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An American National Standard

Standard Specification for ~~United States Coast Guard Type II or IMO MARPOL 73/78 Annex IV Marine Sanitation Devices (Flow Through Treatment)~~Sewage and Graywater Flow Through Treatment Systems[1]

~~This standard is issued under the fixed designation F2363; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.~~

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INTRODUCTION

Shipboard treatment of wastewater has evolved over the years from systems using maceration and chlorination techniques to more advanced biological systems that are designed to treat a single wastestream of sewage followed more recently by complex bio-reactor systems employing advanced oxidation and high-powered UV systems that are designed to remove organic and inorganic materials from a combined wastestream of sewage and graywater.

Advancements in treatment technologies have been fueled, in part, by shipping companies wanting to adopt more environmentally friendly practices as well as by regulatory bodies imposing more stringent standards on wastewater discharges from ships.

This standard is a consolidated source of sewage and graywater treatment system requirements that combines international requirements in MARPOL Annex IV with requirements of other regulatory bodies and overlays industry best practices.

1. Scope

~~1.1This specification covers the design, manufacture, performance, operation, functioning, and testing of USCG Type II Marine Sanitation Device or IMO MARPOL 73/78 Annex IV flow through treatment device intended to process sewage and graywater generated during the ship's normal service. This specification is intended for use by purchasers, designers, and manufacturers of shipboard environmental pollution control equipment to determine the requirements for equipment purchase, equipment use, and design considerations.~~

~~1.2The device shall be capable of meeting the effluent requirements detailed in Table1 with respect to ship's operational area.~~

1.1 This specification covers the design, manufacture, performance, operation, and testing of flow through treatment systems intended to process sewage or graywater, or both, generated during a ship's normal service. This specification is intended for use by designers, manufacturers, purchasers, and operators of shipboard environmental pollution control equipment to determine the requirements for equipment design, manufacture, purchase, and in-service operation.

1.2 The treatment system shall be capable of meeting the effluent requirements detailed in Section 4 with respect to a ship's operational area.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility*

[1] This specification is under the jurisdiction of ASTM Committee F25 on Ships and Marine Technology and is the direct responsibility of Subcommittee F25.06 on Marine Environmental Protection.

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of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A307 Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

~~A530/A530M Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe~~

~~A~~563 Specification for Carbon and Alloy Steel Nuts

B117 Practice for Operating Salt Spray (Fog) Apparatus

~~A999/A999M Specification for General Requirements for Alloy and Stainless Steel Pipe~~

B165 Specification for Nickel-Copper Alloy (UNS N04400) Seamless Pipe and Tube

D1253 Test Method for Residual Chlorine in Water

~~F467 Specification for Nonferrous Nuts for General Use~~ E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

~~F468 Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use~~ 906 Specification for Letters and Numerals for Ships

F992 Specification for Valve Label Plates

F993 Specification for Valve Locking Devices

F998 Specification for Centrifugal Pump, Shipboard Use

F1030 Practice for Selection of Valve Operators

F1098 Specification for Envelope Dimensions for Butterfly ValvesNPS 2 to 24

F1122 Specification for Quick Disconnect Couplings (6 in. NPS and Smaller)

F1155 Practice for Selection and Application of Piping System Materials

F1166 Practice for Human Engineering Design for Marine Systems, Equipment, and Facilities

F1298 Specification for Flexible, Expansion-Type Ball Joints for Marine Applications

F1323 Specification for Shipboard Incinerators

F1387 Specification for Performance of Piping and Tubing Mechanically Attached Fittings

F1510 Specification for Rotary Positive Displacement Pumps, Ships Use

F1511 Specification for Mechanical Seals for Shipboard Pump Applications

F2044 Specification for Liquid Level Indicating Equipment, Electrical

2.2 ~~*ANSI Standards:*~~*ASME Standards:*[3]

B16.1 ~~Cast Iron Pipe Flanges and Flange Fittings~~ Gray iron pipe flanges and flanged fittings: Classes 25, 125, and 250

B16.5 ~~Steel Pipe Flanges, Flanged Valves and Fittings 150, 300, 400, 600, 900, 1500 and 2500 lb~~ Pipe flanges and flanged fittings: NPS ½ through NPS 24 metric/inch standard

B16.11 ~~Forged Steel Fittings, Socket Welding and Threaded~~ Forged fittings, socket-welding and threaded

B16.24 ~~Bronze Flanges and Flanged Fittings 150, 300 lb~~ Cast copper alloy pipe flanges and flanged fittings: Classes 150, 300, 600, 900, 1500, and 2500

B16.34 Valves flanged, threaded, and welding end

2.3 ~~*Code of Federal Regulations:*~~*IMO Regulations:*[4] ~~*33 CFR 159Department of Homeland Security, U.S. Coast Guard (USCG), Marine Sanitation Devices*~~

~~40 CFR Part 136Guidelines Establishing Test Procedures for the Analysis of Pollutants~~ MARPOL Annex IV Regulations for the prevention of pollution by sewage from ships

~~40 CFR 140Environmental Protection Agency, Marine Sanitation Device Standard, January 29, 1976~~ MEPC.159(55) Guidelines on implementation of effluent standards and performance tests for sewage treatment plants

2.4 *ISO Standards:*[5]

~~46 CFR Part 111Department of Homeland Security, U.S. Coast Guard (USCG), Electrical Systems~~ ISO 5815-1 Water quality–Determination of biochemical oxygen demand after n days (BOD_n)–Part 1: Dilution and seeding method with allylthiourea addition

~~46 CFR Part 147Department of Homeland Security, U.S. Coast Guard (USCG), Hazardous Ships' Stores~~ ISO 15705 Water quality–Determination of the chemical oxygen demand index (ST-COD)–Small-scale sealed-tube method

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

~~[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.~~

[3] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, http://www.asme.org.

