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E-20

COMPARTMENT FLOODING WATER LEVEL DETECTORS (INCLUDING SENSORS)

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Foreword:

China Classification Society (hereinafter refferred to as CCS) Product Inspection and Testing Guideline (hereinafter referred to as this Guideline) contains the technical requirements, inspection and testing criteria related to classification and statutory survey of marine products to be applied for CCS approval/inspection.

This Guideline frees the users to adopt other test methods and requirements which are equivalent to or are stricter than this Guideline.

This Guideline is published and updated by CCS, and is released at http://www.ccs.org.cn. Your comments or suggestions are welcomed and may be sent to our email addressed mp@ccs.org.cn.

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Main changes:

1. adjust this guideline according to the requirement of MSC.188(79) Rev.1;

2. correct clerical mistakes;

3. update the version of normative references.

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COMPARTMENT FLOODING WATER LEVEL DETECTORS (INCLUDING SENSORS)

1 Application

1.1 This guideline is applicable to the approval and inspection of water level detectors equipped on the ships below:.

(1) Bulk carriers for compliance with SOLAS regulation XII/12;

(2) Single hold cargo ships other than bulk carriers for compliance with SOLAS regulation II-1/25; and

(3) Multiple hold cargo ships other than bulk carriers and tankers for compliance with SOLAS regulation II-1/25-1.

1.2 This guideline also provides technical functional requirements for bilge alarms used as water level detectors in multiple hold cargo ships for compliance with SOLAS regulation II-1/25-1.

1.3 This guideline is also applicable to passenger ships for compliance with SOLAS regulation II-1/22-1.

1.4 This guideline does not involve the onboard installation and arrangement of water level detectors.

2 Normative references

The applicable normative references are as follows:

2.1 Regulation II-1/22-1, II-1/25, II-1/25-1, XII/12 of SOLAS 1974 and amendments thereto;

2.2 Resolution MSC.188(79)/Rev.1 (2022.4.28) Performance Standards for Water Level Detectors on ships subject to SOLAS regulation II-1/25, II-1/25-1 and XII/12;;

2.3 MSC.1/Circ.1291(2008.12.9) Guidelines for flooding detection systems on passenger ships;

2.4 MSC.1/Circ.1572 (2020.12.08) Unified interpretations of SOLAS chapter II-1 and XII, of the technical provisions for means of access for inspections (Resolution MSC.158(78)) and of the performance standards for water level detectors on bulk carriers and single hold cargo ships other than bulk carriers (Regulation MSC.188(79)).

2.5 IACS UI SC180 (Rev.1May 2004) (Rev.2 Nov 2005) (Rev.3Mar 2012)(Rev.4 Feb 2021) Hold, ballast and dry space water level detectors and performance standards for water level detectors on bulk carriers and single hold cargo ships other than bulk carriers (Resolution MSC.188(79));

2.6 China Classification Society “Rules for Classification of Sea-going Steel Ships” ;

2.7 IMO A.1021(26) Code on alerts and indicator;

2.8 IACS UR E10 (Rev.8) Test specification for type approval ;

2.9 CCS GD 22-2015 Guidelines for Type Approval Test of Electric and Electronic Products;

2.10 IEC 60529:1989+AMD1:1999+AMD2:2013 CSV Degrees of Protection Provided by Enclosures (IP Code).

3 Terms and Definitions

The terms and definitions specified in the references mentioned above apply to this Guideline.

3.1 Water level detector means a system comprising sensors and alarms that detect and warn of water ingress in cargo holds and other spaces as required in SOLAS regulations II-1/22-1, II-1/25, II-1/25-1 or XII/12.

3.2 Sensor means a unit fitted at the location being monitored that activates a signal to identify the presence of water at the location..

3.3 Pre-alarm level means the lower level at which the sensor(s) in the cargo hold space will operate.

3.4 Main alarm level means the higher level at which the sensor(s) in the cargo hold space will operate or the sole level in spaces other than cargo holds.

3.5 Visual indication means indication by activation of a light or other device that is visible to the human eye in all levels of light or dark at the location where it is situated.

