

# NOTICE

In early 2008, Eco Sensors Inc. was acquired by KWJ Engineering Inc. The two companies are now combined as one corporate entity, under the name of KWJ Engineering Inc., a company that has been engaged in the manufacture of gas detection instruments since 1993. The former Eco Sensors Inc. is now known as the Eco Sensors Division of KWJ Engineering Inc.

Under its new management, the Eco Sensors Division will continue to produce and service its many existing quality ozone measurement instruments, as well as new instruments like DO3. KWJ Engineering offers its own line of toxic gas detecting equipment as well. Learn more by visiting [kwjengineering.com](http://kwjengineering.com).



# **WARNING!**

**Read all of the information in this booklet, and any relevant Application Notes, before using the Eco Sensors DO3.**

Many factors can affect water quality. This instrument will give a dependable indication of ozone levels in water, but should not be considered an all-inclusive monitor for overall water quality. DO3 is only one tool for ozone in water measurement.

DO3's "Self-Test" function checks most of its functionality, but does not test the ozone sensor, which can only be tested with actual exposure to ozone. Period testing by exposure to a source of water with a known concentration of ozone is recommended.

# INDEX

|   |           |
|---|-----------|
| <b>1. Specifications</b>                | <b>3</b>  |
| <b>3. Using Your DO3</b>                |           |
| <b>2.1 About Measurements</b>           | <b>5</b>  |
| <b>2.2 Making Measurements</b>          | <b>6</b>  |
| <b>2.3 Viewing the Measurement Log</b>  | <b>10</b> |
| <b>2.4 Replacing the Battery</b>        | <b>11</b> |
| <b>2.5 Calibration</b>                  | <b>14</b> |
| <b>2.6 Additional Usage Information</b> | <b>14</b> |
| <b>3. Interferences</b>                 | <b>15</b> |
| <b>4. Glossary of Terms</b>             | <b>16</b> |
| <b>5. Care and Maintenance</b>          | <b>17</b> |
| <b>6. Contact Us</b>                    | <b>18</b> |
| <b>7. Warranty</b>                      | <b>19</b> |

