

**KBSO Project #:** 25142  
**Project Name:** IU #20250569 – AHU-5 Replacement – AHU Procurement  
**Issue Date:** 12/22/2025

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This Addendum number 1 to the drawings and specifications shall supplement, amend, and become a part of the bidding documents, plans, and specifications. All bids and construction contracts shall be based on these modifications to the original contract documents.

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## **Part 1. BIDDING AND CONTRACT DOCUMENTS**

1.01 N/A

## **Part 2. SPECIFICATIONS**

2.01 23 73 13 - Custom Air-Handling Unit

- a. Specification section to be reissued in its entirety.
- b. Section 1.7 Coordination
  - i. Modify 1.7 'C' to read:
    - 1. Anticipated delivery date shall be **05/25/2026 to 07/04/2026**. Coordinate exact delivery date with contractor on site for IU project #20250569. Final delivery date shall be determined by installing contractor.
- c. Section 2.2 Manufactured Units
  - i. Add note #4 to 2.2 'D' Submit the following at the time of bid:
    - 1. 4. **Bidders to submit a factory letter confirming authorized dealer status and factory vetting.**
- d. Section 2.7 DIRECT DRIVE FAN SECTION
  - i. Modify 2.7 'A' to read:
    - 1. Fan-Section Construction: Fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure and equipped with formed-steel channel base for integral mounting of fan, motor, and casing panels. Mount fan scroll, wheel, shaft, bearings, and motor on concrete inertia fan bases with structural-steel frame, with frame mounted on base with spring vibration isolation. Concrete to be factory poured, leveled, and painted. Factory fan vibration readings are to be taken with concrete in place. **Concrete only required to achieve BV-4 rating.**
  - ii. Modify 2.7 'H' to read:
    - 1. Vibration test all fans at design rpm at minimum BV-4 requirements **at minimum**. Maximum allowed movement in any 3 planes is 0.15"/sec.
- e. Section 2.14 Factory and Field Leakage and Factory Deflection Test
  - i. Factory leakage testing not required for knockdown unit.

**Part 3. DRAWINGS**

3.01 M-1 - AHU-5 PROFILE & SCHEDULE

- a. Drawing reissued in its entirety.
- b. Steam coil dimensions and performance modified.
- c. Supply Fan performance modified.
- d. Chilled Water and Heat Recovery coil quantity adjusted.
- e. Plan notes modified and re-numbered.

**ATTACHMENTS:**

23 73 13 - Custom Air-Handling Unit

M-1 - AHU-5 PROFILE & SCHEDULE

**END OF ADDENDUM**

## SECTION 23 73 13 - CUSTOM AIR-HANDLING UNIT

### PART 1 - GENERAL

- 1.1 This specification shall apply to the following air handling units: AHU-5.
- 1.2 RELATED DOCUMENTS
  - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
  - B. Refer to the drawings for configuration, size, capacities, and other characteristics of each unit.
- 1.3 SUMMARY
  - A. This Section includes custom air-handling units with coils, wiring, and accessories as further described herein.
- 1.4 ACTION SUBMITTALS
  - A. Product Data: For each type of air-handling unit indicated. Include the following:
    - 1. Certified fan-performance curves with system operating conditions indicated.
    - 2. Certified fan-sound power ratings.
    - 3. Certified coil-performance ratings with system operating conditions indicated.
    - 4. Motor ratings, electrical characteristics, and motor and fan accessories.
    - 5. Material gages and finishes.
    - 6. Filters with performance characteristics.
    - 7. Dampers, including housings and linkages.
    - 8. Product data for all specified accessories.
  - B. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.
  - C. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer- installed and field-installed wiring.
  - D. Coordination Drawings: Submit with Shop Drawings. Show mechanical-room layout and relationships between components and adjacent structural and mechanical elements. Show

support locations, type of support, and weight on each support. Indicate and certify field measurements.

- E. Field Quality-Control Test Reports: From manufacturer.

## 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain air-handling units through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of air-handling units and are based on the specific system indicated.
- C. NFPA Compliance: Air-handling units and components shall be designed, fabricated, and installed in compliance with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
- D. Fan Performance Ratings: Rate according to AMCA 210, "Laboratory Methods of Testing Fans for Rating." In addition, all airfoil fans shall comply with AMCA standard 99-2408-69 and 99-2401-82 and shall bear the AMCA Seal.
- E. Sound Power Level Ratings: Rate according to AHRI 260-2001, "Sound Rating of Ducted Air Moving and Conditioning Equipment."
- F. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with AHRI 410.
- G. UL and NEMA Compliance: Provide motors required as part of air-handling units that are listed and labeled by UL and comply with applicable NEMA standards.
- H. Comply with NFPA 70 for components and installation.
- I. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled. The terms "Listed" and "Labeled" are defined in the National Electrical Code, Article 100.

## 1.6 WARRANTY

- A. Two (2) years on all parts and labor. Warranty starts at substantial completion of project.

## 1.7 COORDINATION

- A. Coordination: Coordinate layout and installation of air-handling units with piping and ductwork and with other installations.

- B. Deliver air handling unit AHU-5 to 402 N Blackford St, Indianapolis, IN 46202. Coordinate delivery with contractor on site for IU project #20250569.
- C. Anticipated delivery date shall be 05/25/2026 to 07/04/2026. Coordinate exact delivery date with contractor on site for IU project #20250569. Final delivery date shall be determined by installing contractor.