3.6 Audible indication means an audible signal that is detectable at the location where it is signaled.

4 Drawings and documentation

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

(1) General plan;

(2) Main parts diagram;

(3) Panel arrangement plan;

(4) Electric circuit and power supply diagrams;

(5) Product technical specifications.

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

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

(2) Software specification (including programming platform, software type, software version, software flow chart, software function etc., applicable to products with programmable elements);

(3) Type, specification and list of qualified suppliers of main raw materials and parts (e.g. sensor, integrated circuit chip, etc.);

(4)System wiring diagram or hardware block diagram;

(5) External wiring diagram;

(6) Nameplate (both in English and Chinese);

5 Technical requirements

5.1 System components

The water level detector is a system composed of a number of sensors and display devices.

5.2 Method of water level detection (MSC.188(79)Rev.1, 3.1)

5.2.1 Water level may be detected by the following direct or indirect means:

(1) Indirect means of detection: existence of water is determined through physical contact between water and the detector.

(2) Indirect means of detection: include devices that do not involve physical contact with water.

5.2.2 Water level detection system is to be capable of operating continuously while the ship is navigating on the sea.

5.3 Requirements for detector system

5.3.1 The detection system is to provide reliable display when the water reaches the preset level. (MSC.188(79)Rev.1, 3.2.1)

Use of sensors capable of detecting two preset levels (pre-alarm level and main alarm level) is allowed. （UI SC180, 3.2.1 ）

5.3.2 The detector system should: (MSC.188(79)Rev.1, 3.2.2)

For cargo holds:

(1) An alarm, both visual and audible, activated when the depth of water reaches the pre-alarm level in the space being monitored. The indication should identify the space.

(2) An alarm, both visual and audible, activated when the depth of water reaches the main alarm level, indicating increasing water level in a cargo hold. The indication should identify the space and the visual and audible alarm should not be the same as that for the pre-alarm level.

(3) For compartments other than cargo holds:An alarm, both visual and audible, indicating the presence of water in a compartment other than a cargo hold when the level of water in the space being monitored reaches the sensor. The visual and audible characteristics of the alarm indication should be the same as those for the main alarm level in a hold space.

5.3.3 Detection equipment should be suitably corrosion resistant for all intended cargoes. (MSC.188(79)Rev.1, 3.2.3)Detection equipment includes the sensor and any filter and protection arrangements for the detector installed in cargo holds and other spaces. (MSC.1/CIRC.1572/Rev.1, 9.1)

5.3.4 The detector indicating the water level should be capable of activating to an accuracy of ±100 mm. (MSC.188(79)Rev.1, 3.2.4)

5.3.5 Detection equipment should be of certified safe type appropriate for the intended cargoes. The part of the system which has circuitry in the cargo area should be intrinsically safe or explosion proof with appropriate apparatus group and temperature class which is to be determined depending on the cargo carried. (MSC.188(79)Rev.1, 3.2.5)

(1) In general, the construction and type testing should be in accordance with publication IEC 60079: Electrical Equipment for Explosive Gas Atmospheres to a minimum requirement of EX(ia). Where a ship is designed only for the carriage of cargoes that cannot create a combustible or explosive atmosphere then the requirement for intrinsically safe circuitry should not be insisted upon, provided the operational instructions included in the Manual required by 4.1 of the appendix to the annex specifically exclude the carriage of cargoes that could produce a potential explosive atmosphere. Any exclusion of cargoes identified in the annex should be consistent with the ship's Cargo Book and any Certification relating to the carriage of specifically identified cargoes.

(2) The maximum surface temperature of equipment installed within cargo spaces should be appropriate for the combustible dusts and/or explosive gases likely to be encountered. Where the characteristics of the dust and gases are unknown, the maximum surface temperature of equipment should not exceed 85ºC.

(3) Where intrinsically safe equipment is installed, it should be of a certified safe type.

