



THE REPUBLIC OF LIBERIA
LIBERIA MARITIME AUTHORITY

TYPE APPROVAL CERTIFICATE OF BALLAST WATER MANAGEMENT SYSTEM

This is to certify that the ballast water management system listed below has been examined and tested in accordance with the requirements of the specifications contained in the Guidelines contained in IMO resolution MEPC.174 (58) adopted on 10 October 2008. This certificate is valid only for the ballast water management system referred to below.

Ballast water management system supplied by..... Wartsila Water Systems Ltd.
Fleets Corner, Poole, Dorset,
United Kingdom, BH17 0JT

under type and model designation..... Wartsila AQUARIUS® BWMS AQ-3000-EC
and incorporating:

Ballast water management system manufactured by..... Wartsila Water Systems, Ltd.

to equipment/assembly drawing No.....Single System P&ID; EC-T-001-171; issue3 date... 07.Nov.2017
Typical P&ID Symbols; EC-T-003-171; issue1 date ... 12 Feb. 2017

Electrolysis Unit manufactured by..... Wartsila Water Systems Ltd

to components drawing No.....H3300ECC-xxx-172 date... 13.Nov.2017

Filtration system manufactured by..... Wartsila Water Systems Ltd.

To components drawing No.....H3000FK-xxx-171 date... 06.Nov.2017

TRO sensor unit manufactured by..... HF Scientific or Xylem Water Systems

To components drawing No.....H3600ECMK-xxx-172 date... 30.Oct.2017

TRO neutralization unit manufactured by..... Wartsila Water Systems Ltd.

To components drawing No..... H4000ECBD-xxx-171 date... 01.Nov.2017

Gas Hydrogen (H₂) sensor unit manufactured by..... Honeywell Analytics Ltd.

Salinity sensor unit manufactured by..... Endress & Hauser

Treatment rated capacity..... 3000 m³/h

Active Substances (as Total Residual Oxidants) Sodium Hypochlorite

Relevant Chemical Halogenated Aliphatic and Aromatic Compounds including THMs,
Halogenated Aceto-Nitriles, Halogenated Acetic Acids

Final approval granted by IMO for systems using active substances..... MEPC 65/2/9 Annex 5, para 7.4

A copy of this Type Approval Certificate should be carried on board vessels fitted with this ballast water management system at all times. A reference to the test protocol and a copy of the test results should be available for inspection on board the vessel. This Type Approval Certificate is issued based on approval by the Ministry of Infrastructure and Environment, the Netherlands Shipping Inspectorate with Type Approval Certificate No. 6997/2017.

Limiting Conditions imposed and operating parameters are described in the Appendix to this document.



Margaret Ansumana

Deputy Commissioner of Maritime Affairs

Republic of Liberia

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Date of Expiry: 27/October/2020

Enc. This certificate consists of 8 pages, including the appendices and summary of the original test results.

APPENDIX

Limiting Conditions for operation of the BWMS

Maximum treatment rated capacity (TRC).....	3,000 m ³ /h
Maximum Allowable Dosage Concentration of TRO (as Cl ₂).....	10 mg/L
Maximum Allowable Discharge Concentration of TRO after neutralizing.....	< 0.2 mg/L
Ballast water salinity range.....	≥10 PSU
Ballast water temperature range	-2 to 45°C
For operation with ballast water under 15° C: Heat Exchanger shall be used	
Operation with <10 PSU ballast water..... Using the holding tank as electrolyte storage, minimum 10 PSU for the generation of oxidants.	
Minimum holding time.....	no minimum holding time
Approved for use in explosive atmosphere	Yes
Conditions for use in explosive atmosphere:	
ECMX: Ex II 2G IIC T4	
FX: Ex II 2G IIC T4	
Installation on open deck	No
Maximum Hydrogen gas generation.....	To be not more than 25% of LEL
Differential pressure across the filter.....	should not exceed 0.8 Bar

