



1 VARIABLE AIR VOLUME AIR HANDLING UNIT WITH MINIMUM OUTSIDE AIR CONTROL DIAGRAM

SEQUENCE OF OPERATION FOR VARIABLE AIR VOLUME AIR HANDLING UNIT WITH MINIMUM OUTSIDE AIR

A. GENERAL:
1. THE AIR HANDLING UNIT IS VARIABLE AIR VOLUME, INDOOR AIR UNIT.
2. THE AIR HANDLING UNIT IS CONTROLLED BY DIRECT DIGITAL CONTROLLER (DDC).
3. THE AIR HANDLING UNIT IS EQUIPPED WITH THE FOLLOWING:
a. SUPPLY FAN WITH VFD FURNISHED BY THE AHU MANUFACTURER.
b. OUTSIDE AIR FLOW/MEASURING STATIONS.
c. (2) SUPPLY AIR FLOW/MEASURING STATIONS.
d. RELIEF FAN WITH VFD FURNISHED BY TCC.
e. ECONOMIZER OUTSIDE AIR DAMPER FURNISHED BY TCC.
f. MINIMUM OUTSIDE AIR DAMPER FURNISHED BY TCC.
g. 1ST PRE-FILTER BANK.
h. 2ND PRE-FILTER BANK.
i. RETURN AIR DAMPER.
j. RELIEF AIR DAMPER.
k. CHILLED WATER COIL.
l. HOT WATER (GLYCOL) HEATING COIL.
m. FINAL FILTER BANK.
n. ACTUATORS FURNISHED BY TCC.
o. DUCT HUMIDIFIER AND CONTROL VALVE BY THE MECHANICAL CONTRACTOR MC.
4. OTHER DEVICES REQUIRED FOR SYSTEM OPERATION BY TEMPERATURE CONTROL CONTRACTOR INCLUDE BUT ARE NOT LIMITED TO:
a. DIFFERENTIAL PRESSURE SENSORS AND SWITCHES.
b. TEMPERATURE AND HUMIDITY SENSORS.
5. UNIT IS NORMALLY STABLE AFTER THE SPACE IS OCCUPIED. PROVIDE A TREND GRAPH TO SHOW THE RELATIVE STABILITY OF THE STATIC PRESSURE SETPOINT. FINAL MAXIMUM SETPOINT SHALL BE DETERMINED BY THE BALANCING CONTRACTOR TO SATISFY THE WORST CASE ZONE AT MAXIMUM DESIGN CONDITION.
6. THE RELIEF FAN STATIC PRESSURE: THE RELIEF FAN SHALL MODULATE DURING ECONOMIZER MODE TO MAINTAIN THE RETURN DUCT STATIC PRESSURE SETPOINT. SETPOINT SHALL BE DETERMINED BY THE TAB CONTRACTOR AND THE CONTROL CONTRACTOR, THE STATIC PRESSURE SHALL BE RESET BASED ON THE ECONOMIZER DAMPER POSITION.
7. THE MINIMUM OUTSIDE AIR DAMPER SHALL MODULATE TO MAINTAIN THE MINIMUM OUTSIDE AIR FLOW VENTILATION SETPOINT. WHEN THE MINIMUM OUTSIDE AIR DAMPER IS FULLY OPEN AND THE VENTILATION AIR FLOW RATE IS BELOW SETPOINT, THE RETURN DAMPER SHALL BE OVERRIDDEN TO MODULATE CLOSED TO MAINTAIN THE MINIMUM VENTILATION AIR FLOW RATE. THE RETURN DAMPER SHALL BE LIMITED TO BEING OVERRIDDEN TO 80% CLOSED (ADJ) IN THIS MODE. THE TEMPERATURE CONTROL CONTRACTOR SHALL WORK WITH THE BALANCING CONTRACTOR TO DETERMINE THE RETURN DAMPER LIMIT SETPOINT REQUIRED TO PROVIDE THE MAXIMUM VENTILATION AIR FLOW RATE WHEN THE AIR HANDLING UNIT IS AT FULL TURNDOWN. WHEN THE ECONOMIZER OUTSIDE AIR DAMPER IS MODULATED OPEN TO MAINTAIN THE DISCHARGE AIR TEMPERATURE, THE RETURN AND RELIEF DAMPERS WILL MODULATE IN SEQUENCE WITH THE ECONOMIZER OUTSIDE AIR DAMPER AND WILL NOT BE OVERRIDDEN TO MAINTAIN MINIMUM VENTILATION. FINAL SETPOINTS SHALL BE INCLUDED IN THE AS-BUILT SEQUENCE OF OPERATION BY THE TEMPERATURE CONTROL CONTRACTOR.
8. HUMIDITY CONTROL:
1. WHEN THE DIGITAL CONTROL PANEL IS NOT CALLING FOR HUMIDITY, SENSED BY RETURN AIR HUMIDITY, 2-WAY "ON-OFF" CONTROL VALVE SHALL REMAIN CLOSED WHEN THE DIGITAL CONTROL PANEL IS CALLING FOR HUMIDITY, ON-OFF VALVE SHALL REMAIN OPEN.
2. RETURN AIR HUMIDITY SHALL BE MAINTAINED AT SETPOINT OF 30% RH (ADJ) IN THE RETURN AIR DUCTWORK.
3. THE HUMIDITY HIGH LIMIT IN THE SUPPLY DUCTWORK SHALL TURN OFF HUMIDIFIER WHENEVER THE HIGH LIMIT SENSOR IS READING OVER 90% RH (ADJ).
9. DISHUMIDIFICATION MODE:
1. RESET THE DISCHARGE AIR TEMPERATURE BASED ON MAINTAINING RETURN AIR HUMIDITY AT 50% (ADJ) WHENEVER THE OUTDOOR AIR IS ABOVE 55 DEG. F (ADJ).
10. AIR HANDLING UNIT SMOKE CONTROL:
1. SIGNAL(S) FROM THE FIRE ALARM SYSTEM WILL BE EXTENDED TO

