FAQ – SENSOR CARE & MAINTENANCE

For Turtle Tough pH and ORP Sensors

Document Version 1.7

A Guide to Cleaning and Calibration

A frequently asked question pertains to the cleaning and calibration frequency of Turtle Tough sensors. While providing a definitive answer is challenging due to the complex nature of individual scenarios, a Turtle Tough sensor offers a decreased frequency for cleaning and calibration due to its enhanced durability. Capable of lasting up to 10 times longer than ordinary sensors, a Turtle Tough sensor experiences a reduced rate of deterioration, thereby extending the time between cleaning intervals while still upholding the necessary accuracy and performance levels.

In the pursuit of optimal sensor performance, it is essential to understand the correlation between cleaning frequency, efficacy, and the resulting effects on sensor life and accuracy. Striking a balance between the labour hours dedicated to cleaning and maintaining sensors and the desired expectations for longevity and precision is a highly individualized decision.

As a user of our cutting-edge sensor technology, we encourage you to consider these factors and make informed choices based on your unique requirements and goals. Recognizing that one size does not fit all, we refrain from imposing a single solution for all our valued customers. Instead, we are committed to providing you with the necessary guidance and support to tailor your sensor maintenance strategy, ensuring peak performance and reliability.

Factors influencing cleaning and calibration

There are several factors that determine how often a sensor will require cleaning and calibration, these include:

- **Sensor Contamination:** the rate at which major constituents poison the sensor
- **Sensor Deterioration:** the rate at which the sensor is naturally depleted by the process through chemical ion exchange, heat, pressure etc
- **Accuracy:** The user defined accuracy required to maintain acceptable process control
- **Fouling:** how quickly the process coats and blocks the sensor
- **Cleaning Quality:** using the right chemicals and techniques to remove contamination and fouling from the sensor. Poor cleaning will lead to accelerated deterioration.
- **Cleaning Frequency:** Yes, even the frequency affects the frequency. More frequent cleaning keeps the sensor in optimal condition for longer periods, whereas neglecting a sensor will actually cause permanent changes & damage to the chemical structure which leads to an increased requirement for cleaning & calibration.

IMPORTANT TIP: Often the biggest mistake users make is not attending to a sensor until it shows signs of failure or incorrect readings (which could be weeks or months after installation). Often this is too late to be recovered as permanent damage has already occurred. A sensor must be regularly cleaned whether it is showing signs of distress or not.

Do I need to clean a Turtle Tough Sensor?

YES, it is necessary to clean a Turtle Tough pH sensor to maintain its accuracy and performance. Although these sensors are designed to be more stable and robust than conventional sensors, they still require regular cleaning to remove fouling or process build-up that can affect their performance. Additionally specific cleaning methods must be used to remove or neutralise chemical contamination that is invisible to the naked eye. Conditioning is an important finishing step that ensure replenishment of the reference system.

By following the recommended cleaning schedule for your application, you will prolong the life of your Turtle Tough pH sensor and ensure hassle-free operation. Keep in mind that the cleaning process should be carried out with care, using appropriate chemicals and avoiding any mechanical damage to the delicate sensing elements.

Cleaning Made Easier

No one enjoys the task of cleaning, but we have engineered a range of enhancements over traditional sensors that significantly alleviate this chore. These improvements encompass:

- Reduced Fouling: Our sensors are designed with expansive surface areas and composed of low-fouling materials, taking much longer to clog or foul compared to conventional sensors.
- Open Geometry: The open designs promote high flow through the sensing element, naturally preventing the accumulation of solids and build-up. Our robust sensing elements withstand high velocities without any adverse effects, which in turn help maintain sensor cleanliness.
- Chemical Resilience: The distinct selection of construction materials renders our sensors highly resistant to potent chemicals. This quality proves essential during the cleaning process, as strong acids, alkaline, and surfactants can effectively eliminate contaminants without damaging the sensor, unlike ordinary sensors.
- Physical Resilience: Our sensing elements rank among the most durable worldwide. With proper techniques, you can mechanically clean a sensor and remove contaminants and fouling that would be impossible with traditional sensors.

Important Note: It is crucial to differentiate between fouling and contaminants when cleaning the sensor. Fouling refers to the visible accumulation of debris on the sensor's surface, which effectively insulates it from the process. In contrast, contaminants are invisible substances that can chemically alter and damage the sensor at a microscopic level. During the cleaning process, it is essential to not only remove visible debris but also eliminate contaminants using appropriate chemical treatments. This is why merely rinsing a sensor in water is insufficient for proper cleaning.

