

**RESOLUTION MEPC.159(55)**  
**Adopted on 13 October 2006**

**REVISED GUIDELINES ON IMPLEMENTATION OF EFFLUENT STANDARDS  
AND PERFORMANCE TESTS FOR SEWAGE TREATMENT PLANTS**

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(a) of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee (the Committee) conferred upon it by international conventions for the prevention and control of marine pollution,

NOTING resolution MEPC.2(VI) adopted on 3 December 1976 by which the Marine Environment Protection Committee adopted, at its sixth session, the Recommendation on International Effluent Standards and Guidelines for Performance Tests for Sewage Treatment Plants and invited Governments to apply the Effluent Standards and Guidelines for approving sewage treatment plants; to take steps to establish testing programmes in accordance with the Guidelines for Performance Tests; and provide the Organization with a list of sewage treatment plants meeting the standards,

NOTING ALSO resolution MEPC.115(51) adopted on 1 April 2004 by which the Marine Environment Protection Committee adopted, at its fifty-first session, the revised MARPOL Annex IV and which entered into force on 1 August 2005,

NOTING FURTHER the provisions of regulation 9.1.1 of MARPOL Annex IV, in which reference is made to the above-mentioned guidelines,

RECOGNIZING that resolution MEPC.2(VI) should be amended in order that current trends for the protection of the marine environment and developments in the design and effectiveness of commercially available sewage treatment plants be reflected; and the proliferation of differing unilateral more stringent standards that might be imposed worldwide be avoided,

HAVING CONSIDERED the recommendation made by the Sub-Committee on Bulk Liquids and Gases, at its tenth session,

1. ADOPTS the Revised Guidelines on Implementation of Effluent Standards and Performance Tests for Sewage Treatment Plants, the text of which is set out in the Annex to this resolution;
2. INVITES Governments to:
  - (a) implement the Revised Guidelines on Implementation of Effluent Standards and Performance Tests for Sewage Treatment Plants and apply them so that all equipment installed on board on or after 1 January 2010 meets the Revised Guidelines in so far as is reasonable and practicable; and

- (b) provide the Organization with information on experiences gained from their application and, in particular, on successful testing of equipment against the Standards;
- 3. FURTHER INVITES Governments to issue an appropriate “Certificate of type approval for Sewage Treatment Plants” as referred to in paragraph 5.4.2 and the annex of the Revised Guidelines and to recognize such certificates issued under the authority of other Governments as having the same validity as certificates issued by them; and
- 4. SUPERSEDES the Recommendation on International Effluent Standards and Guidelines for Performance Tests for Sewage Treatment Plants contained in resolution MEPC.2(VI).

ANNEX

**REVISED GUIDELINES ON IMPLEMENTATION OF EFFLUENT STANDARDS  
AND PERFORMANCE TESTS FOR SEWAGE TREATMENT PLANTS**

**TABLE OF CONTENTS**

- 1 Introduction
- 2 Definitions
- 3 General
- 4 Standards
- 5 Testing considerations
- 6 Renewal and additional surveys
- 7 Familiarization of ship personnel in the use of the sewage treatment plant

ANNEX

Form of Certificate of Type Approval for Sewage Treatment Plants and Appendix

## **REVISED GUIDELINES ON IMPLEMENTATION OF EFFLUENT STANDARDS AND PERFORMANCE TESTS FOR SEWAGE TREATMENT PLANTS**

### **1 INTRODUCTION**

1.1 The Marine Environment Protection Committee (MEPC) of the International Maritime Organization (IMO) adopted resolution MEPC.2(VI) Recommendation on International Effluent Standards and Guidelines for Performance Tests for Sewage Treatment Plants in 1976.

1.2 This document contains the Revised Guidelines on Implementation of Effluent Standards and Performance Tests for Sewage Treatment Plants (Guidelines). These Guidelines are intended to assist Administrations in establishing operational performance testing programmes for sewage treatment plants for the purpose of type approval under regulation 9.1.1 of Annex IV of the Convention.

1.3 These Guidelines apply to sewage treatment plants installed on board on or after 1 January 2010.

### **2 DEFINITIONS**

Annex IV – the revised Annex IV of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) as amended by resolution MEPC.115(51).

Convention – the International Convention for the Prevention of Pollution from Ships 1973/1978 (MARPOL 73/78).