#### 1.8 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver air-handling unit as knockdown units with protective crating and covering.
- B. Lift and support units with manufacturer's designated lifting or supporting points.

#### 1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Filters: One set for each air handling unit.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Haakon
  - 2. Air Enterprises
  - 3. AirFlow Equipment
  - 4. Ingenia
  - 5. Ventrol

#### 2.2 MANUFACTURED UNITS

- A. General Description: Factory-assembled, minimum 2.25-inch solid double wall units consisting of fan motors and drive assembly, coils, dampers, plenums, filters, and condensate pans.
- B. After the bids are received, the Owner and Engineer will evaluate the air handlers to determine the most responsive and responsible air handler bid.

- C. In order for the air handler manufacturer's price – submitted by the bidder – to be valid, the air handler manufacturer must submit the following criteria by which the air handler bid will be evaluated. One (1) electronic copy of the information containing all of the proposed air handler submittal in PDF format.
- D. Submit the following at the time of bid:
  - 1. Product Data: Include unit dimensions and weight, including shipping splits and weight of each split, cabinet material, metal thickness, finishes, insulation thickness and density.
  - 2. Shop Drawings: Include a complete set of certified prints of the air handler assembly, controls, sections, and elevations; assembled unit dimensions; fan information including performance curves, sound-power ratings, construction, bearing L10 life, motor ratings, efficiency and VFD compatibility; fan vibration isolation requirements; coil performance ratings, tube thickness, fin thickness, and materials; clearances for maintenance and operation; size and location for duct, piping, and power connections; wiring diagram; control panel product data and Energy Management System interface information.
  - 3. Product Evaluation Criteria (optional): List any components or characteristics which differentiate the submitted equipment with that of a different model or manufacturer.
  - 4. Bidders to submit a factory letter confirming authorized dealer status and factory vetting.

## 2.3 CABINET

- A. Walls and roofs shall be constructed of a minimum of 16 gauge galvanized steel acoustic thermal panels. If aluminum exterior panels are used, the walls and roofs shall be a minimum of 14 gauge. All exterior surfaces are to be painted. Panel thickness shall be minimum 2.25". The inner liner shall be minimum of 22 gauge wash-down liner in all sections except the chilled water coil sections. The chilled water section shall be wash-down stainless steel liner. Insulation shall be a minimum of 2", 3 lbs density fiberglass. Minimum casing R-value=9. Insulation shall meet flame spread rating of less than 25 and a smoke developed rating of less than 50 when measured in accordance with ASTM E84. All permanently joined flanged panel surfaces shall be sealed with an individual strip of 1/8" x 3/8" tape sealer. Tape sealer shall be LEED qualified. Wall (and roof) seams shall be turned inward to provide a clean flush exterior finish. All panel seams shall be sealed during assembly to produce an airtight unit.
- B. Provide thermal break construction by installing a continuous 1/8-inch by 2-inch neoprene gasketing between the inner liner and the casing return flanges at all wall and roof panel interfaces, preventing thermal bridging through the double-wall panel system.
- C. Internal liner shall be suitable for washing with a 75 psi pressure washer or steam cleaned without risk of wetting the insulation. The liner shall be installed over top of the panel flanges and each liner seam shall be sealed with a lap joint. The wall liner shall be installed over top of the base water dam such that any water run-off from the liner will drip into the water tight base

rather into the wall panel. The roof liner shall be installed over top of the roof support so that water cannot enter the roof insulation.

- D. Under scheduled supply air temperature and design conditions on the exterior of the unit, condensation shall not form on the casing exterior (doors included).
- E. All insulation edges shall be joined on 8" centers using zinc plated TEK screws, bolts or metal clinches.
- F. All insulation edges shall be protected with metal lagging. Insulation systems using stickpins or adhesives are not acceptable.
- G. Stiffeners of angle steel shall be supplied as required to maintain casing deflection criteria of 1/200 at 10" of static pressure. If panels cannot meet this deflection, add additional internal reinforcing.

## 2.4 BASE CONSTRUCTION

- A. Base shall be constructed from structural steel channel around the perimeter of the unit, with intermediate channel and angle supports. Units shall have a minimum 6" base, or as shown on the drawings. Base steel shall be primed and painted on both the inside and outside. Base and cross supports shall be continuously welded at all seams.
- B. A minimum of 3/16" thick aluminum checker plate flat floor shall be installed on the base. Floor shall be flat reinforced from below, with all seams continuously welded. Drive screw or bolt attachment and caulking are not acceptable. Base shall be provided with lifting lugs, minimum four (4) per unit section. The base shall be insulated with a minimum of 3" spray foam insulation sheeted with a 22 gauge galvanized steel liner. Sloped floors and/or floors that "oil can" are not acceptable.
- C. Provide a 1.5" perimeter collar around the entire unit, and around each floor opening to ensure the unit is internally watertight. The entire base shall act as an auxiliary drain pan and hold up to 1.5" of water. The perimeter collar shall be continuously welded to the floor plate and positioned behind the inner casing liner.
- D. Provide auxiliary 1.25" aluminum drains in each section except the chilled water coil section. The chilled water coil section will have a drain pan and stainless steel condensate connection.
- E. All drain connections on floor mounted air handling units shall terminate at the side of the unit and capped.
- F. Maximum base deflection shall be 1/4" on 240" unsupported span.
- G. Duct openings through the unit floor shall be covered with expanded metal grating. Grating shall be capable of supporting a person.

