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# K-07 OIL-WATER INTERFACE DETECTORS

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Foreword:

This Guide is a part of CCS Rules, which contains technical requirements, inspection and testing criteria related to classification and statutory survey of marine products.

This Guide is published and updated by CCS and can be found through http://www.ccs.org.cn . Comments or suggestions can be sent by email to ps@ccs.org.cn .

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# Oil-water Interface Detectors

## 1 Application

1.1 This guideline is applicable to the approval and inspection of oil-water interface detectors installed and used on ships.

1.2 This guideline does not involve the on-board installation and arrangement of oil-water interface detectors.

## 2 Normative references

The reference documents for approval and inspection used in this guideline are as follows (the latest revisions of the standards below are to apply when these standards are updated):

Regulation 32, Part B, Chapter 4 of MARPOL 73/78

Volume 1 of Code for Statutory Inspection of Ships and Offshore Installations-Technical Regulation for Statutory Inspection of Sea-going Ships Engaged in International Voyage, issued by China Maritime Safety Administration;

Chapter 3, PART ONE and Chapter 1, PART FOUR of CCS Rules for Classification of Sea-going Steel Ships

Resolution MEPC.5 (XIII) Specification for Oil/water Interface Detectors;

IEC 68-2-32 (1990) Environmental Testing Procedures Part 2: Test-Test Ed: Free fall;

IEC 60068-2-10:2005 Environmental Testing for Electric and Electronic Products—Part 2: Test Methods—Test J and guidance: Mold growth

GD01-2006 Guidelines for Type Approval Test of Electric and Electronic Products

## 3 Definitions

3.1 The terms and definitions used in this guideline are consistent with those defined in MARPOL 73/78.

## 4 Drawings and documentation to be submitted

4.1 The following drawings and documentation to be submitted are to be submitted to CCS for approval:

(1) General plan;

(2) Shell drawing (including panel plate drawing, bottom plate drawing, etc.);

(3) Panel arrangement plan;

(4)Label plate and marking diagram;

(5) Electrical circuit diagram;

(6) List of elements and components (including the name, type, specification, quantity, manufacturer or brand of the elements and components, as well as their codes in the electrical circuit);

(7) Product technical specifications or enterprise standard;

(8) Product manufacturer inspection/test program and format of the inspection record.

4.2 The following drawings and documentation to be submitted are to be submitted to CCS for review:

(1) Instructions for use (both in English and Chinese);

(2) Process flow chart showing the quality monitoring points;

(3) Process documents, including documents relevant to welding procedure, wiring process, assembly process, sheet metal process, tack welding procedure, "moisture, fungi and salt fog proofing" treatment process, printed circuit board fabrication process, etc.;

(4) Type, specification and list of suppliers of main raw materials and parts (e.g. integrated circuit chip, printed circuit board, semi-conductor element, fuse, switch, power module, light emitting diode, printed product, insulation paint, etc.);

(5) External wiring diagram (if applicable).

## 5 General requirements

5.1 An oil/water interface detector may be of fixed type or portable type.

5.2 The oil/water interface detectors on board are to be capable of detecting the vertical position of the oil/water interface (including oil/water interface) in liquid tanks (holds).

5.3 The oil/water interface detector needs not indicate the position of the interface continuously.

5.4 Where fixed probes are used in fixed detectors, the interface data measured by fixed detectors is to be at least equivalent to the data obtained by the portable detectors under normal operating conditions.

5.5The fixed detectors fitted within tanks/holds are to be capable of withstanding the impact by the jet flow of the tank washing machine.

5.6 The fixed and portable detectors are to be arranged and used taking into due consideration the relevant operational safety measures.

5.7 The detectors are to comply with the relevant statutory requirements for safe use in the hazardous areas for sea-going ships and not to interfere with the radio communication.

5.8 The density (specific weight) difference of the media measured by the detectors is to be within the range of $0.06g/cm^3$~$0.25g/cm^3$.

## 6 Technical requirements

6.1 Power source:

Marine power source or power supply by battery.

6.2 Appearance, structure and marks:

The detectors and their accessory depth sounding devices are to be applicable, reliable and of seaworthy materials. The electrically conductive parts are to be of copper or copper alloy materials.

