



monitoring services

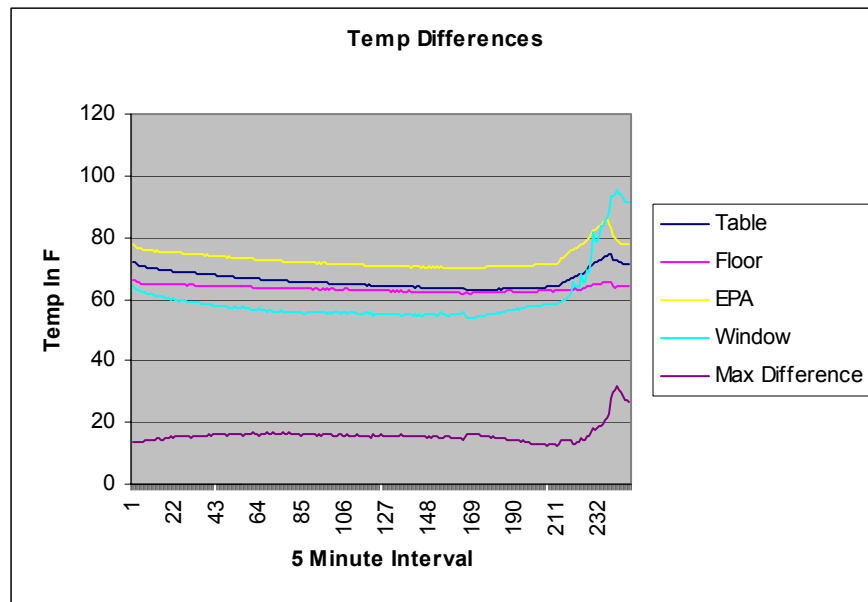
**ROOM TEMPERATURE
AND
RELATIVE HUMIDITY**

WHAT IS ROOM TEMPERATURE?

TEMPERATURE IS EASY, IT'S THE MEASURE OF HOW HOT OR COLD SOMETHING IS. THE DEFINITION OF ROOM TEMPERATURE, ON THE OTHER HAND, IS A TOUGH QUESTION TO ANSWER. IT'S NOT WHAT TEMPERATURE IS THAT MAKES IT HARD; WE CAN FEEL IF IT'S HOT OR COLD, BUT HOW TO MEASURE IT. THERE ARE SEVERAL METHODS OF MEASURING THAT CAN BE USED TO ACCURATELY REPRESENT A NUMERICAL VALUE ASSOCIATED WITH HOT OR COLD.

AS PREVIOUSLY STATED, THE RX MONITORING TEMPERATURE SENSOR ONLY READS AT ANY ONE GIVEN POINT. THIS ONE POINT IS NOT A REPRESENTATION OF ROOM TEMPERATURE. ROOM TEMPERATURE IS BEST DESCRIBED AS THE AVERAGE TEMPERATURE OF A ROOM. HOW DO YOU COME ABOUT THAT "AVERAGE" TEMPERATURE?

IT'S NOT A GOOD PRACTICE TO TAKE AN AVERAGE OF A WHOLE AREA FROM ANY ONE GIVEN POINT. BY LOOKING AT THE PROVIDED GRAPH, YOU CAN SEE THAT THERE IS A SIGNIFICANT DIFFERENCE IN TEMPERATURE ACROSS A SINGLE ROOM. THE BOTTOM LINE SHOWS THE MAXIMUM DIFFERENTIAL IN TEMPERATURE AT ANY TWO GIVEN POINTS IN A ROOM.



KEEP IN MIND THAT THESE DATA POINTS WERE TAKEN USING THE SAME SENSOR THAT WE USE IN OUR TEMPERATURE PROBES, WITH TWO AT EACH POINT, AND THEN AVERAGED OVER A FIVE-MINUTE PERIOD FOR ONE DAY. DUE TO THIS METHOD, THESE MEASUREMENTS ARE EXTREMELY ACCURATE.

AS YOU CAN SEE, THERE CAN BE A 13° DIFFERENCE IN TEMPERATURE FOR A ROOM AT ANY GIVEN TIME. SEVERAL THINGS SUCH AS SUN, HEAT DISSIPATION FROM THE EPA, HVAC SYSTEMS, AND NORMAL THERMAL CONVECTION CAN CAUSE THESE DIFFERENCES. THEREFORE, UNLESS THE TWO MEASURING DEVICES ARE AT THE SAME POINT, IT WOULD NEVER BE AN ACCURATE MEASUREMENT COMPARISON OF TEMPERATURE AT ONE POINT.

