AQUA LAB LITE

Operator's Manual

Version 7

Decagon Devices, Inc.

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1. Introduction

Welcome to Decagon's AquaLab LITE intermediate bench-top water activity meter. The AquaLab LITE is another quality water activity meter from Decagon: the world leader in water activity technology. AquaLab LITE combines technology from AquaLab, the world's fastest and most accurate water activity meter, and the ultra-compact Pawkit into this midrange instrument. AquaLab LITE is easy to use and provides accurate and timely results. We hope you find this manual informative and helpful in understanding how to maximize the capabilities of your AquaLab LITE. All AquaLab models are supported by an experienced staff. When you buy an AquaLab LITE from us, you get both instrument and application support.

About this Manual

Included in this manual are instructions for setting up your AquaLab LITE, verifying the calibration of the instrument, preparing samples, and maintaining and caring for your instrument. Please read these instructions before operating your AquaLab LITE to ensure that the instrument performs to its full potential.

Note to our AquaLab LITE Users

This manual is written to aid the end user in understanding the basic concepts of water activity, enabling them to use our instrument with confidence. Every effort has been made to ensure that the content of this manual is correct and scientifically sound.

Customer Support

If you ever need assistance with your AquaLab LITE, or if you just have questions or feedback, there are several ways to contact us. Customer service representatives are available to speak with you Monday thru Friday, between 7am and 5pm Pacific time.

NOTE: *If you purchased your AquaLab LITE through a distributor, please contact them for assistance.*

E-mail:
support@aqualab.com or **sales@aqualab.com**

Phone:
1-509-332-5601

Fax:
1-509-332-5158

If contacting us by email or fax, please include as part of your message your instrument's serial number, your name, address, phone, and fax number.

Warranty

AquaLab LITE has a 30-day satisfaction guarantee and a one-year warranty on parts and labor. To validate your warranty, please complete and return the warranty card included with this manual within 30 days. You can return your warranty information by fax, e-mail, phone or by mailing the postage-paid card. Please include all the information requested on the card. It is necessary for Decagon to have your current mailing address and telephone number in case we need to send updated product information to you.

Seller's Liability

Seller warrants new equipment of its own manufacture against defective workmanship and materials for a period of one year from date of receipt of equipment (the results of ordinary wear and tear, neglect, misuse, accident and excessive deterioration due to corrosion from any cause are not to be considered a defect); but Seller's liability for defective parts shall in no event exceed the furnishing of replacement parts F.O.B. the factory where originally manufactured. Material and equipment covered hereby which is not manufactured by Seller shall be covered only by the warranty of its manufacturer. Seller shall not be liable to Buyer for loss, damage or injuries to persons (including death), or to property or things of whatsoever kind (including, but not without limitation, loss of anticipated profits), occasioned by or arising out of the installation, operation, use, misuse, nonuse, repair, or replacement of said material and equipment, or out of the use of any method or process for which the same may be employed. The use of this equipment constitutes Buyer's acceptance of the terms set forth in this warranty. There are no understandings, representations, or warranties of any kind, express, implied, statutory or otherwise (including, but without limitation, the implied warranties of merchantability and fitness for a particular purpose), not expressly set forth herein.

2. About the AquaLab LITE

The AquaLab LITE is designed to be a simple, rapid, bench-top system for measurement of water activity. It is easy to use, durable, and requires little maintenance.

AquaLab LITE and water activity

Water activity (a_w) is a measurement of the energy status of the water in a system. It indicates how tightly water is "bound", structurally or chemically, within a substance. Water activity is the relative humidity of air in equilibrium with a sample in a sealed measurement chamber. The concept of water activity is of particular importance in determining product quality and safety. Water activity influences color, odor, flavor, texture and shelf-life of many products. It predicts safety and stability with respect to microbial growth, chemical and biochemical reaction rates, and physical properties. For a more detailed definition of water activity as it pertains to products, please refer to Chapter 8: "Theory: Water Activity of Products".

How AquaLab LITE works

AquaLab LITE uses a dielectric humidity sensor to measure the water activity of a sample. With this technique, a special hygroscopic polymer is placed between two porous electrodes in the headspace of a sealed chamber. The electrical properties of the polymer change depending on the relative humidity of the chamber. The electrodes give a signal based upon the relative humidity in the closed chamber. This signal is then translated by the firmware and displayed as water activity on the instrument's display. At equilibrium, the relative humidity of the air in the chamber is the same as the water activity of the sample.

Accuracy

The AquaLab LITE is accurate to ±0.015 a_w. For many applications, this accuracy is more than adequate. If you require higher accuracy in your measurements, we recommend you use Decagon's AquaLab water activity meter, which is a lab-grade, bench-top instrument that has an accuracy of ±0.003 a_w and measures based upon the chilled-mirror dew point method. Contact Decagon for more details.

