

VARIABLE AIR VOLUME BOX SEQUENCE OF OPERATION

- OFFICE SPACE VAV CONTROL: THERMOSTAT SET AT 75°F (ADJUSTABLE) MAINTAINS CONSTANT SPACE TEMPERATURE BY MODULATING THE VARIABLE AIR VOLUME DAMPER OPERATOR. ON A RISE OF TEMPERATURE ABOVE THE COOLING SET POINT (75°F ADJUSTABLE), THE VAV TERMINAL UNIT SHALL MODULATE TOWARD ITS MAXIMUM CFM. AS THE TEMPERATURE DROPS BELOW THE COOLING SET POINT, THE TERMINAL UNIT SHALL MODULATE TO ITS MINIMUM CFM. AS THE SPACE TEMPERATURE CONTINUES TO FALL TO THE HEATING SET POINT (70°F ADJUSTABLE), THE VAV DAMPER SHALL MODULATE TO HEATING CFM, AND THE PROPORTIONAL HOT WATER VALVE SHALL MODULATE OPEN.
- PROVIDE NIGHT SETBACK AND MORNING WARM-UP AS REQUIRED BY THE ASSOCIATED SYSTEM.
- CONFERENCE ROOM VAV CONTROL: SEQUENCE FOR HEATING, COOLING AND SETBACK SHALL BE AS DESCRIBED ABOVE FOR OFFICE SPACES. HOWEVER, UPON AN INCREASE IN CO2 THE VARIABLE AIR VOLUME DAMPER SHALL MODULATE OPEN TO ITS MAXIMUM CFM TO MAINTAIN CO2 BELOW 1000 PPM. IF THE CO2 CONTINUES TO INCREASE ABOVE THE 1000 PPM THEN THE OUTSIDE AIR DAMPER AT THE AIR HANDLER SHALL MODULATE OPEN TO PROVIDE MORE OUTSIDE AIR.

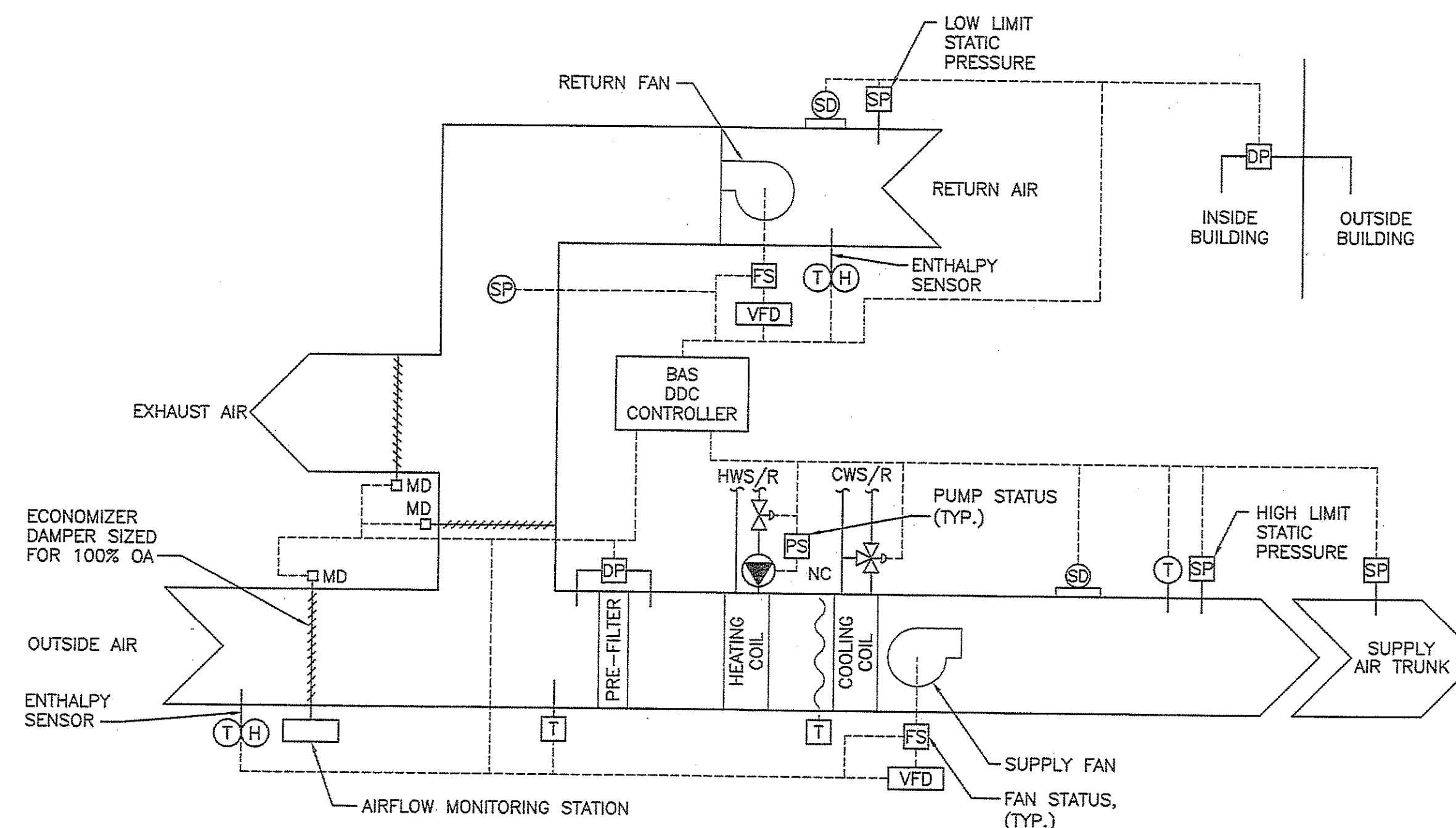
N1 VAV BOX SEQUENCE OF OPERATION (OFFICE AREA)

