Sewage Effluent Test Kit 2
Instruction Manual

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Introduction

Sewage Effluent Test Kit Overview

There is increasing pressure on the marine industry to lessen the environmental impact of ocean going vessels. Mandatory requirements for the installation and ongoing operation of sewage treatment systems came into force on the 27th September 2008. New vessels over 400gst must comply together with new vessels less than 400gst certified to carry more than 15 persons. Existing vessels have five years to comply from this date.

A port Authority can instruct a survey of the sewage treatment system at any time. If the system is shown not to substantially comply, i.e. perform to type approval, then the vessel can be held until repairs are undertaken (MARPOL Annex IV Regulation 4 (5)). Type approval criteria for sewage treatment systems is already in place.

The Sewage Effluent Test Kit contains equipment to rapidly carry out all type approved tests on the effluent water, demonstrating that the system is operating correctly and the log book supplied can be used to record results.

Having the ability to carry out regular performance checks while at sea will ensure compliance or give early indication of malfunctions or maintenance requirements.

The test kit is supplied with equipment to perform the following tests:

1. Coliform bacteria test
2. Total suspended solids
3. Biological oxygen demand
4. Chemical oxygen demand
5. pH Value
6. Chlorine

Introduction

Regulatory Compliance

IMO MARPOL Annex IV – Resolution MEPC.115(51) came into force on the 27th September 2008. An extract from Regulation 9 is:

9.1 – Every ship which, in accordance with regulation 2, is required to comply with the provisions of this annex shall be equipped with one of the following sewage systems:

9.1.1 – A sewage treatment plant which shall be of a type approved by the administration, taking into account the standards and test methods adopted by the Organisation*, or

* Refer to the recommendation on international effluent standards and guidelines for performance tests for sewage treatment plants adopted by the organisation by **resolution MEPC.2(VI)**. For existing ships national specifications are acceptable.

Regulation 2 states the following:

2.1 – The provisions of this Annex shall apply to the following ships engaged in international voyages:

2.1.1 – New ships of 400gst and above; and

2.1.2 – New ships of less than 400gst which are certified to carry more than 15 persons.

2.1.3 – Existing ships of 400gst and above, five years after the date of entry into force of this Annex: and

2.1.4 – Existing ships of less than 400gst which are certified to carry more than 15 persons, five years after the date of entry into force of this Annex.

Regulatory Compliance – continued

MEPC.2(VI) Revised Guidelines on Implementation of Effluent Standards and Performance Tests for Sewage Treatment Plants.

Reference is made above to **resolution MEPC.2(VI)**, which is superseded by **resolution MEPC.159(55)**.

As set out in Annex 22 Resolution MEPC. 227(64) adopted on the 5th October 2012, sewage treatment plants installed prior to 1st January 2016 and on or after 1st January 2010, on ships other than passenger ships operating in MARPOL Annex IV special areas and intending to discharge treated effluent into the sea, should comply with resolutions MEPC.159(55) adopted on 13th October 2006

These guidelines list a set of performance criteria for obtaining type approval for on-board sewage treatment systems. The criteria is as follows:

1. Coliforms – less than 100 CFU/100ml
2. Total suspended solids – less than 35mg/l or 35ppm
3. Biological oxygen demand – less than 25mg/l or 25ppm
4. Chemical oxygen demand – less than 125mg/l or 125ppm
5. pH – between 6.0 – 8.5
6. Chlorine (discharge) – less than 0.5mg/l or 0.5ppm

Testing Limitations

The tests contained within the test kit are not intended to replace type approval testing. This test kit has been designed to enable regular on-board assessment of the performance of the sewage treatment plant whilst at sea.

The tests included are representative of the BOD, COD & TSS of the effluent water and enable a close approximation to be made within minutes rather than days. These tests, in combination with other approved methods provided within this test kit will enable a rapid and suitably accurate performance assessment of the sewage system.

Test Methods

Coliplate – Coliform Bacteria Test (0 – 2424 CFU/100ml)

Intended Use:

The Coliplate is a convenient and accurate test for quantitative measuring of total coliforms and E.coli. The test is designed to meet regulatory guidelines for surface waters, recreational waters, processing waters and wastewaters (effluent). The Coliplate enables a quantitation of coliforms and E.coli density ranging from between 3 – 2424 CFU/100ml in a single test without the need to perform a dilution of the sample taken.

The distinctive blue/green coloration of positive samples enables analysis of brownish, turbid or rust filled waters.

