10) PHASE MONITOR: PHASE MONITOR SHALL PROVIDE 100% PROTECTION FOR MOTORS AND COMPRESSORS AGAINST PROBLEMS CAUSED BY PHASE LOSS, PHASE IMBALANCE, AND PHASE REVERSAL. PHASE MONITOR IS EQUIPPED WITH AN LED THAT PROVIDES AN ON OR FAULT INDICATOR. THERE ARE NO FIELD ADJUSTMENTS. THE MODULE WILL AUTOMATICALLY RESET FROM A FAULT CONDITION.

11) FILTERS: ALL UNIT FILTERS SHALL BE MIN. 4" THICK MERV-13 RATED.

12) CONTROLS: UNIT SHALL BE COMPLETELY FACTORY-WIRED WITH NECESSARY CONTROLS AND CONTACTOR PRESSURE LUGS OR TERMINAL BLOCK FOR POWER WIRING. UNIT SHALL PROVIDE AN EXTERNAL LOCATION FOR MOUNTING A FUSED DISCONNECT DEVICE. A CHOICE OF MICROPROCESSOR OR ELECTROMECHANICAL CONTROLS SHALL BE AVAILABLE. MICROPROCESSOR CONTROLS PROVIDE FOR VOLT CONTROL FUNCTIONS. THE RESIDENT CONTROL ALGORITHMS SHALL MAKE ALL HEATING, COOLING, AND/OR VENTILATING DECISIONS IN RESPONSE TO ELECTRONIC SIGNALS FROM SENSORS MEASURING INDOOR AND OUTDOOR TEMPERATURES. THE CONTROL ALGORITHM MAINTAINS ACCURATE TEMPERATURE CONTROL, MINIMIZES DRIFT FROM SET POINT, AND PROVIDES BETTER BUILDING COMFORT. A CENTRALIZED MICROPROCESSOR SHALL PROVIDE ANTI-SHORT CYCLE TIMING AND TIME DELAY BETWEEN COMPRESSORS TO PROVIDE A HIGHER LEVEL OF MACHINE PROTECTION.

B. VAV BOXES

1) FURNISH AND INSTALL TITUS MODEL DESV SINGLE DUCT, VARIABLE AIR VOLUME TERMINALS OF THE SIZES AND CAPACITIES SHOWN IN THE PLANS.

2) TERMINALS SHALL BE CERTIFIED UNDER THE ARI STANDARD 880 CERTIFICATION PROGRAM AND CARRY THE ARI SEAL. NONCERTIFIED TERMINALS MAY BE SUBMITTED AFTER TESTING AT AN INDEPENDENT TESTING LABORATORY UNDER CONDITIONS SELECTED BY THE ENGINEERING CONSULTANT IN FULL COMPLIANCE WITH ARI STANDARD 880. THESE TESTS MUST BE WITNESSED BY THE ENGINEERING CONSULTANT WITH ALL COSTS TO BE BORNE BY THE TERMINAL MANUFACTURER. TESTING DOES NOT ENSURE ACCEPTANCE.

3) THE TERMINAL CASING SHALL BE MINIMUM 22-GAUGE GALVANIZED STEEL, INTERNALLY LINED WITH ½-INCH DUAL DENSITY INSULATION WHICH COMPLIES WITH UL 181 AND NFPA 90A. ALL EXPOSED INSULATION EDGES SHALL BE COATED WITH NFPA 90A APPROVED SEALANT TO PREVENT ENTRAINMENT OF FIBERS IN THE AIRSTREAM. THE DISCHARGE CONNECTION SHALL BE SLIP AND DRIVE CONSTRUCTION FOR ATTACHMENT TO METAL DUCTWORK. THE CASING SHALL BE CONSTRUCTED TO HOLD LEAKAGE TO THE MAXIMUM VALUES SHOWN IN THE CASING LEAKAGE TABLE.

