UNITED COOLAIR

Dedicated Outdoor Air DOAS

Sequence of Operations

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MEMBER
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AIR-CONDITIONING, HEATING, & REFRIGERATION INSTITUTE
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Dedicated Outdoor Air System (DOAS) Sequence

The Dedicated Outdoor Air System otherwise known as "DOAS" is a unit designed to deliver 100% conditioned outdoor air at room/space neutral conditions to satisfy fresh air for Indoor Air Quality (IAQ) requirements. Each unit is designed to dehumidify the outdoor air based on actual outdoor air dew point temperature to maintain the supply air dew point temperature. The supply air is reheated back to room/space neutral conditions using the Supply Air Temperature sensor and Reheat Set point. The DOAS unit is based on the space or zone being conditioned having their own primary source of cooling and/or heating and provides outdoor air at room neutral conditions only.

System Start/Stop

The system is on when all enable points are set to the ON position. These enable points are as follows:

System ON/OFF: The System ON/OFF selector is found in the System ON/OFF menu of the controller's Main Menu using the unit's display terminal.

Remote ON/OFF: If a Remote ON/OFF switch is field wired into the unit controller, the remote ON/OFF input requires a voltage free dry contact closure to start unit operation. Terminal blocks are provided with a jumper installed to close the input if the function is not used.

BMS ON/OFF: (optional) System must be enabled through BMS. Default position is on.

Outdoor Air Damper Output

Once all enable points are on, and the system is on and in the occupied mode, a relay output will energize and open the field supplied field installed outdoor air damper after an initial (adjustable) unit start delay. The outdoor air damper output allows the damper to drive open based on either of two methods.

1. Outdoor Air Damper Time Delay – Allows the Outdoor Air Damper to drive open for the adjustable damper time delay before starting the unit's Supply Air Blower.
2. Outdoor Air Damper End Switch (option) – Allows the Outdoor Air Damper to drive open but will not start the unit's Supply Air Blower(s) until the Outdoor Air Damper End Switch provides contact closure back to the unit's controller verifying that the Outdoor Damper is open.

Supply Air Blower

Once the optional Outdoor Air Damper is open, the output for the Supply Air Blower energizes. The supply air blower operates continuously to provide constant air flow while the unit is on and in the occupied mode. The controller monitors for loss of air flow by the air proving switch. When a loss of airflow occurs, the output for the supply air blower is de-energized and the controller provides a loss of airflow alarm.

Ventilation Mode

The system will operate in the Ventilation Mode only when the outdoor air dew point temperature is below the supply air dew point set point and the Supply Air Temperature is between Supply Air Temp Cooling/Heating Proportional Band Set Points.

Dehumidification by Supply Air Dew Point

The Outdoor Air Dew Point is calculated by the Outdoor Temperature and Humidity Sensor. If the Outdoor Air Dew Point is greater than the Supply Air Dew Point Set point, the controller energizes compressors for dehumidification mode. If the unit has a modulated compressor, the modulated compressor shall temper the outdoor air to maintain the supply air dew point set point. Compressors are modulated/staged by the Leaving Evaporator Temperature Sensor (DXT). Should the outdoor air dew point temperature continue to rise and/or the air temperature leaving the evaporator coil continue to rise, the unit controller shall energize additional modulated or staged compressors available to condition the leaving air temperature of the evaporator to the supply dew point set point. Dehumidification takes priority over cooling and heating modes.

Smart Cool Mode

The system shall perform smart cooling when the outdoor air temperature is below the supply air temperature minus ½ of the control set point's band setting and the supply temperature is above the supply temperature set point plus ½ the proportional band set point. Smart Cool Mode was developed in efforts to help lower energy costs to the customer.

Cooling Mode by Supply Air Temperature

Cooling is based on Cooling Demand which is calculated by the Supply Air Temperature (SAT) sensor, Supply Cool Set point, and Supply Cool Proportional Band. If the Supply Air Temperature is greater than or equal to the Supply Air Temperature Set point plus the Supply Air Temperature Proportional Band Set Point, the Cooling Demand shall be 100%. A modulated compressor starts when the demand for the compressor is greater than 30%. Each additional stage of fixed speed compressor is then energized when the demand for the modulated compressor is equal to 100% plus 25% demand (this is the minimum allowable for the digital or variable compressor) for start of the next stage. Once the next stage of compressor starts, the modulated compressor falls back to the 25% minimum demand and then slowly starts to ramp upward based on further increase of demand for the cooling. Should the total cooling demand start to fall, the staged compressor shall de-energize when the cooling demand for the staged compressor falls below 75%. At that point, the modulated compressor shall return to 100% full capacity and then modulate downward if the total cooling demand continues to fall.

