# P Series
# INDICATING PROBES
# PA1 / PM1 / PS1

# INSTRUCTION MANUAL

## CONTENTS



### PLEASE, READ THIS FIRST

- Check the product for any physical damage that may have occurred during shipment. We carefully pack and routinely insure all shipments. If any damage has occurred, it is your responsibility to file a claim with the carrier, **prior to returning the damaged product**. Please note that our warranty does not cover damage during shipment.

- Prior to installation, get fully familiarized with the operating limits of the probe and with the measurement tips provided in this manual.

- Do not unnecessarily remove the sensor protection (protective sleeve or dust filter) from the probe. Both sensors (humidity and temperature) can be mechanically damaged by careless removal of the protection. The ROTRONIC HYGROMER™ humidity sensor looks like a small white paper tag. Do not remove from the probe!

Each ROTRONIC instrument is carefully calibrated before shipment. No further adjustments should be required before installation. If you have any question or problem, please call our service department at 631/427-3898 and press 5 (or ask for extension 21).

## DESCRIPTION

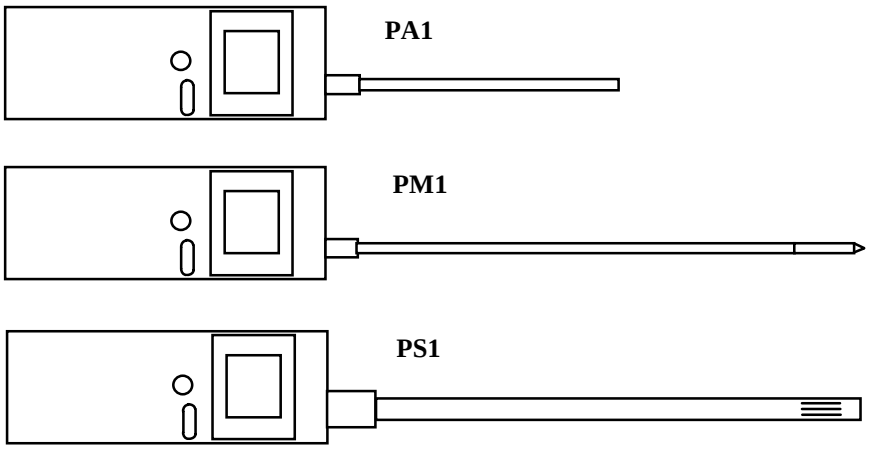
The ROTRONIC HYGROMER™ P series indicating probes are battery operated portable instruments that measure temperature and relative humidity. Both parameters are simultaneously displayed on an easy to read LC display. These probes are available in 3 basic configurations that cover typical requirements for humidity measurement:

• **PA1 Probe:** The perfect instrument for checking ambient conditions. Direct readout means no charts or dials. Measurement at low humidity, a weak area of the psychrometer, is no longer a problem.

• **PM1 Probe:** Tubular probe for the measurement of hygroscopic materials in bulk (powders, granules or pellets). Typical areas of application include pharmaceutical powders, powdered sugar, dried foods, beverages in powder form, coffee and cocoa beans, tea leaves, cereals, seeds, etc.

• **PS1 Probe:** Sword probe for the measurement of paper stacks and rolls. The result of many years of collaboration with the paper industry, this probe is routinely used as a quality assurance tool by paper mills, paper converters, paper distributors, printers and packagers.

All probe configurations feature a HOLD function to facilitate measurements in hard to reach locations or in poor lighting conditions. The display also provides an indication of battery status. Automatic shut-off of the display after 2 minutes conserves the battery.



## OPERATION

Place a standard 9V alkaline battery in the compartment at the back of the instrument.

For storage, the swivel probe of the instrument is folded back under the case. Unfold the swivel probe of the instrument prior to use.

**Do not adjust the probe without pressing the button located near the base of the probe on the right hand side of the instrument case.**

Use the blue push button to turn the instrument on. The instrument is ready for use after a start-up time of about 2 seconds. The LC display shows both the value of relative humidity (%RH) and that of temperature (°F or °C as ordered). A graphic bar located at the bottom of the display shows the status of the 9V battery. After about 2 minutes, the instrument is automatically powered off to conserve the battery.

