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#	Description	Date

## BEATRICE NEW ELEMENTARY SCHOOL

320 N. 5th St. Beatrice, NE  
68310

## BEATRICE PUBLIC SCHOOLS

## MECHANICAL CONTROL DIAGRAMS

# M4-1

### SEQUENCE OF OPERATION

A. THE FACTORY PROVIDED CONTROLLER (INTEGRAL TO UNIT) SHALL CONTROL ALL BASIC FUNCTIONS (COOLING, HEATING, DEHUMIDIFICATION, ECONOMIZER, ETC.). THE BAS SHALL PROVIDE INPUT POINTS AS REQUIRED TO INTERFACE WITH SPACE CONDITIONS AND PROVIDE THE OPERATOR THE ABILITY TO ADJUST INTERNAL UNIT CONTROLLER SETPOINTS THROUGH THE BAS. THE BAS SHALL ALSO COMMUNICATE POINTS AS REQUIRED FROM THE FACTORY PROVIDED CONTROLLER TO THE BAS / OCCUPANT WORKSTATION FOR MONITORING AND ALARMING. COORDINATE WITH EQUIPMENT SUPPLIER. ALL SENSORS / THERMOSTATS WITH OCCUPANT INTERFACE SHALL BE PROVIDED BY THE TEMPERATURE CONTROL CONTRACTOR AND BE CONSISTENT THROUGHOUT THE BUILDING.

B. SYSTEM OFF - WHEN THE SYSTEM IS OFF:

1. THE SUPPLY FAN SHALL BE OFF.
2. THE POWERED EXHAUST FAN SHALL BE OFF.
3. THE RELIEF AIR DAMPER SHALL BE CLOSED.
4. THE OUTSIDE AIR DAMPER SHALL BE CLOSED.
5. THE RETURN AIR DAMPER SHALL BE OPEN.
6. THE DX COOLING COIL SHALL BE DISABLED.
7. THE HOT GAS REHEAT SYSTEM SHALL BE DISABLED.
8. THE NATURAL GAS-FIRED HEATING SYSTEM SHALL BE DISABLED.

B. INITIATION OF SYSTEM START-UP - THE SYSTEM SHALL BE STARTED:

1. MANUALLY BY AN OPERATOR THROUGH THE BAS.
2. AUTOMATICALLY BY THE BAS FOR MORNING WARM-UP / COOL-DOWN (OPTIMAL START).
3. AUTOMATICALLY BY THE BAS THROUGH OCCUPANCY SCHEDULE.
4. AUTOMATICALLY BY THE BAS DUE TO OCCUPANT OVERRIDE REQUEST.
5. AUTOMATICALLY BY THE BAS TO MAINTAIN UNOCCUPIED SETPOINTS.

C. SYSTEM OPERATION - AFTER SYSTEM START-UP HAS BEEN INITIATED THE FOLLOWING SHALL OCCUR:

1. THE SUPPLY FAN SHALL BE ENABLED. DURING OCCUPIED HOURS (OR DURING OCCUPANT OVERRIDE REQUEST), THE FAN SHALL RUN CONTINUOUSLY. THE FACTORY PROVIDED UNIT CONTROLLER SHALL MODULATE SUPPLY FAN SPEED TO MATCH COOLING AND HEATING LOADS. DURING UNOCCUPIED HOURS, THE FAN SHALL CYCLE TO MAINTAIN THE UNOCCUPIED TEMPERATURE SETPOINTS.
2. THE BAS SHALL PROVIDE THE FACTORY UNIT CONTROLLER WITH THE SPACE TEMPERATURE, SPACE TEMPERATURE SETPOINT, SPACE RELATIVE HUMIDITY AND SPACE RELATIVE HUMIDITY SETPOINT. THE FACTORY UNIT CONTROLLER SHALL OPERATE THE COOLING, HEATING AND REHEAT COMPONENTS IN A SIMILAR MANNER AS FOLLOWS:
  - A. WHEN THE SPACE TEMPERATURE IS ABOVE THE SPACE COOLING TEMPERATURE SETPOINT, THE DX COOLING SYSTEM AND SUPPLY FAN SHALL MODULATE TO MAINTAIN THE SPACE COOLING TEMPERATURE SETPOINT.
  - B. ECONOMIZER:
    - a. WHEN THE OUTDOOR AIR ENTHALPY IS BELOW THE RETURN AIR ENTHALPY, THE CONTROL SYSTEM SHALL ENABLE THE AIRSIDE ECONOMIZER. FACTORY CONTROLLER SHALL MODULATE THE OUTSIDE AND RETURN AIR DAMPERS TO MAINTAIN THE SUPPLY AIR TEMPERATURE SETPOINT.
    - b. DX COOLING SHALL BE ALLOWED TO SUPPLEMENT ECONOMIZER WHEN 100% ECONOMIZER IS NOT ADEQUATE FOR SPACE COOLING THROUGH OCCUPANCY SCHEDULE.
    - c. WHEN THE OUTDOOR AIR ENTHALPY IS ABOVE THE RETURN AIR ENTHALPY, THE AIRSIDE ECONOMIZER SHALL BE DISABLED AND THE FACTORY CONTROLLER SHALL MODULATE THE OUTSIDE AIR DAMPER TO ITS MINIMUM POSITION AND RETURN AIR DAMPER TO ITS MAXIMUM POSITION.
  - C. WHEN THE SPACE RELATIVE HUMIDITY IS ABOVE THE MAXIMUM SPACE RELATIVE HUMIDITY SETPOINT (BUT SENSIBLE COOLING IS NOT REQUIRED), THE DEHUMIDIFICATIONS CYCLE (COOLING COIL AND REHEAT COIL) SHALL BE SEQUENCED TO MAINTAIN THE SPACE RELATIVE HUMIDITY SETPOINT WITHOUT OVER COOLING THE SPACE.
  - D. WHEN THE SPACE TEMPERATURE IS BELOW THE SPACE HEATING TEMPERATURE SETPOINT, THE GAS-FIRED HEAT EXCHANGER AND SUPPLY FAN SHALL MODULATE TO MAINTAIN THE SPACE HEATING TEMPERATURE SETPOINT.
  - E. HEATING SUPPLY AIR TEMPERATURE SETPOINT SHALL BE 1°F (ADJ.) LESS THAN THE COOLING SUPPLY AIR TEMPERATURE SETPOINT. THIS SHALL PREVENT UNNECESSARY CYCLING BETWEEN HEATING AND COOLING MODES OF OPERATION.
3. THE BAS SHALL PROVIDE THE FACTORY CONTROLLER WITH SPACE PRESSURE AND SPACE PRESSURE SETPOINT. THE POWERED EXHAUST SHALL OPERATE DURING ECONOMIZER MODE TO MAINTAIN THE SPACE STATIC PRESSURE SETPOINT. THE SPACE PRESSURE SENSOR SHALL COMPARE THE PRESSURE DIFFERENCE BETWEEN THE INSIDE AND OUTSIDE.

