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Ships and marine technology — Guidelines for the operation and installation of voyage data recorders (VDR)

Navires et technologie maritime — Lignes directrices pour le fonctionnement et l'installation des enregistreurs de données de voyage (VDR)

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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ISO 22472 was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 6, *Navigation and ship operations*.

This second edition cancels and replaces the first edition (ISO 22472:2006) of which has been technically revised.

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Ships and marine technology — Guidelines for the operation and installation of voyage data recorder (VDR)

1 Scope

The purpose of this document provides guidance for the planning, installation and operational testing of VDR installations according to specifications of IMO Resolution MSC.333 (90) and associated IEC 61996-1:2013. These standards mainly deal with interfaces between VDR and external sensors, which are the main subject for technical agreements amongst user, shipyard, VDR supplier and/or sensor manufacturers when installations are planned. In addition, matters of performance test and playback are described as well. Furthermore, details for checking of items related to the interfaces and the installation are introduced. This standard is not intended for the standardization of performance factors and functional requirements related to VDR.

When whole or partial replacement of an existing simplified VDR (S-VDR) is required, this document provides guidance according to the requirements of IMO Resolution MSC.163(78) and IEC 61996-2 for installation of the items concerned.

NOTE All text of this International Standards which is identical to that of IMO Resolution MSC.333(90) and/or IEC 61996-1:2013 are formatted in *italics*, and the Regulation and associated performance standard clause numbers are indicated in brackets, where necessary.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60945, *Maritime navigation and radiocommunication equipment and systems - General requirements - Methods of testing and required testing results*

IEC 61097-7:1996, *Global maritime distress and safety system (GMDSS) - Part 7: Shipborne VHF radiotelephone transmitter and receiver - Operational and performance requirements, methods of testing and required test results*

IEC 61162-1:2010, *Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part1: Single talker and multiple listeners*

IEC 61162-2:1998, *Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part2: Single talker and multiple listeners, high-speed transmission*

IEC 61162-450:2011, *Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part 450: Multiple talkers and multiple listeners – Ethernet interconnection*

IEC 61996-1:2013, *Marine navigation and radiocommunication equipment and systems - Shipborne voyage data recorder (VDR) - Performance requirements - Methods of testing and required test results*

IMO Resolution MSC.302 (87) 2010, *Performance standards for bridge alert management*

IMO Resolution MSC.333 (90) 2012, *Performance standards for shipborne voyage data recorders (VDRs)*

VESA:2007, *Video electronics standards association – VESA and industry standards and guidelines for computer display monitor timing (DMT), Version 1.0, Revision 0.11*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms, definitions and abbreviated terms apply.

3.1 Terms and definitions

3.1.1

alert

announcement of abnormal situations and conditions requiring attention. Alerts are divided in four priorities: emergency alarms, alarms, warnings and caution

3.1.2

alarm

high priority of an alert. A condition requiring immediate attention and action, to maintain the safe navigation and operation of the ship

3.1.3

bridge work station

position at which a person is expected to be when performing one of the normal bridge duties at, for example, the following work stations:

- centre line conning;
- bridge wing(s);
- main radar;
- chart table;
- helmsman;
- communication

3.1.4

combined EPIRB/VDR capsule

single unit which meets all the requirements of a satellite EPIRB (as required by the carriage requirements of SOLAS IV) and all the requirements of a VDR (as required by the carriage requirements of SOLAS V).

Note 1 to entry: Combined EPIRB/VDR capsule was defined by IMO COMSAR 8.

3.1.5

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 record and to convert the data record into information that assists casualty investigation during playback.

3.1.6

data

any item of information received by the VDR for recording, including numerical values, text and audio or radar signals and including all configuration data, except where specifically stated or where the context dictates otherwise.

3.1.7**dedicated reserve power source**

a battery, with suitable automatic charging arrangements, dedicated solely to the VDR, of sufficient capacity to operate it as required by IMO Resolution MSC.333(90)/5.4.2.

