Water-Tube Package Boilers
Reliable and Economical Steam Production
Since 1867, The Babcock & Wilcox Company (B&W) has been designing, manufacturing and installing the world’s most reliable and efficient energy-generating systems and environmental equipment. B&W also services, repairs, upgrades and replaces existing systems and associated equipment, regardless of the original manufacturer. With boiler installations operating in more than 90 countries, B&W has the experience and flexibility to meet the ever-changing needs of both our utility and industrial customers.
B&W: the Single-Source Supplier of Innovative Energy Solutions and Total-Scope Services

Dependable performance for a wide variety of industries

B&W's water-tube package boiler (FM) continues this tradition of excellence with more than 4,200 units in operation. Our established reputation for reliability and proven performance is continually enhanced by incorporating the latest technological advancements into our design. B&W is dedicated to providing its water-tube package boilers to a variety of industries, including:

- Hospitals
- Universities
- Manufacturing and processing facilities
- Utilities
- Petrochemical
- Pulp and paper
- Pharmaceuticals

System components complement operation

Specifically designed to complement each other in operation, all major components in the FM package boiler system are supplied by B&W:

- Boiler
- Burner
- Controls
- Fan
- Economizer
- Sootblowers
- Added options (feed pumps, deaerators, chemical feed systems)
- SCR and CO catalyst

Wide capacity range

B&W water-tube package boilers are available in a wide range of capacities:

- Steam flow from 8,200 to 260,000 lb/h (1 to 33 kg/s)
- Superheat temperatures up to 875F (468C)
- Design pressures from 250 to 1250 psi (1.7 to 7.2 MPa)

High capacity package boilers are also available for both oil and gas firing. B&W provides the high capacity FM (HCFM) and the PFM boiler engineered with the same quality standards as our smaller package boilers. These units feature multiple burners for increased capacity. The HCFM can be either shop, dock or field assembled, while the PFM must be assembled either at the dock or field location. Both types of units are shipped by barge or ocean vessel.

Support services

In addition to equipment supply, B&W offers comprehensive support services, including:

- Field engineering services
- Inspection and maintenance services
- Engineered upgrades
- Long-term service programs
- Training programs
- Operating instructions
- Start-up services
- Spare parts manuals
- Replacement parts
- Sales assistance

The compact, efficient design of B&W’s water-tube package boilers allows for economical shipment via rail or truck.

B&W's engineering expertise and complete project management skills help to ensure that a project is right the first time and on time without additional costs.
Water-Tube Package Boilers: B&W’s Engineering Expertise Offers Many Benefits

Long-term reliability

B&W maintains the same cornerstone company values as we did in 1867 when the first B&W water-tube steam boiler was patented. These values include a commitment to excellence, outstanding customer service, quality and continuous improvement, integrity, technology leadership, accountability and a commitment to our people. Based on these values, B&W builds equipment that is designed to last. In fact, many 1950s-vintage B&W package boilers are still in service today.

Fast load response

B&W’s 2.5 in. (6.35 cm) tubes are spaced 1 in. (2.54 cm) apart. This provides a larger volume of water in our furnace walls and contributes to a faster load response. In addition, our uniquely designed drum internals can handle varying loads without circulation disruptions or carryover. Connections for lower drum heating coils are also standard.

Low operating and maintenance costs

The B&W package boiler drives maintenance to a minimum with:
- No reliance on refractory seals
- Positive circulation, 100% water-cooled rear wall
- A fully drainable superheater located in the convection bank
- Galvanized, primed and enamel-painted exterior lagging
- Hinged drum manways for improved waterside access

Controlled emissions

B&W’s combustion design engineers work with outside burner suppliers to meet your stringent requirements. The elimination of floor brick gives our furnace more water-cooled surface, thereby helping to meet today’s tough emissions limits.
# Water-Tube Package Boilers: Capacities to Meet the Most Demanding Requirements

