

DESIGNED BY: MSA  
 DRAWN BY: KLG  
 CHECKED BY: RNC  
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**UNIVERSITY OF NEW ENGLAND  
 PORTLAND CAMPUS  
 STEVENS AVENUE ARMORY**  
 716 STEVENS AVE  
 PORTLAND, MAINE 04103  
 T: (207)283-0171

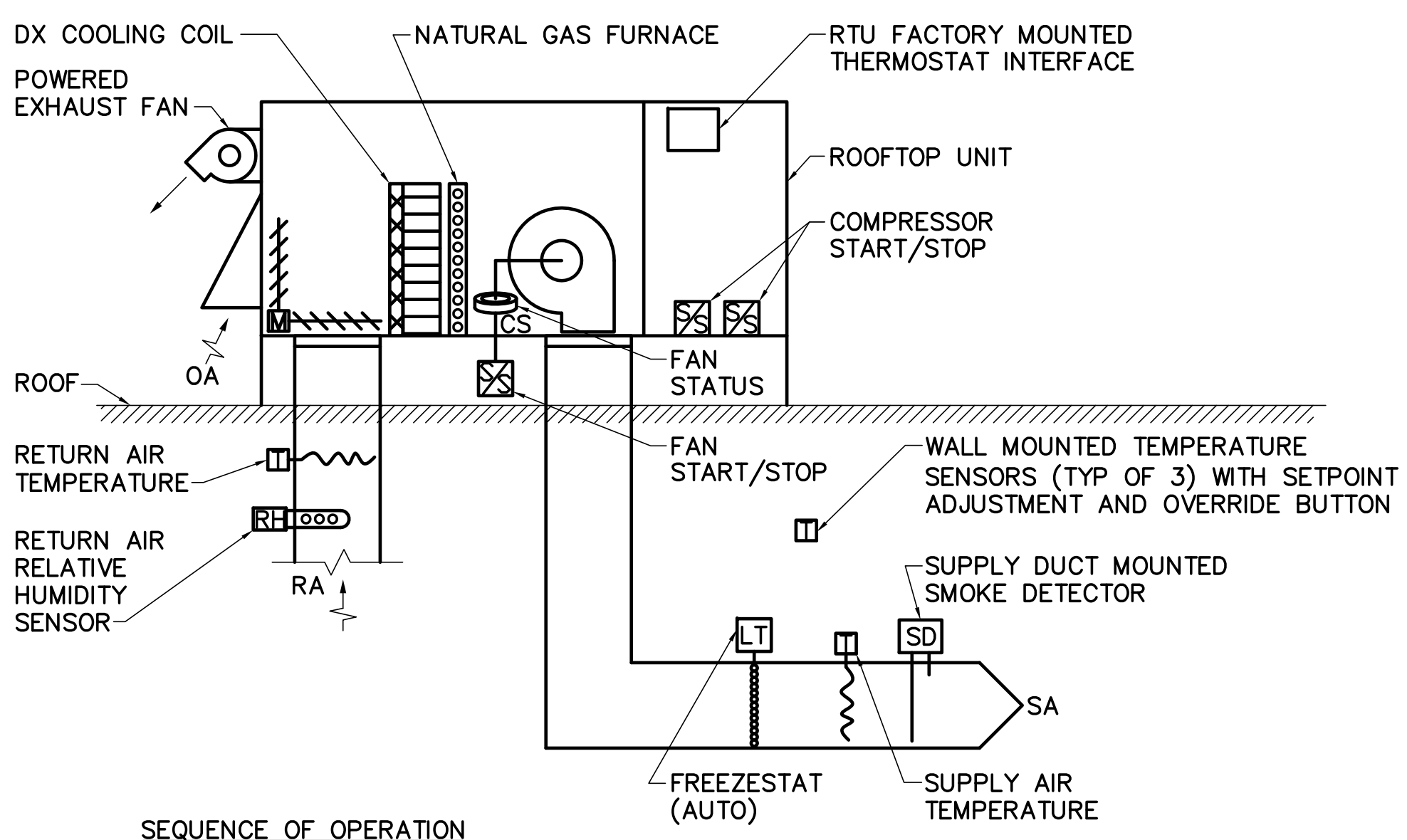
**RENOVATIONS TO THE  
 STEVENS AVENUE ARMORY**

**CONTROL  
 DIAGRAMS 4**

SCALE: AS NOTED  
 DATE: 05-24-16

DWG. **M-704**

SHEET: 144 OF 169



**SEQUENCE OF OPERATION**

**FACTORY CONTROLLER:**  
 THE RTU SHALL BE PROVIDED WITH A FACTORY MOUNTED THERMOSTATIC INTERFACE, FACTORY MOUNTED ENTHALPY CONTROLLER, AND GAS BURNER CONTROLS TO MAINTAIN DISCHARGE AIR TEMPERATURE.

**OCCUPANCY:**  
 THE RTU SHALL OPERATE IN THE OCCUPIED MODE WHENEVER THE ASSOCIATED USER ADJUSTABLE OCCUPANCY SCHEDULE IS IN THE OCCUPIED MODE; OTHERWISE THE RTU SHALL BE IN THE UN-OCCUPIED MODE. THE SCHEDULE SHALL BE ACCESSED BY THE USER THROUGH ICONS ON THE GRAPHICAL USER INTERFACE (GUI) COMPUTER. THE CONTRACTOR SHALL COORDINATE INITIAL SCHEDULE SETTINGS WITH BUILDING MAINTENANCE PERSONNEL.