3.1.8**final recording medium**

the items of hardware on which the data is recorded such that 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 and float-free recording medium and long-term recording medium, together, is recognized as the final recording medium.

3.1.9**fixed recording medium**

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.

3.1.10**float-free recording medium**

part of the Final Recording Medium which should float-free after a sinking. It has a means of indicating location.

3.1.11**long-term recording medium**

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.

3.1.12**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.

3.1.13**playback software**

copy of the software program to provide the capability to download the stored data and play back the information. The software should 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 should convert the stored data into open industry standard formats

3.1.14**playback system**

system including the playback equipment that is capable of downloading and playing back the recorded data

3.1.15**Voyage data recorder
VDR**

complete system, including any items required to interface with the sources of input signals, their processing and encoding, the final recording medium, the playback equipment, the power supply and dedicated reserve power source

3.1.16**resolution**

smallest detectable increment between two values

3.1.17**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.

3.2 Abbreviated terms

EPFS	Electronic Position Fixing System
s and safety system	
IMO	International Maritime Organization
IEC	International Electrotechnical Commission
INS	Integrated Navigation System
LAN	Local area network
ROV	Remotely operated vehicle
UTC	Coordinated universal time
VHF	Very high frequency

4 VDR interface

According to IMO Resolution MSC.333 (90)/8 and IEC 61996-1:2013/4.3.5, *interfacing between the various sensors and VDR shall be in accordance with the relevant international interface standard IEC 61162 series, where possible*. As a minimum, the sentences that VDR is to support are given in Annex A of IEC 61996-1:2013.

In case there is no free interface port available for the connection to the VDR, a "data splitter"-interface should be added for providing the additionally required output port of a sensor. A 'data splitter-interface' shall comply with IEC 60945.

It is also specified that *any connection to any item of the ship's equipment shall be such that operation of that equipment suffers no deterioration, even if the VDR system develops faults*. (MSC.333 (90)/8).

It may be noted that the use of signals defined under common standards results in fewer problems for the installation of any VDR, even if the interfaces of several mandatory shipborne equipment are (still) not internationally standardised, such as VHF communication signals, radar image, watertight door / fire door / hull opening (door) status signals and alert signals. It is therefore desired on the installation planning phase that equipment output signals should at least be in accordance with the alternative signals that specified on paragraph 5 of this guideline.

4.1 Input signals required for VDR interfaces

To promote common understanding amongst equipment manufacturers, ship builders and operators, the signals used for the interfaces between sensors and the VDR are described in clauses 4.1.1 to 4.1.6, 4.2 and 4.3. clauses 5.1 to 5.20 then provide forms for filling in and checking the details for each individual input to the VDR.

4.1.1 Signals defined in applicable parts of IEC 61162 series

IEC 61162

The characteristics of 'talkers' and 'listeners' referred to IEC 61162-1. With regard to VDR interfacing the VDR is considered the 'listener' and the sensors are considered the 'talkers'. Thus, when planning VDR installation, care shall be taken to ensure that sensors and VDR are compatible in terms of interface signal types.

- a) IEC 61162-1 and IEC 61162-2

IEC 61162-1 and IEC 61162-2 are of the single talker and multi-listener type communication. The difference between types is the communication speed, i.e. 4 800 bps by IEC 61162-1 and 38,4 kbps by IEC 61162-2. At present, IEC 61162-1 is normally used for communications between marine equipment, except that IEC 61162-2 is typically used for Gyro compass and AIS interfaces.

