5 ppm Bilge Water Separators

MARCH 2014
FOREWORD

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CHANGES – CURRENT

General
This document supersedes STC No. 2.9 TAP No. 771.60, May 2011.

Text affected by the main changes in this edition is highlighted in red colour. However, if the changes involve a whole chapter, section or sub-section, normally only the title will be in red colour.

Det Norske Veritas AS, company registration number 945 748 931, has on 27th November 2013 changed its name to DNV GL AS. For further information, see www.dnvgl.com. Any reference in this document to “Det Norske Veritas AS” or “DNV” shall therefore also be a reference to “DNV GL AS”.

Main changes

• General
Scope for the TAP has been changed since requirements regarding alarms has been moved into a new TAP 771.61 “5 ppm bilge alarms”.

• Sec.4 Conformity assessment of design of product type
— [4.2]: Docreq. has been specified

• Sec.5 Design requirements
— [5.1]: Specified that TA can only be given for the tested equipment
— Previous 5.3 has been removed

• Sec.7 Installation requirements
— Previous 7.2: Item a) and b) have been moved to [7.1] and 7.2 c) has been deleted.

Previous Appendix B “Test and performance specifications for type approval of 5 ppm bilge alarms” has been removed and the following appendixes have been renumbered.

Editorial corrections
In addition to the above stated main changes, editorial corrections may have been made.
CONTENTS

CHANGES – CURRENT ..................................................................................................................................................... 3

1 Scope ........................................................................................................................................................................ 5

2 Background .............................................................................................................................................................. 5

3 Definitions .................................................................................................................................................................. 5

4 Conformity assessment of design of product type .................................................................................................... 6
   4.1 Type approval procedures ................................................................................................................................... 6
   4.2 Documentation to be submitted .......................................................................................................................... 6

5 Design requirements .................................................................................................................................................. 6
   5.1 General ............................................................................................................................................................... 6
   5.2 Specific requirements to 5 ppm bilge separator ................................................................................................. 6

6 Product marking .......................................................................................................................................................... 7

7 Installation requirements ............................................................................................................................................ 7
   7.1 5 ppm bilge separator ......................................................................................................................................... 7

App. A Test and performance specifications for type approval of 5 ppm bilge separators ......................................................... 9
   A.1 General ............................................................................................................................................................... 9
   A.2 Test specifications ............................................................................................................................................. 9

App. B Specifications for environmental testing for type approval of pollution prevention equipment ................................ 15
   B.1 General ............................................................................................................................................................... 15
   B.2 Test specifications ............................................................................................................................................. 15

App. C Method for determination of oil content ........................................................................................................... 16
   C.1 Scope and application ............................................................................................................................................. 16
   C.2 Checklist ............................................................................................................................................................ 16
   C.3 Test results (in ppm) and test procedures .......................................................................................................... 17

CHANGES – HISTORIC ............................................................................................................................................... 18
1 Scope

Type approval is a procedure for certifying that the design of a product type is in conformity with a set of predetermined requirements.

This type approval programme gives the requirements on which Det Norske Veritas bases its type approval of 5 ppm Bilge Water Separators.

The procedure for assessment of conformity of manufactured products (production) and the installation on board is not within the scope of the type approval programme. However if during the type approval process it will be discovered that certain issues may affect onboard performance and satisfactory operation within given in this programme limits and requirements then all these issues shall be clarified by the manufacturer before the issuance of type approval certificate.

In general the conditions outlined in this programme shall be fulfilled before the type approval certificate is issued.

2 Background

DNV Rules for Ships in relevant parts stipulates that the oil content of the effluent from 5 ppm bilge separators to overboard should not exceed 5 ppm. The areas with 5 ppm overboard discharge are also defined by some Flag Authorities.

3 Definitions

For the purpose of this programme “Pollution prevention equipment” comprises:

— 5 ppm bilge separator
— automatic stopping device.

Bilge water means water which may be contaminated by oil resulting from things such as leakage or maintenance work in machinery spaces. Any liquid entering the bilge system, bilge piping, tank top or bilge holding tanks is considered oily bilge water.

5 ppm bilge separator may include any combinations of a separator, filter, coalesces or other means, and also a single unit designed to produce an effluent with oil content not exceeding 5 ppm.

