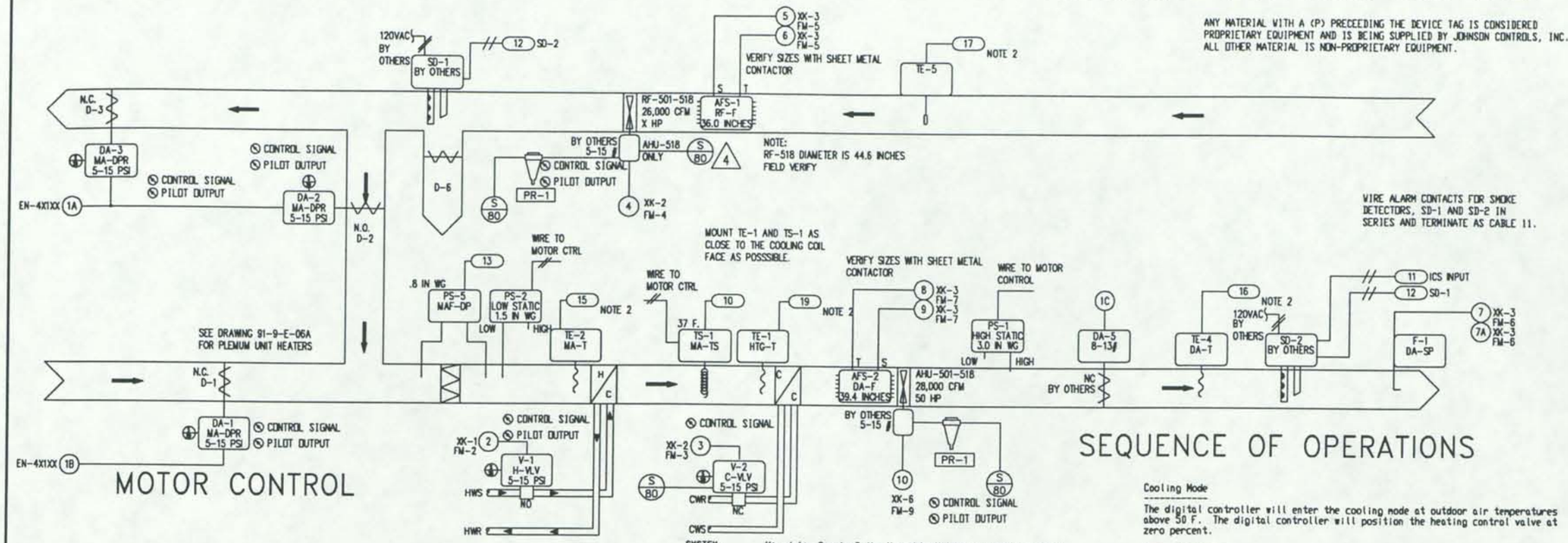
FLOW DIAGRAM AND EQUIPMENT LOCATIONS FOR AIR HANDLING UNITS, AHU-501 THRU AHU-518

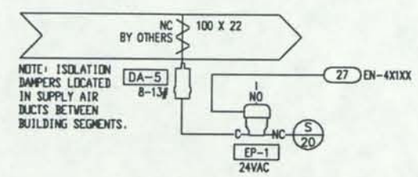


ANY MATERIAL WITH A (P) PRECEEDING THE DEVICE TAG IS CONSIDERED PROPRIETARY EQUIPMENT AND IS BEING SUPPLIED BY JOHNSON CONTROLS, INC. ALL OTHER MATERIAL IS NON-PROPRIETARY EQUIPMENT.

