

Guideline No.: N-04 (201712)



N-04 Voyage Data Recorder

Issued date: December 26, 2017

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Foreword

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

This Guideline 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.

Historical versions and release date: N-04(201605)

Main changes:

This edition is revised from the *N-04 Voyage Data Recorder* (201605) because of the update of IEC 60945 and IEC 61162 series Standards

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Voyage Data Recorder

1 Application

1.1 This guideline is applicable to the type approval and single-piece/batch inspection of the voyage data recorders (VDRs) installed and used on ships and offshore facilities.

1.2 The VDRs include:

1.2.1 The shipborne VDRs as required in Articles 18 and 20, Chapter 5 in the 2010 amendment of the 1974 International Convention for the Safety of Life at Sea (SOLAS) of IMO;

1.2.2 Resolution MSC.333 (90), Adoption of Revised Performance Standards for Shipborne Voyage Data Recorders (VDRs);

1.2.3 Resolution MSC.163 (78), Performance Standards for Simplified Voyage Data Recorders (S-VDR) and Resolution MSC. 214 (81), Amendment to MSC.A.861 (20) Performance Standards for VDRs and MSC.163 (78) Performance Standards for S-VDRs.

2 Normative references

- (1) Resolution MSC.333 (90): Adoption of Revised Performance Standards for Shipborne Voyage Data Recorders (VDRs);
- (2) Resolution MSC.163 (78): Performance Standards for Shipborne Simplified Voyage Data Recorders (S-VDRs);
- (3) Resolution MSC. 214 (81): Amendment to MSC. A.861 (20) Performance Standards for VDRs and MSC.163 (78) Performance Standards for S-VDRs;
- (4) IMO A.694(17): General Requirements for Shipborne Radio Equipment Forming Part of the Global Maritime Distress and Safety System (GMDSS) and for Electronic Navigational Aids;
- (5) IMO A.810(19): Performance Standards for Float-free Satellite Emergency Position-indicating Radio Beacons (EPIRBs) Operating on 406 MHz;
- (6) IEC 61996-1 (2013): Maritime Navigation and Radiocommunication Equipment and Systems – Shipborne Voyage Data Recorder (VDR) – Part 1: Performance Requirements, Methods of Testing and Required Test Results

- (7) IEC 61996-2:2007: Maritime Navigation and Radiocommunication Equipment and Systems - Shipborne Voyage Data Recorder (VDR) - Part 2: Performance Requirements, Methods of Testing and Required Test Results for Simplified Shipborne Voyage Data Recorder (S-VDR);
- (8) ~~IEC 60945:2002: Maritime Navigation and Radio Communication Equipment and Systems - General Requirements, Methods of Testing and Required Test Results; IEC 60945:2002/COR1:2008: Maritime Navigation and Radio Communication Equipment and Systems - General Requirements, Methods of Testing and Required Test Results;~~
- (9) IEC61097-2:2008: Global Maritime Distress and Safety System (GMDSS) - Part 2: COSPAS - SARSAT EPIRB - Satellite Emergency Position Indicating Radio Beacon Operating on 406 MHz - Operational and Performance Requirements, Methods of Testing and Required Test Results;
- (10) ~~IEC 61162-1:2010: Maritime Navigation and Radiocommunication Equipment and Systems - Digital Interfaces - Part 1: Single Input Multiple Output; IEC 61162-1:2016: Maritime Navigation and Radiocommunication Equipment and Systems - Digital Interfaces - Part 1: Single Talker and Multiple Listeners;~~
- (11) ~~IEC 61162-2:1998: Maritime Navigation and Radiocommunication Equipment and Systems - Digital Interfaces - Part 2: Single Input Multiple Output High-speed Transmission; IEC 61162-2:1998: Maritime Navigation and Radiocommunication Equipment and Systems - Digital Interfaces - Part 2: Single Talker and Multiple Listeners, High-speed Transmission;~~
- (12) ~~IEC 61162-3:2010: Maritime Navigation and Radiocommunication Equipment and Systems - Digital Interfaces - Part 3: Serial Data Instrument Network; IEC61162-3:2008+AMD1:2010+AMD2:2014: Maritime Navigation and Radiocommunication Equipment and Systems - Digital Interfaces - Part 3: Serial Data Instrument Network;~~
- (13) ~~IEC 61162-450:2011: Maritime Navigation and Radiocommunication Equipment and Systems - Digital Interfaces - Part 450: Multiple Talkers and Multiple Listeners - Ethernet~~

Interconnection. IEC 61162-450:2011+AMD1:2016: Maritime Navigation and Radiocommunication Equipment and Systems - Digital Interfaces - Part 450: Multiple Talkers and Multiple Listeners – Ethernet Interconnection.

