

Ballast-Check™ 2 User Manual

Product Code 777848

Handheld PAM Fluorometer for Rapid Compliance Monitoring of Ballast Water



Contents

1. Principles of Operation	3
1.1 General Approach	3
1.2 Abundance of Algae	3
1.3 Activity of Algae (viability)	3
2. Instrument start up	4
2.1 Inspection	4
2.2 General Information, Precautions and Cleaning	4
2.3 Instrument Power Up	4
2.4 Home Screen	5
3. Instrument Operation	5
3.1 Button Identification and Function	5
4. Sampling and Analysis Approach	6
4.1 Setting SHIP and TANK labels	6
4.2 Sample Handling Guidelines	6
4.3 Sampling and Measuring Method	7
4.4 Data Displayed and Interpretation of Results	8
4.4 Viewing Data	9
4.5 Filter Washing Procedure	9
5. Calibration Verification	10
6 Warranty	11
6.1 Terms	11
6.2 Warranty Service	11
7. Spares and Accessories	11
Appendix i. IMO/USCG D2 standard for discharged Ballast Water	12
Appendix ii. Ballast-Check 2 Specifications	13

1. Principles of Operation

1.1 General Approach

Ballast-Check 2 quantifies algae of the size class 10 – 50µm in ballast water samples as an indicator that can be used to assess the performance of Ballast Water Treatment Systems (BWTS) in achieving the IMO/USCG D-2 standard (ref. appendix i).

The instrument is a multiple turnover Pulse Amplitude Modulated (PAM) fluorometer that provides a rapid, indicative analysis of the Abundance and Activity of algae in ballast water samples.

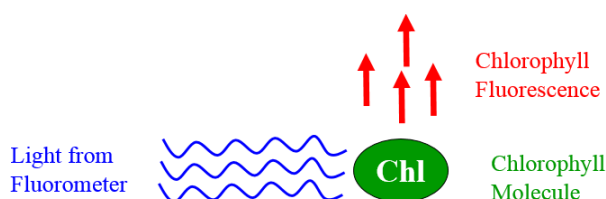
This enables ship operators to quickly assess the risk of exceedance of the D2 discharge standard for ballast water. Risk of contamination is determined using measurements of the Abundance and Activity of algae in ballast water.

High Risk:	High Algal Abundance	AND High Algal Activity
Low Risk:	Low Algal Abundance	OR Low Algal Activity

This approach is in line with [IMO BWM.2/Circ.42/Rev.1 - 28th May 2015. GUIDANCE ON BALLAST WATER SAMPLING AND ANALYSIS FOR TRIAL USE IN ACCORDANCE WITH THE BWM CONVENTION AND GUIDELINES \(G2\)](#). Where indicative analysis shows poor or suspect control users are advised to confirm performance of the BWTS using more detailed analysis methods as in the above document.

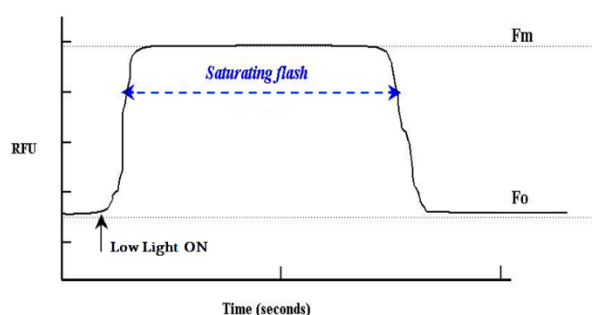
1.2 Abundance of Algae

The Ballast-Check 2 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, which causes the cell to fluoresce. Fluorescence emitted by the cells is detected, quantified, and displayed as a digital number estimating the abundance of algae in the sample. Environmental conditions such as; presence of interfering compounds, cellular physiology, and light history can influence abundance estimates, the procedure used to analyse samples on Ballast-Check 2 accounts for most of the interferences, providing an accurate estimate of algal abundance as cells/ml for 10 – 50 micron sized cells.



1.3 Activity of Algae (viability)

The Ballast-Check 2 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 centres. While continuously monitoring the sample using the monitoring LED, the second LED (saturating) blasts the sample with a high intensity of light to bring algae to a higher fluorescence state (F_m). The difference between the monitoring LED's measurement of the maximum (F_m) and minimum (F_o) fluorescence states is called variable fluorescence (F_v). The ratio (F_v/F_m) is a good measure of the algal activity, which is measured as a ratio between 0.01 and 0.75.



