

**EXHAUST FAN EF-9 AND EF-10
SEQUENCE OF OPERATION**

EXHAUST FAN - EF-9 AND 10 (TYPICAL OF 2)

RUN CONDITIONS - SCHEDULED:
THE FAN SHALL RUN ACCORDING TO A USER DEFINABLE SCHEDULE.

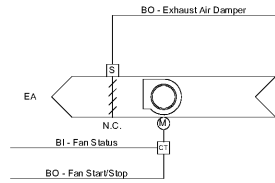
FAN:
THE FAN SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.

EXHAUST AIR DAMPER:
THE EXHAUST AIR DAMPER SHALL OPEN ANYTIME THE UNIT RUNS AND SHALL CLOSE ANYTIME THE UNIT STOPS. THE EXHAUST AIR DAMPER SHALL CLOSE 30 SEC (ADJ.) AFTER THE FAN STOPS.

ALARMS SHALL BE PROVIDED AS FOLLOWS:
• DAMPER FAILURE: COMMANDED OPEN, BUT THE STATUS IS CLOSED.
• DAMPER IN HAND: COMMANDED CLOSED, BUT THE STATUS IS OPEN.

FAN STATUS:
THE CONTROLLER SHALL MONITOR THE FAN STATUS.

ALARMS SHALL BE PROVIDED AS FOLLOWS:
• FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
• FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.
• FAN RUNTIME EXCEEDED: FAN STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT (ADJ.).



POINT NAME	HARDWARE POINTS			SOFTWARE POINTS							SHOW ON GRAPHIC
	AI	AO	BI	BO	AV	BV	LOOP	SCHED	TREND	ALARM	
FAN STATUS			X						X		X
EXHAUST AIR DAMPER				X					X		X
FAN START/STOP				X					X		X
SCHEDULE							X				
FAN FAILURE										X	
FAN IN HAND										X	
FAN RUNTIME EXCEEDED										X	
TOTALS	0	0	1	2	0	0	1	3	3		3
TOTAL HARDWARE (3)			TOTAL SOFTWARE (7)								

**OUTSIDE AIR CONDITIONS
SEQUENCE OF OPERATION**

OUTSIDE AIR CONDITIONS

OUTSIDE AIR CONDITIONS:
THE CONTROLLER SHALL MONITOR THE OUTSIDE AIR TEMPERATURE AND HUMIDITY AND CALCULATE THE OUTSIDE AIR ENTHALPY ON A CONTINUOUS BASIS. THESE VALUES SHALL BE MADE AVAILABLE TO THE SYSTEM AT ALL TIMES.

ALARMS SHALL BE GENERATED AS FOLLOWS:

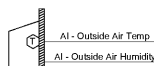
• SENSOR FAILURE: SENSOR READING INDICATES SHORTED OR DISCONNECTED SENSOR. IN THE EVENT OF A SENSOR FAILURE, AN ALTERNATE OUTSIDE AIR CONDITIONS SENSOR SHALL BE MADE AVAILABLE TO THE SYSTEM WITHOUT INTERRUPTION IN SENSOR READINGS.

IF AN OA TEMP SENSOR CANNOT BE READ, A DEFAULT VALUE OF 65°F WILL BE USED.

IF AN OA HUMIDITY SENSOR CANNOT BE READ, A DEFAULT VALUE OF 50% WILL BE USED.

OUTSIDE AIR TEMPERATURE HISTORY:

THE CONTROLLER SHALL MONITOR AND RECORD THE HIGH AND LOW TEMPERATURE READINGS FOR THE OUTSIDE AIR. THESE READINGS SHALL BE RECORDED ON A DAILY, MONTH-TO-DATE, AND YEAR-TO-DATE BASIS.