A general guideline for cleaning and calibration frequency is provided below:

Desired Accuracy	**Application Difficulty**		
Drift (pH units)	**TOUGH**	**MODERATE**	**EASY**
0.1	**2**	**7**	**14**
0.3	**7**	**14**	**28**
0.5	**14**	**28**	**56+**

TABLE 1.0 – Frequency of cleaning and calibration interval represented in DAYS.

NOTE: this is a general guideline only and should not be relied upon for accurate process control. Your Turtle Tough consultant can advise in general terms whether your application is of TOUGH, MODERATE or EASY application difficulty. As a general guide: if your existing sensors last less than 6 months, consider you application TOUGH, up to 6-18 Months MODERATE and more than 18 months would be considered EASY.

CIP Processes

The Clean-in-Place (CIP) process can have various effects on pH sensors, depending on the specific conditions and procedures used. It should always be recognised that a pH/ORP sensor is an electrochemical device and the more a pH/ORP sensor is exposed to chemicals, the faster its performance and functionality will degrade, eventually leading to its failure. Here are some potential effects:

- **Exposure to Cleaning Agents:** During the CIP process, pH sensors may come into contact with cleaning agents or chemicals. These substances can potentially affect the performance and accuracy of pH sensors. Strong acidic or alkaline solutions used in the cleaning process may cause deterioration or damage to the sensor's sensitive glass membrane or other components.
- **Fouling or Coating:** If the CIP process involves substances that can deposit or coat the sensor surface, it can lead to fouling. Deposits on the sensor can create a barrier, affecting the diffusion of ions and thus altering the pH readings. This can result in slow response times or inaccurate measurements.
- **Temperature Effects:** CIP processes often involve high temperatures to enhance cleaning effectiveness. Extreme temperature changes can impact the performance and calibration of pH sensors. Thermal stress can affect the integrity of the sensor's construction, alter the properties of the reference electrolyte, or cause shifts in the sensitivity of the sensor.
- **Mechanical Stress:** CIP processes typically involve vigorous flow rates and pressures. Strong flows or pressure fluctuations can subject pH sensors to mechanical stress. Excessive stress or physical impacts may damage the sensor or affect its calibration, leading to inaccuracies in pH measurements.
- **Sensor Contamination:** If the CIP process does not effectively remove residues from the cleaning agents or other substances, the sensor may become contaminated. Contaminants can interfere with the sensor's performance, resulting in inaccurate pH readings.

To mitigate these effects, it is important to consider the compatibility of pH sensors with the cleaning agents and conditions used in the CIP process. Selecting pH sensors specifically designed for CIP applications, following manufacturer guidelines for sensor maintenance and cleaning, and regularly calibrating the sensors after the CIP process can help minimize potential issues and ensure accurate pH measurements. It may be necessary to completely remove the pH sensor during the CIP process if it is sufficiently aggressive and leads to unacceptable sensor life.

How to determine calibration frequency

Please note that our guidelines should not be solely relied upon to determine your calibration requirements. Each chemical process is unique, and the required accuracy can only be determined by your site-specific needs and the expertise of your process control personnel. Users must establish a drift profile for their application before deciding on a suitable calibration interval. Cleaning and calibration intervals may differ significantly between individual applications.

To ascertain drift characteristics, periodically test the sensor against a known buffer or accurate grab sample to determine the rate of drift (i.e., the discrepancy between the displayed value and the standardized solution). Test frequently at half the expected calibration frequency to gauge the sensor's deviation from the standard solution. When the sensor reaches the threshold of your accuracy requirement, this can serve as an indicator for establishing your calibration regimen. It is advised that

a sensor is thoroughly cleaned each time it is removed for calibration. Even if it appears clean, follow the cleaning process to eliminate microscopic contaminants that could impact sensor performance.

The recommendations provided in this document apply to most Turtle Tough pH and ORP sensors. However, care and maintenance for your specific sensor may differ from the descriptions provided here. For information on proper care and maintenance for your particular pH or ORP sensor, tailored to your installation and application, please contact the factory.

