



MANUAL

M4M TOUGH DISSOLVED OXYGEN SYSTEM

+ Dissolved Oxygen



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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.
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 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.

 Danger	<p>NOTICE Read and follow all instructions. Save these instructions.</p>
 Warning	<p>WARNING To reduce the risk of injury, do not permit children to use this product.</p>
 Electric Shock Hazard	<p>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 Residual Current Detector or is in any event in compliance with all local electrical regulations. Do not bury electrical supply cable.</p>
 Electric Shock Hazard	<p>WARNING To reduce the risk of electric shock, replace damaged electrical cable immediately.</p>
 Danger Electric Shock Hazard	<p>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</p>

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.

Safety Instructions for the Owner/Operator

Danger due to electric current must be excluded. Refer to local electrical safety standards and 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.



Disconnect electrical supply before working on this equipment

PPE: examples of protective clothing, gloves and goggles.



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

Sensors

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.



Take care when removing the sensor

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.

Introduction

When it comes to TOUGH, nothing surpasses our Tough Portable System. For almost 30 years this unit has been used worldwide throughout the mining community, renown for its extreme durability and low maintenance in some of the world's harshest conditions. Utilising a Teflon membrane there have been many sceptics, tainted by their experience with cheap membrane technology that drifts, is un-repeatable and that fails due to tears and ruptures of the membrane that ultimately contaminate and destroy the sensor.

The Turtle Tough - Tough Portable System couldn't be more different. This German-made technology sets a new benchmark in membrane technology. The Ultra Tough Teflon membranes are resilient to highly abrasive slurries and maintain excellent repeatability and accuracy. The membrane usually only requires replacement annually at the recommended service interval. Calibration stability is an astounding 3-4 months and the units simply calibrate in the air, without any need for zero solutions.

The sensor has an extremely fast response, which is critical for applications that demand accuracy or measure at high ppm. This is especially true for portable units which are often tank dipped or used to measure grab samples. Operators rarely allow the required time for stabilisation, so the fast response of the sensor means less human error and high accuracy. The standard unit is capable of 0-40ppm while 0 to 60ppm is optional.

Tough Portable System Dissolved Oxygen meter is equally at home in the laboratory as it is in the field. It has been designed with this dual-use in mind and powers directly from a 240Volt mains powered cable for full-time lab use. Disconnecting it, the unit has full field portability, with a provision of up to 20 hours of use of battery backup power, and a long 7.5-metre cable that conveniently winds up onto the back of the unit.

The enclosure is seriously tough. Made from ABS plastics in an IP65 enclosure the major components and switches are all replaceable. To this day we still see field serviceable units that are greater than 25 years old. It is truly a testament to the quality and longevity of this model, one that has stood the test of time.

Specifications

Product name	M4M TOUGH Dissolved Oxygen System – Portable
Code	TT-TOUGH-DO-M4M
O₂-Measuring ranges	0.0 – 40.0 ppm dissolved O ₂ / 0 - 400%
O₂-Accuracy	± 0.5 % of full-scale point
°C-Measuring rang	0.0 – 50.0 °C
°C-Accuracy	± 0.1°C, automatic temperature compensation
Recorder outputs	2 simultaneous O ₂ : 0.0 – 40.0 ppm / 0 - 400 mV °C: 0.0 – 50.0 °C / 0 - 500 mV
Power supply	240 V AC / 50/60 Hz - 1.8 VA Battery with integrated charger
Burden	> 100KΩ
Fuse	0.3 A
Display	13 mm high, 3-½ digit LCD
Sensor	TT-TOUGH-DO-M4M
Calibration	Air calibration in the atmosphere
Housing	IP 65, PVC housing
Dimensions	200 x 270 x 250 mm (H x W x D: approx.)
Weight	2.3 kg approx.
Field case	385 x 355 x 180 mm (H x W x D) approx. Weight 1.5 kg approx.

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 sales outlet 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.



Danger
Electric
Shock
Hazard



Important

Operation

Temperature Measurement

Set the functional switch to °C. The liquid-crystal display will immediately indicate the temperature value. If the value shown is not stable, the temperature stabilisation time has probably been too short; it will be necessary to wait until the display has become steady.

Note: Since most of the M4S sensor is made of plastic material, the sensor should never be used in water samples with temperatures above 60°C. This would damage the sensor body, the right to claim under warranty would be lost.