(4) Where detector systems include intrinsically safe circuits, plans of the arrangements should be appraised/approved by individual classification societies.(MSC.1/CIRC.1572/Rev.1, 9.2)

5.4 Requirements for alarm system

5.4.1The visual and audible alarms should be suitable for location on the navigation bridge. (MSC.188(79)Rev.1, 3.3.1)

5.4.2 Visual and audible alarms should conform to the Code on Alerts and Indicators, 2009, as may be amended, as applicable to a primary alarm for the preservation or safety of the ship. (MSC.188(79)Rev.1, 3.3.2)

The pre-alarm, as a primary alarm, should indicate a condition that requires prompt attention to prevent an emergency condition; the main alarm, as an emergency alarm should indicate that immediate actions must be taken to prevent danger to human life or to the ship.

5.4.3Visual and audible alarms are to meet the following requirements: (MSC.188(79)Rev.1, 3.3.3)

(1) Light of special color or digital display unit clearly visible under varying expected illumination conditions is to be used for visual display, and such display is not to cause serious interference with other activities required for safe operation of the ship. Visibility of such visual display is to be maintained unless the activation condition of the visual display has been restored to a point below the set value of relevant sensors. Visual display is not to be capable of being closed by the operator.

(2) The system is to be capable of providing visual and auditory display and alarm of the same sensor in the compartment where the display unit is located. Auditory display is to be capable of being closed by the operator.

(3) The alarm signal panel is to be fitted with switches for testing visual and audible alarm devices and these switches are to be in off position when they are not in use. (MSC.188(79)Rev.1 APPENDIX, 3.1.2)

(4) The visual and audible alarms of water level detectors are to be different from other alarm signals. (MSC.188(79)Rev.1 APPENDIX, 3.2.3)

5.4.4 Time delays may be incorporated into the alarm system to prevent spurious alarms due to sloshing effects associated with ship motions.. (MSC.188(79)Rev.1, 3.3.4)

5.4.5 An alarm overriding device may be installed for water level detectors in cargo holds or tanks which can be used for water ballast (SOLAS regulations II-1/25-1 and XII/12.1). An override visual indication capability should be provided throughout deactivation of the water level detector for such holds or tanks. Where such an override capability is provided, cancellation of the override condition and reactivation of the alarm should automatically occur after the hold or tank has been de-ballasted to a level below the lowest alarm indicator level. (MSC.188(79)Rev.1, 3.3.5)

5.4.6 Requirements for malfunctions, alarms and indications should include a facility for continuous monitoring of the system which, on detecting a fault, activates a visual and audible alarm. The audible alarm should be capable of being muted, but the visual indication should remain active until the malfunction is cleared. (MSC.188(79)Rev.1, 3.3.6)

Fault monitoring should address faults associated with the system that include open circuit, short circuit, as well as arrangement details that would include loss of power supplies and CPU failure for computer-based alarm/monitoring system, etc. (MSC.1/CIRC.1572/Rev.1, 9.4)

5.4.7 The water level detector system should be capable of being supplied with electrical power from two independent electrical supplies. Failure of any of the two electrical power supplies should be indicated by an alarm. (MSC.188(79)Rev.1, 3.3.7)

(1) The electrical power supply should be from two separate sources, one should be the main source of electrical power and the other should be the emergency source, unless a continuously charged dedicated accumulator battery is fitted, having arrangement, location and endurance equivalent to that of the emergency source (18 hours). The battery supply may be an internal battery in the water level detector system.

(2) If the backup power supply is not an internal battery, the changeover arrangement of supply from one electrical source to another need not be integrated into the water level detector system.

(3) Where batteries are used for the secondary power supply, failure alarms for both power supplies should be provided.(MSC.1/CIRC.1572/Rev.1, 9.5)

5.5 Water level detectors are to be provided with warning and main alarm output interface to VDR.

5.6 For flood detector system required by SOLAS regulation II-1/22-1, the visual and audible alarms should conform to the Code on Alarms and Indicators, as may be amended, as applicable to a *primary alarm.* （*MSC.1/Circ.1291*）

5.7 protection of the enclosure: (MSC.188(79)Rev.1 APPENDIX, 2.1.1.1, 2.1.2)

(1) Protection of the enclosures of electrical components installed in the cargo holds, ballast tanks and dry spaces should satisfy the requirements of IP68 in accordance with IEC 60529. The water pressure testing of the enclosure should be based on a pressure head held for a period depending on the application. For detectors to be fitted in holds intended for the carriage of water ballast or ballast tanks the application head should be the hold or tank depth and the hold period should be 20 days. For detectors to be fitted in spaces intended to be dry the application head should be the depth of the space and the hold period should be 24 h.

