Relative Humidity and Temperature Measurement

Lee-Dickens offer a comprehensive range of Relative Humidity, Dewpoint and Temperature measuring and indicating probes and transmitters. Relative Humidity is accurately measured in the range 0 to 98% and Temperature generally in the range 0 to 100ºC, with some minor exceptions. We also offer portable calibration capsules that fit all of the probes we supply and give a good two point field check. We have been increasing the range of products that we offer for many years and this is backed up by our extensive applications experience.

SENSOR TECHNOLOGY

All of the probes offered by Lee- Dickens use RH sensors of the capacitive type. The sensors are constructed with one plate etched on to a metallised glass substrate which is very thinly coated with active polymer. The second plate consists of a moisture permeable metallic film over the polymer. This method of construction gives the capacitive sensor a very quick response time.

Indeed the sensors we use respond to such minute changes in humidity that when digital meters reading to 0.1mV are used, users may be disconcerted by rapid fluctuations in last digit value. This is NOT a fault indication. In practice, the use of filter-type sensor guards will reduce the rate of signal fluctuation, as will the use of analogue panel meters.

IMPORTANT NOTE:

Sensors come to equilibrium with the environment regardless of whether probes are switched ON or OFF. This is of particular significance when using the hand-held models in 'Sampling' applications. Hand held instruments which are specifically designed for *sampling* humidity levels, are often moved from one location to another where the ambient temperature may be different. Relative Humidity levels are directly related to the temperature of the area being monitored. As a generalisation it may be stated that the %RH of air with the same water content will change by 0.5% when air temperature changes by only 0.1ºC.

It is most important therefore that hand held probes be allowed time to come up (or down) to the same temperature as the ambient atmosphere.

In general, bringing a 'cold' probe into a warmer atmosphere will cause initial humidity readings to be too high; conversely initial readings will be 'low' when taking a probe into a colder environment.

Recommendation: A rapid 'to and fro' movement of the probe will hasten its reaching temperature equilibrium, and therefore steady and correct readings. Sensor guards will slow up the process, sintered bronze guards far more so than polypropylene cage types.

SENSOR LIFE

All primary measuring probes are prone to damage by the environment in which they are used and the more sensitive the probe, the more prone it is to damage. Humidity sensors are no exception to the rule and anyone using these devices should accept that the sensor is unlikely to last forever. On the question of "How long will the sensor last?", we can not say. If the humidity measurement is taking place in a computer suite or a clean room then the sensor should last for many years. On the other hand if the humidity measurement is taking place in a process where the temperature is fluctuating a great deal, the probe experiences regular periods of saturation and the atmosphere contains reducing or oxidising agents, then the senor life will be shortened. If you have a particular application in mind, please call our internal sales office who will offer you the benefit of many years experience.

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INSTRUMENT LOCATION AND RELATED FACTORS

Instrument location, choice of sensor guard and attitude of probes are of paramount importance when measuring Relative Humidity. The following will give some clues as to the things to be considered prior to specifying the instrument required and the location for the installation.

The first thing to note is that without forced air circulation there will exist humidity differentials across a room or chamber. There will also exist temperature differentials, which whilst normally accepted as of no consequence, will make a big difference when measuring humidity (as noted above). Therefore it will be appreciated that probe location must be considered in terms of air movement and sometimes temperature. In control applications some form of forced air movement can be anticipated, and INLETS/OUTLETS and/or MAIN/BY-PASS ducts are recommended probe locations. Users are also reminded that temperature measurement accuracy and response times must always be a function of air velocity.

PRESSURE EFFECTS

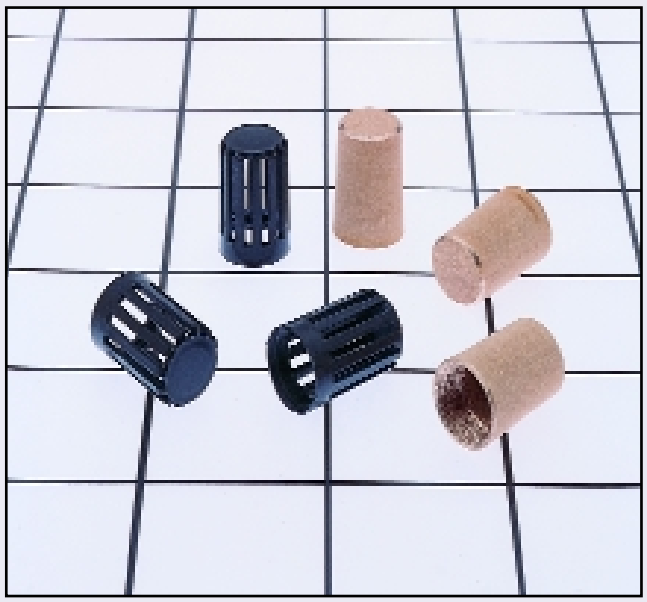
These are generally totally disregarded but are of great significance. At any given water content the %RH of air (or any gas (es)) is a direct function of absolute pressure. For example the water content of air measured at 70%RH at 1050mB and 20ºC is the same as that of air measured at 77.37%RH at 950mB and the same temperature. When a probe is located within a duct, the pressure at that location relative to the chamber to be monitored/controlled should be checked.