Temperature Stabilisation Time

Before carrying out measurements, the sensor must be given sufficient time to adapt to the ambient temperature. This temperature stabilisation is necessary because a change of temperature affects both the conductivity of the electrolyte inside the sensor body and the diffusion capacity of the cathode membrane.

The temperature stabilisation time can be calculated in minutes by allowing a waiting time of three-quarters of a minute for each degree Celsius temperature difference. This results in the following general formula:

$$\text{Temperature stabilisation time [min]} = 3/4 \times (\text{maximum } ^\circ\text{C value} - \text{minimum } ^\circ\text{C value})$$

For example, in the case of a temperature difference of 40 °C, which is quite likely with field instruments during summer, the temperature stabilisation time will amount to about 30 minutes.

With sensors that are constantly kept in the measuring liquid, it will not be necessary to observe a temperature stabilisation time. The best procedure is to wait until the temperature value on the liquid-crystal display remains stable.

Dissolved Oxygen Measurement

In order to obtain reliable measurements, the Turtle Tough sensor must be placed in a position where the natural approach flow amounts to a minimum of 30 cm/s.

If there is no natural approach flow, it will be necessary to create an artificial flow. This can be done as follows:

- The first possibility to create an artificial flow is also the simplest: make a stirring movement with the sensor by hand.
- However, where longer distances are involved, especially when measuring at great depth, the hand-generated approach flow will no longer be adequate since the movement is impeded by the resistance of the liquid.
- Pull and release the cable continuously during measurement so that the sensor is constantly moving up and down. Note that this method is not suitable for exact measurement results.
- Where high-accuracy measurements are required, an absolutely even and reproducible approach flow has to be created artificially.
- This can only be done with the aid of a flow transmitter, such as our unique and internationally utility-patented TT-O₂-FLOW, a device using an oscillating paddle for creating the necessary approach flow.
- Once the proper approach flow has been established, you can proceed with the measurement of the oxygen content. Set the functional switch on O₂. The liquid-crystal display will now indicate the value of the oxygen dissolved in the liquid.

Calibration

Calibration Verification Check

Every instrument leaves our manufacturing facility in a calibrated condition after going through a test programme of several hours. The user should nevertheless re-check the calibration since a change may have occurred due to long transport or storage periods.

For a fast routine check it is sufficient to have the sensor in atmospheric air. The air calibration table on the front panel of your instrument shows the appropriate oxygen calibration value per degree Celsius.

For example: 20 °C equals 9.7 mg/l O₂ or 21 °C equals 9.5 mg/l.

- If the liquid-crystal display of the instrument indicates, for example a temperature of 20.5°C, the changeover to oxygen should produce the reading 9.6 mg/l O₂. This is the arithmetic mean between the values 20 °C (9.7 mg/l O₂) and 21 °C (9.5 mg/l O₂).
- If the value displayed does not correspond to the value on the table or to the calculated value, it will be necessary to recalibrate using the calibration potentiometer by means of the screwdriver included.
- If the setting is correct, the device is ready for carrying out measurement.

Calibration in Atmospheric Air

The 1-point calibration in atmospheric ambient air is the simplest type of calibration. The front panel of the instrument incorporates the calibration table for air calibration.

1. Put the sensor in a shaded place (avoid direct sunlight). The tip of the sensor and the membrane have to be dry - remove any humidity by dabbing the tip with tissue paper. Cover the sensor i.e. with newspaper to avoid any wind on the tip.
2. Wait for at least 15-20 minutes to be sure that the sensor has reached ambient temperature.
3. After determining the air temperature please read the associated calibration value on the air calibration table. Switch over to O₂ and calibrate using the calibration potentiometer by means of the screwdriver included.

Note: For high accuracy calibration of your instrument, barometric pressure should be taken into consideration.

Calibration to Barometric Pressure

Different air pressures result in different calibration values, so for high accuracy readings a calibration of your instrument taking barometric pressure into consideration must be performed. If you know the pressure for your location you can correct the calibration value according to the following formula:

$$\text{Corrected calibration value [ppm]} = \text{Pressure}^n \text{ [mbar] } \times \text{Table calibration value [ppm]} / 1013 \text{ [mbar]}$$

This is clarified further by the following example:

You have measured a temperature of 20 °C. The air calibration table states the relevant calibration value of 9.7 ppm. If the environment has a different pressure than 1013 mbar, the calibration value has to be corrected. For example if we are at 1500m above sea level then the pressure per the pressure table (shown above) equates to 838 mbar. Then the corrected calibration value would be as follows:

$$\underline{838 \times 9.7 / 1013 = 8.0}$$

After determining the correct calibration value, set the calibration potentiometer accordingly by means of the screwdriver included.

