TURO T-612

SUBMERSIBLE
WATER QUALITY ANALYSER

OPERATOR’S MANUAL

T U R O   T E C H N O L O G Y   P T Y   L T D

Revision A6

CONTENTS

1. Introduction

1.1 General Description

The T-612 Submersible Water Quality Analyser is a submersible multi-parameter field instrument that can be used for real-time and remote water quality measurements. The unit can be submerged to depths of 300 meters.

The instrument consists of a multi sensor probe with on board storage facilities. The unit has been designed to be compact, lightweight and easy to use. Data is transferred to a computer using serial RS232 communications giving reliable, interference free measurements. The surface software is used to control the unit in real time as well as set the unit for remote operation and provides easy access to the data. The data can be viewed in table or graphical form. The unit contains a real time clock and all stored data includes the date and time of measurement. Both stored data and calibration information can be easily downloaded to a computer using the surface software program.

1.2 Specifications

1.2.1 Pressure Housing:

Case: Machined PVC construction to depths of 150 meters.

Dimensions: 73 mm diameter * 600 mm long

Weight: 3.0 kg

Memory: 130,000 samples or 16250 sensor sets of samples. All samples include date and time. memory is backed up by lithium battery to guard against main battery failure.

Power: 8 ‘C’ size alkaline cells. Memory backup voltage supplied by ½ ‘AA’ lithium cell

Communications: Baud rate 4800, 8 data bits, 0 parity, 2 stop bits

External Power Supply: 12 volt DC. T-612 electronics is isolated from external electrical disturbances, power supply tie-ups and surges.

1.2.2 Sensors

Temperature

Range:	-2 - 50ºC
Accuracy:	±0.05ºC
Resolution:	0.01ºC
Type:	pt 100 platinum element

Conductivity

High Range:	0 - 80 ms/cm
Accuracy:	±0.05 ms/cm
Resolution:	0.02 ms/cm
Low Range:	0-8000 us/cm
Accuracy:	±5 us/cm
Resolution:	3 us/cm
Type:	Four electrode cell

Salinity

Range:	0 - 60 ppt
Accuracy:	±0.05 ppt
Resolution:	0.02 ppt
Type:	See Appendix 1 - Conversions Used

Dissolved Oxygen

Range:	0 - 200% saturation 0 - 20 mg/l
Accuracy:	±0.5%
Resolution:	0.1%
Type:	Active silver and lead electrode sensor with PTFE* membrane and built-in stirrer

Turbidity

Range:	0 - 600 ntu
Accuracy:	±0.5 ntu (0 - 300 ntu range) ±5 ntu (300 - 600 ntu range)
Resolution:	0.3 ntu
Type:	Nephelometric measurement from a 90 sensor with pulsed infra-red light source

pH

Range:	0 - 14
Accuracy:	±0.03
Resolution:	0.01
Type:	Combination silver/silver chloride type with sintered Teflon* junction

ORP

Range:	-700 mV to +1100 mV
Accuracy:	±3 mV
Resolution:	1 mV
Type:	Combination bare metal electrode common reference junction with pH electrode (see Appendix 1 - Conversions Used)

Depth (optional)

Range:	0 - 100 m or 0 - 150 m
Accuracy:	±0.1% of full scale
Resolution:	0.1 m
Type:	Dual active silicone strain gauge
Cable length:	3 m or 10 m. Other lengths made to order.
Dimensions:	50 mm diameter, 320 mm long

1.2.3 Connector Pins

The connector pins on the reader unit connectors are numbered in clockwise order from the polarising pin (see figure 1). The following table lists the purpose of each pin on the connectors.

Pin 1	Ground
Pin 2	RS232 out
Pin 3	RS232 in
Pin 4	Auxiliary power +12v

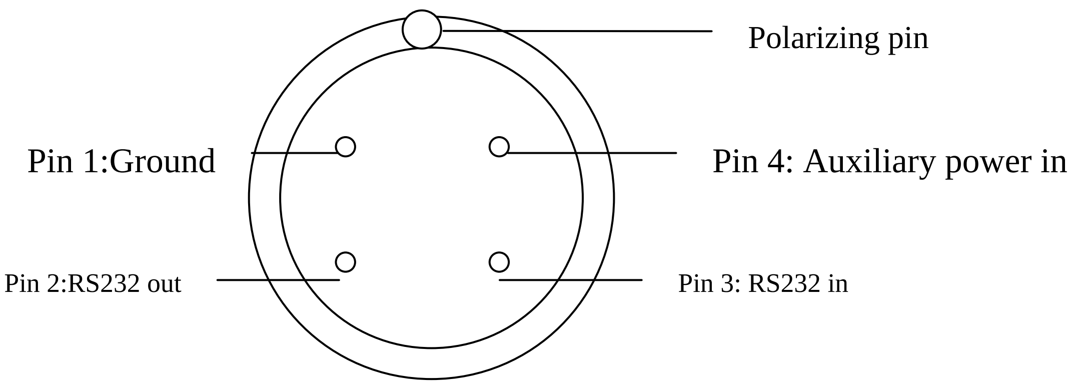

Figure 1: Bulkhead connector. Showing pins 1-4.

