Guideline No.: E-20(202306)

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:~~single hold cargo ships and bulk carriers other than the passenger ships and bulk carriers required in Regulation 22-1 and Regulation 25, Chapter II-1 and Regulation 12, Chapter XII of SOLAS~~.

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~~2~~ 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~~ and Regulation 25, Chapter II-1 and Regulation 12, Chapter XII~~ of SOLAS 1974 and a~~A~~mendments thereto;

2.2 Resolution MSC.188(79)/Rev.1 (2022.4.28~~04.12.3~~) Performance Standards for Water Level Detectors on ships subject to SOLAS regulation II-1/25, II-1/25-1 and XII/12;~~ on Bulk Carriers and Single Hold Cargo Ships other than Bulk Carriers~~;

2.3 MSC.1/Circ.1291(2008.12.9) Guidelines for f~~F~~looding d~~D~~etection s~~S~~ystems on p~~P~~assenger s~~S~~hips;

2.4 MSC.1/Circ.1572 (2020.12.08~~2017.6.09~~) 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)). ~~UNIFIED INTERPRETATIONS OF SOLAS~~

~~CHAPTERS 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 (RESOLUTION MSC.188(79)).~~

2.5 IACS UI SC180 ~~(Sept2003)~~ (Rev.1May 2004) (Rev.2 Nov 2005) (Rev.3Mar 2012)(Rev.4 Feb 2021) Hold, bBallast and dDry sSpace wWater lLevel dDetectors ~~(Chapter II-1/25 and Chapter XII/12)~~ and pPerformance sStandards for wWater lLevel dDetectors on bBulk cCarriers and sSingle hHold cCargo sShips other than bBulk cCarriers (Resolution MSC.188(79));

2.6 ~~Chapters 1, 2, 3, PART FOUR and Section 7 (sensors), Chapter 2, PART SEVEN of CCS~~ China Classification Society "Rules for Classification of Sea-going Steel Ships" ~~and Amendments thereto~~;

2.7 IMO A.1021(26)~~(2009.12.2)~~ Code on aAlerts and iIndicator;

2.8 IACS UR E10 (Rev.8) Test specification for type approval ~~IEC60092-504:2016 Electrical Installations in Ships-Part 504: Special Features-Control and Instrumentation~~;

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).~~;~~

~~2.11 IEC60079-0:2017 RLV Explosive Atmospheres - Part 0: Equipment - General requirements;~~

~~2.12 IEC60079-11:2011/COR1:2012 Explosive Atmospheres – Part 11: Equipment Protection by Intrinsic Safety 'i''.~~

3 Terms and Definitions

~~3.1 The terms and definitions used in this guideline are consistent with those in SOLAS.~~

~~3.2 The terms and definitions used in this guideline are consistent with those in CCS Rules for Classification of Sea-going Steel Ships.~~

~~3.3 The terms and definitions used in this guideline are consistent with those in IEC60092-504.~~

~~3.4 The terms and definitions used in this guideline are consistent with those in IMO A. 1021(26).~~

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

3.1~~5~~ *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.~~Water level detector is a system comprised of sensor and display device, which is used to detect any water ingress in cargo holds and other spaces and activate the corresponding alarm, as required by SOLAS Regulation XII/12 or Regulation II-1/22-1 or Regulation II-1/25.~~

3.2~~6~~ *Sensor* means a unit fitted at the location being monitored that activates a signal to identify the presence of water at the location.~~Sensor is a component which is fitted in monitored spaces~~

~~and able to activate signals alarming water flooding in such spaces~~.

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.

~~3.7 Water ingress detection pre-alarm means an alarm given when the water level reaches a lower level in cargo holds or other spaces on bulk carriers or single hold cargo ships.~~

~~3.8 water ingress detection main-alarm means an alarm given when the water level reaches the main alarm level in cargo holds or other spaces on bulk carriers or single hold cargo ships. This is applicable to SOLAS Regulation XII/12 or Regulation II-1/25; or the unique water level required by SOLAS Regulation II-1/22-1 which is applicable to the compartments other than cargo holds.~~

~~3.9 Visual display means the light device or other devices visible to human eyes under various illuminated and dim conditions in various spaces or places.~~

~~3.10 Audible display means the audible signal detectable in the space from which such signal is given.~~

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) List of elements and devices (including the name, type, specifications, quantity, manufacturer or brand of elements and devices, the code of elements and devices in the electric circuit diagram, etc.);~~

~~(6) Type test plan;~~

(5~~7~~) Product technical specifications ~~or enterprise standard~~.