SPACE TEMP SETPOINT				
COOLING			HEATING	
UNOCC.	OCC.	R.H.	OCC.	UNOCC.
80°F	74°F	60%	70°F	64°F

### SEQUENCE OF OPERATION (CONTINUED)

D. SYSTEM SHUTDOWN - SHALL BE INITIATED AS FOLLOWS:

1. MANUALLY BY AN OPERATOR THROUGH THE BAS.
2. AUTOMATICALLY BY THE BAS THROUGH OCCUPANCY SCHEDULE.
3. AUTOMATICALLY BY THE BAS DUE TO EXPIRATION OF OCCUPANCY OVERRIDE REQUEST.
4. AUTOMATICALLY BY THE BAS UPON SATISFYING UNOCCUPIED SETPOINTS.
5. AUTOMATICALLY BY THE BAS DUE TO HIGH/LOW DISCHARGE AIR TEMPERATURE.
6. AUTOMATICALLY IN THE EVENT OF BUILDING POWER FAILURE OR FIRE ALARM.

E. SYSTEM SETPOINTS - THE SETPOINTS SHALL BE OPERATOR CHANGEABLE AND INITIALLY SET AS FOLLOWS:

1. SEE SPACE SETPOINT TABLE FOR OCCUPIED / UNOCCUPIED SPACE SETPOINTS.
  - A. THE OCCUPANT SHALL HAVE THE CAPABILITY TO ADJUST THE SPACE TEMPERATURE SETPOINT THROUGH THE SPACE THERMOSTAT. THE PROGRAMMING SHALL LIMIT USER ADJUSTMENT TO + OR - 2°F OF THE BASE SETPOINT.
  - B. THE OCCUPANT SHALL NOT HAVE THE CAPABILITY TO ADJUST THE SPACE RELATIVE HUMIDITY SETPOINT.
  - C. SEE SCHEDULE FOR DESIGN HEATING DISCHARGE AIR TEMPERATURE SETPOINT.
  - D. SEE SCHEDULE FOR DESIGN COOLING DISCHARGE AIR TEMPERATURE SETPOINT.
2. THE MINIMUM DESIGN OUTSIDE AIR FLOW RATE SETPOINT SHALL BE AS SCHEDULED ON THE MECHANICAL DRAWINGS.
3. THE BUILDING PRESSURE SETPOINT SHALL BE -0.05 INCHES W.G.
4. THE HIGH DISCHARGE AIR TEMPERATURE ALARM SETPOINT SHALL BE 110°F.
5. THE LOW DISCHARGE AIR TEMPERATURE ALARM SETPOINT SHALL BE 45°.
6. THE HIGH SPACE PRESSURE ALARM SETPOINT SHALL BE 0.15 INCHES W.G.
7. THE LOW SPACE PRESSURE ALARM SETPOINT SHALL BE 0.05 INCHES W.G.

F. ALARMS - THE BAS SHALL GENERATE AN ALARM FOR THE FOLLOWING CONDITIONS:

1. SUPPLY FAN FAILURE.
2. EXHAUST FAN FAILURE.
3. HIGH DISCHARGE AIR TEMPERATURE.
4. LOW DISCHARGE AIR TEMPERATURE.
5. HIGH SPACE RELATIVE HUMIDITY.
6. HIGH SPACE TEMPERATURE.
7. LOW SPACE TEMPERATURE.
8. HIGH SPACE PRESSURE.
9. LOW SPACE PRESSURE.
10. FREEZE/STAT.
11. ALL ALARMS SHALL BE INHIBITED IF THE SUPPLY FAN IS NOT IN OPERATION. THE ALARMS, EXCEPT THE FAN FAILURE TO START, SHALL REMAIN INHIBITED FOLLOWING START-UP OF THE UNIT FOR AN OPERATOR DETERMINED PERIOD OF TIME, INITIALLY SET AT TWO MINUTES.

G. FAILURE POSITIONS - THE FOLLOWING SHALL OCCUR UPON COMPONENT FAILURE OR LOSS OF POWER:

1. RELIEF AIR DAMPER SHALL CLOSE.
2. OUTSIDE AIR DAMPER SHALL CLOSE.
3. RETURN AIR DAMPER SHALL OPEN.
4. THE SUPPLY FAN SHALL REMAIN IN THE LAST COMMANDED STATE AND THE SPEED SIGNAL SHALL GO TO THE MINIMUM SPEED.
5. DX COOLING SHALL BE DISABLED.
6. DX HOT GAS REHEAT SHALL BE DISABLED.
7. GAS HEATING SHALL BE DISABLED.

