GRUMMAN|BUTKUS
ENERGY EFFICIENCY CONSULTANTS
AND SUSTAINABLE DESIGN ENGINEERS

ADDENDUM 1

Date: **March 18, 2026**

To: Bidders of Record

Cc: Laura McGrath, Skokie Public Library
Suzy Rodela-Sulik, Skokie Public Library

Re: 2nd Floor AHU Replacement
Skokie Public Library
5215 Oakton St.

This Addendum forms a part of the Bidding Documents and amends the original documents dated March 11, **2026**.

Acknowledge receipt of this addendum in the space provided on Bid Form. Failure to do so may subject bidder to disqualification.

SPECIFICATION REVISIONS

1. Construction 00 1116 Invitation to Bid
    a. No changes, included as part of Project Manual.
2. 20 0513-Motor Requirements for M-P-FP-BA1
    a. Revised the type of motor permitted.
    b. Refer to full specification section for additional changes.
3. 20 2923-Variable Frequency Drives for M-P-FP-BA1
    a. Revised type of VFD drive permitted.
    b. Refer to full specification section for additional changes
4. 23 7300-Custom Indoor Air Handling Units-BA1
    a. Revised AHU construction materials, motor, and VFD type.
    b. Added knock-down construction language and requirements.
    c. Refer to full specification section for additional changes

DRAWING REVISIONS

1. M001 – Mechanical Schedules.
    a. Revised VFD schedule.
    b. Revised Fan schedule.
    c. Revised Cooling Coil schedule.
    d. Revised Air Blender schedule.

e. Refer to drawing for additional changes.

END ADDENDUM

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SECTION 00 1116
INVITATION TO BID

1. DATE

March 11, 2026

2. PROJECT

2nd Floor AHU Replacement
Skokie Public Library
5215 Oakton St.
Skokie, IL 60077
GBA #P25-1226-00

3. BID SCHEDULE

Documents Issued to Bidders:	March 11, 2026 after 10:00 AM
Pre-Bid Conference/Site Tour:	March 17, 2026 at 1:00 PM
Bids Due:	April 1, 2026 at 3:00 PM

4. DOCUMENT PROCUREMENT

4.1 Bid documents may be obtained at the issuing office as follows:

A. Date: March 11, 2026 after 10:00 AM

B. Time: 9:00 am - 5:00 pm weekdays

C. Issuing Office: Grumman|Butkus Associates
820 Davis Street, Suite 300
Evanston, IL 60201

Contact Andrew Milleville
Project Manager

amilleville@grummanbutkus.com

5. TYPE OF BID REQUESTED

5.1 Bids for performing the Work shall be on a lump sum basis.

5.2 Owner reserves the right to retain 10% on payments to Contractor until Final Acceptance of Work.

5.3 Base Bid and Alternates shall include all Work called for in the Project Manual, on the Drawings and in any Addenda that may be issued.

5.4 Prices for Work performed by all subcontractors (including a General Contractor, if used) shall be included in Base Bid and Alternates. Owner reserves the right to request a copy of any subcontractor's proposal.

5.5 All copies of Project Manual, Drawings and Addenda shall be returned with Bids. Successful Bidder shall receive copies of bidding documents back after signing contract for the Work.

6. PRE-BID CONFERENCE AND SITE TOUR

6.1 The pre-bid conference and site tour is mandatory (see bid schedule for times).

6.2 A site tour will be conducted for all Bidders and will be led by Owner's personnel immediately following the pre-bid conference.

6.3 Additional site visits relating to examining the existing facilities and systems may be made during the bidding period. Arrangements may be made with:

Vinny Tangherlini
Building Services Manager
Skokie Public Library
224-392-5138
vtangherlini@skokielibrary.info

7. TECHNICAL ISSUES

7.1 Technical questions should be directed to the Engineer:

Grumman|Butkus Associates
820 Davis Street, Suite 300
Evanston, IL 60201

Attention:
Andrew Milleville
Project Manager
847.328.3555 x285
amilleville@grummanbutkus.com

7.2 Questions shall be submitted in writing. Answers will be provided in writing, with the original questions, to all bidders.

8. RECEIPT OF BIDS

8.1 Place (Hand delivered or mailed):

Skokie Public Library, Administration Office
5215 Oakton St.
Skokie, IL 60077

Attention:
Richard Kong
Executive Director

8.2 Format Lump Sum Bids on Bid Form (two copies)

Label envelope as follows:
TECHNICAL/PRICE PROPOSAL

To:	Skokie Public Library
Attn:	Richard Kong
	Executive Director
	5215 Oakton St.
	Skokie, IL 60077
For:	2nd Floor AHU Replacement
Bidder:	Bidder's Name
Date Due:	April 1, 2026 at 3:00 PM

8.3 TIME: All Proposals shall be time-stamped as received. Any Proposal received after time due may be returned unopened at Owner's discretion.

8.4 TYPE OF BID OPENING: Public

9. RIGHT TO REJECT BIDS

9.1 Owner reserves the right to reject any or all bids, to award all or part of a bid to any vendor, to accept an alternate, or to award the contract to other than the lowest bidder, and to waive any nonconformity, informality or irregularity in any bid at its sole discretion.

10. BID SECURITY

10.1 No Bid Security will be required.

11. CONTRACT SECURITY (PERFORMANCE BOND AND PAYMENT BOND)

11.1 Performance bond and Labor and Material Bond will be required for this project. Refer to the Instructions to Bidders for requirements.

12. CONTRACT FORM

12.1 A copy of the Contract Form is included in the Project Manual.

13. PREVAILING WAGE NOTICE

13.1 The contractor shall comply with the Illinois Prevailing Wage Act. Refer to the Instructions to Bidders for requirements.

14. SUBSTANCE ABUSE PREVENTION ACT

14.1 The Contractor shall comply and cause all subcontractors to comply with requirements and provisions of the Illinois Substance Abuse Prevention on Public Works Projects Act. Refer to the Instructions to Bidders for requirements.

15. COMPLIANCE WITH ALL LAWS NOTICE

15.1 Contractor shall comply with all applicable laws, regulations, and rules promulgated by any Federal, State, County, Municipal and or other governmental unit or regulatory body now in effect during the performance of the work, and the orders and decrees of any courts or administrative bodies or tribunals in any manner affecting the performance of the Contract for this project. By way of example, the following are included within the scope of the laws, regulations and rules referred to in this paragraph, but in no way operate as a limitation on the laws, regulations and rules with which Contractor must comply: all forms of Workers Compensation Laws, all terms of the Equal Employment Opportunity Clause of the Illinois Fair Employment Practices Commission, the Illinois Preference Act, Illinois Substance Abuse Prevention on Works Projects Act, the Social Security Act, Statutes relating to contracts let by units of government, all applicable Civil Rights and Anti-Discrimination Laws and Regulations, and traffic and public utility regulations.

END OF SECTION

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SECTION 20 0513
MOTOR REQUIREMENTS FOR MECHANICAL, PLUMBING, AND FIRE SUPPRESSION EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Motor requirements specifically applicable to Divisions 20, 21, 22, and 23, including:

1. Single-phase general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 volts.
2. Three-phase general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 volts.

B. Coordination

1. Coordinate features of motors, installed units, and accessory devices to be compatible with the following such that all items furnished constitute a properly related package:
   a. Motor starters
   b. Motor controllers
   c. Variable frequency drives
   d. Torque, speed and horsepower requirements of the load
   e. Ratings and characteristics of supply circuit and required control sequence
   f. Ambient and environmental conditions of installation location
2. Providing a motor to satisfy the efficiency requirements specified herein, is the responsibility of the Contractor. If any given manufacturer or supplier of the motorized equipment cannot provide a motor that satisfied the specified efficiency requirements, the Contractor is responsible for any and all steps necessary to provide an adequate motor including but not necessarily limited to:
   a. Coordinating delivery and installation of an acceptable motor to the motorized equipment supplier for factory-installation.
   b. Field-installation of an acceptable motor on the motorized equipment. Field installation shall not void the warranty of the motorized equipment.

1.2 DEFINITIONS

A. Factory-installed motor: A motor installed by the motorized equipment manufacturer at the equipment manufacturer's factory as a component of the equipment.

B. Field-installed motor: A motor installed on the motorized equipment at the Project site.

1.3 CODES AND STANDARDS (UTILIZE LATEST EDITION)

A. ASHRAE 90: Energy Standard for Buildings except Low-Rise Residential Buildings

B. AFBMA 9: Load Ratings and Fatigue Life for Ball Bearings

C. ANSI/IEEE 112B: Test Procedure for Polyphase Induction Motors and Generators

D. EISA: The Energy Independence and Security Act of 2007

E. IECC: International Energy Conservation Code

F. IEEE 112-2004: Standard Test Procedure for Polyphase Induction Motors and Generators

G. IEEE 841-2001: Standard for Petroleum and Chemical Industry - Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors - Up to and Including 370 kW (500 hp)

H. NETA ATS: Acceptance Testing Specification

I. NFPA 70: National Electrical Code

J. NEMA MG : Motors and Generators

K. UL 1004: Electric Motors

1.4 QUALITY ASSURANCE

A. Manufacturer shall be a company specializing in manufacture of electric motors for the intended use and their accessories, with minimum three years documented product development, testing and manufacturing experience.

B. All motors shall be UL 1004 listed.

C. Motor efficiencies shall be based on the IEEE 112, Test Method B.

1.5 SUBMITTALS

A. Preconstruction – Prior to construction provide the following in accordance with Division 01 and Specification 20 0500 – Basic Requirements for Mechanical, Plumbing, and Fire Suppression:

1. Product data
    a. Submit manufacturer's literature indicating:
        (1) Type and size of motor
        (2) Name plate data and rating
        (3) Weight
        (4) Conduit entry and ground lug locations
        (5) Enclosure type and mounting arrangement
        (6) Insulation class
        (7) Information on coating or finishes
        (8) Nominal minimum efficiency
            (a) Provide statement that all motors 1 hp and larger meet "premium efficiency" requirements specified herein.
        (9) Nominal minimum power factor
        (10) Sound power levels in dba
    b. Submit manufacturer's test results verifying guaranteed minimum efficiency and power factor for all three phase motors larger than 1 hp.
    c. Submit manufacturer's literature for bearing protection grounding rings. If not integral to the motor supplied, but field installed as an option, also provide manufacturer's installation instructions.
2. Manufacturer's installation and operating manuals.

B. Contract Closeout – At contract closeout provide the following in accordance with Division 01 and Specification 20 0500 – Basic Requirements for Mechanical, Plumbing, and Fire Suppression:

1. Operating and Maintenance Data including:
    a. Product data
    b. Installation instructions
    c. Assembly drawings
    d. Replacement parts list
    e. Maintenance and operation instructions
2. Test Reports
    a. Field installed motor test
    b. Field installed bearing protection ring tests
3. Warranties

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site.

B. Protect motors stored on-site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.7 SPARE PARTS

Not Applicable

1.8 WARRANTY

A. Provide five year manufacturer's warranty for motors 1 hp and larger.

PART 2 - PRODUCTS

2.1 MOTORS

A. Acceptable manufacturers

1. Toshiba
2. Baldor Electric
3. Emerson Motors
4. GE Motors
5. Leeson (Lincoln)
6. Marathon Electric
7. Siemens
8. TECO – Westinghouse

B. General motor requirements applicable to all motors

1. Comply with the requirements in this section except when stricter requirements are specified on the drawings or Division 23 Equipment Sections.

