

# AquaFlash™

Handheld Active Fluorometer

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P/N: 998-8601  
Revision: B  
April 22, 2016

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#### **WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT (WEEE) DIRECTIVE**

Turner Designs is in the business of designing and selling products that benefit the well-being of our environment. Accordingly, we are concerned with preserving the surroundings wherever our instruments are used and happy to work with customers by complying with the WEEE Directive to reduce the environmental impact resulting from the use of our products.

#### **WEEE Return Process:**

To arrange the return of an end-of-life product, proceed as follows:

If you purchased your instrument through a Turner Designs Distributor please contact your local representative. They will instruct you where to return the end-of-life product.

If you purchased your instrument directly from Turner Designs please contact Turner Designs Customer Service

By Phone: 1-408-212-4041 or Toll Free: (877) 316.8049

By Email: Customer Service at [support@turnerdesigns.com](mailto:support@turnerdesigns.com)

Turner Designs will provide a WEEE RMA Number, a Shipping Account Number, and a Ship to Address. Package and ship the product back to Turner Designs.

The product will be dealt with per Turner Designs' end-of-life recycling program in an environmentally friendly way.

# 1 Introduction

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## 1.1 Description

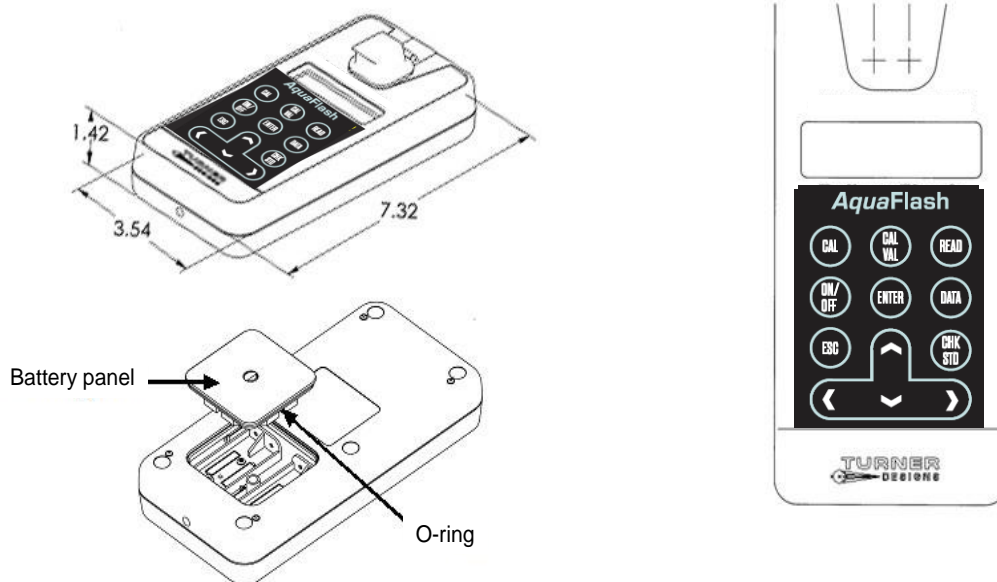
The *AquaFlash* is a handheld active fluorometer that provides estimates for Total Chlorophyll ( $\mu\text{g/L}$ ) and photosynthetic efficiency of algae (Yield). This information helps users rapidly assess the photosynthetic capability of phytoplankton in both oligotrophic and mesotrophic environments.

## 1.2 Pulse Amplitude Modulated (PAM) Fluorometry

Pulse amplitude modulation is a process that uses varying light intensities, delivered in a series of pulses, to look at specific phytoplankton fluorescence characteristics which are used to directly estimate the photosynthetic efficiency of algae or plant material. There are two measurement modes, single and multiple turnover. The *AquaFlash* is a multiple turnover PAM fluorometer in that one saturating pulse of light is delivered to the sample to quickly reach the maximum fluorescence value with the interest of looking at how efficient algae are at photosynthesizing, essentially determining “health” of the organisms. Nutrient limited or light stressed algae are examples of an “unhealthy” organism.

## 1.3 Quick View Diagrams

The *AquaFlash* uses four standard or rechargeable AAA user-replaceable batteries.



