Chelsea Technologies
A COVELYA GROUP COMPANY

FastBallast System

Handbook

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FIGURES

1 SAFETY WARNINGS

Throughout the Handbook the warning symbols presented in Table 1 are used to highlight potential hazards. These warnings should be read before operating the equipment.

SYMBOL	ISSUE HIGHLIGHTED
	Used where the warning of a potentially dangerous condition applies, to notify of a condition that needs immediate investigation or to highlight specific issues regarding the use of the equipment.
	Used where the warning of a potentially dangerous electrical condition applies.
	Used where specific Health and Safety Warning applies.
NOTE	Used to highlight information which is specifically relevant to the maintenance and/or operation of the equipment.

Table 1: Warning symbols used throughout the manual.

1.1 RECHARGEABLE BATTERIES

1.1.1 FastBallast battery

The FastBallast unit uses an internal rechargeable lithium-ion battery that need to be maintained with care.

FastBallast runs off an internal rechargeable lithium-ion battery. Only the charger supplied with the equipment should be used for charging.

The FastBallast battery specifications are outlined in Table 2.

ITEM	SPECIFICATION
UN safety class	Class 9 – Miscellaneous Hazard Classification
UN shipping name	UN 3481 Lithium-ion batteries contained in equipment
Type	Lithium-ion 6-cell battery pack
Size	55 mm x 68 mm x 41 mm
Battery weight per package	0.28 kg
Nominal voltage	11.1 V
Capacity	5.2 Ahr
Battery rating	57.7 Wh
Certification	Safety Datasheet and Test Results Summary are available on request.

Packaging label	

Table 2: FastBallast lithium-ion battery specification.

1.1.2 FastBallast battery charger

The FastBallast charger is illustrated in Figure 1 fitted with a UK plug lead. A Universal Adapter (Figure 2) is supplied for use in other regions.

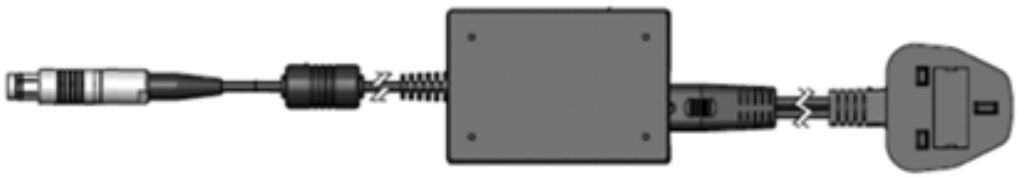


Figure 1: Illustration of the supplied battery charger shown fitted with a UK plug lead.

The charger has a dedicated connector that plugs into the **Power In 15 VDC** socket on the front panel of the FastBallast unit.

1.1.3 Tablet battery

The Galaxy Tab A9 tablet should only be charged with an appropriately certified USB-C charger. A suitable combined Universal Charger/Plug Adapter is supplied with the system, see Figure 2.

Figure 2: Universal Charger and Plug Adapter supplied.

1.2 FASTBALLAST OPERATION

FastBallast runs off an internal rechargeable lithium-ion battery. Only the charger supplied with the equipment should be used to recharge the battery.

FastBallast operates with high internal voltages. Under no circumstances should the equipment be opened or run outside its case.

NOTE

FastBallast is a sealed instrument. However, every care should still be made to minimise spillage of liquids over the equipment.

NOTE

FastBallast should be operated on a secure level surface.

1.3 SERVICE & MAINTENANCE

NOTE

FastBallast contains no user serviceable parts, opening of the equipment will invalidate the warrant.

1.4 TRANSPORTATION

Use the packaging supplied with the FastBallast for transportation.

When closing the FastBallast lid, prior to transportation, ensure nothing gets trapped that could activate the power button, as the unit must be unpowered when being transported.

Ensure the **Stirrer** collar is moved to its transportation location and secured in the Sample Chamber (Figure 4) before the FastBallast lid is closed.

2 INTRODUCTION

2.1 SCOPE

This Handbook covers the operation and maintenance of Chelsea Technologies' FastBallast ballast water compliance monitor.

2.2 ACCOMPANYING DOCUMENTS

This is one of two end-user documents supplied with the FastBallast system. The other document is 2473-129-RP FastBallast Quick Start Guide.

Additional information is available on the FastBallast website www.fastballast.com.

Figure 3: QR code link to FastBallast website.

2.3 INTENDED USE

FastBallast is a portable, battery operated, active chlorophyll fluorometer designed to rapidly assess living phytoplankton cell density in ballast water discharges, both onboard vessels and in a laboratory setting.

2.4 TARGETED TEST REQUIREMENTS

It has long been accepted that ballast water functions as a vector for the transfer of harmful species. To prevent such transfer, the U.S. Coast Guard Ballast Water Discharge Standards (USCG BWDS) are currently being implemented. These standards (summarized below) are largely consistent with the International Convention for the Control and Management of Ships' Ballast Water and Sediments (IMO, 2004).

DIVISION OF THE USCG BWDS		LIMIT (SI UNITS)	LIMIT (BWDS UNITS)
1	Living cells greater than or equal to 50 µm in the minimum dimension	< 10 cells/m^3	< 10 cells/mL
2	Living cells greater than or equal to 10 µm and less than 50 µm in the minimum dimension	< 1 x 10^7 cells/m^3	< 10 cells/mL
3i	Toxicogenic *Vibrio cholerae* (O1 and O139)	< 1 x 10^4 cfu/m^3	< 1 cfu/100 mL
3ii	*Escherichia coli*	< 2.5 x 10^6 cfu/m^3	< 250 cfu/100 mL
3iii	Enterococci	< 1 x 10^6 cfu/m^3	< 100 cfu/100 mL

Table 3: Summary of the U.S. Coast Guard Ballast Water Discharge Standards (2012).

The U.S. Coast Guard Ballast Water Discharge Standards (2012) as enshrined within the Code of Federal Regulations (Title 33, Chapter 1, Subchapter O, Part 151, Subpart D, Section 151.2030). IMO Regulation D-2 incorporates the same limits. A cfu is a colony forming unit.

Although zooplankton and phytoplankton are both represented within USCG BWDS divisions 1) and 2), it is generally the case that zooplankton dominate the former while phytoplankton dominate the latter. Throughout this document, the PASS/FAIL threshold for a FastBallast test should be taken to mean 10 phytoplankton cells greater than or equal to 10 µm in the smallest dimension.

3 THE FASTBALLAST INSTRUMENT

Chelsea Technologies' FastBallast ballast water Compliance Monitoring Device (CDM) is presented in Figure 4.

Item	Description	Item	Description
①	Android tablet	⑤	Charging indicator LED
②	Illuminated power button	⑥	Power in (15 VDC) connector
③	USB connector	⑦	Stirrer (in transport location)
④	Stirrer connector	⑧	Sample chamber

Figure 4: The FastBallast instrument.

3.1 PACKING LIST

A checklist of the equipment provided with the FastBallast CMD is provided in Table 4.

ITEM	DESCRIPTION	QTY	PART NUMBER
FastBallast Delivery Pack		1	2473-100-PL
1	FastBallast System Handbook	1	2473-100-HB
2	FastBallast System Quick Start Guide	1	2473-129-RP
3	FastBallast Calibration Certificate	1	2473-140-RP
4	Galaxy Tab A9 Android Tablet	1	2473-055-PL
5	Universal Charger/Plug Adapter	1	200794
6	Mains Converter Cable Assembly	1	2355-052-PL
7	Stirrer Assembly	1	2355-138-PL
8	Cable, FastBallast to USB-C	1	2408-261-PL
9	FastBallast Filter Assembly	1	2473-065-PL
10	Polystyrene Beaker, 20 mL	40	119125
11	Sterile Disposable Syringe	2	120067
12	Silicone Tubing, 3 mm bore x 1 mm wall thickness	500 mm	117725
13	Silicone Grease Sachet, 7 mL	1	113639
14	Backpack	1	200718
15	Mains UK Lead	1	1841122000

Table 4: The FastBallast Packing list.

3.2 FASTBALLAST OVERVIEW

FastBallast is an ultra-sensitive active chlorophyll fluorometer designed for the rapid assessment of living phytoplankton cell density in ballast water discharges. It is a portable device, providing more than 6.5 hrs of continuous operation from a single battery charge.

FastBallast's uncompromising design provides the measurement sensitivity and dynamic range to resolve variable fluorescence from a single photosynthetically active phytoplankton cell within the interrogated volume, even in the presence of a high level of non-variable fluorescence from other sources.

FastBallast incorporates two 16 LED arrays to excite chlorophyll and other light harvesting pigments within phytoplankton cells. The LED emission wavebands have been selected to better discriminate species that typically fall within the 10 µm to 50 µm size range. The following excitation wavelengths are used: deep blue (416 nm), Royal Blue (442 nm), Blue (468 nm), Cyan (495 nm), Green (520 nm), Amber (598 nm) and Red (630 nm).

The fluorescence emission stimulated by light from the LEDs is detected within a waveband centred at 685 nm (deep red). This closely matches the variable fluorescence emission from functional Photosystem II (PSII) complexes within phytoplankton, which provides the best indication of photochemical activity and cell vitality.

3.2.1 Summary of FastBallast advantages

The FastBallast measurement approach provides the following advantages:

- It provides a detection limit of below 1 phytoplankton cell/mL
- Cell density estimations are independent of cell size, using a proprietary patented data analysis algorithm
- Cell density estimations are not dependent on an assumed level of variable fluorescence (F_v) per phytoplankton cell
- Sampling issues associated with analyzing small static volumes at close to the PASS/FAIL threshold are overcome by using a larger stirred volume of 20 mL
- The measurement approach provides a low level of false negatives and a negligible possibility of false positives
- Wide dynamic range provides a high tolerance to background fluorescence, e.g., from dead cells, Fluorescent Dissolved Organic Matter (FDOM) and other sources.
- High level of turbidity rejection
- Tests are reagent free and require minimal consumables
- Minimal sample preparation is required
- Long service interval (two years)

3.3 GETTING STARTED

Remove the Galaxy Tab A9 tablet from its packaging – it can be stored in the lid of the FastBallast instrument.

The FastBallast charging cable can be used with the Universal Charger/Plug Adapter provided. This also provides a USB-C socket to charge the tablet.

While both the Galaxy Tablet and the FastBallast are shipped partially charged it is worth topping up the charge before initial use.

3.3.1 FastBallast battery capacity indicator

FastBallast runs off an internal rechargeable lithium-ion battery (safety datasheet and a safety test result summary are available on request). Only the battery charger supplied with the equipment should be used.

The FBtest application continually calculates the expected battery capacity, which is displayed at the top of the **Home** screen (Figure 5) and during a test run.

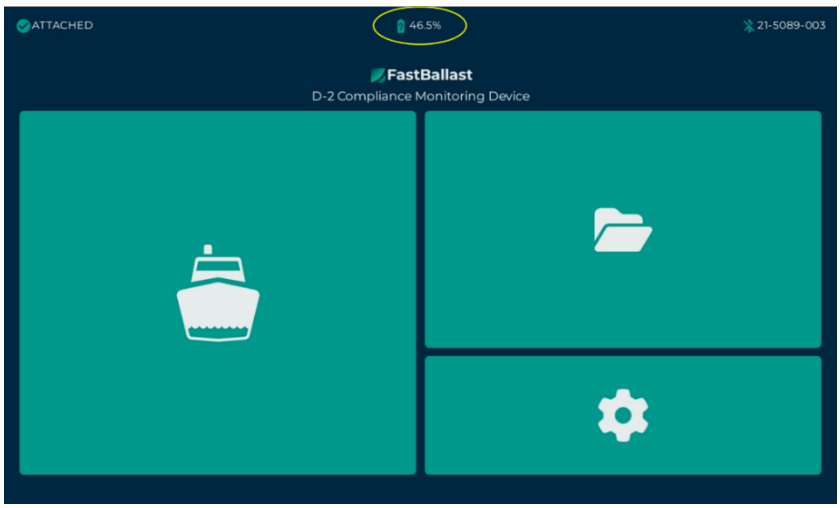


Figure 5: FBtest **Home** screen showing the current battery charge status, circled in yellow.

In addition to the battery icon, the colour of the illuminated ring on the Power Switch also provides the user with an indication of the current battery status, at outlined in Table 5.

Battery Capacity	Power Switch LED Status
>40%	Green
<= 40% and > 20%	Orange
<= 20% and > 10%	Red
<= 10%	Red (slow blink)
0%	Red (fast blink) then shutdown

Table 5: LED status as a function of battery status.

When the battery capacity is equal to or less than 10% the battery icon at the top of the **Home** screen will change to the charge battery warning icon shown in Figure 6:

Figure 6: The charge battery warning icon.

