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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

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

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

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

1 Scope

This International Standard provides guidance for the planning, installation and operational testing of VDR S-VDR installations according to the electric/electronic and acoustic specifications of IMO A.861 (20), IMO MSC.163 (78) and IEC 61996 (including IEC 61996-2, Simplified voyage data recorder). These standards mainly deal with interfaces between VDR/S-VDR and external sensors, which is the main subject for technical agreements between user, shipyard, VDR/S-VDR supplier and/or sensor manufacturers when installations are planned. In addition, matters of performance test and playback are also described. Furthermore, details for checking of items related to the interfaces and the installation are introduced. This International Standard is not intended for the standardization of performance factors and functional requirements related to VDR and/or S-VDR.

Hereafter, VDR means VDR and S-VDR unless specifically indicated otherwise.

NOTE All text of this International Standard which is identical to that of IMO A.861, IMO MSC.163, IEC 61996 and IEC 61996-2 is formatted in *italics*, and the Regulation and associated performance standard paragraph 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 test 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 61162-1:2000, *Maritime navigation and radiocommunication equipment and systems — Digital interfaces — Part 1: Single talker and multiple listeners*

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

IEC 61996:2000, *Maritime navigation and radiocommunication equipment and systems — Shipborne voyage data recorder (VDR) — Performance requirements — Methods of testing and required test results*

IEC 61996-2:2006, *Maritime navigation and radiocommunication equipment and systems — Shipborne voyage data recorder (VDR) — Part 2: Simplified voyage data recorder (S-VDR) — Performance requirements, methods of testing and required test results*

IMO A.830 (19):1995, *Code on Alarms and Indicators*

IMO A.861 (20):1997, *Performance standards for shipborne voyage data recorders (VDRs)*

IMO MSC.163 (78):2004, *Performance standards for shipborne simplified voyage data recorders (S-VDRs)*

IMO MSC/Circ.1024:2002, *Guidelines on voyage data recorder (VDR) ownership and recovery*

IMO SN/Circ.246:2005, *Recommended means for extracting stored data from voyage data recorders (VDRs) and simplified voyage data recorders (S-VDRs) for investigation authorities*

International *convention on the Safety of Life at Sea (SOLAS), IMO, 1974, as amended*

VESA:1996, *Video electronics standards association — Discrete monitor timings standard 1.0, Revision 0.7 (DMTS)*

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
recorder (VDR)
complete system, including any items required to interface with the sources of input data, for processing and encoding the data, the final recording medium in its capsule, the power supply and dedicated reserve power source

[IMO A.861 / 4.1]

3.1.2
sensor
any unit external to the VDR to which the VDR is connected and from which it obtains data to be recorded

[IMO A.861 / 4.2]

3.1.3
final recording medium
item of hardware on which the data is recorded such that access to it would enable the data to be recovered and played back by use of suitable equipment

[IMO A.861 / 4.3]

3.1.4
playback equipment
equipment, compatible with the recording medium and the format used during recording, employed for recovering the data. It includes also the display or presentation hardware and software that is appropriate to the original data source equipment. Playback equipment is not normally installed on a ship and is not regarded as part of *a VDR for the purposes specified by performance standards*

[IMO A.861 / 4.4]

3.1.5
dedicated reserve power source
secondary battery, with suitable automatic charging arrangements, dedicated solely to the VDR, of sufficient capacity to operate it as required by 4.5.3 of IEC 61996

[IMO A.861 / 4.5]

3.1.6
resolution
smallest detectable increment between two values

[IEC 61996 / 3.1.6]

3.1.7
data
any item of information received by the VDR for recording, including numerical values, text and audio or radar signals, except where specifically stated or the context dictates otherwise

[IEC 61996 / 3.1.7]

3.1.8
activation of a suitable alarm
mutable audible alarm and persistent visual indication, given according to the requirements of IMO A.830, but with an audible level in the range of 55 dBA to 65 dBA

[IEC 61996 / 3.1.8]

3.1.9
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 table*
- *chart table*
- *helmsman*
- *communication*

[IEC 61996 / 3.1.9]

3.2 Abbreviated terms

EPFS	Electronic Position Fixing System
IMO	International Maritime Organization
INS	Integrated Navigation System
ITU	International Telecommunication Union
AIS	Automatic Identification System

4 VDR interface

According to IMO A.861 (20), IMO MSC.163 (78) and IEC 61996 (including IEC 61996-2) *interfacing between the various sensors and VDR shall be in accordance with the relevant international interface standard IEC 61162 series, where possible.*

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.

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.* (A.861/7).

Regarding S-VDR installation, it is stated in IMO MSC.163 (78), 5.4.9 that *any additional data items listed by IMO with the requirements set out in resolution A.861 (20) should be recorded when the data is available in accordance with the international digital interface standards* [1] *using approved sentence formatters.* In addition to this, it is stated in IMO MSC.163 (78), 5.4.8 as well that*, If it is impossible to obtain radar data* [2] *then AIS target data should be recorded as a source of information regarding other ships.*

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1) IEC 61162.

2) Where commercial off the shelf (COTS) interfaces are not available.

Consequently, S-VDR may have the same interfaces as VDR. In addition, an S-VDR shall also include a port for interfacing an AIS in case radar data cannot be obtained. Though minimum interface requirements of an S-VDR are less than those of a VDR, as "*any additional data items*" stated in IMO MSC.163 (78), 5.4.9 may be taken into consideration, it is recommended to carefully review for each individual ship, in accordance with this standard, which item of "*any additional data items*" can be interfaced in digital format according to IEC 61161 or through signal converter(s). *Any additional data items* are Echo sounder (Depth), Main Alarms, Rudder order / response, Engine order / response (main engine, thruster), Hull openings, Watertight doors, Fire doors, Accelerations / hull stress and Wind speed and Direction. These signals are principally not different from those for VDR.

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 sound captured by microphone, VHF communication signals, radar image, watertight door / fire door / hull opening (door) status signals and alarm signals. It is therefore desired that equipment output signals should at least be in accordance with IEC 61996 Annex A, Table A.1-References and IEC 61162-102.

Equipment which will interface with VDR include but may not be limited to those listed below. The specific requirements for each interface are detailed at paragraphs 5.3.1 to 5.3.16.

4.1 Input signals required for VDR interfaces

To promote common understanding between equipment manufacturers, ship builders and operators, the signals used for the interfaces between sensors and the VDR are described in paragraphs 4.1.1 to 4.1.5, 4.2 and 4.3. Paragraph 5.1 to 5.16 then provide forms for filling in and confirming and the details for each individual input to the VDR.

4.1.1 Signals defined in IEC 61162 series

a) IEC 61162

Four (4) standard signals are described in the IEC 61162 series. Of these only two (2) are used for VDR and they are listed at IEC 61996, Annex A, Table A.1. The characteristics of 'talkers' and 'listeners' referred to in IEC 61162 are compared in Annex B to this standard. With regard to VDR interfacing the VDR is considered the 'listener' and the sensors are considered the 'talkers'. Thus, when planning VDR installation, care must be taken to ensure that sensors and VDR are compatible in terms of interface signal types.

b) 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 interfaces.

c) IEC PAS 61162-102

Signal sentences used for interfaces between VDR and sensors are shown in IEC 61996 Annex A, Table A.1 as informative. However, some more sentences following the international standard of IEC 61162 would be appropriate for interfacing the required sensor information to a VDR. In December 2003, additional sentences were approved as IEC/PAS 61162-102. For reference, these sentences are briefly described in paragraph A.3, annex A. This PAS will remain valid for an initial maximum period of 3 years starting from 2003-09. The validity may be extended for a single 3-year period, following which the standard should have been revised to become a normative document, or will be withdrawn. A summary of the new sentences is shown in Annex-B of this standard.

Signals and sentences available for being used for VDR are listed in table 1 below. Data items in table 1, no. 1, 2, 3, and 4, are required for S-VDR installations in any case, while the remaining items in table 1 are specified in IMO MSC.163 (78), 5.4.9 as "O*ther items*". (*Any additional data items listed by IMO with the requirements*

set out in resolution A.861 (20) should be recorded when the data is available in accordance with the international digital interface standards [3] *using approved sentence formatters.)*

Therefore, if "*Other items*" are available in the international digital format of IEC 61162, such signals have to be interfaced to S-VDR. If any signal of item No.1, 2, 3 and 4 is not available in the international digital format, it may have to be converted accordingly.

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

No.	Parameter to be recorded	IEC 61996 clause(s)	Sentence format	Notes
1	Date and time	4.6.1	ZDA, GNS[a], GGA[a]	
2	Ship's position and datum used	4.6.2	GNS, DTM, GGA[a], GLL[a], RMC[a]	
3	Speed (water and/or ground)	4.6.3	VBW, VHW[a], VTG[a]	
4	Heading (true)	4.6.4	HDT	
5	Heading (magnetic)	4.6.4	HDG	
6	Depth (echo sounder)	4.6.8	DPT	
7	Alarms	4.6.9	ALR, ALA*[2]	
8	Rudder order / response manual	4.6.10	RSA	Note 1
9	Rudder order / response automatic	4.6.10	HTC, HTD	
10	Engine order / response	4.6.11	RPM, XDR, ETL[b], PRC[b], TRC[b], TRD[b]	Note 1 and 2
11	Hull openings, watertight doors, Fire doors	4.6.12, 4.6.13	XDR, DOR[b]	Note 2
12	Accelerations and hull stress	4.6.14	XDR, ALR, HSS[b]	Note 2
13	Wind speed and direction	4.6.15	MWV	
14	VDR alarm output		$VRALR	Note 3
15	AIS		VDO, VDM[c]	

[a] Sentences marked with [a] are defined in IEC 61162-1 are not shown in Table A.1 Annex A (informative) of IEC 61996, but these contain the same information as the required parameter in this Table 1 above.

[b] Sentences marked with [b] are new sentences specified in IEC PAS 61162-102), which are not shown in Annex A Table A.1 (informative) of IEC 61996.