Use the red push button to activate the HOLD function. This freezes the display to facilitate readings in hard to reach locations and in poor lighting conditions. The HOLD function is indicated by a bar at the bottom left corner of the display. The automatic power cut-out is disabled when the HOLD function is on. To deactivate the HOLD function, push the red button again. After 2 minutes, the instrument will be automatically powered off.

1. Temperature Limits

The indicating probes of the P series can operate within 20..+130°F (-5°C..+55°C). Operating the probes outside of the temperature limits may result in inaccurate measurements and can cause permanent damage.

2 Humidity Limits

The indicating probes of the P series can operate within 0 and 100 %RH. Direct condensation on the sensors does not damage the sensors. However, this will produce an overflow reading (a reading of more than 100 %RH) for as long as condensation is present on the humidity sensor. The probes provide a humidity reading that is referenced to the saturated water vapor pressure above liquid water. With this reference, the maximum humidity at temperatures below freezing is as follows:

100 %RH at 0°C  95 %RH at -5°C  91 %RH at -10°C

3. Temperature Compensation

Practically every make of relative humidity sensor requires a compensation for the effect of temperature on the humidity output signal in order to measure accurately over a wide range of temperature conditions. In the specific case of an instrument using a capacitive sensor, compensation is required because the dielectric characteristics of both the water molecule and the hygroscopic polymer used in the sensor vary with temperature. The electronic circuit of the P series indicating probes uses data from the temperature sensor to automatically compensate the effect of temperature on the accuracy of humidity measurement.

## MEASUREMENTS

When using a portable probe, it is important to keep in mind that there is no such thing as an instantaneous humidity and temperature measurement.. By nature, this type of measurement requires that the probe be given sufficient time to equilibrate with the environment to be measured.

The most common source of error in relative humidity measurement is a difference between the temperature of the probe and the temperature of the environment at the time of measurement. At average and high humidity levels, even a small difference such as 1 or 2°F will result in a substantial error on relative humidity. For this reason, it is always a good idea to monitor the temperature display for stability when measuring relative humidity.

Equilibration time will be shorter and errors will be less likely when using the correct probe configuration for your application:

| APPLICATION | PROBE CONFIGURATION |
|---|---|
| Air Measurement | PA1 |
| Powders, Granulates or Pellets in bulk | PM1 |
| Stacks and Rolls of Paper | PS1 |

1. Measurements in Air

The following are the two most important points for measurements in air:

- Initial temperature difference between probe and environment.

The larger the initial temperature difference, the longer it takes to measure. When the probe is inserted in a hot environment, condensation will occur on the sensors when the dew point of the environment is higher than the temperature of the probe. When the probe is being used within its temperature limits, condensation will not alter the calibration of the humidity sensor. However, the sensor will have to dry before it can provide a valid measurement.

- Air movement at the sensors

Non-moving air is an excellent temperature insulator and works against rapid equilibration of the probe. For this reason, the standard sensor protection on air probes is a slotted cap. This permits air movement at the sensors. Unless the environment requires it, you should not use the dust filter supplied with the PA1 probe because this filter does not permit air movement at the sensors.

2. Measurement of Materials in Bulk

These measurements require the use of a dust filter to protect the sensors from direct contact with the material to be measured. The foam filter used on the PM1 probe is not penetrated by liquids and can be easily be washed with a mild detergent.

Because of the filter, the sensors are surrounded by non-moving air and can adapt only slowly to the temperature and humidity of the material. Measurements usually require at least 15 to 30 minutes.

If the material is hot and humid, condensation will occur on the sensors unless the probe has been warmed up prior to insertion in the material. This can be done by placing a humidity insulating shield (for example a metal cap) on the tip of the probe and by letting the shielded probe come to the temperature of the material. Once the probe is at the temperature of measurement, it can be rapidly withdrawn to remove the shield, and inserted again in the material.

3. Measurement of Paper Stacks and Rolls

To introduce the PS1 probe in a paper stack, the layer of paper above the desired measuring location must be lifted a little. Do not force the probe into the paper stack since this would break the probe. To speed up measurements, move the probe by about half an inch after about 30 seconds. This bring the slots located at the tip of the probe in contact with fresh paper. When the initial temperature of the probe and that of paper are close, equilibration typically requires 5 to 10 minutes. Avoid touching the metal parts of the probe with the hand prior or during measurements since this affect the temperature of the probe.

