

SECTION 23 52 33.19 - SAMPLE SPECIFICATION FOR RBI FUTERA XLF MODULATING BOILER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes gas-fired, non-condensing finned copper water tube boilers for heating hot water.

- B. Related Sections include the following:

1. Division 23 Section "Breechings, Chimneys, and Stacks" for connections to breechings, chimneys, and stacks.
2. Division 23 Section "Feedwater Equipment" for connections to condensate and feedwater system.
3. Division 23 Sections for control wiring for automatic temperature control.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each model indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, and method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer installed and field installed wiring.
- C. Source Quality Control Tests and Inspection Reports: Indicate and interpret test results for compliance with performance requirements before shipping.
- D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- E. Maintenance Data: Include in the maintenance manuals specified in Division 1. Include parts list, maintenance guide, and wiring diagrams for each boiler.

1.4 QUALITY ASSURANCE

- A. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- B. ASME Compliance: Water heaters shall bear ASME "H" stamp and be National Board listed.
- C. CSD-1 Compliance: Control devices and control sequences according to requirements of CSD-1.
- D. FM Compliance: Control devices and control sequences according to requirements of FM.
- E. IRI Compliance: Control devices and control sequences according to requirements of IRI.
- F. Comply with NFPA 70 for electrical components and installation.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

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1.6 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents. Installing contractor shall provide one year of warranty parts and labor.
- B. Special Warranty: Submit a written warranty, executed by the contractor for the heat exchanger.
 - 1. Warranty Period: The heat exchanger assembly shall carry a ten (10) year warranty with an additional twenty one (21) year thermal shock warranty on heat exchanger.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Manufacturer shall be a company specializing in manufacturing the products specified in this section with minimum five (5) years experience. Subject to compliance with requirements, manufacturers offering boilers that may be incorporated into the Work include, but are not limited to, the following:
- B. Design: Boilers shall be CSA design certified as a non-condensing water heater. Boilers shall be designed for a minimum of 5:1 continuous turn down with constant CO₂ over the turndown range. The boiler shall operate with natural or propane gas and have a CSA certified input rating as noted on the drawings, and a thermal efficiency rating up to 87.4% at rated input and up to 88% at minimum input. The boiler shall incorporate a **TrueFlow™** fuel-air system, which is symmetrically air-fuel coupled such that changes in combustion air flow or flue flows affect the BTUH input without affecting combustion quality. The boiler will automatically adjust input for altitude and temperature induced changes in air density. The boiler will use a proven pilot interrupted spark ignition system. The boiler shall use a UL approved flame safeguard ignition control system using UV detection flame sensing. The design shall provide for silent burner ignition and operation. Burner shall be premix radial-type and fire in a 360° vertical pattern. Boiler shall be able to vent a horizontal distance of 60 equivalent feet, 18.3 m.
- C. Service Access: The boilers shall be provided with stainless steel jacket panels, minimum 16 gauge, with push-button fasteners for easily accessing all serviceable components. Sheet metal screws may not be used in the securing of jacket panels to the boiler. The boiler shall not be manufactured with large enclosures, which are difficult to remove and reinstall. All accesses must seal completely as not to disrupt the sealed combustion process. All components must be accessible and able to adjust with the removal of a single cover or cabinet component.
- D. Indicating Lights: Each boiler shall include a diagnostic control panel with a full text display indicating the condition of all interlocks and the BTUH input percentage. Access to the controls shall be through a swing-access door, leaving diagnostic panel intact and not disrupted.
- E. Manufacturers: RBI (a Mestek Company) is the basis of design. Listed acceptable manufacturers shall be subject to compliance with requirements. Provide boilers by one of the following:
 - 1. Thermal Solutions - Evolution
 - 2. Raypak – MVB