Specifications

- Range: 0 to 1.000 a_w
- Accuracy: ±0.015a_w
- Resolution: ±0.001a_w
- Measurement Time: 5 minutes
- Sensors: Dielectric humidity sensor and infrared sample temperature sensor
- Case Dimensions: 6 x 7 inches (15cm x 17.78cm), oval
- Weight: 1.5 kg (3.3 lbs.)
- Power: 110V AC adapter

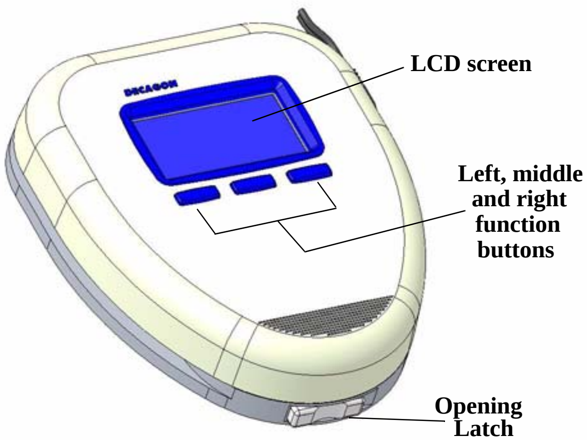
Out of the Box

Components of your AquaLab LITE system:
Your AquaLab LITE should have been shipped to you with the following items:

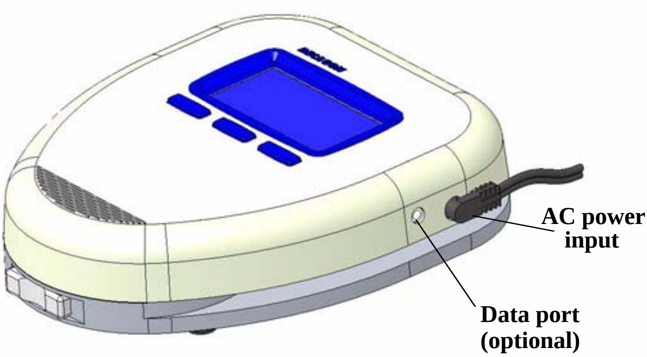
- AquaLab LITE
- Operator's Manual
- Quick Start Guide
- AC power adapter*
- USB interface cable
- 100 disposable Sample cups
- 3 vials each of the following calibration solutions:
  0.920 a_w solution (2.33 molal NaCl)
  0.760 a_w solution (6.0 molal NaCl)
  0.500 a_w solution (8.57 molal LiCl)
  0.250 a_w solution (13.41 molal LiCl)

Note: The AquaLab LITE is shipped with a 110V AC power connector for use in North America and Japan. If you live in a country that uses 220V, you will need to acquire a 220V AC adapter before using the AquaLab LITE.

Features



Front view of AquaLab LITE



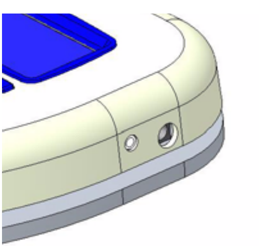
Side view of AquaLab LITE

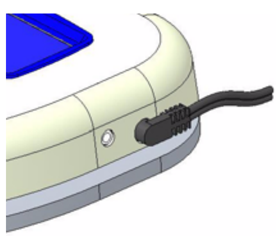
3. Getting Started

Preparing for Operation

Operation of the AquaLab LITE is very simple. To ensure that your AquaLab LITE operates correctly and consistently, always place it on a level surface when measuring. This reduces the chance that sample material will spill inside the instrument. To avoid inaccurate readings, place your AquaLab LITE in a location where the temperature remains fairly stable. This location should be well away from air conditioner and heater vents, open windows, outside doors, refrigerator exhausts, or other items that may cause rapid temperature fluctuation. Once you have ensured that you have a stable working environment, you are ready to begin sampling.

After finding a good location for your AquaLab LITE, plug the power cord into the connector on the side of the instrument as pictured below.





Turning the AquaLab LITE on

After the power adaptor is connected to the AquaLab LITE and plugged into an outlet, the instrument automatically turns on. Pressing any one of the three buttons will turn the AquaLab LITE on if the instrument has been turned off or has automatically shut off if left idle for more than 15 minutes. The following screens will appear on the display:

then:

This is the main display menu for the AquaLab LITE. The top line displays water activity to three digits. The next line displays the sample temperature in degrees Celsius. The rectangular bar is a measurement progress indicator. The icons on the bottom line correspond to the buttons located below them. The instrument will perform a specific function when a button next to an icon is pressed. The left button turns the AquaLab LITE off. The center button starts the water activity measurement. The right button proceeds to a new menu screen.

The Menus

Pressing the right button from the main display menu will proceed to a system menu screen shown below.

From this system menu, many functions of the AquaLab LITE may be accessed. Press the left button to scroll through the options on the screen. Pressing the button an additional time when the "About" function is highlighted will scroll back to the "Calibrate" function. Press the center button to select the highlighted function. Press the right button to return to the main display menu.

"Calibrate" Function

Press the center button when the "Calibrate" function is highlighted to proceed to the Calibration menu. The following screen will appear:

Auto

Using the “Auto” calibration function allows the instrument to detect the inserted calibration solution and adjust the instrument without further input from the user.

Manual

Using the “Manual” calibration function allows you to select a standard for calibration as seen in the screen below.

NOTE: Selecting one standard type and inserting another will incorrectly alter the firmware on the instrument and may be hard to correct. Please make sure and insert the correct standard when using “Manual” mode.

Use the left button to scroll and select the standard that you are using for calibration, then press the center button to begin the calibration procedure (refer to the Calibration section in the next chapter). To stop the calibration procedure and return to the last window, press the right button.

Defaults

Use the “Defaults” option to reset the instruments calibration to the factory setting.