2. Instrument start up

2.1 Inspection

Upon receiving your instrument, please inspect everything carefully and make sure all accessories are included. The Ballast-Check 2 package comes in a carrying case that includes:

- The Ballast-Check 2 inside a storage pouch with 4 x AAA batteries installed
- Instrument-specific Calibration Check Standard (stored in pouch's compartment)
- 2 - glass 10x10mm cuvettes
- 60cc plastic syringe
- 3-10um filter capsules
- Filter Washing Kit
- Kim Wipes
- Wrist Strap
- Quick Start Guide and User Manual on USB flash drive
- Calibration certificate

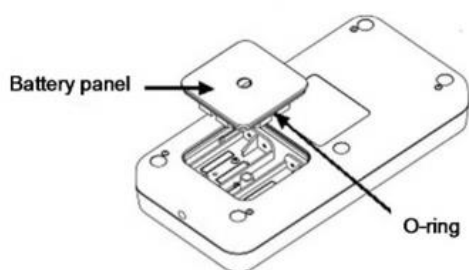
2.2 General Information, Precautions and Cleaning

- Use caution around solvents, they may degrade the plastic case of the Ballast-Check 2.
- If a sample is accidentally spilled inside the sample compartment, invert the Ballast-Check 2 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 the Kim Wipes provided.
- If extra cleaning is needed, use a mild detergent to dampen the towel for cleaning.
- Although the Ballast-Check 2 floats, do not submerge it in water.
- Do not expose the Ballast-Check 2 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.

2.3 Instrument Power Up

The Ballast-Check 2 is shipped with four standard AAA user-replaceable batteries installed.

The plastic battery tab at the back of the Ballast-Check 2 must be removed before use. Grasp it firmly and pull gently to remove it exposing the battery terminals to enable power to the Ballast-Check 2.



Press the ON/OFF button to power on the Ballast-Check 2. After a 5 second warm up, the Ballast-Check 2 is ready for operation. Pressing the ON/OFF button again will turn the unit off or if left idle for 3 minutes the unit will automatically turn off to save battery power.

Note: The Ballast-Check 2 will only automatically turn off if left idle while running on the HOME screen.

2.4 Home Screen

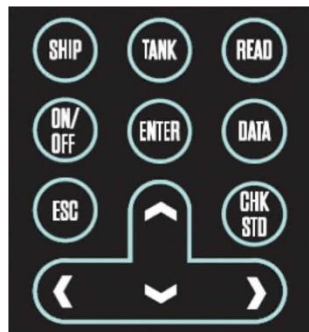
The home screen will display the current date, time, Ballast-Check 2 firmware version, and remaining battery power as a percentage. These parameters will be displayed after powering the instrument on and warm up has completed as well as every time the ESC button is pressed to exit to the home screen. 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.

3. Instrument Operation

3.1 Button Identification and Function



ON/OFF - Turns the instrument ON or OFF.

SHIP - Displays the ship number or name as a 12-digit alphanumeric value. All characters in the alphanumeric value can be adjusted to set the SHIP number. **↑↓** keys can be used to cycle through numbers 0-9 and characters A-Z. **←→** keys can be used to move the cursor to the next digit. After setting the SHIP number ENTER is pressed to save the value. If ESC is pressed at any time, the screen is exited and nothing is saved.

Saved values are appended to a data point after a sample is analysed. The sample number will count sequentially, beginning with "#0001" for the first sample analysed.

TANK - Displays the tank number or name as a configurable 10-digit alphanumeric value. All characters in the alphanumeric value can be adjusted to set a desired TANK number.

↑↓ keys can be used to cycle through numbers 0-9 and characters A-Z. **←→** keys can be used to move the cursor to the next value. After setting the TANK number ENTER is pressed to save the value. If ESC is pressed at any time, the screen is exited and nothing is saved.

Saved values are appended to a data point after a sample is analysed. The sample number will count sequentially, beginning with "#0001" for each set TANK number. For example, if the TANK value is changed, the sample count will reset to start with "#0001" for that new set of TANK values.

READ - Begins the sample analysis procedure detailed in section 4.3, only if SHIP and TANK values are saved. If SHIP and TANK values are not saved, pressing READ will display the message "First Set SHIP and TANK Values", you will not be allowed to continue with measuring a sample until SHIP and TANK values are saved.

ENTER - This button is used to save SHIP or TANK values after they have been set and allows users to proceed to the next screen/menu.