Geometric mean – the  $n$ th root of the product of  $n$  numbers.

Greywater – is drainage from dishwater, shower, laundry, bath and washbasin drains.

Testing onboard – testing carried out on a sewage treatment plant that has been installed upon a ship.

Testing ashore – testing carried out on a sewage treatment plant prior to installation e.g. in the factory.

Thermotolerant coliforms – the group of coliform bacteria which produce gas from lactose in 48 hours at 44.5°C. These organisms are sometimes referred to as “faecal coliforms”; however, the term “thermotolerant coliforms” is now accepted as more appropriate, since not all of these organisms are of faecal origin.

### **3 GENERAL**

3.1 An approved sewage treatment plant must meet the standards in section 4 and the tests outlined in these Guidelines. It should also be noted that, when ships are operating approved sewage treatment plants, Annex IV also provides that the effluent shall not produce visible floating solids or cause discolouration of the surrounding water.

3.2 It is acknowledged that the performance of sewage treatment plants may vary considerably when the system is tested ashore under simulated shipboard conditions or onboard a ship under actual operating conditions. Where testing ashore demonstrates that a system complies with the standards, but subsequent onboard testing does not meet the standards, the Administration should determine the reason and take it into account when deciding whether to type approve the plant.

3.3 It is recognized that Administrations may wish to modify the specific details outlined in these Guidelines to take account of very large, very small or unique sewage treatment plants.

#### 4 STANDARDS

4.1 For the purpose of regulation 4.1 of Annex IV, a sewage treatment plant should satisfy the following effluent standards when tested for its Certificate of Type Approval by the Administration:

.1 Thermotolerant Coliform Standard

The geometric mean of the thermotolerant coliform count of the samples of effluent taken during the test period should not exceed 100 thermotolerant coliforms/100 ml as determined by membrane filter, multiple tube fermentation or an equivalent analytical procedure.

.2 Total Suspended Solids (TSS) Standard

(c) The geometric mean of the total suspended solids content of the samples of effluent taken during the test period shall not exceed 35 mg/l.

(d) Where the sewage treatment plant is tested onboard ship, the maximum total suspended solids content of the samples of effluent taken during the test period may be adjusted to take account of the total suspended solid content of the flushing water. In allowing this adjustment in maximum TSS, Administrations shall ensure sufficient tests of TSS are taken of the flushing water throughout the testing period to establish an accurate geometric mean to be used as the adjustment figure (defined as  $x$ ). In no cases shall the maximum allowed TSS be greater than 35 plus  $x$  mg/l.

Method of testing should be by:

- .1 filtration of representative sample through a 0.45  $\mu\text{m}$  filter membrane, drying at 105°C and weighing; or
- .2 centrifuging of a representative sample (for at least five minutes with mean acceleration of 2,800-3,200 g), drying at least 105°C and weighing; or
- .3 other internationally accepted equivalent test standard.

.3 Biochemical Oxygen Demand and Chemical Oxygen Demand

Administrations should satisfy themselves that the sewage treatment plant is designed to reduce both soluble and insoluble organic substances to meet the requirement that, the geometric mean of 5-day Biochemical Oxygen Demand (BOD<sub>5</sub>) of the samples of effluent taken during the test period does not exceed 25 mg/l and the Chemical Oxygen Demand (COD) does not exceed 125 mg/l. The test method standard should be ISO 15705:2002 for COD and ISO 5815-1:2003 for BOD<sub>5</sub>, or other internationally accepted equivalent test standards.

.4 pH

The pH of the samples of effluent taken during the test period shall be between 6 and 8.5.

.5 Zero or non-detected values

For thermolerant coliforms, zero values should be replaced with a value of 1 thermotolerant coliform/100 ml to allow the calculation of the geometric mean. For total suspended solids, biochemical oxygen demand and chemical oxygen demand, values below the limit of detection should be replaced with one half the limit of detection to allow the calculation of the geometric mean.

4.2 Where the sewage treatment plant has been tested ashore, the initial survey should include installation and commissioning of the sewage treatment plant.

## 5 TESTING CONSIDERATIONS

5.1 Testing of the operational performance of a sewage treatment plant should be conducted in accordance with the following subparagraphs. Unless otherwise noted, the subparagraphs apply to testing both onboard and ashore.