<table>
<thead>
<tr>
<th>Boilers</th>
<th>Capacity Range* (lb/h)</th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
<th>Drum Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>FM 9-22</td>
<td>8,200 to 40,000</td>
<td>7 ft 7 in.</td>
<td>10 ft 2-⅔ in.</td>
<td>12 ft 4 in.</td>
<td>36 in. Steam Drum</td>
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<tr>
<td></td>
<td></td>
<td>8 ft 11 in.</td>
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<td></td>
<td>24 in. Lower Drum</td>
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<td></td>
<td></td>
<td>9 ft 11 in.</td>
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<td>11 ft 3 in.</td>
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<tr>
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<td>12 ft 7 in.</td>
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<tr>
<td></td>
<td></td>
<td>13 ft 11 in.</td>
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<tr>
<td></td>
<td></td>
<td>15 ft 3 in.</td>
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<tr>
<td></td>
<td></td>
<td>16 ft 7 in.</td>
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<td></td>
<td>17 ft 11 in.</td>
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<tr>
<td>FM 10-52</td>
<td>35,000 to 75,000</td>
<td>16 ft 7 in.</td>
<td>10 ft 10-⅛ in.</td>
<td>13 ft 6 in.</td>
<td>36 in. Steam Drum</td>
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<tr>
<td></td>
<td></td>
<td>17 ft 11 in.</td>
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<td></td>
<td>24 in. Lower Drum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19 ft 3 in.</td>
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<td>20 ft 7 in.</td>
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<tr>
<td></td>
<td></td>
<td>21 ft 11 in.</td>
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<tr>
<td></td>
<td></td>
<td>24 ft 7 in.</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>27 ft 3 in.</td>
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</tr>
<tr>
<td>FM 103-70</td>
<td>70,000 to 100,000</td>
<td>21 ft 3-⅜ in.</td>
<td>11 ft 9 in.</td>
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<td>42 in. Steam Drum</td>
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<tr>
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<td></td>
<td>23 ft 11-⅝ in.</td>
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<td></td>
<td>24 in. Lower Drum</td>
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<tr>
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<td></td>
<td>26 ft 7-⅝ in.</td>
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<td></td>
<td>29 ft 11 in.</td>
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</tr>
<tr>
<td>FM 106-79</td>
<td>100,000 to 155,000</td>
<td>23 ft 11-⅝ in.</td>
<td>11 ft 9 in.</td>
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<td>48 in. Steam Drum</td>
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<td>26 ft 7-⅝ in.</td>
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<td>24 in. Lower Drum</td>
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<td>29 ft 3-⅜ in.</td>
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<td>26 ft 7-⅝ in.</td>
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<td></td>
<td></td>
<td>29 ft 3-⅜ in.</td>
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<tr>
<td>FM 120-97</td>
<td>155,000 to 260,000</td>
<td>29 ft 3-⅜ in.</td>
<td>12 ft 5-⅜ in.</td>
<td></td>
<td>54 in. Steam Drum</td>
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<tr>
<td></td>
<td></td>
<td>33 ft 7-⅞ in.</td>
<td></td>
<td></td>
<td>24 in. Lower Drum</td>
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<tr>
<td></td>
<td></td>
<td>37 ft 3-⅛ in.</td>
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<td>37 ft 3-⅛ in.</td>
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<td></td>
<td>37 ft 3-⅛ in.</td>
<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Steam capacity</th>
<th>Steam pressure</th>
<th>Steam temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCFM 200,000 to 350,000 lb/h (25.2 to 44.1 kg/s)</td>
<td>to 1250 psig (7.2 MPa)</td>
<td>to 825F (441C)</td>
</tr>
<tr>
<td>PFM 200,000 to 600,000 lb/h (25.2 to 75.6 kg/s)</td>
<td>to 1800 psig (12.4 MPa)</td>
<td>to 900F (482C)</td>
</tr>
</tbody>
</table>

**NOTES:**
1. All package boilers are of membrane construction.
2. Because of B&W's constant effort to improve design, equipment supplied may differ slightly from that described above.

**METRIC CONVERSIONS:**
- inches x 25.4 = mm
- inches x 2.54 = cm
- feet x 0.3048 = m
- lb/h x 0.000126 = kg/s

* Steam capacities shown are saturated steam. Capacities shown will vary depending on conditions and limitations.
Proven D-type construction, which has separate boiler and furnace sections, creates proper geometry of the burning chamber resulting in increased combustion efficiency.

B&W’s package boiler designs offer many other features and benefits not available with competitive units. The features described below are numbered to refer to the main illustration above and to the detailed illustrations on the next page.