DATA – This menu is used to CLEAR DATA when the memory is full or to access the DATE/TIME set up.

Please note: the SEND DATA option is not used for single vessel operation.

Press DATA and press ENTER to select SEND/CLEAR DATA. Use the $\uparrow\downarrow$ keys to choose CLEAR DATA. Press ENTER and a submenu will display. To CLEAR DATA, press ENTER to confirm and all stored results

will be deleted.

SET DATE/TIME. use the $\uparrow\downarrow$ keys to choose SET DATE /TIME. Input values and press ENTER to store.

ESC - Exits to the previous or home screen

CHK STD - Is used to determine instrument performance. "Cal. Check Passed" or "Cal. Check Failed" will be displayed after measuring the Calibration Check Standard using the CHK STD button indicating whether the Ballast-Check 2 can continue to be used for sample analysis or should be returned to the factory.

4. Sampling and Analysis Approach

4.1 Setting SHIP and TANK labels

IMPORTANT: Prior to reading a sample, Ship and Tank labels need to be set.

To set SHIP label; switch on the instrument and press SHIP whilst on the HOME screen.

1. Use the left/right arrow keys to scroll to the first desired space.
2. Use the up/down arrow keys to cycle through alphanumeric values 0-Z and then scroll to the next desired space.
3. Press ENTER when done. This label is displayed with the data output for each measurement.

To set TANK label; press TANK whilst on the HOME screen.

1. Use the left/right arrow keys to scroll to the first desired space.
2. Use the up/down arrow keys to cycle through alphanumeric values 0-Z and then scroll to the next desired space.
3. Press ENTER when done. This label is displayed with the data output for each measurement

4.2 Sample Handling Guidelines

- 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 (3/4 full). Significant error in readings may result if the cuvette contains less than this minimum volume.
- Use the same cuvette for your samples; it is very important that you thoroughly rinse the cuvette between samples. The Ballast-Check 2 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

4.3 Sampling and Measuring Method

The following materials are required for measuring a sample:

- Ballast-Check 2 Fluorometer with SHIP and TANK labels set. Ref. 4.1
- 60 cc plastic syringe with male luer lock end
- Glass Cuvette
- Kim Wipes for wiping the outside of the glass cuvette
- 10 micron mesh filter capsule
- Filter washing kit
- De-ionised or distilled water

The following procedure is used to measure a sample:

1. Aspirate a small amount of sample into your 60cc syringe to rinse any residual from your previous sample and purge all the water from the syringe.
2. Aspirate 50cc of sample into your syringe.
3. Using the sample in your syringe, rinse a glass cuvette 3 times, then fill the cuvette $\frac{3}{4}$ full.
4. Dry and clean all faces of the cuvette using Kim Wipes.
5. Insert the cuvette into your Ballast-Check 2 and close the lid.
6. Turn the Ballast-Check 2 on with the ON/OFF button. Wait 5 seconds for the unit to power on.
7. Press READ.
8. The message "SHIP/TANK OKAY?" will be displayed and you'll be prompted to select "YES" to proceed with measuring or "NO" to return to the HOME screen. To select "YES" press the ENTER key and you will be prompted to press the READ button to continue with the measurement.
9. Press READ and the measurement will begin.
 - If LOW risk is displayed, the measurement is complete and you can read values for Abundance and Activity by pressing the  key.
Record the results for Risk, Abundance and Activity on your Ballast Water testing log sheet.
Note: If the sample shows HIGH Risk, you may be prompted to insert a 10 micron sample. The Ballast-Check 2 comes with 3 filter capsules with 10 micron nylon mesh filters already installed. These filters are used to fractionate samples to more accurately determine abundance and activity of 10-50 micron sized cells.
10. Attach a 10 micron filter to your 60cc syringe
11. Remove the cuvette from your Ballast-Check 2 and discard the sample
12. Using the remaining sample in your syringe, rinse the glass cuvette 3 times, then fill the cuvette $\frac{3}{4}$ full with your 10 micron filtered sample.
13. Dry and clean all faces of the cuvette using Kim Wipes.
14. Insert the cuvette into your Ballast-Check 2 and close the lid.
15. Press READ.
Results will be displayed as HIGH or LOW risk. The measurement is complete.
Associated Abundance and Activity values can be viewed by pressing the  key.
Record the results for Risk, Abundance and Activity on your Ballast Water testing log sheet.
16. Remove the cuvette from the Ballast-Check 2 and discard the sample
17. Remove the 10 micron filter from your 60cc syringe and discard the sample remaining in the syringe.
18. Rinse the syringe 3 times with de-ionised water.