Smart Heat Mode

The system shall perform smart heating when the outdoor air temperature is above the supply air temperature plus ½ of the control set point's band setting and the supply temperature is below the supply temperature set point plus ½ the proportional band set point. Smart Heat Mode was developed in efforts to help lower energy costs to the customer.

Heating Mode by Supply Air Temperature

Heating is based on Heating Demand which is calculated by the Supply Air Temperature (SAT) sensor, Supply Heat Set point, and Supply Heat Proportional Band. If the Supply Air Temperature is less than or equal to the Supply Air Temperature Set point minus the Supply Air Temperature Proportional Band Set Point, the Heating Demand shall be brought back to 100% full capacity. If the heat demand continues to fall, the output to the modulating heat device continues to fall.

The output to the heating device starts immediately as the heating demand rises above 0% heating demand. When the demand for the modulating heater is 100%, if there are additional staged heaters within the system the next stage of heating is brought on and the modulating device is dropped to 0% demand and starts to modulate upward again if the heating demand continues to rise. If the heating demand starts to fall and the demand for the staged heater reaches 0%, the staged heater de-energizes. At that point, the modulating heating device is brought back to 100% full capacity and then modulates downward as the total heating demand continues to fall.

Modulating Hot Gas Reheat

The Hot Gas Reheat coil is modulated to maintain the supply air temperature at the Reheat Set Point. During dehumidification/dew point control, the outdoor air is conditioned to maintain the Leaving Evaporator Temperature of the evaporator coil at the Supply Air Dew Point Set Point. If the supply air temperature is less than the Reheat Set point and the modulated compressor is operating for dehumidification/dew point control, the Hot Gas Reheat is modulated to maintain the Supply Air Temperature at the Reheat Set point.

Space Dew Point Control (Option)

Space Dew Point Control is a feature that is disabled by default. For Space Dew Point Control to operate properly, the factory provided Wall Mount Temperature and Humidity Sensor must be installed inside the space being conditioned. In addition, when the United CoolAir provided Dedicated Outdoor Air unit is directly coupled with other air handing units, this feature must be left disabled as this setup cannot condition the spaces being controlled.

Customers can enable Space Dew Point Control under the System Enables menu by setting Space Dew Point to Yes. A Space Dew Point Set Point and Dead Band shall then appear under the Set Points menu. Space Dew Point must be greater than the Space Dew Point Set Point plus the Space Dew Point Dead Band to activate Space Dew Point Control. Space Dew Point Control shall be active until the Space Dew Point is less than the Space Dew Point Set Point minus the Space Dew Point Dead Band. Example: Space Dew Point Set Point is 55.0˚F and the Dead Band is 1.0˚F. If the Space Dew Point rises above 56.0˚F then Space Dew Point Control becomes active.

During Space Dew Point Control, the leaving air temperature from the evaporator coil shall be limited to the Supply Dew Point Set Point. So if the Supply Dew Point Set Point is 54.0˚F the leaving air temperature from the evaporator shall maintain as close to 54.0˚F as possible during Space Dew Point Control mode. With this option, the Reheat is still based on the same Modulating Hot Gas Reheat.

Unoccupied Mode

During Unoccupied Mode, all outputs are de-energized, fresh air dampers are closed and the supply air blower is off.

Unoccupied Override

There are three methods of Unoccupied Override that may be utilized to override the Unoccupied Mode, to restart the unit to temporarily continue the conditioning process. These methods for Unoccupied Override are initiated 1) by User Interface, 2) by Digital Input, or 3) by BMS point interlock.

Unoccupied Override by User Interface

The User Interface has an Unoccupied Override trigger built in on the last page of the main System Status screens. Simply press the Up one time and the Unoccupied Override screen appears. Set the Duration (Override Time) and Override position (on), to start the override process. Once the Elapsed time equals the Duration, the unit will return to unoccupied mode.

Unoccupied Override by Digital Input

(Requires available digital input and a voltage free dry contact closure momentary push button)

A digital input can be set up to receive a momentary push button contact closure to initiate the start period of the Unoccupied Override function. The Unoccupied Time period will follow the existing Duration (Override Time) that is set into the wall display just as it would by initiating it at the wall controller.

Unoccupied Override by BMS

(Requires the BMS Communications option)

A BMS Point is available and requires the BMS Option to initiate the Unoccupied Override function. The Duration (Override Time) for Unoccupied Override mode is also adjustable through BMS. Simply set the unoccupied override time period in minutes. Then Enable/Disable the Unoccupied Override point to start the Unoccupied Override process. If terminating Unoccupied Override before time expiration is desired then a reset point is also available.