2. Comply with NEMA MG 1.
3. Motor size:
    a. Motors shall be capable of driving the intended load and not exceeding the design horsepower.
    b. Motors shall be selected such that the brake horsepower (bhp), including drive losses of the driven equipment, does not exceed 90% of the motor nameplate rating at design conditions.
4. Visible nameplate:
    a. Provide a visible motor nameplate indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, and service factor.
    b. Nameplates for all three-phase motors shall also indicate power factor and efficiency.
    c. Nameplate shall indicate "Premium Efficiency" where such a motor is provided.
5. Motor characteristics:
    a. Duty rating:
        (1) Continuous duty at ambient temperature of 104°F (40°C) and at altitude of 3,300 feet above sea level.
        (2) Motors shall be capable of not less than six starts in a 24-hour period.
    b. Capacity and torque characteristics:
        (1) Sufficient to start, accelerate and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or service factor.
6. Enclosures:
    a. Enclosure material:
        (1) Cast iron for motor frame 25 hp and larger.
        (2) Rolled steel for motor frame sizes smaller than 25 hp.
    b. Open drip proof (ODP) for indoor locations not in an airstream.
    c. Totally enclosed fan cooled (TEFC) for all motors located within an airstream including within air handling unit housings, ducted airstreams, and ceiling or floor air plenums.
        (1) Totally enclosed air over (TEAO) motors are acceptable for air handling units with fan arrays provided they meet the efficiency requirements of the TEFC motors.
    d. Motors located in exterior locations shall be TEFC with weatherproof cover.
        (1) Totally enclosed air over (TEAO) motors are acceptable for cooling tower applications provided they meet the efficiency requirements of the TEFC motors.

C. Three-phase motors
1. Efficiency:
    a. Motor efficiencies shall at a minimum comply with the most recent editions of the International Energy Conservation Code and ASHRAE Standard 90.1.
    b. All general purpose, three-phase motors from 1 hp up to 200 hp driving Division 21-, 22-, and/or 23-specified equipment (e.g. stand-alone fans, fans within air handling units, heating hot water pumps, chilled water pumps, domestic water pumps) except those

motors defined in Paragraph [C] below shall be premium efficiency and meet the minimum efficiencies specified in the following table:

HP	TOTALLY ENCLOSED, FAN COOLED MOTORS			OPEN, DRIP-PROOF MOTORS		
	1200 rpm	1800 rpm	3600 rpm	1200 rpm	1800 rpm	3600 rpm
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	87.5	86.5	84.0	86.5	86.5	84.0
2	88.5	86.5	85.5	87.5	86.5	85.5
3	89.5	89.5	86.5	88.5	89.5	85.5
5	89.5	89.5	88.5	89.5	89.5	86.5
7.5	91.0	91.7	89.5	90.2	91.0	88.5
10	91.0	91.7	90.2	91.7	91.7	89.5
15	91.7	92.4	91.0	91.7	93.0	90.2
20	91.7	93.0	91.0	92.4	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.0	93.6	91.7	93.6	94.1	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.4	93.6	94.5	95.0	93.6
100	95.0	95.4	94.1	95.0	95.4	93.6
125	95.0	95.4	95.0	95.0	95.4	94.1
150	95.8	95.8	95.0	95.4	95.8	94.1
200	95.8	96.2	95.4	95.4	95.8	95.0

c. The following motor types and sizes driving Division 21, 22, and/or 23 specified equipment shall meet the minimum efficiencies defined in the table below:

(1) Fire pump motors

(2) General purpose motors greater than 200 hp up to 500 hp

(3) U-frame motors

(4) Design C motors

(5) Motors for close-coupled pumps

(6) Footless motors

(7) Vertical solid shaft normal thrust motors

(8) Eight-pole motors (900 rpm)

(9) Three-phase motors smaller than 600 volts and operating at voltages other than 230 or 460 volts

HP	TOTALLY ENCLOSED, FAN COOLED MOTORS			OPEN, DRIP-PROOF MOTORS		
	1200 rpm	1800 rpm	3600 rpm	1200 rpm	1800 rpm	3600 rpm
1	80	82.5	75.5	80	82.5	NR
1.5	85.5	84	82.5	84	84	82.5
2	86.5	84	84	85.5	84	84
3	87.5	87.5	85.5	86.5	86.5	84
5	87.5	87.5	87.5	87.5	87.5	85.5
7.5	89.5	89.5	88.5	88.5	88.5	87.5
10	89.5	89.5	89.5	90.2	89.5	88.5
15	90.2	91	90.2	90.2	91	89.5
20	90.2	91	90.2	91	91	90.2
25	91.7	92.4	91	91.7	91.7	91
30	91.7	92.4	91	92.4	92.4	91
40	93	93	91.7	93	93	91.7
50	93	93	92.4	93	93	92.4
60	93.6	93.6	93	93.6	93.6	93
75	93.6	94.1	93	93.6	94.1	93
100	94.1	94.5	93.6	94.1	94.1	93
125	94.1	94.5	94.5	94.1	94.5	93.6
150	95	95	94.5	94.5	95	93.6
200	95	95	95	94.5	95	94.5
250	95	95	95.4	95.4	95.4	94.5
300	95	95.4	95.4	95.4	95.4	95
350	95	95.4	95.4	95.4	95.4	95
400	NR	95.4	95.4	NR	95.4	95.4
450	NR	95.4	95.4	NR	95.8	95.8
500	NR	95.8	95.4	NR	95.8	95.8

2. Service factor
   a. Per the following NEMA Service Factor Table

HP	900 RPM	1200 RPM	1800 RPM	3600 RPM
1/6 to 1/3	1.35	1.35	1.35	1.35
½	1.15	1.25	1.25	1.25
¾	1.15	1.15	1.25	1.25
1	1.15	1.15	1.15	1.25
1½ to 150	1.15	1.15	1.15	1.15

   b. Do not take advantage of service factors in selection of motors.
3. Rotor: Random-wound, squirrel cage.

4. Bearings:
    a. Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for re-lubrication, rated for minimum AFBMA 9, L 10 life of 150,000 hours for direct-coupled applications and 50,000 hours for belted applications. Calculate bearing load with NEMA minimum V belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
    b. Motors not installed in horizontal position shall be provided with suitable bearings.
    c. Grease fittings shall be provided. Both fittings and drain plugs shall be fully accessible while the motor is in operation. Where motors are installed in an inaccessible location, the grease fitting shall be extended to an accessible location. High pressure hydraulic steel tubing and fittings shall be used.
5. Temperature rise and insulation:
    a. Motors smaller than 1 hp: NEMA Class B temperature rise with Class B insulation.
    b. Motors 1 hp and larger: NEMA Class B temperature rise with Class F insulation.
6. Starting code designation:
    a. Motors smaller than 15 hp: Manufacturer's standard starting characteristics.
    b. Motors 15 hp and larger: NEMA starting Code F or Code G.
7. Motor windings shall be first grade copper.

D. Additional requirements for three-phase motors used with variable frequency drives
1. Motor shall be "inverter-ready" by complying with or exceeding the NEMA MG1 Part 31 requirements regarding special purpose motors for use with variable frequency drives.
2. Windings shall be copper magnet wire with moisture-resistant insulation, varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses, produced by pulse-width modulated inverters.
3. Motors shall be equipped with shaft grounding ring(s) to dissipate potential VFD-induced motor shaft currents by grounding through the motor housing.
    a. Provide one grounding ring per motor.
    b. Provide solid ring or split ring, based on grounding ring manufacturer's recommendations.
    c. Shaft grounding brushes or insulated bearings are not acceptable.
    d. Shaft grounding rings shall be factory-installed or field-installed by the motor manufacturer or field-installed by the contractor.
    e. Acceptable product: Aegis SGR Bearing Protection Ring as manufactured by Electric Static Technology.
    f. This provision for grounding devices shall not apply to motors used in environments defined as Class 1 Division 1, Division 2, or Class 1 Zone 1, Zone 2 hazardous locations.

E. Additional requirements for motor-driven equipment located outdoors
1. Epoxy seal windings using vacuum and pressure with rotor and stator surfaces protected with epoxy enamel.
2. Bearings shall be double shielded with waterproof non-washing grease.
3. Provide weatherproof enclosure for motor.

F. Additional requirements for motors 100 hp and larger

1. Provide with thermistor system: Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Electrical Specifications.

G. Single-phase motor

1. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
    a. Permanent-split capacitor
    b. Split phase
    c. Capacitor start, inductor run
    d. Capacitor start, capacitor run
2. Multispeed motors: Variable-torque, permanent-split-capacitor type.
3. Bearings: Pre-lubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
4. Motors 1/20 hp and smaller: Shaded-pole type.
5. Thermal protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal protection device shall automatically reset when motor temperature returns to normal range.
6. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.

PART 3 - EXECUTION

3.1 APPLICATION

A. Electrical service

1. Motors ¾ hp and larger shall operate on 480 or 208 volt, three-phase 60 Hertz, alternating current, except as otherwise noted.
2. Motors smaller than ¾ hp shall operate on 120 volt, single-phase, 60 Hertz, alternating current, except as otherwise noted.

B. Motor speed shall not exceed 1,750 rpm unless otherwise specified.

3.2 INSTALLATION

A. Factory-installed motors

1. Not used

B. Field-installed motors

1. Examine area to receive field installation for compliance with required tolerances and other conditions affecting performance. Examine roughing-in of conduit systems to verify actual locations. Correct any deficiencies found during examination.
2. Anchor motor assembly to base, adjustable rails or other support according to manufacturers' instructions. Level and align.

3. Clean motors according to manufacturers' written instructions.

C. Field-installed bearing protection rings

1. Verify applicable maximum and minimum temperature and humidity allowances with manufacturer's technical support.

2. Based on motor application, motor size, motor frame, and bearing types, use shaft grounding ring kit that corresponds to shaft grounding ring manufacturer's installation recommendations and instructions.

3. Based on manufacturer's installation instructions, clean the motor shaft and other motor surfaces to remove any coatings, paint or other nonconductive material to prepare all conducting surfaces.

4. Apply conductive shaft surface coating per manufacturer's recommendations and installation instructions.

5. As required by the installation and per manufacturer's recommendations and installation instructions:

a. Drill and tap installation holes in the motor end bracket per manufacturer's installation instructions.

b. Apply manufacturer supplied adhesive and hold in place until the adhesive sets.

3.3 TESTING

A. Field-installed motor test

1. Run each motor. Demonstrate correct rotation, alignment and speed.

2. Test interlocks and control features for proper operation.

3. Verify that current in each phase is within nameplate rating.

4. NETA Acceptance Test

a. Perform an acceptance test in accordance with NETA Acceptance Testing Specification, Section 7.15.1.

b. Correct any deficiencies found by test and repeat acceptance test.

5. Provide test result report within two weeks of testing indicating that each of the above tests was completed and the results of those tests.

B. Field-installed bearing protection ring tests

1. Pre-installation test:

a. Place the positive and negative meter leads on the shaft at a place where the grounding ring fibers will contact the shaft and read the resistance.

b. If the reading is higher than 2 ohms, provide additional cleaning and retest.

c. Provide test result report within two weeks of testing indicating the resistance of each motor.

2. Post-installation test:

a. Place one meter lead on the grounding ring and the other on the motor frame and read the resistance. NOTE: Motor must be grounded to common earth ground with drive according to application standards.

b. Provide test result report within two weeks of testing indicating the resistance of each motor.

END OF SECTION

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SECTION 20 2923
VARIABLE FREQUENCY DRIVES FOR MECHANICAL, PLUMBING, AND FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section includes solid-state VFDs with bypass as scheduled for speed control of three-phase, squirrel-cage induction motors specifically applicable to Divisions 20, 21, 22, and 23 for mechanical, plumbing, and fire suppression systems (variable torque).

1.2 DEFINITIONS

A. BMS: Building management system

B. IGBT: Integrated gate bipolar transistor

C. LAN: Local area network

D. PID: Control action, proportional plus integral plus derivative

E. PWM: Pulse-width modulated

F. VFD: Variable frequency drive

1.3 CODES AND STANDARDS (USE LATEST EDITION)

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.

1. ANSI/IEC 60529: Degrees of Protection Provided by Enclosures (IP Code)
2. CSA C22.2 No. 14-13 (Industrial Control Equipment)
3. FCC CFR 47 Part 15 Subpart B
4. IEC 61800-3 – Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods
5. IEEE Standard 519: Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
6. NEMA ICS 3.1: Guide for the Application, Handling, Storage, Installation, and Maintenance of Medium-Voltage AC Contactors, Controllers, and Control Centers
7. NEMA ICS 7.1: Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable-Speed Drive Systems
8. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum)
9. OSHPD: California Office of Statewide Health Planning and Development
10. UL 508A: Standard for Industrial Control Panels
11. UL 508C: Standard for Power Conversion Equipment
12. UL 61800-5-1: Standard for Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal and Energy

1.4 QUALITY ASSURANCE

A. Manufacturer qualifications: Maintain, within 100 miles (160 km) of project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Testing agency qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated; NETA member.

