HB Products

**INSTRUCTION MANUAL**

# HBPH-MK2 – pH sensor

## Suited for brine/NH3 Leakage detection

## DIFFERENTIAL 2-WIRE (4-20 mA) pH Sensor



Salt bridge kit

**Included in the package**

- Sensor with cable
- Replacement salt bridge
- Liquid for flushing and filling

**TABLE OF CONTENTS**


General Information ..... 1
Specifications ..... 2
Installation ..... 3
Cold Liquid applications ..... 3
Electrical connection ..... 4
Storage ..... 4
Maintenance and calibration ..... 4
Calibrating the Sensor ..... 4
Checking the Sensor ..... 5
Probe Cleaning ..... 6
Replacement of Salt Bridge ..... 6
Troubleshooting ..... 7
Parts and Accessories ..... 8
Sensor Return ..... 8
Further Information ..... 8


## General Information

This manual covers HBPH sensor for pH measurement in water and brine.

The HBPH sensor features differential design for long lifetime, user serviceability and more accurate readings. In typical installations these probes will last for years whereas the more common combination probe lasts only months.

The sensor is a 2-wire device. It incorporates an encapsulated transmitter that outputs a 4-20 mA analog signal. It is designed to connect directly to a PLC.

The output from a two-wire transmitter type is non-isolated and un-calibrated. The system must provide 24 VDC, with the "low" input isolated from earth ground, and a means of calibrating for offset and span.

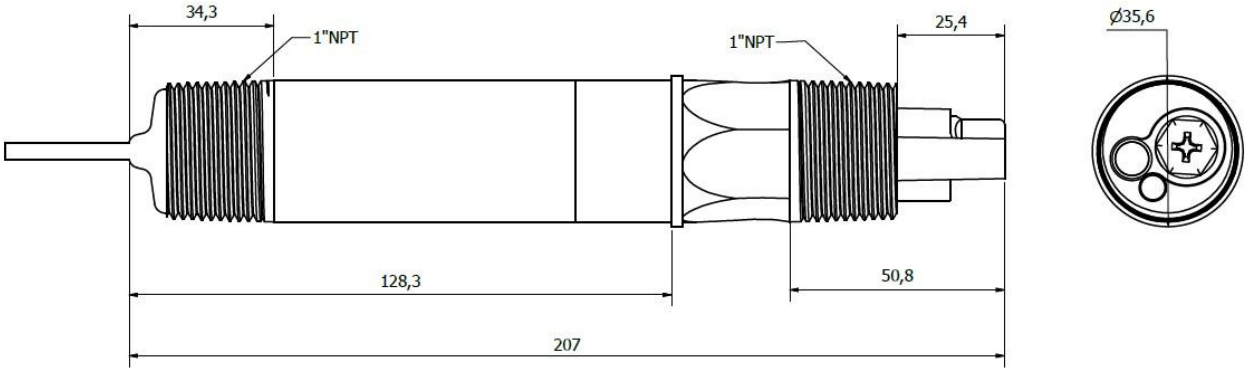
**NOTE**: Do not discard the protective cap that came with the sensor. If the sensor is removed from the process for a longer period, thoroughly clean the sensor, put a piece of cotton ball with a few drops of water into the protective cap and place it on the sensor. This keeps the junction from drying out which causes slow response when the sensor is put back into operation or causes permanent damage to the sensor. **Sensors should not be left in dry lines or empty vessels for longer periods of time.**

Do not store the sensor in a dry or humid location. When storing, check the protective cap regularly to make sure the cotton ball remains moist. Improper storage of sensors voids the warranty.

## Specifications

| | |
|---|---|
| Measurement Range | 0 to 14.00 pH |
| Wetted Materials | Ryton®(PPS), glass, ceramic, titanium, Viton |
| Ambient Temperature | -15…+50°C |
| Liquid Temperature | -15…+95°C |
| Stability | 0.03 pH/day |
| Resolution | 0.01 pH |
| Sensitivity | < 0.005 pH |
| | |