5 ppm bilge alarm is an oil content meter with associated alarm which is capable of detecting and measuring 5 ppm or less of oil in a ship’s bilge water overboard discharge.

ppm means parts of oil per million parts of water by volume.

ppm display is a numerical scale display of the 5 ppm bilge alarm.

Automatic Stopping Device is a device used, where applicable, to automatically stop any discharge overboard of oily mixture when the oil content of the effluent exceeds 5 ppm. The automatic stopping device should consist of a valve arrangement installed in the effluent outlet line of the 5 ppm bilge separator which automatically diverts the effluent mixture from being discharged overboard back to the ship’s bilges or bilge tank when the oil content of the effluent exceeds 5 ppm.

Accredited laboratory means:

a) DNV's laboratories at Høvik, Norway.
b) At a European Laboratory accredited for all the required tests by an Accreditation Body being member of European Accreditation, EA.
c) At a non-European Laboratory accredited by an organisation who has signed a multilateral agreement (MLA) with EA.
d) At a laboratory having the quality system audited by DNV. A quality audit by DNV means that a competent person has gone through the Quality System of the laboratory in accordance with ISO/IEC 17025 (and EN45001) and that a “Statement of Recognition” has been issued.
e) At a laboratory recognised/certified by the Marine Administration of one EU Member State or by another Notified Body (MED).
f) At any laboratory when testing is witnessed by a DNV surveyor.
4 Conformity assessment of design of product type

4.1 Type approval procedures
All the aspects such as obtaining, retention, renewal, suspension and withdrawal of type approval certificate are described in DNV Standard for Certification – No.1.2. Type Approval is valid for 4 years.

4.2 Documentation to be submitted
The following documentation shall be submitted electronically well in advance before the testing at the manufacturer:

- DNV Application form (90.01a)
- performance test plan according to App.A
- environmental test plan according to App.B
- functional description of all essential parts of the equipment
- control and automation documentation:
  - hardware, firmware and software revision information.
- assembly drawings showing main dimensions and equipment arrangement
- detailed drawings of all mechanical components with material list
- piping diagram with material list
- electrical system and instrumentation layout and diagrams
- operation and maintenance manual and instructions.

These documents will be evaluated in accordance with this document and other applicable rules.

Note:
All drawings and descriptions are to be marked with drawing number, name, revision no., issue date, etc. Manufacturer must submit a proposal for performance testing which must be approved before the testing can begin.

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5 Design requirements

5.1 General
This programme is considered to be applicable for use of pollution prevention equipment in conjunction with oily bilge water and ballast water from fuel oil tanks, as these are of a low or medium capacity, and are conditioned by the need to avoid discharging oil mixtures with oil content more than 5 ppm of the mixture.

The production model of the pollution prevention equipment, for which the approval will apply, shall be identical to the equipment, type-tested and environmental tested in accordance with the test and performance specifications contained in App.A and App.B.

It should be understood that a 5 ppm bilge separator must be capable of handling any oily mixtures from the machinery space bilges and be expected to be effective over the complete range of oils which might be carried on board ship, and deal satisfactorily with oil of very high relative density, or with a mixture presented to it as an emulsion. Cleansing agents, emulsifiers, solvents or surfactants used for cleaning purposes may cause the bilge water to emulsify. With the possibility of emulsified bilge water always present the 5 ppm bilge separator must be capable of separating the oil from the emulsion to produce an effluent with an oil content not exceeding 5 ppm.

The routine maintenance permitted operating parameters and procedures for the 5 ppm bilge separator should be clearly defined by the manufacturer in the associated operating and maintenance manuals.

5.2 Specific requirements to 5 ppm bilge separator
a) The 5 ppm bilge separator should be strongly constructed and suitable for shipboard use, bearing in mind its intended location on the ship.

b) It should, if intended to be fitted in locations where flammable atmospheres may be present, comply with the relevant safety regulations for such spaces. Any electrical equipment which is part of the 5 ppm bilge separator should be based in a non-hazardous area, or should be certified as safe for use in a hazardous area. Any moving parts which are fitted in hazardous areas should be arranged so as to avoid the formation of static electricity.