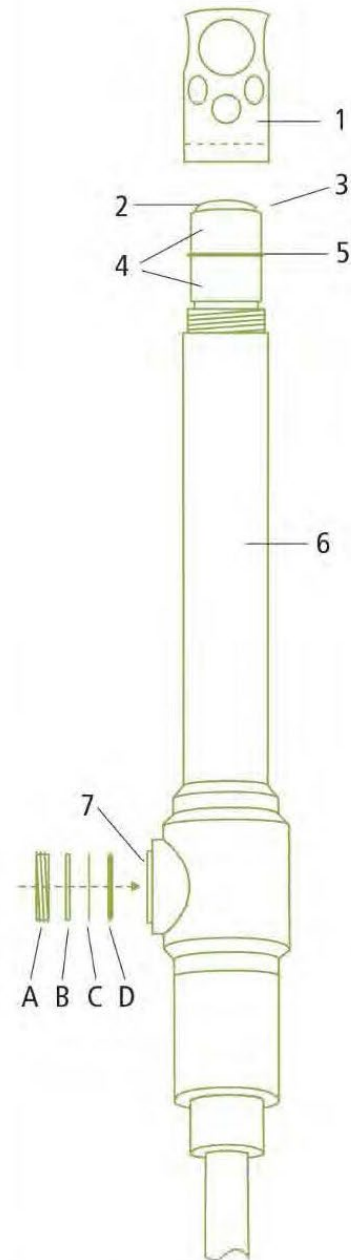


Sensor Maintenance

The M4S TOUGH Dissolved Oxygen Sensors are extremely corrosion, vibration, and knock resistant, due to their design and construction.

- The sensor body (6) and most other sensor components are made of plastic material suitable for recycling.
- The visible cathode (3) consists of fine silver in the case of the “active” sensor and of gold in the case of the “passive” sensor.
- The anode, which can only be seen through the automatic pressure compensation (7), consists of lead or, in the case of the “passive” sensor, of silver.
- Directly behind the cathode (not visible!), there are two temperature sensors for supporting the display and compensation of the temperature.
- The cathode membrane (2) is the most sensitive part of the sensor, although it is made of a strong Teflon material. It is held by means of two red collars (4) and one O-Ring (5). During measurements, the membrane must not come into contact with sharp objects such as stones or sharp-grained sand, which might damage the membrane surface.
- The sensor tip is provided with a screw-on protection cap (1).
- The active sensor elements and the electrolyte tank are dimensioned to permit application with great long-term stability. The theoretical life amounts to at least 20 years.
- We offer our sensors in two different types: the “active” and the “passive” sensors. The outer design of both systems are nearly the same, the selection of the electrode materials and of the electrolyte are different:

Element	Active Sensor	Passive Sensor
Cathode	Silver	Gold
Anode	Lead	Silver
Electrolyte	Liquid	Liquid
Material of sensor body	PVC	PVC
Membrane	Teflon	Teflon
Pressure compensation	Automatic	Automatic
Temp. compensation	Automatic	Automatic
Max operation temp.	50 °C	50 °C
Calibration	Single point air	Single point air



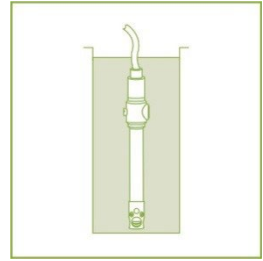
- 1 protective cap
- 2 cathode membrane
- 3 cathode
- 4 red collar
- 5 O-ring
- 6 sensor body
- 7 pressure compensation

- A pressure nut
- B pressure washer
- C pressure compensation membrane
- D O-ring

Storage of the Sensor

When a sensor is not being used for a longer period of time, it is recommended to store it in water, where it should be immersed up to the beginning of the cable. This prevents evaporation of the electrolyte and guards against loss of membrane elasticity.

Note: The sensor must never be stored in a so-called zero solution! This would damage the electrode and void the warranty.