When the battery capacity shows 0% the FastBallast the Power Switch LED will rapidly blink red ten times, after which the FastBallast will shut down. If the FastBallast is switched on again, the Power Switch will flash rapidly red 10 times, to prompt the user connect the charger, before the instrument switches off again.

On a full charge the FastBallast will typically be able to runs test continuously for over 6.5 hours.

3.3.2 Android tablet battery

The Galaxy Tab A9 tablet should only be charged with an appropriately certified USB-C charger. A suitable combined Universal Charger/Plug Adapter is supplied with the system, see Figure 2.

The run time of the Android tablet on a single charge will typically be over 8 hrs but depends on a range of settings, including screen brightness and wireless connectivity.

3.4 CONSUMABLES

The consumable items provided in the Consumable Kit supplied with the FastBallast are illustrated in Figure 7.

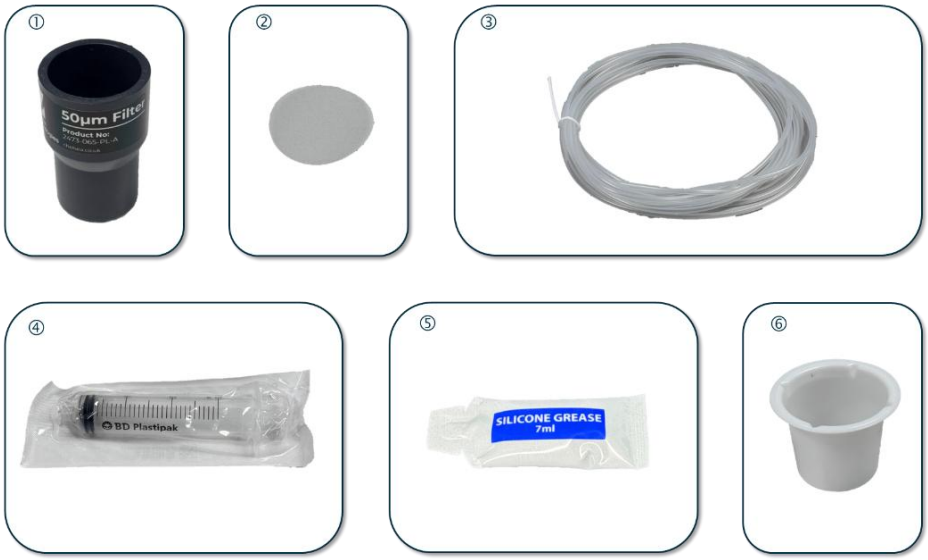


Figure 7: Consumables (see Table 6).

ID	Item	Quantity	Description
①	Filter Funnel	1	A Filter Funnel is supplied to remove cells or organisms larger than 50 µm. This fits into the Sample Chamber and the sample is poured through it before running a test. The Filter Funnel can be washed and reused.
②	Filter	2	Spare Filters are provided if the filter supplied in the Filter Funnel becomes severely blocked or damaged. To replace the filter, remove the inner retaining ring from the Filter Funnel and remove the old filter. Place the new filter in the funnel and secure in place using the retaining ring.
③	Silicone Tubing	1 m	A length of Silicone Tubing is supplied to help extract the sample from the Sample Chamber using the Syringe supplied. Cut off a short length of the tubing, ~50 mm, and push one end onto the Syringe.

④	Syringe	2	Two 30 mL Syringes are provided for removing the sample. As an alternative, kitchen towel can be used to soak up the sample. Kitchen towel can also be used to dry the Sample Chamber and Stirrer. Tap water is ideal for flushing the Sample Chamber between tests and for running a blank test.
⑤	Silicone Grease	1	A 7 mL sachet of silicone grease is provided to lubricate the piston of the Syringe, if needed.
⑥	Sample Cup	40	The 20 mL Sample Cups provide the correct volume needed to run a test. These can be washed and re-used many times.

Table 6: Consumable Kit components.

3.5 FASTBALLAST SPECIFICATIONS

The FastBallast specifications are outline in Table 7 below.

PARAMETER	SPECIFICATION
Weight	3.82 kg
Dimensions	Width: 273 mm Depth: 246 mm Height: 122 mm
IP Rating	IP67 with lid closed
User interface:	FBtest running on an Android tablet (supplied)
Connectivity	USB or Bluetooth
Power	Internal 11.1V 5200 mAh rechargeable battery (the battery safety datasheet and safety test result summary are available on request)
Operational duration	6.5 hrs continuous from full charge
Charging voltage	15 Vdc at 2.5 Amps
Sample volume	20 mL
Interrogated volume	0.5 mL
Excitation	LEDs, 7 wavelengths: UV, royal blue, blue, cyan, green, amber and red
Sensitivity	< I cell/mL
Dynamic range	0 - 4000 cells/mL
Time to result	<1.5 minutes for Level 1 test (confident pass) <7 minutes for completed Level 2/Level 3 test
Operating temperature range	0 - 45°C
Service interval	2 years
Operational environment	Indoor use
Operating Altitude	Maximum 2000m
Operating relative humidity	Maximum 80% relative humidity

Table 7: FastBallast specifications.

4 MEASUREMENT PRINCIPLE

FastBallast employs the Single Turnover (ST) variable fluorescence method. This involves applying 100 microsecond pulses from the excitation LEDs to saturate Photosystem II (PSII) photochemistry. The ST pulse generates an increase in the emission of chlorophyll-a fluorescence from PSII, as illustrated in Figure 8. Extrapolating the fluorescence signal back to the start of the ST pulse provides the F_o fluorescence level. The maximum fluorescence level is termed F_m. The difference between Fo and Fm is termed variable fluorescence, F_v. Variable fluorescence is only generated by living phytoplankton cells within the sample.

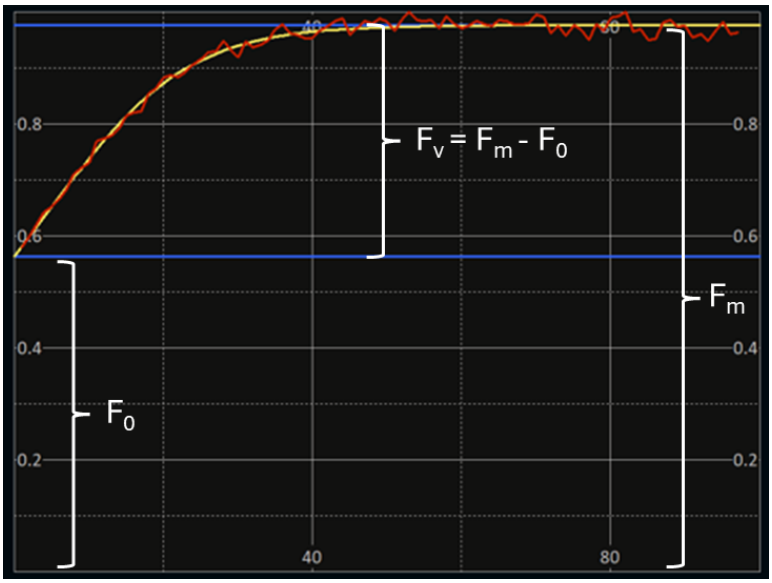


Figure 8: A typical data trace from FastBallast showing the key measurement parameters F_o, F_m and F_v.

STAF data are acquired from an interrogated volume of approximately 0.4 mL within a stirred sample of 20 mL. For these measurements, ST pulses of 100 µs duration are applied with a dark interval of 90 ms between the end of one ST sequence and the start of the next. Eight successive sequences are averaged to generate each Test point it follows that the default set of 480 Test points is acquired in just under six minutes. The total test time, which includes optimisation of PMT sensitivity and measurement LED intensity, is just under seven minutes.

Several competing systems use the Multiple Turnover (MT) method, which applies pulses of several hundred milliseconds. Although the ST method is more difficult to implement than MT-based methods, the thousand-fold decrease in pulse duration provided by the ST method provides a dramatic increase in sampling rate. Consequently, the signal to noise (S:N) ratio of ST-based systems is orders of magnitude higher than can be provided by MT−based systems. With FastBallast, this S:N ratio advantage is further enhanced through the optimisation of:

- The optical configuration
- The LED drive system
- The measurement protocol
- The analysis algorithm

The FastBallast sample chamber holds 20 mL of sample. The interrogated volume, from which the variable fluorescence emission is recorded during a test, is 0.4 mL (~2% of the total sample volume). Because the measurement frequency is high (> 1 Hz), it is possible to take

reliable measurements as the sample is stirred. The stir speed is slow enough to provide a low level of sample exchange during each Test point, but fast enough to ensure that the entire 20 mL volume is interrogated over the duration of the test.

A more detailed discussion of active chlorophyll fluorometry and the analysis methods embedded within FBtest is provided within 2473-129-RP FastBallast Technical Background.

4.1 DATA ANALYSIS

The Test procedure incorporates three levels of analysis.

4.1.1 Level 1 analysis

The first 120 Test points are averaged to provide a single value of F_v at high precision.

Level 1 incorporates an Apparent Cell Diameter (ACD) of 10 µm. This is the size boundary between PASS and FAIL, as defined by the IMO D-2 discharge standard.

If the Level 1 cell density is below 10 cells/mL, the test result will be reported as a PASS at Level 1. This is because an actual cell diameter below 10 µm (which could increase the cell density to above 10 cells/mL) would automatically generate a PASS based on cell size, while an actual cell diameter greater than 10 µm would further decrease the cell density.

A Level 1 test will never generate a FAIL. This is because the Level 1 analysis does not calculate cell size. As an example, a test sample that generates a Level 1 cell density of a hundred cells/mL, at the assumed ACD of 10 µm, could contain several hundred cells with an ACD that is lower than 10 µm (a PASS) or fewer than ten cells per mL with an ACD that is much larger than 10 µm (also a PASS).

4.1.2 Level 2 and Level 3 analysis

If the Level 1 test result does not return a PASS, The Level 2 and Level 3 analysis protocols are run in parallel.

A single ballast water discharge from a container ship can easily exceed 1000 m^3. If it was possible to extract 480 samples of 1 mL from random locations within the discharge, and the phytoplankton cells between 10 and 50 µm within each 1 mL sample could be counted accurately, the data could be plotted with cell count divisions (cells/mL) along the x-axis and the number of samples within each cell count division on the y-axis. If the distribution of cells within the ballast water discharge collected was random, the data plot should be a Poisson Distribution, and the standard deviation of the plot would be equal to the square root of the mean.

As with the theoretical measurement protocol described above, the 480 acquisition test points generated by a Test protocol are organised into divisions. The initial sorting of the data is based on the amplitude of F_v from each acquisition test point measurement, the assumption being that F_v is proportional to cell density. The x-axis range is 192 equally spaced divisions, running from zero to twice the average F_v from the entire dataset.

Although the range of F_v values is continuous, there is still an expectation that the 480 Test Point values will approximate to a Normal Distribution with a standard deviation equal to the square root of the mean.

The Level 2 analysis assumes that the distribution of 480 Test points provides a normal distribution.

The Level 3 analysis checks for a data skew towards high F_v values that could indicate the presence of a small number of large cells hiding a larger number of smaller cells. The skew points are removed, and the remaining Test points are reanalysed.

In addition to the variability in F_v due to changes in cell density within the interrogated volume, a time-dependent drift in F_v is sometimes observed. This feature of the dataset can reasonably be attributed to the change in environment experienced by the sample between the ballast tank and FastBallast sample chamber. The Test data are processed to minimize the impact of drift on the assessment of cell density during Level 2 and Level 3 analysis. This involves regression analysis of the Test data in batches of 120 points, called zones. Provisional Level 2 and Level 3 estimates of cell density and cell size are generated after each zone.

4.2 DATA ANALYSIS FLOWCHART

The software flowchart showing how the test results are derived is presented in **Error! R eference source not found.**.