c) The 5 ppm bilge separator should be so designed that it functions automatically. However, fail-safe arrangements to avoid any discharge in case of malfunction should be provided.
d) Changing the feed to the 5 ppm bilge separator from bilge water to oil, bilge water to emulsified bilge water, or from oil and/or water to air should not result in the discharge overboard of any mixture containing more than 5 ppm of oil.

e) The system should require the minimum of attention to bring it into operation. In the case of equipment used for engine room bilges, there should be no need for any adjustment to valves and other equipment to bring the system into operation. The equipment should be capable of operating for at least 24 hours of normal duty without attention. It should be understood that the complete type approval with the test fluids A, B and C should be performed in series, without interruption to attend, clean or maintain the bilge water separator. This test would be regarded as a simulation of the 24 hours of unattended operation not requiring any crew attention.

f) All working parts of the 5 ppm bilge separator which are liable to wear or to damage should be easily accessible for maintenance.

g) 5 ppm bilge separator shall comply with test and performance requirements of App.A.

h) 5 ppm bilge separator must be designed to operate in each plane that forms an angle of 22.5° with the plane of its normal operating position.

i) Where a range of 5 ppm bilge separators of the same design, but of different capacities, requires certification in accordance with these specifications, testing of minimum two capacities within the range are required, providing that the two tests are performed are from the lowest quarter and highest quarter of the range.

6 Product marking

The product is to be marked with name of manufacturer, type designation and serial number. In addition the product shall be marked with the maximum throughput and the maximum influent pressure at which the separator is designed to operate.

7 Installation requirements

7.1 5 ppm bilge separator

a) For future inspection purposes on board ship, a sampling point shall be provided in a vertical section of the water effluent piping as close as is practicable to the 5 ppm bilge separator outlet. Re-circulating facilities shall be provided, after and adjacent to the overboard outlet of the stopping device to enable the 5 ppm bilge separator system, including the 5 ppm bilge alarm and the automatic stopping device, to be tested with the overboard discharge closed (see Figure 7-1).

The re-circulating facility shall be so configured as to prevent under all operating conditions any by-pass of the oily-water separator.

b) The capacity of the supply pump shall not exceed 110% of the rated capacity of the 5 ppm bilge separator with size of pump and motor to be stated on the certificate of type approval.

c) The 5 ppm bilge separator shall be fitted with a permanently attached plate giving any operational or installation limits considered necessary by the manufacturer or the Classification Society.

d) A vessel fitted with a 5 ppm bilge separator shall, at all times, have on board a copy of the operating and maintenance manuals.

e) The layout of the installation shall be arranged so that the overall response time (including the response time of the 5 ppm bilge alarm) between an effluent discharge from the 5 ppm bilge separator exceeding 5 ppm, and the operation of the Automatic Stopping Device preventing overboard discharge, should be as short as possible and in any case not more than 20 s.

f) The arrangement on board ship for the extraction of samples from the 5 ppm bilge separator discharge line to the 5 ppm bilge alarm should give a truly representative sample of the effluent with an adequate pressure and flow.
Figure 7-1
Typical onboard arrangement of pollution prevention equipment
Appendix A
Test and performance specifications for type approval of 5 ppm bilge separators

A.1 General

A.1.1 These test and performance specifications for type approval relate to 5 ppm bilge separators. In addition, the electrical and electronic systems of the 5 ppm bilge separator shall be tested in accordance with the specifications for environmental testing contained in App.B. A test report with the results of these tests must be submitted to DNV for approval.

A.1.2 The 5 ppm bilge separator being tested shall comply with the relevant requirements of the specific requirements contained in section [5.2].

A.2 Test specifications

A.2.1 These Specifications relate to 5 ppm bilge separators. 5 ppm bilge separators should be capable of producing an effluent for discharge to the sea containing not more than 5 ppm of oil irrespective of the oil content of the feed supplied to it.

A.2.2 The influent, whether emulsified or non-emulsified, which the system has in practice to deal with, depends on:

— the position of the oil/water interface, with respect to the suction point, in the space being pumped
— the type of pump used
— the type and degree of closure of any control valve in the circuit
— the general size and configuration of the system.