### SEQUENCE OF OPERATION

A. THE FACTORY PROVIDED CONTROLLER (INTEGRAL TO UNIT) SHALL CONTROL ALL BASIC FUNCTIONS (COOLING, HEATING, DEHUMIDIFICATION, ECONOMIZER, ETC.). THE BAS SHALL PROVIDE INPUT POINTS AS REQUIRED TO INTERFACE WITH SPACE CONDITIONS AND PROVIDE THE OPERATOR THE ABILITY TO ADJUST INTERNAL UNIT CONTROLLER SETPOINTS THROUGH THE BAS. THE BAS SHALL ALSO COMMUNICATE POINTS AS REQUIRED FROM THE FACTORY PROVIDED CONTROLLER TO THE BAS / OCCUPANT WORKSTATION FOR MONITORING AND ALARMING. COORDINATE WITH EQUIPMENT SUPPLIER. ALL SENSORS / THERMOSTATS WITH OCCUPANT INTERFACE SHALL BE PROVIDED BY THE TEMPERATURE CONTROL CONTRACTOR AND BE CONSISTENT THROUGHOUT THE BUILDING.

B. SYSTEM OFF - WHEN THE SYSTEM IS OFF:

1. THE SUPPLY FAN SHALL BE OFF.
2. THE POWERED EXHAUST FAN SHALL BE OFF.
3. THE RELIEF AIR DAMPER SHALL BE CLOSED.
4. THE OUTSIDE AIR DAMPER SHALL BE CLOSED.
5. THE RETURN AIR DAMPER SHALL BE OPEN.
6. THE DX COOLING COIL SHALL BE DISABLED.
7. THE HOT GAS REHEAT SYSTEM SHALL BE DISABLED.
8. THE NATURAL GAS-FIRED HEATING SYSTEM SHALL BE DISABLED.

B. INITIATION OF SYSTEM START-UP - THE SYSTEM SHALL BE STARTED:

1. MANUALLY BY AN OPERATOR THROUGH THE BAS.
2. AUTOMATICALLY BY THE BAS FOR MORNING WARM-UP / COOL-DOWN (OPTIMAL START).
3. AUTOMATICALLY BY THE BAS THROUGH OCCUPANCY SCHEDULE.
4. AUTOMATICALLY BY THE BAS DUE TO OCCUPANT OVERRIDE REQUEST.
5. AUTOMATICALLY BY THE BAS TO MAINTAIN UNOCCUPIED SETPOINTS.

