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Ships and marine technology — Marine environment protection — Tanks and piping systems for facilitating 5 ppm oil-water separation

Navires et technologie maritime — Protection de l'environnement marin — Réservoirs et systèmes de systèmes de tuyauterie utilisés pour faciliter la séparation entre le pétrole et l'eau à 5 ppm

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Contents

Page

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 2, *Marine environment protection*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Marine environment protection is required by national, regional and international regulations.

The *International Convention for the Prevention of Pollution by Ships* (MARPOL) was adopted in 1973 and it has been regularly updated by amendments made by the Marine Environment Protection Committee (MEPC) of the International Maritime Organization (IMO). MARPOL is the legal basis for the prevention of marine pollution. MARPOL requires the installation of oil-water separation systems to treat fluids consisting of mixtures of oil and water generated on board ships.

On fixed offshore marine structures (e.g. converter stations and transformer substations of offshore wind turbines), oil-in-water emulsions, oily mixtures of surface water, fuel and lubrication oil, and many other substances covered by regulations might spill or otherwise cause hazards. Hence there is a need to separate these mixtures to an oil concentration of less than what is currently required by MARPOL.

Ships and marine technology — Marine environment protection — Tanks and piping systems for facilitating 5 ppm oil-water separation

1 Scope

This document provides requirements and test methods for tanks, piping and separation systems facilitating the separation of contaminated fluids of oil and water on fixed offshore marine structures and ships, where treatment is performed by separation systems that optimize oil-water separation to a concentration equal to or less than 5 ppm.

It is applicable to fixed offshore marine structures and to ships operating in designated sea areas determined by the relevant authorities.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 8217, *Petroleum products — Fuels (class F) — Specifications of marine fuels*

ISO 9377-2, *Water quality — Determination of hydrocarbon oil index — Part 2: Method using solvent extraction and gas chromatography*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
parts per million
ppm
number of parts of oil per one million parts of water, expressed by volume

Note 1 to entry: 1 ppm equals to 1 µl of oil per 1 l of water.

3.2
ppm display
numerical scale display of the *parts per million* (3.1)

4 Technical specifications

4.1 Oil-water separation equipment (OWSE)

Oil-water separation equipment (OWSE) installed on fixed offshore marine structures shall be constructed suitable for offshore use.

The OWSE shall comprise:

— an oil-water separator (5 ppm OWS);

— a 5 ppm oil content meter (5 ppm OCM); and

— an automatic discharge stopping device (ADSD).

If intended to be fitted in locations where flammable atmospheres can be present, OWSE are expected to comply with the relevant safety regulations for such spaces. Any electrical or electronic equipment which is part of the 5 ppm oil-water separation equipment shall be either intended and designated for use in non-hazardous areas, or, if intended to be used in hazardous areas, it shall be type-approved by the Administrations or recognized organizations on their behalf as safe for use in hazardous areas.

Figure 1 shows an example of the functional layout of an OWSE.

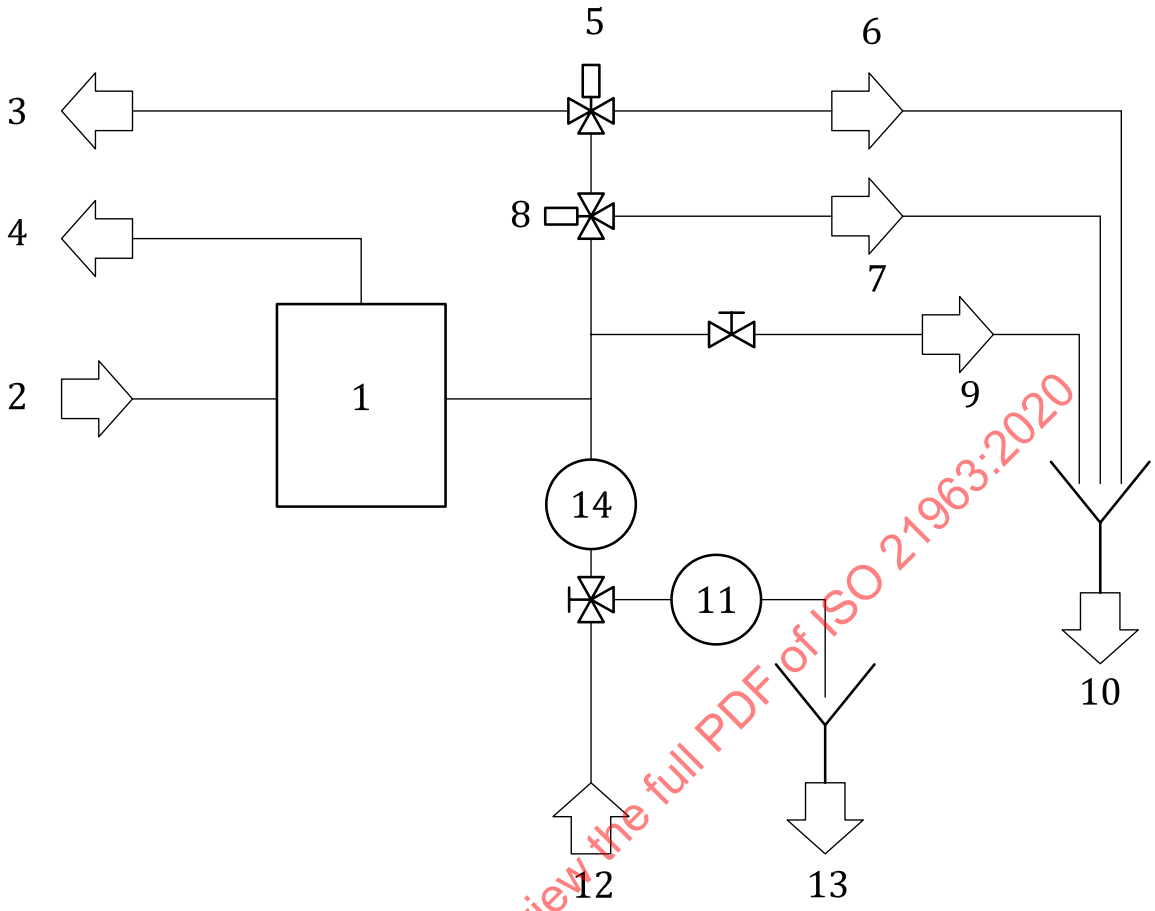
The OWSE shall be resistant to corrosion and to other conditions of the marine environment where it is in use.

