



MANUAL

pH/ORP SENSOR

+ Installation + Calibration + Cleaning + Care & Maintenance



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Safety Precautions

Before **attempting** to unpack, set up, or operate this instrument, please read this entire manual.


- Make certain the unit is disconnected from the power source before attempting to service or remove any component.
- Make certain the unit is disconnected from other sources of force or pressure (for example, pneumatic or hydraulic), before attempting to service or remove any component.
- Failure to follow these precautions could result in personal injury and damage to the equipment.






General

This manual contains basic information to be noted during installation, operation and maintenance. It is therefore essential that this manual be read by the contractor before installing and commissioning the system, as well as by the relevant operating personnel/owner of the unit. It must remain available for reference at all times. In addition to the general safety instructions under this main heading Safety Precautions, the special safety precautions outlined in other sections must also be observed.

Warnings used in this manual

This manual contains vital information relating to the safety of people and the environment, the analyser and any equipment attached. These statements are identified by the following symbols:

Danger Electric shock risk		Disconnect electrical supply before working on this equipment.
--------------------------------------	---	---

 Danger	DANGER Refers to an imminent danger. Non-compliance can lead to death or extremely serious injury.
 Warning	WARNING Refers to a potentially hazardous situation. Non-compliance can lead to death or extremely serious injury.
 Caution	CAUTION Refers to a potentially hazardous situation. Non-compliance can lead to minor injury or property damage.
 Notice	NOTICE Appears in conjunction with safety instructions which may endanger the analyser and its operation if disregarded.
 Important	IMPORTANT Draws attention to supplementary information to make the work easier and ensure trouble-free operation. Markings that are affixed directly to the equipment must be observed without fail and must remain fully legible at all times.

Qualification and training of personnel

The personnel employed for installation, operation, inspection, and maintenance, must be suitably qualified for this work. The areas of responsibility, competence and supervision of the personnel must be precisely defined by the owner. Personnel who do not have the required know-how must be trained and instructed. Also, the owner of the system must ensure that the relevant personnel are fully familiar with and have understood the contents of this manual. Should training be required please contact your Turtle Tough distributor

Important safety instructions

When installing and using this electrical equipment, basic safety precautions should always be observed, including the following:



Danger

NOTICE

Read and follow all instructions. Save these instructions.



Warning

WARNING

To reduce the risk of injury, do not permit children to use this product.



Electric Shock
Hazard

WARNING

Risk of Electric Shock. Connect only to a suitable isolated, hard-wired electrical outlet. It is recommended that the outlet is protected by an RCD (Residual Current Detector) or is in any event in compliance with all local electrical regulations. Do not bury the electrical supply cable.



Electric Shock
Hazard

WARNING

To reduce the risk of electric shock, replace damaged electrical cable immediately.



Danger
Electric Shock
Hazard

WARNING

To reduce the risk of electric shock, do not use an extension cable to connect the unit to an electric supply; provide a properly located outlet

Hazards due to non-compliance

Failure to comply with the safety instructions may endanger not only people but also the environment and the system. The following hazards, in particular, may arise:

- Failure of major system functions.
- Failure of specified methods for maintenance and repair.
- Danger to people due to electrical, mechanical and chemical effects.

Safe Operation

The safety instructions contained in this manual must be observed.

The owner is responsible for ensuring compliance with local safety regulations.

Installation, Maintenance and Inspection

The owner must ensure that all maintenance, inspection and installation work is undertaken by authorised and duly qualified personnel who have also studied this manual.



Warning

- Sensors must always be isolated before starting any work.
- Please be aware that the connected sensor(s) and the associated analyser may be controlling chemical dosing and as such shutting down the unit without due regard to the systems it is controlling can lead to the chemical release.

Impermissible Modes of Operation

Usage other than as described in this manual will lead to the immediate cancellation of the warranty and any other manufacturer's liability.



Caution

Unauthorised Modification

Usage other than as described in this manual will lead to the immediate cancellation of the warranty and any other manufacturer's liability.



Danger

Chemicals

Should the sensor(s) be in contact with hazardous chemicals, great care must be taken when handling them.



Important

CAUTION

When handling this equipment, the accident prevention regulations applicable on-site must be observed and the specified personal protective equipment worn.

PPE: examples of protective clothing, gloves and goggles.



Disconnect electrical supply before working on this equipment



DANGER Fire hazard. No parts are suitable for use in a hazardous rated area.

IMPORTANT

Please unpack the equipment and ordered accessories carefully in order not to miss small parts. Immediately compare the scope of delivery to the delivery note. If there are any discrepancies, contact your Turtle Tough Representative.



Appropriate PPE to be worn when in contact with the sensor

Health and Safety

Before making or breaking any electrical or signal connections, ensure that the instrument is isolated from the electrical supply. When handling the sensor please wear the appropriate PPE.

Environmental Considerations

Please use this product in a manner sensitive to the environment and at the end of its life dispose or recycle in a manner appropriate at that time that complies with local regulations.



Take care when removing the sensor

Introduction

Congratulations on purchasing a Turtle Tough sensor. Turtle Tough sensors are handmade with care and precision, combining state-of-the-art technology and materials to deliver superior performance under extreme conditions. This instruction manual provides information for the correct installation and use of Turtle Tough pH/ORP sensors to ensure you get the maximum life and performance from your sensor.

All Turtle Tough pH/ORP sensors utilise a solid-state conductive reference junction. With this technology, we can achieve accurate measurement while resisting process contamination into the reference system. This ability to maintain high ionic conductivity while resisting aggressive gas intrusion is what makes our sensors outlast virtually all others in any process conditions.

Your Turtle Tough sensor is built with our unique and proprietary glass formulations and sensing elements to provide extreme performance in harsh environments. Through our experience in the world's toughest applications, we have developed systems that have been optimised for high hydrofluoric acid, saturated sodium, high sulphide, organic solvents, high temperature and slurry/viscous applications. Our application-specific sensors include Industrial, Wastewater, Acid Etching, Nickel, Gold, Titanium Dioxide, Food and Beverage and Pharmaceutical.

Please ensure that the system you are using is suitable for your intended application. You can locate your specific sensor in the sensor selection matrix, which can be found under support at www.turtletoughsensors.com

Specifications

Turtle Tough sensors are made from a variety of specialised plastics, sealants and materials.

For your sensor configuration please refer to our website www.turtletoughsensors.com

Please ensure the composition of your chosen pH/ORP sensor is appropriate for your application.

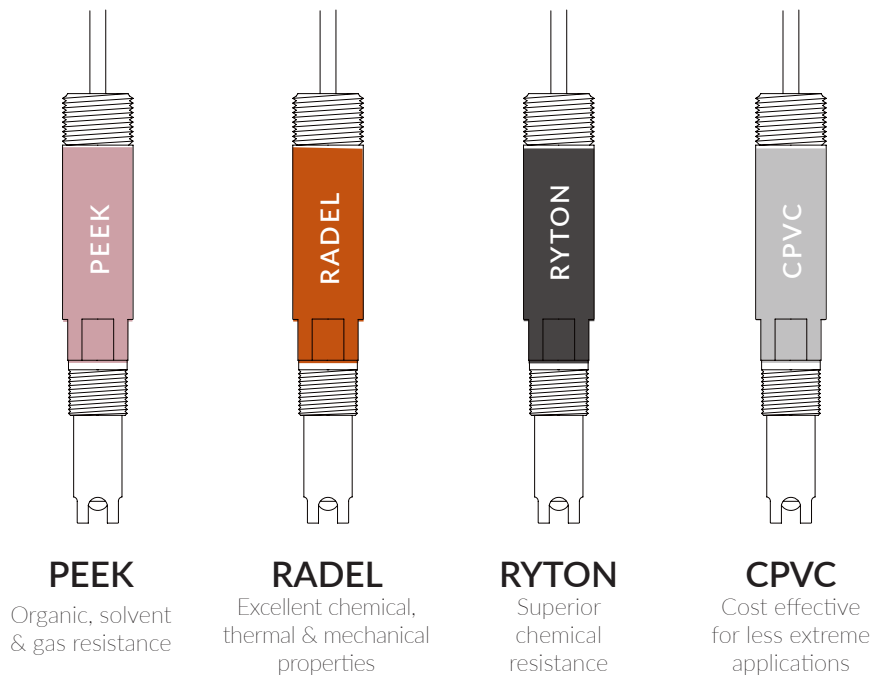
To ensure your sensor is fully optimized it is recommended a Turtle Tough Application Questionnaire be completed which can be found in the "Contact Us" menu at www.turtletoughsensors.com

Body Plastics

Turtle Tough Sensors are available in 4 main body plastics which include:

- CPVC - Chlorinated-Polyvinyl-Chloride
- RYTON - Poly-Phenylene-Sulfone
- RADEL - Poly-Phenyl-Sulfone
- PEEK - Poly-Ether-Ether-Ketone

Each body plastic serves a function based on cost versus chemical and physical resistance.



Reference Materials

Turtle Tough sensors are available in two types of reference materials:

- HDPE - High-Density Polyethylene
- Polypropylene - (PP)
- KYNAR - Poly-Vinylidene-Fluoride

Each reference provides benefits around accuracy, cost, chemical/gas resistance and temperature resistance.