C. SYSTEM OPERATION - AFTER SYSTEM START-UP HAS BEEN INITIATED THE FOLLOWING SHALL OCCUR:

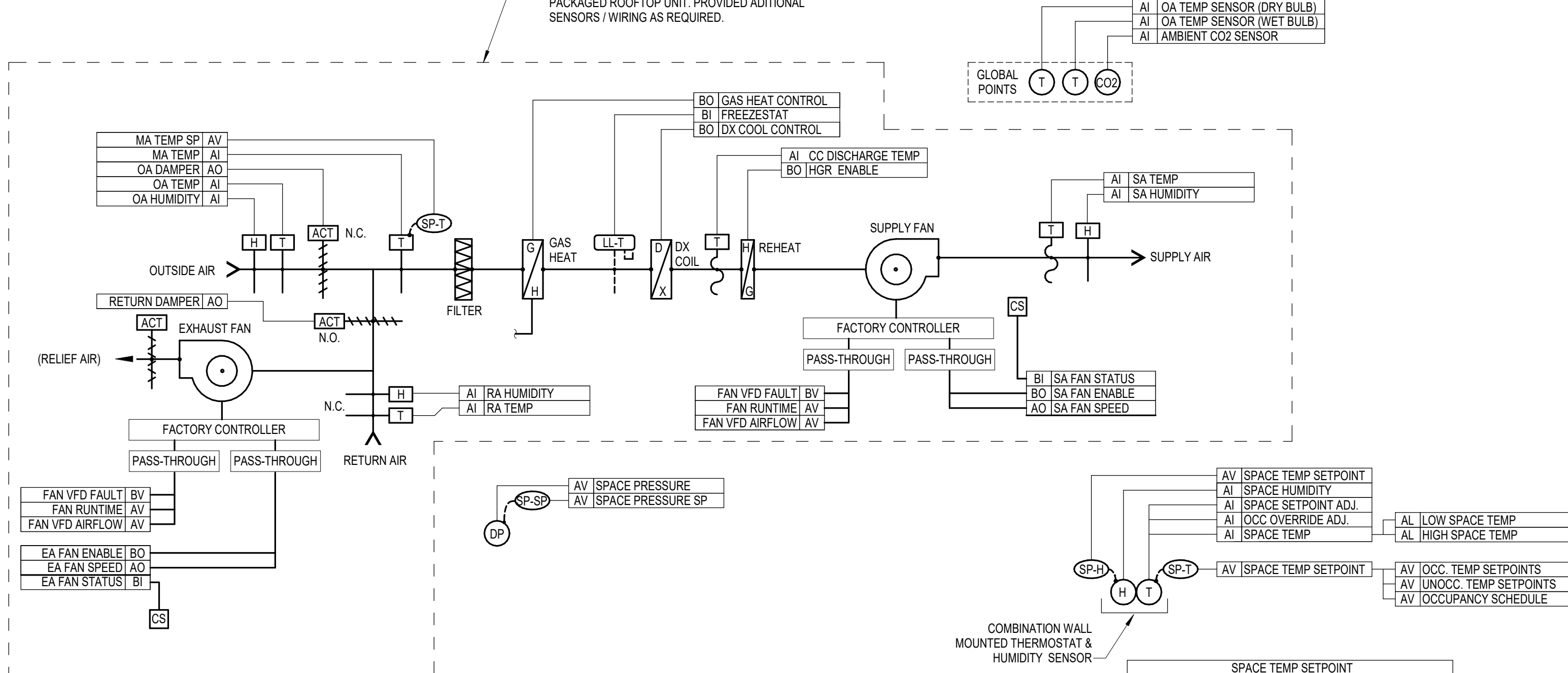
1. SEQUENTIAL RTU CONTROL.
  - A. THE TWO RTUS SHALL OPERATE IN A LEAD/LAG CONFIGURATION; SEQUENCED TO MEET COOLING / HEATING DEMAND.
  - B. THE LEAD RTU SHALL BE SELECTED BY ONE OF THE FOLLOWING OPERATOR SELECTABLE METHODS:
    - a. OPERATOR SELECTION OF INDIVIDUAL EQUIPMENT.
    - b. RUN TIMES TO EQUALIZE EQUIPMENT OPERATIONS.
    - c. OPERATOR SELECTED LEAD/LAG STAGING SEQUENCES.
  - C. IF THE LEAD RTU'S FAN SPEED IS ABOVE 75% (ADJUSTABLE) FOR MORE THAN 20 MINUTES (ADJUSTABLE), THE LAG RTU SHALL BE ENABLED. ONCE BOTH RTUS HAVE BEEN ENABLED, THEY SHALL MODULATE SIMULTANEOUSLY TO MEET THE SPACE COOLING / HEATING DEMAND. THE LAG RTU SHALL OPERATE FOR A MINIMUM OF 20 MINUTES (ADJ.) BEFORE IT CAN BE DISABLED.
  - D. IF BOTH RTUS ARE ENABLED AND THE FAN SPEED IS BELOW 50% (ADJUSTABLE) FOR MORE THAN 20 MINUTES (ADJUSTABLE), THE LAG RTU SHALL BE DISABLED. THE LAG RTU SHALL REMAIN DISABLED FOR A MINIMUM OF 20 MINUTES (ADJ.) BEFORE IT CAN BE ENABLED AGAIN.
  - E. ONLY ONE RTU SHALL BE ALLOWED TO OPERATE DURING UNOCCUPIED HOURS.
2. THE SUPPLY FAN SHALL BE ENABLED. DURING OCCUPIED HOURS (OR DURING OCCUPANT OVERRIDE REQUEST), THE FAN SHALL RUN CONTINUOUSLY. THE FACTORY PROVIDED UNIT CONTROLLER SHALL MODULATE SUPPLY FAN SPEED TO MATCH COOLING AND HEATING LOADS. DURING UNOCCUPIED HOURS, THE FAN SHALL CYCLE TO MAINTAIN THE UNOCCUPIED TEMPERATURE SETPOINTS.
3. THE BAS SHALL PROVIDE THE FACTORY UNIT CONTROLLER WITH THE SPACE TEMPERATURE, SPACE TEMPERATURE SETPOINT, SPACE RELATIVE HUMIDITY AND SPACE RELATIVE HUMIDITY SETPOINT. THE FACTORY UNIT CONTROLLER SHALL OPERATE THE COOLING, HEATING AND REHEAT COMPONENTS IN A SIMILAR MANNER AS FOLLOWS:
  - A. WHEN THE SPACE TEMPERATURE IS ABOVE THE SPACE COOLING TEMPERATURE SETPOINT, THE DX COOLING SYSTEM AND SUPPLY FAN SHALL MODULATE TO MAINTAIN THE SPACE COOLING TEMPERATURE SETPOINT.
  - B. ECONOMIZER:
    - a. WHEN THE OUTDOOR AIR ENTHALPY IS BELOW THE RETURN AIR ENTHALPY, THE CONTROL SYSTEM SHALL ENABLE THE AIRSIDE ECONOMIZER. FACTORY CONTROLLER SHALL MODULATE THE OUTSIDE AND RETURN AIR DAMPERS TO MAINTAIN THE SUPPLY AIR TEMPERATURE SETPOINT.
    - b. DX COOLING SHALL BE ALLOWED TO SUPPLEMENT ECONOMIZER WHEN 100% ECONOMIZER IS NOT ADEQUATE FOR SPACE COOLING.
    - c. WHEN THE OUTDOOR AIR ENTHALPY IS ABOVE THE RETURN AIR ENTHALPY, THE AIRSIDE ECONOMIZER SHALL BE DISABLED AND THE FACTORY CONTROLLER SHALL MODULATE THE OUTSIDE AIR DAMPER TO ITS MINIMUM POSITION AND RETURN AIR DAMPER TO ITS MAXIMUM POSITION.
  - C. WHEN THE SPACE RELATIVE HUMIDITY IS ABOVE THE MAXIMUM SPACE RELATIVE HUMIDITY SETPOINT (BUT SENSIBLE COOLING IS NOT REQUIRED), THE DEHUMIDIFICATIONS CYCLE (COOLING COIL AND REHEAT COIL) SHALL BE SEQUENCED TO MAINTAIN THE SPACE RELATIVE HUMIDITY SETPOINT WITHOUT OVER COOLING THE SPACE.
  - D. WHEN THE SPACE TEMPERATURE IS BELOW THE SPACE HEATING TEMPERATURE SETPOINT, THE GAS-FIRED HEAT EXCHANGER AND SUPPLY FAN SHALL MODULATE TO MAINTAIN THE SPACE HEATING TEMPERATURE SETPOINT.
  - E. HEATING SUPPLY AIR TEMPERATURE SETPOINT SHALL BE 1°F (ADJ.) LESS THAN THE COOLING SUPPLY AIR TEMPERATURE SETPOINT. THIS SHALL PREVENT UNNECESSARY CYCLING BETWEEN HEATING AND COOLING MODES OF OPERATION.
4. THE BAS SHALL PROVIDE THE FACTORY CONTROLLER WITH SPACE PRESSURE AND SPACE PRESSURE SETPOINT. THE POWERED EXHAUST SHALL OPERATE DURING ECONOMIZER MODE TO MAINTAIN THE SPACE STATIC PRESSURE SETPOINT. THE SPACE PRESSURE SENSOR SHALL COMPARE THE PRESSURE DIFFERENCE BETWEEN THE INSIDE AND OUTSIDE.
5. DEMAND CONTROL VENTILATION.
  - A. IF THE SPACE CO2 LEVEL EXCEEDS THE HIGH LIMIT SETPOINT WHEN THE OUTSIDE AIR DAMPER IS AT MINIMUM POSITION, THE OUTSIDE AIR DAMPER SHALL MODULATE OPEN IN 10% INCREMENTS TO MAINTAIN SETPOINT. IF AFTER A 10 MINUTE DELAY (ADJ.), THE SPACE CO2 LEVEL STILL EXCEEDS THE HIGH LIMIT SETPOINT, THE OUTSIDE AIR DAMPER SHALL MODULATE OPEN AN ADDITIONAL 10% AND SO ON UNTIL THE SPACE CO2 LEVEL FALLS BELOW THE HIGH LIMIT SETPOINT FOR 50 MINUTES (ADJ.) OR THE MAXIMUM OUTSIDE AIR DAMPER POSITION IS REACHED.
  - B. IF AFTER A 20 MINUTE DELAY (ADJ.) THE SYSTEM CANNOT MAINTAIN SPACE TEMPERATURE DUE TO THE INCREASED VENTILATION LOAD, THE OUTSIDE AIR DAMPER SHALL RETURN TO ITS MINIMUM POSITION. THE DAMPER SHALL REMAIN AT ITS MINIMUM POSITION FOR 30 MINUTES (ADJ.) BEFORE ALLOWING THE OUTSIDE AIR DAMPER TO RESPOND TO THE CO2 LEVEL AGAIN.