2.2 COMPONENTS

- A. Combustion Chamber: The combustion chamber shall be constructed of minimum 16 gauge stainless steel. Aluminum or galvanized steel is not acceptable. An access door shall be provided for ease of service and inspection of the heat exchanger.
- B. Heat Exchanger: The heat exchanger shall be inspected and bear the A.S.M.E. Section IV seal of approval. The heat exchanger shall be a four pass heat exchanger with a maximum working pressure of 160 psi. The heat exchanger's vertical design shall provide equal amounts of heat transfer throughout the entire heating surface. Each heat exchanger shall have copper tubes, with an integral copper finned tube of 7/8" I.D., .064" minimum wall thickness, 7 fins per inch, with a fin height of 3/8". Each end of the water tubes shall be strength rolled into the header. The heat exchanger shall be gasketless. Each individual tube can be re-tubed without the disturbance of the surrounding tubes. A pressure relief valve of 50 lb/sq. in. shall be equipped with the boiler and factory mounted. The headers shall be of cast iron construction.
- C. Jackets: 18 gauge brushed stainless steel

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- D. Gas Burner: The burner shall be metal fiber mesh construction, allowing high turndown of the fuel-air mixture. The burner flame shall burn horizontally and be of the pre-mix type with a forced draft fan. Burner shall fire to provide equal distribution of heat throughout the entire heat exchanger. The burner shall be easily removed for maintenance without disruption of any major component of the boiler. A window view port shall be provided for visual inspection of the boiler during firing.
- E. Ignition components: Ignition system shall incorporate the 'sure fire' Turbo Pilot™ design. The pilot is completely independent of the burner system and installed as a single point 'gun' type arrangement. This pilot system shall provide a strengthened pin point flame. Pilot systems utilizing a dual function gas valve, hot surface ignition or direct spark to burner design shall not be accepted. The ignition hardware shall consist of Alumina ceramic insulated ignition electrodes and UV sensing tube permanently arranged to ensure proper ignition electrode and UV alignment.
- F. Rated Capacity: The boiler shall be capable of operating at rated capacity with pressures as low as 3.5" W.C. at the inlet to the burner pressure regulator. Boilers that cannot provide full BTUH inputs at 3.5" W.C. *will not* be accepted.
- G. High Altitude: Boiler shall operate at altitudes up to 6,000 feet above sea level without additional parts or adjustments.
- H. The burner and gas train shall be provided with the following trim and features:
 - The burner shall be a premix design and constructed of woven stainless steel.
 - The burner shall be capable of and provide variable modulating firing rates.
 - The burner shall be capable of operating with repeatable CO₂ at both low fire and high fire modulating firing rates.
 - The burner shall be capable of operating without exceeding 20ppm of NO_x
 - The boiler shall be supplied with a zero governor gas valve coupled with a variable speed blower system, to precisely control the fuel/air mixture for maximum combustion efficiency.
 - Burner Ignition: pilot with Intermittent spark
 - Safety Controls: Energize ignition, limit time for establishing flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, and allow gas valve to open.
 - Flue Gas Collector: Enclosed combustion chamber with integral combustion air blower and single venting connection.
 - Gas Train: Manual ball type gas valves (2), main gas valve, manual leak test valve, pilot gas pressure regulator, and automatic pilot gas valve. All components to be factory mounted and CSD-1 compliant.
 - Safety Devices: Low gas pressure switch, air flow switch, and blocked flue detection switch, low water cutoff (manual reset), high temperature manual reset. All safeties to be factory mounted.

2.3 BOILER TRIM

- A. Controls: The boiler control package shall be a MTI HeatNet or equivalent, integrated boiler management system. The control system must be integral to each boiler, creating a control network that eliminates the need for a "wall mount" stand-alone water heater system control. Additional stand-alone control panels, independent of a Building Management System (BMS), shall not be allowed to operate the boiler network.

The HeatNet control shall be capable of operating in the following ways:

1. As a stand-alone boiler control system using the HeatNet protocol, with one "Master" and multiple "Member" units.
2. As a boiler network, enabled by a Building Management System (BMS), using the HeatNet protocol, with one "Master" and multiple "Member" units.
3. As "Member" water heater to a Building Management System (BMS) with multiple input control methods.