### 5.2 Raw sewage quality

5.2.1 Sewage treatment plants tested ashore - the influent should be fresh sewage consisting of faecal matter, urine, toilet paper and flush water to which, for testing purposes primary sewage sludge has been added as necessary to attain a minimum total suspended solids concentration appropriate for the number of persons and hydraulic loading for which the sewage treatment plant will be certified. The testing should take into account the type of system (for example vacuum or gravity toilets) and any water or greywater that may be added for flushing to the sewage before treatment. In any case the influent concentration of total suspended solids should be no less than 500 mg/l.

5.2.2 Sewage treatment plants tested onboard - the influent may consist of the sewage generated under normal operational conditions. In any case the average influent concentration of total suspended solids should be no less than 500 mg/l.

### **5.3 Duration and timing of test**

5.3.1 The duration of the test period should be a minimum of 10 days and should be timed to capture normal operational conditions, taking into account the type of system and the number of persons and hydraulic loading for which the sewage treatment plant will be type approved. The test should commence after steady-state conditions have been reached by the sewage treatment plant under test.

### **5.4 Loading factors**

5.4.1 During the test period the sewage treatment plant should be tested under conditions of minimum, average and maximum volumetric loadings.

- .1 For testing ashore, these loadings will be as laid down in the manufacturer's specifications. Figure 1 shows suggested timings for sampling each loading factor.
- .2 For testing onboard, minimum loading will represent that generated by the number of persons on the ship when it is alongside in port, and average and maximum loadings will represent those generated by the number of persons on the ship at sea and will take account of meal times and watch rotations.

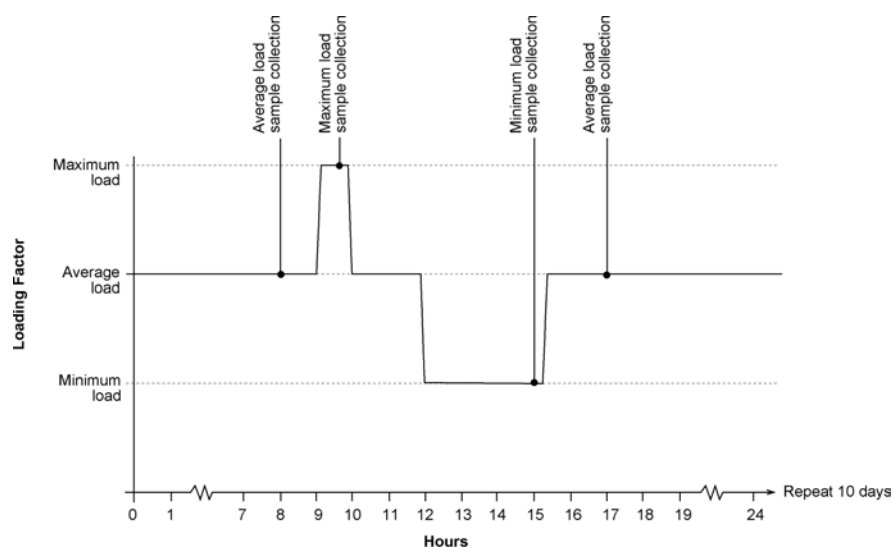
5.4.2 The Administration should undertake to assess the capability of the sewage treatment plant to produce an effluent in accordance with the standards prescribed by section 4 following minimum, average and maximum volumetric loadings. The range of conditions under which the effluent standards were met should be recorded on the Certificate of Type Approval. The form of the Certificate of Type Approval and appendix is set out in the annex to these Guidelines.

### **5.5 Sampling methods and frequency**

5.5.1 Administrations should ensure that the sewage treatment plant is installed in a manner which facilitates the collection of samples. Sampling should be carried out in a manner and at a frequency which is representative of the effluent quality. Figure 1 provides a suggested frequency for sampling, however, the frequency should take account of the residence time of the influent in the sewage treatment plant. A minimum of 40 effluent samples should be collected to allow a statistical analysis of the testing data (e.g. geometric mean, maximum, minimum, variance).

5.5.2 An influent sample should be taken and analyzed for every effluent sample taken and the results recorded to ensure compliance with section 4. If possible, additional influent and effluent samples should be taken to allow for a margin of error. Samples should be appropriately preserved prior to analysis particularly if there is to be a significant delay between collection and analysis or during times of high ambient temperature.