~~[4] Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401.~~

[4] Available from the International Maritime Organization, 4 Albert Embankment, London SE1 7SR, United Kingdom, http://www.imo.org.

~~[5] Available from Institute of Electrical and Electronics Engineers, Inc. (IEEE), 445 Hoes Ln., P.O. Box 1331, Piscataway, NJ 08854-1331~~

[5] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

2.5 *US Laws and Regulations:*[6]

49 CFR 171Department of Transportation (DoT), Research and Special Programs Administration (RSPA), General Information, Regulations and Definitions

2.4 *Other Documents:* *33 CFR Part 159 Marine sanitation devices*

TABLE 1 Effluent RequiTreatments Stand Operational Ards by Typea of System[A]

U.S.C.G.	MARPOL 73/78 Annex IV					
Type	Coliform, Annex IV					
	U.S. Coastal Zone Operations	Alaskan Special Area Operations[A] (Cruise Ships)	International Area Operations			
CFU/100 mL	TSS, mg/L	BOD_5 (Cruise Ships)	International Area, Operations			
Suspended Solids	150 mg/L	7 day average: 45 mg/L 30 day average: 30mg/L 30 day average removal efficiency: 85 %	50 mg/L (in lab) 100 mg/L (shi	pboard)		
Suspended Solidsmg/L	150 mg/L	7 day average: 45 mg/LCOD, mg/L	Chlorine, µg/L	pH		
Fecal Coliform	200/100 mL	Geometric mean f or 30 day period: 20/100 mL and not more than 10 % exceeding 40/100 mL	250/100 mL	—	—	—
I	≤1000	(see Note 1)	—	—	—	—
BOD[B]	Not specified	7 day average: 45 mg/L 30 day average: 30 mg/L 30 day average removal efficiency: 85 %	50 mg/L	—	—	—
II-A	≤200	≤150	—	—	—	—
Residual (CL)	Not specified	Total Residual Chlorine cannot exceed 10 mg/L	To the degree, practicable[C]≤25	≤125	<5006–8.5	
II-B	≤100	≤35	≤25	≤125	<5006–8.5	
pH	Not specified	Maintained between 6.0 and 9.0	Not specified≤30	—	≤10	6–9
II-C	≤20	≤30	≤30	—	≤10	6–9
III						

[A] TAmounts preatedsewage and graywaterd isen this table arged foutsider cof AImpariskaon S pecial Aureapos, while in Alaska on watelly. Fors, must m deet U.S. Coastail Zone Oped rations requirements a, cond be discharged whiule st thip is unde rwegulay at not lery ssthan 6 knots.

[B] 5-day BOD (biord chemical oxygtendema ind) 4.CSewage dise1 tharouged when the 4.6, ashi ap is undeprway at not less thprian 4 knotse.

ANSI/NFPA No. 70National Electrical Code[3] 33 CFR 159.301 Subpart E–Discharge of effluents in certain Alaskan waters by cruise vessel operations

IEEE 45-2002Recommended Practice for Electric Installations on Shipboard 40 CFR Part 136 Guidelines establishing test procedures for the analysis of pollutants

2.6 *Other Standards:*

Instrument Society of America (RP 12.2) ANSI/ASSE 1001 Performance requirements for atmospheric type vacuum breakers[5]

International Convention for the Prevention of Pollution from Ships (1973)as modified by the Protocols of 1978 (MARPOL 73/78) and 1997 and associated Annexes, Including Annex IV and Annex VI

Resolution MEPC.2(IV)Recommendation on International Effluent Standards and Guidelines for Performance Tests for Sewage Treatment Plants[7]

MARPOL 73/78 Annex IV Annex BGuidelines for Performance Tests for Sewage Treatment Plants with Respect to Effluent Standards[7] ANSI/ASSE 1013 Performance requirements for reduced pressure principle backflow preventers and reduced pressure principle fire protection backflow preventers[5]

Public Law 92-500Federal Water Pollution Control Act, October 18, 1972, as amended by Public Law 95-217, Clean Water Act, December 27, 1977, as amended[4]

Public Law 106-554 Title XIVCertain Alaskan Cruise Ship Operations, of the Miscellaneous Appropriations Act of 2001[4] ANSI/ISA 60079-1 Explosive atmospheres–Part 1: Equipment protection by flameproof enclosures *d*[5]

ANSI/ISA 60079-11 Explosive atmospheres–Part 11: Equipment protection by intrinsic safety *i*[5]

[6] Available from Instrumentation, Systems, and Automation Society, 67 Alexander Dr., Research Triangle Park, NC 27709.

[6] Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, http://www.access.gpo.gov.