3 Terms and definitions

For the purpose of this guideline, the definitions as specified in IEC61996-1 (2013) apply. For a better understanding, the following definitions are also provided:

3.1 Voyage data recorder (VDR) : A complete system, including any items required to interface with the sources of input signals, the data processing and encoding equipment, the final recording medium, the playback equipment, the power supply and dedicated reserve power source.

3.2 Signal source: Any sensor or device external to the VDR, to which the VDR is connected and from which it obtains signals and data to be recorded.

3.3 Final recording medium: The items of hardware on which the data is recorded such that the access to any one of them would enable the data to be recovered and played back by use of suitable equipment. The combination of a fixed recording medium, a float-free recording medium and a long-term recording medium, together, is recognized as the final recording medium.

3.4 Fixed recording medium: A part of the final recording medium which is protected against fire, shock, penetration and a prolonged period on the ocean floor. It is expected to be recovered from the deck of the vessel that has sunk. It has a means of indicating location.

3.5 Float-free recording medium: A part of the final recording medium which should be float-free after a sinking. It has a means of indicating location.

3.6 Long-term recording medium: A permanently installed part of the final recording medium. It provides the longest record duration and has a readily accessible interface for downloading the stored data.

3.7 Playback equipment: Any data medium with the playback software, the operational instructions and any special parts required for connecting a commercial-off-the-shelf laptop computer to the VDR.

3.8 Playback software: A software program to provide the capability to download the stored data and play back the information. The software shall be compatible with an operating system

available with commercial-off-the-shelf laptop computers and where non-standard or proprietary formats are used for storing the data in the VDR, the software shall convert the stored data into open industry standard formats.

3.9 Dedicated reserve power source: A battery, with suitable automatic charging arrangements, dedicated solely to the VDR, of sufficient capacity to continuously record the bridge audio.

3.10 The configuration data describes the vessel's equipment, its installation on the vessel and its relation to the VDR. The storage and playback software uses this data to store the data records and to convert the data records into the information that assists casualty investigation during the playback.

4 Plans and documents

4.1 The following drawing documents shall be submitted for review. The drawings/documents for product review shall at least include the following:

- (1) Outline drawings and system composition structural drawings of the complete machine;
- (2) Drawings of main parts, such as the main unit, operating units (or including displays), indoor and outdoor microphones, image acquisition units, serial port (or non-standard) data acquisition units, fixed data storage units, float-free data storage units, long-term data storage units and etc.;
- (3) Schematic diagrams of systems;
- (4) External wiring diagrams;
- (5) Product technical specifications;
- (6) Product operating manuals, installation manuals, maintenance manuals and guidance for the placement of the information;
- (7) Instructions on software (including the version number and the playback software for data playback);
- (8) List of key raw materials and parts.

4.2 The following drawing documents shall be submitted for review. The drawings/documents for product approval shall at least include the following:

- (1) Factory profile: factory name, address, production history, production capacity, technicians and testing personnel, main products, membership relation, product brand and etc.;
- (2) Details of the products applying for approval;
- (3) List of the main production equipment;
- (4) List of the main testing equipment;
- (5) Brief production processes of the product applying for approval, at least including the assembly, commissioning and other key processes;
- (6) Quality management documents or quality system certificates;
- (7) Corporate registration certificate;
- (8) Qualification certificate and/or production license, if applicable;
- (9) Copies of product quality certificates or certificates of conformity;
- (10) Quality control plan, if applicable;
- (11) List of eligible suppliers;
- (12) Outline of the type test.

5 Technical requirements

5.1 The functions and performance of the products shall be suitable for the working environment of ships and in line with the testing requirements as specified in IEC61996-1:13 (for VDRs) or IEC61996-2:2007 (for S-VDRs).