POINT NAME	HARDWARE POINTS			SOFTWARE POINTS							SHOW ON GRAPHIC
	AI	AO	BI	BO	AV	BV	LOOP	SCHED	TREND	ALARM	
OUTSIDE AIR HUMIDITY									X		X
OUTSIDE AIR TEMP	X								X		X
OUTSIDE AIR ENTHALPY				X					X		X
HIGH TEMP MONTH-TO-DATE								X			X
HIGH TEMP TODAY								X			X
HIGH TEMP YEAR-TO-DATE								X			X
LOW TEMP MONTH-TO-DATE								X			X
LOW TEMP TODAY								X			X
LOW TEMP YEAR-TO-DATE								X			X
SENSOR FAILURE										X	
TOTALS	2	0	0	1	0	0	0	9	1		9
TOTAL HARDWARE (2)			TOTAL SOFTWARE (11)								

**RTU-1
SEQUENCE OF OPERATION**

RTU-1 (TYPICAL OF 1)

RUN CONDITIONS - REQUESTED:
THE UNIT SHALL RUN WHENEVER:

• ANY ZONE IS OCCUPIED.
• OR A DEFINABLE NUMBER OF UNOCCUPIED ZONES NEED HEATING OR COOLING.

EMERGENCY SHUTDOWN:
THE UNIT SHALL SHUT DOWN AND GENERATE AN ALARM UPON RECEIVING AN EMERGENCY SHUTDOWN SIGNAL.

FREEZE PROTECTION:
THE UNIT SHALL SHUT DOWN AND GENERATE AN ALARM UPON RECEIVING A FREEZE STAT STATUS.

HIGH STATIC SHUTDOWN:
THE UNIT SHALL SHUT DOWN AND GENERATE AN ALARM UPON RECEIVING A HIGH STATIC SHUTDOWN SIGNAL.

SUPPLY AIR SMOKE DETECTION:
THE UNIT SHALL SHUT DOWN AND GENERATE AN ALARM UPON RECEIVING A SUPPLY AIR SMOKE DETECTOR STATUS.

SUPPLY FAN:
THE SUPPLY FAN SHALL RUN ANYTIME THE UNIT IS COMMANDED TO RUN, UNLESS SHUTDOWN ON SAFETIES. TO PREVENT SHORT CYCLING, THE SUPPLY FAN SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.

ALARMS SHALL BE PROVIDED AS FOLLOWS:
• SUPPLY FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
• SUPPLY FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.
• SUPPLY FAN RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT (ADJ.).

SUPPLY AIR DUCT STATIC PRESSURE CONTROL:
THE CONTROLLER SHALL MEASURE DUCT STATIC PRESSURE AND MODULATE THE SUPPLY FAN VFD SPEED TO MAINTAIN A DUCT STATIC PRESSURE SETPOINT. THE SPEED SHALL NOT DROP BELOW 30% (ADJ.). THE STATIC PRESSURE SETPOINT SHALL BE RESET BASED UPON THE POSITION OF THE ZONE DAMPERS, WITH A GOAL OF REDUCING THE STATIC PRESSURE UNTIL AT LEAST ONE ZONE DAMPER IS NEARLY WIDE OPEN.
• THE INITIAL DUCT STATIC PRESSURE SETPOINT SHALL BE 1.5IN H2O (ADJ.).
• IF NO ZONE DAMPER IS NEARLY WIDE OPEN, THE SETPOINT SHALL INCREMENTALLY RESET DOWN TO A MINIMUM OF 1.3IN H2O (ADJ.).
• AS ONE OR MORE DAMPERS NEARS THE WIDE OPEN POSITION, THE SETPOINT SHALL INCREMENTALLY RESET UP TO A MAXIMUM OF 1.8IN H2O (ADJ.).

ALARMS SHALL BE PROVIDED AS FOLLOWS:
• HIGH SUPPLY AIR STATIC PRESSURE: IF THE SUPPLY AIR STATIC PRESSURE IS 25% (ADJ.) GREATER THAN SETPOINT.
• LOW SUPPLY AIR STATIC PRESSURE: IF THE SUPPLY AIR STATIC PRESSURE IS 25% (ADJ.) LESS THAN SETPOINT.
• SUPPLY FAN VFD FAULT.

RETURN FAN:
THE RETURN FAN SHALL RUN WHENEVER THE SUPPLY FAN RUNS.

ALARMS SHALL BE PROVIDED AS FOLLOWS:
• RETURN FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
• RETURN FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.
• RETURN FAN RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT (ADJ.).
• RETURN FAN VFD FAULT.

