



Ballast Water Sampling & Testing

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Source: imo.org



Company Profile



Prüf- und Entwicklungsinstitut für Abwassertechnik an der RWTH Aachen e.V.

Development and Assessment Institute in Waste Water Technology at RWTH Aachen University



Prüfinstitut für Abwassertechnik GmbH

Testing Institute for Waste Water Technology

Marine Department – Sewage Treatment Plants

- **Type Approval**

 - IMO - MEPC.227(64)

 - U.S. Coast Guard - 33 CFR Part 159

 - EU Inland - Directive 2006/87/EC

- **Compliance Testing**

 - U.S. Coast Guard - 33 CFR Part 159

 - EU Inland - Directive 2006/87/EC

- **Performance Evaluation**

- **Training**

Scrubber Wash Water Testing

Ballast Water Testing EPA VGP 2013



Dienststelle Schiffssicherheit
BG Verkehr



United States Coast Guard
U.S. Department of Homeland Security



WSV.de
Wasser- und
Schiffahrtsverwaltung
des Bundes



Ballast Water Performance Standard

as stated in regulation D-2 of the BWM Convention and as required by U.S. regulations

1. For organisms greater than or equal to 50 micrometers in minimum dimension:
discharge must include fewer than 10 living organisms per cubic meter of ballast water.
2. For organisms less than 50 micrometers and greater than or equal to 10 micrometers:
discharge must include fewer than 10 living organisms per milliliter (mL) of ballast water.
3. Indicator microorganisms must not exceed:
 - (i) For Toxicogenic *Vibrio cholerae* (serotypes O1 and O139):
a concentration of less than 1 colony forming unit (cfu) per 100 mL.
 - (ii) For *Escherichia coli*:
a concentration of fewer than 250 cfu per 100 mL.
 - (iii) For intestinal enterococci:
a concentration of fewer than 100 cfu per 100 mL.

Source: <http://globallast.imo.org>



MEPC.173(58) & Corrigenda - Guidelines for Ballast Water Sampling (G2)

Chapter 6 – Ballast Water Sampling and Analysis

(...) the sampling protocol should result in samples that are representative of the whole discharge of ballast water from any single tank or any combination of tanks being discharged

MEPC.252(67) - Guidelines for Port State Control under the BWM Convention

Questions

What has to be tested for compliance with the effluent limits?
Whole discharge, whole tank, ...?
How can samples be representative of the whole discharge?
Worst case sampling for compliance of whole discharge?

Studies:

- Gollasch J., David M. 2017. *Recommendations for representative ballast water sampling; Journal of Sea Research* 123 (2017) 1–15
- Bradie, J. 2016. *METEOR Voyage M116/2: Report on performance of ballast water collection and analysis devices. Prepared for BSH*
- SGS, BSH 2014. *Effective new Technologies for the Assessment of Compliance with the Ballast Water Management Convention – Final Report*

Type of sample

- Grab sample
 - Random sampling
 - Qualified sampling
- Composite sample
 - Flow-proportional sampling
 - Time-based sampling

Representative sampling

(composition, viability of organisms)

Sample volume

(100ml – 1m³)

Sample container

(material, sterility)