ON THE PLANS, LOCATE THE RETURN STATIC PRESSURE SENSOR AS SHOWN ON THE PLANS. THE CONTROL SIGNAL FROM THE DUCT STATIC PRESSURE SENSOR/TRANSMITTER SHALL BE EXTENDED TO THE AIR HANDLING UNIT CONTROL PANEL. THE INPUTS TO THE DIFFERENTIAL PRESSURE TRANSMITTER SHALL BE THE STATIC PRESSURE INSIDE OF THE DUCT AND THE REFERENCE INPUT SHALL SENSE THE ACTUAL SPACE SERVED BY THE AIR SYSTEM. THE DDC SYSTEM SHALL MODULATE THE SUPPLY AND RELIEF FAN VFDs TO MAINTAIN THE STATIC PRESSURE SETPOINTS AS SENSED BY THE STATIC PRESSURES. TWO DUCT STATIC PRESSURE SENSOR/TRANSMITTERS SHALL BE PROVIDED FOR BOTH SUPPLY & RETURN DUCTWORK. THE DDC SYSTEM SHALL MAINTAIN THE STATIC PRESSURE SETPOINTS AT THE LOWEST READING SENSOR. IF THE STATIC SENSORS DEVIATE BY MORE THAN 0.1 IN. W.G. (ADJ), AN ALARM SHALL BE SENT THROUGH THE DDC SYSTEM.
4. STATIC PRESSURE RESET CONTROL FOR SUPPLY DUCT: STATIC PRESSURE SETPOINTS SHALL BE RESET USING TRIM & RESPOND LOGIC WITHIN THE RANGE OF 0.6 IN. W.G. TO 3 IN. W.G. WHEN THE FAN IS OFF, THE SETPOINTS SHALL BE 0.6 IN. W.G. WHILE THE FANS ARE PROVEN ON, EVERY TWO MINUTES, TRIM THE SETPOINT BY 0.04 IN. W.G.
5. A ZONE PRESSURE REQUEST IS GENERATED WHEN A SUPPLY AIR VALVE IS GREATER THAN 80% OPEN UNTIL IT DROPS TO 80% OPEN. PROVIDE A BINARY DATA ENABLE POINT FOR EACH ZONE TO ENABLE/DISABLE THE ZONE DAMPER IN THE TRIM AND RESPOND ALGORITHM. ALL SETPOINTS, TIMERS, AND ZONE PRESSURE REQUEST THRESHOLD FOR THE STATIC PRESSURE RESET SHALL BE ADJUSTABLE. TUNE THE RESET TO PREVENT CYCLIC INSTABILITY AFTER THE SPACE IS OCCUPIED. PROVIDE A TREND GRAPH TO SHOW THE RELATIVE STABILITY OF THE STATIC PRESSURE SETPOINT. FINAL MAXIMUM SETPOINT SHALL BE DETERMINED BY THE BALANCING CONTRACTOR TO SATISFY THE WORST CASE ZONE AT MAXIMUM DESIGN CONDITION.
6. THE RELIEF FAN STATIC PRESSURE: THE RELIEF FAN SHALL MODULATE DURING ECONOMIZER MODE TO MAINTAIN THE RETURN DUCT STATIC PRESSURE SETPOINT. SETPOINT SHALL BE DETERMINED BY THE TAB CONTRACTOR AND THE CONTROL CONTRACTOR, THE STATIC PRESSURE SHALL BE RESET BASED ON THE ECONOMIZER DAMPER POSITION.