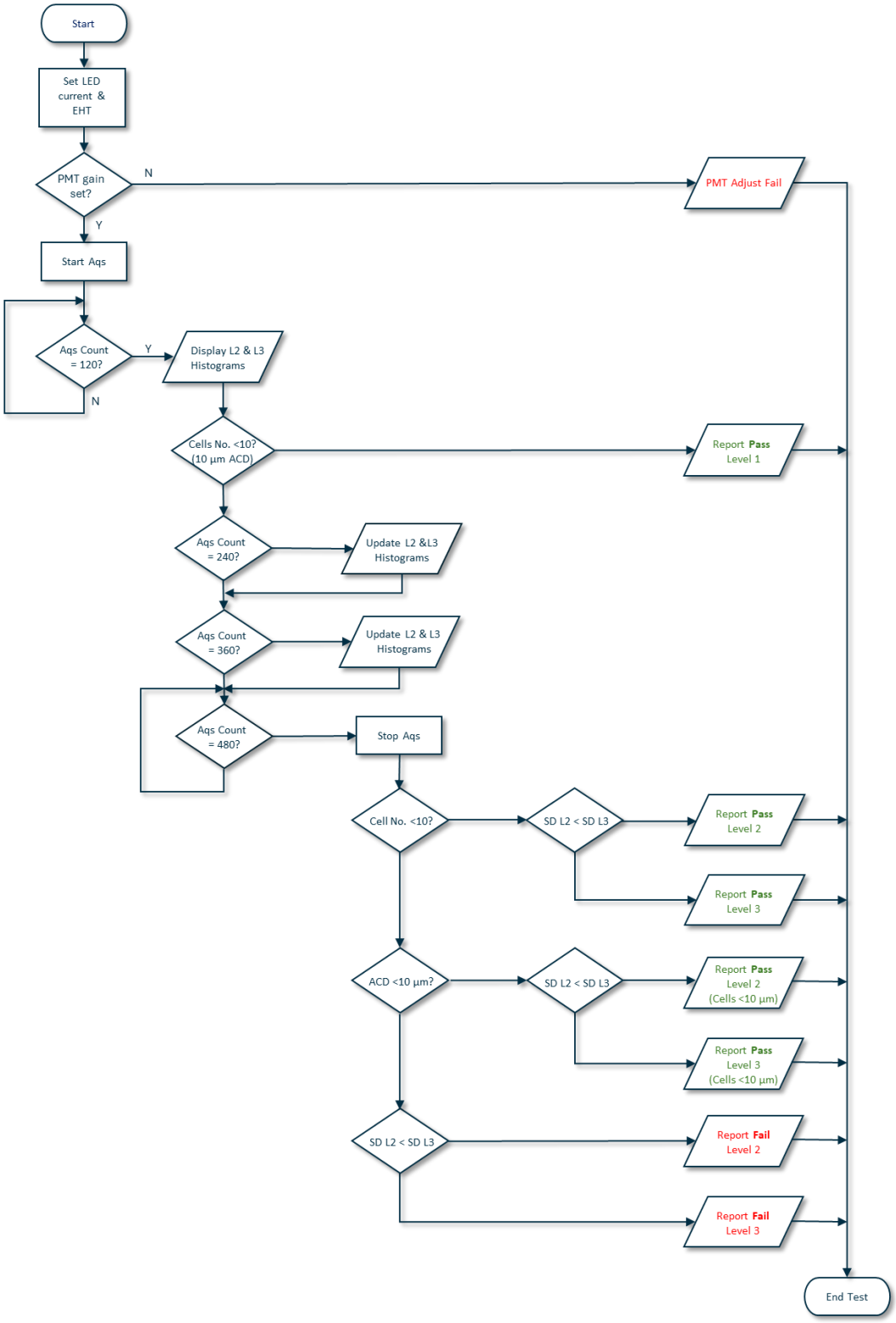


Figure 9: Software flowchart showing the test result decision tree.

5 FBTEST

FBtest is a touch-optimised Android application used to operate the FastBallast instrument. It is preinstalled on the Galaxy Tab A9 tablet supplied with the FastBallast system. The FBtest application icon is available on the tablet's home screen at start-up, as illustrated in Figure 10.

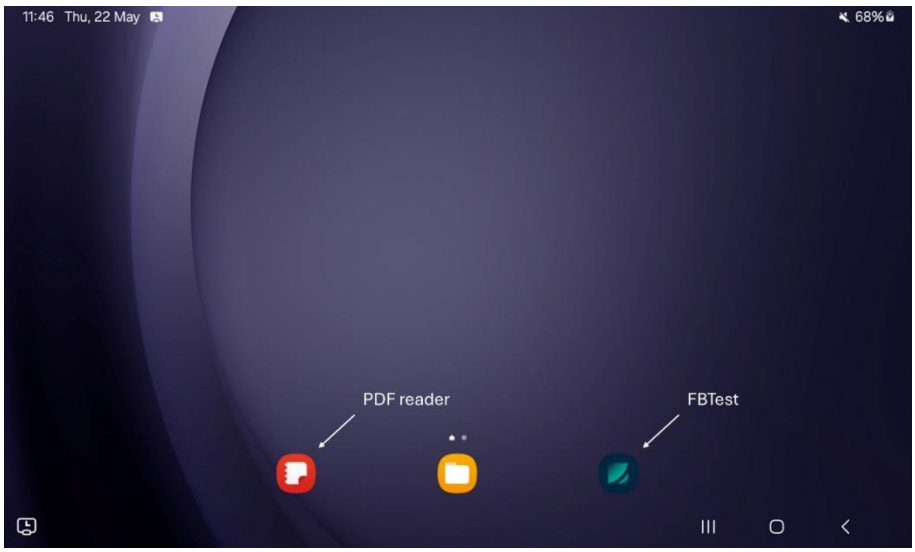


Figure 10: Galaxy Tab A9 start-up screen.

Tap on the FBtest icon to launch the application.

A storyboard of the main application screens is presented in **Error! Reference source not found.**.

NOTE	Instructions for updating the FBtest installation are provided in Section 5.7.

5.1 SOFTWARE STORYBOARD

An outline of the FBtest Graphic User Interface (GUI) is presented in Figure 11.

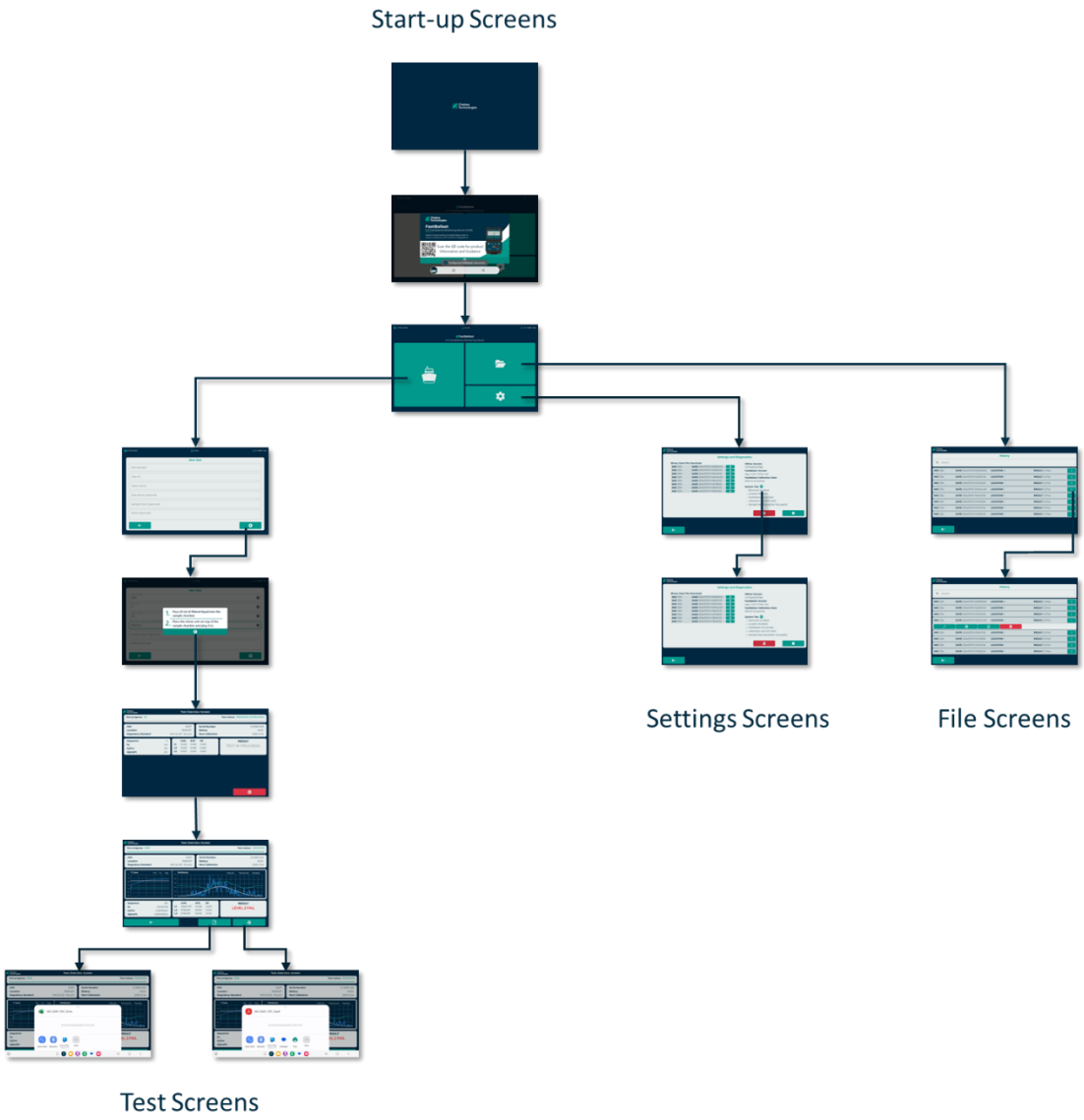


Figure 11: FBtest GUI storyboard.

Pressing the Return button:

on any screen takes the user back to the previous screen.

5.2 START-UP SCREENS

Start-up Screens	Function	Description
	**Start-up**	After launching FBtest a **Start-up** flash screen is displayed for a few second before being replaced by the Introduction screen.
	**Introduction**	The **Introduction** screen provides information about FastBallast and a QR code linking to the FastBallast website. If a FastBallast is paired via Bluetooth, FBtest will automatically initiate a connection. Three dialogues boxes will appear in succession: 1) FastBallast instrument found, connecting … 2) Configuring FastBallast instrument. 3) Calibration is valid, expires on yyyy-mm-dd Once the connection has been made tap on the play button:  to open the **Home** screen.
	**Home**	If a connection has been successful, the **Run Test** button will be green:  and FastBallast will be ready to run a test. If a connection has not been made, the **Run Test** button will be grey. Subsequently switching on a FastBallast in the vicinity will initiate a connection. The **Home** screen icons are described in detail in Section 5.3.

Table 8: Start-up screens.

5.3 HOME SCREEN

The FBtest home screen is presented in Figure 12.

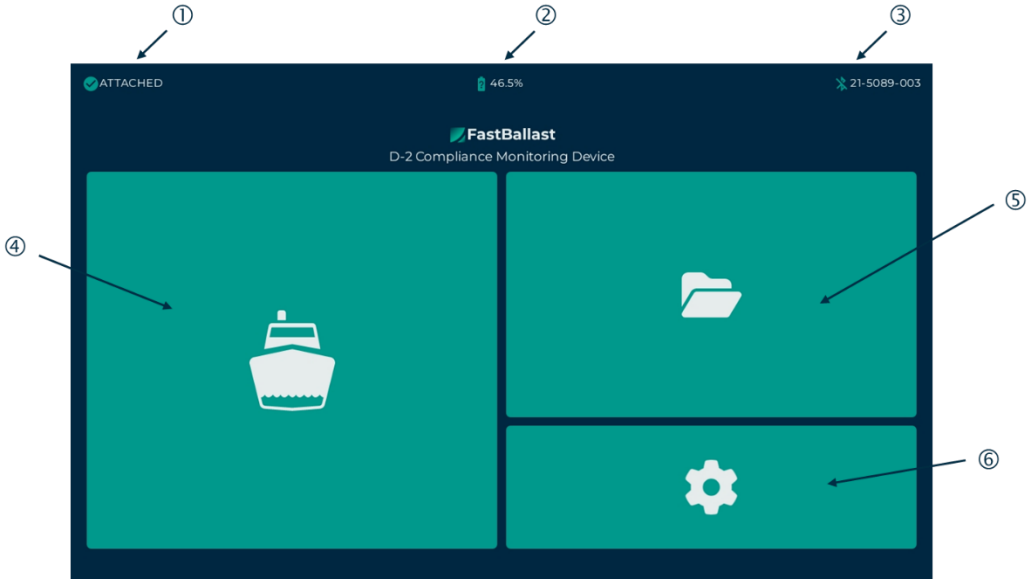


Figure 12: FBtest **Home** screen (after connection).

Item	Function	Description
①	FastBallast Status	The status field provides information on the current operation.
②	Battery Status	The Battery Status field displays an icon and battery capacity percentage that is updated regularly.
③	Bluetooth status and Serial Number	This field indicates the current Bluetooth status and the serial number of the connected FastBallast.
④	**Run Test**	The **Run Test** button is used to initiate a sample analysis. If the button is grey, it indicates that a FastBallast is not connected. Switching on a FastBallast nearby will automatically initiate a connection. If the button in is green, it will be possible to run a test, see Section 5.4.
⑤	**File**	The **File** button provides access to previous test results and allows the associated **Test Report** to be download in either .pdf or .csv file formats.
⑥	**Settings**	The **Settings** button provides access to the binary files containing the acquisition data from previous tests, which is used for diagnostics purposes. The screen also give access to **System Test** and **Information** functions.

