210 E. Main St.
Lancaster, OH 43130

OWNER'S PROJECT REQUIREMENTS

FOR:

Government Services Center (GSC) HVAC Renovations 2024
HVAC Equipment Pre-Purchase

October 29, 2024

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Owner's Project Requirements (OPR)

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Project:

Fairfield County, Ohio: Government Services Center HVAC Equipment Pre-Purchase 2024

Government Services Center: 239 W. Main St., Lancaster, Ohio 43130

OPR Documents Available (may be posted/shared as multiple files) as exhibits to final Equipment POs:

SECTION 230916 - VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes matched replacement motors and variable frequency drives (VFD) with open standard protocol capabilities for HVAC systems and components.

B. Related Sections include the following:

1. Division 23 Section "High-Efficiency Packaged Rooftop HVAC Units" contains requirements that relate to this Section.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract.

B. Product Data for each type of product specified. Include manufacturer's technical Product Data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, installation instructions, and startup instructions.

C. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

D. Shop Drawings containing the following information for each control system:

1. Diagrams for all required electrical wiring (matched motor & VFD Starter). Clearly differentiate between factory-installed and field-installed wiring.
2. Details of control panel faces, including controls, instruments, and labeling.
3. System graphics.
4. System configuration.
5. Software description and sequence of operation.

E. Wiring diagrams detailing wiring for power, signal, and control systems and differentiating clearly between manufacturer-installed and field-installed wiring.

F. Maintenance data for motors/variable frequency drives to include in the operation and maintenance manuals specified. Include the following:

1. Maintenance instructions and applicable spare parts lists.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

G. Field Test Reports: Procedure and certification of variable frequency drive system.

H. Harmonic Testing: Compliance to IEEE 519 - harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion.

1. The VFD manufacturer shall provide calculations, specific to this installation, showing total harmonic voltage distortion is less than 5%. Input line filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE standard 519 (latest version), guide for Harmonic Control and Reactive Compensation for Static Power Converters. The acceptance for this calculation must be completed prior to VFD installation.
2. Prior to installation, the VFD manufacturer shall provide the estimated total harmonic distortion (THD) caused by the VFDs. The results shall be based on a computer aided circuit simulation of the total actual system, with information obtained from the power provider and the user.
3. If the voltage TDH exceeds 5%, the VFD manufacturer is to recommend the additional equipment required to reduce the voltage THD to an acceptable level.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Wiring installation shall be accomplished by a licensed electrician.

B. Manufacturer Qualifications: Engage a firm experienced in manufacturing variable frequency drive & matched motor replacement systems similar to those indicated for this Project and that have a record of successful in-service performance. It is required that the drive manufacturer have an existing sales representative exclusively for HVAC products, with expertise in HVAC systems and controls and must have an independent service organization within a 50 mile radius of the project site. The drive and all necessary controls, as herein specified, shall be supplied by the drive manufacturer. The manufacturer shall have been engaged in the production of VFDs for a minimum of ten (10) years.

C. Startup Personnel Qualifications: Engage specially trained personnel in direct employ of local representative of variable frequency drives.

D. Comply with NFPA 90A.

E. Comply with NFPA 70.

F. Comply with UL 508C, including all Bypass and accessory components.

G. Comply with IEEE Standard 519-1992, Guide for Harmonic Content and Control.

H. Comply with NEMA ICS 7.0 AC Adjustable Speed Drives.

I. Comply with IEC 16800 Parts 1 and 2.

J. Testing:
1. All printed circuit boards shall be completely tested and burned-on before being assembled into the completed VFD. The VFD shall then be subjected to a computerized systems test (cold), burn-in, and computerized system test (hot). The burn-in shall be at 104 deg. F. (40 deg. C), at full rated load.
2. All testing and manufacturing procedures shall be ISO 9001 certified.

K. Failure Analysis:

1. VFD manufacturer shall have an analysis laboratory to evaluate the failure to any component. The failure analysis lab shall allow the manufacturer to perform complete electrical testing, x-ray of components, and decap or delaminate of components and analyze failures within the component.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store equipment and materials inside and protected from weather.

B. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping control devices to unit manufacturer.

1.6 WARRANTY

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide original manufactured/non-branded products by one of the following:

1. ABB – base models and engineered branded.
2. Danfoss – base models and engineered/branded
3. Johnson Controls/Eaton.
4. Yaskawa HVAC.

2.2 VARIABLE FREQUENCY DRIVES (VFDs)

A. The Variable Frequency Drives (VFDs) shall be solid state, with a Pulse Width Modulated (PWM) output waveform utilizing insulated gate bipolar transistors (IGBT’s). The VFD

package specified herein shall be completely assembled in a NEMA 1 enclosure and tested by the manufacturer. The drive efficiency shall be 97% or better at full speed and full load and the fundamental power factor shall be 0.98 at all speeds and loads.

B. General Requirements: VFDs and options shall be UL Listed as a complete assembly. All items in this specification must be adhered to strictly. Any deviations must be submitted and approved in writing ten working days prior to the bid date.

C. All VFDs shall have the following standard features:

1. All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be used for local control, for setting all parameters and for stepping through the displays and menus. The keypad shall be removable, capable of remote mounting, and shall have its own non-volatile memory. The keypad shall allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs. Provide integral time clock with 10-year backup battery and four (4) separate & independent settable timer functions, for both weekday and weekend time periods.
2. The VFDs shall utilize plain English digital display (code numbers and letters are not acceptable). All set-up parameters, indications, faults, warnings and other information must be displayed in words to allow the user to understand what is being displayed without the use of an installation manual or cross-reference table. VFDs utilizing codes are not acceptable.
3. The keypad shall include Hand-Off-Auto membrane selections. When in the "Hand" position, the VFD will be started and the speed will be controlled from the up/down arrows. When in the "Off" position, the VFD shall be stopped. When in the "Auto" position, the VFD shall start via an external contact closure and the VFD speed will be controlled via an external speed reference. The drive shall incorporate “bumpless transfer” of speed reference when switching between “Auto” and “Hand” modes and vice-versa.
4. The VFDs shall have impedance line reactors to meet IEEE Standard 519 at no greater than 5% total harmonic voltage distortion.
5. The VFDs shall utilize pre-programmed application macro's specifically designed to facilitate start-up. The Application Macros shall provide one command to reprogram all parameters and customer interfaces for a particular application to reduce programming time.
6. The VFD shall have the ability to automatically restart after an overcurrent, overvoltage, undervoltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable.
7. The VFD shall be capable of stating into a rotating load (forward or reverse) and accelerate or decelerate to setpoint without safety tripping or component damage (flying start). The VFD shall also be capable of DC injection braking at start to stop a reverse spinning motor prior to ramp.
8. The VFD shall be equipped with an automatic extended control power ride-through circuit, which will utilize the inertia of the load to keep the drive powered. Typical control power ride-through for a fan load shall be 2 second minimum.
9. If the input reference (4-20mA or 2-10V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning

to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communication bus.

10. The customer terminal strip shall be isolated from the line and ground.
11. The drive shall employ current limit circuits to provide trip free operation:
    a. The Slow Current Regulation limit circuit shall be adjustable to 150% (minimum) of the VFD's normal duty current rating. This adjustment shall be made via the keypad, and shall be displayed in actual amps, and not as percent of full load.
    b. The Current Switch-off limit shall be fixed at 350% (minimum, instantaneous) of the VFD's normal duty current rating.
12. The overload rating of the drive shall be 110% of its normal duty current rating for one minute in every ten minutes.
13. The VFD shall have integral Input Reactor(s) with a minimum of 3% impedance in the form of AC or DC reactors. DC reactors shall be located on both the positive and negative bus rails to reduce the harmonics to the power line and to increase the fundamental power factor.
14. The VFD shall be capable of sensing a loss of load (broken belt/no water in the pump) and signal the loss of load condition. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false underload condition.
15. The VFD shall allow feedback to BAS over serial communication bus when “loss-of-load” signal is received and provide for programmable actions:
    a. stop-and-display fault.
    b. Run at pre-programmed speed.
    c. Hold last speed.
    d. Issue Warning.
16. The VFD shall have programmable "Sleep" and "Wake-up" functions to allow the drive to be started and stopped from the level of a process feedback or follower signal.
17. VFD heat sinks shall be cooled by an integral cooling fan sized for the application of VFD. Locate cooling fan at exterior of unit to allow service maintenance to be performed without an internal teardown of the VFD.

D. All VFDs shall have the following adjustment capabilities:

1. Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.
2. Two (2) PID Setpoint controllers shall be standard in the drive, allowing a pressure or flow signal to be connected to the VFD, using the microprocessor in the VFD for the closed loop control. The VFD shall have 250 mA of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The auxiliary power supply shall have overload and over current protection. the PID setpoint shall be adjustable from the VFD keypad, analog inputs, or over the communications bus.
3. Two (2) programmable analog inputs shall accept a current or voltage signal for speed reference, or for reference and actual (feedback) signals for PID controller. Analog inputs shall include a filter; programmable from 0.01 to 10 second to remove an oscillation in the input signal. The minimum and maximum values (gain and offset) shall be adjustable within the range of 0-20 ma and 0-10 Volts. Additionally, the reference must be able to be scaled so that maximum reference can represent a frequency less than 60Hz, without lowering the drive maximum frequency below 60Hz. Process variables

shall be modifiable by math functions such as multiplication and division between the two signals (fan tracking), high/low select, as well as inverted follower.

4. Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices. One digital input is to be utilized as a customer safety connection point for fire, freeze, and smoker interlocks (Enable). Upon customer reset (reclosure of interlock) drive is to resume normal operation.
5. Two (2) programmable analog outputs proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, and other data.
6. Three (3) programmable digital relay outputs. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC: Continuous current rating 2 amps RMS. Outputs shall be true form C type contacts; open collector outputs are not acceptable. Relays shall be capable of programmable on and off delay times.
7. Seven (7) programmable preset speeds.
8. Two independently adjustable accel and decel ramps. These ramp times shall be adjustable from 1 to 1800 seconds.
9. The VFD shall Ramp or Coast to a stop, as selected by the user.
10. The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on the actual VFD temperature that allows the highest carrier frequency without derating the VFD or operating at high carrier frequency only at low speeds.
11. The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and reduce audible motor noise.
12. The VFD shall include routines for password protection against unauthorized parameter changes.

E. The following operating information displays shall be standard VFD digital display. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of two operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words:

Output Frequency
Motor Speed (RPM, % or Engineering units)
Motor Current
Calculated Motor Torque
Calculated Motor Power (kW)
DC Bus Voltage
Output Voltage
Heatsink Temperature (F)
Analog Input Values
Analog Output Value
Keypad Reference Values
Elapsed Time Meter (resettable)
kWh meter (resettable)
mWh meter
Digital input status
Digital output status

F. The VFD shall have the following protection circuits. In the case of a protective trip, the drive shall stop, and announce the fault condition in complete words (alphanumeric codes are not acceptable).

Overcurrent trip 350% instantaneous (170% RMs) of the VFD's variable torque current rating
Overvoltage trip 130% of the VFD's rated voltage
Undervoltage trip 65% of the VFD's rated voltage
Overtemperature +90 deg. C, Heatsink Temperature
Ground Fault either running or at start
Adaptable Electronic Motor Overload (I2T). The Electronic Motor Overload protection shall protect the motor based on speed, load curve, and external fan parameter. Circuits, which are not speed dependent, are unacceptable. The electronic motor overload protection shall be UL Listed for this function.