IMPORTANT TIP: To perform cross verification of measurement or measure sensor drift, always user a buffer solution, rather than a grab sample. Buffers are the “gold standard” and present us with a known, undisputable value for accuracy. Grab samples on the other hand are HIGHLY prone to human and equipment error and serve as a rough guide only.

Maintenance Free (Not Clean Free)

Turtle Tough Digital pH and ORP sensors are a completely sealed assembly and are sealed for life. This provides extreme process resistance as well as a maintenance-free sensor which greatly increases sensor life and reduces labour costs. A Turtle Tough sensor does not contain any o-rings, washers, gaskets, or serviceable components/assemblies. It does not require refilling of electrolyte or replacement of any individual components. The only requirement is regular cleaning following our recommended cleaning schedule for your application. Regular cleaning will prolong the life of your sensor and ensure hassle-free operation.

General Cleaning Guidelines

To assist with the cleaning process, Turtle Tough provides a Cleaning Instruction Video on our website, which serves as a visual guide. It is crucial to note that cleaning requirements will vary based on the sensor's application, and we recommend obtaining a customized cleaning plan or guideline from your Turtle Tough consultant to ensure optimal cleaning.

To achieve the best results during cleaning, we suggest using the Turtle Tough cleaning kit, which can be obtained from your local outlet. This kit has been specially formulated to provide the utmost care to the sensing element and reference components, enhancing the sensor's performance and lifespan. The kit includes a specialized glass cleaner/polish powder, a sensor conditioning solution, 15% HCl solution, and various tools for reference cleaning and glass polishing.

To carry out proper cleaning, follow these steps:

1. Use a brush to remove any large solids and contaminants from the sensor tip while rinsing it under tap water.
2. Soak the sensor in the 15% HCl solution for a minimum of 10 minutes or longer, if required, to dissolve deposits.
3. Rinse the sensor thoroughly with water.
4. Use a blade to carefully scrape the reference material clean, taking care to avoid any contact with the glass or sensing element.
5. Add a small amount of the glass cleaning powder (approximately 1/4 tsp) into a beaker. Wet a cotton bud tip and create a paste with the powder. Apply the paste to the glass and polish the glass tip with the cotton bud to remove any film or coatings.
6. Rinse the sensor thoroughly with water.

7. Soak the sensor in the sensor conditioning solution for at least 10 minutes or longer, if required, to enhance sensor response.

IMPORTANT: We emphasize that appropriate protective equipment, such as gloves and eye protection, should always be worn when handling the cleaning kit and cleaning the sensor. Additionally, it is important to follow all safety precautions and work safe methods of your particular workplace or jurisdiction.

By utilizing the Turtle Tough cleaning kit and following these recommended cleaning steps, you can ensure optimal performance and longevity of your Turtle Tough pH/ORP sensor.

OTHER TIPS:

- Avoid scratching or vigorously scrubbing the pH or ORP (sensing) elements. These glass electrochemical electrodes are delicate and can be easily damaged by mechanical force.
- The reference junction is made of solid-state material and can be cleaned using aggressive chemicals. Consult the list of recommended cleaning solutions below. A sharp razor-edged tool can also be used for mechanically cleaning this solid-state reference effectively.
- Exercise caution not to scratch the pH glass or ORP element when cleaning the reference junction.

Approved cleaning solutions include:

- 5-15% Hydrochloric Acid (for alkaline deposits)
- 5-15% Sodium Hydroxide (for organic contaminants)
- Surfactant (non-ionic soaps such as Micro-90)
- 10% Ammonium Bifluoride

Cleaning the Reference Junction in the Presence of Oils and Fats

To effectively clean the reference junction, employ a mechanical method using a suitable straight-edge razor. Carefully scrape the surface of the reference junction, taking precautions not to touch or scratch the pH glass. This is achievable due to our unique solid-state reference technology.

To remove oily or fatty build-up from the pH glass, there are two primary methods. Begin with the milder approach, and if necessary, proceed to the more aggressive technique.

1. The first method involves using a dye-free and fragrance-free surfactant, such as MICRO-90 cleaner. This effectively removes build-up without dehydrating the pH glass element.
2. If the first method is insufficient due to the build-up's nature or extent, employ a NaOH solution to chemically break the bonds in the oil or fat. While this caustic cleaning solution is highly effective, it can dehydrate the pH glass, necessitating reconditioning time with HCl acid. This step neutralizes any residual NaOH on the sensor. Conclude the process with final conditioning in the conditioning solution before recalibration.