Table 1 — Sentences used for interface of VDR (referred to IEC 61996-1:2013, Annex A)

	Parameter to be recorded	IEC 61996 clause(s)	Sentence format
1	Date and time	4.6.1	ZDA
2	Ship's position and datum used	4.6.2	GNS, DTM, GLL, GGA, RMC, NSR ^a
3	Speed (water and/or ground)	4.6.3	VBW, VLW, VTG
4	Heading (true)	4.6.4	THS, HDT
5	Heading (magnetic)	4.6.4	HDG
6	Depth (echo sounder)	4.6.9	DPT
7	Alarms	4.6.10	ALR, ALA, FIR, WAT, ACM ^a , HBT, ALC ^a , ALF ^a
8	Rudder order / response manual	4.6.11	RSA, ROR
9	Rudder order / response automatic	4.6.11	HTC, HTD
10	Engine order / response	4.6.12	ETL, PRC, TRC, TRD, RPM, XDR, ROR, RSA
11	Hull openings, watertight doors, Fire doors	4.6.13, 4.6.14	DOR, GEN, XDR
12	Accelerations and hull stress	4.6.15	HSS, XDR
13	Wind speed and direction	4.6.16	MWV, MWD
14	AIS	4.6.17	VDM, VDO, ALR
15	VDR alert output		ALC ^a , HBT

Note No.15 is as "talker" and not recording data for VDR

b) IEC 61162-450

IEC 61162-450 is based on the application of an appropriate suite of existing international standards to provide a framework for implementing data transfer between devices on a shipboard Ethernet network. IEC 61162-450 provides a higher speed and higher capacity alternative to the IEC 61162-1 and IEC 61162-2 standards while retaining these standards' basic data format. Sentences available for being used for VDR are listed in table 1.

4.1.2 Signals in other than IEC 61162 format

Any interface units which may be required to convert non-IEC 61162 signals, shall conform to the requirements of IEC 60945 (IEC 61996-1 / 4.3.5).

According to the requirement that *any connection to any item of the ship's equipment shall be such that operation of that equipment suffers no deterioration, even if the VDR system develops faults* (MSC. 333(90) /8), interface signals shall be provided by the sensors in such a way, that failures of the VDR or of cables

connecting the VDR cannot hamper the functionality of the source equipment: i.e. contacts or signals of equipment for primary ship manoeuvring functions shall be provided as “dry contacts” or via isolation amplifiers.

Signal formats not specified in IEC 61996-1 such as ‘contact’ signal and analogue signals (e.g. voltage, current, synchro and pulse, etc.) except Bridge and Communications audio signals, have to be converted to a ‘serial signal’ before they can be interfaced to VDR.

In some VDR units a signal converter will be included. In other instances it will be possible to insert a converter between the sensor and the VDR. Thus in most instances of non-standard signals it should still be possible to achieve an interface. However, there are still many sensors which output analogue signals and it is recommended that operators, shipbuilders and owners ensure that interface between specific equipments is possible.

4.1.3 Bridge audible sound captured by microphones

In accordance with IEC 61996-1:2013/4.6.5 Bridge audio (MSC. 333(90) /5.5.5), requirement of microphone is as follows. *Microphones shall be positioned on the bridge covering all work stations as described in MSC/Circ.982 so that conversation is recorded. The recording shall be such that, on playback, a normal speaking voice shall provide adequate intelligibility while the ship is performing its normal operations. This performance shall be maintained at all work stations while there is a single audio alarm anywhere on the bridge or any noise, including noise from faulty equipment or mounting, or wind. This shall be achieved through the use of at least two channels of audio recording. Microphones positioned outside on bridge wings, shall be recorded on at least one additional separate channel.*

In addition, it is stated in IEC 61996-1, 5.6.1 that *the microphones forming the bridge audio data source are to be considered to be parts of the VDR. The form of the connections, signal levels and impedances, are at the option of the manufacturer. However, for the purposes of testing, each microphone shall be connected via a plug/socket combination, which is referred to hereafter as a microphone input port.*

4.1.3.1 Location of microphones

Microphones shall be installed to cover certain areas around main workstations on the bridge, and also at each wing or other manoeuvring workstation outside the wheelhouse, whereby suitable locations shall be selected considering ambient noise and work area's circumstances, which shall also include their proximity to forced air flow, ventilation systems and speakers. Even on an enclosed bridge, attention shall be paid not only to main workstations but also to wing sides as well.

