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W **H** **R**
M H B



WASTE HEAT RECOVERY BOILERS

MAKE EVERY BTU COUNT

Waste heat is a valuable resource. **Johnston Boiler Company's** line of single and triple pass Waste Heat Recovery (WHR) boilers offer your company a way to save valuable energy, energy typically lost in waste heat. The WHR series are used in petrochemical plants, refineries, steel mills, ore converters, brick or cement plants, glass works, and food processing plants. The WHR boiler extracts the BTU from these exhaust gasses, putting them to use generating plant steam or hot water.

Example:

A combination waste heat recovery unit (See **FIG. 1**) with an auxiliary gas/oil burner returned its capital investment 18 months after installation in an east coast chemical plant. Estimates indicate that #2 fuel oil usage dropped from 45 gallons per hour to approximately 7 gallons per hour. As an added benefit, the lower fuel consumption made it possible for management to add to its built-in fuel reserve for periods when fuel supplies are in short supply.

This "Hybrid" WHR boiler with supplemental fuel burners generates heat continuously to meet plant steam or hot water requirements. During periods when the heat content of waste exhaust gas is insufficient, the support burner will fire to provide steam within the desired range of operation.

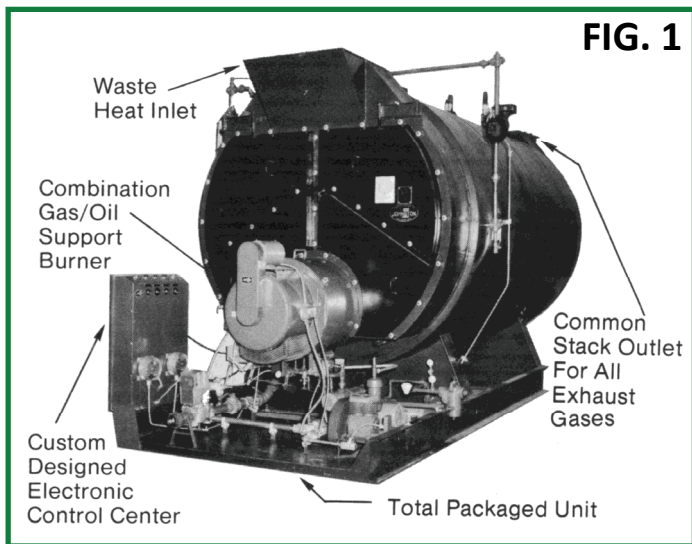


FIG. 1

Find out how you can get the most out of every BTU. Call **Johnston Boiler Company** and our design team will use our resources to help you save your resources.

WHR Boilers allow for:

- High efficiency heat transfer
- Minimum gas side pressure drop
- Reduced installation time and cost
- Use of a wide range of gas types, gas weights and gas temperatures

Design and Operating Range

Saturated Steam	Lbs/hr	2,000—165,000
Steam Design Pressure	PSIG	15—300
Hot Water	MBH	2,000—165,000
Hot Water Design Pressure	PSIG	30—160
Waste Heat Inlet Gas Temperature	°F	600—2,500
Waste Heat Mass Gas Flow	Lbs/hr	1,000—400,000