[c] Sentences marked with [c] are new sentences specified in the IEC 61993-2 and have been prepared solely for AIS output signals. Those sentences are not shown in Table A.1 Annex A (informative) of IEC 61996.

(Referred to IEC 61996 Annex A.)

Note 1	The current specifications for RSA and RPM do not have fields for 'order', only 'response'
Note 2	The table of transponder types in the current specification for XDR does not specifically include these uses.
Note 3	There is no requirement for the VDR to send alarm messages. If, as an option, such messages are sent, then the appropriate sentence format is ALR.

3) Refer to publication IEC 61162.

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 / 4.3.6).

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* (A.861/7), 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 such as 'contact' signal and analog 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 or S-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 analog signals and it is recommended that operators, shipbuilders and owners satisfy themselves that interface between specific equipments is possible. Refer to the list below.

Analog to IEC 61162 format converters
Discrete voltage or contact to IEC 61162 format converters
Gyro compass synchro or stepper signal to IEC 61162 converters
Rate-of-turn synchro or stepper signal to IEC 61162 converters
Synchro to IEC 61162 format converters for other interfaces, such as controls or indicators
Echo sounder Start-Stop signal to IEC 61162 converters
Speed-log Pulse signal to IEC 61162 converters
Interface channel splitters for providing additional interface channels from one sensor interface
Data protocol converters for generating IEC 61162 data formats from non-IEC 61162 data.
VHF radio tabs for existing VHF radios
video interfaces for existing radars, accommodating a variety of different video standards, pixel resolutions and refresh frequencies
video buffers for existing radars
hydraulic and pneumatic pressure transducers with analogue voltage output
angular pick-ups for angles of mechanical controls such as propulsion levers and rudder gears
pulse counters for picking-up rotations such as propeller shaft rotations

4.1.3 Bridge audible sound captured by microphones

In accordance with IEC 61996, 4.6.5 Bridge audio (A.861 / 5.4.5), requirement of microphone is as follows. *One or more microphones positioned on the bridge shall be placed, such that conversation at or near the conning stations, radar displays, chart tables, etc. (i.e. at work stations as defined in 3.1.9) may be adequately recorded. As far as is practicable, the positioning of microphones shall also capture the input and output of intercom, public address systems and the audible alarms on the bridge (bridge mounted equipment) (see 5.6 for technical characteristics). The audio signals at all workstations shall be recorded continuously. Optionally, means may be provided so that the originating workstation can be identified with the audio signal being analyzed during playback of the recorded information.*

In addition, it is stated in IEC 61996, 5.6.1 that *the microphones forming the bridge audio data source are to be considered to be parts of the VDR.* The manufacturer's VDR documentation should therefore include information about the coverage range of indoor and outdoor microphones, so that the planning of their installation can be based on certified values.

4.1.3.1 Location of microphones

Microphones should 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. 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

According to IMO A.861/5.4.6 and 4.6.6, *VHF communications relating to ship operations* shall *be recorded,* 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, which 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

The VDR shall *include electronic signal information from within one of the ship's radar installations which records all the information which was actually being presented on the master display of that radar at the time of recording* (IMO A.861/5.4.7). However, on ships over 3,000 GT two radars or more may be installed each with a "master display", but the IMO requirements do not define which radar display(s) shall be interfaced to the VDR. Unless a bridge design makes it obvious that decisions regarding collision avoidance are routinely based on more than one radar display, it should be sufficient if the signals of the radar display is connected, which is mainly used for navigation.

In the case of S-VDR installation, refer to the paragraph 4.3 AIS in this standard.

4.2 Alarms

The recording of alarms shall *include the status of all IMO mandatory alarms on the bridge (IMO Res. A.861(20), 5.4.9). The status of all IMO mandatory alarms* shall *be recorded by the bridge audio and as a data parameter where practicable.*

IMO Resolution A.861(20) and SOLAS II-1 and II-2 mandate alarms to be available on the Bridge. These alarms are generally defined in Resolutions A.686(17) and A.830(19). The interfacing of alarms to VDR is outlined in IEC 61996. Signals listed specifically in Annex B, Tables B1, B2 and B3 will ensure the source of an alarm is recorded.

4.3 AIS

For S-VDR installations it is stated in MSC.163(78), 5.4.8 that, *if it is impossible to obtain radar data* [4], *then AIS target data should be recorded as a source of information regarding other ships. If radar data is recorded, AIS information may be recorded additionally as a beneficial secondary source of information on both other and own ship.*

AIS is a secondary source of information, which is not as complete as the information radar can provide, and is only a substitute for RADAR data.

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4) Where commercial off the shelf (COTS) interfaces are not available.

Therefore, when a new RADAR, which can easily provide its information (e.g. Buffer amplifier is fitted) to a S-VDR, is installed on existing ship on which S-VDR connected with AIS has been already installed, the RADAR data is to be captured by the S-VDR instead of AIS the interface of which may be disconnected.

When VDR (Not S-VDR) is installed on an existing cargo vessel, and existing RADAR has not been provided with interface to VDR, the existing RADAR may be replaced by new RADAR with capable interface to VDR by the ship owner's option.

An AIS is designed to have two output data channels for external equipment or systems, such as own ship's data and other ships' data, in the digital format as defined by IEC 61162-2. Thereby the S-VDR digital interface for AIS data is specified by the IEC 61162 series which includes IEC 61162-2. Consequently, AIS and S-VDR can be generally interfaced readily.

5 Details of interfaces between sensors and VDR

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

Generally all interfaces may be the same for VDR and S-VDR, except for the AIS interface which may only be required for S-VDR, and except for interfaces from 5.8 to 5.15 if these do not comply with IEC 61162.

In addition, in the case of an S-VDR installation, additional data items, such as from Echo sounder (Depth), Main Alarms, Rudder order / response, Engine order / response (main engine, thruster(s)), Hull openings, Watertight doors, Fire doors, Accelerations / Hull stress and Wind speed and Direction, shall be recorded if signals are available in the international digital format. For an existing ship the actual states of installed equipment shall be confirmed at first, and then it can be established how a S-VDR might be interfaced with the existing sensors.

5.1 Date and Time (A.861 / 5.4.1)

a) Standard: Date and time referred to UTC, shall be obtained from a source external to the ship (for example, an EPFS or radio time signal) if available, or from an internal clock at least once per hour. 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 sufficient to reconstruct the history of the incident in detail, not worse than 1 s.

Data to be recorded	Relevant Standard		IEC 61162	Remarks (type of signal)
	IMO A.861(20)	IEC 61996		
Date and UTC	5.4.1	4.6.1	ZDA	
Sentence	$--ZDA, hhmmss.ss, xx, xx, xxxx, xx, xx *hh <CR><LF>			

b) Alternative signals may be used, if the signal required by the standard above is not available.

Data to be recorded	Standard	Signal Specification	Confirmed type of signal
Date and UTC	IEC 61162	GNS, GGA	
Ship's Internal Clock			
EPFS			

c) Agreed specification of the signal to be interfaced (including a) standard signal, and b) alternative signal, may be described down here).

[Agreement:][Document or Drw. No.:][Date: / /]

Item		Content of confirmation	Remarks
Sensor	Type of signal		
	Location		
Manufacturer (Who supplies information)			
Type of equipment			
Interface Standard to be applied			
Modification No .			
Header			
Information of Sentence			
Signal interval			
Cable length between sensor signal terminal and VDR			
Type of cable / Number of conductors			
Related to signal interface			

d) When the type of input signal to the VDR, including the alternative signal, is already specified, such signals shall be preferably used. If by the above steps of a) and b) the appropriate signal, including the alternative signal(s) cannot be verified to be available, the specification of another alternative signal should be discussed and agreed by persons concerned and the results may be filled in the table c) above.

e) In the case of S-VDR installation, connection to S-VDR shall follow paragraph a) to d).

5.2 Ship's position (A.861 / 5.4.2)

a) Standard: Latitude and longitude, and the datum used, shall be derived from a designated EPFS or INS if available. The recording shall ensure that identity and status of the source can always be determined on playback. The ship's position shall be recorded, as available on the ship, up to a resolution of 0,0001min of arc.

Data to be recorded	Relevant Standard		IEC 61162	Remarks
	IMO A.861(20)	IEC 61996		(Confirmed type of signal)
Ship's position	5.4.2	4.6.2	GNS/DTM	
Sentence position geographical datum	$--GNS,hhmmss.ss,III.II,a,yyyyy.yy,a,c-c,xx,x.x,x.x,x.x,x.x,x.x*hh<CR><LF> $--DTM,ccc,a,x.x,a,x.x,a,x.x,ccc*hh<CR><LF>			

b) Alternative signals may be used, if the signal required by the standard above is not available.

Data to be recorded	Standard	Signal Specification	Confirmed type of signal
Ship's position	IEC 61162	GGA, GLL, RMC etc.	
Manufacturer's sentence	NMEA	Propriety sentence: Signal voltage ___V	

c) Agreed specification of the signal to be interfaced (including a) standard signal, and b) alternative signal, may be described down here).

[Confirmation:][Document or Dw No.:][Date: / /]

Item		Content of confirmation	Remarks
Sensor	Type of signal		
	Location		
Manufacturer (Who supplies information)			
Type of equipment			
Interface Standard to be applied			
Modification No.			
Header			
Information of Sentence			
Signal interval			
Cable length between sensor signal terminal and VDR			
Type of cable / Number of conductors			
Related to signal interface			

d) When the type of input signal to the VDR, including the alternative signal, is already specified, such signals shall be preferably used. If by the above steps of a) and b) the appropriate signal, including the alternative signal(s) can not be verified to be available, the specification of another alternative signal should be discussed and agreed by persons concerned and the results may be filled in the table c) above.

e) In the case of S-VDR installation, connection to S-VDR shall follow the paragraph a) to d).

5.3 Speed (A.861 / 5.4.3)

a) Standard: Speed through the water, or speed over the ground (traverse as well as longitudinal in either case, as available on the ship), including an indication from which it is derived, from the ship's designated speed and distance measuring equipment, shall be recorded, as available on the ship, up to a resolution of 0,1 knot.

