ST-772 Dissolved Oxygen Probe
Operation Manual

April. 10, 2020
Rev. A

Pyxis Lab, Inc.
1729 Majestic Dr. Suite 5
Lafayette, CO 80026 USA
www.pyxis-lab.com

Limited Warranty

Pyxis Lab warrants its products for defects in materials and workmanship. Pyxis Lab will, at its option, repair or replace instrument components that prove to be defective with new or remanufactured components (i.e., equivalent to new). The warranty set forth is exclusive and no other warranty, whether written or oral, is expressed or implied.

Device Warranty Term

The Pyxis warranty term for the ST-772 probe is thirteen (13) months from original shipment from Pyxis. In no event shall the standard limited warranty coverage extend beyond thirteen (13) months from original shipment date.

Warranty Service

Damaged or dysfunctional instruments may be returned to Pyxis for repair or replacement. In some instances, replacement instruments may be available for short duration loan or lease.

Pyxis warrants that any labor services provided shall conform to the reasonable standards of technical competency and performance effective at the time of delivery. All service interventions are to be reviewed and authorized as correct and complete at the completion of the service by a customer representative or designate. Pyxis warrants these services for 30 days after the authorization and will correct any qualifying deficiency in labor provided that the labor service deficiency is exactly related to the originating event. No other remedy, other than the provision of labor services, may be applicable.

Repair components (parts and materials), but not consumables, provided in the course of a repair, or purchased individually, are warranted for 90 days ex-works for materials and workmanship. In no event will the incorporation of a warranted repair component into an instrument extend the whole instrument's warranty beyond its original term.

Warranty Shipping

A Repair Authorization Number (RA) must be obtained from Pyxis Technical Support before any product can be returned to the factory. Pyxis will pay freight charges to ship replacement or repaired products back to the customer. The customer shall pay freight charges for returning products to Pyxis. Any product returned to the factory without an RA number will be returned to the customer.

Pyxis Technical Support

Contact Pyxis Technical Support at service@pyxis-lab.com or 1-866-203-8397 (Mo-Fri 7:00AM-5PM MT)

Table of Contents

1   Introducing the Pyxis ST-772 Probe

The Pyxis ST-772 dissolved oxygen (DO) sensor is based on the principle of fluorescence quenching to determine the dissolved oxygen content in water. It incorporates Pyxis' advanced technology in the field of fluorescence detection and uses dual light source detection technology with excitation and reference light sources, offering a wide detection range and low detection limit. The sensor integrates temperature and pressure sensors, which can perform temperature and pressure compensation for the measurement of dissolved oxygen based on ambient environmental conditions present in the application of use. The ST-772 offers an easily replaceable, front loading DO membrane cap that has been independently developed by Pyxis Lab, with a typical service life of up to two years. This unique DO membrane cap design incorporates a black microporous PTFE membrane material designed to provide extreme scratch resistance, extended life span and simple replacement. The flat front-end design of the ST-772 makes this platform less prone to contamination or fouling and is very easy to clean. The sensor body is composed of 304 stainless steel and is well suited for aggressive industrial application use. The ST-772 may be utilized in a drop in submersed application with the Pyxis submersion rod and stand-pipe assembly, or it may also be used in an in-line pressurized Tee assembly format. Both options are discussed in the Installation Section 2.0 of this manual. The ST-772 offers both 4-20mA and RS-485 Modbus outputs and is Bluetooth enabled when used in conjunction with the MA-CR Bluetooth Adapter.

1.1   Features of the Pyxis ST-772 Probe

The ST-772 includes the following features:

- 0.004-20mg/L measurement range
- Built-in temperature and pressure sensor with automatic compensation
- Accurate and stable measurement with ultra-low drift
- Built-in transmitter without preamplifier or meter head
- Dual Outputs both 4-20mA isolated signal or RS-485 Modbus
- Long-distance transmission with higher stability & accuracy
- Wireless Calibration, Diagnostics, Data Trend via uPyxis APP when used with MA-CR Adapter
- The sensor can be Slope calibrated with air or air saturated water
- Zero-point calibration with 5% Sodium Sulfite solution or Nitrogen gas
- Submersible or Inline Pipe Tee installation accessories are optional
- Suitable for dissolved oxygen monitoring of
    - Activated Sludge / Aerated Basin
    - Wastewater & Sewage Processing
    - Chemical & Process Water Applications
    - Domestic Water Applications
    - Filtration Applications
    - Aquaculture
    - Agriculture

1.2   Specifications

Specifications are subject to change without notice. Contact Pyxis (service@pyxis-lab.com) for an updated specification list.

Item	Specification
P/N	53703
Measuring Range	0.004-20mg/L
Resolution	0.01mg/L
Accuracy	± 0.1mg / L or ± 1%, whichever is greater
Light Source	Blue Light Irradiated Emission Red Light Quenching Excitation
Response Time	<60s
Operational Temperature	0 °C – 45 °C (32 - 113° F)
Operating Voltage	22 – 26V DC, Power 0.6W
Signal Output	4-20mA analog output / RS-485 digital output
Dimension (L x D)	296 x33.6 mm (11.65x 1.32 inches)
Weight	760 g (1.67 lb) cable excluded
Installation Method	Pipeline installation or submerged installation
Material	304 stainless steel
Working Pressure	20 psi
Wet Material	304 stainless steel / PVC and polycarbonate
Cables Provided	MA-1.5CR – 8Pin Female Adapter / Flying Lead Cable – 1.5m MA-50CR – 8Pin Male/Female Adapter Cable – 15m
Calibration	Slope calibration：Air or Air Saturated Water Zero calibration: 5% Sodium Sulfite or Nitrogen Gas
DO Membrane Cap Life	2 years
Protection Grade	IP-67/IP-68
Regulation	CE

1.3   Unpacking the Pyxis ST-772 Probe

Remove the instrument and accessories from the shipping container and inspect each item for any damage that may have occurred during shipping. Verify that all items listed on the packing slip are included. If any items are missing or damaged, please contact Pyxis Customer Service at service@pyxis-lab.com

1.4   Standard Accessories

The following accessories are included in the ST-772 probe package (as shown in Figure 1):

- One **ST-772** Dissolved Oxygen Probe (P/N - 53703)
- One **DCC-1** Membrane Cap for ST-772 (P/N – 53712)
- One **MA-1.5CR** Cable (1.5 Meter/ 4.9 ft 8Pin Female Adapter/Flying Lead)
- One **MA-50CR** Cable (15 Meter/ 50 ft 8Pin Male/Female Extension Cable)
- One **MA-CR** Bluetooth Adapter for 8Pin Sensors
- One **MA-NEB** Bluetooth/USB Adapter for use with Desktop uPyxis APP
- The full instrument manual is available for download at www.pyxis-lab.com/support.html

Figure 1 ST-772 Dissolved Oxygen Probe / DCC-1 Membrane Cap / MA-CR Bluetooth Adapter / MA-NEB USB Adapter

1.5   Optional Accessories

The following optional accessories can be ordered at order@pyxis-lab.com or the Pyxis E-Store at www.pyxis-lab.com/shop

Optional Accessory	P/N
MA-CR Bluetooth Adapter for 8-Pin Pyxis Sensors	MA-CR
MA-150-1 Submersion Adapter Mounting Bracket for Floating Install	53705
MA-150-3 Submersion Pipe Assembly with Float Plate *(Floating installation)*	50791
MA-120-B Submersion Pipe & Adapter Mounting Bracket *(Fixed installation)*	50783
ST-001 Inline Tee Assembly (¾" FNPT – CPVC)	50704
DCC-1 Dissolved Oxygen Membrane Cap - Replacement	53712
MA-50CR (50' Extension Cable w/8Pin Adapters)	50743
MA-100CR (100' Extension Cable w/8Pin Adapters)	50744
Pyxis ST-Series Pro	SER-01