G. Speed Command Input shall be via:

1. Keypad.
2. Two Analog inputs, each capable of accepting a 0-20mA, 4-20mA, 0-10V, 2-10V signal.
3. Floating point input shall accept a three-wire input from a Dwyer Photohelic (or equivalent type) instrument.
4. Serial Communications – coordinate with Owner's Master Systems Integrator/Temperature Control System provider.

H. Serial Communications

1. The VFD shall have a BacNET™ certified bus Serial Interface connection for capability with supporting an HVAC industry accepted open standard protocol for communications.
2. The VFD shall be able to communicate with PLC's, DCS's and DDC's.
3. Serial communication capability shall include, but not be limited to, Power consumed, run-stop control; speed set adjustment, proportional/integral/derivative PID control (Set Point) adjustments, current limit, and accel/decel time adjustments. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed/frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), relay outputs, digital inputs and diagnostic warning and fault information. Additionally, remote (LAN) VFD fault reset shall be possible. A minimum of 15 field parameters shall be capable of being monitored.
4. The VFD shall allow the DDC to control the drive's digital and analog outputs via the serial interface. The serial communications interface shall allow for DO (relay) control and AO (analog) control without being tied to a VFD function. In addition, all drive digital and analog inputs shall be capable of being monitored by the DDC system.
5. The VFD shall have the capability of accepting fiber optic cables for connection to standard fieldbus adapter. Communications between the drive and fieldbus adapters shall be a 1 Mega Baud.
6. The VFD HMI shall be capable of operating, programming, monitoring the drive as well as diagnosing faults.

2.3 VFD CONFIGURATION FEATURES & ACCESSORIES

A. General: Features shall be furnished and mounted by the drive manufacturer, including integral-to-main Cabinet Electronic Bypass Feature that allows manual/automatic switching from

"Automatic" Mode to "Run" Mode. All features shall be ETL/UL Listed by the drive manufacturer as a complete assembly. In addition to Electronic Bypass feature, VFDs, provide VFDs with the following:

1. Customer Interlock Terminal Strip - provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in Hand, Auto, Drive or Bypass modes.
2. Fast acting semi-conductor fuses exclusive to the VFD - fast acting semi-conductor fuses allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection, maintaining bypass capability.

B. Provide VFDs with NEMA 12 Enclosures in applications where the installed environment is subject to excessive conditions and/or as noted on the plans.
C. Provide VFDs with Panel-accessible Disconnect Switch, padlockable in the "Off" position.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that conditioned power supply is available to units. Verify that wiring is adequately provided before proceeding with installation.

3.2 INSTALLATION

A. Install equipment as indicated to comply with manufacturer's written instructions and proper reconnection to each existing parameter (Fan shafts, Fire Alarm interface, etc.).

B. Connect and configure equipment to achieve the sequence of operation specified.

C. Install labels and nameplates to identify control components according to Sections specifying mechanical identification.

3.3 ELECTRICAL WIRING AND CONNECTIONS

A. Install raceways, boxes, and cabinets according to NEC and electrical specifications.

B. Install line voltage wire and cable according to NEC and electrical specifications. Install control signal (low voltage) and communication (BacNET) cable according to NEC and electrical specifications.

1. Conceal cable routings to be protective.
2. Install exposed cable in raceway.
3. Install concealed cable in raceway.
4. Bundle and harness multiconductor instrument cable in place of single cables where a number of cables follow a common path.

5. Fasten flexible conductors, bridging cabinets and doors, neatly along hinge side; protect against abrasion. Tie and support conductors neatly.
6. Number-code or color-code conductors, except local individual room controls, for future identification and servicing of control system.

C. Connect electrical components as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.

3.4 COMMISSIONING

A. Manufacturer's Field Services: In conjunction/coordaintion with the Owner’s Master Systems Integrator and Commissioning Services provider, provide & schedule the services of a factory-authorized service representative to start each VFD used on the project.

B. Test and adjust controls and safeties.

C. Replace damaged or malfunctioning controls and equipment.

D. Start, test, and adjust systems.

E. Demonstrate compliance with requirements.

F. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

3.5 DEMONSTRATION

A. Manufacturer's Field Services: Provide the services of a factory-authorized service representative to demonstrate and train Owner's maintenance personnel as specified below.

1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
2. Schedule training with Owner with at least 7 days' notice.
3. Provide operator training on data display, alarm and status descriptors, requesting data, execution of commands, and request of logs. Include a minimum of four (4) hours dedicated instructor time on-site.

END OF SECTION 230916

SECTION 230919 – HVAC AIRFLOW MEASURING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes components for accurate measurement and/or control of airflow streams in HVAC ducts, plenums and unit enclosures.

B. Related Sections include the following:
   1. Division 23 Section "High-Efficiency Packaged Rooftop Units" contains requirements that relate to this Section.

1.3 SUBMITTALS

A. Product Data: For each type of airflow measuring system indicated/required. Include the following:

   1. Component product data sheets (probes, tranducers, monitors) for designer’s review.
   2. Wiring Diagrams: Power, signal and control wiring.
   3. Installation Diagrams: Clearance designations, mechanical installation, minimum recommended performance criteria for specified duty.

B. Coordination Drawings: Submit with Shop Drawings. Show layout and relationships between airflow measuring systems components and the HVAC systems/mechanical elements they serve. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

C. Maintenance data and requirements shall be included in the operation and maintenance manuals specified.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain airflow measuring systems through one source from a single manufacturer.

B. 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.

C. Comply with the following references:

1. NEMA – Control panel enclosures.

1.5 PRE-COMMISSIONING CRITERIA

A. Coordinate size and location of airflow measuring probes with Rooftop Unit Hood(s), HVAC ductwork, plenums and/or equipment.

1. Verify that manufacturer's recommendations for installation addressing serviceability and operational accuracies are achieved by jobsite conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Dwyer Instruments.
2. Ebtron.
3. Greenheck.
4. Johnson Controls.
5. Paragon.
6. Ruskin.
7. Tek-Air Systems.

2.2 AIRFLOW MEASURING SYSTEMS

A. Configuration: Provide integrated system of components to reliably and accurately measure HVAC airflows. As a minimum, system to include:

1. Airstream-mounted probe(s)
2. Differential pressure/temperature signal transducer.
3. Microprocessor-based airflow monitor.
4. Accuracy of System: +/- 5% in range of 200 to 2000 feet per minute velocity.
5. Accuracy of System: +/- 10% in range of 75 to 200 feet per minute velocity.

B. Probe: Engineered-shape PVC probe designed to create accurate differential pressure signal. Include high pressure chamber, low pressure chamber, high and low pressure pick-up ports and adjustable mounting hardware suitable for duct/plenum/HVAC unit installation. PVC probe to meet UL94-5VB standard for flame spread rating. Provide probes with the following minimum capabilities:
1. Air velocity range (Discharge of intake louver): 75 to 750 feet per minute.
2. Air velocity range (Free airflow, before damper): 100 to 1000 feet per minute.

C. Transducer: Provide transducer to measure both temperature and pressure. Include the following features and specifications:

1. Enclosure: NEMA 4, weatherproof.
2. Operational Temperature range: -40 deg F to 120 deg F.
3. Thermal Span-shift eliminator: integral heater.
4. Pressure pick-up ports: Brass, high and low, ¼ inch barb fittings.
5. Transducer drift eliminator: auto zeroing device.
6. Transmitting cable: Integral, weatherproof, for remote mounting.

D. Monitor: Microprocessor-based monitor suitable to receive input differential pressure and temperature signals from probe(s) and transducer and continuously calculate airflow quantities in the HVAC airstream being measured. Provide monitor with plexiglas viewing window to monitor. Include the following features/specifications:

1. Enclosure: NEMA 4, weatherproof. Operational Temperature range: 30 deg F to 110 deg F.
2. Display: (4)-20 line, Backlit digital with pushbutton keys.
3. Fan-status Input signal: Dry-contact.
4. Functional Output signals: 4-20 ma, linear and proportional, time-averaged for windy conditions.
   a. Airflow (in CFM)
   b. Temperature (in deg F)
5. Alarm Output signals: SPDT, dry-contact, 0.5a
6. Power source: 24 VAC, isolated.
7. Power range: 19-31 VAC
8. Setup Programming: Password-protected routines designed for air balancer, controls contractor and owner.
9. Serial Communications: BACnet™.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

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

3.2 INSTALLATION

A. Install HVAC airflow measuring systems in accordance with system manufacturer’s published installation instructions.

1. Mount probes in HVAC ducts and/or plenums as indicated and required for airflow measuring.
2. Mount transducer and monitor in locations acceptable to project conditions.
3. Coordinate installation to include Access Doors in ductwork for servicing.

B. Arrange installation of systems to provide access space around components for service and maintenance.

C. Electrical: Comply with applicable requirements of NEC and in Electrical specification Sections for power wiring, switches, and motor controls.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-installed components installation, including piping and electrical connections.

3.4 DEMONSTRATION

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

END OF SECTION 230919

SECTION 237319 – HIGH EFFICIENCY ROOFTOP HVAC UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS AND INTENT

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

B. Related specification Sections include the following:
   1. Division 23 Section "Variable Frequency Drives" contains requirements that relate to this Section.
   2. Division 23 Section "HVAC Airflow Measuring Systems" contains requirements that relate to this Section

C. It is the Intent of this Pre-Purchase Project to first SELECT and then after equipment is approved, completely final design/install/coordinate the applicable Owner qualified Equipment & coordinate the applicable manufacturer-based Support Services purchased (equipment & services delivery, lead times/field-coordinate options, confirm technical performance, confirm physical information and fully integrate pertinent accessories/Options) from the selected Vendor(s) designated with the ultimate responsibilities of performing the final pre-order coordination/recommended solutions being accepted with the Vendor(s) by the yet-to-be determined Design Build Contractor. The selected Vendor(s)/manufacturer of the High-Efficiency Rooftop HVAC Equipment/Services will accept and will properly execute all reasonable and required equipment furnishing & support services to the Installing Contractor as if the Design Build Contractor issued the Purchase order to the selected Vendor.

D. Within this offering, and in addition to the physical equipment being furnished, the Vendor(s) of the High-Efficiency Rooftop HVAC Equipment is expected to provide the following support services and documents:
   1. Detailed & complete pre-order and as-ordered Submittal preparation, including selected adapter-type roof curbs:
      a. For use in installation coordination, including product-related data/information to be published in the Contractor installation/coordination documents.
      b. Updated for Accurate As-Built and Systems Manual (IOMM) documentation with installing Contractor.
   2. Engineering/Coordination assistance for Ductwork/Piping/Wiring/IAQ Systems components, routing & sizing for the solution(s) accepted.
   3. Engineering/Coordination assistance for field-installed Controls Components, Duct-Mounted/Piping & Wiring components, routing & sizing for the solution(s) accepted.
   4. Engineering for Factory-recommended Sequences of Operation and Controls Interlocks coordination.
      a. Basic Sequence: interlock & operate the High-Efficiency Rooftop Units for designated HVAC Airflows such that after all safety control circuits are satisfied, the SYSTEM operates Stand-Alone to provide conditioned Airflow to the facility with proper/designated Energy-efficiency routines in place, including interface required for IAQ Systems.

b. Ventilation Controls: engineering assistance for updated Outdoor Air (Ventilation) and Building Pressure Control Systems and upgrades/modifications required to meet High-Efficiency Rooftop HVAC Unit Manufacturer's requirements.
c. Unitary/Vendor Controls include full design & field implementation between the High-Efficiency Rooftop HVAC Units to establish "packaged HVAC Rooftop System Operation", including updates to applicable building Ventilation System Controls. Refer to published Sequences of Operation, as applicable.
d. Coordination directly with Owner's Master System Integrator to address basic Integration (Point/Data transfers, Status, Alarms, etc.) and Operational Integrations for the upgraded High-Efficiency Rooftop HVAC Systems (Main System interlocks, special timing/reset sequences, scheduling, temperature setpoints, etc.).

