HYGRODYNAMICS

NARROW RANGE HYGROSENSOR

CONTENTS

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I. DESCRIPTION - NARROW RANGE

Hygrodynamics® Hygrosensors® are transducers whose resistance varies with humidity. The narrow range sensors consist of a polystyrene core. A dual winding of palladium metal wire is wound around this core and is coated with a lithium chloride or lithium bromide solution forming a thin film on the wire. A perforated aluminum or plastic cover protects the element from physical damage.

Dimensions: 2" length
3/4" diameter

PRINCIPLE OF OPERATION

Operation of the Hygrosensor is based on the ability of the coated hygroscopic film to change its resistance almost instantly with variations in relative humidity. The resistance change is measured in terms of an A.C. current flowing through the sensing element which is indicated or recorded by instruments manufactured by Newport Scientific.

TYPES OF HYGROSENSORS

A. Type H-3 sensors measure humidity only with two classes of accuracy:

1. Class A to within ± 1% RH.
2. Class B to within ± 2% RH.

B. Type TH-3 sensors measure both humidity and temperature. They are Class A sensors that include a thermistor which measures temperature.

*Accuracy of RH ±1% RH
Temp. ±2°F

HUMIDITY RANGES AT CORRESPONDING DRY-BULB TEMPERATURE			CATALOG NUMBERS			COLOR CODE
			TYPE H3		TYPE TH-3	
40 °F	80°F	120°F	CLASS A	CLASS B		
1.7 TO 8.6% 4.4 TO 14%	1.6 TO 6% 3 TO 10%	1.5 TO 4.8% 2.4 TO 8%	4812 4814	1205 1207	4828 4829	WHITE BLACK
7 TO 20% 15 TO 27%	5 TO 15% 11 TO 23%	3.5 TO 11% 9 TO 19%	4815 4816	1209 1211	4830 4831	BROWN RED
22 TO 39% 33 TO 51%	18 TO 33% 26 TO 42%	14 TO 27% 21 TO 36%	4817 4818	1213 1215	4832 4833	ORANGE YELLOW
49 TO 68% 60 TO 81%	41 TO 61% 51 TO 74%	34 TO 55% 41 TO 67%	4819 4820	1217 1219	4834 4835	GREEN BLUE
75 TO 94% 87 TO 99%	68 TO 88% 81 TO 99%	62 TO 83% 76 TO 97%	4821 4822	1223 1225	4836 4837	VIOLET GRAY

FOR SPECIAL APPLICATIONS

1. Suffix K denotes construction with polycarbonate core for hydrocarbon atmospheres and the ability to withstand temperatures to 200°F.
2. Suffix W denotes a sensor with weather-proofing; a Teflon wrap to prevent liquid water from coming in contact with the core.
3. Suffix D denotes a cellulose wrap for service in dirty or dust environments.

HUMIDITY LIMITS

Sensors that may be placed in an environment with possible condensation should be weather-proofed to prevent damage to the hygroscopic salts. (Suffix W)

TEMPERATURE LIMITS

Standard sensors may be used in atmospheres with an air temperature of up to 160°F. For operation to 200°F the sensor should be constructed with a polycarbonate core. (Suffix K)

PRESSURE AND VACUUM LIMITS

Sensors have been successfully used at 10,000 psig and have withstood exposure to a vacuum of less than 1mm Hg. (For brief periods as low as 10^{-3}mm Hg)

GAS AND VELOCITY LIMITS

Sensors have withstood several hundred miles per hour velocities. However, a deflection shield is recommended as protection against high velocity particulate matter.

ELECTRICAL OPERATING LIMITS

Only A.C. excitation current may be connected to the sensor. Never apply D.C. voltage nor test the sensor with a DC Voltmeter.

- **NOTE:** The sensitive surface is exposed and cannot meet Class 1 Group D explosion proof requirements; however, the element is sparkless and draws a maximum of 100 microamperes when used with Hygrodynamics instrumentation.

VOLTAGE

AC voltage must be applied to the sensor to prevent polarization of the conductive film. Polarization will cause a shift in calibration. Most Hygrodynamics products apply an AC voltage of 5-10VRMS at a frequency of 20-60Hz. DC component of the signal should be less than 10mV. Wave shape is not critical, but high frequency components such as those found in a fast rise-time square wave should be avoided. At high frequencies the connecting cable could have impedance comparable to the sensor. Inaccuracies at the low end of the sensor's range would be apparent.

CURRENT

The power dissipated by the sensor should be minimized to eliminate self-heating effects.

Hygrodynamics equipment uses a 909K ohm series resistor in the measurement circuitry to keep current low. Keep in mind that at high humidity the sensor's resistance will be a few hundred ohms. A high series resistance will ensure the current and its heating effects are negligible throughout the measurement range of the sensor.