Instruction for Use

1. Remove the microplate lid.
2. Using the sample bottle or thio-bag used to collect the sample, pour gently a small stream of water onto the plate, running the stream along each row of wells so that water enters each well.
3. When all wells are full, any excess water can be drained by gently tapping the side of the microplate. This will also remove any air bubbles that have remained at the bottom of any well.
4. Top up any wells which are not full and drain of any excess water
5. Replace the microplate lid and incubate at 35°C for 24 to 30 hours

Interpretation of Results

Blue Colour indicative of coliforms

Fluorescence indication of E.coli

A most probable number count (MPN) can then be obtained by referring to the number of wells giving a positive reaction to the above colour change or fluorescence indication.

Test Methods

Coliplate – Coliform Bacteria Test (0 – 2424 CFU/100ml) - continued

Interpretation of Results Table (Most Probable Number (MPN) Count)

No Wells Giving Positive Reaction	MPN 100ml Sample	No Wells Giving Positive Reaction	MPN 100ml Sample	No Wells Giving Positive Reaction	MPN 100ml Sample	No Wells Giving Positive Reaction	MPN 100ml Sample
0	<3						
1	3	25	76	49	182	73	388
2	5	26	79	50	188	74	403
3	8	27	83	51	194	75	418
4	11	28	87	52	200	76	343
5	13	29	90	53	206	77	451
6	16	30	94	54	213	78	469
7	19	31	98	55	219	79	489
8	22	32	102	56	226	80	510
9	25	33	106	57	233	81	534
10	28	34	110	58	240	82	559
11	30	35	114	59	247	83	587
12	33	36	119	60	255	84	619
13	36	37	123	61	263	85	654
14	39	38	127	62	271	86	694
15	43	39	132	63	280	87	740
16	46	40	136	64	289	88	794
17	49	41	141	65	298	89	858
18	52	42	146	66	307	90	938
19	55	43	151	67	317	91	1038
20	59	44	156	68	328	92	1174
21	62	45	161	69	339	93	1370
22	65	46	166	70	350	94	1696
23	69	47	171	71	362	95	2424
24	72	48	177	72	375	96	>2424

Test Methods
Total Suspended Solids (TSS) and Biological Oxygen Demand (BOD)

The turbidity tube is designed to give measurement of the total suspended solids and a probable BOD which can be calculated from the result of the TSS.

Test Procedure

1. Hold the tube vertically over a white surface and view downwards.
2. Gradually pour the effluent sample until the black cross is just no longer visible.
3. Read off the graduation corresponding to the height of the sample in the tube. This reading represents a close approximation of the TSS of the effluent.

Cleaning

The tube should be thoroughly washed with strong detergent and water, rinsed after use.

Probable BOD

The probable BOD can be calculated from the result of the TSS test using the following formula:

Probable BOD (mg/l) = (TSS Value divided by 2) + 5

Note*

A check should be made on the temperature of the effluent discharge and these should always be close to the ambient temperature.

Test Methods

Chemical Oxygen Demand (COD) – Permanganate Value (PV)

It is possible to determine the chemical oxygen demand from the results of the permanganate value test. This is based on the relationship between organic pollution obtained experimentally for sewage and effluents.

Test Procedure

1. Take three 100ml sample containers (120ml) and fill each to the 100ml with sewage effluent.
2. Add two scoops of Acidifying SE Powder to each container and shake to disintegrate.
3. To the first, second and third containers add 1, 2 and 3 drops of Permanganate Value Liquid respectively. Cap each container and shake.
4. Stand for 30 minutes then note how many containers have remained pink. Read the result from the following table.

Containers Pink	Permanganate Value	Grading
All three	0 – 10	Excellent
Two	10 – 20	Satisfactory
One	20 – 30	Dubious
None	Over 30	Unsatisfactory

When testing crude sewage, add a 10ml sample to each container and make up to the 100ml mark with deionised water. Multiply the end result (PV) by 10.
When testing settled sewage, add a 20ml sample to each container and make up to the 100ml mark with deionised water. Multiply the end result (PV) by 5.

To convert the Permanganate Value (PV) to the probable COD value, please use the following formulas:

Sewage: Permanganate Value (PV) x 10

Effluent: Permanganate Value (PV) X 7

Test Methods

Chlorine (Free) Drop Test – Process Control

This chlorine test can be used to optimise the chlorine levels prior to discharge.

Test Procedure

Take sample according to expected range.	Add **6 drops of FCL1** In very high hardness areas add 10 drops	Add drops of **FCL2**	Until colour changes to **blue / green**




Colours may vary depending on sample and test conditions.