C. Source limitations: Obtain VFDs of a single type through one source from a single manufacturer.

D. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Product selection for restricted space: Drawings indicate maximum dimensions for VFDs, minimum clearances between VFDs, and adjacent surfaces and other items. Comply with indicated dimensions and clearances.

F. Comply with NFPA 70.

G. Minimum meantime between failure (MTBF) ratings of 25 years (219,000 hours).

1.5 SUBMITTALS

A. Preconstruction – Prior to construction provide the following in accordance with Division 01 and Specification 20 0500 – Basic Requirements for Mechanical, Plumbing, and Fire Suppression:

1. Product data: For each type of VFD provide:
    a. Dimensioned plans, elevations, and sections
    b. Mounting arrangements
    c. Location for conduit entries
    d. Shipping and operating weights
    e. Features
    f. Performance
    g. Electrical ratings
    h. Characteristics
    i. Finishes
    j. Required clearances and service space
    k. Each installed unit's type and details
    l. Nameplate legends
    m. Short-circuit current ratings of integrated unit
    n. Factory settings
    o. Wiring diagrams
2. Coordination drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around VFDs where pipe and ducts are prohibited. Show VFD layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
3. Qualification data: For testing agency and manufacturer.
4. Manufacturer's installation and operating manuals.

B. Contract Closeout – At contract closeout provide the following in accordance with Division 01 and Specification 20 0500 – Basic Requirements for Mechanical, Plumbing, and Fire Suppression:

1. Operating and Maintenance Data including:
    a. Product data
    b. Installation instructions
    c. Assembly drawings
    d. Replacement parts list
    e. Maintenance and operation instructions
    f. Instructions for testing and adjusting overcurrent protective devices
    g. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that VFD programming settings and the solid state overload relay settings (in the bypass circuit) have been set to suit actual motor to be protected.
2. Test Reports
    a. Manufacturer Start-Up Report
3. Warranties

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store VFDs indoors in clean, dry space with uniform temperature to prevent condensation. Protect VFDs from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover VFDs to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.7 WARRANTY

A. Warranty shall be 24 months from the date of certified start-up. The warranty shall include all parts, labor, travel, and expenses.

1.8 MAINTENANCE

A. Cooperate with the Owner during testing, adjusting, and balancing (TAB), phase of construction, to minimize conflicts.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers and products: Subject to compliance with specified requirements, provide products from a single manufacturer from the following:

1. VFDs 75 HP and less (six-pulse with built-in 5%-line impedance):
    a. ABB ACH180
    b. Eaton micro-drives.
    c. Danfoss micro-drives.

2.2 VARIABLE FREQUENCY DRIVES

A. Description: NEMA ICS 2, IGBT, PWM, VFD; listed and labeled as a complete unit and arranged to provide variable speed of a standard NEMA MG 1, Parts 30 and 31, three-phase, induction motor by adjusting output voltage and frequency.

B. PWM design:

1. For motors 75 HP and less, the drive shall use a minimum of six-pulse PWM technology with 5% built-in line impedance.

2. For motors 100 HP and above 18-pulse PWM or Matrix technology shall be used.

C. Design and rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power transmission connection.

D. Output frequency rating: Three-phase; 0 to 120 Hz.

E. Unit operating requirements

1. Input AC voltage tolerance of ±10% of voltage rating shown on plans

2. Input frequency tolerance of 60 Hz, ±5 Hz

3. Capable of driving full load, under the following conditions, without derating:

a. Ambient Temperature: 14°F to 104°F

b. Humidity: Less than 95% (non-condensing)

c. Altitude: 3,300 feet (1,000 m); higher altitudes achieved by derating

4. Minimum efficiency: 96% at half speed; 98% at full speed

5. Minimum displacement primary-side power factor: 98%

6. Overload capability (variable torque): 110% the rated full load current for 60 seconds, 180% of rated full load current

7. Starting torque: 100% of rated torque or as indicated

8. Speed regulation: ±3%

9. Isolated control interface to allow controller to follow control signal over an 11:1 speed range

F. Internal adjustability capabilities

1. Minimum speed: 5 to 25% of maximum rpm

2. Maximum speed: 80 to 100% of maximum rpm

3. Acceleration: Adjustable from 0 to 6,000 seconds

4. Deceleration: Adjustable from 0 to 6,000 seconds

5. Current limit: 50% to a minimum of 110% of maximum rating

G. Self-protection and reliability features

1. Input transient protection by means of surge suppressors

2. Under- and over-voltage trips; inverter over-temperature, overload, and overcurrent trips

3. Adjustable motor overload relay, Class 20

4. Instantaneous line-to-line and line-to-ground overcurrent trips

5. Loss-of-phase protection
6. Reverse-phase protection
7. Short-circuit protection
8. Motor over-temperature fault
9. Dynamic braking

H. Automatic reset and restart: To attempt three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bi-directional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

I. Power-interruption protection: To prevent motor from re-energizing after a power interruption until motor has stopped.

J. Torque boost: Automatically vary starting and continuous torque to at least 1.5 times the minimum torque to insure high-starting torque and increased torque at slow speeds.

K. Input line conditioning:

1. Provide each VFD with a minimum 5% equivalent impedance for harmonic reduction and line conditioning.
2. VFDs equipped with dual DC-bus chokes that provide not less than 5% equivalent impedance are acceptable.
3. Where the VFD does not include at least 5% equivalent impedance integral to the drive, provide separate 5% AC line reactors at the VFD input.

L. Motor Lead Length and dV/dt Filters

1. Where the motor lead length (one-way conduit length between VFD and motor terminals) is 100 feet or greater, provide a dV/dt output filter.
2. Locate and install the dV/dt filter within 10 feet of the VFD output terminals, unless the VFD manufacturer specifically recommends otherwise.
3. Coordinate dV/dt filter selection and installation with the VFD manufacturer's published maximum cable length and motor insulation requirements.

M. Status pilot lights: Door-mounted light indicators or keypad indication of the following conditions:

1. Power on
2. Run
3. Bypass
4. Fault

N. Panel-mounted operator station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter. Equivalent functionality via the VFD's keypad is acceptable.

O. Digital display: The VFD shall provide a LCD display capable of displaying multiple lines of text on the VFD's operating values. The following are to be available at a minimum:

1. Output frequency (Hz)

2. Motor speed (rpm)
3. Motor status (running, stop, fault)
4. Motor current (amperes)
5. Motor torque (percent)
6. Fault or alarming status (code)
7. Motor power (kW)
8. kWh meter
9. DC-link voltage (VDC)
10. Set-point frequency (Hz)
11. Motor output voltage (V)
12. Analog input values
13. Analog output values
14. Digital input status
15. Digital output status

P. Control signal interface: Provide VFD with the following:

1. Electric input signal interface: A minimum of two analog inputs (0 to 10 V or 0/4-20 mA) and six programmable digital inputs.
2. Remote signal inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:
    a. 0 to 10-VDC
    b. 4-20 mA
    c. Potentiometer using up/down digital inputs
    d. Fixed frequencies using digital inputs
    e. RS485 and RS232
    f. Keypad display for local hand operation
3. Output signal interface:
    a. A minimum of two analog output signals (0/4-20 mA), which can be programmed to any of the following:
        (1) Output frequency (Hz)
        (2) Output current (load)
        (3) DC-link voltage (VDC)
        (4) Motor torque (percent)
        (5) Motor power
        (6) Motor voltage
        (7) Motor speed (rpm)
    b. A minimum of three programmable dry circuit relay outputs (Form C, 120VAC, 2 amp) for remote indication of the following:
        (1) Motor running

(2) Ready

(3) At speed

(4) Jogging

(5) Fault

(6) Over-temperature

Q. Communications: Coordinate with building BAS provider to provide a VFD compatible with the BAS. At a minimum, VFD shall have one of the following communications capabilities and protocols that are compatible with the building automation system:

1. BACnet
2. Modbus
3. Johnson Controls N2
4. Siemens

R. Two-contactor bypass: Two-contactor bypass with a service switch that allows for service of VFD while bypass is in use shall include a drive input disconnect, a VFD input isolation contactor (or isolation switch), bypass contactor, and an VFD output contactor that is electrically and mechanically interlocked with a bypass contactor. This circuit shall include control logic, optional status lights, and Class 20 motor overcurrent protection. The unit may be set up for manual or automatic bypass operation upon a VFD trip. The bypass shall include a NEMA ICS 2, full voltage, non-reversing enclosed controller with across-the-line starting capability in manual-bypass mode. Provide motor overload protection under both modes of operation with control logic that allows common start-stop capability in either mode.

1. Manual bypass: Drive input disconnect must be manually operated; electronic controls not allowed. Bypass cabinet shall be made up entirely of standard industrial control components.

S. Integral disconnecting means: Provide a NEMA instantaneous-trip 65KAIC circuit breaker to provide disconnecting means and protection during bypass. The handle position shall indicate on, off, and tripped. The disconnect handle shall be able to be padlocked in the off position.

T. The VFD must meet IEC 61800-3 for 1st environment, restricted distribution.

2.3 ENCLOSURES

A. For indoor applications: All standard and optional features shall be housed in a single NEMA 1 plenum-rated enclosure with a U.L. Certification label.

B. For outdoor applications: All standard and optional features shall be housed in a single NEMA 3R enclosure with a UL Certification label.

2.4 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Standard displays

1. Output frequency (Hz)
2. Set-point frequency (Hz)
3. Motor current (amperes)
4. DC-link voltage (VDC)

5. Motor torque (percent)
6. Motor speed (rpm)
7. Motor output voltage (V)

C. Historical logging information and displays
1. Real-time clock with current time and date
2. Running log of total power versus time
3. Total run time
4. Fault log, maintaining last four faults with time and date stamp for each

D. Current-sensing, phase-failure relays for bypass controller: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40%, or loss of supply voltage; with adjustable response delay.

2.5 FACTORY FINISHES

A. Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and factory-tested VFDs before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFDs for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in for conduit systems to verify actual locations of conduit and motor connection points before VFD installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Select features of each VFD to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, drive, and load.

B. Select rating of controllers to suit motor controlled.

3.3 INSTALLATION

A. Anchor each VFD assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with VFD mounting surface.

B. Install VFDs on concrete bases, where applicable, complying with Division 20 Section 20 0529, "Hangers and Supports for Mechanical, Plumbing and Fire Suppression Systems."

C. Coordinate layout and installation of VFDs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

D. Coordinate size and location of concrete bases where required. Cast anchor-bolt inserts directly into bases.

E. Where the VFD is mounted above the roof line, coordinate installation of roof curbs, equipment supports, and roof penetrations.

F. Coordinate features of VFDs, installed units, and accessory devices with pilot devices and control circuits to which they connect.

G. Coordinate features, accessories, and functions of each VFD and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

H. Motors intended for use with variable frequency drives shall be “inverter-ready” by complying with or exceeding the NEMA MG1 Part 31 requirements regarding special purpose motors for use with variable frequency drives.

1. Windings shall be copper magnet wire with moisture-resistant insulation, varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses, produced by pulse-width modulated inverters.

2. Motors shall be equipped with shaft grounding ring(s) to dissipate potential VFD-induced motor shaft currents by grounding through the motor housing.

a. Provide one grounding ring per motor.

b. Provide solid ring or split ring, based on grounding ring manufacturer’s recommendations.

c. Shaft grounding brushes or insulated bearings are not acceptable.

d. Shaft grounding rings shall be factory-installed or field-installed by the motor manufacturer or field-installed by the contractor.

e. Acceptable product: Aegis SGR Bearing Protection Ring as manufactured by Electric Static Technology.

f. This provision for grounding devices shall not apply to motors used in environments defined as Class 1 Division 1, Division 2, or Class 1 Zone 1, Zone 2 hazardous locations.

