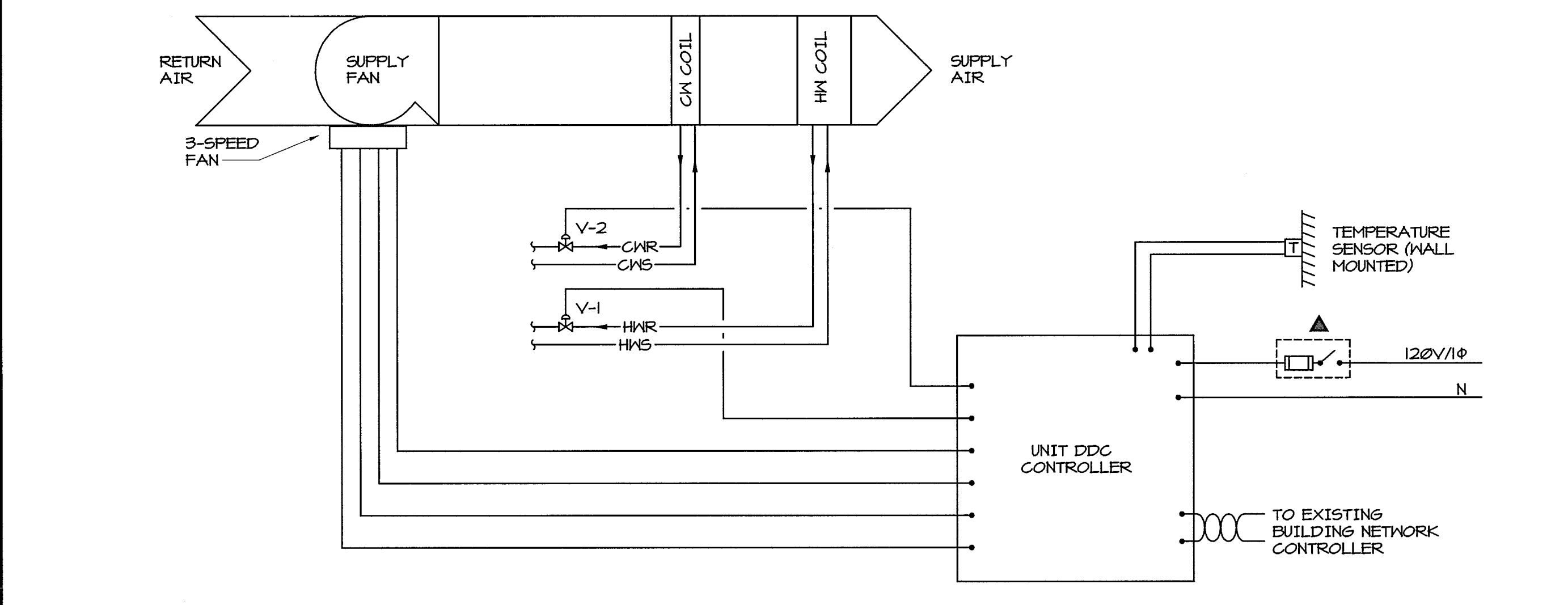


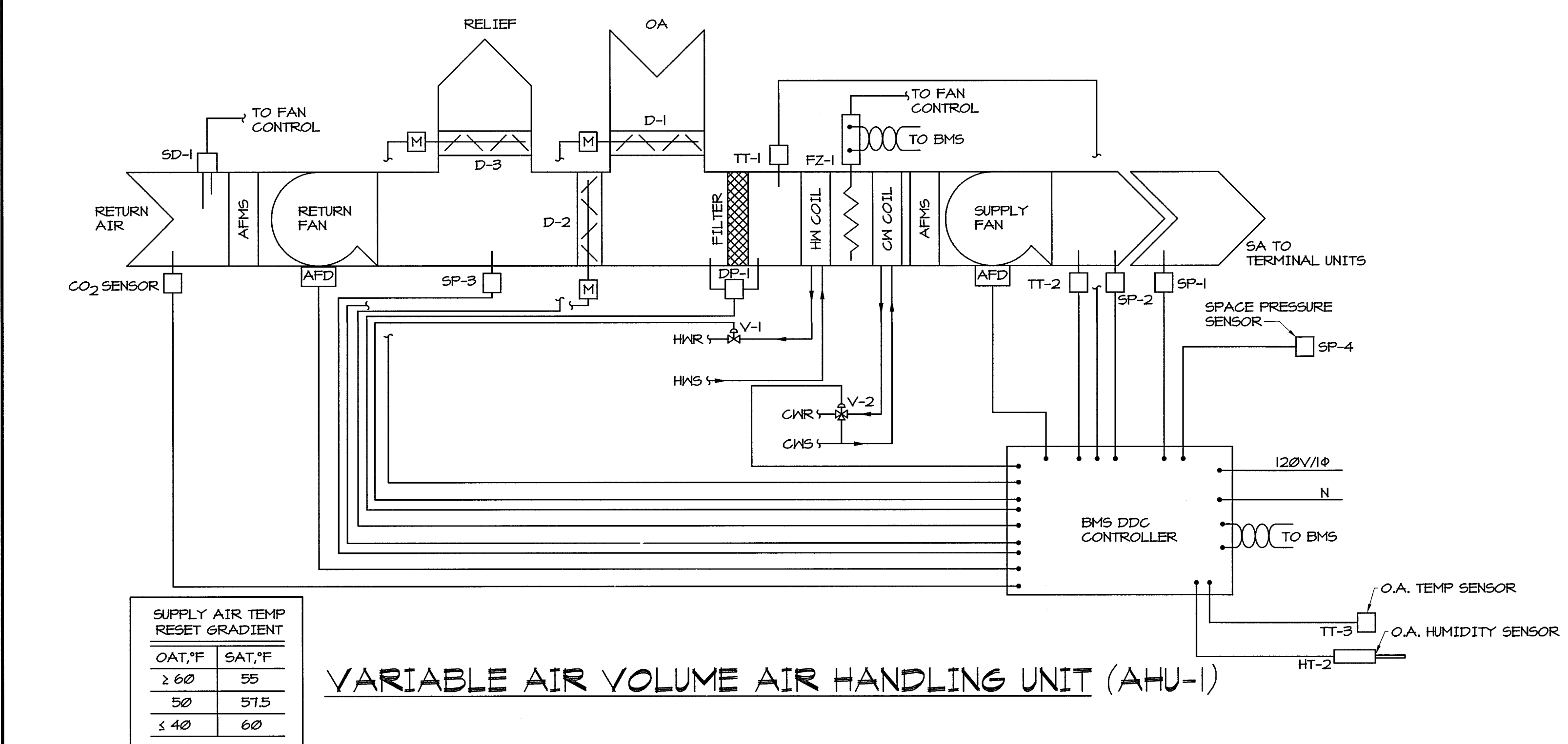
three inches = one foot  
one and one half inches = one foot  
one inch = one foot  
three quarters inch = one foot  
three eighths inch = one foot  
one quarter inch = one foot  
one eighth inch = one foot

EQUIPMENT	CONTROL FEATURES																																	
	MONITOR																CONTROL														ALARM			
CHILLED WATER SYSTEM																																		
CHILLER AND CHILLED WATER PUMPS																																		
HEATING WATER SYSTEM																																		
HEATING WATER PUMPS																																		
VAV AIR HANDLING UNITS, AHU-I																																		
DOMESTIC HM RECIRCULATING PUMPS																																		
AIR TERMINAL UNITS																																		
FAN POWERED AIR TERMINAL UNITS																																		
FANS																																		
FAN COIL UNIT																																		