**HEATING/COOLING MODE:**  
 THE RTU SHALL ENTER HEATING MODE WHENEVER THE OUTSIDE AIR TEMPERATURE IS BELOW 60° F (ADJUSTABLE) AND THERE IS A CALL FOR HEATING FROM A MAJORITY OF THE SPACE THERMOSTATS. THE RTU SHALL ENTER THE COOLING MODE WHENEVER THE OUTSIDE AIR TEMPERATURE IS ABOVE 65° F (ADJUSTABLE) AND THERE IS A CALL FOR COOLING FROM A MAJORITY OF THE SPACES. THE RTU SHALL REMAIN IN ITS CURRENT MODE (HEATING OR COOLING) UNTIL CONDITIONS ARE SATISFIED TO CHANGE MODES.

**OCCUPIED MODE:**  
 THE RTU SUPPLY FAN SHALL START AUTOMATICALLY AND RUN CONTINUOUSLY. THE OUTSIDE AIR DAMPER MINIMUM POSITION SHALL BE 10% OPEN (ADJUSTABLE). DURING COOLING MODE THE HEATING SHALL REMAIN OFF AND COOLING STAGES 1 AND 2 SHALL CYCLE TO MAINTAIN THE WARMEST SENSOR AT THE COOLING SET POINT 76° F (ADJUSTABLE). COOLING STAGE 1 SHALL BE ENABLED WHEN THE WARMEST TEMPERATURE IS 1° F (ADJUSTABLE) ABOVE THE COOLING SET POINT AND DISABLED AT SET POINT. COOLING STAGE 2 SHALL BE ENABLED 3° F (ADJUSTABLE) ABOVE THE COOLING SET POINT AND DISABLED AT SET POINT. DURING THE HEATING MODE THE COOLING STAGES SHALL REMAIN OFF AND THE HEATING SHALL MODULATE TO MAINTAIN THE SUPPLY AIR TEMPERATURE AT THE HEATING SET POINT, 68° F (ADJUSTABLE).

