Coolerado Hybrid Air Handler

Sequence of Operation:

START / STOP
1. The disconnect switch must be in the "ON" position for the air handler to run.
2. The Fan operates under control of the software "Hand-Off-Auto" control as follows:
   - In the "OFF" mode, the fan is commanded OFF. This cannot be overridden by any of the other controls.
   - In the "HAND" mode, the fan is commanded ON continuously. If a Low Discharge Temperature error occurs, however, the fan will be commanded OFF.
   - In the "AUTO" mode:
     - ✓ The fan is commanded ON whenever it's in the Occupied or Heating mode, unless a Low Discharge Temperature or Overpressure error occurs.
     - ✓ During the Unoccupied mode, the fan is commanded ON only when there is a call for heat.

SAFETY
1. (Optional or field-installed) The supply fan stops whenever a smoke detector is activated. The smoke detector must be *manually reset* before the fan can be re-started.
2. The fan stops whenever the discharge air temperature falls below the Low Temp Limit setpoint for longer than 5 minutes and must be *manually reset* before it can be re-started. (Resetting for this safety control is accomplished by:
   - Command the Fan "Off", then either to "Auto" or "Hand".

OUTDOOR AIR
1. The outdoor air damper closes and the return air damper opens fully when the fan is OFF.
2. The outdoor air damper opens to its minimum position whenever the fan is commanded ON. There are separate, adjustable minimum outdoor air setpoints for the:
   - Occupied period (cooling and heating modes) and Unoccupied period cooling mode
   - Unoccupied heating mode
   - Economizer-only mode
3. The outdoor air damper modulates <u>above</u> minimum position to maintain the adjustable minimum discharge air temperature whenever there is a call for cooling and its not overridden by a condition that forces it to the minimum position.
4. The return air damper modulates closed AFTER the outdoor air damper is fully open and there is still a call for more cooling.

FAN SPEED
1. The minimum supply fan speed has adjustable setpoints for the occupied and unoccupied periods.
2. The supply fan and exhaust / condenser speeds modulates to maintain the temperature setpoint when the HMX are active.
3. When HMXs are NOT active and cooling is provided by the DX coil, both the supply and exhaust / condenser fan speeds modulate to match the fraction of cooling currently being provided.
4. When HMXs are NOT active and heating is provided by the gas heat exchanger, the supply fan speed modulates to match the fraction of heating currently being provided.

HEATING
1. Heating is not provided on this air handler.

COOLING
1. When the room temperature rises above the room cooling setpoint, cooling modes are energized as follows:
2. Cooling Mode 1 (HMXs are de-energized and remain dry while there is freezing potential.
   - Unless forced to minimum position (see Outdoor Air section), the mixing dampers are positioned to maintain the discharge temperature of at least the Minimum Discharge Temperature. (Outdoor air is assumed to be cooler than room air.)
   - The supply fan modulates to maintain the cooling setpoint.
   - The condenser fan modulates in proportion to the DX cooling fraction.
   - When the outdoor temperature exceeds the Economizer Changeover Setpoint (75F; adjustable), the mixing dampers position to maintain the Minimum Outdoor Air % setpoint.
   - DX cooling is cycled after the supply fan reaches 100% speed and is still unable to maintain the Cooling Setpoint. The control program maintains a minimum "OFF " time of 5 minutes for each stage.
3. Cooling Mode 2 (HMXs are energized and remain wet.)
   - Unless forced to minimum position (see Outdoor Air section), the mixing dampers are positioned for 100% outdoor air
   - The supply fan modulates to maintain the thermostat setpoint.
   - The condenser fan modulates in proportion to the supply fan speed.
   - DX cooling is cycled after the supply fan reaches 100% speed and is still unable to maintain the Cooling Setpoint.
4. (All cooling modes) The Cooling setpoint is forced higher than the Occupied Heating setpoint by at least the amount of the "Heating / Cooling SP Delta". (e.g., if the Heating / Cooling SP Delta is 3F, and the Occupied Heating setpoint is 70F, you will NOT be able to set the Cooling setpoint below 73F. If you need a lower Cooling setpoint, reduce either the Occupied Heating or the Heating / Cooling SP Delta. Setting them too close together, however, can cause "fighting" between the heating and cooling systems. Minimum allowable Delta is 3F.)

