

Humidity and Temperature Monitoring in Data Centers

Over the years there has been a rapid increase in large stand-alone data centers housing computer systems, hosting cloud computing servers and supporting telecommunications equipment. These data centers are crucial entities for every company's IT operations around the world.

It is paramount for manufacturers of information technology equipment (ITE) to increase computing capability and improve computing efficiency. Data centers have become significant power consumers. All the stakeholders including ITE manufacturers, physical infrastructure manufacturers, data center designers and operators have been focusing on reducing power consumption from the non-computing part of the overall



power load. One major cost of operating a data center is the cooling infrastructure that supports the ITE.

Too much or too little humidity not only causes discomfort to human beings, but can also cause problems with ITE. With too much

humidity, condensation can occur and with too little humidity, static electricity can occur. Both can have a significant impact and can cause damage to computers and equipment in data centers.

It is therefore essential to maintain and control ideal environmental conditions, with precise humidity and temperature measurement thus increasing energy efficiency while reducing energy costs in Data Centers. ASHRAE *Thermal Guidelines for Data Processing Environments* has helped create a framework for the industry to follow and better understand the implications of ITE cooling requirements on the data center and vice versa. There is a growing concern about energy efficiency in data centers, particularly the cooling component.

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Definitions

- **Relative humidity** (%RH) is the amount of water vapor in the air, expressed as a percentage of the maximum amount that the air can support at the given temperature.
- **Absolute humidity:** also known as water vapor density is the amount of water vapor (kg) contained per unit volume (m³) of the gas mixture. In a gas mixture the water vapor generates a certain partial pressure that is part of the total barometric gas pressure. The vapor pressure can only rise to its saturation limit, which is determined by the temperature. Thereafter water is given off in liquid form (dew). The maximum pressure is called saturation pressure and is temperature dependent. The temperature dependence is, however, not included in the term of absolute humidity.
- **Dew point temperature** is the temperature at which water vapor in any gas, at constant pressure begins to condense in to liquid water at the same rate as it evaporates. If the air or gas temperature is equal to or below the dew point temperature, condensation will occur. When the gas temperature is equal to the dew point temperature, the gas is at saturation and the relative humidity is 100%.

Why the need to measure temperature and humidity?

Maintaining temperature and humidity levels in the data center can reduce unplanned downtime caused by adverse environmental conditions and can save companies thousands or even millions of dollars per year. A recent whitepaper from The Green Grid ("Updated Air-Side Free Cooling Maps: The Impact of ASHRAE 2011 Allowable

Ranges") discusses the new ASHRAE recommended and allowable ranges in the context of free cooling.

The humidity varies to some extent with temperature, however, in a data center, the absolute humidity should never fall below 0.006 g/kg, nor should it ever exceed 0.011 g/kg.

Maintaining temperature range between 20° to 24°C is optimal for system reliability. This temperature

range provides a safe buffer for equipment to operate in the event of air conditioning or HVAC equipment failure while making it easier to maintain a safe relative humidity level. In general, ITE should not be operated in a data center where the ambient room temperature has exceeded 30°C. Maintaining ambient relative humidity levels between 45% and 55% is recommended.