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MASTER:

A boiler becomes a Master when a resistance type 10K sensor is connected to the J10 "SYS/DHW HEADER" terminals. **The sensor shall be auto detected.** The Master senses and controls the header/loop temperature utilizing a system setpoint. It uses any boiler it finds "HeatNet Members" or those defined in the control setup menus to accomplish this. The "Master" shall also have the option of monitoring Outside Air Temperature "OA" to provide full outdoor air reset functionality. **Only one master shall be allowed in the boiler network.**

When operating as a "Master", the HeatNet control provides a stand-alone method using a PID algorithm to regulate water temperature. The algorithm allows a single boiler "Master" or multiple "Master + Member" water heater in a network of up to 16 total boilers.

The control algorithm is based upon a control band, at the center of which is the setpoint. While below the control band, boilers are staged on and modulated up until the control band is entered. Once in the control band, modulation is used to maintain setpoint. Optimized system efficiency is always accomplished by setting the Modulation Maximum "Mod-Max" setting to exploit each boiler in the network's inverse efficiency curve. The control shall operate so that the maximum number of boilers required, operate at their lowest inputs until all boilers are firing. Once all boilers are firing, the modulation clamp is removed and all boilers are allowed to fire above this clamped percentage up to 100%. This "boiler efficiency" clamp is defaulted to 80% and thus limits all the boiler individual outputs to 80% until the last boiler fires. **The 80% default must be field adjustable for varying operating conditions.** All boilers modulate up and down together always at the same modulation rate. Boilers are shut down only when the top of the band is breached, or before the top of the band, if the control anticipates that there is a light load. Timers shall also be included in each control in the network to prevent any boiler from short cycling.

MEMBER:

Additional boilers in the network always default to the role of member. The lack of sensors connected to the J10 terminals "SYS/DHW Header" on each additional boiler shall ensure this.

Each "Member" shall sense its supply outlet water temperature and modulate based on signals from a Building Management System (BMS) or "Master" boiler. When operating as a member, starting, stopping, and firing rate shall also be controlled by the "BMS" or "Master" boiler.

When using the HeatNet protocol, the system setpoint shall be sent from the "Master", along with the modulation value to control firing rate. It also receives its command to start or stop over the Heat-Net cable. Each "Member" will continuously monitor its supply outlet temperature against its operating limit. If the supply temperature approaches the operating limit temperature (adjustable), the water heater input control rate is limited and its modulation value decreases to minimize short cycling. If the operating limit is exceeded, the water heater shall shut off.

Each HeatNet control in the boiler network shall have the following standard features:

1. Digital Communications Control.
 - A. Boiler to Boiler: HeatNet
 - B. Building Management System (BMS): MODBUS standard protocol.
 - C. Building Management System (BMS): BACnet, LonWorks and N2 optional protocols.
2. Analog 4:20 and 0-10vdc also supported.
3. Distributed control using HeatNet protocol for up to 16 total boilers.
4. System/Boiler operating status in English text display.
5. Interlock, Event, and System logging with a time stamp.
6. Advanced PID algorithm optimized for specific boilers.
7. Four dedicated temperature sensor inputs for: Outside Air Temperature, Supply (Outlet)Temperature, Return Temperature (Inlet), and Header Temperature.
8. Automatically detects the optional temperature sensors on start up.
9. Menu driven calibration and setup menus with a bright 4-line Vacuum Fluorescent Display.
10. (8) Dedicated 24vac interlock monitors and 8 dedicated 120vac system monitors used for diagnostics and providing feedback of faults and system status.
11. Multiple boiler pump or motorized boiler valve control modes.
12. Combustion Air Damper control with proof time.
13. Optional USB/RS485 network plug-in to allow firmware updates or custom configurations.
14. Optional BACnet, LonWorks and N2 interface.
15. Alarm contacts.
16. Runtime hours.
17. Outdoor Air Reset with programmable ratio.
18. Time of Day clock to provide up to four (4) night setback temperatures.
19. Failsafe mode when a Building Management System (BMS) is controlling setpoint. If communications is lost, the boiler/system shall run off the Local Setpoint.