~~SNAME T&R Bulletin No. 3-37Design Guide for Shipboard Airborne Noise Control~~ ANSI/NEMA 250 Enclosures for electrical equipment (1000 Volts Maximum)[5]
~~Underwriters Laboratories STD 698Industrial Control Equipment for Use in Hazardous Locations~~ ANSI/NEMA MG 1 Motors and generators[5]
DoD 4715.6-R1 Regulations on vessels owned or operated by the Department of Defense[7]
IEC 60079-1 Explosive atmospheres–Part 1: Equipment protection by flameproof enclosures *d*[8]
IEC 60079-11 Explosive atmospheres–Part 11: Equipment protection by intrinsic safety *I*[8]
IEC 60085 Electrical insulation–Thermal evaluation and designation[8]
IEC 60092–350 Electrical installations in ships–Part 350: General construction and test methods of power, control, and instrumentation cables for shipboard and offshore applications[8]
IEC 60092–353 Electrical installations in ships–Part 353: Single and multicore non-radial field power cables with extruded solid insulation for rated voltages 1 kV and 3 kV[8]
IEC 60529 Degrees of protection provided by enclosures (IP Code)[8]
IEEE 1580 Recommended practice for marine cable for use on shipboard and fixed or floating platforms[9]
MIL-S-167-1 Test method standard for mechanical vibrations of shipboard equipment[10]
MIL-S-901 Requirements for shock tests: High-impact shipboard machinery, equipment, and systems[10]
NFPA 70 National Electrical Code[11]
SNAME T&R Bulletin 3-37 Design guide for shipboard airborne noise control[12]
SM 4600-Cl Chlorine (residual)–Standard methods for the examination of water and wastewater[13]
UL 913 Intrinsically safe apparatus and associated apparatus for use in class I, II, and III, division 1, hazardous (classified) locations[14]
UL 1203 Explosion-proof and dust-ignition-proof electrical equipment for use in hazardous (classified) locations[14]
UL 1309 Marine shipboard cables[14]

3. Terminology

~~3.1*Definitions of Terms Specific to This Standard:*~~
3.1 *Definitions:*
3.1.1 ~~*collection, holding, and transfer tank (CHT)—*~~tank used to collect by gravity sewage or graywater, or both, prior to legal ~~discharge or pumping to shore facility.~~ blackwater—see *sewage* .
3.1.2 ~~*deodorant—*~~substance which masks or destroys offensive odors. chlorine, *n*—residual disinfectant or byproducts associated with the use of chlorine or its compounds.
3.1.3 ~~*discharge—*~~includes spilling, leaking, pumping, pouring, emitting, emptying, and dumping. coliform, *n*—thermotolerant coliform bacteria which produce gas from lactose in 48 h at 44.5°C [112.1°F].
3.1.4 ~~*effluent—*~~discharge from a properly functioning MSD. cruise ship, *n*—ship, including submersible craft, carrying at least one passenger for hire for whom consideration is contributed as a condition of carriage, whether directly or indirectly flowing to the owner, charterer, operator, agent, or any other person having an interest.
3.1.5 ~~*failure—*~~any malfunction that causes an MSD to shut down or that, if not corrected, would preclude sewage processing or prevent the MSD from meeting the applicable performance requirements. deleterious effect, *n*—cracking, softening, deterioration, displacement, breakage, leakage, or damage of components or materials that affects the operation or safety of a treatment system.
3.1.6 ~~*fecal coliform bacteria—*~~organisms, associated with the intestines of warm-blooded animals, that commonly are used to ~~indicate the presence of fecal material and the potential presence of organisms capable of causing human disease.~~ dilution, *n*—process water added to the treatment system.

~~[7] Available from International Maritime Organization (IMO), 4 Albert Embankment, London SE1 7SR, U.K.~~
[7] Available from the Under Secretary of Defense (AT&L), Department of Defense, 3400 Defense Pentagon, Washington, DC 20301-3400, USA, http://www.dtic.mil/whs/directives/corres/pub1.html.
~~[8] Available from Society of Naval Architects and Marine Engineers, 601 Pavonia Ave., Jersey City, NJ 07306.~~
[8] Available from the International Electrotechnical Commission, 3 rue de Varembé, PO Box 131, CH-1211 Geneva 20, Switzerland, http://www.iec.ch.
~~[9] Available from Underwriters Laboratories (UL), Corporate Progress, 333 Pfingsten Rd., Northbrook, IL 60062.~~
[9] Available from Institute of Electrical and Electronics Engineers, Inc. (IEEE), 445 Hoes Ln., Piscataway, NJ 08854, http://www.ieee.org.
[10] Available from the Document Automation and Production Service, Department of Defense, Bldg 4/D, 700 Robbins Ave, Philadelphia, PA 19111, USA, http://dodssp.daps.dla.mil/
[11] This specification is under the jurisdiction of ASTM Committee F25 on Ships and Marine Technology and is the direct responsibility of Subcommittee F25.06 on Marine Environmental Protection.
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[12] Available from the Society of Naval Architects and Marine Engineers, 601 Pavonia Ave, Jersey City, NJ 07306, USA, www.sname.org.
[13] Available from American Public Health Association, 800 I St N.W., Washington, DC 20001-3710, USA, www.standardmethods.org.
[14] Available from Underwriters Laboratories (UL), 2600 N.W. Lake Rd., Camas, WA 98607-8542, http://www.ul.com.