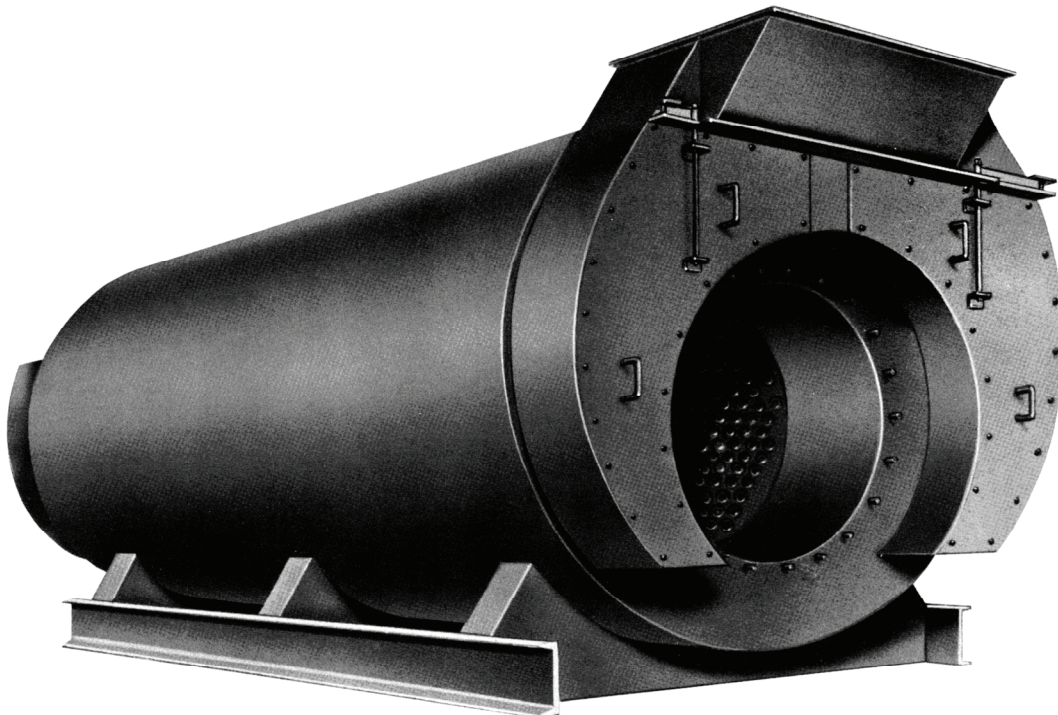
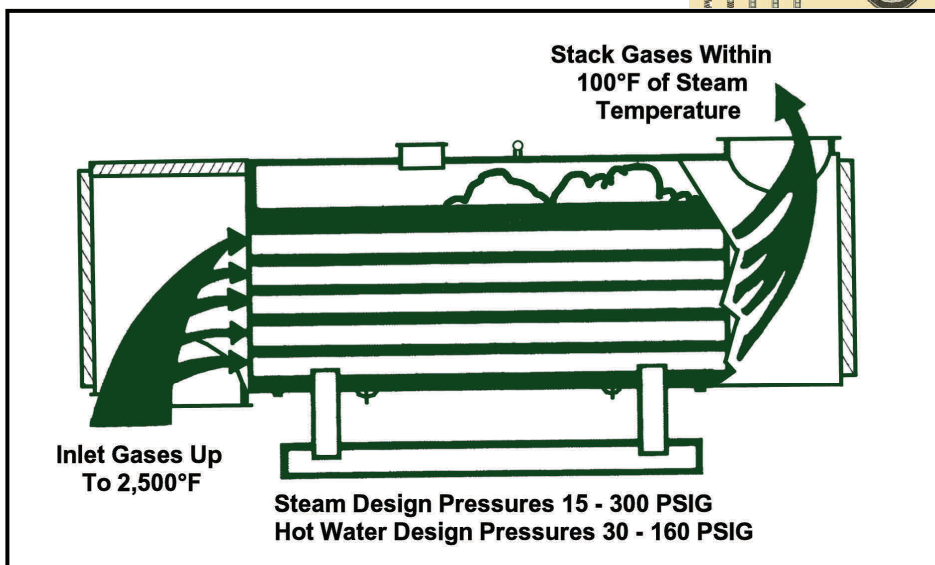
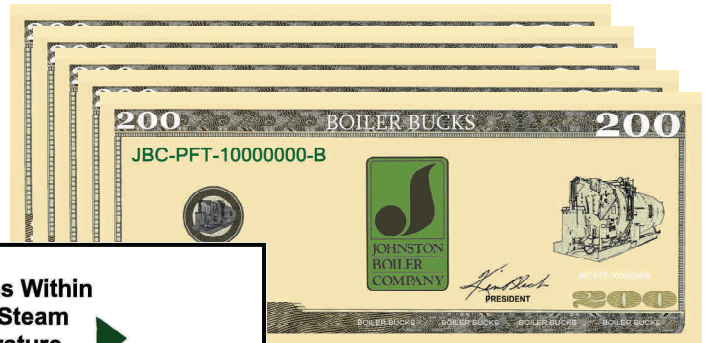
Note: Design and operating conditions listed and nominal. Increased capacities and higher design pressures may be available for some applications.

