ADDENDUM #1

DATE: Sept. 25, 2014

PROJECT: Rome-Floyd Health Dept. HVAC Upgrades

OWNER: Floyd County, GA

ENGINEER: Drinkard Engineering Group, Inc.

TO: All Bidders

This Addendum forms a part of the Contract Documents and modifies the Bidding Documents, with amendments and additions noted below.

Acknowledge receipt of this Addendum on the Bid Form. Failure to do so may disqualify the Bidder.

CHANGES TO BID PACKET

1. Replace Section 15620 – Air Cooled Chillers with new Section 15620 attached. The original specification was for a scroll type chiller, the new matches the plans in calling for a screw type chiller.
2. Add Section 15720 – Central Station Air Handlers for RTU-1.
3. Add Section 15722 – HVAC Coils for the new chilled water coils for ERU-1 and ERU-2.

ANSWERS TO QUESTIONS

1. Drawing M0-1 Mini-Split Heat Pump Schedule mentions the Basis of Design is CARRIER but the mechanical equipment schedule shows MITSUBISH. Please provide clarification as to what system is the correct basis of design. BASIS OF DESIGN IS MITSUBISHI. EQUALS BY TRANE AND DAIKIN ARE ALLOWED.

2. Drawing M0-1 General Scope of Work note 7 calls for one (1) new PIU and the Parallel Fan Powered PIU Schedule shows two (2) [PIUs 2-A13 and PIU 2-B9]. Please provide clarification as to which is correct. THERE ARE TWO NEW PIUS.

3. Drawing M0-2 indicates New Chilled Water Coil for ERU-1 & ERU-2 by SEMCO; is SEMCO responsible to provide the coils size to fit within the existing equipment ERU-1? a. If not, and coil replacement needs access by removing one side of the mechanical room wall or dismantling existing equipment, is the potential additional cost to the contractor to be included in the project cost? CONTRACTOR SHOULD ASSUME ALL COSTS FOR REMOVING ENOUGH WALL TO INSTALL AND COMMISSION NEW COIL AND RESTORING WALL TO LIKE NEW.

4. Drawing M0-2 Fan schedule Basis of Design calls for Greenheck, can alternative manufacture(s) be considered if the performance specification are met. BASIS OF DESIGN IS GREENHECK. EQUALS BY COOK AND PENBARRY ARE ALLOWED.

5. Drawing M0-4 Chilled water piping schematic indicates chilled water pump piped to each chiller. Below the schematic there is a note that states “Pumps onboard chillers” There is no equipment

schedule for these pumps or location provide on documents, please provide this information. SEE CHILLER SCHEDULE. THE PUMPS ARE PROVIDED BY THE CHILLER MANUFACTURER ON BOARD THE CHILLERS.

6. Drawing M0-4 CHW Piping Diagram shows an Expansion tank, Air Separator and Chemical Feeder, there is no schedule for those items. Please provide the performance criteria for those items. WILL PROVIDE SPECIFICATIONS IN A SUBSEQUENT ADDENDUM.

7. Drawings and the scope of work requests for a waterside test and balancing to be performed on ERU-1, ERU-2 and all terminal units. However, we did not find any balancing valve(s) on the drawing M0-4 CHW piping Diagram. Please provide clarification. BALANCING VALVES ARE TO BE INSTALLED ON CHILLED WATER COILS FOR ERU-1, ERU-2, AND RTU-1 (ITEM #3 ON DETAIL).

8. During the HVAC equipment replacement, the bldg. air condition will not be available, what provision has the owner made, use of OA? Please advise. WILL ANSWER IN A SUBSEQUENT ADDENDUM.

9. Mechanical drawings M-03 and M4-3 show new duct smoke detectors in the ductwork for the air handlers. The electrical drawings E1-0 thru E3-0 do not show any type of fire alarm devices and or notes addressing the new F/A devices in the ductwork. Will owner F/A provider be performing this works or contractor? a. Please provide drawing showing the schematic of the new F/A devices (Duct Smoke Defectors), and panel to which they will be wired to. b. Will the contractor be responsible for re- programing the existing F/A panel(s) or is this work by the Owner? c. If this work is by contractor, does the bldg. owner require a specific F/A Vendor/Contractor to this work? If so, please provide contact info. WILL ANSWER IN A SUBSEQUENT ADDENDUM.

10. During construction will the bldg. utilities be available to the contractor? WILL ANSWER IN A SUBSEQUENT ADDENDUM.

11. Does the owner have a roof warranty in place at this time? Who provides service for this warranty? WILL ANSWER IN A SUBSEQUENT ADDENDUM.

12. Please provide detail of rupture HP truck. THE EXISTING TRUNK DUCT FOR ERU-1 ABOVE CEILING ON THE LOWER FLOOR IS RUPTURED DUE TO AN OVER-PRESSURE ISSUE IN THE PAST. THIS RUPTURED DUCT WORK IS BEING REPLACED PER M1-1.

13. Drawing M3-1 note indicate existing equipment being removed is turned over to owner. Will owner pick-up this equipment from site or should contractor include transportation cost to owner's storage site, please provide address of owner storage site. ALL EQUIPMENT BEING REMOVED BECOMES THE PROPERTY OF THE CONTRACTOR AND SHOULD BE REMOVED FROM THE SITE.

END OF DOCUMENT

SECTION 15620 - AIR-COOLED SCREW CHILLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Chiller package.

B. Charge of refrigerant and oil.

C. Controls and control connections.

D. Chilled water connections.

E. Starters.

F. Electrical power connections.

1.2 REFERENCES

A. ANSI/AHRI 550/590-2003 - Standard for Water Chilling Packages using the Vapor Compression Cycle

B. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration

C. ANSI/ASHRAE 90.1 - Energy Efficient Design of New Buildings

D. ANSI/ASME SEC 8 - Boiler and Pressure Vessel Code

E. ANSI/NEMA MG 1 - Motors and Generators

F. ANSI/UL 1995 - Central Cooling Air Conditioners.

G. ANSI/UL 984 - Safety Standard for Hermetic Motor Compressors

H. ANSI/AFBMA 9-1978 - Load Ratings and Fatigue Life for Ball Bearings.

I. California Administrative Code - Title 24

J. ASTM B117 - Standard Method of Salt Spray (Fog) Testing

K. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

L. ASTM A525 - Zinc (Hot-Dip Galvanized) Coatings on Sheet Steel Products

M. ASTM D1654 - Evaluation of Painted or Coated Specimens, Subjected to Corrosive Environments

1.3 SUBMITTALS

A. Submit drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate accessories where required for complete system.

B. Submit product data indicating rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.

C. Submit manufacturer's installation instructions.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include start-up instructions, maintenance data, controls, and accessories.

1.5 REGULATORY REQUIREMENTS

A. Conform to ANSI/AHRI 550/590-2003 Standard for testing and certified rating of Water Chilling Packages using the Vapor Compression Cycle.

B. Conform to ANSI/UL 1995 code for construction of water chillers. In the event the unit is not UL approved, the manufacturer shall, at manufacturer expense, provide for a field inspection by an UL representative to verify conformance to UL standards. If necessary, contractor shall perform modifications to the unit to comply with UL, as directed by the UL representative.

C. Conform to ANSI/ASME SEC 8 Boiler and Pressure Vessel Code for construction and testing of water chillers.

D. Conform to ANSI/ASHRAE 15 code for construction and operation of water chillers.

E. Conform to the most recent versions of OSHPD for seismic applications.

F. Chiller must be built in an ISO 9001 classified facility.

G. Shall meet or exceed EER rating per current energy codes.

1.6 VERIFICATION OF CAPACITY AND EFFICIENCY

A. The chiller (one of each size) shall be factory performance tested in an ambient controlled, AHRI 550/590 approved test facility. The manufacturer shall supply a certified test report to confirm performance as specified. The performance test shall be conducted in accordance with AHRI Standard 550/590 procedures and tolerances.
   1. The test shall simulate the effect of the glycol solution being used on the job site. Shall use water as the testing fluid and maintain the saturated evaporator temperature of the job site glycol condition.
   2. The performance test shall be run with clean tubes in accordance with AHRI 550/590 to include the following:

3. A downward temperature adjustment shall be made to the design leaving evaporator water temperature to adjust from the design fouling to the clean tube condition.
4. The factory test instrumentation shall be per AHRI 550/590 and the calibration of all instrumentation shall be traceable to the National Institute of Technology.
5. The owner or his representative shall be notified 14 days in advance to witness the factory performance test. If the owner or his representative desires to witness the performance test, all travel expenses will be the owner's responsibility.
6. A certified test report of all data shall be submitted to the Contracting Officer prior to completion of the project. The factory certified test report shall be signed by an officer of the manufacturer's company. Preprinted certification will not be acceptable; certification shall be in the original.

1.7 STORAGE AND HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

B. Protect units from physical damage. Factory coil shipping covers shall be kept in place until installation.

C. Unit controls shall be capable of withstanding 203 Deg F (95 Deg C) storage temperatures in the control compartment for an indefinite period of time.

1.8 WARRANTY

A. Provide a full parts, labor, and refrigerant warranty for one year from start-up or 18 months from shipment, whichever occurs first.

B. A 5-year motor and compressor parts only warranty shall be provided. Compressor VFD shall also include a 5 year warranty.