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20. Boiler(s) shall be equipped with an integrated web based monitoring system.
 - A. Monitoring system shall provide an email or SMS text message notification upon detecting an out of tolerance condition.
 - B. The integrated monitoring system shall provide a web portal with performance dashboard displaying key data points for the system and each boiler in the system.
 - C. The web portal shall provide the following capabilities;
 - Detailed status of data points and system set-points
 - Boiler and System runtime and cycle count
 - Intelligent diagnostics and troubleshooting guide
 - Provide original factory test data including as built bill of materials
 - The ability to enter field service records with file upload capabilities
 - The ability to view time stamped history of data points and settings
 - The ability to view detailed event log entries
 - Video tutorials explaining each section of the web portal
 - D. The monitoring system shall have the capability of connecting directly to a 10/100mbps TCP/IP network
Optionally when a facility network connection is not available the system shall be capable of utilizing wireless cellular network
 - E. The monitoring system shall utilize a non-public proprietary data encryption algorithm
 - F. Secure data transmission shall be directly to the cloud from HeatNet enabled system(s) without third party integration
- B. Safety Relief Valve: ASME rated, factory set to protect boiler and piping as per schedule/drawings.
- C. Gauge: Combination water pressure and temperature shipped factory installed. LCD inlet/outlet temperature gauges to be an integral part of the front boiler control panel to allow for consistent easy monitoring of temperatures factory mounted and wired.
- D. Flow Switch: Prevent burner operation when water falls below a safe level or when water flow is low. Flow switch shall be factory mounted and wired. Provision for installation of a low water cut off shall be provided.
- E. Operating Controls: Boiler shall be provided with a Honeywell RM7800 series digital flame safeguard. The flame safeguard shall be capable of prepurge cycles.
- F. Operating Temperature Control: Shall be a manual probe type controller adjustable from 120°F to 240°F, 49°C to 116°C. Control shall be factory mounted and sense the inlet and outlet temperature of the boiler through a resistance sensor.
- G. High Limit: Temperature control with manual reset limits water heater water temperature in series with the operating control. High limit shall be factory mounted and sense the outlet temperature of the water heater through a dry well.
- H. PROVIDE THE FOLLOWING STANDARD TRIM:
 1. Cast iron headers
 2. Low air pressure switch
 3. Blocked flue detection switch
 4. Flow switch (factory mounted and wired)
 5. Modulation control
 6. Temperature/pressure gauge
 7. Manual reset high limit
 8. Air inlet filter
 9. Inlet/outlet temperature display
 10. Full digital text display for all boiler series of operation and failures
 11. Variable frequency drive and combustion air fan
 12. FM and CSD-1 gas train
 13. Probe type low water cut off, manual reset

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I. PROVIDE THE FOLLOWING JOB SPECIFIC TRIM AND FEATURES

1. Air inlet hood for exterior termination of air intake pipe (shipped loose)
2. Vent termination hood for exterior termination of vent pipe (shipped loose)
3. FM or IRI controls and gas train
4. Diagnostic keyboard display for RM7800 series control
5. Bronze fitted circulator provided by the manufacturer (shipped loose) (models 2500-5000)
6. Bronze headers (models 2500 – 5000)
7. Outdoor installation (models 2500 - 5000)
8. 460/600V 3PH
9. 208 - 240V 3PH

2.4 MOTORS

- A. Refer to Division 23 Section "Motors" for factory installed motors.
- B. Boiler Blower Motor: Open drip-proof motors where satisfactorily housed or remotely located during operation. There shall be no requirement to remove gas train components to remove the blower motor. Blower motor *shall not* exceed 3 HP and *not* require more than 17 amps (models 2500-4000) and 5HP and *not* require more than 21 amps (models 5000-10000).