2 Installation

Submersed Floating Installation: The ST-772 may be installed in a submersed/floating application using the MA-150-1 Submersion Adapter Mounting Bracket and the MA-150-3 Floating Submersion Pipe Assembly. The ST-772 dissolved oxygen probe needs to be installed as shown in Figure 2. For installation, users only need to keep the MA-105-1 and MA-105-3 assemblies in place permanently. For probe replacement and maintenance, users only need to pull the MA-150-3 and DO probe from fixing bracket vertically (upwards).
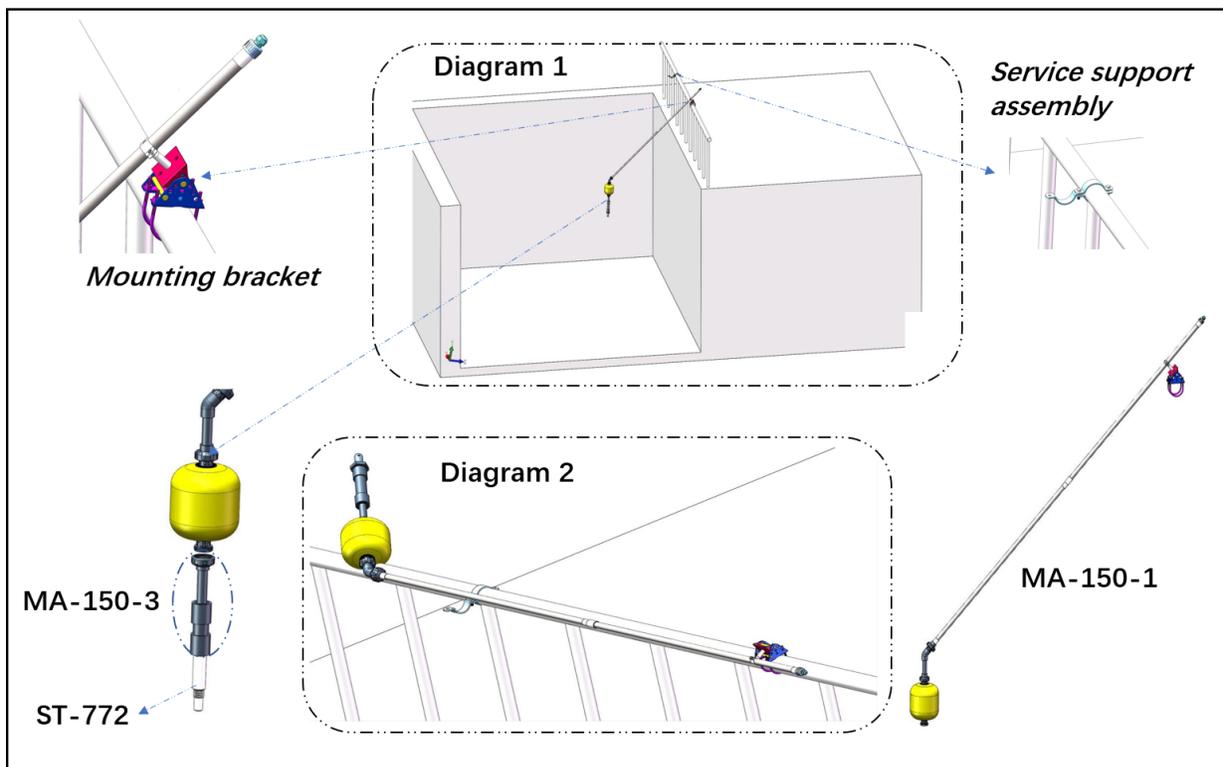
Figure 2 ST-772 in a submersed floating installation

Submersed Fixed Installation: The ST-772 may be installed in a submersed/fixed application using the MA-120-B Submersion Adapter Mounting Bracket. The ST-772 dissolved oxygen probe needs to be installed as shown in Figure 3. For installation, users only need to keep the MA-120-B assembly in place permanently. For probe replacement and maintenance, users only need to pull the MA-120-B and DO probe from fixing bracket vertically (upwards).
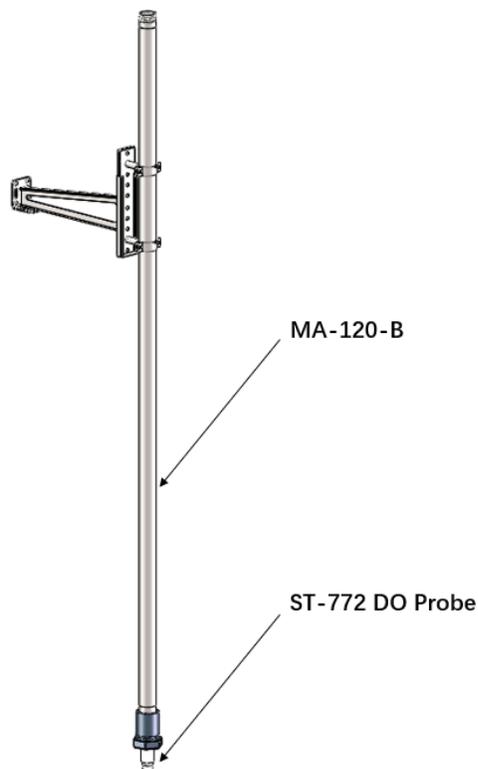
Figure 3 ST-772 in a submersed fixed installation

Pipeline Installation The ST-772 may also be installed in an inline flow application using the Pyxis ST-001 Inline Tee Assembly. The ST-001 offers ¾" FNPT Thread or Socket Weld Adapters with Unions for easy installation and sensor maintenance. Pyxis recommends installation in a vertical flow format from bottom up to reduce the impact of water bubbles. Install O-ring on the probe and then install the probe into the tee and ensure the DCC-1 membrane cap is in the direction of water flow as shown in Figure 3.
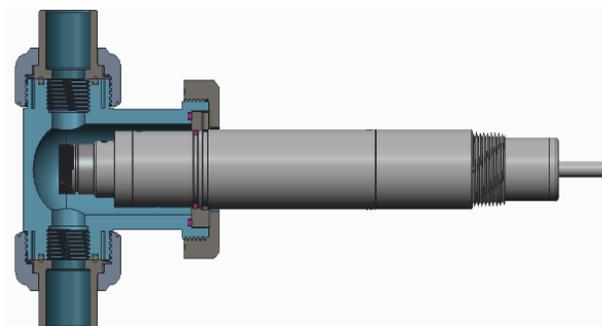
Figure 4 ST-772 in a pipeline installation using ST-001 inline Tee Assembly

3   Quick 4-20mA Start

Follow the wiring table below to connect the ST-772 probe to a controller.

Color	Designation
Red	24V
Brown	0V-

Color	Designation
Grey	0V
White	4-20mA +
Pink	485GND
Blue	RS-485 A
Yellow	RS-485 B
Green	Shield

NOTE *The 24V power ground and the 4-20 mA- return are internally connected.*

If the 24V power ground and the 4-20 mA return in the controller are internally connected (non-isolated 4-20mA input), it is unnecessary to connect the 4-20 mA- (blue wire) to the 4-20 mA negative terminal in the controller. If a separate DC power supplier other than that from the controller is used, make sure that the output from the power supply is rated for 22-26 VDC @ 65mA.

Detailed wiring diagrams for common controllers are available from https://pyxis-lab.com/support-2/

4 Calibration and Diagnosis

The ST-772 dissolved oxygen probe is rigorously calibrated before leaving the factory. Users can calibrate according to their needs. Before calibration, the probe needs to have a relatively stable temperature and dissolved oxygen reading when placed in the calibration solution or gas.

