# SEQUENCE OF OPERATION AHU–1:

1.0 SEQUENCE OF OPERATION – GENERAL

A. SEQUENCE OF OPERATION IS DESIGNED TO ILLUSTRATE THE STAND ALONE CONTROLS BASIC FUNCTIONS ONLY. TEMPERATURE CONTROLS CONTRACTOR SHALL REVIEW DRAWINGS AND SUBMIT COMPLETE INSTALLATION DATA, INCLUDING MINOR DETAILS, TO PROVIDE PROPER OPERATION IN THEIR SUBMITTAL. WHERE AN ITEM DIFFERS FROM SPECIFICATIONS, CONTROLS CONTRACTOR SHALL SUBMIT MANUFACTURER'S RECOMMENDATIONS SUBJECT TO ENGINEERS' APPROVAL.

B. GENERAL: WITH THE VFD H–O–A SWITCH IN THE "AUTO" POSITION, THE SYSTEM SHALL START PROVIDED THE SAFETIES HAVE BEEN SATISFIED. WHEN THE AHU IS ENERGIZED, THE SUPPLY FAN SHALL OPERATE CONTINUOUSLY, THE DX COOLING COIL AND ASSOCIATED CONDENSING UNIT AS WELL AS THE ELECTRIC HEATING COIL SHALL MODULATE IN SEQUENCE TO CONTROL THE DISCHARGE AIR TEMPERATURE TO MAINTAIN THE SPACE TEMPERATURE AS REQUIRED. THE OUTSIDE AIR DAMPER SHALL OPEN TO THE MINIMUM POSITION REQUIRED TO MAINTAIN SPACE PRESSURIZATION WHENEVER THE SUPPLY FAN STARTS. THE CONTROLLER SHALL CONTINUOUSLY MONITOR SPACE TEMPERATURE AND PRESSURIZATION TO DETERMINE THE REQUIRED MODE OF OPERATION: HEATING, COOLING, OR VENTILATION MODE.

2.0 SEQUENCE OF OPERATION––AIR HANDLING UNIT. (AHU–1)

A. GENERAL: CONSTANT VOLUME AIR HANDLING UNIT IS LOCATED IN THE MEZZANINE MECHANICAL ROOM ADJACENT TO THE CLEANROOM SPACES. AIR HANDLING UNIT SUPPLIES CONDITIONED OUTDOOR AIR AND RETURN AIR TO THE CEILING PLENUM SPACE ABOVE THE CLEANROOM AREAS. THE AIR HANDLING UNIT CONSISTS OF SUPPLY FAN, RELIEF FAN, OUTDOOR AIR INTAKE, ELECTRIC HEATING COIL, DIRECT EXPANSION COOLING COIL, MERV 8 PRE–FILTERS, AND MERV 14 FINAL FILTERS.

B. THE AHU COOLING SHALL BE PROVIDED BY A DUAL CIRCUIT DX COOLING COIL AND ASSOCIATED REMOTE AIR COOLED CONDENSING UNIT LOCATED ON GROUND LEVEL, ADJACENT TO THE BUILDING. THE CONDENSING UNIT SHALL BE SUPPLIED WITH TWO INDEPENDENT REFRIGERATION CIRCUITS WITH HOT GAS BYPASS FOR CAPACITY CONTROL.

C. START–UP: THE SUPPLY FANS SHALL BE STARTED AND STOPPED BASED ON AN OCCUPIED AND UNOCCUPIED SCHEDULE. THESE SCHEDULES SHALL BE ADJUSTABLE, EASILY MODIFIED BY THE OWNER. INITIAL SETTINGS SHALL BE TO OPERATE THE UNIT CONTINUOUSLY.
1. TO ALLOW ADEQUATE TIME FOR TEMPERATURE AND PRESSURE SENSORS AND SEQUENCES TO OPERATE CORRECTLY, THE SUPPLY FAN SHALL START PRIOR TO ANY EXHAUST FANS.
2. SUPPLY AIR TEMPERATURE SETPOINT: FOR BOTH THE COOLING AND HEATING MODES, THE DRY–BULB SUPPLY AIR TEMPERATURE SETPOINT SHALL MODULATE BETWEEN 53°F(ADJ.) AND 65°F(ADJ.).