Free Chlorine (mg/l) = Drops (FCL2) x Factor

Expected Range	Sample Size	Factor
1 – 4	40ml	0.25
2 – 8	20ml	0.5
5 – 15	10ml*	1
10 – 30	5ml*	2

***Dilute samples less than 20ml to 20ml with distilled or deionised water.**

Test Methods

Chlorine (Free) Comparator Test – Discharge

This chlorine test can be used to measure the free chlorine levels in the final discharge. MARPOL Annex IV regulations stipulate that the free chlorine concentration should be below 0.5 mg/l.

Test Procedure For Free Chlorine

1. Fill both cells to the 10ml mark and place one cell in the left-hand compartment of the comparator as a blank.
2. Add one DPD No. 1 tablet in the other cell, crush and mix until the tablet has dissolved.
3. Place this second cell in the right-hand compartment of the comparator and match the two colour fields against north day light.
4. Read off the result as mg/l **free chlorine**.

Test Methods

pH Comparator Test

MARPOL Annex IV regulations stipulate that the pH values should be between 6.0 – 8.5 pH

Test Procedure For pH

1. Fill both cells to the 10ml mark and place one cell in the left-hand compartment of the comparator as a blank.
2. Add one **Universal pH** tablet in the other cell, crush and mix until the tablet has dissolved.
3. Place this second cell in the right-hand compartment of the comparator and match the two colour fields against north day light.
4. Read off the result as the pH Value.

MDI 2214 INCUBATOR

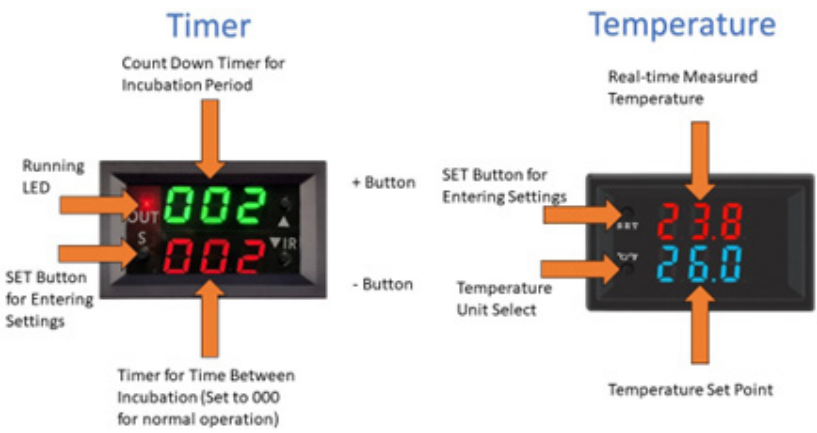
The MDI 2214 is a temperature-controlled incubator purposely developed for the incubation of microbiological samples such as dip slides, media well plates and Thiobags. The incubator provides a stable environment at a user defined set temperature allowing the user to safely perform microbiological tests on various water samples. The incubator incorporates safety features so that it can be run autonomously for extended periods and then automatically switch off the power to the internal heating/cooling components. The Incubator will thermostatically isolate the electrical input if the internal temperatures exceed 90°C; ensuring the incubator should never overheat.

SPECIFICATIONS

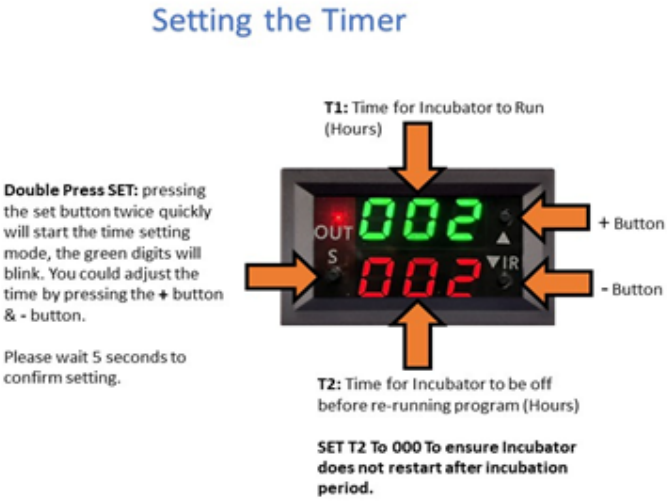
External Dimensions	246 x 215 x 162mm
Internal Chamber Dimensions	135 x 160 x 145mm
Incubation Temperature Range	35°C - 41°C
Temperature Resolution	0.1°C
Temperature Accuracy	±0.5 °C
Timer	999s/999m/999h
Supply Voltage	12v (5A 60W)
Display Colour	Red (Actual Temp) Blue (Set Temp)
Case Material	PP (Polypropylene)
Weight	1.6 Kgs
Safety Feature	Automated electrical isolation at 90°C