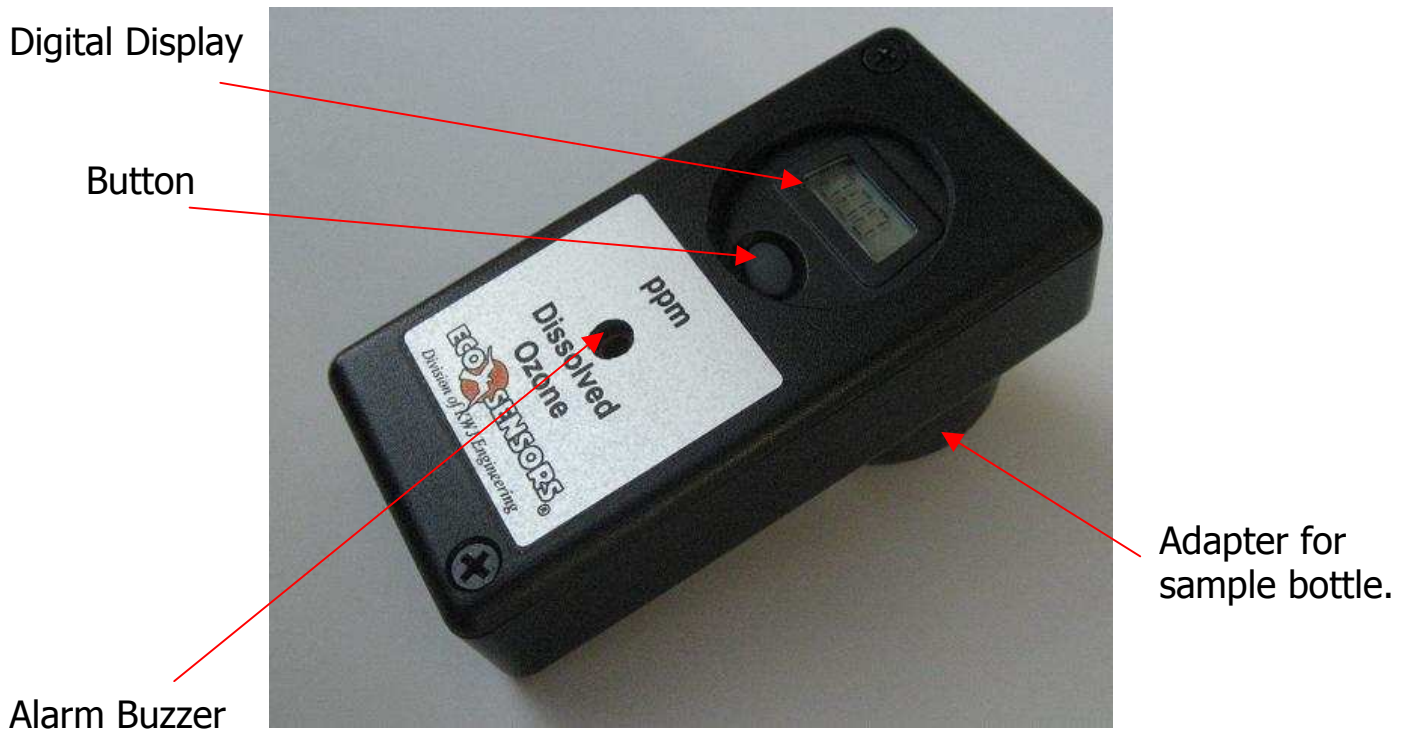
# 1. Specifications

|                                      |  |
|--------------------------------------|--|
| Size:                                | 3.13 x 1.56 x 1.36 inches (79.5 x 39.6 x 34.5 mm)  |
| Weight:                              | < 2 ounces (49 grams)  |
| Range:                               | 0.00 - 2.00 mg/L (ppm in water by weight)<br>NOTE: Display indicates to 5.00ppm; accuracy above 2ppm is not implied.   |
| Recommended Water Temperature:       | 20 – 30 C (68 - 86 F)  |
| Operating Temperature of Instrument: | 7 - 35 C (45-95 F)   |
| Accuracy*:                           | ±25% (0-1ppm); ±30% (1-2ppm) when operated near room temperature, in water samples with low ozone demand.  |
| Response Time:                       | >90% value after 2 minutes. Maximum reading displayed at end of 5 minutes  |
| Alarms: Audible Buzzer, Backlight    | Alarms once when measurement completes<br>Alarms if temperature above 35°C / 95°F: "HOT" displayed<br>Alarms if temperature below 7°C / 45°F: "COLD" displayed |
| Sampling method:                     | Gaseous diffusion  |
| Environmental Use:                   | Only for measurement of ozone in water with bottle and sampling method provided. Not to be used for measuring ozone in air.                                    |
| Interferences**:                     | Dissolved Chlorine.  |
| Display:                             | Digital LCD in increments of 0.01 mg/L (0.01 ppm in water by weight)   |
| User interface:                      | Single button operation.   |
| Tests:                               | Self-Test on startup checks circuitry, alarms, battery, and operating temperature. Does not check sensor.  |
| Calibration***:                      | Recommended at least 1x per year, or whenever accuracy of reading is critical.**   |
| Sensor:                              | Transducer Technology T-Series electrochemical (3ET1PO3)   |
| Battery information:                 | Battery check on startup and during operation. User replaceable CR2450 coin battery.   |
| Warranty:                            | Instrument, including sensor: One year. Does not include battery.  |

\* The accuracy is based on comparison of DO3 reading with split from same sample measured on Reference meter at exactly the same time. Dissolved ozone is extremely unstable in water, for best accuracy, follow the procedure in the Manual exactly!

\*\* The amount of interference depends upon the interfering gas concentration and type. Contact Eco Sensors for additional information if needed.

\*\*\* Eco Sensors recommends periodic functional check using the OG-1AC ozone calibration checker. ("bump test" only.)



**Figure 1: DO3 by Eco Sensors**



**Figure 2: DO3 with 250 ml Beaker and Sample Bottle (provided)**

## **2. Using Your DO3**

### **2.1 About Measurements**

DO3 by Eco Sensors (a division of KWJ Engineering) is a fast, easy to use device for checking the ozone concentration in water and is calibrated in mg/L (same as parts-per-million by weight in water). This small, battery-operated detector offers an inexpensive alternative to more costly inline monitors and requires no disposable reagents. DO3 is a practical, versatile detector for applications where the user needs to confirm the presence of ozone in water.

DO3 provides fast readings (5 minutes or less), with typical accuracy of  $\pm 25\%$ . DO3 measures the ozone in the airspace above the sample, using Henry's Law which describes the ratio between the ozone actually present in the water and the ozone in the air immediately above the surface of the water. While affected to some extent by temperature and atmospheric pressure, this measurement is sufficiently accurate for use in a wide range of ozonated water applications and compares well to more costly analytical instruments and the inconvenient colorimetric determinations.

