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**100% Issue for Construction**

## **JHU APL Building 14 Systems Integration 3**

### **PROJECT MANUAL**

Volume 2 – Divisions 20-26  
Divisions 31-41

Laurel, MD



**SECTION 23 52 16**  
**BOILER - PACKAGED CONDENSING BOILER**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Furnish labor, materials, tools, equipment, and services for Boiler – Packaged Condensing Boiler, as indicated, in accordance with provisions of Contract Documents.
- B. Completely coordinate with work of other trades.

**1.2 QUALITY ASSURANCE**

- A. Factory test: In accord with ASME code.
  - 1. Boiler construction test for 80 PSIG water working pressure.
  - 2. Fire test with specified fuel to check operation and function of controls.
- B. Standard for manufacture: ASME Code for Boilers and Pressure Vessels and State and local boiler codes.
- C. Referenced standards:
  - 1. ASME CSD-1: Control and Safety Devices for Automatically Fired Boilers.
  - 2. ASME Section IV: Heating Boilers.
  - 3. ASME B31.3: Process Piping 516-70.
  - 4. ANSI Z21.13/CSA 4.9: Gas Fired Low Pressure Boilers.
  - 5. NFPA 85: Boiler and Combustion Systems Hazards Code.
  - 6. CSA: CSA International
- D. Emissions permitting:
  - 1. Provide assistance to Contractor and Owner with regard to state, local or federally required air quality, source emissions or pollution control permitting.

**1.3 SUBMITTALS**

- A. Product data:
  - 1. Boiler.
    - a. Factory test reports.
    - b. Assembly Drawings.
    - c. Performance Data.
    - d. Wiring Diagrams.
    - e. Gas Train Diagrams.
    - f. ASME certification documents.
- B. Contract closeout information:
  - 1. Field test reports.
  - 2. Operation and Maintenance Data.
  - 3. Owner instruction report.


**PART 2 - PRODUCTS**

**2.1 ACCEPTABLE MANUFACTURERS**

- A. Packaged Condensing Boiler:
  - 1. Base:
    - a. Patterson-Kelley.
  - 2. Optional:
    - a. Aerco.
    - b. Cleaver-Brooks.

- B. Multiple Boiler Control Panel:
1. Base:
    - a. Patterson-Kelley
  2. Optional:
    - a. Cleaver-Brooks
    - b. Thermodynamic Process Control, TPC

## 2.2 MATERIALS

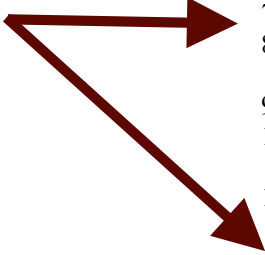
- A. Boiler: Factory packaged low pressure hot water boiler complete with controls and accessories ready to operate on natural gas as primary fuel.
1. Stamped in accordance with Section IV of the ASME code and National Board Registered for a **maximum allowable working pressure of 80 PSIG.** 
  2. Capacities: As scheduled.
  3. **Heat Exchanger Construction:**
    - a. **Cast aluminum or stainless steel.** ~~Coated heat exchangers are not acceptable.~~
  4. Heat Exchanger Header Construction:
    - a. Fabricated Steel.
    - b. Removable for inspection.
    - c. Provide with EPDM seals for 400 DEGF service.
  5. Boiler Casing:
    - a. Boiler shall be enclosed with a single wall outer casing fabricated from steel with a powder coat finish.
    - b. Composite structure of the boiler combustion chamber, insulating air gap and outer casing shall be of such thickness and materials designed such that the outer casing temperature does not exceed 50 DEGF above ambient temperature when the boiler is operated at full load.
  6. Size: To fit space allowed in accordance with Local and State Authorities Having Jurisdiction.
  7. Boiler shall be designed for condensing operation.
  8. Provide necessary piping connections.
  9. Efficiency: The boiler shall be capable of operating at a CSA certified thermal efficiency of up to 92 PCT.
- B. Boiler trim:
1. The boiler will be completely factory packaged and plumbed, requiring only job site hookup to utilities, venting, relief valve outlet, fuel gas inlet, feed water inlet, and boiler water outlet.
  2. Provide boiler with safety relief valve in compliance with ASME Code, operating temperature control to control the sequential operation of the burner, water pressure-temperature gauge, inlet water temperature sensor, outlet water temperature sensor, and exhaust temperature sensor.
  3. Boiler shall monitor flow by flow switch, temperature differential, or pressure differential.
  4. Lock out control, requiring manual reset, after any of the following:
    - a. Pilot or main flame interruption.
    - b. **Low water cutout.**
    - c. High limit operation.
  5. The boiler shall be jacketed with coated steel panels, and mounted on heavy-duty channel skids.
- C. Burner: Natural Gas.
1. Include an integral, power type, straight natural gas, fully automatic burner.
  2. The burner assembly shall consist of gas burner, combustion air blower, valve train, and ignition system.
  3. Burner Construction
    - a. Steel with stainless steel inner and stainless steel mesh outer screen.