Removing Silicate Contamination

To eliminate silicate contamination, use a potent acidified ABF cleaning solution. A 10% ammonium bifluoride (ABF) solution acidified with hydrochloric acid (HCl) is recommended for effective removal. The degree of activation required (i.e., the amount of acid added to the 10% ABF stock solution just before cleaning) depends on the extent of silicate fouling on the sensor and the cleaning frequency. Silicate contamination cannot be removed without a strong activated ABF cleaning, as it binds to the

pH glass and reference surfaces. The strong acidified ABF cleaning solution dissolves deposited silicates, making them easier to remove from the sensor tip. The Turtle Tough Ultra pH sensor with High HF resistant glass is one of the few sensors globally capable of withstanding this intensive HF cleaning regimen. The pH glass used for this cleaning service exhibits high impedance to ensure durability and longevity.

WARNING: This procedure should only be attempted if the sensor is equipped with the High HF resistant glass option.

IMPORTANT SAFETY NOTICE: The cleaning methods described above may involve hazardous materials. These recommendations do not cover all necessary safety precautions and it is the responsibility of the end user to determine safe working principles to carry out this maintenance regime. This should only be undertaken by qualified and trained personnel.

Conditioning for Calibration

Once the sensor has been cleaned, ensure it is thoroughly rinsed with deionized water to eliminate any remaining cleaning agents. Subsequently, immerse the sensor in conditioning solution to recondition the pH and reference elements. Conditioning solution is supplied in all Turtle Tough pH/ORP Cleaning Kits. This solution consists of 1:1 mixture of Buffer pH 4 and saturated potassium chloride (KCl). Certain sensors may also necessitate conditioning in saturated potassium chloride alone if the reference junction's solid-state conductive polymer has been depleted of ions (common in clean water applications). Allow the sensor to condition in saturated potassium chloride and/or pH 4 buffer for the duration needed to obtain the best calibration results.

Implement a Proven Cleaning and Maintenance Strategy

We strongly advise you to consult with a Turtle Tough representative to create a customized cleaning plan tailored to your specific needs. In many cases, inadequate sensor performance can be attributed to improper cleaning and maintenance practices. Failing to safely and effectively remove contaminants can lead to premature sensor failure. Contact us to discuss the most suitable cleaning regimen for your site or facility.

Improve Your Maintenance Program

Leverage the Power of Digital Smart Sensors

Hot swapping pH/ORP sensors is only feasible with smart digital sensors due to their advanced features and capabilities that facilitate seamless sensor interchange. These intelligent sensors offer several advantages that make hot swapping possible and efficient:

- **Built-in Memory:** Smart digital sensors store calibration data and sensor-specific information within their internal memory. This enables the immediate recognition and accurate operation of the sensor when it is connected to the system, eliminating the need to recalibrate when switching sensors.
- **Automatic Sensor Recognition:** Digital sensors communicate with the transmitter or controller, allowing for automatic recognition of the sensor type, calibration data, and other essential information. This ensures a smooth transition when hot swapping sensors without requiring manual input or adjustments.

- **Enhanced Diagnostics:** Smart digital sensors provide real-time diagnostic data, such as sensor health and performance indicators, making it easier to identify when a sensor needs cleaning or maintenance. This allows for timely hot swapping to maintain optimal process control.
- **Simplified Maintenance:** Digital communication simplifies the maintenance process by providing detailed information about the sensor's condition and history. This enables more effective cleaning and calibration regimes and ensures that the hot swapped sensor is in optimal condition for use.
- **Reduced Error:** The digital communication between smart sensors and the control system minimizes the risk of errors caused by signal noise or degradation, ensuring that the hot swapped sensor operates accurately and reliably.
- **Plug-and-play Capability:** The ease of connecting and disconnecting smart digital sensors from the system simplifies the hot swapping process, allowing for quick and straightforward sensor replacement.

By utilizing smart digital sensors, hot swapping becomes a practical and efficient option for maintaining accurate process monitoring, reducing downtime, and extending the life of your pH sensors, ultimately enhancing overall process efficiency and quality.