19. Using the filter washing kit, backwash the 10 micron filter with a clean water source such as deionized or distilled water to prepare it for reuse or storage. See Filter Washing Procedure in Section 4.5 for more information on filter washing.
20. When finished viewing data, or if ready to run the next sample, press ESC to get to the Home screen and repeat sampling procedure.

Note; It is recommended you repeat the above steps 3 times on separate aliquots of the sample. If you see inconsistent results, please refer to the Sample Handling Guidelines in Section 4.2.

4.4 Data Displayed and Interpretation of Results

The set fluorescence thresholds in Ballast-Check 2 define values for the Abundance and Activity of algae in the ballast water sample.

These correlate to the Ballast Water discharge standard, in IMO/USCG D2, for organisms: less than 10 viable/living organisms/ml in the 10-50 micron size class.

The Ballast-Check 2 provides a RISK assessment as either HIGH, for samples that are in gross exceedance of the discharge standard, or LOW if the sample has not exceeded the discharge standard's requirements. Samples with HIGH RISK will report an Abundance greater than 10 AND an Activity greater than 0.25. If the Abundance is less than 10 OR the Activity is less than 0.25, then the RISK assessment will display as LOW.

The Abundance value represents a count of the algal cells in the sample in cells/ml.

The Activity value measures the photosynthetic efficiency (capability of reproduction) of algae in ballast water to assess viability of the algal cells. The Activity is reported as a ratio between 0.01 and 0.75. All values outside of this range are reported as Non-Detect (ND).

The table below shows example readings and advice on restorative action:

Example Readings	Risk	Abundance cells/ml	Activity	Interpretation	Advised action
1	LOW	<10	<0.25	Within D2 Guidelines	Maintain BWTS performance
2	LOW	<10	≥.25	Within D2 Guidelines	Maintain BWTS performance
3	LOW	>10	<.25	Within D2 Guidelines	Maintain BWTS performance
4	HIGH	>10	≥.25	Exceeds D2 Guidelines	Retest from sample flow. Check BWTS performance. If results remain high, plan for a more detailed analysis at earliest opportunity.

If the sample being analysed exceeds the upper detection limit of the instrument (>2000 cells per ml), then HIGH will be displayed for RISK and a value of OVER will be displayed for Abundance. Activity will not be valid for this sample and will display NA.

Note: *You will not be prompted to filter the sample through the 10 micron filter in this case.* This sample will be considered too high to count and will either need to be noted as such or diluted to within the measuring range and re-analysed.

4.4 Viewing Data

Stored data results can be viewed on the Ballast-Check 2 by using the arrow keys.

1. Press the ESC button.
2. If you wish to view results for a specific sample, toggle to that sample using left/right arrow keys. The sample no. is displayed in the bottom right corner of the screen.
3. When the required sample is displayed use the down key to show the Abundance and Activity values for that sample.

The Ballast-Check 2'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 and clear stored data.

When memory is full, the instrument will display "Memory Full"

When READ is pressed you will not be allowed to analyse samples until data has been cleared from memory using the DATA menu.

4.5 Filter Washing Procedure

Included in the Ballast-Check 2 package is a 10 micron filter washing kit to rinse the 10 micron filters after use. The 10 micron filters can be reused many times if properly rinsed after each use. The following procedure guides users on how to properly rinse the 10 micron filters:

- 1) Locate the filter washing kit
- 2) Attach the plastic tube included in the filter washing kit to the 5cc plastic syringe
- 3) Obtain some deionized or distilled water
- 4) Fill the 5cc syringe by drawing water from the clean water source obtained in step 3
- 5) Attach the other end of the plastic tube to the outflow port of the 10 micron filter holder
- 6) Make sure there is nothing attached to the inflow port of the 10 micron filter holder
- 7) Push water through the filter to remove any materials trapped on the nylon mesh
- 8) Repeat as necessary as determined by visual inspection

When finished sampling and prior to storage follow the procedure above to ensure filters are clean. If they are not properly rinsed using clean water prior to storage, filter damage may occur.