**CSD-1 compliant  
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**Make default 75**

**Oil Gas Fired  
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4. Burner shall be fully modulating at any firing rate between 20 PCT and 100 PCT with constant O<sub>2</sub> levels equal to or less than 5 PCT.
  5. Combustion air blower:
    - a. Variable speed.
    - b. Shall be provided with low airflow differential pressure switch and high exhaust back pressure switch.
    - c. Provide blower with sufficient capacity at the rated firing rate to provide air for stoichiometric combustion and excess air.
  6. Provide gas regulator to reduce gas supply pressure from 2 PSIG to manufacturer's inlet design pressure. Verify gas supply pressure to burner controls.
  7. Provide burner flame observation port.
  8. The boiler shall be a category IV appliance according to NFPA-54 and be UL-listed for use with a positive pressure stainless steel vent.
  9. The boiler shall be capable of direct venting both inlet air and exhaust gases.
  10. Boiler shall be able to automatically adjust to maintain air and gas ratios due to changing inlet air conditions to maintain ratios set up by start-up technician.
  11. Burner certification, one of the following:
    - a. The burner shall meet U.L. Standard 795 gas train requirements.
    - b. The burner shall be CSA certified.
- D. Boiler Controls:
1. Boiler shall be provided with a micro-processor control panel.
  2. Provide with burner on-off switch and electronic combination temperature control.
  3. The micro-processor shall use a proportional algorithm to determine the firing rate. The control must have the following capabilities.
    - a. Ability to sequence other boilers in a lead-lag operation that uses same control device/platform.
    - b. Maintain single set point.
    - c. Reset the set point based upon outdoor air temperature.
    - d. Boiler shutdown based on outdoor air temperature.
    - e. Internal dual set point program with an external switchover via the Building Automation System (BAS) and shall be coordinated with Division 25 Sections.
    - f. Alarm relay for any manual reset alarm function.
    - g. Programmable low fire delay to prevent short cycling based on a time and temperature factor for release to modulation.
    - h. LED Display showing current supply and return temperatures, burner sequence, service codes, fan speed, current set points as well as differential set points. It must also display any fault codes whether automatically reset or manually reset.
    - i. Local Manual Operation.
    - j. The boiler control shall be capable of accepting a 0 -10vdc remote external analog signal to control the firing rate from an external source.
    - k. Computer (PC) interface for programming and monitoring all functions.
    - l. Provide 5 amp control circuit breaker and 24 VAC transformer for control system.
  4. Electrical connection: Single point 120V/1phase/60Hz power supply to each boiler protected by a 15 amp circuit breaker.
  5. Provide an electric spark ignition system. Main flame shall be monitored and controlled by flame rod (rectification) system.
  6. Each boiler shall be provided with necessary controls, necessary programming sequences, and safety interlocks. Each boiler control system shall be properly interlocked with safeties.
  7. Provide thermal overload protection.
  8. Provide under voltage protection.
  9. Locate control devices and relays in splash-proof steel cabinet mounted on boiler.
  10. Flame safeguard, UV scanner for monitoring main flame and pilot.
    - a. If other technology is used, obtain approval from architect.
  11. Other safety limits:
    - a. Combustion air interlock.

- b. Enforced low fire start.
- 12. Automatic recycling after power failure or normal operation of operating control.
- 13. Provide pre-purge and post-purge cycles with full protection against flame failure during both ignition and normal burning periods.
- 14. Interlock burner-blower controls to prevent burner operation without mechanical draft.
- 15. Conform to local gas company codes and regulations.
- 16. Gas solenoid valves, diaphragm valves, hydraulic valves and regulators: UL or Factory Mutual approved and labeled.
- E. Gas piping:
  - 1. Provide necessary gas piping properly valved between main and connection to burner and pilot.
  - 2. Size in accord with National, State and Local ordinances and Codes, and NFPA recommendations.
  - 3. Gas cocks: Lubricated plug cocks with operating handles.

