MicroClimate Control Unit® Specifications:

1 Specification Data

1.1 The AUTOMATION & CONTROL CONCEPTS MicroClimate Control Unit® is a micro-sized environmental control package that provides cooling, heating, dehumidification, humidification, high efficiency particulate control and gas-phase absorption pollution control. The Unit shall function to independently control and maintain multiple environments.

1.2 The Micro Climate Control Unit shall be ETL Listed and shall bear the rating agency label on entire unit assembly. The Unit includes compressors, dehumidification / cooling coil, condenser coil, hot gas reheat coil, refrigerant receiver, refrigeration head pressure controls, supply air fan, condenser fan (if air cooled), supply and condenser fan motors, high efficiency particulate and gas-phase filter system, mechanical and micro-processor controls. Unit shall be shipped in one piece construction designed for indoor or outdoor installation complete with compressor section, supply fan section, coil section, filter section, condenser section, intake section and discharge plenum section. Unit shall be weatherproof type without screw penetrations in horizontal plane of top, designed for curb or pad installation. Unit shall include access doors for cleaning and service access, with sufficient space inside the cabinet to make all piping connections and insulation coverings and space downstream of wet surface coils to allow for access to fin area for cleaning.

2 Modes Of Operation

Upon "SYSTEM START", the refrigerant cooling system shall start and run continuously. The system shall detect the incoming air temperature and humidity and determine if one compressor or two compressors are required to cool the air to 45° F (normal operation will require one compressor; if the building conditions are above normal, the second compressor is required to provide additional capacity. Each compressor is on an independent refrigeration circuit. The first compressor on (normal operation) is connected to the last evaporator coil in the air stream, to provide the final cooling. The second compressor (building out of spec operation) is connected to the first evaporator coil in the air stream and is used to precool the air to the second evaporator coil. Each refrigeration circuit is provided with an electronic hot gas bypass valve to maintain proper discharge air temperatures from the evaporator coils. The electronic hot gas (discharge) bypass valves shall be modulated, using proportional-integral-derivative (PID) control, to maintain 64°F discharge air temperature from the first evaporator coil and to maintain 45° F discharge air temperature from the second evaporator coil. The unit is also provided with an electronic hot gas reheat valve to maintain proper discharge air temperatures from the unit. This valve directs hot discharge gas from the compressor to a hot gas reheat coil positioned downstream of the second evaporator coil, where the air is reheated with this free energy source. The unit leaving air temperature is controlled using proportional-integral-derivative (PID) control, based on the calculated value from the higher of either the discharge dewpoint temperature based on the exhibit case average dehumidification demand or the discharge air temperature based on the highest case cooling demand. The control loop shall be a cascaded loop that will reset discharge air dewpoint setpoint based on the average exhibit case relative humidity or discharged air temperature setpoint based on the highest case temperature.

3 Products

3.1 Acceptable Manufacturers:

3.2 No Equal: Specified unit manufacturer shall be AUTOMATION & CONTROL CONCEPTS LLC., MicroClimate Control Unit® Series, with performance and capabilities per unit schedule, no equal.

3.3 Base Bid, Alternate: Specified base bid unit manufacturer shall be AUTOMATION & CONTROL CONCEPTS LLC., MicroClimate Control Unit® Series, with performance and capacities per unit schedule.

3.4 Add or deduct alternate may be substituted as indicated on the bid forms, subject to the following conditions:

3.5 Substitutions shall include a full disclosure (by paragraph and schedule) to be submitted with submittals. Full disclosure shall clearly list and define any exceptions or deviations to the specified equipment and performance.

3.6 Provide a detailed schedule comparison with explanations in any performance deviations.

3.7 Alternate bid shall include equipment layout, ventilation, piping, electrical, and control connections. The unit must fit in the allocated space as specified.

3.8 Any additional work and related expense resulting from the installation of alternate equipment shall be the responsibility of the installing mechanical contractor.

3.9 Alternate equipment must be bid as such with full submittals and approved by the design engineer ten (10) days prior to bid date no exceptions.