6.3 Measuring accuracy:

The accuracy of detector readings is to be within ±25mm relative to the actual position of the clearly layered oil/water interface (including oil/gas interface).

Where oil contamination affects the accuracy and response time of the detectors, it is to be stated.

6.4 Response time:

The detectors are to promptly reflect the changes between oil and water (oil and gas) by visual means. The response time of the detectors to reflect the changes of oil/water interface is not to exceed 3s.

The effect of temperature on the response time of detectors is to be tested at the ambient temperature and 50 ℃ temperature respectively using Arabian light crude oil (or its equivalent) and salt water (of 1.025 specific weight) mixture. Any effect of temperature on the response time is to be stated.

6.5 Degree of protection

The degree of protection provided by the enclosure is to be IP22 for the display control device of the detectors mounted indoors, IP56 for detectors used on open decks and IPX8 for the probes and connectors of detectors.

6.6 Requirements for use in hazardous areas

The explosion-proof performance of detectors or components used in hazardous spaces is to meet the safety requirements for such spaces.

6.7 Vibration, inclining and swaying:

The proper functioning of fixed detectors is not to be affected by the ship's motion and vibration. Particularly, the electric and electronic detectors are to be tested to verify that they are able, as a minimum, to operate continuously under the following vibration conditions:

2~13.2 Hz, vibration amplitude ±1.0 mm; and

13.2~80 Hz, acceleration amplitude ±0.7 g.

In addition, the detectors are to be able to operate reliably when they are inclined for 22.5 ℉from their normal working position to any plane.

**7 Type test**

Oil/water interface detectors are to be type tested as specified. The specific test requirements are as follows:

7.1 Unless otherwise specified, the detectors are to be connected by simulating the actual conditions. All tests are to be carried out under the following atmospheric conditions:

(1) Ambient temperature: 15 ℃~35 ℃;

(2) Relative humidity: 30%RH~90%RH;

(3) Atmospheric pressure: 86~106 kPa.

7.1.1 The detectors are to be tested depending on one or more specific applications, for example, the interface between oil and salt water, brackish water or fresh water specified in Annex I of MARPOL 1973. The approved application range and relevant restrictions are to be expressly stated in the approval document.

7.1.2 Oil/water interface detectors are to be assembled and used in accordance with the manufacturer's instructions for operation.

7.1.3 The testing equipment is to consist of a container in which the oil/water interface is clearly visible. The depth of oil and water in the container is to be such that the detector probe is fully immersed.

7.1.4 The accuracy of detectors is to be determined by comparing the readings with the known oil/water interface.

7.1.5 The following oils or their equivalent are to be mixed respectively with fresh water (of 1.000 specific weight) and brackish water (of 1.012 specific weight) or salt water (of 1.025 specific weight) at ambient temperature to prepare the testing liquid:

1.1.1.1.1. Leaded automobile gasoline——(standard designation)

1.1.1.1.2. Light diesel oil————————(#2 fuel oil)

1.1.1.1.3. Arabian light crude oil————(moderate specific weight and viscosity)

1.1.1.1.4. Residual oil————————————(#C fuel oil or #6 fuel oil)

7.2 Visual inspection

7.2.1 The appearance, structure and marking of detectors are to be consistent with the approved drawings; the assembly and wiring process is to comply with the requirements of the manufacturer's process documents.

7.2.2 The external surface of the detector enclosure is to be free from crack, sand hole, dent, rust, etc. The surface paint is to be free from coating defects such as peeling and flaking.

7.2.3 A permanent external wiring diagram (where applicable) is to be posted on the enclosure of the display and control device of detectors.

7.2.4 The enclosure of the display and control device of the detectors is to be provided with a working earth terminal and a protective earth terminal and permanent earth marks adjacent to those earth terminals.

7.3 Accuracy test

7.3.1 Move the detector probe up and down in the sample liquid at a speed of 20mm/s, compare the values measured by the detector with the corresponding positions of the oil/water interface and record the results into Table 7.3. The results are to meet the requirements of 6.3.