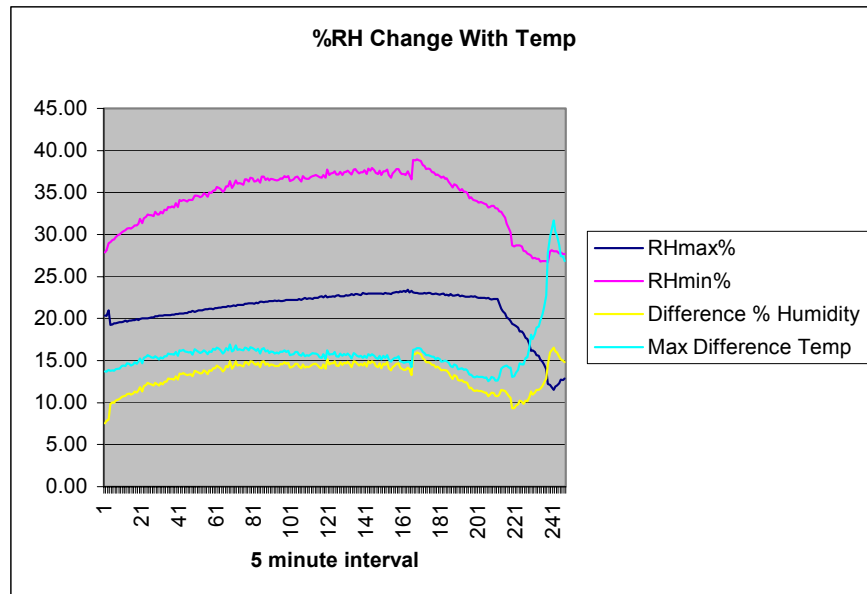
WHAT IS RELATIVE HUMIDITY?

RELATIVE HUMIDITY IS DEFINED AS THE RATIO OF WATER VAPOR PRESSURE TO THE SATURATION VAPOR PRESSURE AT THE PREVAILING AMBIENT TEMPERATURE, EXPRESSED AS A PERCENTAGE. IN SIMPLER TERMS, IT IS THE MEASURE OF THE AMOUNT OF WATER VAPOR IN THE AIR COMPARED TO HOW MUCH IT CAN POSSIBLY HOLD AT THAT TEMPERATURE.

FOR EXAMPLE, AIR AT 20°C CAN HOLD, AT A MAXIMUM, ABOUT 17 GRAMS OF MOISTURE PER CUBIC METER OF AIR. AIR THAT IS HOLDING THIS MUCH MOISTURE WOULD BE CONSIDERED "SATURATED" AND WOULD HAVE A MEASURE OF 100%RH. IF THE 20°C AIR DRIES OUT TO THE POINT WHERE IT ONLY CONTAINS 8.5 GRAMS OF MOISTURE PER CUBIC METER, THEN THE AIR IS HOLDING ONLY ONE-HALF, OR 50%, OF ITS TOTAL CAPACITY. THE MEASURE OF THE AIR WOULD NOW BE 50% RH.

THE CAPACITY OF AIR TO HOLD WATER IS HEAVILY DEPENDENT ON THE TEMPERATURE OF THE AIR. THE WARMER THE AIR, THE MORE MOISTURE IT CAN HOLD. AIR AT 30°C CAN HOLD ABOUT 30 GRAMS OF MOISTURE PER CUBIC METER OR ABOUT 75% MORE THAN IT CAN HOLD AT 20°C. AIR AT 60°C CAN HOLD ABOUT FIFTEEN TIMES THE AMOUNT OF WATER THAN AT 10°C.

THIS DEMONSTRATES HOW REPRESENTING A VALUE IN %RH CAN MAKE A LARGE DIFFERENCE IN THE AIR TEMPERATURE AT THE POINT TO WHICH IT IS BEING MEASURED. THE GRAPH BELOW SHOWS A CONSTANT WATER VAPOR VALUE AND IT IS ONLY CALCULATED FOR THE CHANGE IN TEMPERATURE AND HOW IT WOULD READ ON A RELATIVE HUMIDITY SENSOR'S OUTPUT. THERE CAN BE A SIGNIFICANT DIFFERENCE IN THE VALUE THE MONITOR IS OUTPUTTING. IN THE GRAPH, YOU CAN SEE A 7% - 16% CHANGE IN THE READING, JUST BECAUSE OF THE TEMPERATURE IN THE ROOM. DUE TO THE SENSOR HAVING DIFFERENT VALUES FOR TEMPERATURE AND SATURATION OF WATER AT ANY GIVEN POINT IN A ROOM, IT CAN CAUSE A LARGER VARIANCE IN %RH OUTPUT VALUE.