4.1.4 VHF radio connection

In accordance with IEC 61996-1:2013, 4.6.6 Communications audio(IMO RESOLUTION MSC.333 (90) /5.5.6), *VHF communications relating to ship operations shall be recorded, VHF communications relating to ship operations shall be recorded on an additional separate channel to those referred to in 4.3.5, independently of the bridge audio. The recording shall include both transmitted and received audio signals and shall be continuous from a directly connected fixed VHF set to be designated at installation.* Although more than one VHF communication equipment may normally be installed on the bridge, the IMO requirements do not define which VHF shall be interfaced to the VDR. Unless a bridge design makes it obvious that VHF communication related to ship operations of navigation and manoeuvring is routinely performed via more than one VHF unit, it should be sufficient if the VHF unit is connected that is installed at the workstation for navigation and manoeuvring. In such case the other VHF unit(s) shall be covered by microphone(s).

4.1.5 Radar display connection

In accordance with IEC 61996-1:2013, 4.6.7 Radar data – post display selection (MSC.333(90)/5.5.7). *The electronic signals of the main displays of both ship's radar installations as required by SOLAS regulations shall be recorded. The recording method shall be such that, on playback, it is possible to present a faithful replica of the entire radar display that was on view at the time of recording, albeit within the limitations of any bandwidth compression techniques that are essential to the working of the VDR.*

NOTE In the case of a ship fitted with an INS, 'Radar display' signifies 'collision avoidance task with related information'

4.1.6 ECDIS display connection

In accordance with IEC 61996-1:2013, 4.6.8 ECDIS (MSC.333(90)/5.5.8). *Where a vessel is fitted with an ECDIS installation, the VDR shall record the electronic signals of the ECDIS display in use at the time as the primary means of navigation. The recording method shall be such that, on playback, it is possible to present a faithful replica of the entire ECDIS display that was on view at the time of recording, albeit within the limitations of any bandwidth compression techniques that are essential to the working of the VDR and in addition the source of the chart data and the version used.*

NOTE In the case of a ship fitted with an INS, 'ECDIS display' signifies 'route monitoring task or voyage planning task with related information'

4.2 Main Alarms

In accordance with IEC 61996-1:2013, 4.6.10 Main alarms (MSC.333(90)/5.5.10). This shall *include the status of all IMO mandatory alarms on the bridge as given in Resolution A.1021(26) Table 10.1.1 (see Annex A) or as received from the Bridge Alert Management System, if installed, recorded as individually identified alarms.*

Note The Bridge Alert Management is defined on MSC.302(87). 'Overall concept for management, handling and harmonized presentation of alerts on the bridge'. The Central Alert Management that defined on MSC.302(87) doesn't transmit all received alerts to VDR.,

4.3 AIS

In accordance with IEC 61996-1:2013, 4.6.17 AIS (MSC.333(90)/5.5.17), *all AIS data shall be recorded.*

4.4 Bridge alert management interface

In accordance with IEC 61996-1:2013, 5.13 Bridge alert management system. *The VDR shall output alerts to a bridge alert management system if fitted.*

Note The Bridge Alert Management system means the Central Alert Management system in this paragraph.

5 Details of interfaces between sensors and VDR

By using the following sections for each system, the factors related to the interfaces between VDR and sensors can be confirmed between the parties involved.

5.1 Date and Time (IEC 61996-1:2013/4.6.1)

- a) Standard: *Date and time, referenced to UTC, shall be obtained from a source external to the ship and an internal clock shall be synchronized with valid date and time data. During times of a loss of the external source, the internal clock shall be used. The recording shall indicate which source is in use. The recording method shall be such that the timing of all other recorded data items can be derived on playback with a resolution and continuity sufficient to reconstruct the history of the incident in detail, not worse than 1 s.*

Data to be recorded	Relevant Standard		IEC 61162-1	Remarks (type of signal)
	IMO Resolution MSC.333 (90)	IEC 61996-1		