1.3 Description of Submersible Water Quality Analyser

(See figure 2A)

The unit consists of sensor, main pressure housing and connector. The body of the probe and sensor guard are made of PVC. A powder coated stainless steel cage protects the sensors. An eyelet is situated at the end of the cage so that a weight may be attached. An interface cable can be connected to the main pressure housing for direct communications to the computer. This allows the analyser to be set up for remote or real time logging. In the event of the cable being cut, the probe has a waterproof seal between the cable connection and the electronics package. The unit can be programmed via the PC for remote logging. The start, stop and sample rates are set up using the PC software.

The sensors can be easily accessed by removing the cage and sliding the sensor guard up and rotating the bottom section of the probe. (see Figure 2B)

The conductivity and dissolved oxygen sensors can be removed for servicing. However, the whole unit must be **thoroughly dry** before these sensors are removed. A cotton bud can be used to dry the spaces between the sensors.

The communications cable can be supplied at any length to 100 meters. The cable consists of internal conductors, a screen and kevlar strands to support the conductors. The cable is sheathed with polyurethane for protection.

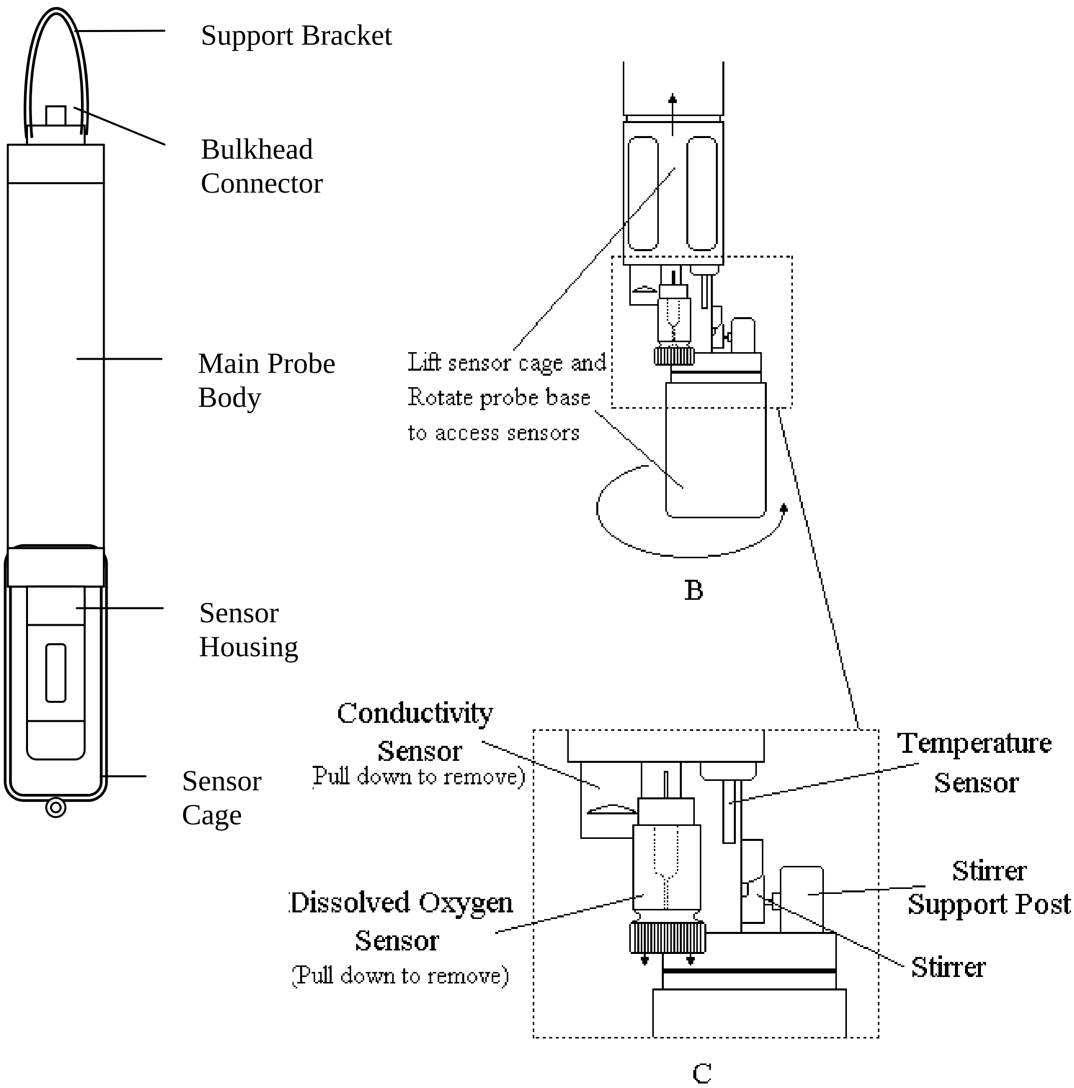

Figure 2: A) Complete probe assembly B) Sensor cluster exposed by lifting sensor cage and rotating probe base C) Expanded view of sensor cluster with Dissolved Oxygen sensor detached.

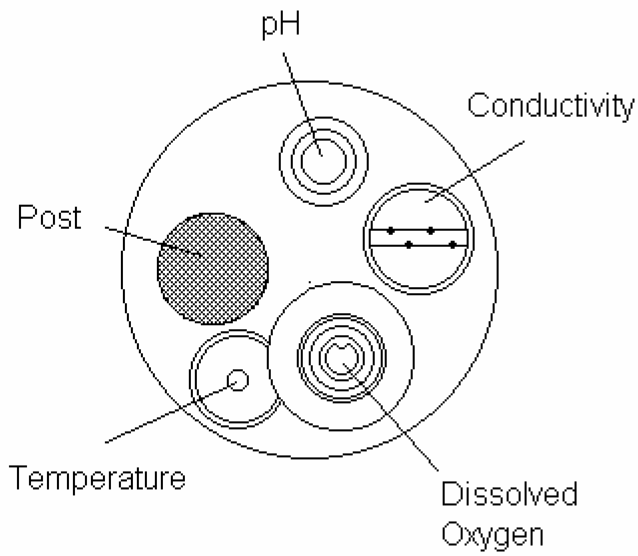

Figure 3: End view of probe (without bottom section) showing position of sensors.

1.3.1 Temperature Sensor

The temperature sensor consists of a pt 100 platinum element, housed in a stainless steel sheath for robustness and corrosion resistance. The temperature sensor requires little maintenance however the temperature measurement is used for calculating the dissolved oxygen in mg/l and for temperature correction of the conductivity sensor and so it is important that the temperature sensor is properly calibrated.

1.3.2 Dissolved Oxygen Sensor

