

SECTION 23 00 00

HEATING, VENTILATION AND AIR CONDITIONING

1. PART 1 – GENERAL

1.1 DESCRIPTION

- A. Work under this section includes all labor, equipment, material, services, transportation, etc. required for and reasonably incidental to the complete and satisfactory installation of all of the HVAC Systems as indicated on the Drawings or specified herein.

1.2 Work included in this section:

- A. Row-Based Cooling Systems.
- B. Exhaust Fans
- C. Grilles, Registers and Diffusers.
- D. Vibration Isolation.
- E. Test and Balance.
- F. Submittals and Shop Drawings.
- G. Record Drawings.
- H. Operation and Maintenance Manuals.
- I. Guarantee.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Electrical supply to units. See Electrical Drawings.

1.4 GENERAL REQUIREMENTS

- A. This section of the specification shall be considered as a part of the entire specification and all applicable portions of General Conditions, Special Conditions, and Division 1 shall apply.
- B. Erection: The Contractor shall furnish the services of an experienced superintendent, who shall be constantly in charge of the erection of the work, together with all necessary journeymen, helpers, and laborers required to properly unload, erect, connect, adjust, start of operate and test the work involved.

1.5 REFERENCES

- A. AABC - National Standards for Field Measurement and Instrumentation, Total System Balance.
- B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.

- C. AMCA 300 - Test code for sound rating air-moving devices.
- D. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilation System.
- E. ARI 270 - Sound rating of Outdoor Unitary Equipment.
- F. ASHRAE 52-76 - Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
- G. ASTM A90 - Weight of Coating on Zinc - Coated (Galvanized) Iron or Steel Articles.
- H. ASTM A120 - Black and Galvanized Steel Pipe.
- I. ASTM B88 - Seamless Copper Water Tube.
- J. ASTM C518 - Steady State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- K. ASTM C553 - Mineral Fiber Blanket and Felt Insulation.
- L. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.
- M. ASTM E84 - Surface Burning Characteristics of Building Materials.
- N. ASTM E96 - Water vapor Transmission of Materials.
- O. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.
- P. NFPA 255 - Surface Burning Characteristics of Building Materials.
- Q. SMACNA - Low Pressure Duct Construction Standards.
- R. UL 181 - Factory Made Air Ducts and Connectors.
- S. UL 723 - Surface Burning Characteristics of Building Materials.
- T. California Mechanical Code - 2007 Edition.

1.6 SUBMITTALS AND SHOP DRAWINGS

- A. Contractor agrees that shop drawings submittals processed by the District do not become Contract Documents and are not Change Orders; that the purpose of the shop drawing review is to establish a reporting procedure and is intended for the Contractor's convenience in organizing his work and to permit the District to monitor the Contractor's progress and understanding of the design. The process of review of the Contractor's submittals is not of testing the District's perception. If deviations, discrepancies or conflicts between shop drawings submittals and the Contract Documents are discovered either prior to or after the shop drawing submittals are processed by the District, the Contractor agrees that the Contract Documents shall control and shall be followed.
- B. Prepare and furnish fully coordinated shop drawings showing ductwork and piping on separate drawings. The drawings shall be minimum 1/4" = 1'-0" scale and shall show dimensioning of piping and ductwork from gridlines, bottom of elevation marks for ductwork and piping and fittings, valves, dampers, devices, etc. with labels. In addition, coordinate with related work and reference on the same drawings major plumbing piping, structural steel, fire protection piping, conduit runs and cable trays. Review and sign these drawings to verify coordination of related equipment. Conflicts, which occur shall be brought to the attention of the District prior to issuance of the drawings.

- C. Materials and Equipment: As soon as possible and within 35 days after award of the contract, and before their purchase, the Contractor shall submit to the District seven bound booklets for approval containing a complete list of materials, specialties and equipment he is to furnish for the installation. Literature shall be standard manufacturer's catalog cuts and items to be installed shall be clearly indicated. All submittals shall be made at one time.
- D. Each item shall be identified by manufacturer, brand and trade name, number, size, rating and whatever other data is necessary to properly identify and check the materials and equipment. The words: "as specified" will not be considered sufficient identification.
- E. Accessories, controls, finish, etc., not submitted or identified with the submitted equipment shall be furnished and installed as specified.
- F. Shop drawings shall be approved only to extent of information indicated. Approval of an item of equipment shall not be construed to mean approval for components for that item for which Contractor has provided no information.
- G. Approval of shop drawings shall not relieve Contractor of responsibility for providing all controls, wiring, components, etc. which are shown or specified, or all additional controls, wiring, components, etc. required to provide complete and correctly operating mechanical systems.
- H. Submit product data for the following manufactured products, assemblies, personnel and testing agencies required for this project.
 - 1. Row based cooling systems
 - 2. Exhaust Fans
 - 3. Diffusers, Registers and Grilles.
 - 4. Louvers.
 - 5. Controls.
 - 6. Ductwork and Accessories – Zone Dampers & Bypass Dampers
 - 7. Insulation Materials.
 - 8. Vibration Isolation.
 - 9. Detailed procedures, agenda, sample report forms, and copy of AABC National Project Performance Guarantee.

