

# B+II WaterWizard

Steam-to-Water Heaters



## More Than 50 Years of Innovative Engineering



The AERCO B+II WaterWizard high-efficiency heater is designed to satisfy potable water heating needs in commercial and institutional environments. The packaged, steam fired system incorporates real-time, load tracking and responsive controls to maintain accurate hot water temperatures under diversified loads.

The unit's semi-instantaneous design (steam in tubes and water in shell) is compatible with low or high steam pressures. And installation is easy because of its small footprint (0.37m<sup>2</sup>) and doorway size. Outstanding thermal efficiency, tight temperature control, low maintenance, longevity and overall reliability make the AERCO B+II WaterWizard the most logical choice for any commercial or institutional water heating installation.

# A Closer Look at a Truly Innovative Design

In 1949, AERCO's founder, Henry Angelery, had an idea for a water heater that offered accurate temperature control without storage tanks. From this idea, he designed and manufactured the world's first compact, tankless water heater—paving the way for the thousands of semi-instantaneous and instantaneous heating units that are available today. Although a wide variety of various products and technologies have emerged over the ensuing 50+ years, none rival the performance, ease of ownership and durability of the B+II WaterWizard™ heater. Based on Angelery's original concepts for heat exchanger design, fully modulating steam input and temperature-control approach, this time-tested design has been consistently improved by AERCO to meet the needs of 21st century applications. Introduced in 1993, the steam-to-water B+II WaterWizard heater delivers the following:

- Available in 13 sizes from 3-coil to 15-coil heaters
- Accurate temperature control – maintains unit at  $\pm 2.2^{\circ}\text{C}$  even under rapidly fluctuating loads
- Advanced electronic controls – provide detailed operating information and support BAS integration
- Energy efficient – engineered to deliver more usable heat from each pound of steam input
- Low-cost installation – compact  $<0.37\text{ m}^2$  footprint; no tanks, traps or blending valves required
- Low maintenance – self-descaling design means no messy chemical cleaning—ever!
- Long-lasting durability – robust design and materials maintain performance as decades pass
- Integrated safety shut-off system – operates independently of power and unit controller
- Single phase 110V/60Hz installation
- Supports a variety of applications
  - 0.34 to 10.3 bars steam supply
  - Intermittent water flow rates up to 15.8 LPS
  - Set point range  $10^{\circ}\text{C}$  to  $96.1^{\circ}\text{C}$
  - 16.2 bar ASME working pressure certified
  - Single or multiple installation
  - Ideal for new or retrofit

It is important to look closely at the B+II WaterWizard's unique design, especially its dual-control strategy, fully modulating steam control valve and helically shaped, heat exchanger design. Each of these elements helps deliver precise temperature control, low installation and operating costs, easy maintenance and long life. Understanding the unit's theory of operations will also help you appreciate why the B+II WaterWizard is far superior to other heaters.

# Theory of Operation

The B+II WaterWizard heat exchanger consists of a vertical stack of individual free-floating, helically-shaped coils—each of which is attached to both a steam riser and condensate return. Water flows from the bottom to the top of the unit and is heated as it passes over the coils in a counterflow design. As the steam enters each coil, it circles within three channels to its center endpoint before being forced back via the remaining channel into the condensate drain pipe.

As steam condenses inside the coils, the resulting change in volume (and therefore pressure) induces steam flow, which is controlled by a fast-acting, fully modulating, steam-regulating valve. All condensate from the upper coils is forced through a dedicated subcooling coil located at the very bottom of the ASME-coded, copper-lined pressure vessel nearest to the incoming cold water. Condensate discharged from the unit is typically <math>60^{\circ}\text{C}</math>, so no steam traps are required. A maintenance-free orifice (supplied) controls the flow of the liquid condensate.

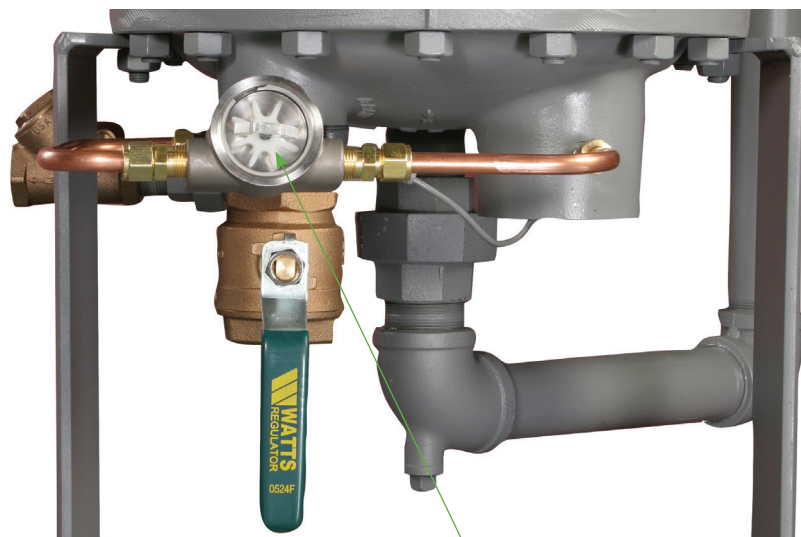
## Dual-Control Strategy: Feed-Forward and Feedback