4.1 Calibration and Diagnosis by uPyxis Mobile App

Connect and power the ST-772 probe using the MA-CR Pyxis Bluetooth adapter (P/N: MA-CR) as shown in the following connection diagram. The power should be sourced from a 24 VDC power terminal from the receiving controller. If a controller is not available, please purchase a 24 V power supply that can directly connect to the ST-772 probe with proper cable connectors from Pyxis.
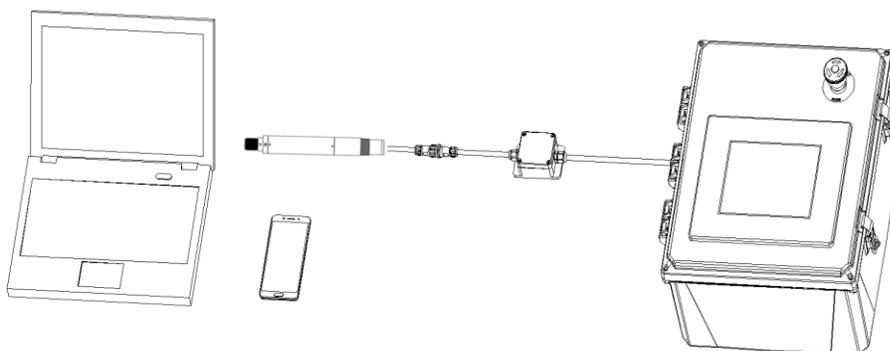
Figure 5 ST-772 and MA-CR Bluetooth Adapter powered by Receiving Controller

Download and install the uPyxis APP from Apple iStore or Google Play. Turn on the Bluetooth in the mobile device being used (please do not pair the device Bluetooth to any Pyxis device, the uPyxis APP will do the pairing). Open the uPyxis APP in the mobile device. Swipe down to refresh the phone screen and scan for available Pyxis Bluetooth devices. The discovered devices will be listed (Figure 4).

Tap the discovered ST-772 probe to connect to the probe. The uPyxis app can identify the probe type if multiple Pyxis probes are discovered in the scan. For legacy generation Pyxis probes, a dialog message window will be displayed to ask the user to tell the app the probe type. In this case, please select ST-772.
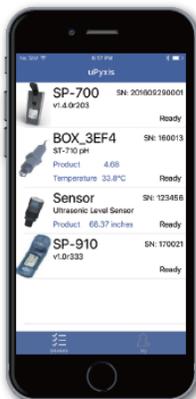
As shown in Figure 6, after connected to the ST-772 probe through the MA-CR Bluetooth Adapter and uPyxis APP, the Calibration Page will display the current/live dissolved oxygen value. Three functional tabs are available in this page: Zero Calibration, Slope Calibration, and 4-20mA Span.

4.1.1   Calibration by uPyxis Mobile App

Remove the ST-772 dissolved oxygen probe from the water and wipe it with a damp cloth to remove debris and any biofouling. If there is water on the membrane, dry it with a soft cloth, taking special care not to damage the membrane.

Conducting Air Calibration - Place the dissolved oxygen probe in the air with a stable temperature or in air-saturated water and allow it to stand for a minimum of 6 minutes. Observe the values being displayed in uPyxis Calibration Page data readout. Once the displayed oxygen and temperature values are stable proceed by click "Air Calibration" to perform air calibration as shown in Figure 8.

Enter the humidity value into the uPyxis APP through the "Air Calibration Process" outlined using the following entry values.

- If you are using air for calibration, you will need to enter the real-time (current) humidity value.

- If you are using air-saturated water for calibration, you will need to enter a humidity value of "1".

If the Air-Calibration was successful, the interface will return a message "Calibration Succeeded". If you receive a "Calibration Failed" message, please click "Air Calibration" again and repeat.

Conducting ZERO Calibration - Place the probe in Nitrogen Gas or 5% Sodium Sulfite solution (anaerobic water) and allow the probe to stand for a minimum of 15 minutes. Observe the values being displayed in

uPyxis Calibration Page data readout. Once the displayed oxygen and temperature values are stable, then click "Zero Calibration" to perform zero calibration (Figure 7). If the calibration is successful, the interface will feedback a message "Calibration Succeeded". If the calibration fails, click "Zero Calibration" again.
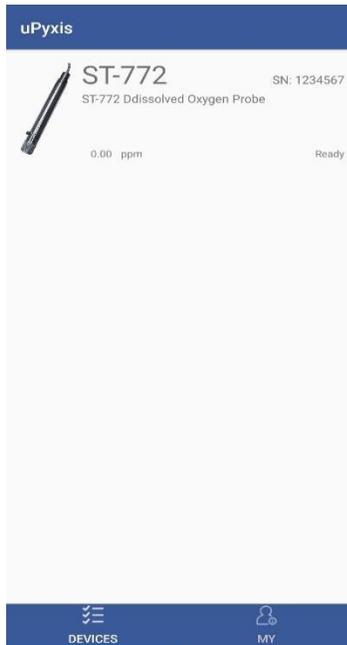
Figure 6 A ST-772 discoveredby Bluetooth scan
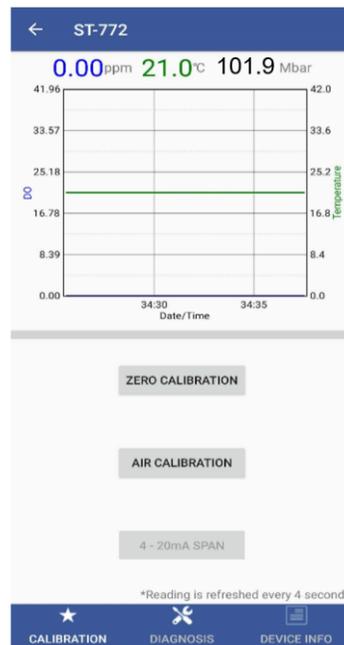
Figure 7 Calibration page

Figure 8 Zero calibration
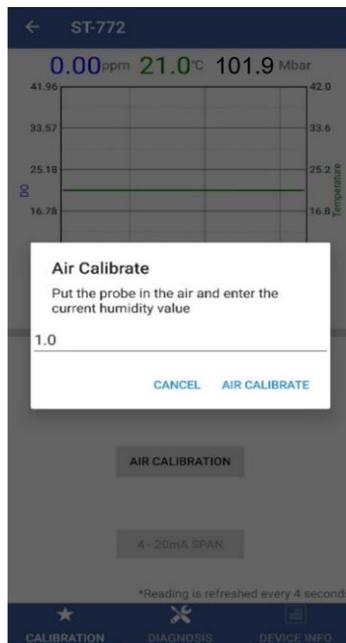
Figure 9 Air calibration
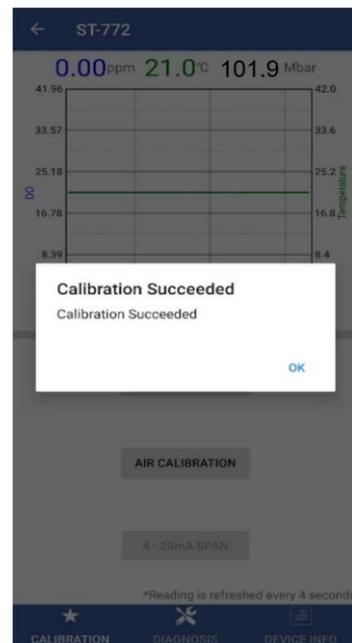
Figure 10 Calibration feedback