## 2.5 ACCESS DOORS

- A. Access doors shall be manufactured from minimum of 16 gauge galvanized steel for the outer skin. The doors shall be double wall construction with 22 gauge solid galvanized steel liner on the inside all sections except for the chilled water section. The chilled water coil sections shall be 304 stainless steel inner liner. Corners of the doors shall be continuously welded for rigidity. Insulation shall be 4" thick - 3 lb/cu ft. density fiberglass. Doors must be the same thickness as the unit casing to maximize thermal and acoustical resistance. Hinges shall be continuous piano type stainless steel.
- B. Two chrome plated "Ventlok" Model #310 high pressure latches operable from either side of the door shall be provided. (PLASTIC or NYLON REINFORCED DOOR HANDLES ARE NOT ACCEPTABLE) Door opening shall be fully gasketed with continuous ½" closed cell hollow round black gasket with a metal encapsulated reinforcing backing that mechanically fastens to the door frame. Door frames shall be made from 16 gauge galvanized steel with the outside size of the door flush with the unit. Minimum door opening size shall be 24" x 70" (where height permits). Fan compartments must have a door of minimum width to remove the motor or the largest component.
- C. All access doors must swing against the air pressure (i.e. positive pressure plenum doors must swing in) and must be fully gasketed.
- D. All access doors shall be provided with Metal Test Ports for unit air stream for testing in each plenum section between each component with the AHU.
- E. Provide windows which are at a minimum 10" X 10" or 12" diameter double pane safety vision in all access doors.

## 2.6 DRAIN PANS

- A. Drain Pans: Readily cleanable, formed sections of stainless steel sheet complying with ASHRAE Standard 62. Fabricate pans in sizes and shapes to collect condensate from cooling coils (including coil piping connections and return bends) when units are operating at maximum catalogued face velocity across cooling coil. Pans shall be sloped in two planes for complete drainage to a single outlet without standing water. The drain pans at floors shall be depressed below the air handler floor level to prevent overflow.
  - 1. Double-Wall Construction: Fill space between walls with minimum of 4-inches insulation and seal moisture tight.
  - 2. Drain Connection: Same side of unit as coil connection side, unless noted otherwise; pre-piped to exterior of unit.
  - 3. Units with stacked coils shall have an intermediate drain pan or drain trough to collect condensate from top coil. Provide stainless steel intermediate drain pans that extend a minimum 3" downstream of coil face. Provide multiple 1" stainless steel condensate



pipng from intermediate pan to main drain pan.All portions of the drain pan, including intermediate pans and any hardware subject to contact with condensate, shall be constructed of Type 304 stainless steel.

4. Fasteners: All fasteners exposed to weather shall be corrosion-resistant.
5. Drain pans shall extend a minimum of 18" downstream of the cooling coil.

## 2.7 DIRECT DRIVE FAN SECTION

- A. Fan-Section Construction: Fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure and equipped with formed-steel channel base for integral mounting of fan, motor, and casing panels. Mount fan scroll, wheel, shaft, bearings, and motor on concrete inertia fan bases with structural-steel frame, with frame mounted on base with spring vibration isolation. Concrete to be factory poured, leveled, and painted. Factory fan vibration readings are to be taken with concrete in place.  
**Concrete only required to achieve BV-4 rating.**
  1. Mount fan and motor on an internal, fully welded, rigid structural steel base. Base shall be free floating at four corners on housed spring vibration isolators, minimum 2- inch static deflection, with seismic snubbers. Vibration isolators shall be Mason Industries Model SLF or equal. The fan base shall be fitted with necessary rebar and bottom skin for concrete inertia base. The concrete shall be installed at the factory. The available fill space provided in the base shall allow for enough fill weight to equal or exceed 1.5 times the weight of the rotating mass. Concrete inertia bases are required for all fans.
  2. Hoist Rail: Provide I beam hoist rail above fan section access doors to remove motors of 15hp and above. An extendable arm shall be provided to transport the motor to the unit exterior. Hoist rail shall be supported off of the flooring system of the unit.
- B. Fans, General: All fans shall be direct drive plenum style including aluminum wheels, with continuously welded blades, with smooth- curved inlet flange, heavy back-plate, and hollow die-formed airfoil-shaped blades continuously welded at tip flange and back-plate; cast-iron or cast-steel hub riveted to back-plate and fastened to shaft with set screws.
- C. Fan Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower.
- D. Shafts: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
  1. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.

- 2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
- E. Plenum fan assembly must have an enclosed safety screen as per OSHA Standards.
- F. Fans shall have inlet OSHA approved inlet screens.
- G. Fans shall be selected at a maximum of 60 Hz and shall not exceed 60 Hz at peak load.
- H. Vibration test all fans at design rpm BV-4 requirements **at minimum**. Maximum allowed movement in any 3 planes is 0.15"/sec.