3.1.7 ~~*gravity collection*—the method of collection for sewage and graywater used in CHT systems.~~ discharge, *n*—spilling, leaking, pumping, pouring, emitting, emptying, or dumping, however caused.

3.1.8 ~~*graywater*—discarded water from deck drains, lavatories, showers, dishwashers, laundries, and drinking fountains. Does not include industrial wastes, infectious wastes, human body wastes, and animal wastes.~~ effluent, *n*—liquid containing sewage, graywater, or other wastes, whether treated or untreated, flowing out of the treatment system or holding tank usually to be discharged.

3.1.9 ~~*holding tank*—generally designed to collect and store treated or untreated waste until it can be legally discharged or pumped to a dockside facility.~~ flushwater, *n*—transport medium used to carry sewage or other wastes from toilets or urinals to the treatment system.

3.1.10 ~~*hydraulic loading*—the volume of sewage or graywater, or both, applied to the surface of the filtering media per time period.~~ geometric mean, *n*—the nth root of the product of n numbers.

3.1.11 ~~*manufacturer*—company that designs, assembles, or imports the various parts of the system (except where specified otherwise).~~ graywater, *n*—(*1*) drainage from galley sink and dishwater drains; (*2*) drainage from laundry facilities; or (*3*) drainage from bath, shower, and washbasin drains.

3.1.12 ~~*marine sanitation device (MSD)*—any equipment designed to receive, retain, treat, or discharge sewage, and any process to treat such sewage.~~ holding tank, *n*—tank for collecting or storing of sewage or graywater, whether treated or untreated, having suitable design, construction, fittings, and coatings for the intended purpose as designated by the certifying body.

3.1.12.1 *Discussion*—The terms sludge tank, bioreactor tank, collection tank, receiving tank, and flow equalization tank are synonymous with holding tank, but for a different purpose.

3.1.13 ~~*organic loading*—the concentration of pollutants applied to the surface of the filtering media per time period.~~ influent, *n*—liquid containing sewage, graywater, or other wastes, whether treated or untreated, flowing into the treatment system or holding tank.

3.1.14 ~~*recognized facility*—recognized facility means any laboratory or facility listed by the Coast Guard as a recognized facility under 33 CFR 159.~~ international voyage, *n*—voyage from a port or place in one country to a port or place outside such country, or conversely.

3.1.15 ~~*sewage*—wastes of human origin from water closets, urinals, and medical facilities transported by the ship soil drain system. It also includes animal wastes from spaces containing living animals. When graywater is combined with sewage, the waste stream is characterized as sewage.~~ operational, *adj*—(*1*) quality of performance or quality of effluent, a treatment system that continually processes, treats, and discharges wastewater to the applicable treatment standard, or is ready to do so following an individual use; (*2*) functional area, a description of the ship's route, duration of voyage, and distance from nearest land; (*3*) daily routine, a schedule of events, meal times, and work hours for the ship's crew.

3.1.16 ~~*USCG Type II MSD*—a flow through device capable of producing an effluent with a fecal coliform bacterial count of not more than 200 per 100 mL and with a total suspended solids concentration of not more than 150 mg/L.~~ passenger ship—see *cruise ship*.

3.1.17 ~~*vacuum collection*—the method for collection of sewage used in VCHT systems.~~ process water, *n*—seawater or other liquid added to the treatment process.

3.1.18 ~~*vacuum collection, holding, and transfer tank (VCHT)*—tank utilizing vacuum suction to hold sewage and/or graywater for legal discharge or pumping ashore.~~

~~**4.Ordering Information**~~

~~4.1Orders shall include the following information:~~

~~4.1.1*Sizing Requirements*~~residual chlorine—see *chlorine*.

3.1.19 *retention tank*, *n*—auxiliary tank, pressure vessel, container, reservoir, or similar component for storing liquids, solids, or gasses used or capable of being used during the treatment process.

3.1.20 *sewage*, *n*—(*1*) drainage and other wastes from any form of toilets and urinals; (*2*) drainage from medical premises (for example, dispensary, sick bay, etc.) by means of wash basins, wash tubs, and scuppers located in such premises; (*3*) drainage from spaces containing living animals; or (*4*) other wastewater when mixed with the drainages defined above.

3.1.21 *ship*, *n*—every description of watercraft, other than a seaplane on the water, used or capable of being used as a means of transportation in water.

3.1.21.1 *Discussion*—The terms ship and vessel are interchangeable and synonymous.

3.1.22 *thermotolerant coliform*—see *coliform*.

3.1.23 *tonnage*, *n*—a function of the moulded volume of enclosed spaces on the ship, gross or net, as indicated on the ship's international tonnage certificate.

3.1.24 *wastestream*—see *wastewater* .

3.1.25 *wastewater*, *n*—liquid containing sewage, graywater, or other similar wastes, including flushwater.

3.1.25.1 *Discussion*—Wastes do not include industrial wastes, such as from fixed or floating platforms engaged in exploration, exploitation, and associated offshore processing of seabed mineral resources.

3.1.26 *vessel*—see *ship*.

4. Classification

NOTE 1—Concentration limit for solids is ≤10 % of calculated TSS. See 11.14.1.