**UNOCCUPIED MODE:**  
 THE RTU FAN SHALL REMAIN OFF. THE OUTSIDE AIR DAMPER SHALL BE CLOSED. THE 2 STAGES OF COOLING SHALL REMAIN OFF, AND THE HEAT SHALL REMAIN OFF. IF A NIGHT OVERRIDE BUTTON IS PRESSED ON AN ASSOCIATED ROOM THERMOSTAT THE RTU SHALL OPERATE IN OCCUPIED MODE FOR 1 HOUR. THE FINTUBE RADIATION CONTROL VALVES SHALL CYCLE TO MAINTAIN THE NIGHT SETBACK TEMPERATURE OF 65° F (ADJUSTABLE)

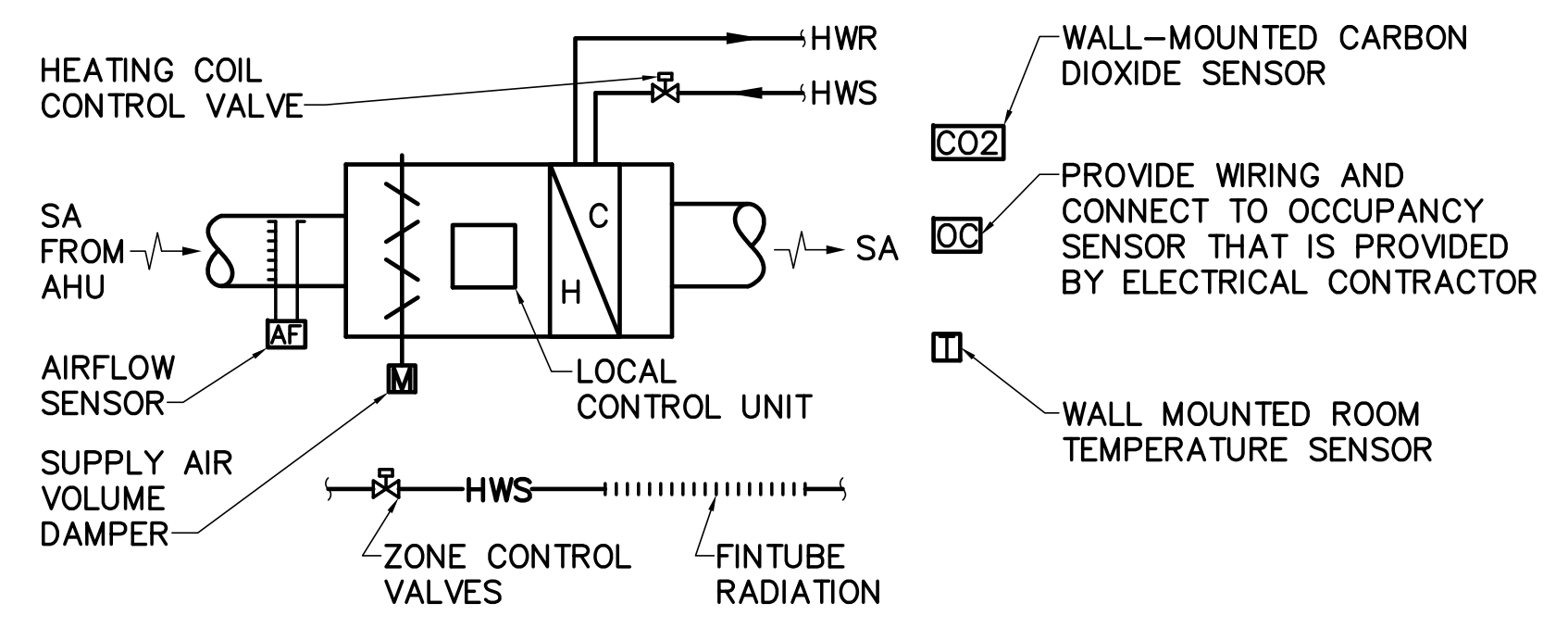
**SAFETY - SMOKE DETECTOR:**  
 THE DUCT MOUNTED SMOKE DETECTOR SHALL BE HARD-WIRED TO SHUT DOWN THE RTU IF THE SMOKE DETECTOR INDICATES AN ALARM CONDITION.