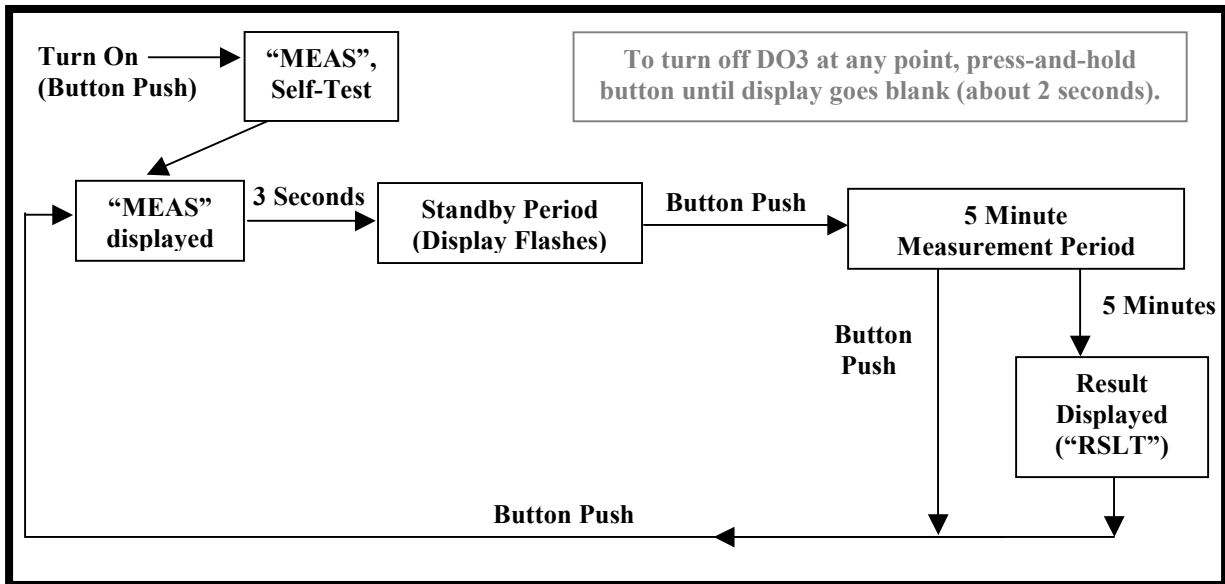
## 2.2 Making Measurements

***Please read this section before making any measurements to ensure you fully understand how to operate the instrument, and how to collect the sample of water to test.***

### The Standby Period:

After turning the instrument on, and between each measurement, enough time must be given for the reading on the display to come back down to a reading below to 0.02 mg/L (usually a few minutes). At these times, DO3 will enter a *Standby Period*.

During the *Standby Period* the display will repeatedly flash on and off. Once you see that the reading has returned below 0.02, a press of the button will begin the first/next measurement. This is illustrated in Figure 3.



**Figure 3: Flowchart that describes DO3 operation during measurement.**

### How to Make a Measurement:

1. Turn on DO3 (press button once). After showing "MEAS" and then performing a self test, it will enter the *Standby Period* (described previously). Do not push the button again until you are ready to test your water sample.
2. Rinse all beakers and bottles with ozone-free water (preferably distilled water) before first test and any subsequent tests.
3. Start the ozonated water source, if required, and allow it to warm up as directed by instructions from the manufacturer.
4. If the ozonated water system operates at constant flow, open the bypass or sample line to collect a sample of the ozonated water. Allow water to flow through sample line for 10 seconds, or until the sample line has been flushed of any standing water.



5. Collect a 200 mL sample of the water in the provided beaker. When sampling from a pool or spa, collect the sample from at least 6" below the surface, to avoid trapped air near surface.
6. Allow the beaker to sit for 30 seconds to allow any entrained ozone to clear<sup>1</sup>, then pour half (100 mL) of the sample water into the 500mL sample bottle and screw on the cap.
7. Allow the water to sit in the bottle for no more than 30 seconds, and then vigorously shake the bottle for 5 seconds (10 shakes).
8. To start the measurement:
  - a. Immediately after shaking the bottle, press-and-release DO3's button. The display will briefly read "STRT", which indicates the start of the 5 minute measurement period.
  - b. Unscrew the cap from the bottle.
  - c. Place DO3 over the neck of the bottle (see Figure 4), until seated.
  - d. The display will update with a new reading every 5 seconds.
9. If ozone is present, you should see the display reading begin to increase within about 15 seconds. It will reach 60-70% of the final value in about 1 minute, and 90% of the final value in about 2 minutes. To obtain 100% of the final value, wait for the entire measurement period of 5 minutes. To quit

---

<sup>1</sup> In high ozone demand situations (high bacterial count, chlorine) residual ozone may be consumed within tens of seconds. In these cases, pour from the beaker as soon as possible.

early<sup>2</sup>, push the button once and DO3 will return to the *Standby Period* (see Figure 3).