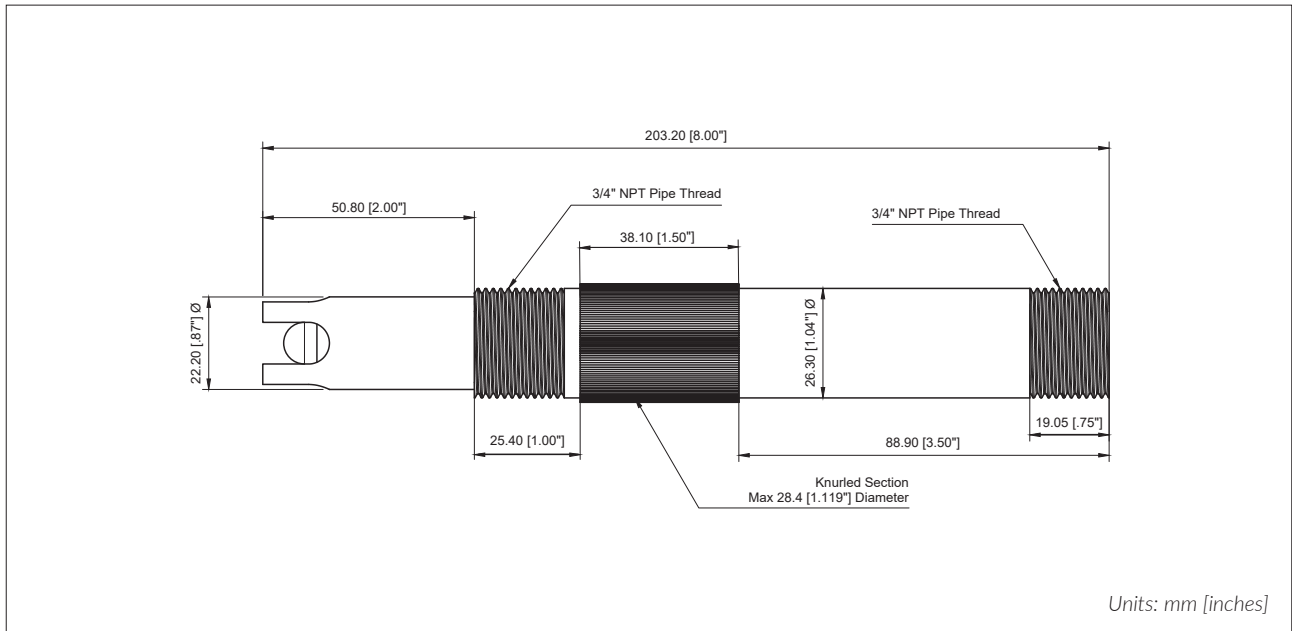
Dimensions

Turtle Tough Sensors are available in the following body configurations:

- Immersion with 3/4" MNPT and 3/4" MNPT back-end
- Immersion with 3/4" MNPT front-end and 1" MNPT back-end
- Twist Lock with 1" MNPT back-end
- Inline with 3/4" MNPT back-end

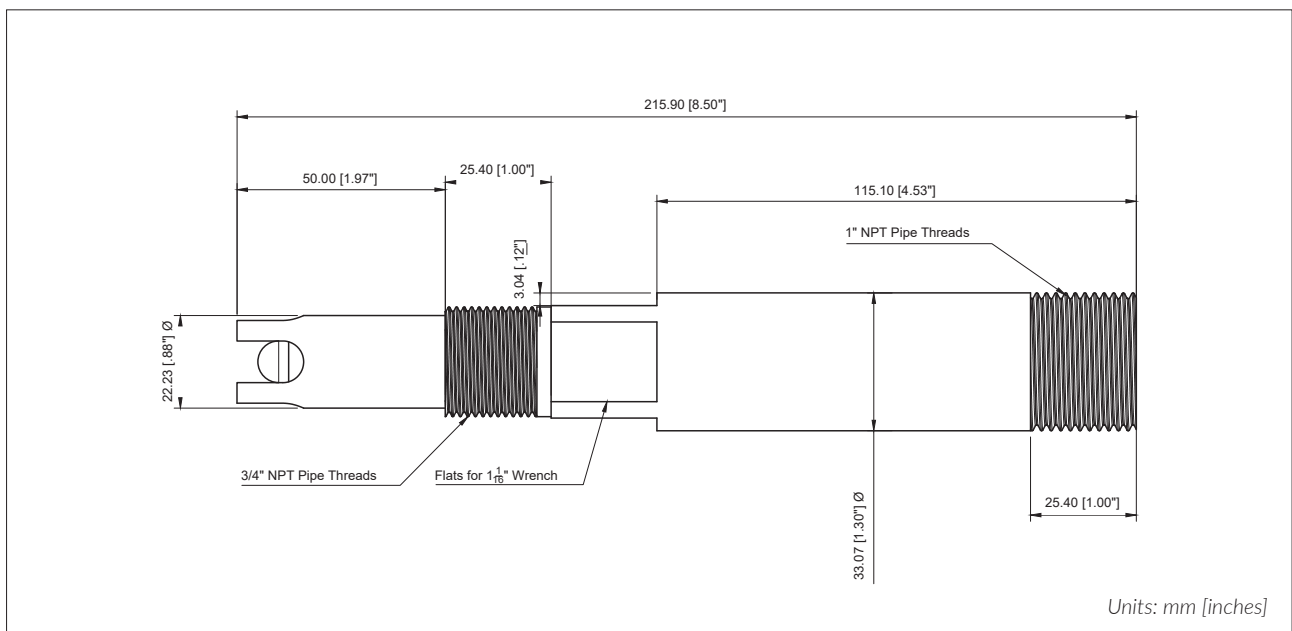
Immersion with 3/4" MNPT and 3/4" MNPT back-end

(pH sensor shown with optional guard and without waterproofing and cable)



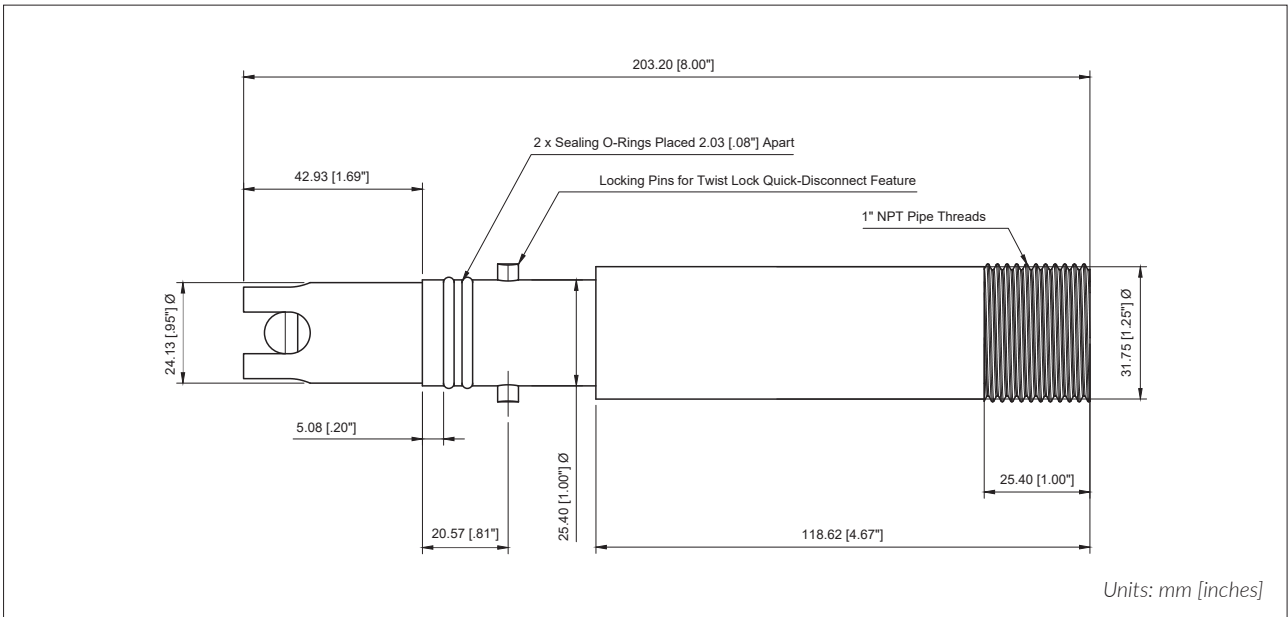
Immersion with 3/4" MNPT front-end and 1" MNPT back-end

(ORP sensor shown with optional guard and without waterproofing and cable)



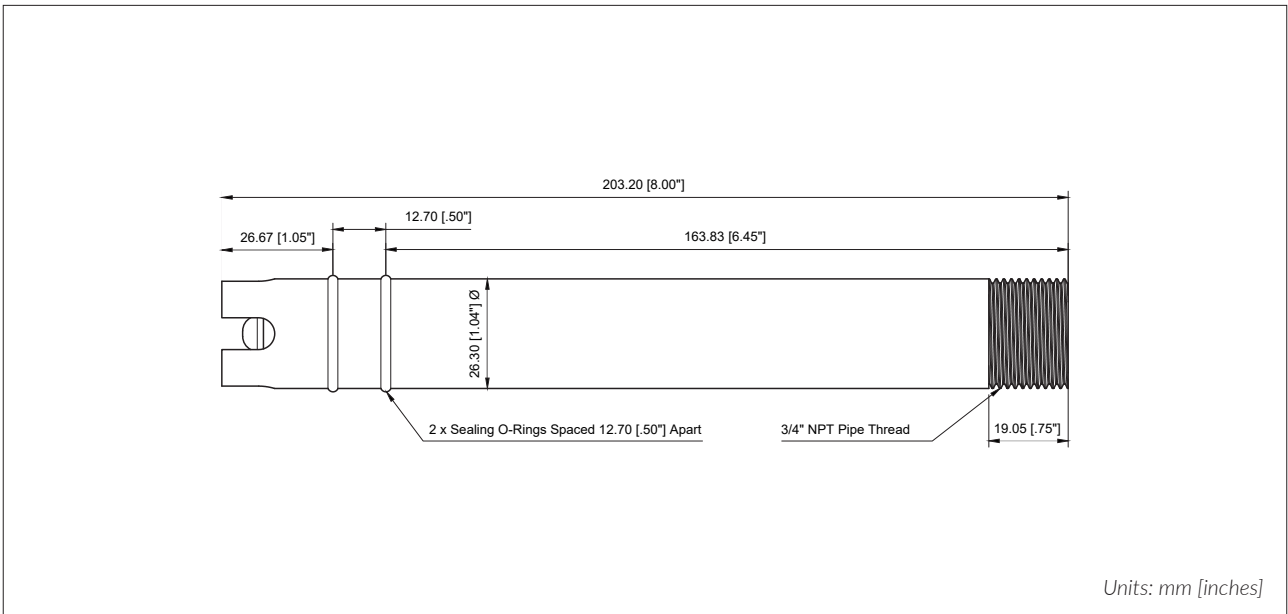
Twist Lock with 1" MNPT back-end

(pH sensor shown without optional guard, waterproofing and cable)



Inline with 3/4" MNPT back-end

(ORP sensor shown without optional guard, waterproofing and cable)



Installation

As with all instrumentation, the installation and commissioning of this instrument are crucial to its safe and effective operation. This instrument must only be used for its purpose as outlined in this manual. It must be installed and commissioned following this manual and by trained, qualified personnel.



Danger
Electric
Shock
Hazard

Site Selection

Please choose a suitable location for the installation of the electronics. The choice of installation point on any site is a compromise and is best undertaken by an experienced installation engineer. The following is a list of the factors that need to be taken into consideration. This list is not intended as a checklist neither is it implied that the list is complete.