4 Refrigerant: Units to be provided with non-ozone depleting HFC refrigerant. The use of CFC or HCFC refrigerants shall not be acceptable.

5 Unit Description

5.1 BASE: The unit base shall be minimum 14 gauge galvanized steel formed channels fitted with cross members to support all interior components and equipped with lifting lugs or fork slots for rigging. The base assembly shall be arc welded to form a unitized assembly for support of coils, filter, compressors, fans, controls and accessories as required. All welds shall be painted with a zinc rich paint for corrosion protection.

5.2 FLOOR: The unit floor shall be minimum 14 gauge galvanized steel. The floor shall be attached to the unit base with gasketed stainless steel fasteners.

5.3 DRAIN PAN: The primary drain pan shall be 3” deep fabricated of 18 gauge welded 304 stainless steel with ¾” MPT stainless pipe drain connections, and shall be pitched to provide full drainage of pan through side connection. Pans shall be configured to allow washing of entire pan area while preventing accumulation of debris at bottom of pan.

5.4 CASING

Unit shall be fabricated with double wall construction, with .063” aluminum inner and

0.080” aluminum outer casing panels, internally insulated with 1” thick, 2 #/ft3, Polyisocyanurate CFC-Free foam insulation with an overall R Value of 6.5. All exposed surfaces such as angles, braces, etc. in contact with exterior surfaces shall be covered with insulation in such a manner to prevent condensation on the exterior casing. All insulation and accessories including adhesives shall have a composite fire and smoke hazard rating tested by ASTM E84, NFPA 225, and UL 723 not exceeding: Flame Spread 25, Smoke Developed 50.

Outer casing panels shall be die formed, lock forming quality and secured to inner casing framework with gasketed, stainless steel fasteners. Panels in the unit coil section shall be removable for coil pull access. All panels shall be gasketed or sealed with silicone sealant to provide an airtight enclosure.

5.5 ACCESS DOORS: Access doors shall be double wall, flush mounted and fitted with Ventlok type cast aluminum cam-action handles. Access doors shall be constructed in the same manner as the casing panels. Outdoor units shall include drip gutters over each access door.

5.6 FANS: The supply fan shall be Plenum type with airfoil blade, Class I, designed without an involute housing, with a turned, ground and polished solid steel shaft rated at maximum RPM below critical speed. Fan wheel and drive sheaves shall be keyed to the shaft. Fan shall be rated in accordance with AMCA 210 for performance and AMCA 300 for sound. The fan shall be provided with a safety cage and inlet guard that meet OSHA standards.

5.7 Bearings shall be pillow block, self aligning type ball or roller bearings selected for 50,000 hours average life under specified load and speed conditions. Bearing lubrication lines shall be extended to access door side of unit for lubrication from one location. Fan shall be IRD balanced after assembly.

5.8 The entire fan, drive and motor assembly shall be mounted on a heavy gauge galvanized steel frame.

5.9 ISOLATION: The entire supply air fan assembly shall be internally 1” deflection seismic spring isolated with neoprene flex connection on fan inlet.

5.10 MOTORS: Motors shall be NEMA design B T-frame with open drip proof fan cooled enclosures, insulated for 40 degrees C ambient continuous duty with ball bearings and 1.15 service factor. The motors shall be tested to IEEE standard 112 test method B and NEMA MG1 12.53. Each motor shall be mounted on an adjustable type motor mount inside the unit casing.

5.11 DRIVES: V-belt fan drives shall be selected for 150% of motor nameplate horsepower. Drives shall be inside air handler cabinet to provide safety protection. The supply fan motor sheave shall be adjustable pitch type.

5.12 INDOOR CONDENSER FANS: Condenser fan shall be forward curved housed blower, with blades and hub fabricated from galvanized steel for corrosion resistance, efficiency and strength. The blade shanks shall be fully supported by the hub. A metal hub insert is to transfer the motor torque to the propeller. The complete blower assembly shall be balanced and run tested at full speed. The entire fan, drive and motor assembly shall be mounted on a heavy gauge structural frame and isolated with vibration isolators. All hardware shall be zinc plated for corrosion resistance. The fan shall be direct driven by 1750 rpm ODP NEMA design B T-frame motors with permanently lubricated and sealed

ball bearings. The fans shall be rated in accordance with AMCA 210 for performance.