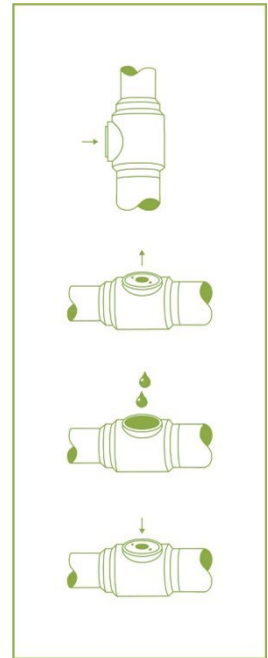
Refilling of Electrolyte

If a measuring instrument has been stored over a longer period without being kept in water, or if it is exposed to high temperatures during summer, it is possible for part of the electrolyte to evaporate. This would, to some extent, impair the functioning of the automatic pressure compensation.

The electrolyte level can be verified by holding the sensor horizontally. You should now be able to see an air bubble no larger than 4 mm in the centre of the pressure-compensation membrane. Should refilling of the electrolyte be required, it is carried out as follows:

1. Unscrew the side pressure membrane ring nut with the Pressure Compensator Tool TT-TOUGH-DO-SWT or a set of Circlip pliers. Remove the o-rings and side membrane. (For a complete exchange, shake out the old electrolyte, taking care not to knock against anything with the sensor.)
2. Hold the sensor slightly at an angle and fill up with new electrolyte. Gently tapping against the sensor body helps to release trapped air bubbles.
3. Replace the membranes and o-rings back in position and screw in the ring nut. Use a small cloth or tissue-paper for wiping off any electrolyte spilt during fastening of the ring nut.

Note: If the electrolyte comes into contact with your skin, rinse the affected part immediately under running water.



Replacement of the Cathode Membrane

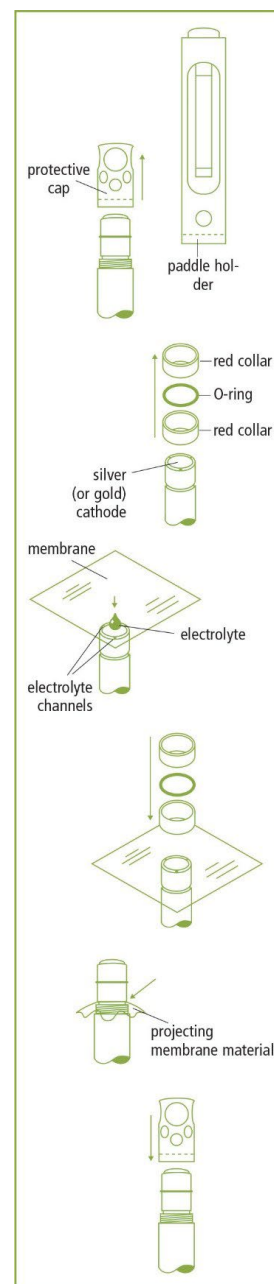
The cathode membrane has to be replaced immediately in cases where over-pressure during refilling of the electrolyte has led to a shift in the position of the membrane, or where the sensor has not been stored in water over a longer period resulting in a loss of membrane elasticity.

The steps for replacing the membrane are as follows:

1. Unscrew protective cap (or paddle holder).
2. Pull off the first red collar.
3. Pull off the O-Ring.
4. Pull off the second red collar; the membrane normally comes off at the same time.
5. Hold the sensor vertically and check whether electrolyte is visible in the white electrolyte channels next to the cathode. If this is not the case make “pumping movements” with your thumb on the pressure-compensation membrane until electrolyte appears in all the electrolyte channels.
Note: Never use a needle or other sharp objects to create flow, since the white wick-like insert would otherwise be damaged! Doing this voids the warranty.
6. Wipe the cathode clean with tissue-paper, but do not polish it because the “scratched” surface helps to form a film of the electrolyte.
7. Put one drop of electrolyte onto the cathode.
8. Put on the membrane and pull slightly downwards at the corners; there must be no wrinkles formed on the silver surface. You can use a Membrane Positioner TT-TOUGH-DO-MP for this if available. (See: Using the Membrane Positioner)
9. Replace the red collar (with the smoothed-off edge forward) and push it down until the groove of the O-Ring is again visible (but no further).
10. Fit the O-Ring.
11. Subsequently fit the second red collar (with the smoothed-off edge forward).
12. Using a sharp knife carefully cut off any projecting membrane material below the second red collar.
13. Rinse membrane with water.
14. Screw on protective cap (or paddle holder).

After membrane replacement, recheck calibration (see: “Calibration Verification”).

Note: The sensor must never be stored in a so-called zero solution! This would damage the electrode and void the warranty.