Therefore the test rig must be so constructed as to include not only the 5 ppm bilge separator, but also the pumps, valves, pipes and fittings as shown in Figure A-1. It is to be so designed for testing 5 ppm bilge separators with and without an integral supply pump.

a) For the testing of 5 ppm bilge separators having no integral pump, the centrifugal pump “A” (Figure A-1) is used to feed the 5 ppm bilge separator with valves 4 and 6 open, and valve 5 closed. The rate of flow from the centrifugal pump “A” is matched to the design throughput of the 5 ppm bilge separator by the adjustment of the centrifugal pump’s discharge valve.

b) Where the 5 ppm bilge separator is fitted with an integral pump, the centrifugal pump “A” is not required.

c) A centrifugal pump “B” should be fitted to re-circulate the test fluid C in the tank to ensure that the Test Fluid C is maintained in a stable condition throughout the testing. Re-circulation is not required for Test Fluids A and B.

d) To ensure a good mix of the test fluid and the water, a conditioning pipe as specified in [A.2.5] shall be fitted immediately before the 5 ppm bilge separator.

e) Other valves, flow meters and sample points should be fitted to the test rig as shown in Figure A-1.

f) The pipe work should be designed for a maximum liquid velocity of 3 m/s.
A.2.3
The tests should be carried out with a supply rate equal to the full throughput for which the 5 ppm bilge separator is designed.

A.2.4
Tests should be performed using three grades of test fluids:

1) Test fluid “A” which is a marine residual fuel oil in accordance with ISO 8217, type RMG 35 (density at 15°C not less than 980 kg/m³)

2) Test fluid “B” which is a marine distillate fuel oil in accordance with ISO 8217, type DMA (density at 15°C not less than 830 kg/m³).

3) Test fluid “C” which is a mixture of an oil-in-fresh water emulsion, in the ratio whereby 1 kg of the mixture consists of:

   — 947.8 g of fresh water
   — 25.0 g of test fluid “A”
   — 25.0 g of test fluid “B”
   — 0.5 g surfactant (sodium salt of dodecylbenzene sulfonic acid) in the dry form
   — 1.7 g “iron oxides” (The term “iron oxide” is used to describe black ferrosiferic oxide (Fe₃O₄) with a particle size distribution of which 90% is less than 10 microns, the remainder having a maximum particle size of 100 microns).

Note:
Procedure for preparing test fluid “C”: (see example calculation)*
* Calculation of ingredients of test fluid “C” (Example: 2 m³/h bilge separator).

- Operating period for the test with test fluid “C” as per [A.2.11]:
  - 2.5 hours plus conditioning time (say 0.5 hour) = 3 hours

- Net volume needed for the test:
  - Volume of test water: 2 m³ × 3 hours = 6 m³
  - Volume test fluid “C”: 6% of test water = 0.06 × 6 m³ = 0.36 m³

- Actual volume to be prepared:
  - Volume of test fluid “C” to be prepared: 1.2 times of the net volume of test fluid “C” = 1.2 × 0.36 = 0.432 m³
  - Volume of fresh water in test fluid “C”: (947.8g/1000g) of test fluid “C” = 0.9478 × 0.432 = 0.4094 m³
  - Weight of test fluid “A”: (25g/1000g) of test fluid “C” = 25/1000 × 0.432 × 1000 = 10.8kg
  - Weight of test fluid “B”: (25g/1000g) of test fluid “C” = 25/1000 × 0.432 × 1000 = 10.8kg
A.2.4.1 Preparation

1) Measure out 1.2 times the quantity of surfactant required for the “Test with test fluid C” as described in [A.2.11]

2) 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.

A.2.4.2 To make test fluid C in the test fluid tank (Figure A-2)

1) Fill test fluid tank with fresh water with a quantity 1.2 times the volume of the total quantity of water in the test fluid “C” needed for the test described in [A.2.11].

2) Operate centrifugal pump B running at a speed of not less than 3000 rpm (nominal) with a flow rate at which the volume of the test fluid has been changed out at least once per minute.

3) 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,

4) To establish a stable emulsion keep running the centrifugal pump B for one hour and confirm no oil floats on the surface of the test fluid.

5) After the one hour stated in paragraph (6) above keep running the centrifugal pump B at reduced speed to approximately 10% of original flow rate, until the end of the test.