4.1.2   4-20mA Span

The default 4-20mA span is 20 mA = maximum range (20ppm) and 4 mA = 0 ppm DO in water. Tap 4-20mA Span to change the DO in water value corresponding to the 20 mg/L output (Figure 10). ***NOTE*** The 4-20mA Span feature allows users to REDUCE the upper 20mA output scale only. You cannot INCREASE the upper limit of the sensor.
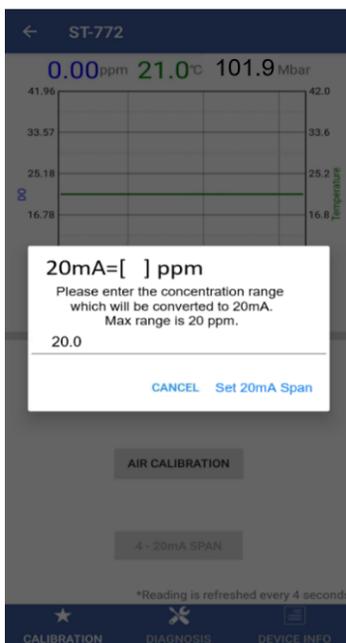
Figure 11 Enter DO ppm In Water concentration to set 4-20mA

4.1.3   Diagnosis

Tap Diagnosis in the bottom of the app page to launch the diagnosis page (Figures 11 and 12).
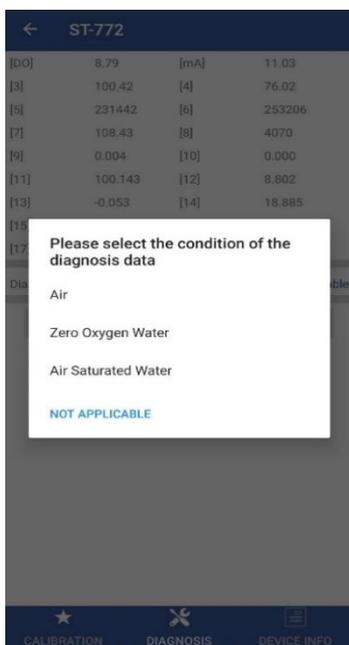
Figure 12 Select Diagnosis Condition   *Figure 13 Operation tips*
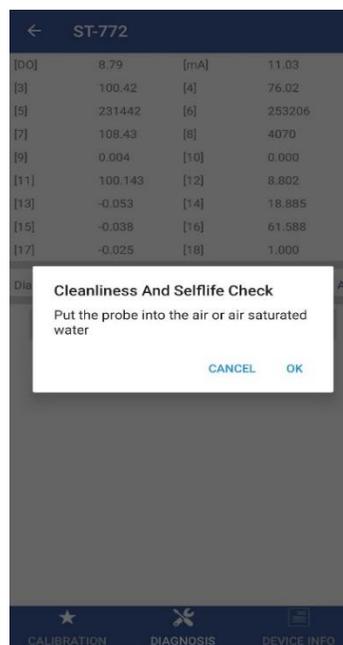
In this page, the raw data measured by the probe is displayed. To help troubleshooting possible issues with the probe, please remove the dissolved oxygen probe from the water and put the probe in air or air-saturated water, Nitrogen gas or 5% Sodium Sulfite solution (anaerobic water) respectively to save the image of these data. This data can be exported to service@pyxis-lab.com for real-time support in trouble shooting needs.

In the Diagnosis page, the probe cleanliness check can be performed. Please put the probe in air or air-saturated water and select the sample condition by tapping Diagnosis Condition (Figure 12). Tap Cleanliness Check to carry out the check.

As shown in Figure 13, If the DCC-1 (DO membrane cap) is in need of replacement, the APP will display "Please replace the DO membrane cap". In this case, please replace the DCC-1 dissolved oxygen membrane cap. If you are in need of a new replacement cap, contact order@pyxis-lab.com for pricing details.

Figure 14 Cleanliness check result and raw data

4.2 Calibration and Diagnosis by uPyxis Desktop App

Download and install the uPyxis desktop app from www.pyxis-lab.com/support-2 . Connect and power the ST-772 probe using the MA-CR Pyxis Bluetooth adapter (P/N: MA-CR) as shown in the following connection diagram. The power should be sourced from a 24 VDC power terminal from the receiving controller. If a controller is not available, please purchase a 24 V power supply that can directly connect to the ST-772 probe with proper cable connectors from Pyxis.
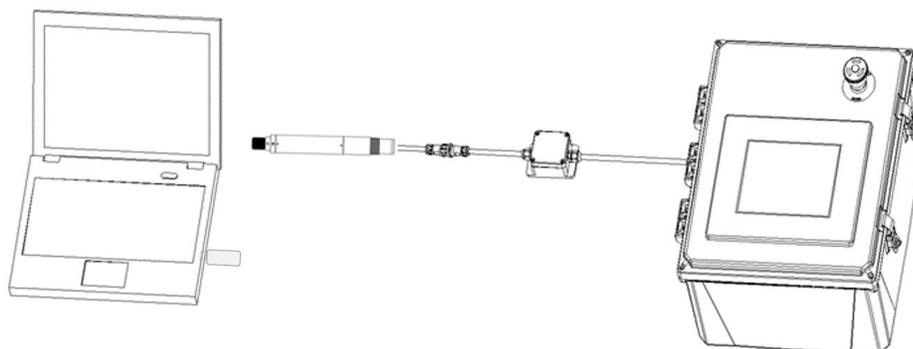
Figure 15 Connect the ST-772 to a computer via Pyxis MA-CR Bluetooth adapter

Establish connection between uPyxis app and the ST-772 through the following steps:

1. Open the desktop uPyxis app.
2. Click Device tap to launch the connection option menu.

3. Select Connect via MA-NEB Bluetooth USB adapter. (Figure 15)
4. Normally only one Bluetooth adapter is identified by uPyxis. If more than one Bluetooth adapter listed in the selection dropdown, select the appropriate device to make connection. (Figure 16)

After the connection is established, the ST-772 probe series number and current DO in water reading are displayed on the left of the information page (Figure 17). In this page, a nickname can be assigned to the probe. The probe Modbus address can be changed.