5.13 OUTDOOR CONDENSER FANS: Condenser fans shall be multi-blade axial airfoil propeller type, with blades and hub fabricated from aluminum or corrosion resistant engineering grade resins, precision injection molded for maximum efficiency and strength. The blade shanks shall be fully supported by the hub, and pitch adjustment to be provided by a brass collar with set screw sonically inserted into the hub. A metal hub insert is to transfer the motor torque to the propeller. The complete propeller assembly shall be balanced and run tested at full speed. The fan assembly shall include a heavy gauge steel frame with elliptical spun orifice, steel motor supports and mounting plate all finished with a baked enamel. All hardware shall be zinc plated for corrosion resistance. Fan guards shall comply with OSHA safety specifications and shall be heavy gauge concentric wire rings welded to radial support struts finished with a baked polyester powder and bolted to stand-offs at each corner for ease of removal. The fans shall be direct driven by 1160 rpm TEFC NEMA design B T-frame motors with permantly lubricated and sealed ball bearings. The fans shall be rated in accordance with AMCA 210 for performance.

5.14 EVAPORATIVE COIL PACK

5.15 Unit shall be provided with an Evaporative Coil Pack that shall provide a continuous amount of cooling and heat recovery that will not cause varying discharge air temperatures from the unit under varying load conditions. Heat exchanger coils shall be constructed of 3/8” minimum OD seamless copper tubes with .0055” thick formed aluminum fins. Headers shall be seamless copper with non-ferrous connections. Coil casings shall be minimum 18-gauge die-formed galvanized steel flanges and shall be provided with a removable casing panel for access to the fins for cleaning. Coils shall be leak tested at 315 lb. pressure under water, suitable for 200-PSI working pressure and be manufacturer certified as complying with ARI STD 410. Distributors shall be venturi type. Unit shall be provided with cascade coil configuration with a minimum of two independent refrigeration circuits to assure design dew point is achieved on the process air stream under full and part load conditions. Interlaced and face split coils are not acceptable. The minimum allowable fin spacing is 10 fins per inch and the maximum allowable fin spacing is 12 fins per inch.

5.16 Unit shall be provided with cascade coil configuration utilizing two evaporator coils and a refrigerant hot gas reheat coil with a minimum of two independent refrigeration circuits to assure design dew point and full reheat are achieved on the process air stream under full and part load conditions. All coils shall affect the full air stream and shall be sized for 300 fpm face velocity. The evaporator coils shall contain no less than 6 rows to assure efficient operation and maximum control under all load conditions. Interlaced and face split coils are not acceptable. The coils shall be assembled in such a manner as to create an air tunnel inside the unit that isolates the temperature extremes from the unit casing exterior. The hot gas reheat coil shall be positioned a minimum of 5 inches downstream of the evaporator coils to provide access for cleaning. The coil pack shall be provided with a removable access panel to facilitate cleaning of the wet surface coils.

6 REFRIGERATION SYSTEM

6.1 Compressors shall be fully hermetic scroll type mounted on compressor manufacturer’s rubber vibration isolators. Each compressor shall be on an isolated refrigerant circuit. Compressors shall be mounted in a compartment isolated from the process air stream to prevent noise transmission into the supply air stream.

6.2 Each refrigerant circuit shall be controlled by a thermal expansion valve and include a liquid line filter drier with replaceable cores, equipped with shut-off valves to isolate the drier without evacuating the unit, liquid receiver, analog hot gas bypass valve, analog hot gas reheat valve, Schraeder type service fittings on both the high side and low pressure sides of the system, floodback head pressure controls, high and low pressure transducers and suction and discharge line temperature sensors.

6.3 Compressors shall be mounted in a compartment isolated from the process air-stream to permit normal operation of the unit when the compartment is open and to prevent noise transmission into the supply air-stream or building area.