3. Motors are furnished and installed by mechanical or plumbing contractor, wired by electrical contractor.

3.4 IDENTIFICATION

A. Identify VFDs, components, and control wiring according to Division 20 Section 20 0553, “Identification for Mechanical, Plumbing, and Fire Suppression Systems.”

B. Operating instructions: Frame printed operating instructions for VFDs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFD units.

3.5 CONTROL WIRING INSTALLATION

A. Install wiring between VFDs and remote devices according to Electrical Specifications.

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switch and other automatic-control devices where available.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switches are in hand position.

2. Connect selector switches with control circuit in both hand and automatic positions for safety-type control devices such as low-pressure and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

A. Conduit installation requirements are specified in Electrical Specifications. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment per the latest edition of NFPA 70 (NEC).

C. 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.

3.7 START-UP SERVICE

A. Engage a factory-authorized service representative to perform start-up service.

B. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 Sections.

C. Complete installation and start-up checks according to manufacturer's written instructions.

3.8 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.9 TESTING

A. Manufacturer installation start-up

1. Engage a factory-authorized service representative to inspect field assembled components and equipment installation, including pretesting and adjusting VFDs.

2. Provide start-up report within two weeks of testing indicating completion of the Manufacturer Start-Up Certification for each VFD.

3.10 CLEANING

A. Clean VFDs internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain VFDs.

END OF SECTION

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SECTION 23 7300
CUSTOM INDOOR AIR HANDLING UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This specification pertains to the supply air handling unit and separate return fan scheduled with fan array (also referred to as fan matrix) technology fan systems.

B. Custom indoor Air Handling Unit (AHU) shall be factory assembled to meet the performance criteria as identified on the plans and within this specification. Unit shall be shipped in multiple sections to construction site. Refer to drawings for mechanical room maximum wall opening dimensions. Contractor and manufacturer representative shall determine the best method of delivery and coordinate delivery of the air handling unit with Owner. AHU shall be field assembled, and pressure tested in the mechanical room by the installing mechanical contractor. Submit testing results to Owner and Engineer.

C. Casing Construction

D. Floor Construction

E. Access Doors and Plenums

F. Mixed Air Section

G. Fan Section

H. Air Blender

I. Motors and Drives

J. Coil Sections

K. Condensate Drain Pans

L. Filter Sections

M. Return Fan Section

N. Electrical Components

O. Factory Provided Field Services

1.2 REFERENCES

A. AMCA 99 - Standards Handbook.

B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.

C. AMCA 300 - Test Code for Sound Rating Air Moving Devices.

D. AMCA 301 - Method of Calculating Fan Sound Ratings from Laboratory Test Data.

E. AMCA 500 Test Methods for Louver, Dampers, and Shutters.

F. AMCA 611-06 Certified Ratings Program - Product Rating for Airflow Measurement Performance

G. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

H. ANSI/AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

I. ANSI/UL 586 - Test Performance of High Efficiency Particulate Air Filter Units.

J. ANSI/UL 900 - Test Performance of Air Filter Units.

K. ARI 410 - Forced Circulation Air Cooling and Air Heating Coils.

L. ARI 430 - Standard for Central Station Air Handling Units.

M. ARI 435 - Standard for Application of Central Station Air Handling Units.

N. ASHRAE 52 - Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

O. ASHRAE 62.1-2004 - Ventilation for Acceptable Indoor Air Quality.

P. ASHRAE 90.1-2004 - Energy Standard for Building except Low-Rise Residential Buildings.

Q. ASTM A 36/A 36M-97a - Specification for Carbon Structural Steel

R. ASTM A 366/A 366M-97 - Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality

S. ASTM A 480/A 480M-98a - Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

T. ASTM A 653/A 653M-99a - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process

U. ASTM B 209-96 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate

V. ISO 9000, 9001, 9002 - International Organization for Standardization Certified Manufacturing Facility

W. NFPA 70 - National Electrical Code

X. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

Y. SMACNA - HVAC Duct Construction Standard, Metal and Flexible.

Z. UL - Underwriters Laboratory

AA. ETL listed - Intertek Testing Laboratories (an alternative to the CSA and UL marks)

BB. CSA - Canadian Testing Association (According to OSHA regulations, the CSA-US mark qualifies as an alternative to the UL mark).

1.3 SUBMITTALS

A. Refer to General Conditions and Division 01.

B. Submit the following data:

1. Drawings indicating unit dimensions, shipping splits, unit shipping and operating weight, weight loading, required clearances, construction details and field connections.

2. Product data indicating individual components; dimensions, shipping and operating weights, capacities, ratings, performance, electrical characteristics, gauges and finishes.

3. Provide computer generated fan curves with specified operating point clearly plotted. The fan curve provided must be for all fans and motors operating in an array. Standalone individual cell performance shall not be acceptable.

4. Provide sound power levels for fan outlet, unit outlet, and unit casing radiated for the design capacity.

5. Product data for filter media, filter performance data, filter assembly and filter frames.

6. Coil performance ratings at system design operating conditions.

7. Fan, motor and drive component characteristics.
8. Electrical requirements for all power supply wiring including wiring diagrams for interlock, access lights, service outlets and control wiring. Clearly indicate factory installed wiring and field installed wiring.
9. Provide a copy of field testing procedures for tests required within this specification.
10. Provide unit manufacturer's installation instructions including any unit support requirements.
11. Operation and maintenance instructions.
12. Instructions for lubrication, filter replacement, motor and drive replacement, spare part list and wiring diagrams.

C. At contract closeout provide the following in accordance with specification 20 0500 – Basic Requirements for Mechanical, Plumbing and Fire Suppression:
1. Source quality control test reports
2. Operating and Maintenance Data including:
   a. Product Data
   b. Installation Instructions
   c. Assembly Drawings
   d. Replacement parts list
   e. Maintenance and operation instructions
3. Test Reports
   a. Manufacturer installation inspection report
   b. Factory test report
   c. Field test report
4. Warranties

1.4 QUALITY ASSURANCE

A. Refer to General Conditions and Division 01.

B. Comply with product data under provisions of Division 01.

C. Fan Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.

D. Fan Sound Ratings: AMCA 301; tested to AMCA 300 and bear the AMCA Certified Sound Rating Seal.

E. Fabrication: Conform to AMCA 99 and ARI 430.

F. Filter Media: ANSI/UL900 listed, Class I or Class II, approved by local authorities.

G. Air Coils: Certify capacities, pressure drops and selection procedures in accordance with ARI 410.

H. Air handling unit assembly shall have UL 1995 certification for safety, including use with electric heat.

I. Products requiring electric components shall be listed and classified by UL, ETL and CSA as suitable for the purpose specified and indicated.

1.5 DELIVERY, STORAGE AND HANDLING

A. Refer to General Conditions and Division 01.

B. Deliver products to site under provisions of Division 01.

C. Store and protect products under provisions of Division 01.

D. The unit shall be cleaned and inspected before crating.

E. All equipment shall be delivered to the job site suitably packaged and protected for overland trucking and for storing the equipment outside exposed to the weather.

F. Match-mark factory disassembled parts to facilitate erection in the field. Suitable brace units and pack for shipment to prevent distortion and damage while in transit. Protect from damage by weather or road conditions during shipment and storage.

G. Provide temporary closure on all openings of all sections of the units. Duct connection openings shall be covered with plywood or sheet metal caps. Coil fins shall be protected from damage during shipping and installation. Coil piping connections shall be protected with plastic caps.

H. Shrink-wrap unit for shipment with minimum 10 mil plastic.

I. Comply with applicable regulations and laws for crating and shipment.

J. Where multiple units are required, a schedule of priority will be furnished which shall determine the manufacturing and delivery sequence.

K. All items shipped loose such as filters, steam humidifier assemblies, caulking, etc. shall be itemized on the shipping ticket and be suitable secured in the unit or on a separate pallet. Clearly mark crates, boxes, and cartons in order to immediately identify the equipment. Show unit number, contents, and contract number.

L. Fan assemblies stored more than two months shall have their fan wheels rotated and shafts shall be treated to protect them from degradation due to humidity, dust, or debris. The packaging shall be maintained at all times while in transit, in storage, or on site. Failure to comply with this requirement will allow the Owner the right to reject damaged or exposed components and demand new replacements if necessary.

M. A factory representative shall be on site to supervise all assemblies of components, modules and parts of the Air Handling Units. No components or modules or parts will be assembled without factory supervision.

1.6 START-UP REQUIREMENTS

A. Do not operate unit(s) until air handling unit is clean, filters are in place, bearings lubricated, condensate properly trapped, piping connections verified and leak tested, belts aligned and tensioned, all shipping braces have been removed, and fans have been run under observation.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not operate air handling unit(s) for any purpose, temporary or permanent, until the ductwork has been pressure tested, cleaned, filters in place, permanently lubricated motors, and fans tested and run under observation.

1.8 OPERATION AND MAINTENANCE DATA

A. Refer to General Conditions and Division 01.

B. Submit operation and maintenance data under provisions of Division 01.

C. Include instructions for lubrication, motor and drive replacement, spare parts list and wiring diagrams.

1.9 EXTRA STOCK

A. One extra set of pre-filters, secondary filters and final filters to be provided to Owner.

B. One additional set of access door gasket for each size door to be provided to Owner.

1.10 WARRANTY

A. The complete unit shall be covered by a parts warranty issued by the manufacturer covering the first year of operation. This warranty period shall start on the date of startup or eighteen months after the date of shipment (whichever is the shortest). This includes all third party devices provided by the factory as part of the air handling unit.

B. The contractors warranty shall cover parts and labor from the date of final completion of the project.

1.11 FIELD TESTING

A. The air handling unit manufacturer and contractor shall provide with all test results a comprehensive list of all instruments used for measurements and a copy of their latest calibration certificates.

B. The air handling unit manufacturer shall factory run-test each fan/motor set to insure design integrity and proper fan rpm.

C. Factory and field leak test all coils: fill water coils with water and test coils and connections for leaks.

D. All factory installed piping shall be hydrostatically leak-tested. Steam and hydronic systems shall be tested for minimum of four hours at 1½ times design pressure or 100 psig minimum, whichever is greater, unless otherwise specified.

E. After the AHU has been field assembled and the manufacturer's representative has been onsite to verify and approve the assembly/construction, the unit shall be positive and negative pressure leak tested. Air handling unit shall be air leak tested by the contractor under the manufacturer's representatives supervision in the field at plus 8 in. wg (doors swing in) and minus 8 in. wg (doors swing out).

1. Tests shall be conducted in compliance with SMACNA's HVAC Air Duct Leakage Test Manual, latest edition.
2. The leakage rate of the entire unit shall not exceed 0.5% of design flow or 5 cfm per 100 ft2 surface area at 8-in. wg, whichever is greater.
3. Surface caulking shall not be used to correct any leakage problems.

F. After the AHU has been field assembled and the manufacturer's representative has been onsite to verify and approve the assembly/construction, the Air handling unit shall be tested, by the installing contractor, to verify that the AHU airflow is within the range of 100% to 110% of the scheduled system CFM at the scheduled external system resistance.

1. The test shall include an airflow measuring downstream or upstream of the AHU, and static pressure ports across the entire AHU.
2. Resistance external to the AHU shall be simulated by dampers in ductwork or other means to build up design operating pressure for the fan system.

3. Corrective action shall be by the AHU manufacturer to meet the design system airflow and resistance.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Ventrol (Basis of Design)

B. TMI

C. Ingenia

2.2 GENERAL

A. All proposed units shall meet the following parameters with respect to the basis of design. If any of the following parameters are not met by the proposed unit the unit will be rejected. If the proposed unit manufacturer cannot provide a unit within these parameters an alternate unit manufacturer shall be selected.

1. All proposed units shall be no greater than 3" longer and 3" wider than the basis of design. All proposed units shall have a height above finished floor (including required equipment pad height for cooling coil trapping) equal to or less than the basis of design.

2. All proposed units shall have supply fan inlet and outlet sound power performance less than or equal to the basis of design in all octave bands.