Important

- Ensure that the sensor is positioned to enable adequate flow
- Avoid installing the sensor within 1m of any dosing point
- Minimise all potential sources of electrical interference
- Static and ground loop faults can damage the sensor or cause erroneous readings and all precautions should be taken to avoid them

Note: This list is not intended as a checklist neither is it implied that the list is complete.

Unpacking

- Please have a copy of your order with you when you unpack your instrument. All orders are checked when they leave the factory.
- 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 Turtle Tough representative immediately.
- If the instrument needs to be returned for any reason please follow the return instructions given in this manual.
- Please dispose of the packing in an environmentally responsible manner and in compliance with local regulations.



Important

Mounting

A Turtle Tough pH/ORP Sensor has been engineered for installation into industrial processes. Use within the specifications is highly recommended to obtain optimal sensor life.

Care should be taken to avoid any moisture ingress through the cable inlet/outlet. pH Sensors are optimally installed at 45° as this avoids air bubbles being trapped at the sensor/process interface and ensures optimal glass/silver-chloride interaction. It is also acceptable to install vertically down. They should never be installed inverted (ie upside down).



Important

All pH/ORP Sensors can be installed in-line. Submersible installation is also possible provided adequate waterproofing is selected at the time of order or adequate sealing is made between the sensor and installation hardware at the time of installation for example.

Turtle Tough has a range of installation hardware available as optional accessories including but not limited to KYNAR/PEEK Twistlock fittings, Stainless Steel Immersion Rods, Stainless Steel Inline Sensor Holders and Extension Tubes and Valve Retractable Assemblies. Contact your Turtle Tough Distributor for technical support on the optimal installation hardware to suit your application.

Please Note: Avoid excessive force when installing a pH/ORP Sensor.

Installation Recommendations

Turtle Tough pH and ORP Sensors have been engineered for installation into industrial processes. It is the responsibility of the end-user to ensure that the process conditions are within the specifications of the sensor to obtain optimal sensor life.

Submersible Installations

When installing care should be taken to avoid any moisture ingress through the cable inlet/outlet. For fully submersible installations adequate waterproofing options must be selected at the time of order. Alternatively, you can provide your waterproofing method by using a fully sealed immersion rod with adequate sealing applied to the sensor thread (ie with thread sealing tape), ensuring that process liquid cannot sit on the backend of the sensor.

It is recommended that immersion rods be made from stainless steel or a suitable metal product to provide adequate earthing for the sensor. Plastic immersion rods are very susceptible to static and provide no grounding to relieve the sensor of any stray current in the process environment. Sensors will often produce "jumpy" or erratic results if not properly grounded.

Never suspend the sensor by the cable as this will cause damage to the backend connections within the sensor. If such an installation method is required, the cable protection (CP) option should be invoked. Cable protection uses vinyl or noreprene sheath around the cable which is fixed to the body of the sensor thus providing the required strain relief, allowing the sensor to be raised or lowered by the cable. It also provides additional protection from the environment, protecting the cable from accidental damage from sharp, hot or abrasive materials which compromise its integrity. Please note that cable protection only ever covers $\frac{2}{3}$ of the sensor cable length.

Inline Installation

All pH/ORP sensors can be installed in-line and the correct inline method should be chosen at the time of order. For inline installation, please pay attention to the following:

- Where possible, avoid using front end threaded connections. When threading the sensor in/out of the process continuously (ie each time you clean and calibrate) the cable is constantly exposed to stresses from twisting. This constant twisting and curling of the cable can damage the connections in the backend of the sensor. It is recommended to use either twist lock, Inline or hot-tap installation methods.
- Both twist lock and Inline tri-clamp installation methods require isolation of the process line for insertion and removal. Hot-tap is the only method that allows insertion and removal while the line is live.
- All inline sensors have their temperature compensation (TC) element located at the tip of the sensor for accurate process temperature measurement. This does expose the element to potential damage, so for sensors ordered as fully submersible, they have their TC located in the backend of the sensor for better protection. In circumstances where you want to use a submersible sensor for an inline installation, it's important to note that the TC is sitting in "ambient" conditions and will not accurately represent the process liquid unless that liquid is also at ambient temperature.
- Where possible avoid plastic pipework. Static and stray current can produce very erratic readings. If you do have plastic pipework, sensors should be installed in metallic housings that can be adequately earthed, or you must have some other means of adequately earthing your pipework.

Earthing and the Electrical Environment

It is important that ALL electrical equipment is properly earthed and that sensors are installed in adequate earthed environments. As such it is recommended that pH/ORP sensors are installed in metallic fittings that can be properly grounded. pH and ORP sensors measure small incremental millivolts (ie there are just 59mV per pH unit), so any small amount of current, static or otherwise can cause large shifts to the sensors readings. In these instances, there is nothing wrong with the sensor; it can only see what it sees. Instead, the cause of the stray current must be eliminated. Stray currents are usually caused by improperly earthed or shielded equipment. They can occur

on either the process side of the power/electrical side and they can even occur through the atmosphere/air. As such the pH/ORP sensor should be installed as far away as possible from high current carrying equipment such as pumps, motors, variable speed drives etc.

Position-Sensitive Sensors

It is recommended that pH Sensors be optimally installed at a 45° angle as this avoids air bubbles being trapped at the sensor/process interface and ensures optimal glass/silver-chloride interaction. It is also acceptable to install vertically down. pH sensors should never be installed inverted (ie upside down) or below the horizontal axis. They must be at least 15° above the horizontal axis.

Position Insensitive Sensors

For ORP and Conductivity, these are both positions insensitive, meaning the sensor can be installed at any angle. pH and Dissolved Oxygen on the other hand are not, and must always be in the vertically down position. It is still recommended to install these sensors vertically down (tip down) for several good reasons:

- Upside down is messy and can result in product spillage and overflow.
- It can be unsafe if the process is not isolated correctly.
- Product with any solids... solids can settle out and get trapped in the sensor tip and cause excess fouling.
- People see an ORP or Conductivity sensor upside.... They then install a pH or DO sensor upside down (which is not good).

Should you require any more assistance regarding the installation of our sensors, please contact Turtle Tough.

Choosing the correct waterproofing option

Recommendations for Inline, Immersion and Submersible Installations

Turtle Tough Inline Twist Lock sensors and immersion sensors are NOT intended to have rain or other continuous forms of water on the back of the cable. In this case, a shorting can result in a variety of anomalous failure modes.

**** IF SUCH ANOMALOUS FAILURE MODES RELATED TO THIS OCCUR THIS IS CONSIDERED AN IMPROPER INSTALLATION ISSUE AND THUS NOT COVERED UNDER THE STANDARD TURTLETOUGH WARRANTY ****

The sealing on the back of a twist lock and immersion sensors is water-resistant, but not waterproof. The standard default isolation on the back of a sensor is a strain relief grommet. This allows for the sensor to be somewhat moved and for some minor water exposure without causing sensor failure. For more aggressive water exposure to the back of the sensor, additional precautions must be taken.

Indoor Inline Use

If a standard sensor (such as our immersion or Twist Lock sensor series) is used for inline installations only (no immersion or submersible use is planned) then no special precautions are required if it is for indoor use. This assumes that the back of the sensor will not be exposed to corrosive gas present and/or the plant will not cause any process media to get onto the back of the sensor, nor give it significant water exposure by washing down the area.

Outdoor Inline Use

If a standard sensor (such as an immersion or Twist Lock sensor series) is used for inline installations only (no immersion or submersible use is planned) then there generally ARE special precautions required for outdoor inline use. The most common is to seal the back end of the sensor in conduit to isolate the back end of the sensor. The most common approach so to use sufficient TEFLON tape and an FNPT coupling to create this back sensor seal, and then either a rigid or flexible conduit back to the transmitter where the plugs are terminated for cable isolation. This creates a barrier that makes the sensor suitable for conditions where rain and other outdoor elements could damage the seal on the back of the sensor. Specifically, this can prevent water from attacking along the sensor cable and causing internal shorting to solder joints inside the unit itself.

Another approach for sealing the back of the sensor if there will be significant water exposure is to add a waterproofing option. In general, for such cases, just the least expensive cable protection option is sufficient, with a 3/8"X1/2" vinyl tubing properly installed. The cable protection option has a slight surcharge for extended cable lengths. In some cases, the more robust Standard waterproofing option can also be used to fulfil this purpose. Unfortunately, waterproofing options cannot be added once a sensor has been fabricated but rather must be installed at the time of manufacture.

Immersion Use

Immersion use is defined as when the sensor is immersed into the process media, but the entire sensor is not submersed. This means that the back of the sensor is NOT completely below the process media level. Immersion installations always require the back of the sensor/waterproofing to be sealed with a mating 1" FNPT coupling and the cable run in conduit. The cable protection or standard waterproofing options can be added if desired/required to make the sensor life better even for such immersion installations. It is possible to use the standard immersion or Twist Lock sensor for immersion use without adding a waterproofing option if VERY GOOD care is taken to seal the back of the sensor with a coupling and properly running the cable in conduit back to the transmitter.

Submersible Use

Submersible use is defined as when the sensor is COMPLETELY immersed into the process media (anywhere from 30cm below the fluid level too much, much deeper). In this case, the entire sensor is submersed. This means that the back of the sensor is completely below the process media level. Submersible installations always require the back of the sensor/waterproofing to be sealed with a mating FNPT coupling and the cable run in conduit.

For additional sealing option a standard waterproofing option can be added if desired/required. There is a special surcharge if the sensor has a longer cable length than the standard 3 metres for the cable protection and extreme waterproofing options only. It is possible to use the standard Immersion or Twist Lock sensor for submersible use without adding a waterproofing option if very, very good care is taken to seal the back of the sensor with a coupling and properly running the cable in conduit back to the transmitter. The use of Standard or Extreme Waterproofing options is VERY STRONGLY recommended (although not strictly required) for submersible installations.