Data to be recorded	Relevant Standard		IEC 61162	Remarks
	IMO A.861(20)	IEC 61996		(Confirmed type of signal)
Speed	5.4.3	4.6.3	VBW	
Sentence	$--VBW,x.x,x.x,A,x.x,x.x,A,x.x,A,x.x*hh<CR><LF>			

b) Alternative signals may be used, if the signal required by the standard above is not available.

Data to be recorded	Standard	Signal Specification	Confirmed type of signal
Speed	IEC 61162	VHW (to the water), VTG(over ground)	
Manufacturer's sentence	NMEA	Propriety sentence Signal voltage ___V	
Pulse signal		200 p/nm, 400 p/nm etc.	

c) Agreed specification of the signal to be interfaced (including a) standard signal, and b) alternative signal, may be described down here).

[Confirmation:][Document or Dw No.:][Date: / /]

Item		Content of confirmation	Remarks
Sensor	Type of signal		
	Location		
Manufacturer (Who supplies information)			
Type of equipment			
Interface Standard to be applied			
Modification No.			
Header			
Information of Sentence			
Signal interval			
Cable length between sensor signal terminal and VDR			
Type of cable / Number of conductors			
Related to signal interface			

d) When the type of input signal to the VDR, including the alternative signal, is already specified, such signals shall be preferably used. If by the above steps of a) and b) the appropriate signal, including the alternative signal(s) can not be verified to be available, the specification of another alternative signal should be discussed and agreed by persons concerned and the results may be filled in the table c) above.

e) In the case of S-VDR installation, connection to S-VDR shall follow the paragraph a) to d).

5.4 Heading (A.861 / 5.4.4)

a) Standard: As indicated by a designated ship's compass. The ship's heading shall be recorded, as available on the ship, up to a resolution of 0,1.

Data to be recorded	Relevant Standard		IEC 61162	Remarks (Confirmed type of signal)
	IMO A.861(20)	IEC 61996		
Heading (true)	5.4.4	4.6.4	HDT/HDG	
Sentence Gyro Magnetic compass	$--HDT,x.x,T*hh<CR><LF> $--HDG,x.x,x.x,a,x.x,a*hh<CR><LF>			

b) Alternative signals may be used, if the signal required by the standard above is not available.

Data to be recorded	Standard	Signal Specification	Confirmed type of signal
Manufacturer's sentence	NMEA	Propriety sentence[a] Signal voltage____V	
Synchro signal		360X, 180X, 90X, 36X, 1X etc. primary Voltage: ____V, ____Hz	
Step signal		360X, 180X, 90X, 36X, 1X Voltage: 24V, 35V, 50V, 70V etc.	
[a] Propriety sentence: Manufacture's specific sentences are submitted and allowed in NMEA standard. (Example: sentence:$Paaa. ……*<CR><LF>)			

c) Agreed specification of the signal to be interfaced (including a) standard signal, and b) alternative signal, may be described down here).

[Confirmation:][Document or Dw No.:][Date: / /]

Item		Content of confirmation	Remarks
Sensor	Type of signal		
	Location		
Manufacturer (Who supplies information)			
Type of equipment			
Interface Standard to be applied			
Modification No.			
Header			
Information of Sentence			
Signal interval			
Cable length between sensor signal terminal and VDR			
Type of cable / Number of conductors			
Related to signal interface			

d) When the type of input signal to the VDR, including the alternative signal, is already specified, such signals shall be preferably used. If by the above steps of a) and b) the appropriate signal, including the alternative signal(s) can not be verified to be available, the specification of another alternative signal should be discussed and agreed by persons concerned and the results may be filled in the table c) above.

e) In the case of S-VDR installation, connection to S-VDR shall follow the paragraph a) to d).

5.5 Bridge audio (A.861 / 5.4.5)

a) Standard: One or more microphones positioned on the bridge shall be placed, such that conversation at or near the conning stations, radar displays, chart tables, etc. (i.e. at work stations as defined in 3.1.9) may be adequately recorded. As far as is practicable, the positioning of microphones shall also capture the input and output of intercom, public address systems and the audible alarms on the bridge (bridge mounted equipment).

The audio signals at workstations shall be recorded continuously. Optionally, means may be provided so that the originating workstation can be identified with the audio signal being analyzed during playback of the recorded information.

Data to be recorded	Relevant Standard		IEC 61162	Remarks
	IMO A.861(20)	IEC 61996		(Confirmed type of signal)
Bridge Audio (Audio signal)	5.4.5	4.6.5	None	
Sentence	None			

b) Alternative signals may be used, if the signal required by the standard above is not available.

Data to be recorded	Standard	Signal Specification	Confirmed type of signal
None			

c) Agreed specification of the signal to be interfaced (including a) standard signal, and b) alternative signal, may be described down here).

[Confirmation:][Document or Dw No.:][Date: / /]

Item		Content of confirmation	Remarks
Sensor	Type of signal		
	Location		
Manufacturer (Who supplies information)			
Type of equipment			
Interface Standard to be applied			
Modification No.			
Header			
Information of Sentence			
Signal interval			
Cable length between sensor signal terminal and VDR			
Type of cable / Number of conductors			
Related to signal interface			

Refer to Paragraph 6. Installation Direction 6.5 Position of microphones.

d) In the case of S-VDR installation, connection to S-VDR shall follow the paragraph a, b) and c).

5.6 VHF communication (A.861 / 5.4.6)

a) Standard: VHF communications relating to ship operations shall be recorded, 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 (i.e. VHF remote controller) to be designated at installation. (Refer to technical characteristics in 5.7 of IEC 61996.)

Data to be recorded	Relevant Standard		IEC 61162	Remarks (Confirmed type of signal)
	IMO A.861(20)	IEC 61996		
VHF communication (Audio signal)	5.4.6	4.6.6	None	
Sentence	None			
VHF output signal	IEC 61097-7	0,775V RMS (600 ohm)		

b) Alternative signals may be used, if the signal required by the standard above is not available.

Data to be recorded	Standard	Signal Specification	Confirmed type of signal
None			

c) Agreed specification of the signal to be interfaced (including a) standard signal, and b) alternative signal, may be described down here).

[Confirmation:][Document or Dw No.:][Date: / /]

Item		Content of confirmation	Remarks
Sensor	Type of signal		
	Location		
Manufacturer (Who supplies information)			
Type of equipment			
Interface Standard to be applied			
Modification No.			
Header			
Information of Sentence			
Signal interval			
Cable length between sensor signal terminal and VDR			
Type of cable / Number of conductors			
Related to signal interface			

d) When the type of input signal to the VDR, including the alternative signal, is already specified, such signals shall be preferably used. If by the above steps of a) and b) the appropriate signal, including the alternative signal(s) can not be verified to be available, the specification of another alternative signal should be discussed and agreed by persons concerned and the results may be filled in the table c) above.

e) Normally two (2) international VHF transceivers are installed on the bridge. 3 sets of VHF transceivers may be sometimes installed on a ship. If VHF transceivers are connected to VDR, each VHF transceiver shall be connected independently to each VHF port and each VHF signal shall be confirmed.

f) In the case of S-VDR installation, connection to S-VDR shall follow the paragraph a) to e).

5.7 Radar data-post-display selection (VDR: A.861 / 5.4.7) (S-VDR: MSC.163(78) / 5.4.7)

a) Standard: *This shall include electronic signal information from within one of the ship's radar installations which records all the information which was actually being presented on the master display of that radar at the time of recording. This shall include any range rings or markers, bearing markers, electronic plotting symbols, radar maps, whatever parts of the SENC or other electronic chart or map that were selected, the voyage plan, navigational data, navigational alarms and the radar status data that were visible on the display. 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 (S-VDR: VDR shall be replaced by S-VDR).*

Data to be recorded	Relevant Standard		IEC 61162	Remarks (Confirmed type of signal)
	IMO A.861(20)	IEC 61996		
Radar display image (image) recording interval: 1time/15s or less (Referred to 5.8.1.1 of IEC 61996)	5.4.7	4.6.7	None	
Sentence	None			
Resolution of image (pixel)	640 x 350 to 1 280 x 1 024			
Refresh rate	60 Hz to 85 Hz			
Signals	R, G, B, V, H			
Level of signal	Below 1 V			

b) Specifications of radar display are specified in VESA DMTS or in manufacture's standards. Therefore, there may be many specimens of radar displays that are briefly summarized in table down below.

Method of Scanning		Signal Type	Remarks
1	Non- interlaced[a]	R, G, B V/H each independent signal	
2	Non-interlaced[a]	R, G, B each independent signal V/H are composited on G	
3	Interlaced[b]	R, G, B V/H each independent signal	
4	Interlaced[b]	R, G, B each independent signal V/H are composited on G	
5	Others	Composite signal	@ NTSC (scanning of Japan, USA TV) @ PAL (scanning of European TV)etc.
		UXGA	Other methods may be taken into account to record the radar image.

A Non- interlaced: This method is VESA DMTS method which is used for display of personnel computer. Scanning from the top of display to the bottom of display.

b Interlaced: This method of scanning is normally used for TV. Even lines and odd lines scanning separately moved in turn from the top of display to the bottom of display.

c) Agreed specification of the signal to be interfaced (including a) standard signal, and b) alternative signal, may be described down here).

[Confirmation:][Document or Dw No.:][Date: / /]

Item		Content of confirmation	Remarks
Sensor	Type of signal		
	Location		
Manufacturer (Who supplies information)			
Type of equipment			
Interface Standard to be applied			
Modification No.			
Header			
Information of Sentence			
Signal interval			
Cable length between sensor signal terminal and VDR			
Type of cable / Number of conductors			
Related to signal interface			

d) When the type of input signal to the VDR, including the alternative signal, is already specified, such signals shall be preferably used. If by the above steps of a) and b) the appropriate signal, including the alternative signal(s) can not be verified to be available, the specification of another alternative signal should be discussed and agreed by persons concerned and the results may be filled in the table c) above.

e) It is stated in IEC 61996, 4.6.7 that *all the information, being actually presented on the master display of that radar at the time of recording,* shall be recorded in VDR. Any regulation related to VDR does not in particular make mention of the number of radar displays to be connected to VDR. But, it could be taken into account that one or more than one radar display may be connected to VDR. As for VDR designed according to IEC 61996, VDR may be designed as at least one radar display may be connected to VDR. Therefore, if more than one radar display are connected to VDR, it is may be advisable that specification of radar display connection to VDR may be confirmed. And when one radar display is connected, one of radar displays must be selected within the radar displays on Bridge.

f) In the case of S-VDR installation, if radar-post-display is impossible [5)] to be obtained, *AIS target data should be recorded as a source of information regarding other ships.*

5) Where commercial off the shelf (COTS) interface are not available.