4.1 *Type I marine sanitation device* is a flow-through sewage treatment system certified by the U.S. Coast Guard for installation on a U.S. flagged vessel ≤19.7 m [65 ft] in length and designed to meet the requirements in 33 CFR Part 159. This treatment system is typically a small device that is designed to be used for processing, treating, and discharging sewage "on demand" following each individual use. In the United States, vessels are able to discharge through this device while operating within three nautical miles (nm) of land, except where otherwise prohibited.

4.2 *Type II-A marine sanitation device* is a flow-through sewage treatment system certified by the U.S. Coast Guard for installation on a U.S. flagged vessel of any length to meet the requirements in 33 CFR Part 159. For U.S. flagged vessels that engage in international voyages, Type II-A devices fitted with holding tank for the temporary storage of treated sewage meet the requirements of regulation 9.1.2 of MARPOL Annex IV as a sewage comminuting and disinfecting system. This treatment system is typically a large device that is designed to be used for processing, treating, and discharging sewage continuously between individual uses. In the United States, vessels are able to discharge through this device while operating within 3 nm of land, except where otherwise prohibited. However, while operating on an international voyage, such discharges are at a distance of >3 nm from nearest land.

4.3 *Type II-B sewage treatment plant* is a flow-through treatment system of a type approved by the flag Administration for installation on a ship engaged in international voyages of 400 gross tonnage (GT) and above, and ships of <400 GT which are certified to carry >15 persons, to meet the requirements of regulation 9.1.1 of MARPOL Annex IV as amended by MEPC.159(55). This treatment system is typically a large device that is designed to be used for processing, treating, and discharging sewage or graywater, or both, continuously between individual uses. While on an international voyage, vessels are able to discharge through this treatment system while operating within 3 nm of land, except where otherwise prohibited.

4.4 *Type II-C advanced wastewater treatment system* are Type II-B sewage treatment plants that are designed to treat a combined sewage and graywater influent to a more stringent standard for installation on a cruise ship authorized to carry ≥500 passengers operating in certain Alaskan waters to meet the requirements Subpart E to 33 CFR 159.301 et seq. Cruise ships are able to discharge through this treatment system while operating in certain Alaskan waters.

4.5 *Type III-A marine sanitation device* certified by the U.S. Coast Guard for installation on a U.S. flagged vessel of any length designed to prevent the overboard discharge of treated or untreated sewage to meet the requirements in 33 CFR Part 159. Typically this holding tank is used solely for the storage of wastewater (for example, sewage, graywater, flushwater) at ambient air pressure and temperatures. In the United States, vessels are able to discharge from a holding tank while operating outside of 3 nm of land, except where otherwise prohibited. However, while operating on an international voyage, such discharges occur at a distance of >12 nm from nearest land and while the vessel is en route proceeding at ≥4 kts.

4.6 *Type III-B sewage holding tank* constructed to the satisfaction of the flag Administration and having capacity for the retention of all sewage, with visual means to indicate the amount of its contents, taking into account the operation of the ship, the number of persons on board, and other relevant factors, to meet the requirements of regulation 9.1.3 of MARPOL Annex IV. Discharges are similar to Type III-A.

5. Ordering Information

5.1 *General*:

~~4.1.1.1Design sizing requirements shall include consideration of collection method (gravity or vacuum) utilized for Marine Sanitation Device.~~

~~4.1.1.2Hydraulic loading for both graywater and sewage generation rates.~~

~~*(1)* If capacity is provided in litres per day per person or gallons per day per person, the maximum number of personnel (crew and passenger) must also be supplied.~~

~~*(a)* When specifying growth margin, it is important to consider the potential for increases in crew size or number of passengers, or both, over the life of the ship.~~

~~4.1.1.3Organic loading for both graywater and sewage generation rates.~~

~~4.1.1.4Thermal loading and expected temperature variation if processing combined sewage and graywater waste streams.~~

~~*(1)* Take into account the management of potential influent temperature variation in applications where the MSD treats a combined sewage and graywater waste stream. Consideration might include the addition of a temperature/flow equalization tank or other means to adjust temperature to meet 6.9.1~~

5.1.1 Purchaser shall provide treatment system manufacturer with all pertinent acquisition requirements, including items shown in 5.2.

~~4.1.2*Processing Rate Requirements*~~

5.2 *Acquisition Requirements*:

~~4.1.2.1Based on hydraulic and organic loading rates for target waste streams and reduced processing capability.~~

~~4.1.3System start up times.~~

~~4.1.4Space, weight, and service restrictions, if any.~~

~~4.1.5Operational profile of ship.~~

~~4.1.6Additional control requirements.~~

~~4.1.7Any additional requirements required by the purchaser to meet special needs.~~

~~4.2Level of operator interfacing as determined by purchaser consistent with ship operational and maintenance procedures.~~

~~5.Materials and Manufacture~~

~~5.1The MSD shall not use dilution as a means of achieving operational effluent limits nor for purpose of passing regulatory certification requirements.~~

~~5.2The MSD shall operate as specified herein within relative humidity limits of 5 to 95 % non-condensing.~~

~~5.3The MSD equipment shall not be damaged nor shall subsequent operational performance by degraded as a result of exposure to salt fog.~~

~~5.3.1When in a non-operating state, the MSD shall not be damaged nor shall subsequent operational performance be degraded as a result of external components being subjected to seawater spray.~~