RETURN AIR FLOW:
THE RETURN FAN VFD SHALL MODULATE IN UNISON WITH THE SUPPLY FAN VFD. RETURN AIRFLOW SETPOINT SHALL BE 100% (ADJ.) OF THE SUPPLY AIRFLOW MINUS 1000FT³/MIN (ADJ.). THE RETURN FAN VFD SPEED SHALL NOT DROP BELOW 20% (ADJ.).

ALARMS SHALL BE PROVIDED AS FOLLOWS:
• HIGH RETURN AIRFLOW: IF THE RETURN AIRFLOW IS AN ADJUSTABLE PERCENTAGE GREATER THAN SETPOINT.
• LOW RETURN AIRFLOW: IF THE RETURN AIRFLOW IS AN ADJUSTABLE PERCENTAGE LESS THAN SETPOINT.

SUPPLY AIR TEMPERATURE SETPOINT - FIXED:
THE CONTROLLER SHALL MONITOR THE SUPPLY AIR TEMPERATURE AND SHALL MAINTAIN A FIXED SUPPLY AIR TEMPERATURE SETPOINT OF 55°F (ADJ.).

COOLING STAGES:
THE CONTROLLER SHALL MEASURE THE SUPPLY AIR TEMPERATURE AND STAGE THE COOLING TO MAINTAIN ITS COOLING SETPOINT. PREVENT SHORT CYCLING. THERE SHALL BE A USER DEFINABLE (ADJ.) DELAY BETWEEN STAGES, AND EACH STAGE SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.

THE COOLING SHALL BE ENABLED WHENEVER:
• OUTSIDE AIR TEMPERATURE IS GREATER THAN 60°F (ADJ.).
• AND THE ECONOMIZER (IF PRESENT) IS DISABLED OR FULLY OPEN.
• AND THE SUPPLY FAN STATUS IS ON.
• AND THE HEATING (IF PRESENT) IS NOT ACTIVE.

ALARMS SHALL BE PROVIDED AS FOLLOWS:
• HIGH SUPPLY AIR TEMP: IF THE SUPPLY AIR TEMPERATURE IS 5°F (ADJ.) GREATER THAN SETPOINT.

LOW SUPPLY AIR TEMPERATURE ALARM:
THE CONTROLLER SHALL ALARM IF THE SUPPLY AIR TEMPERATURE IS LESS THAN 45°F (ADJ.).

ECONOMIZER:
THE CONTROLLER SHALL MEASURE THE MIXED AIR TEMPERATURE AND MODULATE THE ECONOMIZER DAMPERS IN SEQUENCE TO MAINTAIN A SETPOINT 2°F (ADJ.) LESS THAN THE SUPPLY AIR TEMPERATURE. THE OUTSIDE AIR DAMPERS SHALL MAINTAIN A MINIMUM ADJUSTABLE POSITION OF 20% (ADJ.) OPEN WHENEVER OCCUPIED.

THE ECONOMIZER SHALL BE ENABLED WHENEVER:
• OUTSIDE AIR TEMPERATURE IS LESS THAN 60°F (ADJ.).
• AND THE OUTSIDE AIR ENTHALPY IS LESS THAN 20 BTU/LB (ADJ.).
• AND THE OUTSIDE AIR TEMPERATURE IS GREATER THAN THE RETURN AIR TEMPERATURE.
• AND THE OUTSIDE AIR ENTHALPY IS LESS THAN THE RETURN AIR ENTHALPY.
• AND THE SUPPLY FAN STATUS IS ON.

THE ECONOMIZER SHALL CLOSE WHENEVER:
• MIXED AIR TEMPERATURE DROPS FROM 40°F TO 35°F.
• OR THE FREEZE STAT (IF PRESENT) IS ON.
• OR ON LOSS OF SUPPLY FAN STATUS.

THE OUTSIDE AIR DAMPERS SHALL CLOSE AND THE RETURN AIR DAMPER SHALL OPEN WHEN THE UNIT IS OFF. IF OPTIMAL START UP IS AVAILABLE, THE OUTSIDE AIR DAMPER SHALL OPERATE AS DESCRIBED IN THE OCCUPIED MODE EXCEPT THAT THE OUTSIDE AIR DAMPER SHALL MODULATE TO FULLY CLOSED.