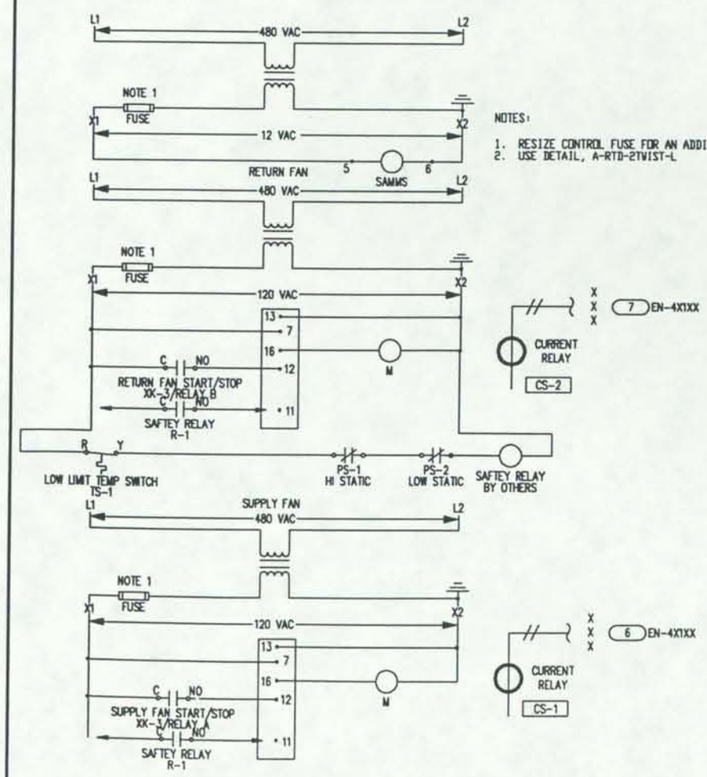
FIELD MATERIAL

DEVICE TAG	QTY	CODE NUMBER	DESCRIPTION
V-1-V-2	--	----	SEE SCHEDULE
D-1-D-5	--	----	SEE SCHEDULE
DA-1-3,DA-6	--	----	SEE SCHEDULE
DA-4	--	----	SEE SCHEDULE
PS-1-PS-2	36	1900-5-MR	DUCT PRESS MONITOR-DWYER
TE-1,2,4	54	TE-6100-1	17 ' AVE TEMP ELEMENT
TE-5	18	TE-6000-100	SENSOR, 1000 OHM +/- .1%
	18	TE-6001-1	ELEMENT HOLDER
TS-1	18	A70HA-1C	TEMP CONTROL, 2-C
ACC	234	G-2010-5	AIR GAGE 1-1/2"
CS-1-CS-2	36	705ND	CURRENT SWITCH-VERIS
PS-5	18	P32AF-2C	SENSITIVE DIFF PRESSURE SWITCH
F-1	18	FTG18A-600R	STATIC PROBE
PR-1	36	R-130-14	PRV
EP-1	9	V-2410-1	E/P SWITCH
DA-5	18	D-3153-2	DAMPER ACTUATOR
AFS-1-AFS-2	36	VOLU-PROB-F1	AIR FLOW MEASURING STATION-AMI

WIRE ALARM CONTACTS FOR SMOKE DETECTORS, SD-1 AND SD-2 IN SERIES AND TERMINATE AS CABLE 11.



MOTOR CONTROL



SEQUENCE OF OPERATIONS

SYSTEM: Mixed Air Single Path, Variable Volume Air Handling Unit AHU-501, AHU-518

CONFIGURATION: Single Supply Air Temperature Setpoint
Variable Air Volume with Supply and Return Fans

Occupied Mode

The supply and return fans will operate continuously in this mode.

Discharge Air Temperature Setpoint

The building operating engineer will set the discharge air temperature by adjusting the discharge air setpoint, DA-SP from any ISC terminal. The digital controller will modulated controlled devices as described below to maintain a fan discharge temperature of 47 F.

Discharge Temperature Loop

The discharge cooling deadband is added to the discharge air setpoint. This value establishes the point at which mechanical cooling begins when the controller uses proportional only control. The digital controller will continually adjust the damper and mechanical cooling command in sequence according to the controller's result of the proportional-intergal cooling loop calculation. The digital controller modulates the controlled devices until the discharge air temperature equals the calculated discharge setpoint. The digital controller will continually adjust the heating command according to the controller's result of the proportional-integral heating loop calculation. The digital controller will modulate the heating control valve, V-1, mixed air dampers, DA-1-DA-3 and cooling control valve, V-2 until the discharge air temperature equals the setpoint. The controller will provide an output between 0 and 100 percent as the discharge air temperature travels through the proportional bands. The state of 'Heating Mode' and 'Cooling mode' will lockout the operation of the controlled device, V-1 and V-2 if the respective mode is set 'Off'. The PID control algorithm will sequence the heating and cooling devices so that both do not operate in the same proportional band. The digital controller will control the mixed air dampers between minimum and 100 percent in the occupied mode and from 0 percent in the unoccupied mode.

Mixed air low limit

The mixed air low limit setpoint and the mixed air low limit proportional band will establish a back off effect to the mixed air damper output command. This happens when the mixed air temperature, TE-2 decreases into the range of the mixed air low limit plus the mixed air low limit proportional band. This back-off feature multiplies the damper command by the proportional percentage of the mixed air temperature inside the mixed air low limit proportional band. The mixed air low limit proportional band is reset inversely by 20 degrees between outdoor air temperatures of 40 and -30 degrees F.

Dry Bulb Economizer Switchover

When the outdoor air temperature is greater then the Summer Economizer Switchover setpoint, 68 F.(Adj.) in the Summer Mode or 45 F.(Adj.) in the Winter Mode, the digital controller commands the mixed air dampers to minimum position(Adj.). When the outdoor air temperature decreases below the Summer Economizer Setpoint or rises above the Winter Economizer Setpoint, the controller modulates the mixed air dampers to provide free cooling. When ECON is on, free cooling is available.

Control systems, AHU-501 - AHU-518 will use a common outside air temperature value while the digital controller is online with its controlling NCM. In the event that communication is lost the controller will operate using the temperature element that is hardwired to that system, TE-3.