The OCM may include an oil content alarm.

An example of a schematic plan for the management of oil-in-water effluents in fixed marine offshore structures is shown in Figure A.1.

An example of a schematic diagram for the management of the separation and treatment of oil-in-water effluents on fixed marine structures is shown in Figure A.2.

Fixed offshore marine structures or ships fitted with an OWSE shall, at all times, have a copy of the operating and maintenance manuals available.



Key

1 5 ppm OWS
2 mixture inlet, filling and rinsing (oil-free water)
3 discharge treated water, oil <5 ppm into the sea
4 discharge separated media into waste oil tank
5 manual recirculation facility or valve for testing (inherently safe)
6 discharge for testing
7 recirculation water, oil >5 ppm
8 ADSD
9 sampling location
10 back to bilge water holding tank or bilge
11 OCM
12 flushing water inlet
13 back to bilge water holding tank or bilge
14 flow switch controller

Figure 1 — Example of functional layout of an OWSE

4.2 5 ppm OWS

The 5 ppm OWS shall be designed to reduce the oil content in an oil-in-water mixture to a volume concentration equal to or less than 5 ppm.

The 5 ppm OWS shall be so designed that it functions automatically. However, fail-safe arrangements to avoid any discharge in case of malfunction shall be provided.

The 5 ppm OWS may include any combination of a separator utilizing gravity separation, filtration, and coalescence to produce an effluent with an oil content not exceeding 5 ppm by volume.

The 5 ppm OWS shall utilize a continuous automatic process and shall indicate when it is in operation. It shall be capable of continuous operation for at least 24 h or normal duty without attention.

All parts of the 5 ppm OWS which are subject to wear and tear shall be easily accessible for maintenance.

4.3 Oil content meter (OCM)

The OCM shall be able to measure the oil content in the water mixture with a resolution of 1 ppm and shall provide a ppm display. The ppm reading shall not be affected by emulsions and/or the type of oil.

The OCM shall give an alarm signal if the oil content exceeds 5 ppm in the effluent. The response time of the OCM, that is the duration between a deviation in the sample being supplied to the OCM and the display showing the current oil content (ppm), shall not exceed 5 s.

If the OCM is flushed with water for more than 5 s, the system shall create an alarm.

The accuracy of the OCM shall be checked at least every 5 years according to the manufacturer's instructions. Alternatively, the unit may be replaced by a calibrated OCM. The calibration certificate for the OCM, certifying the date of the last calibration check, shall be retained on the fixed offshore marine installation for inspection purposes. The accuracy checks can only be done by the manufacturer or duly authorized entity.

The bilge alarm shall record date, time and alarm status, and operating status of the OWS. The recording device shall also store data for at least eighteen months and shall be able to display or print a protocol for official inspections as required. In the event the bilge alarm is replaced, means shall be provided to ensure the data recorded remains available on board for 18 months.

To avoid willful manipulation of the bilge alarms, every access of the bilge alarm requires the breaking of a seal.

The alarm is always activated even when clean water is used for cleaning or zeroing purposes.

The Administration shall require the type approval of the 5 ppm OCM[2].

4.4 Automatic discharge stopping device (ADSD)

The ADSD shall stop automatically any discharge overboard of the oily mixture if the content of the effluent exceeds 5 ppm measured by the OCM, or when failure of the OCM occurs.

The ADSD shall consist of a valve arrangement, installed in the effluent outlet line of the 5 ppm OWS, which diverts the effluent mixture from being discharged overboard back to the source or other tank if the free oil content of the effluent exceeds the pre-set value.

4.5 Electric and electronic systems

The switchboard of the OWSE shall be type-approved by the Administration or recognized organization on their behalf in accordance with Annex C of this document.

4.6 Heating facilities

If the OWSE is fitted with heating facilities to retain the oil in it to a maximum of 40 °C by any process, the certificate of type approval shall be endorsed with the following statement:

"The 5 ppm OWSE is fitted with heating facility"

5 Installation requirements

5.1 5 ppm OWS

For inspection purposes, a sampling point shall be provided at a position in a vertical section of the water effluent piping as close as is practicable to the 5 ppm OWS outlet. Recirculation facilities shall be provided, after and adjacent to the overboard outlet of the stopping device, to enable the OWSE system to be tested with the overboard discharge closed (see Figure 1).