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Weight of surfactant: \((0.5g/1000g)\) of test fluid “C” = \(0.5/1000 \times 0.432 \times 1000 = 0.216kg\)

Weight of iron oxide: \((1.7g/1000g)\) of test fluid “C”) = \(1.7/1000 \times 0.432 \times 1000 \times 0.734kg\)

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A.2.5
If the 5 ppm bilge separator includes an integrated feed pump, this 5 ppm bilge separator should be tested with that pump supplying the required quantity of test fluid and water to the 5 ppm bilge separator at its rated capacity.

If the 5 ppm bilge separator is to be fed by the ship's bilge pumps, then the unit will be tested by supplying the required quantity of test fluid and water mixture to the inlet of a centrifugal pump operating at not less than 1000 rpm (see dotted line in Figure A-1). This pump should have a delivery capacity of not less than 1.1 times the rated capacity of the 5 ppm bilge separator at the delivery pressure required for the test. The variation in Test Fluid/water ratio will be obtained by adjusting valves on the test fluid and water suction pipes adjacent to the pump suction, and the flow rate of test fluid and water or the test fluid content of the supply to the 5 ppm bilge separator should be monitored. If a centrifugal pump is used, the excess pump capacity should be controlled by a throttle valve on the discharge side of the pump.

In all cases, to ensure uniform conditions, the piping arrangements immediately prior to the 5 ppm bilge separator should be such that the influent to the 5 ppm bilge separator should have a Reynolds Number of not less than 10000 as calculated in fresh water, a liquid velocity of not less than 1 m/s and the length of the supply pipe from the point of test fluid injection to the 5 ppm bilge separator should have a length not less than 20 times its diameter. A mixture inlet sampling point and a thermometer pocket should be provided near the 5 ppm bilge separator inlet and an outlet sampling point and observation window should be provided on the discharge pipe.

A.2.6
In order to approach isokinetic sampling - i.e. the sample enters the sampling pipe at stream velocity - the sampling arrangement should be as shown in Figure A-3 and, if a cock is fitted, free flow should be effected for at least one minute before any sample is taken. The sampling points should be in pipes running vertically.

A distance A, not greater than 400mm
B distance B, sufficient to insert sampling bottle
C dimension C, straight length should not be less than 60mm
D dimension D, pipe thickness should not be greater than 2mm
E detail E, chisel-edged chamfer (30º)

Figure A-3
Diagram of sampling arrangements

A.2.7
In the case of the 5 ppm bilge separator depending essentially on gravity, the feed to the system of the test water and test fluid mixture should be maintained at a temperature not greater than 40°C, and heating and cooling coils should be provided where necessary. The water shall have a density of not more than 1.015 at 20°C. In other forms of separation where the dependence of separation efficiency on temperature is not established, tests should be carried out over a range of influent temperatures representing the normal shipboard operating range.
of 10°C to 40°C or should be taken at a temperature in this range where the separation efficiency is known to be worst.

A.2.8
In those cases where, for the 5 ppm bilge separator, it is necessary to heat water up to a given temperature and to supply heat to maintain that temperature, the tests should be carried out at the given temperature.

If the preheating of the feed is necessary for the proper functioning of the 5 ppm bilge separator than the preheater shall be the part of the unit at testing, the range of the pre-heater outlet temperature shall be defined and stated in the type approval certificate and automatic operation of the pre-heater shall be arranged.

A.2.9
The tests with test fluid “A” should be carried out as follows:

1) To ensure that the 5 ppm bilge separator commences the test with the oil section full of test fluid and with the supply line impregnated with test fluid, the 5 ppm bilge separator should, after filling with water (density at 20°C not more than 1.015) and while in the operating condition, be fed with pure test fluid for not less than 5 min.

2) The 5 ppm bilge separator should be fed with a mixture composed of between 5000 and 10 000 ppm of test fluid in water until steady conditions have been established. Steady conditions are assumed to be the conditions established after pumping through the 5 ppm bilge separator a quantity of test fluid/water mixture not less than twice the volume of the 5 ppm bilge separator. The test should then proceed for 30 min. Samples should be taken at the effluent outlet at 10 min and 20 min from the start of this period. At the end of this test, an air cock should be opened on the suction side of the pump and, if necessary, the oil and water valves should 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).

3) A test identical to that described in item 2), including the opening of the air cock, should be carried out with a mixture composed of approximately 25% (of volume) test fluid and 75% (of volume) water.