Table 9: FBtest **Home** Screen icon description.

5.4 THE RUN TEST SCREENS

5.4.1 Test set-up screens

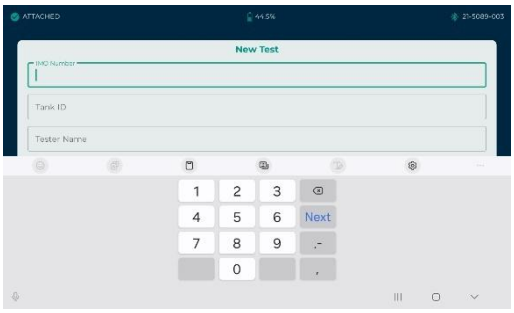
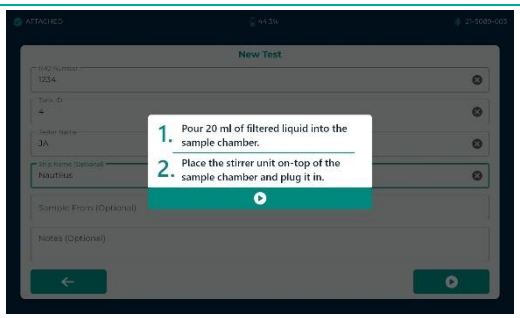
Run Test Screens	Function	Description
	**Home**	First check the **Run Test** button is green, indicating that the FastBallast is connected to the Tablet. Tap the **Run Test** button to start a test.
	**New Test**	A **New Test** screen appears where specific data can be entered. Tapping on a field opens a keypad, which enables data entry.
	**New Test**	The **IMO Number**, **Tank ID** and **Tester Name** fields must be completed. The **Ship Name**, **Sample From**, and **Notes** fields are optional. The **Run** button:  becomes active once the first three fields are filled.
	**Add Sample**	The **Add Sample** dialogue appears prompting the user to pour 20 mL of sample through the **Filter Funnel** into the **Sample Chamber** and then locate the **Stirrer**. Pressing **Run** initiates the measurement sequence.

Table 10: **Run Test** set-up screens.

5.4.2 Test Overview screens

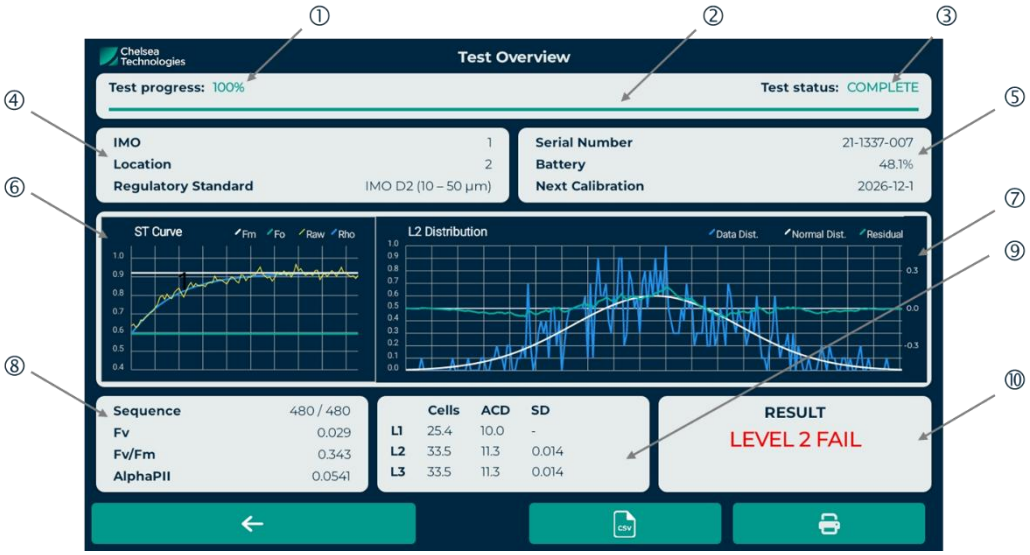


Figure 13: **Test Overview** screen.

Item	Function	Description
①	Test Progress Field	Indicates the test completion percentage.
②	Test Progress Bar	The Progress Bar provides a visual indication the time to test completion.
③	Test Status Field	Describes the current test phase: • PREPARING INSTRUMENT • L1 ANALYSIS • ANALYSING • COMPLETE
④	Test Data Box	Provides a summary of the specific test data entered at the start of the test.
⑤	FastBallast Information Box	Provides a summary of the connected FastBallast configuration.
⑥	ST Curve Plot	This window appears after three test points have been acquired and plots the averaged sequence data from the last test point (yellow), lines indicating F_0 (green) and F_m (white) and a curve fit (blue).
⑦	ST Parameter Plot	This window appears after three test points have been acquired. For the first 120 test points only a running trace of F_m, F_0 and F_v are plotted. After this, the window can be toggled sequentially between the ST Parameters and the L2 and L3 distribution histograms (blue). The distributions also provide a normal distribution fit to the data (white) and the residual error (green).
⑧	Sequence Data Window	This window displays the current sequence number and the derived parameters for the last acquisition test point. Including F_v, F_v/F_m and AlphaPII (see Glossary in Section 9.5).
⑨	Results Box	The results box is updated 4 times during a test. After 120 acquisitions the L1 test result is presented assuming an ACD of 10 µm, and an initial assessment of cell counts, ACD and F_v

		Standard Deviation is provided for L2 and L3 analyses. These are subsequently updated after 240, 360, and 480 acquisitions.
⑩	Final Results Box	The final test result is presented in this box after 480 acquisitions have been completed.
		The Return button halts the current test and returns the user to the Home Screen.
		This button enables a download of a Test Report .pdf file.
		This button initiates a download of a Test Report .csv file.

Table 11: The Run Test screens.

5.5 THE TEST HISTORY SCREEN

Figure 14: The **Test History** screen.

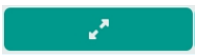
Item	Function	Description
①	Search Field	The search field allows the user to search for specific test results.
②	Test Results Listing	Lists the previous test results performed.
③	Expand Button	Selecting the button associated with a specific test result opens box beneath the listed file that enables different options.
④	Options Box	This appears when a test file is selected giving the user the options listed below.
		This button opens a test result display screen, an example is presented in Figure 15.
		This button enables a Test Report .pdf file to be downloaded via Bluetooth.
		This button enables a Test Report .csv file to be downloaded via Bluetooth.
		This button deletes the test file.
		This button returns the user to the Home Screen.

Table 12: **Test History** screen functional description.

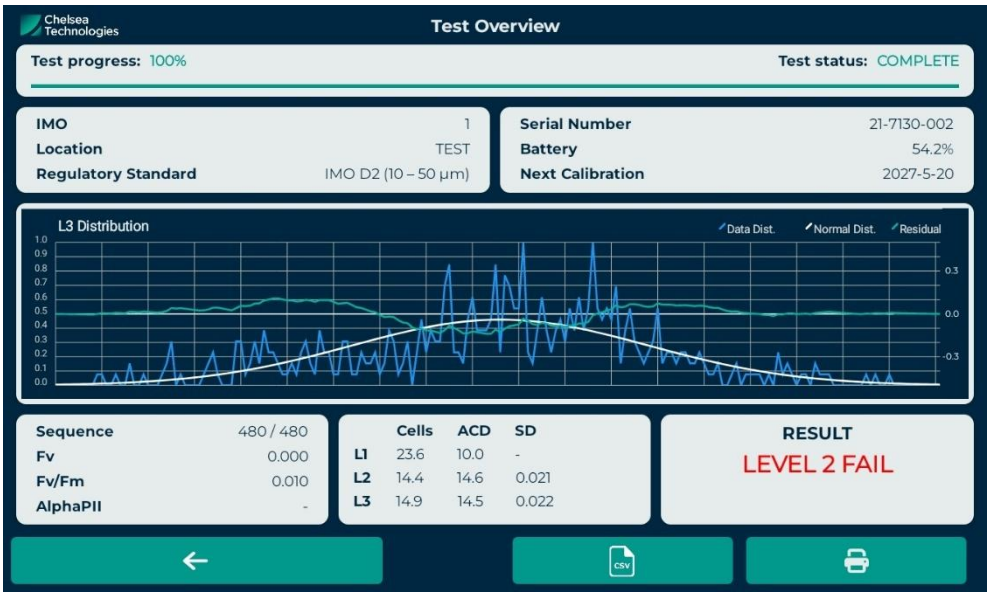


Figure 15: Example of an historical test result screen.

5.6 THE SETTINGS AND DIAGNOSTICS SCREENS

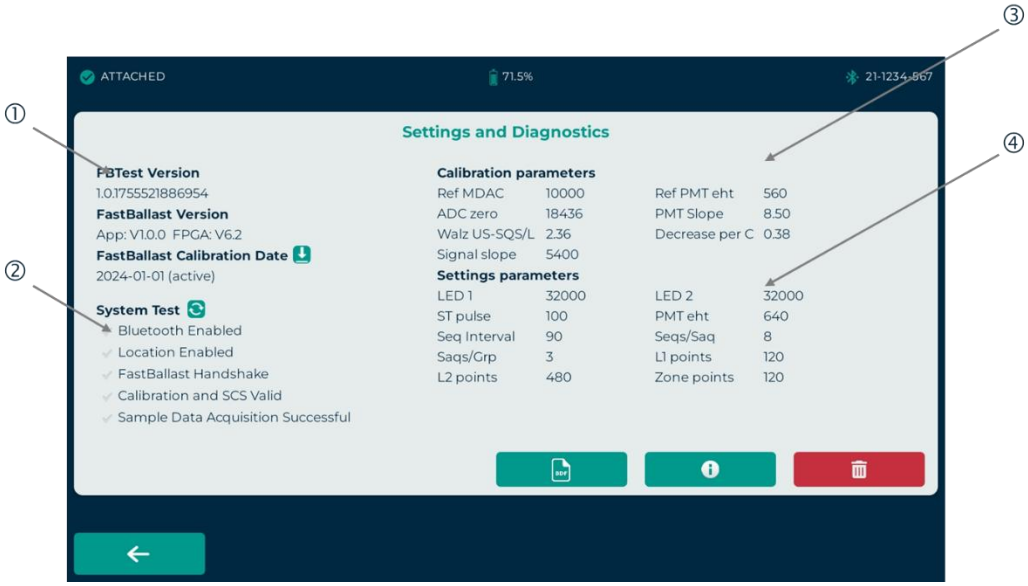


Figure 16: The **Setting and Diagnostics** screen.

Item	Function	Description
①	System Information	These fields list specific software and instrument related information.
②	System Test Results	These fields display the results of a System Test.
③	Calibration parameters	This field lists parameters associated with the specific calibration of the FastBallast instrument in use.
④	Settings Parameters	This field lists the current measurement settings parameters.
		The **System Test** button initiates a system diagnostics test.

	This button toggles between the Calibration and Setting parameters and a list of the Binary Data Files (BDF) associated with each of the tests performed. The BDF files contain all the raw data from each test and are used for diagnostics purposes, Figure 17.
	The **Information** button displays a glossary of FastBallast terms.
	The **Delete** button is used to delete all stored Binary File data.
	The **Return** button returns the user to the Home Screen.

Table 13: **Settings and Diagnostics** screen functional description.