~~5.4All parts of the MSD shall minimize the effort required for their draining, accessing, cleaning, maintenance, and prevention.~~

~~5.5The MSD shall be compliant with Public Law 92-500 as amended and 33 CFR 159~~

5.2.1 Title, number, and date of this specification.

5.2.2 Type of treatment system (for example, Type II-B) from Section 4.

~~5.6Coatings or paints containing heavy metals, such as chromium, lead, or tin or other materials banned by regulatory authorities shall not be used.~~

~~5.7Asbestos, mercury, cadmium, and polychlorinated biphenyls (PCBs) shall not be used in the construction of the MSD or any subsystem.~~

~~5.8The MSD shall have a means installed to ensure the effluent meets fecal coliform limits.~~

~~5.8.1If chlorine is used to meet fecal coliform limits, it is often necessary to conduct effluent dechlorination prior to releasing the effluent to the environment, based upon regulatory regime for operational area of intended service.~~

~~5.9The MSD shall be designed to process or retain sewage wastes, or combined sewage/graywater wastes for the maximum number of assigned personnel, including non-crew members as specified by purchaser.~~

~~5.10The MSD shall be capable of receiving wastes with freshwater, and/or seawater, or some other form of transport medium.~~

~~5.11The MSD shall be designed and constructed to resist internal and external corrosion as found in a marine environment.~~

~~5.12The MSD shall be capable of intermittent operation of relatively short time intervals and shall be capable of being secured for long periods without disrupting the treatment system's efficiency and ability to activate.~~

~~5.13The MSD shall remain safe and sanitary, and shall not create dangerous or unsanitary conditions during normal operation.~~

~~5.14MSD components, such as valves, fittings, pumps, and motors, shall be standard items, such as those complying with Practice~~

5.2.3 Whether treatment system is designed to process or retain sewage or graywater, or combined sewage and graywater.

5.2.4 Maximum number of persons, including non-crew members.

5.2.5 *Design Sizing Requirements* :

5.2.5.1 Hydraulic loading for both graywater and sewage in accordance with Table 2, including method of collection, whether gravity or vacuum feed.

5.2.5.2 When specifying growth margin, it is important to consider the potential for increases in the number of crew and passengers over the life of the ship.

NOTE 2—If vacuum collection is used for graywater, then design generation rate is expected to be the same as for gravity collected graywater.

5.2.6 Organic loading for both graywater and sewage in accordance with Table 3.

5.2.7 Thermal loading for both graywater and sewage influent temperature taking into account management of variations in influent temperature.

5.2.7.1 Consideration should include the addition of a temperature or flow equalization tank, or other means to adjust temperature.

5.2.8 Treatment system start-up and stabilization periods.

5.2.9 Space, weight, and service restrictions, if any.

5.2.10 Doorway, hatch, and compartment dimensions, including clearance restrictions for access to parts for service.

5.2.11 Operational profile of ship.

5.2.12 Additional control requirements.

5.2.13 Any additional requirements as required by purchaser to meet special needs.

5.2.14 Level of operator interfacing as determined by purchaser consistent with ship operational and maintenance procedures.

5.2.15 Supplementary requirements, if any, from Section 17.

6. Materials and Manufacture

6.1 *Material Deterioration, Prevention, and Control*:

6.1.1 Treatment system shall be fabricated from compatible materials, inherently corrosion resistant or treated to provide protection against corrosion and deterioration for the service life of the treatment system from the following:

TABLE 2 ~~IMO MARPOL~~Hydraulic L ~~73/78 Annex IV Stoandard Dimeng Desiogns for Flanges fow per D Capischtarge by Conllections~~ Method

~~Description~~	~~Dimensionwage, L/day [gal/day]~~	~~Graywater, L/day [gal/day]~~
Collection Method	Sewage, L/day [gal/day]	Graywater, L/day [gal/day]
~~Outside diameter~~	~~2 10 mm25~~	~~34 – 189~~
Gravity	23 – 125	34 – 189
~~Inner diameter~~	~~According to pipe outside diameter[6 – 33]~~ [6 – 33]	~~[9 – 50]~~ [9 – 50]
~~Bolt circle diameter~~	~~170 mm~~	
Vacuum, ~~Slo- tsin flange~~	~~Four holes 18 mm in diameter equidi3~~	~~(stantly placed; on a blot circle ofthe above dia flange periphery. The slot width to be~~
with urinals	2.3 – 13	(see Note 2)
~~Flange thickness~~	~~16 mm – 3.3]~~ [0.6 – 3.3]	
~~Bol- ts and nuts: q uantity and diameter~~	~~Four, each of 16 mm in diameter and of suitable length.The flange i2 – 23~~	~~(s designed t o accept pipes up to a maximum 2)~~
without urinals	4.2 – 23	(see Note 2)
	~~[100 mm and shall be of steel or other equivalent material having a flat face. This flange, together with a suitable gasket, shall be suitable for a service pressure of 6 kg/cm^2.For ships having a molded depth of 5 m and less, the inner diameter of the discharge connection may be 38 mm.~~ [1.1 – 6.~~For ships having a molded depth of 5 m and less, the inner diameter of the discharge connection may be 38 mm.~~ ~~For ships in dedicated trades, such as passenger ferries, alternatively the ship's discharge pipeline may be fitted with a discharge connection that can be accepted by the Administration, such as quick-connection couplings.~~1]	

TABLE 3 Organic Loading Design Rate per Capita by Influent

Influent	TSS, kg/day [lb/day]	BOD_5, kg/day [lb/day]
Sewage	0.044 – 0.073 [0.096 – 0.161]	0.016 – 0.035 [0.036 – 0.078]
Graywater	0.033 – 0.061 [0.072 – 0.134]	0.118 – 0.156 [0.259 – 0.343]

6.1.1.1 Internal exposure to wastestreams, chemicals, and other substances commonly found in treatment systems or as part of the treatment process; and

6.1.1.2 External exposure to petroleum products, cleaning compounds, and other substances commonly used on ships in the compartment where a treatment system will be installed.