USB Bluetooth Adapter (P/N - MA-NEB) for use with PC and uPyxis Desktop App
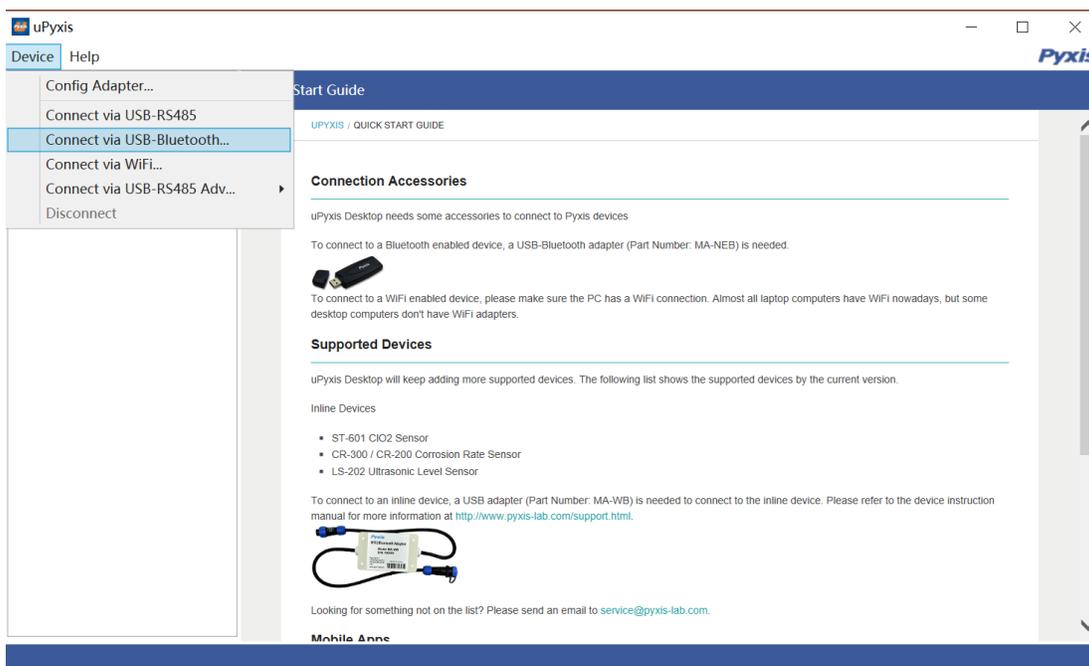
Figure 16 Connection Options
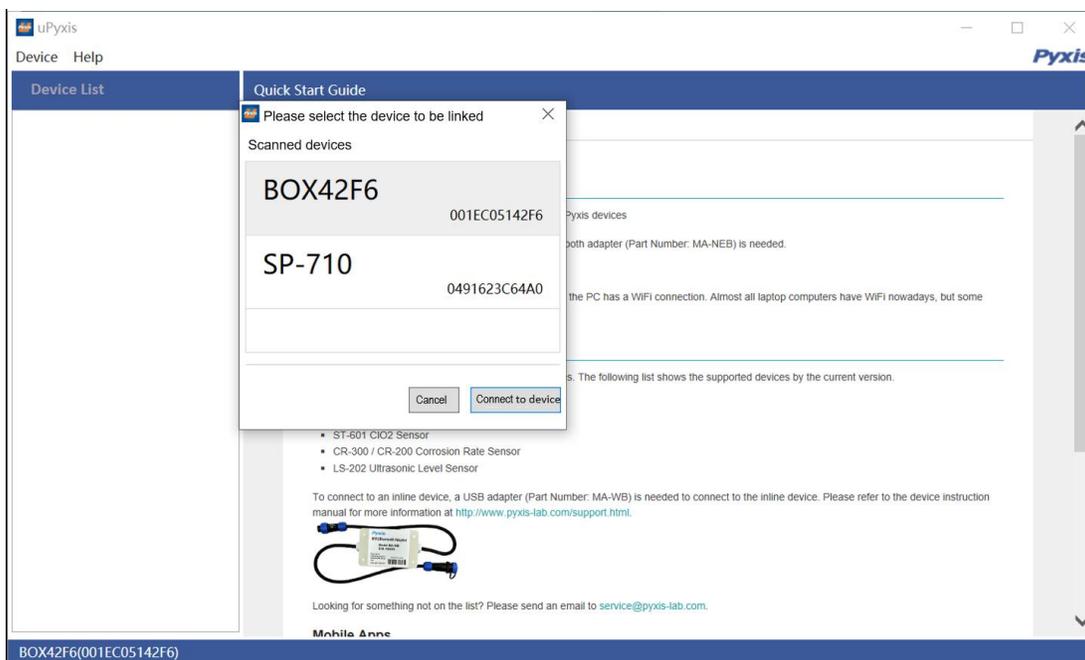
Figure 17 Select Appropriate Bluetooth Source
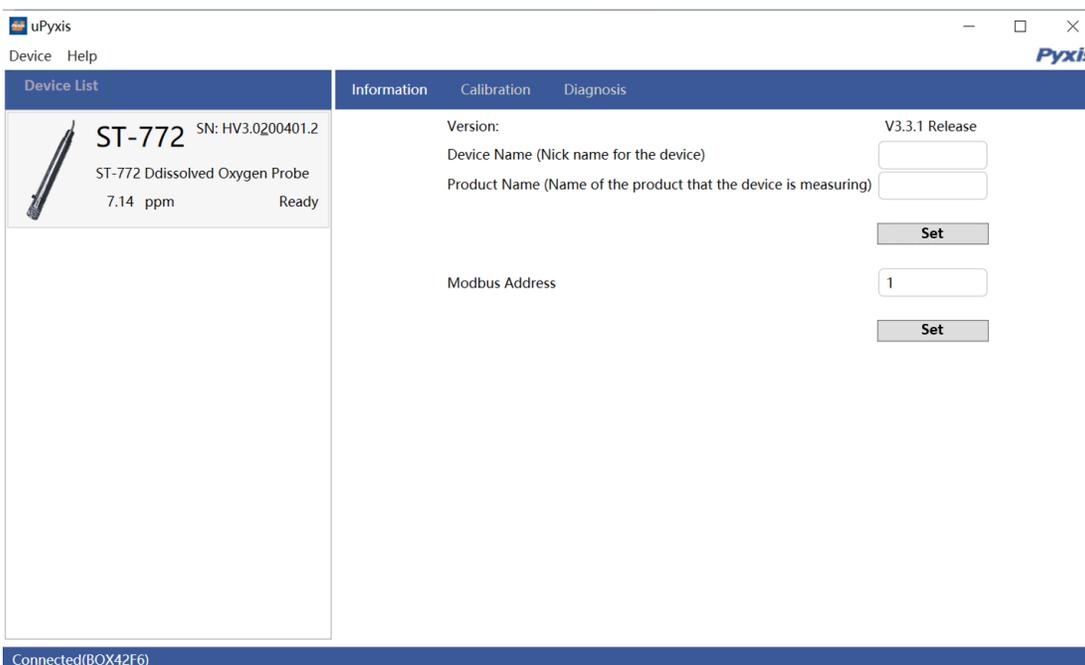
Figure 18 Connected to the ST-772 probe and information page

4.2.1   Calibration

Remove the ST-772 dissolved oxygen probe from the water and wipe it with a damp cloth to remove debris and any biofouling. If there is water on the membrane, dry it with a soft cloth, <u>taking special care not to damage the membrane</u>.

<u>Conducting Air Calibration</u> - Place the dissolved oxygen probe in the air with a stable temperature or in air-saturated water and allow it to stand for a minimum of 6 minutes. Observe the values being displayed

in uPyxis Calibration Page data readout. Once the displayed oxygen and temperature values are stable proceed by click "Air Calibration" to perform air calibration as shown in Figure 19.

Enter the humidity value into the uPyxis APP through the "Air Calibration Process" outlined using the following entry values.

- If you are using air for calibration, you will need to enter the real-time (current) humidity value.

- If you are using air-saturated water for calibration, you will need to enter a humidity value of "1".

If the Air-Calibration was successful, the interface will return a message "Calibration Succeeded" as in Figure 21. If you receive a "Calibration Failed" message, please click "Air Calibration" again and repeat.

