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Alexander Olsen · Pamela Rossi Ciampolini

Ballast Water Treatment and Exchange for Ships

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Ballast Water Treatment and Exchange for Ships

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Preface

The inadvertent transfer of harmful aquatic organisms and pathogens in a vessel's ballast water has been scientifically proven to cause significant damage to many of the world's coastal regions. The international maritime community, under the leadership of the International Maritime Organization (IMO) has developed several policy documents, including the *International Convention for the Control and Management of Ship's Ballast Water and Sediment, 2004*, (Ballast Water Management Convention or the 'Convention'), which are aimed at preventing the introduction of unwanted aquatic organisms and pathogens through the discharge of ballast water and sediments. The Ballast Water Management Convention applies to (a) all vessels registered under any Flag which is party to the Convention and (b) to those vessels registered with a Flag State who are not party to the Convention but who are operating in the waters of a country that is party to the Convention. As noted above, the Convention entered into force in 2004 and has since been readily adopted by many Flag and Port States including Canada, France, Germany, the UK and the United States. These Flag and Port States have, in addition to the Convention, established national frameworks and regulations mandating the safe exchange of ballast water, and thereafter supplemented with evidence to support the exchange took place (ballast water records) in accordance with the provisions of the Convention/national regulations (whichever is deemed stricter).

As a means to prevent, minimise and ultimately eliminate risk to the environment, human health, property and resources arising from the transfer of harmful aquatic organisms and pathogens through the control and management of vessel's ballast water and sediment, as well as to avoid unwanted side-effects from that control, the Convention requires vessels to conduct a ballast water exchange or be fitted with an approved ballast water management system. It is noted that several studies have shown that the effectiveness of ballast water exchange varies and is dependent on the vessel type (design), exchange method (sequential, flow-through and dilution methods), ballasting system configuration, exchange location, weather conditions and vessel's trading pattern. For these reasons (and others), it has been determined that ballast water exchange does not provide adequate protective measures to prevent damage from organisms and pathogens carried in a vessel's ballast, even though exchange was considered to be acceptable as an interim

solution. The installation of ballast water management systems (or ballast water treatment systems), designed, reviewed, approved, installed and operated to satisfy an agreed-upon ballast water discharge performance standard has been determined by the international marine industry to provide a more effective means to prevent, minimise and ultimately eliminate the transfer of organisms and pathogens via vessel ballast discharge, when compared to ballast water exchange.

One of the key strategies incorporated into the Ballast Water Management Convention is ballast water exchange (BWE). Ballast water exchange is the process of exchanging coastal water, which may be fresh water, salt water or brackish water, for mid-ocean water. During the exchange process, biologically laden water taken on in the last port of call is flushed out of the ballast tanks with open ocean water, typically 200 nautical miles from the nearest land. Scientists, specifically Marine Biologists, have determined that marine organisms and pathogens are, in general, less numerous in the open ocean and, due to changes in the water's chemistry, temperature and salinity would be less likely to survive once they are discharged into the near shore receiving waters.

While the vast majority of vessels are capable of conducting ballast water exchange, and the procedures do not typically require any special structural modifications to most of the vessels in operation, it does present challenges for designers, builders, owners and operators. These challenges include over-pressurisation or under-pressurisation of tanks, longitudinal strength and transverse stability concerns, as well as manoeuvrability issues. To assist the marine industry, many leading classification societies have issued guidance on the exchange of ballast water, such as the *Advisory Notes on Ballast Water Exchange Procedures from the American Bureau of Shipping in October 1999* and the *2019 Best Practices for Operations of Ballast Water Management Systems Report*. The ABS Advisory describes the implications associated with ballast water management and ballast water exchange using 14 typical vessels as examples. While the findings contained in the ABS Advisory focused on existing vessels, many of the conclusions can also be applied to assist in the development of new buildings. However, it is to be noted that the details provided in the ABS Advisory are vessel-specific and that the information contained therein are to be viewed as typical and provide representative values that might be obtained for any single vessel and are highly dependent on the vessel's design and structure, which may vary greatly from one vessel to another.

To that end, this book is intended to provide vessel designers, builders, owners, and operators of vessels guidance on the requirements for obtaining the optional classification notation associated with ballast water treatment and exchange. The ballast water treatment/exchange notation identifies a level of compliance with the applicable regulations contained in the IMO *International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004*, as well as those IMO guidelines referenced in the Convention addressing ballast water treatment and exchange. Importantly, it includes references to contingency measures developed by the Committee, updates to IMO/MEPC resolutions, and incorporates the latest amendments to regulation B-3 (Implementation

schedule). It also adds requirements for mobile offshore units (MOU) and mobile offshore drilling units (MODU) for assessment with approved operation manuals and AVCG curve.

