216-684 kW Benchmark E Boiler Series with Edge Control

# SECTION 235213 – ELECTRIC BOILERS

PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract apply to this section, including General and Supplementary Conditions and Division 01 Specification Sections.

## 1.2 SUMMARY

A. This section includes packaged, factory-fabricated and assembled, resistive electric boilers, trim and accessories for generating hot water.

## 1.3 SUBMITTALS

A. Product Data: Include performance data, operating characteristics, furnished specialties and accessories.

1. Prior to installation, engineered calculations and drawings must be submitted to Architect/Engineer to thoroughly demonstrate that size and configuration conform to recommended size, length and footprint for each submitted boiler.

B. Pressure Drop Curve. Submit pressure drop curve for the following flow ranges per designated capacities below.

216 – 684 kW: 25 – 350 GPM

C. Shop Drawings: For boilers, boiler trim and accessories include:

1. Plans, elevations, sections, details and attachments to other work
2. Wiring Diagrams for power, signal and control wiring

D. Source Quality Control Test Reports: Reports shall be included in submittals.

E. Field Quality Control Test Reports: Reports shall be included in submittals.

F. Operation and Maintenance Data: Data to be included in boiler emergency, operation and maintenance manuals.

G. Warranty: Standard warranty specified in this section

H. Other Informational Submittals:

ASME Stamp Certification and Report: Submit "H" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: The manufacturer must have been regularly engaged in the manufacture of hydronic boilers for not less than thirty (30) years. The manufacturer must be headquartered in North America and manufacture pressure vessels in an ASME-certified facility wholly owned by the manufacturer. The specifying engineer, contractor and end customer must have the option to visit the factory to witness test fire and other relevant procedures.

B. Electrical Components, Devices and Accessories: Boilers must be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. ASME Compliance: boilers must be constructed in accordance with ASME Boiler and Pressure Vessel Code, Section IV “Heating Boilers”. Boilers must be in compliance with CSD-1.

D. UL Compliance: Boilers must be tested for compliance with UL 834 and CAN/CSA-C22.2 No. 165. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Anchor unit to concrete base. Concrete, reinforcement and formwork requirements are specified in Division 03.

1.6 WARRANTY

A. Standard Warranty: Boilers shall include manufacturer's standard form in which manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.

Warranty Period for Electric Boilers

1. The pressure vessel/heat exchanger shall carry a 10‑year from shipment, non-prorated, limited warranty against any failure due to mechanical defects or workmanship.
2. Manufacturer labeled control panels are conditionally warranted against failure for (2) two years from shipment.
3. All other components are conditionally guaranteed against any failure for (1) one year from shipment.
4. PRODUCTS
	* + 1. MANUFACTURERS

A. This specification is based on the Benchmark E Series boilers that are fitted with Edge control as manufactured by AERCO International Inc. Equivalent units and manufacturers must meet all performance criteria and will be considered upon prior approval.

B.Basis-of-Design Product: Subject to compliance with requirements, provide AERCO International, Benchmark E Series Boiler with Edge control:

1. BMK E 216, 360, 432, 576, 684 (216 to 684 kW input)
2. Approved Equals:
	1. [Insert Approved Equals]
	2. Request for substitutions will be considered in accordance with provisions of Section 235216 - Electric Boilers, in writing no less than 30 days prior to bid date.
		* 1. CONSTRUCTION

A. Description: Boiler shall be resistive element design. It shall be designed to operate in variable primary or primary secondary piping configuration. The boiler shall include an SSR controlled element group for near-infinite turndown. Boilers that do not have an SSR controlled element group will not be considered.

Boiler shall be factory-fabricated, factory-assembled and factory-tested, resistive electric boiler with heating elements sealed pressure-tight, built on a steel base, including insulated jacket, water supply, inlet return, drain valve connection, and controls.

B. Heating Elements: The heating element sheaths shall be constructed of Incoloy, with a maximum of three single-bend U-shaped element blades per flange. The element watt density shall be 88 W/in2 (13.6 W/cm2).

The elements shall be no larger than 24” long with 4” flange connections. Large element bundles are not acceptable.

C. Pressure Vessel: The pressure vessel shall have a maximum water volume of 160 gallons.

The boiler water connections shall be flanged 150‑pound, ANSI rated.

* BMK E 216 - 684: 4-inch flange

The pressure vessel shall be constructed of ASME SA516-70 carbon steel, with a 0.375-inch-thick wall and 0.625-inch-thick upper head. Inspection openings in the pressure vessel shall be in accordance with ASME Section IV pressure vessel code.

