White Paper

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June 16, 2008

Humidity Control with Modern HVAC Equipment

condair

HUMIDITY CONTROL WITH MODERN HVAC EQUIPMENT

During my Roadshow visits I had many questions from engineers regarding how to solve the following problems they have been experiencing.

A. **"Why do I have puffs of fog discharging from the supply grills in Operating Rooms and Labs?"**

B. **"Why do I see fluctuations in the space Relative Humidity as the outdoor temperature moderates or when we have rain or wet weather"?**

C. **"What is the best way to control humidifiers when using 100% Outdoor Air Units, Economizer or VAV Air Handling Systems"?**

These questions were asked repeatedly by engineers, hospital facilities staff, and contractors.

I have attached a psychrometric chart and a diagram of an air handling system to help you explain how to help solve these situations for your engineers and clients. In a 10,000 CFM system with 100% O/A the humidification load can vary greatly in order to maintain 72°F and 50% indoors. If the outdoor conditions are 0°F and 50% RH the load will be about 354 lbs/hr, with 45°F and 99% RH the load will be about 76 Lbs/hr. This variation provides some very interesting control situations.

There are two basic psychrometric conditions that must be better address when designing humidification systems for ducted applications as listed above. How do we control the Space RH set point and how do we control the Duct High Limit RH set point. When viewing the chart it indicates how the system reacts to the design conditions. Example; Outside air is introduced into the system at 0°F and 50% RH (A) and is heated to 55°F and basically 0% RH. Moisture is added at (C) raising the duct conditions to 55° and 88% RH. This air exits the system into the space to maintain the desired space conditions at 72°F and 50%RH. The duct air at (C) has the same weight of water per cubic foot as the air in the space at (D).

Generally the engineer specifies the humidity controller for the space to be supplied by the BMS or by the humidifier manufacturer. This is to be set for the desired percent of RH in the space.

> ie; 72°F and 50% RH. This is the condition their customer usually is monitoring and the humidistat could be either ON/OFF or in many instances a Modulating Space Humidistat will be specified.

The general opinion is the main thing I have to control is the conditions in the space.

However, where in the system is close control most critical? In the large volume of the space where the air temperature is higher and will hold a much larger volume of moisture or in the confines of the duct or AHU where the temperature is lowest and the RH is near saturation?

Most engineers will specify a Modulating Space Humidistat supplied by the BMS or by the humidifier manufacturer. Most agents and competitors then specify," manufacturer to supply high limit duct humidistat". When this occurs most agents bidding on the project will quote a simple On/Off Duct High Limit Humidistat at a price of about $150.00. This is what creates most of the above problems the clients are experiencing.

Examining the HVAC System Diagram and how the Outdoor Air affects the system it can be seen that there are two sources of moisture affecting the conditions in the duct and eventually the space.

The moisture entering the system from outside and the moisture entering the duct from the humidifier, both need to be controlled. When using an On/Off Duct High Limit Humidistat optimum control is difficult. The system is at the mercy of the moisture entering from outside. If it is dry outside the humidifier will operate and the On/Off High Limit will usually allow the humidifier to operate for long periods of time and maintain fairly good indoor conditions.

However, as the outdoor temperature moderates or it is warm enough to rain, a large volume of water vapor will be entering the system from outside. The On/Off High Limit will sense the rise in duct RH and turn the humidifier OFF. As the air moves through the duct the humidistat clears and senses the lower RH and the humidifier will turn ON again. The Relative humidity in the duct is at the mercy of the differential of the High Limit which is usually ± 3 to 5% RH. This RH differential can create high and low RH changes in the duct, with the air approaching saturation before the humidifier shuts off and low RH before the humidifier is reactivated. This can also cause repeated short cycling of the humidifiers and affect their long-term operation.

One other aspect of the situations the engineers are experiencing is low duct temperatures, especially in hospital OR, MRI and lab applications. Reviewing the psychrometric chart the "C" to "D" horizontal line indicates how the Relative Humidity drops as the temperature rises. However, the absolute humidity, the actual amount of water in the air, remains the same. The amount of water at 72°F and 50% is the same as 55°F and 88% RH about 0.008 lbs of water per pound of air. Even at 120°F and 15% RH the amount of water is the same. This decrease in RH is because the air above 55°F has the ability to hold more water, therefore the RH drops,

However, extend the “C” to “D” horizontally to the left towards “B”, as the temperature drops below “C” the RH increases and the duct conditions approach saturation (100% RH), because the lower the air temperature the less water it is capable of holding. Many times we see schedules and designs listing the air temperature before the humidifier is to be 45° to 50°F. We simply cannot add water to air at these low temperatures and properly control the duct conditions when they are near saturation. The solution is to lower the space RH requirements or increase the duct temperature and increase the ability of the air to hold more water. We simply cannot add water to a bucket that is full.