3. All proposed units shall have a rated fan power (HP) less than or equal to the basis of design.

B. The unit shall be custom field assembled indoor air handling unit and consists of the components as specified on the drawings or within this specification.

C. The air handling unit shall be double wall construction; walls, floor and roof panels shall have a minimum thickness of 2 inches and match the overall thermal conductivity as specified.

D. This custom air handling unit shall be factory and field tested. Unit shall be transported to job-site ready for assembly. It shall be the installing contractor's responsibility to reconnect the adjoining modules, re-connect any wiring and ensure the unit is leak tight.

E. These units are variable volume systems. These units shall be of a draw-through configuration. The units shall consist of the following components and/or sections: filter section, pre-heat coil section, steam humidifier section, cooling coil section, supply fan section, and all required access sections. The unit configuration is as indicated on the drawings and schedules.

F. When sections are supplied as separate components either assembled or shipped separately, each section shall have mating flanges for bolted assembly. The flange shall extend around the complete perimeter of each section. The manufacturer shall supply bolts, and sufficient closed cell gasket for full perimeter coverage. If unit is supplied with corner-only connection points, the equipment manufacturer shall install mating flanges for each of the sections to match this specification.

G. The air handling unit manufacturer shall provide the airflow resistance of the unit from the inlet to the outlet in terms of static pressure difference at design airflow and standard air density (0.075 lbs/ft^3).

H. The air handling unit housing shall be constructed of aluminum.

I. Return fan-array unit shall be of the same quality and type as the supply fan array. Return fan cubes shall be field installed. Air handling unit manufacturer shall provide fan cubes, air flow monitoring and variable frequency drives.

J. The air handling unit manufacturer shall furnish one set of pre-filters, and final filters.

K. Fans and components weighing more than 150 pounds shall have a lifting rail permanently installed.

L. A manufacturer's representative shall be on site during the entire assembly process to ensure the unit is assembled properly and will meet the performance requirements.

2.3 UNIT CASING CONSTRUCTION (WALLS AND ROOF)

A. Casing shall be double wall construction with insulation completely encapsulated. The walls and roof panel thickness shall be a minimum of 2". The cabinet shall consist of dual formed panels; an external embossed aluminum shell and an internal smooth aluminum liner. The panel and casing joints and connections inside and outside shall be smooth and finished. *Perforated liners* are not acceptable. All casing panels shall be removable for easy access without affecting the structural integrity of the air handling unit. Manufacturer shall guarantee that there will be no exterior condensation when the inside air is 55F saturated and the ambient air is 60F dew point.

B. The air handling unit shall be suitable for operating at a standard differential pressure up to +/- 8" w.g. static pressure or the shutoff pressure of the fan (no flow), whichever is greater.

C. The exterior cabinet walls and roof shall be a minimum 0.063" embossed aluminum.

D. The interior cabinet walls and roof shall be a minimum of 0.04 smooth aluminum; the humidifier, cooling coil section and downstream plenum shall be a minimum of 0.04 smooth aluminum.

E. Bolts and screws shall be stainless steel (chromium coated/plated not allowed). Panels shall be bolted together. No fan supports; structural members, panels or flooring shall be welded unless aluminum, stainless steel or other corrosion-resistant material is used. Painted welds on steel or galvanized steel are not acceptable. Panels shall have gasketing material between sections. A minimum of silicone caulk shall be used and only after start-up and leaks are identified.

F. Panels to be injected with a minimum 2" thick, 2.5 lb/ft^3 polyisocyanurate foam, UL rated, non-combustible, semi-rigid insulation with a minimum R-value of 16 sf-F/Btu.

1. Assembly shall meet the requirements of NFPA 90A, NFPA 90B and ASTM E 84 for Flame Spread of 25 or less and Smoke Development of 50 or less.

2. Insulation shall have a thermal conductivity K factor, k=0.23 Btu/hr/sq ft/degree F at a mean temperature of 75°F.

3. Insulation shall provide the following sound attenuation characteristics (per ASTM C 423 - Type "A" Mounting):

Octave bands	125	250	500	1k	2k	4k	8k
Absorption Coefficient	.17	.80	1.16	1.15	1.11	1.10	1.05

4. All cut edges of the board insulation shall be completely enclosed by the unit panels.

G. Unit panel shall have a minimum R-value of 16 sf-F/Btu.

H. Roof and wall panel joints and panel reinforcement members shall not deflect more than 1:180 or ¼-in., whichever is smaller. Panels shall not deflect more than 3/8-in. between joints and reinforcement.

I. Casing construction shall be constructed as to minimize thermal losses and prevent condensation on the exterior of the unit. Manufacturer shall guarantee that there will be no exterior condensation when the inside air is 55F saturated and the ambient air is 60F dew point.

2.4 FLOOR CONSTRUCTION (INCLUDING BASE RAIL)

A. Base rail shall be 5-in. minimum, 8.2-lb/ft minimum aluminum structural channel or tube fully seam welded with a 2-in. perimeter lip. Manufacturer shall size and factory install base rail. The air handling unit manufacturer shall provide adequate intermediate structural members to transfer component loads to base rail.

B. Manufacturer shall size perimeter base rail and intermediate structural supports as to ensure sufficient height for field installed condensate P-traps.

C. Floor structural members and the floor panels between structural members shall not deflect more than 1:360.

D. Floor shall be 5 gauge minimum aluminum diamond tread plate fully welded.

E. Sub-floor shall be 0.04 smooth aluminum.

F. Base shall be provided with removable minimum 10-gauge lifting lugs minimum (4) per section, properly located to assure uniform loading. Maximum spacing between lifting lugs shall be 8 feet.

G. The underside of the floor panels shall be insulated with 3" thick minimum polyurethane foam insulation (under the base skin and covered with 0.04 smooth aluminum**.** Manufacturer shall guarantee that there will be no exterior condensation when the inside air is 55°F saturated and the ambient air is 60°F dew point.

H. Drain pans shall be 304 Stainless Steel, double wall construction with solid welded seams for complete water capture and containment. Pans shall be insulated between the liner and the main pan. Pans shall be IAQ type, double sloping to a single drain. Drain connection shall be a minimum 1¼" diameter MIPS thread extending out through the channel base the same side as the coil connections unless otherwise indicated on the drawings. Pans under coils, including intermediate drain pans shall extend a minimum of one-half the vertical dimension of the water producing device beyond the leaving air edge. Pans shall be provided for cooling coils, outside air intakes and under other components as required. Drain pan shall meet the requirements of ASHRAE 62.1-2004. Intermediate drain pans shall be insulated.

I. Provide 2-in. floor drains in cooling coil and heating coil sections and pipe externally to the peripheral channel base on the same side as the doors.

J. Provide 2-in. upturned lip, fully welded around perimeter of entire base to facilitate cleaning of unit. Provide a floor drain for each section that doesn't have a drain pan.

K. The air handling unit base shall be flood tested to ensure no leaks in the base or at the perimeter exist.

2.5 ACCESS DOORS AND PLENUMS

A. Plenums and access doors shall be double wall construction and shall be consistent with the double wall construction as specified in paragraphs 2.3 and 2.4 of this specification. Door panels shall match requirements given for insulation of walls and roof panels.

B. Doors shall be provided with a minimum of (2) dual acting stainless steel latches through 48" high, (3) latches through 72" high. Latches shall be operable from both the interior and exterior of the unit. Fan section door latches shall be provided with a mechanism to facilitate locking of the doors. Door hinge shall be heavy duty stainless steel. Door shall be sealed with continuous closed cell foam gasket.

C. Doors to be provided with a continuous double high performance closed cell replaceable neoprene bulb type gasket seal around the entire perimeter of the door/frame. One system will be placed on the door and one system will be placed on the frame.

D. Doors located downstream of the cooling coil shall have a thermal break frame.

E. Each access door or section shall have a static pressure port.

F. Doors shall open against pressure for safety. Standard door size shall be a minimum 20" wide by 60" high unless restricted by height or section width. Recommended minimum length of access section is 24".

G. Doors shall be provided with hermetically sealed dual pane thermal glass viewing wire-mesh reinforced windows. Minimum window size to be 12" x 10" frame provided. Viewing windows to be provided on all access doors. Centerline height of window above finished floor shall be 5'-6" (assume concrete curb height is adequate for the cooling coil and condensate drain).

H. All doors shall have a port for the insertion of temperature and pressure measuring devices for troubleshooting and commissioning.

I. All doors with access to moving parts shall have provision for padlocking and meet UL 1995 mechanical protection guidelines. The Safety "lockout" provision allows the owner the opportunity to provide padlocks to lock doors in the closed position.

J. Access doors shall be provided upstream and downstream of the following equipment for means of providing routine inspection, maintenance, or calibration to equipment: fan, coils, humidifier, filters, and dampers.

K. Discharge air plenum shall have a top or front discharge opening per drawings. Plenum shall be double wall construction and shall match the unit casing in materials and details.

2.6 DRAIN PANS

A. Provide cooling coil, humidifier and heating coil drain pans.

B. Drain pans recessed into the base shall be type 304 stainless steel, 16 gauge.

C. Drains from each pan shall be 304 stainless steel, 2-in. minimum.

D. Floor drain pan shall be completely under the coil, 2-in. minimum upstream, and 12-in. minimum downstream. Drain shall be in the middle of the downstream section sloped from the far side of the drain, and from each side to the center. Underside of the drain pan shall have insulation attached to the pan and a vapor barrier (pan may be double wall with insulation).

E. Drain pan seams shall be continuously welded watertight and dye penetrant checked.

F. Provide intermediate drain pan for split cooling coil a minimum of 4” from the face of the cooling coil. Provide 2” downspout to floor drain pan and terminate with 2-in. gap. Intermediate drain pan shall be supported independently of the coils.

G. If coils are staggered, manufacturers shall provide drain pans that fully extend beneath all piping extensions, U-bends and headers.

2.7 MIXED AIR SECTION/INTAKE PLENUM

A. This section shall match unit and floor construction as specified in paragraphs 2.3 and 2.4.

B. Mixing box section shall be arranged to eliminate freeze stat trips, minimize sensor error and enhance outdoor air distribution due to stratification. AHU manufacturer shall provide air blending devices. See 2.8 Air Blender Section for details.

C. Mixing box section equipped with air blenders shall have a minimum section length of 3'-6" or as required by air blending devices manufacturer.

D. Control dampers:

1. Control dampers shall not be required to be supplied with the unit. Mechanical contractor shall provide control dampers for field installation. Temperature controls contractor shall provide control damper actuators for field installation.

2. Dampers shall be low leakage type Tamco 1500 series with silicone seals extruded aluminum 0.08" min thickness. Blades shall be 4" parallel type. Axles shall be plated steel. Leakage based on 24"x24" damper shall not exceed 7.6 cfm and 27.2 cfm for 48"x48" damper.

3. Bearing materials shall meet or exceed tensile strength of 8,800 psi and flexural strength of 12,000 psi.

4. Damper leakage not to exceed 3.0 cfm/sf at 1" W.G. pressure differential when a maximum of 3 in-lb/sf of holding torque is applied to the operating axle.

5. Arrange maximum outside air blades alongside air direction such that blades direct air toward return air opening.

2.8 FAN SECTION (SUPPLY AND RETURN)

A. The fan section shall be consistent with the double wall construction and shall utilize the fan-array (fan-matrix) system of multiple plenum-type fans with direct drive motors.

B. Fans shall be factory mounted on a aluminum platform. The fan array shall be provided with vibration isolation per stacked fan section or as an entire fan assembly to prevent the transmission of sound and/or vibration to the floor of the unit and to the floor of the mechanical room.

C. Motors shall be TEAO induction type. Electrically Commutated Motors (ECM) are not permitted and will not be considered.

D. The Fan-Array (fan-matrix) System shall consist of multiple, direct driven, arrangement 4 plenum fans constructed per AMCA requirements for the duty specified. The Fan Array shall be selected to operate at a system total static pressure that does not exceed 90% of the specified fan’s peak static pressure producing capability at the specified fan/motor speed. All motors shall be standard pedestal mounted type, TEFC, T-frame motors. All motors shall include isolated bearings or shaft grounding to prevent bearing damage associated with stray electrical current. Each fan and motor assembly shall be statically and dynamically balanced to meet AMCA standard 204-96, category BV-5, to meet or exceed Grade 1.0 residual unbalance.