C. OEM should provide alternate pricing as well for an Extended Warranty option to include:
1. Whole Unit Parts and Labor Warranty (10 years)

PART 2 PRODUCTS

2.1 SUMMARY

A. The contractor shall furnish and install air-cooled screw type water chillers as shown as scheduled on the contract documents. The chillers shall be installed in accordance with this specification and perform at the specified conditions as scheduled.

B. Chilled water pumps and accessories shall be provided by manufacturer and shall be mounted on board chillers. Pump package shall include isolation valves, strainers, gauges, and thermometers. VFD with bypass shall be included for pump.

C. Chiller/pump will be single point electrical power connection.

D. APPROVED MANUFACTURERS
1. Trane
2. Daikin-McQuay
3. Carrier

2.2 COMPRESSORS

A. Construct semi-hermetic helical rotary screw compressors with heat treated forged steel or ductile iron shafts, and sealing surface immersed in oil. Rotors shall be of high grade steel or iron alloy.

B. Statically and dynamically balance rotating parts.

C. Provide oil lubrication system with oil charging valve and oil filter to ensure adequate lubrication during starting, stopping, and normal operation.

D. Provide compressor with automatic capacity reduction equipment consisting of capacity control slide valve. Compressor must start unloaded for soft start on motors.

E. For manufacturer's who use Variable Speed Compressors the VSD design shall include as standard integrated active rectification control system to limit total demand distortion (TDD) in current at the VSD to less than or equal to 5-percent. If active filters are used to meet less than or equal to 5% TDD, then the losses associated with the filter shall be included in the chiller performance on the selection.

F. Provide constant speed 3600 rpm for 60Hz (or 3000 rpm for 50Hz) compressor motor, suction gas cooled with robust construction and system design protection, designed for across-the-line or wye-delta starting. Furnish with starter.

G. Provide compressor heater to evaporate refrigerant returning to compressor during shut down. Energize heater when compressor is not operating.

H. Provide sound absorbing blankets to attenuate compressor noise. Provide after market sound attenuating insulation as needed to achieve A-weighted sound pressure of 67 dBa and A-weighted sound power of 94 dBa.

2.3 EVAPORATOR

A. The evaporator shall be designed, tested, and stamped in accordance with ASME code for a refrigerant side working pressure of 200 psig. Waterside working pressure shall be 150 psig.

B. Insulate the evaporator and water boxes with a minimum of 3/4 inch (K=0.26) insulation. If field installed the additional money to cover this in the field should be included in the bid.

C. Evaporator heat tape shall be factory installed and shall protect unit down to -20 F. Contractor shall wire separate power to energize heat tape and protect cooler while chiller is disconnected from the main power.

D. Provide shell and tube type evaporator, seamless or welded steel construction with cast iron or fabricated steel heads, seamless internally and externally finned copper tubes, roller expanded into tube sheets.

E. Provide ability to remove evaporator tubes from either end of the heat exchanger.

F. Provide water drain connection, vent and fittings for factory installed leaving water temperature control and low temperature cutout sensors.

G. Water connections shall be grooved pipe. Evaporator shall have only one entering and one leaving connection. If manufacturer provides 2 separate evaporators, contractor shall provide manifold and pressure gauges to ensure equal flow is provided to each evaporator.

H. Proof of flow shall be provided by the equipment manufacturer, mechanically installed and electrically wired, at the factory of origin.

2.4 CONDENSER AND FANS

A. Provide vertical discharge direct driven propeller type condenser fans with fan guard on discharge. Entire fan assembly shall be statically and dynamically balanced and fan assembly shall be either painted or zinc coated steel. Fan guard shall be either PVC, chrome, or zinc coated.

B. Provide TEAO (Totally Enclosed Air Over) fan motors with permanently lubricated ball bearings.

C. Chiller shall be able to operate in ambient conditions down to 0 degrees F. Low ambient operation is accomplished with a VFD on at least one fan of each circuit.

D. Construct condenser coils of aluminum fins mechanically bonded to seamless copper tubing. Provide sub-cooling circuits. Air test under water to 506 psig.

E. Provide factory mounted, louvered, guard panels. Panel louvers shall cover condenser, evaporator and compressor sections so all are hidden from sight. Wire screens or wire mesh will not be allowed.

F. Condenser fans shall be of “ultra-low sound’ operation type.

2.5 ENCLOSURES / STARTERS

A. Rapid Re-Start after a Power Loss – The chiller, upon power loss restoration, must be able to start the compressor within 120 seconds. The chiller time to fully load up shall be no longer than 10 minutes. The manufacturer shall supply documentation to support their ability to do this. If the documentation is not adequate, the manufacturer must demonstrate this in the factory on an AHRI certified loop.

B. A molded case standard interrupting capacity circuit breaker shall be factory pre-wired with terminal block power connections and equipped with a lockable external operator handle, making it available to disconnect the chiller from main power.

C. House components in a galvanized steel frame and mounted on welded structural steel base. Hot-dip galvanized steel frame coating shall be Underwriters Laboratories Inc. (UL) recognized as G90-U, UL guide number DTHW2.

D. Unit panels and control panels shall be finished with a baked on powder paint. Control panel doors shall have door stays. Paint system shall meet the requirements for outdoor equipment of Federal Government Agencies.

E. Mount starters and Terminal Blocks in weatherproof panel provided with full opening access doors. If a disconnect or circuit breaker is chosen, it should be a lockable, through-the-door type with an operating handle and clearly visible from outside of unit indicating if power is on or off.

F. Casings fabricated from steel that do not have a Zinc coating conforming to ASTM A 123 or ASTM A525 shall be treated for the prevention of corrosion with a factory coating or paint system. The coating or paint system shall withstand 500 hours in a salt-spray fog test in accordance with ASTM B 117. Each specimen shall have a standard scribe mark as defined in ASTM D 1654. Upon completion of exposure, the coating or paint system shall be evaluated and rated in accordance with procedures A and B of ASTM D 1654. The rating of failure at the scribe mark shall be not less than six (average creepage not greater than 1/8 inch). The rating of the unscribed area shall not be less than ten (no failure). Thickness of coating or paint system on the actual equipment shall be identical to that on the test specimens with respect to materials, conditions of application, and dry-film thickness.

G. For each compressor provide a wye-delta starter. Delta-Delta and Solid State Starters shall be unacceptable because they accomplish a smaller reduction in inrush than Y-delta.

H. Compressors utilizing variable speed drive design shall be IEEE 519-1992 compliant. They shall include as standard integrated active rectification control system to limit total demand distortion (TDD) in current at the VSD to less than or equal to 5-percent as measured at the VSD input. If optional active filters are used to meet the less than or equal to 5% TDD, then the losses associated with the filter shall be included in the chiller performance on the selection.

2.6 REFRIGERANT CIRCUIT

A. All units shall have 2 refrigeration circuits to provide redundancy, each with one or two (manifolded) compressors on each circuit. Single refrigerant circuit chillers are not acceptable.

B. All units shall have factory installed refrigeration valves capable of isolating the entire charge. Provide for each refrigerant circuit:
1. Liquid line shutoff valve.
2. Suction Service Valve
3. Filter (replaceable core type).
4. Liquid line sight glass.
5. Electronic or thermal expansion valve sized for maximum operating pressure.
6. Charging valve.
7. Discharge and oil line check valves.

8. High side pressure relief valve.
9. Full operating charge of HFC-134a and oil for packaged units only. Units with remote evaporator option selected will ship with an oil charge and a nitrogen holding charge.

C. Capacity Modulation: Provide capacity modulation that includes linear unloading to maintain close leaving water temperature control. Unit shall be capable of operation down to 20%.

2.7 CONTROLS

A. A Chilled Water Flow switch shall be factory installed provided by the equipment manufacturer and installed the correct number of pipe diameters from any elbow and in the correct orientation.

B. Variable Primary Flow - 30% change per minute in a comfort cooling application with a typical +/- of 2 degrees F from set point. The chiller can be as tight as +/- .5 degrees F when operating with a load and flow changes of less than 10% per minute. Flow switch is factory installed.

C. Chilled water temperature control shall be microprocessor-based, proportional and integral controller to show water and refrigerant temperature, refrigerant pressure, and diagnostics. This microprocessor-based controller is to be supplied with each chiller by the chiller manufacturer. Controls shall include the following readouts and diagnostics:
1. Phase reversal/unbalance/single phasing and over/under voltage protection.
2. Low chilled water temperature protection.
3. High and low refrigerant pressure protection.
4. Load limit thermostat to limit compressor loading on high return water temperature.
5. Condenser fan sequencing to automatically cycle fans in response to load, expansion valve pressure, condenser pressure, and differential pressure to optimize unit efficiency.
6. Display diagnostics.
7. Oil pressure control based off of maintaining system differential pressure.
8. Compressors: Status (on/off), %RLA, anti-short cycle timer, and automatic compressor lead-lag.

D. On chiller, mount weatherproof control panel, containing starters, power and control wiring, factory wired with terminal block power connection. Provide primary and secondary fused control power transformer and a single 115 volt 60 Hz single phase connection for evaporator freeze protection heaters.
1. The unit controller shall utilize a microprocessor that shall automatically prevent unit shut down due to abnormal operating conditions associated with: evaporator refrigerant temperature, high condensing pressure and motor current overload.