SPACE TEMP SETPOINT				
COOLING			HEATING	
UNOCC.	OCC.	R.H.	OCC.	UNOCC.
80°F	74°F	60%	70°F	64°F

### LEFT BINDING EDGE

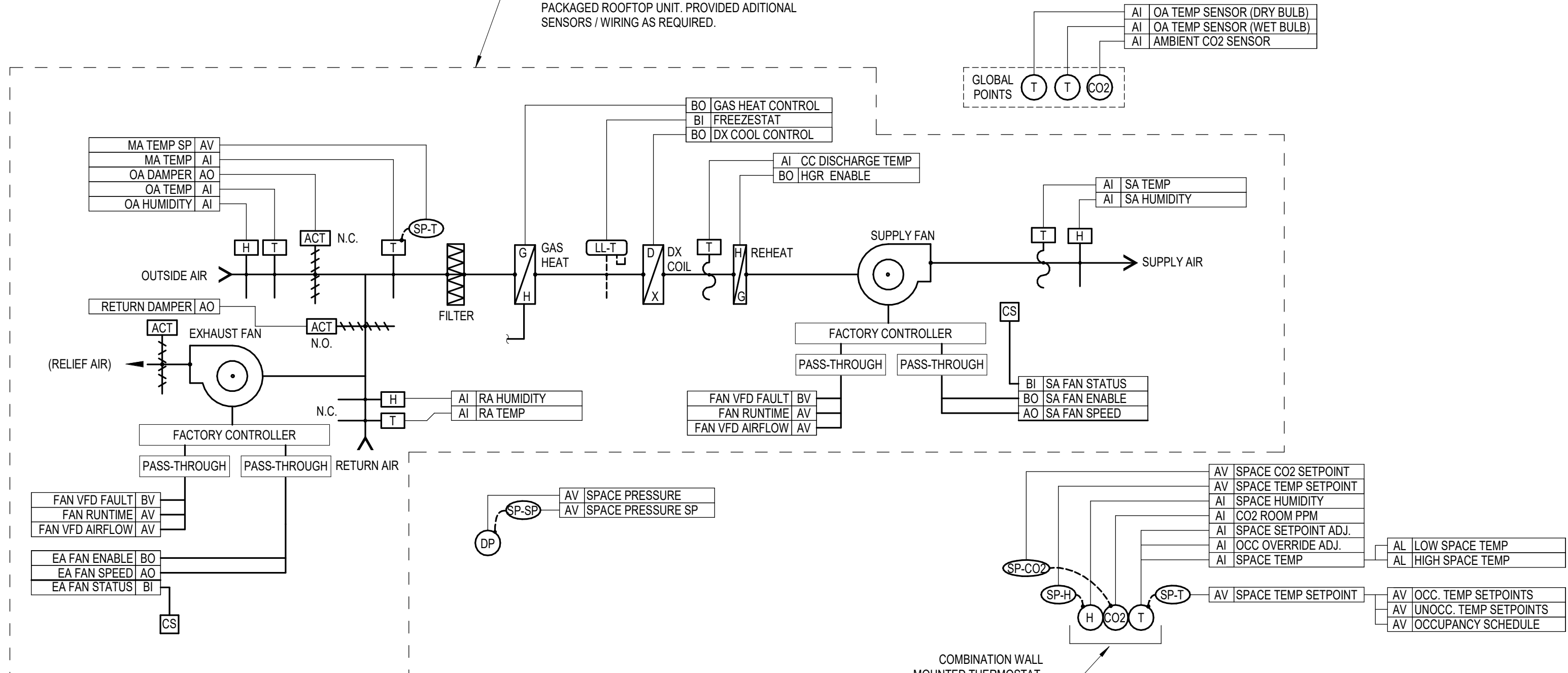
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ALL CONTROLS ARE EXPECTED TO BE PROVIDED AS A PART OF THE ROOFTOP UNIT. TEMPERATURE CONTROL CONTRACTOR TO PROVIDE WIRING TO RTU CONTROL PANEL FOR INTERFACE WITH RTU SYSTEM. TEMPERATURE CONTROL CONTRACTOR TO VERIFY ALL DESIRED POINTS HAVE BEEN PROVIDED WITH THE PACKAGED ROOFTOP UNIT. PROVIDED ADDITIONAL SENSORS / WIRING AS REQUIRED.