The PS1 probe can also be used to measure paper rolls. Cut through 3 or 4 layers of paper, over a length of 7 to 10 inches from one edge of the roll, to permit insertion of the probe. Tape the cut paper over the probe so as to cover it.

## MAINTENANCE

1) Cleaning or Replacing the Dust Filter:

If the probe has a dust filter, this filter should be cleaned from time to time, depending on the conditions of measurement. Cleaning should be done without removing the filter from the probe. Gently wipe the filter with a solution of water and mild detergent.

If cleaning does not remove most of the stains, the filter should be replaced. To do this, unscrew the filter from the probe. When removing the filter, make sure that the sensors do not get caught. The humidity sensor is sometimes mistaken for a "white paper tag". Do not remove from the probe!

Before putting on a new dust filter, check the alignment of both sensors with the probe. The wires that connect the sensors to the probe are very thin and bend easily. If this happens, correct the alignment by holding the sensor very gently with a pair of small flat nosed pliers. Do not use sharp pliers or tweezers as this could puncture the sensor and do not pull hard on the sensor.

2) Periodic Calibration Check:

Long term stability of the humidity sensor is typically better than 1 %RH per year. For maximum accuracy, calibration of the probe should be verified every 6 to 12 months. Applications where the probe is exposed to significant pollution may require more frequent verifications.

Both the Pt 100 RTD temperature sensor and associated electronics are very stable and should not require any calibration after the initial factory adjustment.
For routine calibration checks, the probe should be verified at two values of humidity. If an adjustment is required, **a one-point calibration at 50%RH is generally sufficient**. The calibration procedure is described in detail under "CALIBRATION".

## CALIBRATION BASICS

1. Temperature Calibration

The stability of the Pt100 RTD sensor used to measure temperature is such that temperature calibration in the field is seldom required.

In order to be able to correctly evaluate the accuracy of the temperature measurements provided by the probe, you should be able to meet the following requirements:

- Both the probe and a reference thermometer should be ventilated with the same stream of air. Any dust filter used to protect the sensors should be removed from the probe. If the probe has a slotted cap, this should be left on the probe.

- Air velocity should be within the limits of 200 to 500 feet/minute (1 to 2.5 meters/second). Any comparison between two instruments at velocities under 200 feet/minute may not be valid. Air velocity above 500 feet/minute may damage the unprotected humidity sensor.

- The temperature of the air stream should be constant or at least it should not change at a rate that is less than 10 times the shortest time constant of either the probe or reference thermometer.

**If you are not able to meet the above requirements, you cannot correctly check the accuracy of temperature measurement and should not attempt to calibrate temperature.**

2. Humidity Calibration

When calibrating humidity, **temperature stability is the single most important requirement**. Do not calibrate unless the probe is at room temperature (20 to 25°C) and this temperature is stable to ±0.25°C or better during the period of time required for each calibration point. Do not calibrate close to an air vent or a heater, in direct exposure to sun rays, etc. If necessary during calibration, place the tip of the probe with the calibration device on it (see below) inside an insulating box filled with sand.

a) Calibration Device:

The calibration device is a small airtight container that fits on the instrument probe and seals around the humidity sensor. During calibration, a known reference humidity is produced inside the calibration device by means of a humidity standard (usually an aqueous salt solution).

| PROBE | CALIBRATION DEVICE |
|---|---|
| PA1 | EGL (slip on) |
| PM1 | EGL (slip-on) |
| PS1 | EGS (slip-on) |

b) Humidity Standards:

RIC humidity standards permit calibration by non-skilled personnel. These standards are available in boxes of 5 glass ampoules of the same value, which can be stored indefinitely. Standards in the range of 5 to 95 %RH are non-saturated aqueous salt solutions that are precisely titrated at our factory for the right concentration. The 0 %RH humidity standard is made of small granules of a highly porous ceramic that have been dried at a high temperature. A Material Safety Data Sheet is available for each standard. Since most standards are a salt solution, parts which have come in contact with the liquid should be cleaned after each use.

