

Target Truss Level Air Handler & Zone Temperature Controls Description TD8027

1. Operating Philosophy

1.1. Purpose

The purpose of air handler and zone temperature operations are to:

1. Control the seventeen zone air temperatures. The seventeen zones include north stairwell 1, center stairwell, north stairwell 2, switchgear, HP Office/lobby/east stairwell/telecom, break room, level 1 restrooms/west stairwell, 2TU heating coil, 11TU heating coil, and eight zones in the instrument floor.
2. Save energy by using outside air to cool the building when possible
3. De-energize air handler fan/dampers upon detection of smoke
4. Provide the operator with modes of operation that insure adequate control and aid in trouble shooting and startup testing
5. Provide freeze protection for air handlers
6. Provide humidity control for the output of the air handlers

1.2. Assumptions

1. Outside air will not be needed to heat the building.
2. The zone air handlers only heat the zones, therefore, it may not always be possible to maintain this temperature at its setpoint
3. Space temperature setpoints will not be automatically changed (such as between winter and summer). Manually changing the setpoints will be possible.
4. A smoke damper in the air handler outlet must be closed when the air handler fan/damper is de-energized and open when the fan/damper is energized. This action is provided by hardwiring in the MCC, not PLC logic. Closing the damper in response to a smoke detection signal from the fire alarm system is accomplished by de-energizing the fan/damper.
5. A mechanical stop will be provided to prevent the outside air damper from completely closing. This will provide a minimum of outside air at all times and enable the pressure control loop to function at all times.
6. MCCs for smoke exhaust fans/dampers are equipped with a Hand, OFF, Auto (HOA) switch that will prevent the logic from energizing the fan/damper if the switch is in the OFF position. This has been examined and found to be in compliance with an appropriate exception in NFPA 92A. Thus no special wiring or logic will be implemented to energize fans/dampers when the HOA switch is not in the AUTO position. However, a graphical alarm that obviously stands out from others will be presented to the operator whenever any smoke exhaust fan/damper is not in the AUTO position.
7. The Fire Alarm Control Panel (FACP) provides a hardwired signal to shutdown the air handler fan/damper in response to detection of smoke. The FACP must reset this shutdown signal when the smoke exhaust switch is actuated to permit the CF controls PLC to energize the fan and open the damper.
8. Freeze protection will be provided as follows:

- a. When air handler internal temperatures fall below 45 degF, the logic will issue a command to close the outside air damper and generate an operator alarm
 - b. If the temperature continues to fall below 40 degF, the logic will:
 - i. De-energize air handler fans/dampers
 - ii. Open the valves to heating coils closest to the outside air to 50% to add heat
 - iii. Generate an operator alarm
9. Signals from the fire alarm system, would override these commands.

1.3. Operator Controls and Operating Modes

1. OFF: Air handler and zone heaters are not in use. Fans/dampers are de-energized. All dampers are closed, heating valve is closed, chilled water valve is closed, and humidity valve is closed. Setpoints remain at last setting.
2. Auto: Logic determines the air handler coil discharge temperature setpoint from the actual space humidity based on the following table: 65 DegF if humidity is below 30%, 54 DegF if humidity is above 40%, and use linear interpolation if humidity is between 30% and 40%. Utilize a 1% deadband around the 30% and 40 % values to avoid constant switching. For example, if the setpoint is 65 DegF because the humidity is below 30%, don't change the setpoint until the humidity is above 31%. If the setpoint is being interpreted because the humidity is between 30% and 40%, don't set the setpoint to 65 DegF until the humidity falls below 29%. The supply temperature will be maintained (via heating control valve, chilled water control valve, or outside air and return dampers) and automatically transitions from one configuration to the other as appropriate. Fans/dampers are energized. Zone heaters will modulate the heating control valve to maintain the zone temperature setpoint. Exhaust fans/dampers will be automatically transitioned and controlled as appropriate.
3. Heat: Air handler is forced to control supply temperature with heat. Fans/dampers are energized. Outside air damper is closed, exhaust damper is closed, return damper is opened, and chilled water valve is closed. Heating water valve is modulated. Zone heaters will modulate the heating control valve to maintain the zone temperature setpoint. Exhaust fans will be de-energized.
4. Cooling with Outside Air: Air handler is forced to control supply temperature with outside air. Fans/dampers are energized. Outside air damper is modulated and exhaust dampers are opened. Chilled water valve is closed. Heating water valve is closed. Zone heaters will modulate the heating control valve to maintain the zone temperature setpoint. Exhaust fans will modulate their speed to maintain the pressure setpoint.
5. Cooling with Chilled Water: Air handler is forced to control supply temperature with chilled water. Fans/dampers are energized. Outside air and exhaust dampers are closed. Chilled water valve is modulated. Heating water valve is closed. Zone heaters will be de-energized. Exhaust fans will be de-energized and exhaust dampers closed.
6. Humidity Only: Air handler is forced to control humidity with the humidifier valve. Heating water control valve, chilled water control valve and outside

damper are closed. Exhaust fans are de-energized and exhaust dampers closed. Zone heaters will modulate the heating control valve to maintain the zone temperature setpoint.