Since 1864 **Johnston Boiler Company** has built a reputation on innovative designs and rigid adherence to quality. We believe that boilers must be dependable. Today, as in 1864, Johnston's employees take personal pride in the quality and craftsmanship of each boiler produced.

REDUCING FUEL COSTS BY CONSERVING ENERGY

As natural gas and oil prices continue to rise it is increasingly important to find ways to conserve fuel costs. **Johnston Boiler Company's** line of WHR boilers are designed to recover heat from a variety of sources. Reducing fuel consumption is the key behind the **Johnston Boiler Company** WHR system. The WHR will save you money, money which can be reinvested into more profitable revenue streams.

Think of the WHR as a Green Money Saving Machine



Following is a typical waste heat recovery application involving operating conditions relating to a **Johnston Boiler Company** WHR boiler installation.

Gas Flow Lb/Hr	Inlet Gas Temperature °F	Boiler Model Number	Gas Side Pressure Drop “ WC	Outlet Gas Temperature °F	Heat Recovered MBH
100,000	1,200	WHR-132-16	4.5	435	21,369

We can calculate the energy conservation and applicable fuel cost reduction for this application and compare the zero fuel cost of **Johnston Boiler Company’s** WHR boiler with the fuel cost of a traditional gas or oil fired boiler, using the following equation.

$$\frac{\text{BTU/Lb. Steam} \times \text{Lb./Hr. Steam Capacity}}{\% \text{ Efficiency of Fuel Fired Boiler}} \times \frac{\text{\$/Gal. or Cu./Ft. Fuel Fired}}{\text{BTU/Gal. or Cu. Ft. of Fuel Fired}} = \text{Fuel Cost Per Hour}$$

Example:

Using the example from the table above with the following assumed operating conditions:

- Steam Operating Pressure = 100 PSIG
- Feedwater Temperature = 212°F
- Fuel Fired = #2 Oil having a HHV of 140,000 BTU/Gal.
- Fuel Cost = 3.58/Gal.
- Boiler Efficiency = 81.5%
- Steam Capacity = 21,165 Lb/Hr. [21,369 MBH ÷ (1,189.7 BTU/Lb. Steam @ 100 PSIG - 180.07 BTU/Lb. of Feedwater @212°F.)]

In this example the **Johnston Boiler Company** waste heat recovery boiler is capable of reducing fuel costs by as much as:

- \$402.00/Hr
- \$9,655.00/Day
- \$67,768.00/Week
- \$293,662.00/Month

Factor this savings out for one year and the numbers become staggering

$$\frac{1009.63 \times 21,165}{81.5\% \times 140,000} = 187.28 \times \$3.58/\text{Gal} \times 5,256 = \boxed{\$3,523,950.00/\text{Year}}$$

Estimated fuel savings are based on a conservative duty cycle of 60%

WASTE HEAT RECOVERY FROM INCINERATOR GASES

Continuous Steam / Intermittent Waste Heat

Job: ACME Chemical Company
New Haven, CT

System:

Thermal oxidizer (fume incinerator afterburner) fires 24 hours a day to remove objectionable gases emitted from process curing ovens. Steam demand in the plant is continuous, of which most is supplied by the waste heat boiler. The gas—oil burner runs about 5—10 minutes in an hour. Annual fuel consumption was reduced by about one-sixth of that previously required. Combination waste heat/fired unit size was very close to original fired Johnston boiler installed at this facility eliminating the need for building modifications.

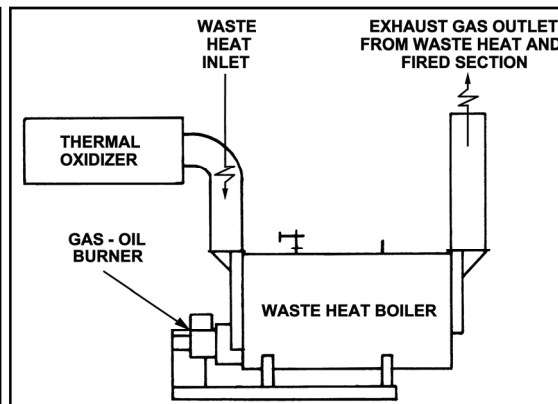
Duty:

Fired Section: 150 HP (5,180 lbs/hr), 130# operating (150# DP), #2 Oil, #4 Oil, or Natural Gas.