5.5.3 Any disinfectant residual in samples should be neutralized when the sample is collected to prevent unrealistic bacteria kill or chemical oxidation of organic matter by the disinfectant brought about by artificially extended contact times. Chlorine (if used) concentration and pH should be measured prior to neutralization.



**Figure 1: Suggested hydraulic loading factors and sampling frequency for testing sewage treatment plants. May be modified as necessary to take account of characteristics of individual sewage treatment plants**

## 5.6 Analytical testing of effluent

5.6.1 The Administration should give consideration to the recording of other parameters in addition to those required (thermotolerant coliforms, total suspended solids, BOD<sub>5</sub>, COD, pH and residual chlorine) with a view to future technological development. Parameters which might be considered include total solids, volatile solids, settleable solids, volatile suspended solids, turbidity, total phosphorus, total organic carbon, total coliforms and faecal streptococci.

## 5.7 Disinfectant residual

5.7.1 The potential adverse environmental effects of many disinfectant residuals and by-products, such as those associated with the use of chlorine or its compounds, are well recognized. It is, therefore, recommended that Administrations encourage the use of ozone, ultra-violet irradiation or any other disinfectants which minimize adverse environmental effects, whilst pursuing the thermotolerant coliform standard. When chlorine is used as a disinfectant, the Administration should be satisfied that the best technical practice is used to keep the disinfectant residual in the effluent below 0.5 mg/l.

## 5.8 Scaling considerations

5.8.1 Only full-scale marine sewage treatment plants should be accepted for testing purposes. The Administration may certify a range of the manufacturer's equipment sizes employing the same principles and technology, but due consideration must be given to limitations on performance which might arise from scaling up or scaling down. In the case of very large, very small or unique sewage treatment plants, certification may be based on results of prototype tests. Where possible, confirmatory tests should be performed on the final installation of such sewage treatment plants.



## **5.9 Environmental testing of the sewage treatment plant**

5.9.1 The Administration should be satisfied that the sewage treatment plant can operate under conditions of tilt consistent with internationally acceptable shipboard practice.

5.9.2 Tests for certification should be carried out over the range of temperature and salinity specified by the manufacturer, and the Administration should be satisfied that such specifications are adequate for the conditions under which the equipment must operate.

5.9.3 Control and sensor components should be subjected to environmental testing to verify their suitability for marine use. The Test Specifications section in part 3 of the annex to resolution MEPC.107(49) provides guidance in this respect.

5.9.4 Any limitation on the conditions of operation should be recorded on the Certificate.

5.9.5 The Administration should also consider requiring the manufacturer to include in the operating and maintenance manuals, a list of chemicals and materials suitable for use in the operation of the sewage treatment plant.

## **5.10 Other considerations**

5.10.1 The type and model of the sewage treatment plant and the name of the manufacturer should be noted by means of a durable label firmly affixed directly to the sewage treatment plant. This label should include the date of manufacture and any operational or installation limits considered necessary by the manufacturer or the Administration.

5.10.2 Administrations should examine the manufacturer's installation, operating and maintenance manuals for adequacy and completeness. The ship should have on board at all times a manual detailing the operational and maintenance procedures for the sewage treatment plant.

5.10.3 Qualifications of testing facilities should be carefully examined by the Administration as a prerequisite to their participation in the testing programme. Every attempt should be made to assure uniformity among the various facilities.

## **6 RENEWAL AND ADDITIONAL SURVEYS**

6.1 Administrations should endeavour to ensure, when conducting renewal or additional surveys in accordance with regulations 4.1.2 and 4.1.3 of Annex IV, that the sewage treatment plant continues to perform in accordance with the conditions outlined in regulation 4.1.1 of Annex IV.

## **7 FAMILIARIZATION OF SHIP PERSONNEL IN THE USE OF THE SEWAGE TREATMENT PLANT**

7.1 Recognizing that the appropriate regulations relating to familiarization are contained within the Ships Safety Management Systems under the International Safety Management Code, Administrations are reminded that ship staff training should include familiarization in the operation and maintenance of the sewage treatment plant.