Sensor Refurbishment

Refurbishment is recommended every six months and also whenever the membrane has been damaged. The refurbishment procedure involves both electrolyte replacement and membrane replacement. This ensures that no foreign substances can get into the electrolyte in the case of a damaged membrane.

Steps for replacing the electrolyte and the cathode-membrane:

1. Unscrew protective cap or paddle holder.
2. Pull off the first red collar.
3. Pull off the O-Ring.
4. Pull off the second red collar, remove the old membrane.
5. Unscrew the side pressure membrane ring nut with the Pressure Compensator Tool TT-TOUGH-DO-SWT or a set of Circlip pliers. Remove the o-rings and side membrane.
6. Shake out the old electrolyte, taking care not to knock against anything with the sensor
7. Hold the sensor slightly at an angle and fill up with new electrolyte. Gently tapping against the sensor body helps to release trapped air bubbles.
8. Replace the membranes and o-rings back in position and screw in the ring nut. Use a small cloth or tissue-paper for wiping off any electrolyte spilt during fastening of the screw in cap.

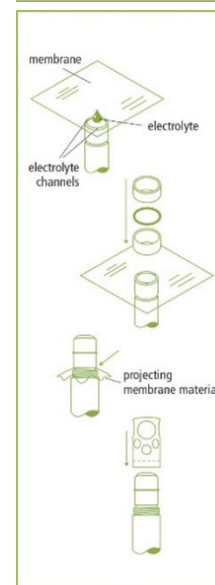
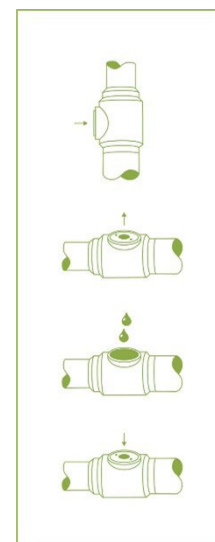
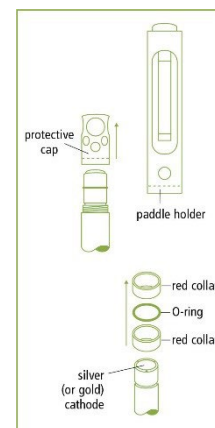
Note: If the electrolyte comes into contact with your skin, rinse the affected part immediately under running water.

9. Hold the sensor vertically and check whether electrolyte is visible in the white electrolyte channels next to the cathode.
10. If this is not the case make "pumping movements" with your thumb on the pressure-compensation membrane until electrolyte appears in all the electrolyte channels.

Note: Never use a needle or other sharp objects to create flow, since the white wick-like insert would otherwise be damaged! Doing this voids the warranty.

11. Wipe the cathode clean with tissue-paper, but do not polish it because the "scratched" surface helps to form a film of the electrolyte.
12. Put one drop of electrolyte onto the cathode.
13. Put on the membrane and pull slightly downwards at the corners; there must be no wrinkles formed on the silver surface. You can also use a Membrane Positioner TT-TOUGH-DO-MP for this. (see: Using the Membrane Positioner).
14. Replace the red collar (with the smoothed-off edge forward) and push it down until the groove of the O-Ring is again visible (but no further!).
15. Fit the O-Ring.
16. Subsequently fit the next red collar (with the smoothed-off edge forward).
17. Use a sharp knife to cut off any projecting membrane material below the second red collar.
18. Rinse membrane with water.
19. Screw on protective cap or paddle holder.

Note: Wait at least 30-45 minutes before carrying out recalibration. For accurate measurements it is recommended to leave the sensor overnight to stabilise and then recalibrate the next day. The waiting period is necessary because the Teflon material of the membrane expands slightly during fitting, but will always shrink back to its original size. This is also indicated by the liquid-crystal display. Immediately after sensor refurbishment the value is relatively high and then falls progressively over time. Please read the relevant sections of this manual with regard to the special points to be observed when changing the electrolyte or the membrane.



Pressure Compensation Membrane Replacement

Pressure compensation membranes have to be replaced when the sensor has been stored over a longer period without being kept in water and the membranes have lost their elasticity; or when the membranes have been damaged. When measuring often at great depths, the pressure compensation membrane should be checked regularly.

The pressure compensation membrane can be changed as the following describes:

1. Unscrew the side pressure membrane ring nut with the Pressure Compensator Tool TT-TOUGH-DO-SWT or a set of Circlip pliers
2. Remove the pressure washer.
3. Remove the old pressure membrane and the O-Ring.
4. Refill with electrolyte.