Waste Heat Section: 4,000 scfm waste gas @ 1,400°F reduced to 500°F recovering 4,250 lbs/hr steam at 130# with a 5" w.c. gas side pressure drop.

Control:

Operating limit actuates burner to maintain steam output. High limit and low water cutoff shut down system allowing for safe operation. On/Off feedwater control provided through boiler water level control.



WASTE HEAT RECOVERY FROM FURNACE GASES

Continuous Steam Waste Heat

Job: Casting Engineers
Chicago, IL

System:

Fume incinerator is used to burn core and mold gases 24 hours a day. Waste heat boiler uses heat tracing, external piping and internal coil to prevent freezing. All controls were boxed to protect from weather. Waste heat boiler provides all steam used in make-up air and ventilation in foundry. Connection to plant steam system provides savings through conserving fuel required for plant heating boilers.

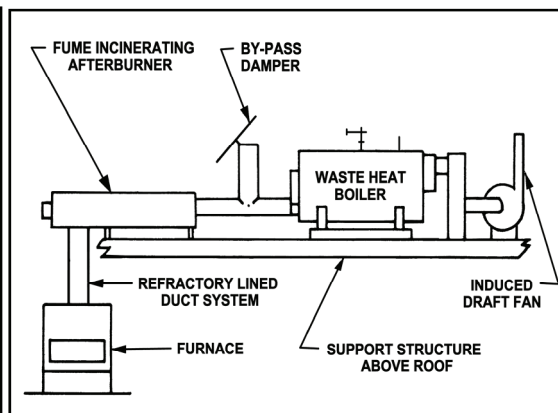
Duty:

330 HP (11,385 lbs/hr), 13# operating (15# DP)

Waste Heat Section: 6,000 scfm waste gas ranging from 1,400°F to 2,200 °F reduced to 384°F recovering from 8,470 MBH to 15,500 MBH with a 4.2" w.c. gas side pressure drop.

Control:

Operating limit actuates by-pass damper in response to steam demand. High limit and low water cutoff shut down system allowing for safe operation. On/Off feedwater control provided through boiler water level control.



WASTE HEAT RECOVERY FROM BY-PRODUCT FUELS

Modulating Steam Waste Heat

Job: Nestle Company
Granite City, IL

System:

Spent tea laves are incinerated after drying and mixing wood chips from tea boxes. 200 PSIG steam developed is taken into plant steam mains reducing fuel usage.

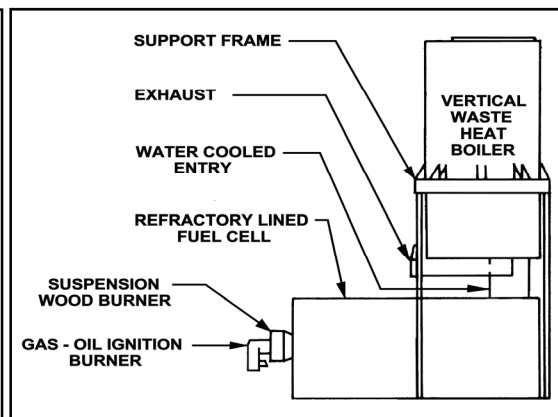
Duty:

905 HP (30,273 lbs/hr), 200# operating (250# DP) Tea/Wood fired by gas or oil until self-igniting.

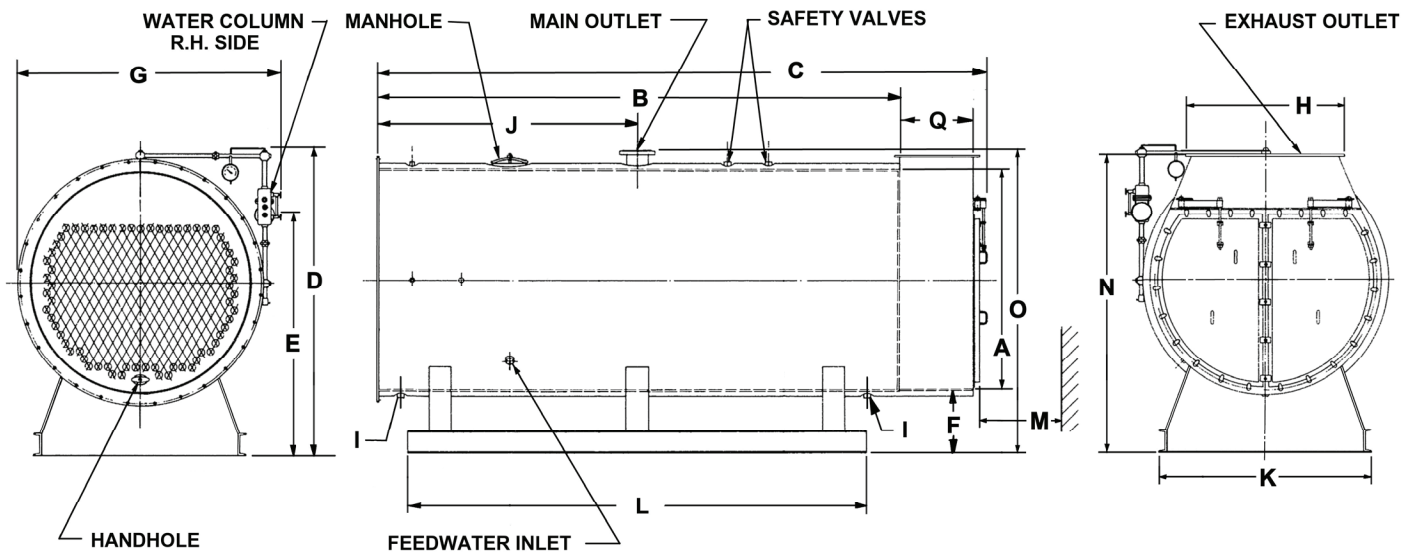
Waste Heat Section: 33,570 lbs/hr waste gas from 2,000 °F is reduced to 500°F recovering from 30,273 MBH with a 5" w.c. gas side pressure drop.

Control:

Modulating fire control is provided adjusting fire to steam pressure. High limit and low water cutoff shut down system allowing for safe operation. Modulating feedwater control provides constant steam pressure in main.



WHR-1 Single Pass Waste Heat Recovery Boiler



SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE
 MANUFACTURER RESERVES THE RIGHT TO CHANGE SPECIFICATIONS AT ANY TIME WITHOUT INCURRING ANY OBLIGATION FOR ANY EQUIPMENT PREVIOUSLY OR SUBSEQUENTLY SOLD

MODEL NUMBER														
Dimension	WHR1 54X114	WHR1 58X115	WHR1 64X115	WHR1 64X131	WHR1 72X131	WHR1 80X131	WHR1 80X179	WHR1 85X179	WHR1 91X216	WHR1 99X216	WHR1 108X216	WHR1 112X244	WHR1 112X268	WHR1 123X268
A	54	58	64	64	72	80	80	85	91	99	108	112	112	123
B	114	114	114	130	130	130	178	178	215	215	215	243	267	267
C	129	130	130	148	149	150	200	201	239	241	242	271	295	296
D	81	85	91	93	101	109	111	116	122	130	140	144	144	155
E	60	66	70	72	77	84	86	91	97	102	108	112	112	121
F	18	18	18	20	20	20	22	22	22	22	22	22	22	22
G	67	71	77	77	85	93	93	98	104	112	121	125	125	136
H	12	14	15	16	18	21	21	23	25	28	31	32	32	35
I	1.50	1.50	2	2	2	2	2	2	2	2	2	2	2	2
K	51	54	60	60	66	72	75	80	84	90	100	102	102	112
L	81	81	81	102	102	102	132	132	168	168	168	180	204	204
M	107	107	107	123	123	123	169	169	206	206	206	234	258	258
N	75	79	86	89	95	103	105	110	116	124	134	138	138	149
O	36	36	36	36	36	36	36	36	36	36	36	36	36	36