E. Factory Installed Freeze Protection as Standard - The evaporator shall be protected with an immersion heater and heat trace. This combination shall provide freeze protection down to -20F ambient temperatures while the heater is powered. Contractor shall provide separate power to energize heater and protect evaporator while chiller is disconnected.

Contractor shall provide interlock between chiller and pump starter so that chiller can request flow in a freeze avoidance scenario.

F. Provide the following safety controls with indicating lights or diagnostic readouts.
1. Low chilled water temperature protection.
2. High refrigerant pressure.
3. Low oil flow protection.
4. Loss of chilled water flow.
5. Contact for remote emergency shutdown.
6. Motor current overload.
7. Phase reversal/unbalance/single phasing.
8. Over/under voltage.
9. Failure of water temperature sensor used by controller.
10. Compressor status (on or off).

G. Provide the following operating controls:
1. Eight (8) or more step leaving chilled water temperature controller which cycles compressors and activates cylinder unloaders or slide valve based on PI algorithms. If manufacturer is unable to provide at least 8 steps of unloading, providing hot gas bypass shall be required.
2. Five minute solid state anti-recycle timer to prevent compressor from short cycling. Compressor minimum stop-to-start time limit shall be 2 minutes. If a greater than 5 minute start-to-start, or greater than 2 minute stop-to-start timer is included, hot gas bypass shall be provided to insure accurate chilled water temperature control in light load applications.
3. Chilled water pump output relay that closes when the chiller is given a signal to start.
4. Load limit thermostat to limit compressor loading on high return water temperature to prevent nuisance trip outs.
5. High ambient unloader pressure controller that unloads compressors to keep head pressure under control and help prevent high pressure nuisance trip outs on days when outside ambient is above design.
6. Compressor current sensing unloader unit that unloads compressors to help prevent current overload nuisance trip outs.
7. Auto lead-lag functions that constantly even out run hours and compressor starts automatically. If contractor cannot provide this function then cycle counter and hour meter shall be provided for each compressor so owner can be instructed by the contractor on how to manually change lead-lag on compressors and even out compressor starts and running hours.
8. Low ambient lockout control with adjustable set point.
9. Condenser fan sequencing which automatically cycles fans in response to ambient, condensing pressure and expansion valve pressure differential thereby optimizing unit efficiency.

G. Provide user interface on the front of the panel. If display is on the inside of the panel, then a control display access door shall be provided to allow access to the display without removal of panels. Provide user interface with a minimum of the following features:
1. Leaving chilled water set point adjustment from LCD input
2. Entering and leaving chilled water temperature output
3. Percent RLA output for each compressor

4. Pressure output of condenser for circuits one and two
5. Pressure output of evaporator for circuits one and two
6. Ambient temperature output
7. Voltage output
8. Current limit set point adjustment from LCD input.
9. Alarm indicating light and relay

H. Digital Communications to BAS system shall consist of a BACnet interface.

I. The chiller control panel shall provide leaving chilled water temperature reset based upon return water temperature.

J. The chiller control panel shall provide an alarm relay output that shall energize whenever a fault requiring manual reset is detected by the panel.

K. The chiller control panel shall provide input for leaving chilled water temperature setpoint based upon a 2-10VDC or 4-20mA signal from a building automation system.

L. The chiller control panel shall provide input for chiller current limit setpoint based upon a 2-10VDC or 4-20mA signal from a building automation system.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Align chiller package on steel or concrete foundations.

C. Install units on vibration isolators.

D. Connect to electrical service.

E. Connect to chilled water piping.

F. Arrange piping for easy dismantling to permit tube cleaning.

3.2 MANUFACTURER'S FIELD STARTUP AND FIRST YEAR WARRANTY SERVICES

A. Chiller manufacturer shall have a factory trained and supported service organization that is within a 75 mile radius of the site.

B. OEM Startup shall be performed by factory trained and authorized servicing technicians confirming equipment has been correctly installed and passes specification checklist prior to equipment becoming operational and covered under OEM warranty. Pre-Startup Support and Startup shall be performed by an OEM factory-trained technician in strict accordance with the manufacturer’s specifications and requirements. Third-party service agencies are not permitted. Start up and warranty services shall include the following:
1. Pre-Startup Support – Jobsite visit prior to equipment startup.

a. Review installation checklist with installing contractor. Confirm that all chiller safety interlocks are installed and operational.
b. Review startup procedures and required support
c. Review training requirements, timing and logistics with the installing contractor

2. Startup - Provide all labor and materials to perform startup.
a. Provide a complete log of all operating parameters.
b. Assure actual performance matches with submittals and computerized selection programs for other than submittal conditions.
c. Submit a hard copy of the service report and logs.

C. Manufacturer must provide factory start-up of the unit. Contractor shall provide completed Start up logs from the Manufacturer. In addition to this the Manufacturer will provide a Full Labor Warranty for the 1st year. Warranty will begin on the date of Final Acceptance. The warranty will include a minimum of 3 Preventative Maintenance Inspections during the 1st Year by a Factory Trained Service Technician who is employed by the Chiller Manufacturer.

D. The manufacturer shall furnish complete submittal wiring diagrams of the package unit as applicable for field maintenance and service.

END OF SECTION

SECTION 15720 – CENTRAL STATION AIR HANDLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Central Station Air Handling Units

1.2 REFERENCES

A. AMCA Publication 99 – Standards Handbook.

B. AMCA Publication 611 – Certified Ratings Program – Airflow Measurement Performance

C. AMCA Standard 500-D – Laboratory Methods of Testing Dampers for Rating.

D. ANSI/ABMA Standard 9 - Load Ratings and Fatigue Life for Ball Bearings.

E. ANSI/AMCA Standard 204 – Balance Quality and Vibration Levels for Fans.

F. ANSI/AMCA Standard 610 – Laboratory Methods of Testing Airflow Measuring Stations for Rating.

G. ANSI/AHRI Standard 410 - Forced Circulation Air-Cooling and Air-Heating Coils.

H. ANSI/AHRI Standard 430 - Central Station Air Handling Units.

I. ANSI/AHRI Standard 1060 – Rating Air-To-Air Energy Recovery Ventilation Equipment

J. ANSI/ASHRAE Standard 52.2 – Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

K. ANSI/ASHARE Standard 62.1 – Ventilation for Acceptable Indoor Air Quality.

L. ANSI/ASHARE Standard 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings.

M. ANSI/NEMA MG 1 – Motors and Generators.

N. ANSI/UL 900 – Standard for Safety Air Filter Units.

O. AHRI Standard 260 – Sound rating of Ducted Air Moving and Conditioning Equipment.

P. ASHRAE Standard 84 - Method of Testing Air-to-Air Heat Exchangers.

Q. ASHRAE Standard 111 – Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems.

R. ASTM B117 - Standard Practice for Operation Salt Spray Apparatus.

S. ASTM C1071 – Thermal and Acoustic Insulation (Mineral Fiber, Duct Lining Material).

T. ASTM C1338 – Standard Test Method for Determining Fungi Resistance of Insulation Material and Facings.

U. ASTM E477 – Standard Test Method for Measure Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.

V. NFPA 70 – National Electrical Code®.

W. NFPA 90A – Standard for the Installation of Air Conditioning and Ventilation Systems.

X. UL 1995 – Standard for Safety Heating and Cooling Equipment

1.3 SUBMITTALS

A. No equipment shall be fabricated or delivered until the receipt of approved shop drawings from the Owner or Owner's approved representative.

B. AHU manufacturer shall provide the following information with each shop drawing/product data submission:

a. Dimensioned arrangement drawings for each AHU including a plan and elevation view of the assembled unit with overall dimensions, lift points, unit shipping split locations and dimensions, installation and operating weights, and installation, operation and service clearances.

b. All electrical, piping, and ductwork requirements, including sizes, connection locations, and connection method recommendations.

c. Each component of the unit shall be identified and mechanical specifications shall be provided for unit and accessories describing construction, components, and options.

d. All performance data, including capacities and airside and waterside pressure drops, for components.

e. Fan curves shall be provided for fans with the design operating points indicated. Data shall be corrected to actual operating conditions, temperatures, and altitudes.

f. For units with multiple fans, a fan curve shall be provided showing the performance of the entire bank of fans at design conditions. In addition, a fan curve shall be provided showing the performance of each individual fan in the bank of fans at design conditions. Finally, a fan curve shall be provide showing the performance of the bank of fans when one fan is down. The percent redundancy of the bank of fans with one fan down shall be noted on the fan curve

or in the tabulated fan data.

g. A filter schedule must be provided for each air handling unit supplied by the air handling unit manufacturer. Schedule shall detail unit tag, unit size, corresponding filter section location within the AHU, filter arrangement (e.g. angled/flat), filter depth, filter type (e.g. pleated media), MERV rating, and filter quantity and size.

h. A schedule detailing necessary trap height shall be provided for each air handling unit. Schedule shall detail unit tag, unit size, appropriate trap schematic with recommended trap dimensions, and unit supplied base rail height. Contractor shall be responsible for additional trap height required for trapping and insulation beyond the unit supplied base rail height by adequate housekeeping pad or roof curb.

i. A coil valve coordination schedule shall be provided for each air handling unit supplied by the air handling unit manufacturer. Schedule shall detail unit tag, coil type and corresponding section location within the AHU, valve style (e.g. global, ball), valve type (e.g. electronic 2-way/3-way), valve position (e.g. normally open/closed), size, flow coefficient (CV), and close-off pressure.

j. An electrical MCA – MOP schedule shall be provided for each electrical circuit to which field-power must be supplied. Schedule to detail unit tag, circuit description, voltage/phase/hertz, Minimum Circuit Ampacity (MCA), and calculated Maximum Overcurrent Protection (MOP).

k. Sound data shall be provided using AHRI 260 test methods. Unit discharge, inlet, and radiated sound power levels in dB shall be provided for 63, 125, 250, 500, 1000, 2000, 4000, and 8000 Hz.