E. OCCUPIED CONTROL: COOLING MODE – UPON A CALL FOR COOLING FROM THE CLEANROOM RETURN SENSOR, LOCATED IN THE RETURN CHASE AS SHOWN IN THE DRAWINGS, THE AHU SHALL ENTER THE COOLING MODE OF OPERATION. THE ECONOMIZER CYCLE OPERATION SHALL BE INTEGRATED WITH MECHANICAL COOLING TO BE THE FIRST STAGE OF COOLING. THE ECONOMIZER CYCLE SHALL BE ENABLED WHEN THE OUTSIDE AIR ENTHALPY IS 24.5 BTU/LB OR LESS AND THE OUTSIDE AIR TEMPERATURE IS LESS THAN 65 DEG F. IF THE ECONOMIZER IS ENABLED THE OUTSIDE AIR DAMPER SHALL MODULATE BEYOND ITS MINIMUM POSITION UP TO A MAXIMUM OF 100% OUTSIDE AIR. PROPORTIONATELY MODULATE THE RETURN DAMPER AND THE RELIEF AIR FAN ACCORDINGLY TO MAINTAIN THE REQUIRED BUILDING PRESSURE. IF EITHER OR BOTH OF THE OUTSIDE AIR CONDITIONS ARE ABOVE THE ECONOMIZING CONDITIONS THE ECONOMIZER CYCLE WILL BE DISABLED AND THE UNIT SHALL ENTER MECHANICAL COOLING OPERATION. THE OUTSIDE AIR DAMPER SHALL MODULATE TO THE MINIMUM AIRFLOW, INITIALLY SET AT 2100 CFM (ADJ.), AND MODULATE OPEN THE RETURN DAMPER TO MAINTAIN TOTAL AHU FLOW OF 6000 CFM. THE RELIEF FAN SHALL MODULATE TO MAINTAIN THE PROPER PRESSURE RELATIONSHIPS. THE UNIT HEATING COIL AND COOLING SYSTEM SHALL DISABLED DURING ECONOMIZER OPERATION.
1. DURING MECHANICAL COOLING, THE AIR HANDLING UNIT SHALL RUN CONTINUOUSLY. UPON COMMAND FOR COOLING, THE FIRST DX CIRCUIT COOLING COIL SOLENOID VALVE SHALL OPEN AND THE CONDENSING UNITS FIRST STAGE COMPRESSORS SHALL SHALL START, STAGE AND MODULATE TO MAINTAIN THE COIL LEAVING AIR TEMPERATURE SETPOINT (ADJUSTABLE), INITIALLY SET AT 53 DEGREES F TO SATISFY THE CLEANROOM SPACE TEMPERATURE.
2. IF THE ROOM TEMPERATURE CANNOT BE SATISFIED, THE SECOND DX CIRCUIT COOLING COIL SOLENOID VALVE SHALL OPEN AND THE CONDENSING UNITS SECOND STAGE COMPRESSORS SHALL SHALL START, STAGE AND MODULATE TO MAINTAIN THE COIL LEAVING AIR TEMPERATURE SETPOINT AND ROOM TEMPERATURE SETPOINT.
3. UPON A DECREASE IN REQUIRED COOLING CAPCIYTY, THE REVERSE SHALL OCCUR.

F. HEATING MODE:
1. OCCUPIED CONTROL: TO MAINTAIN THE SPACE TEMPERATURE SETPOINT THE ELECTRIC HEATER SHALL BE INITIATED AND MODULATE THROUGH SCR CONTROLS AS REQUIRED TO MAINTAIN THE SPACE TEMPERATURES, INITIALLY SET AT 68 DEGREES F (ADJ.).
2. THE AIR PROVING SWITCH SHALL VERIFY THAT THERE IS SUFFICIENT AIR AVAILABLE FOR THE HEATING COIL TO BE ENERGIZED.
3. THE HEATING COIL SHALL ALWAYS BE ENERGIZED INITIALLY AT THE MINIMUM STAGE.

G. UNOCCUPIED OPERATION: WHEN SCHEDULED BY THE OWNER, THE AIR HANDLING UNIT SHALL CYCLE THE SUPPLY FAN WHENEVER THE UNIT IS IN HEATING OR COOLING. THE OUTSIDE AIR DAMPER SHALL BE CLOSED DURING UNOCCUPIED OPERATION. WHEN THE SPACE TEMPERATURE FALLS BELOW THE UNOCCUPIED HEATING SETPOINT (60°F ADJ.) THE ELECTRIC HEATING COIL SHALL STAGE AND MODULATE. THE REVERSE SHALL OCCUR WHEN THE SPACE TEMPERATURE RISES ABOVE (62°F ADJ.) WHEN THE SPACE TEMPERATURE RISES ABOVE THE UNOCCUPIED COOLING SETPOINT (85°F ADJ.), THE DX COOLING SYSTEM SHALL START AND MODULATE. THE REVERSE SHALL OCCUR WHEN THE SPACE TEMPERATURE DROPS BELOW 82°F (ADJ.)