## **2.3 MULTIPLE BOILER CONTROL PANEL**

- A. Provide Main Boiler Sequencing Control Panel that shall communicate to the boilers to sequence them on and off as required to maintain building heating water setpoint temperatures.
  - 1. Equal to TPC Flow Intelligence Boiler Control System. Coordinate with Section 25 10 00 for wiring and programming.
- B. Main Boiler Sequencing Control panel shall be provided with the following:
  - 1. Color touch screen with human-machine-interface (HMI) and shall communicate to control devices and transmitters.
  - 2. Provide one (1) Main Boiler Control Panel.
  - 3. Provide two (2) Temperature sensors with transmitters that shall be located in the main supply and main return heating hot water piping.
  - 4. Provide one (1) water flow sensor with transmitter that shall be located in the main hot water heating loop.
  - 5. Provide one (1) outdoor air sensor.
  - 6. Provide six (6) field control devices two (2) for each boiler. One shall communicate with the local boiler control panel and one shall communicate with the motorized combustion air damper.
- C. Provide additional field control devices, sensors, transmitters, etc. as required for a complete installation according to the manufacturer's installation instructions.

## **2.4 VIBRATION ISOLATION**

- A. Vibration Isolation: Section 20 05 50.

# **PART 3 - EXECUTION**

## **3.1 INSTALLATION**

- A. Install boiler in accord with NFPA, ASME, local codes and manufacturer's instructions.
- B. Verify boiler manufacturer's PH level requirements and verify that chemical treatment procedures account for correct PH level maintenance.
- C. Wire low water cutoff to burner control circuit with manual reset device (if applicable).
- D. Teflon tape shall not be used for natural gas piping.

## **3.2 VIBRATION ISOLATION**

- A. Vibration Isolation: Section 20 05 50.

### **3.3 DUTIES OF SERVICE REPRESENTATIVE**

- A. Boiler and burner manufacturer's factory trained service representative to perform start-up services.
- B. Instruct personnel designated by Owner in operation and maintenance of equipment.
- C. Service representative shall supervise following:
  - 1. Setting of safety valves.
  - 2. Adjustment of firing equipment.
  - 3. Boiler performance demonstration.

### **3.4 CLEANING (WASH-OUT)**

- A. Before boilers and heating system are placed in service either for temporary or permanent use, clean and flush.
  - 1. When used temporarily, flush boiler and piping each time additional new piping is added to the system. Boil air from water each time.
  - 2. Circulate for a short time then drain and refill.

### **3.5 START-UP**

- A. Start-up shall consist of:
  - 1. Set and calibrate safety valves.
  - 2. Adjust firing equipment.
  - 3. Check safety devices and confirm that safeties operate correctly.
  - 4. Verify that burner operates over full range burner firing capacity.
  - 5. Verify that boiler sequencing control panel is sequencing boilers correctly.

### **3.6 OPERATING DEMONSTRATION**

- A. Demonstrate to Owner operation of system over entire range.

**END OF SECTION**

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**SECTION 23 65 ~~13~~ 00**  
**COOLING TOWER - PACKAGED**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Furnish labor, materials, tools, equipment, and services for Cooling Tower - Packaged, as indicated, in accordance with provisions of Contract Documents.
- B. Completely coordinate with work of other trades.

**1.2 QUALITY ASSURANCE**

- A. Thermal Performance Standard:
  - 1. Cooling Tower Institute (CTI), Certification Standard STD-201 For Water Cooling Towers.
- B. Listed Manufacturers and Manufacturers Desiring Approval:
  - 1. Meet dimensions of base manufacturer without affecting the pad or enclosure layout shown on the contract documents or ability to service equipment.
  - 2. Manufacturers who do not meet this requirement may be rejected at discretion of Engineer.

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Layout of cooling tower with connection sizes and locations.
  - 2. Layout of sump tank sweeper eductors and associated piping. Pipe sizes shall be as recommended by manufacturer. Include calculations confirming eductor flow and system performance coordinated with pumping supply system.
  - 3. All listed manufacturers shall meet the dimensions of base manufacturer without affecting the mechanical room or enclosure layout shown on the contract documents, the ability to service equipment, or tower performance. Manufacturers who do not meet this requirement may be rejected at the discretion of the Engineer.
- B. Product Data:
  - 1. Cooling tower.
    - a. Performance curves or actual performance test results on tower of same design criteria.
    - b. Sound performance data: Manufacturer's sound power levels by frequency (60 to 8000 Hz) on every side and top; and overall dBA rating.
- C. Project Information:
  - 1. Test reports.
- D. Contract Closeout Information:
  - 1. Operation and Maintenance Data, Owner instruction report and Warranty.
    - a. See Section 01 78 23.