Last comments on waterproofing options

The waterproofing options offer nominal isolation to extreme isolation in the following order going from least isolating to most isolating:

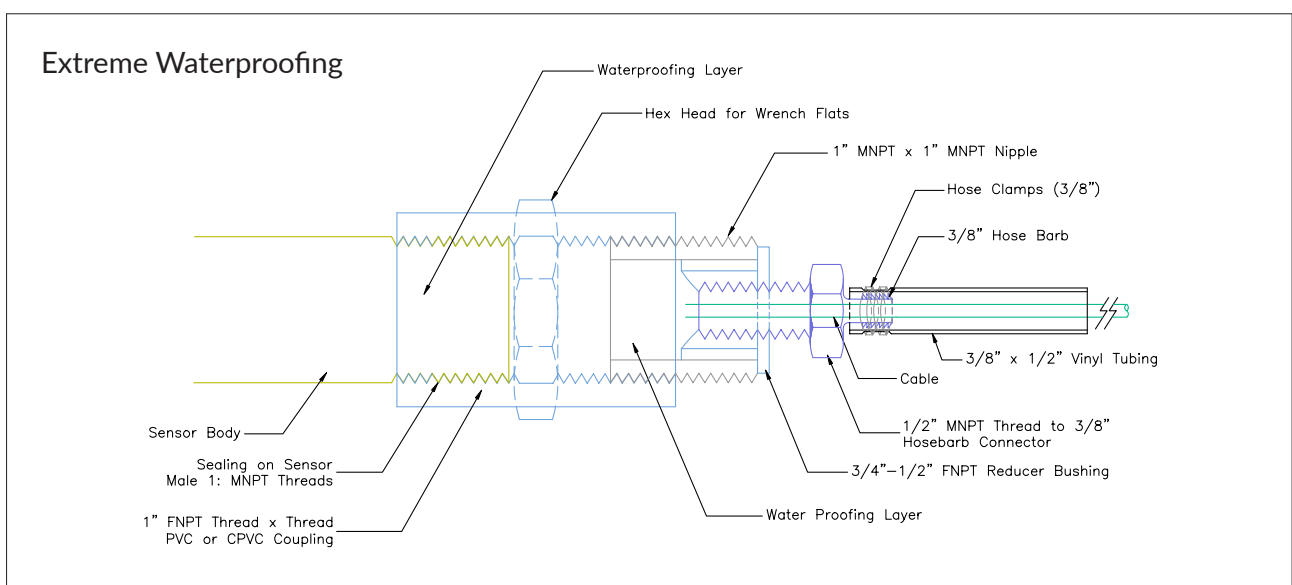
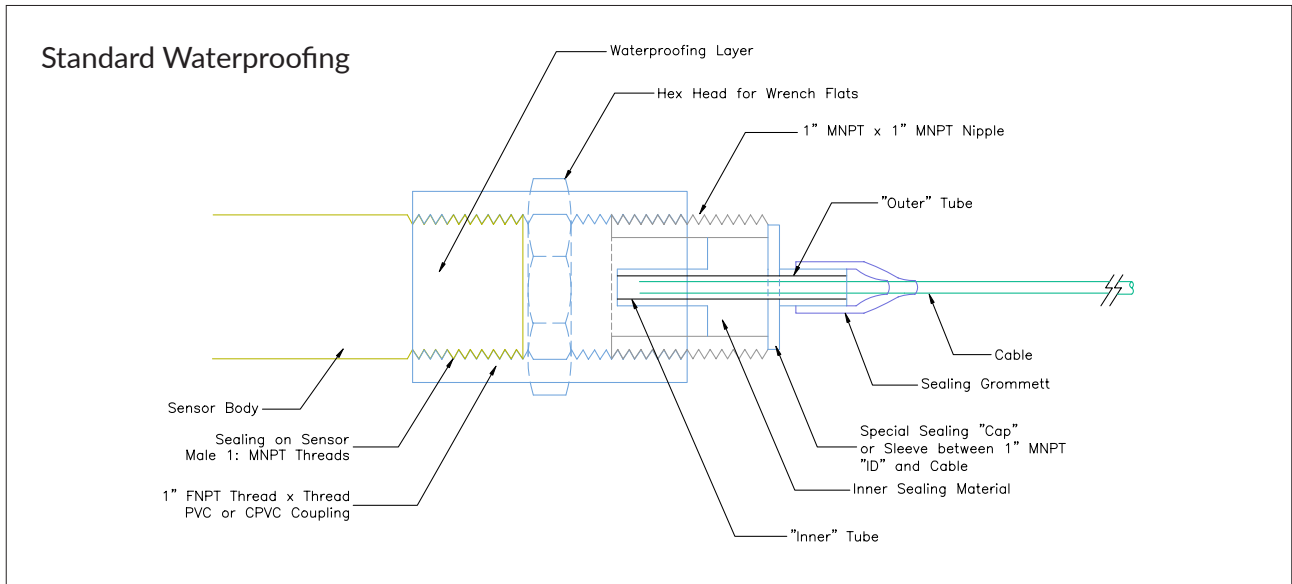
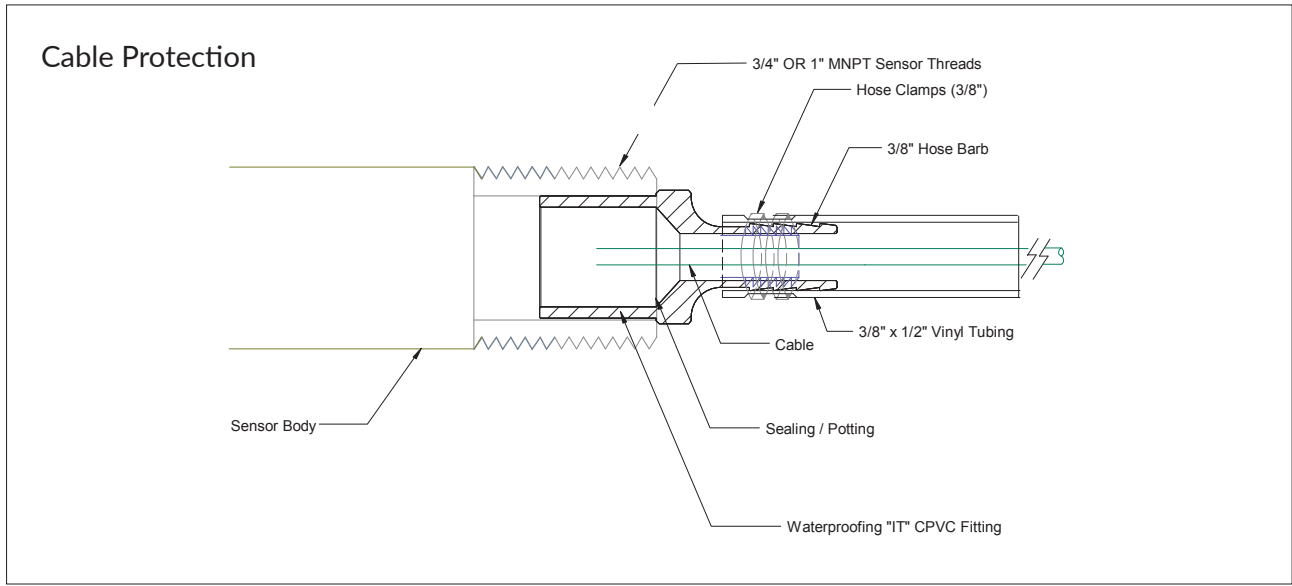
cable protection << standard waterproofing <<extreme waterproofing

Most users will only ever require the cable protection, standard waterproofing or extreme waterproofing options but the more extreme version that supports the presence of oxidizing chemicals and organic solvents are provided for such customers. In general, the Extreme Waterproofing option is only really required for submersible type installations.

Note that ONLY the Cable Protection and Extreme Waterproofing provide for COMPLETE cable isolation back to the transmitter.

If you should have any doubt about whether the exact sensor model that you are using is appropriate for the installation style that you are planning to implement, please contact Turtle Tough for further assistance.

Back-End Waterproof Sealing Options

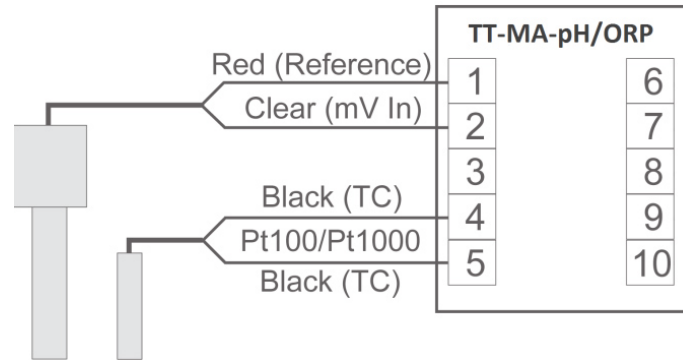


Wiring

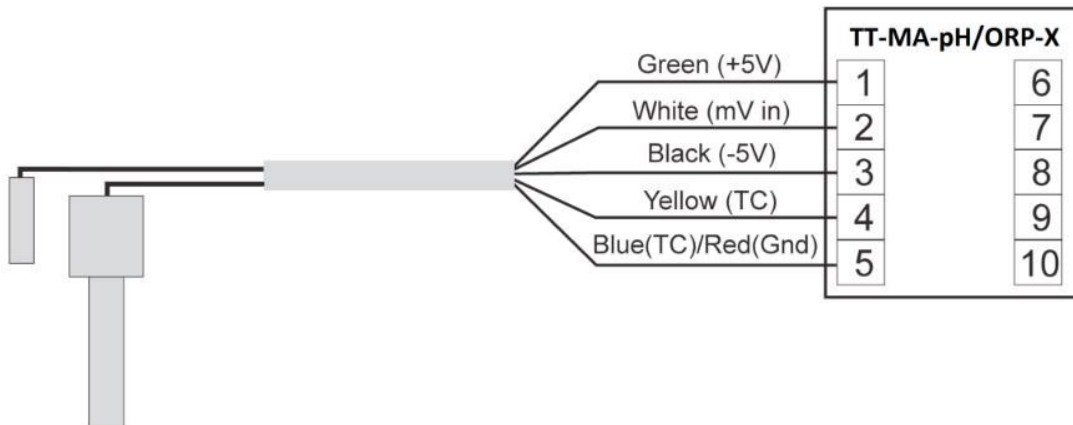
Turtle Tough pH/ORP sensors are designed to provide optimal life when connected to a TT-MA Online Analyser. The connection to the TT-pHP is via BNC and banana plug connectors.