5. Site-specific field-coordination for Factory-authorized/recommended installations.
6. Factory-authorized Equipment/Systems Start-up and proper documentation.
7. Vendor expertise and support for end-of-project Commissioning Provider and/or Balancing Contractor activities.
8. Manufacturer-based Equipment/Systems/Product/Accessories and Sequences of Operation Training for Owner.
9. Factory-sponsored Preventative Maintenance Services, as applicable.
10. Factory-authorized Warranty support.

E. Field-INSTALLATION (Rigging, Final Assembly, Mounting, Ducting, Piping, Wiring, Remote Controls, field install of furnished Accessories) of the designated HVAC Equipment IS NOT intended for this specification, but does include Vendor-based coordaintion and physical/programming modifications required that affect existing HVAC & Ventilation Setups/Sequences to best serve the new/replaced Equipment.

F. **RTU-1, 2 & 3** Criteria: Basic criteria to use in preparing options/proposals:
1. Nominal Tonnage: refer to supplemental information provided as basis for new Proposal selections:
   a. RTU-1:
      1) Supply CFM: 22,250 at 2.75" External Static Pressure.
      2) Ventilation CFM: 18% Peak Design.
   b. RTU-2:
      1) Supply CFM: 26,250 at 2.75" External Static Pressure.
      2) Ventilation CFM: 18% Peak Design
   c. RTU-3:
      1) Supply CFM: 23,150 at 2.75" External Static Pressure.
      2) Ventilation CFM: 18% Peak Design
2. Voltage: 480/3/60.
3. Physical Dimensions: match as practical to existing roof-mounted HVAC RTU.
   a. Refer to Tag information as applicable.
4. Air Design Temperatures:
   a. Evaporator Leaving Unit: 54 deg F.
   b. Heat Mode Leaving Unit: 65 deg F.
   c. Winter Outside Air: -10 deg. F.
   d. Air-Cooled Condenser: 95 deg F.
5. Acoustic Performance: 87 dBA from unit, per standard AHRI Ratings.
6. Efficiency ratings: Provide units with IEER ratings meeting current/applicable ASHRAE 90.1 references.

1.2 SUMMARY

A. Configuration and Setup: This Section includes Packaged High-Efficiency Rooftop HVAC Units for outdoor installations as shown on layout drawings. Scope is to furnish and fully-Install High-Efficiency Packaged Rooftop HVAC unit(s) in the following Configuration(s)/ Controls Setup(s):
   1. **RTU-1, 2 & 3 :** Multiple Zone Variable Air Volume (VAV)
      a. Direct Expansion Multi-circuit Cooling with Low-Load Capacity Control.
      b. Electric Resistance (or optional Heat Pump version) Heating (65 deg F Leaving Air Temperature, based on inlet conditions noted).
      c. Direct Expansion Dehumidification-Reheat capability.
      d. Return Fan with Integral Building Pressure, Demand Ventilation & Economizer Control.
      e. Unit Section for Field installation of integral UV-C Airstream and Coil Cleaning System.

B. High-Efficiency Rooftop HVAC Unit manufacturer is responsible for the unit housing (walls, floors, roof) and provision for the specified Mechanical/Electrical equipment as shown. Items pertaining to the High-Efficiency Rooftop HVAC Units that are NOT both furnished and installed by the High-Efficiency Rooftop HVAC Units manufacturer include:
   1. Support curb-steel/Concrete supports – furnished and installed by Mechanical Contractor/General Trades Sub-Contractors.
   2. Support Roof Curb – New (matched-to-Unit) Pre-Fabricated Full-Perimeter Roof Support Adapter Curb furnished by Rooftop Unit manufacturer and installed by Mechanical Contractor.
   3. HVAC, Plumbing and Fire Protection piping/installation – provision of general supports for piping and piping systems are to be done in field by the trade contractors in a coordinated effort.
   4. Electrical Power – High-Efficiency Rooftop HVAC Unit manufacturer provides internal raceways and conductors for noted 120-volt receptacles & lighting. Mechanical Contractor/Electrical Sub-Contractor field-provides all final electrical connections, external power wiring, raceways, labeling, etc.
   5. Temperature Control & IAQ Systems (loose components & systems integration) – installed by Mechanical Contractor, unless specifically noted otherwise in specifications/schedules (Airflow Control Monitor devices, UV-C Systems, etc.)
   6. Fire Alarm Systems – furnished and installed by Electrical Contractor (alarm devices, smoke detectors, controls, etc.), unless noted otherwise in Selected Equipment information.

1.3 RELATED SECTIONS (as applicable)

A. The equipment manufactured under the descriptions noted in this specification section is integrally-related to other building systems and the proposer/manufacturer of the High-Efficiency Rooftop HVAC Unit equipment/systems is responsible for complying to and coordinating with the related sections. Any construction costs required by Equipment manufacturers for a complete System Installation are the joint responsibility of the designated HVAC Vendor(s) and this Mechanical contractor/proposer. Related sections include, but are not limited to:
   1. "General HVAC Items":
      a. Basic Mechanical Materials and Methods (pipe supports, labeling, etc.)

b. External-to-unit Vibration Isolation Devices
c. Piping and insulation systems.
d. Fire Protection Sprinkler Systems (piping, valves, controls, etc.).
e. Fire Alarm Systems (controls, devices, raceways, conductors, smoke detectors, etc.) as related to alarms/safeties regarding Hi-Efficiency Rooftop Units.

2. "Metal Duct Systems" for HVAC Ductwork items.
3. "Variable Frequency Drives" for Motors/Motor Starters (specific motor/Variable Frequency Drive (VFD) requirements not specified herein).
4. "HVAC Airflow Measurement Systems" for Airflow Monitoring Stations (specific AFMS requirements not specified herein).
5. "HVAC Indoor Air Quality Systems" for Filter Media/Ultraviolet-C Lamp Assemblies (specific Indoor Air Quality Systems requirements not specified herein).
6. "OPEN Temperature Control Systems" for Integration-based Temperature Control Equipment NOT unit-furnished (panels, devices, raceways, etc.).
7. "HVAC Sequences of Operation" for related elements of operations as integrated to Packaged Controls in High-Efficiency Rooftop Units".

1.4 SUBMITTALS

A. Product Data: For each type of High-Efficiency Rooftop HVAC Unit indicated, include documentation on the following:

1. Fan-performance curves with system operating conditions indicated.
2. Fan/Unit-sound power ratings.
3. Unit Efficiency Ratings (IEER).
4. Unit Static Pressure Calculation.
5. Vibration Isolation Devices.
6. Heat Exchanger/Coil-performance ratings with system operating conditions indicated.
7. Compressor/condenser components with system efficiencies and operating conditions indicated, including information on refrigerant.
8. Motor ratings, electrical characteristics, and motor and fan accessories.
9. Material gages and finishes (walls, floors, roof) with leakage rate performance noted.
10. Piping components and internal unit arrangements – valves, flow measuring devices, refrigerant piping specialties, etc.
11. Filters/accessories with performance characteristics.
12. Control Dampers.
13. Louvers & hoods.
14. Pre-Fabricated Roof Support (Adapter-type) Curbs – Matched-to-Unit (Manufacturer-standard and/or Custom as required by application).
    a. Acoustic Materials to be installed inside Roof Support Curbs by Installing Contractor (Fiber-boards, Blankets, Sealers, etc.).
15. Control System components and accessories, indicating which items are furnished in the factory and what is field-installed by others, including Airflow Monitoring Systems.
16. Field-applied Indoor Air Quality Systems, Components, Controls – coordinate Utility Sections in RTU required for complete IAQ System implementation.
17. Unitary Control Programming and Sequences of Operation.
18. BacNet™ PICS Statement-documentation.
19. Unit factory Certification Reports – as applicable.
20. Unit factory testing Reports.
21. Warranty terms and associated project documentation

22. Maintenance and Operation data, for inclusion in master job O & M manuals.

B. Control System (BAS) Interface Data: Provide complete Serial Communication Point List information for chosen control integration interface (BACNet™). This includes, but is not limited to, PICS statements and Open Standard Protocol PROFILEs.

C. Shop Drawings:

1. Dimensioned drawings of equipment, clearly noting shipping pickup points and Access Door/Panel locations.
2. Base/footprint drawings, coordinated and dimensioned for structural support means.
3. Roof Curb (Adapter-type) drawings specifically matched to unit for application noted.
4. Piping/equipment support layouts.
5. Unit-furnished electrical wiring layouts.
6. Unit-furnished Temperature Control Devices/System, both unit-mounted in factory and field-mounted by installers.

D. Operation and Maintenance Data: For each type of High-Efficiency Rooftop HVAC Unit, include in emergency, operation, and maintenance manuals:
1. Include a SPECIFIC Summary of required maintenance items for each unit, complete with pertinent part numbers and frequency of actions recommended.
2. Include Specified Start-up/Training and Turn-over/Commissioning-related Documents.

E. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain High-Efficiency Rooftop HVAC Units through one source from a single manufacturer, unless noted otherwise.

B. Experience: Provide High-Efficiency Rooftop HVAC Units from a manufacturer with a minimum experience level:
1. Five (5) years

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of High-Efficiency Rooftop HVAC Units and are based on the specific system indicated.
1. Seismic Certifications: Provide Packaged Units as required to meet applicable local “seismic” design standards/certifications with regards to ratings/components necessary for compliance.
2. Wind-Load Certifications: Provide Packaged Units as required to meet applicable local “wind load resistance” design standards/certifications with regards to ratings/components necessary for compliance.

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. Insulation: Provide High-Efficiency Rooftop HVAC Units with internal insulation products/methods meeting NFPA 90A and 90B with regards to flame spread and smoke developed safety ratings.

F. ARI/AHRI Certification: High-Efficiency Rooftop HVAC Units shall have their applicable components be factory tested according to current standards, including, but not limited to: ARI/AHRI 410, "Central-Station Air-Handling Unit Coils," and ARI/AHRI 1060 “Energy Recovery Ventilators” and shall be listed and labeled by ARI/AHRI.

G. ETL Listing: Provide labeled units subject to the requirements of ETL/UL 60335-2-40.

H. ASHRAE 90.1 Compliance: Provide High-Efficiency Rooftop HVAC Units and equipment tested and rated to achieve SPECIFIED system efficiencies according to the latest version of the locally-enforced energy standard, including applicable Sequence of Operation recommendations found in ASHRAE Guideline 36.

I. ASHRAE 15 Compliance: Provide High-Efficiency Rooftop HVAC Units and equipment that is designed, tested and rated to achieve required system safeties according to the latest version of the locally-enforced refrigeration safety standard, including applicable leak detection and leak mitigation recommendations found in ASHRAE Standard 15.

J. Sound Performance: Provide High-Efficiency Rooftop HVAC Units with sound performance established by the procedures in the applicable AHRI/ANSI Standard.