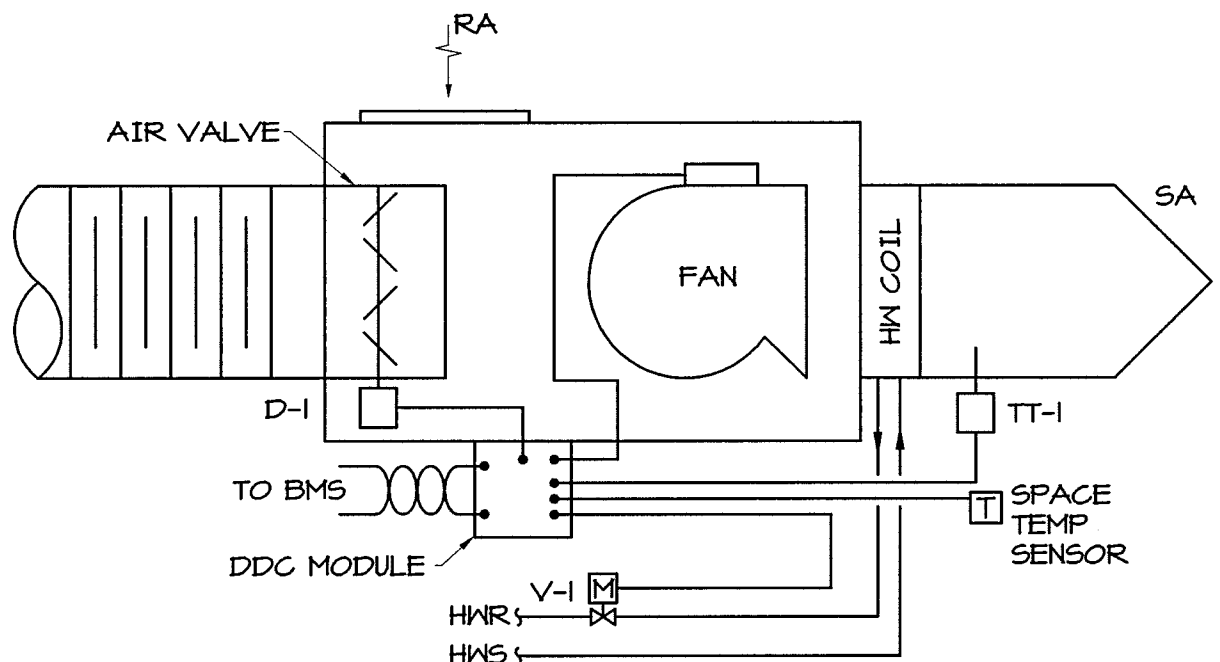


NOTE:  
1. THE TEMPERATURE CONTROL RANGE WILL BE SET REMOTELY BY RESIDENT ENGINEER WITH LIMITED RANGE ADJUSTMENT BY OCCUPANT. (IE, REMOTE RANGE 70° - 75°F WITH LOCAL RESET ± 2°F, 68° - 71°F)