H. OUTDOOR AIR VOLUME CONTROL: THE OUTSIDE AIR DAMPER AND RETURN AIR DAMPER SHALL MODULATE TO MAINTAIN A SUFFICIENT QUANTITY OF OUTSIDE AIR TO PROVIDE A POSITIVE PRESSURE OF BETWEEN +0.02 AND +0.05 IN. W.C. WHICH SHALL BE ADJUSTABLE BY THE OWNER.

I. HUMIDIFICATION MODE: N/A.

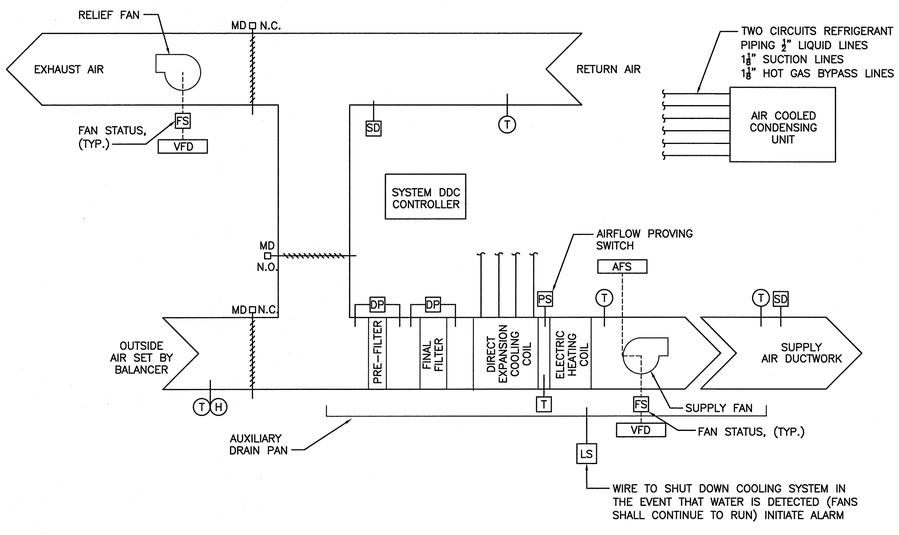
J. DEHUMIDIFICATION MODE: WHEN THE HUMIDITY LEVEL IN THE SPACE RISES ABOVE 60% RH (ADJ)THE COOLING COIL SHALL OPERATE TO MAINTAIN DUCT DISCHARGE OF 53F. THE ELECTRIC REHEAT COIL SHALL MODULATE AND STAGE AS REQUIRED TO MAINTAIN THE SPACE TEMPERATURE SETPOINT. .

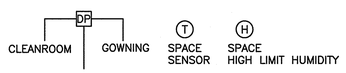
K. DUCT–MOUNTED SMOKE DETECTOR (PHOTOELECTRIC TYPE):
1. AIR HANDLING UNIT: LOCATED IN THE SUPPLY AND RETURN AIR DUCTS, ACTIVATION OF SMOKE DETECTOR SHALL SHUT DOWN THE AIR HANDLING UNIT WHEN SMOKE IS DETECTED IN THE AIR STREAM. SMOKE DETECTORS SHALL REQUIRE MANUAL RESETTING IN ORDER TO RE–START MAKEUP AIR UNIT SYSTEM.