5.8 Depth (Echo sounder) (A.861 (20) / 5.4.8)

a) Standard: This shall include depth under keel, up to a resolution of 0,1m as available on the ship. The depth scale currently being displayed and other status information shall be recorded where available.

Data to be recorded	Relevant Standard		IEC 61162	Remarks
	IMO A.861(20)	IEC 61996		(Confirmed type of signal)
Depth	5.4.8	4.6.8	DPT	
Sentence	$--DPT,x.x,x.x,x.x*hh<CR><LF>			

b) Alternative signals may be used, if the signal required by the standard above is not available.

Data to be recorded	Standard	Signal Specification	Confirmed type of signal
Manufacturer's sentence	NMEA	Propriety sentence Signal voltage ___V	
Analog signal		Voltage: ± 10 V etc. Current : 4-20mA etc.	

c) Agreed specification of the signal to be interfaced (including a) standard signal, and b) alternative signal, may be described down here).

[Confirmation:][Document or Dw No.:][Date: / /]

Item		Content of confirmation	Remarks
Sensor	Type of signal		
	Location		
Manufacturer (Who supplies information)			
Type of equipment			
Interface Standard to be applied			
Modification No.			
Header			
Information of Sentence			
Signal interval			
Cable length between sensor signal terminal and VDR			
Type of cable / Number of conductors			
Related to signal interface			

d) When the type of input signal to the VDR, including the alternative signal, is already specified, such signals shall be preferably used. If by the above steps of a) and b) the appropriate signal, including the alternative signal(s) can not be verified to be available, the specification of another alternative signal should be discussed and agreed by persons concerned and the results may be filled in the table c) above.

e) In the case of S-VDR, if the signal is available in the approved international digital formatter (IEC 61162), Depth data shall be recorded.

5.9 Main alarms on the Bridge (A.861 (20) /5.4.9)

a) Standard: This shall include the status of all IMO mandatory alarms on the bridge (see Annex B of IEC 61996). The status of all IMO mandatory alarms shall be recorded by the bridge audio and as a data parameter where practicable. Summary of Annex B of IEC 61996 is shown in alarm table f).

Data to be recorded	Relevant Standard		IEC 61162	Remarks (Confirmed type of signal)
	IMO A.861(20)	IEC 61996		
Alarm, Date and Time	5.4.9	4.6.9	ALR[a]	
Sentence	$--ALR,hhmmss.ss,xxx,A, A,c---c*hh<CR><LF>[a]			
[a] ALR is recommended, but all systems do not out put signal ALR. Confirmation shall be made.				

b) Alternative signals may be used, if the signal required by the standard above is not available.

Data to be recorded	Standard	Signal Specification	Confirmed type of signal
Alarm	IEC 61162-102	ALA	
Manufacturer's sentence	NMEA	Propriety sentence Signal voltage ___V	
Contac signal		No voltage contact signal	
Voltage		AC/DC ___V, (voltage of alarm signal etc.)	

c) Agreed specification of the signal to be interfaced (including a) standard signal, and b) alternative signal, may be described down here).

[Confirmation:][Document or Dw No.:][Date: / /]

Item		Content of confirmation	Remarks
Sensor	Type of signal		
	Location		
Manufacturer (Who supplies information)			
Type of equipment			
Interface Standard to be applied			
Modification No.			
Header			
Information of Sentence			
Signal interval			
Cable length between sensor signal terminal and VDR			
Type of cable / Number of conductors			
Related to signal interface			

d) When the type of input signal to the VDR, including the alternative signal, is already specified, such signals shall be preferably used. If by the above steps of a) and b) the appropriate signal, including the alternative signal(s) can not be verified to be available, the specification of another alternative signal should be discussed and agreed by persons concerned and the results may be filled in the table c) above.

e) Due consideration shall be taken into for the requirements of SOLAS, the appropriate Classification Society and any Flag country requirements for alarms.

f) Table of alarm described in IEC 61996 Annex B, Table B.1, B.2 and B.3 (ship-specific availability of bridge alarms to be confirmed).

No.	Source of alarm	Alarm	Notes	SOLAS item number	Number of connection	Signal type Confirmed
1	Main and auxiliary steering gear power units	Failure of power	Required on each steering unit	II-1 29.5(2)		
2		Overload (including short circuit)		II-1 30.3		
3		Loss of phase		II-1 30.3		
4		Failure of power to control system		II-1 29.8(4)		
5		Low level of fluid in hydraulic fluid reservoir		II-1 29.12(2)		
6	Propulsion machinery system	Propulsion machinery remote control system Failure		II-1 31.2.(7)/49.5		
7		Propulsion machinery low starting air pressure		II-1 31.2.(9)/49.7		
8		Automatic shut-down of propulsion machinery		II-1 52		

9		Fault requiring action by or attention of the OOW		II-1 51.1.(3)		
10		Alarm system normal power sully failure		II-1 51.2.2		
11		High water alarm[a]		II-1 21.1.6.2		
12		Personal alarm		A.481annex 2 7.3		
13	Watertight door System	Watertight door low hydraulic fluid level	Applicable to passenger ship	II-1 15.7.3.(1)		
14		Watertight door low gas pressure, loss of stored energy		II-1 15.7.3.(1)		
15		Watertight door electrical Power loss		II-1 15.7.8		
16	Shell door system	Door open	Applicable to Ro-Ro passenger ship	II-1 23-2.1		
17		Door locking device not secured		II-1 23-2.1		
18		Leakage of water into Ro-Ro spaces or special category spaces		II-1 23-2.2		
19	Fire detection in automated or remotely controlled machinery space	Activation of detection system		II-2 13.1.2 II-2 13.1.5/13.1.6 II-2 11.8/14.2		
20	Fire detection or automatic sprinkler operation	Activation of sprinkler or Fire detection system Fault or loss of power to either system		II-2 12.1.2 II-2 12.1.2.1/2		
No.	Source of alarm	Alarm	Notes	SOLAS item number	Number of connection	Signal type Confirmed
21	Smoke detection system	Smoke detection Failure of power to system		II-2 13-1.4.6 II-2 13-1.1.3		
22	Halon system	Gas release Loss of container Electric power loss or fault Hydraulic or pneumatic pressure loss		II-2 5.3.4(3) II-2 5.3.3(8) II-2 5.3.3(2) II-2 5.3.3(3)		After 1992 Not applicable to new ship

[a] For reference, SOLAS II-1 21.1.6.2 is cited as follows. Where the freeboard is such that the edge of bulkhead deck or the edge of freeboard deck, respectively, is immersed when the ship heels 5 degrees or less, the drainage of the enclosed cargo spaces on the bulkhead deck or freeboard deck, respectively, shall be led to a suitable space, of adequate capacity, having a high water level alarm and provided with suitable arrangements for discharge overboard.

g) In the case of S-VDR, if the signal is available in the approved international digital formatter (IEC 61162), mandatory alarms on the bridge shall be recorded. See f) table above.

5.10 Rudder order and response (A.861(20) / 5.4.10)

5.10.1 Rudder order and response (Automatic control: where HCS or TCS installed)

a) Standard: *Both rudder order and response angles shall be recorded up to a resolution of 1° as available and permitted on the ship. Status and settings of heading or track controller, if fitted, shall also be recorded.*

Data to be recorded	Relevant Standard		IEC 61162	Remarks
	IMO A.861(20)	IEC 61996		(Confirmed type of signal)
Rudder order/response (Automatic)	5.4.10	4.6.10	HTC/HTD[a]	
Sentence	$--HTC,A,x.x,a,a,a,x.x,x.x,x.x,x.x,x.x,x.x,x,a,*hh<CR><LF> [a] $--HTD,A,x.x,a,a,a,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x,a,A,A,A,x.x*hh<CR><LF> [a]			
[a] HTC/HTD sentence include order field, but not include response field (refer to Annex A of IEC 61996). Therefore, as for response signal, serial signal (RSA) or actual rudder signal shall be derived.				

b) Alternative signals may be used, if the signal required by the standard above is not available.

Data to be recorded	Standard	Signal Specification	Confirmed type of signal
Manufacturer's sentence	NMEA	Propriety sentence Signal voltage ____ V	
Synchro signal		360X, 180X, 90X, 36X, 1X Primary voltage: V ____ Hz	
Step signal		360X, 180X, 90X, 36X, 1X Voltage 35 V, 50 V, 70 V etc.	
Analog signal		Voltage: ±10 V etc. Current: 4-20 mA etc.	
Operation Mode		Contact etc.	

c) Agreed specification of the signal to be interfaced (including a) standard signal, and b) alternative signal, may be described down here).

[Confirmation:][Document or Dw No.:][Date: / /]

Item		Content of confirmation	Remarks
Sensor	Type of signal		
	Location		
Manufacturer (Who supplies information)			
Type of equipment			
Interface Standard to be applied			
Modification No.			
Header			
Information of Sentence			
Signal interval			
Cable length between sensor signal terminal and VDR			
Type of cable / Number of conductors			
Related to signal interface			

d) When the type of input signal to the VDR, including the alternative signal, is already specified, such signals shall be preferably used. If by the above steps of a) and b) the appropriate signal, including the alternative signal(s) can not be verified to be available, the specification of another alternative signal should be discussed and agreed by persons concerned and the results may be filled in the table c) above.

e) In the case of S-VDR, if the signal is available in the approved international digital formatter (IEC 61162), Rudder order and response shall be recorded where autopilot fitted for use of TCS/HC.