Dissolved Oxygen is measured using an active type membrane covered sensor. The sensor itself consists of silver and lead electrodes and a 25um ptfe membrane and is filled with a 1.0M potassium hydroxide. A constant flow of water passes the sensor which is maintained by a stirrer located on the bottom section of the probe.

When the silver and lead electrodes are connected through the external circuit, electrons pass from the lead electrode to the silver electrode. When oxygen is present at the surface of the silver electrode, it reacts with electrons to produce hydroxyl ions.

At the lead electrode the loss of electrons produces lead ions. The lead's electrons combine with hydroxyl to precipitate lead hydroxide on the lead electrode.

The rate of transference of electrons via the external circuit from the lead to silver electrode ie that is the current flowing in the external circuit, is the measure of the rate of cell reaction and thus the rate at which oxygen reaches the silver electrode. The current flowing in the external circuit is directly related to the oxygen concentration in the sample being measured by the electrodes.

The Dissolved Oxygen sensor may periodically require a new membrane and electrolyte. A unique knurled nut is used to hold the sensor membrane in position without overstressing the membrane. This gives long term stability and allows easy replacement. The sensor can be removed from the probe for servicing. A replacement probe is ready for use immediately after installation and calibration.

1.3.3 Conductivity Sensor

The conductivity is measured using a 4 electrode bridge. The four electrode system uses automatic compensation to overcome any build up of contamination on the electrodes. The electrodes are made from fine platinum and are coated with platinum black to enhance the long term stability and sensitivity of the sensor. The coating should last for a long period of time if it is not mechanically removed, however, the coating can be replaced using the optional platiniser or by returning the sensor to Turo Technology Pty Ltd.

1.3.4 Turbidity Sensor

The turbidity sensor is located in the hole which runs through the bottom section of the probe and is lined with a glass tube. Turbidity is measured by the nephelometric method which uses a light source and a detector which measures light scattered at 90 degrees to the incident light beam. A pulsed infra-red light source is used.