NOT TO SCALE

SEQUENCE OF OPERATION:

- A. GENERAL:**
- WITH THE H-O-A SWITCH IN THE "AUTO" POSITION, UNIT SHALL START THROUGH THE BAS SYSTEM PROVIDED THE SAFETIES HAVE BEEN SATISFIED.
 - BAS PROGRAMMING SHALL DEFINE OCCUPIED AND UNOCCUPIED SCHEDULING.
 - IN THE EVENT THAT THE UNIT IS DISABLED THE OUTSIDE AIR DAMPER AND CHILLED WATER VALVE SHALL CLOSE AND THE RETURN DAMPER AND HOT WATER VALVE SHALL OPEN 100%. THE FREEZE PROTECTION PUMP SHALL START.
- B. OCCUPIED PERIODS:** SYSTEM SUPPLY AND RETURN FANS SHALL RUN CONTINUOUSLY. SUPPLY AND RETURN FANS SHALL BE INTERLOCKED.
- C. UNOCCUPIED PERIODS:** SYSTEM SUPPLY AND RETURN FANS SHALL CYCLE TO MAINTAIN THE HEATING SET POINTS IN EACH OF THE SPACES SERVED. THE SYSTEM SHALL PROVIDE AN ADJUSTABLE ANTI-SHORT CYCLE TIMER TO PREVENT EXCESSIVE FAN STARTS/STOPS.
- DURING UNOCCUPIED PERIODS THE OUTDOOR AIR (OA) DAMPER SHALL CLOSE AND THE RETURN AIR DAMPER SHALL OPEN, RELIEF AIR DAMPER SHALL CLOSE.
- D. OPTIMUM START/STOP:** THE SYSTEM FANS SHALL BE STARTED/STOPPED BASED ON THE OCCUPANCY SCHEDULE, WHICH SHALL BE ADJUSTABLE BY OPTIMUM START AND STOP CALCULATIONS. THE TEMPERATURE AT THE END OF THE OCCUPIED PERIOD WILL BE ALLOWED TO DRIFT A MAXIMUM OF 2°F ABOVE OR BELOW TEMPERATURE SET POINT. HEATING AND COOLING COIL VALVES SHALL BE CLOSED. THE SUPPLY AND RETURN FAN WILL CONTINUE TO OPERATE. HISTORICAL PERFORMANCE DATA SHALL BE USED TO DETERMINE HOW QUICKLY THE SPACE HEATS OR COOLS AND WILL START THE SYSTEM AS LATE AS POSSIBLE IN THE MORNING TO ACHIEVE OCCUPIED TEMPERATURE SETPOINT. HISTORICAL DATA WILL ALSO DETERMINE THE EARLIEST POSSIBLE TIME THE SYSTEM CAN STOP TO ALLOW THE MAXIMUM TEMPERATURE DRIFT.
- E. MORNING WARM UP:** THE UNIT SHALL OPERATE IN THE MORNING WARM-UP MODE WHEN THE RETURN AIR TEMPERATURE IS BELOW THE WARM-UP MODE SET POINT, 68 DEG F (ADJ.), AS MEASURED BY THE RETURN DUCT TEMPERATURE SENSOR.
- THE OA DAMPER AND RELIEF AIR DAMPER SHALL CLOSE TO 0% AND THE RETURN AIR DAMPER SHALL OPEN TO 100%.