OPERATION

UNDERSTANDING THE DISPLAYS



TIMER SETTINGS



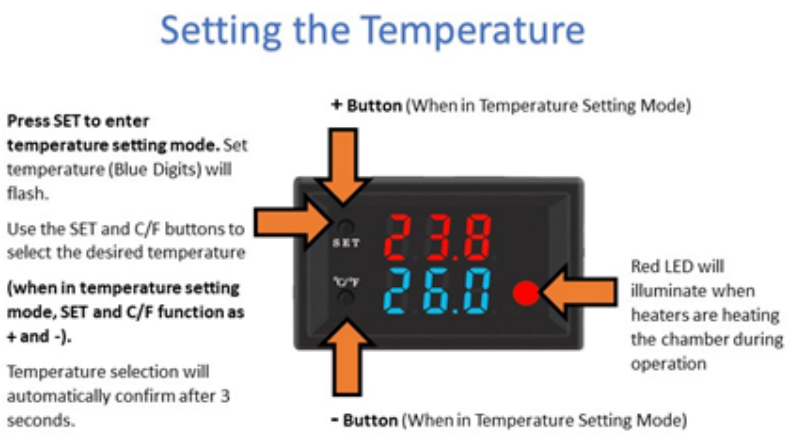
The Green digits of the incubation timer is set to hours. Therefore, set to 024 for twenty-four hours incubation or 048 for forty-eight hours incubation time. The incubator will cut power to the temperature controller once the incubation time has elapsed.

The recommended settings for normal operation are:

P0--2: Timing time mode: 0---999 hours
P1--1: The relay will disconnect after T1 (Green) time has counted down. (T2 becomes irrelevant).

***Note** The Incubator will come from the manufacturer supplied set to these settings.*

TEMPERATURE SETTINGS



To Set Celsius or Fahrenheit:

When not in programming mode, the C/F switches between Celsius and Fahrenheit.

***Note** the program settings should already be set by the manufacturer to the recommended settings and should not require changing.*

TO PROGRAM

The program is set by the manufacturer. However, if the settings are accidentally reset, please follow the below instructions to set back to the recommended settings

Press and hold SET for 5 seconds to enter programming mode.

From programming mode, use SET and C/F (+ and -) to navigate parameters P0 through P8. Once the desired parameter is reached (P0-P8), press SET and C/F at the same time to confirm. At this time your selection will flash. Use SET and C/F to navigate through your options.

Press SET and C/F at the same time to confirm your choice.

Code	Description	Setting Range	Recommended Range
P0	Heating / cooling	H/C	H
P1	Return difference	0.1-30	0.2
P2	Set upper limit	110	41
P3	Set lower limit	-50	35
P4	Temperature correction	-15-15	0
P5	Delay start	0-10	0
P6	High temperature alarm	-50-110	OFF
P7	Celsius / Fahrenheit (this can also be done by pressing the C/F button)	CS/FH	CS
P8	Factory reset (this can also be done by holding SET and C/F at the same time for an extended length of time)	ON-OFF	OFF

RECOMMENED PRACTICE OF OPERATION

- Please follow incubation protocols outlined by the manufacturers of the media used for each test.

- Set the timer to run for the duration of the desired incubation period (e.g. 24 hours), this will isolate the internal components once the incubation period has elapsed for safety purposes.

- It is recommended to use the optional dip slide tray when using dip slide media and to even space the dip slides throughout the allotted positions to allow for maximum airflow throughout the incubation chamber.

- Do not bunch up samples, the more air flow around each sample gives a better temperature accuracy.

- Thio bags should be kept in an upright position to avoid leaking of liquid into the incubator chamber.

- Once the incubator has been loaded with media samples and set to run, there should be no need to open the incubator during the incubation period. The Incubator display should indicate the chamber temperature and the timer will indicate when the incubation period is completed.

- The incubator should be switched off after use and the power cable isolated from the incubator unit.

- If the internal temperature exceeds 90°C an internal thermostat will isolate the power for the incubator. The thermostat is autonomously reset when the internal temperature reduces to ~50°C.

- Only use the power supply provided with the incubator by the manufacturer.

- If temperature program settings are accidentally reset to factory settings, please follow the program instructions given within this manual to set the settings to the recommended settings.

- A larger Incubator is available to purchase upon request.

- It is recommended to have the incubator serviced every 2 years by the manufacturer to ensure longevity of operational use and temperature accuracy of internal chamber. A calibration certificate is provided with each service. To request a service please contact enquiries@marinetestingsolutions.com.

SEWAGE EFFLUENT TREATMENT SYSTEM
TESTING LOG SHEET

Date	Operator Initials	PH	Coliforms	TSS	BOD	COD	Chlorine Process	Chlorine Discharge