C. The AHU manufacturer shall provide appropriate sets of submittals as referenced in the General Conditions and shall submit to the Owner electronic copies of the IOM.

D. The AHU manufacturer shall list any exceptions to the specification.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include start-up instructions, maintenance data, controls, and accessories.

1.5 QUALITY ASSURANCE

A. Air Coils: Certify capacities, pressure drops and selection procedures in accordance with current AHRI Standard 410.

B. Air handling units with fan sections utilizing single fans shall be rated and certified in accordance with AHRI Standard 430.

C. Air handling units with fan sections utilizing multiple fans shall be rated in accordance with AHRI Standard 430 for airflow, static pressure, and fan speed performance.

D. ISO 9001 Certification.

1.6 REGULATORY REQUIREMENTS

A. Agency Listings/Certifications

1. Unit shall be manufactured to conform to UL 1995 and shall be listed by either UL/CUL or ETL. Units shall be provided with listing agency label affixed to the unit. In the event the unit is not UL/CUL or ETL approved, the contractor shall, at his/her expense, provide for a field inspection by a UL/CUL or ETL representative to verify conformance. If necessary, contractor shall perform modifications to the unit to comply with UL/CUL or ETL as directed by the representative, at no additional expense to the owner.

2. Certify air handling units in accordance with AHRI Standard 430. Units shall be provided with certification label affixed to the unit. If air handling units are not certified in accordance with AHRI Standard 430, contractor shall be responsible for expenses associated with testing of units after installation to verify performance of fan(s). Any costs incurred to adjust fans to meet scheduled capacities shall be the sole responsibility of the contractor.

3. Certify air handling coils in accordance with AHRI Standard 410. Units shall be provided with certification label affixed to the unit. If air handling coils are not certified in accordance with AHRI Standard 410, contractor shall be responsible for expenses associated with testing of coils after installation to verify performance of coil(s). Any costs incurred to adjust coils to meet scheduled capacities shall be the sole responsibility of the contractor.

4. Certify airflow monitoring stations are tested for differential pressure in accordance with AMCA 611 in an AMCA registered laboratory and comply with the requirements of the AMCA Certified Ratings Program. Airflow monitoring station shall be licensed to bear the AMCA Seal.

1.7 STORAGE AND HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

B. Units shall ship fully assembled up to practical shipping and rigging limitations. Units not shipped fully assembled shall have tags and airflow arrows on each section to indicate location and orientation in direction of airflow. Shipping splits shall be clearly defined on submittal drawings. Cost associated with non-conformance to shop drawings shall be the responsibility of the manufacturer. Each section shall have lifting lugs for field rigging and final placement of AHU sections. Indoor AHUs less than 100 inches wide shall allow for forklift transport for maneuverability on jobsite.

C. Deliver units to jobsite with fan motor(s), sheave(s), and belt(s) completely assembled and mounted in units.

D. Indoor air handling units shall be shipped in a clear shrink-wrap or stretch-wrap to protect unit from in-transit rain and debris per ASHRAE 62.1 recommendations. See Section 2.26 for outdoor air handling unit requirements.

E. Installing contractor shall be responsible for storing AHU in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.8 WARRANTY

A. AHU manufacturer shall provide, at no additional cost, a standard parts warranty that covers a period of one year from unit start-up or 18 months from shipment, whichever occurs first. This warrants that all products are free from defects in material and workmanship and shall meet the capacities and ratings set forth in the equipment manufacturer's catalog and bulletins.

PART 2 PRODUCTS

2.1 SUMMARY

A. The contractor shall furnish and install central station air handlers as scheduled. The equipment shall be installed in accordance with this specification and perform at the specified conditions as scheduled.

B. APPROVED MANUFACTURERS
1. Trane
2. Daikin-McQuay
3. Carrier

C. Unit layout and configuration shall be as defined in project plans and schedule.

D. Unit manufacturer to provide an integral base frame to support all sections of unit and raise unit for proper trapping. Contractor will be responsible for providing a housekeeping pad when indoor air handling unit base frame is not of sufficient height to properly trap unit. Unit base frames not constructed of galvanized steel shall be chemically cleaned and coated with both a rust-inhibiting primer and finished coat of rust-inhibiting enamel.

2.1 UNIT CASING

A. Unit manufacturer shall ship separate segments so unit can be broken down for ease of installation in tight spaces. The entire air handler shall be constructed of galvanized steel. Indoor air handling unit casing finish to meet ASTM B117 250-hour salt-spray test. See Section 2.26 for outdoor air handling unit requirements. The removal of access panels or access doors shall not affect the structural integrity of the unit. All removable panels shall be

gasketed. All doors shall have gasketing around full perimeter to prevent air leakage. Contractor shall be responsible to provide connection flanges and all other framework that is needed to properly support the unit.

B. Casing performance – Casing air leakage shall not exceed leak class 9 (C_L = 9) per ASHRAE 111 at specified casing pressure, where maximum casing leakage (cfm/100 ft^2 of casing surface area) = C_L X $P^{0.65}$.

C. Under 55°F supply air temperature and design conditions on the exterior of the unit of 81°F dry bulb and 73°F wet bulb, condensation shall not form on the casing exterior. The AHU manufacturer shall provide tested casing thermal performance for the scheduled supply air temperature plotted on a psychrometric chart. The design condition on the exterior of the unit shall also be plotted on the chart. If tested casing thermal data is not available, AHU manufacturer shall provide, in writing to the Engineer and Owner, a guarantee against condensation forming on the unit exterior at the stated design conditions above. The guarantee shall note that the AHU manufacturer will cover all expenses associated with modifying units in the field should external condensate form on them. In lieu of AHU manufacturer providing a written guarantee, the installing contractor must provide additional external insulation on AHU to prevent condensation.

D. Unit casing (wall/floor/pressure bulkhead roof panels and doors) shall be able to withstand up to 1.5 times design static pressure up to +8" w.g. in all positive pressure sections and -8" w.g. in all negative pressure sections, whichever is less, and shall not exceed 0.0042" per inch of panel span (L/240).

E. Floor panels shall be double-wall construction and designed to support a 300-lb load during maintenance activities and shall deflect no more than 0.0042" per inch of panel span.

F. Unit casing panels shall be 2" double-wall construction, with solid galvanized exterior and solid galvanized interior, to facilitate cleaning of unit interior.

G. Unit casing panels (pressure bulkhead roof panels, walls, floor) and doors shall be provided with a minimum thermal resistance (R-value) of 13 Hr*Ft^2*°F/BTU.

H. Unit casing panels (pressure bulkhead roof panels, walls, floor) and external structural frame members shall be completely insulated filling the entire panel cavity in all directions so that no voids exist. Panel insulation shall comply with NFPA 90A.

I. Structural frame must not extend from air-handling unit interior to exterior. All component and panel support structure must be internal to AHU. Casing panel inner liners must not extend to the exterior of the unit or contact the exterior frame. A mid-span, no-through-metal, internal thermal break shall be provided for all unit casing panels.

J. Access panels and/or access doors shall be provided in all sections to allow easy access to drain pan, coil(s), motor, drive components and bearings for cleaning, inspection, and maintenance.

K. Access panels and doors shall be fully removable without the use of specialized tools to allow complete access of interior surfaces.

2.04 Access Doors

A. Access doors shall be 2” double-wall construction. Interior and exterior shall be of the same construction as the interior and exterior wall panels.

B. All doors downstream of cooling coils shall be provided with a thermal break construction of door panel and door frame.

C. Gasketing shall be provided around the full perimeter of the doors to prevent air leakage.

D. Door hardware shall be surface-mounted to prevent through-cabinet penetrations that could likely weaken the casing leakage and thermal performance.

E. Handle hardware shall be designed to prevent unintended closure.

F. Access doors shall be hinged and removable without the use of specialized tools.

G. Hinges shall be interchangeable with the door handle hardware to allow for alternating door swing in the field to minimize access interference due to unforeseen job site obstructions.

H. Door handle hardware shall be adjustable and visually indicate locking position of door latch external to the section.

I. All doors shall be a minimum 60” high when sufficient height is available, or the maximum height allowed by the unit height.

J. Multiple door handles for indoor air handling units shall be provided for each latching point of the door necessary to maintain the specified air leakage integrity of the unit. See Section 2.26 for outdoor air handling unit requirements.

K. A shatterproof window shall be provided in access doors where indicated on the plans.

2.05 PRIMARY DRAIN PANS

A. All cooling coil sections shall be provided with an insulated, double-wall, stainless steel drain pan.

B. The drain pan shall be designed in accordance with ASHRAE 62.1 being of sufficient size to collect all condensation produced from the coil and sloped in two planes, pitched toward drain connections, promoting positive drainage to eliminate stagnant water conditions when unit is installed level and trapped per manufacturer's requirements. See section 2.07, paragraph F through H for specifications on intermediate drain pans between cooling coils.