10. If the test is not quit early, after 5 minutes the instrument will sound its alarm to indicate the end of the measurement period. The instrument display will alternate between "RSLT" and the *maximum* measured level of ozone in the water (mg/L) until the button is pushed (read next step before pushing).
11. Remove DO3 from the bottle and set down. Press DO3's button once. The display will show "MEAS". If you are done, press-and-hold the button until DO3 turns off (about 2 seconds).

If, however, you want to perform an additional measurement, do not push the button again. After showing "MEAS", the instrument will enter the *Standby Period*. Wait until the reading on the display has returned to below 0.02 before pushing the button to proceed with another measurement.

NOTE: For better accuracy in water of low Dissolved Ozone, or high ozone demand, it is recommended that you repeat the measurement several times.

---

<sup>2</sup> In high ozone demand situations, the ozone level in the water may drop off more rapidly than normal. If you notice that the measured ozone reaches a maximum and then starts dropping, you can record the maximum and stop the measurement early.



**Figure 4: DO3 on sample bottle for measurement.**

### **2.3 Viewing the Measurement Log**

The DO3 stores the most recent 10 measurements in a log, for situations where multiple measurements are made and it is not convenient to write them down immediately. After 10 measurements have been made, the 11<sup>th</sup> measurement will be stored over the 1<sup>st</sup>, and so on, so the most recent 10 are always in the log. To view the stored measurements, turn instrument off and then press button once to turn back on. When display reads "MEAS," immediately press button again. The display will read "LOG" and will then step backwards through the 10 readings in the log, starting with the most recent. When done, the DO3 will turn off (you can also push the button once to turn off sooner).

## 2.4 Replacing the Battery

The lifetime of the battery in DO3 will vary depending on usage, but the battery should last at least 3 months. Most batteries also have a shorter lifetime if used in a cold environment.

DO3 will let you know that the battery is weak by displaying "BATT" for several seconds during the Self-Test.

When you see the "BATT" warning you should take action soon to replace the battery. When the battery becomes too low for DO3 to operate, the display will show "----" after the Self-Test.

The battery in DO3 is easily replaceable, and available through Eco Sensors and at many stores. Be sure to purchase a new, CR2450 coin battery for replacement (any high-quality brand), and insert it according to the steps shown in Figure 5.



**1. Remove the 2 screws in opposite corners of the adapter case (don't lose them!)**



**2. After removing screws, remove face-plate, exposing the instrument inside.**



**3. Put aside face-plate and gently remove the instrument from the cavity inside.**



**4. Lay the instrument face-down, and remove the screw from the battery cover. Put screw aside (don't lose it!).**



**5. Use coin to remove battery cover. Turn coin *clockwise*. Battery cover will pop off.**



**6. Remove old battery. Wait 10 seconds before inserting new one.**

*Check inside of battery cover for calibration due date.*



**7. Insert new battery, positive (+) side facing up.**



**8. Gently push battery forward as far as it will go.**



**9. Replace cover, as shown. Cover will snap into place. Replace screw. Place instrument back into the adapter case, and replace 2 screws on face-plate.**

**Figure 5: Replacing the Battery**

After inserting a new battery, DO3's display may show high readings, or the message "SNSR". This new battery warmup period will last from a few minutes to a few hours, depending on how long the instrument was without power. Place DO3 in an area free of ozone or other interfering gases and wait for the reading to return to 0.00 mg/L before beginning to use.

When changing the battery, always check the inside of the battery cover to see when the next calibration is due. See Section 2.5 for important information about calibration.

## 2.5 Calibration

DO3 uses an electrochemical sensor to detect ozone. The sensitivity of this type of sensor can drift with environment and time, resulting in less accurate measurements. **Calibrating DO3 at least once per year, or whenever the accuracy of the reading is critical, is strongly recommended.** Failing to do so may result in lower accuracy measurement.