Wiring of non-preamp, preamp and external preamp sensors to the TT-MA are as follows:

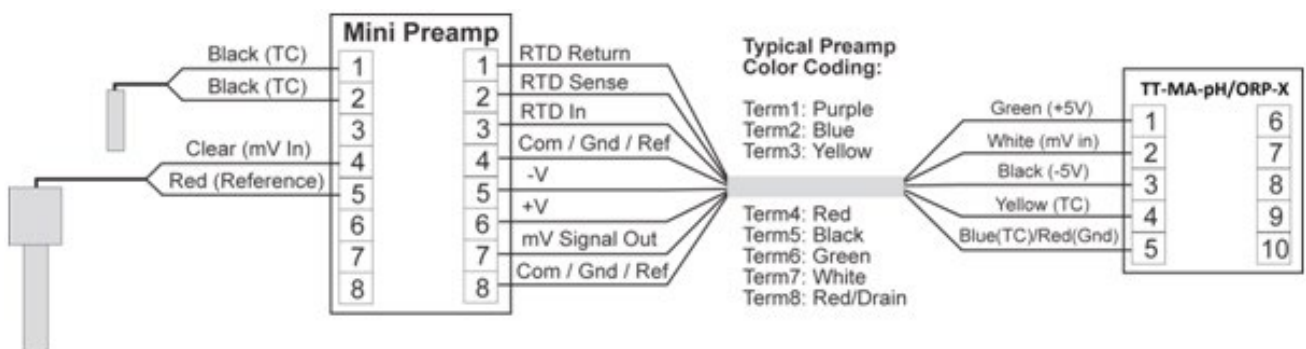
Non-Preamp Sensor



Preamp Sensor



External Preamp Sensor



Calibration

This section covers the calibration of Turtle Tough pH & ORP sensors when mated with a TT-MA Analyser Module. If you are using a different analyser please consult the manual supplied with the unit or the Turtle Tough website www.turtletoughsensors.com

pH Calibration - Buffer and Slope Adjustment

- Ensure software lock is *Off* before commencement.
- Use *Mode*, select *Offset* and calibrate to the first solution value by using the *Up* and *Down* keys.
- The recommend pH buffer for calibration is 6.86 (*preferred*) or 7.00.
- Use *Mode*, select *Slope* and use the *Up/Down* keys until the display reads the second solution value, typically using *pH buffer 4.01 (when measuring pH<7) or pH Buffer 9.18 (preferred) or 10.00 (when measuring pH>7)*.
- Enabling dual-slope mode is recommended when the process media frequently crosses the pH 7 boundary.
- The dual-slope mode is disabled (*Off*) by default, but can be enabled by setting parameter P08 to the *On* state. When dual-slope is enabled, the pH sensor is calibrated at three points: one near pH 7 (*in Offset mode*), then in a pH buffer below pH7 (*in Slope mode*) and then in a pH buffer above pH7 (*in Slope mode*).

You must exit the *Slope* mode by using the *Mode* key after completing the acidic slope (*below pH7*) calibration before entering the alkaline slope (*above pH7*) calibration.

The *Offset* calibration can achieve a process offset whereby the online reading can be made to agree with any grab sample analysis. All calibrations are saved instantaneously as they are performed so there is no “*save*” or “*enter*” operation required. Note that a two (2) second dampener exists for both calibrate modes and a ten (10) second dampener for the measure mode.

The temperature can be calibrated by pushing the *Up* and *Down* buttons when in the temperature display (°C) mode provided the software lock is *Off*.

ORP Calibration

Unlike pH two-point calibrations which establish offset and slope, an ORP Calibration is a single point offset adjustment.

1. Ensure software lock is *Off* before commencement.
2. Using *Mode* select *Slope* (*Note: Offset will not be an option*)
3. Calibrate to the mV value of your prepared calibration solution by using the *Up* and *Down* keys. Negative values will be shown as flashing.

Note: Fresh mV Solution is required to ensure accurate calibration. Unlike a pH buffer, they do not self-stabilise and deteriorate in the air. Solutions will maintain ideal values for about two hours.

Troubleshooting

Many potential issues are involved in the uncertainty of an online pH/ORP measurement. Some of the most common possible issues are summarised below and may apply to your particular installation.

Raw mV Display

For troubleshooting, it is often useful to access the raw uncompensated mV potential of the pH sensor. When assisting you with a diagnosis, a Turtle Tough representative may ask you to place the analyser into the Raw mV Display mode. This can be accessed by pressing the Down key in the main pH/mV display mode. The display now changes from pH to mV units. **Negative values will be displayed as flashing.**

Common Thermal Related Issues

Make sure that the online industrial sensor is in thermal and chemical equilibrium with the process before making any one-point offset calibration. Please note that sensors that run in hot processes should be allowed to cool down to room temperature before performing a 2-point calibration. The temperature indicated on the sensor can be used as a gauge of when it is ready to proceed with a calibration having reached thermal equilibrium with ambient conditions. Calibrating a pH sensor when it is not at thermal equilibrium is a very common cause of calibration error.

Common Offset Type Issues

If the display of the online sensor diverges from the lab expected reference value it is possible to force agree between these two readings with the TT-MA-pH transmitter even after a calibration has been performed with pH buffers. As such, a one-point grab sample type offset calibration is performed when in the *Offset* LED mode. Navigate with the *Mode* key to the *Offset* mode while the pH sensor is installed into the process and while the reading is quite stable. Use the *Up* and *Down* keys to adjust the displayed value to agree with the laboratory determined reference value if desired. Such a grab sample offset type calibration should only be performed after all pH buffer calibrations have been completed.

Ph Buffer Accuracy and Stability Issues

It is important to consider that some pH buffers degrade in quality much more quickly than others when left open to the air, or with exposure to heat and/or light. In particular, both commonly used pH buffer 7.00 and 10.00 are notorious for losing the accuracy of their values when exposed to the air, sunlight or just simply degrade with time. In contrast, the 4.01 pH buffer is a well-known very stable pH buffer and so is the industry default standard for both conditioning and spot 1-point tests for pH sensors. One important step to ensure accurate calibrations with pH buffers is to check whether the buffers employed are still within the expiry period and that they were stored in a cool, dry storage location away from sunlight.

In addition to the 4.01 pH buffer, the 6.86 and 9.18 pH buffers are amongst the most stable pH buffers available. It is strongly recommended colourless pH buffers be used rather than the more common coloured pH buffers. If coloured pH buffers are used for calibrations, they mustn't be also used as the conditioning solution in which pH sensors are stored (this should be reserved for colourless type pH buffers. For higher value pH buffers (10+) it is recommended to purchase only smaller amounts (*to ensure that they stay within expiry*) and keeping them stored in a sealed container in a cool, dry place. This minimises the absorption of carbon dioxide from the air that can alter the value of these high pH buffers. In general, the higher value pH buffers are very unstable, much as the very low pH buffers also tend to be rather more unstable. The best available option for calibration of pH above 10 is the 12.45 type pH buffer. The best available option for calibration of pH below 4 is the type of pH buffer. For general purpose calibrations, the MOST stable pH buffers are 4.01 and 6.86 and to a lesser degree 9.18. If the preferred 6.86 or 9.18 buffers are not available, then 7.00 and 10.00 buffers can be substituted with some slight loss of precision due to the differences in relative pH buffer stabilities.

pH Buffer During Calibration

Since the TT-MA-pH/ORP transmitter does not automatically correct for the temperature effects on your particular pH buffer, you will need to manually enter the correct buffer pH value at your particular temperature to ensure optimum accuracy during the calibration process. Each pH buffer solution is always labelled with the pH value at various temperatures so that you can adjust the pH to the appropriate number. Temperature compensation on the TT-MA-pH does not account for the change in the pH buffer values due to temperature and so this correction must be done manually.

Temperature Effects on pH Reading

More generally, note that temperature compensation for pH mode ONLY accounts for the change in potential of the pH sensor itself due to temperature. Any other temperature-induced changes to the pH of any given solution (*such as changing the effective mean activity coefficient or equilibrium of the process media or pH buffer*) are NOT accounted by temperature compensation and thus must all be considered separately. Lastly, for ORP measurements there exists no temperature compensation at all meaning that the temperature displayed is simply for reference purposes.

Sensor Care and Maintenance

Storage

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. Sensors should be stored in a cool, dry location with the sensor tip (where the pH/ORP element is located) oriented toward the ground. All sensors come standard with a conditioning solution in the cap. This conditioning solution is 50% pH 4 buffer and 50% saturated potassium chloride (mixed by volume). The sensor cap should be kept tightly affixed to the sensor body and sealed with common piping PVC tape when the sensor is not in use. 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 Turtle Tough factory before returning any sensor for warranty claim to obtain a valid RMA.

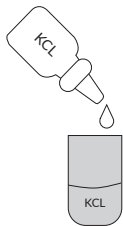
You may need to store your pH or ORP sensor if you don't need to use it right away, or you are using it intermittently. Please follow the storage steps below to ensure your sensor's longevity.



cool & dry

STEP 1

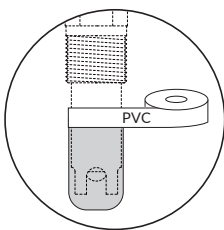
Always store pH or ORP sensors in a cool, dry location.



conditioning solution

STEP 2

All Turtle Tough sensors are delivered with our conditioning solution inside the cap. If you are storing the sensor, this conditioning solution must be present. Contact us if you need to purchase some or make your own by mixing 50% pH 4 buffer with 50% saturate potassium chloride. KCl is the same electrolyte used in our reference systems.



STEP 3

Sensors should always be stored with their rubber cap tightly affixed and sealed PVC tape to ensure that the tip of the sensor remains moist.



STEP 4

The orientation of the sensor is of utmost importance. Always store with the sensor tip (sensing element) pointing downwards so the silver chloride solution stays in contact with the glass bulb, keeping it hydrated.

By following these simple steps, you will ensure that your Turtle Tough sensor remains in working order for 12 months or more.

IMPORTANT: *The recommendations given in this document are valid for most Turtle Tough pH and ORP sensors. Care and maintenance for your particular sensor may vary from that described here. Contact Turtle Tough for specific information regarding proper care and maintenance of your particular pH or ORP sensor for a given installation and application.*

Maintenance Free

Turtle Tough 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 refreshing or refilling of electrolyte. The only requirement is regular cleaning. (Please refer to our general guideline). Regular cleaning will prolong the life of your sensor and ensure hassle-free operation.

Cleaning

Cleaning methods can vary greatly depending upon the application for which the sensor is used. Common rules for cleaning include:

1. Never scratch or aggressively scrub the pH or ORP elements. These are delicate glass electrochemical electrodes. They can be broken easily by mechanical force.
2. The reference junction is a solid-state non-porous cross-linked conductive polymer embedded in a porous Kynar matrix. Since the reference is solid-state, it can be cleaned with aggressive chemicals. This solid-state reference can also be cleaned effectively by using a sharp razor-edged tool.