6.1.2 A listing of common substances that a treatment system may be exposed to is provided in Table 4.

6.1.3 Manufacturer should develop a list of specific substances considered in the design of a particular treatment system.

6.1.4 Dissimilar metals shall not be used in intimate contact with each other unless protected against galvanic corrosion.

6.1.5 Treatment system shall not be damaged nor shall subsequent operational performance be degraded:

6.1.5.1 As a result of exposure to salt fog in accordance with ASTM Practice B117; and

6.1.5.2 When in a non-operating state, such as when secured for winter layup.

6.1.6 Components, such as valves, fittings, pumps, and motors shall be of corrosion resistant material suitable for the intended service and shall be standard items such as those complying with ASME B16.34, Practice F1030 and Specifications A307, A563, F992, F993, F998, F1098, F1122, F1298,~~F1510, or F1511 that are easy to maintain and replace.~~

~~5.14.1It is recommended that collection system design and components be compatible with the materials used for the MSD.~~

~~5.14.2Fasteners shall meet Specification A307, A563, F467, or F468~~F1387, F1510, and F1511, which are easy to maintain and replace.

6.1.7 Component design shall be compatible with treatment system materials.

6.1.8 Metallic holding and retention tanks shall be provided with cathodic protection, or by insulation of the galvanic coupling, to minimize corrosion due to galvanic reactions.

6.1.9 Fasteners shall be of corrosion resistant material.

6.2 *Design for Human Interface and Safety*:

TABLE 4 Common Substances by Exposure Type[A]

Substance	Internal[B]	External[B]
Sewage, graywater, flushwater incl intermediate process fluids, vapors	X	X
Toilet bowl cleaners, pipe scale prevention chemicals incl bleach, citric acid tablets, acid-based & biological substances	X	X
Disinfectants incl solid, liquid or gas, in quantity specified by manufacturer	X	X
Fuel oils or other fuels incl diesel fuel, marine fuel oil	_	X
Lubricating oils incl synthetic & petroleum-based oils	_	X
Cleaning agents incl mineral spirits, methyl alcohol, petroleum-based solvents	_	X

[A]Substance list may vary by treatment system type, ship type, etc.
[B]"X" indicates the listed substance is common.

6.2.1 Practice F1166 shall be used for the design, construction, and layout of the treatment system, controls, displays, equipment, and labels.

6.2.1.1 Warning and operating labels shall be affixed to treatment system where necessary in accordance with Practice F1166.

~~5.15All piping shall be selected per Practice F1155~~

6.2.2 All rotating or moving parts with the potential to cause injury shall be guarded to avoid accidental contact.

6.2.3 Equipment requiring routine maintenance shall be easily accessible.

6.3 *Features*:

6.3.1 *Vents*—Vents shall be designed and constructed to minimize clogging by either contents of holding and retention tanks or climatic conditions such as snow or ice.

6.3.2 *Baffles*—Baffles in holding and retention tanks, if any, shall have openings to allow contents to flow freely across the top and bottom of the tank.

6.3.3 *Level Indicator*—Holding and retention tanks, if any, shall have a means of indicating tank level that complies with Specification F2044.

~~5.15.1It is recommended that piping system components be compatible with the materials used for the MSD.~~

~~5.15.2If nickel-copper alloy piping is used, it shall meet Specification B165~~

6.3.4 *Chemical Level Indicator*—If the treatment system uses one or more chemicals for its effective operation, then the system shall be fitted with one of the following:

6.3.4.1 means of indicating the amount of the chemical in the retention and holding tanks; or

6.3.4.2 Means of indicating when chemicals need to be added to the retention and holding tanks for the proper continued operation of the treatment system.

6.3.5 *Independent Support*—Treatment system shall have provisions for support that are independent from connecting pipes.

6.3.5.1 Piping shall not be used to support the treatment system or its major components.

6.3.6 *Backflow Prevention*—Treatment system shall be protected from backflow of wastewater through supply and discharge piping.

6.3.6.1 Manufacturer may specify in the installation instructions backflow prevention requirements as part of ship's piping.

6.3.6.2 Where pressurized backflow is not possible, atmospheric type vacuum breaker conforming to ANSI/ASSE 1001 shall be used.

6.3.6.3 Treatment system using ship supplied potable water shall be fitted with a reduced pressure principle sanitary backflow preventer conforming to ANSI/ASSE 1013 in order to protect the ship's potable water from cross-contamination.

6.3.7 *Sampling ports*—Treatment system shall provide for manually collecting representative samples of influent and effluent without opening tanks, voids, or vents.