The recirculating facility shall be so configured as to prevent, under all operating conditions, any by-pass of the OWS.

The capacity of the supply pump shall not exceed 90 % of the rated capacity of the 5 ppm OWS.

The OWS shall be fitted with a permanently attached nameplate giving any operational or installation limits considered necessary by the manufacturer.

5.2 Oil content meter (OCM)

The arrangement for the monitoring of the OWS discharge line to the OCM shall give a representative sample of the effluent with an adequate pressure and flow.

5.3 Automatic discharge stopping device (ADSD)

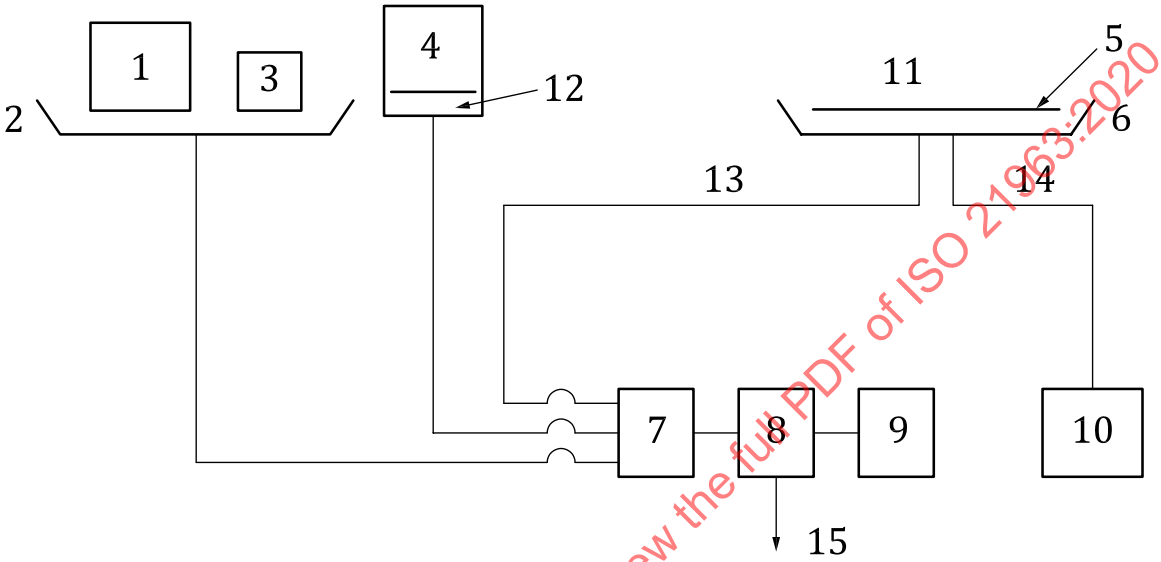
The layout of the installation shall be arranged so that the overall response time, including the response time of the OCM between an effluent discharge from the OWS exceeding 5 ppm and the operation of the ADSD preventing overboard discharge, shall be as short as possible and in any case not more than 20 s.

6 Testing of the 5 ppm OWS

The OWS shall be tested in accordance with Annex B.

Annex A
(informative)

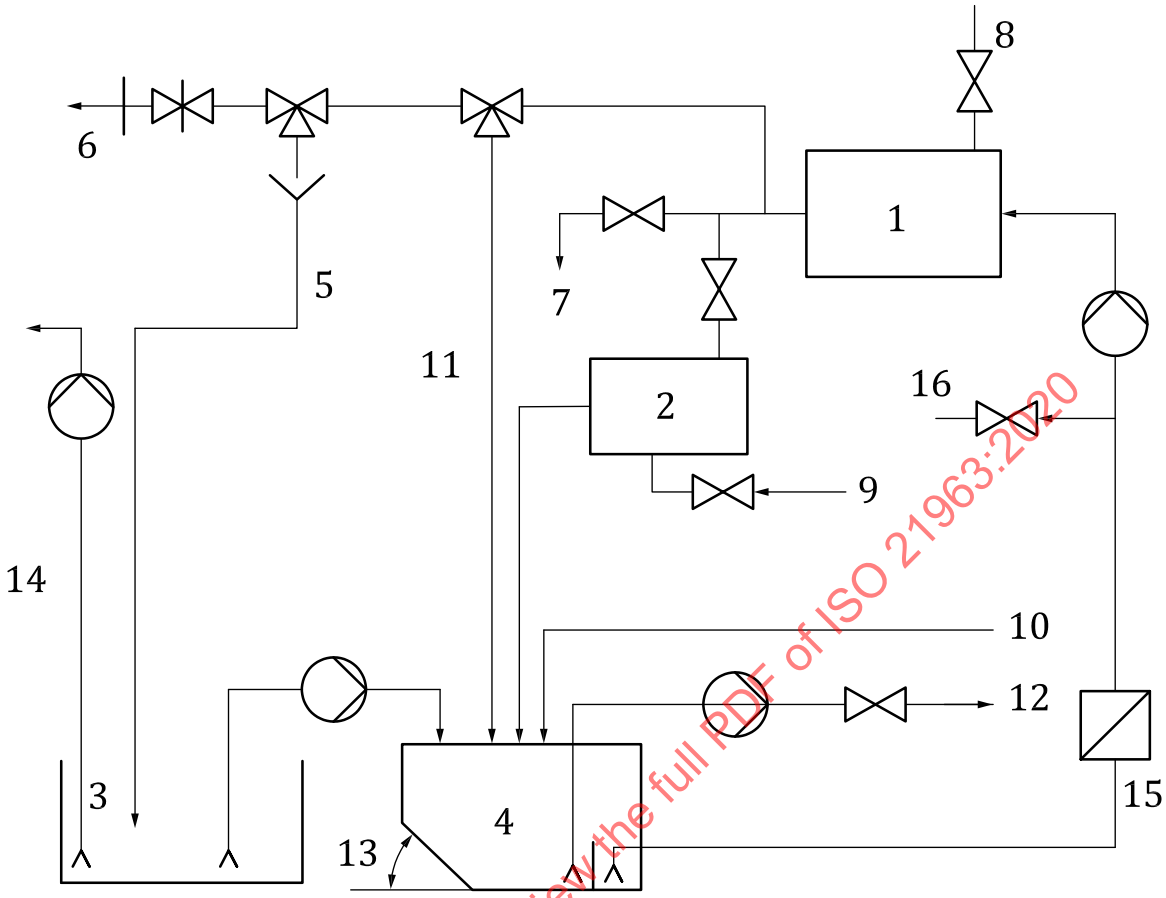
Examples of schematic diagrams for the management of oil-water effluents on fixed offshore marine structures