A sticker underneath the battery cover indicates the date of the next recommended calibration. Check this date every time you change the battery. When calibration is due, visit this website for more information on how to send your DO3 in for calibration service.

<http://ecosensors.com/do3>

## 2.6 Additional Usage Information

### Application Notes:

Application notes for DO3 are available on the KWJ website (<http://ecosensors.com/do3>), and provide helpful information on proper use and applications for DO3 and should be read/used to get the most from DO3.

### 3. Interferences

For best results, do not use DO3 to test water with high levels of chlorine. Chlorinated water may contain dissolved chlorides. These not only reduce the ozone concentration, but also generate chlorine species that may give a false high reading on DO3. For best results, the water being tested should have no chlorine, or should pass through a chlorine-removing filter.

Water with suspended sediment, dissolved organic compounds, etc., will also react away the ozone very rapidly. The observed Dissolved Ozone in such sample will decrease more rapidly after collecting the batch sample for measurement. Do not leave sample sit for more than a minute before making measurement.



## 4. Glossary of Terms

**mg/L:** Milligrams per liter is a concentration term that indicates the number of milligrams of ozone in 1 liter of water.

**PPM:** Parts per million is a concentration term that indicates that there is one part ozone in one million parts water. Because water has a mass of 1 g per mL, 1 mg/L corresponds to 1 ppm O<sub>3</sub> by weight.

### **Ozone Demand:**

Dissolved chemicals, organic matter, etc, that react with ozone in the water.

### On the Display:

**HOT:** Ambient temperature is more than 35°C (95°F).

**COLD:** Ambient temperature is less than 7°C (45°F).

**SNSR:** Sensor may be malfunctioning, or may be responding to a strongly interfering gas. Move DO<sub>3</sub> to an area free of ozone and other interfering gases. If message does not go away after 1-2 hours, contact Eco Sensors or your authorized supplier.

## 5. Care and Maintenance

To maintain best performance clean it with a cloth, lightly dampened with water. Never use soap, cleansers, alcohol, gasoline, paint thinner, or other solvents to clean the device. Do not submerge the device in water or any liquids. Do not refrigerate or heat the device, or subject it to extremes of temperature or pressure. Non-adherence to general maintenance will void the warranty.

For optimum lifetime and use, keep the device away from extremes in temperature and humidity, and store it in a clean place away from solvents, chemicals, disinfectants, pesticides, and cleaners. Also avoid excess exposure to smoke, dirt, and pollutants of all kinds. For maximum lifetime of electronics and sensors, store and operate in clean, moderate environmental conditions, such as temperatures between 45-80°F (7-27°C), RH between 40-85%, and atmospheric pressure. Maximum accuracy is achieved when the unit is calibrated and used under the same environmental conditions. All DO3 instruments are calibrated at KWJ Engineering in conditions of approximately 22°C (72°F) and 50% RH.

For highest accuracy results, or if DO3 is being used in non-standard environmental conditions (such as very dry air or high humidity), calibration may be required at more frequent intervals. It is best for every user to determine optimum calibration cycles in their particular application.

## 6. Contact Us

### By Telephone:

For technical or operational questions about DO3, you may contact Eco Sensors directly at: (800) 472-6626.

Calls are answered between the hours of 8:00 a.m. and 5:00 p.m., Pacific Standard Time.

### By Email:

Support: [tech@ecosensors.com](mailto:tech@ecosensors.com)

Sales: [sales@ecosensors.com](mailto:sales@ecosensors.com)

### On the Web:

<http://www.ecosensors.com>

<http://www.kwjengineering.com>

### By Mail:

KWJ Engineering Inc.  
Eco Sensors Division  
8440 Central Ave. Suite # 2D  
Newark, CA 94560

## 7. WARRANTY

KWJ Engineering warrants to the original purchaser that this product shall be free from any defect in the materials or workmanship for 1 year from the date of purchase (excluding the battery). This warranty does not apply to those items that, by their nature, are subject to deterioration or consumption in normal service (including but not limited to batteries). It does not apply to any product that has been subjected to misuse, abuse, neglect, accident, tampering or unauthorized repairs. KWJ Engineering may elect to replace the unit, at no extra cost, with the same or a similar unit rather than repair it.

KWJ is confident you will have many years of use from your DO3. If a defect covered by this warranty should occur, contact KWJ and obtain a return authorization. Then return the product to us at your expense, along with a dated sales receipt, and a brief explanation of the problem.