

SECTION 23 52 33.19 - SAMPLE SPECIFICATION FOR RBI FUTERA FUSION XLF 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, 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: Boilers shall bear ASME "H" stamp and be National Board listed.
- C. ASME Compliance: Secondary heat exchanger shall meet ASME Section VIII.
- D. CSD-1 Compliance: Control devices and control sequences according to requirements of CSD-1.
- E. FM Compliance: Control devices and control sequences according to requirements of FM.
- F. IRI Compliance: Control devices and control sequences according to requirements of IRI.
- G. 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

The water heaters specified in the section shall be completely 'packaged' by the manufacturer. The primary/secondary condensing heat exchanger system must be the complete 'listed' and 'packaged' design of its manufacturer. Upon shipment, the boiler shall be packaged with all piping, pumps, bypass valves, and controls mounted, wired, and completely controlled by the individual water heater. Each water heater shall come ready for installation with a single inlet and outlet connection. Separated heat exchangers with multiple pumps and/or temperature controls valves will not be considered.

- 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 condensing boiler. Boilers shall be equipped to accept return water temperatures as low as 40°F, 4°C and operate in the condensing mode at all times. 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 94% at rated input and up to 99.1% at minimum input. The boiler shall incorporate a 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 100 equivalent feet, 30.5 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 boilers 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.

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 gasket-less. 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.

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The secondary heat exchanger shall be inspected and bear the ASME Section VIII seal of approval. The heat exchanger shall have a maximum working pressure of 125 psi. Each heat exchanger shall be constructed of 316L stainless steel throughout the internal vessel and 304L stainless steel for the external shell. Secondary heat exchanges constructed of finned copper or cupronickel tubes shall not be acceptable.

- C. Jackets: 18 gauge brushed stainless steel
- 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.
- H. The burner and gas train shall be provided with the following trim and features:
 - 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 NOx
 - 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.
 - 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.
- I. Non Metallic Vent Adapter: The boiler shall be configured with a PP vent adapter that allows for the use of PP material with the boiler. The vent adapter shall be shipped loose for field installation. The vent adapter shall include a stack sensor mounted to the boiler flue outlet and wired to the boiler operating HeatNet control. The boiler shall have a manual reset high limit mounted into the vent adapter and interlocked into the safety circuit of the boiler.

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 boiler 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" boilers 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 boilers 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" boilers in a network of up to 16 total.

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 are firing. Once all are firing, the modulation clamp is removed and all are allowed to fire above this clamped percentage up to 100%. This "efficiency" clamp is defaulted to 80% and thus limits all the units' individual outputs to 80% until the last unit 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 unit 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".

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 HeatNet 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 boiler's input control rate is limited and its modulation value decreases to minimize short cycling. If the operating limit is exceeded, the unit shall shut off.

Non Metallic Vent Option: Each HeatNet Control will continuously monitor its exhaust temperature against the exhaust temperature threshold, and a higher exhaust temperature limit. If the exhaust temperature approaches the exhaust temperature threshold, the boiler's input control rate is limited and its modulation value decreases to minimize short cycling, and keep the exhaust temperature below this threshold. If the exhaust temperature threshold is exceeded, the unit will shut off, and be allowed to recycle once the exhaust temperature drops to an acceptable temperature. However, if the exhaust temperature limit is exceeded, the boiler will shut down and will require a manual reset in order to allow the boiler to fire again.

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 and 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 boiler.
7. Four dedicated temperature sensor inputs: 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. USB/RS485 network plug-in to allow firmware updates or custom configurations.
14. Optional BACnet, LonWorks and N2 interface.
15. Alarm contacts.

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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 system shall run off the Local Setpoint.
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 digital P.I.D. controller adjustable from 40° F to 240° F, 4° C to 116° C. Control shall have the capability to provide outdoor air reset function. 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 boiler water temperature in series with the operating control. High Limit shall be factory mounted and sense the outlet temperature of the boiler 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

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11. Variable frequency drive and combustion air fan
12. FM and CSD-1 gas train
13. Condensate "P" trap
14. Manual reset LWCO
15. Pump motor starter
16. High and low gas pressure switches
17. Bypass assembly to include mixing valve, circulator and piping must be factory installed and wired. Conditioning bypass valves must be thermostatic and not electric. No control, pilots, or motors shall be required for constant conditioning of return water.
18. Knockdown ready for ease of installation

I. PROVIDE THE FOLLOWING JOB SPECIFIC TRIM AND FEATURES

1. 460 / 600V 3PH
2. Air inlet hood for exterior termination of air intake pipe (shipped loose)
3. Vent termination hood for exterior termination of vent pipe (shipped loose)
4. FM or IRI controls and gas train
5. CSD-1 controls
6. Diagnostic keyboard display for RM7800 series control
7. Bronze headers
8. Boiler Onboard Pump with Fixed Delta T (Variable Flow)
9. Outdoor Installation
10. Non Metallic Venting
11. Category II Venting

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 1 HP and *not* require more than 13 amps.

2.5 SOURCE QUALITY CONTROL

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. Install boilers level and plumb, according to manufacturer's written instructions and referenced standards.

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- B. Install gas-fired boilers according to NFPA 54.
- C. Support boilers on 4" (100 mm) thick concrete base, 4" (100 mm) larger on each side than base of unit.
- D. Install electrical devices furnished with boiler, 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 boiler gas train inlet with union.
- B. Connect hot water piping to supply and return boiler tappings with shutoff valve and union or flange at each connection.
- C. Install piping from safety relief valves to nearest floor drain.
- D. Connect breeching to boiler outlet, full size of outlet. Vent material must be listed AL29-4C stainless double wall stack when installed (Category II) combined negative pressure and (Category IV) positive pressure. A vent kit must be supplied by the manufacturer for outdoor applications and when utilizing the non metallic (PVC, PP) option.
- 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 boilers, 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 boilers.

3.5 CLEANING

- A. Flush and clean boilers 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 boiler startup until wiring installation is acceptable to equipment Installer.
- C. Complete manufacturer's installation and startup checklist and verify the following:
 - 1. Boiler 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.

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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. Boiler, 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.
- F. Check that fluid level, flow switch, and high temperature interlocks are in place.
- G. Start pumps and boilers, 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 boilers 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 boiler 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 boiler.
- 3.7 DEMONSTRATION
- A. Engage a factory authorized service representative to train Owner's maintenance personnel as specified below:
1. Operate boiler, 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