 - THE HOT WATER PREHEAT COIL VALVE SHALL MODULATE TO MAINTAIN A SUPPLY AIR TEMPERATURE OF 85 DEG F (ADJ.).
 - ALL VAV BOXES SHALL OPEN TO 100% UNTIL OCCUPIED SET POINT TEMPERATURE IS ESTABLISHED. AS ZONES REACH OCCUPIED MODE SET POINT THEY SHALL MODULATE TO PREVENT OVERHEATING.
- F. MORNING COOL DOWN:** THE UNIT SHALL OPERATE IN THE MORNING COOL DOWN MODE WHEN THE RETURN AIR TEMPERATURE IS ABOVE THE COOL DOWN MODE SET POINT, 75 DEG F (ADJ.), AS MEASURED BY THE RETURN AIR DUCT TEMPERATURE SENSOR.
- THE OA DAMPER AND RELIEF AIR DAMPER SHALL CLOSE TO 0% AND THE RETURN AIR DAMPER SHALL OPEN 100%.
 - THE CHILLED WATER COIL VALVE SHALL MODULATE TO MAINTAIN A SUPPLY AIR TEMPERATURE OF 55 DEG F (ADJ.).
 - ALL VAV BOXES SHALL OPEN TO 100% UNTIL OCCUPIED SET POINT TEMPERATURE IS ESTABLISHED. AS ZONES REACH OCCUPIED MODE SET POINT THEY SHALL MODULATE TO PREVENT OVER COOLING.
- G. SUPPLY FAN CONTROL:** THE UNIT SUPPLY FAN SPEED SHALL MODULATE, THROUGH ITS VFD, TO MAINTAIN A SUPPLY DUCT STATIC PRESSURE BETWEEN 0.5" W.G. AND THE MAXIMUM STATIC PRESSURE DETERMINED FROM THE SYSTEM TAB (ADJ.).
- THE STATIC PRESSURE SET POINT SHALL BE RESET TO MAINTAIN THE VAV BOX CFM REQUIRING THE MOST STATIC PRESSURE AT 90% OPEN.
 - ALL VAV BOX DAMPER POSITIONS SHALL BE CONTINUOUSLY POLLED TO DETERMINE THE VAV BOX THAT IN THE MOST OPEN.
 - THE STATIC PRESSURE SENSOR SHALL BE LOCATED AS SHOWN ON MECHANICAL DRAWINGS BUT NOT LESS THAN THE DISTANCE OF THE LONGEST SUPPLY DUCT RUN.
 - FINAL STATIC PRESSURE SET POINT SHALL BE DETERMINED DURING TESTING AND BALANCING OF THE SYSTEM.
- H. RETURN FAN CONTROL:** THE SYSTEM RETURN FAN SHALL OPERATE WHEN THE ASSOCIATED SUPPLY FAN IS PROVEN ON. THE RETURN FAN SPEED SHALL MODULATE, THROUGH ITS VFD, TO MAINTAIN DISCHARGE STATIC PRESSURE AT SET POINT. THE STATIC PRESSURE SENSOR SHALL BE LOCATED APPROXIMATELY BETWEEN THE RETURN FAN DISCHARGE AND THE RELIEF DAMPER. THE RETURN FAN DISCHARGE STATIC PRESSURE SET POINT SHALL BE THE LARGER OF THE TWO FOLLOWING CONDITIONS.