1.6 COORDINATION

A. Coordinate with all trades the placement, support and utility requirements for each High-Efficiency Rooftop HVAC Unit. This includes, but is not limited to:
   1. Substrate elements – Roofs, Roof curbs, structural steel, concrete pads, exterior ductwork locations/sizes, wall sleeves, applicable mechanical room/closet structures.
   2. External-to-Unit Sound-absorbing/Insulation materials installed in Roof Curb cavities.
   3. Proximity to existing Plumbing System & HVAC Exhaust Vents.
   4. Piping – mechanical condensate drain piping.
   5. Ductwork – planned routing from unit connections.
   6. Electrical – power wiring, including means of disconnect.
   7. Controls/IAQ Systems – location of components/accessories not factory-mounted.

1.7 PRE-COMMISSIONING CRITERIA

A. Coordinate layout and installation of High-Efficiency Rooftop HVAC Units and suspension systems with other construction elements that penetrate ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Receive High-Efficiency Packaged Rooftop HVAC Systems from the factory fully ready for Coordinated Systems Installation. Provide protective coverings to electronic components and open piping connections.

B. Handle and store High-Efficiency Packaged Rooftop HVAC Systems per manufacturer's published recommendations, including, but not limited to: protection from weather and unclean jobsite conditions.

1.9 HIGH-EFFICIENCY ROOFTOP HVAC UNIT STARTUP

A. Startup for High-Efficiency Rooftop HVAC Units must be performed by Factory-trained personnel experienced in working with specified equipment and Controls/Sequences, including specified IAQ Systems. Coordinate integrated functions with Owner's Master Systems Integrator.

1.10 WARRANTY

A. Basic Unit warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of High-Efficiency Rooftop HVAC Unit equipment that fails in materials or workmanship. Submit a written warranty signed by the High-Efficiency Rooftop HVAC Unit manufacturer and installer agreeing to furnish labor and parts for failures within a warranty period of one (1) year from the date of substantial completion/documented Start-up.

B. Packaged Unitary Controls Extended warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of High-Efficiency Rooftop HVAC Unit Controls equipment that fails in materials or workmanship. Submit a written warranty signed by the High-Efficiency Rooftop HVAC Unit manufacturer and installer agreeing to furnish labor and parts for failures within a warranty period of two (2) years from the date of substantial completion/documented Start-up.

C. Compressor Extended warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace compressor(s) that fail in materials or workmanship. Submit a written warranty signed by the High-Efficiency Rooftop HVAC Unit manufacturer and installer agreeing to furnish parts and labor for compressor failures within a warranty period of five (5) years from the date of substantial completion/documented Start-up.

D. Heat Exchanger Extended warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace heat exchanger(s) that fail in materials or workmanship. Submit a written warranty signed by the High-Efficiency Rooftop HVAC Unit manufacturer and installer agreeing to furnish parts and labor for heat exchanger failures within a warranty period of ten (10) years from the date of substantial completion/documented Start-up.

E. Motor Control/VFD Extended warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace Variable Frequency Motor Controller(s) that fail in materials or workmanship. Submit a written warranty signed by the High-Efficiency Rooftop HVAC Unit manufacturer and installer agreeing to furnish parts and labor for motor controller failures within a warranty period of two (2) years from the date of substantial completion/documented Start-up.

1.11 EXTRA MATERIALS/ATTIC STOCK

A. Furnish total sets of materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Touch-up Paint: Quantity of complete containers to be used by Owner to maintain corrodible surfaces after construction is completed
   a. Paint containers: One (1) for each system/equipment employed.

2. Mechanical Unit Belts: Three (3) complete sets of new spare belts for each unit affected.

3. Filters: Extra sets for each Bank of Filters furnished.
   a. Pre-Filters: Two (2) extra for each terminal, rounded to even Full-BOX quantity as commonly distributed.
   b. Final/After Filters: One (1) extra set for each Bank.

PART 2 - PRODUCTS

2.1 HIGH-EFFICIENCY ROOFTOP HVAC UNIT MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide High-Efficiency Packaged Rooftop HVAC Units by the following:

1. Carrier.
2. Daikin Applied.
3. Trane.
4. York.

2.2 MANUFACTURED UNITS

A. High-Efficiency Rooftop HVAC Units shall be factory assembled and consist of fans, motor and drive assemblies, coils, heat exchangers, dampers, plenums, filters, condensate pans, mixing dampers, full-perimeter pre-fabricated roof support curb (adapter-type) and accessories as specified herein/Related Sections and as noted on the layout drawings.
   1. High-Efficiency Rooftop HVAC Unit manufacturer shall fully-assemble and run-test entire unit prior to shipment.
      a. Refrigerant Circuit Run Test.
      b. Unit Controls Systems checkout.
      c. Refrigerant Leak Test.
   2. Configuration, as specified and described on the OPR drawings & selected for Application(s) noted:
      a. Outdoor.
      b. Packaged.
      c. Direct-Expansion Cooling.
      d. Electric Resistance/Heat Pump (option) Heating – as applicable.
      e. Return/Relief Fan.

2.3 CABINET

A. Materials: Formed and reinforced double-wall insulated panels, designed & fabricated to allow removal for access to internal parts and components, with joints between sections/panels sealed.

1. Unit Panel (Walls, Floors, Roof Partition) Assembly: nominal 2 inch thick (minimum), Thermal-break doublewall assembly, injected with foam insulation for minimum R-value of R-13 (wall), non-condensing on all surfaces for design stated.
2. Outer Panel – G-90 Galvanized Steel
3. Outer Panel Finish – Smooth, Pre-painted Enamel Finish (Std. color), meeting ASTM B117, 750 hours, capable of field-applied paint finish.
4. Inner Panel – 22 Ga. G-90 Solid Galvanized Steel.
5. Inner Panel Finish – Smooth Solid
6. Cabinet Pressure Design: 5.0 inches w.c.

B. Roof System: Sloped frame structure over unit roof partition panels, one-half inch overhang minimum.

C. Curb-Ready Rail: Entire unit shall have a full perimeter Curb-ready base rail for structural rigidity and condensate trapping. Provide the required height of the baserail to allow for adequate drainage.

D. Pre-Fabricated Roof Curb (Adapter-type): Provide full perimeter structural Roof Curb "Matched" & ready to receive base rail of unit. Provide a minimum height of 14 inches, or as required to result in OA intakes above the expected moisture intake limit and as required to allow required supply and return ductwork transitions to be field installed (to new duct systems as applicable).

E. Access Panels and Doors: Same materials and finishes as cabinet, complete with quick-release, full-height doors & non-corrosive hinges (no screwed in panels allowed), latches/handles, and continuous-perimeter corrosion-resistant compression gaskets. Inspection and access panels and doors shall be sized and located to allow periodic maintenance and inspections, without complete removal of the panels. Provide access panels and doors in the following locations:

1. Fan Section.
2. Coil/Heat Exchanger Sections.
3. Control Panel & Motor Control Sections.
4. Filter Section: Doors to allow periodic removal and installation of filters.

F. Condensate Drain Pans: Provide pans of non-corrosive materials complying with requirements found in ASHRAE 62. Fabricate pans with slopes in three planes to collect condensate from cooling coils (including coil piping connections) when units are operating at maximum catalogued face velocity across cooling coil.

1. Insulated Construction: Provide non-condensing construction and seal moisture tight.
2. Drain Connections: One end of pan, threaded.

2.4 FAN SECTIONS

A. Fan-Section Components: Double Width Double Inlet (DWDI) Belt-driven Steel blade or Single Width Single Inlet (SWSI) Direct-drive aluminum blade fans consisting of wheel, fan shaft, bearings, motor/drive assembly (conventional or ECM-type) and support structure and equipped with slide-out channel base for integral mounting of fan, motor, and access for fully safe servicing.

B. Fan Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower. Perform Trim Balance prior to unit being shipped from factory.
   1. Vibration Isolation: provide equivalent performance to 2" Spring isolation on each unit fan/assembly.

C. Modulation Control: Provide Supply fan capable of modulation from 30% to 100% of scheduled design airflow, without surge at any point of operation.

D. Fan-Section Source Quality Control:

   1. Sound Power Level Ratings: Fans shall bear AMCA-certified sound ratings seal.

2.5 MOTORS

A. General: Provide Unit-mounted/matched VFD or totally enclosed Electrically Commutated motor(s) (ECMs) that are speed controlled by Rooftop unit unitary controller. Include:
   1. Thermal Overload Protection.
   2. Phase Failure Protection.
   3. Shaft Grounding Rings.

B. Noise Rating: Quiet.

C. Efficiency Rating: Premium.

2.6 COILS

A. Coil Sections: Common or individual, insulated, galvanized-steel casings for heating and cooling coils. Design and construct to facilitate removal and replacement of coil for maintenance and to ensure full airflow through coils.

B. Refrigerant Coils: Main Cooling and Hot Gas Reheat Coils designed for use with specified compressor/condensing unit, fabricated according to AHRI 410, connected with brazed fittings.

   1. Tubes: Copper.
   2. Frames: Galvanized steel, channel frame.
   3. Configuration: Draw-thru.
   4. Main Cooling Rows: Minimum 3-rows, or as scheduled on drawings.
   5. Circuiting: multi-circuit interlaced.
   6. Control: Standard/Electronic-controlled Expansion Valve with Hot Gas Reheat System.
   7. Ratings: Design tested and rated according to ASHRAE 33 and ARI/AHRI 410.

C. Electric Resistance Coils: Provide open coil heater elements made of A-Grade resistance wire (80 percent nickel, 20 percent chromium). Include standard safety controls (automatic reset primary thermal cutout, differential pressure airflow switch secondary thermal cutout). Include standard operating controls for achieving Discharge Air Reset and Dehumidification-Reheat Sequences of Operation. Component configurations:
   1. Wire nuts and terminals: stainless steel.
   2. Insulators: high-temperature ceramic.
   3. Frames: Galvanized steel, channel frame.
   4. Ratings: Design tested and rated according to UL/ETL.
   5. Controls: multistage with SCR Vernier controller w/ contactors, fuses and transformers.

2.7 CONDENSING UNIT SECTION – AIR-COOLED

A. General: Provide condensing section open on the sides and bottom to provide access and to allow airflow through the coils. Condenser coils shall be all-aluminum Microchannel-type or multi-row coils fabricated from 3/8" high efficiency rifled copper tubing mechanically bonded to high efficiency aluminum fins. Each condenser coil shall be factory leak tested with high-pressure air under water. Each refrigerant circuit shall include a subcooling circuit to provide 15 degrees of liquid subcooling.

B. Condenser Fans: Provide Hi-efficiency PSC Motor or Electrically Commutated Motor (ECM), direct drive, propeller type fans designed for low tip speed (Low Sound Energy), vertical air discharge, and include service guards. Fan blades shall be constructed of composite material. Condenser fan motors shall be heavy-duty, inherently protected, three-phase, non-reversing type with permanently lubricated ball bearing and integral coated-steel guard.
   1. Provide Thermal Overload Protection.
   2. Provide Phase Failure Protection.

C. Temperature Operation: Units shall have condenser fans controlled to maintain positive head pressure. Integral controls shall allow the refrigeration system to operate at 25º F ambient.