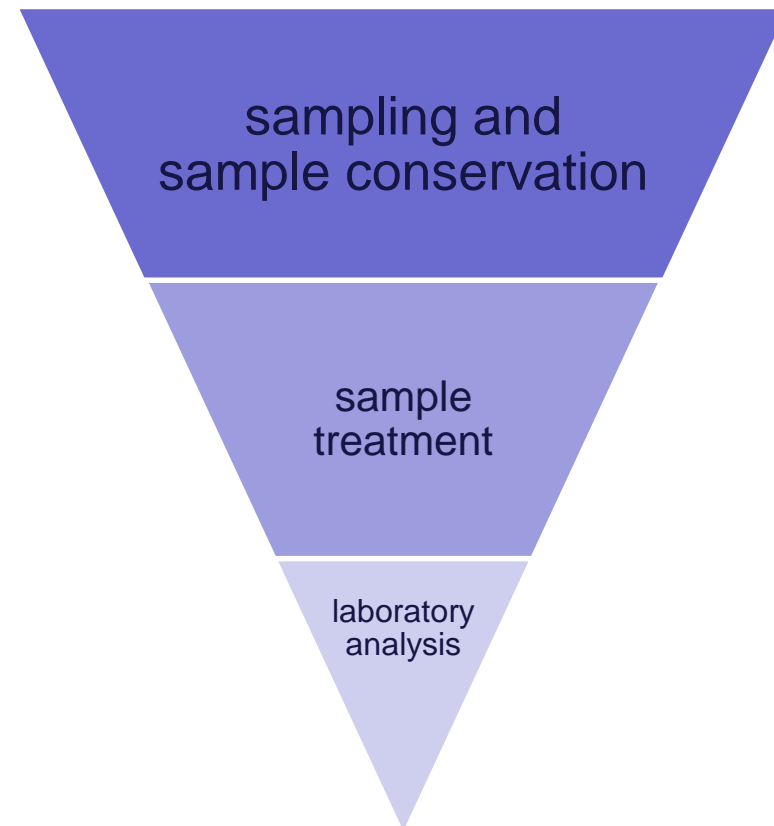
Sample treatment

(homogenization, neutralisation)

Storage and conservation

(temperature, holding time)

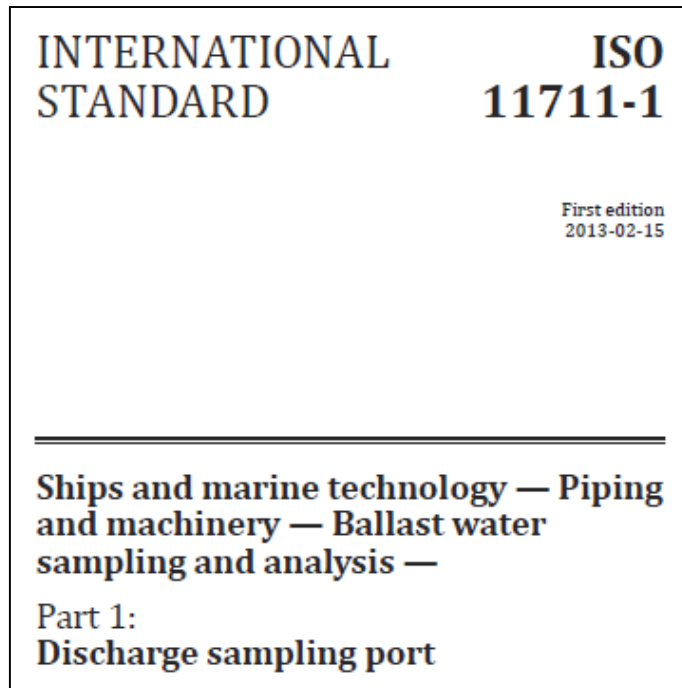
potential sources of error



ISO 11711

ISO 11711 consists of the following parts, under the general title *Ships and marine technology — Piping and machinery — Ballast water sampling and analysis*:

- *Part 1: Discharge sampling port*



The following parts are under preparation:

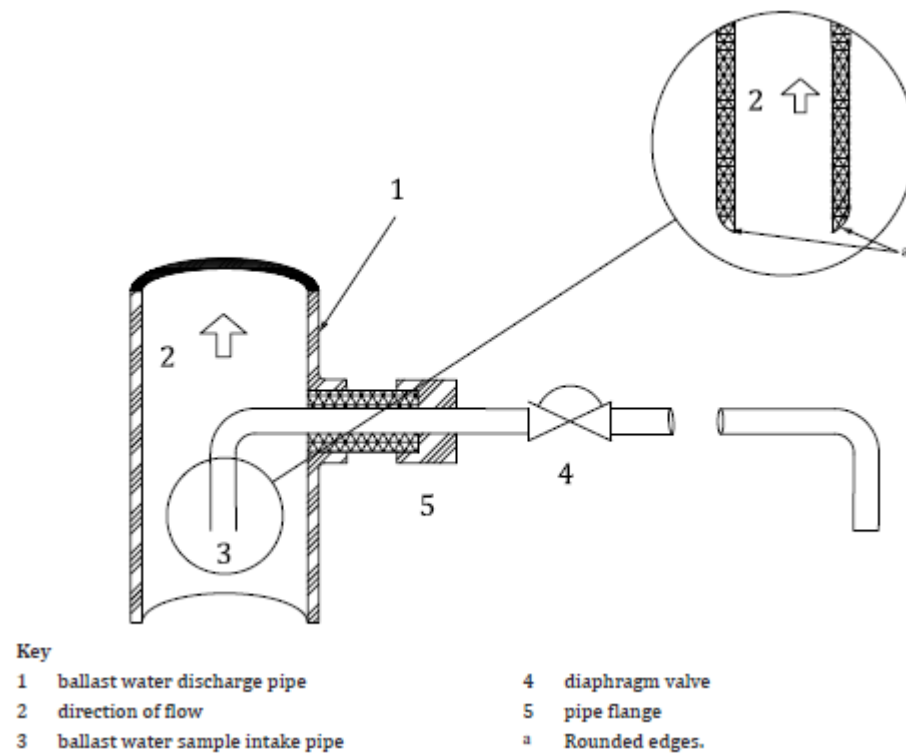
- *Part 2: On-board ballast water sampling and sample processing*
- *Part 3: Analyses of ballast water samples*