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) Process documents and process flow chart showing quality monitoring points;~~

(2~~3~~) Software specification (including programming platform, software type, software version, software flow chart, software function etc., applicable to products with programmable elements);

~~(4) Software flow chart/program block diagram (applicable to products with programmable elements);~~

(~~5~~3) Type, specification and list of qualified suppliers of main raw materials and parts (e.g. sensor, integrated circuit chip~~, printed circuit board, semi-conductor element, fuse, switch, power module, light emitting diode, printed product, insulation paint~~, etc.);

(4~~6~~) ~~-~~System wiring diagram or hardware block diagram;

(5~~7~~) External wiring diagram;

(6~~8~~) Nameplate (both in English and Chinese);

~~(9) Product quality certificates;~~

~~(10) Information on the manufacturer's production capacity and quality system documents.~~

5 Technical requirements

5.1 System components

The water level detector is a system composed of a number of sensors ~~(sensors of explosion-proof type include safety barrier)~~ and display devices. ~~(usually electric control box), among which the electric control box and safety barrier are installed in safe areas and sensors are installed in hazardous areas (if they are explosion proof).~~

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 ~~water level~~ 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 (~~warning~~ 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) ~~Requirements for water level detectors on bulk carriers~~

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.

For compartments other than cargo holds:

3) 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)

~~(1) A visual and audible alarm is to be activated when the water in each cargo hold reaches a level 0.5m above the inner bottom of the cargo hold, and a visual and audible alarm is also to be activated when the height of water level is not less than 15% of the cargo hold depth and not more than 2m. For bulk carriers to which SOLAS Regulation XII/9.2 is applicable, only the alarm device giving the latter alarm is required. For cargo holds used for water ballasting, an alarm overriding control device may be installed. The visual and audible alarm is to be capable of clearly distinguishing the two kinds of water levels detected in each cargo hold.~~

~~(2) The audible and visual alarms are to be activated when the water within any ballast tank forward of the collision bulkhead required in SOLAS Regulation Ⅱ-1/11 has reached a level not greater than 10% of the tank capacity. The displayed visual and auditory features of the alarm are to be identical to those corresponding to the main alarm level of cargo holds. An alarm overriding control device is to be installed for the purpose of level alarm overriding control when the tank is being used.~~

~~(3) In any dry space or void space other than the chain locker, extended to any location forward of the fore cargo hold, the audible and visual alarms are to be activated when the water reaches a level 0.1m above the deck. The displayed visual and auditory features of the alarm are to be identical to those corresponding to the main alarm level of cargo holds. Such alarms does not have to be installed provided that the capacity of enclosed spaces is not more than 0.1% of the ship's maximum displacement.~~

~~5.3.3 Requirements for the performance of water level detectors on single hold cargo ships other than bulk carriers~~

~~An audible and visual alarm is to be activated when the water in a cargo hold reaches a level not less than 0.3m above the inner bottom of the cargo hold and the same is to be also activated when the water reaches a level not more than 15% of the average cargo hold depth.~~

~~5.3.4 Requirements for water level detectors on passenger ships~~

~~Refer to Regulations 6 and 7 of MSC.1/Circ.1291 Guidelines for Flooding Detection Systems on Passenger Ships for the requirements for detector configuration on passenger ships:~~

~~Regulation 6 of Guidelines for Flooding Detection Systems on Passenger Ships: water level detectors are to be provided in all enclosed spaces that are located below the bulkhead deck and have a capacity larger than:~~

~~(1) Molded volume of displacement per centimeter at deepest subdivision draught, or~~

~~(2) 30m3, whichever is greater.~~

~~Regulation 7 of Guidelines for Flooding Detection Systems on Passenger Ships: compliance with the requirements of Regulation 6 may be waived provided that the liquid (e.g. freshwater, ballast water, fuel oil, etc.) level sensors are installed individually in the spaces of abovementioned capacities and indicator board or other monitoring devices are provided in the navigation bridge.~~

~~The provided water level detection system on passenger ships is to be installed as close to the compartment bottom as possible in the vertical direction to ensure that alarms are activated immediately upon detection of any flooding in the abovementioned watertight compartments.~~