**Table 7.3**

| Oil water | Fresh water (of 1.000 specific weight) | | Brackish water (of 1.012 specific weight) | | Salt water (of 1.025 specific weight) | |
|---|---|---|---|---|---|---|
| | mm | s | mm | s | mm | s |
| Leaded automobile gasoline of standard designation | | | | | | |
| Light diesel oil (#2 fuel oil) | | | | | | |
| Arabian light crude oil (moderate specific weight and viscosity) | | | | | | |
| Residual oil (#C fuel oil or #6 fuel oil) | | | | | | |

Note: where other types of oil having the same properties as the tabulated oil types are used, they are to be filled into the corresponding columns.

7.4 Response time:

The method specified in 7.3is to be followed and the response time is to be measured using a chronograph. The measuring results are to be entered into Table 7.3. The results are to meet the requirements of Table 6.4.

7.5 Test of degree of protection provided by enclosure

7.5.1 The selected protection type of enclosure of detectors is to be suitable for the space where the detectors are located and comply with the requirements of 1.3.2.2, Chapter 1, PART FOUR of CCS Rules for Classification of Sea-going Steel Ships.

7.5.2 The degree of protection for detector probes and connectors is to be IP X8.

7.6 Pressure test:

7.6.1 The detector probes and connectors are to be pressure tested to 2 times maximum hydraulic pressure for a duration of 10 minutes;

7.6.2 Where fixed probes are used in fixed detectors (note: see 5.4), these probes and their

connectors are to be subject to 24h maximum hydraulic pressure test (refer to 2.1.1.1 Testing of Water Level Detectors of Cargo Hold Flooding Alarm System, Annex to MSC.188(79)) or 12h immersion test at 600kPa pressure (refer to 8.9 of IEC60945-2002 Water Immersion Test of Subsea Equipment).

7.7 Voltage withstanding test

7.7.1 The test is to be carried out by the method specified in2.14 ofGD01-2006 and comply with the requirements contained therein.

7.8 Measurement of insulation resistance

7.8.1 The measurement is to be carried out by the method specified in2.3 of GD01-2006 and comply with the requirements contained therein.

7.9 Steady-state power fluctuation test:

7.9.1 The detectors powered by AC electricity are to be tested by the method specified in2.4 of GD01-2006 and comply with the requirements contained therein.

7.9.2 The detectors powered by accumulator battery (including battery for portable detectors) are to be allowed to operate for 15min at each fluctuation rate listed in the table and the measured accuracy and response time of the detectors are to meet the requirements of 6.3 and 6.4.

**Table 7.9.2**

| Status | Voltage fluctuation % | |
|---|---|---|
| Devices connected to the battery when being charged | +30 | -25 |
| Devices not connected to the battery when being charged | +20 | -25 |
| Portable devices using dry batteries | +10 | -20 |

Note: the voltage fluctuation test of explosion-proof portable devices is to be carried out in accordance with the explosion-proof requirements.

7.10 Transient power fluctuation test (not applicable to the portable devices using dry batteries):

7.10.1 The test is to be carried out by the method specified in2.4 of GD01-2006 and comply with the requirements contained therein.

7.11 Power failure test (not applicable to the portable devices using dry batteries):

7.11.1 The test is to be carried out by the method specified in 2.5 of GD01-2006 and comply with the requirements contained therein.

7.12 High temperature test

7.12.1 The test is to be carried out in accordance with 2.8 of GD01-2006 and the results of test at 70 ℃(55 ℃ for portable detectors) are to meet the requirements of 6.3 and 6.4.

7.13 Low temperature test

7.13.1 The test is to be carried out in accordance with 2.8 of GD01-2006 and the results of test at -25 ℃are to meet the requirements of 6.3 and 6.4 (oil water in non-frozen state).And insulation resistance is to meet the requirements of 2.3 of GD01-2006.

7.14 Humid heat test

7.14.1 The test is to be carried out by the method specified in 2.10 of GD01-2006 and comply with the following requirements: the results of detector test, at temperatures not exceeding 40 ℃ and at 95% humidity, at temperatures higher than 40 ℃ and at 70% humidity, are to meet the requirements of 6.3; and insulation resistance is to meet the requirements of 2.3 of GD01-2006.