1.3.5 pH/ORP Sensor

The pH and oxidation reduction potential (ORP) are measured using a single sensor. This consists of a glass pH electrode and a platinum electrode for ORP measurements with a combination internal reference electrode. The sensor only requires maintenance if there is a build up of contamination on the electrodes and/or the reference becomes blocked or depleted of electrolyte.

2. Assembly

The T-612 comes already assembled. The only disassembly and reassembly is when the batteries need replacing or a sensor needs servicing.

2.1 Connecting the Analyser to the PC

To attach the analyser, first unscrew the knurled connector cap from the analyser connector. The connector cap is attached to the unit by a chord so that it can be replaced whenever the analyser assembly is submerged. To connect the analyser, align the locating pin on the reader unit with the slot on the cable connector and push the cable connecter into the analyser socket then screw home the retaining ring. The retaining ring should tightened firmly as the waterproof sealing relies on ‘O’-ring compression.

3. Operation

If the pH sensor has a cap over it, the cap should be removed prior to operation. The cap should be carefully PULLED OFF, DO NOT ATTEMPT TO UNSCREW IT, **see section 6 for IMPORTANT INFORMATION.**

3.1 Operating Instructions

The Surface software allows the analyser to be used in remote or direct mode of operation. This allows operator to control the analyser via a modem or directly through a communications cable. For remote telephone modem operation a separate manual is issued.

In order to set the analyser for remote or real time logging and down load the data stored in memory to a computer, use surface software and the purpose built communications cable to transfer data.

1) Connect the 4 pin connector of the communications cable to the COMMS connector on the water quality analyser. Use the surface software as outlined in section **3.2 Real Time Data Transfer via Serial Port** on how to set, calibrate, measure, retrieve and analyse data.

2) **Before deploying the analyser be sure to *remove the pH sensor plastic storage boot*. Keep in a safe place.**

3.2 Real Time Data Transfer via Serial Port

Connect the communications cable to the water quality analyser and the PC. Be sure that the cable connector ferule is screwed up tightly to the water quality analyser bulkhead connector as the watertight seal relies on ‘O’-ring compression.

Never rely on the connector to support the weight of the submersible water quality analyser. Use a support tie from the support bracket (see Figure 2) on the analyser to the communications cable so that it will take the strain off the connector. Plug the ‘D’ type connector into the PC, be sure to tie off the cable so that the PC connector does not take any load.

Use surface software to run real time data logging. The surface software for real time data logging has two methods to use the program. Either use the mouse to access the various functions or use the ***ENTER*** key. The ***ENTER*** key is useful if the operator is in a pitching boat and the mouse is difficult to use. Click onto key operation and use **ENTER** to start and store data onto disk. Use the **ESC** key to stop Real Time Logging. For further details use the ON LINE help.

4. Calibration

In order to ensure the accuracy of the T-612, the instrument needs to be calibrated on a regular basis as well as after any maintenance that has to be performed on the probe. The frequency at which calibration is required will depend on the specific application for which the instrument is to be used. The optimum time between calibrations for your particular application can be established by regularly checking the performance of your instrument in standard solutions. If your T-612 is kept well maintained and calibrated on a regular basis, you will find that a single point calibration is sufficient to keep the instrument performing to specification. However, you should perform a two-point calibration whenever a sensor has had any maintenance.

The calibration procedures require that the probe be immersed in standard solutions. The probe storage container can be supplied with the T-612 is ideal for this purpose as it provides a water tight seal on the probe and minimises the volume of standard solution required (about 150 ml). Make sure that you rinse both the probe and container before each calibration and between each calibration solution. The standard solutions are available from Turo or most major scientific suppliers.

Both dissolved oxygen and conductivity measurements require a correction for temperature (this correction is automatically made by the instrument) hence the temperature sensor must be correctly calibrated before you can calibrate either the dissolved oxygen or salinity/conductivity sensors. Single or two point calibration may be done.

4.1 Temperature Calibration

The temperature calibration should vary very little over the lifetime of the instrument however it is worth checking on the accuracy of your temperature measurements before calibrating the dissolved oxygen or salinity sensors.

Temperature calibration is performed at two temperatures. The low temperature must be between 0^oC and 20^oC and the high temperature must be between 30^oC and 50^oC temperature.

In the surface software go to the main menu and then click on calibration button and then click on temperature. Place the probe into the stirred water baths and wait until the raw data that is displayed in the surface software is stable then calibrate.

4.2 High Conductivity/Salinity Calibration

Rinse and wipe the probe thoroughly after each calibration to avoid contaminating the next standard solution.