Conducting ZERO Calibration - Place the probe in Nitrogen Gas or 5% Sodium Sulfite solution (anaerobic water) and allow the probe to stand for a minimum of 15 minutes. Observe the values being displayed in uPyxis Calibration Page data readout. Once the displayed oxygen and temperature values are stable, then click "Zero Calibration" to perform zero calibration (Figure 20). If the calibration is successful, the interface will feedback a message "Calibration Succeeded" as in Figure 21. If the calibration fails, click "Zero Calibration" again.
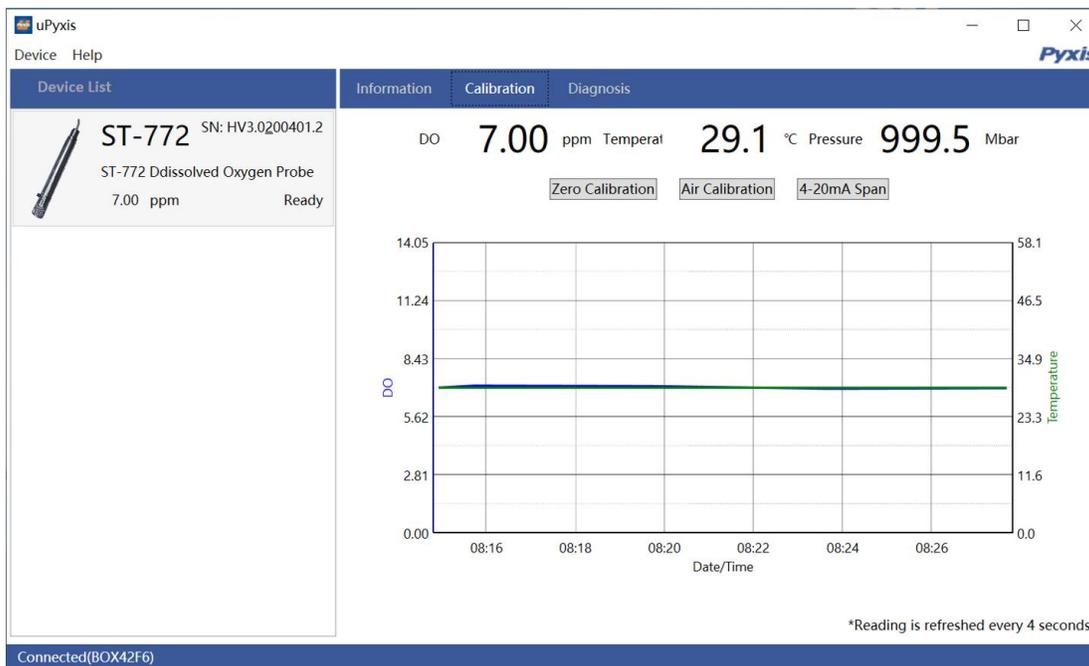
Figure 19 Calibration Page
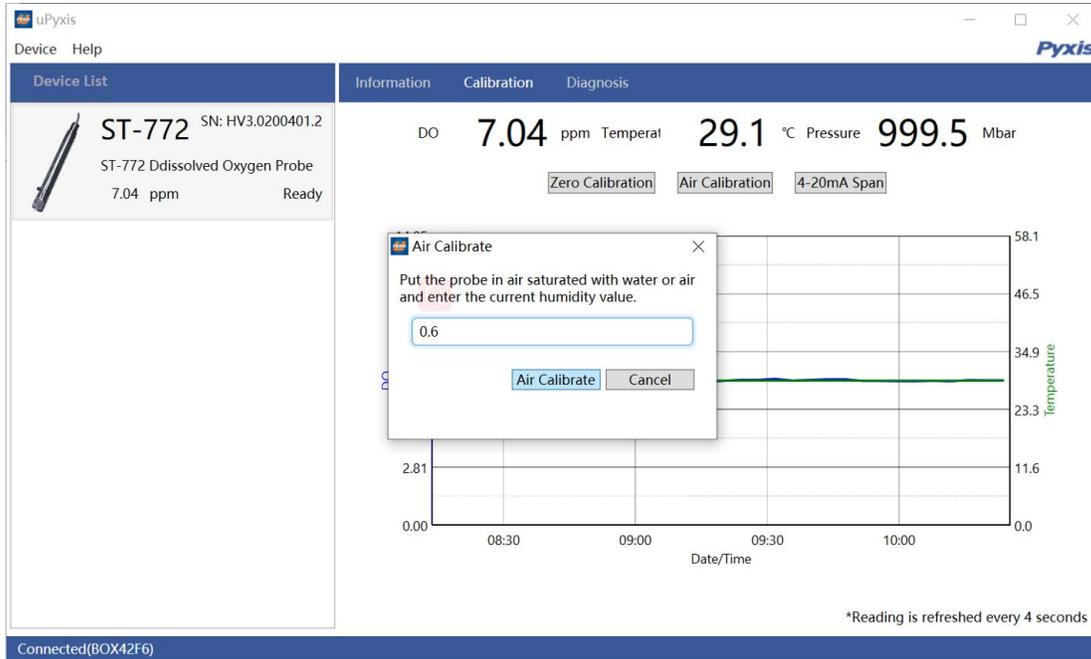
Figure 20 Air Calibration
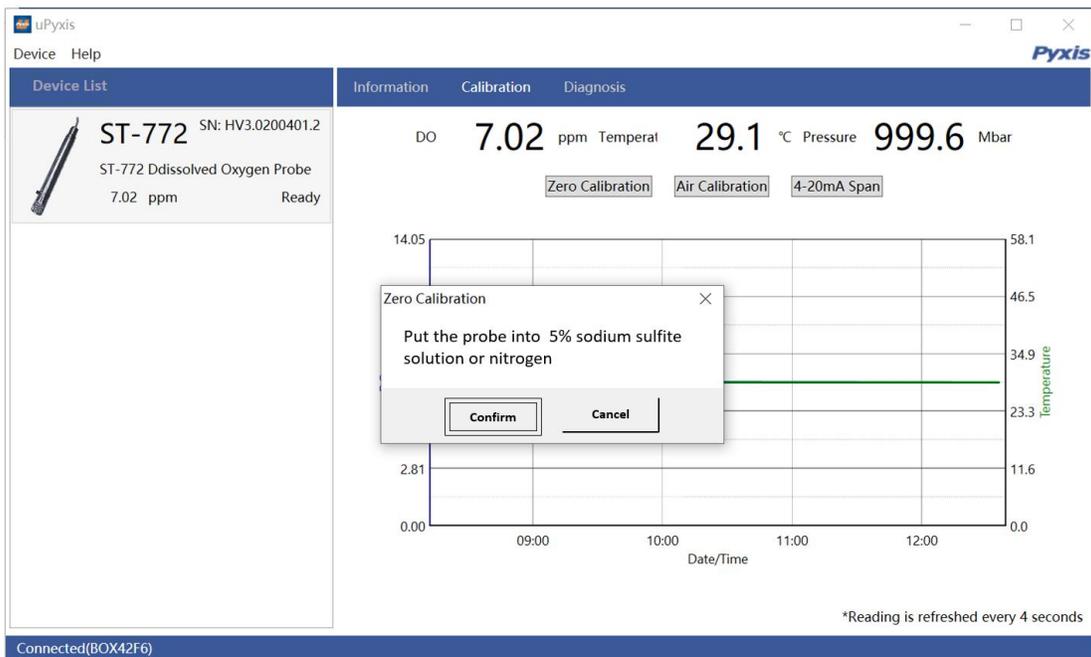
Figure 21 Zero Calibration
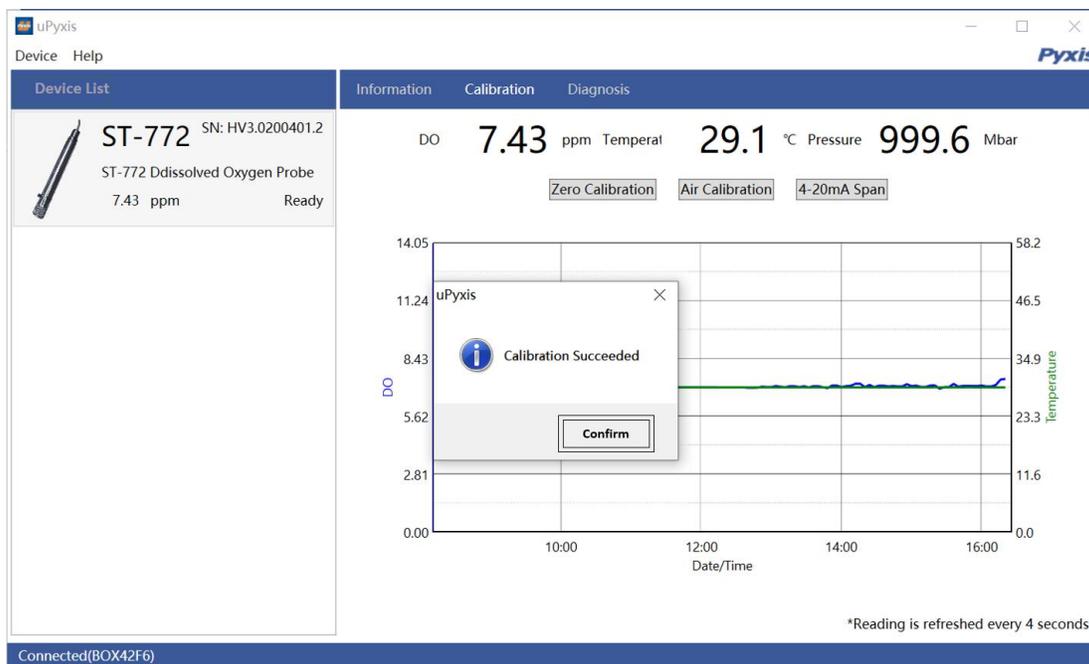
Figure 22 Calibration Feedback