C. The outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition.

D. All drain pan threaded connections shall be visible external to the unit. Threaded connections under the unit floor shall not be accepted.

E. Drain connections shall be of the same material as the primary drain pan and shall extend a minimum 2-1/2" beyond the base to ensure adequate room for field piping of condensate traps.

F. The installing contractor is responsible to ensure the unit is installed level, trapped in accordance with the manufacturer's requirements, and visually inspected to ensure proper drainage of condensate.

G. Coil support members inside the drain pan shall be of the same material as the drain pan and coil casing.

2.06 FANS

A. Fan sections shall have a minimum of one access door located on the drive side of the unit to allow inspection and maintenance of the fan, motor, and drive components. Construct door(s) per Section 2.04.

B. Provide fans of type and class as specified on the schedule. Fan shafts shall be solid steel, coated with a rust-inhibiting coating, and properly designed so that fan shaft does not pass through first critical speed as unit comes up to rated RPM. All fans shall be statically and dynamically tested by the manufacturer for vibration and alignment as an assembly at the operating RPM to meet design specifications. Fans controlled by variable frequency drives shall be statically and dynamically tested for vibration and alignment at speeds between 25% and 100% of design RPM. If fans are not factory-tested for vibration and alignment, the contractor shall be responsible for cost and labor associated with field balancing and certified vibration performance. Fan wheels shall be keyed to fan shafts to prevent slipping.

C. Belt-driven fans shall be provided with grease lubricated, self-aligning, anti-friction bearings selected for L-50 200,000-hour average life per ANSI/AFBMA Standard 9. Lubrication lines for both bearings shall be extended to the drive side of the AHU and rigidly attached to support bracket with zerk fittings. Lubrication lines shall be a clear, high-pressure, polymer to aid in visual inspection. If extended lubrication lines are not provided, manufacturer shall provide permanently lubricated bearing with engineering calculations for proof of bearing life.

D. All fans, including direct-drive plenum fans, shall be mounted on spring isolation bases. Internally-mounted motor shall be on the same isolation base. Fan and motor shall be internally isolated with spring isolators. Unit sizes up to nominal 4,000 cfm shall have 1-inch springs. Unit sizes larger than nominal 4,000 cfm shall have 2-inch spring isolators. A flexible connection (e.g. canvas duct) shall be installed between fan and unit casing to ensure complete isolation. Flexible connection shall comply with NFPA 90A and UL 181 requirements. If fans and motors are not internally isolated, then the entire unit shall be externally isolated from the building, including supply and return duct work, piping, and electrical connections. External isolation shall be furnished by the installing contractor in order to avoid transmission of noise and vibration through the ductwork and building structure.

E. Fan sections containing multiple fans shall be provided as indicated on the schedule and drawings. Each fan shall operate in parallel to each other fan in the array. The fans shall be SWSI plenum type with high efficient AF blades. Fans shall be direct-driven. Fan wheels shall be aluminum. The Hp characteristic of the fans shall be non-overloading.

F. Fan sections containing multiple fans shall be controlled using a common control signal, such as the duct static control signal, to modulate the fan speed.

G. Belts shall be enclosed as required by OSHA standard 29 CFR 1910 to protect worker from accidental contact with the belts and sheaves.

H. MOTORS AND DRIVES

1. All motors and drives shall be factory-installed and run tested. All motors shall be installed on a slide base to permit adjustment of belt tension. Slide base shall be designed to accept all motor sizes offered by the air-handler manufacturer for that fan size to allow a motor change in the future, should airflow requirements change. Fan sections without factory-installed motors shall have motors field installed by the contractor. The contractor shall be responsible for all costs associated with installation of motor and drive, alignment of sheaves and belts, run testing of the motor, and balancing of the assembly.

2. Motors shall meet or exceed all NEMA Standards Publication MG 1 – 2006 requirements and comply with NEMA Premium efficiency levels when applicable. Motors shall comply with applicable requirements of NEC and shall be UL Listed.

3. Fan Motors shall be heavy duty, NEMA Premium efficient exceeding the EPAct efficiency requirements.

4. Belt-driven fan sections with single fans shall use 4-pole (1800 rpm) motors, NEMA Design B, with Class B insulation to operate continuously at 104°F (40°C) ambient without tripping of overloads.

5. Direct-driven fan sections shall use 2-pole (3600 rpm), 4-pole (1800 rpm), or 6-pole (1200 rpm) motors, NEMA Design B, with Class B insulation to operate continuously at 104°F (40°C) ambient without tripping of overloads. Multiple fan selections utilizing 8-pole (900 rpm) motors are unacceptable due to motor inefficiency, cost, and replacement lead times.

6. Motors shall have a +/- 10 percent voltage utilization range to protect against voltage variation.

7. V-Belt Drive shall be fixed pitch rated at 1.5 times the motor nameplate. Drives 20 hp and larger or any drives on units equipped with VFDs shall be fixed pitch.

8. All fans with fixed-pitch drives and motors 15 hp and larger shall be equipped with multiple belt drives.

9. Manufacturer shall provide for each fan a nameplate with the following information to assist air balance contractor in start up and service personnel in maintenance:

   a. Fan and motor sheave part number
   b. Fan and motor bushing part number
   c. Number of belts and belt part numbers

d. Fan design RPM and motor HP
e. Belt tension and deflection
f. Center distance between shafts

2.07 COILS

A. Coils section side panel shall be removable to allow for removal and replacement of coils without impacting the structural integrity of the unit.

B. Install coils such that headers and return bends are enclosed by unit casing to ensure that if condensate forms on the header or return bends, it is captured by the drain pan under the coil.

C. Coils shall be manufactured with plate fins to minimize water carryover and maximize airside thermal efficiency. Fin tube holes shall have drawn and belled collars to maintain consistent fin spacing to ensure performance and air pressure drop across the coil as scheduled. Tubes shall be mechanically expanded and bonded to fin collars for maximum thermal conductivity. Use of soldering or tinning during the fin-to-tube bonding process is not acceptable due to the inherent thermal stress and possible loss of bonding at that joint.

D. Construct coil casings of stainless steel. End supports and tube sheets shall have belled tube holes to minimize wear of the tube wall during thermal expansion and contraction of the tube.

E. All coils shall be completely cleaned prior to installation into the air handling unit. Complete fin bundle shall be degreased and cleaned to remove any lubricants used in the manufacturing of the fins, or dirt that may have accumulated, in order to minimize the chance for water carryover.

F. When two or more cooling coils are stacked in the unit, an intermediate drain pan shall be installed between each coil. The intermediate drain pan shall be designed being of sufficient size to collect all condensation produced from the coil and sloped to promote positive drainage to eliminate stagnant water conditions. The intermediate drain pan shall be constructed of the same material as the primary drain pan.

G. The intermediate drain pan shall begin at the leading face of the water-producing device and be of sufficient length extending downstream to prevent condensate from passing through the air stream of the lower coil.

H. Intermediate drain pan shall include downspouts to direct condensate to the primary drain pan. The intermediate drain pan outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition.

I. Hydronic Coils

1. Supply and return header connections shall be clearly labeled on unit exterior such that direction of coil water-flow is counter to direction of unit air-flow.

2. Coils shall be proof-tested to 300 psig and leak-tested to 200 psig air pressure under water.

3. Headers shall be constructed of round copper pipe or cast iron.

4. Tubes shall be 1/2 inch O.D., 0.025 inch thick copper. Fins shall be aluminum.

2.07 FILTERS

A. Provide factory-fabricated filter section of the same construction and finish as unit casings. Filter section shall have side access filter guides and access door(s) extending the full height of the casing to facilitate filter removal. Construct doors in accordance with Section 2.04. Provide fixed filter blockoffs as required to prevent air bypass around filters. Blockoffs shall not need to be removed during filter replacement. Filters to be of size and quantity required to maximize filter face area for each air handling unit.

B. Filter type, MERV rating, and arrangement shall be provided as defined in project plans and schedule.

C. Manufacturer shall provide one set of startup filters.

2.09 DAMPERS

A. All dampers, with the exception of external bypass and multizones (if scheduled), shall be internally mounted. Dampers shall be premium ultra-low leak type and located as indicated on the schedule and plans. Blade arrangement (parallel or opposed) shall be provided as indicated on the schedule and drawings. Dampers shall be Ruskin CD60 double-skin airfoil design or equivalent for minimal air leakage and pressure drop. Leakage rate shall not exceed 3 CFM/square foot at one inch water gauge complying with ASHRAE 90.1 maximum damper leakage and shall be AMCA licensed for Class 1A. All leakage testing and pressure ratings shall be based on AMCA Standard 500-D. Manufacturer shall submit brand and model of damper(s) being furnished, if not Ruskin CD60.

2.10 ACCESS SECTIONS

A. Access sections shall be provided where indicated in the schedule and plans to allow additional access for inspection, cleaning, and maintenance of unit components. The unit shall be installed for proper access. Procedure for proper access, inspection and cleaning of the unit shall be provided in the AHU manufacturer’s maintenance manual. Access section doors shall be constructed per Section 2.04.