II. INSTALLATION

SELECTING A SUITABLE LOCATION

Humidity measurement and control is complicated by the effect of other variables such as temperature and pressure and the presence of hygroscopic materials. The humidity sensor indicates the moisture conditions at the ambient environment immediately surrounding the sensor and it should be located in a space representative of the conditions to be measured or where the difference is known and recorded for conversion purposes. Avoid installation in stagnant air or near a radiant of conductive heating or cooling surface. In some applications a small electric fan may be used to draw air over the sensor to provide a representative air sample and to reduce the risk of condensation from warm moist air flowing over a cold sensor. Not always as obvious is the presence of hygroscopic material (wood, textile, etc.) near the proposed mounting location which, in semi-stagnant air, could significantly influence the immediate environment.

EXPOSURE HAZARDS

In normal clean atmospheres, the useful life of the HYGROSENSOR is limitless. However, the sensor's calibration can be altered by certain contaminants, or by realignment or changes in the concentration of the hygroscopic salt.

The contaminants listed below affect the calibration and response of the sensor. These contaminants also affect other means of measurement and the information obtained by using the HYGROSENSOR may be of sufficient value to consider the sensors expendable. Frequent calibration verification may provide months of service even in contaminating atmospheres. The change in calibration or response is on a time-and-concentration of contaminant exposure basis.

CONTAMINATES

- PHYSICAL

HYGROSENSORS should not be used in dusty or dirty atmospheres unless protected by a 200 x 200 mesh metal screen (Part Number 4825) or cellulose acetate cellophane (sensor with suffix D).

Physical contaminants, which may be deposited on the sensor, such as dust and oil, may be chemically and electrically inert and not affect the sensor's calibration. However dust is generally hygroscopic and slows down the response time and oil forms an insulating film (to water vapor) on the sensor rendering it inactive.

Realignment of the hygroscopic salt crystals can occur from extended exposure to high vacuums (low absolute pressures) or by high temperature and/high vapor pressure exposure.

-CHEMICAL

Chemical contaminants cause a permanent shift in calibration. The hygroscopic salt concentration can be changed by exposure to any material or chemical vapor that will

react with the salt. These corrosive chemicals include: mercury vapor, unstable hydrocarbons such as ketons, halogen gases, sulfur compounds such as hydrogen sulfide and sulfur dioxide.

Temporary poisoning of the HYGROSENSOR can result from exposure to polar vapors wherein the conductivity of the salt is affected by the material in a manner similar to the effect of water vapor. Normally these materials are volatile and the sensor's response returns to normal after removal from the contaminated atmosphere. Included in this class of contaminants are: ammonia, amines, alcohols, glycols and glycerols.

The concentration of the salt can be changed by physical removal through exposure to liquid water by splashing or condensation such that the salt is washed out. When condensation occurs but evaporates without running off, the salt crystals could be realigned or the condensate remaining could be electrolytic thus changing the calibration. The possible damage from liquid water can be minimized by weather-proofing the sensors, or by sampling and heating the air to a temperature reasonably above the existing dew point temperature.

- CONDUCTIVE

This contamination results from deposition of electrolytic particles such as metallic dust or salts on the HYGROSENSOR, which change the conductivity. Filtering provides protection against these contaminants. Example: 200 by 200 mesh screen and moisture-pervious cellulose acetate.

MOUNTINGS

1. Part no. 9215 is used for direct temperature readings with digital instruments and Hygrotrans. For analog Instruments, a TH3 sensor is recommended.

2. 6101 Flange Mounting used when connecting a TH3 sensor with an indicator or a recorder for duct installation.

3. 6130 Pressure Mounting 25 psig maximum. Used with H-3.

4. 6146 Pressure Mounting 300 psig maximum. Used with H-3.

5. 6147 Pressure Mounting 300 psig maximum. Used with TH-3.

CABLING

Contact Hygrodynamics or it's authorized representative to select the appropriate cable to use with the Narrow Range Sensors.

NOTE: Never run cables adjacent or parallel to A.C. power lines.

III. OPERATION

HUMIDITY MEASUREMENTS

1. Refer to instrument instruction manual.

2. Narrow-range HYGROSENSORS are each supplied with a specific calibration curve. For highest accuracy of relative humidity determinations compare the instrument dial readings to the calibration curve for the specific sensor in use.

> Curves for Class A HYGROSENSORS carry a correction factor in the legend box which must be added to the values obtained for an accuracy of ± 1% RH.
>
> Curves for Class B HYGROSENSORS do not have a correction factor, but readings are accurate within ±2% of the RH values obtained.