1.7 SUBSTITUTIONS

- A. Should the Contractor desire to substitute any material, equipment or other items for those specified, he shall submit a complete list, including detailed equipment layouts and performance characteristics within 35 calendar days after the scheduled Start of Construction. Said data shall be submitted in 7 copies, assembled in individual brochures.
- B. The entire cost of all changes of any type due to substitution for materials specified shall be born by the Contractor at no extra cost to the District.
- C. Unsolicited and voluntary deducts, on the part of the Contractor for substituting unapproved systems and/or equipment, shall not be considered for the purpose of awarding the Contract.
- D. The contractor shall submit the amount of cost credit to the Contract in the event the proposed substitution is accepted.
- E. In all cases where substitutions are proposed after bids are received, the Contractor shall bear the cost of evaluation on the basis of 2-1/2 times technical salaries of engineering personnel involved.

1.8 AVAILABILITY OF SPECIFIED EQUIPMENT

- A. Verify prior to bidding that all specified equipment is available and can be obtained in time for installation during orderly and timely progress of the work.
- B. In the event that specified items will not be so available, notify the District prior to receipt of bids.
- C. Costs of delays because of non-availability of specified items, when such delays could have been avoided by proper investigation on the part of the Contractor, will be back-charged as necessary and shall not be born by the District.

1.9 RECORD DRAWINGS

- A. The contractor shall arrange and pay for one set of white prints of the HVAC drawings, which he shall alter in red to show all changes made to the original layout. These drawings shall be kept current.
- B. The contractor shall deliver these completed to the District when the job is finished and accepted prior to final payment.

1.10 OPERATION AND MAINTENANCE DATA

- A. Submit two sets prior to final inspection, bound in 8-1/2 x 11 inch text pages, binders with durable plastic covers. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", and title of project. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- B. Contents: Prepare a Table of Contents with each Product or system description identified.
 - 1. Part 1: Directory listing names, addresses, and telephone numbers of District, Contractor, Subcontractors, and major equipment suppliers.
 - 2. Part 2: Operation and maintenance instructions, arranged by system. Identify the following:
 - (a) Significant design criteria.
 - (b) List of equipment.
 - (c) Parts list for each component.
 - (d) Operating instructions.
 - (e) Maintenance instructions for equipment and systems.
 - (f) Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.
- C. Submit one copy of completed volumes in final form 15 days prior to final inspection. This copy will be returned after final inspection, with District comments. Revise content of documents as required prior to final submittal.
- D. Submit final volumes (revised) within ten days after final inspection.

1.11 GUARANTEES

- A. The Contractor, in accepting this contract, binds himself to replace or repair at his own expense any defect in workmanship or material which may appear within a period of one year from the date of the final acceptance of the building, and to pay for all resulting damage which shall appear within the said period; provided always that the Contractor shall not be liable for anything attributable to acts of the agents of the District, or for ordinary wear. Also, given date of work performed by the Contractor be accepted as

complete, he shall agree to correct any deficiencies or omissions in respect to the plans or specifications which may appear in the afore-mentioned twenty-four month period.

- B. The Contractor guarantees that all piping as provided in this specification will be free from all obstructions, and that all piping will be tight and drip free.
- C. All refrigerant compressors shall carry a five-year manufacturer's warranty.

1.12 LOCAL CONDITIONS

- A. The Contractor and trade submitting tenders on this work shall visit and will be deemed to have visited the site to ensure that they are familiar with all conditions relating to the work. Failure to visit the site will in no way relieve the successful Contractor of the necessity of furnishing any material or performing any work that may be required to complete the work in accordance with the drawings and specifications without additional cost to the District.

1.13 RULES, REGULATIONS AND CODES

- A. All work and materials shall be in full accordance with the latest California Mechanical Code, California Plumbing Code, California Building Code and local rules and regulations, State Fire Marshal regulations, the safety orders of the Division of Industrial Safety; the National Electric Code; the standards of the National Fire Protection Association; American Gas Association; Occupation and Safety Act; American National Standards Institute; American Society of Mechanical Engineers; American Society for Testing and Materials; Installation Standards published by the International Association of Plumbing And Mechanical officials (IAPMO) and other applicable laws, codes, or regulations. Nothing in these specifications shall be construed to permit work not conforming to these codes.
- B. Electrical Work: Motors, electrical apparatus and wiring specified in this section shall conform to the National Electrical Manufacturer's Standards and the National Electric Code and bear the Underwriter's label of approval.
- C. The Contractor shall furnish, without extra charge, any additional material and labor when and where required to comply with these rules and regulations, though the work be not mentioned in these Specifications or shown on the Drawings. When these Specifications or Drawings call for or describe materials or construction of a better quality or larger sizes than required by the above mentioned rules and regulations, the provisions of these specifications and accompanying drawings shall take precedence.

1.14 FEES AND PERMITS

- A. The Contractor must obtain and pay all fees for permits, licenses, inspections, etc., which are required by any legally constituted authority. Coordinate exact requirements with the District prior to bid.