Sensors

OAT: Outdoor Air Temperature is used to calculate the Outdoor Air Dew Point temperature. The OAT is a combination OAT/OAH sensor that is factory-supplied, field-installed duct mount type that is to be installed in the outdoor air stream. The OAT is also used as a compressor lockout function when the outdoor temperature is too cold for cooling/dehumidification due to low coil loading. In addition, the OAT is used to determine if smart cooling or heating mode is available to satisfy the cooling or heating requirement.

OAH: Outdoor Air Humidity is used to calculate the Outdoor Air Dew Point temperature. The OAH is a combination OAT/OAH sensor that is factory-supplied, field-installed duct mount type that is to be installed in the outdoor air stream.

SPAT: Space Air Temperature is used to determine the space dew point temperature for the Space Dew Point Control option (disabled by default). The SPAT is a combination SPAT/SPAH sensor that is factory-supplied, field-installed wall mount type that is to be installed in the space or zone being conditioned.

SPAH: Space Air Humidity is used to determine the space dew point temperature for the Space Dew Point Control option (disabled by default). The SPAH is a combination SPAT/SPAH sensor that is factory-supplied, field-installed wall mount type that is to be installed in the space or zone being conditioned.

DXT: Is the sensor installed between the Evaporator Coil and the Hot Gas Reheat Coil. The DXT is an Air Leaving Evaporator Temperature sensor. The DXT is used to determine the required dehumidification and cooling demands using the modulated compressor(s) to maintain the Supply Dew Point Set Point.

SAT: Supply Air Temperature sensor is factory-supplied field-installed in the supply air ducting for calculating the Reheat Demand when the unit is dehumidifying. The Supply Air Temperature sensor is also used to calculate cooling and heating demands when there is no dehumidification requirement.

RPT: A refrigerant pressure transducer is factory installed in each compressor circuit on water cooled packaged units to maintain compressor head pressure during colder entering water conditions.

Global Alarm

As a standard, Interlock Terminal Blocks are provided for field connection to the Global Alarm dry contact closure output. Should the unit go into an alarm condition on any of the following items listed below, a relay will be energized to provide a dry contact closure to control a field provided alarm buzzer or indicator light to alert the customer of the alarm condition with the unit. The power required to drive

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the field provided device shall be 24VAC powering a device of less than 3 amps maximum through the factory provided relay.

- Loss of Airflow
- Drain Pan Overflow
- Dirty Air Filter
- Heater High Temperature Limit
- Damper Failed to Open
- Fan Motor Overload
- Fire/Smoke Detected
- Freeze Stat Alarm (with Freeze Stat option)
- Preheat Coil Freeze Protection (with Preheat Coil option)
- Compressor High and Low Pressure
- Sensor Failure
- Temperature High or Low Alarms

Compressor High Pressure Switch

Each Compressor is protected with a high pressure cutout switch. The switch may vary in pressure range based on the type of refrigerant within the refrigerant circuit. For ON/OFF Type Compressors, the high pressure switch is wired in series with the digital output that controls the ON/OFF function of the corresponding compressor.

The High pressure switch will open if the refrigerant pressure is greater than the refrigerant pressure set point. The open Compressor 1 High Pressure Switch will de-energize the relay that energizes and de-energizes the Compressor 1 Contactor. One of the relay contacts energizes and de-energizes the compressor contactor and the other relay contact sends the alarm signal back to the controller to let the controller know that Compressor 1 High Pressure switch tripped. The high pressure switch will take the compressor offline as it is wired to the relay that controls the contactor for the compressor but it will also allow the relay to provide the alarm signal.

Once the High Pressure Trip occurs, the compressor must be re-enabled under the System Enables menu in the controller.

NOTE: R410A Refrigerant Systems require a manual reset of the switch due to higher operating pressures within the system.

Compressor Low Pressure Switch

Each Compressor is protected by a Low Pressure cutout switch. The switch may vary in pressure range based on the type of refrigerant within the refrigerant circuit. Unlike the high pressure switch, the low pressure switch is connected directly to a digital input on the controller. Should the Low Pressure Switch open during a compressor run cycle, the corresponding compressor will trip on low pressure safety. If this occurs, the controller will de-energize the corresponding digital output to the compressor contactor.

Once the Low Pressure Trip occurs, the compressor must be manually re-enabled under the System Enables menu in the controller. The low-pressure switches automatically reset once the pressure at switch rises above the switch's reset point.

Heater High Temperature Cutout

Factory provided heating banks are supplied with a heater high temperature cutout switch that trips as the surrounding air temperature at the switch causes the temperature on the switch to rise above the cutout point. The switch is bimetallic auto reset type. Should the switch trip, an alarm will be displayed on the controller alerting the customer to Heater High Temperature Cutout. If a heater high temperature cutout occurs, the heaters automatically restart once the surrounding air temperature cools the surface of the switch enough to allow the switch to reset.