5.10.2 Rudder order and response (by Manual operation: where HCS or TCS not installed)

a) Standard: *Both rudder order and response angles shall be recorded up to a resolution of 1° as available and permitted on the ship (A.861(20) /5.4.10).*

Data to be recorded	Relevant Standard		IEC 61162	Remarks
	IMO A.861(20)	IEC 61996		(Confirmed type of signal)
Rudder order/response (Manual)	5.4.10	4.6.10	RSA [a]	
Sentence	$--RSA,x.x, A, x.x, A*hh<CR><LF> [a]			
[a] There is not order filed in RSA, but only response field is included in RSA. Sentence for order shall be confirmed.				

b) Alternative signals may be used, if the signal required by the standard above is not available.

Data to be recorded	Standard	Signal Specification	Confirmed type of signal
Synchro signal		360X, 180X, 90X, 36X, 1X Primary voltage: V, Hz	
Step signal		360X, 180X, 90X, 36X, 1X Voltage 35 V, 50 V, 70 V etc.	
Analog signal		Voltage: ± 10 V etc. Current: 4-20 mA etc.	
Operation Mode		Contact etc.	

c) Agreed specification of the signal to be interfaced (including a) standard signal, and b) alternative signal, may be described down here).

[Confirmation:][Document or Dw No.:][Date: / /]

Item		Content of confirmation	Remarks
Sensor	Type of signal		
	Location		
Manufacturer (Who supplies information)			
Type of equipment			
Interface Standard to be applied			
Modification No.			
Header			
Information of Sentence			
Signal interval			
Cable length between sensor signal terminal and VDR			
Type of cable / Number of conductors			
Related to signal interface			

d) When the type of input signal to the VDR, including the alternative signal, is already specified, such signals shall be preferably used. If by the above steps of a) and b) the appropriate signal, including the alternative signal(s) can not be verified to be available, the specification of another alternative signal should be discussed and agreed by persons concerned and the results may be filled in the table c) above.

e) In the case of S-VDR, if the signal is available in the approved international digital formatter (IEC 61162), Rudder order and response in manual operation shall be recorded.

5.11 Engine order / response and Thruster order / response (A.861 / 4.4.11)

Standard: *This shall include the positions of any engine telegraphs or direct engine/propeller controls, including shaft(s) r.p.m. (or equivalent), and feedback indicators, if fitted, including ahead/astern indicators. This shall also include status of bow and astern thruster if fitted. RPM shall be recorded up to a resolution of 1 r.p.m. and pitch shall be recorded up to a resolution of 1 degree.*

5.11.1 Engine order and response

a) Standard.

Data to be recorded	Relevant Standard		IEC 61162	Remarks
	IMO A.861(20)	IEC 61996		(Confirmed type of signal)
Main Engine order/response	5.4.11	4.6.11	RPM / XDR [a]	
Sentence	$--RPM,a,x, x.x, x.x, A*hh<CR><LF> [a] $--XDR,a, x.x, a, c-c, ……a, x.x, c-c* hh<CR><LF> [a]			
[a] Sentence such as RPM is applicable to only response. XDR is not intended for this kind of use. Another sentence shall be considered (refer to annex A).				

b) Alternative signals may be used, if the signal required by the standard above is not available.

Data to be recorded	Standard	Signal Specification	Confirmed type of signal
Main Engine order / response	IEC 61162-102	ETL(telegraph order), PRC	
Manufacturer's sentence	NMEA	Propriety sentence Signal voltage ____V	
Analog signal		Voltage: ± 10 V etc. Current : 4-20 mA etc.	
Contac signal		No voltage contact	

c) Agreed specification of the signal to be interfaced (including a) standard signal, and b) alternative signal, may be described down here).

[Confirmation:][Document or Dw No.:][Date: / /]

Item		Content of confirmation	Remarks
Sensor	Type of signal		
	Location		
Manufacturer (Who supplies information)			
Type of equipment			
Interface Standard to be applied			
Modification No.			
Header			
Information of Sentence			
Signal interval			
Cable length between sensor signal terminal and VDR			
Type of cable / Number of conductors			
Related to signal interface			

d) When the type of input signal to the VDR, including the alternative signal, is already specified, such signals shall be preferably used. If by the above steps of a) and b) the appropriate signal, including the alternative signal(s) can not be verified to be available, the specification of another alternative signal should be discussed and agreed by persons concerned and the results may be filled in the table c) above.

e) In the case of S-VDR, if the signal is available in the approved international digital formatter (IEC 61162), Engine order and response shall be recorded.

5.11.2 Thruster order and response

a) Standard.

Data to be recorded	Relevant Standard		IEC 61162	Remarks (Confirmed type of signal)
	IMO A.861(20)	IEC 61996		
Thruster order / response	5.4.11	4.6.11	RPM / XDR [a]	
Sentence	$--RPM,a,x, x.x, x.x, A*hh<CR><LF> [a] $--XDR,a, x.x, a, c-c, ……a, x.x, c-c* hh<CR><LF> [a]			
[a] Sentence such as RPM is applicable to only response. XDR is not intended for this kind of use. Another sentence shall be considered (refer to annex A).				

b) Alternative signals may be used, if the signal required by the standard above is not available.

Data to be recorded	Standard	Signal Specification	Confirmed type of signal
Thruster order / response	IEC 61162-102	TRC, TRD	
Manufacturer's sentence	NMEA	Propriety sentence Signal voltage ___V	
Analog signal		Voltage: ± 10 V etc. Current : 4-20 mA etc.	
Contac signal		No voltage contact	

c) Agreed specification of the signal to be interfaced (including a) standard signal, and b) alternative signal, may be described down here).

[Confirmation:][Document or Dw No.:][Date: / /]

Item		Content of confirmation	Remarks
Sensor	Type of signal		
	Location		
Manufacturer (Who supplies information)			
Type of equipment			
Interface Standard to be applied			
Modification No.			
Header			
Information of Sentence			
Signal interval			
Cable length between sensor signal terminal and VDR			
Type of cable / Number of conductors			
Related to signal interface			

d) When the type of input signal to the VDR, including the alternative signal, is already specified, such signals shall be preferably used. If by the above steps of a) and b) the appropriate signal, including the alternative signal(s) can not be verified to be available, the specification of another alternative signal should be discussed and agreed by persons concerned and the results may be filled in the table c) above.

e) In the case of S-VDR, if the signal is available in the approved international digital formatter (IEC 61162), Thruster order and response shall be recorded where thrusters fitted.

5.12 Hull openings (doors) status (A.861 / 5.4.12)

a) Standard: *This shall include all IMO mandatory status information required to be displayed on the bridge.*

Data to be recorded	Relevant Standard		IEC 61162	Remarks
	IMO A.861(20)	IEC 61996		(Confirmed type of signal)
Hull opening	5.4.12	4.6.12	XDR [a]	
Sentence	$--XDR,a, x.x, a, c-c, ……a, x.x, c-c* hh<CR><LF> [a]			
[a] XDR is not intended for this kind of use. Another sentence shall be considered (refer to annex A).				

b) Alternative signals may be used, if the signal required by the standard above is not available.

Data to be recorded	Standard	Signal Specification	Confirmed type of signal
Door status	IEC 61162-102	DOR	
Manufacturer's sentence	NMEA	Propriety sentence Signal voltage ___V	
Contac signal		No voltage contact	

c) Agreed specification of the signal to be interfaced (including a) standard signal, and b) alternative signal, may be described down here).

[Confirmation:][Document or Dw No.:][Date: / /]

Item		Content of confirmation	Remarks
Sensor	Type of signal		Prepare the hull opening table. Confirm signals.
	Location		
	Number		
Manufacturer (Who supplies information)			
Type of equipment			
Interface Standard to be applied			
Modification No.			
Header			
Information of Sentence			
Signal interval			
Cable length between sensor signal terminal and VDR			
Type of cable / Number of conductors			
Related to signal interface			

d) When the type of input signal to the VDR, including the alternative signal, is already specified, such signals shall be preferably used. If by the above steps of a) and b) the appropriate signal, including the alternative signal(s) can not be verified to be available, the specification of another alternative signal should be discussed and agreed by persons concerned and the results may be filled in the table c) above.

e) In the case of S-VDR, if the signal is available in the approved international digital formatter (IEC 61162), Hull openings (doors) status shall be recorded where required to be displayed on bridge.

5.13 Watertight and fire door status (A.861 / 5.4.13)

5.13.1 Watertight door status

a) Standard: This shall include all IMO mandatory status information required to be displayed on the bridge.

Data to be recorded	Relevant Standard		IEC 61162	Remarks
	IMO A.861(20)	IEC 61996		(Confirmed type of signal)
Water tight door status	5.4.13	4.6.13	XDR [a]	
Sentence	$--XDR,a, x.x, a, c-c, ……a, x.x, c-c* hh<CR><LF> [a]			
[a] XDR is not intended for this kind of use. Another sentence shall be considered (refer to annex A).				

b) Alternative signals may be used, if the signal required by the standard above is not available.

Data to be recorded	Standard	Signal Specification	Confirmed type of signal
Door status	IEC 61162-102	DOR	
Manufacture's sentence	NMEA	Propriety sentence Signal voltage ___V	
Contac signal		No voltage contact	

c) Agreed specification of the signal to be interfaced (including a) standard signal, and b) alternative signal, may be described down here).

[Confirmation:][Document or Dw No.:][Date: / /]

Item		Content of confirmation	Remarks
Sensor	Type of signal		Prepare the watertight door table. Confirm signals.
	Location		
	Number		
Manufacturer (Who supplies information)			
Type of equipment			
Interface Standard to be applied			
Modification No.			
Header			
Information of Sentence			
Signal interval			
Cable length between sensor signal terminal and VDR			
Type of cable / Number of conductors			
Related to signal interface			

d) When the type of input signal to the VDR, including the alternative signal, is already specified, such signals shall be preferably used. If by the above steps of a) and b) the appropriate signal, including the alternative signal(s) can not be verified to be available, the specification of another alternative signal should be discussed and agreed by persons concerned and the results may be filled in the table c) above.

e) In the case of S-VDR, if the signal is available in the approved international digital formatter (IEC 61162), Watertight door status shall be recorded where required to be displayed on bridge.