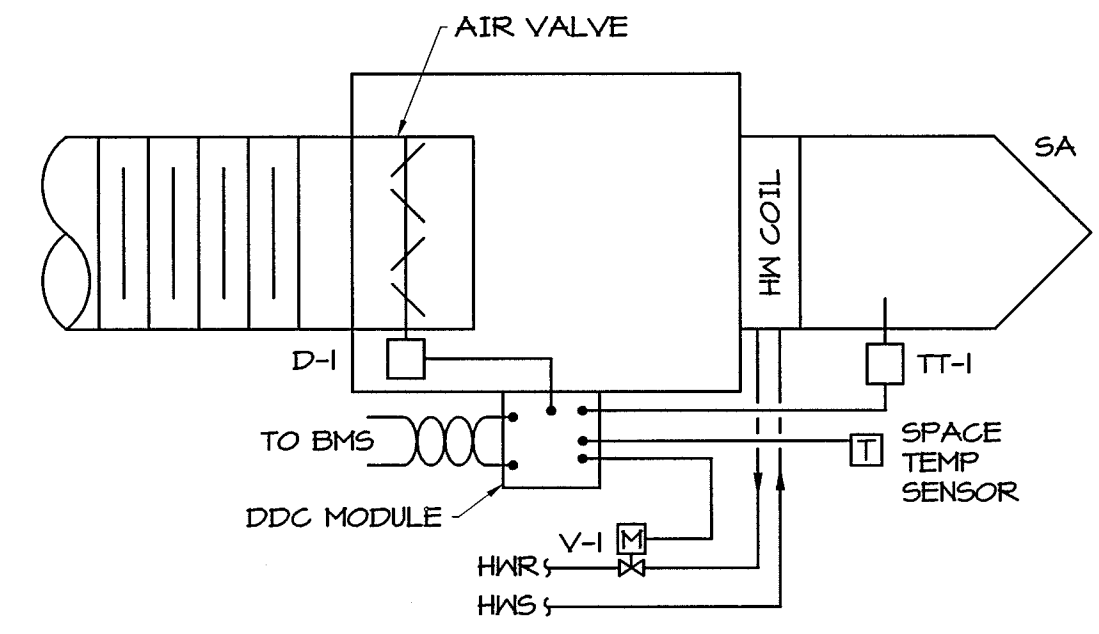
### FAN COIL UNITS



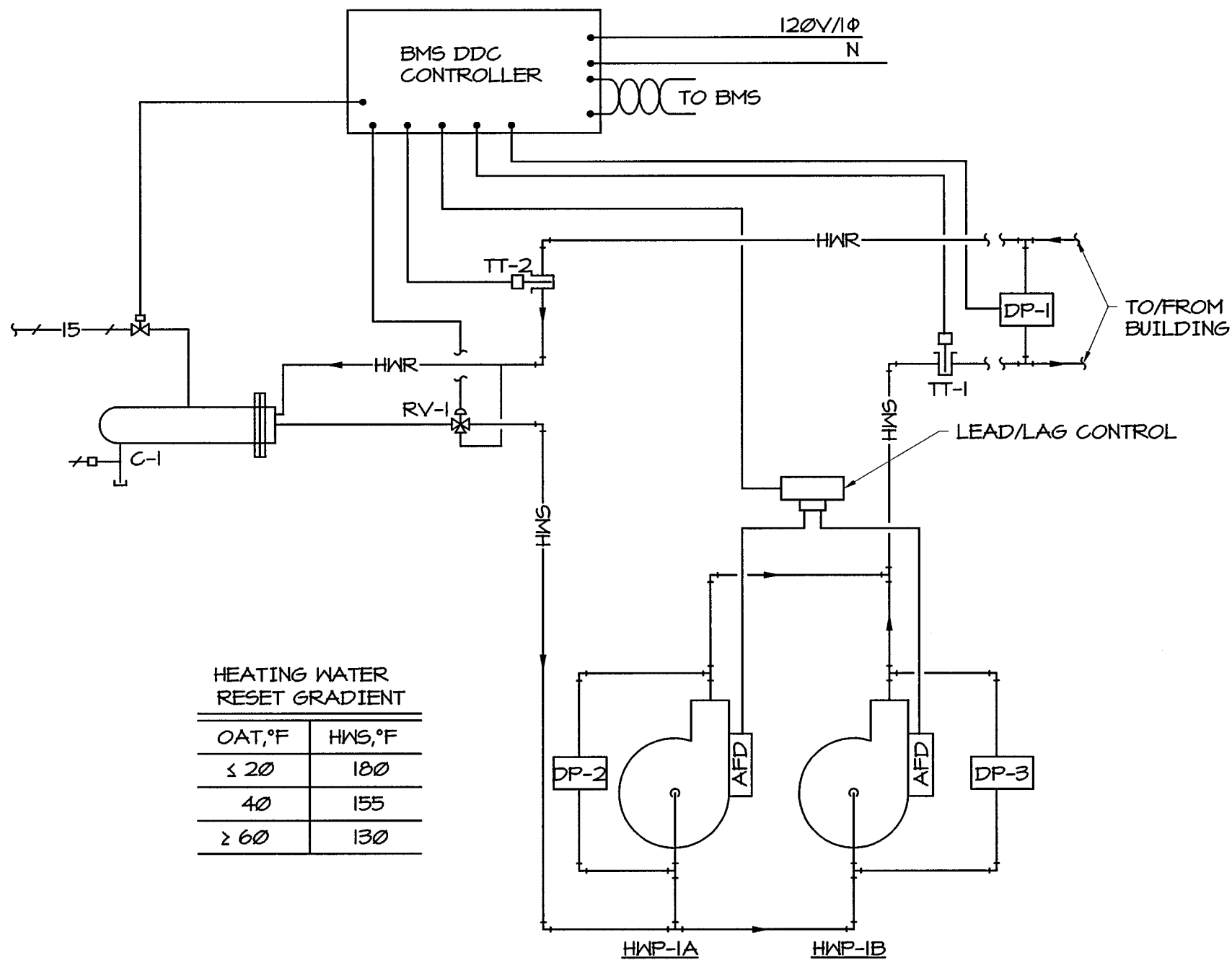
### VARIABLE AIR VOLUME AIR HANDLING UNIT (AHU-I)