5. Calibration Verification

Ballast-Check 2 is factory-calibrated and does not require user calibration. Calibration can be checked using the Calibration Check Standard (CCS) included with the instrument. Calibration Check Standards are paired with specific Ballast-Check 2 instruments. To check instrument calibration:

- 1 Press the ON/OFF button to turn the Ballast-Check 2 ON
- 2 Locate the Calibration Check Standard (CCS) in the interior pocket of the pouch's flap. Confirm the serial number on the CCS and Ballast-Check 2 are the same.
- 3 After warm up has completed, holding the CCS by the tab, insert it with the tab at the back end of the sample compartment and close the sample compartment lid
NOTE: The Ballast-Check 2 should be placed on a flat surface prior to reading the Calibration Check Standard (CCS).
- 4 Press the CHK STD button
 - a. If the calibration is valid, the Ballast-Check 2 will display "Cal. Check Passed"
 - b. If the Ballast-Check 2 displays "Cal. Check Failed", remove the CCS from the instrument, re-insert the CCS, press the ESC button and press the CHK STD button to run another calibration check. Repeat this procedure 5 times. If the calibration check fails 3 out of 5 times, you may need to clean the sample well.
 - i. Wipe the windows in the sample compartment with a clean dry end of a Q-tip to lightly wipe away any debris or residue from moisture that may be interfering with the measurement.
 - ii. Rerun the Calibration Check Standard 5 times while on a flat surface.
 - iii. If the Calibration Check passes 3 out of 5 times, the instrument is ready for use.
 - iv. If the Calibration Check fails 3 out of 5 times, repeat the cleaning procedure.
 - v. Rerun the Calibration Check Standard 5 times while on a flat surface.
 - vi. If the Calibration Check passes 3 out of 5 times, the instrument is ready for use.
 - vii. If the Calibration Check fails 3 out of 5 times, contact Turner Designs

NOTE: Temperature change may cause slight variability in the response of the CCS causing the CHK STD to fail. Running the CCS multiple times as described above will account for this variability.

- 5 Return the CCS to the interior pocket of the pouch's flap.

For a CCS reading, the date, time, serial number, result type, and "Passed/Failed" will be logged to memory. CCS readings are not counted as actual samples, therefore NA (Not Applicable) will be displayed in place of a sample number and all other parameters included in the data output string for the measurement.

6 Warranty

6.1 Terms

Wilhelmsen Ships Service (WSS) warrants the Ballast-Check 2 PAM 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, with the following restrictions:

- WSS 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 WSS products and does not extend to equipment used with our products.
- Damage incurred in shipping is not covered.

6.2 Warranty Service

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

Write, email, or call your local WSS Customer Service office and describe as precisely as possible the nature of the problem.

Carry out any adjustments or tests as suggested by the Customer Services. You may be directed to return the Instrument for repair.

7. Spares and Accessories

Description	WSS Part No.
Ballast Check 2 Test Kit (full kit)	777848
Ballast Check 2 Spares and Accessories	
Reusable 10um Filter Capsules (pack 3)	735173
60cc Plastic Syringes (pack 3)	735179
10 mm x 10 mm Square Glass Cuvettes (pack 2)	735175
Filter Washing Kit	735177
Supplementary Test Kits (add as required)	
Potable Water Test Kit (Basic kit contains 25 tests for E Coli and Coliforms, Incubator, UV detection lamp. Instruction manual, video and logsheet)	778419
Intestinal Enterococci Kit (pk20)	778416
Free and Total Chlorine	
Checkit Comparator	778420
Checkit Test Cell (minimum 2)	778457
Free Chlorine Disc (Checkit)	778421
Free Chlorine DPD No. 1 Tablets (250)	777934
Total Chlorine DPD No. 3 Tablets (250)	777935

Appendix i. IMO/USCG D2 standard for discharged Ballast Water

	Micro organism Category	Control Limit
1	Viable/living organisms, size > 50 µm	< 10 cells/m ³
2	Viable/living organisms, size 10-50 µm	< 10 cells/ml
3	Toxicogenic Vibrio Cholerae	< 1 Colony Forming Unit/100ml
4	Escherichia Coli	< 250 Colony Forming Unit/100ml
5	Intestinal Enterococci	< 100 Colony Forming Unit/100ml

Appendix ii. Ballast-Check 2 Specifications

Ballast-Check 2 Specification	
Sensitivity	< 10 cells/ml
Warm Up Time	5 seconds
Power	4 AAA standard or rechargeable batteries
Auto Power Off	After 3 minutes of inactivity
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	4.4 x 8.9cm x 18.4cm