Benefits of Hot Swapping

Hot swapping pH/ORP sensors offers several advantages when implementing a cleaning regime. By having multiple sensors available for use, you can ensure minimal process downtime and maintain consistent monitoring and control. Here are some benefits of hot swapping pH sensors:

- **Reduced Downtime:** With hot swapping, you can replace a fouled or contaminated sensor with a clean, calibrated one immediately, minimizing the time your process is without pH/ORP monitoring. This helps maintain the efficiency and effectiveness of your process.
- **Consistent Monitoring:** By swapping out sensors for cleaning, you can ensure that your process is consistently monitored by well-maintained and accurate sensors, contributing to improved process control and product quality.
- **Optimized Cleaning:** Removing a sensor for cleaning allows for thorough and proper maintenance without rushing or compromising the cleaning process. This can lead to a longer sensor lifespan and better performance.
- **Calibration Efficiency:** While one sensor is being cleaned and calibrated, the other sensor continues to monitor the process, ensuring uninterrupted data collection and process control.
- **Extended Sensor Life:** Regularly swapping and cleaning sensors can help extend their lifespan by preventing excessive fouling or damage from contaminants, reducing the need for frequent sensor replacement.
- **Flexibility:** Hot swapping pH/ORP sensors allows you to adapt your cleaning and maintenance regime to specific process conditions or changes, ensuring optimal sensor performance.

By incorporating hot swapping into your pH/ORP sensor cleaning regime, you can maintain accurate process monitoring, reduce downtime, and extend the life of your sensors, ultimately improving overall process efficiency and quality.

ULTRA Communication Hub and Management Software

Enhance your sensor management toolkit with the Turtle Tough ULTRA Communication Hub and Sensor Management Software. It's not just another communication and configuration tool—it's the

most comprehensive solution available for seamless connectivity and control over your Digital Smart Sensors (DSS).

With the ULTRA Communication Hub, you can directly connect Turtle Tough Digital Smart Sensors to your PC, opening up a world of possibilities. Our user-friendly Windows PC Management Software empowers you to calibrate, configure, and manage your sensors with ease, all in one centralized platform.

Key Features of the ULTRA Communication Hub:

- **Windows PC Management Software:** Our intuitive software grants you unprecedented control over your sensors. View real-time sensor readings, perform calibrations, access sensor diagnostics and history, and effortlessly determine sensor health. Experience unparalleled visibility and make informed decisions with confidence.
- **Calibration Reports Made Easy:** Printing calibration reports has never been simpler. The ULTRA Communication Hub seamlessly generates detailed reports, providing a comprehensive record of sensor calibrations for your documentation needs.
- **Easy Plug & Play Interface:** Enjoy a hassle-free experience with our user-friendly plug and play design. Simply connect the ULTRA Communication Hub to your PC, and you're ready to go. No complicated setup or configurations required.
- **USB Powered Convenience:** The ULTRA Communication Hub draws power directly from your PC through a USB connection. No need for additional power sources or batteries—just plug in and get to work. Experience hassle-free operation and uninterrupted productivity.
- **Rugged and Reliable:** Designed to thrive in industrial environments, the ULTRA Communication Hub comes housed in a rugged NEMA 4X enclosure. It features three NEMA 6P quick-connect plugs, allowing simultaneous connection of up to 4 Smart Sensors, maximizing efficiency and productivity. You can also connect multiple hubs to expand you connectivity.

Elevate your sensor management capabilities with the ULTRA Communication Hub and Management Software. Experience the power of seamless connectivity, advanced diagnostics, and effortless control over your Digital Smart Sensors. Unlock the full potential of your Digital Smart Sensors and revolutionize your sensor management workflow. Experience the future of sensor connectivity today.

Self-Cleaning Systems: Efficacy, Limitations, and Calibration Considerations

Self-cleaning systems for pH/ORP sensors are designed to automate cleaning processes, reducing manual intervention and maintenance efforts. While these systems have their benefits, they also come with certain drawbacks and limitations, particularly when it comes to calibration.

- Efficacy: Although self-cleaning systems help maintain sensor performance by removing fouling and build-up from the sensor surface, they may not be effective in eliminating all types of contaminants, especially those that are chemically or microscopically bound to the sensor. This can lead to reduced sensor life and accuracy over time.
- Calibration requirements: Despite the automated cleaning capabilities of self-cleaning systems, sensors still need to be periodically removed for calibration, as these systems alone cannot perform this crucial task. Calibration ensures that the sensor maintains its accuracy and performs optimally in various process environments.