**1.4 WARRANTY**

- A. Signed Manufacturer Warranty:
  - 1. Guarantee drift eliminators, fill and supports for 18 months after substantial completion.
  - 2. Provide 60 month comprehensive motor and drive warranty to include fan, fan shaft, belts, sheaves, fan bearings, gear box, flexible coupling, driveshaft and motor. Guarantee to begin after substantial completion.
- B. Provide full parts and labor manufacturer warranty to include parts, labor, travel time, and incurred expenses.
- C. Warranty to cover from date of start up to date of substantial completion, plus an additional 60 month parts and labor manufacturer warranty from date of substantial completion..



## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Cooling Towers, Induced Draft:
  - 1. Base:
    - a. Baltimore Air Coil.
  - 2. Optional:
    - a. Evapco.
    - b. Marley Cooling Tower.
- B. Basin Cleaner System:
  - 1. Base:
    - a. Process Efficiency Products Inc. (PEP).
  - 2. Optional:
    - a. Griswold Controls.
    - b. Lakos.

### **2.2 MATERIALS**

- A. Cooling Tower:
  - 1. Packaged, induced draft, axial fan, vertical discharge, crossflow type.
  - 2. Performance: As scheduled on drawings
  - 3. Structure: Suitable for applications requiring equipment anchorage to resist wind loads up to 30 LBS per square foot. Fan deck and basin covers designed for 50 LBS per square foot live load or 200 LB concentrated load.
- B. Construction:
  - 1. Heavy gauge 304 stainless steel angles, channels, panels, cold water basin, hot water basin, and fan deck.
  - 2. Access doors: Stainless steel, hinged or sliding type. Provide for access to eliminators, fan plenum section or any other section requiring routine maintenance.
  - 3. Bolts, nuts and washers: Stainless steel.
  - 4. Alternate side panel construction: Fiberglass reinforced polyester (FRP) with UV protection.
- C. Cold Water Collection Basin:
  - 1. Joints sealed and caulked at factory to ensure watertight performance.
  - 2. Self-cleaning and complete with depressed center section, clean out and drain fitting, bottom outlet suction connection with screen and anti-cavitation device. Bottom outlet shall have grooved mechanical or flanged connection.
  - 3. Construction: Heavy gauge type 304 stainless steel.
  - 4. Makeup valve: Float operated; one per tower cell.
  - 5. Design to support tower when resting on only 2 grillage beams or 4 piers per cell.
- D. Multiple Cell Towers:
  - 1. Provide bottom equalizer connection for connection to equalizer piping.
- E. Hot Water Distribution:
  - 1. Open basin gravity type with nozzles or schedule 40 PVC spray header with plastic diffusing type metering orifices.
  - 2. Furnish distribution basin with flanged connections suitable for direct piping connection or flow control valves as indicated.
  - 3. Provide basin covers.
  - 4. Basin construction: Heavy gauge type 304 stainless steel.
  - 5. For crossflow towers (gravity type basin), provide heavy duty flow control valves at inlet to each basin or self-balancing chamber as indicated.
  - 6. Each tower cell shall be capable of reduced flow at 25% of design flow while maintaining wet fill without any dry fill surfaces.