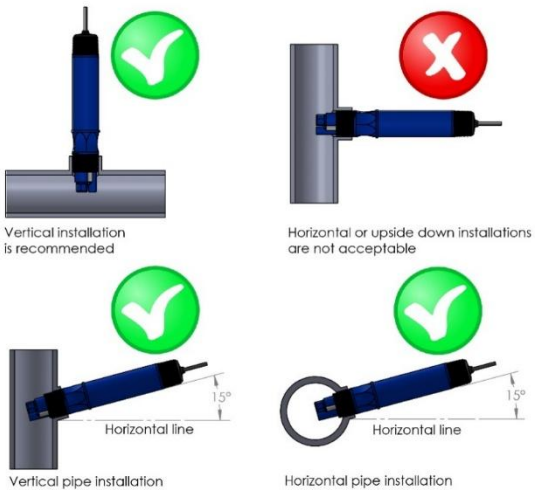
| | |
|---|---|
| Output Span | 1.14 mA/pH |
| Output Offset | 12±1.0 mA @ pH 7 |
| Mounting | 1" NPT |
| Max. Flow Rate | 3,0 m/sec (10 ft/sec) |
| Maximum Load | 450 Ω |
| Temperature Limits | 6,9 barg (100 psig) @ 65 °C, 2,75 barg (40 psig) @ 95°C |
| Power Supply Limit | 24±4 VDC |
| Cable | 4.6 m (15 ft) |



# Installation

**General Instructions**

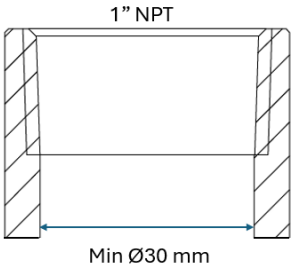
1. If the distance between the probe and the instrument is such that a direct connection is not possible, the probe cable should be routed to a junction box with a terminal strip. The box should be well sealed and away from corrosion danger. Be sure that you have enough slack cable to allow for probe removal for calibration and servicing.
2. Route the interconnect cable from the junction box to the instrument, preferably in metal conduit. Do not run the power cable or control cables in the same conduit with the probe interconnect cable.
3. Remove the protective plastic cap from the end of the probe before placing it in service.
4. The sensor must be installed in direct contact with the brine to be able to measure the pH value. The preferred mounting is from vertical and down to at least 15° above horizontal. Trapped air will disturb the measurement and must be avoided




# The socket

To make sure the sensor isn't damaged when screwed into the vessel you need to make sure there is minimum Ø30 mm clearance below the thread.

If the clearance is smaller than the Ø30 mm the glass electrode can break and the sensor will be damaged beyond repair.



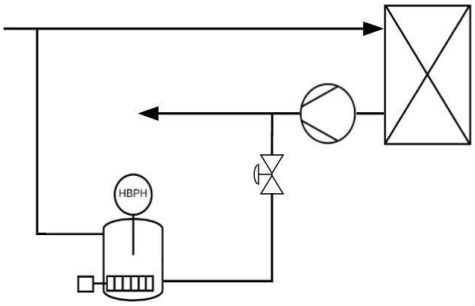

The sensor shown to the right has been in contact with a hard object which has broken the glass electrode inside the blue plastic pipe. Often the breakage is not visible from the top but for this example it is visible as shown below





# Cold Liquid applications

If there is a risk for brine temperatures falling below -15 °C, we recommend using an additional system where a small amount brine is bypassed into a pot with a built-in heating element and thermostat controlling the temperature in a range of 0 to + 10°C.



## Electrical connection

HBPH probes have two wires: black and red. The red wire is to be connected to the +24 VDC terminal and the black wire to the 24 VDC common terminal via the load in the loop. When shortening the cable other wires become visible but only the red and black should be used.

## Storage

1. Do not discard the protective cap that came with the sensor. If the sensor is removed from the process for longer periods of time, thoroughly clean the sensor, put a piece of cotton ball with a few drops of water into the protective cap and place it on the sensor with tape, this keeps the junction from drying out which causes slow response when put back into operation or causes permanent damage to the sensor. **Sensors should not be left in dry lines or empty vessels for longer periods of time.**
2. Do not store the sensors in a dry or humid location. When storing, check the protective cap regularly to make sure the cotton ball remains moist. Improper storage of sensors voids the warranty.

## Maintenance and calibration

### Precise measurement

If you use the sensor for a precise measurement of the pH value, you need frequent checks of the calibration. The drift of the sensor is maximum 0.03pH per day but that is the maximum figure for a sensor in high or low pH environments. Significant lower drift can be expected in neutral environments. Your sensor verification frequency must reflect your needed accuracy.