**SAFETY- FREEZE PROTECTION:**  
 THE FREEZE STAT SHALL BE AUTOMATIC RESET TYPE SET TO TRIP AT OR BELOW 45° F (ADJUSTABLE). DURING A FREEZING CONDITION THE FANS SHALL REMAIN OFF, THE OUTSIDE AND THE EXHAUST AIR DAMPERS SHALL REMAIN CLOSED, AND AN ALARM SHALL BE GENERATED ON THE GUI COMPUTER.

TYPICAL RTU POINTS LIST						
SYSTEM POINT DESCRIPTION	GRAPHIC	ANALOG INPUT		ANALOG OUTPUT		NOTES
		ANALOG INPUT	BINARY INPUT	ANALOG OUTPUT	BINARY OUTPUT	
SPACE TEMPERATURE	x	x				1
SPACE SET POINT	x	x				
UN-OCCUPIED OVERRIDE			x			
COOLING STAGE 1	x		x			
COOLING STAGE 2	x		x			
HEATING ENABLE	x			x		
SUPPLY AIR TEMPERATURE	x	x				
RETURN AIR TEMPERATURE	x					
FREEZESTAT (AUTOMATIC)	x		x	x		
SUPPLY FAN START/STOP	x					
SUPPLY FAN STATUS (CURRENT SENSOR)	x		x	x		2
RETURN AIR RELATIVE HUMIDITY	x	x				

NOTES:  
 1. GENERATE ALARM IF TEMPERATURE IS NOT ±5°F OF SETPOINT FOR MORE THAN 30 MINUTES.  
 2. GENERATE ALARM IF FAN FAILS TO SHOW PROOF OF AIRFLOW.

**1 TYPICAL RTU CONTROL DIAGRAM**  
 M-704 NOT TO SCALE



**SEQUENCE OF OPERATION**

**OCCUPIED MODE:**  
 THE VAV BOX SHALL MODULATE THE SUPPLY AIR VOLUME DAMPER TO MAINTAIN THE SUPPLY AIRFLOW SETPOINT. THE ZONE TEMPERATURE SENSOR SHALL RESET THE SUPPLY AIRFLOW SETPOINT. AS THE ZONE TEMPERATURE RISES ABOVE THE ZONE COOLING SETPOINT (78° F ADJUSTABLE) THE SUPPLY AIRFLOW SETPOINT SHALL INCREASE. THE SUPPLY AIRFLOW SETPOINT SHALL DECREASE AS THE ZONE TEMPERATURE APPROACHES THE COOLING SETPOINT. AS THE ZONE TEMPERATURE FALLS BELOW THE ZONE HEATING SETPOINT (68° F ADJUSTABLE) THE AIRFLOW SETPOINT SHALL BE AT MINIMUM AND THE FINTUBE RADIATION VALVES SHALL CYCLE TO MAINTAIN THE HEATING SETPOINT. IF THE FINTUBE RADIATION VALVES IS OPEN FOR 15 MINUTES AND THE ROOM TEMPERATURE IS STILL BELOW THE HEATING SET POINT THE REHEAT COIL VALVE SHALL OPEN AND VAV BOX AIRFLOW SHALL SLOWLY INCREASE TO THE MAXIMUM SCHEDULED AIRFLOW. THE VAV BOX SHALL REMAIN IN THE OCCUPIED MODE FOR A MINIMUM OF 1 HOUR (ADJUSTABLE) AFTER THE OCCUPIED MODE IS STARTED.