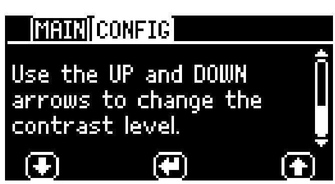
“Language” Function

The AquaLab LITE comes to you with English as the default on-screen user language. If you prefer not to use English, you can change it to one of a variety of other languages: German, French, Spanish, Italian, Swedish, Danish, Norwegian, Czech, Portuguese, Japanese, Polish, Finnish or Chinese. This is done simply by pressing the center button when the “Language” function is highlighted to display the following menu.

Press the left button to scroll to the next language option. Once the desired language is highlighted, press the center button to accept it, or press the right button to cancel out of the menu.

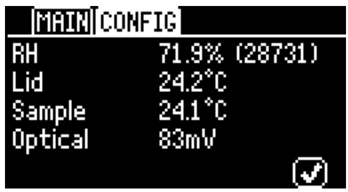
“Contrast” Function

From the configuration menu, press the left button to scroll down to Contrast. Press the middle button to enter the contrast adjustment screen. You can then use the up and down arrows to adjust the contrast level. Press the middle button to save the contrast.



“Diagnostics” Function

The diagnostics screen allows you to monitor real time sensor readings of the AquaLab LITE. It can be used for troubleshooting if the instrument isn’t reading properly. It can also be used to determine when your sample is thermally equilibrated.



“About” Function

From the main menu, press the middle button when the “About” option is highlighted to proceed to an instrument information screen. The screen displays important information about your AquaLab LITE water activity meter, including the serial number and version of the firmware or operation code.

4. AquaLab LITE Operation

Sample Preparation and Insertion

Your AquaLab LITE comes with 100 disposable plastic sample cups. The sample cups are intended to be single-use disposable cups. We do not recommend that you wash and re-use your cups. There is a chance that a washed cup may still have residual contamination from the previous sample or may not be completely dry from washing. More cups are always available from Decagon when you run out.

Sample Preparation

Special care should be taken in preparing the sample in order to get the best readings possible. Follow these guidelines when preparing samples.

- Make sure that the sample to be measured is homogeneous. Multi-component samples (e.g., muffins with raisins) or samples that have outside coatings (like deep-fried, breaded foods) can be measured, but may take longer to equilibrate. Samples like these may require additional preparation (crushing or slicing) to obtain a representative sample.

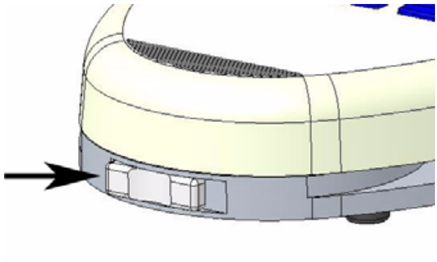
- Completely cover the bottom of the cup with the sample, if possible. AquaLab LITE is able to accurately measure a sample even with small spaces of the cup bottom exposed. For example, raisins only need to be placed in the cup and not flattened to cover the bottom. A larger sample surface area increases instrument efficiency by shortening the time needed to reach vapor equilibrium.

- Fill the cup no more than half-full of sample. AquaLab LITE does not require a large sample size to make its reading (water activity is not a volumetric measurement). As long as the bottom of the cup is covered by the sample, and the sample is representative of the product to be measured, accurate readings should be possible. If the sample cup is too full, you risk contaminating the sensor, which will lead to inaccurate readings.
- Make sure that the rim and outside of the sample cup are clean. Wipe any excess sample material from the rim of the cup with a clean tissue. Material left on the rim or the outside of the cup may contaminate the sample chamber and affect the accuracy of readings.

If a sample will be read at some other time, put a lid on the cup to restrict water transfer. To seal the lid, place tape or Parafilm® completely around the cup/lid junction. It is necessary to seal the cup if it will be a long time before the measurement is made.

