The World of Cooling

How can high quality humidity and temperature transmitters help improve your data center PUE?

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Power usage in data centers represents a steadily larger share of the global electricity consumption. A recent figure for the US puts data center electricity use at 1.8% of the national total. A large fraction of the energy use above what the actual computer equipment is using comes from cooling. Another environmental consideration is clean water used for evaporative cooling. Many schemes to reduce the data center power usage efficiency (PUE) towards one, including use of artificial intelligence.

One of the most important requirements in order to reduce your cooling costs is to measure the conditions properly in the first place. The first things to consider are:

What do you measure? Do you for instance need to control air-side economizers or evaporative coolers? This might influence what humidity parameters you need from the instrument.
Where will you measure it? The installation location should be representative. If you want to measure the outdoor humidity and temperature, the sensor should be placed in a location with free airflow, away from any surfaces that might radiate heat and disturb the measurement.
How accurately do you need to measure? Consider the requirements of your control system.
When selecting instruments to fulfill these needs you should consider also long term drift and you service schedule
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Choose an instrument designed for the desired installation location. For outdoor measurements you will need purpose designed transmitters that can survive outdoors.

How will you verify and maintain these measurements? All instruments need periodic checking. Do you plan to do this with in-house trained personnel, use a third party services or have a few extra instruments and rotate them to factory calibration. How easy is it to do these periodic checks with your chosen kit?

There are a few types of Humidity and Temperature transmitters that are typically used in data centers.

Outdoor Humidity Sensors

The outdoor humidity and temperature sensors are used with airside economizers and with cooling towers. The most advanced economizer control paradigm is to use the differential enthalpy

(heat content). You measure the enthalpy of the outdoor air and the return air to control when to recondition hot return air and when to use outdoor air.

Outdoor humidity sensors with wet-bulb temperature output indicate directly when evaporative coolers can be used. The wet-bulb temperature indicates the temperature that can be reached with evaporative cooling. If the outdoor humidity is too high the rate of evaporation is low and the cooling effect too low.

One of the most important parts of an outdoor humidity and temperature sensor is the solar radiation shield. The purpose of the solar radiation shield is to reduce the influence of heat from the sun disturbing the measurement. Seemingly small design changes can easily cause 1-2°C extra heating in unfavorable conditions.

Outdoor sensors are also subjected to everything Mother Nature might throw at them, including icing rain, and heavy winds. A data center runs 24/7 around the year; you do not want to see failures!

A proper outdoor humidity sensor needs to have a good solar radiation shield. Observe the black lower surfaces of the plates, which are essential for a good radiation shield.

Duct Humidity Sensors

The duct humidity and temperature sensors are used to duct and air-handling units to measure control the condition of incoming air and measure the return air from the data center. These are used as to complement to the outdoor humidity sensor so that the enthalpy difference between return air and outdoor air can be calculated. Some of the duct sensors may be subjected to harsh conditions in humidifiers or in inlet air ducts.

Consider also how you will make periodic checks when you install the devices. It is often easy to add a port for a reference probe during installation. In this way, you can easily introduce a reference probe to the duct and compare the reading to the duct sensor.

Wall or Space Humidity Sensors

Wall or space sensors measure the actual conditions inside the data center. Humidity conditions are usually benign. However, the rate of change can be fast in response to load level fluctuations and when switching between reconditioned air and free cooling. As the airflow rate around these sensors are typically slower than for duct sensors the response time to temperature changes are slower. There might also be outgassing from cables and other equipment running at ever-higher design temperatures that may cause drift in some humidity sensors. With fast temperature fluctuations it might be a better choice to use dew point temperature as humidity control parameter as it doesn´t depend on the temperature on the sensor.

You also need to consider what conditions you are measuring and using for control purposes as the temperature and humidity will be dramatically different in before and after the heat load. (Cold or warm aisles). You can get high quality instruments that measure the condition with high accuracy, devices with 0.1°C and 1%RH accuracy are readily available, but moving the sensor slightly can cause much larger changes

Even small measurement errors can cause significant increases in your energy bill. It pays to get quality instruments and maintain the measurements in good condition. Careful consideration of the installation location also pays off.