D. Compressors: Each unit shall have multiple, R-410a (preferred), R-32, or R-454B heavy-duty scroll compressors. Each compressor shall be complete with gauge ports, suction and discharge service valves, crankcase heater, oil-level adjustment, anti-reversal protection, motor overload protection, high & low pressure limit controls, and a time delay to prevent short cycling and simultaneous starting of compressors following a power failure. Compressors shall be isolated with resilient rubber isolators to decrease noise transmission.

E. Refrigerant Circuiting: Each unit shall have multiple and easily serviceable independent refrigeration circuits designed for (VAV) Cooling and Dehumidification/Reheat Sequences noted and to operate compressor tandems efficiently and reliably.

F. Capacity Control: Refrigeration capacity control shall be accomplished by manufacturer-designed automatic staging of the unit's multiple compressors and use of Hot Gas Bypass circuiting as required to provide reliable compressor & discharge air temperature control at lower load conditions. All compressor capacity control staging shall be controlled by the factory installed main unit control system.
   1. Low Load Design Expectations: 20% of maximum cooling tonnage at 30% of maximum Supply Air volume.

2.8 DAMPERS/HOODS - ECONOMIZER

A. General: Damper leakage rate, according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating," shall not exceed 2 percent of air quantity at 2000-fpm face velocity through damper and 4-inch wg (1000-Pa) pressure differential. Refer to drawings for configuration of unit openings and damper locations.

B. Economizer Configuration: Parallel blade dampers with jamb seals for proper mixing and control/measurement of Outside Air, Return Air and Exhaust Air.
   1. Actuators for OA/RA: Modulating, spring-return, controlled by RTU packaged unit controller.
   2. Temperature Control: Comparative Enthalpy.
   3. Ventilation Control: Sub-Minimum setting with Demand-Controlled Sequence override and Building Pressure Sequence interlocks.
   4. Hood(s): Prepainted Steel to match unit finish, factory-mounted with bird screen and moisture eliminator/design for no-carryover inlet velocities.

2.9 FILTER SECTION

A. Filters: Comply with NFPA 90A.

B. Filter Section: Provide filter holding frames arranged for flat orientation, with access doors as shown on drawings.

C. PRE-Filters - Extended-Surface, Disposable Panel Filters: Factory-fabricated, dry, extended-surface filters with holding frames.

   1. Media: Fibrous material formed into deep-V-shaped pleats and held by self-supporting wire grid.
   2. Media and Media-Grid Frame**:** Nonflammable cardboard, Galvanized steel, or Fire-retardant, 3/4-inch (20-mm) particleboard with gaskets.
   3. Thickness: 2 inches.
   4. MERV Rating: 8.

D. AFTER-Filters - Extended-Surface, Disposable Panel Filters: Factory-fabricated, dry, extended-surface filters with holding frames, 4 inch deep.

   1. Media: Fibrous material formed into deep-V-shaped pleats and held by self-supporting wire grid.
   2. Media and Media-Grid Frame**:** Nonflammable cardboard, Galvanized steel, or Fire-retardant, 3/4-inch (20-mm) particleboard with gaskets.
   3. Thickness: 4 inches (min).
   4. MERV Rating: 13.

2.10 ENHANCED CONFIGURATIONS

A. Outside Air Inlet: Provide sections with Inlet Hoods to minimize inlet velocities.

1. Provide for Outdoor Airflow Measurement Device(s) at unit Inlet: to be utilized in Demand-Controlled Ventilation and Building Pressurization Control sequences.

B. Indoor Air Quality (IAQ) Systems: Provide unit-matched Utility Section with full size access doors for coordinated/designed systems to allow field/factory implementation of Ultraviolet C-spectrum devices as part of field-applied & engineered IAQ Systems installed within the Packaged RTU Units.
   1. Basic Project Parameters: The specified UV-C IAQ Systems are intended for dual-functions. Coil sanitizing UV-C systems are to be individually-engineered/selected for constant energy face-of-coil duty. Airstream sanitizing UV-C systems are expected to provide a 1 Log reduction of infectious particles at design air velocity with a minimum target dosage of 1,500 $\mu W \cdot s/cm^2$, according to current ASHRAE Recommendations/Standards. It is expected that the Proposer and RTU/UV-C Vendors design these dual-function UV-C systems and configurations appropriate for each application noted. Some unit applications may involve compromises on expected design parameters given limited available space in selected units. Significant deviations from having systems be properly installed within RTU cabinetry may be necessary to provide in-duct components of IAQ Systems. In-duct airstream disinfection is permissible only in exposed ductwork, accessible for maintenance. Any duct-airstream UV-C required due to in-unit dimensional limitations is expected to complement separate coil disinfection UV-C Systems and maintain the same schematic design requirements for safety and integration. All required In-duct UV-C IAQ applications require new duct-mounted maintenance/access doors to be installed with related safety interlocks as specified for In-Unit applications. All outdoor installations are to use appropriate weather and exposure rated materials.

2.11 AUXILLIARY ELECTRICAL COMPONENTS

A. Provide GFCI receptacle in Fan/Control section. Factory wire devices to a junction box and on-off switch mounted on the outside of the cabinet for each specified electrical device. Final Main Unit connections are provided by field electrician.

2.12 CONTROLS

A. Manufacturer must provide a stand-alone programmable digital control system for complete temperature & humidity control of the delivered supply air and relative building pressure. The manufacturer will provide a standard sequence of operation for the type of equipment provided per this specification. The controller will be manufacturer-programmed to control:
   1. Supply Air temperature.
   2. Supply Air Volume/(duct pressure).
   3. Ventilation Air volumes.
   4. Zone Building Pressure (Relative Local).
   5. Zone temperature – only as specifically noted beyond Air Terminal Controls.
   6. Zone/Area humidity.
   7. Monitoring & Alarms:
      a. Return Air Temperature & Humidity.
      b. Unit/Setpoint Faults.
      c. Smoke Detectors
      d. Filter Bank Pressure Drops.

B. STAND ALONE DDC CONTROLLER**.** Controller shall be provided with required sensors and custom programming for the specified VAV configurations (air handling unit, duct pressure/fan speed, discharge air temperature, etc.). Controller shall be factory programmed, mounted, and tested. Controller shall have a user terminal with LCD readout for changing set points and monitoring unit operation. Functional capabilities for the unitary DDC controller shall include, but not be limited to, the following:

1. Mixing Box Damper Modulation, based on Supply Air/Zone Temperature.
2. Cooling Modulation, based on Supply Air/Zone Temperature.
   a. As applicable: HGRH for Zone Humidity/Zone Dewpoint Temperature.
3. Economizer with applicable lockout control & related Enhanced Sequences specified.
   a. Building Pressure Control/Airflow Monitoring Station integrations.
   b. Demand Controlled Ventilation routines.
4. Occupied/Unoccupied Mode control.
5. Fan Enable/Disable.
6. Fan(s) Speed VFD/ECM control.
7. Indoor Air Quality Systems Integrations.
   a. UV-C Sanitizing and Coil Cleaning Stations.
8. Remote Control Interface/Integration: BacNet™
9. Filter Pressure Drop – analog for each bank utilized.
10. Alarms.
11. Smoke Detection input (redundant to Fire Alarm System).
12. Data Tracking – provide Controller collection and storage of applicable operating parameters for a minimum period of 30 days to be used for systems management & troubleshooting.

C. SEQUENCES OF OPERATION: The Stand-alone DDC controller shall perform the following basic control sequences employing the applicable ASHRAE Guideline 36 Trim & Respond methods (Optimizations, Resets, Fault Detection, Alarm Suppression routines, etc.):
1. Unit OCCUPIED Command
   a. Outside air/Mixing Box damper actuators are powered.
   b. DDC controller confirms damper end switch status.
   c. Supply fan starts after damper is open (minimum of 120sec delay, adjustable).
   d. Heating, cooling, economizer operation per below.
2. Unit UNOCCUPIED Command
   a. Supply fan is de-energized.
   b. Outside air damper actuator is de-energized, dampers spring return closed.
   c. Dampers are closed after the fans are de-energized.
3. OCCUPIED Mode – Base (Opposite for UNOCCUPIED Mode)
   a. Supply fan ON, Relief/Return Fan ON/Ready.
      1) VAV Control sequence to meet Supply Air Temperature Control w/ Reset, Optimizations & Limits, Duct Static Pressure w/ Reset, Optimization & Limits, Ventilation Air Setpoints and Building Pressure balance.
   b. OAD is open to sub-minimum, executing Demand-Controlled Ventilation as required (minimum, then increase on CO2 sensor).
   c. UNOCCUPIED DEHUMIDIFICATION Mode: On a call for dehumidification (room %RH – differential, 70%RH-5%RH=65%RH) supply fan cycles on, and the cooling decreasing the Zone-Area %RH. Unit cycles off when room humidity reaches the unoccupied set point 50%RH, adjustable)
4. Re-Heating Mode:

a. Lockout: The heating will be locked out when the outside air is > 70ºF + 2ºF hysteresis, adjustable
b. Heat Stage 1: The heating (HGRH Option) is controlled to maintain the Discharge supply temperature set point (Dehumidifcation mode Reheat).
c. Heat Stage 2: The Heating Section is controlled to maintain the Discharge supply temperature set point.

5. Cooling Mode
   a. Lockout: The cooling will be locked out when the outside air is < 55ºF - 2ºF hysteresis, adjustable
   b. Temperature Control: The cooling is controlled to maintain the supply temperature set point
   c. Dehumidification Control: The cooling/hot gas reheat coil is controlled to maintain the supply dew point temperature set point.
6. Safeties
   a. SAFETIES:
      1) (OA PRE-FILTER) DIRTY FILTER SWITCHES. If the outside air or return air filter differential pressure rises above the switch set point (adj.), the differential pressure switch shall signal the DDC to activate an alarm
      2) SUPPLY DISCHARGE LOW LIMIT. If the supply discharge temperature drops below 40°F (adjustable), the DDC shall de-energize the unit after a preset time delay
      3) HIGH DUCT STATIC PRESSURE. If the supply duct differential pressure rises above the switch set point (4" w.c., adj.), the differential pressure switch shall signal the DDC to de-energize the unit
      4) LOW DUCT STATIC PRESSURE. If the return duct differential pressure falls below the switch set point (-4" w.c., adj.), the differential pressure switch shall signal the DDC to de-energize the unit
      5) ALARM INDICATION. DDC shall have one digital output for remote indication of an alarm condition. (i.e. Blower current/differential pressure switch, damper end switches, freeze stat, fire stat, smoke, dirty filters…)

2.13 ACCESSORIES (refer to & coordinate w/ published information on Selected Equipment)

A. Provide the following accessories for High-Efficiency Rooftop HVAC Units:
   1. Non-fused Disconnect Switch.
   2. Full Hail Guard protection for exposed Condenser Coils.
   3. Full-coverage insulated pan below unit for horizontal discharge configurations.
   4. Provisions for Outdoor Air Measurement System as part of Demand Controlled Ventilation and Building Pressurization Control sequences (DCV/BPC) – field/factory-installed as applicable.
   5. Provisions for Indoor Air Quality Systems as part of required coil cleaning/air sanitizing UV-C Lighting Systems – field/factory-installed as applicable.
   6. Carbon Dioxide Sensor (DCV) – field-installed as applicable.
   7. Return Air Smoke Detector(s) – field-installed as applicable.
   8. Building Pressure/Space Static Pressure Sensor(s) – field-installed as applicable.
   9. Pre-fabricated Roof Curb (Adapter-type) – minimum to provide 16 inches clear above roof surface & required clearances for Outdoor Air Intakes and as required to allow required sound attenuation systems & supply and return ductwork transitions to be field installed.