### Leakage detection

When used for leakage detection the required accuracy is low and annual or biannual checks should be sufficient, especially when a warning is used. For brines with a pH value between 6 and 8 it is easy to detect ammonia. Leakage of 1ml/l will increase the pH value from 7 to 10. Brines using NaCl or glycols will have a pH value like water around 7 and they can be set up with a dual level warning/alarm system.

A dual level warning /alarm system contains a warning level at which you need to check your sensor calibration and a second level where you stop due to leakage. If you have a base pH value of 7 it will make sense to use a warning for pH above 8 and pH below 6. The second level can then be an alarm at pH=9. With such a system it is not necessary to make frequent checks and calibrations, however we recommend an annual or biannual check of the calibration.

## Calibrating the Sensor

When you receive your sensor, it is not calibrated which is needed to provide a precise result. The sensor calibration is made in the PLC, PC, display or where you translate your mA signal into a pH value. So, the calibration is in principle a formula which calculate your pH value based on the mA signal. The parameters

in the formula are based on measurements done with two well-known solutions. Two pH buffer solutions, 7 pH and either 4 pH or 10 pH, and a DC milliammeter are required. The calculations below are done with pH 7 and pH 10. The process is similar for other buffer pH values.

1. Disconnect the red wire at the instrument or power supply and connect it to the multimeter (-) black.
2. Connect the multimeter (+) red to the instrument or power supply red wire output terminal.
3. Rinse the probe and place it in 7 pH buffer solution. Allow the temperature of the buffer and probe to stabilize at room temperature.
4. Write down the reading on the multimeter as mApH7 (in the example called: ”mApH7”). The reading should be between 11 and 13 mA. If not, the probe is defective, or the salt bridge needs to be replaced
5. Rinse the probe and place it in 10 pH buffer solution. Allow the temperature of the buffer and probe to stabilize at room temperature.
6. Write down the reading on the multimeter as mApH10 (in the example called: ”mApH10”).
7. Reinstall

The pH value is calculated using this formula: pH= K * mA signal + C

**Example:**

The two constants can be calculated like this for 7 and 10 pH solutions:

The noted currents for the two solutions in the example are: mApH7 =11.08mA and mApH10=14.47mA

K = (pH value1-pH value2) / (mApH7 - mApH10) =7 - 10 / 11.08 - 14.47 = -3/-3.39 =0.885

C = pH value1 - K* mApH7 = 7 – 0,885 *11.08 = - 2.81

The formula looks like this: pH = 0.885 * mA signal - 2.81

## Checking the Sensor

The operation of the 2-wire, 4-20 mA sensor can be checked by a few simple measurements. Two pH buffer solutions, 7 pH and either 4 pH or 10 pH, and a DC milliammeter are required.

1. Disconnect the red wire at the instrument or power supply and connect it to the multimeter (-) black.
2. Connect the multimeter (+) red to the instrument or power supply red wire output terminal.

3. Rinse the probe and place it in 7 pH buffer. Allow the temperature of the buffer and probe to stabilize at room temperature.
4. Check the offset of the probe by reading the multimeter. The reading should be between 11 and 13 mA. If not, the probe is defective, or the salt bridge needs to be replaced. If the offset is OK, please note the exact reading and proceed to the next step.
5. Rinse the probe and place it in 4 pH or 10 pH buffers. Allow the temperature of the probe and buffer to stabilize at room temperature. Now check the span of the probe by reading the multimeter. If the probe is in 4 pH buffers, the reading should be between 2.75 and 3.5 mA lower than the reading obtained in 7 pH buffers.
6. If the probe is in 10 pH buffers, the reading should be between 2.75 and 3.5 mA higher than the reading obtained in 7 pH buffers.
7. If this test is not satisfied the probe is defective, or the salt bridge needs to be replaced.
8. If the span of the probe drops below 2.75mA than the probe still can be used. Adjustments will have to be made to the receiving device to compensate for the low span.