Conventional heaters typically use crude, “feedback-only” controls to sense temperature changes inside the heater. Control corrections are based solely on outlet water temperatures. Much like steering a boat based on the wake, adjustments are merely after-the-fact responses to conditions caused by flow variations that may have already changed or ended.

For more precise temperature control, the B+II WaterWizard controller leverages “feed-forward” programming to measure real-time load changes. A flow meter, located at the base of the unit, signals current demand changes based on inlet water flow. In conjunction with a simultaneous measure of outlet water temperature, the control system then adjusts the steam valve to ensure that an ideal amount of steam is supplied to heat the incoming load to the desired outlet temperature.



Controller



Flow meter

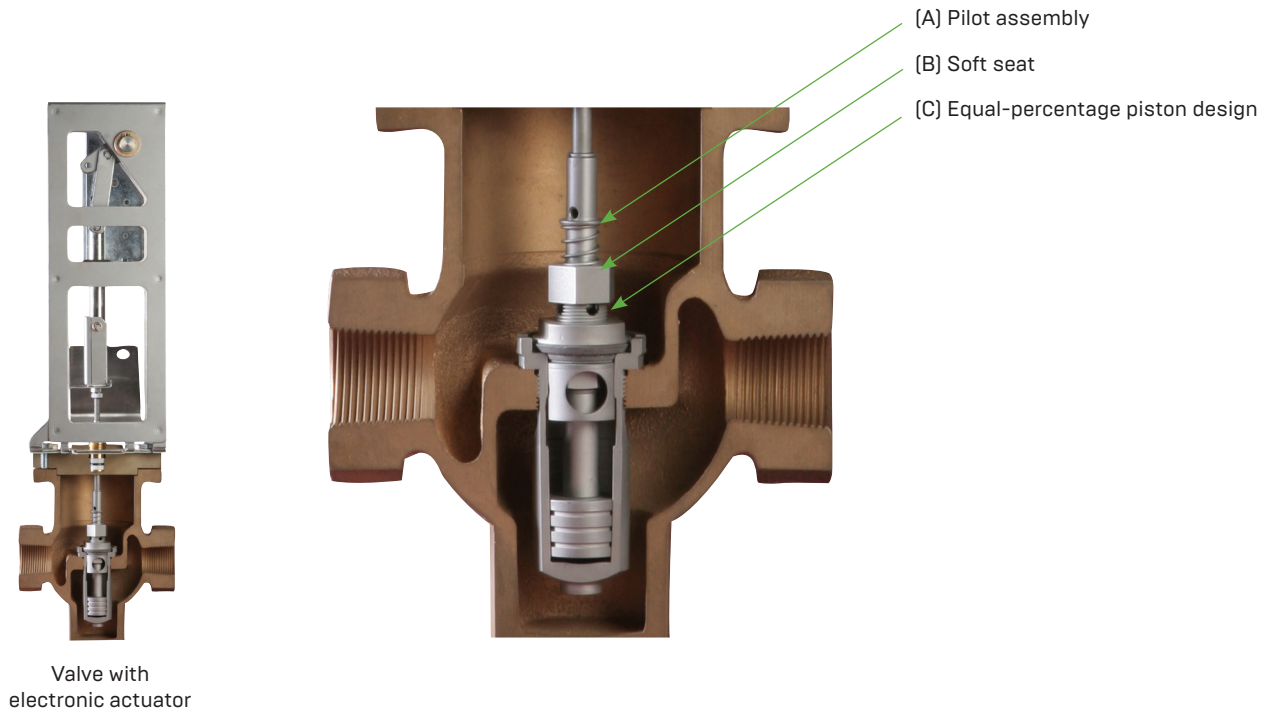
# Control System

## Fully Modulating, Steam-Control Valve and Electronic Actuator

Because accurate temperature control depends upon carefully modulating steam input, even the best control systems will be of little value if coupled with an unresponsive control valve. So rather than rely on an off-the-shelf, generic valve that may fail to close tightly due to premature seat wear, the B+II WaterWizard heater incorporates a proprietary valve designed by AERCO and performance-proven since 1982.