4) The 5 ppm bilge separator should be fed with 100% (of volume) of test fluid for at least 5 min during which time the observation window should be checked for any oil discharge. Sufficient test fluid should be fed into the 5 ppm bilge separator to operate the automatic oil discharge valve. After the operation of the oil discharge valve, the test should be continued for 5 min using a 100% (of volume) test fluid supply in order to check the efficiency of the oil discharge system.

5) The 5 ppm bilge separator should be fed with water (density at 20°C not more than 1.015) for 15 min. Samples of the separated water effluent are taken at the beginning of the test and after the first 10 min.

6) A test lasting a minimum of 2 h should be carried out to check that the 5 ppm bilge separator will operate continuously and automatically. This trial should use a cycle varying progressively from water to oily mixture with approximately 25% (of volume) test fluid content and back to water every 15 minutes, and should test adequately any automatic device which is fitted. The whole test sequence should be performed as a continuous programme.

During the last hour, the separator must be inclined at an angle of 22.5° with the plane of its normal operating position. At the end of the test, while the 5 ppm bilge separator is being fed with 25% (of volume) test fluid, a water effluent sample should be taken for analysis.

It should be understood that the 5 ppm bilge separator should operate continuously and automatically without any interruptions.

It should be assured that back flushing if performed during the certification test does not cause:

— dilution of the test fluids A, B, or C, or
— dilution of the test sample sent to the laboratory for analysis.

If input flow of the test fluid is interrupted during the performance of the test it should be assured that the total quantities of the test fluids A, B, and C processed automatically are not less than the nominal flow of the separator multiplied by the specified test duration for each fluid.

While all the time, the bilge separator operates continuously and automatically without human intervention.

A.2.10
The tests with test fluid “B” should be carried out as follows:

1) The 5 ppm bilge separator should be fed with a mixture composed of between 5000 and 10 000 ppm of test fluid in water until steady conditions have been established. Steady conditions are assumed to be the conditions established after pumping through the 5 ppm bilge separator a quantity of test fluid/water mixture not less than twice the volume of the 5 ppm bilge separator. The test should then proceed for 30 min. Samples should be taken at the effluent outlet at 10 min and 20 min from the start of this period.
At the end of this test, an air cock should be opened on the suction side of the pump and, if necessary, the oil and water valves should 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).

2) A test identical to that described in 1), including the opening of the air cock, should be carried out with a mixture composed of approximately 25% (of volume) test fluid and 75% (of volume) water.

A.2.11
The tests with test fluid “C” should be carried out as follows:

1) The 5 ppm bilge separator should be fed with a mixture composed of 6% test fluid “C” and 94% water to have emulsified oil content of 3000 ppm in the test water until steady conditions have been established. Steady conditions are assumed to be the conditions established after pumping through the 5 ppm bilge separator a quantity of test fluid “C”/water mixture not less than twice the volume of the 5 ppm bilge separator.

2) The test should then proceed for 2.5 h. Samples should be taken at the effluent outlet at 50 minutes and 100 minutes after conditioning. At the end of this test, an air cock should be opened on the suction side of the pump and, if necessary, the test fluid “C” and water valves should 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).

A.2.12
Sampling should be carried out as shown in Figure A-3 so that the sample taken will suitably represent the fluid issuing from the effluent outlet of the 5 ppm bilge separator.

A.2.13
Samples should be taken in accordance with ISO 9377-2:2000. The sample is to be extracted on the same day of collection, and be sealed and labelled in the presence of surveyor and arrangements should be made for analysis as soon as possible and in any case within seven days provided the samples are being kept between 2°C and 6°C at the accredited laboratories.

A.2.14
The oil content of the samples should be determined in accordance with App.C.

A.2.15
When accurate and reliable DNV type approved 5 ppm oil content meters are fitted at inlet and outlet of the 5 ppm bilge separator, one sample at inlet and outlet taken during each test will be considered sufficient if they verify, to within ± 10%, the meter readings noted at the same instant.

A.2.16
In the presentation of the results, the following data testing methods and readings should be reported:

1) Properties of test fluids A and B:
   - density at 15°C
   - kinematic viscosity (centistokes at 100°C/40°C)
   - flashpoint
   - ash
   - water content.