Item		Content of confirmation	Remarks
Sensor	Type of signal		Prepare the fire door table. Confirm signals.
	Location		
	Number		
Manufacturer (Who supplies information)			
Type of equipment			
Interface Standard to be applied			
Modification No.			
Header			
Information of Sentence			
Signal interval			
Cable length between sensor signal terminal and VDR			
Type of cable / Number of conductors			
Related to signal interface			

5.13.2 Fire door status

a) Standard: This shall include all IMO mandatory status information required to be displayed on the bridge.

Data to be recorded	Relevant Standard		IEC 61162	Remarks
	IMO A.861(20)	IEC 61996		(Confirmed type of signal)
Fire door status	5.4.13	4.6.13	XDR [a]	
Sentence	$--XDR,a, x.x, a, c-c, ……a, x.x, c-c* hh<CR><LF> [a]			
[a] XDR is not intended for this kind of use. Another sentence shall be considered (refer to Annex A).				

b) Alternative signals may be used, if the signal required by the standard above is not available.

Data to be recorded	Standard	Signal Specification	Confirmed type of signal
Door status	IEC 61162-102	DOR	
Manufacture's sentence	NMEA	Propriety sentence Signal voltage ___V	
Contac signal		No voltage contact	

c) Agreed specification of the signal to be interfaced (including a) standard signal, and b) alternative signal, may be described down here).

d) When the type of input signal to the VDR, including the alternative signal, is already specified, such signals shall be preferably used. If by the above steps of a) and b) the appropriate signal, including the alternative signal(s) can not be verified to be available, the specification of another alternative signal should be discussed and agreed by persons concerned and the results may be filled in the table c) above.

e) In the case of S-VDR, if the signal is available in the approved international digital formatter (IEC 61162), Fire door status shall be recorded where required to be displayed on bridge.

5.14 Accelerations and hull stresses (A.861 / 5.4.14)

a) Standard: *Where a ship is fitted with IMO mandated hull stress and response monitoring equipment, all the data items that have been pre-selected within that equipment and are available shall be recorded.*

Data to be recorded	Relevant Standard		IEC 61162	Remarks
	IMO A.861(20)	IEC 61996		Confirmed type of signal)
Accelerations and hull stresses	5.4.14	4.6.14	XDR, ALR [a]	
Sentence	$--XDR,a, x.x, a, c-c, ……a, x.x, c-c* hh<CR><LF> [a] $--ALR,hhmmss.ss,xxx,A, A,c-c*hh<CR><LF> [a]			
[a] XDR and ALR are not intended for this kind of use. Another sentence shall be considered (refer to Annex A).				

b) Alternative signals may be used, if the signal required by the standard above is not available.

Data to be recorded	Standard	Signal Specification	type of signal
Accelerations and hull stresses	IEC 61162-102	HSS	
Manufacture's sentence	NMEA	Propriety sentence Signal voltage ____V	
Analog signal		Voltage: ± 10 V etc. Current:: 4-20 mA etc.	

c) Agreed specification of the signal to be interfaced (including a) standard signal, and b) alternative signal, may be described down here).

[Confirmation:][Document or Dw No.:][Date: / /]

Item		Content of confirmation	Remarks
Sensor	Type of signal		
	Location		
Manufacturer (Who supplies information)			
Type of equipment			
Interface Standard to be applied			
Modification No.			
Header			
Information of Sentence			
Signal interval			
Cable length between sensor signal terminal and VDR			
Type of cable / Number of conductors			
Related to signal interface			

d) When the type of input signal to the VDR, including the alternative signal, is already specified, such signals shall be preferably used. If by the above steps of a) and b) the appropriate signal, including the alternative signal(s) can not be verified to be available, the specification of another alternative signal should be discussed and agreed by persons concerned and the results may be filled in the table c) above.

e) In the case of S-VDR, if the signal is available in the approved international digital formatter (IEC 61162), Accelerations and hull stresses data shall be recorded where mandated to be fitted.

5.15 Wind speed and direction (A.861/ 5.4.15)

a) Standard: This shall be applicable where a ship is fitted with a suitable sensor. Either relative or true wind speed and direction may be recorded, but an indication of which it is shall be recorded.

Data to be recorded	Relevant Standard		IEC 61162	Remarks (Confirmed type of signal)
	IMO A.861(20)	IEC 61996		
Wind speed and direction	5.4.15	4.6.15	MWV	
Sentence	$--MWV,x.x, a, x.x, a, A*hh<CR><LF>			

b) Alternative signals may be used, if the signal required by the standard above is not available.

Data to be recorded	Standard	Signal Specification	Confirmed type of signal
Synchro signal	NMEA	360X, 180X, 90X, 36X, 1X primary voltage: V, Hz	
Analog signal		Voltage: ± 10 V etc. Current: 4-20 mA etc.	

c) Agreed specification of the signal to be interfaced (including a) standard signal, and b) alternative signal, may be described down here).

[Confirmation:][Document or Dw No.:][Date: / /]

Item		Content of confirmation	Remarks
Sensor	Type of signal		
	Location		
Manufacturer (Who supplies information)			
Type of equipment			
Interface Standard to be applied			
Modification No.			
Header			
Information of Sentence			
Signal interval			
Cable length between sensor signal terminal and VDR			
Type of cable / Number of conductors			
Related to signal interface			

d) When the type of input signal to the VDR, including the alternative signal, is already specified, such signals shall be preferably used. If by the above steps of a) and b) the appropriate signal, including the alternative signal(s) can not be verified to be available, the specification of another alternative signal should be discussed and agreed by persons concerned and the results may be filled in the table c) above.

e) In the case of S-VDR, if the signal is available in the approved international digital formatter (IEC 61162), Wind speed and direction shall be recorded where fitted with a suitable sensor.

5.16 AIS Data (MSC.163(78) / 5.4.8)

This item is applicable only to S-VDR case.

a) Standard: If it is impossible to obtain radar data [6] then AIS target data should be recorded as a source of information regarding other ships. If radar data is recorded, AIS information may be recorded additionally as a beneficial secondary source of information on both other and own ship.

6) Where commercial off the shelf (COTS) interfaces are not available.

Data to be recorded	Relevant Standard		IEC 61993-2 Annex B B.2.13	Remarks (Confirmed type of signal)
	IMO MSC.163(78)	IEC 61996 Annex		
other ship's data / own ship data	5.4.8	4.6.16	VDM / VDO	
Sentence (VDM) (other ship's data)	!--VDM, x.x, x, a, s….s, x*hh<CR><LF>			
Sentence (VDO) (own ship's data)	!--VDO, x.x, x, a, s….s, x*hh<CR><LF>			
Baud rate	38,4 kbps			
NOTE own ship data (VDO: !--VDO,x.x, x, a, s….s, x*hh<CR><LF>) is output from AIS simultaneously to external equipment.				

b) Conflict of interface between AIS and S-VDR, AIS signal required by more than two equipments.

In the case that AIS outputs are required at more than two b) equipments, additional unit, e.g. distributor, may be necessary. In the case that high speed output signal specified by IEC 61162-2 from AIS might not be acceptable at S-VDR, signal conversion function may be prepared. If S-VDR might be modified internally so as to be interfaced with S-VDR, confirmation of type approval for modification may be recommended.

Data to be recorded	Standard	Signal Specification	Confirmed type of signal
To be specified			

c) Confirmation (in the case of b), additional unit, e.g. signal converter or distributor, may be necessary).

[Confirmation:][Document or Dw No.:][Date: / /]

Item		Content of confirmation	Remarks
Sensor	Type of signal	Baud rate: 38,4 kbps (IEC 61162-2)	
	Location		
Manufacture (Who supplies information)			
Type of equipment			
Interface Standard to be applied			
Modification No.			
Header			
Information of Sentence		specified by IEC 61993-2 / IEC 61162-101 !--VDM, x.x, x, a, s….s, x*hh<CR><LF> !--VDO, x.x, x, a, s….s, x*hh<CR><LF>	Converted signal to be specified
Signal interval			
Cable length between sensor signal terminal and S-VDR			
Type of cable / Number of conductors			
Related to signal interface			

6 Installation Direction

6.1 Required VDR equipment

VDR consists of signal processor, microphones, capsule and belongings to VDR (except interface cables). Installation shall be in accordance with requirements of A.861 (20) and IEC 61996. Interface between VDR and sensors may be confirmed according to each item of preceding paragraph 5. (Regarding S-VDR, MSC.163(78) and IEC 61996-2 shall be referred to respectively.)

6.2 Power supply of the VDR and interfaces

6.2.1 Power supply from the ship's emergency source of electrical power

To ensure that the VDR continues to record events during an incident, it shall be capable of operating from the ship's emergency source of electrical power. (IMO Res. A.861/ 5.3.1). However, regarding the power supply to sensors to be interfaced to VDR, the requirement for power supply of each sensor shall be referred to respectively.

Interfaces which are part of the VDR installation shall also be powered under the control of the VDR, i.e. their activation / de-activation shall be controlled by the same control which is used for activating / de-activating the VDR.

Interfaces which are not part of the VDR installation then logically belong to the sensor which data they provide to the VDR. The power supply for such interfaces shall be controlled by the same control which is used for activating / de-activating the sensor.

6.2.2 Power supply from the reserve power source

If the ship's emergency source of electrical power supply fails, the VDR shall continue to record bridge audio (see4.6.5) from a reserve source of power, solely dedicated to the VDR, for a period of 2 h. (A.861/5.3.2). Consequentially it should be verified during installation, that at least the main processor of the VDR, the capsule with the final recording medium, the interface for receiving the audio signals from the microphones, and the microphones, are supplied with power from the reserve power source if the ship's emergency source of electrical power supply fails.