4.2.2 4-20mA Span

The default 4-20mA span is 20 mA = maximum range (20ppm) and 4 mA = 0 ppm DO in water. Tap 4-20mA Span to change the DO in water value corresponding to the 20 mg/L output (Figure 22). ***NOTE*** The 4-20mA Span feature allows users to REDUCE the upper 20mA output scale only. You cannot INCREASE the upper limit of the sensor.
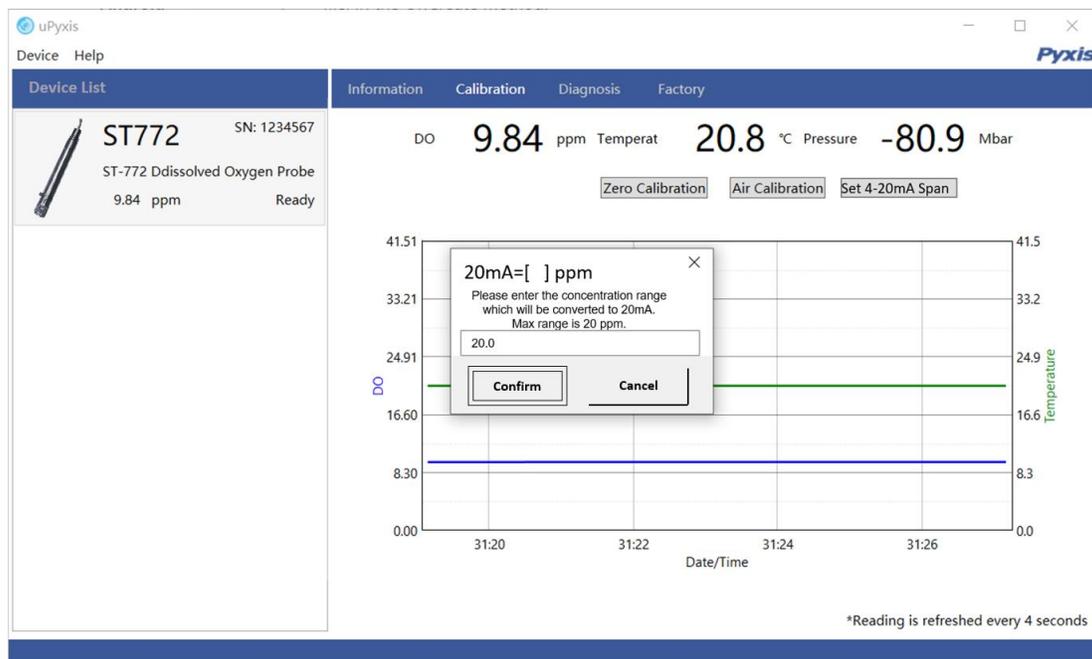
Figure 23 Set 4-20mA Span

4.2.3   Diagnosis

In this page, the raw data measured by the probe is displayed. To help troubleshooting possible issues with the probe, please remove the dissolved oxygen probe from the water and put the probe in air or air-saturated water, Nitrogen gas or 5% Sodium Sulfite solution (anaerobic water) respectively to save the image of these data. This data can be exported to service@pyxis-lab.com for real-time support in trouble shooting needs.

In the <u>Diagnosis</u> page, the probe cleanliness check can be performed. Please put the probe in air or air-saturated water and select the sample condition by tapping Diagnosis Condition (Figure 24). Tap Cleanliness Check to carry out the check.