ISO 1711 – Part 1 Sampling Port

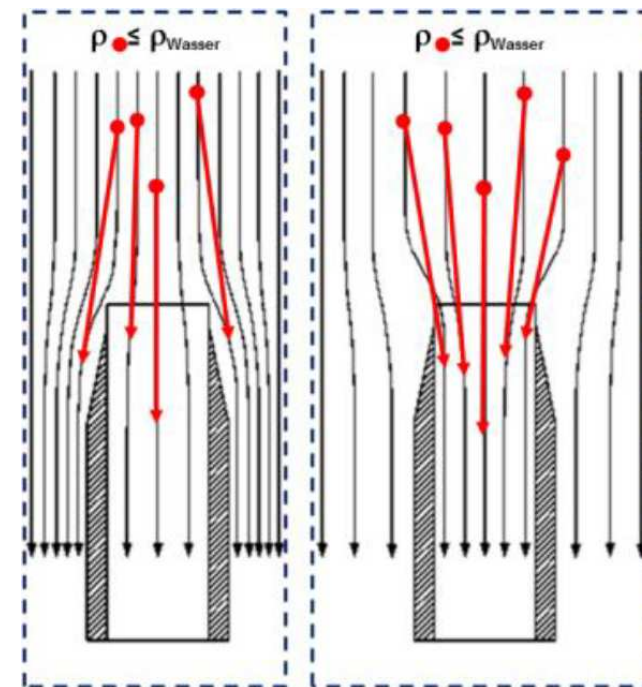
ISO 1711 – Part 1

Part 1: Discharge sampling port

Since September 2016 revision is under development



Source: ISO 11711:2013



Source: BSH

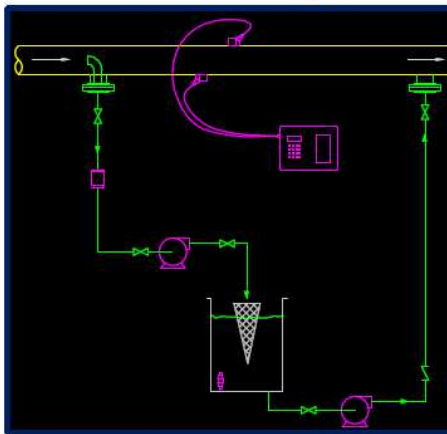
ISO 11711 – Part 2 Outline

U.S. NAVAL
RESEARCH
LABORATORY

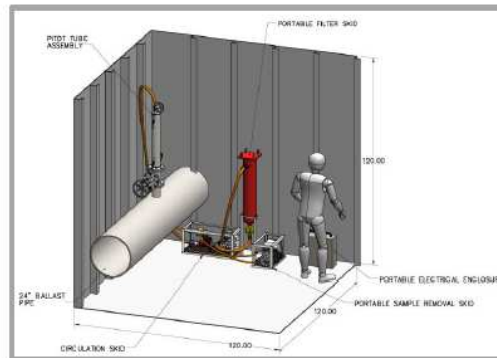
Part 2—Sample Collection Device

Considerations

- Open vs. closed system
- Connection to sample probe
- Sample removal devices
- Cleaning



Great Ships Initiative



The Glosten Associates



SGS S.A.

Competence of Laboratories

Laboratories need to use quality management and to implement a quality system aimed at improving their ability to consistently produce valid results

Quality management

ISO 9001 certified quality management system

Quality management and technical requirements

ISO/IEC 17025 testing laboratories

"(...) confirm to an independent accreditation body that they carry out their activities with technical competence, in compliance with statutory and standards-based requirements and at an internationally comparative standard. The accreditation body assesses and monitors the management system and the competence of the conformity assessment body's assigned personnel."
(DakKS.de)



Finding a sampling service provider and/or an analytical laboratory:

- Search for national accreditation bodies
 - International Accreditation Forum (<http://www.iaf.nu>)
 - International Laboratory Accreditation Cooperation (<http://ilac.org>)
- Search for national accredited laboratories
 - Germany (<http://www.dakks.de>)
 - Greece (<http://www.esyd.gr>)
 - ...

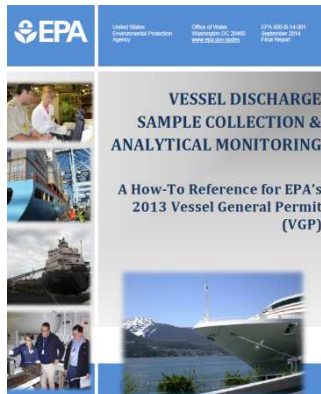
EPA VGP 2013



The VGP is a Clean Water Act National Pollutant Discharge Elimination System (NPDES) permit that authorizes, on a nationwide basis, discharges incidental to the normal operation of non-military and non-recreational vessels greater than or equal to 79 feet in length. The 2013 VGP replaced the 2008 VGP, which expired in December 2013. The 2013 establishes requirements for 27 specific types of incidental discharges from vessels.

Discharge	Section of VGP	Applicable Vessels	Frequency	Analytes
Ballast Water	2.2.3.5.1.1	All Vessels using a ballast water treatment system once they use that system	1 per month	Equipment performance
			1 to 4 per year dependent on type of system	Biological indicators
		BWTS that use active substances/ Biocides	3 to 5 times during first 10 discharges, 2 to 4 times per year dependent on type of system	biocides and residuals of treatment

EPA VGP 2013



Vessel Discharge Sample Collection & Analytical Monitoring A How-To reference for EPA's 2013 Vessel General Permit (VGP)

<https://www.epa.gov/npdes/vessel-discharge-sample-collection-and-analytical-monitoring>

Table 2-5. Indicator Organism Monitoring Parameters*

Measurement	Instrument or Analysis	EPA Method	Standard Method	ASTM	ISO	Other
Total Heterotrophic Bacteria	Plate Counts		SM 9215	ASTM D5465	ISO 6222:1999	
<i>E. coli</i>	Selective Substrate	EPA Method 1103.1 and 1603	SM 9223B	ASTM D5392 – 93	ISO 9308-1:2000	Colilert®
Enterococci	Selective Substrate	EPA Method 1106.1 and 1600	SM 9230C	ASTM D5259 – 92(2006)	ISO 7899-2:2000	Enterolert®

* Sampling and testing shall be conducted according to 40 CFR Part 136. The listed methods are suggested methods, but EPA will also accept Part 136 methods that are considered equivalent.