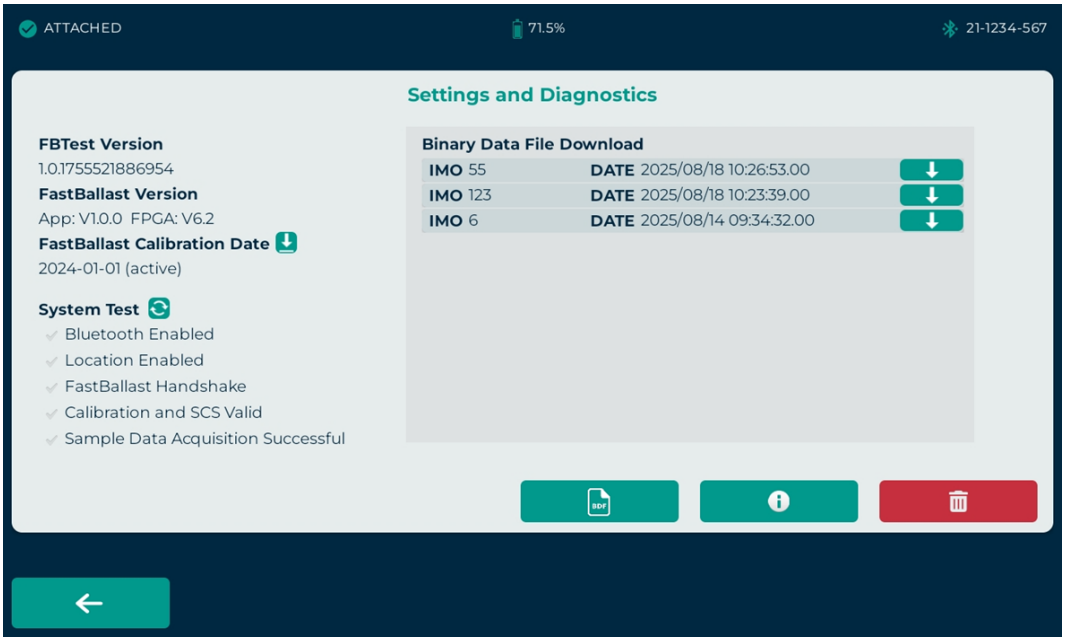


Figure 17: The **Setting and Diagnostics** displaying the Binary Data File Download window.

5.7 UPDATING THE FBTEST SOFTWARE

From time to time updates to the FBTest application will be made available through the FastBallast website.

Instruction on how to update the application on the Galaxy tablet are provided below:

1. Connect the Galaxy Tab A9 tablet to a PC using its USB-C cable.
2. The Tablet will appear in the file view window listing as ‘Galaxy Tab A9’
3. In the file view window navigate to the Download Folder on the Tablet.
4. Copy the FBTest .apk file that will be made available into the Download Folder.
5. Disconnect the Tablet from the PC.
6. On the Tablet, navigate to the Download Folder and tap on the copied .apk file to launch its installation.
7. This should automatically upgrade the application on the Tablet.

6 RUNNING A TEST

6.1 PREPARATION

If either the FastBallast or Tablet are completely discharged, they should be charged for at least 30 minutes before attempting to run a test. Suitable chargers and cables are supplied.

FastBallast is powered by an internal rechargeable lithium-ion battery. Only the charger supplied with the equipment should be used to recharge the FastBallast battery.

The battery charge state is displayed when FBtest is running and communicating with the FastBallast unit, see Section 3.3.1.

The steps needed to prepare for a test are illustrated in Table 14.

While the FastBallast remains sealed with the lid is open care should still be taken to avoid splashing liquid outside the Sample Chamber.

6.2 CONNECTING FASTBALLAST TO THE TABLET

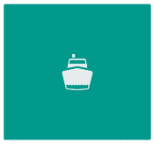
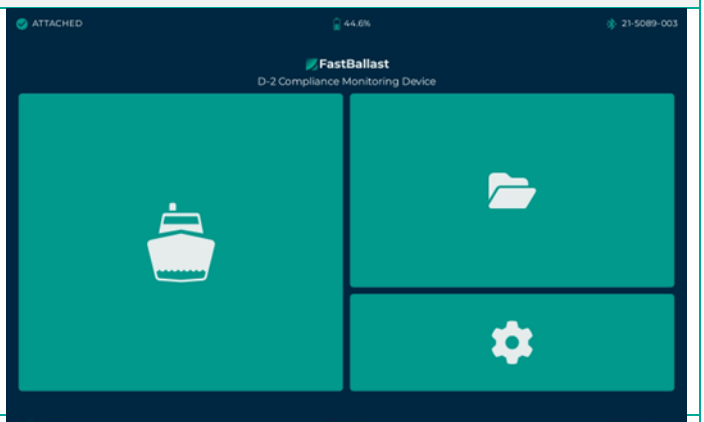
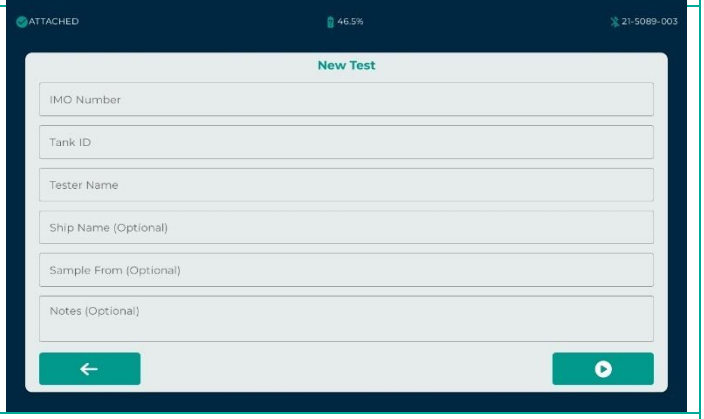
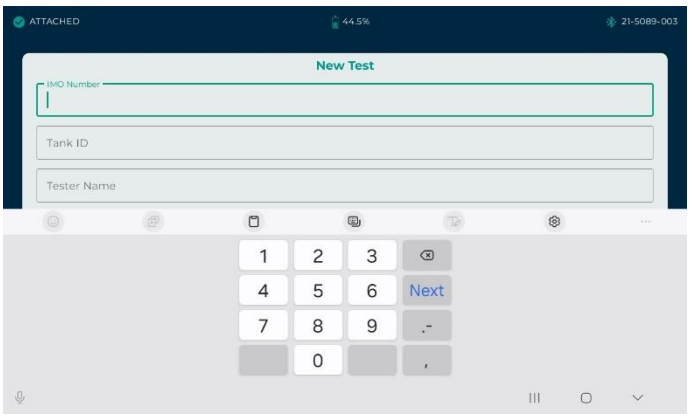
Operation	Illustration
Place the case onto a secure level Surface. Open the FastBallast lid.	
Turn on the FastBallast by pressing the Power Button on the top panel for a few seconds until it illuminates. Remove the Tablet from the lid. The Tablet can be either retained in the lid or hand-held while running a test.	

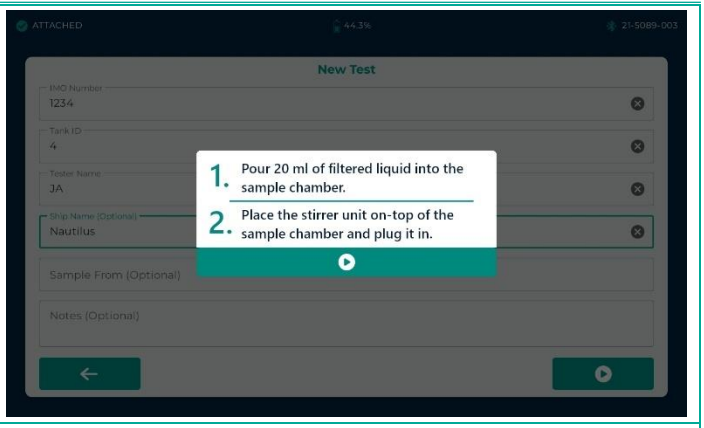
Wait a minute to allow the FastBallast to fully boot before switching-on the Tablet and launching the FBtest application. The FBtest application will run through the set-up screens describes in Table 8.	
Tap the **Run Test** Icon from **Home** screen to initiate a test run.	

Table 14: Basic operating instructions.

6.3 INITIATING A TEST RUN

Table 15 describes the initial steps needed to run a test.

Operation	Illustration
Press the test button:  to initiate a test run.	
A dialogue screen appears where specific test data is entered. Press on any of the fields to reveal a keyboard to allow data entry.	
The ship's **IMO Number**, **Tank ID** and **Tester Name** must be entered before a test can be run. The **Ship's Name**, **Sample From**, and **Notes** fields are all optional. All the text fields will be saved and are incorporated within the Test Report. Having entered the required data fields, FastBallast is then ready to run a test. Press the run button at the bottom right of the screen: 	

A dialogue box appears prompting the user to add sample to the **Sample Chamber** through the **Filter Funnel**.	
Remove the **Stirrer** from the **Sample Chamber** where it is stored during transit.	
Move the **Stirrer** collar to the test position by sliding it down the barrel and rotating until it clicks into position. The picture opposite shows the **Stirrer** collar in its correct test position.	
Put the **Stirrer** to one side and place the **Filter Funnel** into the **Sample Chamber**, as shown.	
Fill a **Measuring Cup** with sample to the base of the rim grooves (~20 mL).	

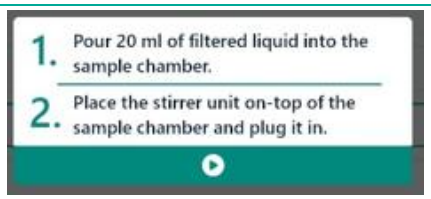
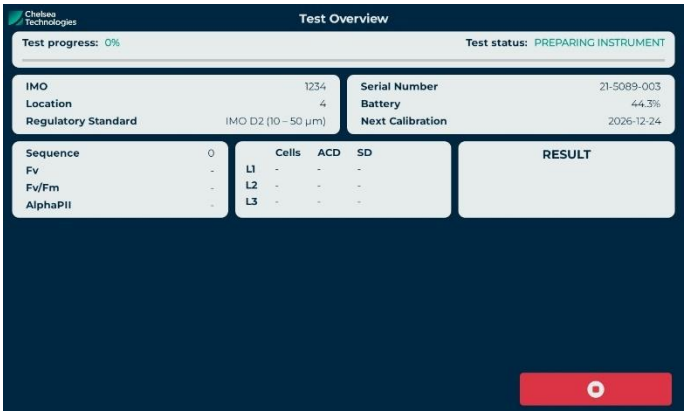
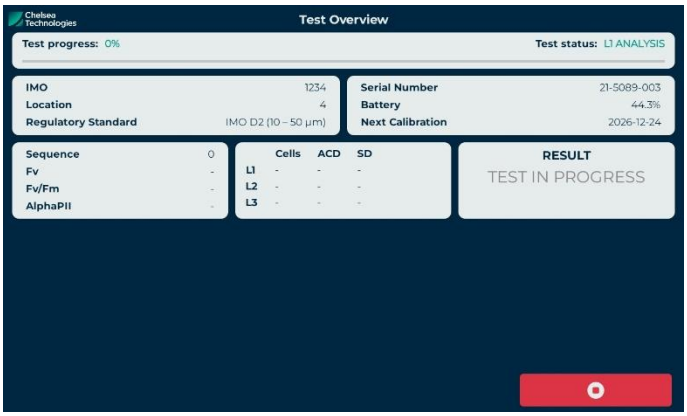
Pour the sample into the **Sample Chamber** through the **Filter Funnel.**	
Remove the **Filter Funnel** and place the **Stirrer** in the **Sample Chamber**, ensuring it is correctly registered (as indicated by the red circle). Plug the **Stirrer** connector into the appropriate socket on the front panel. You will hear a quiet buzz indicating that the **Stirrer** is rotating.	
Press the **Run** button in the dialogue box to initiate the measurement sequence.	

Table 15: Preparing to run a test.

6.4 TEST EXAMPLES

6.4.1 Level 1 test example - tap water

The test outlined in Table 17 describes a blank test conducted using tap water. This is a good test to apply between ballast water samples, to ensure there is no carry over of cells between tests.

Action	Illustration
Once the test run is started the FastBallast first adjusts the detector gain and LED intensities to optimize test performance for the given sample. While this process is running the **Test status** field will show: PREPARING INSTRUMENT The **RESULT** box will flash with: PREPARING	
The FastBallast will then initiate a Level 1 test, indicated by the **Test status** field reporting: L1 ANALYSIS During a Level 1 test an ACD of 10 µm is assumed (Section 4.1.1). The **RESULT** box will flash with: TEST IN PROGRESS	
After acquiring 3 test points two progress plots will be displayed: The **ST Curve** plot shows the current variable fluorescence sequence data, while the **ST Parameters** plot provides a running trace of F_0, F_m & F_v. For tap water the ST Curves should be flat, indicating no variable fluorescence is being generated by the sample.	