Key

1	transformer/converter room	9	holding tank for separated oil
2	collection pan	10	collector tank for extinguishing agent
3	oil cooler	11	rain water
4	engine room	12	bilge water
5	helicopter deck	13	surface water
6	collection pan	14	extinguishing agent
7	holding tank	15	clean water with residual oil ≤5 ppm
8	OWSE		

Figure A.1 — Example of a schematic plan for the management of oil-in-water effluents



Key

1	5 ppm OWS	9	rinsing water/no drinking water
2	OCM	10	tank drains
3	bilge in engine room	11	recirculation
4	holding tank (bilge water tank)	12	pipeline for sludge into a sludge tank
5	outlet to function test of ADSD	13	bottom inclination ≥10 degrees
6	treated water, oil content ≤5 ppm	14	emergency bilge pipeline
7	sampling	15	non-return valve
8	separated oil	16	filling and rinsing/no drinking water

Figure A.2 — Example of schematic diagram of oil-in-water effluents systems in the machinery space of fixed offshore marine structures and ships

Annex B
(normative)

Testing of 5 ppm OWS

B.1 General

This annex specifies the test procedures of 5 ppm OWS.

The 5 ppm OWS shall be tested using the test rig described in B.2 and the test fluids described in B.3 in accordance with the test procedures specified in B.4. The effluent out from the 5 ppm OWS under these tests shall be examined, in particular the oil content, in accordance with the procedures specified in B.5, and reported in the way presented in B.6.

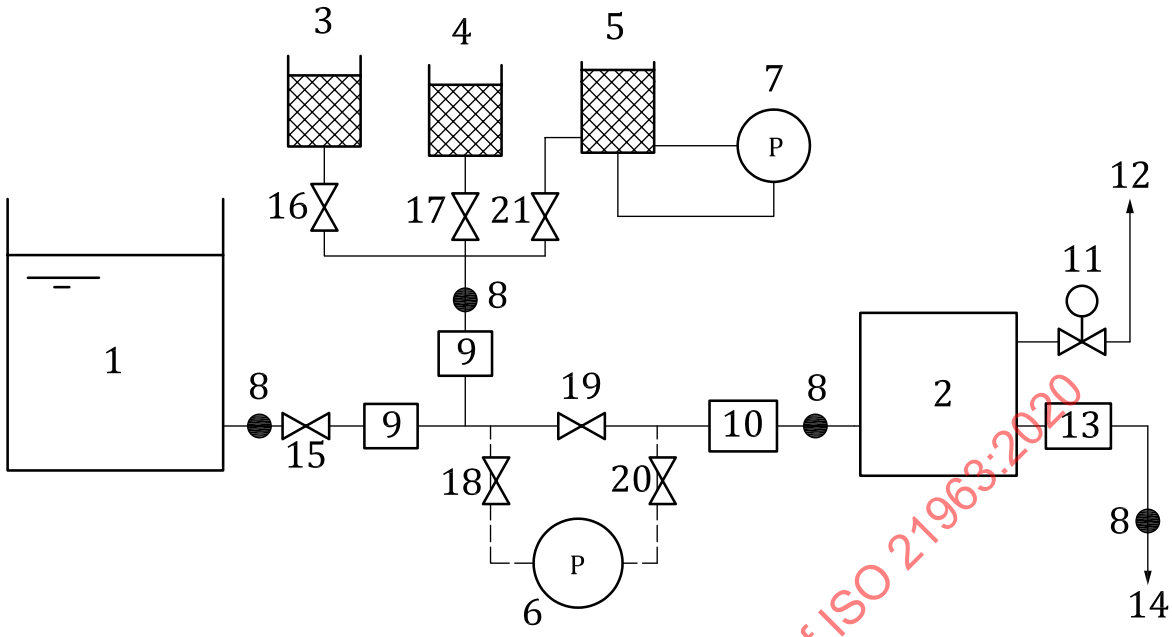
Where a range of 5 ppm OWS of the same design, but of different capacities, requires certification in accordance with these specifications, the tests may be accepted in two capacities within the range, in lieu of accepting tests on every size, provided that the two tests actually performed are from the lowest quarter and highest quarter of the range.