PART 3 - EXECUTION

3.1 INSTALLATION (Instructions for Installing Contractors with full Vendor-based Coordination)

A. General: Proposers are responsible for field-verifying all existing conditions for how they may impact/relate to providing the new Scopes of Work. No post-proposal compensation is expected to cover costs of reasonably-accessible and known existing conditions.
   1. Make provisions to properly coordinate HVAC Units/piping and Electrical Power and make safe for installation/set of the new equipment. Determine exact locations for ductwork, piping and electrical connections before final rigging scope.

B. Install High-Efficiency Rooftop HVAC Units with the appropriate curb-based sound attenuation materials and vibration devices as applicable for the application (multi layers of dense board and top layer of batt insulation).

C. Arrange installation of units to provide access space around High-Efficiency Rooftop HVAC Units for service and maintenance and to avoid proximity to proximate HVAC & Plumbing System Vents.

D. Install High-Efficiency Rooftop HVAC Units on equipment supports or pre-fabricated roof curbs as specified.
   1. Install Curbs per manufacturer's instructions/recommendations for the application.
   2. Complete preparations of existing roof decks and roofs to properly accept new equipment, piping and ductwork systems.
   3. Install Sound-dampening materials in base of pre-fabricated roof curbs prior to setting of unit: full cavity coverage - two layers of thin dense absorbing material and one thicker layer of less-dense absorbing material.

3.2 CONNECTIONS

A. Piping connections noted on the Drawings which indicate general arrangement of piping, fittings, and specialties – all to be field-verified prior to actual final design & installations.
   1. Coordinate proper & safe custom installations of IAQ Systems within the RTU Cabinetry (Electrical power, equipment and controls).

B. Install and properly label piping/IAQ Equipment within/adjacent to equipment to allow safe service and maintenance.

C. Complete installation of all drain pan piping, with traps per manufacturer's recommendations.

D. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections per manufacturer's requirements and with proper flexible connections, duct-width stiffeners and indoor/outdoor insulation & jacketing systems (Interior/Exterior).

E. Electrical: Connect Power and Controls wiring according to manufacturer's documented instructions and applicable/Overall specification means and methods.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage Vendor-provided factory-authorized service representative to inspect field-assembled components and equipment installation, including external piping and electrical connections.

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 STARTUP SERVICE

A. Engage Vendor-provided factory-authorized service representative to perform startup service as per manufacturer's instructions and recommendations. Coordinate activities with Owner's Commissioning Services provider.
1. Complete installation and startup checks according to manufacturer's written instructions and do the following, as a minimum:
   a. Notify Owner's personnel of scheduled Check-Test-Start activities and allow personnel to witness all procedures.
   b. Verify that inlet duct connections are as recommended by High-Efficiency Rooftop HVAC Unit manufacturer to achieve proper performance.
   c. Verify that condensing sections are properly installed and charged with refrigerant.
   d. Verify that temperature-humidity-pressure controls/IAQ Systems and control enclosures are accessible.
   e. Verify that temperature-humidity-pressure control/IAQ Systems connections are complete & all factory-programmed/(field adjusted) unitary-based VAV sequences are met.
   f. Verify that nameplate and identification tag are visible.
   g. Verify that controls respond to inputs as specified – coordinate directly with Owner's Master Systems Integrator/Commissioning Services Provider.

B. Document installation and startup checks according to manufacturer's written instructions.

C. Provide basic RTU System Testing, Measuring & Adjusting/Balancing services to assure installed components deliver expected performance results; with documentation accompanying As-Builts. Refer to Overall Specification Section - Testing, Adjusting, and Balancing for High-Efficiency Rooftop HVAC Unit testing, adjusting, and balancing.
1. The Intent for this function is to assure Owner that the controls & new RTUs VAV Systems (new HVAC RTUs) are capable of delivering the expected Sequences and Airflows to the existing spaces being served/constructed: It is intended for Installing Contractor to Test, Adjust & Balance the overall RTU System components for airflow/control performance.

3.5 CLEANING

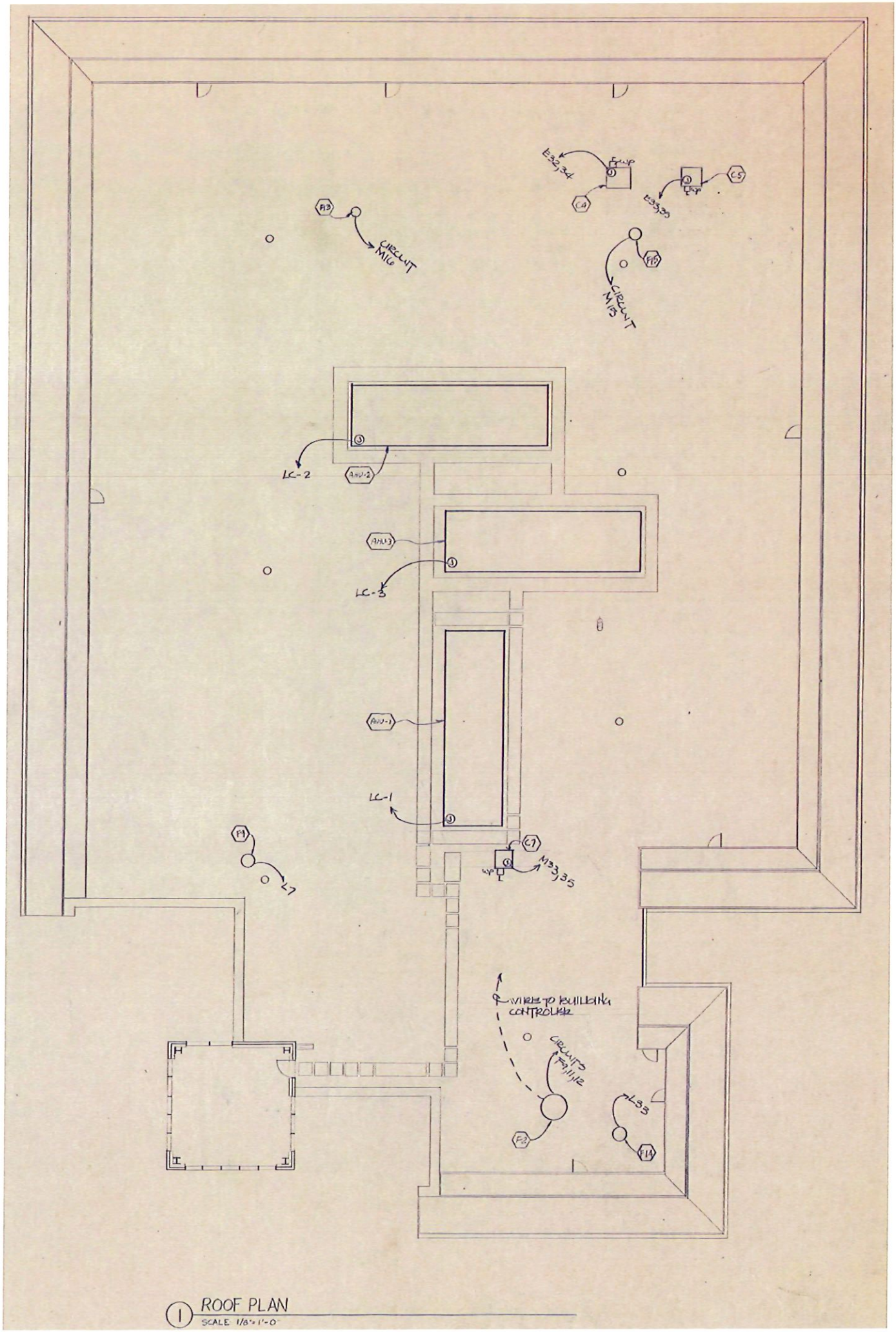
A. Clean High-Efficiency Rooftop HVAC Units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.

B. After completing system installation and testing, adjusting, and balancing High-Efficiency Rooftop HVAC Units, IAQ Systems and air-distribution systems, clean filter housings and install new filters.

3.6 DEMONSTRATION

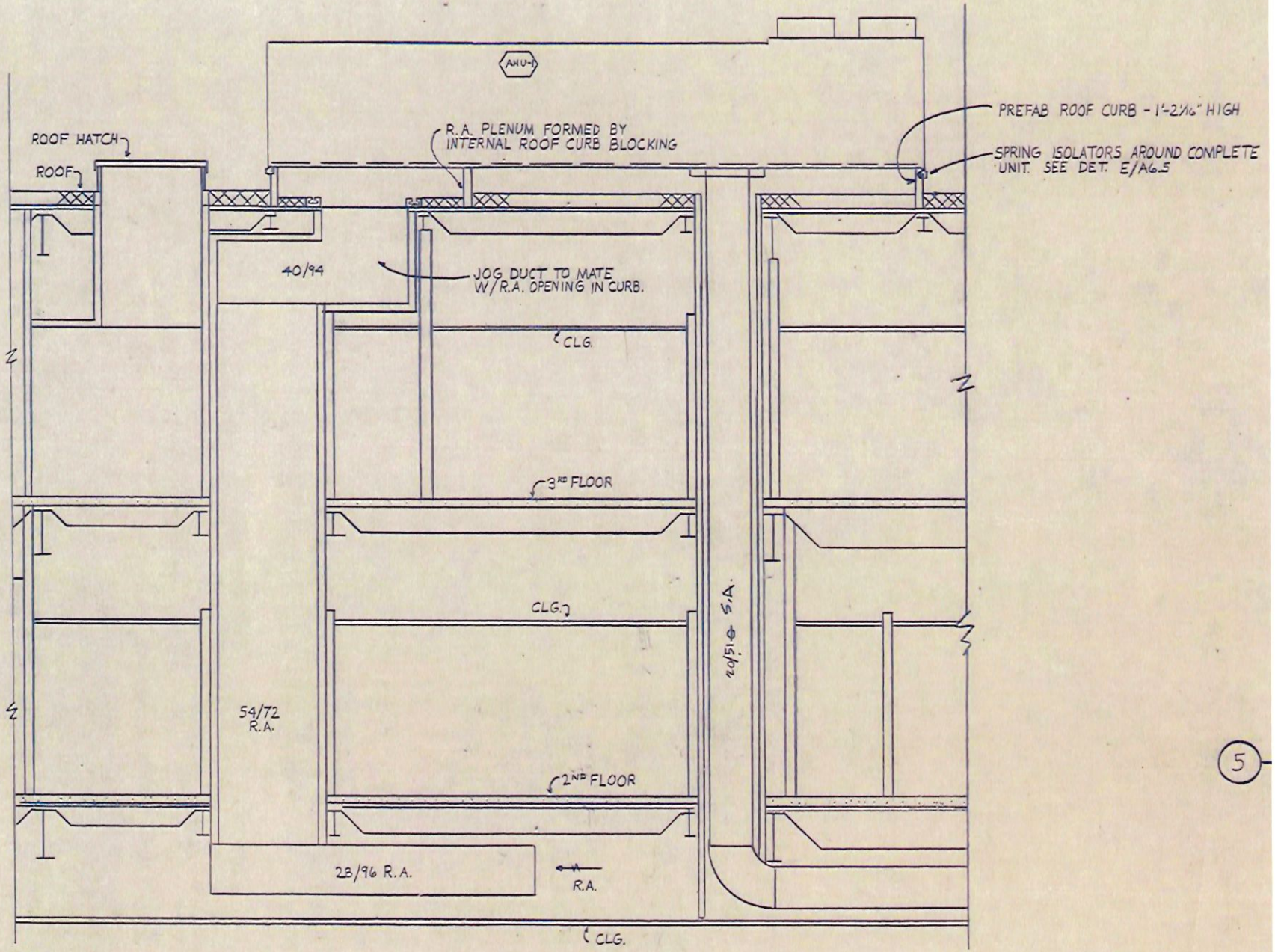
A. Engage Vendor-provided factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain High-Efficiency Rooftop HVAC Units. Coordinate activities with Owner’s Commissioning Services provider.
   1. Document Training procedures completed.
   2. Document Start-up & Coordinate Commissioning activities with Owner’s Master Systems Integrator/Commissioning Services Provider.
   3. Document Warranty Contacts, Provisions & Responsibilities.
   4. Document Warranty-Period/Termed Maintenance Provisions & Responsibilities – as applicable.