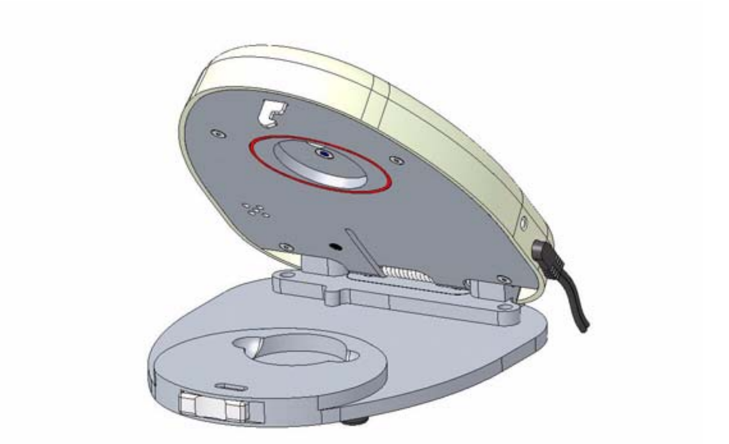
Sample Insertion

1. Open the AquaLab LITE by sliding the latch on the front of the instrument to the right as shown:



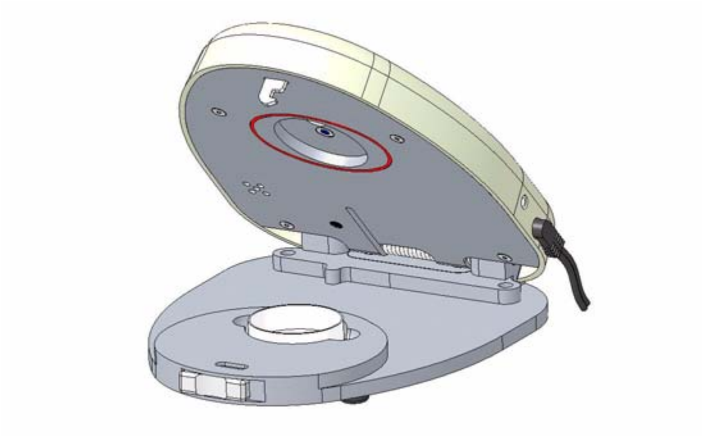
Location of opening latch

The top half of the AquaLab LITE will automatically open to a sample loading position as shown:



AquaLab LITE in open (loading) position

2. Place a prepared sample cup inside the instrument's cup holder as shown, making sure the cup is entirely within the chamber and the cup lid has been removed.



Sample cup loaded in cup holder

3. Once the sample cup is properly inserted, lower the AquaLab LITE cover and press firmly to latch and seal the sample chamber. You are now ready to take readings (see the "Taking Measurements" section below).

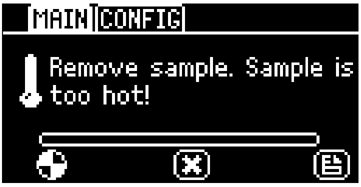
NOTE: You may need to press down firmly on the front top of the case to ensure that the latch has fully engaged and that the O-ring is completely sealing the chamber.

4. When you are finished with the water activity measurement on this sample, slide the latch to the right to re-open the AquaLab LITE and remove the sample cup. To take another water activity measurement, insert a new sample as described above. When finished using the AquaLab LITE, close the instrument to prevent dirt

or contamination from entering the chamber.

Sampling Cautions

- **Never leave a sample in your AquaLab LITE after a reading has been taken. The sample may spill and contaminate the sample chamber.**
- **Never try to move your instrument after a sample has been loaded. Movement may cause the sample material to spill and contaminate the sample chamber.**
- **Do not fill the sample cup more than half full. Overfilled cups will contaminate the chamber.**
- **If a sample has a temperature that is four degrees or more higher than the AquaLab LITE's chamber, the instrument will display:**



If this screen appears, quickly remove and place a lid on the sample cup, and allow the sample to cool before taking another reading. Warm samples can cause condensation in the chamber, especially if they have a high water activity.

Taking Measurements

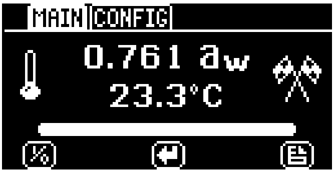
1. Make sure the sample cup is inserted as described in the previous section.

2. Press the middle button from the main display menu to start the measurement. The water activity and temperature will reset to zero. On the left side of the display, a thermometer icon appears and indicates if the sample temperature is too hot (4°C or more above chamber temperature). If the thermometer is completely filled then the "Sample too hot" error message will appear on the screen as described above.

3. Once the measurement process is started, water activity measurements and temperature are displayed every 10 seconds. During this time, the measurement status will be indicated by the progress bar filling across the screen and the lower left "read" icon spinning in place:

NOTE: the water activity values displayed during the measurement process are not the final water activity value for this sample. The final water activity value for the sample is the value shown after the instrument has "beeped," the progress bar is completely filled (see below), and the "finished" flags are shown.

4. After 5 minutes, the instrument will display the final water activity and beep 5 times. A checkered flag will flash when the water activity reading is finished.



5. At this point, you can either restart the measurement by pressing the middle button again, or you can record the shown value and take the sample cup out. The AquaLab LITE does not store any data internally. Make sure to write down the result or send the data to a computer via AquaLink 4 or a terminal program (see Chapter 5).

6. When water activity measurement of a sample is completed, push the latch slide to the right to re-open the AquaLab LITE and remove the sample cup. To take another water activity measurement, insert a new sample as described above. When finished using the AquaLab LITE, close the instrument to prevent dirt or contamination from entering the chamber.

NOTE: Samples should be removed after sampling. You risk contaminating the chamber or damaging sensors through extended contact with the sample or by spilling liquid samples inside the chamber.

Turning the AquaLab LITE off

To turn off the AquaLab LITE, either press the left button or leave it idle for more than 15 minutes and it will shut off automatically. If the AquaLab LITE has automatically shut itself off, press any button to wake up the instrument and display the last water activity measurement.

Calibration

As mentioned earlier, the AquaLab LITE takes water activity measurements by measuring the change in electrical properties of a special polymer held between two electrodes. Due to the nature of the dielectric humidity sensor, there may be times when you need to calibrate. This section explains how to do so.

Calibration needs to be verified daily or before each use (if not used daily) with salt standards.

Calibration Standards
The AquaLab LITE may only be calibrated using one of the following calibration standards listed:

Verification Standard	Water Activity @25°C
2.33m NaCl	0.920 ± 0.015
6.0m NaCl	0.760 ± 0.015
8.57m LiCl	0.500 ± 0.015
13.41m LiCl	0.250 ± 0.015

You received a small supply of salt standards with your instrument. These standards are specially prepared salt solutions at specific concentrations for constant and accurate water activity measurements. They have been produced under a strict quality-assurance regime, and their accuracy is verified by quality assurance testing. They are very accurate, easy to use, and readily available from Decagon Devices. Most importantly, they greatly reduce preparation errors. Because of these reasons, we require using these standards for the most accurate calibration of your AquaLab LITE. The calibration standards are shelf-stable for one year.