(2) Protection of the enclosures of electrical equipment located on the deck above ballast and cargo spaces should satisfy the requirements of IP56 in accordance with IEC 60529.

5.8 Equipment which is to be used in refrigerated cargo spaces should satisfy the requirements of a suitable industry standard covering the relevant service temperatures. (MSC.188(79)Rev.1 APPENDIX, 2.1.3)

6 Materials and components

Materials and components should be controlled by the relevant requirements of CCS current rules.

The type and specifications of sensors are to be expressly indicated in the approval certificate and controlled by the list of approved and qualified suppliers. Where approved sensors are to be replaced by sensors of other types, CCS product certificate is to be presented or the corresponding type test is to be performed.

7 Type test

7.1 Type test items

Table 7.1 type test items

No.	Test items	Chapter of this guideline	Note
1	Level alarm function	5.3.1；5.3.2；5.4.2	-
2	Audible and visual alarm	5.4.3	-
3	Time delay for alarm	5.4.4	-
4	Detecting accuracy	5.3.4	-
5	Alarm override	5.4.5	-
6	Fault monitoring and alarm	5.4.6	Should include open circuit, short circuit, and CPU failure for computer-based alarm/monitoring system, etc.
7	Power supply switch and alarm	5.4.7	-
8	Output interface to VDR	5.5	-
9	Detector device water pressure test	7.1.1.1	The pressure and submerged period of this test can be noted in the Type Approval Certificate and the Product Certificate.
10	Detector device immersion test	7.1.1.2	-
11	Protection of enclosure test	5.7	The IP code of those components not mentioned in this guideline, should meet the requirement of CCS Rules for classification of see-going steel ships. The test should be carried out according to IEC 60529.
12	electrical power supply failure test;	According to CCS “Guidelines for Type Approval Test of Electric and Electronic Products” and IACS UR E10	-
13	power supply variation test;		-
14	Dry heat		-
15	Low temperature		-
16	Damp heat		-
17	Vibration test		-
18	Insulation resistance test		-
19	High-voltage test		-
20	inclinations		if moving parts are contained
21	Electromagnetic compatibility test		-

7.1.1 Detector equipment performance test

7.1.1.1 Hydraulic test

Technical requirements:

Protection of the enclosures of electrical components installed in the cargo holds, ballast tanks and dry spaces should satisfy the requirements of IP68 in accordance with IEC 60529. The water pressure testing of the enclosure should be based on a pressure head held for a period depending on the application. For detectors to be fitted in holds intended for the carriage of water ballast or ballast tanks the application head should be the hold or tank depth and the hold period should be 20 days. For detectors to be fitted in spaces intended to be dry the application head should be the depth of the space and the hold period should be 24 h. (MSC.188(79)Rev.1 APPENDIX, 2.1.3)

Test method:

(1) The test should be carried out according to IEC 60529 IPX8.

(2) Test pressure: based on the depth of the space where the detectors apply.

(3) The submerged test period for electrical components intended to be installed in ballast tanks and cargo tanks used as ballast tanks should be not less than 20 days.

(4) The submerged test period for electrical components intended to be installed in dry spaces and cargo holds not intended to be used as ballast tanks should be not less than 24 hours.

(5) Where detectors and/or cable connecting devices (e.g. junction box, etc.) are installed in spaces adjacent to cargo holds (e.g. lower seat) and such spaces are deemed flooded during calculation of damage stability, such detectors and devices are to comply with the requirements of IP68 for water head. The water head is to be equivalent to the tank depth. The test duration, either 20 days or 24h, is to be determined based on whether the tanks described in the previous two points are intended to be used as ballast water tanks.