MINIMUM OUTSIDE AIR ENTHALPY:
WHEN IN THE OCCUPIED MODE, THE CONTROLLER SHALL MEASURE THE OUTSIDE AIRFLOW AND MODULATE THE OUTSIDE AIR DAMPERS TO MAINTAIN THE PRESET MINIMUM OUTSIDE AIR VENTILATION, OVERRIDING NORMAL DAMPER CONTROL. ON DROPPING OUTSIDE AIRFLOW, THE CONTROLLER SHALL MODULATE THE OUTSIDE AIR DAMPERS OPEN TO MAINTAIN THE OUTSIDE AIRFLOW SETPOINT (ADJ.).

PREFILTER DIFFERENTIAL PRESSURE MONITOR:
THE CONTROLLER SHALL MONITOR THE DIFFERENTIAL PRESSURE ACROSS THE PREFILTER.

ALARMS SHALL BE PROVIDED AS FOLLOWS:
• PREFILTER CHANGE REQUIRED: PREFILTER DIFFERENTIAL PRESSURE EXCEEDS A USER DEFINABLE LIMIT (ADJ.).

MIXED AIR TEMPERATURE:
THE CONTROLLER SHALL MONITOR THE MIXED AIR TEMPERATURE AND USE AS REQUIRED FOR ECONOMIZER CONTROL (IF PRESENT) OR PREHEATING CONTROL (IF PRESENT).

ALARMS SHALL BE PROVIDED AS FOLLOWS:
• HIGH MIXED AIR TEMP: IF THE MIXED AIR TEMPERATURE IS GREATER THAN 90°F (ADJ.).
• LOW MIXED AIR TEMP: IF THE MIXED AIR TEMPERATURE IS LESS THAN 45°F (ADJ.).

RETURN AIR HUMIDITY:
THE CONTROLLER SHALL MONITOR THE RETURN AIR HUMIDITY AND USE AS REQUIRED FOR ECONOMIZER CONTROL (IF PRESENT) OR HUMIDITY CONTROL (IF PRESENT).

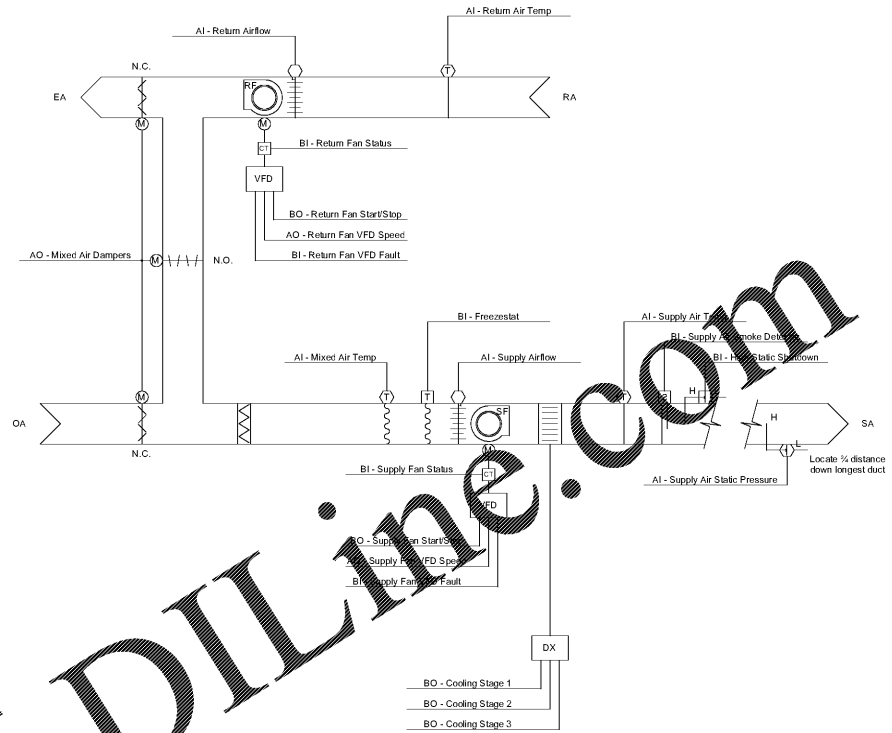
ALARMS SHALL BE PROVIDED AS FOLLOWS:
• HIGH RETURN AIR HUMIDITY: IF THE RETURN AIR HUMIDITY IS GREATER THAN 70% (ADJ.).
• LOW RETURN AIR HUMIDITY: IF THE RETURN AIR HUMIDITY IS LESS THAN 35% (ADJ.).