## 1.4 Inspection

Upon receiving your instrument, please inspect everything carefully and make sure all accessories are present. All shipments include:

- The *AquaFlash* inside a storage pouch (batteries installed)
- Laminated Quick Start Guide (QSG)
- Data download cable and serial to USB adapter cable
- USB Flash Drive with User's Manual, QSG, *AquaFlash* Software, and serial to USB cable driver

Optional Accessories available:

- Wrist strap P/N 030-8500
- 10mm x 10mm Square Glass Cuvette (1 ea) P/N 7000-955
- Adjustable Solid Secondary Standard P/N 8000-951
- *AquaFlash* Calibration Solution P/N 8600-225
- Replacement Download Cable P/N 021-0830
- Replacement Storage Pouch P/N 142-8000
- Replacement Communication Cable P/N 2300-115

## 1.5 General Information, Precautions and Cleaning

- **The *AquaFlash* is factory calibrated and ready to read samples when received. *NOTE: Do not overwrite the factory calibration unless you have the proper standards and glass cuvettes for calibrating the *AquaFlash*, see Appendix C.***
- The plastic battery tab at the back of the *AquaFlash* must be removed before use. Grasp it firmly and pull gently to remove it to activate the batteries that power the *AquaFlash*.



- Use caution around solvents, they may degrade the plastic case of the *AquaFlash*.
- If a sample is accidentally spilled inside the sample compartment, invert the *AquaFlash* to drain out the excess liquid. Then wipe the inside area dry with a clean soft towel or tissue followed by a quick wipe using non-abrasive material, such as Kim Wipes.
- If extra cleaning is needed, use a mild detergent to dampen a towel for cleaning.
- Although the *AquaFlash* floats, do not submerge it in water.
- Do not expose the *AquaFlash* to temperatures outside the specified range of 5 to 40 °C or damage may occur to the unit that will not be covered under warranty.



## 2 Instrument Operation and Calibration Check

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### 2.1 Button Identification and Function



**CAL** – Is used to calibrate the instrument. When selected it will prompt the user to insert blank. After blank is read, it will prompt user to insert CAL solution. After CAL solution is read, the screen will display “Calibration Done”.

**NOTE: SEE APPENDIX C BEFORE CALIBRATING THE AquaFlash.**

**CAL VAL** – Is used to assign a value to the calibration solution used when calibrating the AquaFlash. When selected it will prompt the user to set a calibration value from 1 to 50. After the value is set, the user will press enter to save the setting.

**READ** – Begins the sample analysis procedure detailed in section 2.4.

**ON/OFF** – Turns the instrument ON or OFF.

**ENTER** –Allows users to proceed to the next screen/menu.

**DATA** – When the DATA button is pressed users can choose between either sending/clearing data or setting date/time. Use the  $\uparrow\downarrow$  keys to choose between the two options; a marker will indicate the selection made.

If SEND/CLEAR DATA is selected, press ENTER and a submenu will display. Users can choose, using  $\uparrow\downarrow$  keys, to either send data to a connected computer, see section 2.6 or clear logged data; a marker will indicate the selection made.

- If *SEND DATA* is selected and ENTER is pressed, the instrument will send all logged data out as an ASCII file, see section 2.6.
- If *CLEAR DATA* is selected, the following message will display; “ENTER TO CONFIRM CLEAR DATA”; when ENTER is pressed all logged data will be deleted.

If SET DATE/TIME is selected, press ENTER and date and time will display on the screen as (MM/DD/YYYY) and (hh:mm). Use the  $\uparrow\downarrow$  keys to select either parameter; a marker will indicate selection.

- If MM/DD/YYYY is selected, press ENTER and you will be allowed to adjust the month, date, and year using the  $\uparrow\downarrow\leftarrow\rightarrow$  keys. Press ENTER to save the set date. If ESC is pressed prior to saving the set date, the screen is exited and nothing is saved. Date is logged per sample.
- If hh:mm is selected, press ENTER and you will be allowed to adjust the hour and minutes using the  $\uparrow\downarrow\leftarrow\rightarrow$  keys. Press ENTER to save the set time. If ESC is pressed prior to saving the set time, the screen is exited and nothing is saved. Time is logged per sample.