## 2.8 MOTORS

- A. General: Refer to Division 23 Section "Electrical Requirements For HVAC Equipment" for general requirements, which are fully applicable to the work of this Section as if repeated herein.
- B. Motor Sizes: Minimum size as indicated, but larger if necessary so driven load will not require motor to operate in service factor range at design point, and larger if necessary so driven load will not require motor to operate beyond the service factor at any point on the fan curve. Motor HP must be at least 1.15 times BHP.
- C. Location: Motor, drive, and access door shall be on the same side of the fan as the coil connection side, unless otherwise indicated. Provide motor on an adjustable base, inside the air handling unit housing. Motors external to the air-handling unit housing are not acceptable.
- D. Inverter-Duty or Inverter-Ready Motors are required for all fans indicated to be controlled by a variable frequency drive.
- E. Noise Rating: Quiet.
- F. Provide an Aegis shaft grounding kit for all motors.
- G. Motors shall have extended lube lines.
- H. Motor bearing life shall be L10-100,000 hours.

## 2.9 HYDRONIC COILS (HEAT RECOVERY AND CHILLED WATER COIL)

- A. Coil Sections: Individual, insulated casings for cooling coil. Design and construct to facilitate removal and replacement of coil for maintenance and to assure full airflow through coils.
- B. Chilled Water Cooling Coils: Comply with all requirements specified herein for cooling coils.

- C. Coil Casing: Cooling coils shall be all 304 stainless steel materials. The hot water coil shall have galvanized steel casing.
- D. Circuit Arrangement: Self-draining and self-venting coil fabricated according to AHRI 410. Number of rows shall be determined by manufacturer to meet scheduled performance requirements. Unless noted otherwise, do not exceed 2 rows for heating coils or 10 rows for cooling coils.
- E. Piping Connections: Threaded or flanged, on same side. Coil connections shall be on the side of the unit indicated on the Drawings. Coil connections shall extend 4" outside of casing for ease of connection.
- F. Tubes: Copper, 5/8-inch O.D. with 0.035-inch minimum wall. Select coils for not less than 2 fps water velocity and not more than 6 fps water velocity.
- G. Fins: Aluminum of minimum thickness 0.075-inch. Spacing shall not exceed 10 per inch for cooling coils.
- H. Fin and Tube Joint: Mechanical bond created via thermal expansion.
- I. Headers: Non-ferrous, such as seamless copper tube with brazed joints, with drain and air vent tapings. Headers and return bends shall be enclosed within the air handling unit casing.
- J. Frames: 304 Stainless steel, 0.0625-inch is required for cooling coils. Galvanized- steel channel frame, 0.052-inch is acceptable for heating coils.
- K. Ratings: Design tested and rated according to ASHRAE 33 and AHRI 410.
- L. Working-Pressure Ratings: 200 psig, 325°F.
- M. Source Quality Control: Test to 300 psig and to 200 psig underwater.
- N. AHU-5 Heat Recovery Water Coil: Hot water heating coil to be split at midpoint to facilitate removal and replacement of coil for maintenance.
- O. Steam IFB Coil:
  - 1. AHRI 410: Air-handling unit coils shall be rated in accordance with AHRI 410 and shall be listed by AHRI.
  - 2. Integral face and bypass coils general requirements:
    - a. Opposed-blade bypass dampers to be extruded aluminum or galvanized steel blades with full length drive rod with seals.
      - 1) Damper blades and linkage to be external to airstream where applicable.
      - 2) Leakage rates and torque requirements shall be compatible with unit operating conditions.

- b. Actuators sized and provided by manufacturer.
  - c. Provide mixing baffles on discharge of coil.
    - 1) Provide factory-installed mixing baffles to ensure uniform air discharge temperature at all bypass ratios.
    - 2) Mixing baffles are required due to the high heat content of entering steam and elevated coil leaving air temperatures.
  - d. Full perimeter casing assembly designed for installation in a custom air-handling unit.
  - e. Assembly shall be designed to maintain proper air mixing and uniform discharge temperatures across a wide range of coil bypass positions.
3. Coils shall be rated for system operating pressures and temperatures encountered by installation, but not less than 100 psig and 400 deg F.
4. Fins:
- a. Aluminum 0.01 inch thick.
  - b. 1/2" high edge-wound, tin-coated copper fin construction.
  - c. 12 fins per inch (FPI).
5. Headers: Construct header of carbon steel or seamless copper with brazed joints, ASTM B75/B75M drawn temper.
- a. Drains: Include low point of supply header with a NPS 3/4 drain connection. Extend copper or red brass pipe through air-handling unit casing and terminate end with male national pipe threads (MNPT). Pipe shall be threaded on both ends to facilitate easy field removal and replacement.
  - b. Vents: Include high point of return header with a NPS 3/4 vent connection. Extend copper or red brass pipe through air-handling unit casing and terminate end with MNPT. Pipe shall be threaded on both ends to facilitate easy field removal and replacement.
  - c. Protect openings of supply, return, vent, and drain connections with a threaded cap to prevent entry of dirt into the coil.
6. Frames: Galvanized steel channel frame.
7. Tubes: Steam distributing type with 1 inch OD copper outer tube and 5/8 inch O.D. copper inner tube, ASTM B75/B75M annealed temper or ASTM B280 drawn temper with 0.025 inch minimum wall thickness. Return bends shall be a minimum of 0.035 inch thick prior to bending. Tubes shall be horizontal and sloped for drainage.

