



INTERNATIONAL STANDARD

**Maritime navigation and radiocommunication equipment and systems –
Automatic identification systems (AIS)
Part 2: Class A shipborne equipment of the automatic identification system (AIS) –
Operational and performance requirements, methods of test and required test
results**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE

XF

ICS 47.020.70

ISBN 978-2-83220-416-0

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	9
INTRODUCTION.....	11
1 Scope.....	12
2 Normative references.....	12
3 Abbreviations.....	13
4 General requirements.....	14
4.1 General.....	14
4.1.1 Overview.....	14
4.1.2 General requirements.....	14
4.1.3 Capabilities of the AIS.....	15
4.1.4 Additional requirements.....	15
4.1.5 Transmitter shutdown procedure.....	15
4.1.6 Quality assurance.....	15
4.2 Modes of operation.....	15
4.3 Manuals.....	15
4.4 Marking and identification.....	16
5 Other requirements.....	16
5.1 Environmental, power supply, special purpose and safety requirements.....	16
5.2 Display of information.....	16
6 Performance requirements.....	16
6.1 Composition.....	16
6.2 Time and position.....	17
6.2.1 Source for UTC.....	17
6.2.2 Source for AIS position reporting.....	17
6.3 User interface.....	17
6.4 Identification.....	18
6.5 Information.....	18
6.5.1 Information provided by the AIS.....	18
6.5.2 Information reporting intervals.....	19
6.5.3 Ship reporting capacity.....	19
6.6 Event log.....	20
6.7 Permissible initialization period.....	20
6.8 Power supply.....	20
6.9 Technical characteristics.....	20
6.10 Alarms and indications, fall-back arrangements.....	20
6.10.1 Built-in test equipment.....	20
6.10.2 Alarm messages.....	21
6.10.3 Status messages.....	23
6.11 Display, input and output.....	26
6.11.1 Minimum keyboard and display (MKD).....	26
6.11.2 Communication test.....	28
6.11.3 Alarms and status information.....	29
6.11.4 Data protection.....	29
6.11.5 Distance calculation.....	29
6.12 Protection from invalid controls.....	30
7 Technical requirements.....	30

7.1	General	30
7.2	Physical layer	30
7.2.1	General	31
7.2.2	Transmitter parameters	31
7.2.3	Receiver parameters	32
7.3	Link layer	32
7.3.1	General	32
7.3.2	Link sublayer 1: Medium Access Control (MAC).....	33
7.3.3	Link sublayer 2: Data Link Service (DLS).....	33
7.3.4	Link sublayer 3 – Link Management Entity (LME)	33
7.4	Network layer	35
7.4.1	General	35
7.4.2	Management of regional operating settings	35
7.5	Transport layer	37
7.6	Presentation interface	37
7.6.1	General	37
7.6.2	Automatic input of sensor data	38
7.6.3	High speed input/output ports	38
7.6.4	Long-range communication ports.....	41
7.6.5	BIIT alarm output.....	43
8	Long-range applications	43
8.1	General	43
8.2	Long-range application by two-way interface	43
8.2.1	General	43
8.2.2	Interrogations and responses	44
8.2.3	Manual and automatic response	44
8.2.4	Data formats and contents.....	44
8.2.5	Addressing AIS-units	44
8.3	Long-range application by broadcast	45
9	Test conditions	45
9.1	Normal and extreme test conditions.....	45
9.1.1	Normal test conditions	45
9.1.2	Extreme test conditions	45
9.2	Standard test environment.....	46
9.3	Additional test arrangements	46
9.3.1	Arrangements for test signals applied to the receiver input	46
9.3.2	Encoder for receiver measurements	46
9.3.3	Waiver for receivers	46
9.3.4	Impedance.....	47
9.3.5	Artificial antenna (dummy load)	47
9.3.6	Facilities for access	47
9.3.7	Modes of operation of the transmitter	47
9.4	Common test conditions for protection from invalid controls	47
9.5	Measurement uncertainties	47
10	Test signals	48
10.1	Standard test signal number 1 (DSC)	48
10.2	Standard test signal number 2 (TDMA).....	48
10.3	Standard test signal number 3 (TDMA).....	48
10.4	Standard test signal number 4 (PRBS)	48

