



Certificate no.:
TAP0000336

TYPE APPROVAL CERTIFICATE

This is to certify:

that the **5 ppm Bilge Alarm**

with type designation(s)
SMART BILGE+

issued to

Rivertrace Limited
Redhill, United Kingdom

is found to comply with

DNV class programme DNV-CP-0485 – Type approval – 5 ppm bilge alarms
IMO Resolution MEPC.107(49) – Revised Guidelines and Specifications for Pollution Prevention Equipment
for Machinery Space Bilges of Ships

Application:

Product(s) approved by this certificate is/are accepted for installation on all vessels classed by DNV.

Issued at **Høvik** on **2025-09-30**

This Certificate is valid until **2030-09-29**.

for **DNV**

DNV local unit: **UK & Ireland CMC & VMC**

Approval Engineer: **Martin Olofsson**

This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid.
The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.

LEGAL DISCLAIMER: Unless otherwise stated in the applicable contract with the holder of this document, or following from mandatory law, the liability of DNV AS, its parent companies and their subsidiaries as well as their officers, directors and employees ("DNV") arising from or in connection with the services rendered for the purpose of the issuance of this document or reliance thereon, whether in contract or in tort (including negligence), shall be limited to direct losses and under any circumstance be limited to USD 300 000.

Product description

The SMART BILGE+ bilge water alarm is intended for installation on board ships for monitoring the oil content of bilge water. The unit monitors the effluent from an approved bilge water separator and sends an alarm signal that facilitates the activation of discharge control devices when the oil content exceeds 5 ppm.

The SMART BILGE+ holds two logical modules, the control module, which contains the LCD screen and the control PCB, and the measuring cell, which contains the optoelectronics used in the calculation of the sample oil content.

Analysis of the oily water sample is undertaken by a unique detector array arrangement. A narrow beam of light is emitted across a glass cell tube which the oily water sample passes through. Light scattered and transmitted is detected across the array and passed through a complex oil content calculation algorithm. The resulting oil content is then displayed on the LCD screen. The SMART BILGE+ analyses all three oil types (HFO, diesel and emulsions) simultaneously without the need for re-calibration.

The SMART BILGE+ was originally designed for measuring 15 ppm, in compliance with MEPC.107(49) and is now also tested for measuring accurately down to 5 ppm. This is a factory setting and the hardware of the bilge water alarm is in principle the same. For compliance with DNV-CP-0485 in this certificate, the alarms are locked to 5 ppm, and the SMART BILGE+ shall be installed with the sample water flow switch (optional for general 15 ppm installations).

The SMART BILGE+ is equipped with two alarm relays where relay one will control the automatic stopping device and relay two will control an audible warning device. The alarms are activated within 5 seconds. If low sample water flow is detected by the sample flow switch, both the alarms will be activated to prevent discharging water overboard.

There is an analogue 0(4) - 20 mA current signal output for remote surveillance and recording of oil content.

The SMART BILGE+ has optional components like discharge flow meter, GPS hardware kit (position), and arrangements for automatic cleaning of the cell glass tube.

Application/Limitation

The SMART BILGE+ bilge water alarm is designed and tested to meet the requirements of DNV class programme for type approval DNV-CP-0485 and the requirements of IMO Resolution MEPC.107(49). This means among other criteria, an accuracy of ± 2 ppm and a response time of 5 seconds or less.

The following shall be verified during installation:

- The alarm is always activated whenever clean water is used for cleaning or zeroing purposes.
- The alarm is always activated whenever no flow of sample through the alarm is detected by the flow switch.
- Any alarm will activate the automatic stopping device preventing overboard discharge and lead to recirculation.
- The overall response time (including the response time of the alarm) between the effluent discharge exceeding 5 ppm oil and the operation of the automatic stopping device preventing overboard discharge is less than 20 seconds.
- By-passing the alarm during normal operation shall by no means be possible.
- Every access of the alarm (beyond check on instrument drift, repeatability of the instrument reading, and the ability to re-zero the instrument) requires the breaking of a seal.