8. Air-Handling Unit Factory Assembly:
  - a. Face and bypass section shall be furnished as a single integrated assembly for installation into a knockdown AHU.
  - b. Bypass dampers shall be fully sized to divert required airflow around the coil while maintaining casing integrity and leakage class appropriate to AHU design.
  - c. All joints and penetrations shall be sealed to match AHU leakage test requirements.
  - d. Coil Connections: Extend each coil connection through casing access panel and terminate connections, approximately 4 inches beyond exterior face of access panel, and seal each penetration as indicated. Casing access panels shall be removed and reinstalled with coils installed inside air-handling units.
  - e. Removal and Replacement: Each coil shall be independently removable and replaceable through a removable access panel installed in air-handling unit casing.
  - f. Supports for Coils:
    - 1) Construct a freestanding and self-supporting structural framework to support each coil individually from and independent of adjacent coils.
    - 2) Construct framework for coils from galvanized steel.
  - g. Manufacturer shall provide all necessary documentation, including:
    - 1) Dimensional drawings,
    - 2) Installation details,
    - 3) Performance schedules,
    - 4) Damper torque requirements,
    - 5) Piping and connection information.

## 2.10 FILTER SECTION

- A. Pre-filters: Filter Section: Pre Filters shall be MERV 8 pleated, disposable types. Each filter shall consist of a non-woven cotton and synthetic fabric media, media support grid and enclosing frame. The filter shall be listed by Underwriters' Laboratories as Class 2.
  1. Pre-filters shall be installed in prefabricated channel rack.
  2. Pre-filters shall be lift-out where access is available upstream of the filter, or slide out when access is not available. Provide vertical blockoffs at filter seams to prevent air bypass when filters are loaded.

- B. Final filters shall be MERV 13 high performance, deep pleated, totally rigid and disposable type. Each filter shall consist of high density microfine glass fiber media, media support grid, contour stabilizer and enclosing frame.
  - 1. Final filter media shall be of high density microfine glass fibers that are laminated to a non-woven synthetic backing to form a lofted filter blanket. The filter media shall have an average efficiency of 90-95% on the ASHRAE Test Standard (52-76) and a MERV 13 rating. It shall have an average arrestance of not less than 99% on that standard. Filters shall be listed by Underwriters' Laboratories as Class 2.
  - 2. Holding Frames: Holding frames shall be factory fabricated of 16 gauge galvanized steel and shall be equipped with gaskets on all 4 sides of the filter and 2 heavy duty positive sealing fasteners. Each fastener shall be capable of withstanding 25 lbs. pressure without deflection and be attached or removed without the use of tools.
  - 3. Final Filters shall be lifted out where access is available upstream of the filter. Side slideout filters are not acceptable.
- C. Provide Dwyer 2000 (photohelic) magnehelic gauge. The gauge shall be accurate to  $\pm 2\%$  of full range. One gauge shall be provided for each filter bank. Gauges shall be recessed into cabinet casing.

#### 2.11 FAN INLET AIRFLOW MEASURING STATION

- A. Provide an airflow piezometer measuring probes for each fan capable of continuously monitoring the air handling capacity of the respective fans.
- B. Each piezometer airflow probes shall contain multiple, averaged velocity pressure taps located symmetrically around the throat of the fan inlet(s) and a single static pressure tap located on the fan housing. The entire airflow monitoring probe must be located outside the inlet throat as to not obstruct the airflow. Provide interconnecting tubing and single connection point for transducer. Interconnecting tubing shall be mounted outside the inlet throat.
- C. The piezometer probes shall be capable of producing steady, non-pulsating signal of the velocity pressure, independent of the upstream static pressure without adversely affecting the performance of the fan. The sensing probes shall be accurate to 5 percent of actual fan airflow.
- D. Provide differential pressure versus airflow calibration curves and equations. The air handling unit manufacturer shall provide the transducer with LCD screen to display CFM. Supply voltage shall be 24 VAC and output signal shall be 4-20 mA. Provide Bacnet connection to building automation system.
- E. Fan inlet airflow measure shall be manufactured by air handling unit manufacturer or by Ebtron or CRC.

2.12 FINISH

- A. Unit shall be finished painted with two components, etch bond primer or epoxy primer and finish painted with alkyd enamel or Acrycote acrylic, the color shall be manufacturer standard color. All uncoated steel and aluminum shall be painted with grey enamel. All metal surfaces shall be pre-painted with vinyl wash primer to ensure paint bonds to metal. All paint shall be suitable for outdoor installation.

2.13 ELECTRICAL

- A. Factory wire and test all air handling units. by CSA, ETL or UL.
- B. Unit manufacturer shall provide non-fused disconnect for each fan power connection for the air handling unit. The disconnects shall be mounted on drive side of air handling unit. Wiring and devices shall comply with the NEC. All wiring shall be concealed in conduit, provide junction boxes as required.
- C. Unit manufacturer shall provide, install, and wire the complete electrical system and all branch circuit wiring and conduit.
- D. Label and number code all wiring and electrical devices in accordance with the unit electrical diagram. Mount the devices in a control panel inside the unit's service enclosure or on the outside. Ensure the control panel meets the CSA, ETL or UL.
- E. Marine Lights in Airstream: Each section which includes an access door shall also include a factory-mounted, enclosed and gasketed, vapor-tight, LED light fixture. Include junction box, globe, aluminum globe guard, receptacle, and bulb ready for field wiring. 60 minute timer switch shall be provided for the lights. Provide lights where shown on the drawings, minimum of two lights in each section.
- F. GFCI Receptacle: Provide duplex GFI receptacle; 20 amp / 120 volt, on the unit exterior.