4) THE DAMPER SHALL BE HEAVY GAUGE STEEL WITH SHAFT ROTATING IN DELRIN® SELF-LUBRICATING BEARINGS. NYLON BEARINGS ARE NOT ACCEPTABLE. SHAFT SHALL BE CLEARLY MARKED ON THE END TO INDICATE DAMPER POSITION. STICKERS OR OTHER REMOVABLE MARKINGS ARE NOT ACCEPTABLE. THE DAMPER SHALL INCORPORATE A MECHANICAL STOP TO PREVENT OVER STROKING AND A SYNTHETIC SEAL TO LIMIT CLOSE-OFF LEAKAGE TO THE MAXIMUM VALUES SHOWN IN THE DAMPER LEAKAGE TABLE.

5) ACTUATORS SHALL BE CAPABLE OF SUPPLYING AT LEAST 35-INCH LBS. OF TORQUE TO THE DAMPER SHAFT AND SHALL BE MOUNTED EXTERNALLY FOR SERVICE ACCESS. TERMINALS WITH INTERNAL ACTUATOR MOUNTING OR LINKAGE CONNECTION MUST INCLUDE GASKETED ACCESS PANEL, REMOVABLE WITHOUT DISTURBING DUCTWORK. CASING WITH ACCESS PANEL SHALL BE CONSTRUCTED TO HOLD LEAKAGE TO THE MAXIMUM VALUES SHOWN IN THE CASING LEAKAGE TABLE.

6) AT AN INLET VELOCITY OF 2000 FPM, THE MINIMUM STATIC PRESSURE REQUIRED TO OPERATE ANY TERMINAL SIZE SHALL NOT EXCEED 0.13-INCH WG FOR THE BASIC TERMINAL.

7) SOUND RATINGS FOR THE TERMINAL SHALL NOT EXCEED 25 NC AT 0.25 STATIC PRESSURE. SOUND PERFORMANCE SHALL BE ARI CERTIFIED.

8) ACCESSORIES

a. THE PROPORTIONAL ELECTRONIC AIRFLOW SENSOR SHALL BE TOTALLY INDEPENDENT OF THE DUCT STATIC PRESSURE AND SHALL ADJUST THE HEATER CAPACITY ACCORDING TO THE AVAILABLE AIRFLOW. THE HEATERS SHALL DELIVER MAXIMUM HEATING WHEN NEEDED WITH NORMAL MINIMUM AIRFLOW, REDUCE HEATING WITH LOWER THAN MINIMUM AIRFLOW AND STOP HEATING WITH NO AIRFLOW. UNIT SHALL INCLUDE AN INTEGRAL DOOR INTERLOCK TYPE DISCONNECT SWITCH WHICH WILL NOT ALLOW THE ACCESS DOOR TO BE OPENED WHILE POWER IS ON. NON-INTERLOCKING TYPE DISCONNECTS ARE NOT ACCEPTABLE. ALL INDIVIDUAL COMPONENTS SHALL BE UL LISTED OR RECOGNIZED.

b. FACTORY INTEGRAL SOUND ATTENUATOR

c. ULTRALOC LINER:
THE TERMINAL CASING SHALL BE MINIMUM 22-GAUGE GALVANIZED STEEL. THE UNITS SHALL BE LINED WITH 1-INCH THICK MATTE FACED INSULATION, MEETING UL 181 AND NFPA 90A, ENCLOSED BETWEEN THE UNIT CASING AND A NON-PERFORATED INTERNAL
22-GAUGE SHEET METAL COVER EXTENDING OVER THE FIBERGLASS INSULATION, AS WELL AS COVERING THE LINER CUT EDGES. THE DISCHARGE CONNECTION SHALL BE SLIP AND DRIVE CONSTRUCTION FOR ATTACHMENT TO METAL DUCTWORK. THE CASING SHALL BE CONSTRUCTED TO HOLD LEAKAGE TO THE MAXIMUM VALUES SHOWN IN THE CASING LEAKAGE TABLE.