Type approval documentation

Dwg. no.	Title	Date/Rev.
109080	SMART BILGE+ Customer Manual	2025-09-17 / Rev.AQ
109069-RC	SMART BILGE+ Module Assembly	2024-12-03 / Rev.E
109072	SMART BILGE+ Cell Assembly	2022-09-12 / Rev.J
109275	SMART BILGE+ Calibration Procedure (factory calibration procedure – internal)	2024-01-15 / Rev.R

Tests carried out

The equipment is tested in accordance with the requirements of the DNV programme for type approval DNV-CP-0485 and IMO Resolution MEPC.107(49), which is documented by the following test reports.

- TEi summation test data and results of test report Tei-TS-P00372, TEi Testing Services, Salt Lake City, USA, dated 2004-10-25 (documents previous testing for 15 ppm).
- Environmental testing of control and cell modules, Intertek Testing Services, Guilford, United Kingdom, test report no.: 04014866, issued September 2004.
- 5 ppm SMART BILGE+ test protocol according to DNV-CP-0485, Rivertrace Limited, dated 2025-09-12.
- Survey report - performance test of SMART BILGE+ as 5 ppm bilge water alarm, DNV, report 262.1-040679-J-4, rev. 0, dated 2025-09-18.

Software and firmware

The SMART BILGE+ 5 ppm bilge water alarm is type approved with the software versions v2.1 (control and display module) and v2.1 (measuring cell module). The third digit (indicated red) shall be 1 or higher, or 2 or higher, respectively. The software versions (Bilge/Cell) and serial number can be found in the Version Info of the LCD screen.

The records of all software changes are to be forwarded periodically to DNV for evaluation. Major changes in the software, which can alter the performance of the system, require approval. Testing of the application functions of the revised software may be required.

Marking of product

For traceability of this Type Approval, each unit is to be marked with:

- Identification of manufacturer
- Equipment type designation and model identification
- Serial number
- Revision information, as applicable, for all firmware or software modules installed per hardware unit
- TA certificate number and revision

Periodical assessment

For retention of the Type Approval, DNV surveyor shall perform periodical assessments to verify that the conditions of the TA are not altered since the certificate was issued. The scope of periodical assessment includes:

- Review of the TA documentation and verification that the documentation is still used as basis for the production.
- Review of possible changes in design, material and performance of the product.
- Verification of the company's production and quality systems ensuring continued consistent production of the type approved products to the required quality.
- Verification that the product marking for identification and traceability to the TA Certificate is not altered.

Copy of type approval certificate

A copy of this Type Approval Certificate shall be carried on board a vessel fitted with this 5 ppm bilge water alarm, for inspections on board. A reference to the test protocol and a copy of the test results (Appendix to this certificate) should be available for inspection on board the vessel.

Revision history

Rev.	Date of issuance	Description
0	2025-09-30	Initial certificate based on performance test completed 12 September 2025

APPENDIX – SUMMARY OF TEST DATA AND RESULTS

Test data and results conducted with the 5 ppm bilge water alarm in accordance with DNV class programme for type approval DNV-CP-0485, also complying with IMO Resolution MEPC.107(49).