### FAN-POWERED AIR TERMINAL UNITS

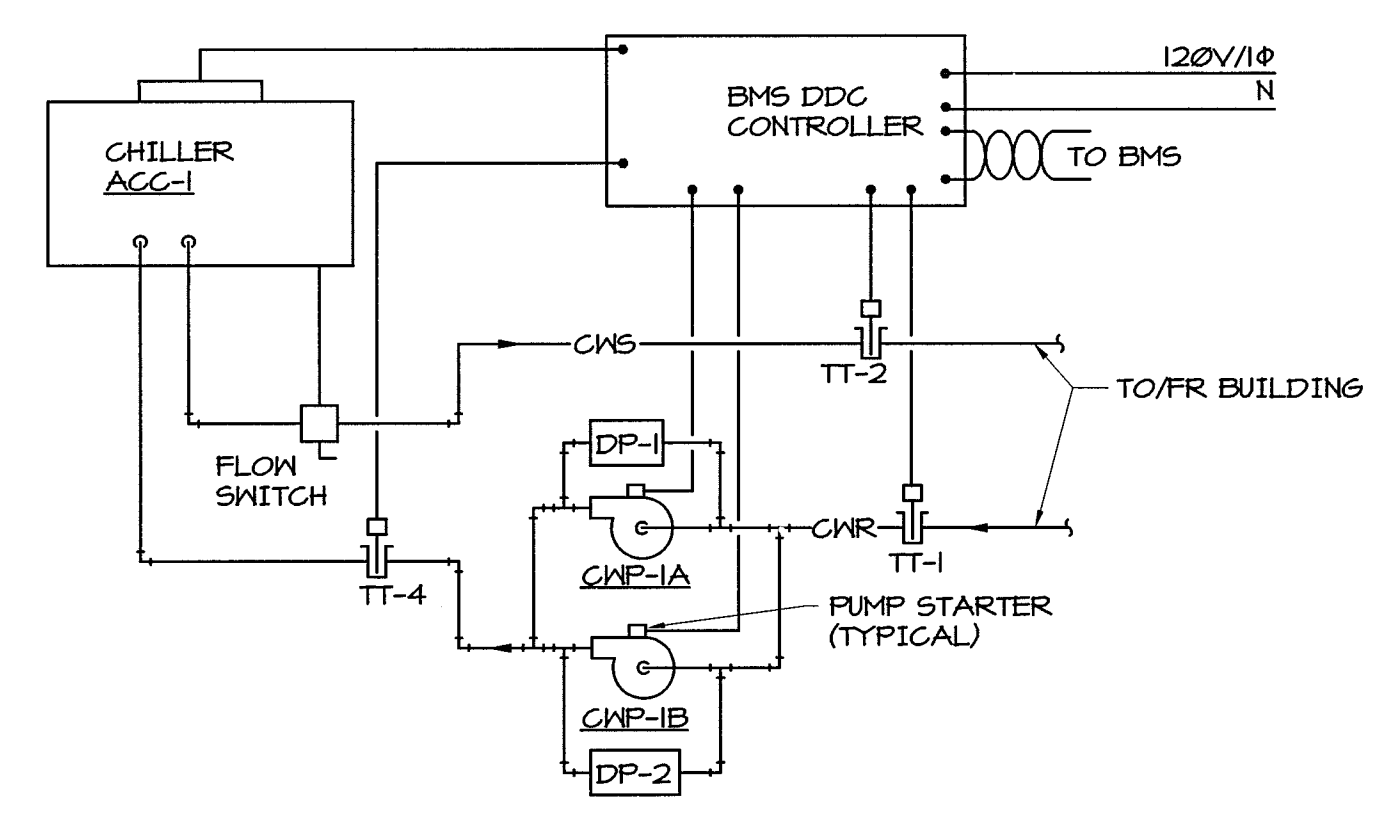


### AIR TERMINAL UNITS



### HEATING WATER SYSTEM

HEATING WATER RESET GRADIENT	
OAT, °F	HWS, °F
≤ 20	180
40	155
≥ 60	130



### CHILLED WATER SYSTEM

#### GENERAL:

The scope of work shall include a complete and working system including all engineering, programming, controls and installation materials, installation labor, commissioning and start-up, training, final project documentation and warranty.

Automatic temperature controls shall be microprocessor, DDC type with electronic valves and actuators.

All controls shall be tied into and interfaced with the existing campus building automation control system (Siemens Controls) for monitoring and control.

Facility operators shall have complete operations and control capability over all new systems including monitoring, trending, graphing, scheduling, alarm management, global point sharing, global strategy deployment, graphical operations interface and custom reporting. Modify the existing building control system as necessary to accommodate the additional control points.

The controls shall include time of day scheduling for night setback and morning warm-up and outside ventilation air damper control.

#### Variable Air Volume Air Handling Unit Control (AHU-I):

The unit shall be automatically started by the BMS for occupied mode of operation, beginning with a "morning warm-up" cycle. In the "morning warm-up cycle", the unit supply and return air fans shall operate at full airflow with outside air damper D-1 and relief air damper D-3 fully closed, return air damper D-2 fully open, chilled water valve V-2 fully closed, and heating water valve V-1 fully open, supplying heated air (75°F, adjustable) to system air terminal units and fan powered units. All VAV air terminal units shall go to their full open position. The morning warm-up cycle shall be completed when all spaces are up to their occupied mode temperature setpoint and the normal occupied mode of operation shall begin.