Authors Note

This book should be read in conjunction with other Rules published by Class and of course IMO guidelines. Readers of this book acknowledge and agree that the author is not responsible for a vessel's operation pertaining to ballast water exchange and shall bear no liability for such operations. This book references relevant international regulations and guidelines that are considered to be applicable. While it is the intent of the author to be consistent with these relevant regulations and guidelines, it is the ultimate responsibility of the reader to refer to the most recent texts of those regulations and guidelines.

Southampton, UK
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Abbreviations and Acronyms

°C	Degrees Celsius
°F	Degrees Fahrenheit
ATB	Articulated tug-barge
BWE	Ballast water exchange
BWM	Ballast water management
BWMO	Ballast water management officer
BWMP	Ballast water management plan
BWMR	Ballast water management room
BWMS	Ballast water management system
BWT	Ballast water treatment notation
BWT+	Ballast water treatment + notation
BWTS	Ballast water treatment system
CCR	Cargo control room
cfu	Colony forming unit
Cl_2	Chlorine
ClO_2	Chlorine dioxide
CO	Carbon monoxide
CO_2	Carbon dioxide
DWT	Deadweight
ECR	Engine control room
ECU	Electro chlorination unit
EEBD	Emergency escape breathing apparatus
FMEA	Failure mode and effects analysis
FP	Flashpoint
FPSO	Floating production storage and offloading unit
FRP	Fibre reinforced plastic
FSU	Floating storage unit
Ft	Foot/feet
ft^2	Foot/feet squared
G2	Guidelines for Ballast Water Sampling

G4	Guidelines for Ballast Water Management and Development of Ballast Water Management Plans
G6	Guidelines for Ballast Water Exchange
G8	Guidelines for Approval of Ballast Water Management Systems (2008)
G8	Guidelines for Approval of Ballast Water Management Systems (2016)
G9	Procedure for Approval of Ballast Water Management Systems that Make Use of Active Substances
G12	Guidelines on Design and Construction to Facilitate Sediment Control on Ships
GT	Gross tonnage
H_2	Hydrogen
H_2O	Water
HSSC	Harmonised system of survey and certification
IACS	International Association of Classification Societies
IBC Code	International Bulk Chemical Code, 1987
IEC	International Electrotechnical Commission
IL	Independent laboratory
IMO	International Maritime Organization
IP	Ingress protection rating
ISM Code	International Management Code for the safe operation of Ships and for Pollution Prevention, 1993
L1	Level 1 fire endurance test
L2	Level 2 fire endurance test
L3	Level 3 fire endurance test
LFL	Low flashpoint liquids
LFL	Lower flammable limit
LOA	Length overall
m	Metre
M/V	Motor vessel
m^2	Metre squared
MEPC	Marine Environment Protection Committee
MODU	Mobile offshore drilling unit
MOU	Mobile offshore unit
MSDS	Material safety data sheet
N_2	Nitrogen
O_2	Oxygen
O_3	Ozone
ODS	O^3 destructor device
PDA	Product design assessment
PPM	Parts per million
PVC	Polyvinyl chloride

RO	Recognised organisation
SOLAS	International Convention for the Safety of Life at Sea, 1974
SWBM	Still-water bending moment
SWSF	Still-water shear force
SWTM	Still-water torsional moment
TA	Type approval
TRC	Treatment rated capacity
TRO	Total residual oxidants
TSB	Trim and stability booklet
USCG	United States Coastguard
UV	Ultraviolet
VIN	Vessel identification number

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Part I
Ballast Water Treatment

Vessels with Ballast Systems Classification and Documentation

1

1.1 General

The inadvertent transfer of harmful aquatic organisms and pathogens in the ballast water of ships has been scientifically proven to have caused a significant adverse impact to many of the world's coastal regions. The international maritime community, under the auspices of the International Maritime Organisation (IMO) has developed several documents, including the *International Conventions for the Control and Management of Ship's Ballast Water and Sediments, 2004*, (Ballast Water Management Convention), which are aimed at preventing the introduction of unwanted aquatic organisms and pathogens through the discharge of ballast water and sediments. The Ballast Water Management Convention applies to vessels registered in a country which is party to the Convention and to those vessels registered in other countries when operating in the waters of a country which is party to the Convention. As a means to prevent, minimise and ultimately eliminate the risk to the environment, human health, property and resources arising from the transfer of harmful aquatic organisms and pathogens through the control and management of vessel's ballast water and sediment, as well as to avoid unwanted side-effects from that control, the Convention requires vessels to conduct a ballast water exchange or be fitted with an approved ballast water management system. It is noted that several studies have shown that the effectiveness of ballast water exchange varies and is dependent on the vessel type (design), exchange method (sequential, flow-through and dilution methods), ballasting system configuration, exchange location, weather conditions and vessel's trading pattern. For these reasons (and others), it has been determined that ballast water exchange does not provide adequate protective measures to prevent damage from organisms and pathogens carried in a vessel's ballast, even though exchange was considered to be acceptable as an interim solution.

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