The conductivity/salinity sensor is calibrated using solutions with a salinity of 0 ppt (air calibration) and 35 ppt. Conductivity is a parameter derived from the salinity measurement and so calibrating salinity simultaneously calibrates the conductivity measurements. Ensure that the temperature sensor is reading accurately and, if necessary, perform the temperature calibration described above.

In the surface software go to the main menu and then click on calibration button and then click on salinity. Place the probe into the standard, the raw data is displayed in the calibration routine, wait until the data is stable and calibrate.

4.3 Low Conductivity calibration

The low conductivity calibration using zero calibration (air) and an upper calibration point, for example 1413 us/cm. Rinse and wipe the probe thoroughly after each calibration to avoid contaminating the next standard solution. Ensure that the temperature sensor is reading accurately and, if necessary, perform the temperature calibration described above.

In the surface software go to the main menu and then click on calibration button and then click on conductivity. Place the probe into the standard, the raw data is displayed in the calibration routine, wait until the data is stable and calibrate.

4.4 Dissolved Oxygen calibration

Dissolved oxygen calibration is performed using solutions with zero % or 100% oxygen saturation. To prepare a sample with zero % saturation, dissolve 26 grams of sodium sulphite in 500 ml of water and add 0.2 grams of cobalt chloride. Stir the solution until the crystals are dissolved. Discard the solution after 30 minutes, as it will begin to absorb oxygen. To make a solution with 100% saturation, aerate a sample of fresh water for about two hours. A fish tank air pump and bubbler is ideal for this purpose. Alternatively use nitrogen gas to purge oxygen from the vicinity of the probe. Use Turo purging tube adaptor. When you have the calibration standard ready, perform the following steps:

1) Before calibrating dissolved oxygen, ensure that the temperature sensor is reading accurately and, if necessary, perform the temperature calibration described above. You should also check that the stirrer is operating correctly. The paddle should oscillate freely when the instrument is performing measurements. The zero point will not change so it is only necessary to calibrate at 100%

2) In the surface software go to the main menu and click on calibration button and then click on dissolved oxygen. Place the sensor into the buffers and allow adequate time for the sensor to stabilize. The raw data is displayed in the software calibration routine, wait until the data is stable and then calibrate.

4.5 pH Calibration

The pH sensor is calibrated using buffer solutions with a pH of 4 - 7.5 and 8-12. To calibrate the pH sensor, proceed as follows:

In the surface software go to the main menu and click on calibration button and then click on pH. Place the sensor into the buffers and allow adequate time for the sensor to stabilize. The raw data is displayed in the surface software calibration routine, wait until the data is stable and then calibrate.

4.6 ORP Calibration

Oxidation-reduction potential is calibrated using standard solutions producing ORP of 86 mV and 263 mV.

To prepare the 86 mV solution, measure out enough pH 7 buffer to cover the ORP sensor and saturate the solution with quinhydrone. This will only require a small amount of quinhydrone and is best done by adding a pinch and then stirring for 30 seconds. There should still be solid, undissolved quinhydrone in the solution. If no solid is seen, add an additional amount and repeat stirring until solid quinhydrone is seen. To prepare the 263 mV standard, repeat the above except use pH 4 buffer instead of pH 7. Perform the calibration as follows:

In the surface software go to the main menu and click on calibration button and then click on ORP. Place the sensor into the calibration standards and allow adequate time for the sensor to stabilize. The raw data is displayed in the surface software calibration routine, wait until the data is stable then calibrate. Note: After calibration the sensor can take many hours to perform normally. To reduce this time clean the bare metal electrode with a cotton bud soaked in alcohol **DO NOT DAMAGE THE pH GLASS ELECTRODE**

4.7 Turbidity Calibration

The turbidity sensor is calibrated using solutions with a turbidity of 0 ntu (distilled water) and a high value between 100 - 300 ntu’s. These solutions can be prepared by diluting a concentrated formazin solution. Beware, formazin is a suspected carcinogen. Always wear rubber gloves when handling formazin solutions. Note: Always clean the glass tube before calibration. Shake the turbidity formazin standard before use. Proceed as follows:

In the surface software go to the main menu and click on calibration then click on Turbidity. Place the sensor into the standards and allow adequate time for the sensor to stabilize. The raw data is displayed in the surface software calibration routine, wait until the data is stable and then calibrate.

4.8 Depth calibration

If the optional depth sensor is fitted then it will also require calibration. To perform the depth calibration you need to lower the probe to a known depth in the water. This can be done by placing a mark on the T-612 cable or rope at a measured distance from the bottom of the probe assembly then, making sure that the probe cable is vertical, lower the probe until the mark is at the surface of the water. In the surface software go to the main menu and click on calibration then click on depth.