IMPORTANT: *Great care should be taken not to scratch the pH glass or orp element during cleaning of the reference junction.*

Common 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)*

Please contact your Turtle Tough representative if you plan to use any other cleaning agent.

Cleaning of Reference Junction in Presence of Oils & Fats

Cleaning the reference is best accomplished in a mechanical way by the use of a suitable straight-edge razor. You want to scrape clean the surface of the reference junction taking care not to touch nor scratch the pH glass. This is possible because of our unique solid-state reference technology.

Cleaning of pH Glass in Presence of Oils & Fats

There are two main ways to remove oily/fatty type build-up. The first method is the more mild way and should be tried first.

1. The first method is to use a dye and fragrance-free surfactant. We recommend using the MICRO-90 cleaner. This is a very effective means to remove such build-up without dehydrating the pH glass element.
2. The second method is to use NaOH solution to chemically cleave the bonds in the oil/fat. This might be required if the first method of using just a surfactant is insufficient, either due to the nature of the build-up or the extent of the build-up. The NaOH solution is very effective at this task. The use of this kind of strong caustic cleaning solution will, however, dehydrate the pH glass and necessitate some reconditioning time with HCl acid. This will also neutralize any excess NaOH on the sensor. This should also be followed by final conditioning in the conditioning solution before recalibration.

Removing Silicate Contamination

In order to remove silicate contamination you will need to use a strong acidified ABF cleaning solution. It is recommended that 10% ammonium bifluoride (ABF) is sufficiently acidified with hydrochloric acid (HCl) such that it removes the contamination from the surface. The amount of activation needed (that is to say how much acid is added to the 10% ABF stock solution just prior to cleaning) will depend upon the extent of the silicate fouling on the sensor as well as the frequency with which the cleaning is performed. This silicate contamination cannot be removed without this strong activated ABF cleaning because it is bound to the surface of the pH glass and reference. Using the strong acidified ABF cleaning solution the deposited silicates will become soluble and much more easily removed from the sensor tip. The Turtle Tough ULTRA pH sensor with High HF resistant glass is one of the few in the world able to withstand this high HF cleaning regimen itself. The pH glass for this type of cleaning service will have a rather high impedance to ensure sufficient integrity and longevity.

WARNING: *This must only be attempted if the sensor is fitted with the High HF resistant glass option.*

IMPORTANT SAFETY: *The above cleaning methods may involve the use of hazardous materials. They above recommendations do not purport to address all the safety measures required.*

How Often Do I Need To Clean And Calibrate My Sensor?

The most common question we are asked is how often must you clean and calibrate a Turtle Tough sensor. While this question is virtually impossible to answer, a Turtle Tough sensor will have up to 10 times the stability of mainstream sensors. Most of our customers can extend calibration intervals by 2 to 5 times, whilst still maintaining their required accuracy and performance.

How often a sensor requires cleaning and calibration depends upon:

- The process conditions and how quickly the major constituents are poisoning the sensor
- The desired accuracy for the measurement to maintain acceptable process control
- The amount of fouling or process build-up that will eventually affect sensor performance
- How well the sensor is cleaned and maintained at the specified interval (ie. using the correct chemicals to decontaminate the sensor)

Turtle Tough sensors are specifically designed to improve these maintenance requirements by incorporating the following:

- Turtle Tough sensors have very tough measurement elements that are slow to deteriorate and therefore drift is minimised
- Turtle Tough sensors utilised open geometry designs and low fouling materials to reduce build-up and extend cleaning intervals
- Turtle Tough sensors have very resilient materials of construction to withstand harsh cleaning regimes. Strong acids, alkaline, organic solvents and abrasive mechanical cleaning can be deployed to efficiently and effectively clean sensors returning them to optimum operating condition

General Guideline

DRIFT (pH units)	TOUGH APPLICATION (ie: intensive chemical process)	MODERATE (ie: wastewater)	EASY (ie: clean water)
0.1	3 x per week	1 x per week	1 x per 2 weeks
0.3	1 x per week	1 x per 2 weeks	1 x per 2 months
0.5	1 x per 2 weeks	1 x per 4 weeks	1 x per 6 months

Please note this is a general guideline only and should not be relied upon for accurate process control.

How Do I Determine The Calibration Frequency?

It is important to note that you can never rely on our guideline as to the basis for your calibration requirement. Every chemical process is unique and the accuracy required can only be determined by your site requirements and expert process control personnel. Each user will need to establish a drift profile on their application before deciding on an appropriate calibration interval. Cleaning and calibration intervals can vary significantly across individual applications. To determine the drift characteristics you will need to periodically test the sensor against a known buffer or accurate grab sample to determine the rate of drift (ie. the difference between the displayed value and the standardised solution). Test frequently at the half-life of your expected calibration frequency to determine how far the sensor has deviated from the standard solution. Once the sensor reaches the threshold of your accuracy requirement, that is a good indicator for establishing your calibration regime. It is recommended that a sensor is properly cleaned each time it is removed for calibration. Even if it does not appear dirty, you should following the cleaning process to remove microscopic contamination that will affect the performance of the sensor.

Conditioning For Calibration

After the sensor has been cleaned, it must be thoroughly rinsed with deionized water to remove any residual cleaning reagents. The sensor can then be soaked in pH 4 buffer to recondition the pH and reference elements. Some sensors will also require conditioning in saturated potassium chloride if the reference junction has been depleted of the ions in the solid-state conductive polymer (typical for clean water applications). Condition the sensor in saturated potassium chloride and/or pH 4 buffer for whatever period is required to achieve optimal calibration results.

Sensor Selection For Individual Process Lines

No sensor should be used beyond the indicated temperature and pressure limitations for that given sensor. Sensors should only be used for the application(s) that an authorised TurtleTough representative has recommended. If you are unsure that your sensor is recommended for a particular application, please contact Turtle Tough.

Avoiding Thermal Shock

For high-temperature applications where process liquid exceeds 70°C, you will prolong the life of the sensor by avoiding thermal shock. Thermal shock occurs when you rapidly change the temperature of the sensor from hot to cold or vice versa. This rapid expansion/contraction of sensor components can damage internal elements and cause micro-cracking that will accelerate the rate of deterioration. In extreme cases, it will crack the sensing element causing a total failure. To avoid this the sensor should be heated or cooled slowly during removal/insertion and cleaning and calibration processes.

TIPS: Always allow sensors to air cool back to ambient before inserting into a cold liquid (i.e. such as buffer or cleaning solution). When heating up the sensor, wherever possible, gradually heat the sensor. If this is not possible in the process, heat the sensor in 2 stages prior to inserting the sensor in the process. One such method is placing the sensor in hot tap water (i.e. at 50-60 deg C) first and allowing it to get up to temperature, prior to inserting it into a hot process. This will greatly reduce the thermal shock and extend the life of the sensor.

Accessories and Spares

Cleaning Kit (optional)

Turtle Tough recommend the use of our cleaning kit to clean the sensor. This kit has been specially formulated to provide optimal care for the sensing element and reference components to enhance sensor life and performance. The kit contains a special powdered glass cleaner/polish, sensor conditioning solution, 10% HCl solution, and various tools for polishing the glass and cleaning the reference.



Instructions:

1. Rinse the tip of the sensor in tap water
2. Then gently scrub the reference with the nail brush to remove any fouling. If you can't remove the fouling with the brush use the scraper to scrape away the top layer of the reference and expose fresh uncontaminated material. Be sure to avoid the glass element as scratching it will irreparably damage the sensor.
3. Once most of the fouling is removed, pour some of the HCl solution into the beaker and soak the tip of the sensor in the HCl for 5 to 10 minutes. Then rinse the tip thoroughly with DI water.
4. Tap a small amount of the glass cleaning polish powder onto a hard surface and use a wet cotton bud to form a polishing paste. Gently polish the glass tip to remove any film oils or contaminants.
5. After polishing rinse the tip with the DI water and wipe clean using a lint-free cloth or chem wipes*.
6. Soak the tip of the sensor in conditioning solution for at least 10 minutes. Severely compromised sensors can even be soaked overnight to help rejuvenate the reference.





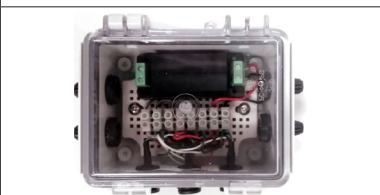
Interfacing Hardware, Plugs and Lead Connectors

Turtle Tough's quick connect plugs are a feature on all our ULTRA Series Sensors. This NEMA6P connector is fully submersible, is non-conductive plastic, low noise and small enough that it can easily fit through common conduit sizes. The connector system provides several advantages over bare tinned leads including:

- Reduces the chances of sensors being wired incorrectly**
 Factory supplied components such as transmitters, junction boxes, field communicators, windows PC interface etc are all pre-wired and configured. This guarantees that you can't connect them incorrectly which can result in sensor damage.
- Allows Plug 'n' Play Connectivity for instant hot-swapping of sensors**
 Smart Sensors allow the sensor to be calibrated in the lab or workshop as the calibration data is stored locally on the sensor rather than in the transmitter. Accordingly in service sensors can simply be swapped over for a freshly calibrated one. This provides a vastly superior maintenance program compared to traditional in-situ servicing, reducing both maintenance time and improving sensor life.
- Provides seamless connectivity with all DSS products**
 Instant connectivity with communicators and calibration devices that allows powerful and convenient maintenance, configuration and troubleshooting functions.