A pilot assembly (A) in the valve body ensures that a small inner seat is the only component that must be actuated to regulate the initial flow of steam through the valve. Once open, the equal-percentage piston design (B) immediately achieves and maintains equal pressure on both sides of the valve. And this, in turn, affords far greater control over the low loads that characterize typical operating conditions—more than can be achieved with linear or quick-open-flow designs. Finally, the soft seat (C), designed to exceed ANSI Class VI shutoff requirements, provides a bubble-tight seal for applications where periods of zero demand or safety shutdown are encountered. This tight seal also enables the B+II WaterWizard heater to operate in a vacuum, extracting additional energy from the steam.

The valve also enables AERCO to leverage the faster performance of the smallest possible actuator package. The valve can go from full open to full close (and vice versa) in just seven or nine seconds (depending on valve size) and can handle up to 10.3 bars steam.



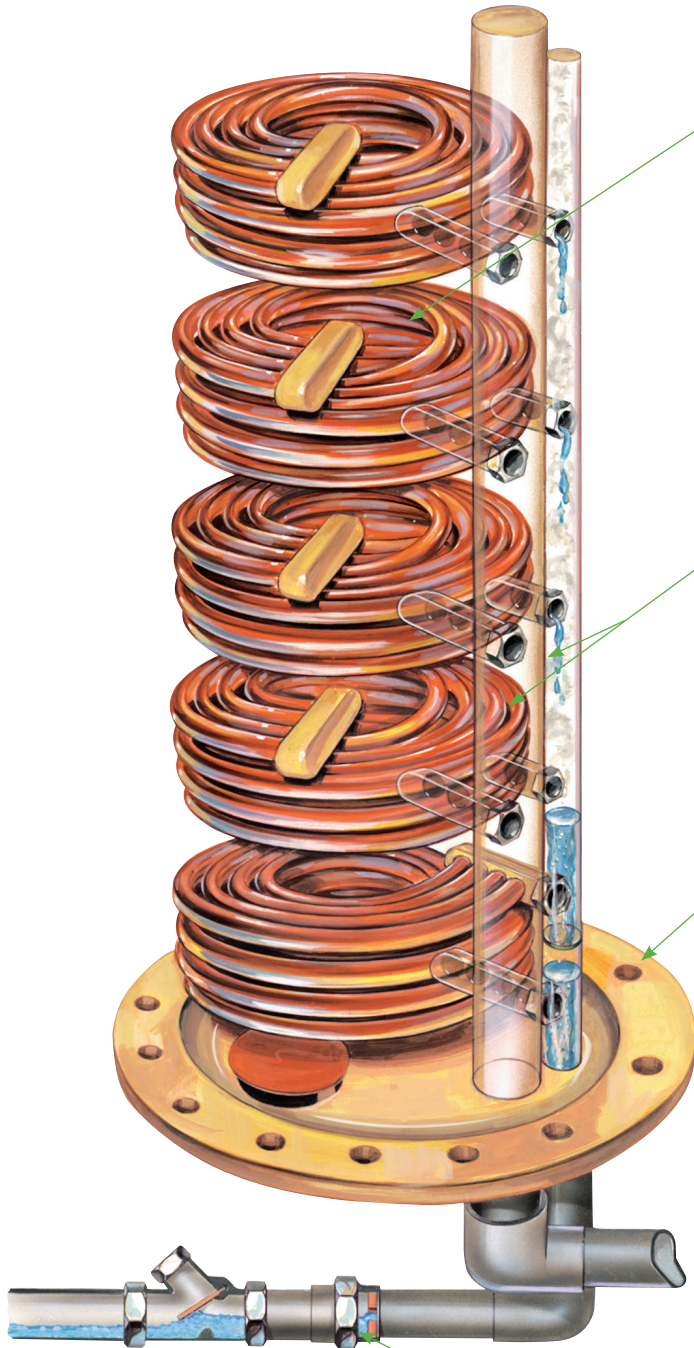
# Sub-cooling and Self-Descaling Helical Coil Heat Exchanger

The B+II WaterWizard heat exchanger consists of a vertical stack of individual free-floating, helically-shaped coils—each of which is attached to both a steam riser and condensate drain pipe. Key features of this innovative design deliver distinct advantages versus conventional U-tube and plate-and-frame-style heat exchangers.