2. Operator Interface Definitions

2.1. Local Hardware/Manual Operator Controls

1. HOA switch on MCC for supply fan/damper starter (*HS2504, HS2505, HS2506, HS2507*)
2. Pressure differential indicator across air filter (*PDI2504, PDI2505, PDI2506, PDI2507*)
3. Chilled water supply temperature indicator (*TI2504D, TI2505D, TI2506D, TI2507D*)
4. Chilled water return temperature indicator (*TI2504C, TI2505C, TI2506C, TI2507C*)
5. Heated water supply temperature indicator (*TI2504B, TI2505B, TI2506B, TI2507B*)
6. Heated water return temperature indicator (*TI2504A, TI2505A, TI2506A, TI2507A*)
7. Humidifier water pressure indicator (*PI2504, PI2505, PI2506, PI2507*)
8. Humidifier water pressure indicator hand valve (*HV2504, HV2505, HV2506, HV2507*)
9. Zone heater heated water return temperature indicator (*TI2564A, TI2566A, TI2567A, TI2568A, TI2569A, TI2570A, TI2571A, TI2572A, TI2574A, TI2576A, TI2577A, TI2578A, TI2579A, TI2580A, TI2581A, TI2582A, TI2583A*)
10. Zone heater heated water supply temperature indicator (*TI2564B, TI2566B, TI2567B, TI2568B, TI2569B, TI2570B, TI2571B, TI2572B, TI2574B, TI2576B, TI2577B, TI2578B, TI2579B, TI2580B, TI2581B, TI2582B, TI2583B*)
11. FAULT indicator light on MCC
12. READY indicator light on MCC
13. RUN indicator light on MCC

2.2. Software HMI/EPICS Digital Operator Controls

1. Temperature control mode (selection switch)
 - a. Off
 - b. Semi- Auto (Heat Only)
 - c. Semi- Auto (Cool W/OA)
 - d. Semi- Auto (Cool W/CHW)
 - e. Semi- Auto (Humidity Only)
 - f. Auto
 - g. Zone Heaters Off
 - h. Zone Heaters Auto

2.3. Software HMI/EPICS Digital Displays

1. Mode switch status
 - a. OFF

- b. Auto
 - c. Semi- Auto (Heat Only)
 - d. Semi- Auto (Cool W/OA)
 - e. Semi- Auto (Cool W/CHW)
 - f. Semi- Auto (Humidity Only)
 - g. Zone Heaters Off
 - h. Zone Heaters Auto
2. Smoke detector status from fire alarm system (*NE2504A, NE2505A, NE2506A, NE2507A, NE2504B, NE2505B, NE2506B, NE2507B*)
 3. Supply air fan/damper HOA switch status (*HS2504, HS2505, HS2506, HS2507*)
 4. Supply air fan/damper status (*F2504/SOV2504A/FCV2504A, F2505/SOV2505A/FCV2505A, F2506/SOV2506A/FCV2506A, F2507/SOV2507A/FCV2507A*)
 5. Exhaust fan/damper status (*EF2531/SOV2531/FCV2531C, EF2532/SOV2532/FCV2532C, EF2533/SOV2533/FCV2533C, EF2534/SOV2534/FCV2534C*)
 6. Exhaust fan alarm status (*YA2531, YA2532, YA2533, YA2534*)
 7. Exhaust fan pressure differential status (*PDS2531, PDS2532, PDS2533, PDS2534*)

2.4. Software HMI/EPICS Analog Operator Controls

1. Temperature cooling sp (return air for building space)
2. Temperature heating sp (return air for building space)
3. Zone temperature sp (zone temperatures)
4. Humidity sp (humidity for building space)
5. Pressure sp (pressure for building space)