B.2 Test rig, equipment and arrangement

B.2.1 General

The test rig shall consist of a test tank, a flow meter, pump, a conditioning pipe and valves 15 to 21 shown in Figure B.1. Each component of the test rig shall meet the requirements of B.2.2 to B.2.6.

The pipe work shall be designed for a maximum liquid velocity of 3 m s^{-1}.



Key

1	clean water	12	separated oil
2	5 ppm OWS	13	observation window
3	test fluid "A" (B.3.2)	14	effluent
4	test fluid "B" (B.3.3)	15	cocks
5	test fluid "C" (B.3.4)	16	
6	centrifugal pump A	17	
7	centrifugal pump B	18	
8	sampling point	19	
9	flow meter	20	
10	conditioning pipe	21	
11	automatic oil discharge valve		

Figure B.1 — Schematic plan of the test rig

B.2.2 Test tanks

The test tanks shall be of sufficient supply capacity to ensure continuous operation of the OWS and shall be connected as shown in Figure B.1.

B.2.3 Flow meters

The flow meters to measure the flow rate of the test fluids shall be located as shown in Figure B.1.

NOTE There is no fixed rate for the flow meters. The rate depends on the rate of the OWS.

B.2.4 Pumps

B.2.4.1 Centrifugal pumps

For the testing of a 5 ppm OWS having no integrated feed pump, the centrifugal pump A (see Figure B.1) shall be used to feed the 5 ppm OWS with cocks 18 and 20 open, and cock 19 closed. The rate of flow from the centrifugal pump A shall be matched to the design throughput of the 5 ppm OWS by the adjustment of the centrifugal pump's discharge valve.

The centrifugal pump shall operate at not less than 1 000 r/min and shall have a delivery capacity of not less than 1,1 times the rated capacity of the 5 ppm OWS at the delivery pressure required for the test.

The variation in the test fluid/water ratio is obtained by adjusting the valves on the test fluid and the water suction pipes adjacent to the pump suction. The flow rate of the test fluid and the water or the test fluid content of the supply to the 5 ppm OWS shall be monitored.

B.2.4.2 Integrated feed pump

If the 5 ppm OWS includes an integrated feed pump, this OWS shall be tested with that pump supplying the required quantity of test fluid and water to the OWS at its rated capacity.