In normal occupied mode of operation, D-1 shall go to minimum outside air position, D-2 shall go to maximum return air position, and D-3 shall open and modulate as required to maintain neutral pressure in the mixing box. (These minimum and maximum damper positions shall be set during balancing of the system with the system operating at full airflow capacity.) The supply air system static pressure, as sensed by SP-1, shall be maintained at setpoint by modulating supply fan adjustable frequency drive as VAV boxes modulate closed. The system static pressure control shall be overridden to limit the discharge static pressure, as sensed by SP-2, to a maximum setpoint. The return air fan adjustable frequency drive shall be modulated to maintain a positive building pressure as sensed by space pressure sensor SP-3 (setpoint +.05" wg, adjustable) as system VAV boxes modulate closed.

System temperature controls shall operate to modulate unit dampers and control valves to maintain discharge air temperature setpoint (55°F, adjustable) as sensed by temperature sensor TT-2. Setpoint adjustment is made through the BMS. Discharge air temperature setpoint shall be automatically reset inversely with outside air temperature in accordance with reset schedule.

When discharge air temperature sensed at TT-2 is below setpoint, D-1 shall be at minimum outside air position, D-2 shall be at maximum return air position, V-2 shall be fully closed, and V-1 shall be fully open. As discharge air temperature rises, V-1 shall modulate closed to maintain discharge air temperature setpoint. As discharge air temperature continues to rise, D-1 and D-3 shall modulate open and D-2 shall modulate closed to utilize outdoor air for "free" cooling to maintain discharge air temperature setpoint (economizer mode of operation), overriding the minimum outdoor air controls. As discharge air temperature continues to rise further, V-2 shall modulate open to maintain discharge air temperature setpoint. On a drop in discharge air temperature, the reverse sequence shall occur.