2.11 AIR MIXER/BLENDER SECTIONS

A. Air mixers (blenders) shall be provided and located as indicated on the schedule and drawings. Mixers shall incorporate fixed blades, with no moving parts. Mixer panels shall be sized and installed in the unit with adequate distances upstream and downstream, based on the manufacturer’s cataloged performance, to ensure a minimum mixing effectiveness of 70% at 25% outside air, one mixer diameter downstream of the mixer. The pressure drop rating for static air mixers installed with the unit shall include the pressure loss due to the mixer design and the mixer-to-plenum area ratio.

2.12 INTERNAL FACE AND BYPASS SECTIONS

A. Dampers shall be provided as indicated on the schedule and plans to divert airflow around the coil internally within the air handling unit. Dampers shall be low leak and opposed blade arrangement. Dampers shall be Ruskin CD60 double-skin airfoil design or equivalent for minimal air leakage and pressure drop. Leakage rate shall not exceed 5 CFM/square foot at one inch water gauge. All leakage testing and pressure ratings shall be based on AMCA Standard 500-D. Manufacturer shall submit brand and model of damper(s) being furnished, if not Ruskin CD60.

2.13 OUTDOOR AIR HANDLING UNITS

A. In addition to all other details specified within for air handling units, units that are installed outdoors shall also comply with the following sections. Outdoor air handling units shall have only single door handles for each door linking multiple latching points necessary to maintain the specified air leakage integrity of the unit and ease of maintenance. Outdoor AHUs shall be shipped with all openings covered to protect unit interior from in-transit debris.

B. Unit Paint

1. External surfaces of all outdoor unit casings shall be prepared and painted with a minimum 1.5 mil thick enamel finish or equal. Paint shall be able to withstand a salt spray test in accordance with ASTM B117 for a minimum of 500 consecutive hours. Paint shall be AHU Manufacturer's standard color, unless otherwise indicated in the schedule and drawings.

C. Unit Base

1. Outdoor units shall have a 6-inch welded base and steel cross members for structural rigidity and supports the full perimeter of the air handling unit. AHU panels must overhang the primary unit base such that no ledge exists for water to pool. The entire AHU perimeter shall be sealed for additional water management protection. A drain pan under the entire unit or sections shall not be an acceptable alternative to prevent water from entering the building space.

2. Unit base shall be designed to allow the unit to be either pier-mounted or rest on a roof curb when field-installed as indicated on the schedule and drawings.

D. Unit Roof

1. Outdoor unit roofs shall incorporate a standing seam on the exterior to ensure a rigid roof construction and prevent water infiltration. Roof assembly shall overhang all walls by 1.5-inch minimum to prevent sheeting from roof to side panels. Rain gutters shall also be provided over all doors to direct rain away from the door assembly.

2. Outdoor roofs shall be sloped, not less than 0.125 inches per foot, for water drainage. Where outdoor units are shipped in multiple sections, provide standing-seam joiners at each split with adhesive, hardware, and cover strips for field joining by the installing contactor.

E. External Pipe Cabinets

1. The AHU manufacturer shall provide external pipe cabinet assemblies as indicated on the schedule and drawings. External pipe cabinets shall be factory assembled and shipped with the units for field mounting. Cabinet walls and doors shall be the same double-wall construction and exterior color/finish as the unit wall panels. Cabinet roofs shall be sloped away from the unit for water drainage.

F. Weather Hoods

1. Outside and exhaust air weather hoods shall be fabricated from the same material as the unit exterior. Hoods shall extend past the perimeter of the unit casing opening to ensure the hood does not obstruct the airflow path. Hoods shall be painted with the same paint requirements identified for the external casing herein.

2. Inlet hoods for each outside damper shall be provided with a high performance sine-wave moisture eliminator to prevent entrainment of water into the unit from outside air. Wire mesh screens shall not be acceptable as a moisture eliminator. Exhaust hoods shall be provided on exhaust air openings.

3. All hoods shall be sized for 100 percent of nominal damper capacities and furnished with bird screens or similar protection to prevent nesting and entry into AHU inlet or exhaust paths.

G. Roof Curbs

1. Roof curbs shall be provided where indicated on the plans and shall be galvanized steel. Roof curb shall support the full perimeter of the air handling unit, including pipe chases.

2. A 2”x4” nominal wood nailing strip shall be supplied attached to the roof curb. Wood nailing strip shall be of #4 Spruce or #4 Yellow Pine.

3. Roof curb shall include frame work necessary to support supply and return duct installation prior to unit placement.

4. Roof curb shall be shipped loose for field installation prior to unit placement.

5. Curbs and equipment tie downs shall be designed to resist code-mandated local wind and seismic conditions.

2.14 Variable Frequency Drives (VFDs)

A. Variable frequency drives shall be provided, mounted and wired by the AHU manufacturer as indicated on the schedule and drawings. All standard and optional features shall be included within the VFD enclosure, unless otherwise specified. The VFDs shall be UL listed. The listing shall allow mounting in plenum or other air handling compartments.

B. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to

maintain desired motor magnetization current suitable for centrifugal pump and fan control and to eliminate the need for motor derating.

C. With the motor's rated voltage applied to the VFD input, the VFD shall allow the motor to produce full rated power at rated amps, RMS fundamental volts, and speed without using the motor's service factor. VFDs utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.

D. The VFD shall include an input full-wave bridge rectifier and maintain a fundamental power factor near unity regardless of speed or load.

E. The VFD and options shall be tested to ANSI/UL Standard 508. The complete VFD, including all specified options, shall be assembled by the manufacturer, which shall be UL 508 certified for the building and assembly of option panels. Assembly of separate panels with options by a third-party is not acceptable. The appropriate UL stickers shall be applied to both the VFD and option panel, in the case where these are not contained in one panel.

F. The VFD shall have DC link reactors on both the positive and negative rails of the DC bus to minimize power line harmonics. VFDs without DC link reactors shall provide a minimum 3% impedance line reactor.

G. The VFDs full load amp rating shall meet or exceed NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 160% of rated current for up to 0.5 second while starting.

H. The VFD shall be able to provide full torque at any selected frequency from 28 Hz to base speed to allow driving direct drive fans without derating.

I. An automatic energy optimization selection feature shall be provided standard in the VFD. This feature shall automatically and continually monitor the motor's speed and load and adjust the applied voltage to maximize energy savings and provide up to an additional 3% to 10% energy savings.

J. Input and output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD. Switching rate may be up to 1 time per minute on the input and unlimited on the output.

K. An automatic motor adaptation test algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to run the test.

L. Galvanic and/or optical isolation shall be provided between the VFDs power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VFDs not including either galvanic or optical isolation on both analog I/O and discrete I/O shall include additional isolation modules.

M. The VFD shall minimize the audible motor noise through the use of an adjustable carrier

frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD efficiencies while reducing motor noise.

N. Protective Features

1. Protection shall be provided against input transients, loss of AC line phase, output short circuit, output ground fault, overvoltage, undervoltage, VFD overtemperature and motor overtemperature. The VFD shall display all faults as words. Codes are not acceptable.

2. The VFD shall be protected from sustained power or phase loss. The VFD shall provide full rated output with an input voltage as low as 90% of the nominal. The VFD shall continue to operate with reduced output with an input voltage as low as 164 V AC for 208/230 volt units, 313 V AC for 460 volt units, and 394 volts for 600 volts units.

3. The VFD shall incorporate a motor preheat circuit to keep the motor warm and prevent condensation build up in the stator.

4. The VFD package shall include semi-conductor rated input fuses to protect power components.

5. To prevent breakdown of the motor winding insulation, the VFD shall be designed to comply with IEC Part 34-17. Otherwise the AHU manufacturer shall ensure that inverter rated motors are supplied.

6. The VFD shall include a “signal loss detection” circuit to sense the loss of an analog input signal such as 4 to 20 mA or 2 to 10 V DC, and shall be programmable to react as desired in such an instance.

7. The VFD shall function normally when the keypad is removed while the VFD is running and continue to follow remote commands. No warnings or alarms shall be issued as a result of removing the keypad.

8. The VFD shall catch a rotating motor operating forward or reverse up to full speed.

9. The VFD shall be rated for 100,000 amp interrupting capacity (AIC).

10. The VFD shall include current sensors on all three output phases to detect and report phase loss to the motor. The VFD shall identify which of the output phases is low or lost.

11. The VFD shall continue to operate without faulting until input voltage reaches 300 V AC on 208/230 volt units, 539 V AC on 460 volt units, and 690 volts on 600 volt units.

O. Interface Features

1. Hand/Start, Off/Stop and Auto/Start selector switches shall be provided to start and stop the VFD and determine the speed reference. On units with bypass, a VFD/Off/Bypass

selector switch shall be provided.

2. The VFD shall be able to be programmed to provide a 24 V DC output signal to indicate that the VFD is in Auto/Remote mode.

3. The VFD shall provide digital manual speed control. Potentiometers are not acceptable.

4. A lockable, alphanumeric backlit display keypad shall be provided. The keypad shall be remotely mountable up to 10 feet away using standard 9-pin cable.

5. The keypads for all sizes of VFDs shall be identical and interchangeable.

6. To set up multiple VFDs, it shall be possible to upload all setup parameters to the VFDs keypad, place that keypad on all other VFDs in turn and download the setup parameters to each VFD. To facilitate setting up VFDs of various sizes, it shall be possible to download from the keypad only size independent parameters.

7. The display shall be programmable to display in English, Spanish and French at a minimum.

8. A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.

9. A quick setup menu with factory preset typical HVAC parameters shall be provided on the VFD eliminating the need for macros.