E. Each fan/motor assembly shall be dynamically balanced to meet AMCA standard 204-96, category BV-5, with a maximum of .55 mil peak (0.022 in/sec peak, filter in) deflection at the design operating speed for the fan/motor assembly. Final balancing of the fan and motor combination shall be performed while the fan/motor is secured to the actual fan cell mounting rail. Certified copies of all dynamic balancing results for all fans shall be provided with the unit Operation and Maintenance manuals prior to unit shipment.

F. Wheel and Inlet: Airfoil wheel shall be of Class III aluminum construction with smooth curved inlet flange, heavy back plate die formed hollow airfoil shaped blades continuously welded at tip flange and back plate.

G. The fan array shall consist of multiple fan and motor cubes, spaced in the airway tunnel cross section to provide a uniform air flow and velocity profile across the entire air way tunnel cross section and components contained therein. Each fan shall be individually wired to a VFD, as specified elsewhere. If at least (1) VFD per fan is provided, a bypass will not be required. A single VFD serving the entire array will not be accepted. Wire sizing shall be determined and installed in accordance with applicable NEC standards.

H. The basis of design shall have individual fans which are staged on and off by manufacturer supplied controller. A PLC controller shall be provided with internal logic to sequence fans/motors on and off dynamically in response to airflow needs.

I. Each fan shall be equipped with an airflow monitoring device. The airflow of each fan shall be transmitted to the PLC for use with the fan sequencing system. The fan manufacturer shall field install all required tubing from each fan to the unit mounted overload/control panel.

J. All variable frequency drives shall be factory wired in a UL-508A electrical panel and shall be listed as such. Wire sizing shall be determined in accordance with NEC standards. The supply fan array shall each have its own individual unit mounted and wired control panels. The control panels shall incorporate individual thermal overloads/disconnects for each motor. Each overload will have an auxiliary contact wired in series. The dry contact will be used as an alarm for the building automation system indicating that there has been a fan motor failure. In addition, the unit control panel shall be provided with individual door mounted pilot lights showing the status (ON/OFF) of each motor. If the motors are enabled and functioning properly, the lights shall be “ON.” It is the intent to have the control panels mounted on the same sections as their respective fan arrays. It is mandatory that the unit manufacturer factory mount and wire all control panels to the units in the factory. If the panels must be removed to facilitate rigging or shipment, the installing Contractor is responsible for reconnecting any wiring.

K. Each fan & motor assembly shall be removable through a 24” wide, free area, access door located on the discharge side of the fan array without removing the fan wheel from the motor.

L. Provide each fan section with a motor removal rail.

M. Provide a discharge safety guard surrounding each fan cube.

N. Motor and Drive:

1. Refer to Specification 20 0513 – Motor Requirements for HVAC and Plumbing Equipment.

2. Variable frequency drives to be provided by the AHU manufacturer. The Unit manufacturer shall wire each group of motors of the fan array system for the number of VFDs indicated in the equipment schedule to a NEMA 1 enclosure. The NEMA 1 enclosure shall be fitted with indicating lights for motor fault status and the required number of knockouts for field wiring of the VFDs. Refer to Section 20 2923.

3. The AHU electrical panel shall be single point power panel with main disconnect.

4. The air handling unit shall be capable of meeting the design air volume flow rate (cfm) at the design static pressure rating without over-speeding the motors.

O. Each fan array shall be provided with acoustical coplanar silencers that reduce the bare fan discharge sound power levels by a minimum of 15 dB re 10^-12 watts throughout the eight octave bands with center frequencies of 125, 250, 500, 1000, 2000, 4000, and 8000 Hz when compared to the same unit without the silencers. The silencer system shall have the equivalent discharge sound power values throughout the eight octave bands as the basis of design with sound attenuation, provide additional sound attenuation as required.

1. Silencer filler material shall be inorganic glass fiber of a proper density to obtain the specified acoustic performance and be packed under not less than 5% compression to eliminate voids due to vibration and settling. Material shall be inert, vermin- and moisture-proof. Filler material shall be totally encapsulated and sealed with polymeric film of an appropriate thickness. The encapsulated fill material shall be separated from the interior baffles by means of a non-combustible, erosion resistant, factory-installed, acoustic stand-off

2.9 MOTOR AND DRIVES

A. Motors: Refer to specification Section 20 0513 – Motor Requirements for HVAC and Plumbing Equipment.

B. Air handling unit fans shall be provided with premium efficient, inverter duty and inverter ready rated motor with AEGIS bearing protection ring for use with variable frequency drives.

C. Each supply and fan shall be provided with factory installed variable frequency drive.

D. Variable frequency drives: Refer to specification Section 20 2923 – Variable Frequency Drives.

2.10 COIL SECTIONS

A. General Requirements for Coil Sections

1. Fabricate coil section to allow removal and replacement of coil for maintenance to allow in-place access for service and maintenance of coil(s). All coils must be easily removable from the side of horizontal units.

2. Coils shall not act as a structural component of unit.

3. Coil section shall be consistent with the double wall construction as specified in paragraphs 2.3 and 2.4 of this specification.

4. These air handling units shall be provided with hot water pre-heat coils and chilled water cooling coils as indicated on drawings.

5. Coils shall include stainless steel blank-off sheets to hold coils rigid and prevent air from bypassing the coils.

6. Water Coils

a. Water coils shall comply with ARI 410.

b. Coil Connections: All coils shall be threaded, flanged or grooved, extended to a minimum of 4" outside of casing through rubber grommets and be clearly labeled. All coil sections shall include dual rubber grommets; on the outer skin and inner liner.

c. All coil piping connections shall be extended to the outside of the casing from the factory. Factory insulate gap between coil stub-out connection and casing with spool shaped sleeve grommets.

7. Cooling Water Coils
   a. Coil Type: Continuous serpentine
   b. Headers: Seamless copper tube with brazed joints, prime coated.
   c. Tubes: ⅝" outer diameter (OD) seamless copper with smooth interior surface (no heat transfer enhancement devices), 0.035" nominal tube wall, silver brazed at joints. Return bends shall have a final thickness of 0.035".
   d. Fins: Aluminum with a minimum thickness of 0.0075"continuous plate type with full fin. Fins shall be mechanically bonded or silver brazed to tube.
   e. Coil Casing: Die formed channel frame of 304 stainless steel. Provide tube supports for coils longer than 36".
   f. Coil Working-Pressure Ratings: Cooling: 200 psig and 220°F
   g. Maximum physical height of an individual cooling coil is 45". Provide stacked coils if coil height exceeds 45". Stacked coils shall have an intermediate pan under each coil in conformance with the Condensate Drain Pans for Humidifiers and Cooling Coils paragraph earlier in this section.
   h. Maximum Fins per Inch: 11
   i. An overlapping staggered coil arrangement is not acceptable.
   j. Maximum Face Velocity: As scheduled on drawings.

8. Heating Water Coils
   a. Coil Type: Continuous serpentine
   b. Headers: Cast iron; seamless copper tube with brazed joints, prime coated; or fabricated steel, with brazed joints, prime coated.
   c. Tubes: ⅝" outer diameter (OD) seamless copper with smooth interior surface (no heat transfer enhancement devices), 0.035" nominal tube wall, silver brazed at joints. Return bends shall have a final thickness of 0.035".
   d. Fins: Aluminum with a minimum thickness of 0.0075"continuous plate type with full fin. Fins shall be mechanically bonded or silver brazed to tube.
   e. Coil Casing: Die formed channel frame of 304 stainless steel. Provide tube supports for coils longer than 36".
   f. Coil Working-Pressure Ratings: 200 psig and 325°F
   g. Maximum Fins per Inch: 11
   h. Maximum Face Velocity: As scheduled on drawings.

2.11 FILTER SECTIONS

A. This section shall be consistent with the double wall construction as specified in paragraphs 2.3 and 2.4 of this specification. Omit inspection window on the filter section access doors.

B. Filters shall be arranged for face, rear or side loading as indicated on the detailed drawings. Face loading is preferred where space allows. Face or rear loading to be in gasketed universal holding frames. The filter rack assemblies shall be blanked off to the sides, roof and floor of the unit and properly sealed to minimize filter bypass.

C. The pre-filter section shall be factory fabricated as an integral part of the air handling unit. Filters to be arranged for face (rear) loading into a gasketed universal holding frame. Filters are to be a MERV 8 (30% efficiency and performance). Refer to drawing schedules for quantity and size of filters.

D. The secondary pre-filter section shall be factory fabricated as an integral part of the air handling unit. Filters to be arranged for face (rear) loading into a gasketed universal holding frame. Filters are to be a MERV 13 (85% efficiency and performance). Refer to drawing schedules for quantity, efficiency and size of filters.

E. Each filter bank shall be provided with a flush mounted air filter gauge with an adjustable signal flag.

F. Provide access sections upstream and downstream of filter section of adequate size for filter service.

G. Filter banks shall be sized so the maximum filter face velocity does not exceed 500 fpm.

H. Refer to specification Section 23 4100 – Particulate Air Filtration.

2.12 INSTRUMENTATION

A. Filter gauges

1. Approved Manufacturers
    a. Dwyer Instruments
    b. Trerice
    c. B. Ashcroft
    d. Marsh Instruments
2. Direct Reading Dial: 4" diameter diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, range of 0.0 inches though 3.0 inches w.c., 2% of full scale accuracy. Series 2000 Magnehelic manufactured by Dwyer.
3. Accessories: Vent valves and static pressure taps with integral compression fittings, ¼" aluminum tubing, plastic vent valves.

2.13 ELECTRICAL COMPONENTS

A. The unit shall come with electrical connections sized to accommodate all unit electrical requirements; 480V for equipment and 120V for lights and courtesy power outlets.

B. Each unit shall be equipped with a unit mounted fused disconnect switch. The disconnect switch shall be mounted on the exterior of the unit in a NEMA 1 enclosure. The disconnect switch shall be UL listed.

C. Provide one (1) 20 amp, 120 volt, GFI receptacle at the motor section. Receptacle shall be factory wired power/control panel.

D. A linear LED vapor proof service light with guard shall be provided in the fan section, mixing box and all accessible sections. Each light shall be 100 watt incandescent equivalent and shall be wired to one master switch. Lights require a 115/1/60 power source that is separate from the main power to the unit to permit light operation during periods of unit shutdown.

E. Provide required step-down transformers for 120 volt electrical service requirements other than lights and courtesy power outlets.

2.14 RETURN FAN UNIT

A. Return air handling unit shall be fan array (fan matrix type) manufactured by the same manufacturer as supply air handling unit and consisting of multiple plenum type fans with direct driven motors.

B. Each fan cell shall be provided with a coplanar silencer surrounding all sides of the fan.

2.15 CONTROLS

A. All controls shall be furnished and installed at the Project site by the Controls Contractor.

B. See Project documents for controls sequence.

2.16 FACTORY PROVIDED FIELD SERVICES

A. Air handling unit(s) shall be field certified by an authorized factory representative.

B. Field testing shall performed by the installing contractor under factory supervision.

C. Field certification of compliance with design shall be signed by the authorized factory representative and incorporate a list of all repairs and modifications made to the unit.

PART 3 - EXECUTION

3.1 MANUFACTURER'S FIELD SERVICES

A. Unit manufacturer shall provide a factory trained field service representative to instruct and supervise the Installing Contractor in rigging, erecting, preoperational checkout and starting of each unit as necessary. The price for these services shall be included in the unit manufacturer's quote to the Installation Contractor.

B. A factory trained, field service representative shall supervise the unit reassembly and installation in the field.

C. Provide services of a factory trained field service representative for a minimum, however not limited to, two days (16 hours) to supervise unit reassembly, start-up, and final installation of the air handling units.

D. The manufacturer shall provide 8 hours of operator training.

E. Provide a written report, prepared by the manufacturer's representative stating that the systems are installed and services provided under this section are in accordance with manufacturer's recommendations and are operating properly. Field certification of compliance with the design shall be signed by the authorized factory representative and incorporate a list of repairs and modifications made to the unit.

