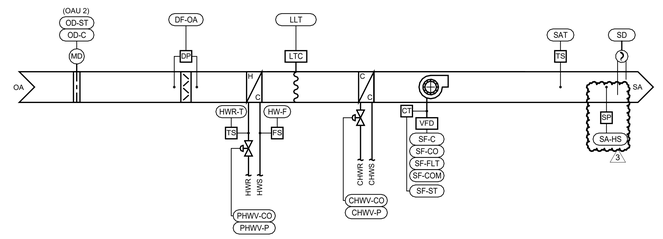
DUCT MOUNTED SMOKE DETECTORS ONLY REQUIRED WHERE SHOWN ON MECHANICAL OR FIRE ALARM FLOOR PLANS.

SEQUENCE OF OPERATIONS GENERAL NOTES

This sequence of operations is organized into the following main categories: operating modes, control setpoint resets, safeties, overrides and interlocks, and component control loops. The operating modes describe the criteria that either enable or disable the various modes of operation. If a mode of operation is not listed within a component control loop section then that mode of operation has no direct influence on the operation of the component. The control setpoint reset section describes the logic and reference variables that will be used to reset control setpoints to a new value within its reset range. The safeties, overrides, and interlocks section outlines the hardwired interlocks that will be required to meet life safety requirements. Safeties and interlocks take precedence over all other control strategies outlined in this document. The control responses of each component for the various modes of operation are described in the component control loop sections.

The sequence of operations, the points list and control diagrams shall be used to provide a complete description of the control philosophy for the controlled equipment. Individual setpoint values, reset ranges, and alarm action levels are listed in the points list. Components and control sensor locations are graphically depicted on the control diagram. The controls contractor shall be responsible for coordinating any necessary time delay setpoints to establish stable system operation.



POINTS LIST - DOAS AIR HANDLING UNIT

POINT ID	DESCRIPTION	POINT TYPE	DEFAULT SET POINT	SET POINT RESET RANGE	FAIL POSITION	TRENDING INTERVAL	TRENDING STORAGE	DISPLAY GRAPHIC	STATUS ALARM	ALARM RANGE	NOTES
GLOBAL VALUES											
OAT	OUTSIDE AIR TEMPERATURE	AV					X	X			
OAH	OUTSIDE AIR RELATIVE HUMIDITY	AV					X	X			
AIR SENSING											
SAT	SUPPLY AIR TEMPERATURE	AI	53 F CLG, 60 F HTG				X	X	X	48 F > SAT > 60 F	A, C
OAT-C	OUTSIDE AIR COOLING ENABLE	AV	60 F								A
OAT-H	OUTSIDE AIR HEATING ENABLE	AV	50 F								A
LLT	LOW LIMIT TEMPERATURE	AI	35 F				X	X	X	ON ACTIVATION	A
SUPPLY FAN											
SF-COM	SUPPLY FAN VFD COMMUNICATION	COM						X			
SF-C	SUPPLY FAN COMMAND (START/STOP)	BO					X	X			
SF-CO	SUPPLY FAN CONTROL OUTPUT - SPEED (PERCENT)	AO		SCHED							
SF-ST	SUPPLY FAN STATUS	BI					X		X	SF-ST <> SF-C	
SF-FLT	SUPPLY FAN VFD FAULT	BI					X	X	X	COMMON ALARM	
SAHS	SUPPLY AIR HIGH STATIC CONTROLLER	BI	2 ALARMS						X	ON ACTIVATION	G
OUTSIDE AIR DAMPER (2-POSITION)											
OD-C	OUTSIDE AIR DAMPER COMMAND	BO			NC			X			
OD-ST	OUTSIDE AIR DAMPER STATUS (END SWITCH)	BI					X	X	X	OD-ST <> OD-C	
FILTERS											
DF-OA	DIRTY FILTER INDICATION (OA FILTER)	BI	SCHED.					X	X	ON ACTIVATION	A
COOLING COIL - CHILLED WATER MODULATING											
CHWV-CO	CHILLED WATER VALVE CONTROL OUTPUT	AO			NO		X	X			
CHWV-P	CHILLED WATER VALVE POSITION (PERCENT)	AI					X	X	X	CHWV-P <> CHWV-CO	
HEATING COIL - HOT WATER MODULATING											
PHWV-CO	HEATING HOT WATER VALVE CONTROL OUTPUT	AO			NO		X	X			
PHWV-P	HEATING HOT WATER VALVE POSITION (PERCENT)	AI					X	X	X	HHW-P <> HHW-CO	
HWR-T	HEATING HOT WATER RETURN TEMPERATURE	AI							X	HWR-T < 80 F	
HW-F	HEATING HOT WATER FLOW SWITCH	BI							X	FAIL TO CLOSE	
FIRE ALARM/SMOKE DETECTORS											
SD	SMOKE DETECTOR STATUS	BI						X	X	ON ACTIVATION	B

ALL POINTS SHOWN SHALL BE PROVIDED BY BAS CONTRACTOR UNLESS NOTED OTHERWISE.