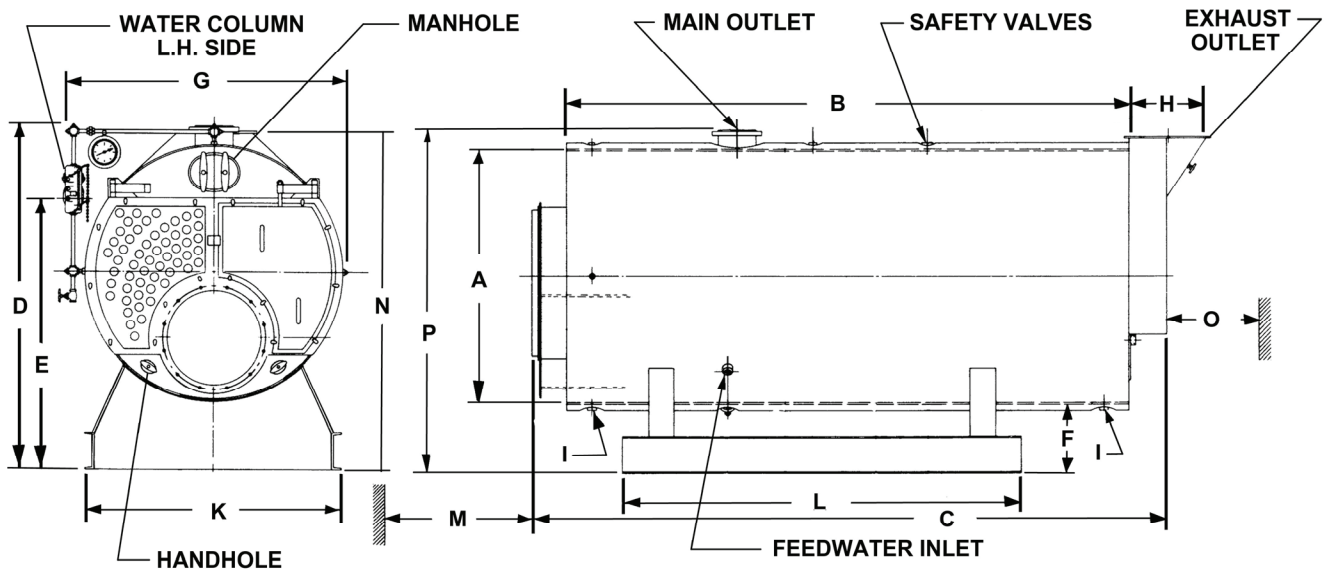
Notes: 1. Models listed are representative tabulations only. Consult factory for specific applications
 2. Consult factory for specific dimensions, weights, and capacities

Standard Trim/Equipment:

Insulation with sheet metal jacket
 Flanged exhaust gas inlet/outlet
 Hinged front and rear tube access doors
 Structural steel base
 Manholes and handholes for inspection and cleaning
 Steam trim and water column including related piping

Gauge glass with valves, try cocks, and chain operator
 Safety relief valves
 Steam pressure gauge
 Blowdown valves
 Main Blow-off valves
 Primary low water cutoff with pump control

WHR-3 Three Pass Waste Heat Recovery Boiler



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MODEL NUMBER														
Dimension	WHR3 54X114	WHR3 58X115	WHR3 64X115	WHR3 64X131	WHR3 72X131	WHR3 80X131	WHR3 80X179	WHR3 85X179	WHR3 91X216	WHR3 99X216	WHR3 108X216	WHR3 112X244	WHR3 112X268	WHR3 123X268
A														
B														
C														
D														
E														
F														
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H														
I														
K														
L														
M														
N														
O														
P														

CUSTOM DESIGN

Notes: 1. Models listed are representative tabulations only. Consult factory for specific applications.
 2. Consult factory for specific dimensions, weights, and capacities

Standard Trim/Equipment:	
Insulation with sheet metal jacket	Gauge glass with valves, try cocks, and chain operator
Flanged exhaust gas inlet/outlet	Safety relief valves
Hinged front and rear tube access doors	Steam pressure gauge
Structural steel base	Blowdown valves
Manholes and handholes for inspection and cleaning	Main Blow-off valves
Steam trim and water column including related piping	Primary low water cutoff with pump control