- Recalibration after cleaning: It is important to note that every time a sensor is cleaned, it should also be recalibrated to ensure optimal performance. This step cannot be overlooked or automated by self-cleaning systems, further emphasizing the need for manual intervention.
- High expense: The installation and maintenance of self-cleaning systems can be costly, particularly for smaller operations. Considering the potential shortcomings in cleaning efficacy, system failures, and the need for manual calibration, the added expense may not be justifiable.
- Maintenance: Self-cleaning systems, designed to reduce maintenance efforts, may still require periodic inspection, repair, and replacement of components, adding to the overall cost and effort required for maintaining optimal sensor performance.

In summary, while self-cleaning systems offer some advantages in terms of automation and reduced manual intervention, they may not be the most effective or cost-efficient solution for all applications due to their limitations in terms of calibration and cleaning efficacy. Hot-swapping smart digital sensors provides a more reliable and comprehensive cleaning approach, ensuring accurate and consistent performance across a wide range of process environments. Additionally, it allows for controlled removal and calibration of sensors, contributing to improved sensor longevity and performance.

If you would still like to explore the feasibility of a self clean system, please contact your Turtle Tough representative.

Important Sensor Care Information

Sensor Selection

It is the end user's responsibility to ensure that sensors are not used beyond their specified temperature and pressure limitations. Users should carefully assess the suitability of sensors for their intended application(s). If you have any doubts about whether your sensor is appropriate for a specific application, please consult the manufacturer for guidance. However, the ultimate decision regarding the sensor's suitability lies with the end user.

Minimizing Thermal Shock for Enhanced Sensor Longevity

In high-temperature applications where the process liquid exceeds 70°C, taking preventive measures against thermal shock is essential for prolonging the life of the sensor. Thermal shock occurs when a sensor undergoes rapid temperature changes, resulting in the expansion and contraction of its internal components. This process can cause damage, micro-cracking, accelerated deterioration, or even complete sensor failure. To mitigate the effects of thermal shock, follow these guidelines for carefully heating or cooling the sensor during removal, insertion, cleaning, and calibration processes.

Tips for Preventing Thermal Shock:

- Gradual Cooling: When removing a sensor from a hot process, allow it to air cool to ambient temperature before immersing it in a cold liquid, such as a buffer or cleaning solution. This gradual cooling helps to prevent thermal shock by allowing the sensor's components to contract slowly and evenly, minimizing the risk of damage.
- Gradual Heating: Whenever possible, heat the sensor gradually during the insertion process. If a gradual increase in temperature is not feasible within the process, consider a two-stage heating approach before inserting the sensor into the hot process. For example, first immerse the sensor in hot tap water (around 50-60°C) to bring it up to temperature, allowing the components to expand slowly and uniformly. Then, place it into the hot process. This method

significantly reduces the impact of thermal shock, extending the sensor's lifespan and ensuring reliable performance.

By following these guidelines for minimizing thermal shock, you can protect your sensor from damage and extend its useful life, ensuring consistent and accurate results in your high-temperature applications.

Unpacking

- Please have a copy of your order with you when you unpack your instrument.
- Please check that you have all the parts that were ordered as soon as you open the box. If anything is missing, or damaged, please contact your sales outlet immediately.
- All orders are checked when they leave the factory and performance indicators recorded on our QA documentation.
- It is **ALWAYS** recommended to bench test the sensor upon receipt and **prior to installation** in a controlled environment (ie in the lab or workshop) to verify correct operation.
- During installation, handle the sensor with care. Despite being tougher than your average sensor, these are still delicate sensing instruments and can be damaged by improper handling, unstable electrical installations and accidental contact with hard or sharp surfaces.
- Special care must be taken with the cable, to ensure it is not damaged by sharp or abraded surfaces. Damage to the sensor cable will allow the ingress of liquid or moisture which will cause internal failure of the electronics.
- If the instrument needs to be returned for any reason please follow the return instructions given in the manual.

Installation

- Please refer to our manual for installation requirements and always install in accordance with the manufacturers directions.