~~5.3.5 Detection devices are to be adequately protected against corrosion caused by the intended cargo to be loaded. Detection devices consist of sensors and filters installed in cargo holds and other spaces and the protective devices of detectors.~~

~~5.3. 6 The activation precision of water level detectors is to be ±100mm.~~

~~5.3.7 The electric circuit in cargo area, if any, of water level detectors, is to be intrinsically safe circuit of grade ib specified in IEC 60079. Such intrinsically safe circuit may not be mandatorily required provided that the ship is designed to carry only the cargos that will not generate combustible or explosive atmospheres, which is specified in the ship's operational manual of the detection system, ship loading manual and relevant certificate for carrying special cargos.~~

~~Intrinsically safe equipment in cargo spaces, if installed, is to be qualified explosion-proof electrical equipment meeting the requirements. The explosion-proof grade and maximum surface temperature of such equipment are to be suitable for the combustible dust and/or explosive gas that may be present. Where the properties of such combustible dust and/or explosive gas are unknown, the explosion-proof grade is to be no less than ⅡC and the temperature class is to beT6 or the maximum surface temperature is to be no more than 85℃ (ExibIICT6).~~

~~If intrinsically safe circuit is included in the detector system, the plan of its installation and arrangement on board is to be evaluated /approved by CCS.~~

~~5.3.8 Degree of protection by enclosure~~

~~(1) The degree of protection by enclosure is to be IP22 for control box of detection devices and IP56 for safety barrier junction box installed on decks.~~

~~(2) Degree of protection of sensors~~

~~For liquid level sensors installed in cargo holds, ballast tanks and dry spaces, the degree of protection provided by their enclosures is to be in compliance with the requirements for IP68 in IEC 60529.~~

5.4 Requirements for alarm system

5.4.1 The visual and audible alarms should be suitable for location on the navigation bridge~~Visual and audible alarms are to be installed in 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.

~~Visual and audible alarms are to comply with the requirements of IMO A1021 (26) Code on Alerts and Indicators:~~

~~This code is applicable to alarms activated for ship protection or ship safety;~~

~~Warning level means an alarm level on which the circumstance is to be displayed for immediate attention to prevent occurrence of any emergency;~~

~~Main alarm level is an emergency alarm level on which the circumstance is to be displayed for immediate actions to be taken to prevent damage to human life or 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 ~~(in the navigation bridge)~~. (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.~~The alarm system may have time delay function to prevent false alarm from being triggered under the sloshing effects arising from ship movement~~. (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)~~For detection systems installed only in liquid tanks and cargo holds designed to hold ballast water, the alarm system is to have display and alarm overriding control ability (SOLAS~~

~~Regulation XII/12.1). Compartments that may be designed with overriding control include:~~

~~(1) One alarm overriding control device may be installed in the cargo hold used for ballast tank.~~

~~(2) Any ballast tank forward of the collision bulkhead.~~

~~For a flooding alarm system, arrangement of alarm overriding control is not allowed in the spaces (e.g. dry space, cargo hold, etc.) which cannot be designed with alarm overriding control and used for water ballasting.~~

~~5.4.6 The water level detectors in cargo holds or liquid tanks described in 6.4.5 are to be capable of overriding visual display at all times during the out-of-service period. If such overriding ability is provided, the water level detectors are to be capable of automatically cancelling the overriding state and restoring the alarming ability when the ballast water in cargo holds or liquid tanks is drained to the indicated minimum alarm level.~~

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)

~~5.4.7 The failure, alarm and display system is to include a device for continuous monitoring and such device is to be capable of activating visual and audible alarms once any failure is detected. The audible alarm is to be capable of being silenced while the visual display continues to function until the failure is eliminated.~~

~~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.~~

~~5.4.8 Power supply to water level detectors~~

~~The power supply to water level detectors is to comply with the following requirements:~~

~~(1) Water level detectors are to be energized by two independent sources of power:~~

~~① Main source of power and emergency source of power; or~~

~~② Main source of power and one continuously charged special accumulator battery whose arrangement, location and power supply duration are equivalent to those of the emergency source of power (18h). This accumulator battery may be an internal battery of the water level detection system;~~

~~(2) The power supply changeover equipment for changeover from one source of power to another needs not be integrated into the water level detection system;~~