RETURN AIR TEMPERATURE:
THE CONTROLLER SHALL MONITOR THE RETURN AIR TEMPERATURE AND USE AS REQUIRED FOR SETPOINT CONTROL OR ECONOMIZER CONTROL (IF PRESENT).

ALARMS SHALL BE PROVIDED AS FOLLOWS:
• HIGH RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS GREATER THAN 90°F (ADJ.).
• LOW RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS LESS THAN 45°F (ADJ.).

SUPPLY AIR TEMPERATURE:
THE CONTROLLER SHALL MONITOR THE SUPPLY AIR TEMPERATURE.

ALARMS SHALL BE PROVIDED AS FOLLOWS:
• HIGH SUPPLY AIR TEMP: IF THE SUPPLY AIR TEMPERATURE IS GREATER THAN 120°F (ADJ.).
• LOW SUPPLY AIR TEMP: IF THE SUPPLY AIR TEMPERATURE IS LESS THAN 45°F (ADJ.).



POINT NAME	HARDWARE POINTS			SOFTWARE POINTS							SHOW ON GRAPHIC
	AI	AO	BI	BO	AV	BV	LOOP	SCHED	TREND	ALARM	
MIX AIR TEMP	X								X		X
RETURN AIR TEMP	X								X		X
RETURN AIRFLOW	X								X		X
SUPPLY AIR STATIC PRESSURE	X								X	X	X
SUPPLY AIR TEMP	X								X		X
SUPPLY AIRFLOW	X								X		X
MIXED AIR DAMPERS	X								X		X
PREHEATING VALVE	X								X		X
MIXED AIR DAMPERS	X								X		X
RETURN FAN VFD SPEED	X								X		X
SUPPLY FAN VFD SPEED	X								X		X
FREEZE STAT			X						X	X	X
HIGH STATIC SHUTDOWN			X						X	X	X
RETURN FAN STATUS			X						X		X
RETURN FAN VFD FAULT			X						X		X
SUPPLY AIR SMOKE DETECTOR			X						X	X	X
SUPPLY FAN STATUS			X						X		X
SUPPLY FAN VFD FAULT			X						X		X
COOLING STAGE 1		X							X		X
COOLING STAGE 2		X							X		X
COOLING STAGE 3		X							X		X
RETURN FAN START/STOP			X						X		X
SUPPLY FAN START/STOP			X						X		X
ECONOMIZER MIXED AIR TEMP SETPOINT				X					X		X
RETURN AIRFLOW SETPOINT				X					X		X
SUPPLY AIR STATIC PRESSURE SETPOINT			X						X		X
SUPPLY AIR TEMP SETPOINT			X						X		X
COMPRESSOR RUNTIME EXCEEDED										X	
HIGH MIXED AIR TEMP										X	
HIGH RETURN AIR TEMP										X	
HIGH RETURN AIRFLOW										X	
HIGH SUPPLY AIR STATIC PRESSURE										X	
HIGH SUPPLY AIR TEMP										X	
HIGH SUPPLY AIR TEMP										X	
LOW MIXED AIR TEMP										X	
LOW RETURN AIR TEMP										X	
LOW RETURN AIR TEMP										X	
LOW SUPPLY AIR STATIC PRESSURE										X	
LOW SUPPLY AIR TEMP										X	
LOW SUPPLY AIRFLOW										X	
RETURN FAN FAILURE										X	
RETURN FAN IN HAND										X	
RETURN FAN RUNTIME EXCEEDED										X	
SUPPLY FAN FAILURE										X	
SUPPLY FAN IN HAND										X	
SUPPLY FAN RUNTIME EXCEEDED										X	
TOTALS	6	3	7	5	4	0	0	0	23	25	24
TOTAL HARDWARE (21)			TOTAL SOFTWARE (52)								

CITY OF MONROE
PUBLIC SAFETY & MUNICIPAL
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MECHANICAL CONTROLS

PROJECT # 19160MONR-Po
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M400

SCALE 1/8" = 1'-0"
PERMIT SET

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