5. Maintenance

5.1 Analyser

The unit requires little maintenance except to ensure that the batteries are not discharged and the connectors are kept clean and dry. When the voltage from the battery pack falls below 7.2 volts, the unit stops logging then records the date and time at which this has occurred. The instrument will then automatically shut down, although any data stored in the memory will be retained. When this occurs, the only way to restart the instrument is to replace the batteries.

5.1.1 Reset Software

Should the unit fail to function (Hang-up), i.e. the reader unit will not switch ON or OFF.

The reset function should be initiated by using the surface software. The reset function will not change or clear the calibration constants from the units' memory. However it will clear all stored data.

5.1.2 Hardware Reset

If the unit will not operate after using software reset it will be necessary to use hardware reset. This is accomplished by:

a) Remove the connector back plate/pressure tube assembly from the analyser by unscrewing two Allen headed screws. Use the allan key supplied in the spares kit to remove the screws. Slide back the back plate/pressure tube assembly to expose the batteries.

b) To hardware reset, slide a 'C' size battery to open circuit the connection and then slide back. The unit is now reset.

c) Try to communicate with the analyser. If no response contact the supplier.

5.1.3 Battery Replacement

The procedure for replacing the unit batteries is as follows:

1) Remove the main housing by unscrewing two allen headed screws on the connector end plate and sliding off the back plate/pressure tube assembly. Use the Allan key supplied in the spare parts kit to remove the screws.

2) Take out the old batteries and replace with eight new ‘C’ size batteries positioned with the ‘-‘ terminals against the spring connecters of the battery space. Be sure that the battery contacts are clean.

3) Reassemble in reverse order, be sure all ‘O’-ring is clean. **Do not over-tighten**. The connector end plate can only be installed one way. Three locating pins ensure that the ‘D’ Type connector is located correctly and accurately.

Before any maintenance can be carried out on the sensors first remove the powder coated stainless steel cage. Remove four allen headed screws by using the allen key provided in the spares kit.

5.2 D.O. Sensor Maintenance

To maintain the performance and accuracy of the dissolved oxygen sensor, the membrane should also be replaced if it becomes damaged or contaminated with organic matter. Clean the membrane with cotton wool saturated with alcohol

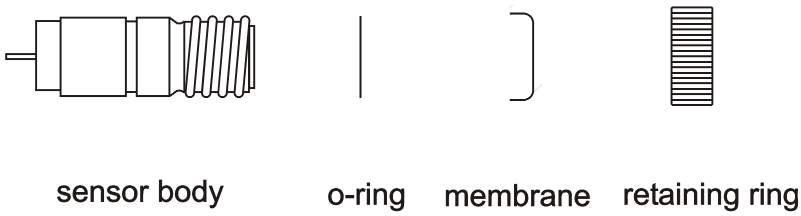

Figure 5: Exploded view of dissolved oxygen sensor.

5.2.1 Changing the Membrane

To change the membrane, perform the following steps, refer to figure 5.

1. Remove the dissolved oxygen sensor from the probe. To do this, lift the sensor guard and rotate the bottom section of the probe to expose the sensors. Ensure that the probe and sensors are completely dry. Use a cotton bud to dry the area between the sensors. Using pliers, lever the dissolved oxygen sensor out of the probe.
2. Unscrew the retaining ring and remove the old membrane.
3. Check the O-ring and discard if it is damaged then flush out the old electrolyte.
4. To refill with electrolyte (1.0 M KOH), hold the probe vertical and place the nozzle of the squeeze bottle beside the silver electrode. Squeeze the bottle to fill the probe with electrolyte until it flows over the top of the probe.
5. Be sure that there are no bubbles inside the sensor.
6. Take a new membrane and centralise it on top of the electrode and let it float on the surface.
7. Place the retaining nut over the membrane and screw down firmly so that the membrane is well tensioned.
8. Check that there are no bubbles in the electrolyte. If bubbles are found, repeat the above procedure.
9. Apply a smear of O-ring grease to the body of the sensor and push it back into the probe. Be sure not to damage the membrane and be sure to push the sensor in until it clicks into place
10. **Wait at least 2 hours for the sensor to stabilise** then recalibrate the dissolved oxygen readings.

5.2.2 Dissolved Oxygen Stirrer Maintenance

The Stirrer for the dissolved oxygen sensor is a magnetically operated paddle which oscillates and forces water past the sensor membrane. This stirrer may occasionally become clogged, particularly if the water you are testing contains a large amount of magnetic particles. To remove the stirrer paddle for cleaning, proceed as follows:

1. Loosen the two retaining screws in the stirrer support posts, (refer to figure 3), do not remove them.
2. Remove the stainless steel pin on which the paddle is held by pushing it from one end. Be very careful to not lose the spacers which are between the paddle and support posts.
3. Clean the paddle and replace it in the reverse order. Do not over tighten the retaining screws or you will strip the thread in the support post.