3.2 AIR HANDLING UNIT INSTALLATION

A. Install in accordance with manufacturer installation instructions and conformance with ARI 435.

B. Assemble the complete knockdown unit in the field according to the manufacturer's written installation instructions.

C. Provide all wiring, conduit, and raceways for the supply fan array, and the light fixtures.

D. Install pneumatic tubing provided by the air handling unit manufacture between the high and low pressure fan inlet cones and the single point power panel for airflow measurement.

E. All electrical wiring shall be installed in EMT conduit, minimum size of ¾ inch, except at motor whip and across splits. All wiring, conduit, and raceways shall be provided and installed in the field by the Installing Contractor.

3.3 COIL INSTALLATION

A. Protect coils to prevent damage to fins and flanges. Comb out bent fins.

B. Make connections to coils with unions and flanges.

C. On water coils, provide shut-off valve on supply line and balancing valve with memory lock on return line for each of coil sections. Locate water supply at bottom of supply header and return water connection at top. Provide manual air vents at high points complete with stop-valve. Ensure water coils are drainable and provide drain connection at low points.

D. Connect chilled or hot water supply to air leaving side of coil (counterflow arrangement).

E. Coordinate floor drain installation with plumbing trade. Provide floor drains as close to unit cooling coil drains as possible.

3.4 FILTER INSTALLATION

A. Install air cleaning devices in accordance with manufacturer's instructions.

B. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction.

C. Locate each filter accurately in position indicated in relation to other work. Position unit with sufficient clearance for normal service and maintenance.

D. Coordinate with other work, including ductwork and air handling unit work, as necessary to interface installation of filters properly with other work.

E. Operate installed air filters to demonstrate compliance with requirements. Test for air leakage of unfiltered air while system is operating. Correct malfunctioning units at site, then retest to demonstrate compliance; otherwise remove and replace with new units and proceed with retesting.

F. Demonstrate each filter installation to the Owner. Filters shall be installed snug with no gaps left between filters or filters and housing.

3.5 EQUIPMENT SUPPORT/BASES

A. Refer to specification Section 20 0529 – Supports, Anchors and Sleeves.

B. Furnish anchor bolts and anchor bolt sleeves of adequate size and length to properly anchor all equipment to be installed.

3.6 CONNECTIONS

A. Arrange piping installations adjacent to units to allow servicing and maintenance.

B. Connect condensate drain pan piping to the nearest floor drain. Construct deep trap at piping connection to drain pan and install cleanouts at changes in direction.

C. Electrical power wiring to be provided under Division 26.

3.7 ADJUSTING, CLEANING AND PROTECTING

A. Adjust water coil flow, with control valves at full coil flow, to indicated gpm.

B. Adjust damper linkages for proper damper operation.

C. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet and coils entering air face.

3.8 FIELD INSPECTION AND REPORT

A. Provide report, in accordance with Section 20 0001, prepared by manufacturer's representative, stating that systems installed and services provided under this Section are in accordance with manufacturer's recommendations and are properly operating.

3.9 MANUFACTURER FIELD SERVICES

A. The air handling unit manufacturer shall provide the services of a factory trained, field service representative to supervise the unit assembly and installation.

B. Provide services of factory trained representative for minimum two days (16 hours) to supervise start up, calibration of controls and final installation of the air handling units.

C. Provide a written report prepared by the manufacturer's representative stating that systems are installed and services provided under this section are in accordance with manufacturer's recommendations and are operating properly.

D. Provide training for Owner's maintenance personnel on the following:

1. Procedures and schedules related to start-up and shut-down, troubleshooting, servicing, preventative maintenance and how to obtain replacement parts.

2. Familiarization with contents of Operating and Maintenance Manuals specified in Division 01, Section 01 7700 – Closeout Procedures, and Division 20, Section 20 0001 – Basic Mechanical Requirements.

E. Schedule training with at least seven days' advance notice. Provide two (2), 4-hour training sessions to accommodate hospital shifts. One training session shall be in the morning and the second training session shall be in the late afternoon/evening to accommodate the hospital's different shifts. Coordinate exact requirements with the Owner.

3.10 SYSTEM START-UP

A. Final checks before start-up:

1. Remove shipping, blocking and bracing.

2. Verify unit is secure on mountings and supportive devices and that connection for piping, ductwork and electrical are complete. Verify proper thermal overload protection is installed in motors, starters and disconnects.

3. Perform cleaning and adjusting specified in this Section.

4. Verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations.

5. Lubricate bearings, pulleys and other moving parts with factory-recommended lubricants.

6. Comb coil fins for parallel orientation.

7. Install clean filters.

8. Verify manual and automatic volume control, fire and smoke dampers in connected ductwork systems are in the full-open position.

9. Disable automatic temperature control operators.

B. Starting procedures for central station air handling units:

1. Energize motor; verify proper operation of motor, drive system and fan wheel. Adjust fan to indicated rpm.

C. Shut unit down and reconnect automatic temperature control operators.

D. Refer to Division 23, Section 23 0593 – Testing, Adjusting and Balancing for HVAC for procedures for air handling unit testing, adjusting and balancing.

3.11 AIR HANDLING UNIT SCHEDULE

A. Refer to schedule on drawings.

3.12 TESTING

A. Manufacturer Installation Inspection Report - Provide report prepared by manufacturer's representative, stating that systems installed and services provided under this Section are in accordance with manufacturer's recommendations and are properly operating.

B. Field Testing

1. The air handling unit manufacturer and contractor shall provide a report with all test results and a comprehensive list of all instruments used for measurements and a copy of their latest calibration certificates.

2. The air handling unit manufacturer shall factory run-test each fan/motor set to insure design integrity and proper fan rpm.

3. Factory and field leak test all coils: fill water coils with water and test coils and connections for leaks.

4. All factory installed piping shall be hydrostatically leak-tested. Steam and hydronic systems shall be tested for minimum of four hours at 1½ times design pressure or 100 psig minimum, whichever is greater, unless otherwise specified.

5. After the AHU has been field assembled and the manufacturer's representative has been onsite to verify and approve the assembly/construction, the unit shall be positive and negative pressure leak tested. Air handling unit shall be air leak tested by the contractor under the manufacturer's representatives supervision in the field at plus 8 in. wg (doors swing in) and minus 8 in. wg (doors swing out).

a. Tests shall be conducted in compliance with SMACNA's HVAC Air Duct Leakage Test Manual, latest edition.

b. The leakage rate of the entire unit shall not exceed 0.5% of design flow or 5 cfm per 100 ft2 surface area at 8-in. wg., whichever is greater.

c. Surface caulking shall not be used to correct any leakage problems.

6. After the AHU has been field assembled and the manufacturer's representative has been onsite to verify and approve the assembly/construction, the Air handling unit shall be tested, by the Installing Contractor, to verify that the AHU airflow is within the range of 100% to 110% of the scheduled system CFM at the scheduled external system resistance.

a. The test shall include an airflow measuring downstream or upstream of the AHU, and static pressure ports across the entire AHU.

b. Resistance external to the AHU shall be simulated by dampers in ductwork or other means to build up design operating pressure for the fan system.

c. Corrective action shall be by the AHU manufacturer to meet the design system airflow and resistance.

END OF SECTION

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COILS, CHILLED WATER COOLING

TAG	SERVICE	LOCATION	SYSTEM CONFIGURATION (DRAW-THROUGH OR BLOW-THROUGH)	AIRFLOW (CFM)	COOLING CAPACITY		COIL BANK DATA						AIR SIDE					FLUID SIDE					OPPERATING WEIGHT (LBS)	MANUFACTURER	MODEL NUMBER	REMARKS
					SENSIBLE (MBH)	TOTAL (MBH)	MAXIMUM FACE VELOCITY (FPM)	MINIMUM NUMBER OF ROWS	MAXIMUM FINS PER INCH	OVERALL COIL BANK DIMENSIONS W x H (IN x IN)	INDIVIDUAL COILS		ENTERING TEMP		LEAVING TEMP		MAXIMUM PRESSURE DROP (IN WG)	FLUID TYPE	FLOW RATE (GPM)	ENTERING TEMP (°F)	LEAVING TEMP (°F)	MAXIMUM PRESSURE DROP (FT WG)				
											NUMBER	DIMENSIONS W x H (IN x IN)	DRY BULB (°F)	WET BULB (°F)	DRY BULB (°F)	WET BULB (°F)										
CC-1	AHU-201	2ND FLOOR - MECH ROOM	DRAW-THROUGH	30,000	1,024	1,794	494	8	7	111x87	3	108x27	82	70	51	50.8	0.97	H2O	357	42	52	17.8	784	PRECISION COILS	CWS8S08S07-27X108-LH	1,2,3
CC-2	AHU-202	2ND FLOOR - MECH ROOM	DRAW-THROUGH	30,000	1,024	1,794	494	8	7	111x87	3	108x27	82	70	51	50.8	0.97	H2O	357	42	52	17.8	784	PRECISION COILS	CWS8S08S07-27X108-LH	1,2,3

NOTES:
1. COIL SHALL BE PRESSURE TESTED AT 315 PSI
2. PROVIDE STAINLESS STEEL DRAIN PAN UNDER COIL
3. PROVIDE WITH ALL PIPING ACCESSORIES AS SHOWN IN DETAILS AND DIAGRAMS
4. COILS SHALL BE PIPED OPPOSITE ENDED.

FANS

TAG	SERVICE	LOCATION	AIRFLOW		EXTERNAL STATIC PRESSURE (IN WG)	TOTAL STATIC PRESSURE (IN WG)	DRIVE (BELT OR DIRECT)	TYPE	AMCA CLASS (I, II, III, IV)	WHEEL DIAMETER (IN)	FAN SPEED (RPM)	MAXIMUM OUTLET VELOCITY (FPM)	ABSORBED POWER (BHP)	INDIVIDUAL FANS	MOTOR DATA					WEIGHT (LBS)	MANUFACTURER	MODEL NUMBER	REMARKS
			SYSTEM REQUIRED (CFM)	EQUIPMENT CAPACITY (CFM)											RATED POWER (HP)	SPEED (RPM)	VI/Ø/Hz	EMERGENCY POWER SOURCE REQUIRED (YES OR NO)	CONNECTED TO VFD? (YES OR NO)				
SF-1	AHU-201	2ND FLOOR - MECH ROOM	27860	30000	2.5	5.6	DIRECT	FAN WALL	I	22	2234	675	9.34	4	10	1,760	460/3/60	YES	YES	1976	NORTEK	22-95-215T-44X44X32-B2	1,2
RF-1	AHU-201	2ND FLOOR - MECH ROOM	27860	30000	2.0	2.1	DIRECT	FAN WALL	I	20	2652	1263	8.92	3	10	1,760	460/3/60	YES	YES	1404	NORTEK	20-105-215T-34X42X32-C1	1,2
SF-2	AHU-202	2ND FLOOR - MECH ROOM	26000	30000	2.5	5.6	DIRECT	FAN WALL	I	22	2234	675	9.34	4	10	1,760	460/3/60	YES	YES	1976	NORTEK	22-95-215T-44X44X32-B2	1,2
RF-2	AHU-202	2ND FLOOR - MECH ROOM	26000	30000	2.0	2.1	DIRECT	FAN WALL	I	20	2652	1263	8.92	3	10	1,760	460/3/60	YES	YES	1404	NORTEK	20-105-215T-34X42X32-C1	1,2

NOTES:
1. ALTERNATE AHU MANUFACTURERS SHALL PROVIDE SAME NUMBER OF FAN UNA-COMBA ARRANGEMENT AS BASIS OF DESIGN. FAN ARRAY SHALL BE CAPABLE OF PROVIDING DESIGN FLOW AND PRESSURE WITH ONE FAN INACTIVE
2. PROVIDE WITH TEAO STYLE MOTORS. EC MOTORS (ECM) ARE NOT PERMITTED AND WILL NOT BE CONSIDERED.