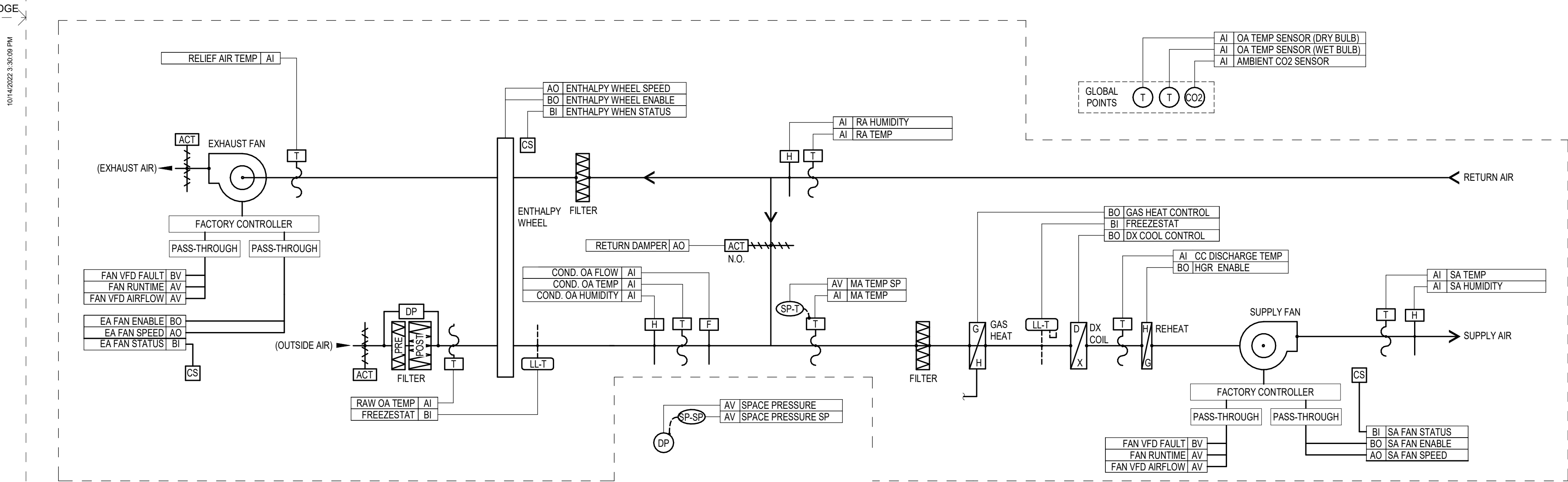


## 1 ROOFTOP UNIT (RTU-1) NTS

ALL CONTROLS ARE EXPECTED TO BE PROVIDED AS A PART OF THE ROOFTOP UNIT. TEMPERATURE CONTROL CONTRACTOR TO PROVIDE WIRING TO RTU CONTROL PANEL FOR INTERFACE WITH RTU SYSTEM. TEMPERATURE CONTROL CONTRACTOR TO VERIFY ALL DESIRED POINTS HAVE BEEN PROVIDED WITH THE PACKAGED ROOFTOP UNIT. PROVIDED ADDITIONAL SENSORS / WIRING AS REQUIRED.



## 2 ROOFTOP UNIT (RTU-3 & RTU-4) NTS



1 ROOFTOP UNIT (RTU-ER-2)  
M4-2 NTS

SEQUENCE OF OPERATION

A. THE FACTORY PROVIDED CONTROLLER (INTEGRAL TO UNIT) SHALL CONTROL ALL BASIC FUNCTIONS (COOLING, HEATING, DEHUMIDIFICATION, ECONOMIZER, ETC.). THE BAS SHALL PROVIDE INPUT POINTS AS REQUIRED TO INTERFACE WITH SPACE CONDITIONS AND PROVIDE THE OPERATOR THE ABILITY TO ADJUST INTERNAL UNIT CONTROLLER SETPOINTS THROUGH THE BAS. THE BAS SHALL ALSO COMMUNICATE POINTS AS REQUIRED FROM THE FACTORY PROVIDED CONTROLLER TO THE BAS / OCCUPANT WORKSTATION FOR MONITORING AND ALARMING. COORDINATE WITH EQUIPMENT SUPPLIER. ALL SENSORS / THERMOSTATS WITH OCCUPANT INTERFACE SHALL BE PROVIDED BY THE TEMPERATURE CONTROL CONTRACTOR AND BE CONSISTENT THROUGHOUT THE BUILDING.

B. SYSTEM OFF - WHEN THE SYSTEM IS OFF:

1. THE SUPPLY FAN SHALL BE OFF.
2. THE POWERED EXHAUST FAN SHALL BE OFF.
3. THE RELIEF AIR DAMPER SHALL BE CLOSED.
4. THE OUTSIDE AIR DAMPER SHALL BE CLOSED.
5. THE RETURN AIR DAMPER SHALL BE OPEN.
6. THE DX COOLING COIL SHALL BE DISABLED.
7. THE HOT GAS REHEAT SYSTEM SHALL BE DISABLED.
8. THE NATURAL GAS-FIRED HEATING SYSTEM SHALL BE DISABLED.
9. THE ENTHALPY WHEEL SHALL BE DISABLED.

C. INITIATION OF SYSTEM START-UP - THE SYSTEM SHALL BE STARTED:

1. MANUALLY BY AN OPERATOR THROUGH THE BAS.
2. AUTOMATICALLY BY THE BAS FOR MORNING WAKEUP / COOL-DOWN (OPTIMAL START).
3. AUTOMATICALLY BY THE BAS THROUGH OCCUPANCY SCHEDULE.
4. AUTOMATICALLY BY THE BAS DUE TO OCCUPANT OVERRIDE REQUEST.
5. AUTOMATICALLY BY THE BAS TO MAINTAIN UNOCCUPIED SETPOINTS.