5.3 pH/ORP Sensor Maintenance

To service the pH sensor it is better to remove the sensor from the probe housing. This done by drying the probe by shaking of excess water and drying as best as possible. Then move the probe cage up and swivel the bottom section to one side. Firmly grasp the pH sensor and pull down.

Slow response or non-reproducible measurements are signs that the electrodes have become coated or clogged. The glass electrode is susceptible to coating by many substances. The speed of response, normally 95% of the reading in less than 10 seconds, is dramatically changed if a coating is present. Usually a rinse with methyl alcohol will remove any films on the glass and restore the speed of response.

If the methanol rinse does not restore the response, soak the sensor in 0.1 Molar HCl for five minutes. Remove and rinse the sensor with water and place in 0.1 Molar NaOH for five minutes. Remove and rinse again, then place the sensor in pH 4.0 buffer for 10 minutes. The response should now be improved. Do not use abrasive cleaners as this will destroy the sensor.

After cleaning the sensor, be sure to recalibrate both pH and ORP.

If cleaning the sensor does not restore performance, the sensor will have to be replaced.

The pH and ORP electrodes share a common reference (half cell). As the electrolyte gel becomes exhausted it can become replaced by water and the pH and ORP sensors become unstable. Unplug the pH sensor as previously described. An indication if water is present is that the viscosity is low compared with gel. The can be seen though the pH sensor housing. If there is water present either replace with a new pH sensor or return the sensor to Turo for regelling.

5.4 Turbidity Sensor Maintenance

The turbidity sensor requires little maintenance except ensuring that the glass tube is kept clean. Do not use an abrasive cleaner. Clean the tube with a soft rag and, if required, detergent. Make sure that you rinse the probe so that there is no residual detergent film to interfere with the sensor optics. Make sure that you recalibrate turbidity after cleaning the sensor.

5.5 Conductivity Sensor Maintenance

To maintain the performance and accuracy of the conductivity / salinity sensor, the electrodes need to be periodically cleaned and if the platinum black coating is damaged, the electrodes will need to be re-platinised.

Inspect the sensor on a regular basis. If there is any evidence of a build up of contamination on the electrodes, then the sensor should be removed and cleaned using the platiniser unit as described below. If the platinum black coating is damaged, the electrodes should be cleaned and then re-platinised. To perform these operations, proceed as follows:

1. To remove the sensor, lift the sensor guard and rotate the bottom section of the probe to expose the sensors. Ensure that the probe and sensors are completely dry. Use a cotton bud to dry the area between the sensors. Pull the conductivity sensor down out of the probe by hand. Do not twist the sensor. Ensure that the vacant sensor socket is kept completely dry.
2. To clean the electrodes, plug the sensor into the platiniser unit. Connect the unit to a 6V power supply (such as a lantern battery). Fill the platiniser with 0.1M HCl and switch on the platiniser for 5 minutes. Switch off the platiniser and rinse with distilled water. Now inspect the electrodes. If the platinum black coating is intact, replace the sensor in the probe assembly as described in step 5 below. If the electrodes need to be re-platinised, proceed as follows.
3. To strip the old platinum black coating from the electrodes, plug the sensor into the platiniser unit fill with 5M HCl. Connect the unit to a 6V power supply and switch the unit on. The old platinum black will be stripped off the

electrodes. Once completed, switch the platiniser off and rinse with distilled water.

4. To replace the electrode coating, plug the sensor into the platiniser unit and connect to a 6V power supply. To make the platinising solution, mix 3g of chloroplatinic acid with 0.3g of lead acetate and top up to 100ml with distilled water. Fill the platiniser with platinising solution and switch the unit on for 10 minutes. The electrodes will be plated with a sooty black coating. When complete, rinse the unit and electrodes with distilled water then fill the unit with 0.1M HCl and switch on for 2 minutes to remove any occluded platinum black solution remaining on the electrodes. Rinse the sensor and platiniser with distilled water and install the sensor in the probe assembly.

5. Before installing the conductivity sensor into the probe assembly, make sure that both the sensor and probe assembly are dry. Apply a smear of vacuum grease to the sensor body to ensure that a water tight seal is achieved. The sensor can only be installed with the black dot on the electrode housing pointing to the outside of the probe. Align the sensor and push it into the probe assembly. Be sure to recalibrate the salinity and low conductivity.