- **Extensive surface area**
  - Heat transfer is maximized for superior efficiency in a compact <0.37 m<sup>2</sup> footprint
  - Smaller unit can be used for most applications
  - Stacked-coil arrangement keeps water-side velocities low to curtail erosion
- **Self-descaling coil design**
  - Each baffle-free, flexible coil acts as an independent, free-floating, stress-free spring, continuously expanding and contracting with changing water and steam temperatures during normal unit operation
  - Self-descaling design eliminates the need for periodic acid or mechanical tube cleaning
  - Durability of design supports thermal shocking procedure as part of routine maintenance
- **Dedicated subcooling coil**
  - Recovers more energy from each pound of steam than conventional products
  - Heat loss from condensate return piping can be reduced by up to 75% or more
  - Eliminates flash loss to cut energy use by up to 15% and minimize expenses for makeup feed-water and treatment chemicals
  - Increases life of condensate pump motor and seal and reduces impeller cavitation damage
  - No steam traps or vacuum breakers needed



# Specifications



Individually replaceable and fabricated from 1.25 mm wall copper tube, the free-flowing manifolded design of the heat exchanger coils increases steam-flow capacity and improves heat transfer significantly; ASME-rated to no less than 17 BAR working pressure at 204°C

Steam and condensate risers made from schedule 80 red brass pipe are strong, corrosion resistant and long-lasting

Cast bronze heads are considered the most durable, corrosion-resistant and reliable material available for potable water applications

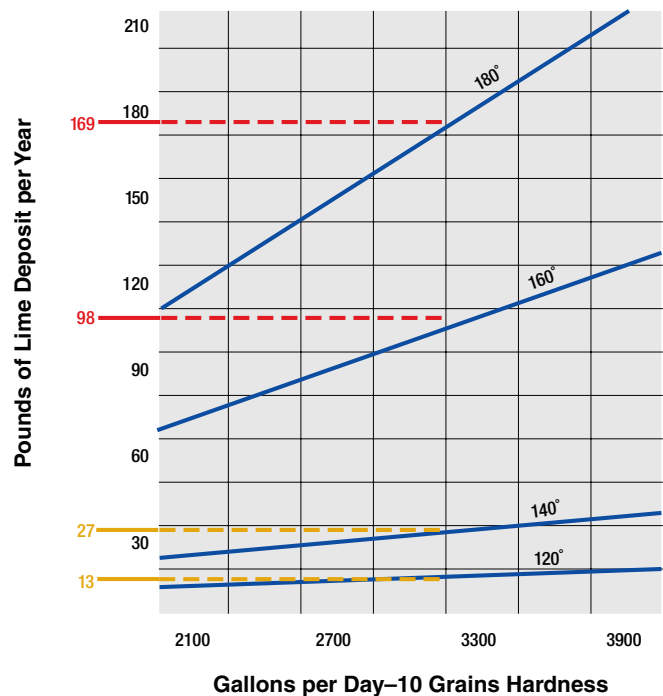
Subcooling eliminates the need for traps in most applications; A bronze condensate orifice provides an effective, reliable and maintenance-free solution for controlling the flow of liquid condensate

# Accurate Temperature Control

Precise temperature control delivers more than just comfort and peace of mind – it helps reduce operating and maintenance costs across the overall system. By tightly controlling outlet temperature, the set point can be lowered to the absolute acceptable minimum with no extra cushioning to compensate for swings. A lower set point will reduce the amount of steam required as well as reduce piping-system radiation losses that would have had to be removed (at extra cost) by the air conditioning system.

- Integrated load-monitoring system and patented steam valve deliver precise temperature control
- Temperature can be controlled to  $\pm 1.1^{\circ}\text{C}$  under constant loads and  $\pm 2.2^{\circ}\text{C}$  control under normal load changes
- Reliable performance, even when load fluctuation exceeds 50% of heater capacity
- No storage tanks, blending valves or other temperature-averaging components required
- Lower system set point reduces operating and maintenance costs

A lower set point will produce far less scale, which leads to better long-term efficiency, less maintenance and a longer heater life. As shown, heating hard water (ten-grain hardness) to  $60^{\circ}\text{C}$  will produce twice as much lime scale as heating it to  $49^{\circ}\text{C}$ . A  $82^{\circ}\text{C}$  set point generates thirteen times as much scale as  $49^{\circ}\text{C}$ .