Connecting and Interface Components

All Turtle Tough DSS transmitters and controllers are fitted with female panel mount plugs that directly accept the male sensor plug. There will be times when you want to extend cable runs or integrate sensors directly with your hardware. Turtle Tough make a variety of hardware to accommodate a wide range of installation options:

	<p>Female Panel Mount Connectors These pre-soldered and wired plugs provide a tinned lead connection. Ideal for making your junction box or panel mount interface.</p>
	<p>Interface Cables This industrial-grade cable has a female plug at one end and tinned leads on the other. This is designed for connecting directly to your hardware via the tinned leads and provides a flexible coupling from your input device. Interface cables are available in 1.5m, 3m, 6m and 12 meter lengths.</p>
	<p>Extension Leads This industrial-grade cable has a female plug at one end and a male on the other. This is designed for extending the sensor cable length directly to a DSS transmitter or controller. Extension leads are available in 3m, 6m, 12m and 24m lengths.</p>
	<p>Junction Boxes This IP65 enclosure is fitted with a female panel mount plug, connected to an internal terminal strip. On the outgoing side is a cable gland allowing you to connect a signal cable of your chosen length back to your input hardware. DSS sensors support a total cable run of up to 1000m, so junction boxes are ideal when you have long cable runs.</p>
	<p>Powered Junction Boxes This IP65 enclosure is fitted with a female panel mount plug, internal terminal strip and cable gland. Additionally, it is fitted with a power converting for providing galvanically isolated power for sensors. Both AC/DC and DC/DC power supplies are available and outlined in our field implementation guide.</p>

Notes

- It is important to note that all the above cables and connectors are made to a very high industrial grade and have been professionally fabricated for high reliability for their intended application. Failure to have quality connections and interfaces can lead to a variety of problems including sensor dropouts and errors on the input side.
- The connector type is a MICRO-CON-X and readily available from commercial suppliers. If you wish to fabricate your connectors and interface cables you are welcome to do so. However please keep in mind that dropouts or connectivity issues cannot be supported if you are using your cables and you should always have at least one genuine Turtle Tough interface on hand for troubleshooting or testing. Please contact Turtle Tough for specifications.

IMPORTANT -----

Please note that integral sensor cables, connectors and plugs must **NOT** be cut, removed or modified in any way.

Sensors contain sensitive internal electronics and our cables and connectors are designed to protect the integrity of these components. Any modification or alteration to cables and connectors can compromise their integrity and will void the warranty. Always use factory-approved/manufactured cables and connectors. Additionally, the cable contains a unique identifier laminated to the cable end and this must not be removed or it will also void the warranty.

Installation Hardware Fittings: Immersion, Drop Tube & Hot-Tap Inline

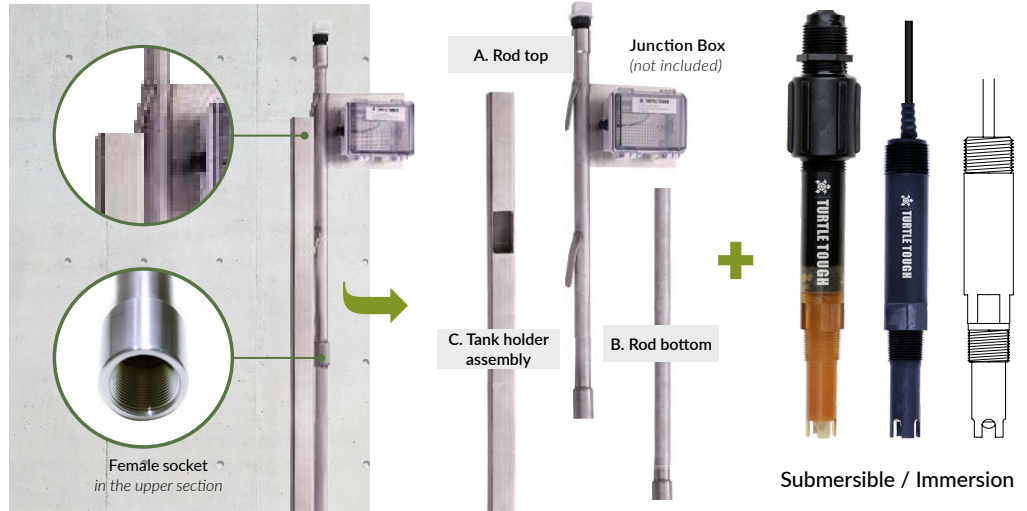
INSTALLATION METHOD	COMPLETE ASSEMBLY	FITTINGS HARDWARE + SENSOR'S BODY STYLE
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Immersion Rod

Code: TT-ACC-UNI-IROD-SS-3M

Allows easy access from the top of the tanks direct into critical measurement locations.

- Allows sensor installation from the top of a tank
- 316 Stainless steel
- 3 metres long
- Supplied as 2 pieces of 1.5m (L)
 - a) Rod top section
 - b) Rod bottom section
- Comes with:
 - Tank holder assembly
 - Female fittings
 - Mounting plate

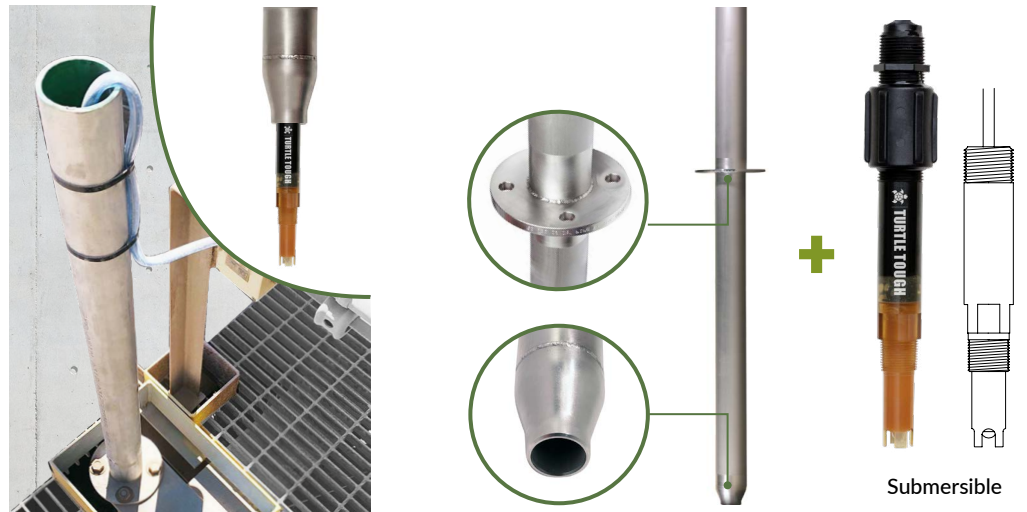


Drop Tube Submersion

Code: TT-MISC-DTUBE-5M

Drop a sensor directly into a tank without any attachments using Turtle Tough's 5 metre Drop Tube.

- Designed for submersion depths greater than 3 metres
- Improves the ease of retrieving sensors for cleaning & calibration
- Improves operator safety
- Acts as a guide-tube holding the sensor in the preferred measurement location
- Allows shorter cable runs on the sensor
- Ideal for tank mounting

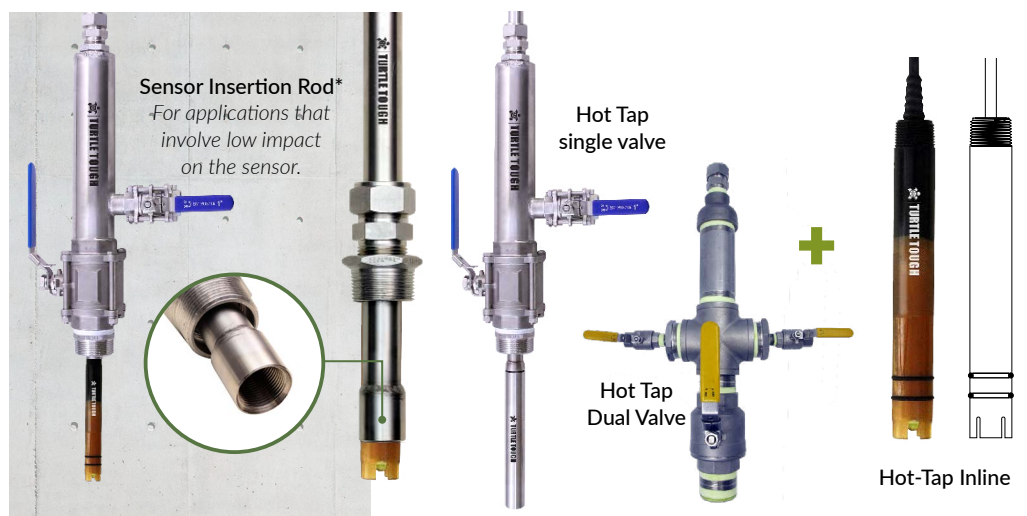


Hot-Tap Inline

Code: TT-ACC-UNI-HTA

The unique Turtle Tough Hot-Tap assembly allows fast and easy insertion and removal of sensors directly into process tanks or pipes at pressures up to 100 psig.

- 316 Stainless steel
- Flush sensors with cleaning solution before removal from process
- Single or double ball valve available
- Stainless, Duplex or SAF available
- 2", 1" or 1/2" available
- Comes with:
 - Valve
 - Body with Pressure relief valve
 - Top threaded fitting



*Required components for complete Hot-Tap Inline assembly; Sensor Holder, Extension Tube, Insertion Rod (sold separately)

IMPORTANT: TURTLE TOUGH DIRECT SMART SENSORS (DSS) are fully supported by a range of factory hardware solutions including SMART Analysers, Handheld Field Communicators, PC Communication tools and field implementation devices such as junction boxes, extensions leads and power supplies. This ecosystem provides a complete solution of reliable connectivity and sensor management. TURTLE TOUGH sensors may also be directly interfaced with end user hardware via the MODBUS RTU protocol. Integrating sensors directly into your industrial network requires a moderate to high level of onsite expertise in system integration, and should not be undertaken by anyone without the requisite experience. We suggest you read the sensor implementation guide carefully to understand the full scope and requirement for installation, because:

- Turtle Tough Pty Ltd and their representatives can provide only limited factory support when integrating sensors into 3rd party hardware.
- Product support is limited to the information provided in our field implementation notes and guidelines.