Note: *If the electrolyte comes into contact with your skin, rinse the affected part immediately under running water.*

5. Install the O-Ring and a new pressure compensation membrane.
6. Refit the pressure washer.
7. Finally put on the pressure ring nut and screw it on carefully.

Using the Membrane Positioner

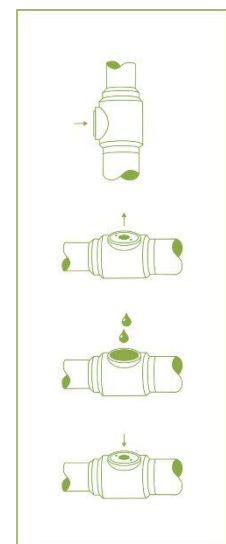
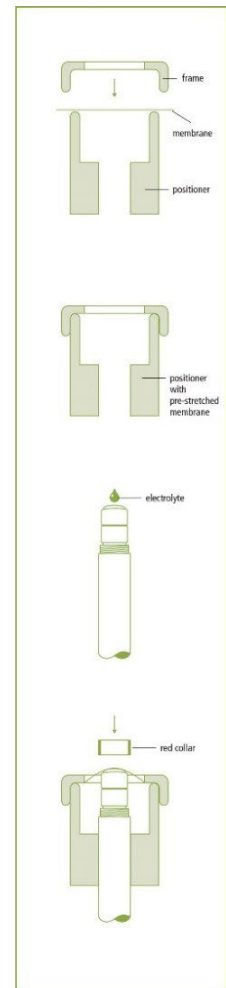
Use the Membrane Positioner TT-TOUGH-DO-MP to easily replace the cathode membrane without any wrinkles.

Follow these steps for replacing the membrane using a Turtle Tough Membrane Positioner:

1. Pull off the frame.
2. Put the Positioner on a table.
3. Centre one membrane on the Positioner.
4. Press the frame over the Positioner - the membrane gets pre-stretched like on a drum.
5. Hold the Turtle Tough sensor vertically, with the tip upwards.
6. Put one drop of electrolyte onto the cathode.

Note: *If the electrolyte comes into contact with your skin, rinse the affected part immediately under running water.*

7. Place the Positioner over the sensor - so that the membrane touches the cathode - and let it hang down by its own weight.
8. Gently push down and hold the red collar in its position, then remove the Positioner by sliding it down.
9. Push the red collar down until the groove of the O-Ring is visible (but not further!) Continue with replacing the O-Ring and the second red collar as usual (see: Replacement of the cathode membrane or Sensor refurbishment).



Spare Parts List

Part Number	Description
TT-TOUGH-DO-M4S	TOUGH Series Heavy Duty Dissolved Oxygen Sensor to suit M4M Portable Analysers
TT-TOUGH-DO-SK	TOUGH Series DO Sensor Full Service Kit Includes: <ul style="list-style-type: none"> - Membrane Positioner - Side Window Tool - Screwdriver for TC Pot - 10 x Sensor Membranes - 2 x O-Rings - 1 x Bottle of Electrolyte - 10 x Side Window Membranes - 2 x Side Window O-Rings - 1 x Side Window Nylon Spacer (White) - 1x Side Window Grub Nut
TT-TOUGH-DO-MRK	Refill Kit for sensor tip with 10 membranes, 3 O-Rings and 1 bottle electrolyte solution
TT-TOUGH-DO-MEM	Refill Kit, without electrolyte
TT-TOUGH-DO-ELEC	Electrolyte Solution, 125 ml bottle
TT-TOUGH-DO-SWM	Refill Kit for pressure compensation part of sensor, with 10 membranes and 1 O-Ring
TT-TOUGH-DO-SWT	Special Tool for pressure compensation ring nut
TT-TOUGH-DO-ORING	O-Ring for sensor tip, expansion proof
TT-TOUGH-DO-COLLAR	Polythene Collar (red collar) for sensor tip (one set = 2 pcs.)
TT-TOUGH-DO-MP	Membrane Positioner
TT-TOUGH-DO-PC4	TOUGH Series DO Sensor Protection Cap Small - Suits M4M & M4M Sensors
TT-TOUGH-DO-PC6	TOUGH Series DO Sensor Protection Cap Large - Suits M4M Sensors

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 Teflon 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 turtletooughsensors.com for details.

Support

For technical support contact head office on +61 (0)3 9872 5055 or visit our website turtletooughsensors.com for information on sensor care, calibration, wiring and installation-related issues.