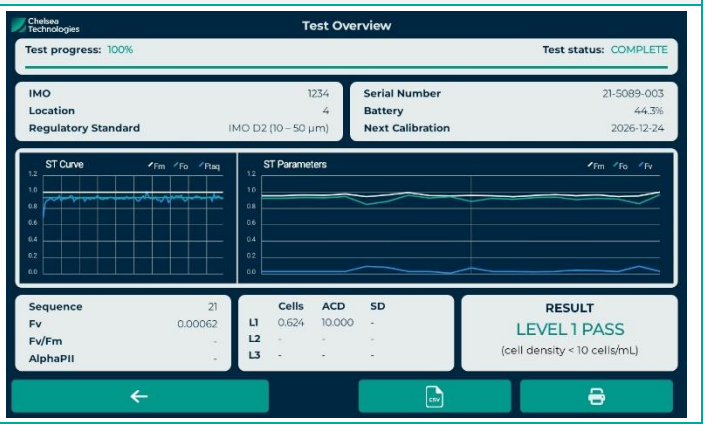
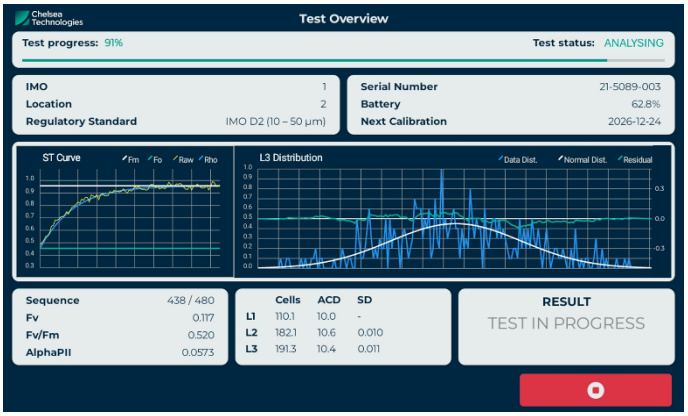
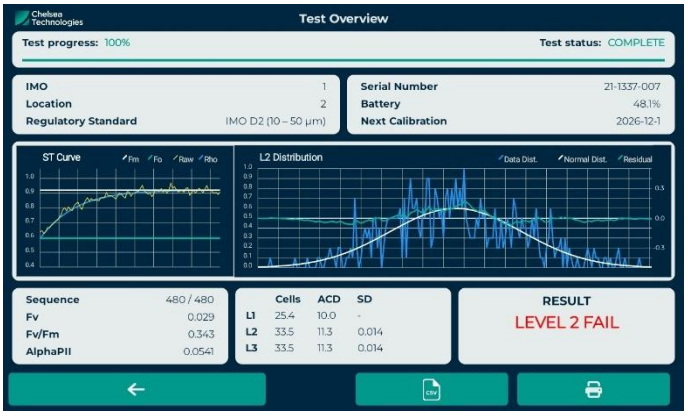
Action	Illustration
For a clean tap water sample the test will stop after completing 20 acquisitions and the following result will be displayed in the **Result** box: LEVEL 1 PASS (cell density < 10 cells/mL)	

Table 16: Running a tap water blank.

6.4.2 Level 2 / Level 3 test example – live cells

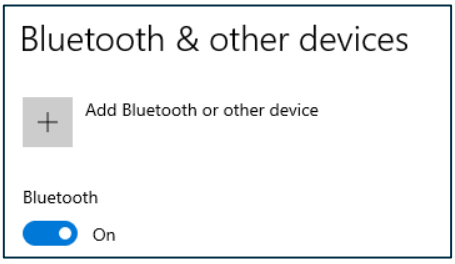
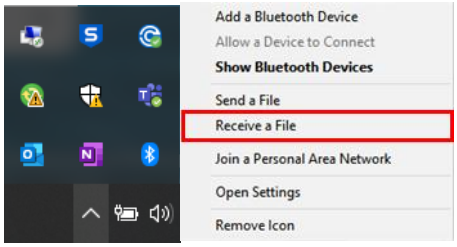
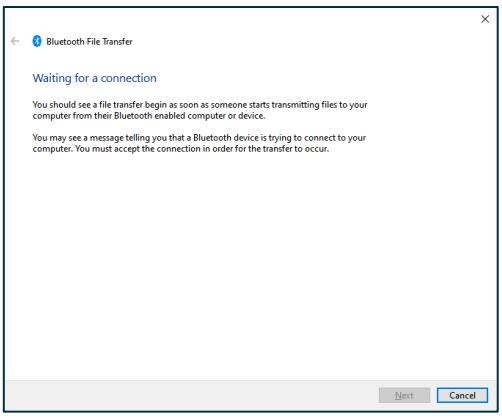
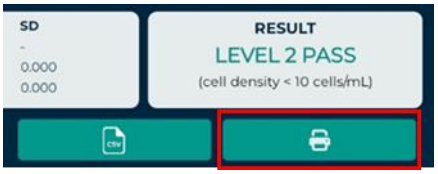
If the Level 1 test does not provide a clear result FastBallast will automatically perform a Level 2 & Level 3 test and analysis, see Section 4.1 for a description of how these analyses are preformed.

Action	Illustration
With live cells a clear time dependent fluorescence response will be seen in the **ST Curve** plot. During a Level 2 & 3 test the screen also displays a histogram of the F_v distribution, which is updated, along with the estimates cell count and ACD, after 120, 240, 360 and 480 acquisitions.	
The screen shot opposite shows the results screen from Level 2 failed test. The test result decision tree is presented in **Error! Reference s ource not found.**.	

6.5 DOWNLOADING THE TEST REPORT VIA BLUETOOTH

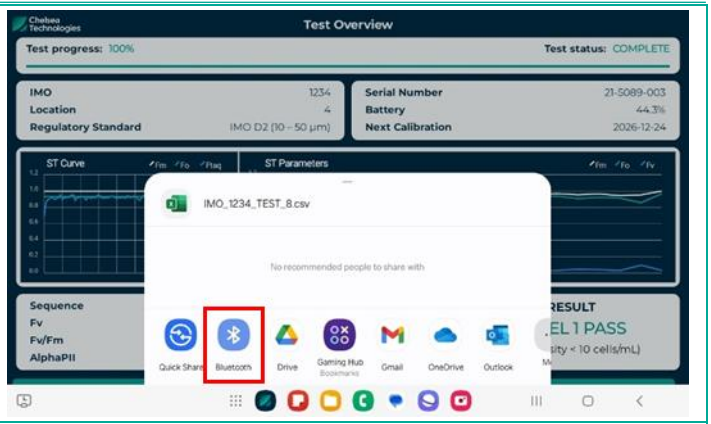
To transfer files you must first pair the Tablet to the device that you want to transfer the files to. This can be initiated in the Android Bluetooth menu.

The **Test Report** can be downloaded from the **Test Overview** screen when the test is completed. It can also be downloaded from the **File** screen.

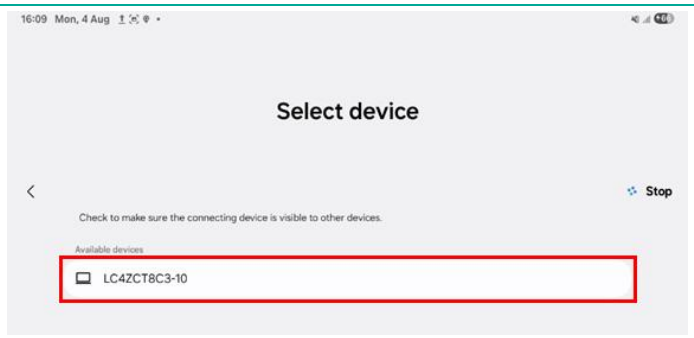
Ensure Bluetooth is enabled on the Windows device you want to transfer to: 1. Go to the Start menu -> settings 2. Click 'Devices' 3. Make sure Bluetooth is toggled **On**	
On the Windows device, go to the system tray and right-click the Bluetooth icon. Note: you may need to expand the system tray to view the icon.	
Leave this transfer dialog open and initiate the transfer from the Android app.	
To initiate a transfer, click one of the green buttons to share a file	

A .csv **Test Report** file can be downloaded from the results screen via Bluetooth or WiFi (if connected) from the result screen by tapping:

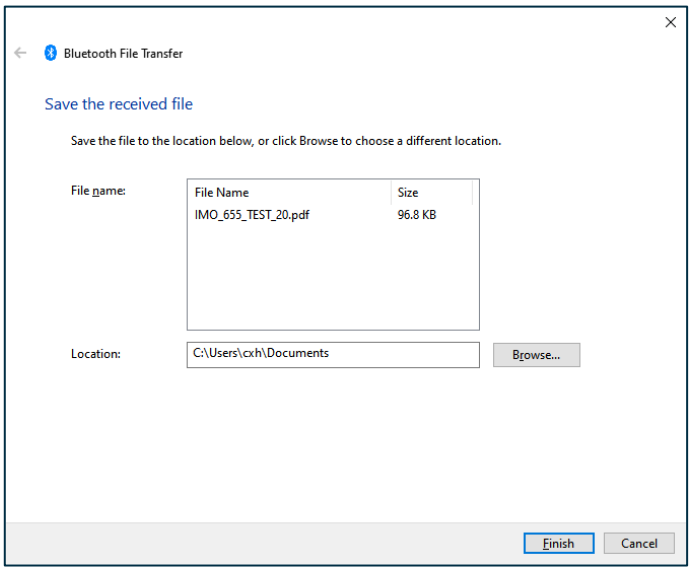
A dialogue box will appear showing the file name and listing the download options.



Select the device to share to.



The dialog will update once the transfer has completed, select the output folder and click finish.



Alternatively, a .pdf **Test Report** file can be downloaded by tapping:

Once the download is finished, tap the **Return** button to return to the **Home** screen.

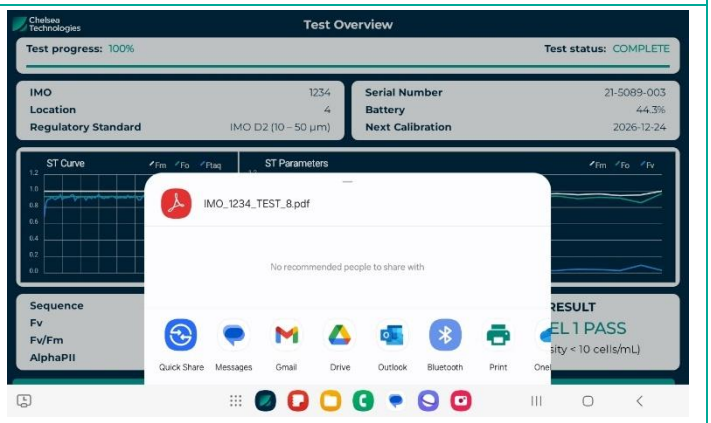


Table 17: Downloading Test Files via Bluetooth.

An example of a Test Report is presented in Figure 18: Example of a .pdf **Test Report** file.

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6.6 DOWNLOADING TEST FILES VIA WIRED USB