- THE STATIC PRESSURE REQUIRED TO DELIVER THE DESIGN RETURN AIR VOLUME ACROSS THE RETURN DAMPER WHEN THE SUPPLY AIR FAN IS AT DESIGN AIRFLOW AND THE OUTSIDE AIR DAMPER IS SET TO ITS MINIMUM POSITION
 - THE STATIC PRESSURE REQUIRED TO EXHAUST ENOUGH AIR TO MAINTAIN SPACE PRESSURE AT SET POINT (0.05" W.G. ADJ.) WHEN THE SUPPLY AIR FAN IS AT DESIGN AIR FLOW AND THE OUTSIDE AIR DAMPER IS AT 100% OUTSIDE AIR. SEE BUILDING PRESSURE CONTROL BELOW.
 - FINAL STATIC PRESSURE SET POINT SHALL BE DETERMINED DURING TESTING AND BALANCING OF THE SYSTEM.
- I. BUILDING PRESSURE CONTROL:** THE EXHAUST AIR DAMPER SHALL MODULATE TO MAINTAIN A BUILDING STATIC PRESSURE SET POINT OF 0.05" W.G. BUILDING STATIC PRESSURE SHALL BE TIME AVERAGED WITH A SLIDING FIVE MINUTE WINDOW.
- J. ECONOMIZER CONTROL:** ECONOMIZER CYCLE OPERATION SHALL BE INTEGRATED WITH MECHANICAL COOLING TO ACT AS THE FIRST STAGE OF COOLING.
- THE ECONOMIZER CYCLE SHALL BE ENABLED WHEN THE OA ENTHALPY IS LESS THAN THE RETURN AIR ENTHALPY.
 - OA DAMPER SHALL MODULATE BETWEEN MINIMUM POSITION AND 100% OPEN TO MAINTAIN SUPPLY AIR TEMPERATURE SET POINT OF 55 DEG F (ADJ.).
 - THE RETURN AIR DAMPER SHALL OPERATE IN INDIRECT PROPORTION WITH THE OA DAMPER.
 - IF THE DISCHARGE AIR TEMPERATURE RISES ABOVE THE SET POINT BY 1.5°F FOR 5 MIN. AND THE OUTSIDE DAMPER IS 100% OPEN THE COOLING COIL VALVE SHALL MODULATE OPEN.
- K. VENTILATION CONTROL:** THE OA DAMPER POSITION SHALL BE DYNAMIC AND ESTABLISHED BY MODULATING THE RETURN AIR DAMPER TO MAINTAIN THE MINIMUM AIRFLOW RATE. THE RETURN DAMPER SHALL MODULATE TO MAINTAIN THE SYSTEM MINIMUM VENTILATION RATE INDICATED IN THE AIR HANDLER SCHEDULE.
- L. DISCHARGE AIR TEMPERATURE CONTROL:**
- WHEN SUPPLY AIR TEMPERATURE RISES ABOVE THE 55 DEG F SET POINT (ADJ.), THE CHILLED WATER VALVE SHALL MODULATE OPEN TO MAINTAIN SET POINT.
 - WHEN THE SUPPLY AIR TEMPERATURE DROPS BELOW THE 55 DEG F SET POINT (ADJ.), THE HOT WATER PREHEAT COIL VALVE SHALL MODULATE OPEN TO MAINTAIN SET POINT.
 - THE HOT WATER PREHEAT VALVE SHALL BE DISABLED ABOVE OA TEMPERATURES OF 50 DEG F (ADJ.).