1) **Furnace wall water cooling** includes not only the side walls, roof and floor, but the high-duty rear wall as well – eliminating refractory and its inherent maintenance. This unique boiler feature locates total water cooling where it can contribute most to keeping maintenance costs down. Each rear wall tube is a single flow path between drums to assure proper circulation and cooling.

2) **Gas-tight setting membrane** provides the gas-tight setting absolutely necessary on all package boilers. This construction uniquely inhibits dew-point sulfur corrosion and outages caused by gas leaks. B&W’s membrane panels use large diameter tubes and small membrane spacing that provide the best combination of heat transfer efficiency and maintenance accessibility.

Scalloped seal plates (illustrated in 2-A, next page) on the membrane design also provide a continuous gas-tight seal between the tube membrane and drums. Where inner-cased construction is used, a 10-gauge plate is welded to the tie bars instead of directly to the pressure parts (shown in 2-B, next page). To maintain casing above the dew point temperature, the plate is formed around the tie bar to ensure close plate-to-tube contact.

3) **Rugged steel-base frame** supports the entire boiler and allows jacking and skidding of the boiler. A concrete slab with no special saddle, supports or piers is all that is needed for the package boiler. To ease installation and relocation, B&W’s frame has built-in lifting lugs and jacking pads.

4) **Outer lagging** is galvanized, primed and painted, making it weather-tight for outdoor installations. The side lagging is composed of 20-gauge corrugated aluminum. The remaining exterior casing is 12-gauge steel. The 12-gauge roof casing also provides a surface strong enough to walk on.

5) **Drum internals** provide high steam purity and ensure positive circulation. There are two primary separators to choose from – a baffle-type for 3 ppm solids or an optional cyclone-type (shown in main illustration, left) for 1 ppm solids. Both designs incorporate corrugated-type secondary scrubbers. Dry pipe steam separation is also available for 0.5% moisture steam.

6) **Water wash troughs and drains** are standard on every new package boiler.

7) **Grooved tube seats** with polished tube ends provide maximum protection during initial handling and transportation, as well as against leakage throughout the life of the unit. B&W’s tube seats provide maximum holding power and seal integrity.

8) **Sootblowers** are properly located for effective convection bank cleaning. Sootblower bearings, wallbox(es) and tube openings are standard on all package boilers, regardless of fuels fired. An additional B&W boiler feature is that the alternating front-to-rear bank spacing allows removal of any tube without removing adjacent tubes. (illustrated in 8-A, next page)

9) **Front wall fire brick** is designed for expansion and protection of the front corner seals, and the front wall tile is anchored by a floating alloy retainer. To protect the corner seals, the front wall of the membrane unit is set inside furnace D tubes. (illustrated in 9-A, next page)

10) **Membraned division wall** prohibits furnace gases from bypassing the generating tubes which can lead to high CO levels. The division wall stretches approximately three-quarters of the furnace length.

11) **Superheaters** are the inverted loop-type and are located in the first gas pass. Screen tubes are provided in front of the superheater. The number of rows depends on the desired temperature and on the number of superheater loops. The superheaters are completely drainable and designed for balanced flow throughout each tube for added longevity. Drum protection is also added to safeguard thicker wall drums in the superheater areas.
Adequate slope is designed on all heat absorbing surfaces, and all downcomers are located in the cooler zone of the convection bank for proper circulation. Each tube is completely drainable.

Even when load changes are wide or frequent enough to affect water level in the drum, positive circulation is assured with B&W drum internals. As hot furnace flue gas crosses the first row of tubes in the boiler bank, a considerable amount of steam is generated. This quantity is substantially greater on higher-capacity units for essentially the same drum length, imposing a tremendous burden on drum internals.

B&W separation equipment is specifically designed to handle this rapid, intense generation of steam effectively. Diffuser baffles direct portions of the steam to less turbulent zones of the drum, making use of the entire length of scrubbing elements to remove unwanted moisture droplets.

**Enhanced superheater reliability**

Steam with less than 1 ppm solids can be obtained when required by superheaters or special processes. Turbine blades are kept cleaner, and the reliability of the superheater is greatly enhanced. An equally important feature designed into B&W's drum internals is the supply of steam-free solid water back to the downcomer circuits for positive circulation. The drum internals' design also allows free end flow to minimize turbulence and end-to-end water level fluctuation.