# Advanced Controls

More than simply an add-on actuator and PID controller, the fully integrated design of the electronic controls package incorporates a combination flow meter/inlet temperature sensor, inlet-steam vacuum/pressure gauge at the heat exchanger, feedback sensor, outlet temperature indicator and safety system. Together, these components work in concert to maximize the superior performance and control of AERCO's patented valve.

- Easy, one-touch start-up—just “set and go”
- Dial-in operating set point and digitally tune system parameters
- Remote access to monitor or control performance settings
- Fully compatible with BAS or EMS systems via Modbus Open Protocol
- Control or monitor many operating parameters, including:
  - Operating set point and real-time flow (GPM)
  - Outlet, peak, average and low temperatures
  - Over-temperature warning and full alarm settings

The top-left value displayed is the unit's real-time outlet temperature as measured by a thermocouple at the shell outlet. Directly below, the operating set point value established by the customer is displayed. Up and Down buttons located below enable users to change the outlet temperature set point.

Located on the right is a separate Over Temperature display. By default, it shows the real-time outlet temperature as it has been independently measured by a second thermocouple in the shell. Pressing the Set, Up and Down buttons on this panel enables the customer to view and change the settings for over temperature alarm values.



Controller

# Energy Efficiency

With the B+II WaterWizard, you'll get more usable heat per pound of steam than conventionally designed products.

- Extensive surface area maximizes heat transfer
- Self-descaling capability of helical coils keeps heat-transfer surface clean
- Precise temperature control supports lower system set points and minimizes potential for scaling
- Dedicated subcooling coil eliminates flash loss to cut energy use by up to 15%
- Condensate discharge temperatures typically below 60°C reduce return piping losses by up to 75+%

Operating Parameters of Some Typical Applications*					Operating Efficiency**		Estimated Savings
Model	LPS	Steam Pressure [bars]	Annual Water Usage [m <sup>3</sup> ]	Subcooled Condensate Temperature	Without Subcooling	With Subcooling	
B+ 04	2.52	6.9	12,435	60°C	76%	91%	\$5,433
B+ 06	2.52	1.7	12,435	61.1°C	81%	91%	\$3,518
B+ 05	2.52	6.9	17,271	54.4°C	77%	92%	\$7,503
B+ 08	2.52	1.7	17,271	63.3°C	81%	90%	\$4,710

\*Annual water usage is based on ASHRAE Handbook recommendations for 150-unit and 250-unit apartment buildings; flow rate calculated for 10°C inlet, 60°C outlet application

\*\*Assumes 100°C condensate temperature without subcooling

\*\*\*Estimated savings assumes cost for steam is \$14.2 per million BTUs

## Integrated Safety System

The B+II WaterWizard incorporates an integrated safety system that can operate independently of the unit controller. In the event of an over-temperature condition or power loss in the facility, this fail-safe mechanism will close the control valve and open the solenoid to dump water. The safety system employs redundant sensors that alert both the controller and valve actuator of over-temperature conditions measured at the outlet.

# Low Cost Installation and Maintenance

Keep up-front materials and installation labor costs low and minimize the size of the mechanical room.

- Compact <0.37 m<sup>2</sup> footprint
- No storage tanks, steam traps, mixing/blending valves or vacuum breaker required
- No ancillary safety mechanisms needed
- No acid or mechanical tube cleaning required
- No mechanical adjustments of pneumatic components

The robust nature of the helical coil, heat exchanger design safely supports thermal shocking as part of a routine maintenance plan where water conditions are especially harsh. And the patented AERCO valve has a soft-seat design that won't wear out quickly like the metal-to-metal seat of off-the-shelf valves.

## Long Lasting Durability

- Corrosion-resistant materials of construction
  - Copper-lined vessel designed and manufactured in accordance with ASME Pressure Vessel Code, Section VIII, Division 1, for not less than 16 BAR working pressure at 204°C
  - Individually replaceable heat exchanger coils are fabricated from 1.25 mm wall copper tube and are ASME- rated to not less than 17 BAR working pressure at 204°C; 1.65 mm thick copper or copper-nickel tubing optional
  - Steam and condensate risers are made from schedule 80 red brass pipe
  - Stainless steel heads and condensate orifice
  - All copper-or copper-alloy-wetted-surfaces
- Robust, heat exchanger design
  - Self-descaling action helps maintain ideal surface for maximum heat transfer
  - Stacked-coil arrangement keeps water side velocities low to curtail erosion
  - Free-floating design eliminates thermal stress which, over time, weakens Hx
  - Design is so robust, the heat exchanger is warranted against thermal shock



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