2) Properties of test fluid C:
   - type of surfactant
   - particle size percentage of the non soluble suspended solids; and
   - surfactant and iron oxide quality verification.

3) Properties of the water in the water tank:
   - density of water at 20°C
   - details of any solid matter present.

4) Temperature at the inlet to the 5 ppm bilge separator.

5) A diagram of the test rig.

6) A diagram of the sampling arrangement.

7) The method used in analysis of all samples taken and the results thereof, together with oil content meter.

8) Readings, where appropriate.
Appendix B
Specifications for environmental testing for type approval of pollution prevention equipment

B.1 General
The specifications for environmental testing for type approval relate to the electrical and electronic sections of:
— 5 ppm bilge separator.

Satisfactory compliance with the environmental tests laid down in these guidelines and specifications, where applicable, should be shown on the environmental test protocol issued by the testing laboratory. The protocol shall include at least a statement of the tests conducted on the equipment, including the results thereof. The environmental test protocol shall be endorsed by either the surveyor or a competent authority of the manufacturer's home country to confirm that the laboratory is approved to conduct such tests. The protocol shall also be signed and dated by the person in charge of the laboratory.

B.2 Test specifications

B.2.1 Testing requirements
The electrical and electronic sections of the equipment in the standard production configuration should be subjected to the programme of environmental tests set out in this specification at the accredited laboratory. A copy of the environmental test document, in a format similar to that specified in [C.1], should be submitted to the Class by the manufacturer, together with the application for type approval.

B.2.2 Test specification details
Equipment should operate satisfactorily on completion of each of the following environmental tests:

B.2.2.1 Vibration tests:
1) A search should be made for resonance over the following range of frequency and amplitude of acceleration:
   a) 2 to 13.2 Hz with an amplitude of ± 1mm
   b) 13.2 to 80 Hz with an acceleration of ± 0.7 g. This search should be made in each of the three planes at a rate sufficiently low to permit detection of resonance.
2) The equipment should be vibrated in the planes at each major resonant frequency for a period of 2 hours.
3) If there is no resonant frequency, the equipment should be vibrated in each of the planes at 30 Hz with an acceleration of ± 0.7 g for a period of 2 hours.
4) After completion of the tests specified in 2) or 3) a search should again be made for resonance and there should be no significant change in the vibration pattern.

B.2.2.2 Temperature tests (procedure according to IEC60068-2-2 Tests Bb, Bd)
1) Equipment that may be installed in an enclosed space that is environmentally controlled, including an engine-room, should be subjected, for a period of not less than 2 h, to:
   a) a low temperature test at 0°C
   b) a high temperature test at 55°C.
2) At the end of each of the tests referred to, the equipment should be switched on and it should function normally under the test conditions.

B.2.2.3 Humidity tests
Equipment should be left switched off for a period of 2 h at a temperature of 55°C in an atmosphere with a relative humidity of 90%. At the end of this period the equipment should be switched on and should operate satisfactorily for 1 hour (First the temperature test of the electronic part should be operated under the test condition mentioned under [B.2.2.2], followed by the humidity test.)

B.2.2.4 Inclination test
Equipment should operate satisfactorily at angles of inclination up to 22.5° in any plane from the normal operating position.

B.2.2.5 Reliability of electrical and electronic equipment
The electrical and electronic components of the equipment should be of a quality guaranteed by the manufacturer and suitable for their intended purpose.
Appendix C
Method for determination of oil content

C.1 Scope and application
The International Standard ISO 9377-2:2000 “Water quality - Determination of hydrocarbon oil index - Part 2: Method using solvent extraction and gas chromatography” specifies a method for the sampling and subsequent determination of the hydrocarbon oil index in water using solvent extraction and gas chromatography. This method should be used for the determination of oil content requirements outlined in this programme.

C.2 Checklist
Test data and results of tests conducted on a 5 ppm bilge separator in accordance with App.A to the DNV type approval programme of 5 ppm bilge water separators

<table>
<thead>
<tr>
<th>5 ppm bilge separator submitted by</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Test location</td>
<td></td>
</tr>
<tr>
<td>Method of sample analysis</td>
<td></td>
</tr>
<tr>
<td>Samples analysed by</td>
<td></td>
</tr>
</tbody>
</table>

Environmental testing of the electrical and electronic sections of the 5 ppm bilge separator has been carried out in accordance with Appendix C to the DNV type approval programme of 5 ppm Bilge Water Separators. The equipment functioned satisfactorily on completion of each test specified on the environmental test protocol.