10. The VFD shall include a standard EIA-485 communications port and capabilities to be connected at a future date to a Johnson Controls N2 Metasys or Siemens FLN system at no additional cost to the owner. The connection shall be software selectable by the user.

11. At a minimum, the following points shall be controlled and/or accessible:

    a. VFD Start/Stop

    b. Speed reference

    c. Fault diagnostics

    d. Meter points

        (i) Motor power in HP

        (ii) Motor power in kW

        (iii) Motor kW-hr

        (iv) Motor current

(v) Motor voltage

(vi) Hours run

(vii) 2 Feedback signals

(viii) DC link voltage

(ix) Thermal load on motor

(x) Thermal load on VFD

(xi) Heatsink temperature

12. Four additional Form C 230 volt programmable relays shall be available for field installation within the VFD

13. LonWorks® communication shall be available for factory or field installation within the VFD.

14. Two set-point control interfaces (PID control) shall be standard in the unit. The VFD shall be able to look at two feedback signals, compare with two set-points and make various process control decisions.

15. Floating point control interface shall be provided to increase/decrease speed in response to contact closures.

16. Four simultaneous displays shall be available. They shall include frequency or speed, run time, output amps and output power. VFDs unable to show these four displays simultaneously shall provide panel meters.

17. Sleep mode shall be provided to automatically stop the VFD when its speed drops below set “sleep” level for a specified time. The VFD shall automatically restart when the speed command exceeds the set “wake” level.

18. The sleep mode shall be functional in both follower mode and PID mode.

19. A run permissive circuit shall be provided to accept a “system ready” signal to ensure that the VFD does not start until dampers or other auxiliary equipment are in the proper state for VFD operation. The run permissive circuit shall also be capable of sending an output signal as a start command to actuate external equipment before allowing the VFD to start.

20. The following displays shall be accessible from the control panel in actual units: Reference Signal Value, Output Frequency in Hz or percent, Output Amps, Motor HP, Motor kW, kWhr, Output Voltage, DC Bus Voltage, VFD Temperature in degrees, and unit CFM.

21. The display shall be programmed to read in inches of water column (in-wg).

22. The VFD shall be able to be programmed to sense the loss of load and signal a no load/broken belt warning or fault.

23. If the temperature of the VFDs heat sink rises to 80°C, the VFD shall automatically reduce its carrier frequency to reduce the heat sink temperature. If the temperature of the heat sink continues to rise the VFD shall automatically reduce its output frequency to the motor. As the VFDs heat sink temperature returns to normal, the VFD shall automatically increase the output frequency to the motor and return the carrier frequency to its normal switching speed.

24. The VFD shall have temperature controlled cooling fans for quiet operation and minimized losses.

25. The VFD shall store in memory the last 10 faults and related operational data.

26. Eight programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.

27. Two programmable relay outputs, one Form C 240 V AC, one Form A 30 V AC, shall be provided for remote indication of VFD status.

28. Three programmable analog inputs shall be provided and shall accept a direct-or-reverse acting signal. Analog reference inputs accepted shall include two voltage (0 to 10 V DC, 2 to 10 V DC) and one current (0 to 20 mA, 4 to 20 mA) input.

29. Two programmable 0 to 20 mA analog outputs shall be provided for indication of VFD status. These outputs shall be programmable for output speed, frequency, current and power. They shall also be programmable to provide a selected 24V DC status indication.

30. Under fire mode conditions, the VFD shall be able to be programmed to automatically default to a preset speed.

P. Adjustments

1. The VFD shall have an adjustable carrier frequency in steps of not less than 0.1 kHz to allow tuning the VFD to the motor.

2. A minimum of sixteen preset speeds shall be provided.

3. Four acceleration and four deceleration ramps shall be provided. Accel and decel time shall be adjustable over the range from 0 to 3,600 seconds to base speed. The shape of these curves shall be automatically contoured to ensure no-trip acceleration and deceleration.

4. Four current limit settings shall be provided.

5. If the VFD trips on one of the following conditions, the VFD shall be programmable for automatic or manual reset: undervoltage, overvoltage, current limit and inverter overload.

6. The number of restart attempts shall be selectable from 0 through 20 or infinitely and the time between attempts shall be adjustable from 0 through 600 seconds.

7. An automatic “on delay” shall be selectable from 0 to 120 seconds.

Q. Service Conditions

1. VFDs shall provide full output in an ambient temperature from -10 to 50°C (14 to 104°F).

2. VFDs shall provide full output in a relative humidity from 0 to 95%, non-condensing.

3. VFDs shall provide full output up to 3,300 feet elevation without derating.

4. VFDs shall provide full output with an AC line voltage variation from -10 to +10% of nominal voltage.

5. No side clearance shall be required for cooling of any units. All power and control wiring shall be done from the bottom.

R. Warranty

1. The VFD shall be warranted by the manufacturer for a period of 42 months from date of shipment, or 36 months from start-up, which ever occurs first. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory-authorized on-site service.

2.15 Factory-Installed Motor Wire Termination, VFD, and Combination Starter/Disconnect Enclosures

A. VFDs shall be factory mounted on the drive side of the fan section. VFD may be mounted on the interior of the unit, accessible from the unit exterior through an access door, or on the casing exterior in a NEMA Type 1 enclosure for indoor units. If not mounted on the fan section due to NEC disconnect height limitations or serviceability constraints in the mechanical equipment room, VFD may be mounted in another location other than the fan.

B. Any welds shall be properly finished with no rough edges. Enclosures shall house circuit breaker disconnects, bypass circuitry, Drive-OFF-Bypass switches, manual speed controls, and control transformers. VFDs and starter/disconnects shall have an external disconnect located on the outside of the access door.

2.16 Factory Wiring of Lights, VFDs, and Combination Starters/Disconnects

A. VFDs shall be wired per NEC, UL, and NFPA 90A requirements. Units with factory-mounted

controls shall also include power wiring from the VFD or starter/disconnect control transformer to the control system transformers. Units with VFDs and factory-mounted controls shall have a binary start-stop signal and an analog speed signal wired from the direct digital controller to the VFD.

B. All power wiring for voltages greater than 24V and traveling through multiple unit sections shall be contained in an enclosed, metal, power-wiring raceway or EMT. Sections less than 6' in length may be contained in FMC.

2.17 Factory Commissioning of VFDs and Combination Starter/Disconnects

A. After mounting and wiring of VFDs, on the AHUs, trained factory personnel shall ensure proper operation of each VFD, through a thorough factory test. Testing shall include a Hypot test of unit wiring to ensure that no weaknesses exist in wiring or motor. Each VFD shall be energized and the fan run to ensure the VFD will operate throughout the usable range of the drive and that the fan rotation is correct. Each VFD with bypass shall also be tested in the bypass position to ensure the bypass is operational.

2.18 FACTORY-ENGINEERED AUTOMATIC TEMPERATURE CONTROLS

A. Damper actuators shall be selected, provided, and mounted by the AHU manufacturer on each damper. Actuators shall be of sufficient size and quantity to ensure complete damper operation. Actuators shall be direct coupled to minimize linkage.

B. Differential pressure switches shall be provided by the AHU manufacturer. Pressure switches shall be factory installed across each filter bank for individual filters to monitor clean/dirty filter status.

C. Differential pressure gauges shall be provided by the AHU manufacturer. Pressure gauges shall be factory installed across each filter bank for individual filters. The gauge shall be diaphragm-actuated dial type.

D. A momentary push-button reset circuit using a double-pole low limit switch shall be provided by the AHU manufacturer. Low limits shall be factory engineered to maximize coil coverage. Capillary radius clips shall be used at low limit bends to ensure no crimping or wear of low limits. Low limits shall be wired to shut down the fan to protect the unit.

E. Fan status switches shall be provided and mounted by the AHU manufacturer.

F. Discharge temperature sensors shall be provided and mounted on the fans by the AHU manufacturer. Temperature sensors mounted within the AHU shall have sensor material selected to integrate with the BAS controller. Sensors shall not be proprietary and shall be readily available for long-term replacement. Sensors not acceptable for AHU installation are 1.8k ohm thermistor, 2.252k ohm thermistor, and 3k ohm thermistor.

G. Outside air temperature sensors shall be provided by the AHU manufacturer.

H. Averaging temperature sensors shall be provided by the AHU manufacturer. Sensors shall be factory engineered to accurately measure mixed air temperatures. Capillary radius clips shall

be used at capillary bends to ensure no crimping or wear of the tube. Temperature sensors mounted within the AHU shall have sensor material selected to integrate with the BAS controller. Sensors shall not be proprietary and shall be readily available for long-term replacement. Sensors not acceptable for AHU installation are 1.8k ohm thermistor, 2.252k ohm thermistor, and 3k ohm thermistor.

I. For variable-air-volume units, duct static pressure switches shall be provided by the AHU manufacturer in the unit. Switches shall be piped in the field.

J. Valves shall be provided by the AHU manufacturer. Valves shall be shipped from the valve manufacturer directly to the job site or Mechanical Contractor for installation. Electrical connections shall be provided on the valves and at the AHU coil section for field connection.