Sensor Storage Guidelines

The standard shelf life for all Turtle Tough pH and ORP sensors is one year from the date of shipment. Sensors stored longer than this period may still be functional but are no longer under warranty. To maintain the performance and longevity of your sensor, adhere to the following storage guidelines:

- Storage Environment: Store sensors in a cool, dry location with the sensor tip (where the pH/ORP element is located) oriented toward the ground.
- Conditioning Solution: All sensors come standard with a conditioning solution in the cap. This solution is a mixture of 50% pH 4 buffer and 50% saturated potassium chloride (mixed by volume). Ensure the sensor cap remains tightly affixed to the sensor body when not in use.
- Sealing the Cap: Seal the sensor cap with common piping Teflon or PVC tape to preserve the conditioning solution and protect the sensor.
- Warranty Claims: Sensors that are to be returned for a shelf-life warranty claim must have the original sensor cap and conditioning solution intact to be eligible for warranty replacement. Contact the Turtle Tough factory before returning any sensor for warranty claim to obtain a valid RMA (Return Merchandise Authorization) number.

If you need to store your pH or ORP sensor for future use or plan to use it intermittently, following these storage steps will help ensure the sensor's longevity and continued performance.

General Tips for Sensor Care

- Buffers must be fresh and free from contamination.
- It is recommended to utilize buffer 4 or 10, or a buffer solution with a value close to the process measurement value, when testing or validating a sensor's operation or accuracy. Buffer 7 should never be used as a reference standard, as it represents 0 mV.
- Never use tap water or de-ionised water as a calibration standard.
- ALWAYS STORE your sensor in recommended conditioning solutions. Never store sensors in demineralised/de-ionised water as this will cause irreparable damage to the sensor.
- Never follow the care instructions of another manufacturer and apply them to Turtle Tough sensors. Our construction and chemistry is uniquely different and applying other care and maintenance techniques may result in sub-optimal performance or even damage.
- It is important to clean and calibrate the sensor at the same interval, as rinsing the sensor and returning it to the process may not effectively remove microscopic contamination. This type of contamination can be more detrimental than surface debris that is visible. Therefore, every time a sensor is removed for maintenance, it should be thoroughly cleaned according to the manufacturer's instructions, followed by a calibration.

Caustic Soda & Extreme Alkaline Environments

Caustic soda, also known as sodium hydroxide (NaOH), is a strong base that can impact the lifespan of a pH sensor in several ways:

- **Physical Deterioration:** Strong caustic solutions can potentially erode or damage the physical structure of the sensor, particularly if the sensor is made of materials that are susceptible to such erosion.
- **Chemical Degradation:** Caustic soda is a strong base and its presence could cause chemical degradation of the glass bulb at the tip of the sensor which is sensitive to hydrogen ion concentration. This could lead to slow response times and eventually inaccurate readings.
- **Ionic Strength Interference:** High concentrations of sodium ions from caustic soda can affect the liquid junction of the pH sensor (the part that allows the measurement circuit to be completed). The ionic strength difference can create a junction potential, leading to offset in the pH measurement.
- **Alkaline Error:** At very high pH values (generally above 12), most pH sensors start to exhibit an error due to interference of sodium ions with hydrogen ions at the glass membrane of the electrode. This is called alkaline error and can lead to the sensor displaying lower pH values than actual.

To prolong the life of pH sensors, they should be cleaned and calibrated regularly, and if possible, a sensor specifically designed to withstand high pH or caustic conditions should be used. It is highly recommended to use our Teflon Silicone Sealant option for this application (consult with Turtle Tough). Furthermore, the sensor should not be left in the caustic solution longer than necessary for the measurement to prevent unnecessary exposure.

DISCLAIMER:

The information provided by Turtle Tough, inclusive but not limited to care recommendations and procedures, is of a general nature and is intended solely to furnish users with product information. It should not be interpreted as professional advice tailored to your specific needs, nor should it be considered as an endorsement or assurance of the suitability of our products for your particular application.

While we strive to provide accurate and useful information, we do not guarantee that our products or recommendations will be appropriate for your specific purpose or application. It remains the end user's responsibility to assess and ensure the suitability of our products and/or procedures for their own needs and safety requirements.

Please note that Turtle Tough shall not be held liable for any damages, losses, or inconveniences that may arise from the use or misuse of our products, or from any reliance on the information we provide. This disclaimer applies to any potential liabilities, including but not limited to, direct, indirect, incidental, consequential, or special damages.

Users are strongly advised to conduct their own independent evaluations and tests to ascertain the suitability and performance of our products within their specific circumstances.

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