ANNEX

FORM OF CERTIFICATE OF TYPE APPROVAL  
FOR SEWAGE TREATMENT PLANTS AND APPENDIX

BADGE  
OR  
CIPHER

NAME OF ADMINISTRATION

**CERTIFICATE OF TYPE APPROVAL  
FOR SEWAGE TREATMENT PLANTS**

This is to certify that the Sewage Treatment Plant, Type .....,  
having a designed hydraulic loading of ..... cubic metres per day, (m<sup>3</sup>/day), an organic loading of  
..... kg per day Biochemical Oxygen Demand (BOD) and of the design shown on Drawings Nos. ....  
manufactured by .....

has been examined and satisfactorily tested in accordance with the International Maritime Organization  
resolution MEPC.159(55) to meet the operational requirements referred to in regulation 9.1.1 of Annex IV  
of the International Convention for the Prevention of Pollution from Ships, 1973/78 as modified by  
resolution MEPC.115(51).

The tests on the sewage treatment plant were carried out  
ashore at\* .....  
onboard at\* .....  
and completed on .....

The sewage treatment plant was tested and produced an effluent which, on analysis, produces:

- (i) a geometric mean of no more than 100 thermotolerant coliforms/100 ml;
- (ii) a geometric mean of total suspended solids of 35 mg/l if tested ashore or the maximum total  
suspended solids not exceeding 35 plus  $x$  mg/l for the ambient water used for flushing purposes if  
tested on board;
- (iii) a geometric mean of 5-day Biochemical Oxygen Demand (BOD<sub>5</sub>) of no more than 25 mg/l;
- (iv) a geometric mean of Chemical Oxygen Demand of no more than 125 mg/l;
- (v) pH of the effluent is between 6 and 8.5.

The Administration is satisfied that the sewage treatment plant can operate at angles of inclination  
of 22.5° in any plane from the normal operating position.

Details of the tests and the results obtained are shown on the Appendix to this Certificate.

A plate or durable label containing data of the manufacturer's name, type and serial numbers, hydraulic  
loading and date of manufacture is to be fitted on each sewage treatment plant.

A copy of this Certificate shall be carried on board any ship equipped with the above described sewage  
treatment plant.

Official stamp Signed .....

Administration of .....

Dated this.....day.....of.....20....

\* Delete as appropriate.

BADGE  
OR  
CIPHER

**APPENDIX TO  
CERTIFICATE OF TYPE APPROVAL FOR SEWAGE TREATMENT PLANTS**

Test results and details of tests conducted on samples from the Sewage Treatment Plant in accordance with resolution MEPC.159(55):

Sewage Treatment Plant, Type .....  
 Manufactured by .....  
 Organization conducting the test .....  
 Designed hydraulic loading ..... m<sup>3</sup>/day  
 Designed organic loading ..... kg/day BOD

Number of effluent samples tested .....  
 Number of influent samples tested .....  
 Raw sewage (influent) quality ..... mg/l Total Suspended Solids  
 Maximum hydraulic loading ..... m<sup>3</sup>/day  
 Minimum hydraulic loading ..... m<sup>3</sup>/day  
 Average hydraulic loading ..... m<sup>3</sup>/day

Geometric Mean of Total  
 Suspended Solids ..... mg/l  
 Geometric Mean of the thermotolerant  
 coliform count ..... coliforms/100 ml  
 Geometric Mean of BOD<sub>5</sub> ..... mg/l

Type of disinfectant used .....  
 If Chlorine - residual Chlorine:  
     Maximum ..... mg/l  
     Minimum ..... mg/l  
     Geometric Mean ..... mg/l

Was the sewage treatment plant tested with:  
     Fresh Water flushing? ..... Yes/No\*  
     Salt Water flushing? ..... Yes/No\*  
     Fresh and Salt Water flushing? ..... Yes/No\*  
     Greywater added? ..... Yes – proportion: /No\*

Was the sewage treatment plant tested against the environmental conditions specified in section 5.9 of resolution MEPC.159(55):  
     Temperature ..... Yes/No\*  
     Humidity ..... Yes/No\*  
     Inclination ..... Yes/No\*  
     Vibration ..... Yes/No\*  
     Reliability of Electrical and Electronic Equipment ..... Yes/No\*

Limitations and the conditions of operation are imposed:  
     Salinity .....  
     Temperature .....  
     Humidity .....  
     Inclination .....  
     Vibration .....

Results of other parameters tested .....  
 Official stamp ..... Signed .....  
 Administration of ..... Dated this ..... day of ..... 20 .....

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\* Delete as appropriate.