Sensor Failure

There are two methods for sensor failure. One method is when the reading is above or below minimum and maximum range of the sensor. With this method, the sensor should be displaying a value on the display of the controller. The other method is a mis-wired or a sensor that simply was not installed during installation. This method will display a ###.# output for the failed sensor on the wall controller along with the label of the sensor.

High and Low Limit Alarms

Each controller has adjustability for High and Low set point alarms for the following sensors. The High and Low Limit Set Points are available under the Alarm Set Points menu. The sensors must be enabled for the High and Low Alarm Set Point display screens to appear. The following sensors have high and low alarm set point capability:

- Space Temperature
- Space Humidity
- Supply Temperature
- Refrigerant Pressure

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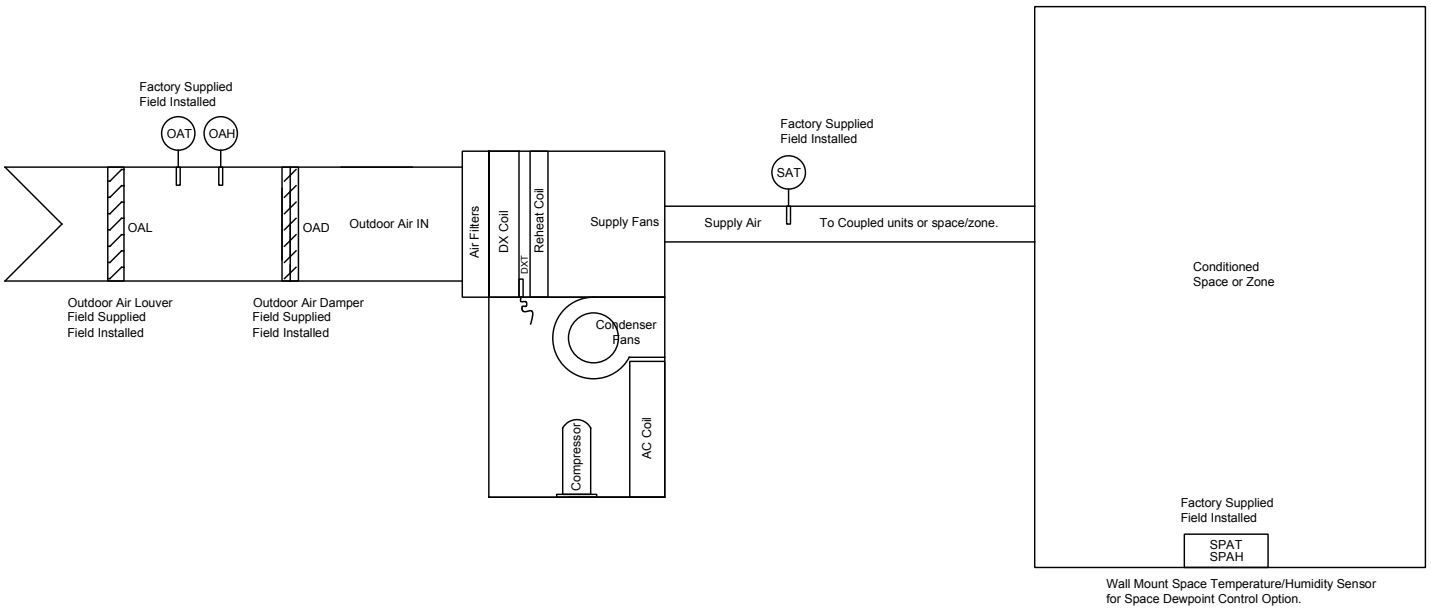
Drain Pan Overflow Switch

The drain pan overflow switch is a water level detection switch that opens when the water level is too high in the unit's condensate drain pan. If there is a blockage in the condensate line, the rising water level in the condensate drain pan will open the drain pan switch creating an alarm at the controller. The drain pan overflow switch shuts down cooling preventing the condensate from overflowing the drain pan. The alarm will notify the customer of the drain pan overflow condition. Once the blockage is removed from the condensate drain line, the system must be manually reset at the controller's user interface.

Dirty Filter Switch

When the air filter(s) become clogged with dirt and debris, the contacts on the filter switch will open causing a Dirty Filter Alarm at the controller. The alarm will be in the form of a notification recommending that the air filter(s) be changed for preventive maintenance. No modes of operation are locked out during the Dirty Filter Alarm and the unit will continue operation in the presently operating mode. The alarm notification can be reset through the controller's user interface once the filter(s) are replaced.



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