<table>
<thead>
<tr>
<th>Test fluid “A”</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Density at 15ºC</td>
<td></td>
</tr>
<tr>
<td>Viscosity Centistokes at 100ºC</td>
<td></td>
</tr>
<tr>
<td>Flashpoint ºC</td>
<td></td>
</tr>
<tr>
<td>Ash content %</td>
<td></td>
</tr>
<tr>
<td>Water content at start of test %</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test fluid “B”</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Density at 15ºC</td>
<td></td>
</tr>
<tr>
<td>Viscosity Centistokes at 40ºC</td>
<td></td>
</tr>
<tr>
<td>Flashpoint ºC</td>
<td></td>
</tr>
<tr>
<td>Ash content %</td>
<td></td>
</tr>
<tr>
<td>Water content at start of test %</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test fluid “C”</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Surfactant - documentary evidence*</td>
<td></td>
</tr>
<tr>
<td>Iron oxides - documentary evidence*</td>
<td></td>
</tr>
<tr>
<td>* Certificate or laboratory analysis.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test water</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Density at 20ºC</td>
<td></td>
</tr>
<tr>
<td>Solid matter present</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test temperatures</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient ºC</td>
<td></td>
</tr>
<tr>
<td>Test fluid “A” ºC</td>
<td></td>
</tr>
<tr>
<td>Test fluid “B” ºC</td>
<td></td>
</tr>
<tr>
<td>Test fluid “C” ºC</td>
<td></td>
</tr>
<tr>
<td>Test water ºC</td>
<td></td>
</tr>
</tbody>
</table>

Diagram of test rig attached
Diagram of sampling arrangement attached
C.3 Test results (in ppm) and test procedures

**Test Fluid A**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Efficiency test 0.5 - 1% oil</td>
<td>Efficiency test 25% oil</td>
<td>Oil fine</td>
<td>25% oil every 15 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>100% oil</td>
<td>100% oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>not less than 5</td>
<td>not less than 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2Ve</td>
<td>2Ve</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vm ≥ 30</td>
<td>Vm ≥ 30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Ve - volume of equipment
Vm - quantity of oil/water mixture

**Test Fluid B**

<table>
<thead>
<tr>
<th></th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Efficiency test 0.5 - 1% oil</td>
<td>Efficiency test 25% oil</td>
</tr>
<tr>
<td></td>
<td>100% oil</td>
<td>100% oil</td>
</tr>
<tr>
<td></td>
<td>not less than 5</td>
<td>not less than 5</td>
</tr>
<tr>
<td></td>
<td>2Ve</td>
<td>2Ve</td>
</tr>
<tr>
<td></td>
<td>Vm ≥ 30</td>
<td>Vm ≥ 30</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test Fluid C

<table>
<thead>
<tr>
<th></th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Efficiency test 6% Test Fluid C</td>
</tr>
<tr>
<td></td>
<td>100% oil</td>
</tr>
<tr>
<td></td>
<td>not less than 5</td>
</tr>
<tr>
<td></td>
<td>2Ve</td>
</tr>
<tr>
<td></td>
<td>Vm ≥ 150</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 - 9 steps refer to paragraph
① - ⑯ points where samples to be taken

Signed .............................................. Date .............................................. Official stamp

(Official stamp or equivalent identification and the date of approval to be placed on all pages of the test protocol.)

**Guidance:**

The continuous and automatic operation should apply to the performance tests with the test fluids A, B and C according to the test result diagrams. However, if due to the separation process any interruption in feeding the test fluid with nominal flow rate e.g., for back flushing, is deemed necessary, the time for these interruptions should be added to the required time of the test step which was interrupted during the performance test. While all the time, the bilge separator operates continuously and automatically without human intervention.
CHANGES – HISTORIC

Note that historic changes older than the editions shown below have not been included. Older historic changes (if any) may be retrieved through http://www.dnv.com.

May 2011 edition

General

This is a new document.