10.5	Standard test signal number 5 (PRBS)	48
11	Power supply, special purpose and safety tests	49
12	Environmental tests	49
13	EMC tests	50
14	Operational tests	50
14.1	Identification and operating modes	50
14.1.1	Autonomous mode	50
14.1.2	Assigned mode	51
14.1.3	Polled mode	51
14.1.4	Addressed operation	52
14.1.5	Broadcast operation	52
14.1.6	Multiple slot messages	53
14.2	Information	53
14.2.1	Information provided by the AIS	54
14.2.2	Reporting intervals	54
14.3	Event log	55
14.3.1	Method of measurement	56
14.3.2	Required results	56
14.4	Initialization period	56
14.4.1	Method of measurement	56
14.4.2	Required results	56
14.5	Technical characteristics	56
14.5.1	Channel selection	56
14.5.2	Transceiver protection	57
14.5.3	Automatic power setting	57
14.6	Alarms and indicators, fall-back arrangements	57
14.6.1	Loss of power supply	57
14.6.2	Monitoring of functions and integrity	57
14.6.3	Monitoring of sensor data	59
14.7	Display, input and output	62
14.7.1	Data input/output facilities	62
14.7.2	Initiate message transmission	62
14.7.3	Communication test	63
14.7.4	System control	63
14.7.5	Display of received targets	64
14.7.6	Display of position quality	65
14.7.7	Display of targets if optional filter is implemented	65
14.7.8	Display of received safety related messages	66
14.7.9	Presentation of navigation information	66
15	Physical tests	66
15.1	TDMA transmitter	67
15.1.1	Frequency error	67
15.1.2	Carrier power	67
15.1.3	Slotted transmission spectrum	68
15.1.4	Modulation accuracy	69
15.1.5	Transmitter output power characteristics	69
15.2	TDMA receivers	70
15.2.1	Sensitivity	70

15.2.2	Error behaviour at high input levels	71
15.2.3	Co-channel rejection.....	71
15.2.4	Adjacent channel selectivity.....	72
15.2.5	Spurious response rejection	72
15.2.6	Intermodulation response rejection and blocking	75
15.2.7	Transmit to receive switching time.....	76
15.2.8	Immunity to out-of-band energy	77
15.3	Conducted spurious emissions	77
15.3.1	Spurious emissions from the transmitter	77
15.3.2	Spurious emissions from the receiver	78
16	Specific tests of link layer.....	78
16.1	TDMA synchronisation.....	78
16.1.1	Synchronisation test using UTC.....	78
16.1.2	Synchronisation test using UTC with repeated messages.....	79
16.1.3	Synchronisation test without UTC, semaphore.....	79
16.1.4	Synchronisation test without UTC.....	80
16.1.5	Reception of un-synchronised messages.....	80
16.2	Time division (frame format).....	80
16.2.1	Method of measurement.....	80
16.2.2	Required results	80
16.3	Synchronisation and jitter accuracy.....	81
16.3.1	Definition.....	81
16.3.2	Method of measurement.....	81
16.3.3	Required results.....	81
16.4	Data encoding (bit stuffing)	81
16.4.1	Method of measurement.....	81
16.4.2	Required results	81
16.5	Frame check sequence	81
16.5.1	Method of measurement.....	81
16.5.2	Required results	81
16.6	Slot allocation (channel access protocols).....	82
16.6.1	Network entry.....	82
16.6.2	Autonomous scheduled transmissions (SOTDMA).....	82
16.6.3	Autonomous scheduled transmissions (ITDMA).....	82
16.6.4	Safety related/binary message transmission.....	83
16.6.5	Transmission of Message 5 (ITDMA).....	83
16.6.6	Assigned operation.....	83
16.6.7	Group assignment	84
16.6.8	Fixed allocated transmissions (FATDMA)	88
16.6.9	Randomisation of message transmissions	88
16.7	Message formats.....	88
16.7.1	Received messages	88
16.7.2	Transmitted messages.....	89
17	Specific tests of network layer	89
17.1	Dual channel operation – Alternate transmissions	89
17.1.1	Method of measurement.....	89
17.1.2	Required results	89
17.2	Regional area designation by VDL message.....	89
17.2.1	Method of measurement.....	89

17.2.2	Required results	90
17.3	Regional area designation by serial message	90
17.4	Regional area designation with lost position	91
17.4.1	Method of measurement	91
17.4.2	Required results	91
17.5	Power setting	91
17.5.1	Method of measurement	91
17.5.2	Required results	91
17.6	Message priority handling	91
17.6.1	Method of measurement	91
17.6.2	Required results	91
17.7	Slot reuse and FATDMA reservations	91
17.7.1	Method of measurement	91
17.7.2	Required results	92
17.8	Management of received regional operating settings	92
17.8.1	Test for replacement or erasure of dated or remote regional operating settings	92
17.8.2	Test of correct input via presentation interface or MKD	93
17.8.3	Test of addressed telecommand	94
17.8.4	Test for invalid regional operating areas	94
17.9	Continuation of autonomous mode reporting interval	95
17.9.1	Method of test	95
17.9.2	Required results	95
18	Specific tests of transport layer	95
18.1	Addressed messages	95
18.1.1	Transmission	95
18.1.2	Acknowledgement	95
18.1.3	Transmission retry	95
18.1.4	Acknowledgement of addressed safety related messages	96
18.1.5	Behaviour of NavStatus 14 reception	96
18.2	Interrogation responses	96
18.2.1	Method of measurement	96
18.2.2	Required results	96
19	Specific presentation interface tests	97
19.1	General	97
19.2	Checking manufacturer's documentation	97
19.3	Electrical test	97
19.3.1	Method of test	97
19.3.2	Required results	97
19.4	Test of input sensor interface performance	97
19.4.1	Method of measurement	97
19.4.2	Required results	98
19.5	Test of sensor input	98
19.5.1	Test of GNS input	98
19.5.2	Test of RMC input	98
19.5.3	Test of DTM input	99
19.5.4	Test of GBS input	99
19.5.5	Test of VBW input	100
19.5.6	Test of VTG input	100