J. SAFETIES: VARIOUS COMPONENTS AND DEVICES SHALL BE PROVIDED AND CONTROLLED AS FOLLOWS:
1. SUPPLY FAN FAILURE: UPON FAILURE THE SUPPLY FAN PROVIDED IN THE AHU, SHALL BE COMMANDED OFF. THE OUTSIDE AIR DAMPER SHALL BE CLOSED AND THE RETURN AIR DAMPER SHALL OPEN. CRITICAL ALARM SHALL BE ANNUNCIATED.
2. FREEZE PROTECTION: PROVIDE FREEZE–STAT AT DISCHARGE OF COOLING COIL WITH AUTOMATIC RESET. HARDWIRE FREEZE–STAT TO BOTH SUPPLY & RELIEF FANS. UPON ACTIVATION OF FREEZE–STAT (INITIALLY SET AT 38 DEGREES F), CLOSE OUTSIDE AIR DAMPERS AND SHUTDOWN THE SUPPLY FANS. DDC SHALL MONITOR FREEZE–STAT, AND UPON ACTIVATION.
3. COOLING COIL DRAIN PAN: HIGH LEVEL SWITCH SHALL BE ACTIVATED AND CRITICAL ALARM ANNUNCIATED UPON A RISE IN THE CONDENSATE DRAIN PAN LEVEL OF AHU COOLING COIL. WHEN WATER IS DETECTED, THE COOLING SHALL BE DISABLED AND THE SUPPLY AND RELIEF FANS SHALL CONTINUE TO RUN.

K. MONITORING: FOLLOWING POINTS LISTED BELOW SHALL BE MONITORED FOR DISPLAY AND ALARMING THROUGH LOCAL CONTROL PANEL. ALL POINTS SHALL BE DISPLAYED AND ALARM FUNCTIONS SHALL BE GIVEN AT THE OPERATOR'S TERMINAL.
1. MIXED AIR TEMPERATURE MOUNTED IN MIXING PLENUM OF AHU.
2. ELECTRIC HEATING COIL LEAVING AIR TEMPERATURE.
3. DX COOLING COIL LEAVING AIR TEMPERATURE.
4. SUPPLY DUCT STATIC PRESSURE (LOW AND HIGH STATIC PRESSURE ALARMS), .
5. SUPPLY FAN RUN STATUS (FAILURE ALARMS)
6. RELIEF FAN RUN STATUS (FAILURE ALARMS)
7. SUPPLY AIR TEMPERATURE (LOW AND HIGH TEMPERATURE ALARMS).
8. RELATIVE HUMIDITY LEVEL.
9. SUPPLY AIR DISCHARGE AIR TEMPERATURE.
10. INDOOR SPACE TEMPERATURE.

L. FAN FILTER UNITS
1. FANS SHALL RUN AT CONSTANT SPEED TO PRESET VALUE REQUIRED TO MAINTAIN ISO CLASS RATING.
2. FAN SPEED SHALL BE SET DURING T–A–B USING THE SOLID STATE SPEED CONTROLLER.




# SEQUENCE OF OPERATION EF–1 (ALTERNATE #1) :

1.0 SEQUENCE OF OPERATION – GENERAL

A. THE EXHAUST FAN SHALL BE ENABLED AND DISABLED FROM THE STAND ALONE DDC CONTROL PANEL.

B. THE EXHAUST FAN SHALL TYPICALLY RUN CONTINUOUSLY.

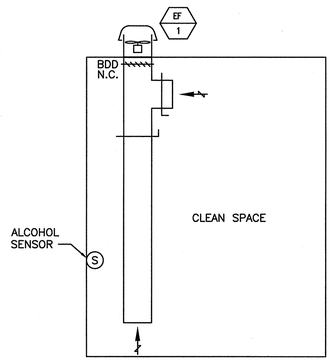
C. WHEN THE FAN DISABLED, THE FAN SHALL BE OFF.

D. THE FAN STATUS SHALL BE MONITORED BY THE STAND ALONE DDC CONTROL PANEL.

E. WHEN THE FAN IS ENABLED AND THE CURRENT SENSOR FAILS TO DETECT FAN OPERATION, AN ALARM SHALL BE ISSUED AT THE CONTROL PANEL.

F. ALCOHOL SENSOR SHALL ALARM AUDIBLY AND VISUALLY UPON ALCOHOL LEVELS ABOVE THE ACCEPTABLE LIMITS.

G. AN ALCOHOL ALARM SHALL DISABLE ALL ELECTRICAL POWER TO WALL OUTLETS IN THE IMMEDIATE AREA. SEE ELECTRICAL PLANS FOR LOCATIONS.

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| A1 | CONSTANT VOLUME AIR HANDLER CONTROL SCHEMATIC & SEQUENCE OF OPERATION: DX COOLING–ELECTRIC HEAT |
| NOT TO SCALE | |

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| A12 | EF–1 SEQUENCE OF OPERATION & CONTROL DIAGRAM |
| NOT TO SCALE | |


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