## ONE-POINT HUMIDITY CALIBRATION

For a one point calibration of the instrument, you should select a humidity standard that is at the center of the range of humidity values typical of your application. The ROTRONIC EA50 standard (50 %RH) is the most commonly used.

Proceed as follows:

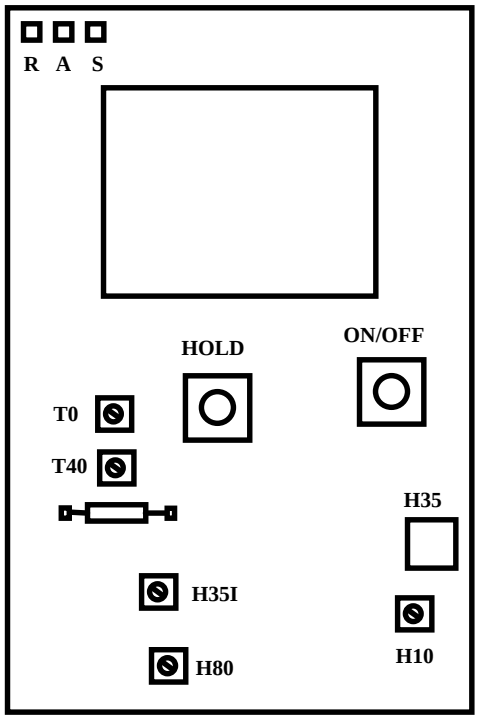
- Install the calibration device on the probe so that the receptacle (or solution holder) is under the probe. Check for a tight fit and remove the receptacle from the calibration device.
- Place one fiber disc (each box of RIC humidity standards includes 5 discs) in the receptacle of the calibration device. The purpose of this disc is to prevent accidental spilling of the solution inside the calibration device or on the humidity sensor.
- Tap the top of one ampoule of 35 %RH solution so that all liquid drops to the bottom of the ampoule. Snap off top and empty contents on fiber disc. **Since the ampoule is made of glass, exercise proper caution (gloves, safety glasses) when snapping off the top.**
- Put the receptacle back on the calibration device and make sure that the solution does not come in contact with the sensor: **The solution inside the calibration device should never be on top of the sensors.**
- Allow at least 60 minutes to insure that the calibration device, the solution and the sensor are in a state of equilibrium. This is verified by monitoring the display.

- At equilibrium (stable readings), **adjust the potentiometer accessible on the right hand side of the instrument** so that the display agrees with the value of the solution.
- Remove the receptacle from the calibration device. Throw away the wet disc (non reusable). **Thoroughly wash and dry the receptacle, removing all traces of the humidity standard.**

## FULL CALIBRATION

1. Calibration Potentiometers

To access the calibration potentiometers, remove the 4 screws located on the back of the instrument case. Hold the base of the swivel probe in place and separate the back of the case from the top. Secure the base of the swivel probe by putting back one of the screws near the base of the probe. Remove the screw located at the center of the electronic board. Remove the board from the case and flip over the board.



2. Calibration Procedure

Full calibration of the P series indicating probes requires a 2-point calibration of temperature and a 3-point calibration of humidity.

**Calibration should be done exactly in the sequence indicated in this manual. Because of the high stability of the Pt100 RTD sensor, temperature calibration is optional. However, if temperature calibration becomes necessary, it must be done prior to humidity calibration and must always be followed by a humidity calibration.**

2.1 Temperature Calibration (optional)

Should a temperature calibration be necessary, you should proceed as follows, depending on the equipment available to you:

a) Two Temperatures Air Generator:

- Position the T40 potentiometer in the middle of its span.
- Set the air generator at 0°C and adjust the probe display with the T0 potentiometer. If you cannot go as low as 0°C, you will have to repeat the entire procedure a few times.
- Set the air generator at a temperature such as 40 to 50°C and adjust the probe display with the T40 potentiometer.

b) One Temperature Air Generator (Room Temperature)

Unsolder the two wires from pads A and S (top left on the board). Connect to the pads a decade box that simulates the resistance of the RTD at different temperatures. Adjust the electronic circuit as follows:

- Position the T40 potentiometer in the middle of its span.
- Set the decade box to simulate 0 °C.
- Adjust the probe display with the T0 potentiometer.
- Set the decade box to simulate a temperature of 50°C.
- Adjust the probe display with the T40 potentiometer.
- Disconnect the decade box and solder the two wires to pads A and S. Check the probe at room temperature. If necessary, adjust the probe display with the T0 potentiometer.