- M. HOT WATER COIL FREEZE PROTECTION PUMP:** AT OUTDOOR AIR TEMPERATURES BELOW 37°F, OR ON A CALL FOR HEATING, THE COIL FREEZE PROTECTION PUMP SHALL OPERATE. ALARM SHALL ENABLE IF PUMP STATUS INDICATES A FAILURE AND THE UNIT SHALL BE DISABLED.
- N. DEHUMIDIFICATION:** THE CHILLED WATER COOL VALVE SHALL MODULATE TO MAINTAIN A RETURN DUCT RELATIVE HUMIDITY SET POINT OF 60% RH (ADJ.). IF RETURN AIR RELATIVE HUMIDITY RISES ABOVE 60% RH THE UNIT DISCHARGE TEMPERATURE SHALL BE RESET LOWER BY 1°F. IF THE RETURN AIR RELATIVE HUMIDITY REMAINS ABOVE 60% FOR 5 MIN. THE DISCHARGE AIR TEMPERATURE SHALL CONTINUE TO BE RESET LOWER BY 1°F EVERY 5 MIN. UNTIL RH DROPS BELOW 60%. DISCHARGE AIR TEMPERATURE SHALL NOT BE RESET BELOW 52°F.
- O. SAFETY DEVICES:**
- SMOKE DETECTORS LOCATED IN THE SUPPLY AND RETURN DUCTS SHALL STOP THE UNIT FANS AND PUT THE UNIT IN UNOCCUPIED MODE IF SMOKE IS DETECTED, AND ALSO SEND A FIRE ALARM SIGNAL.
 - FREEZE STAT SERPENTINED ACROSS THE HEATING COIL FACE SHALL STOP UNIT FANS, PUT THE UNIT IN UNOCCUPIED MODE, AND SETS ALARM AT A TEMPERATURE BELOW 38 DEG F (ADJ.).
 - DUCT HIGH STATIC PRESSURE SENSOR SHALL DISABLE UNIT FANS WHEN MEASURED PRESSURE EXCEEDS 6" W.C. (ADJ.).
 - DUCT LOW STATIC PRESSURE SENSOR SHALL DISABLE UNIT FANS WHEN MEASURED PRESSURE DROPS BELOW -6" W.C. (ADJ.).
- P. OTHER DEVICES:**
- THE UNIT AIR FILTER STATUS SHALL BE MEASURED AND INDICATED ON THE GRAPHICAL INTERFACE TO INDICATE THE STATIC PRESSURE AND PRESSURE DROP ACROSS THE UNIT FILTERS AND PROVIDE NOTIFYING CONDITIONS INDICATING THE NEED FOR FILTER CHANGE-OUT.
 - PUMP STATUS SHALL BE DETERMINED BY CURRENT SENSING DEVICE AND DIFFERENTIAL PRESSURE SENSOR ACROSS PUMP SUCTION AND DISCHARGE..
 - FAN STATUS SHALL BE DETERMINED BY CURRENT SENSING DEVICE AND LOSS OF DISCHARGE STATIC PRESSURE.



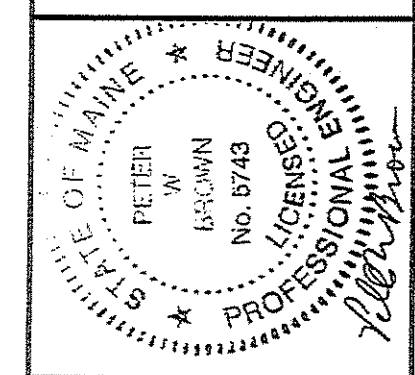
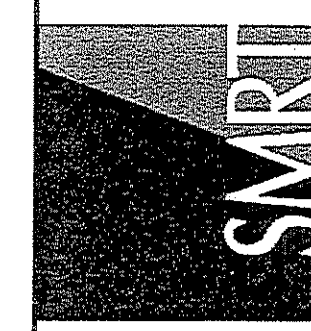
A1 VAV AIR HANDLER CONTROL SCHEMATIC & SEQUENCE OF OPERATION

NOT TO SCALE

TYPICAL FOR AHU-1 AND AHU-2

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SEQUENCE OF OPERATIONS

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