14. AUTOMATIC CONTROLS - GENERAL REQUIREMENTS

A. FURNISH AND INSTALL A COMPLETE ELECTRIC OR ELECTRONIC CONTROL SYSTEM TO PROVIDE TEMPERATURE CONTROL AS SPECIFIED UNDER DESCRIPTION OF OPERATION.

B. WORK SHALL INCLUDE ALL WIRING, CONTROL EQUIPMENT, AND ACCESSORIES NECESSARY TO MAKE THIS SYSTEM COMPLETE. ALL WIRING SHALL BE 24 VOLT. COORDINATE WITH MANUFACTURER FOR INTERCONNECTION WITH CONTROLS INCLUDED IN EQUIPMENT. ALL CONTROL WORK SHALL BE INSTALLED BY HVAC CONTRACTOR.

C. THE CONTROLS CONTRACTOR SHALL FURNISH AND INSTALL ALL REQUIRED HARDWARE, SUCH AS CONTROLLERS, TRANSMITTERS, SENSORS, AND CONTROL WIRING TO ENABLE THE INDICATED SEQUENCES OF OPERATION. THE BUILDING CONTROLS SHALL BE LOCAL/ STANDALONE TYPE CONSISTING OF DIRECT DIGITAL CONTROL (DDC) OR ELECTRONIC DEVICES, UNLESS INDICATED OTHERWISE.

D. ACCEPTABLE MANUFACTURERS:

1) JOHNSON SERVICE CO.

2) HONEYWELL, INC.

3) OR APPROVED EQUAL

E. SEQUENCE OF OPERATIONS:

1) ROOFTOP AIR-CONDITIONING UNIT (RTU-1)

a. UNIT SHALL BE PROVIDED WITH A PACKAGED MICROPROCESSOR CONTROLLER. THIS CONTRACTOR SHALL FURNISH, MOUNT AND WIRE ANY ADDITIONAL COMPONENTS NOT PROVIDED BY THE UNIT MANUFACTURER TO ACHIEVE A COMPLETELY OPERATIONAL SYSTEM.

b. OCCUPIED MODE:

a) EACH VAV TERMINAL SHALL USE PRESSURE-INDEPENDENT CONTROL, WITH AIRFLOW MEASUREMENT, TO VARY PRIMARY AIRFLOW TO MAINTAIN ZONE TEMPERATURE AT ITS OCCUPIED SETPOINT. THE RTU SHALL MODULATE THE SUPPLY FAN TO MAINTAIN DUCT STATIC PRESSURE AT SETPOINT AND MODULATE (OR CYCLE) COMPRESSORS, MODULATE (OR STAGE) HEAT, AND/OR ENABLE AIRSIDE ECONOMIZING TO MAINTAIN DISCHARGE AIR TEMPERATURE AT SETPOINT. THE OA DAMPER SHALL MODULATE, IN PROPORTION TO CHANGING SUPPLY FAN SPEED, TO BRING IN THE REQUIRED AMOUNT OF VENTILATION.

c. MORNING WARM-UP/PRE-COOL:

a) EACH VAV TERMINAL UNIT SHALL VARY PRIMARY AIRFLOW TO RAISE/LOWER ZONE TEMPERATURE TO ITS OCCUPIED SETPOINT. THE RTU SHALL MODULATE THE SUPPLY FAN TO MAINTAIN DUCT STATIC PRESSURE AT SETPOINT AND MODULATE (OR CYCLE) COMPRESSORS OR MODULATE (OR STAGE) HEAT TO MAINTAIN DISCHARGE AIR TEMPERATURE AT SETPOINT. THE OA DAMPER SHALL REMAIN CLOSED, UNLESS ECONOMIZING.

c. FAN-PRESSURE OPTIMIZATION:

a) THE SYSTEM CONTROLLER SHALL MONITOR ALL VAV DAMPER POSITIONS AND RESET THE RTU'S DUCT STATIC PRESSURE SETPOINT BASED ON THE POSITION OF THE FURTHEST-OPEN DAMPER.