## Probe Cleaning

The probe should be kept reasonably clean to avoid measurement errors. Frequency of cleaning can only be determined by experience. **To** clean proceed as follows:

1. Rinse with clean warm water.
2. Soak the end of the probe in warm water and dish detergent for 3 or 4 minutes.
3. Brush the end of the probe, particularly the three electrodes with a soft bristle brush such as a toothbrush. Take care not to scratch the glass electrode.
4. If the probe is still not clean, it may have to be cleaned with acid. *CAUTION: Do not acid clean probes used in processes containing cyanide solutions.* Some experimentation may be required to determine the most suitable acid for your process. Use the most dilute acid, which is effective. Normally 10 parts of water to one-part muriatic acid (HCl) is sufficient. *Do not use hydrofluoric acid.*
5. Soak the probe for not more than 5 minutes in the chosen acid; then rinse thoroughly with clean warm water and soak in water for 3-5 minutes.
6. Calibrate the system in accordance with the instrument instruction manual.

## Replacement of Salt Bridge

1. If the system cannot be calibrated after cleaning the probe, it may be necessary to replace the standard cell solution and/or the salt bridge. A salt bridge kit is available from HB Products for this purpose.

2. Hold the probe vertically electrodes up. Remove the used salt bridge. The salt bridge is a hexagonal-shaped capsule that can be removed using a #3 Phillips screwdriver. ½" wrench or pliers can also be used.
3. Discard the used salt bridge.
4. Dispose of the used solution inside the bridge chamber and rinse with pH 7 solution or distilled water.
5. Refill the chamber with a reference solution supplied with the salt bridge, up to the tip of the electrode inside the chamber. DO NOT OVERFILL. It is important to leave space for the salt bridge thread and a small amount of air.
6. Screw the new salt bridge into the cavity until finger tight. If needed, use a #3 Phillips screwdriver to make sure that the salt bridge edges are aligned with the front of the probe face.




## Troubleshooting

A sensor that is not functioning properly will output a current that is out of range of the specifications listed in Checking Sensor section.

The change in output with calibration standard constitutes the span. For a pH probe, the span between pH 4 and pH 7 or between pH 7 and pH 10 should be between 2.75 and 3.5 mA.

| **Issue:** | **Likely cause:** | **Troubleshooting:** |
|---|---|---|
| The output of the sensor DOES change between pH buffers but not as good (quick) as it should (or did) before.<br>Span less than 0.9mA/pH | The process electrode (glass bulb) is coated with scaling or biofouling<br>A coated electrode will create a narrower span | If the coating is from scaling then soaking the probe in a weak acid (e.g. vinegar or 0.1M HCl) will remove the scale. If the coating is from fouling then soaking the probe in bleach will clear it. |

| | | |
|---|---|---|
| The offset is outside of spec:<br>11mA > pH7 > 13mA | The reference solution has been contaminated with the process or the salt bridge has fouled | Salt bridge replacement is needed |
| The pH reading DOES NOT change at all when changing from one calibration solution to another | The process electrode is inoperable (likely cracked or broken) or the printed circuit board (PCB) has failed | Sensor is non-repairable |
| The output is outside of 4-20mA | The sensor electronic has failed or the measuring system does have common ground | Sensor is non-repairable if faulty.<br>To check the measuring system: disconnect the sensor from the system and test it using a separate power supply and an amp meter |

## Avoiding Isolation Problems

The sensor is a loop-powered, and therefore, subject to issues caused by different ground potential for the water the sensor is immersed in and the ground for the PLC/measuring device. Isolation issues (or lack thereof) can be some of the most difficult problems to solve. The symptom of a pH sensor that the output measured in a simple circuit consisting of a power supply, a multimeter, and the sensor, is different from what is measured when the sensor is mounted in the system – when having the same fluid. If you suspect that the process in which the probe is installed has a different potential, then an external galvanic isolator into between a sensor and the PLC will solve the problem. The galvanic isolator exists in a loop powered version.

## Parts and Accessories

| Description | Part # |
|---|---|
| 3-pack salt bridge replacement kit | HBPH-SB-KIT |
| Controller for pH Sensor | HBPH-C1 |
| Controller for pH Sensor | HBPH-C1-ENC |

## Sensor Return

If you are returning a probe for inspection, enclose description of the problem. Pack the probe adequately to avoid damage to the glass electrode and ensure that it will not be exposed to temperatures below -15°C. HB Products cannot be responsible for shipping damage or for damage due to frozen electrodes. For safety reasons, HB Products cannot accept probes which have not been thoroughly cleaned to remove all process material and put a piece of cotton ball with a few drops of water into the protective cap and place it on the sensor with tape to prevent it from drying out.

## Further Information

For further information, please visit our website, www.hbproducts.dk, or send an email to: support@hbproducts.dk.