6.4 Unit shall maintain 68° F and 45% r.h. with a daily maximum fluctuation of +/- 1° F and +/- 1% r.h. in the controlled environment.

6.5 HOT GAS REHEAT COIL: The unit shall be provided with a hot gas reheat coil positioned downstream of the evaporator coils to reheat the discharge air to a controllable temperature. The hot gas reheat coil shall be constructed of 3/8" minimum OD seamless copper tubes with .0055" thick formed aluminum fins. Headers shall be seamless copper with non-ferrous connections. Coil casings shall be minimum 18-gauge die-formed galvanized steel flange. The unit shall use analog controlled modulating refrigerant flow controls to provide the amount of reheat provided. The electronic flow controls shall be modulated by the unit's internal controller to maintain a constant discharge air temperature +/- 0.5° F under any conditions.

6.6 CONDENSER COIL: Air cooled units shall be provided with a hot gas condenser coil positioned in a separate section of the unit to reject the waste heat of the refrigeration system. The condenser coil shall be constructed of 3/8" minimum OD seamless copper tubes with .0055" thick formed aluminum fins. Headers shall be seamless copper with non-ferrous connections. Coil casings shall be minimum 18-gauge die-formed galvanized steel flange. Each refrigeration circuit shall be provided with a condenser coil. Water cooled units shall be provided with coaxial tube-in-tube condensers. The heat exchangers shall be provided with cupro-nickel tubes and carbon steel shell.

7 **FILTERS**: The Unit shall be furnished with 2" 30% pleated media pre-filters for the supply fan, 12" 90 – 92% arrestance, 99.97% DOP efficiency HEPA filters and an 18" gaseous pollutant filter with a 50% Activated Carbon / 50% Potassium permanganate impregnated activated alumina media. Filters shall be mounted in side access racks. The HEPA and Activated Carbon filters shall be positioned downstream of all other air-stream components.

8 **RATIO-METRIC VOLUME COMPENSATOR** (max life on carbon filter) Units shall be provided with ratio-metric volume compensator (RVC) that shall maintain unit airflow to design conditions regardless of internal or external temperature, turbulence, air density, humidity, duct leakage, static pressure drop, varying voltage or other forces acting on unit. RVC device shall utilize self-correcting DC powered modules incorporating self-averaging aluminum airflow traverse with Fechhelmer offset copper static pressure sensors on averaging manifold, and shall operate in full compliance with Standard IEEE 519 for harmonic and current distortion and FCC Part 15 subpart J specifications on RFI/EMI disturbances.

8.1 RVC shall generate fully autarchic analog signal utilizing both static and velocity pressures and shall be self-controlling via variable voltage DC rectifier circuitry, differential pressure transmitter, square root extractor and scaling multiplier, and shall include transformer, MOV and minimizer circuit for line notch reduction. RVC shall not create objectionable

acoustic noise or audible or objectionable electronic noise throughout entire operating range, and shall not cause the creation of generation of additional motor heat or noise under any conditions.

8.2 RVC shall be immune to electronic line noise generated by other electronic equipment or turbulent airflow. Regulation of RVC shall be continuously accurate from 1 to 100% of its operating range within +/- 0.5% accuracy with a 0.5 second response time for 98% full span step. RVC shall be suitable for installation and operation in a 99% rh saturated turbulent air-stream and shall automatically resume volume compensation following power restoration after total power failure to unit.

8.3 RVC shall operate in automatic or manual operation and shall fully interface with unit microprocessor control or be able to operate in a stand alone configuration. RVC device shall provide soft-start for the motor with a gradual ramp up to required speed.

9 **ELECTRICAL - MOTOR CONTROL/STARTER PACKAGE**: Each unit shall be equipped with a motor control/starter package which includes a NEMA 1 metal enclosure with hinged door, single point power connection, external unit "HAND-OFF-AUTO" selector switch, magnetic across-the-line starters with 3 phase overload protection for each motor, programmable microprocessor controller, auxiliary contacts, smoke and fire alarm interlock contacts for unit shut-off, 24 Volt internal control transformer, transformer primary fusing, terminal blocks and phase failure, reversal and undervoltage protection.