- F. Fill, Louvers and Drift Eliminators:
  - 1. Formed polyvinyl chloride material.
  - 2. Fill suspended from structural tubing supported from upper tower structure.
  - 3. Drift eliminators maximum drift rate: 0.005 PCT or less of the circulating water rate.
  - 4. Crossflow towers: Provide factory installed hot dipped galvanized steel wire screens over air inlets.
- G. Fans:
  - 1. Axial type with adjustable pitch, heavy duty, cast aluminum blades.
  - 2. Provide one for each cell.
  - 3. Each blade adjustable and individually attached to stainless steel or aluminum hub.
  - 4. Fan:
    - a. Motor:
      - 1) Protected type with 1.15 service factor constructed for cooling tower service.
      - 2) Single speed, totally enclosed, complying with 20 05 00.
      - 3) Mount motors out of fan cylinder.
    - b. Drive:
      - 1) Right angle, industrial duty, oil lubricated, geared speed reducer type.
    - c. Provide variable frequency drive for control of fan motor. Refer to specification section 25 23 00 for requirements.
    - d. Fan cylinder: Designed to minimize fan tip loss.
    - e. Fan cowl and guard: Conical shape welded stainless steel with hot dipped galvanized steel guard, conforming to OSHA standards. Provide over each fan cylinder.
- H. For crossflow towers, provide perimeter OSHA approved handrail of 1-1/2 IN diameter galvanized steel pipe on top of tower and an OSHA approved ladder to provide access from base of tower to fan deck.
- I. Internal access: provide internal galvanized steel bar grating walkway for access to drift eliminators and fan plenum section. Top of grating shall be above the cold water basin overflow level.
- J. Cold Water Basin Heaters:
  - 1. Provide two (2) 12 kW electric heaters installed at opposite sides of basin and ready for field wiring.
  - 2. Provide thermostat control with sensing bulb located in water basin.
  - 3. Provide low water cutoff control to prevent heater operation unless element is fully submerged.
  - 4. 460 volt electrical connection to heater by Electrical Specification Divisions.
  - 5. Contactor:
    - a. Provide 3-pole electrically held contactor with contacts rated for voltage and current of the cooling tower pan heaters.
    - b. Contactor coil voltage shall be rated to match the rating of the pan heaters control thermostat.
    - c. Contactor enclosure:
      - 1) Rating: NEMA 3R.
      - 2) Mounting: Between the pan heaters and the branch feeder disconnect switch.
      - 3) Control transformer: mounted within contactor enclosure and fuse both primary and secondary voltages. The primary voltage of the transformer shall match the supply voltage of the pan heater circuit and the secondary voltage of the transformer shall match the voltage rating of the pan heater thermostat.
    - d. Provide a control wiring diagram for the pan heater thermostat control with the cooling tower submittal.
- K. Vibration Limit Switch (one per tower cell):
  - 1. Type: Single pole, double-throw, vibration limit switch.
  - 2. Housing: NEMA 4.
  - 3. Provide with manual reset.

4. Provide with sensitivity adjustment.
5. Vibration Limit Switch shall be mercury free.
6. Installed at grade on the mechanical equipment support for wiring into the Owner's control panel.
7. In the event of excessive vibration, the limit switch will interrupt power to the motor.

## **2.3 VIBRATION ISOLATION**

- A. Vibration Isolation: Section 20 05 50.

## **2.4 BASIN CLEANER SYSTEM**

- A. Basin cleaner system shall serve the cold water basin of the cooling towers.
- B. Separator package:
  1. Factory assembled, prewired, prepiped system with the following:
  2. Solids separator: Carbon steel.
  3. Circulating pump:
    - a. In-line or close coupled end suction, single stage.
    - b. Cast iron housing.
    - c. Stainless steel or bronze impeller.
    - d. Stainless steel shaft.
    - e. Tungsten carbide or ceramic mechanical seal.
  4. Basket strainer.
  5. Solids collection vessel with 20-25 micron filter bag.
  6. Service indicator with dry contacts for remote indication. Includes differential pressure sensor and gauge with valving.
  7. Prewired control panel:
    - a. Motor starter with three phase protection.
    - b. Nema 4X enclosure.
    - c. HOA selector switch.
    - d. UL listed.
  8. Maximum working pressure: 50 PSI .
  9. Piping: Schedule 40 steel with reinforced rubber hose to collection vessel.
  10. Provide isolation valves on inlet, outlet, and purge line.
  11. Capacity: As scheduled.
  12. Finish: Enamel.
- C. Tank Sweeper Eductors:
  1. Provide tank sweeper eductors in basin. Number of eductors and eductor installation pattern shall be as recommended by the factory.
  2. Piping within sump: schedule 80 PVC.
  3. Pipe supports: Stainless steel.
  4. Eductor submergence: in accordance with manufacturer's recommendations for the eductor size used.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install components in accordance with manufacturer's instructions and as indicated.
- B. Install piping for tank sweeper eductors in accordance with approved manufacturer's shop drawings.
- C. Attach piping eductor system piping supports to basin or sump by method approved by basin or sump manufacturer.

### **3.2 FIELD QUALITY CONTROL**

- A. Perform operational tests to determine performance.
  - 1. Test in conjunction with chillers and pumps tests.
- B. Make alterations necessary to conform to design criteria.
- C. Retest as necessary.

### **3.3 VIBRATION ISOLATION**

- A. Vibration Isolation:
  - 1. See Section 20 05 50.

**END OF SECTION**

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3001 Washington Blvd., Ste. 200  
Arlington, VA 22201  
703.518.8500

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