Table 2-6. Example Ballast Water Indicator Organism Sample Collection and Preservation Techniques

Analyte	Method	MRL	Unit	Container	Sample Volume	Preservation	Holding Time
Total Heterotrophic Bacteria	SM 9215	1	CFU or MPN/100 mL	Plastic Bottle	120-mL	Cool, $\leq 4^{\circ}\text{C}$, $\text{Na}_2\text{S}_2\text{O}_3$ if Chlorine Present	8 hours
<i>E. coli</i>	EPA 1603 or Colilert®	1	CFU or MPN/100 mL	Plastic Bottle	120-mL	Cool, $\leq 10^{\circ}\text{C}$, $\text{Na}_2\text{S}_2\text{O}_3$ if Chlorine Present	8 hours
Enterococci	EPA 1600 or Enterolert®	1	CFU or MPN/100 mL	Plastic Bottle	120-mL	Cool, $\leq 10^{\circ}\text{C}$, $\text{Na}_2\text{S}_2\text{O}_3$ if Chlorine Present	8 hours
Total Residual Chlorine ^a	SM 4500-Cl G	Field Test					

MRL = Method Reporting Limit.

^a Collected to determine sample preservation requirements and not for compliance monitoring.

Table 3: Maximum Ballast Water Effluent Limits for Residual Biocides

Biocide or Residual	Limit (instantaneous maximum)
Chlorine Dioxide	200 µg/l
Chlorine (expressed as Total Residual Oxidizers (TRO as TRC))	100 µg/l
Ozone (expressed as Total Residual Oxidizers (TRO as TRC))	100 µg/l
Peracetic Acid	500 µg/l
Hydrogen Peroxide (for systems using Peracetic Acid)	1,000 µg/l

Table 2-8. Residual Biocides and Biocide Derivative Monitoring Requirements

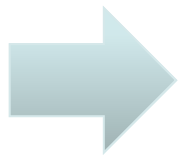
Biocide	Analyte	Analytical Methods	Minimum Volume	Sample Holding Time	MDL	Effluent Limit or Action	Limit Type
Chlorine or Chlorine dioxide	Chlorine Dioxide	EPA Method 327.0-1; SM 4500 CLO ₂ E	16 mL (327.0-1)	4 hours (327.0-1); As soon as possible (SM)	Varies (327.0-1); 10 to 100 mg/L (SM)	200 µg/L	Instantaneous Maximum
	Total Residual Oxidizers (TRO) as Cl ₂	SM 4500-Cl G; ISO 7393/2	50 mL	15 minutes	10 µg/L, under ideal conditions	100 µg/L	Instantaneous Maximum
	Chlorite*	EPA Method 300.1	250 mL	14 days	Varies	Report	NA
	Chlorate*	EPA Method 300.1	250 mL	28 days	Varies	Report	NA
	Total Trihalomethanes ^{a*}	EPA Method 8260	25 mL	14 days	Varies	Report	NA
	Haloacetic Acids ^{b*}	EPA Method 552.2	40 mL	14 days	Varies by compound	Report	NA

Conclusion

Needed clarification and improvement of regulations:

- Definition of testing for compliance
- Sampling needs to be representative for whole discharge?
- Development of detailed standard for sampling
 - Revision of G8
 - ISO 11711
 - MEPC, USCG, EPA, ...

Sampling and analysis need to be done by competent laboratories



In the meantime, compliance inspection is focusing on documentation and use of accepted BW management methods

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- Department Environmental Protection in Maritime Traffic
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Thank you!

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