5.2 The electrical safety, suitability of power supply conditions, environmental suitability and electromagnetic compatibility shall be suitable for the working environment of ships and in line with the testing requirements as specified in ~~IEC60945:2002~~ IEC60945:2002/COR1:2008.

5.3 The digital formats and interfaces of the products shall be suitable for the working environment of ships and in line with the testing requirements as specified in IEC61162 series.

5.4 Float-free capsule

5.4.1 Release: The float-free release mechanism shall comply with the relevant requirements of IMO Resolution A.662(16). To ensure that the capsule can be retrieved safely after release, suitable large pad eyes or handles shall be incorporated.

5.4.2 Light: The float-free capsule shall have a light conforming to the relevant requirements of IEC 61097-2. In addition, this light shall remain activated during daylight hours.

5.4.3 Locating transmitter: The float-free capsule shall be capable of resolving and transmitting its last received position or its current position with a minimum accuracy of 4 s of arc and conform to the relevant requirements of IEC 61097-2.

5.4.3 Combined EPIRB/VDR capsule: In case of a combined EPIRB/VDR capsule, this shall also meet the requirements of IEC 61097-2.

5.5 Co-relation in date and time

To ensure that relevant time can be determined within the resolution of 0.1s, all data items shall be recorded based on the VDR time system during the sampling of the VDR. The resolution of the VDR system clock is 0.05 s. The deviation of the system clock shall not be more than 1s/h.

5.6 Design requirements for the final recording medium

5.6.1 Fixed recording medium: The fixed recording medium shall be installed in a fixed protective capsule which shall meet all of the following requirements:

- (1) Be capable of being accessed following an incident but secured against a physical or electronically manipulated change or deletion of recorded data;
- (2) Maintain the recorded data for a period of at least 2 years following termination of recording;
- (3) Maximize the probability of survival against fire, shock, penetration and deep-sea-pressure and recovery of the final recorded data after any incident;
- (4) Be of a highly visible colour and marked with retro-reflective materials; and
- (5) Be fitted with an appropriate device to aid the location under water.

5.6.2 Float-free recording medium: The float-free recording medium shall be installed in a float-free capsule which shall meet all of the following requirements:

- (1) Be fitted with the means to facilitate grappling and recovery;
- (2) Maintain the recorded data for a period of at least 6 months following termination of recording;
- (3) Be so constructed as to comply with the requirements specified in Resolution IMO A.810(19) and to minimize the risk of damage during the recovery operations;
- (4) Be capable of transmitting an initial locating signal and further locating homing signal for at least 48 hours over a period of not less than 7 days/168 hours; and
- (5) Be capable of being accessed following an incident but secure against a physical or electronically manipulated change or deletion of recorded data;

5.6.3 Long-term recording medium: The long-term recording medium shall:

- (1) Be capable of being accessed from an internal, easily accessible area of the vessel; and
- (2) Provide access to the data held on it but be secured against a physical or electronically manipulated change or deletion of recorded data.

5.7 Location beacon

5.7.1 The fixed protective capsule shall include an acoustic underwater beacon operating in the frequency band centered on 37.5 kHz with a battery life of 90 days, which shall meet the requirements of SAE AS 8045A.

5.7.2 The float-free capsule shall include a homing transmitter operating on 121.5 MHz, complying with Annex D of IEC 61097-2:2008.

5.8 Recording period and duration

The unit shall be entirely automatic in the normal operation. The recording shall be continuous unless terminated in accordance with 5.10.2. The time for which all stored data items are retained shall be at least 30 days/720 hours on the long-term recording medium and at least 48 hours on the fixed and float-free recording media. The data items which are older than this may be overwritten with new data.

5.9 Data items to be recorded

Date and time, ship's position, speed, heading, bridge audio, communications audio, radar data, ECDIS, echo sounder, main alarms, rudder order and response, engine and thruster order and response, hull opening status, watertight and fire door status, accelerations and hull stresses, wind speed and direction, AIS, rolling motion, configuration data and electronic logbook.

5.10 Power source

5.10.1 The VDR shall be capable of operating from the ship's main and emergency sources of electrical power.

5.10.2 If the ship's source of electrical power supply fails, the VDR shall continue to record the bridge audio from the dedicated reserve power source for a period of 2 hours. At the end of this 2 hour period, all recording shall cease automatically.

