What to do when indoor environments demand precise humidity controls

Application Note

Air Quality **Case Study**

Many commercial facilities have humidity sensing and control needs that are more critical than those of standard human comfort. What may seem to be a small amount of variation in humidity in a home or commercial office building may ruin a product, interrupt a process, or cause important systems to malfunction.

In these sensitive environments, only the most accurate and dependable sensing elements are used, and they must be checked and calibrated for accuracy once or twice a year.

Tools: Fluke 975 AirMeter™ test tool

Expert: Ron Auvil for Fluke Corporation

Tests: Verify humidity and temperature sensors by logging measurements over time

Ron Auvil is a lead instructor for a major controls manufacturer, where he is certified to teach 20 different courses, an author for American Technical Publishers, and a consultant.

Job scenario:

A local culinary college has been complaining of three separate humidity sensing problems.

Problem #1:

The culinary college has a 'Chocolate Lab' where students create the finest cakes, tortes, and other delicacies. Chocolate is very sensitive to both temperature and humidity. Ideal storage temperatures are between 15 °C to 17 °C (59 °F to 63 °F), with a relative humidity of less than 50 %.

If refrigerated or frozen without containment, chocolate can absorb enough moisture to cause a whitish discoloration, the result of fat or sugar crystals rising to the surface. Moving chocolate from one temperature extreme to another can result in an oily texture. An example would be from a refrigerator to a hot workspace. This texture can be visually unappealing and indeed ruin the final product.

The college's humidity and temperature control is provided by several package units in the ceiling. The college maintenance personnel suspect that the humidity sensors are not reading correctly. This, in turn, is affecting the humidity control in the lab. Both instructors and students are complaining that their chocolate products are inconsistent and unappealing.

A contractor with humidity control experience is called in to help solve the problem. The contractor uses the Fluke 975 AirMeter™ test tool to check, calibrate, and if needed replace the humidity sensors. He also checks the temperature sensors that control the package units.


Ron Auvil verifying a sensor with the Fluke 975 AirMeter.

The contractor starts with the four humidity sensors, one for each package unit. He uses the AirMeter to take measurements over approximately one hour at each sensor. The package units have a readout that allows him to see what the sensors currently read.

The technician uses the data logging capability of the air meter to capture the data readings and transfer them to his laptop. Then he uses FlukeView Forms software to convert the data into charts and other easy-to-read formats for a customer report.

As he checks each sensor and compares their readings to the logged data, he finds that their calibration is off by anywhere from 5 % to 9 % RH. The college had received an NIST Certificate of traceability for the sensors, so at this point, the humidity sensors are replaced.

After the new sensors are installed, the contractor checks them Fluke 975 AirMeter and FlukeView Forms. Humidity and temperature are both at proper levels and the complaints cease.

Problem #2:

The culinary college has an additional humidity sensing and control problem. Their air handling unit economizer control systems do not seem to be operating properly.

The economizer cycle uses outside air under the proper conditions for 'free' cooling. The control is performed by a building automation system. The decision on whether the outside air temperature is suitable is based on the enthalpy of the outside air. The enthalpy is the total heat content of the air measured in btu/lb. The enthalpy value is calculated by measuring both the temperature and the relative humidity of the outside air.

The building automation system performs the psychometric calculations and then broadcasts the decision across the communications network to all of the air handlers in the college. The problem according to the college maintenance staff is that the economizer function seems to operate erratically. 'Too hot' complaints have occurred all over campus several times.

Upon inspection, the outside air dampers are wide open, admitting air that is too hot and humid into the air handler. The college is in a southern climate. Until the problem can be fixed, the maintenance staff has disabled the economizer function in software, temporarily alleviating the issue.

After the chocolate lab problem is fixed, the contractor uses the Fluke 975 AirMeter to check the building's humidity sensor. The sensor was installed four years ago when the building automation system was installed. It has not been checked since and is out of manufacturer's warranty.