HMX STARTUP
1. "Startup " assumes that the HMXs are dry. This condition will occur when a Coolerado Cooler is newly installed or after a winter shutdown. The Coolerado Cooler initiates Startup mode whenever the HMXs are <u>energized</u> via the BACView handheld interface. The "energize" command is on the Cooling control screen.
2. "Startup" proceeds in the following order (The Fan's operation does not matter to Startup):
   - Normal water solenoid valve operation is suspended.
   - The Soap Pump and Water Solenoid Valve turn ON for 2 ½ minutes.
   - The Soap Pump and Water Solenoid Valve turn OFF for the next 10 minutes. The Soap Pump stays OFF until the next Startup mode.
   - The Water Solenoid valve cycles ON for 30 seconds, then OFF for 2 minutes until an additional 60 minutes has elapsed.
   - Startup mode then releases control of the Water Solenoid valve to Normal operation after it is complete (which takes a total of 72.5 minutes).

HMX NORMAL WATER CONTROL
1. Using a) the measured outdoor air temperature and relative humidity and fan speed, and b) the user-entered site altitude and HMX design airflow, exhaust fraction and water solenoid characteristics, the Coolerado Cooler calculates the amount of water evaporation and energizes the water solenoid valve approximately every 5 minutes to replace evaporated water.

Coolerado, Inc.

Configuration & Setpoints

Configuration Setting	Setpoint Range	Factory Setting		
		AHU – 1 sn _____	AHU – 2 sn _____	AHU – 3 sn _____
Network Type and Baud Rate	Varies	BACNet ____ @ _____K		
Network address	N/A	2	2	2
Scheduling Source is	BACView, WEBCtrl, 3rd party	Always BACView @ factory (per Customer @ site)		
Altitude	0 – 10,000ft. ASL			
Design Supply CFM	Varies	1800		
Supply fan "K" factor	Varies	155		
GPH to each HMX core from Water Solenoid valve	7	7		
Exhaust / Product Ratio	50 - 150	122		
CFM per core	100 - 350	225		
Economizer Type	None, DryBulb, Enthalpy	Enthalpy		
Mech. Cooling Type	None , DX , ChWater	DX		
Number of DX stages	0 - 4	2		
DX Stage 1 %	0 – 100%	65%		
DX Stage 2 %	0 – 100%	100%		
DX Stage 3 %	0 – 100%	NA		
DX Stage 4 %	0 – 100%	NA		
Heating Type	None, Staged, Modulating	None		
MaxMBH / Turndown	Varies	NA		
Heating Stage 1 %	0 – 100%	50%		
Heating Stage 2 %	0 – 100%	100%		
Heating Stage 3 %	0 – 100%	NA		
Heating Stage 4 %	0 – 100%	NA		
Min. OA % (unoccupied)	0%	0%		
Min. OA % (occupied)	30%	30%		

Configuration & Setpoints (cont.)

Configuration Setting	Setpoint Range	Factory Setting		
		AHU – 1 sn _____	AHU – 2 sn _____	AHU – 3 sn _____
Program Feature or Setpoint				
HMXs enabled?	Yes / No	No		
Exhaust Fan Speed (HMX only)	5 – 10	5		
Exhaust Fan Speed (Clg Stage1)	5 - 10	6		
Exhaust Fan Speed (Clg Stage2)	5 - 10	8		
Dry Bulb Econo. Changeover SP	> 70ºF	75ºF		
Occupied Heating SP	40- 100ºF	68ºF		
Unoccupied Heating SP	40- 80ºF	55ºF		
Occupied Cooling SP	70- 95ºF	80ºF		
Unoccupied Cooling SP	70- 95ºF	90ºF		
Heating / Cooling SP Delta	3 - 25ºF	5ºF		
Heating Lockout OA SP	Any	60ºF		
Low Temperature Shutdown SP	20 – 50ºF	40ºF		