**DEMAND VENTILATION CONTROL:**  
 DURING THE OCCUPIED MODE, IN ZONES EQUIPPED WITH CO2 SENSORS THE VAV BOX MINIMUM AIRFLOW SET POINT SHALL MODULATE BETWEEN THE MINIMUM AND MAXIMUM SCHEDULED AIRFLOWS ACCORDING TO THE FOLLOWING SCHEDULE:

CO2 LEVEL	VAV BOX MINIMUM AIRFLOW
700 PPM	VAV BOX SCHEDULED MINIMUM
900 PPM	VAV BOX SCHEDULED MAXIMUM

IF THE VAV BOX IS AT MAXIMUM SCHEDULED AIR FLOW AND THE CO2 LEVEL CONTINUES TO INCREASE, THE ASSOCIATED AIR HANDLER WILL BE SIGNALLED AND THE AHU OUTSIDE AIR DAMPER SHALL SLOWLY OPEN TO SATISFY THE CO2 TO MAINTAIN THE CO2 LEVEL BELOW 900 PPM.

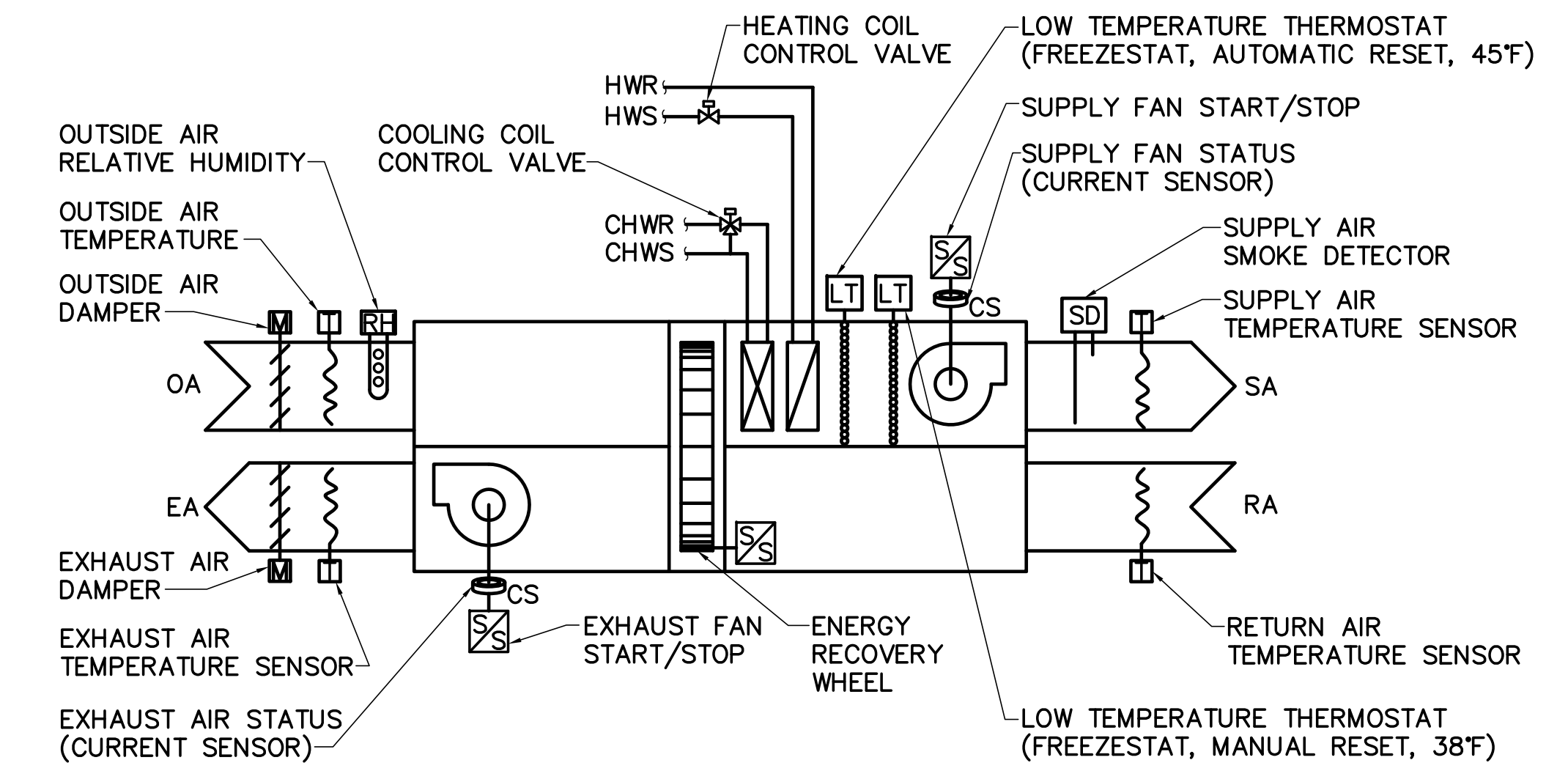
**UNOCCUPIED MODE:**  
 IF THE UNOCCUPIED OVERRIDE BUTTON IS PRESSED THE VAV BOX SHALL ENTER THE OCCUPIED MODE FOR 2 HOURS (ADJUSTABLE), OTHERWISE THE VAV BOX DAMPER SHALL REMAIN CLOSED.