While the Fluke 975 AirMeter is logging data at the sensor location, the technician is talking to the maintenance person who is located at the building automation system computer. While the sensor is reading 32 % RH at the building automation system computer, the Fluke 975 Air Meter was reading 41 % relative humidity.

The 9 % difference between the values was enough to cause the enthalpy value calculations to be incorrect. This, in turn, caused the air handling unit's outside air dampers to be open at a total heat content value that was much higher that desired. This value then overloaded the cooling coil and cause hot humid air to be introduced into the space.

To ensure that the sensor is actually off, the contractor checks the humidity values at three different times during the day. This three-point check verifies that the sensor is bad. A new, higher quality sensor is purchased, installed, and checked. The economizer calculations are checked as well, with the economizer functions now operating properly.

Problem #3:

In addition to the two problems mentioned previously, the college maintenance staff also noticed an increase in energy consumption over the past few months. This has been especially noticeable on a year-to-year basis.

The maintenance staff has noticed an increase in chilled water consumption and longer chiller run times each year. When informed of this, the service technician immediately links the increase in energy consumption to the bad outside air humidity sensor.

After the humidity sensor is replaced, the chiller energy consumption and flow are rechecked. They are now lower than before due to the reduced amount of hot, humid outside air coming into the air handling units.

Chocolate room humidity measurements

Measurements taken within one day. Please see floor plan for sensor placement.

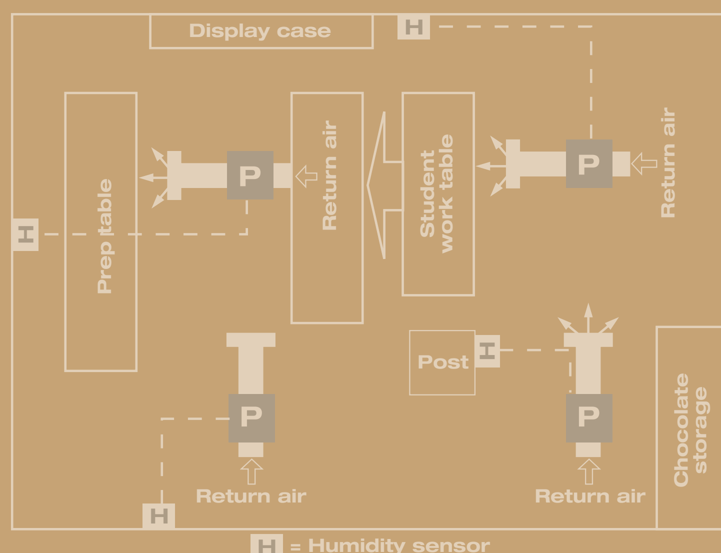
Sensor #4
9:29 AM Start
9:36 AM Finish (7 minutes instrument settle time)
Fluke: 54 % RH, 20 °C (68 °F), 938 ppm CO_2
Readout: 73.4 °F, 62.3 % RH

Sensor #3 (Unmarked)
9:36 AM Start
9:40 AM Finish (4 minutes settle time)
Fluke: 50 % RH, 20.3 °C (68.54 °F), 863 ppm CO_2
Readout: 73.7 °F, 61.4 % RH

Sensor #2
9:42 AM Start
9:46 AM Finish
Fluke: 20.5 °C, 49.8 % RH, 890 ppm CO_2
Readout: unclear

Sensor #1 (Inaccessible)
Placed Fluke on cooking prep table in front of instructor during class.
9:46 AM Start
9:50 AM Finish
Fluke: 20.8 °C (68.9 °F), 49.4 % RH, 904 ppm CO_2
Readout: 60.9 % RH, 74.1 °F

Placed Hobo's at 10:00 AM
#2 on #2, #1 close to #1
Tests taken while class running with a load of approx 21 people and cooking equipment running.
Outside air conditions at time of test:
10:18 AM, 17.8 °C (64.04 °F), 54.7 % RH, 632 ppm CO_2



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