NOTES:
A. POINT SHALL BE ADJUSTABLE.
B. DEVICE AND RELAY FROM FIRE ALARM SYSTEM PROVIDED BY DIVISION 28 3
C. OAU 1 HEATING SETPOINT SHALL BE 58 F.
G. DETERMINE SETPOINT DURING TESTING AND BALANCING. COORDINATE WITH THE TEST AND BALANCE CONTRACTOR.

2 DEDICATED OUTSIDE AIR UNIT CONTROL DIAGRAM
NTS

SEQUENCE OF OPERATIONS DEDICATED OUTSIDE AIR AIR HANDLING UNITS (OAU 1, OAU 2)

GENERAL DESCRIPTION

The air handling unit(s) described by this sequence of operations consist(s) of a variable speed supply fan, chilled water cooling coil, and a gas fired heating coil to provide conditioned ventilation air for the conditioned spaces as shown on the drawings.

OPERATING MODES

OCCUPIED MODE:

The unit shall be in occupied mode per the Project Design Conditions Schedule shown on the control drawings.

UNOCCUPIED MODE:

The unit shall be in unoccupied mode for all periods not included in the occupied hours of operation. Overrides of unoccupied schedule are defined at the zone level control.

COOLING MODE:

The unit shall be in cooling mode when the outside air temperature (OAT) rises above the outside air cooling enable setpoint (OAT-C)

HEATING MODE:

The unit shall be in heating mode when the outside air temperature (OAT) falls below the outside air heating enable setpoint (OAT-H)

VENTILATION ONLY MODE:

The unit shall be in ventilation only mode when the outdoor air temperature is between the outdoor air cooling enable (OAT-C) and outdoor air heating enable (OAT-H) setpoints.

ECONOMIZER MODE - DIFFERENTIAL ENTHALPY WITH FIXED DRY-BULB TEMPERATURE ENABLED:

The unit shall be in economizer mode when:

The supply fan status is on;

And- the unit is in cooling mode;

And- the AHU is not in freeze protection mode;

And- the outside air enthalpy is less than the return air enthalpy.

And- the outside air temperature is less than 75 F (adj.);

FREEZE PROTECTION MODE:

The unit shall be in freeze protection mode when:

The low limit temperature controller (LLT) senses a temperature less than the alarm setpoint.

CONTROL SETPOINT RESETS

Not Used.

SAFETIES, OVERRIDES AND INTERLOCKS

SMOKE DETECTOR INTERLOCK:

The unit shall be disabled via hard wired interlock on activation of a system smoke detector. Display smoke detector relay status (normal or alarm) at the BAS front end.

FIRE ALARM CONTROL PANEL INTERLOCK:

The unit shall be disabled via relay circuit signal from the fire alarm control panel. Division 28 shall provide the relay and leads from relay to unit. BAS contractor shall connect leads to unit. Display relay status (normal or alarm) at BAS front end.

FREEZE PROTECTION MODE INTERLOCK:

The supply fan shall be disabled via hard wired interlock at the supply fan start circuit from the low limit temperature controller.

3 HIGH SUPPLY AIR STATIC PRESSURE INTERLOCK:

The unit shall be disabled via hard wired interlock at the fan start circuit upon activation of duct high static pressure controller.

COMPONENT CONTROL LOOPS

SUPPLY FAN CONTROL- CONSTANT VOLUME

When in Occupied Mode:

The fan shall be ON.

The VFD shall be used for soft start and to balance the fan for constant speed operation to achieve the scheduled airflow value.

When in Unoccupied Mode:

The fan shall be OFF. On an override signal from the zone level, the fan shall operate as in occupied mode until the override is removed.

When in Freeze Protection Mode:

The fan shall be OFF.

When in Economizer Mode:

The fan shall be ON.