Heating Mode

The digital controller will enter the heating mode if binary data object, HTG_MODE is set ON by the building operating engineer. This mode is adjustable from any ICS terminal. The digital controller will position the cooling control valve at zero percent.

Cooling Mode

The digital controller will enter the cooling mode at outdoor air temperatures above 50 F. The digital controller will position the heating control valve at zero percent.

Warm-up/Cooldown

The warm-up/cooldown mode initiation will take place through a command from the higher level digital controller, NC-4X on a schedule basis. When made active the AHU digital controller will start the fan system and will control at the occupied mode setpoints without the operation of the mixed air dampers. The controller will switch into the occupied mode when the mixed air temperature reaches 72 F., at this point the mixed air system will be enabled.

Single Supply and Return Fan - Volume Matching

The digital controller will provide an output command to the supply fan variable pitch in motion actuator based on the controller's PI loop calculation. The controller will add the static pressure offset value to the PI control calculation. The static pressure deadband value establishes a range above and below the static pressure setpoint where the error is considered zero, causing corrective action to stop. This value is input above and below the static pressure setpoint. The controller will establish a return fan volume setpoint by subtracting the CFM Differential, 2,000 CFM from the actual supply fan CFM. The return volume proportional band integration value will cause the controller to continually provide corrective action until the actual return volume equals the return volume setpoint. If the calculation becomes unreliable, the output to the return fan will be zero percent.

Supply Static High/Low limit

The supply/return fans system will stop in the event that the supply static exceeds 5.00 inch WG or the mixed air static exceeds a negative 1.50 inches WG. at pressure sensing switches, PS-1 and PS-2. All controlled devices will be commanded to the position indicated in 'Loss of Air Flow' until the appropriate pressure sensing switch is reset.

Electric Low Limit

The supply/return fans system will stop and the mixed air dampers will be positioned at zero percent in the event that the heating coil discharge drops below 37 F.(adjustable) at temperature switch, TS-1.

Filter Alarm

The mixed air filter condition will be monitored by differential pressure switch, PS-5. The switch will close in the event that the pressure drop exceeds .8 inches WG(adjustable) and an alarm will be sent to the ICS network, 'Dirty Mixed air Filter'.

Loss of Air Flow

Upon loss of air flow as determined by current sensing switches, CS-1 and CS-2 the following controlled devices will be commanded to the following states:

- Heating valve, V-1 will remain in control.
- Cooling valve, V-2 will be positioned at zero percent.
- Mixed air dampers, DA-1-3 will be positioned at zero percent.
- Return and supply fan positions will be commanded to zero percent.

Supply air isolation damper

The building operating engineer has the ability to make the supply air plenums common between experiment has segments by setting binary output object, 'ISD_SXX' to 'open'. The systems will operate individually with the damper closed.

Damper actuator, DA-5 will open when status is read on by current switch, CS-1.

Unoccupied Mode

The supply and return fans will remain off and the controlled devices will be commanded to the positions indicated above under 'Loss of Air Flow'.

Shutdown

Upon a command from the higher level digital controller, NC-4X, the AHU digital controller will command all analog outputs to zero percent and will turn off all binary outputs.

Power Fail Restart

The power fail restart will delay the startup of the digital controller for the time indicated below(adjustable at the DWS) after a power failure or controller reset condition. This logic will hold the controller in the sutdown node until the restart timer has expired. See restart delay timer schedule below:

Sytsten Name	Restart Timer Value	Sytsten Name	Restart Timer Value
AHU-501	1 minute	AHU-510	10 minute
AHU-502	2 minute	AHU-511	11 minute
AHU-503	3 minute	AHU-512	12 minute
AHU-504	4 minute	AHU-513	13 minute
AHU-505	5 minute	AHU-514	14 minute
AHU-506	6 minute	AHU-515	15 minute
AHU-507	7 minute	AHU-516	16 minute
AHU-508	8 minute	AHU-517	17 minute
AHU-509	9 minute	AHU-518	18 minute

The following point objects will be adjustable from any ICS terminal:
- -Discharge air setpoint
- -Heating and Cooling lockout setpoints
- -Cooldown temperature setpoint(return air)
- -Supply air static pressure setpoint.

The following point objects will be monitored/alarmed at any ICS terminal:
- -Electric low limit temperature switch, TS-1 status
- -Mixed air filter differential pressure alarm, PS-5
- -Supply and Return fan status, CS-1 and CS-2
- -Smoke detectors, SD-1 and SD-2 status

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DRAWING TITLE
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Argonne, IL 60439

REFERENCE DRAWING			NO.	REVISION-LOCATION	ECN	DATE	BY
			5	ADD SMOKE FANS		01/24/94	SF
			4	MODIFY AFMS		06/20/93	SF
			3	GENERAL		01/02/93	SF
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