d. DISCHARGE AIR TEMPERATURE RESET:

a) THE SYSTEM CONTROLLER SHALL RESET THE RTU'S DISCHARGE AIR TEMPERATURE SETPOINT BASED ON CURRENT ZONE COOLING/HEATING DEMANDS.

e. COOLING/HEATING CHANGEOVER LOGIC:

a) THE SYSTEM CONTROLLER SHALL DETERMINE THE OVERALL SYSTEM COOLING/HEATING MODE BASED ON "VOTING" FROM EACH ZONE. WHEN THE MAJORITY OF ZONES REQUIRE COOLING, THE RTU SHALL OPERATE IN COOLING MODE AND ANY ZONE THAT REQUIRES HEATING SHALL REDUCE PRIMARY AIRFLOW TO MINIMUM. WHEN THE MAJORITY OF ZONES REQUIRE HEATING, THE RTU SHALL OPERATE IN HEATING MODE AND ANY ZONE THAT REQUIRES COOLING SHALL REDUCE PRIMARY AIRFLOW TO MINIMUM.

f. SMOKE DETECTOR (FURNISHED BY ELECTRICAL CONTRACTOR AND INSTALLED BY MECHANICAL CONTRACTOR) LOCATED IN THE SUPPLY AIR DUCTWORK SHALL AUTOMATICALLY SHUTDOWN FANS UPON THE DETECTION OF SMOKE. ELECTRICAL CONTRACTOR SHALL INTERLOCK ALARM SIGNAL WITH BASE BUILDING FIRE ALARM SYSTEM.

2) VARIABLE AIR VOLUME BOXES (VAV BOXES)

a. COORDINATE FACTORY MOUNTING AND WIRING OF SECONDARY CONTROL PANEL, ACTUATOR AND TRANSFORMER WITH THE VAV BOX MANUFACTURER. THE BMS CONTRACTOR SHALL BE RESPONSIBLE FOR FURNISHING, INSTALLING AND WIRING OF CONTROLS NOT FURNISHED, INSTALLED OR WIRED BY OTHERS THAT ARE REQUIRED FOR AN OPERATIONAL SYSTEM.

b. OCCUPIED MODE

a) IF THE VAV BOX ENTERING TEMPERATURE IS LESS THAN 70°F, THE VAV BOX SHALL OPERATE IN COOLING MODE. UPON A FALL IN SPACE TEMPERATURE BELOW SETPOINT, THE BOX DAMPER SHALL MODULATE CLOSED TO THE MINIMUM CFM SETPOINT. UPON A RISE IN SPACE TEMPERATURE, THE BOX DAMPER SHALL MODULATE FROM THE MINIMUM TO THE MAXIMUM CFM SETTING AS NECESSARY TO MAINTAIN THE CFM SETPOINT AS RESET BY THE SPACE TEMPERATURE. THE MINIMUM AND MAXIMUM CFM SETTINGS SHALL BE THOSE SCHEDULED ON THE MECHANICAL DRAWINGS.

b) IF THE VAV BOX ENTERING TEMPERATURE IS GREATER THAN 70°F PLUS A DIFFERENTIAL, THE VAV BOX SHALL OPERATE IN HEATING MODE. UPON A RISE IN SPACE TEMPERATURE ABOVE SETPOINT, THE BOX DAMPER SHALL MODULATE CLOSED TO THE MINIMUM CFM SETPOINT. UPON A FALL IN SPACE TEMPERATURE, THE BOX DAMPER SHALL MODULATE FROM THE MINIMUM TO THE MAXIMUM CFM SETTING AS NECESSARY TO MAINTAIN THE CFM SETPOINT AS RESET BY THE SPACE TEMPERATURE. THE MINIMUM AND MAXIMUM CFM SETTINGS SHALL BE THOSE SCHEDULED ON THE MECHANICAL DRAWINGS.

c. UNOCCUPIED MODE

a) WHEN THE PRIMARY FAN SYSTEM SERVING THE VAV BOX IS NOT RUNNING, THE VAV BOX DAMPER SHALL CLOSE.