7. THE MINIMUM OUTSIDE AIR DAMPER SHALL MODULATE TO MAINTAIN THE MINIMUM OUTSIDE AIR FLOW VENTILATION SETPOINT. WHEN THE MINIMUM OUTSIDE AIR DAMPER IS FULLY OPEN AND THE VENTILATION AIR FLOW RATE IS BELOW SETPOINT, THE RETURN DAMPER SHALL BE OVERRIDDEN TO MODULATE CLOSED TO MAINTAIN THE MINIMUM VENTILATION AIR FLOW RATE. THE RETURN DAMPER SHALL BE LIMITED TO BEING OVERRIDDEN TO 80% CLOSED (ADJ) IN THIS MODE. THE TEMPERATURE CONTROL CONTRACTOR SHALL WORK WITH THE BALANCING CONTRACTOR TO DETERMINE THE RETURN DAMPER LIMIT SETPOINT REQUIRED TO PROVIDE THE MAXIMUM VENTILATION AIR FLOW RATE WHEN THE AIR HANDLING UNIT IS AT FULL TURNDOWN. WHEN THE ECONOMIZER OUTSIDE AIR DAMPER IS MODULATED OPEN TO MAINTAIN THE DISCHARGE AIR TEMPERATURE, THE RETURN AND RELIEF DAMPERS WILL MODULATE IN SEQUENCE WITH THE ECONOMIZER OUTSIDE AIR DAMPER AND WILL NOT BE OVERRIDDEN TO MAINTAIN MINIMUM VENTILATION. FINAL SETPOINTS SHALL BE INCLUDED IN THE AS-BUILT SEQUENCE OF OPERATION BY THE TEMPERATURE CONTROL CONTRACTOR.
8. HUMIDITY CONTROL:
1. WHEN THE DIGITAL CONTROL PANEL IS NOT CALLING FOR HUMIDITY, SENSED BY RETURN AIR HUMIDITY, 2-WAY "ON-OFF" CONTROL VALVE SHALL REMAIN CLOSED WHEN THE DIGITAL CONTROL PANEL IS CALLING FOR HUMIDITY, ON-OFF VALVE SHALL REMAIN OPEN.
2. RETURN AIR HUMIDITY SHALL BE MAINTAINED AT SETPOINT OF 30% RH (ADJ) IN THE RETURN AIR DUCTWORK.
3. THE HUMIDITY HIGH LIMIT IN THE SUPPLY DUCTWORK SHALL TURN OFF HUMIDIFIER WHENEVER THE HIGH LIMIT SENSOR IS READING OVER 90% RH (ADJ).
9. DISHUMIDIFICATION MODE:
1. RESET THE DISCHARGE AIR TEMPERATURE BASED ON MAINTAINING RETURN AIR HUMIDITY AT 50% (ADJ) WHENEVER THE OUTDOOR AIR IS ABOVE 55 DEG. F (ADJ).
10. AIR HANDLING UNIT SMOKE CONTROL:
1. SIGNAL(S) FROM THE FIRE ALARM SYSTEM WILL BE EXTENDED TO