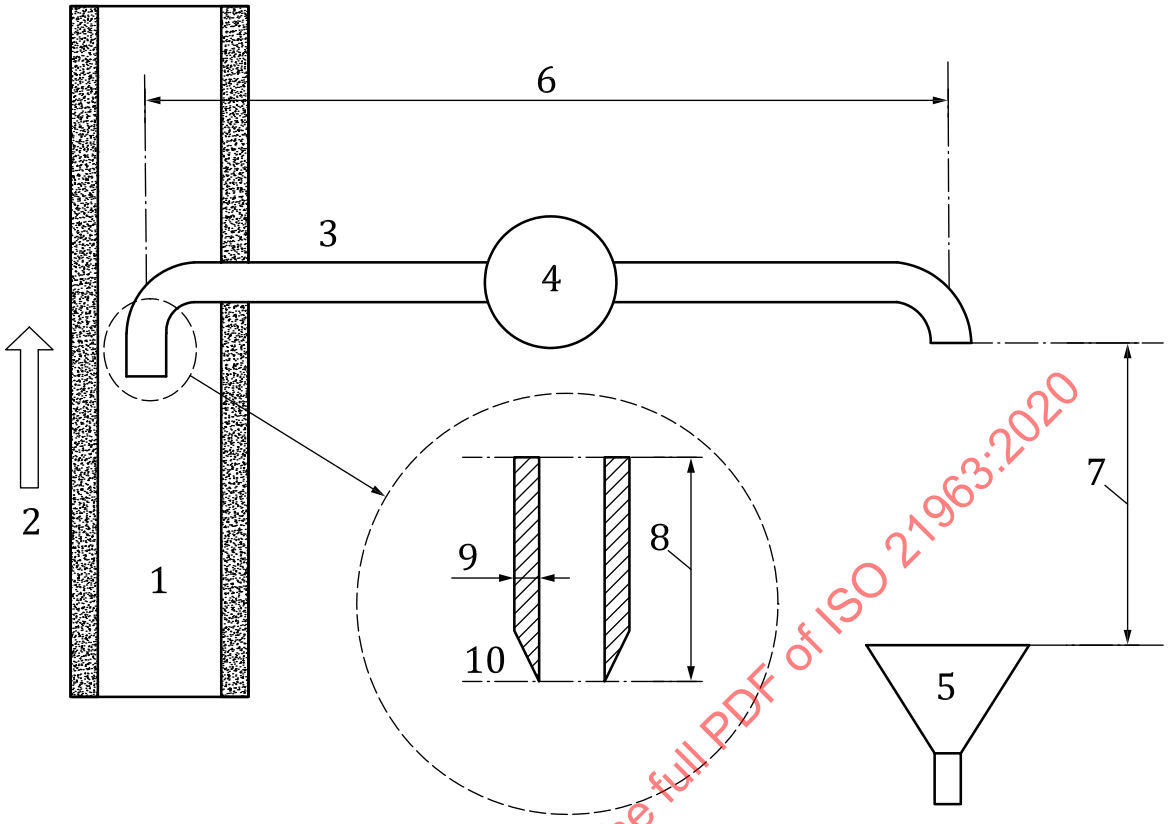
B.2.5 Conditioning pipe

To ensure uniform conditions, the piping arrangements immediately prior to the 5 ppm OWS shall be such that the influent to the OWS shall have a Reynold's number of not less than 10 000, as calculated for fresh water, and a liquid velocity of not less than 1 m s^{-1}. The length of the supply pipe from the point of test fluid injection to the OWS shall be of not less than 20 times its diameter. A mixture inlet sampling point and a thermometer pocket shall be provided near the OWS inlet, and an outlet sampling point and an observation window shall be provided on the discharge pipe.

B.2.6 OWS sampling arrangement

In order to achieve an isokinetic flow for sampling purposes, the sample shall enter the sampling pipe at stream velocity. The sampling arrangement shall be as shown in Figure B.2 and, if a cock is fitted, a free flow shall be achieved for at least 1 min before any sample is taken. The sampling point for the test fluid shall be installed in pipes running vertically.

The samples should be taken without any back-flushing of oil-free water and/or other operating media. Before a sample is taken, the separating operation shall not be interrupted.



Key

1	OWS outlet pipe	6	not more than 400 mm
2	direction of flow upwards	7	distance sufficient for the sampling bottle
3	sampling pipe to OCM	8	straight length not less than 60 mm
4	straight through on/off cock	9	pipe thickness not greater than 2 mm
5	sampling bottle receiver	10	chisel edged chamfer 30 degrees

Figure B.2 — Diagram of OWS sampling arrangement

B.3 Test fluids

B.3.1 General

Tests shall be performed using three grades of test fluids, i.e., test fluid "A," test fluid "B," and test fluid "C."

B.3.2 Test fluid "A"

The test fluid "A" shall be a marine residual fuel oil in accordance with ISO 8217, type RMG 380 (density at 15 °C not exceeding 991,0 kg/m^3).

B.3.3 Test fluid "B"

The test fluid "B" shall be a marine distillate fuel oil in accordance with ISO 8217, type DMA (density at 15 °C not exceeding 890 kg/m^3).

B.3.4 Test fluid "C"

The test fluid "C" is a mixture of an oil-in-fresh water emulsion, in the ratio where 1 kg of the mixture consists of the following:

— 947,8 g fresh water;

— 25,0 g test fluid "A";

— 25,0 g test fluid "B";

— 0,5 g surfactant (sodium salt of dodecyl benzene sulfonic acid) in the dry form; and

— 1,7 g "iron oxides."

The term "iron oxide" is used to describe black ferrosoferric oxide (Fe_3O_4) with a particle size distribution of which 90 % is less than 10 microns, the remainder having a maximum particle size of 100 microns.

The procedure for preparing a test fluid "C" shall be as follows.

a) Calculation of the ingredients of a test fluid "C" for an example of 2 m^3/h 5 ppm OWS.

   — Operating period for the test with test fluid "C" as per B.4.4: 2,5 h plus conditioning time (for example 0,5 h) = 3 h.

   — Net volume needed for the test:

      — volume of test water: 2 m^3/h × 3 h = 6 m^3;

      — volume of test fluid “C”: 6 % of test water = 0,06 × 6 m^3 = 0,36 m^3.

   — Actual volume to be prepared:

      — volume of test fluid “C” to be prepared: 1,2 times the net volume of test fluid “C” = 1,2 × 0,36 = 0,432 m^3

      — volume of fresh water in test fluid “C”: (947,8 g/1 000 g) of test fluid “C” = 0,947 8 × 0,432 = 0,409 4 m^3;

      — mass of test fluid “A”: (25 g/1 000 g) of test fluid “C” = 25/1 000 × 0,432 × 1 000 = 10,8 kg;

      — mass of test fluid “B”: (25 g/1 000 g) of test fluid “C” = 25/1 000 × 0,432 × 1 000 = 10,8 kg;

      — mass of surfactant: (0,5 g/1 000 g) of test fluid “C” = 0,5/1 000 × 0,432 × 1 000 = 0,216 kg;

      — mass of iron oxide: (1,7 g/1 000 g) of test fluid “C” = 1,7/1 000 × 0,432 × 1 000 = 0,734 kg.

b) The preparation of test fluid “C” shall be as follows:

   — measure out 1,2 times the quantity of surfactant required for the “Test with test fluid C” as described in B.4.4; and

   — mix it with fresh water and stir well in a small container (e.g., a beaker or bucket) to make a mixture (“Mixture D”) until the surfactant has been thoroughly dissolved.

c) The test fluid “C” shall be made in the test fluid tank (Figure B.3), in accordance with the following procedures:

   — fill the test fluid tank with fresh water with a quantity of 1,2 times the volume of the total quantity of water in the test fluid “C” needed for the test described in B.4.4;