6 Materials and parts

The raw materials and parts of the products shall be controlled in accordance with the current regulations of the state. The final recording medium shall be provided with the product certificate issued by CCS.

Other raw materials and parts to be listed in the lists of the eligible suppliers, for which the manufacturers are not allowed to change without the approval of CCS, shall at least include: the main unit (including the mainboard core processor) and the dedicated reserve power source (battery).

7 Type test

7.1 Selection of typical samples

The models and specifications of the test samples shall be representative, covering all the products for which the applications for type approval are submitted. All standard and optional configurations shall be selected to ensure that the samples with the most functions and available interfaces of the system are used for the type tests.

7.2 Testing agency of the type test

The type approval tests shall be carried out by a testing agency authorized by CCS. The audio tests are recommended to be performed at the Institute of Acoustics of the Chinese Academy of Sciences; the video tests are recommended to be performed at the National Institute of Metrology, China; the float-free capsule shall pass the tests carried out by an authorized international

COSPAS-SARSAT testing authority. If the laboratories authorized by CCS are not available and an authorized testing agency or the product manufacturer is provided with the required testing conditions, some test items may be carried out at the premise of the manufacturer upon the review and approval of the surveyors of CCS and under their supervision on the site.

7.3 Type approval test items

7.3.1 In accordance with the requirement of IEC61996-1, the items to be tested for the VDR are listed in Table 7.3.1 below:

Type test items specified in IEC61996-1

Table 7.3.1

S/N	Test item	Testing methods and required test results (Provisions of IEC 61996-1)	Remarks
1	Comprehensive performance test	6.1.1~6.1.4	
2	Download and playback equipment	6.1.2	
3	Test sequence	6.1.3	
4	Requirements to be checked only	6.1.4	
5	Environmental test conditions in normal operation	6.1.5	The products shall meet the requirements of IEC 60945. The special conditions and tests of the data survived from an incident shall meet the requirements of 6.13 and 6.14 in IEC61996-1.
6	Recording period	6.1.6	
7	Reserve power source	6.1.7	
8	Reserve power source charging test	6.1.8	
9	Brief interruption of electrical power	6.1.9	
10	Recording integrity	6.1.10	
11	Maintenance of sequential records	6.1.11	
12	Co-relation in date and time	6.1.12	
13	Design and construction of the fixed protective capsule	6.1.13	See the note.
14	Design and construction of the float-free protective capsule	6.1.14	
15	Operational performance test	6.1.15	
16	Power source test	6.1.16	
17	Data items to be recorded	6.2	
18	Date/time - ship's position - speed - heading	6.2.1	
19	Bridge audio - audio response	6.2.2.1	
20	Bridge audio - quality index - single channel	6.2.2.2.1	
21	Bridge audio - quality index - multi-channel	6.2.2.2.2	
22	Bridge audio - audio noise level - signal to no signal	6.2.2.3	
23	Bridge audio - audio noise level – signal to noise and distortion	6.2.2.4	
24	Communications audio - audio response	6.2.3.1	
25	Communications audio - quality index	6.2.3.2	
26	Communications audio - audio noise level - signal to no signal	6.2.3.3	

Continued Table 7.3.1

S/N	Test item	Testing methods and required test results (Provisions of IEC 61996-1)	Remarks
27	Communications audio - audio noise level – signal to noise and distortion	6.2.3.4	
28	Radar image, post-display selection and ECDIS	6.2.4	
29	Fidelity test objective	6.2.4.1	
30	Principles of the fidelity test	6.2.4.2	
31	Comparison of images	6.2.4.3	
32	Pre-determined test images	6.2.4.4	
33	Colour errors	6.2.4.5	
34	Horizontal position errors	6.2.4.6.1	
35	Vertical position errors	6.2.4.6.2	
36	Subjective evaluation	6.2.4.7	
37	Other data interfaces	6.2.5	
38	Electronic logbook	6.2.6	

Notes: The test sequence is as follows: a) shock test; b) penetration test; c) low temperature fire test; d) high temperature fire test; e) deep-sea pressure and sea water immersion test. These tests shall normally be carried out on a single EUT.