CONNECTION POINTS IN THE SUPPLY FAN VARIABLE SPEED DRIVE TO STOP THE UNIT FAN IF SMOKE IS SENSED WITHIN THE SUPPLY OR RETURN AIR DUCT
EMERGENCY CONSTANT SPEED OPERATION:
1. UPON FAILURE OF THE VSMC, THE SUPPLY AND RELIEF FANS SHALL OPERATE AT THEIR LAST SPEED SETPOINT.
H. UNIT SHUTDOWN:
1. WHENEVER THE AIR HANDLING UNIT IS INDEXED OFF, THE SUPPLY AND RELIEF FANS SHALL STOP. IF THE RELIEF FAN FAILS OFF, THE SUPPLY FAN SHALL BE INDEXED OFF. ON A FAILURE OF EITHER THE SUPPLY OR RELIEF FAN, AN ALARM WILL BE SENT THROUGH THE DDC SYSTEM. WHENEVER BOTH SUPPLY AND RELIEF FANS ARE OFF FOR ANY REASON THE FOLLOWING SHALL OCCUR:
a. THE OUTSIDE AIR DAMPERS AND RELIEF AIR DAMPERS SHALL CLOSE AND THE RETURN DAMPERS SHALL OPEN.
b. THE CHILLED WATER CONTROL VALVE(S) SHALL CLOSE.
c. THE HEATING COIL CONTROL VALVE SHALL REMAIN UNDER CONTROL FROM DUCT TEMPERATURE SENSOR TO MAINTAIN 55°F (ADJ).
I. FILTERS:
1. INSTALL A DIFFERENTIAL STATIC PRESSURE SENSOR ACROSS EACH FILTER BANK. ENSURE THAT THE STATIC PROBES DO NOT IMPEDE FILTER REMOVAL.
2. FOR PRE-FILTER BANKS, PROVIDE AN ALARM TO THE OPERATOR INTERFACE WHEN THE DIFFERENTIAL STATIC PRESSURE EXCEEDS 1.0" W.G. (ADJ).
3. FOR FINAL FILTER BANK, PROVIDE AN ALARM TO THE OPERATOR INTERFACE WHEN THE DIFFERENTIAL STATIC PRESSURE EXCEEDS 1.5" W.G. (ADJ).
J. SAFETIES:
1. GENERAL: ALL SAFETIES SHALL BE HARD WIRED TO THE SUPPLY AND RELIEF FAN STARTERS OR VFD SAFETY CIRCUITS. STARTERS SHALL NOT FUNCTION IN THE "HAND" OR "AUTO" AND VFDs SHALL BE DISABLED IF THEY ARE INDEXED TO THE "AUTO" OR "HAND" POSITION IN EITHER THE VFD OR BYPASS MODES.
2. INSTALL AN ELECTRIC FREEZE/STAT TO SHUT DOWN THE UNIT (SEE UNIT SHUTDOWN FOR ADDITIONAL INFORMATION) IF THE TEMPERATURE UPSTREAM OF THE COOLING COIL DROPS BELOW 39°F (ADJ). THE ELECTRIC FREEZE/STAT SHALL ACT INDEPENDENTLY OF THE DDC SYSTEM VIA HARDWIRED INTERLOCK AND SHALL OVERRIDE THE DDC SYSTEM CONTROL SIGNAL TO START THE COOLING COIL CIRCULATING PUMP. A FREEZE/STAT TRIP SHALL NOTIFY THE DDC SYSTEM TO SEND AN ALARM TO THE OPERATOR INTERFACE.