Whenever the outdoor air enthalpy (as determined by remote outdoor air temperature sensor TT-3 and outdoor air humidity sensor HT-2) is greater than the return air enthalpy (as determined by space temperature sensor TT-1 and space humidity sensor HT-1), dampers D-1 and D-3 shall return to minimum outdoor air and relief air position and damper D-2 shall be positioned to maximum return air position.

The status of the supply air and return air fans shall be indicated by current sensing transformers on the fan motor electrical leads which shall detect fan motor amperage draw. Abnormally low or high amperage readings shall cause an alarm to be reported.

Filter condition shall be indicated by differential pressure measured by DP-1 across the filter media. A high or low differential pressure shall initiate an alarm condition.

If the heating coil discharge air temperature drops below 35°F (adjustable), as sensed by low limit thermostat FZ-1, the unit fan shall be de-energized and require manual reset. If products of combustion are detected as sensed by smoke detector SD-1, the unit fans shall be de-energized, requiring manual reset, and an alarm signal shall be sent to the fire alarm system. Whenever the unit shuts down, D-1 and D-3 shall go to fully closed position and D-2 shall go to fully open position.

The system controls shall automatically increase the unit minimum outside air quantity to compensate for increase in space occupant load as determined by increase in space carbon dioxide level. As the space carbon dioxide level, as sensed by return air CO2 sensor, increases above a level greater than 600 ppm above outside air reference or 1000 ppm maximum, D-1 shall modulate open and D-2 shall modulate closed to increase system outdoor air quantity. (Outside air reference CO2 level and control setpoint shall be calibrated by Contractor during system balancing.)

During unoccupied periods, the BMS shall operate the system in a "night setback" mode of operation. The system fans shall be off.

Filter condition shall be indicated by differential pressure measured by DP-1 across the filter media. A high or low differential pressure shall initiate an alarm condition.

#### Fan Powered Air Terminal Units

Start/Stop:  
If the BMS senses alarm conditions, the fan shall be shut down and the heating water valve V-1 shall be closed.

Occupied mode:  
The air damper D-1 shall modulate from 100% open to the minimum setpoint to maintain the space temperature at setpoint. If the air damper is closed to its minimum setpoint and the space temperature continues to decrease, the water valve V-1 shall open and shall modulate to maintain the space temperature at setpoint.

Unoccupied mode:  
During unoccupied mode, the space temperature sensor shall control at a reduced heating setpoint. Fan shall be normally off and V-1 shall be positioned fully closed. On a call for heating, space temperature sensor TT-1 shall energize terminal unit fan and modulate valve V-1 to fully open.

Morning Warm-up:  
The air damper D-1 shall be 100% open and the water valve V-1 shall modulate to maintain the space temperature at setpoint.

Temperature Setpoints:  
Occupied and unoccupied space temperature setpoints shall be set by the BMS.

#### Air Terminal Units:

Start/Stop:  
If the BMS senses alarm conditions, the heating water valve V-1 shall be closed.

Occupied Mode:  
The water valve V-1 shall modulate from 100% open to the minimum setpoint to maintain the space temperature at setpoint. If the air damper is closed to its minimum setpoint and the space temperature continues to decrease, the water valve V-1 shall open and shall modulate to maintain the space temperature at setpoint.

Unoccupied mode:  
The water valve V-1 shall be closed. If the ATU's associated air handling unit is active, the air damper D-1 shall modulate from 100% open to the minimum unoccupied mode setpoint to maintain the space temperature at setpoint. If the ATU's associated air handling unit is inactive, the air damper shall be closed.

Morning Warm-up:  
The air damper D-1 shall be 100% open and the water valve V-1 shall modulate to maintain the space temperature at setpoint.

Temperature Setpoints:  
Occupied and unoccupied space temperature setpoints shall be set by the BMS.

