

# The ultimate system for ballast water discharge analysis

Chelsea Technologies designs and manufactures ingenious environmental monitoring technology to make the world safer, cleaner and smarter. Across shipping, marine science, water quality, defense and industrial process control, our best-in-class sensors and systems are trusted for their sensitivity, accuracy, reliability and sophistication.

FastBallast provides a highly-sensitive solution for on-board ballast water monitoring. The distribution-based analysis used by FastBallast provides compliance-level cell counts that are as accurate as laboratory methods.



## FastBallast

Portable compliance monitor

Rapid on-board testing of treated ballast water to ensure compliance with the IMO D-2 & USCG Discharge Standards

### FastBallast flow-through

Because STAF measurements are very short (no more than 400  $\mu$ s), FastBallast is able to make accurate measurements in flow-through mode. Consequently, the FastBallast flow-through accessory provides for continuous testing during ballasting and/or discharge. When required, automated filtration steps improve the verification of cell size to ensure D-2 compliance.



### Summary

- Highly-sensitive solution to on-board ballast water monitoring
- Compliance-level testing to the D-2 standard in under 10 minutes
- Distribution-based fluorescence method ensures accurate cell counts
- Very low chance of either false negatives or false positives

|                     |                |   |                |
|---------------------|----------------|---|----------------|
| Indicative test     | Confident PASS | PASS level unknown: could be 100x D-2 threshold | Confident FAIL |
| FastBallast Level 1 | Confident PASS | Go to Level 2 test                              | Confident FAIL |
| FastBallast Level 2 | Confident PASS | Confident FAIL                                  |                |

Table 3: The measurement approach used by FastBallast

### Specifications

|                                |   |
|--------------------------------|---|
| User interface                 | Panasonic ToughPad or Windows PC running FaBtest GUI                |
| Sample volume                  | 20 mL   |
| Interrogated volume            | 0.5 mL  |
| Excitation                     | Four channels: royal blue, blue, green, and red                     |
| Sensitivity                    | <1 cell/mL  |
| Dynamic range                  | 0-4000 cells/mL   |
| Time to result                 | <2 minutes for Level 1<br><10 minutes for Level 2                   |
| Power                          | Internal rechargeable battery pack provides 8h continuous operation |
| Connectivity                   | USB or Bluetooth  |
| Dimensions                     | 240 x 198 x 109 mm  |
| Mass                           | 5.0 kg  |
| IP rating with lid closed/open | IP68/IP65   |
| Service interval               | >2 years  |

\*In view of our continual improvements, the designs and specifications of our products may vary from those described.







# FastBallast Portable compliance monitor

Variable fluorescence as a probe of cell viability

## BALLAST WATER MONITORING

Invasive species cause devastation to marine habitats worldwide. In 2004 the International Marine Organisation (IMO) introduced the *Ballast Water Management Convention* to prevent the spread of harmful organisms through ballast water. All ships must now meet the IMO D-2 Performance Standard which states that discharged ballast water must not contain more than 10 viable cells/mL in the 10-50 µm size range (smallest dimension).

FastBallast is a rapid, on-board compliance monitor designed to assist in meeting these standards. FastBallast uses Single Turnover Active Fluorometry (STAF) to provide an accurate count of living cells. While most systems only provide an indicative result, FastBallast can provide a compliance-level test in under 10 minutes.

| Step | Standard procedure                            | FastBallast procedure    |
|------|---|--------------------------|
| 1    | Inspection of documents and BWMS              |                          |
| 2    | Detailed inspection and check against plan    |                          |
| 3    | On-board indicative test                      | On-board compliance test |
| 4    | Shore-based compliance test (e.g. microscopy) |                          |

Table 1: FastBallast provides an on-board compliance-level test



### Users

- Manufacturers of Ballast Water Management Systems (BWMS)
- Ship operators, owners, and yards
- Port State Control
- Service suppliers
- Analytic laboratories

### Features

- Rapid on-board compliance testing to the IMO D-2 standard
- Detection limit of <1 cell/mL
- Accurate cell count regardless of cell size
- Compliance-level testing in only 2 to 10 minutes
- Stirred sample allows accurate statistical analysis
- Negligible false positives, avoiding unnecessary delays in port
- Very low levels of false negatives allowing confident ballast water discharge
- High tolerance to background fluorescence from dead cells and CDOM
- Minimum consumables and no costly reagents or laboratory testing required
- Long service interval (>2 years)
- Optional flow-through system can provide continuous testing during ballast water discharge