* + - * 1. Number of Stages: The boiler shall have multiple stages to provide accurate temperature control. The number of stages shall be as follows and are based on kW size:
* BMK E 216: 6
* BMK E 360: 10
* BMK E 432: 10
* BMK E 576: 10
* BMK E 684: 10
1. Internal Power Distribution: The power shall connect to distribution blocks capable of accepting copper wire of a size of up to 500 MCM. The power shall connect to current-limiting fuses, then contactor and heating elements. The Contactors shall be 3-pole magnetic and UL-tested for 500,000 cycles at full load.
	* + 1. CONTROLS
				1. The boiler shall have an integrated boiler control that is capable of operating the boiler and associated accessories including but not limited to: its pumps, valves and dampers.

The control shall have a 7-inch color touch screen display. User shall have the ability to navigate the menus via touchscreen.

The control shall display one temperature using a dedicated three-digit seven-segment display.

The control shall offer an Enable/Disable toggle switch as well as two buttons for Testing and Resetting the Low Water Cutoff.

The control shall have LED indicators for the following status indicators.

Unit Demand

Unit Fault

Manager Unit

Cascade Communication

BAS Communication

* + - * 1. The Manager designated boiler control shall be capable of the following functions without the need for additional external controls:

Sequence up to 16 electric boilers,

Control single speed pumps and/or modulating motorized valves,

The control shall connect to other plant boiler controls using RS485 and communicate using Modbus protocol.

* + - * 1. Minimum number of boiler plant open valves: The control shall manage the minimum number of boiler motorized valves to reduce variable speed pump flow and energy used. The control shall offer a setting to control the number of valves open during low load and standby operation. Manufacturers without this feature shall offer additional pump controller and a smaller single speed pump to run during the low load and standby periods.
				2. Building Automation: The control shall be able to communicate to Building Management Systems using BACnet without the use of external gateways. The use of external gateways is not acceptable. The control shall be able to communicate to the building management system using:

BACnet IP/Ethernet.

When using the BACnet IP protocol, the control shall provide added security by requiring BAS server IP address to communicate with authorized BAS or BMS.

BACnet MS/TP.

* + - * 1. Unit and Plant Status: The control shall provide a quick view of the unit status and plant status.

The unit status screen shall provide temperature setpoint, water inlet and outlet sensors’ values. It shall also provide target power output. Additional screens shall display unit run hours and cycle count.

The plant status screens shall provide plant temperature setpoint, plant water supply and return temperatures, outdoor temperature and domestic hot water setpoint and current temperatures. Additionally, a status screen shall show the boiler status of each plant unit and plant power output.

Unit event history: The control shall display at least the last 200 historical events.

* + - * 1. Software update: The control shall be capable of field software updates without a need for hardware component(s) replacement. This shall be performed either using software on a USB flash drive or via Internet connection. The software update mechanism shall be performed by a trained technician. The software update menus shall be secured using a password level. After the software update, the control shall retain all its prior field settings.
				2. Copy settings from one boiler to the other: To significantly reduce installation time by reducing long repetitive work, the control shall have the capability of saving its settings to a USB flash drive. In addition, the control shall have the ability of copying new settings from a flash drive.
				3. Save and Restore: The control shall automatically save event logs on to USB. The controller shall allow users to manual save configured settings on demand onto the USB.
				4. Configurable Inputs and Outputs: The control shall be equipped with multiple dry contact relays, analog outputs and analog inputs. Each shall be field configurable to meet installation needs. The following I/O options shall be available:

Relay outputs: There shall be at least two output relays that are configurable.

Inputs and interlocks: The following interlocks shall be available:

Remote Interlock input

Delayed Interlock input

Secondary LWCO input

Analog output: There shall be at least three analog outputs that are configurable.

Analog input: There shall be at least three analog inputs that are configurable. The control shall have configurable analog inputs that can be used as one of the following options:

Remote setpoint

Peak Load Management

* + - * 1. Reserve boiler: The control shall be able to operate a reserve boiler during peak periods when main plant boilers are at or close to peak load.
				2. The controls shall enunciate boiler and sensor status and include extensive self-diagnostic capabilities.
				3. The control panel shall incorporate:
1. Failsafe Mode: Failsafe mode allows the boiler to switch its mode to operate from an internal setpoint if its external control signal is lost, rather than shut off. This is a selectable mode, enabling the control can shut off the unit upon loss of external signal, if so desired.
	* + - 1. The boiler control system shall incorporate the following additional features for enhanced external system interface:
2. Auxiliary start delay timer
3. Auxiliary temperature sensor
4. Fault relay for remote fault alarm
5. The control shall offer multi-level user security access using different passwords. For additional security, the passwords shall expire if control display was not touched for an extended period of time.
	* + - 1. Each boiler shall have integrated Boiler Sequencing Technology (BST), capable of multi-unit sequencing with lead-lag functionality and parallel operation. The system will incorporate the following capabilities:

Efficiently sequence 2-to-16 units on the same system to meet load requirement.