END OF SECTION 237319



1 ROOF PLAN

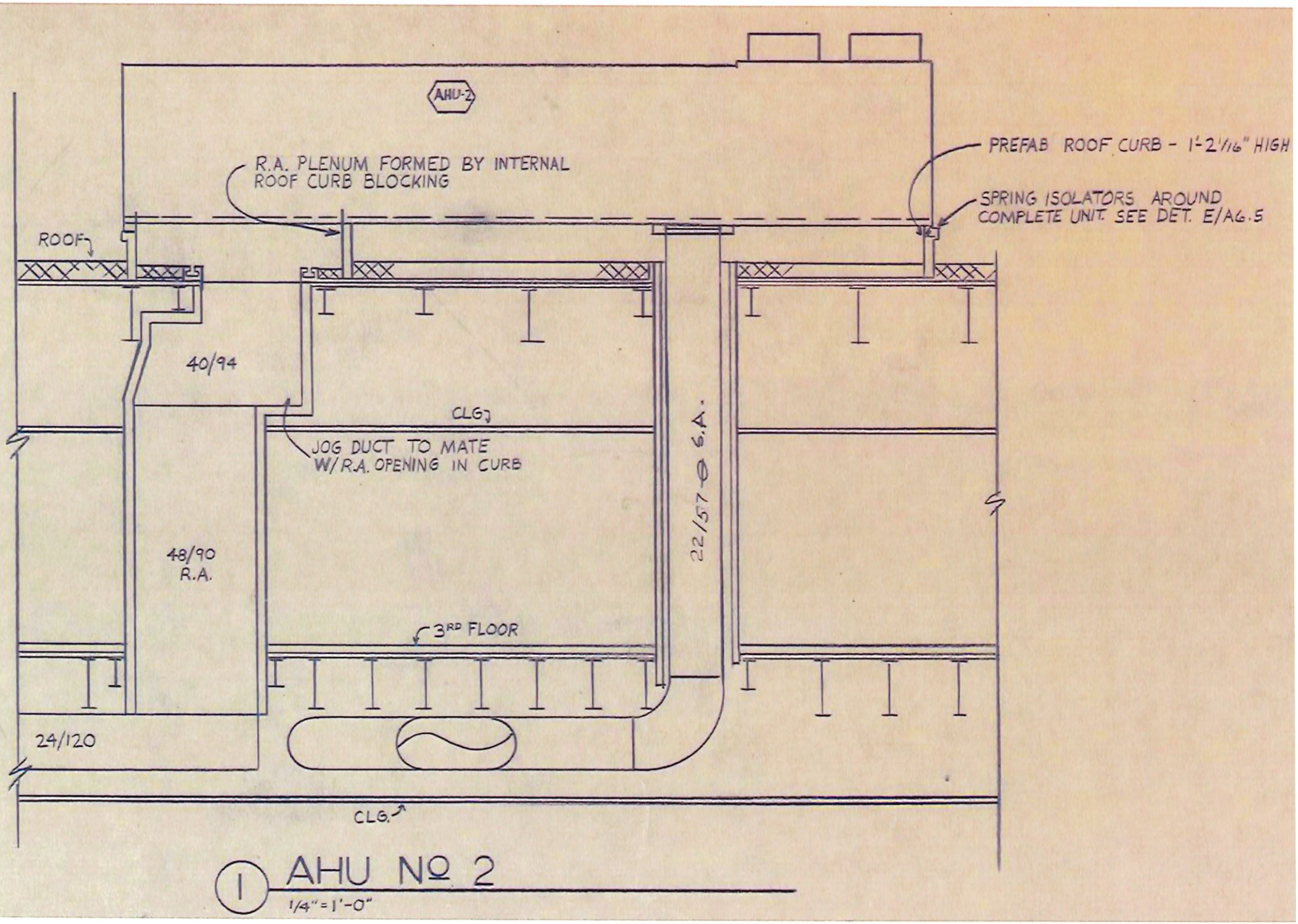
SCALE 1/8"=1'-0"



7 AHU Nº 1

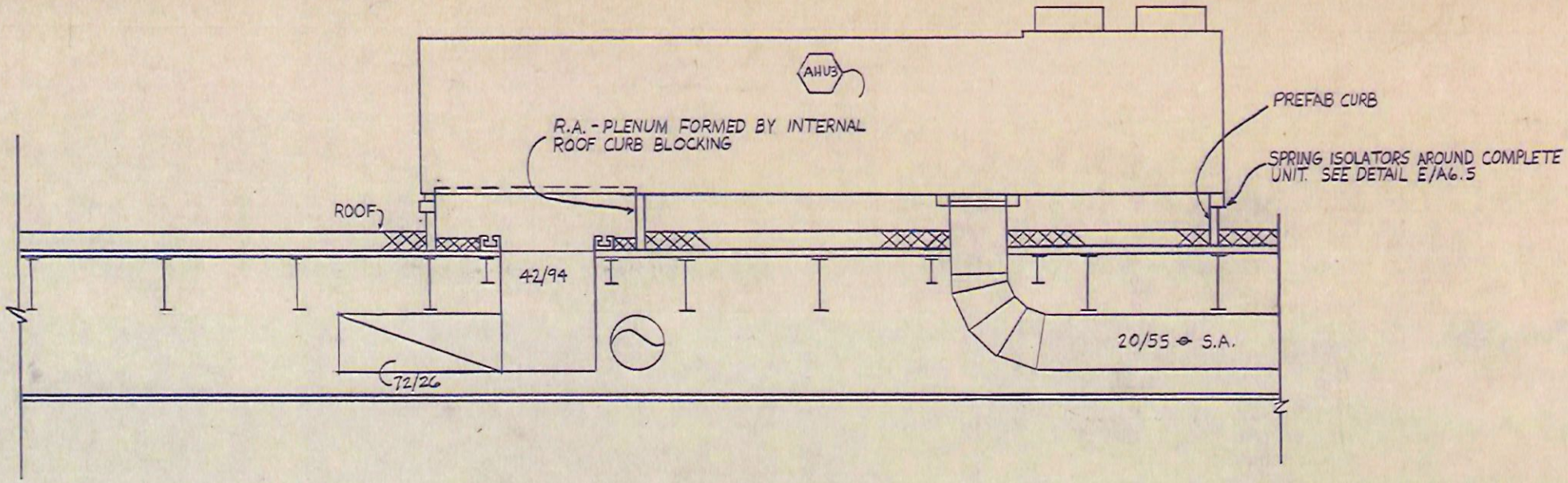
1/4" = 1'-0"

5



1 AHU NO 2

1/4" = 1'-0"



(4) AHU Nº 3

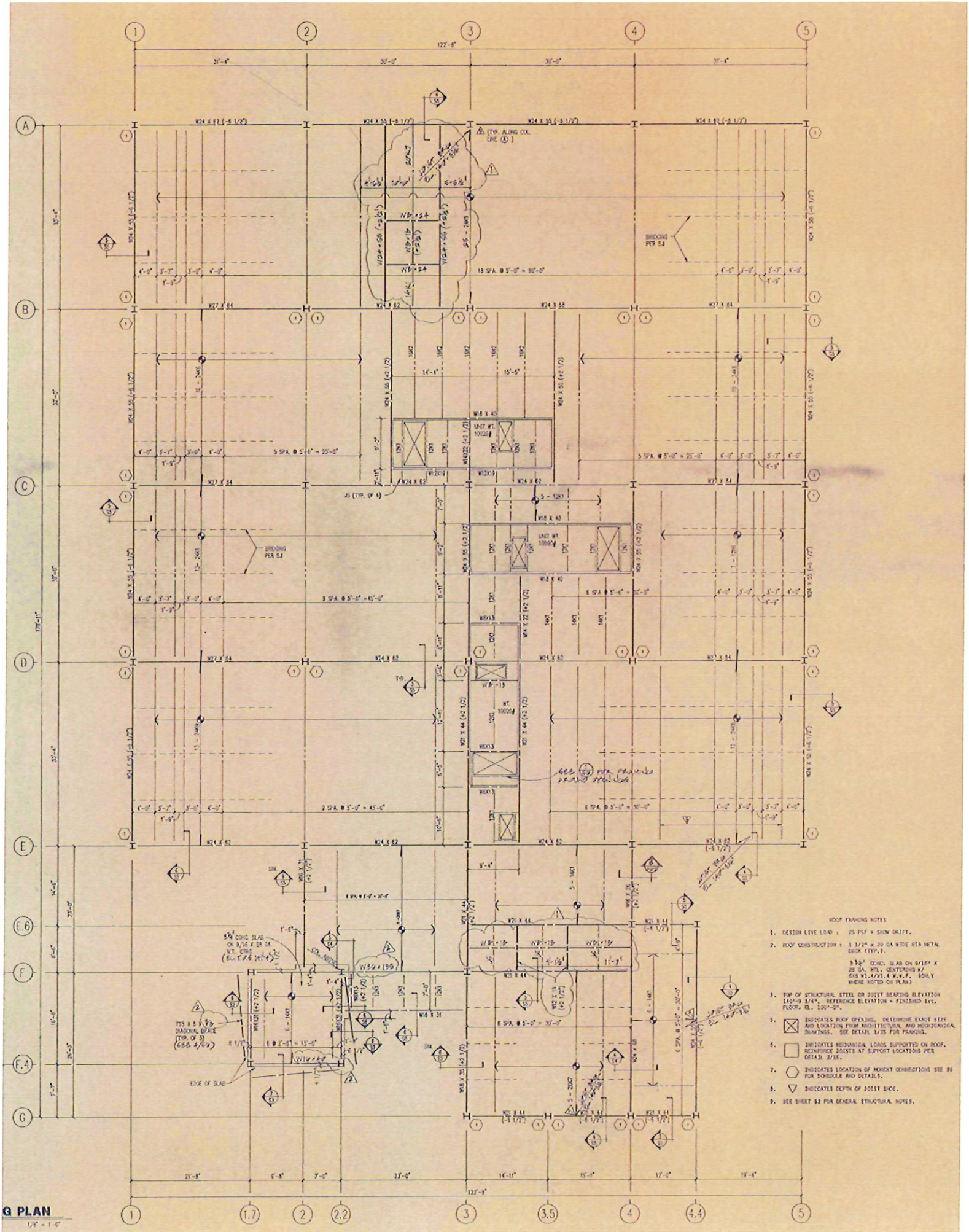
1/4" = 1'-0"

MECHANICAL EQUIPMENT LIST

AHU 1 TRANE NO. SEHCC754, 905.6 MBH T.C.- 730.5 MBH S.C. AT 95-78/67 DEG. F., HIGH CAPACITY COOLING COIL, 22250 CFM AT 3.50" TSP, 30 HP SUPPLY AIR FAN, 10 HP EXHAUST MOTOR, 90 KW HEATING COIL, 480V-3PH, WITH INLET VANES, HIGH CAP THROWAWAY FILTER, STARTER, DISCONNECT SWITCH, ECONOMIZER CONTROL AND PREFAB ROOF CURB.