Summary of conditions during land and ship-based testing

Ballast water salinity range during land-based testing	28±1 PSU (low salinity) to 37±2 PSU (high salinity)
Ballast water salinity range during ship-based testing	29.6 to 31.5 PSU
Ballast Water temperature range during land-based testing	12±1°C – 16±1°C
Ballast Water temperature range during ship-based testing	5.6°C – 15.4°C
Ballast water dissolved organic compounds (DOC).....	1.85 mg/L to 8.09 mg/L
Ballast water particulate organic compounds (POC).....	2.88 mg/L to 10.02 mg/L
Ballast water total suspended solids (TSS).....	Land-based testing 12±5 mg/L to 48±5 mg/L Ship-based testing 17.2 mg/L to 26.4 mg/L
Flow rates during land-based testing	maximum 250 m ³ /hour
Flow rates during shipboard testing.....	maximum 250 m ³ /hour

(The total TRC of the Wartsila AQUARIUS® BWMS AQ-3000-EC can be increased to 3,000 m³/hr by parallel installation of the basic electrolyzers according to BWM.2/Circ.8.)

Corrosion Tests

1. Monitoring programme to be installed to provide for long term inspection of ballast systems using HiB treatment to ensure that no common obvious or extensive corrosion failures occur as a result of using HiB ballast water treatment system.
2. Longer term studies on both uniform and localized corrosion rate determination of corrosion of carbon steel to be performed at the TRO level in ballast water applied by the treatment system.

Operating Parameters during land-based and ship-based testing

Operating TRO dosage.....	Max. 10 mg/L
Energy consumption at 250 m ³ /hour.....	46 KW/hour

The system is to be operated according to the manual provided by the manufacturer.

A plate or durable label containing the manufacturer’s name, the type, the serial number, the date of manufacture and the treatment rated capacity must be attached to each system.

Summary of Land Based Test Results

For Ballast Water Management System, Type Wartsila Water Systems Ltd.,
Wartsila AQUARIUS® BWMS AQ-3000-EC
 Manufactured by..... Wartsila Water Systems Ltd., Fleets Corner, Poole, Dorset, United
Kingdom, BH17 0JT
 Organization conducting the test..... NIOZ Royal Netherlands Institute for Sea Research, Texel, the Netherlands

The test results of the tested Ballast Water Management System are valid for the System that is given type approval with this document.

Notes:

At high (seawater) salinity, six and at low (brackish) salinity, six independent experiments were carried out. A reference and a treated sample were taken with a minimum of 250 m³ at each sampling time. Samples were taken as triplicates.

High salinity test results (> 32 PSU):

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
>50 µm (/m ³)	Min. 64,950 Max. 119,600	≥ 100 000	Min. 19,400 Max. 42,250	> 90	Max. 1	< 10
Phyla > 50 µm	9	≥ 3 different	N.A.	-	N.A.	-
Species > 50 µm	29	≥ 5 different		-		-
10-50 µm (/ml)	Min. 470 Max. 790	> 1000	Min. 40 Max. 120	> 90	Max. 0	< 10
Phyla 10-50 µm	7	≥ 3 different	N.A.	-	N.A.	-
Species 10-50 µm	32	≥ 5 different	N.A.	-	N.A.	-
Escherichia Coli ¹ (cfu/100 ml)	<10	-	<10	-	<1	< 250
Vibrio cholerae (cfu /100 ml)	-	-	-	-	-	< 1
Enterococcus group ² (cfu/100 ml)	<1	-	<1	-	<1	< 100

Low salinity test results (3-32 PSU):

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
>50 μm (/m ³)	Min. 24,250 Max. 152,350	$\geq 100\ 000$	Min. 17,900 Max. 47,350	> 90	Max. 3	< 10
Phyla > 50 μm	9	≥ 3 different	N.A.	-	N.A.	-
Species > 50 μm	29	≥ 5 different	N.A.	-	N.A.	-
10-50 μm (/ml)	Min.350 Max. 6,350	> 1000	Min. 36 Max. 130	> 90	0	< 10
Phyla 10-50 μm	7	≥ 3 different	N.A.	-	N.A.	-
Species 10-50 μm	32	≥ 5 different	N.A.	-	N.A.	
Escherichia Coli ¹ (cfu/100 ml)	<10	-	<10	-	<1	< 250
Vibrio cholerae (cfu /100 ml)	-	-	-	-	-	< 1
Enterococcus group ² (cfu/100 ml)	<1	-	<1	-	<1	< 100