COMPARED TO WHAT?

THERE ARE SEVERAL TYPES OF EQUIPMENT ON THE MARKET FOR MEASURING TEMPERATURE AND RELATIVE HUMIDITY. SOME ARE BETTER THAN OTHERS AT REPRESENTING AN ACCURATE VALUE. LET'S LOOK AT SOME OF THE MORE POPULAR SENSORS AND HOW ACCURATE THEY CAN BE.

MANY PEOPLE HAVE THE SMALL LCD DESKTOP TEMPERATURE AND RELATIVE HUMIDITY SENSORS. MANY OF THESE ARE IN THE PRICE RANGE OF \$20 TO \$60. THESE DEVICES ARE MADE MORE FOR A REFERENCE AND ARE NOT ACCURATE IN THEIR READINGS. TEMPERATURE USUALLY HAS A VARIANCE OF +/- 2°, AND IS +/- 3%RH. THE READING OF +/- 3%RH HAS A CATCH; THESE UNITS CANNOT READ BELOW 20%RH, AND CAN TAKE UPWARDS OF ONE MINUTE TO GET A CORRECT READING.

DIAL HYDROMETERS FALL INTO THE SAME SITUATION AS THE DESKTOP LCD SENSORS; THEY HAVE AN OVERALL %RH ACCURACY READING OF +/- 6% AND MOST CAN ONLY READ DOWN TO 10%RH.

NOW, IF YOU STEP UP IN PRICE TO ABOUT \$400, YOU WILL BE ABLE TO FIND A MORE ACCURATE %RH AND TEMPERATURE SENSOR. THESE UNITS ARE USUALLY HANDHELD AND THE SENSORS ARE LOCATED EXTERNALLY ON A WAND. THESE HAVE A BETTER RANGE AND ARE MORE ACCURATE, USUALLY AROUND +/- 1.5° F AND +/- 3%RH - +/-2%RH. THEY ARE ALSO CAPABLE OF READING DOWN TO 5%RH – 10%RH ACCURATELY, AND TEMP RANGES FROM -5° F TO 175° F.

WE AT RX MONITORING SERVICES USE THE FAHRENHEIT SCALE FOR OUR REPRESENTATION. WE PLACE OUR ACCURACY AT 3.5% ACROSS THE SCALE FROM -50° F - +100° F. THIS MEANS THAT WE CAN ACCURATELY READ +/- 2° F OFF THE "TRUE" TEMPERATURE AT ONE POINT. WE RATE OUR RELATIVE HUMIDITY SENSORS TO A +/- 5% ON THE RANGE OF 10%RH - 100%RH.

WHEN YOU GET A READING DIFFERENCE, WHETHER IT'S TEMPERATURE OR RELATIVE HUMIDITY, REMEMBER THAT THERE ARE MANY FACTORS TO GETTING THE EXACT MEASUREMENTS THROUGHOUT A ROOM. THERE ARE MANY VARIABLES AND CIRCUMSTANCES THAT CAN CAUSE A READING TO GO ASKEW. THERE IS NO SUCH READING OF A ROOM TEMPERATURE, THERE IS ONLY TEMPERATURE THROUGHOUT A ROOM. THERE ARE READINGS IN A VENT, EXHAUST TEMPERATURES FROM EQUIPMENT, AND MANY OTHER OUTSIDE INFLUENCES THAT CAN CAUSE READINGS TO BE DIFFERENT. INFLUENCES CAN INCLUDE THE AIRFLOW IN A ROOM AND HOW IT CIRCULATES, SUNLIGHT, FLOOR MATERIAL, INSULATION, VENTS, EQUIPMENT, LIGHTING ETC. NOT ONLY CAN OUTSIDE INFLUENCES CHANGE THE READING OF A TEMPERATURE PROBE, BUT ALSO IT'S ABILITY TO MEASURE. EACH PROBE CAN BE AT ITS OUTERMOST LIMITS OF THE +/- TEMPERATURE OR RELATIVE HUMIDITY RATING. THIS CAN CAUSE AN ERROR OF 3° TO 4° OR 8%RH, AND THIS IS IN THE DESIGNATED OPERATING RANGE OF THE DEVICE. COMPARING TWO READINGS OF TEMPERATURE AND RELATIVE HUMIDITY FROM SEPARATE SOURCES CAN BE A VERY HARD MEASUREMENT TO MAKE AND HARDER TO MAKE IT ACCURATELY.