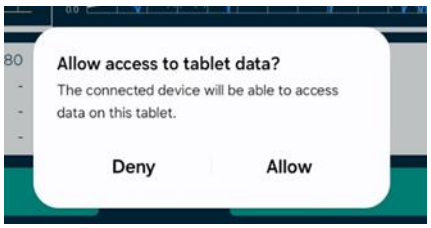
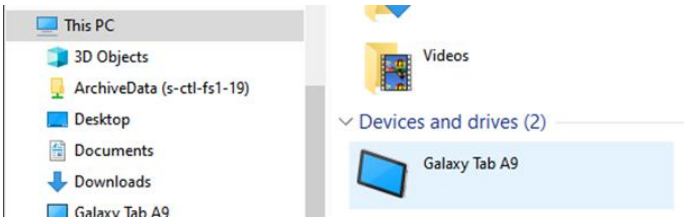
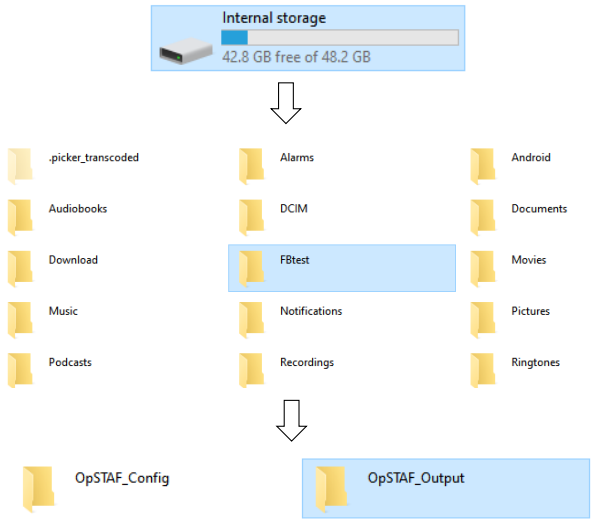
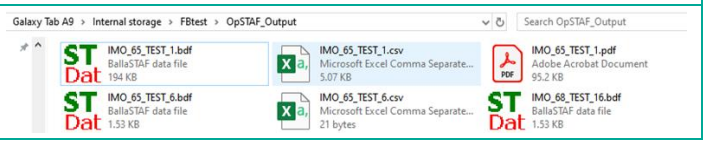
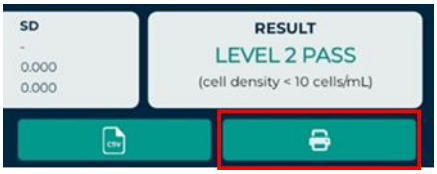
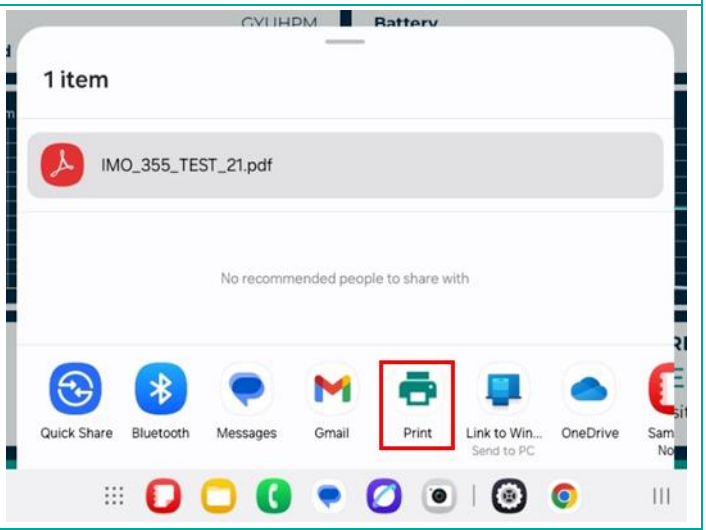
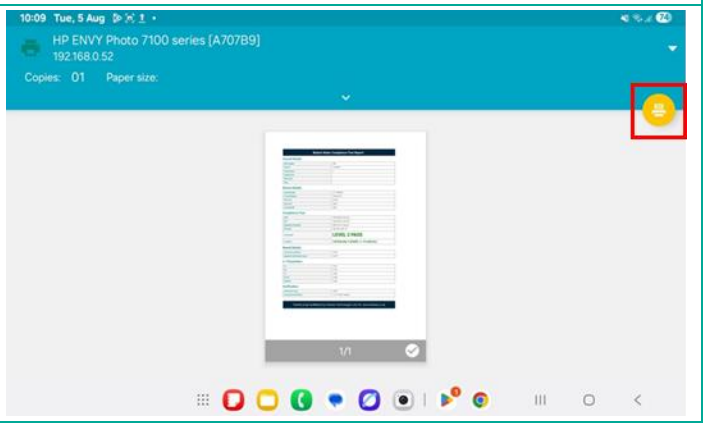
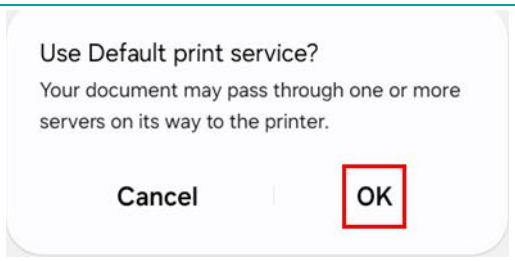
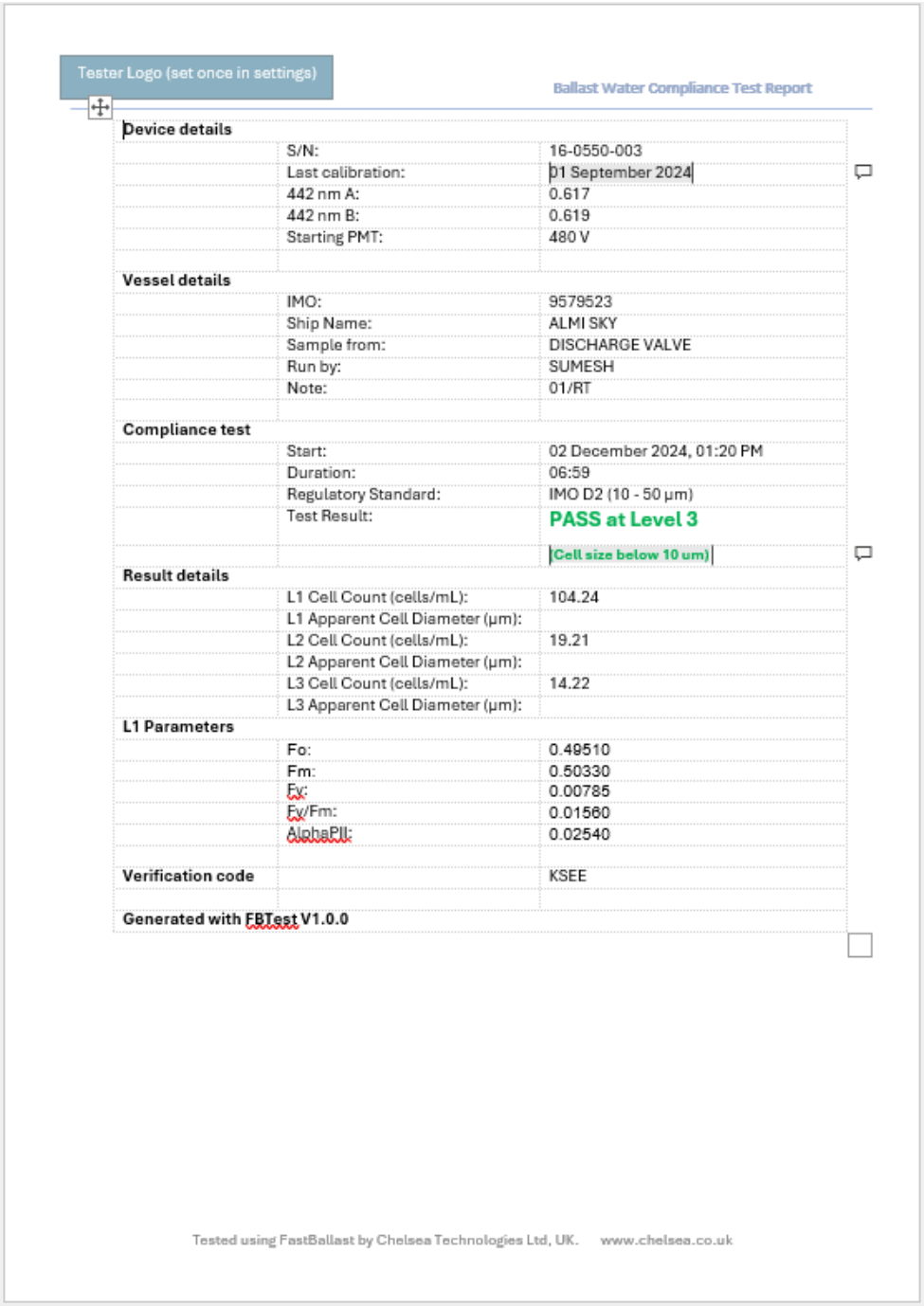
Connect the tablet to a Windows computer via USB using the USB data cable supplied. If prompted on the tablet, allow file access to the computer.	
On the Windows PC, open file explorer, go to 'This PC' and double-click 'Galaxy Tab A9'.	
Navigate to Internal storage -> FBTest -> OpSTAF_Output to view test files OR Internal storage -> FBTest -> OpSTAF_Config to view calibration and configuration files.	
Cut, Copy or drag and drop to transfer files to the computer.	

Table 18: Transferring files via wired USB.

6.7 PRINTING

Note: You may need to connect the tablet and printer to your local network if Wi-Fi direct/Bluetooth is not supported by the printer. Wired printing is not natively supported but can be achieved with vendor apps such as the HP Print Service Plugin for HP printers along with a specialised cable.

Turn the printer on, ensure it is discoverable via Bluetooth or Wi−Fi. On the FBTest application, click one of the green buttons to share a file.	
Select the 'Print' icon from the dialogue that appears.	
Click 'Select a printer'. Select 'All printers…' Wait for your printer to appear in the list and then select it. Click the Yellow print icon.	
Click 'OK' to using the default print service.	



Tester Logo (set once in settings)

Ballast Water Compliance Test Report

Device details		
	S/N:	16-0550-003
	Last calibration:	01 September 2024
	442 nm A:	0.617
	442 nm B:	0.619
	Starting PMT:	480 V
Vessel details		
	IMO:	9579523
	Ship Name:	ALMI SKY
	Sample from:	DISCHARGE VALVE
	Run by:	SUMESH
	Note:	01/RT
Compliance test		
	Start:	02 December 2024, 01:20 PM
	Duration:	06:59
	Regulatory Standard:	IMO D2 (10 - 50 µm)
	Test Result:	**PASS at Level 3**
		(Cell size below 10 um)
Result details		
	L1 Cell Count (cells/mL):	104.24
	L1 Apparent Cell Diameter (µm):	
	L2 Cell Count (cells/mL):	19.21
	L2 Apparent Cell Diameter (µm):	
	L3 Cell Count (cells/mL):	14.22
	L3 Apparent Cell Diameter (µm):	
L1 Parameters		
	Fo:	0.49510
	Fm:	0.50330
	Fv:	0.00785
	Fv/Fm:	0.01560
	AlphaPII:	0.02540
Verification code		KSEE
Generated with FBTest V1.0.0		

Tested using FastBallast by Chelsea Technologies Ltd, UK. www.chelsea.co.uk

Figure 18: Example of a .pdf **Test Report** file.

6.8 AFTER RUNNING A TEST

To prepare for the next test follow the steps listed in Table 19.

STEP	ACTION	IMAGE
1	Remove the Stirrer and rinse gently with tap or deionised water then dry it with kitchen towel or equivalent.	
2	Empty the sample chamber using the **Syringe** fitted with a short length (~50 mm) of the silicone tubing supplied. Alternatively, a couple of pieces of kitchen towel can be used to soak up the sample.	
3	Wash the sample chamber out with tap water or deionised water at least twice, using the **Syringe** or kitchen towel to empty the chamber each time.	
4	Dry the chamber out with a clean piece of kitchen towel.	

Table 19: Steps to perform after a test is completed.

6.9 SHUTTING DOWN

6.9.1 Quitting FBtest

To exit the FBtest application:

1. Swipe up from the bottom of the screen to access the Android dock.
2. Select the icon with the 3 vertical lines to display the open applications.
3. Swipe the FBtest window to the top of the screen to exit.

6.9.2 Switching off the FastBallast

To switch off the FastBallast, hold down the Power Switch for a few seconds until the illuminated ring flashes green.

The FastBallast will flash once after a few seconds, indicating that it has fully shut down. Do not attempt to restart the FastBallast before it has fully shut down.

6.10 ROUTINE MAINTENANCE

6.10.1 FastBallast battery

The FastBallast unit incorporates a battery level gauge, which is automatically accessed by the FBtest software and is displayed on the **Home** screen:

A 100% charge will provide at least 6.5 hrs of continuous operation when the battery is new.

The LED indicator on the FastBallast Power Switch will illuminate orange when the unit is at 35% power remaining. This indicates that the FastBallast should be recharged at the earliest convenient opportunity.

A full charge from a flat battery takes about 6 hrs.

6.10.2 Sample chamber

The FastBallast sample chamber should kept clean to prevent false results. Further details on cleaning the sample chamber between tests are provided in Sections 0.

6.10.3 Stirrer unit

The stirrer unit should be rinsed and dried between tests to prevent the build-up of contamination.

7 TROUBLESHOOTING

7.1 FASTBALLAST FAILS TO CONNECT TO FBTEST

The Tablet supplied will have been paired to the FastBallast via Bluetooth.

If problems are encountered with FBtest recognizing the FastBallast check the Bluetooth connection:

4. Navigate to the Android home screen.
5. Swipe down from the top of the screen to access the device settings.
6. Select the Bluetooth icon.
7. FastBallast should appear as one of the paired options. If not, ensure that the FastBallast has been switched on for at least a couple of minutes and then scan for available devices and select the FastBallast option when it appears.