How to Verify if Calibration Adjustment Is Needed

To verify if a calibration adjustment is needed, do the following:

1. Choose a verification standard that is close to the water activity of the sample you are measuring. Make sure that the standard is at ambient temperature before you place it into the sample chamber. For example, if your running a sample with a high water activity of around 0.96 a_w use the 0.92 a_w standard for verification. *Note: we do not recommend using distilled water to verify performance in the AquaLab Lite.*

2. Empty the whole vial of solution into a sample cup and place it in the AquaLab LITE's sample chamber.

3. Close the lid of the AquaLab LITE to seal the standard within the measuring chamber.

4. Press the middle button from the main display menu to start a reading. The final reading should be within ±0.015 a_w of the given value for the chosen salt solu-

tion.

5. If your AquaLab LITE is reading within ±0.015 a_w of the salt solution then the instrument is in calibration. You may begin measuring the water activity of your sample.

6. If you consistently get readings that are outside of the water activity of your salt solution by more than 0.015 a_w then a calibration adjustment is necessary.

NOTE: Make sure that the chamber, infrared temperature sensor, and filter are clean before proceeding to adjust the calibration. A contaminated chamber, dirty infrared temperature sensor or filter may cause the salt solutions to measure outside of specification. Please review the AquaLab Series 4TE Cleaning Video at http://www.aqualab.com/education/series-4te-cleaning-video/ for an example of how to clean the sample chamber and sensors. Although this is not specifically for the AquaLab Lite the steps for cleaning are the same

Adjusting the Calibration

1. Once you are certain that a calibration offset has occurred, use the 0.76 a_w standard to conduct a calibration. If you do not use the 0.76 standard to verify your LITEs performance, use the standard closest to your sample's a_w.. DO NOT use water to calibrate your LITE. Make sure the standard is at ambient temperature before pouring it in a sample cup and placing it in the instrument for calibration.

2. Empty the whole vial of solution into a sample cup and place it in the AquaLab LITE's sample chamber as described above.

3. Carefully close the lid of the AquaLab LITE to seal the standard within the measuring chamber.

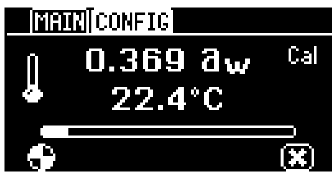
4. Enter the system menu by pressing the right button. Once in the system menu, press the middle button with the “Calibrate” function highlighted to enter calibration mode. The following screen will appear:

5. Press the left button to scroll down to the calibration options and press the middle button to select an option. Selecting “Manual” will allow you to choose the specific standard that you are calibrating. If you select “Auto”, the AquaLab LITE will automatically determine which calibration solution (0.250, 0.500, 0.760, 0.920a_w) was inserted, select “Defaults” to restore the factory calibration settings and begin the verification process again.

6. After selecting the desired option, you will be guided through the automatic calibration routine. The follow-

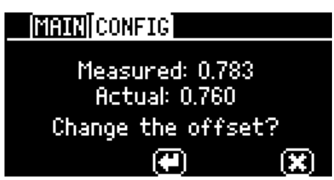
ing screen will appear:

7. Follow the on-screen instructions and place a standard in the chamber. Press the center button to start the calibration procedure. The word "CAL" will appear after the water activity value on the display during the calibration procedure, as shown below.



NOTE: If you decide to stop the calibration procedure, just press the right button to return to the calibration menu screen.

8. After 5 minutes, the calibration measurement will be completed and the following screen will appear:



Press the center button to accept the new calibration or press the right button to exit and return to the configuration menu.

9. Decagon recommends reading the verification standard again in the normal sampling mode. It should read the proper value ±0.015a_w for your particular standard. If it doesn't, clean the chamber once again, and re-calibrate the instrument. If you still cannot read the proper value after repeating the calibration, contact Decagon or your local distributor for assistance.

Sampling Precautions

1. **Volatiles/High Water.** Long exposure to high concentration of certain volatile substances or to samples with water activities near 1.00 may shift the sensor calibration. Therefore, always remove samples as soon as the AquaLab LITE is finished sampling (beeps) to avoid calibration shifts to the sensor. If a sample is accidentally left in the chamber for an extended period of time, be sure to check the calibration prior to measuring the next sample.

2. **Ethyl Alcohol.** AquaLab LITE's sensor can be damaged by long-term exposure to high concentrations of ethyl alcohol. Reading samples with alcohol concentrations above about 10% can shift the calibration. If the instrument is used to read water activity of extracts and other samples with high alcohol concentrations, the calibration should be checked frequently to make sure the readings are accurate. Effects on the sensor can be reduced by removing the sample immediately after reading and allowing the AquaLab LITE to stand open for a time between readings to allow the alcohol to diffuse out of the sensor chamber, or by measuring a cup of activated charcoal.