2.5. Software HMI/EPICS Analog Displays

1. Outside air temperature (*TT2504B, TT2505B, TT2506B, TT2507B*)
2. Outside air humidity (*MT2504B, MT2505B, MT2506B, MT2507B*)
3. Return air temperature (*TT2504C, TT2505C, TT2506C, TT2507C*)
4. Return air humidity (*MT2504C, MT2505C, MT2506C, MT2507C*)
5. Outside air flow (*FT2504B, FT2505B, FT2506B, FT2507B*)
6. Mixed air temperature (*TT2504D, TT2505D, TT2506D, TT2507D*)
7. Coil discharge air temperature (*TT2504E, TT2505E, TT2506E, TT2507E*)
8. Supply air temperature (*TT2504A, TT2505A, TT2506A, TT2507A*)
9. Supply air flow rate (*FT2504A, FT2505A, FT2506A, FT2507A*)
10. Building space humidity (*MT2504A, MT2505A, MT2506A, MT2507A*)
11. Zone space air temperatures (*TT2564, TT2566, TT2567, TT2568, TT2569, TT2570, TT2571, TT2572, TT2574, TT2576, TT2577, TT2578, TT2579, TT2580, TT2581, TT2582, TT2583*)
12. Space pressure (*PT2531, PT2532, PT2533, PT2534*)
13. Exhaust fan speed (*ST2531, ST2532, ST2533, ST2534*)
14. Zone heated water valve controller output (*IP2564/TCV2564, IP2566/TCV2566, IP2567/TCV2567, IP2568/TCV2568, IP2569/TCV2569, IP2570/TCV2570, IP2571/TCV2571, IP2572/TCV2572, IP2574/TCV2574, IP2576/TCV2576*)

*IP2577/TCV2577, IP2578/TCV2578, IP2579/TCV2579, IP2580/TCV2580,
IP2581/TCV2581, IP2582/TCV2582, IP2583/TCV2583)*

15. Outside air damper controller output (*IP2504C/FCV2504B, IP2505C/FCV2505B,
IP2506C/FCV2506B, IP2507C/FCV2507B*)
16. Heated water valve controller output (% open) (*IP2504A/TCV2504A,
IP2505A/TCV2505A, IP2506A/TCV2506A, IP2507A/TCV2507A*)
17. Chilled water valve controller output (% open) (*IP2504B/TCV2504B,
IP2505B/TCV2505B, IP2506B/TCV2506B, IP2507B/TCV2507B*)
18. Humidity valve controller output (*MC2504, MC2505, MC2506, MC2507*)

2.6. Software HMI/EPICS Alarms (via EPICS Alarm Handler)

1. Mixed air temperature low (45 DegF)
2. Mixed air temperature low low (40 DegF)
3. High and low temperature
4. High and low humidity
5. Smoke detected

3. Operational Modes Descriptions

3.1. Control Logic Description

In the OFF mode, the air handler, zone heaters, and exhaust fans are not in use. The dampers and all control valves are closed.

Automatic temperature controls used in the AUTO mode work as follows:

If the building space humidity is less than 30%, then set the temperature cooling setpoint and temperature heating setpoint to 65 DegF. If the building space humidity is greater than 40%, then set the temperature cooling setpoint and temperature heating setpoint to 54 DegF. If the building space humidity is between 30% and 40%, use linear interpolation to set the temperature cooling and temperature heating setpoint between 54 DegF and 65 DegF. Utilize a 1% deadband around the 30% and 40% values to avoid constant switching. For example, if the setpoint is 65 DegF because the humidity is below 30%, don't change the setpoint until the humidity is above 31%. If the setpoint is being interpreted because the humidity is between 30% and 40%, don't set the setpoint to 65 DegF until the humidity falls below 29%.

If the coil discharge temperature is less than temperature heating setpoint, modulate the heating control valve to maintain the temperature heating setpoint.

If the coil discharge temperature is greater than the temperature cooling setpoint, the heating valve will be closed and cooling will be provided as follows:

If the enthalpy calculation shows that outside air can be used and the mixed air temperature is greater than the temperature cooling setpoint, the outside air damper control loop will be used to modulate the outside damper. If not, the chilled water control loop will be used to modulate the

chilled water control valve. In both cases, control will be to the temperature cooling setpoint.

If the air handler is not in the Off mode, modulate the zone heater control valve to maintain the space temperature at the zone temperature setpoint.

If the outside damper is greater than the minimum position, the exhaust fan will be energized, exhaust damper opened, and the fan speed modulated to maintain the building pressure setpoint. Control will be to the building space pressure. If the outside damper is at the minimum position, the exhaust fan will be de-energized, exhaust damper closed, and exhaust fan set to 0 speed.

In the manual modes the air handler is forced to cool with outside air by modulating the outside air damper, cool with chilled water by modulating the chilled water valve, heat by modulating the heating water valve, or adjust the humidity by modulating the humidifier control valve respectively.

Freeze protection will be provided as follows:

- When air handler internal temperatures fall below 45 degF, the logic will issue a command to close the outside air damper and generate an operator alarm
- If the temperature continues to fall below 40 degF, the logic will:
 - a. De-energize air handler fans/dampers
 - b. Open the valves to heating coils closest to the outside air to 50% to add heat
 - c. Generate an operator alarm