D. SYSTEM OPERATION - AFTER SYSTEM START-UP HAS BEEN INITIATED THE FOLLOWING SHALL OCCUR:

1. THE SUPPLY FAN SHALL RUN CONTINUOUSLY. THE FACTORY PROVIDED UNIT CONTROLLER SHALL MODULATE SUPPLY FAN SPEED TO MATCH COOLING AND HEATING LOADS. DURING UNOCCUPIED HOURS, THE FAN SHALL CYCLE TO MAINTAIN THE UNOCCUPIED TEMPERATURE SETPOINTS.
2. THE BAS SHALL PROVIDE THE FACTORY UNIT CONTROLLER WITH THE SPACE TEMPERATURE, SPACE PRESSURE SETPOINT, SPACE RELATIVE HUMIDITY AND SPACE RELATIVE HUMIDITY SETPOINT. THE FACTORY UNIT CONTROLLER SHALL OPERATE THE COOLING, HEATING AND REHEAT COMPONENTS IN A SIMILAR MANNER AS FOLLOWS:
  - a. WHEN THE SPACE TEMPERATURE IS ABOVE THE SPACE COOLING TEMPERATURE SETPOINT, THE DX COOLING SYSTEM AND SUPPLY FAN SHALL MODULATE TO MAINTAIN THE SPACE COOLING TEMPERATURE SETPOINT.
  - b. ECONOMIZER:
    - a. WHEN THE OUTDOOR AIR ENTHALPY IS BELOW THE RETURN AIR ENTHALPY, THE CONTROL SYSTEM SHALL ENABLE THE AIRSIDE ECONOMIZER. FACTORY CONTROLLER SHALL MODULATE THE OUTSIDE AND RETURN AIR DAMPERS TO MAINTAIN THE SUPPLY AIR TEMPERATURE SETPOINT.
    - b. DX COOLING SHALL BE ALLOWED TO SUPPLEMENT ECONOMIZER WHEN 100% ECONOMIZER IS NOT ADEQUATE FOR SPACE COOLING.
  - c. WHEN THE OUTDOOR AIR ENTHALPY IS ABOVE THE RETURN AIR ENTHALPY, THE AIRSIDE ECONOMIZER SHALL BE DISABLED AND THE FACTORY CONTROLLER SHALL MODULATE THE OUTSIDE AIR DAMPER TO ITS MINIMUM POSITION AND RETURN AIR DAMPER TO ITS MAXIMUM POSITION.
3. WHEN THE SPACE RELATIVE HUMIDITY IS ABOVE THE MAXIMUM SPACE RELATIVE HUMIDITY SETPOINT (BUT SENSIBLE COOLING IS NOT REQUIRED), THE DEHUMIDIFICATION CYCLE (COOLING COIL AND REHEAT COIL) SHALL BE SEQUENCED TO MAINTAIN THE SPACE RELATIVE HUMIDITY SETPOINT WITHOUT OVER COOLING THE SPACE.
4. WHEN THE SPACE TEMPERATURE IS BELOW THE SPACE HEATING TEMPERATURE SETPOINT, THE GAS-FIRED HEAT EXCHANGER AND SUPPLY FAN SHALL MODULATE TO MAINTAIN THE SPACE HEATING TEMPERATURE SETPOINT.
5. HEATING SUPPLY AIR TEMPERATURE SETPOINT SHALL BE 1°F (ADJ.) LESS THAN THE COOLING SUPPLY AIR TEMPERATURE SETPOINT. THIS SHALL PREVENT UNNECESSARY CYCLING BETWEEN HEATING AND COOLING MODES OF OPERATION.
6. THE BAS SHALL PROVIDE THE FACTORY CONTROLLER WITH SPACE PRESSURE AND SPACE PRESSURE SETPOINT. THE POWERED EXHAUST SHALL OPERATE DURING ECONOMIZER MODE TO MAINTAIN THE SPACE STATIC PRESSURE SETPOINT. THE SPACE PRESSURE SENSOR SHALL COMPARE THE PRESSURE DIFFERENCE BETWEEN THE INSIDE AND OUTSIDE.
7. DEMAND OUTSIDE VENTILATION:
  - a. IF THE SPACE CO2 LEVEL EXCEEDS THE HIGH LIMIT SETPOINT WHEN THE OUTSIDE AIR DAMPER IS AT MINIMUM POSITION, THE OUTSIDE AIR DAMPER SHALL MODULATE OPEN IN 10% INCREMENTS TO MAINTAIN SETPOINT. IF AFTER A 10 MINUTE DELAY (ADJ.), THE SPACE CO2 LEVEL STILL EXCEEDS THE HIGH LIMIT SETPOINT, THE OUTSIDE AIR DAMPER SHALL MODULATE OPEN AN ADDITIONAL 10% AND SO ON UNTIL THE SPACE CO2 LEVEL FALLS BELOW THE HIGH LIMIT SETPOINT FOR 30 MINUTES (ADJ.) OR THE MAXIMUM OUTSIDE AIR DAMPER POSITION IS REACHED.
  - b. IF AFTER A 20 MINUTE DELAY (ADJ.) THE SYSTEM CANNOT MAINTAIN SPACE TEMPERATURE DUE TO THE INCREASED VENTILATION LOAD, THE OUTSIDE AIR DAMPER SHALL RETURN TO ITS MINIMUM POSITION. THE DAMPER SHALL REMAIN AT ITS MINIMUM POSITION FOR 30 MINUTES (ADJ.) BEFORE ALLOWING THE OUTSIDE AIR DAMPER TO RESPOND TO THE CO2 LEVEL AGAIN.
8. ENERGY WHEEL CONTROL:
  - a. BYPASS DAMPERS: BYPASS DAMPERS ARE OPENED WHEN THE UNIT ENTERS THE ECONOMIZER OPERATING STATE. OTHERWISE, THE BYPASS DAMPERS REMAIN CLOSED.
  - b. WHEEL EFFECTIVENESS: CONTROL ENERGY RECOVERY WHEEL WILL START/STOP TO MEET THE DISCHARGE AIR TEMPERATURE SET POINT USING FACTORY MOUNTED TEMPERATURE SENSORS. THE ENERGY WHEEL IS THE FIRST FORM OF HEATING OR COOLING WHEN ACTIVE. COMPRESSORS OR HEAT WILL ONLY BE ACTIVE WHEN THE ENERGY RECOVERY WHEEL CANNOT SATISFY THE DAT.
  - c. ON/OFF DEFROST CONTROL: WHEN THE OUTSIDE AIR TEMP IS BELOW AN ADJUSTABLE FROST TEMPERATURE (DEFAULT 32°F) THE WHEEL IS STOPPED FOR AN ADJUSTABLE PERIOD OF TIME (DEFAULT 5 MINUTES) ONCE EVERY 60 MINUTES (ADJUSTABLE).