**ESC** – Exits to the previous or home screen

**CHK STD** – Is used to determine instrument drift. “Cal. Check Passed” or “Cal. Check Failed” will be displayed after measuring an Adjustable Solid Secondary Standard (SSS) using the CHK STD button indicating whether there is drift in the *AquaFlash*’s calibration. SSS is available for purchase as accessory P/N 8000-951.

## 2.2 Instrument Power Up

Press the ON/OFF button to power on the *AquaFlash*. After a 5 second warm up, the *AquaFlash* is ready for operation. Pressing the ON/OFF button again will turn the unit off or if left idle on the HOME screen for 3 minutes the unit will automatically turn off to save battery power.

**Note:** *The AquaFlash will NOT automatically turn off if left idle while running a sample or if on any screen other than the Home Screen.*

## HOME SCREEN

The home screen will display the unit’s current date, time, *AquaFlash* firmware version and remaining battery power as a percentage. These parameters will be displayed after powering the instrument on and warm up has completed as well as every time the ESC button is pressed to exit to the home screen.

MM/DD/YYYY	HH:MM
FW1.00	Batt: 100%

Battery power is checked whenever users turn the instrument on using the ON/OFF button. After the 5 second countdown,

- If the battery power is < 20%, the following warning message will display “**Battery <20%! Press <ENTER>**” you can continue making measurements after pressing ENTER.



- If the battery power is < 10%, the following message will display “**Battery Low Pwr! Replace Battery!**” you will not be able to make any measurements until batteries are replaced.

### 2.3 Calibration Check

The *AquaFlash* is factory calibrated and should remain calibrated for many years. Calibration can be checked using an Adjustable Solid Secondary Standard (SSS). To check instrument calibration using a SSS:

- 1 Press the ON/OFF button to turn the *AquaFlash* on and wait until the warm up has completed
- 2 Press the CAL VAL button to see what the calibration value is set to
- 3 Obtain an Adjustable Solid Secondary Standard (SSS) and loosen the small black locking hex screw located on the back of the SSS.
- 4 Holding the SSS by the tab, insert it with the tab at the back of the sample compartment and close the sample compartment lid  
**NOTE: The *AquaFlash* should be on a flat surface when reading the Adjustable Solid Secondary Standard (SSS).**
- 5 Press the READ button
  - a. If the CHL value displayed is lower than the calibration value determined in step 2, adjust the SSS to give you a larger response by rotating the silver hex screw located at the top of the SSS counterclockwise and re-read the SSS.
  - b. If the CHL value displayed is higher than the calibration value determined in step 2, adjust the SSS to give a smaller response by rotating the silver hex screw located at the top of the SSS clockwise and re-read the SSS.
- 6 Continue adjusting and reading the SSS until the CHL value displayed matches the calibration value +/-5% determined in step 2.
- 7 When finished, tighten the locking screw on the back by turning clockwise to lock the SSS's response.
- 8 Insert the SSS into the instrument.
- 9 Press the CHK STD button.
  - a. If the setting is valid, the *AquaFlash* will display “Cal. Check Passed”.
  - b. If the *AquaFlash* displays “Cal. Check Failed”, repeat steps 3-9.

The SSS can now be used to periodically check for instrument drift and can be stored in the side pocket of the *AquaFlash* storage pouch.

## 2.4 Measuring a Sample

**NOTE: See Section 3 for Sample Analysis Guidelines before proceeding.**

The following materials are required for measuring a sample:

- AquaFlash
- Glass or Quartz Cuvette
- Kim Wipes for wiping the outside of the cuvette

The following procedure is used to measure a sample:

1. Obtain a cuvette and fill it  $\frac{3}{4}$  full with your water sample.
2. Dry and clean all faces of the cuvette using Kim Wipes.
3. Make sure the AquaFlash is on and ready for use. Press READ. You will be prompted to insert your sample and press READ.
4. Insert the cuvette into your AquaFlash and close the lid.
5. Press READ again and the measurement will begin.
6. The measurement is complete, remove the cuvette and discard the sample.
7. Results will be displayed as shown below:

CHL: 5.25	HH:MM
YLD: 0.54	# 0001

*Note: The figure to the left is an example of how results will be displayed after measuring a sample. CHL is total chlorophyll, YLD is Yield or photosynthetic efficiency, Time is displayed as hours and minutes, and the sample number is displayed as 4 digits representing sample numbers from 1 to 1000.*

8. Press the down arrow key to view Fo (minimum), Fm (maximum), and Blank raw fluorescence values.

Fo: 250	Fm: 450
Blank: 50	

9. When finished viewing data, or if ready to run the next sample, press ESC to get to the Home screen and repeat the sampling procedure.