① If more than one EUT is used, the sequence above is acceptable;

② If two EUTs are used, the sequence of tests shall be:

a), b) on one unit and c), d), and e) on the other, or

a), b), c), and e) on one unit and a), b), d), and e) on the other.

③ If three EUTs are used, the sequence of tests shall be:

a), and b) on one unit, c), and e) on the second unit, and d), and e) on the third unit.

As a minimum, the fire tests and the deep-sea immersion tests shall be conducted on the same EUT. However, it is not a mandatory requirement that a single EUT shall survive other tests in addition to these.

The deep-sea immersion test can be carried out on the final recording medium in the EUT alone if it can be shown that the final recording medium cannot be damaged as a consequence of collapse of the protective capsule.

7.3.2 In accordance with the requirement of IEC60945, the items to be tested for the VDR are listed in Table 7.3.2 below:

Test items specified in IEC60945**Table 7.3.2**

S/N	Test item	Testing methods and required test results (Provisions of IEC60945)	Remarks
1	High temperature test	8.2&7.1	
2	Low temperature test	8.4&7.1	
3	High and low temperature alternating temperature humidity test	8.3	
4	Shock test	8.7	
5	Rain test	8.8	
6	Salt mist test	8.12	
7	Power source test under extreme conditions	7.1	
8	Excessive power supply test (overcurrent, overvoltage or reverse polarity)	7.2	
9	Conducted disturbance measurement	9.2	
10	Measurement of radiated emissions from enclosure ports	9.3	
11	Immunity to conducted disturbances, induced by radio-frequency fields	10.3	
12	Radio-frequency and electromagnetic field immunity test	10.4	
13	Electrical fast transient/burst immunity test	10.5	
14	Surge immunity test	10.6	
15	Power supply short-term variation immunity	10.7	
16	Electrostatic discharge immunity test	10.9	
17	Noise and audible signals	11.1	
18	Magnetic compass safe distance	11.2	
19	Insulation of dangerous voltage (and enclosure protection)	12.1	The enclosure protection testing method shall be as specified in IEC60529-2001.
20	Ergonomics	6.1	
21	Hardware inspection (visual inspection)	6.2	
21	Software inspection (including the inspection of software version number)	6.3	
23	Interconnection between devices	6.4	

7.3.3 The float-free protective capsule in the VDR is subject to the tests listed in Table 7.3.3 below in accordance with the requirements of IEC61097-2.

Test items specified in IEC61097-2**Table 7.3.3**

S/N	Test item	Testing methods and required test results (Provisions of IEC 61097-2)	Remarks
1	Comprehensive performance test	5.1 & 5.2.	The type approval of COSPAS-SARSAT shall be obtained.
2	Operating test	5.3	
3	Activation function test	5.4	
4	Floating test	5.5	
5	Environmental test	5.6 & 5.7 & 5.17	
6	Electromagnetic compatibility test	5.8 & 5.17	
7	Maintenance and manual	5.9 & 5.11	
8	Safety considerations	5.10	
9	Label	5.12	
10	Installation	5.13	
11	Technical parameters	5.14	
12	Power supply	5.15	
13	Parameters of antenna	5.16	
16	Interface test	5.18	
17	Spurious emission test	5.19	
18	Compass safe distance	5.20	
19	Conducted interference	5.21	

8 Unit/batch testing

The products are among those subject to the type approval as specified in the convention. The single-piece/batch testing not approved is generally not acceptable. Where it is accepted, the test items shall include the type test items.

The factory shall test the products submitted for inspection one by one. Once the products pass the inspection, it shall apply for delivery test which is to be carried out by CCS. The surveyors of CCS may, on the basis of the inspection of all products, witness the following tests with the sampling rate of 5% (no less than two sets).

8.1 Single-piece/batch test items after approval:

8.1.1 Inspection of software version number of the product;

8.1.2 Visual inspection;

8.1.3 Download and playback equipment;

8.1.4 Reserve power source;

8.1.5 Brief interruption of electrical power;

8.1.6 Recording integrity;

8.1.7 Inspection of image acquisition and recording functions;

8.1.8 Inspection of audio acquisition and recording functions;

8.1.9 Verification of acoustic underwater beacons: verify whether the beacons are provided with the certificates in line with the requirements of SAE AS 8045A and the battery life of 90 days, and check the validity period of the batteries.