1.15 COORDINATION

- A. Following the general arrangement indicated on the Drawings as closely as possible, the Contractor shall coordinate with the architectural, structural, plumbing, electrical and all other trades prior to installation of the materials and equipment to verify adequate space available for installation of the work shown. The District shall be immediately notified if an area of conflict occurs between trades.
- B. The Contractor shall bear all costs incurred for work that must be relocated due to conflicts between trades.
- C. The Mechanical Contractor shall coordinate all requirements for all points of connection with the General Contractor and other trades prior to bid.

1.16 DRAWINGS

- A. The work shall be installed as indicated on Drawings, however, changes to accommodate installation of this work with other work, or in order to meet Architectural or structural conditions, shall be made without additional cost to the District.
- B. For the purpose of clarity and legibility, the Drawings are essentially diagrammatic to the extent that many offsets, bonds, unions, special fittings and exact locations are not indicated. The Contractor shall make use of all data in all of the Contract Documents, and shall verify this information at the site.

1.17 INSPECTION

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.18 DELIVERY, STORAGE AND PROTECTION OF PROPERTY

- A. Place orders for all equipment in time to prevent any delay in construction schedule or completion of project. If any materials or equipment are not ordered in time, additional charges made by equipment manufacturers to complete their equipment in time to meet construction schedule, together with any special handling charges, shall be borne by the contractor.
- B. Materials shall be delivered in ample quantities from time to time as may be necessary for the uninterrupted progress of the work. They shall be stored as to cause the least obstruction to the premises and distributed so as to prevent overloading to any portion of the structure.
- C. The Contractor shall provide temporary storage and shop areas that are required at the site for the safe and proper storage of materials, tools, and other items used in the performance of this work. These areas shall be constructed only in approved locations and shall not interfere with the work of any other Contractor.
- D. All work, equipment and materials shall be protected at all times. The Contractor shall make good all damage caused either directly or indirectly by his own workmen. The Contractor shall also protect his own work from damage. He shall close all pipe and duct openings with caps or plugs during installation. He shall protect all of his equipment and materials against dirt, water, chemical, and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.

1.19 DAMAGE BY LEAKS, ETC.

- A. The Contractor shall be responsible for all damage to any part of the premises or work of other Contractors, caused by leaks or breaks in the piping or equipment furnished and/or installed under this section, during the construction and guarantee period.

1.20 ACCESS TO EQUIPMENT FOR MAINTENANCE

- A. Install all equipment, piping, etc. to permit access for normal maintenance. Maintain easy access to filters, motors, etc. Install all such equipment and accessories to facilitate maintenance. Perform any relocation of pipes, etc. required to permit access at request of District at no additional cost to District.

- B. Furnish and install access doors or panels in walls, floors, and ceilings to permit access to equipment, dampers, and all other items requiring service. Coordinate location of access doors with other trades as required.
- C. Size access panels to allow inspection and removal of all items served.
- D. Use Milcor style as required for material in which door is installed. Where door is installed in fire rated construction, provide door bearing UL label required for condition.

2. PART 2 – PRODUCTS

2.1 GENERAL

- A. All materials and equipment shall be new and of the best of their respective grades, free from all defects and of the make, brand or quality herein specified or as accepted by the District.
- B. All materials and equipment shall be identified by manufacturer's name or nameplate data. Unidentified material or equipment shall be removed from the site.
- C. Equipment specified by manufacturer's number shall include all accessories, controls, etc., listed in the catalog as standard with the equipment. Optional or additional accessories shall be furnished as specified.
- D. Where no specific make of material or equipment is mentioned, any first class product of a reputable manufacturer may be used, provided it conforms to the requirements of the system and meets with the approval of the District.
- E. Equipment and materials damaged during transportation, installation and operation shall be considered as "totally damaged" and shall be replaced with new. Any variance from this clause shall be made only with written approval of the District.

2.2 MANUFACTURER

- A. Row-Based Cooling Systems:
 - 1. Leibert
 - 2. Or Approved Equal
- B. Exhaust Fans:
 - 1. Greenheck
 - 2. Or Approved Equal
- C. Diffusers, registers, and grilles:
 - 1. Krueger.
 - 2. Titus.
 - 3. Price.
- D. Vibration Isolation:
 - 1. Mason.
 - 2. M.W. Sausse'.
 - 3. Approved equal.