Integrated control and wiring for seamless installation of optional modulating motorized valve. When valves are utilized, the system shall operate one motorized valve per unit as an element of load sequencing. Valves shall close with decreased load as units turn off, with all valves open under no-load conditions.

Automatically rotate lead/lag amongst the units on the chain and monitor run hours per unit and balance load to equalize run hours among active units.

Designated manager control, used to display and adjust key system parameters.

* + - * 1. Data Security

The control software shall be encrypted while it is stored and while it is in transit.

The control shall have isolated ethernet ports for BAS and other communication. The control shall not allow unauthorized ping from local network. User shall be able to enable/disable ping feature. All available ports shall be firewalled. When ping feature is enabled, the control shall use internal firewall to allow authorized access and prevent unauthorized access of ports.

The controller shall have SSH PKI security mechanism.

The control hardware and software shall be black box tested (penetration test) by a reputable cybersecurity firm.

* + - 1. ELECTRICAL POWER
				1. Controllers, Electrical Devices and Wiring: Electrical devices and connections are specified in Division 26 sections.
				2. Single-Point Field Power Connection: Factory-installed and factory-wired switches, motor controllers, transformers and other electrical devices shall provide a single-point field power connection to the boiler.
				3. Electrical Characteristics:

|  |  |
| --- | --- |
| **Electrical****Specifications** | **Models** |
| BMK E 216 | BMK E 360  | BMK E 432 | BMK E 576 | BMK E 684 |
| Voltage | 480/600 V | 480/600 V | 480/600 V | 480/600 V | 480/600 V |
| Phase | 3 | 3 | 3 | 3 | 3 |
| Frequency | 60 Hz | 60 Hz | 60 Hz | 60 Hz | 60 Hz |
| Full Load Current | 260/208 Amps | 433/347 Amps | 520/416 Amps | 693/555 Amps | 823/659 Amps |
| MCA | 325/260 | 542/434 | 650/520 | 867/694 | 1029/824 |

* + - * 1. Short Circuit Current Rating (SCCR): The boiler shall have an SCCR of 100kA or greater. Using a fused disconnect switch to achieve this rating is not acceptable.
				2. Hydrostatic Test: Perform hydrostatic testing.
				3. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.
				4. Allow Owner access to source quality-control testing of boilers. Notify Architect fourteen days in advance of testing.
1. EXECUTION
	* + 1. EXAMINATION

A. Before boiler installation examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations and piping and electrical connections to verify actual locations, sizes and other conditions affecting boiler performance, maintenance and operations.

Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

* + - * 1. Examine mechanical spaces for suitable conditions where boilers will be installed.
				2. Proceed with installation only after unsatisfactory conditions have been corrected.
			1. BOILER INSTALLATION
				1. Install boilers level on concrete bases. Concrete base is specified in Division 23 Section "Common Work Results for HVAC," and concrete materials and installation requirements are specified in Division 03.
				2. Assemble and install boiler trim.
				3. Install electrical devices furnished with boiler but not specified to be factory mounted.
				4. Install control wiring to field-mounted electrical devices.
			2. CONNECTIONS
				1. Piping installation requirements are specified in other Division 23 sections. Drawings indicate general arrangement of piping, fittings and specialties.
				2. Install piping adjacent to boiler to permit service and maintenance.
				3. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.
				4. Connect hot-water piping to supply and return boiler tapings with shutoff valve and union or flange at each connection.
				5. Install piping from safety relief valves to nearest floor drain.
				6. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
				7. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
			3. FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections

1. Perform installation and startup checks according to manufacturer's written instructions.

2. Perform hydrostatic test. Repair leaks and retest until no leaks exist.

3. Start units to confirm proper unit operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

a. Check and adjust initial operating setpoints and high- and low-limit safety setpoints of water level and water temperature.

b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Remove and replace malfunctioning units and retest as specified above.

D. Occupancy Adjustments: When requested within 2 months of date of Substantial Completion, provide on-site assistance adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

**END OF SECTION 235216**