b) IF THE SPACE TEMPERATURE FALLS BELOW THE UNOCCUPIED SETBACK TEMPERATURE SETPOINT OF 60°F (ADJ.) OR RISES ABOVE THE UNOCCUPIED SETUP TEMPERATURE SETPOINT OF 80°F (ADJ.), THE FAN SYSTEM SERVING THE VAV BOX SHALL BE ENABLED AND THE VAV BOX SHALL BE INDEXED TO THE MAXIMUM CFM SETTING. THE FAN SYSTEM SHALL RUN FOR A MINIMUM OF 1/2 HOUR (ADJ.).

c) THE VAV DDC CONTROLLER SHALL BE PROGRAMMED FOR OCCUPANCY OVERRIDE. BY DEPRESSING THE OCCUPANCY OVERRIDE BUTTON LOCATED ON THE SPACE TEMPERATURE SENSOR, THE VAV BOX AND THE FAN SYSTEM SERVING THE VAV BOX SHALL BE RESTORED TO THE OCCUPIED MODE.

c. THE VAV BOX SHALL NOT OPEN BEYOND THE MAXIMUM CFM SETTING. PROVIDE ONE (1) DDC CONTROLLER AND ONE (1) WALL-MOUNTED TEMPERATURE SENSOR FOR EACH VAV BOX.

3) EXHAUST FAN (EF-1):

a. FAN SHALL ENERGIZE WHENEVER THE SPACE TEMPERATURE RISES ABOVE THE TEMPERATURE SETPOINT OF 80°F (ADJUSTABLE). FAN SHALL BE DE-ENERGIZED WHEN SPACE TEMPERATURE IS AT OR BELOW SETPOINT.

15. EXECUTION

A. PROVIDE AND INSTALL ALL EQUIPMENT AND ACCESSORIES OF THE SIZES AND CAPACITIES AS SCHEDULED AND AS INDICATED ON THE DRAWINGS AND IN ACCORDANCE WITH APPROVED SHOP DRAWINGS AND MANUFACTURERS RECOMMENDATIONS. PROVIDE ALL MOTOR STARTERS AS REQUIRED; MOTOR STARTERS WILL BE INSTALLED BY THIS CONTRACTOR AND WIRED BY ELECTRICAL TRADE.

B. CONTRACTOR IS RESPONSIBLE FOR MAINTAINING ALL REQUIRED CLEARANCES FOR SERVICING AND MAINTENANCE. COORDINATE REQUIREMENTS WITH ALL TRADES.

C. IDENTIFICATION OF EQUIPMENT AND CONTROLS

1) ALL EQUIPMENT SHALL BE STENCILED OR LABELED WITH LAMACOID PLATES SCREWED THEREON WHICH SHALL INDICATE SYSTEMS SERVICE.

16. EQUIPMENT START-UP AND TESTING

A. UPON COMPLETION OF THE INSTALLATION, THIS CONTRACTOR SHALL ENSURE THAT ALL EQUIPMENT AND SYSTEMS ARE TESTING AND BALANCED UNDER FIELD OPERATING CONDITIONS TO DEMONSTRATE ITS COMPLIANCE WITH SPECIFICATION REQUIREMENTS.

B. SHOULD ANY PART OF THE EQUIPMENT OR SYSTEM FAIL TO MEET THE CONTRACT REQUIREMENTS, THIS CONTRACTOR SHALL ADJUST, REPAIR OR REPLACE ALL DEFECTIVE OR INOPERATIVE PARTS AND AGAIN CONDUCT THE COMPLETE START-UP TEST.

17 SYSTEM TESTING AND BALANCING (AIR BALANCING)

A. AIR SYSTEM BALANCING SHALL BE PERFORMED BY AN APPROVED INDEPENDENT CERTIFIED TESTING AND BALANCING FIRM. THE TESTING AND BALANCING FIRM SHALL BE AABC, NEBB, TABB CERTIFIED OR DIRECTLY SUPERVISED BY A STAFFED LICENCED PROFESSIONAL ENGINEER WITH A MINIMUM OF FIVE YEARS EXPERIENCE. AIR SYSTEM BALANCING SHALL BE PERFORMED IN THE PRESENCE OF A BUILDING REPRESENTATIVE.