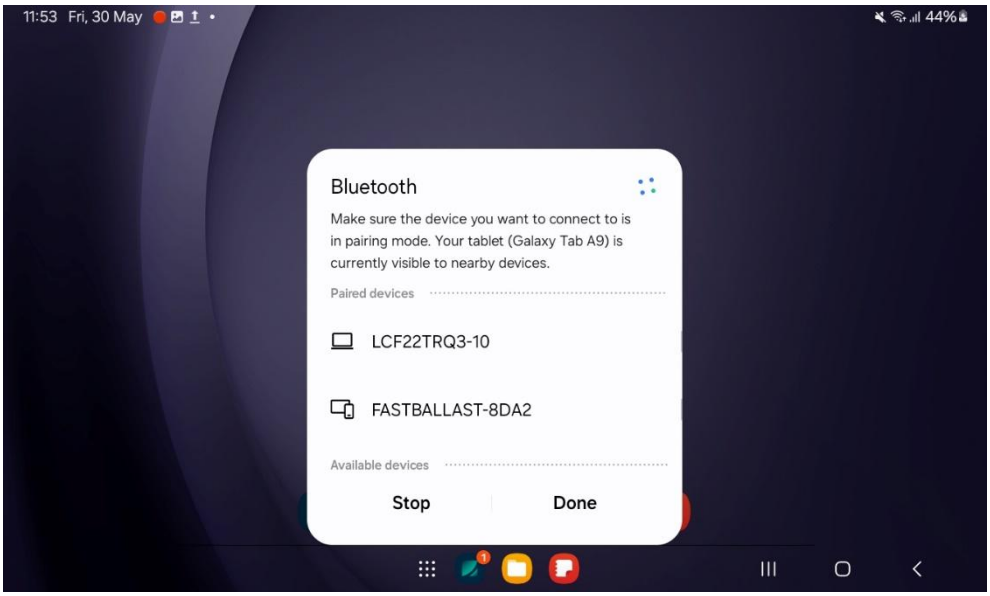


Table 20: Bluetooth pairing settings dialogue.

If problems are still encountered, switch off both the FastBallast and the Tablet. Switch on the FastBallast and wait for a least two minutes to allow the instrument to boot fully. Switch on the Tablet and then open FBtest to initiate a connection.

7.2 UNRELIABLE BLUETOOTH CONNECTIVITY

Under rare circumstances the electrical environment many be too noisy for a secure Bluetooth connection to be established. If this happens, the FastBallast can be directly connected to the Surface Go using the USB cable supplied.

Figure 19: USB cable used directly to connect the Surface Go with the FastBallast.

After connecting the cable and launching FBtest a connected FastBallast unit will automatically be detected, as it does via Bluetooth.

8 MAINTENANCE, SPARES

8.1 WARRANTY

Chelsea Technologies' ("The Company") warranty terms are provided by using the QR code found at page 10 of this Handbook.

8.1.1 Warranty Service

If service is required during the warranty period, please take the following steps:

1. Contact Chelsea Technologies' Customer Support team, describing the nature of the problem and supplying relevant supporting data, if possible, as follows:

   Phone: +44 (0)208 841 9000

   Email: service@chelsea.co.uk

2. Carry out any adjustments or tests as suggested by the Customer Support team.

3. If normal performance cannot be obtained, you will be issued with a Return Merchandise Authorization number (RMA). Securely package the unit, ideally in the packaging supplied, and write the RMA number on the outside of the shipping carton, then ship the instrument, prepaid, to Chelsea Technologies. If the failure is covered under the warranty terms, the instrument will be repaired and returned free of charge.

If the equipment was purchased from one of our authorized resellers, please initially contact them to arrange for repair. If you purchased directly from Chelsea Technologies, contact us. The Customer pays for the return shipping duties and documentation, while Chelsea Technologies will pay for the return shipment (custom duties, taxes and fees are the responsibility of the customer).

8.1.2 Out-of-Warranty Service

Follow steps for Warranty Service as listed above. If the equipment is returned to Chelsea Technologies, on receipt, we will survey the equipment and provide a fixed price for its repair plus any applicable duties and/or taxes. Shipment to Chelsea Technologies should be prepaid. Your bill will include return shipment freight charges.

Our Customer Support Team may also be able to assist you by phone or correspondence, however; Chelsea Technologies' guidance and support are based solely on the information provided at the time of the request. We do not accept liability for any outcomes resulting from incomplete, inaccurate, or insufficient details. To help us assist you effectively, please ensure all relevant operational, technical, and contextual information is included when contacting our Customer Support Team. Chelsea Technologies accepts no liability for any advice given by its personnel free of charge and/or any advice for which it is not required to provide on a contractual basis.

8.2 MAINTENANCE INTERVAL

NOTE FastBallast contains no user serviceable parts, opening of the equipment will invalidate the warranty.

The FastBallast system should be returned for a factory refit and calibration every two years. The refit includes:

- Replacement of the internal rechargeable battery.
- Replacement of all O-ring seals.
- Testing of internal electronics.
- Instrument re-calibration.
- Reset and updating of the Surface Go and FBtest software.

8.3 STIRRER ASSEMBLY

After a significant amount of use the two Phillips nylon screws that guide the locating collar around the barrel of the stirrer unit can become worn.

Figure 20: Stirrer assembly with nylon locating screw indicated.

Spare screws can be supplied if needed (Part Number 113947). Replace the screws using a Phillips screwdriver ensuring the collar locates in the alignment groove on the **Stirrer's** barrel. The screw position and alignment groves are indicated in Figure 20.

8.4 SPARES AND REPLACEMENT PARTS

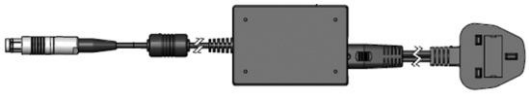
ITEM	IMAGE	PART NUMBER
FastBallast Stirrer		2355-138-PL
Galaxy Tab A9		TBA
Universal Charger and Plug Adapter		TBA
FastBallast charger		2355-137-PL
FastBallast to USB-C cable		2408-261-PL

Table 21: FastBallast spares.

FastBallast spares can be purchased directly from Chelsea Technologies Ltd at:

http://www.chelsea.co.uk/sales@chelsea.co.uk

9 REGULATORY COMPLIANCE

9.1 IMO ACCREDITATION TO IMO PPR 10-17

TBA

9.2 CE MARKING

TBA

9.3 ROHS

TBA

9.4 WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT (WEEE) DIRECTIVE

Chelsea Technologies aim to design and sell products that benefit the environment. Accordingly, we are concerned with preserving the environment where our instruments are used and are happy to work with customers in complying with the WEEE Directive to reduce the environmental impact resulting from the use of our products.

FastBallast should be disposed of using services that adhere fully to the Waste Electrical and Electronic Equipment (WEEE) directive, or, alternatively, can be returned to Chelsea Technologies Ltd.

9.4.1 WEEE return process

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

1. If you purchased your instrument through one of Chelsea Technologies resellers, then contact them directly. They will instruct you on how to return the end-of-life product.
2. If you purchased your equipment directly from Chelsea Technologies, then please contact our Customer Service Team directly:

   Phone: +44 (0)208 841 9000

   Email: service@chelsea.co.uk

   Our Customer Service Team will provide you with a WEEE RMA Number, a Shipping Account Number, and a Ship to Address.
3. Package and ship the product back to Turner Designs. The product will be safely disposed of in accordance with our internal end of life procedure (2442-059-PQ-A Waste Disposal (Hazardous & Non-Hazardous)).

9.5 GLOSSARY OF TERMS

Term	Definition
Active Fluorescence	The increase in the normalised fluorescence signal that is induced by a saturating light pulse (see F_v).
ACD	Apparent Cell Diameter calculated from the analysis of Level 2 & 3 statistical variation of F_v .
Baseline Fluorescence	Fluorescence signal arising from sources other than active PSII complexes.
F_o	The 'origin' of variable fluorescence (F_v). F_o can include fluorescence from sources other than photochemically active PSII complexes.
F_m	The 'maximum' fluorescence, assessed as the asymptote of the fluorescence signal induced by a saturating pulse.
F_v	Variable (active) fluorescence, calculated as $F_m - F_o$ Active fluorescence (F_v) originates from photochemically active (functional) PSII complexes. Photochemistry provides the energy required for cell growth and maintenance.
F_v/F_m	The proportion of the total fluorescence signal that is active. In the absence of Baseline Fluorescence, this parameter provides an estimate of PSII photochemical efficiency. In the context of ballast water testing (where Baseline fluorescence can be very high), this parameter is of limited value. It is not used within the FastBallast data analysis algorithm.
PSII	Photosystem II. Active fluorescence (F_v) originates from PSII complexes.
AlphaPII	Parameter related to the absorbance cross section of PSII photochemistry. The value is theoretically equal to the proportion of PSII complexes closed during the first microsecond of an ST pulse.
Single Turnover (ST) pulse	A 100 µs pulse provided to the sample from the measurement LEDs. The intensity (photon flux) is approximately equal to ten times full sunlight. The ST pulse increases the fluorescence signal from F_o to F_m by transiently saturating PSII photochemistry.

10 AVERTISSEMENTS DE SÉCURITÉ

Tout au long du manuel, les symboles d'avertissement présentés dans le Table 1 sont utilisés pour mettre en évidence les dangers potentiels. Ces avertissements doivent être lus avant d'utiliser les équipements.

SYMBOLE	PROBLÈME SURLIGNÉ
	Utilisé lorsque l'avertissement d'une condition potentiellement dangereuse s'applique, pour signaler une condition nécessitant une enquête immédiate ou pour mettre en évidence des problèmes spécifiques liés à l'utilisation de l'équipement.
	Utilisé lorsque l'avertissement d'une condition électrique potentiellement dangereuse s'applique.
	Utilisé lorsqu'un avertissement spécifique de santé et de sécurité s'applique.
	Utilisé pour mettre en évidence les informations spécifiquement pertinentes pour la maintenance et/ou le fonctionnement de l'équipement.

Tableau 22 : Symboles d'avertissement utilisés tout au long du manuel.

10.1 BATTERIES RECHARGEABLES

10.1.1 Batterie du FastBallast

L'appareil FastBallast utilise une batterie lithium-ion rechargeable interne qui doit être entretenue avec soin.

FastBallast fonctionne avec une batterie lithium-ion rechargeable interne. Seul le chargeur fourni avec l'équipement doit être utilisé pour la charge.

10.1.2 Batterie de la tablette

La tablette Galaxy Tab A9 ne doit être chargée qu'à l'aide d'un chargeur USB-C certifié. Un chargeur universel/adaptateur de prise adapté est fourni avec le système, voir la Figure 2.

10.2 FONCTIONNEMENT DU FASTBALLAST

FastBallast fonctionne avec une batterie lithium-ion rechargeable interne. Seul le chargeur fourni avec l'équipement doit être utilisé pour la charge.

FastBallast fonctionne avec des tensions internes élevées. L'équipement ne doit en aucun cas être ouvert ou utilisé en dehors de son boîtier.

NOTE

FastBallast est un instrument scellé. Cependant, toutes les précautions doivent être prises pour minimiser les déversements de liquides sur l'équipement.

NOTE

FastBallast doit être utilisé sur une surface plane et sécurisée.

10.3 SERVICE ET MAINTENANCE

NOTE

FastBallast ne contient aucune pièce réparable par l'utilisateur, l'ouverture de l'équipement annulera la garantie.

10.4 TRANSPORT

Utilisez l'emballage fourni avec le FastBallast pour le transport.

Lors de la fermeture du couvercle du FastBallast, avant le transport, assurez-vous que rien ne se coince qui pourrait activer le bouton d'alimentation, car l'appareil doit être hors tension pendant le transport.

Assurez-vous que le collier de l'**agitateur** est déplacé vers son emplacement de transport et fixé solidement dans la chambre d'échantillonnage (Figure 4) avant de fermer le couvercle du FastBallast.

10.4.1 Indicateur de capacité de la batterie du FastBallast

FastBallast fonctionne avec une batterie lithium-ion rechargeable interne (une fiche technique de sécurité et un résumé des résultats des tests de sécurité sont disponibles sur demande). Seul le chargeur de batterie fourni avec l'équipement doit être utilisé.

L'application de test FBtest calcule continuellement la capacité de batterie attendue, qui est affichée en haut de l'écran **d'accueil** (Home) (Figure 5) et pendant une mise à l'essai.

10.4.2 Batterie de la tablette Android

La tablette Android ne doit être chargée qu'à l'aide d'un chargeur USB-C convenable. Veuillez lire les informations sur le produit fournies avec la tablette pour plus d'informations sur la sécurité.

10.5 PRÉPARATION

Si le FastBallast ou la tablette sont complètement déchargés, ils doivent être chargés pendant au moins 30 minutes avant d'essayer d'exécuter un test. Des chargeurs et des câbles adaptés sont fournis.

FastBallast est alimentée par une batterie lithium-ion rechargeable interne. Seul le chargeur fourni avec l'équipement doit être utilisé pour la recharge de la batterie du FastBallast.

L'état de charge de la batterie est affiché lorsque FBtest est en cours d'exécution et communique avec l'appareil FastBallast, voir la section 3.3.1.

Les étapes nécessaires à la préparation d'un test sont illustrées dans le Table 14.

Tant que le FastBallast reste scellé et que le couvercle est ouvert, il convient de veiller à éviter les éclaboussures de liquide à l'extérieur de la chambre échantillon.

10.6 INTERVALLE DE MAINTENANCE

NOTE

FastBallast ne contient aucune pièce réparable par l'utilisateur, l'ouverture de l'équipement annulera la garantie.

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