3. IF THE TEMPERATURE UPSTREAM OF THE HEATING COIL DROPS BELOW 39°F (ADJ), THE HEATING COIL CIRCULATING PUMP SHALL START. THIS SEQUENCE SHALL NOTIFY THE DDC SYSTEM TO SEND AN ALARM TO THE OPERATOR INTERFACE.
4. INSTALL A STATIC PRESSURE HIGH LIMIT PROBE LOCATED IN THE AIR HANDLING UNIT MAIN DISCHARGE DUCT AT LEAST SIX FEET OR AS FAR AS PHYSICALLY POSSIBLE DOWNSTREAM OF THE FAN AND UPSTREAM OF ANY DAMPERS AND PIPE TO A DIFFERENTIAL PRESSURE SWITCH LOCATED IN THE TEMPERATURE CONTROL PANEL. WIRE IN SERIES WITH THE SAFETY CIRCUIT OF THE SUPPLY AND RETURN FAN. DIFFERENTIAL PRESSURE SWITCH SHALL BE A MANUAL RESET TYPE AND THE DDC SYSTEM SHALL MONITOR THE STATUS OF THE DIFFERENTIAL PRESSURE SWITCH. INITIAL SETPOINT SHALL BE +3.0" W.G. (ADJ).
5. INSTALL A STATIC PRESSURE LOW LIMIT PROBE LOCATED IN THE RETURN DUCTWORK SIX FEET OR AS FAR UPSTREAM AS PHYSICALLY POSSIBLE OF THE RETURN FAN AND BEFORE ANY DAMPERS AND PIPE TO A DIFFERENTIAL PRESSURE SWITCH LOCATED IN THE TEMPERATURE CONTROL PANEL. WIRE IN SERIES WITH THE SAFETY CIRCUIT OF THE SUPPLY AND RETURN FANS. DIFFERENTIAL PRESSURE SWITCH SHALL BE A MANUAL RESET TYPE AND THE DDC SYSTEM SHALL MONITOR THE STATUS OF THE DIFFERENTIAL PRESSURE SWITCH. INITIAL SETPOINT SHALL BE -2.0" W.G. (ADJ).
FIRE ALARM SHUTDOWN: UPON A FIRE ALARM SYSTEM ALARM, THE FIRE ALARM CONTROL MODULE PROVIDED BY THE ELECTRICAL CONTRACTOR AT THE TEMPERATURE CONTROL PANEL SHALL CHANGE STATE OF ITS CONTACTS. THIS SHALL CAUSE THE UNIT TO BE SHUT DOWN (SEE UNIT SHUTDOWN FOR ADDITIONAL INFORMATION). AN AUXILIARY CONTACT SHALL BE PROVIDED TO NOTIFY THE DDC SYSTEM OF A FIRE ALARM SHUTDOWN.