B. SUBMIT A DIGITAL COPY OF AIR BALANCING REPORT FOR REVIEW CONSISTING OF DESIGN AND ACTUAL READINGS OF ALL EQUIPMENT/DEVICES, LOCATION PLANS OF ALL EQUIPMENT/ DEVICES BALANCED, BALANCING EQUIPMENT USED AND METHODS OF BALANCING.

C. CONTRACTOR SHALL SUBMIT AIR BALANCE DATA SHEETS AND REPORTS WHICH TABULATE TEST DATA FROM FINAL ADJUSTED SYSTEM CONDITIONS WITHIN 10% OF DESIGN QUANTITIES FOR SYSTEM COMPONENTS AIR OUTLETS, RETURNS AND TERMINAL UNITS INDICATING CFM AND PRESSURE DROP; PERFORMANCE CHARACTERISTICS FOR ALL FANS AND AIR CONDITIONING EQUIPMENT INDICATING RPM, CFM, PRESSURE DROP ACROSS EACH COMPONENT (FILTERS, COILS, DAMPERS, ETC), AMPS, SUCTION AND DISCHARGE STATIC PRESSURE, OUTSIDE AIR CFM, BHP AND HP AT DESIGN CONDITIONS; AIR OUTLET DISCHARGE TEMPERATURE AND CFM; TERMINAL BOX INLET SP, MINIMUM AND MAXIMUM AIR SETTINGS.

D. CONTRACTOR SHALL INCLUDE IN THEIR BID ONE (1) JOB SITE COMFORT BALANCE UPON ACCEPTANCE OF THE FINAL BALANCING REPORT.

18. ELECTRICAL WORK

A. ELECTRICAL CONTRACTOR SHALL BE RESPONSIBLE FOR POWER WIRING UNDER A SEPARATE DIVISION OF CONTRACT WORK. AUTOMATIC TEMPERATURE, SAFETY AND INTERLOCKING CONTROLS FOR MOTORS, MOTOR STARTERS AND OTHER ELECTRICAL APPARATUS AND DEVICES SHALL BE PROVIDED BY THE HVAC CONTRACTOR. CONTROL WIRING SHALL INCLUDE BUT NOT LIMITED TO ALL 12, 24, AND 120 VOLT WIRING.

B. THE MECHANICAL CONTRACTOR SHALL PREPARE AND SUBMIT FOR APPROVAL TERMINAL POINT TO TERMINAL POINT, COMPLETELY COORDINATED AND INTEGRATED WIRING DIAGRAMS FOR ALL WIRING REQUIRING FIELD INSTALLATION BY THE ELECTRICAL CONTRACTOR.

C. SPECIFIC WIRING DIAGRAMS OF FACTORY INSTALLED EQUIPMENT WIRING SHALL ALSO BE SUBMITTED FOR APPROVAL AND FURNISHED TO THE ELECTRICAL CONTRACTOR FOR HIS INSTALLATION REQUIREMENTS AND OTHER USES.

D. HVAC CONTRACTOR SHALL COORDINATE WITH THE ELECTRICAL CONTRACTOR FOR THE INSTALLATION OF DUCT DETECTORS. DUCT DETECTOR SHALL BE FURNISHED AND WIRED BY THE ELECTRICAL CONTRACTOR AND MOUNTED BY THE HVAC CONTRACTOR.

SYMBOLS

Revisions

REVISION #	DATE	REVISION	APPROVED
-	7/8/21	FINAL REVIEW SET	
-	9/14/21	ISSUED FOR BID	

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PROJECT

Purchase College
Studio A
Renovations

DRAWING NAME

MECHANICAL SPECIFICATIONS
(SHEET 2)

SEAL & SIGNATURE

SCALE NONE

DATE

CAD FILE#

DRAWING NUMBER

M-003.00

SHEET

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