2.5 ROW-BASED COOLING SYSTEMS

- A. Air-Cooled Refrigeration Systems
 - i. The single refrigeration circuit shall include a liquid line filter drier, a refrigerant sight glass with moisture indicator, an adjustable, externally equalized expansion valve and a liquid line solenoid valve.
 - ii. The indoor evaporator refrigerant piping shall be spun shut with a nitrogen holding charge.
 - iii. Field relief of the Schrader valve shall indicate a leak-free system..
- B. Hydrophilic-Coated Evaporator Coil
 - a. The direct expansion, tilted-slab cooling coil shall have 7.25 SF face area, four or five rows deep. It shall be constructed of copper tubes and hydrophilic-coated aluminum fins. The hydrophilic coating shall significantly improve the speed of condensate drainage from the fins and shall provide superior water carryover resistance. Two stainless steel condensate pans shall be provided.
- C. Compressor.
 - a. The compressor shall be scroll-type with variable capacity operation from 20-100%, commonly known as a digital scroll.
 - b. The compressor solenoid valve shall unload the compressor to provide variable capacity operation.
 - c. The compressor shall have a suction gas-cooled motor, vibration isolators, internal thermal overloads, manual reset high-pressure switch, rota-lock service valves, low-pressure and high-pressure transducer, crankcase heater, internal centrifugal oil pump and an operating speed of 3500 rpm at 60Hz (2900rpm @ 50Hz).
 - d. The compressor shall be located outside the air stream and shall be removable and serviceable from the rear of the unit.
- D. Refrigerant
 - a. The system shall be designed for use with R410A refrigerant, which meets the U.S. Clean Air Act for phaseout of HCFC refrigerants..
- E. Low Noise Package
 - a. The low noise package shall reduce the level of sound emitted from the compressor.
 - b. The package shall consist of a 3/8 inch closed cell polymeric 4.5 – 8.5 lb/cu.ft. density compressor sound jacket that encloses the compressor.
 - c. Additional half-inch, closed cell polymeric 3-8 lb/cu.ft density sound deadening material shall be affixed to the underside of the Superior Service Access Panel located above the compressor and attached to the inner side of the compressor compartment panels that face the hot and cold aisles.
 - d. All sound deadening materials shall be non-shedding and located outside the air stream.
- F. Fan Section:
 - a. The unit shall be equipped with two plug fans: direct-driven centrifugal fans with backward-curved blades and electronically commutated DC motors; commonly referred to as EC plug fans.
 - b. The fan speed shall be variable and automatically regulated by the Liebert iCOM through all modes of operation.
 - c. Each fan shall have a dedicated motor, fault monitoring circuitry and speed controller which provides a level of redundancy.
 - d. The impellers shall be made of steel and balanced.
 - e. The EC plug fans shall be mounted on the rear door.
 - f. The entire fan assembly shall be capable of swinging out of the unit for accessibility.
 - g. The fans shall be located to blow air through the filters and tilted-slab cooling coil to ensure even air distribution and maximum coil performance.
- G. Advanced Air flow Management:
 - a. Provide a field-adjustable, modular supply air baffle system.
 - b. The modular supply air baffle system shall be located in the discharge air stream on the front of the cabinet to direct air toward the equipment racks and balance airflow requirements within the row.
 - c. The modular supply air baffle system shall have a minimum of six modular baffle segments and shall be easily reconfigurable to redirect airflow as cooling requirements change..

- H. Cabinet Construction:
 - a. The exterior panels shall be 20 gauge steel and powder coated with charcoal color paint to protect against corrosion.
 - b. The double wall side panels separate the half inch 2.0 lb/cu.ft insulation from the air stream and increase unit rigidity.
 - c. The unit shall be mounted on casters for quick installation and provided with leveling feed.
 - d. The perforated inlet and outlet panels shall have 81% open area.
 - e. The rear door shall utilize a knurr rack style handle and hinges to mirror the appearance of server racks.
- I. Serviceability:
 - a. The cabinet shall be designed so all components are easily accessible for service and maintenance through either the front or rear of the unit.
 - b. Units that are not fully accessible from front and rear or not serviceable in place shall be unacceptable.
 - c. The Superior Service Access Panel shall provide additional access to the top of the system components.
 - d. Side access shall not be required.
 - e. The variable speed EC plug fans shall be mounted on the rear door to provide access to all sides when swung out of the unit.
 - f. Units with a compressor, dual float condensate pump and canister humidifier shall have components conveniently mounted near the edge of the unit.
- J. Condensate Pumps:
 - a. Dual float condensate pump shall have a minimum capacity of 6 GPM at 30 ft. head.
 - b. The pump shall be complete with integral primary and secondary float switches, pump, motor assembly and reservoir.
 - c. The secondary float shall send a signal to the local alarm, DDC system, and shut down the unit upon high water condition.
- K. Control – Liebert iCOM microprocessor control with 9-inch color touchscreen.
 - a. General Notes
 - i. The Liebert iCOM shall be microprocessor-based with a 9" color touchscreen display and shall be mounted in an ergonomic, aesthetically pleasing housing.
 - ii. The controls shall be menu-driven.
 - iii. The system shall display user menus for active alarms, event log, graphic data, unit view/status overview (including the monitoring of room conditions, operational status in percentage of each function, date and time), total run hours, various sensors, display setup and service contacts.
 - iv. A password shall be required to make system changes.
 - v. Service menus shall include setpoints, standby settings (lead/lag), timers/sleep mode, alarm setup, sensor calibration, maintenance/wellness settings, options setup, system/network setup, auxiliary boards and diagnostics/service mode.
 - b. Password Protection:
 - i. The Liebert iCOM shall contain two unique passwords to protect against unauthorized changes. An auto hide/show feature shall allow the user to see applicable information based on the login used.
 - c. Unit Backup and Restore:
 - i. The user shall be able to create safe copies of important control parameters. The Liebert iCOM shall have the capacity for the user to automatically backup unit configuration settings to internal memory or USB storage drive. Configuration settings may be transferred to another unit for a more streamlined unit startup.
 - d. Parameter Download –
 - i. The Liebert iCOM shall enable the user to download a report that lists parameter names, factory default settings and user programmed settings in .csv format for remote reference.
 - e. Parameter Search:
 - i. The Liebert iCOM shall have search fields for efficient navigation and parameter lookup.
 - f. Setup Wizards:
 - i. The Liebert iCOM shall contain step-by-step tutorials or wizards to provide easy setup of the control.
 - g. Context-Sensitive Help:
 - i. The Liebert iCOM shall have an on-board help database. The database shall provide context-sensitive help to assist with setup and navigation of the menus.
 - h. Display Setup:

- i. The user shall be able to configure the display information based on the specific user's preference. Language, units of measure, screen contrast, home screen layout, back-light timer and the hide/show of certain readouts shall be configurable through the display.
 - i. Additional Readouts:
 - i. The display shall enable the user to configure custom widgets on the main screen. Widget options will include items such as fan speed, call for cooling, call for free-cooling, maintenance status, call for hot water reheat, call for electric reheat, call for dehumidification, call for humidification, airflow, static pressure, fluid flow rate and cooling capacity.
 - j. Status LED's
 - i. The Liebert iCOM shall show the unit's operating status using an integral LED. The LED shall indicate if the unit has an active alarm; if the unit has an active alarm that has been acknowledged; or if the unit is On, Off or in standby status.
 - k. Event Log
 - i. The Liebert iCOM shall automatically store the last 400 unit-only events (messages, warnings, and alarms).
 - l. Service Contact Information
 - i. The Liebert iCOM shall be able to store the local service or sales contact information.
 - m. Upgradeable
 - i. Liebert iCOM upgrades shall be performed through a USB connection.
 - n. Timers/Sleep Mode
 - i. The menus shall allow various customer settings for turning the unit On or Off.
 - o. Menu Layout
 - i. The menus shall be divided into two main menus: User and Service.
 - ii. The User screen shall contain the menus to access parameters required for basic unit control and setup.
 - iii. The Service screen shall be designed for service personnel and shall provide access to advanced control setup features and diagnostic information.
 - p. Sensor Calibration
 - i. The menus shall allow unit sensors to be calibrated with external sensors.
 - q. Maintenance/Wellness Settings
 - i. The menus shall allow reporting of potential component problems before they occur.
 - r. Options Setup
 - i. The menus shall provide operation settings for the installed components.
 - s. Auxiliary Boards
 - i. The menus shall allow setup of optional expansion boards.
 - t. Various Sensors:
 - i. The menus shall allow setup and display of optional custom sensors.
 - ii. The control shall include four customer accessible analog inputs for field-supplied sensors.
 - iii. The analog inputs shall accept a 4 to 20mA signal.
 - iv. The user shall be able to change the input to 0 to 5VDC or 0 to 10VDC.
 - v. The gains for each analog input shall be programmable from the front display.
 - vi. The analog inputs shall be able to be monitored from the front display.
 - u. Diagnostics/Service Mode
 - i. The Liebert iCOM control shall be provided with self-diagnostics to aid in troubleshooting. The microcontroller board shall be diagnosed and reported as pass/not pass.
 - ii. Control inputs shall be indicated as On or Off at the front display.
 - iii. Control outputs shall be able to be turned On or Off from the front display without using jumpers or a service terminal. Each control output shall be indicated by an LED on a circuit board.
- L. ALARMS
 - a. All unit alarms shall be annunciated through both audio and visual cues, clearly displayed on the screen, automatically recorded in the event log and communicated to the customers Building Management System/Building Automation System. The Liebert iCOM shall activate an audible and visual alarm in event of any of the following conditions:
 - i. High Temperature
 - ii. Low Temperature
 - iii. High Humidity
 - iv. Low Humidity
 - v. EC Fan Fault
 - vi. Change Filters