Reference Methods:

Parameters	Reference Method
Heterotrophic Bacteria (counts/mL)	NEN-EN-ISO 6222
Escherichia coli (cfu/100mL)	ISO 9308-3
Enterococci (cfu/100 mL)	NEN/ISO 7899-2.
Vibrio cholerae (cfu /100 ml)	N/A
Organisms $\geq 10 < 50 \mu\text{m}$ (viable cells/mL)	Determined by flow cytometry, PAM fluorometry and enumerated using microscopic counts, and included a variety of different groups and species.
Organisms $\geq 50 \mu\text{m}$ (viable organisms/m ³)	Determined by staining Neutral Red and enumerated using microscopic counting and the FlowCam

Summary of Ship Based Test Results

Organization conducting the test..... GoConsult, 22763 Hamburg, Germany
 Tests were conducted on board the vessel..... “ANVIL POINT”, IMO No.9248540
 Time of testing..... February 2012 – February 2013
 Maritime Area of testing..... Marchwood, U.K

Summary of ship-based test results

Test Cycle 1

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
> 50 µm (/m3)	2115	> 90	Min. 1568	> 9	Average 5.6	<10
10-50 µm (/ml)	306	> 90	Min. 152	> 9	ND	<10
Escherichia coli (cfu /100 ml)	82	-	74	-	Average 0.3	<250
Vibrio cholerae (cfu /100 ml)	ND	-	ND	-	ND	<1
Enterococcus group (cfu /100 ml)	46	-	56	-	Average 13.3	<100
Temperature (°C)	5.6		6.9		6.6	
Salinity (PSU)	31.5		31.6		31.8	
POC (mg/l)	9.0		12.4		Max. 10.4 Min. 9.2	
TSS [mg/l]	22.6		37.6		Max. 23.45 Min. 20.2	

Test Cycle 2

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
> 50 µm (/m3)	3754	> 90	2367	> 9	Average 4.9	<10
10-50 µm (/ml)	23	> 90	4	> 9	ND	<10
Escherichia coli (cfu /100 ml)	30	-	6	-	Average 10	<250
Vibrio cholerae (cfu /100 ml)	ND	-	ND	-	ND	<1
Enterococcus group (cfu /100 ml)	7	-	8	-	Average 3.7	<100
Temperature (°C)	15.4		13.8		6.6	
Salinity (PSU)	31.3		31.7		31.1	
POC (mg/l)	7.8		7.2		Max. 8.4 Min. 6.4	
TSS [mg/l]	22.6		37.6		Max. 16.0 Min. 13.4	

Test Cycle 3

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
> 50 μm (/m3)	25,970	> 90	22,614	> 9	ND	<10
10-50 μm (/ml)	426	> 90	144	> 9	ND	<10
	170	-	120	-	ND	<250
Escherichia coli (cfu /100 ml)	ND	-	ND	-	ND	<1
Vibrio cholerae (cfu /100 ml)	130	-	26	-	Average 8.7	<100
Enterococcus group (cfu /100 ml)	14.1		14.7		14.8	
Temperature (°C)	30.5		31.0		30.7	
Salinity (PSU)	9.4		8.8		Max. 8.8 Min. 7.4	
POC (mg/l)	22.6		37.6		Max. 17.0 Min. 12.8	
TSS [mg/l]						

Test Cycle 4

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
> 50 μm (/m3)	4738	> 90	2456	> 9	Average 2.9	<10
10-50 μm (/ml)	110	> 90	39	> 9	ND	<10
	250	-	170	-	ND	<250
Escherichia coli (cfu /100 ml)	ND	-	ND	-	ND	<1
Vibrio cholerae (cfu /100 ml)	780	-	90	-	Average 8	<100
Enterococcus group (cfu /100 ml)	7.4		7.8		7.8	
Temperature (°C)	29.6		3.8		30.1	
Salinity (PSU)	9.2		7.2		Max. 8.8 Min. 7.4	
POC (mg/l)	21.0		12.8		Max. 17.2 Min. 16.2	
TSS [mg/l]						

Official Stamp



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