## 2.5 Data Displayed

Data can be viewed on the *AquaFlash*'s display or downloaded to a computer for viewing. To view data use the  $\leftarrow\rightarrow$  arrow keys to scroll to a desired sample, sample number will be displayed in the bottom right corner of the screen. Press the down arrow key to view raw fluorescence data for that sample.

The following parameters are recorded in the order specified below for a single measurement and can be downloaded to a computer after they've been logged:

Date	MM/DD/YYYY
Time	hh:mm:ss
Serial Number	86XXXXX
Sample Number	1 - 1000
Chlorophyll	00.01 - 2000, "ND"
Yield	0.01 - 0.75, "ND"
Fo	Raw minimum fluorescence value
Fm	Raw maximum fluorescence value
Blank Value	Value recorded during cal for blank
STD Read Value	Value recorded during cal for standard
STD Entered Value	Standard value set during cal for CAL VAL

**Note:** "ND" indicates a Non Detect, meaning the sample is well below the lower detection limit of the instrument.

## 2.6 Downloading Data

If your computer does not have a serial port available, you will need to install the Interface/Integration Adaptor Cable (see section 2.7) before proceeding. Once installed plug the Data Download Cable into the Adaptor Cable and continue with Downloading Data instructions.

If your computer has a serial port, plug the Data Download Cable into the serial port and continue with Downloading Data instructions.

The *AquaFlash* can log a total of 1000 data points which can be downloaded to a computer using the provided Data Download Cable and Download Utilities Software.

- 1) Plug the USB drive into your computer
- 2) Open the Download Utilities Software folder
- 3) Double click the Setup file
- 4) Wait for setup to finish installing Download Software
- 5) Double click to open the Download Software
- 6) Assign the appropriate COM port by manually typing the designated port number into the COM port box available
- 7) Make a connection between the *AquaFlash* and your computer using the Data Download Cable
- 8) Click the Browse button and navigate to a folder or location where the downloaded data will be saved

- 9) Name the file and click Save
- 10) Click Start
- 11) Turn the *AquaFlash* on and press the DATA button after warm up has completed
- 12) Press Enter to select Send/Clear Data
- 13) Press Enter to Send Data

**Note: Download Software should indicate data are being saved.**

- 14) When all data have been downloaded the Download Software will indicate Data Download has completed
- 15) Click the Stop button and you may now open the saved file to view your data set

**Note: Data are saved in a .csv file which can be opened using Microsoft Excel or as a text file.**

It is recommended that you confirm data are saved to your computer by navigating to the saved file and opening the file to view data before clearing data from the *AquaFlash*.

## 2.7 Installing the Interface/Integration Adaptor Cable

This cable allows you to convert from RS232 to USB. You will need the USB drive and the Interface/Integration Adaptor Cable, both included in the *AquaFlash* package, to complete the installation.

- 1) Plug the USB drive into your computer.
- 2) Double click the "InstallParallaxUSBDriversv2.08.02.exe" file.
- 3) Follow installation wizard's instructions for installing the driver.
- 4) Plug the Interface/Integration Adaptor Cable into any available USB port on your computer.
- 5) Access the Device Hardware manager to determine what COM was assigned to the Interface/Integration Adaptor Cable.

The installation is now complete and you may plug your Data Download Cable into the Integration/Interface Adaptor Cable's serial port. See section 2.6 for instructions on how to download *AquaFlash* data.

### 3 Sample Analysis Guidelines

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- Take care not to spill samples into the sample chamber. Wipe up any spills promptly.
- The cuvette MUST BE DRY on the outside when taking readings. Any moisture or condensation on the outside of the cuvette can affect the reading.
- Fill the cuvette with at least 3.5 mL volume ( $\frac{3}{4}$  full).
- Use the same cuvette for your samples, it is very important that you thoroughly rinse the cuvette between samples. The *AquaFlash* is very sensitive, therefore cross contamination between subsequent samples will skew results. Three rinses with the sample intended for measurement will help flush out any residual and decrease the chance for cross contamination.
- Do not use a cuvette cap as it may cause the cuvette to not seat properly in the sample compartment.
- When handling the cuvette, hold it near the top.
- Any bubbles in the sample will affect the readings. Take care not to introduce bubbles into samples. Remove any bubbles by lightly tapping with your finger on the outside cuvette wall or cover the top of the cuvette and tilt the sample to help dissipate bubbles.
- Wait at least 3 seconds between consecutive measurements to allow the optics to return to normal state.