2.14 FACTORY AND FIELD LEAKAGE AND FACTORY DEFLECTION TEST

- A. Leakage Testing: The unit manufacturer shall field pressure tests the air handling units. The leakage rate of the casing shall not exceed 1.0% of the unit air flow at +/- 10" static pressure.
  - 1. The test shall be conducted in accordance with SMACNA duct construction manual. A calibrated orifice shall be used to measure leakage airflow.
  - 2. An officer of the manufacturing company shall certify test results and forward copies of the certified test results to the engineer and owner.
  - 3. Positive pressure plenums shall be tested positively and negative pressure plenums shall be tested negatively.

4. Units must be tested in a fully assembled state equal to that of operational equipment with unit sections mated and attached per Installation and Operation Manual instructions. AHU may not have temporary modifications, caulking, lubricant, tape, or other item designed to help it pass the test. Air handler doors will be closed using the factory locking mechanism normally supplied with the door, no additional blocking or modifications are allowed. Testing individual sections are NOT acceptable.
  5. Temporary panels may be used to secure all duct, damper and similar openings in the air handler (ONLY)
- B. Deflection Testing: The unit manufacturer shall provide field deflection test for the air handling unit. The deflection shall be less than  $L/200$  at  $\pm 10''$  static pressure.
1. The test shall be conducted in accordance with SMACNA duct construction manual. A calibrated orifice shall be used to measure pressure.
  2. An officer of the manufacturing company shall certify test results and forward copies of the certified test results to the engineer and owner.
  3. Positive pressure plenums shall be tested positively and negative pressure plenums shall be tested negatively.
  4. A dimensioned cross section of the units being tested showing the test locations must be provided to the University representative prior to test being performed.
  5. Deflection shall be measured using a laser.
  6. For each the test, either positive or negative, all points will be tested simultaneously. This typically involves at least three and no more than six points, one on the largest panel in each wall and the roof, one on a panel in the end wall, and two other points determined at the time of the test. The test point is typically at the midpoint of the cabinet height and midpoint of the width but at no point will the unit deflect more than specified. If, during testing, the witnessing University or Engineer representative observes excessive deflection in a panel other than that being tested the test will be repeated and the suspect panel tested in addition to any panel that failed the initial test. Panels that passed the initial test do not need to be retested.
  7. Maximum allowable floor deflection is  $L/400$  of the width of the floor being tested. Floor test with a 300 lb load on one square foot at the center of the floor.

## 2.15 FACTORY VIBRATION AND TESTING

- A. Fans and motors shall be dynamically balanced to exceed a BV-4 criterion as per AMCA 204-96. The test shall be conducted after the fan and motor base assembly has been completed. The entire fan assembly including fan wheels, shafts, bearings, drives, belts, motors, isolation bases shall be tested. During the test, the fan and motor base shall be supported by its isolators which



are set in the freely floating operating position. (In cases where a concrete inertia base is provided, the factory poured concrete shall be installed at the time of the vibration test).

- B. The required measurement points are as follows: one horizontal measurement and one vertical measurement shall be taken for each fan and motor bearing and one axial measurement shall be taken for each shaft. The measurements shall be taken using calibrated, magnetically mounted accelerometers and a calibrated measuring instrument.
- C. Vibration measurement locations shall be as close as possible to the bearing or shaft centerlines. Measurements shall be taken from the bearing housings, bearing pedestals, or motor casings. Measurements shall not be taken from flexible covers or shields.
- D. Fans and motors shall be tested at the design RPM and the maximum overall filter-in vibration levels at each measurement point shall be less than or equal to 0.15 in/second peak velocity at the operating speed. If any measurements exceed the above criterion, the assembly shall be rebalanced and re-tested until the criterion is achieved.
- E. Certified measurements shall be provided to the consultant.

## 2.16 KIT / KNOCKDOWN CONSTRUCTION

- A. For units that are required to be knock-down, the unit shall be completely assembled at the factory with Dry-Fitting of ALL parts, including walls, roofs, bases, fans, motors, coils, dampers, conduit, lights, etc. For Quality Control and Owner/Engineer Verification, pictures from the factory of the completed Dry-Fitted assembly are to sent to the Engineer of Record, prior to disassembly and shipment.
- B. After QC pictures are submitted and approved, all components are to be tagged and dis- assembled into the size of pieces required for moving the pieces into the mechanical room space.
- C. Palletize, shrink wrap, and or crate all component for shipment.
- D. All electrical component shall ship loose for installation and wiring by the on-site contractors; this includes the lights, light conduit, motor conduit, motor wire, exterior junction boxes or non- fused disconnects where specified above.
- E. Unit manufacturer shall provide on-site factory or factory authorized supervision of the complete re-assembly of the air handling unit.
- F. Units are to be field tested for casing leakage at +8"/-8" static pressure and the combined leakage of both test shall not exceed 1% of total unit design cfm. Units will not be accepted until the tests have been verified to have passed.

