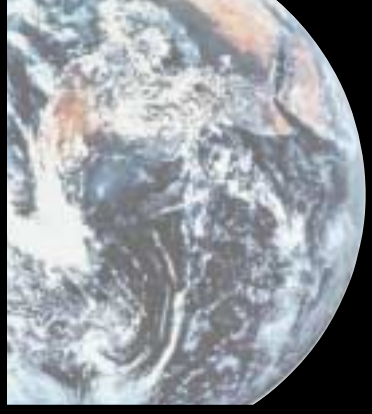
*MODULAR

Worldwide Delivery

Foster Wheeler's global production and procurement strategy provides the Package Boiler Business Unit with a strong local presence in many areas of the world. Local content can be optimized to minimize shipping costs, or specific country content can be maximized to support government financed projects and customer preferences.

Wherever the boiler and auxiliary components are fabricated, our experienced shipping personnel will coordinate shipment of all products we supply, with final destinations to any location worldwide.

For sites where access is limited, Foster Wheeler can provide a full range of boiler-erection services. These services can be extended to the installation of auxiliary equipment, thereby offering our customers Foster Wheeler quality and know-how through to project completion.



Worldwide Support

Foster Wheeler offices span the globe, ensuring your easy access to a wealth of technology and aftermarket support.
All offices are interconnected through advanced communication technologies providing seamless and efficient support for all of your steam generation needs. Our goal is to exceed your expectations in every respect.

FOSTER WHEELER

PACKAGE STEAM
GENERATING SYSTEMS
CENTER OF EXCELLENCE

ST. CATHARINES, CANADA