6.3 Check items for the VDR installation

Item	Requirement on installation	Remarks
1. Equipment (a) operation / maintenance space (b) installation method (c) place for installation		@ as for installation of VDR and all belongings @ keep the working space and clearance recommended by manufactures
2. Cable (a) cable bend (b) cable diameter etc. (c) clearance for cable entrance etc.		@ as for installation of VDR and all belongings @ consideration of equipment to which many cables are leaded, distance from power cables, interference of noise of conduction and radiation
3. Connection to VDR (a) cable type (b) connection (1) terminal connection (2) connector connection		@ as for installation of VDR and all belongings
4. Place of capsule installation (a) place (b) method of installation (c) safety distance from magnetic compass		Refer to Paragraph 6.4
5. Others		

6.4 Location of the protective capsule

The capsule shall be capable of being accessed following an incident but secure against tampering (A.861/5.1.3.1).
The protective capsule shall be sited in the vicinity of the bridge on the external deck area of the vessel so as to maximize the probability of its survival and recovery following an incident. The capsule shall be positioned clear of rigging and other potential obstructions and as near to the centre line of the ship as practically possible. A distance 1.5 m from other constructions in the vicinity of the capsule should be suficient to satisfy this requirement.

Criteria to be considered when assessing the optimum position shall include but not be limited to the following:

a) separation from fuel or other potential fire sources,

b) separation from probable sources of mechanical damage,

c) operational environment and accessibility for continued serviceability,

d) accessibility for copying of recorded data and for routine maintenance,

e) facilitation of underwater removal and retrieval by both divers and ROVs. There shall be a clear unobstructed space in the vicinity of the capsule to allow an ROV or diver to work,

f) in the case of float-free configuration, minimization of the risk of obstruction after release.

6.5 Positions of microphones

According to IEC 61996, more than one microphone shall be placed at or near the bridge workstations, taking into account the operational ranges and limitations specified by the manufacturer. (Regarding bridge workstation, refer to paragraph 3.1.9). As far as provided by any design of the VDR, microphones should be connected to separate recording channels, so that during playback of the recordings, audio events can be associated with locations.

No.	Item	Requirement of installation	Remarks
1	Number of equipments	Number	
2	Installation place	1. 2. 3. 4. 5. 6. 7. 8. 9.	

6.6 Cable connections

Where critical connections to devices for manoeuvring of the ship cannot be avoided, these shall be as short as possible and the risk of short circuits or cable breaks shall be minimised by appropriate cable routeing and safe distances of connections. And In such serious interfaces, the isolation circuitry etc. had better be placed between VDR and sensors.

6.7 Ship specific documentation and recording requirements

6.7.1 Planning and approval documentation

For planning and coordinating of the VDR installation with the parties involved, i.e. owner, shipyard, flag state authority and classification society, the following documents shall be provided and updated during the states from planning to final commissioning.

6.7.1.1 List of interfaces, for each data item including

a) data item according to IMO requirement, type of signal (e.g. voltage, current, normally open/closed contact, serial data string, IEC 61162-sentence(s), etc.

b) sensor providing the data including type, designation, manufacturer, location of installation

c) update rate of the information (normally 1 second or instantaneous upon the relevant change of status).

6.7.1.2 Plan of locations of bridge equipment

Typically the plan of the bridge and bridge wings including all workstations, with locations of microphones marked. Also the locations of the connected radar(s), VHF radio(s) and the location of the VDR operation & alarm unit should be marked in this plan.

6.7.1.3 Plan of capsule location

Typically the plan of the wheel house top (monkey island) with the location of the capsule marked, including an outline of a concentric 3 m diameter around it, all other ship structures and installed devices around and above the capsule location, and a side view of the capsule installation and mounting parts.

6.7.2 Recording of the system configuration (IEC 61996, 4.4.1)

In addition to the operational data referred to in the preceding paragraphs, a data block defining the configuration of the VDR and the sensors to which it is connected shall be written into the final recording medium during commissioning of the VDR. This configuration data shall be permanently retained in the final recording medium and protected from modification other than by a duly authorised person following any change to the configuration. Any change to the configuration of this data block shall not affect the recording of the mandatory items.

The following system configuration information and data source identity shall be included in this data block:

a) type approval authority and reference;

b) IMO vessel identification number;

c) software version(s) used;

d) microphone locations and recording port allocation;

NOTE This does not imply channelization.

e) VHF communications – which VHF channel(s) recorded;

f) date and time – from which source obtained;

g) ship's position – from which EPFS obtained and relative position on the vessel;

h) other data inputs – identification of which equipment is supplying recorded data; sign conventions and identity of all alarm/door inputs;

i) automatic insertion of date and time of last amendment.

6.8 Acceptance test

A final acceptance test shall be provided after the completion of the VDR installation. The test shall be conducted following a prepared test protocol to be provided by the VDR supplier. The content of the test should be principally the same as shown in Annex C (informative) for the annual performance test, but it

should also completely verify the correct connection and signal transfer of all interfaces. Additionally it shall be verified that critical interface connections, such as to devices for steering and propulsion, do not produce limitations or malfunctions of the relevant equipment.

The documents provided as per 6.7.1 above and the entries into the configuration recording file as per 6.7.2 above shall be presented for comparison with the actual installation and for final approval.

As the relevant international standards for VDR and S-VDR do not require the playback of recorded data to be provided on-board of the ship, the means for verifying that the recorded data comply with the requirements shall be defined and documented by the manufacturer of the VDR. As a minimum such functions shall however include the replay of audio data in audible form, the replay of radar data in form of a radar type display, and the replay of other information at least in the text and numeric format (ASCII-Format) as specified for IEC 61162 data sentences. Data provided by digital proprietary sentences shall at least be reproduced as provided by the sensor.

7 Performance Test

Annual performance test ("Annual Re-certification) of each VDR and S-VDR is required in SOLAS V regulation 18, paragraph 8 to verify the accuracy, duration and recoverability of the recorded data. In addition, the serviceability of all protective enclosures and devices fitted to aid location is required to be confirmed through test and inspection. Recommended items to be confirmed are shown in annex C (informative) for reference.

8 Playback tools

A program shall be available from the manufacturer of the VDR for retrieving the recorded data from the final recording medium using the same format that is used for the recording. A program for playback of the data retrieved from the VDR shall be available from the manufacturer of the VDR as described in IEC61996, 5.5.3.

And ownership and recovery of VDR are stated in MSC/Circ.1024. In addition, in SN/Circ.246, *it is recommended that all VDR and S-VDR systems installed on after 1 July 2006 be supplied with an accessible means for extracting the stored data from the VDR or S-VDR to a laptop computer*.

And it is going to be put into force after 1 June 2008 that all VDR and S-VDR systems installed on after 1 June 2008 be supplied with an accessible means for extracting the stored data from the VDR or S-VDR to a laptop computer, downloading /playback software and instructions about it on board ship for investigator of accident. The VDR supplier shall also provide guidelines by which the investigation authority is enabled to utilize the playback tools as follows.

a) Instructions to enable an investigation authority to manufacture any special tools or interface equipment required for retrieval of recorded data from the recorder;

b) Retrieval of data from the final recoding medium in the capsule:

1) Instructions of the necessary actions to be followed for data retrieval from an undamaged protective capsule;

2) Instructions *of the necessary actions to be followed for data retrieval from a protective capsule that has been damaged in an incident;*

c) Details of software required to enable playback of recorded data:

Two methods are required for retrieval of data from the final recording medium. One is to read out the data from the capsule under normal operation of the VDR. The other is to read out the data directly from the final recording medium of a capsule which has been recovered from the ship after an incident;

The function of reading out the data from the final recording medium during normal operation of the VDR is also required for verifying that the data recording is properly functioning. In addition, there may be

some other ways of recording and reading out the data from a VDR, e.g. simultaneously storing data onto the final recording medium and onto an internal or external auxiliary medium, and downloading data from any of such media.

The manufacturers and installers (including ship yards) of the VDR should prepare following documentations for reading out the data from the final recording medium and for the playing back, for ship owners or investigation authorities.

1) Characteristics of electrical interface including power supply to capsule.

2) How to interface directly to the capsule for reading out the data, for down loading the data to an external device, including the requirements for such device.

3) In case the playback device is not easily obtainable in the relevant flag state, or other country where an investigation may be conducted, the seller or the manufacturer of the VDR shall provide contact information for assistance in interfacing between the playback device and the capsule and for providing of or operation of playback.

4) In case of supply of the playback software, items including operational instructions and factors related to the recording method (e.g. CD-ROM etc.) may be shown (PC CPU operating speed, capacity of memory and OS, etc.).

5) The VDR manufacturer shall include in his documentation contact information for assistance in interfacing between the playback device and the capsule and for assisting an on board investigation of the data recorded by the VDR.

9 Guideline of assessment of Interfacing

Since the dead line dates for re-fitting ships with VDR according to SOLAS Ch. V. 20 have expired on 1. January 2004, the following recommendations of this section are only valid for S-VDR:

In regulation SOLAS V 20 2., which enters into force 1 July 2006, it is provided that *administrations may exempt cargo ship from the application of the requirements of subparagraphs .1 and .2 when such ships will be taken out of service within two years after the implementation date specified in paragraph .1 and .2 above.* The factors, that interfacing to VDR may be considered to be unreasonable and impracticable, are listed for decision-making. Technical factors of interfacing signals and cost of remodelling equipments are major factors for decision-making. These factors depend mainly upon the manufacturer's circumstances, which are, when the product has been developed, when international regulation or standard etc. has been adopted, when the product has been manufactured and how the product has been revised. Interface problems may be caused by the difference between generators' specification and receivers' specification and there are some cases to be considered as shown in the table (Interface check sheet) down below. In addition, if some interface problems may be found, it shall be measured how different it is and how it shall be rectified in order that the persons concerned shall have the same understanding of it. As the case may be, reasons of difficulty shall be explained to the competent authority.