*B&W designs and manufactures its drum internals, including cyclone steam separators.*
Water-Tube Package Boilers: Complemented by a Complete Line of Auxiliary Equipment

Economizers, superheaters, burners and controls are available from B&W for package boilers in accordance with operating and economic design considerations. Additional accessory equipment, including a forced draft fan and drive, flues and ducts, stacks, feedwater pumps, deaerator, and an oil pump and heater set can be ordered to simplify planning and engineering.

Economizers increase efficiency

Economizers are available for increased efficiency. Pre-engineered arrangements of extended surface or bare-tube economizers are offered to meet varying fuel, space and economic considerations.

Fully drainable superheaters

Proven, dependable and fully drainable superheaters – especially designed for package boilers – are also available. The vertical-tube design provides positive bottom support and excellent expansion characteristics. Multi-pass steam flow ensures high steam velocities and good distribution of fluid throughout, effectively cooling each tube. Because it is positioned out of the full radiant heat zone, it has a convective-radiant temperature characteristic for a relatively constant superheater steam temperature over the load range. For further convenience, the steam outlet is located near floor level. To protect the thicker wall drums in the superheater area, refractory drum protection is provided.

For higher steam capacities, B&W offers HCFM and PFM boilers that are engineered with the same quality standards as our smaller package boilers.

For oil-fired applications, sootblowers are a typical feature. The soot blower supply and superheater outlet connection are shown in this picture.
Water-Tube Package Boilers: Total-Scope Supply and Services

B&W’s extensive, worldwide experience allows us the flexibility to meet diverse project requirements easily – anything from a knock-down boiler for field assembly to an entire steam island. We can package your boiler system with properly sized auxiliaries to match your needs and our standards of quality and excellence.

Typical project scope

Although every project is unique in scope, a typical project includes:

- FD fan and drive
- Burners and fuel trains
- Burner management system
- Combustion controls – jackshaft to DCS
- Economizer
- Stack
- Platforms
- Deaerator and feedwater pump set
- Selective catalytic reduction (SCR) system, when required

Stringent quality control standards

At B&W, quality assurance is integral to our design, engineering and manufacturing processes. To ensure all codes and specifications are met, B&W uses stringent quality control procedures and sophisticated testing apparatus. Rigid standards have been established for our material suppliers as well.

B&W’s commitment to quality is evident by our:

- Advanced technology – B&W builds quality into its products during every process and stage
- Strength in size and capacity – facilities, manpower and global presence provide you with a complete range of fabricating processes
- Outstanding responsiveness – B&W is equipped and structured to meet your delivery needs and requirements

Manufacturing and safety excellence

B&W’s package boilers are designed, engineered and manufactured at our West Point, Mississippi, U.S.A. facility. This plant is ISO-9001 registered, holds ASME Code stamps S, PP and U, and is in compliance with AWS code requirements. B&W’s West Point plant also maintains an outstanding safety record and has been awarded the OSHA Star Status in the Voluntary Protection Program. Manufacturing and safety excellence are continuous goals for B&W.

Worldwide, responsive service and manufacturing support

B&W’s network of domestic and international sales representatives and field service engineers assures you of a prompt response – whether servicing and upgrading your existing system or specifying new equipment. Our package boilers are also available through various licensees around the world. We can provide services ranging from routine inspections and controls tuning to capacity increase engineering studies, low emissions conversions or new digital control systems.

Reliable single-source supplier

B&W’s proven expertise in boilers, burners and controls makes us a reliable and responsive single source for package boilers and auxiliary equipment. From engineering and manufacturing to start-up and operation, B&W knows how to make it all work together for maximum operating efficiency and dependability.
B&W is dedicated to generating powerful solutions in an environmentally safe, efficient and economical manner.
Babcock & Wilcox Power Generation Group, Inc. is a subsidiary of The Babcock & Wilcox Company (B&W). Established in 1867, B&W is a world leader in providing steam generating and emissions control equipment, nuclear operations and components, and defense program management services.

For more information, or a complete listing of our sales and service offices, call 1-800-BABCOCK (222-2625), send an e-mail to info@babcock.com, or access our Web site.

www.babcock.com