~~(3) Alarm indication is to be activated when the main source of power supply sustains any failure. Where the accumulator battery is used as the alternative source of power, both sources of power are to be provided with failure alarm.~~

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	-

13	power supply variation test;	Approval Test of Electric and Electronic Products" and IACS UR E10	-
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		-

~~The water level detectors installed on bulk carriers are, as a minimum, to be type tested in accordance with this chapter; the water level detectors installed on passenger ships and single hold cargo ships may be type tested with reference to this chapter.~~

~~7.1.1 Environmental test and EMC test~~

~~Environmental test and EMC test items, see Table 7.1.1~~

~~**Environmental test and EMC test Items Table 7.1.1**~~

~~No.~~	~~Test item~~	~~Technical requirements~~	~~Test method~~	~~Remark~~
~~1~~	~~Inspection of appearance, structure and marks~~	~~2.1 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)~~	~~2.1 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)~~	~~—~~
~~2~~	~~High voltage test~~	~~2.14 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)~~	~~2.14 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)~~	~~—~~
~~3~~	~~Insulation resistance~~	~~2.3 of GUIDELINE FOR~~	~~2.3 of GUIDELINE FOR TYPE~~	~~—~~

	test	TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	
4	Power supply variation test;	2.4 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	2.4 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	–
5	Power supply failure test	2.5 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	2.5 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	–

Continued Table 7.1.1

No.	**Test item**	**Technical requirements**	**Test method**	**Remark**
6	Static and dynamic inclinations tests,	2.6 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	2.6 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	if the detectors contain moving parts.
7	Vibration test	2.7 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	2.7 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	–

8	Dry heat test	2.8 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	2.8 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	Control box: +55 ℃, 16h; safety barrier, sensor: +70 ℃, 16h;
9	Cold test	2.9 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	2.9 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	Control box: +5 ℃, 2h; safety barrier, sensor: -25 ℃, 2h ;
10	Damp heat test	2.10 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	2.10 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	–

Continued Table 7.1.1

No.	Test item	Technical requirements	Test method	Remark
11	Salt mist test (Kb) (applicable to installations on open decks or in open cargo holds	2.12 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	2.12 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	Salt mist test is to be carried out for sensors located in open spaces; The safety barrier junction box, if installed on open decks, is also to be subject to the salt mist test.
12	IP code test	2.15 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)(or IEC 60529)	2.15 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)(or IEC 60529)	- control boxes: IP22(at least); electrical equipment installed above ballast and cargo spaces should satisfy the requirements of IP56; electrical components installed in the cargo holds, ballast tanks and dry spaces should satisfy the requirements of IP68 .
13	Electromagnetic compatibility test			
13.1	Measurement of conducted emission	3.2 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	3.2 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	--

Continued Table 7.1.1

No.	Test item	Technical requirements	Test method	Remark
13.2	Measurement of enclosure port radiated emission testing	3.3 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	3.3 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	--
13.3	Electrostatic discharge immunity test	3.4 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	3.4 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	--
13.4	Radiated, radio-frequency, electromagnetic field immunity test	3.5 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	3.5 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	--
13.5	Low-frequency transduction immunity test	3.8 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	3.8 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	--
13.6	Test of immunity to conducted disturbances, induced by radio-frequency fields	3.9 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	3.9 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	--

Continued Table 7.1.1

No.	Test item	Technical requirements	Test method	Remark
13.7	Electrical fast transient/burst immunity test	3.6 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	3.6 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	--
13.8	Surge immunity test	3.7 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	3.7 of GUIDELINE FOR TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT VALID VERSION)	--

7.1.2 Performance test of detecting system

Detecting system should be tested according to Table 7.1.2

Detecting system performance test items Table 7.1.2

No.	Test item	Technical requirements	Test method	Remark
1	Alarm testing switch functions	A switch for testing audible and visual alarms should be provided at the alarm panel and the switch should return to the off position when not operated (MSC.188(79) Appendix 3.1.2)	Manual inspection	--
2	Alarm silencing function	The audible alarm should be capable of being muted, but the visual indication should remain active until the malfunction is cleared. (3.3.7 of MSC.188(79))	Manual inspection	--