19.5.7	Test of HDT/THS input	101
19.5.8	Test of ROT input	101
19.5.9	Test of different inputs	102
19.5.10	Test of multiple inputs	102
19.6	Test of high speed output	103
19.6.1	Method of measurement	103
19.6.2	Required results	103
19.7	High speed output interface performance	103
19.7.1	Method of measurement	103
19.7.2	Required results	103
19.8	Output of undefined VDL messages	103
19.8.1	Method of measurement	103
19.8.2	Required results	103
19.9	Test of high speed input	103
19.9.1	Method of measurement	103
19.9.2	Required results	104
20	Long-range functionality tests	104
20.1	Long-range application by two-way interface	104
20.1.1	LR interrogation	104
20.1.2	LR "all ships" interrogation	104
20.1.3	Consecutive LR "all ships" interrogations	105
20.2	Long-range application by broadcast	105
20.2.1	Long-range broadcast	105
20.2.2	Multiple assignment operation	106
Annex A (informative)	Block diagram of AIS	108
Annex B (normative)	AIS interface overview (see Table 13)	109
Annex C (informative)	Block diagram of standard test environment	110
Annex D (normative)	DSC functionality	111
Annex E (informative)	Optional PI port sentences	117
Annex F (informative)	Alarm handling	121
Annex G (normative)	Calculation of area size and distance	122
Annex H (normative)	Transmission of binary Messages 25 and 26	125
Bibliography	129
Figure 1	– OSI layer model	30
Figure 2	– Power versus time characteristics	31
Figure 3	– Format for repeating four-packet cluster	48
Figure 4	– Measurement arrangement for frequency error	67
Figure 5	– Measurement arrangement for carrier power	67
Figure 6	– Emission mask for slotted transmission	68
Figure 7	– Measurement arrangement for modulation accuracy	69
Figure 8	– Measurement arrangement	70
Figure 9	– Measurement arrangement with two generators	71
Figure 10	– SINAD or PER/BER measuring equipment	74
Figure 11	– Test set-up	75
Figure 12	– Transmit to receive switching time measurement setup	76

Figure 13 – Regional area scenario	90
Figure D.1 – Measurement arrangement for inter-modulation	114
Table 1 – Information reporting intervals for autonomous mode	19
Table 2 – Integrity alarm conditions signalled using ALR sentence formatter	22
Table 3 – Sensor status indications signalled using TXT sentence formatter	23
Table 4 – Position sensor fallback conditions	24
Table 5 – Use of accuracy (PA) flag	25
Table 6 – ROT sensor fallback conditions	26
Table 7 – Message display on MKD	27
Table 8 – Position quality	28
Table 9 – Transmitter parameters	31
Table 10 – Power versus time characteristics	32
Table 11 – Receiver parameters	32
Table 12 – Use of VDL messages	33
Table 13 – Presentation interface access	37
Table 14 – IEC 61162-1 sensor sentences	38
Table 15 – AIS High-speed input data and formats	39
Table 16 – AIS high-speed output data and formats	40
Table 17 – AIS Long-range communications input data and formats	42
Table 18 – LR output data formats	43
Table 19 – LR data types	44
Table 20 – Content of first two packets	49
Table 21 – Fixed PRS data derived from Recommendation ITU-T O.153	49
Table 22 – Peak frequency deviation versus time	69
Table 23 – Tests to be performed	76
Table 24 – Primary channels for each region	90
Table E.1 – Property identifier	118
Table G.1 – Coordinate points	122

INTERNATIONAL ELECTROTECHNICAL COMMISSION

MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – AUTOMATIC IDENTIFICATION SYSTEMS (AIS)

Part 2: Class A shipborne equipment of the automatic identification system (AIS) – Operational and performance requirements, methods of test and required test results

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61993-2 has been prepared by IEC technical committee 80: Maritime navigation and radiocommunication equipment and systems.

This second edition cancels and replaces the first edition, published in 2001. This edition constitutes a technical revision.