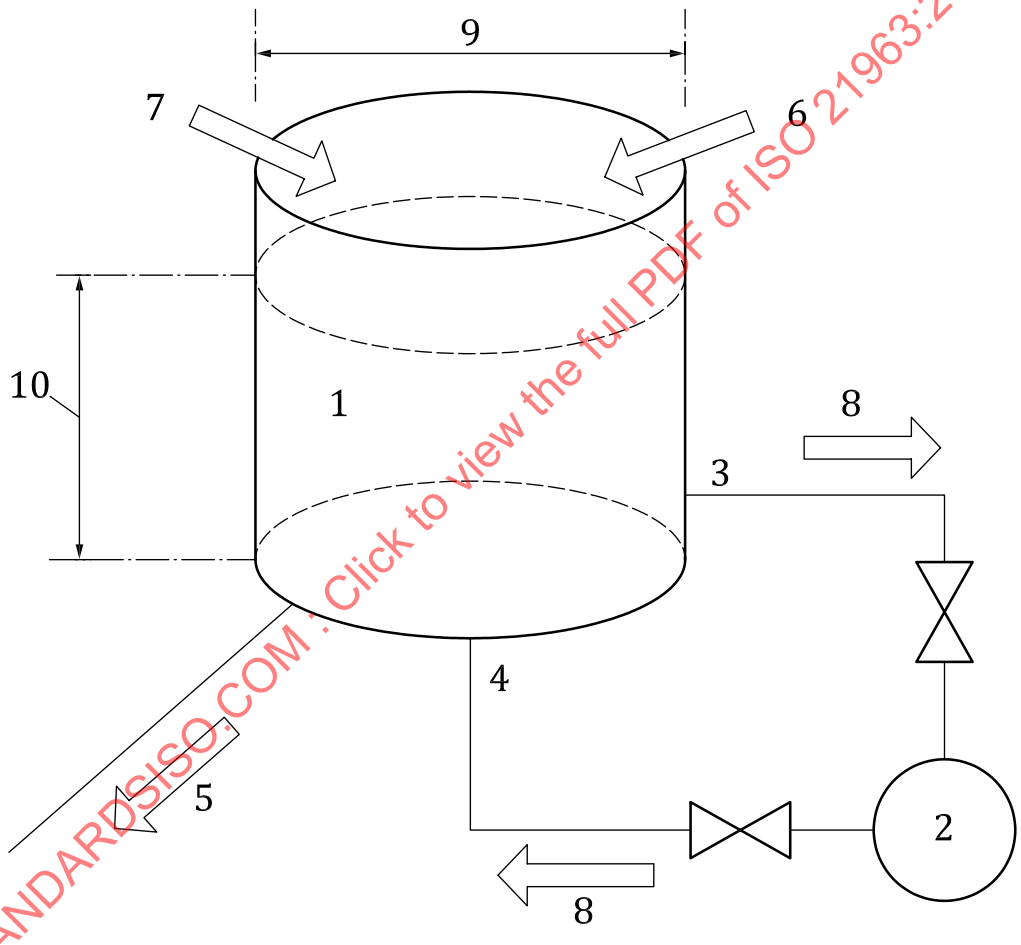
   — operate the centrifugal pump B running at a speed of not less than 3 000 r/min (nominal) with a flow rate at which the volume of the test fluid has been changed out at least once per minute;

— add “Mixture D” first, followed by oil and suspended solids (iron oxides) respectively, both 1,2 times of the required amounts, to the fresh water in the tank;

— to establish a stable emulsion, keep running the centrifugal pump B for 1 h and confirm no oil floats on the surface of the test fluid;

— after the 1 h stated in the list item above, keep running the centrifugal pump B at reduced speed to approximately 10 % of original flow rate, until the end of the test.

The tank to make fluid "C," as shown in Figure B.3, shall be of a cylindrical shape, and the level of the water (shown as 10 in Figure B.3) shall be within 0,5 *D* to 2 *D* (where *D* is the inner diameter of the tank shown as 9 in Figure B.3), when preparing test fluid "C." In Figure B.3, the outlet going to the centrifugal pump B shall be fitted as low as possible on the tank, and the inlet to the tank shall be fitted at the centre of the tank bottom so that the mixture flows upward to obtain a uniform and stable emulsion.



Key

1 tank for making test fluid "C"
2 centrifugal pump
3 outlet
4 inlet
5 to 5 ppm OWS
6 mixture D, oils and suspended solids
7 fresh water
8 direction of flow
9 inner tank diameter
10 height of mixture in the tank

Figure B.3 — Tank for making test fluid "C"

B.4 Test procedures

B.4.1 General

B.4.1.1 If the OWSE is fitted with heating facilities to retain the oil in it to a maximum of 40 °C by any process, the OWSE shall be tested with the heating facilities in operation, and the test report shall indicate the heating conditions.

B.4.1.2 If the OWS includes an integrated feed pump, the OWS shall be tested with the feed pump in operation, and the test report shall indicate the tested flow rate.

B.4.1.3 For an OWS depending essentially on gravity, the feed of the test water and the test fluid mixture to the system shall be maintained at a temperature not greater than 40 °C, and heating and cooling coils shall be provided where necessary. The water shall have a density of not more than 1 015 kg/m^3 at 20 °C. In other forms of separation where the dependence of separation efficiency on temperature is not established, tests shall be carried out over a range of influent temperatures representing the normal shipboard operating range of 10 °C to 40 °C, or shall be taken at a temperature in the range where the separation efficiency is known to be worst.