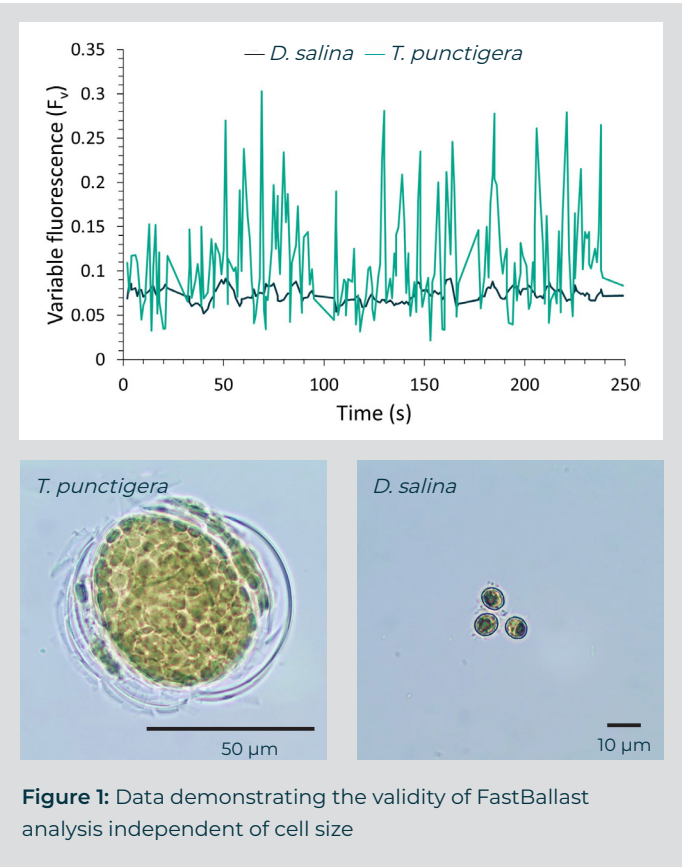


Figure 1: Data demonstrating the validity of FastBallast analysis independent of cell size

| Standard parameter | <i>T. punctigera</i> | <i>D. salina</i> |
|--------------------|----------------------|------------------|
| F <sub>v</sub>     | 0.254                | 0.263            |
| Cells per mL       |                      |                  |
| Level 1            | 111 (FAIL)           | 94 (FAIL)        |
| Level 2            | 8.8 (PASS)           | 360 (FAIL)       |
| Microscope         | 7.0 (PASS)           | 427 (FAIL)       |
| SCF                | 0.0288               | 0.0007           |

Table 2: Data demonstrating the validity of FastBallast analysis independent of cell size

### Living cells and cell viability

Although no existing compliance monitors for on-board testing can determine if cells are viable (capable of reproduction), the STAF technology incorporated within FastBallast provides a reliable probe of the capacity for photosynthesis by phytoplankton. This provides a highly reliable method for detection of living cells and represents one of the key indicators of cell viability.

### Size matters

Most compliance monitors that rely on active fluorometry assume that a fixed level of variable fluorescence (F<sub>v</sub>) is emitted from each phytoplankton cell. In reality, F<sub>v</sub> varies enormously among species. In the example shown left, *Thalassiosira punctigera* (a large diatom) emits around 40 times the F<sub>v</sub> per cell of *Dunaliella salina* (a small chlorophyte). Consequently, although the average F<sub>v</sub> emitted from each cell sample was very similar, the cell densities were very different. It follows that systems relying on a fixed F<sub>v</sub> per cell can generate wildly inaccurate values of cell density.

### FastBallast vs. indicative testing

Here, FastBallast stands out from the crowd. If the Level 1 indicative test is neither a confident PASS or confident FAIL, FastBallast performs a detailed Level 2 test. This test incorporates analysis of the distribution of 480 F<sub>v</sub> values and uses Poisson theory to generate an estimate of cell density and calculate the actual F<sub>v</sub> per cell (Standardised Cell Fluorescence, SCF). As a result, FastBallast Level 2 testing provides a rapid, size-independent cell count that is as accurate as shore-based analysis, as demonstrated in Table 2.