- vii. Loss of Air Flow
 - viii. Loss of Power
 - ix. Humidifier Problem
 - x. High Head Pressure
 - xi. • Low Suction Pressure
 - b. • Custom Alarms
 - i. Custom alarm inputs shall be provided to indicate facility-specific events. Custom alarms can be identified with programmable labels. Frequently used alarm inputs include:
 - 1. Leak Under Floor
 - 2. Smoke Detected
 - 3. Standby Unit On
 - ii. Each alarm (unit and custom) shall be separately enabled or disabled, selected to activate the common alarm and programmed for a time delay of 0 to 255 seconds
- M. Air Cooled Microchannel Condenser:
- a. General Notes
 - i. The condenser shall consist of microchannel condenser coil(s), propeller fan(s) direct-driven by individual fan motor(s), electrical controls, housing and mounting legs.
 - ii. The Liebert air-cooled condenser shall provide positive refrigerant head pressure control to the indoor cooling unit by adjusting heat rejection capacity.
 - iii. Microchannel coils shall provide superior heat transfer, reduce air-side pressure drop, increase energy efficiency and shall significantly reduce the system refrigerant volume required.
 - iv. EC fans and fan operating techniques shall provide reduced maximum sound levels.
 - v. Various methods shall be available to match indoor unit type, maximum outdoor design ambient and maximum sound requirements.
 - b. Condenser Coil
 - i. Liebert microchannel coils shall be constructed of aluminum microchannel tubes, fins and manifolds.
 - ii. Tubes shall be flat and contain multiple, parallel flow microchannels and span between aluminum headers.
 - iii. Full-depth, louvered aluminum fins shall fill spaces between the tubes. Tubes, fins and aluminum headers shall be oven-brazed to form a complete refrigerant-to-air heat exchanger coil.
 - iv. Copper stub pipes shall be electric resistance welded to aluminum coils and joints protected with polyolefin to seal joints from corrosive environmental elements.
 - v. Coil assemblies shall be factory leak-tested at a minimum of 300 psig (2068kPag).
 - vi. Hot gas and liquid lines shall be copper and shall be brazed using nitrogen gas flow to the stub pipes with spun-closed ends for customer piping connections.
 - vii. Complete coil/piping assembly shall be then filled and sealed with an inert gas holding charge for shipment.
 - c. Fan Motor/Blade Assembly
 - i. The fan motor/blade assembly shall have an external rotor motor, fan blades and fan/finger guard.
 - ii. Fan blades shall be constructed of cast aluminum or glass-reinforced polymeric material.
 - iii. Fan guards shall be heavy gauge, close-meshed steel wire, coated with a black, corrosion-resistant finish.
 - iv. Fan terminal blocks shall be located in an IP54 enclosure located on the top of the fan motor.
 - v. Fan assemblies shall be factory balanced, tested before shipment and mounted securely to the condenser structure.
 - d. EC Fan Motor
 - i. The EC fan motors shall be electronically commutated for variable speed operation and shall have ball bearings.
 - ii. The EC fans shall provide internal overload protection through built-in electronics.
 - iii. Each EC fan motor shall have a built-in controller and communication module, linked via RS-485 communication wire to each fan and the Premium Control Board, allowing each fan to receive and respond to precise fan speed inputs from the Premium Control Board
 - e. Electrical Controls
 - i. Electrical controls and service connection terminals shall be provided and factory-wired inside the attached control panel section.
 - ii. A locking disconnect switch shall be factory-mounted and wired to the electrical panel and controlled via an externally mounted locking and lockable door handle.

- iii. Only high-voltage supply wiring and low-voltage indoor unit communication/interlock wiring shall be required at condenser installation.
- f. Premium Control
 - i. The EC fan/Premium Control System shall include an electronic control board, EC fan motor(s) with internal overload protection, refrigerant and ambient temperature thermistors and refrigerant pressure transducers.
 - ii. The control board shall receive an indoor unit run signal via field-supplied low-voltage interlock wires to the compressor side switch via field-supplied CANbus communication wires from the indoor unit's Liebert iCOM® or via both.
 - iii. The control board shall use sensor and communication inputs to maintain refrigerant pressure by controlling each EC fan on the same refrigerant circuit to the same speed.
- g. 4.1.5 Cabinet
 - i. The condenser cabinet shall be constructed of bright aluminum sheet and divided into individual fan sections by full width baffles.
 - ii. Internal structural support members, including the coil support frame, shall be galvanized steel for strength and corrosion resistance.
 - iii. Panel doors shall be provided on two sides of each coil/fan section to permit coil cleaning.
 - iv. An electrical panel shall be contained inside a factory mounted, NEMA 3R weatherproof electrical enclosure.
- h. Mounting Legs
 - i. Galvanized Steel Legs with Bracing
 - 1. Condensers shall be shipped with 48in. (1219mm) mounting legs with stabilization bracing. Legs, bracing and hardware shall be galvanized steel.

2.6 ROOF-TOP EXHAUST FANS

- A. Centrifugal Fan Unit: V-belt driven.
- B. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
- C. Accessories
 - 1. See equipment schedules.

2.7 DUCTWORK AND ACCESSORIES

- D. General: Non-combustible or conforming to requirements for Class 1 air duct materials, or UL 181.
- E. Steel Ducts: ASTM A525 or ASTM A527 galvanized steel sheet, lock-forming quality, having zinc coating of 1.25 oz per sq ft for each side in conformance with ASTM A90. Round duct shall be spiral seam construction.
- F. Flexible Ducts: Interlocking spiral of galvanized steel or aluminum construction; rated to (2 inches WG positive and 1.5 inches WG negative for low pressure ducts) (and 15 inches WG positive or negative for medium high pressure ducts.)
- G. Insulated Flexible Ducts: Flexible duct wrapped with flexible glass fiber insulation, enclosed by Pressure Ductwork: seamless aluminum pigmented plastic vapor barrier jacket; maximum 0.23 K value at 75 degrees F w/metal connectors.
- H. Fasteners: Rivets, bolts, or sheet metal screws.
- I. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

- J. Hanger Rod: Steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
- K. Paint exposed surfaces, whether or not colors are designated in schedules, except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surface. If color or finish is not designated, the Owner's Representative is select from standard colors or finishes available. Painting includes field painting exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
- L. Low Pressure Ducts:
 1. Fabricate and support in accordance with 2007 CMC, SMACNA Low Pressure Duct Construction Standards and ASHRAE handbooks, except as indicated. Gages for galvanized steel ducts for low pressure systems where velocities do not exceed 2000 FPM shall be as follows:

RECTANGULAR DUCT		ROUND DUCT	
<u>Dimension of Largest Side (L) in Inches</u>	<u>Gage</u>	<u>Diameter (D) In Inches</u>	<u>Ga.</u>
$L \leq 12$	26	$D < 9$	26
$12 \leq L \leq 30$	24	$9 \leq D < 14$	24
$30 < L \leq 54$	22	$14 \leq D < 23$	22
$54 < L \leq 84$	20	$23 \leq D < 37$	20
$84 < L$	18	$37 \leq D < 51$	18
		$51 \leq D < 61$	16
		$61 \leq D < 84$	14

All joint and seam constructions as indicated in the CMC are acceptable.

2. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission.
 3. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide turning vanes.
 4. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.
 5. Use double nuts and lock washers on threaded rod supports.
- M. Volume Control Dampers:
 1. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.
 2. Opposed blade dampers shall have factory-fabricated blades, with factory assembled linkages, mounted in frames. Blades shall have interlocking edges and ends. Rectangular dampers 6" or more wide, shall be the multi-blade type. Blades on multi-blade type dampers must not be over 6" wide. Dampers shall be of the opposed blade type. Dampers shall have bar or channel frames and corner bracing. All blade and linkage bearings shall be self lubricating plastic. Damper assembly leakage not to exceed 1% with 4.0 W.C. static pressure.
 3. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 4. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
 - N. Duct Test Holes:
 1. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

- O. Diffusers, Supply Registers, Return Registers, and Exhaust Grilles:
 - 1. Fabricate of steel with steel or aluminum frame and baked enamel off-white finish.
 - 2. Provide opposed blade damper and multi-louvered equalizing grid with damper adjustable from diffuser face as indicated on the drawings.
 - 3. Ceiling Supply Diffusers (SD): Krueger Model 124O or approved equal, with 4-way throw, with balancing damper, or approved equal.
 - 4. Exposed Round Supply Diffuser (SD): Krueger Model RA-2 concentric round or approved equal, with adjustable throw, with volume damper.
 - 5. Wall Supply Register (SR) and Wall or Ceiling Exhaust or Return grille (EG) or (RG): Krueger Type 88OH double deflection type and S8OH fixed bar-type or approved equal. Constructed of steel with opposed blade damper.
 - 6. Heavy Duty Wall Return or Exhaust Register (RG) or (EG): Krueger Type 480H Heavy Duty fixed blade or approved equal. Provide opposed blade damper as required.

2.8 CONTROLS

- A. The Mechanical Contractor shall be responsible for the proper coordination of all control work and electrical work in connection therewith. He shall also be responsible for the proper operation of the entire system.
- B. The Electrical Contractor shall furnish and install all line voltage control wiring, and in all conduit. Wire sizing and length of run shall be coordinated with the manufacturer and Electrical Engineer. All EMS controls, wiring, and conduit shall be by EMS contractor.
- C. Electrical Work: All electric relays, hand-off automatic switches and all electrical wiring and all conduit will be provided under the Electrical Section, except as otherwise specified. Furnish and install additional conduit, wiring, relays, hand-off automatic switches made necessary by the use of approved substituted equipment under this Section with no additional cost to the Owner.
- D. Refer to drawings for control diagrams and additional requirements.
- E. Where stand-alone controls are indicated, mechanical contractor shall be responsible for low voltage controls conduit, wiring, and thermostat.

2.9 INSULATION

- A. General:
 - 1. All insulation shall have composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to the insulation) fire smoke hazard ratings as tested by procedure ASTM E84, NFPA 255 and UL 723 not exceeding:

Flame Spread:	25
Smoke Developed:	50
 - 2. All products or their shipping cartons shall bear a label indicating that flame and smoke ratings do not exceed above requirements. Any treatment of jackets or facings to impart flame and smoke safety shall meet the above requirements.
 - 3. The Contractor shall certify that all products used have met the above criteria.
 - 4. The insulation values shown are a minimum. If the requirements of Title 24 exceed these values, the amount of and/or type must be increased to meet the Title 24 requirements.
- B. Duct Insulation:
 - 1. Fiberglass Duct Wrap:

- (a) Insulation: ASTM C553; flexible, noncombustible blanket.
 - (1) 'K' value: ASTM C518, 0.48 at 75 degrees F.
 - (2) Maximum service temperature: 250 degrees F.
 - (3) Density: 0.75 lb/ ft3.
 - (b) Vapor Barrier Jacket:
 - (1) Kraft paper reinforced with glass fiber yarn and bonded to aluminized film vinyl.
 - (2) Moisture vapor transmission: ASTM E96; 0.5 perm.
 - (3) Secure with pressure sensitive tape.
 - (c) Vapor Barrier Tape: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
 - (d) Tile Wire: Annealed steel, 16 gage.
2. Glass Fiber Duct Liner, Flexible:
- (a) Insulation: ASTM C553; flexible, noncombustible blanket.
 - (1) 'K' value: ASTM C518, 0.24 at 75 degrees F.
 - (2) Maximum service temperature: 250 degrees F.
 - (3) Density: 1.5 to 3.0 lb/ft3.
 - (4) Maximum Velocity on Coated Air Side: 4,000 ft/min.
 - (b) Adhesive: Waterproof (fire-retardant) type.
 - (c) Liner Fasteners: Galvanized steel, self-adhesive pad.
3. Glass Fiber Duct Liner, Rigid:
- (a) Insulation: ASTM C612; semi-rigid, noncombustible.
 - (1) 'K' value: ASTM C518, 0.24 at 75 degrees F.
 - (2) Maximum service temperature: 250 degrees F.
 - (3) Density: 1.5 to 3.0 lb/cu ft.
 - (4) Maximum Velocity on Coated Air Side: 4,000.
 - (b) Adhesive: Waterproof (fire-retardant) type.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install all equipment in locations indicated on the Drawings. Contractor will be responsible to verify with the District, if suitability is doubted. Contractor shall notify the District before installation into any apparent improper locations of interference with other work such as electrical outlets, windows, cabinetwork or other features.