COILS, HOT WATER HEATING

TAG	SERVICE	LOCATION	AIRFLOW (CFM)	HEATING CAPACITY (MBH)	COIL BANK DATA						AIR SIDE			FLUID SIDE					MANUFACTURER	MODEL NUMBER	REMARKS
					MAXIMUM FACE VELOCITY (FPM)	MINIMUM NUMBER OF ROWS	MAXIMUM FINS PER INCH	OVERALL COIL BANK DIMENSIONS W x H (IN x IN)	INDIVIDUAL COILS		ENTERING TEMP	LEAVING TEMP	MAXIMUM PRESSURE DROP (IN WG)	FLUID TYPE	FLOW RATE (GPM)	ENTERING TEMP (°F)	LEAVING TEMP (°F)	MAXIMUM PRESSURE DROP (FT WG)			
									NUMBER	DIMENSIONS W x H (IN x IN)	DRY BULB (°F)	DRY BULB (°F)									
HC-1	AHU-201	2ND FLOOR - MECH ROOM	30,000	2,047	493	2	6	115.25x82	2	112.25x39	30	93	0.12	H2O	210.5	200	180	7.96	NORTEK	5WC-2-39x112.25x2-6AL	1,2,3
HC-2	AHU-202	2ND FLOOR - MECH ROOM	30,000	2,047	493	2	6	115.25x82	2	112.25x39	30	93	0.12	H2O	210.5	200	180	7.96	NORTEK	5WC-2-39x112.25x2-6AL	1,2,3

NOTES:
1. COIL SHALL BE PRESSURE TESTED AT 315 PSI
2. PROVIDE STAINLESS STEEL DRAIN PAN UNDER COIL
3. PROVIDE WITH ALL PIPING ACCESSORIES AS SHOWN IN DETAILS AND DIAGRAMS

VARIABLE FREQUENCY DRIVES

TAG	EQUIPMENT SERVED	LOCATION	MOTOR		VFD RATING			WITH BYPASS (YES OR NO)	MANUFACTURER	MODEL NUMBER	REMARKS
			RATED POWER (HP)	VI/Ø/Hz	RATED POWER (HP)	AMPS	VI/Ø/Hz				
VFD-SF1-1	SF-1 (AHU-201)	2ND FLOOR - MECH ROOM	10	460/3/60	10	14	460/3/60	NO	ABB	ACH180	1
VFD-SF1-2	SF-1 (AHU-201)	2ND FLOOR - MECH ROOM	10	460/3/60	10	14	460/3/60	NO	ABB	ACH180	1
VFD-SF1-3	SF-1 (AHU-201)	2ND FLOOR - MECH ROOM	10	460/3/60	10	14	460/3/60	NO	ABB	ACH180	1
VFD-SF1-4	SF-1 (AHU-201)	2ND FLOOR - MECH ROOM	10	460/3/60	10	14	460/3/60	NO	ABB	ACH180	1
VFD-RF1-1	EF-1 (AHU-201)	2ND FLOOR - MECH ROOM	10	460/3/60	10	14	460/3/60	NO	ABB	ACH180	1
VFD-RF1-2	EF-1 (AHU-201)	2ND FLOOR - MECH ROOM	10	460/3/60	10	14	460/3/60	NO	ABB	ACH180	1
VFD-RF1-3	EF-1 (AHU-201)	2ND FLOOR - MECH ROOM	10	460/3/60	10	14	460/3/60	NO	ABB	ACH180	1
VFD-SF2-1	SF-2 (AHU-202)	2ND FLOOR - MECH ROOM	10	460/3/60	10	14	460/3/60	NO	ABB	ACH180	1
VFD-SF2-2	SF-2 (AHU-202)	2ND FLOOR - MECH ROOM	10	460/3/60	10	14	460/3/60	NO	ABB	ACH180	1
VFD-SF2-3	SF-2 (AHU-202)	2ND FLOOR - MECH ROOM	10	460/3/60	10	14	460/3/60	NO	ABB	ACH180	1
VFD-SF2-4	SF-2 (AHU-202)	2ND FLOOR - MECH ROOM	10	460/3/60	10	14	460/3/60	NO	ABB	ACH180	1
VFD-RF2-1	EF-2 (AHU-202)	2ND FLOOR - MECH ROOM	10	460/3/60	10	14	460/3/60	NO	ABB	ACH180	1
VFD-RF2-2	EF-2 (AHU-202)	2ND FLOOR - MECH ROOM	10	460/3/60	10	14	460/3/60	NO	ABB	ACH180	1
VFD-RF2-3	EF-2 (AHU-202)	2ND FLOOR - MECH ROOM	10	460/3/60	10	14	460/3/60	NO	ABB	ACH180	1

NOTES:
1. VFD SHALL MEET IEE 519 PER VFD SPECIFICATIONS

AIR FILTERS

TAG	SERVICE	LOCATION	TOTAL AIRFLOW (CFM)	MAXIMUM FACE VELOCITY (FPM)	FILTER SERVICE (PRE, SECONDARY, FINAL)	MINIMUM EFFICIENCY REPORTING VALUE (MERV)	INDIVIDUAL FILTER SIZE		OVERALL FILTER BANK ARRANGEMENT				MAXIMUM PRESSURE DROP		MANUFACTURER	MODEL NUMBER	REMARKS
							FACE DIMENSIONS W x H (IN x IN)	DEPTH (IN)	FILTER BANK DIMENSIONS (IN x IN)	TOTAL NUMBER OF FILTERS	NUMBER OF FILTERS WIDE	NUMBER OF FILTERS HIGH	CLEAN (IN WG)	DIRTY (IN WG)			
F-1	AHU-201	2ND FLOOR - MECH ROOM	30,000	500	SECONDARY	13	24x24	22	120x72	15	5	3	0.38	0.76	CAMFIL	HFESMV13/24/24/22/10	1,2,3
PF-1	AHU-201	2ND FLOOR - MECH ROOM	30,000	500	PRE-FILTER	8	24x24	2	120x72	15	5	3	0.31	0.62	CAMFIL	FARR 30/30	1,2,3
F-2	AHU-202	2ND FLOOR - MECH ROOM	30,000	500	SECONDARY	13	24x24	22	120x72	15	5	3	0.38	0.76	CAMFIL	HFESMV13/24/24/22/10	1,2,3
PF-2	AHU-202	2ND FLOOR - MECH ROOM	30,000	500	PRE-FILTER	8	24x24	2	120x72	15	5	3	0.31	0.62	CAMFIL	FARR 30/30	1,2,3

NOTES:
1. FILTER FRAMES SHALL BE BY AIR HANDLING UNIT MANUFACTURER
2. PROVIDE A MINIMUM OF 1 SPARE OF EACH FILTER SIZE AND TYPE FOR EMERGENCY REPLACEMENT
3. FILTER PRESSURE DROP SHALL BE RECORDED DURING COMMISSIONING TO ENSURE IT MEETS DESIGN SPECIFICATIONS

CUSTOM AIR HANDLING UNITS

TAG	SERVICE	LOCATION	OVERALL UNIT REQUIREMENTS				EXHAUST/ RETURN FAN TAG	FILTER TAG	AIR BLENDER TAG	HEATING COIL TAG	COOLING COIL TAG	SUPPLY FAN TAG	OVERALL UNIT DATA		MANUFACTURER	MODEL NUMBER	REMARKS
			MINIMUM OUTSIDE AIRFLOW (CFM)	EQUIPMENT AIRFLOW CAPACITY (CFM)	SYSTEM REQUIRED AIRFLOW (CFM)	EXTERNAL STATIC PRESSURE (IN WG)							OVERALL DIMENSIONS W x H x L (IN x IN x IN)	OPERATING WEIGHT (LBS)			
AHU-201	1ST & 2ND FLOOR EAST	2ND FLOOR - MECH ROOM	6,000	30,000	27,860	2.50	RF-1	PF-1 / F-1	CB-1	HC-1	CC-1	SF-1	126x105x190	9,698	NORTEK	KNOCKDOWN	1,2
AHU-202	1ST & 2ND FLOOR EAST	2ND FLOOR - MECH ROOM	6,000	30,000	26,000	2.50	RF-2	PF-2 / F-2	CB-2	HC-2	CC-2	SF-2	126x105x190	9,698	NORTEK	KNOCKDOWN	1,2

NOTES:
1. AIR HANDLING UNIT SHALL MEET ALL PERFORMANCE REQUIREMENTS INDICATED IN ALL APPLICABLE EQUIPMENT SCHEDULES AND AS SPECIFIED
2. PROVIDE WITH FACTORY INSTALLED SINGLE POINT POWER PANELS WITH INDIVIDUAL VFD'S

AIR BLENDER

TAG	SERVICE	LOCATION	TOTAL AIRFLOW (CFM)	FACE VELOCITY (FPM)	MAXIMUM PRESSURE DROP (IN WG)	PHYSICAL CHARACTERISTICS			MANUFACTURER	MODEL NUMBER	REMARKS
						QTY.	BLENDER HEIGHT (IN)	BLENDER WIDTH (IN)			
CB-1	AHU-201	2ND FLOOR - MECH ROOM	30,000	1250	0.37	3	30	30	BLENDER PRODUCTS	ABS30	1
CB-2	AHU-202	2ND FLOOR - MECH ROOM	30,000	1250	0.37	3	30	30	BLENDER PRODUCTS	ABS30	1

NOTES:
1. PRESSURE DROP SHALL NOT EXCEED SCHEDULED VALUE

AIRFLOW MEASURING STATION

TAG	SERVICE	LOCATION	TYPE	AIRFLOW		DIMENSIONS		# OF PROBES	# OF SENSORS PER PROBE	MANUFACTURER	MODEL NUMBER	REMARKS
				MINIMUM (CFM)	MAXIMUM (CFM)	DUCT W x L (IN x IN)	FAN INLET (IN DIA)					
AFMS-OA1	AHU-201	2ND FLOOR - MECH ROOM	DUCT-MOUNTED	6000	9000	36x96	--	2	8	EBTRON	GTC116e-P+	1,2
AFMS-RA1-1	AHU-201	2ND FLOOR - MECH ROOM	DUCT-MOUNTED	2285	9140	54x26	--	2	6	EBTRON	GTC116e-P+	1,2
AFMS-RA1-2	AHU-201	2ND FLOOR - MECH ROOM	DUCT-MOUNTED	1730	6920	72x18	--	2	6	EBTRON	GTC116e-P+	1,2
AFMS-SA1	AHU-201	2ND FLOOR - MECH ROOM	FAN INLET	10000	30000	--	26	1	4	EBTRON	GTC108e-F/A4	1,2
AFMS-OA2	AHU-202	2ND FLOOR - MECH ROOM	DUCT-MOUNTED	6000	9000	36x96	--	2	8	EBTRON	GTC116e-P+	1,2
AFMS-RA2-1	AHU-202	2ND FLOOR - MECH ROOM	DUCT-MOUNTED	3130	12540	36x42	--	2	6	EBTRON	GTC116e-P+	1,2
AFMS-RA2-2	AHU-202	2ND FLOOR - MECH ROOM	DUCT-MOUNTED	3650	14610	64x28	--	2	7	EBTRON	GTC116e-P+	1,2
AFMS-SA2	AHU-202	2ND FLOOR - MECH ROOM	FAN INLET	10000	30000	--	26	1	4	EBTRON	GTC108e-F/A4	1,2

NOTES:
1. INSTALL PER MANUFACTURER'S INSTRUCTIONS
2. LOCAL REPRESENTATIVE MUST MEET ON-SITE TO LOCATE EQUIPMENT PRIOR TO ORDERING

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CONSULTANTS

SEAL

MECHANICAL SCHEDULES

2ND FLOOR AHU REPLACEMENT
Skokie Public Library
5215 Oakton St.
Skokie, IL 60077

ISSUES & REVISIONS

NO.	DESCRIPTION	DATE
1	50% OWNER REVIEW	2.11.26
2	100% OWNER REVIEW	3.04.26
3	ISSUED FOR BID	3.11.26
4	BID ADDENDUM #1	3.18.26

KEYPLAN

SCALE

DRAWN	CHECKED	APPROVED
BTR	APM	APM

PROJECT NO.
P25-1226-00

M001