Continued Table 7.1.2

No.	Test item	Technical requirements	Test method	Remark
3	Level alarm test	(1) For cargo holds: ① An alarm, both visual and audible, activated when the depth of water at the sensor 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 level of water at the sensor reaches the main alarm level, indicating increasing water level in a cargo hold. The indication should identify the space and the audible alarm should not be the same as that for the pre-alarm level. (2)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. (3)The detector indicating the water level should be capable of activating to an accuracy of ±100 mm. (3.2 of MSC. 188 (79))	For liquid level (pressure) sensors, the following methods may be employed: 1. direct method: using plastic pipe containing water; 2. indirect method: using pressure calibrator. For float-type sensors or electrode-type sensors, testing methods suitable to these types may be employed.	--
4	Indicator light lamp brightness adjustment function	The indicator lamps of the product, other than alarm indicator lamp and illuminating light of the light adjusting and controlling device, are to have the function of manual brightness adjustment.	Manual inspection	--

Continued Table 7.1.2

No.	Test item	Technical requirements	Test method	Remark
5	Alarm overriding function	An override visual indication capability should be provided throughout deactivation of the water level detector for the holds or tanks referred to in 3.3.5 above. 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. (3.3.6 of MSC.188 (79))	Manual inspection	--
6	Power supply failure alarm function	The water level detector system should be capable of being supplied with electrical power from two independent electrical supplies. Failure of the primary electrical power supply should be indicated by an alarm. Where batteries are used for the secondary power supply, failure alarms for both power supplies are to be provided. (3.3.8 of MSC.188 (79), UI SC 180)	Manual inspection	if the water level detecting system contains batteries as back-up power source, a duration test of 18h should be carried out.
7	Open circuit / short circuit alarm test	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. (3.3.7 of MSC.188 (79))	Manual inspection	--

Continued Table 7.1.2

No.	Test item	Technical requirements	Test method	Remark
8	CPU failure test	In the event of any CPU failure (including cutoff of CPU power, program failure, communication failure, etc.), the buzzer and visual alarm indicator light on the control box panel are to give visual and audible alarm signals. (3.3.7 of MSC.188 (79))	1.Cut off the Power supply to CPU ,or 2clear the CPU program,; or 3. disconnect the CPU communication line, or 4. other reasonable methods.	This test should be carried out for computer based alarm/monitoring system.
9	Alarm output interface to VDR	The detection devices are to be capable of outputting the warning and main alarm to VDR.	Necessary equipment is to be connected. Manual inspection.	--
10	Audible alarm function	Range of sound signal frequency: 200-2500Hz; Range of sound pressure: 75-95 decibels, not more than 115 decibels; (5.4.3.4.1 and 5.4.3.4.2 of MSC/Circ.982)	Manual inspection. Sound pressure level is to be measured from a distance 1m away from the audible alarm using audio frequency meter.	--
11	Explosion-proof performance test	The part of the system which has circuitry in the cargo area should be intrinsically safe. (3.2.5 of MSC.188 (79))	IEC 60079-0; IEC 60079-11.	Test can be waived where the manufacturer is able to produce evidence that the equipment would satisfy the test.

7.1.13 Detector euquipment performance test

7.1.1.1 (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) ~~(2.1.1 (1) of Appendix to MSC.188 (79))~~

Test method:

~~0)~~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.

~~0)~~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.

~~Test time:~~

~~for detectors to be fitted in holds intended for the carriage of water ballast or ballast tanks: 20days;~~

~~for detectors to be fitted in spaces intended to be dry: 24h.~~

~~0)~~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.

7.1.1.2~~(2)~~ Immersion 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)~~(2.1.1 (2) of Appendix to MSC.188 (79))~~

0)1) Test method:

a) 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.

b) 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 ~~sed~~ by pressurization ~~sation~~ or by using a container of sufficient height.

c) 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.

d) The cargo/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.

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

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

g) 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.

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

0)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.

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.

~~7.3.1 For initial type approval, the organization undertaking the test is to be an appropriate testing agency holding the corresponding CCS Product Inspection and Testing agency Approval Certificate.~~

~~7.3.2 For the purpose of type approval certificate renewal, with the consent of CCS, the option of conducting type testing 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 the competent inspection and testing personnel.~~

8 Unit/batch inspection

8.1 After type approval, the products should be inspected ~~one by one~~ 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 ~~1~9~~ of Table 7.1.2.

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