3.2 INSTALLATION

- A. High Volume, Low Speed, Ceiling Fans:

1. Preparation

- a. The fan location shall have an appropriate ceiling-mounted outlet box marked, "Acceptable for Fan Support".

- b. Install the ceiling fan per manufacturer's installation requirements and guidelines.
 - c. Fans shall be located free from obstacles such as lights, cables, or other building components.
 - d. Contractor shall coordinate the location of the ceiling-mounted outlet box.
2. Installation:
- a. Install the fan according to the manufacturer's installation guide, which includes acceptable mounting methods.
 - b. Fans shall have the minimum distances away from obstacles:
 - i. Airfoils shall be a minimum of 7 ft. above the finished floor.
 - ii. Airfoils shall be provided a minimum of 2 ft clearance from any/all obstructions.
 - c. Fans shall not be located where it will be continuously subjected to wind gusts or in close proximity to the outputs of HVAC systems or radiant heaters.
- B. Ductwork and Accessories:
- 1. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
 - 2. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
 - 3. Install accessories in accordance with manufacturer's instructions and to meet the provisions of SMACNA "Seismic Restraint Manual: Guidelines For Mechanical Systems," Latest Edition.
 - 4. Provide balancing dampers at points on low-pressure supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Use splitter dampers only where indicated.
 - 5. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.
 - 6. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated. Provide minimum 12 x 12 inch size for hand access, 30 x 30 inch size for shoulder access, and as indicated.
 - 7. Provide duct test holes where indicated and required for testing and balancing purposes.
 - 8. Check location of outlets and inlets and make necessary adjustments in position to conform to Architectural features, symmetry, and lighting arrangement.
 - 9. Install diffusers to ductwork with airtight connection.
 - 10. Provide balancing dampers on duct take-off to diffusers and registers, regardless of whether dampers are specified as part of the diffuser, or register assembly.
 - 11. Paint ductwork visible behind air outlets and inlets matte black.
- C. Thermostats and over-ride switches: Install at 48" above finished floor to top of thermostat unless otherwise stated. Coordinate with other trades.
- D. Insulation:
- 1. Duct Insulation:
 - (a) Unless specifically indicated on the drawings the Contractor may line or wrap ductwork to meet insulation requirements.

- (b) Fiberglass ductwrap:
 - (1) Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
 - (2) Secure insulation without vapor barrier with staples, tape, or wires.
 - (3) Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
 - (4) Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
 - (5) Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- (c) Duct (and Plenum) liner Application:
 - (1) Install as indicated (sound lining) on the drawings.
 - (2) Adhere insulation with adhesive for 100 percent coverage. Secure insulation with mechanical liner fasteners. Refer to SMACNA Standards for spacing. Seal and smooth joints. Seal liner surface penetrations with adhesive.
 - (3) Duct dimensions indicated are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.

3.3 AIR SYSTEM TEST AND BALANCE

- A. Perform all tests to the entire satisfaction of the District. Air balancing contractor shall notify District one week prior to scheduling air balance at the site.
- B. Regulating and Adjusting Air Systems:
 - 1. The Contractor shall have an experienced independent testing company certified member of the Associated Air Balance Council (A.A.B.C.) specializing in air conditioning system testing completely balance the air systems so that the volume of air indicated on the drawings is being delivered to the outlets. He shall adjust and re-adjust this part of the work until the operation complies with the requirements of the drawings and specifications.
 - 2. Testing Procedure: Procedures shall conform to A.A.B.C. standards. Provide reports in sort cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
 - 3. The following test data shall be taken and three (3) copies submitted in tabulated form to the Architect for each system:
 - (a) Test and adjust all supply, return & exhaust blower RPM to design requirements.
 - (b) Test and record all motor full load amperes.
 - (c) Test and record system static pressures, suction and discharge.
 - (d) Test and adjust system for design re-circulated air, CFM.
 - (e) Test and adjust system for design CFM outside air.
 - (f) Adjust all supply, return and exhaust outlets to within 5% of design CFM.

3.4 SOUND AND VIBRATION ISOLATION

- A. All vibrating equipment shall be sound isolated from the structure.
- B. The Contractor shall submit all necessary data for each vibration isolator, including static deflection and weight loading, for equipment in operation.

- C. All vibrating equipment shall be provided with flexible pipe connections. Submit for approval prior to installation.

END OF SECTION