## PART 3 - EXECUTION

3.1 INSTALLATION – NOT APPLICABLE – PROVIDED BY CONTRACTOR ON SITE FOR IU  
PROJECT 20250569

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
1. Leak Test: After installation, fill coils with water and test coils and connections for leaks. Repair leaks and retest until no leaks exist.
  2. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
  3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Final Checks before Startup: Perform the following:
1. Verify that shipping, blocking, and bracing are removed.
  2. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
  3. Perform cleaning and adjusting specified in this section.
  4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify free fan wheel rotation and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
  5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
  6. Set zone dampers to fully open position for each zone.
  7. Comb coil fins for parallel orientation.
  8. Install clean filters.

9. Verify that manual and automatic control and fire dampers in connected duct systems are in fully open position.
  - C. Starting procedures for air handling units include the following:
    1. Energize motor; verify proper operation of motor, drive system, and fan wheel.
    2. Measure and record motor electrical values for voltage and amperage.
    3. Manually operate dampers from fully closed to fully open position and record fan performance.
  - D. Testing, Adjusting, and Balancing is the work of Division 23 Section "Testing, Adjusting, and Balancing" which shall include adjustment of fan to indicated rpm.
- 3.4 CLEANING – NOT APPLICABLE – PROVIDED BY CONTRACTOR ON SITE FOR IU PROJECT 20250569
- 3.5 DEMONSTRATION
- A. Engage the service of a factory-authorized service representative to train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
    1. Schedule training with Owner, through Engineer, with at least 7 days advance notice.

END OF SECTION 23 73 13

AIR HANDLING UNIT SCHEDULE - HEAT RECOVERY COIL

UNIT ID	MBH	EAT (°F)	LAT (°F)	ROWS	FINS/INCH	MAX APD (IN-WG)	MAX VEL (FPM)	EWT (°F)	GPM
AHU-5	1596.6	9.3	42.6	6	8	0.41	500	70	135

AIR HANDLING UNIT SCHEDULE - STEAM IFB COIL

UNIT ID	STEAM HEATING HEATING COIL DATA									
	HEATING MBH	EAT (°F)	LAT (°F)	ROWS	FINS/INCH	MAX APD (IN-WG)	MAX VEL (FPM)	STEAM TEMP (°F)	LBS/HR	PSIG
AHU-5	2928.8	9.3	76.3	2	12	0.53	830	307	3237.6	60.00

AIR HANDLING UNIT - HYDRONIC COOLING COIL

UNIT ID	HYDRONIC COOLING COIL DATA												
	TOTAL MBH	SENS MBH	EAT		LAT		ROWS	FINS/INCH	MAX APD (IN-WG)	MAX VEL (FPM)	EWT (°F)	GPM	MAX WPD (IN-WG)
			DB (°F)	WB (°F)	DB (°F)	WB (°F)							
AHU-5	2505	1539.6	87.1	72.0	55.1	54.9	6	8	0.93	500	47	501	9.70