AquaLab LITE and Temperature

AquaLab LITE makes its most accurate measurements when the temperatures of the sample and instrument are within 1°C. If the sample is too warm, the “mercury” on the animated thermometer icon on the left of the screen will fill the thermometer. If the mercury reaches the top of the thermometer, the “Sample too hot” screen will appear. If you get this warning while sampling, remove the sample, place a lid on the sample cup and wait until it has reached ambient temperature before attempting to read again.

If a sample is colder than the ambient temperature of the AquaLab LITE, the accuracy of the reading after 5 minutes may be questionable. Wait until the sample's temperature is similar to that of the AquaLab LITE.

5. Computer Interface

Your AquaLab LITE comes with a USB interface cable. Using this cable, you can connect to your LITE and send water activity data to a computer for further analysis and storage. The interface is run through the AquaLink 4 Software or a terminal communication program.

AquaLink 4 Software

An optional software program, AquaLink 4, is available for use with your AquaLab. AquaLink 4 is a Windows based program designed for data collection and customized report generation for all AquaLab models. AquaLink 4 logs water activity, temperature, time of measurement, and date stamps along with other information. AquaLink 4 also has sample identification and comment fields that you can use to help annotate the data your AquaLab is gathering.

A 30 day trial CD of this program is attached to the front cover of this manual. If you are interested in purchasing a licence of AquaLink 4, contact Decagon or your local distributor.

Using a Communication Program

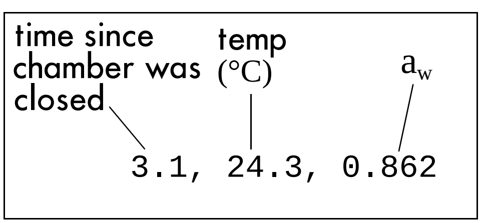
NOTE: If using the USB interface cable **without** AquaLink 4, you will need to install the driver for the USB interface cable. The driver can be downloaded at http://www.aqualab.com/support/usb-cable-adaptor-driver/
There are several terminal program options. Decagon has

its own terminal program (DecaTerm) which can be downloaded from http://aqualab.com/software/DecaTerm.zip. Two other options are TeraTerm, which is a free program that can be found on the internet and Hyperterminal which came standard with Windows prior to Windows 7.

To use any of these terminal programs with your AquaLab LITE, follow the instructions for the program with the following settings. Be sure to power on the AquaLab LITE prior to connecting the USB interface cable to your computer.

- Choose correct Com port
- Set/Verify Com Properties
  - ✔ Bits per second 9600
  - ✔ 8 Databits
  - ✔ No parity
  - ✔ 1 stop bit
  - ✔ Flow control set to none

After successfully connecting the LITE to your computer and upon completion of a water activity reading the data will be displayed in the terminal program in the format: measurement time (minutes), sample temperature, and water activity. Here is an example:



6. Cleaning and Maintenance

Cleaning

The AquaLab LITE water activity measurement system is designed to be an easy-to-use, low maintenance instrument. However, it is still important to keep it clean to ensure it works and functions properly. Here are some tips for keeping your AquaLab LITE clean:

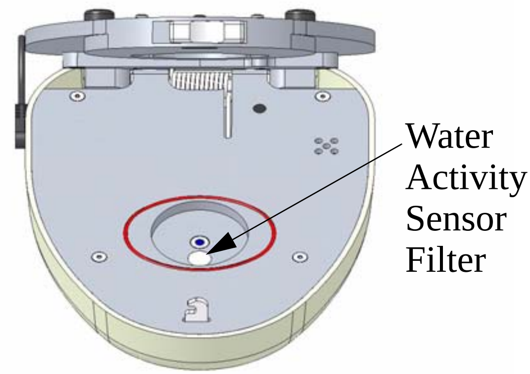
- **Use only a soft cotton cloth to clean the LCD. Tissues can scratch the plastic, causing damage.**
- **Use a moist cotton cloth or lint-free tissue to clean the rest of the outer case.**
- **For cleaning inside the sample chamber and other inner areas, use either a lint-free tissue or cotton swab moistened with water to clean sample residue. If you have spilled sample material on the sensor filter and it doesn't come off, clean or replace the filter as explained in the next section. It is important that contamination to this filter be minimized, as the relative humidity of the sample is measured via the filter.**
- **The infrared temperature sensor needs to be cleaned with a Kimwipe tissue moistened with distilled water or isopropyl alcohol. This sensor must be free of all dirt and lint.**

Maintenance

Sensor Filter Cleaning/Replacement

You may periodically need to clean or replace the white Teflon sensor filter if it becomes dirty. To remove the sensor filter, follow these steps:

1. Open the AquaLab LITE and turn the entire instrument upside down.

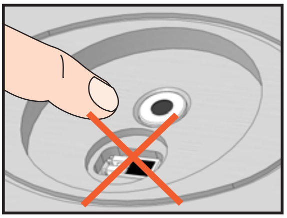


AquaLab LITE, open and upside-down

2. Locate the white sensor filter inside the sensor chamber. The sensor filter is press-fit into the ring below the dielectric humidity sensor.

3. To remove the filter, use a pair of fine-tipped tweezers or a sharp knife-point to **gently** pry the edge of the filter.

4. Remove the filter. The sensor beneath does not require cleaning, as the filter does an excellent job of preventing dirt and contamination from contacting the sensor. *NOTE: The sensor is extremely sensitive!* **Do not touch**!