7.15 Inclining and swaying tests (applicable to fixed detectors)

7.15.1 The detector is to be fixed onto the test bench and tested for 15 minutes along each of the four directions, namely, forward, afterward, left and right direction, at an inclining angle of 22.5 °. The results are to meet the requirements of 6.7.

7.15.2 Upon completion of the inclining test, the detector is to be rolled at an angle of 22.5 °with a rolling period of 10s along the two axial (horizontal) directions, namely, forward-afterward and left-right axial directions, for 15 minutes along each axial direction. The results are to meet the requirements of 6.7.

7.16 Vibration test (applicable to fixed detectors)

7.16.1 The test is to be carried out by the method specified in 2.7 of GD01-2006 and meet the requirements of 6.7.

7.17 Salt fog test (applicable to the detectors fixed on decks)

7.17.1 The test is to be carried out by the method specified in 2.12 of GD01-2006 and comply with the requirements contained therein.

7.18 Fungi (applicable to the detectors fixed on decks)

7.18.1 The grade of fungi growth under the conditions specified in IEC 60068-2-10:2005 is not to exceed grade 2.

7.19 Drop test (applicable to portable detectors)

7.19.1 According to the test specified in IEC 68-2-32(1990), the detector is to be free from damage, loosening, etc. after being dropped from a height of 250mm. The test results are to meet

the requirements of 6.3 and 6.4.

7.20 Surge immunity test (not applicable to portable detectors)

7.20.1 The test is to be carried out in accordance with 3.7 of GD01-2006 and the results are to meet the requirements of 6.3.

7.21 Low frequency conducted disturbance immunity test(not applicable to portable detectors)

7.21.1 The test is to be carried out in accordance with 3.8 of GD01-2006 and the results are to meet the requirements of 6.3.

7.22 Selection of typical test specimens

7.22.1 The test specimens used for prototype test are to be sampled from the manufacturer's qualified products by CCS surveyor.

7.22.2 A least one set (may be increased as required for the test) of oil/water interface detector, including all components, is to be selected as the test specimen.

7.23 Testing organization

7.23.1 For initial type approval, the organization undertaking the test is to be an appropriate testing organization which holds the corresponding CCS Approval Certificate for Product Inspection and Testing Organizations.

7.23.2 For renewal of type approval certificate, upon the approval of CCS, the option of conducting prototype test in the manufacturer's lab under the witness of CCS surveyor may be considered, provided that the equipment manufacturer has the test environment and equipment specified by relevant standard and has competent inspection and testing personnel.

**Oil/water Interface Detector Prototype test Items (items marked with "√" mean applicable items)** **Table 7.23.2**

| No. | Test item | Portable oil/water interface detector | Fixed oil/water interface detector |
|---|---|---|---|
| 1 | Visual inspection | √ | √ |
| 2 | Accuracy test | √ | √ |
| 3 | Response time | √ | √ |
| 4 | Test of degree of protection provided by enclosure | √ | √ |
| 5 | Pressure test | √ | √ |

**Continued Table 7.23.2**

| No. | Test item | Portable oil/water interface detector | Fixed oil/water interface detector |
|---|---|---|---|
| 6 | Voltage withstanding test | √ | √ |
| 7 | Insulation resistance verification | √ | √ |
| 8 | Steady-state power fluctuation test | √ | √ |
| 9 | Transient power fluctuation test | | √ |
| 10 | Power failure test | | √ |
| 11 | High temperature test | √ | √ |
| 12 | Low temperature test | √ | √ |
| 13 | Humid heat tests | √ | √ |
| 14 | Inclining and swaying tests | | √ |
| 15 | Vibration test | | √ |
| 16 | Salt fog test (Kb) (applicable to the equipment mounted on open decks) | | √ |
| 17 | Fungi | | √ |
| 18 | Drop test | √ | |
| 19 | Surge immunity test | | √ |
| 20 | Low frequency conducted disturbance immunity test | | √ |

**8 Unit/path inspection**

8.1 The oil/water interface detector is to be sampled (at least one set) at the manufacturer for verification of the following items:

8.1.1 Visual inspection

8.1.2 Accuracy verification

8.1.3 Response time

8.1.4 Insulation resistance measurement

8.1.5 Voltage withstanding test

8.2 The verification is to be carried out according to product inspection plan during the unit/path inspection.