**NIGHT SETBACK MODE:**  
 THE FINTUBE RADIATION OR PANEL VALVE SHALL CYCLE TO MAINTAIN NIGHT HEATING SETBACK, (65° F ADJUSTABLE).

VAV BOX WITH REHEAT AND FR POINTS LIST						
SYSTEM POINT DESCRIPTION	GRAPHIC	ANALOG INPUT		ANALOG OUTPUT		NOTES
		ANALOG INPUT	BINARY INPUT	ANALOG OUTPUT	BINARY OUTPUT	
ZONE TEMPERATURE	x	x				1
HEATING SET POINT	x					
COOLING SET POINT	x					
AIR FLOW (CFM)	x	x				2
DAMPER POSITION	x	x				
FINTUBE RADIATION CONTROL VALVE	x		x			
NIGHT HEATING SET-BACK	x			x		
NIGHT COOLING SET-BACK	x			x		
OCCUPANCY SENSOR	x		x			3
HEATING COIL CONTROL VALVE	x	x				
CO2 SENSOR	x		x			4

NOTES:  
 1. GENERATE ALARM IF ROOM TEMPERATURE IS GREATER THAN 3°F ABOVE THE COOLING SET POINT OR LOWER THAN 3°F BELOW THE HEATING SET POINT FOR MORE THAN 30 MINUTES.  
 2. GENERATE ALARM IF AIRFLOW IS NOT BETWEEN MINIMUM AND THE MAXIMUM AIRFLOW SETTINGS.  
 3. CONNECT TO OCCUPANCY SENSOR PROVIDED BY ELECTRICAL CONTRACTOR.  
 4. GENERATE AN ALARM IF CO2 LEVEL EXCEEDS 1000 PPM.

**2 TYPICAL VAV BOX W/ REHEAT AND FINTUBE RADIATION CONTROL DIAGRAM**  
 M-704 NOT TO SCALE



**SEQUENCE OF OPERATION - ENERGY RECOVERY**

THE ENERGY RECOVERY UNIT (ERV) SHALL OPERATE IN THE OCCUPIED MODE WHENEVER AN ASSOCIATED ZONE IS OPERATING IN THE OCCUPIED MODE OR THE UN-OCCUPIED OVERRIDE MODE; OTHERWISE THE ERV SHALL BE IN THE UN-OCCUPIED MODE.

**OCCUPIED MODE:**  
 DURING THE OCCUPIED MODE THE EXHAUST FAN SHALL RUN CONTINUOUSLY AND THE OUTSIDE AND EXHAUST AIR DAMPERS SHALL BE OPEN. WHENEVER THE OUTSIDE AIR TEMPERATURE IS BELOW 35° F (ADJUSTABLE) THE SUPPLY FAN SHALL STOP FOR 5 MINUTES (ADJUSTABLE) ONCE EVERY HOUR, TO ALLOW THE ERV TO DEFROST, OTHERWISE IT SHALL RUN CONTINUOUSLY. THE ERV WHEEL SHALL RUN CONTINUOUSLY.