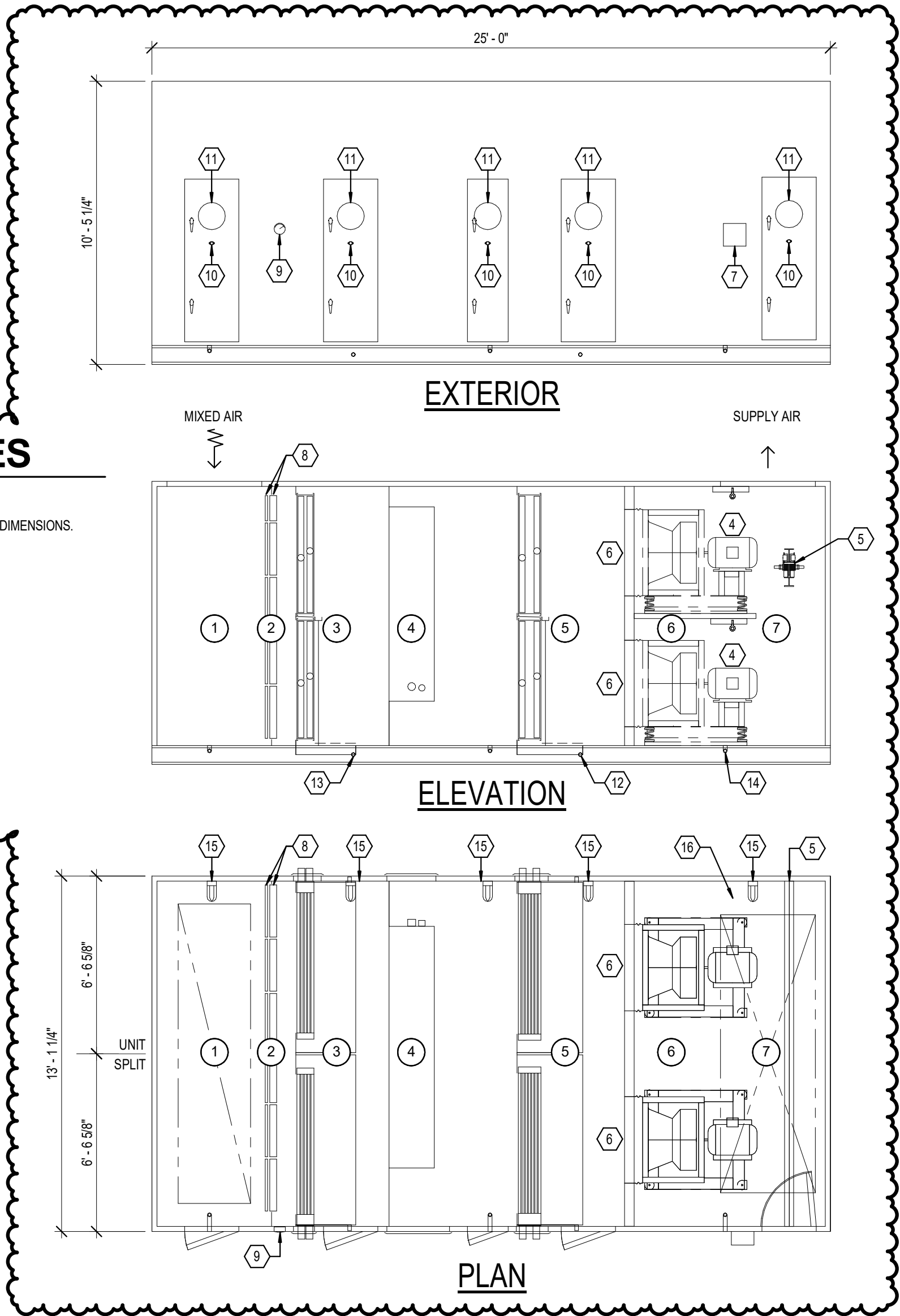
AIR HANDLING UNIT SCHEDULE - SUPPLY FAN & FILTER DATA

UNIT ID	AIR CAPACITY		SUPPLY FAN DATA							FILTER DATA				ELECTRICAL DATA				BASIS OF DESIGN MANUFACTURER	NOTES
	CFM	MIN OA CFM	QTY	WHEEL DIA (IN)	TSP (IN-WG)	ESP (IN-WG)	BHP	RPM	HP	PRE-FILTER TYPE	PRE-FILTER MERV	FINAL FILTER TYPE	FINAL FILTER MERV	FLA	VOLTAGE	PHASE	MOCP (A)		
AHU-5	44490	26695	4	27	6.74	3.25	16.6	1750	20	PLEATED	8	PLEATED	13	23.5	460	3	50	HAAKON	1,2,3,4

- NOTES:
- HEAT RECOVERY COIL IS 20% PROPYLENE GLYCOL.
  - INTEGRAL FACE & BYPASS STEAM COIL. 80 PSIG STEAM PRESSURE.
  - (4) SUPPLY FANS - EACH @ 11,125CFM, 6.55" TSP, 20HP, 16.2BHP, 27" DIAMETER DIRECT DRIVE, 12 BLADES, CLASS 2, 1750 RPM, 460/3PH, 23.5 FLA, 30 MCA, 50 MOCP.
  - COIL CAPACITY NOTED IS TOTAL FOR ALL COILS.

AHU-5 PROFILE KEYNOTES

- UNIT SHALL BE SHIPPED AS A KIT FOR REASSEMBLY ON SITE.
- ALL AHU COMPONENTS AND SPLITS MUST FIT WITHIN FREIGHT ELEVATOR AND SHIPPING DOCK DOOR DIMENSIONS. FREIGHT ELEVATOR IS 96"W x 96"T x 125"L. SHIPPING DOCK DOOR IS 88"W x 84"T.
- UNIT SHALL BE DESIGNED TO BE MOUNTED ON AN EXISTING CONCRETE PAD.
- DIRECT DRIVE FAN MOTOR. VARIABLE SPEED DRIVE WITH GROUNDING RING ON SHAFT.
- TROLLEY RAIL FOR MOTOR REMOVAL THRU EXTERIOR DOOR.
- SUPPLY FAN ISOLATION BLANK-OFF PANELS AND AIR-FLOW MEASURING STATIONS ON FAN INLETS.
- AIR-FLOW MEASURING STATION READOUT.
- 2" MERV-8 PRE-FILTERS AND 4" MERV-13 FINAL FILTERS.
- MAGNEHELIC GAUGE ACROSS FILTERS.
- PROVIDE DURODYNE IP INSTRUMENT TEST PORTS IN ALL ACCESS DOORS.
- PROVIDE VIEWPORT ON ALL ACCESS DOORS.
- 1-1/2" COOLING COIL CONDENSATE CONNECTION.
- 1-1/2" HEAT RECOVERY COIL CONDENSATE CONNECTION.
- FLOOR DRAIN (TYPICAL).
- LED MARINE LIGHT.
- DUPLEX RECEPTACLE PROVIDED IN FAN SECTION.



AHU-5 SECTIONS

- |                      |                           |
|----------------------|---------------------------|
| 1 AHU INLET          | 5 COOLING COIL            |
| 2 FILTER RACK        | 6 SUPPLY FANS - (QTY : 4) |
| 3 HEAT RECOVERY COIL | 7 AHU DISCHARGE           |
| 4 STEAM IFB COIL     |                           |

1 AHU-5 PROFILE