## 4 Measurement Parameters

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### 4.1 Chlorophyll ( $\mu\text{g/L}$ )

The *AquaFlash* is configured for detecting chlorophyll fluorescence from live algal cells (i.e. *in vivo* detection of Chlorophyll). Light from the fluorometer is absorbed by algae and fluorescence emitted by the cells is detected, quantified, and displayed as a digital number estimating the abundance of algae in the sample as chlorophyll ( $\mu\text{g/L}$ ) concentration. Environmental conditions, presence of interfering compounds, cellular physiology, and light history can influence abundance estimates.

### 4.2 Photosynthetic Efficiency (Yield)

The *AquaFlash* uses two measuring LEDs to estimate photosynthetic efficiency. The first LED (monitoring) is used to excite the sample with very low light intensity so as not to induce a change in chlorophyll reaction centers. While continuously monitoring the sample using the monitoring LED, the second LED (saturating) blasts the sample with a high intensity of light to effectively close chlorophyll reaction centers and bring algae to a maximum fluorescence state ( $F_m$ ). The difference between the maximum ( $F_m$ ) and minimum ( $F_o$ ) fluorescence states is called variable fluorescence ( $F_v$ ). The ratio ( $F_v/F_m$ ) is used to estimate the photosynthetic capability of algae, which ranges from 0.01 to 0.75.

## 5 Warranty

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### 5.1 Terms

Turner Designs warrants the *AquaFlash* Handheld Active Fluorometer and accessories to be free from defects in materials and workmanship under normal use and service for a period of 12 months from the date of shipment from Turner Designs, with the following restrictions:

- Turner Designs is not responsible for replacing parts damaged by accident or neglect. Damage from corrosion is not covered. Damage caused by customer modification of the instrument is not covered.
- This warranty covers only Turner Designs products and is not extended to equipment used with our products. We are not responsible for incidental or consequential damages, except in those states where this limitation is not allowed. This warranty gives you specific legal rights and you may have other rights which vary from state to state.
- Damage incurred in shipping is not covered.

### 5.2 Warranty Service

To obtain service during the warranty period, the owner shall take the following steps:

- 1 Write, email, or call the Turner Designs Technical Support department and describe as precisely as possible the nature of the problem.

**Phone:** 1 (877) 316-8049

**Email:** [support@turnerdesigns.com](mailto:support@turnerdesigns.com)

- 2 Carry out any adjustments or tests as suggested by the Technical Support Department.
- 3 If proper performance is not obtained you will be issued a Return Authorization number (RMA). Package the unit, write the RMA number on the outside of the shipping carton, and ship the instrument, prepaid, to Turner Designs. If the failure is covered under the warranty terms, the instrument will be repaired and returned free of charge, for all customers in the contiguous continental United States.

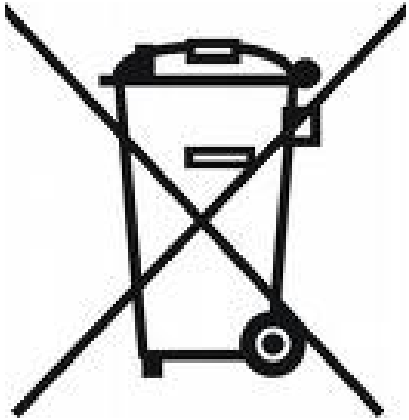
For customers outside of the contiguous continental United States who purchased equipment from one of our authorized distributors, contact the distributor. If you purchased directly, contact us. We will repair the instrument at no charge. Customer pays for shipping duties and documentation to Turner Designs. Turner Designs pays for return shipment. Custom duties, taxes and fees are the responsibility of the customer.

### 5.3 Out-of-Warranty Service

Follow steps for Warranty Service as listed above. If our Technical Support department can assist you by phone or correspondence, we will be glad to, at no charge. Repair service will be billed on a fixed price basis, plus any applicable duties and/or taxes. Shipment to Turner Designs should be prepaid. Your bill will include return shipment freight charges.