SEQUENCE OF OPERATION (CONTINUED)

D. SYSTEM SHUTDOWN - SHALL BE INITIATED AS FOLLOWS:

1. MANUALLY BY AN OPERATOR THROUGH THE BAS.
2. AUTOMATICALLY BY THE BAS THROUGH OCCUPANCY SCHEDULE.
3. AUTOMATICALLY BY THE BAS DUE TO EXPIRATION OF OCCUPANCY OVERRIDE REQUEST.
4. AUTOMATICALLY BY THE BAS UPON SATISFYING UNOCCUPIED SETPOINTS.
5. AUTOMATICALLY BY THE BAS DUE TO HIGH/LOW DISCHARGE AIR TEMPERATURE.
6. AUTOMATICALLY IN THE EVENT OF BUILDING POWER FAILURE OR FIRE ALARM.

E. SYSTEM SETPOINTS - THE SETPOINTS SHALL BE OPERATOR CHANGEABLE AND INITIALLY SET AS FOLLOWS:

1. SEE SPACE SETPOINT TABLE FOR OCCUPIED / UNOCCUPIED SPACE SETPOINTS.
  - a. THE OCCUPANT SHALL HAVE THE CAPABILITY TO ADJUST THE SPACE TEMPERATURE SETPOINT THROUGH THE SPACE THERMOSTAT. THE PROGRAMMING SHALL LIMIT USER ADJUSTMENT TO + OR - 2°F OF THE BASE SETPOINT.
  - b. THE OCCUPANT SHALL NOT HAVE THE CAPABILITY TO ADJUST THE SPACE RELATIVE HUMIDITY SETPOINT.
  - c. SEE SCHEDULE FOR DESIGN HEATING DISCHARGE AIR TEMPERATURE SETPOINT.
  - d. SEE SCHEDULE FOR DESIGN COOLING DISCHARGE AIR TEMPERATURE SETPOINT.
2. THE MINIMUM DESIGN OUTSIDE AIR FLOW RATE SETPOINT SHALL BE AS SCHEDULED ON THE MECHANICAL DRAWINGS.
3. THE RETURN AIR CO2 HIGH LIMIT SHALL BE 1,000 PPM.
4. THE BUILDING PRESSURE SETPOINT SHALL BE 0.05 INCHES W.G.
5. THE HIGH DISCHARGE AIR TEMPERATURE ALARM SETPOINT SHALL BE 110°F.
6. THE LOW DISCHARGE AIR TEMPERATURE ALARM SETPOINT SHALL BE 45°.
7. THE HIGH SPACE PRESSURE ALARM SETPOINT SHALL BE 0.15 INCHES W.G.
8. THE LOW SPACE PRESSURE ALARM SETPOINT SHALL BE 0.05 INCHES W.G.
9. THE RETURN AIR CO2 HIGH LIMIT SHALL BE 1,000 PPM.

F. ALARMS - THE BAS SHALL GENERATE AN ALARM FOR THE FOLLOWING CONDITIONS:

1. SUPPLY FAN FAILURE.
2. EXHAUST FAN FAILURE.
3. HIGH DISCHARGE AIR TEMPERATURE.
4. LOW DISCHARGE AIR TEMPERATURE.
5. HIGH SPACE RELATIVE HUMIDITY.
6. HIGH SPACE TEMPERATURE.
7. LOW SPACE TEMPERATURE.
8. HIGH SPACE PRESSURE.
9. LOW SPACE PRESSURE.
10. ENTHALPY WHEEL FAILURE.
11. FREEZE/STAT.
12. ALL ALARMS SHALL BE INHIBITED IF THE SUPPLY FAN IS NOT IN OPERATION. THE ALARMS, EXCEPT THE FAN FAILURE TO START, SHALL REMAIN INHIBITED FOLLOWING START-UP OF THE UNIT FOR AN OPERATOR DETERMINED PERIOD OF TIME, INITIALLY SET AT TWO MINUTES.

G. FAILURE POSITIONS - THE FOLLOWING SHALL OCCUR UPON COMPONENT FAILURE OR LOSS OF POWER:

1. RELIEF AIR DAMPER SHALL CLOSE.
2. OUTSIDE AIR DAMPER SHALL CLOSE.
3. RETURN AIR DAMPER SHALL OPEN.
4. THE SUPPLY FAN SHALL REMAIN IN THE LAST COMMANDED STATE AND THE SPEED SIGNAL SHALL GO TO THE MINIMUM SPEED.
5. DX COOLING SHALL BE DISABLED.
6. DX HOT GAS REHEAT SHALL BE DISABLED.
7. GAS HEATING SHALL BE DISABLED.

PROJECT TEAM

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