7.1.1.2Immersion test

Technical requirements:

Operation in cargo/water mixture for a selected range of cargo groups such as iron ore dust, coal dust, grains and oils using seawater with a suspension of representative fine material for each cargo group. For type test purposes an agitated suspension of representative fine materials in seawater, with a concentration of 50% by weight, should be used with the complete detector assembly including any filtration fitted. The functioning of the detection assembly with any filtration arrangements should be verified in the cargo/water mixture with immersion repeated ten times without cleaning any filtration arrangements. (MSC.188(79)Rev.1 APPENDIX, 2.1.1.2)

(1) Test method:

① The test container for the cargo/water mixture is to be dimensioned so that its height and volume are such that the sensor and any filtration fitted can be totally submerged for the repeated functionality tests required by immersion test and the static and dynamic

inclination tests identified in the previous interpretation. The detector and any filter intended to be immersed and installed in the container are to be installed according to the instructions for installation contained in the equipment manual.

② The pressure in the container for testing the complete detector is to be not more than 0.2 bar at the sensor and any filter arrangement. The pressure may be realized by pressurization or by using a container of sufficient height.

③ The cargo/water mixture is to be pumped into the test container and suitable agitation of the mixture provided to keep the solids in suspension. The effect of pumping the cargo/water mixture into the container is not to affect the operation of the sensor and filter arrangements.

④ The argo/water mixture is to be pumped into the test container to a predetermined level that submerges the detector and the operation of the alarm observed.

⑤ The test container is then to be drained and the de-activation of the alarm condition observed.

⑥ The test container and sensor with any filter arrangement are to be allowed to dry without physical intervention.

⑦ The test procedure is to be repeated consecutively ten times without cleaning any filter arrangement that may be fitted in accordance with the manufacturer's installation instructions.

⑧ Satisfactory alarm activation and de-activation at each of the ten consecutive tests will demonstrate satisfactory type testing.

(2) The cargo/water mixture used for type testing are to be representative of the range of cargoes within the following groups and is to include the cargo with the smallest particles expected to be found from a typical representative sample:

① iron ore particles and seawater;

② coal particles and sea water;

③ grain particles and seawater; and

④ aggregate (sand) particles and sea water.

(3) The smallest and largest particle size together with the density of the dry mixture is to be ascertained and recorded. The particles are to be evenly distributed throughout the mixture. Type testing with representative particles will in general qualify all types of cargoes within the four groupings shown above.

The following provides guidance on the selection of particles for testing purposes:

① Iron ore particles are to mainly consist of small loose screenings of iron ore and not lumps of ore (dust with particle size < 0.1 mm).

② Coal particles are to mainly consist of small loose screenings of coal and not lumps of coal (dust with particle size < 0.1 mm).

③ Grain particles are to mainly consist of small loose grains of free flowing grain (grain having a size > 3mm, such as wheat).

④ Aggregate particles are to mainly consist of small loose grains of free flowing sand and without lumps (dust with particle size < 0.1 mm).

7.2 Selection of typical test specimens

7.2.1 The test specimens for type test are to be sampled by CCS surveyor from the manufacturer's qualified finished products. Type tests should be carried out on a prototype or randomly selected item(s) which are representative of the manufactured item that is being type tested.

7.2.2 For water level detectors, at least one set of test specimens is to be taken (may be increased if required).

7.3Testing agency

Test agencies approved by CCS or the authoritative and impartial ones have the priority for type approval test. For functional and performance tests, those tests can be conducted at the factory provided that the factory meets the test requirement and the test is approved and supervised by the CCS Surveyor.

8 Unit/batch inspection

8.1 After type approval, the products should be inspected by the Surveyor.

Surveyor can conduct sampling inspection with sampling proportion of 10%.

The following test items should be carried out.

(1) Appearance and structure check;

(2) High voltage test;

(3) Insulation resistance test;

(4) Functional test, including Test Item of Table 7.1.

8.2 Check the Explosion-proof Certificate of explosion-proof components. (if applicable)