2.19 Unit DDC Controller

A. One programmable DDC controller shall be provided by the AHU manufacturer for each AHU as indicated on the schedule and drawings. Control of multiple units from a single controller is not acceptable. Each programmable DDC controller shall use the protocol specified for the BAS. Complete communications and diagnostics including all AI, BI, AO, BO, set points and alarms shall only require a twisted pair of wires between the unit controller and the BAS. Each unit controller shall be factory wired to the unit end devices. For indoor units, each controller shall have a user display touch screen for user interface. The display on indoor units shall be unit mounted in the factory. For outdoor units, one portable user display touch screen for user interface shall be provided for all controllers. Displays shall give user access to AHU status, set points and alarms.

B. The programmable DDC controller and the control components shall be selected, mounted, wired and tested by the AHU manufacturer to ensure delivery of specified performance and to minimize jobsite startup time. Testing shall be performed to ensure wiring continuity between the controller and all devices, and to ensure proper operation of the end devices. DDC controllers shall be located on unit as indicated on the drawings.

PART 3 EXECUTION

3.1 SHIPPING

A. Paper copies of the IOM shall also be shipped with each AHU.

B. The AHU manufacturer shall identify all shipments with the order number. Enough information shall be provided with each shipment to enable the Mechanical Contractor to confirm the receipt of units when they are received. For parts too small to mark individually, the AHU manufacturer shall place them in containers.

C. To protect equipment during shipment and delivery, all indoor units shall be completely stretch or shrink wrapped. Wrap shall be a minimum of 7 mil plastic. Pipe ends and pipe connection holes in the casing shall be capped or plugged prior to shipment.

D. After loading the equipment for shipment, the AHU manufacturer shall contact the shipping contact on the order and provide the name of the carrier, description of equipment, order number, shipping point, and date of shipment.

3.05 ON-SITE STORAGE

A. If equipment is to be stored for a period of time prior to installation, the Mechanical Contractor shall remove all stretch or shrink wrap from units upon receipt to prevent unit corrosion and shall either place the units in a controlled indoor environment or shall cover the units with canvas tarps and place them in a well-drained area. Covering units with plastic tarps shall not be acceptable.

3.06 FIELD EXAMINATION

A. The Mechanical Contractor shall verify that the mechanical room and/or roof are ready to receive work and the opening dimensions are as indicated on the shop drawings and contract documents.

B. The Mechanical Contractor shall verify that the proper power supply is available prior to starting of the fans.

3.07 INSTALLATION

A. The Mechanical Contractor shall be responsible to coordinate ALL installation requirements with the Owner and the Owner’s selected Mechanical Contractor to ensure that a complete installation for each unit is being provided. Coordination efforts shall include such items as unloading and hoisting requirements, field wiring requirements, field piping requirements, field ductwork requirements, requirements for assembly of field-bolted or -welded joints, and all other installation and assembly requirements.

B. The AHU manufacturer shall provide all screws and gaskets for joining of sections in the field.

C. The Mechanical Contractor shall verify that the following items have been completed prior to scheduling the AHU manufacturer's final inspection and start up:

1. All spring-isolated components have had their shipping restraints removed and the components have been leveled.

2. On all field-joined units, that all interconnections have been completed, i.e., electrical and control wiring, piping, casing joints, bolting, welding, etc.

3. All water and steam piping connections have been completed and hydrostatically tested and all water flow rates have been set in accordance with the capacities scheduled on the Drawings.

4. All ductwork connections have been completed and all ductwork has been pressure tested for its intended service.

5. All power wiring, including motor starters and disconnects, serving the unit has been completed.

6. All automatic temperature and safety controls have been completed.

7. All dampers are fully operational.

8. All shipping materials have been removed.

9. All (clean) filter media has been installed in the units.

3.08 LEVELING

A. The Mechanical Contractor shall level all unit sections in accordance with the unit manufacturer’s instructions. The Mechanical Contractor shall provide and install all necessary permanent shim material to ensure individual sections and entire assembled units are level.

3.09 FINAL INSPECTION AND START UP SERVICE

A. After the Mechanical Contractor has provided all piping connections, ductwork connections, and field control wiring, and Electrical Contractor has provided all the field power wiring, the Mechanical Contractor shall in¬spect the installation. The Mechanical Contractor shall then perform startup of the equipment.

B. The Automatic Temperature Control (Building Direct Digital Control) Contractor shall be scheduled to be at the job site at the time of the equipment start up.

C. The Mechanical Contractor, shall perform the following tests and services and submit a report outlining the results:

1. Record date, time, and person(s) performing service.

2. Lubricate all moving parts.

3. Check all motor and starter power lugs and tighten as required.

4. Verify all electrical power connections.

5. Conduct a start up inspection per the AHU manufacturer's recommendations.

6. Record fan motor voltage and amperage readings.

7. Check fan rotation and spin wheel to verify that rotation is free and does not rub or bind.

8. Check fan for excessive vibration.

9. Check V belt drive or coupling for proper alignment.

10. Check V belt drive for proper tension. Tighten the belts in accordance with the AHU manufacturer's directions. Check belt tension during the second and seventh day's operation and re-adjust belts, as may be required, to maintain proper tension as directed by the AHU manufacturer.

11. Remove all foreign loose material in ductwork leading to and from the fan and in the fan itself.

12. Disengage all shipping fasteners on vibration isolation equipment.

13. Check safety guards to insure they are properly secured.

14. Secure all access doors to the fan, the unit and the ductwork.

15. Switch electrical supply "on" and allow fan to reach full speed.

16. Physically check each fan at start up and shut down to insure no abnormal or problem conditions exist.

17. Check entering and leaving air temperatures (dry bulb and wet bulb) and simultaneously record entering and leaving chilled water temperatures and flow, steam pressures and flow, and outside air temperature.

18. Check all control sequences.

PART 4 SEQUENCE OF OPERATIONS

4.01 See plans.

END OF SECTION

SECTION 15722

HVAC COILS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Chilled Water Coils

1.2 SUBMITTALS

A. No equipment shall be fabricated or delivered until the receipt of approved shop drawings from the Owner or Owner's approved representative.

B. The AHU manufacturer shall provide appropriate sets of submittals as referenced in the General Conditions and shall submit to the Owner electronic copies of the IOM.

C. The AHU manufacturer shall list any exceptions to the specification.

1.3 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include start-up instructions, maintenance data, controls, and accessories.

1.4 QUALITY ASSURANCE

A. Air Coils: Certify capacities, pressure drops and selection procedures in accordance with current AHRI Standard 410.

B. ISO 9001 Certification.

1.6 STORAGE AND HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

B. Installing contractor shall be responsible for storing AHU in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.7 WARRANTY

A. Manufacturer shall provide, at no additional cost, a standard parts warranty that covers a period of one year from unit start-up or 18 months from shipment, whichever occurs first. This warrants that all products are free from defects in material and workmanship and shall meet the capacities and ratings set forth in the equipment manufacturer's catalog and bulletins.

PART 2 PRODUCTS

2.1 SUMMARY

A. The contractor shall furnish and install new chilled water coils as shown on plans for ERU-1 and ERU-2. The equipment shall be installed in accordance with this specification and perform at the specified conditions as scheduled.

B. APPROVED MANUFACTURERS
1. Semco
2. No other manufacturers will be allowed in this application.

2.1 CHILLED WATER COILS

A. Chilled Water Coils - Primary surface shall be round seamless 5/8 inch O.D. by 0.020 - inch thick copper tube on 1.5-inch centers, staggered in the direction of airflow. All joints shall be brazed.

B. Secondary surface - Secondary surface shall consist of 0.0060 inch rippled aluminum plate fins for higher capacity and structural strength. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Bare copper tube shall not be visible between fins and the fins shall have no openings punched in them to accumulate lint and dirt. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates.

C. Casings - Casings shall be constructed of continuous stainless steel with 3/8” diameter bolt holes for mounting on 6” centers. Coil side plates shall also be of continuous galvanized steel of reinforced flange type for greater strength and ease of stacking coils in banks.

D. Coils - Coils shall have equal pressure drop through all circuits. Coils shall be circuited for counter flow heat transfer to provide the maximum mean effective temperature difference for maximum heat transfer rates. The use of internal restrictive devices to obtain turbulent flow will not be acceptable as they prevent complete drawing of the coil and give high water pressure drop. All coils exceeding 45” FL shall be furnished with four fin angles to properly position the coil core.

E. Water Headers - Headers on coils shall be of non-ferrous materials using seamless copper tubing. The headers shall have intruded tube holes to provide a large brazing surface for maximum strength and inherent flexibility. Vent connections shall be provided at the highest point to assure proper venting.

F. Connections - The chilled water coil connection will be a carbon steel, male pipe thread type.

G. Tests - The complete coil core shall be tested with 315 psig air pressure under warm water and be suitable for operation at 250 psig working pressures. Individual tube tests and core tests before installation of headers shall not be considered satisfactory. Water-cooling coils

shall be circuited for drainability. Use of internal restrictive devices to obtain turbulent flow shall not be acceptable. Vents and drains shall be furnished on all water coils. Coils shall be rated in accordance with ARI.

H. Installation - Coils shall be mounted in stainless holding racks. Water coil supply and return connections shall be extended to the unit exterior. Water coil drain and vent connections are accessible from the interior of the unit and are not extended. Cooling coils shall be mounted in an insulated pitched 304 stainless steel condensate pan.

END OF SECTION

PRE-BID SIGN IN SHEET
HEALTH DEPARTMENT HVAC
SEPTEMBER 21, 2015 10:00AM

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