SENSOR POLLUTION

In dusty, dirty, etc., conditions, it is taken for granted that a sensor guard will have been chosen. However, errors which may arise from accumulated deposits onto guards and the required guard cleaning frequency can be minimised by looking for the CLEANEST LOCATION compatible with getting results representative of the process. Sometimes this is a simple case of visual observation; other circumstances demand a little ingenuity. For example, it is known that the upstream, central portion of a bluff body within a duct remains relatively clean – a good position for a probe.

SENSOR GUARDS

The Lee-Dickens range of probes can all be fitted with either a Polypropylene Cage or a Sintered Bronze Guard. The Sintered Bronze Guard (SBG) has a screening efficiency of 99% of all particles greater than 25 microns and can be used in temperatures up to 125ºC. The SBG will minimise the risk of sensor pollution with the bonus of improved mechanical protection. However, it should be borne in mind that response times will be increased, although in general this will be an insignificant effect, compatible with air velocity. Furthermore, the SBGs have a considerably greater heat-mass than the Polypropylene cages, and therefore, the latter are the preferred choice for service below 70ºC, and where little airflow is available.



CONDENSATION

Immersion of the sensors in clean water does not permanently alter calibration. However, condensed water must be looked upon as a very good pollutant, and steps must be taken to prevent condensed water reaching sensors. Whenever there is any risk of condensation conditions during a process cycle, or most frequently during process start-up, ensure that probes are mounted VERTICALLY, sensor-end DOWNWARD. Even copiously condensed water will then run down the outside surfaces of a probe and guard without risk of sensor contamination. Polypropylene guards are recommended when condensation is anticipated, their low thermal mass minimising drying out time.

SENSOR CARE

In general air-borne solids are not expected to penetrate sensor filter guards, although sub-micron particles may do so. Further, accidents happen – particularly to probes with 'cage' type guards where the only function is mechanical protection.

The sensor is very lightweight and delicate and its surface has to remain porous to permit absorption and desorption of moisture. It should therefore be appreciated that on no account should sensors be touched by even the softest materials, e.g. a sable hair brush. The following procedures are offered as a guide to cleaning if necessary, but cannot be construed to be a guaranteed process:

1) Visual examination: The use of a X10 lens will assist in identifying the nature of the contamination.
2) If dust is observed a squeeze bulb (as used for cleaning lenses) can be used to apply a squirt of air to remove dust. If success is not total, direct a stream of distilled water onto the sensor from a squeeze-bottle, the instrument being held sensor-end downward. Shake excess water from the sensor, and dry in a warm airstream (a hair dryer is suitable) in a dust free environment.
3) If an oily pollution is observed or the treatment in 2) above is unsuccessful, apply a stream of perchlorethylene from a squeeze-bottle.
4) Sensor replacement: Avoid all hand/tool to sensor contact; handle from lead wires only, avoiding all wire-to-sensor stress. Heat sink leads properly when soldering avoiding any possibility of flux splatter onto the sensor. Use tweezers.
5) CHECK CALIBRATION. It is recommended that instruments should always be check calibrated after a cleaning process has been carried out, and of course after sensor replacement. Please note that a linearity check is advisable. Occasionally, some forms of pollution cause loss of linearity.

SENSOR DAMAGE DIAGNOSIS

Visual examination before/after cleaning may reveal inadvertent mechanical damage. As a generalisation, this would result in low readings through loss of capacitance. In this event, sensor replacement is indicated. The presence of non-hygroscopic deposits will tend to increase capacitance and therefore signal output. Hygroscopic materials will act similarly but to a greater extent. A very high reading, from your probe/transmitter is likely to indicate partial/total polymer dielectric breakdown. In this event, sensor replacement is necessary.

SENSOR FILTER GUARD CLEANING

Hard and fast rules cannot be provided regarding cleaning frequency – this must be dictated by operating conditions and commonsense, backed up by periodic visual examination. The danger of insufficient cleaning/replacement of guards is threefold:

1) The guard may become significantly obstructed
2) The materials build-up may be of such nature as to increase or reduce %RH readings
3) Excessive corrosion product build up on bronze guards may increase the danger of sensor pollution under saturation conditions

REMOVAL OF SENSOR GUARDS

When removing guards ALWAYS ensure that the final guard separation from the probe is effected co-axially, preventing any contact with the sensor.

Cleaning is best effected by applying a clean air-blast into the hollow portion of the guard and/or similarly applying a hose connected to a mains water supply. In the latter case, dry guards thoroughly, polypropylene at 70ºC max, bronze guards at up to 150ºC. Fatty materials are best removed by suitable solvents such as trichlor or perchlor ethylene or 'freon'-type solvents.

CAUTION: NEVER use any kind of detergent or surfactant. It is unlikely that all traces can be removed and non-linearity of readings will result.

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