**Address for Shipment:**

Turner Designs  
1995 N. 1<sup>st</sup> Street  
San Jose, CA 95112





## Appendix A: Specifications

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<b>AquaFlash</b>	
Sensitivity	< 0.3 µg/L of Chlorophyll
Linear Range	0.3-100 µg/L
Warm Up Time	5 seconds
Power	4 AAA standard or rechargeable batteries
Auto Power Off	After 3 minutes of inactivity on the HOME screen <b><u>only</u></b>
Light Source	LED
Detector	Photodiode
LCD Display	2 x 16 characters
Resolution	12 bits
Case	Meets IP 67 Standard; dustproof and waterproof
Temperature	41-104 °F; 5-40 °C
Internal Memory	1000 records
Data Output Format	ASCII
Weight	0.87 lbs. (0.4kg)
Size	1.75" x 3.5" x 7.25"(4.45cm x 8.9cm x 18.4cm)

## Appendix B: Warning Messages

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### Memory Warning Messages

The AquaFlash's memory starts at 100% allowing for a maximum of 1,000 data points to be logged. If the memory is more than 90% full and the READ button is pressed, the following message will display:

"Warning: Memory > 90% Full"

Indicating that you have reached more than 90% of the total memory allowed. You will be allowed to continue sampling, but it is highly recommended you stop measuring samples at this point, download data to your PC and clear the data log.

When memory is full, the instrument will display:

"Memory Full"

When READ is pressed you will not be allowed to analyze samples until data have been downloaded and cleared from memory.

### Battery Warning Messages

Battery power is checked whenever users turn the instrument on using the ON/OFF button. After the 5 second countdown,

- If the battery power is < 20%, the following warning message will display "**Battery <20%! Press <ENTER>**" You can continue making measurements after pressing ENTER.
- If the battery power is < 10%, the following message will display "**Battery Low Pwr! Replace Battery!**" You will not be able to make any measurements until batteries are replaced.

## Appendix C: Calibrating the AquaFlash

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The AquaFlash can be user calibrated. **This action will overwrite the factory calibration which can only be restored using AquaFlash Calibration Solution P/N 8600-225 purchased from Turner Designs.**

**NOTE: Do not overwrite the factory calibration unless you are sure you have the proper standards and cuvettes for calibrating the AquaFlash.**

### Calibration Procedure

The materials required for calibrating the AquaFlash are:

- Two glass cuvettes
  - Standard that has a known chlorophyll concentration value; this can either be live algae or a secondary standard, such as a dye solution.
  - Deionized water
  - Kim wipes
  - AquaFlash instrument
1. Turn the AquaFlash on and wait until the warm up has completed.
  2. Press the CAL button.
  3. Press the ENTER button.
  4. Fill a cuvette  $\frac{3}{4}$  full with deionized water.
  5. Insert the cuvette into the AquaFlash and press ENTER.
  6. When measurement has completed, remove the cuvette from the instrument.
  7. Fill a second cuvette  $\frac{3}{4}$  full with the standard solution.
  8. Insert the cuvette into the AquaFlash and press ENTER.
  9. When measurement has completed, remove the cuvette from the instrument.
  10. Press the CAL VAL button and adjust using the  $\uparrow\downarrow$  arrow keys to set the value displayed to match the standard solution's known chlorophyll ( $\mu\text{g/L}$ ) concentration.  
**Note: If you are using P/N 8600-225 the approximate concentration equivalent is 38.5  $\mu\text{g/L}$  chlorophyll (*Thalassiosira sp.*).**
- If the message "Standard<Blank Recalibrate<ENT>" is displayed, it means the standard solution used didn't generate a response higher than the blank. Either the standard being used isn't appropriate for this application or a standard with a higher concentration is required to proceed with calibration.
  - If the message "RE-CAL USING HIGHER CONC." is displayed, it means the standard solution's response was slightly higher than the blank's response but not high enough and a standard with a higher concentration is required to proceed with calibration.
  - If the message "RE-CAL USING LOWER CONC." is displayed, it means the standard solution's response was too high and a standard with a lower concentration is required to proceed with calibration. You can either dilute the standard by half and re-calibrate or obtain a new standard.