



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..... Samsung Heavy Industries Co., Ltd.
89, Gongdanseo2gil, Chilseo-myeon,
Haman-gun, Gyeongsangnam-do, Korea

under type and model designation..... Purimar™ Ballast Water Management System,
Model: SP-100

and incorporating:

Ballast water management system manufactured by..... Samsung Heavy Industries Co., Ltd.
to equipment/assembly drawing No..... LA400-0000N date..... 29 May 2014

Electrolysis Unit manufactured by..... Samsung Heavy Industries Co., Ltd.
to components drawing No..... PD3AO-4000N date..... 29 May 2014

Filtration system manufactured by..... Samsung Heavy Industries Co., Ltd.
To components drawing No..... LA100-2000E, LA100-0400N date..... 29 May 2014

TRO sensor unit manufactured by..... Samsung Heavy Industries Co., Ltd.
To components drawing No..... LA500-1013E date..... 29 May 2014

TRO neutralization unit manufactured by..... Samsung Heavy Industries Co., Ltd.
To components drawing No..... LA4A0-0102N date..... 29 May 2014

Gas Hydrogen (H₂) sensor unit manufactured by..... GASTRON

Gas Chlorine (Cl₂) sensor unit manufactured by..... GASTRON

Salinity sensor unit manufactured by..... JUMO

Treatment rated capacity..... 1000 m³/h

Active Substances (as Total Residual Oxidants)

Chlorine, Bromine, Sodium Hypochlorite,
Sodium Hypobromite, Hypochlorous Acid,
Hypobromous Acid, Chloramines, Bromamines

Relevant ChemicalBromate, Chlorate, Halogenated Aliphatic and Aromatic Compounds including THMs, halogenated Aceto-Nitriles, Halogenated Acetic Acids, Halogenated Phenol

Final approval granted by IMO for systems using active substances..... MEPC 62/2/18 Annex 6, 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 Land, Transport and maritime affairs of the Republic of Korea with Type Approval Certificate No. 2014-17.

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



Margaret Ansumana

Deputy Commissioner of Maritime Affairs
Republic of Liberia

Date of issue: 07/June/2017 Place of issue: Vienna, USA

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).....	1000 m ³ /h
Maximum Allowable Dosage Concentration of TRO (as Cl ₂).....	2.3~3.0 mg/L
Maximum Allowable Discharge Concentration of TRO after neutralizing.....	≤ 0.1 mg/L
Ballast water salinity range.....	1 to 35 PSU
Operation with >1<10 PSU ballast water.....	Mixing 1% by volume salt water from holding tank
Ballast water temperature range	0 to 35°C
Operation with >1<10 PSU ballast water.....	Using the holding tank as electrolyte storage, minimum 10 psu for the generation of oxidants.
Minimum holding time.....	< 1 day
Approved for use in explosive atmosphere	No
Installation on open deck	No
Maximum Hydrogen gas generation.....	To be not more than 2% (LEL)
Maximum Chlorine gas generation.....	To be not more than 0.55% (LEL)
Differential pressure across the filter.....	should not exceed 0.5 Bar

Summary of conditions during land and ship-based testing

Ballast water salinity range during land-based testing	18.9 PSU (low salinity) to 34.4 PSU (high salinity)
Ballast water salinity range during ship-based testing	21.97 PSU (low salinity) to 35.87 PSU (high salinity)
Ballast Water temperature range during land-based testing	16.5°C – 26.0°C
Ballast Water temperature range during ship-based testing	7.73°C – 26.07°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 20.65 mg/L to 98.45 mg/L Ship-based testing 6.83 mg/L to 9.03 mg/L
Flow rates during land-based testing	maximum 250 m ³ /hour
Flow rates during shipboard testing.....	maximum 1000 m ³ /hour

(The Purimar system has basic electrolyzers with the Treatment Rated Capacity (TRC) of 250m³/hr. The total TRC of the Purimar system can be increased to 1000 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. 3 mg/L
Energy consumption at 500 m ³ /hour.....	14 KW/hour*

*Remark: The value is the averaged value and is not used for determining whether the system is operated properly or not.

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... Samsung Purimar™ Ballast Water Management System, SP-100

Manufactured by..... Samsung Heavy Industries Co., Ltd.214880-3, Daechi-RI, Chilseo-Myeon, Korea

Organization conducting the test..... Korea Institute of Ocean Science and Technology, Busan Techno Park, Korea

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, five and at low (brackish) salinity, five independent experiments were carried out. A reference and a treated sample were taken with a minimum of 237.9 m³ at each sampling time. Samples were taken as triplicates.