THE HEATING COIL AND COOLING COIL CONTROL VALVES SHALL MODULATE, WITHOUT OVERLAP, TO MAINTAIN THE SUPPLY AIR TEMPERATURE SET POINT (65° F ADJUSTABLE).

**UNOCCUPIED MODE:**  
 DURING THE UN-OCCUPIED MODE THE EXHAUST AND SUPPLY FAN SHALL REMAIN OFF AND THE OUTSIDE AND EXHAUST AIR DAMPERS SHALL REMAIN CLOSED. THE HEATING COIL CONTROL VALVE SHALL MODULATE TO MAINTAIN THE SUPPLY AIR TEMPERATURE SENSOR AT 50° F (ADJUSTABLE).

IF THE UN-OCCUPIED OVERRIDE BUTTON ON A ROOM SENSOR IS PRESSED THE ERV SHALL OPERATE AS LONG AS ANY ZONE IS OCCUPIED.

**SAFETY- FREEZE STAT:**  
 DURING A FREEZING CONDITION THE FANS SHALL REMAIN OFF, THE OUTSIDE AND THE EXHAUST AIR DAMPERS SHALL REMAIN CLOSED, THE HEATING COIL CONTROL VALVE SHALL BE OPEN AND AN ALARM SHALL BE GENERATED ON THE GRAPHICAL USER INTERFACE.

**SAFETY - SMOKE DETECTOR/FIRE ALARM:**  
 UPON ACTIVATION OF A SMOKE DETECTOR OR THE FIRE ALARM THE ERV SHALL ENTER UNOCCUPIED MODE AND SHALL REMAIN IN UNOCCUPIED MODE UNTIL THE ALARM IS CLEARED. THE SMOKE DETECTOR SHALL BE HARD WIRED TO SHUT DOWN THE SUPPLY FAN AND CLOSE THE OUTSIDE AND EXHAUST AIR DAMPERS.

ENERGY RECOVERY VENTILATOR UNIT POINTS LIST						
SYSTEM POINT DESCRIPTION	GRAPHIC	ANALOG INPUT		ANALOG OUTPUT		NOTES
		ANALOG INPUT	BINARY INPUT	ANALOG OUTPUT	BINARY OUTPUT	
SUPPLY FAN START/STOP	x					
SUPPLY FAN STATUS (CURRENT SENSOR)	x		x			1
EXHAUST FAN START/STOP	x					
EXHAUST FAN STATUS (CURRENT SENSOR)	x		x			1
SUPPLY AIR TEMPERATURE	x	x				2
RETURN AIR TEMPERATURE	x					
EXHAUST AIR TEMPERATURE	x					3
OUTSIDE AIR TEMPERATURE	x					
OUTSIDE AIR RELATIVE HUMIDITY	x	x				
OUTSIDE AIR DAMPER	x		x			
EXHAUST AIR DAMPER	x		x			
HEATING COIL VALVE	x	x				
COOLING COIL VALVE	x	x				
FREEZESTAT MANUAL RESET	x		x			4
FREEZESTAT AUTOMATIC RESET	x		x			4
ERV WHEEL START/STOP	x					
SUPPLY AIR SMOKE DETECTOR	x		x			5

NOTES:  
 1. GENERATE ALARM IF FAN FAILS TO SHOW PROOF OF AIRFLOW.  
 2. GENERATE ALARM IF SUPPLY AIR TEMPERATURE FALLS BELOW 32°F (ADJUSTABLE).  
 3. GENERATE ALARM IF EXHAUST AIR TEMPERATURE FALLS BELOW 15°F (ADJUSTABLE).  
 4. GENERATE ALARM IF FREEZESTAT INDICATES A LOW TEMPERATURE CONDITION.  
 5. GENERATE ALARM IF SMOKE DETECTOR INDICATES AN ALARM CONDITION.

**3 TYPICAL ENERGY RECOVERY VENTILATOR CONTROL DIAGRAM**  
 M-704 NOT TO SCALE