As shown in Figure 26, If the DCC-1 (DO membrane cap) is in need of replacement, the APP will display "Please replace the DO membrane cap" . In this case, please replace the DCC-1 dissolved oxygen membrane cap. If you are in need of a new replacement cap, contact order@pyxis-lab.com for pricing details.
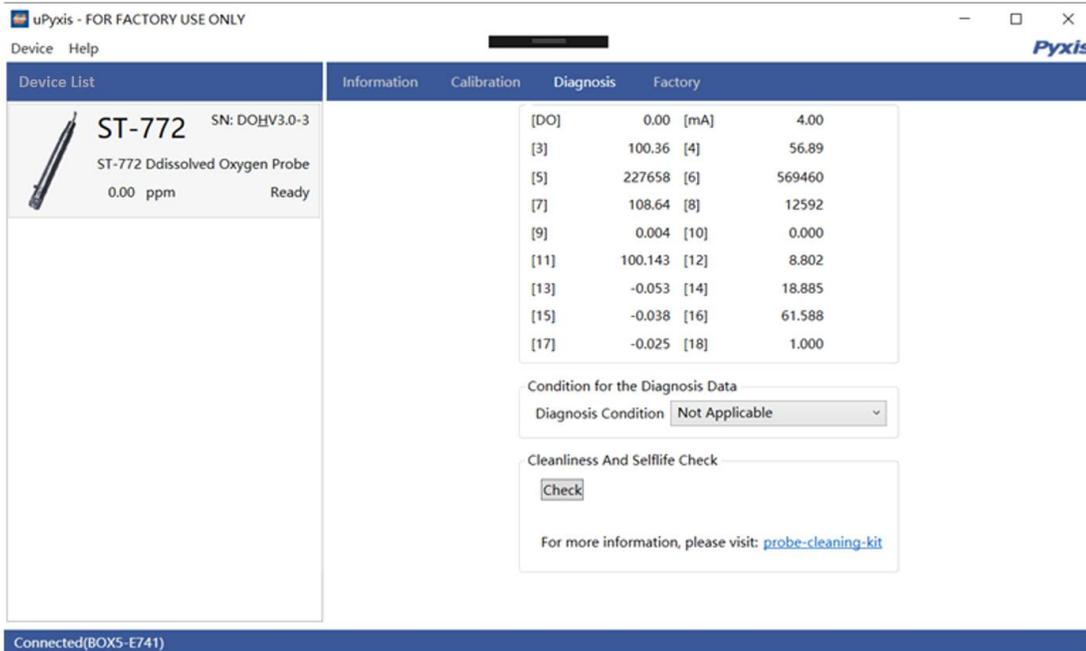
Figure 24 Select Diagnosis Condition
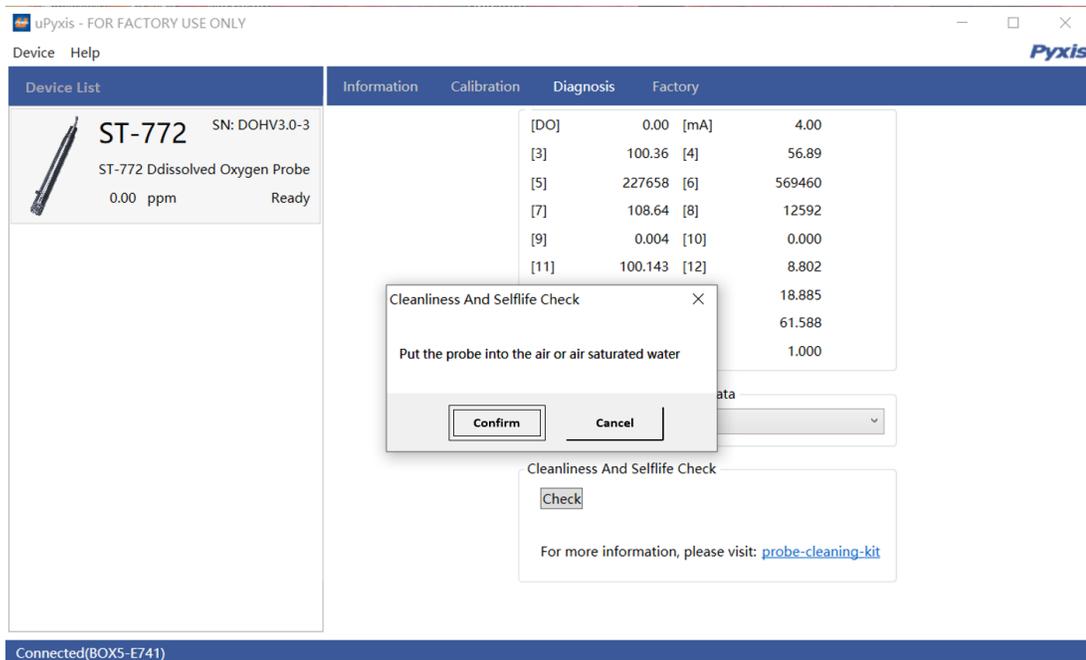
Figure 25 Operation Tips
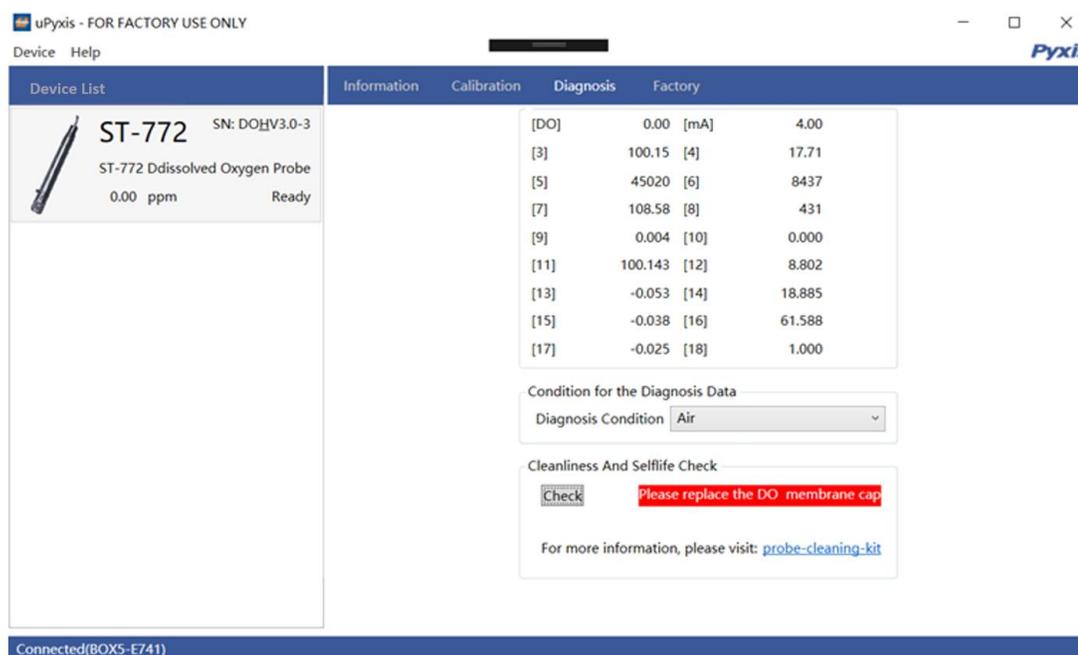
Figure 26 Cleanliness check result and raw data2

4.3 Calibration Through the Controller

It is recommended that ST-772 probe be calibrated by using uPyxis APP for Mobile or Desktop devices, as demonstrated in the sections above. Alternatively, a single point calibration can be carried on the receiving controller by adjusting the mA-to-DO ratio. A two-point calibration could be also carried out on the controller by adjusting both the mA-to-DO ratio and the zero-point 4-20mA current value. When conducting a two-point calibration the probes via the controller, Pyxis recommends thorough pre-cleaning of the probe be conducted prior to calibration steps. Please follow the controller manufacturer's procedure to carry the 4-20mA calibration. With the default probe settings, the receiving controller should be set up to convert 4 mA to 0 NTU and 20 mA to maximum range of the probe in use. If the user implements a 4-20mA SPAN adjustment of the Pyxis probe via uPyxis, the new span (4-20mA output scale) must be correspondingly configured in the receiving controller for proper results.

5 Modbus RTU

The ST-772 probe is configured as a Modbus slave device. In addition to the ppm dissolved oxygen value, many operational parameters, including warning and error messages, are available via a Modbus RTU connection.

Contact Pyxis Lab Customer Service service@pyxis-lab.com for more information.

6 Probe Cleaning and Maintenance

The ST-772 probe is designed to provide reliable and continuous dissolved oxygen readings even in moderately polluted industrial water. However, if the ST-772 is used as part of an automatic control system it is important to note that without proper probe maintenance and cleaning severe dirt or fouling can and will prevent oxygen from reaching the sensor. This can result in lower readings and a higher probability of being inaccurate. Pyxis Lab recommends a consistent frequency of probe cleaning and calibration and while utilizing the uPyxis app for probe diagnostics as a preventative measure to ensure the highest degree of accuracy.

The design of the ST-772 probe makes it easy to disassemble, inspect and clean (if necessary). It is recommended to check the ST-772 probe for cleanliness with the uPyxis app and conduct a thorough probe cleaning every month. Severely contaminated waters may require more frequently cleanliness checks and cleanings. Clean water sources that are less polluted may not need to be cleaned for months.

6.1 Cleaning Procedure

The surface of the DCC-1 dissolved oxygen membrane cap can be cleaned with a cotton swab. <u>Please do not use sharp instruments to clean the membrane cap.</u> In addition, the Pyxis ST Series Probe Cleaning Solution Kit (Figure 28) may also be used to removal of heavy deposits, especially inorganics.

Remove the ST-772 probe and the DO membrane cap from the water in use, wipe it with a damp cloth to remove debris and growing organisms, and use a cotton swab dipped in water to clean up the dirt on the membrane surface. Remove the membrane cap, check whether the inside of the ST-772 probe flashes blue and red light; after the inspection, install the DO membrane cap back onto the probe. The diagnosis function in the uPyxis app can be used to "Check Cleanliness" of the probe before and after cleaning as described in Section 4 of this manual.

Figure 26 Pxyis ST Series Probe Cleaning Solution Kit (P/N: SER-01)

6.2 Other Common Troubleshooting Issues

If the ST-772 probe output signal is not stable and fluctuates significantly, make an additional solution ground connection – connect the clear solution ground wire to a conductor that contacts the sample water electrically such as a brass pipe adjacent to the ST-772 tee.

Contact us

Contact us if you have questions about the use or maintenance of the ST-772 probe:

Pyxis Lab, Inc.

1729 Majestic Dr. Suite 5
Lafayette, CO 80026 USA
1-866-203-8397
www.pyxis-lab.com
service@pyxis-lab.com