OUTSIDE AIR DAMPER (OA)

When in Occupied Mode:

The damper shall be open.

When in Unoccupied Mode:

The damper shall close after the supply fan is off and a time delay.

When in Freeze Protection Mode:

The damper shall close after the supply fan is off and a time delay.

When in Economizer Mode:

The damper shall be open.

FILTER MONITORING

When in All Modes:

The controller shall monitor the differential pressure across each filter bank and shall provide a signal when the setpoint is exceeded.

HEATING COIL- HOT WATER VALVE- MODULATING

When in Occupied Mode:

When in Ventilation Only Mode:

The valve shall be closed.

When in Cooling Mode:

The valve shall be closed.

When in Heating Mode:

The controller shall modulate the heating to maintain the supply air temperature setpoint (SAT).

3 When in Unoccupied Mode:

The valve shall be closed.

When in Freeze Protection Mode:

The valve shall be fully open.

COOLING COIL CHILLED WATER VALVE - MODULATING

When in Occupied Mode:

When in Ventilation Only Mode:

The valve shall be closed.

When in Cooling Mode:

The valve shall modulate to maintain the supply air temperature setpoint (SAT).

When in Heating Mode:

The valve shall be closed.

3 When in Unoccupied Mode:

The valve shall be closed.

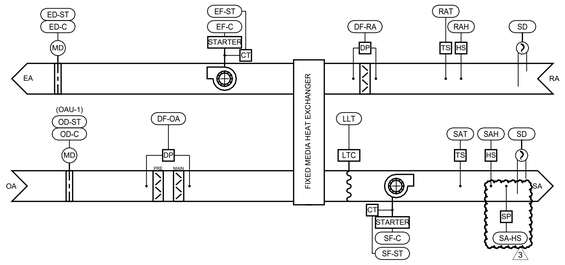
When in Freeze Protection Mode:

The valve shall be fully open.

And- The chilled water plant AHU freeze protection mode shall be activated .

When in Economizer Mode:

The valve shall be closed.



POINTS LIST - ENERGY RECOVERY VENTILATOR

POINT ID	DESCRIPTION	POINT TYPE	DEFAULT SET POINT	SET POINT RESET RANGE	FAIL POSITION	TRENDING INTERVAL	TRENDING STORAGE	DISPLAY GRAPHIC	STATUS ALARM	ALARM RANGE	NOTES
GLOBAL VALUES											
OAT	OUTSIDE AIR TEMPERATURE	AV					X	X			A
OAH	OUTSIDE AIR RELATIVE HUMIDITY	AV					X	X			A
AIR SENSING											
SAT	SUPPLY AIR TEMPERATURE	AI					X	X	X	45 F > SAT > 85 F	B
SAH	SUPPLY AIR RELATIVE HUMIDITY	AI					X	X			
RAT	RETURN AIR TEMPERATURE	AI					X	X			
RAH	RETURN AIR RELATIVE HUMIDITY	AI					X	X			
LLT	LOW LIMIT TEMPERATURE	AV	42 F				X	X	X	ON ACTIVATION	B
SUPPLY FAN											
SF-C	SUPPLY FAN COMMAND (START/STOP)	BO					X	X			
SF-ST	SUPPLY FAN STATUS	BI					X		X	SF-ST <> SF-C	
SAHS	SUPPLY AIR HIGH STATIC CONTROLLER	BI	2 ALARMS						X	ON ACTIVATION	C
EXHAUST FAN											
EF-C	EXHAUST FAN COMMAND (START/STOP)	BO					X	X			
EF-ST	EXHAUST FAN STATUS	BI					X		X	EF-ST <> EF-C	
EXHAUST AIR DAMPER (2-POSITION)											
ED-C	EXHAUST AIR DAMPER COMMAND	BO			NC			X			
ED-ST	EXHAUST AIR DAMPER STATUS (END SWITCH)	BI					X	X	X	ED-ST <> ED-C	
OUTSIDE AIR DAMPER (2-POSITION)											
OD-C	OUTSIDE AIR DAMPER COMMAND	BO			NC			X			
OD-ST	OUTSIDE AIR DAMPER STATUS (END SWITCH)	BI					X	X	X	MOD-ST <> MOD-C	
FILTERS											
DF-OA	DIRTY FILTER INDICATION (OA FILTER)	BI	SCHED.					X	X	ON ACTIVATION	B
DF-RA	DIRTY FILTER INDICATION (RA FILTER)	BI	SCHED.					X	X	ON ACTIVATION	B
HEAT EXCHANGER - FIXED MEDIA											
	(NO ADDITIONAL CONTROL)							X			
FIRE ALARM/SMOKE DETECTORS											
SD	SMOKE DETECTOR STATUS	BI						X	X	ON ACTIVATION	C

ALL POINTS SHOWN SHALL BE PROVIDED BY BAS CONTRACTOR UNLESS NOTED OTHERWISE.