However, in the regulation SOLAS V 20 2., existing cargo ships shall be required to be fitted with VDR (it may be S-VDR). In the case of S-VDR, sensor items to be interfaced are reduced in comparison with VDR requirements, and such items may more easily be obtained on cargo ship. AIS data is required to be interfaced with S-VDR in case a "commercial off the shelf radar interface" is not available. In order to thoroughly prepare for an S-VDR installation, all required data interfaces should be verified prior to the installation on any existing cargo ship, over 3 000GT, engaged on international voyage.

In the case of existing equipment onboard, it shall be confirmed whether

a) cable conductor terminals are available,

b) additional interfaces or a software revision may be necessary,

c) replacement of an obsolete sensor may be necessary, and whether

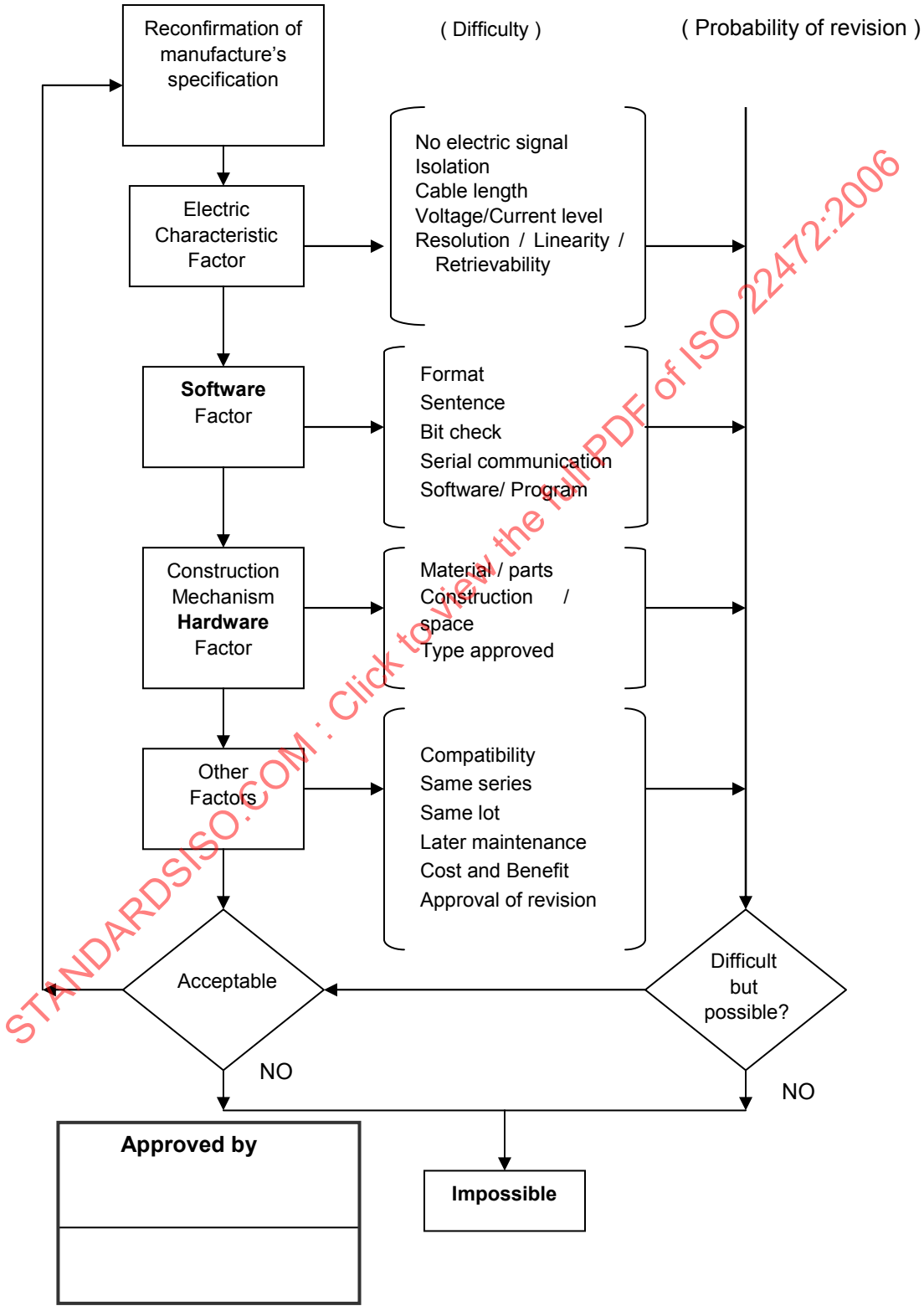
d) such additions or modifications may cause interference with another functions.

Such technical factors of engineering and the organisation which is responsible for retrofitting the equipment, the cost and the quality, shall be assessed and decided. In order to make sure that an S-VDR can successfully be installed on a certain ship, other considerations may be required and the technical manuals of the relevant equipment should be consulted, including alternative types of S-VDR equipment. Therefore, a pre-installation inspection may be necessary for each ship, and appropriate installation documentations should be issued by the inspecting organisation as the basic information for the installation of a S-VDR.

Check sheet for interface characteristics

No.	Factor of Discrepancy	Difficulty	How to recover	Conclusion
1-1	Electric Characteristics Factor	No electric signal		
1-2		Isolation		
1-3		Cable Length		
1-4		Voltage/Current level		
1-5		Resolution / Linearity / Derivability		
2-1	Software Factor	Format		
2-2		Sentence		
2-3		Bit Check		
2-4		Serial Communication		
2-5		Software / Program		
3-1	Construction / Mechanism / Hardware Factor	Material / Parts		
3-2		Construction / Space		
3-3		Type Approved		
4-1	Other Factor	Compatibility		
4-2		Same series product		
4-3		Same lot product		
4-4		Later maintenance		
4-5		Cost / Benefit		
4-6		Approval of revision		

(Flow of confirmation of interface to VDR)



Annex A
(informative)

Explanation of sentences, defined in IEC 61162 and IEC 61996, used for VDR

A.1 Approved Sentence (common explanatory part)

Approved Sentence

(1) (2) (3) (4) (5)(6) (7)

$ aaccc , ... * hh <CR><LF>

	ASCII	HEX	Description
(1)	$	24	Start of sentence: stating delimiter
(2)	aaccc		Address field
			Alphanumeric characters identifying type of talker, and sentence formatter. The first two characters identify the talker. The last the three sentence formatter mnemonic code identifying the data type and the string format of the successive fields. Mnemonic will be used as far as possible to facilitate read-outs by users.
(3)	“,”	2C	Field delimiter
			starts each field except address and checksum fields. If it is followed by a null field, it is all that remains to indicate not data in a field.
(4)	c…..c		Data sentence block
			follows address field and is a series of data fields containing all of the data to be transmitted. Data field sequence is fixed and identified by the third and subsequent fields of the address field (the sentence formatter). Data fields may be of variable length and are preceded by delimiters“,”.
(5)	“*”	2A	Checksum delimiter
			follows last data field of the sentence. It indicates that the following two alpha-numeric characters show the HEX value of the checksum.
(6)	hh		Checksum field
			the absolute value calculated by exclusive-OR’ ing the eight data bits (no start bits or stop bits) of each character in the sentence between, but excluding,”$” and “*”. The hexadecimal value of the most significant and least significant four bits of the result are converted to two ASCII characters (0-9, A-F) for transmission. The most significant character is transmitted first. The checksum field is required in all cases.
(7)	<CR><LF>	0D0A	End of sentence
			sentence terminating delimiter

A.2 Details of approved sentences

A.2.1 ZDA: Time and date

As for head and last part of sentence, refer to A.1.

Sentence	(1) (2) (3) (4) (5) (6)
ZDA	$--ZDA, hhmmss.ss, xx, xx, xxxx, xx, xx *hh <CR><LF>
	(1) UTC
	(2) Day (01-31) (UTC)
	(3) Month (01-12) (UTC)
	(4) Year (UTC)
	(5) Local zone hours
	(6) Local zone minutes

A.2.2 GNS: GNSS fix data

As for head and last part of sentence, refer to A.1.

Sentence	(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12)
GNS	$--GNS, hhmmss.ss, III.II, a, yyyyy.yy, a, c-c, xx, x.x, x.x, x.x, x.x, x.x *hh<CR><LF>
	(1) UTC of position
	(2) Latitude
	(3) N/S
	(4) Longitude
	(5) E/W
	(6) Mode indicator
	(7) Total number of satellites in use(00-99)
	(8) HDOP
	(9) Antenna altitude, m, re: mean-sea-level
	(10) Geoidal separation, m
	(11) Age of differential data
	(12) Differential Reference Station ID

A.2.3 DTM: Datum reference

As for head and last part of sentence, refer to A.1.

Sentence	(1) (2) (3) (4) (5) (6) (7) (8)
DTM	$--DTM, ccc, a, x.x, a, x.x, a, x.x, ccc *hh <R><LF>
	(1) Local datum (example: WGS84)
	(2) Local datum subdivision code
	(3) Lat offset, min
	(4) N/S
	(5) Lon offset, min
	(6) E/W
	(7) Altitude offset, m
	(8) Reference datum

A.2.4 VBW: Dual ground / water speed

As for head and last part of sentence, refer to A.1.

Sentence	(1) (2) (3) (4) (5) (6) (7) (8) (9) (10)
VBW	$--VBW, x.x, x.x, A, x.x, x.x, A, x.x, A, x.x, A, *hh<CR><LF>
	(1) Longitudinal water speed, knots
	(2) Traverse water speed, knots
	(3) Status : water speed, A =valid, V =data invalid
	(4) Longitudinal ground speed, knots
	(5) Traverse ground speed, knots
	(6) Status : ground speed, A =valid, V =data invalid
	(7) Stern traverse water speed, knots
	(8) Status: stern water speed, A =valid, V =data invalid
	(9) Stern traverse ground speed, knots
	(10) Status: stern ground speed, A =valid, V =data invalid

A.2.5 HDT: Heading true

As for head and last part of sentence, refer to A.1.

Sentence	(1) (2)
HDT	$--HDT, x.x, T *hh<CR><LF>
	(1) Heading, degrees
	(2) True