2.5 SOURCE QUALITY CONTROL

- A. Test and inspect water heater according to the ASME Boiler and Pressure Vessel Code, Section IV. Water heater shall be test fired in the factory with a report attached permanently to the exterior cabinet of the water heater for field reference.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine area to receive water heater for compliance with requirements for installation tolerances and other conditions affecting water heater performance. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install water heater level and plumb, according to manufacturer's written instructions and referenced standards.
- B. Install gas-fired boilers according to NFPA 54.
- C. Support water heaters on 4 in. (100 mm) thick concrete base, 4 in. (100 mm) larger on each side than base of unit.
- D. Install electrical devices furnished with water heater, but not specified to be factory mounted.
- E. Install a 3/4" drain valve on the outlet piping prior to the first shut off valve.

3.3 CONNECTIONS

- A. Connect gas piping full size to water heater gas train inlet with union.
- B. Connect hot water piping to supply and return water heater tappings with shutoff valve and union or flange at each connection.
- C. Install piping from safety relief valves to nearest floor drain.

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- D. Connect breeching to water heater outlet, full size of outlet. The water heater shall operate under positive (Category IV) or negative (Category II) stack pressure. Vent material must be listed AL29-4C Stainless Double Wall Stack for condensing appliances.
- E. Electrical: Comply with applicable requirements in Division 26 Sections.
- F. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory authorized service representative to supervise the field assembly of components and installation of water heater, including piping and electrical connections. Report results in writing.
 - 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Manufacturer's representative shall supply a factory authorized service technician to start up the water heater.

3.5 CLEANING

- A. Flush and clean water heaters on completion of installation, according to manufacturer's written instructions.
- B. After completing boiler installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes including chips, scratches, and abrasions with manufacturer's stainless steel cleaner.

3.6 COMMISSIONING

- A. Engage a factory authorized service representative to provide startup service. Start up to be performed only after complete boiler room operation is field verified to offer a substantial load, and complete system circulation. One year warranty shall be handled by factory authorized tech.
- B. Verify that installation is as indicated and specified.
 - 1. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 Sections. Do not proceed with water heater startup until wiring installation is acceptable to equipment Installer.
- C. Complete manufacturer's installation and startup checklist and verify the following:
 - 1. Water heater is level on concrete base.
 - 2. Flue and chimney are installed without visible damage.
 - 3. No damage is visible to boiler jacket, refractory, or combustion chamber.
 - 4. Pressure reducing valves are checked for correct operation and specified relief pressure. Adjust as required.
 - 5. Clearances have been provided and piping is flanged for easy removal and servicing.
 - 6. Heating circuit pipes have been connected to correct ports.
 - 7. Labels are clearly visible.
 - 8. Water heater, burner, and flue are clean and free of construction debris.
 - 9. Pressure and temperature gauges are installed.
 - 10. Control installations are completed.
- D. Ensure pumps operate properly.
- E. Check operation of pressure reducing valve on gas train, including venting.

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- F. Check that fluid level, flow switch, and high temperature interlocks are in place.
- G. Start pumps and water heaters, and adjust burners to maximum operating efficiency.
 - 1. Fill out startup checklist and attach copy with Contractor Startup Report.
 - 2. Check and record performance of factory provided boiler protection devices and firing sequences.
 - 3. Check and record performance of boiler fluid level, flow switch, and high temperature interlocks.
 - 4. Run-in water heater as recommended or required by manufacturer.
- H. Perform the following tests for each firing rate for high/low burners and for 100, 66, and 33 percent load for modulating burners. Adjust water heater combustion efficiency at each firing rate. Measure and record the following:
 - 1. Inlet gas pressure.
 - 2. Gas pressure on manifold.
 - 3. Flue gas temperature at boiler discharge.
 - 4. Flue gas carbon dioxide and oxygen concentration.
 - 5. Natural flue draft.
- I. Measure and record temperature rise through each water heater.

3.7 DEMONSTRATION

- A. Engage a factory authorized service representative to train Owner's maintenance personnel as specified below:
 - 1. Operate water heater, including accessories and controls, to demonstrate compliance with requirements.
 - 2. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
 - 3. Review data in the maintenance manuals. Refer to Division 1 Section "Contract Closeout."
 - 4. Review data in the maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
 - 5. Schedule training with Owner with at least 7 days advance notice.

END OF SECTION 23 52 33.19