5.6 Main Features of Surface Software

The surface software is operated from IBM™/Compatible computer. The software uses Windows 95-98™.

The main operations of the unit are accessed and processed via the main menu. The operator can practice using the software by switching from active, (ie controlling the submersible unit) to passive (via the control box) that allows the operator to practice without using the unit.

Help commands are available for each of the functions.

IMPORTANT NOTICE:

The displayed table of parameters used in real time display and logged data, can be altered in their sequence to suit the operator by a simple drag and place procedure.

A graphics display allows the user to plot up to five parameters for X and Y coordinates. Many features allow for optimal presentation.

Calibration can be accomplished with either one or two calibration points. The calibration points are variable to suit the environment to where the unit is to be used. This will give the most accurate results. Eg pH can be calibrated for natural water systems between pH's of 7.XX and 8.XX.

The stored data is retrieved in raw or processed data files. This is useful if the submersible unit is incorrectly calibrated. The raw file can be reprocessed with new calibration constants for correct data.

Calibration constants are stored in the submersible's memory and/or to floppy disk. The calibration constants stored on disk can be down loaded to the submersible's memory.

Another useful feature is the trigger facility. Logging will commence when a pre-programmed event is met and will cease when the event is removed. Eg The trigger is set so that logging will start when conductivity is 100us/cm and will stop when the conductivity is lower than 100s/cm. These conditions will be met after the programmed start time has occurred and stop when the programmed stop time is met.

6. Storage

When storing the instrument, the pH electrode should be kept moist in a solution of 3M KCl (approximately 22 grams of KCl dissolved in water to make 100 ml of solution). It is advisable to buffer this solution to bring it to approximately pH 5 or 6.

This solution may be contained in either the small pH sensor cap (in some T-612 models) or in the probe storage canister:

- If the T-612 pH sensor has a small cap around it, this simply pushes into place. The solution can be put into this cap for storage of the pH sensor. A small piece of cotton wool inside the cap can be used to absorb the solution, creating a sufficiently damp environment. If this method is used, a drop of clean water should be put into the storage container to keep air around the DO sensor damp.

  CARE SHOULD BE TAKEN when removing or replacing this cap. The cap should be carefully PULLED OFF, DO NOT ATTEMPT TO UNSCREW IT. The glass sensor is EXTREMELY DELICATE and should not be bumped or touched.

  Alternatively, the probe storage canister may be used to hold the storage solution.

- The T-612 comes with a storage canister which clamps onto the probe providing a waterproof seal. Enough storage solution should be put into the canister so that the pH sensor is kept wet. This allows the instrument to be stored and transported with the sensors kept immersed in the storage solution.

7. Appendix 1 - Conversions Used

The T-612 measures dissolved oxygen as % saturation and then automatically converts the reading to milligrams per litre. This conversion is calculated from the dissolved oxygen solubility tables found in International Oceanographic Tables vol.2. National Institute of Oceanography 1972.

The conversion between conductivity and salinity is performed using the Practical Salinity Scale. UNESCO Technical Papers in Marine Science 1983.

The conversion of low conductivity raw data to conductivity referenced to 25 Deg C is performed using constants derived from HANDBOOK OF CHEMISTRY AND PHYSICS, 1963, Chemical Rubber Publishing Company, Page 2691, Conductivity of Standard Solutions using KCl, 0.001 M solution.

Redox potential (ORP) conforms to International Standard IEC 746-5, “Expressions of Performance of Electrochemical Analyzers, Part 5: Oxidation-Reduction potential”. In accordance with this standard, the Redox potential is referred to the standard (“normal”) hydrogen electrode (NHE) and is expressed in mV.

8. Appendix 2 - Compliance

CE

N 10255

9. Appendix 3 - Part Numbers

Part Number	Description
T-611-001	Probe assembly
T-611-002	Cable assembly
T-611-003	Dissolved oxygen sensor
T-611-004	pH/ORP sensor
T-611-005	Conductivity sensor
T-611-006	Depth sensor
T-611-007	Dissolved oxygen membrane
T-611-008	Dissolved oxygen O-ring
T-611-009	Dissolved oxygen membrane retaining ring
T-611-010	Dissolved oxygen electrolyte
T-611-011	Platiniser unit
T-611-012	Platinising solution
T-611-013	Sensor storage solution
T-611-014	pH buffer 4.0 1 litre
T-611-015	pH buffer 10.0 1 litre
T-611-016	Salinity standard 35.00 ppt 1 litre
T-611-017	Formazin solution 1 litre
T-612-021	Communications cable
T-612-022	Communications bulk head connector
T-612-023	Communications bulk head connector cap
T-612-024	Powder coated stainless steel cage