High salinity test results (> 33 – 34.4 PSU):

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
>50 um (/m ³)	Min. 238,438	≥ 100 000	Min. 6111	> 90	0	< 10
Phyla > 50 um	≥3	≥ 3 different	N.A.	-	N.A.	-
Species > 50 μm	≥ 5	≥ 5 different		-		-
10-50 μm (/ml)	Min. 2149	> 1000	Min. 124	> 90	Max. 1	< 10
Phyla 10-50 μm	≥3	≥ 3 different	N.A.	-	N.A.	-
Species 10-50 μm	≥ 5	≥ 5 different	N.A.	-	N.A.	-
Hetero. bact./ml	Min. 33,389	≥10, 000		-		-
Escherichia Coli ¹ (cfu/100 ml)	Min. 108	-	N.A.	-	Max. 84	< 250
Vibrio cholerae (cfu /100 ml)	0	-	0	-	0	< 1
Enterococcus group ² (cfu/100 ml)	Min.108	-	N.A.	-	Max.1	< 100

Low salinity test results (18.9-20.2 PSU):

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
>50 μm (/m ³)	Min. 249,167	$\geq 100\ 000$	4514	> 90	0	< 10
Phyla > 50 μm	≥ 3	≥ 3 different	N.A.	-	N.A.	-
Species > 50 μm	≥ 5	≥ 5 different	N.A.	-	N.A.	-
10-50 μm (/ml)	Min.1399	> 1000	Min. 120	> 90	Max. 2	< 10
Phyla 10-50 μm	≥ 3	≥ 3 different	N.A.	-	N.A.	-
Species 10-50 μm	≥ 5	≥ 5 different	N.A.	-	N.A.	-
Hetero. bact./ml	Min. 53,889	$\geq 10\ 000$	Min. 231,111	-	Max. 1,295,111	-
Escherichia Coli ¹ (cfu/100 ml)	Min. 58	-	Min. 31	-	Max. 36	< 250
Vibrio cholerae (cfu /100 ml)	0	-	0	-	0	< 1
Enterococcus group ² (cfu/100 ml)	Min. 45	-	Min. 2	-	0	< 100

Reference Methods:

Parameters	Reference Method
Heterotrophic Bacteria (counts/mL)	APHA 9215[Heterotrophic plate count:2005]
Escherichia coli (cfu/100mL)	Sample is filtered onto the 0.45 μm membrane filter and then filters are placed on the top of modified mTEC (DIFCO) plate. The plate is incubated at $35^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$ for 2 ± 0.5 hours. Transfer the plates to a Whirl-Pak® bag, seal the bag, and submerge in a $44.5^{\circ}\text{C} \pm 0.2^{\circ}\text{C}$ water-bath for 22 ± 2 hours. Select the plate with 20-80 magenta or red colonies, and calculate the number of E. coli per 100 mL . Report results as E. coli CFU per 100 mL of sample (EPA 821-R-06-011).
Enterococci (cfu/100 mL)	Sample is filtered onto the 0.45 μm membrane filter and then filters are placed on the top of modified mEI (DIFCO) plate. The plate is incubated at $41^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$ for 24 ± 2 hours. Select the plate with 20-60 colonies (regardless of colony color) with a blue halo. Calculate the number of enterococci per 100 mL. Report results as enterococci CFU per 100 mL of sample (EPA 821-R-02-022)
Vibrio cholerae (cfu /100 ml)	APHA 9260H. Vibrio cholerae
Organisms $\geq 10 < 50 \mu\text{m}$ (viable cells/mL)	The disinfection efficacy on 10–50 μm sized organisms (mainly phytoplankton) is assessed by two kinds of measurements using photomicroscope, epifluorescence microscope. With the use of the light microscope, the motility; for example of sliding or its own original movement assesses vitality of the phytoplankton. Chlorophyll autofluorescence is used as an indicator of cell viability (Pouneva, 1997). Intact chlorophyll of living cells shows red fluorescence, while dead or severely damaged chlorophyll lose the red fluorescence. Commonly, under a blue filter (460-490nm) using an epifluorescence microscope, most living cells show brightly red color, while dead cells show faintly green color or disappearance of red fluorescence (Pouneva, 1997, MBDC SOP-BWMS-008).
Organisms $\geq 50 \mu\text{m}$ (viable organisms/m ³)	Survivability of the larger organisms 50 μm (mainly zooplankton) is determined based on the appendage's movement under a stereomicroscope (APHA-804C, 1985). In each taxonomic group, individuals are classified as live or dead and counts of each group are recorded. Animals are designated as 'live' if they are actively moving or exhibiting an escape behavior when probed with a fine needle. If no activity or

Summary of Ship Based Test Results

Organization conducting the test..... Korea Institute of Ocean Science and Technology,
Busan techno Park, Korea

Tests were conducted on board the vessel..... "HANJIN Durban", IMO No.9375305

Time of testing..... 11 September 2010 – 25 March 2011

Maritime Area of testing..... New York/Kaoshiung/Busan

Summary of ship-based test results

Organism Type	Influent Water	IMO req.	Discharge control	IMO req.	Discharge treated	IMO req.
> 50 µm (/m3)	Min. 4776	> 90	Min. 2049	> 9	0	<10
10-50 µm (/ml)	Min. 715	> 90	Min. 64	> 9	0	<10
Escherichia coli (cfu /100 ml)	Min. 3	-	N.A.	-	0	<250
Vibrio cholerae (cfu /100 ml)	0	-	N.A.	-	0	<1
Enterococcus group (cfu /100 ml)	Min. 1	-	N.A.	-	0	<100



M. Ansumana

Margaret Ansumana

Deputy Commissioner of Maritime Affairs

Republic of Liberia

Date of issue: 07/June/2017 Place of issue: Vienna, USA