5. The sensor filter can be rinsed with distilled water to remove any contamination. If the filter cannot be cleaned, then replace it with a new sensor filter. Your AquaLab LITE comes with 3 replaceable sensor filters. If you need more, please contact Decagon or your local distributor. Replace the filter using tweezers, making sure it is securely pressed in place.

6. Use a lint free tissue such as a Kimwipe® moistened with distilled water or Isopropyl Alcohol to clean the surrounding chamber area and infrared temperature sensor. Never clean the filter with Isopropyl Alcohol.

7. Turn the AquaLab LITE upright onto the feet for normal operations.

8. Verify the calibration according to the instructions outlined in the calibration section to correct any linear offset that may have occurred during cleaning.

7.Repair Instructions

NOTE: If you purchased your AquaLab LITE from one of our international distributors, please contact them. They will be able to provide you with local support and service.

When encountering problems with your AquaLab LITE(that can't be resolved with the help of this manual), please contact Decagon Customer Support at support@aqualab.com, (509) 332-5601 or fax us at (509) 332-5158. Please have the serial number and model of the instrument ready.

All AquaLab LITE's returning to Decagon for servicing must be accompanied with a Return Material Authorization (RMA) form. Prior to shipping the instrument, please contact a Decagon customer support representative to obtain an RMA.

Shipping Directions:

The following steps will help to ensure the safe shipping and processing of your AquaLab LITE.

1. Ship your AquaLab LITE in its original cardboard box with suspension packaging. If this is not possible, use a box that has at least 4 inches of space between your instrument and each wall of the box.

2. Place the AquaLab LITE in a plastic bag to avoid disfiguring marks from the packaging.

3. Don't ship the power cord or serial cable.

4. If the original packaging is not available, pack the box moderately tight with packing material (e.g. styrofoam peanuts or bubble wrap), ensuring the instrument is suspended in the packing material.

5. On the RMA form, please verify the ship to and bill to information, contact name, and problem description. If anything is incorrect please contact a Decagon representative.

6. Tape the box in both directions for added support.

7. Include the RMA number in the attention line on the shipping label.

Ship to:
Decagon Devices Inc.
ATTN: RMA (insert your RMA #)
2365 NE Hopkins Court
Pullman, WA 99163

Repair Costs

Manufacturer's defects and instruments within the one-year warranty will be repaired at no charge. Non-warranty repair charges for parts, labor and shipping will be billed to you. An extra fee will be charged for rush work. Decagon will provide an estimated repair cost, if requested.

Loaner Service

Decagon has loaner instruments to keep you measuring water activity while your instrument is being serviced. If your AquaLab LITE is still under calibration warranty or you have a service plan with your instrument, there is no charge for the loaner service.

8. Theory: Water Activity in Products

Water is a major component of foods, pharmaceuticals, and cosmetics. Water influences the texture, appearance, taste and spoilage of these products. There are two basic types of water analysis: water content and water activity.

Water Content

The meaning of the term *water content* is familiar to most people. It implies a quantitative analysis to determine the total amount of water present in a sample. The primary method for determining water content is by loss on drying or Karl Fisher titration, but secondary methods such as infrared or NMR are also used. Moisture content determination is essential in meeting product nutritional labeling regulations, specifying recipes and monitoring processes. However, water content alone is not a reliable indicator for predicting microbial responses and chemical reactions in materials. The limitations of water content measurement are attributed to differences in the intensity with which water associates with other components.

Water Activity

Water activity is a measure of the energy status of the water in a system, and thus is a far better indicator of perishability than water content. *Figure 1* shows how the relative activity of microorganisms, lipids and enzymes relate to water activity. While other factors, such as nutrient availability and temperature, can affect the relationships, water activity is the best single measure of how water affects these processes.

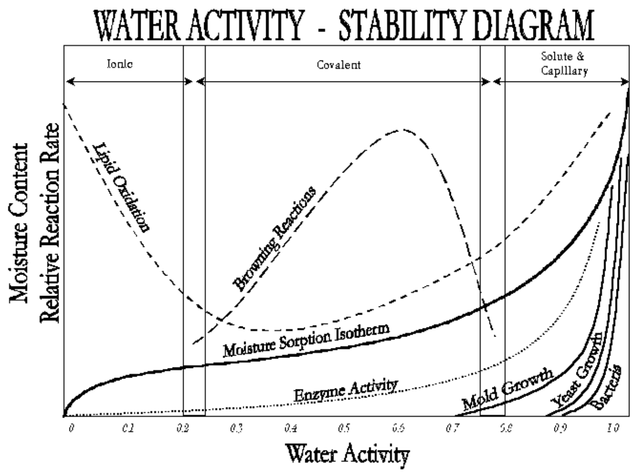


Fig. 1: Water Activity Diagram—adapted from Labuza

Water activity of a system is measured by equilibrating the liquid phase water in the sample with the vapor phase water in the headspace and measuring the relative humidity of the headspace. In the AquaLab LITE, a sample is placed in a sample cup which is sealed inside a chamber. Inside the chamber is a dielectric humidity sensor. Changes in the electrical conductance of the dielectric sensor occur as the relative humidity of the chamber changes. By monitoring the change in electrical conductance, the relative humidity of the headspace is computed. When the water activity of the sample and the relative humidity of the air are in equilibrium, the measurement of the headspace humidity gives the water activity of the sample.