Manufacturer of 5 ppm bilge water alarm	Rivertrace Limited
Model name	SMART BILGE+
Serial number of test unit	S/N 109072 26177 and S/N 109072 26179
Test location	Redhill, Surrey, United Kingdom
Date of test	26-27 August and 10-12 September 2025
Organization responsible for the test	Rivertrace Limited
Samples sealed and labelled by	Rivertrace Limited
Method of sample analysis	SS-EN ISO 9377-2
Samples analysed by (name of laboratory)	Core Laboratories (UK) Limited
Test fluid “A”	
Density at 15°C	991 kg/m ³
Viscosity at 100°C	69.35 mm ² /s (69.35 centistokes)
Flashpoint	>80°C
Ash content	-
Water content at start of test	1.11% (mass)
Test fluid “B”	
Density at 15°C	830 kg/m ³
Viscosity at 40°C	3.25 mm ² /s (3.25 centistokes)
Flashpoint	>55°C
Ash content	-
Water content at start of test	-
Test fluid “C”	
Surfactant specification	Sodium dodecylbenzenesulfonate, Sigma-Aldrich, product number 289957-25G
Iron oxide specification	Iron oxide, Sigma-Aldrich, product number 637106
Test water	
Density at 20°C	1000 kg/m ³
Solid matter present	-
Test temperatures	
Ambient	22°C
Test fluid “A”	78°C
Test fluid “B”	31°C
Test fluid “C”	20°C
Test water	18°C

Diagram of test facility submitted: ☒ Yes ☐ No

Diagram of sampling arrangement submitted: ☒ Yes ☐ No

Display calibration and activation accuracy test

Test fluid "A"	Time	Expected oil content [ppm]	Reading from alarm display [ppm]	Lab analysis oil content in grab sample ⁽¹⁾ [ppm]	Accuracy of reading [ppm]	Alarm activated [Yes/No]
Clean water	2025-09-11	0.0				
2 ppm		1.9				
Clean water		0.0				
4 ppm		3.7				
Clean water		0.0				
6 ppm		5.6				
Clean water		0.0				
Water temperature	29°C in the cell and 17°C in the water tank					
Re-zero	☐ Yes ☒ No if Yes, when:					
Re-calibrate	☐ Yes ☒ No if Yes, when:					

(1) Laboratory analysis results only used for reference; the expected oil content (from mixing procedure) is used as the true value.

Test fluid "B"	Time	Expected oil content [ppm]	Reading from alarm display [ppm]	Lab analysis oil content in grab sample ⁽¹⁾ [ppm]	Accuracy of reading [ppm]	Alarm activated [Yes/No]
Clean water	2025-08-26	0.0				
2 ppm		2.0				
Clean water		0.0				
4 ppm		4.0				
Clean water		0.0				
6 ppm		6.0				
Clean water		0.0				
Water temperature	31°C in the cell and 20°C in the water tank					
Re-zero	☐ Yes ☒ No if Yes, when:					
Re-calibrate	☐ Yes ☒ No if Yes, when:					

(1) Laboratory analysis results only used for reference; the expected oil content (from mixing procedure) is used as the true value.

Contaminant and colour test

Test fluid	Time ⁽¹⁾	Expected oil content [ppm]	Reading from alarm display [ppm]	Calibration shift ⁽²⁾ [ppm]
Clean water	13:45	0.0		
Clean water and 4 ppm test fluid "B"	14:05	4.0		
4 ppm test fluid "B" and iron oxide 4 ppm	14:20	4.0		
Clean water and 4 ppm test fluid "B"	14:45	4.0		
4 ppm test fluid "B" and iron oxide 50 ppm	14:52	4.0		
Clean water and 4 ppm test fluid "B"	15:10	4.0		
4 ppm test fluid "B" and iron oxide 100 ppm	15:20	4.0		
Clean water and 4 ppm test fluid "B"	15:30	4.0		
Clean water and 4 ppm test fluid "B"	09:25	4.0		
4 ppm test fluid "B" and very salt water (6%)	09:40	4.0		

(1) Total testing time >15 minutes. Testing was performed 26-27 August 2025.

(2) Calibration shift is defined as temporary movements from the true (expected) value.