6.3.7.1 Ports shall be located in: (*1*) influent line, or receiving and collection tank, for sampling influent; and (*2*) effluent line immediately downstream of treatment system for sampling effluent.

6.3.7.2 Manufacturer may specify in installation instructions additional sampling port requirements as part of ship piping.

6.3.7.3 If a sludge collection tank or discharge line is included in the treatment system design, then a sampling port is required.

6.3.7.4 For biological treatment systems, provisions shall be made on the bioreactor tank for assessing the condition of the biomass.

6.3.8 *Removal Fittings*—Standard discharge fittings, if provided with treatment system, shall be in accordance with Table 5.

~~5.15.3If carbon steel or alloy steel piping is used, it shall meet Specification A530/A530M or A999/A999M~~

6.3.8.1 Flange in Table 5 is designed to accept pipes up to a maximum internal diameter of 100 mm [3.9 in] and shall be of steel or other equivalent material having a flat face. This flange, together with a gasket, shall be suitable for a service pressure of 6 kg/cm^2[85.3 psi].

TABLE 5 Standard Dimensions for Flanges for Discharge Connections

Description	Dimension
Outside diameter	210 mm [8.3 in.]
Inner diameter	According to pipe outside diameter
Bolt circle diameter	170 mm [6.7 in.]
Slots in flange	4 holes 18 mm [0.7 in.] in diameter equidistantly placed; on a bolt circle of the above diameter, slotted to the flange periphery. The slot width to be 18 mm [0.7 in.]
Flange thickness	16 mm [0.6 in.]
Bolts and nuts, quantity and diameter	4, each of 16 mm [0.6 in.] in diameter and of suitable length

6.3.8.2 For ships having a molded depth ≤ 5 m [16.4 ft], the inner diameter of the discharge connection may be 38 mm [1.5 in.].

6.3.8.3 For ships in dedicated trades, that is, passenger ferries, alternatively the ship discharge pipeline may be fitted with a discharge connection which can be accepted by the flag Administration, such as quick connection couplings.

6.4 *Piping*:

6.4.1 Piping shall be compatible with treatment system materials.

6.4.2 Piping selection and application shall be in accordance with Practice F1155.

~~5.15.4If alternate materials are used other than those listed in Practice F1155, manufacturer shall obtain buyer approval for their use.~~

~~5.16MSD inlet and outlet connections shall be in accordance with ANSI B16.1~~

6.4.3 Pipe bends, if any, shall have minimum 3:1 bend radius to diameter.

6.4.4 Inlet and outlet connections shall be in accordance with ASME B16.1, B16.5~~, B16.11, or B16.24, or equivalent ISO or DIN standards.~~

~~5.17The system shall be designed to function at ambient air pressure and at an ambient temperature range of 1 to 50°C and shall withstand, when empty, a range of -30 to 60°C.~~

~~5.18The system shall be capable of operation when heeled 22.5° to either side (30° for a sailing vessel) and trimmed 10° by bow or stern and prevent escape of gases, liquids, and sewage to the exterior under the above conditions of heel or trim.~~

~~5.19The system shall prevent escape of liquids or sewage, or both, to the interior of the vessel when heeled 45° to either side and trimmed 10° by bow or stern.~~

~~5.20The operation of the MSD shall be automatic and shall require a minimum of crew attention.~~

~~5.21Installation, operation, and maintenance instructions:~~

~~5.21.1The instructions supplied by the manufacturer must contain directions for each of the following:~~

~~5.21.1.1Installation of the device in a manner that will permit ready access to all parts of the device requiring routine service and that will provide any flue clearance necessary for fire safety.~~

~~5.21.1.2List of cleaning materials that can be safely introduced to system without causing harm to MSD or affecting its operation.~~

~~5.21.1.3Safe operation and servicing of the device so that any discharge meets the applicable requirements of Section 9.~~

~~5.21.1.4Cleaning, winter lay-up, and sludge removal.~~

~~5.21.1.5Installation of a vent or flue pipe.~~

~~5.21.1.6The type and quantity of chemicals that are required to operate the device, including instructions on the proper handling, storage, and use of these chemicals.~~

~~5.21.1.7Recommended methods of making required piping and electrical connections including supply circuit overcurrent protection.~~

~~5.21.2The instructions supplied by the manufacturer must include the following information:~~

~~5.21.2.1The name of the manufacturer.~~

~~5.21.2.2The name and model number of the device.~~

~~5.21.2.3Whether the device is certified for use on an inspected or uninspected vessel.~~

~~5.21.2.4A complete parts list.~~

~~5.21.2.5A schematic diagram showing the relative location of each part.~~

~~5.21.2.6A wiring diagram.~~

~~5.21.2.7A description of service for the user to perform without coming into contact with sewage or chemicals.~~

~~5.21.2.8Average and peak capacity of the device for the flow rate for sewage or combined sewage and graywater, volume, or number of persons that the device is capable of serving and the period of time the device is rated to operate at peak capacity for sewage or combined sewage and graywater waste streams.~~

~~5.21.2.9The power requirements, including voltage and current.~~

~~5.21.2.10The maximum angles of pitch and roll at which the device operates in accordance with the applicable requirements of Section 9~~, or B16.11, or ASME B16.24 or equivalent ISO or DIN standards.