JOB:	055-09	POINT	LEGEND	SYSTEM	SYSTEM INPUTS	SYSTEM SOFTWARE/CONTROL	PAGE
BUILDING:	VA SAMPLE POINTS LIST	LEGEND	LEGEND	LEGEND	LEGEND	LEGEND	
SYSTEM:	VAV AIR HANDLER	LEGEND	LEGEND	LEGEND	LEGEND	LEGEND	
SYSTEM COMPONENT:		LEGEND	LEGEND	LEGEND	LEGEND	LEGEND	
RETURN AIR TEMPERATURE T-4	AH-1	RAT					
MIXED AIR TEMPERATURE T-5	AH-2	MAT					
COOLING COIL TEMPERATURE T-6	AH-3	CCT					
DISCHARGE AIR TEMPERATURE T-7	AH-4	DAT					
COOLING COIL INLET TEMPERATURE T-7	AH-5	COIT					
COOLING COIL OUTLET TEMPERATURE T-8	AH-6	COOT					
HEATING COIL INLET TEMPERATURE T-9	AH-7	HCIT					
HEATING COIL OUTLET TEMPERATURE T-10	AH-8	HCOIT					
OUTSIDE AIR TEMPERATURE T-2	AH-9	OAT					
DISCHARGE STATIC PRESSURE SPS-1	AH-10	DASP					
RETURN AIR STATIC PRESSURE SPS-2	AH-11	RASP					
RETURN AIR HUMIDITY H-1	AH-12	RAH					
DISCHARGE AIR HUMIDITY HT-2	AH-13	DAH					
SUPPLY AIR FLOW (CFM) FT-1	AH-14	SAF					
SUPPLY AIR FLOW (CFM) FT-2	AH-15	SAF					
OUTSIDE AIR FLOW (CFM) FT-3	AH-16	SAF					
RETURN LOW PRESSURE PSL-2	B-1	RLP					
RELIEF FAN STATUS	BI-2	RF-STs					
SUPPLY FAN STATUS	BI-3	SF-STs					
FREEZE STAT	BI-4	TSL-1					
STATIC PRESSURE HIGH LIMIT PSH-1	BI-5	SPS-2					
HUMIDITY HIGH LIMIT HHL-1	BI-6	HH-1					
SUPPLY FAN VSMC ALARM	BI-7	SF-ALA					
RELIEF FAN VSMC ALARM	BI-8	RF-ALA					
RELIEF FAN VSMC	AO-1	RF-SPD					
SUPPLY FAN VSMC	AO-2	SF-SPD					
ECONOMIZER OUTSIDE AIR DAMPER ZC-1	AO-3	OAD					
RETURN AIR DAMPER ZC-2	AO-4	RAD					
EXHAUST AIR DAMPER ZC-3	AO-5	EAD					
MINIMUM OUTSIDE AIR DAMPER ZC-A	AO-7	MIN-OAD					
PRE-HEAT VALVE V-2	AO-8	PHT-V1					
COILING VALVE V-1	AO-9	CLG-V1					
RELIEF FAN START/STOP	BO-1	RF-SST					
SUPPLY FAN START/STOP	BO-2	SF-SST					
STEAM HUMIDIFIER VALVE V-4	AO-10	HUM-V4					
STEAM ISOLATION VALVE V-3	BO-3	HUM-ISO-V3					
PRE-FILTER	DPS-1	PF-1					
FILTER	DPS-2	F-1					
FINAL FILTER	DPS-3	FF-1					

NOTE: 1. CONTROLS CONTRACTOR TO PROVIDE NEW CONTROL PANEL, EXISTING AHU-4 MUST REMAIN IN OPERATION DURING THE INSTALLATION OF THE NEW AHU-4.
2. CONTROLS CONTRACTOR TO COORDINATE THE VFD'S COMMUNICATION CABLE WITH AIR HANDLER MANUFACTURER AND ELECTRICAL CONTRACTOR.

POINTS LIST FOR VAV AIR HANDLING UNIT WITH MINIMUM OUTSIDE AIR

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ARCHITECT/ENGINEERS:

Drawing Title
MECHANICAL CONTROLS

Approved: Project Director

Project Title
UPGRADE AHU-4 PHARMACY

Location
OSCAR J JOHNSON VA MEDICAL CENTER

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Drawing Number
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Office of Construction and Facilities Management

VA U.S. Department of Veterans Affairs