Installation Hardware Fittings: Sanitary Tri-clover Inline, Twist Lock Inline & Front-end Inline

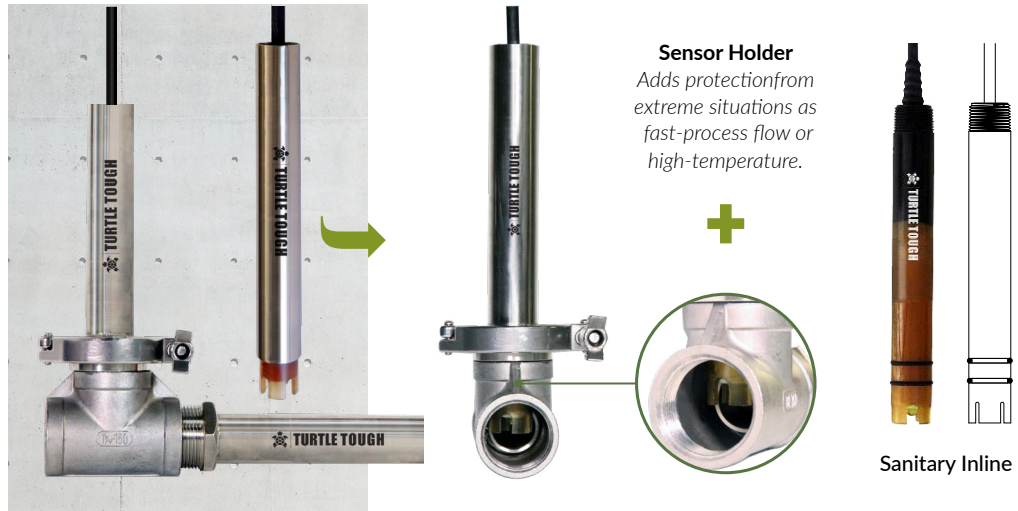
INSTALLATION METHOD	COMPLETE ASSEMBLY	FITTINGS HARDWARE + SENSOR'S BODY STYLE
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Sanitary Tri-clover Inline

Code: TT-ACC-UNI-1345

The Turtle Tough Sanitary Sensor holder has been designed for installations with Tri-Clover fittings.

- FDA 3A Grade 316SS Sanitary sensor holder
- Allows accurate sensor insertion
- Custom lengths & sizes available on request
- Includes: Sensor holder, Custom sanitary flange sizes: 1 1/2", 2", 2 1/2", Cable gland (IP69K optional)



Twist Lock Inline

Code: 1"MNPT-TWISTLOCK

Allows for a rapid insertion and removal of the sensor inline applications.

- The 1" Turtle Tough Twist Lock Receptacle fits together with any suitable mating 1" Turtle Tough Twist Lock Sensor.
- Designed to interface with a 1" FNPT pipe tee fitting.
- Easy line installation and removal
- Available in Kynar or PEEK plastic
Kynar – 50 psig
PEEK – 100 psig
- 1" MNPT male thread for line installation



Front-end Inline

All standard immersion type sensors have a 3/4" front-end thread that can interface directly with the process.



3. Turtle Tough and their representatives are unable to provide support on 3rd party hardware or provide troubleshooting on equipment not supplied by us. We are unable to warrant the performance or compatibility of our product with 3rd party hardware or software. If you intend to integrate the sensor directly with your own hardware we highly recommend the following:

- Read the Field Installation Guide and Sensor Implementation Guide.
- Purchase a handheld field communicator (HFC) from Turtle Tough. This stand alone device, self powers the sensor and provides complete diagnostics and communication. The HFC allows us to independently test and verify the sensor performance, independent of your system or hardware and is the single fastest way to rule out any sensor performance issues and be able to identify field installation problems.
- Alternatively, you may purchase a windows PC interface box. Once again, this factory supplied and tested component will ensure reliable communication with the sensor and it can be tested independently of your system.

Please note that our quick connect plugs may never be cut or removed from the sensor. This will immediately void warranty. Only use Turtle Tough factory interface leads or panel mount connectors to interface with your hardware.

Warranty

Product Warranty

Every Turtle Tough product is thoroughly inspected and tested before leaving the factory and prior to shipping. In addition to any statutory rights and remedies you may have, Turtle Tough warrants all its products against defective workmanship and faulty materials for 12 months from the date of purchase and undertakes, at its option, to repair or replace, free of charge, each product or part thereof on condition that:

- The complete product is returned to Turtle Tough or one of its authorised service agents, in person or freight pre-paid by you, and found, on examination, to be suffering from a manufacturing defect.
- The product or relevant part has not been subject to misuse, neglect, or been involved in an accident.
- The repairs are not required as a result of normal wear and tear.
- Damage caused by wear and tear, inadequate maintenance, improper installation, corrosion, or by the effects of chemical processes is excluded from this warranty coverage.

Sensor Warranty

Turtle Tough sensors are electrochemical devices and as such have a limited operating life. Life expectancy depends on the field of application such as the medium, pressure and temperature. It can vary between a number of weeks to several years. There are special cases in extreme environments where operating life will only be a few days. Characteristic and response time will also change with aging. As such electrochemical sensors are articles of consumption and are not subject to a common guarantee. Replacements or exchanges are generally excluded unless a manufacturing defect is determined to be the cause. It is not possible to predict the rate of deterioration for a particular process, nor can we provide a guarantee on sensor life because it is impossible to predict the rate of exposure, contamination and deterioration. Damage caused by wear and tear, inadequate maintenance, faulty installations, corrosion, or the effects of chemical processes is excluded from this warranty coverage. Our agents or representatives may provide you with a life expectancy guide based on similar applications we have experienced, however, this in no way constitutes a warranty of performance and is a general indicator.

Shelf Life Warranty

The standard shelf life for a Turtle Tough sensor is one year from the date of shipment. Sensors stored longer than this period may still be functional but are no longer under warranty. Sensors should be stored in a cool, dry location with the sensor tip (*where the pH/ORP element is located*) oriented toward the ground. All pH/ ORP/ISE sensors come standard with a conditioning solution in the cap. This conditioning solution is 50% pH 4 buffer and 50% saturated potassium chloride (*mixed by volume*). The sensor cap should be kept tightly affixed to the sensor body and sealed with common piping PVC tape when the sensor is not in use. 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.

Damage to Internal Electronics

Damage to the sensor's internal electronic components is not covered under warranty. Analogue sensors with internal preamplifiers are sensitive to electrostatic discharge. Sensors with preamps are clearly marked and extra care must be taken when handling these sensors as human contact with the electrical connections can discharge static to the preamplifier causing it to blow. This will render the product inoperable. Additionally, sensors containing digital RS485 boards are susceptible to damage when powered incorrectly or improperly installed. Sensors containing internal electronic boards undergo additional quality checks prior to shipment to ensure that components are 100% operational upon delivery. Ground loop and 3rd party hardware problems (including but not limited to power supplies) may also cause blown electronics or damage to the sensor components and as such faulty installations are not covered by warranty.

IMPORTANT: Ground loops, poor earthing and faulty electrical installations are a common cause of sensor damage. If you are experiencing unusual or erratic readings, please refer to our support document on ground loops.

Damage to Cables and Connectors

Please note that integral sensor cables, connectors and plugs must NOT be cut, removed or modified in any way. Sensors contain sensitive internal electronics and our cables and connectors are designed to protect the integrity of these components. Any modification or alteration to cables and connectors can compromise their integrity and will void the warranty. Always use factory-approved/manufactured cables and connectors. Additionally, the cable contains a unique identifier laminated to the cable end and this must not be removed or it will also void the warranty.

Return Goods

For all return goods the following information must be included in the letter accompanying the returned goods:

- Model Code and Serial Number
- Original Purchase Order and Date
- Length of time in service and description of the process
- Description of the fault and circumstances of the failure
- Process/environmental conditions that may be related to the failure of the sensor
- Statement as to whether warranty or non-warranty service is requested
- Complete shipping and billing instructions for return of material, plus the name and phone number of a contact person that can be reached for further information
- Clean Statement: returned goods that have been in contact with process fluids must be decontaminated and disinfected prior to shipment. Goods should carry a certificate to this effect, for the health and safety of our employees. Material Safety Datasheets must be included for all components of the process to which the sensor(s) have been exposed.

All sensor returns are to be accompanied by a completed return material authorisation document clearly stating the reason for the return and with the clean statement filled in.

See the warranty and returns section under support on our website www.turtletooughsensors.com for details.

Support

For technical support, please contact head office on +61 (0)3 9872 5055 or go to www.turtletoughsensors.com for information on sensor care, calibration, wiring and installation-related issues.

IMPORTANT INFORMATION ABOUT INTEGRATING DIGITAL SMART SENSORS (DSS)

Turtle Tough Digital Smart Sensors (DSS) are fully supported by a range of factory hardware solutions including Smart Analysers, Handheld Field Communicators, PC Communication tools and field implementation devices such as junction boxes, extensions leads and power supplies. This ecosystem provides a complete solution for reliable connectivity and sensor management.

Turtle Tough sensors may also be directly interfaced with end-user hardware via the MODBUS RTU protocol. Integrating sensors directly into your industrial network requires a moderate to a high level of onsite expertise in system integration and should ONLY be undertaken by someone with the requisite experience. While direct integration provides some significant benefits, it also incurs a higher degree of risk as integrating with 3rd party hardware provides a lot of opportunities for unexpected issues to arise. 3rd party hardware includes any device or component not supplied by Turtle Tough and can include, but is not limited to, PLC's, SCADA systems, DCS's, data loggers, power supplies/isolators, or any other externally sourced interfacing device or component. We suggest you read the sensor implementation guide carefully to understand the full scope and requirement for installation, because:

1. Turtle Tough Pty Ltd and its representatives can provide only limited factory support when integrating sensors with 3rd party hardware. Unexpected behaviour or damage as the result of 3rd party hardware is not the responsibility of Turtle Tough.
2. Product support is limited to the information provided in our field implementation notes and guidelines. The product is fully supported for installation requirements, field implementation and programming protocols in direct relation to our product. It does not extend to the compatibility of our sensor with or the subsequent behaviour of 3rd party hardware. Due to the infinite amount of 3rd party hardware available we are unable to support issues related to 3rd party problems and it is the sole responsibility of the end-user to test and verify the compatibility of our product with their equipment.
3. Turtle Tough and its representatives are unable to provide support on 3rd party hardware or provide troubleshooting on equipment not supplied by us. If you intend to integrate the sensor directly with your hardware, we highly recommend the following:
 - Read the Field Installation Guide and Sensor Implementation Guide. Make sure you understand the requirements and please contact us if you require clarification or further information.
 - Seek advice from your 3rd party hardware provider and make sure this equipment meets the minimum specification requirement outlined in our support documentation.
 - Purchase a handheld field communicator (HFC) from Turtle Tough. This stand-alone device, self-powers the sensor and provides complete diagnostics and communication. The HFC allows us to independently test and verify the sensor performance, independent of your system or hardware and is the single fastest way to rule out any sensor performance issues and be able to identify field installation problems.
 - Alternatively, you may purchase a windows PC interface box. Once again, this factory-supplied and tested component will ensure reliable communication with the sensor and it can be tested independently of your system.
 - Please note that our quick connect plugs must never be removed or modified in any way. This will immediately void the warranty. Only use Turtle Tough factory interface leads or panel mount connectors to interface with your hardware.