AHU 2 TRANE NO. SEHCC754, 918.4 MBH T.C.- 757.8 MBH S.C. AT 95-78/65 DEG. F., HIGH CAPACITY COOLING COIL, 26250 CFM AT 3.78" TSP, 40 HP SUPPLY AIR FAN, 15 HP EXHAUST MOTOR, 90 KW HEATING COIL, 480-3PH, WITH INLET VANES, HIGH CAP THROWAWAY FILTER, STARTER, DISCONNECT SWITCH, ECONOMIZER CONTROL AND PREFAB ROOF CURB.

AHU 3 TRANE NO. SEHCC754, 905.6 MBH T.C.- 730.5 MBH S.C. AT 95-78/65 DEG. F., HIGH CAPACITY COOLING COIL, 23150 CFM AT 3.78" TSP, 40 HP SUPPLY AIR FAN, 10 HP EXHAUST MOTOR, 90 KW HEATING COIL, 480V-3PH, WITH INLET VANES, HIGH CAP THROWAWAY FILTER, STARTER, DISCONNECT SWITCH, ECONOMIZER CONTROL AND PREFAB ROOF CURB.


ROOF FRAMING NOTES
1. DESIGN LIVE LOAD : 25 PSF + SNOW DRIFT.
2. ROOF CONSTRUCTION : 1 1/2" x 20 GA WIDE RIB METAL DECK (TYP.).
3 1/2" CONC. SLAB ON 9/16" x 20 GA. WIRL. CENTERING W/ 6X6 W1.4/W1.4 W.W.F. (ONLY WHERE NOTED ON PLAN)
3. TOP OF STRUCTURAL STEEL OR JOIST BEARING ELEVATION 140'-0 3/4". REFERENCE ELEVATION = FINISHED FLOOR EL. 100'-0".
5. INDICATES ROOF OPENING. DETERMINE EXACT SIZE AND LOCATION FROM ARCHITECTURAL AND MECHANICAL DRAWINGS. SEE DETAIL 1/S5 FOR FRAMING.
6. INDICATES MECHANICAL LOADS SUPPORTED ON ROOF. REINFORCE JOISTS AT SUPPORT LOCATIONS PER DETAIL 2/S5.
7. INDICATES LOCATION OF MOMENT CONNECTIONS SEE S6 FOR SCHEDULE AND DETAILS.
8. INDICATES DEPTH OF JOIST SHOE.
9. SEE SHEET S2 FOR GENERAL STRUCTURAL NOTES.
G PLAN
1/8" = 1'-0"

THE TRANE COMPANY
A DIVISION OF AMERICAN STANDARD INC.

INTELLIFAN®

MODEL NUMBER **SEHFF754NA66C8AD7001A0WE0G00L00RT0Y8000#**

SERIAL NUMBER **C07H08835**

LISTED
AIR CONDITIONING
SYSTEM EQUIPMENT
SELF – CONTAINED UNIT
59R9

RATED VOLTAGE 460	HZ 60	PHASE 3		
UTILIZATION VOLTAGE RANGE	414 – 506			
NOMINAL SYSTEM VOLTAGES	440 – 460 – 480			

	CIRCUIT – 1	CIRCUIT – 2	CIRCUIT – 3	
MINIMUM CIRCUIT AMPACITY	200			AMPS
RECOMMENDED DUAL ELEMENT FUSE	225			AMPS
MAXIMUM OVERCURRENT PROTECTION DEVICE	225			AMPS

	QTY	VOLTS	HZ	PHASE	RLA EA	LRA EA
COMPRESSOR MOTOR A	2	460	60	3	18.2	117
COMPRESSOR MOTOR B	2	460	60	3	18.2	117
COMPRESSOR MOTOR C	2	460	60	3	27.3	178
COMPRESSOR MOTOR D	– 0 –					

	QTY	VOLTS	HZ	PHASE	FLA EA	HP EA
CONDENSER FAN MOTOR	6	460	60	3	1.8	1.00
EVAPORATOR FAN MOTOR	1	460	60	3	37.5	30.0
EXHAUST FAN MOTOR	1	460	60	3	13.2	10.0
BURNER MOTOR	– 0 –					– 0 –
ELECTRIC HEATER CKT	1	480	60	3	90	KW
EVAPORATOR HEAT TAPE		– 0 –				VA
UNIT CONTROL CIRCUIT		460	60	1	2	VA

	CKT 1	CKT 2		
FACTORY CHARGED – EACH SYSTEM	81	81	LBS OF	R – 22

DESIGN PRESSURE	450	PSIG	TEST PRESSURE	HIGH (PSIG) 450 / LOW (PSIG) 300

FOR NONRESIDENTIAL INSTALLATION ONLY

THIS UNIT COMPLIES WITH THE
ENERGY EFFICIENCY RATINGS OF ASHRAE 90.1

MANUALS	RT – SVX10E – E	RT – SVP02A – E		
UNIT WIRING DIAGRAMS	2309 – 3357 – 01 2307 – 3892 – 01 2309 – 3064 – 01	2307 – [illegible] – 01 [illegible] – 3894 – 01 [illegible] – 8933 – 01	2309 – 3017 – 01 2307 – 4526 – 01 2307 – 2172 – 01	2307 – 4524 – 01 2309 – 3035 – 01 2309 – 3199 – 01

PAD ASSEMBLED IN U.S.A. X39630365-01

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STORED VO
DRIVE, REF
CAPACITOR
FAILURE T
DEATH OR

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A DIVISION OF AMERICAN STANDARD INC.

INTELLIPAK®

MODEL NUMBER **SEHFF754NA66C8AD7001A0WE0G00L00RT0Y8000#**

SERIAL NUMBER **C07H08834**

LISTED
AIR CONDITIONING
SYSTEM EQUIPMENT
SELF – CONTAINED UNIT
59R9

RATED VOLTAGE 460	HZ 60	PHASE 3		
UTILIZATION VOLTAGE RANGE	414 – 506			
NOMINAL SYSTEM VOLTAGES	440 – 460 – 480			

	CIRCUIT – 1	CIRCUIT – 2	CIRCUIT – 3	
MINIMUM CIRCUIT AMPACITY	200			AMPS
RECOMMENDED DUAL ELEMENT FUSE	225			AMPS
MAXIMUM OVERCURRENT PROTECTION DEVICE	225			AMPS

	QTY	VOLTS	HZ	PHASE	RLA EA	LRA EA
COMPRESSOR MOTOR A	2	460	60	3	18.2	117
COMPRESSOR MOTOR B	2	460	60	3	18.2	117
COMPRESSOR MOTOR C	2	460	60	3	27.3	178
COMPRESSOR MOTOR D	– 0 –					

	QTY	VOLTS	HZ	PHASE	FLA EA	HP EA
CONDENSER FAN MOTOR	6	460	60	3	1.8	1.00
EVAPORATOR FAN MOTOR	1	460	60	3	37.5	30.0
EXHAUST FAN MOTOR	1	460	60	3	13.2	10.0
BURNER MOTOR	– 0 –					– 0 –
ELECTRIC HEATER CKT	1	480	60	3	90	KW
EVAPORATOR HEAT TAPE		– 0 –				VA
UNIT CONTROL CIRCUIT		460	60	1	2	VA

	CKT 1	CKT 2	
FACTORY CHARGED – EACH SYSTEM	81	81	LBS OF R – 22

		HIGH (PSIG)	LOW (PSIG)
DESIGN PRESSURE 450 PSIG	TEST PRESSURE	450	300

FOR NONRESIDENTIAL INSTALLATION ONLY

THIS UNIT COMPLIES WITH THE
ENERGY EFFICIENCY RATINGS OF ASHRAE 90.1

MANUALS	RT – SVX10E – E		RT – SVP02A – E	
UNIT WIRING DIAGRAMS	2309 – 3357 – 01 2307 – 3892 – 01 2309 – 3064 – 01	2307 – 4505 – 01 2307 – 3894 – 01 2306 – 8933 – 01	2309 – 3017 – 01 2307 – 4526 – 01 2307 – 2172 – 01	2307 – 4524 – 01 2309 – 3035 – 01 2309 – 3199 – 01

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ASSEMBLED IN U.S.A.

X39630365-01

THE TRANE COMPANY
A DIVISION OF AMERICAN STANDARD INC.

INTELLIPAK®

MODEL NUMBER SEHFF754NA66C8AD7001A0WE0G00L00RT0Y8000#

SERIAL NUMBER C07H08833

LISTED
AIR CONDITIONING
SYSTEM EQUIPMENT
SELF – CONTAINED UNIT
59R9

RATED VOLTAGE 460	HZ 60	PHASE 3	
UTILIZATION VOLTAGE RANGE	414 – 506		
NOMINAL SYSTEM VOLTAGES	440 – 460 – 480		

	CIRCUIT – 1	CIRCUIT – 2	CIRCUIT – 3	
MINIMUM CIRCUIT AMPACITY	200			AMPS
RECOMMENDED DUAL ELEMENT FUSE	225			AMPS
MAXIMUM OVERCURRENT PROTECTION DEVICE	225			AMPS

	QTY	VOLTS	HZ	PHASE	RLA EA	LRA EA
COMPRESSOR MOTOR A	2	460	60	3	18.2	117
COMPRESSOR MOTOR B	2	460	60	3	18.2	117
COMPRESSOR MOTOR C	2	460	60	3	27.3	178
COMPRESSOR MOTOR D	– 0 –					

	QTY	VOLTS	HZ	PHASE	FLA EA	HP EA
CONDENSER FAN MOTOR	6	460	60	3	1.8	1.00
EVAPORATOR FAN MOTOR	1	460	60	3	37.5	30.0
EXHAUST FAN MOTOR	1	460	60	3	13.2	10.0
BURNER MOTOR	– 0 –					– 0 –
ELECTRIC HEATER CKT	1	480	60	3	90	KW
EVAPORATOR HEAT TAPE		– 0 –				VA
UNIT CONTROL CIRCUIT		460	60	1	2	VA

	CKT 1	CKT 2	
FACTORY CHARGED – EACH SYSTEM	81	81	LBS OF R – 22

DESIGN PRESSURE	450 PSIG	TEST PRESSURE	HIGH (PSIG) 450	LOW (PSIG) 300

FOR NONRESIDENTIAL INSTALLATION ONLY

THIS UNIT COMPLIES WITH THE
ENERGY EFFICIENCY RATINGS OF ASHRAE 90.1

MANUALS	RT – SVX10E – E		RT – SVP02A – E	
UNIT WIRING DIAGRAMS	2309 – 3357 – 01 2307 – 3892 – 01 2309 – 3064 – 01	2307 – 4505 – 01 2307 – 3894 – 01 2306 – 8933 – 01	2309 – 3017 – 01 2307 – 4526 – 01 2307 – 2172 – 01	2307 – 4524 – 01 2309 – 3035 – 01 2309 – 3199 – 01