VAISALA / APPLICATION NOTE

Choice of outdoor humidity sensors critical to economical free cooling system

Changing weather conditions can make measuring outdoor humidity a challenge, so selecting the right sensor is essential to the performance of a building's HVAC system.

HVAC systems often rely on outdoor relative humidity measurements, or calculated parameters based upon humidity, to optimize the energy efficiency of the cooling equipment. If the outdoor humidity sensor is inaccurate, building controls, energy efficiency, and human comfort are sub-optimized. Sensor selection is often overlooked, yet it is a critical decision that building owners must endure periodically throughout the life of a building.

When the outdoor air temperature is sufficiently cool and dry, a temperature-controlled air-side economizer can use outdoor air with no additional conditioning to cool the building. This is known as free cooling. An economizer consists of the following components: outside and return air dampers, damper actuators, outside air enthalpy (temperature & humidity) sensor or dry-bulb (temperature only) sensor, discharge air temperature sensor, and economizer controller. Some economizers control enthalpy by utilizing outdoor air when its enthalpy level is lower than that of the air indoors. However, outdoor air with a low temperature or low enthalpy level can still carry a high moisture load. A better solution is to use only outdoor air with a lower dewpoint temperature than the desired indoor dewpoint level to prevent moisture build up in the building.

With water-side economizers, free cooling is achieved when the working liquid (chilled water) bypasses the chiller and is cooled directly by the cooling towers. Cooling towers use the evaporation of water to remove process heat and cool the working fluid to near the wet-bulb air temperature. The working fluid and

What Is Wet-Bulb Temperature?

- The temperature of an air sample that has passed over a large surface of liquid water in an insulated channel is the thermodynamic wet-bulb temperature – it has become saturated by passing through a constant pressure, ideal, adiabatic saturation chamber.
- Thermodynamic wet-bulb temperature is the minimum temperature that may be achieved by purely evaporative cooling
- Wet-bulb temperature is the temperature of a volume of air when cooled adiabatically (when no heat is transferred to or from the working fluid) to saturation at constant pressure by evaporation of water into it, all latent heat being supplied by the volume of air.
- The wet-bulb temperature is a function of the dry-bulb temperature and relative humidity or dewpoint.
- Download a free program to calculate wet-bulb temperatures and other parameters: www.vaisala.com/humiditycalculator.

the evaporated fluid are usually both water. An outdoor wet-bulb temperature reading is necessary to determine a cooling tower's efficiency and to initiate the free cooling cycle. This practice is suitable for cooler, drier climates where the wet-bulb temperature of the air is significantly lower than the dry bulb temperature.

Reliable Humidity Measurements

Whether using an air- or water-side economizer, facility managers must rely on their outdoor sensors to provide accurate information. Sensor drift and instability can be detrimental, especially to high energy consumption facilities such as data centers. A high quality outdoor humidity transmitter with tight tolerance is required for calculating other parameters such as dewpoint, enthalpy, and wet bulb. A reliable outdoor sensor will recover from saturated conditions, and some sensors even have built-in heating cycles to prevent saturation.

Withstanding the Elements

Vaisala introduced the Vaisala HUMICAP® thin-film capacitive humidity sensor in 1973. Since then, Vaisala has become the market leader in relative humidity measurements and the thin-film capacitive humidity sensor has developed from one company's innovation into a global industry standard.

Today, capacitive thin-film polymer humidity sensors are widely used in industrial and commercial applications. The sensor consists of a substrate on which a thin film of polymer is deposited between two conductive electrodes. The thin-film polymer absorbs and releases water vapor as the relative humidity of the surrounding air increases and decreases. The dielectric properties of the polymer film depend on the amount of absorbed water. A change in the relative humidity of the surrounding environment changes the capacitance of the sensor. The electronics of the instrument measure the capacitance and convert it into a humidity reading.

Vaisala's outdoor humidity transmitters incorporate this sensing technology, resulting in accuracy and stability even under extremely harsh outdoor conditions. The Vaisala HUMICAP® sensors fully recover from saturation. Optional heating to prevent condensation is also available for high humidity conditions. Outdoor transmitters come with flexible installation options and are available with solar radiation and precipitation shields, which provide excellent ventilation while blocking both direct and reflected solar radiation. For more information visit: www.vaisala.com/hvac

Recommended Instrument Specifications

- Full scale 0 to 100% RH measurement range.
- Minimum recommended accuracy is ±3% RH (preferred is ±2% or better); acceptable variation in temperature is ±1°C (±2°F).
- Ensure instrument will work in the most extreme conditions the building experiences e.g. wide operating temperature range -40 to 60°C (-40 to 140°F).
- Sensor is fully recoverable from saturation.
- Electronics are encased in a weatherproof enclosure.

Transmitter Placement

- Avoid areas near exhaust fans or shaded areas that may affect measurements.
- Locate sensors away from heat and moisture sources.
- Avoid locations where air circulation is obstructed by structures or equipment.
- Utilize a mounting kit for installation in inlet ducts, or a pole-mast installation kit for cooling towers or building roof tops.
- Use a radiation shield to protect the sensor from precipitation and solar radiation.

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Please contact us at
www.vaisala.com/requestinfo

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