B.4.1.4 In those cases where, for the OWS, it is necessary to heat water up to a given temperature and to supply heat to maintain that temperature, the test shall be carried out at the given temperature.

B.4.1.5 The timing of sampling is illustrated in Figure B.4 in relating to B.4.2, B.4.3, and B.4.4.

B.4.2 Test with test fluid "A

B.4.2.1 After filling with water (density at 20 °C not more than 1 015 kg/m^3), the OWS commences the test with the oil section of the OWS with the test fluid, and with the supply line impregnated with the test fluid. The OWS shall, while in the operating condition, be fed with the pure test fluid for not less than 5 min.

B.4.2.2 The OWS shall be fed with a mixture composed of between 5 000 ppm and 10 000 ppm of the test fluid in water until steady conditions have been established. Steady conditions are assumed to be the conditions established after pumping through the OWS a quantity of the test fluid/water mixture not less than twice the volume of the OWS. The test shall then proceed for 30 min. Samples shall be taken at the effluent outlet at 10 min and 20 min from the start of this period. At the end of the test, an air cock shall be opened on the suction side of the pump and, if necessary, the oil and water valves shall be slowly closed together, and a sample taken at the effluent discharge as the flow ceases (this point can be checked from the observation window).

B.4.2.3 A test identical to that specified in B.4.2.2, including the opening of the air cock, shall be carried out with a mixture composed of approximately a 25 % volume fraction of test fluid and a 75 % volume fraction of water.

B.4.2.4 The OWS shall be fed with 100 % test fluid for at least 5 min during which time the observation window shall be checked for an oily discharge. Sufficient test fluid shall be fed into the OWS to operate the automatic oil discharge valve. The test shall be continued for 5 min using 100 % test fluid supply in order to check the sufficiency of the oil discharge system.

B.4.2.5 The OWS shall be fed with water (density at 20 °C not more than 1 015 kg/m^3) for 15 min. Samples of the separated water effluent are taken at the beginning of the test and after the first 10 min.

B.4.2.6 A test lasting a minimum of 2 h shall be carried out to check that the OWS operates continuously and automatically. This trial shall use a cycle varying progressively from water to oily mixture with approximately a 25 % volume fraction of test fluid and back to water every 15 min, and shall test

adequately any automatic device which is fitted. The whole test sequence shall be performed without interruption. At the end of the test, while the OWS is being fed with a 20 % volume fraction of test fluid, a water effluent sample shall be taken for analysis.

B.4.3 Test with test fluid "B"

B.4.3.1 The OWS shall be fed with a mixture composed of test fluid "B" and water with an oil content between 5 000 ppm to 10 000 ppm until steady conditions have been established. Steady conditions are assumed to be the conditions established after pumping through the OWS a quantity of the test fluid and water mixture not less than twice the volume of the OWS. The test shall then proceed for 30 min. Samples shall be taken at the effluent outlet at 10 min and 20 min from the start of this period. At the end of the test, an air cock shall be opened on the suction side of the pump and, if necessary, the oil and water valves shall be slowly closed together, and a sample shall be taken at the effluent outlet as the flow ceases (this can be checked from the observation window).

B.4.3.2 A test identical to that specified in B.4.3.1, including the opening of the air cock, shall be carried out with a mixture composed of approximately a 25 % volume fraction of test fluid "B" and a 75 % volume fraction of water. In this test, the operation of the oil discharge system shall be checked.

B.4.4 Tests with test fluid "C"

B.4.4.1 The OWS shall be fed with a mixture composed of a 6 % volume fraction of test fluid "C" and 94 % volume fraction of water to have an emulsified oil content of 3 000 ppm in the test water until steady conditions have been established. Steady conditions are assumed to be the conditions established after pumping through the OWS a quantity of test fluid "C" and water mixture not less than twice the volume of the OWS.

B.4.4.2 The test shall then proceed for 2,5 h. Samples shall be taken at the effluent outlet at 50 min and 100 min after conditioning. At the end of the test, an air cock shall be opened on the suction side of the pump and, if necessary, the test fluid "C" and water valves shall be slowly closed together, and a sample shall be taken at the effluent discharge as the flow ceases (this point can be checked from the observation window).

B.5 Analysis

Oil content in sampled water taken from the outlet of the tested OWS shall be measured according to ISO 9377-2, which specifies a method for the sampling and subsequent determination of the hydrocarbon oil index in water using solvent extraction and gas chromatography.

B.6 Reporting

The following data of testing methods and test results shall be reported:

a) properties of test fluids "A" and "B":

- density at 15 °C,
- kinetic viscosity (centistokes at 100 °C and 40 °C),
- flashpoint,
- ash, and
- water content;

b) properties of test fluid "C":

- type of surfactant,
- particle size percentage of non-soluble suspended solid, and
- surfactant and iron oxide quality verification;

c) properties of the water in the water tank:

- density of water at 20 °C, and
- details of any solid matter present;

d) temperature at the inlet to the 5 ppm OWS;

e) a diagram of the test rig used;

f) a diagram of the sampling arrangement;

g) the method used in the analysis of all samples taken and the results thereof;

h) certification from the manufacturer that the tests were completed and successful.

NOTE Appendix 1 of MEPC.107(49)[3] gives the format of the certificate of Type Approvals which includes the diagram of the sampling timing.