**After calibrating temperature you should always calibrate humidity since the humidity output is affected by the temperature output.**

2.2. Humidity Calibration

**The first calibration adjustment should be at 35 %RH or at a value close to that.**

- Install the calibration device on the probe so that the receptacle (solution holder) is below the sensors. Check for a tight fit and remove the receptacle from the calibration device.
- Set the H80 potentiometer in mid position.
- Unscrew the receptacle of the calibration device.
- Place one fiber disc (each box of RIC humidity standards includes 5 discs) in the receptacle of the calibration device. The purpose of this disc is to prevent accidental spilling of the solution inside the calibration device or on the humidity sensor.
- Tap the top of one ampoule of 35 %RH solution so that all liquid drops to the bottom of the ampoule. Snap off top and empty contents on fiber disc. **Since the ampoule is made of glass, exercise proper caution (gloves, safety glasses) when snapping off the top.**
- Put the receptacle back on the calibration device and make sure that the solution does not come in contact with the sensor: **The solution inside the calibration device should never be on top of the sensors.**
- Allow at least 60 minutes to insure that the calibration device, the solution and the sensor are in a state of equilibrium. This is verified by monitoring the display.
- At equilibrium (stable output signal), adjust the display with the H35 potentiometer.
- Remove the receptacle from the calibration device. Throw away the wet disc (non reusable). **Thoroughly wash and dry the receptacle, removing all traces of the humidity standard.**

**Use 80 %RH as the second calibration value as this provides the best overall accuracy over the full range of measurement.**

- Repeat the procedure used for the 35 %RH adjustment with an 80 %RH standard. Allow at least 60 minutes for equilibrium.
- At equilibrium, adjust the probe display with the H80 potentiometer
- Remove the receptacle from the calibration device and clean thoroughly.

**The low humidity calibration is the last step of the calibration sequence.**

- Repeat the procedure used before with a 10%RH standard. Allow at least 90 minutes for equilibrium.
- At equilibrium, adjust the probe display with the H10 potentiometer
- Carefully remove the calibration device from the probe. Thoroughly clean the receptacle.

## SPECIFICATIONS

| | |
|---|---|
| Humidity Sensor | ROTRONIC HYGROMER ™ C80 |
| Temperature Sensor | Pt 100 RTD |
| Temperature Limits | 20-130°F (-5 to 55°C) |
| Measuring Range | 0 to 100 %RH<br>20 to 130°F (-5 to 55°C) |
| Humidity Accuracy | ± 2.0 %RH @ 77°F) |
| Temperature Accuracy | ± 0.5°F (0.3°C) at 77°F (25°C) |
| RH Sensor Hysteresis | ± 0.3 %RH, Max. |
| Typical Long Term Stability | 1 %RH or better over one year |
| Sensors Time Constant | 10 seconds or better |
| Display | LCD, 3 1/2 Digits |
| Resolution | 0.1 %RH and 0.1°F or 0.1°C |
| Battery | Standard 9V Alkaline Battery |
| Calibration Adjustment | 35, 80, 10 %RH<br>T0 and T40 |
| Calibration Device | PA1 and PM1: EGL<br>PS1: EGS |
| Humidity Standards | EA05-10-20-35-50-65-80-95 %RH |
| Sensor Protection | PA1: slotted cap (standard)<br>dust filter MF12 (optional)<br>PM1: dust filter FF10 (standard) |
| Probe Dimensions | PA1: 150 x 10 mm<br>PM1: 280 x 10 mm<br>PS1: 280 x 18 x 4 mm |
| Overall Case Dimensions | 190mm x 63mm x 26mm |
| Weight | PA1 Set: 1,110 g (2.5 lbs)<br>PA1 only:230 g (0.5 lb)<br>PM1 and PS1 Set: 1300 g (2.9 lbs)<br>PM1 and PS1 only: 360 g (0.8 lb) |