AHU’s WITH 100% OUTDOOR AIR

The Dual Modulating System is also excellent for 100% Outdoor Air system because the load variation from cold dry conditions to raining and high humidity outdoors is very dramatic. These systems are usually for laboratories or production areas where closer RH control is desired. Using these controls allows much better control of the indoor space conditions and reduces the possibility of saturating the duct system.

AHU’S WITH VAV CONTROLS

Consider the psychrometrics of a VAV air handling system throughout the years. The humidification rate is usually defined by the CFM of fresh air being introduces into the system for proper ventilation for the occupants or process. Many times when the system is in the cooling mode the outdoor conditions have moderated and the humidification load is reduced. In the cooling mode the total airflow through the AH system is usually at or near maximum CFM, and there is ample airflow in the system to absorb the moisture from the humidifier. However, in the wintertime, or heating mode the airflow in the system may be reduced to 50% or less. At the same time the fresh air remains at the minimum CFM for proper ventilation. In this situation the CFM through the system could be at its lowest and the humidification at its highest. The minimum airflow through the AHU has less capacity to absorb the moisture from the outdoors and the humidifier and the RH in the system will rise. The dual modulating control system described above will help maintain proper control of the conditions in the ducts or AHU.

In the past we called this the VAV Control System and many of you used it successfully to properly control project. In order to accomplish this now all that is required is to select the controllers as listed below to match your projects requirements.

BE A HERO TO YOUR ENGINEERS AND CLIENTS

Tell them to add one word in their specification.

Change their specification from High Limit Duct Humidistat to MODULATING HIGH LIMIT DUCT HUMIDISTAT.

We can't control the water entering the system from outside; however, this system will control the output of the humidifier. It will raise and lower the output of the humidifier as required to maintain the desired conditions in the duct. This will supply a more even amount of water to the space and provide more even duct and space control. It will also reduce the possibility of saturation in the duct system and short cycling of the humidifiers. If desired the engineer can still specify the modulating space humidistat to achieve optimum control.

Most BMS systems can supply this type of control system. They will send a modulating signal to the humidifier from the H/L and Space controllers. They may also interpret the signal from both controls and send a single modulating signal to the humidifier.

NORTEC can also supply many options to achieve this Dual Modulation Control System as listed below. The difference in pricing between the low cost ON/OFF Duct High Limit and Modulating Humidistats by Nortec is approximately $300.00. If the BMS is supplying the signals the cost from NORTEC is lower than the ON/Off Duct High Limit. Refer to the latest version of our **HELP** software for current prices and possible new options.

NORTEC's controls are listed in the Options section of HELP as follows:

A. MODULATING CONTROLS BY OTHERS (coordinate signal required with BMS)

- **Dual Modulating Demand Signal by Others**
  Allows the BMS to monitor and adjust the set point and control the humidifier from a modulating space and modulating high limit control system

- **Modulating Dual and Single Transducer Signal by others**
  The set point (s) is adjusted through the display and keypad on the humidifier. The BMS can only monitor the conditions at the sensor(s).

- **Single Channel Demand Signal Acceptance**
  Allows the BMS to monitor and adjust the set point and control the humidifier from a single or dual modulating control system and supply only one signal to the humidifier.

B. **Modulating Controls by NORTEC**
(Nortec adjusts the set point and controls the humidifier.)

Set point is adjusted at the location of the controller (s). This allows anyone with access to the controller to change the set point

- 0 to 10V Digital Duct Humidistat Package
- 0 to 10V Digital Wall Humidistat Package

C. **Modulating Transducer c/w Digital Display**
(Nortec adjusts the set point and controls the humidifier.)

Set point is adjusted through the humidifier keypad and display. This requires access to the humidifier to change the set point. The sensors are inactive.

- 2 to 10V Digital Wall Humidity Sensor
- 2 to 10V Digital Duct Humidity Sensor.

The above control systems cannot be combined. Either the BMS supplies their signal as shown as in (A) above or NORTEC controls the signal to the humidifier as in (B) and (C) above.

When Nortec is supplying the controllers select either (B) or (C) above. Do not combine. 0 to 10 V and 2 to 10V options.

The following chart shows the controls system that will be accepted by the different NORTEC humidifiers

Why Condair?

Condair specializes in the design and production of superior humidification systems. We create the most appropriate solutions to meet your specific needs in the most efficient and cost effective way. To this end, we draw upon our extensive experience to develop an ever growing range of products manufactured to our stringent ISO 9001:2000 certified quality standards that will provide our customers with maximum reliability, minimum maintenance and a choice of energy sources.

When you choose Condair, you are choosing the company that has built a reputation for superior quality humidification systems. Only with Condair can you select a system operating with electrode steam, subsonic air nozzles, high pressure nozzles, steam injection, steam exchange, or gas-fired technology.

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