#### Fan Coil Units:

When the FCU is energized by the BMS, the unit fan shall run continuously. The return air or wall mounted temperature sensor shall modulate the heating and cooling control valves, V-1 and V-2, in sequence to maintain the desired space temperature. As the space heating or cooling requirements increase the unit fan shall be reset from "low" speed to "medium" or "medium" speed to "high" as required to match the room load capabilities. This automatic fan speed control may be overridden by using the "auto-manual" switch and set the 3-speed fan switch to "lock-in" a fixed speed setting. If desired or required by the system design. All spaces that are likely to be unoccupied for significant time periods (4 hours or more) shall be configured for night setback/morning warm up control sequences. (Coordinate and review this requirement with the Owner's Representative and Project Engineer prior to installing control components for these spaces.) During unoccupied mode, the unit fan will be allowed to cycle "on/off" during heating season as required to maintain a reduced night setback temperature of 65°F (adjustable). When the unit fan is de-energized, the unit control valves shall be fully closed. When the unit is in setback mode and there is a call for heat, the heating coil control valve V-1 shall cycle full open as the fan is energized. All units located in or serving "EXIT" corridors shall be de-energized anytime the fire alarm system is activated.

#### Wall Heaters:

Unit built-in thermostat shall cycle fan and electric heating coil in order to meet the space temperature setpoint. No connection to BMS is required.

#### Fans:

F-1 - (F-2, and F-3 similar): The BMS shall enable the fan to run continuously and the motor operated discharge damper shall be open during occupied mode. The BMS shall de-energize the fan and close the motor operated discharge damper in the unoccupied mode.

Chilled Water System: When the outside air temperature is above 55°F, the chilled water system shall be enabled through the BMS and the "lead" chilled water pump CWP-1(A or B) shall be energized. The "lead/lag" control shall switch the lead pump each time the system is restarted or at a regular interval of operation hours (100 hours, adjustable). If the lead pump should fail, the lag pump will automatically energize and an alarm shall be announced to the BMS. Software interlocks shall prevent operation of chiller unless a chilled water pump is running and flow is detected. Flow switches shall be used to determine flow. The chiller manufacturer's factory supplied controls shall operate to maintain the supply water temperature at setpoint.

Heating Water System: When outside air temperature is below 60°F (adjustable), the heating water system shall be enabled through the BMS, steam supply valve V-1 shall fully open to Converter C-1, and the "lead" heating water pump HWP-1(A or B) shall be energized. The heating water pumps are variable speed drive units controlled through an adjustable frequency drive (AFD) unit to maintain a setpoint differential pressure (adjustable) between the supply and return water mains at a selected point in the piping system (DP-1). The "lead/lag" control shall switch the lead building system pump each time the system is restarted or at a regular interval of operating hours (100 hours, adjustable). If the lead pump should fail, the lag pump will automatically energize. If the AFD unit should fail, the pump will continue to run at 1750 RPM as a constant speed driver. Heating water reset valve RV-1 shall modulate to maintain the supply water temperature to match the values listed in the reset schedule.

Miscellaneous Controls: The BMS shall provide time clock start-stop control for the domestic hot water recirculating pump.

AUTOMATIC TEMPERATURE CONTROLS		SCHEMATIC 2		SCOPE OF WORK/SEQUENCE OF OPERATION	
CONSULTANTS:		ARCHITECT/ENGINEERS:		Drawing Title: <b>AUTOMATIC TEMPERATURE CONTROLS</b>	
				Project Title: <b>Adult Day Care Building VA Medical Center</b> Comm No. 1010.00	
				Location: <b>Beckley, West Virginia</b>	
				Date: <b>08/05/2011</b>	
				Checked: <b>LBC</b>	
				Drawn: <b>PAA</b>	
				Building Number: <b>-</b>	
				Drawing Number: <b>M4.2</b> Dwg 61 of 17	
Revisions:		Date:		Office of Construction and Facilities Management	
				Department of Veterans Affairs	