This edition includes the following technical changes with respect to the previous edition:

It incorporates the technical characteristics included in Recommendation ITU-R M.1371-4 which was published in 2010. New technical characteristics result in sundry clarifications to the requirements and the ability to handle five new messages – Messages 23, 24, 25, 26 and 27.

The significant changes in this edition include:

- a new requirement in 6.9 for vessels of type “tanker” to use a low power setting;
- expanded requirements for the functionality of the minimum keyboard and display in 6.11 including new requirements for display of AIS-SART together with an AIS-SART alarm and new requirements for the protection of the static data of the ship;
- expanded requirements for the transmitters and receivers in 7.2 but with the removal of the previous requirement for 12,5 kHz channel operation which has not been used in practice;
- expanded requirements for long-range applications in Clause 8 to add a broadcast method;
- a definition of the pilot plug pin out in 7.6 together with some new requirements for interfaces;
- extensively revised test methods in Clauses 14 to 19 based on the experience of testing AIS equipment;
- expanded test methods in Annex D for DSC functionality but the removal of the previous requirement for DSC polling which is no longer used.

The text of this standard is based on the following documents:

CDV	Report on voting
80/656/CDV	80/675/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

In comparison with the previous edition of this Standard, the structural changes to the document are that the original Clause 8 on DSC compatibility together with the corresponding tests in Clause 20 have been moved into a new Annex D. A new Clause on test signals has been added as Clause 10. The original Annex B detailing IEC 61162 sentences has been deleted and replaced with a new Annex H, noting that much of this information is now included in IEC 61162-1. The original Annex C describing long-range applications has also been deleted as IMO has decided to adopt a different system for long-range identification and tracking. A new Annex E has been added to describe optional presentation interface port sentences, a new Annex F has been added on alarm handling and a new Annex G has been added on calculation of area size and distance.

Withdrawn

MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – AUTOMATIC IDENTIFICATION SYSTEMS (AIS)

Part 2: Class A shipborne equipment of the automatic identification system (AIS) – Operational and performance requirements, methods of test and required test results

1 Scope

This part of IEC 61993 specifies the minimum operational and performance requirements, methods of testing and required test results conforming to performance standards adopted by the IMO in Resolution MSC.74(69), Annex 3, Shipborne Automatic Identification System. This standard incorporates the applicable technical characteristics of Class A shipborne equipment included in Recommendation ITU-R M.1371-4 and takes into account the ITU Radio Regulations, where applicable. In addition, it takes account of IMO Resolution A.694(17) to which IEC 60945 is associated. When a requirement in this standard is different from IEC 60945, the requirement of this standard takes precedence.

This part of IEC 61993 also specifies the minimum requirements both for the means to input and display data and for the interfaces to other equipment suitable to be used as means of input and display data.

NOTE All text of this standard, that is identical to that in IMO resolution MSC.74(69), Annex 3 or to that in ITU-R Recommendation M.1371-4 is printed in *italics* and references to the resolution (abbreviated to "A3") or the recommendation (abbreviated to "M.1371") and paragraph numbers are indicated in parentheses, for instance (A3/3.3) or (M.1371/A2-3.3) respectively.

2 Normative references

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

IEC 60945:2002, *Maritime navigation and radiocommunication equipment and systems – General requirements – Methods of testing and required test results*

IEC 61108 (all parts), *Maritime navigation and radiocommunication equipment and systems – Global navigation satellite systems (GNSS)*

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

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

IEC 62288, *Maritime navigation and radiocommunication equipment and systems – Presentation of navigation-related information on shipborne navigational displays – General requirements, methods of testing and required test results*

IEC 62388, *Maritime navigation and radiocommunication equipment and systems – Shipborne radar – Performance requirements, methods of testing and required test results*

IMO Resolution A.694(17), *General requirements for shipborne radio equipment forming part of the Global Maritime Distress and Safety System (GMDSS) and for electronic navigational aids*

IMO Resolution MSC.43(64), as amended by MSC.111(73), *Guidelines and Criteria for Ship Reporting Systems*

IMO Resolution MSC.74(69) Annex 3, *Recommendation on performance standards for AIS*

ITU-R Recommendation M.493-13, *Digital selective-calling system for the use in the maritime mobile service*

ITU-R Recommendation M.541-9, *Operational procedures for the use of digital selective-calling (DSC) equipment in the maritime mobile service*

ITU-R Recommendation M.825-3, *Characteristics of a transponder system using digital selective calling techniques for use with vessel traffic services and ship-to-ship identification*

ITU-R Recommendation M.1084-5, *Interim solutions for improved efficiency in the use of the band 156-174 MHz by stations in the maritime mobile service*

ITU-R Recommendation M.1371-4, *Technical characteristics for an automatic identification system using time division multiple access in the VHF maritime mobile band*

ITU-T Recommendation O.153, *Basic parameters for the measurement of error performance at bit rates below the primary rate*

Withhold