9.1 All wiring in the enclosure and to fan motor and compressor shall be THHN stranded copper wires - 600 volt rated. Enclosure to motor wiring shall be run in flexible metal conduit where exposed to process air stream. The control enclosure shall be mounted in a compartment with access door isolated from the process air stream and shall have single point power connection.

10 **SYSTEM MICROPROCESSOR CONTROLLER**: The Microprocessor Control Unit (MCU) shall be a stand-alone, fully flexible microprocessor panel for monitoring, control, real time-based scheduling, trend logging and alarm notification. The MCU shall operate in "C" language and shall have Windows7 based Visual C++7 programming for PC interface. The MCU shall communicate to all other MCU devices and support real time color graphics. The MCU shall be panel mounted in the unit electrical control/starter panel, shall be UL listed, have an Intel 80c196, 8 bit, 12 Mhz microprocessor, 64K battery backed up RAM, non-volatile 8 K EEPROM memory, 16 key keypad and 2 line by 16 character backlit LCD menu driven display of operating parameters, 15 level password access, alarm history screen, automatic daylight savings time fall back-spring forward scheduling, battery backed up clock, RS232 port for host computer operating at 19200 baud and two RS485 long distance communications ports operating at 38,400 baud. The MCU shall be provided with a modem that operates at 14400 bps with programming for automatic call out notification on alarm of all MCU's in communication, fused isolation of digital inputs and outputs and power requirements of 120 VAC, 50/60 Hz.

10.1 The microprocessor controller shall provide the following functions: opening, modulation and closing of outside air damper; sequencing of supply air and condenser fans; control over IBVC device; sequencing of compressors; separate and distinct control of ventilation cooling and space dehumidification; sequencing of heat; time delay relay/anti-short cycle protection of compressors; alarm notification and historical data recording; and interlock of supply fan that prevents operation of the fan should the access door to the fan section be opened. The programming shall include real time color graphics representation of the unit's operation and data points, and one year remote alarm monitoring and trend log

reporting shall be included.

11 ALARM AND HISTORICAL TREND LOGGING

11.1 The microprocessor shall provide a digital output alarm signal and record historical data for the following conditions:

1. Air flow is below requirement when fan motor is called for.
2. Compressors do not operate when called for.
3. Compressor high pressure switch is open and stops compressor.
4. Compressor low pressure condition that causes a failure mode.
5. Fan or compressor motor overload is open and motor operation is called for.
6. Outside air cfm supplied to space Trend Log.
7. Electric heat failure

12 **START-UP AND WARRANTY**: Unit manufacturer shall factory run test and owner technician training on units at completion of manufacture. The unit manufacturer shall provide a two year warranty on workmanship and materials and an additional three year compressor parts warranty (labor is not included). Filter and belt replacements and change-outs are not included in warranty service and are responsibility of the owner.

13 OPTIONS

13.1 CORROSION PROTECTIVE COATINGS: Unit shall be provided with optional Corrosion Protective Coating Packages as specified on schedules. Coil Package shall have baked on ElectroFin polymeric coating applied in a submersion / dip process on all copper tube / aluminum fin coils.

13.2 ELECTRIC MAIN POWER DISCONNECT SWITCH

13.3 The unit shall be provided with a factory installed electrical service disconnect switch. The switch shall be non-fused, three blade type in a NEMA-3R housing on outdoor units and a NEMA-1 housing on indoor units, and shall be mounted on the outside of the unit.

13.4 ULTRAVIOLET LIGHTS: The unit shall be provided with a factory installed ultraviolet lamps for microbial control of the drain pan and cooling coils. The lamps shall be UVC emitter type manufactured by Steril-Aire and shall be installed in the unit so as to bathe the leaving air side of the cooling coils and the entering air side of the reheat coils. The lamps shall be wired to a separate transformer in the unit’s control panel.