In addition to equilibrium between the liquid phase water in the sample and the vapor phase, the internal equilibrium of the sample is important. If a system is not at internal equilibrium, one might measure a steady vapor pressure (over the period of measurement) which is not the true water activity of the system. An example of this might be a baked good or a multi-component food. Initially out of the oven, a baked good is not at internal equilibrium; the outer surface is at a lower water activity than the center of the baked good. One must wait a period of time in order for the water to migrate and the system to come to internal equilibrium. It is important to remember the restriction of the definition of water activity to equilibrium.

Effect of Temperature on Water Activity

Temperature plays a critical role in water activity determinations. The most critical measurement is the difference between sample and sensor temperature. Best accuracy is therefore obtained when the sample temperature is near chamber temperature.

Water Potential

Some additional information may be useful for understanding what water activity is and why it is such a useful measure of moisture status in products. Water activity is closely related to a thermodynamic property called the water potential, or chemical potential (μ) of water, which is the change in Gibbs free energy (G) when water concentration changes. Equilibrium occurs in a system when μ is the same everywhere in the system. Equilibrium between the liquid and the vapor phases implies that μ is the same in both phases. It is this fact that allows us to measure the water potential of the vapor phase and use that to determine the water potential of the liquid phase. Gradients in μ are driving forces for moisture movement. Thus, in an isothermal system, water tends to move from regions of high water potential (high water activity) to regions of low water potential (low water activity). Water content is not a driving force for water movement, and therefore can not be used to predict the direction of water movement, except in homogeneous materials.

Factors in Determining Water Potential

The water potential of the water in a system is influenced by factors that affect the binding of water. They include osmotic, matric, and pressure effects. Typically water activity is measured at atmospheric pressure, so only the osmotic and matric effects are important.

Osmotic Effects

Osmotic effects are well known from biology and physical chemistry. Water is diluted when a solute is added. If this diluted water is separated from pure water by a semi-permeable membrane, water tends to move from the pure water side through the membrane to the side with the added solute. If sufficient pressure is applied to the solute-water mixture to just stop the flow, this pressure is a measure of the osmotic potential of the solution. Addition of one mole of an ideal solute to a kilogram of water produces an osmotic pressure of 22.4 atm. This lowers the water activity of the solution from 1.0 to 0.98 a_w. For a given amount of solute, increasing the water content of the systems dilutes the solute, decreasing the osmotic pressure, and increasing the water activity. Since microbial cells are high concentrations of solute surrounded by semi-permeable membranes, the osmotic effect on the free energy of the water is important for determining microbial water relations and therefore their activity.

Matrix Effects

The sample matrix affects water activity by physically binding water within its structure through adhesive and cohesive forces that hold water in pores and capillaries, and to particle surfaces. If cellulose or protein were added to water, the energy status of the water would be reduced. Work would need to be done to extract the water from this matrix. This reduction in energy status of the water is not osmotic, because the cellulose or protein concentrations are far too low to produce any significant dilution of water. The reduction in energy is the result of direct physical binding of water to the cellulose or protein matrix by hydrogen bonding and van der Waal forces. At higher water activity levels, capillary forces and surface tension can also play a role.

Sorption Isotherms

Relating Water Activity to Water Content

Changes in water content affect both the osmotic and matric binding of water in a product. Thus a relationship exists between the water activity and water content of a product. This relationship is called the sorption isotherm, and is unique for each product. *Figure 1* shows a typical isotherm. Besides being unique to each product, the isotherm changes depending on whether it was obtained by drying or wetting the sample. These factors need to be kept in mind if one tries to use water content to infer the stability or safety of a product. Typically, large safety margins are built in to water content specifications to allow for these uncertainties.

While the sorption isotherm is often used to infer water activity from water content, one could easily go the other direction and use the water activity to infer the water content. This is particularly attractive because water activity is much more quickly measured than water content. This method gives particularly good precision in the center of the isotherm. In order to infer water content from water activity, one needs an isotherm for the particular product; produced, ideally, using the process that brings the product to its final water content. Decagon now offers a Isotherm Service as well as a Isotherm Generator using a Dyamic Dewpoint method.

For example, if one were using the AquaLab to monitor the water content of dried potato flakes, one would measure the water activity and water content of potato flakes dried to varying degrees using the standard drying process for those flakes. An isotherm would be constructed using those data, and the water content would be inferred using the measured water activity of samples and that isotherm.

The importance of the concept of water activity of foods, pharmaceuticals, and cosmetics cannot be over emphasized. *Water activity* is a measure of the energy status of the water in a system. More importantly, the usefulness of water activity in relation to microbial growth, chemical reactivity, and stability over water content has been shown.

9. Further Reading

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Declaration of Conformity

Application of Council Directive:	89/336/EEC
Standards to which conformity is declared:	EN55022: 1987 EN500082-1: 1992
Manufacturer's Name:	Decagon Devices, Inc. 2365 NE Hopkins Court Pullman, WA 99163 USA
Type of Equipment:	AquaLab LITE water activity meter.
Model Number:	
Year of First Manufacture:	2004

This is to certify that the AquaLab LITE water activity meter, manufactured by Decagon Devices, Inc., a corporation based in Pullman, Washington, USA meets or exceeds the standards for CE compliance as per the Council Directives noted above. All instruments are built at the factory at Decagon and pertinent testing documentation is freely available for verification. This certification applies to all AquaLab LITE models.

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