3. In measuring an unknown relative humidity, the proper sensor must be selected by trial. When the approximate relative humidity is known, the correct sensor may be selected by referring to the calibration chart attached. When the anticipated humidity value is within the range of two sensors, select a sensor which will permit a reading to be taken near the center or lower portion of the indicator or controller scale.

4. When the measurement is made at a temperature and/or pressure different than the location at which the determination is to be referenced, these other variables should be measured for calculation purposes because the sensor indicates the ambient environment. The temperature relationship can be converted using psychrometric charts or tables. The effect of pressure can be expressed as:

$$\%RH_R = (\%RH_S) \times \frac{P_R}{P_S} \times \frac{K_R}{K_S}$$

Where subscripts R and S stand for reference and system respectively, P is absolute pressure, and K is a factor, which compensates for the water-carrying capacity of gases at elevated pressures. The value of K varies with the gas, and the values listed in Table 1 apply to air, oxygen, hydrogen and nitrogen. The factor for helium is essentially 1, and considerably lower for carbon dioxide than listed in Table 1.

TABLE 1. WATER-CARRYING CAPACITY OF A GAS INCREASES WITH PRESSURE. FOLLOWING (K) FACTORS APPLY TO AIR, OXYGEN, AND NITROGEN.

PRESSURE PSIG	K	PRESSURE PSIG	K
0	1.0000	1000	.8239
15	.9972	1100	.8079
30	.9943	1200	.7921
45	.9915	1300	.7766
60	.9886	1400	.7613
80	.9849	1500	.7464
100	.9813	1600	.7319
150	.9717	1700	.7174
200	.9625	1800	.7033
250	.9534	1900	.6894
300	.9442	2000	.6759
350	.9352	2500	.6125
400	.9262	3000	.5561
450	.9173	3500	.5066
500	.9084	4000	.4641
600	.8910	4500	.4287
700	.8738	5000	.4004
800	.8569	5500	.3792
900	.8403	6000	.3647

IV. MAINTENANCE

CAUTION: Never apply DC voltage or test the sensor with a DC voltmeter.

A small accumulation of lint or dust may collect on the sensor element, if used continually in an exposed place. This accumulation will not seriously affect its calibration and NO attempt should be made to remove this coating, as injury to the sensor may result. In applications subject to vibration, the Sensors are secured to the base sockets by a screw inserted through the center of the Sensor. Use a small screwdriver to loosen the screw before removing the Sensor.
Precise field-calibration of sensors is extremely difficult, therefore, if after extensive use it is desired to have the sensor recalibrated, it may be returned to NEWPORT SCIENTIFIC, INC. for recalibration at nominal cost. Please include the original calibration data, if available.

NEWPORT SCIENTIFIC, INC.

Certificate of Conformance

This certifies that the humidity sensor(s) covered by this certificate was manufactured, inspected and calibrated in accordance with NEWPORT SCIENTIFIC, INC Quality Control procedures, and conforms in all respects with applicable drawings and specifications. Records to substantiate this certification are maintained in our files and are subject to inspection.

Calibration of your humidity sensor(s) was performed on a carefully controlled humidity chamber using a high precision Dewpoint Hygrometer employing 0.1C, calibration traceable to NIST.

In normal clean atmospheres, used in accordance with NEWPORT SCIENTIFIC, INC. instructions and with approved equipment, the Hygrodynamics Wide-Range Sensors are warranted for six months from date of shipment and the Hygrodynamics Narrow-Range Sensors and repaired equipment are warranted for three months from date of shipment.

HYGRODYNAMICS

LIMITED WARRANTY

NEWPORT SCIENTIFIC, INC. warrants that all equipment manufactured by NSI shall be free from defects in material and workmanship, which might impair its usefulness. SELLER DOES NOT WARRANT THAT THE EQUIPMENT IS FIT FOR ANY PARTICULAR USE. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEROF; the obligation under this warranty is limited to repairing or replacing, at Seller's factory, any defective parts which, when returned by the buyer, **TRANSPORTATION PREPAID,** examination discloses to have been factory defective. The time limit of this warranty is ONE YEAR from date of shipment of new equipment, SIX MONTHS from date of shipment of Hygrodynamics Wide Range Sensors and THREE MONTHS from date of shipment of Hygrodynamics Narrow-Range Sensors and repaired equipment. THIS WARRANTY IS EXPRESSLY IN LIEU OF OTHER WARRANTIES. Seller shall not be held liable for any special, indirect, consequential damages arising out of this warranty or any breach thereof, of any defect in or failure or malfunction of the equipment and materials are further subject to tolerances and variations consistent with usages of trade. This warranty shall run in favor only of the purchaser from Seller and may not be passed on or represented on behalf of Seller to any subsequent purchaser.

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