NOTES:
A. DISPLAY VALUE WITH AHU GRAPHIC AT BAS FRONT-END. REFERENCE GLOBAL BUILDING MONITORING SCHEDULE FOR CONTROL POINT.
B. POINT SHALL BE ADJUSTABLE.
C. DEVICE AND RELAY FROM FIRE ALARM SYSTEM PROVIDED BY DIVISION 28 3
G. DETERMINE SETPOINT DURING TESTING AND BALANCING. COORDINATE WITH THE TEST AND BALANCE CONTRACTOR.

1 ENERGY RECOVERY VENTILATOR CONTROL DIAGRAM
NTS

SEQUENCE OF OPERATIONS ENERGY RECOVERY VENTILATOR AIR HANDLING UNITS (ERU 1)

GENERAL DESCRIPTION

The energy recovery unit(s) described by this sequence of operations consist(s) of a constant volume supply fan, constant volume exhaust fan, and an air-to-air plate exchanger to precondition ventilation air for the conditioned spaces as shown on the drawing.

OPERATING MODES

OCCUPIED MODE:

The unit shall be in occupied mode per the Project Design Conditions Schedule shown on the control drawings.

UNOCCUPIED MODE:

The unit shall be in unoccupied mode for all periods not included in the occupied hours of operation. Overrides of unoccupied schedule are defined at the zone level control.

FREEZE PROTECTION MODE:

The unit shall be in freeze protection mode when:

The unit shall be in freeze protection mode when the supply air temperature sensor (SAT) senses a temperature less than the alarm setpoint.

SAFETIES, OVERRIDES AND INTERLOCKS

3 HIGH SUPPLY AIR STATIC PRESSURE INTERLOCK:

The unit shall be disabled via hard wired interlock at the fan start circuit upon activation of duct high static pressure controller.

SMOKE DETECTOR INTERLOCK:

The unit shall be disabled via hard wired interlock on activation of a system smoke detector. Display smoke detector relay status (normal or alarm) at the BAS front end.

FIRE ALARM CONTROL PANEL INTERLOCK:

The unit shall be disabled via relay circuit signal from the fire alarm control panel. Division 28 shall provide the relay and leads from relay to unit. BAS contractor shall connect leads to unit. Display relay status (normal or alarm) at BAS front end.

COMPONENT CONTROL LOOPS

SUPPLY FAN CONTROL- CONSTANT VOLUME

When in Occupied Mode:

The fan shall be ON.

The VFD shall be used for soft start and to balance the fan for constant speed operation to achieve the scheduled airflow value.

When in Unoccupied Mode:

The fan shall be OFF. On an override signal from the zone level, the fan shall operate as in occupied mode until the override is removed.

When in Freeze Protection Mode:

The fan shall be OFF

EXHAUST FAN (EF) - CONSTANT VOLUME

When in Occupied Mode:

The fan shall be ON.

The EC motor shall be used for soft start and to balance the fan for constant speed operation to achieve the scheduled airflow value.

When in Unoccupied Mode:

The fan shall be OFF.

When in Freeze Protection Mode:

The fan shall be OFF

OUTSIDE AIR DAMPER (OA)

When in Occupied Mode:

The damper shall be open.

When in Unoccupied Mode:

The damper shall close after the supply fan is off and a time delay

When in Freeze Protection Mode:

The damper shall close after the supply fan is off and a time delay

EXHAUST AIR DAMPERS

When in Occupied Mode:

The damper shall be open.

When in Unoccupied Mode:

The damper shall close after the exhaust fan is off and a time delay

When in Freeze Protection Mode:

The damper shall close after the relief/exhaust fan is off and a time delay

FILTER MONITORING

When in All Modes:

The controller shall monitor the differential pressure across each filter bank and shall provide a signal when the setpoint is exceeded.

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No. 17560
SEAN O. EISLER
4/24/2025

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MECHANICAL CONTROLS

LSL PROJECT NUMBER: 2024-107.000

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