Sample pressure or flow test

Test fluid	Pressure [bar] or flow [l/min]	Expected oil content [ppm]	Reading from alarm display [ppm]	Zero shift ⁽¹⁾ [ppm]	Calibration shift ⁽²⁾ [ppm]
Clean water, normal pressure/flow	2.00 bar	0.0			
4 ppm test fluid "B", normal pressure/flow	2.05 bar	4.0			
4 ppm test fluid "B", half of normal pressure/flow	1.01 bar	4.0			
4 ppm test fluid "B", normal pressure/flow	2.03 bar	4.0			
4 ppm test fluid "B", twice of normal pressure/flow	4.02 bar	4.0			
Clean water, normal pressure/flow	1.98 bar	0.0			
Deviations and other comments					

(1) Zero shift is defined as temporary movements from an expected zero value.

(2) Calibration shift is defined as temporary movements from the true (expected) value.

Shut-off test

Test fluid	Time ⁽³⁾	Expected oil content [ppm]	Reading from alarm display [ppm]	Zero shift ⁽¹⁾ [ppm]	Calibration shift ⁽²⁾ [ppm]
Clean water	15:00	0.0			
4 ppm test fluid "B" before shut-off	15:15	4.0			
Shut-off, minimum 8 hours					
4 ppm test fluid "B" min. 8 hours after shut-off	07:45	4.0			
Clean water	08:13	0.0			
Deviations or damage to bilge water alarm					

- (1) Zero shift is defined as temporary movements from an expected zero value.
(2) Calibration shift is defined as temporary movements from the true (expected) value.
(3) Test performed 11-12 September 2025 and agreed to be performed without the presence of a DNV surveyor.

Utilities supply variation test

Test fluid	Expected oil content [ppm]	Reading from alarm display [ppm]	Zero shift ⁽¹⁾ [ppm]	Calibration shift ⁽²⁾ [ppm]
Clean water	0.0			
Clean water and 4 ppm test fluid "B"	4.0			
110% voltage	4.0			
90% voltage	4.0			
90% air pressure	n/a			
110% air pressure	n/a			
90% hydraulic pressure	n/a			
110% hydraulic pressure	n/a			
Clean water	0.0			
Deviations and other comments				

- (1) Zero shift is defined as temporary movements from an expected zero value.
(2) Calibration shift is defined as temporary movements from the true (expected) value.

Calibration and zero drift test

Test fluid	Time ⁽⁴⁾	Expected oil content [ppm]	Reading from alarm display [ppm]	Lab analysis oil content in grab sample ⁽⁵⁾ [ppm]	Calibration shift ⁽¹⁾ [ppm]	Calibration drift ⁽²⁾ [ppm]	Zero drift ⁽³⁾ [ppm]
Clean water	07:30	0.0					
4 ppm test fluid "B" after 0 hours	07:45	4.0					
4 ppm test fluid "B" after 2 hours	09:45	4.0					
4 ppm test fluid "B" after 4 hours	11:45	4.0					
4 ppm test fluid "B" after 6 hours	13:45	4.0					
4 ppm test fluid "B" after 8 hours	15:45	4.0					
Clean water	16:00	0.0					

(1) Calibration shift is defined as temporary movements from the true (expected) value. Zero shift is used for temporary movements from an expected zero value.

(2) Calibration drift is defined as slow movements from the true (expected) value, that becomes permanent over time.

(3) Zero drift is defined as slow movements from an expected zero value, that becomes permanent over time.

(4) Test performed 10 September 2025 and agreed to be performed without the presence of a DNV surveyor.

(5) Laboratory analysis results only used for reference; the expected oil content (from mixing procedure) is used as the true value.

Response time test

Test fluid	Time ⁽¹⁾	Expected oil content [ppm]	Reading from alarm display [ppm]	Response time [s]
Clean water	2025-09-11	0.0		
Test fluid "A"	2025-09-11	10.0		
Clean water	2025-08-26	0.0		
Test fluid "B"	2025-08-26	10.0		
Clean water	2025-08-27	0.0		
Test fluid "C"	2025-08-27	10.0		

(1) Test fluid "B" and "C" was done before test fluid "A" for practical reasons.